

Team 202 Microcontroller Selection

1. Determine your project-specific requirements		3. Look up specifications in the PIC datasheet		
Design Considerations	Team Project-Specific Requirements from Problem Definition and Block Diagram	PIC16F15256-E/STX	PIC18F05Q41-I/SL	PIC24FJ64GA702-I/SO
How many GPIO Pins? ¹	2 I2C, 4 UART, 6 GPIO	26	12	22
Built-in Analog to Digital Converter? How many?	None	17	11	10
Built-in Hardware PWM? How many?	None	2	3	3
Built-in I2C? SPI? How many?	>=1 I2C	1 MSSP	2 SPI/1 I2C	1 SPI, 2 I2C
Built-in UART? How many?	2 UART (ESP32, and debug)	1	2	2
Other Required Built-In Features? (<i>optional</i>)				
Additional considerations specific to your project specifications (<i>optional</i>)	Amount of program memory	28k	32k	64k

¹ No PIC16F887, PIC16F917, PIC18F47Q10, or dsPICs allowed

2. Find 3 microcontrollers that meet your team project-specific requirements and find information on each		4. Look up part details in the PIC datasheet		
Microcontroller Considerations	Instructions	PIC Option 1	PIC Option 2	PIC Option 3
Part Number ²	<i>Include the entire part number (leave off any letters at the end that specify the package type)</i>	PIC16F15256	PIC18F05Q41	PIC24FJ64GA702
Link (URL) to product page	<i>Do not paste links directly into the table. Instead, link them like this.</i>	Microchip	Microchip	Microchip
Links (URL) to Data Sheets		Datasheet	Datasheet	Datasheet
Links (URL) to Application Notes	<i>Often provided by manufacturers to give you specific examples of how to use their products. Search for them in the search bar on the Microchip's website.</i>	Microchip	Microchip	Microchip
Links (URL) to Code Examples		Microchip	Microchip	Microchip
Links (URL) to External Resources	<i>Search on Google and YouTube for other resources for each specific microcontroller.</i>	Video	Forum post	Forum posts
Production Unit Cost	<i>Find in the Microchip online store, or Digikey</i>	\$1.39	\$1.41	\$1.90
Supply Voltage Range	<i>Find in the microcontroller datasheet</i>	1.8-5.5v	1.8-5.5v	2-3.6v

² General Purpose Input/Output Pins - calculate based on your block diagram and include at least 20% more than you need. Avoid using In-System Programming (ISP) pins for GPIO.

Absolute Maximum Current for entire IC	<i>Find in the microcontroller datasheet</i>	$\geq 300\text{mA}$	$\geq 350\text{mA}$	200mA
Maximum GPIO Pin Current (Source/Sink)	<i>Find in the microcontroller datasheet</i>	25mA	50mA	25mA
8-bit or 16-bit Architecture	<i>Find in the microcontroller datasheet</i>	8 bit	8 bit	16 bit
Available IC Packages / Footprints	<i>Find in the microcontroller datasheet. Choose a microcontroller with both surface mount and DIP/through-hole packages available. See Most Common Mistakes below for requirements to improve manufacturing reliability.</i>	SPDIP28, SOIC28, SSOP28, VQFN28	SOIC28, PDIP28, QFN28, SSOP28	SOIC28, SSOP28, QFN28, UQFN28
Supports External Interrupts?	<i>Find in the microcontroller datasheet</i>	1 external	3 external	5 external
In-System Programming Capability and Type	<i>Allows for programming the microcontroller without removing it from the PCB. Find in the microcontroller datasheet.</i>	ICSP, 2 pins	ICSP, 2 pins	ICSP, 2 pins
Programming Hardware, Cost, and URL	<i>Find on the microcontroller product page</i>	PICkit 4, \$77	PICkit 4, \$77	PICkit 4, \$77
Works with MPLAB® X Integrated Development Environment (IDE)?	<i>Required. See Microchip Development Tools</i>	Yes	Yes	Yes

Works with Microchip Code Configurator ?	<i>Required. Go to the MCC website, click the “Manual Downloads” tab, scroll to the device library that goes with the PIC you chose (likely “MCC 8-bit PIC”) and read the release notes to make sure your microcontroller is in the list of supported devices.</i>	Yes	Yes	Yes, currently only in classic
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5. Write overall pros, cons, and rankings for the chosen microcontrollers				
Overall Pros	<i>Write at least 2 for each microcontroller</i>	<ul style="list-style-type: none"> • High max current rating • Supports in circuit programming 	<ul style="list-style-type: none"> • Sufficient number of USARTs • 3 external interrupts • Full Classic and Melody MCC support 	<ul style="list-style-type: none"> • Sufficient number of USARTs • 5 external interrupts • Multiple I2C peripherals
Overall Cons	<i>Write at least 2 for each microcontroller</i>	<ul style="list-style-type: none"> • Low program memory size • Insufficient number of USARTs 	<ul style="list-style-type: none"> • Only 12 GPIO pins • Only 1 I2C peripheral 	<ul style="list-style-type: none"> • Low max current rating • Not supported in MCC Melody
Ranking	<i>1 = first, 2 = second, 3 = third</i>	3	2	1

6. Final Microcontroller Choice: PIC24FJ64GA702-I/SO (28-SOIC package)

Rationale: This PIC has the largest program memory of the models evaluated and has multiple EUSART peripherals to support debugging, while keeping a small footprint and low power usage. Having multiple I2C peripherals will enable separation between sensors, if needed.

PIC16F15256

The screenshot displays the MPLAB IDE environment for a PIC16F15256 project. The interface is divided into several panels:

- Project Resources:** Located on the left, it shows a tree view of project files including System, Clock Control, Configuration Bits, Interrupt Manager, Main, and Pins.
- Device Resources:** Below Project Resources, it lists Libraries, Data Visualizer, Drivers, System, and Hardware Peripherals.
- Kit Window:** At the top, it shows the current kit (PIC16F15256) and the target device (PIC16F15256).
- Central Workspace:** A large grid area where the PIC16F15256 component is placed. A "System Firmware" button is also visible.
- Pin Package View:** At the bottom, it shows the pin configuration for the SOIC28 package. The package is shown as a 28-pin component with pins numbered 1 to 28.

The Pin Package View panel includes a table showing the pin configuration for the SOIC28 package:

Package	Pin No.	2	3	4	5	6	7	10	9	21	22	23	24	25	26	27	28	11	12	13	14	15	16	17	18	1				
Module	Function	Direction																												
OSC	CLKOUT	output																												
RESET	MCLR	input																												
Pins	GPIO	input																												
	GPIO	output																												

PIC18F05Q41

The screenshot shows the MPLAB IDE interface for a PIC18F05Q41 project. The Project Resources panel on the left lists System resources (Clock Control, Configuration Bits, Interrupt Manager, Main, Pins) and Device Resources (Libraries, Data Visualizer, Drivers, System, Hardware Peripherals). The central workspace displays a grid with a PIC18F05Q41 component and a System Firmware button. The Pin Grid View at the bottom right shows the pin configuration for the PIC18F05Q41 package (SOIC14).

Package:	Pin No:	13	12	11	4	3	2	10	9	8	7	6	5
PORTA													
Module	Function	Direction	0	1	2	3	4	5	0	1	2	3	4
OSC	CLKOUT	output											
RESET	MCLR	input											
Pins	GPIO	input											
	GPIO	output											

PIC24FJ64GA702

The screenshot displays the MPLAB X IDE interface for configuring the PIC24FJ64GA702 microcontroller. The main window shows the 'Easy Setup' tab with various configuration options:

- Project Resources:** Includes System (Interrupt Module, Pin Module, System Module), Device Resources (PIC24FJ64GA702 Product Page, Libraries, Peripherals), and MCC Core Versions (MPLAB Code Configurator v5.2.1).
- Easy Setup:**
 - Clock:** 8000000 Hz, FRC Oscillator, (8.0 MHz) Clock Source. PLL is disabled. Fosc is 8 MHz, Fosc/2 is 4 MHz. Oscillator Fractional Divider is disabled. Clock Output Pin Configuration is OSC2 is clock output. Use Secondary Oscillator is disabled (31 - 33) kHz. Reference Oscillator Output is disabled. Enable Clock Switching and Enable Fail-Safe Monitor are disabled. Auto Tuning Mode is Disabled.
 - ICD:** Emulator Pin Placement is Communicate on PGEC1 and PGED1.
- Pin Manager:**
 - Package View:** Shows the PIC24FJ64GA702 package with pins 1-26 and their functions (e.g., NMCLR, RA0, RA1, RB0, RB1, etc.).
 - Grid View:** Shows the pin grid with columns for Port A (0-15) and Port B (0-15). The grid shows the configuration for each pin, including the module (e.g., Clock, PGCx), function (e.g., CLKI, CLKO, OSCI, OSCO, REFO, SOSCI, SOSCO), and direction (input/output).