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TS90-033
Document No. 〔900079〕

DIGITAL VALVE CONTROLLER

DC-A1-20

INSTRUCTION MANUAL

TOKIMEC

TOKIMEC INC.
CONTROL SYSTEMS DIVISION

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1. Introduction

The digital valve controller DC-A1-20 is a further improved model of the conventional reputable controller DC-A1-11 for wider applications.

The DC-A1-20 can be used in the system capable of incorporating the DC-A1-11 without any change and the installation dimensions and connection method are the same as the conventional type. In addition, the function to facilitate the input of step signals from outside is provided.

These points enable not only the conventional control by contact input but also other diversified controls by connecting various system equipments (for example, sequencer).

The major features of this product DC-A1-20 are described below.

- o Capable of connecting with all the types incorporating a 4 phase stepping motor of our digital valve series.

- o Controls our digital valves easily by means of a 24V DC contact of a sequencer.

- o Capable of setting the pressure and flow rate independently for 5 channels of input contact signals each by means of an external digital switch.
  (By installing an optional extension adapter DC-AE-10, the channels available can be increased by 5 channels totaling to 10 channels.)

- o The function for controlling the valve step setting by not only an external digital switch but also an external signal (VAS) from a sequencer, etc., is added to the conventional 11 design.

- o The reset signal returns the valve to 0-home position with top priority during the entry of input contact signal.

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o If all the input contact signals (VA0 to VA4, VAS) turn off, the valve returns to 0-home position.

2. Part Names and Functions

Figure 1 shows the part names of this product (DC-A1-20).

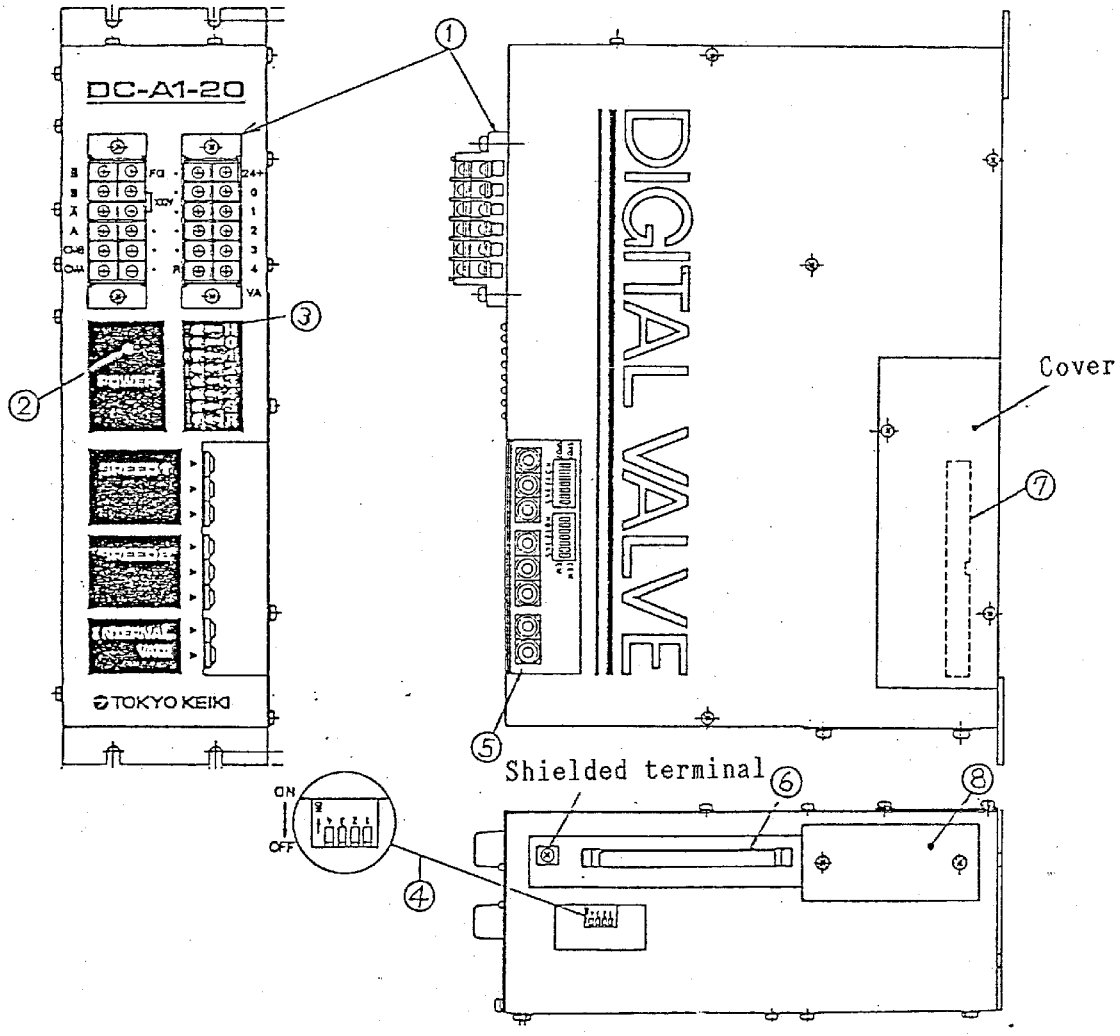


Fig. 1 Part Names

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The function of each part is described below.

① Terminal board:
Connects wires to outside. See 4. Connection Method.

② Power lamp:
Lamp indicating the power to the main unit. When the power supply is turned on, this lamp lights in red.

③ Contact indicating lamp (LED):
Lamp indicating the contact signal (VA0 to VA4), VAS* and R (reset) condition. The lamp color is red for VA0 through VA4, green for VAS and yellow for reset condition. Unless VA0 through VA4 or VAS is entered, the home position (H) lamp lights in red. See 5. on VAS*.

④ Valve mode switch:
Selects the type of a valve to be controlled. See 3.1.

⑤ Setting switch:
Selects the pulse rate and direction of contact signal and step No. of contact VA0. See 3.2 - 3.4.

⑥ Connector for external digital switch:
Connector for connecting the external digital switch with the main unit. See 4.2.1

⑦ Connector for extension adapter:
Connector for connecting the extension adapter (option)
Upon use, remove the cover.

⑧ Cover for external step input terminal:
A special terminal for external step input is provided behind this cover.

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3. Internal Setting Method

For use of this controller, the setting method is described below. Upon the setting of this controller, do on the following four items.

1) Setting the valve mode:
   Set according to the type of a valve to be applied.

2) Setting the direction:
   When using the directional flow control valve, set the direction of oil flow.

3) Setting the pulse rate:
   Set the pressure or flow rate switching speed.

4) Setting a valve step No.
   Set the pressure or flow rate.

These setting methods are described below in order.

3.1 Setting Valve Mode

The valve mode switch is located on the bottom of the controller. (See Fig. 1-④.) Set this switch corresponding to the type of a valve to be connected and the step setting condition as shown in Table 1.

This switch consists of four dip switches. Turn each dip switch to ON side or OFF side. (See Fig. 2.)

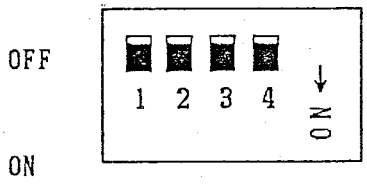


Fig. 2 Valve Mode Switch

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The meanings of the switches 1 through 4 are as follows.

Switch 1: Set corresponding to the type of a valve to be connected.

Switch 2: When using a directional flow control valve, select "real setting"* or "percent setting"**.
The relief valve and flow control valve are not concerned with which is selected.

Switch 3: Select BCD input or binary input as step input value.

Switch 4: Because this switch is not applied, either ON or OFF is acceptable.

o The ON/OFF settings of the switches 1 through 4 are shown in Table 1.

Table 1 Valve Mode Switch Setting

No.	Setting item	OFF	ON
1	Valve type	Relief valve, flow control valve	Directional flow control valve
2	Percent	Real setting*	Percent setting**
3	Input mode	BCD input*** (usually)	Binary input****
4	---	Whichever is acceptable.	

Note:

① Real setting*:
Means that the setting number is the same as the actual step number of valve.

② Percent setting**:
Means that the step number is equal to setting number (%) x 63/100 when the directional flow control valve is applied.

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③ BCD input***:

Refers to input by binary-code decimal character. Select this mode usually (when no external step input is used).

④ Binary input****

Refers to input by binary number.

For ③ and ④, see 5. External Step Input.

3.2 Setting Direction

The direction setting switch is a 7-contact slide switch on the front side panel. (See Fig.1-⑤.)

When using a directional flow control valve, set each contact (VA0 - VA4) to either P → A (B → T) direction (counterclockwise) or P → B (A → T) direction (clockwise). (When a relief valve or flow control valve is used, which direction is chosen is not concerned.)

The setting method is explained below.

When an external digital switch is connected, set each required contact to counterclockwise or clockwise. Figure 3 shows the condition that all the contacts (VA0 through VA4) are set to clockwise.

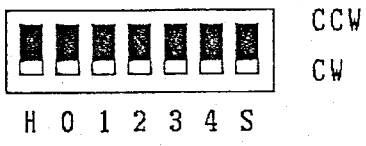


Fig. 3 Setting Direction

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(Note)

o The switch marked with "H" may be set to any side of clockwise or counterclockwise.

o The switch marked with "S" is the switch dedicated for external step input. Set this switch to clockwise usually (when no external signal is used). For details, see 5. External Step Input.)

3.3 Setting Pulse Rate (SPEED)

For the pulse rate setting switch, (1) the slide switch is provided on the left side of the direction setting switch mentioned before and (2) the rotary switch is provided on the front panel. (See Fig. ⑤)

3.3.1 Selection of pulse rate (slide switch)

For each contact (VA0 through VA4, VAS), select the operation speed of a valve to be controlled from SPEED 1 and SPEED 2. For this purpose, set the 7-contact slide switch on the front panel. (Refer to Fig. 4.)

Figure 4 shows the condition that all the contacts (VA0 through VA4, VAS) are set to SPEED 2.

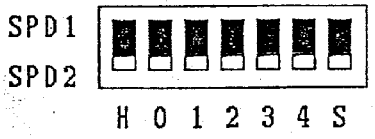


Fig 4. Selection of Pulse Rate

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(Note)

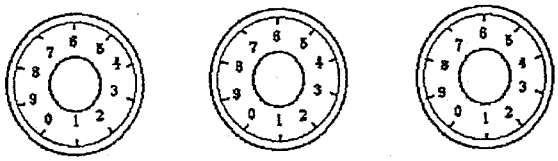
* The switch marked with "H" means to select the pulse rate when any input of the contacts VA0 through VA4 or VAS is turned off and the valve returns to 0-home position (The home position "H" lights).

3.3.2 Setting pulse rate (rotary switch)

The SPEED 1 or SPEED 2 is set by rotary switches indicating a three-digit number each on the front panel to determine a pulse rate. (See Fig.1-⑤.)

The switch is set in □□.□ mS. For example, for setting the pulse rate to 12.3 mS, set 1, 2 and 3 in order from the left. The pulse rate can be set from 1.2 mS to 100 mS by 0.1 mS each. (Only when 0, 0 and 0 is setting, this is counted as 100 mS.)

Figure 5 shows below the condition that 11.1 mS is set.



Indication on the front panel ----------→ (SPEED 1 and SPEED2 indicated)

△ △ △

Fig. 5 Setting Pulse Rate

o Pulse Rate (SPEED)

This is the valve operating speed and changing this rate accelerates and decelerates the actuator.

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If the pulse rate is set to 5 mS for example, it takes 0.25 seconds (5 mS x 50 = 250 mS) for the valve to move by 50 steps. (See Fig. 6.)

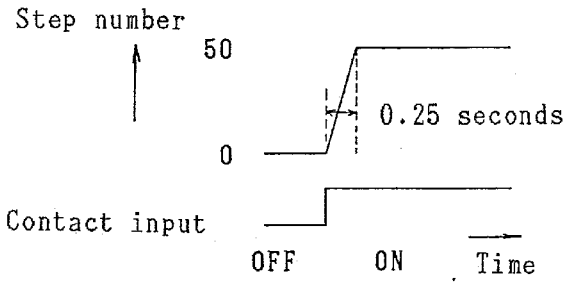


Fig. 6

3.4 Setting Valve Step No. (internal & external)

3.4.1 Setting the valve step number by internal setting → INTERNAL [VA0]

This setting is enabled by only VA0*. This setting is performed by a pair of rotary switches on the right side of the pulse rate setting switch indicating a two-digit number mentioned on the previous item. (INTERNAL [VA0] is indicated.) (See Fig.1-⑤.)

For example, if 1 1 is set in real setting, the valve is set to 11 step. (See Fig. 7.)

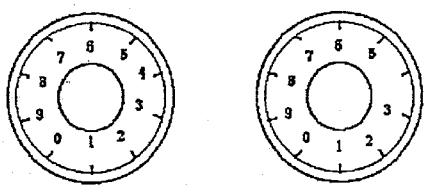


Fig. 7

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3.4.2 Setting the valve step number by external digital switch and external step input

The valve step number is set for each contact.
Two types of contacts are provided, that is, (1) five points VA0 through VA4 and (2) external step input VAS (Note).

The points (1) are set by an attached digital switch.
(Use a digital switch of BCD real code.)

o The optional type of the controller DC-A1-20-S2 provided with a digital switch box incorporating five compact digital switches instead of the external digital switch is available.

The point (2) is set by signal input from outside. See 5. External Step Input.

Depending on the purpose of application, the following three combinations are available (See 4-2-2.):

① Only external digital switch (VA0* through VA4)
② Only external step input (VAS)
③ Both external digital switch (VA0* through VA4) and external step input (VAS)

(Note)

For VA0*, set internal input or external input which is not applied to 00.

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4. Connection Method

4.1 Power Supply (100V AC)

Connect [100V] on the terminal board on the front panel to the power supply 100V AC, 50/60 Hz. Ground the frame via [FG]. (See Fig.1-①.)

4.2 Control Input

4.2.1 By contact input

The contact inputs VA0 through VA4 and R (reset) operate by the contact "a" of 24V DC. The connection is done on the terminal board on the front panel as shown in Fig. 8 (left). (Fig.1-①)
Each contact input is electrically insulated by the photocoupler as shown in Fig. 9. There is priority of contact input and only one contact is selected in any case.

Priority

The contact inputs are given priority order and if two or more inputs occurs simultaneously, the contact with a higher priority is validated. The priority order is from R (reset) to VA4 to VA3 to VA2 to VA1. See 6. Reset.

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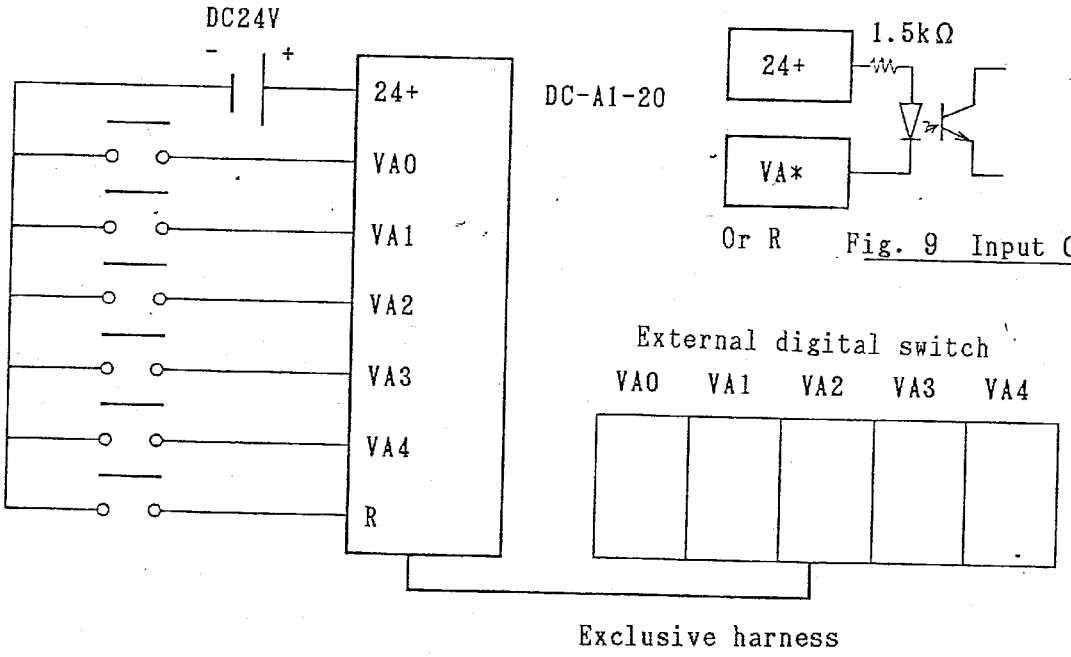


Fig. 9 Input Circuit

Fig. 8

The valve step number corresponding to each contact input can be set by connecting the external digital switch connector on the bottom of the main unit to the digital switch of the BCD real code through the exclusive harness. (See the right section of Fig. 6.)

As the exclusive harness, DC-H-P5*-***-10 is recommended.

Specification of harness	DC	-	H	-	P5*	-	***	-	10
	①		②		③		④		⑤

① Digital control
② Harness
③ P5S: single-sided connector P5D: both-side connector
④ Cable length Example 300:300 cm
⑤ Design No.

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4.2.2 By external step input

In this case, the valve is controlled directly by a signal from the sequencer or other external device. A signal is entered from the external step input terminal at the bottom deepest of the main unit. (Fig. 1-⑧)
(For this purpose, remove the cover for external step input terminal and install the dedicated connector terminal board.)

When controlling the valve step directly from external device such as a sequencer, this dedicated connector terminal board is required.

When only the external step input is used, remove the connector terminal board to the right of the front side of the panel before use. (The connector terminal base is common.)
If you use external step input and external digital switch, please purchase a SATO PARTS made ML-100AP-12P as the dedicated connector terminal board.

Table 2 shows the connection table of the pin Nos. (12 pins) of the dedicated connector terminal base. For the content of a signal corresponding to pin No., see 5. External Input Signal.

The input circuit for each signal is the same as the contact input circuit mentioned previously.

Tabel 2

Front panel ← side								Mounting surface side
	Upper side	B	B6	B5	B4	B3	B2	B1	
	Lower side	A	A6	A5	A4	A3	A2	A1	

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4.3 Output (to the valve)

The digital valve is connected through the DC-A1-20 terminal [CMA, CMB,A, A, B, B]. For the connection, it is recommended to use our specially designed harness DC-H-DV-***-10.

Specification of our specially designed hardness

DC - H - DV - *** - 10
① ② ③ ④ ⑤

① Digital control
② Harness
③ For connection between the controller and valves
④ Cable length Example 300.300 cm
⑤ Design No.

Table 3 shows the connection.

Table 3

DC-A1-20 terminal name	A	B	$\overline{A}$	$\overline{B}$	CMA	CMB
Special harness line color	Red	Green	Yellow	Brown	Black	White
Valve connector No.	A	B	C	D	E	F

5. External Step Input

Conventionally, the valve step number was set by the digital switches to turn ON/OFF the corresponding contact input. The external step input refers to changing the valve step number directly from an external device such a sequencer to control the valve action.

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The use is enabled by setting the valve step number and turning the external step input contact VAS to ON. To turn the VAS to ON, (1) the method by external input and (2) method by controller internal setting switch are selectable.

In the case of (1), the VAS is turned ON from the external step input terminal. In the case of (2), the "S" of the direction setting switch mentioned in 3.2 Setting Direction is set to the counterclockwise (CCW) direction.

(Note)

o The case (2) is available only when the VAS is used specially for external input. At this time, the contacts VA0 through VA4 are not accepted.

o The priority order is from R(Reset) to VAS to VA4 to VA3 to VA2 to VA1 to VA0.

If the external step input is turned ON, the contact indication lamp "VAS" on the front panel lights in green.
In addition to reset by the contact input mentioned in 4.2.1, an independent reset input is prepared. Whichever is used, the same effect is gained. See 6 Reset.

For valve step number input, either (1) BCD data or (2) binary data is selectable.

The input method of each signal is described on next page.

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5.1 BCD Input

Turn the valve mode switch 3 described in 3.1 Setting Valve Mode to OFF position. Table 4 shows the pin arrangement corresponding to the signal name.

Table 4

	6	5	4	3	2	1
Upper side	B	24V+	VAS	8	4	2	1
Lower side	A	RST	SGN	8	4	2	1

Description of signals

24V+ : + common of 24V DC contact of each input

VAS : Turning this signal to ON enables the input of external step input.

RST : Reset signal input

SGN : Indicates the direction in the case of directional flow control valve.
Turning ON selects counterclockwise direction.
Turning OFF selects clockwise direction.

1248 : Part of BCD data for the number of valve steps.
BCD lower digits correspond with the lower side (A), and upper digits with the upper side (B).

5.2 Binary Input

Turn the valve mode switch 3 described in 3.1 Setting Valve Mode to ON. Table 5 shows the pin arrangement corresponding to the signal name.

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Table 5

		6	5	4	3	2	1
Upper side	B	24V+	VAS	---	64	32	16
Lower side	A	RST	SGN	8	4	2	1

Description of signals

24V+,VAS,RST,SGN: same as BCD input
1,2,4,8,16,32,64: binary data part of valve step number

6. Reset

The input of reset turns electrically OFF the output so that the valve returns to 0-home position by means of the return spring. This action is performed because the excitation of the stepping motor serving as the valve actuator is released.
The function is effective for raising the system reliability if it is used for emergency stop or if it is used once for every sequence.

7. Examples of Application

7.1 Example of Application, Part 1 (basic application)

Setting condition:
a) Valve to be selected: relief valve D-CG-** series
b) Objective for control: cylinder pressure control
c) Pressure setting: five steps by external digital switch

Connect the five steps of setting pressure signals and reset signal as shown in Fig. 10.

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1) Setting the valve mode

Select D-CG-** series, use BCD digital switch and set real step.

Then, 1: OFF, 2: OFF, 3: OFF, 4: OFF or ON

2) Setting the direction

H : clockwise or counterclockwise

VA1 through VA4: clockwise or counterclockwise

VAS : CW

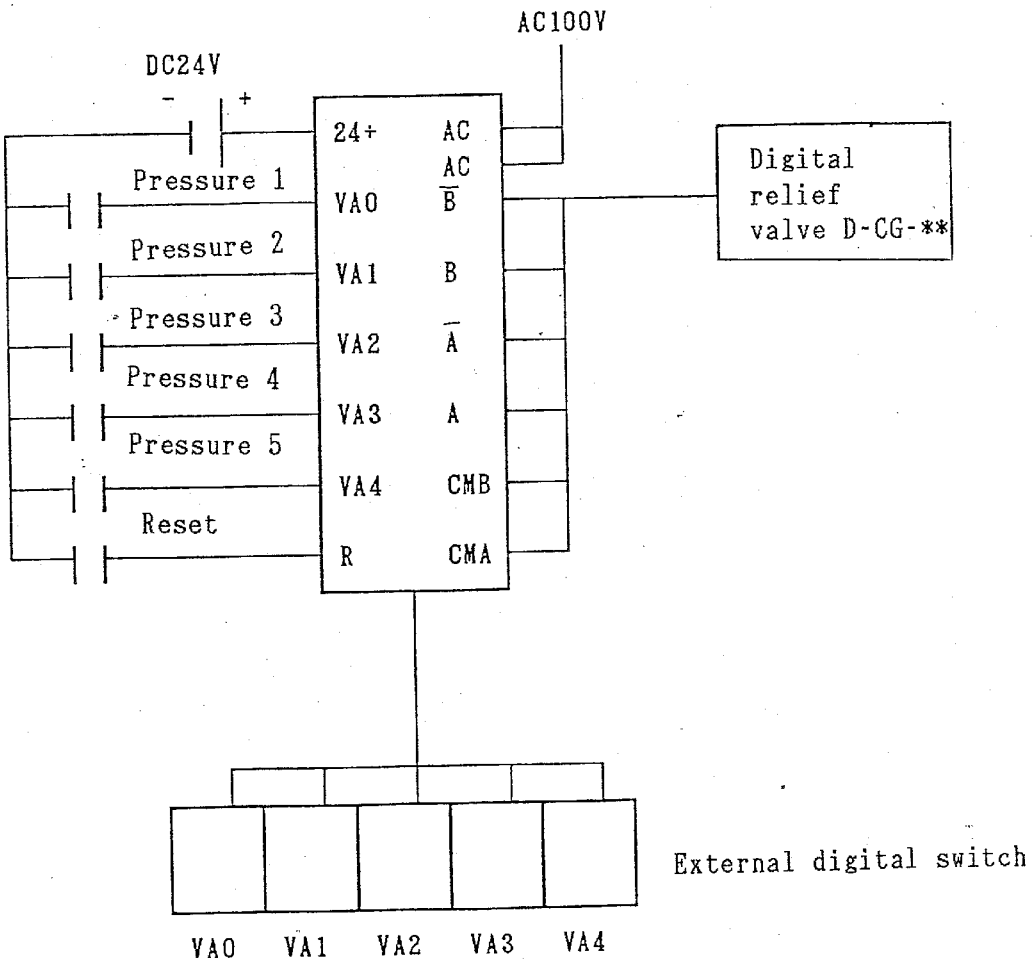


Fig. 10 Example of Application, Part 1

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3) Setting valve step number/setting pulse rate
Set valve step number and set pulse rate correspond to pressure intensity and valve switching response speed respectively.
Depending on the purpose of your application, set both items.

7.2 Example of Application, Part 2 (when using the extension adapter DC-AE-10 simultaneously)

Setting condition:

a) Valve to be selected: directional flow control valve D-DFG-** series
b) Objective for control: cylinder ascent/descent speed control
c) Speed setting: four speeds for ascent and descent each selectable by external digital switch

Connect the four speed signals of cylinder ascent/descent signals each and reset signal as shown in Fig. 11. The priority order is shown below.

① Reset signal
② Ascent signal 4
③ Ascent signal 3
④ Ascent signal 2
⑤ Ascent signal 1
⑥ Descent signal 4
⑦ Descent signal 3
⑧ Descent signal 2
⑨ Descent signal 1

If two signals or more are entered at the same time, the priority order rises as shown above.

1) Setting valve mode

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Select the valve D-DFG-** series, use the BCD digital switch and set a real step. Consequently, 1: ON, 2: OFF, 3: OFF, 4: OFF or ON

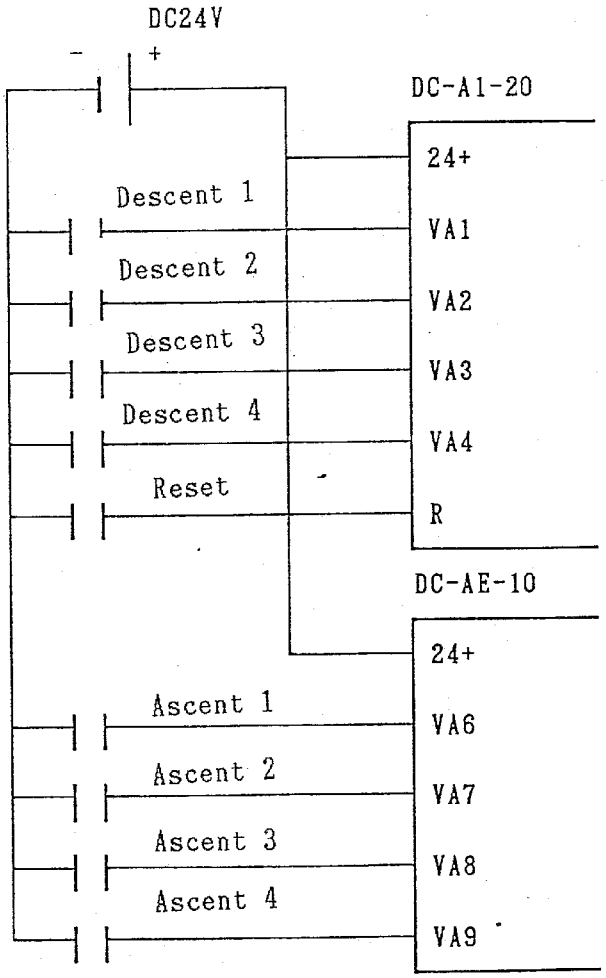


Fig. 11 Example of Application, Part 2

Note: The power supply, output and external switch are omitted because of the same as Fig. 7.

2) Setting direction

VA1 through VA4: CW (VAS: CW)

VA6 through VA9: CCW

The directions of clockwise and counterclockwise are reverse depending on the hydraulic pipe.

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3) Setting valve step number and pulse rate

Setting valve step number corresponds to ascent/descent speed, and setting pulse rate corresponds to valve switching respond speed.

Depending on the purpose of your application, set both items.

As for the valve switching time (set as pulse rate), set from any one of SPEED 1 to SPEED 2 and SPEED 3 to SPEED 4 for descent and ascent each.

The valve switching response speed (time taken until the valve start operating after the contact is ON) is 7 mS.

7.3 Example of Application, Part 3 (When using external step input simultaneously)

Setting condition

(1) Valve to be selected: directional flow control valve D-DFG-** series
(2) Objective for control: cylinder forward/retraction speeds control
(3) Speed setting: two levels of forward/retraction speeds each by external digital switch and forward/retraction signals by a sequencer

Connect two levels of cylinder forward/retraction signals each, cylinder forward/retraction variable signals and reset signal as shown in Fig. 12.

1) Setting valve mode

Select the valve D-DFG-** series, use BCD digital switch and set percent.

Consequently, 1: ON, 2: ON, 3: OFF, 4: OFF or ON

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2) Setting direction

VA1, VA2: CW

VA3, VA4: CW

The directions of clockwise and counterclockwise are reverse depending on the hydraulic pipe.

3) Setting valve step number and pulse rate

Setting valve step number corresponds to forward/backward speed, and setting pulse rate corresponds to valve switching respond speed respectively.

Depending on the purpose of your application, set both items.

4) External step input

Because attached digital switch input is BCD, external step input is also BCD.

For example, for setting the valve at -57 by VAS, feed it by 57 steps counterclockwise.

Pin No.	B5	A5	B4	B3	B2	B1	A4	A3	A2	A1
Signal name	VAS	SGN	8	4	2	1	8	4	2	1
ON/OFF	1	1	0	1	0	1	0	1	1	1

1: ON 0: OFF

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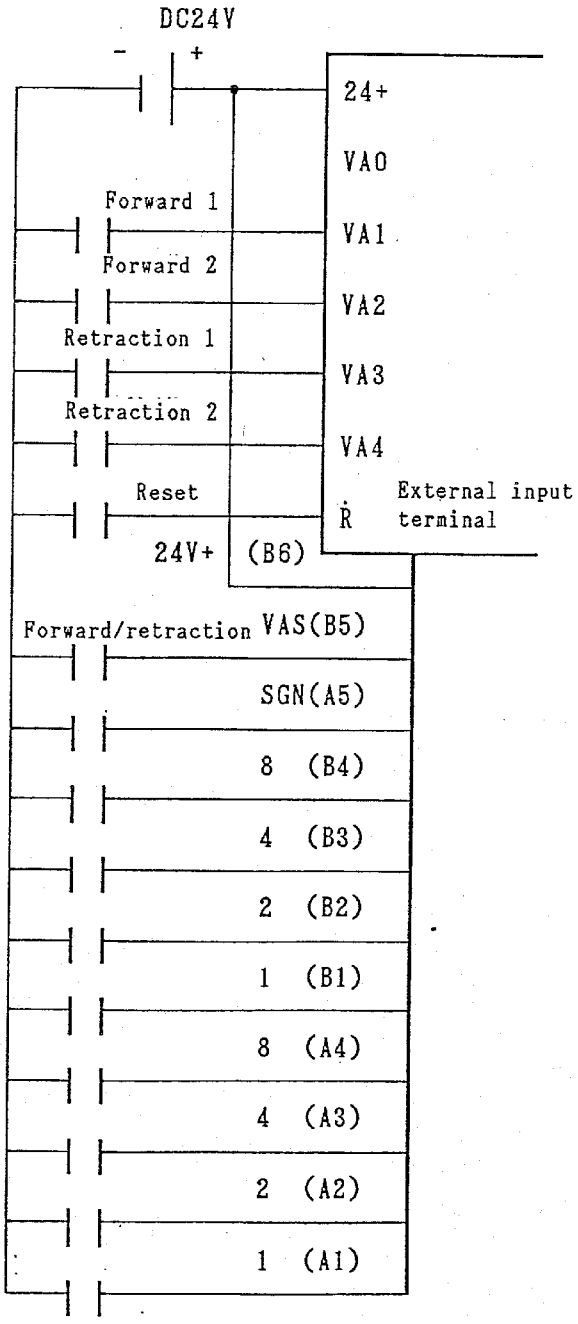


Fig. 12 Example of Application, Part 3

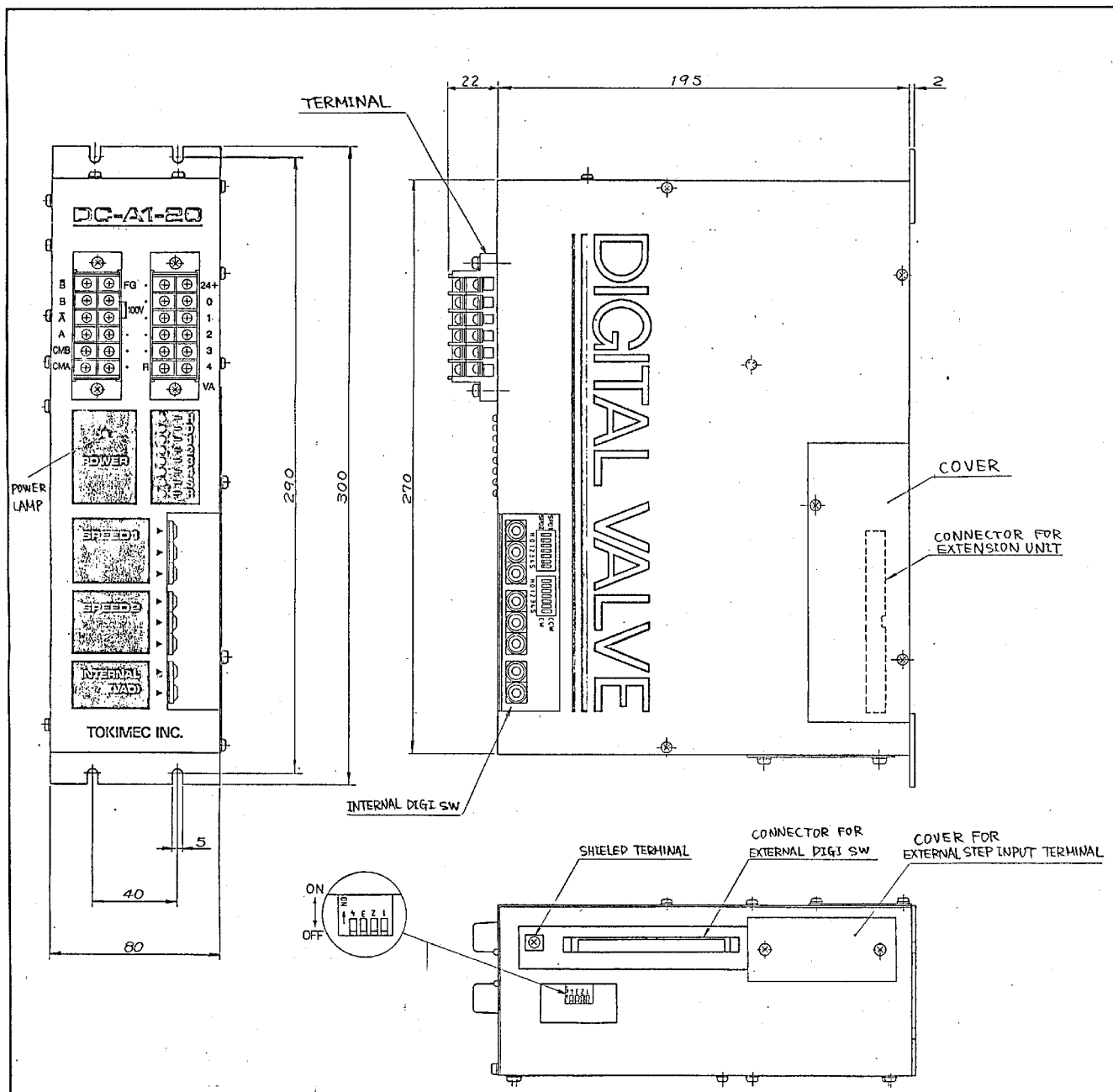
Note: The power supply, output and external switch are omitted, because of the same as Fig. 7.

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8. Product Specification

(1)	Power supply:	100 VAC ±5%, 50/60 Hz Power consumption: Less than 80 VA 24 VDC ±10% Less than 0.1A
(2)	Signal input:	Contact or 24 V contactless
(3)	Setting:	Number of setting values: 5: BCD real code digital switch 1: external step input Setting range: Relief valve and flow control valve: 0 to 99 (100 steps) Directional flow control valve, -63 to +63 (64 steps for P → A and P → B each) Pulse interval setting number: 2 Pulse interval range: 1.2 mS to 100 mS by 0.1 mS step
(4)	Output:	2-phase excitation type for 4-phase stepping motor 1.1 A/phase (when static condition)
(5)	Operating temperature range:	0℃ ～ 55℃
(6)	Storage temperature range:	-5℃ ～ 60℃
(7)	External dimensions:	See next page.

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DIGITAL VALVE CONTROLLER
DC-A1-20

THIS CONTROLLER CONTROLS AND DRIVES AN OUR DIGITAL VALVE AND CAN BE CONNECTED DIRECTLY WITH THE SEQUENCER.

SPECIFICATIONS

POWER SUPPLY:
AC 100V±15% 50/60Hz
POWER CONSUMPTION 80VA LESS THAN
DC 24V±10% 20mA/

CONTROL INPUT:
ON/OFF SIGNAL OF CONTACTOR OR DC24V

SETTING:
NUMBER OF SETTING VALUES
5:EXTERNAL (2DIGIT)DIGITAL SWITCH
DIGITAL SWITCH SPEC.
REAL CODE BCD TYPE
1:EXTERNAL STEP INPUT(OPTIONAL)

SETTING RANGE:
RELIEF VALVE AND FLOW CONTROL VALVE : 0 TO 99
(100 STEPS)
DIRECTIONAL FLOW CONTROL VALVE : -63 TO +63
(64 STEPS FOR P→A AND P→B EACH)
PULSE INTERVAL SETTING NUMBER : 2
PULSE INTERVAL RANGE : 1.2mS TO 100mS
BY 0.1mS STEP

OUTPUT:
2-PHASE EXCITATION TYPE
FOR 4-PHASE STEPPING MOTOR
1.1A/PHASE

FOR FURTHER DETAILS, REFER TO
THE INSTRUCTION MANUAL & OPERATION MANUAL

MODEL CODE
DC - A1 - 20
20 — DESIGN NUMBER
A1 — CONTROLLER FOR ONE VALVE
DC — DIGITAL CONTROL

MASS: APPROX. 3.7Kg

DIGITAL VALVE CONTROLLER

DC-A1-20

日付 DATE	91・7・18	サイズ SIZE	B
図面番号 DRAWING NO. 4296306900		枚数 SHEET	1/1

TOKIMEC 株式会社トキメック TOKIMEC INC.

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