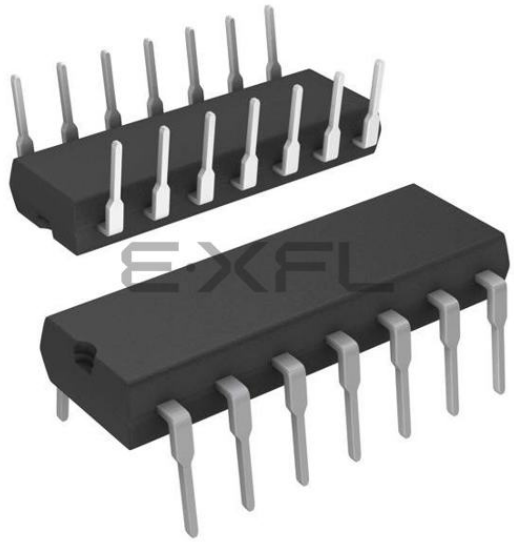


Welcome to E-XFL.COM

What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Active
Core Processor	PIC
Core Size	8-Bit
Speed	32MHz
Connectivity	I²C, LINbus, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	12
Program Memory Size	14KB (8K x 14)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	2.3V ~ 5.5V
Data Converters	A/D 8x10b; D/A 1x8b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Through Hole
Package / Case	14-DIP (0.300", 7.62mm)
Supplier Device Package	14-PDIP
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic16f1615-i-p

PIC12/16(L)F161X

8/14/20-Pin, 8-Bit Flash Microcontroller Product Brief

Description:

PIC12/16(L)F161X microcontrollers deliver on-chip features that are unique to the design for embedded control of small motors and general purpose applications in 8/14/20-pin count packages. Features like 10-bit A/D, CCP, 24-bit SMT and Zero-Cross Detection offer an excellent solution to the variety of applications. The product family also has a CRC+ memory scan and Windowed WDT to support safety-critical systems in home appliances, white goods and other end equipment.

Core Features:

- C Compiler Optimized RISC Architecture
- Only 49 Instructions
- Operating Speed:
  - DC – 32 MHz clock input
  - 125 ns minimum instruction cycle
- Interrupt Capability
- 16-Level Deep Hardware Stack
- Up to Four 8-bit Timers
- Up to Three 16-bit Timers
- Low Current Power-on Reset (POR)
- Configurable Power-up Timer (PWRT)
- Brown-out Reset (BOR) with Selectable Trip Point
- Window Watchdog Timer (WWDT):
  - Variable prescaler selection
  - Variable window size selection
  - All sources configurable in hardware or software

Memory:

- Up to 8 KW Flash Program Memory
- Up to 1024 Bytes Data SRAM Memory
- Direct, Indirect and Relative Addressing modes
- High-Endurance Flash Data Memory (HEF):
  - 128 B (nonvolatile), 100K Erase/Write Cycles

Operating Characteristics:

- Operating Voltage Range:
  - 1.8V to 3.6V (PIC16LF161X)
  - 2.3V to 5.5V (PIC16F161X)
- Temperature Range:
  - Industrial: -40°C to 85°C
  - Extended: -40°C to 125°C

eXtreme Low-Power (XLP) Features:

- Sleep mode: 50 nA @ 1.8V, typical
- Watchdog Timer: 500 nA @ 1.8V, typical
- Secondary Oscillator: 500 nA @ 32 kHz
- Operating Current:
  - 8 uA @ 32 kHz, 1.8V, typical
  - 32 uA/MHz @ 1.8V, typical

Digital Peripherals:

- Configurable Logic Cell (CLC):
  - Up to four CLCs
  - Integrated combinational and sequential logic
- Complementary Waveform Generator (CWG):
  - Rising and falling edge dead-band control
  - Full-bridge, half-bridge, 1-channel drive
  - Multiple signal sources
- Two Capture/Compare/PWM (CCP) modules
- PWM: Two 10-bit Pulse-Width Modulators
- Two Signal Measurement Timers (SMT):
  - 24-bit timer/counter with prescaler
  - Multiple gate and clock inputs
- Angular Timer:
  - Single pulse
  - Multiple pulses with missing pulse recovery
- Hardware Limit Timer (HLT):
  - 8-bit timer with prescaler
  - 8-bit period register and postscaler
  - Asynchronous H/W reset sources
- Math Accelerator:
  - Four operation modes
  - Add and multiply
  - Simple multiplier
  - Multiply and Accumulate (MAC)
  - Programmable PID controller
- Cyclic Redundancy Check with Memory Scan (CRC):
  - Software configurable
- Serial Communications:
  - Enhanced USART (EUSART)
  - SPI, I^2C™, RS-232, RS-485, LIN compatible
  - Auto-Baud Detect, Auto-Wake-up on start
- Up to 18 I/O Pins:
  - Individually programmable pull-ups
  - Slew rate control
  - Interrupt-on-change with edge-select
- Peripheral Pin Select (PPS):
  - Enables pin mapping of digital I/O

Intelligent Analog Peripherals:

- 10-Bit Analog-to-Digital Converter (ADC):
  - Up to 12 external channels
  - Conversion available during Sleep
- Two Comparators (CMP):
  - Low-Power/High-Speed mode
  - Up to three external inverting inputs
  - Fixed Voltage Reference at non-inverting input(s)
  - Comparator outputs externally accessible
- 8-Bit Digital-to-Analog Converter (DAC):
  - 8-bit resolution, rail-to-rail
  - Positive Reference Selection
- Voltage Reference:
  - Fixed Voltage Reference (FVR): 1.024V, 2.048V and 4.096V output levels
- Zero-Cross Detect (ZCD):
  - Detect when AC signal on pin crosses ground

Clocking Structure:

- 16 MHz Internal Oscillator:
  - ±1% at calibration
  - Selectable frequency range from 32 MHz to 31 kHz
- 31 kHz Low-Power Internal Oscillator
- 4x Phase-Locked Loop (PLL):
  - For up to 32 MHz internal operation
- External Oscillator Block with:
  - Three external clock modes up to 32 MHz

TABLE 1: PIC12/16(L)F161X FAMILY TYPES

Device	Data Sheet Index	Program Memory Flash (W)	Data SRAM (bytes)	I/O Pins	8-bit/16-bit Timers	Comparators	10-bit ADC (ch)	Zero-Cross Detect	CCP/10-bit PWM	CWG	CLC	SMT/HLT	Angular Timer	Window Watchdog Timer	CRC with Memory Scan	Math Accelerator	PPS	EUSART	I²C™/SPI	Debug(1)
PIC12(L)F1612	(A)	2048	256	6	1/1	1	4	1	2/0	1	0	2/3	0	Y	Y	0	0	0	0	I/H
PIC16(L)F1613	(A)	2048	256	12	1/1	2	8	1	2/0	1	0	2/3	0	Y	Y	0	0	0	0	I/H
PIC16(L)F1614	(B)	4096	512	12	1/3	2	8	1	2/2	1	2	2/3	1	Y	Y	1	Y	1	1	I/H
PIC16(L)F1615	(C)	8192	1024	12	1/3	2	8	1	2/2	1	4	2/3	1	Y	Y	1	Y	1	1	I/H
PIC16(L)F1618	(B)	4096	512	18	1/3	2	12	1	2/2	1	2	2/3	1	Y	Y	1	Y	1	1	I/H
PIC16(L)F1619	(C)	8192	1024	18	1/3	2	12	1	2/2	1	4	2/3	1	Y	Y	1	Y	1	1	I/H

Note 1: Debugging Methods: (I) – Integrated on Chip; (H) – via ICD Header; E – using Emulation Product.

Data Sheet Index:

A. DS40001737 PIC12(L)F1612/16(L)F1613 Data Sheet, 8/14-Pin, 8-bit Flash Microcontrollers

B. Future Release PIC16(L)F1614/8 Data Sheet, 14/20-Pin, 8-bit Flash Microcontrollers

C. Future Release PIC16(L)F1615/9 Data Sheet, 14/20-Pin, 8-bit Flash Microcontrollers

Note: For other small form-factor package availability and marking information, please visit **http://www.microchip.com/packaging** or contact your local sales office.

TABLE 2: PACKAGES

Packages	PDIP	SOIC	DFN	UDFN	TSSOP	QFN	UQFN	SSOP
PIC12(L)F1612	X	X	X	X				
PIC16(L)F1613	X	X			X	X	X	
PIC16(L)F1614	X	X			X	X		
PIC16(L)F1615	X	X			X	X		
PIC16(L)F1618	X	X				X		X
PIC16(L)F1619	X	X				X		X

Note: Pin details are subject to change.

PIN DIAGRAMS

FIGURE 1: 8-PIN PDIP, SOIC, DFN, UDFN

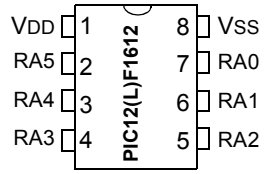


FIGURE 2: 14-PIN PDIP, SOIC, TSSOP

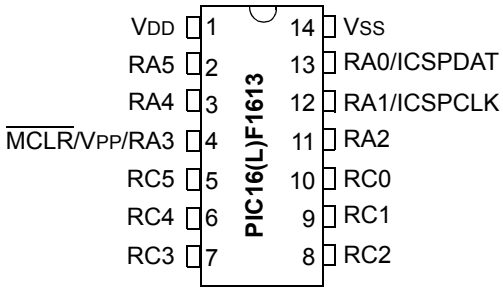


FIGURE 3: 16-PIN QFN, UQFN

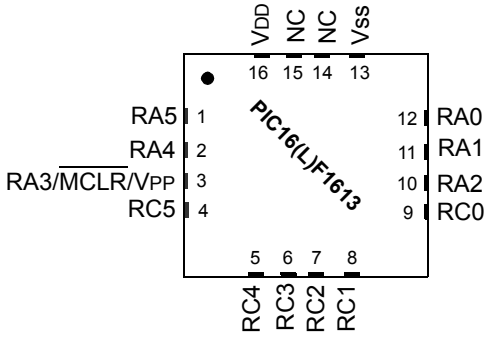


FIGURE 4: 14-PIN PDIP, SOIC, TSSOP

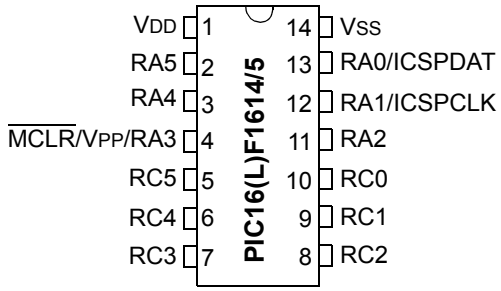


FIGURE 5: 16-PIN QFN

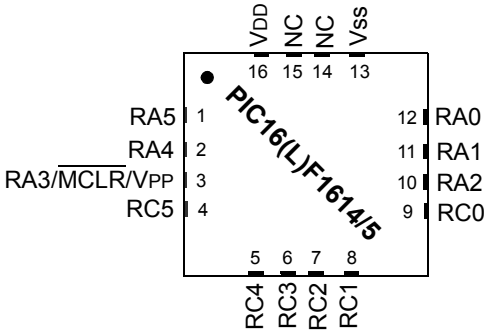


FIGURE 6: 20-PIN PDIP, SOIC, SSOP

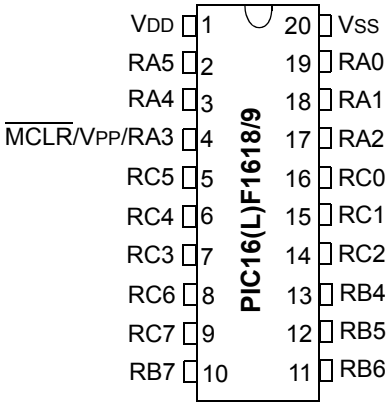
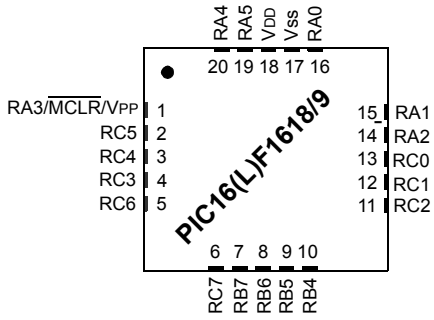


FIGURE 7: 20-PIN QFN



PIN ALLOCATION TABLES

TABLE 3: 8-PIN ALLOCATION TABLE (PIC12(L)F1612)

I/O	8-Pin PDIP, SOIC, DFN, UDFN	A/D	Reference	Comparator	Timers	CCP	CWG	ZCD	Interrupt	SMT	Pull-up	Basic
RA0	7	AN0	DAC1OUT1	C1IN+	—	CCP2	CWG1B	—	IOC	—	Y	ICSPDAT
RA1	6	AN1	VREF+	C1IN0-	—	—	—	ZCD1OUT	IOC	—	Y	ICSPCLK
RA2	5	AN2	—	C1OUT	T0CKI T4IN	CCP1	CWG1A CWG1IN	ZCD1IN	INT IOC	SMTSIG2	Y	—
RA3	4	—	—	—	T1G(1) T6IN	—	—	—	IOC	SMTWIN2	Y	$\overline{MCLR}$/VPP
RA4	3	AN3	—	C1IN1-	T1G	—	CWG1B(1)	—	IOC	SMTSIG1	Y	CLKOUT
RA5	2	—	—	—	T1CKI T2IN	CCP1(1)	CWG1A(1)	—	IOC	SMTWIN1	Y	CLKIN
VDD	1	—	—	—	—	—	—	—	—	—	—	VDD
VSS	8	—	—	—	—	—	—	—	—	—	—	VSS

Note 1: Alternate pin function selected with the APFCON register.

TABLE 4: 14/16-PIN ALLOCATION TABLE (PIC16(L)F1613)

I/O	14-Pin PDIP, SOIC, TSSOP	16-Pin QFN, UQFN	A/D	Reference	Comparator	Timers	CCP	CWG	ZCD	Interrupt	SMT	Pull-up	Basic
RA0	13	12	AN0	DAC1OUT1	C1IN+	—	—	—	—	IOC	—	Y	ICSPDAT
RA1	12	11	AN1	VREF+	C1IN0- C2IN0-	—	—	—	ZCD1OUT	IOC	—	Y	ICSPCLK
RA2	11	10	AN2	—	C1OUT	T0CKI T4IN	—	CWG1IN	ZCD1IN	INT IOC	—	Y	—
RA3	4	3	—	—	—	T1G(1) T6IN	—	—	—	IOC	SMTWIN2	Y	$\overline{MCLR}$/VPP
RA4	3	2	AN3	—	—	T1G	—	—	—	IOC	SMTSIG1	Y	CLKOUT
RA5	2	1	—	—	—	T1CKI T2IN	CCP2(1)	—	—	IOC	SMTWIN1	Y	CLKIN
RC0	10	9	AN4	—	C2IN+	—	—	—	—	IOC	—	Y	—
RC1	9	8	AN5	—	C1IN1- C2IN1-	T4IN	—	—	—	IOC	SMTSIG2	Y	—
RC2	8	7	AN6	—	C1IN2- C2IN2-	—	—	CWG1D	—	IOC	—	Y	—
RC3	7	6	AN7	—	C1IN3- C2IN3-	—	CCP2	CWG1C	—	IOC	—	Y	—
RC4	6	5	—	—	C2OUT	—	—	CWG1B	—	IOC	—	Y	—
RC5	5	4	—	—	—	—	CCP1	CWG1A	—	IOC	—	Y	—
VDD	1	16	—	—	—	—	—	—	—	—	—	—	VDD
VSS	14	13	—	—	—	—	—	—	—	—	—	—	VSS

Note 1: Alternate pin function selected with the APFCON register.

TABLE 5: 14/16-PIN ALLOCATION TABLE (PIC16(L)F1614/5)

I/O	14-Pin PDIP, SOIC, TSSOP	16-Pin QFN	A/D	Reference	Comparator	Timers	CCP	CWG	ZCD	CLC	EUSART	SMT	Angular Timer	MSSP	PWM	High Current I/O	Interrupt	Pull-up	Basic
RA0	13	12	AN0	DAC1OUT1	C1IN+	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	ICSPDAT
RA1	12	11	AN1	VREF+	C1IN0- C2IN0-	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	ICSPCLK
RA2	11	10	AN2	—	C2IN+	T0CKI(1)	—	CWG1IN(1)	ZCD1IN	—	—	—	—	—	—	—	INT IOC	Y	—
RA3	4	3	—	—	—	T6IN(1)	—	—	—	—	—	SMTWIN2(1)	—	—	—	—	IOC	Y	$\overline{MCLR}$/VPP
RA4	3	2	AN3	—	—	T1G(1)	—	—	—	—	—	SMTSIG1(1)	—	—	—	—	IOC	Y	CLKOUT
RA5	2	1	—	—	—	T1CKI(1) T2IN(1)	—	—	—	—	—	SMTWIN1(1)	—	—	—	—	IOC	Y	CLKIN
RC0	10	9	AN4	—	C2IN+	T5CKI(1)	—	—	—	—	—	—	—	SCK(1,3)	—	—	IOC	Y	—
RC1	9	8	AN5	—	C1IN1- C2IN1-	T4IN(1)	—	—	—	—	—	SMTSIG2(1)	—	SDI(1)	—	—	IOC	Y	—
RC2	8	7	AN6	—	C1IN2- C2IN2-	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	—
RC3	7	6	AN7	—	C1IN3- C2IN3-	T5G(1)	CCP2(1)	—	—	CLCIN0(1)	—	—	ATCC(1)	$\overline{SS}$(1)	—	—	IOC	Y	—
RC4	6	5	—	—	—	T3G(1)	—	—	—	CLCIN1(1)	CK(1)	—	—	—	—	HIC4	IOC	Y	—
RC5	5	4	—	—	—	T3CKI(1)	CCP1(1)	—	—	—	RX(1,3)	—	ATIN(1)	—	—	HIC5	IOC	Y	—
VDD	1	16	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	VDD
VSS	14	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	VSS
OUT(2)	—	—	—	—	C1OUT	—	CCP1	CWG1A	ZCD1OUT	CLC1OUT	DT(3)	—	—	SDO	PWM3OUT	—	—	—	—
	—	—	—	—	C2OUT	—	CCP1	CWG1B	—	CLC2OUT	CK	—	—	SCK(3)	PWM4OUT	—	—	—	—
	—	—	—	—	—	—	—	CWG1C	—	—	TX	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	CWG1D	—	—	—	—	—	—	—	—	—	—	—

Note 1: Default peripheral input. Input can be moved to any other pin with the PPS input selection registers.
2: All pin outputs default to PORT latch data. Any pin can be selected as a digital peripheral output with the PPS output selection registers.
3: These peripheral functions are bidirectional. The output pin selections must be the same as the input pin selections.

TABLE 6: 20-PIN ALLOCATION TABLE (PIC16(L)F1618/9)

I/O	20-Pin PDIP, SOIC, SSOP	20-Pin QFN	A/D	Reference	Comparator	Timers	CCP	CWG	ZCD	CLC	EUSART	SMT	Angular Timer	MSSP	PWM	High Current I/O	Interrupt	Pull-up	Basic
RA0	19	16	AN0	DAC1OUT	C1IN+	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	ICSPDAT
RA1	18	15	AN1	VREF+	C1IN0- C2IN0-	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	ICSPCLK
RA2	17	14	AN2	—	—	T0CKI(1)	—	CWG1IN(1)	—	—	—	—	—	—	—	—	INT IOC	Y	—
RA3	4	1	—	—	—	T6IN(1)	—	—	—	—	—	SMTWIN2(1)	—	—	—	—	IOC	Y	$\overline{\text{MCLR}}$ VPP
RA4	3	20	AN3	—	—	T1G(1)	—	—	—	—	—	SMTSIG1(1)	—	—	—	—	IOC	Y	CLKOUT
RA5	2	19	—	—	—	T1CKI(1) T2IN(1)	—	—	—	CLCIN3(1)	—	SMTWIN1(1)	—	—	—	—	IOC	Y	CLKIN
RB4	13	10	AN10	—	—	—	—	—	—	—	—	—	—	SDI(1)	—	—	IOC	Y	—
RB5	12	9	AN11	—	—	—	—	—	—	—	RX(1,3)	—	—	—	—	—	IOC	Y	—
RB6	11	8	—	—	—	—	—	—	—	—	—	—	—	SCK(1,3)	—	—	IOC	Y	—
RB7	10	7	—	—	—	—	—	—	—	—	CK(1)	—	—	—	—	—	IOC	Y	—
RC0	16	13	AN4	—	C2IN+	T5CKI(1)	—	—	—	—	—	—	—	—	—	—	IOC	Y	—
RC1	15	12	AN5	—	C1IN1- C2IN1-	T4IN(1)	—	—	—	CLCIN(2)	—	SMTSIG2(1)	—	—	—	—	IOC	Y	—
RC2	14	11	AN6	—	C1IN2- C2IN2-	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	—
RC3	7	4	AN7	—	C1IN3- C2IN3-	T5G(1)	CCP2(1)	—	—	CLCIN0(1)	—	—	ATCC(1)	—	—	—	IOC	Y	—
RC4	6	3	—	—	—	T3G(1)	—	—	—	CLCIN1(1)	—	—	—	—	—	HIC4	IOC	Y	—
RC5	5	2	—	—	—	T3CKI(1)	CCP2(1)	—	—	—	—	—	ATIN(1)	—	—	HIC5	IOC	Y	—
RC6	8	5	AN8	—	—	—	—	—	—	—	—	—	—	$\overline{\text{SS}}$(1)	—	—	IOC	Y	—
RC7	9	6	AN9	—	—	—	—	—	—	—	—	—	—	—	—	—	IOC	Y	—
VDD	1	18	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
VSS	20	17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Note 1: Default peripheral input. Input can be moved to any other pin with the PPS input selection registers.
2: All pin outputs default to PORT latch data. Any pin can be selected as a digital peripheral output with the PPS output selection registers.
3: These peripheral functions are bidirectional. The output pin selections must be the same as the input pin selections.

TABLE 6: 20-PIN ALLOCATION TABLE (PIC16(L)F1618/9)

I/O	20-Pin PDIP, SOIC, SSOP	20-Pin QFN	A/D	Reference	Comparator	Timers	CCP	CWG	ZCD	CLC	EUSART	SMT	Angular Timer	MSSP	PWM	High Current I/O	Interrupt	Pull-up	Basic
OUT(2)	—	—	—	—	C1OUT	—	CCP1	CWG1A	ZCD1OUT	CLC1OUT	DT(3)	—	—	SDO	PWM3OUT	—	—	—	—
	—	—	—	—	C2OUT	—	CCP2	CWG1B	—	CLC2OUT	CK	—	—	SCK(3)	PWM4OUT	—	—	—	—
	—	—	—	—	—	—	—	CWG1C	—	CLC3OUT	TX	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	CWG1D	—	CLC4OUT	—	—	—	—	—	—	—	—	—

Note 1: Default peripheral input. Input can be moved to any other pin with the PPS input selection registers.
2: All pin outputs default to PORT latch data. Any pin can be selected as a digital peripheral output with the PPS output selection registers.
3: These peripheral functions are bidirectional. The output pin selections must be the same as the input pin selections.

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Microchip received ISO/TS-16949:2009 certification for its worldwide headquarters, design and wafer fabrication facilities in Chandler and Tempe, Arizona; Gresham, Oregon and design centers in California and India. The Company's quality system processes and procedures are for its PIC® MCUs and dsPIC® DSCs, KEELOQ® code hopping devices, Serial EEPROMs, microperipherals, nonvolatile memory and analog products. In addition, Microchip's quality system for the design and manufacture of development systems is ISO 9001:2000 certified.

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