### 16-bit PIC® Microcontroller Peripheral Integration

**Quick Reference Guide**

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<tr>
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1: 16-bit PIC® MCU offers SAR ADC, High-speed ADC and Delta-Sigma ADC
2: Security, PWM lock*   L2: Includes features of L1 + CRC   L3: Includes features of L2 + Flash ECC and/or DMT   L4: Includes features of L3 + RAM MBIST
3: Functional Safety Features
   L1: Includes WDT, oscillator fail-safe, illegal opcode detect, TRAP, reset trace, register lock, frequency check, CodeGuard™ security, PWM lock*
   L2: Includes features of L1 + CRC   L3: Includes features of L2 + Flash ECC and/or DMT   L4: Includes features of L3 + RAM MBIST
   *PWM lock available in devices with MC PWM/SMPS PWM peripheral
   (v) 16-bit PIC MCUs and dsPIC DSCs with 5V operating Voltage

**Notes:** Similar family of devices with fewer variations are grouped with the same color coding.

www.microchip.com/16bit
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1: 16-bit PIC MCU offers SAR ADC, high-speed ADC and Delta-Sigma ADC
2: 16-bit PIC MCU offers general-purpose DAC and audio DAC
3: Functional Safety Features:
   L1: Includes WDT, oscillator fail-safe, illegal opcode detect, TRAP reset trace, register lock, frequency check, CodeGuard™ security, PWM lock*
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* : PWM lock available in devices with MC PWM/SMPS PWM peripheral

(SV) 16-bit PIC MCUs and dsPIC DSCs with 5V operating Voltage

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*PWM lock available in devices with MC PWM/SMPS PWM peripheral
**PIC® MCUs and dsPIC DSCs with 3V operating Voltage

Note: Similar family of devices with fewer variations are grouped with the same color coding.
General-purpose ADC with up to 10-/12-/16-bit resolution
Hardware true random number generation
High-speed SAR ADC with 12-bit resolution and sampling speed of 10 Msps
General-purpose 4-wire synchronous serial interface for communicating with System supervisory circuit that generates a reset when instruction sequence
General purpose 2-wire inter IC serial interface for communicating with other Industrial- and automotive-centric communication bus
Highly integrated graphics controller supporting direct interface with display
Multiple option for key storage, selection and management
User-programmable sequencer, capable of generating complex trigger signal
USB 2.0 full-speed (host and device), low-speed (host) and On-The-Go (OTG) support
Low-power saving modes
Highly integrated segmented LCD controller
General-purpose 16-/32-bit timer/counter with compare capability
LVD detects drops in system operating voltage using an internal reference
Hardware Functional Safety support with Flash error correction, RAM MBIST, ECC detects the presence of single and double bit errors, and corrects single
Bipolar differential inputs configurable gain integrated PGA Delta-Sigma ADC
CVer: Internal Voltage Reference
Programmable voltage reference with multiple internal and external connections
HS Comp: High-Speed Comparator
General-purpose rail-to-rail comparator with <1 ns response time
OPA/PGA: Operational Amplifier and Programmable Gain Amplifiers
General-purpose op amp and PGAs for internal and external signal source conditioning
WAVEFORM CONTROL: PWM Drive and Waveform Generation
CCP/ECCP: (Enhanced) Capture/Compare/PWM
Multi-purpose timers with functionality of the comparable input capture, output compare and PWM with four outputs
SCCP: Single Capture/Compare/PWM
Multi-purpose 16-/32-bit input capture, output compare and PWM
MCCP: Multiple Capture/Compare/PWM
Multi-purpose 16-/32-bit input capture, output compare and PWM with up to six outputs and an extended range of output control features
PWM: Pulse Width Modulation
16-bit PWM with up to nine independent time bases
MC PWM: Motor Control Pulse Width Modulation
Motor control 16-bit PWM with multiple synchronized pulse-width modulation, up to six outputs with four duty cycle generators and resolution up to 1 ns
SMPS PWM: Power Supply Pulse Width Modulation
Power supply 16-bit PWM with multiple synchronized pulse-width modulation, up to eight outputs with four independent time bases and resolution up to 1 ns
IG: Input Capture
Input capture with an independent timer base to capture an external event
OC: Output Compare
Output compare with an independent time base to compare value with compare registers and generate a single output pulse, or a train of output pulses on a compare match event
CLOCKS AND TIMERS: Signal Measurement with Timing and Counter Control
16-/32-bit Timer
General-purpose 16-/32-bit timer/counter with compare capability
RTCC: Real-Time Clock/Calendar
Real-time clock and calendar with a Binary-Encoded Decimal (BCD) clock calendar to maintain accurate timing with external 32/768 kHz crystal
QE2: Quadrapole Encoder Interface
Quadrapole encoder interface to increment encoders for obtaining mechanical position data
SAFETY AND MONITORING: Hardware Monitoring and Fault Detection
Flash ECC: Error Correction Code
ECC detects the presence of single and double bit errors, and corrects single bit error automatically
RAM MBIST: Memory Built-In Self-Test
RAM MBIST tests for functional correctness of all memory locations
LVD: Low-Voltage Detection
LVD detects drops in system operating voltage using an internal reference voltage for comparison, especially in battery-powered applications
WDT: Watch Dog Timer
System supervisory circuit that generates a reset when software timing anomalies are detected within a configurable critical window
DMT: Dead Man Timer
System supervisory circuit that generates a reset when instruction sequence anomalies are detected within a configurable critical window
CRC: Cyclic Redundancy Check with Memory Scan
Automatically calculates CRC checksum of Program/DataEE memory for NVM integrity and a general-purpose 16-bit CRC for use with memory and communications data
Functional Safety
Hardware Functional Safety support with Flash error correction, RAM MBIST, backup system oscillator, WDT, DMT, CRC scan, etc.
COMMUNICATIONS: General, Industrial, Lighting and Automotive
USB OTG: Universal Serial Bus
USB 2.0 full-speed (host and device), low-speed (host) and On-The-Go (OTG) support
CAN/CAN FD: Controller Area Network
Industrial- and automotive-centric communication bus
UART: Universal Asynchronous Receiver Transceiver
General-purpose full-duplex, 8-bit or 9-bit data serial communications with optional ISO 7816 Digital Smart Card support
LIN: Local Interconnect Network
1. Industrial- and automotive-centric communication bus 2. Support for LIN when using the EUSART
IrDA: Infrared Data Association
IrDA encoder and decoder logic support through UART
PC: Inter-Integrated Circuit
General purpose 2-wire inter IC serial interface for communicating with other peripherals or microcontroller devices
SPI: Serial Peripheral Interface
General-purpose 4-wire synchronous serial interface for communicating with other peripherals or microcontroller devices
FS: Data Converter Interface
3-wire synchronous half duplex serial interface to handle the stereo data
SENT: Single-Edge Nibble Transmission
SENT is an unidirectional, single-wire serial communications protocol designed for point-to-point transmission of signal values
Parallel Port
General-purpose parallel communication interface
USER INTERFACE: Capacitive Touch Sensing and LCD Control
CTMU and mTouch
Capacitive sensing for touch buttons, sliders and system measurements and detection (e.g. water level, intrusion detection, etc.) using an analog CTMU that provides accurate differential measurement between pulse sources and asynchronous pulse generation
Sensing: Microchip Proprietary Capacitive Touch Technology Using Charge Time Measurement Unit
Highly integrated segmented LCD controller
GFX: Graphics Controller
Highly integrated graphics controller supporting direct interface with display glasses with built-in analog drive for individual pixel control
SECURE DATA: Hardware Integrated Cryptographic Engine
Cryptographic Engine
Independent NIST-standard encryption and decryption engine
Secure Key Storage
Multiple option for key storage, selection and management
RING: Random Number Generator
Hardware true random number generation
SYSTEM FLEXIBILITY: System Peripherals and Interconnects
Dual Partition Flash
Dual partition flash operation, allowing the support of robust bootloader systems and fail-safe storage of application code, with options designed to enhance code security
CLC: Configurable Logic Cell
Integrated combinational and sequential logic with custom interconnection and re-routing of digital peripherals
PPS: Peripheral Pin Select
I/O pin remapping of digital peripherals for greater design flexibility and improved EMI board layout
PTG: Peripheral Trigger Generator
User-programmable sequencer, capable of generating complex trigger signal sequences to coordinate the operation of other peripherals
DMA: Direct Memory Access
Direct memory access for transfer of data between the CPU and its peripherals without CPU assistance
DOZE, IDLE, SLEEP and PMD
Low-power saving modes
XLP: xTreme Low Power Technology
XLP technology devices with extreme low-power operation modes for battery/ low power applications
Vxar
Hardware-based power mode that maintains only the most critical operations when a power loss occurs on Vbat
Learn more about 16-bit PIC microcontrollers at www.microchip.com/16bit.