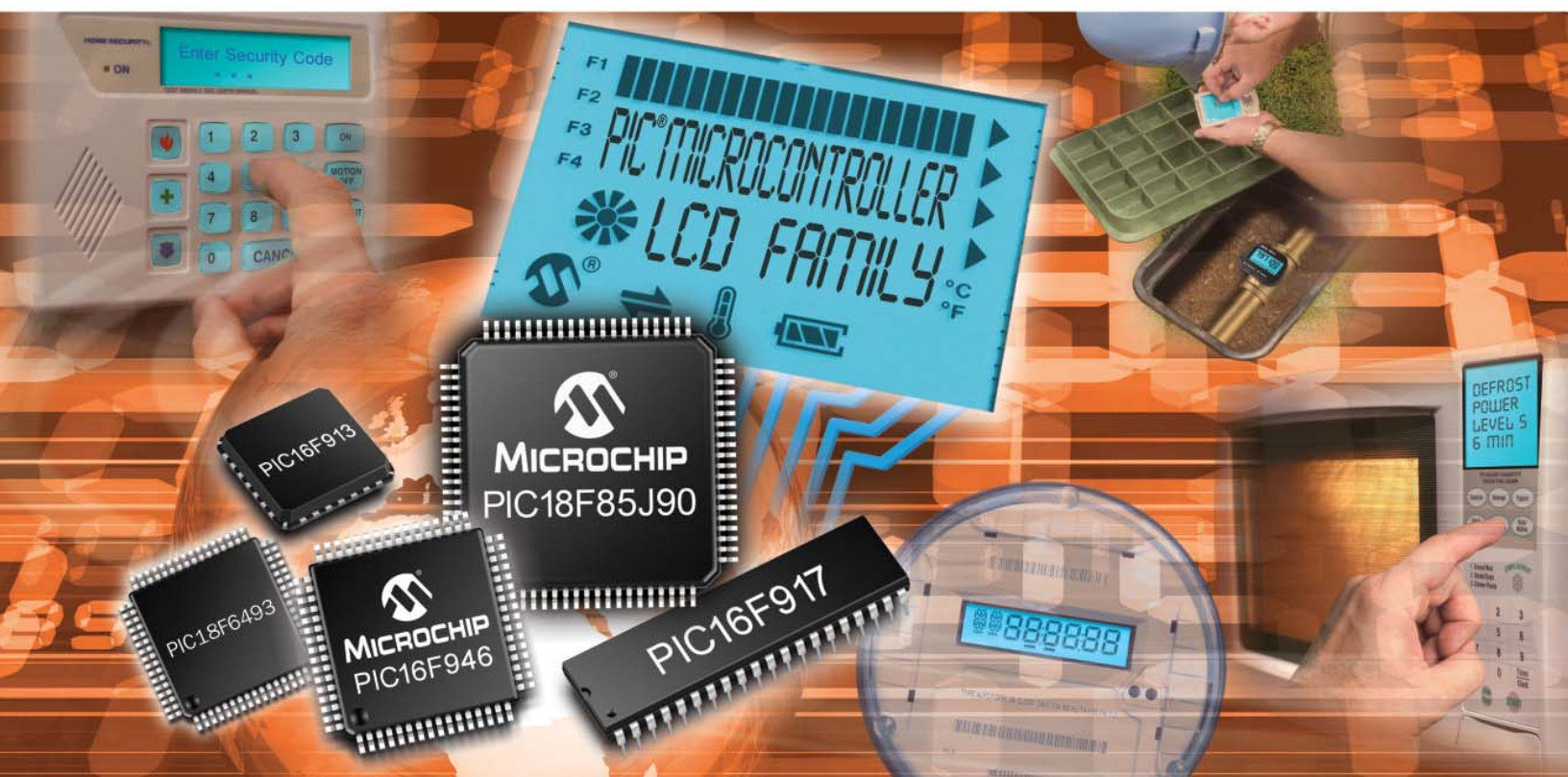




PIC® Microcontrollers with Integrated LCD Driver Module



The demand for a human interface in consumer and industrial products has fueled the market for liquid crystal display applications. Microchip Technology has met this need with a new series of PIC® microcontrollers with on-chip LCD driver control consisting of the PIC16F913/914/916/917/946, the PIC18F6393/6493/8393/8493 and the PIC16F65J90/85J90. These new additions to Microchip's existing LCD microcontroller family complements an already extensive product portfolio by providing the greatest breadth of LCD segment drivers, package sizes and integrated features for embedded control applications.

The Microchip Advantage

The Flash-based, power-managed, LCD PIC microcontroller family meets low power design requirements including driving the LCD display in Sleep mode while maintaining desired functional features. With the ability to select from an array of available LCD PIC microcontrollers, a designer can provide additional value by creating scalable designs and products. This gives the designer flexibility to offer different solutions based on the demand of varying market segments all from a single design.

Supported LCD Types

Design engineers with applications that need a human interface, whether they require a segmented or touch screen display, can benefit from designing with Microchip's LCD PIC microcontrollers.

Segment/Icons

Segmented displays are often 7-segment or 16-segment types used to create numbers and letters in addition to custom characters and icons.



Segmented Displays

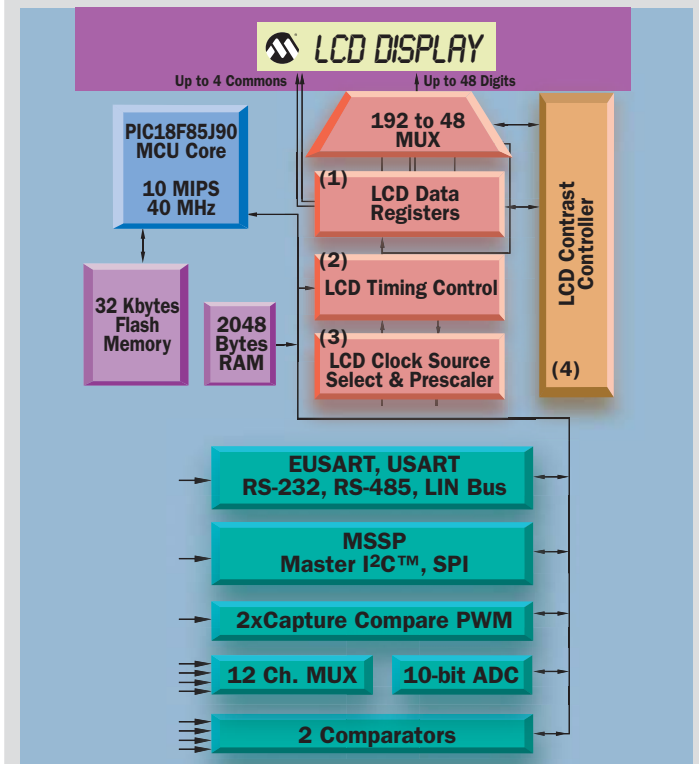
Touch Screen

The on-chip 10 or 12-bit Analog-to-Digital converter provides an interface for resistive touch screen displays. Touch screen displays eliminate specialized keyboards and the need for a mouse, bringing simplicity to the user and an opportunity for the designer to further differentiate the end product from the competition.



Touch Screen Display

Integrated LCD Module



LCD Driver Module Block Diagram

LCD Driver Module

The block diagram above of the LCD driver module is comprised of three main blocks including the Clock Source, the Timing Control and the LCDDATA Registers.

- 1) LCDDATA Registers:** The first block of the LCD module, the LCDDATA Registers, contains the bits which correspond to the individual pixels that will be displayed. A total of 24 LCD data registers allows up to 192 pixels to be controlled individually. Each common is connected to one of the LCD backplane electrodes and each segment will be driven based on whether the corresponding pixel and active common is on or off.
- 2) Timing Control:** The second block of the LCD driver module is the Timing Control. The Timing Control block generates the appropriate waveforms based on the LCD control register (LCDCON), the LCD phase register (LCDPS) and the six LCD segment enable registers (LCDSE0-LCDSE5). Microchip's enhanced LCD module can generate two waveform types for static, 1/2, 1/3 and 1/4 multiplex modes.
- 3) Clock Source:** The third block of the LCD driver module is the Clock Source. In order to generate the waveforms for driving the LCD display, a clock source is necessary. Microchip's LCD PIC microcontrollers provide a very flexible clock system which offers three options for selecting the clock source.
- 4) LCD Contrast Controller:** The fourth block exists only on the PIC18F85J90 and is called the Contrast Controller. This block can boost the voltage to the glass above the power supply, or lower it, via software control.

Benefits and Results of Integrated LCD Modules		
Features	Benefits	Results
Directly drives LCD display	Eliminates separate display driver chip	Reduces system components/cost
Drive glass while microcontroller is in Sleep mode	Reduces power consumption	<ul style="list-style-type: none"> • Constant display • Longer battery life • Efficient resource use
Optional clock sources (3)	Design efficiency and flexibility, control power, adapt to changes	<ul style="list-style-type: none"> • Fail-safe operation • Longer battery life
Configurable segment driver pins	Maintain desired microcontroller features while driving display	Design flexibility and reliability
Generates appropriate voltage wave forms for driving the LCD panel	Multiple options for glass selection	<ul style="list-style-type: none"> • Flexible Design • Lower Cost
Multiplex commons (backplane)	Maximize the number of pixels that can be driven per available segment driver I/O	Drive more sophisticated displays, end application differentiation

Benefits of Integrated LCD Control Module

The benefits of integrating the LCD control module within a Flash-based PIC microcontroller are numerous and can be quickly appreciated by any design engineer. With the LCD module on board the PIC microcontroller, overall design is simplified for an immediate reduction in component count and board space, thus reducing total system cost.

Mid-Range LCD Solution

The PIC16F913/914/916/917/946 LCD microcontrollers represent Microchip's mid-range LCD control solution providing a strong balance between price and LCD pixel count. The PIC16F913/914/916/917/946 LCD microcontrollers are available in either 28, 40 or 64-pin package options and include:

- 60-168 LCD segments
- 7/14 KB Flash program memory
- 256B Data EEPROM
- Low-power nanoWatt Technology
- 35 easy-to-learn instructions
- 32 kHz to 8 MHz internal oscillator for flexible clock system, fail-safe clock
- Integrated analog peripherals such as A/D converters and comparators
- Serial communications via I²C™/SPI/AUSART

The PIC16F913/914/916/917/946 LCD microcontrollers are the first of their kind – no competitor currently offers a low pin-count Flash LCD solution equivalent to these microcontrollers.

High-Performance LCD Solution

Some of today's LCD applications are more complex and require greater performance than available with the mid-range LCD microcontrollers. Microchip's high-performance PIC18F6393/6493/8393/8493/65J90/85J90 LCD microcontrollers can fill this need with greater memory

density and higher pin counts. The PIC18F6393/6493/8393/8493/65J90/85J90 LCD microcontrollers provide greater pixel count, higher performance (10 MIPS), and a generous feature set. Available in 64 and 80-pin package options, the standard feature set includes:

- 128-192 LCD segments
- 8/16/32 KB Flash program memory
- Low-power nanoWatt Technology
- Advanced instruction set optimized for C code efficiency and performance
- 32 kHz to 8 MHz internal oscillator for flexible clock system, fail-safe clock
- Integrated analog peripherals such as 10 or 12-bit A/D converters and comparators
- Serial communications I²C/SPI/AUSART/EUSART interface

For LCD applications requiring high segment count and high performance, the PIC18F6393/6493/8393/8493/65J90/85J90 LCD microcontrollers offer the best in class.

Flexible Power-managed nanoWatt Technology

The new LCD PIC microcontrollers feature nanoWatt Technology, the industry's lowest power, widest operating voltage range and the most flexible power-managed technology available today. With up to seven new power managed modes, designers have the flexibility of switching between various modes and incorporating power saving methodologies in their application's design. On-chip peripherals include selectable oscillator options with crystal modes, external clock modes, external RC oscillator modes, and an internal oscillator block that provides multiple clock frequencies under software control. Given the many oscillator options, users can gain tighter control of their system power consumption, adapt to changes on the fly, and reduce external components, resulting in dynamic speed control and reduced system cost.

Multiplex Commons	Maximum Number of Segments					Bias
	PIC16F913/916	PIC16F914/917	PIC16F946	PIC18F6X93 (PIC18F6XJ90)	PIC18F8X93 PIC18F8XJ90	
Static (COM0)	15	24	42	32 (33)	48	Static
1/2 (COM1:COM0)	30	48	84	64 (66)	96	1/2 or 1/3
1/3 (COM2:COM0)	45	72	126	96 (99)	144	1/2 or 1/3
1/4 (COM3:COM0)	60	96	168	128 (132)	192	1/3

Recommended Glass Suppliers



Varitronix International Limited
www.varitronix.com

From the outset Varitronix has been a research-driven company, working with customers to develop advanced LCD products for a broad range of markets, including sophisticated commercial, industrial, medical and military display products. These products range from simple LCD displays to complete turnkey assemblies for many of the world's leading OEM manufacturers. The emphasis on providing products of the highest quality was instrumental in Varitronix gaining ISO 9001 certification in March 1995.

Application Notes and Design Resources

Please visit the LCD Design Center on Microchip's web site for an up-to-date listing of application notes, data sheets and design resources.

www.microchip.com/lcd



Typical Product Applications for LCD PIC Microcontrollers

Appliances	Medical	Automotive	Industrial	Consumer
Refrigerator	Temperature Reader	Dashboard	Utility Meters	Thermostat
Stove/Oven	Fertility Computer	Tire Pressure Sensor	Portable Instruments	Battery Management
Microwave	Drug Injector	Battery Vehicle Display	Data Acquisition	Sprinkler Controller
Coffee Maker	Nurse Call System	Audio System	Gasoline Pumps	Security System
Bread Maker	Medical Pump		Air Conditioner	Exercise Equipment
Washing Machine	Glucose Meter		Payment Systems	Baby Alarm
Clothes Dryer			Gas Detection	Lawnmower
			Solar Power Measurement	Clock Radio

Product Specifications for Selected PIC® Microcontrollers with Integrated LCD Module

Product	Flash Program Memory	Data EEPROM	Data RAM	I/O	ADC ch x bits	Comparators	Serial Communications	CCP	LCD Segments	LCD Contrast Regulator	Timers	Packages
PIC18F85J90	32 KB	*	2048B	67	12x10	2	MI ² C™/SPI, EUSART, AUSART	2	4x48 (192)	Yes	3 16-bit, 1 8-bit, 1 WDT	80TQFP
PIC18F84J90	16 KB	*	1024B	67	12x10	2	MI ² C/SPI, EUSART, AUSART	2	4x48 (192)	Yes	3 16-bit, 1 8-bit, 1 WDT	80TQFP
PIC18F83J90	8 KB	*	1024B	67	12x10	2	MI ² C/SPI, EUSART, AUSART	2	4x48 (192)	Yes	3 16-bit, 1 8-bit, 1 WDT	80TQFP
PIC18F65J90	32 KB	*	2048B	51	12x10	2	MI ² C/SPI, EUSART, AUSART	2	4x33 (132)	Yes	3 16-bit, 1 8-bit, 1 WDT	64TQFP
PIC18F64J90	16 KB	*	1024B	51	12x10	2	MI ² C/SPI, EUSART, AUSART	2	4x33 (132)	Yes	3 16-bit, 1 8-bit, 1 WDT	64TQFP
PIC18F63J90	8 KB	*	1024B	51	12x10	2	MI ² C/SPI, EUSART, AUSART	2	4x33 (132)	Yes	3 16-bit, 1 8-bit, 1 WDT	64TQFP
PIC18F8493**	16 KB	—	768B	66	12x12	2	I ² C/SPI, EUSART, AUSART	2	4x48 (192)	No	3 16-bit, 1 8-bit, 1 WDT	80TQFP
PIC18F8393**	8 KB	—	768B	66	12x12	2	I ² C/SPI, EUSART, AUSART	2	4x48 (192)	No	3 16-bit, 1 8-bit, 1 WDT	80TQFP
PIC18F6493**	16 KB	—	768B	50	12x12	2	I ² C/SPI, EUSART, AUSART	2	4x32 (128)	No	3 16-bit, 1 8-bit, 1 WDT	64TQFP
PIC18F6393**	8 KB	—	768B	50	12x12	2	I ² C/SPI, EUSART, AUSART	2	4x32 (128)	No	3 16-bit, 1 8-bit, 1 WDT	64TQFP
PIC16F946	14 KB	256B	336B	53	8x10	2	AUSART, I ² C/SPI	2	4x42 (168)	No	3 16-bit, 1 8-bit, 1 WDT	64TQFP
PIC16F917	14 KB	256B	352B	36	8x10	2	AUSART, I ² C/SPI	2	4x24 (96)	No	3 16-bit, 1 8-bit, 1 WDT	40P, 44TQFP, 44QFN
PIC16F916	14 KB	256B	352B	25	5x10	2	AUSART, I ² C/SPI	1	4x15 (60)	No	3 16-bit, 1 8-bit, 1 WDT	28P, 28SO, 28SS, 28QFN
PIC16F914	7 KB	256B	256B	36	8x10	2	AUSART, I ² C/SPI	2	4x24 (96)	No	3 16-bit, 1 8-bit, 1 WDT	40P, 44TQFP, 44QFN
PIC16F913	7 KB	256B	256B	25	5x10	2	AUSART, I ² C/SPI	1	4x15 (60)	No	3 16-bit, 1 8-bit, 1 WDT	28P, 28SO, 28SS, 28QFN

Abbreviations: ADC - Analog-to-Digital Converter

CCP - Capture Compare Pulse Width Modulation (PWM)

EEPROM - Electrically Erasable Programmable Read Only Memory

*Offers Self-Write Flash

**10-bit ADC Also Available

I/O - Input/Output

LCD - Liquid Crystal Display

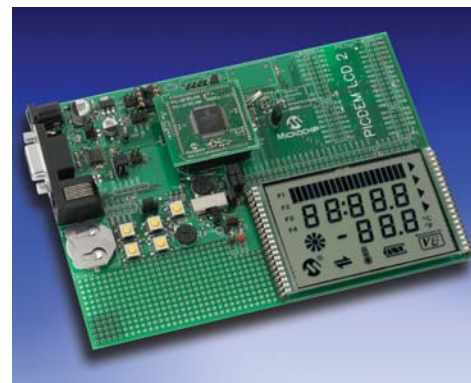
RAM - Random Access Memory

WDT - Watchdog Timer

Design Cycles and Time-to-Market can be Shortened with Easy-To-Use Development Tools Supporting LCD PIC Microcontrollers

World-class, easy-to-use development tools allow engineers to design quickly and efficiently with LCD PIC microcontrollers. Because the silicon and tools have been produced by the same source, technical problems resulting from tool and silicon incompatibility are eliminated, and the technical support offered is maximized. Microchip's development tools operate under the free MPLAB® Integrated Development Environment. Complete documentation, emulation and debug support provides the designer with an extensive development environment that simplifies development and reduces time to market. All of this adds up to a simpler design resulting in significant cost savings. Visit the Microchip web site for information on LCD-specific emulation and development products:

www.microchip.com/lcd



PICDEM™ LCD 2 Demonstration Board

Development Tools from Microchip	
Product	Description
MPLAB® IDE	Integrated Development Environment (Hardware/Software Project Manager)
MPASM™ Assembler	Universal PIC® Microcontroller Macro-Assembler Software
MPLINK™ Object Linker	Linker/Librarian Software
MPLAB C18	C Compiler
C Compilers	Third Party Sources (Hi-Tech, IAR, CCS)
MPLAB ICD 2	Low-cost In-Circuit Debugger
MPLAB ICE 2000/4000	Full featured, In-Circuit Emulator
PICDEM™ LCD 2	40, 60, 80-pin LCD 2 Demonstration Board

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If additional training interests you, then Microchip can help. We continue to expand our technical training options, offering a growing list of courses and in-depth curriculum locally, as well as significant online resources – whenever you want to use them.

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- eLearning: www.microchip.com/webseminars
- Resources from our Distribution and Third Party Partners www.microchip.com/training

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DS39666F




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