



# MICROCHIP PIC16F194X/16LF194X

## 64-Pin 8-Bit Flash Microcontroller Product Brief

### High-Performance RISC CPU:

- Only 49 Instructions to Learn
- 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

### Special Microcontroller Features:

- 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
- External Oscillator Block with:
  - 4 crystal/resonator modes up to 32 MHz
  - 3 external clock modes up to 32 MHz
- 4x Phase Locked Loop (PLL)
- Fail-Safe Clock Monitor
- Two-Speed Start-up
- 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 Watch-Dog Timer (WDT)
- In-Circuit Serial Programming™ (ICSP™) via two pins
- In-Circuit Debug (ICD) via Two Pins
- Enhanced Low-Voltage Programming (LVP)
- Operating Voltage Range:
  - 1.8V to 3.6V (PIC16LF194X)
  - 1.8V to 5.5V (PIC16F194X)
- Programmable Code Protection
- Self-Programmable under Software Control

### Low-Power Features:

- Standby Current (PIC16LF194X):
  - 100 nA @ 1.8V, typical
- Operating Current (PIC16LF194X):
  - 150  $\mu$ A @ 1 MHz, 1.8V, typical
- Low-Power Watchdog Timer Current (PIC16LF194X):
  - 1.0  $\mu$ A @ 1.8V, typical

### Peripheral Features:

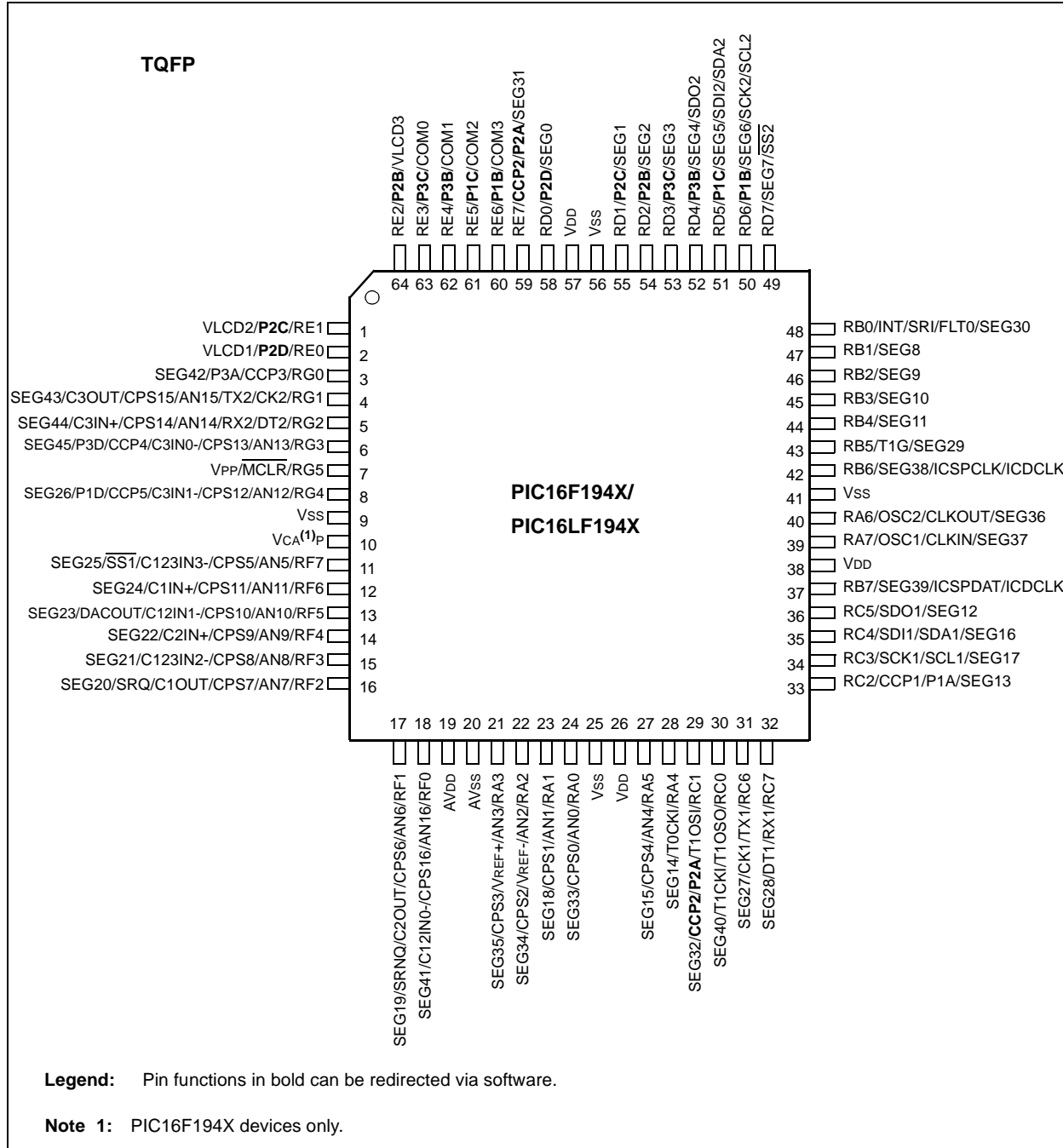
- Integrated LCD Controller:
  - Up to 184 segments
  - Variable clock input
  - Contrast control
  - Internal voltage reference selections
- Up to 53 I/O Pins and 1 Input-only Pin:
  - High current sink/source for LED drivers
  - Individually programmable interrupt-on-change pins
  - Individually programmable weak pull-ups
- 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, 4, 6: 8-Bit Timer/Counter with 8-Bit Period Register, Prescaler and Postscaler
- Two Capture/Compare/PWM modules (CCP):
  - Software selectable time bases
- Three Enhanced Capture, Compare, PWM modules (ECCP):
  - Software selectable time bases
  - Auto-shutdown and auto-restart
  - PWM steering
- Two Master Synchronous Serial Ports (MSSP) with SPI and I<sup>2</sup>C™ with:
  - 7-bit address masking
  - SMBus/PMBus™ compatibility
- Two Enhanced Universal Synchronous Asynchronous Receiver Transmitters (EUSART):
  - RS-232, RS-485 and LIN compatible
  - Auto-Baud Detect
  - Auto-wake-up on start
- SR Latch (Integrated 555 Timer):
  - Multiple Set/Reset input options
- Analog-to-Digital Converter (ADC):
  - 10-bit resolution
  - Up to 17 channels
- 3 Comparators:
  - Rail-to-rail inputs/outputs
  - Power mode control
  - Software controllable hysteresis
- Voltage Reference module:
  - Fixed Voltage Reference (FVR) with 1.024V, 2.048V and 4.096V output levels
  - 5-bit rail-to-rail resistive DAC with positive and negative reference selection
- mTouch™ Oscillator Module
  - 17 channels for button, sensor, or slider input

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**TABLE 1: FAMILY TYPES**

Device	Program Memory Flash (words)	Data EEPROM (bytes)	SRAM (bytes)	I/Os	10-bit A/D (ch)	Timers 8/16-bit	EUSART	I <sup>2</sup> C™ and SPI	CCP/ECCP	LCD segments/commons
PIC16F1946	8192	256	512	54	17	4/1	2	2	2/3	46/4
PIC16LF1946	8192	256	512	54	17	4/1	2	2	2/3	46/4
PIC16F1947	16384	256	1024	54	17	4/1	2	2	2/3	46/4
PIC16LF1947	16384	256	1024	54	17	4/1	2	2	2/3	46/4

**FIGURE 1: 64-PIN TQFP PACKAGE DIAGRAM FOR PIC16F1946/1947**



# PIC16F194X/16LF194X

**TABLE 2: 64-PIN DEVICE ALLOCATION TABLE (PIC16F1946/1947)**

I/O	64-Pin TQFP	A/D	Cap Sense	Comparator	SR Latch	Timers	CCP	EUSART	MSSP	LCD	Interrupt	Pull-up	Basic
RA0	24	AN0	CPS0	—	—	—	—	—	—	SEG33	—	—	—
RA1	23	AN1	CPS1	—	—	—	—	—	—	SEG18	—	—	—
RA2	22	AN2/ VREF-	CPS2	—	—	—	—	—	—	SEG34	—	—	—
RA3	21	AN3/ VREF+	CPS3	—	—	—	—	—	—	SEG35	—	—	—
RA4	28	—	—	—	—	TOCKI	—	—	—	SEG14	—	—	—
RA5	27	AN4	CPS4	—	—	—	—	—	—	SEG15	—	—	—
RA6	40	—	—	—	—	—	—	—	—	SEG36	—	—	OSC2/ CLKOUT
RA7	39	—	—	—	—	—	—	—	—	SEG37	—	—	OSC1/ CLKIN
RB0	48	—	—	—	SRI	—	FLT0	—	—	SEG30	INT/ IOC	Y	—
RB1	47	—	—	—	—	—	—	—	—	SEG8	IOC	Y	—
RB2	46	—	—	—	—	—	—	—	—	SEG9	IOC	Y	—
RB3	45	—	—	—	—	—	—	—	—	SEG10	IOC	Y	—
RB4	44	—	—	—	—	—	—	—	—	SEG11	IOC	Y	—
RB5	43	—	—	—	—	T1G	—	—	—	SEG29	IOC	Y	—
RB6	42	—	—	—	—	—	—	—	—	SEG38	IOC	Y	ICSPCLK/ ICDCLK
RB7	37	—	—	—	—	—	—	—	—	SEG39	IOC	Y	ICSPDAT/ ICDDAT
RC0	30	—	—	—	—	T1OSO/ T1CKI	—	—	—	SEG40	—	—	—
RC1	29	—	—	—	—	T1OSI	CCP2 <sup>(1)</sup> / P2A <sup>(1)</sup>	—	—	SEG32	—	—	—
RC2	33	—	—	—	—	—	CCP1/ P1A	—	—	SEG13	—	—	—
RC3	34	—	—	—	—	—	—	—	SCK1/ SCL1	SEG17	—	—	—
RC4	35	—	—	—	—	—	—	—	SDI1/ SDA1	SEG16	—	—	—
RC5	36	—	—	—	—	—	—	—	SDO1	SEG12	—	—	—
RC6	31	—	—	—	—	—	—	TX1/CK1	—	SEG27	—	—	—
RC7	32	—	—	—	—	—	—	RX1/DT1	—	SEG28	—	—	—
RD0	58	—	—	—	—	—	P2D <sup>(1)</sup>	—	—	SEG0	—	—	—
RD1	55	—	—	—	—	—	P2C <sup>(1)</sup>	—	—	SEG1	—	—	—
RD2	54	—	—	—	—	—	P2B <sup>(1)</sup>	—	—	SEG2	—	—	—
RD3	53	—	—	—	—	—	P3C <sup>(1)</sup>	—	—	SEG3	—	—	—
RD4	52	—	—	—	—	—	P3B <sup>(1)</sup>	—	SDO2	SEG4	—	—	—
RD5	51	—	—	—	—	—	P1C <sup>(1)</sup>	—	SDI2/ SDA2	SEG5	—	—	—
RD6	50	—	—	—	—	—	P1B <sup>(1)</sup>	—	SCK2/ SCL2	SEG6	—	—	—
RD7	49	—	—	—	—	—	—	—	SS2	SEG7	—	—	—
RE0	2	—	—	—	—	—	P2D <sup>(1)</sup>	—	—	VLCD1	—	—	—
RE1	1	—	—	—	—	—	P2C <sup>(1)</sup>	—	—	VLCD2	—	—	—
RE2	64	—	—	—	—	—	P2B <sup>(1)</sup>	—	—	VLCD3	—	—	—
RE3	63	—	—	—	—	—	P3C <sup>(1)</sup>	—	—	COM0	—	—	—
RE4	62	—	—	—	—	—	P3B <sup>(1)</sup>	—	—	COM1	—	—	—
RE5	61	—	—	—	—	—	P1C <sup>(1)</sup>	—	—	COM2	—	—	—
RE6	60	—	—	—	—	—	P1B <sup>(1)</sup>	—	—	COM3	—	—	—
RE7	59	—	—	—	—	—	CCP2 <sup>(1)</sup> / P2A <sup>(1)</sup>	—	—	SEG31	—	—	—

**Note** 1: Pin functions in bold can be redirected via software.  
 2: Weak pull-up always enabled when MCLR is enabled, otherwise the pull-up is under user control.

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I/O	64-Pin TQFP	A/D	Cap Sense	Comparator	SR Latch	Timers	CCP	EUSART	MSSP	LCD	Interrupt	Pull-up	Basic
RF0	18	AN16	CPS16	C12IN0-	—	—	—	—	—	SEG41	—	—	—
RF1	17	AN6	CPS6	C2OUT	SRNQ	—	—	—	—	SEG19	—	—	—
RF2	16	AN7	CPS7	C1OUT	SRQ	—	—	—	—	SEG20	—	—	—
RF3	15	AN8	CPS8	C123IN2-	—	—	—	—	—	SEG21	—	—	—
RF4	14	AN9	CPS9	C2IN+	—	—	—	—	—	SEG22	—	—	—
RF5	13	AN10	CPS10	C12IN1-DACOUT	—	—	—	—	—	SEG23	—	—	—
RF6	12	AN11	CPS11	C1IN+	—	—	—	—	—	SEG24	—	—	—
RF7	11	AN5	CPS5	C123IN3-	—	—	—	—	SS1	SEG25	—	—	—
RG0	3	—	—	—	—	—	CCP3 P3A	—	—	SEG42	—	—	—
RG1	4	AN15	CPS15	C3OUT	—	—	—	TX2/CK2	—	SEG43	—	—	—
RG2	5	AN14	CPS14	C3IN+	—	—	—	RX2/DT2	—	SEG44	—	—	—
RG3	6	AN13	CPS13	C3IN0-	—	—	CCP4 P3D	—	—	SEG45	—	—	—
RG4	8	AN12	CPS12	C3IN1-	—	—	CCP5 P1D	—	—	SEG26	—	—	—
RG5	7	—	—	—	—	—	—	—	—	—	—	γ(2)	MCLR/VPP
VDD	26, 38, 57	—	—	—	—	—	—	—	—	—	—	—	VDD
VSS	9, 25, 41, 56	—	—	—	—	—	—	—	—	—	—	—	VSS
AVDD	19	—	—	—	—	—	—	—	—	—	—	—	AVDD
AVSS	20	—	—	—	—	—	—	—	—	—	—	—	AVSS
VCAP	10	—	—	—	—	—	—	—	—	—	—	—	VCAP

- Note** 1: Pin functions in bold can be redirected via software.  
2: Weak pull-up always enabled when MCLR is enabled, otherwise the pull-up is under user control.

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