

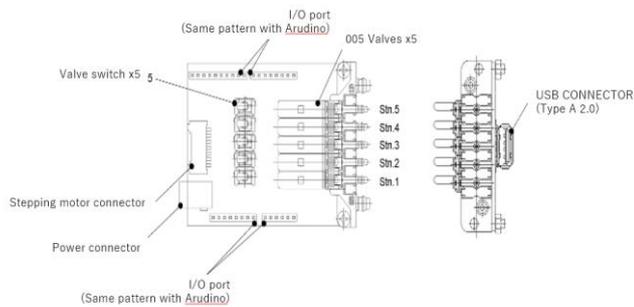


Instruction Manual for Controller for Pneumatic Artificial Muscles (Ver.1.1)

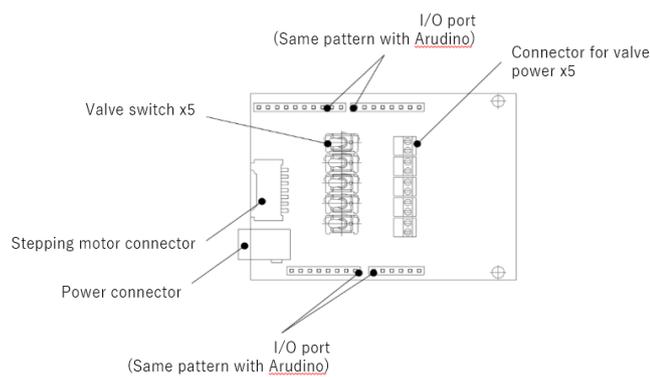
Design and selection

Names of parts

For PMC-PT-AC



For PMC-CN-AC (USB-connector in same position as PMC-PT-AC)



Product Overview

This product integrates valve drive circuitry and switches to facilitate experimentation using solenoid valves when using Arduino Uno R3 (or interchangeable products) as the main control unit. In addition, using the software distributed by our HP (<http://www.mirai-projects.com/pneumuscle-pmc>) makes it easy to realize the operation of the 4 modes (for more information, about the operation mode).

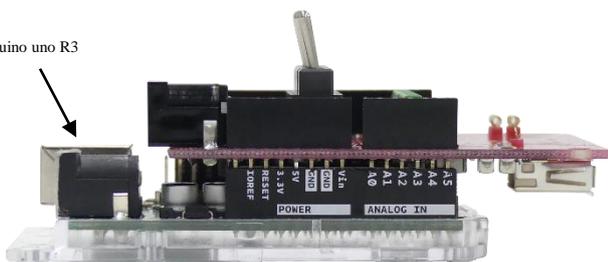
Mounting, wiring and piping

Installing the Product

1. Align Arduino Uno R3 with the power connector on the appliance.
2. Insert the product pins straight into the sockets on Arduino Uno R3.

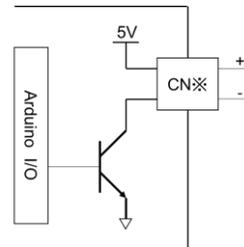
Please note that the pins are easy to bend.

Arduino uno R3



Valve-wiring (PMC-CN-AC only)

The internal circuitry of the valve connectors (CN4 to 8) is shown below.

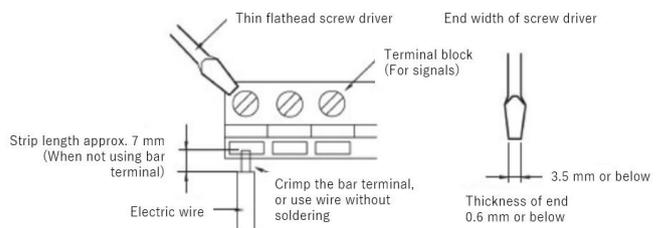


※4~8



e.g.) For our G010 series. Lead wire red to +
Connect the black lead wire to -.

The valve power supply connector is a screw terminal block. Fix/release with a thin flat head screwdriver, etc.



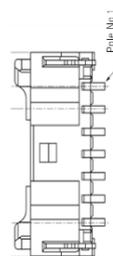
Stepping motor connector

This connector is designed to be connected to our product iB-Flow series. However, any 2-phase stepping motor can control other products.

<When using a stepping motor prepared by the customer>

※ When connecting a product other than iB-Flow, we are not responsible for any damage caused by the product's failure or performance change, as well as other equipment damage caused by such failure. Please check beforehand.

Refer to the connector layout below.



Connector: JST-manufactured
SM07B-PASS-TFT (LF) (SN)
Compatible housings: JST-manufactured
PAP-07V-S

1	2	3	4	5	6	7
B	A	B	A	NC	NC	NC

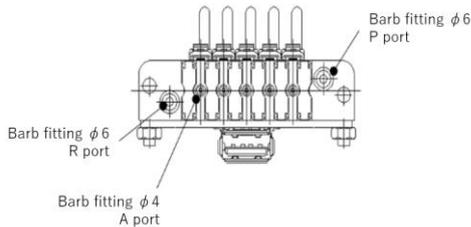
Piping

<For PMC-CN-AC>

Connect the piping according to the specifications of the equipment to be connected.

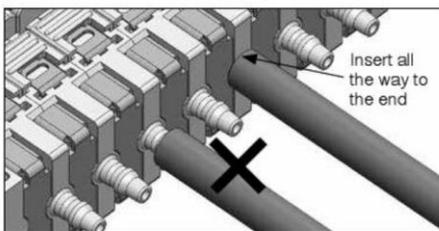
<For PMC-PT-AC>

Hold the valve body or manifold part when inserting or removing the tube, etc., during work where external force is applied. Each port arrangement is as follows.



P port and A port are connected when the valve is ON. Connect an air source to the P port side.

How to connect tubing



Note: Hold the main body and the manifold when connecting or disconnecting tubes.

1. Cut the tube vertically in the axial direction. Allow a margin for the length.
2. Insert the tube securely to the end of the barbed fitting. Failure to do so may cause air leakage or disconnection of the tube.
3. When inserting the tube, be careful not to apply an excessive lateral load to the barbed fitting.
4. When pulling out the tube, be careful not to apply an excessive lateral load to the barbed fitting. When removing the tube using a cutter, etc., be careful not to damage the barbed fitting.
5. If the urethane tube is used at a high temperature, the tube may expand due to aging, which may lead to air leakage or tube missing. Use of soft nylon tube is recommended when using at high temperature. Do not use the nylon tube, as excessive force is applied when inserting it.

HOW TO USE

• Equipment preparation

1. A pneumatic source is required to drive pneumatic equipment. Prepare separate pneumatic pressure source such as a compressor separately.
2. Check if the connections are correct after completing all wiring.
3. Apply pressure to the pneumatic equipment after starting the equipment to which this product is installed.

• Preparing the Software

If you want to use the software distributed from our <http://www.mirai-projects.com/pneumuscle-pmc>, write it to your Arduino Uno R3 as follows. The version of Arduino IDE is 1.8.15 when this instruction manual is prepared and when software is manufactured.

Please download Arduino IDE from Arduino formula and expand it to your PC in advance.

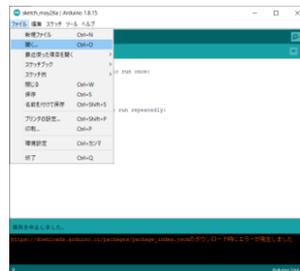
Arduino official website (<https://www.arduino.cc/en/software>)

1. The library "USB_Host_Shield_2.0" must be installed on Arduino IDE in advance in order to write "Soft_hogehoge.ini" to the board. Download and install from Arduino IDE Library Manager or from GitHub. Restart Arduino IDE after installing.

※Installing the library is the first-time only task.

GitHub(https://github.com/felis/USB_Host_Shield_2.0)

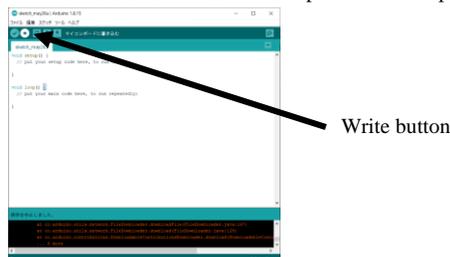
2. Please open from Arduino IDE Files tab after downloading "Soft_Actuator_Ver.1.0.0.txt" from our website and changing the extension to "Soft_Actuator_Ver.1.0.0.ino".



3. Use the USB cable to connect Arduino IDE to a computer that is open. Make sure "Board" on the Tool tab is set to "Arduino Uno". In addition, select the COM port to which Arduino is connected from "Serial Port" on the Tools tab. Basically, the system recognizes the connected Arduino automatically. However, if you change to a different unit, you may need to re-select the COM port.



4. Writing starts when "Write to microcomputer board" is clicked on Arduino IDE. Wait for a while until the operation is complete.



5. Open the serial monitor and send the SET_FD command when the "Ready" message is returned. ※First time only

●About the operation mode

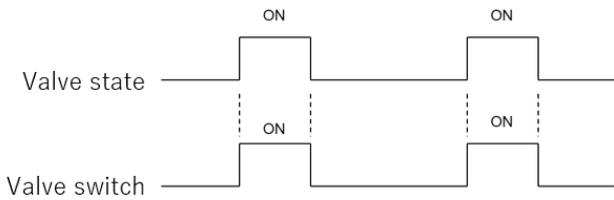
4 operation modes are available. Settings such as ON time OFF time can be controlled via serial monitor from mode switching.

Mode name	Explanation
ON/OFF arbitrary control mode	Turns ON corresponding valve only while the valve switch is ON.
ON time control mode	Set valve ON time.
ON/OFF time-control mode	Set valve ON time, and OFF time.
ON/OFF interlock mode	Set ON/OFF time, and start delay time

<ON/OFF arbitrary control mode> (Default after power-on)

This mode turns ON the corresponding valve only while the valve switch is ON. The table below shows the correspondence between valve switches and valves to be turned on.

Valve switch	Valve power connector	005 valve stn.
SW1	CN4	Stn. 5
SW2	CN5	Stn. 4
SW3	CN6	Stn. 3
SW4	CN7	Stn. 2
SW5	CN8	Stn. 1



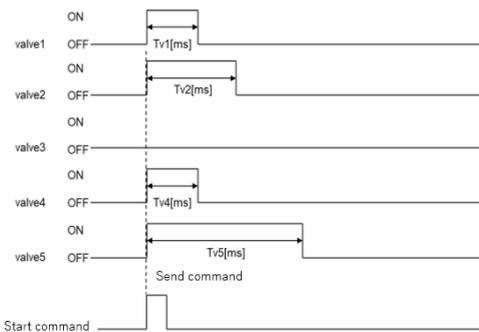
<ON time control mode>

This mode is used to set the ON time of the specified valve and operate it. The operation of each valve starts from the timing when the start command is sent. After the operation is completed, the LSI enters the standby state until the start command is sent again.

The setting range of ON time is 0 to 5000 [ms] (in 1ms increments).

Set 0 [ms] for valves that are not used.

Example of operation)



※For the above example, valve3 is set to Ton3:0[ms].

<ON/OFF time-control mode>

This mode is used to set the ON time and OFF time of the specified valve for operation. Operation of each valve starts from the timing when the start command is sent.

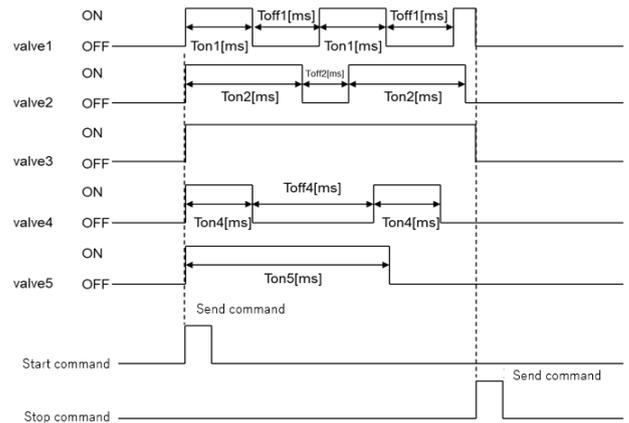
ON⇒ OFF is 1 set, and the operation is repeated until stop command is sent.

The setting range of ON and OFF time is 0 to 5000 [ms] (in 1ms increments).

For valves that are not used, set the ON time to 0 [ms].

When the OFF time is set to 0 [ms], it is always ON.

Example of operation)



※In the above example, Valve3 is set to Toff3:0 [ms]

<ON/OFF interlock mode>

This mode operates by setting the specified valve ON time, OFF time and start delay time. Operation of each valve starts from the timing when the start command is sent.

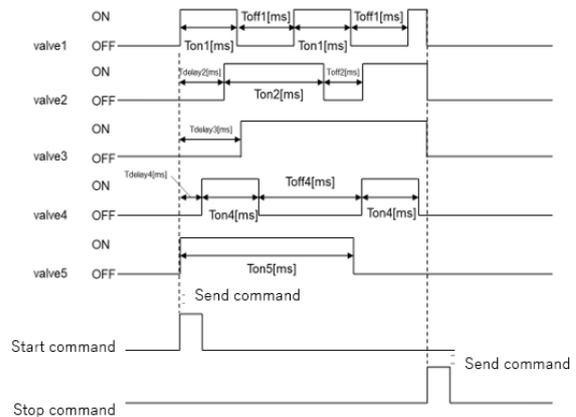
ON⇒With OFF set to 1, the operation is repeated until a stop command is sent. The start delay time is applied only once for the first time.

The setting range for each time is 0 to 5000 [ms] (in 1ms increments).

For valves that are not used, set the ON time to 0 [ms].

When the OFF time is set to 0 [ms], it is always ON. (The start delay time is applied.)

Example of operation)



※For the above example, valve3 is set to Toff3:0[ms].

●Other Functions

<Bluetooth function>

The distributed software is already equipped with a communication function for Bluetooth. This function is available by connecting your Bluetooth dongle to USB Type-A port and enabling communication with the command. You can use the serial monitor application to connect to a PC or smartphone for remote control.

<iB-Flow Control Function>

The needle opening can be controlled externally by connecting our iB-Flow series to the stepping motor connection connector. Refer to iB-Flow series catalogue for the applicable flow rate and other specifications.

●Control Commands

Common specifications

- It is not case sensitive.
- The effect is applied at the command reception timing.
- The delimiter character is "," (comma).

<Communication parameter>

Status	Setting
Data transfer rate	115200[bps]
Data length	8[bit]
Parity	None
Stop bit	1[bit]

Command Details

<MODE>

Function: Operation mode setting

Configuration: Command, mode number

Transmission example: MODE,2

Response example: set_Mode2

Response example: Error1

- Mode number
- 1: ON/OFF arbitrary control mode
- 2: ON time control mode
- 3: ON/OFF time-control mode
- 4: ON/OFF interlock

※If a command is received during valve operation, the operation will stop.

<ValveON>

Function: ON time setting of specified valve

Configuration: Command, target valve, ON time

Transmission example: ValveON,1,100

Response example: Set_Valve_1_OnTime 100 [ms]

Response example: Error1

•Target valve

- 1 : CN8 or Stn.1
- 2 : CN7 or Stn.2
- 3 : CN6 or Stn.3
- 4 : CN5 or Stn.4
- 5 : CN4 or Stn.5

•ON time

Setting range: 0 to 5000 [ms] (in 1ms increments)

If a value outside the setting range or a decimal point is input, the ON time of the target valve is set to 0 [ms] and an error is returned.

<ValveOFF>

Function: OFF time setting of specified valve

Configuration: Command, target valve, OFF time

Transmission example: ValveOFF,1,100

Response example: Set_Valve_1_OffTime 100 [ms]

Response example: Error1

•Target valve

- 1 : CN8 or Stn.1
- 2 : CN7 or Stn.2
- 3 : CN6 or Stn.3
- 4 : CN5 or Stn.4
- 5 : CN4 or Stn.5

•OFF time

Setting range: 0 to 5000 [ms] (in 1ms increments)

If a value outside the setting range or a decimal point is input, the OFF time of the target valve is set to 0 [ms] and an error is returned.

<ValveDelay>

Function: Set start delay time of specified valve

Configuration: Command, target valve, start delay time

Transmission example: ValveDelay,1,100

Response example: Set_Valve_1_DelayTime 100 [ms]

Response example: Error1

•Target valve

- 1 : CN8 or Stn.1
- 2 : CN7 or Stn.2
- 3 : CN6 or Stn.3
- 4 : CN5 or Stn.4
- 5 : CN4 or Stn.5

•Start delay time

Setting range: 0 to 5000 [ms] (in 1ms increments)

If a value outside the setting range or a decimal point is input, an error is returned by setting the start delay time of the target valve to 0 [ms].

<BT>

Function: Prepare Bluetooth dongle for use
Configuration: Command, startup flag
Transmission example: BT,1
Response example: OK

• Activation Flag

- 1: Connection enable
- 2: Connection not allowed

<FLOW>

Function: Change the needle opening of iB-Flow
Configuration: Command, opening
Transmission example: FLOW,30
Response example: OK

• Opening

Setting range: 0 to 100% (in 10% increments)

<MOVE>

Function: Start valve operation
Configuration: Command
Transmission example: MOVE
Response example: Start

<STOP>

Function: Stops valve operation.
Stop immediately in the middle of operation.
Configuration: Command
Transmission example: STOP
Response example: Stop

<MODE_PRM>

Function: Returns the mode when the command is sent.
Configuration: Command
Transmission example: MODE_PRM
Response example: Mode1

- Mode1: ON/OFF arbitrary control mode
- Mode2: ON-time control mode
- Mode3: ON/OFF time-control mode
- Mode4: ON/OFF interlock

<ON_PRM>

Function: Returns the ON time set when the command is sent.
Configuration: Command
Transmission example: ON_PRM
Response example: Valve_1100[ms]
Valve_2,300[ms]
Valve_3,1000[ms]
Valve_4,0[ms]
Valve_5,600[ms]

<OFF_PRM>

Function: Returns the OFF time set when sending a command.
Configuration: Command
Transmission example: OFF_PRM
Response example: Valve_1100[ms]
Valve_2,300[ms]
Valve_3,1000[ms]
Valve_4,0[ms]
Valve_5,600[ms]

<DERAY_PRM>

Function: Returns the start delay time set when the command is sent.
Now
Configuration: Command
Transmission example: DERAY_PRM
Response example: Valve_1100[ms]
Valve_2,300[ms]
Valve_3,1000[ms]
Valve_4,0[ms]
Valve_5,600[ms]

<BT_PRM>

Function: Returns the status of Bluetooth function.
Configuration: Command
Transmission example: BT_PRM
Response example: Bluetooth OFF

<FLOW_PRM>

Function: Change the needle opening when sending a command
Configuration: Command
Transmission example: FLOW_PRM
Response example: 30%

<SAVE_PRM>

Function: Save the parameters when sending a command to EEPROM,
The initial value when the power is turned on the next time.
Configuration: Command
Transmission example: SAVE_PRM
Response example: OK

<SET_FD>

Function: Sets the default setting to EEPROM.
Configuration: Command
Transmission example: SET_FD
Response example: OK

• Set value

- Initial mode : Mode1(ON/OFF arbitrary control mode)
- ON time : All valves 1000 [ms]
- OFF time : All valves 1000 [ms]
- Start delay time : All valves 1000 [ms]
- Bluetooth :OFF
- iB-Flow opening :0%

●Specifications

Type

	Type	PMC-PT-AC	PMC-CN-AC
Item		005 valve installed type	Connector installed type
Voltage		DC12V \pm 10%	
Consumption current		When valves OFF: 71mA When all valves ON:	When valves OFF: 70mA
Output signal		None	Output voltage: DC5V Max. output current: 250mA
Communication		Serial communication	
Mass		63g	33g
Accessories		AC adapter: 1pcs (Input: AC100V(50Hz/60Hz), Output: DC12V/1.2A)	

PETIT VALVE SPECIFICATIONS

Media	Air
Operating pressure range	0 – 0.7 MPa
Operating temperature range	5 – 50°C
Effective area	0.1mm ²
Compliant tube	1 (P), 3 (R) : ϕ 6 2(A) : ϕ 4

Recommended valve with connector

G(A) (V) OOBDC5V made by Koganei

Operating voltage range :5 V \pm 10%

Current when rated voltage is applied: 200 mA

Power consumption :1 W

※Valves of the same characteristics can be driven.

※On our website for detailed specifications and selection of G010 series

Please refer our website

https://official.en.koganei.co.jp/product/G010_ALL