Compact controller with integrated driver

FMC32 Hardware

User's Manual

FMC32

PCD2112
NP3775E3
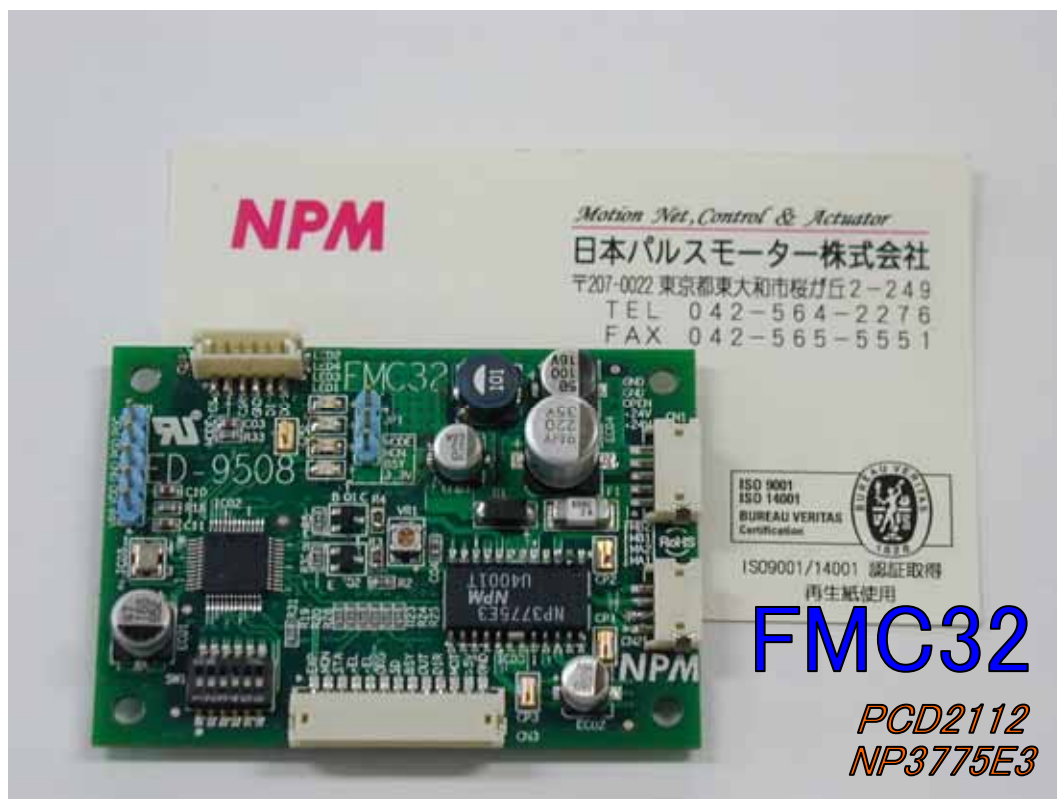
NPM

Nippon Pulse Motor Co., Ltd.

Table of Contents

1. Preface

Thank you for considering our FMC32, a compact controller with integrated driver.

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The FMC32, a compact controller with integrated driver is equipped with a pulse control LSI PCD2112 for controlling a serial bus. Using with USB to 4-wire serial conversion unit PUSB-3503, you can design a series of execution sequence programs and write the designed execution sequence program to the FMC32. The designed execution sequence program can be verified and confirmed on the PC.

By using control software, you can monitor the contents of all registers of the PCD 2112 in real time. You can use this function to understand the PCD2112 thoroughly.

A CPU is equipped with the FMC 32. You can repeat the execution sequence program that is written to the FMC 32 automatically. If you use a motor and a driver additionally, you can confirm operation in more detail.

☐

This manual describes how to use the FMC32 hardware.
Please read this manual and use its functions thoughtfully.

This manual does not describe the followings.
    - How to inspect FMC32 and write execution sequence program on the PC.
    - PUSB-3503's function and handling method
    - The contents of PCD2112's register

Additionally, please use the following user's manual.
    - Compact controller with integrated driver FMC 32 control software, User's manual   (Document No. YA7175)
    - USB to 4-wire serial conversion unit PUSB-3503, User's manual   (Document No. YA7176)
    - Pulse Control LSI PCD2112 for serial bus controls, User's manual   (Document No. DA70115)

2. Product Warranty

2-1. In the case of purchase from a supplier other than NPM

Regarding the product warranty in the case of purchase from a supplier other than NPM, please contact to the supplier

2-2. Warranty period

The warranty period is one year from the date of the delivery to an assigned place.

2-3. Warranty scope

If defects are found in the product during the warranty period under normal use following this document, NPM will repair the product without charge.　However, the following cases are not covered by the warranty and free repair does not apply to the product even during the warranty period.
- The products are modified or repaired by anyone other than NPM or an authorized person by NPM.
- The defect results from falling of the product after delivery or mishandling in transit.
- -Wearing of components, natural deterioration or fatigue (motor axle bearing, gear, grease, cables, etc.)
- The defect results from any use other than original use.
- The product has been subjected to natural disaster or force majeure such as fire, earthquake, lightning strike, wind and flood, salt, and electrical surges.
- The defects or damage results from the cause other than the fault of NPM.

Note 1)　Products exported outside of Japan are not covered by this warranty.
Note 2)　Only if the product with defects is carried to the specific place to repair, NPM will repair the product and we will not provide on-site repair.
Note 3)　The warranty period of the repaired product is not extended beyond the warranty period of the product before the failure. It is the same as the warranty product of the product before the repair.
Note 4)　This warranty covers the product. It does not cover the detriments caused by the product's defects, etc.
Note 5)　A replacement may be provided instead of a repair at the direction of NPM.

This documents aims to describe the detail of the function of the product and it does not warrant fitness for a particular purpose of the customers.
The examples of application and circuit diagram in this manual are described for your reference.　Please confirm the feature and the safety of device or equipment before use.

Please do not use this product for the following use in principle.
If you use the product for the following use, please contact our sales department.

- Any equipment that may require high reliability or safety, such as nuclear facility, electricity or gas supply system, transportation facilities, vehicle, various safety system, medical equipment, etc.
- Any equipment that may directly affect human survival or property
- Usage under conditions or circumstances that are not specified in the brochure, manual, etc.

When this product is used in any equipment where faults or malfunctions may directly affect human survival or property, please secure high reliability and security with redundancy design, etc.

⚠ **Caution**
During applying current and for a while after turning the power off, a bipolar stepper driver (NP3775E3) on the board may have high temperature. Do not touch it with hands or components (such as cables). It could cause burn injury or component's damage.

3. Outline

The FMC32 can register up to 32 operation patterns and up to 256 steps of execution sequence program in the internal memory and automatically process them in the registered sequence using only the board.
To control operation patterns, Pulse control LSI PCD 2112 for Serial Bus Control is equipped.
The FMC 32 contains a 2 phase stepper motor driver (NP3775E3) to drive bipolar stepper motor.
Through the use of a switch, the FMC32 can output pulses to external drivers.

4. Features

- FMC32 can register up to 32 operation pattern and up to 256 steps of execution sequence program in the internal memory and automatically process them in the registered sequence using only the board (without connecting to the PC).
- To control the operation pattern, pulse control LSI PCD 2112 for serial bus control is equipped.
- The FMC32 contains a 2 phase stepper motor driver (NP3775E3) to drive a bipolar stepper motor. It has a switch to choose between full step and half step excitation.
- Through the use of a switch, the FMC32output pulses to an external driver.
- FMC32 contains a DC-DC converter for control power supply, you need only DC +24 to operate this device.
- Using a dedicated USB to 4-wire serial conversion unit (PUSB-3503), you can write and save operation patterns and execution sequence programs to the nonvolatile memory easily through USB.
- If you use the dedicated software, you can design an operation pattern while confirming one operation to be executed. Additionally, you can debug by simulation (actual or virtual operation) after creating the execution sequence program and compiling it (checking the descriptive content).

5. Specifications

Product name			FMC32, a compact controller with built-in driver
Input voltage[VM]/Maximum current A			DC +24V ±10% / 1.2A
Integrated driver	Model		NP3775E3
	Control method		Bipolar constant current operation
	Excitation method		2 phase excitation(FULL)/1-2 phase excitation(HALF) Selectable by switching SW1 to 4
	Output current		0.5 A/phase [MAX], changeable by using VR Current-down function after stopped (approximately 50% of setting value) is available.
	Motor to be used		2 phase bipolar stepper motor
I/O signal	Input signal	I/F	DC4.5 to 7V photocoupler input, 1KΩ input resistance
		Signal name	MON, STA, +EL, -EL, ORG, SD The ±EL logic can be selected by using DSW1 to 5. The ORG and SD logic can be selected by using software.
	Output signal	I/F	Open collector (74LV07) output Drain applied voltage　= 5.5 V MAX
		Signal name	END, PLS, DIR, MOT Built-in driver / output pulses (PCL, DIR) can be selected by using SW 1 to 3.

Operation control IC	Model	PCD2112
	Reference clock	9.8304 MHz
	Control method	4-wire serial bus interface
	Output pulse frequency	2.4 Mpps max
	Number of positioning pulses	0 to 268,435,455 (28 bits)
Programming operation	Operation pattern	Available to save up to 32 operation patterns to the nonvolatile memory.
	Execution sequence program	Available to save up to 256 steps of the execution sequence program to the nonvolatile memory.
	Create data	Operation pattern and execution sequence program can be designed by the dedicated software. - Process check per operation pattern - Compile program (check descriptive content) - Operation simulation (actual or virtual operation) etc.
	Save data	Dedicated USB to 4-wire serial conversion unit (PUSB3503)
Environmental condition	Operating temperature	0 to 50 °C
	Storage humidity	0 to 80 % RH (No condensation)
	Storage temperature	-10 to 60°C
Others	External diameters	65(W) x 45(D) x 17.5(H) [mm]
	Weight	22g Max (Board only)
	Cooling method	Natural cooling

	Accessories	Connector (Housing and connector pin)
		[JST ZH series]
		  CN1 (for power supply):ZHR-5
		  CN2 (for motors):ZHR-4
		  CN3 (for I/O) : ZHR-13
		  Contact pin : SZH-002T-P0.5 (23 pins)

	RoHS compatible	This product is compatible with RoHS.

6. Function description

6-1. Terminal functions

CN1	For DC +12V power input		
Terminal Name	Terminal No.	I/O	Signal description
PWR		IN	DC +24V power input
PWR	2	IN	
NC	3	---	Open
GND	4	OUT	DC +24V power GND
GND	5	OUT	

CN2	For connection with a motor			
Terminal Name	Terminal No.	I/O	Motor phase	Signal description
A	1	OUT	A phase	Connect to a bipolar stepper motor
/A	2	OUT	/A phase	
B	3	OUT	B phase	
/B	4	OUT	/B phase	

CN3		External interface	
Terminal name	Terminal No.	I/O	Signal explanation
EXP	1	IN	External power input for photocouplers of MON, STA, +EL, -EL, ORG and SD. The anode side of the photocouplers for the above signals is pulled up to EXP with 1KΩ. EXP input range : DC4.5V to 7V
MON	2	IN	Excitation ON/OFF Input 　Photocoupler ON : Excitation ON 　Photocoupler OFF : Excitation OFF When photocoupler is OFF, excitation ON/OFF can be controlled by internal SW1-2. Note 1.
STA	3	IN	Operation starts / Operation stops 　Photocoupler ON : Operation starts. 　Photocoupler OFF : Operation stops. When photocoupler is OFF, excitation ON/OFF can be controlled by internal SW1-1. Note 1
+EL	4	IN	+ End limit 　Photocoupler ON : Limit ON 　Photocoupler OFF : Limit OFF Note 2
-EL	5	IN	- End limit 　Photocoupler ON : Limit ON 　Photocoupler OFF : Limit OFF Note 2
ORG	6	IN	Origin position signal 　Photocoupler ON : Origin position ON 　Photocoupler OFF : Origin position OFF Note 3
SD	7	IN	Deceleration signal 　Photocoupler ON : Deceleration ON 　Photocoupler OFF : Deceleration OFF Note 3
END	8	OUT	Open collector output (SN74LV07) Outputs LOW when operation is completed
PLS	9	OUT	Open collector output (SN74LV07) Outputs pulse strings specified by the RENV1 of PCD2112 Note 4
DIR	10	OUT	Open collector output (SN74LV07) Outputs pulse strings specified by the RENV1 of PCD2112 Note 4
MOT	11	OUT	Open collector output (SN74LV07) Outputs LOW when excitation is ON
+5V	12	OUT	Outputs +5V power supply of the board Note 5
GND	13	IN	

Note 1. : When signals are input from outside, make SW1-1 and SW1-2 OFF.
Note 2. : The logic of end limit is selected by SW1-5. The above table shows a condition with SW1-5 being OFF.
Note 3. : The logic of ORG and SD is selected by software. The above table shows the default.
Note 4. : You can select between use of the integrated driver or pulse string output by using SW1-3. When output pulse string is selected, you can change the pulse output method such as CW/CCW or PLS/DIR by changing the RMD in the RENV1 of PCD2112.
Note 5. : You can use it when +5V power supply for EXP cannot be prepared at the test. You can use them by connecting +5V terminals (CN3-13) to EXP(CN3-1) and turning input signals ON/OFF to GND (CN3-13). (Do not use +5V power for any signals other than input and output signals.)

CN4	For connection with SPI		
Terminal name	Terminal No.	I/O	Signal description
CS	1	IN	SPI CS signal input
MODE	2	IN	MODE signal to PCD2112 Note 1
CSK	3	IN	SPI clock
GND	4	IN	GND
DI	5	IN	SPI DI
DO	6	OUT	SPI DO

Note 1:   When connecting with PUSB-3503 (USB-SPI conversion unit), MODE signal is connected to GND. The mode become the PC control one. When not connecting with it, the mode become the stand-alone one.

6-2. SW1 settings

[SW1 to 5 setting]

SW1 No.	DSW=ON	DSW=OFF(default)
SW1-1	Operation starts Note 1	Operation stops Note 1
SW1-2	Excitation ON Note 2	Excitation OFF Note 2
SW1-3	Pulse string output	Use built-in driver
SW1-4	1-2 phase excitation (HALF)	2 phase excitation (FULL)
SW1-5	±EL is ON by turning photocoupler OFF	±EL is ON by turning photocoupler ON
SW1-6	Unused	Unused

Note 1 : Its feature is the same as the external STA input. If you input the STA signal externally, turn SW1-1 OFF.
Note 2 : Its feature is the same as the external MON input. If you input the MON signal externally, turn SW1-2 OFF.
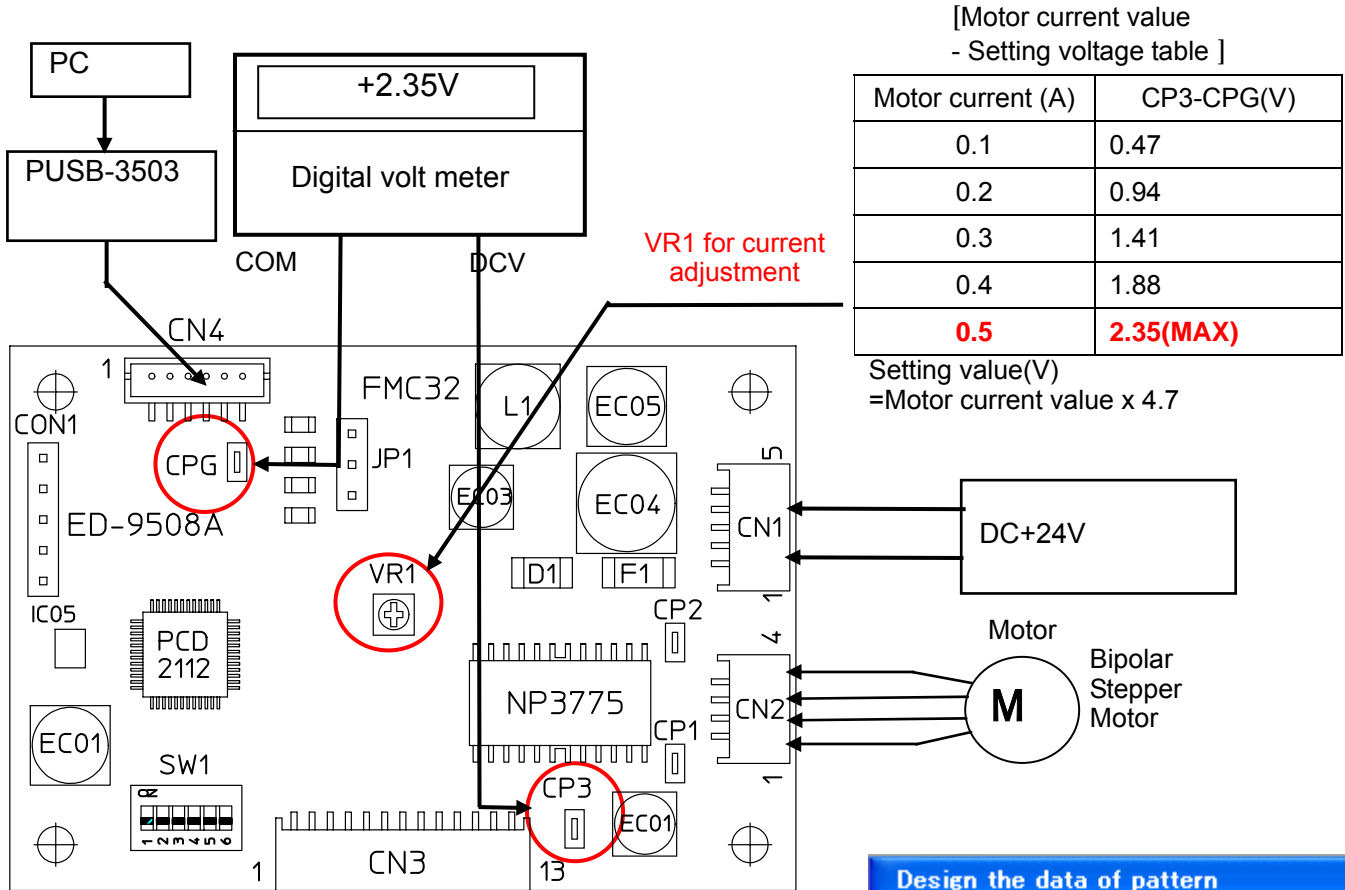
6-3. LED display

[LED displays]

LED name	LED=ON	LED=OFF
MODE	PC control one	Stand-alone mode
MON	Excitation ON	Excitation OFF
END	Operation completes	Operating
3.3V	Power ON	Power OFF

Please see "8. External diameters and component layout" regarding to LED alignment.

6-4 Current adjustment

Procedure of Current Adjustment is as follows.
Connect CN1 to DC+24V, CN2 to a bipolar stepper motor, a digital volt meter between CP2 and CPG, and CN4 to PUSB-3503. Connect PUSB-3503 to USB port of PC. First of all, turn the VR1 to the maximum on the scale in the CCW direction and then make the motor current value minimum.

[Motor current value - Setting voltage table]

Motor current (A)	CP3-CPG(V)
0.1	0.47
0.2	0.94
0.3	1.41
0.4	1.88
0.5	**2.35(MAX)**

Setting value(V)
=Motor current value x 4.7

After +24V is powered ON, start the operation software (FMC32_Vxxx.exe) and create the necessary projects (or read an existing project), and open the window of "Design the data of pattern".
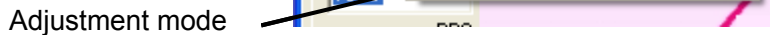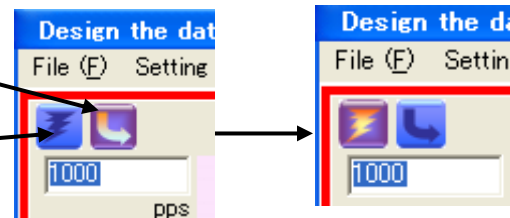
Select the "Adjustment mode" in the "Setting" menu of this window.

The "Current down switching" button appears on this window.

Click the "Current down switching button" to turn current down function OFF and click the "excitation ON" button.

In this situation, adjust the current to the necessary value according to the above table (Motor current value - Setting voltage table) while monitoring the digital volt meter value and turning the VR1.
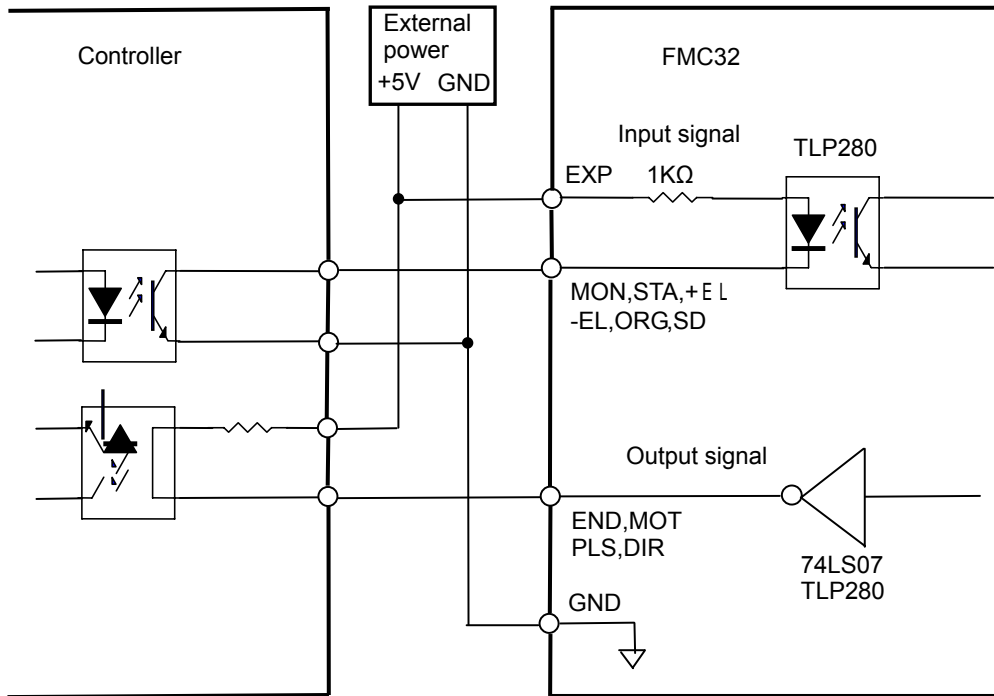Note 1. Do not set the current value more than the maximum value (0.5A). It could cause damage.
After adjustment, click the "Current down switching button" to turn current down function ON.
With that, current adjustment is completed.
Exit the operation software and remove the digital voltage meter after turning +24V OFF.

7. Connection example of input/output interface

8. External diameters and component layout

Unit : mm

9. Circuit block diagram

[Circuit block diagram]
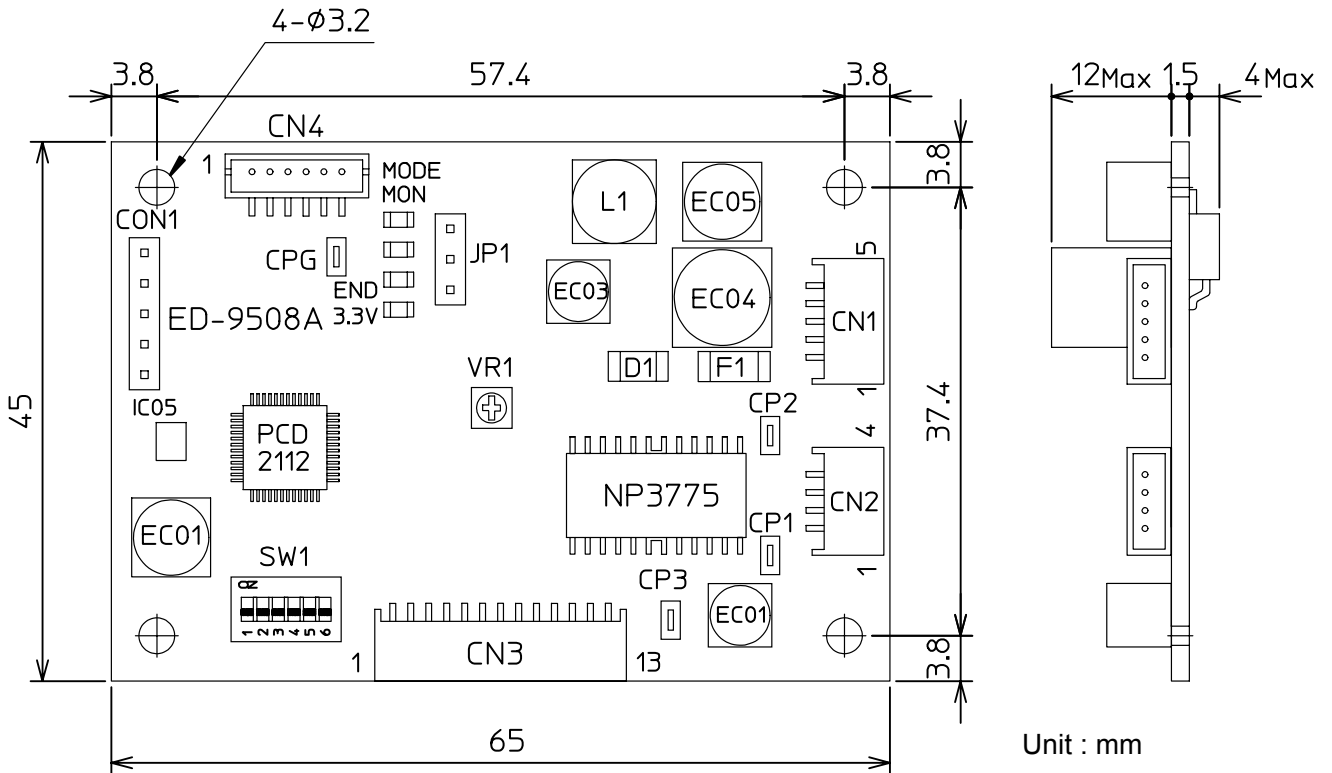
CAUTION	The descriptions in this manual may be changed without prior notice to improve performance or quality.