ASCII Code Table

Character	Hex	Decimal
NUL	0	0
SOH	1	1
STX	2	2
ETX	3	3
EOT	4	4
ENQ	5	5
ACK	6	6
BEL	7	7
BS	8	8
HT	9	9
NL	A	10
VT	B	11
NP	C	12
CR	D	13
SO	E	14
SI	F	15
DLE	10	16
DC1	11	17
DC2	12	18
DC3	13	19
DC4	14	20
NAK	15	21
SYN	16	22
ETB	17	23
CAN	18	24
EM	19	25
SUB	1A	26
ESC	1B	27
FS	1C	28
GS	1D	29
RS	1E	30
US	1F	31
SPACE	20	32
!	21	33
"	22	34
#	23	35
$	24	36
%	25	37
&	26	38
'	27	39
(	28	40
)	29	41
*	2A	42

Character	Hex	Decimal
+	2B	43
,	2C	44
-	2D	45
.	2E	46
/	2F	47
0	30	48
1	31	49
2	32	50
3	33	51
4	34	52
5	35	53
6	36	54
7	37	55
8	38	56
9	39	57
:	3A	58
;	3B	59
<	3C	60
=	3D	61
>	3E	62
?	3F	63
@	40	64
A	41	65
B	42	66
C	43	67
D	44	68
E	45	69
F	46	70
G	47	71
H	48	72
I	49	73
J	4A	74
K	4B	75
L	4C	76
M	4D	77
N	4E	78
O	4F	79
P	50	80
Q	51	81
R	52	82
S	53	83
T	54	84
U	55	85

Character	Hex	Decimal
V	56	86
W	57	87
X	58	88
Y	59	89
Z	5A	90
[	5B	91
\	5C	92
]	5D	93
^	5E	94
_	5F	95
`	60	96
a	61	97
b	62	98
c	63	99
d	64	100
e	65	101
f	66	102
g	67	103
h	68	104
i	69	105
j	6A	106
k	6B	107
l	6C	108
m	6D	109
n	6E	110
o	6F	111
p	70	112
q	71	113
r	72	114
s	73	115
t	74	116
u	75	117
v	76	118
w	77	119
x	78	120
y	79	121
z	7A	122
{	7B	123
|	7C	124
}	7D	125
~	7E	126
DEL	7F	127

Command Table 4 Data Buffer Function

Transmit without Command 3 in reading out, or with Command 3 in writing. (→ 5. Transmission Data Format (Command))
The string of Command 3 is received as a response when reading out, ">" is received in writing respectively.
(→ 6. Incoming Data Format (Response))
For the details of Data Buffer Function (→ 8. Data Buffer Function)

Setting / Operating Data Buffer				
Command 1	Command 2	Command 3	Description (**For details, refer to the term of Data Buffer Function in this manual.**)	Default
BUFFER	**MODE**	**OFF**	**Setting Trigger Mode**	OFF
		AFTER	When not using the Data Buffer function, set to OFF.	
		BEFORE		
		CENTER		
	DATA	**A**	**Data Setting for Buffer** (*4)	A
		B		
		CAL		
		A&B		
	RATE	**1**	**Setting Buffer Rate**	1
		2		
		4		
		8		
		16		
		32		
		64		
		128		
		256		
		512		
		1024		
		2048		
		4096		
		8192		
		16384		
		32768		
	SIZE	**100**	**Setting Buffer Size**	100
		200		
		300		
		400		
		500		
		600		
		700		
		800		
		900		
		1000		
		1100		
		1200		
		1300		
		1400		
		1500		
		1600		
		1700		
		1800		
		1900		
		2000		
	TRIGGER		**Control Command (Buffer Trigger)**	
	READ		**Control Command (Buffer Reading out)** (*4)	

(*4) The digit of 1μm of read out data always remains "0" in the following condition: 《For CD4A》
- A is selected in data for the buffer setting and HEAD A is the 350 mm type.
- B is selected in data for the buffer setting and HEAD B is the 350 mm type.
- CAL or A&B is selected in data for the buffer setting and HEAD A or HEAD B is the 350 mm type.

Command Table 3 Operating Control Input (Control Command)

For the details of command. (→ 5. Transmission Data Format (Command))
For the details of response (→ 6. Incoming Data Format (Response))

Hold Input Control				
Command 1	Command 2	–	Description **(Be sure to refer to the Amplifier Instruction Manual as well.)**	–
HOLD_IN	**ON_A**		**HOLD A Input ON** Sending this command makes the same status as that when the HOLD A input on the terminal board is turned ON. The ON status is maintained until the following OFF command is transmitted.	
	ON_B		**HOLD B Input ON** Sending this command makes the same status as that when the HOLD B input on the terminal board is turned ON. The ON status is maintained until the following OFF command is transmitted.	
	OFF_A		**HOLD A Input OFF** Sending this command makes the same status as that when the HOLD A input on the terminal board is turned OFF. The OFF status is maintained until the following ON command is transmitted.	
	OFF_B		**HOLD B Input OFF** Sending this command makes the same status as that when the HOLD B input on the terminal board is turned OFF. The OFF status is maintained until the following ON command is transmitted.	
	RESET		**HOLD RST Input** Sending this command makes the same status as that when the HOLD RST input on the terminal board is turned ON. (There is no OFF command as the HOLD RST input is not the level input but the edge input.)	

Zero Reset Input Control				
Command 1	Command 2	–	Description	–
ZERO	**A**		**Zero Reset (HEAD A)** Zero-resets the measurement value of HEAD A.	
	B		**Zero Reset (HEAD B)** Zero-resets the measurement value of HEAD B.	
	CAL		**Zero Reset (Calculation Result)** Zero-resets the calculation result.	
	CAN_A		**Cancellation of Zero Reset (HEAD A)** Cancels the zero reset status of HEAD A measurement value.	
	CAN_B		**Cancellation of Zero Reset (HEAD B)** Cancels the zero reset status of HEAD B measurement value.	
	CAN_CAL		**Cancellation of Zero Reset (Calculation Result)** Cancels the zero reset status of calculation result.	

Command Table 2 Reading out Measurement Value / Control Output

For the details of command. (→ 5. Transmission Data Format (Command))
For the details of response (→ 6. Incoming Data Format (Response))

Reading out of Measurement Value / Control Output				
Command 1	Command 2	—	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	—
MEASURE	**A**		**Reading out of HEAD A Measurement Value** The current measurement value of HEAD A is set as the response. (only 1 data) (*1)	
	B		**Reading out of HEAD B Measurement Value** The current measurement value of HEAD B is set as the response. (only 1 data)(*1)	
	CAL		**Reading out of Calculation Result** The current Calculation Result is set as the response. (only 1 data)(*2)	
	Q1		**Reading out of Control Output (JDGE 1)** Reads out the state of current control output (JDGE 1). Response will be "ON" or "OFF."	
	Q2		**Reading out of Control Output (JDGE 2)** Reads out the state of current control output (JDGE 2). Response will be "ON" or "OFF."	
	Q3		**Reading out of Control Output (JDGE 3)** Reads out the state of current control output (JDGE 3). Response will be "ON" or "OFF."	
	Q4		**Reading out of Control Output (JDGE 4)** Reads out the state of current control output (JDGE 4). Response will be "ON" or "OFF."	
	Q5		**Reading out of Control Output (JDGE 5)** Reads out the state of current control output (JDGE 5). Response will be "ON" or "OFF."	
	ALARM_A		**Reading out of Alarm Output (ALM A)** Reads out the status of current HEAD A alarm output (ALM A). Response will be "ON" or "OFF."	
	ALARM_B		**Reading out of Alarm Output (ALM B)** Reads out the state of current HEAD B alarm output (ALM B). Response will be "ON" or "OFF."	

Continous Reading out of Measurement Value				
Command 1	Command 2	—	Description	—
MEASURE	**START_A**		**Continuous Reading out of Measurement value of HEAD A** After accepting this command, CD4 transmits the HEAD A measurement value to the PC continuously. (*3)	
	START_B		**Continuous Reading out of Measurement value of HEAD B** After accepting this command, CD4 transmits the HEAD B measurement value to the PC continuously. (*3)	
	START_CAL		**Continuous Reading out of Calculation Result** After accepting this command, CD4 transmits the calculation result to the PC continuously. (*3)	
	STOP		**Stopping of Continuous Reading out** After accepting this command, CD4 stops the continuous reading out.	

(*1) When the 350 mm type is connected, the digit of 1 µm always remains "0." 《For CD4A》
(*2) When the 350 mm type is connected to HEAD A or HEAD B, the digit of 1 µm always remains "0." 《For CD4A》
(*3) Transmission speed is 1 character per 5 - 10 ms, regardless the baud rate.
CR (0DH) is inserted between measurement values or calculation results.
To stop continuous reading out, be sure to use the "Continuous Reading out Stop" command "MEASURE( )STOP." Even though the continuous reading out stops after accepting the command other than the stop command, the response against it cannot be guaranteed.

Memory Setting				
Command 1	Command 2	Command 3	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	Defalut
MEMORY	**WRITE**	**ENABLE**	**Memory Writing Setting** Sets whether or not to save the record to the memory when performing the Zero-reset.	ENA BLE
		DISABLE		
	RESET	**NO**	**All Setting Reset** Writing YES resets all settings to the factory defaults.	NO
		YES		

Bank Setting				
Command 1	Command 2	Command 3	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	Defalut
BANK	**BANK**	**0**	**Bank Setting** Switches the banks. (0 - 7). Either the bank switching button or the bank input terminal is also available to switch. The bank number set at the power rising is the final bank set with the button or this command when the bank input terminal is 0 (in the state that the terminal is not connected), and becomes bank set in the input terminal when the bank input terminal is other than 0.	0
		1		
		2		
		3		
		4		
		5		
		6		
		7		

The value in ( ) of the initial value field is for CD4A-L.

Analog Output Setting				
Command 1	Command 2	Command 3	Description (Be sure to refer to the Amplifier Instruction Manual as well.)	Defalut
ANALOG	CAL_HI	《For CD4A》 ±9999.999 《For CD4A-L》 ±999.9999	**Setting of Analog Output Range of Calculation Result** **To use this function, set the OUTPT setting on the screen to [ ][CAL].** **The analog output of calculation result is output from ANALOG B terminal.**	+5.000 (+1.0000)
	CAL_LO			-5.000 (-1.0000)
	OUTPUT	AB	**Analog Output Setting** Selects whether to analog-output the measurement value of Sensor head A/B as they are or to analog-output the calculation result. (They cannot be output at the same time.)	AB
		CAL		
	SFT_A	±5.000	**Analog Output Shift Setting** Allows adding/subtracting any value to ANALOG A output and ANALOG B output. This setting value can be automatically set with the Zero-reset function. A and B indicate HEAD A and HEAD B respectively.	+0.000
	SFT_B	±5.000		
	SPN_A	0.100 to 1.000	**Analog Output Span Setting** Enables to set slant of ANALOG A output and ANALOG B output.	1.000
	SPN_B	0.100 to 1.000		

Sensor Head Sensitivity Setting				
Command 1	Command 2	Command 3	Description (Be sure to refer to the Amplifier Instruction Manual as well.)	Defalut
SENS	A	AUTO	**Sensor Head Sensitivity Setting** Sets the sensitivity of HEAD A and HEAD B. Normally use AUTO. Setting the sensitivity to AUTO allows automatic switching from MIN to MAX in accordance with the work. In this case, 2 sampling cycles are required to switch the sensitivity by 1 step. Thus, the time required for switching from MIN to MAX is: 2 sampling cycles x 10 steps = 2 ms. Measurement may fail while the sensitivity is switching. Fixing the sensitivity (setting to other than AUTO) prevents the sensitivity from switching. However, measurement may fail due to shortage of sensitivity if the work status changes significantly. When fixing the sensitivity, set to the following as a standard: Minimum measurable sensitivity + 4 (MAX when this value exceeds 9)	AUTO
		MAX		
		9		
		8		
		7		
		6		
		5		
		4		
		3		
		2		
		1		
		MIN		
	B	AUTO		
		MAX		
		9		
		8		
		7		
		6		
		5		
		4		
		3		
		2		
		1		
		MIN		

Time Setting				
Command 1	Command 2	Command 3	Description (Be sure to refer to the Amplifier Instruction Manual as well.)	Defalut
TIMER	MODE	OFF	**Timer Mode Setting** Sets the delay mode for control output.	OFF
		OFF_DELAY		
		ON_DELAY		
		1SHOT		
	TIMER	0.000 to 60.000	**Delay Time Setting**	0.000

Hold Setting				
Command 1	Command 2	Command 3	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	Defalut
HOLD	**A**	**OFF** **SAMPLE** **PEAK** **BOTTOM** **P-P** **AUTOPEAK** **AUTOBOTOM**	**HEAD A Hold Setting** Selects the Hold mode of HEAD A. The hold operation is to be performed with inputting HOLD A and HOLD RST. (Operation can be performed with the operation command.) **To use this function, set the INPUT setting on the screen to [A][B].** Selecting OFF (normal measurement) allows to laser off HEAD A with HOLD A inputting (and the corresponding command).	OFF
	B	**OFF** **SAMPLE** **PEAK** **BOTTOM** **P-P** **AUTOPEAK** **AUTOBOTOM**	**HEAD B Hold Setting** Selects the Hold mode of HEAD B. Operate the Hold with the inputting HOLD B and HOLD RST. (Operation can be performed with the operation command.) **To use this function, set the INPUT setting on this screen to [A][B].** Selecting OFF (normal measurement) allows to laser off HEAD B with HOLD B inputting (and the corresponding command).	OFF
	CAL	**OFF** **SAMPLE** **PEAK** **BOTTOM** **P-P** **AUTOPEAK** **AUTOBOTOM**	**Calculation Result Hold Setting** Selects the Hold mode of calculation result. Operate the Hold with inputting HOLD B and HOLD RST. (Operation can be performed with the operation command.) **To use this function, set the INPUT setting on the screen to [ ][CAL].**	OFF
	INPUT	**AB** **CAL**	**Hold Input Setting** Selects whether to use the Hold function to the measurement value of Sensor head A/B or to the calculation result (CAL). (They cannot be used at the same time.)	AB
	ALARM	**CLAMP** **HOLD**	**Measurement Value Setting in Alarm** Sets the state of measurement value when the measurement is impossible.	CLAMP

Control (Judging) Output Setting				
Command 1	Command 2	Command 3	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	Defalut
CONTROL	**Q1_HI**	〈For CD4A〉 **±9999.999** 〈For CD4A-L〉 **±999.9999**	**Upper/Lower Limit Setting** Sets the upper/lower limit of five control outputs. (The control output is performed against the calculation results. Set the calculation expression setting to A (or B) when using the Sensor head A (or B) alone.)	+3.000 (+0.6000)
	Q1_LO			+2.000 (+0.4000)
	Q2_HI			+2.000 (+0.4000)
	Q2_LO			+1.000 (+0.2000)
	Q3_HI			+1.000 (+0.2000)
	Q3_LO			-1.000 (-0.2000)
	Q4_HI			-1.000 (-0.2000)
	Q4_LO			-2.000 (-0.4000)
	Q5_HI			-2.000 (-0.4000)
	Q5_LO			-3.000 (-0.6000)
	HYSTE	〈For CD4A〉 **0 to 9999.999** 〈For CD4A-L〉 **0 to 999.9999**	**Hysteresis Setting** Sets the hysterisis of Control output. (Do not write a negative value.)	0.100 (0.0200)

Command Table 1 Reading out / Writing Setting

Transmit without Command 3 in reading out, or with Command 3 in writing.(→ 5. Transmission Data Format (Command))
The string of Command 3 is received as a response when reading out, ">" is received in writing respectively. (→ 6. Incoming Data Format (Response))

Filter Function Setting

Command 1	Command 2	Command 3	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	Defalut
FILTER	**AVERAGE**	**OFF**	**Average Count Setting** Sets the average count of measured value. **Set this item to OFF when selecting HIPASS or LOPASS in the filter setting.**	256
		4		
		16		
		64		
		256		
		1024		
		4096		
	FILTER	**OFF**	**Filter Setting** Select from OFF (Normal Measurement), HIPASS, or LOPASS. **Set this item to OFF when selecting other than OFF in the average count setting.**	OFF
		HIPASS		
		LOPASS		
	FREQ	**650/2000**	**Frequency Setting** Sets the cut-off frequency of filter. The left side of slash mark (/) is the frequency when selecting HIPASS, the left side is the one when selecting LOPASS. This item has no relationship with measurement when selecting OFF (normal measurement) in the filter setting.	650/2000
		350/800		
		200/400		
		100/200		
		50/100		
		25/50		
		15/20		
		10/10		

Calculation Function Setting

Command 1	Command 2	Command 3	Description (**Be sure to refer to the Amplifier Instruction Manual as well.**)	Defalut
CAL	**FORMULA**	**A**	**Calculation Expression Setting** Enables to set the calculation expression. The operation result is displayed on the RUN mode screen. A is HEAD A, B is HEAD B, and K is the K-item as described below.	A
		B		
		A+B		
		A-B		
		-A-B		
		K-A-B		
		K+A+B		
		K+A-B		
		K+A		
		K+B		
	K	〈For CD4A〉 **±9999.999** 〈For CD4A-L〉 **±999.9999**	**K-item Setting** Sets the K-item contained in the set calculation expression. This item has no relationship with measurement when the expression does not contain the K-item.	+0.000 (+0.0000)
	SIGN_A	**FARSIDE+**	**Setting of Measurement Value Increasing/Decreasing Direction** Sets the relationship with distance of work and size of measurement value. SIGN_A corresponds to Sensor head A, SIGN_B corresponds to Sensor head B.	FAR SIDE+
		NEARSIDE+		
	SIGN_B	**FARSIDE+**		
		NEARSIDE+		
	SFT_A	〈For CD4A〉 **±9999.999** 〈For CD4A-L〉 **±999.9999**	**Shift Setting** Allows adding/subtracting any value to measurement value and calculation value. This setting value can be automatically set by the Zero-reset function. A, B, and CAL are HEAD A, HEAD B, the calculation result respectively.	+0.000 (+0.0000)
	SFT_B			
	SFT_CAL			

9. Communication Failure

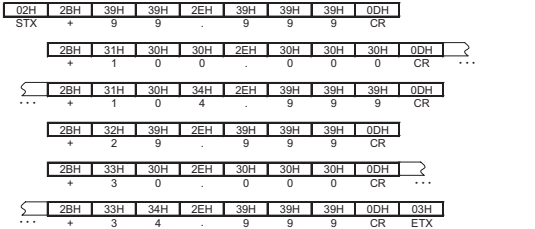
（1） CD4 returns nothing after transmitting the command.

- Check the connection. (RS232C cable, straight, 9 pin female, －9 pin female)
- Set the same communication setting at CD4 and the PC. (Baud rate, data length, parity check)
- Check if the ETX(03H) is added to the end of the command.
- It takes several seconds to perform all setting reset commands from transmitting to return of ">."

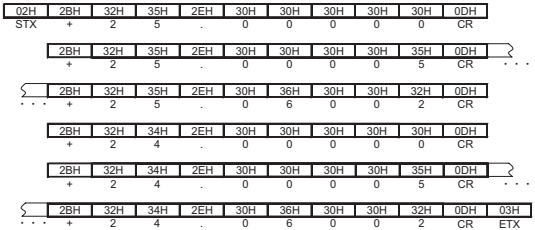
（2） CD4 returns "?" after transmitting the command.

- Check if the command is correct. (Spelling, position of the space, addition of STX(02H), ETX(03H))
- Set the same communication setting at CD4 and the PC. (Baud rate, data length, parity check)
- Keep distance from the noise source as much as possible.
- Return all unused functions to the initial value.
- When using at 115200 bps, retry at 38400 bps.

(Example of Response 2)《CD4A》
For HEAD A： +99.999, +100.000, ・・・+104.999
HEAD B： +29.999, +30.000, ・・・+34.999,



(Example of Response 2)《CD4A-L》
For HEAD A： +25.00000, +25.00005, ・・・+25.06002
HEAD B： +24.00000, +24.00005, ・・・+24.06002



After all buffers are read out, the function starts reading out the measurement value to the buffer, and changes to the standby state for the next trigger.
Be sure to read out the buffer before starting the next trigger. (The buffer is not overwritten unless it is readout.)

In case of the following conditions, the digit of 1μm of readout data remains always "0."《For CD4A》
- When A is selected in the data setting for buffer and HEAD A is the 350 mm type.
- When B is selected in the data setting for buffer and HEAD A is the 350 mm type.
- When CAL or A&B is selected in the data setting for buffer and HEAD A or HEAD B is the 350 mm type.

(7) Other Operations
- When the reading out is performed before recording stops after triggering:
  The number of buffers set in the buffer size is readout, which contains the last contents.
  (When the trigger mode is BEFORE, recording stops at the time trigger is started and the buffer is fixed.)
- When the next trigger is input before recording stops after triggering:
  The first trigger after the buffer readout becomes valid.

After triggering and at the time of completion of data buffering, the PC receives the response ">" from CD4.

(Example of command) STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

Transmission		Reception	
Command	Meaning	Response	Meaning
BUFFER( )TRIGGER	Start trigger	**>**	Completion of triggering
(When the data buffer is completed)		**>**	Completion of buffering

(6) Reading out Buffer

Using the following command, the same number of buffers as set in the buffer size is readout.

BUFFER( )READ STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

Transmitting this command reads out the data of CD4 sequentially from the old one as the response.

The data format of a data is the same in reading out the measurement value.

CR(0DH) is inserted between data.

The example when selecting HEAD A, HEAD B, and the calculation result is displayed on (Example of Response 1)

in the data for the buffer.

The example when selecting A&B is displayed on (Example of Response 2) in the data for the buffer.

In the case of A&B, transmit all the buffer contents of HEAD A as the response.

Then the buffer content of HEAD B is responded.

(Example of Response 1) 《For CD4A》

For +99.999, +100.000, +100.001, ・・・ +104.999,

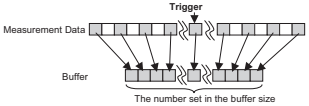
02H	2BH	39H	39H	2EH	39H	39H	39H	0DH	
STX	+	9	9	.	9	9	9	CR	
	2BH	31H	30H	30H	2EH	30H	30H	30H	0DH
	+	1	0	0	.	0	0	0	CR
	2BH	31H	30H	30H	2EH	30H	30H	31H	0DH
	+	1	0	0	.	0	0	1	CR
・・・	2BH	31H	30H	34H	2EH	39H	39H	39H	0DH	03H
・・・	+	1	0	4	.	9	9	9	CR	ETX

(Example of Response 1) 《For CD4A-L》

For +25.00000, +25.00005, +25.00009, ・・・ +25.06002,

02H	2BH	32H	35H	2EH	30H	30H	30H	30H	30H	0DH	
STX	+	2	5	.	0	0	0	0	0	CR	
	2BH	32H	35H	2EH	30H	30H	30H	30H	35H	0DH	
	+	2	5	.	0	0	0	0	5	CR	
	2BH	32H	35H	2EH	30H	30H	30H	30H	39H	0DH	
	+	2	5	.	0	0	0	0	9	CR	・・・
・・・	2BH	32H	35H	2EH	30H	36H	30H	30H	32H	0DH	03H
・・・	+	2	5	.	0	6	0	0	2	CR	ETX

・**CENTER** Use to record the phenomenon before and after triggering.
Until the trigger occurs, the state keeps recording into the buffer. Once the trigger occurs, another recording to the buffers of half size of buffer size is performed. Then recording stops.
Thus, the following is the time from the trigger enters until the recording all buffer is completed:
100[μsec] x Buffer Record Cycle x (Buffer Size [number] ÷ 2)
(However, in the case the data for buffer is A&B, the buffer size is 1/2.)
When recording all buffers is completed, the PC receives the response ">" from CD4.
The buffer is held until the readout is completed.
The data is read out from the oldest one.



(Example of command)

Transmission		Reception	
Command	Meaning	Response	Meaning
BUFFER( )MODE( )OFF	Select OFF.	**>**	Completion of setting
BUFFER( )MODE( )AFTER	Select AFTER.	**>**	Completion of setting
BUFFER( )MODE	Readout the trigger mode.	**AFTER**	Set to AFTER.

STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

(5) Selecting Trigger Factor
There are 2 types of triggers: One from the command and the one from the external terminal.

・Trigger from the command
Transmitting the following command enables to trigger the data buffer function:
The trigger from the command is useful when the data buffer function test or the strict trigger timing is not necessary.
(For the case when Buffer Rate is low = Buffer Record Cycle is long)

BUFFER( )TRIGGER STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

・Trigger from the external terminal
HOLD RST terminal of CD4 is the trigger input of data buffer function.

When using the trigger from the external terminal, be sure to turn OFF the hold settings (HEAD A, HEAD B, and the calculation result).
(They cannot be used with the hold function at the same time.)
You can run on the CD4 main unit or by transmitting the following command.

HOLD( )A( )OFF
HOLD( )B( )OFF
HOLD( )CAL( )OFF (All STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.)

・Triggering is available by connecting the photoelectronic sensor or the programmable logic controller (PLC) to the HOLD RST terminal.
In this case, connect the NPN type output to CD4A-N, the PNP type output to CD4A-P.
・The JDGE output or the ALM output of CD4 can be connected to the HOLD RST terminal.
When connecting the JDGE output, triggering starts when the measurement value reaches the upper/lower limit of set control output.
Also when connecting the ALM output, triggering starts in the case the sensor head fails the measurement.

(3) Setting Buffer Size

Set the number of buffer.

100 to 2000 buffers can be set in 100 units. Adjust to the necessary number.

When A&B is selected in the data setting for buffer, the each number of buffer to be assigned to the measurement value of HEAD A and HEAD B becomes 1/2 of the number set here.

(Example of Command) STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

Transmission		Reception	
Command	Meaning	Response	Meaning
BUFFER( )SIZE( )500	Select 500 buffers.	**>**	Completion of setting
BUFFER( )SIZE( )2000	Select 2000 buffers.	**>**	Completion of setting
BUFFER( )SIZE	Readout the buffer size.	**2000**	Set to 2000 buffers.

(4) Selecting Trigger Mode

The relationship of timing of trigger occurrence and the data to record in the buffer can be selected from 3 types.

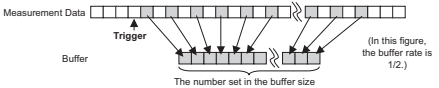
When not using the data buffer function, be sure to turn OFF.

- **OFF** The data buffer function does not work.
- **AFTER** Use to record the phenomenon after triggering.

  After the trigger occurred, recording to the same number of buffers as buffer size record is performed
  then the recording stops.
  Thus, the time is as follows from the trigger is input until all buffers are completely recorded:

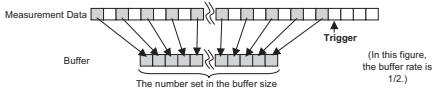
  100 [μ sec] x Buffer Record Cycle x Buffer Size [number]
  (However, in case the data for the buffer is A&B, the buffer size is 1/2.)

  After the record stops, the PC receives the response ">" from CD4.
  The buffer is held until the readout is completed.
  The data is read out from the oldest one.



- **BEFORE** Use to record the phenomenon before triggering.

  Until the trigger occurs, the state keeps recording into the buffer. Once the trigger occurs the record to the buffer stops.
  Thus, the buffer recording is completed just after the trigger enters.
  Then the PC receives the response ">" from CD4.
  Normally, the buffer becomes full before the trigger enters. In this case, the data is overwritten from the old one.
  The buffer is held until the readout is completed after the trigger enters.
  The data is read out from the oldest one.



・The trigger mode can be selected from 3 types. When setting the buffer size to 2000,
2000 data are recorded from the time when a trigger occurs.
2000 data right before the trigger occurred are recorded.
1000 data right before the trigger occurred and the 1000 data after that are recorded.

Follow the following steps for setting and the operation test:

(1) Data Setting for Buffer

Select the data to record in the buffer.
Select from A, B, CAL, and A&B.
When A&B is selected, the measurement values of HEAD A and HEAD B are recorded in the buffer simultaneously.
However, the buffer size described later becomes 1/2 each.

(Example of Command) STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

Transmission		Reception	
Command	Description	Response	Description
BUFFER( )DATA( )CAL	Select the calculated result.	**>**	Completion of setting
BUFFER( )DATA( )A&B	Select the measurement value of HEAD A and B.	**>**	Completion of setting
BUFFER( )DATA( )A	Select the measurement value of HEAD A.	**>**	Completion of setting
BUFFER( )DATA	Readout the data type to record.	**A**	Set to HEAD A.

(2) Setting Buffer Rate

Select the frequency to record in the buffer (Buffer Record Cycle).
The CD4 measurement sampling cycle is 100 μ sec. Setting the buffer rate to 1/1 records all the data in the buffer.
Setting to 1/4 records one data per 4 measurements in the buffer.

The relationship between Buffer Rate Setting and Buffer Record Cycle is as follows:

Command	Buffer Rate Setting	Buffer Record Cycle
1	1/1	100[μsec]
2	1/2	200[μsec]
4	1/4	400[μsec]
8	1/8	800[μsec]
16	1/16	1.6[msec]
32	1/32	3.2[msec]
64	1/64	6.4[msec]
128	1/128	12.8[msec]
256	1/256	25.6[msec]
512	1/512	51.2[msec]
1024	1/1024	102.4[msec]
2048	1/2048	204.8[msec]
4096	1/4096	409.6[msec]
8192	1/8192	819.2[msec]
16384	1/16384	1.6384[s]
32768	1/32768	3.2768[s]

(Example of Command) STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

Transmission		Reception	
Command	Meaning	Response	Meaning
BUFFER( )RATE( )1	Select 1/1.	**>**	Completion of setting
BUFFER( )RATE( )128	Select 1/128.	**>**	Completion of setting
BUFFER( )RATE	Readout the buffer rate.	**128**	Set to 1/128.

・Example of reading out measurement value and control output

Transmission		Reception	
Command	Meaning	Response	Meaning
MEASURE( )A	Reads out measurement value of HEAD A.《CD4A》	**+34.123**	+ 34.123 mm
MEASURE( )A	Reads out measurement value of HEAD A.《CD4A-L》	**+34.1230**	+ 34.1230 mm
MEASURE( )Q1	Reads out control output Q1.	**ON**	The output status is ON.
MEASURE( )Q5	Reads out control output Q5.	**OFF**	The output status is OFF.
MEASURE( )ALARM_A	Reads out output A	**ON**	The output status is ON.
MEASURE( )ALARM	"ALARM" does not exist in the command list.	**?**	Error

・Example of operating control input

Transmission		Reception	
Command	Meaning	Response	Meaning
HOLD_IN( )ON_A	Turn ON HOLD A input.	**>**	The status became ON.
HOLD_IN( )OFF_A	Turn OFF HOLD A input.	**>**	The status became OFF.
ZERO( )A	Perform Zero reset of measurement value of HEAD A.	**>**	Completion of Zero reset
ZERO( )CAN_A	Cancel Zero reset of measurement value of HEAD A.	**>**	Completion of cancel of Zero reset
HOLD( )ON_A	The combination of "HOLD" and "ON_A" does not exist.	**?**	Error

・Example of continuous readout of measurement value

Transmission		Reception	
Command	Meaning	Response	Meaning
MEASURE( )START_A	Continuously performs readout of measurement value of HEAD A. See below.		

For + 99.999, + 100.000, + 100.001,《CD4A》

2BH	39H	39H	2EH	39H	39H	39H	0DH
+	9	9	.	9	9	9	CR

2BH	31H	30H	30H	2EH	30H	30H	30H	0DH
+	1	0	0	.	0	0	0	CR

2BH	31H	30H	30H	2EH	30H	30H	31H	0DH	・・・
+	1	0	0	.	0	0	1	CR	

For + 25.00000, + 25.00005, + 25.00009,《CD4A-L》

2BH	32H	35H	2EH	30H	30H	30H	30H	30H	0DH
+	2	5	.	0	0	0	0	0	CR

2BH	32H	35H	2EH	30H	30H	30H	30H	35H	0DH
+	2	5	.	0	0	0	0	5	CR

2BH	32H	35H	2EH	30H	30H	30H	30H	39H	0DH	・・・
+	2	5	.	0	0	0	0	9	CR	

Neither STX nor ETX exists.
The transmission speed is 1 character per 5 - 10 ms, regardless the baud rate.
CR(0DH) is inserted between the measurement values or calculation results.
To stop the continuous readout, be sure to use the continuous read out stops, however the response to the command cannot be buaranteed.

8. Data Buffer Function

This function enables to temporally store the 2000 measurement data at maximum and readout them sequentially.
Example of operation available with this function:

- Continuous data per 100 μ sec can be recorded (max for 0.2 sec.).
- Data up to for 109 minutes can be recorded (interval of 3.28 sec, 2000 data).
- Various trigger factors can be selected.
  Starts (completes) the record when the measurement value enters the set upper/lower limit.
  Completes the record when sensor fails to measure.
  Starts (completes) the record when the synchronous sensor turns ON.
  Some commands can enable to trigger.
- Available to simultaneously record the both data of sensor head A and B.
  (In this case, up to 1000 data can be recorded each.)

Therefore, the total is 7 - 10 characters.

MEASURE( )A MEASURE( )START_A
MEASURE( )B MEASURE( )START_B
MEASURE( )CAL MEASURE( )START_CAL
BUFFER( )READ
(STX and ETX are omitted in this example. The space (20H) is shown as() for convenience.)

(Example)
25.00101

・For the case of numerical value ± 5.000:
The total is 6 characters composed of the sign, 1 digit of integer, decimal point, and 3 places of decimals.
(Example)
5 → +5.000

・For the case of numerical value from 0.100 to 1.000:
The total is 5 characters composed of 1 digit of integer, decimal point, and 3 places of decimals.
(Example)
0.1 → 0.100

・For the case of numerical value from 0.000 to 60.000,:
The total is 5 - 6 characters composed of 1 - 2 digit(s) of integer(s), decimal point, and 3 places of decimals.
(Example)
5 → 5.000
60 → 60.000

・When reading out the status of control output or alarm output:
Either "ON" or "OFF" is set.

7. Example of Command and Response

STX and ETX are omitted in this example. The space (20H) is shown as ( ) for conveniencw.

・Example of reading out setting

Transmission		Reception	
Command	Meaning	Response	Meaning
FILTER( )AVERAGE	Reading out the average count.	**256**	Set to 256 times.
CAL( )FORMULA	Reading out the arithmetic expression.	**K-A-B**	Set to K-A-B.
HOLD( )A	Reading out the HEAD A Hold setting.	**SAMPLE**	Set to "Sample Hold."
CONTROL( )Q1_HI	Reading out the upper limit of JDGE 1.（CD4A）	**+10.000**	Set to +10.000 mm.
CONTROL( )Q1_HI	Reading out the upper limit of JDGE 1.（CD4A-L）	**+10.0000**	Set to +10.0000 mm.
TIMER( )MODE	Reading out the timer mode.	**1SHOT**	Set to 1 shot.
TIMER( )TIMER	Reading out the delay time.	**0.100**	Set to 0.1 second.
BANK( )BANK	Reading out the bank number.	**4**	Set to 4.
BANK( )BANC	The spelling of "BANC" is incorrect.	**?**	Error

・Example of writing setting

Transmission		Reception	
Command	Meaning	Response	Meaning
FILTER( )AVERAGE( )4	Setting/Writing the average count to 4 times.	**>**	Completion of setting/writing to 4 times.
CAL( )FORMULA( )A+B	Setting/Writing the arithmetic expression to A+B.	**>**	Completion of setting/writing to A+B.
HOLD( )A( )P-P	Setting/Writing the HEAD A Hold setting to P-P.	**>**	Completion of setting to/writing P-P.
CONTROL( )Q1_HI( )-3.5	Setting/Writing the upper limit of JDGE 1 to - 3.5 mm.	**>**	Completion of setting to/writing -3.5 mm.
TIMER( )MODE( )1SHOT	Setting/Writing the timer mode to 1SHOT.	**>**	Completion of setting to/writing 1SHOT.
TIMER( )TIMER( )10	Setting/Writing the delay time to 10 seconds.	**>**	Completion of setting to/writing 10 sec.
BANK( )BANK( )7	Setting/Writing the bank number to 7.	**>**	Completion of setting to/writing 7.
BANK( )BANK( )8	"8" does not exist.	**?**	Error

・When 0.100 to 1.000 is written, set the value from 0.100 to 1.000.

(Valid example)		(Invalid example)	
1	1.000	01	(integer digits are two or more.)
1.	+1	1.0000	(decimal places are four or more.)
1.0		+ 1.0	(space between the numerical values)

・When 0.000 to 60.000 is written, set the value from 0.000 to 60.000.

(Valid example)		(Invalid example)	
60	60.0	060	(integer digits are three or more.)
+60	60.000	60.0000	(decimal places are four or more.)
60.		+ 60	(space between the numerical values)

・For others, set the command according to the command table.

6. Incoming Data Format (Response)

02H		03H
STX	RESPONSE	ETX
1	2	3

1	STX	The code showing the head of incoming data (02H).
2	RESPONSE	The response data is set to the transmitted command.
3	ETX	The code showing the completion of incoming data (03H).

・The following two responses are for the written command:
> (3EH) Written properly.
? (3FH) Failed to receive, such as the command was wrong.

・The following two responses are for the control command:
> (3EH) Received successfully.
? (3FH) Failed to receive, such as the command was wrong.

・For the continuous reading out of measurement value, refer to the next section "Example of continuous reading out of measurement value."

Basically, for the response against the readout command, the string is set as shown in Command 3 of the command table.
The followings are exceptions:

・For the case of numerical value ± 9999.999:《CD4A》
The total is 6 - 9 characters composed of the sign, 1-4 digit(s) of integer(s), decimal point, and 3 places of decimals.

(Example)
1 → +1.000
100 → +100.000
-0.3 → -0.300

・For the case of numerical value ± 999.9999:《CD4A-L》
The total is 6 - 9 characters composed of the sign, 1-3 digit(s) of integer(s), decimal point, and 4 places of decimals.

(Example)
1 → +1.0000
10 → +10.0000
-0.3 → -0.3000

Note that the decimal places are five when reading out the measurement value with the commands below.

5. Transmission Data Format (Command)

- The transmission data (Command) format can be roughly divided into two types, depending on the presence of Command 3.
  The combination of Command 1 and 2 is the setting items. Command 3 is the setting value.
- When sending Command 1 or 2 only, the setting value of the setting item is returned as a response. (Reading out)
- To read out (change) the setting item, add and send Command 3 as a setting value.
  When written properly, the response ">"(3EH) is returned.
  When the command is wrong, the response "?" (3FH) is returned.
- Command 3 does not exist in case of control command (operating the control input).
  When accepted successfully, the response ">" (3EH) is returned.
  When the command was wrong, the response "?" (3FH) is returned.

For Reading out Setting/Measurement Value/Output Status, and Control Command:

02H		20H		03H
STX	COMMAND 1	SPACE 1	COMMAND 2	ETX
1	2	3	4	5

1	STX	The code showing the head of transmit data (02H).
2	COMMAND 1	Selects from the column of command 1 on the command table to set.
3	SPACE 1	Shows the separation between Command 1 and 2 (20H).
4	COMMAND 2	Selects from the column of command 2 on the command table to set.
5	ETX	The code showing the completion of transmit data (03H).

For writing the setting:

02H		20H		20H		03H
STX	COMMAND 1	SPACE 1	COMMAND 2	SPACE 2	COMMAND 3	ETX
1	2	3	4	5	6	7

1	STX	The code showing the head of transmit data (02H).
2	COMMAND 1	Selects from the column of command 1 on the command table to set.
3	SPACE 1	Shows the separation between Command 1 and 2 (20H).
4	COMMAND 2	Selects from the column of command 2 on the command table to set.
5	SPACE 2	Shows the separation between Command 2 and 3 (20H).
6	COMMAND 3	Selects from the column of command 3 on the command table to set.
7	ETX	The code showing the completion of transmit data (03H).

To input the numerical value of Command 3, see the following examples:

- For the item with "±9999.999," set the value from -9999.999 to +9999.999.
  For the item with "0 to 9999.999," set the value from 0 to 9999.999. 《CD4A》

(Valid example)		(Invalid example)	
+100	100.	00100	(integer digits are five or more.)
0100	100.0	100.0000	(decimal places are four or more.)
100	100.000	+ 100	(space between the numerical values)

- For the item with "±999.9999," set the value from -999.9999 to +999.9999.
  For the item with "0 to 999.9999," set the value from 0 to 999.9999. 《CD4A-L》

(Valid example)		(Invalid example)	
+10	10.	0010	(integer digits are four or more)
010	10.0	10.00000	(decimal places are five or more)
10	10.0000	+ 10	(space between the numerical values)

- When ±5.000 is written, set the value from -5.000 to +5.000.

(Valid example)		(Invalid example)	
+5	5	05	(integer digits are two or more.)
+5.0	5.	5.0000	(decimal places are four or more.)
+5.000		+ 5	(space between the numerical values)

1. Communication Function of CD4

Connecting the PC and CD4 allows following operations from the PC:

- Writing and reading out the setting value
- Reading out the measurement value
- Reading out the control output status
- Operating the control input
- Data buffer function

2. Communication Specification

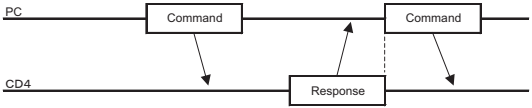
Communication method	RS-232C
Synchro system	Asynchronous
Baud rate	9600/19200/**38400**/115200 bps
Transmission code	ASCII
Data length	7/**8** bit
Stop bit length	1 bit
Parity check	**Nil**/Even number/Odd number
Data classification	STX・ETX

The underlined setting is the factory defaults of CD4.

Adjust the communication setting of PC and CD4 within the the range shown in the above table.
Set the CD4 setting at 14 .RS232C in the SET mode.

3. Communication Procedure

When the PC sends a command to CD4, CD4 sends a response to the PC.
Basically, there is one response per command.
When sending a command, be sure to send after receiving the response of the previous command.



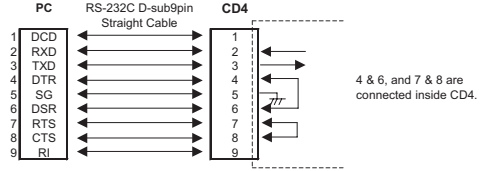
However,

- The stop command can be sent while performing the continuous reading out of measurement value. (→7. Example of Commands and Responses)
- In the Data Buffer Function, receives the response ">" when the buffer record is completed. (→8. Data Buffer Function)

For details, refer to the relevant item.

4. Connecting to PC

Use the RS232C cable (Straight, 9 pin female, －9 pin female).



OPTEX FA

Amplifier Instruction Manual (Communication Version)

Displacement Sensor CD4 Series

CD4A-N/CD4A-P/CD4A-LN/CD4A-LP

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