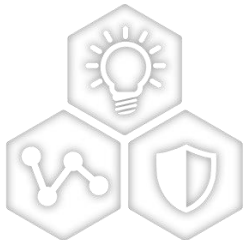


Smart Energy Platform 2.0



A Leading Provider of Smart, Connected and Secure Embedded Control Solutions



SMART | CONNECTED | SECURE

July 2022

Key Differentiators

- **One Platform, Multiple Designs**

- Product options optimized for variety of meter designs
- Common firmware libraries and architecture
- Improved Time-to-Market



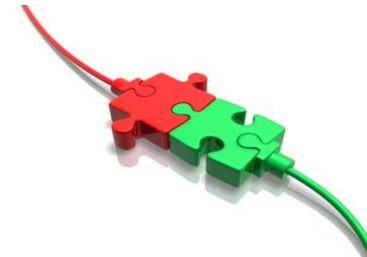
- **Up to Class 0.2 Metrology**

- Residential, Commercial and Industrial
- ANSI, IEC Measurement libraries

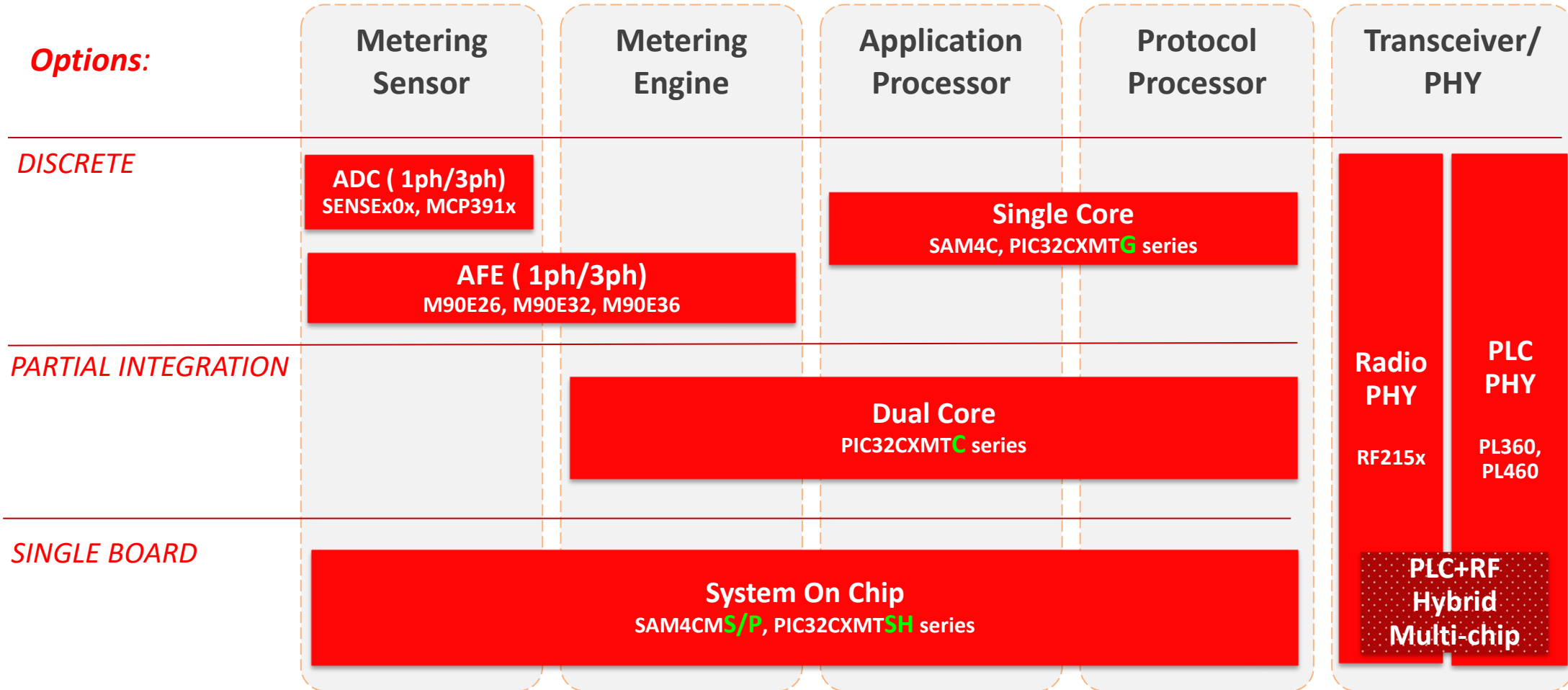


- **Communication**

- Certified PRIME and G3-PLC Libraries
- WiSun, 802.15.4g all modes
- G3-PLC and PRIME PLC/RF Hybrid solutions supported



Smart Energy Platform 2.0



+ Microchip portfolio:

Crypto

Mem

Ana/Pwr

BT, WiFi

MCU/ MPU

Smart Energy Solutions

Stand-alone Metrology Solutions

ADC: ATSENSE101/201/301

- # of ADC: 3/4/7
- 0.1% accuracy over 3000:1 range
- SINAD: 84dB
- Shunt, CT and Rogowski coil support
- 50ppm/°C reference, 10ppm/°C (H version)
- Digital temperature compensation for Vref
- Works with MCHP ANSI & IEC qualified Metrology Library

- **ATSENSE-301**

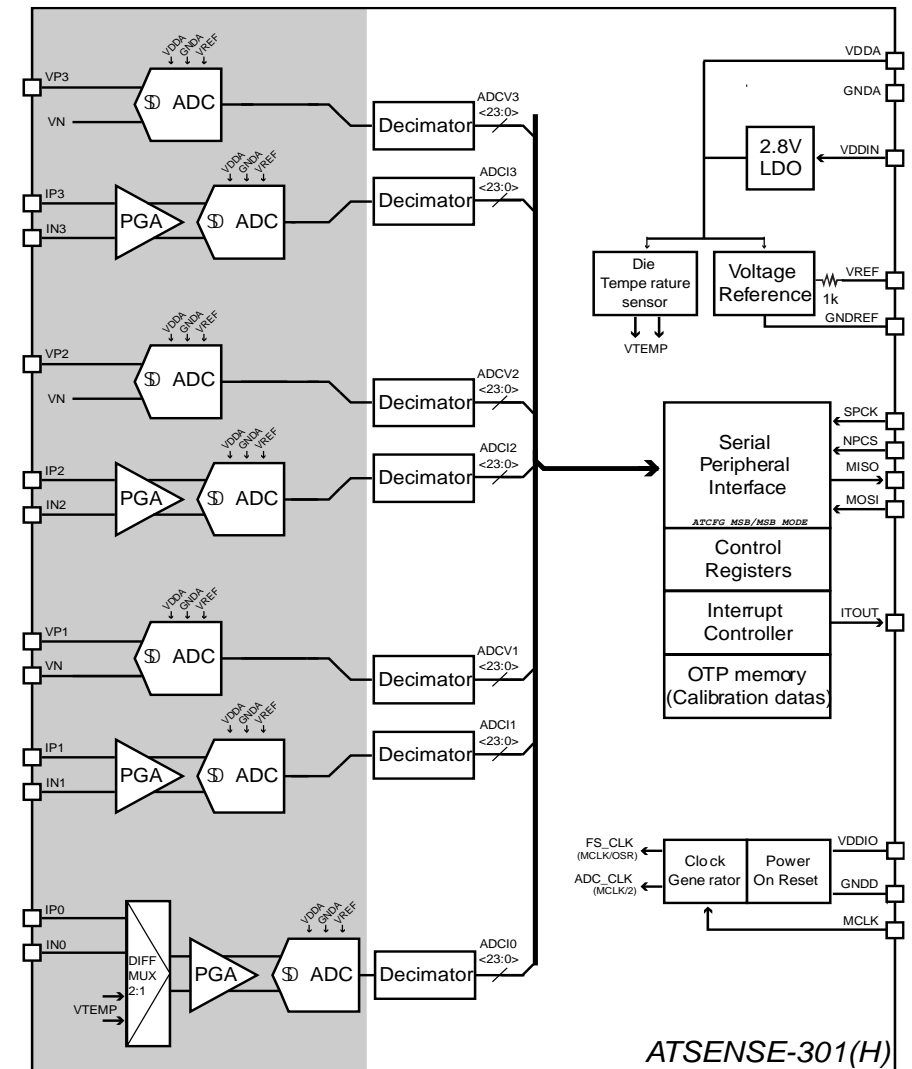
- 32-pin TQFP package
- 7 synchronous Σ - Δ ADCs, <16Ks/s
- 3-V, 4-I channels with 8x PGA

- **ATSENSE-201**

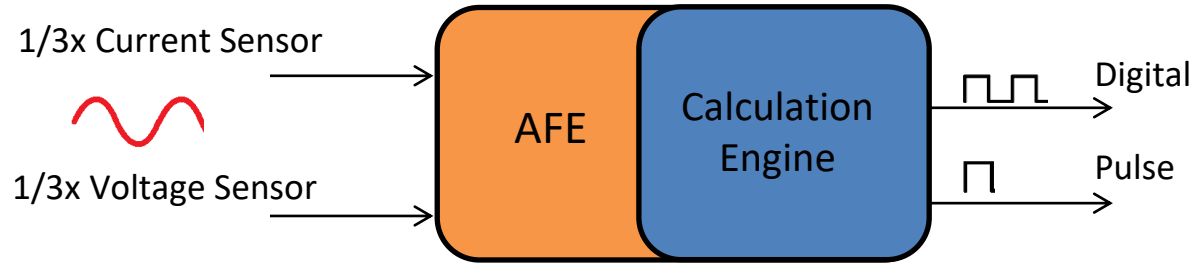
- 32-pin TQFP package
- 4 synchronous Σ - Δ ADCs, <16Ks/s
- 2-V, 2-I channels with 8x PGA

- **ATSENSE-101**

- 20-pin SOIC package
- 3 synchronous Σ - Δ ADCs, <16Ks/s
- 1-V, 2-I channels with 8x PGA



AFE: Single/Poly Phase Energy Meter

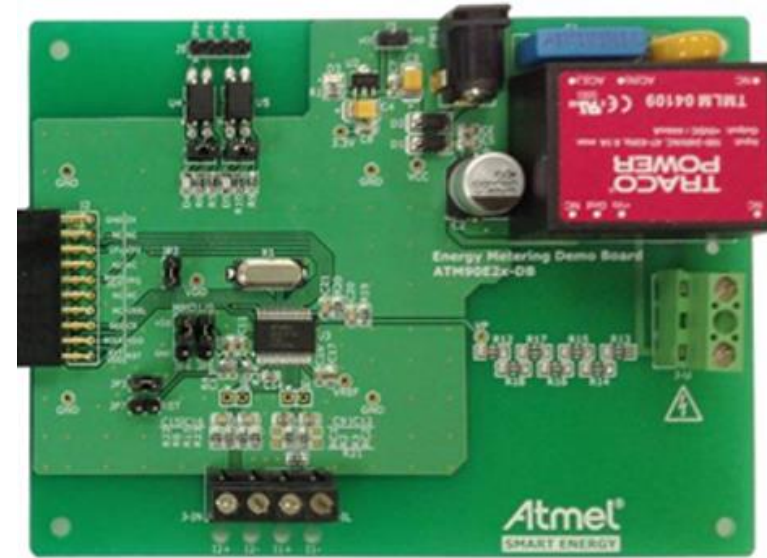


Part Number	ATM90E26	ATM90E32AS	ATM90E36
Phase	Single	Poly	Poly
Number of $\Sigma\Delta$ ADC Channel	3	6	7
Accuracy	0.1% Active, 0.2% Reactive	0.1% Active, 0.2% Reactive	0.1% Active, 0.2% Reactive
Dynamic Range	5000:1	6000:1	6000:1
Calculations	Power & Energy PF, f, Zero-Cross	Power & Energy PF, f, Zero-Cross	Power & Energy PF, f, Zero-Cross
Output Pulse	Yes	Yes	Yes
Event Detection	Yes	Yes	Yes
Harmonic Measurement	No	Yes	DFT & THD Analysis
Neutral Monitoring	Yes	No	Yes
Comm. I/F	UART, SPI	SPI	SPI
Temperature Sensor	No	Yes	Yes

AFE: ATM90Ex Energy Measurement Demo Boards

ATM90E26: single-phase energy metering board

- Supports resistive Shunt or Current Transformer (CT)
- Energy pulses
- Active energy pulse indicator and isolated output
- Reactive energy pulse indicator and isolated output
- One communication connector
- 8.192MHz Crystal
- External 3.3V input



ATM90E26 DB

ATM90E32AS or ATM90E36A: Poly-phase energy Metering board

- Supports Current Transformer (CT) or Rogowski Coil
- Isolated Energy pulse outputs for Active, Reactive,
- Apparent, Fundamental and Harmonic Energy
- 16.384MHz Crystal
- 100-240VAC or 9VDC input power



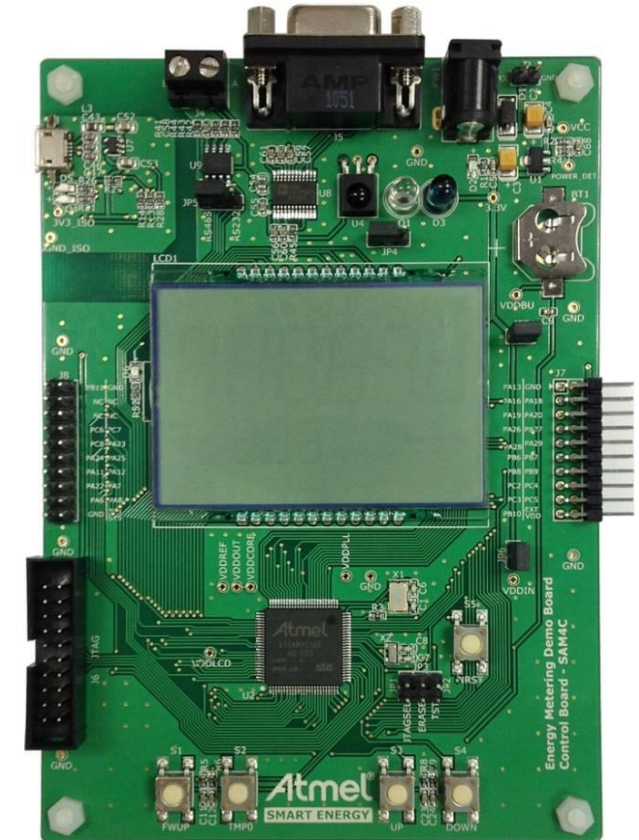
ATM90E3x DB

Ordering Code

- ATM90E2x-DB
- ATM90E32AS-DB
- ATM90E36A-DB

AFE Control Board – SAM4C

- Atmel® SAM4C microcontroller
- Programming and debugging (target) through the JTAG port
- Two possible power sources: External DC9V, External 3.3V from the daughter board
- Digital I/O
 - Five mechanical buttons
 - One reset button
 - Two switch buttons for display (including forward and backward button)
 - Two wake up buttons (one is FWUP, the other is TMP0)
 - One extension header
 - One communication connector
- Segment LCD display
- Communication interfaces
 - USB, RS485, RS232
 - One Infrared Radiation (IR)
 - One Optical Infrared Radiation (OIR)
- One EEPROM



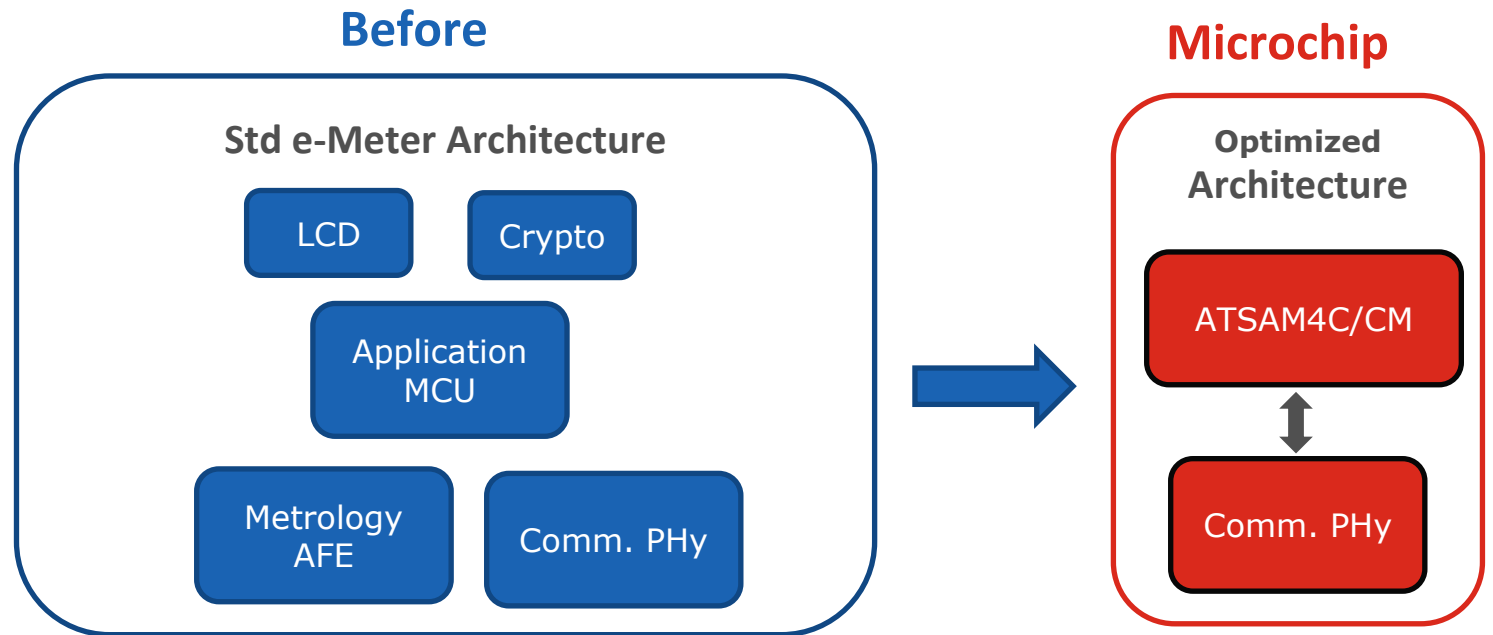
Smart Energy Solutions

Smart Meter SoC Solutions: SAM4CMx

Key Platform Objectives

- **Addressing Smart Metering challenges**

- Reducing BOM and Form Factor (cost, PCB layers)
- Comm. Solution (RF, PLC)
- Future Proof Room (Body Regulation Evolution)
- Lower Power
- Advanced Security features

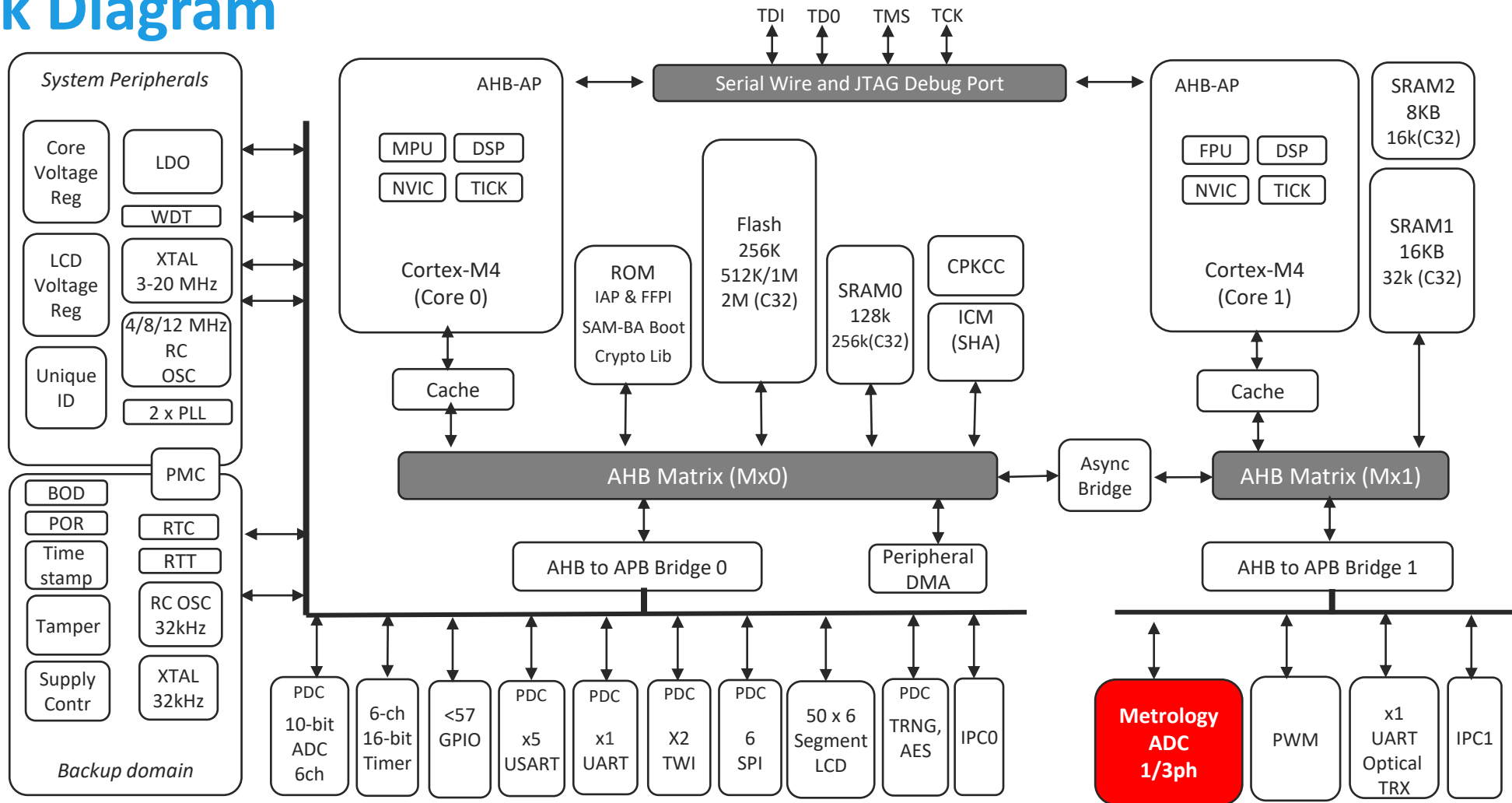


SAM4Cx Device Comparisons

Part	SAM4C4	SAM4C8	SAM4C16	SAM4C32C	SAM4C32E	SAM4CMS4	SAM4CMP/S8	SAM4CMP/S16	SAM4CMP/S32
Flash	256 KB	512 KB	1MB	2MB		256 KB	512 KB	1MB	2MB
SRAM	128 + 16 + 8 KB			256 + 32 + 16 KB		128 + 16 + 8 KB			256 + 32 + 16KB
Package	100 LQFP				144 LQFP	100 LQFP			
GPIO	74				106	52 / 57			
PWM	4					3			
UART	2 x UARTs, 5 x USARTs					2 x UARTs, 3/4 x USARTs			
SPI	2 x Controllers – 8 Chip Selects, + 5 x USARTs in SPI Mode					1 x Controller – 4 C/S + 3/4 x 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								

SAM4CMx Series

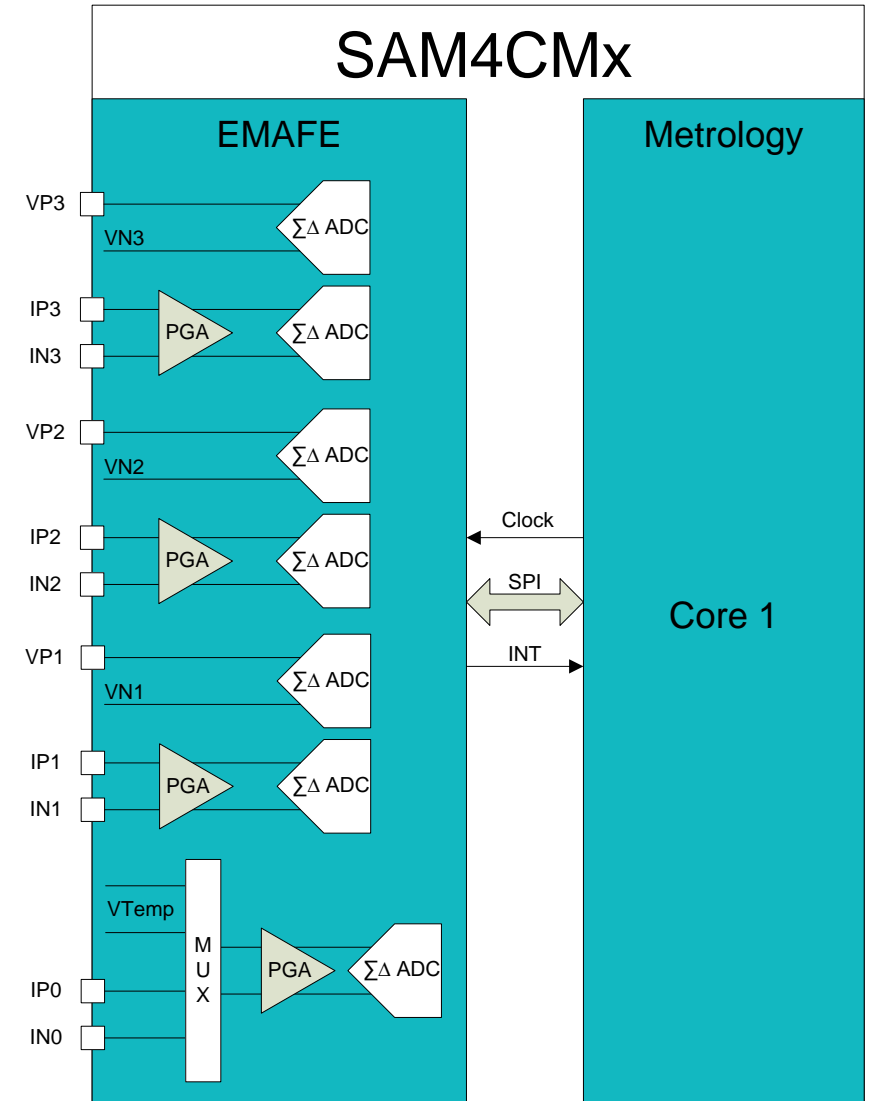
Block Diagram



C32 devices have 2M flash, full speed USB, more GPIO, more RAM

SAM4CMx Embedded Metrology

- **Poly-Phase EMAFE**
 - 7 synchronous $\Sigma\Delta$ ADCs, <16ks/s
 - 3-V, 4-I channels with 8x PGA
- **Single-Phase EMAFE**
 - 4 synchronous $\Sigma\Delta$ ADCs, <16ks/s
 - 2-V, 2-I channels with 8x PGA
- **Neutral current measurement (anti-tamper).**
- **Precise Voltage Reference: 10ppm/°C typ.**
- **Dedicated LDO regulator supplying the EMAFE.**
- **Ultra-low-power: < 2.5mW/channel @ 3.3V.**



Best In Class Metrology DSP Lib

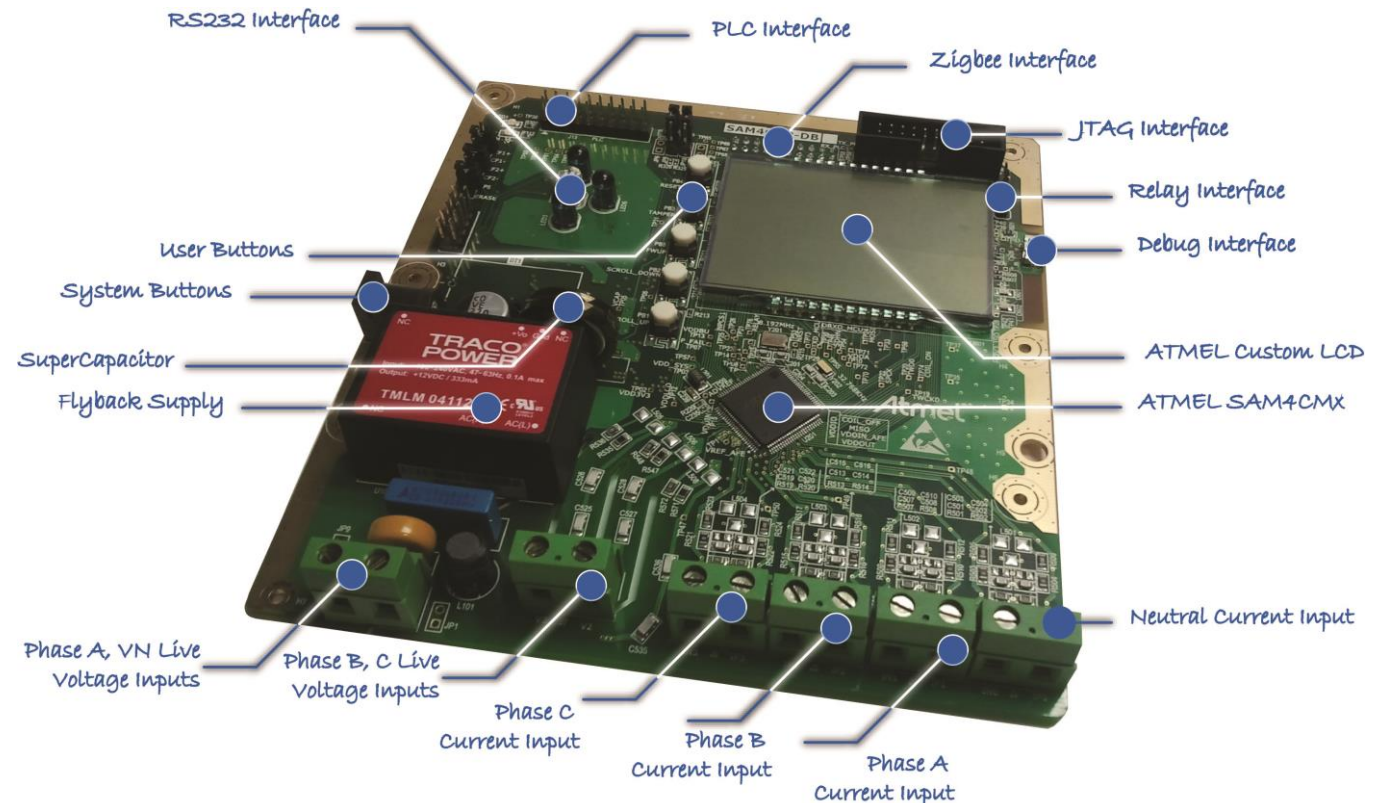
- Microchip delivers Comprehensive FW Metrology Suite compliant with IEC 62053-22 and ANSI C12.20-2002 Std requirement
- Highly Flexible to Local Requirement
 - Mix between high performance embedded Analog, High ARM cortex-M4 CPU
 - DSP instructions and Flexible Metrology FW
- High Performance
 - Active Energy up to class 0.1
 - Reactive Energy up to class 0.2
 - Dynamic Range of 3000:1
 - Harmonics measurement up to 27th order
- Supporting any sensors (Shunt, CT & RC)

SAM4CMS-DB: Single-Phase Meter Demo Board

SAM4CMP-DB: Poly-Phase Meter Demo Board

- **Support for SAM4CMS and SAM4CMP**

- Connectors for customer current sensors
- Voltage dividers on-board
- LCD (Custom Atmel), Buttons
- Atmel ATSHA204 Crypto Memory
- Atmel AT30TS75 Temp. Sensor
- Metrology LEDs (Wh, ...)
- ANSI or IEC base fitting
- Adesto AT25DF321A
- Supercap backup supply
- PLC connectors
- JTAG debug port
- RF/Zigbee Connectors
- Flyback Supply
- Opto ports
- Metrology Library
- Application Firmware



SAM4CMx/ATsense

Flexibility to support WW requirements

- **Exceed class 0.2 accuracy standards**

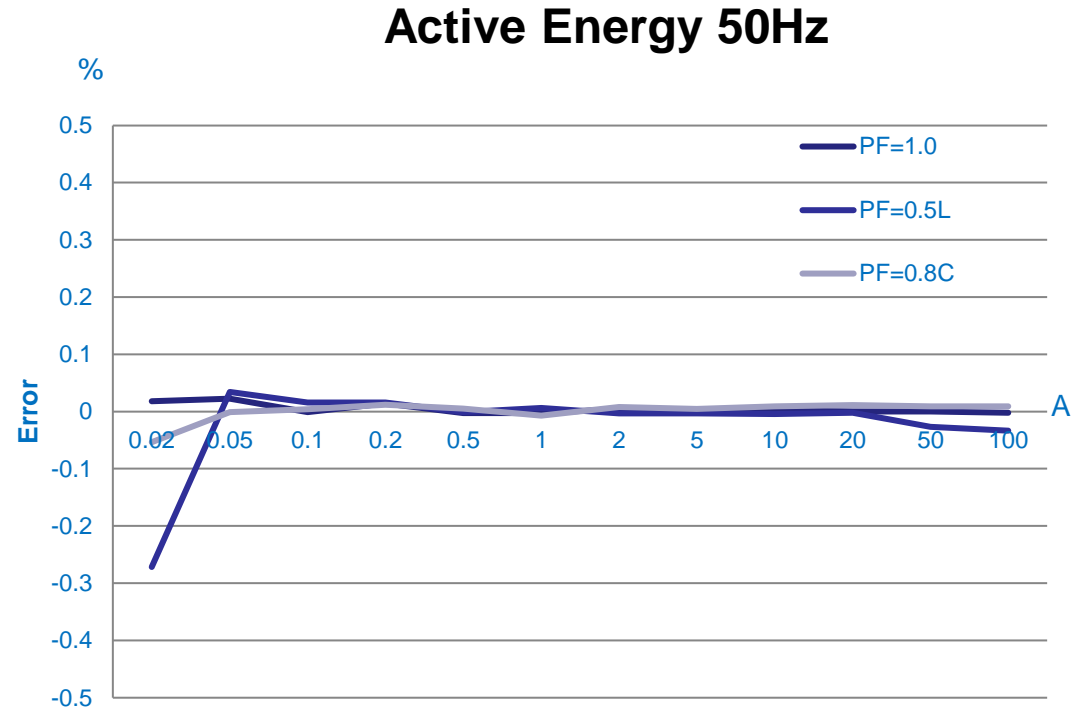
- IEC 62052-11, 62053-22/23
- ANSI C12.1, C12.20
- Up to seven 16ksps $\Sigma\Delta$ ADC
- 10ppm/c reference
- 3000:1 dynamic range

- **Highest flexibility**

- Customizable metrology
- Shunt, CT, Rogowski sensors

- **Highly integrated**

- Dual-core cortex-M4 architecture
- Lowest smart meter BOM cost



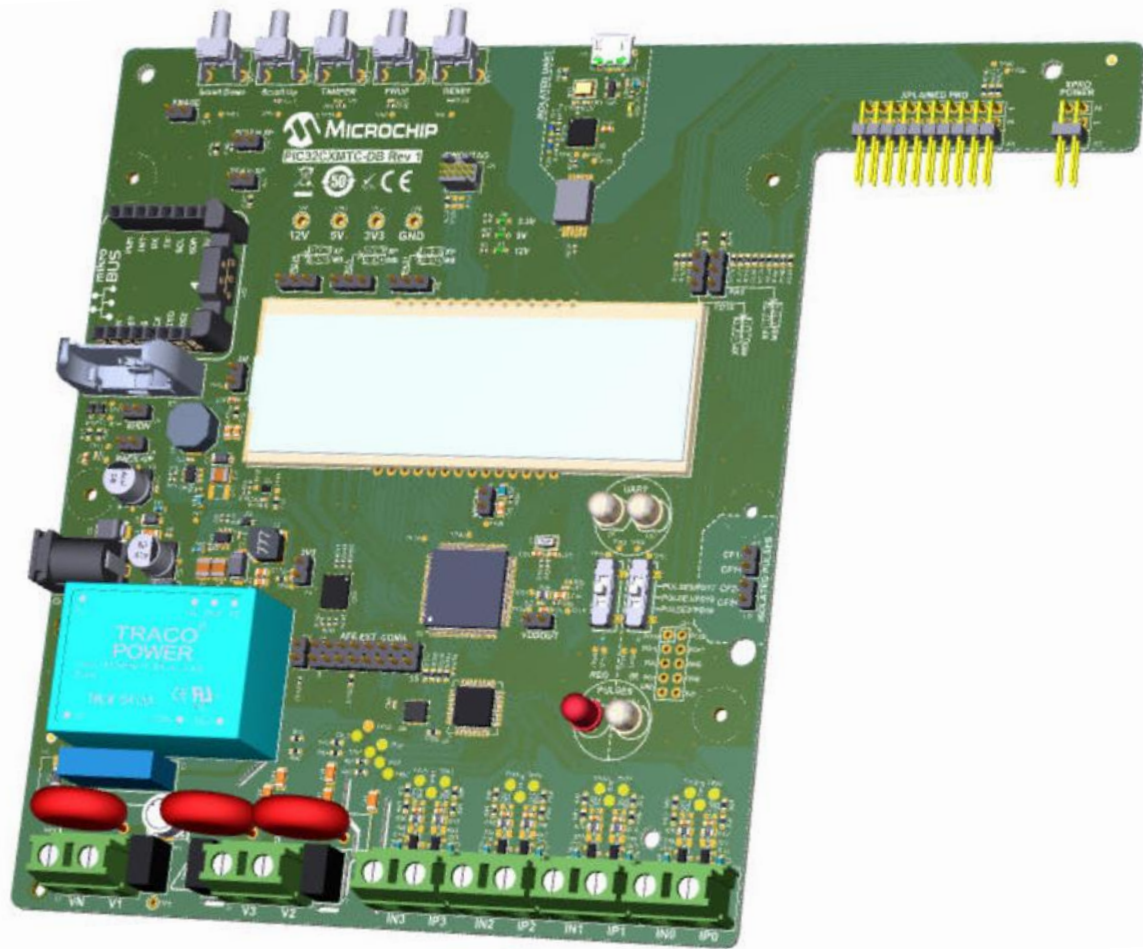
Obtained using PTC-8320 Tester,
CT Ratio 2000:1, Burden Resistor
4.8Ohm
3P4W service type

Smart Energy Solutions

Smart Meter New SoC Solutions: PIC32CXMTx

Smart Energy Platform 2.0

Value proposition



Upward Migration Path from ATSAM4C

- Accelerate TTM & Maximize Re-Use
- ARM CM4 based Dual Core and Single Core MCU architecture
- ANSI & IEC Metrology DSP lib support
- G3 & Prime 1.3/4 PLC stacks support

Increased Scalability

- Future Proof Enabling Platform
- While supporting high level of integration, introducing a new single core series tailored for comm. module
- Higher Performance & Enhanced Architecture ready for Energy Disaggregation
- Increase Embedded Memory
- Low Power architecture

Leading Security

- Meeting State of the Art Authority Regulation Requirement
- DLMS/COSEM suite 2 compliancy
- CAVP certification and NIST compliancy (including TRNG)
- Embedded Secure Element functions

PIC32CXMT Family

Gen 2

- **PIC32CXMTG**

Single Core for either metrology, apps or comm processing

- **PIC32CXMTC**

Dual Core to include Apps & Comms with External Metrology AFE(s) for Residential, C&I

- **PIC32CXMTS**

Residential SOC, includes all resources for Apps, Comm/Security and Metrology

Common HW, SW architecture with Gen 1 (SAM4Cxx) facilitates design reuse and improved TTM for Gen1 customers, enhanced platform scalability to meet various design targets

PIC32CXMT Family Target Application

Introducing **3 Series** under One Common ASSP Platform to address the different Meter Architecture requirements

- **PIC32CXMTS**

Residential Single-Dual Phase SOC, highly integrated solution to include all Residential Meter building blocks (Apps, Comm/Security and Metrology)

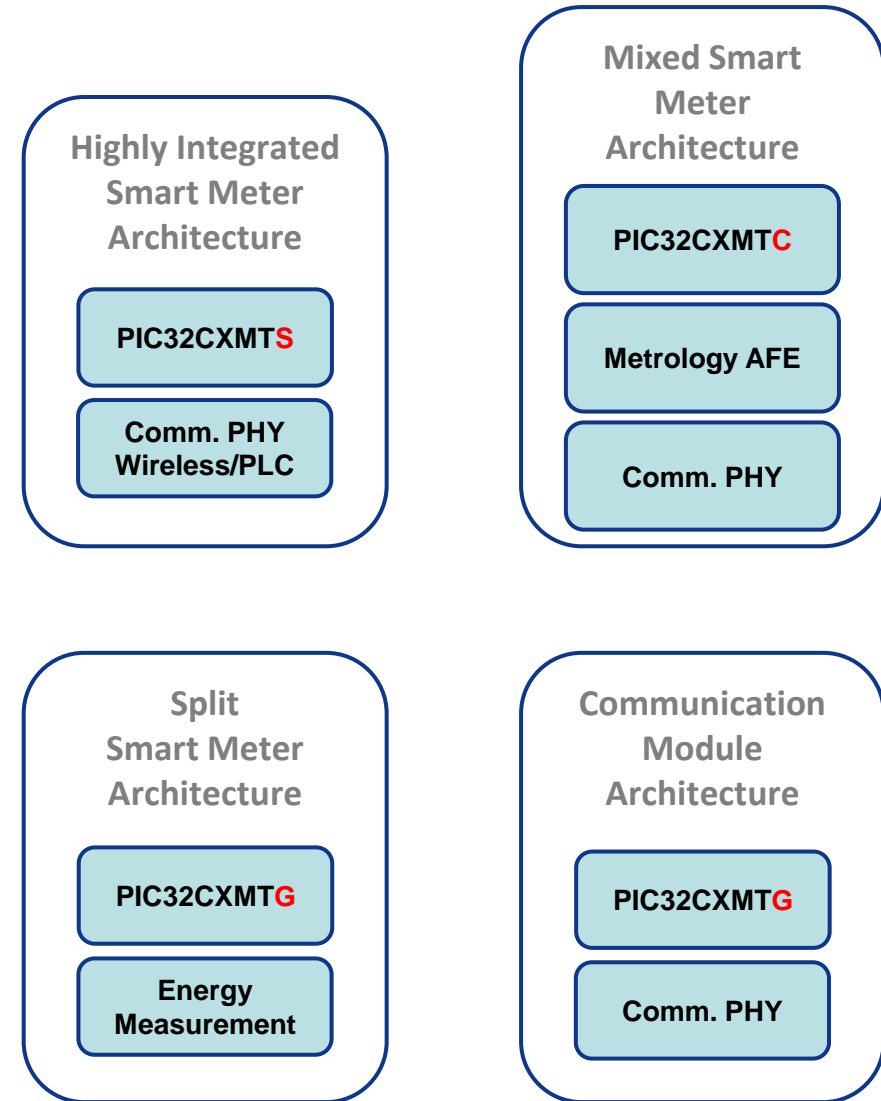
- **PIC32CXMTC**

Dual Core to include Apps, Comm/Security and enable to run Metrology with an external AFE

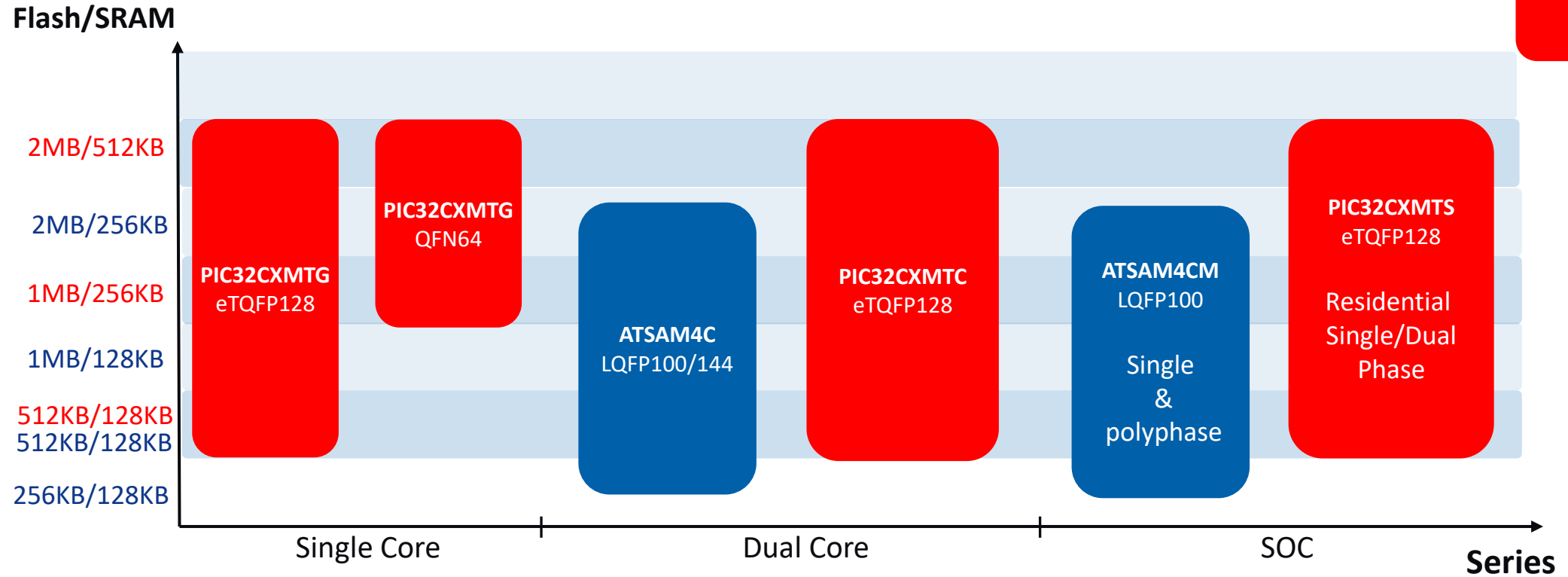
- **PIC32CXMTG**

Single Core Tailored for:

- Splitted Meter
- Communication Module Host MCU
- Hybrid PLC/Wireless GTW



PIC32CXMT and SAM4C



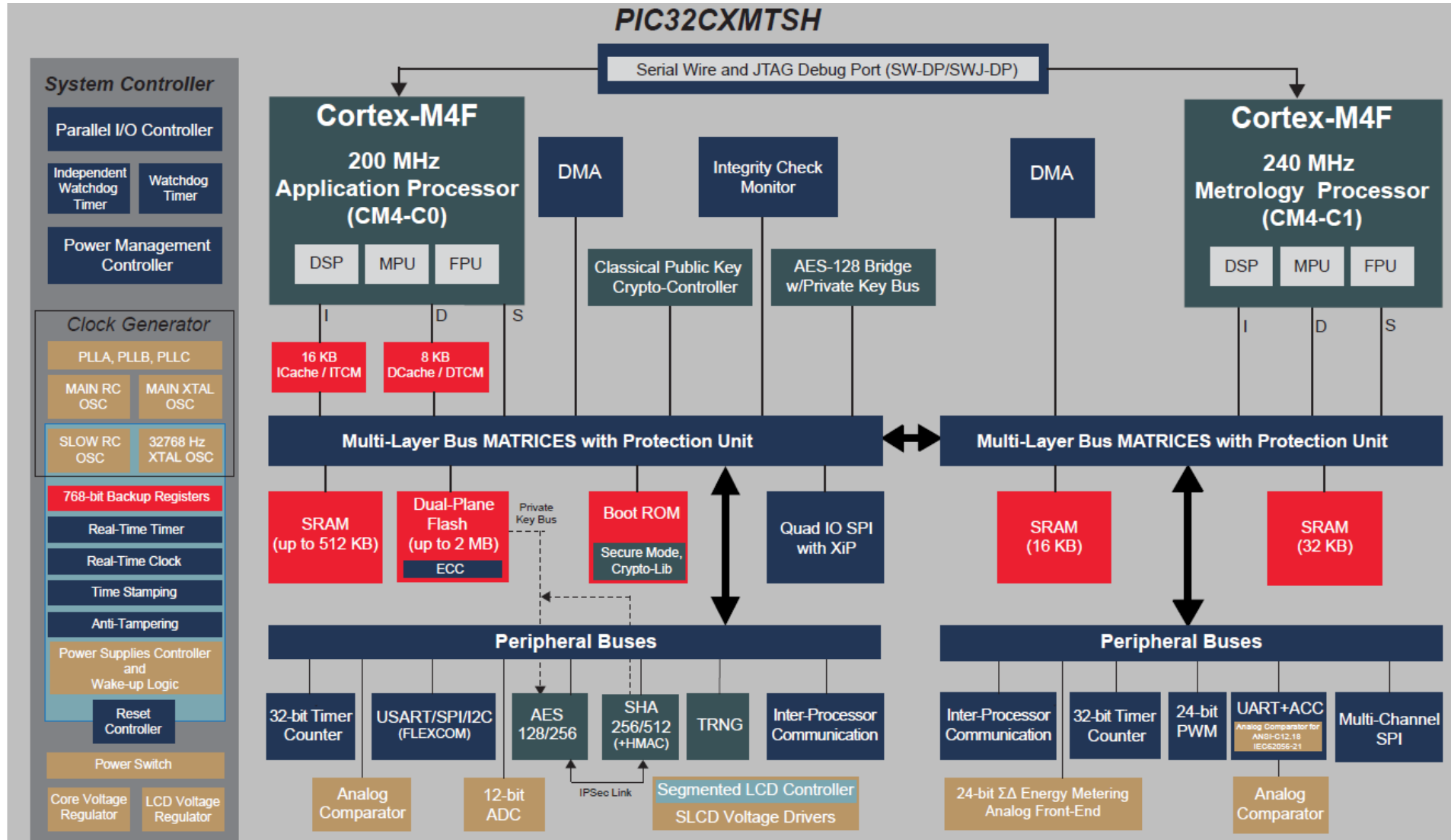
SAM4C
(Gen1)

PIC32CXMT
(Gen2)

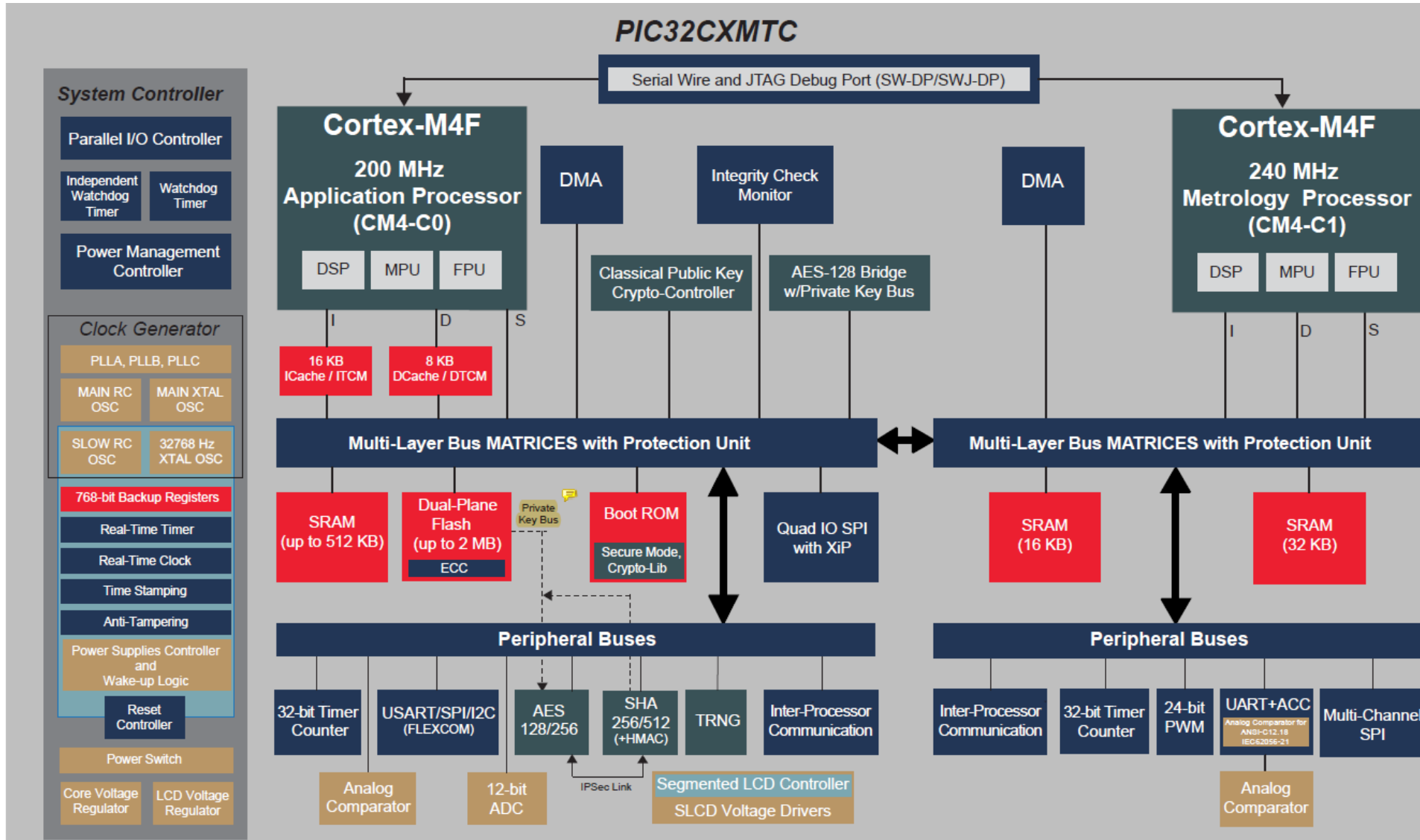
ATSAM4C/CM
Dual Cortex-M4 core based, 120MHz
Up to 6x50 Segment LCD
1.6 – 3.6V operation

PIC32CXMT
Dual Cortex-M4F core based, 200MHz+
Up to 8x32 Segment LCD , New Exposed Pad package
Increased embedded Security
2.2V – 3.6V operation

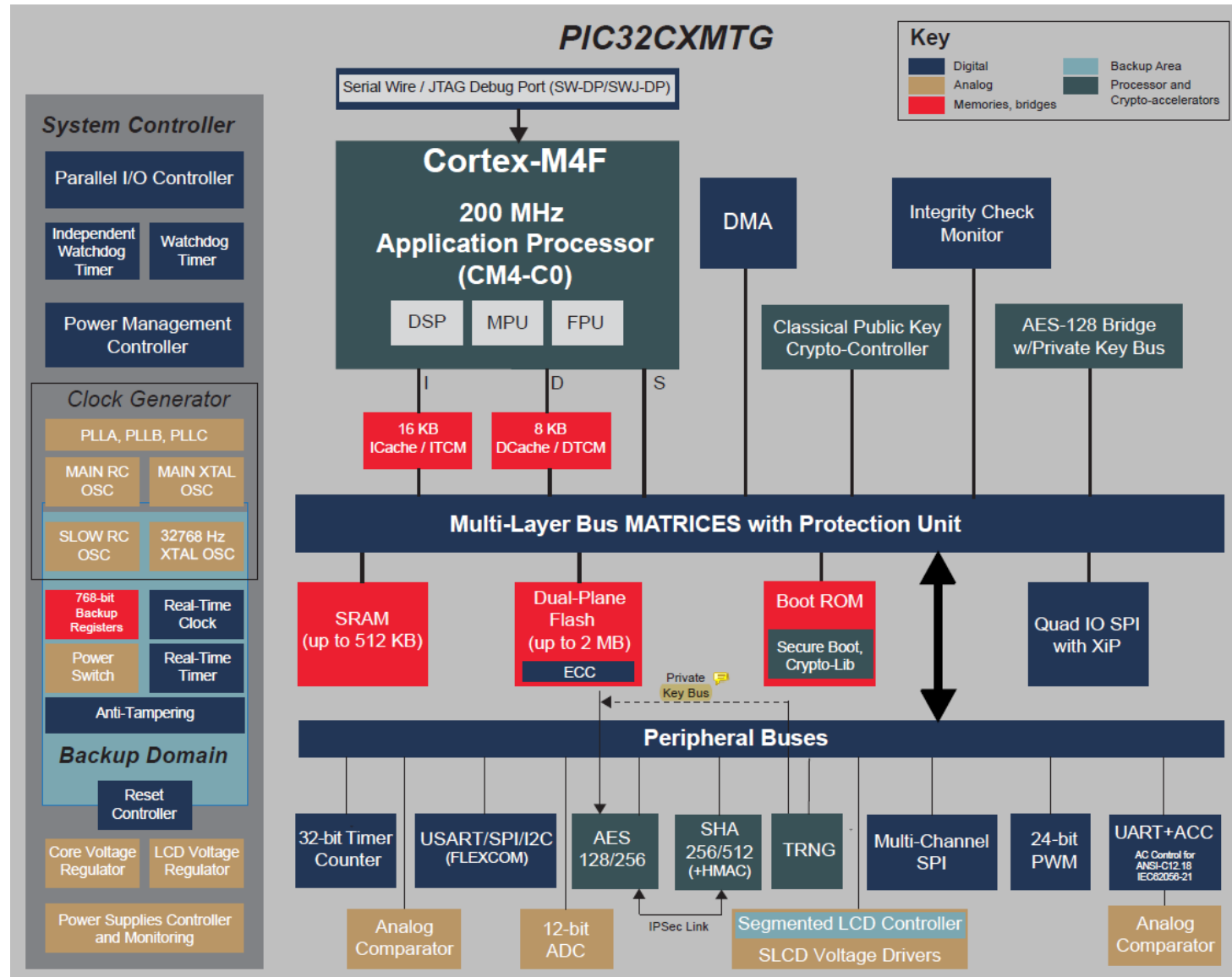
PIC32CXMTSH Block Diagram



PIC32CXMTC Block Diagram

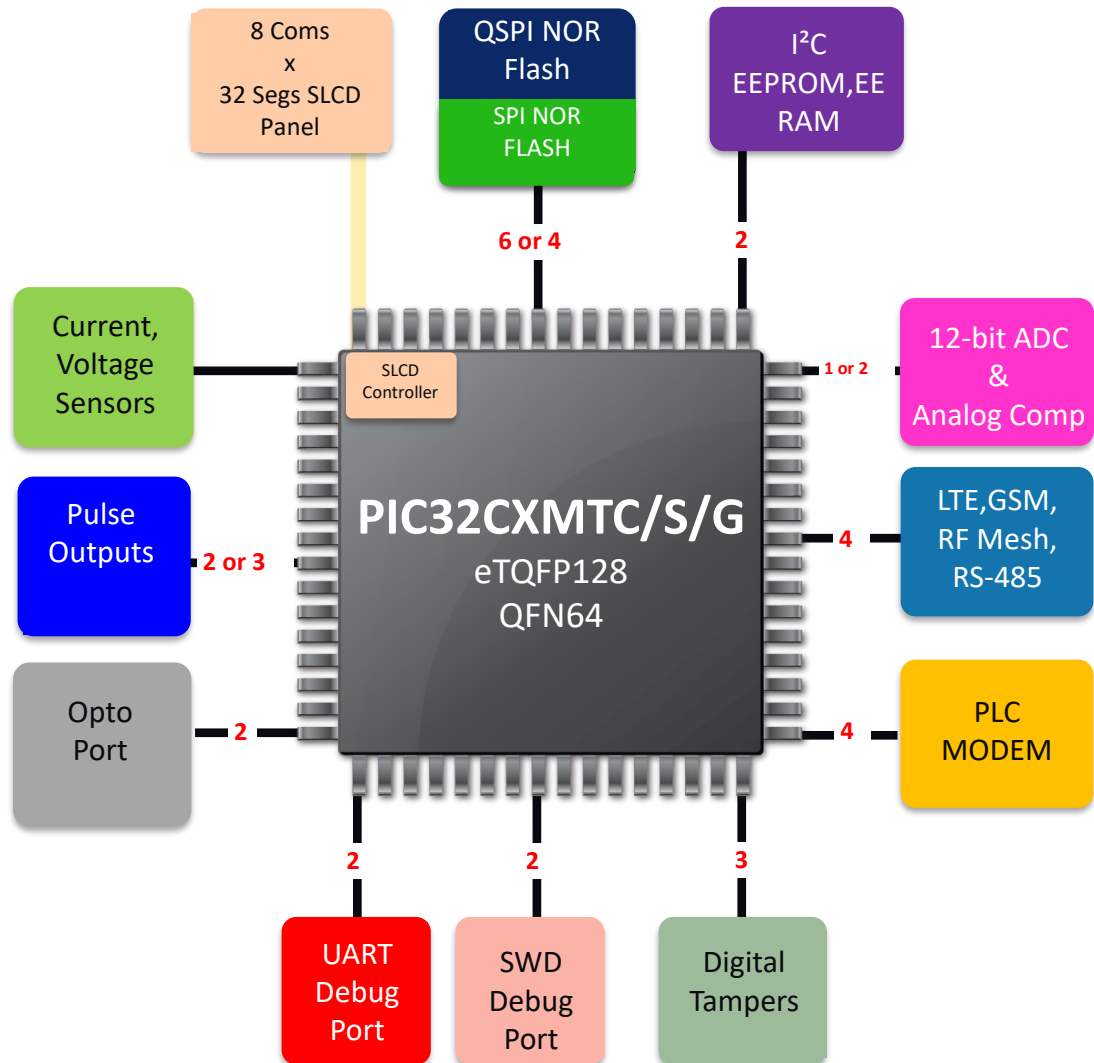


PIC32CXMTG Block Diagram



PIC32CXMT Family Overview

PIC32CXMT C/S/G Series



Main Features

- 200+ MHz Dual Core and Single Core Cortex-M4F + MPU
- Up to 2MB Dual Bank/Dual Boot Flash
- Up to 560KB Multi Port SRAM
- Quad IO SPI with Encrypted XIP
- Ultra Low Power in RTC mode (~2μA)
- Advanced HW Crypto Features
 - ECC, RSA
 - AES256, SHA512, TRNG
 - Secure Key Storage
 - Secure Boot
 - Counter Measure Mechanism (SPA/DPA)
- 3x Anti-Tampering IOs in Back Up Domain
- Single 32KHz Crystal Operation
- 8*32 SLCD Controller
- Up to Additional 40 IOs when all peripherals in this Use Case are used
- 5x $\Delta\Sigma$ ADC Channels (2V, 2I, Temp sensor)
- Embedded Metrology AFE & ANSI/IEC compliant DSP Libs

PIC32CXMT Family Overview

Fulfilling DLMS/COSEM Security Suite Requirement

PIC32CXMT	Security Suite Id	Suite Name	Authenticated Encryption	Digital Signature	Key Agreement	Hash	Key Transport
Yes	0	AES GCM 128	AES GCM 128	-	-	-	AES WRAP 128
Yes	1	ECDH, ECDSA, AES GCM 128 SHA 256	AES GCM 128	ECDSA with P-256	ECDH with P-256	SHA 256	AES WRAP 128
Yes	2	ECDH, ECDSA, AES GCM 256 SHA 384	AES GCM 256	ECDSA with P-384	ECDH with P-384	SHA 384	AES WRAP 256

PIC32CXMT Family

Value Proposition

CONFIDENTIAL

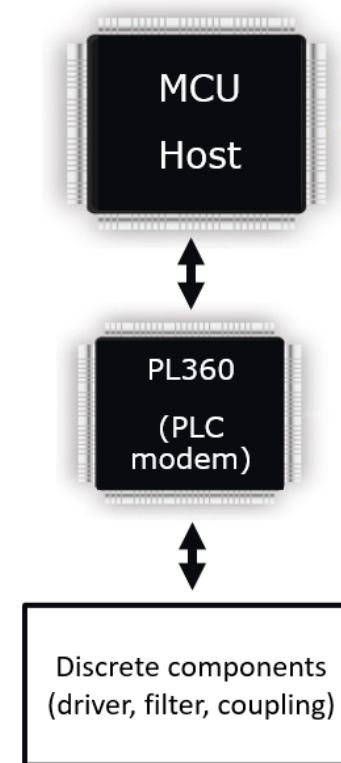
	SYSTEM	METERING FEATURE SPECIFIC			COMM.	SECURITY
PIC32CXMT ^S	<ul style="list-style-type: none"> Core @ 200MHz+ Dual Bank Flash up to 2MB with 1 Mcycle Endurance! De/Encryption on-the-fly QSPI I/F (XiP) Embedded Sram up to 560KB Safety <ul style="list-style-type: none"> 32KHz Crystal fall-back mechanism to 32KHz Osc Dual watchdog connected to 32KHz Crystal & 32KHz Osc 	<ul style="list-style-type: none"> Embedded SLCD up to 8x32 3x HW Anti-tampering with dedicated Time Stamping registers in Vbat Domain UART supporting isolated Optical Link RTC Out signal with fast RTC update (ms) Enhanced MID support with LR code isolation protection (MPU from both Core & Peripherals Access) 2 Wire I/F for reducing #isolators on 3P Shunt Application using MCP3910 AFE 	<ul style="list-style-type: none"> 5x Embedded Metering channels $\Delta\Sigma$ ADCs (2V, 2I, 1x Temp. Sensor) Neutral Measurement Ultra Low Voltage Ref. Drift (10ppm/°C) Additional 128p package easing the embedded SLCD use 	<ul style="list-style-type: none"> ANSI & IEC Metrology DSP Lib Class 0.2 support (Active & Reactive Energy) Harmonic support up to the 50th 	<ul style="list-style-type: none"> Prime 1.3 & 1.4, G3 PLC stacks support with MPL360 & 4xx Modem/Phy Wireless Wisun upcoming support with AT86RF215 Wireless Tx 	<ul style="list-style-type: none"> Compliant w. DLMS/COSEM Suite 2 CAVP Certified ECC/ECDSA SHA512 AES256 (GCM,...) TRNG Secure key storage Secure boot
PIC32CXMT ^C						
PIC32CXMT ^G			<ul style="list-style-type: none"> NA 	<ul style="list-style-type: none"> NA 		

Smart Energy Solutions

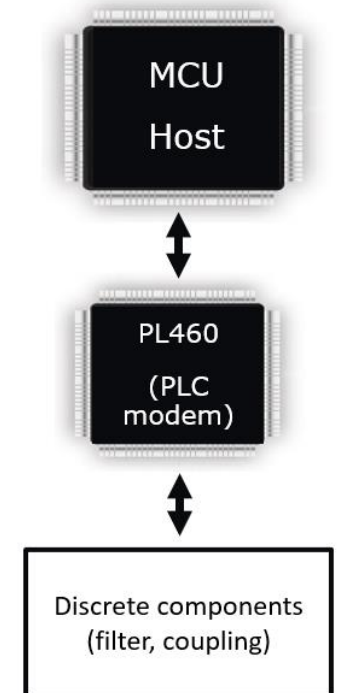
Power Line Communication (PLC)

Power Line Communications

	PL360	PL460
Description	PLC Modem (PHY only)	PLC Modem (PHY only)
Standard	PRIME, G3	PRIME, G3
Band	< 500 kHz	< 500 kHz
PLC signal amplification	External discrete components	Embedded in device
PLC injection efficiency	43% in CEN-A - Class D amplifier -	43% in CEN-A - Class D amplifier -
Package	QFN 48 / TQFP 48	BGA 81
Availability	Mass Production	Mass production Oct'22
Comments	<i>Controlled by host MCU</i>	<i>Controlled by host MCU</i>



Typical PL360 application



PL460 embeds the PLC driver

PLC HYBRID

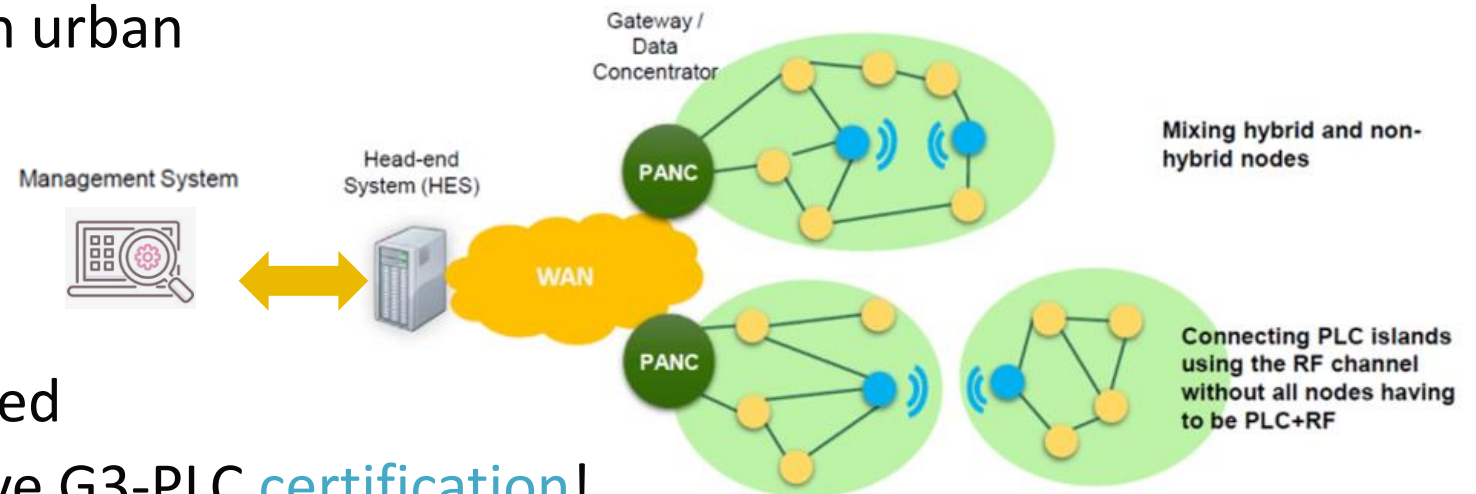
- Combination of Radio and PLC for Smart Grid and IoT applications
- Provides one single network over wired and wireless media

- **Radio interface – based on IEEE 802.15.4g**

- WiSUN-FSK PHY (863-870 MHz) by default
- OFDM PHY supported by Microchip enables 4x more robust communications in urban environments!

- **PLC interface**

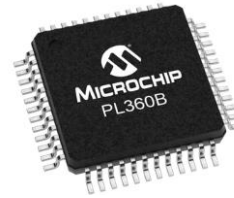
- G3-PLC and PRIME PLC supported
- Microchip hybrid: first to achieve G3-PLC [certification!](#)



Microchip PLC HYBRID

- **Field proven PLC**

- +16M modems installed
- Multi-protocol (G3, PRIME)
- Class-D amplifier provides highest efficiency up to 43%
- Solution includes device and coordinator software



[MPL360B](#)



[PL460](#)



[ATPL360-EK](#)



[PL460-EK](#)



[PL360G55CF-EK](#)

- **Field proven Radio**

- +18M modems installed
- AT86RF215M Sub-GHz transceiver
- MR-FSK, MR_OFDM, MR-O-QPSK
- Microchip supports OFDM option for 4x higher robustness in urban environment vs default FSK



[AT86RF215M](#)



[AT86RF215](#)
(dual band)



[ATREB215-XPRO-A](#)

Smart Energy Tools & Ecosystem

Visit us at [microchip.com / Smart Energy Solutions](http://microchip.com/SmartEnergySolutions)

METER DEMO

DLMS/COSEM

TERRANOVA
INNOVATIONS FOR UTILITIES

WiSUN, Zigbee

exegin
TECHNOLOGIES LIMITED

FreeRTOS



SECURITY

CAVP CERTIFICATION
ECC, AES, TRNG
CPKCL LIB

METROLOGY

IEC & ANSI
DSP LIB
Class 0.2
CT, Rogo, Shunt, Propr.

COMMS

PLC & Hybrid
G3, PRIME
WiSUN PHY
Simulator, sniffer

Thanks for your interest!
The Smart Energy team will be glad to address your questions:

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Thank you!