
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.

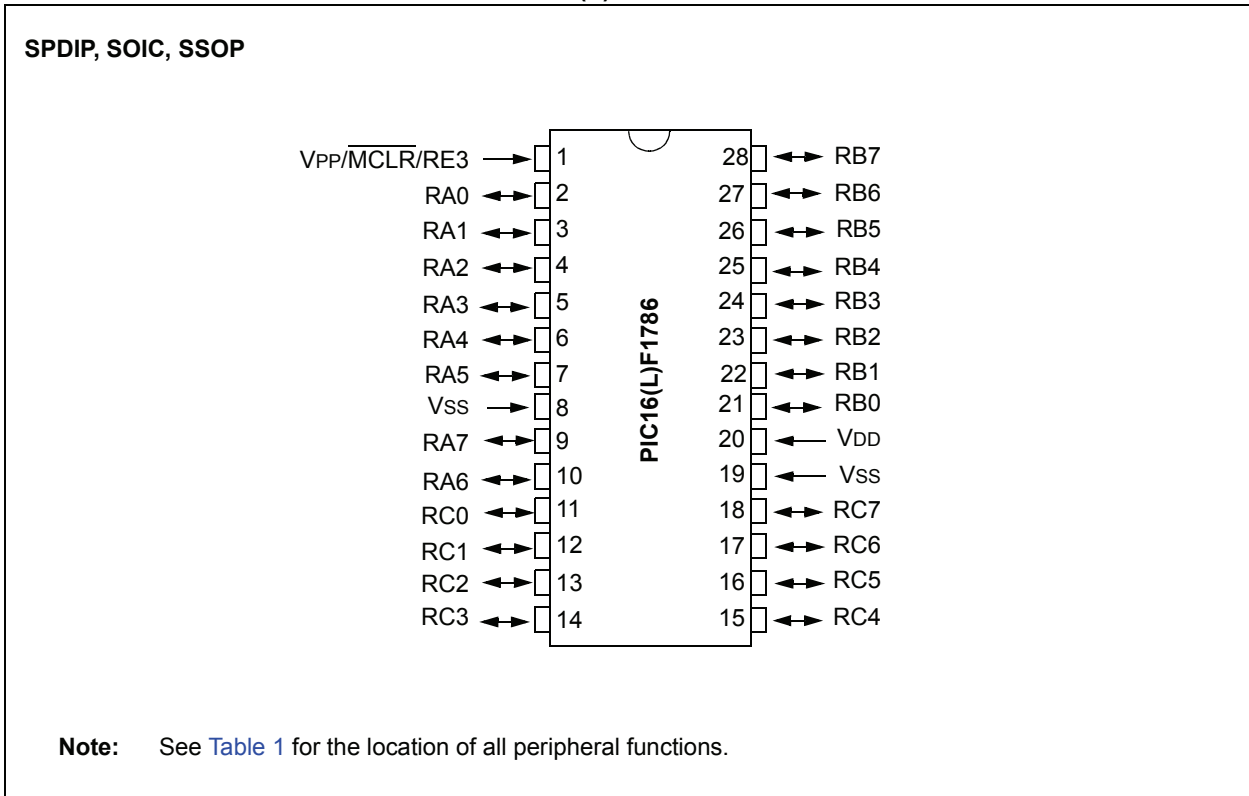
Data Sheet Index: (Unshaded devices are described in this document.)

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.](#)

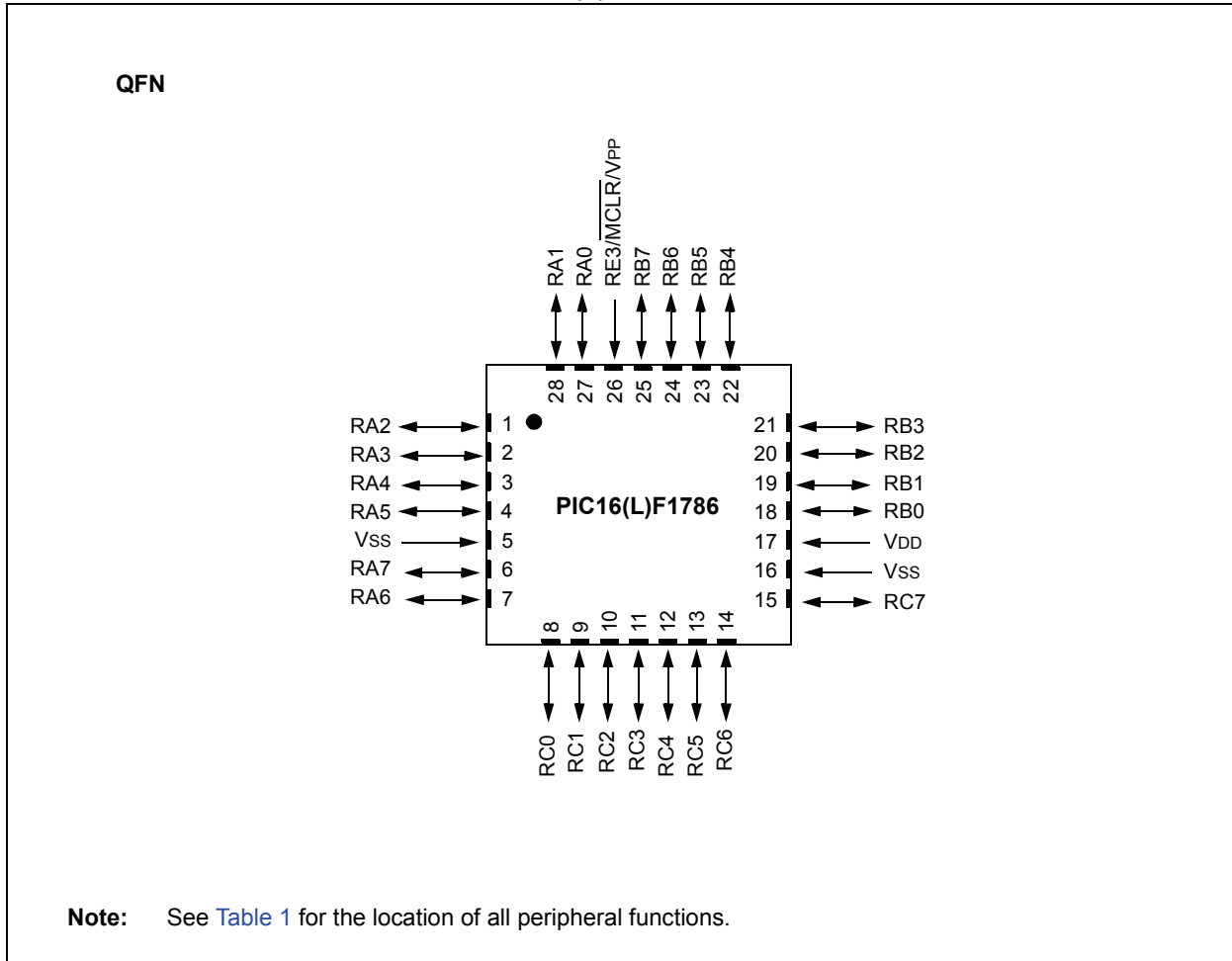
Note: Pin details are subject to change.

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

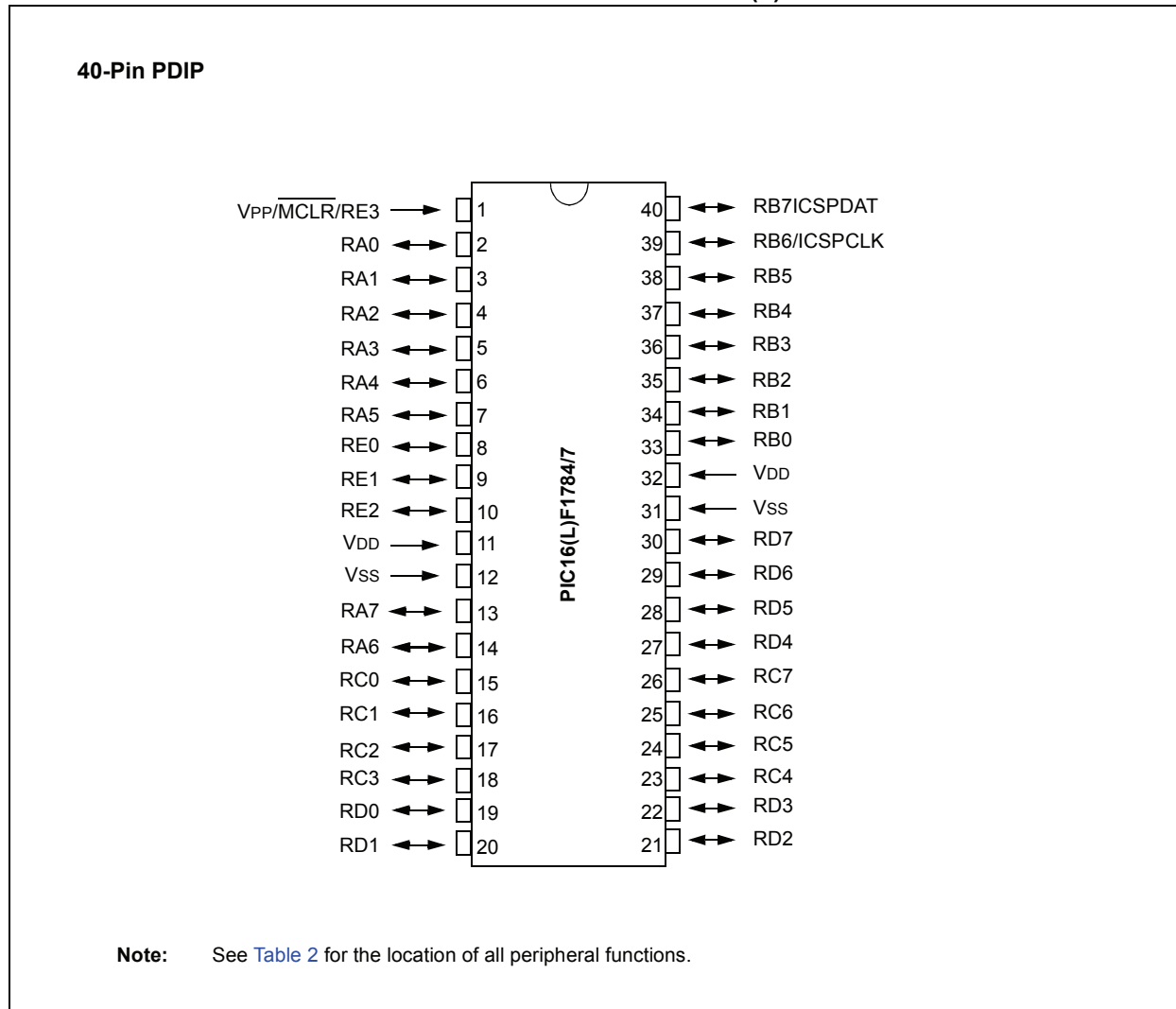
TABLE 1: 28-PIN ALLOCATION TABLE (PIC16(L)F1786)

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.

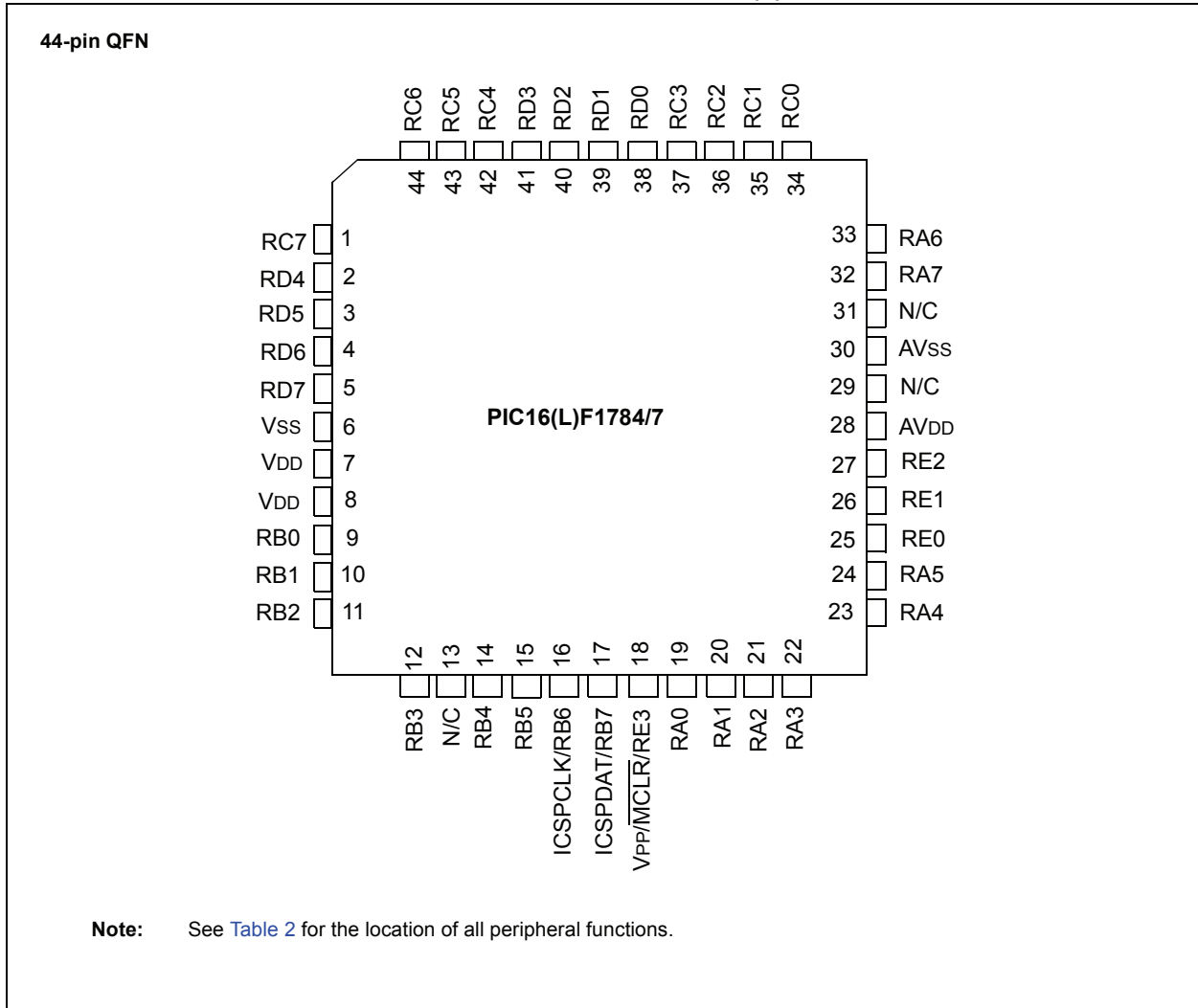
PIC16(L)F1784/6/7

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



PIC16(L)F1784/6/7

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

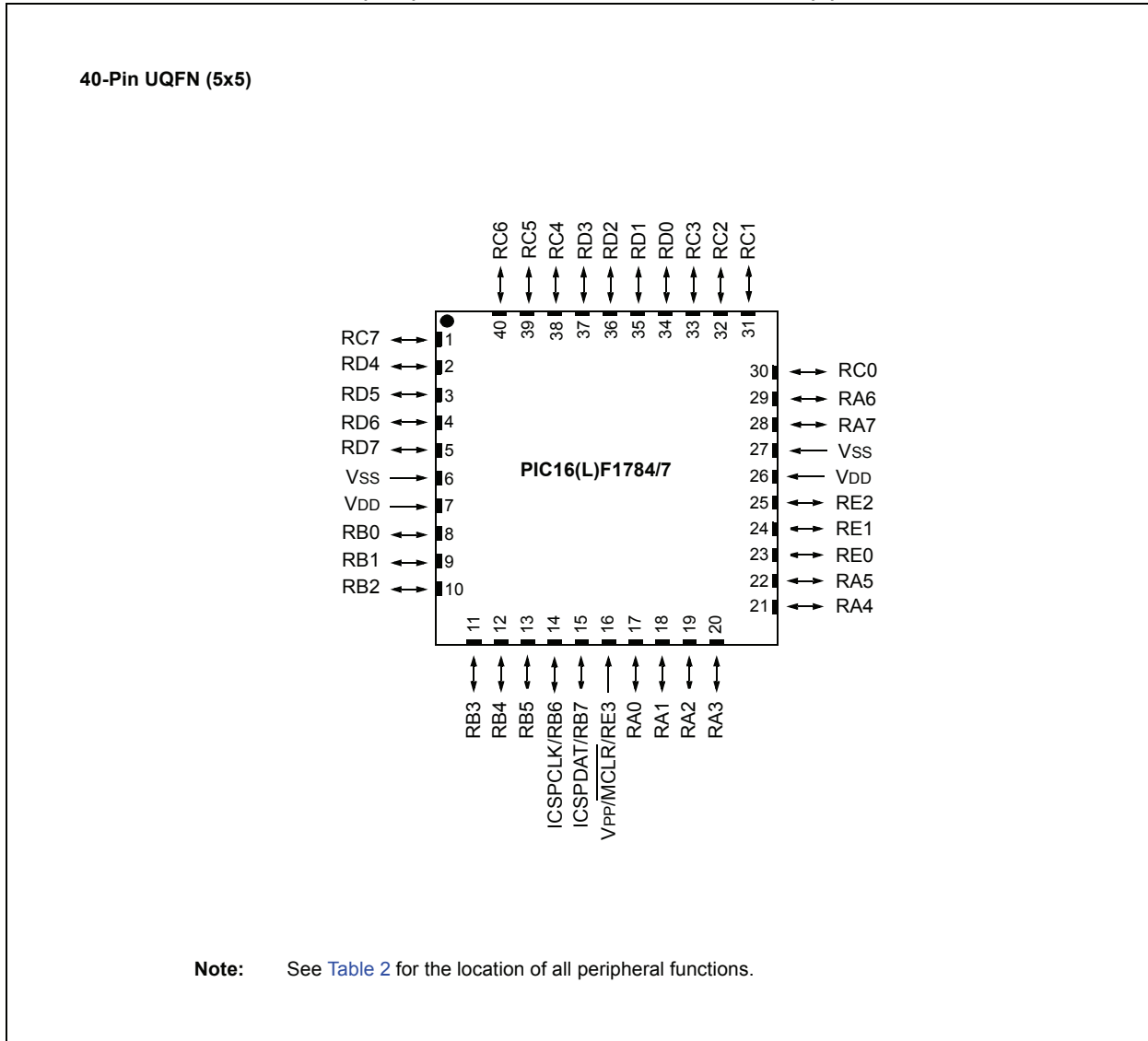
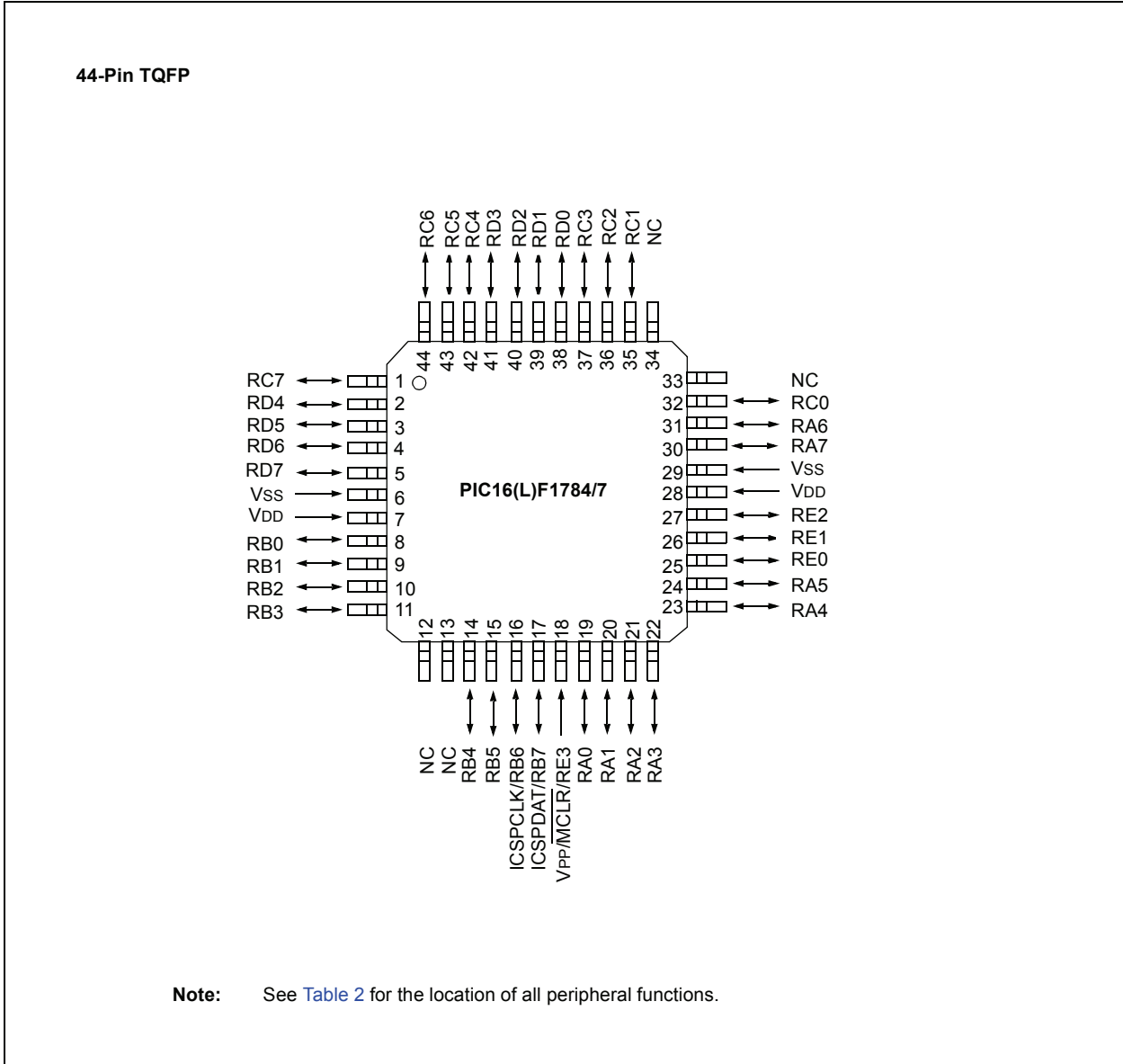


FIGURE 6: 44-PIN TQFP PACKAGE DIAGRAM FOR PIC16(L)F1784/7



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:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
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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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