

# Materials for IERG4230 / IEMS5721 Internet of Things Mini-project

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*Students are allowed to borrow project material as their proposals from laboratory for their mini-project. Students must return the material to laboratory after finish demonstration immediately. All late return cases will be reported to the course professor and the department.*

*Materials in Group-A and Group-B are reserved for each group. The rule is first-come-first-serve if students need the material more than the reservation.*

*Materials in Group-C are first-come-first-serve and need self-study. Students have to read the datasheet by themselves before consulting technicians.*

*Students can also use the component that is not on this list if students can get approval from professor or TA. Reimbursement is allowed for small value component. You need self-study on the component that is not on this list. You need provide the source of purchasing and the estimate price of the component. You need to consider the transit times too.*

## Group A: Project boards and basic setup

- A1. IERG4230 full size Main project board (with  $I^2C$  16-key keypad and LCD display. Nano and ESP8266 are NOT included).
- A2. IERG4230 half size Main project board
- A3. ESP8266 with or without I/O extended board
- A4. Bluetooth BLE project board
- A5. Arduino Nano (match to the number of project boards)
- A6. XBee
- A7. 2.4GHz USB WiFi LAN adapter
- A8. USB to Serial Cable (for XBee)
- A9. CC-Debugger (Bluetooth BLE)
- A10. Sniffer dongle (Bluetooth BLE)
- A11. Host dongle (Bluetooth BLE)
- A12. 3V FeLiPO4 re-chargeable battery
- A13. 3V FeLiPO4 battery charger (ONLY for FeLiPO4 re-chargeable battery)
- A14. Mini-USB cable
- A15. Micro-USB cable

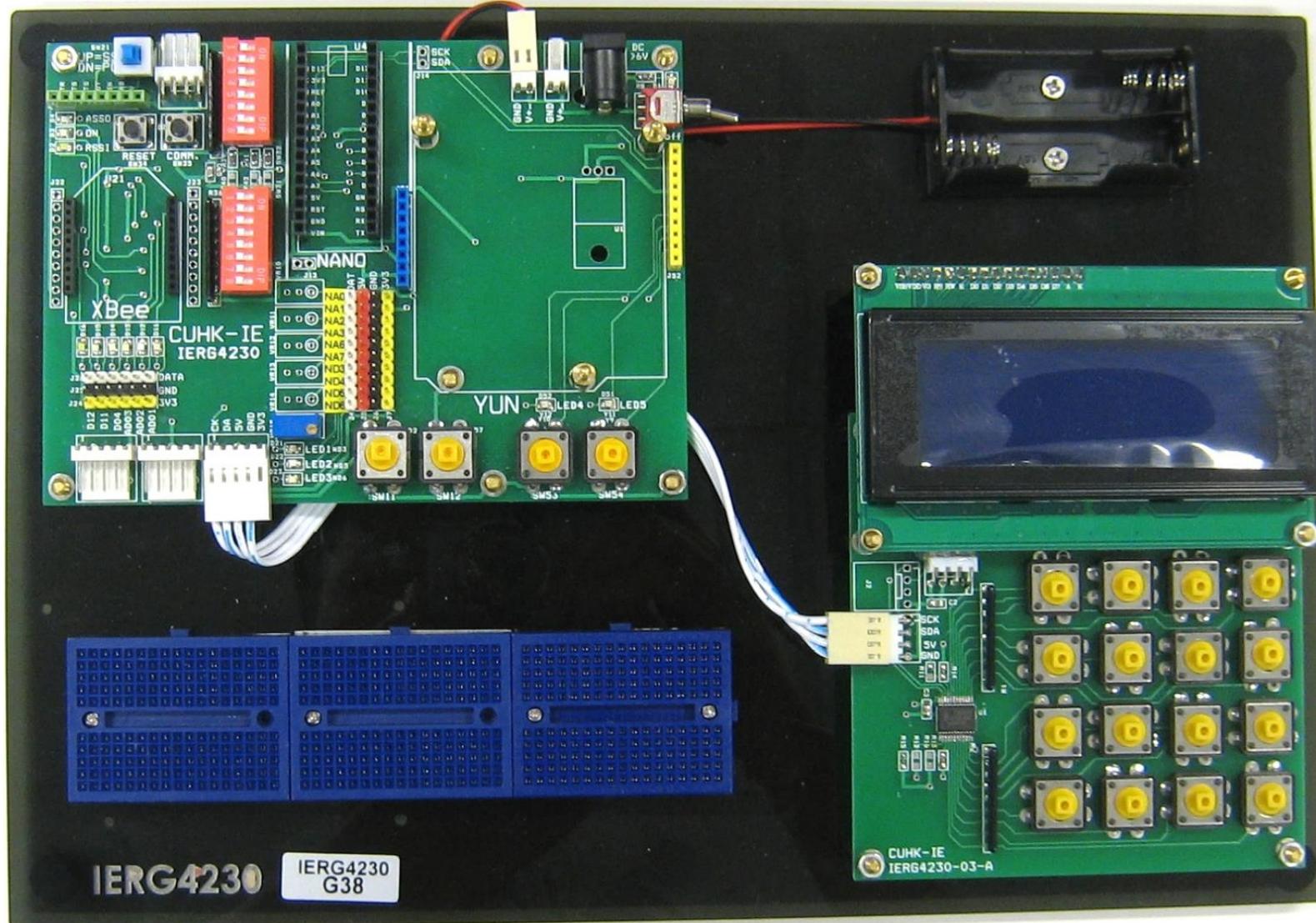
## Group B: Sensors, relate to course experiments

- B1. 3-axis acceleration sensor module ([MMA7361](#), Analogues)
- B2. Light detected resistor ([LDR](#), Analogues)

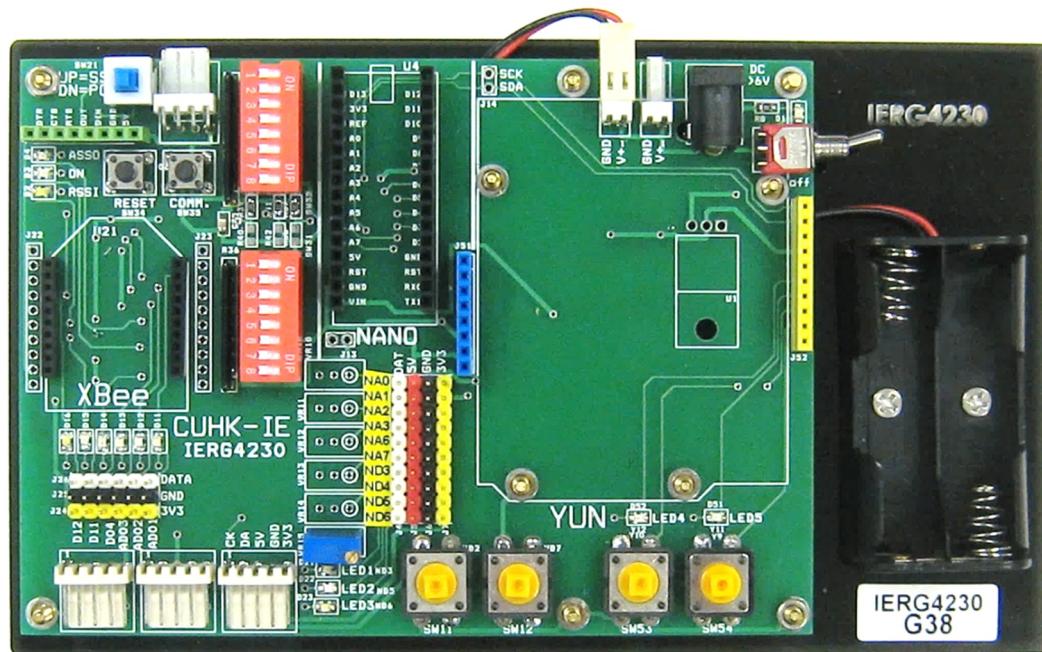
## Group C: Other devices (by request, *self-study, first come first serve*)

- C1. Human movement sensor (Passive infrared sensor, **5V**, Digital).
- C2. Temperature Sensor (**LM35**, Analogue).
- C3. Temperature Sensor (**LM75**,  $I^2C$ ).
- C4. Temperature and Humidity Sensor (**AM2320**,  $I^2C$ ).
- C5. Temperature and Humidity sensor (**AHT10**,  $I^2C$ )
- C6. Sound source - Beeper, (**Buzzer**, Digital Output)
- C7. Switch (**Dual tact switches**, Digital Input)
- C8. Light sensor module (**Light Dependent Resistor with op-amp**, Analogue & digital outputs)
- C9. MEMS Motion sensor (**LIS3DSH**, Three-axis linear accelerometer,  $I^2C$ )
- C10. Heart Rate Sensor (**MAX30102**,  $I^2C$ )
- C11. Microphone (**MIC**, Analogue & digital outputs)
- C12. OLED Display (**SSD1306**,  $I^2C$ )
- C13. Touch switch (**TIP223**, Digital)
- C14. Microwave Motion Sensor (**RCWL-0516**, **5V**, Digital)
- C15. Soil Moisture Sensor (Analogue)
- C16. Ultrasonic Sensor Distance Measuring Module (**HC-SR04**, **5V**, Digitals)
- C17. Electronic scale, weight sensor (**HX711AD**, Digitals)
- C18. RFID reader (**MFRC522**,  $I^2C$ )
- C19. Light density detector (**BH1750**,  $I^2C$ )
- C20. Servo (it take high current, consult technicians)

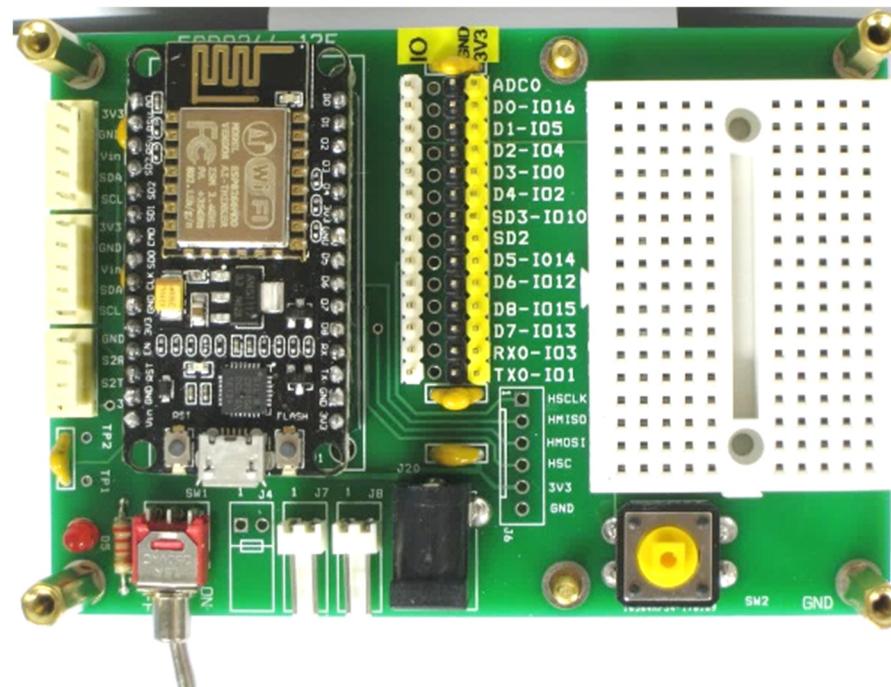
S/N	Material	Power	Max. Quantities for each group
A1	IERG4230 full size Main project board (with $I^2C$ 16-key keypad and LCD display. Nano and ESP8266 are NOT included)	6V	1



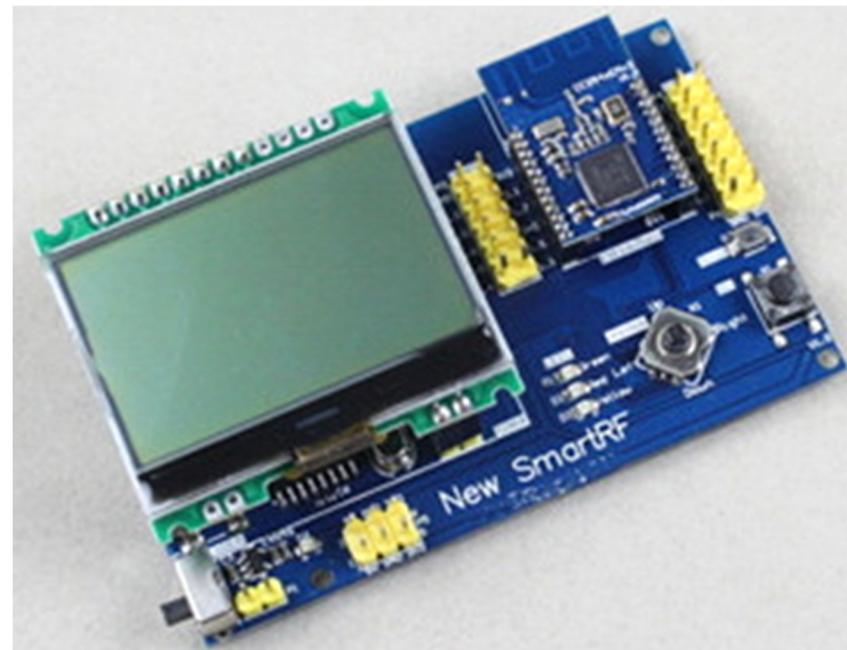
S/N	Material	Power	Max. Quantities for each group
A2	IERG4230 half size Main project board (Nano and ESP8266 are NOT included)	6V	2



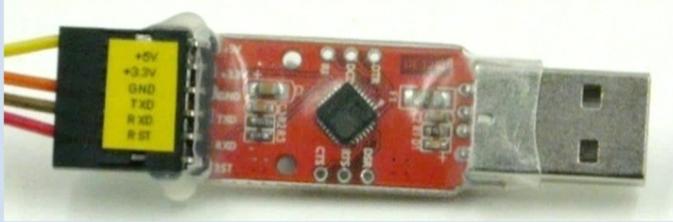
S/N	Material	Power	Max. Quantities for each group
A3	ESP8266 (with or without I/O extended board)	5V	3



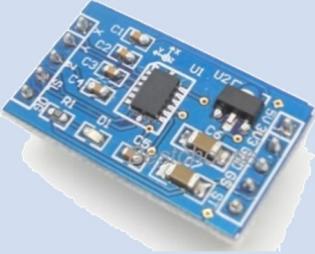
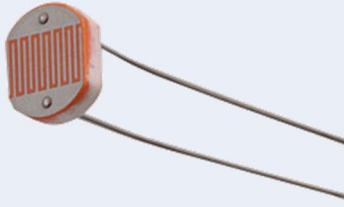
S/N	Material	Power	Max. Quantities for each group
A4	Bluetooth BLE project board	5V	2

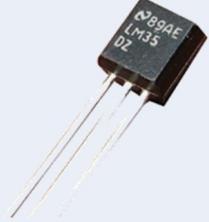
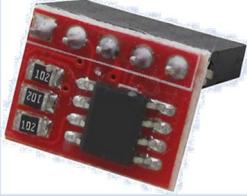


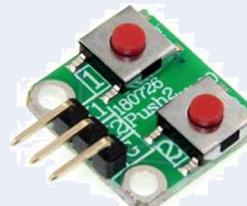
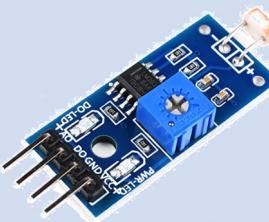
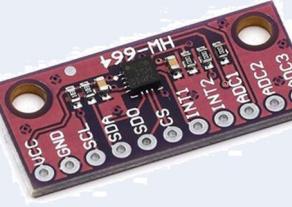
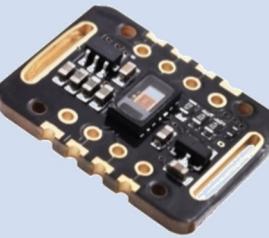
S/N	Material	Photo	Max. quantities for each group
A5	Arduino Nano	 A blue Arduino Nano microcontroller board with a ATmega328P chip and various pins.	match to the number of project boards
A6	XBee	 A blue XBee wireless module with a black antenna and a MaxStream logo.	match to the number of project boards
A7	2.4GHz USB WiFi LAN adapter	 A black 2.4GHz USB WiFi LAN adapter with a long black antenna.	1

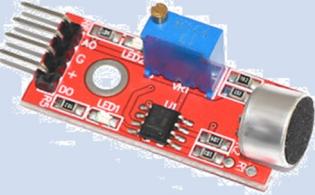
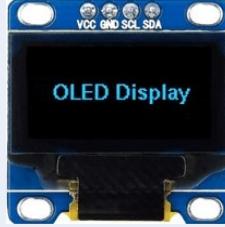
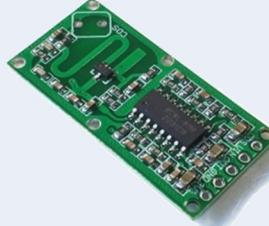
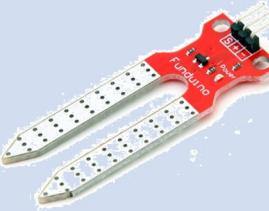
S/N	Material	Photo	Max. quantities for each group
A8	USB to Serial Cable (for XBee)		1
A9	CC-Debugger (for Bluetooth BLE)		1
A10	Sniffer dongle (for Bluetooth BLE)		1
A11	Host dongle (for Bluetooth BLE)		1

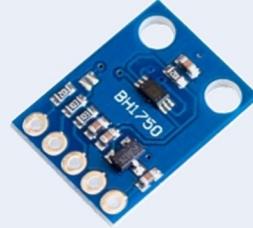
S/N	Material	Photo	Max. quantities for each group
A12	3V FeLiPO4 re-chargeable battery		match to the number of project boards x 2
A13	3V FeLiPO4 battery charger		1
A14	Mini-USB cable		1
A15	Micro-USB cable		1

S/N	Material	Model	Photo	Power	Interface	Max. quantities for each group
B1	3-axis acceleration sensor module	MMA7361		5V	Analogues	1
B2	Light detected resistor	LDR		--	Analogues	1

S/N	Material	Model	Photo	Power	Interface	Max. quantities for each group
C1	Human movement sensor	PIR		5V	Digital	1
C2	Temperature Sensor	LM35		3.3V	Analogues	1
C3	Temperature Sensor	LM75		3.3V	$I^2C$	1
C4	Temperature and Humidity Sensor	AM2320		3.3V	$I^2C$	1
C5	Temperature and Humidity sensor	AHT10		3.3V	$I^2C$	1

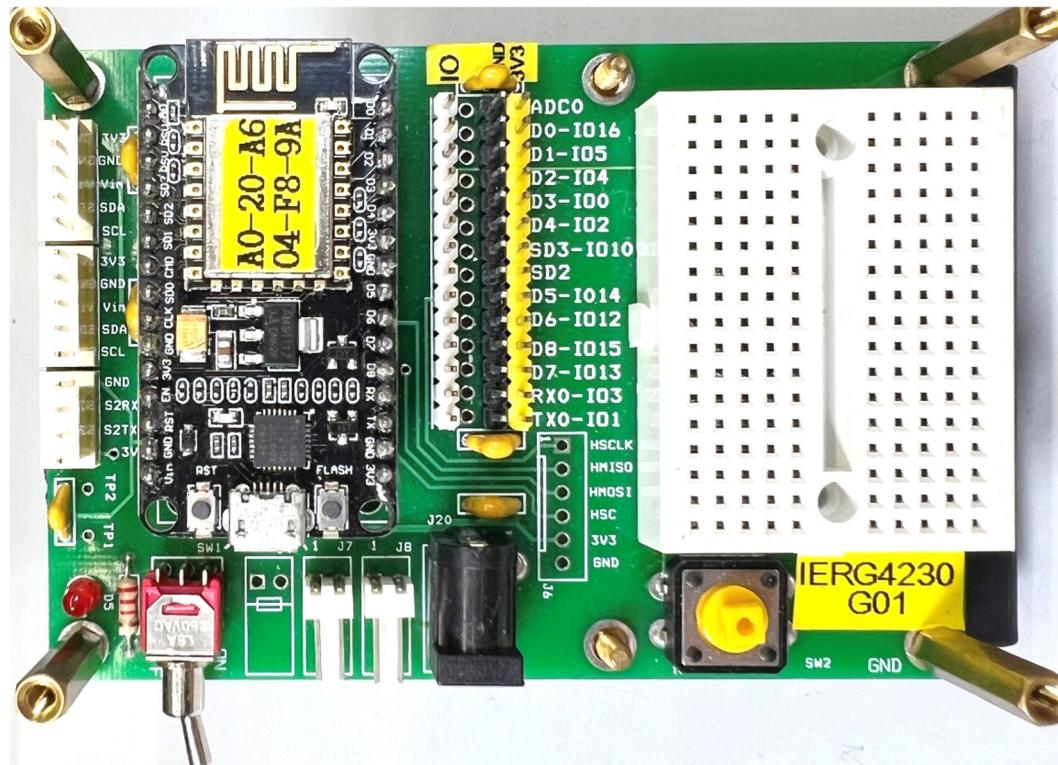
S/N	Material	Model	Photo	Power	Interface	Max. quantities for each group
C6	Sound source - Beeper	Buzzer		3.3V	Digital	1
C7	Switch			3.3V	Digital	1
C8	Light sensor module			3.3V	Analogue & digital	1
C9	MEMS Motion sensor	LIS3DSH		3.3V	$I^2C$	1
C10	Heart Rate Sensor	MAX30102		3.3V	$I^2C$	1

S/N	Material	Model	Photo	Power	Interface	Max. quantities for each group
C11	Microphone			3.3V	Analogue & digital	1
C12	OLED Display	SSD1306		3.3V	$I^2C$	1
C13	Touch switch	TIP223		3.3V	Digital	1
C14	Microwave Motion Sensor	RCWL-0516		5V	Digital	1
C15	Soil Moisture Sensor			3.3V	Analogue	<i>First-come-first-serve</i>

S/N	Material	Model	Photo	Power	Interface	Max. quantities for each group
C16	Ultrasonic Sensor Distance Measuring Module	HC-SR04		5V	Digitals	<i>First-come-first-serve</i>
C17	Electronic scale, weight sensor	HX711AD		3.3V	Digitals	<i>First-come-first-serve</i>
C18	RFID reader	MFRC522		3.3V	$I^2C$	<i>First-come-first-serve</i>
C19	Light density detector	BH1750		3.3V	$I^2C$	<i>First-come-first-serve</i>
C20	Servo				Digitals	<i>First-come-first-serve</i>

S/N	Material	Model	Photo	Power	Interface	Max. quantities for each group
C21	Alcohol Gas Sensor	MQ3	 A blue printed circuit board (PCB) with a red cylindrical sensor component labeled "MQ-3".	5V	Analogue & digital	<i>First-come-first-serve</i>
C22	Carbon Monoxide Sensor (CO)	MQ7	 A blue printed circuit board (PCB) with a grey cylindrical sensor component labeled "MQ-7".	5V	Analogue & digital	<i>First-come-first-serve</i>
C23	Gas Sensor (NH <sub>3</sub> , NO <sub>x</sub> , alcohol, Benzene, smoke, CO <sub>2</sub> )	MQ135	 A blue printed circuit board (PCB) with a silver cylindrical sensor component labeled "MQ135".	5V	Analogue & digital	<i>First-come-first-serve</i>
C24	Ammonia Gas Sensor	MQ137	 A blue printed circuit board (PCB) with a silver cylindrical sensor component labeled "MQ-137".	5V	Analogue & digital	<i>First-come-first-serve</i>
C25	TP-Link Smart Wi-Fi Plug	HS110	 A white electrical plug with a small circular control panel featuring a power button and a TP-Link logo.	220V		<i>First-come-first-serve</i>

# ESP8266 with I/O extended board



## Advantages of ESP8266:

- Support  $I^2C$  interface, suggest using  $I^2C$  modules.
- Support two UARTs.
- Support 802.11 b/g/n WLAN MAC protocol.
- Support sleep mode for power saving.
- Max. 17 digital I/Os (reduce number of I/O when special functions are used.).
- Support SPI interface.
- Support four PWM outputs.

## Important notes (limitations) of ESP8266:

- The **max.** power supply of ESP8266 is **3.3V**.
- Only one analogue input (10-bit A to D) A0.
- The output of on board regulator is 700mA only.
- For Digital I/Os, suggest using pin D5, D6, D7 and **D8**.
- **No 5V supply**. You **need** a voltage converter for interfacing to **5V** I/O modules.

## Matter needing attention:

### On Boot/Reset/wakeup,

- D8(GPIO15) **MUST** keep LOW **AND** D4(GPIO2) **MUST** keep HIGH
- D3(GPIO0 ) **MUST** keep HIGH (Run mode) running downloaded program
- D3(GPIO0 ) **MUST** keep LOW (Flash mode) for downloading program

## On Board LEDs (active LOW):

- D0(GPIO16)
- D4(GPIO2)

## Important notes of our design.

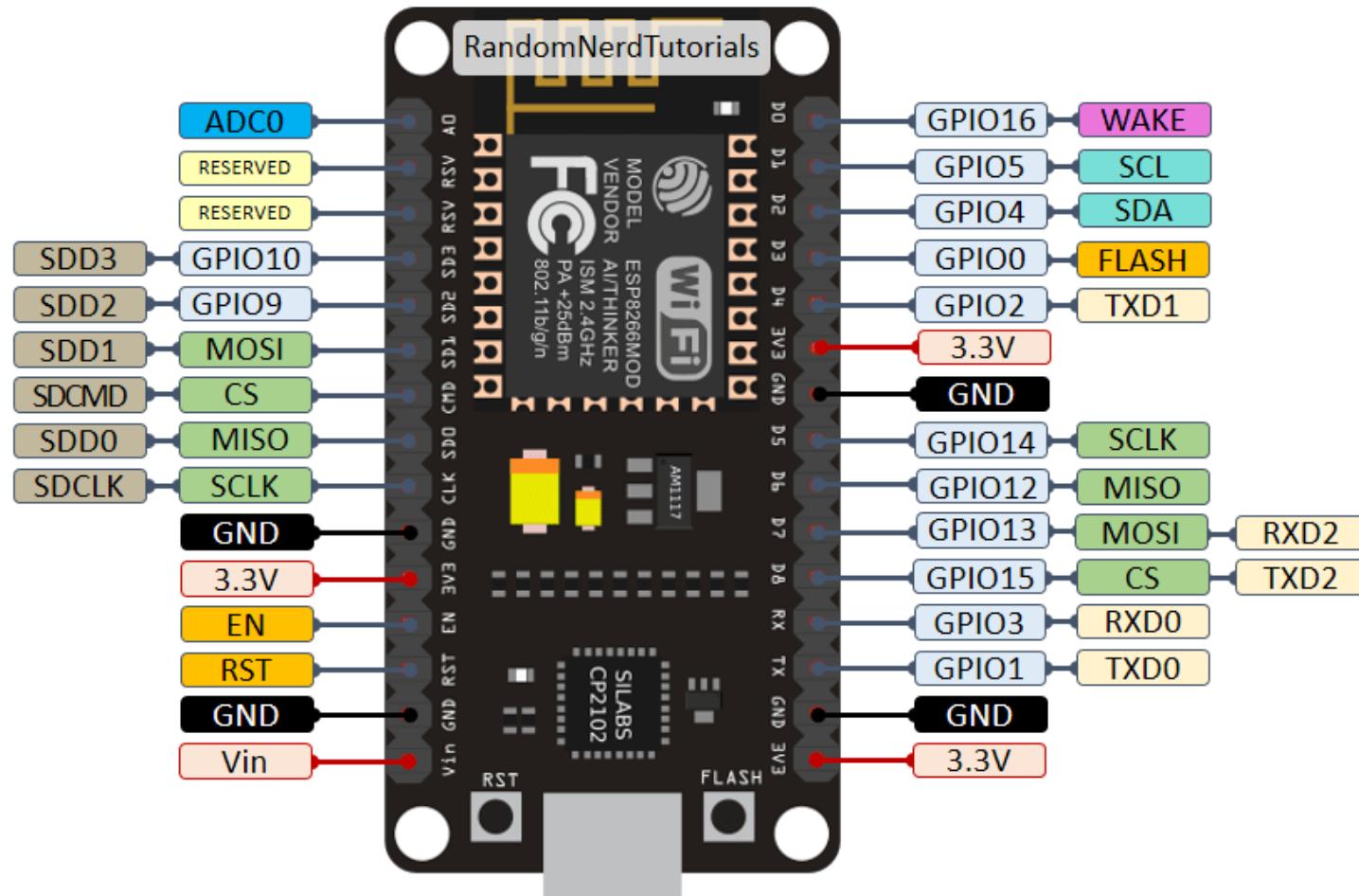
- The provided ESP8266 board powered by computer USB port (normal 500mA). Do not powered by external power source (e.g. Mobile phone charger).
- For safety reason, the ESP8266 boards are powered by USB battery pack. Do not use AC-to-USB converter. Nobody know your AC converter that fulfils safety regulation or not.
- The current limit of ESP8266 on board regulator (5V to 3V3) is 700mA. Do not take too much current from it. It will be damaged by over current. Consult our technicians if your project needs to drive high current (e.g. motor, servo).
- ESP8266 does not support 5V I/O default. Need a voltage converter (simple resistor potential divider) for interface 5V modules. The provided 5V modules are tested. Consult our technicians if other 5V modules are connected to the CPU boards.
- For multiplex/protocol device, use  $I^2C$ .
- Release SPI pins for general I/Os .
- Use UART monitor in Arduino for programme debugging.

# Best Pins to Use

<https://randomnerdtutorials.com/esp8266-pinout-reference-gpios/>

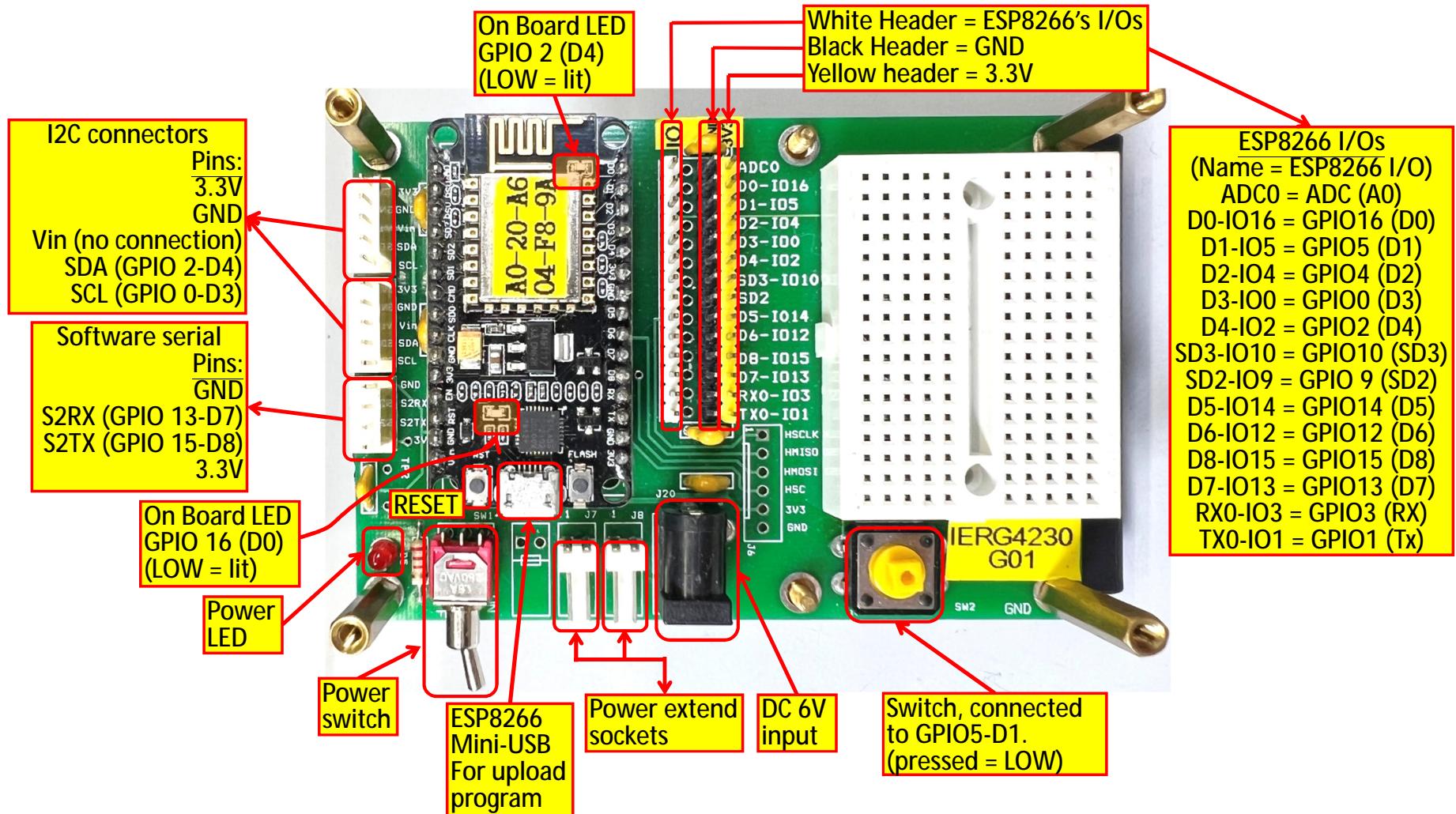
Label	GPIO	Input	Output	Notes
D0	GPIO16	no interrupt	no PWM or I2C support	HIGH at boot used to wake up from deep sleep
D1	GPIO5	OK	OK	often used as SCL (I2C)
D2	GPIO4	OK	OK	often used as SDA (I2C)
D3	GPIO0	pulled up	OK	connected to FLASH button, boot fails if pulled LOW
D4	GPIO2	pulled up	OK	HIGH at boot connected to on-board LED, boot fails if pulled LOW
D5	GPIO14	OK	OK	SPI (SCLK)
D6	GPIO12	OK	OK	SPI (MISO)
D7	GPIO13	OK	OK	SPI (MOSI)
D8	GPIO15	pulled to GND	OK	SPI (CS) Boot fails if pulled HIGH
RX	GPIO3	OK	RX pin	HIGH at boot
TX	GPIO1	TX pin	OK	HIGH at boot debug output at boot, boot fails if pulled LOW
A0	ADC0	Analog Input	X	

## Pin assignment of ESP8266-12-E



<https://i2.wp.com/randomnerdtutorials.com/wp-content/uploads/2019/05/ESP8266-NodeMCU-kit-12-E-pinout-gpio-pin.png?ssl=1>

## ESP8266 with I/O extended board



- VIN = USB(5V) – diode = 4.3V
- A0 is 10-bit A/D input.
- 3 rows of pins are I/O (White), GND (Black) and 3.3V (Yellow).
- The socket of provided modules are multiple pins for these pins. Face the colour marks to the breadboard.