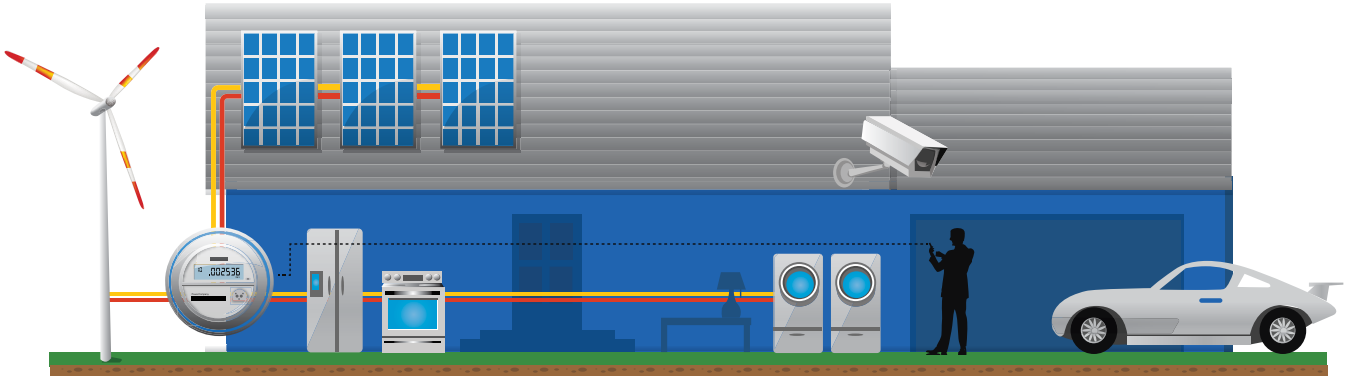
# Atmel Smart Energy Solution Guide



# Smart Energy Applications

It's all about energy management

- Smart Grid
- Industrial Lighting and Automation
- Home Automation
- Street Lighting
- Solar Energy
- PHEV Charging Stations

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, metering developers need solutions that can provide:

- Leading-edge Connectivity
- Best-in-class Metrology
- Integration & Flexibility
- Advanced Security



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# Atmel Smart Energy Solutions

Not just a Chip, but a Platform

Atmel® 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 Atmel | SMART line of ARM®-based microcontrollers.

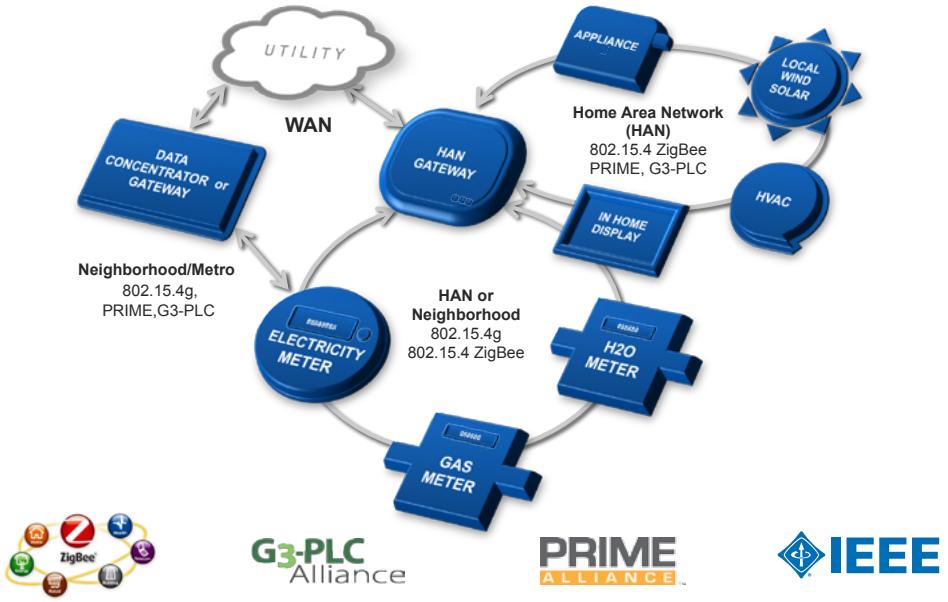


Figure 1. Smart Grid Equipment and Governing Communications Standards

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

Table 1. Atmel Platform Products by Equipment Type

## Atmel 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 Atmel 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.

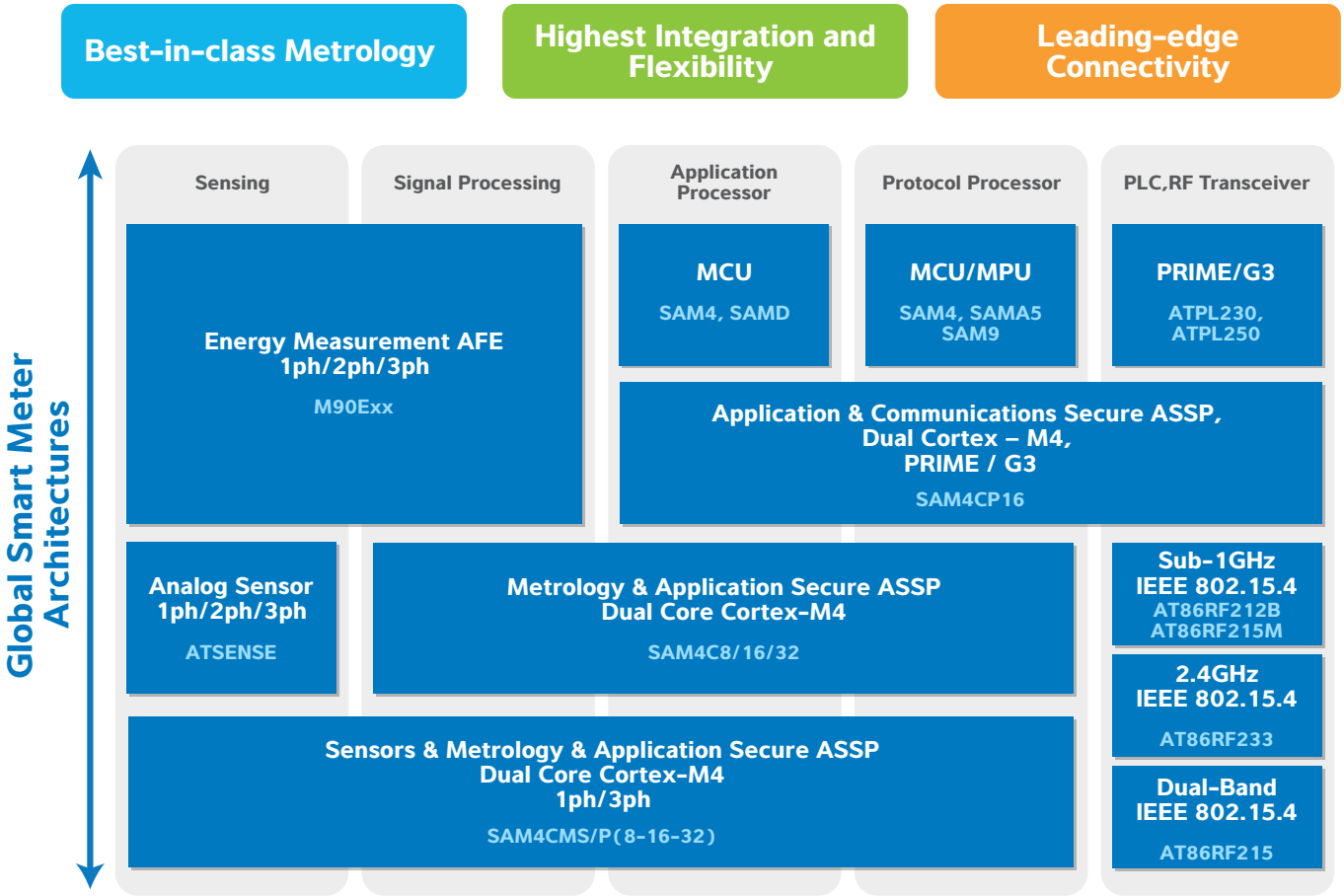


Figure 2. Atmel Smart Metering Platform


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## Atmel Value Proposition

The broadest portfolio targeting at metering market.

- Leading-edge Connectivity
  - Low power 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
  - Standalone Sensing AFE and SOC with integrated AFE offering
  - Dynamic range of up to 6000:1
  - 25M units shipped since 90's
- Broad Atmel | SMART ARM-based Portfolio
  - Large array of SAMD, SAM4 and SAMA5 solutions
  - Best-in-class tools from Atmel, IAR, Keil

## Newest Smart Energy Platform Core: SAM4C

At the core of Atmel's smart energy platform is the Atmel | SMART SAM4C series of products. The SAM4C8/16/32 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 2Mbyte of embedded Flash, 304 Kbytes 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 (analog front end) 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.

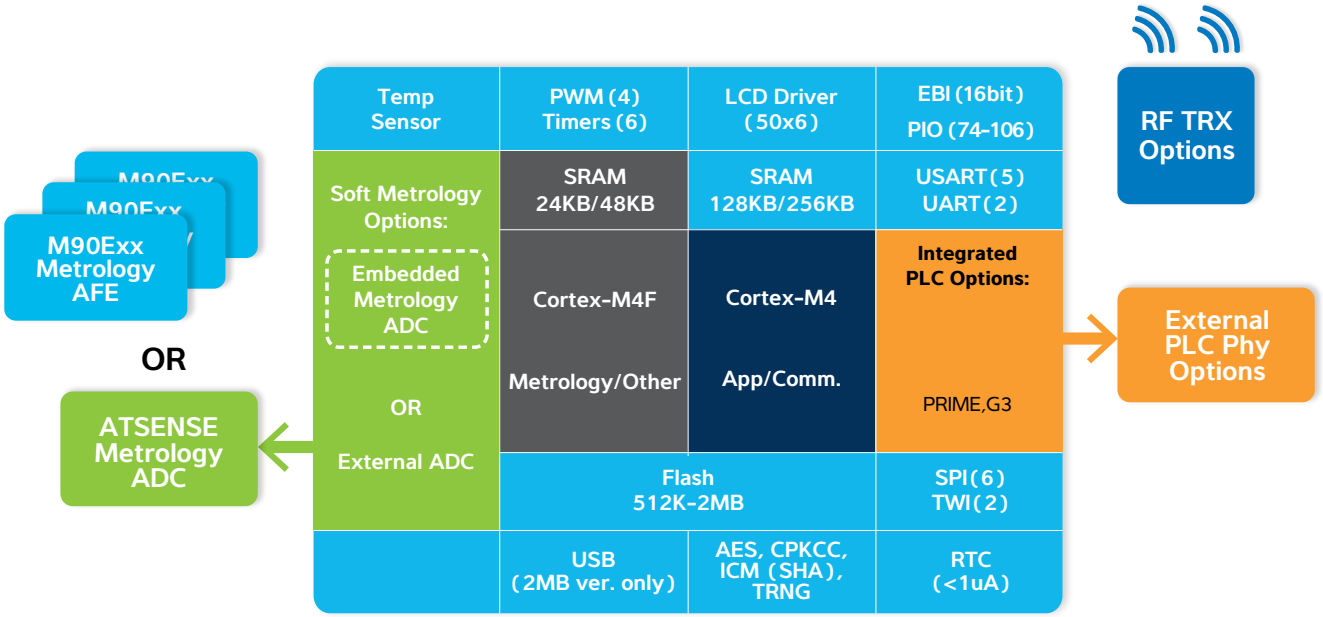


Figure 3. SAM4C Platform

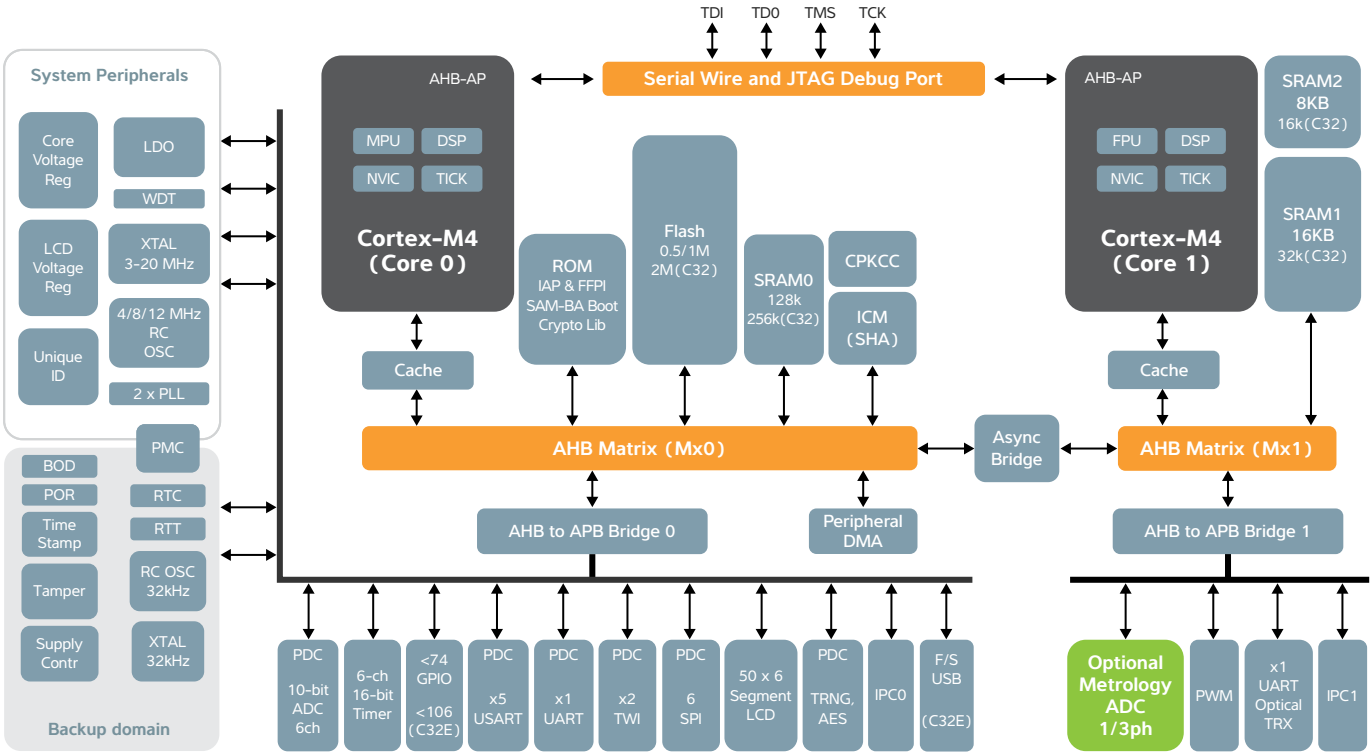


Figure 4. SAM4C Block Diagram

| | SAM4C8 | SAM4C16 | SAM4C32C | SAM4C32E | SAM4CMP8/ SAM4CMS8 | SAM4CMP16/ SAM4CMS16 | SAM4CMP32/ SAM4CMS32 |
|---|---|---|---|---|---|---|---|
| Flash | 512KB | 1MB | 2MB | | 512KB | 1MB | 2MB |
| SRAM | 128 + 16 + 8KB | | 256 + 32 + 16KB | | 128 + 16 + 8KB | | 256 + 32 + 16KB |
| Package | 100 LQFP | | | 144 LQFP | 100 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 | 10bit, 6 x Externals + 2 x Internals | | | | 10bit, 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 | | | | | | |

Table 2. SAM4C Metering SOC Feature Comparison


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## SAM4Cx Software Metrology

Flexibility to support various country-specific requirements

Atmel's software metrology library provides unprecedented level of performance, scalability, and flexibility which supports the integration of proprietary advanced metrology and signal processing algorithms. Atmel'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.

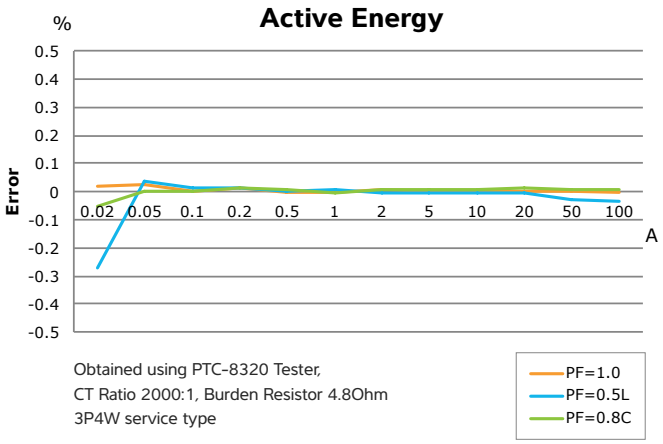



Figure 5. SAM4CM Linear Curve

The ATSENSE-301, ATSENSE-201 and ATSENSE-101 are analog front end (AFE) devices targeting metrology applications. They feature up to 7 channels of high-precision sigma-delta analog to digital converters (ADCs) with a 16ksps 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 SPI (serial peripheral interface).

### ATSENSE Features

- 0.1% accuracy over 3000:1 range
- Shunt, CT and Rogowski coil support
- 50ppm/°C reference, 10ppm/°C (H version)
- Works with Atmel Metrology library
- Ultra-low-power: < 2.5mW/channel @ 3.3V
- 8 MHz Serial Peripheral Interface (SPI) compatible mode 1 (8-bit) for ADC data and AFE controls.
- ATSENSE-301(H)
  - 32-pin TQFP package
  - 7 synchronous ∑-Δ ADCs, <16Ks/s
  - 3-V, 4-I channels with 8x PGA
- ATSENSE-201(H)
  - 32-pin TQFP package
  - 4 synchronous ∑-Δ ADCs, <16Ks/s
  - 2-V, 2-I channels with 8x PGA
- ATSENSE-101
  - 20-pin SOIC package
  - 3 synchronous ∑-Δ ADCs, <16Ks/s
  - 1-V, 2-I channels with 8x PGA

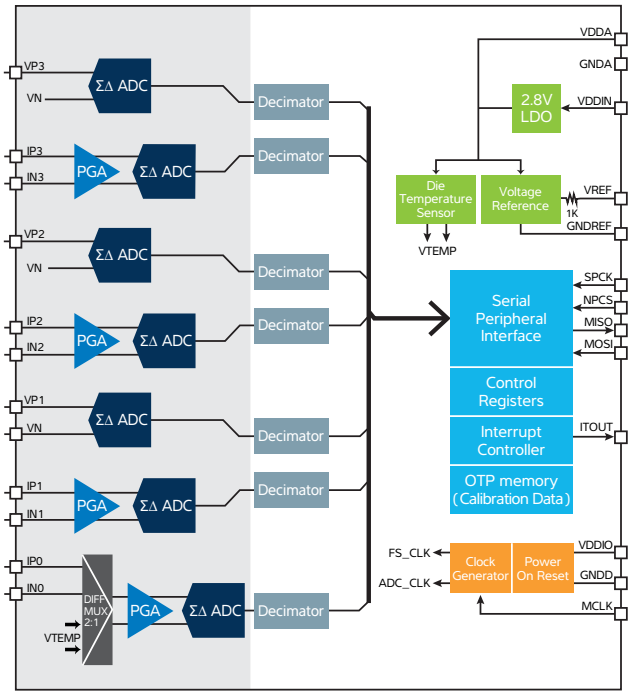
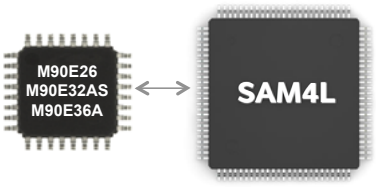



Figure 6. ATSENSE Block Diagram

## 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 @ 90µA/MHz
  - Full RAM retention @1.5µA
  - SleepWalking™
  - 4x40 Segment LCD Controller
  - Hardware Crypto block



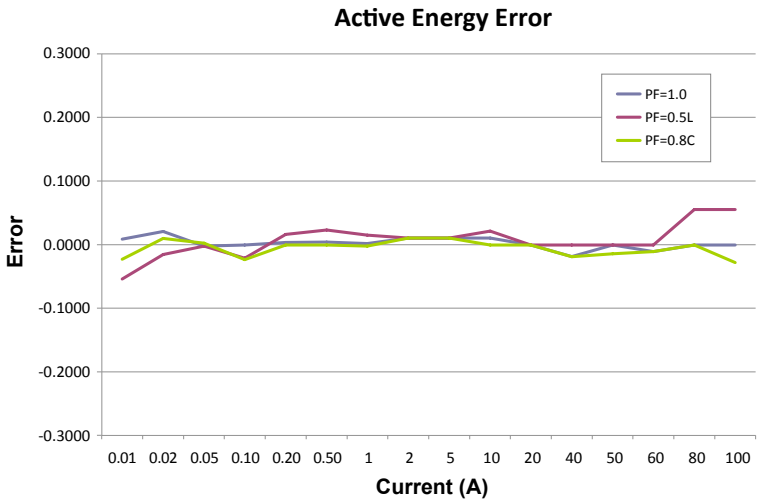




Figure 7. M90E36A Linearity

| | Service Type | Dynamic Range | Active Energy Accuracy | Reactive Energy Accuracy | Key Features |
|---|---|---|---|---|---|
| SAM4CMS8/16 | 1 phase | 3000:1 | 0.1% | 0.2% | High End Metrology SOC |
| SAM4CMP8/16 | 3 phase | 3000:1 | 0.1% | 0.2% | |
| SAM4C8/16 | - | - | - | - | Security SOC |
| SAM4CMS32 | 1 phase | 3000:1 | 0.1% | 0.2% | High End Metrology SOC |
| SAM4CMP32 | 3 phase | 3000:1 | 0.1% | 0.2% | |
| SAM4C32 | - | - | - | - | Security SOC |
| ATSENSE101 | 1 phase | 3000:1 | 1% | 1% | Software Metrology ADC |
| ATSENSE201 | 2 phase | 3000:1 | 0.2% | 0.2% | Software Metrology ADC |
| ATSENSE301 | 3 phase | 3000:1 | 0.2% | 0.2% | Software Metrology ADC |
| 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 & harmonics measurement, piece-wise compensation, event detection |
| M90E36A | 3 phase | 6000:1 | 0.1% | 0.2% | AFE, active, reactive energy, instantaneous, fundamental & harmonics measurement, Discrete Fourier Transform (DFT) Function, raw data capture |

Table 3. Atmel Metrology Solutions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## PLC Connectivity Products

Atmel 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 PRIME (PoweRline Intelligent Metering Evolution) and G3-PLC. Thanks to the communications software provided by our solution, the management of PLC networks turns into a transparent process. Users can focus on top-level applications and access the Atmel PLC software stack via user-friendly application programming interfaces (APIs).

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

### Flexible Architecture

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

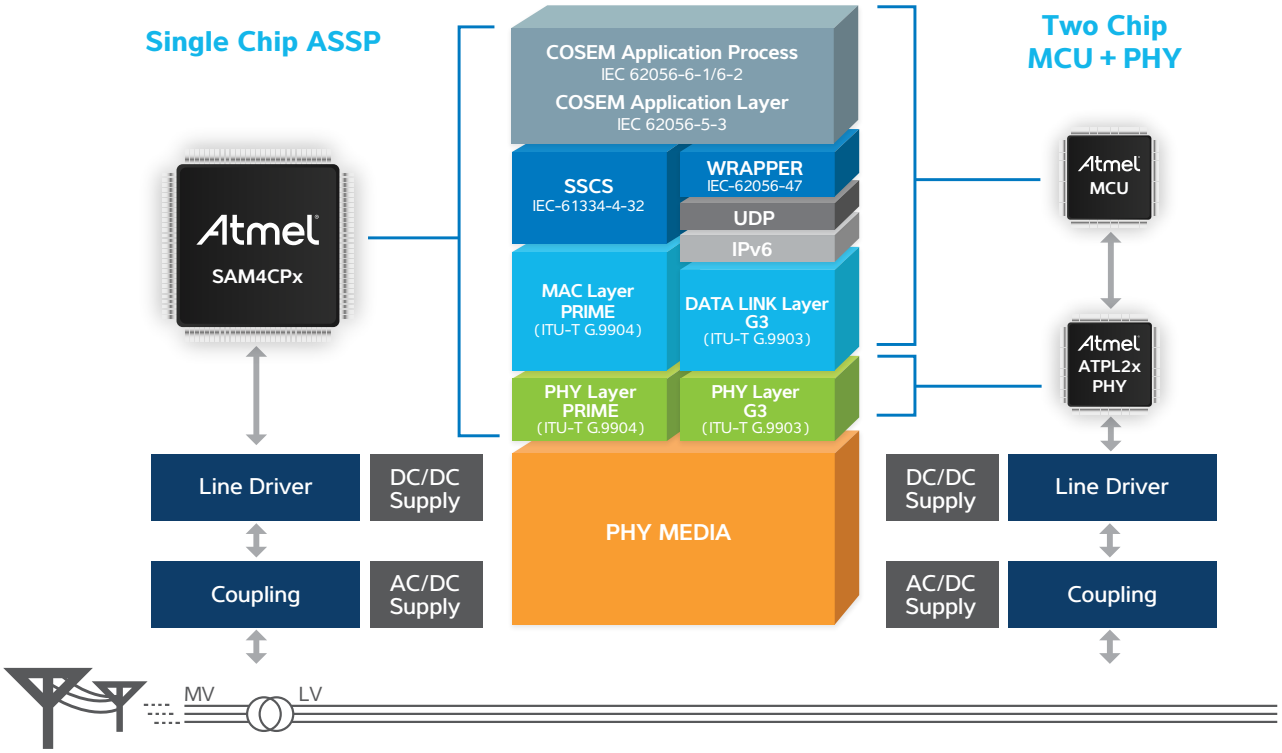


Figure 8. Atmel PLC Solutions. Flexible Architecture

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 Atmel | SMART SAM4CP series allow integration of application, communication and metrology software (using external Atmel metrology devices) to achieve highly reliable, flexible and cost effective smart meter designs.

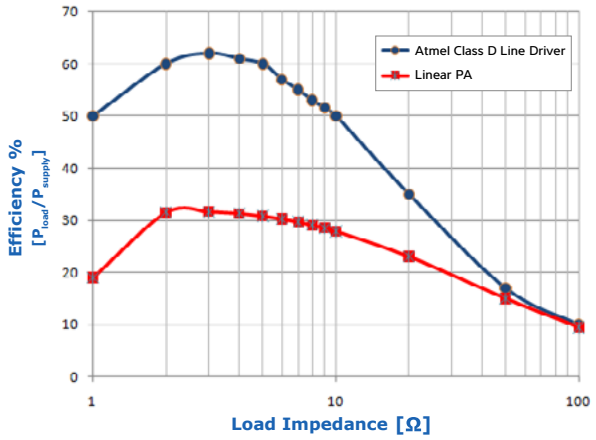


Figure 9. Class D Amplifier vs. Linear Power Amplifier Efficiency

| | Standard | Frequency Band | Core | CPU Clock | Flash | SRAM | Package |
|---|---|---|---|---|---|---|---|
| PL230A | PRIME | CEN / ARIB / FCC | -- | -- | -- | -- | LQFP 80 |
| PL250A | G3 | CEN / ARIB / FCC | -- | -- | -- | -- | LQFP 80 |
| SAM4CP16B | PRIME | CEN / ARIB / FCC | Dual Cortex-M4 | 120 MHz @core | 1 MB | 128 +16 + 8 KB | LQFP 176 |
| SAM4CP16C | G3 | CEN / ARIB / FCC | Dual Cortex-M4 | 120 MHz @core | 1 MB | 128 +16 + 8 KB | LQFP 176 |

Table 4. PLC Product Features

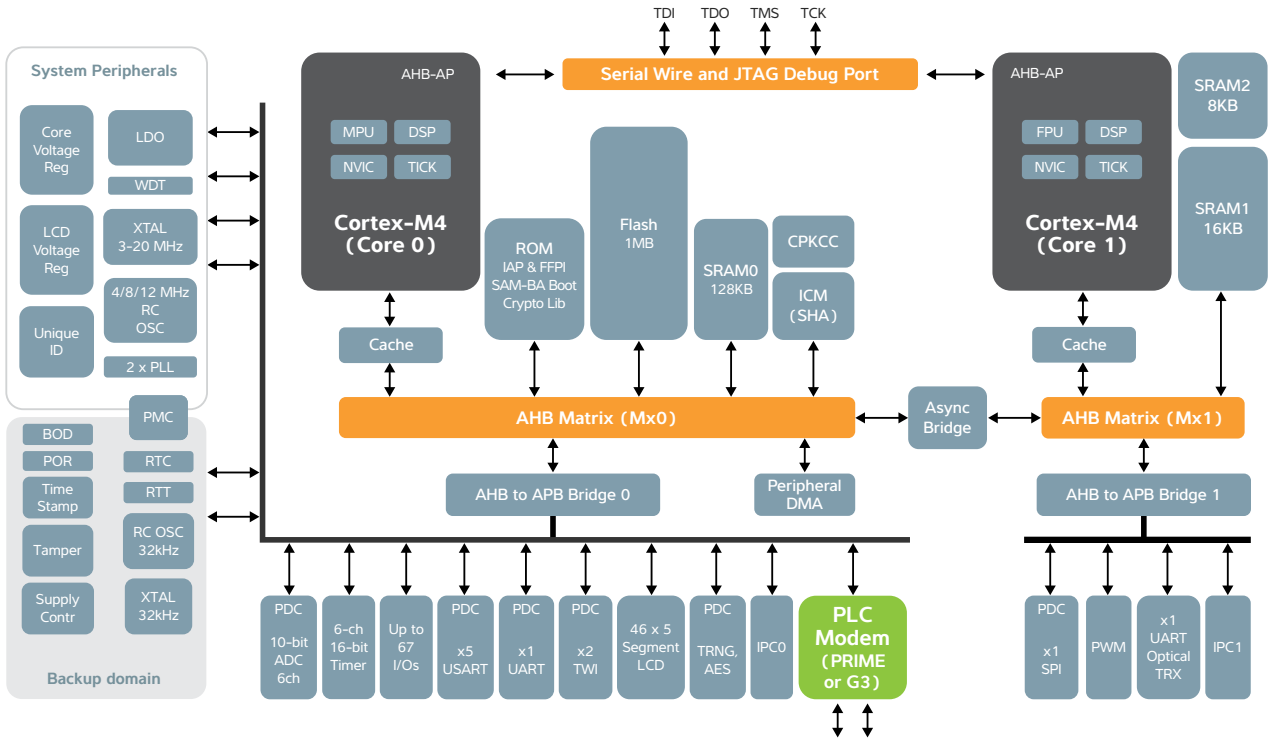


Figure 10. SAM4CP Series Block Diagram


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## Atmel PLC Software Stacks

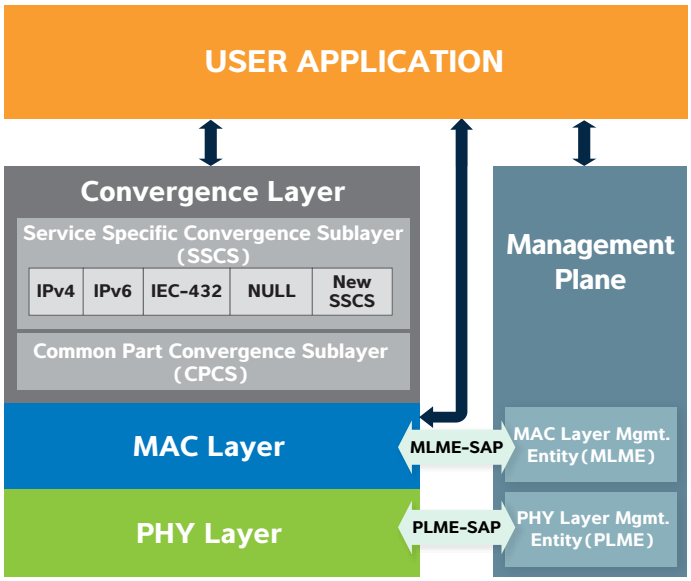


Figure 11. Atmel PRIME Software Stack

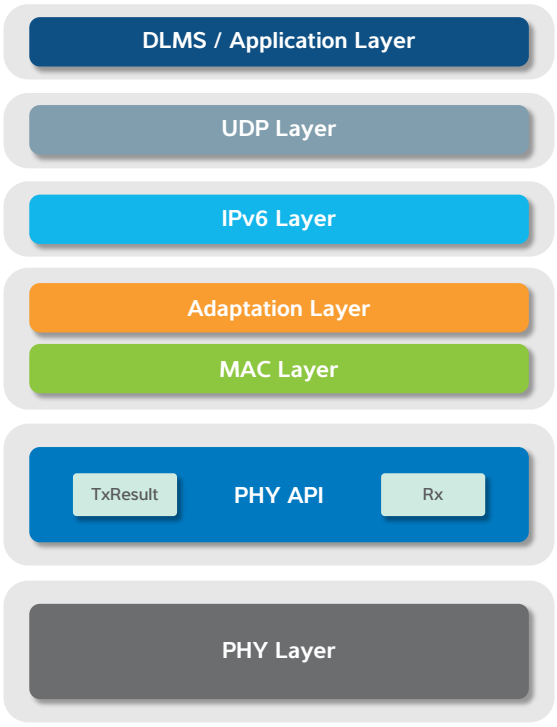


Figure 12. Atmel G3 Software Stack

Atmel provides PRIME and G3 software stacks that turn the management of PLC networks into a transparent process. Users can focus on top-level applications and access the Atmel PLC software stacks via user-friendly application programming interfaces (APIs).

## Wireless Connectivity Products

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

Additionally, Atmel 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. Atmel transceivers support not only IEEE 802.15.4-compliant applications, but provide on-air data rates up to 2 Mbit/s for general purpose ISM (industrial scientific medical) applications. Pin compatibility ensures an easy transition between devices or frequency bands.

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

## Key Products

The AT86RF212B 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 Atmel AT86RF233 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.

AT86RF215 is a dual-band sub-1 GHz/2.4 GHz transceiver compliant to IEEE 802.15.4g-2012 and ETSI TS 102 887-1. The 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.

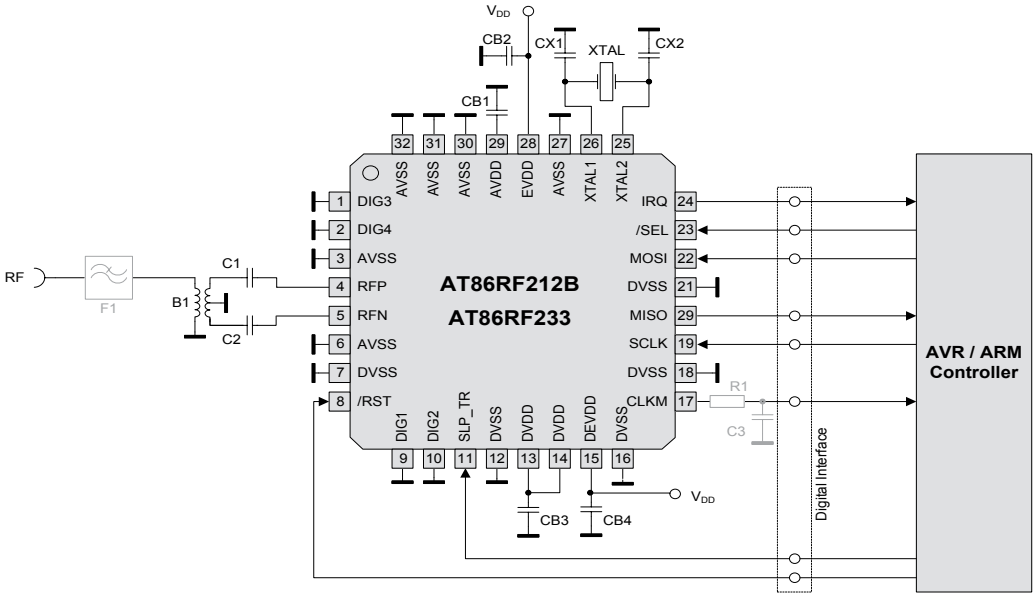


Figure 13. Wireless Tranceiver Application Diagram


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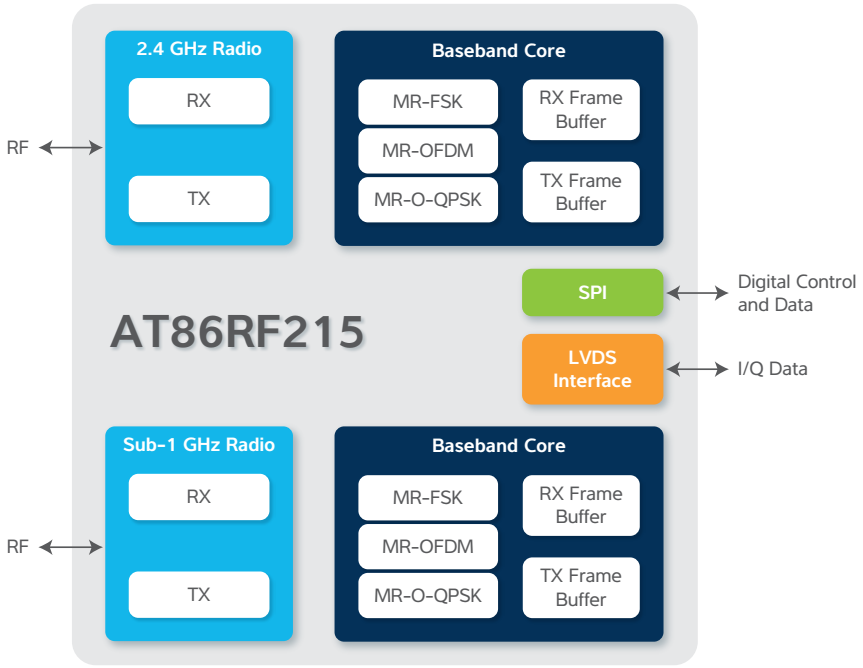


Figure 14. RF215 Block Diagram

| 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 |
|---|---|---|---|---|---|---|---|---|
| **AT86RF212B** Transceiver | 769 ... 935 | BPSK, O-QPSK | 20, 40, 100, 250<br>*proprietary: 200, 400, 500, 1000* | -110<br>@ 20 kbit/s | 10 | 0.2 µA<br>0.4 mA<br>9.2 mA<br>17.0 mA @ 5 dBm | QFN32 | IEEE 802.15.4-2006, IEEE 802.15.4-2011 |
| **AT86RF233** Transceiver | 2322 ... 2527 | O-QPSK | 250<br>*proprietary: 500, 1000, 2000* | -101<br>@ 250 kbit/s | 4 | 0.02/0.2 µA<br>0.3 mA<br>6.0/11.8 mA<br>13.8 mA @ 4 dBm | QFN32 | IEEE 802.15.4-2006, IEEE 802.15.4-2011 |
| **AT86RF215** Transceiver and I/Q radio | 389 ...510<br>779 ...1020<br>2400 ...2483 | MR-FSK, MR-OFDM, MR-O-QPSK, O-QPSK | 6.25 ... 800<br>*proprietary up to 2400* | -123<br>@ 6.25 kbit/s | 14 | 30 nA<br>3.0 mA<br>28 mA<br>65 mA @ 14 dBm | QFN48 | IEEE 802.15.4-2006, IEEE 802.15.4-2011, IEEE 802.15.4g-2012, ETSI TS 102 887-1 |
| **AT86RF215M** Transceiver and I/Q radio | 389 ...510<br>779 ...102 | MR-FSK, MR-OFDM, MR-O-QPSK, O-QPSK | 6.25 ... 800<br>*proprietary up to 2400* | -123<br>@ 6.25 kbit/s | 14 | 30 nA<br>3.0 mA<br>28 mA<br>65 mA @ 14 dBm | QFN48 | IEEE 802.15.4-2011, IEEE 802.15.4g-2012, ETSI TS 102 887-1 |

Table 5. Wireless Transceiver Products

# Smart Energy Portfolio

| | | Product | Ordering Code | Package | Features | Flash | MRL |
|---|---|---|---|---|---|---|---|
| Metering MCU | | ATSAM4C8C | ATSAM4C8CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | A |
| | | | ATSAM4C8CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | A |
| | | | ATSAM4C8CB-AU | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | B |
| | | | ATSAM4C8CB-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | B |
| | | ATSAM4C16C | ATSAM4C16CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | A |
| | | | ATSAM4C16CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | A |
| | | | ATSAM4C16CB-AU | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | B |
| | | | ATSAM4C16CB-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | B |
| | | ATSAM4C32CA | ATSAM4C32CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| | | | ATSAM4C32CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| | | ATSAM4C32EA | ATSAM4C32EA-AU | 144LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| | | | ATSAM4C32EA-AUR | 144LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| Metrology SoC | Single Phase | ATSAM4CMS8C | ATSAM4CMS8CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | A |
| | | | ATSAM4CMS8CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | A |
| | | | ATSAM4CMS8CB-AU | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | B |
| | | | ATSAM4CMS8CB-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | B |
| | | ATSAM4CMS16C | ATSAM4CMS16CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | A |
| | | | ATSAM4CMS16CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | A |
| | | | ATSAM4CMS16CB-AU | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | B |
| | | | ATSAM4CMS16CB-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | B |
| | | ATSAM4CMS32C | ATSAM4CMS32CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| | | | ATSAM4CMS32CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| | 3 Phase | ATSAM4CMP8C | ATSAM4CMP8CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | A |
| | | | ATSAM4CMP8CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | A |
| | | | ATSAM4CMP8CB-AU | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | B |
| | | | ATSAM4CMP8CB-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 512 KB | B |
| | | ATSAM4CMP16C | ATSAM4CMP16CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | A |
| | | | ATSAM4CMP16CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | A |
| | | | ATSAM4CMP16CB-AU | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | B |
| | | | ATSAM4CMP16CB-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 1 MB | B |
| | | ATSAM4CMP32C | ATSAM4CMP32CA-AU | 100LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |
| | | | ATSAM4CMP32CA-AUR | 100LQFP | Green, IND TEMP, CRYPTO | 2 MB | A |


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| Package | | Part Numbers | Kit Contents Pictures | IDE | RTOS | STACKS/LIBRARIES |
|---|---|---|---|---|---|---|
| Tray | Tools | ATSAM4C-EK | | ATMEL Studio & ASF IAR KEIL | FreeRTOS | ATMEL Metrology & Crypto Libraries |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4C32-EK | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | Tools | ATSAM4CMS-DB | | ATMEL Studio & ASF IAR KEIL | FreeRTOS | ATMEL Metrology & Crypto Libraries |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4CMP-DB | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |

# Smart Energy Portfolio (Continued)

| | | Product | Ordering Code | Package | Features | Flash | MRL |
|---|---|---|---|---|---|---|---|
| PLC | PRIME Modem | ATPL230A | ATPL230A-AKU-Y | 80LQPF | Green, IND TEMP | -- | A |
| | | | ATPL230A-AKU-R | 80LQPF | Green, IND TEMP | -- | A |
| | PRIME SoC | ATSAM4CP16B | ATSAM4CP16B-AHU-Y | 176LQFP | Green, IND TEMP | 1 MB | A |
| | G3 Modem | ATPL250A | ATPL250A-AKU-Y | 80LQPF | Green, IND TEMP | -- | -- |
| | | | ATPL250A-AKU-R | 80LQPF | Green, IND TEMP | -- | -- |
| | G3 SoC | ATSAM4CP16C | ATSAM4CP16C-AHU-Y | 176LQFP | Green, IND TEMP | 1 MB | -- |
| RF | Sub-1 GHz Transceiver (IEEE 802.15.4-2011) | AT86RF212B | AT86RF212B-ZU | 32QFN | 700/800/900 MHz ZigBee Transceiver, 85°C | -- | B |
| | | | AT86RF212B-ZUR | 32QFN | 700/800/900 MHz ZigBee Transceiver, 85°C | -- | B |
| | 2.4 GHz Transceiver (IEEE 802.15.4-2006) | AT86RF233 | AT86RF233-ZF | 32QFN | 2.4 GHz ZigBee Transceiver, 125°C | -- | A |
| | | | AT86RF233-ZFR | 32QFN | 2.4 GHz ZigBee Transceiver, 125°C | -- | A |
| | | | AT86RF233-ZU | 32QFN | 2.4 GHz ZigBee Transceiver, 85°C | -- | A |
| | | | AT86RF233-ZUR | 32QFN | 2.4 GHz ZigBee Transceiver, 85°C | -- | A |
| | Dual-Band Transceiver (IEEE 802.15.4g-2012) | AT86RF215 | AT86RF215-ZU | 48QFN | Dual-Band Transceiver, 85°C | -- | A |
| | | | AT86RF215-ZUR | 48QFN | Dual-Band Transceiver, 85°C | -- | A |
| | Sub-1 GHz Transceiver (IEEE 802.15.4g-2012) | AT86RF215M | AT86RF215M-ZU | 48QFN | Sub-1 GHz Transceiver, 85°C | -- | A |
| | | | AT86RF215M-ZUR | 48QFN | Sub-1 GHz Transceiver, 85°C | -- | A |
| | Dual-Band I/Q Radio | AT86RF215IQ | AT86RF215IQ-ZU | 48QFN | Dual-Band I/Q Radio, 85°C | -- | A |
| | | | AT86RF215IQ-ZUR | 48QFN | Dual-Band I/Q Radio, 85°C | -- | A |


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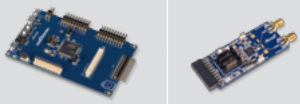
| Package | | Part Numbers | Kit Contents Pictures | IDE | RTOS | STACKS/LIBRARIES |
|---|---|---|---|---|---|---|
| Tray | Tools | ATPL230A-EK (2 Modem Boards + 4 Couplings) | | ATMEL Studio & ASF IAR | FreeRTOS | PRIME |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4CP16B-EK (2 Boards + 4 Couplings) | | ATMEL Studio & ASF IAR | FreeRTOS | PRIME |
| Tray | | ATPL250A-EK (2 Modem Boards + 4 Couplings) | | ATMEL Studio & ASF IAR | FreeRTOS | G3 |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4CP16C-EK (2 Boards + 4 Couplings) | | ATMEL Studio & ASF IAR | FreeRTOS | G3 |
| Tray | Tools | ATSAM4L-XPRO + ATZB-212B-XPRO | | ATMEL Studio ASF<br>Wireless Performance Analyzer | FreeRTOS eCOS (SAM9) | Exegin Technologies:<br>IEEE 802.15.4 MAC, ZigBee Pro/SEP1.x, ZigBee IP/SEP2.0, 6LoWPAN |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4L-XPRO + ATREB233-XPRO or ATZB-A-233-XPRO (Amplified) | | | | |
| Tape & Reel | | | | | | |
| Tray | | | | | | |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4L-XPRO + ATREB215-XPRO |  | | | |
| Tape & Reel | | | | | | |
| Tray | | ATSAM4L-XPRO + ATREB215-XPRO | | | | |
| Tape & Reel | | | | | | |
| Tray | | ATREB215-XPRO | | n/a | n/a | n/a |
| Tape & Reel | | | | | | |

# Smart Energy Portfolio (Continued)

| | | Product | Ordering Code | Package | Features | Flash | MRL |
|---|---|---|---|---|---|---|---|
| SAM4C AFE Companion Chip | Single Phase | ATSENSE100 | ATSENSE101A-SU | 20SOIC | GREEN, IND TEMP | -- | A |
| | | | ATSENSE101A-SUR | 20SOIC | GREEN, IND TEMP | -- | A |
| | Two Phase | ATSENSE200 | ATSENSE201A-AU | 32LQFP | GREEN, IND TEMP | -- | A |
| | | | ATSENSE201A-AUR | 32LQFP | GREEN, IND TEMP | -- | A |
| | | | ATSENSE201HA-AU | 32LQFP | GREEN, IND TEMP | -- | A |
| | | | ATSENSE201HA-AUR | 32LQFP | GREEN, IND TEMP | -- | A |
| | 3 Phase | ATSENSE300 | ATSENSE301A-AU | 32LQFP | GREEN, IND TEMP | -- | A |
| | | | ATSENSE301A-AUR | 32LQFP | GREEN, IND TEMP | -- | A |
| | | | ATSENSE301HA-AU | 32LQFP | GREEN, IND TEMP | -- | A |
| | | | ATSENSE301HA-AUR | 32LQFP | GREEN, IND TEMP | -- | A |
| Stand Alone AFE (90E series) | Single Phase | ATM90E26 | ATM90E26-YU-B | 28-SSOP | IND TEMP, 1.8V/3V | -- | -- |
| | | | ATM90E26-YU-R | 28-SSOP | IND TEMP, 1.8V/3V | -- | -- |
| | 3 Phase | ATM90E32 | ATM90E32AS-AU-R | 48-TQFP | IND TEMP, 1.8V/3V | -- | -- |
| | | | ATM90E32AS-AU-Y | 48-TQFP | IND TEMP, 1.8V/3V | -- | -- |
| | | ATM90E36 | ATM90E36A-AU-R | 48-TQFP | IND TEMP, 1.8V/3V | -- | -- |
| | | | ATM90E36A-AU-Y | 48-TQFP | IND TEMP, 1.8V/3V | -- | -- |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| Package | | Part Numbers | Kit Contents Pictures | IDE | RTOS | STACKS/LIBRARIES |
|---|---|---|---|---|---|---|
| Tube | Tools | Use Metrology SoC Tools | | | | |
| Tape & Reel | | | | | | |
| Tube | | | | | | |
| Tape & Reel | | | | | | |
| Tube | | | | | | |
| Tape & Reel | | | | | | |
| Tube | | | | | | |
| Tape & Reel | | | | | | |
| Tube | | | | | | |
| Tape & Reel | | | | | | |
| Tube | Tools | ATM90E2X-DB | | All SAM4C Software tools + Metrology Libraries | | |
| Tape & Reel | | ATM90E32AS-DB | | All SAM4C Software tools + Metrology Libraries | | |
| Tray | | ATM90E32AS-RD | | Atmel Cortex-M4 based SAM4LC4C microcontroller and ATM90E32A Atmel Poly-Phase Energy Metering AFE chipset | | |
| Tape & Reel | | ATM90E36A-DB | | All SAM4C Software tools + Metrology Libraries | | |
| Tray | | ATM90E36A-RD | | Atmel Cortex-M4 based SAM4LC4C microcontroller and ATM90E36A Atmel Poly-Phase Energy Metering AFE chipset | | |

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