

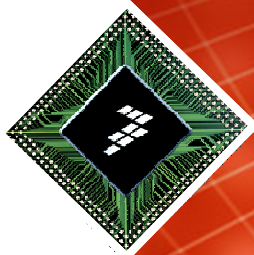


EU-IND-T0766

8-bit microcontroller evolution

S08Px family

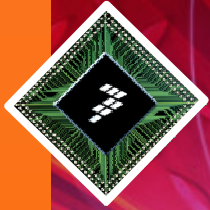
Milan
October 2012



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Introducing the **New** **S08P MCU** **Families** for industrial and automotive applications

- Get exceptional EFT/ESD performance with the **new MC9S08P MCU family**, helping your designs to be more **durable** and **reliable in both harsh industrial** and **user-interface environments**.

- The S08P family is simple, yet powerful, and offers **exceptional EFT/ESD performance** for harsh and high-touch environments, **meeting safety standard IEC-60730 for appliance**

- The new **scalable** and **pin-compatible** S08P families offers **scalable flash memory** and a **choice of packages** allowing memory space and feature set **flexibility**

- The S08P/R family of MCUs **integrates** key features, **TSI (touch sensing interface)**, **EEPROM** and **motor control FlexTimer** designed to help **reduce system costs**

Advantages of New Rugged S08P/R MCUs

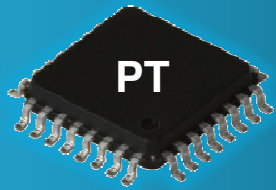
Robust & Reliable	Scalable & Pin-Compatible	Feature-Rich
<ul style="list-style-type: none">• Compliance with safety standard IEC-60730 for home appliances and AEC-Q100 for automotive• GPIO & high-drive capability designed to increase immunity to external noise• Get design flexibility for differing voltage levels with 2 pins with true open drain for industrial and automotive use	<ul style="list-style-type: none">• Wide range of feature/price options for product differentiation.<ul style="list-style-type: none">– PT class: full-featured + TSI (Touch Sensing Interface) – enabled for industrial and automotive– PA class: full-featured without TSI– PL class: designed for cost sensitive applications	<ul style="list-style-type: none">• Capacitive touch sensing detection hardware with high sensitivity and enhanced robustness, internal clock, pulse width modulator, comparator & on-chip real time counter further reduce system costs• Upgraded memory includes EEPROM for simpler system design and data logging /recording• Fully enabled hardware and software development kits for automotive and industrial usage

and user interface environments



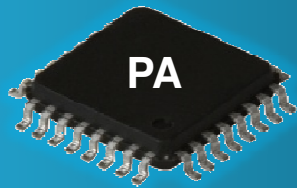
S08P MCU Families

Features & Performance



PT

Full-featured class, including capacitive touch sensing detection hardware



PA

Full-featured class without touch sensing interface

- 16-ch TSI for touch-sensing on PT
- 20MHz
- 4KB RAM; 256B EEPROM
- 3 x UART; 2 x SPI; IIC
- 6ch + 2ch + 2ch FTM; 2 x MTIM
- RTC; CRC
- 16ch 12bit ADC with 4 entry buffer registers
- 1 ACMP
- 8 pins with 20mA sink capability
- 2 pins with true open drain
- 2.7V~5.5V
- PT: -40°C...105°C
- P Family: IEC-60730 for appliances



Medical



Remote Controls



Motor Control



Large Appliances



Low-end E-meter



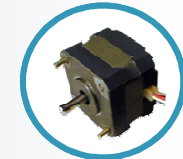
Keypads



Off-line UPS



HVAC



EC motor



Power tools

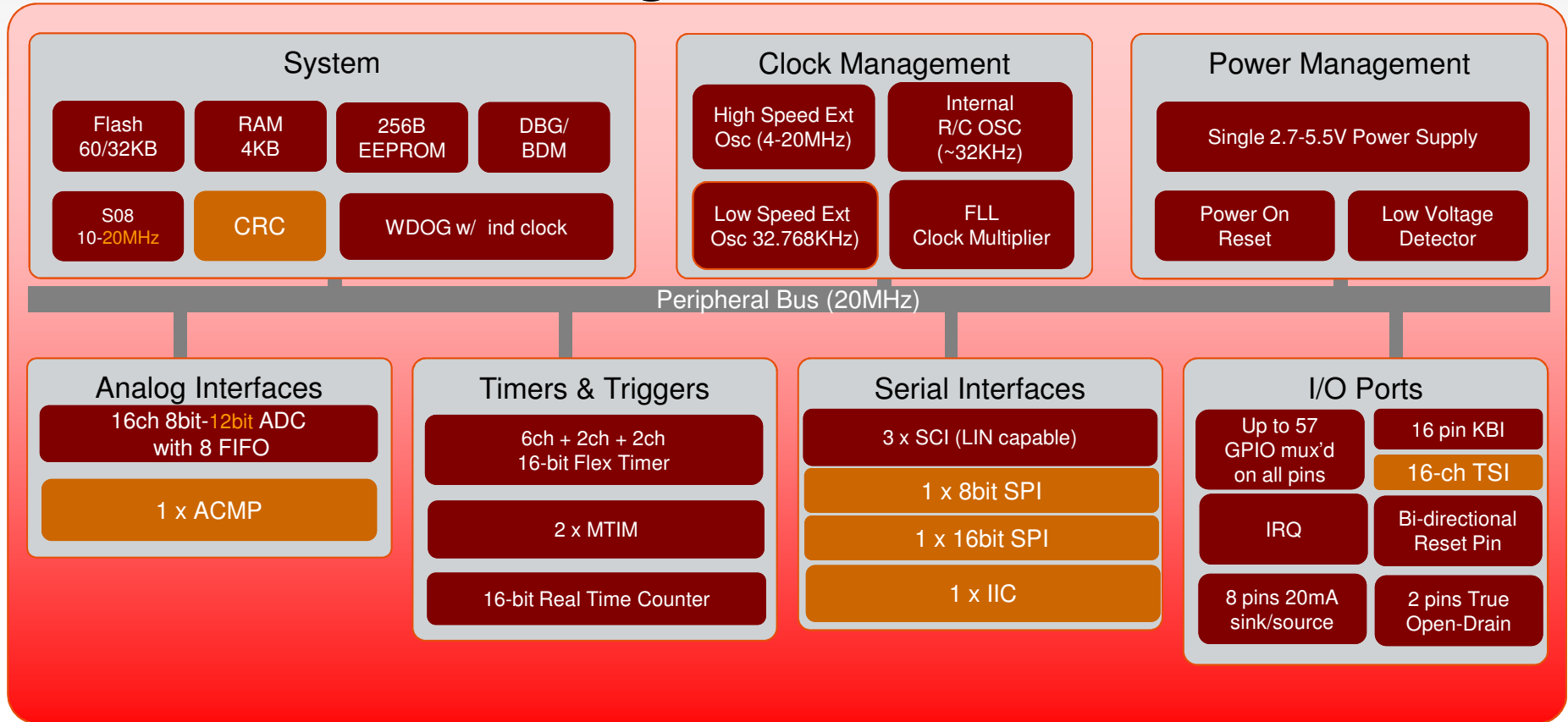


Small Appliance



Lighting control

S08PT60/32 Block Diagram



- GPIO Slew Rate as S08
- Passive Filter on GPIO
- Digital Filter for selectable pins
- 2.7V ~ 5.5V / -40~105°C operation

**64LQFP (0.5mm pitch); 64QFP (0.8mm pitch);
44LQFP (0.8mm pitch); 32LQFP (0.8mm pitch);
48LQFP (0.5mm pitch); 48QFN**

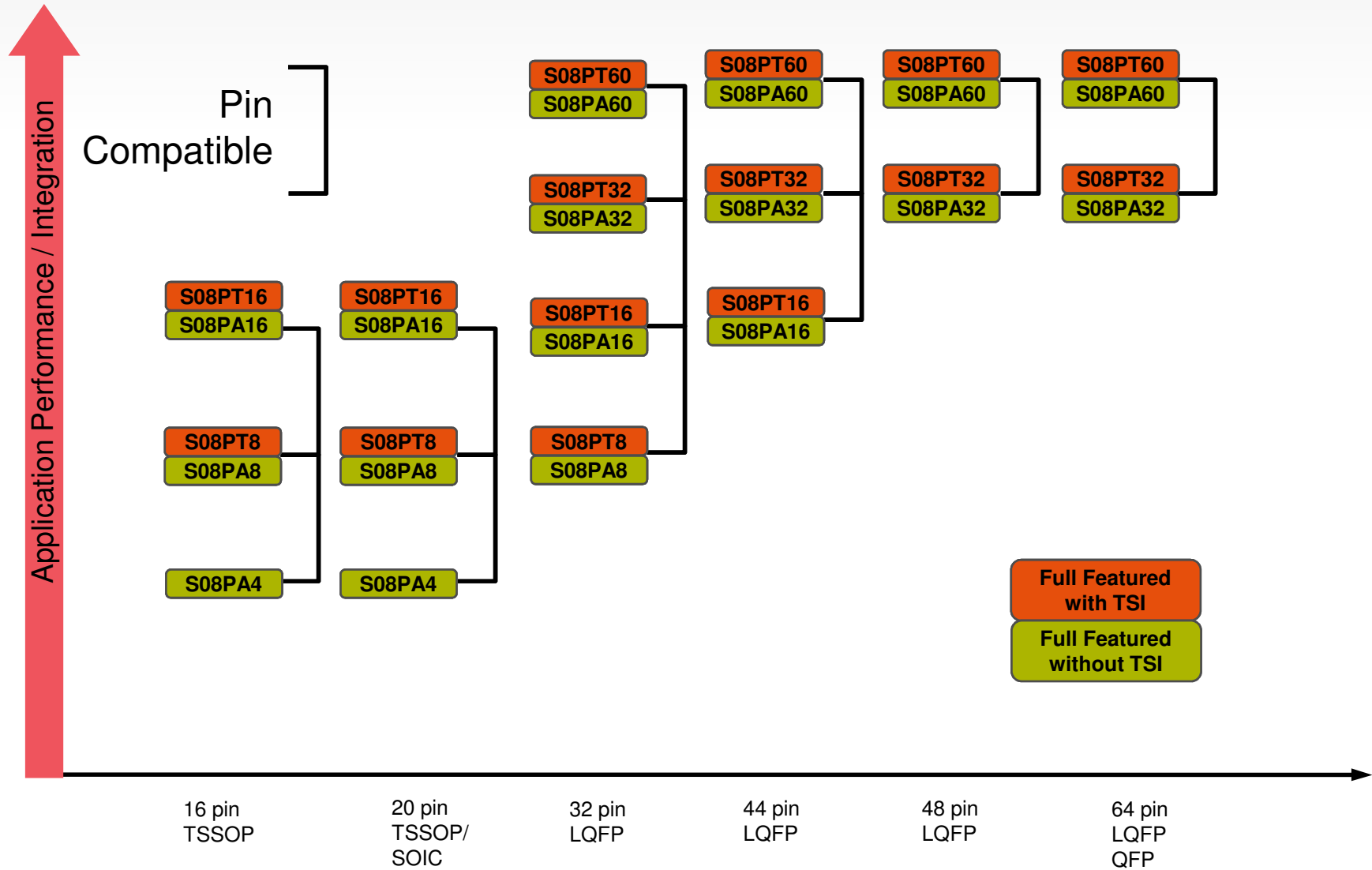
Features Available on: **All Px** **PT/A Only**



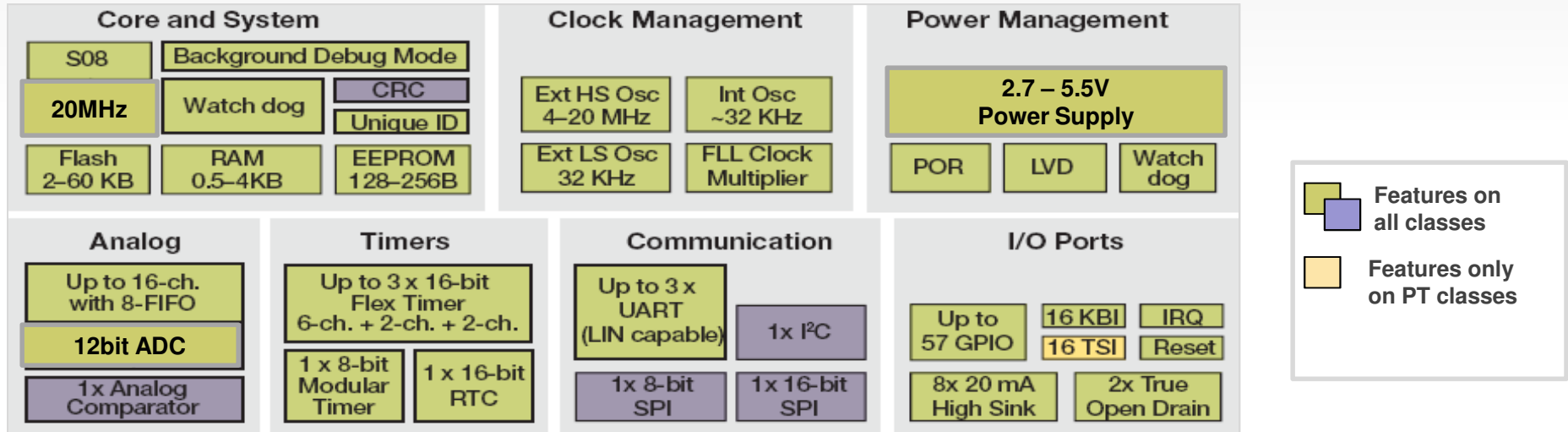
S08PT/A Industrial Level Feature List

Feature	PT60/PA60	PT32/PA32	PT16/PA16	PT8/PA8	PA4
Flash	60KB	32KB	16KB	8KB	4KB
RAM	4KB	4KB	2KB	2KB	512B
EEPROM	256B	256B	256B	256B	128B
Max Speed	20MHz	20MHz	20MHz	20MHz	20MHz
CRC	Yes	Yes	Yes	Yes	Yes
WDOG w/ ind clk	Yes	Yes	Yes	Yes	Yes
ADC /w 8 FIFO	16ch x 12bit	16ch x 12bit	12ch x 12bit	8ch x 12bit	8ch x 12bit
Hardware Timer	1x 6ch-FTM 2x 2ch-TPM	1x 6ch-FTM 2x 2ch-TPM	1x 6ch-FTM 1x 2ch-TPM	1x 6ch-FTM 1x 2ch-TPM	- 2x 2ch-TPM
Software Timer	2 x 8bit MTIM	2 x 8bit MTIM	1 x 8bit MTIM	1 x 8bit MTIM	-
RTC	1x16bit	1x16bit	1x16bit	1x16bit	1x16bit
SPI	1x8bit, 1x16bit	1x8bit, 1x16bit	1x8bit	1x8bit	-
IIC	1	1	1	1	-
SCI	3	3	2	2	1
Comparator	1	1	1	1	1
Temperature Range	-40c to 105c	-40c to 105c	-40c to 105c	-40c to 105c	-40c to 105c
Operation Voltage	2.7v to 5.5v	2.7v to 5.5v	2.7v to 5.5v	2.7v to 5.5v	2.7v to 5.5v
GPIO	Passive Filter; Digital Filter	Passive Filter; Digital Filter	Passive Filter; Digital Filter	Passive Filter; Digital Filter	Passive Filter; Digital Filter
TSI (S08PT only)	16ch	16ch	16ch	8ch	-
Package	64/48/44/32LQFP; 64QFP	64/48/44/32LQFP 64QFP	44/32LQFP 20/16 TSSOP	44/32LQFP 20/16 TSSOP	20 SOIC 20/16 TSSOP

Freescale 5V S08P Family Roadmap



S08P Block Diagram



• Enhanced memory configuration

- *On-chip EEPROM* simplifies system design for data logging and recording
- Flash/RAM ratio allows for more sophisticated software applications

• 16bit FlexTimer

- Supports input capture, output compare and PWM. Supports up to 4 fault inputs & dead time insertion to improve reliability of the end application. Can directly trigger ADC sampling.

• 16-ch touch-sensing interface (TSI) on PT family

- Simplifies external circuit on touch-sensing design
- Ability to wake-up from lowest power modes from touch
- Easy-to-use hardware and software configuration allows straightforward customization and automatic calibration

• IP for robust environments

- 8ch 20mA high current drive
- 2 x True open drain pins.
- CRC Engine
- Filtering on I/O
- POR, LVD, WDT & COP for IEC60730 compliance

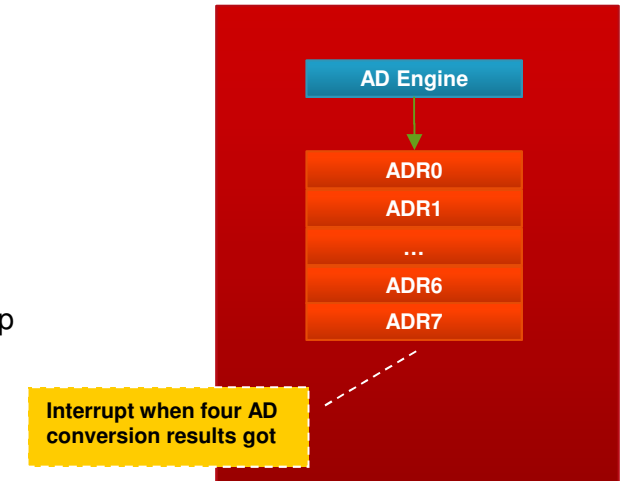
• Multiple Clock Options, Internal & External

• 16-ch 12-bit SAR ADC

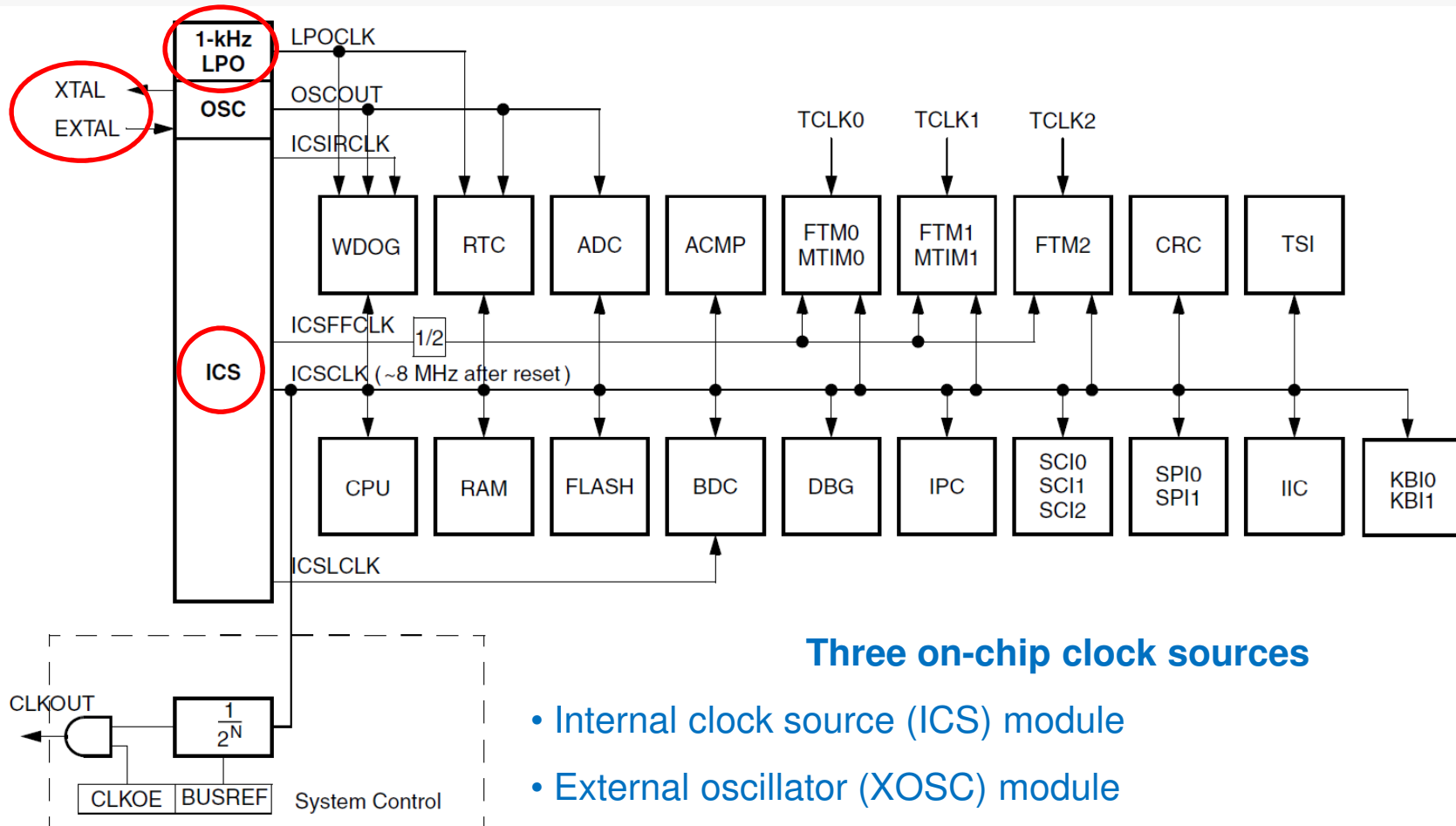
- Linear successive approximation algorithm with up to 12-bit resolution enables fast and accurate analog measurement
- Single or continuous conversion (automatic return to idle) enables more software implementation options with less intervention
- 8-, 10-, and 12-bit modes, along with 8-deep result FIFO, improves MCU core efficiency
- Flexible routing of input signals improves overall EMC performance

Intelligent Integration in S08P

- **Memory Combination:**
 - Increased Flash/RAM ratio (4KB RAM in Px60): Easy for C-Coding
 - On-chip EEPROM with 500K~1M write/erase cycle: Simplify the system design for data logging and recording
- **Robust GPIO & High Drive Capability:**
 - Up to 58 GPIO with filtering in 64pin: simplify external circuit design
 - Up to 8 pins with 20mA sink drive capability: save external components for high current drive like TRIAC and LED
 - 2 pins with True Open-Drain: provide design flexibility for different voltage level
- **16ch 12bit SAR ADC:**
 - Linear successive approximation algorithm with up to 12-bit resolution
 - Up to 16-ch single-ended external analog inputs
 - 12-bit, 10-bit, and 8-bit modes, 8-deep result FIFO
 - Single or continuous conversion (automatic return to idle after single conversion)
- **16ch Touch-Sensing Interface on PT**
 - Dedicated hardware module to sense touch-input, minimum software intervention
 - Functional in all power modes - run, wait & low-power stop. Wake-up capable from stop
 - Designed for harsh environment operation with high sensitivity
 - Highly configurable through HW & SW
- **Feature-Rich integration:**
 - 6ch + 2ch + 2ch Flex Timer; 2 x MTIM
 - Real Time Counter: helpful for any task scheduling functions
 - 3 x SCI; 2 x SPI; IIC
 - Enhanced Watch-dog and prog-CRC to meet IEC60730
 - High accuracy internal clock to eliminate external clock source



System clock distribution



Three on-chip clock sources

- Internal clock source (ICS) module
- External oscillator (XOSC) module
- Low-power oscillator (LPO) module - 1 kHz reference clock

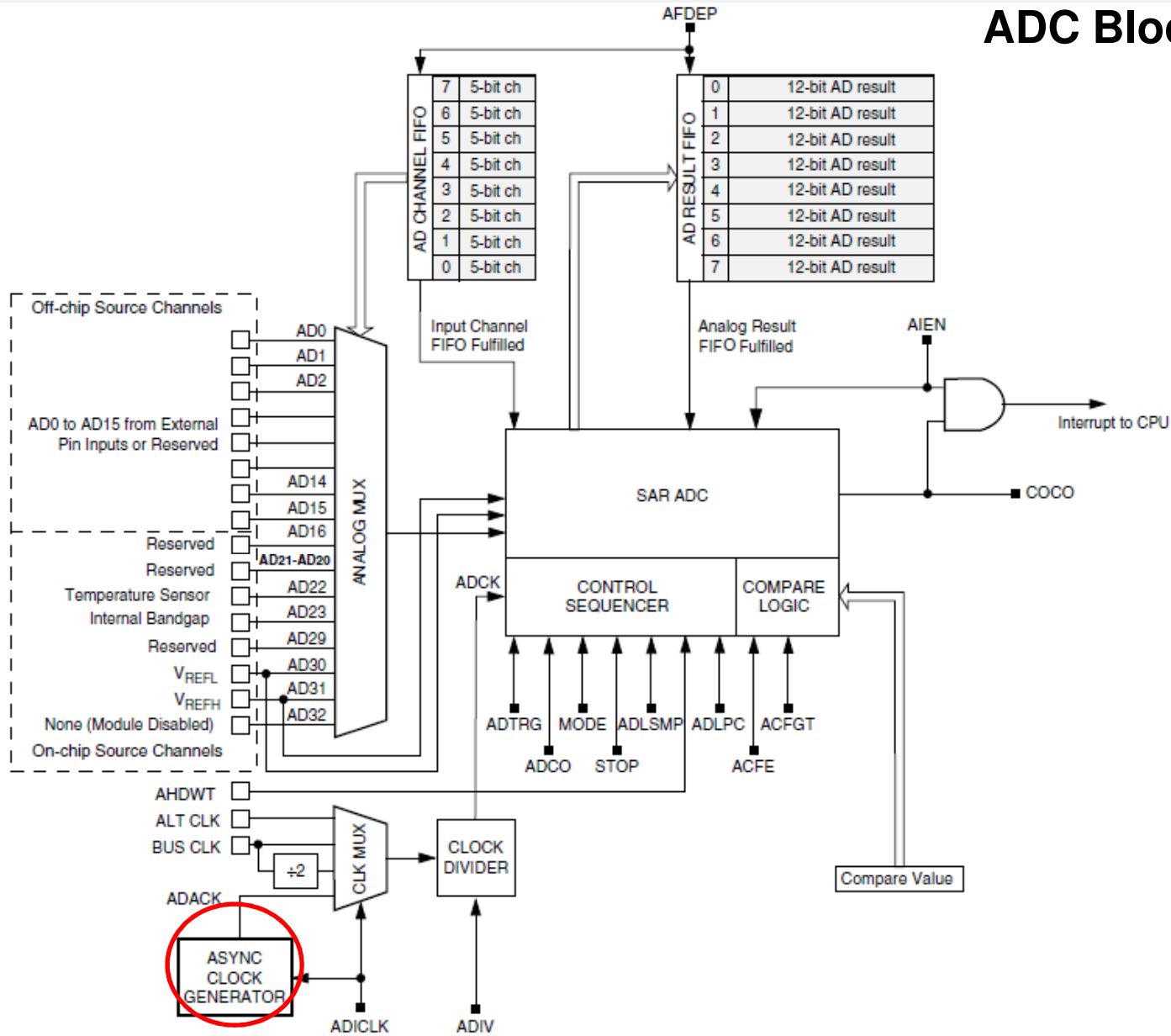
ADC Features

The 12-bit analog-to-digital converter (ADC) is a successive approximation ADC designed for operation within an integrated microcontroller system-on-chip.

...with:

- Linear Successive Approximation algorithm with 8-10 or 12-bit resolution
- Up to 16 external analog inputs, external pin inputs, and 5 internal analog inputs including internal bandgap, temperature sensor, and references
- Output formatted in 8-10 or 12-bit right-justified unsigned format
- Support up to eight result FIFO with selectable FIFO depth
- Input clock selectable from up to four sources
- Operation in wait or stop3 modes for lower noise operation
- Asynchronous clock source for lower noise operation
- Selectable asynchronous hardware conversion trigger
- Automatic compare with interrupt for less-than, or greater-than or equal-to, programmable value

ADC Block Diagram

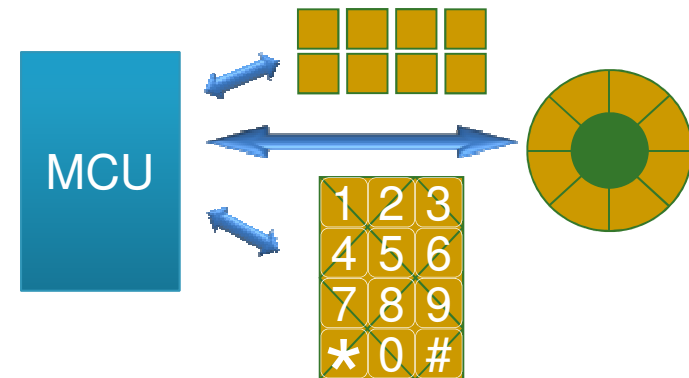
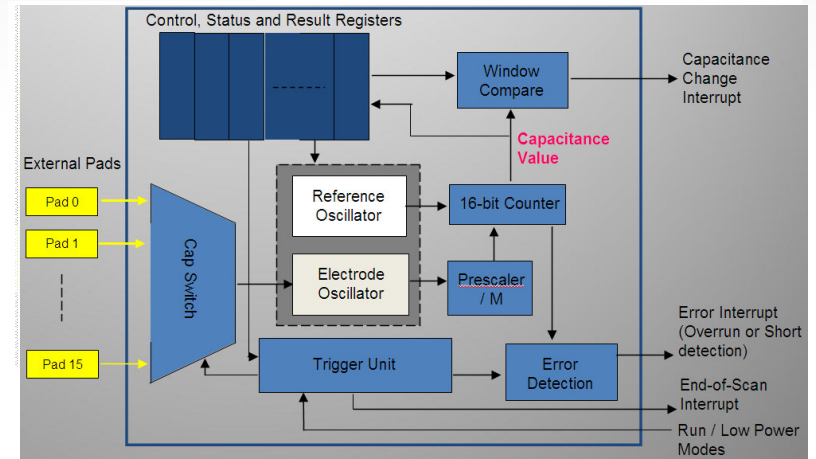


Hardware Touch-Sensing Interface (TSI)

overview

- **Capacitive Touch Sense Module**

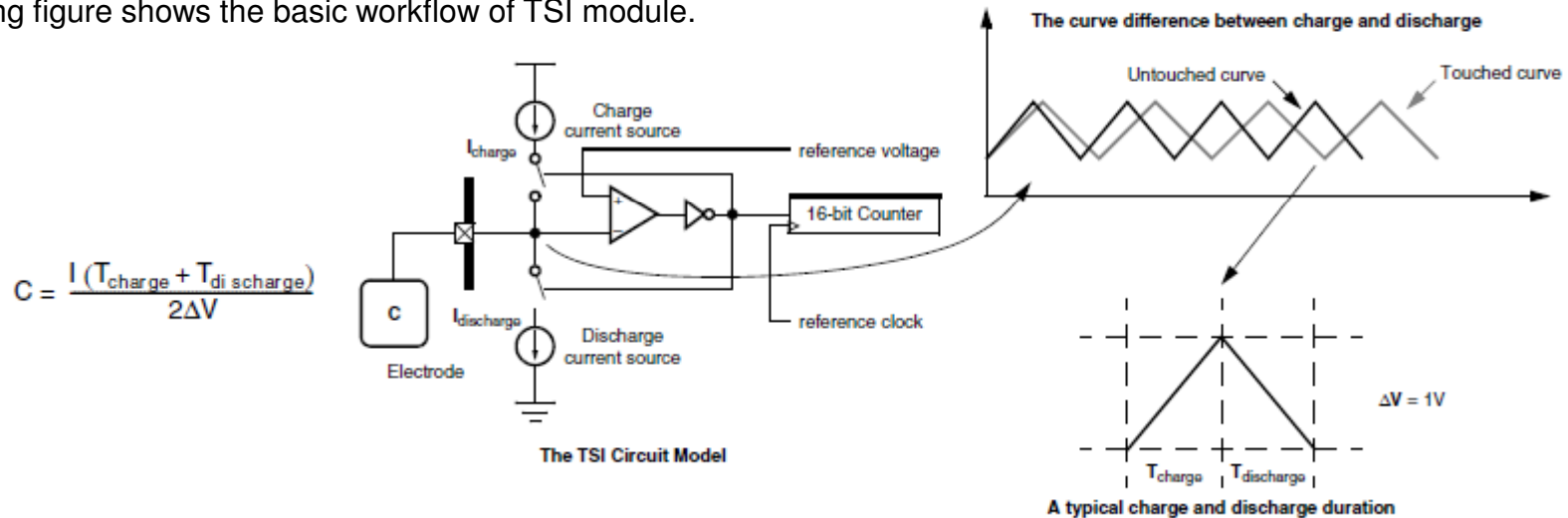
- capacitive touch sensing detection with high sensitivity and enhanced robustness.
- Up to 16 electrodes, using a single pin per electrode, with individual result registers
- No need for external components
- Capacitive touch sensing detection across all low power modes – with capability to wake MCU from stop-modes
- Automatic detection of Electrode Capacitance Change with programmable upper and lower threshold
- Automatic periodic scan with configurable duty cycle
- Low Power Mode current consumption adder of 1-3uA
- Capacitance measurement resolution down to 0.02pf
- Configurable software or hardware scan trigger
- Compensate temperature and supply voltage variations
- Fully support Freescale touch sensing software library of button, keyboards, sliders, and rotaries



Hardware Touch-Sensing Interface (TSI)

functional description (1/2)

- A pair of configurable constant current sources are used to charge and discharge each electrode to a configurable volt change (ΔV).
- The TSI module measures the electrode pin capacitance by detecting both durations of charging and discharging the electrodes (T_{charge} & $T_{\text{discharge}}$).
- The charge and discharge durations are measured by a 16-bit counter referred by reference oscillator (up to 10 MHz) or external reference clock (up to 20 MHz).
- The current sources and 16-bit counter provides a wide range of combinations allowing application-specific optimisation
- The following figure shows the basic workflow of TSI module.



- **C**: Capacity of Electrode (changing its value upon touch) \rightarrow as a result T_{charge} and $T_{\text{discharge}}$ will change
- **ΔV** : configurable value (0,388V .. 1,440V); use higher values for higher immunity; lower values for faster response
- **$I_{\text{charge}} = I_{\text{discharge}} = I$** : configurable current source (0,5uA .. 64uA); low values give lower power consumption; higher values give faster charging of the Capacitor

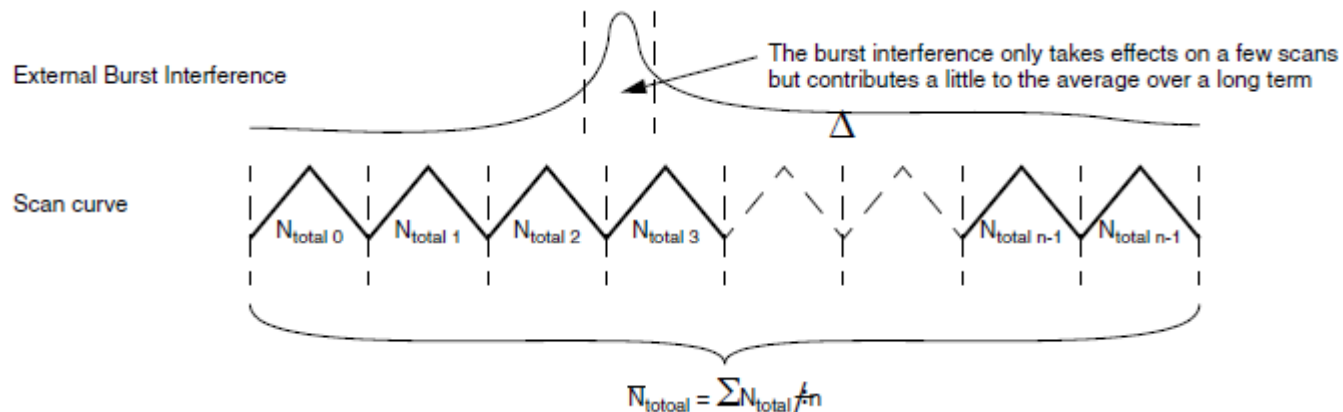
Hardware Touch-Sensing Interface (TSI)

functional description (2/2)

- In a single scan multiple charge/discharge-cycles are captured by a 16-Bit Counter with configurable clock f_{ref}

$$N_{total} = \frac{2C\Delta V_{ref}}{I}$$

- N_{total} is the sum of number of charge & discharge-pulses N_{charge} & $N_{discharge}$
- a change in Capacitance is represented by a change in N_{total}
- In harsh environments unwanted spikes/bursts can be filtered out by using the TSI's Multiscan-option (up to 32 consecutive scans)



- For convenient detection of touched electrodes the TSI-module allows to set upper/lower threshold:
 - Freescale is pre-configuring threshold values in manufacture before shipment
 - threshold can be initialized (set to a “non-touched” value) when the system is powered up
 - Or the threshold may be dynamically updated to adapt change in temperature, humidity, ...

Xtrinsic TSS 3.0 – The Latest Touch Advantages

- Freescale continues improving on new features and robustness and flexibility and now releases its fifth touch-sensing software version: TSS 3.0
- TSS 3.0 provides reliable touch detection, with extremely high sensitivity and very low capacitance measurement resolution, offering a highly accurate and robust solution
- TSS 3.0 offers **water tolerance** to the droplets of water. TSS is also able to distinguish touch on the electrodes evTSS and is totally immune though the electrodes are covered with a water film.
- Enabled **auto sensitivity calibration** allows the user to define sensitivity or ASC will do it for you based on noise level analysis. This leads to the right sensitivity determination which is continuously updated.
- The TSS 3.0 brings software library with unified API for **ARM®Cortex™-M0**, **ARM®Cortex™-M4**, ColdFire+ and HCS08 platforms and different capacitance measurement algorithms



Xtrinsic TSS 3.0: The Latest Touch Features

Features:

- Water tolerant
- Support for S08 TSI (for S08PT and S08RN family)
- Support for L-series (currently KL2x, others coming soon)
- MQX support
- KwikStik support
- Shielding electrode/electrodes
- Memory usage optimization
- Analog decoder



Freescale recently released the new Touch Sensing Input (TSI) module embedded into several platforms, adding robustness to touch sensing solutions.

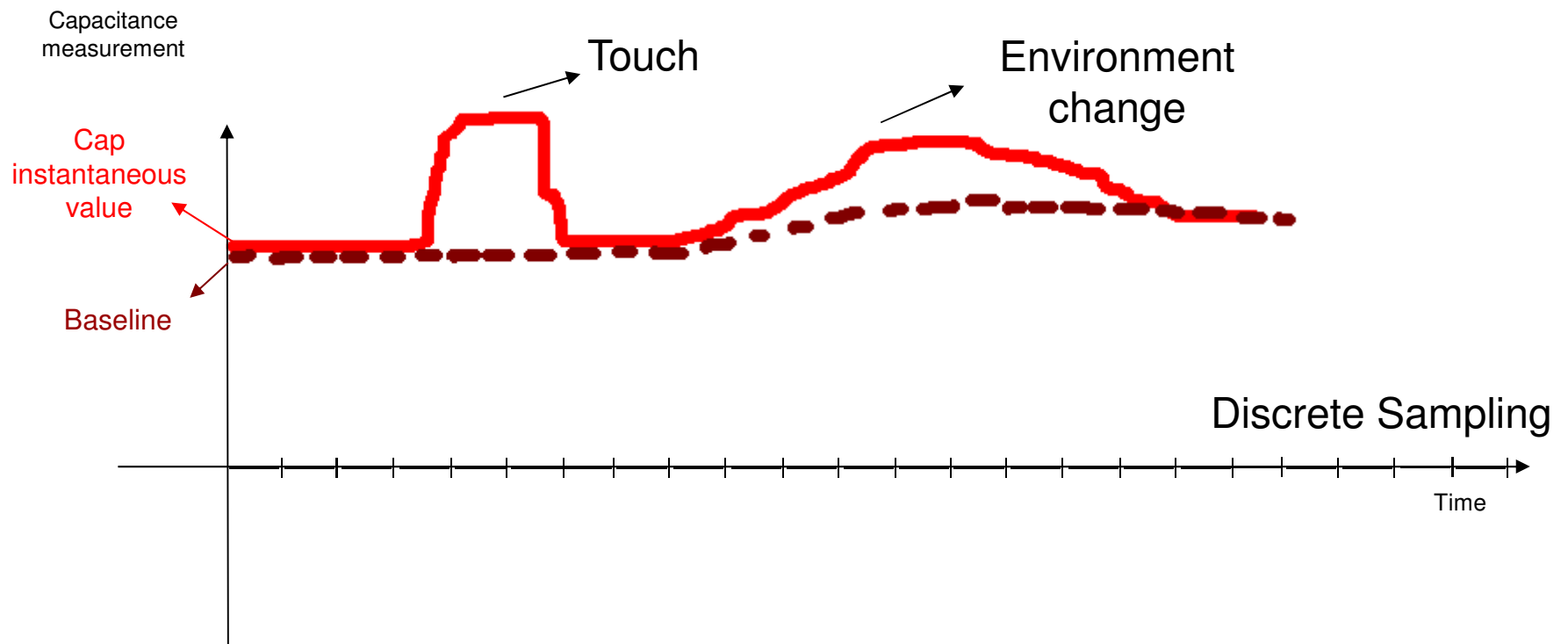
The TSS directly supports FreeMASTER GUI which enables to setup and analyze the TSS application

Baseline Tracking and Debouncing

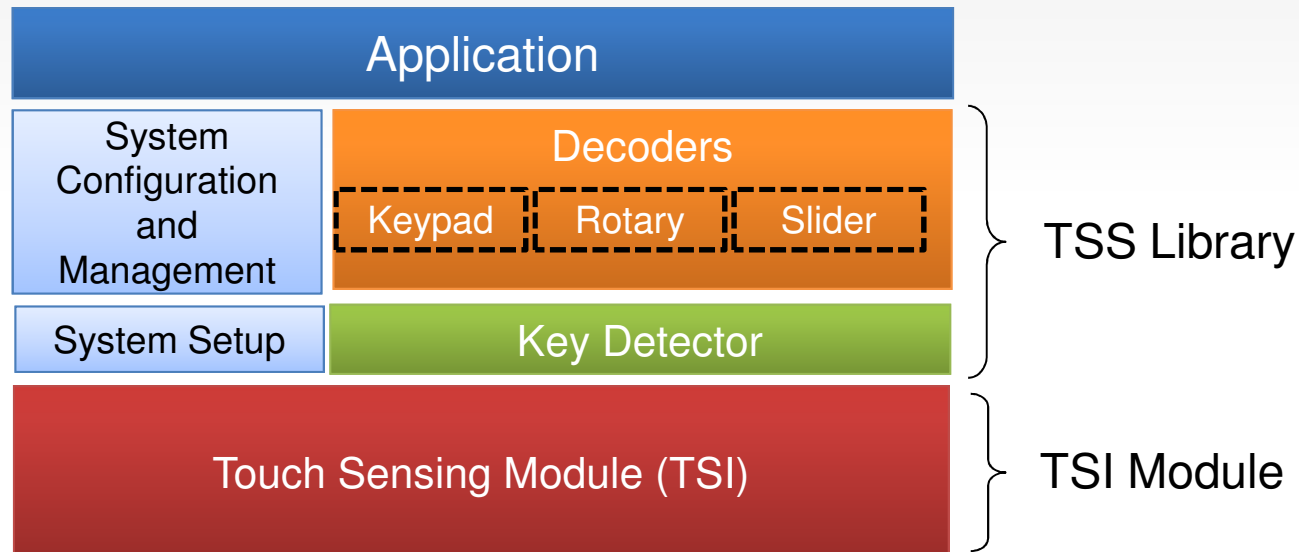
Baseline: instantaneous value filtered with a low pass filter

Delta: Instantaneous Value – Baseline

DEBOUNCE(If (Delta > Sensitivity)) => **Touch Detected**



Touch Sensing Library Integration



Freescale provides the complete Touch Solution by seamless integration of the Touch Sensing Module (TSI) in the Freescale Touch Sensing Library.

While the TSI Module provides robust, precise electrode capacitance measurement, the library allows easy implementation of sliders, rotaries and keypads. Keeps flexibility to adjust very specific application requirements.

Processor Expert for Touch Sensing

- PE component for TSS 2.5 and above supported in CW 10.x
- TSS 2.0 (for S08 and CFV1 families) PE component in CW 6.3

The screenshot displays the Component Inspector window on the left and the Memory Map window on the right. The Component Inspector shows the following settings for the TSI component:

Name	Value
Component name	TSI
Device	TS10
Settings	
Clock gate	Enabled
Clock settings	
Low Power Clock Source	LPOCLK
Active Mode Clock Source	Bus clock
Active Mode Prescaler	divide by 1
Active Mode ClockDivid	divider set to 1
Electrode Oscillator Prescale	divide by 1
Num of Scan times per elect	1
Scan Modulo	
Scan modulo value	0
Scan Trigger Mode	Software trigger
Ref OSC Charge Current	1 uA
External OSC Charge Current	1 uA
Delta voltage	100 mA
Internal Capacitance Trim	0.5 pF
Low Power settings	
Scan Interval	1 ms
Low Power Scan Pn	TS1_IN[0]
STOP Enable in Low Power	no
TouchSensing Threshold	
Pins	
Shield driving pin	Disabled
Sensing Input pins	
Interrupts	
TSI Interrupt	
Interrupt	End-of-Scan
Request	Disabled
Priority	0 (Highest)
ISR Name	
Touch Sensing Input int	Disabled
Error (Electrode Failure)	Disabled
Initialization	
Touch Sensing Input	Disabled
Call Init method	yes

The Memory Map window shows a grid of peripheral addresses. The TSI component is highlighted in blue in the grid, located at address 0x40000000.

ADC0	ADC1	AIP50	AIP51	AXBS
CAN0	CAV1	CMP0	CMP1	CMP2
CMT	CPU	CRC	DAC0	DAC1
DAC6b0	DAC6b1	DAC6b2	DMA	EWM
FB	FTFL	FTM0	FTML	FTM2
I2C0	I2C1	I2S0	LCD	LPTMR0
MCM	MPJ	PDB0	PGA0	PGA1
PIT	PTA	PTB	PTC	PTD
PTE	RTC	SDHC	SPI0	SPI1
SPI2	SysTick	TSIO	UART0	UART1
UART2	UART3	UART4	UART5	USB0
USBD0CD	VREF	WDOG		

CodeWarrior Development Studio

CodeWarrior Development Studio for Microcontrollers v10.3 integrates the development tools for ColdFire, ColdFire+, DSC, **Kinetis L Series**, Kinetis K Series, Qorivva, PX Series, RS08, S08 and **S12Z** architectures into a single product based on the Eclipse open development platform



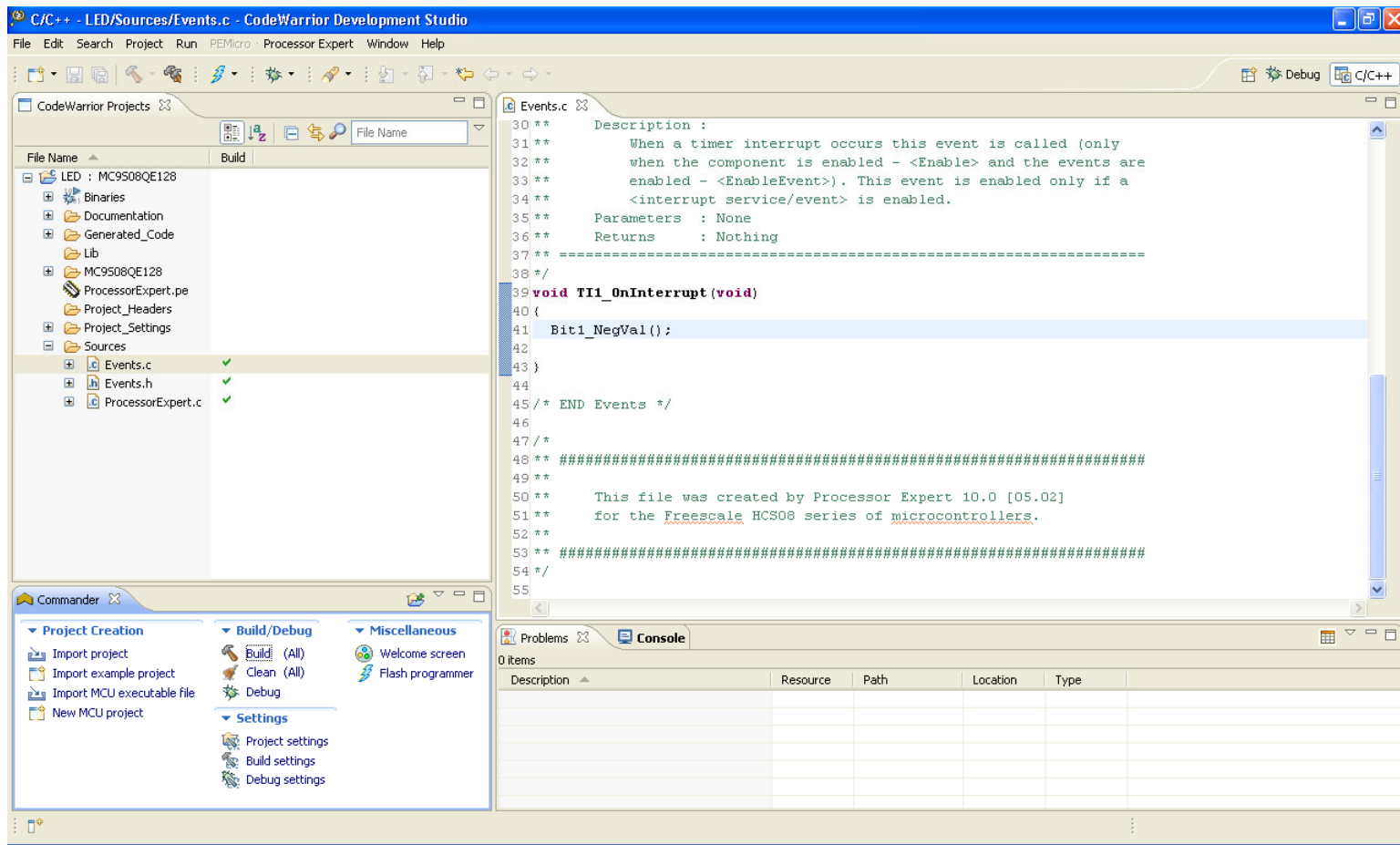
Freescale CodeWarrior for Microcontrollers v10.x: A Single Dev tool for your MCU Designs

- **An award winning IDE for product evaluation, application development & debugging for all Freescale MCU architectures; 8bit (R)S08, 16bit HCS12(X), Digital Signal Controllers, 32bit ColdFire, Kinetis & Power based Qorivva & PX MCUs.**
- **Eclipse Front End for industry standard interface**
- **Special Edition – Free.** The following limitations apply -
 - unlimited assembly code
 - up to 64KB of C code for HC(S)08/RS08 & HCS12(X), DSC, ColdFire V1 & ColdFire+ derivatives (*available on CW10.2 for HC(S)08/RS08*)
 - up to 64KB of C code for DSC, V1 ColdFire/ColdFire+ derivatives
 - up to 128KB of C code for V2-V4 ColdFire, and Power based MCU families
- **New Project Wizard** – create a project in as few as 6 clicks
- **MCU Change Wizard** – re-target to a new processor in as few as 6 clicks
- **LiveView** – Allows registers, memory and global variables to be monitored without stopping the processor
- **Processor Expert** – Creates tested, optimized initialization code and low-level drivers tuned to application needs and selected Freescale derivative
- **Trace and Profile support for on-chip trace buffer** – provides sophisticated emulator-like debug capability without additional trace capture hardware.
- **MQX Task Aware support available on CodeWarrior Proffional Edition**
- **Flexible Licensing and Support models available**

CodeWarrior

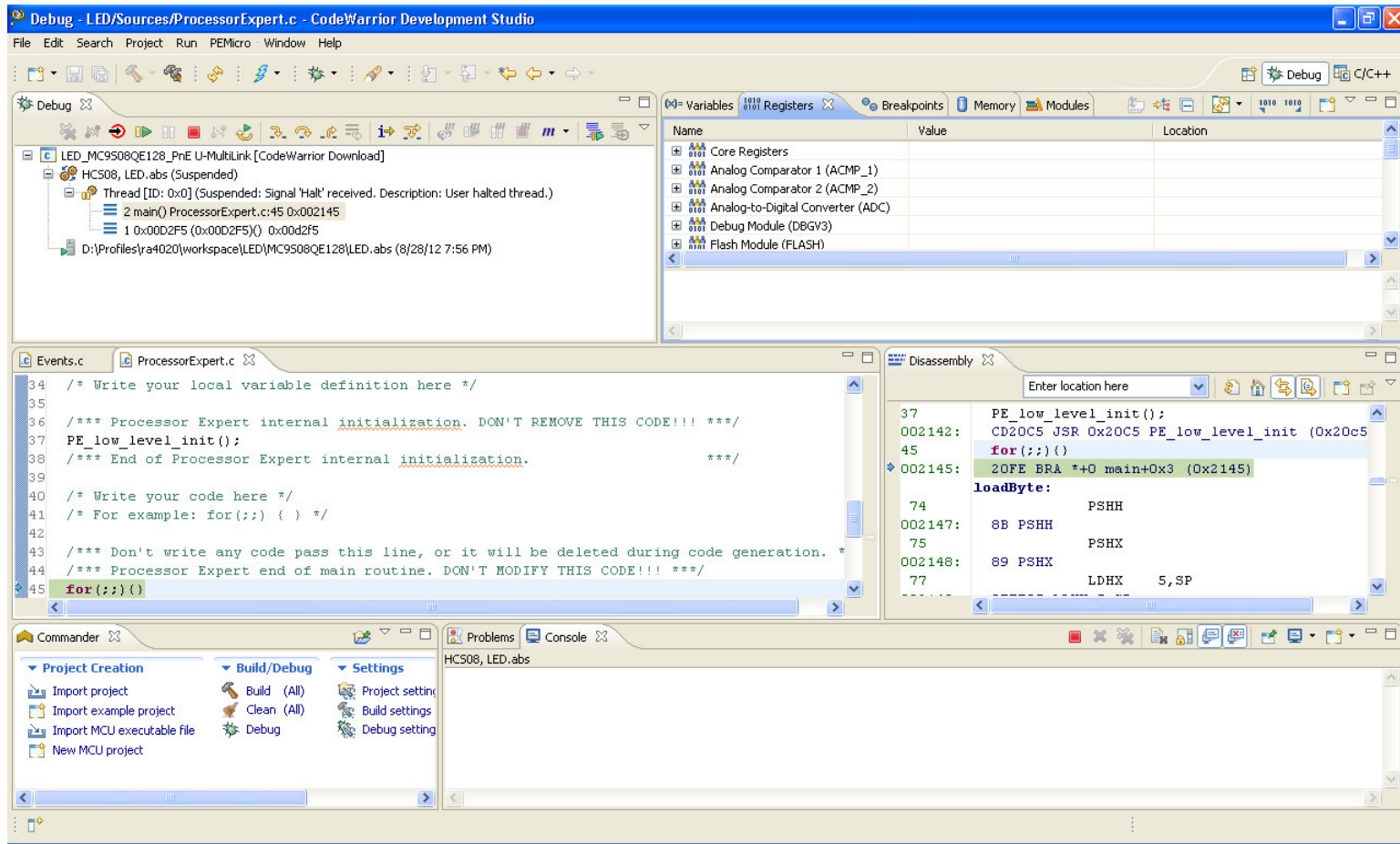


What's New in 10.3? C/C++ Perspective



Simplified C/C++ Perspective by removing menu items and views

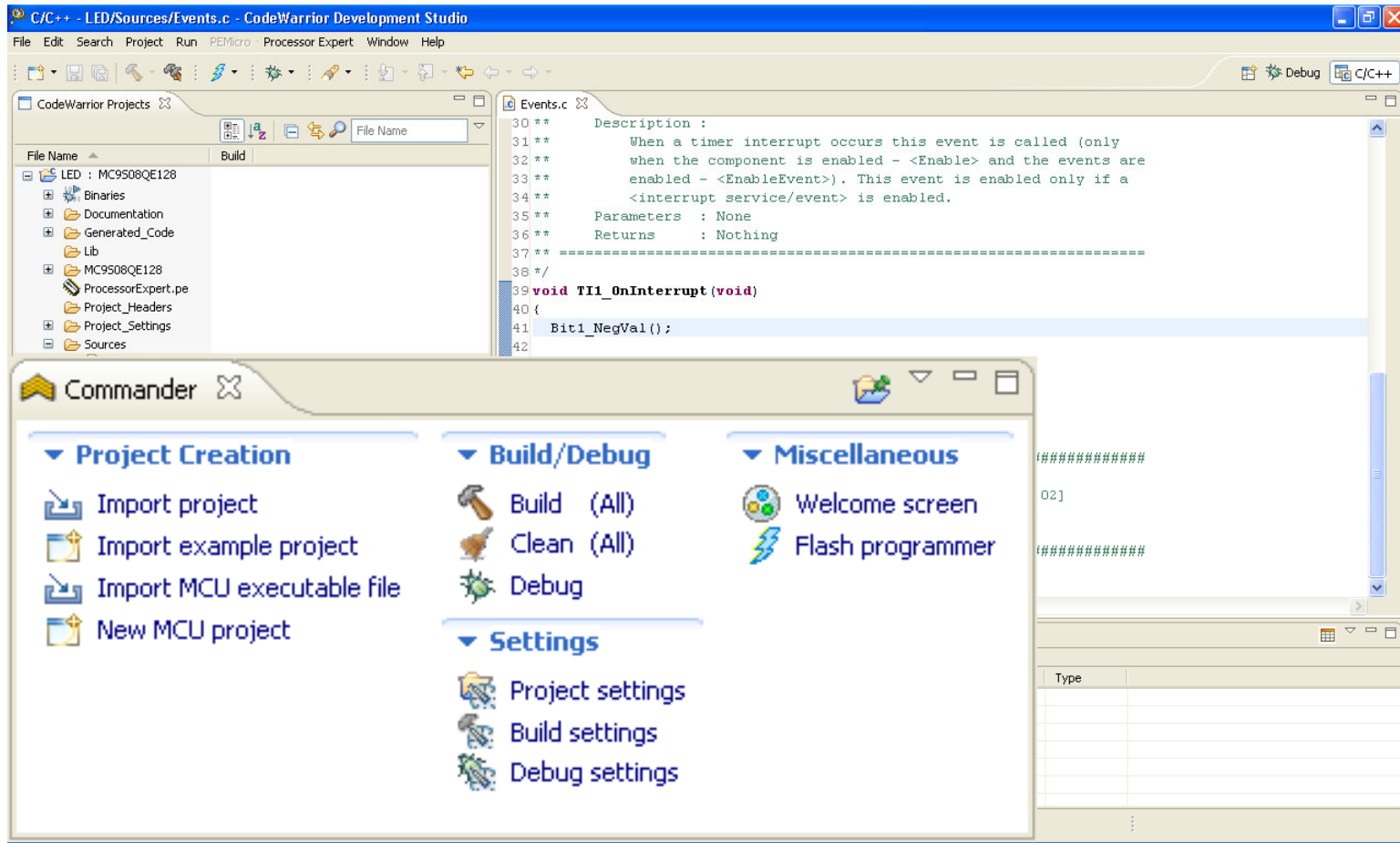
What's New in 10.3? Debug Perspective



Simplified Debug Perspective by removing menu items and views

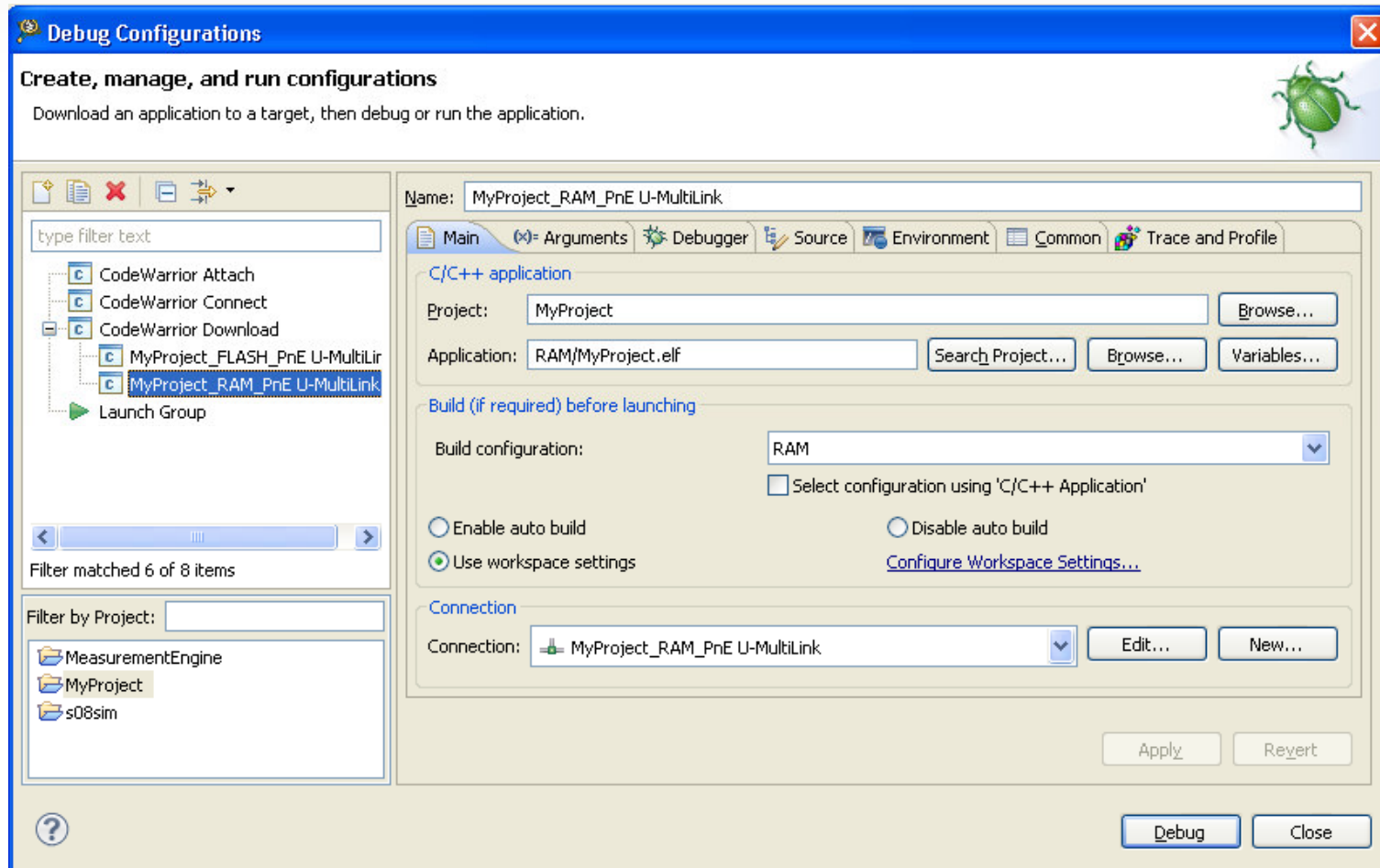


What's New in 10.3? Commander View



Commander View gives one click access to many basic tasks

What's New in 10.3? Debug Configuration



Only debug configurations for selected projects are displayed

What's New in 10.3? Processor Expert

The screenshot displays the CodeWarrior Development Studio interface with the Processor Expert hardware perspective. The main window shows a target board with various peripheral modules connected to pins. Three callout boxes provide details:

- Configuration Registers View**
 - Shows register settings
- Target View**
 - Shows pins/ball map and peripheral modules
 - Select peripheral module to display in Component Inspector
- Component Inspector**
 - Shows properties, methods, and events for a peripheral module

The Configuration Registers View shows a table for DAC0 registers:

Reg. name	Init. value
Peripheral registers	
DAC0_DAT0L	00
DAC0_DAT0H	00
DAC0_DAT1L	00
DAC0_DAT1H	00
Additional registers	
Unused0	1
Unused1	1
DACBFUP	1

The Component Inspector shows properties for the MQX1 component:

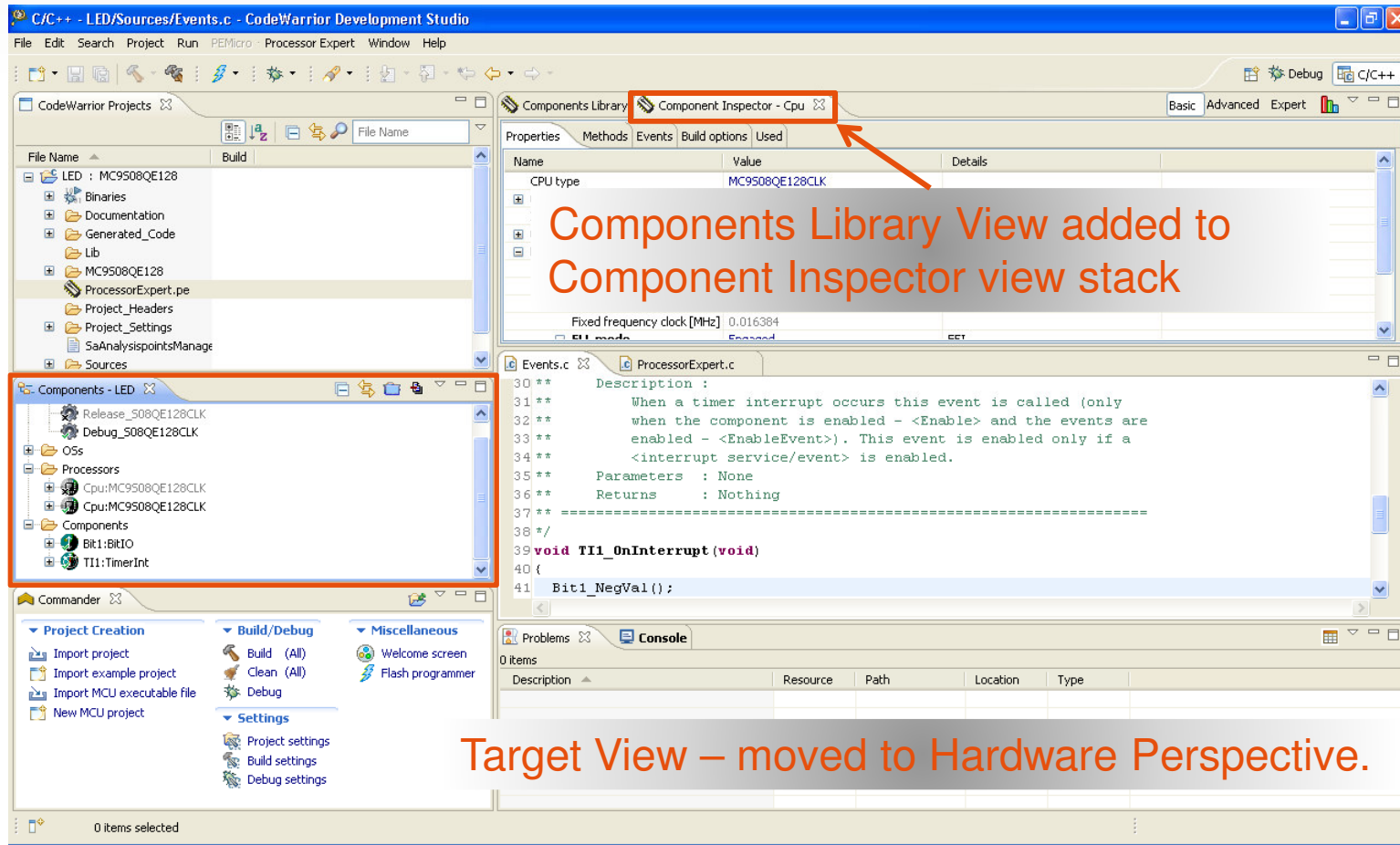
Name	Value
Component name	MQX1
MQX version	mqx_1_0
Copy source files to project	yes
System timer	SystemTimer

The Console window shows the following output:

```
Processor Expert  
LINK file: Unknown variable:${CW_MCU_Name}  
I2C_RGB_MQX: Aug 23, 2012 11:12:43 AM Code generation started.  
XLKR file: Unknown variable:${CW_MCU_Name}  
I2C_RGB_MQX: project was successfully generated.
```

New Hardware Perspective to create code for board bring up.

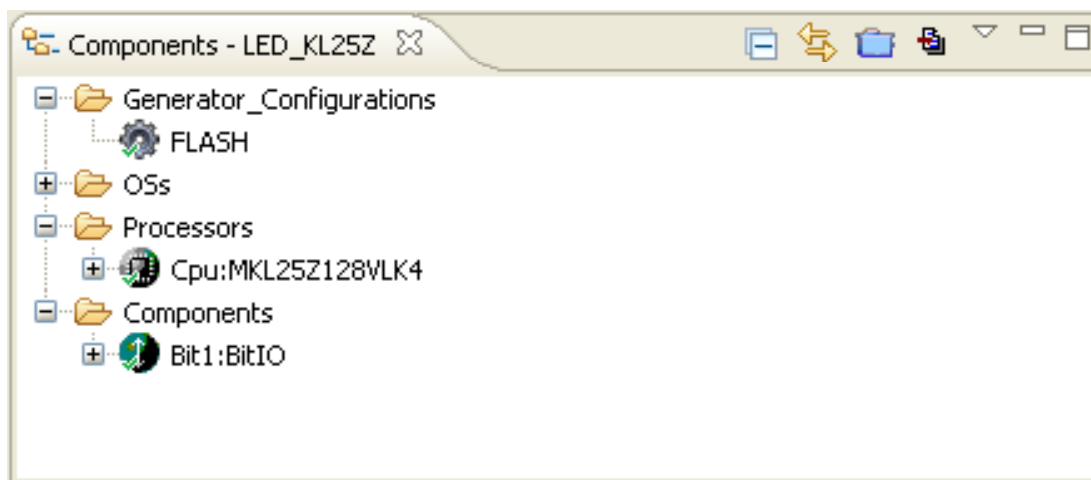
What's Different in 10.3? Processor Expert



Components View displays all Processor Expert component information.

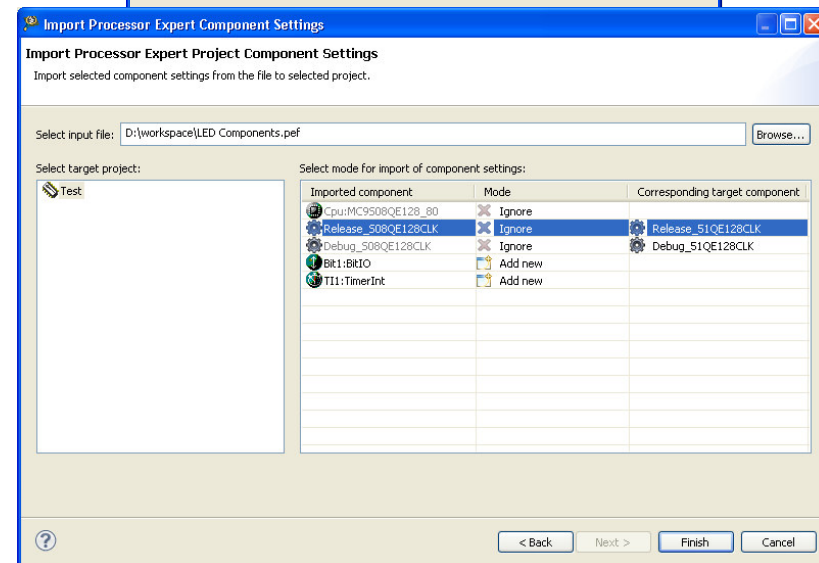
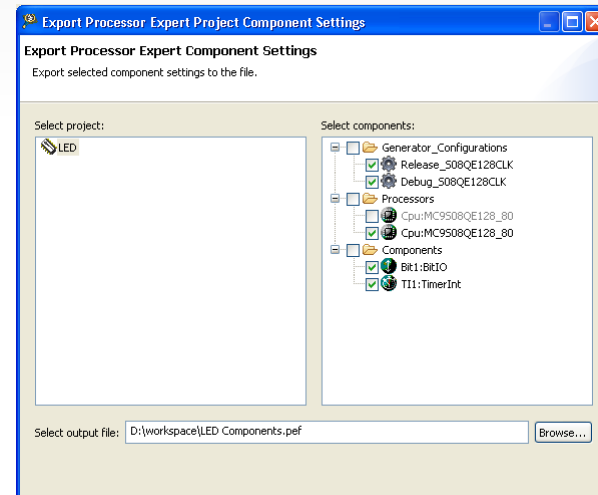
What's New in 10.3? Processor Expert

- New Software Components
 - Provide the same API as existing S08 components to ensure easy migration between S08 and Kinetis L Series devices
 - Work as “wrappers” for Kinetis Logical Device Drivers. Customers can review generated source code to learn how to use the inherited/linked LDD component.
- Available components
 - BitIO, BitsIO, ByteIO
 - TimerInt
 - ADC
 - FreescaleAnalogComp



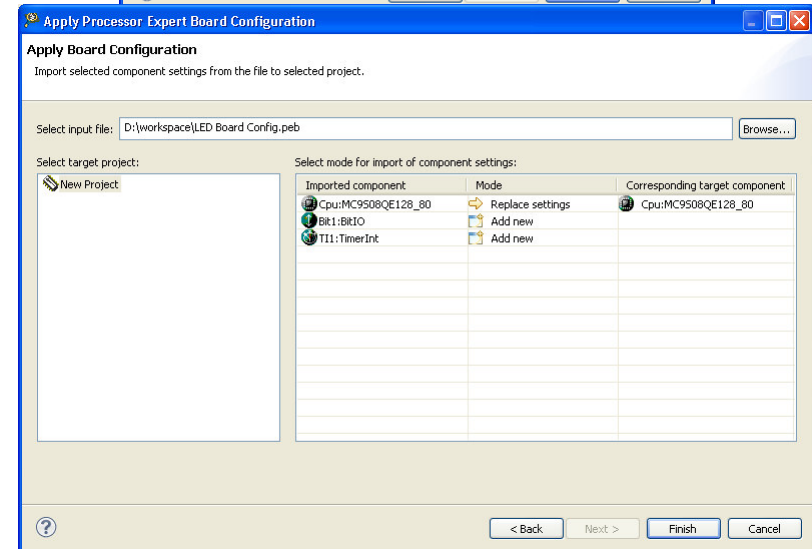
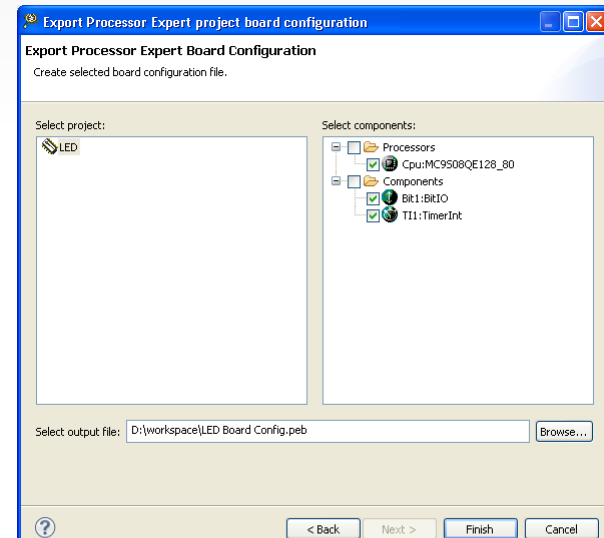
What's New in 10.3? Process Expert

- Export/import one or more components
 - Select components and export to a file
 - Import the file to add the components to another project



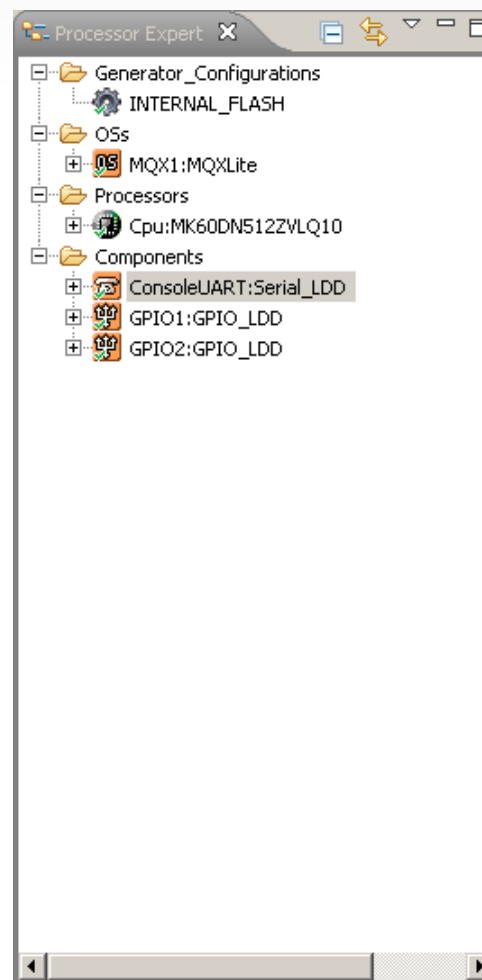
What's New in 10.3? Process Expert

- Export/apply board configurations (CPU + one or more components)
 - Export board configuration related component settings to external file
 - Apply component settings to another project
 - Existing components in project reset to imported settings
 - Methods are enabled in project according to imported settings
 - Missing components are added to project and configured according to imported settings
 - Provides ability to apply pre-defined board settings to existing projects (e.g. TWRMK70.peb)



What's New in 10.3? MQX-Lite

- Adding MQX to a project just got easier!
 1. Use MQX-Lite New Project Wizard to create a project
 - A project is created with Processor Expert
 - MQX-Lite Component is automatically added
 - Encapsulates MQX Kernel
 - Includes RTOS adapter
 2. Add Processor Expert peripheral components
 3. Configure the components' properties, methods, and events
 4. Generate code
 5. Add application code

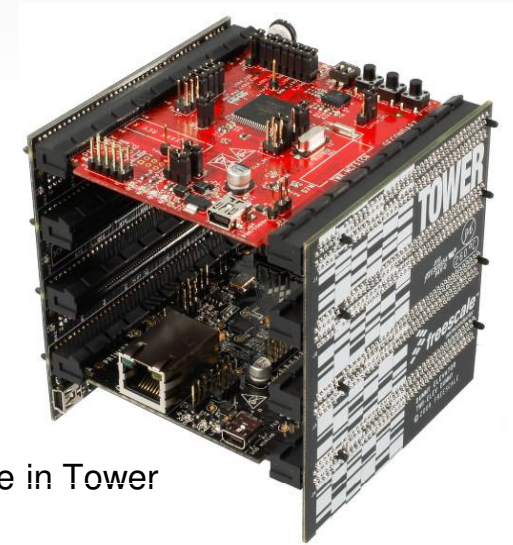


What's New in 10.3? ARM gcc Compiler

- Added support for ARM Ltd. gcc compiler for ARM Cortex-M Series (M0+, M4)
- New Project Wizard creates projects using the ARM gcc compiler by default
 - Kinetis L Series (Cortex M0+)
 - Kinetis K Series (Cortex M4)
- Embedded Warrior Library (EWL) libraries are provided by default
- Support
 - FSL will provide support for the gcc compiler integrated with CodeWarrior.
 - No support will be provided for non-integrated gcc compilers.
- License limitations
 - Special Edition – L Series (64K), K Series (128K)
 - Basic Edition – L Series (128K), K Series (512K)
 - Standard Edition – unlimited C
 - Professional Edition – unlimited C/C++

Easy-to-Use Development Tools and Training

- **TWR-S08PT60 (Available)**
 - MCU card only
 - Includes Quick Start Guide and labs
 - Integrated USB open-source debugger
 - Integrated touch sensing reference design
- **TWR-S08PT60-KIT (Available)**
 - Elevators, supporting peripheral module, MC9S08PT60 MCU card
 - Tower Kit for S08RN60 (automotive) to follow early 2012
- **TWR-S08DC-PT60(Available)**
 - Low Cost Demo Board / Debug Cable option. Demo with Accelerometer
 - \$14 RSL, ideal to get people started quickly, cost effectively on S08. Upgrade in Tower Environment,
- **CodeWarrior Development Studio for Microcontrollers v10.x**
 - Complimentary Special Edition with compiler sizes up to 60K, [free for S08P families on CW10.x](#)
 - Includes Processor Expert, rapid graphical initialization tool, saving time during evaluation phase.
 - Single Tool for Freescale MCU portfolio
- **IAR Embedded Workbench support for S08**



Online training, webcast, technical documentation and application notes available at
www.freescale.com/S08P

Design-in Resources

Application Notes

AN4463 ; How To Develop a Robust Software in Noise Environment
AN4476 System Design Guideline for 5V 8-bit families in Home Appliance Applications
AN4438 AN4438, EMC Design Considerations for MC9S08PT60
AN4347 Transitioning Applications from S08AC and S08FL Family to S08PT Family
AN4431 TSI module application on the S08PT family

Killsheets

S08PT60 vs Renesas R8C/36C killsheet
FSL S08PT60 vs Renesas 78Ko/Kx2
Freescale MC9s08PT60 vs ST STM8S207xx killsheet
Freescale S08PT60 vs ST STM8S105xx killersheet

Demos

Lab 1—Touch Sensing Interface (TSI) with low power demo
Lab 2—Potentiometer demo
Lab 3—Accelerometer demo
Lab 4—UART loop demo
Lab 5—IR demo
Lab 6—SPI demo
Lab 7—Flash and EEPROM demo
Lab 8—BLDC demo

Boards, Tools & Ref-designs

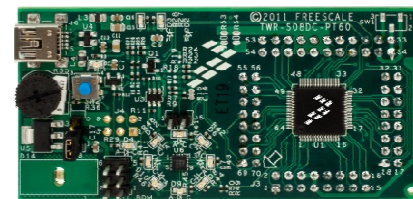
TWR-S08PT60 TWR-S08PT60-KIT	Now	Module - \$99 KIT- \$139
CodeWarrior 10.2 PT60	Now	
TWR-S08DC-PT60	Now	Low-cost PT60. Price @ \$14



TWR-S08PT60



TWR-S08PT60-KIT



TWR-S08DC-PT60





The New Rugged 5V 8-bit S08P Family of MCUs

Built tough, ideal for harsh industrial, automotive and user interface environments!

- Get exceptional EFT/ESD performance in harsh and user interface environments, meeting safety standard IEC-60730 for appliance applications
- The new scalable and pin-compatible S08P family offers scalable flash memory and a choice of packages allowing space and feature set flexibility. Automotive option available see S08R
- This family of MCUs integrates key features like EEPROM and TSI (touch sensing interface), and the motor control FlexTimer is designed to help reduce system costs

