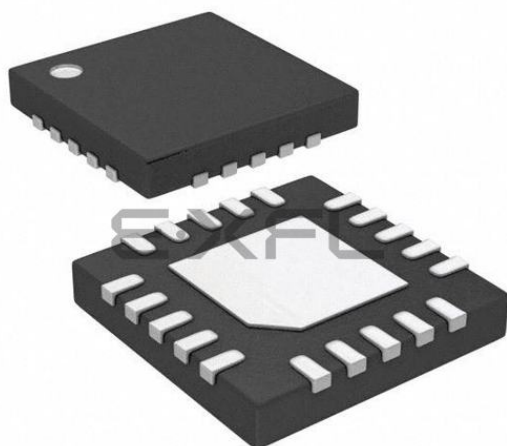




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### What is "[Embedded - Microcontrollers](#)"?

"[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                      | 48MHz                                                                                                                                                                 |
| Connectivity               | I <sup>2</sup> C, LINbus, SPI, UART/USART, USB                                                                                                                        |
| Peripherals                | Brown-out Detect/Reset, POR, PWM, WDT                                                                                                                                 |
| Number of I/O              | 14                                                                                                                                                                    |
| Program Memory Size        | 14KB (8K x 14)                                                                                                                                                        |
| Program Memory Type        | FLASH                                                                                                                                                                 |
| EEPROM Size                | -                                                                                                                                                                     |
| RAM Size                   | 1K x 8                                                                                                                                                                |
| Voltage - Supply (Vcc/Vdd) | 1.8V ~ 3.6V                                                                                                                                                           |
| Data Converters            | A/D 9x10b; D/A 1x5b                                                                                                                                                   |
| Oscillator Type            | Internal                                                                                                                                                              |
| Operating Temperature      | -40°C ~ 85°C (TA)                                                                                                                                                     |
| Mounting Type              | Surface Mount                                                                                                                                                         |
| Package / Case             | 20-UFQFN Exposed Pad                                                                                                                                                  |
| Supplier Device Package    | 20-UQFN (4x4)                                                                                                                                                         |
| Purchase URL               | <a href="https://www.e-xfl.com/product-detail/microchip-technology/pic16lf1459t-i-gz">https://www.e-xfl.com/product-detail/microchip-technology/pic16lf1459t-i-gz</a> |

# PIC16(L)F145X

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

### High-Performance RISC CPU:

- C Compiler Optimized Architecture
- Only 49 Instructions
- 14 Kbytes Linear Program Memory Addressing
- 1024 bytes Linear Data Memory Addressing
- Operating Speed:
  - DC – 48 MHz clock input
  - DC – 83 ns instruction cycle
  - Selectable 3x or 4x PLL for specific frequencies
- Interrupt Capability with Automatic Context Saving
- 16-Level Deep Hardware Stack with Optional Overflow/Underflow Reset
- Direct, Indirect and Relative Addressing modes:
  - Two full 16-bit File Select Registers (FSRs) capable of accessing both data or program memory
  - FSRs can read program and data memory

### Special Microcontroller Features:

- Operating Voltage Range:
  - 1.8V to 3.6V (PIC16LF145X)
  - 2.3V to 5.5V (PIC16F145X)
- Self-Programmable under Software Control
- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Programmable Brown-Out Reset (BOR)
- Low-Power BOR (LPBOR)
- Extended Watchdog Timer (WDT):
  - Programmable period from 1 ms to 256s
- Programmable Code Protection
- In-Circuit Serial Programming™ (ICSP™) via Two Pins
- Enhanced Low-Voltage Programming (LVP)
- Power-Saving Sleep mode

### Universal Serial Bus (USB) Features:

- Self-tuning from USB host (eliminates need for external crystal)
- USB V2.0 Compliant SIE
- Low Speed (1.5 Mb/s) and Full Speed (12 Mb/s)
- Supports Control, Interrupt, Isochronous and Bulk Transfers
- Supports up to 8 Bidirectional Endpoints
- 512-Byte Dual Access RAM for USB
- Interrupt-on-Change (IOC) on D+/D- for USB Host Detection
- Configurable Internal Pull-up Resistors for use with USB

### Low-Power Features

#### PIC16LF145X with XLP:

- Standby Current:
  - 20 nA @ 1.8V, typical
- Watchdog Timer Current:
  - 300 nA @ 1.8V, typical
- Operating Current:
  - 30  $\mu$ A/MHz @ 1.8V, typical
- Timer1 Oscillator:
  - 600 nA @ 32 kHz, 1.8V, typical

### Flexible Oscillator Structure:

- 16 MHz Internal Oscillator Block:
  - Factory calibrated to  $\pm 0.25\%$ , typical
  - Software selectable frequency range from 16 MHz to 31 kHz
  - Tunable to 0.25% across temperature range
  - 48 MHz with 3x PLL
- 31 kHz Low-Power Internal Oscillator
- Clock Switching with run from:
  - Primary Oscillator
  - Secondary Oscillator (SOSC)
  - Internal Oscillator
- Clock Reference Output:
  - Clock Prescaler
  - CLKOUT

### Analog Features<sup>(1)</sup>:

- Analog-to-Digital Converter (ADC):
  - 10-bit resolution
  - Up to 9 external channels
  - Two internal channels:
    - Fixed Voltage Reference channel
    - DAC output channel
  - Auto acquisition capability
  - Conversion available during Sleep
- Two Comparators:
  - Rail-to-rail inputs
  - Power mode control
  - Software controllable hysteresis
- Voltage Reference module:
  - Fixed Voltage Reference (FVR) with 1.024V, 2.048V and 4.096V output levels
- Up to one rail-to-rail resistive 5-bit DAC with positive reference selection

**Note 1:** Analog features are not available on PIC16(L)F1454 devices.

# PIC16(L)F145X

## Peripheral Features:

- Up to 14 I/O Pins and three Input-only Pins:
  - High current sink/source 25 mA/25 mA
  - Individually programmable weak pull-ups
  - Individually programmable Interrupt-On-Change (IOC) pins
- Timer0: 8-Bit Timer/Counter with 8-Bit Programmable Prescaler
- Enhanced Timer1:
  - 16-bit timer/counter with prescaler
  - External Gate Input mode
- Timer2: 8-Bit Timer/Counter with 8-Bit Period Register, Prescaler and Postscaler
- Two 10-bit PWM modules
- Complementary Waveform Generator (CWG)<sup>(1)</sup>:
  - Up to four selectable signal sources
  - Selectable falling and rising edge dead-band control
  - Polarity control
  - Up to four auto-shutdown sources
  - Multiple input sources: PWM, Comparators
- Master Synchronous Serial Port (MSSP) with SPI and I<sup>2</sup>C™ with:
  - 7-bit address masking
  - SMBus/PMBus™ compatibility
- Enhanced Universal Synchronous Asynchronous Receiver Transmitter (EUSART):
  - RS-232, RS-485 and LIN compatible
  - Auto-baud detect
  - Auto-wake-up on Start

**Note 1:** Not available on PIC16(L)F1454 devices.

## PIC16(L)F145X Family Types

| Device        | Data Sheet Index | Program Memory Flash (words) | Data SRAM (bytes) | I/O's <sup>(2)</sup> | 10-bit ADC (ch) | Comparators | DAC | Timers (8/16-bit) | PWM | EUSART | MSSP (I <sup>2</sup> C™/SPI) | CWG | USB | Clock Reference | Debug <sup>(1)</sup> | XLP |
|---------------|------------------|------------------------------|-------------------|----------------------|-----------------|-------------|-----|-------------------|-----|--------|------------------------------|-----|-----|-----------------|----------------------|-----|
| PIC16(L)F1454 | (1)              | 8192                         | 1024              | 11                   | —               | —           | —   | 2/1               | 2   | 1      | 1                            | —   | 1   | 1               | I/H                  | Y   |
| PIC16(L)F1455 | (1)              | 8192                         | 1024              | 11                   | 5               | 2           | 1   | 2/1               | 2   | 1      | 1                            | 1   | 1   | 1               | I/H                  | Y   |
| PIC16(L)F1459 | (1)              | 8192                         | 1024              | 17                   | 9               | 2           | 1   | 2/1               | 2   | 1      | 1                            | 1   | 1   | 1               | I/H                  | Y   |

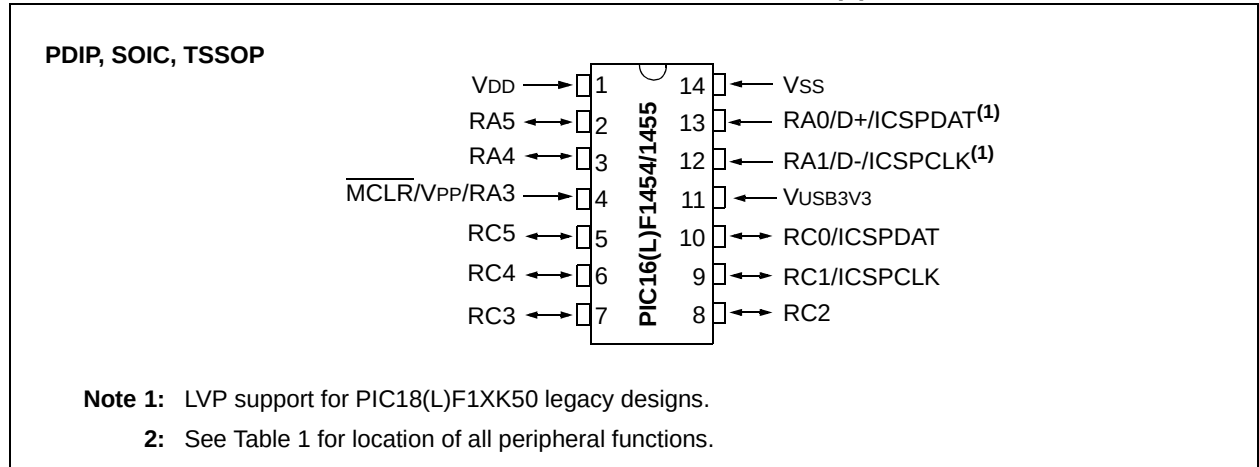
**Note 1:** I - Debugging, Integrated on Chip; H - Debugging, Available using Debug Header;  
E - Emulation, Available using Emulation Header.

**2:** Three pins are input-only.

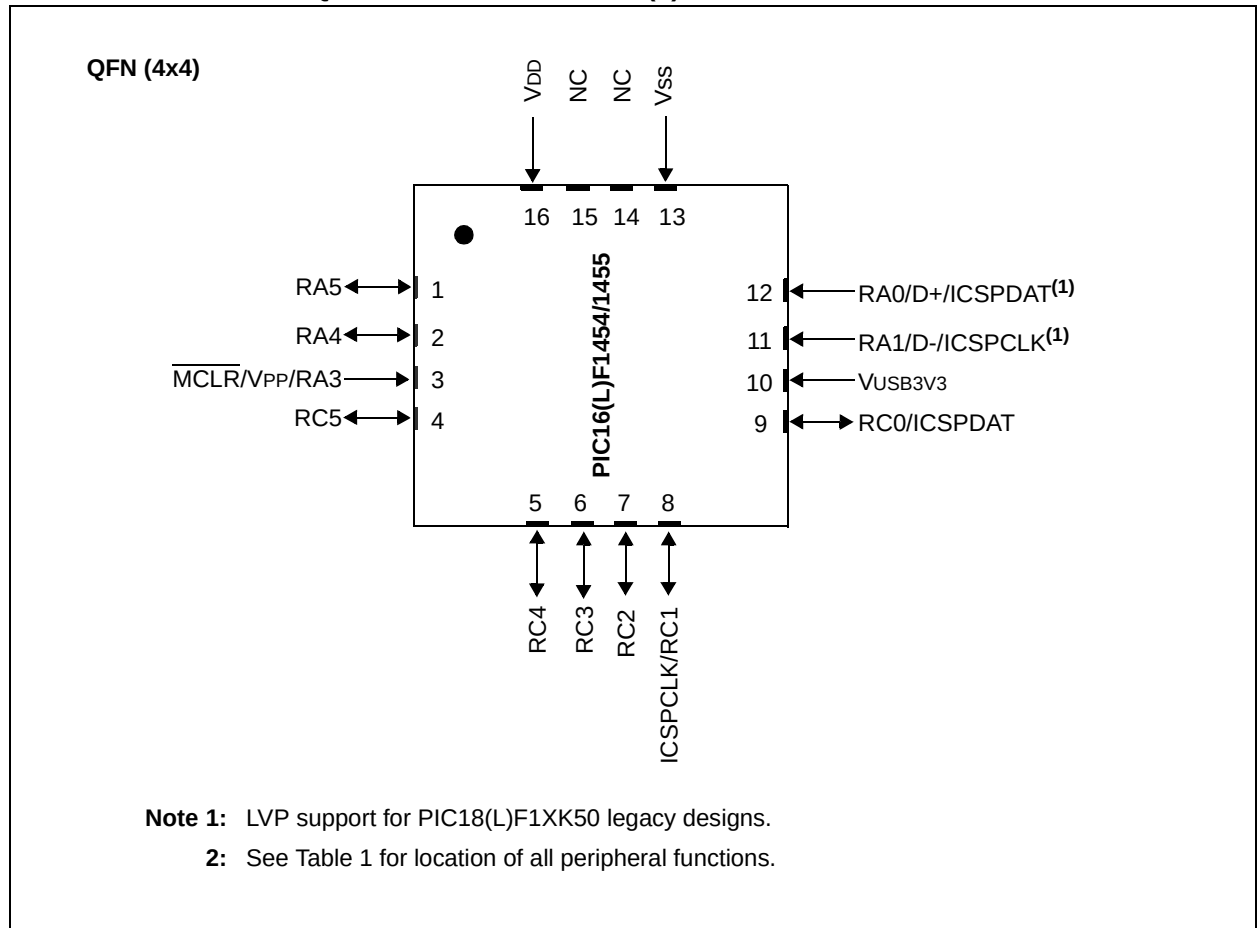
### Data Sheet Index:

**1:** Future Product PIC16(L)F1454/1455/1459 Data Sheet, 14/20-Pin Flash, 8-Bit USB Microcontrollers.

**FIGURE 1: 14-PIN PDIP, SOIC, TSSOP DIAGRAM FOR PIC16(L)F1454/1455**

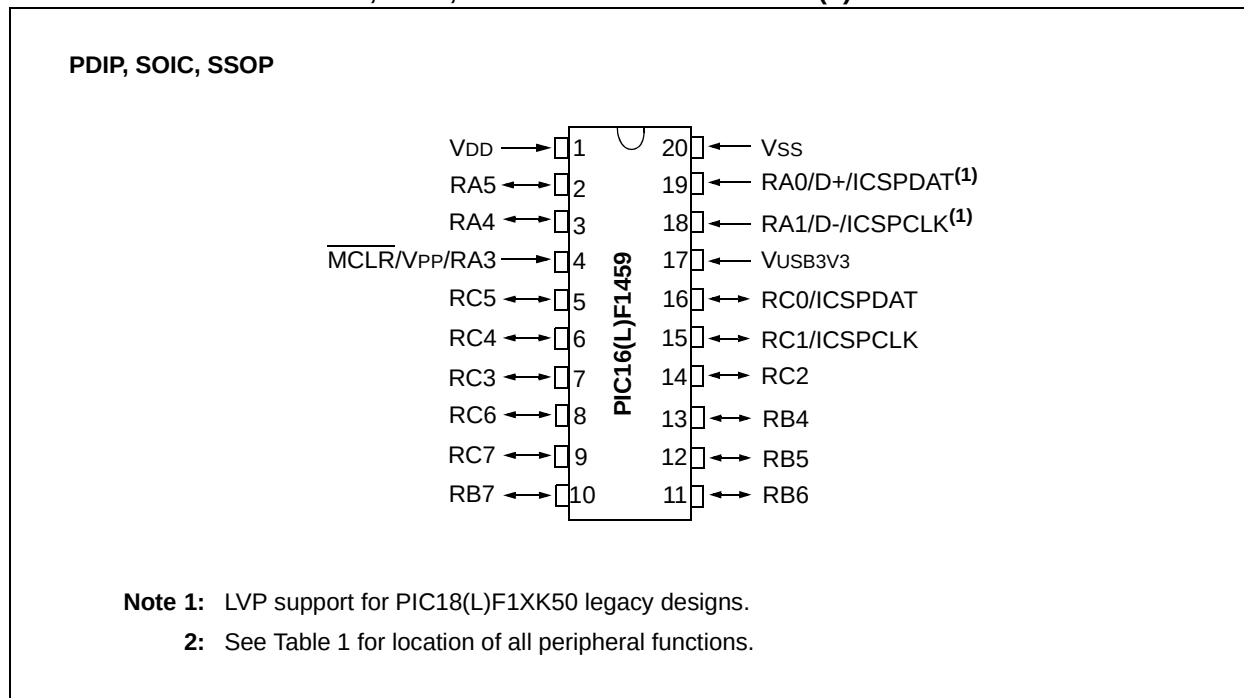


**FIGURE 2: 16-PIN QFN DIAGRAM FOR PIC16(L)F1454/1455**

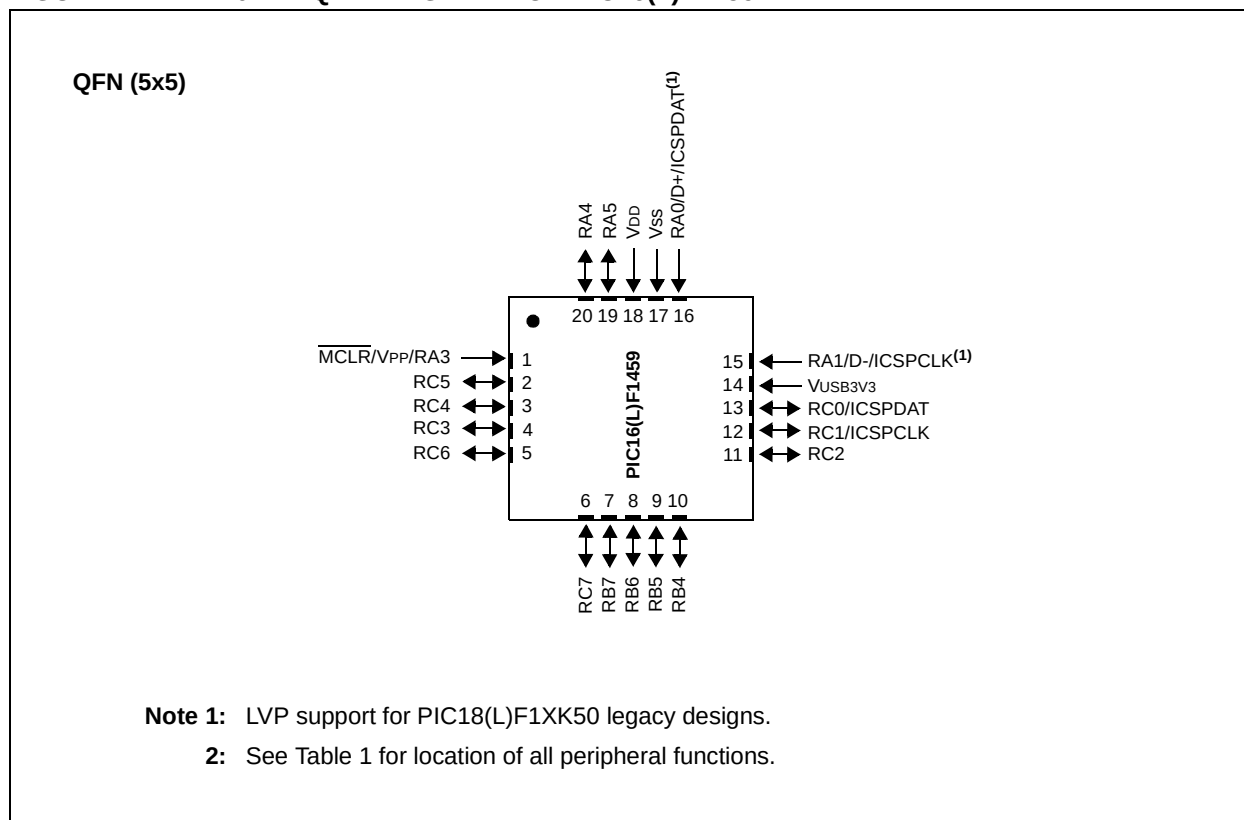


# PIC16(L)F145X

**FIGURE 3: 20-PIN PDIP, SOIC, SSOP DIAGRAM FOR PIC16(L)F1459**



**FIGURE 4: 20-PIN QFN DIAGRAM FOR PIC16(L)F1459**



# PIC16(L)F145X

**TABLE 1: 14-PIN ALLOCATION TABLE (PIC16(L)F1454)**

| I/O                 | 14-Pin PDIP/SOIC/TSSOP | 16-Pin QFN | ADC | Reference | Comparator | Timer                       | CWG | USB                 | EUSART   | PWM                 | MSSP               | Interrupt | Basic                                 |
|---------------------|------------------------|------------|-----|-----------|------------|-----------------------------|-----|---------------------|----------|---------------------|--------------------|-----------|---------------------------------------|
| RA0                 | 13                     | 12         | —   | —         | —          | —                           | —   | D+                  | —        | —                   | —                  | IOC       | ICSPDAT <sup>(3)</sup>                |
| RA1                 | 12                     | 11         | —   | —         | —          | —                           | —   | D-                  | —        | —                   | —                  | IOC       | ICSPCLK <sup>(3)</sup>                |
| RA2                 | —                      | —          | —   | —         | —          | —                           | —   | —                   | —        | —                   | —                  | —         | —                                     |
| RA3                 | 4                      | 3          | —   | —         | —          | T1G <sup>(2)</sup>          | —   | —                   | —        | —                   | SS <sup>(2)</sup>  | IOC       | MCLR<br>V <sub>PP</sub>               |
| RA4                 | 3                      | 2          | —   | —         | —          | SOSCO<br>T1G <sup>(1)</sup> | —   | —                   | —        | —                   | SDO <sup>(2)</sup> | IOC       | CLKOUT<br>OSC2<br>CLKR <sup>(1)</sup> |
| RA5                 | 2                      | 1          | —   | —         | —          | SOSCI<br>T1CKI              | —   | —                   | —        | PWM2 <sup>(2)</sup> | —                  | IOC       | CLKIN<br>OSC1                         |
| RC0                 | 10                     | 9          | —   | —         | —          | —                           | —   | —                   | —        | —                   | SCL<br>SCK         | —         | ICSPDAT                               |
| RC1                 | 9                      | 8          | —   | —         | —          | —                           | —   | —                   | —        | —                   | SDA<br>SDI         | INT       | ICSPCLK                               |
| RC2                 | 8                      | 7          | —   | —         | —          | —                           | —   | —                   | —        | —                   | SDO <sup>(1)</sup> | —         | —                                     |
| RC3                 | 7                      | 6          | —   | —         | —          | —                           | —   | —                   | —        | PWM2 <sup>(1)</sup> | SS <sup>(1)</sup>  | —         | CLKR <sup>(2)</sup>                   |
| RC4                 | 6                      | 5          | —   | —         | —          | —                           | —   | —                   | TK<br>CK | —                   | —                  | —         | —                                     |
| RC5                 | 5                      | 4          | —   | —         | —          | T0CKI                       | —   | —                   | RX<br>DT | PWM1                | —                  | —         | —                                     |
| V <sub>DD</sub>     | 1                      | 16         | —   | —         | —          | —                           | —   | —                   | —        | —                   | —                  | —         | V <sub>DD</sub>                       |
| V <sub>SS</sub>     | 14                     | 13         | —   | —         | —          | —                           | —   | —                   | —        | —                   | —                  | —         | V <sub>SS</sub>                       |
| V <sub>USB3V3</sub> | 11                     | 10         | —   | —         | —          | —                           | —   | V <sub>USB3V3</sub> | —        | —                   | —                  | —         | —                                     |

- Note**
- 1: Default location for peripheral pin function. Alternate location can be selected using the APFCON register.
  - 2: Alternate location for peripheral pin function selected by the APFCON register.
  - 3: LVP support for PIC18(L)F1XK50 legacy designs.

# PIC16(L)F145X

**TABLE 2: 14-PIN ALLOCATION TABLE (PIC16(L)F1455)**

| I/O     | 14-Pin PDIP/SOIC/TSSOP | 16-Pin QFN | ADC | Reference | Comparator       | Timer                       | CWG    | USB     | EUSART   | PWM                 | MSSP               | Interrupt | Basic                                 |
|---------|------------------------|------------|-----|-----------|------------------|-----------------------------|--------|---------|----------|---------------------|--------------------|-----------|---------------------------------------|
| RA0     | 13                     | 12         | —   | —         | —                | —                           | —      | D+      | —        | —                   | —                  | IOC       | ICSPDAT <sup>(3)</sup>                |
| RA1     | 12                     | 11         | —   | —         | —                | —                           | —      | D-      | —        | —                   | —                  | IOC       | ICSPCLK <sup>(3)</sup>                |
| RA2     | —                      | —          | —   | —         | —                | —                           | —      | —       | —        | —                   | —                  | —         | —                                     |
| RA3     | 4                      | 3          | —   | —         | —                | T1G <sup>(2)</sup>          | —      | —       | —        | —                   | SS <sup>(2)</sup>  | IOC       | MCLR<br>V <sub>PP</sub>               |
| RA4     | 3                      | 2          | AN3 | —         | —                | SOSCO<br>T1G <sup>(1)</sup> | —      | —       | —        | —                   | SDO <sup>(2)</sup> | IOC       | CLKOUT<br>OSC2<br>CLKR <sup>(1)</sup> |
| RA5     | 2                      | 1          | —   | —         | —                | SOSCI<br>T1CKI              | —      | —       | —        | PWM2 <sup>(2)</sup> | —                  | IOC       | CLKIN<br>OSC1                         |
| RC0     | 10                     | 9          | AN4 | VREF+     | C1IN+<br>C2IN+   | —                           | —      | —       | —        | —                   | SCL<br>SCK         | —         | ICSPDAT                               |
| RC1     | 9                      | 8          | AN5 | —         | C1IN1-<br>C2IN1- | —                           | CWGFLT | —       | —        | —                   | SDA<br>SDI         | INT       | ICSPCLK                               |
| RC2     | 8                      | 7          | AN6 | DACOUT1   | C1IN2-<br>C2IN2- | —                           | —      | —       | —        | —                   | SDO <sup>(1)</sup> | —         | —                                     |
| RC3     | 7                      | 6          | AN7 | DACOUT2   | C1IN3-<br>C2IN3- | —                           | —      | —       | —        | PWM2 <sup>(1)</sup> | SS <sup>(1)</sup>  | —         | CLKR <sup>(2)</sup>                   |
| RC4     | 6                      | 5          | —   | —         | C1OUT<br>C2OUT   | —                           | CWG1B  | —       | TK<br>CK | —                   | —                  | —         | —                                     |
| RC5     | 5                      | 4          | —   | —         | —                | T0CKI                       | CWG1A  | —       | RX<br>DT | PWM1                | —                  | —         | —                                     |
| VDD     | 1                      | 16         | —   | —         | —                | —                           | —      | —       | —        | —                   | —                  | —         | VDD                                   |
| VSS     | 14                     | 13         | —   | —         | —                | —                           | —      | —       | —        | —                   | —                  | —         | VSS                                   |
| VUSB3V3 | 11                     | 10         | —   | —         | —                | —                           | —      | VUSB3V3 | —        | —                   | —                  | —         | —                                     |

- Note**
- 1: Default location for peripheral pin function. Alternate location can be selected using the APFCON register.
  - 2: Alternate location for peripheral pin function selected by the APFCON register.
  - 3: LVP support for PIC18(L)F1XK50 legacy designs.

# PIC16(L)F145X

**TABLE 3: 20-PIN ALLOCATION TABLE (PIC16(L)F1459)**

| I/O     | 20-Pin PDIP/SSOP | 20-Pin QFN | ADC  | Reference | Comparator       | Timer                       | CWG    | USB     | EUSART   | PWM  | MSSP              | Interrupt | Basic                                 |
|---------|------------------|------------|------|-----------|------------------|-----------------------------|--------|---------|----------|------|-------------------|-----------|---------------------------------------|
| RA0     | 19               | 16         | —    | —         | —                | —                           | —      | D+      | —        | —    | —                 | IOC       | ICSPDAT <sup>(3)</sup>                |
| RA1     | 18               | 15         | —    | —         | —                | —                           | —      | D-      | —        | —    | —                 | IOC       | ICSPCLK <sup>(3)</sup>                |
| RA2     | —                | —          | —    | —         | —                | —                           | —      | —       | —        | —    | —                 | —         | —                                     |
| RA3     | 4                | 1          | —    | —         | —                | T1G <sup>(2)</sup>          | —      | —       | —        | —    | SS <sup>(2)</sup> | IOC       | MCLR<br>VPP                           |
| RA4     | 3                | 20         | AN3  | —         | —                | SOSCO<br>T1G <sup>(1)</sup> | —      | —       | —        | —    | —                 | IOC       | OSC2<br>CLKOUT<br>CLKR <sup>(1)</sup> |
| RA5     | 2                | 19         | —    | —         | —                | SOSCI<br>T1CKI              | —      | —       | —        | —    | —                 | IOC       | OSC1<br>CLKIN                         |
| RB4     | 13               | 10         | AN10 | —         | —                | —                           | —      | —       | —        | —    | SDA<br>SDI        | IOC       | —                                     |
| RB5     | 12               | 9          | AN11 | —         | —                | —                           | —      | —       | RX<br>DX | —    | —                 | IOC       | —                                     |
| RB6     | 11               | 8          | —    | —         | —                | —                           | —      | —       | —        | —    | SCL<br>SCK        | IOC       | —                                     |
| RB7     | 10               | 7          | —    | —         | —                | —                           | —      | —       | TX<br>CK | —    | —                 | IOC       | —                                     |
| RC0     | 16               | 13         | AN4  | VREF+     | C1IN+<br>C2IN+   | —                           | —      | —       | —        | —    | —                 | —         | ICSPDAT                               |
| RC1     | 15               | 12         | AN5  | —         | C1IN1-<br>C2IN1- | —                           | CWGFLT | —       | —        | —    | —                 | INT       | ICSPCLK                               |
| RC2     | 14               | 11         | AN6  | DACOUT1   | C1IN2-<br>C2IN2- | —                           | —      | —       | —        | —    | —                 | —         | —                                     |
| RC3     | 7                | 4          | AN7  | DACOUT2   | C1IN3-<br>C2IN3- | —                           | —      | —       | —        | —    | —                 | —         | CLKR <sup>(2)</sup>                   |
| RC4     | 6                | 3          | —    | —         | C1OUT<br>C2OUT   | —                           | CWG1B  | —       | —        | —    | —                 | —         | —                                     |
| RC5     | 5                | 2          | —    | —         | —                | T0CKI                       | CWG1A  | —       | —        | PWM1 | —                 | —         | —                                     |
| RC6     | 8                | 5          | AN8  | —         | —                | —                           | —      | —       | —        | PWM2 | SS <sup>(1)</sup> | —         | —                                     |
| RC7     | 9                | 6          | AN9  | —         | —                | —                           | —      | —       | —        | —    | SDO               | —         | —                                     |
| VDD     | 1                | 18         | —    | —         | —                | —                           | —      | —       | —        | —    | —                 | —         | VDD                                   |
| VSS     | 20               | 17         | —    | —         | —                | —                           | —      | —       | —        | —    | —                 | —         | VSS                                   |
| VUSB3V3 | 17               | 14         | —    | —         | —                | —                           | —      | VUSB3V3 | —        | —    | —                 | —         | —                                     |

- Note**
- 1: Default location for peripheral pin function. Alternate location can be selected using the APFCON register.
  - 2: Alternate location for peripheral pin function selected by the APFCON register.
  - 3: LVP support for PIC18(L)F1XK50 legacy designs.



# PIC16(L)F145X

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NOTES:

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