

28/40/44-Pin 8-Bit Advanced Analog Flash Microcontroller Product Brief

High-Performance RISC CPU:

- Only 49 Instructions
- Operating Speed:
 - DC – 32 MHz clock input
 - DC – 125 ns instruction cycle
- 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)
 - FSRs can read program and data memory

Extreme Low-Power (XLP) Management:

- Standby Current (PIC16LF1784/6/7):
 - 50 nA @ 1.8V, typical
- Watchdog Timer Current (PIC16LF1784/6/7):
 - 500 nA @ 1.8V, typical
- Timer1 (32.768 kHz Real-Time Clock) Oscillator Current (PIC16LF1784/6/7):
 - 500 nA @ 1.8V, typical
- Operating Current (PIC16LF1784/6/7):
 - 4 μ A @ 32 kHz, 1.8V, typical
- Operating Current (PIC16LF1784/6/7):
 - 150 μ A @ 1 MHz, 1.8V, typical

Memory Features:

- Up to 8 KW Flash Program Memory:
 - Self-programmable under software control
 - Programmable code protection
 - Programmable write protection
- 256 Bytes of Data EEPROM
- Up to 1K Bytes of RAM

High-Performance PWM Controller:

- Up to three Programmable Switch Mode Controller (PSMC) modules:
 - Digital and/or analog feedback control of PWM frequency and pulse begin/end times
 - 16-bit Period, Duty Cycle and Phase
 - 16 ns clock resolution
 - Supports single PWM, complimentary, push-pull and three-phase modes of operation
 - Dead-band control with 8-bit counter
 - Auto-shutdown and restart
 - Leading and falling edge blanking
 - Burst mode

Analog Peripheral Features:

- Analog-to-Digital Converter (ADC):
 - Fully differential 12-bit converter
 - 100 ksps conversion rate
 - Up to 14 single-ended channels
 - Up to 7 differential channels
 - Positive and negative reference selection
- 8-bit Digital-to-Analog Converter (DAC):
 - Output available externally
 - Positive and negative reference selection
 - Internal connections to Comparators, Op Amps, Fixed Voltage Reference (FVR) and ADC
- Up to four High-Speed Comparators:
 - 50 ns response time
 - Rail-to-rail inputs
 - Software selectable hysteresis
 - Internal connection to Op Amps, FVR and DAC
- Up to three Operational Amplifiers:
 - Rail-to-rail inputs/outputs
 - High/Low selectable Gain Bandwidth Product
 - Internal connection to DAC and FVR
- Fixed Voltage Reference (FVR):
 - 1.024V, 2.048V and 4.096V output levels
 - Internal connection to ADC, Comparators and DAC

Digital Peripheral Features:

- Timer0: 8-Bit Timer/Counter with 8-Bit Programmable Prescaler
- Enhanced Timer1:
 - 16-bit timer/counter with prescaler
 - External Gate Input mode
 - Dedicated low-power 32 kHz oscillator driver
- Timer2: 8-Bit Timer/Counter with 8-Bit Period Register, Prescaler and Postscaler
- Up to three Capture/Compare/PWM modules (CCP):
 - 16-bit Capture, maximum resolution 12.5 ns
 - 16-bit Compare, max resolution 31.25 ns
 - 10-bit PWM, max frequency 32 kHz
- Master Synchronous Serial Port (SSP) with SPI and I²C™ 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

PIC16(L)F1784/6/7

Oscillator Features:

- Operate up to 32 MHz from Precision Internal Oscillator:
 - Factory calibrated to $\pm 1\%$, typical
 - Software selectable frequency range from 32 MHz to 31 kHz
- 31 kHz Low-Power Internal Oscillator
- 32.768 kHz Timer1 Oscillator:
 - available as system clock
 - Low power RTC
- External Oscillator Block with:
 - 4 crystal/resonator modes up to 32 MHz using 4x PLL
 - 3 external clock modes up to 32 MHz
- 4x Phase-Locked Loop (PLL)
- Fail-Safe Clock Monitor:
 - Detect and recover from external oscillator failure
- Two-Speed Start-up:
 - Minimize latency between code execution and external oscillator start-up

I/O Features:

- Up to 36 I/O Pins and 1 Input-only Pin:
 - High current sink/source for LED drivers
 - Individually programmable interrupt-on-change pins
 - Individually programmable weak pull-ups
 - Individual input level selection
 - Slew rate control on selected output pins
 - Open drain outputs on selected output pins

General Microcontroller Features:

- Power-Saving Sleep mode
- Power-on Reset (POR)
- Power-up Timer (PWRT)
- Oscillator Start-up Timer (OST)
- Brown-out Reset (BOR) with Selectable Trip Point
- Extended Watchdog Timer (WDT)
- In-Circuit Serial Programming™ (ICSP™)
- In-Circuit Debug (ICD)
- Enhanced Low-Voltage Programming (LVP)
- Operating Voltage Range:
 - 1.8V to 3.6V (PIC16LF1784/6/7)
 - 2.3V to 5.5V (PIC16F1784/6/7)

PIC16(L)F178X Family Types

| Device | Data Sheet Index | Program Memory Flash (words) | Data EEPROM (bytes) | Data SRAM (bytes) | I/Os ⁽²⁾ | 12-bit ADC (ch) | Comparators | Operational Amplifiers | 8-bit DAC | Timers (8/16-bit) | Programmable Switch Mode Controllers (PSMC) | CCP | EUSART | MSSP (I ² C™/SPI) | Debug ⁽¹⁾ | XLP |
|---------------|------------------|------------------------------|---------------------|-------------------|---------------------|-----------------|-------------|------------------------|-----------|-------------------|---|-----|--------|------------------------------|----------------------|-----|
| PIC16(L)F1782 | (1) | 2048 | 256 | 256 | 25 | 11 | 3 | 2 | 1 | 2/1 | 2 | 2 | 1 | 1 | I | Y |
| PIC16(L)F1783 | (1) | 4096 | 256 | 512 | 25 | 11 | 3 | 2 | 1 | 2/1 | 2 | 2 | 1 | 1 | I | Y |
| PIC16(L)F1784 | (2) | 4096 | 256 | 512 | 36 | 14 | 4 | 3 | 1 | 2/1 | 3 | 3 | 1 | 1 | I | Y |
| PIC16(L)F1786 | (2) | 8192 | 256 | 1024 | 25 | 11 | 4 | 2 | 1 | 2/1 | 3 | 3 | 1 | 1 | I | Y |
| PIC16(L)F1787 | (2) | 8192 | 256 | 1024 | 36 | 14 | 4 | 3 | 1 | 2/1 | 3 | 3 | 1 | 1 | I | Y |

Note 1: I – Debugging, Integrated on Chip; H – Debugging, Requires Debug Header.

2: One pin is input-only.

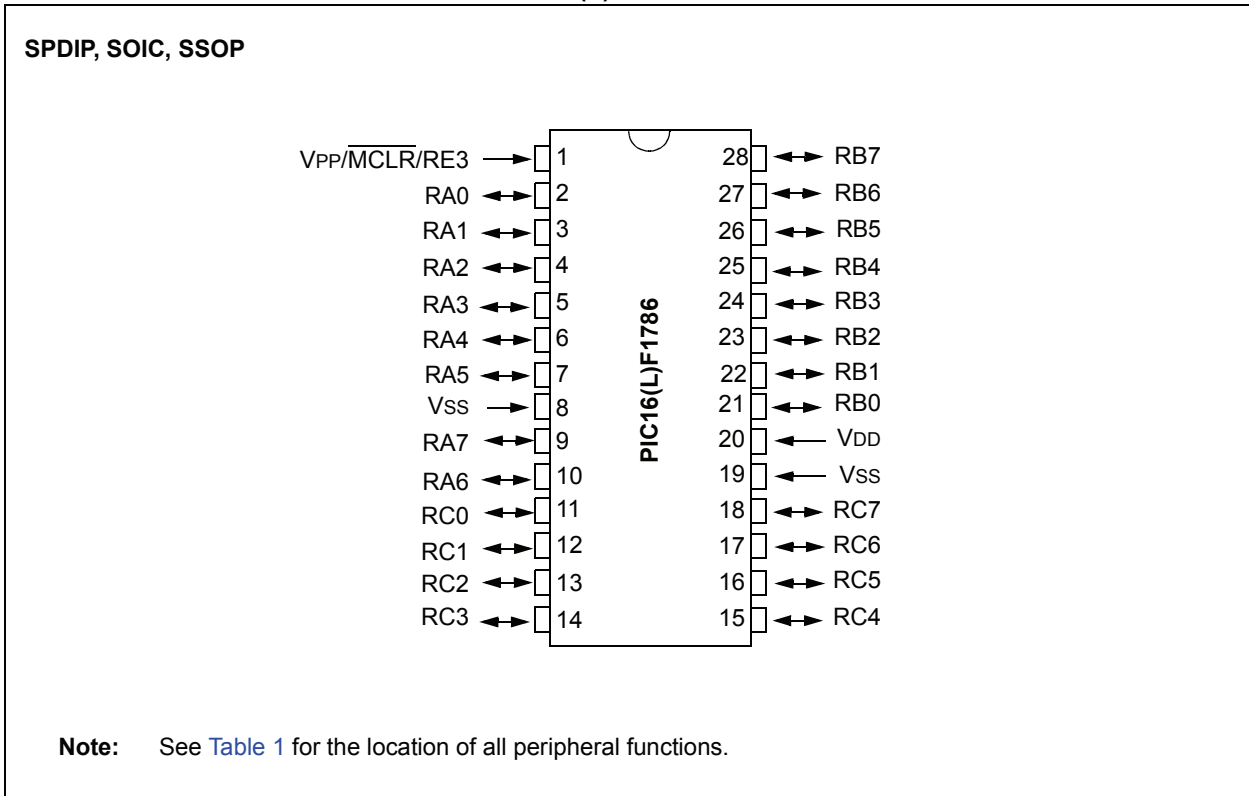
Data Sheet Index: (Unshaded devices are described in this document.)

1: DS41579 [PIC16\(L\)F1782/3 Data Sheet, 28-Pin Flash, 8-bit MCUs.](#)

2: Future Release [PIC16\(L\)F1784/6/7 Data Sheet, 28/40/44-Pin Flash, 8-bit MCUs.](#)

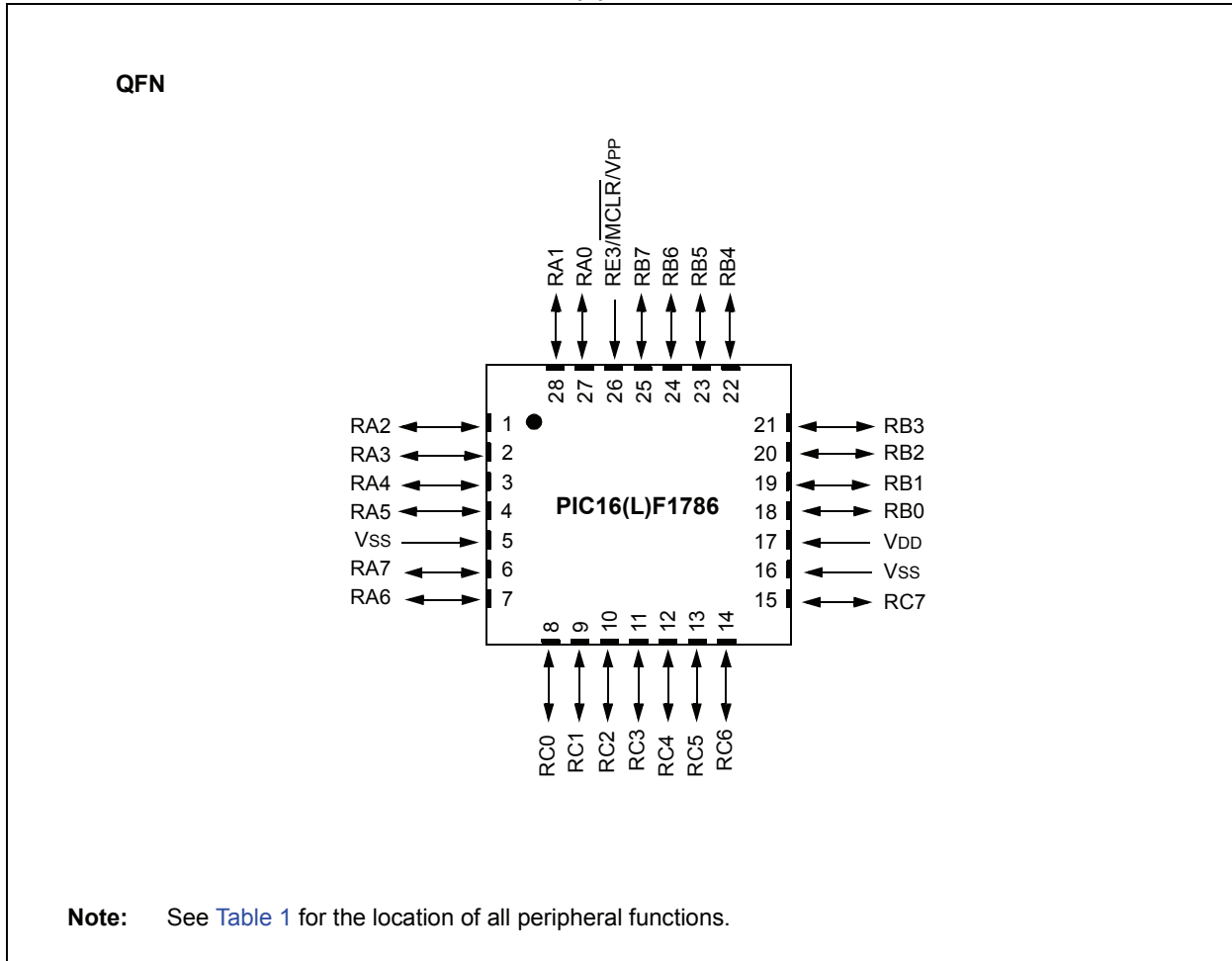
Note: Pin details are subject to change.

FIGURE 1: 28-PIN DIAGRAM FOR PIC16(L)F1786



PIC16(L)F1784/6/7

FIGURE 2: 28-PIN DIAGRAM FOR PIC16(L)F1786



PIC16(L)F1784/6/7

TABLE 1: 28-PIN ALLOCATION TABLE (PIC16(L)F1786)

| I/O | 28-Pin SPDIP, SOIC, SSOP | 28-Pin QFN, | ADC | Reference | Comparator | Operation Amplifiers | 8-bit DAC | Timers | PSMC | CCP | EUSART | MSSP | Interrupt | Pull-up | Basic |
|-----|-----------------------------|-------------|------|--------------------|--------------------------------------|-------------------------|-----------|----------------|----------------------------------|---------------------|--|--|------------|---------|------------------------|
| RA0 | 2 | 27 | AN0 | — | C1IN0- C2IN0- C3IN0- C4IN0- | — | — | — | — | — | — | — | IOC | Y | — |
| RA1 | 3 | 28 | AN1 | — | C1IN1- C2IN1- C3IN1- C4IN1- | OPA1OUT | — | — | — | — | — | — | IOC | Y | — |
| RA2 | 4 | 1 | AN2 | VREF- DAC1VREF- | C1IN0+ C2IN0+ C3IN0+ C4IN0+ | OPA1IN- | DAC1OUT1 | — | — | — | — | — | IOC | Y | — |
| RA3 | 5 | 2 | AN3 | VREF+ DAC1VREF+ | C1IN1+ | — | — | — | — | — | — | — | IOC | Y | — |
| RA4 | 6 | 3 | — | — | C1OUT | OPA1IN+ | — | T0CKI | — | — | — | — | IOC | Y | — |
| RA5 | 7 | 4 | AN4 | — | C2OUT | OPA1IN- | — | — | — | — | — | SS | IOC | Y | — |
| RA6 | 10 | 7 | — | — | C2OUT ⁽¹⁾ | — | — | — | — | — | — | — | IOC | Y | VCAP OSC2 CLKOUT |
| RA7 | 9 | 6 | — | — | — | — | — | — | PSMC1CLK PSMC2CLK PSMC3CLK | — | — | — | IOC | Y | OSC1 CLKIN |
| RB0 | 21 | 18 | AN12 | — | C2IN1+ | — | — | — | PSMC1IN PSMC2IN PSMC3IN | CCP1 ⁽¹⁾ | — | — | INT IOC | Y | — |
| RB1 | 22 | 19 | AN10 | — | C1IN3- C2IN3- C3IN3- C4IN3- | OPA2OUT | — | — | — | — | — | — | IOC | Y | — |
| RB2 | 23 | 20 | AN8 | — | — | OPA2IN- | — | — | — | — | — | — | IOC | Y | CLKR |
| RB3 | 24 | 21 | AN9 | — | C1IN2- C2IN2- C3IN2- | OPA2IN+ | — | — | — | CCP2 ⁽¹⁾ | — | — | IOC | Y | — |
| RB4 | 25 | 22 | AN11 | — | C3IN1+ | — | — | — | — | — | — | — | IOC | Y | — |
| RB5 | 26 | 23 | AN13 | — | C4IN2- C3OUT | — | — | T1G | — | CCP3 ⁽¹⁾ | — | SDO ⁽¹⁾ | IOC | Y | — |
| RB6 | 27 | 24 | — | — | C4IN1+ | — | — | — | — | — | TX ⁽¹⁾ CK ⁽¹⁾ | SDI ⁽¹⁾ SDA ⁽¹⁾ | IOC | Y | ICSPCLK |
| RB7 | 28 | 25 | — | — | — | — | DAC1OUT2 | — | — | — | RX ⁽¹⁾ DT ⁽¹⁾ | SCK ⁽¹⁾ SCL ⁽¹⁾ | IOC | Y | ICSPDAT |
| RC0 | 11 | 8 | — | — | — | — | — | SOSCO T1CKI | PSMC1A | — | — | — | IOC | Y | — |
| RC1 | 12 | 9 | — | — | — | — | — | SOSCI | PSMC1B | CCP2 | — | — | IOC | Y | — |
| RC2 | 13 | 10 | — | — | — | — | — | — | PSMC1C PSMC3B | CCP1 | — | — | IOC | Y | — |
| RC3 | 14 | 11 | — | — | — | — | — | — | PSMC1D | — | — | SCK SCL | IOC | Y | — |
| RC4 | 15 | 12 | — | — | — | — | — | — | PSMC1E | — | — | SDI SDA | IOC | Y | — |
| RC5 | 16 | 13 | — | — | — | — | — | — | PSMC1F PSMC3A | — | — | SDO | IOC | Y | — |
| RC6 | 17 | 14 | — | — | — | — | — | — | PSMC2A | CCP3 | TX CK | — | IOC | Y | — |
| RC7 | 18 | 15 | — | — | — | — | — | — | PSMC2B | — | RX DT | — | IOC | Y | — |
| RE3 | 1 | 26 | — | — | — | — | — | — | — | — | — | — | IOC | Y | MCLR VPP |
| VDD | 20 | 17 | — | — | — | — | — | — | — | — | — | — | — | — | VDD |
| VSS | 8, 19 | 5, 16 | — | — | — | — | — | — | — | — | — | — | — | — | VSS |

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

PIC16(L)F1784/6/7

FIGURE 3: 40-PIN PDIP PACKAGE DIAGRAM FOR PIC16(L)F1784/7

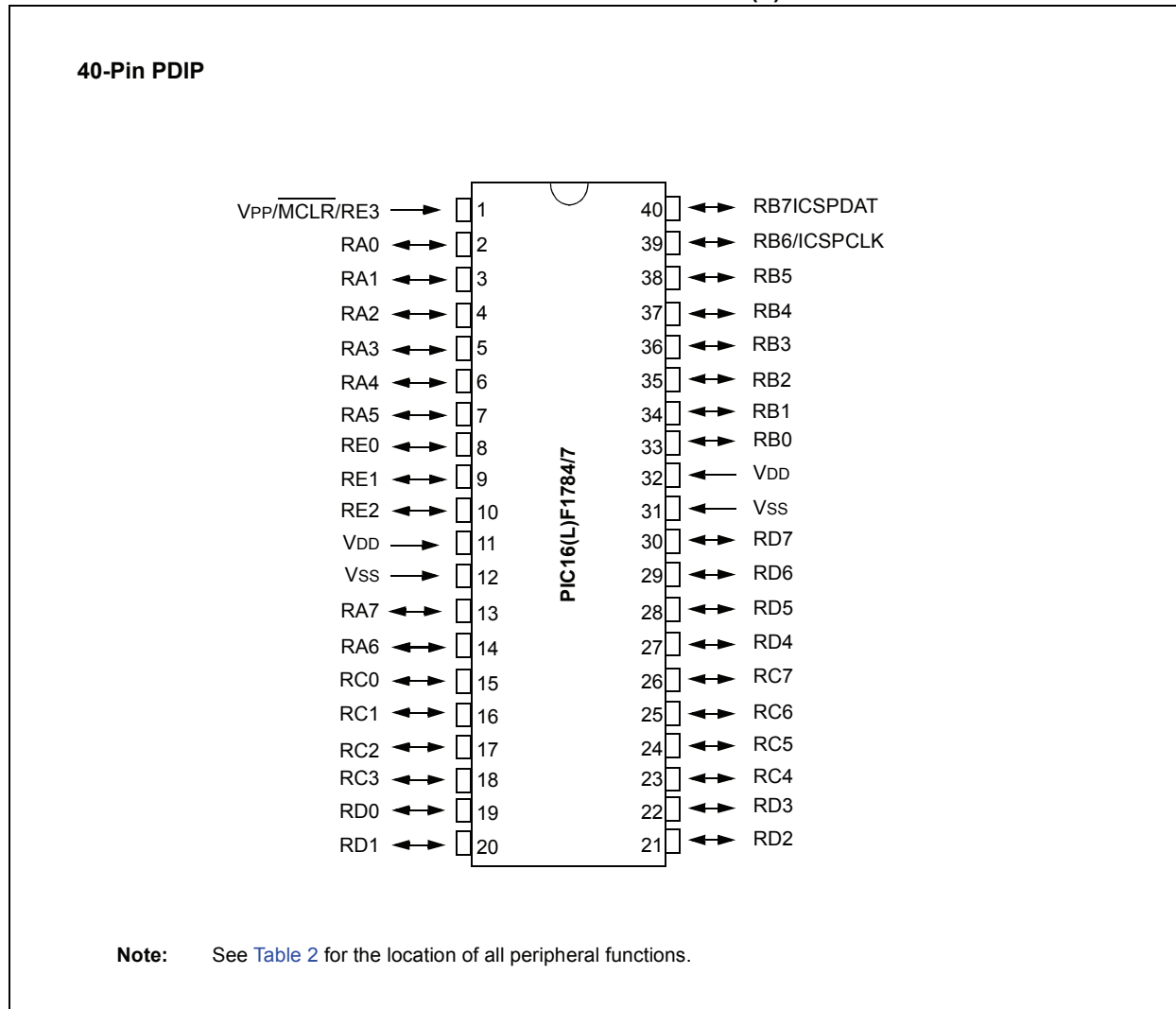
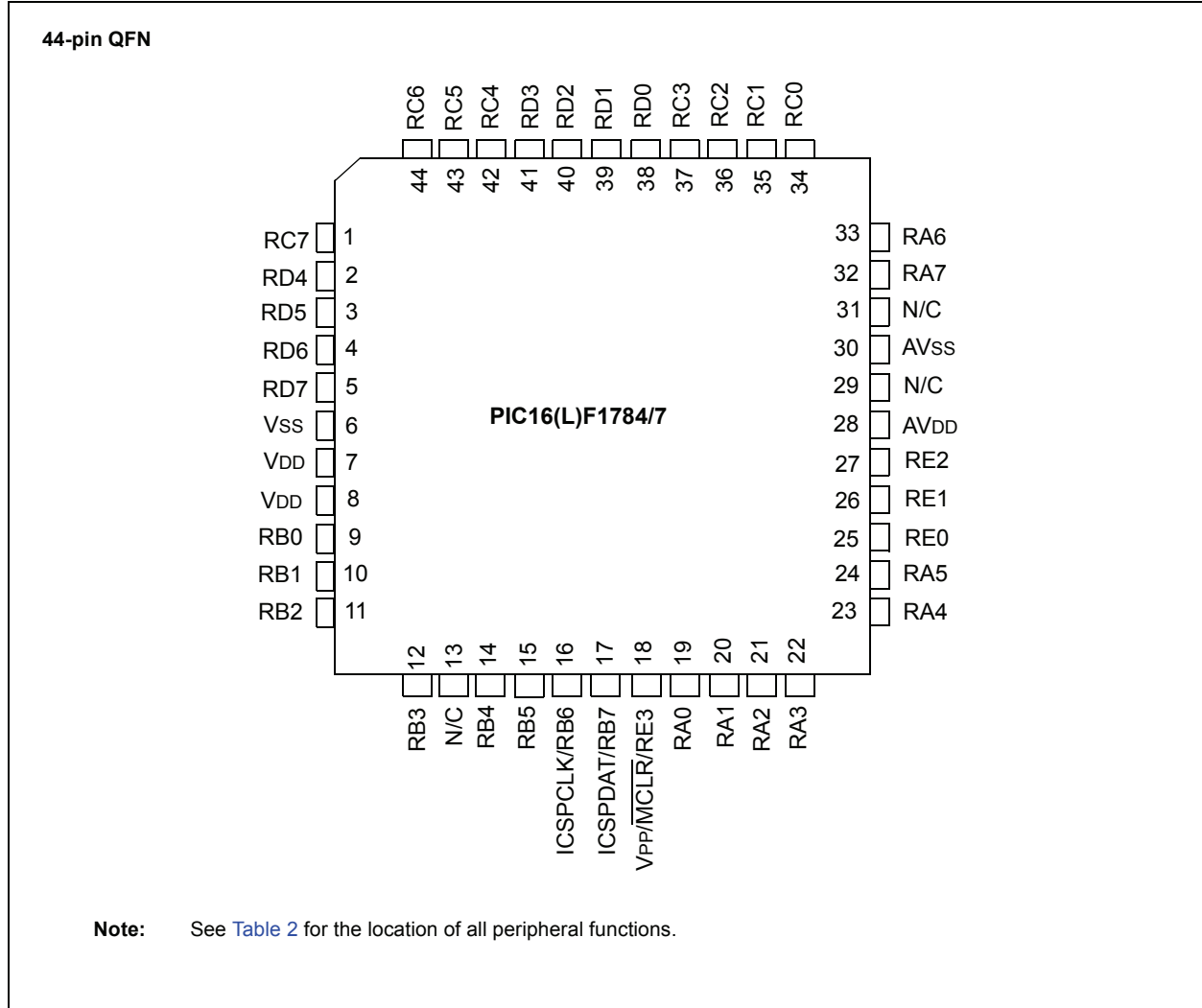


FIGURE 4: 44-PIN QFN PACKAGE DIAGRAM FOR PIC16(L)F1784/7



PIC16(L)F1784/6/7

FIGURE 5: 40-PIN UQFN (5X5) PACKAGE DIAGRAM FOR PIC16(L)F1784/7

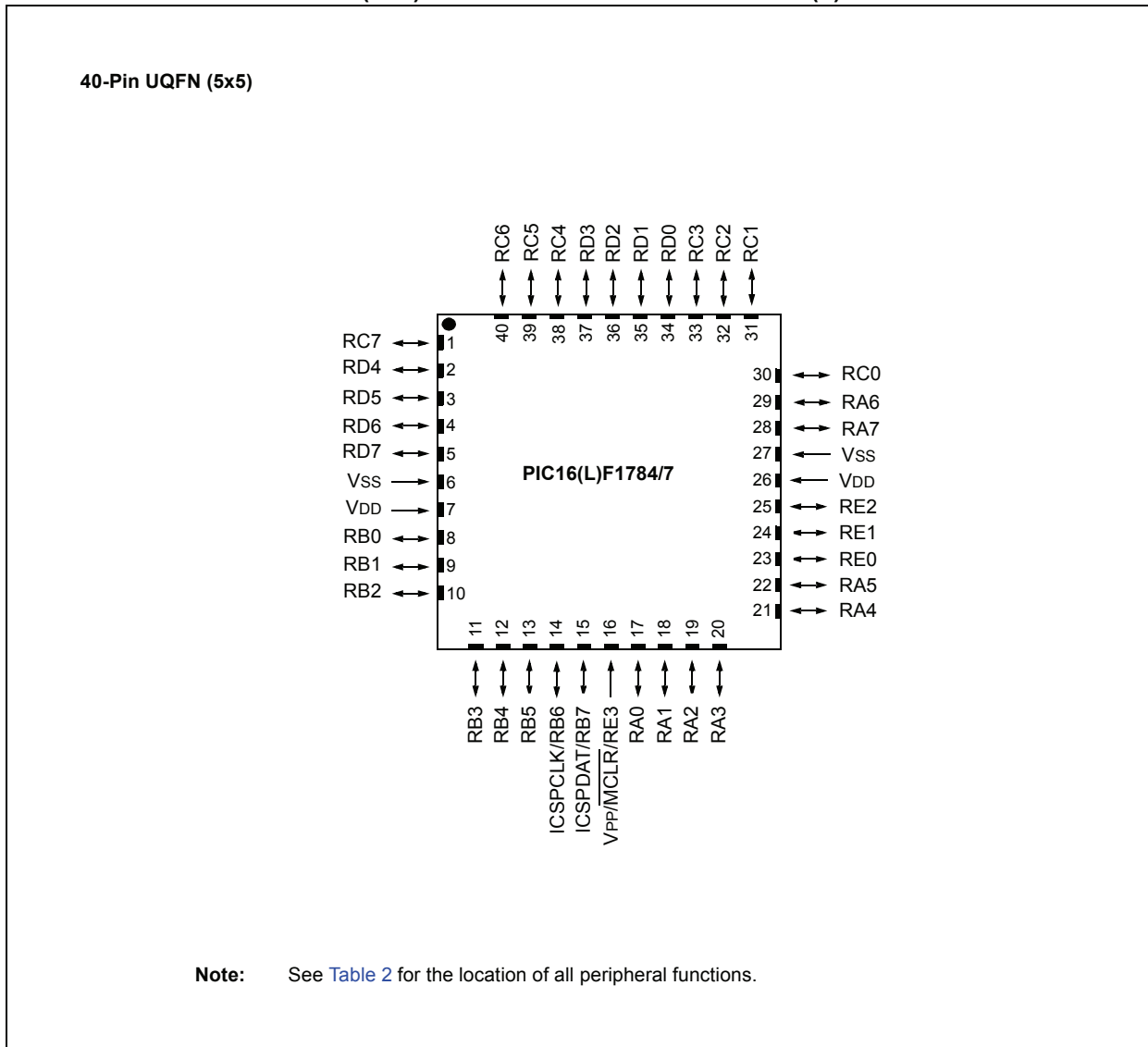
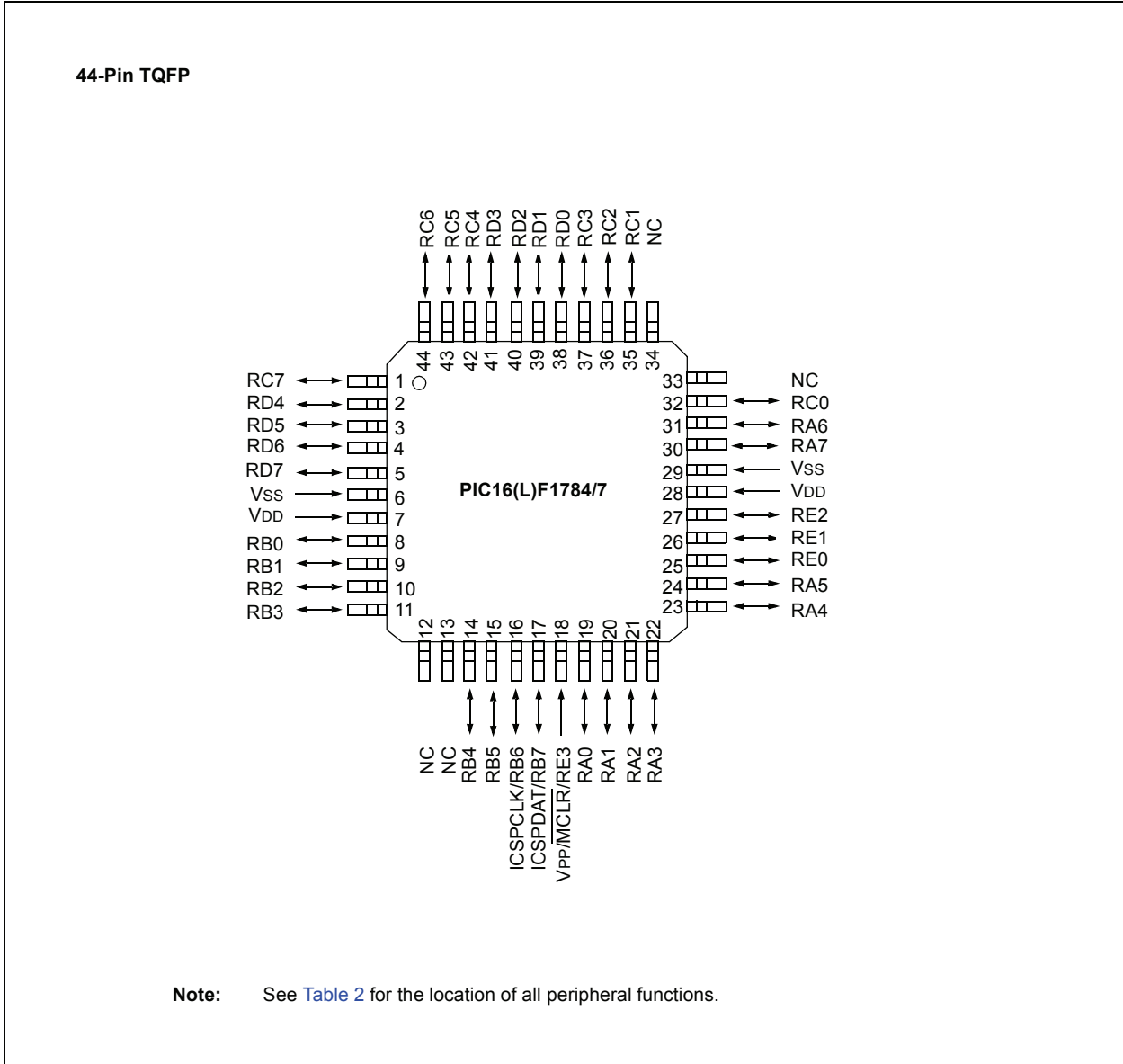


FIGURE 6: 44-PIN TQFP PACKAGE DIAGRAM FOR PIC16(L)F1784/7



PIC16(L)F1784/6/7

TABLE 2: 40/44-PIN SUMMARY(PIC16(L)F1784/7)

| I/O | 40-Pin PDIP | 40-Pin UQFN | 44-Pin TQFP | 44-Pin QFN | A/D | Reference | Comparator | Op Amps | 8-bit DAC | Timers | PSMC | CCP | EUSART | MSSP | Interrupt | Pull-up | Basic |
|-----|-------------|-------------|-------------|------------|------|--------------------|--------------------------------------|---------|-----------|----------------|----------------------------------|---------------------|--|--|-----------|---------|------------------------------------|
| RA0 | 2 | 17 | 19 | 19 | AN0 | — | C1IN0- C2IN0- C3IN0- C4IN0- | — | — | — | — | — | — | — | IO | Y | — |
| RA1 | 3 | 18 | 20 | 20 | AN1 | — | C1IN1- C2IN1- C3IN1- C4IN1- | OPA1OUT | — | — | — | — | — | — | IO | Y | — |
| RA2 | 4 | 19 | 21 | 21 | AN2 | DAC1VREF- VREF- | C1IN0+ C2IN0+ C3IN0+ C4IN0+ | OPA1IN- | DAC1OUT1 | — | — | — | — | — | IO | Y | — |
| RA3 | 5 | 20 | 22 | 22 | AN3 | DAC1VREF+ VREF+ | C1IN1+ | — | — | — | — | — | — | — | IO | Y | — |
| RA4 | 6 | 21 | 23 | 23 | — | — | C1OUT | OPA1IN+ | — | T0CKI | — | — | — | — | IO | Y | — |
| RA5 | 7 | 22 | 24 | 24 | AN4 | — | C2OUT | OPA1IN- | — | — | — | — | — | SS | IO | Y | — |
| RA6 | 14 | 29 | 31 | 33 | — | — | C2OUT ⁽¹⁾ | — | — | — | — | — | — | — | IO | Y | V _{CAP} CLKOUT OSC2 |
| RA7 | 13 | 28 | 30 | 32 | — | — | — | — | — | — | PSMC1CLK PSMC2CLK PSMC3CLK | — | — | — | IO | Y | CLKIN OSC1 |
| RB0 | 33 | 8 | 8 | 9 | AN12 | — | C2IN1+ | — | — | — | PSMC1IN PSMC2IN PSMC3IN | CCP1 ⁽¹⁾ | — | — | INT IO | Y | — |
| RB1 | 34 | 9 | 9 | 10 | AN10 | — | C1IN3- C2IN3- C3IN3- C4IN3- | OPA2OUT | — | — | — | — | — | — | IO | Y | — |
| RB2 | 35 | 10 | 10 | 11 | AN8 | — | — | OPA2IN- | — | — | — | — | — | — | IO | Y | CLKR |
| RB3 | 36 | 11 | 11 | 12 | AN9 | — | C1IN2- C2IN2- C3IN2- | OPA2IN+ | — | — | — | CCP2 ⁽¹⁾ | — | — | IO | Y | — |
| RB4 | 37 | 12 | 14 | 14 | AN11 | — | C3IN1+ | — | — | — | — | — | — | — | IO | Y | — |
| RB5 | 38 | 13 | 15 | 15 | AN13 | — | C4IN2- | — | — | T1G | — | CCP3 ⁽¹⁾ | — | SDO ⁽¹⁾ | IO | Y | — |
| RB6 | 39 | 14 | 16 | 16 | — | — | C4IN1+ | — | — | — | — | — | TX ⁽¹⁾ CK ⁽¹⁾ | SDA ⁽¹⁾ SDI ⁽¹⁾ | IO | Y | ICSPCLK |
| RB7 | 40 | 15 | 17 | 17 | — | — | — | — | DAC1OUT2 | — | — | — | RX ⁽¹⁾ DT ⁽¹⁾ | SCL ⁽¹⁾ SCK ⁽¹⁾ | IO | Y | ICSPDAT |
| RC0 | 15 | 30 | 32 | 34 | — | — | — | — | — | T1CKI SOSCO | PSMC1A | — | — | — | IO | Y | — |
| RC1 | 16 | 31 | 35 | 35 | — | — | — | — | — | SOSCI | PSMC1B | CCP2 | — | — | IO | Y | — |
| RC2 | 17 | 32 | 36 | 36 | — | — | — | — | — | — | PSMC1C | CCP1 | — | — | IO | Y | — |
| RC3 | 18 | 33 | 37 | 37 | — | — | — | — | — | — | PSMC1D | — | — | SCL SCK | IO | Y | — |
| RC4 | 23 | 38 | 42 | 42 | — | — | — | — | — | — | PSMC1E | — | — | SDI SDA | IO | Y | — |
| RC5 | 24 | 39 | 43 | 43 | — | — | — | — | — | — | PSMC1F | — | — | SDO | IO | Y | — |
| RC6 | 25 | 40 | 44 | 44 | — | — | — | — | — | — | PSMC2A | — | TX CK | — | IO | Y | — |
| RC7 | 26 | 1 | 1 | 1 | — | — | — | — | — | — | PSMC2B | — | RX DT | — | IO | Y | — |
| RD0 | 19 | 34 | 38 | 38 | — | — | — | OPA3IN+ | — | — | — | — | — | — | — | Y | — |
| RD1 | 20 | 35 | 39 | 39 | AN21 | — | C1IN4- C2IN4- C3IN4- C4IN4- | OPA3OUT | — | — | — | — | — | — | — | Y | — |
| RD2 | 21 | 36 | 40 | 40 | — | — | — | OPA3IN- | — | — | — | — | — | — | — | Y | — |
| RD3 | 22 | 37 | 41 | 41 | — | — | — | — | — | — | — | — | — | — | — | Y | — |
| RD4 | 27 | 2 | 2 | 2 | — | — | — | — | — | — | PSMC3F | — | — | — | — | Y | — |

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

PIC16(L)F1784/6/7

TABLE 2: 40/44-PIN SUMMARY(PIC16(L)F1784/7) (Continued)

| I/O | 40-Pin PDIP | 40-Pin UQFN | 44-Pin TQFP | 44-Pin QFN | A/D | Reference | Comparator | Op Amps | 8-bit DAC | Timers | PSMC | CCP | EUSART | MSSP | Interrupt | Pull-up | Basic |
|-----|-------------|-------------|-------------|------------|-----|-----------|------------|---------|-----------|--------|--------|------|--------|------|-----------|---------|-------------|
| RD5 | 28 | 3 | 3 | 3 | — | — | — | — | — | — | PSMC3E | — | — | — | — | Y | — |
| RD6 | 29 | 4 | 4 | 4 | — | — | C3OUT | — | — | — | PSMC3D | — | — | — | — | Y | — |
| RD7 | 30 | 5 | 5 | 5 | — | — | C4OUT | — | — | — | PSMC3C | — | — | — | — | Y | — |
| RE0 | 8 | 23 | 25 | 25 | AN5 | — | — | — | — | — | — | CCP3 | — | — | IOC | Y | — |
| RE1 | 9 | 24 | 26 | 26 | AN6 | — | — | — | — | — | PSMC3B | — | — | — | — | Y | — |
| RE2 | 10 | 25 | 27 | 27 | AN7 | — | — | — | — | — | PSMC3A | — | — | — | — | Y | — |
| RE3 | 1 | 16 | 18 | 18 | — | — | — | — | — | — | — | — | — | — | — | Y | MCLR VPP |
| VDD | 11, 32 | 7, 26 | 7, 28 | 7,8, 28 | — | — | — | — | — | — | — | — | — | — | — | — | VDD |
| Vss | 12, 31 | 6, 29 | 6, 27 | 6,30, | — | — | — | — | — | — | — | — | — | — | — | — | Vss |

Note 1: Alternate pin function selected with the APFCON register.
 2: Function selected with ADCON1 register.

PIC16(L)F1784/6/7

APPENDIX A: REVISION HISTORY

Revision A (01/2012)

Initial Release.

Note the following details of the code protection feature on Microchip devices:

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