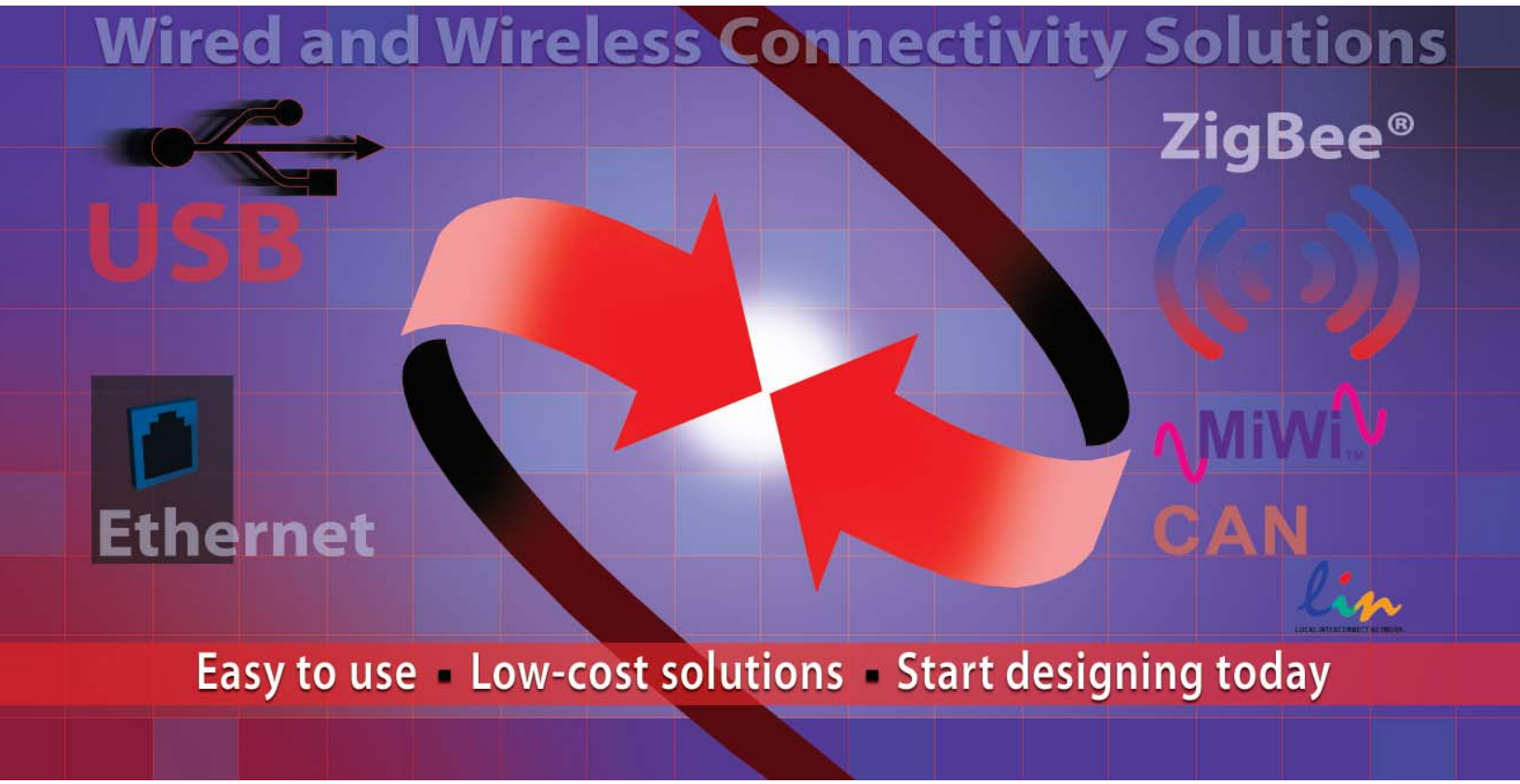
MICROCHIP

Connectivity Solutions for Embedded Design:

USB, Ethernet, ZigBee®, MiWi™, CAN, LIN, IrDA® and RS-485 Protocols



www.microchip.com/connectivity

Offering Scalable and Integrated Solutions for Full-Speed USB and USB On-The-Go

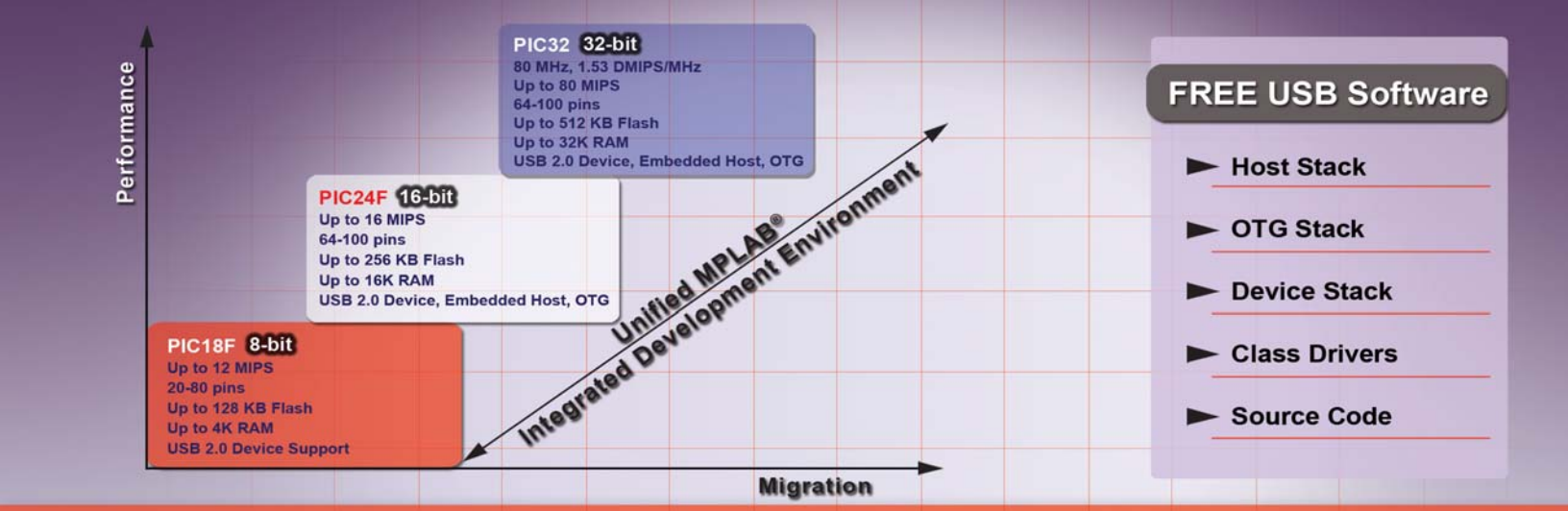
Consumers' desire for more engaging, easy-to-use and upgradable products is driving embedded designers to add USB capabilities to their products.

Microchip provides designers with a scalable choice of integrated USB solutions across 8-, 16- and 32-bit PIC® microcontrollers ranging from the space-saving 20-pin devices to the feature-rich 100-pin USB On-the-Go (OTG) products. This allows simple, compact designs to easily grow to more capable designs as requirements demand.

Memory offerings range from 16 Kbytes to 512 Kbytes of Flash program memory and from 768 bytes to 32 Kbytes of data RAM providing ample code and data space for complex USB applications. Microchip's USB product families include solutions for device, embedded host and dual-role OTG applications.

Microchip provides free source code for USB software stacks and class drivers to shorten development time for USB applications. Microchip's free USB Host Stack, Device Stack and Class Drivers (HID, MSD, CDC, Custom) are available at www.microchip.com/usb.

	PIC18F14K50	PIC18F4450/ 4550/4553	PIC18F87J50	PIC24FJ256GB1	PIC32MX4XX
Core	8-bit	8-bit	8-bit	16-bit	32-bit
USB	USB 2.0 Device	USB 2.0 Device	USB 2.0 Device	USB 2.0 Device, Embedded Host, Dual Role, OTG	USB 2.0 Device, Embedded Host, Dual Role, OTG
Flash	16 Kbytes	Up to 32 Kbytes	128 Kbytes	256 Kbytes	512 Kbytes
RAM	768 bytes	Up to 2048 bytes	3904 bytes	16 Kbytes	32 Kbytes
mTouch™ Support	Yes	Yes, External	Yes, External	Yes, CTMU	Yes, External
UARTs	1	1	2	4	2
SPI	1	1	1	3	2
I²C™	1	1	1	3	2
Peripheral Pin Select	No	No	No	Yes	No
ADC	10-bit, 9 Channel	10-bit, 10 and 13 Channel 12-bit, 10 and 13 Channel	10-bit, 8 and 12 Channel	10-bit, 16 Channel	10-bit, 16 Channel
RTCC	Software	Software	Software	Hardware	Hardware
Parallel Master Port	No	No	Yes	Yes	Yes
Analog Comparators	2	2	2	3	2
Free SW Stacks	Yes	Yes	Yes	Yes	Yes
Free Class Drivers	Yes	Yes	Yes	Yes	Yes
Scalable Development Environment	Yes	Yes	Yes	Yes	Yes
Packages	20 pin	28, 40, 44 pin	64, 80 pin	64, 80, 100 pin	64, 100 pin



Expanding Family of USB PIC® Microcontrollers

The industry's strongest scalable products and software migration path

USB Development Tools and Software Support

Microchip's MPLAB® tools support all of the USB PIC microcontrollers. The PIC18F USB microcontroller solutions have dedicated development boards. The PIC24F and PIC32 series are pin and peripheral compatible and share the Explorer 16 development platform with their own USB Plug-in-Modules (PIMs).

Microchip's support for USB solutions includes peripheral applications for the PIC18F family, and peripheral, embedded host and OTG applications for the PIC24F and PIC32. Designers can use Microchip's free USB stacks – including class drivers, 16- and 32-bit file system drivers and SCSI interface drivers – which are provided in source code form. These can be combined for inclusion into any USB application, such as thumb drives.

Additional software support includes full C and RTOS development environments. Also available are: TCP/IP stacks, graphics libraries and ZigBee software stacks, which allow USB functionality to be combined with other capabilities to support a variety of designs.

USB Starter Kits

Easy-to-use low-cost kits demonstrate the basics of USB designs using 8-, 16- and 32-bit PIC microcontrollers.

Starter Kit Order Numbers

PIC18F14K50	(DV164126)
PIC24FJ256GBI	(DM240011)
PIC32MX4XX	(DM320003)

PICDEM™ FS-USB Demonstration Board
(DM163025)
This evaluation board supports the PIC18F4450 family.

Explorer 16 Development Board
(DM240001)
A low-cost modular development system for Microchip's 16- and 32-bit microcontrollers.

USB Plug-in Modules (PIMs) for Explorer 16 Board
PIC24 (MA240014), PIC32 (MA320002)
These PIMs support Microchip's 16- and 32-bit microcontrollers.

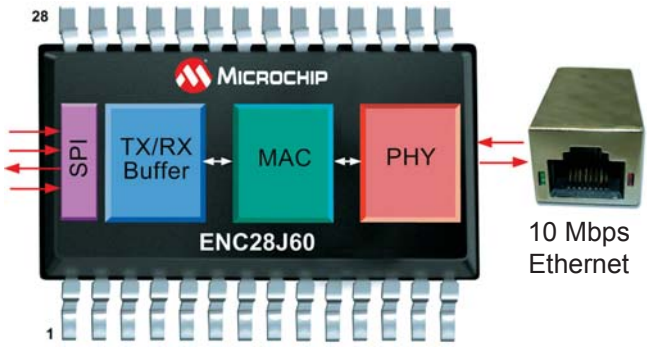
USB PICtail™ Plus Daughter Board
(AC164131)
Enables USB connectivity when using a PIC24 or PIC32 USB PIM in conjunction with the Explorer 16 board.

USB Plug-in Module
(MA180021)
This PIM features the PIC18F87J50 family.

Microchip addresses the growing demand for a small, low-cost embedded Ethernet solution with the ENC28J60 device and the PIC18F97J60 family, which are IEEE 802.3 compliant and fully compatible with 10/100 Base-T networks. Microchip's Ethernet solution also includes a free and robust TCP/IP stack and a broad range of development tools to enhance the user's experience. Microchip's TCP/IP stack is optimized for the PIC18, PIC24 and PIC32 microcontroller and dsPIC® digital signal controller families and supports the following protocols:

- HTTP
- SMTP
- SNMP
- FTP
- TCP
- UDP
- IP
- DHCP
- ICMP
- ARP

Stand-Alone Ethernet Controller



ENC28J60 Embedded Ethernet Controller

- Smallest, low-cost and easy-to-use stand-alone Ethernet Controller with integrated MAC and 10 Base-T PHY
- IEEE 802.3 compliant
- Programmable filtering minimizing host and microcontroller processing requirement
- 10 Mbps SPI interface
- Programmable 8 KB dual-port SRAM buffer provides flexible and reliable data management system
- Available in 28-pin QFN, SOIC, SPDIP and SSOP packages

PIC18F97J60 Ethernet PIC Microcontroller

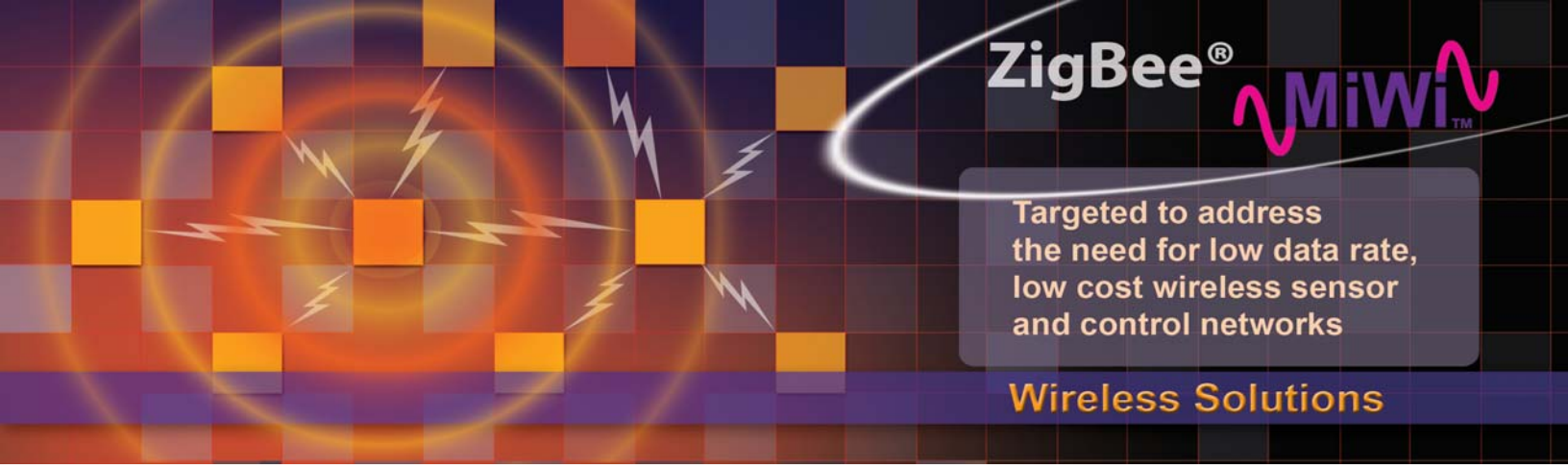
- A cost-effective single chip solution with built-in Ethernet MAC, 10 base-T PHY and PIC18F microcontroller reduces total system cost
- 8 KB dedicated Ethernet Buffer RAM
- Up to 128 KB Flash
- Free TCP/IP stack software
- Advanced analog and communication peripherals

Development Tools Support

- Ethernet PICtail™ Daughter Board (AC164121)
- Ethernet PICtail Plus Daughter Board (AC164123)
- PICDEM.net™ 2 Development Board (DM163024)
- Microchip's TCP/IP software stack (AN833/870)

PICDEM.net™ Development Board
(DM163024)

This Ethernet development board supports both the popular ENC28J60 Ethernet Controller and the single-chip Ethernet microcontroller family, the PIC18F97J60. With this board and Microchip's free TCP/IP stack, a web server can be developed showcasing the capability to remote monitor and control embedded applications over the Internet.



Wireless communication technologies have been commonplace in the home and industry for many years. Recently, appliance and industrial markets and metering and thermostat applications have driven new demand for a standardized, low data rate, wireless technology that works well in remote sensor and control applications. As a result, the IEEE 802.15.4™ standard was developed to address this need.

ZigBee is a wireless protocol based on the IEEE 802.15.4 global standard, ensuring interoperability and reliable communication between various manufacturers' products. ZigBee supports star, cluster and mesh topologies making it well-suited for a wide array of low power wireless networks. Download the free ZigBee stack at: www.microchip.com/zigbee

Easy implementation of a wireless radio node with ZigBee/MiWi™/MiWi Point-to-Point

Start with a MRF24J40 Wireless Transceiver

- Integrates IEEE 802.15.4 MAC and PHY layers
- Includes AES hardware encryption engine
- SPI interface to a PIC microcontroller

Add an 8-, 16- or 32-bit PIC Microcontroller

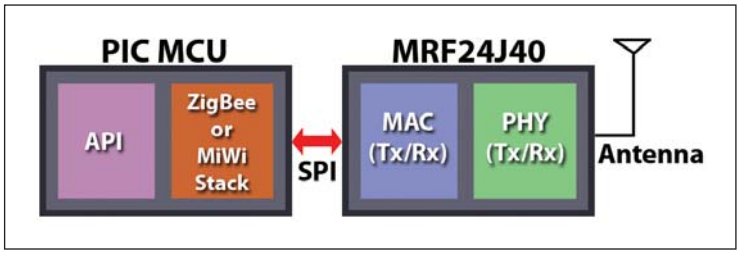
- Minimum 3 Kbytes of program memory for MiWi P2P Stack
- Minimum 7 Kbytes of program memory for MiWi Stack (RFD)
- Minimum 21 Kbytes of program memory for ZigBee Stack (RFD)
- Over 200 microcontrollers to choose from

Use the free ZigBee, MiWi or MiWi P2P software stack

- Free software available via click-thru license
- MiWi and MiWi P2P stacks require no certification fees
- Both stacks are configurable and optimized for reduced code footprint

Develop with the ZENA™ Wireless Network Analyzer

- Provides graphical interface to optimize ZigBee, MiWi and MiWi P2P applications



MiWi and **MiWi Point-to-Point (P2P)** protocols are designed for use with the IEEE 802.15.4 compliant MRF24J40. These proprietary protocols provide lower cost, reduced functionality alternatives to ZigBee for customers who desire robust communication but do not need ZigBee interoperability. The MiWi protocol software is much smaller than ZigBee, allowing it to be implemented using our low-cost PIC microcontrollers. Download the free MiWi/MiWi P2P stacks at: www.microchip.com/miwi

PICDEM™ Z 2.4 GHz Development Kit

(DM163027-4)

- 2x MRF24J40 daughter cards
- Antenna reference design
- 2x PICDEM Z boards
- ZENA Network Analyzer Board
- CD-ROM with documentation

ZENA™ Network Analyzer

(DM183023)

- Graphically displays wireless network traffic
- Supports ZigBee, MiWi and MiWi P2P protocols

Controller Area Network (CAN)

Take your embedded design to the next level with Controller Area Network (CAN) bus solutions

Local Interconnect Network (LIN/J2602)

Industry's first standard to address Class A open multiplexing protocols within vehicles

Take communication and connectivity in your deeply embedded design to the next level with Controller Area Network (CAN) and Local Interconnect Network (LIN) bus solutions from Microchip.

Controller Area Network (CAN)

CAN has become the de facto standard for high integrity serial communication in deeply embedded applications. CAN supports multiple topologies, can be made deterministic and fault-tolerant, and transfers data at speeds up to 1 Mbps.

Microchip offers a complete line of products to meet the needs of high-performance embedded applications using the CAN protocol – including 8- and 16-bit microcontrollers and 16-bit digital signal controllers with integrated CAN, standalone CAN controllers, I/O expanders and CAN transceivers.

Microchip's Enhanced CAN Module

At the heart of Microchip's CAN offering is the enhanced CAN module. Key features include:

- CAN 1.2, CAN 2.0A and CAN 2.0B support
- Up to 8 RX and 8 RX/TX buffers
- 16 full acceptance filters
- Up to 3 full acceptance mask filters
- Time stamping
- DMA support in 16-bit PIC24H PIC microcontrollers and dsPIC33F digital signal controllers
- DeviceNet™ support
- Legacy mode

Local Interconnect Network (LIN)

LIN/J2602 is the industry's first standard designed to address low-cost networking within vehicles. LIN enables a cost-effective communication network for switch, smart sensor and actuator applications within the vehicle where the bandwidth and versatility of CAN is not required.

LIN can be implemented on any PIC microcontroller with a USART interface. Microchip also offers a robust physical layer interface, data link layer implementation and a variety of development aids including a LIN reference design.

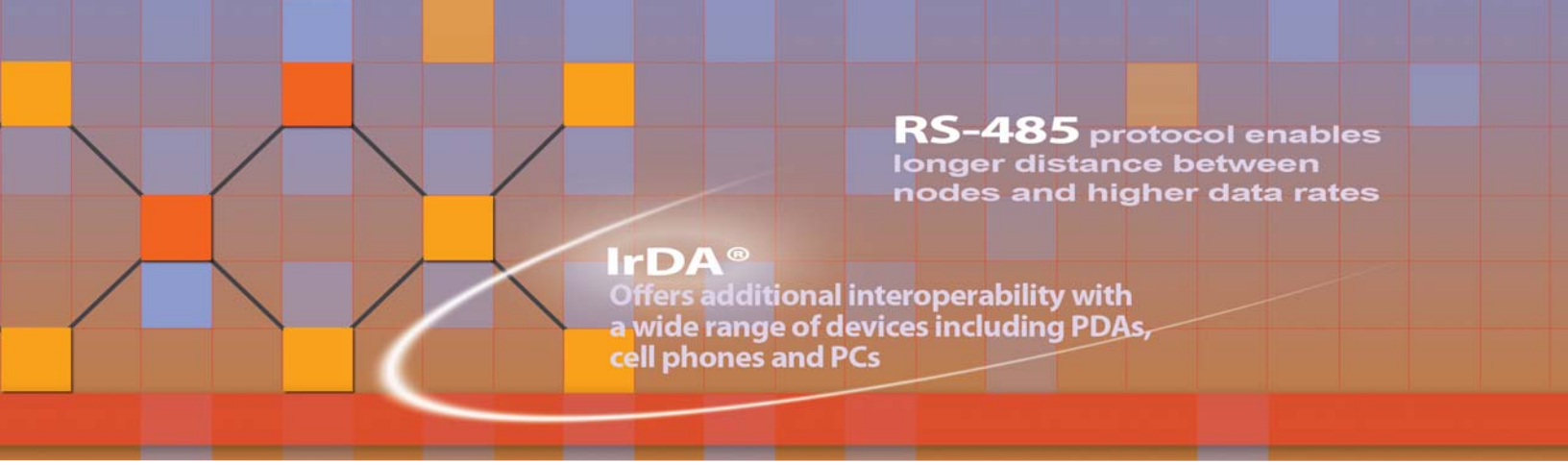
MCP202X LIN Transceivers

The MCP202X family of LIN transceivers integrates a LIN physical layer, internal voltage regulator and POR/BOR Reset function. LIN bus specification versions 1.3, 2.0 and 2.1 are supported. The devices are designed to meet the stringent EMC/ESD requirements of the world's automobile makers.

Window Lift with Anti-Pinch Reference Design
(APGRD002)

Popular CAN/LIN Products

Product Category	Device Example	CAN Controller	LIN Support
8-bit MCU	PIC16F690	N/A	EUSART Slave
8-bit MCU	PIC18F4680	8-bit Enhanced CAN Module	EUSART Master/Slave
16-bit MCU	PIC24HJ256GP506	16-bit Enhanced CAN Module	EUSART Master/Slave
16-bit DSC	dsPIC30F4012	Standard CAN Module	EUSART Master/Slave
16-bit DSC	dsPIC33FJ64MC502	16-bit Enhanced CAN Module	EUSART Master/Slave
Standalone CAN Controller	MCP2515	Standard CAN Module	Via SPI
CAN Transceiver	MCP2551	High-speed CAN Transceiver	N/A
CAN I/O Expander	MCP25050	N/A	N/A
LIN Transceiver	MCP2021	N/A	Physical Layer Interface



CAN/LIN Development Tools

With easy-to-use development systems and application notes, Microchip provides a total CAN/LIN solution that enables low-risk product development, lower total system cost and faster time to market for high performance embedded designs. **Software stacks are also available from a number of third parties.**

LIN Data Link Layer Firmware

LIN Data Link Layer firmware can be downloaded free-of-charge from Microchip's web site. Many third party companies also offer LIN Data Link Layer firmware, providing additional design options.

Reference Designs

To alleviate customer design challenges, Microchip offers complete reference designs that integrate application software, Data Link Layer firmware and the Physical Layer to demonstrate a risk-free path for customers implementing real-time control networks.

PICDEM™ CAN-LIN 3 Demonstration Board
(DM163015)

Microchip's PICDEM CAN-LIN 3 Demonstration Board is an easy way to discover the power of Microchip's CAN and LIN product offerings. Featuring three popular 8-bit PIC microcontrollers, the board simulates a pair of CAN nodes and a LIN sub-node.

Other Connectivity Options

While the most sophisticated protocols and interfaces tend to garner a significant amount of attention, a number of simpler connectivity options are and will remain the embedded interconnects of choice for many deeply embedded applications. Microchip's focus on the embedded market ensures an ongoing commitment to support all of the connectivity solutions utilized by leading designers, including the microcontroller peripherals, application notes and software necessary to implement robust, highly reliable embedded networks.

RS-485 Protocol

The RS-485 protocol is typically used as a more feature-rich alternative to RS-232. The protocol enables longer distance between nodes and higher data rates. Any PIC microcontroller with an on-board UART can support RS-485 communication. Many PIC microcontrollers include enhanced peripherals with an RS-485 mode.

IrDA® Protocol

The IrDA protocol provides many portable devices with an affordable, short distance optical data communications link. IrDA can be implemented using the timers and I/Os found on any PIC microcontroller. Microchip's 16- and 32-bit products include IrDA encoder and decoder logic to enable easy implementation of the protocol.

Support

Microchip is committed to supporting its customers in developing products faster and more efficiently. We maintain a worldwide network of field applications engineers and technical support ready to provide product and system assistance. In addition, the following service areas are available at www.microchip.com:

- **Support** link provides a way to get questions answered fast: **http://support.microchip.com**
- **Sample** link offers free evaluation samples of any Microchip device: **http://sample.microchip.com**
- **Training** link offers webinars, registration for local seminars/workshops and information on annual MASTERs events held throughout the world: **www.microchip.com/training**
- **Forum** link provides access to knowledge base and peer help: **http://forum.microchip.com**

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