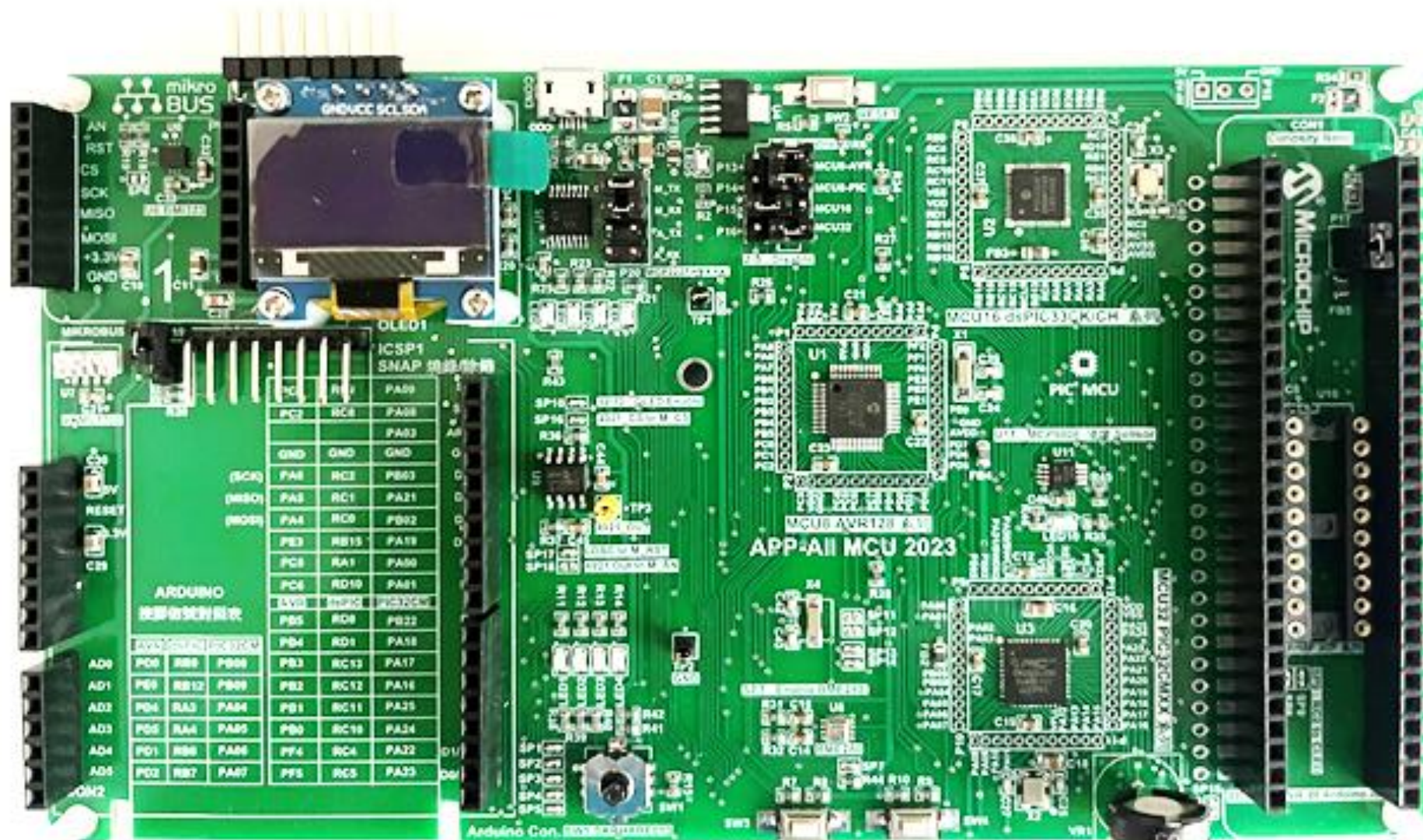


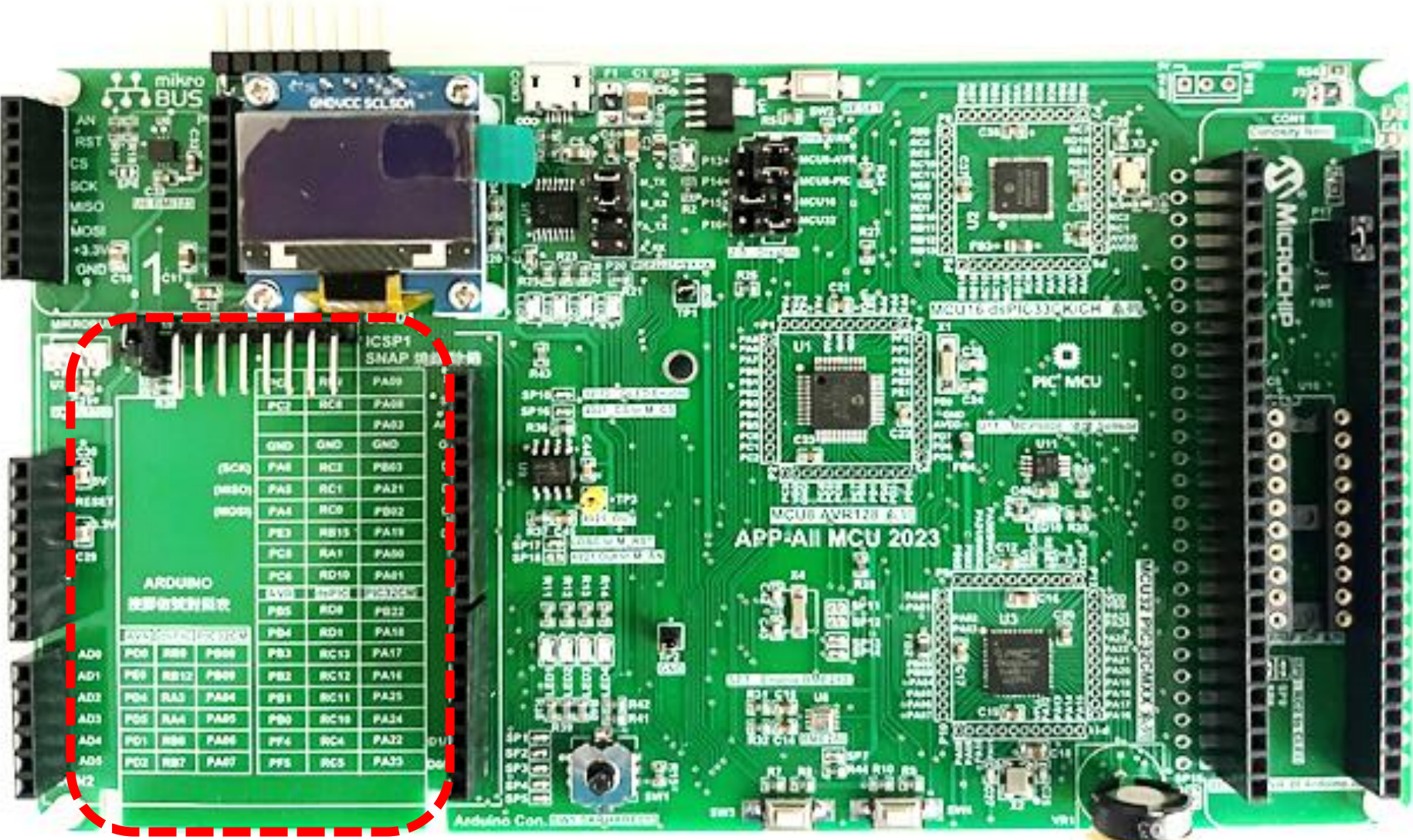
# APP-AI MCU 2023 主題實驗板開箱介紹



# APP-AI MCU 2023 內建的周邊

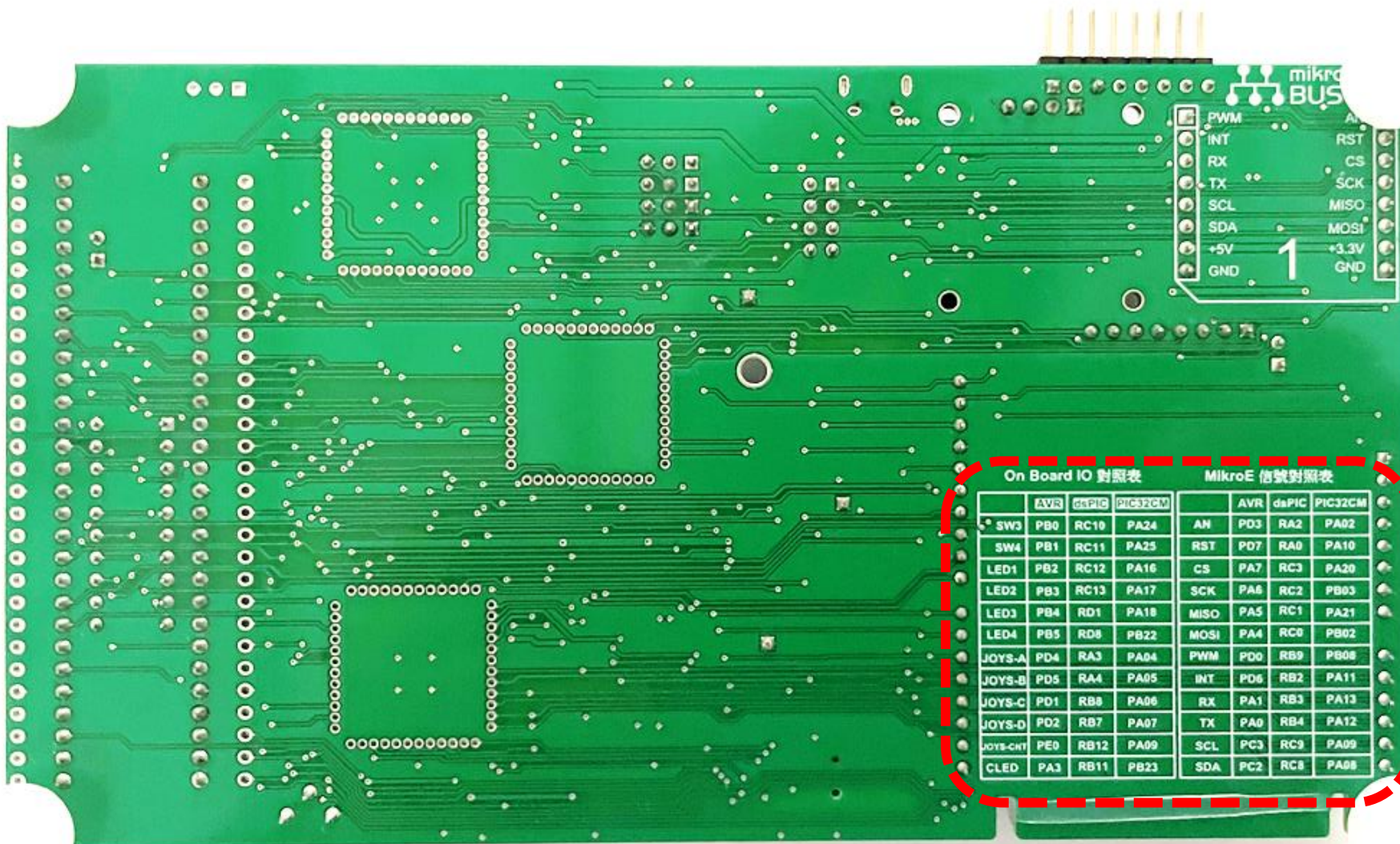
- ✓ 一個 I2C 介面的六軸 IMU - BOSCH BMI323
- ✓ 一個 I2C 介面的 Lighting Sensor – Vishay 的 VEML7700-TT
- ✓ 一個 I2C 介面的 Humidity sensor - BOSCH BME280
- ✓ 一個 I2C 介面的 溫度 Sensor – Microchip MCP9808
- ✓ 一個 I2C 介面的 OLED Display - 單色 128 \* 64
- ✓ 一個 SPI 介面的 DAC – Microchip MCP4921
- ✓ 兩個 WS2812B One-Wire Color LED
- ✓ 一個 MCP2221A 作實驗板上的 UART 以及 I2C 介面轉換至 USB 的介面 IC
- ✓ 一個 ALPS 的 SKRHABE010 五向開關

# APP-AI MCU 2023 Arduino 介面信號對照表



ARDUINO 接腳信號對照表			
AD9	PD6	RB8	PA06
AD1	PD5	RB12	PA09
AD2	PD4	RA3	PA04
AD3	PD5	RA4	PA05
AD4	PD1	RB6	PA06
AD5	PD2	RB7	PA07
AD6	PD3	RB5	PA05
AD7	PD4	RD1	PA18
AD8	PD5	RD2	PA19
AD9	PD6	RD3	PA20
AD10	PD7	RD4	PA21
AD11	PD8	RD5	PA22
AD12	PD9	RD6	PA23
AD13	PD10	RD7	PA24
AD14	PD11	RD8	PA25
AD15	PD12	RD9	PA26
AD16	PD13	RD10	PA27
AD17	PD14	RD11	PA28
AD18	PD15	RD12	PA29
AD19	PD16	RD13	PA30
AD20	PD17	RD14	PA31
AD21	PD18	RD15	PA32
AD22	PD19	RD16	PA33
AD23	PD20	RD17	PA34
AD24	PD21	RD18	PA35
AD25	PD22	RD19	PA36
AD26	PD23	RD20	PA37
AD27	PD24	RD21	PA38
AD28	PD25	RD22	PA39
AD29	PD26	RD23	PA40
AD30	PD27	RD24	PA41
AD31	PD28	RD25	PA42
AD32	PD29	RD26	PA43
AD33	PD30	RD27	PA44
AD34	PD31	RD28	PA45
AD35	PD32	RD29	PA46
AD36	PD33	RD30	PA47
AD37	PD34	RD31	PA48
AD38	PD35	RD32	PA49
AD39	PD36	RD33	PA50
AD40	PD37	RD34	PA51
AD41	PD38	RD35	PA52
AD42	PD39	RD36	PA53
AD43	PD40	RD37	PA54
AD44	PD41	RD38	PA55
AD45	PD42	RD39	PA56
AD46	PD43	RD40	PA57
AD47	PD44	RD41	PA58
AD48	PD45	RD42	PA59
AD49	PD46	RD43	PA60
AD50	PD47	RD44	PA61
AD51	PD48	RD45	PA62
AD52	PD49	RD46	PA63
AD53	PD50	RD47	PA64
AD54	PD51	RD48	PA65
AD55	PD52	RD49	PA66
AD56	PD53	RD50	PA67
AD57	PD54	RD51	PA68
AD58	PD55	RD52	PA69
AD59	PD56	RD53	PA70
AD60	PD57	RD54	PA71
AD61	PD58	RD55	PA72
AD62	PD59	RD56	PA73
AD63	PD60	RD57	PA74
AD64	PD61	RD58	PA75
AD65	PD62	RD59	PA76
AD66	PD63	RD60	PA77
AD67	PD64	RD61	PA78
AD68	PD65	RD62	PA79
AD69	PD66	RD63	PA80
AD70	PD67	RD64	PA81
AD71	PD68	RD65	PA82
AD72	PD69	RD66	PA83
AD73	PD70	RD67	PA84
AD74	PD71	RD68	PA85
AD75	PD72	RD69	PA86
AD76	PD73	RD70	PA87
AD77	PD74	RD71	PA88
AD78	PD75	RD72	PA89
AD79	PD76	RD73	PA90
AD80	PD77	RD74	PA91
AD81	PD78	RD75	PA92
AD82	PD79	RD76	PA93
AD83	PD80	RD77	PA94
AD84	PD81	RD78	PA95
AD85	PD82	RD79	PA96
AD86	PD83	RD80	PA97
AD87	PD84	RD81	PA98
AD88	PD85	RD82	PA99
AD89	PD86	RD83	PA100
AD90	PD87	RD84	PA101
AD91	PD88	RD85	PA102
AD92	PD89	RD86	PA103
AD93	PD90	RD87	PA104
AD94	PD91	RD88	PA105
AD95	PD92	RD89	PA106
AD96	PD93	RD90	PA107
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AD98	PD95	RD92	PA109
AD99	PD96	RD93	PA110
AD100	PD97	RD94	PA111
AD101	PD98	RD95	PA112
AD102	PD99	RD96	PA113
AD103	PD100	RD97	PA114
AD104	PD101	RD98	PA115
AD105	PD102	RD99	PA116
AD106	PD103	RD100	PA117
AD107	PD104	RD101	PA118
AD108	PD105	RD102	PA119
AD109	PD106	RD103	PA120
AD110	PD107	RD104	PA121
AD111	PD108	RD105	PA122
AD112	PD109	RD106	PA123
AD113	PD110	RD107	PA124
AD114	PD111	RD108	PA125
AD115	PD112	RD109	PA126
AD116	PD113	RD110	PA127
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AD118	PD115	RD112	PA129
AD119	PD116	RD113	PA130
AD120	PD117	RD114	PA131
AD121	PD118	RD115	PA132
AD122	PD119	RD116	PA133
AD123	PD120	RD117	PA134
AD124	PD121	RD118	PA135
AD125	PD122	RD119	PA136
AD126	PD123	RD120	PA137
AD127	PD124	RD121	PA138
AD128	PD125	RD122	PA139
AD129	PD126	RD123	PA140
AD130	PD127	RD124	PA141
AD131	PD128	RD125	PA142
AD132	PD129	RD126	PA143
AD133	PD130	RD127	PA144
AD134	PD131	RD128	PA145
AD135	PD132	RD129	PA146
AD136	PD133	RD130	PA147
AD137	PD134	RD131	PA148
AD138	PD135	RD132	PA149
AD139	PD136	RD133	PA150
AD140	PD137	RD134	PA151
AD141	PD138	RD135	PA152
AD142	PD139	RD136	PA153
AD143	PD140	RD137	PA154
AD144	PD141	RD138	PA155
AD145	PD142	RD139	PA156
AD146	PD143	RD140	PA157
AD147	PD144	RD141	PA158
AD148	PD145	RD142	PA159
AD149	PD146	RD143	PA160
AD150	PD147	RD144	PA161
AD151	PD148	RD145	PA162
AD152	PD149	RD146	PA163
AD153	PD150	RD147	PA164
AD154	PD151	RD148	PA165
AD155	PD152	RD149	PA166
AD156	PD153	RD150	PA167
AD157	PD154	RD151	PA168
AD158	PD155	RD152	PA169
AD159	PD156	RD153	PA170
AD160	PD157	RD154	PA171
AD161	PD158	RD155	PA172
AD162	PD159	RD156	PA173
AD163	PD160	RD157	PA174
AD164	PD161	RD158	PA175
AD165	PD162	RD159	PA176
AD166	PD163	RD160	PA177
AD167	PD164	RD161	PA178
AD168	PD165	RD162	PA179
AD169	PD166	RD163	PA180
AD170	PD167	RD164	PA181
AD171	PD168	RD165	PA182
AD172	PD169	RD166	PA183
AD173	PD170	RD167	PA184
AD174	PD171	RD168	PA185
AD175	PD172	RD169	PA186
AD176	PD173	RD170	PA187
AD177	PD174	RD171	PA188
AD178	PD175	RD172	PA189
AD179	PD176	RD173	PA190
AD180	PD177	RD174	PA191
AD181	PD178	RD175	PA192
AD182	PD179	RD176	PA193
AD183	PD180	RD177	PA194
AD184	PD181	RD178	PA195
AD185	PD182	RD179	PA196
AD186	PD183	RD180	PA197
AD187	PD184	RD181	PA198
AD188	PD185	RD182	PA199
AD189	PD186	RD183	PA200
AD190	PD187	RD184	PA201
AD191	PD188	RD185	PA202
AD192	PD189	RD186	PA203
AD193	PD190	RD187	PA204
AD194	PD191	RD188	PA205
AD195	PD192	RD189	PA206
AD196	PD193	RD190	PA207
AD197	PD194	RD191	PA208
AD198	PD195	RD192	PA209
AD199	PD196	RD193	PA210
AD200	PD197	RD194	PA211
AD201	PD198	RD195	PA212
AD202	PD199	RD196	PA213
AD203	PD200	RD197	PA214
AD204	PD201	RD198	PA215
AD205	PD202	RD199	PA216
AD206	PD203	RD200	PA217
AD207	PD204	RD201	PA218
AD208	PD205	RD202	PA219
AD209	PD206	RD203	PA220
AD210	PD207	RD204	PA221
AD211	PD208	RD205	PA222
AD212	PD209	RD206	PA223
AD213	PD210	RD207	PA224
AD214	PD211	RD208	PA225
AD215	PD212	RD209	PA226
AD216	PD213	RD210	PA227
AD217	PD214	RD211	PA228
AD218	PD215	RD212	PA229
AD219	PD216	RD213	PA230
AD220	PD217	RD214	PA231
AD221	PD218	RD215	PA232
AD222	PD219	RD216	PA233
AD223	PD220	RD217	PA234
AD224	PD221	RD218	PA235
AD225	PD222	RD219	PA236
AD226	PD223	RD220	PA237
AD227	PD224	RD221	PA238
AD228	PD225	RD222	PA239
AD229	PD226	RD223	PA240
AD230	PD227	RD224	PA241
AD231	PD228	RD225	PA242
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AD233	PD230	RD227	PA244
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AD243	PD240	RD237	PA254
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AD250	PD247	RD244	PA261
AD251	PD248	RD245	PA262
AD252	PD249	RD246	PA263
AD253	PD250	RD247	PA264
AD254	PD251	RD248	PA265
AD255	PD252	RD249	PA266
AD256	PD253	RD250	PA267
AD257	PD254	RD251	PA268
AD258	PD255	RD252	PA269
AD259	PD256	RD253	PA270
AD260	PD257	RD254	PA271
AD261	PD258	RD255	PA272
AD262	PD259	RD256	PA273
AD263	PD260	RD257	PA274
AD264	PD261	RD258	PA275
AD265	PD262	RD259	PA276
AD266	PD263	RD260	PA277
AD267	PD264		

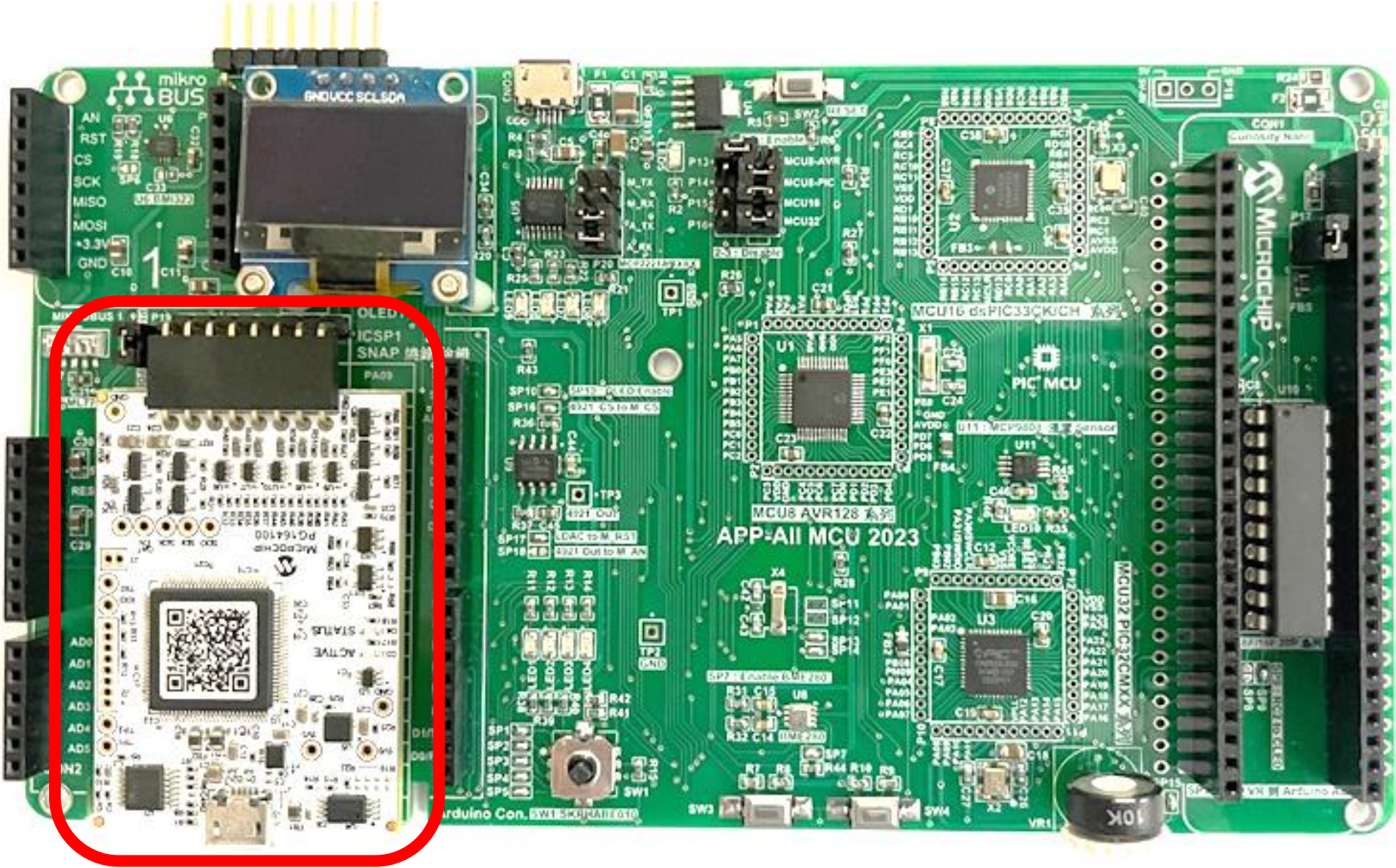
# APP-AII MCU 2023 的背面信號對照表



On Board IO 對照表				MikroE 信號對照表			
	EV13	01218	01062021		AVR	dsPIC	PIC32CM
SW3	PB0	RC10	PA24	AN	PD3	RA2	PA02
SW4	PB1	RC11	PA25	RST	PD7	RA0	PA10
LED1	PB2	RC12	PA16	CS	PA7	RC3	PA20
LED2	PB3	RC13	PA17	SCK	PA6	RC2	PB03
LED3	PB4	RD1	PA18	MISO	PA5	RC1	PA21
LED4	PB5	RD8	PB22	MOSI	PA4	RC0	PB02
JOYS-A	PD4	RA3	PA04	PWM	PD0	RB9	PB08
JOYS-B	PD5	RA4	PA05	INT	PD6	RB2	PA11
JOYS-C	PD1	RB9	PA06	RX	PA1	RB3	PA13
JOYS-D	PD2	RB7	PA07	TX	PA0	RB4	PA12
JOYS-CHT	PE0	RB12	PA09	SCL	PC3	RC9	PA09
CLED	PA3	RB11	PB23	SDA	PC2	RC8	PA08



如果你有 SNAP 即可插接於 ICSP1 → P19 for AVR UPDI



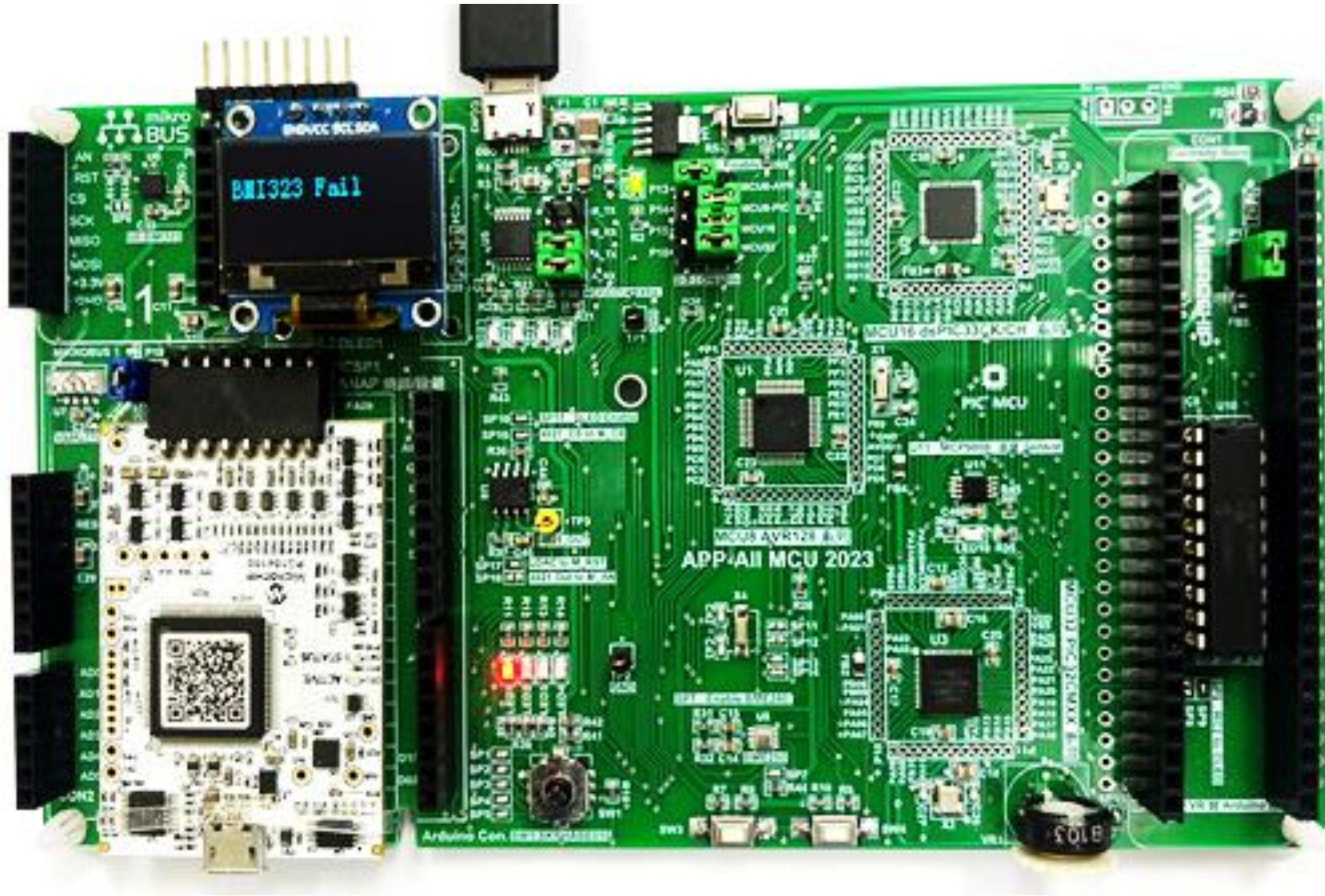
# APP-AII MCU 2023 主題實驗板 – 預設為執行 AVR128DA48 程式







# 如果 BMI323 的 Device ID 讀取錯誤



# APP-All MCU 2023 AVR128DA48 出廠測試程式的 Configuration

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# 選用 MCC Melody

The screenshot shows the 'MCC Content Manager Wizard' interface. At the top, there are browser tabs for 'main.c', 'Start Page', 'OLED128x64.c', 'tmr1.c', and 'MCC Content Manager'. The main heading is 'MCC Content Manager Wizard'. Below it, there are two steps: '1. Content Type' and '2. Required Device Content'. The current step is '1. Content Type', and the sub-heading is 'Select a Content Type'. There are three content type options:

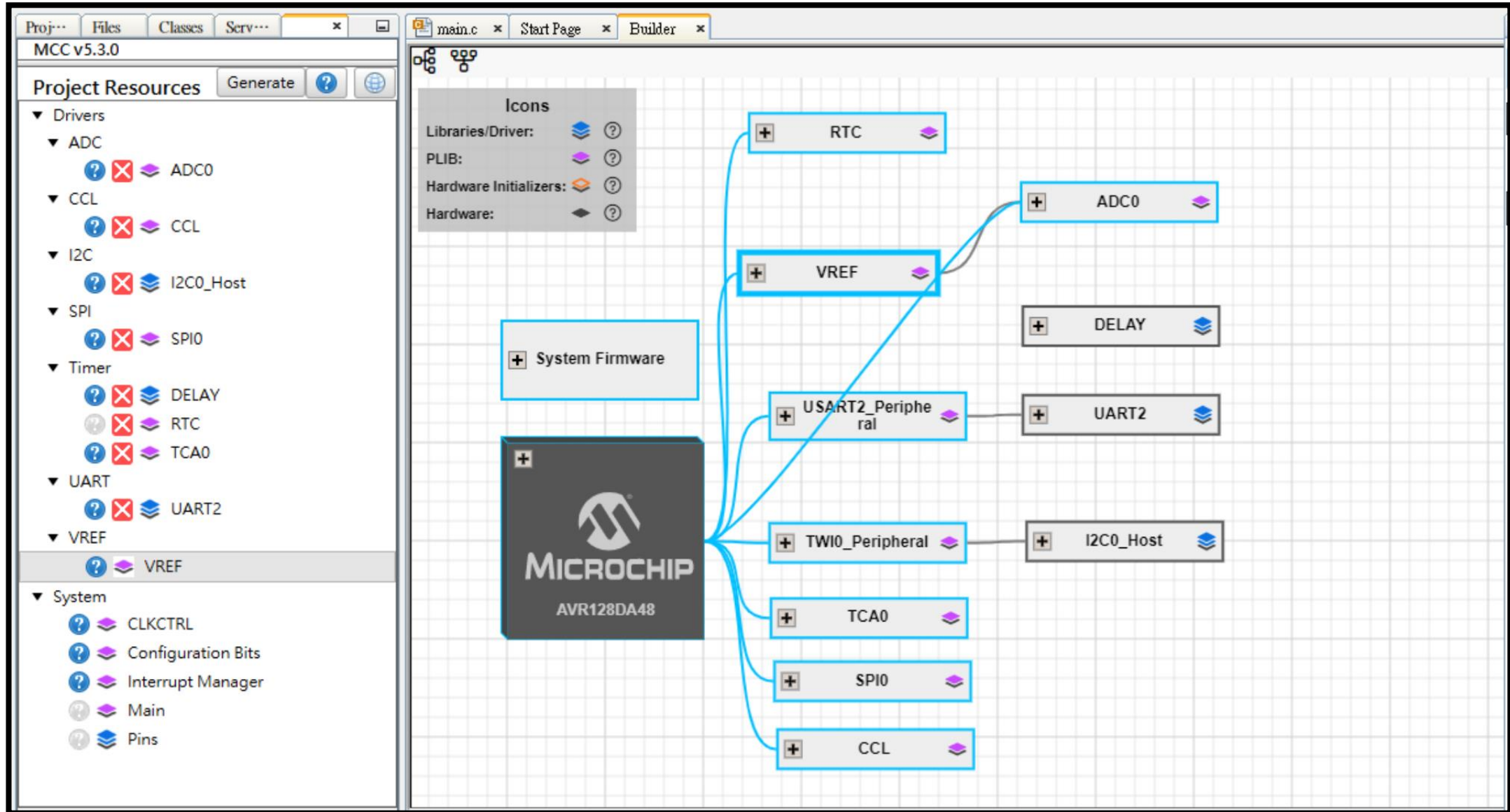
- MCC Melody** (highlighted with a red box):
  - Supports the MCC Builder
  - Supports content versioning at driver level
  - An iteration of MCC Generated Code
  - Works both on- and off-line
  - Button: Select MCC Melody
  - Link: [Release notes and supported devices](#)
- MCC Classic**:
  - Development process you are accustomed to
  - All components and libraries that you have used before
  - Button: Select MCC Classic
  - Link: [Release notes and supported devices](#)
- MPLAB® Harmony**:
  - Embedded Software Development Framework for 32-bit Microcontrollers and Microprocessors
  - Button: Select MPLAB Harmony
  - Link: [Release notes and supported devices](#)

Below the content type options, there is a section titled 'Library support may be a key factor in your choice of MCC flavor:'. It contains two buttons:

- > MCC Melody and MCC Classic - Library Summary
- > MPLAB Harmony - Library Summary

At the bottom, there is a question: 'Still unsure which content type is right for your project?' and a button: 'See More Details'.

# AVR128DA48 所使用到的 Drivers & Resources



# 設定 AVR128DA48 所執行的工作頻率

The image shows the AVR Studio IDE interface. On the left, the hardware configuration window displays a central 'MICROCHIP AVR128DA48' component connected to various peripherals: System Firmware, RTC, VREF, USART2\_Peripheral, TWI0\_Peripheral, TCA0, SPI0, CCL, ADC0, DELAY, UART2, and I2C0\_Host. On the right, the 'CLKCTRL' register settings window is open, showing the following configuration:

- Easy View: Register Initialization
- CLKCTRL Settings
  - Main Clock (Hz): 24000000
  - Clock Selection: Internal high-frequency oscillator
  - Internal Oscillator Frequency: 1-32MHz internal oscillator
  - Oscillator Frequency Selection: 24 MHz system clock
  - PLL Enable: Disabled
  - Multiplication Factor: PLL is disabled
  - External Clock Source for PLL: disabled
  - External Clock (Hz):  $1 \leq 3000000 \leq 24 \times 10^6$
  - Prescaler Enable: Disabled
  - Prescaler Division: 2X
  - System Clock Out Enable: Disabled
- Advanced Settings

# 設定 AVR128DA48 的 CCL – 使用 LUT0

The screenshot displays the AVR Studio IDE interface for configuring the AVR128DA48 microcontroller. The main workspace shows the component configuration tree on the left, with the CCL component highlighted in blue. The right-hand side shows the CCL configuration panel for TCA0, with the Easy View tab selected. Below the configuration panel, the internal logic of LUT0 and LUT1 is visible.

**Component Configuration (Left Panel):**

- System Firmware
- MICROCHIP AVR128DA48
- RTC
- VREF
- ADC0
- DELAY
- USART2\_Peripheral
- UART2
- TWI0\_Peripheral
- I2C0\_Host
- TCA0
- SPI0
- CCL (highlighted)

**CCL Configuration (Right Panel):**

Easy View | Register Initialization

Interrupt	INTDISABLE
LUT3-OUT Interrupt	INTDISABLE
LUT4-OUT Interrupt	INTDISABLE
LUT5-OUT Interrupt	INTDISABLE

**LUT0 Logic Diagram:**

LUT0 is configured with a Custom logic function. The inputs are SPI0 MOSI (0), TCA0 WO1 (1), and TCA0 WO2 (2). The output is connected to a pin.

**LUT1 Logic Diagram:**

LUT1 is configured with an AND logic function. The inputs are 0, 1, and 2. The output is connected to a pin.

**Controls:**

- Pan: Right-click and drag grid
- Zoom: Scroll

# 設定 AVR128DA48 的 TCA0 來搭配SPI0控制CCL → WO1/WO2

The screenshot shows the AVR Studio IDE interface. The main window displays a block diagram of the AVR128DA48 microcontroller with various peripheral modules connected. The TCA0 module is highlighted with a blue border. The right-hand panel shows the configuration settings for the TCA0 module.

**Hardware Configuration:**

- System Firmware
- RTC
- VREF
- ADC0
- DELAY
- USART2\_Peripheral
- UART2
- TWI0\_Peripheral
- I2C0\_Host
- TCA0** (highlighted)
- SPI0
- CCL

**TCA0 Configuration Panel:**

- Input B
- Event Action A: UPDOWN
- Event Action B: NONE
- Interrupt Settings:
  - Enable Overflow Interrupt:
  - Enable Compare Channel 0 interrupt:
  - Enable Compare Channel 1 interrupt:
  - Enable Compare Channel 2 interrupt:
- Waveform Generation Settings:
  - Waveform Generation Mode: Single Slope PWM
- Timer Channels

Channel	Enable	Requested Duty	Actual Duty	Interrupt
Channel 0	<input type="checkbox"/>	66	64.52	<input type="checkbox"/>
Channel 1	<input checked="" type="checkbox"/>	66	64.52	<input type="checkbox"/>
Channel 2	<input checked="" type="checkbox"/>	33	32.26	<input type="checkbox"/>

**Controls:**  
Pan: Right-click and drag grid  
Zoom: Scroll

# 根據輸出需求設定 AVR128DA48 LUT0 的真值表

The screenshot displays the AVR Studio IDE interface. On the left, the 'System Firmwares' tree shows the AVR128DA48 microcontroller. The 'Show system firmware connections' diagram shows various peripheral modules connected to the microcontroller. The 'CCL' module is highlighted with a blue border. On the right, the 'CCL x TCA0' configuration window is open, showing the 'Input 0 Source Selection' set to 'SPI0', 'Input 1 Source Selection' set to 'TCA0', and 'Input 2 Source Selection' set to 'TCA0'. The 'Gate Type' is set to 'Custom'. Below the configuration, a truth table is displayed with columns for 'IN2', 'IN1', 'IN0', and 'OUT'. The 'OUT' column contains values 0, 0, 0, 1, 0, 0, 1, 0, 1, 1. At the bottom right, the 'OUT result' is shown as '0xc8'.

Icons

- Libraries/Driver:
- PLIB:
- Hardware Initializers:
- Hardware:

System Firmwares

- System Firmware
- AVR128DA48

Show system firmware connections

RTC

VREF

ADC0

DELAY

USART2\_Peripheral

UART2

TWI0\_Peripheral

I2C0\_Host

TCA0

SPI0

CCL

Controls

Pan: Right-click and drag grid

Zoom: Scroll

CCL x TCA0

Input 0 Source Selection: SPI0

Input 1 Source Selection: TCA0

Input 2 Source Selection: TCA0

Gate Type: Custom

IN2	IN1	IN0	OUT
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

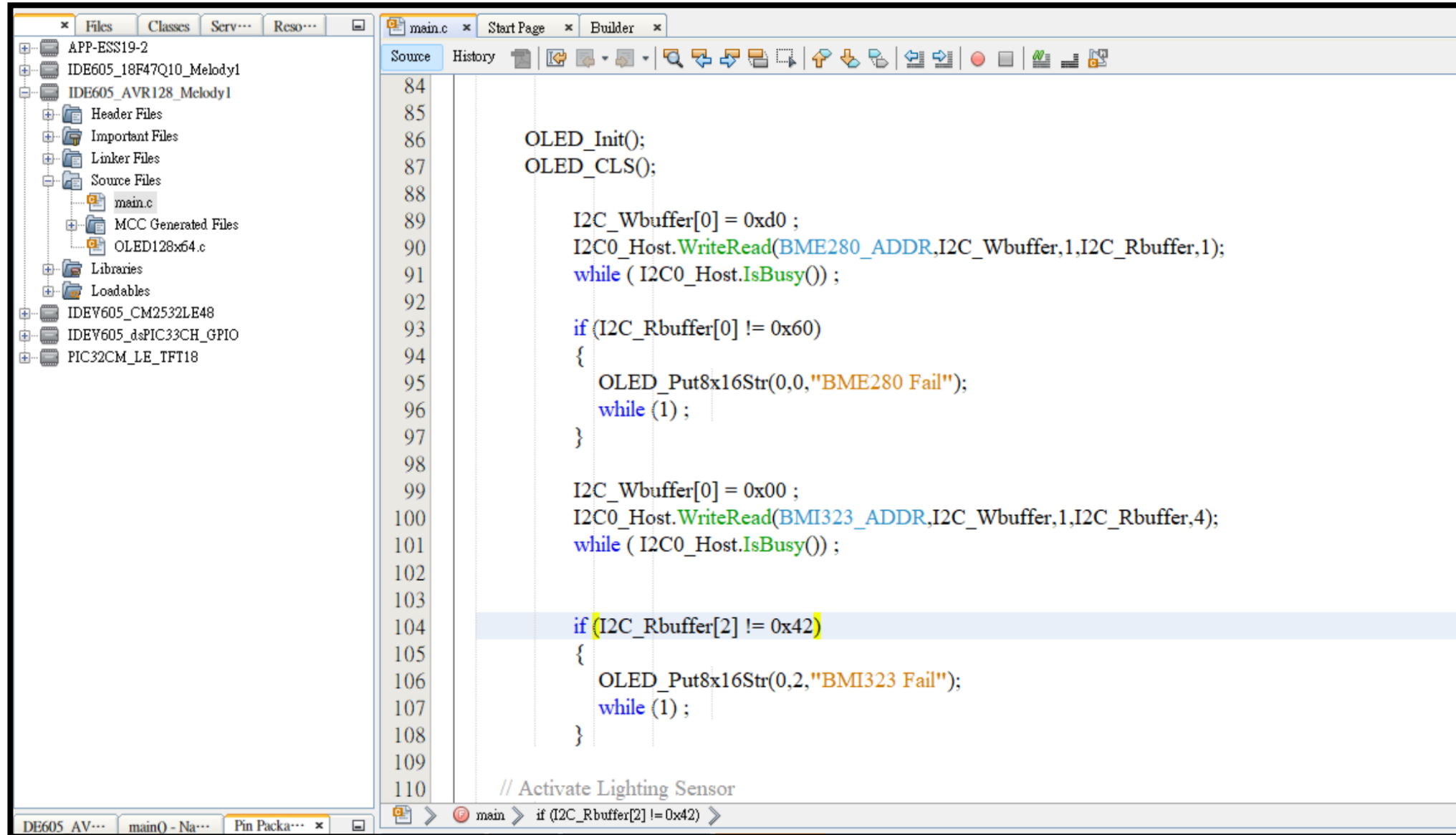
OUT result: 0xc8



# 正確設定 AVR128DA48 的 I/O

Notifications		Output	Notifications [MCC]		Pin Grid View ×																															
Package:	QFN48 ▾	Pin No:	44	45	46	47	48	1	2	3	4	5	6	7	8	9	10	11	12	13	16	17	18	19	20	21	22	23	24	25	26	27	30	31	32	33
			PORTA							PORTB							PORTC							PORTD							PORTE					
Module	Function	Direction	0	1	2	3	4	5	6	7	0	1	2	3	4	5	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3
	LUT4	input									🔒	🔒	🔒																							
CLKCTRL ▾	CLKOUT	output									🔒																									
SPI0 ▾	MISO	input						🔒																												🔒
	MOSI	output					🔒																													🔒
	SCK	output							🔒																											🔒
TCA0 ▾	WO0	output	🔒														🔒								🔒								🔒			
	WO1	output		🔒														🔒								🔒								🔒		
	WO2	output			🔒														🔒								🔒								🔒	
ADC0 ▾	AINx	input																							🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒
Pins ▾	GPIO	input	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒
	GPIO	output	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒

# 加入 OLED128x64.c 來完成 OLED 的控制

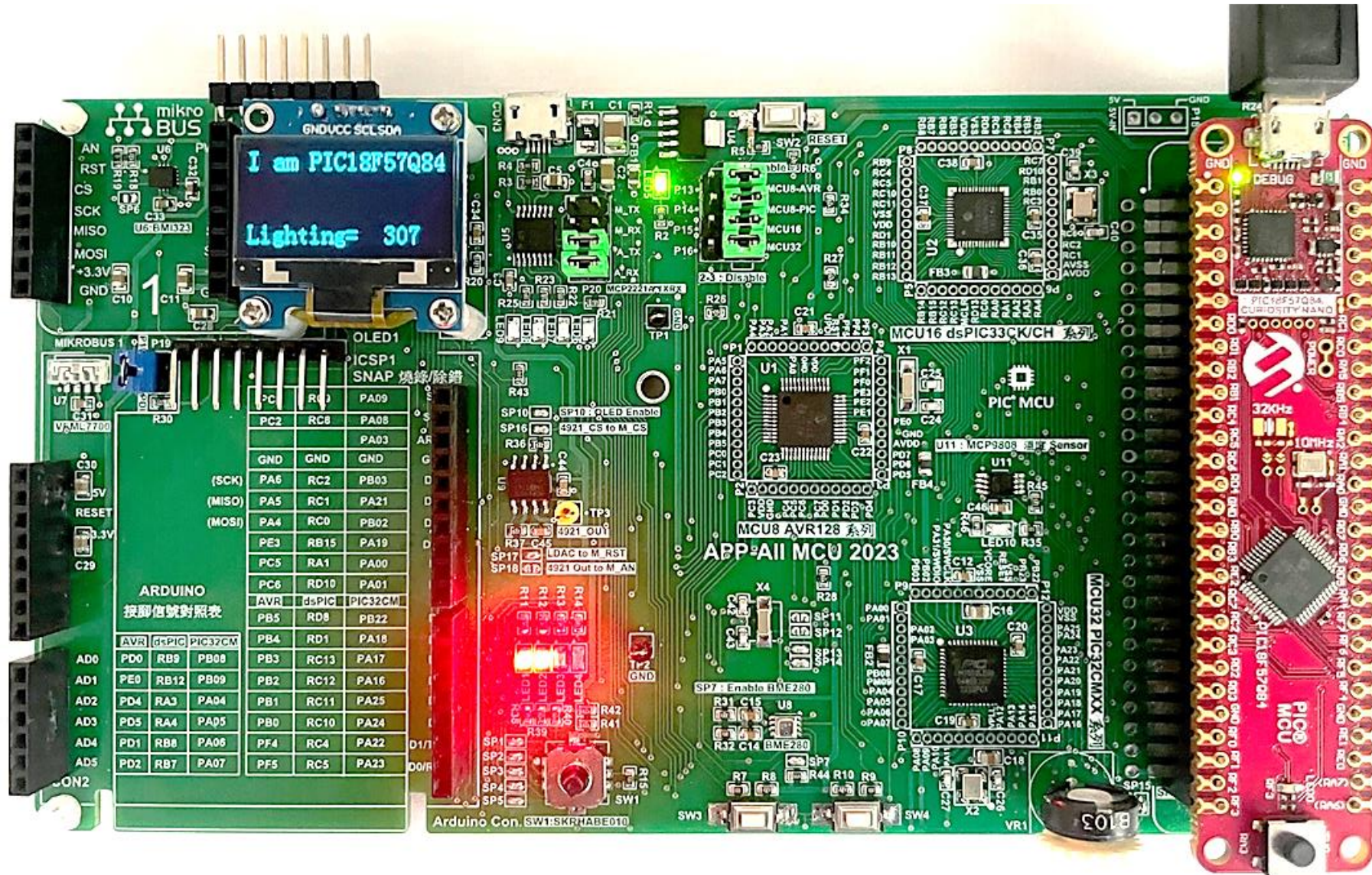


```
84
85
86     OLED_Init();
87     OLED_CLS();
88
89     I2C_Wbuffer[0] = 0xd0 ;
90     I2C0_Host.WriteRead(BME280_ADDR,I2C_Wbuffer,1,I2C_Rbuffer,1);
91     while ( I2C0_Host.IsBusy() );
92
93     if (I2C_Rbuffer[0] != 0x60)
94     {
95         OLED_Put8x16Str(0,0,"BME280 Fail");
96         while (1) ;
97     }
98
99     I2C_Wbuffer[0] = 0x00 ;
100    I2C0_Host.WriteRead(BMI323_ADDR,I2C_Wbuffer,1,I2C_Rbuffer,4);
101    while ( I2C0_Host.IsBusy() );
102
103
104    if (I2C_Rbuffer[2] != 0x42)
105    {
106        OLED_Put8x16Str(0,2,"BMI323 Fail");
107        while (1) ;
108    }
109
110    // Activate Lighting Sensor
```

# APP-AII MCU 2023 相關資料下載點 - 台灣網站首頁

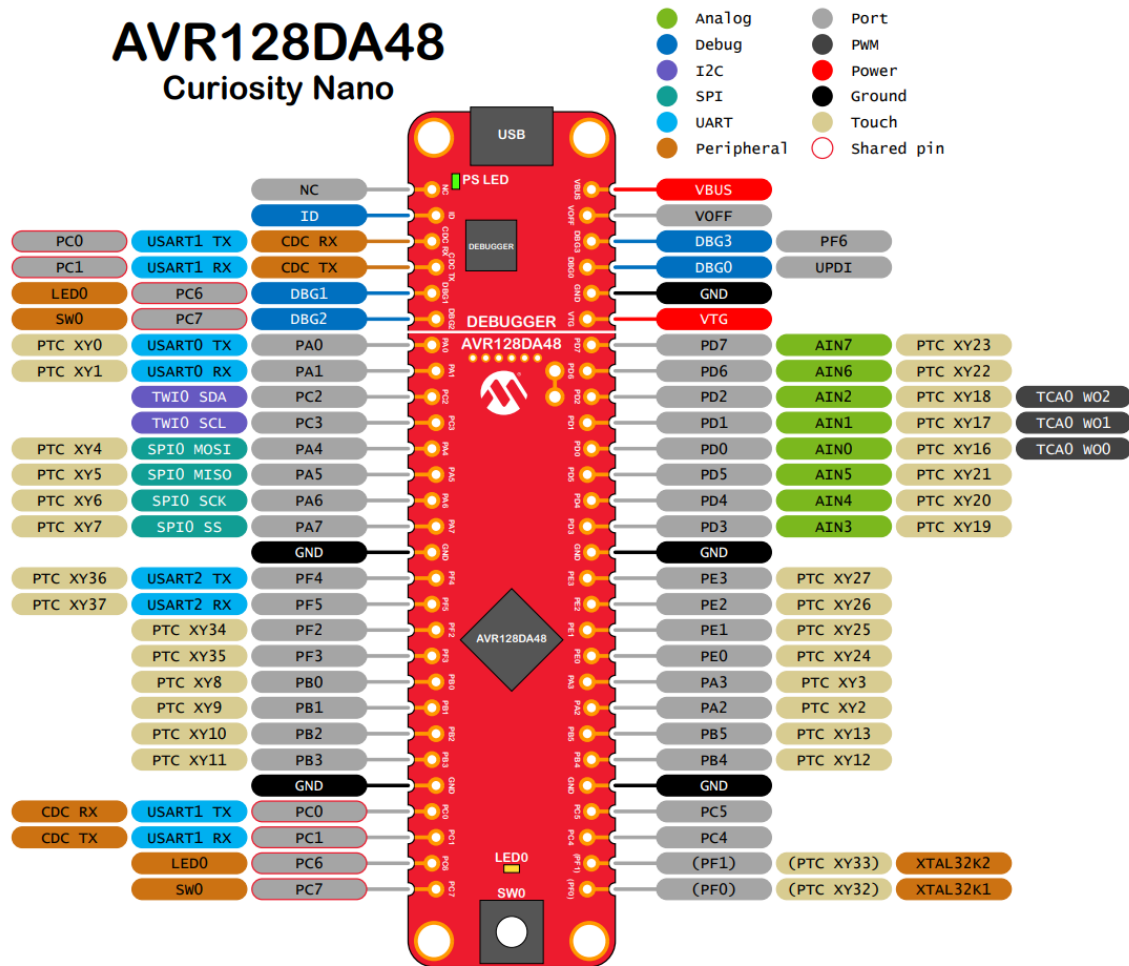
The screenshot shows the Microchip website homepage. At the top, there is a navigation bar with the Microchip logo and links for '回首頁', '主選單', 'Webinar資料區', 'CAE專家教室', and '技術問與答'. Below this is a search bar with the text '請輸入關鍵字' and a '進階搜尋' button. A sidebar on the left contains a '會員選單' with links for '管理區', '檢視帳號', '編輯帳號', '通知', '收件箱' (with a '1' notification), and '登出'. The main content area is titled '研討會/eRTC' and features six event cards. The first card, highlighted with a red border, is for 'APP AII MCU 2023 開發資源下載' and shows a green PCB. The other five cards are for 'Sustainability' events: '台北 5月11日 | 台大集思會議中心', '新竹 5月10日 | 豐邑喜來登大飯店', '台中 5月9日 | 長榮桂冠酒店', '高雄 5月8日 | 蓮潭國際會館', and 'APP-SAM9X60 Hobbv Kit 開發資源連結' which shows another PCB. The Microchip logo is in the bottom right corner.

# 也可以 Disable APP-All MCU 2023 所有的 MCU 而使用外接的 Curiosity Nano – 例如 : PIC18F57Q84

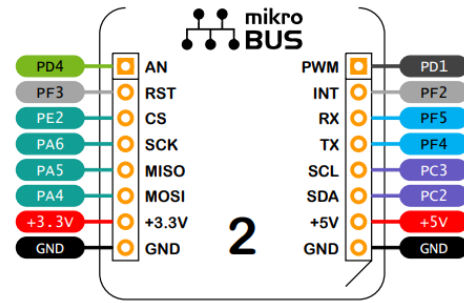
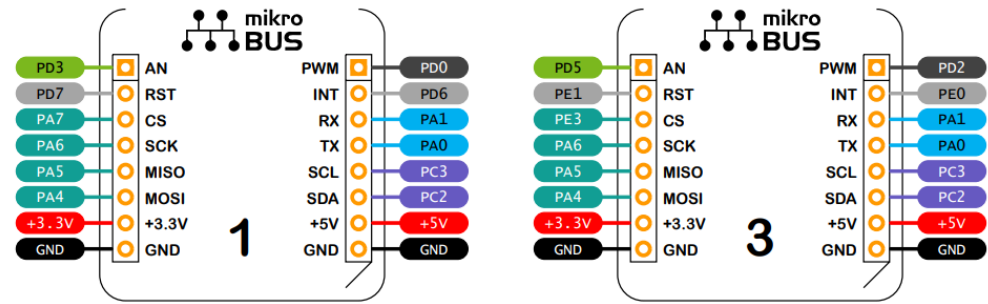




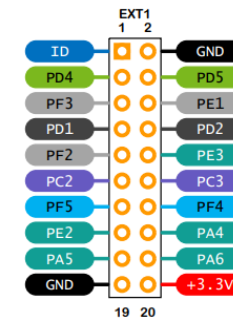
# AVR128DA48 Curiosity Nano 的完整信號連接



## Curiosity Nano Base for Click boards™

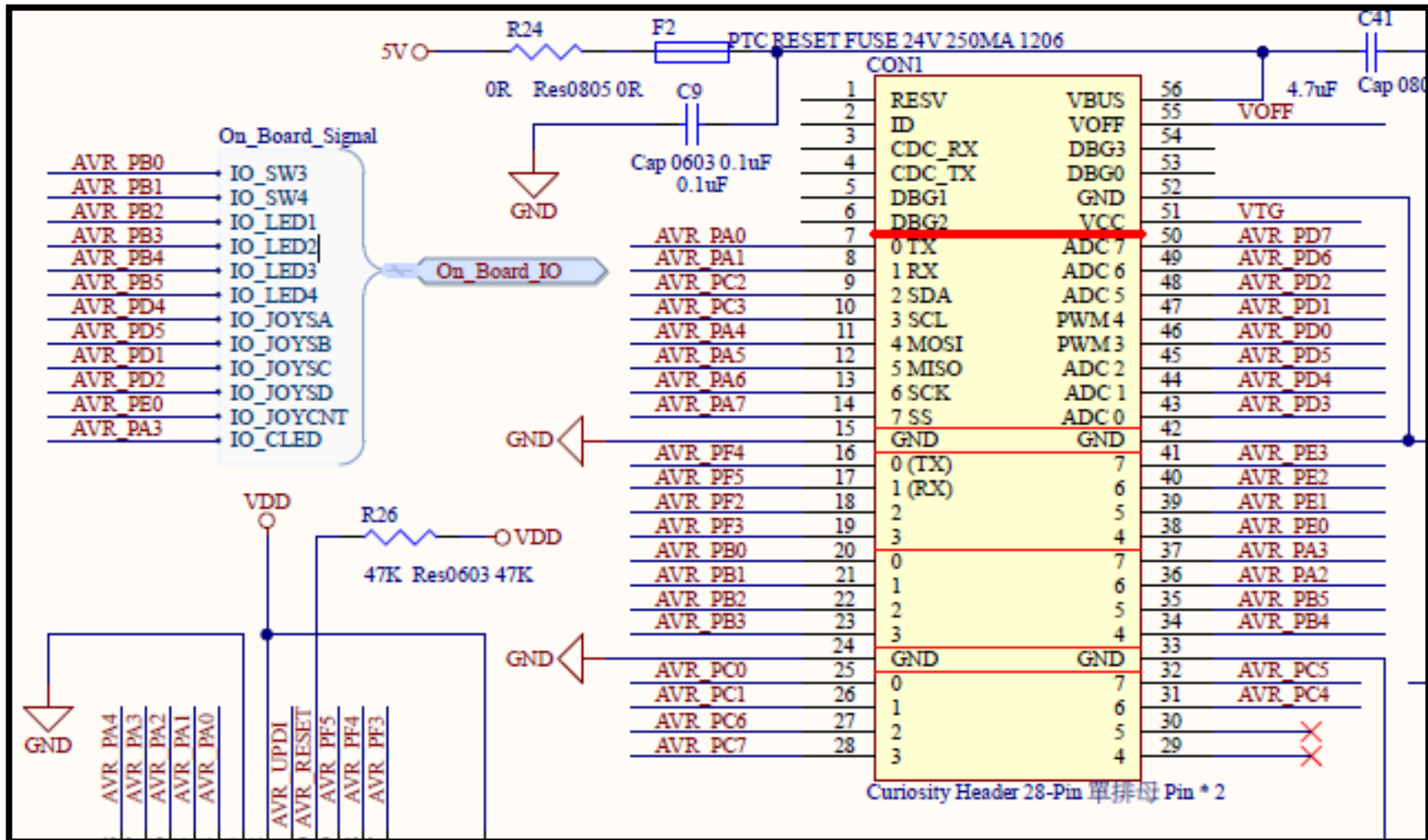


## Xplained Pro Extension



# 參考 AVR128DA48 線路圖

- LED1 = PB2, LED2 = PB3









**SMART | CONNECTED | SECURE**

***“Thank You”***