

PIC and Software Reference

9/5/2022

2:34:27 PM

Contents

MEET THE FAMILY PIC MICROCONTROLLERS	2
Atmel acquired by Microchip Technology for \$3.56 billion.....	2
WHAT IS NEEDED TO CHOOSE MICROCONTROLLER AND IDE	2
8-BIT	3
16-Bit 3 Pages of Chips SHOW.....	5
How to Read the Model Number	7
Download 366 Page Data Sheet SHOW.....	7
Buy Now Price, Any Volume About \$4.00.....	7
Page 2 Data Sheet – quick selection.....	8
PIC24F32KA304 Low Power MCU with 3V and 5V options.....	Error! Bookmark not defined.
Embedded Software.....	9
Development Environment.....	9
MPLAB® ICD 4 In-Circuit Debugger.....	9
QUICK Guide to Microchip Development Tools	10
Here we find a number of PIC24 Video Tutorials	10
Installing MPLAB® X IDE	11
MPLAB installation video (Older).....	11
PIC24 MCUs and dsPIC33 DSCs Easy Migration in a Platform Design	11
How to program MICROCHIP PIC24 microcontrollers on LINUX.....	11
GENERAL REFERENCES- SOFTWARE:.....	11
Languages:	11
A few references that discuss C and Assembly Language.....	11
Python vs. C/C++ in Embedded Systems	12
Assemblers, Linkers & Loaders A brief review	12

MEET THE FAMILY PIC MICROCONTROLLERS

1. From Wikipedia, the free encyclopedia 2022

PIC (usually pronounced as "pick") is a family of [microcontrollers](#) made by [Microchip Technology](#), derived from the PIC1650 originally developed by [General Instrument's](#) Microelectronics Division. The name PIC initially referred to *Peripheral Interface Controller*, and is currently expanded as *Programmable Intelligent Computer*.

https://en.wikipedia.org/wiki/PIC_microcontroller

Atmel acquired by Microchip Technology for \$3.56 billion

APRIL 2016

A large part of Atmel's revenue is from microcontrollers. These include the [AVR](#) 8- and 32-bit microcontrollers, [ARM architecture](#) microprocessors, and ARM-based flash microcontrollers. In addition Atmel still makes microcontrollers that use the [8051](#) architecture, albeit improved to do single-cycle instructions. Supporting the microcontrollers is the Atmel Studio 7 [integrated development environment](#) which Atmel offers for free. They also provide an Atmel Software Framework.

WHAT IS NEEDED TO CHOOSE MICROCONTROLLER AND IDE

- KNOW YOUR REQUIREMENTS
- CHOOSE A CHIP 8, 16, OR 32 BIT
- CHOOSE MODULES NEEDED FOR I/O
- WHAT CAN BE PROVIDED BY THE VENDOR OF THE CHIP
 - 1. USE THE DATA SHEET TO DETERMINE THE CHARACTERISTICS
 - 2. DETERMINE THAT THE VENDOR HAS SUPPORT AND DOCUMENTATION
 - 3. LITERATURE, BOOKS, APPLICATION NOTES?
 - 4. AVAILABLE SPECIAL SOFTWARE – RTOS?
-
- **Which Tools Do I Need To Develop Applications?**
 - 1. DEVELOPMENT SOFTWARE (USUALLY ON PC)
 - 2. INTEGRATED DEVELOPMENT ENVIRONMENT
 - 3. IN CIRCUIT DEBUGGER OR EMULATOR
 - 4. DEVELOPMENT BOARD OR TARGET HARDWARE



In-Circuit Serial Programming Interface

8-BIT

<https://ww1.microchip.com/downloads/en/DeviceDoc/30010068G.pdf>

8-bit PIC® Microcontroller Peripheral Integration

Quick Reference Guide

Product Family	Pin Count	Program Flash Memory (kB)	RAM (kB)	8-bit PIC® Microcontrollers															
				Intelligent Analog				Waveform Control				Logic and Math		Safety and Monitoring		Communications		User Interface	
PIC10(L)F3XX	6	384-896 B	0.064	HEF	8														
PIC16F152XX	8-40	3.5-28	0.5-2	-	10														
PIC2/16 LF155X/6X	14-20	7-14	1.024	HEF	10 ⁽²⁾														
PIC16(L)F145X	14-20	14	1.024	HEF	10 ✓														
PIC1X(L)F157X	8-20	1.75-14	1.024	HEF	10 ✓	5				✓	✓	✓	✓						
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	✓	✓	✓	✓						
PIC1X(L)F161X	8-14	3.5	0.256	HEF	10 ✓	8	✓	✓		✓	✓	✓	✓						
PIC16(L)F161X ⁽³⁾	14-20	7-14	1.024	HEF	10 ✓	8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-Q40/1	14-20	16-32	1-4	512 12 ⁽⁴⁾	✓	8 ✓ ⁽⁵⁾	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
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	8-20	3.5-14	2.048	HEF	10 ✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC16(L)F184XX	14-28	7-28	2.048	256 12 ⁽⁴⁾	✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC16(L)F188XX	28-40	7-56	4.096	256 10 ⁽⁴⁾	✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-Q10	28-40	16-128	1-3.6	256-1K 10 ⁽⁴⁾	✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-Q43	28-48	32-128	2-8	1024 12 ⁽⁴⁾	✓	8	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-Q84 ⁽⁶⁾	28-48	64-128	8-13	1024 12 ⁽⁷⁾	✓	8	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC16(L)F191XX	28-64	14-58	4.096	256 12 ⁽⁴⁾	✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-K40	28-64	16-128	3.728	256-1K 10 ⁽⁴⁾	✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-K42	28-48	16-128	8.192	256-1K 12 ⁽⁴⁾	✓	5	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	
PIC18-J94	84-100	32-128	4.096	-	12 ✓					✓				✓		✓	✓		

Notes: (1) In addition to standard 8-bit and 16-bit timers (2) Independent Dual ADC Modules (3) PIC16F1615/9 include an angular timer. (4) ADCC: Analog-to-Digital Converter with Computation (5) PIC18-Q41 has an OPAMP
 (6) CAN-FD & JTAG capable (7) Analog-to-Digital Converter with Computation and Context Switching

www.microchip.com/8bit



INTELLIGENT ANALOG: Sensor Interfacing and Signal Conditioning	
ADC: Analog-to-Digital Converter	General purpose 8-/10-/12-bit ADC
ADC/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	
COP/ECOP: (Enhanced) Capture Compare PWM	1. COP/ECOP: 10-bit PWM control with 16-bit capture and compare 2. ECOP: 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 modulated 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
RTC: 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
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 K_p , K_i , K_d constants with a 34-bit result
SAFETY AND MONITORING: Hardware Monitoring and Fault Detection	
CRC/SCAN: Cyclic Redundancy Check with Memory Scan	1. Automatically calculates CRC checksum of Program/Data/EEMemory 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. Tunics 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 USART
EUSART/EUSART: 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	
HCD: 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 PVR values for ADC and COMP
DMA: Direct Memory Access	Moves data between memories and peripherals without CPU overhead, improving overall system performance and efficiency
DZSE: 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



Learn more about 8-bit PIC Microcontrollers at www.microchip.com/8bit.
 Learn more about Core Independent Peripherals (CIP) at www.microchip.com/CIP.

PDF version available for download at www.microchip.com/8bitquickreference.

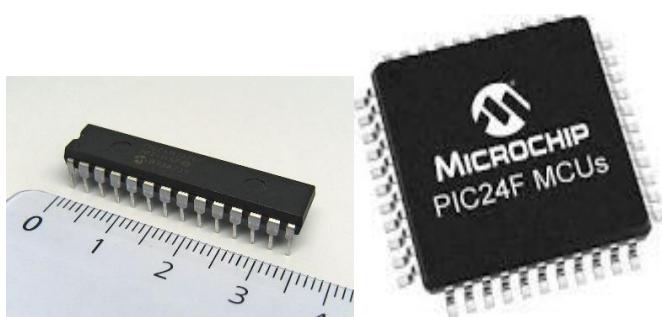
DS30010060G

www.microchip.com/8bit



8-bit Glossary

16-Bit 3 Pages of Chips SHOW



<http://ww1.microchip.com/downloads/en/DeviceDoc/30010109E.pdf>

16-bit PIC® Microcontroller Peripheral Integration

Quick Reference Guide

Product Family	Maximum MIPS	Program Flash Memory (KE)	RAM (KB)	Pin Count	Peripheral Function Focus										User Interface	Secure Data	System Flexibility
					Integrated Analog		Waveform Control		Clocks and Timers		Safety and Monitoring		Communications				
PIC24 Family					ADC (resolution) ¹	DAC (resolution) ²	CVREF	HS Comp	OPA/PPGA	CCP/ECOP	SCCP	MCCP	PWM	MC PWM	SMPS/PWM	IC and OC	PWM Resolution (ns)
PIC24F04KA20X ^{IV}	8	4	0.5	14–20	10	✓ ✓					✓	✓	✓	✓	✓	L1	✓ ✓ ✓ ✓ ✓
PIC24F04KL10X ^V	16	4	0.5	14–20		✓ ✓ ✓	✓		✓	✓	✓	✓	✓	✓	✓	L1	✓ ✓ ✓ ✓ ✓
PIC24F08KL20X ^V	16	8	0.5	14–20	10	✓ ✓ ✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L1	✓ ✓ ✓ ✓ ✓
PIC24F08KL30X ^V	16	8	1	20–28		✓ ✓ ✓		✓	✓	✓	✓	✓	✓	✓	✓	L1	✓ ✓ ✓ ✓ ✓
PIC24FXXXKL40X ^V	16	8–16	1	20–28	10	✓ ✓ ✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L1	✓ ✓ ✓ ✓ ✓
PIC24FXXXKA10X ^V	16	8–16	1.5	20–28	10	✓ ✓ ✓		✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FXXXKM10X ^{IV}	16	8–16	1	20–44	12	✓ ✓ ✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FXXXKM20X ^{IV}	16	8–16	2	20–44	12	✓ ✓ ✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FXXXKA30X ^V	16	16–32	2	20–44	12	✓ ✓ ✓		✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FJXXGA00X ^V	16	16–64	4–8	28–44	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FJXXMC10X ^V	16	16–32	1–2	20–44	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L1	✓ ✓ ✓ ✓ ✓
PIC24EPXXXGP20X ^V	70	32–512	4–48	28–64	12	4	✓ ✓		✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24EPXXXMC20X ^V	70	32–512	4–48	28–64	12	4	✓ ✓		✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FJXXGA10X ^V	16	32–64	8	28–44	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FJXXGB00X ^V	16	32–64	8	28–44	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓
PIC24FJXXGA00XX ^V	16	64–128	8	64–100	10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	L2	✓ ✓ ✓ ✓ ✓

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

L1: Class B Safety Features

L2: Includes WDT, oscillator fail-safe, illegal opcode detect, TRAP, reset trace, register lock, frequency check, CodeGuard™ security, PWM lock*

L3: Includes features of L1 + CRC

L4: Includes features of L2 + Flash ECC and/or DMT

*PWLock located only in devices with MCPWM/GMPS PWM peripheral

^{IV}: 16-bit PIC MCUs and dsPIC DSCs with 5V operating Voltage

^V: Note: Similar family of devices with fewer variations are grouped with the same color coding

Product Family	Maximum MIPS	Program Flash Memory (KB)	RAM (KB)	Pin Count	Peripheral Function Focus				Clocks and Timers	Safety and Monitoring	Communications	User Interface	Secure Data	System Flexibility
					Integrated Analog	Waveform Control	Clocks and Timers	Safety and Monitoring						
HC24 Family (Continued)														
HC24FJ00XGA1XX	16	64–256	16	64–100	10	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGB1XX	16	64–256	16	64–100	10	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGA2XX	16	64–128	8	29–44	12	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGB2XX	16	64–128	8	29–44	12	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGA3XX	16	64–128	8	64–100	12	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGC0XX	16	64–128	8	64–100	16	10	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XA2XX	16	128–256	24–96	64–100	10	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XA2XX	16	128–256	96	64–100	10	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGB2XX	16	128–256	96	64–100	10	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGA4XX	16	64–256	8–16	64–121	12	10	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGB4XX	16	64–256	8–16	64–121	12	10	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XA7XX	16	64–256	16	24–48	12	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XA7XX	60	256–512	25–62	100–144	12	4	✓	✓	✓	✓	✓	✓	✓	✓
HC24EP512GPB06	70	512	52	64–100	12	4	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGA8XX	16	128–1024	32	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
HC24FJ00XGB8XX	16	128–1024	32	64–100	12	✓	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33CH Family - Dual Core (M = Master Core, S = Slave Core)														
M	90	M:64–128 S: 24	M:16 S: 4	29–80	12	12	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33CH128MP20x	90	M:64–128 S: 24	M:16 S: 4	29–80	12	12	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EV Family														
dsPIC33EVXXXGM04X^a	70	32–256	4–16	29–64	12	7	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EVXXXGM04X^b	70	32–256	4–16	29–64	12	7	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EP Family														
dsPIC33EPXXXGS2/50X	70	16–64	2–8	29–64	12	12	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EPXXXGS880X	70	64–128	8	29–60	12	12	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EPXXXGP50X	70	32–512	4–48	29–64	12	4	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EPXXXMC20X	70	32–256	4–48	29–64	12	4	✓	✓	✓	✓	✓	✓	✓	✓
dsPIC33EPXXXMC50X	70	32–512	4–48	29–64	12	4	✓	✓	✓	✓	✓	✓	✓	✓
^a 16-bit PIC [®] MCUs offer SAR ADC, high-speed ADC and Delta-Sigma ADC.	^b 16-bit PIC MCUs offer general-purpose DAC and audio DAC.	L1: Includes MDT, oscillator fail-safe, logic opcode detect, TRAP, reset trace, register lock, frequency check, CodeGuard™ security, PWM lock*	L2: Includes features of L1 + DMT	L3: Includes features of L2 + Flash ECC and/or DMT										
[*] PWM lock available in devices with MCPWM/MPS PWM peripheral														
^b 16-bit PIC MCUs and dsPIC DSCs with 5V operating Voltage														
Note: Similar family of devices with fewer variations are grouped with the same color coding.														

ADC: Analog-to-Digital Converter
General-purpose ADC with up to 10-/12-/16-bit resolution
HS ADC: High-Speed Analog-to-Digital Converter
High-speed SAR ADC with 12-bit resolution and sampling speed of 10 Msps
A_D ΔΣ ADC: Delta-Sigma Analog-to-Digital Converter
Bipolar differential inputs, configurable gain; integrated PGA; Delta-Sigma ADC
DAC: Digital-to-Analog Converter
General-purpose DAC with resolution 16-bit resolution
A_D DAC: Delta-Sigma Digital-to-Analog Converter
Second-order digital-to-analog, two output channel Delta-Sigma DAC with stereo operation support
CVref: Internal Voltage Reference
Programmable voltage reference with multiple internal and external connections
HSP: High-Speed Comparitor
General-purpose rail-to-rail comparitor with 117 ns response time
DPAWG: Operational Amplifier and Programmable Gain Amplifiers
General-purpose op-amp and PGAs for internal and external signal source
WAVEFORM CONTROL: Pulse Generation and Waveform Control
Multi-purpose timer with functionality of the comparable input capture, output compare and PWM with four outputs
CCP/ECCP: (Enhanced) Capture/Compare/PWM
Multi-purpose 16-/32-bit input capture, output compare and PWM
SCOP: Single Capture/Compare/PWM
Mult-purpose 16-/32-bit input capture, output compare and PWM with up to 16 outputs and an extended range of capture and timer features
MCP: Multi-Capture/Compare/PWM
Power-supply 16-bit PWM with multi-frequency pulse-width modulation, up to 8 outputs with four independent time bases and resolution up to 16 bits
SMP/PWM: Power-Supply Pulse Width Modulation
Power-supply 16-bit PWM with multi-frequency pulse-width modulation, up to 8 outputs with four independent time bases and resolution up to 16 bits
IC: Input Capture
Independent input capture with edge detection or level detection
OOC: Output Compare
Output compare with an independent time base to compare value w/ timer 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
General-purpose 8-/16-/32-bit timer/clock with compare capability
RTC: Real-Time Clock/Calendar
Real-time clock/calendar with a binary-coded decimal (BCD) clock
QEI: Quadrature Encoder Interface
Digital-to-encoder interface to increment encoders for obtaining mechanical position information
SAFETY AND MONITORING: Hardware Monitoring and Fault Detection
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 along a configurable critical window
DWT: Deep Sleep Timer
System supervisory circuit that generates a reset when instruction sequence errors are detected along a configurable critical window
CRC: Cyclical Redundancy Check with Memory Scan
Automatically calculates CRC checksums of ProgramData EEPROM memory for NVM integrity and a general-purpose 16-bit CRC for use with memory and communications data
Class B Safety:
Hardware Class B support with Flash error correction, backup system oscillator, WDT, DMT, CRC scan, etc.

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 controller communication bus
UART: Universal Asynchronous Receiver Transmitter
General-purpose full-duplex, ASR or 8-Bit serial data serial communications with optional LIN support
LIN: Local Interconnect Network
1. Industrial and automotive controller communication bus
IDAC: Integrated Data Acquisition
IDAC encoder and decoder logic support through UART
I_C: Inter-Integrated Circuit
General-purpose 2-wire serial parallel 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
I₂S: Data Concourse Interface
3-wire synchronous serial digital interface for handle the stereo data
BENT: Bridge-Edge-Nibble Transfer
SLI™ is an uni-directional, single-wire serial communications protocol designed for point-to-point transmission of signal values
Parallel Port:
General-purpose parallel I/O communication interface
USER INTERFACE: Capacitive Touch Sensing and LCD Control
Capacitive sensing for touch buttons, sliders and system measurements and determination/exit/wake-up/dimension selection, etc., using an analog CTMU and TM320
Sensing: Motion/Proximity
General-purpose proximity sensor using an infrared receiver and infrared transmitter for motion detection in measurement between pulse sources and appropriate pulse generation
LCD: Liquid Crystal Display
High-resolution segmented LCD controller
GFX: Graphics Controller
High-resolution graphics controller supporting direct interface with display glasses with built-in graphics engine for individual pixel control
SECURE DATA: Hardware Integrated Cryptographic Engine
Cryptographic Engine
Independent hardware encryption and decryption engine
Secure Key Storage:
Multiple option: key storage, selection and management
RNG: Random Number Generator
Hardware true random number generation
SYSTEM FLEXIBILITY: System Peripherals and Internal Logic
Support for multiple peripherals, allowing the support of robust bootloader system and fast storage of application code, with option designed to enhance code security
Dual Partition Flash:
Integrated command and sequential logic with custom interconnection and re-routing of digital peripherals
PPB: Peripheral Pin Select
IO pin remapping of digital peripherals for greater design flexibility and improved system performance
PTG: Peripheral Trigger Generator
User programmable sequencer, capable of generating complex trigger signals required 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
IDLE, SLEEP and PMD:
Low-power saving modes
Ability to run the CPU core slower than the system clock used by the internal peripherals
XLP: eXtreme Low-Power Technology
XLP technology: device with extreme low power operation mode for battery-based power applications
Via[®]:
Hardware-based power mode that maintains only the most critical operations when a power loss occurs on V _{DD}

Learn more about 16-bit PIC microcontrollers at www.microchip.com/16bit.

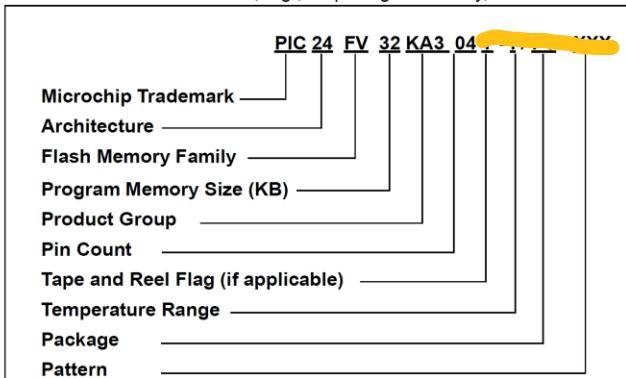
The Microchip name and logo, the Microchip logo and PIC are registered trademarks of Microchip Technology Incorporated in the U.S.A. © 2016 Microchip Technology Incorporated. Datasheet 0001004

How to Read the Model Number

PIC24FV32KA304 FAMILY

PRODUCT IDENTIFICATION SYSTEM

To order or obtain information, e.g., on pricing or delivery, refer to the factory or the listed sales office.

	Examples: a) PIC24FV32KA304-I/ML: Wide voltage range, General Purpose, 32-Kbyte program memory, 44-pin, Industrial temp., QFN package b) PIC24F16KA302-I/SS: Standard voltage range, General Purpose, 16-Kbyte program memory, 28-pin, Industrial temp., SSOP package
<p>Architecture 24 = 16-bit modified Harvard without DSP</p> <p>Flash Memory Family F = Standard voltage range Flash program memory FV = Wide voltage range Flash program memory</p> <p>Product Group KA3 = General purpose microcontrollers</p> <p>Pin Count 01 = 20-pin 02 = 28-pin 04 = 44-pin</p> <p>Temperature Range I = -40°C to +85°C (Industrial) E = -40°C to +125°C (Industrial)</p> <p>Package SP = SPDIP SO = SOIC SS = SSOP ML = QFN P = PDIP PT = TQFP MV = UQFN</p> <p>Pattern Three-digit QTP, SQTP, Code or Special Requirements (blank otherwise) ES = Engineering Sample</p>	

Download 366 Page Data Sheet SHOW

<https://www.microchip.com/content/dam/mchp/documents/OTH/ProductDocuments/DataSheets/3000995e.pdf>

Buy Now Price, Any Volume About \$4.00

1-24

25-99

100+

\$4.69

\$4.30

\$3.88

Page 2 Data Sheet – quick selection

PIC24F Device	Pins	Memory			Timers 16-Bit	Capture Input	Compare/PWM Output	UART w/ IrDA®	SPI	I ² C	12-Bit A/D (ch)	Comparators	CTMU (ch)	RTCC
		Flash Program (bytes)	SRAM (bytes)	EE Data (bytes)										
PIC24FV16KA301/ PIC24F16KA301	20	16K	2K	512	5	3	3	2	2	2	12	3	12	Y
PIC24FV32KA301/ PIC24F32KA301	20	32K	2K	512	5	3	3	2	2	2	12	3	12	Y
PIC24FV16KA302/ PIC24F16KA302	28	16K	2K	512	5	3	3	2	2	2	13	3	13	Y
PIC24FV32KA302/ PIC24F32KA302	28	32K	2K	512	5	3	3	2	2	2	13	3	13	Y
PIC24FV16KA304/ PIC24F16KA304	44	16K	2K	512	5	3	3	2	2	2	16	3	16	Y
PIC24FV32KA304/ PIC24F32KA304	44	32K	2K	512	5	3	3	2	2	2	16	3	16	Y

Look at Brief Data Sheet, Documentation, Embedded Software SHOW

<http://www.microchip.com/wwwproducts/en/PIC24F32KA304>

Status: In Production.

[Download Data Sheet](#)
[Documentation](#)

[Symbols](#)
[Recommended for Automotive Design](#)

Document Category	DS Number	Download	Link	Favorites
Data Sheets	3000995	Download		☆
Errata	80000522	Download		☆

EX: AN1416 - Low-Power Design Guide
Electronic Solutions for Medical and Fitness - And dozens of others

Embedded Software

Ex: 16-bit CPU Self-test Library

Development Environment



<https://www.microchip.com/en-us/development-tool/DM240001-2>

MPLAB® ICD 4 In-Circuit Debugger



USD/unit: \$328.89

<https://www.microchip.com/en-us/development-tool/DV164045>

<https://microchipdeveloper.com/tools:what-do-i-need>

QUICK Guide to Microchip Development Tools

<https://microchipdeveloper.com/tools:what-do-i-need>

Most development setups consist of three main components:

1. A computer running the [MPLAB® X Integrated Development Environment](#)
2. A programmer/debugger such as one of the following:
 - o [MPLAB REAL ICE™](#)
 - o [MPLAB ICD 3](#)
 - o [MPLAB PICkit™ 3](#)
3. A target board with the PIC® MCU of your choice, such as:
 - o Your own hardware
 - o A Microchip demonstration board
 - o A third-party demonstration board
 - o A breadboard



MPLAB® Development Ecosystem and Software Tools

<https://www.microchip.com/en-us/products/microcontrollers-and-microprocessors/16-bit-mcus/mplab-development-ecosystem-and-software-tools>

MPLAB® X IDE

<https://www.microchip.com/en-us/tools-resources/develop/mplab-x-ide>

PIC24F Microcontrollers

<https://www.microchip.com/en-us/products/microcontrollers-and-microprocessors/16-bit-mcus/pic24f-mcus-16-mips>

EXPLORER 16 DEVELOPMENT BOARD

<http://www.microchip.com/Developmenttools/ProductDetails.aspx?PartNO=DM240001>

MPLAB® Code Configurator - graphical programming environment for C code.

<https://www.microchip.com/en-us/tools-resources/configure/mplab-code-configurator>

Here we find a number of PIC24 Video Tutorials

Tutorial for the MPLAB® Starter Kit for PIC24F - Part 1 2009

<https://www.youtube.com/watch?v=S4jPTVjs92w>

MPLAB X and PIC24 #4 3,591 views Feb 8, 2017 11:22 (With Warts and All in C code)

<https://www.youtube.com/watch?v=nMSdSYsSMy0>

Installing MPLAB® X IDE

<https://microchipdeveloper.com/mplabx:installation>

MPLAB installation video (Older)

PIC Programming Tutorials Part 1 - Install MPLAB IDE & HITECH C Compiler



Saravanan AL

https://www.youtube.com/watch?v=9aSL_FAF-Gg

PIC24 MCUs and dsPIC33 DSCs | Easy Migration in a Platform Design

1,578 views Jul 29, 2021 About 9 Minutes

<https://www.youtube.com/watch?v=5z2QLKyxTJo>

How to program MICROCHIP PIC24 microcontrollers on LINUX

533 views Mar 11, 2021 About 20 Minutes

<https://www.youtube.com/watch?v=VdLbZJfQ6iQ>

GENERAL REFERENCES- SOFTWARE:

Languages:

A few references that discuss C and Assembly Language.



An excellent book I have used for the PIC family. On the web site there are excerpts from the book. If you program with a PIC24 chip, this is one of the best books available.

<http://www.reesemicro.com/Home/textbook>

Python vs. C/C++ in Embedded Systems

<https://www.activestate.com/blog/2016/09/python-vs-cc-embedded-systems>

<https://votepair.org/python-vs-c-in-embedded-systems/>

Assemblers, Linkers & Loaders A brief review

<http://www.cs.gmu.edu/~setia/cs365-S02/assembler.pdf>

(Real Programmers Program in Assembly Language! D.Hill Lockheed)