Utility Metering Solutions

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Complete Utility Metering Solutions

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Design Innovation in Gas, Water, Heat and Energy Meters

Engineers face a variety of design challenges as they push new innovations within their own applications. In meter designs, innovation usually rests with increasing accuracy and reliability while lowering total system cost. This is true whether designers are creating the next-generation electronic utility meter or migrating an existing mechanical meter design to contain first-time electronic intelligence.

Several new devices have been introduced to address the metering design challenges of accurate power measurement, low cost display interfaces, low power consumption, remote communication and billing.

Microchip offers a complete portfolio of 8- and 16-bit microcontrollers, 16-bit digital signal controllers, energy measurement integrated circuits (ICs), analog components and serial EEPROMs which allows 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 technology
- Integrate real time clock for advanced billing schemes
- Simplify meter calibration

Recommended Product Families for Utility Metering Designs

Device Type	Gas Meter	Water Meter	Energy Meter	Heat Meter
8-bit PIC®Microcontrollers	PIC16F648A PIC16F722 PIC16F726 PIC16F727 PIC16F886	PIC16F887 PIC16F916 PIC16F917 PIC16F690 PIC16F946	PIC18F6390 PIC18F6490 PIC18F8390 PIC18F8490 PIC18F6393	PIC18F6493 PIC18F8393 PIC18F8493 PIC18F65J90 PIC18F85J90
16-bit PIC® Microcontrollers	PIC24FJ64GA004 PIC24FJ128GA010	PIC24FJ64GA004 PIC24FJ128GA010	PIC24FJ64GA004 PIC24FJ128GA010	PIC24FJ64GA004 PIC24FJ128GA010
16-bit dsPIC® Digital Signal Controller			dsPIC30F3012 dsPIC33FJ64GP206 dsPIC33FJ128GP206	
Energy Measurement ICs			MCP3909 MCP3906A MCP3905A	
Interface (Infrared)			MCP2122 MCP2120	MCP2122 MCP2120
Display	AY0438	AY0438	AY0438	AY0438
Op Amps	MCP6141 MCP601	MCP6141 MCP601	MCP6142 MCP602 MCP6022	MCP6141 MCP601 MCP6021
Programmable Gain Amplifiers			MCP6S28	
ADCs			MCP3304 MCP3208 MCP3008	MCP3304 MCP3208 MCP3008
Digital Potentiometers	MCP4012	MCP4012	MCP4251 MCP4012	MCP4251 MCP4012
DACs			MCP4821	
Voltage Supervisors	MCP131 MCP100	MCP131 MCP100	MCP131 MCP100	MCP131 MCP100
Temperature Sensors			TCN75A TC77 MCP9801	MCP9700 MCP9701
Serial EEPROMs	Yes	Yes	Yes	Yes
Development Systems	MPLAB® ICD 2 In-Circuit Debugger PICkit™ 2 Flash Starter Kit PICDEM™ LCD 2 Demonstration Board	MPLAB® ICD 2 In-Circuit Debugger PICkit™ 2 Flash Starter Kit PICDEM™ LCD 2 Demonstration Board	MPLAB® ICD 2 In-Circuit Debugger PICkit™ 2 Flash Starter Kit PICDEM™ LCD 2 Demonstration Board MCP3905RD-PM1 Energy Meter Reference Design MCP3905EV Evaluation Board MCP3909RD-3PH1 MCP3909 3-phase Energy Meter Reference Design MCP3909/dsPIC33F Advanced 3-phase Energy Meter Reference Design	MPLAB® ICD 2 In-Circuit Debugger PICkit™ 2 Flash Starter Kit PICDEM™ LCD 2 Demonstration Board

*This table represents a sampling of device solutions recommended for utility metering designs. Microchip's broad portfolio of 8-, 16- and 32-bit microcontrollers, 16-bit digital signal controllers, analog and interface products, serial EEPROMs and related development systems contains hundreds of products that could potentially be used for utility metering designs, depending upon the application requirements.

Energy Measurement ICs

The MCP3905A, MCP3906A and MCP3909 are fully functional, stand-alone energy measurement ICs that output average active power. When these ICs are paired with a PIC microcontroller, engineers have a complete, highly accurate solution for energy measurement in residential and industrial power meter applications.

These devices each integrate two 16-bit delta-sigma analog-to-digital converters (ADCs), an internal voltage reference, a programmable gain amplifier (PGA), and all digital circuitry needed to calculate active power from voltage and current channels. The MCP3905A features a PGA with a maximum gain of 16 and a measurement error of 0.1% typical over a dynamic range of 500:1. For energy meters requiring higher accuracy, the MCP3906A has a PGA with a maximum gain of 32 and a measurement error of 0.1% typical over a dynamic range of 1000:1. For meters requiring additional calculations, the MCP3909 can by used by accessing the ADC data from the voltage and current channels and performing calculations on a PIC MCU. These solutions meet or exceed the requirements of the International Electrotechnical Commission IEC62053 energy-metering specifications.

Microcontrollers with LCD Drivers

Most metering designs require user interfaces that are low cost and easy to use. Microcontrollers with on-board liquid crystal display (LCD) modules combine the control and interface functions in a single device.

Microchip's PIC18F85J90 and PIC16F917 series of 8-bit microcontrollers provide high-performance and cost-effective solutions for metering applications. Both families offer Flash program memory, low power consumption and integrated LCD control with a variety of features and package options.

8-/16-bit Microcontrollers and 16-bit Digital Signal Controllers

Engineers require a variety of controller options to select the optimum price and performance for their applications. Microchip offers hundreds of 8- and 16-bit microcontrollers and 16-bit digital signal controllers for metering designs with numerous choices of memory types and sizes, pin counts, peripherals and much more.

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 the reader through all of the building blocks and considerations in creating a utility metering design. The "Introduction to Utility Metering" tutorial supports those who are new to electronic design, offering an overview of the migration from mechanical meter designs to electronic-based solutions. 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 more 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 applications.

MCP3909 3-Phase Energy Meter Reference Design

Part Number: 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.

MCP3905RD-PM1 Energy Meter Reference Design Board

Part Number: 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

Part Number: DM163030

The MCP3909/dsPIC33F Advanced 3-phase Energy Meter Reference Design is a fully functional energy meter reference design with 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.

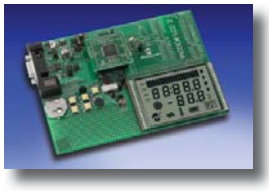
MCP3905RD-EV Energy Meter Evaluation Board

Part Number: 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

Part Number: DM163030)



The PICDEM LCD 2 Board demonstrates the main features of the LCD Flash 28-, 40-, 64- and 80-pin 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.

Visit the Utility Metering Design Center

- Recommended Products
- Application Notes
- Reference Designs
- Technical Documentation
- Development Tools

Energy Meter

Water Meter

Gas Meter

Heat Meter

www.microchip.com/meter

Application Notes & Tech Briefs

Metering

AN1013 Gas and Water Metering with the PIC16F91X Family
AN994 IEC Compliant Active-Energy Meter Design Using the MCP3905/6
AN939 Designing Energy Meters with the PIC16F873A
TB1092 Designing Heat Meters Using PIC16F9XX Microcontrollers

Communications

AN833 Microchip TCP/IP Stack Application Note
AN965 Microchip Stack for the ZigBee™ Protocol
AN979 Interfacing I^2C™ Serial EEPROMs to PIC18 Devices

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

Miscellaneous

AN606 Low-Power Design Using PIC® Microcontrollers
AN851 A Flash Bootloader for PIC16 and PIC18 Devices
TB008 Tranformerless Power Supply Temperature Sensing
AN828 Measuring Temperature with the PIC16F84A Watchdog Timer
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

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
TB028 Technique to Calculate Day of Week

Security

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

Product Specifications

Energy Measurement ICs (IEC Compliant)

Device	Measurement Error (typ.)	Dynamic Range	Output Type	PGA Gain	Supply Current (max)	Supply Voltage Range (V)	Temperature Range (C°)
MCP3905A	0.1%	500:1	Active power pulse output	1,2,8,16	4 mA	4.5 to 5.5	-40 to +85
MCP3906A	0.1%	1000:1	Active power pulse output	1,8,16,32	4 mA	4.5 to 5.5	-40 to +85
MCP3909	0.1%	1000:1	SPI interface with simultaneous active power pulse output	1,2,8,16	4 mA	4.5 to 5.5	-40 to +85

8-bit PIC® Microcontrollers

Device	Flash Program Memory Bytes	Data RAM Bytes	EEPROM Data Memory Bytes	I/O	Analog (Resolution)	Comparators	I²C™/SPI/ Serial USART	CCP/ PWM	LCD Segments	Timers 8-bit/ 16-bit	Pins
PIC16F648A	7168	256	256	16	–	2	AUSART	1	–	2/1	18/20/28
PIC16F690	8192	256	256	18	12 (12-bit)	2	I²C/SPI/EUSART	1	–	2/1	20
PIC16F722	3584	128	–	25	11 (8-bit)	2	AUSART	2	–	2/1	28
PIC16F726	14336	368	–	25	11 (8-bit)	2	AUSART	2	–	2/1	28
PIC16F727	14336	368	–	36	14 (8-bit)	2	AUSART	2	–	2/1	40/44
PIC16F886	14336	368	256	25	11 (10-bit)	2	I²C/SPI/EUSART/AUSART	2	–	2/1	28
PIC16F887	14336	368	256	36	14 (10-bit)	2	I²C/SPI/EUSART/AUSART	2	–	2/1	40/44
PIC16F916	14336	352	256	25	5 (12-bit)	2	I²C/SPI/AUSART	2	4x15 (60)	2/1	28
PIC16F917	14336	352	256	36	8 (12-bit)	2	I²C/SPI/AUSART	2	4x24 (96)	2/1	40/44
PIC16F946	14336	336	256	53	8 (12-bit)	2	I²C/SPI/AUSART	2	4x42 (168)	2/1	64
PIC18F6390	8192	768	–	50	12 (10-bit)	2	I²C/SPI/EUSART/AUSART	2	128	1/3	64
PIC18F6393	8192	768	–	50	12 (12-bit)	2	I²C/SPI/EUSART/AUSART	2	128	1/3	64
PIC18F6490	16384	768	–	50	12 (10-bit)	2	I²C/SPI/EUSART/AUSART	2	192	1/3	64
PIC18F6493	16384	768	–	50	12 (12-bit)	2	I²C/SPI/EUSART/AUSART	2	192	1/3	64
PIC18F65J90	32768	2048	–	51	12 (12-bit)	2	I²C/SPI/EUSART/AUSART	2	4x33 (132)	1/3	64
PIC18F8390	8192	768	–	66	12 (10-bit)	2	I²C/SPI/EUSART/AUSART	2	128	1/3	80
PIC18F8393	8192	768	–	66	12 (12-bit)	2	I²C/SPI/EUSART/AUSART	2	128	1/3	80
PIC18F8490	16384	768	–	66	12 (10-bit)	2	I²C/SPI/EUSART/AUSART	2	192	1/3	80
PIC18F8493	16384	768	–	66	12 (12-bit)	2	I²C/SPI/EUSART/AUSART	2	192	1/3	80
PIC18F85J90	32768	2048	–	67	12 (12-bit)	2	I²C/SPI/EUSART/AUSART	2	4x48 (192)	1/3	80

16-bit PIC® Microcontrollers

Device	Flash Program Memory Bytes	Data RAM Bytes	EEPROM Data Memory Bytes	I/O	Analog (Resolution)	Comparators	I²C™/SPI/ Serial USART	CCP/ PWM	LCD Segments	Timers 16-bit	Pins
PIC24FJ64GA004	64K	8192	–	35	10 (10-bit) (500 ksps)	2	2xI²C, 2xSPI, 2xUART	5	–	5	44
PIC24FJ128GA010	128K	8192	–	86	16 (10-bit) (500 ksps)	2	2xI²C, 2xSPI, 2xUART	5	–	5	100

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	CCP/ PWM	LCD Segments	Timers 16-bit/ 32-bit	Pins
dsPIC30F3012	24K	2048	1024	12	8 (12-bit @ 200 ksps)	–	I²C/SPI/UART	2	–	9/4	18/44
dsPIC33FJ64GP206	64K	8192	–	53	18 (10-bit @ 1.1 Msps) (12-bit @ 500 ksps)	–	I²C, 2xSPI, 2xUART	8	–	5	64
dsPIC33FJ128GP206	128K	8192	–	53	18 (10-bit @ 1.1 Msps) (12-bit @ 500 ksps)	–	I²C, 2xSPI, 2xUART	8	–	5	64

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:

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