

Smart Energy Solution Guide



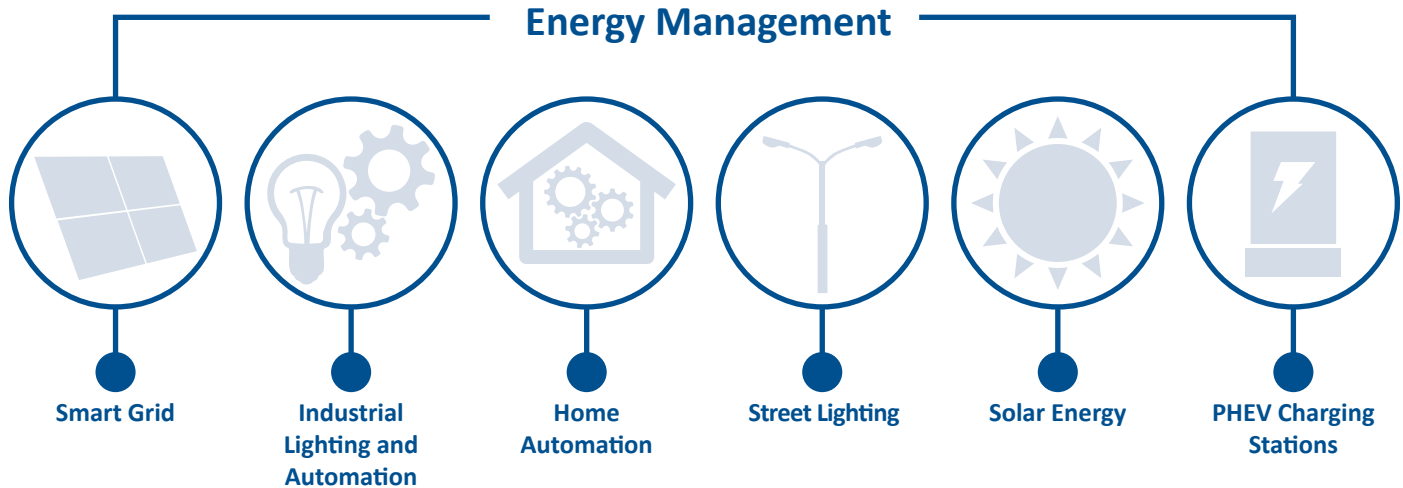


Smart Energy Applications

It's All About Energy Management

The market for energy, water and gas metering systems is rapidly changing, driven by new environmental and conservation concerns and regulations. Traditional standalone meters are now being replaced by complex networked systems that utilize a variety of communication methods. To meet the needs of this evolving smart grid, you need solutions that can provide:

- Leading-edge connectivity
- Best-in-class metrology
- Integration and flexibility
- Advanced security



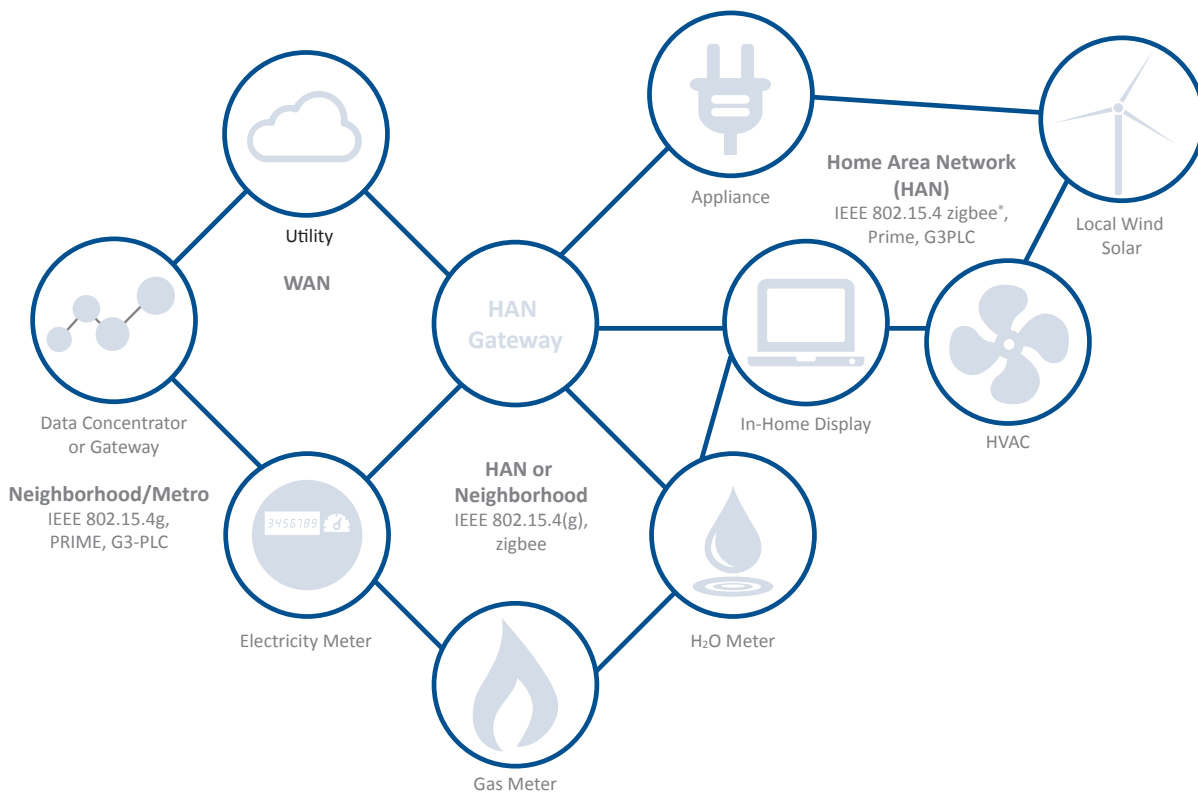


Smart Energy Solutions

Not Just a Chip, But a Platform

Microchip addresses the needs of the smart energy market with application-specific, as well as standard microcontroller, microprocessor, security, memory, wireless and power-line connectivity devices. The application-specific portfolio is defined from the ground up to offer designers best-in-class feature sets and performance in various classes of equipment used in the smart grid. Many of the devices in the Smart Energy Platform are part of the Arm®-based microcontrollers.

HAN Gateway





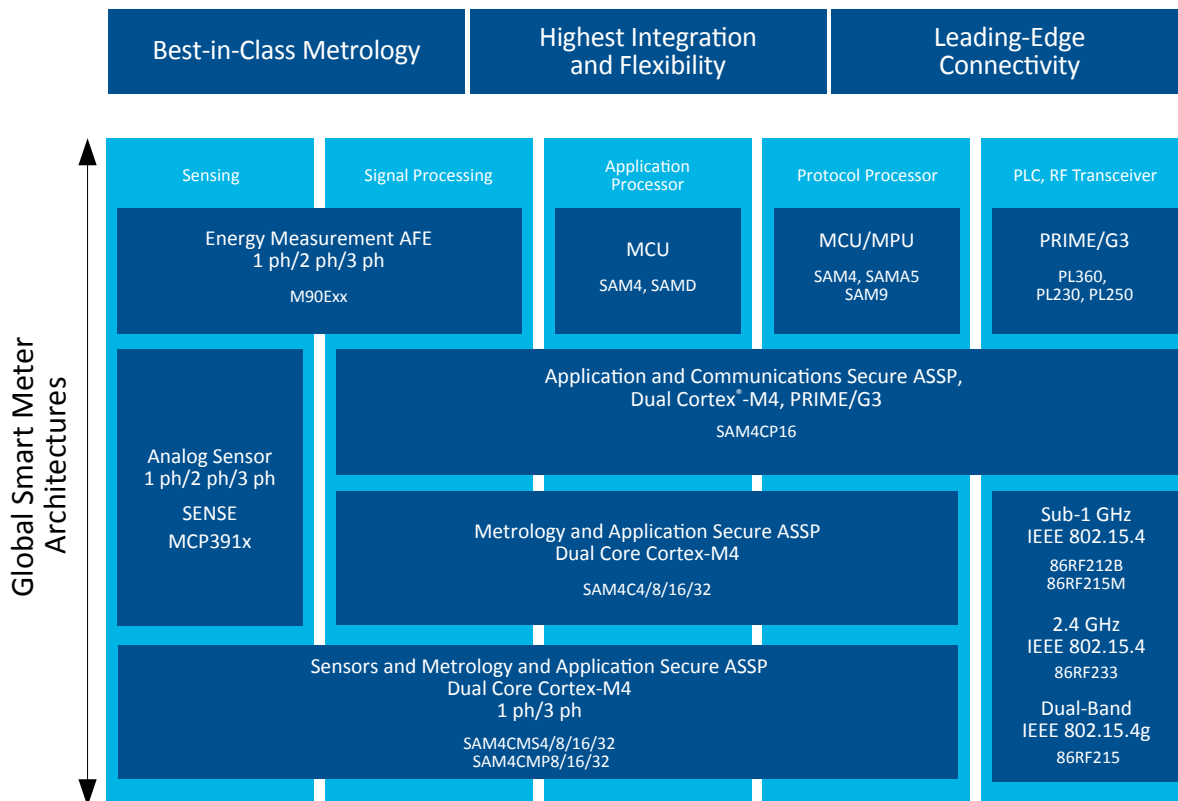
Smart Energy Products by Equipment Type

| | Home Area Network Equipment | Energy Gateway | Data Concentrator | Electricity Meter | Gas & Water Meter |
|-----------|-----------------------------|----------------|-------------------|-------------------|-------------------|
| M90E32/36 | ✓ | – | ✓ | ✓ | – |
| M90E26 | – | – | – | ✓ | – |
| SENSE | – | – | ✓ | ✓ | – |
| MCP391x | – | – | ✓ | ✓ | – |
| PL360 | ✓ | ✓ | ✓ | ✓ | – |
| PL230 | ✓ | ✓ | ✓ | ✓ | – |
| PL250 | ✓ | ✓ | ✓ | ✓ | – |
| 86RF212B | ✓ | ✓ | – | ✓ | ✓ |
| 86RF233 | ✓ | ✓ | – | ✓ | ✓ |
| 86RF215 | – | ✓ | ✓ | ✓ | – |
| 86RF215M | – | ✓ | ✓ | ✓ | ✓ |
| SAM4C | ✓ | ✓ | ✓ | ✓ | ✓ |
| SAM4CM | ✓ | – | ✓ | ✓ | – |
| SAM4CP | ✓ | ✓ | ✓ | ✓ | – |
| SAMD | – | – | – | – | ✓ |
| SAM4L | ✓ | – | – | ✓ | ✓ |
| SAMA5 | – | ✓ | ✓ | – | – |



Smart Metering Platform

Today's smart meter architect demands various levels of integration depending on system architecture partitioning, project timelines, and the level of flexibility needed to address various utility and geographical requirements. The Microchip platform provides a unique multi-level architecture built around the same multi-core architecture as outlined below. Various devices integrate the building blocks of the smart meter, namely, metrology sensing (ADC), metrology DSP, application, communication and security processing, as well as connectivity to home area and neighborhood area networks.





Value Proposition

The Broadest Portfolio Targeting the Metering Market

- Leading-edge connectivity
 - Low-power IEEE 802.15.4 wireless devices
 - Field-proven, low-power PLC (PRIME/G3)
- Integration and flexibility
 - Flexible (SW or HW) metrology
 - Multi-standard wireless and PLC solutions
 - Advanced cryptography
- Best-in-class Metrology
 - Stand-alone sensing Analog Front End (AFE) and SoC with integrated AFE offering
 - Dynamic range of up to 10000:1
- Broad Arm-based portfolio
 - Large array of SAMD, SAM4 and SAMA5 solutions
 - Best-in-class tools from Microchip, IAR, Keil

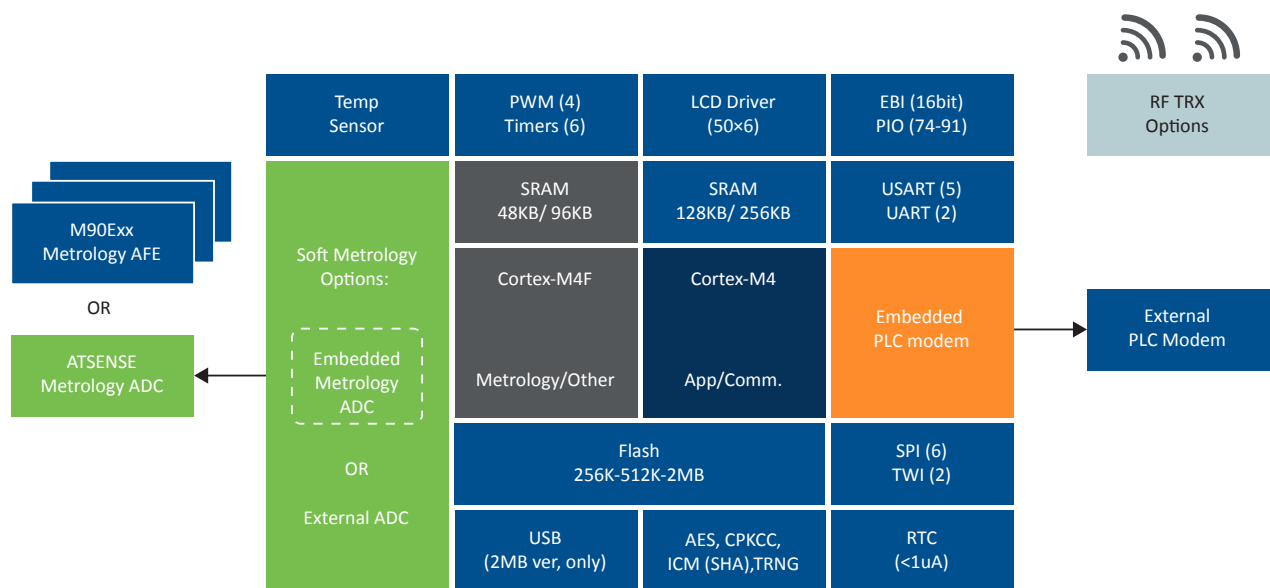


Newest Smart Energy Platform Core: SAM4C

At the core of Microchip's smart energy platform is the SAM4C series of products. The SAM4C4/8/16/32 system-on-chip solutions for smart energy applications are built around two high-performance 32-bit Arm Cortex®-M4 RISC processors. These devices operate at a maximum speed of 120 MHz and feature up to 2 MB of embedded Flash, 304 KB of SRAM and on-chip cache for each core.

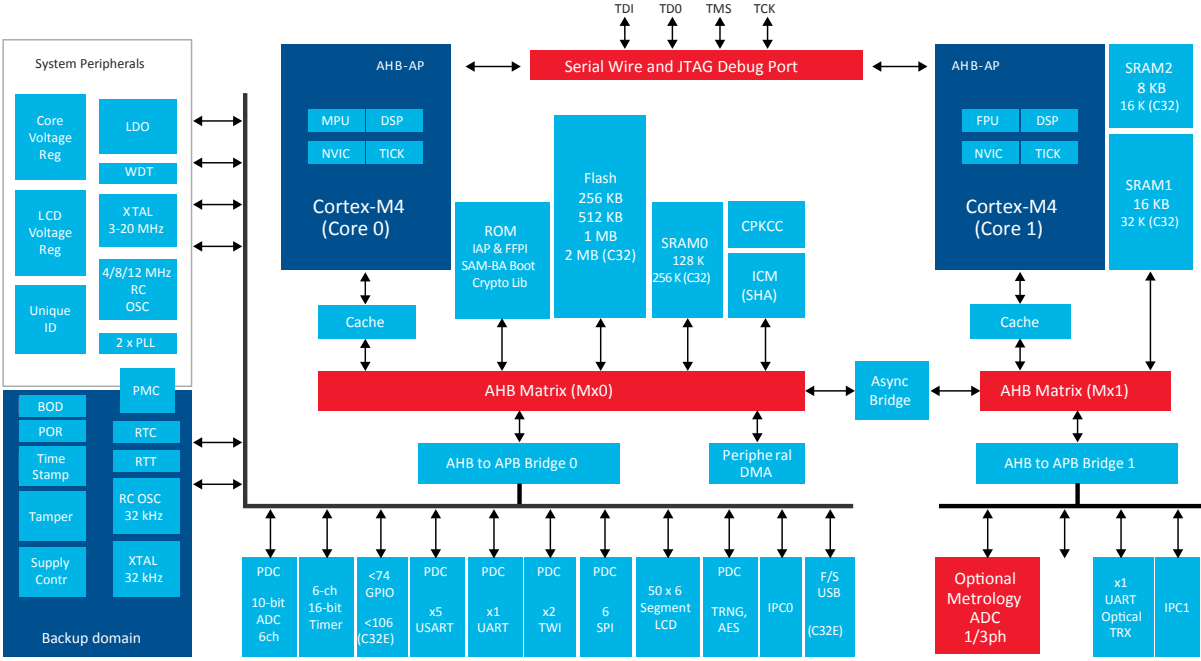
The dual Arm Cortex-M4 architecture allows for integration of application layer, communications layers and metrology functions in a single device. It has options for integrated software metrology or external hardware metrology AFE as well as integrated or external Power-Line Carrier (PLC) physical layer solution. It's a modular approach that is sure to meet various design needs.

SAM4C Platform





SAM4C Block Diagram



C32 devices have 2 MB Flash, full speed USB, more GPIO, more RAM



SAM4C Metering SoC Feature Comparison

| | SAM4C4 | SAM4C8 | SAM4C16 | SAM4C32C | SAM4C32E | SAM4CMS4 | SAM4CMP8/ SAM4CMS8 | SAM4CMP16/ SAM4CMS16 | SAM4CMP32/ SAM4CMS32 |
|----------------------|--|--------|---------|------------------|---------------|--|-----------------------|-------------------------|-------------------------|
| Flash | 256 KB | 512 KB | 1 MB | 2 MB | | 256 KB | 512 KB | 1 MB | 2 MB |
| SRAM | 128 + 16 + 8 KB | | | 256 + 32 + 16 KB | | 128 + 16 + 8 KB | | | 256 + 32 + 16 KB |
| Package | 100-pin LQFP | | | | 144-pin LQFP | | 100-pin LQFP | | |
| GPIO | 74 | | | | 106 | | 52/57 | | |
| PWM | 4 | | | | | | 3 | | |
| UART+USART | 7 | | | | | | 5/6 | | |
| SPI | 2 Controllers - 8 CS, + 5 USARTs in SPI Mode | | | | | 1 Controller - 4 CS + 3/4 USARTs in SPI Mode | | | |
| ADC | 10-bit, 6 x Externals + 2 x Internals | | | | | 10-bit, 4 x Externals + 2 x Internals | | | |
| Metrology AFE | - | | | | | 7 x Channels/4 x Channels | | | |
| Segment LCD | 50 x 6 | | | | 33 x 6/38 x 6 | | | | |
| USB FS | - | | | | Host/Device | | - | | |
| Timer | | | | | | 6 Channels | | | |
| TWI | | | | | | 2 | | | |



SAM4Cx Software Metrology

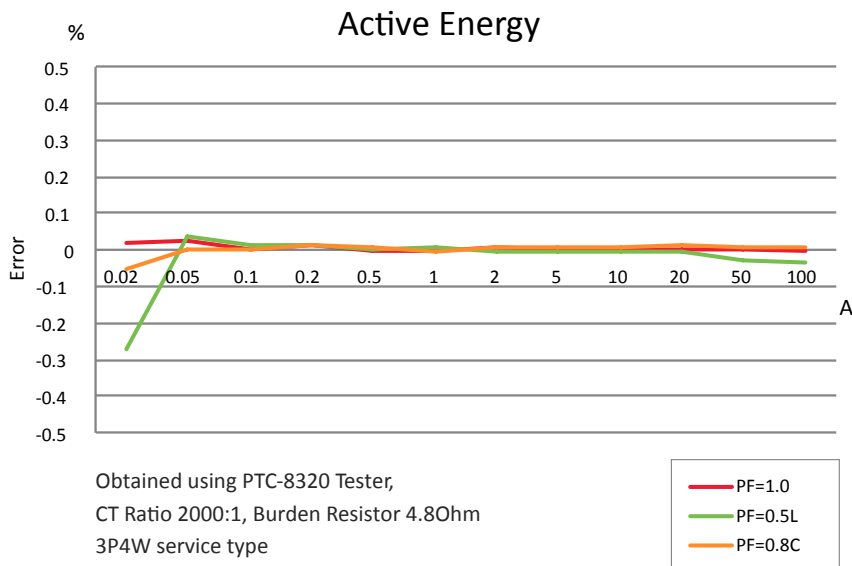
Flexibility to Support Various Country-Specific Requirements

Microchip's software metrology library provides unprecedented level of performance, scalability and flexibility which supports the integration of proprietary advanced metrology and signal processing algorithms. Microchip's standard library enables residential, commercial and industrial meter design up to class 0.2 accuracy, dynamic range of 3000:1, supports shunt, current transformer and Rogowski coil current sensing and is compliant with IEC 62052-11, 62053-22/23, ANSI C12.1, C12.20 and MID.

The SENSE-301, SENSE-201 and SENSE-101 are AFE devices targeting work in conjunction with the SAM4Cx products. They feature up to seven channels of high-precision delta-sigma Analog-to-Digital Converters (ADCs) with a 16 ksp/s sample rate and a highly accurate, integrated voltage reference with 10 ppm/°C temperature stability. They also include programmable current signal amplification, a temperature sensor and a Serial Peripheral Interface (SPI).

They feature up to 8 channels of synchronous sampling 16-24-bit delta-sigma ADCs with programmable data rate, integrated voltage reference, as well as phase delay compensation and programmable gain amplifiers on each channel. They also include security features, such as 16-bit CRC and register map lock, with a high-speed 20 MHz SPI.

SAM4CM Linear Curve



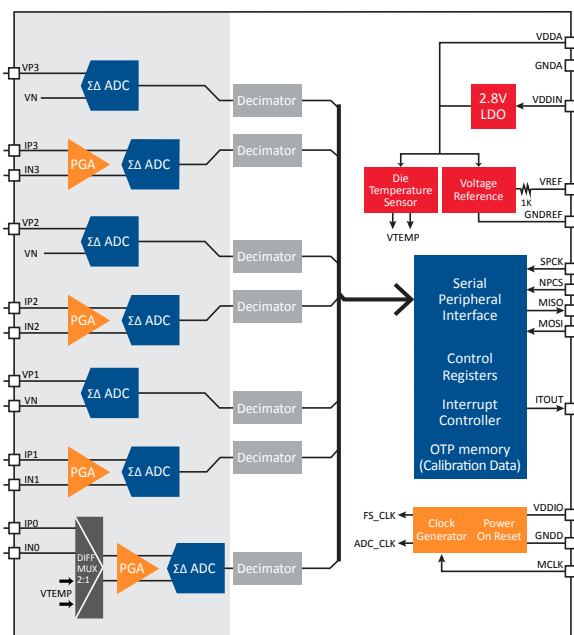


SENSE Features

The MCP391x products are a family of high-performance, flexible AFE devices that can be used alongside your MCU of choice.

- 0.1% accuracy over 3000:1 range
- Shunt, CT and Rogowski coil support
- 50 ppm/°C reference, 10 ppm/°C (H version)
- Works with Microchip metrology library
- Ultra-low power: < 2.5 mW/channel @ 3.3V
- 8 MHz SPI compatible mode 1 (8-bit) for ADC data and AFE controls.
- SENSE-301(H)
 - 32-pin TQFP package
 - Seven synchronous delta-sigma ADCs, <16 Ksps
 - 3-V, 4-I channels with 8x PGA
- SENSE-201(H)
 - 32-pin TQFP package
 - Four synchronous delta-sigma ADCs, <16 Ksps
 - 2-V, 2-I channels with 8x PGA
- SENSE-101(H)
 - 20-pin SOIC package
 - Three synchronous delta-sigma ADCs, <16 Ksps
 - 1-V, 2-I channels with 8x PGA

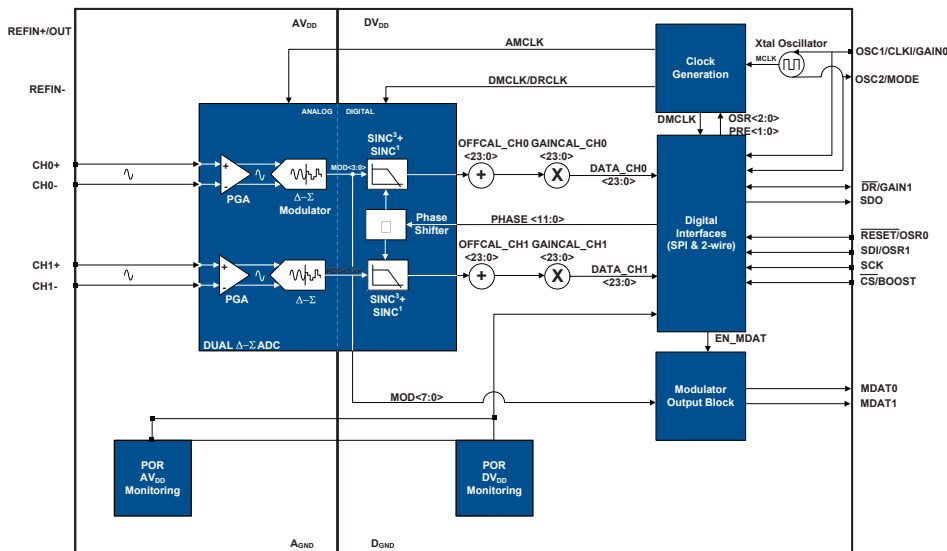
SENSE Block Diagram





MCP391x Features

- Enables 0.1% error over 10000:1 range
- Up to 94.5 dB SINAD, -107 dBc THD, 112 dBFS SFDR
- Programmable data rate up to 125 Ksps
- Oversampling ratio up to 4096
- PGA on each channel up to 32V/V
- Low drift voltage reference: 9 ppm/°C
- High-speed 20 MHz SPI
- Security features:
 - 16-bit CRC
 - Register map lock
- MCP3918/10/19
 - 1, 2, or 3-ch AFE
 - Optimal 2-wire interface mode for poly-phase shunt meters
 - 20/28-pin QFN and SSOP packages
- MCP3912/13/14
 - 4-6, or 8-ch AFE
 - 20 MHz SPI
 - 28-pin QFN and SSOP packages, 40-pin UQFN package



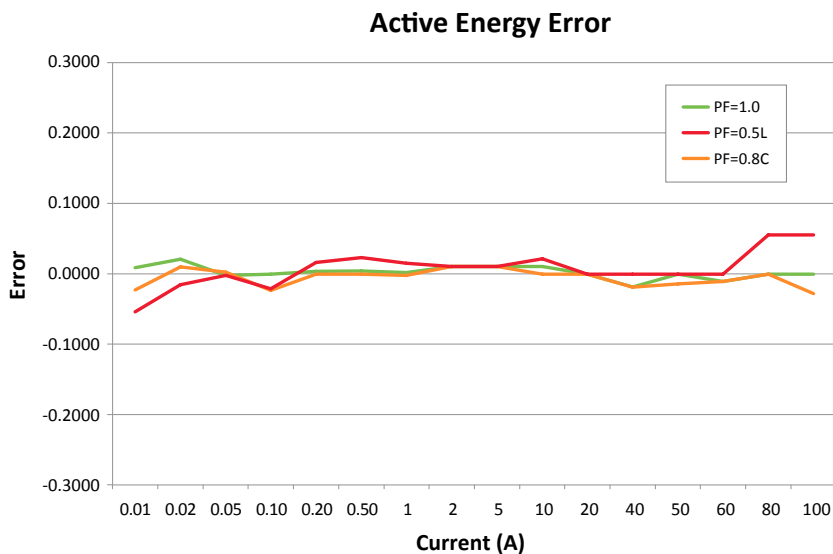


Hardware Metrology AFE

Out-of-the-Box Solution for Basic Metering

- Ideal for basic meter designs
 - Up to class 0.2 accuracy
 - Exceeds IEC, ANSI standards
 - Best-in-class temperature drift
- Best-in-class dynamic range (up to 6000:1)
 - Improves performance
 - Reduces OEM's cost of manufacturing
- Great fit with SAM4L
 - picoPower® technology
 - Active mode @ 90 $\mu\text{A}/\text{MHz}$
 - Full RAM retention @ 1.5 μA
 - SleepWalking
 - 4 x 40 segment LCD controller
 - Hardware crypto block

M90E36A Linearity





Microchip Metrology Solutions

| | Service Type | Dynamic Range | Active Energy Accuracy | Reactive Energy Accuracy | Key Features |
|-------------------------|---|---------------|------------------------|--------------------------|---|
| SAMC4/8/16/32 | - | - | - | - | Security SoC |
| SAM4CMS4/8/16/32 | 1 phase | 3000:1 | 0.1% | 0.2% | High-End Metrology SoC |
| SAM4CMP8/16/32 | 3 phase | 3000:1 | 0.1% | 0.2% | |
| SENSE101 | 1 phase | 3000:1 | 1% | 1% | Software Metrology ADC |
| SENSE201 | 2 phase | 3000:1 | 0.2% | 0.2% | |
| SENSE301 | 3 phase | 3000:1 | 0.2% | 0.2% | |
| MCP3910/18/19 | 1 phase 2 phase (shunt) 3 phase (shunt) | 10000:1 | 0.1% | 0.2% | Software Metrology ADC |
| MCP3912 | 2 phase | 10000:1 | 0.1% | 0.2% | |
| MCP3913/14 | 3 phase | 10000:1 | 0.1% | 0.2% | |
| M90E26 | 1 phase | 5000:1 | 0.1% | 0.2% | AFE, active, reactive energy, instantaneous and anti-tamper |
| M90E32AS | 3 phase | 6000:1 | 0.1% | 0.2% | AFE, active, reactive energy, instantaneous, fundamental and harmonics measurement, piece-wise compensation, event detection |
| M90E36A | 3 phase | 6000:1 | 0.1% | 0.2% | AFE, active, reactive energy, instantaneous, fundamental and harmonics measurement, Discrete Fourier Transform (DFT) Function, raw data capture |



PLC Connectivity Products

Microchip offers PLC solutions designed specifically for narrowband communications using the low-voltage electric grid. Drawing on our deep expertise in PLC modem technology and extensive collaboration with utilities and metering OEMs, we've created solutions offering an unprecedented level of integration and performance. Our solutions support various standards such as PowerLine Intelligent Metering Evolution (PRIME) and G3-PLC. Thanks to the communications software provided by our solution, the management of PLC networks turns into a transparent process. You can focus on top-level applications and access the Microchip PLC software stack via user-friendly application programming interfaces (APIs).

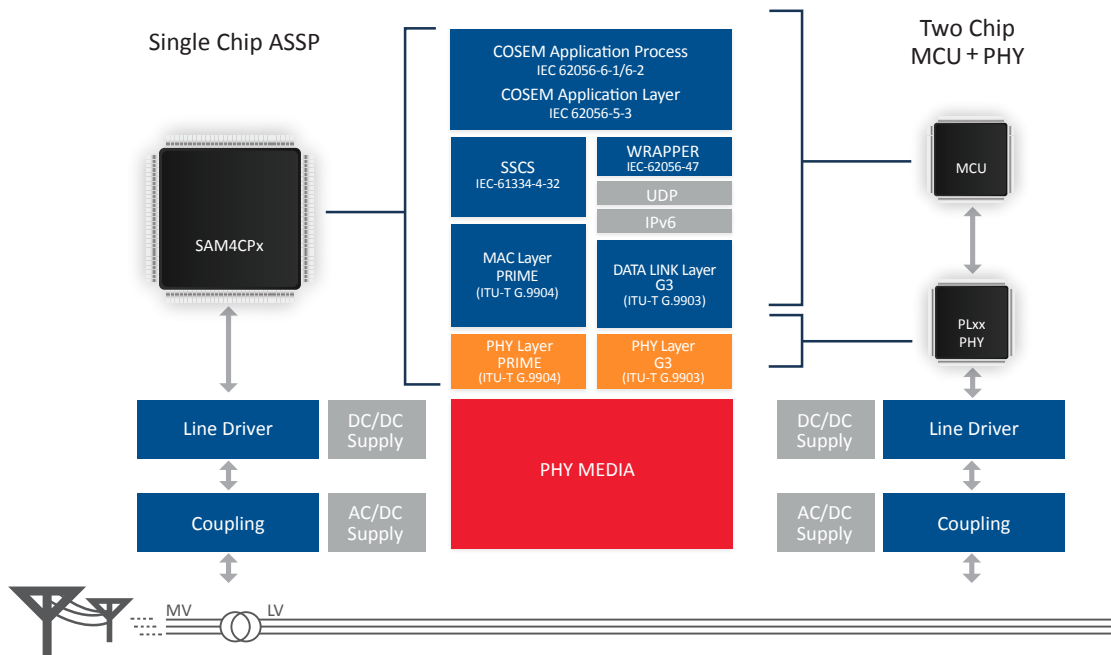
- Best-in-class sensitivity and high-temperature stability
- Improved AFE providing outstanding efficiency
- Price-competitive, high-performance solutions
- Free software stacks for PLC



Flexible Architecture

Microchip PLC solutions are offered in single-chip (SoC) and two-chip (PHY modem + MCU) configurations, respectively. Both configurations are available for PRIME and G3 solutions. Microchip PRIME devices comply with state-of-the-art PRIME 1.3 and PRIME 1.4 specifications and include enhanced PRIME features such as additional robust modes and frequency band extension up to 500 kHz. Microchip's G3 devices support all modulation schemes and modes (coherent, differential) defined in the G3-PLC specification.

Microchip PLC Solutions with a Flexible Architecture



A built in class-D amplifier architecture is up to 30% more efficient than competing solutions with only a handful of external discrete components, reducing power waste due to heat dissipation and increasing long-term reliability due to better thermal behavior.

An extensive array of system I/O, LCD, memory, RTC, DMA and cryptographic resources available in the SAM4CP series allow integration of application, communication and metrology software (using external Microchip metrology devices) to achieve highly reliable, flexible and cost effective smart meter designs.

Microchip provides PRIME and G3 software stacks that turn the management of PLC networks into a transparent process. You can focus on top-level applications and access the Microchip PLC software stacks via well defined Application Programming Interfaces (APIs).

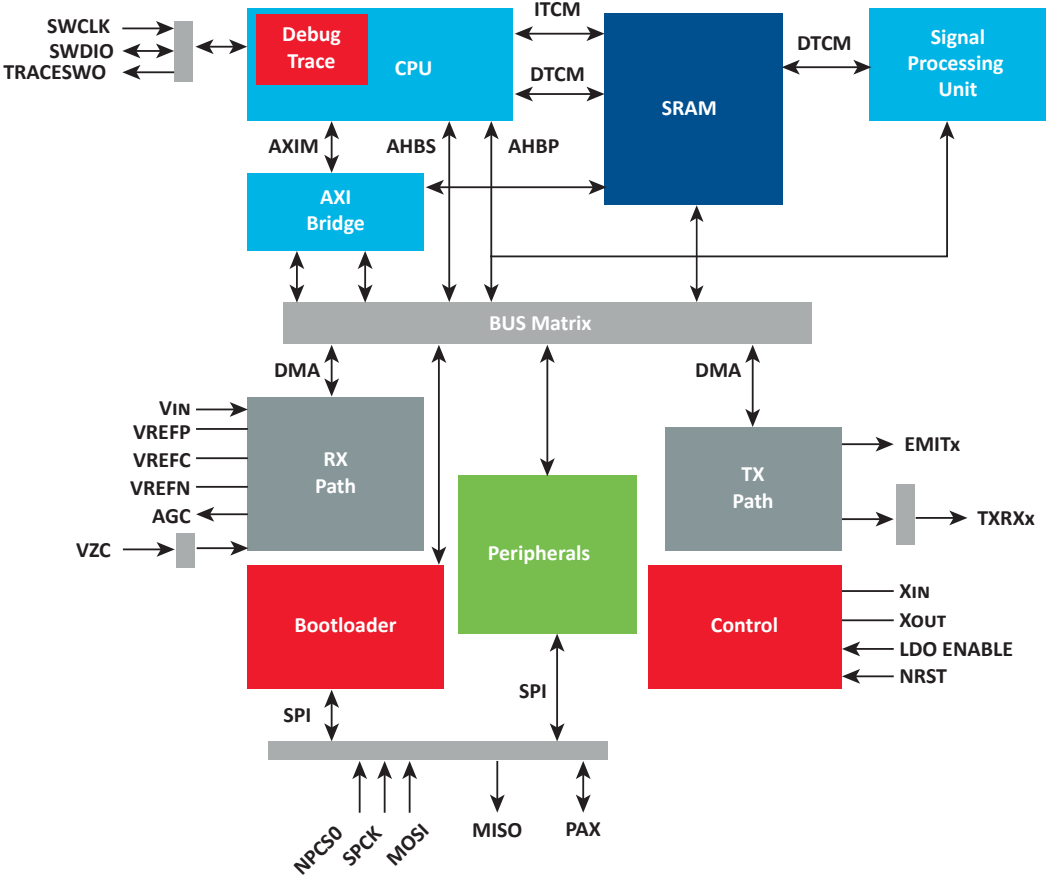


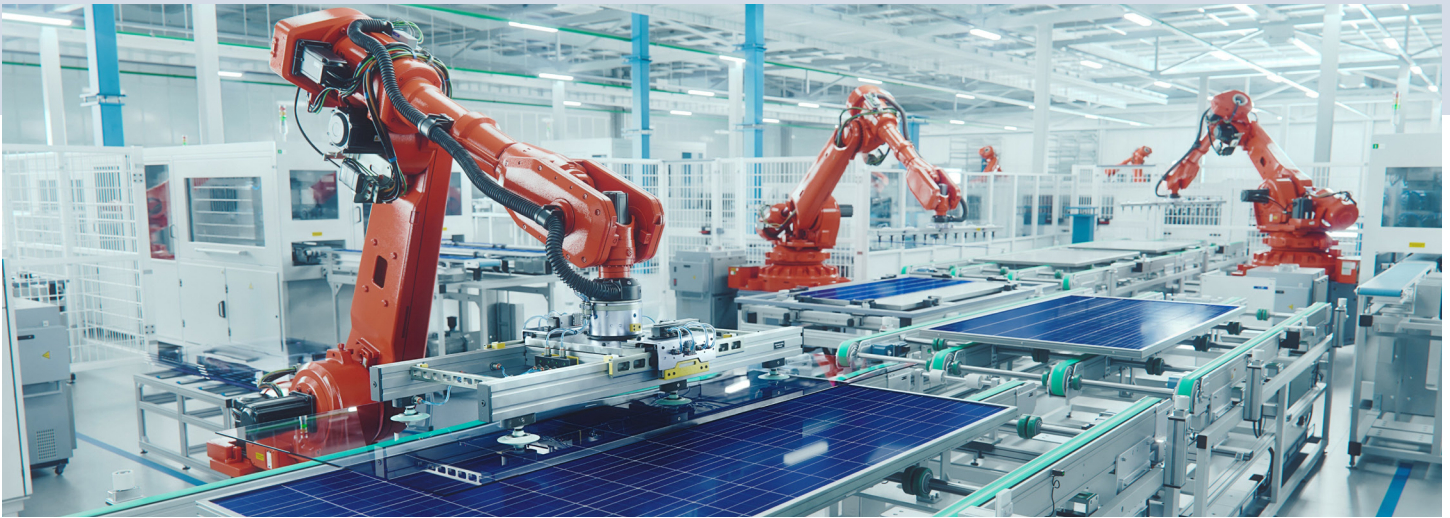
PLC Product Features

| | Standard | Frequency Band | Core | CPU Clock | Flash | SRAM | Package |
|------------------|----------------|---------------------------|-------------------|-------------------|-------|--------------------------|---------------------|
| PL360 | Multi-protocol | CEN/ARIB/FCC 3-500 kHz | Cortex®-M7 | 216 MHz | - | 192 KB for data and code | 48-pin TQFP/ QFN |
| PL230A | PRIME | CEN/ARIB/FCC 3-500 kHz | - | - | - | - | 80-pin LQFP |
| PL250A | G3 | CEN/ARIB/FCC 3-500 kHz | - | - | - | - | 80-pin LQFP |
| SAM4CP16B | PRIME | CEN/ARIB/FCC 3-500 kHz | Dual Cortex-M4 | 120 MHz @ core | 1 MB | 128 +16 + 8 KB | 176-pin LQFP |
| SAM4CP16C | G3 | CEN/ARIB/FCC 3-500 kHz | Dual Cortex-M4 | 120 MHz @ core | 1 MB | 128 +16 + 8 KB | 176-pin LQFP |



PL360 Block Diagram



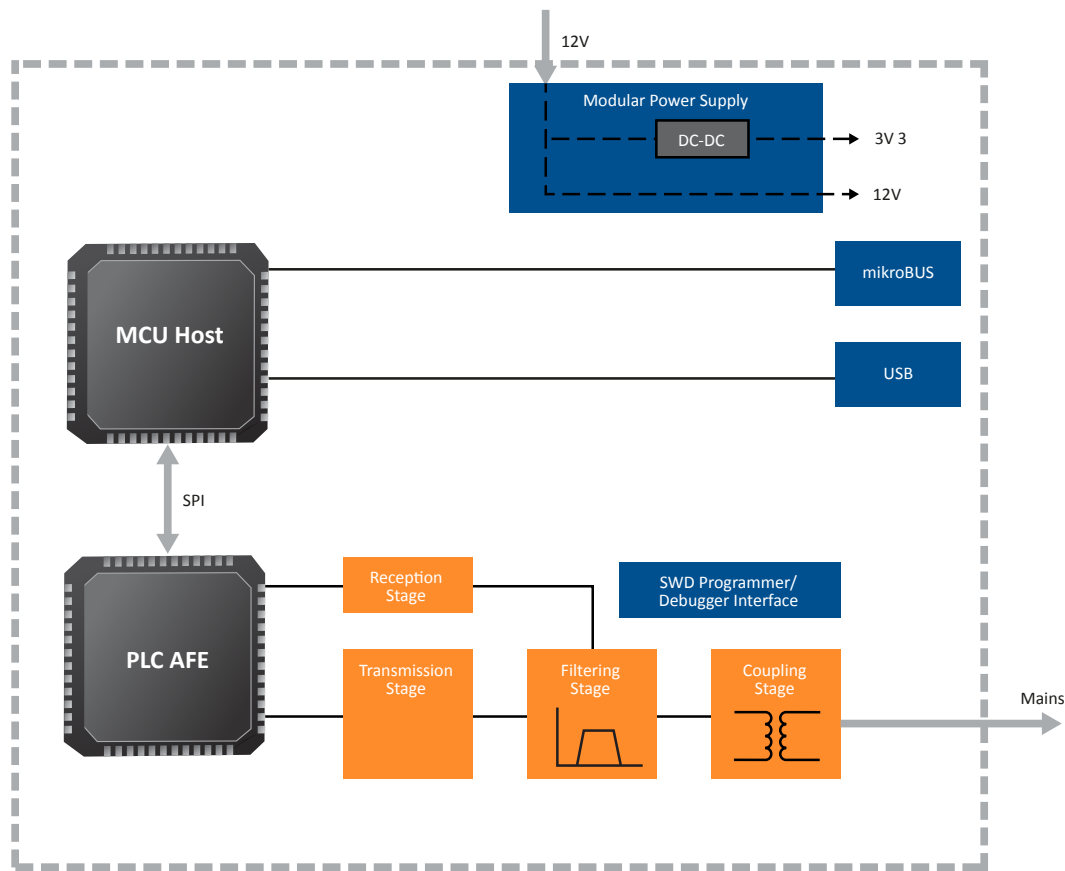


PLC Module Solutions

Microchip PLC modules are designed to support applications that require a Power Line Communication interface, combining a versatile microcontroller with Microchip analog front ends for Power Line Communication.

The microcontroller is an Arm Cortex-M4 (120 MHz, 512 kB Flash, 128 kB RAM) able to implement both PLC stack and control application.

Microchip PLC front ends support PRIME PLC and G3 PLC. They operate in the band below 500 kHz and can provide baud rates from 4.5 kbps to 166 kbps. Microchip OFDM-based PLC technology is designed to provide high data throughput and enhanced robustness in order to establish successful communications across noisy electric lines.



Microchip kits PL360G55CB-EK and PL360G55CF-EK are available for evaluation. Please contact plc@microchip.com for additional information and design resources.



Wireless Connectivity Products

Efficient smart energy wireless applications require both high-performance and power efficiency. Microchip transceivers deliver the leading RF link budget with the industry's lowest power consumption.

Additionally, Microchip offers the most feature-rich IEEE 802.15.4-compliant transceiver family available. Our transceivers support regional sub-1 GHz bands, as well as the global 2.4 GHz band. This enables you to develop wireless applications for customers worldwide, including emerging markets like China.

Enhanced Performance

Powerful hardware features like antenna diversity or external power amplifier support let you further boost transceiver performance to maximize network reliability and RF range of your system. Microchip transceivers support not only IEEE 802.15.4-compliant applications, but provide on-air data rates up to 2 Mbps for general purpose Industrial Scientific Medical (ISM) applications. Pin compatibility ensures an easy transition between devices or frequency bands.

To help you speed up system development and prototyping, Microchip offers a variety of free software suites, various hardware evaluation boards and development kits and modules.

Key Products

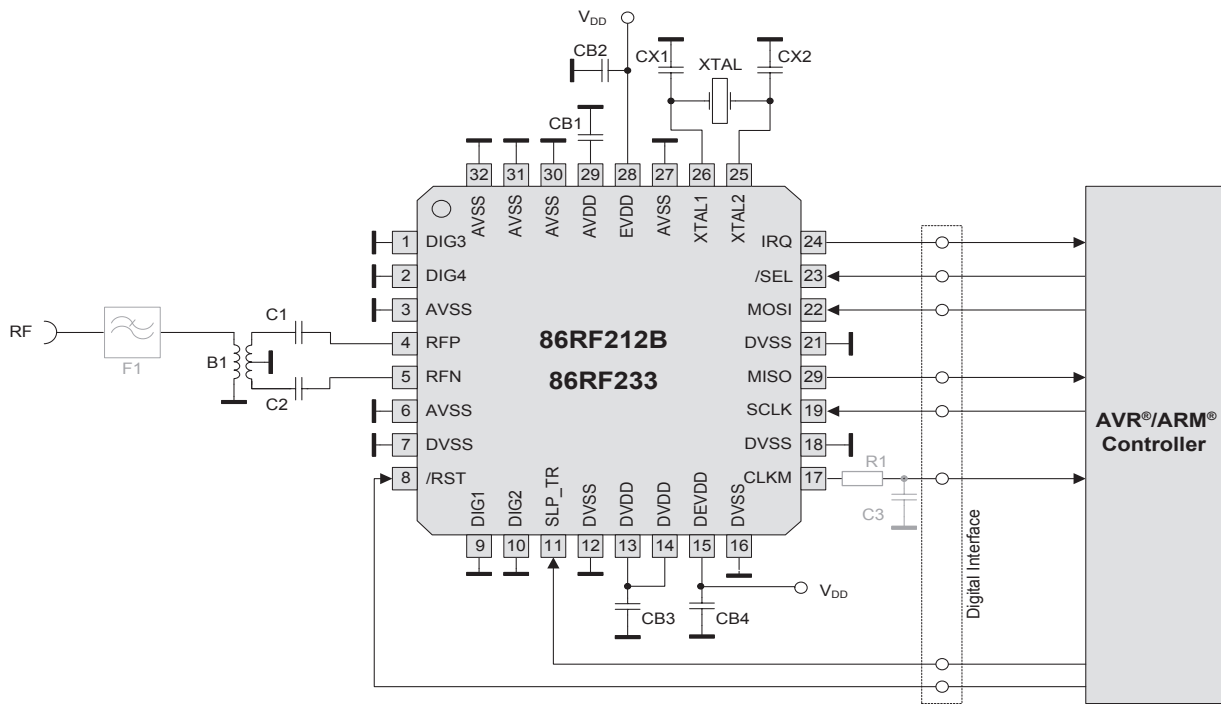
The 86RF212B is a low-power, low-voltage RF transceiver for the regional 700/800/900 MHz frequency bands available in Japan, China, Europe and North America. This transceiver offers an extremely good 120 dB link budget (-110 dBm receiver sensitivity/+10 dBm transmit power) designed for low-cost IEEE 802.15.4, zigbee® and high data rate ISM applications.

The 86RF233 transceiver is designed to operate in the 2.4 GHz ISM band, available worldwide. This transceiver offers link budgets up to 105 dB (-101 dBm receiver sensitivity/+4 dBm transmit power). For a complete overview of features, key parameters and targeted application areas, please see the data sheet.

86RF215 is a dual-band sub-1 GHz/2.4 GHz transceiver compliant to IEEE 802.15.4-2011, IEEE 802.15.4g-2012 and ETSI TS 102 887-1. This device offers very high flexibility by supporting a variety of data rates with three modulation schemes: multi-rate and multi-regional frequency shift keying (MR-FSK), orthogonal frequency division multiplexing (MR-OFDM), as well as offset quadrature phase-shift keying (MR-O-QPSK). This includes the physical layer which is used for zigbee PRO and IP. With an output power of 14 dBm and receiver sensitivities down to -123 dBm, link budgets up to 137 dB can be achieved.

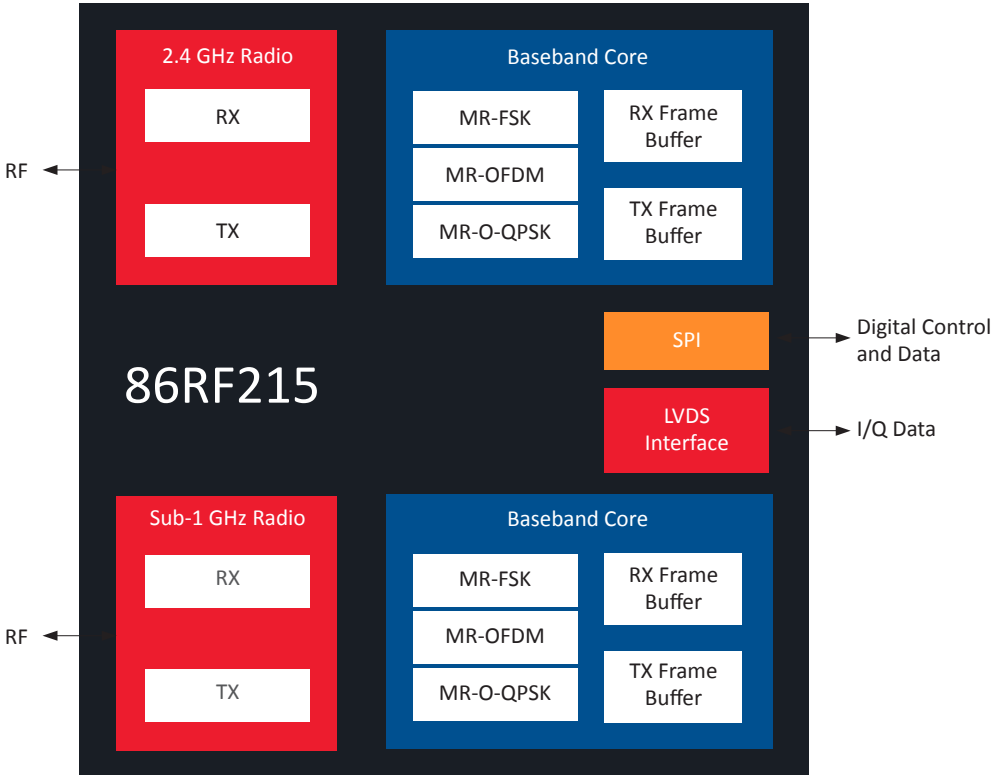


Wireless Transceiver Application Diagram





RF215 Block Diagram

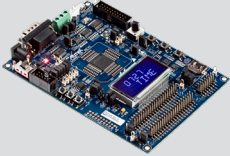
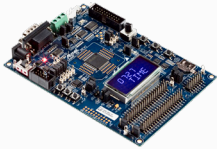








| Device | Band (MHz) | Modulation | Data Rate, (kbit/s) | RX, Sens, (dBm) | Max.TX Power (dBm) | Current: SLEEP, TRX_OFF, RX_ON, BUSY_TX | Pack. | Compliance |
|---|---|------------------------------------|---|------------------|--------------------|--|------------|--|
| 86RF212B Transceiver | 769...935 | BPSK, O-QPSK | 20, 40, 100, 250 <i>proprietary: 200, 400, 500, 1000</i> | -110 @ 20 kbps | 10 | 0.2 μ A, 0.4 mA, 9.2 mA, 17.0 mA @ 5 dBm | 32-pin QFN | IEEE 802.15.4-2006, IEEE 802.15.4-2011 |
| 86RF233 Transceiver | 2322...2527 | O-QPSK | 250 <i>proprietary: 500, 1000, 2000</i> | -101 @ 250 kbps | 4 | 0.02/0.2 μ A, 0.3 mA, 6.0/11.8 mA, 13.8 mA @ 4 dBm | 32-pin QFN | IEEE 802.15.4-2006, IEEE 802.15.4-2011 |
| 86RF215 Transceiver and I/Q radio | 389 ...510 779 ...1020 2400 ...2483 | MR-FSK, MR-OFDM, MR-O-QPSK, O-QPSK | 6.25 ... 800 <i>proprietary up to 2400</i> | -123 @ 6.25 kbps | 14 | 30 nA, 3.0 mA, 28 mA, 65 mA @ 14 dBm | 48-pin QFN | IEEE 802.15.4-2006, IEEE 802.15.4-2011, IEEE 802.15.4g-2012, ETSI TS 102 887-1 |
| 86RF215M Transceiver and I/Q radio | 389 ...510 779 ...1020 | MR-FSK, MR-OFDM, MR-O QPSK, O-QPSK | 6.25 ... 800 <i>proprietary up to 2400</i> | -123 @ 6.25 kbps | 14 | 30 nA, 3.0 mA, 28 mA, 65 mA @ 14 dBm | 48-pin QFN | IEEE 802.15.4-2011, IEEE 802.15.4g-2012, ETSI TS 102 887-1 |

Smart Energy Portfolio

| | | Product | Ordering Code | Package | Features | Flash | Carrier |
|---------------|------------|-------------------|-------------------|-------------------------|-------------------------|-------------|-------------|
| Metering MCU | SAM4C4C | ATSAM4C4CB-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 256 KB | Tray | |
| | | ATSAM4C4CB-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 256 KB | Tape & Reel | |
| | SAM4C8C | ATSAM4C8CB-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 512 KB | Tray | |
| | | ATSAM4C8CB-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 512 KB | Tape & Reel | |
| | SAM4C16C | ATSAM4C16CB-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 1 MB | Tray | |
| | | ATSAM4C16CB-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 1 MB | Tape & Reel | |
| | SAM4C32CA | ATSAM4C32CA-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tray | |
| | | ATSAM4C32CA-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tape & Reel | |
| | SAM4C32EA | ATSAM4C32EA-AU | 144-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tray | |
| | | ATSAM4C32EA-AUR | 144-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tape & Reel | |
| Metrology SoC | 1 Phase | SAM4CMS4C | ATSAM4CMS4CC-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 256 KB | Tray |
| | | | ATSAM4CMS4CC-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 256 KB | Tape & Reel |
| | | SAM4CMS8C | ATSAM4CMS8CC-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 512 KB | Tray |
| | | | ATSAM4CMS8CC-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 512 KB | Tape & Reel |
| | | SAM4CMS16C | ATSAM4CMS16CC-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 1 MB | Tray |
| | | | ATSAM4CMS16CC-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 1 MB | Tape & Reel |
| | SAM4CMS32C | ATSAM4CMS32CB-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tray | |
| | | ATSAM4CMS32CB-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tape & Reel | |
| | 3 Phase | SAM4CMP8C | ATSAM4CMP8CC-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 512 KB | Tray |
| | | | ATSAM4CMP8CC-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 512 KB | Tape & Reel |
| | | SAM4CMP16C | ATSAM4CMP16CC-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 1 MB | Tray |
| | | | ATSAM4CMP16CC-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 1 MB | Tape & Reel |
| | | SAM4CMP32C | ATSAM4CMP32CB-AU | 100-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tray |
| | | | ATSAM4CMP32CB-AUR | 100-pin LQFP | Green, IND TEMP, CRYPTO | 2 MB | Tape & Reel |

| | Ordering Code | Kit Contents Pictures | IDE | RTOS | STACKS/LIBRARIES |
|-------|----------------|---|--------------------------------------|----------|---|
| Tools | ATSAM4C-EK |  | Atmel Studio & ASF IAR KEIL | FreeRTOS | Microchip Metrology & Crypto Libraries |
| | ATSAM4C32-EK |  | | | |
| Tools | ATSAM4CMS32-DB |  | Atmel Studio & ASF IAR KEIL | FreeRTOS | Microchip Metrology & Crypto Libraries |
| | ATSAM4CMS-DB |  | | | |
| | ATSAM4CMP-DB |  | | | |
| | ATSAM4CMP32-DB |  | | | |

Smart Energy Portfolio (Continued)

| | | Product | Ordering Code | Package | Features | Flash | Carrier |
|-----|---|-----------|-----------------|---------------|------------------------------------|-------|-------------|
| PLC | Multi-protocol Modem | PL360 | MPL360B-I/SCB | 48-pin QFN | Green, IND TEMP | - | Tray |
| | | | MPL360BT-I/SCB | 48-pin QFN | Green, IND TEMP | - | Tape & Reel |
| | | | MPL360B-I/Y8X | 48-pin TQFP | Green, IND TEMP | - | Tray |
| | | | MPL360BT-I/Y8X | 48-pin TQFP | Green, IND TEMP | - | Tape & Reel |
| | Multi-protocol SoC | PL485 | MPL485A-I/AJA | 121-pin TFBGA | Green, IND TEMP | - | Tray |
| | | | MPL485AT-I/AJA | 121-pin TFBGA | Green, IND TEMP | - | Tape & Reel |
| RF | Sub-1 GHz Transceiver (IEEE 802.15.4-2011) | 86RF212B | AT86RF212B-ZU | 32-pin QFN | 700/800/900 MHz Transceiver, 85 °C | - | Tray |
| | | | AT86RF212B-ZUR | 32-pin QFN | 700/800/900 MHz Transceiver, 85 °C | - | Tape & Reel |
| | 2.4 GHz Transceiver (IEEE 802.15.4-2006) | 86RF233 | AT86RF233-ZF | 32-pin QFN | 2.4 GHz Transceiver, 125 °C | - | Tray |
| | | | AT86RF233-ZFR | 32-pin QFN | 2.4 GHz Transceiver, 125 °C | - | Tape & Reel |
| | | | AT86RF233-ZU | 32-pin QFN | 2.4 GHz Transceiver, 85 °C | - | Tray |
| | | | AT86RF233-ZUR | 32-pin QFN | 2.4 GHz Transceiver, 85 °C | - | Tape & Reel |
| | Dual-Band Transceiver (IEEE 802.15.4g-2012) | 86RF215 | AT86RF215-ZU | 48-pin QFN | Dual-Band Transceiver, 85°C | - | Tray |
| | | | AT86RF215-ZUR | 48-pin QFN | Dual-Band Transceiver, 85°C | - | Tape & Reel |
| | Sub-1 GHz Transceiver (IEEE 802.15.4g-2012) | 86RF215M | AT86RF215M-ZU | 48-pin QFN | Sub-1 GHz Transceiver, 85°C | - | Tray |
| | | | AT86RF215M-ZUR | 48-pin QFN | Sub-1 GHz Transceiver, 85°C | - | Tape & Reel |
| | Dual-Band I/Q Radio | 86RF215IQ | AT86RF215IQ-ZU | 48-pin QFN | Dual-Band I/Q Radio, 85°C | - | Tray |
| | | | AT86RF215IQ-ZUR | 48-pin QFN | Dual-Band I/Q Radio, 85°C | - | Tape & Reel |

*Contact Microchip for availability

| | Ordering Code | Kit Contents Pictures | | | IDE | RTOS | STACKS/LIBRARIES |
|-------|--|---|---|---|---|-------------------------|---|
| Tools | ATPL360-EK (2 Modem Boards + 4 Couplings) |  |  |  | Atmel Studio, IAR and Keil | FreeRTOS | PRIME PLC < 500 kHz G3-PLC < 500 kHz |
| | PL360G55CB-EK (1 Board) |  | | | Atmel Studio, IAR, Keil | FreeRTOS | G3-PLC in CENELEC-B (95 .. 125 kHz) |
| | PL360G55CF-EK (1 board) |  | | | Atmel Studio, IAR, Keil | FreeRTOS | PRIME PLC in CENELEC-A (9..95 kHz) + FCC (150..500 kHz) |
| Tools | ATSAM4L-EK + ATZB212B-XPRO |  |  | | Atmel Studio ASF Wireless Performance Analyzer | FreeRTOS eCOS (SAM9) | Exegin Technologies: IEEE 802.15.4 MAC, zigbee® Pro/SEP1.x, zigbee IP/SEP2.0, 6LoWPAN |
| | ATSAM4L-EK/ATSAM4S-XPRO + ATREB233-XPRO or ATZB-A-233-XPRO (Amplified) |  |  |  | | | |
| | ATSAM4L-EK/ATSAM4S-XPRO + ATREB215-XPRO |  |  | | | | |
| | ATREB215-XPRO |  | | | N/A | N/A | N/A |



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