5.6 Direct Writing of Positioning Data (Used function code 10)

5.6.1 Numerical Value Movement Command

(1) Function

Specify the target position in PTP positioning operation using absolute coordinates. It is possible to command the actuator to move via numerical values by writing directly to the group of registers at addresses from 9900_H to 9908_H (can be set in one message).
Values of all registers, other than the control flag specification register (address: 9908_H), will become effective once the values are sent. If there is no need to change the target position, positioning band, speed, acceleration/deceleration, push-current limiting value and control specification, therefore, each subsequent numerical movement command can be issued simply by writing a desired register that can effect an actual movement command based on changing of the applicable register alone (refer to “Start address list”).

(2) Start address list

This group of registers is used to move the actuator by specifying the target position coordinates, positioning band, speed acceleration/deceleration, push-operation current limit control specification flags and so on as numerical values.
Data of start addresses in the list (8 registers in total) can be changed with one transmission.

Address [H]	Symbol	Name	Sign	Able to effect an actual movement command by changing the applicable register alone	Register size	Byte size	Unit
9900	PCMD	Target position specification register	○	○	2	4	0.01 mm
9902	INP	Positioning band specification register		×	2	4	0.01 mm
9904	VCMD	Speed specification register		○	2	4	0.01 mm/sec
9906	ACMD	Acceleration/deceleration specification register		○	1	2	0.01 G
9907	PPOW	Push-current limiting value specification register		○	1	2	%
9908	CTLF	Control flag specification register		× Initialization after each movement	1	2	-

(3) Query format

1 register = 2 bytes = 16-bit data

Field	Number of data items (number of bytes)	RTU mode 8-bit data	Remarks
Start		None	Silent interval
Slave address [H]	1	Arbitrary	Axis number + 1 (01_H to 10_H) 00_H if broadcast is specified
Function code [H]	1	10	Numerical value specification
Start address [H]	2	Arbitrary	Refer to 5.6.1 (2), “Start address list”
Number of registers [H]	2	Arbitrary	Refer to 5.6.1 (2), “Start address list”
Number of bytes [H]	1	In accordance with the number of registers above	Enter the value twice as large as the number of registers specified above
Changed data 1 [H]	2		Refer to 5.6.1 (2), “Start address list ”
Changed data 2 [H]	2		Refer to 5.6.1 (2), “Start address list”
Changed data 3 [H]	2		Refer to 5.6.1 (2), “Start address list”
:	:		:
Error check [H]	2	CRC (16 bits)	
End	None		Silent interval
Total number of bytes	Up to 256		

(4) Response format

When normally changed, the response message responds with a copy of the query message excluding the number of bytes and changed data.

Field	Number of data items (number of bytes)	RTU mode 8-bit data	Remarks
Start		None	Silent interval
Slave address [H]	1	Arbitrary	Axis number + 1 (01_H to 10_H) 00_H if broadcast is specified
Function code [H]	1	10	Numerical value specification
Start address [H]	2	Arbitrary	Refer to 5.6.1 (2), “Start address list”
Number of registers [H]	2	Arbitrary	Refer to 5.6.1 (2), “Start address list”
Error check [H]	2	CRC (16 bits)	
End	None		Silent interval
Total number of bytes	8		

(5) Detailed explanation of registers

■ Target position specification register (PCMD)
This register specifies the target position in PTP positioning operation using absolute coordinates. The value of this register is set in units of 0.01 mm in a range of –999999 to 999999 (FFF0BDC1$_H$ (Note 1) to 000F423F$_H$). When the absolute coordinate is indicated, operation starts with 0.2mm in front (Note 2) of the soft limit setting value as the target position if the setting of the parameter exceeds the soft limit. The actuator will start moving when the lower word of this register (symbol: PCMD, address: 9900$_H$) is rewritten. In other words, **a numerical movement command can be issued simply by writing a target position in this register.**
Note 1 To set a negative value, use a two's complement.
Note 2 For a revolution axis set to Index Mode, the soft limit setting value is the target position.

■ Positioning band register (INP)
This register is used in two different ways depending on the type of operation.
The first way is the normal positioning operation, where it specifies the allowable difference between the target position and current position to be used in the detection of position complete.
The second way is the push-motion operation, where it specifies the push-motion band. The value of this register is set in units of 0.01 mm in a range of 1 to 999999 (1$_H$ to 000F423F$_H$).
Whether the normal operation or push-motion operation is specified by the applicable bit in the control flag specification register as explained later.
Changing this register alone will not start actuator movement.

■ Speed specification register (VCMD)
This register specifies the moving speed. The value of this register is set in units of 0.01 mm/sec in a range of 1 to 999999 (1$_H$ to 000F423F$_H$). If the specified value exceeds the maximum speed set by a parameter, an alarm will generate the moment a movement start command is issued.
The actuator will start moving when this lower word of this register is rewritten. In other words, the speed can be changed while the actuator is moving, simply by rewriting this register.

■ Acceleration/deceleration specification register (ACMD)
This register specifies the acceleration or deceleration. The value of this register is set in units of 0.01 G in a range of 1 to 300 (1_H to $012C_H$). If the specified value exceeds the maximum acceleration or deceleration set by a parameter, an alarm will generate the moment a movement start command is issued.
The actuator will start moving when this register is rewritten. In other words, the acceleration/deceleration can be changed while the actuator is moving, simply by rewriting this register.

■ Push-current limiting value (PPOW)
Set the current limit during push-motion operation in PPOW. Set an appropriate value by referring to the table below.

Actuator model name	Pushable range [%]	Settable range (input value) [H]
Actuator other than RCS2-RA13R	20 to 70(Note)	33 to B2
RCS2-RA13R	20 to 200	33 to 1FE

(Note) The setting ranges may vary depending on the actuator.
[For details, refer to the IAI catalog or operation manual of each actuator.]

The actuator will start moving when this register is rewritten. In other words, the current limiting value can be changed during push-motion operation simply by rewriting this register.
Sample push-motion current setting
● When setting the current to 20%
255(100%) × 0.2 (20%) = 51 → 33_H (convert into hexadecimal number)

■ Control Flag Specification Register (CTLF)
Set the method of operation.
If push-motion operation or incremental operation (pitch feed) is selected, set this register every time a movement command is issued. (This is because the register will be overwritten with the default value every time the actuator moves.)

CTLF bit structure

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
MSB	–	–	NTC1	NTC0	–	–	–	–	MOD1	MOD0	GSL1	GSL0	INC	DIR	PUSH	–	LSB

Bit 1 (PUSH) = 0: Normal operation (default)
1: Push-motion operation

Bit 2 (DIR) = 0: The direction of push-motion operation after completion of approach is defined as the forward direction (default).
1: The direction of push-motion operation after completion of approach is defined as the reverse direction.

This bit is used to calculate the direction of final stop position from PCMD. If this bit is set incorrectly, therefore, the target position will deviate from the specified position by a distance corresponding to “2 × INP, ” as shown in Fig. 5.3 below.
If bit 1 is set to 0, the setting of this bit is invalid.

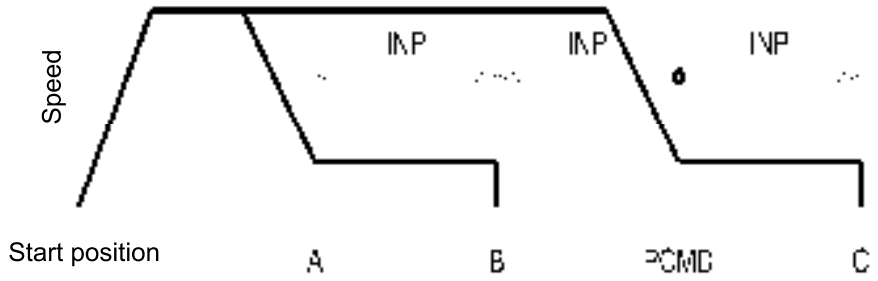


Fig. 5.3 Operating Direction in Push-motion Operation

Bit 3 (INC) = 0: Normal operation (default)
1: Incremental operation (pitch feed)

Setting this bit to 1 will enable the actuator to operate relative to the current position. In this operation, the actuator behaves differently between normal operation and push-motion operation (CTLF bit 1). While the travel is calculated with respect to the target position (PCMD) in normal operation, it is calculated relative to the current position in push-motion operation (when bit 1 = 1).
Here, since relative coordinate calculation involves adding up pulses in mm, followed by conversion, unlike a calculation method involving addition after pulse conversion, **“repeated relative movements will not cause position deviation as a result of cumulative errors corresponding to fraction pulses that are not divisible with certain lead settings”.**

Bit 4 (GSL0), 5 (GSL1) = Refer to the table below. (These bits can be set only on SCON-CA controllers.)

GSL1	GSL0	Function
0	0	Select parameter set 0 (default).
0	1	Select parameter set 1
1	0	Select parameter set 2
1	1	Select parameter set 3

You can register a maximum of four servo gain parameter sets consisting of six parameters and move the actuator to each position by selecting a different parameter set every time. [For details, refer to the operation manual for your controller.]

Bit 6 (MOD0), 7 (MOD1) = Refer to the table below. These bits cannot be set on PCON-* and ERC2 controllers.)

MOD1	MOD0	Function
0	0	Trapezoid pattern (default)
0	1	S-motion
1	0	Primary delay filter
1	1	Cannot be used.

These signals are used to select the acceleration/deceleration pattern characteristics. Set one of the patterns before issuing an actuator movement command. [For details, refer to the operation manual for your controller.]

Bit 12 (NTC0), 13 (NTC1) = Refer to the table below. (These bits can be set only on SCON-CA controllers.)

NTC1	NTC0	Function
0	0	Do not use vibration control (default).
0	1	Select parameter set 1
1	0	Select parameter set 2
1	1	Select parameter set 3

When vibration control is used, you can register a maximum of three parameter sets and move the actuator to each position by selecting a different parameter set every time. [For details, refer to the operation manual for your controller.]

(6) Example of use

Examples of different operations are shown in [1] to [7] below.

[1] Move by changing the target position. (All data other than the target position are the default values of their respective parameters.)

Conditions: The operation conditions conform to the default speed, default acceleration/deceleration and default positioning band set by the controller's user parameters. Only the target position is changed to move the actuator.

Supplement: Controller's user parameters

- Default speed (parameter No. 8) → Maximum speed of the applicable actuator as specified in the catalog
- Default acceleration/deceleration (parameter No. 9) → Rated acceleration of the applicable actuator as specified in the catalog
- Default positioning band (parameter No. 10) → Default value = 0.1 mm

Write the target position specification register (9900_H) (Example 1)

↓

Start of movement

(Example 1) Target position: 50 mm

Target position [mm]	Positioning band [mm]	Speed [mm/s]	Acceleration/ deceleration [G]	Push [%]	Control flag
50	Need not be set.				

■ Query :01 10 9900 0002 04 0000 1388 38FF

■ Response :01 10 9900 0002 6F54

--- The query message is copied, except for the number of bytes and new data, and returned as a response.

■ Breakdown of Query Message

Field	RTU mode 8-bit data	Remarks
Start	None	Silent interval
Slave address	01_H	Axis number + 1
Function code	10_H	
Start address	9900_H	The starting address corresponds to the setting of target position specification register 9900_H.
Number of registers	0002_H	Addresses 9900_H to 9901_H are written.
Number of bytes	04_H	2 (registers) × 2 = 4 (bytes) → 4_H
New data 1, 2 (target position) Input unit (0.01 mm)	0000_H	All upper bits of the 32-bit data are 0.
	1388_H	50 [mm] × 100 = 5000 → 1388_H
Error check	$38FF_H$	CRC checksum calculation result → $38FF_H$
End	None	Silent interval
Total number of bytes	13	

[2] Move by changing the target position. (As well as data other than the target position).

Conditions: Want to move the actuator by changing the target position, speed and acceleration/deceleration every time.

Write the target position specification register (9900_H) through acceleration/deceleration specification register (9906_H)(Example2)

↓

Start of movement

(Example 2) Target position: 50 mm

Target position [mm]	Positioning band [mm]	Speed [mm/s]	Acceleration/ deceleration [G]	Push [%]	Control flag
50	0.1	100	0.3	Need not be set.	

■ Query : 01 10 9900 0007 0E 0000 1388 0000 000A 0000 2710 001E 50CF

■ Response : 01 10 9900 0007 AF57

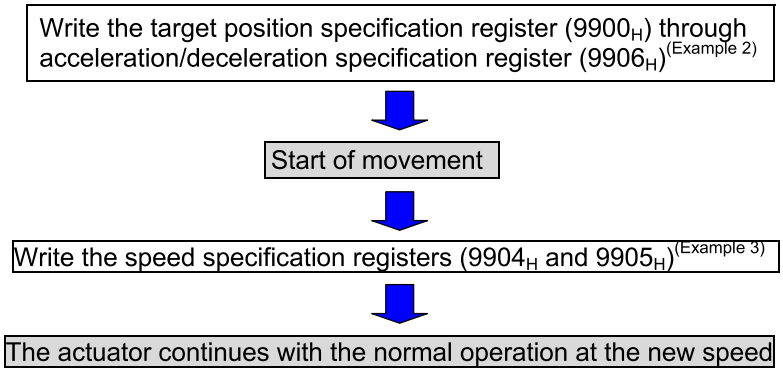
--- The query message is copied, except for the number of bytes and new data, and returned as a response.

■ Breakdown of Query Message

Field	RTU mode 8-bit data	Remarks
Start	None	Silent interval
Slave address	01_H	Axis number + 1
Function code	10_H	
Start address	9900_H	The starting address corresponds to the setting of target position specification register 9900_H.
Number of registers	0007_H	Addresses 9900_H to 9906_H are written.
Number of bytes	$0E_H$	7 (registers) × 2 = 14 (bytes) → E_H
New data 1, 2 (target position) Input unit (0.01 mm)	0000_H	All upper bits of the 32-bit data are 0.
	1388_H	50 [mm] × 100 = 5000 → 1388_H
New data 3, 4 (Positioning band) Input unit (0.01 mm)	0000_H	All upper bits of the 32-bit data are 0.
	$000A_H$	0.1 [mm] × 100 = 10 → $000A_H$
New data 5, 6 (Speed) Input unit (0.01 mm/sec)	0000_H	All upper bits of the 32-bit data are 0.
	2710_H	100 [mm/s] ×100 = 10000 → 2710_H
New data 7 (Acceleration/deceleration) Input unit (0.01 G)	$001E_H$	0.3 [G] × 100 = 30 → $001E_H$
Error check	$50CF_H$	CRC checksum calculation result → $50CF_H$
End	None	Silent interval
Total number of bytes	23	

[3] Change the speed while the actuator is moving.

Conditions: Change the target position, speed and acceleration/deceleration each time the actuator is moved, with the actuator speed changed at a given time during movement.



(Example 3) Change the speed from 100 mm/s to 50 mm/s while the actuator is moving.

Target position [mm]	Positioning band [mm]	Speed [mm/s]	Acceleration/ deceleration [G]	Push [%]	Control flag
50	0.1	100 → 50	0.3	Need not be set.	

(1) Start the movement at a speed of 100 mm/s. [Refer to Example [2], “Move by changing the speed” above.]
- Query : 01 10 9900 0007 0E 0000 1388 0000 000A 0000 2710 001E 50CF
- Response : 01 10 9900 0007 AF57

(2) Change the speed to 50 mm/s.
- Query : 01 10 9904 0002 04 0000 1388 395C
- Response : 01 10 9904 0002 2E95
  --- The query message is copied, except for the number of bytes and new data, and returned as a response.

■ Breakdown of Query Message (Change the speed to 50 mm/s. [Refer to the above example for the query message used to start the movement at 100 mm/s.])

Field	RTU mode 8-bit data	Remarks
Start	None	Silent interval
Slave address	01_H	Axis number + 1
Function code	10_H	
Start address	9904_H	The starting address corresponds to the setting of target position specification register 9904_H.
Number of registers	0002_H	Addresses 9904_H to 9905_H are written.
Number of bytes	04_H	2 (registers) × 2 = 4 (bytes) → 4_H
New data 5, 6 (Speed) Input unit (0.01 mm/s)	0000_H	All upper bits of the 32-bit data are 0.
	1388_H	50 [mm/s] × 100 = 5000 → 1388_H
Error check	$395C_H$	CRC checksum calculation result → $395C_H$
End	None	Silent interval
Total number of bytes	13	