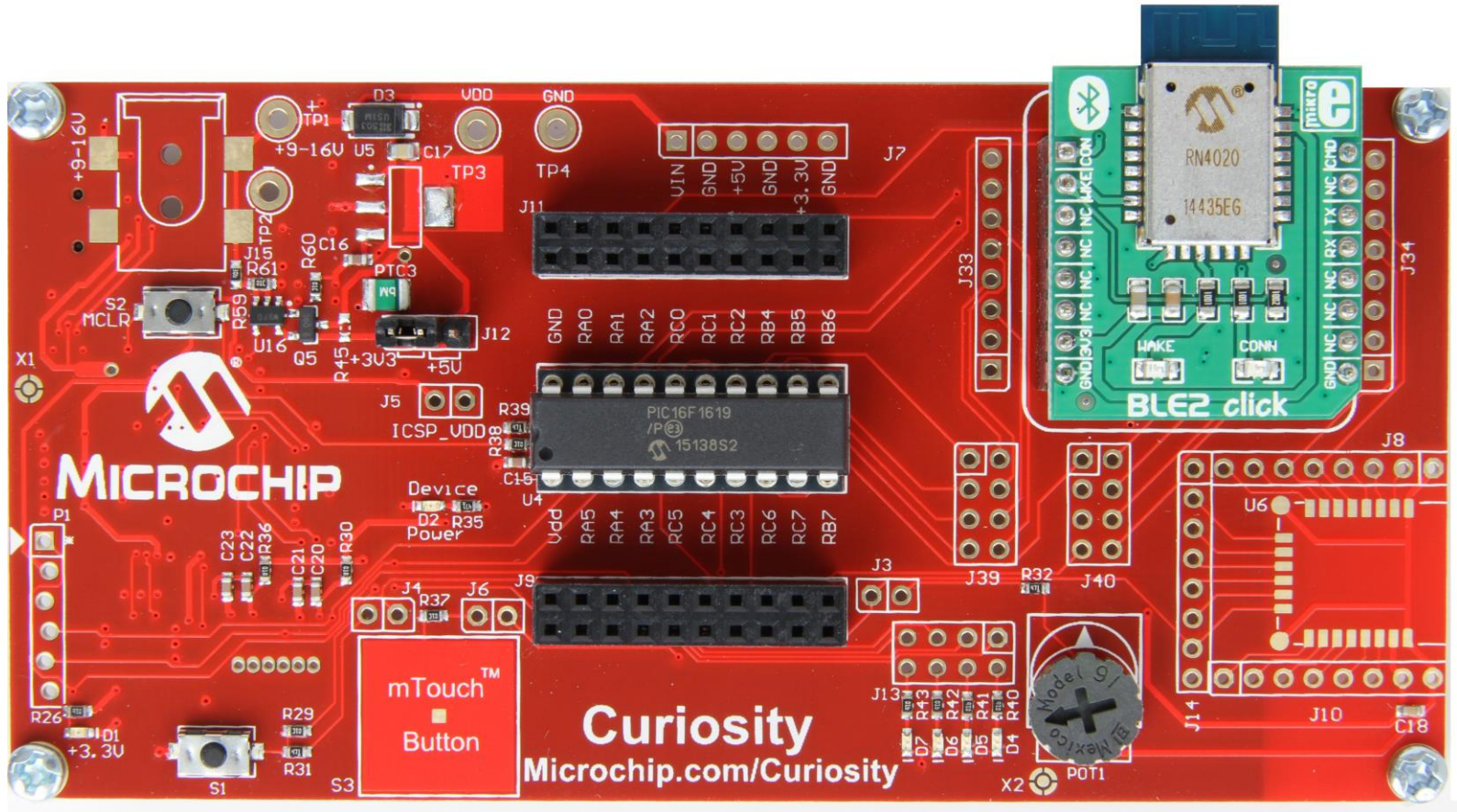


# IoT Development Tools for PIC32



## PIC32MM Curiosity

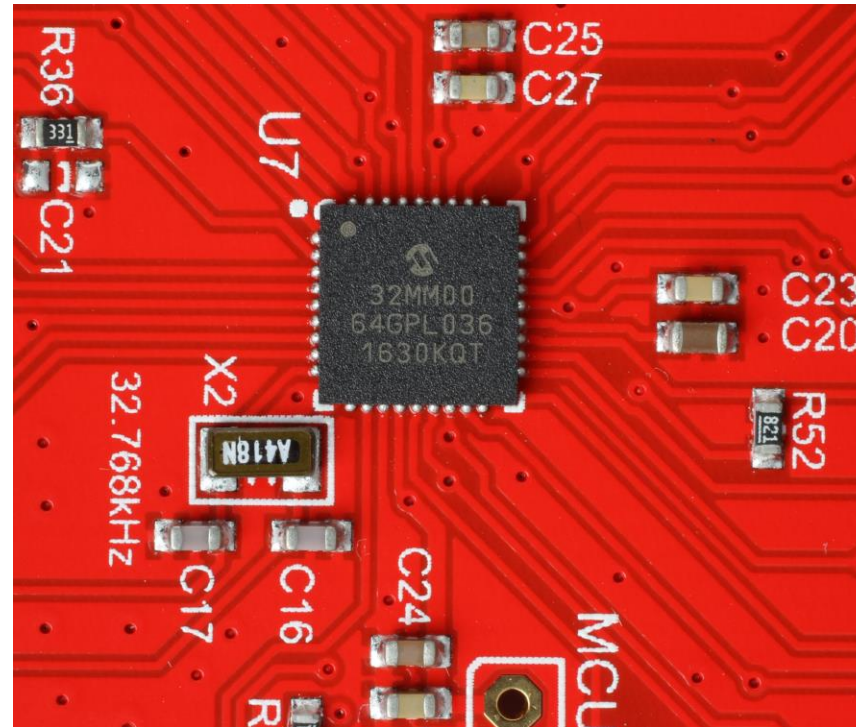
January 29, 2018

FRED EADY

Presented by:

## AGENDA

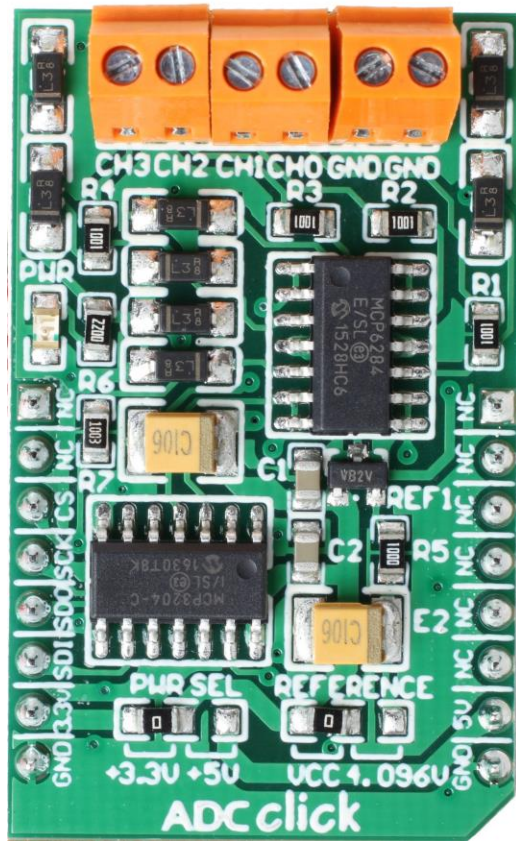
- **PIC32MM Curiosity Hardware**
- **PIC32 Software Development Tools**
- **ADC click Project**
- **Double click – DAC click Project**
- **Hasta Mañana**



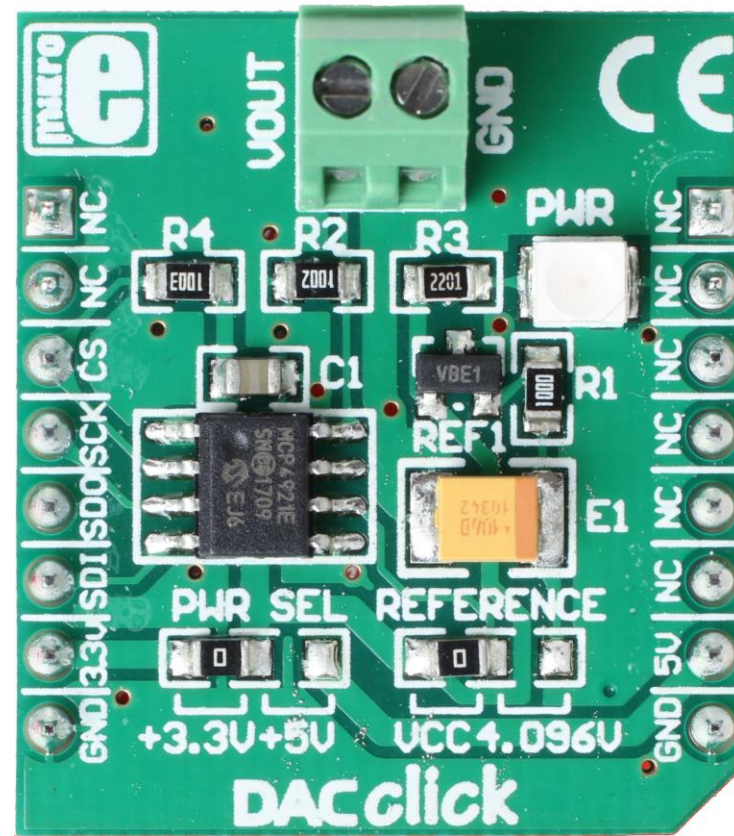


# IoT Development Tools for PIC32

## PIC32MM Curiosity Hardware – [click Part Numbers](#)



**ADC CLICK MCP3204**  
**MIKROE-922**  
**1471-1301-ND**

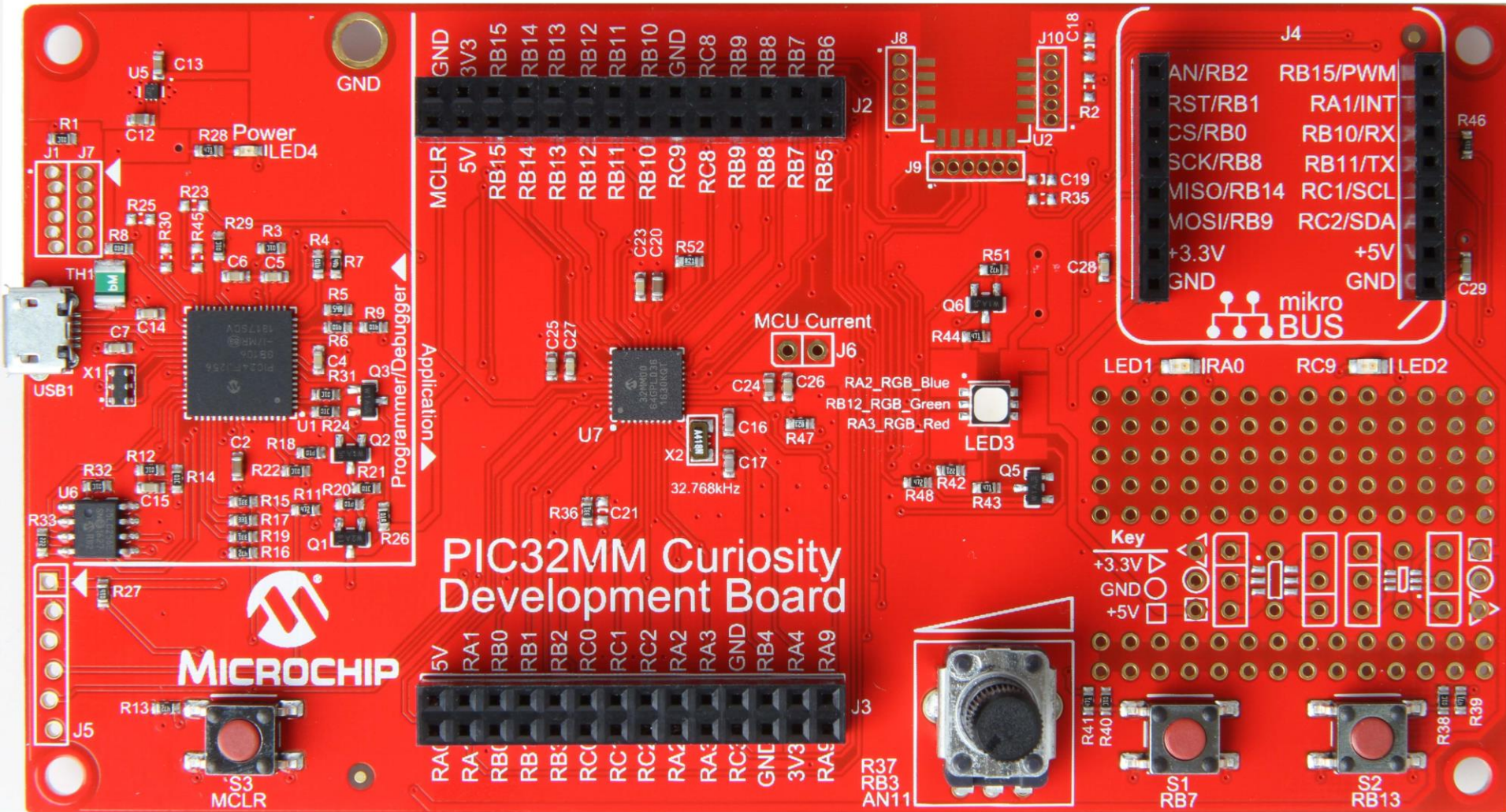


**DAC CLICK MIKROBUS**  
**MIKROE-950**  
**1471-1317-ND**



# IoT Development Tools for PIC32

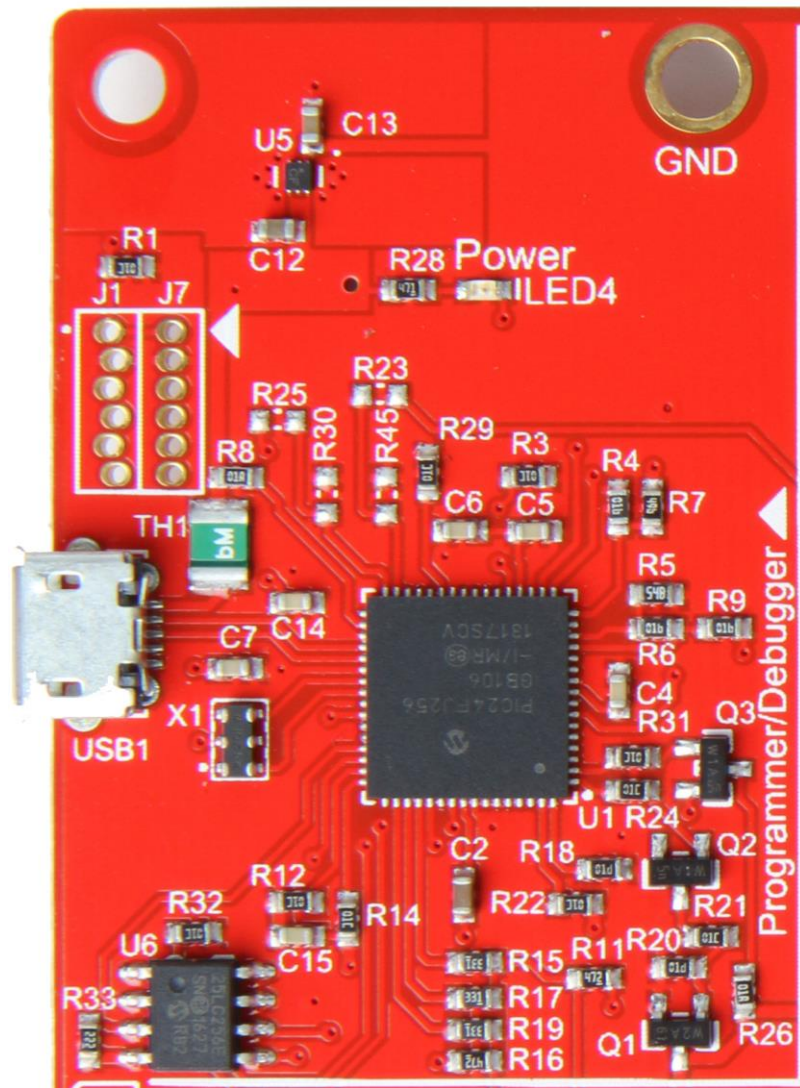
## PIC32MM Curiosity Hardware





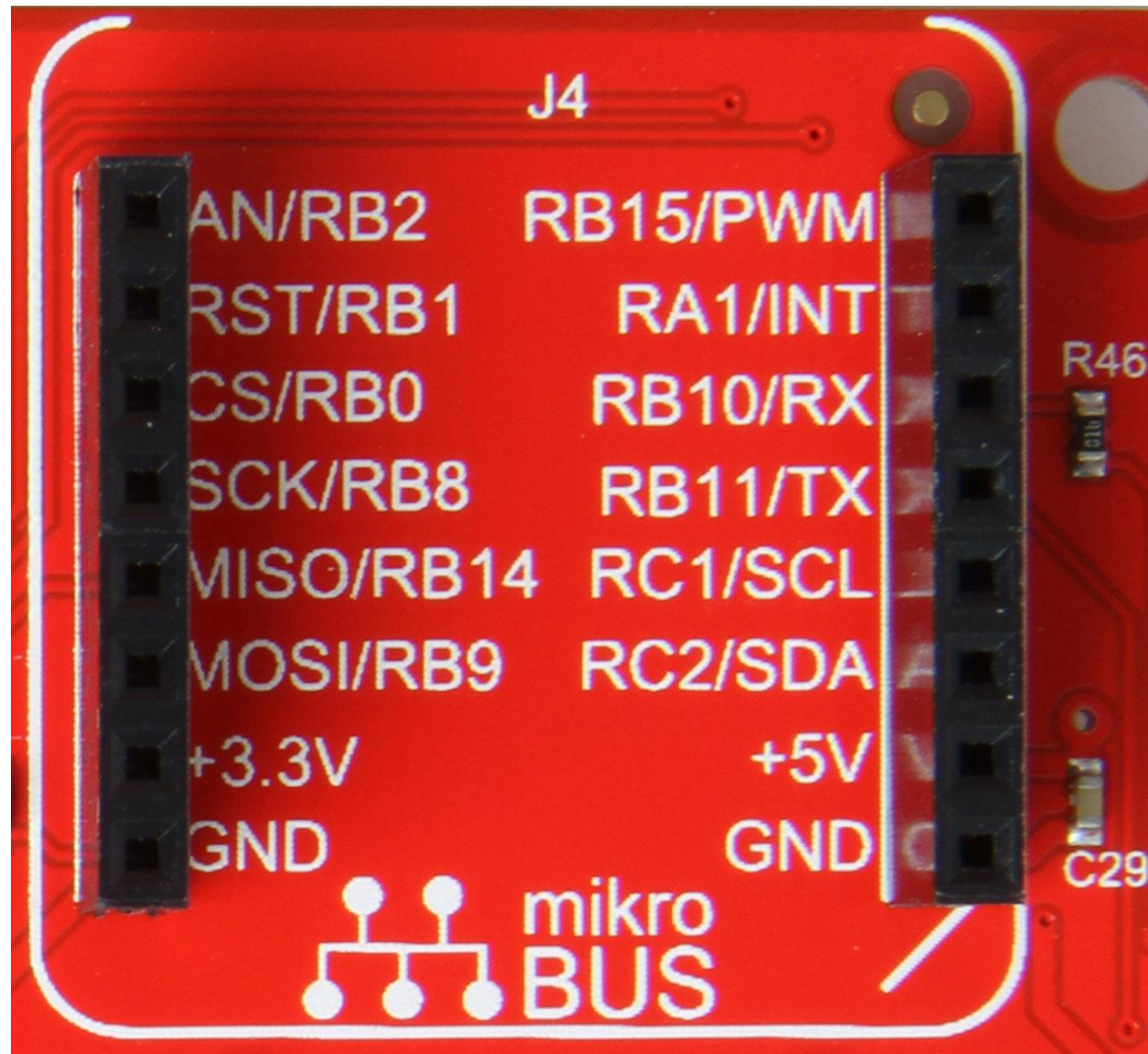
# IoT Development Tools for PIC32

## PIC32MM Curiosity Hardware - PKOB



# IoT Development Tools for PIC32

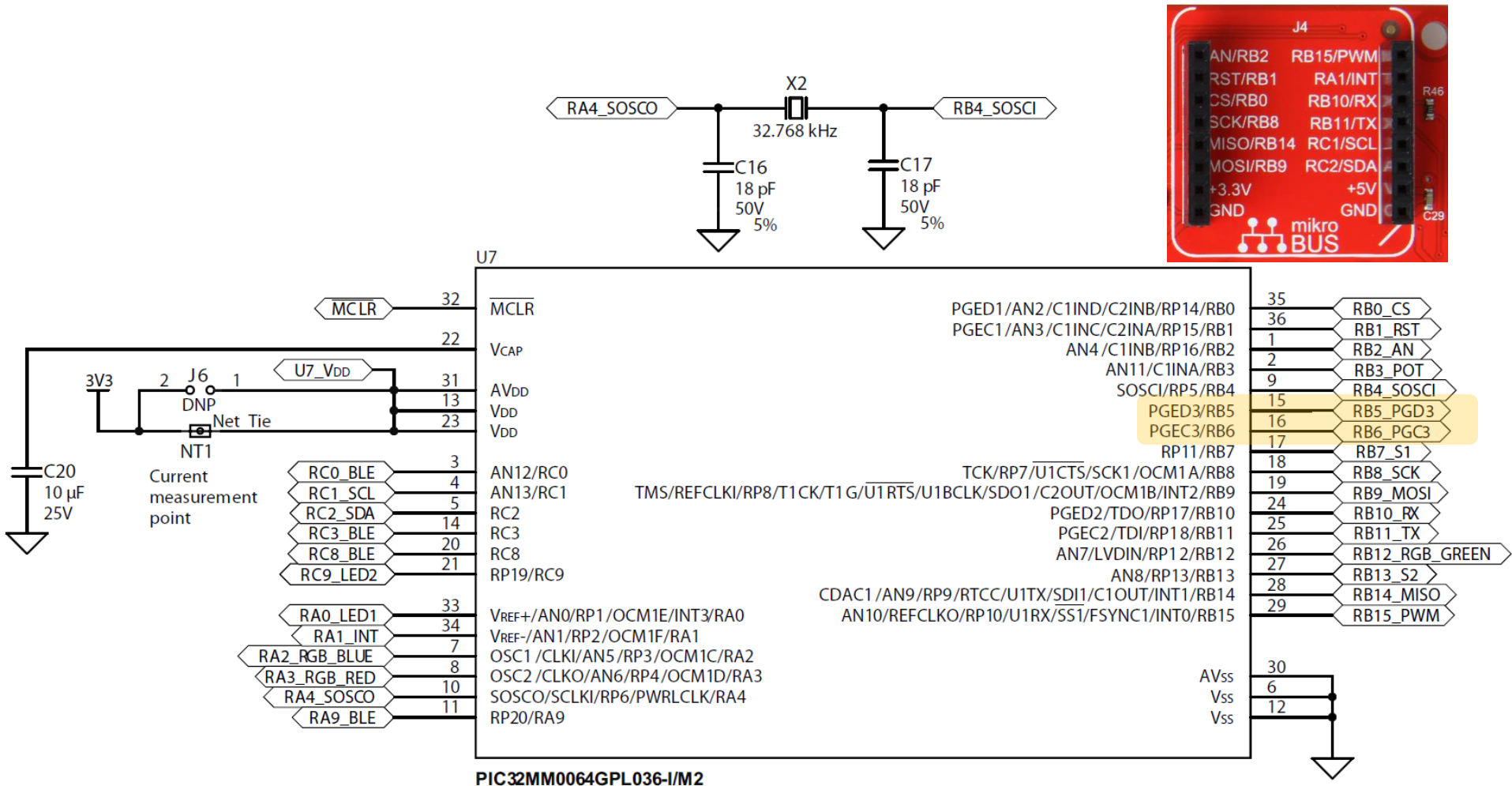
## PIC32MM Curiosity Hardware - mikroBUS





# IoT Development Tools for PIC32

## PIC32MM Curiosity Hardware – Program/Debug Pins



# IoT Development Tools for PIC32

## PIC32 Software Development Tools – MPLAB X

MPLAB X IDE v4.05 - DAC click - PIC32MM Curiosity Development Board : default

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

Search (Ctrl+I)

Projects Files Services Classes

ADC click - PIC32MM Curiosity Development Board

- Documentation
- Header Files
- Important Files
- Linker Files
- Source Files
- Libraries
- Loadables

DAC click - PIC32MM Curiosity Development Board

- Documentation
- Header Files
- Important Files
- Linker Files
- Source Files
- Libraries
- Loadables

Start Page main.c click\_adc.h click\_adc.c read\_me.txt read\_me.txt

**MPLAB X IDE**

**MICROCHIP**

LEARN & DISCOVER | MY MPLAB® X IDE | WHAT'S NEW

**PROJECTS**

- Open Sample
- Create New
- Import Legacy
- Import Prebuilt

**DATA SHEETS**

**EMBEDDED CODE SOURCE**

**INSTALL MORE**

**Recent Projects**

- explorer16\_demo\_pic32mm0064gpi036\_pim
- GSM click - PIC32MM Curiosity Development Board
- fdd
- uart\_basic
- ffss
- ADC click - PIC32MM0064GPL036 PIM
- gps.X
- explorer16\_demo\_pic32mm0256gpm064\_pim
- 3232
- ajunk

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**References & Featured Links**

- Errata
- Product Selection Tools
- Technical Articles and White Papers
- Buy Direct from Microchip

**Output - Configuration Loading Error**

```
info: Configuration "default" will build with toolchain "XC32" at "C:\Program Files (x86)\Microchip\xc32\v1.44\bin".
info: Configuration "default" will build with toolchain "XC32" at "C:\Program Files (x86)\Microchip\xc32\v1.44\bin".
info: Configuration "default" will build with toolchain "XC32" at "C:\Program Files (x86)\Microchip\xc32\v1.44\bin".
```

**Navigation**

DAC click - PIC32MM Curiosity Development Board

- Project Type: Application - Configuration: default
- Device: PIC32MM0064GPL036
- Checksum: Blank, no code loaded
- Compiler Toolchain: XC32 (v1.44) [C:\Program Files (x86)\Microchip\xc32\v1.44\bin]
- Production Image: Optimization:
- Memory
  - Usage Symbols disabled. Click to enable Load Symbols.
  - Data 8192 (0x2000) bytes
  - Program 65536 (0x10000) bytes
- Debug Tool: ICD 3
- Debug Resources
  - Program BP Used: 0 Free: 4
  - Data BP Used: 0 Free: 2
  - Data Capture BP: No Support
  - Unlimited BP (S/W): No Support



# IoT Development Tools for PIC32

## PIC32 Software Development Tools – MCC

MPLAB X IDE v4.05 - pic32MM\_ADC : PIC32MM\_ADC

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

PC: 0x0 How do I? Keyword(s)

Projects Files Services Resource Management [MCC] x

Project Resources Generate Import... Export

System  
Interrupt Module  
Pin Module  
System Module

Mikro-E Clicks  
Mixed-Signal  
Peripherals  
SPI1 [Foundation Services Library by Microchip Technology, Inc.]  
Libraries  
Foundation Services

Device Resources

Documents  
PIC32MM0064GPL036 Product Page  
Peripherals  
ADC  
CDAC  
CLC  
CRC  
Comparator  
Ext Interrupt  
HLVD  
MCCP  
RTCC

pic32MM\_ADC - Dashboard Navigator Versions [MCC] x

Versions

MPLAB® Code Configurator (Plugin) v3.45.1  
Libraries  
Microchip Technology, Inc.  
Microcontrollers and Peripherals  
PIC10 / PIC12 / PIC16 / PIC18 MCUs (v1.55)  
PIC24 / dsPIC33 / PIC32MM MCUs (v1.45)  
PIC32MX MCUs (v1.35)  
Software  
8-bit Bootloader Library (v2.2.0)  
CoAP Library

System Module

Easy Setup Registers

INTERNAL OSCILLATOR

8000000 Hz FRC Oscillator (8.0 MHz) Clock Source

FRC Postscaler

PLL Enable

24 MHz 3:1 Multiplier  
24 MHz 1:1 Divider

24 MHz SYSCLK  
24 MHz PBCLK

Clock Output Pin Configuration OSCO pin operates as a normal I/O

Use Secondary Oscillator (31 - 50) kHz

Pin Manager: Package View x

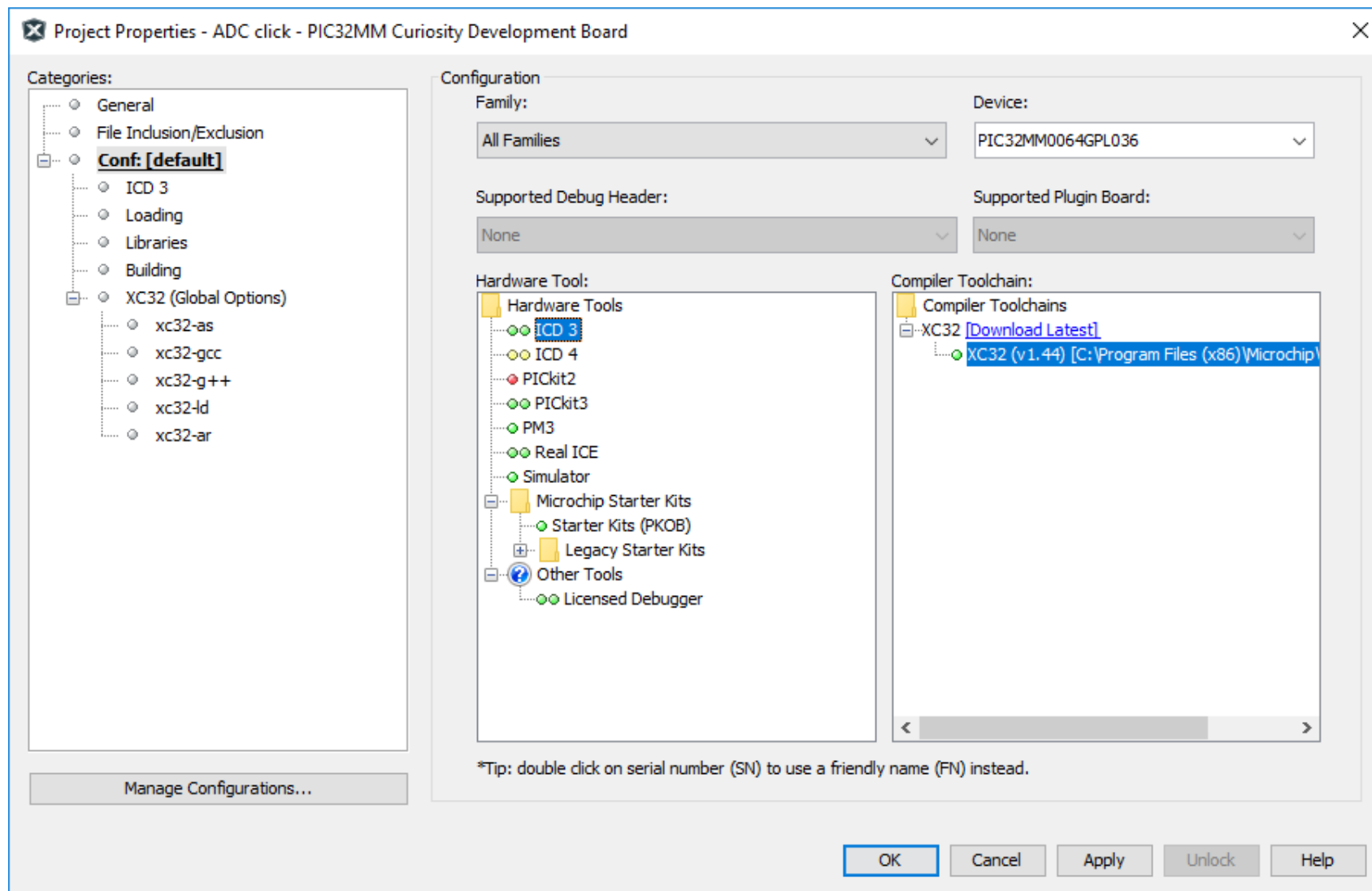
PIC32MM0064GPL036

Pin Manager: Grid View x

Package:	QFN36	Pin No:	33	34	7	8	10	11	35	36	1	2	9	15	16	17	18	19	24	25	26	27	28	29	3	4	5	14	20	21
			Port A ▼									Port B ▼									Port C ▼									
			0	1	2	3	4	9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0	1	2	3	8	9
Module	Function	Direction																												
ADC	nCS	output																												
	PGCx	input																												
ICD ▼	PGDx	input																												
	CLKI	input																												
	CLKO	output																												
OSC ▼	OSC1	input																												
	OSCO	output																												
	REFCLKI	input																												
	REFCLKO	output																												
	SOSCI	input																												
	SOSCO	output																												
Pin Module ▼	GPIO	input																												
	GPIO	output																												
	SCK1	output																												

# IoT Development Tools for PIC32

## PIC32 Software Development Tools – XC32





# IoT Development Tools for PIC32

## ADC click Project - Setup

The image displays three overlapping screenshots of the MPLAB X IDE 'New Project' wizard, illustrating the initial setup steps for a PIC32 project.

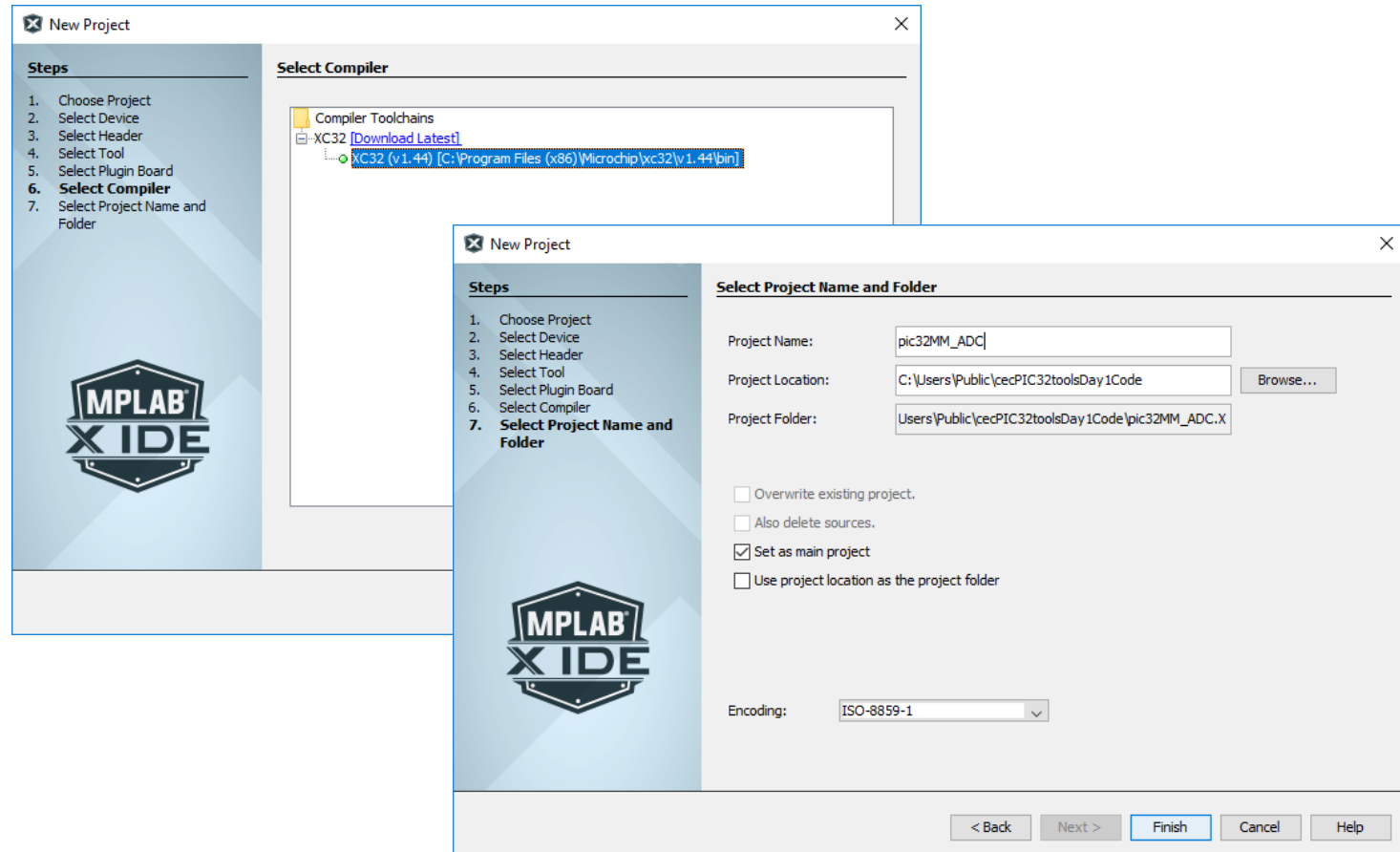
**Top Screenshot (Choose Project):** The 'Steps' pane shows '1. Choose Project' as the current step. The 'Choose Project' pane includes a 'Filter' field and two lists: 'Categories' (Microchip Embedded, Other Embedded, Samples) and 'Projects' (32-bit MPLAB Harmony Project, Standalone Project, Existing MPLAB IDE v8 Project, Prebuilt (Max. Loadable Image) Project). The 'Standalone Project' is selected.

**Middle Screenshot (Select Device):** The 'Steps' pane shows '2. Select Device' as the current step. The 'Select Device' pane includes a 'Family' dropdown set to '32-bit MCUs (PIC32)' and a 'Device' dropdown set to 'PIC32MM0064GPL036'.

**Bottom Screenshot (Select Tool):** The 'Steps' pane shows '3. ...' as the current step. The 'Select Tool' pane includes a tree view of available tools. Under 'Microchip Starter Kits', 'PIC32MM Curiosi...' is selected.

# IoT Development Tools for PIC32

## ADC click Project - Setup





# IoT Development Tools for PIC32

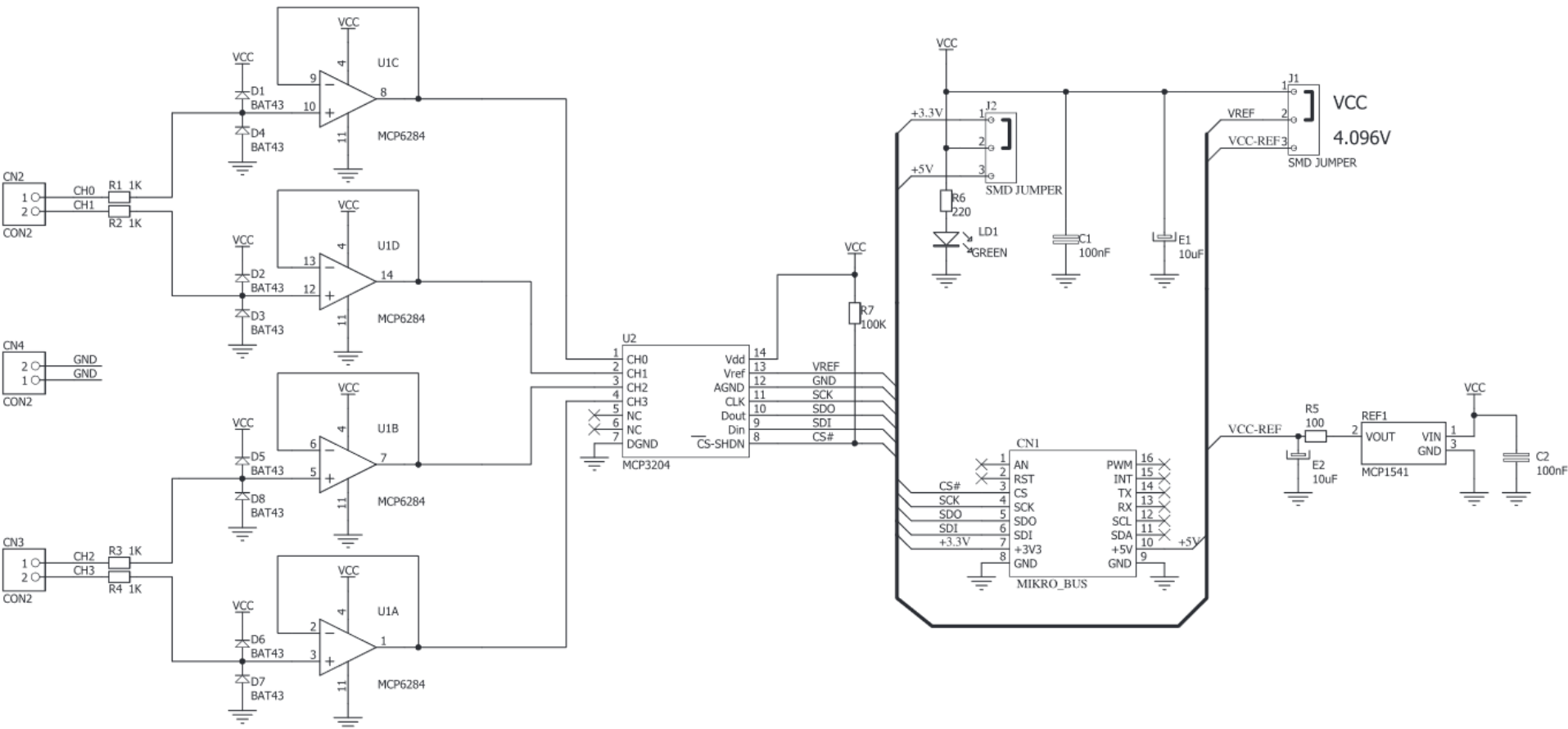
## ADC click Project – MPLAB Code Configurator

The screenshot displays the MPLAB Code Configurator interface. The 'System Module' tab is active, showing the 'INTERNAL OSCILLATOR' settings. The clock source is set to 'FRC Oscillator' at 8.0 MHz. The PLL is enabled, with a 24 MHz multiplier and a 1:1 divider. The clock output pin configuration is set to 'OSCO pin operates as a normal I/O'. The 'ICD' section shows the emulator pin placement set to 'Communicate on PGEC3/PGED3'. The 'Pin Manager: Package View' tab is also visible, showing the pin configuration for the PIC32MM0064GPL036 package. The pin diagram shows the following connections: RB1 (36), RB0 (35), RA1 (34), RA0 (33), MCLR (32), AVdd (31), AVss (30), RB15 (29), RB14 (28), RB13 (27), RB12 (26), RB11 (25), RB10 (24), Vdd (23), Vcap (22), RC9 (21), RC8 (20), RB9 (19), RB8 (18), RB7 (17), RB6PGC3 (16), RB5PGD3 (15), Vdd (14), Vss (13), RA9 (12), RA4 (11), RA2 (10), CLKO (8), RB4 (9), and Vss (6).

Presented by:

# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator





# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator

**Description**

ADC Click is an accessory board in mikroBUS form factor. It includes a 12-bit Analog-to-Digital Converter (ADC) MCP3204 that features 50k samples/second, 4 input channels and low-power consumption (500nA typical standby, 2µA max).

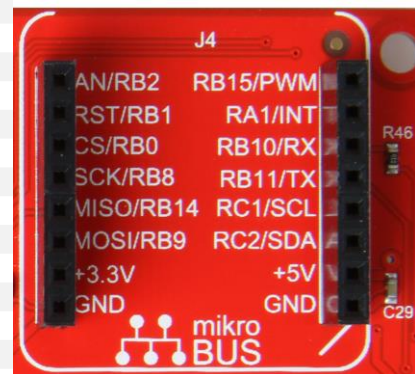
**Product Page**

<https://shop.mikroe.com/click/mixed-signal/adc>

**Pin Manager: Package View**

**Output** **Notifications [MCC]** **Pin Manager: Grid View**

Package:	QFN36	Pin No:	33	34	7	8	10	11	35	36	1	2	9	15	16	17	18	19	24	25	26	27	28	29	3	4	5	14	20	21	
			<b>Port A ▼</b>					<b>Port B ▼</b>										<b>Port C ▼</b>													
<b>Module</b>	<b>Function</b>	<b>Direction</b>	0	1	2	3	4	9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0	1	2	3	8	9	
ADC	nCS	output	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	
ICD ▼	PGCx	input																													
	PGDx	input																													
	CLKI	input				🔒																									
	CLKO	output					🔒																								
OSC ▼	OSC1	input				🔒																									
	OSCO	output					🔒																								
	REFCLKI	input																													
	REFCLKO	output																													
	SOSCI	input																													
	SOSCO	output																													
Pin Module ▼	GPIO	input	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒
	GPIO	output	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒	🔒
SPI1 ▼	SCK1	output																													
	SDI1	input																													
	SDO1	output																													
	SS1	output																													



Presented by:

# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator

MPLAB X IDE v4.05 - pic32MM\_ADC : pic32MM\_ADC

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

pic32MM\_ADC PC: 0x0 How do I? Keyword(s)

**Projects** Files Services Resource Management [MCC] x

**Project Resources** Generate Import... Export

- System
  - Interrupt Module
  - Pin Module
  - System Module
- Mikro-E Clicks
  - Mixed-Signal
    - ADC
- Libraries
  - Foundation Services
  - Peripherals
    - SPI1 [Foundation Services Library by Microchip Technology, Inc.]

**Device Resources**

- Interface
  - Mixed-Signal
    - ACurrent
    - ADC2
    - ADC3
    - Ammeter
    - DAC
    - DAC3
    - DigiPot
  - Sensors
  - Audio and Voice
  - Wireless Connectivity

**pic32MM\_ADC - Dashboard** x Navigator Versions [MCC]

Project Type: Application - Configuration: pic32MM\_ADC

Device: PIC32MM0064GPL036

Checksum: Blank, no code loaded

Compiler Toolchain: XC32 (v1.44) [C:\Program Files (x86)\Microchip\xc32\v1.44\bin]

Production Image: Optimization:

Memory:
 

- Usage Symbols disabled. Click to enable Load Symbols.
- Data 8192 (0x2000) bytes
- Program 65536 (0x10000) bytes

Debug Tool: Starter Kits (PKOB): BUR171271421

Debug Resources

**Start Page** x **System Module** x **Pin Module** x **Interrupt Module** x **ADC** x

**Information** Configuration Advanced Settings

**Description**

ADC Click is an accessory board in mikroBUS form factor. It includes a 12-bit Analog-to-Digital Converter (ADC) MCP3204 that features 50k samples/second, 4 input channels and low-power consumption (500nA typical standby, 2µA max).

**Product Page**

<https://shop.mikroe.com/click/mixed-signal/adc>

**Pin Manager: Package View**

**Output - MPLAB® Code Configurator** x **Notifications [MCC]** **Pin Manager: Grid View**

```

13:33:35.651 INFO: *****
13:33:35.651 INFO: Generation Results
13:33:35.652 INFO: *****
13:33:35.656 INFO: main.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc.h Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc_example.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc_example.h Success. New file.
13:33:35.657 INFO: mcc_generated_files\exceptions.c Success. New file.
13:33:35.658 INFO: mcc_generated_files\exceptions.h Success. New file.
13:33:35.658 INFO: mcc_generated_files\interrupt_manager.c Success. New file.
13:33:35.658 INFO: mcc_generated_files\interrupt_manager.h Success. New file.
13:33:35.658 INFO: mcc_generated_files\mcc.c Success. New file.
13:33:35.658 INFO: mcc_generated_files\mcc.h Success. New file.
13:33:35.659 INFO: mcc_generated_files\pin_manager.c Success. New file.
13:33:35.659 INFO: mcc_generated_files\pin_manager.h Success. New file.
13:33:35.659 INFO: mcc_generated_files\spi_driver.c Success. New file.
13:33:35.659 INFO: mcc_generated_files\spi_driver.h Success. New file.
13:33:35.660 INFO: mcc_generated_files\spi_types.h Success. New file.
13:33:36.315 INFO: *****
13:33:36.315 INFO: Generation complete (total time: 1288 milliseconds)
13:33:36.316 INFO: *****
13:33:36.316 INFO: Generation complete.
13:33:36.357 INFO: Saved configuration to file C:\Users\Public\cecPIC32toolsDay1Code\pic32MM_ADC.X\pic32MM_ADC.mc3
13:34:18.997 INFO: Libraries defined in the configuration:
13:34:18.997 INFO: com.microchip.mcc.mikroEClickLibrary.MikroEClickLibrary v1.0.26
13:34:18.997 INFO: com.microchip.mcc.mcui6.Mcui6PeripheralLibrary v1.45
13:34:18.998 INFO: com.microchip.mcc.foundationServices.library.FoundationServicesLibrary v0.1.23
13:34:22.225 INFO: Loaded configuration from file C:\Users\Public\cecPIC32toolsDay1Code\pic32MM_ADC.X\pic32MM_ADC.mc3
    
```

# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator

MPLAB X IDE v4.05 - pic32MM\_ADC : pic32MM\_ADC

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

pic32MM\_ADC PC: 0x0 How do I? Keyword(s)

**Projects** | **Files** | **Services** | **Resource Management [MCC]** | **Start Page** | **System Module** | **Pin Module** | **Interrupt Module** | **ADC** | **Pin Manager: Package View**

**pic32MM\_ADC**

- Header Files
  - MCC Generated Files
    - adc.h
    - adc\_example.h
    - exceptions.h
    - interrupt\_manager.h
    - mcc.h
    - pin\_manager.h
    - spi1\_driver.h
    - spi1\_types.h
  - Important Files
  - Linker Files
  - Source Files
    - main.c
  - MCC Generated Files
    - adc.c
    - adc\_example.c
    - exceptions.c
    - interrupt\_manager.c
    - mcc.c
    - pin\_manager.c
    - spi1\_driver.c
  - Libraries
  - Loadables

**Information** | **Configuration** | **Advanced Settings**

**Description**

ADC Click is an accessory board in mikroBUS form factor. It includes a 12-bit Analog-to-Digital Converter (ADC) MCP3204 that features 50k samples/second, 4 input channels and low-power consumption (500nA typical standby, 2µA max).

**Product Page**

<https://shop.mikroe.com/click/mixed-signal/adc>

**Pin Manager: Package View**

PIC32MM0064GPL036

**Output - MPLAB® Code Configurator** | **Notifications [MCC]** | **Pin Manager: Grid View**

```
13:33:35.651 INFO: *****
13:33:35.651 INFO: Generation Results
13:33:35.652 INFO: *****
13:33:35.656 INFO: main.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc.h Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc_example.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\adc_example.h Success. New file.
13:33:35.657 INFO: mcc_generated_files\exceptions.c Success. New file.
13:33:35.657 INFO: mcc_generated_files\exceptions.h Success. New file.
13:33:35.658 INFO: mcc_generated_files\interrupt_manager.c Success. New file.
13:33:35.658 INFO: mcc_generated_files\interrupt_manager.h Success. New file.
13:33:35.658 INFO: mcc_generated_files\mcc.c Success. New file.
13:33:35.658 INFO: mcc_generated_files\mcc.h Success. New file.
13:33:35.659 INFO: mcc_generated_files\pin_manager.c Success. New file.
13:33:35.659 INFO: mcc_generated_files\pin_manager.h Success. New file.
13:33:35.659 INFO: mcc_generated_files\spi1_driver.c Success. New file.
13:33:35.659 INFO: mcc_generated_files\spi1_driver.h Success. New file.
13:33:35.660 INFO: mcc_generated_files\spi1_types.h Success. New file.
13:33:36.315 INFO: *****
13:33:36.315 INFO: Generation complete (total time: 1288 milliseconds)
13:33:36.316 INFO: *****
13:33:36.316 INFO: Generation complete.
13:33:36.357 INFO: Saved configuration to file C:\Users\Public\cecPIC32toolsDay1Code\pic32MM_ADC.X\pic32MM_ADC.mc3
13:34:18.997 INFO: Libraries defined in the configuration:
13:34:18.997 INFO: com.microchip.mcc.mikroEClickLibrary.MikroEClickLibrary v1.0.26
13:34:18.997 INFO: com.microchip.mcc.mcui6.Mcui6PeripheralLibrary v1.45
13:34:18.998 INFO: com.microchip.mcc.foundationServices.library.FoundationServicesLibrary v0.1.23
13:34:22.225 INFO: Loaded configuration from file C:\Users\Public\cecPIC32toolsDay1Code\pic32MM_ADC.X\pic32MM_ADC.mc3
```

**pic32MM\_ADC - Dashboard** | **Navigators** | **Versions [MCC]**

pic32MM\_ADC

- Project Type: Application - Configuration: pic32MM\_ADC
- Device: PIC32MM0064GPL036
- Checksum: Blank, no code loaded
- Compiler Toolchain: XC32 (v1.44) [C:\Program Files (x86)\Microchip\xc32\v1.44\bin]
- Production Image: Optimization:
- Memory
  - Usage Symbols disabled. Click to enable Load Symbols.
  - Data 8192 (0x2000) bytes
  - Program 65536 (0x10000) bytes
- Debug Tool
  - Starter Kits (PKOB): BUR171271421
- Debug Resources



# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator

MPLAB X IDE v4.05 - pic32MM\_ADC : pic32MM\_ADC

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

pic32MM\_ADC 1316/1735MB PC: 0x9D001A62 How do I? Keyword(s)

Projects Files Services Resource Management [MCC] x

Project Resources

- System
  - Interrupt Module
  - Pin Module
  - System Module
- Libraries
  - Foundation Services
- Peripherals
  - UART2 [PIC24 / dsPIC33 / PIC32MM MCUs by Microchip Technology, Inc.]
  - SPI1 [Foundation Services Library by Microchip Technology, Inc.]
- Mikro-E Clicks
  - Mixed-Signal

Device Resources

- Documents
  - PIC32MM0064GPL036 Product Page
- Peripherals
  - ADC
  - CDAC
  - CLC
  - CRC
  - Comparator
  - Ext\_Interrupt
  - HLVD
  - MCCP
  - RTCC

pic32MM\_ADC - Dashboard \_mon\_putc(char c) - Navigator Versions [MCC] x

Versions

- MPLAB® Code Configurator (Plugin) v3.45.1
- Libraries
  - Microchip Technology, Inc.
    - Microcontrollers and Peripherals
      - PIC10 / PIC12 / PIC16 / PIC18 MCUs (v1.55)
      - PIC24 / dsPIC33 / PIC32MM MCUs (v1.45)
      - PIC32MX MCUs (v1.35)
    - Software
      - 8-bit Bootloader Library (v2.2.0)

UART2

Easy Setup Registers

Hardware Settings

- ☒ Enable UART
- Clock Source: PBCLK
- Baud Rate: 9600 Error Rate = 0.000
- Parity: None
- Data Bits: 8
- Stop Bits: 1
- Flow Control: None
- ☐ Enable UART Interrupts

Software Settings

- ☒ Redirect Printf to UART

Pin Manager: Package View x

PIC32MM0064GPL036

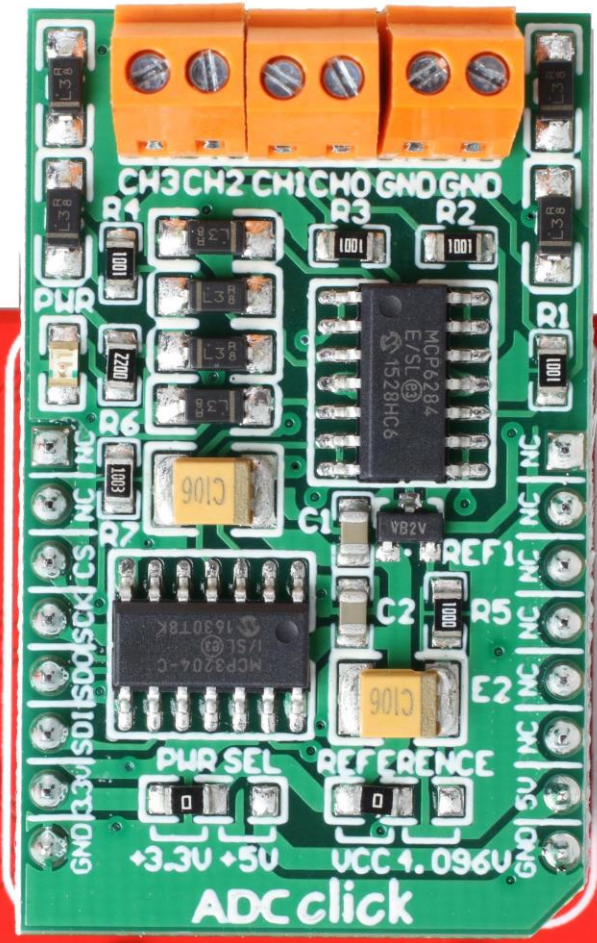
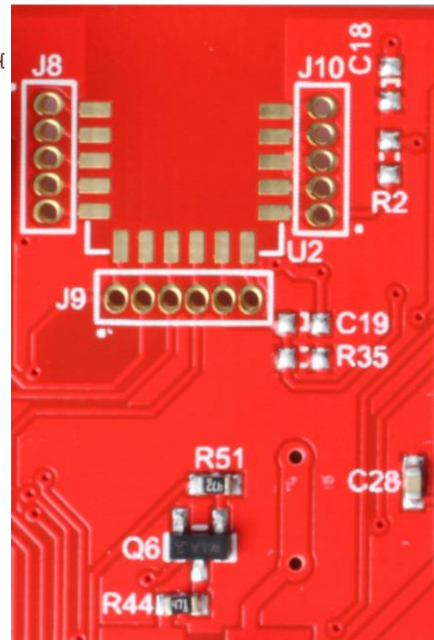
Output Variables Call Stack Breakpoints Notifications [MCC] Pin Manager: Grid View x Simple Serial Port Terminal

Package:	QFN36	Pin No:	33	34	7	8	10	11	35	36	1	2	9	15	16	17	18	19	24	25	26	27	28	29	3	4	5	14	20	21
Module																														
OSC																														
GPIO																														
SPI1																														
UART2																														

# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator

```
1 /**
2  Section: Driver APIs
3  */
4  uint16_t ADC_getConversionCH0(void) {
5      return ADC_getConversionResult(ADC_CH0, SINGLE);
6  }
7  uint16_t ADC_getConversionCH1(void) {
8      return ADC_getConversionResult(ADC_CH1, SINGLE);
9  }
10 uint16_t ADC_getConversionCH2(void) {
11     return ADC_getConversionResult(ADC_CH2, SINGLE);
12 }
13 uint16_t ADC_getConversionCH3(void) {
14     return ADC_getConversionResult(ADC_CH3, SINGLE);
15 }
16 uint16_t ADC_getConversionResult(uint8_t channel, uint8_t input_mode) {
17     if (!adc_initialized) {
18         ADC_initializeClick();
19     }
20     uint8_t readData[3];
21     uint16_t configBits = 0x0400 | (input_mode << 9) | (channel << 6);
22     uint16_t conversionResult;
23     ADC_startConversion();
24     readData[0] = spil_exchangeByte(configBits >> 8);
25     readData[1] = spil_exchangeByte(configBits);
26     readData[2] = spil_exchangeByte(0x00);
27     ADC_stopConversion();
28     conversionResult = ((uint16_t)readData[1]) << 8 | readData[2];
29     return conversionResult;
30 }
31 void ADC_initializeClick(void) {
32     spil_master_open(ADC_CLICK);
33     LATBbits.LATB0 = 1;
34     adc_initialized = 1;
35 }
36 void ADC_startConversion(void) {
37     LATBbits.LATB0 = 0;
38     // __delay_us(CS_DELAY);
39 }
40 void ADC_stopConversion(void) {
41     LATBbits.LATB0 = 1;
42 }
```



# IoT Development Tools for PIC32

## ADC click Project – MPLAB Code Configurator

The screenshot displays the MPLAB X IDE v4.05 interface for the 'pic32MM\_ADC' project. The Project Explorer on the left shows the project structure, including header files (adc.h, exceptions.h, interrupt\_manager.h, mcc.h, pin\_manager.h, spi1\_driver.h, spi1\_types.h, uart2.h) and source files (adc.c, adc\_example.c, exceptions.c, interrupt\_manager.c, mcc.c, pin\_manager.c, spi1\_driver.c, uart2.c). The Source Editor in the center shows the 'main.c' file with the following code:

```
100
101
102 UART2_STATUS UART2_StatusGet (void)
103 {
104     return U2STA;
105 }
106
107 void _mon_putc(char c) {
108
109     while(U2STAbits.TXMT == 0);
110     U2TXREG = c;
111
112 }
113
114 /**
115  * End of File
116  */
117
```

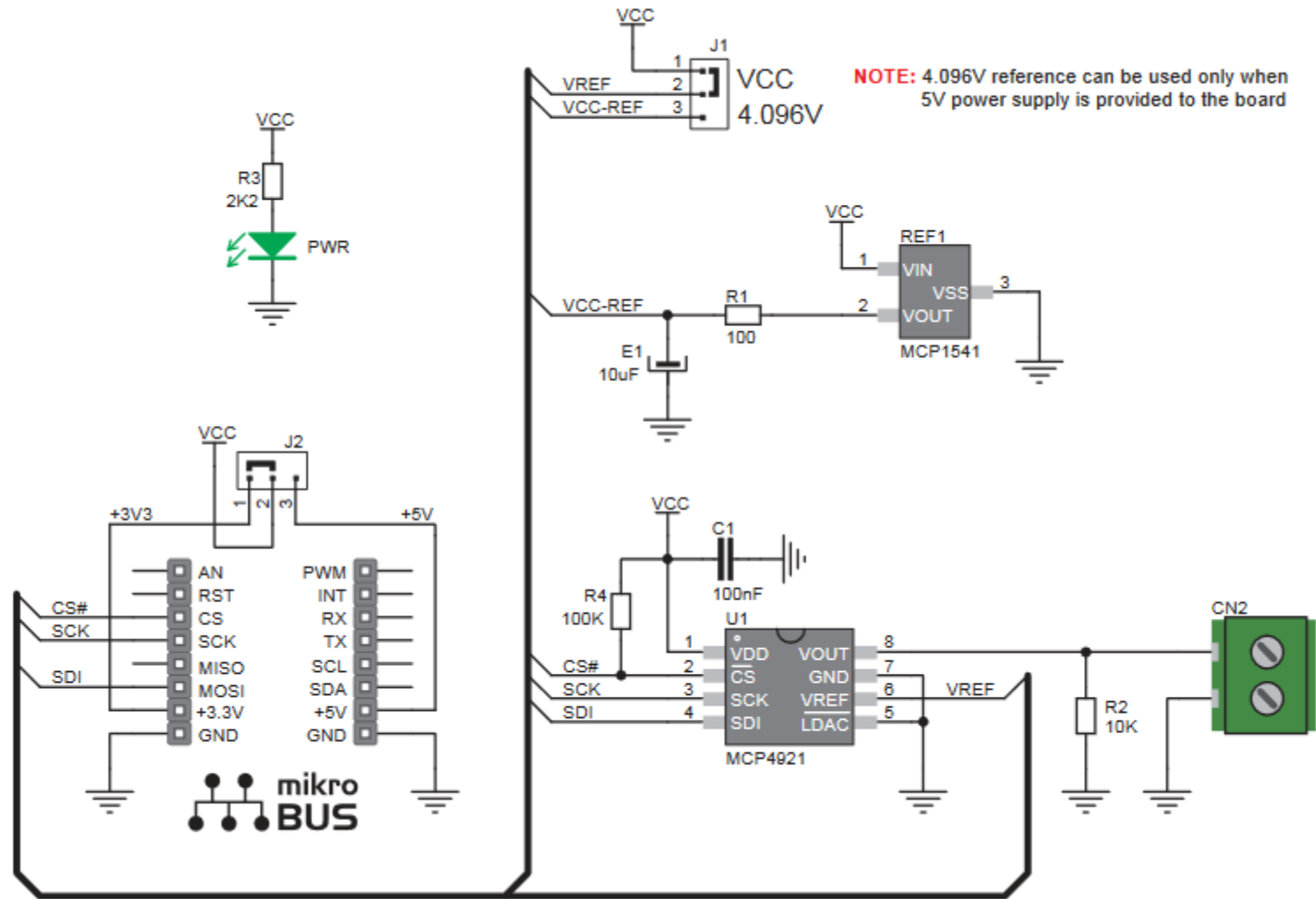
The Pin Manager on the right shows the pin configuration for the PIC32MM0064GPL036 microcontroller. The pins are configured as follows:

- RA0: RB1
- RA1: RB2
- RA2: RB3
- RA3: RB4
- RA4: RB5
- RA5: RB6
- RA6: RB7
- RA7: RB8
- RA8: RB9
- RA9: RB10
- RA10: RB11
- RA11: RB12
- RA12: RB13
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- RA845: RB846
- RA846: RB847
- RA847: RB848
- RA848: RB849
- RA849: RB850
- RA850: RB851
- RA851: RB852
- RA852: RB853
- RA853: RB854
- RA854: RB855
- RA855: RB856
- RA856: RB857
- RA857: RB858
- RA858: RB859
- RA859: RB860
- RA860: RB861
- RA861: RB862
- RA862: RB863
- RA863: RB864
- RA864: RB865
- RA865: RB866
- RA866: RB867
- RA867:



# IoT Development Tools for PIC32

## Double click – DAC click Project



# IoT Development Tools for PIC32

## Double click – DAC click Project

MPLAB X IDE v4.05 - pic32MM\_DAC : PIC32MM\_DAC

File Edit View Navigate Source Refactor Production Debug Team Tools Window Help

PC: 0x0 How do I? Keyword(s)

**Projects** Files **Resource Management [MCC]** x

**Project Resources** Generate Import... Export

System Module

Libraries

Foundation Services

Peripherals

SPI1 [Foundation Services Library by Microchip Technology, Inc.]

Mikro-E Clicks

Mixed-Signal

DAC

**Device Resources**

Mixed-Signal

ACurrent

ADC

ADC2

ADC3

Ammeter

DAC3

DigiPot

**Description**

DAC Click is an accessory board in mikroBUS form factor. It includes a 12-bit Digital-to-Analog Converter MCP4921 that features an optional 2x buffered output and SPI interface.

**Product Page**

<https://shop.mikroe.com/click/mixed-signal/dac>

**Pin Manager: Package View**

**Output - MPLAB® Code Configurator** Notifications [MCC] Pin Manager: Grid View x

Package:	QFN36	Pin No:	33	34	7	8	10	11	2	3	4	9	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	0	1	2	3	8	9				
<b>Module</b>	<b>Function</b>	<b>Direction</b>																																				
DAC	nCS	output																																				
ICD	PGCx	input																																				
	PGDx	input																																				
OSC	CLKI	input																																				
	CLKO	output																																				
	OSC1	input																																				
	OSCO	output																																				
Pin Module	GPIO	input																																				
	GPIO	output																																				
SPI1	SCK1	output																																				
	SDI1	input																																				
	SDO1	output																																				
	SS1	output																																				

**pic32MM\_DAC - Dashboard** Navigator Versions [MCC]

Project Type: Application - Configuration: PIC32MM\_DAC

Device

PIC32MM0064GPL036

Checksum: Blank, no code loaded

Compiler Toolchain

XC32 (v1.44) [C:\Program Files (x86)\Microchip\xc32\v1.44\bin]

Production Image: Optimization:

Memory

Data 8192 (0x2000) bytes

5%

Data Used: 448 (0x1C0) Free: 7744 (0x1E40)

Program 65536 (0x10000) bytes

15%

Program Used: 10080 (0x2760) Free: 55456 (0xD8A0)

Debug Tool

Starter Kits (PKOB): BUR171271421

Debug Resources

Program BP Used: 0 Free: 4

Data BP Used: 0 Free: 2

Data Capture BP: No Support

Unlimited BP (S/W): No Support

**Pin Manager: Grid View**

**J4**

AN/RB2 RB15/PWM

RST/RB1 RA1/INT

CS/RB0 RB10/RX

SCK/RB8 RB11/TX

MISO/RB14 RC1/SCL

MOSI/RB9 RC2/SDA

+3.3V +5V

GND GND

mikro BUS

R46

C29

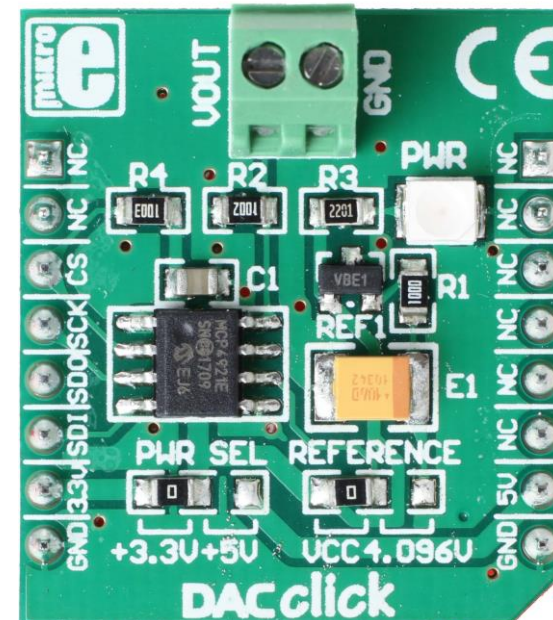


# IoT Development Tools for PIC32

## Double click – DAC click Project – Delay Function

```
1  /*******  
2  /** CORE TIMER DELAY FUNCTION  
3  /** WRITTEN BY FRED EADY  
4  /** NO USB SUPPORT IN THIS VERSION  
5  /** COMPILED USING XC32 v1.44 - MPLABX v4.05  
6  /** LAST UPDATE 01/10/2018  
7  /** NOTES:  
8  /*******  
9  
10 #ifndef CORETIMERDELAY_H  
11 #define CORETIMERDELAY_H  
12  
13 #ifdef __cplusplus  
14 extern "C" {  
15 #endif  
16  
17 void ctDelaysms(uint16_t ms);  
18  
19 #define GetSystemClock()          24000000UL  
20 #define GetPeripheralClock()      24000000UL  
21 #define CoreTicksPerMs           (GetSystemClock() / 2000)  
22  
23 #ifdef __cplusplus  
24 }  
25 #endif  
26 #endif /* CORETIMERDELAY_H */
```

```
45 #include "mcc_generated_files/mcc.h"  
46 #include <cp0defs.h>  
47 #include <sys/attribs.h>  
48 #include "coreTimerDelay.h"  
49 /*******  
50 /** MS DELAY  
51 /*******  
52 void ctDelaysms(uint16_t ms)  
53 {  
54     uint32_t msDelayTime, currentTickCnt;  
55     currentTickCnt = _CP0_GET_COUNT();  
56     msDelayTime = (CoreTicksPerMs * ms) + currentTickCnt;  
57     while((_CP0_GET_COUNT()) < msDelayTime);  
58 }
```

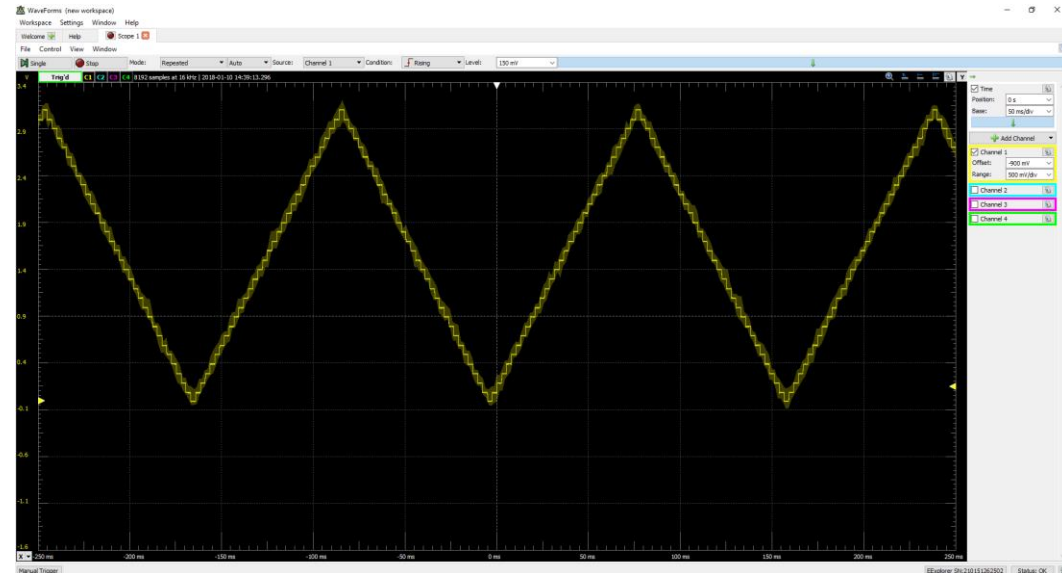




# IoT Development Tools for PIC32

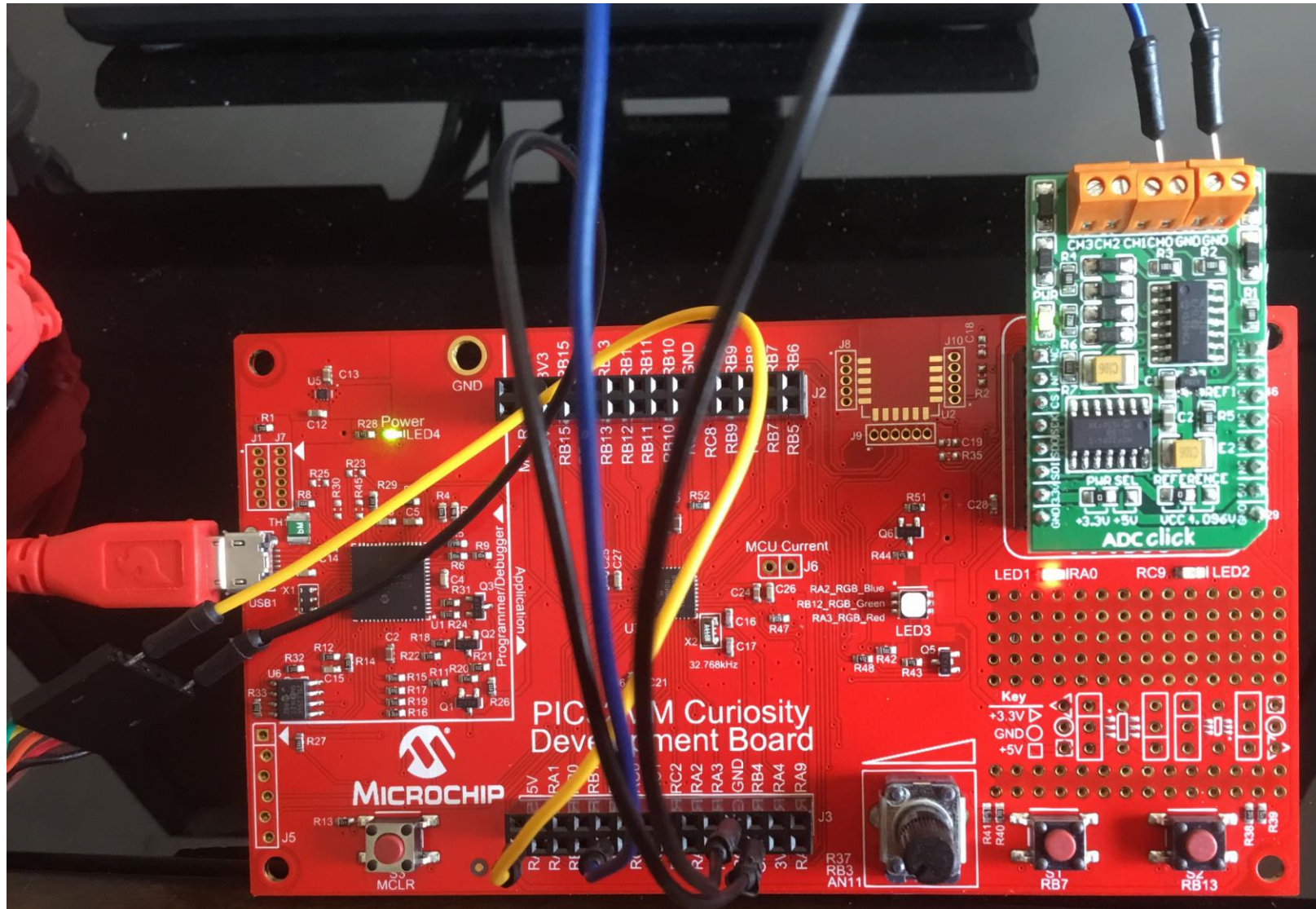
## Double click – DAC click Project – Generated Example

```
23 #include "mcc.h"
24 #include "DAC.h"
25 #include "DAC_example.h"
26 #include <stdio.h>
27
28 void DAC_example(void)
29 {
30     float voltage = 0;
31
32     uint16_t dacVoltage;
33
34     printf("Ramping our voltage UP");
35     while(voltage < 3){
36         dacVoltage = (uint16_t) ((4096*voltage)/3.3);
37         DAC_Set(dacVoltage);
38         ctDelays(1);
39         voltage += 0.1;
40     }
41     printf("Ramping our voltage DOWN\r\n");
42     while(voltage > 0){
43         dacVoltage = (uint16_t) ((4096*voltage)/3.3);
44         DAC_Set(dacVoltage);
45         ctDelays(1);
46         voltage -= 0.1;
47     }
48 }
```



# IoT Development Tools for PIC32

## Hasta Mañana



Presented by: