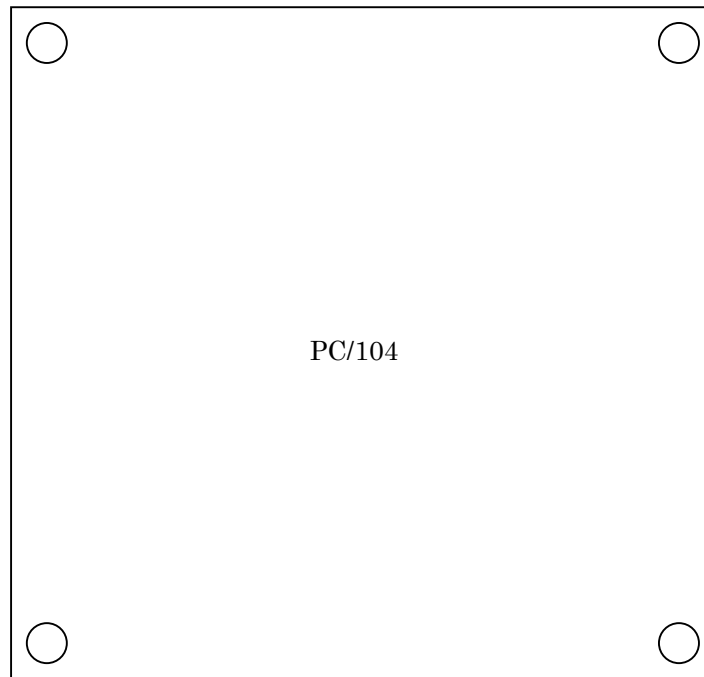


Real Solution for FA & LA



1 axis Pulse-Motor Control, and 4-bit TTL I/O

PMC-311PC104

User's Manual

for PC/104-BUS

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Caution

Unpacking

This package contain a PMC-311PC104 board, and 4 pieces of standoff.

Upon receipt the package, visually inspect the board for missing or damaged materials. This product was shipped in perfect condition as it was new.

Examine the package for physical damage. In the event of damage, save all packing materials and notify your courier to validate shipping claims.

Anti-static discharge

The PMC-311PC104 contains components that are susceptible to static discharge, and should be handled with appropriate caution. The anti-static packing material protects components from being damaged by static discharge.

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MICRO SCIENCE will answer the written questions (including FAX, or Email) in Japanese or English from the registered user about this product.
Send us the question form in this manual filled with the information.

We do not answer on phone with any language but Japanese.
Although MICRO SCIENCE may offer advice, we will not design the user's application.

Price List (# on Aug, 2002)

Items	Unit Price	Description
PMC-311PC104	\$ 200.00	1 axis Pulse-Motor Control board for PC/104
User's Manual	\$10.00	Printed one.(PDF file is free for download from the WEB)

The product consists of a PMC-311PC104 board and 4 pieces of standoff.

Sample program with "C" language is free for download from the WEB.

WEB : www.microscience.co.jp/eng/

Section 1. Introduction

1-1. Guide this Manual

This Manual contains a complete set of hardware and programming information for the PMC-311PC104 board, including configuration, installation, and I/O connection.

Section 1 contains the outline of functional descriptions and detail specifications, the installation, and setup procedure for the board.

Section 2 contains the pulse-motor control, the digital input, output, and their timing information.

Section 3 contains the trouble-shootings, and repair.

The last page is the request form for the Q and A.

1-2. Functional Specification

Pulse-Motor Control. (1 axis)

Control Object	Pulse-Motor Drive Hardware.
Controller	PCD-4511 made by Nippon Pulse-Motor Co.
Operation	Constant Driving, High-speed Driving with acceleration, Immediate Stop, Back to Origin, Change-speed on Drive, Hold-speed on Drive.
Pulse Output	Individual direction pulse output (CW, CCW), or Common Pulse and direction output (PO, DIR), specified with software (Control Command). max. 400Kpps, max. 16,777,215 step (at 1 instruction), Preset or Un-limited operation, output device: 74LS07 (max. 40mA sink current)
Limit Sensors (#1)	End-Limit (+EL, -EL), Slow-down(SD), Origin(ORG).
External Control (#1)	Start (waiting with software command), Stop.
Aux Input (#1)	2-bit
Aux Output (#2)	2-bit, Latched.

(#1) : Photo-coupler isolated, current drive input.
 (#2) : Photo-coupler isolated, open drain output.(max.100mA sink current)

General Purpose Inputs and Outputs.

Input	4-bit, TTL level.
Output	4-bit, TTL level, latched. (74LS04N assembled in the dual-in-line socket.)

System Configuration ###: on-board switch programmable.

Bus Compatibility	PC/104 Bus Data-bus is driven by 74HCT245, and all other signals are driven or accepted by (HCT-type) C-MOS devices.
Board Address ###	Upper 12Bits: programmable by on-board switches. Lower 4Bits: on-board logic decoded for multiple I/O ports.
Interrupt ###	IRQ3,4,5,6,7,9

I/O Connectors

for Pulse-Motor Control	40pin FRC type (2.54mm pitch)
for General Purpose I/O	20pin FRC type (2.54mm pitch)

Physical, Environmental

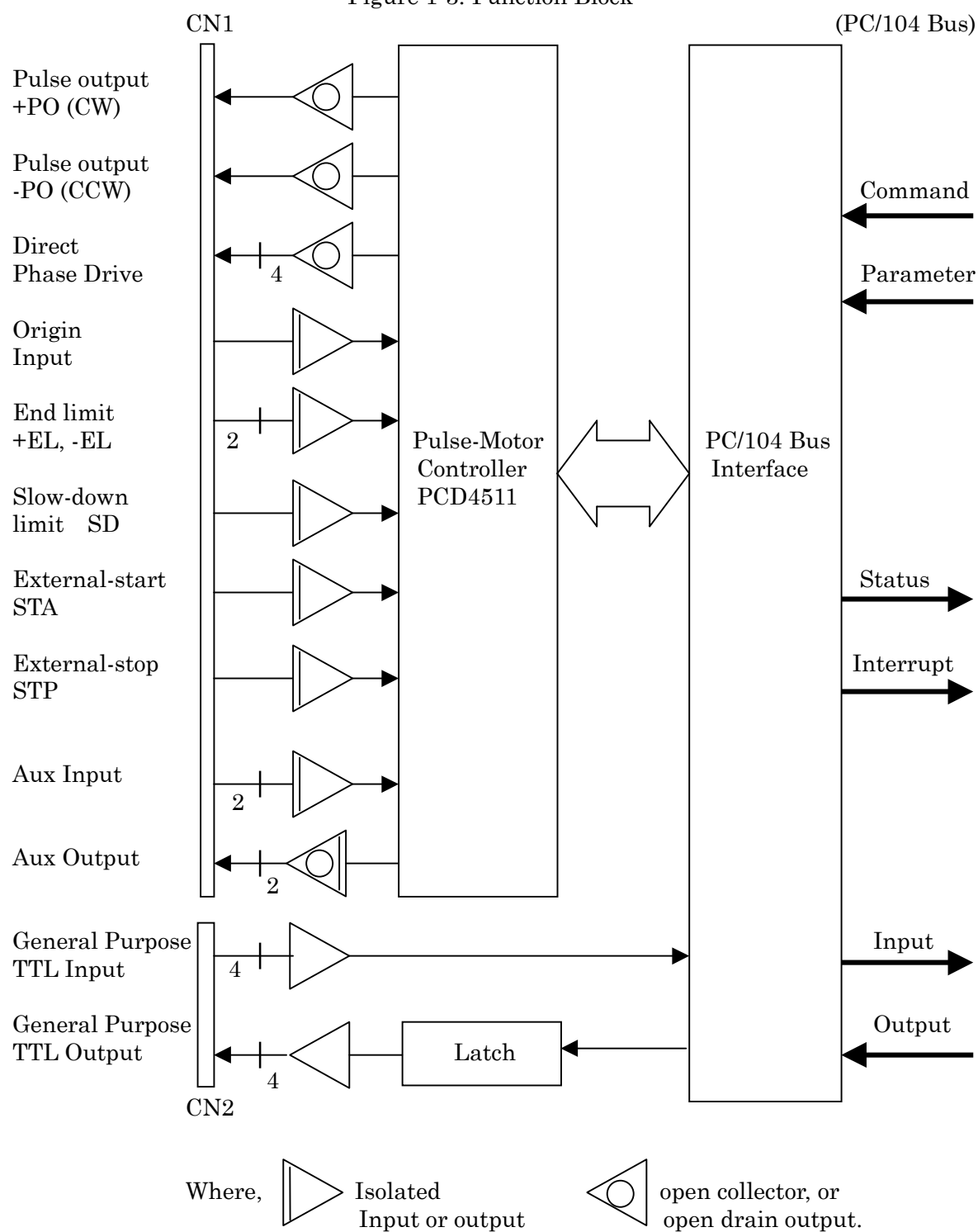
Operating Temperature Range	0 to +55
Storage Temperature Range	-10 to +85
Relative Humidity	80% (Non-condensing)
Power Supply, Consumption	+5v 0.4 A

1-3. Functional Description

PMC-311PC104 is designed for general purpose pulse-motor control and 4-bit TTL inputs and outputs.

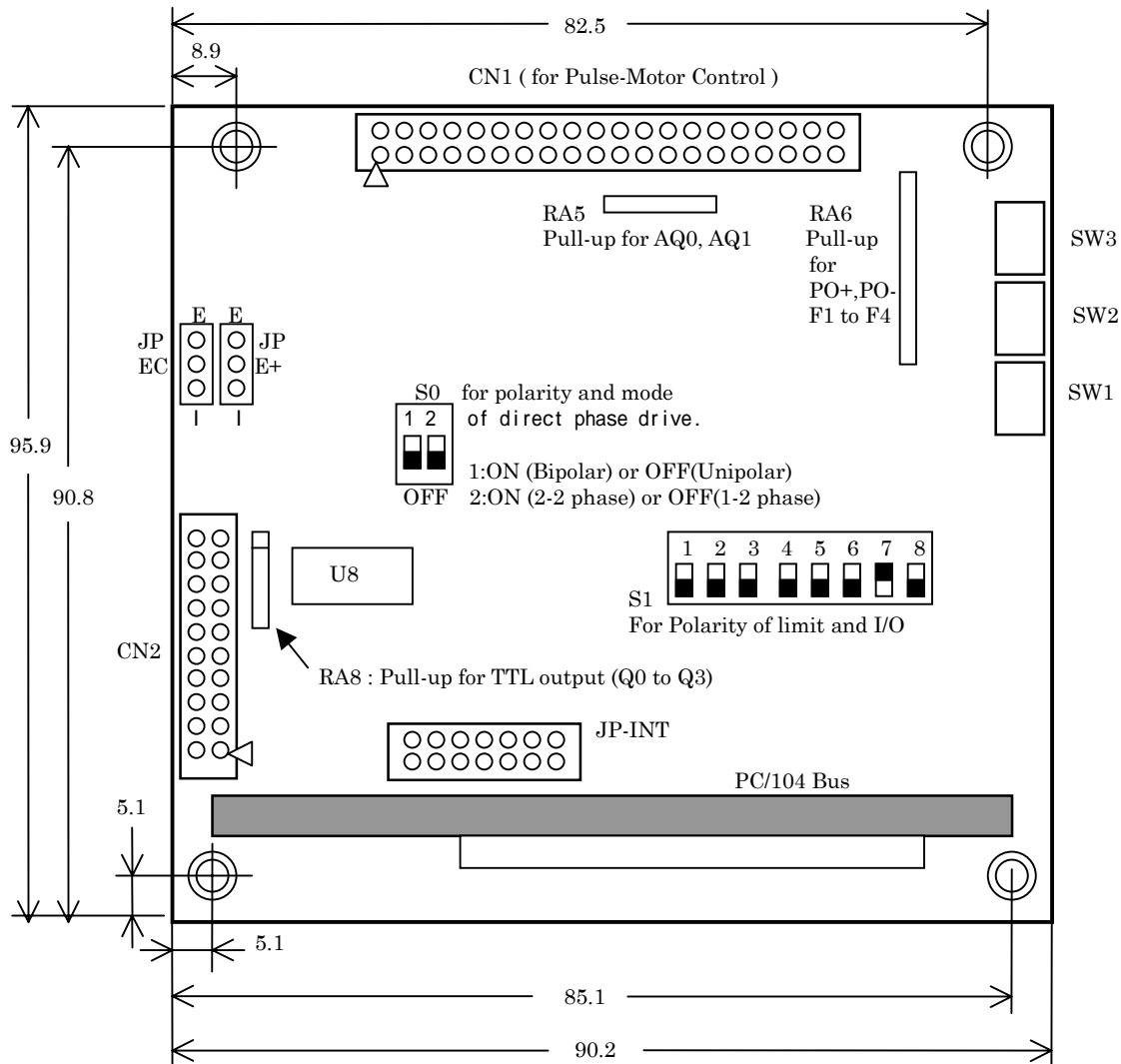
The base address of the board is programmable with the on-board switches.

Figure 1-3. Function Block



1-4. Layout of the board

Figure 1-4.



Unit: mm

At shipping, on-board programmable elements are set to < > position.

SW1, SW2, SW3 : Program switch for Base Address of the board. <0,1,C> / see 1-5-1./

JP-INT : Select jumper-switch for Interrupt Level. <NC> / see 1-5-2./

JP-E+, JP-EC: Power supply selection for isolation input and output. <I> / see 1-5-3./

S1 : Polarity selection for sensor switches, AUX output, and TTL output. / see 1-5-4./

Switch No. >	1	2	3	4	5	6	7	8
Specified Input/output	STA input	STP input	+EL input	-EL input	SD input	ORG input	AUX output	TTL output
Set to OFF >	B	B	B	B	B	B	B	P
Set to ON >	A	A	A	A	A	A	A	N

RA5,RA6,RA8 : Pull-up resistors <Not assembled> / see 1-9 /

U8 : TTL output device in the socket. <74LS04> / see 1-9 /

1-5. Settings on the board

1-5-1. BASE ADDRESS

PMC-311PC104 appears as a 16-byte block of registers within the host CPU's I/O address space. This address block must not conflict with other system I/O devices.



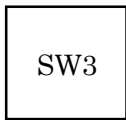
You can program the on-board switches SW1, SW2, and SW3 as BASE ADDRESS of the board.

These hex-a-decimal defined switches are set to SW1=0, SW2=1, SW3=C at the factory of MICRO SCIENCE, that define the BASE ADDRESS to "01C0" hex.

PMC-311PC104 occupies upper 16 byte address from the BASE.

See section 2-4 for more information.


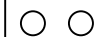
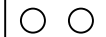
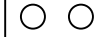
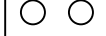

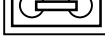
Figure 1-5A. Setting the BASE ADDRESS

Address Line →	AB15 to AB12	AB11 to AB08	AB07 to AB04	AB03 to AB00
On-board Hex-a-decimal → Switches				on-board logic decoded for multiple ports
Factory setting →	0	1	C	(F to 0)

1-5-2. Interrupt Level

Specified state of pulse-motor control can cause an interrupt request to the CPU. Select the interrupt level by the jumper-switch "JP-INT", and program Write (BASE+7H) register to enable the state. See section 2-9 for the details.

Figure 1-5B. select the Interrupt Level.

JP-INT	(Level)
	IRQ3
	IRQ4
	IRQ5
	IRQ6
	IRQ7
	IRQ9
	NC (non-connected)

1-5-3. Power Supply selection

External power supply (5v to 24v) is required between "EXP+" and "EP-COM" for drive the isolation input and output, where set both jumper-switch "JP-E+" and "JP-EC" to "E".

Internal 5v power supply from PC/104-Bus is also available for non-isolation driving. "EXP+" and "EP-COM" are set to "I" at the factory of MICRO SCIENCE for using internal power supply.

1-5-4. Input and Output Logic Polarity

The polarity of the sensor switch inputs, AUX outputs, and TTL outputs are selectable by the switch "S1".

MICRO SCIENCE set "OFF" as positive logic for TTL outputs, set "ON" as type-A contact for AUX outputs, and set "OFF" as type-B contact for the input of all sensor switches.

1-6. Pulse-Motor Control Connector

Pulse-Motor control is available on 40-pin FRC-type male connector CN1 on the board as illustrated in Figure 1-4.

The plug is also provided for general purpose, come with the board.
See whole of section 2 for programming.

Figure 1-6. Pulse-Motor Control Connector CN1 pin assignment

Function	Sign	Pin assign		Sign	Function
Ext-Supply (+) input	EXP+	1	O O	2	EP-COM
End Limit (+) input	EL+	3	O O	4	EP-COM
End Limit (-) input	EL-	5	O O	6	EP-COM
Slow-Down input	SD	7	O O	8	EP-COM
Origin input	ORG	9	O O	10	EP-COM
Ext-Start	STA	11	O O	12	EP-COM
Ext-Stop	STP	13	O O	14	EP-COM
AUX input	AD0	15	O O	16	EP-COM
AUX input	AD1	17	O O	18	EP-COM
AUX output	AQ0	19	O O	20	EP-COM
AUX output	AQ1	21	O O	22	EP-COM
		23	O O	24	
Pulse output (for CW)	PO+	25	O O	26	GND
Pulse output (for CCW)	PO-	27	O O	28	GND
F1 direct drive output	F1	29	O O	30	GND
F2 direct drive output	F2	31	O O	32	GND
F3 direct drive output	F3	33	O O	34	GND
F4 direct drive output	F4	35	O O	36	GND
		37	O O	38	
Internal +5v output	+5v	39	O O	40	GND

<###> On-board bracket : Model=HIF3FC-40PA-2.54DSA /made by HIROSE/
Plug : Model=HIF3BA-40DA-2.54R(11) /made by HIROSE/

<Note-1> Internal 5v power supply from PC/104-Bus is available between “+5v” and “GND”.

<Note-2> External power supply (5v to 24v) is required between “EXP+” and “EP-COM” for drive the isolation input and output, where set both jumper-switch “JP-E+” and “JP-EC to “E” side.

<Note-3> It is selectable either Individual direction pulse output (CW, CCW), or Common Pulse and direction output (PO, DIR) specified with software (Control Command).

Pin-No	Individual direction Pulse	Common Pulse and Direction
25	PO+ (CW)	Common Pulse
27	PO- (CCW)	Direction (CW/CCW)

<Note-4> Function and timing information for direct phase drive output “F1” to “F4” is given in section 3-2.

1-7. General Purpose TTL I/O Connector

General purpose TTL inputs and outputs are available on a 20-pin FRC-type male connector CN2 on the board as illustrated in Figure 1-4.

All outputs have the capability for 10 TTL load.

See section 2-12 for programming.

The plug is also provided for general purpose, come with the board.

Figure 1-7. TTL Input and Output Connector CN2 pin assignment

Function	Sign	Pin assign		Sign	Function
TTL Input 0	D0-IN	1	O O	2	GND
TTL Input 1	D1-IN	3	O O	4	GND
TTL Input 2	D2-IN	5	O O	6	GND
TTL Input 3	D3-IN	7	O O	8	GND
TTL Output 0	Q0-OUT	9	O O	10	GND
TTL Output 1	Q1-OUT	11	O O	12	GND
TTL Output 2	Q2-OUT	13	O O	14	GND
TTL Output 3	Q3-OUT	15	O O	16	GND
External Interrupt	INT-IN	17	O O	18	GND
Internal +5v Output	+5v	19	O O	20	GND

<Note-1> On-board bracket : Model= HIF3FC-20PA-2.54DSA /made by HIROSE/
 Plug : Model= HIF3BA-20DA-2.54R(11) /made by HIROSE/

<Note-2> +5v Output is supplied from PC/104 Bus.

1-8. System Configuration

Typical System

Figure 1-8A shows a typical system of pulse-motor control with PMC-311PC104.

The driver and the pulse-motor must be a matching pair.

Figure 1-8A. Typical Pulse-Motor Control System

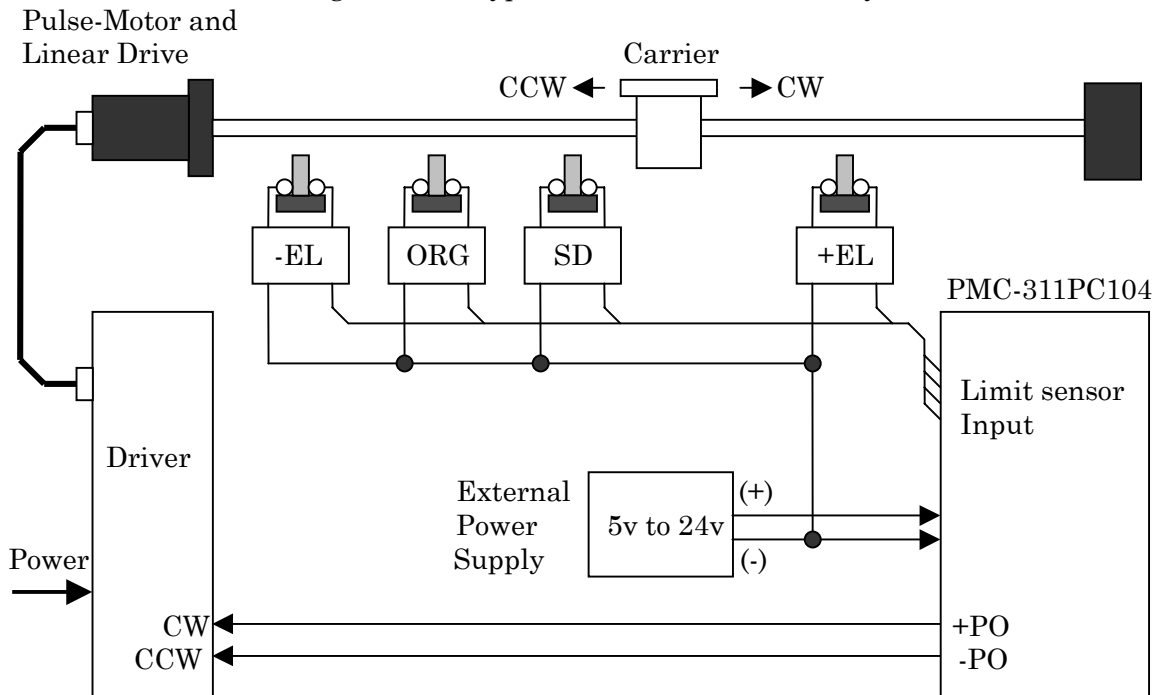
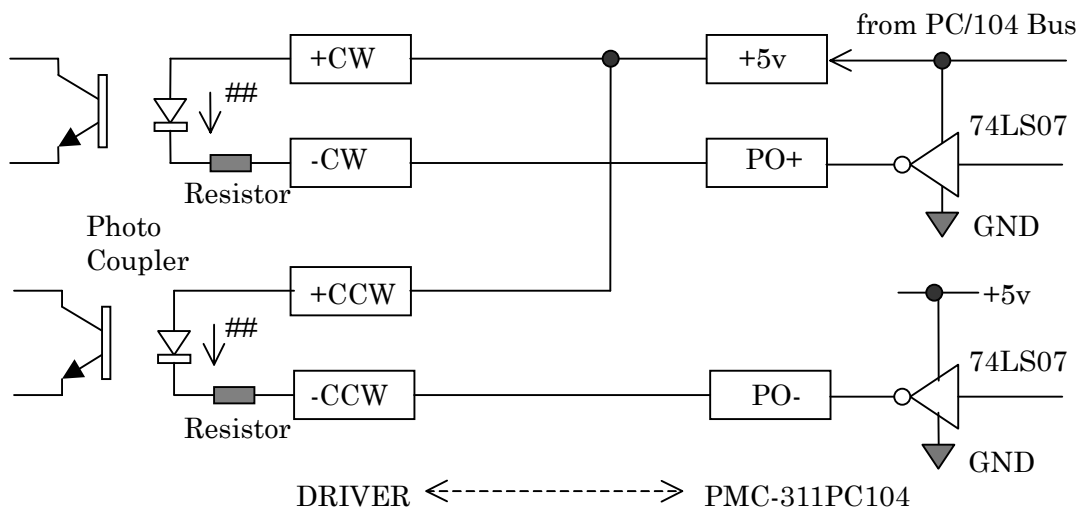
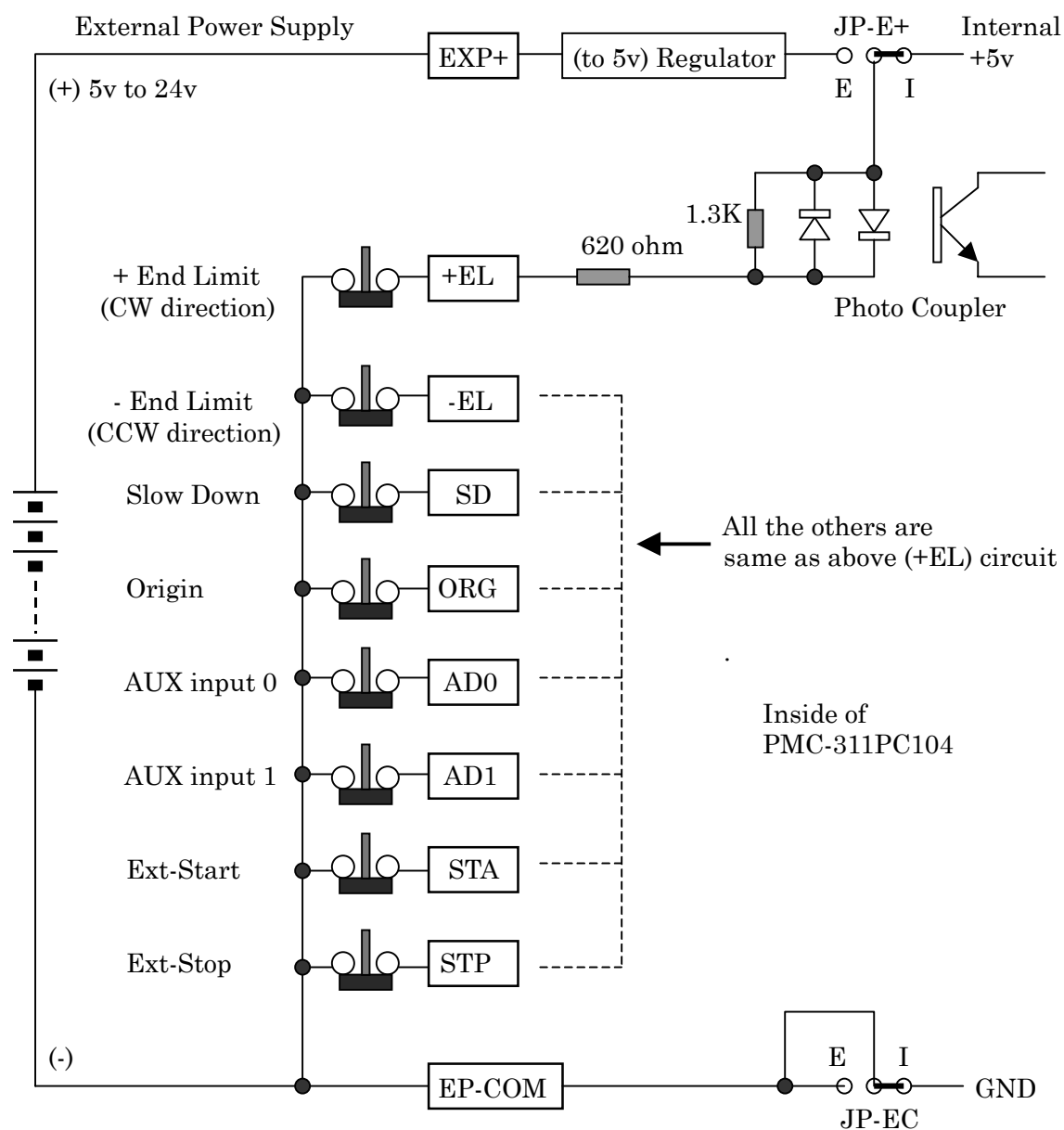


Figure 1-8B. Typical Interface between PMC-311PC104 and DRIVER.



Recommended "ON" drive current is between 5mA to 15mA. (absolute max 30mA)

Figure 1-8C. Limit Sensor Switch and Control Interface



<Note-1>

Jumper switch “JP-E+” and “JP-EC” are the power supply selection, be sure to set them same side.

Set both of them to “E” side cause isolation input with 5v to 24v external power supply. Other hand, set both of them to “I” side cause non-isolation input with internal 5v supply (from PC/104 Bus).

MICRO SCIENCE set both of them “I” side on shipping.

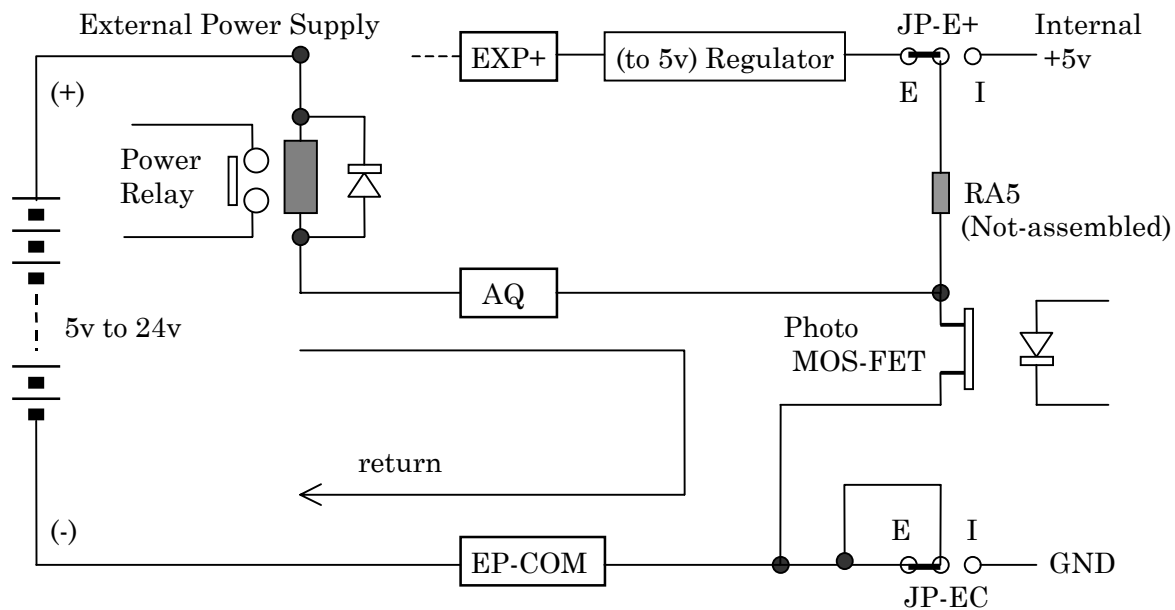
<Note-2>

On-board switch “S1” specifies the polarity of the sensor switches. See Figure 1-4.

<Note-3>

AUX input “AD0” and “AD1” are usable for general purpose, and “STP” is just for emergency stop input.

Figure 1-8D. Example for Power Relay control by AUX Output (AQ0, AQ1)



AUX output “AQ0” and “AQ1” are non-polarity open drain output by photo-isolated MOS transistor, and you can select the logical polarity by on-board switch “7 of S1”. MICRO SCIENCE set “7 of S1” to “ON” as Type-A contact, that cause both output to “OFF” state at the hardware reset in power-on process. They are not cleared by the software reset with Read(BASE+7H) command but cleared by the hardware reset.

They can drive (max) 100mA sink current as just a switch.

Figure 1-8D shows a sample application for control a power relay. In this case, external power input “EXP+” connection is not required, but “EP-COM” must be connected as a return pass for the drive current

<Note-1>

Output MOS transistor is specified as maximum sink current is 100mA, 2.5 ohm resistance, and absolute maximum apply voltage is 50v (DC or AC-peak).

<Note-2>

Both “JP-E+” and “JP-EC” should be set to “E” position for isolated operation.

<Note-3>

Pull-up resistor “RA5” may not be required except for interface to the logical device as like a TTL or CMOS.

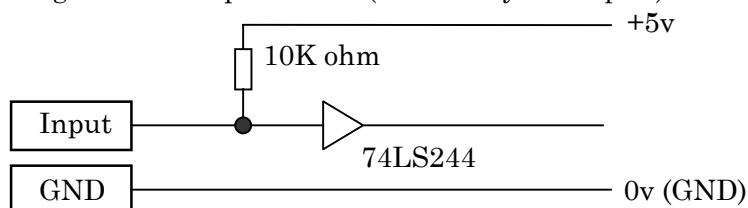
1-9. General Purpose TTL Input and Output

Input.

All Inputs are TTL level, and pulled-up with 10K ohm resistor.

Figure 1-9A shows the circuit.
See section 2-12 for programming.

Figure 1-9A. Input circuit.(shows only one input.)



Where, Input is "D0-IN", "D1-IN", "D2-IN", and "D3-IN".

Output.

All Outputs are also TTL level, latched, and you can select the logical polarity by on-board switch "8 of S1".

MICRO SCIENCE set "8 of S1" to "OFF" as positive logic, that cause all outputs to "TTL-Low" level at the hardware reset in power-on process.

Figure 1-9B shows the circuit for all outputs.

<Note-1>

All outputs are not cleared by the software reset with Read(BASE+7H) command but cleared by the hardware reset.

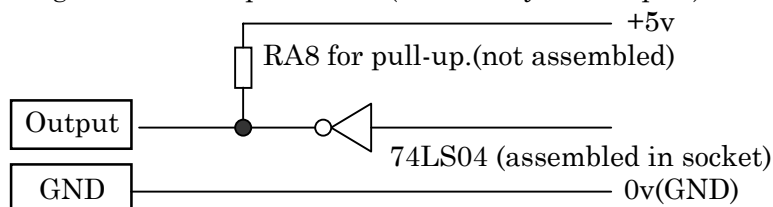
<Note-2>

74LS04 is assembled in the socket as TTL level digital output device at the factory of MICRO SCIENCE.

You can replace it by 74LS06 or 74LS07 for change to open-collector level.

See section 2-12 for programming.

Figure 1-9B. Output circuit.(shows only one output.)



Section 2. General Programming

2-1. General Programming Information

Handling

PMC-311PC104 appears to the host PC/104 bus CPU as a block of contiguous 16 hardware registers mapped within the I/O address space. See Table 2-4 for the map. These registers control the operation of PMC-311PC104 as long as they are accessed using 16bit I/O addressing with each 8bit data transfers.

These registers include Reset-board, Control the Pulse-Motor, General Purpose Digital I/O, Interrupt, and Status.

Operation

Entire information for programming are specified and explained in order as follows.

(section 2-2)

The profile of operations and control registers for pulse motor control.

(section 2-3)

General software sequence for control the pulse motor, Interrupt, and general purpose input and output.

(section 2-4 to 2-12)

The functions of each register.

These are the elements for programming.

2-2. Operations and Control Registers

Here are operations and control registers with the pulse-motor controller “PCD4511” on the board PMC-311PC104.

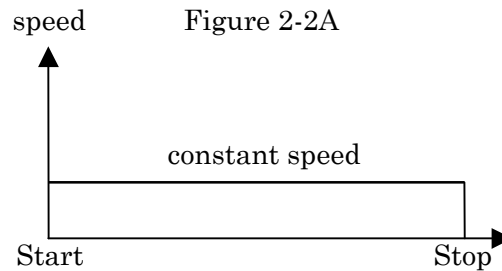
Where “PCD4511” is produced by Nippon Pulse Motor Co., LTD. See “PCD4511” users manual for more information

(1)

Drive with Constant speed

Pulse output is driven for specified direction and specified speed.

Where driven specified steps in Preset Mode, driven Un-limited steps until stop command or End-Limit sensor input or External Stop input in Un-Limited Mode.

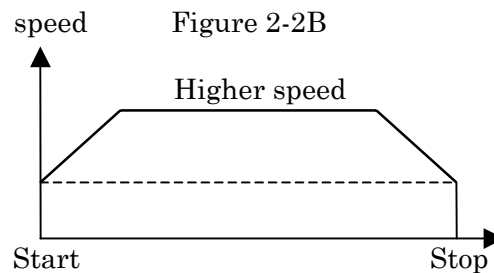


(2)

Drive with Higher Speed

Pulse output is driven for specified direction and specified pattern of speed.

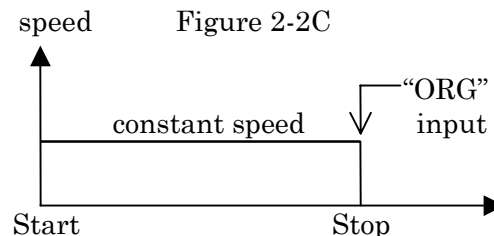
Where driven specified steps in Preset Mode, Driven Un-limited steps until stop command or End-Limit sensor input or External Stop input in Un-Limited Mode.



(3)

Back to “ORIGIN” with Constant speed

Pulse output is driven for specified direction and specified speed until “ORG” sensor input.

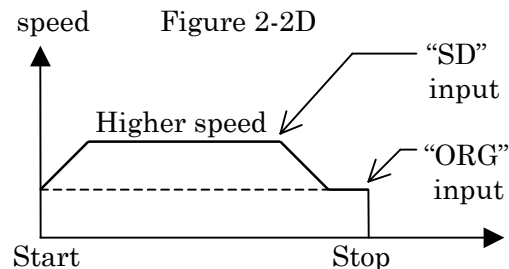


(4)

Back to “ORIGIN” with Higher speed

Pulse output is driven for accelerate from Lower speed to Higher speed, then constantly, until Limit sensor “SD” input.

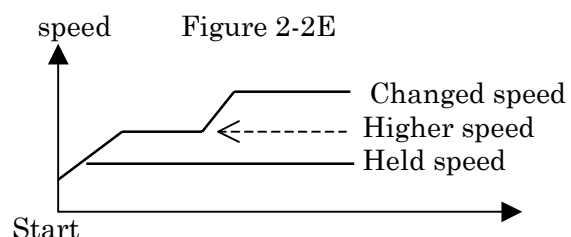
It is driven for slow down to Lower speed on “SD” input then constantly until “ORG” sensor input.



(5)

Changing or Holding the speed

The operation of hanging speed and holding current speed are available with the command.

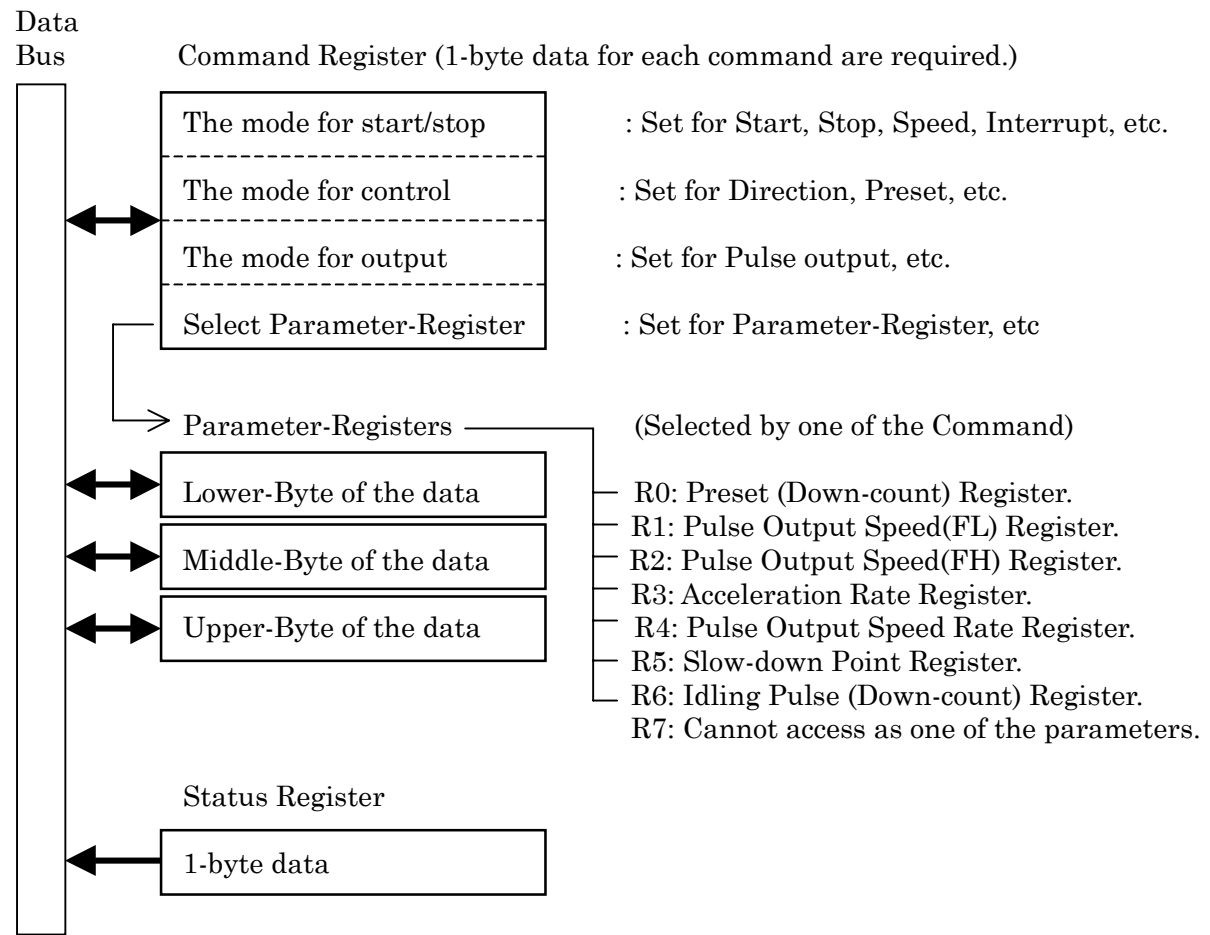


Control Registers

The pulse-motor controller “PCD4511” on PMC-311PC104 has 3 kind of registers. They are Command-Register, Parameter-Registers, and Status-Registers.

You should write 4 kind of command to the Command-Register. Where most significant 2-bit of the data specifies which of them. You can also read/write the Parameter-Registers with same address. Where one of the command data specifies the parameter register which is selected.

Figure 2-2F. The party of pulse-motor control Registers.



2-3. Procedures

The control process has Initial settings, Operations, Reading Status, and general purpose input/output.

Initial settings

Reset the board,
and setting the conditions.

Operations

Apply operation command
and the parameters.

Reading Status

Recognize Busy or Ready (End of the operation),
The current state of Limit Sensor inputs
and interrupt.

General purpose Input / Output

Isolated AUX inputs/outputs,
and non-isolated TTL inputs/outputs are available
for general purpose.

Following list shows a typical control process. MICRO SCIENCE also provide a sample program in “C” language, you can download it free from the WEB:

<http://microscience.co.jp/eng/>

<Note-1>

Wait <#> 400ns or more before write next Command for complete internal process.

<Note-2>

Be sure to keep in order as Upper-byte first, Lower-byte last for writing parameters.

```

RST= inp (BASE+0x7)      ; /* Reset and Get ID(=27H) */
<#> outp (BASE+0x0, OPT) ; /* Set Output Mode */

<#> outp (BASE+0x0, CNTL) ; /* Set Control Mode */

<#> outp (BASE+0x0, 80)   ; /* Select Register “R0” for preset the number of pulse. */
    outp (BASE+0x3, R0U) ; /* Write Upper-byte data to “R0” */
    outp (BASE+0x2, R0M) ; /* Write Middle-byte data to “R0” */
    outp (BASE+0x1, R0L) ; /* Write Lower-byte data to “R0” */

<#> outp (BASE+0x0, 81)   ; /* Select Register “R1” for output speed of the pulse. */
    outp (BASE+0x2, R1U) ; /* Write Upper-byte data to “R1” */
    outp (BASE+0x1, R1L) ; /* Write Lower-byte data to “R1” */

<#> outp (BASE+0x0, 82)   ; /* Select Register “R2” for output speed of the pulse. */
    outp (BASE+0x2, R2U) ; /* Write Upper-byte data to “R2” */
    outp (BASE+0x1, R2L) ; /* Write Lower-byte data to “R2” */

<#> outp (BASE+0x0, 83)   ; /* Select Register “R3” for acceleration of the speed. */
    outp (BASE+0x2, R3U) ; /* Write Upper-byte data to “R3” */
    outp (BASE+0x1, R3L) ; /* Write Lower-byte data to “R3” */

<#> outp (BASE+0x0, 84)   ; /* Select Register “R4” for multiply ratio of the speed. */
    outp (BASE+0x2, R4U) ; /* Write Upper-byte data to “R4” */
    outp (BASE+0x1, R4L) ; /* Write Lower-byte data to “R4” */

<#> outp (BASE+0x0, 85)   ; /* Select Register “R5” for slow-down point. */
    outp (BASE+0x2, R5U) ; /* Write Upper-byte data to “R5” */
    outp (BASE+0x1, R5L) ; /* Write Lower-byte data to “R5” */

<#> outp (BASE+0x0, 86)   ; /* Select Register “R6” for idling pulse before acceleration. */
    outp (BASE+0x1, R6)   ; /* Write 1-byte data to “R6” */

<#> outp (BASE+0x0, STSP) ; /* Set Start/Stop Mode as a START */

STS0= inp (BASE+0x0)     ; /* Read Satus-0 */

AXD= inp (BASE+0x4)      ; /* Read AUX inputs */
GPD= inp (BASE+0x5)      ; /* Read TTL inputs */

Outp (BASE+0x4, AXQ)     ; /* Write AUX outputs for update. */
Outp (BASE+0x5, GPQ)     ; /* Write TTL outputs for update. */

```

2-4. I/O Register Map

PMC-311PC104 appears as a 16-byte block of registers within the host CPU's I/O address space. This address block must not conflict with other system I/O devices. You can program the on-board switches SW1, SW2, and SW3 as BASE ADDRESS of the board.

These hex-a-decimal defined switches are set to SW1=0, SW2=1, SW3=C at the factory of MICRO SCIENCE, that specify the BASE ADDRESS to "01C0" hex.

PMC-311PC104 occupies upper 16 byte address from the BASE.
See figure 1-4 for the location of the board.

Figure 2-4A. Setting the BASE ADDRESS

Address Line →	AB15 to AB12	AB11 to AB08	AB07 to AB04	AB03 to AB00
On-board Hex-a-decimal Switches →	SW1	SW2	SW3	on-board logic decoded for multiple ports
Factory setting →	0	1	C	(F to 0)

Table 2-4. PMC-311PC104 Register Assignment. (All the port consist of 8bit.)

I/O Address	Direction	Description	Refer to
BASE +7H	Read	Reset Board, and get ID.	Section 2-5
	Write	Interrupt control.(Enable/Disable, Polarity, Source)	Section 2-9
BASE +6H	Read	Interrupt Request Flag, and the source state.	Section 2-10
	Write	Interrupt Request Flag Clear	Section 2-10
BASE +5H	Read	AUX inputs. (AD0, AD1)	Section 2-12
	Write	AUX outputs. (AQ0, AQ1)	
BASE +4H	Read	TTL inputs. (D0-IN, D1-IN, D2-IN, D3-IN)	Section 2-11
	Write	TTL outputs.(Q0-OUT, Q1-OUT, Q2-OUT, Q3-OUT)	
BASE +3H	Read	Upper-byte of the Parameter	Section 2-7
	Write		
BASE +2H	Read	Middle-byte of the Parameter	
	Write		
BASE +1H	Read	Lower-byte of the Parameter	
	Write		
BASE +0H	Read	Status-0	Section 2-8
	Write	Command Register	Section 2-6

2-5. Reset the Board, and get ID

```
RST = inp (BASE+0x7) ; /* Reset the Board */
```

Read (BASE+7H) Register cause the board reset.
All registers of the board must be initialized except for the last value of General Purpose AUX Output and TTL output.

Where “RST” is the ID that depend on the board, “27H” for PMC-311PC104.

Table 2-5. Read (BASE+7H) Register Bit Field.

Bit	Description
B7	“27H” is the ID for PMC-311PC104.
B6	
B5	
B4	
B3	
B2	
B1	
B0	

2-6. Command Register

```
outp (BASE+0x0, COMMAND) ; /* Each Command */
```

You should write 4 kind of command to the Command-Register. Where most significant 2-bit of the data specifies which of them.

Table 2-6A. Write (BASE+0H) Register Bit Field.

Bit	Description
B7 B6	Select the kind of Command. (See Table 2-6B.)
B5 B4 B3 B2 B1 B0	Command.

Table 2-6B. Select the group of the functions of the Command.

B7	B6	Group of the Command	Functions
1	1	Pulse Output Mode	For Output pulse controls.
1	0	Parameter Register Selection	Parameter Register selection, External controls.
0	1	Control Mode	Output Directions, Preset(or not), etc.
0	0	Start/Stop Mode	Start, Stop, etc.

2-6-1. Pulse Output Mode

This command may be written only once at the top of the program except for output speed holding operation.

Table 2-6C. Pulse Output Mode Command Bit Field.

bit	Value	Term	"=1" specifies	"=0" specifies
B7 B6	1 1	Pulse Output Mode Command		
B5		Monitor mode of PCD4511	Expansion mode	Legacy mode
B4		Sensitivity for ORG, EL, STP	Low	High
B3		Hold the speed or not.	Hold the current speed	Not-Holding
B2		Direct drive outputs control	Mask them (Disable)	Not-Mask (Enable)
B1		Pulse output control	Disable	Enable
B0		Logical Polarity of the Pulse	Positive Logic	Negative Logic

<Monitor mode of PCD4511>

All Registers, Commands, and Status are readable in Expansion monitor mode. Only Register "R0", Status-0 and Status-1 are readable in Legacy monitor mode compatible with "PCD4500"

< Sensitivity for ORG, EL, STP >

"ORG", "+EL", "-EL", and "STP" sensor inputs are ignored within 800ns or less width of them in Low Sensitivity mode.

< Hold the speed or not >

Set "B3"=1 cause held the current pulse output speed on the way in acceleration.

< Direct drive outputs control >

Set "B2"=1 cause mask the direct phase drive outputs (F1, F2, F3, F4) . See section 3-2 for more information of Direct driving.

< Pulse output control >

Set "B1"=1 cause disable the pulse output.

< Logical Polarity of the Pulse >

Negative Logic is suitable to the typical interface with the pulse-motor driver as illustrated in Figure 1-8B.

2-6-2. Control Mode

This command set the feature of the pulse output operation and Enable /Disable the sensor input “SD” and/or “ORG”.

Table 2-6D. Control Mode Command Bit Field.

bit	Value	Term	“=1” specifies	“=0” specifies
B7 B6	0 1	Control Mode Command		
B5		Pattern of Acceleration	“S” curve driving	Linear driving
B4		Pulse Output Mode	Common Pulse	Individual Pulse
B3		Output Direction	CCW (-)	CW (+)
B2		Output Pulse	Preset	Un-Limited
B1		“SD” input control	Enable	Disable
B0		“ORG” input control	Enable	Disable

< Pattern Acceleration >

Pulse output speed shall be accelerated from starting speed(FL) to cruising speed(FH) with this pattern for Higher speed operation. It shall be also de-accelerated with the same pattern at the ending the operation.

< Pulse Output Mode >

Set “B4”=0 cause Individual pulse output for each direction as “CW(+)” and “CCW(-)”. Other hand, “B4”=1 cause common pulse output and direction output.

See section 1-6 / Note-3 for details.

(PS);

Although “B4” is general purpose output on PCD4511, it is used as pulse output mode on PMC-311PC104.

< Output Pulse >

Set “B2”=0 cause Pulse Output is enabled until “STOP” command, “STP” or “EL” sensor input.

Other hand, set “B2”=1 cause Pulse Output is specified as Preset count. See section 2-7 for the Register(R0).

< “ORG”, “SD” input control >

Set “B0”=1 as enable “ORG” input is only for Return to ORIGIN operation.

In this operation, pulse output shall be stopped by “ORG” input.

Where set “B1”=1 as enable “SD” input, pulse output speed shall be slow-down from (FH) to (FL) by “SD” input, then stopped by “ORG” input.

2-6-3. Parameter Register Selection

Table 2-6E. Parameter Register Selection Command Bit Field.

bit	Value	Term	"=1" specifies	"=0" specifies
B7	1	Parameter Register Selection Command		
B6	0			
B5		Interrupt request by "STA" Control	Enable	Disable
B4		Interrupt request by "SD" Control	Enable	Disable
B3		Preset counter(R0) control	Disable count	Enable count
B2		Parameter Register Selection	See Table 2-6F	
B1				
B0				

< Interrupt request by "STA" Control >

Set "B5"=1 cause enable interrupt request by external start "STA".

< Interrupt request by "SD" Control >

Set "B4"=1 cause enable interrupt request by slow-down input "SD".

<Note>

Interrupt request by "STA", "SD", and Stop of pulse output are the OR-operation. See next section 2-6-4 for interrupt by Stop of pulse output.

They have to be cleared (disabled) in the interrupt service process, and set enable again for the next interrupt request.

See "Status-0" for recognizing the interrupt request source.

< Preset counter control >

Preset counter (R0) must be written and enabled on Preset Output Operation.

< Parameter Register Selection >

"B2, B1, B0" select the Parameter Register for read or write.

<Note>

Selected Parameter Register must be read or written in order as Upper-byte first, Lower-byte last.

Each byte of the read out data is the one at the same timing of read Upper-byte.

Table 2-6F. Parameter Registers.

B2	B1	B0	Selected Parameter Register	Access (#1)	Range for setting
0	0	0	R0: Preset (Count) Register	Read / Write	0 to FFFFFFFH
0	0	1	R1: (FL) Pulse Output Speed Register	Read / Write	1 to FFFH
0	1	0	R2: (FH) Pulse Output Speed Register	Read / Write	1 to FFFH
0	1	1	R3: Acceleration Rate Register	Read / Write	2 to 3FFH
1	0	0	R4: Output Speed Rate Register	Read / Write	2 to 3FFH
1	0	1	R5: Slow-down Point Register	Read / Write	0 to FFFFH
1	1	0	R6: Idling Pulse count Register	Read / Write	0 to 7H
1	1	1	R7: Non.(Status-1, -2, -3 are available.)	Read only	

(#1) This "Read / Write" condition is for Expansion Mode of PCD4511. See section 2-6-1 for Expansion Mode.

(#2) Be sure to keep setting them within the specified range.

2-6-4. Start / Stop Mode

This is the last Command for Start or Stop operation.

Table 2-6G. Start / Stop Command Bit Field.

bit	Value	Term	"=1" specifies	"=0" specifies
B7 B6	0 0	Start / Stop Command		
B5		Interrupt request by Stop Control	Enable	Disable
B4		Pulse Output Start Control	Start	
B3		Pulse Output Stop Control	Stop	
B2		Pulse Output Speed Mode	Higher	Constant
B1		Start by "STA" Control	Wait "STA" input	Immediate Start
B0		Speed Selection	(FH) speed	(FL) speed

< Interrupt request by Stop Control >

Set "B5"=1 cause enable interrupt request by Stop of the pulse output
Pulse output shall be stopped by Stop Command, preset count-up, or sensor input "EL", "STP", "ORG".

<Note>

Interrupt request by Stop of pulse output, "STA" and "SD" are the OR-operation.
See previous section 2-6-3 for interrupt by sensor input "STA" and "SD".
They have to be cleared (disabled) in the interrupt service process, and set enable again for the next interrupt request.
See "Status-0" for recognizing the interrupt request source.

< Pulse Output Speed Mode >

Select the pulse output speed mode either Constant or Higher speed operation.

< Start by "STA" Control >

Set "B1"=1 and "B4"=1 cause waiting sensor input "STA" as the start trigger.

< Speed Selection >

Select the pulse output speed either "FL" or "FH" specified with the Register (R1, R2) for Constant speed operation.
Select "FH" for Higher speed operation.

2-7. Parameter Registers

```

Outp (BASE+0x0, 80)    ; /* Select Register "R0". See section 2-6-3. */
Outp (BASE+0x3, R0U)   ; /* Write Upper-byte data to "R0" */
Outp (BASE+0x2, R0M)   ; /* Write Middle-byte data to "R0" */
Outp (BASE+0x1, R0L)   ; /* Write Lower-byte data to "R0" */

Outp (BASE+0x0, 8?)    ; /* Select Register "R?". See section 2-6-3. */
Outp (BASE+0x2, R?U)   ; /* Write Upper-byte data to "R?" */
Outp (BASE+0x1, R?L)   ; /* Write Lower-byte data to "R?" */

```

Where “?” is 1 to 5.

```

Outp (BASE+0x0, 86)    ; /* Select Register "R6". See section 2-6-3. */
Outp (BASE+0x1, R6)    ; /* Write 1-byte data to "R6" */

```

“R0” Register;

Set number of the output pulse for preset.
This register works as a down counter.

**“R1” Register;
(FL)**

Selectable as a constant speed for Constant speed operation, or
Starting and Ending speed for Higher speed operation.
Pulse output speed with “FL” is specified as,

$$\text{Speed(FL)} = (\text{R1}) \times (\text{Multiplier}) \quad \text{<pps> ----- (a)}$$

Where “Multiplier” is given from Register “R4” described as later.

**“R2” Register;
(FH)**

Selectable as a constant speed for Constant speed operation, or
Cruising speed for Higher speed operation.

$$\text{Speed(FH)} = (\text{R2}) \times (\text{Multiplier}) \quad \text{<pps> ----- (b)}$$

Where “Multiplier” is given from Register “R4” described as later.

“R3” Register;

The value(R3) for acceleration Rate and the value(R1, R2) for speed
specifies the Time of accelerate operation in Higher speed operation.
The time of linear accelerate operation “**TL**” is,

$$\text{TL} = \frac{\{ (\text{R2}) - (\text{R1}) \} \times (\text{R3})}{4.9152} \quad \text{<micro-sec> ----- (c)}$$

The time of S-curve accelerate operation “**TS**” is,

$$\text{TS} = \frac{\{ (\text{R2}) - (\text{R1}) \} \times (\text{R3}) \times 2}{4.9152} \quad \text{<micro-sec> ----- (d)}$$

Where, “4.9152” is the system clock of PCD4511 in “MHz”

“R4” Register;

The value(R4) specifies the “Multiplier” that decides the pulse output speed with the value(R1, or R2) as equation (a, or b).

The “Multiplier” is ,

$$\text{“Multiplier”} = \frac{4.9152 \times 10^6}{(R4) \times 8192} \quad \text{----- (e)}$$

Where, “4.9152” is the system clock of PCD4511 in “MHz”

See Table 2-7B for the value(R4) vs “Multiplier” with the equation(e).

Table 2-7B

The value (R4)	“Multiplier”	The range of pulse output speed. <pps>
600 [258H]	1	1 to 8,192
300 [12CH]	2	2 to 16,382
120 [78H]	5	5 to 40,955
60 [3CH]	10	10 to 81,910
30 [1EH]	20	20 to 163,820
12 [CH]	50	50 to 409,550

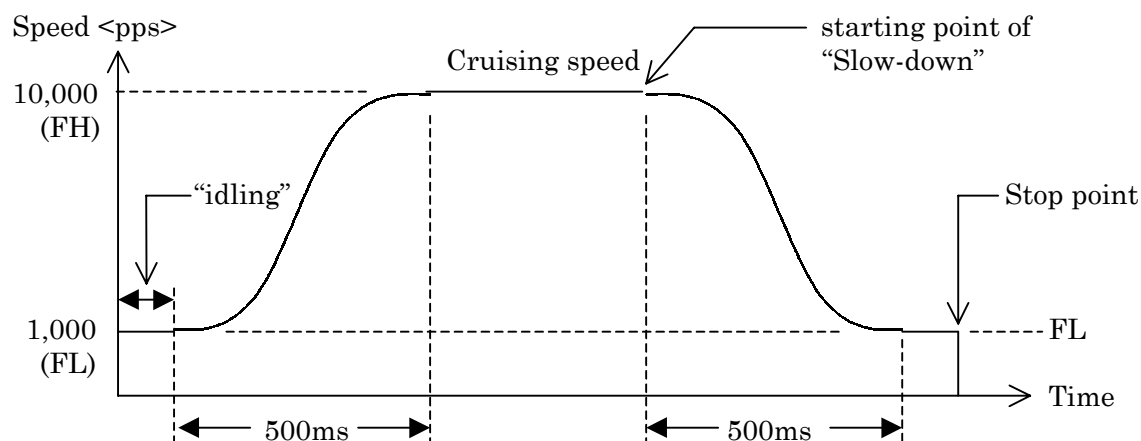
<Note> Using lower value of the “Multiplier” cause available smaller step of speed settings.

Example of the settings for Higher speed operation

Requires are ; Starting and Ending speed = 1000 <pps>,
S-curve acceleration Time = 500 <ms>, Cruising speed = 10000 <pps>.

- (1) Select “Multiplier” = 2, because both speed are in the range. See Table 2-7B.
Set Register (R4) = 300, given from the equation(e).
- (2) Set Register (R1) = 500, given from the equation (a).
- (3) Set Register (R2) = 5000, given from the equation (b).
- (4) Set Register (R3) = 273, given from the equation (d) .

Figure 2-7C. Higher speed preset operation with S-curve acceleration.



Slow-Down

“R5” Register;

The value(R5) specifies the starting point of “Slow-down” for closing the Higher speed preset operation.

Where preset counter shall be counted down by the pulse output, then the meeting point with the value(R5) is the starting point of “Slow-down”.

$$\text{for linear accelerate operation, } (R5) = \frac{\{ (R2) - (R1) \} \times (R3)}{(R4) \times 16384} \text{ ----- (f)}$$

$$\text{for S-curve accelerate operation, } (R5) = \frac{\{ (R2)^2 - (R1)^2 \} \times (R3)}{(R4) \times 8192} \text{ ----- (g)}$$

Where the (R5) is larger than appropriate value, the speed shall become to the Ending speed (FL) before stop point, and keep the speed until stop point as Figure 2-7C. That may be no problem for many application.

<Caution>

Where the (R5) is smaller than appropriate value, the pulse output shall be stopped at higher speed than the Ending speed (FL) .

We are afraid that if the object is stopped at just the point sharp.

Idling

“R6” Register;

The value of Idling pulse count Register(R6) specifies the number of pulse output with the Starting speed(FL) before start acceleration at the start of Higher speed operation.

Set (R6) between 0 to 7, this is like a warming up.

2-8. Get Status

Status-0

Only “Status-0” is required in many application.

STS0 = inp (BASE+0x0) ; /* Status-0 */

Table 2-8A. Read (BASE+0) Register Bit Field as **Status-0**

Bit	Term	“=1” specifies	“=0” specifies
B7	De-acceleration state	On de-accelerating	Not the state
B6	Acceleration state	On accelerating	Not the state
B5	Slow-down point	Arrived or already passed	Not arrived yet
B4	Preset counter (R0)	(R0) = 0	(R0) = Not 0
B3	Pulse output state	On output operation	
B2	IRQ by “STA” input	OFF	ON
B1	IRQ by “SD” input	OFF	ON
B0	IRQ by End of Operation	OFF	ON

<Note> IRQ: Interrupt Request.

“Status-0” shall be read from (BASE+0H) Register without any limitation.
 “Status-1, 2, 3” shall be read from (BASE+1H, 2H, 3H) Register with selecting parameter register “R7” by the command in expansion monitor mode of PCD4511.

Other hand, “Status-1” shall be read from (BASE+1H) Register with selecting any parameter register by the command in legacy monitor mode of PCD4511.
 See section 2-6-1 and 2-6-3 for details.

Table 2-8B. Read data in **Expansion monitor mode**.

Selected Register	Data for read address allocations			
	(BASE+0H)	(BASE+1H)	(BASE+2H)	(BASE+3H)
R0	Status-0	Lower byte of (R0)	Middle byte of (R0)	Higher byte of (R0)
R1	Status-0	Lower byte of (R1)	Higher byte of (R1)	# Start/Stop mode
R2	Status-0	Lower byte of (R2)	Higher byte of (R2)	# Control mode
R3	Status-0	Lower byte of (R3)	Higher byte of (R3)	# Register Selection
R4	Status-0	Lower byte of (R4)	Higher byte of (R4)	# Pulse output mode
R5	Status-0	Lower byte of (R5)	Higher byte of (R5)	(R7) as reserved
R6	Status-0	(R6)	Lower byte of speed	Higher byte of speed
R7	Status-0	Status-1	Status-2	Status-3

: Command

Table 2-8C. Read data in **Legacy monitor mode**.

Selected Register	Data for read address allocations			
	(BASE+0H)	(BASE+1H)	(BASE+2H)	(BASE+3H)
R0	Status-0	Lower byte of (R0)	Middle byte of (R0)	Higher byte of (R0)
anyone	Status-0	Status-1	0	0

Status-1

Table 2-8D. Read (BASE+1H) Register Bit Field as **Status-1**

Bit	Term	"=1" specifies	"=0" specifies
B7	Direct phase drive	Initiation of the sequence	Except for the initiation
B6	" +SD" sensor input	OFF (Active)	ON
B5	" -SD" sensor input	OFF (Active)	ON
B4	" STA" sensor input	OFF (Active)	ON
B3	" STP" sensor input	OFF (Active)	ON
B2	" ORG" sensor input	OFF (Active)	ON
B1	" +EL" sensor input	OFF (Active)	ON
B0	" -EL" sensor input	OFF (Active)	ON

< **Note-1** > "ON/OFF" state of Table 2-8-D shows in the condition of the setting for "type-B" contact.

Status-2

Table 2-8E. Read (BASE+2H) Register Bit Field as **Status-2** in **Expansion monitor mode**.

Bit	Term	"=1" specifies	"=0" specifies
B7	IRQ by any internal source	ON	OFF
B6	Pulse output Mode < Note-2 >	Common pulse output	Individual pulse output
B5	" +PO" output as "CW"	OFF	ON
B4	" -PO" output as "CCW"	OFF	ON
B3	" F4" output < Note-3 >	OFF	ON
B2	" F3" output < Note-3 >	OFF	ON
B1	" F2" output < Note-3 >	OFF	ON
B0	" F1" output < Note-3 >	OFF	ON

< **Note-2** > See section 2-6-2.

<**Note-3**> "F1, F2, F3, F4" are the direct phase drive output, see section 3-2 for details.

Status-3

Table 2-8F. Read (BASE+3H) Register Bit Field as **Status-3** in **Expansion monitor mode**.

Bit	Term	"=1" specifies	"=0" specifies
B7 B6 B5 B4	ID of the device.	= 4H for PCD4541 = 2H for PCD4521 = 1H for PCD4511 (for this board PMC-311PC104)	
B3 B2 B1 B0	Not used.		

2-9. Interrupt Control

Outp (BASE+0x7, icc) ; /* Interrupt Controls */

Write (BASE+7H) Register command specifies the interrupt control as a source selection, valid input edge selection, and Enable/Disable.

Table 2-9A. Write (BASE+7H) Register Bit Field

Bit	Term	"=1" specifies	"=0" specifies	On Reset
B7	Interrupt Control	Enable	Disable	0
B6	Valid edge of external Interrupt input	Rising edge	Falling edge	0
B5	Interrupt Source selection <Note-1>	Internal	External input	0
B4	Not used.			0
B3				0
B2				0
B1				0
B0				0

<Note-1>

Where set Bit "B5"=1 as Internal Interrupt Sources, Interrupt request is available by the End of operation, "SD" input, or "STA" input. They are OR operation. See "Status-0" to have the notice which is the source of this time.

See Table 2-9B for the settings of Internal Interrupt Request control.

External Interrupt Source is the TTL input "INT-IN" assigned in the connector "CN2".

Table 2-9B. Internal Interrupt Sources (by PCD4511)

Sources	Settings <Note-2>
End of Operation.	Bit "B5" of Start/Stop Command.(section 2-6-4)
Meeting the Slow-down point	Bit "B4" of Parameter Command.(section 2-6-3)
Pulse output start by "STA" input	Bit "B5" of Parameter Command.(section 2-6-3)

<Note-2>

The next Interrupt Request by Internal Source is available after clear the control Bit of their Command and set them again, plus clear the General Interrupt Request Flag described in the next section 2-10.

<Note-3>

Interrupt Request is typical 500ns width negative pulse that apply to the line of PC/104 Bus, selected by the jumper switch "JP-INT" on PMC-311PC104 board.

2-10. Interrupt Flag and State

IFS = inp (BASE+0x6) ; /* Interrupt Request Flag and State */

Table 2-10A. Read (BASE+6H) Register Bit Field

Bit	Term	"=1"specifies	"=0"specifies	On Reset
B7	General Interrupt Request Flag.	ON	OFF	0
B6	External interrupt input (INT-IN) state	High	Low	0
B5	Internal interrupt source state	ON	OFF	0
B4	Not used.			0
B3				0
B2				0
B1				0
B0				0

<Note>

"General Interrupt Request Flag" shall be set by any interrupt request source.

Clear this flag by Write (BASE+6H) command, and clear control Bit of the internal interrupt request sources for availability of the next interrupt request.

Outp (BASE+0x6, CIF) ; /* Clear Interrupt Request Flag */

Table 2-10B. Write (BASE+6H) Register Bit Field

Bit	Term	"=1"specifies	"=0"specifies	On Reset
B7	Interrupt Request Flag control	Clear	Non- effect	0
B6	Not used.			0
B5				0
B4				0
B3				0
B2				0
B1				0
B0				0

2-11. AUX Input and Output

AXD = inp (BASE+0x4) ; /* AUX input */
 Outp (BASE+0x4, AXQ) ; /* AUX output */

Read or Write (BASE+4H) Register is available for general purpose.

They work as an isolated I/O with external power supply, see Figure 1-8C and 1-8D in section 1-8 for the interface.

Table 2-11A. Read (BASE+4H) Register Bit Field

Bit	Term	“=1”specifies	“=0”specifies
B7	Not used.		
B6			
B5			
B4			
B3			
B2			
B1	AUX Input 1 (AD1)	ON (driven by the current)	OFF
B0	AUX Input 0 (AD0)		

Table 2-11B. Write (BASE+4H) Register Bit Field [**A-type contact**]

Bit	Term	“=1 ”specifies	“=0 ”specifies	On Reset	
B7	Not used.			All “0” <Note-2>	
B6					
B5					
B4					
B3					
B2					
B1	AUX Output 1 (AQ1)	ON <Note-1>	OFF <Note-1>		
B0	AUX Output 0 (AQ0)				

<Note-1>

The Output State “ON/OFF” is specified by the on-board switch “S1-7”, MICRO SCIENCE set it “ON” as “A-type contact” on shipping cause all outputs to “OFF” state at the hardware reset in the power-on process. See section 1-5-4 for settings.

<Note-2>

Latched outputs are not cleared by the software reset command, but cleared by the hardware reset in the power-on process.

2-12. TTL Input and Output

GPD = inp (BASE+0x5) ; /* TTL input */
 Outp (BASE+0x5, GPQ) ; /* TTL output */

Read or Write (BASE+5H) Register is available for general purpose.

They work as same as “AUX input/output” except for they are non-isolated TTL level.

Table 2-12A. Read (BASE+5H) Register Bit Field

Bit	Term	“=1”specifies	“=0”specifies
B7	Not used.		
B6			
B5			
B4			
B3	TTL Input 3 (D3-IN)	High	Low
B2	TTL Input 2 (D2-IN)		
B1	TTL Input 1 (D1-IN)		
B0	TTL Input 0 (D0-IN)		

Table 2-12B. Write (BASE+5H) Register Bit Field [**Positive Logic**]

Bit	Term	“=1 ”specifies	“=0 ”specifies	On Reset
B7	Not used.			All “0” <Note-2>
B6				
B5				
B4				
B3	TTL Output 3 (Q3-OUT)	High	Low	
B2	TTL Output 2 (Q2-OUT)			
B1	TTL Output 1 (Q1-OUT)			
B0	TTL Output 0 (Q0-OUT)			

<Note-1>

The Output State “High/Low” is specified by the on-board switch “S1-8”, MICRO SCIENCE set it “OFF” as “Positive Logic” on shipping cause all outputs to “Low” state at the hardware reset in the power-on process. See section 1-5-4 for settings.

<Note-2>

Latched outputs are not cleared by the software reset command, but cleared by the hardware reset in the power-on process.

Section 3. Maintenance and Appendix

3-1. Trouble Shootings

Reconfirm.

The PMC-311PC104 supplied by MICRO SCIENCE is fully inspected and tested. If it doesn't work on your system, reconfirm following issues.

- (1) Check the I/O BASE address specified by the on-board switch SW1, SW2, and SW3. On the IBM PC/AT compatible system, the I/O address must be mapped between "0H" to "3FFH" or the image of this range except for the occupied address by the other devices or the peripherals.
- (2) Debug your software or applications. For example, if the Interrupt level is correct or if occupied by any other devices.
- (3) Be careful to connect the inputs, and outputs.

What's wrong?

Fill in and send (Letter, Fax, or Email) the Q&A form to MICRO SCIENCE where you didn't find anything wrong. Although we will study about your system and answer by the letter what you should do, we don't write or debug application software. Sorry, we won't answer with any language but Japanese on the phone. Please write us Japanese or English.

Replace the Board or Repair for free.

MICRO SCIENCE will replace or repair the Board for free which are after examination disclosed to the satisfaction of MICRO SCIENCE to be thus defective, for a period within one year of shipment. This warranty shall not apply which have been subject to misuse, negligence, or accident. See "Caution/Warranty" for details in page-3.

Repair the Board.

MICRO SCIENCE will repair, calibrate, or test the Board on request. These products should have to prepaid the transportation at MICRO SCIENCE. Be sure, give us the information with the products, maybe Q&A form is useful for the report.

Then user have to pay the proper cost in few weeks according to the bill after accept the returned products.

3-2. Direct Phase Drive

“F1, F2, F3, F4” are the direct phase drive output for the sequence of “1-2 phase drive” or “2-2 phase drive” with uni-polar or bi-polar power supply.

The combination of on-board switch “S0-1” and “S0-2” specifies the mode.

<Note-1>

These operation mode of the sequence and driving are suitable for NP-7024M, 7026M, and NP-2918 which are the pulse motor driving devices made by Nippon Pulse Motor Co.

2-2 Phase, Uni-Polar Drive					
Sequence >	0	1	2	3	0
F1 output	H	H	L	L	H
F2 output	L	H	H	L	L
F3 output	L	L	H	H	L
F4 output	H	L	L	H	H
(F-Z)	H	L	L	L	H
[CCW] < << Direction >>> [CW]					

1-2 Phase, Uni-Polar Drive									
Sequence >	0	1	2	3	4	5	6	7	0
F1 output	H	H	H	L	L	L	L	L	H
F2 output	L	L	H	H	H	L	L	L	L
F3 output	L	L	L	L	H	H	H	L	L
F4 output	H	L	L	L	L	L	H	H	H
(F-Z)	H	L	L	L	L	L	L	L	H
[CCW] < << Direction >>> [CW]									

2-2 Phase, Bi-Polar Drive					
Sequence >	0	1	2	3	0
F1 output	H	H	L	L	H
F2 output	L	H	H	L	L
F3 output	L	L	L	L	L
F4 output	L	L	L	L	L
(F-Z)	H	L	L	L	H
[CCW] < << Direction >>> [CW]					

1-2 Phase, Bi-Polar Drive									
Sequence >	0	1	2	3	4	5	6	7	0
F1 output	H	H	H	H	L	L	L	L	H
F2 output	L	L	H	H	H	H	L	L	L
F3 output	L	L	L	H	L	L	L	H	L
F4 output	L	H	L	L	L	H	L	L	L
(F-Z)	H	L	L	L	L	L	L	L	H
[CCW] < << Direction >>> [CW]									

<Note-2> Where “F-Z”=H shows the initiation of the sequence.
See Bit “B7” of “Status-1” for detecting.

Q & A form (in English or Japanese)

To:
MICRO SCIENCE., Co. LTD
 Customer Support Div
 2-37-12, Nishiogi-kita,
 Suginami-ku,
 Tokyo, Japan

From:

Fax: +81-3-3301-5593
 Email: qas@microscience.co.jp

Fax:
 Email:

PMC-311PC104	serial # =	Purchase Date:
Preferences on- Board	SW1 =	JP-INT = 3, 4, 5, 6, 7, 9
	SW2 =	JP-E+ = ,
	SW3 =	JP-EC=
	S1-1 = , S1-2 = , S1-3 = , S1-4 = , S1-5 = , S1-6 = , S1-7 = , S1-8 =	
Other Devices In the system	Product: Occupied Resources: (I/O Address =), (Interrupt =)	
System Information	CPU:	
	OS :	
Software	Language:	
	Compiler:	

(Information)

<Note> MICR SCIENCE does not answer on phone with any language but Japanese.