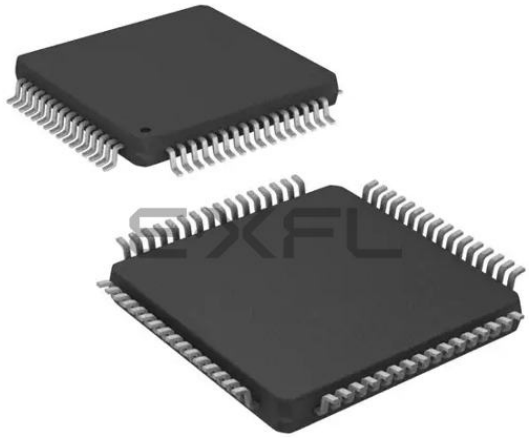


Welcome to E-XFL.COM

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	Obsolete
Core Processor	PIC
Core Size	8-Bit
Speed	40MHz
Connectivity	I²C, SPI, UART/USART
Peripherals	Brown-out Detect/Reset, HLVD, LCD, POR, PWM, WDT
Number of I/O	50
Program Memory Size	16KB (8K x 16)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	768 x 8
Voltage - Supply (Vcc/Vdd)	2V ~ 5.5V
Data Converters	A/D 12x12b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	64-TQFP
Supplier Device Package	64-TQFP (10x10)
Purchase URL	https://www.e-xfl.com/product-detail/microchip-technology/pic18lf6493-i-pt

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.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as "unbreakable."

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

PIC18F6393/6493/8393/8493

64/80-Pin High-Performance, Flash Microcontrollers with LCD Driver, 12-Bit ADC and nanoWatt Technology

LCD Driver Module Features:

- Direct Driving of LCD Panel
- Up to 192 Pixels: Software-Selectable
- Programmable LCD Timing module:
  - Multiple LCD timing sources available
  - Up to four commons: Static, 1/2, 1/3 or 1/4 multiplex
  - Static, 1/2 or 1/3 bias configuration
- Can Drive LCD Panel while in Sleep mode for Low-Power Operation

Power-Managed Modes:

- Run: CPU On, Peripherals On
- Idle: CPU Off, Peripherals On
- Sleep: CPU Off, Peripherals Off
- Ultra Low 50 nA Input Leakage
- Run mode Current Down to 14 μA Typical
- Idle mode Currents Down to 2.3 μA Typical
- Sleep mode Currents Down to 0.1 μA Typical
- Timer1 Oscillator: 1.0 μA, 32 kHz, 2V Typical
- Watchdog Timer: 1.7 μA Typical
- Two-Speed Oscillator Start-up

Flexible Oscillator Structure:

- Four Crystal modes, up to 40 MHz
- 4x Phase Lock Loop (available for crystal and internal oscillators)
- Two External RC modes, up to 4 MHz
- Two External Clock modes, up to 40 MHz
- Internal Oscillator Block:
  - Fast wake from Sleep and Idle, 1 μs typical
  - Eight selectable frequencies, from 31 kHz to 8 MHz
  - Provides a complete range of clock speeds from 31 kHz to 32 MHz when used with PLL
  - User-tunable to compensate for frequency drift
- Secondary Oscillator Using Timer1 at 32 kHz
- Fail-Safe Clock Monitor:
  - Allows for safe shutdown if peripheral clock stops

Peripheral Highlights:

- 12-Bit, up to 12-Channel Analog-to-Digital (A/D) Converter module:
  - Auto-acquisition capability
  - Conversion available during Sleep
- High-Current Sink/Source 25 mA/25 mA
- Four External Interrupts
- Four Input Change Interrupts
- Four 8-Bit/16-Bit Timer/Counter modules
- Real-Time Clock (RTC) Software module:
  - Configurable 24-hour clock, calendar, automatic 100-year or 12,800-year, day-of-week calculator
  - Uses Timer1
- Up to Two Capture/Compare/PWM (CCP) modules
- Master Synchronous Serial Port (MSSP) module Supporting Three-Wire SPI (all four modes) and I^2C™ Master and Slave modes
- Addressable USART module:
  - Supports RS-485 and RS-232
- Enhanced Addressable USART module:
  - Supports RS-485, RS-232 and LIN/J2602
  - Auto-wake-up on Start bit
  - Auto-Baud Detect
- Dual Analog Comparators with Input Multiplexing
- Programmable 16-Level High/Low-Voltage Detection (HLVD) module:
  - Supports interrupt on High/Low-Voltage Detection

Special Microcontroller Features:

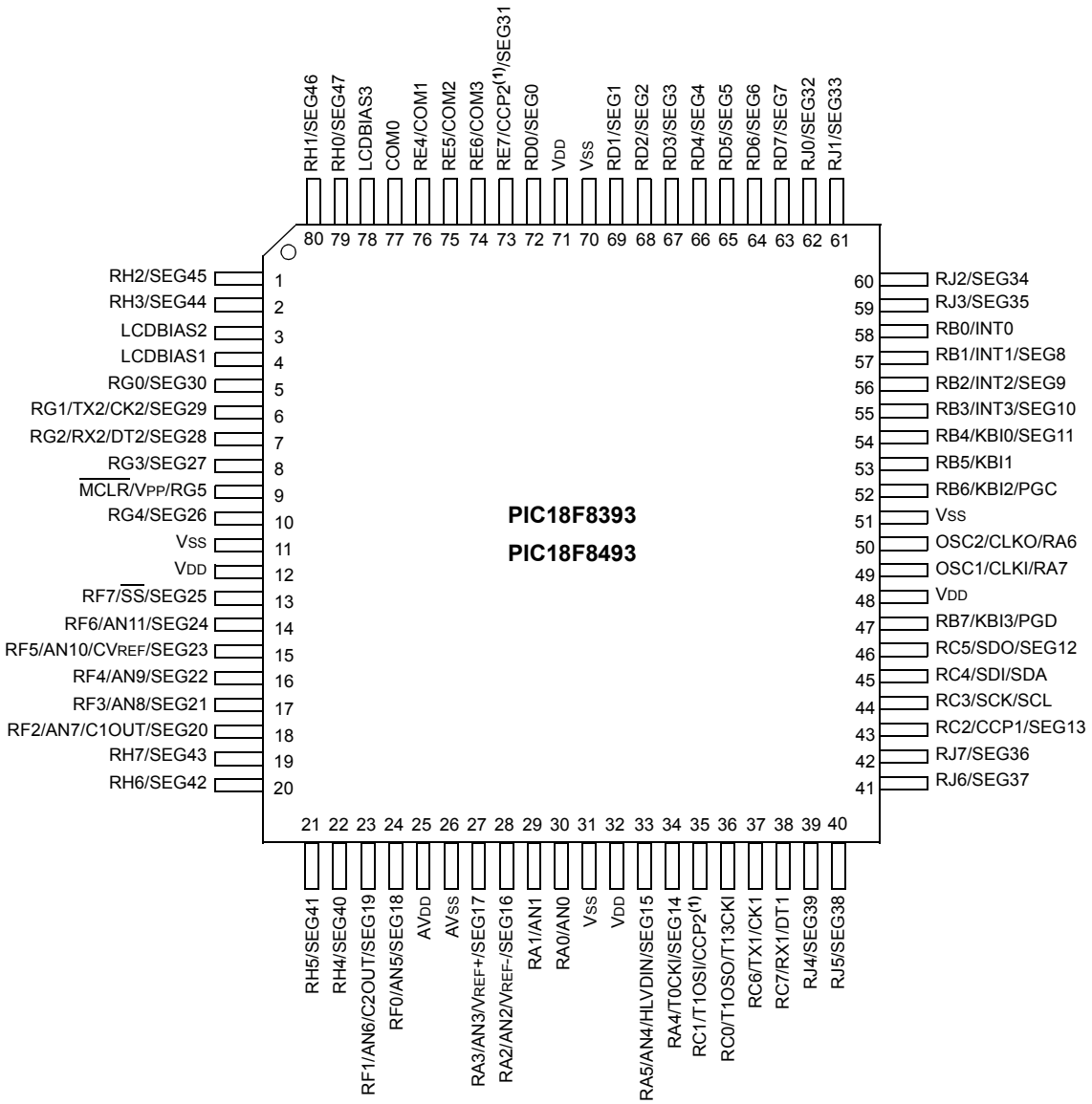
- C Compiler Optimized Architecture:
  - Optional extended instruction set designed to optimize re-entrant code
- 1000 Erase/Write Cycle Flash Program Memory, Typical
- Flash Retention: 100 Years Typical
- Priority Levels for Interrupts
- 8 x 8 Single-Cycle Hardware Multiplier
- Extended Watchdog Timer (WDT):
  - Programmable period from 4 ms to 132s
  - 2% stability over V_{DD} and temperature
- In-Circuit Serial Programming™ (ICSP™) via Two Pins
- In-Circuit Debug (ICD) via Two Pins
- Wide Operating Voltage Range: 2.0V to 5.5V
- Programmable Brown-out Reset (BOR) with Software Enable Option

Note: This document is supplemented by the *"PIC18F6390/6490/8390/8490 Data Sheet"* (DS39629). See **Section 1.0 "Device Overview"**.

Device	Program Memory		Data Memory	I/O	LCD (pixel)	12-Bit A/D (channels)	CCP (PWM)	MSSP		EUSART/ AUSART	Comparators	Timers 8/16-Bit
	Flash (bytes)	# Single-Word Instructions	SRAM (bytes)					SPI	Master I^2C™			
PIC18F6393	8K	4096	768	50	128	12	2	Y	Y	1/1	2	1/3
PIC18F6493	16K	8192	768	50	128	12	2	Y	Y	1/1	2	1/3
PIC18F8393	8K	4096	768	66	192	12	2	Y	Y	1/1	2	1/3
PIC18F8493	16K	8192	768	66	192	12	2	Y	Y	1/1	2	1/3

Pin Diagrams (Continued)

80-Pin TQFP



Note 1: RE7 is the alternate pin for CCP2 multiplexing.

TO OUR VALUED CUSTOMERS

It is our intention to provide our valued customers with the best documentation possible to ensure successful use of your Microchip products. To this end, we will continue to improve our publications to better suit your needs. Our publications will be refined and enhanced as new volumes and updates are introduced.

If you have any questions or comments regarding this publication, please contact the Marketing Communications Department via E-mail at **docerrors@microchip.com** or fax the **Reader Response Form** in the back of this data sheet to (480) 792-4150. We welcome your feedback.

Most Current Data Sheet

To obtain the most up-to-date version of this data sheet, please register at our Worldwide Web site at:

http://www.microchip.com

You can determine the version of a data sheet by examining its literature number found on the bottom outside corner of any page. The last character of the literature number is the version number, (e.g., DS30000A is version A of document DS30000).

Errata

An errata sheet, describing minor operational differences from the data sheet and recommended workarounds, may exist for current devices. As device/documentation issues become known to us, we will publish an errata sheet. The errata will specify the revision of silicon and revision of document to which it applies.

To determine if an errata sheet exists for a particular device, please check with one of the following:

- Microchip's Worldwide Web site; http://www.microchip.com
- Your local Microchip sales office (see last page)

When contacting a sales office, please specify which device, revision of silicon and data sheet (include literature number) you are using.

Customer Notification System

Register on our web site at **www.microchip.com** to receive the most current information on all of our products.

NOTES:

1.0 DEVICE OVERVIEW

This document contains device-specific information for the following devices:

- PIC18F6393
- PIC18F6493
- PIC18F8393
- PIC18F8493

Note: This data sheet documents only the devices' features and specifications that are in addition to the features and specifications of the PIC18F6390/6490/8390/8490 devices. For information on the features and specifications shared by the PIC18F6393/6493/8393/8493 and PIC18F6390/6490/8390/8490 devices, see the *"*PIC18F6390/6490/8390/8490 *Data Sheet"* (DS39629).

This family offers the advantages of all PIC18 microcontrollers – namely, high computational performance at an economical price. In addition to these features, the PIC18F6393/6493/8393/8493 family introduces design enhancements that make these microcontrollers a logical choice for many high-performance, power-sensitive applications.

1.1 Special Features

- **12-Bit A/D Converter:** This module incorporates programmable acquisition time, allowing for a channel to be selected and a conversion to be initiated without waiting for a sampling period and thus, reduces code overhead.

1.2 Details on Individual Family Members

Devices in the PIC18F6393/6493/8393/8493 family are available in 64-pin (PIC18F6X93) and 80-pin (PIC18F8X93) packages. Block diagrams for the two groups are shown in Figure 1-1 and Figure 1-2, respectively.

The devices are differentiated from each other in the following ways:

- I/O Ports:
  - 64-pin devices – 7 bidirectional ports
  - 80-pin devices – 9 bidirectional ports
- LCD Pixels:
  - 64-pin devices – 128 (32 SEGs x 4 COMs) pixels can be driven
  - 80-pin devices – 192 (48 SEGs x 4 COMs) pixels can be driven
- Flash Program Memory:
  - PIC18FX393 devices – 8 Kbytes
  - PIC18FX493 devices – 16 Kbytes

All other features for devices in this family are identical. These are summarized in Table 1-1.

The pinouts for all devices are listed in Table 1-2 and Table 1-3.

Like all Microchip PIC18 devices, members of the PIC18F6393/6493/8393/8493 family are available as both standard and low-voltage devices. Standard devices with Flash memory, designated with an "F" in the part number (such as PIC18F6393), accommodate an operating V_{DD} range of 4.2V to 5.5V. Low-voltage parts, designated by "LF" (such as PIC18LF6490), function over an extended V_{DD} range of 2.0V to 5.5V.

TABLE 1-2: PIC18F6X93 PINOUT I/O DESCRIPTIONS

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	TQFP			
MCLR/VPP/RG5	7			Master Clear (input) or programming voltage (input).
MCLR		I	ST	Master Clear (Reset) input. This pin is an active-low Reset to the device.
VPP		P		Programming voltage input.
RG5		I	ST	Digital input.
OSC1/CLKI/RA7	39			Oscillator crystal or external clock input.
OSC1		I	ST	Oscillator crystal input or external clock source input. ST buffer when configured in RC mode; CMOS otherwise.
CLKI		I	CMOS	External clock source input. Always associated with pin function, OSC1. (See related OSC1/CLKI, OSC2/CLKO pins.)
RA7		I/O	TTL	General purpose I/O pin.
OSC2/CLKO/RA6	40			Oscillator crystal or clock output.
OSC2		O	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode.
CLKO		O	—	In RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
RA6		I/O	TTL	General purpose I/O pin.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; I^2C = ST with I^2C™ or SMB levels

Note 1: Default assignment for CCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for CCP2 when Configuration bit, CCP2MX, is cleared.

TABLE 1-2: PIC18F6X93 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	TQFP			
				PORTA is a bidirectional I/O port.
RA0/AN0	24			
RA0		I/O	TTL	Digital I/O.
AN0		I	Analog	Analog Input 0.
RA1/AN1	23			
RA1		I/O	TTL	Digital I/O.
AN1		I	Analog	Analog Input 1.
RA2/AN2/VREF-/SEG16	22			
RA2		I/O	TTL	Digital I/O.
AN2		I	Analog	Analog Input 2.
VREF-		I	Analog	A/D reference voltage (Low) input.
SEG16		O	Analog	SEG16 output for LCD.
RA3/AN3/VREF+/SEG17	21			
RA3		I/O	TTL	Digital I/O.
AN3		I	Analog	Analog Input 3.
VREF+		I	Analog	A/D reference voltage (High) input.
SEG17		O	Analog	SEG17 output for LCD.
RA4/T0CKI/SEG14	28			
RA4		I/O	ST	Digital I/O.
T0CKI		I	ST	Timer0 external clock input.
SEG14		O	Analog	SEG14 output for LCD.
RA5/AN4/HLVDIN/SEG15	27			
RA5		I/O	TTL	Digital I/O.
AN4		I	Analog	Analog Input 4.
HLVDIN		I	Analog	Low-Voltage Detect input.
SEG15		O	Analog	SEG15 output for LCD.
RA6				See the OSC2/CLKO/RA6 pin.
RA7				See the OSC1/CLKI/RA7 pin.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; I^2C = ST with I^2C™ or SMB levels

Note 1: Default assignment for CCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for CCP2 when Configuration bit, CCP2MX, is cleared.

TABLE 1-2: PIC18F6X93 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	TQFP			
				PORTB is a bidirectional I/O port. PORTB can be software programmed for internal weak pull-ups on all inputs.
RB0/INT0	48			
RB0		I/O	TTL	Digital I/O.
INT0		I	ST	External Interrupt 0.
RB1/INT1/SEG8	47			
RB1		I/O	TTL	Digital I/O.
INT1		I	ST	External Interrupt 1.
SEG8		O	Analog	SEG8 output for LCD.
RB2/INT2/SEG9	46			
RB2		I/O	TTL	Digital I/O.
INT2		I	ST	External Interrupt 2.
SEG9		O	Analog	SEG9 output for LCD.
RB3/INT3/SEG10	45			
RB3		I/O	TTL	Digital I/O.
INT3		I	ST	External Interrupt 3.
SEG10		O	Analog	SEG10 output for LCD.
RB4/KBI0/SEG11	44			
RB4		I/O	TTL	Digital I/O.
KBI0		I	TTL	Interrupt-on-change pin.
SEG11		O	Analog	SEG11 output for LCD.
RB5/KBI1	43			
RB5		I/O	TTL	Digital I/O.
KBI1		I	TTL	Interrupt-on-change pin.
RB6/KBI2/PGC	42			
RB6		I/O	TTL	Digital I/O.
KBI2		I	TTL	Interrupt-on-change pin.
PGC		I/O	ST	In-Circuit Debugger and ICSP™ programming clock pin.
RB7/KBI3/PGD	37			
RB7		I/O	TTL	Digital I/O.
KBI3		I	TTL	Interrupt-on-change pin.
PGD		I/O	ST	In-Circuit Debugger and ICSP programming data pin.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; I^2C = ST with I^2C™ or SMB levels

Note 1: Default assignment for CCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for CCP2 when Configuration bit, CCP2MX, is cleared.

TABLE 1-2: PIC18F6X93 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	TQFP			
				PORTF is a bidirectional I/O port.
RF0/AN5/SEG18	18			
RF0		I/O	ST	Digital I/O.
AN5		I	Analog	Analog input 5.
SEG18		O	Analog	SEG18 output for LCD.
RF1/AN6/C2OUT/SEG19	17			
RF1		I/O	ST	Digital I/O.
AN6		I	Analog	Analog input 6.
C2OUT		O	—	Comparator 2 output.
SEG19		O	Analog	SEG19 output for LCD.
RF2/AN7/C1OUT/SEG20	16			
RF2		I/O	ST	Digital I/O.
AN7		I	Analog	Analog input 7.
C1OUT		O	—	Comparator 1 output.
SEG20		O	Analog	SEG20 output for LCD.
RF3/AN8/SEG21	15			
RF3		I/O	ST	Digital I/O.
AN8		I	Analog	Analog input 8.
SEG21		O	Analog	SEG21 output for LCD.
RF4/AN9/SEG22	14			
RF4		I/O	ST	Digital I/O.
AN9		I	Analog	Analog input 9.
SEG22		O	Analog	SEG22 output for LCD.
RF5/AN10/CVREF/SEG23	13			
RF5		I/O	ST	Digital I/O.
AN10		I	Analog	Analog input 10.
CVREF		O	Analog	Comparator reference voltage output.
SEG23		O	Analog	SEG23 output for LCD.
RF6/AN11/SEG24	12			
RF6		I/O	ST	Digital I/O.
AN11		I	Analog	Analog input 11.
SEG24		O	Analog	SEG24 output for LCD.
RF7/$\overline{SS}$/SEG25	11			
RF7		I/O	ST	Digital I/O.
$\overline{SS}$		I	TTL	SPI™ slave select input.
SEG25		O	Analog	SEG25 output for LCD.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; I^2C = ST with I^2C™ or SMB levels

Note 1: Default assignment for CCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for CCP2 when Configuration bit, CCP2MX, is cleared.

TABLE 1-3: PIC18F8X93 PINOUT I/O DESCRIPTIONS

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	TQFP			
MCLR/VPP/RG5	9			Master Clear (input) or programming voltage (input).
MCLR		I	ST	Master Clear (Reset) input. This pin is an active-low Reset to the device.
VPP		P		Programming voltage input.
RG5		I	ST	Digital input.
OSC1/CLKI/RA7	49			Oscillator crystal or external clock input.
OSC1		I	ST	Oscillator crystal input or external clock source input. ST buffer when configured in RC mode; CMOS otherwise.
CLKI		I	CMOS	External clock source input. Always associated with pin function, OSC1. (See related OSC1/CLKI, OSC2/CLKO pins.)
RA7		I/O	TTL	General purpose I/O pin.
OSC2/CLKO/RA6	50			Oscillator crystal or clock output.
OSC2		O	—	Oscillator crystal output. Connects to crystal or resonator in Crystal Oscillator mode.
CLKO		O	—	In RC mode, OSC2 pin outputs CLKO, which has 1/4 the frequency of OSC1 and denotes the instruction cycle rate.
RA6		I/O	TTL	General purpose I/O pin.

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; I^2C = ST with I^2C™ or SMB levels

Note 1: Default assignment for CCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for CCP2 when Configuration bit, CCP2MX, is cleared.

TABLE 1-3: PIC18F8X93 PINOUT I/O DESCRIPTIONS (CONTINUED)

Pin Name	Pin Number	Pin Type	Buffer Type	Description
	TQFP			
				PORTC is a bidirectional I/O port.
RC0/T1OSO/T13CKI	36			
RC0		I/O	ST	Digital I/O.
T1OSO		O	—	Timer1 oscillator output.
T13CKI		I	ST	Timer1/Timer3 external clock input.
RC1/T1OSI/CCP2	35			
RC1		I/O	ST	Digital I/O.
T1OSI		I	CMOS	Timer1 oscillator input.
CCP2(1)		I/O	ST	Capture 2 input/Compare 2 output/PWM2 output.
RC2/CCP1/SEG13	43			
RC2		I/O	ST	Digital I/O.
CCP1		I/O	ST	Capture 1 input/Compare 1 output/PWM1 output.
SEG13		O	Analog	SEG13 output for LCD.
RC3/SCK/SCL	44			
RC3		I/O	ST	Digital I/O.
SCK		I/O	ST	Synchronous serial clock input/output for SPI mode.
SCL		I/O	I^2C	Synchronous serial clock input/output for I^2C™ mode.
RC4/SDI/SDA	45			
RC4		I/O	ST	Digital I/O.
SDI		I	ST	SPI data in.
SDA		I/O	I^2C	I^2C data I/O.
RC5/SDO/SEG12	46			
RC5		I/O	ST	Digital I/O.
SDO		O	—	SPI data out.
SEG12		O	Analog	SEG12 output for LCD.
RC6/TX1/CK1	37			
RC6		I/O	ST	Digital I/O.
TX1		O	—	EUSART1 asynchronous transmit.
CK1		I/O	ST	EUSART1 synchronous clock (see related RX1/DT1).
RC7/RX1/DT1	38			
RC7		I/O	ST	Digital I/O.
RX1		I	ST	EUSART1 asynchronous receive.
DT1		I/O	ST	EUSART1 synchronous data (see related TX1/CK1).

Legend: TTL = TTL compatible input; CMOS = CMOS compatible input or output; ST = Schmitt Trigger input with CMOS levels; Analog = Analog input; I = Input; O = Output; P = Power; I^2C = ST with I^2C™ or SMB levels

Note 1: Default assignment for CCP2 when Configuration bit, CCP2MX, is set.

2: Alternate assignment for CCP2 when Configuration bit, CCP2MX, is cleared.

2.6 A/D Conversions

Figure 2-4 shows the operation of the A/D Converter after the GO/$\overline{\text{DONE}}$ bit has been set and the ACQT<2:0> bits are cleared. A conversion is started after the following instruction to allow entry into Sleep mode before the conversion begins.

Figure 2-5 shows the operation of the A/D Converter after the GO/$\overline{\text{DONE}}$ bit has been set, the ACQT<2:0> bits are set to '010' and a 4 TAD acquisition time has been selected before the conversion starts.

Clearing the GO/$\overline{\text{DONE}}$ bit during a conversion will abort the current conversion. The A/D Result register pair will *not* be updated with the partially completed A/D conversion sample. This means the ADRESH:ADRESL registers will continue to contain the value of the last completed conversion (or the last value written to the ADRESH:ADRESL registers).

After the A/D conversion is completed or aborted, a 2 TAD wait is required before the next acquisition can be started. After this wait, acquisition on the selected channel is automatically started.

Note:	The GO/$\overline{\text{DONE}}$ bit should **NOT** be set in the same instruction that turns on the A/D. Code should wait at least 2 μs after enabling the A/D before beginning an acquisition and conversion cycle.

2.7 Discharge

The discharge phase is used to initialize the value of the holding capacitor. The array is discharged before every sample. This feature helps to optimize the unity gain amplifier, as the circuit always needs to charge the capacitor array, rather than charge/discharge based on previous measure values.

FIGURE 2-4: A/D CONVERSION TAD CYCLES (ACQT<2:0> = 000, TACQ = 0)

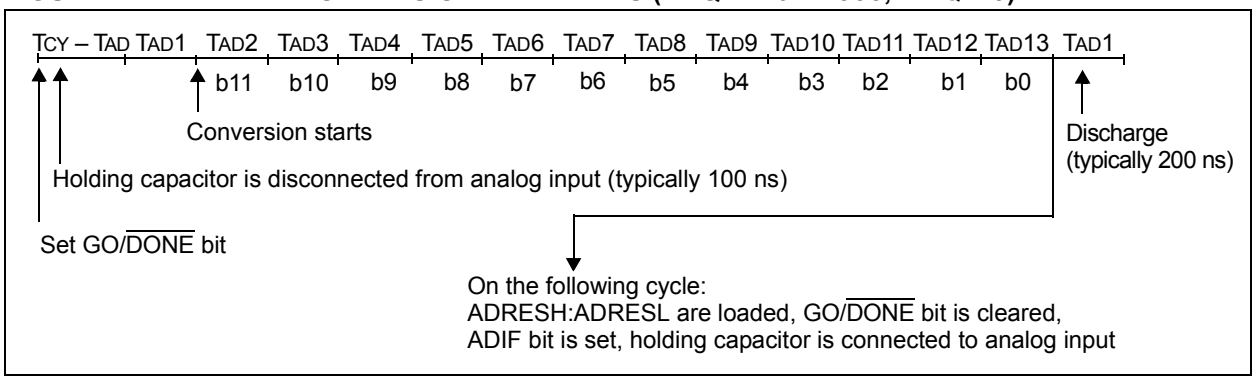
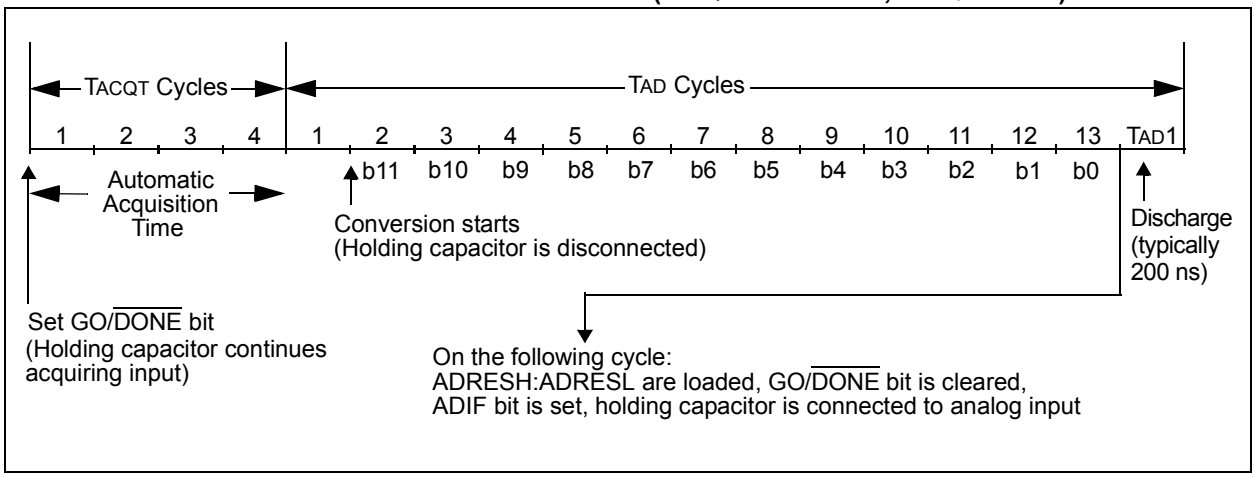


FIGURE 2-5: A/D CONVERSION TAD CYCLES (ACQT<2:0> = 010, TACQ = 4 TAD)



4.0 ELECTRICAL CHARACTERISTICS

Note: Other than some basic data, this section documents only the PIC18F6393/6493/8393/8493 devices' specifications that differ from those of the PIC18F6390/6490/8390/8490 devices. For detailed information on the electrical specifications shared by the PIC18F6393/6493/8393/8493 and PIC18F6390/6490/8390/8490 devices, see the "PIC18F6390/6490/8390/8490 *Data Sheet"* (DS39629).

Absolute Maximum Ratings(†)

Ambient temperature under bias ..... -40°C to +125°C

Storage temperature ..... -65°C to +150°C

Voltage on any pin with respect to V_{SS} (except V_{DD} and $\overline{MCLR}$) ..... -0.3V to (V_{DD} + 0.3V)

Voltage on V_{DD} with respect to V_{SS} ..... -0.3V to +7.5V

Voltage on $\overline{MCLR}$ with respect to V_{SS} **(Note 2)** ..... 0V to +13.25V

Total power dissipation **(Note 1)** 1.0W

Maximum current out of V_{SS} pin ..... 300 mA

Maximum current into V_{DD} pin ..... 250 mA

Input clamp current, I_{IK} (V_I < 0 or V_I > V_{DD}) ..... ±20 mA

Output clamp current, I_{OK} (V_O < 0 or V_O > V_{DD}) ..... ±20 mA

Maximum output current sunk by any I/O pin ..... 25 mA

Maximum output current sourced by any I/O pin ..... 25 mA

Maximum current sunk by all ports ..... 200 mA

Maximum current sourced by all ports ..... 200 mA

Note 1: Power dissipation is calculated as follows:
$P_{DIS} = V_{DD} \times \{I_{DD} - \sum I_{OH}\} + \sum \{(V_{DD} - V_{OH}) \times I_{OH}\} + \sum (V_{OL} \times I_{OL})$

2: Voltage spikes below V_{SS} at the $\overline{MCLR}$/V_{PP}/RG5 pin, inducing currents greater than 80 mA, may cause latch-up. Thus, a series resistor of 50-100Ω should be used when applying a "low" level to the $\overline{MCLR}$/V_{PP}/RG5 pin, rather than pulling this pin directly to V_{SS}.

† **NOTICE:** Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

FIGURE 4-1: PIC18F6393/6493/8393/8493 VOLTAGE-FREQUENCY GRAPH (INDUSTRIAL)

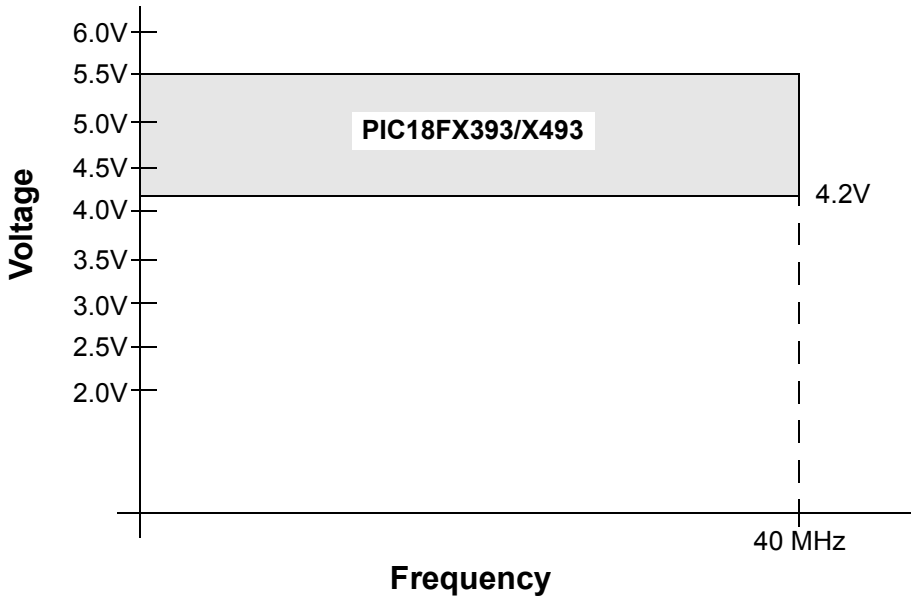
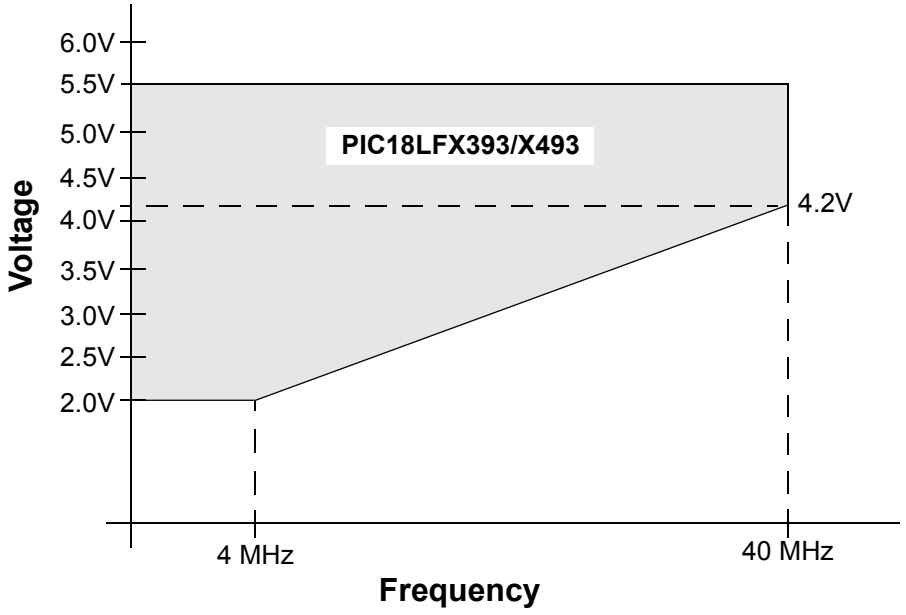


FIGURE 4-2: PIC18LF6393/6493/8393/8493 VOLTAGE-FREQUENCY GRAPH (INDUSTRIAL)



F_{MAX} = (16.36 MHz/V) ($V_{DDAPPMIN}$ – 2.0V) + 4 MHz

Note: $V_{DDAPPMIN}$ is the minimum voltage of the PIC® device in the application.

TABLE 4-1: A/D CONVERTER CHARACTERISTICS: PIC18F6393/6493/8393/8493 (INDUSTRIAL)

Param No.	Sym	Characteristic	Min	Typ	Max	Units	Conditions	
A01	NR	Resolution	—	—	12	bit		ΔVREF ≥ 3.0V
A03	EIL	Integral Linearity Error	—	<±1	±2.0	LSB	VDD = 3.0V	ΔVREF ≥ 3.0V
			—	—	±2.0	LSB	VDD = 5.0V	
A04	EDL	Differential Linearity Error	—	<±1	+1.5/-1.0	LSB	VDD = 3.0V	ΔVREF ≥ 3.0V
			—	—	+1.5/-1.0	LSB	VDD = 5.0V	
A06	EOFF	Offset Error	—	<±1	±5	LSB	VDD = 3.0V	ΔVREF ≥ 3.0V
			—	—	±3	LSB	VDD = 5.0V	
A07	EGN	Gain Error	—	<±1	±2.00	LSB	VDD = 3.0V	ΔVREF ≥ 3.0V
			—	—	±2.00	LSB	VDD = 5.0V	
A10	—	Monotonicity	Guaranteed(1)			—		VSS ≤ VAIN ≤ VREF
A20	ΔVREF	Reference Voltage Range (VREFH – VREFL)	3	—	VDD – VSS	V		For 12-bit resolution
A21	VREFH	Reference Voltage High	VSS + ΔVREF	—	VDD	V		For 12-bit resolution
A22	VREFL	Reference Voltage Low	VSS	—	VDD – ΔVREF	V		For 12-bit resolution
A25	VAIN	Analog Input Voltage	VREFL	—	VREFH	V		
A30	ZAIN	Recommended Impedance of Analog Voltage Source	—	—	2.5	kΩ		
A50	IREF	VREF Input Current(2)	— —	— —	5 150	μA μA		During VAIN acquisition. During A/D conversion cycle.

Note 1: The A/D conversion result never decreases with an increase in the input voltage and has no missing codes.

2: VREFH current is from the RA3/AN3/VREF+/SEG17 pin or VDD, whichever is selected as the VREFH source. VREFL current is from the RA2/AN2/VREF-/SEG16 pin or VSS, whichever is selected as the VREFL source.

APPENDIX A: REVISION HISTORY

Revision A (September 2007)

Original data sheet for the PIC18F6393/6493/8393/8493 devices.

Revision B (October 2009)

Removed “Preliminary” marking.

Revision C (August 2010)

Changes and additions were made to the **“Power-Managed Modes”**, **“Flexible Oscillator Structure”, “Peripheral Highlights”** and **“Special Microcontroller Features”** sections. Changes were made to Figure 1-1, Figure 1-2, Table 1-2 and Table 1-3, including edits to the legends of those tables. New text has replaced all in **2.4 “Operation in Power-Managed Modes”**. Corrections have been made to **4.0 “Electrical Characteristics”**. The extended temperature has been removed from the **“Product Identification System”** information. New packaging diagrams were added because the diagrams referenced in the document, *“*PIC18F6390/6490/8390/8490 *Data Sheet”* (DS39629), have not been updated. Minor typographical edits throughout the document.

APPENDIX B: DEVICE DIFFERENCES

The differences between the devices listed in this data sheet are shown in Table B-1.

TABLE B-1: DEVICE DIFFERENCES

Features	PIC18F6393	PIC18F6493	PIC18F8393	PIC18F8493
Number of Pixels the LCD Driver Can Drive	128 (4 x 32)	128 (4 x 32)	192 (4 x 48)	192 (4 x 48)
I/O Ports	Ports A, B, C, D, E, F, G	Ports A, B, C, D, E, F, G	Ports A, B, C, D, E, F, G, H, J	Ports A, B, C, D, E, F, G, H, J
Flash Program Memory	8 Kbytes	16 Kbytes	8 Kbytes	16 Kbytes
Packages	64-Pin TQFP	64-Pin TQFP	80-Pin TQFP	80-Pin TQFP

NOTES:

THE MICROCHIP WEB SITE

Microchip provides online support via our WWW site at www.microchip.com. This web site is used as a means to make files and information easily available to customers. Accessible by using your favorite Internet browser, the web site contains the following information:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQ), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER CHANGE NOTIFICATION SERVICE

Microchip's customer notification service helps keep customers current on Microchip products. Subscribers will receive e-mail notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, access the Microchip web site at www.microchip.com, click on Customer Change Notification and follow the registration instructions.

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support
- Development Systems Information Line

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the web site at: http://support.microchip.com

WORLDWIDE SALES AND SERVICE

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
http://support.microchip.com
Web Address:
www.microchip.com

Atlanta
Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Boston
Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago
Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Cleveland
Independence, OH
Tel: 216-447-0464
Fax: 216-447-0643

Dallas
Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit
Farmington Hills, MI
Tel: 248-538-2250
Fax: 248-538-2260

Kokomo
Kokomo, IN
Tel: 765-864-8360
Fax: 765-864-8387

Los Angeles
Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608

Santa Clara
Santa Clara, CA
Tel: 408-961-6444
Fax: 408-961-6445

Toronto
Mississauga, Ontario,
Canada
Tel: 905-673-0699
Fax: 905-673-6509

ASIA/PACIFIC

Asia Pacific Office
Suites 3707-14, 37th Floor
Tower 6, The Gateway
Harbour City, Kowloon
Hong Kong
Tel: 852-2401-1200
Fax: 852-2401-3431

Australia - Sydney
Tel: 61-2-9868-6733
Fax: 61-2-9868-6755

China - Beijing
Tel: 86-10-8528-2100
Fax: 86-10-8528-2104

China - Chengdu
Tel: 86-28-8665-5511
Fax: 86-28-8665-7889

China - Chongqing
Tel: 86-23-8980-9588
Fax: 86-23-8980-9500

China - Hong Kong SAR
Tel: 852-2401-1200
Fax: 852-2401-3431

China - Nanjing
Tel: 86-25-8473-2460
Fax: 86-25-8473-2470

China - Qingdao
Tel: 86-532-8502-7355
Fax: 86-532-8502-7205

China - Shanghai
Tel: 86-21-5407-5533
Fax: 86-21-5407-5066

China - Shenyang
Tel: 86-24-2334-2829
Fax: 86-24-2334-2393

China - Shenzhen
Tel: 86-755-8203-2660
Fax: 86-755-8203-1760

China - Wuhan
Tel: 86-27-5980-5300
Fax: 86-27-5980-5118

China - Xian
Tel: 86-29-8833-7252
Fax: 86-29-8833-7256

China - Xiamen
Tel: 86-592-2388138
Fax: 86-592-2388130

China - Zhuhai
Tel: 86-756-3210040
Fax: 86-756-3210049

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444
Fax: 91-80-3090-4123

India - New Delhi
Tel: 91-11-4160-8631
Fax: 91-11-4160-8632

India - Pune
Tel: 91-20-2566-1512
Fax: 91-20-2566-1513

Japan - Yokohama
Tel: 81-45-471- 6166
Fax: 81-45-471-6122

Korea - Daegu
Tel: 82-53-744-4301
Fax: 82-53-744-4302

Korea - Seoul
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

Malaysia - Kuala Lumpur
Tel: 60-3-6201-9857
Fax: 60-3-6201-9859

Malaysia - Penang
Tel: 60-4-227-8870
Fax: 60-4-227-4068

Philippines - Manila
Tel: 63-2-634-9065
Fax: 63-2-634-9069

Singapore
Tel: 65-6334-8870
Fax: 65-6334-8850

Taiwan - Hsin Chu
Tel: 886-3-6578-300
Fax: 886-3-6578-370

Taiwan - Kaohsiung
Tel: 886-7-213-7830
Fax: 886-7-330-9305

Taiwan - Taipei
Tel: 886-2-2500-6610
Fax: 886-2-2508-0102

Thailand - Bangkok
Tel: 66-2-694-1351
Fax: 66-2-694-1350

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4450-2828
Fax: 45-4485-2829

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

UK - Wokingham
Tel: 44-118-921-5869
Fax: 44-118-921-5820

07/15/10