

Bohdan Borowik

Intelligent Systems, Control and  
Automation: Science and Engineering

# Interfacing PIC Microcontrollers to Peripheral Devices



Springer

# Interfacing Pic Microcontrollers To Peripheral Devices Intelligent Systems Control And Automation Science And Engineering

**Jonathan W. Valvano**



## **Interfacing Pic Microcontrollers To Peripheral Devices Intelligent Systems Control And Automation Science And Engineering:**

**Interfacing PIC Microcontrollers to Peripheral Devices** Bohdan Borowik, 2011-02-09 This book is targeted for students of electronics and computer sciences The first part of the book contains 15 original applications working on the PIC microcontroller including lighting diodes communication with RS232 bit banging interfacing to 7 segment and LCD displays interfacing to matrix keypad 3 x 4 working with PWM module and others This material can be used to cover one semester s teaching of microcontroller programming or similar classes The volume contains schematic diagrams and source codes with detailed descriptions All tests were prepared on the basis of the original documentation data sheets application notes The next three chapters The Stack Tables and Table Instruction and Data Memory pertain to PIC18F1320 Software referred to is also presented in assembly language Finally the application of the PIC24FJ microcontroller with the 240x128 LCD display T6963C and with accelerometer sensor written in C are described

**Interfacing PIC Microcontrollers** Martin P. Bates, 2013-09-18 Interfacing PIC Microcontrollers 2nd Edition is a great introductory text for those starting out in this field and as a source reference for more experienced engineers Martin Bates has drawn upon 20 years of experience of teaching microprocessor systems to produce a book containing an excellent balance of theory and practice with numerous working examples throughout It provides comprehensive coverage of basic microcontroller system interfacing using the latest interactive software Proteus VSM which allows real time simulation of microcontroller based designs and supports the development of new applications from initial concept to final testing and deployment Comprehensive introduction to interfacing 8 bit PIC microcontrollers Designs updated for current software versions MPLAB v8 Proteus VSM v8 Additional applications in wireless communications intelligent sensors and more

*PIC Microcontroller* Department of Electrical Engineering and Electronic Engineering Technology Han-Way Huang, Han-Way Huang, Leo Chartrand, 2004-07 This book presents a thorough introduction to the Microchip PIC microcontroller family including all of the PIC programming and interfacing for all the peripheral functions A step by step approach to PIC assembly language programming is presented with tutorials that demonstrate how to use such inherent development tools such as the Integrated Development Environment MPLAB PIC18 C compiler the ICD2 in circuit debugger and several demo boards Comprehensive coverage spans the topics of interrupts timer functions parallel I O ports various serial communications such as USART SPI I2C CAN A D converters and external memory expansion

**The Essential PIC18® Microcontroller** Sid Katzen, 2010-06-18 Microprocessors are the key component of the infrastructure of our 21st century electronic and digital information based society More than four billion are sold each year for use in intelligent electronic devices ranging from smart egg timer through to aircraft management systems Most of these processor devices appear in the form of highly integrated microcontrollers which comprize a core microprocessor together with memory and analog digital peripheral ports By using simple cores these single

chip computers are the cost and size effective means of adding the brains to previous dumb widgets such as the credit card Using the same winning format as the successful Springer guide The Quintessential PIC Microcontroller this down to earth new textbook guide has been completely rewritten based on the more powerful PIC18 enhanced range Microchip MCU family Throughout the book commercial hardware and software products are used to illustrate the material as readers are provided real world in depth guidance on the design construction and programming of small embedded microcontroller based systems Suitable for stand alone usage the text does not require a prerequisite deep understanding of digital systems Topics and features uses an in depth bottom up approach to the topic of microcontroller design using the Microchip enhanced range PIC18 microcontroller family as the exemplar includes fully worked examples and self assessment questions with additional support material available on an associated website provides a standalone module on foundation topics in digital logic and computer architecture for microcontroller engineering discusses the hardware aspects of interfacing and interrupt handling with an emphasis on the integration of hardware and software covers parallel and serial input output timing analog and EEPROM data handling techniques presents a practical build and program case study as well as illustrating simple testing strategies This useful text reference book will be of great value to industrial engineers hobbyists and people in academia Students of Electronic Engineering and Computer Science at both undergraduate and postgraduate level will also find this an ideal textbook with many helpful learning tools Dr Sid Katzen is Associate to the School of Engineering University of Ulster at Jordanstown Northern Ireland

Designing Embedded Systems with PIC Microcontrollers Tim Wilmshurst, 2006-10-24

Embedded Systems with PIC Microcontrollers Principles and Applications is a hands on introduction to the principles and practice of embedded system design using the PIC microcontroller Packed with helpful examples and illustrations the book provides an in depth treatment of microcontroller design as well as programming in both assembly language and C along with advanced topics such as techniques of connectivity and networking and real time operating systems In this one book students get all they need to know to be highly proficient at embedded systems design This text combines embedded systems principles with applications using the 16F84A 16F873A and the 18F242 PIC microcontrollers Students learn how to apply the principles using a multitude of sample designs and design ideas including a robot in the form of an autonomous guide vehicle Coverage between software and hardware is fully balanced with full presentation given to microcontroller design and software programming using both assembler and C The book is accompanied by a companion website containing copies of all programs and software tools used in the text and a student version of the C compiler This textbook will be ideal for introductory courses and lab based courses on embedded systems microprocessors using the PIC microcontroller as well as more advanced courses which use the 18F series and teach C programming in an embedded environment Engineers in industry and informed hobbyists will also find this book a valuable resource when designing and implementing both simple and sophisticated embedded systems using the PIC microcontroller Gain the knowledge and skills required for developing

today's embedded systems through use of the PIC microcontroller Explore in detail the 16F84A 16F873A and 18F242 microcontrollers as examples of the wider PIC family Learn how to program in Assembler and C Work through sample designs and design ideas including a robot in the form of an autonomous guided vehicle Accompanied by a CD ROM containing copies of all programs and software tools used in the text and a student version of the C compiler *PIC Microcontrollers: Know It All* Lucio Di Jasio, Tim Wilmshurst, Dogan Ibrahim, John Morton, Martin P. Bates, Jack Smith, David W Smith, Chuck Hellebuyck, 2007-07-30 The Newnes Know It All Series takes the best of what our authors have written over the past few years and creates a one stop reference for engineers involved in markets from communications to embedded systems and everywhere in between PIC design and development a natural fit for this reference series as it is one of the most popular microcontrollers in the world and we have several superbly authored books on the subject This material ranges from the basics to more advanced topics There is also a very strong project basis to this learning The average embedded engineer working with this microcontroller will be able to have any question answered by this compilation He/she will also be able to work through real life problems via the projects contained in the book The Newnes Know It All Series presentation of theory hard fact and project based direction will be a continual aid in helping the engineer to innovate in the workplace

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Over 900 pages of practical hands on content in one book Huge market as of November 2006 Microchip Technology Inc a leading provider of microcontroller and analog semiconductors produced its 5 BILLIONth PIC microcontroller Several points of view giving the reader a complete 360 of this microcontroller *Embedded Microcontroller Interfacing* Gourab Sen Gupta, 2010-07-15 Mixed Signal Embedded Microcontrollers are commonly used in integrating analog components needed to control non digital electronic systems They are used in automatically controlled devices and products such as

automobile engine control systems wireless remote controllers office machines home appliances power tools and toys Microcontrollers make it economical to digitally control even more devices and processes by reducing the size and cost compared to a design that uses a separate microprocessor memory and input output devices In many undergraduate and post graduate courses teaching of mixed signal microcontrollers and their use for project work has become compulsory Students face a lot of difficulties when they have to interface a microcontroller with the electronics they deal with This book addresses some issues of interfacing the microcontrollers and describes some project implementations with the Silicon Lab C8051F020 mixed signal microcontroller The intended readers are college and university students specializing in electronics computer systems engineering electrical and electronics engineering researchers involved with electronics based system practitioners technicians and in general anybody interested in microcontrollers based projects      *The Essential Pic18 Microcontroller* Sid Katzen,2010-06-20      *Interfacing PIC Microcontrollers* Martin Bates,2011 The advent of interactive design software has allowed the simulation of microcontrollers without having to build and debug hardware Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation discusses microcontroller design and applications The book is divided into three parts Part 1 introduces the PIC 16F877 architecture software and simulation system Part 2 discusses interfacing techniques Part 3 discusses power outputs serial communication sensor interfacing and the design of MCU based systems Each topic is illustrated by designs based on the 16F877 The Proteus design software by Labcenter Electronics is used throughout The book is suited for more advanced readers with prior knowledge of the basics of microcontroller systems Comprehensive coverage of a topic not widely explored in the wealth of PIC books on the market concentrating on the popular PIC16F877 device Circuit simulation software allows step by step examples supplied as assembly source code to be run interactively aiding student technician and hobbyist learning A companion website will provide downloads of application files used in the book and links to associated manufacturers      [Embedded Systems](#) Jonathan W. Valvano,2015-11-03 This book published November 2015 as a 1st edition 1st printing is the second in a series of three books that teach the fundamentals of embedded systems as applied to MSP432 microcontrollers These books are primarily written for undergraduate electrical and computer engineering students They could also be used for professionals learning the ARM platform The first book Embedded Systems Introduction to the MSP432 is an introduction to computers and interfacing focusing on assembly language and C programming This second book focuses on interfacing and the design of embedded systems The third book Embedded Systems Real Time Operating Systems for ARM Cortex M Microcontrollers is an advanced book focusing on operating systems high speed interfacing control systems and robotics An embedded system is a system that performs a specific task and has a computer embedded inside A system is comprised of components and interfaces connected together for a common purpose This book presents components interfaces and methodologies for building systems Specific topics include the architecture of microcontrollers design methodology verification hardware software synchronization interfacing devices to

the computer timing diagrams real time systems data collection and processing motor control analog filters digital filters real time signal processing wireless communication low power design and the internet of things In general the area of embedded systems is an important and growing discipline within electrical and computer engineering The educational market of embedded systems has been dominated by simple microcontrollers like the PIC the 9S12 and the 8051 This is because of their market share low cost and historical dominance However as problems become more complex so must the systems that solve them A number of embedded system paradigms must shift in order to accommodate this growth in complexity First the number of calculations per second will increase from millions/sec to billions/sec Similarly the number of lines of software code will also increase from thousands to millions Thirdly systems will involve multiple microcontrollers supporting many simultaneous operations Lastly the need for system verification will continue to grow as these systems are deployed into safety critical applications These changes are more than a simple growth in size and bandwidth These systems must employ parallel programming high speed synchronization real time operating systems fault tolerant design priority interrupt handling and networking Consequently it will be important to provide our students with these types of design experiences The purpose of writing these books at this time is to bring engineering education into the 21st century This book employs many approaches to learning It will not include an exhaustive recapitulation of the information in data sheets First it begins with basic fundamentals which allows the reader to solve new problems with new technology Second the book presents many detailed design examples These examples illustrate the process of design There are multiple structural components that assist learning Checkpoints with answers in the back are short easy to answer questions providing immediate feedback while reading The book includes an index and a glossary so that information can be searched The most important learning experiences in a class like this are of course the laboratories Each chapter has suggested lab assignments More detailed lab descriptions are available on the web Specifically look at the lab assignments for EE445L and EE445M These books will cover embedded systems for ARM Cortex M microcontrollers with specific details on the MSP432 Although the solutions are specific for the MSP432 it will be possible to use these books for other ARM derivatives Volume 3 can be used for either the TM4C or MSP432 families

Microchip Avr(r) Microcontroller Primer Steven F. Barrett, Daniel J. Pack, 2019-09-19 This textbook provides practicing scientists and engineers a primer on the Microchip AVR R microcontroller The revised title of this book reflects the 2016 Microchip Technology acquisition of Atmel Corporation In this third edition we highlight the popular ATmega164 microcontroller and other pin for pin controllers in the family with a complement of flash memory up to 128 KB The third edition also provides an update on Atmel Studio programming with a USB pod the gcc compiler the ImageCraft JumpStart C for AVR compiler the Two Wire Interface TWI and multiple examples at both the subsystem and system level Our approach is to provide readers with the fundamental skills to quickly set up and operate with this internationally popular microcontroller We cover the main subsystems aboard the ATmega164 providing a short theory

section followed by a description of the related microcontroller subsystem with accompanying hardware and software to operate the subsystem. In all examples we use the C programming language. We include a detailed chapter describing how to interface the microcontroller to a wide variety of input and output devices and conclude with several system level examples including a special effects light emitting diode cube autonomous robots a multi function weather station and a motor speed control system.

PIC16F1847 Microcontroller-Based Programmable Logic Controller Murat Uzam, 2020-10-22. The volume focusses on intermediate concepts of the PIC16F1847 Based PLC project and covers arithmetical operation ability of PLCs logical function performers and operations like AND NAND OR NOR. Further it explains shift and rotate macros moving bits in a register to right or left and selection macros enabling one value to be selected from several given values according to certain criteria. Demultiplexer circuit is illustrated which is used to send a signal to one of many devices. Finally it explains decoder priority encoder and conversion macros. All the concepts are supported using flowcharts. Aimed at researchers and graduate students in electrical engineering power electronics robotics and automation sensors this book Presents arithmetical and logical macros to carry out arithmetical and logical operations to be used for 8 bit or 16 bit variables and or constant values. Provides shift and rotate macros to do arithmetical or logical shift and rotate operations to be used for 8 bit or 16 bit variables. Proposes selection macros to enable the user to do 8 bit or 16 bit move load selection maximum minimum limiting multiplexing and byte multiplexing operations. Develops demultiplexer macros decoder macros and priority encoder macros to be used as combinational circuits. Presents conversion macros to provide functions to convert given data from one format to another one.

*PIC16F1847 Microcontroller-Based Programmable Logic Controller* Murat Uzam, 2020-10-22. The PIC16F1847 Based PLC project supports up to 4 analog inputs and 1 analog output 1 High Speed Counter 2 PWM pulse width modulation outputs 1 Drum Sequencer Instruction with up to 16 steps the implementation of Sequential Function Charts SFCs with up to 24 steps. This volume presents advanced concepts of the PIC16F1847 Based PLC project and consists of topics like program control high speed counter and PWM macros. It further explains memory related drum sequencer instruction sequential functional charts and analog input and output modules. Aimed at researchers and graduate students in electrical engineering power electronics robotics and automation sensors this book Presents program control macros to enable or disable a block of PLC program or to move execution of a program from one place to another. Proposes a High Speed Counter and four PWM Macros for high speed counting and PWM operations. Develops memory related macros to enable the user to do memory read write operations. Provides a Drum Sequencer instruction with up to 16 steps and 16 outputs on each step. Discusses the implementation of Sequential Function Chart SFC elements with up to 24 steps.

**Interface Fundamentals in Microprocessor-Controlled Systems** Chris Georgopoulos, 2012-01-10. There is no doubt that the microprocessor platform will continue into the future and many will be required to specify and integrate microprocessors into products and systems in their disciplines. There are well designed flexible interfaces will be



required to ensure CDM patibility with Dther equipments and to extend design DptiDns AlthDugh there are several bDDks Dn micrDcDmputers and micrDprDcessDrs Dnly few Df thDse devDte but a small part Dn the impDrtant aspects Df interfaces It was with this in mind that the present bDDk was written as a selfcDn tained vDlume to be part Df the mDre general series Mioroprooessors Based Systems Engineering It fills an existing gap in technDIDgy as in terfaces are the last items to be seriDusly cDnsidered in the race Df new technDIDgy and it deals with the systematic study Df micrDprDcessDr interfaces and their applicatiDns in many diversified fields This bDDk is aimed at engineers in industry and engineering stu dents whO need to learn hDW to interface micrDprDcessDrs and hence mi crDcDmputers and Dther related equipments to external digital Dr analDg devices It is suitable fDr use as a textbDDk Dr fDr supplementary read ing either in an applied undergraduate CDurse in electrical engineering Dr in the last year Df three year curriculum technical cDlleges

**PIC**

**Microcontroller and Embedded Systems** Muhammad Ali Mazidi,Rolin D. McKinlay,Danny Causey,2008 Offers a systematic approach to PIC programming and interfacing using Assembly and C languages Offering numerous examples and a step by step approach it covers both the Assembly and C programming languages and devotes separate chapters to interfacing with peripherals such as Timers LCD Serial Ports Interrupts Motors and more A unique chapter on hardware design of the PIC system and the PIC trainer round out coverage Systematic coverage of the PIC18 family of Microcontrollers Assembly language and C language programming and interfacing techniques Thorough coverage of Architectures and Assembly language programming of the PIC18 Thorough coverage of C language programming of the PIC18 Separate chapters on programming and interfacing the PIC with peripherals Includes information on how to interface the PIC with LCD keyboard ADC DAC Sensors Serial Ports Timers DC and Stepper Motors Optoisolators and RTC Covers how to program each peripheral first using the Assembly language and then using the C language Those involved with PIC programming and interfacing using Assembly and C languages

Programming 16-Bit PIC Microcontrollers in C Lucio Di Jasio,2007-03-16 A

Microchip insider tells all on the newest most powerful PICs ever FREE CD ROM includes source code in C the Microchip C30 compiler and MPLAB SIM software Includes handy checklists to help readers perform the most common programming and debugging tasksThe new 16 bit PIC24 chip provides embedded programmers with more speed more memory and more peripherals than ever before creating the potential for more powerful cutting edge PIC designs This book teaches readers everything they need to know about these chips how to program them how to test them and how to debug them in order to take full advantage of the capabilities of the new PIC24 microcontroller architecture Author Lucio Di Jasio a PIC expert at Microchip offers unique insight into this revolutionary technology guiding the reader step by step from 16 bit architecture basics through even the most sophisticated programming scenarios This book s common sense practical hands on approach begins simply and builds up to more challenging exercises using proven C programming techniques Experienced PIC users and newcomers to the field alike will benefit from the text s many thorough examples which demonstrate how to nimbly side

step common obstacles solve real world design problems efficiently and optimize code for all the new PIC24 features You will learn about basic timing and I O operations multitasking using the PIC24 interrupts all the new hardware peripherals how to control LCD displays generating audio and video signals accessing mass storage media how to share files on a mass storage device with a PC experimenting with the Explorer 16 demo board debugging methods with MPLAB SIM and ICD2 tools and more A Microchip insider tells all on the newest most powerful PICs ever Condenses typical introductory fluff focusing instead on examples and exercises that show how to solve common real world design problems quickly Includes handy checklists to help readers perform the most common programming and debugging tasks FREE CD ROM includes source code in C the Microchip C30 compiler and MPLAB SIM software so that readers gain practical hands on programming experience Check out the author s Web site at <http://www.flyingpic24.com> for FREE downloads FAQs and updates

Making PIC Microcontroller Instruments and Controllers Harprit Singh Sandhu, 2009-02-14 Essential Design Techniques From the Workbench of a Pro Harness the power of the PIC microcontroller unit with practical common sense instruction from an engineering expert Through eight real world projects clear illustrations and detailed schematics Making PIC Microcontroller Instruments and Controllers shows you step by step how to design and build versatile PIC based devices Configure all necessary hardware and software read input voltages work with control pulses interface with peripherals and debug your results You ll also get valuable appendices covering technical terms abbreviations and a list of sample programs available online Build a tachometer that gathers processes and displays data Make accurate metronomes using internal PIC timers Construct an asynchronous pulse counter that tracks marbles Read temperature information through an analog to digital converter Use a gravity sensor and servos to control the position of a table Assemble an eight point touch screen with an input scanning routine Engineer an adjustable programmable single point controller Capture log monitor and store data from a solar collector

PIC Microcontrollers Martin P. Bates, 2004-06-09 The use of microcontroller based solutions to everyday design problems in electronics is the most important development in the field since the introduction of the microprocessor itself The PIC family is established as the number one microcontroller at an introductory level Assuming no prior knowledge of microprocessors Martin Bates provides a comprehensive introduction to microprocessor systems and applications covering all the basic principles of microelectronics Using the latest Windows development software MPLAB the author goes on to introduce microelectronic systems through the most popular PIC devices currently used for project work both in schools and colleges as well as undergraduate university courses Students of introductory level microelectronics including microprocessor microcontroller systems courses introductory embedded systems design and control electronics will find this highly illustrated text covers all their requirements for working with the PIC Part A covers the essential principles concentrating on a systems approach The PIC itself is covered in Part B step by step leading to demonstration programmes using labels subroutines timer and interrupts Part C then shows how applications may be developed using the latest Windows

software and some hardware prototyping methods The new edition is suitable for a range of students and PIC enthusiasts from beginner to first and second year undergraduate level In the UK the book is of specific relevance to AVCE as well as BTEC National and Higher National programmes in electronic engineering A comprehensive introductory text in microelectronic systems written round the leading chip for project work Uses the latest Windows development software MPLAB and the most popular types of PIC for accessible and low cost practical work Focuses on the 16F84 as the starting point for introducing the basic architecture of the PIC but also covers newer chips in the 16F8X range and 8 pin mini PICs

Microcontrollers Robert Bryan Reese, J. W. Bruce, Bryan A. Jones, 2009 Microcontrollers From Assembly Language to C Using the PIC24 Family provides an introduction to microprocessors and microcontrollers for either the student or hobbyist It begins by discussing simple microprocessor architecture concepts moves to assembly language programming in a C language context then covers fundamental hardware interfacing topics such as parallel IO asynchronous serial IO synchronous serial IO I2C and SPI interrupt driven IO timers analog to digital conversion and digital to analog conversion Programming topics are discussed using both assembly language and C while hardware interfacing examples use C to keep code complexity low and improve clarity This book's C examples on hardware interfacing strive for code clarity first and optimization second providing a gentle learning curve and ensuring understanding of the key concepts The book's numerous examples include complete schematics and working code to operate a number of useful peripherals including temperature sensors LCD displays a robot and a reflow oven providing a good starting point for your designs Numerous lab experiments are included in the appendices while the companion CD ROM includes complete source code for all book examples which can be compiled using the freely available Microchip C compiler and development environment Visit [www.reesemicro.com](http://www.reesemicro.com) to obtain supplementary information on the text the latest version of the library and example code with accompanying documentation and links to courses which use this text In addition an online discussion group promotes interaction with the authors and a forum to discuss PIC24 based projects

Embedded Systems Interfacing for Engineers using the Freescale HCS08 Microcontroller II Douglas Summerville, 2022-05-31 The vast majority of computers in use today are encapsulated within other systems In contrast to general purpose computers that run an endless selection of software these embedded computers are often programmed for a very specific low level and often mundane purpose Low end microcontrollers costing as little as one dollar are often employed by engineers in designs that utilize only a small fraction of the processing capability of the device because it is either more cost effective than selecting an application specific part or because programmability offers custom functionality not otherwise available Embedded Systems Interfacing for Engineers using the Freescale HCS08 Microcontroller is a two part book intended to provide an introduction to hardware and software interfacing for engineers Building from a comprehensive introduction of fundamental computing concepts the book is suitable for a first course in computer organization for electrical or computer engineering students with a minimal background in digital logic and

programming In addition this book can be valuable as a reference for engineers new to the Freescale HCS08 family of microcontrollers The HCS08 processor architecture used in the book is relatively simple to learn powerful enough to apply towards a wide range of interfacing tasks and accommodates breadboard prototyping in a laboratory using freely available and low cost tools In Part II Digital and Analog Hardware Interfacing hardware and software interfacing concepts are introduced The emphasis of this work is on good hardware and software engineering design principles Device drivers are developed illustrating the use of general purpose and special purpose digital I O interfaces analog interfaces serial interfaces and real time I O processing The hardware side of each interface is described and electrical specifications and related issues are considered The first part of the book provides the programming skills necessary to implement the software in this part

Table of Contents Introduction to the MC9S08QG4 8 Hardware Analog Input Serial Communication Real Time I O Processing

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### **Interfacing Pic Microcontrollers To Peripheral Devices Intelligent Systems Control And Automation Science And Engineering Introduction**

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