

8-bit PIC® and AVR® Microcontrollers



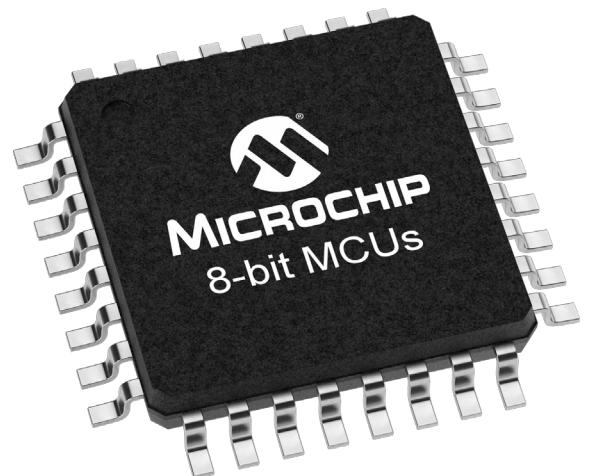
You can save *valuable time*,
optimize constrained space and
lower Bill of Materials (BOM) cost
by reducing the number of parts
needed for your design, with
our Core Independent
Peripherals (CIPs).

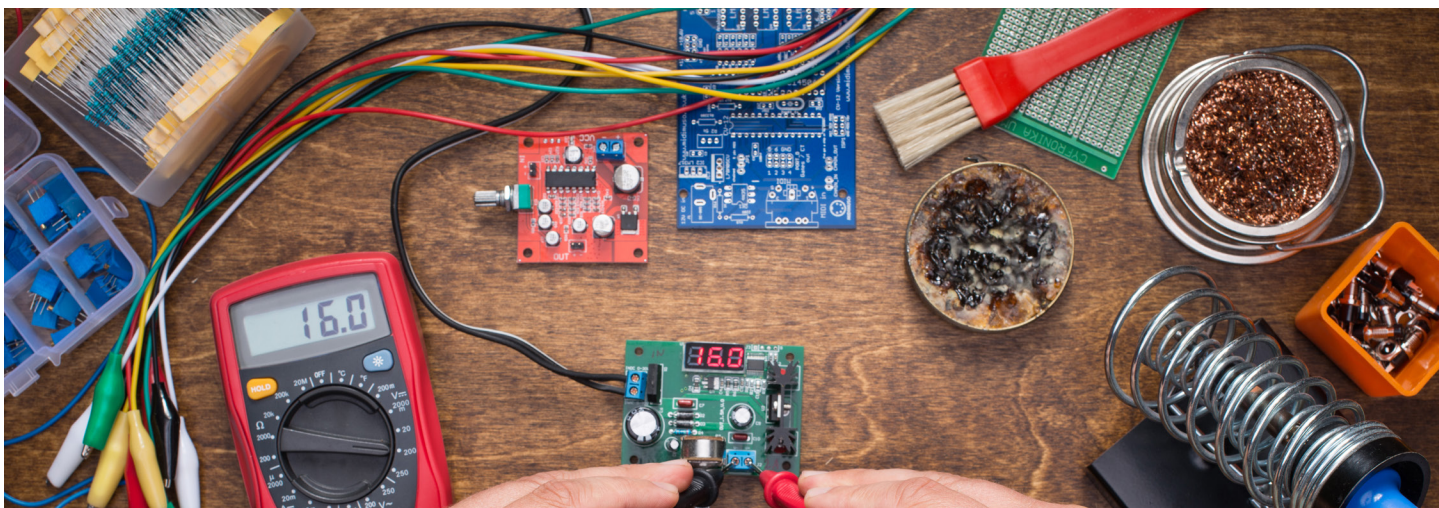


Your Guide to the World of 8-bit PIC® and AVR® MCUs

Less Work, Less Space, More Profit

Your applications require ingenuity and finesse to keep up with competition and the needs of customers. 8-bit PIC and AVR Microcontrollers are designed from the ground up to provide solutions for the most modern embedded systems.



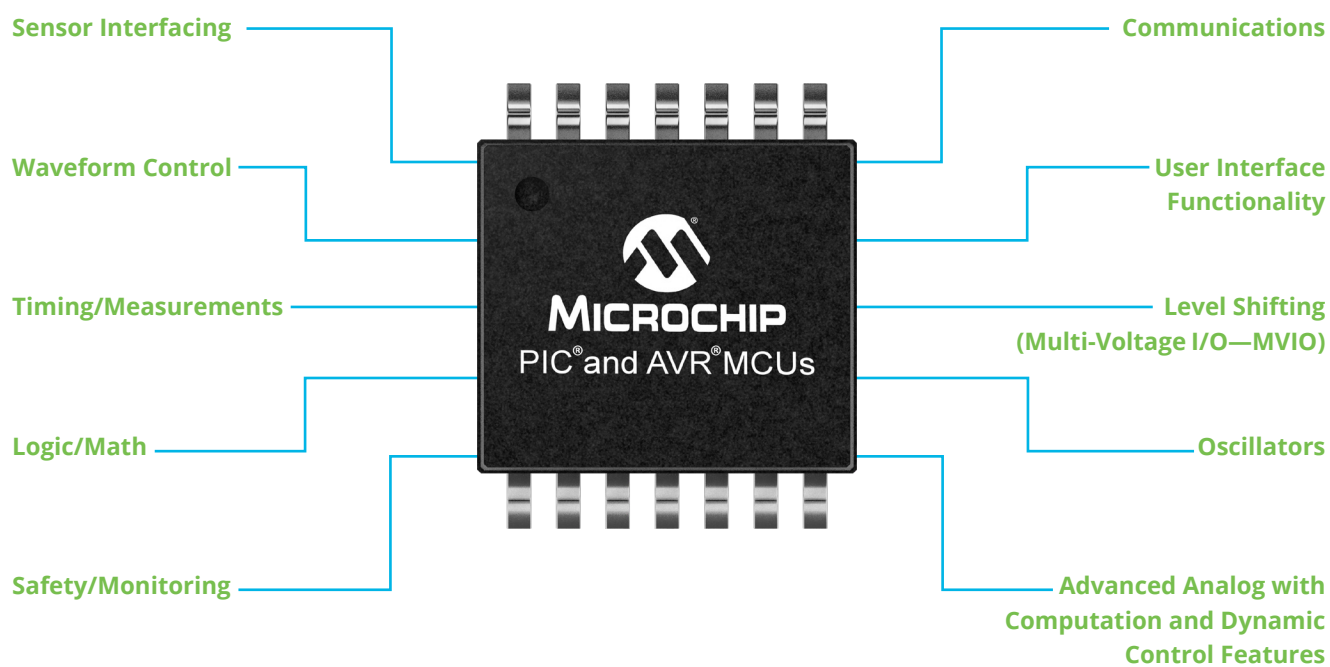


Efficiency Is Key

CIPs and Our Latest Innovations

We have been continuously innovating to meet our customers' requirements. This has led to the development of Core Independent Peripherals (CIPs) and integrated intelligent analog features. Our CIPs allow developers to integrate the key functions performed by the external logic and analog devices into our 8-bit MCUs, making the job of embedded designers easier.

The on-chip CIPs enable PIC and AVR MCUs to perform the same tasks as the much larger and more expensive devices. CIPs enable a wide variety of functions and applications as shown below:





Multiple system tasks can be executed in parallel because hardware-based CIPs have zero dependence on the CPU. The hardware does the heavy lifting.

Ultimately, CIPs provide more creative control to automate tasks—letting you implement complex control systems using a smaller and more cost-effective device.

CIP Benefits

- Easily configurable
- Self-sustaining
- Consume very little power
- Execute with little to no code
- Smaller footprint than the equivalent software-based solution

The Flexibility You Need



When it's time to select a microcontroller, there are over 3,000 8-bit MCUs in our portfolio to choose from, with features that include:

- From 6–100 pins
- Up to 384 KB
- Up to 16 KB RAM
- Operating voltages from 1.6V to 5.5V
- Temperature operating range from -40°C to $+125^{\circ}\text{C}$
- Standby power consumption down to 20 nA with deep sleep current down to 9 nA
- A wide selection of packages to choose from
- 20+ Core Independent Peripherals (CIPs) to increase system capability



Easier Development for Faster Time to Market

Our comprehensive development ecosystem for PIC and AVR MCUs comes with options to suit any design budget. From the award-winning MPLAB® X Integrated Development Environment (IDE) and Microchip Studio IDE to our innovative code generation tools and rapid prototyping hardware, our tool chain is built to get you to revenue faster. We offer additional resources, including:

- Hundreds of code examples in MPLAB Discover repository
- 300+ GitHub repositories
- Demos on demand
- Hardware development platforms
- Knowledge base
- Design communities, including AVR Freaks® and Microchip forums
- Microchip Developer Help
- Online product selection tools
- Engaging content on our YouTube channel

Reliability You Can Trust

We are known for our long-standing commitment to customer-driven obsolescence. With rare exceptions, the PIC or AVR MCU that you design with today will be available over the entire lifecycle of your design.



Key Applications

Our PIC and AVR MCUs are excellent solutions for a wide range of applications. They provide power-efficient and high-performance processing, combined with capable integrated peripherals for automotive, motor control, home appliances, lightning and many other designs. Each device is equipped with a range of powerful peripherals such as Analog-to-Digital Converters (ADCs), fixed voltage references and I²C/SPI/U(S)ART modules.

In addition to powerful hardware, we also offer flexible programming solutions via the MPLAB X IDE, MPLAB Code Configurator, Melody, a graphical code generation tool, XC8 compiler and numerous other tools and plugins.

Our website provides you with the information you need to get started with new designs for specific applications. Resources include product selection tools, application notes, reference designs and development tools. Visit these areas of our website to get started with your next design:

Automotive

You can use 8-bit MCUs in remote keyless entry, lightning control, instrument clusters and many other automotive applications. Many of our products are suitable for safety-critical applications. We also offer the first 8-bit MCU with CAN FD.

Motor Control

Our PIC and AVR MCUs come with innovative motor control Pulse-Width Modulation (PWM) peripherals including complimentary waveforms and dedicated time bases.

Medical

For medical applications, our MCUs offer peripheral features such as analog signal conditioning and advanced sensor functionality to enable remote health monitoring. Many of these MCUs can also be used in safety-critical medical designs.



Home Appliance

We help you implement the new features and functionality your next appliance design requires. We offer MCUs with integrated fault-detecting hardware for safety-critical applications. These MCUs can be used for motor control, analog sensor measurements and front panel keypad control systems.

Lighting

With advanced peripheral integration and support for all lighting technologies, our scalable solutions provide significant flexibility and innovation to expand lighting product capabilities and provide product differentiation.

Smart Energy

Our combination of discrete and highly integrated System-on-Chip (SoC) solutions enable us to address various requirements of smart metering systems. These solutions, which offer unmatched flexibility for meeting new requirements, will reduce your time to market.

Makers

With our Curiosity Nano Development Board and graphical programming tools, rapid prototyping of designs has never been easier or more accessible. Each Curiosity Nano Development Board is fitted with castellated pins and standard-format pin headers. The integrated peripherals in PIC and AVR MCUs offer excellent design flexibility in a conveniently small package. You'll find helpful information about developing projects on our Developer Help portal.

Low Power

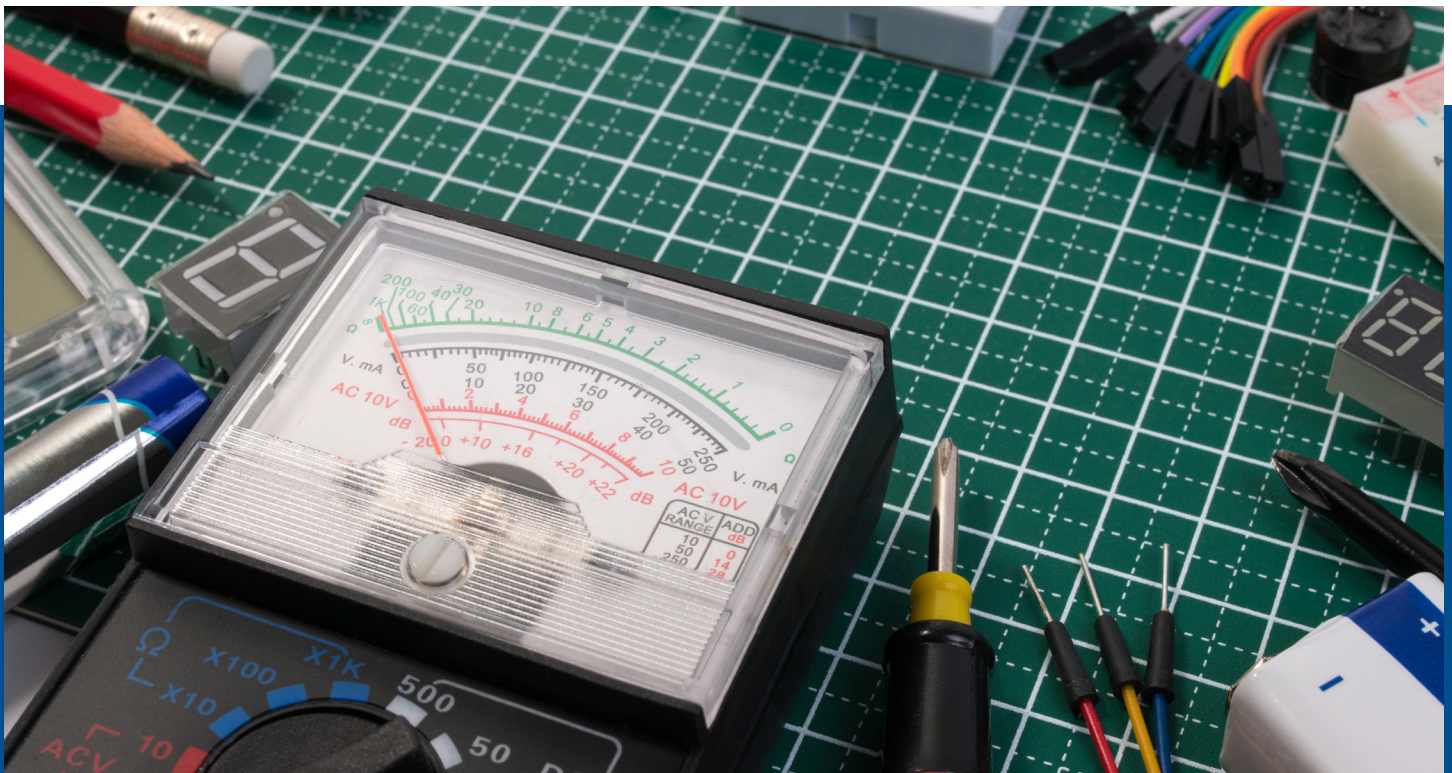
Our low-power solutions with eXtreme Low Power (XLP) technology offer sleep currents down to 9 nA. These devices are equipped with USB, LCD, analog and other peripherals so that you can create designs with smaller physical footprints and reduced Bill of Material (BoM) costs.

USB

If your design requires USB connectivity, we offer PIC and AVR MCUs capable of full-speed USB operation.

Ethernet

Our robust and highly integrated MCUs with Ethernet support enable Ethernet connectivity in a variety of applications.



Key Peripherals

Integrated Analog

Our integrated intelligent analog peripherals make it easy to develop applications that interface, read, react to or generate analog signals. They can interconnect with each other or with other peripherals on the device to minimize the code needed to manage interactions while improving responsiveness. Use the following features in your next device design:

- Differential measurements
- Integrated operational amplifiers
- Automated signal analysis and data acquisition
- Dedicated voltage reference

Waveform Control

Use these peripherals to control various waveforms for basic motor control, LED dimming, custom communications and other applications. They offer features to generate, steer and read waveforms while interconnecting with other on-chip capabilities. These include:

- High-resolution PWM
- Advanced signal mixing
- Hardware waveform control (various topologies)
- Precision frequency generators

User Interface

We offer a variety of peripherals and device features that support user input and feedback. This integrated hardware simplifies the development of everything from a simple push button switch or LED interface to capacitive touch sensing and LCD displays.

- Optimized hardware
- Flexible configuration options
- Pre-written libraries



Communication and Connectivity

We integrate key communication peripherals for common embedded interfaces, such as I2C, SPI and UART, onto many devices. Some devices also feature options for LIN, CAN, CAN FD and USB. These peripherals can also be interconnected with other on-chip capabilities. For example:

- Connect with Microchip Expansion Modules (Ext. PWM, CAN, Bluetooth, etc.)
- Implemented in hardware

System Flexibility

These features and peripherals add flexibility to route/interconnect signals, pass data and even perform logic operations in hardware while minimizing software requirements. Other options can optimize a system for lower-power operation and improved responsiveness to system changes.

- Perform combination or sequential logic in hardware
- Low power
- Flexible peripheral interconnects
- Hardware customization

Timing and Measurements

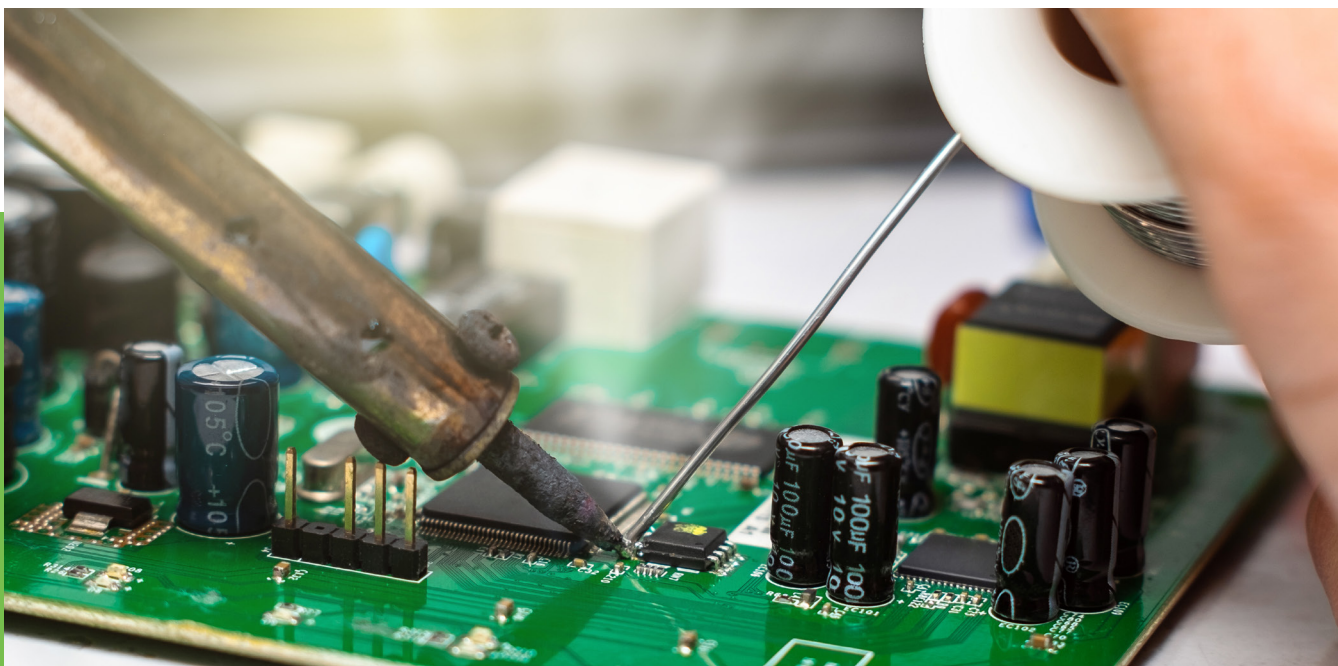
Our selection of timer peripheral options allows you to create applications that control, count, time, measure or generate time-based events. Since they can interface with most features on the device, their capabilities can be expanded to perform more elaborate tasks. The following features simplify your design process:

- Integration with other peripherals (including analog)
- Hardware signal measurements
- Flexible clock selections
- Low power

Safety and Monitoring

These peripheral and device features assist in the development of safe and reliable applications. You can use many of these capabilities to implement MCU self-tests, also known as diagnostic mechanisms, when creating functional safety applications.

- Windowed watchdog
- CRC scan
- Fail-safe clock monitor



Software Development

We offer two tool chains to support both PIC and AVR MCUs. These two separate, dedicated development ecosystems, which include drivers, libraries and documentation, will streamline the path of your next project from prototype to production.

We offer comprehensive online documentation including:

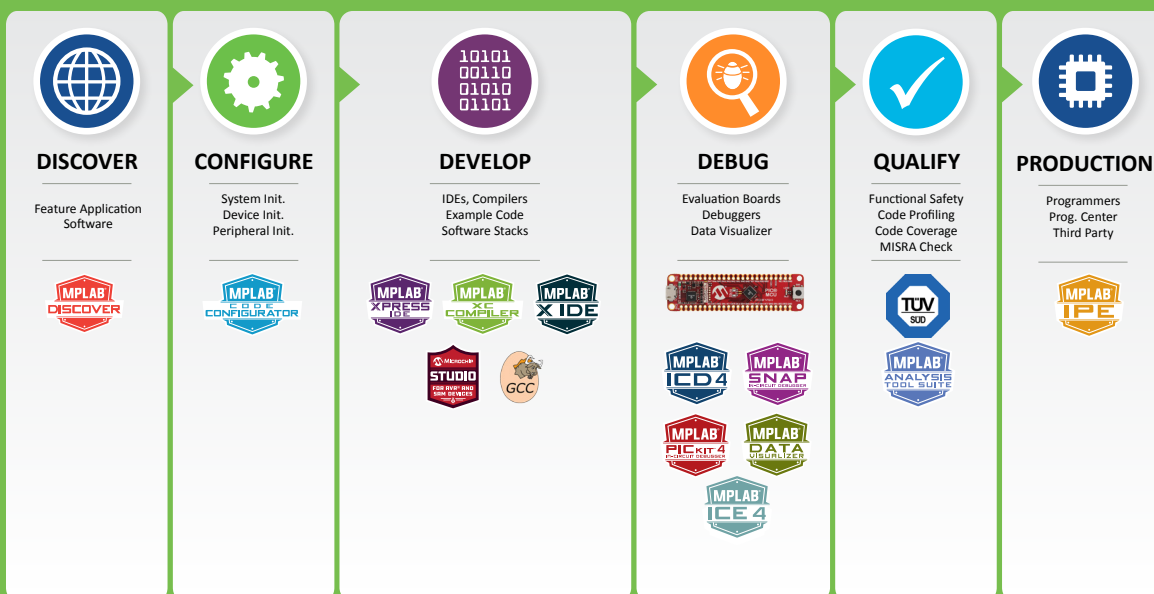
- Data sheets
- Application notes
- White papers
- Technical briefs
- Including “Getting Started With” guides to easily set up peripherals for your device

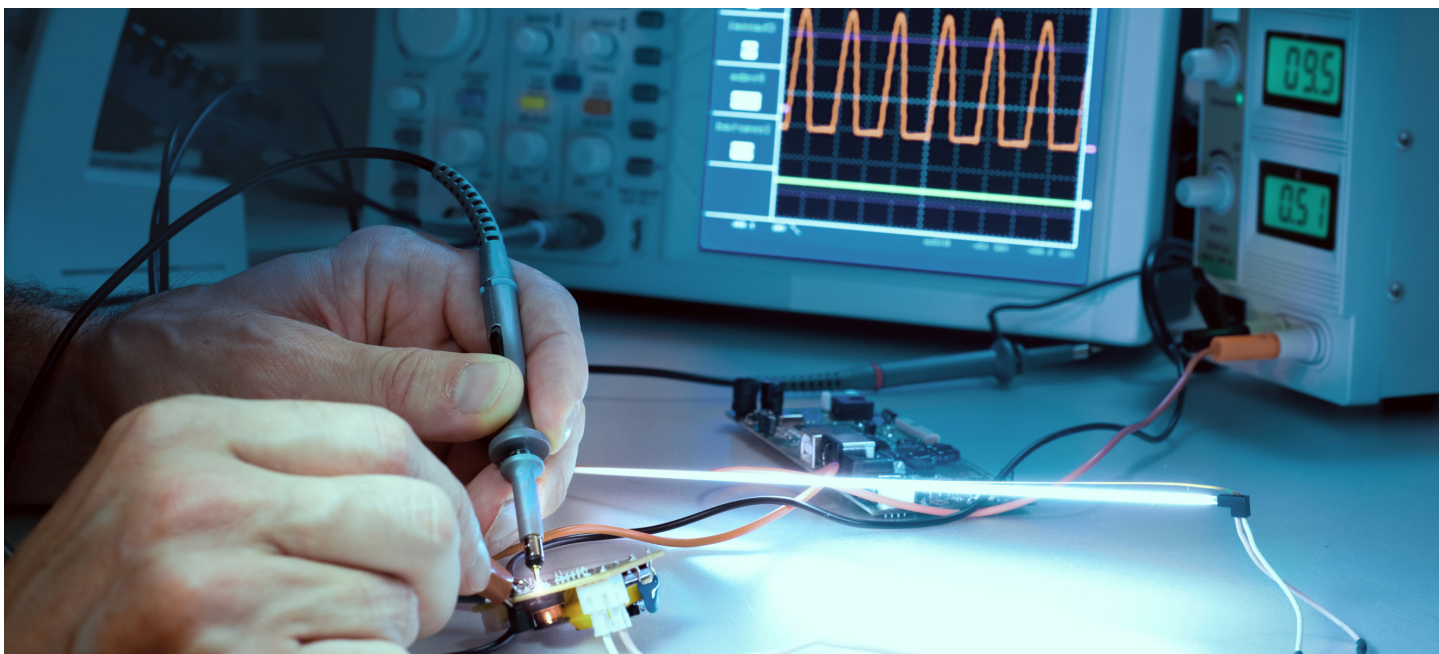
MPLAB Discover

MPLAB Discover has over 100 detailed project examples with GitHub code repos and setup instructions for specific devices. This makes your next prototype much easier as you can now use a reference design and simply modify it to suit your purposes.

You can search by:

- Project name
- Project description
- Device name
- Tags
- Peripherals used





Rapid Prototyping Options

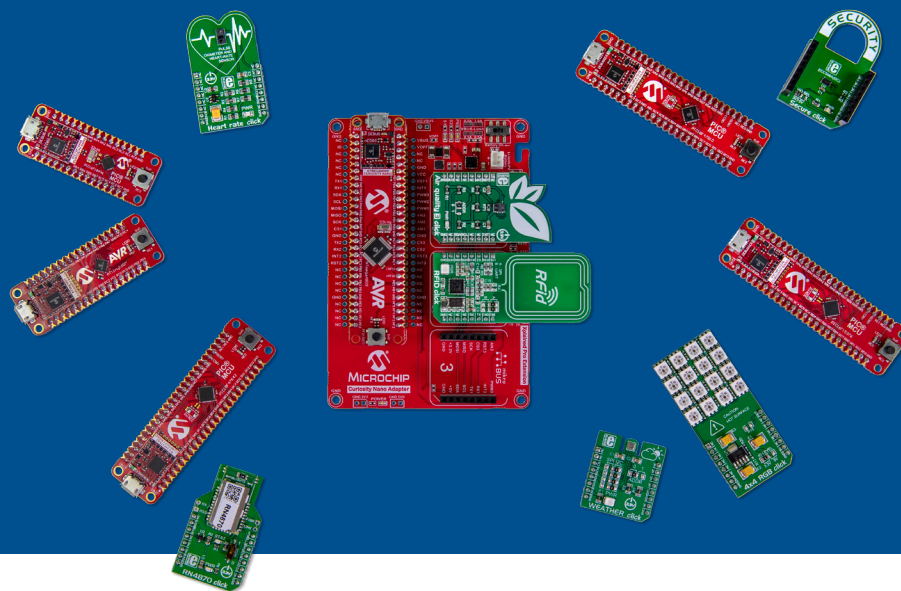
Curiosity Nano Development Platform

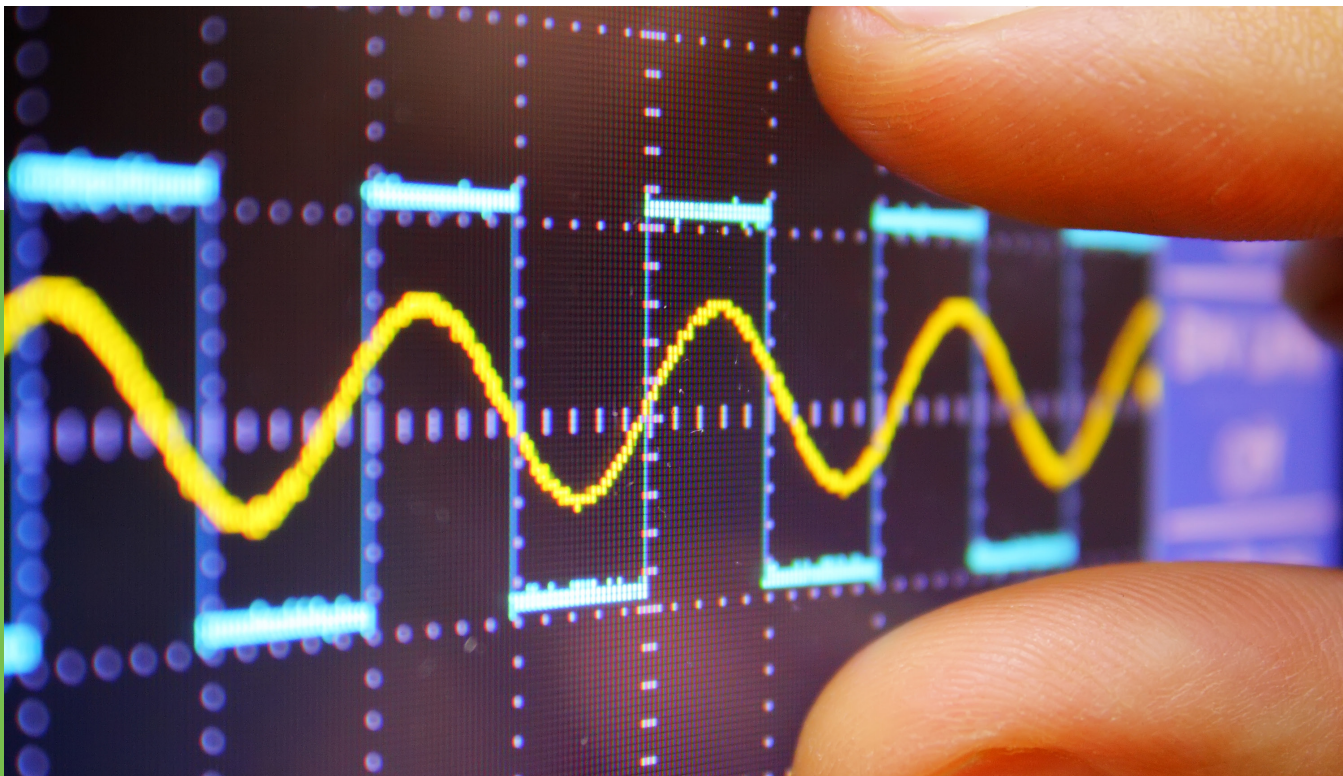
The Curiosity Nano Development Platform simplifies rapid prototyping by breaking out MCU pins in a form factor that can be easily used for breadboarding. Our Curiosity Nano Base for Click Boards™ allows you to easily connect a Curiosity Nano board to up to three MikroElektronika Click Boards to expand the capabilities of your next project. Several different Base boards are available, including some that include touch interfaces to make your next project a breeze.

Design Check Services

If you need additional assistance with your project, our free Design Check services support your design flow by providing guidance through the complete cycle, from initial schematic capture to PCB layout. You can submit your design schematic, PCB layout and PCB routing information to a confidential and secure environment, where they are analyzed by our engineers who will provide you with personalized feedback.

If you need to speed up your development, you can take advantage of our FAST TRACK option, which is available for \$100 per case and typically offers feedback within 3-5 working days.





Quick Reference

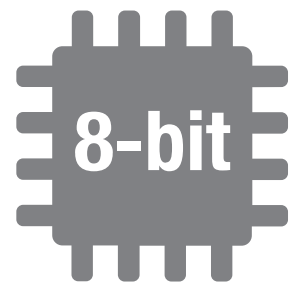
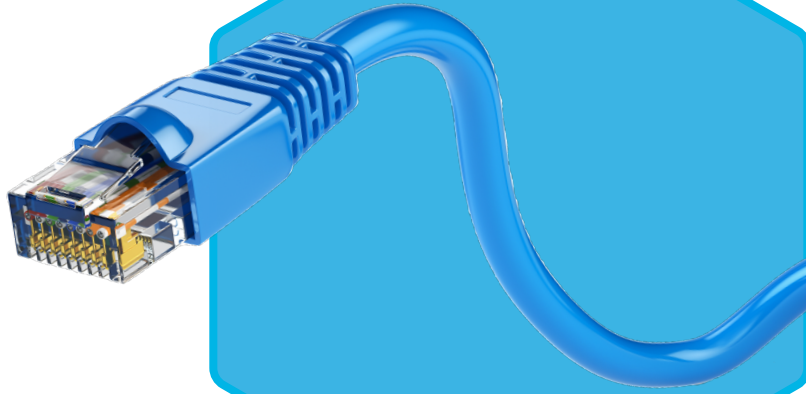
Simplify your design process with the industry's most capable and easy-to-use 8-bit MCUs. PIC and AVR microcontrollers help you bring your ideas to life, no matter your skill level. Pick from our broad portfolio of uniquely configurable MCUs and start designing quickly using our award-winning integrated development environments with production-ready code generation tools and best-in-class rapid prototyping hardware. This complete offering of silicon, development environments and industry knowledge enables you to easily add functionality and robustness to your designs while shortening the overall design cycle.

Working together, our selection of CIPs, intelligent analog, user interface peripherals and on-board communications can enable system functions on MCUs with minimal code footprint and reduced power consumption and help accelerate your time to market.

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Our commitment to long-term availability of PIC and AVR MCUs ensures that you can continue using your existing parts or easily migrate to other fully compatible devices to increase functionality without requiring an extensive redesign.

For more details about Microchip products, please visit our website at microchip.com/8bit





8-bit PIC® Microcontroller Peripheral Integration

Quick Reference Guide

8-bit PIC® Microcontroller Peripheral Integration																
Product Family	Pin Count	Program Flash Memory (KB)	RAM (KB)	Data EE (B)	Intelligent Analog							Waveform				
					ADC (# of bits)	Comp	HSComp	DAC (# of bits)	OPA	SlopeComp / PRG	ZCD	CCP/ECCP/PWM	16-bit PWM	COG / CWG	NCO	DSM
PIC10(L)F3XX	6	384–896 B	0.064	HEF	8									✓	✓	
PIC16F152XX	8–40	3.5–28	0.5–2	–	10							✓		✓	✓	✓
PIC16F180XX	8–40	3.5–28	.256–2	128–256	10	✓		8			✓	✓		✓	✓	
PIC16F171XX	8–40	7–28	0.5–2	128–256	12 ⁽³⁾	✓		8 ⁽⁷⁾	✓		✓	✓	4	✓	✓	
PIC16F181XX	8–40	7–28	0.5–2	128–256	12 ⁽³⁾	✓		8 ⁽⁷⁾			✓	✓	4	✓	✓	
PIC12/16 LF155X/6X	14–20	7–14	1.024	HEF	10 ⁽²⁾											
PIC1X(L)F157X	8–20	1.75–14	1.024	HEF	10	✓		5					3	✓		
PIC16(L)F153XX	8–48	3.5–28	2.048	HEF	10	✓		5			✓	✓		✓	✓	
PIC1X(HV)F752/53	8–14	1.75–3.5	0.128	–	10		✓	5/9	✓	SC		✓		✓		
PIC18-Q40/41	14–20	16–32	1–4	512	12 ⁽³⁾	✓		8	✓ ⁽⁴⁾		✓	✓	✓	✓	✓	✓
PIC16(L)F170X/71X	14–40	3.5–28	2.048	HEF	10		✓	5/8	✓		✓	✓			✓	
PIC16(L)F176X/7X	14–40	7–28	2.048	HEF	10		✓	5/10	✓	✓	✓	✓	✓	✓		✓
PIC16(L)F183XX/88XX	8–40	3.5–56	2–4	256	10 ⁽³⁾	✓		5			✓	✓		✓	✓	✓
PIC18-Q10	28–40	16–128	1–3.6	256–1K	10 ⁽³⁾	✓		5			✓	✓		✓		✓
PIC18-Q71	28–48	16–64	1–4	256	12 ⁽⁶⁾		✓	8 ⁽⁷⁾ /10	2		✓	✓	✓	✓	✓	
PIC18-Q43	28–48	32–128	2–8	1024	12 ⁽³⁾	✓		8			✓	✓	✓	✓	✓	✓
Speciality Families																
PIC16(L)F145X	14–20	14	1.024	HEF	10	✓								✓		
PIC16(L)F191XX	28–64	14–56	4.096	256	12 ⁽³⁾	✓		5			✓	✓		✓		
PIC18-Q84 (6)	28–48	64–128	8–13	1024	12 ⁽⁶⁾	✓		8			✓	✓	✓	✓	✓	✓

Notes: (1) In addition to standard 8-bit and 16-bit timers (2) Independent Dual ADC Modules (3) ADCC: Analog-to-Digital Converter with Computation (4) PIC18-Q41 has an OPAMP (5) CAN-FD & JTAG capable (6) Analog-to-Digital Converter with Computation and Context Switching (7) Two Digital-Analog-Converter

Microcontrollers																										
Form Control(1)						Logic and Math			Safety and Monitoring				Communications					User Interface				Low Power and System Flexibility				
	HLT (8-bit)	Universal Timer	NCO (20-bit)	SMT (24-bit)	RTCC	TEMP/TS	CLC	MULT	MathACC	CRC/SCAN	HLT	WWDT	Functional Safety Ready	USART	UART with Protocols	I2C/SPI	USB with ACT	LIN Capable	CAN FD	mTouch® Sensing	HCVD	LCD w/ charge pump	PPS	IDLE/DOZE/PMD	DMA/VI	DIA/MAP
			✓			✓	✓													✓						
	✓					✓							✓	1		✓		✓					✓	✓		✓
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	✓		✓			✓	✓	✓		✓	✓	✓	✓	2	1	✓		✓		✓	✓		✓	✓	✓	✓
			✓			✓	✓							✓		✓		✓		✓	✓		✓			
	✓	✓		✓		✓	✓			✓	✓	✓	✓	✓		✓		✓		✓			✓			
			✓	✓		✓	✓			✓	✓	✓	✓	✓		✓		✓		✓			✓	✓		
	✓					✓	✓	✓		✓	✓	✓	✓	2		✓		✓		✓	✓		✓	✓		
	✓	✓				✓	✓			✓	✓	✓	✓													
			✓			✓	✓			✓	✓	✓	✓	4	1	✓		✓		✓	✓		✓	✓	✓	✓
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	✓			✓	✓	✓	✓				✓	✓		✓		✓		✓		✓	✓	✓	✓	✓		✓
	✓	✓	✓	✓		✓	✓			✓	✓	✓	✓	3	2	✓		✓	✓		✓		✓	✓	✓	✓

INTELLIGENT ANALOG: Sensor Interfacing and Signal Conditioning

ADC: Analog-to-Digital Converter	General purpose 8-/10-/12-bit ADC
ADC2/ADCC: Analog-to-Digital Converter with Computation	General purpose 10-/12-bit ADC with automated analog signal analysis (ex. oversampling, averaging, etc.)
Comp: Comparator	General purpose rail-to-rail comparator
DAC: Digital-to-Analog Converter	Programmable voltage reference with multiple internal and external connections
HSComp: High-Speed Comparator	General purpose rail-to-rail comparator with < 50 ns response time
OPA: Operational Amplifier	General purpose op amp for internal and external signal source conditioning
PRG: Programmable Ramp Generator	Analog ramp generator (with slope compensation) for current/voltage mode power supplies
SlopeComp: Slope Compensation	Slope compensation for Peak Current Mode power supplies
VREF: Voltage Reference	Stable fixed voltage reference for use with integrated analog peripherals
ZCD: Zero Cross Detect	AC high-voltage zero-crossing detection for simplifying TRIAC control, synchronized switching control and timing

WAVEFORM CONTROL: PWM Drive and Waveform Generation

CCP/ECCP: (Enhanced) Capture Compare PWM	1. CCP/ECCP: 10-bit PWM control with 16-bit capture and compare 2. ECCP: Addition of auto shutdown control
COG: Complementary Output Generator	Automated complementary output with control of key parameters such as programmable rising/falling edge events, polarity, phase, precision dead-band, blanking and auto shutdown
CWG: Complementary Waveform Generator	Automated complementary output with control of key parameters such as dead-band and auto shutdown
DSM: Data Signal Modulator	1. Modulates up to two carrier signals with digital data to create custom carrier synchronized output waveforms 2. LED dimming engine functionality via interconnection with 10-/16-bit PWM, DSM and op amp
NCO: Numerically Controlled Oscillator and 16-/20-bit Timer/Counter	1. Precision linear frequency generator (@ 50% duty cycle) with 0.0001% step size of source input clock frequency 2. General purpose 16-/20-bit timer/counter
PWM: Pulse Width Modulation	General purpose 10-bit PWM control
16-bit PWM: Standalone 16-bit PWM and 16-bit Timer/Counter	1. High-resolution 16-bit PWM with edge- and center-aligned modes 2. General purpose 16-bit timer/counter

TIMING AND MEASUREMENTS: Signal Measurement with Timing and Counter Control

HLT: Hardware Limit Timer and 8-bit Timer/Counter	1. Hardware monitoring for missed periodic events and fault detection 2. General purpose 8-bit timer/counter with external reset capabilities
NCO: Numerically Controlled Oscillator and 16-/20-bit Timer/Counter	1. Precision linear frequency generator (@ 50% duty cycle) with 0.0001% step size of source input clock frequency 2. General purpose 16-/20-bit timer/counter
RTCC: Real-Time Clock/Calendar	Maintains accurate clock and calendar timing with external 32.768 kHz crystal
SMT: 24-bit Signal Measurement Timer and 24-bit Timer/Counter	1. Accurate measurement of any digital signal including period, duty cycle, time of flight; instantaneous vs. average measurements 2. General purpose 24-bit timer/counter
TEMP: Temperature Indicator	Provides relative temperature measurements utilizing the ADC
TS: Temperature Sensor	Provides linear relative temperature measurements utilizing the ADC with two factory-calibrated reference values
8-/16-bit Timer	General purpose 8-/16-bit timer/counter
UTMR: Universal Timer	1. Timer modules with features of TMR0/TMR1/TMR2 (Gate, Hardware Limit) 2. Two 16-bit timers can be chained together to create a combined 32-bit timer



Learn more about 8-bit PIC Microcontrollers at microchip.com/8bit.

Learn more about Core Independent Peripherals (CIP) at microchip.com/CIP.

LOGIC AND MATH: Customizable Logic and Math Functions	
CLC: Configurable Logic Cell	1. Integrated combinational and sequential logic 2. Customer interconnection and re-routing of digital peripherals
MULT: Hardware Multiplier	MULTIPLY function of two 8-bit values with 16-bit result
MathACC: Math Accelerator	1. MULTIPLY, ADD, ACCUMULATE functions of 8-/16-bit values with 35-bit result 2. Calculates a 16-bit PID function based on configurable Kp, Ki, Kd constants with a 34-bit result
PERIPHERALS	
CRC/SCAN: Cyclical Redundancy Check with Memory Scan	1. Automatically calculates CRC checksum of Program/DataEE memory for NVM integrity 2. General purpose 16-bit CRC for use with memory and communications data
HLT: Hardware Limit Timer and 8-bit Timer/Counter	1. Hardware monitoring for missed periodic events and fault detection of external hardware 2. General purpose 8-bit timer/counter with external reset capabilities
WWDT: Windowed Watch Dog Timer	System supervisory circuit that generates a reset when software timing anomalies are detected within a configurable critical window
COMMUNICATIONS: General, Industrial, Lighting and Automotive	
ACT: Active Clock Tuning for Crystal-Free USB	1. Auto-tuning of internal oscillator when connected to USB host (eliminates need for external crystal) 2. Tunes internal oscillator to match accuracy of external clock source
CAN: Controller Area Network	Industrial- and automotive-centric communication bus
LIN: Local Interconnect Network	1. Industrial- and automotive-centric communication bus 2. Support for LIN when using the EUSART
EUSART/AUSART: Enhanced/Addressable Universal Asynchronous Receiver Transceiver	1. General purpose serial communications 2. Support for LIN when using the EUSART
I2C: Inter-Integrated Circuit	General purpose 2-wire serial communications
SPI: Serial Peripheral Interface	General purpose 4-wire serial communications
UART: Universal Asynchronous Receiver Transmitter	Supports LIN master and slave, DMX, DALI and device protocols
USB: Universal Serial Bus	Support for full-speed USB 2.0 device profiles
USER INTERFACE: Capacitive Touch Sensing and LCD Control	
HCVD: Hardware Capacitive Voltage Divider	Simplifies implementation and reduces overhead of mTouch sensing applications
LCD: Liquid Crystal Display	Highly integrated segmented LCD controller
mTouch: Microchip Proprietary Capacitive Touch Technology	1. Capacitive sensing for touch buttons and sliders 2. Capacitive sensing for system measurements and detection (ex. water level, intrusion detection, etc.)
LOW POWER AND SYSTEM FLEXIBILITY: XLP Low-Power Technology, Peripheral and Interconnects	
DIA: Device Information Area	Dedicated memory area for data storage of temp sensor factory calibration values, factory ID and FVR values for ADC and COMP
DMA: Direct Memory Access	Moves data between memories and peripherals without CPU overhead, improving overall system performance and efficiency
DOZE: Power Saving Mode	Ability to run the CPU core slower than the system clock used by the internal peripherals
HEF: High-Endurance Flash	128B Non-volatile data storage with high-endurance 100k E/W cycles
IDLE: Power Saving Mode	Ability to put the CPU core to sleep while the internal peripherals continue to operate from the system clock
MAP: Memory Access Partition	Customizable Flash partitioning with bootloader write protection option
PMD: Peripheral Module Disable	Peripheral power disable hardware to minimize power consumption of unused peripherals
PPS: Peripheral Pin Select	I/O pin remapping of digital peripherals for greater design flexibility and optimized board layout
VI: Vectored Interrupts	Offers faster and more predictable interrupt response times, with lower software overhead
XLP: eXtreme Low Power Technology	XLP technology devices with extreme low-power operation modes for battery/low-power applications

AVR® Microcontrollers Peripheral Integration

Quick Reference Guide

Peripheral Functions																		
Product Family	Pin Count	Program Flash Memory (KB)	SRAM (KB)	EEPROM (B)	Supply Voltage	Speed (MHz) Single Cycle Instruction: MHz = MIPS	Intelligent Analog									Waveform Controller		
							ADC (# of bits)	ADC (# of channels)	Comparators	ADC Gain Stage	DAC (# of bits)	Op-amp	Temperature Sensor	Internal Voltage Reference	Zero Cross Detector (ZCD)	8-bit PWM	16-bit PWM	Quadrature Decoder
ATtiny102/104	8/14	1	0.032		1.8–5.5	12	10	5/8	✓					✓				2
ATtiny20x/40x/80x/160x	8–24	2–16	Up to 1		1.8–5.5	20	10	12	✓				✓	✓				2
ATtiny21x/41x/81x/161x /321x	8–24	2–32	Up to 2		1.8–5.5	20	10	12	✓		8		✓	✓			2	
ATtiny42x																		
ATmega48PB/88PB/168PB /328PB	32	4–32	0.5–2		1.8–5.5	20	10	8	✓				✓	✓		4	2/6 ⁽⁵⁾	
ATmega80x/160x/320x /480x	28–48	8–48	1–6		1.8–5.5	20	10	16	✓				✓	✓		4	3	
ATmega324PB	44	32	2		1.8–5.5	20	10	8	✓					✓		2	2	
AVR-DB Family	28–64	32–128	4–16	512	1.8–5.5	24	12	22	✓		10	2–3	✓	✓	1–4	9–18	3–7	
ATtiny42x/82x/162x/322x	14–24	4–32	0.5–3	128	1.8–5.5	20	12	15	✓	16x			✓	✓		12	8	
AVR-DA Family	28–64	32–128	4–16	512	1.8–5.5	24	12	22	✓		10		✓	✓	1–3	16	16	
AVR-DD Family	14–32	16–64	2–8	256	1.8–5.5	24	12	23	✓		10		✓	✓	1	16	9	
AVR-EA Family	28–48	16–64	2–6	512	1.8–5.5	20	12	28	✓	16x			✓	✓		12	10	
Speciality Families																		
ATmega8U2/16U2/32U2	32	8–32	0.5–1		2.7–5.5	16	–	–	✓				✓	✓		4	6	
ATmega16U4/32U4	32	16/32	1/2		2.7–5.5	16	10	12	✓				✓	✓		5		
ATmega3290PA/6490P	100	32–64	2–4	1K	1.8–5.5	20	10	8	✓	✓				✓		2	2	

1: LIN port also 2: Peripheral Touch Controller 3: Not on the ATtiny212/214/412/414/416 4: Only on the ATmega1281/2561 5: Only on the ATmega328PB 6: Only on the C3 and C4 7: UART only LIN Port also

Function Focus																													
Control	Timing and Measurements				Logic, Crypto and Math			Safety and Monitoring					Communications						User Interface			System Flexibility							
Waveform Extension (WeX)	Real-Time Counter	8-bit Timer/Counters	12-bit Timer Counter	16-bit Timer/Counter	CCL	MULT	Crypto (AES/DES)	CRC/SCAN	POR	BOD	WDT	Functional Safety Ready	USART	USB	I ² C	SPI	IRCOM	Serial Number	QTouch® Technology	QTouch Technology with PTC ⁽²⁾	LCD	External Bus Interface	DMA Channels	Event System	Multi-Voltage I/O	SleepWalking	Sleep Modes	picoPower® Technology	
				2					✓		✓		1														4		
	✓			1	✓	✓		✓	✓	✓	✓		1 ⁽¹⁾		1	1		✓							✓		✓	3	✓
	✓		1	1	✓	✓		✓	✓	✓	✓		1 ⁽¹⁾		1	1		✓		✓ ⁽³⁾				✓		✓	3	✓	
	✓	2		1/3 ⁽⁵⁾		✓			✓	✓	✓		1/2 ⁽⁵⁾		1/2 ⁽⁵⁾	1/2 ⁽⁵⁾			✓	✓ ⁽³⁾							6		
	✓			5	✓	✓		✓	✓	✓	✓		4		1	1		✓						✓		✓	3	✓	
	✓	2		1		✓			✓	✓	✓		1		1	1			✓	✓							5		
	✓		1	1-5	✓	✓		✓	✓	✓	✓		3-6		1-2	2	✓	✓		✓				✓	✓	✓	3	✓	
	✓			6	✓	✓		✓	✓	✓	✓	✓	2		1	1	✓	✓						✓		✓	3	✓	
	✓		1	5	✓	✓		✓	✓	✓	✓	✓	3-6		1-2	2	✓	✓		✓				✓		✓	3	✓	
	✓		1	3	✓	✓		✓	✓	✓	✓	✓	2		1	1	✓	✓						✓		✓	3	✓	
	✓			6	✓	✓		✓	✓	✓	✓	✓	3		1	1	✓	✓						✓		✓	3	✓	
	✓	2		3		✓			✓	✓	✓		2	✓	2	2											6		
		1		1		✓			✓	✓	✓		1	✓		1											6		
	✓	2		1		✓			✓	✓	✓		1		1	1			✓		✓						5		

INTELLIGENT ANALOG: Sensor Interfacing and Signal Conditioning	
ADC: Analog-to-Digital Converter	General purpose 10-/12-bit ADC
ADC Gain Stage: Analog-to-Digital Converter Gain Stage	Programmable gain stage, providing amplification steps on the differential input voltage
Comp: Comparator	General purpose rail-to-rail comparator
DAC: Digital-to-Analog Converter	Programmable voltage reference with multiple internal and external connections
VREF: Voltage Reference	Stable fixed voltage reference for use with integrated analog peripherals
ZCD: Zero Cross Detect	AC high-voltage zero-crossing detection for simplifying TRIAC control, synchronised switching control and timing
WAVEFORM CONTROL: PWM Drive and Waveform Generation	
PWM: Pulse Width Modulation	General purpose 10-bit PWM control
16-bit PWM: Standalone 16-bit PWM and 16-bit Timer/Counter	1. High-resolution 16-bit PWM with edge- and center-aligned modes 2. General purpose 16-bit timer/counter
WeX: Waveform Extension	1. Module for more customised and advanced waveform generation 2. Optimised for various types of motor, ballast and power stage control
TIMING AND MEASUREMENTS: Signal Measurement with Timing and Counter Control	
8-/12-/16-bit Timer	General purpose 8-/12-/16-bit timer/counter
LOGIC, CRYPTO AND MATH: Customizable Logic and Math Functions	
CCL: Configurable Custom Logic	1. Integrated combinational and sequential logic 2. Customer interconnection and re-routing of digital peripherals
MULT: Hardware Multiplier	MULTIPLY function of two 8-bit values with 16-bit result
Crypto (AES/DES)	Data encryption and decryption can be easily performed for both internally stored data or for small external data packets
SAFETY AND MONITORING: Hardware Monitoring and Fault Detection	
CRC/SCAN: Cyclical Redundancy Check with Memory Scan	Automatically calculates CRC checksum of Program/DataEE memory for NVM integrity
POR: Power-On Reset	Keeps the device in reset until the voltage is high enough. Ensures a safe start-up of logic and memories
BOD: Brownout Detector	Prevents code execution if voltage drops below a set threshold
WDT: Watchdog Timer	Monitors correct program operation. Constantly running timer with a configurable time-out period

COMMUNICATIONS: General, Industrial, Lighting and Automotive

UART: Universal Asynchronous Receiver Transmitter	1. General purpose serial communications 2. Support for LIN
USB: Universal Serial Bus	Support for Full-Speed USB 2.0 device profiles
I²C: Inter-Integrated Circuit	General purpose 2-wire serial communications
SPI: Serial Peripheral Interface	General purpose 4-wire serial communications
IRCOM: Infrared Communication Module	Encodes and decodes data according to the IrDA communication protocol
Serial Number	Factory programmed unique ID useful in wired and wireless communications

USER INTERFACE: Capacitive Touch Sensing and LCD Control

LCD: Liquid Crystal Display	Highly integrated segmented LCD controller
QTouch®: Microchip Proprietary Touch Technology	Provides a simple-to-use solution to realize touch-sensitive interfaces
QTouch with PTC: QTouch with Peripheral Touch Controller	Provides a simple-to-use solution to realize touch-sensitive interfaces with a Peripheral Touch Controller

LOW POWER AND SYSTEM FLEXIBILITY: Low-Power Technology, Peripheral and Interconnects

DMA: Direct Memory Access	Moves data between memories and peripherals without CPU overhead, improving overall system performance and efficiency
Event System	Flexible routing of peripheral events, ability to control peripheral independent from the CPU
External Bus Interface	Highly flexible module for interfacing external memories and memory- addressable peripherals
picoPower® Technology	Low-power technology
Sleep Modes	Low-power saving modes, IDLE, power-down, power-save, standby and extended standby
SleepWalking	Ability to put the CPU core to sleep until a relevant event occurs



SMART | CONNECTED | SECURE

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