Utility Metering Solutions

Spring 2011

MICROCHIP

Complete Utility Metering Solutions

www.microchip.com/meter

Design Innovation in Energy, Gas, Water and Heat Meters

The metering market is facing many challenges in today's rapidly evolving world. Government regulations, competitive forces, technology innovations and end customer expectations are fueling unprecedented changes in this market. Having a "smart" partner who can help you stay current and allow you to react quickly will be the difference between success and failure.

With today's meter designs, innovation rests in many areas – some driven by migrations from mechanical meters to first-time electronic intelligence, while others are driven by the advanced intelligence and two-way communications of smart meters and the demands of tomorrow's smart grids. Microchip understands the design challenges facing meter designers, whether it's increasing meter accuracy and reliability while lowering total system cost or engaging the end customer in their home as part of the home area network. Our solutions are used in millions of meters worldwide, Microchip wants to be a partner in your success, not 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 designers 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
- Simplify meter calibration
- mTouch™ sensing solutions enable designers to easily integrate touch-sensing functionality into their designs

Our free MPLAB® 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.

Out Metering Design Center features complete access to all of Microchip's metering application notes, software libraries, reference designs and other technical documentation to help engineers get their 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.

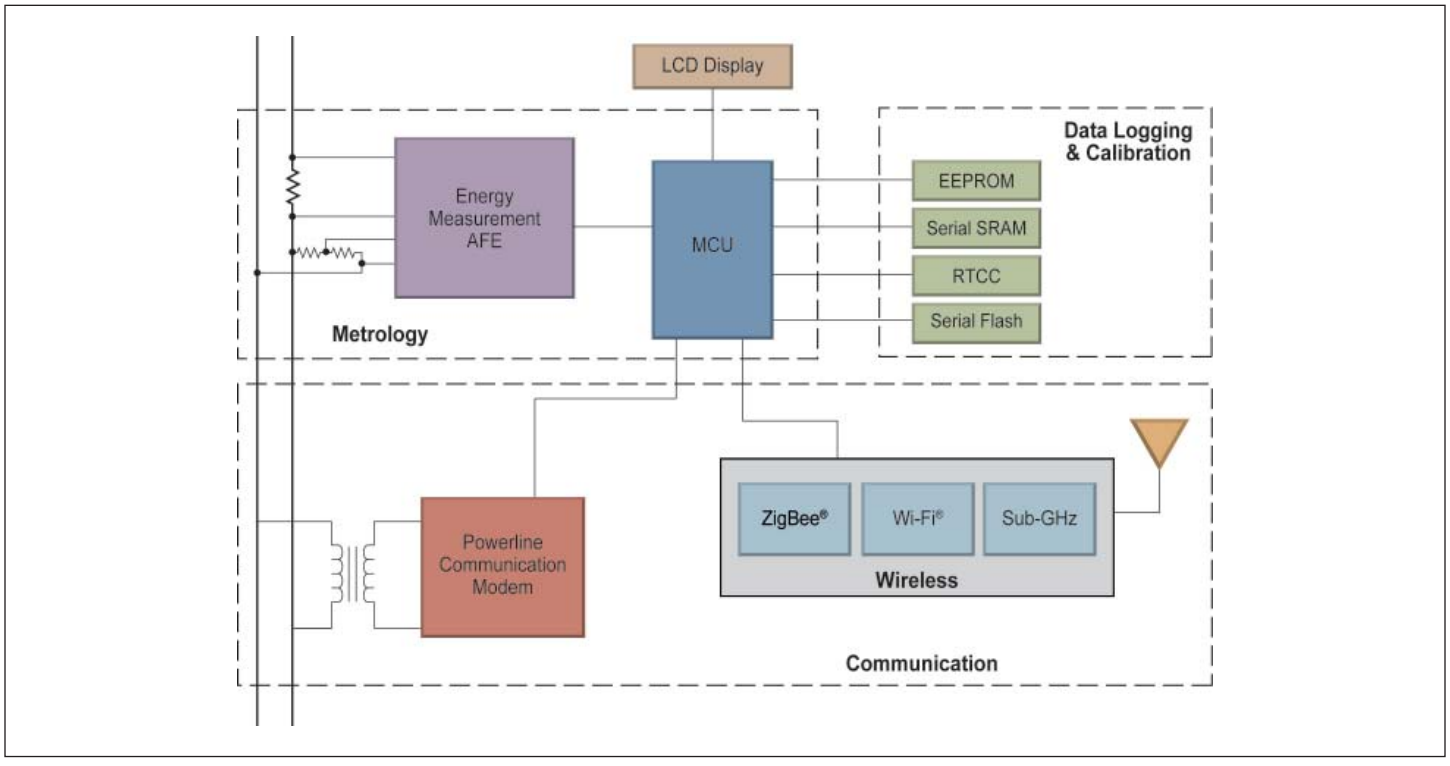
We are committed to being part of your success.

Energy Measurement ICs

The MCP390X devices are highly accurate energy measurement analog front ends. When paired with a PIC® microcontroller, engineers have a complete, highly accurate solution for energy measurement in utility metering and other power monitoring applications.

The MCP3901 features two 16/24-bit resolution delta-sigma A/D converters, an internal voltage reference, and a Programmable Gain Amplifier (PGA) with gain up to 32. The 91 dB SINAD and -104 dB THD performance make it ideal for energy measurement applications. The MCP3905A, MCP3906A and MCP3909 feature similar performance in addition to having a dedicated active power calculation block giving a measurement error of 0.1% over a 1000:1 dynamic range.

Basic Smart Meter



Utility Metering Solutions and Development Systems

Microcontrollers and Digital Signal Controllers

To enable a wide range of utility metering solutions, Microchip offers a flexible Microcontroller (MCU) and Digital Signal Controller (DSC) platform solution with a common Integrated Development Environment (IDE) – MPLAB. The broad portfolio of 8-/16-/32-bit MCUs and DSCs lowers total system cost by enabling the appropriate level of integration (including display functions, real-time clock and calendar, and temperature sensing with the Charge Time Measurement Unit (CTMU)) to match utility metering system requirements and reducing battery life through eXtreme Low Power (XLP) performance. Design flexibility for adapting to changing or local system requirements is provided through our unique approach that allows easy migration across the entire MCU and DSC portfolio. Available 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 Microchip's energy measuring IC with any MCU or DSC.

Analog and Interface Devices

From devices for measuring temperature and signals to flow sensors and infrared interfaces, Microchip provides a wide portfolio of analog and interface components that are well suited for metering applications. Low power, precision operational amplifiers enable signal acquisition for accurate measurements of current, voltage, temperature or flow. Microchip's family of digital temperature sensors provide 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.

Memory Products

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

With SPI-compatible Serial SRAM devices, unlimited endurance and fast Write times can be supported. When non-volatile memory is needed, Microchip has very high endurance Serial EEPROMs that have 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, Microchip's 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 that capability. SuperFlash products also support cost effective non-volatile memory data storage solutions while offering industry-leading features coupled with fixed and fast program/erase times, ultra-low power consumption, high endurance and excellent reliability. For more information visit **www.microchip.com/memory.**

I²C™ Real-Time Clock/Calendar (RTCC)

For the various timekeeping needs, Microchip now offers the MCP794XX family of Real-Time Clocks which have a usable amount of non-volatile SRAM, EEPROM and a battery switchover circuit for backup power. For accurate timekeeping 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 among other technologies. The dsPIC® Digital Signal Controller (DSC) general purpose family is well suited for low cost energy meters due to its fast and efficient CPU, DMA channels and small package footprints. The PIC32MX6 family has both the performance needed to process Automated Meter Reading data and a rich set of connectivity features including UARTs, SPIs, USB and Ethernet. For more information visit **www.microchip.com/powerline.**

Wireless Communications for Smart Grid

The proposed Smart Grid initiatives are placing the meter as 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 our precious 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 walks through all of the building blocks and considerations in creating 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 engineers get their products to market quickly and efficiently.

Development Systems

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

Utility Metering Development Systems

MCP3909 and PIC18F85J90 Single Phase Energy Meter Reference Design (MCP3909RD-1PH1)

This fully functional single phase meter uses a half wave rectified power supply circuit and a shunt current sensing element. A single MCP3909 acts as the analog front end measurement circuitry. The PIC18F85J90 directly drives the LCD glass and displays active energy consumption and can be used to create custom calibration setups. The firmware available on the reference design is intended for flexibility in upgrading to various PIC® microcontrollers.

MCP3909 and PIC18F25K20 Single Phase Energy Meter Reference Design (MCP3909RD-PM1)

This fully functional single phase meter is intended to be low cost and uses a shunt current sensing element. A single MCP3909 acts as the analog front end measurement circuitry. The LCD module is used to display RMS current, RMS voltage, power factor and active power. The meter design is intended to be flexible and able to be upgraded to a variety of PIC microcontrollers.

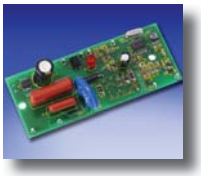
MCP3901 ADC Evaluation Board for 16-bit MCUs (MCP3901EV-MCU16)

This evaluation board for 16-bit MCUs provides the ability to evaluate the performance of the MCP3901 dual channel ADC. It also provides a development platform for 16-bit PIC based applications using existing 100-pin PIM systems. A LabVIEW software interface enables viewing of the MCP3901 performance via USB interface.

MCP3909 3-Phase Energy Meter Reference Design (MCP3909RD-3PH1)

This reference design is a fully functional 3-phase energy meter including PC software used for automated calibration. The reference design consists of two boards: the main metering board with the MCP3909 devices and PIC18F2520 that performs the power calculations, and the USB interface module which uses the PIC18F4550. The meter design contains serially accessible registers and is intended to be flexible and upgraded with a variety of PIC microcontrollers using the included firmware.

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 for high accuracy energy meter designs. The board is compliant with EMC requirements per energy metering standards IEC62053 and legacy IEC61036, IEC1046 and IEC687.

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 MCU 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.

MCP3905A Energy Meter Evaluation Board (MCP3905EV)

This evaluation board allows the user to test a variety of energy meter designs. On the input side, high voltage line and load AC-plug headers are included, along with mounting holes for shunts, current transformers and screw-type connections for wiring. On the output side, a large prototype area is included along with optical isolation and a standard PICtail™ header for experimenting with a variety of PIC microcontroller-based energy meter designs.

PICDEM™ LCD 2 Demonstration Board (DM163030)

This board demonstrates the main features of the LCD Flash PIC microcontrollers with power management functions. The board comes populated with the PIC18F85J90, and supports other PIC16 and PIC18 LCD devices via a plug-in module, (sold separately). The included 3V LCD glass has icons, bar graphs and digits simulating many common applications. Tutorial firmware and documentation are provided. The kit is a complete solution, ready for development right out of the box.

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. Developers are able 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 ICs (IEC Compliant)

Device	Measurement Error	Dynamic Range	Interface	VREF Drift	Active Power Calculation Block	Supply Voltage Range (V)	Temperature Range (C°)	Packages
MCP3901	–	91 dB	SPI	15ppm	No	4.5-5.5V	-40 to +85°C	20-SSOP, 20-QFN
MCP3905A	0.1%	500:1	Pulse Output	15 ppm	Yes	4.5-5.5V	-40 to +85°C	24-SSOP
MCP3906A	0.1%	1000:1	Pulse Output	15 ppm	Yes	4.5-5.5V	-40 to +85°C	24-SSOP
MCP3909	0.1%	1000:1	SPI, Pulse Output	15 ppm	Yes	4.5-5.5V	-40 to +85°C	24-SSOP

Recommended 8-bit PIC® Microcontrollers

Device	Flash Program Memory (bytes)	Data RAM (bytes)	EEPROM Data Memory (bytes)	I/O	ADC Channel (Resolution)	Comparators	MSSP (I²C™ or SPI)/ Serial USART	CCP/ ECCP	LCD Segments	Timers 8/16-bit	Real-Time Clock	Pins
PIC16F722	3.5k	128	–	25	11	–	1/1	2/-	–	2/1	Timer 1	28
PIC16F1827	7k	384	256	16	12	2	2/1	2/2	–	4/1	Timer 1	18
PIC16F690	7k	256	256	18	12	2	1/1	-/1	–	2/1	Timer 1	20
PIC16F1936	14k	512	256	25	11	2	1/1	2/3	60	4/1	Timer 1	28
PIC16F727	14k	368	–	36	14	–	1/1	2/-	–	2/1	Timer 1	40/44
PIC16F1947	28k	1024	256	53	17	3	2/2	2/3	184	4/1	Timer 1	64
PIC18F25K20	32k	1536	256	25	11	2	1/1	1/1	–	1/3	Timer 1	28
PIC18F65J90	32k	2048	–	51	12 (10-bit)	2	1/2	2	132	1/3	Timer 1	64
PIC18F65J11	32k	2048	–	52	12 (10-bit)	2	1/2	2	–	1/3	Timer 1	64
PIC18F46K22	64k	3896	1024	36	28	2	2/2	2/2	–	3/4	Timer 1	40/44
PIC18F66J90/3	64k	3923	–	51	12 (10-bit)	2	1/2	2	132	1/3	HW RTCC*	64
PIC18F66J11	64k	3930	–	52	11 (10-bit)	2	2/2	5	–	2/3	Timer 1	64
PIC18F86J90/3	64k	3923	–	67	12 (10-bit)	2	1/2	2	192	1/3	HW RTCC	80
PIC18F66J16	96K	3930	–	52	11 (10-bit)	2	2/2	5	–	2/3	Timer 1	64
PIC18F67J90/3	128k	3923	–	51	12 (10-bit)	2	1/2	2	132	1/3	HW RTCC	64
PIC18F67J11	128k	3930	–	52	11 (10-bit)	2	2/2	5	–	2/3	Timer 1	64
PIC18F87J90/3	128k	3923	–	67	12 (10-bit)	2	1/2	2	192	1/3	HW RTCC	80

Recommended 8-bit PIC® Microcontrollers with Energy Measurement AFE

Device	Flash Program Memory (bytes)	Data RAM (bytes)	EEPROM Data Memory (bytes)	I/O	ADC Channel (Resolution)	Comparators	MSSP (I²C™ or SPI)/ Serial USART	CCP/ ECCP	LCD Segments	Timers 8/16-bit	Real-Time Clock	Pins
PIC18F86J72	64k	3923	–	51	2 (16/24-bit) & 12 (12-bit)	2	1/2	2	132	1/3	HW RTCC*	64
PIC18F87J72	128k	3923	–	51	2 (16/24-bit) & 12 (12-bit)	2	1/2	2	132	1/3	HW RTCC	64

Recommended 16-bit PIC® Microcontrollers

Device	Flash Program Memory (bytes)	Data RAM (bytes)	EEPROM Data Memory (bytes)	I/O	ADC Channel (Resolution)	Comparators	I²C™/SPI/ Serial USART	CCP/ ECCP	LCD Segments	Timers 8/16-bit	Real-Time Clock	Pins
PIC24FJ128GA106	128K	16K	–	53	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC*	64
PIC24FJ128GA108	128K	16K	–	69	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	80
PIC24FJ128GA110	128K	16K	–	85	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	100
PIC24FJ192GA106	192K	16K	–	53	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	64
PIC24FJ192GA108	192K	16K	–	69	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	80
PIC24FJ192GA110	192K	16K	–	85	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	100
PIC24FJ256GA106	256K	16K	–	53	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	64
PIC24FJ256GA108	256K	16K	–	69	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	80
PIC24FJ256GA110	256K	16K	–	85	16 (10-bit)	3	3/3/4	9/9	–	5	HW RTCC	100

Recommended 32-bit PIC® Microcontrollers

Device	Flash Program Memory (bytes)	Data RAM (bytes)	EEPROM Data Memory (bytes)	I/O	ADC Channel (Resolution)	I²C™/SPI/ Serial UART	FS USB OTG	CAN	Ethernet 10/100	CCP/ PWM	Timers 16/32-bit	Real-Time Clock	Pins
PIC32MX340F128H	128k	32k	–	53	16 (10-bit @ 1 Msps)	2/2/2	–	–	–	5	5/1	HW RTCC*	64
PIC32MX440F128H	128k	32k	–	51	16 (10-bit @ 1 Msps)	2/1/2	1	–	–	5	5/1	HW RTCC	64
PIC32MX543F064L	64k	16k	–	85	16 (10-bit @ 1 Msps)	5/4/6	1	1	–	5	5/2	HW RTCC	100
PIC32MX675F256L	256k	64k	–	85	16 (10-bit @ 1 Msps)	5/4/6	1	–	1	5	5/2	HW RTCC	100
PIC32MX795F512L	512k	128k	–	85	16 (10-bit @ 1 Msps)	5/4/6	1	2	1	5	5/2	HW RTCC	100

*RTCC: Real-Time Clock and Calendar

Product Specifications

Recommended dsPIC® Digital Signal Controllers (DSC)

Device	Flash Program Memory (bytes)	Data RAM (bytes)	EEPROM Data Memory (bytes)	I/O	Analog (Resolution)	Comparators	I²C™/SPI/ Serial USART	OC/ PWM	LCD Segments	Timers 8/16-bit	Pins
dsPIC33FJ64GP206A	64K	8K	–	53	18 (10-bit @ 1.1 Msps) (12-bit @ 500 ksps)	–	1/2/2	8	–	5	64
dsPIC33FJ128GP206A	128K	8K	–	53	18 (10-bit @ 1.1 Msps) (12-bit @ 500 ksps)	–	1/2/2	8	–	5	64
dsPIC30F30F6014A	144K	8K	4K	68	16 (12-bit @ 200 ksps)	–	1/2/2	8	–	5/2	80

Recommended Flash Memory

Device	Memory Type	Bus	Density (bits)	Operating Voltage	Typical Standby Current	Speed	Typical Program/Erase Endurances	Supported Packages
SST25VF512A/010A	Flash	SPI	512K to 1M	2.7V to 3.6V	8 µA	33 MHz	100K cycles	8-SOIC, 8-TDFN-5, 8-XFBGA
SST25VF020B/040B/080B	Flash	SPI	2M to 8M	2.7V to 3.6V	5 µA	80 MHz	100K cycles	8-SOIC, 8-TDFN-5, 8/8/16-XFBGA
SST25VF016B/032B	Flash	SPI	16M to 32M	2.7V to 3.6V	5 µA	up to 80 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST25VF064C	Flash	SPI	64M	2.7V to 3.6V	5 µA	80 MHz	100K cycles	8-SOIC, 16-SOIC, 8-TDFN-8
SST25WF512/010/020/040/080	Flash	SPI	512K to 8M	1.65V to 1.95V	2/2/2/2/5 µA	up to 75 MHz	100K cycles	8-SOIC, 8-TDFN-5, 8-XFBGA
SST26VF016/032	Flash	SQI®	16M to 32M	2.7V to 3.6V	8 µA	80 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST26WF032	Flash	SQI	32M	1.65V to 1.95V	8 µA	80 MHz	100K cycles	8-SOIC, 8-TDFN-5
SST39VF512/010/020/040	Flash	x8 Parallel	512K to 4M	2.7V to 3.6V	1 µA	55 ns, 70 ns	100K cycles	32-PLCC, 32-TSOP, 48-TFBGA, 34-WFBGA
SST39VF200A/400A	Flash	x16 Parallel	2M to 4M	2.7V to 3.6V	3 µA	55 ns, 70 ns	100K cycles	48-TSOP, 48-TFBGA, 48-WFBGA, 48-XFLGA
SST39VF801C/802C	Flash	x16 Parallel	8M	2.7V to 3.6V	3 µA	55 ns, 70 ns	100K cycles	48-TSOP, 48-TFBGA, 48-WFBGA
SST39VF1601C/1602C	Flash	x16 Parallel	16M	2.7V to 3.6V	3 µA	70 ns	100K cycles	48-TSOP, 48-TFBGA
SST39VF3201C/3202C	Flash	x16 Parallel	32M	2.7V to 3.6V	3 µA	70 ns	100K cycles	48-TSOP, 48-TFBGA
SST38VF6401/2/3/4	Flash	x16 Parallel	64M	2.7V to 3.6V	3 µA	90 ns	100K cycles	48-TSOP, 48-TFBGA
SST39WF400B/800B	Flash	x16 Parallel	4M to 8M	1.65V to 1.95V	5 µA	70 ns	100K cycles	48-TFBGA, 48-WFBGA, 48-XFLGA
SST39WF1601/2	Flash	x16 Parallel	16M	1.65V to 1.95V	2 µA	70 ns	100K cycles	48-TFBGA, 48-WFBGA

Recommended Serial Memory

Device	Memory Type	Bus	Density (bits)	Operating Voltage	Max Standby Current (@5.5V, 85°C)	Max. Clock Frequency	Typical E/W Endurance	Typical Meter Selection	Typical Packages in Meters
93LC46B	EEPROM	µwire	1K	2.5V to 5.5V	1 µA	3 MHz	>1M cycles	Heat	8-SN, 8-P
24LC02B	EEPROM	I²C	2K	2.5V to 5.5V	1 µA	400 kHz	>1M cycles	Gas, Water	5-OT, 8-SN, 8-MS, 8-ST
24LC024	EEPROM	I²C	2K	2.5V 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
24LC08B	EEPROM	I²C	8K	2.5V to 5.5V	1 µA	400 kHz	>1M cycles	Electricity	8-SN, 8-MS, 8-ST
24LC16B	EEPROM	I²C	16K	2.5V to 5.5V	1 µA	400 kHz	>1M cycles	Electricity	8-SN, 8-MS, 8-ST
24LC64	EEPROM	I²C	64K	2.5V to 5.5V	1 µA	400 kHz	>1M cycles	Electricity, Heat	8-SN, 8-MS, 8-ST
24LC128	EEPROM	I²C	128K	2.5V to 5.5V	1 µA	1 MHz	>1M cycles	Electricity, Gas	8-SN, 8-MS, 8-ST
24LC256	EEPROM	I²C	256K	2.5V 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
24LC512	EEPROM	I²C	512K	2.5V 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
24LC1025	EEPROM	I²C	1M	2.5V 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 3.6V	4 µA	20 MHz	∞	Electricity	8-SN, 8-ST
23K256	SRAM	SPI	256K	2.7V to 3.6V	4 µA	20 MHz	∞	Electricity	8-SN, 8-ST

Recommended Real-Time Clock/Calendar (RTCC) Products

Device	Alarm(1) Settings	Outputs	Digital Trim(2) (Adj/Range)	SRAM (Bytes)	EEPROM (Kbits)	ID(3)/ MAC	Minimum Voltage	IBAT (nA)	Additional Features	Packages
MCP79410	2	1 MFP (IRQ/CLK)	+1 ppm ±127 ppm	64	1	Blank ID	VCC: 1.8V VBAT: 1.3V	700	Battery Switchover, Power-Fail Timestamp	8-SN, 8-MS, 8-ST, 8-MNY
MCP79411	2	1 MFP (IRQ/CLK)	+1 ppm ±127 ppm	64	1	EUI-48	VCC: 1.8V VBAT: 1.3V	700	Battery Switchover, Power-Fail Timestamp	8-SN, 8-MS, 8-ST, 8-MNY
MCP79412	2	1 MFP (IRQ/CLK)	+1 ppm ±127 ppm	64	1	EUI-64	VCC: 1.8V VBAT: 1.3V	700	Battery Switchover, Power-Fail Timestamp	8-SN, 8-MS, 8-ST, 8-MNY

Note 1: Alarm settings on 1 second count.
Note 2: 1 PPM is approximately 86 msec/day.
Note 3: Unique ID is 64 bits of protected EEPROM.

Product Specifications and Utility Metering Resources

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	# per pkg	GBWP (kHz)	Iq Typical (µA)	Vos Max (mV)	Operating Voltage (V)	Temperature Range (C°)
MCP602	2	2,800	230	2000	2.7 to 6.0	-40 to +125
MCP6272	2	2,000	170	3000	2.0 to 6.0	-40 to +125
MCP6292	2	10,000	1000	3000	2.4 to 6.0	-40 to +125

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
MRF24J40MB	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

IEEE 802.11 Modules

Device	Pin Count	Freq. Range	Sensitivity	Power Output	RSSI	Tx Pwr	Rx Pwr	Clock	Sleep	MAC	MAC Feature	Encryption	Interface	Packages
MRF24WB0MA	36	2.412-2.484	-91	10	Yes	156	85	25 MHz	0.1	Yes	802.11	WPA, WPA-2, WEP	4-wire SPI	36/Module
MRF24WB0MB	36	2.412-2.484	-91	10	Yes	156	85	25 MHz	0.1	Yes	802.11	WPA, WPA-2, WEP	4-wire SPI	36/Module

Application Notes & 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
AN1300 Designing with the MCP3901 Dual Channel Analog-to-Digital Converters
TB1092 Designing Heat Meters Using PIC16F9XX Microcontrollers

Communications

AN833 Microchip TCP/IP Stack Application Note
AN979 Interfacing I²C™ 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 4x4 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 I²C 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 Microcontroller
ADN011 Flexible Integrated Temp Sensors Lower System Costs
TB008 Transformerless Power Supply Temperature Sensing

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