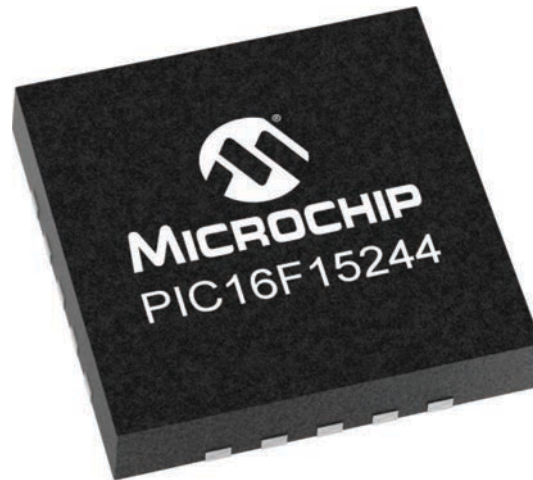


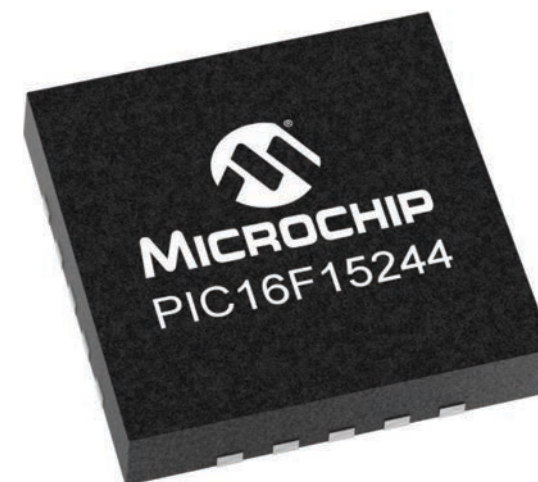


# PIC16F152xx Product Family



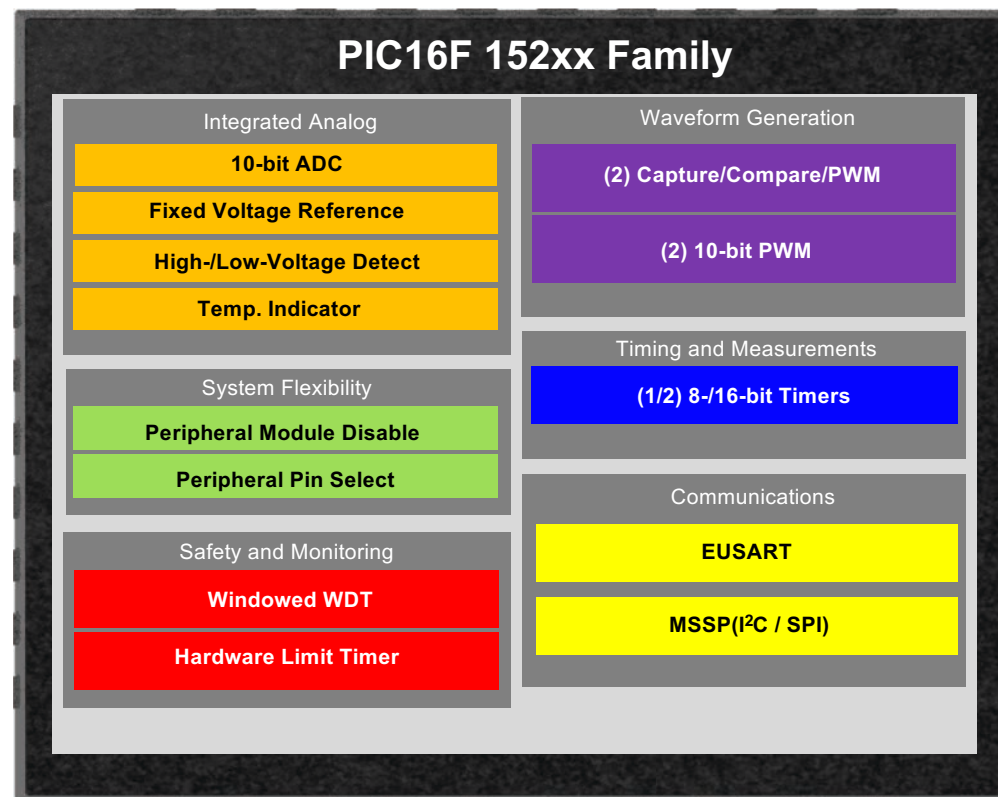
# PIC16F152xx Product Family

- **Combines our most versatile Core Independent Peripherals (CIPs) with advanced interconnection capabilities**
- **Quickly respond and manage critical system tasks with fast data transfers and interrupt handling**
- **Large on-chip memory to accommodate:**
  - Substantial application code
  - Existing libraries
- **Robust 5 V system operation for increased noise immunity**
- **Operation down to 1.8 V**
- **Low power modes for battery-powered applications**
- **Features that support functional safety applications**
- **Reduce development cycle:**
  - Write/debug less code
  - Easy-to-use tools to evaluate and develop with new technologies
- **Backed by Microchip's customer driven obsolesce promise**

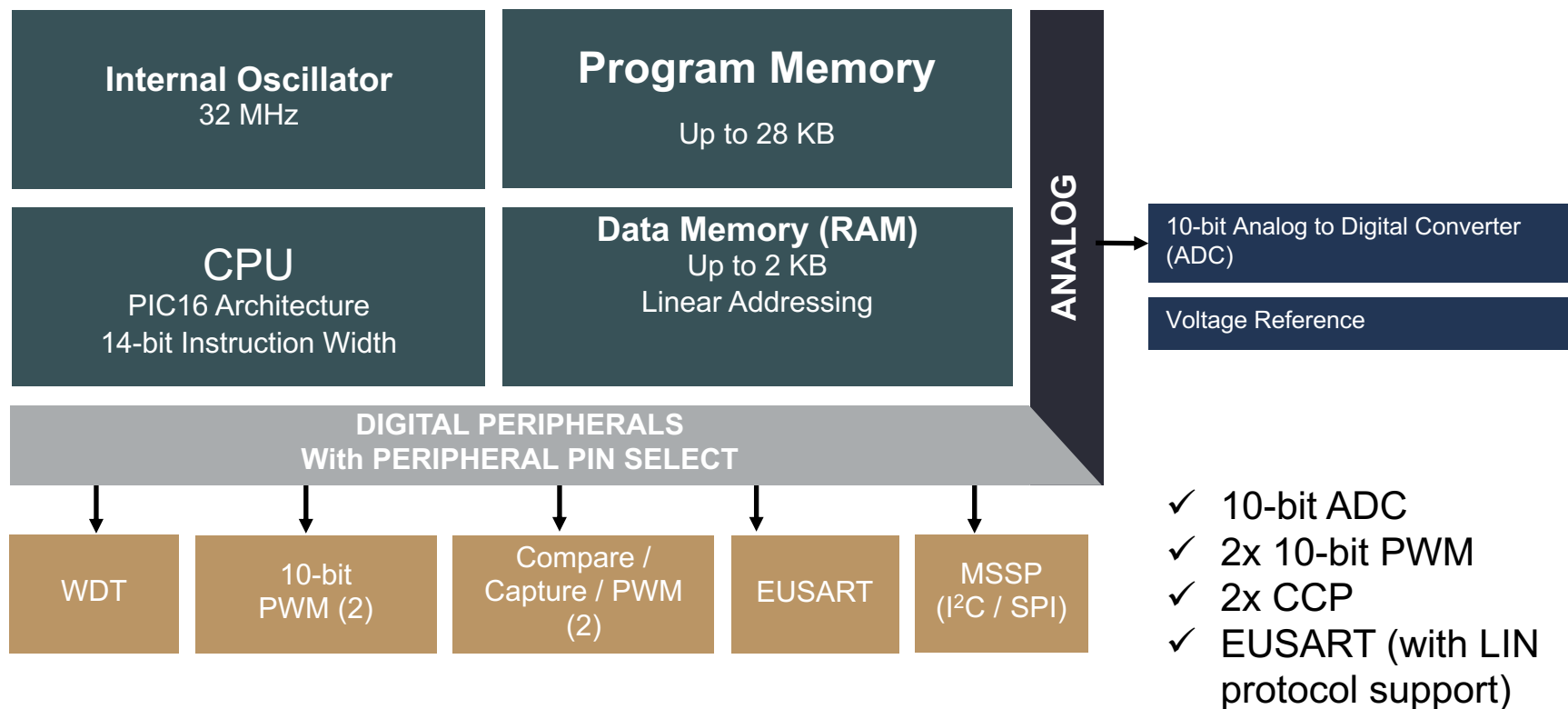


# High Performance 8-bit MCUs

- ❑ **8- to 40-pin Devices**
  - ❑ 6 - 36 I/O pins
  - ❑ 6 - 36 ADC channels
- ❑ **Memory**
  - ❑ Flash up to 28 KB
  - ❑ RAM up to 2 KB
- ❑ **Operating Speed**
  - ❑ Up to 32 MHz
- ❑ **Operating Voltage**
  - ❑ 1.8 V - 5.5 V
- ❑ **Temp. Range**
  - ❑ -40°C to 125°C



# PIC16F152xx Block diagram





# PIC16F152xx Product Family

## What is it?

- Evolution of the PIC12F150x
- Ideal for sensor and simple real-time control applications, increased memory (up to 28KB Flash and 2KB RAM) at low cost, and multiple communication peripherals
- Available in 8-, 14-, 20-, 28- and 40- pins

## Key Features:

1. Up to 28 KB Flash & 2 KB RAM
2. 10-bit ADC
3. 8 & 16-bit Timers
4. Two 10-bit PWMs
5. Two Capture/Compare/PWMs
6. Memory Access Partitioning (MAP)
9. Peripheral Pin Select (PPS)
10. Peripheral Module Disable (PMD)
11. Device Information Area (DIA)
12. EUSART with LIN Protocol support

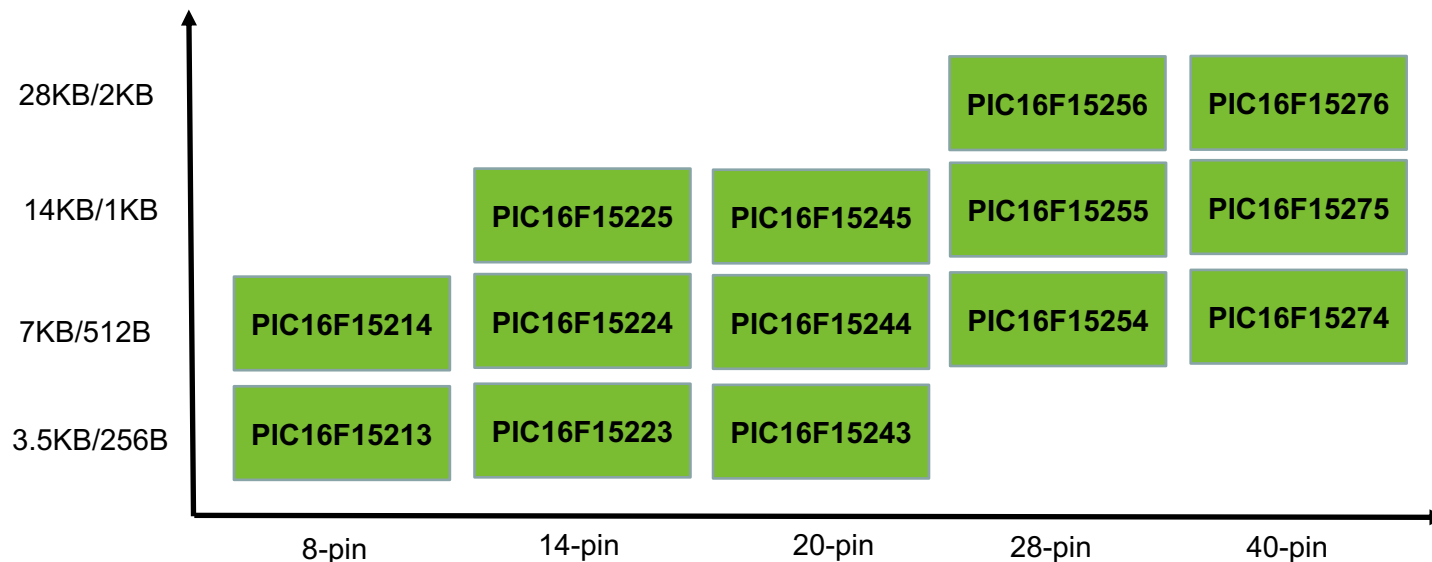
## Benefits

- Quickly respond and manage critical system tasks with fast data transfers and interrupt handling
- Mix of our popular CIPs enable effortless sophisticated hardware customization
- Create custom functions with peripheral interconnectivity in hardware reduces external connections, BOM and design footprint



# PIC16F152xx Product Family

- Up to 28KB Flash Program Memory
- Up to 2 KB Data SRAM
- No EEPROM
- 1.8V to 5.5V Operation
- 10-bit ADC (no capacitive touch)
- Two Capture/Compare/PWM(CCP)
- Two 10-bit PWMs
- **Standard PIC16F1 timers:**
  - Configurable 8/16-bit (TMR0)
  - 16-bit (TMR1) with Gate Control
  - 8-bit(TMR2) with Hardware Limit Timer(HLT)
- **One EUSART**
- **One MSSP (I2C/SPI)**
- **Peripheral Pin Select**
- **Watchdog Timer**





# Features

# Reliable Deterministic Real-time Control Capabilities

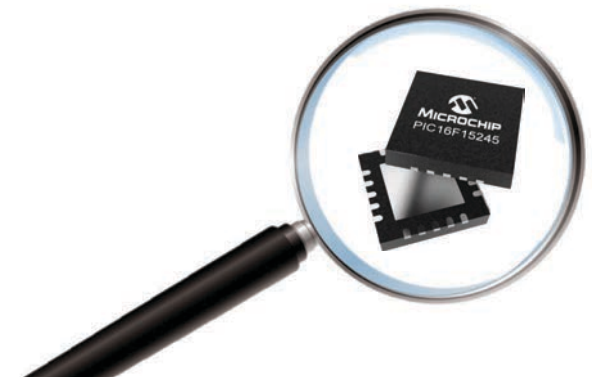
- **Seamless data transfer**
  - Transfer data between peripheral and memories with no CPU intervention
  - Automate tasks with low latency
- **Interconnection of peripherals**
  - Create custom hardware-based logic functions
  - Improves response time
  - Reduces software overhead
- **High resolution PWM drive and waveform generation with automated:**
  - Flexible bridge/drive configurations
  - Control of dead-band and auto-shutdown capabilities
  - Integrated timer/counter
- **AC high-voltage zero cross detection**
  - Simplifies TRIAC control
  - Synchronized switching control and timing
- **Flexible communication**
  - Hardware for multiple protocol support





# Smaller Application Footprint

- **Small device packages to minimize real estate taken**
  - Various package options as small as 3 x 3 x 1.0 mm (VQFN)
- **Peripheral interconnectivity within MCU reduces external connections and BOM**
- **Many peripherals feature highly configurable pin options:**
  - Reduce overall layout complexity
  - Minimizes application redesign



# Remote Applications

(IoT Sensor Nodes, Wearables etc...)

- **Low-power capabilities to support prolonged battery life**
  - Various operating modes
  - Disable peripherals/features while not in use (on the fly)
  - Fast and low-power operational modes to balance response with current consumption
- **Simplified connection to a wide variety of sensors:**
  - Many analog input channels
- **Connect easily to Microchip wireless expansion modules**
  - Common communication interfaces (I<sup>2</sup>C, SPI, UART)
  - DMX, DALI and LIN protocol support
  - Easily connects to Bluetooth® Low Energy (BLE) modules with embedded security



# PIC16F152xx Target Applications



## Sensor Node Applications

- Integrated ADC for sensor interfacing and precision measurement
- Up to 5V operation provides compatibility to majority of digital and analog sensors
- Small footprint package for space-constrained sensor node designs



## Low Power Applications

- DOZE, IDLE and PMD modes for extending battery life
- Peripherals can operate together while the CPU is off
- Flexible power management scheme for perfect functions vs. power balancing



## Real-time Control Applications

- Fast data transfers between memories without CPU intervention
- Interrupt management accelerates real-time control and simplifies software loops
- Extended operating conditions with deterministic response



## Connected Applications

- Easy connectivity with support for a wide variety of communication protocols
- Hardware support for communication protocols - DMX, LIN, DALI



# **Reducing Development Time**

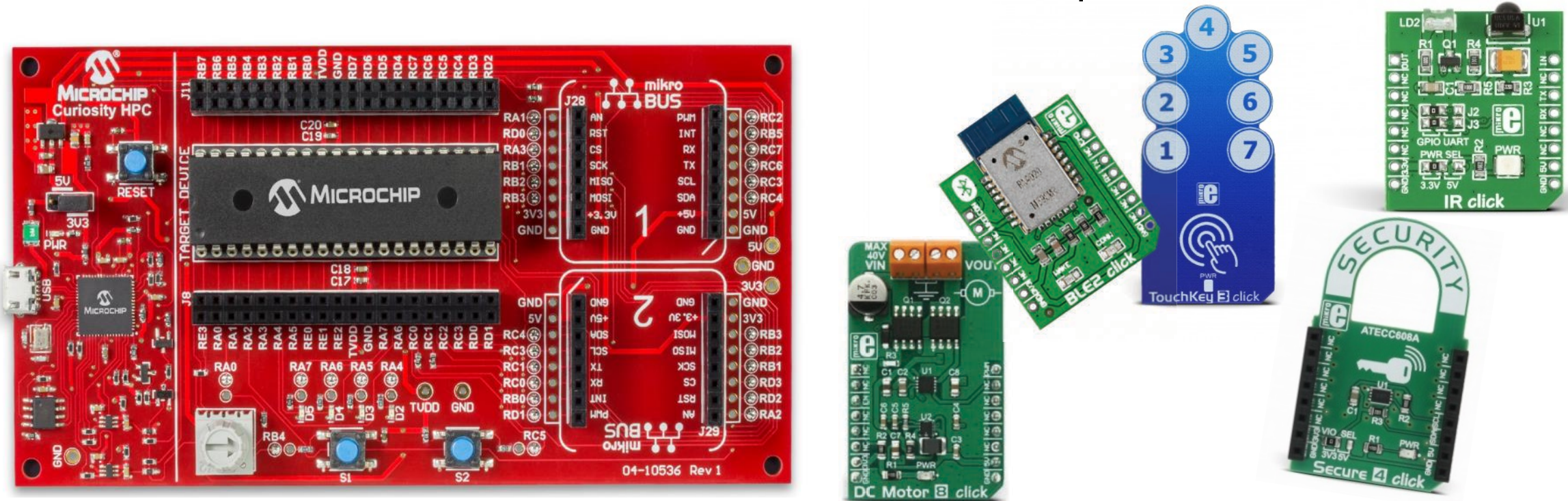
## **with FREE Easy-to-Use Development Tools**



# Hardware Development Tools

(minimize custom hardware while prototyping)

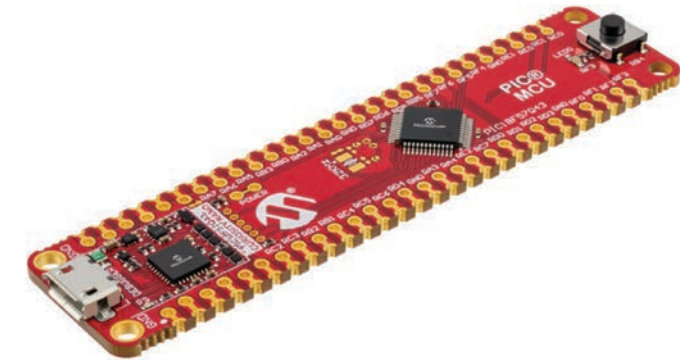
- **Curiosity Development Boards**
  - Integrated programmer/debugger
  - Dual-row headers provide connectivity to all pins on the MCU
  - Dual MikroBUS™ connectors for click board™ expansion boards



# Effortless Design

## Curiosity Nano Development Board

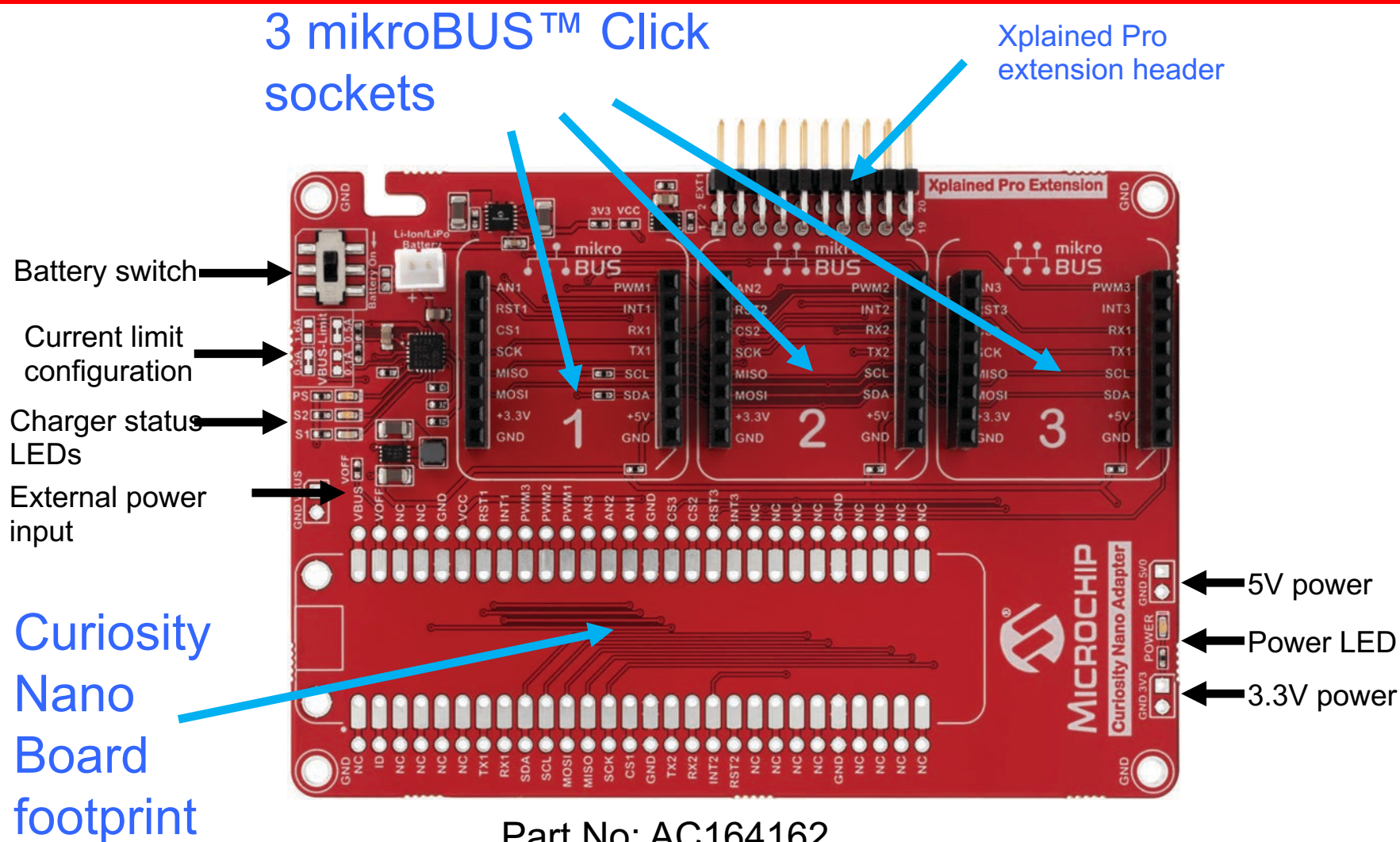
- **Fully Integrated**
  - On-board programmer/debugger
    - For use with MPLAB X
    - Virtual COM port via UART
  - Shows documentation in IDE when connected
  - Fits in standard proto typing boards
- **Small Footprint with Powerful Features**
  - Full access to all pins at the board edge
  - Drag-and-drop programming
    - No software required
  - Variable power supply from 1.8V to 5.0V
  - LED and Button for basic I/O



PIC16F15245 Curiosity Nano

# Curiosity Nano

Click Boards™ Expansion



Part No: AC164162



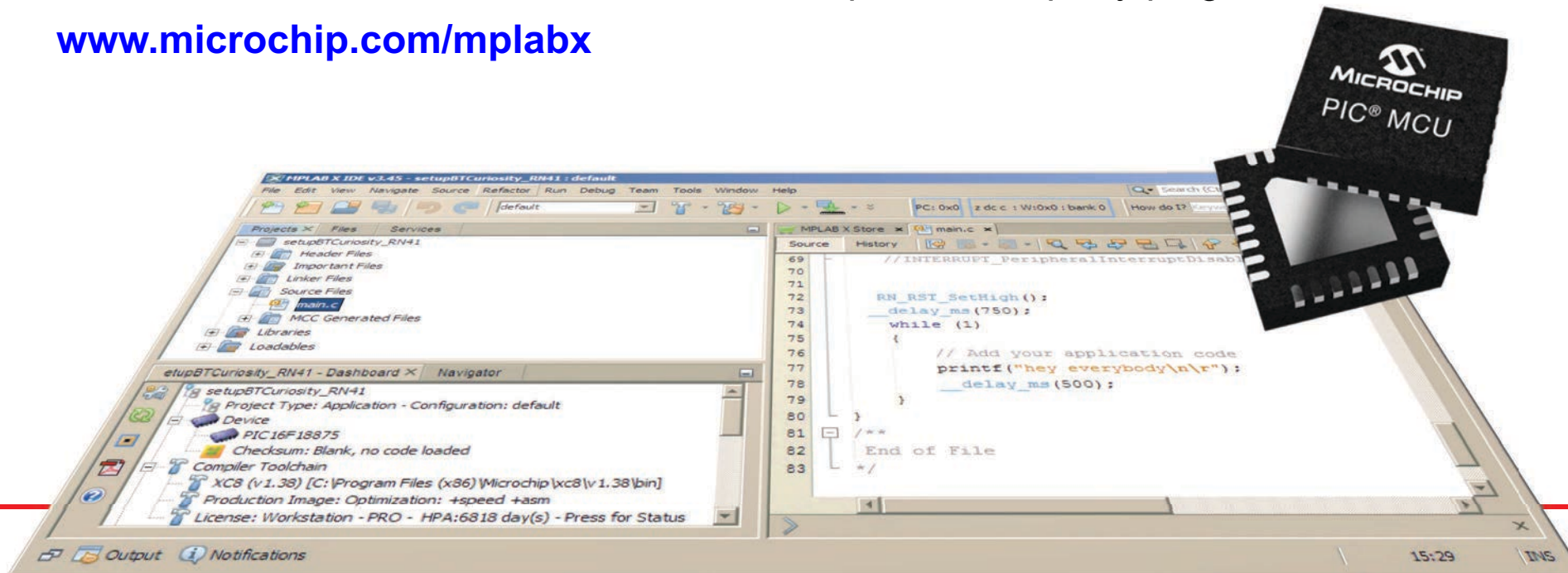
# MPLAB® X Integrated Development Environment (IDE)



[www.microchip.com/mplabx](http://www.microchip.com/mplabx)

## FREE Development Environment:

- Develop code for 8-, 16- and 32-bit MCUs
- Simulate
- Interface with hardware tools
- Microchip and third party plug-ins





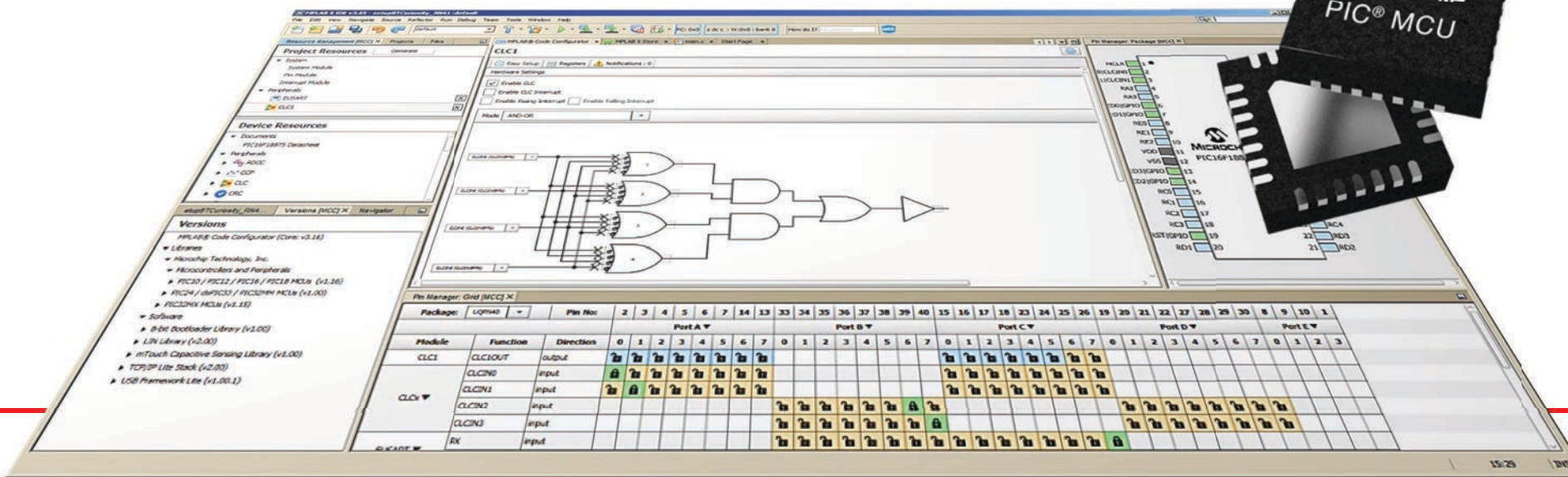
# MPLAB<sup>®</sup> Code Configurator (MCC)



[www.microchip.com/mcc](http://www.microchip.com/mcc)

**FREE easy-to-use graphical programming tool:**

- Easily configure and use peripherals
- Generates efficient C code for your project
- Supports 8- and 16-bit devices
- Minimizes reliance on datasheets



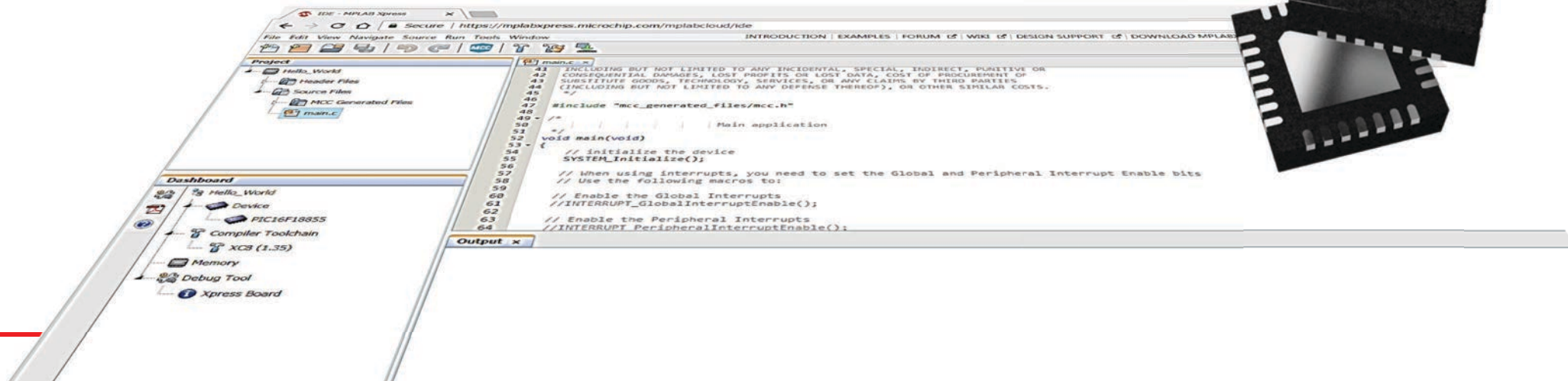
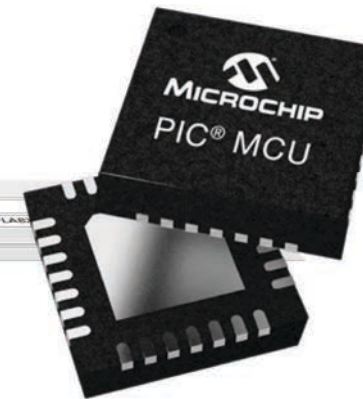
# MPLAB<sup>®</sup> Xpress IDE



## Online streamlined version of MPLAB X IDE:

- Integrates MPLAB XC8 Compiler
- Integrates MPLAB Code Configurator
- Library of code examples
- MPLAB Xpress Community
- Supports popular hardware tools

[www.microchip.com/xpress](http://www.microchip.com/xpress)





# PIC16F152xx Family

## Options & Availability

Product	Flash (Bytes)	RAM (Bytes)	Package Options	Sample Availability	Production Availability
PIC16F15213	3.5K	256	8-pin: 3x3mm DFN, SOIC	Q3 '20	Q3 '20
PIC16F15214	7K	512		EA Program	Q3 '20
PIC16F15223	3.5K	256	14-pin: SOIC, TSSOP, 3x3mm VQFN(16)	Q3 '20	Q3 '20
PIC16F15224	7K	512		Q3 '20	Q3 '20
PIC16F15225	14K	1K		Q3 '20	Q3 '20
PIC16F15243	3.5K	256	20-pin: PDIP, SSOP, 3x3mm VQFN	Q3 '20	Q3 '20
PIC16F15244	7K	512		EA Program	Q3 '20
PIC16F15245	14K	1K		Q3 '20	Q3 '20
PIC16F15254	7K	512	28-pin: SOIC, SSOP, 6x6mm VQFN	TBD	TBD
PIC16F15255	14K	1K		TBD	TBD
PIC16F15256	28K	2K		TBD	TBD
PIC16F15274	7K	512	40-pin: PDIP, 5x5mm VQFN, 10x10mm TQFP(44)	TBD	TBD
PIC16F15275	14K	1K		TBD	TBD
PIC16F15276	28K	2K		TBD	TBD



# Summary

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**The PIC16F152xx family's simplified feature set is well suited for small format and cost-sensitive designs.**

**With a 10-bit ADC and essential feature set, this product family is ideal for sensor and simple real-time control applications.**

**This microcontroller family is designed as an entry-point into the PIC product line by providing the same user-friendly development experience as our more advanced PIC microcontrollers.**



# **Appendices**

## **Peripheral Overview Slides**

# Memory Access Partition

## Custom Memory Partition

### Memory Access Partition (MAP)

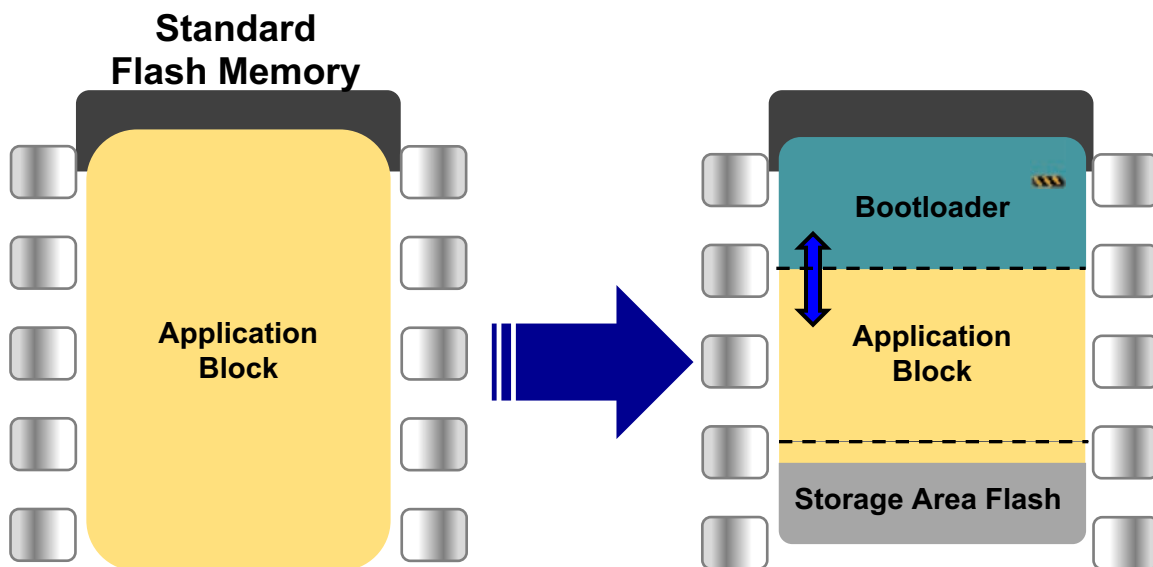
- ❑ Customize partition with:
  - ❑ Application
  - ❑ Bootloader
  - ❑ Storage Area Flash (SAF)
    - ❑ 224B RAM
- ❑ Ability to write protect

### Benefits

- ❑ Improve bootloader capability
- ❑ Code protection
- ❑ Program flexibility
- ❑ Additional memory

### Example Uses

- ❑ Bootloader
- ❑ Data logging
- ❑ Look-up tables
- ❑ Data storage



# Device Information Area

## Factory Programmed Reference Values

### Device Information Area (DIA)

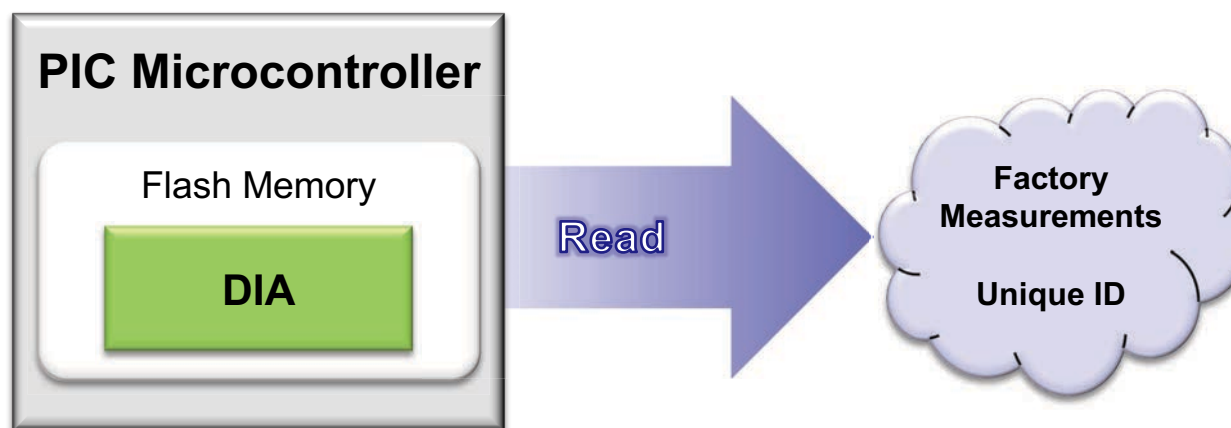
- ❑ Dedicated memory space for factory programmed device ID and peripheral calibration values
- ❑ Contains
  - ❑ Unique device ID
    - ❑ IEEE 64-bit unique ID available
  - ❑ Temperature Sensor Calibration
    - ❑ ADC measurements at 2 temperatures
  - ❑ ADC measurements of FVR for ADC and Comparator with multiple gains

### Benefits

- ❑ Preprogrammed unique address for communications
- ❑ Factory calibrated temperature sensing
- ❑ Premeasured data to improve FVR accuracy

### Example Uses

- ❑ Applications requiring unique addresses for communication (USART, SPI, I2C, LIN, DMX and DALI applications)
- ❑ Applications requiring increased accuracy for ADC, Comparator and Temp Sensor



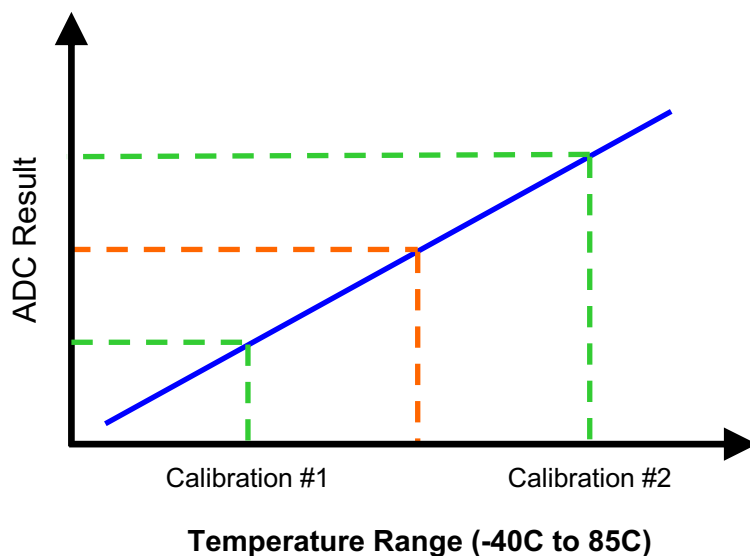


# Temperature Indicator

## Low Cost Temperature Measurements

### Temperature Indicator (TEMP)

- ❑ Provides integrated temperature measurements
- ❑ Absolute accuracy  $\pm 5^{\circ}\text{C}$
- ❑ Measure between  $-40^{\circ}\text{C}$  &  $85^{\circ}\text{C}$
- ❑ Internally connected to ADC
- ❑ ADC result changes with TEMP
- ❑ Reference Application Note: AN1333

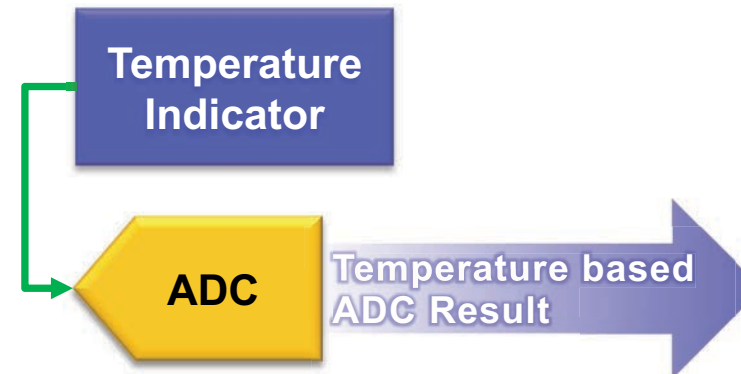


### Benefits

- ❑ Low cost TEMP measurements
- ❑ No external hardware
- ❑ Improved RTC accuracy over TEMP
- ❑ Core independent operation
- ❑ Operation while in low power SLEEP

### Example Uses

- ❑ Over temperature detection
- ❑ Power supplies
- ❑ Motor control
- ❑ Lighting
- ❑ Home appliance





# Hardware Limit Timer

## Hardware Monitoring & Fault Detection

### Hardware Limit Timer (HLT)

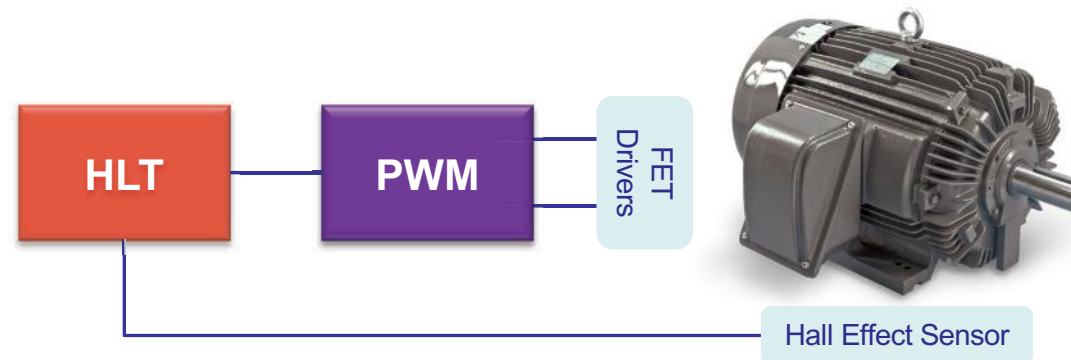
- ❑ Extension of 8-bit timer/counter with external reset capabilities
- ❑ Hardware monitoring for missed periodic events and fault detection (stalls, stops, etc.)
- ❑ Period timer with external reset input
- ❑ Flexible design
  - ❑ Selectable start of event trigger
  - ❑ Multiple modes
  - ❑ Seven available clock sources
- ❑ Resolution of  $\frac{1}{4}$  instruction cycle

### Benefits

- ❑ Reduces code complexity
  - ❑ No code for detection set-up
  - ❑ No code to manage timer
- ❑ Core independent operation
- ❑ Operation while in low power SLEEP

### Example Uses

- ❑ Safety limit in closed loop control applications
  - ❑ Power supplies
  - ❑ Motor driver



Example: Monitoring a motor for fault conditions

# Watch Dog Timer

## System Supervisory Circuit

---

### Watch Dog Timer (WDT)

- ❑ Detects software timing anomalies
- ❑ Resets the CPU if...
  - ❑ the WDT overflows

### Benefits

- ❑ Monitors timing critical functions
- ❑ Eases implementation of safety standards (ex. Class B, UL, etc.)
- ❑ Core independent operation
- ❑ Operation while in low power SLEEP

### Example Uses

- ❑ Dishwashers
- ❑ Ovens / microwaves
- ❑ Laundry equipment
- ❑ Power tools

# Idle & Doze Modes

## Scalable Performance & Power Consumption

### Idle Mode

- ❑ CPU will stop executing instructions
- ❑ Peripherals continue operating at full performance
- ❑ Enables lower power consumption while still monitoring system

### Doze Mode

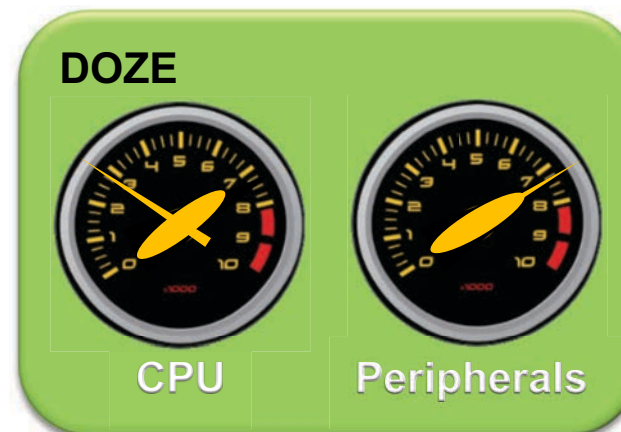
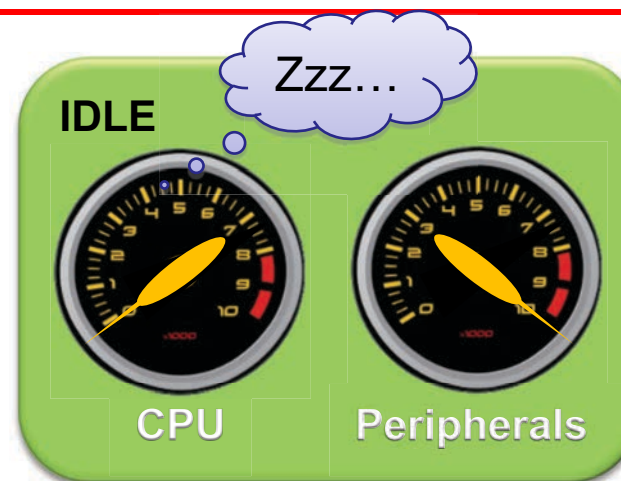
- ❑ Separate control of CPU and peripheral speed
- ❑ Scalable CPU and peripheral performance
- ❑ Enables balance of performance vs. power consumption

### Benefits

- ❑ Increases battery life
- ❑ Decreases standby power consumption for AC powered devices

### Example Uses

- ❑ Consumer appliances
- ❑ Smoke & CO detectors
- ❑ Battery operated devices
- ❑ Devices requiring low standby power



# Peripheral Module Disable

Eliminates Power Consumption of Unused Peripherals

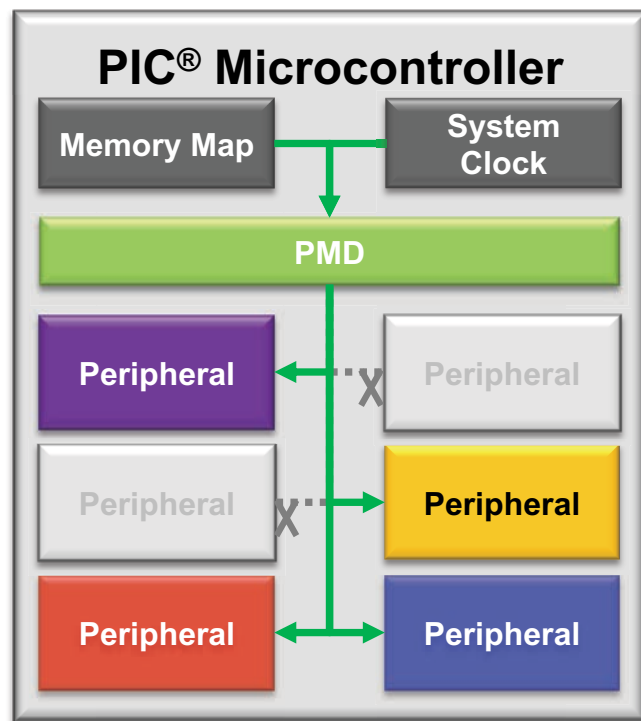
## Peripheral Module Disable

Mode 1:

- ❑ Disables unused peripherals individually
  - ❑ Removes peripheral from memory map

Mode 2:

- ❑ Disables system clock to all peripherals



## Benefits

- ❑ Zero power consumption from disabled peripherals
- ❑ Optimizes power consumption
- ❑ Improves battery life for battery powered applications
- ❑ Reduces standby currents in AC power applications

## Example Uses

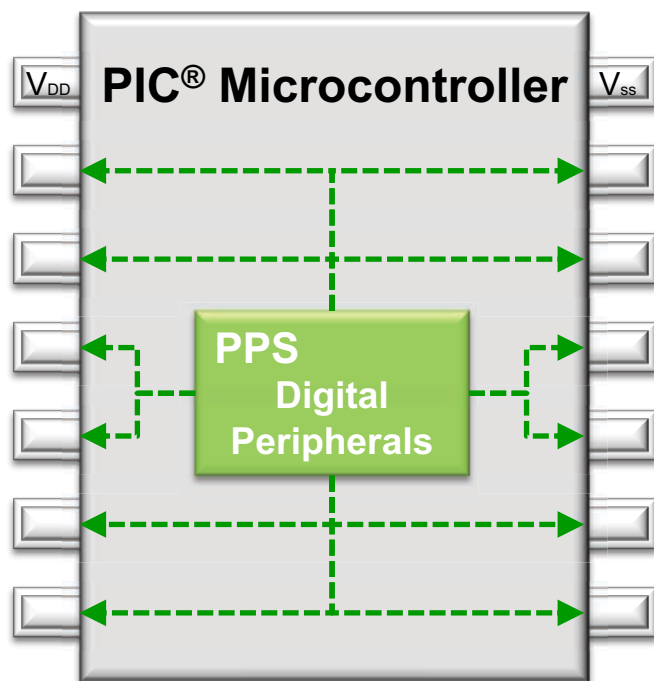
- ❑ Battery powered applications
- ❑ AC powered applications requiring low standby power consumption

# Peripheral Pin Select

I/O Pin Remapping of Digital Signals

## Peripheral Pin Select (PPS)

- ❑ Configure any digital peripheral to any I/O pin
- ❑ Provides increased freedom & optimized use of integrated digital resources
- ❑ Flexible pin function assignment
- ❑ Route peripheral to multiple pins to increase current drive
- ❑ Runtime configuration of pin out



## Benefits

- ❑ Eliminates “pin overlap” for total optimization of peripheral resources
- ❑ Simplified and optimized migration
- ❑ Provides layout flexibility

## Example Uses

- ❑ Systems requiring highest signal integrity
- ❑ Migration of legacy designs
- ❑ Support for new pin-out configurations
- ❑ Applications that require optimized tracing & board space usage