MICROCHIP

Connectivity Solutions for Embedded Design:
USB, Ethernet, Wi-Fi®, ZigBee®, MiWi™, CAN, LIN, IrDA® and RS-485 Protocols

Wired and Wireless Connectivity

USB · Wi-Fi® · ZigBee® · Ethernet · MiWi™ · CAN · LIN

Easy to use · Low-cost · Start designing today

www.microchip.com/connectivity

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 8 Kbytes to 512 Kbytes of Flash program memory and from 768 bytes to 128 Kbytes of data RAM providing ample code and data space for complex USB applications. Microchip's USB product families include solutions for peripheral, embedded host and dual-role OTG applications.

In addition, the MCP2200 is a stand-alone USB to UART serial converter that enables full-speed USB connectivity in applications containing a UART interface. The MCP2200 has 256 bytes of EEPROM and 8 general purpose I/O. It offers a simple "plug-and-play" solution, allowing USB connectivity with very little design effort.
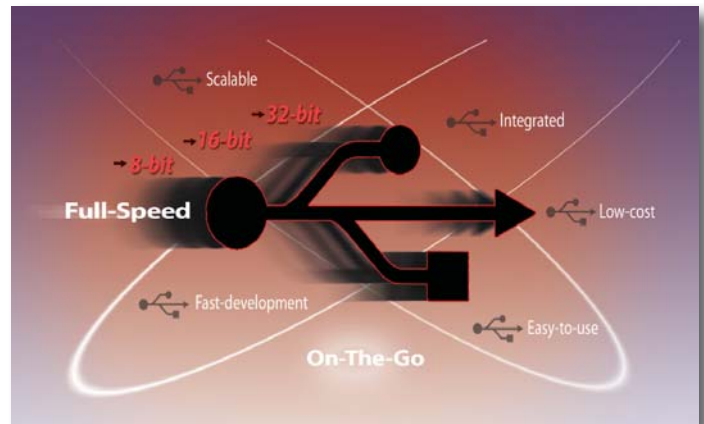
Microchip provides free source code for USB software stacks and class drivers to shorten development time for USB applications, including thumb drive bootloaders and printer support. Supported classes are: audio, CDC, HID, MSD, printer and custom. Microchip's free USB Host Stack, Device Stack and Class Drivers (HID, MSD, CDC, Custom) are available at www.microchip.com/usb.
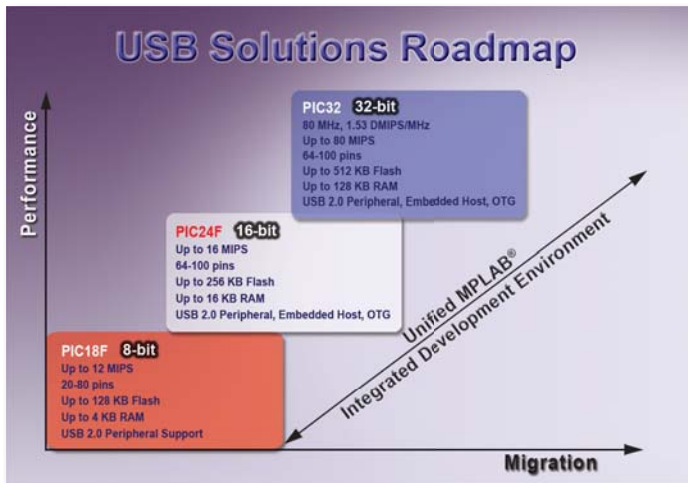
USB Microcontrollers

Device	Core	USB	Flash	RAM	mTouch™ Support	UARTs	SPI	I²C	Peripheral Pin Select	ADC	RTCC	Parallel Master Port	Analog Comp	Free SW Stacks	Free Class Drivers	Scalable Development Environment	Packages
PIC18F14K50	8-bit	USB 2.0 Peripheral	16 KB	768B	Yes	1	1	1	No	10-bit, 9 ch.	SW	No	2	Yes	Yes	Yes	20 pin
PIC18F4450/ 4550/4553	8-bit	USB 2.0 Peripheral	Up to 32 KB	Up to 2048B	Yes External	1	1	1	No	10-bit, 10 & 13 ch. 12-bit, 10 & 13 ch.	SW	No	2	Yes	Yes	Yes	28, 40, 44 pin
PIC18F46J50	8-bit	USB 2.0 Peripheral	64 KB	3904B	Yes CTMU	2	2	2	Yes	10-bit, 13 ch.	Yes	Yes	2	Yes	Yes	Yes	28, 40, 44 pin
PIC18F87J50	8-bit	USB 2.0 Peripheral	128 KB	3904B	Yes External	2	1	1	No	10-bit, 8 & 12 ch.	SW	Yes	2	Yes	Yes	Yes	64, 80 pin
PIC24FJ64GB004	16-bit	USB 2.0 Peripheral, Embedded Host, Dual Role, OTG	32 KB to 64 KB	8 KB	Yes CTMU	2	2	2	Yes	10-bit, 13 ch.	Yes	Yes	3	Yes	Yes	Yes	28, 44 pin
PIC24FJ256GB110	16-bit	USB 2.0 Peripheral, Embedded Host, Dual Role, OTG	64 KB to 256 KB	16 KB	Yes CTMU	4	3	3	Yes	10-bit, 16 ch.	Yes	Yes	3	Yes	Yes	Yes	64, 80, 100 pin
PIC32MX4XX	32-bit	USB 2.0 Peripheral, Embedded Host, Dual Role, OTG	512 KB	32 KB	Yes External	2	2	2	No	10-bit, 16 ch.	Yes	Yes	2	Yes	Yes	Yes	64, 100 pin
PIC32MX5XX	32-bit	USB 2.0 Peripheral, Embedded Host, Dual Role, OTG	512 KB	64 KB	Yes External	6	4	5	No	10-bit, 16 ch.	Yes	Yes	2	Yes	Yes	Yes	64, 100 pin
PIC32MX6XX	32-bit	USB 2.0 Peripheral, Embedded Host, Dual Role, OTG	512 KB	128 KB	Yes External	6	4	5	No	10-bit, 16 ch.	Yes	Yes	2	Yes	Yes	Yes	64, 100 pin
PIC32MX7XX	32-bit	USB 2.0 Peripheral, Embedded Host, Dual Role, OTG	512 KB	128 KB	Yes External	6	4	5	No	10-bit, 16 ch.	Yes	Yes	2	Yes	Yes	Yes	64, 100 pin

Stand-alone USB Converters

Device	USB Version	USB Speed (Mbps)	MCU Interface	Number of GPIO	Operating Voltage	Temperature Range	Packages
MCP2200	USB 2.0	12	UART	8	2.7V to 5.5V	-40°C to +85°C	20 pin SOIC, 20 pin SSOP, 20 pin QFN

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 applications 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)**
PIC24FJ256GB110 **(DM240011)**
PIC32MX7XX **(DM320003-2)**

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

PIC24FJ256GB110 **(MA240014)**
PIC24FJ64GB004 **(MA240019)**
PIC32 **(MA320002, MA320003)**
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 Modules

PIC18F87J50 **(MA180021)**,
PIC18F46J50 **(MA180024)**
These PIMs support Microchip's 8-bit microcontrollers.

USB Solutions Design Center
www.microchip.com/usb

▶ Getting Started
▶ Technical Documentation
▶ Programming Support
▶ FAQs – Design General
▶ Development Tools
▶ Circuit Diagrams
▶ Silicon Solutions
▶ Technical Training

Ethernet Solutions with Integrated MAC and PHY

Offering the World's Smallest Embedded Ethernet Controller

Microchip addresses the growing demand for embedded Ethernet products with the ENC624J600, ENC424J600 and ENC28J60 as standalone Ethernet controllers, PIC32MX6XX and PIC32MX7XX as Ethernet PIC microcontrollers and with PIC18F97J60 family, which are IEEE 802.3 compliant and fully compatible with 10/100/1000 Base-T networks. Microchip's Ethernet solution also includes:

- Free and robust TCP/IP stack that is optimized for the PIC18, PIC24 and PIC32 microcontroller and dsPIC® digital signal controller families (www.microchip.com/tcpip)
- Some of the supported protocols are: HTTP, SMTP, SNMP, FTP, SNTP, SSL, TCP, UDP, IP, DHCP, DDNS, ICMP and ARP

PIC18F97J60 Ethernet PIC Microcontroller

- PIC18F microcontroller with built-in Ethernet MAC and 10 Base-T PHY
- 8 KB dedicated Ethernet Buffer RAM
- Up to 128 KB Flash
- Advanced analog and communication peripherals
- Available in 64-, 80- and 100-pin TQFP

PIC32MX6XX, PIC32MX7XX Ethernet PIC® Microcontroller

- Integrated 10/100 Mbit Ethernet MAC
- Dedicated DMA interface for direct access to the entire system RAM
- Industry standard RMII/MII interface to PHY
- Pre-programmed MAC address
- 80 MHz, 512 KB Flash, 64 KB or 128 KB RAM
- Available in 64-pin (TQFP, QFN) and 100-pin (TQFP, BGA)
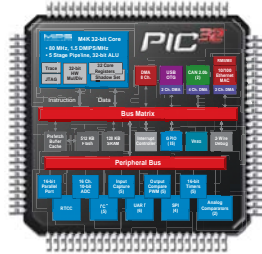
ENC624J600, ENC424J600 Embedded Ethernet Controllers

- Integrated MAC and 10/100 Base-T PHY
- 24 Kbyte transmit/receive buffer SRAM
- MCU Interface Supported: SPI and 8/16-bit parallel
- Cryptographic Security Engines
- Pre-programmed unique MAC address
- Available in 44-pin (TQFP, QFN) and 64-pin (TQFP)
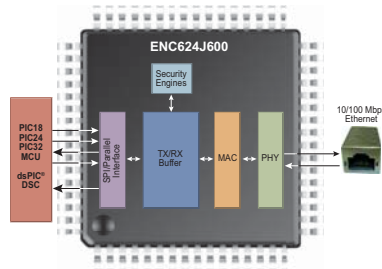
ENC28J60 Embedded Ethernet Controller

- Integrated MAC and 10 Base-T PHY
- 8 KB transmit/receive buffer SRAM
- MCU Interface Supported: SPI
- Available in 28-pin SPDIP, SSOP, SOIC, QFN packages
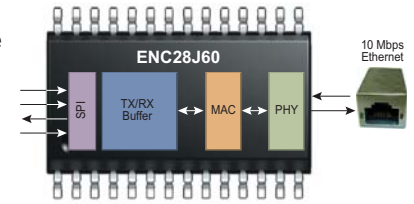
MAC Address Chips – Solving Your MAC Address Needs

- Pre-programmed EUI-48™ and EUI-64™ node address
- Up to 1.5 Kb Serial EEPROM functionality
  SPI – 25AA02E48
  I²C™ – 24AA02E48
  UNI/O® – 11AA02E48
  www.microchip.com/MAC
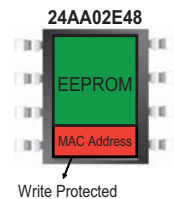
Development Tools Support

PIC32 Ethernet Starter Kit (DM320004)

Contains everything needed to develop Ethernet or USB peripheral/host/OTG applications using the PIC32. The kit contains free Microchip TCP/IP software and the necessary cables. There is an integrated debugger/programmer on the board as well as an expansion connector.

Fast 100 Mbps Ethernet PICtail Plus Daughter Board (AC164132)

Populated with the ENC624J600, this Ethernet board interfaces to the RJ-45 connector. It can be plugged into the Explorer 16 development board (DM240001) and the PIC18 Explorer board (DM183032) allowing connection to any of Microchip's 8, 16- and 32-bit products.

PICDEM.net™ 2 Development Board (DM163024)

This Ethernet development board supports both the ENC28J60 controller and the PIC18F97J60 MCU. With this board and Microchip's free TCP/IP stack, a web server can be developed showcasing the capability to remotely monitor and control embedded applications over the Internet.

Ethernet PICtail Plus Daughter Board (AC164123)

This board is populated with the 28-pin ENC28J60 Ethernet controller which interfaces to the RJ-45 connector. It can be plugged into the Explorer 16 development board (DM240001), allowing connection to any of Microchip's 16- and 32-bit products when used in conjunction with the free Microchip TCP/IP stack.

www.microchip.com/ethernet

Wireless Solutions

Targeting the Need for Low Data Rate, Low Cost Wireless Sensor and Control Networks

Wireless communication technologies have been commonplace in homes and industry for many years. Recent Smart Grid initiatives have driven new demand for a standardized, low data rate, low power, wireless technology in metering, home, business and industrial automation markets for remote sensor and control applications. As a result, the IEEE 802.11™, IEEE 802.15.4™ and ZigBee® standards were developed to address this need.

Easy implementation of a wireless radio node with ZigBee/RF4CE/MiWi™/MiWi P2P

Start with a Wireless Transceiver
- MRF24J40 – 2.4 GHz IEEE 802.15.4
- MRF49XA or MRF89XA – Sub-GHz Transceiver
- ZG210XM – Wi-Fi Modules

Select a Protocol Stack; ZigBee, RF4CE, MiWi or MiWi P2P
- Free software available via click-thru license
- All Microchip stacks are configurable and optimized for reduced code footprint
- ZigBee PRO, ZigBee SEP and ZigBee RF4CE require registration

Add an 8-, 16- or 32-bit PIC Microcontroller
- 3 Kbytes (min.) of program memory for MiWi P2P Stack
- 7 Kbytes (min.) of program memory for MiWi Stack
- 14 Kbytes (min.) of program memory for ZigBee RF4CE
- 40 Kbytes (min.) of program memory for ZigBee Stack
- Over 200 microcontrollers to choose from

ZigBee and ZigBee RF4CE are standards based wireless protocols, ensuring interoperability and reliable communication between various manufacturers' products. ZigBee is well-suited for a wide array of low power wireless mesh networks and RF4CE is targeted for peer-to-peer remote control of entertainment consumer electronic audio/visual equipment.

MiWi and MiWi Point-to-Point (P2P) protocols are designed to provide lower cost, reduced functionality alternatives for customers who desire robust communication but do not need ZigBee interoperability or large Mesh networks.

Stack	Topography	Hops	Flash Size	PIC18	PIC24	PIC32
MiWi P2P Proprietary	Star/P2P	1	3K-9K	Yes	Yes	Yes
MiWi Proprietary	Star/Mesh	4	7K-17K	Yes	Yes	Yes
ZigBee PRO Certified	Star/Mesh	Infinite	64K-96K	N/A	Yes	Yes
ZigBee RF4CE Certified	Star/P2P	1	14K-16K	Yes	Yes	Yes
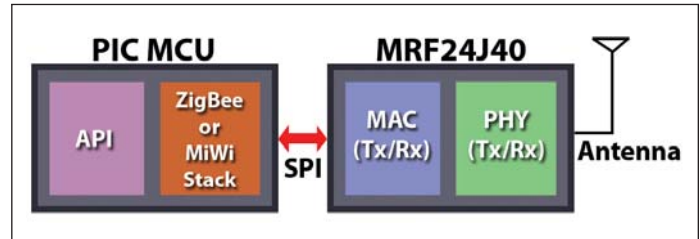
Agency Certified Transceiver Modules
(MRF24J40MA-I/RM, MRF24J40MB-I/RM, ZG2100MC)
- RF design completed
- Optimized antenna
- FCC, ETSI, IC-Certified and C-Tick

Development Tools Support

RF Daughter Cards
- **AC164134-1** MRF24J40MA PICtail/PICtail Plus
- **AC164134-2** MRF24J40MB PICtail/PICtail Plus
- **AC164137-1** MRF49XA PICtail/PICtail Plus 433 MHz
- **AC164137-2** MRF49XA PICtail/PICtail Plus 868/915 MHz
- **AC164136-2** Wi-Fi PICtail/PICtail Plus

ZENA™ Network Analyzer (DM183023)
- Graphically displays wireless network traffic
- Supports ZigBee, MiWi and MiWi P2P protocols

Wireless Design Center
www.microchip.com/wireless
- ▶ Getting Started
- ▶ Technical Documentation
- ▶ Programming Support
- ▶ FAQs – Design General
- ▶ Development Tools
- ▶ Circuit Diagrams
- ▶ Silicon Solutions
- ▶ Technical Training

CAN and LIN Bus Solutions

Taking Communication and Connectivity in Deeply Embedded Designs to the Next Level

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-, 16- and 32-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
- 32 buffers for TX/RX
- 32 acceptance filters
- 4 acceptance mask filters
- Time stamping
- DMA support in 16-bit PIC24H and PIC32 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, LIN compliant drivers and a variety of development aids including a LIN reference design.

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

MCP200X LIN Transceivers

The MCP2003/4 family of LIN transceivers offers a stand-alone LIN transceiver option. The transceivers EMC/ESD performance is among the best in the industry and meets all automotive requirements. The MCP2003 is available in an industry standard pinout and the MCP2004 offers a TXE/Fault pin which allows users the ability to disable and enable the transmitter in addition to a fault output which signals a fault condition. Both parts meet LIN bus specification versions 1.3, 2.0 and 2.1.

MCP202X LIN Transceivers

The MCP202X family of LIN transceivers integrates a LIN physical layer, 3.3V or 5V 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.

Popular CAN/LIN Products

Product Category	Device Example	CAN Controller	LIN Support
8-bit MCU	PIC16F690	N/A	EUSART Slave
8-bit MCU	PIC16F182X	N/A	EUSART Slave
8-bit MCU	PIC18F4680	8-bit Enhanced CAN Module	EUSART Master/Slave
16-bit MCU	PIC24HJ256GP506A	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
32-bit MCU	PIC32MX5XX/PIC32MX7XX	32-bit 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	MCP2003, MCP2021	N/A	Physical Layer Interface

www.microchip.com/CAN

Development Resources and Other Connectivity Options

Focusing on the Embedded Market to Ensure Support for All Popular Connectivity Solutions

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.**

ECAN/LIN PICtail Plus Daughter Board (AC164130)

This daughter board can be used with the Explorer 16 development board to facilitate rapid implementation and evaluation of CAN/LIN applications using PIC24F and PIC32MX5/MX7 MCU and dsPIC33F DSC families.

PICkit™ 28-pin LIN Demonstration Board (DM164130-3)

The PICkit 28-pin LIN demo board enables a quick start in developing and debugging applications with the LIN drivers. The kit includes a 28-pin socket which supports various PIC16F devices, includes a LIN transceiver, plus a generous prototype area with various indicator LEDs and buttons to support the test and debug of the application.

PICDEM CAN-LIN 3 Demonstration Board (DM163015)

The PICDEM CAN-LIN 3 demo board is an easy way to discover the power of Microchip's CAN and LIN product offerings. The board demonstrates the main features of the 64-pin TQFP PIC18F6680 and 80-pin TQFP PIC18F8680 devices, including those features of the integrated CAN module. In addition, the board employs a LIN sub-network using Microchip's 20-pin SSOP PIC18F1320 and MCP201 LIN Bus.

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.

LIN Serial Analyzer Development System (APGDT001) CAN BUS Analyzer (APGDT002)

The LIN and CAN analyzer development systems enables a personal computer (PC) to communicate with the LIN and CAN buses. The PC program uses a graphical user interface to enter and display message frames occurring on the target bus.
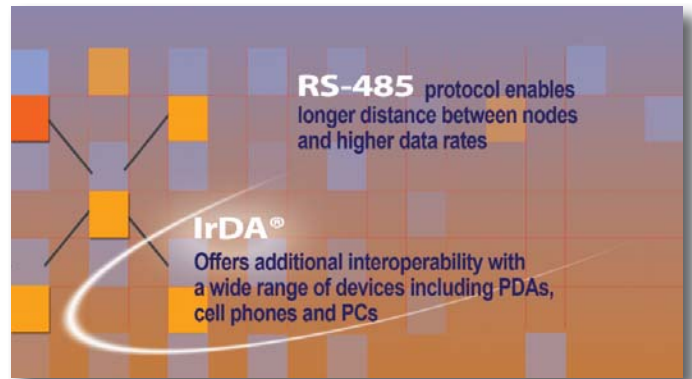
Other Connectivity Options

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 on many Microchip MCUs using Microchip's free-of-charge IrDA software stack. In addition, Microchip offers UART to IrDA protocol converter products (MCP2140A, MCP2150) to enable any system to easily add IrDA wireless connectivity.

IrDA PICtail Plus Daughter Board (AC164124)

Enables IrDA connectivity when used with the Explorer 16 development board (DM240001).

MCP2140 Wireless Temperature Sensor Demonstration Board (MCP2140DM-TMPSNS)

Demonstrates the communication of temperature data to a primary device (PDA or PC with IR port) via IrDA.

www.microchip.com/connectivity

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 evaluation samples of any Microchip device: http://sample.microchip.com
- **Forum** link provides access to knowledge base and peer help: http://forum.microchip.com
- **Buy** link provides locations of Microchip Sales Channel Partners: www.microchip.com/sales

Training

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.

- Regional Training Centers: www.microchip.com/rtc
- MASTERs Conferences: www.microchip.com/masters
- Worldwide Seminars: www.microchip.com/seminars
- eLearning: www.microchip.com/webseminars
- Resources from our Distribution and Third Party Partners www.microchip.com/training

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