Webinar

Designing smarter automotive systems with MSPM0 AEC-Q100 MCUs

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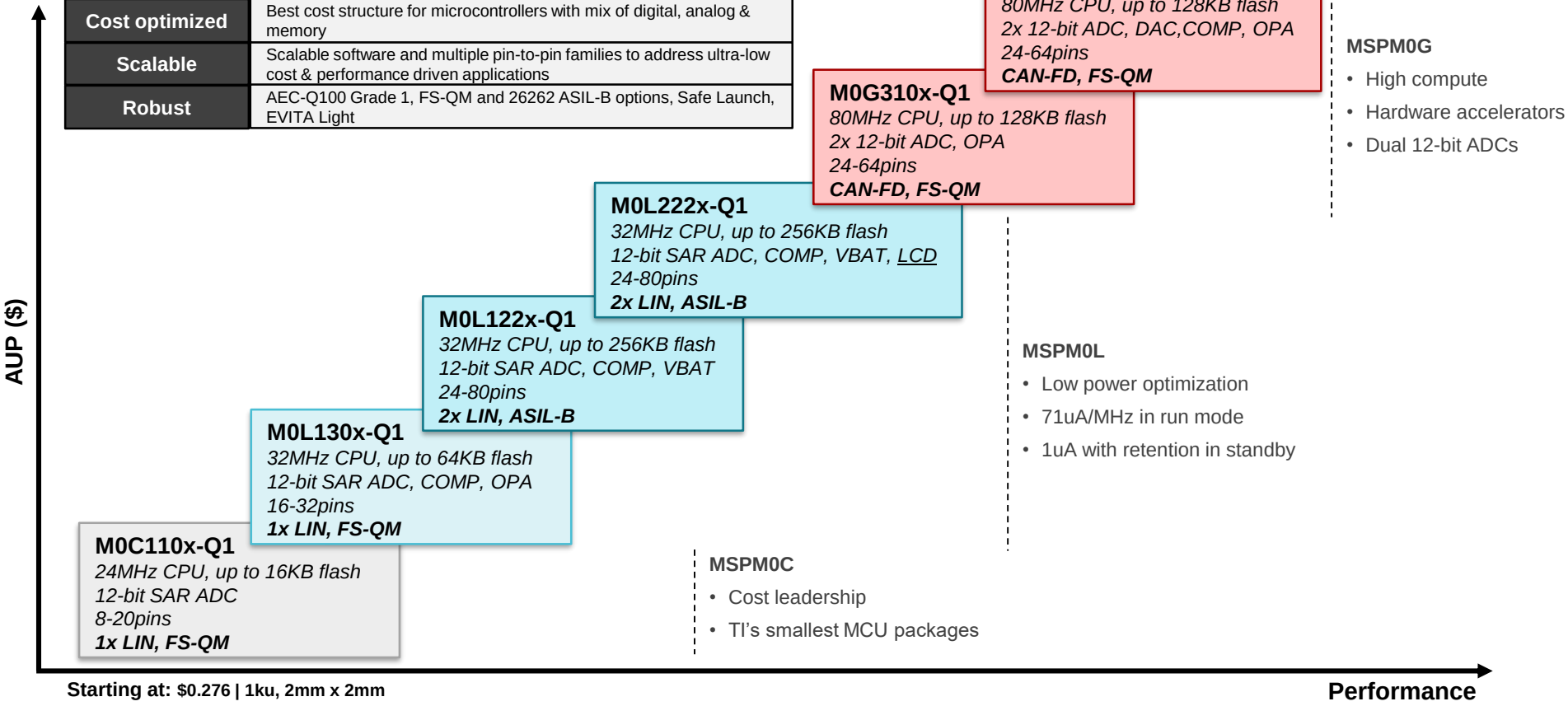
Applications Engineer

Agenda

- MSPM0 AEC-Q100 portfolio update
- MSPM0 technical benefits for automotive designs
- MSPM0 MCU automotive applications and demonstrations
- Getting started with MSPM0 MCUs

MSPM0 microcontrollers

Cost optimized	Best cost structure for microcontrollers with mix of digital, analog & memory
Scalable	Scalable software and multiple pin-to-pin families to address ultra-low cost & performance driven applications
Robust	AEC-Q100 Grade 1, FS-QM and 26262 ASIL-B options, Safe Launch, EVITA Light



MSPM0 C-Series microcontrollers

MSPM0C1103/4

1.62 - 3.6V
-40 to 125 C

CPU
ARM Cortex-M0+
24 MHz

NVIC / 1-ch Basic DMA

On-chip Memory
- 8, or 16 kB flash
- 1 kB SRAM

Data Integrity & Security
- CRC accelerator (16 bit)

Programming & Debug
- ARM SWD interface

Power & Clocking
- POR / BOR
- Internal LF 32kHz (3%)
- Internal HF 24MHz (1%)

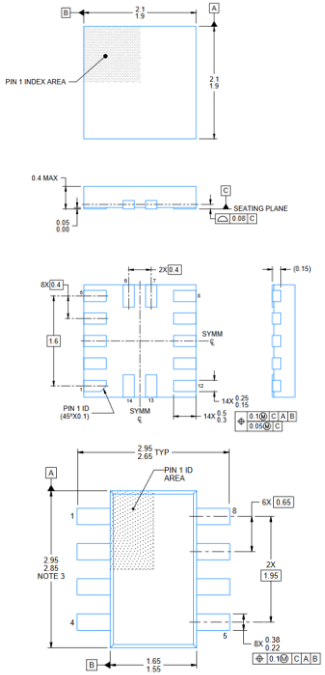
Communication
- UART w/ LIN (1)
- SPI (1)
- I2C (1) w/ FastMode+

Precision Analog
- 12-bit SAR ADC (10-ch)
- Internal ADC reference (1.5%)

Timers
- Advanced control 16-bit 4 CC (1)
- General purpose 16-bit 4 CC (1)
- General purpose 16-bit 2 CC (1)
- Windowed watchdog

IO
- Up to 18 GPIO

Leaded packages: SOT-8/16, VSSOP-20, TSSOP-20
No-lead packages: WSON-8, WQFN-20



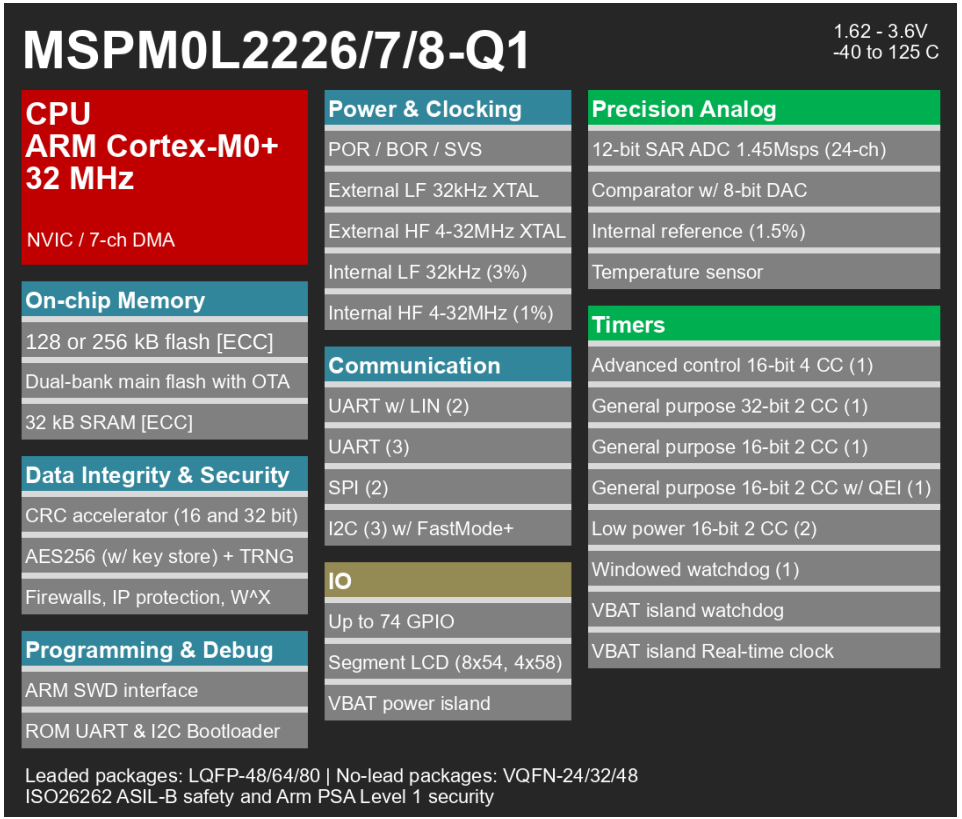
< $0.27
starting at 1 Ku

5
Of the industry's smallest, easiest to assemble MCU packages

1x LIN
Local Interconnect Network

FS-QM
Functional Safety – Quality Managed

MSPM0 L-Series microcontrollers



< $0.74

starting at 1 Ku

Dual Bank

OTA Firmware Updates

2x LIN

Local Interconnect Network

ASIL-B

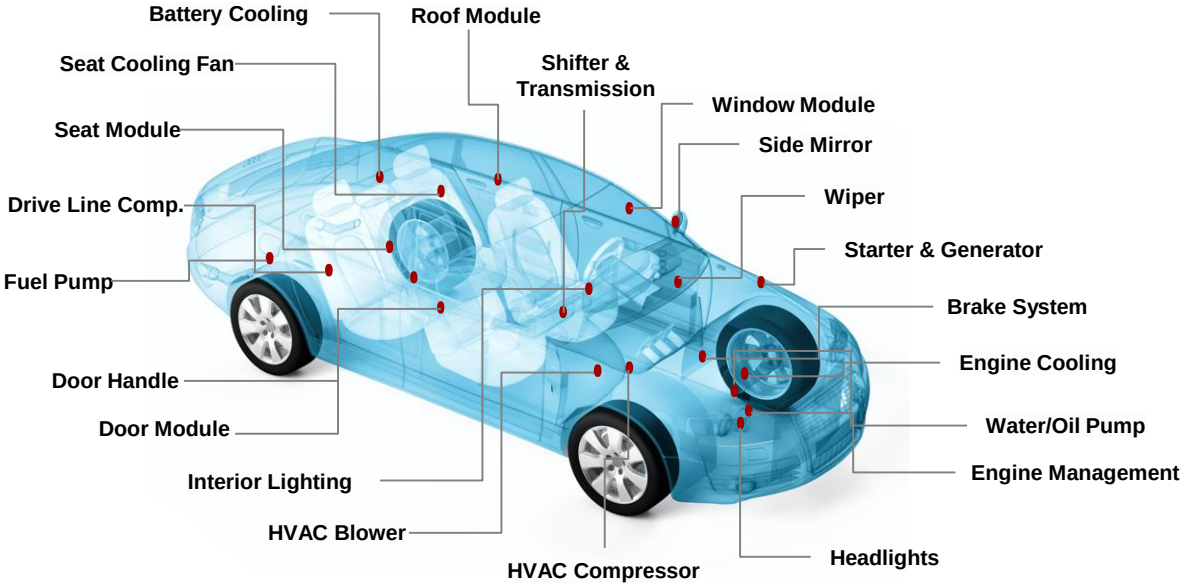
MSP's first ASIL-B automotive MCU

Expanding use of MCUs in automotive

Lighting

Sensing

Control



Innovations

- Integrated precision sensing & control
- Industry leading package & scalability
- Energy efficiency
- Functional safety-quality managed
- 011100 100010 001111 Networking
- SDK Ease of use software development kit

MSPM0 portfolio advances automotive systems

- AEC Q-100 Grade 1 qualified products
- Integrated 12-bit ADC, OP-AMP's, DAC's and Comparators
- Low-cost, small form factor packages
- Integrated CAN-FD and LIN controllers

- Embedded CAN/LIN controller
- Communication interfaces (UART/SPI/I2C)

Lighting

- Scalable portfolio across memory and package
- Small form factor
- Precision Analog for smart sensing
- Embedded LIN+CAN controller

Body Electronics

- Integrated Op-amps / comparators for HV charging/discharging circuits.
- Microcontroller for AC chargers
- Motor control solutions for pumps

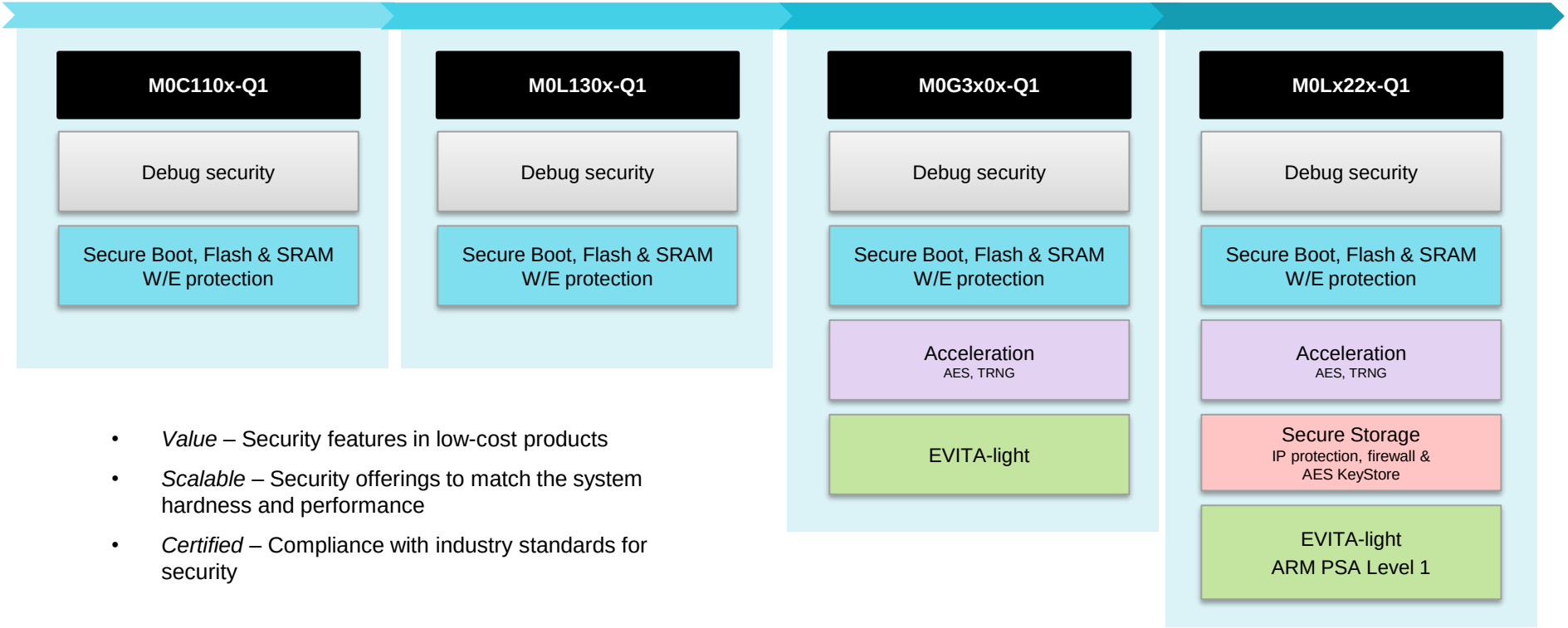
HEV and Power Train

- Microcontroller with integrated CAN for remote audio applications
- Microcontroller for housekeeping/IO expansion

Infotainment & Cluster

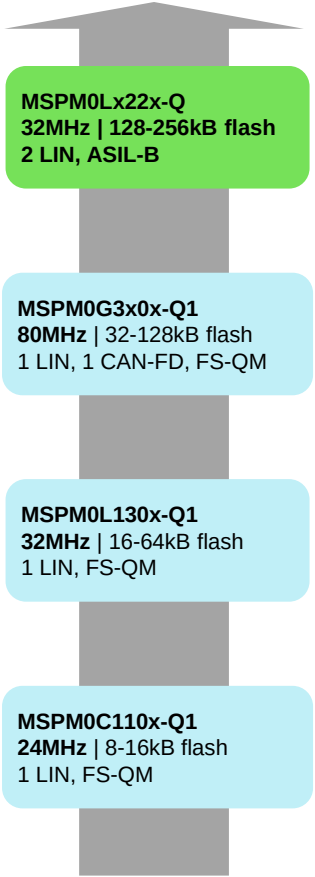
MSPM0 platform security

Security features to match application requirements



- *Value* – Security features in low-cost products
- *Scalable* – Security offerings to match the system hardness and performance
- *Certified* – Compliance with industry standards for security

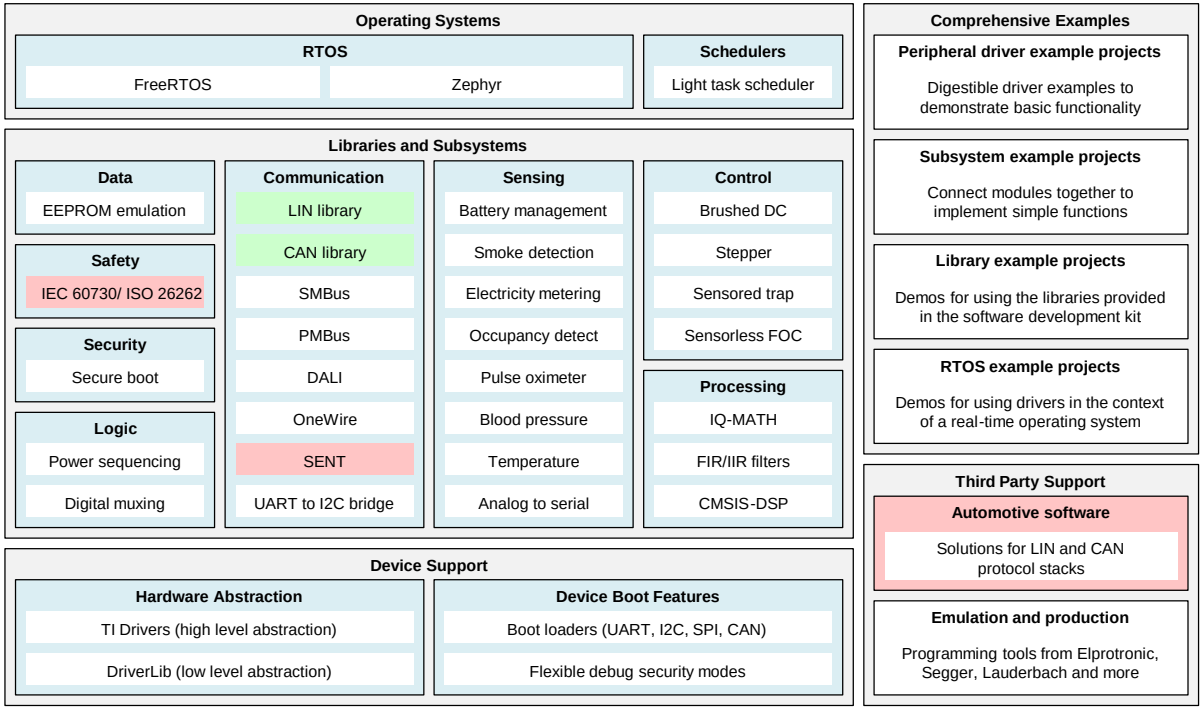
MCU Solutions | Functional Safety



	FS-QM			ASIL-B
	M0C110x-Q1	M0L130x-Q1	M0G3x0x-Q1	M0Lx22x-Q1
FuSa Compliance	FS-QM	FS-QM	FS-QM	ASIL-B
FIT Analysis	Planned	Available	Available	Planned
FMEDA	Planned	Available	Available	Planned
FuSa Manual	Planned	Available	Available	Planned
Flash ECC	No	No	Yes	Yes
SRAM ECC	No	No	No	Yes
Boot Protection	Yes	Yes	Yes	Yes
POR/BOR/SWRST	Yes	Yes	Yes	Yes
Clock Monitoring	Yes	Yes	Yes	Yes
Lockable Registers	Yes	Yes	Yes	Yes
GPIO Protect	Yes	Yes	Yes	Yes
Watchdog	Yes	Yes	Yes	Yes

Embedded software available today

MSPM0-SDK: Optimized, robust, and flexible embedded software



TI: https://www.ti.com/tool/mspm0-sdk **GitHub:** https://github.com/TexasInstruments/mspm0-sdk

GitHub

Choose your favorite delivery format

- Windows, macOS, and Linux support
- Make a clone of MSPM0-SDK from GitHub
- Core contents are BSD 3-clause licensed

Develop with TI Code Composer Studio

- VS-code (Theia) based environment
- Eclipse-based environment
- TI Arm compiler with functional safety

IAR Embedded Workbench

KEIL™ Tools by ARM

Develop with fully supported 3P environments

- IAR Embedded Workbench for ARM
- Arm Keil uVision environment

Texas Instruments
Third Party

MSPM0 Automotive Applications

Body Electronics & Lighting | Infotainment | ADAS | HEV/EV

Side mirror module

Hero devices

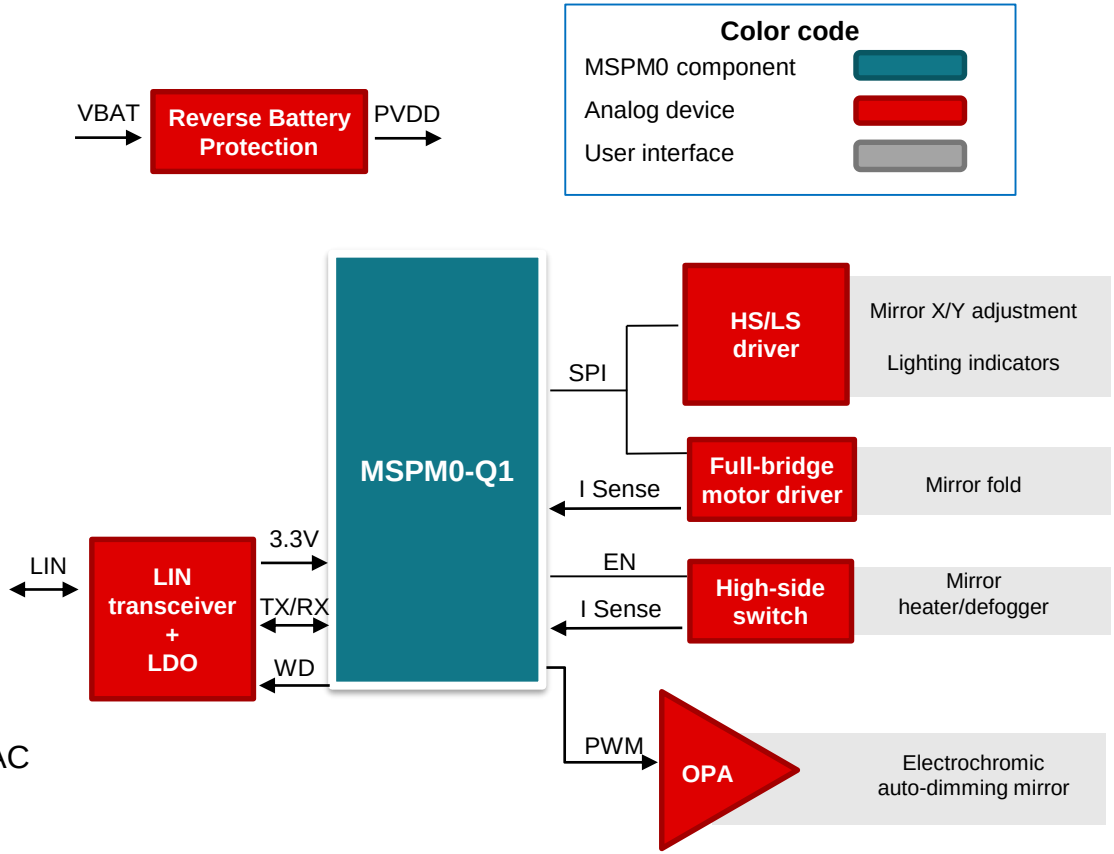
M0L130x-Q1 | M0G350x-Q1

Requirements

- Optimized form factor to allow mirror assembly and fold functionality
- High thermal efficiency to control the heating element for defogging
- Monitoring and protection of fold motor and heater loads for faults

Features

- UART with LIN support
- Integrated ADC, OPA, and 8-bit reference DAC
- I2C and SPI communication interfaces
- Integrated temperature sensor



Window lifter

Hero devices

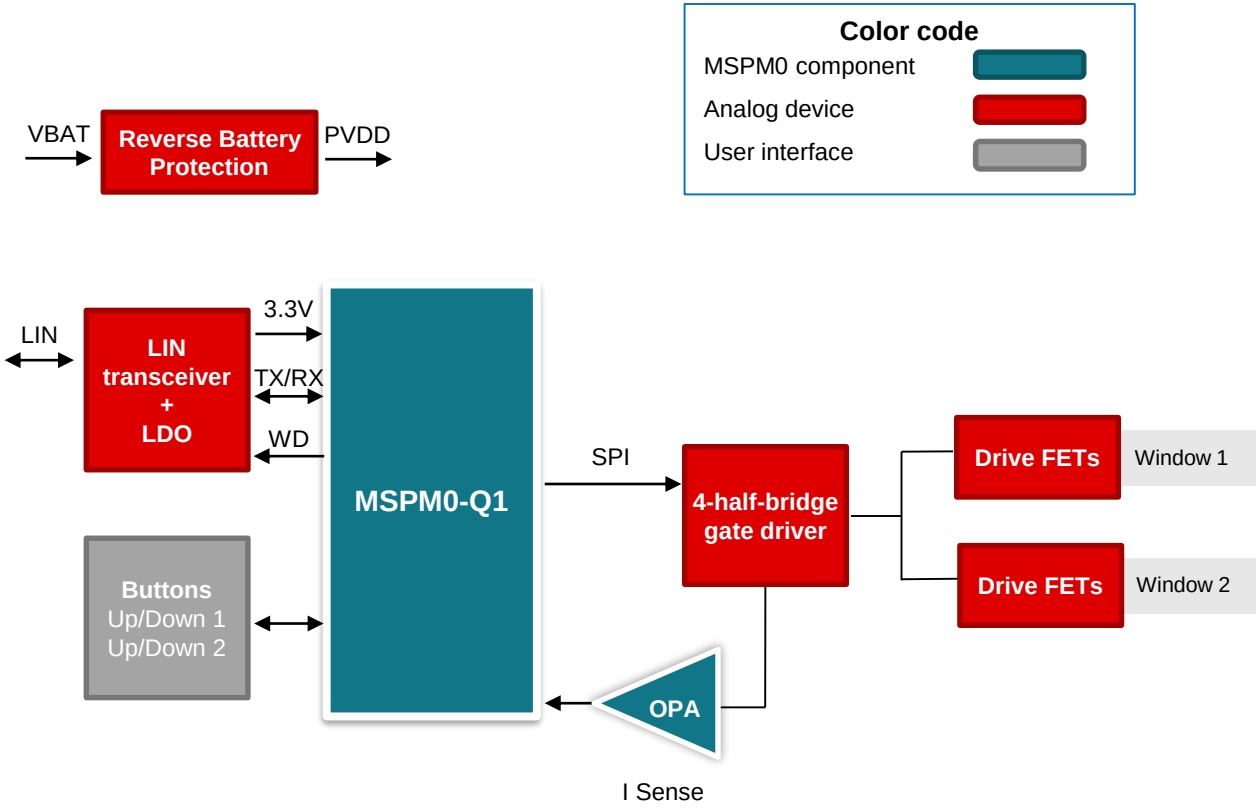
M0L130x-Q1 | M0G350x-Q1

Requirements

- Control of powerful mechanism with sensitive anti-pinch detection
- Low-power dissipation while driving high-current loads
- Minimal conducted and radiated emissions
- Integrity of position information during brief battery supply transients

Features

- UART with LIN support
- Integrated ADC, OPA, and 8-bit reference DAC
- I2C and SPI communication interfaces
- Integrated temperature sensor



Trunk actuator

Hero devices

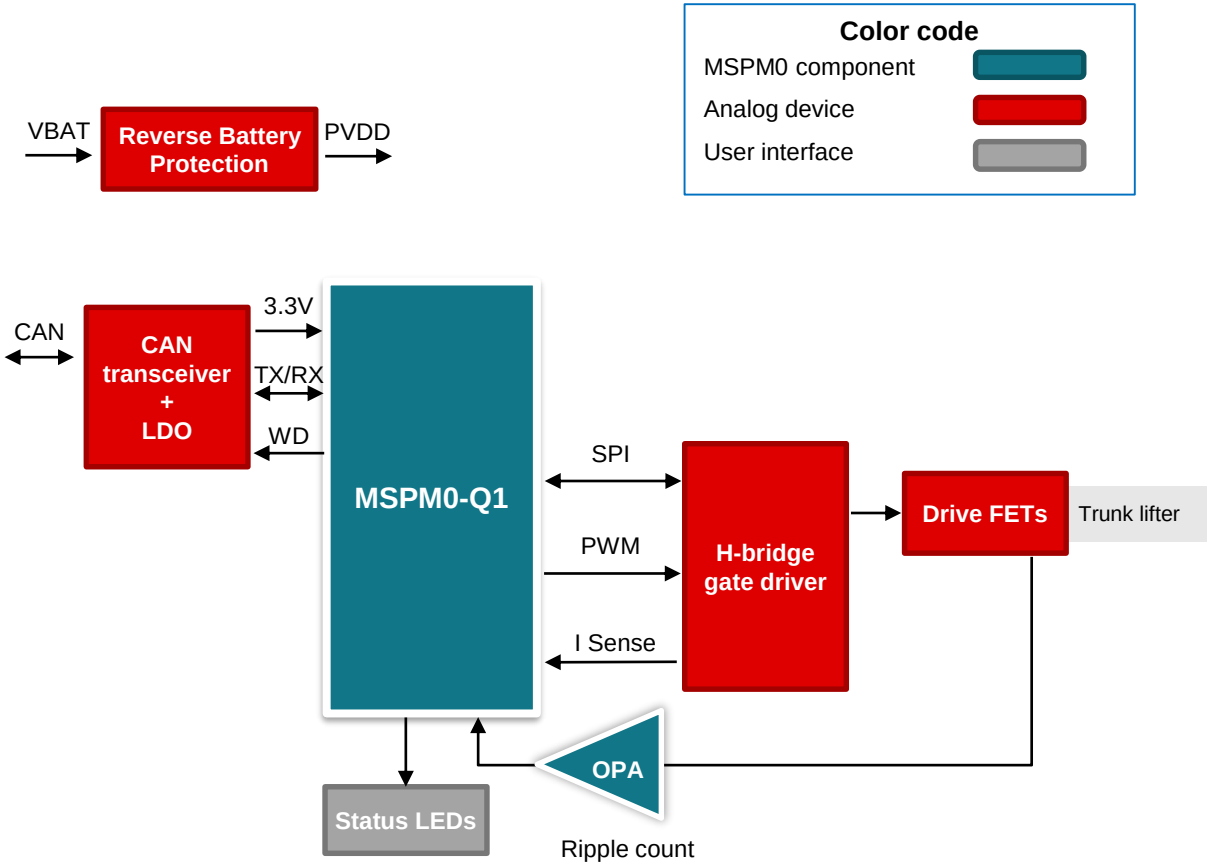
M0G350x-Q1

Requirements

- Control of powerful mechanism with sensitive obstacle detection
- Flexibility for motorized or manual operation
- Low-power dissipation while driving high-current loads

Features

- CAN-FD
- Integrated ADC, OPA, DAC, COMP
- I2C and SPI communication interfaces
- Integrated temperature sensor



Water pump

Hero devices

M0G350x-Q1

Application information

Low voltage (24/48V) BLDC/BDC/Stepper Control in Pumps or platform design

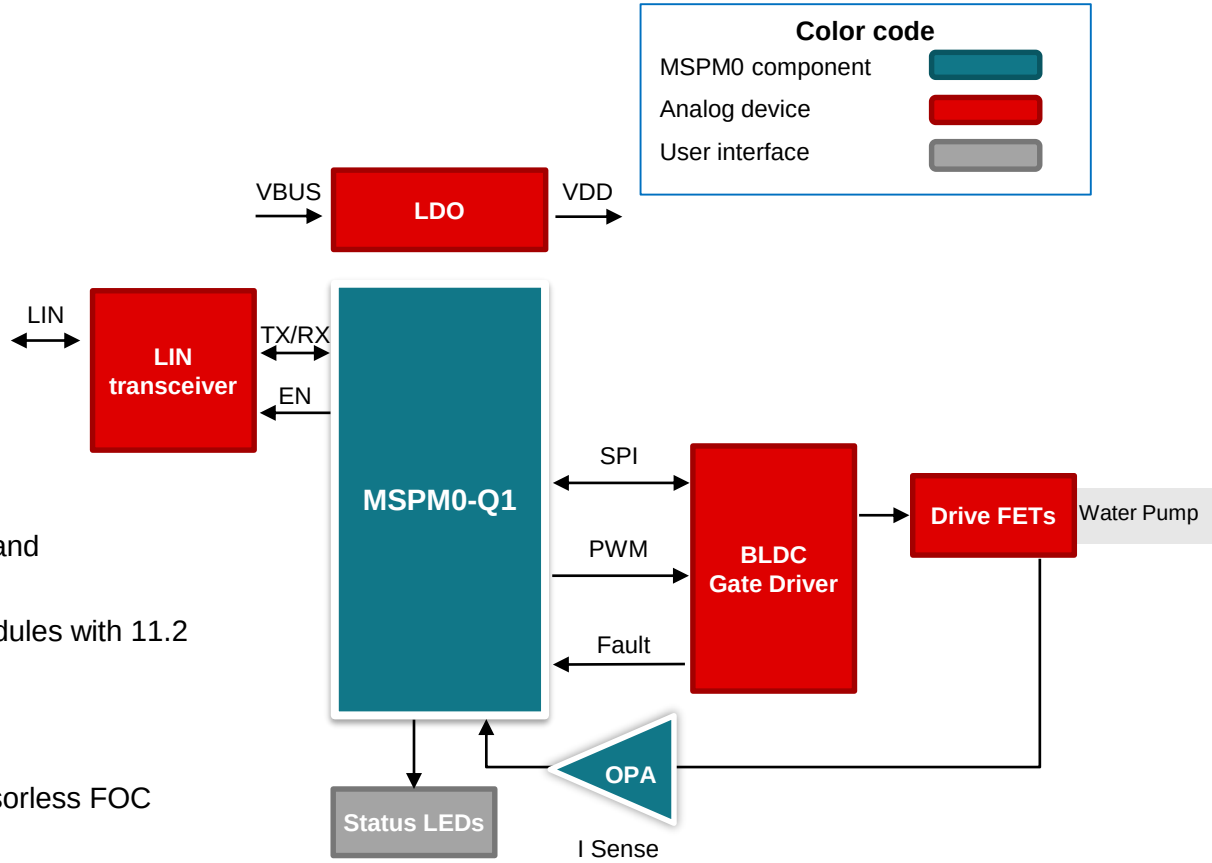
Why MSPM0?

Silicon Level

- Advanced timers supporting dead band and complementary PWM pair outputs.
- two independent 4-Msps 12-bit ADC modules with 11.2 ENOB for accurate current sampling.
- UART, SPI, I2C CAN-FD & LIN Interface

Software/Algorithm Level

- High-performance estimator enables sensorless FOC
- 1-Shunt algorithm to save BOM cost.
- Power close loop control to meet pump requirement



Car access & security

Hero devices

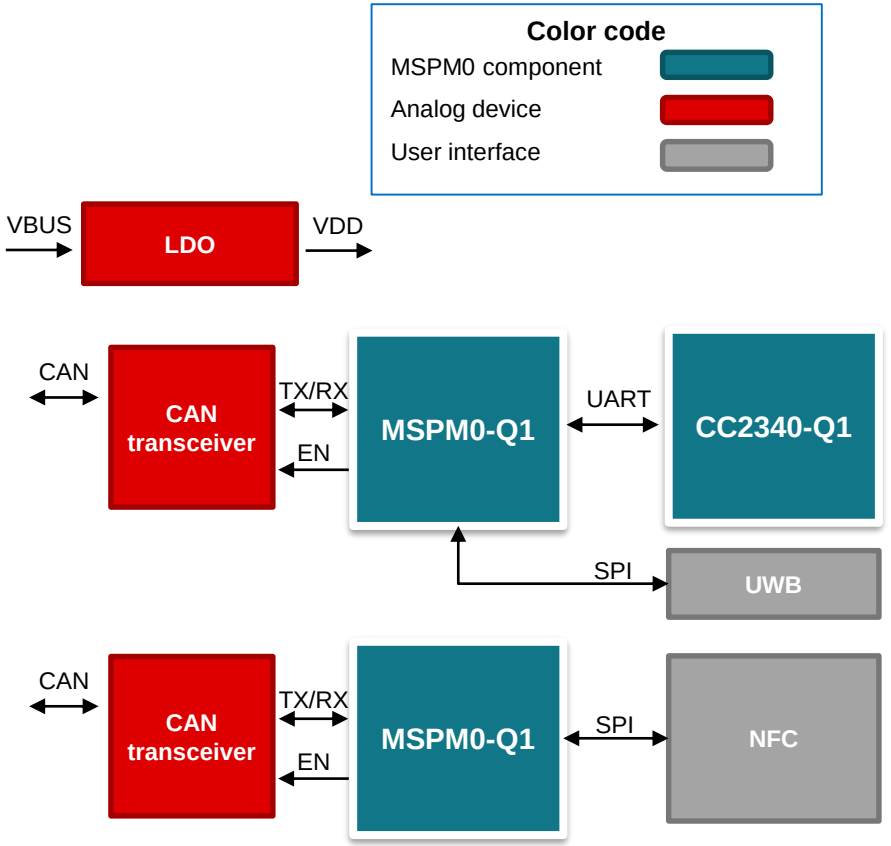
M0G350x-Q1

Application information

- Passive Entry Passive Start
- Door Handle module
- Kick to open Module

Why MSPM0?

- Compact solution size to fit inside door handles
- Low power operation in active and sleep states
- Analog Integration: Internal Comparator (3xCOMP) in G350x; Connect the sensor;
- 4 UART, SPI, I2C, 1 CAN-FD & LIN Interface



Headlight

Hero devices

M0G310x-Q1 | M0G350x-Q1

Application information

Headlights, Taillights, Ambient lighting MSP

MSP MCU + TPS Led Driver Solution

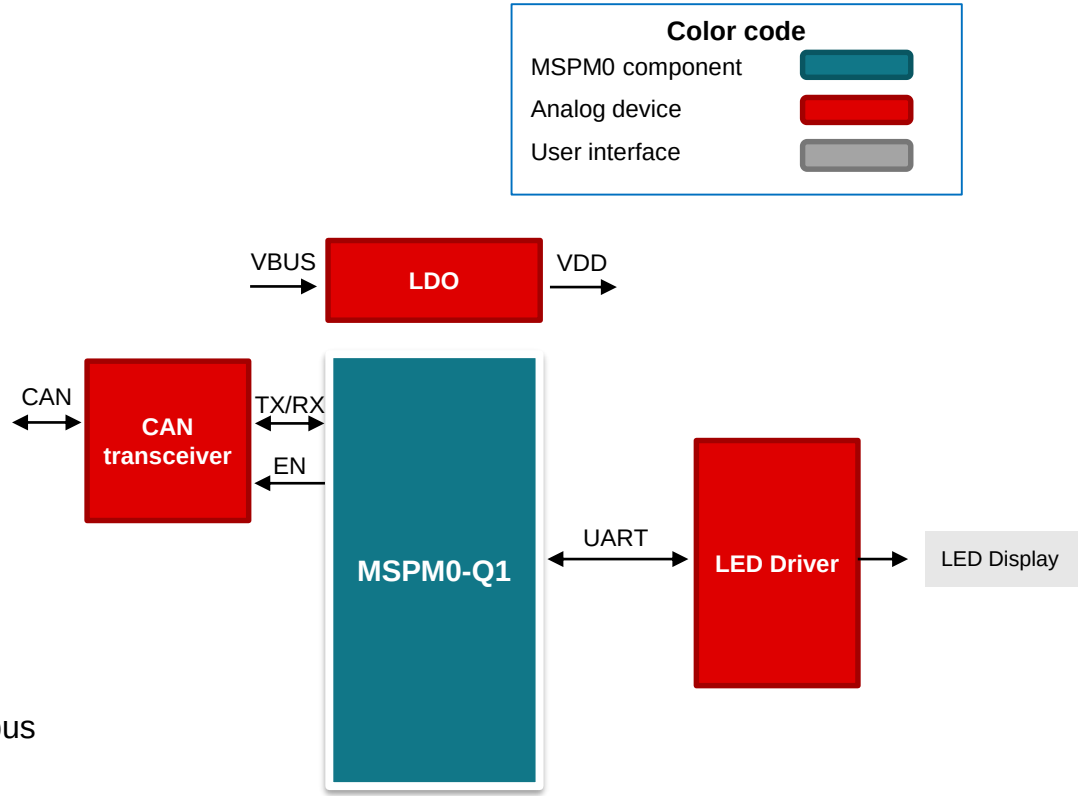
Why MSPM0?

Silicon Level

- Advanced timers with internal 1% oscillator to supporting high accuracy PWM output.
- UART + DMA for LED driver communication
- CAN-FD & LIN Interface to support automotive bus

Software/Algorithm Level:

- ASIL-B certified MCAL software support(free EB license)
- Example code supporting CAN, LIN interface



IO expander

Hero devices

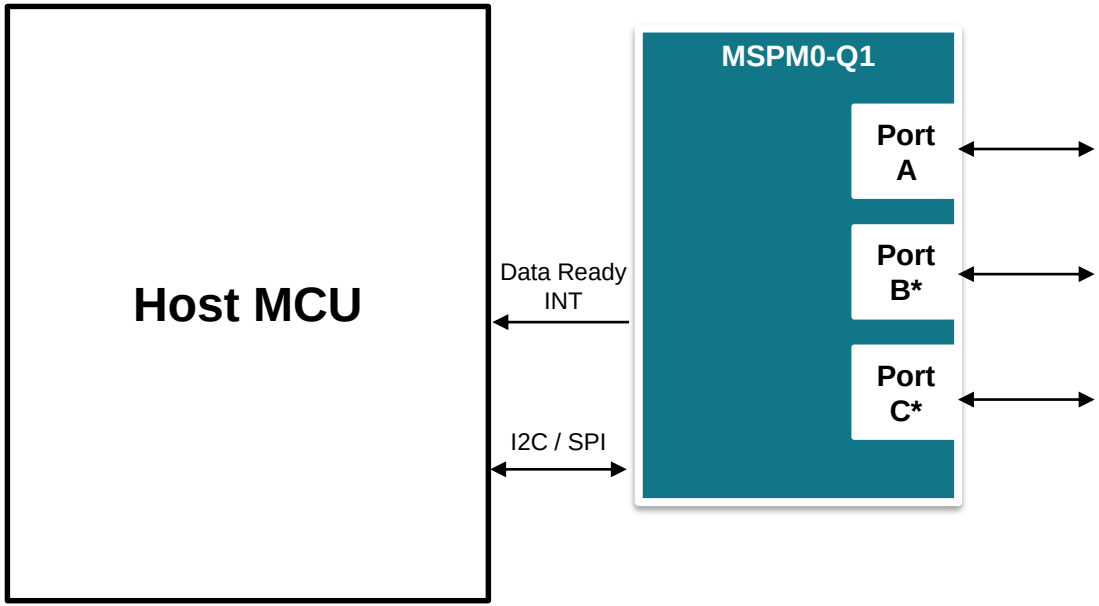
M0C110x-Q1 | M0L130x-Q1

Requirements

- Control of powerful mechanism with sensitive anti-pinch detection
- Low-power dissipation while driving high-current loads
- Minimal conducted and radiated emissions
- Integrity of position information during brief battery supply transients

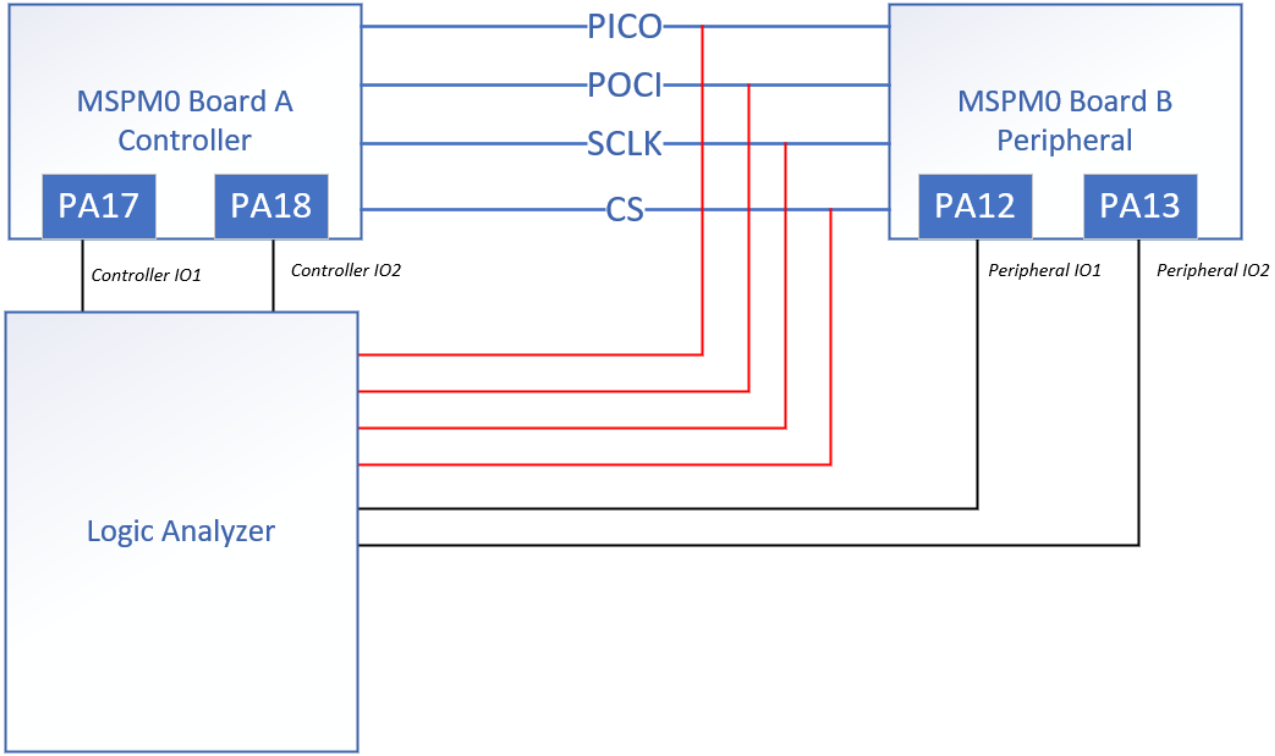
Features

- UART with LIN support
- Integrated ADC, OPA, and 8-bit reference DAC
- I2C and SPI communication interfaces
- Integrated temperature sensor

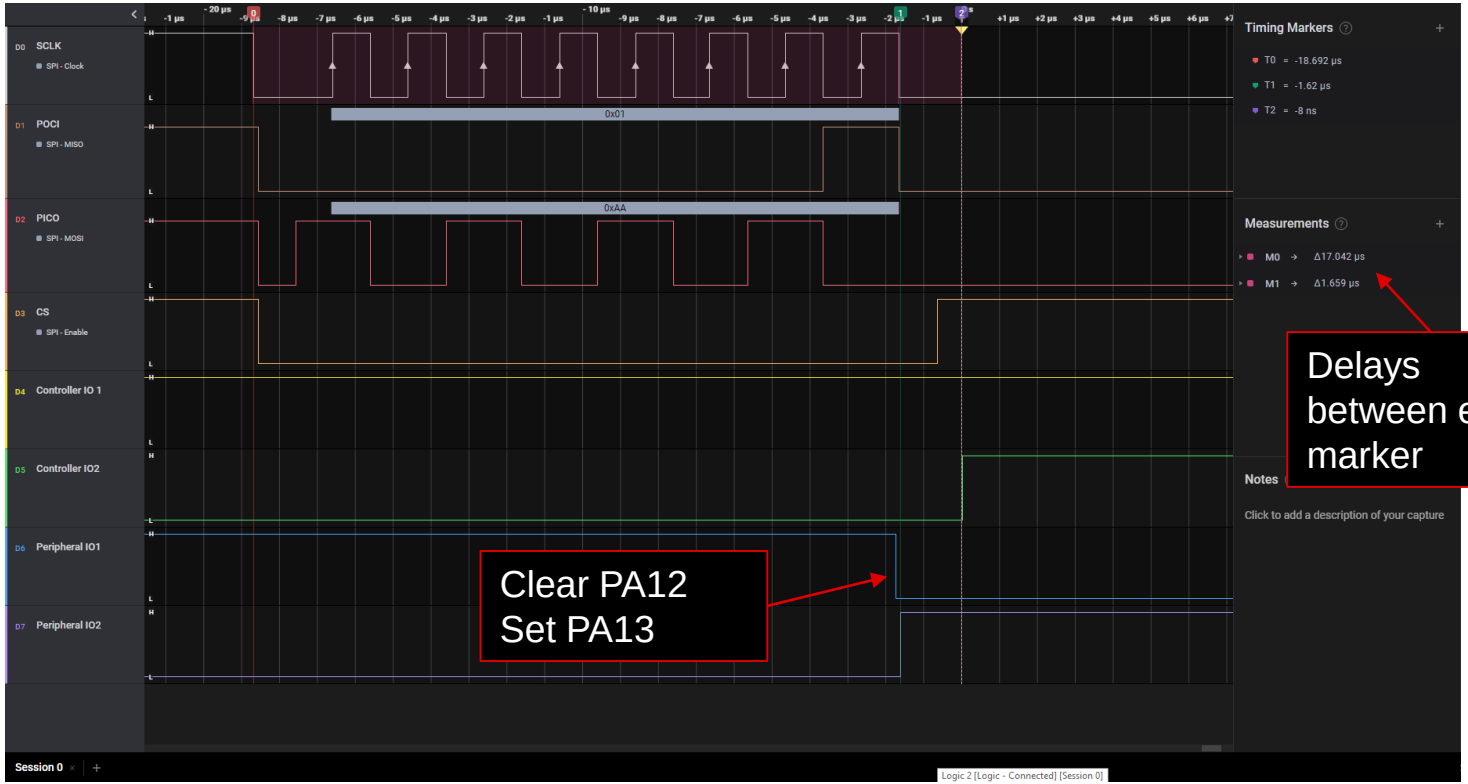


*Number of available IO ports is device dependent

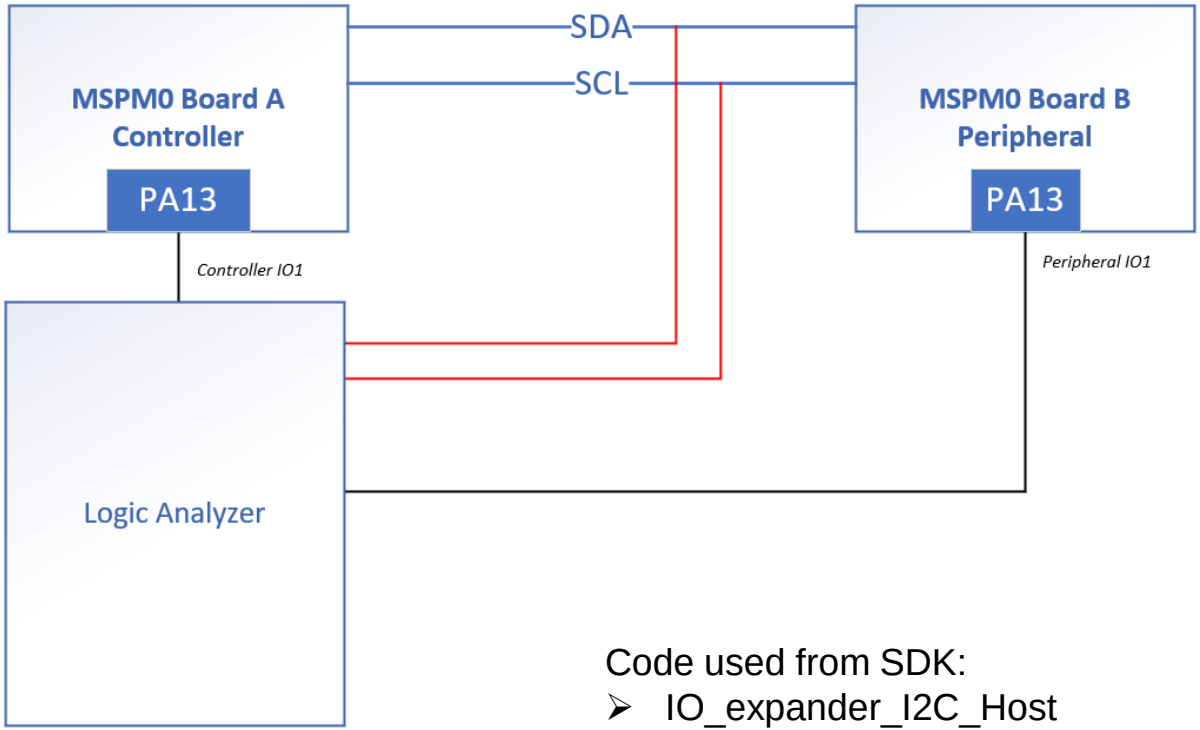
Test block diagram (MSPM0 IO Expander w/ SPI)



MSPM0 IO Expander w/ SPI Scopeshot (500KHz)



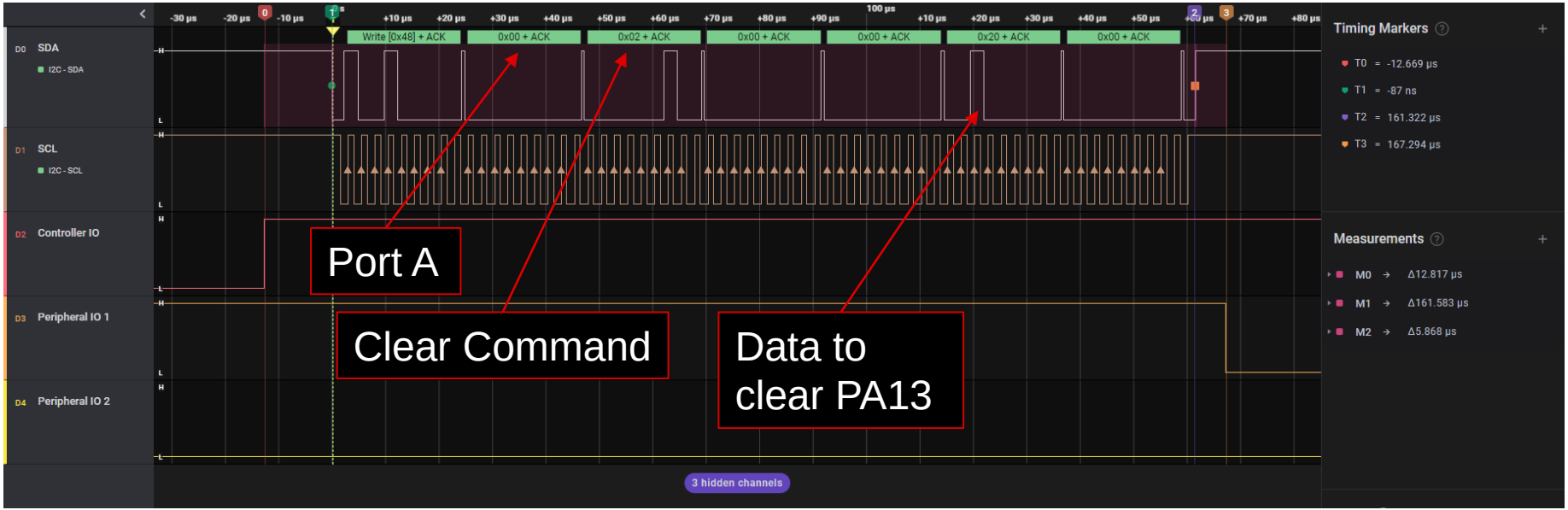
Test block diagram (MSPM0 IO Expander w/ I2C)



Code used from SDK:

- IO_expander_I2C_Host
- IO_expander_I2C_Target

MSPM0 IO Expander w/ I2C Scopeshot (SCL = 400KHz)

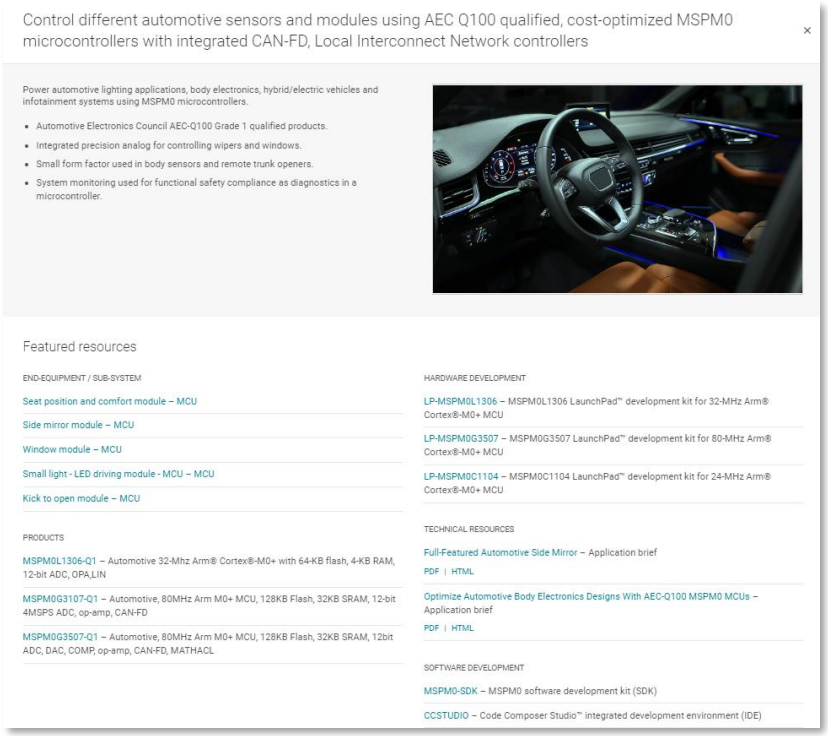


Latency comparison

Protocol	Target	Bits sent in Test	Frequency	Latency from start of transaction to IO change
SPI	MSPM0L1306	8 (Modify 8 IO)	500KHz	18.7us
			5 MHz	2.506us
			16 MHz	1.7us
I2C	MSPM0L1306	65 (Modify 32 IO)	400KHz	180.268us
			800KHz	98.543us
I2C IO Expander IC	TCAL9539-Q1	29 (Modify 8 IO) (16 of these bits only have to be sent once. After, any amount of IO can be configured.)	400KHz	72.9us
			800KHz	36.7us
			1MHz (Max)	29.4us

Getting started

Arm Cortex-M0+ MCUs | TI.com



Control different automotive sensors and modules using AEC Q100 qualified, cost-optimized MSPM0 microcontrollers with integrated CAN-FD, Local Interconnect Network controllers

Power automotive lighting applications, body electronics, hybrid/electric vehicles and infotainment systems using MSPM0 microcontrollers.

- Automotive Electronics Council AEC-Q100 Grade 1 qualified products.
- Integrated precision analog for controlling wipers and windows.
- Small form factor used in body sensors and remote trunk openers.
- System monitoring used for functional safety compliance as diagnostics in a microcontroller.

Featured resources

END-EQUIPMENT / SUB-SYSTEM

Seat position and comfort module – MCU

Side mirror module – MCU

Window module – MCU

Small light - LED driving module - MCU – MCU

Kick to open module – MCU

PRODUCTS

MSPM0L1306-Q1 – Automotive 32-Mhz Arm® Cortex®-M0+ with 64-KB flash, 4-KB RAM, 12-bit ADC, OPA,LIN

MSPM0G3107-Q1 – Automotive, 80MHz Arm M0+ MCU, 128KB Flash, 32KB SRAM, 12-bit 4MSPS ADC, op-amp, CAN-FD

MSPM0G3507-Q1 – Automotive, 80MHz Arm M0+ MCU, 128KB Flash, 32KB SRAM, 12bit ADC, DAC, COMP, op-amp, CAN-FD, MATHACL

HARDWARE DEVELOPMENT

LP-MSPM0L1306 – MSPM0L1306 LaunchPad™ development kit for 32-MHz Arm® Cortex®-M0+ MCU

LP-MSPM0G3507 – MSPM0G3507 LaunchPad™ development kit for 80-MHz Arm® Cortex®-M0+ MCU

LP-MSPM0C1104 – MSPM0C1104 LaunchPad™ development kit for 24-MHz Arm® Cortex®-M0+ MCU

TECHNICAL RESOURCES

Full-Featured Automotive Side Mirror – Application brief

PDF | HTML

Optimize Automotive Body Electronics Designs With AEC-Q100 MSPM0 MCUs – Application brief

PDF | HTML

SOFTWARE DEVELOPMENT

MSPM0-SDK – MSPM0 software development kit (SDK)

CCSTUDIO – Code Composer Studio™ integrated development environment (IDE)

MSPM0 SDK

https://www.ti.com/tool/MSPM0-SDK

MSPM0C launchpad

https://www.ti.com/tool/LP-MSPM0C1104

MSPM0L launchpads

https://www.ti.com/tool/LP-MSPM0L1306
https://www.ti.com/tool/LP-MSPM0L2228

MSPM0G launchpad

https://www.ti.com/tool/LP-MSPM0G3507

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