

HCA8C-4DA User's manual

1. Outline

This section outlines HCA8C - 4DA.

For common descriptions of the HCA8 - 4AD/HCA8C - 4AD, these model names are referred to as the 4AD.

1.1 Outline of function

The HCA8C - 4DA special function block for analog output converts digital values supplied from PLC into analog values (voltage, current) and outputs those analog values from its four output points.

- 1) Up to 8 units can be connected to the HCA8/HCA8C series PLC. (including the other special function blocks).
- 2) Either "voltage output" or "current output" can be specified for each channel.
- 3) The block converts the digital values stored in the HCA8C-4DA buffer memory (BFM) in HCA8C-4DA to analog signals (voltage/current).
- 4) A predetermined output pattern is set as data table, and analog signal can be output according to the data table.

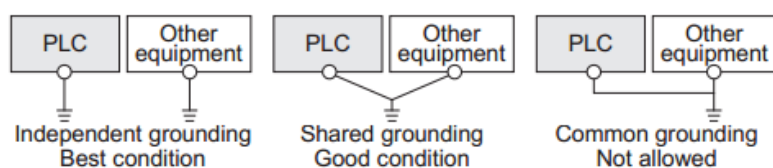
2 Specifications

2.1 Generic specifications

Item	Specifications				
Ambient temperature	0 to 55° C (32 to 131°F) when operating -25 to 75° C (-13 to 167°F) when stored				
Relative humidity	5 to 95 %RH (no condensation) when operating				
Vibration resistance *4		Frequency (Hz)	Acceleration (m/s ²)	Half amplitude (mm)	10 times of testing in each direction (X-, Y-, and Z-axis directions) (Total: 80 min, each)
	DIN Rail Mounting	10 to 57	-	0.035	
	Direct Mounting	57 to 150	4.9	-	
	*1	10 to 57	-	0.075	
		57 to 150	9.8	-	
Shock resistance*4	147 m/s ² Acceleration, Action time: 11 ms, 3 times by half-sine pulse in each direction X, Y, and Z				
Noise resistance	Using noise simulator of: Noise voltage: 1,000 Vp-p / Noise width: 1 μs / Rise: 1 ns / Cycle: 30 to 100 Hz				
Dielectric withstand voltage	500 V AC, for 1 min			Between all terminals and ground terminal	
Insulation resistance	5 MΩ or more using 500 V DC insulation resistance meter				
Grounding	Class D grounding (grounding resistance: 100Ω or less) <Common grounding with a heavy electrical system is not allowed.>*2				
Working atmosphere	Free from corrosive or flammable gas and excessive conductive dust.				
Working altitude	< 2000 m*3				

*1 The direct mounting method cannot be used with HCA8C - 4DA.

*2



*3 If the pressure is higher than the atmospheric pressure, do not use it; 4DA may malfunction.

*4 The criterion is shown in IEC61131-2.

2.2 Power specifications

Item	Specifications
D/A conversion circuit drive power	24V DC $\pm 10\%$, 160mA (It is necessary to supply 24V DC from the terminal block.)
CPU drive power	5V DC, 120mA (Since the internal power is supplied from the main unit, it is not necessary to supply power externally.)

2.3 Performance specifications

Item	Specifications	
	Voltage input	Current input
Analog output range	-10V to +10V DC (External load: 1k Ω to 1M Ω)	0mA to +20mA DC, 4mA to 20mA DC (External load: 500 Ω or less)
Offset *1	-10V to +9V*2	0mA to 17mA*3
Gain *1	-9V to +10V*2	3mA to 30mA*3
Digital input	With sign, 16bits, binary	15bits, binary
Resolution	0.32mV(20V/64000)	0.63 μ A(20mA/32000)
Overall accuracy	<ul style="list-style-type: none"> Ambient temperature: 25$^{\circ}$C $\pm 5^{\circ}$C 0.3% (± 60mV) for 20V full scale Ambient temperature: 0$^{\circ}$C $\sim 55^{\circ}$C 0.5% (± 100mV) for 20V full scale 	<ul style="list-style-type: none"> Ambient temperature: 25$^{\circ}$C $\pm 5^{\circ}$C $\pm 0.3\%$(± 60 μ A) for 20mA full scale Ambient temperature: 0$^{\circ}$C $\sim 55^{\circ}$C $\pm 0.5\%$(± 100 μ A) for 20mA full scale
D/A conversion time	1ms (The number of selected channels will not affect this value.)	
Insulation method	<ul style="list-style-type: none"> The photo-coupler is used to insulate the analog input area from the PLC. The DC/DC converter is used to insulate the analog input area from the power supply unit. Channels are not insulated from each other. 	
Number of I/O points occupied	8 points (Taken from either the input or output points of the PLC.)	

*1 Adjustment of the offset or gain value will not affect the resolution. In output mode 6 or 9, however, the offset/gain cannot be adjusted.

*2 The offset and the gain should satisfy the following condition:

$$1V \leq (\text{Gain} - \text{Offset}) \leq 10V$$

*3 The offset and the gain should satisfy the following condition:

$$3mA \leq (\text{Gain} - \text{Offset}) \leq 30mA$$

2.4 Output mode (characteristics) BFM #0

For the 4DA, there are two types of output characteristics: voltage (-10 to +10V) and current (0 to 20mA, 4 to +20mA) output characteristics. The output characteristics depend on the set output mode as described below.

1. Voltage input characteristics [-10 to +10V] (Input mode: 0 to 2)

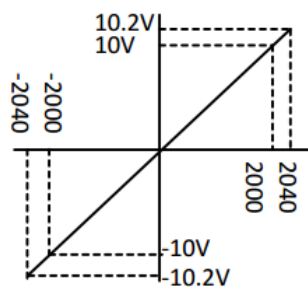
Set output mode: 0

Output type: Voltage output

Digital output range: -2000 to +2000

Offset/gain adjustment:

Possible



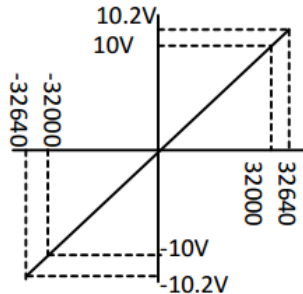
Set output mode: 5

Output type: Voltage output

Digital output range: -32000 to +32000

Offset/gain adjustment:

Possible

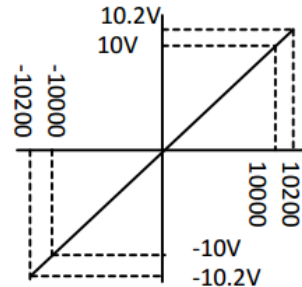


Set output mode: 6

Output type: Voltage output

Digital output range: -10000 to +10000

Offset/gain adjustment: Impossible



2. Current output characteristics [0 to +20mA]

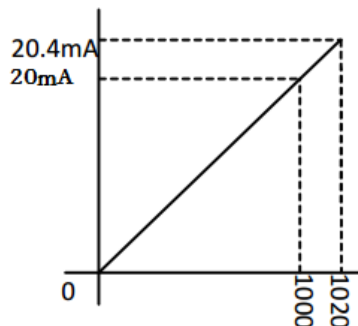
Set output mode: 2

Output type: Current output

Digital output range: 0 to +1000

Offset/gain adjustment:

Possible



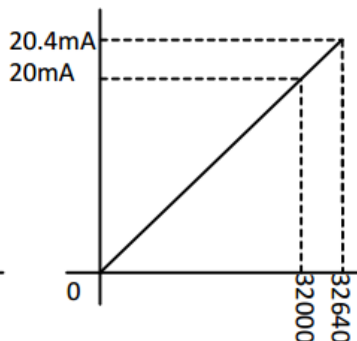
Set output mode: 7

Output type: Current output

Digital output range: 0 to +32000

Offset/gain adjustment:

Possible

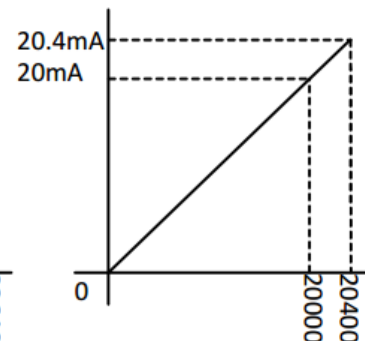


Set output mode: 9

Output type: Current output

Digital output range: 0 to +20000

Offset/gain adjustment: Impossible



3. Current output characteristics [4 to +20mA]

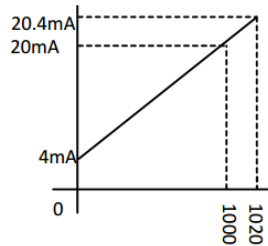
Set output mode: 1

Output type: Current output

Digital output range: 0 to +1000

Offset/gain adjustment:

Possible



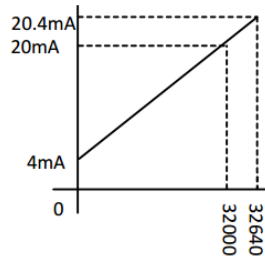
Set output mode: 8

Output type: Current output

Digital output range: 0 to +32000

Offset/gain adjustment:

Possible



3. Wiring

This chapter describes wiring of the HCA8C-4DA.

Observe the following cautions wiring the HCA8C-4DA.

- Make sure to cut off all phases of the power supply externally before attempting wiring work.

Failure to do so may cause electric shock or damage to the product.

- Connect the DC power supply wiring to the dedicated terminals described in this manual.

If an AC power supply is connected to a DC input/output terminal or DC power supply terminal, the PLC will burn out.

- Do not wire vacant terminals externally.

Doing so may damage the product.

- Perform class D grounding (grounding resistance: 100 Ω or less) to the grounding terminal on the main unit.

Do not use common grounding with heavy electrical systems.

- When drilling screw holes or wiring, make sure cutting or wire debris does not enter the ventilation slits.

Failure to do so may cause fire, equipment failures or malfunctions.

- Make sure to observe the following precautions in order to prevent malfunctions under the influence of noise:

- Do not bundle the power line or shield of the analog input/output cable together with or lay it close to the main circuit, high-voltage line, or load line.

Otherwise, noise disturbance and/or surge induction are likely to take place. As a guideline, lay the control line at least 100mm (3.94") or more away from the main circuit, high-voltage line, or load line.

- Ground the shield of the analog input/output cable at one point on the signal receiving side.

However, do not use common grounding with heavy electrical systems.

- Make sure to properly wire to the terminal block (European type) in accordance with the following precautions.

Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.

- The disposal size of the cable end should be 9mm.


- Tightening torque should be within 0.22~0.25N·m.

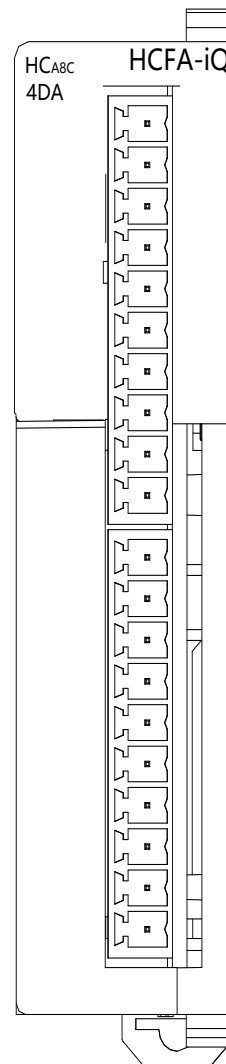
- Twist the end of strand wire and make sure that there are no loose wires.

- Do not solder-plate the electric wire ends.

- Do not connect more than the specified number of wires or electric wires of unspecified size.
 - Affix the electric wires so that neither the terminal block nor the connected parts are directly stressed.
 - Make sure to properly wire the terminal block in accordance with the following precautions.
- Failure to do so may cause electric shock, equipment failures, a short-circuit, wire breakage, malfunctions, or damage to the product.
- The disposal size of the cable end should follow the dimensions described in the manual.
 - Tightening torque should be within 0.5~0.8N•m.

3.1 Terminal layout

Signal name	Application
V1	Channel 1 analog output
I1	
COM1	
V2	Channel 2 analog output
I2	
COM2	
V3	Channel 3 analog output
I3	
COM3	
V4	Channel 4 analog output
I4	
COM4	
•	Do not connect any lines.
•	Do not connect any lines.
•	Do not connect any lines.
•	Do not connect any lines.
•	Do not connect any lines.
24+	24V DC power supply
24 -	
	Ground terminal



3.2 Cable and terminal tightening torque

The connected cable and end disposal of cable are shown below.

1. Cable

Applicable cable and tightening torque

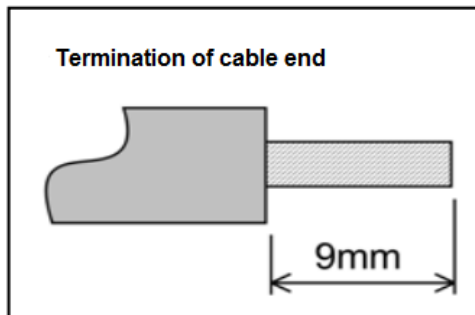
	Wire size (stranded/ single-wire)	Tightening torque	Termination
Single wire	0.3 mm ² to 0.5 mm ² (AWG22 to 20)	0.22 to 0.25 N•m	<ul style="list-style-type: none"> • To connect a stranded cable, peel the cover off the cable and then twist the core before connection. • To connect a single-wire cable, peel the cover off the cable before connection.
Double wire	0.3 mm ² (AWG22)		

Rod terminal with insulation sleeve	0.3 mm ² to 0.5 mm ² (AWG22 to 20) (Refer to the external view of rod terminal shown in the following figure.)		<ul style="list-style-type: none"> • Rod terminal with insulation sleeve (recommended terminal) AI 0.5-8WH : Manufactured by Phoenix Contact <ul style="list-style-type: none"> • Caulking tool CRIMPFOX ZA 3: Manufactured by Phoenix Contact (or CRIMPFOX UD 6: Manufactured by Phoenix Contact)
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2. Termination of cable end

To terminate the cable, treat the stranded/single-wire directly or use the rod terminal with insulation sleeve.

- To directly terminate end of stranded/single-wire cable:
 - Terminate the end of the stranded cable so that the "barbed wires" cannot protrude.
 - Do not solder-plate the end of the cable.



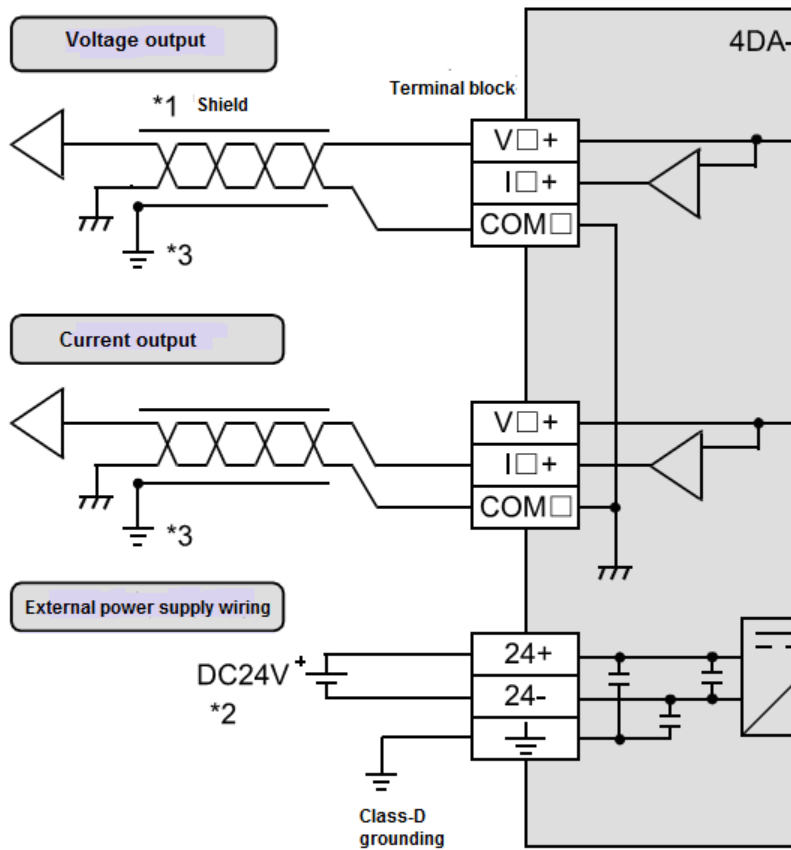
3.3 Power supply wiring

The power (24VDC) of 4DA is supplied from the terminal block 「24+」、 「24 - 」 .

- Ground the " ⊥ " terminal and " ⊕ " terminal to the Class - D grounding line (100Ω or less) together with the ground terminal of the main unit.

3.4 Analog output line

The analog output type, "voltage output " or "current output", can be selected for each channel.



□ in V□+, I□+, ch□ represents channel number.

4. Analog output

4.1 Analog output procedures

1 Unit number check

Unit numbers from 0 to 7 will be assigned to the special function units/blocks starting from the left. Check the unit number assigned to the HCA8C-4DA.

Unit number: 0

Unit number: 1

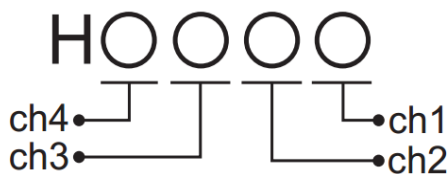
Unit number: 3

Main unit	Input/ output	Special function	Special function	Input/output	Special function
HCA8C	extension block	block	block	extension block	block

2 Input mode (BFM#0) setting

Depending on the analog signal generator to be connected, set the output mode (BFM#0) for each channel.

Use hexadecimal numbers for output mode setting. Set the corresponding channel digit to the output mode setting value specified in the following table:



Setting value	Output mode	Analog output range	Digital input range
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0	Voltage output mode	- 10V~+10V	- 2000~+2000
1	Current output mode	4mA~20mA	0~1000
2	Current output mode	0mA~20mA	0~1000
3	Not used		
4	Not used		
5	Voltage output mode	-10V~+10V	-32000~+32000
6 *1	Voltage output analog analog value mV specification mode	10V~+10V	-10000~+10000
7	Current output mode	0mA~20mA	0~32000
8	Current output mode	4mA~20mA	0~32000
9 *1	Current output analog analog value μ A specification mode	0mA~20mA	0~20000
F	Channel not used		

5. Buffer memory (BFM)

5.1 Buffer memory list (BFM)

This chapter describes the buffer memory incorporated in HCA8C-4DA.

BFM number	Description	Setting range	Initial value	Data type
#0E	Output mode setting for channels 1 to 4	*2	H0000	Hexadecimal
#1	Channel 1 output data	Depending on the mode used	K0	Decimal
#2	Channel 2 output data		K0	Decimal
#3	Channel 3 output data		K0	Decimal
#4	Channel 4 output data		K0	Decimal
#5	Output setting upon PLC stop	*3	H0000	Hexadecimal
#6	Not used	-	-	-
#7				
#8	Command to write offset/gain setting value of CH1, CH2	0, 1	H0000	Hexadecimal
#9	Command to write offset/gain setting value of CH3, CH4	0, 1	H0000	Hexadecimal
#10	Channel-1 offset data (Unit: mV or μ A)	Depending on the mode used	Depending on the mode used	Decimal
#11	Channel-1 gain data (Unit: mV or μ A)			Decimal
#12	Channel-2 offset data (Unit: mV or μ A)			Decimal
#13	Channel-2 gain data (Unit: mV or μ A)			Decimal
#14	Channel-3 offset data (Unit: mV or μ A)			Decimal
#15	Channel-3 gain data (Unit: mV or μ A)			Decimal
#16	Channel-4 offset data (Unit: mV or μ A)			Decimal
#17	Channel-4 gain data (Unit: mV or μ A)			Decimal
#18	Not used	-	-	-
#19				
#20	Initialization function: Set "K1" in this buffer memory to perform initialization.	K0 or K1	k0	Decimal

	At the completion of initialization, the "K0" will be automatically set			
#21E	I/O characteristics change prohibition	To permit data change: K1 To disable data change: Value other than K1	K1	Decimal
#22E	Channel 1 output data (Valid only when BFM#5=H0002)	Depending on the mode used	K0	Decimal
#23E	Channel 2 output data (Valid only when BFM #5=H0020)	Depending on the mode used	K0	Decimal
#24E	Channel 3 output data (Valid only when BFM #5=H0200)	Depending on the mode used	K0	Decimal
#25E	Channel 4 output data (Valid only when BFM #5=H2000)	Depending on the mode used	K0	Decimal
#26	Not used	-	-	-
#27	Not used	-	-	-
#28	Not used	-	-	-
#29	Error status	-	H0000	Hexadecimal
#30	Model code K3031	-	K3031	Decimal
#31	Not used	-	-	-
#32	Not used	-	-	-

*1 If power failure occurs, the EEPROM will retain the data.

*2 Specify the output mode of each channel setting one of hex code 0 to 4 and F in each digit.

*3 Specify the data to be output from each channel upon PLC stop setting one of hex code 0 to 2 in each digit.

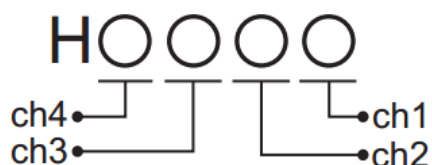
5.2 Buffer memory details

5.2.1 BFM#0: Output mode specification

Specify the output modes of channel 1 to 4.

4 hexadecimal digits are assigned to specify the output modes of the 4 channels.

Change the value of each digit to change the output mode of each channel. 0 to 4 and F can be set for each digit..



The different types of output modes are shown in the following table:

Set value	Input mode	Analog input range	Digital output range
0	Voltage output mode	- 10V~+10V	- 2000 ~ +2000
1	Current output mode	4mA~20mA	0~1000
2	Current output mode	0mA~20mA	0~1000

3	Not used		
4	Not used		
5	Voltage output mode	-10V~+10V	-32000~+32000
6 *1	Voltage output analog value mV specification mode	-10V~+10V	-10000~+10000
7	Current output mode	0mA~20mA	0~32000
8	Current output mode	4mA~20mA	0~32000
9 *1	Current output analog value μ A specification mode	0mA~20mA	0~20000
F	Channel not used		

*1 The offset/gain values cannot be changed.

1. Cautions regarding output mode setting

For the mode 0,1 and 2, it is compatible with TX2N-4DA.

- It takes approximately 1ms to determine the output mode.

For this reason, after changing the output mode, be sure to wait for 1ms or more, and then write the other data.

2. Caution regarding EEPROM writing

If data is written to BFM#0, #5,# 21~#25, the data will also be written to the HCA8C-4DA EEPROM.

Do not turn off the power immediately after writing values in these buffer memories.

The maximum number of EEPROM rewrites is 10,000 times. Therefore, when creating a program, do not frequently write data to the above buffer memories (BFM).

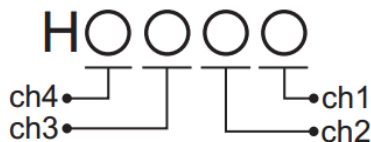
5.2.2 BFM#1 to #4: Output data

Input the digital values corresponding to the analog signals to be output in BFM#1 to #4.

BFM number	Description
#1	Data to be output from channel 1
#2	Data to be output from channel 2
#3	Data to be output from channel 3
#4	Data to be output from channel 4

5.2.3 BFM#5: Output setting upon PLC stop

It is possible to set the output conditions from channel 1 to 4 when the PLC is in the stopped state.



Set value (HEX)	Output conditions
0	The final value during running is held.
1	The offset signal is output.*1
2	The output data set in BFM#22 to #25 are output.*1
3~F	Invalid (setting values unchanged)

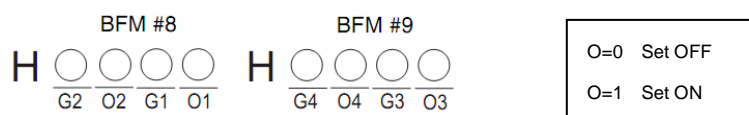
*1 The output conditions depend on the output mode (BFM#0).

In the PLC program if there is no the FROM/TO instruction module within 200ms, the PLC in the STOP state. please pay

attention when programming.

5.2.4 [BFM #8 & #9]: Offset/gain setting command

When "1" is written into BUF# # 8 and 9 corresponding hexadecimal data bits, the offset /gain value of CH1 to CH4 will be changed. Only when the command is output, the current value will be valid. Please amend the gain and offset command used at the same time, don't separate them. For example, when BFM#8=H0011, the offset/ gain adjustment command of CH1 is open.



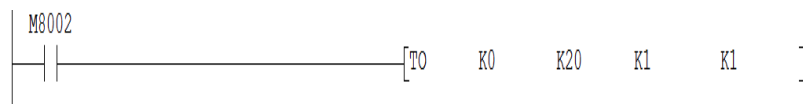
5.2.5 [BFM #10 and #17]: Offset/gain setting command

Write the data into BFM#10 to #17 to change the offset/ gain value. The unit of written data should be mV or μ A.

For example, K5000 is for 5000mV ,K20000 is for 20000uA. BFM#8 and #9 should be set accordingly after the data is written. Please note that if there's no any setting values in #10 to #17, the offset of system default voltage mode is K0(0V), the gain is K5000(5V). The offset in current mode is K0(0A), the gain is K20000(20mA). The offset/ gain in output mode 6 and 9 cannot be changed.

5.2.6 [BFM #20] Initialization function

When K1 is set in BFM#20, all functions and all buffer memory will be initialized to the default status. Please execute the Initialization function by pulse command as follows:



5.2.7 [BFM #21] I/O characteristics change prohibition

When 2 is set in BFM#2, the I/O characteristics adjustment will be prohibited (even if the offset/ gain is set ON)). This function will be invalid until the permission command is set (BFM#21=1). Initial value is 1. The setting value will be retained even the power is cut off. In error status, if BFM#21 \neq 1, b12 will be 1 in BFM#29.

5.2.8 [BFM #22~#25] Data to be output upon PLC stop

To enable the output data set when the PLC stops, Set (H0000) O=2 in the output data at PLC's stop.

BFM number	Description
#22	Data in channel 1
#23	Data in channel 2
#24	Data in channel 3
#25	Data in channel 4

The setting range depends on the output mode and I/O characteristics.

5.2.9 [BFM #29] Error status

If error occurs, the error details can be read out by FROM command.

Bit No.	Item	Status when bit is 1 (ON)	Status when bit is 0 (OFF)
b0	Error detection	If one of b1 to b11 is turned on, b0 will turn on.	No error
b1	O/G error	Gain setting error: error in offset gain data or in EEPROM offset gain setting	No error in offset/ gain data
b2	Power supply error	24 V power is not supplied properly	No error in power supply
b3	Hardware error	DA converter may be defective or other hardware error	No error in hardware
b10	Over-scale	The digital input or analog output is out of the specified range.	The I/O values are in the specified range.
b12	O/G change prohibition status	"1" is set in BFM #21.	Adjustable when BFM#21=1

The other bits are not specified.

When it operates normally, the indicator light flickers. The indicator light will be ON or OFF when power supply error or other hardware error occur.

5.2.10 [BFM #30] Identification code of special blocks

It can be read out by FROM command. The identification code of HCA8C-4DA is K3031.

6 Changing Output Characteristics

For HCA8C-4DA, the standard output characteristics are provided for each output mode (BFM#0) at the time of factory shipment.

Changing the offset data and gain data (BFM#10 to #17) can change the output characteristics of each channel. This chapter describes how to change the output characteristics.

6.1 Procedure for Changing Output Characteristics

1 Cancel the setting change prohibition mode

If setting change is prohibited, write K1 in BFM#21. The setting change prohibition mode will be canceled.

2 Determine the output mode (BFM#0)

Determine the output mode (BFM#0) optimum for the selected channels and the voltage/current specifications.

Set value	Output mode	Analog output range	Digital input range
0	Voltage output mode	-10V~+10V	-2000~+2000
1	Current output mode	4mA~20mA	0~1000
2	Current output mode	0mA~20mA	0~1000
3	Not used		
4	Not used		
5	Voltage output mode	-10V~+10V	-32000~+32000
6 *1	Voltage output analog value mV specification mode	The offset/ gain cannot be changed.	
7	Current output mode	0mA~20mA	0~32000
8	Current output mode	4mA~20mA	0~32000
9 *1	Current output analog	The offset/ gain cannot be changed.	

	value specification mode	μA	
F	Channel not used	-	-

Cautions regarding data setting

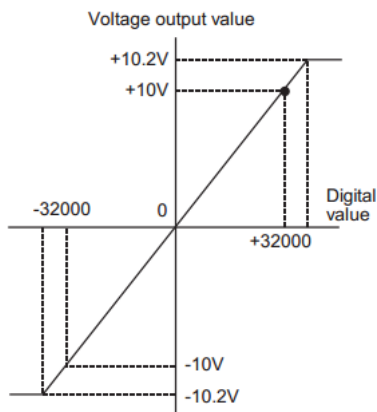
- If a value "6" or "9" is set for a channel, the output characteristics of the channel cannot be changed.
- Set the optimum output mode for the analog signal to be output.

3 Determine the output characteristics to be changed

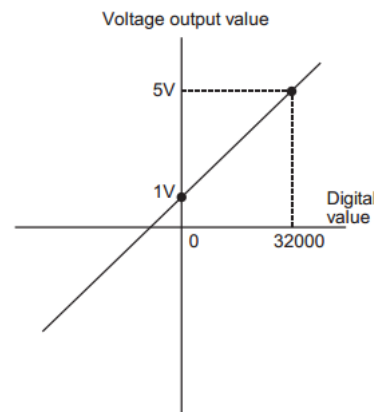
Example: Change to output voltage of 1 to 5 V with digital values 0 to 32000

Output mode: 5

Output characteristics provided at the time of factory shipment



Output characteristics newly provided



4 Determine the offset data.

Determine the analog output value for the digital output value of 0.

Set the analog output value in mV for the voltage output mode, and the analog output value in μA for the current output mode.

Example: To set the offset value of 1 V, set 1000 mV, that is offset = K1000.

Example: To set the offset value of 3mA, set 3000 μA , that is offset = K3000.

5 Determine the gain data.

Determine the analog output value for the max. digital output value (Mode 5: 32000, Mode 0: 2000)

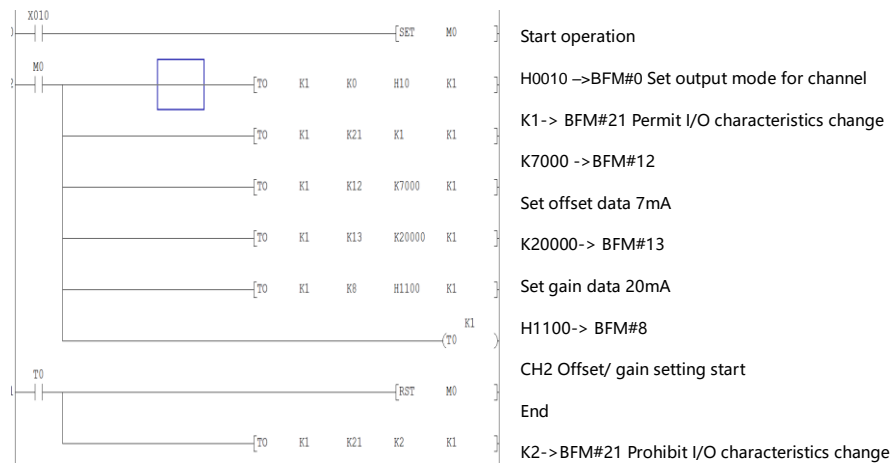
Set the analog output value in mV for the voltage output mode, and the analog output value in μA for the current output mode.

Example: To set the gain value of 5 V, set 5000 mV, that is gain = K5000

Example: To set the gain value of 18mA, set 18000 μA , that is gain = K18000

6 Create a sequence program.

The following example is for CH2 of NO.1 in HCA8C-4DA. Set the offset data to 7mA and gain data to 20mA. Please pay attention to set the standard voltage output for CH1, CH3, CH4.



After the PLC is started and the output characteristic write command (X000) is turned on, the offset data and gain data will be written.

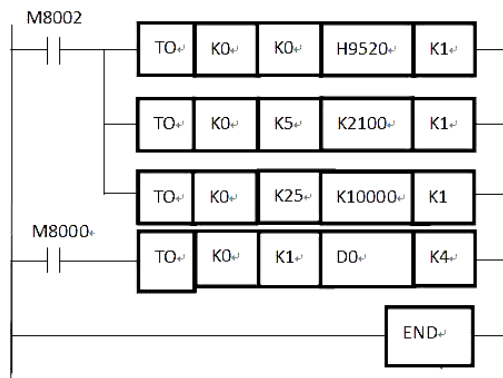
Since the offset data and gain data are stored in the EEPROM incorporated in HCA8C-4DA, it is possible to delete the pre-written sequence program.

Check that the output analog signals correspond to the set output data.

6. Examples of Practical Programs

6.1 Example of Program for Analog Output Operation (Regular Operation)

When you want to use the initial output characteristics but do not need to use the status information, you can operate the PLC with a simple program as shown below.



Transfer H9520 to BFM#0 (output modes of channels 1 to 4)

Ch 1: voltage output (-10~+10V) -2000~+2000

Ch 2: current output (0~20mA) 0~+1000

Ch 3: voltage output (-10~+10V) -32000~+32000

Ch 4: current output (0~20mA) 0~+20000

Transfer K2100 to BFM#5 (STOP output modes of channels 1 to 4)

Ch 1: stop Retain output

Ch 2: stop Retain output

Ch 3: stop Output offset value

Ch 4: stop Output the value (K10000)10mA in BFM#20

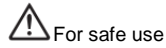
D0->BFM#1(Output to channel 1)

D1->BFM#2(Output to channel 2)

The value of BFM#0, BFM#5 and BFM#25 will be retained in EEPROM even if power failure occurs. After the output mode is specified, if the same output mode is used, it is not necessary to write the above BFM.

Warranty

HCFA will not be held liable for damage caused by factors found not to be the cause of HCFA; opportunity loss or lost profits caused by faults in the HCFA products; damage, secondary damage, accident compensation caused by special factors unpredictable by HCFA; damages to products other than HCFA products; and to other duties.



- This product has been manufactured as a general-purpose part for general industries, and has not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the product for special purposes such as nuclear power, electric power, aerospace, medicine or passenger movement vehicles, consult with HCFA.
- This product has been manufactured under strict quality control. However when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions in the system.