Utility Metering Solutions

MICROCHIP

Complete Utility Metering Solutions

www.microchip.com/meter

Design Innovation in Energy, Gas, Water and Heat Meters

The metering market is currently facing many challenges. Government regulations, competitive forces, technology innovations and end customer expectations are fueling unprecedented changes in this rapidly-evolving market. Innovation in the latest meter designs are being driven by a number of factors including the migration from mechanical meters to smart meters, the need to provide advanced intelligence and two-way communications in smart meters and the demands of tomorrow's smart grids.

Having a "smart" partner who can help you keep up with the latest trends and allow you to react quickly to new developments will be the key to your success in designing for the metering market. Microchip understands the design challenges facing meter designers. Our solutions are used in millions of meters worldwide, helping to increase meter accuracy and reliability while lowering total system cost. We provide products and technical support to assist you with developing engaging energy management solutions for use by end customers over their home area networks. Microchip wants to be a partner in your success rather than just a vendor.

Microchip offers a complete portfolio of 8-, 16- and 32-bit microcontrollers, 16-bit digital signal controllers, energy measurement integrated circuits (ICs), analog components, Flash memory and serial EEPROMs. Our devices allow you to:

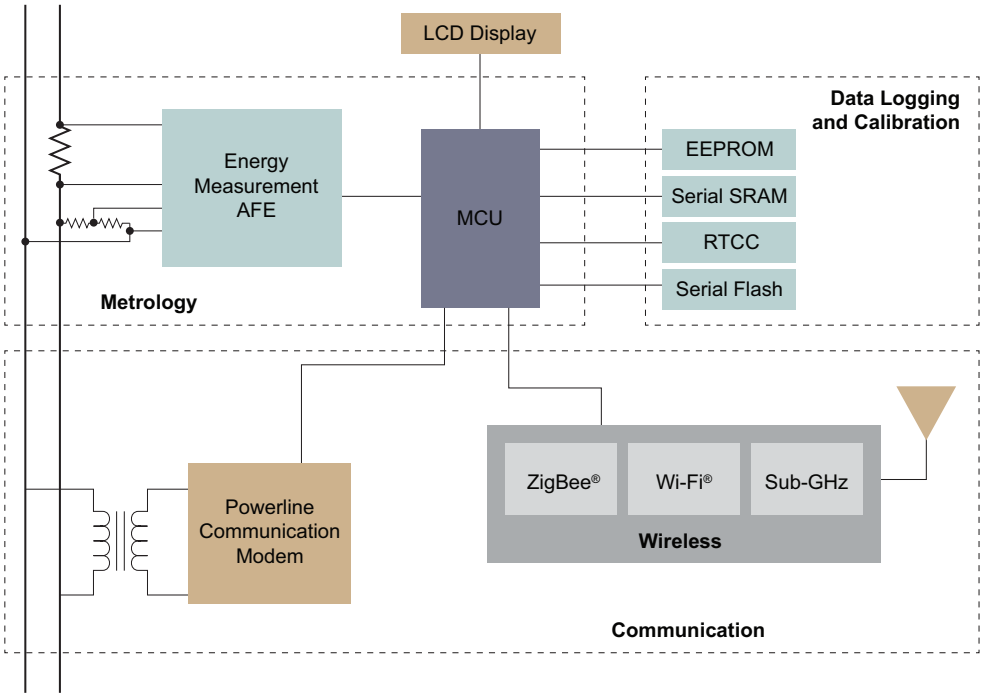
- Directly drive inexpensive LED and LCD displays
- Add wireless communication for automated meter reading
- Implement anti-tampering techniques
- Manage low-power design with nanoWatt XLP technology
- Integrate real time clock for advanced billing schemes
- Improve accuracy and simplify meter calibration
- Easily integrate touch sensing functionality into your designs with mTouch® sensing solutions

Our free MPLAB® X Integrated Design Environment provides a single platform for product development which shortens the time it takes to complete new designs or to modify existing designs to meet regional needs.

Our Metering Design Center features complete access to all of Microchip's metering application notes, software libraries, reference designs and other technical documentation to help you get your products to market quickly and efficiently.

Microchip's global 24/7 technical support team, regional training centers and our local application teams are here to help you meet your customers' expectations and schedules. We are committed to being part of your success.

Basic Smart Meter



Utility Metering Solutions

Energy Measurement ICs

The devices in the MCP391X family are highly accurate energy measurement analog front ends with up to eight channels for single-phase and three-phase metering. When paired with a PIC® microcontroller, the MCP391X offers you a complete, flexible and highly accurate solution for energy measurement in utility metering and power monitoring applications.

The MCP391X devices feature simultaneous sampling 16/24-bit delta-sigma A/D converters, internal voltage reference and Programmable Gain Amplifiers (PGA). With up to 94.5 dB SINAD and –107 dB THD performance this family allows for the highest accuracy designs enabling 0.1% active power measurement error over a 10,000:1 dynamic range. Additional innovations include a unique 2-wire serial interface that reduces expensive isolation requirements. For more information, visit www.microchip.com/energymetering.

Microcontrollers and Digital Signal Controllers

Microchip's flexible microcontroller (MCU) and digital signal controller (DSC) platform, along with the common MPLAB X Integrated Development Environment (IDE), can enable a wide range of utility metering solutions. Our broad portfolio of 8-/16-/32-bit MCUs and DSCs lowers total system cost by enabling the appropriate level of integration to match utility metering system requirements. Features include display functions, real-time clock and calendar, temperature sensing with the Charge Time Measurement Unit (CTMU) and eXtreme Low Power (XLP) performance to extend battery life. Our unique approach allows for easy migration across the entire MCU and DSC portfolio, giving you the flexibility to adapt or change your design to meet local system requirements. Utility metering solutions with free energy calculation firmware range from a single-chip design with the PIC18F87J72 which offers ease of use and smaller board space to a two-chip solution using our Energy Measurement ICs with any MCU or DSC.

Analog and Interface Devices

From devices for measuring temperature and signals to power management and infrared interfaces, Microchip provides a wide portfolio of analog and interface components that are well suited for metering applications. Low-power and precise operational amplifiers enable signal acquisition for accurate measurements of current, voltage, temperature or flow. Our family of digital temperature sensors provides accurate measurements to compensate for temperature drifts in meter components. Infrared interface devices provide a platform of products for developing a robust communication method for data gathering at meter locations. For more information, visit www.microchip.com/analog.

Memory Products

For reliable data and code storage, Microchip offers a broad range of memory devices, which include SRAM, EEPROM and Flash. Supporting a variety of densities that can operate over wide voltage and temperature ranges in very small packages, these devices can meet the requirements of any metering application.

SPI-compatible Serial SRAM devices support unlimited endurance and fast Write times. If non-volatile memory is needed, our very high-endurance Serial EEPROMs offer the highest Erase/Write cycle endurance in the industry. These devices are available with I²C™, SPI or Microwire serial interfaces to support any microcontroller serial port that has been selected.

For applications with higher-density memory requirements, our SuperFlash® SPI, SQI® and Parallel Flash products are ideal solutions. In designs that require a boot loader, SPI Flash can be used to store the boot code, making it available for download into shadow memory upon power-up. For applications that require execute-in-place, the higher bandwidth SQI Flash and Parallel Flash have this same capability. SuperFlash products are cost-effective non-volatile memory data storage solutions, offering industry-leading features along with fixed and fast program/erase times, ultra-low power consumption, high-endurance and excellent reliability. For more information visit www.microchip.com/memory.

Utility Metering Solutions

Real-Time Clock/Calendar (RTCC)

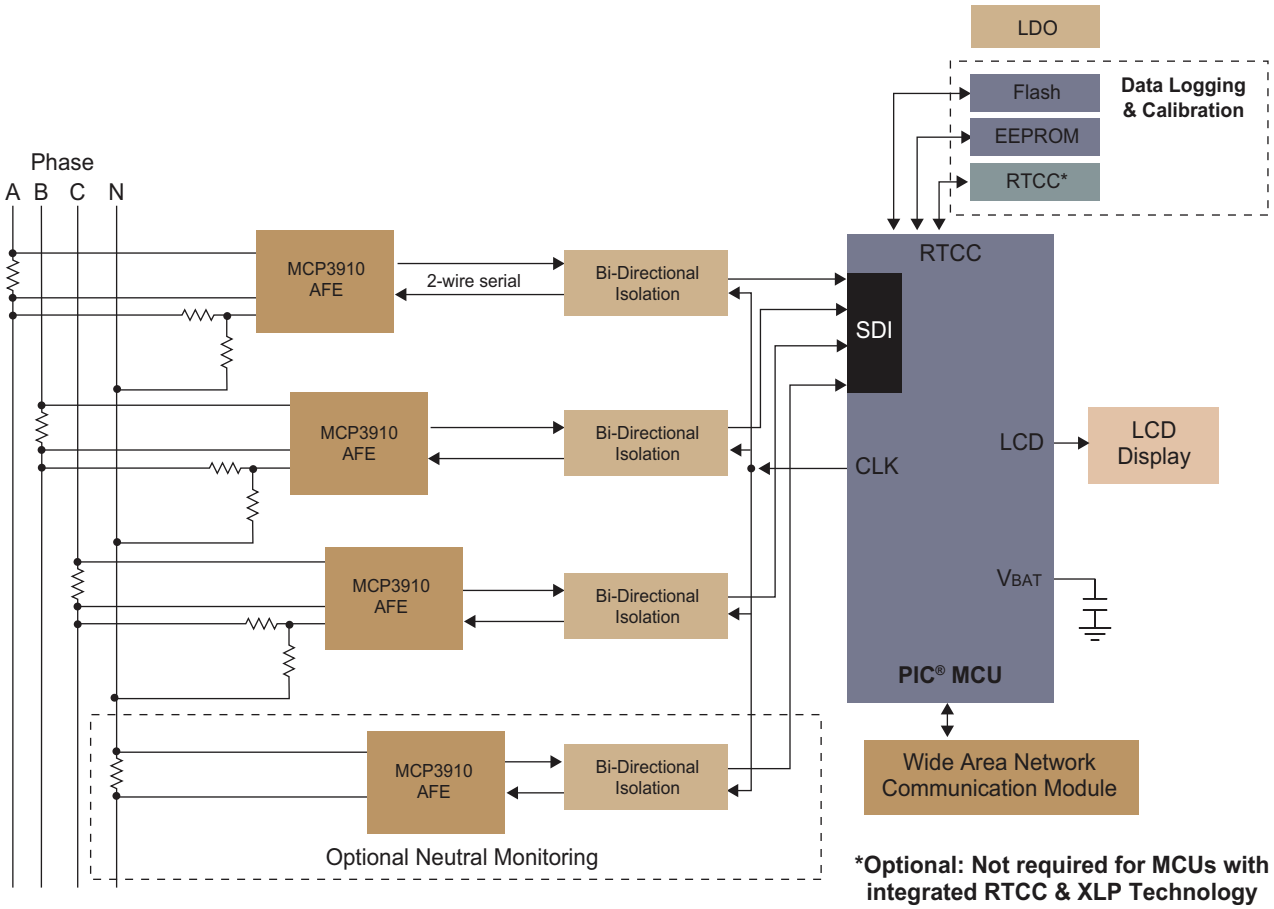
For low-cost and accurate timekeeping, the MCP794XX and MCP795XX families of Real-Time Clocks have a usable amount of non-volatile SRAM, EEPROM and a battery switchover circuit for backup power. This family has a digital trimming circuit with a wide adjustment range to compensate for crystal frequency drift that can occur over temperature. In the event of a power failure, the RTCC has a power-fail timestamp that can log the time that main power was lost and the time that it was restored. A Unique ID with a MAC Address is also included in protected memory to provide a unique identifier when communicating over wired or wireless interfaces. For more information visit www.microchip.com/clock.

Wired Communications for Smart Grid

Power line repeaters collect data from power meters using wired communications such as RS-485 and Power Line Carrier (PLC) technology. This data is transmitted to concentrators for processing and subsequent transmission to utility companies using power line modems (PLM) and Ethernet, as well as other technologies. The dsPIC® Digital Signal Controller (DSC) general purpose family is well-suited for low-cost energy meters, offering a fast and efficient CPU, DMA channels and small package footprints. The PIC32MZ and PIC32MX family have the performance needed to process automated meter reading data as well as a rich set of connectivity features including UARTs, ADCs, SPIs, high-speed USB, CAN, Ethernet, I^2C, EBI and SQI. For more information visit www.microchip.com/PIC32.

Polyphase Shunt Meter with the MCP3910 Analog Front-End

Resistive shunts are inexpensive, small, highly linear and immune to magnetic influences when compared to alternative current sensing solutions, such as current transformers and Rogowski coils. However, they lack the electrical isolation needed in polyphase systems, thus requiring isolaters at an additional cost. The MCP3918 and MCP3910 2-wire serial interfaces greatly reduce system cost by halving isolation requirements, needing only a single bidirectional isolator per phase for polyphase shunt-based meter designs.



Utility Metering Solutions

Wireless Communications for Smart Grid

The meter is evolving with Smart Grid initiatives to become the hub of communication from the home to the utility provider. Enabling communication within the grid is key to presenting, monitoring and controlling usage of precious energy resources. Microchip provides development platforms to enable wireless communication of ZigBee® networks including the Smart Energy Profile, Wi-Fi® Connectivity and Sub-GHz AMI solutions. See all of Microchip's wireless solutions at www.microchip.com/wireless.

Complete Technical Resources for Metering Designs

Engineering resources are often limited, which makes access to existing application reference designs and technical documentation critical in reducing time to market. Microchip's Utility Meter Design Center at www.microchip.com/meter offers material that will walk you through all of the building blocks and considerations necessary to create a utility metering design. The design center also features complete access to all of Microchip's metering application notes, reference designs and other technical documentation to help you get your products to market quickly and efficiently.

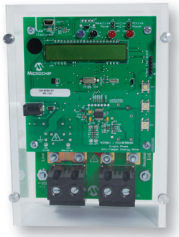
Development Systems

Low-cost and easy-to-learn development tools can save you time, money and engineering resources. Microchip offers a number of development boards and evaluation kits to demonstrate the capabilities of its silicon solutions for utility metering and power monitoring applications.

Utility Metering Development Systems

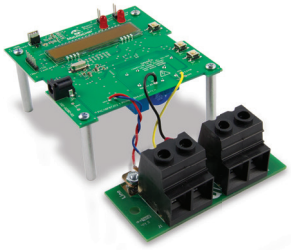
Single-Phase Meter Reference Designs

MCP3911 and PIC18F85K90 Anti-Tamper Meter Reference Design (ARD00385)



This fully functional IEC Class 0.5 compliant single-phase meter has enhanced capabilities, such as battery backup, RTC and anti-tamper features. The PIC18F85K90 MCU drives the LCD and communicates via UART with the MCP2200, offering an isolated USB connection for calibration and access to power calculations. The system calculates active energy, active power, RMS current, RMS voltage, reactive energy, reactive power, apparent power and other typical power quantities.

PIC18F87J72 Single Phase Energy Meter Reference Design (ARD00280)

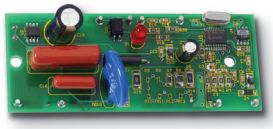


This is a fully functional single phase meter featuring the PIC18F87J72 MCU with Analog Front End. This low-cost design uses a shunt for the current sensor. The PIC18F87J72 drives the LCD and includes both an isolated USB and non-isolated RS232 interface for calibration and access to power calculations. The system calculates active/reactive energy, forward/reverse energy, active/reactive/apparent power and RMS current/voltage.

Utility Metering Development Systems

Single-Phase Meter Reference Designs (Continued)

MCP3905A Energy Meter Reference Design (MCP3905RD-PM1)



This low-cost energy meter board acts as a stand-alone energy meter or as the analog front-end design for LCD microcontroller-based meters. The MCP3905A design is specified with an energy measurement error of 0.1% typical across 1:500 dynamic range. The board is compliant with EMC requirements per energy metering standards IEC62053 and legacy IEC61036, IEC1046 and IEC687.

MCP39F501 Metering and Power Monitoring Demonstration Board (ARD00455)

The MCP39F501 Demonstration Board is a fully functional, single-phase power monitor. This low-cost design does not use any transformers and requires few external components. The device calculates active power, reactive power, RMS current, RMS voltage, power factor, line frequency, other typical power quantities and programmable event notifications.

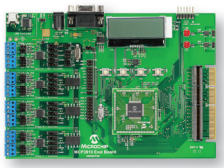
3-Phase Meter Reference Designs

MCP3909/dsPIC33F Advanced 3-Phase Energy Meter Reference Design (MCP3909RD-3PH3)

This fully functional energy meter reference design has many advanced features such as harmonic analysis, per phase distortion information, sag detection, four quadrant energy measurement, and active and reactive power calculation. It uses Microchip's 16-bit DSC dsPIC33FJ64GP206. This reference design takes advantage of the dsPIC33F by performing all calculations in the DSP engine. All output quantities are calculated in the frequency domain yielding a large number of outputs for a variety of meter designs.

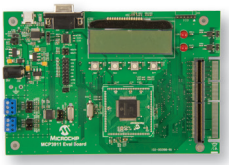
Development Tools and Evaluation Boards

MCP3910 ADC Evaluation Board for 16-bit MCUs (ADM00425)



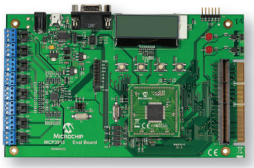
The MCP3910 ADC Evaluation Board provides the opportunity to evaluate the performance of the MCP3910 dual-channel ADCs in a multiple device, isolated system. It comes with four MCP3910s, three of which are isolated and operate in 2-wire Serial Interface mode. It also provides a development platform for 16-bit PIC microcontroller-based applications, using existing 100-pin PIM systems, compatible with the Explorer 16 and other PIC MCU demonstration boards.

MCP3911 ADC Evaluation Board for 16-bit MCUs (ADM00398)



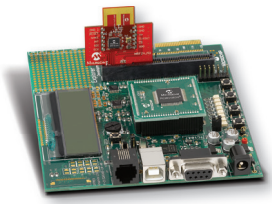
This evaluation board for 16-bit MCU systems provides the ability to evaluate the performance of the MCP3911 dual-channel ADC. It also provides a development platform for 16-bit PIC MCU-based applications, using existing 100-pin PIM systems compatible with the Explorer 16 and other PIC MCU demo boards.

MCP3913/14 ADC Evaluation Boards for 16-bit MCUs (ADM00522/ADM00523)



The MCP3913 and MCP3914 ADC Evaluation Boards for 16-bit MCU systems allow you to evaluate the performance of the MCP3913 six channel sigma-delta ADC or MCP3914 eight-channel sigma-delta ADC. It also provides a development platform for 16-bit PIC MCU-based applications, using existing 100-pin PIM systems compatible with the Explorer 16 and other MCU demonstrations boards.

Explorer 16 Development Board (DM240001/ DM240002) and MRF24J40MA PICtail™ Plus Daughter Board (AC164134-1)



This board offers an economical way to evaluate Microchip's 16- and 32-bit microcontrollers and dsPIC33F DSC Families. It allows you to create IEEE 802.15.4™/ ZigBee and IEEE 802.11™/ Wi-Fi wireless communication applications by adding wireless PICtail daughter cards to the Explorer 16 using the associated software protocol stack.

Product Specifications

Energy Measurement AFE

Device	Resolution	SINAD	ADC Channels	Typical Voltage Reference Drift (ppm/°C)	Output Type	Analog V_{DD} (V)	Digital V_{DD} (V)	Features
MCP3918	24-bit	93.5 dB	1	9	SPI/2-wire	2.7 to 3.6	2.7 to 3.6	Phase compensation, programmable data rate up to 125 ksps, 16-bit CRC
MCP3910	24-bit	93.5 dB	2	9	SPI/2-wire	2.7 to 3.6	2.7 to 3.6	Phase compensation, programmable data rate up to 125 ksps, 16-bit CRC
MCP3911	24-bit	94.5 dB	2	7	SPI	2.7 to 3.6	2.7 to 3.6	Phase compensation, programmable data rate up to 125 ksps
MCP3913	24-bit	94.5 dB	6	9	SPI	2.7 to 3.6	2.7 to 3.6	Phase compensation, programmable data rate up to 125 ksps, 16-bit CRC
MCP3914	24-bit	94.5 dB	8	9	SPI	2.7 to 3.6	2.7 to 3.6	Phase compensation, programmable data rate up to 125 ksps, 16-bit CRC

Energy Measurement ICs

Device	Dynamic Range	Measurement Error	ADC Channels	Typical Voltage Reference Drift (ppm/°C)	Output Type	Analog V_{DD} (V)	Digital V_{DD} (V)	Features
MCP3905A	500:1	0.1%	2	15	Active power pulse	4.5 to 5.5	4.5 to 5.5	Active power calculation
MCP3906A	1000:1	0.1%	2	15	Active power pulse	4.5 to 5.5	4.5 to 5.5	Active power calculation
MCP3909	1000:1	0.1%	2	15	Active power pulse, SPI	4.5 to 5.5	4.5 to 5.5	Active power calculation
MCP39F501	4000:1	0.1%	2	10	UART	2.7 to 3.6	2.7 to 3.6	Active, reactive and apparent power, RMS current and voltage, power factor, line frequency

Recommended 8-bit PIC® Microcontrollers

Device	MIPS	ADC Bits	Flash	RAM	LCD	UART	RTCC	Temp. Sensing	DMA	Power Down/RTCC* Current* (µA)
PIC18F87J72	12	16 and 12	64–128	4	4 × 33	2	RTCC	CTMU	–	3.6/1.6
PIC18F67K90	16	12	32–128	2–4	4 × 33	2	RTCC	CTMU	–	0.06/1.1
PIC18F67J93	12	12	64–128	4	4 × 33	2	RTCC	CTMU	–	3.6/1.6
PIC18F67J90	12	10	64–128	4	4 × 33	2	RTCC	CTMU	–	3.6/1.6
PIC18F65J90	12	10	8–32	1–2	4 × 33	2	Timer 1	–	–	3.5/9
PIC18F87K90	16	12	32–128	2–4	4 × 33	2	RTCC	CTMU	–	0.06/1.1
PIC18F89J93	12	12	64–128	4	4 × 33	2	RTCC	CTMU	–	3.6/1.6
PIC18F87J90	12	10	64–128	4	4 × 33	2	RTCC	CTMU	–	3.6/1.6
PIC18F85J90	12	10	8–32	1–2	4 × 33	2	Timer 1	–	–	3.5/9
PIC18F67K22	16	12	62–128	2–4	–	2	RTCC	CTMU	–	0.06/1.1
PIC18F67J11	12	12	64–128	4	–	2	Timer 1	–	–	3.6/21
PIC18F65J11	12	10	8–32	1-2	–	2	Timer 1	–	–	3.5/9

Recommended 16-bit PIC® Microcontrollers and dsPIC® Digital Signal Controlls (DSCs)

Device	MIPS	ADC Bits	Flash	RAM	LCD	UART	RTCC	Temp. Sensing	DMA	Power Down/ RTCC* Current* (µA)
PIC24FJ128GA310	16	12	64–128	8	8 × 60	4	RTCC	CTMU	Yes	0.04/0.4
PIC24FJ128GA308	16	12	64–128	8	8 × 46	4	RTCC	CTMU	Yes	0.04/0.4
PIC24FJ128GA306	16	12	64–128	8	8 × 30	4	RTCC	CTMU	Yes	0.04/0.4
PIC24FJ128GC010	16	12/16	64–128	8	8 × 59	4	RTCC	CTMU	Yes	0.07/0.4
PIC24FJ256GA110	16	10	128–256	16	–	4	RTCC	CTMU	–	4/3.5
PIC24FJ128FA010	16	10	64–128	8	–	2	RTCC	–	–	27/8
dsPIC33EP64GP506	60	12	64–512	8–48	–	2	–	CTMU	Yes	45/–
PIC24EP512GP206	60	12	64–512	8–48	–	2	–	CTMU	Yes	45/–

Product Specifications

Recommended 32-bit PIC® Microcontrollers

Device	MHz	ADC Bits	Flash	RAM	LCD	UART	RTCC	Temp. Sensing	DMA	Power Down/ RTCC* Current (µA)
PIC32MX120F032D	50	10	32	8	–	2	RTCC	CTMU	Yes	44/23
PIC32MX120F032B	50	10	32	8	–	2	RTCC	CTMU	Yes	44/23
PIC32MX130F064D	40	10	64	16	–	2	RTCC	CTMU	Yes	44/23
PIC32MX130F064B	40	10	64	16	–	2	RTCC	CTMU	Yes	44/23
PIC32MX150F128D	50	10	128	32	–	2	RTCC	CTMU	Yes	44/23
PIC32MX150F128B	50	10	128	32	–	2	RTCC	CTMU	Yes	44/23
PIC32MX250F128D	50	10	128	32	–	2	RTCC	CTMU	Yes	44/23
PIC32MX270F256D	50	10	256	64	–	2	RTCC	CTMU	Yes	44/23
PIC32MX350F256	100	10	256	64	–	5	RTCC	CTMU	Yes	26/29
PIC32MX370F512	100	10	512	128	–	5	RTCC	CTMU	Yes	49/29
PIC32MX450F256	100	10	256	64	–	5	RTCC	CTMU	Yes	26/29
PIC32MX470F512	100	10	512	128	–	5	RTCC	CTMU	Yes	12/16
PIC32MX664F128	80	10	128	32	–	6	RTCC	–	Yes	20/23
PIC32MX675F256	80	10	256	64	–	6	RTCC	–	Yes	41/23
PIC32MX695F512	80	10	512	128	–	6	RTCC	–	Yes	41/23
PIC32MZ2048ECG100	200	10	2048	512	–	6	RTCC	–	Yes	–

*RTCC: Real-Time Clock and Calendar

Recommended NOR Flash Memory

Device	Bus	Density (bits)	Operating Voltage	Speed	Typical Program/ Erase Endurances	Supported Packages
SST25VF512A/010A	SPI	512K to 1M	2.7V to 3.6V	33 MHz	100K cycles	8-SOIC, 8-TDFN-5, 8-XFBGA
SST25VF020B/040B/080B	SPI	2M to 8M	2.7V to 3.6V	80 MHz	100K cycles	8-SOIC, 8-TDFN-5, 8/8/16-XFBGA
SST26VF016B	SQI®	16M	2.7V to 3.6V	104 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST26VF032B	SQI	32M	2.7V to 3.6V	104 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST26VF064B	SQI	64M	2.7V to 3.6V	104 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST25WF020A/040B/080B	SPI	512K to 8M	1.65V to 1.95V	75 MHz	100K cycles	8-SOIC, 8-TDFN-8
SST26WF032B	SQI	32M	1.65V to 1.95V	80 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST39WF512/010/020/040	×8 Parallel	512K to 4M	2.7V to 3.6V	55 ns, 70 ns	100K cycles	32-PLCC, 32-TSOP, 48-TFBGA, 34-WFBGA
SST39VF200A/400A	×16 Parallel	2M to 4M	2.7V to 3.6V	55 ns, 70 ns	100K cycles	48-TSOP, 48-TFBGA, 48-WFBGA, 48-XFLGA
SST39VF801C/802C	×16 Parallel	8M	2.7V to 3.6V	55 ns, 70 ns	100K cycles	48-TSOP, 48-TFBGA, 48-WFBGA
SST39VF1601C/1602C	×16 Parallel	16M	2.7V to 3.6V	70 ns	100K cycles	48-TSOP, 48-TFBGA
SST39VF3201C/3202C	×16 Parallel	32M	2.7V to 3.6V	70 ns	100K cycles	48-TSOP, 48-TFBGA
SST38VF6401/2/3/4	×16 Parallel	64M	2.7V to 3.6V	90 ns	100K cycles	48-TSOP, 48-TFBGA
SST39WF400B/800B	×16 Parallel	4M to 8M	1.65V to 1.95V	70 ns	100K cycles	48-TFBGA, 48-WFBGA, 48-XFLGA
SST39WF1601/2	×16 Parallel	16M	1.65V to 1.95V	70 ns	100K cycles	48-TFBGA, 48-WFBGA

Product Specifications

Recommended Serial SRAM and EEPROM Memory

Device	Memory Type	Bus	Density (bits)	Operating Voltage	Max Stanby Current (@5.5V, 85°C)	Max Clock Frequency	Typical E/W Endurance	Typical Meter Selection	Typical Packages in Meters
93LC46B	EEPROM	µwire	1K	1.8V to 5.5V	1 µA	3 MHz	> 1M cycles	Heat	8-SN, 8-P
24AA02	EEPROM	I²C™	2K	1.8V to 5.5V	1 µA	400 kHz	> 1M cycles	Gas, Water	5-OT, 8-SN, 8-MS, 8-ST
24AA024	EEPROM	I²C	2K	1.8V to 5.5V	1 µA	400 kHz	> 1M cycles	Water	8-SN, 8-MS, 8-ST
93LC66B	EEPROM	µwire	4K	2.5V to 5.5V	1 µA	3 MHz	> 1M cycles	Heat	8-SN, 8-P
24AA08	EEPROM	I²C	8K	1.8V to 5.5V	1 µA	400 kHz	> 1M cycles	Electricity	8-SN, 8-MS, 8-ST
24AA16	EEPROM	I²C	16K	1.8V to 5.5V	1 µA	400 kHz	> 1M cycles	Electricity	8-SN, 8-MS, 8-ST
24AA64	EEPROM	I²C	64K	1.8V to 5.5V	1 µA	400 kHz	> 1M cycles	Electricity, Heat	8-SN, 8-MS, 8-ST
24AA128	EEPROM	I²C	128K	1.8V to 5.5V	1 µA	1 MHz	> 1M cycles	Electricity, Gas	8-SN, 8-MS, 8-ST
24AA256	EEPROM	I²C	256K	1.8V to 5.5V	1 µA	1 MHz	> 1M cycles	Electricity	8-SN, 8-MS, 8-ST
25AA256	EEPROM	SPI	256K	1.8V to 5.5V	1 µA	10 Mhz	> 1M cycles	Electricity	8-SN, 8-MS, 8-ST
24AA512	EEPROM	I²C	512K	1.8V to 5.5V	1 µA	1 MHz	> 1M cycles	Electricity, Water	8-SN, 8-SM
25AA512	EEPROM	SPI	512K	1.8V to 5.5V	10 µA	20 MHz	> 1M cycles	Electricity	8-SN, 8-SM
24AA1025	EEPROM	I²C	1M	1.8V to 5.5V	5 µA	1 MHz	> 1M cycles	Electricity, Water	8-SN, 8-SM
25AA1024	EEPROM	SPI	1M	1.8V to 5.5V	12 µA	20 MHz	> 1M cycles	Electricity	8-SM
23K640	SRAM	SPI	64K	2.7V to 5.5V	4 µA	20 MHz	∞	Electricity	8-SN, 8-ST
23K256	SRAM	SPI	256K	2.7V to 5.5V	4 µA	20 MHz	∞	Electricity	8-SN, 8-ST
23LC512	SRAM	SPI	512K	2.5V to 5.5V	4 µA	20 MHz	∞	Electricity	8-SN, 8-ST
23LC1024	SRAM	SSPI	1024K	2.5V to 5.5V	4 µA	20 MHz	∞	Electricity	8-SN, 8-ST

Recommended Real-Time Clock/Calendar (RTCC) Products

Device	Interface	Outputs	Digital Trim(1) (Adj/Range)	SRAM (Bytes)	EEPROM (kbits)	Protected EEPROM (bits)	Protected EEPROM contents	Minimum Voltage	Additional Features	Pins	Packages
MCP7940N	I²C™	1 MFP (IRQ/CLK)	+1 ppm ±129 ppm	64	–	0	–	V_{CC}: 1.8V V_{BAT}: 1.3V	Battery Switchover, Power-Fail Timestamp	8	SOIC (SN), TTSOP (ST), MSOP (MS), TDFN (MNY)
MCP79410	I²C	1 MFP (IRQ/CLK)	+1 ppm ±129 ppm	64	1	64	Blank ID	V_{CC}: 1.8V V_{BAT}: 1.3V	Battery Switchover, Power-Fail Timestamp	8	SOIC (SN), TTSOP (ST), MSOP (MS), TDFN (MNY)
MCP79411	I²C	1 MFP (IRQ/CLK)	+1 ppm ±129 ppm	64	1	64	EUI-48	V_{CC}: 1.8V V_{BAT}: 1.3V	Battery Switchover, Power-Fail Timestamp	8	SOIC (SN), TTSOP (ST), MSOP (MS), TDFN (MNY)
MCP79412	I²C	1 MFP (IRQ/CLK)	+1 ppm ±129 ppm	64	1	64	EUI-64	V_{CC}: 1.8V V_{BAT}: 1.3V	Battery Switchover, Power-Fail Timestamp	8	SOIC (SL), TSSOP (ST), MSOP (MS), TDFN (MNY)
MCP79520	SPI	1 MFP (IRQ/CLK)	+1 ppm ±259 ppm	64	2	128	Blank ID	V_{CC}: 1.8V V_{BAT}: 1.3V	Battery Switchover, Power-Fail Timestamp	10	MDOP (MS), TDFN (MN)
MCP795W20	SPI	1) CLK 2) IRQ 3) WDO RST	+1 ppm ±259 ppm	64	2	128	Blank ID	V_{CC}: 1.8V V_{BAT}: 1.3V	Battery Switchover, Power-Fail Timestamp, Watchdog, Events	14	SOIC (SL), TSSOP (ST)

Note 1: 1 ppm is approximately 86 msec/day
Note 2: Unique ID is 64 bits (I²C) and 128 bits (SPI) of protected EEPROM.

Product Specifications

Recommended Analog and Interface Solutions

Analog-to-Digital Converters

Device	Resolution (bits)	Maximum Sampling Rate (samples/sec)	# of Input Channels	Interface	Supply Voltage Range (V)	Typical Supply Current (µA)	Typical INL	Temperature Range (°C)	Features
MCP3421/2/3/4	18 to 12	4 to 240	1/2/2/4 Diff	I²C™	2.7 to 5.5	155	10 ppm	–40 to +125	PGA, VREF
MCP3425/6/7/8	16 to 12	15 to 240	1/2/2/4 Diff	I²C	2.7 to 5.5	155	10 ppm	–40 to +125	PGA, VREF
MCP3201/2/4/8	12	100k	1/2/4/8 SE	SPI	2.7 to 5.5	400	±1 LSB	–40 to +85	–

Op Amps

Device	Amplifiers Per Package	GBWP (kHz)	Iq/Amp Typical (µA)	Vos Max (µV)	Operating Voltage (V)
MCP644X	1/2/4	9	0.45	4500	1.4–6.0
MCP603X	1/2/4	10	0.9	150	1.8–5.5
MCP6V1X	1/2/4	80	7.5	8	1.6–5.5
MCP642X	1/2/4	90	4.4	1000	1.8–5.5
MCP6V3X	1/2/4	300	23	8	1.8–5.5
MCP640X	1/2/4	1000	45	4500	1.8–6.0

Temperature Sensors

Device	Typical Accuracy (°C)	Maximum Accuracy @ 25°C (°C)	Maximum Temperature Range (°C)	Vcc Range (V)	Maximum Supply Current (µA)	Interface
MCP9800	0.5	1	–55 to +155	2.7 to 5.5	400	I²C
TCN75A	0.5	1	–55 to +125	2.7 to 5.5	400	I²C
TC77	0.5	3	–55 to +125	2.7 to 5.5	400	SPI

Recommended Wireless Solutions

IEEE 802.15.4 Transceivers/Modules

Device	Pin Count	Freq. Range	Sensitivity	Power Output	RSSI	Tx Pwr	Rx Pwr	Clock	Sleep	MAC	MAC Feature	Encryption	Interface	Packages
MRF24J40	40	2.405–2.48	–95	0	Yes	23	19	20 MHz	Yes	Yes	CSMA-CA	AES128	4-wire SPI	40-QFN
MRF24J40MA	12	2.405–2.48	–95	0	Yes	23	19	20 MHz	Yes	Yes	CSMA-CA	AES128	4-wire SPI	12/Module
MRF24J40MD	12	2.405–2.475	–102	20	Yes	130	25	20 MHz	Yes	Yes	CSMA-CA	AES128	4-wire SPI	12/Module
MRF24J40MC	12	2.405–2.475	–102	20	Yes	130	25	20 MHz	Yes	Yes	CSMA-CA	AES128	4-wire SPI	12/Module

Sub-GHz Transceivers/Modules

Device	Pin Count	Freq. Range	Sensitivity	Power Output	RSSI	Tx Pwr	Rx Pwr	Clock	Sleep	Interface	Packages
MRF49XA	16	433/868/915	–110	7	Yes	15 mA @ 0 dBm	11	10 MHz	Yes	4-wire SPI	16-TSSOP
MRF89XA	32	868/915/950	–113	12.5	Yes	25 mA @ 10 dBm	3	12.8 MHz	Yes	4-wire SPI	32-TQFN
MRF89XAM8A	12	868 MHz	–113	12.5	Yes	25 mA @ 10 dBm	3	12.8 MHz	Yes	4-wire SPI	12/Module
MRF89XAM9A	12	915 MHz	–113	12.5	Yes	25 mA @ 10 dBm	3	12.8 MHz	Yes	4-wire SPI	12/Module

Bluetooth® Modules

Device	Bluetooth® Spec	Frequency Range (GHz)	Sensitivity (dBm)	Power Output (Typ. dBm)	RSSI	Tx Pwr	Rx Pwr	Sleep Pwr	Interface	Packages
RN4020	4.1 BTLE	2.4000–2.4835	–92	7	Yes	16 mA @ 0 dBm	16 mA	< 5 µA @ 3.0V	ASCII over UART	SMT Module
RN41	2.1 + EDR	2.402–2.480	–80	16	Yes	65 mA @ 15 dBm	45 mA	26 µA @ 3.3V	ASCII over UART	SMT Module
RN42	2.1 + EDR	2.402–2.480	–80	2	Yes	25 mA @ 2 dBm	45 mA	26 µA @ 3.3V	ASCII over UART	SMT Module

IEEE 802.11 Modules

Device	Radio	Power Consumption						Max. Power Output	Sustained Throughout	Host MCU
		Off*	Sleep**	PS	Rx	Tx				
RN171	802.11 b/g	–	4 µA	–	30 mA	120 mA (0 dBm)	185 mA (+10 dBm)	+12 dBm	Up to 2.7 mbps	On module or any MCU
RN131G/RN131C	802.11 b/g	–	4 µA	–	40 mA	210 mA (+18 dBm)		+18 dBm	Up to 2.7 mbps	On module or any MCU
MRF24WB0MA/MB	802.11 b/g	0.1 µA	–	250 µA	85 mA	154 mA		+10 dBm	Up to 1 mbps	PIC® MCU
MRF24WG0MA/MB	802.11 b/g	0.1 mA	–	4 mA	95 mA	240 mA		+18 dBm	Up to 5 mbps	PIC MCU

*__Off:__ denoted as Hibernate state of MRF24WB0MA/MB. State information is not saved.
**__Sleep mode:__ device state saved, wake on input change and RTC active.

Resources

Application Notes and Tech Briefs

Metering

AN939	Designing Energy Meters with the PIC16F873A
AN994	IEC Compliant Active-Energy Meter Design Using the MCP3905/6
AN1013	Gas and Water Metering with the PIC16F91X Family
AB1426	Design Tips for the MCP3911
AN1300	Designing with the MCP3901 Dual Channel Analog-to-Digital Converters
TB1092	Designing Heat Meters Using PIC16F9XX Microcontrollers
AN1607	PIC24FJ128GC010 Analog Design Guide

Communications

AN833	Microchip TCP/IP Stack Application Note
AN979	Interfacing I^2C Serial EEPROMs to PIC18 Devices
AN1255	Microchip ZigBee PRO Feature Set Protocol Stack

Display

AN234	Hardware Techniques for PIC Microcontrollers
AN529	Multiplexing LED Drive and 4 × 4 Keypad Sampling
AN557	Four Channel Digital Voltmeter with Display and Keyboard
AN563	Using PIC16C5X Microcontrollers as LCD Drivers
AN587	Interfacing PIC Microcontrollers to an LCD Module
AN658	LCD Fundamentals Using PIC16C92X Microcontrollers
TB029	Complementary LED Drive
TB062	High Power IR LED Driver Using the PIC16C781/782

Temperature Sensing

AN1333	Use and Calibration of the Internal Temperature Indicator
TB3016	Using the PIC MCU CTMU for Temperature Measurement

Security

AN583	Implementation of the Data Encryption Standard Using PIC17C42
AN821	Advanced Encryption Standard Using the PIC16XXX
AN953	Data Encryption Routines for PIC18 Microcontrollers

Timekeeping

AN582	Low-Power Real-Time Clock
AN590	A Clock Design Using the PIC16C54 for LED Displays and Switch Inputs
AN615	Clock Design Using Low Power/Cost Techniques
AN649	Yet Another Clock Featuring the PIC16C924
AN1155	Run-Time Calibration of Watch Crystals
AN1365	Recommended Usage of Microchip's I^2C Serial RTCC Devices
TB028	Technique to Calculate Day of Week

Miscellaneous

AN606	Low-Power Design Using PIC Microcontrollers
AN828	Measuring Temperature with the PIC16F84A Watchdog Timer
AN851	A Flash Bootloader for PIC16 and PIC18 Devices
AN871	Solving Thermal Measurement Problems Using the TC72 and TC77 Digital Silicon Temperature Sensors
AN913	Interfacing the TC77 Thermal Sensor to a PIC Microcontroller
AN981	Interfacing a MCP9700 Analog Temperature Sensor to a PIC MCU
ADN011	Flexible Integrated Temp Sensors Lower System Costs
TB008	Transformerless Power Supply Temperature Sensing

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