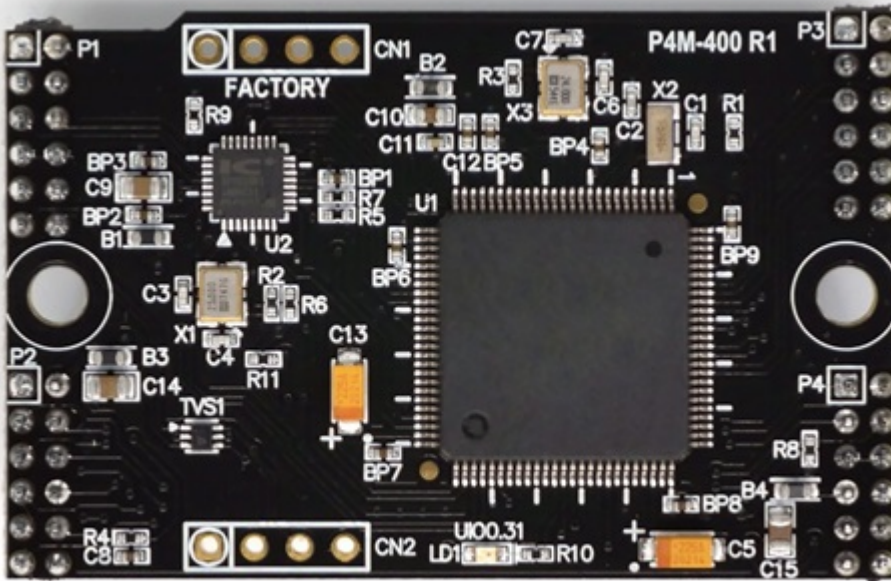# Introduction

The P4M-400 is a module type of PHPoC product. Since PHPoC function is provided in module form, it is possible to implement the board suitable for user application.

The P4M-400 supports 10/100M Ethernet as well as wireless LAN interface using USB type wireless LAN dongle. In addition, various interfaces such as analog input, UART, SPI, I2C, hardware timer, digital input / output, etc. can be implemented to meet various needs of users.

Features

- Modular PHPoC
- Provides self-development PHPoC Interpreter
- Provides simple development environment via USB
- Provides 10/100Mbit Ethernet
- Provides IEEE802.11b/g Wireless LAN
- Provides 26 digital i/o
- Provides 4 analog input ports
- Provides 2 UART ports
- Provides 4 hardware timer
- Provides I2C and SPI interfaces
- Embeds 32.768KHz crystal for RTC
- Provides self-developed TCP/IP stacks
- Provides a Web Server
- Support Websocket, Telnet, SSH, SSL
- Provides the various libraries such as Email, DNS, MySQL and so on
- Provides PHPoC Debugger - a development tool for Windows

H/W Specification

| Power	Input	DC 3.3V (±0.16V)
	Current Consumption	Typical - about 110mA(※ without USB WLAN adapter) Power Down mode - less than 200uA
Dimension		50mm x 32mm x 9mm
Weight		about 8g
Interface	UART	2 X UART Ports(UART0 ~ 1), Baudrate: 1,200 bps ~ 230,400 bps
	Network	10/100Mbps Ethernet IEEE802.11b/g Wireless LAN (require Ralink RT3070/5370 chipset Wireless LAN Adapter)
	USB	USB Host - for WLAN adapter USB Device - for PC
	Digital I/O	maximum 26 ports
	Analog Input	ADC_CH0 ~ 3, AREF, 12-bit resolution
	Hardware Timer (HT)	HT0 ~ 3, toggle/pulse/pwm output and capture mode
	SPI	NSS, SCK, MISO, MOSI
	I2C	SCL, SDA
Wireless LAN Security		WPA-PSK / WPA2-PSK, WPA-Enterprise(TLS/TTLS/PEAP)
Temperature	Storage /Operating	-40℃ ~ 85℃
Environment		RoHS Compliant

Dimension
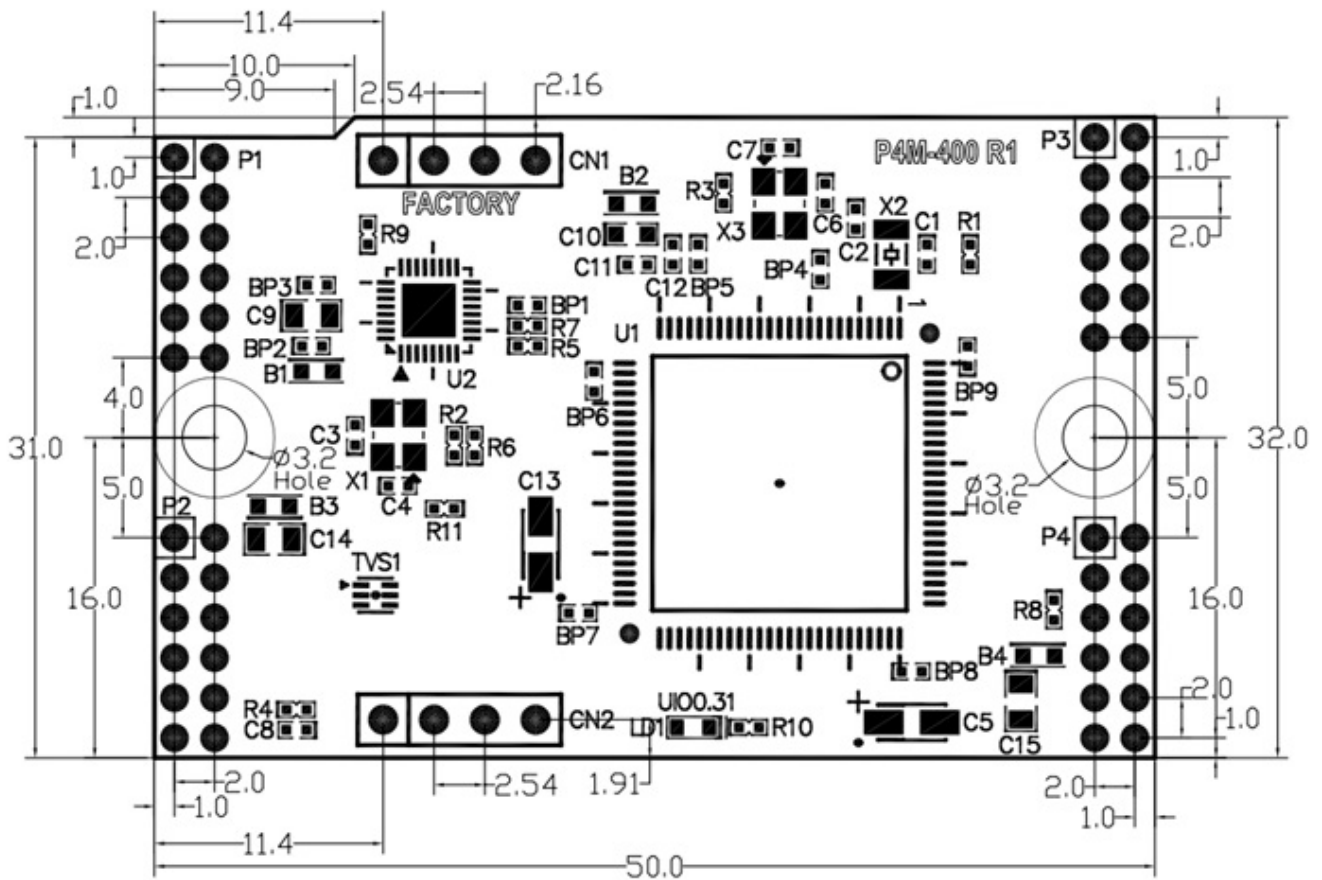
※ Note: The positions of the P1 to P4 connectors are designed asymmetrically to prevent miss insertion and reverse insertion of the module.

※ Dimensions(unit : mm) may vary according to a method of measurement.

Layout
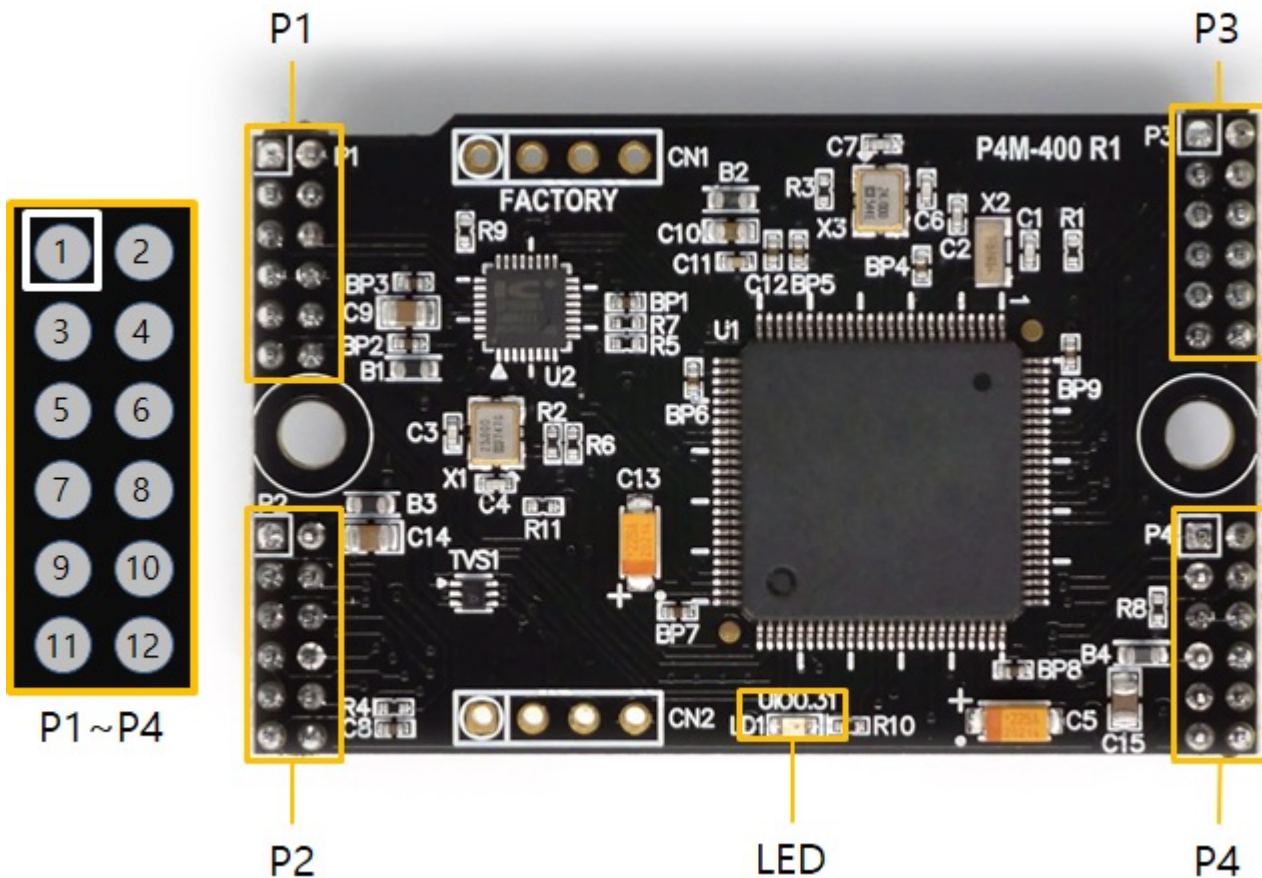
The P4M-400 interfaces with four 6 x 2-pin headers (P1 to P4). Space of each pin is 2 mm.

P1

Pin#	Name	I/O	Description
P1.1	GND	-	Ground
P1.2	GND	-	Ground
P1.3	TPTX+	In/Out	Ethernet Transmit +
P1.4	TPTX-	In/Out	Ethernet Transmit -
P1.5	TPRX+	In/Out	Ethernet Receive +
P1.6	TPRX-	In/Out	Ethernet Receive -
P1.7	GND	-	Ground
P1.8	GND	-	Ground
P1.9	USB_H_D+	In/Out	USB Host Data +
P1.10	USB_H_D-	In/Out	USB Host Data -
P1.11	USB_D_D+	In/Out	USB Device Data +
P1.12	USB_D_D-	In/Out	USB Device Data -

P2

Pin#	Name	I/O	Description
P2.1	VBUS	In	USB Device VBUS
P2.2	+3.3V	-	+3.3V Power Input
P2.3	HT0(1.6)	In/Out	UIO 1.6 / Hardware Timer/Counter 0

Pin#	Name	I/O	Description
P2.4	HT1(1.7)	In/Out	UIO 1.7 / Hardware Timer/Counter 1
P2.5	HT2(1.8)	In/Out	UIO 1.8 / Hardware Timer/Counter 2
P2.6	HT3(1.9)	In/Out	UIO 1.9 / Hardware Timer/Counter 3
P2.7	UIO(0.14)	In/Out	UIO 0.14
P2.8	SRO(0.15)	In/Out	UIO 0.15 / Slave Reset Out
P2.9	ISP#	In	ISP Input (Active LOW)
P2.10	DTX	Out	Debug Out (UART)
P2.11	RESET#	In	Reset Input (Active LOW)
P2.12	VBAT	In	Battery Input

P3

Pin#	Name	I/O	Description
P3.1	NSS(0.0)	In/Out	UIO 0.0 / SPI NSS
P3.2	SCK(0.1)	In/Out	UIO 0.1 / SPI SCK
P3.3	MISO(0.2)	In/Out	UIO 0.2 / SPI MISO
P3.4	MOSI(0.3)	In/Out	UIO 0.3 / SPI MOSI
P3.5	U0TX(0.4)	In/Out	UIO 0.4 / UART0 TX
P3.6	U0RX(0.5)	In/Out	UIO 0.5 / UART0 RX
P3.7	SCL(0.6)	In/Out	UIO 0.6 / I2C SCL
P3.8	SDA(0.7)	In/Out	UIO 0.7 / I2C SDA
P3.9	U0RTS(0.8)	In/Out	UIO 0.8 / UART0 RTS / UART0 TxDE
P3.10	U0CTS(0.9)	In/Out	UIO 0.9 / UART0 CTS
P3.11	U1TX(0.10)	In/Out	UIO 0.10 / UART1 TX
P3.12	U1RX(0.11)	In/Out	UIO 0.11 / UART1 RX

P4

Pin#	Name	I/O	Description
P4.1	U1RTS(0.12)	In/Out	UIO 0.12 / UART1 RTS / UART1 TxDE
P4.2	U1CTS(0.13)	In/Out	UIO 0.13 / UART1 CTS
P4.3	STX(1.10)	In/Out	UIO 1.10 / Slave TX
P4.4	SRX(1.11)	In/Out	UIO 1.11 / Slave RX
P4.5	GND	-	Ground
P4.6	GND	-	Ground
P4.7	+3.3V	-	+3.3V Power Input
P4.8	AREF	In	ADC Reference Input
P4.9	ADC0(1.0)	In/Out	UIO 1.0 / ADC0
P4.10	ADC1(1.1)	In/Out	UIO 1.1 / ADC1
P4.11	ADC2(1.2)	In/Out	UIO 1.2 / ADC2
P4.12	ADC3(1.3)	In/Out	UIO 1.3 / ADC3

LED

At the bottom center of the module is the user-defined LED. This LED is connected to UIO 0.31 and is set to LED for status display at the factory. It can be set to the user output port if necessary, and when the LOW is output, the LED is turned on.

Interface

This page provides a description of each pin according to the various interfaces provided by the P4M-400. Unused pins do not need to be connected except when special mention is made in this page.

System

- +3.3V

  Input the power supply of 3.3V DC to this pin. Make sure the DC voltage is in the range of 3.15V ~ 3.45V. It is recommended to use a power supply capable of supplying more than 500mA current while stable output of DC 3.3V for the stable operation of the module.

- GND

  Connect the ground of your main system to this pin. It is recommended that the ground is as wide as possible to shorten the path of return signal.

- RESET#

  This pin is used to restart the system. If you enter a LOW pulse of 1 millisecond (1ms) or more to this pin, the system will restart. Since this pin is LOW Active, normally it should be pulled up with 100K ohm resistance and keep it high state.

- ISP#

  ISP # is the pin used to put the product into ISP mode. Since this pin is LOW Active, normally it should be pulled up with 100K ohm resistance and keep it high state.

  ※ ISP mode is a necessary mode for system maintenance such as Escaping infinite reset state.

- VBAT

  Connect the battery to VBAT so that the built-in RTC time information and back up SRAM contents are not erased when power is not applied. Connect this pin to +3.3V if you do not use any battery. The allowable voltage is DC 1.65V to DC 3.6V.

Ethernet

Pin#	Name	I/O	Description
P1.3	TPTX+	In/Out	Ethernet Transmit +
P1.4	TPTX-	In/Out	Ethernet Transmit -
P1.5	TPRX+	In/Out	Ethernet Receive +
P1.6	TPRX-	In/Out	Ethernet Receive -

P4M-400 provides 10/100Base-TX Ethernet Interface. Note that RJ45 connector is required to use Ethernet.

Refer to a circuit diagram of the Application Circuit Diagram for the connection.

USB Host (Wireless LAN)

Pin#	Name	I/O	Description
P1.9	USB_H_D+	In/Out	USB Host Data +
P1.10	USB_H_D-	In/Out	USB Host Data -

P4M-400 provides IEEE802.11b/g wireless LAN via USB host port using a wireless LAN dongle which embeds RT3070 or RT5370 chipset. The USB host port must be connected to USB type A connector. Refer to a circuit diagram of the Application Circuit Diagram for the connection.

USB Device

Pin#	Name	I/O	Description
P1.11	USB_D_D+	In/Out	USB Device Data +
P1.12	USB_D_D-	In/Out	USB Device Data -
P2.1	VBUS	In	USB Device VBUS

This port must be interfaced for product development and configuration. After connecting this port and connecting the product with PC via a USB cable, you can access the product using the development tool (PHPoC Debugger). Either type B USB connector, mini USB or micro USB connector can be used for this port.

※ Note: The VBUS pin cannot be used for supplying power to P4M-400.

Digital I/O

Pin#	Name	I/O	Description
P3.1	NSS(0.0)	In/Out	UIO 0.0 / SPI NSS
P3.2	SCK(0.1)	In/Out	UIO 0.1 / SPI SCK
P3.3	MISO(0.2)	In/Out	UIO 0.2 / SPI MISO
P3.4	MOSI(0.3)	In/Out	UIO 0.3 / SPI MOSI
P3.5	U0TX(0.4)	In/Out	UIO 0.4 / UART0 TX
P3.6	U0RX(0.5)	In/Out	UIO 0.5 / UART0 RX
P3.7	SCL(0.6)	In/Out	UIO 0.6 / I2C SCL
P3.8	SDA(0.7)	In/Out	UIO 0.7 / I2C SDA
P3.9	U0RTS(0.8)	In/Out	UIO 0.8 / UART0 RTS / UART0 TxDE
P3.10	U0CTS(0.9)	In/Out	UIO 0.9 / UART0 CTS
P3.11	U1TX(0.10)	In/Out	UIO 0.10 / UART1 TX
P3.12	U1RX(0.11)	In/Out	UIO 0.11 / UART1 RX
P4.1	U1RTS(0.12)	In/Out	UIO 0.12 / UART1 RTS / UART1 TxDE
P4.2	U1CTS(0.13)	In/Out	UIO 0.13 / UART1 CTS
P2.7	UIO(0.14)	In/Out	UIO 0.14
P2.8	SRO(0.15)	In/Out	UIO 0.15 / Slave Reset Out
P4.9	ADC0(1.0)	In/Out	UIO 1.0 / ADC0
P4.10	ADC1(1.1)	In/Out	UIO 1.1 / ADC1
P4.11	ADC2(1.2)	In/Out	UIO 1.2 / ADC2
P4.12	ADC3(1.3)	In/Out	UIO 1.3 / ADC3
P2.3	HT0(1.6)	In/Out	UIO 1.6 / Hardware Timer/Counter 0
P2.4	HT1(1.7)	In/Out	UIO 1.7 / Hardware Timer/Counter 1
P2.5	HT2(1.8)	In/Out	UIO 1.8 / Hardware Timer/Counter 2

Pin#	Name	I/O	Description
P2.6	HT3(1.9)	In/Out	UIO 1.9 / Hardware Timer/Counter 3
P4.3	STX(1.10)	In/Out	UIO 1.10 / Slave TX
P4.4	SRX(1.11)	In/Out	UIO 1.11 / Slave RX

Analog input, UART, SPI and I2C ports can be set or used to digital I/O pins. These ports are mapped to UIO 0 and UIO 1. Digital I/O ports can also be operated as output ports of ST(Software Timer).

- Electrical Characteristics of Digital I/O

Parameter	Description	Min.[V]	Max.[V]	Current
V_{IH}	HIGH level input	2.31	-	-
V_{IL}	LOW level input	0	0.99	-
V_{OH}	HIGH level output	2.9	-	±8mA(CMOS)
V_{OH}	HIGH level output	2.4	-	±8mA(TTL)
V_{OL}	LOW level output	-	0.4	±8mA(CMOS/TTL)

※ Note: Each UIO port is 5V tolerant in input mode and the maximum driving current is ±8mA in output mode.

Analog Input

Pin#	Name	I/O	Description
P4.8	AREF	In	ADC Reference Input
P4.9	ADC0(1.0)	In/Out	UIO 1.0 / ADC0
P4.10	ADC1(1.1)	In/Out	UIO 1.1 / ADC1
P4.11	ADC2(1.2)	In/Out	UIO 1.2 / ADC2
P4.12	ADC3(1.3)	In/Out	UIO 1.3 / ADC3

ADC0, ADC1, ADC2 and ADC3 pins are analog input ports and each port has 12-bit resolution. The measured voltage of each port depends on a reference voltage. (0 ~ reference voltage) The reference voltage is input to the AREF pin, and the range of allowable voltage is DC 2.1V to DC 3.3V.

※ Note: The AREF pin must be connected regardless of whether the analog input port is used or not.

UART

Pin#	Name	I/O	Description
P3.5	U0TX(0.4)	In/Out	UIO 0.4 / UART0 TX
P3.6	U0RX(0.5)	In/Out	UIO 0.5 / UART0 RX
P3.9	U0RTS(0.8)	In/Out	UIO 0.8 / UART0 RTS / UART0 TxDE
P3.10	U0CTS(0.9)	In/Out	UIO 0.9 / UART0 CTS
P3.11	U1TX(0.10)	In/Out	UIO 0.10 / UART1 TX
P3.12	U1RX(0.11)	In/Out	UIO 0.11 / UART1 RX
P4.1	U1RTS(0.12)	In/Out	UIO 0.12 / UART1 RTS / UART1 TxDE
P4.2	U1CTS(0.13)	In/Out	UIO 0.13 / UART1 CTS

There are two UART ports and each of them has RXD, TXD, RTS, CTS and TxDE.

SPI

Pin#	Name	I/O	Description
P3.1	NSS(0.0)	In/Out	UIO 0.0 / SPI NSS
P3.2	SCK(0.1)	In/Out	UIO 0.1 / SPI SCK
P3.3	MISO(0.2)	In/Out	UIO 0.2 / SPI MISO
P3.4	MOSI(0.3)	In/Out	UIO 0.3 / SPI MOSI

There is SPI port which has NSS, SCK, MISO and MOSI.

I2C

Pin#	Name	I/O	Description
P3.7	SCL(0.6)	In/Out	UIO 0.6 / I2C SCL
P3.8	SDA(0.7)	In/Out	UIO 0.7 / I2C SDA

There is I2C port which has SCL and SDA.

Hardware Timer/counter

Pin#	Name	I/O	Description
P2.3	HT0(1.6)	In/Out	UIO 1.6 / Hardware Timer/Counter 0
P2.4	HT1(1.7)	In/Out	UIO 1.7 / Hardware Timer/Counter 1
P2.5	HT2(1.8)	In/Out	UIO 1.8 / Hardware Timer/Counter 2
P2.6	HT3(1.9)	In/Out	UIO 1.9 / Hardware Timer/Counter 3

There are four precision hardware timer/counters.

SPC

Pin#	Name	I/O	Description
P2.8	SRO(0.15)	Out	UIO 0.15 / Slave Reset Out
P4.3	STX(1.10)	Out	UIO 1.10 / Slave TX
P4.4	SRX(1.11)	In	UIO 1.11 / Slave RX

P4M-400 does not support SPC yet. These pins are only allowed to set digital I/O ports.

※ Note: The SPC port can be used for other purposes in the future.

Application Circuit Diagram

This is an application circuit diagram for interfaces of P4M-400.

- P4M-400-Interface-PO.pdf

Software (IDE)

PHPoC Debugger

PHPoC Debugger is a software used for developing and setting PHPoC products. You need to install this program on your PC for using PHPoC.

- PHPoC Debugger Download Page
- PHPoC Debugger Manual

Functions and Features of PHPoC Debugger

- Upload files from local PC to PHPoC
- Download files in PHPoC to local PC
- Edit files stored in PHPoC
- Debug PHPoC scripts
- Monitor resources of PHPoC
- Configure parameters PHPoC
- Upgrade Firmware of PHPoC
- Support MS Windows O/S

Connecting

USB Connection

1. Connect the USB device port of P4M-400 to PC via a USB cable.

2. Run the PHPoC Debugger.

3. Select connected COM PORT and press connect ( ) button.

4. If USB is successfully connected, connect button will be inactivated and disconnect button ( ) will be activated.

Remote Connection

Starting with firmware version 1.4.0, the remote connection is provided. Please refer to the PHPoC Debugger manual page for details.

Reset

Settings Reset

Settings Reset makes all the settings of your PHPoC products to factory default.

A certificate in PHPoC is also deleted.

- Settings Reset Procedure

Step	Action	Product State	STS LED
1	Input LOW signal to ISP# shortly (less than 1 second)	Button setup mode	On
2	Input LOW signal again over 5 seconds	Preparing initialization	Blink very rapidly
3	Check if the STS LED is turned OFF	Initialization ready	Off
4	Release the LOW input right after the STS is OFF.(※ If you don't release the button within 2 seconds, the state goes back to the step 3)	Progressing initialization	On
5	Rebooting automatically	Initial state	Off

Factory Reset

Factory Reset makes all the settings including saved password of your PHPoC products to factory default. Furthermore, all files stored in flash memory are deleted as well as certificate. Because of this, you have to back up your files before doing Factory Reset.

- Factory Reset Procedure

Web Interface

PHPoC itself has a webserver to provide a web interface. When receiving a HTTP request, it executes the php script in the requested file (if there) and respond to the client. Webserver is independent of PHPoC main script. TCP 80 is used for web server and you can use the interface via Internet Explorer, Chrome or any other web browsers.

How to use web interface

To use the web interface, "index.php" file should be in the file system of P4M-400. Connect to this page by entering device IP address after connecting it to network.
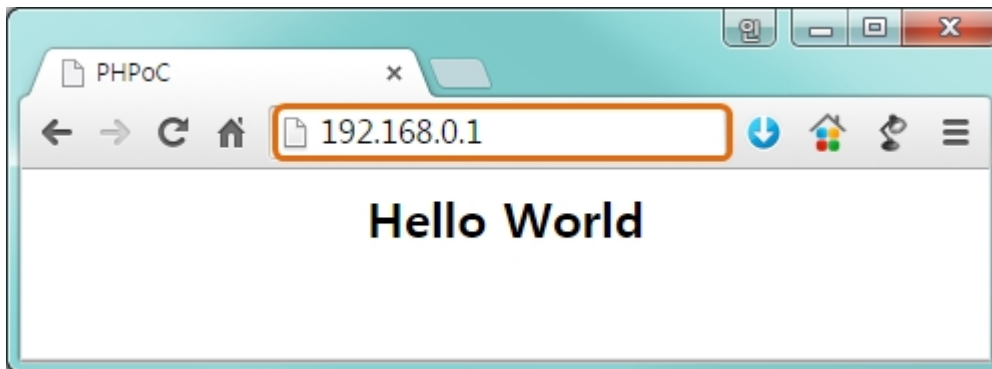
If the name of file is not "index.php", just specify the name of file after the IP address with slash mark.
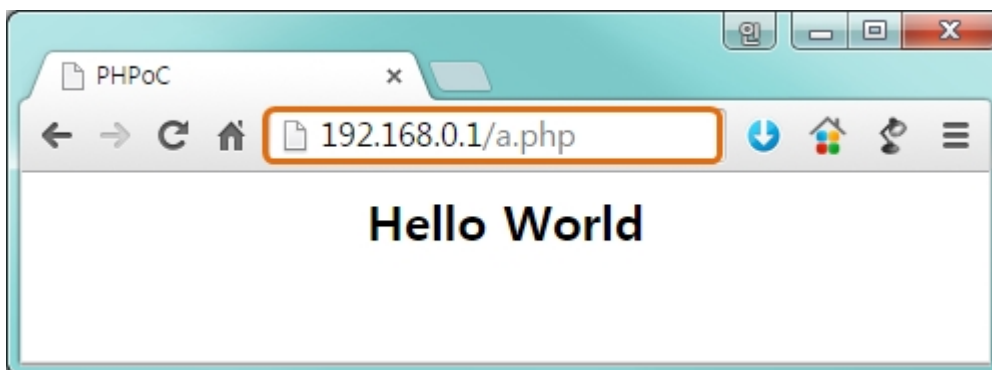
Practical Use of Web Interface

Since the web server executes the php script in the requested file, user can put php code in the requested file to interact with peripherals such as I/O port, I2C, SPI, UART, ADC and so on.
It is worth noting that there is other way to interact with the peripherals in real-time from web interface. This can be done by using websocket.

Setting Passwords

If you set a password for the product, you must enter the password when connecting the product via USB or network.

Please refer to the PHPoC Debugger manual page for details.

Escaping Infinite Reset

PHPoC basically runs scripts when it boots up. Therefore, it is possible that a P4M-400 cannot be escaped from infinite reboot when script contains system command such as "reboot". Refer to the Following to solve this problem since it needs to stop the running script.

1. Entering ISP mode

   Make P4M-400 to enter ISP mode by supplying power while inputting LOW to ISP# pin. In the ISP mode, you can access to PHPoC by PHPoC Debugger without running a script.

2. Connect to PHPoC

   Connect a PC to PHPoC via a USB cable and connect to the port via PHPoC Debugger. A message window related with ISP mode will be popped up.

3. Reboot PHPoC

   Reboot PHPoC by using "Reboot a product" menu in PHPoC Debugger. After rebooting, PHPoC stops running script even it is not in the ISP mode.

4. Correct source code

   Correct the source code to prevent infinite reboot state.

Device Information

Device	Channel	Path	Note
UART	2	/mmap/uart0~1	-
NET	2	/mmap/net0~1	net0: Ethernet, net1: Wireless LAN
TCP	5	/mmap/tcp0~4	-
UDP	5	/mmap/udp0~4	-
Digital I/O	2	/mmap/uio0~1	UIO 0: pin #0 ~ #16 UIO 1: pin #0 ~ #3, #6 ~ #11
ADC	2	/mmap/adc0~1	-
ST	8	/mmap/st0~7	-
HT	4	/mmap/ht0~3	-
SPI	1	/mmap/spi0	-
I2C	1	/mmap/i2c0	-
RTC	1	/mmap/rtc0	-
UM	4	/mmap/um0~3	-
NM	1	/mmap/nm0	-

※ Refer to the PHPoC Device Programming Guide for p40 for detailed information about using devices.

Evaluation Board

This evaluation board is only can be used with P4M-400.
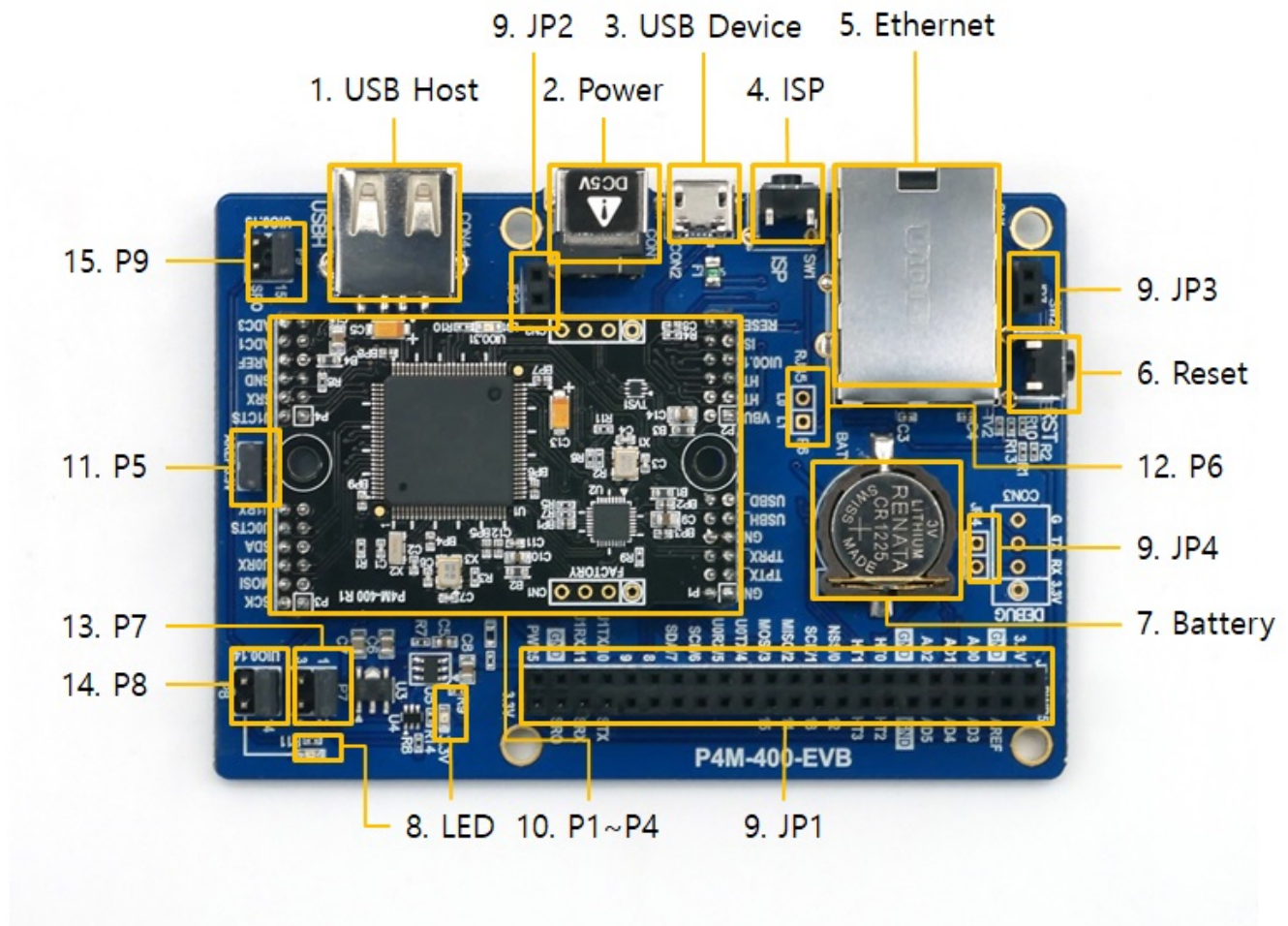
## 1. USB Host Port for Connection with WLAN adapter

This board provides a USB host port for an USB WLAN adapter. You can connect P4M-400 to 802.11b/g wireless LAN by connecting a wireless LAN adapter to this port.

※ Caution: Only adapters using Ralink RT3070/5370 chipsets are available.

2. Power

- DC 5V Input

    This port is the main input port for supplying power(DC 5V). Specification is as follows:
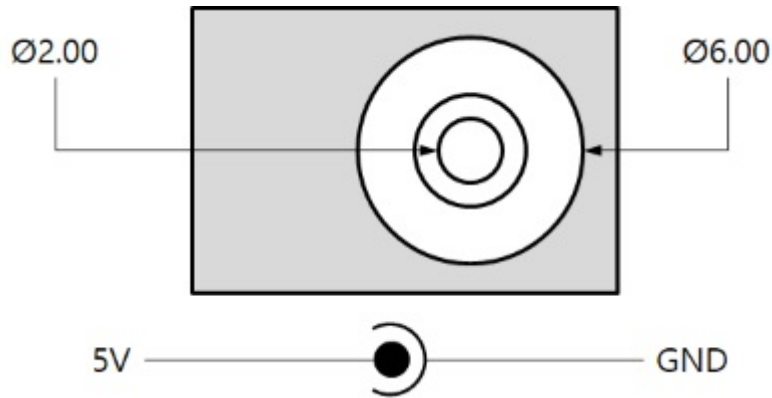
- USB Device port (Micro USB)

  This port can be a sub input port for supplying power. P4M-400 may not work properly in case of supplying power via this port only due to insufficient current.

3. USB Device Port for connection with PC

The USB device port is to connect with PC. You can access to P4M-400 via the development tool(PHPoC Debugger) by connecting USB cable to this port. You can supply DC 5V power through this port.

4. ISP Button

If this button is pressed, LOW signal is connected to the ISP# pin.

5. Ethernet

This port provides 10/100Base-TX Ethernet interface of P4M-400. Internal LEDs (L0 and L1) can be operated by connecting jumper on P6. The LEDs are LOW active.

6. Reset Button

If this button is pressed, LOW signal is connected to the RESET# pin.

7. Battery

The CR1225 of RENATA is embedded as battery for RTC. The battery socket is also compatible with CR1220.

※ Refer to the datasheet for more information about the battery

8. LED

There are two LEDs on this board.

LED	Color	Description
3.3V	red	supplying power > ON
P8 connected LED	green	user-defined LED

9. JP1 / JP2 / JP3 / JP4

Name	Description
JP1	PHPoC board-compatible interface socket
JP2	PHPoC board-compatible socket
JP3	PHPoC board-compatible socket
JP4	reserved

The pin numbers of JP1 are as follows:
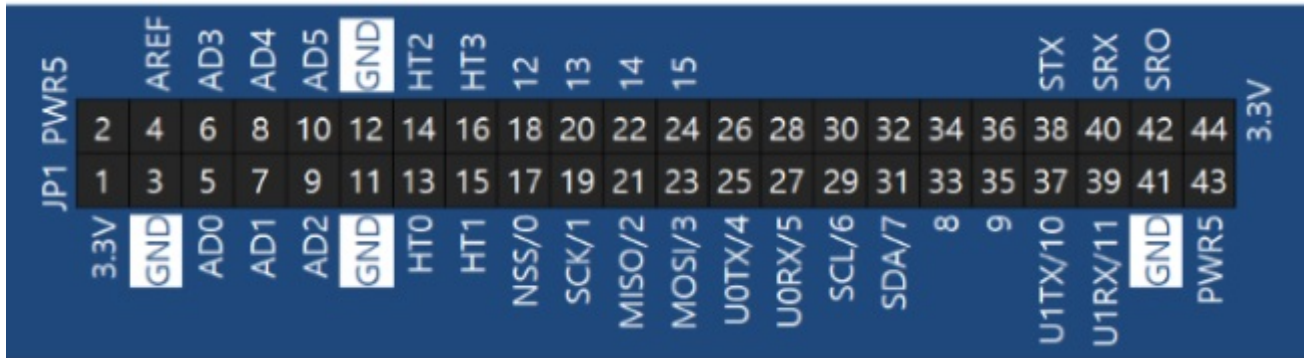
※ JP1, JP2 and JP3 are designed to connect expansion boards for PHPoC boards.

10. P1 / P2 / P3 / P4

P1, P2, P3 and P4 are ports to connect P4M-400.

※ Note : The positions of the P1 to P4 connectors are designed asymmetrically to prevent miss insertion and reverse insertion of the module.
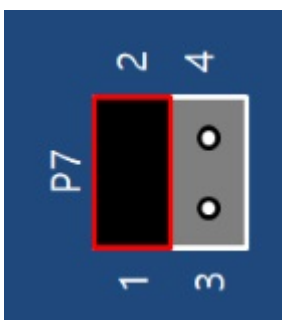
11. P5

If the jumper on this port is connected, 3.3V is supplied as a reference voltage pin (AREF) for ADC.

12. P6

It is a connector for signal input to LED on RJ45. Pins are connected to the L0 and L1 pins of the RJ45. The LEDs are LOW active.
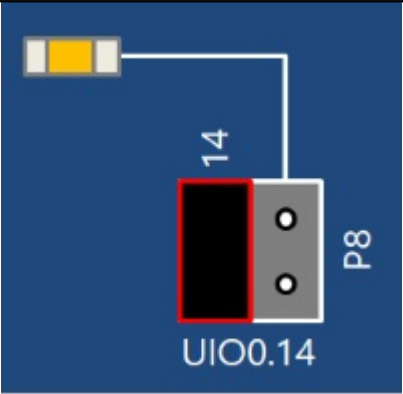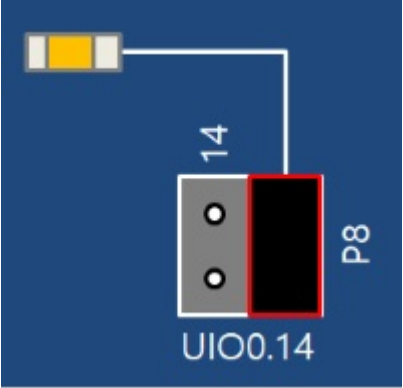
13. P7

This port is reserved for the future use. Keep the jumper position on 1 and 2.

14. P8

This port is for selecting usage of UIO0.14 of P4M-400. The UIO0.14 can be connected to the 22th pin(14) of JP1 or the user-defined LED.

Jumper position	Description
	connect UIO0.14 to the 22th pin of JP1(14)
	connect UIO0.14 to the user-defined LED

15. P9

The UIO0.15 is connected to the 24th pin of JP1(15). Be sure to connect jumpers as shown in the following figure.