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Analog Mixed Signal and Power Products for Automotive

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Product Line Manager

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- ▶ Freescale means over **50 years** of innovation in semiconductors and over **25 years** in the high-performance analog market
- ▶ Consumers expect everything to be **intelligent and connected**
 - Need high-performance analog circuitry combined with digital smarts and power outputs
- ▶ We have industry-leading, **differentiated** SMARTMOSTM process technology
 - Integrates digital, power and standard analog functions in a single device
- ▶ Highly integrated System on Chip (**SoC**) and System in Package (**SiP**) solutions
- ▶ Today we will cover new products for:
 - Body Electronics
 - Powertrain
 - Safety

▶ After completing this session you will be able to:

- Name the key features and differentiators of our new products in the following families:
 - System Basis Chips
 - Intelligent Distributed Control
 - eXtreme Switch
 - Powertrain Products
 - Safety Products



Agenda

1 System Basis Chips

2 Intelligent Distributed Control

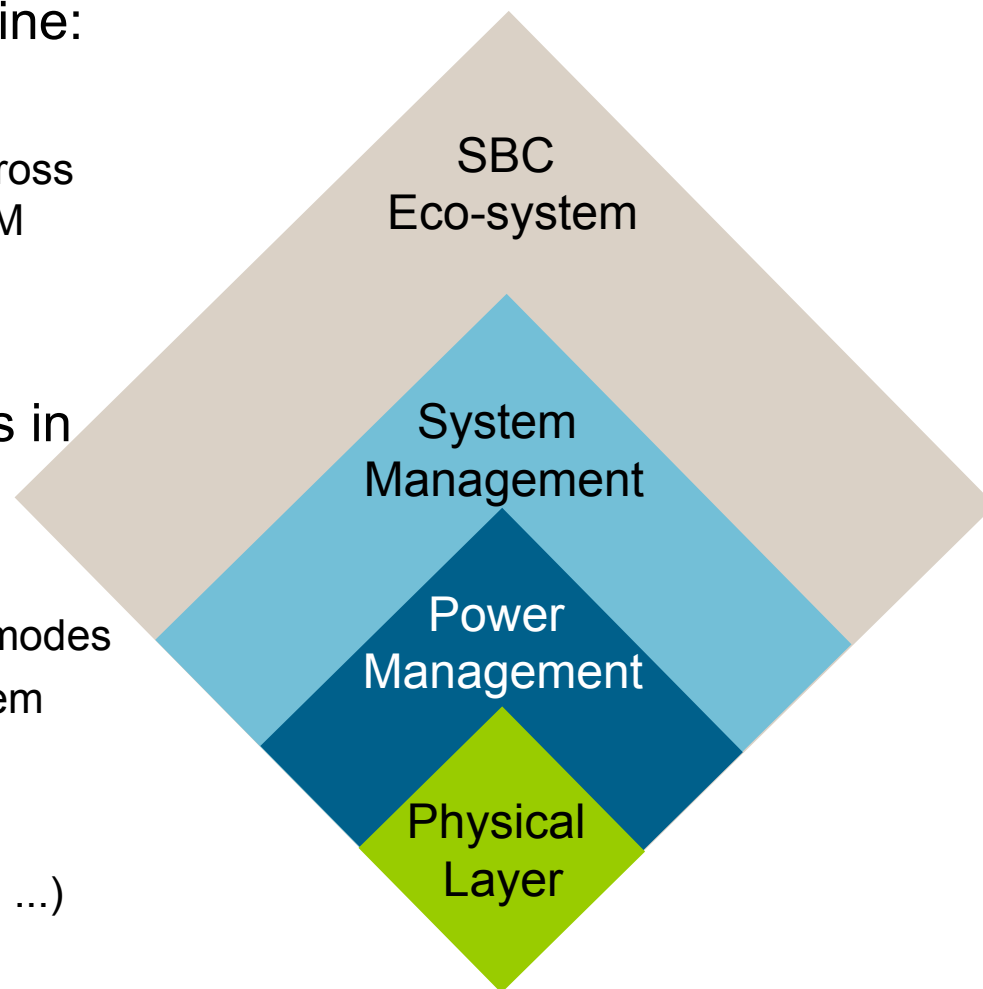
3 eXtreme Switch

4 Powertrain Products

5 Safety Products

What is an SBC?

- ▶ SBCs (System Basis Chips) combine:
- ▶ Physical Layer (**CAN & LIN**)
 - Transmit digital network information across the network in line with automotive OEM standards
- ▶ Power Management (**LDOs**)
- ▶ Supply MCU, CAN and other loads in linear or DC/DC mode
- ▶ System Management
 - **Energy savings** : Manage low power modes
 - **Functional safety** : Participate in system safety strategy
- ▶ Complete **Ecosystem**
 - Simplify customer usage (SPI, thermal, ...)
 - Provide EMC compliance reports



Wide Range of SBC Applications

► High-performance Automotive applications

- Body control modules
- Lighting modules
- Door/seat modules
- Airbag Safety Applications
- Centralized TPMS
- Cooling – Fuel system (electronic control of pump motor)
- Diesel Powertrain (glow plugs)
- Low-end engine management systems



Customer Concerns and Freescale Solutions

- ▶ These devices have been designed to help our customers meet the following challenges while providing the associated benefits:

Customer Concerns	SBC Benefits
Increased electrical content can increase battery discharge in parked mode or increase CO2 emission	Freescale SBCs save energy by minimizing current consumption and optimizing wake up events
Customer platforms can require multiple semiconductors or increase bill of materials	Freescale SBCs offer an ideal scalable (pin-to-pin compatible) power management solution for our MCUs to address multiple applications
Need to improve determinism during failure modes	Freescale SBCs offer flexible safety solutions and documentation to support application safety integrity level (SIL) assessment
A wide range of networked electronic systems mean scar environments need to be less sensitive to external noise and highly robust (less sensitive to power injection)	Freescale SBCs integrate fully certified CAN and LIN according to latest electrical/ESD/EMC market requirements

SBCs: Ideal MCU Companions

	MCU Type	8 bit MCUs	16bit MCUs	32bit MCU	32bit MCUs
	TAM 2014 (M#)	950M#	500M#	580M#	
Market Segment	Freescale MCU Core	S08	S12, S12X	Power Arch (z0,1)	Power Arch (z3,4,5,7)
PowerTrain	Engine Control	S08SG/MP	Fuel pump, Glow Plug, LE EMS	MPC560xM	Parts TBA
	Transmission			MPC563xM	Parts TBA
	Hybrid		S12DG	MPC563xM	Parts TBA
Body	BCM/Gateway	S08SG	LE/ME BCM	MPC560xP (P014)	MPC560xB Gateway
	Windows/Doors/Seat	S08EL / S08SG	S12P, S12XS, HE Door/Seat	MPC560xB	
	Lighting	S08DZ	S12XS, S12XF	MPC560xB	
	HVAC	S08LG	S12XH, S12G	MPC560xB	
	Security	S08EL / S08SG	S12XS		
Safety & Chassis	Braking / VSC	S08SG/SL/EL			
	Suspension	S08SG/SL/EL		MPC560xP	MPC564xL & TBA
	Steering	S08SG/SL/EL		MPC560xP	MPC564xL & TBA
	ICM			MPC560xP	MPC564xL & TBA
	ADAS			MPC560xP	MPC564xL & TBA
	Airbag	S08SG/SL/EL	Seat Belt Pret.		
	TPMS		TPMS receiver		
Driver Infotainment	Dashboard		ME Dashboards	MPC560xS	
	Infotain/Telematics				

 SBC Market

Freescale SBC CAN LIN Gen2 Portfolio & Segmentation

Features	MC 33902	MC 33903	MC 33904	MC 33905S	MC 33905D
Vreg MCU (3.3V/5.0V)		100mA	150mA	150mA	150mA
Vreg MCU w Pwr Sharing			+ 300mA	+ 300mA	+ 300mA
Vreg CAN	✓	✓	✓	✓	✓
Vaux ballast (3.3V/5.0V)			✓	✓	✓
eCAN HS (ISO11898-5)	✓	✓	✓	✓	✓
eLIN				1	2
I/O (config. Input/output)	1 input	1	4	3	2
SPI (16bit)	Pseudo SPI	Std.	Adv W/D	Adv W/D	Adv W/D
Analog MUX			✓	✓	✓
Low Power (Voff/Von µA)	15	15/25	15/25 (+10 osc.)	✓	✓
Fail safe	Std.	new Std.	Adv.	Adv.	Adv.
Package	SO14	SOIC32eP	SOIC32eP	SOIC32eP	SOIC54eP
MCU companion	Autonomous CAN HS node	8 / 16 bit MCUs	S12XE / MPC560xB MPC560xP, MPC563xM	S12XE / MPC560xB MPC560xP, MPC563xM	S12XE / MPC560xB MPC560xP, MPC563xM

A Unique Combination of Differentiators

Areas of Focus

- ▶ Advanced Functional Safety
- ▶ Innovative Energy Management
- ▶ Robust In-vehicle Networking

Development Status

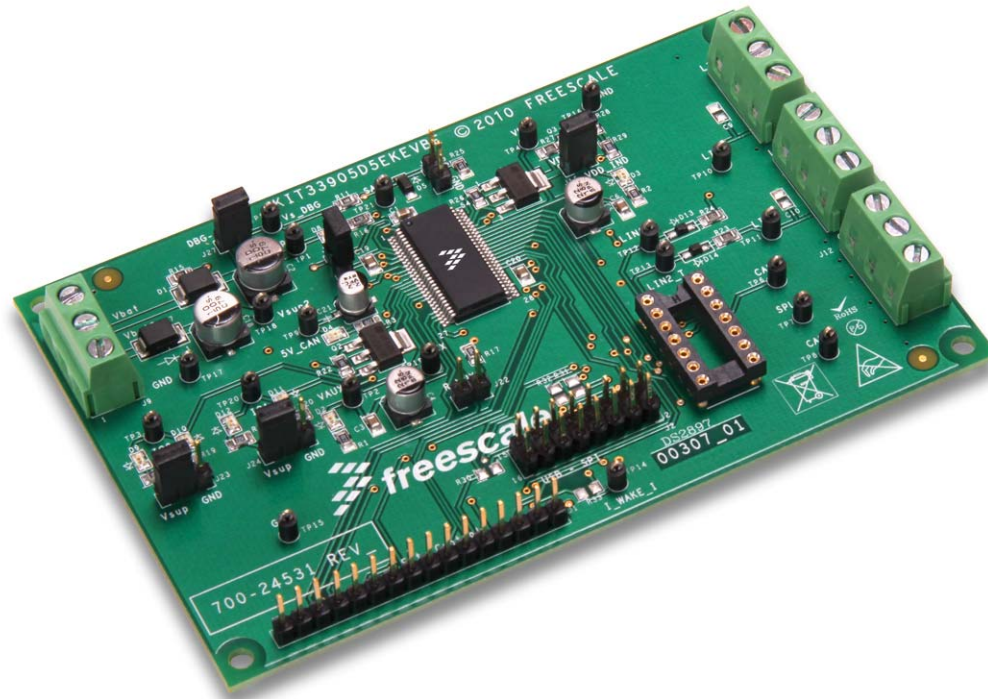
- ▶ Three products covering 16 and 32-bit low end MCUs
- ▶ Auto Qualified products with industry certified transceivers
- ▶ DFMEA and System FMEA
- ▶ Safety applications guide
- ▶ Innovative development tool ecosystem to save design time (simulators, SW interface)

Value Proposition

- ▶ **Advanced Safety Features**
 - Secured SPI (parity checks, EMC dist. Proof ..)
 - Monitoring of critical pins (RST, CSB, ...)
 - SAFE pin to drive external ICs in MCU “fault” mode
 - Secured critical changes of state machine
 - Advanced watchdog mechanisms
 - Monitors critical analog signals (Vbat, Ivdd, T ..)
 - Programmable fail safe default status
- ▶ **Innovative Energy Management**
 - Scalable power supply to reduce thermal constraints, ideal for Freescale’s 32-bit MCU
 - Innovative cranking pulse management
 - Energy savings in low power modes
- ▶ **Robust In-vehicle Network (CAN HS & LIN)**
 - ESD +/- 8kV (150pF/330 Ohm) gun stress test
 - EMC : Low emission / high Immunity in line with market standards
 - Various network diagnostics

SBC Evaluation Board – KITMC33905SEVME

- ▶ Quickly evaluate SBC Gen2 with CAN & LIN performance
- ▶ Comprehensive technical documentation
- ▶ Easy-to-use tools including thermal prediction capability





Agenda

1 System Basis Chips

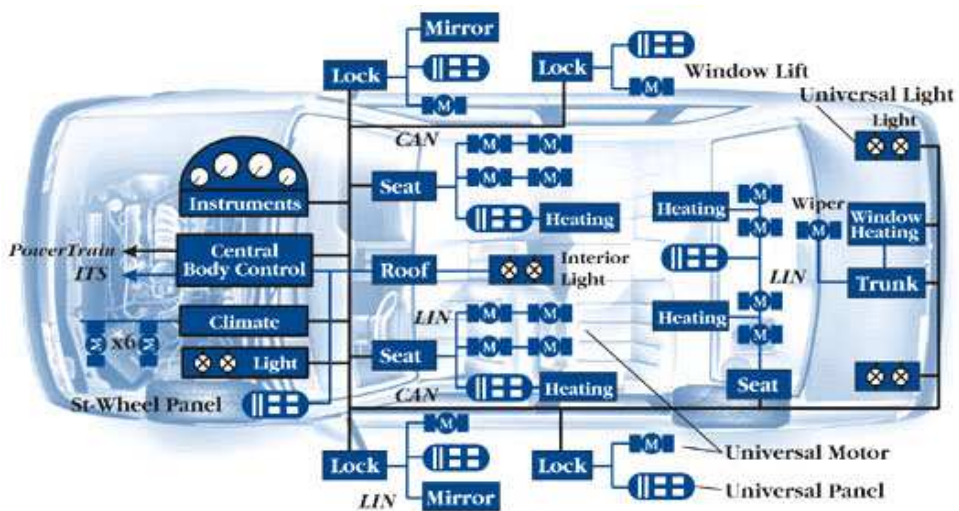
2 Intelligent Distributed Control

3 eXtreme Switch

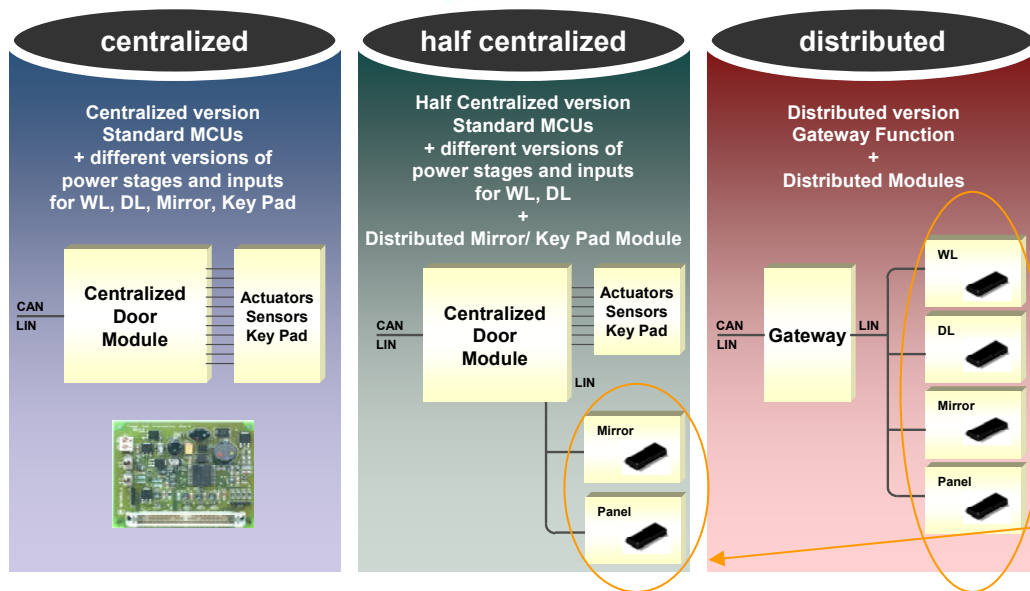
4 Powertrain Products

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IDCs Support the Distributed LIN Systems Approach



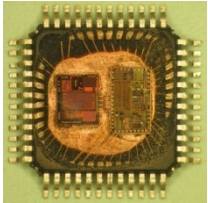
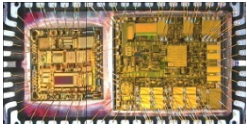
Typical Automotive Body Network



Door Architectures can be Centralized, Half-centralized or Distributed

Typical IDC Applications

IDC – Intelligent Distributed Control

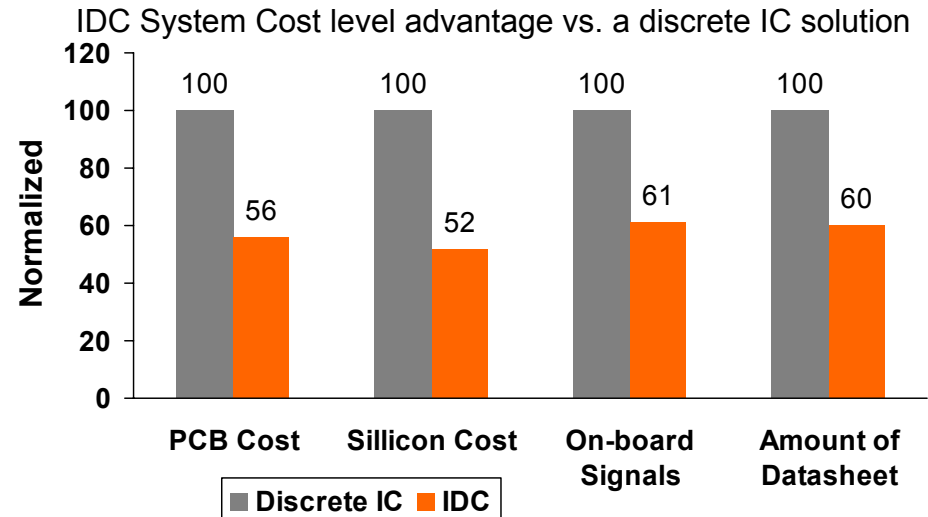
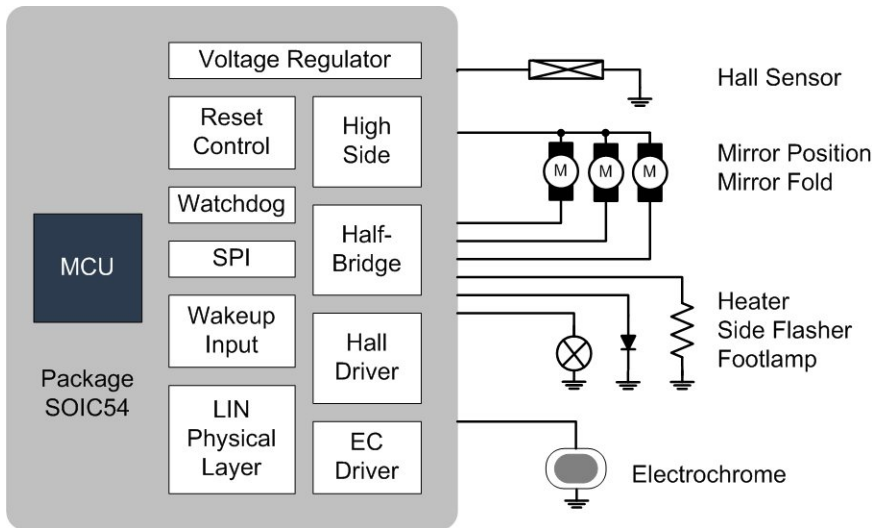


- Single DEVICE solution (2 die in one package, or monolithic solution), allows the **integration** of analog functions with standard microcontrollers each using the appropriate Si process.
- IDCs are a highly integrated products – all are optimized for a specific set of **applications** (e.g. Window Lift, Sunroof, Light Leveling, EC Mirror, Power Seat, Keypad, Steering Wheel, HVAC)
- IDC products are designed for today's **LIN** distributed systems

Customer Benefits

Space / Weight saving
 Fewer external components
 100% MCU-Analog compatibility
 Improved system level reliability
 Reduced development cycles
 Reduced logistic costs

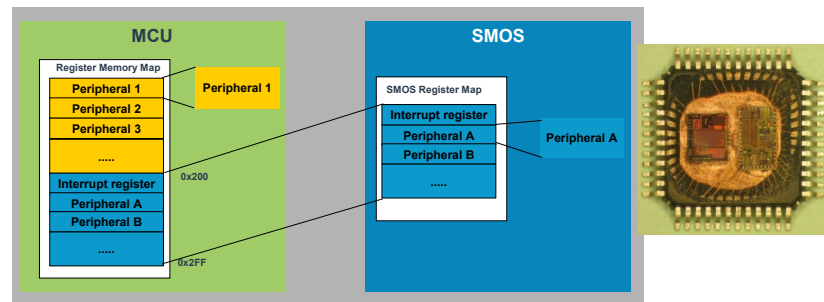
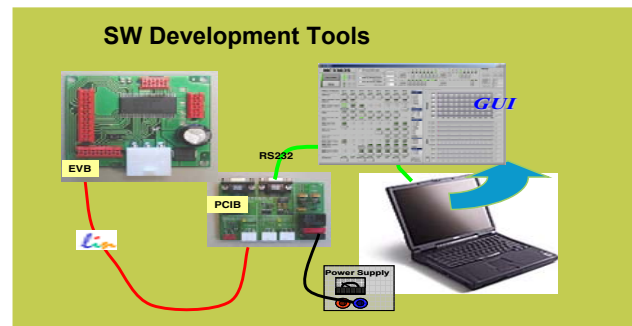
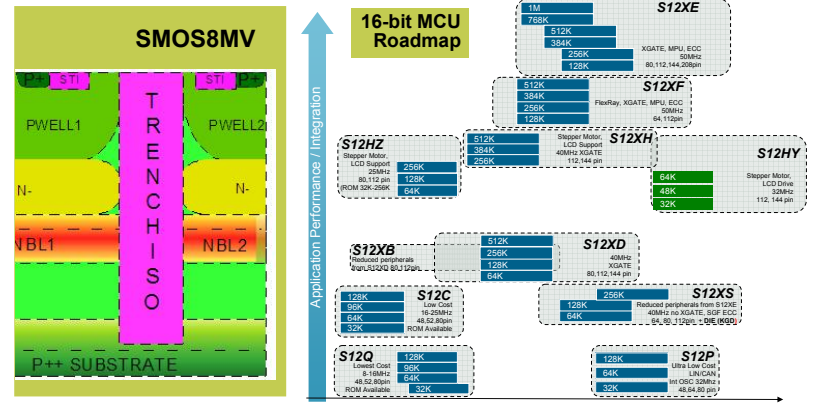
Example: High-end Electro Chromeric mirror application



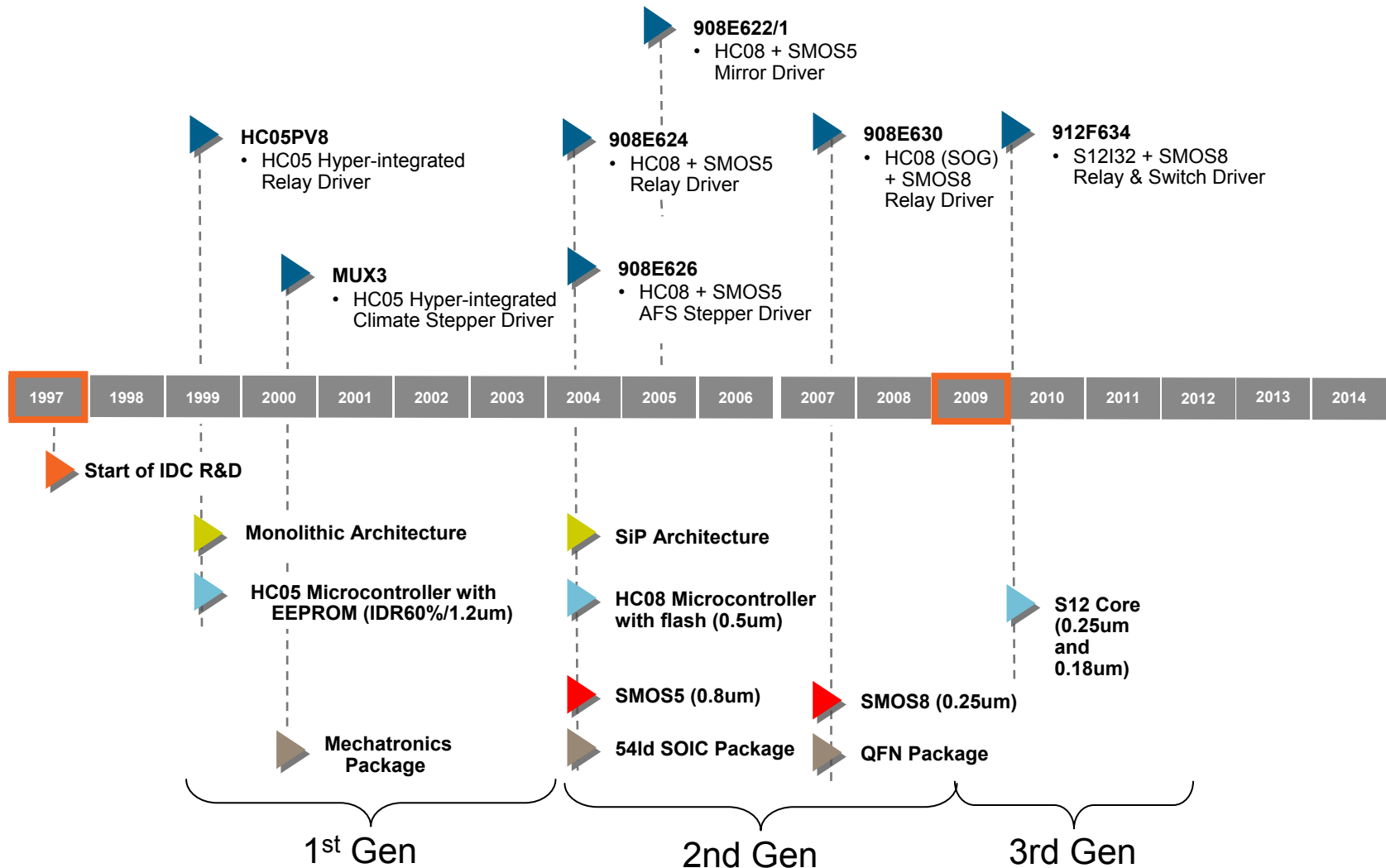
Source: EC mirror application, discrete devices are sampled from various major vendors (anonymous)

Added Values of Freescale's IDC Product Line

- ▶ FSL Automotive MCU market infrastructure
 - Widely used 8-16-bit HW/SW architectures, SW tools availability and a host of trained SW developers
 - Available FSL Controller architectures:
 - Xgate (programmable state-machine): in use today by AMPD
 - S12 (16-bit MCU): in use today within AMPD/IDC products
 - PPC (32-bit) (potentially in the future)
- ▶ FSL's Automotive proven NVM (Flash) technology
 - 0.25um Split Gate Flash (SGF), 0.180um SGF
- ▶ IDC takes advantage of FSL's Automotive qualified SMOS8MV Analog Mixed-Signal technology
- ▶ Transparent Register Access
 - Registers of SMOS die are mapped into MCU memory map and are accessed by MCU like local peripherals
 - Virtually 1 device from a programmer's SW point of view
- ▶ FSL has more than 10 Years of IDC design and production experience



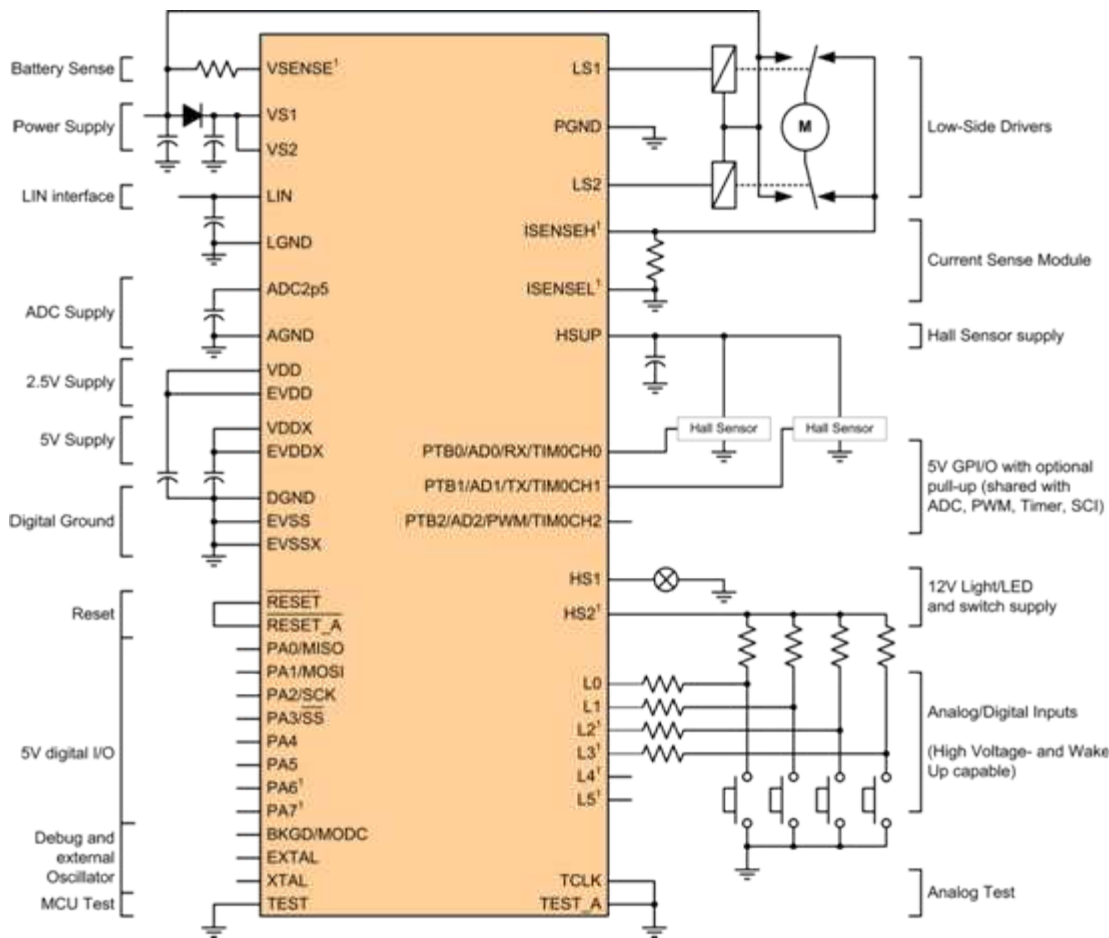
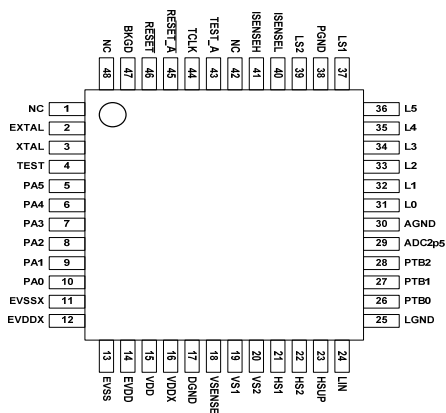
Freescale has 10+ Years of Experience in IDC/ MCU & Analog



MM912F634BV1AE - Intelligent LIN DC Motor Controller

Key Characteristics

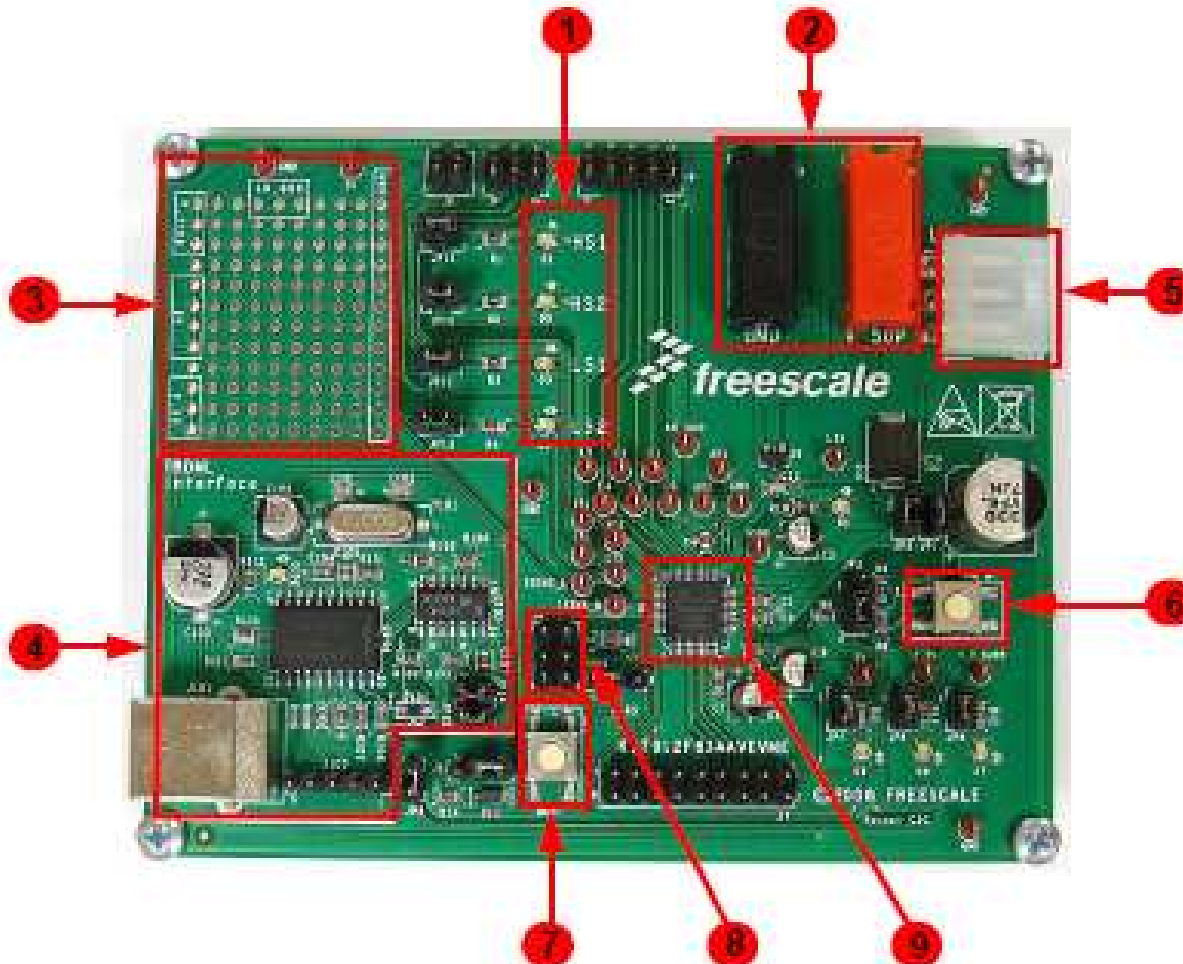
MCU	S12S		
Memory	Flash	Data Flash	RAM
	32k	---	2k
Power Outputs	LSD	HSD	HSUP
	2x	2x	1x
Physical Layer	LIN		
Watchdog	Yes		
Stop Current	35µA		
Sleep Current	15µA		
ESD	±8000V LIN		
Operating Voltage	Nominal	Functional	
	5.5V-18V	5.5V-27V	
Temperature	Ambient	$-40^{\circ}\text{C} < T_A < 105^{\circ}\text{C}$	
	Junction	$-40^{\circ}\text{C} < T_J < 125^{\circ}\text{C}$	
Bus Frequency	20MHz		
Package	48LD LQFP	EP	



Key Features

- High-Performance 16-Bit S12S CPU
- LIN 2.0 Physical Layer Interface
- Low-Side outputs to drive inductive loads (clamp)
- Battery Voltage Sense with Low Voltage warning (interrupt)
- Chip Temperature Sensor
- Current Sense Module
- Hall Sensor supply (18V VREG with clamp)
- High voltage inputs with digital and analog wakeup
- Digital inputs shared with PWM, Timer, ADC, SCI/LIN
- Low voltage (5V) GPIO shared with SPI

MM912F634 – Evaluation Board



1. LEDs for indicating of HS and LS switching
2. Input power connectors
3. Prototype area
4. TBDML interface
5. LIN connector
6. Wake-up button
7. Reset button
8. BDM connector for external programming/debugging BDM interface
9. **MM912F634**



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- 1 System Basis Chips
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- 4 Powertrain Products
- 5 Safety Products

Three Innovations in One Product

► **eXtreme Switch**

- Intelligence - Power - Protection

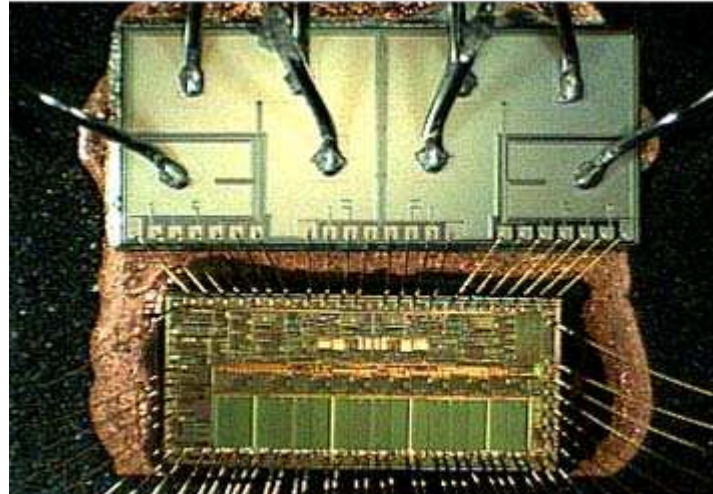
SMARTMOS™

• Protection and Diagnostic

- Over temperature
- Over current
- Over/Under Voltage
- Short circuit
- Reverse battery
- Loss of ground/Vbat
- Energy discharge protection

• SPI Interface

- Easy connection to the uP
- Programmability
- Daisy chain using SPI
- Programmable over current trip level
- Watchdog



Power MOSFETs

- Low $R_{ds(on)}$ MOSFETs
 - 1.7mOhm typ. at 25°C
 - 3.4mOhm typ at 150°C
- Protection in the power stage
 - Temperature sensor
 - Current sensor

PQFN

- Design Flexibility
- AI power wirebonds
 - Low series resistance
- Low cost power package
 - 0.5 mm thick leadframe
 - Solder die attach
 - $R_{thj-c} < 0.5^{\circ}\text{C/W}$
 - Current capability > 200A
- High reliability

eXtreme Switch Product Family

PhD24/03/10									
	Part Number	Number of Outputs and On-Resistance	Nickname	Package	System Voltage	Datasheet	Samples	Mcqual	EVB
Gen III Quad	MC10XS3412C	Dual 10mΩ, Dual 12mΩ	SPQ1012	24-pin PQFN	12V	final	in production	done	yes
	MC10XS3435C	Dual 10mΩ, Dual 35mΩ	SPQ1035	24-pin PQFN	12V	final	in production	done	yes
	MC15XS3400C	Quad 15mΩ	SPQ15	24-pin PQFN	12V	final	in production	done	yes
	MC35XS3400C	Quad 35mΩ	SPQ35	24-pin PQFN	12V	final	in production	done	yes
Gen III Penta	MC10XS3535	Triple 10mΩ, Dual 35mΩ	SPP1035	24-pin PQFN	12V	final	now	May-10	May-10
	MC35XS3500	Penta 35mΩ	SPP35	24-pin PQFN	12V	final	now	May-10	May-10
Gen 3L	TBD	Dual 6mΩ, Dual 17mΩ with LFET	SPQL0617	24-pin PQFN	12V	preliminary	now*	Dec-11	no*
	TBD	Quad 9mΩ with LFET	SPQL09	24-pin PQFN	12V	preliminary	now*	Dec-11	no*
	TBD	Dual 7mΩ with LFET	SPDL07	32-pin SOICEP	12V	preliminary	Jul-10	Dec-11	no
	TBD	Triple 6mΩ, Dual 17mΩ	SPPL0617	24-pin PQFN	12V	preliminary	now*	Dec-11	no*
Gen24V	MC06XS4200	Dual 6mΩ for trucks	SPD6_24	24-pin PQFN	24V	preliminary	Jul-10	Jun-11	Jul-10
	MC10XS4200	Dual 10mΩ for trucks	SPD10_24	24-pin PQFN	24V	final	now	Feb-11	yes
	MC20XS4200	Dual 20mΩ for trucks	SPD20_24	24-pin PQFN	24V	preliminary	Jul-10	Jun-11	Jul-10
Viper	MC33981B	Single 4mΩ, 60KHz	Viper	16-pin PQFN	12V	final	in production	done	yes**
Main switch	MC33982C	Single 2mΩ	SPSS+	16-pin PQFN	12V	final	in production	done	no
	MC33984C	Dual 4mΩ	SPD4+	16-pin PQFN	12V	final	in production	done	yes
	MC33988C	Dual 8mΩ	SPD8+	16-pin PQFN	12V	final	in production	done	yes
								* early proto.	

Vehicle Lighting Market Evolution

Gen 3

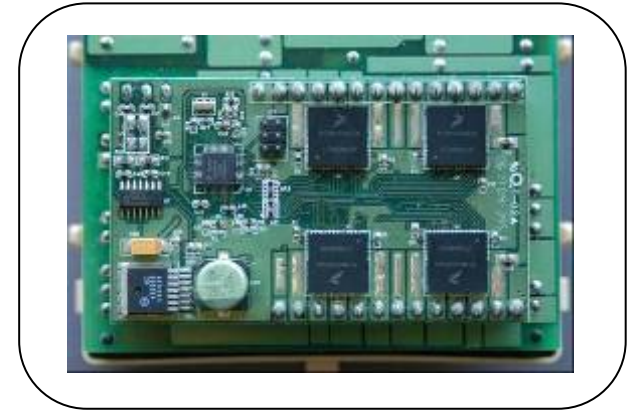
- ▶ **CO₂ regulation** drives innovation and integration (weight, space)
- ▶ Beyond 2010 most OEMs will require over voltage protection to extend bulb operating lifetime (**PWM**)
- ▶ Protection / Reliability / Safety / **Robustness**
- ▶ **Diagnostics** for switch, load and wiring harness faults
- ▶ LED interior and exterior lighting **is** expected to grow dramatically – allows for styling options and higher efficiency. Still needed Xenon, Halogen and LED **compatibility**

Gen 3L

- ▶ Newer bulb technologies are driving **higher inrush** currents.
- ▶ Higher end architectural variations plus separate Vbatt requirements limit Quad and Penta devices for some loads

Gen 4

- ▶ Car OEMS attempt to **standardize** their Body Control Modules to support global volumes while meeting unique OEM requests



Output Channel Name	Total Pd/device [W]
Rear Turn Signal Lamp RH Tail Lamp RH Tail Lamp LH Rear Fog Lamp	1.018
Head Lamp Low RH FRT Fog Lamp LH FRT Turn Signal Lamp RH Reverse Lamp	1.084
FRT Fog Lamp RH Head Lamp High RH Stop Lamp RH FRT Turn Signal Lamp LH	1.052
Head Lamp High LH Head Lamp Low LH Stop Lamp LH Rear Turn Signal Lamp LH	1.219
	4.373 W

eXtreme Switch for Lighting Market: Gen3

Applications

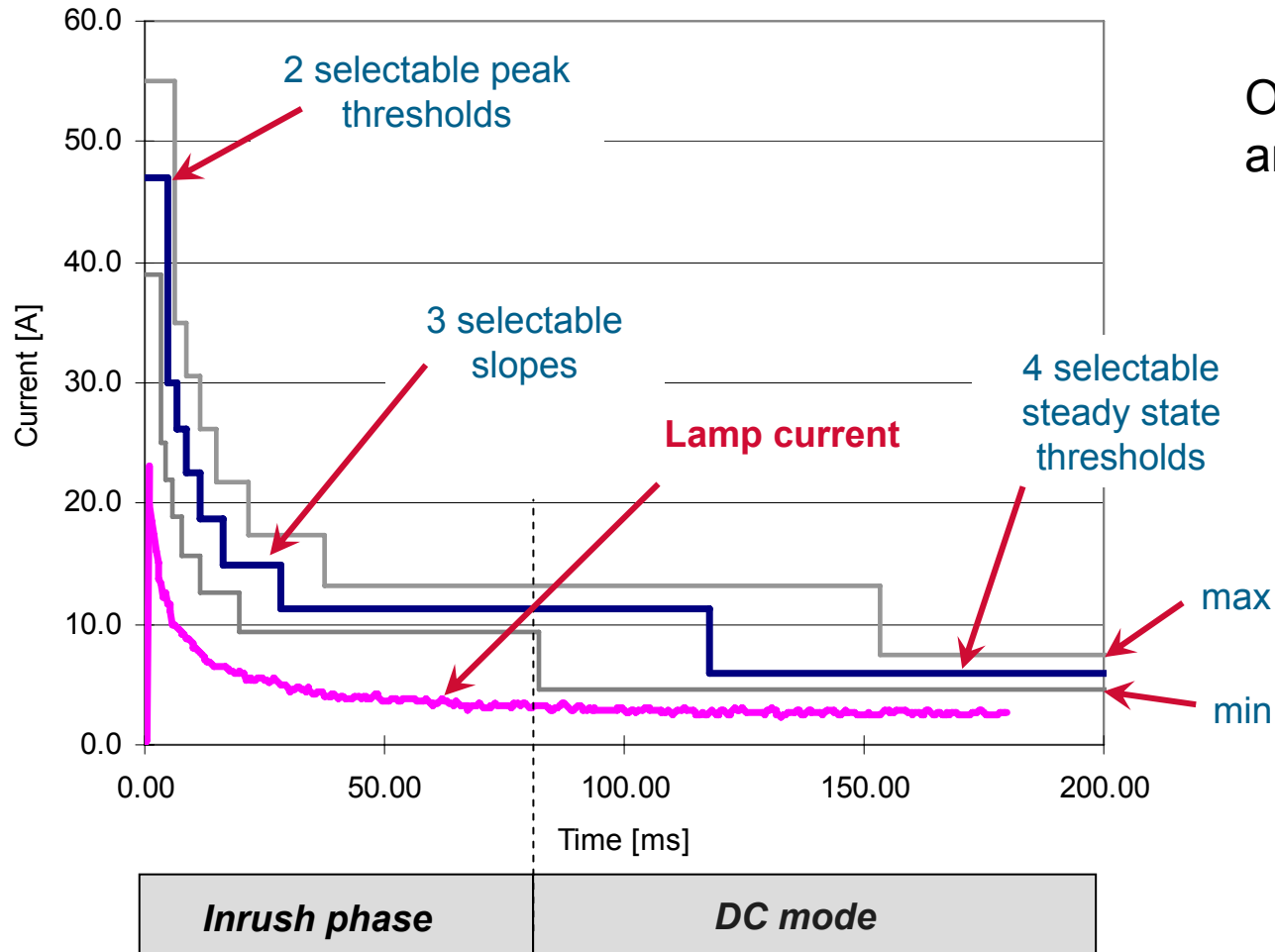
- ▶ Lighting with PWM management
- ▶ 12 V battery systems
- ▶ Halogen, LED and Xenon compatible



Key Features and Benefits

- ▶ **Quad /Penta devices in SM8/HD5**
 - Module integration with extremely low sleep state current.
- ▶ **Multi-step overcurrent strategy with auto restart**
 - Robust and reliable solution
- ▶ **SPI interface for adaptability**
 - Specific configuration for bulbs, HID, LED
- ▶ **Full fault diagnostics for each output stage viaSPI**
 - Full diagnostics, no real time fault mgt needed
- ▶ **Embedded PWM function with optimized slew rates**
 - Easy PWM management, EMC optimized

Programmable Overcurrent Profile Example (MC10XS3412)



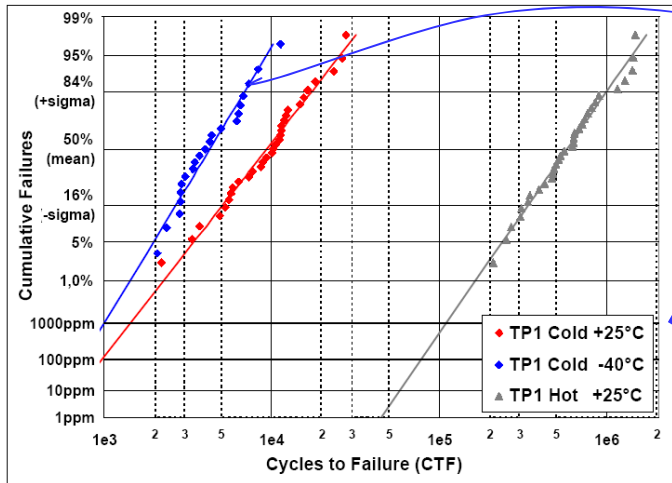
Optimizes fuse and wire sizing

AEC Q100-12 Cold Short Circuit – Results

Grade	# Cycles	Lots/Samples per lot	# Fails
A	>1,000,000	3/10	0
B	>300,000 – 1,000,000	3/10	0
C	>100,000 – 300,000	3/10	0
D	>30,000 – 100,000	3/10	0
E	>10,000 – 30,000	3/10	0
F	>3,000 – 10,000	3/10	0
G	>1,000 – 3,000	3/10	0
H	300 – 1,000	3/10	0
O	< 300	3/10	0

Test Name	Ambient Temp.	Activated Device Protection	Number of Cycles Passed
Load short-circuit	-40° C	Latched overcurrent for 90A at 250 μ sec	1M cycles
Load short-circuit	+85° C	Latched overcurrent for 65A at 250 μ sec	> 1.2M cycles
Over-load	+40° C	Latched overcurrent for 40A at 95msec	> 1M cycles
Terminal short-circuit	+85° C	Latched severe short-circuit for 40A at 100 μ sec	> 1M cycles

Competitors
Overcurrent performance



Freescal
MC15XS3400

Superior Robustness & Reliability



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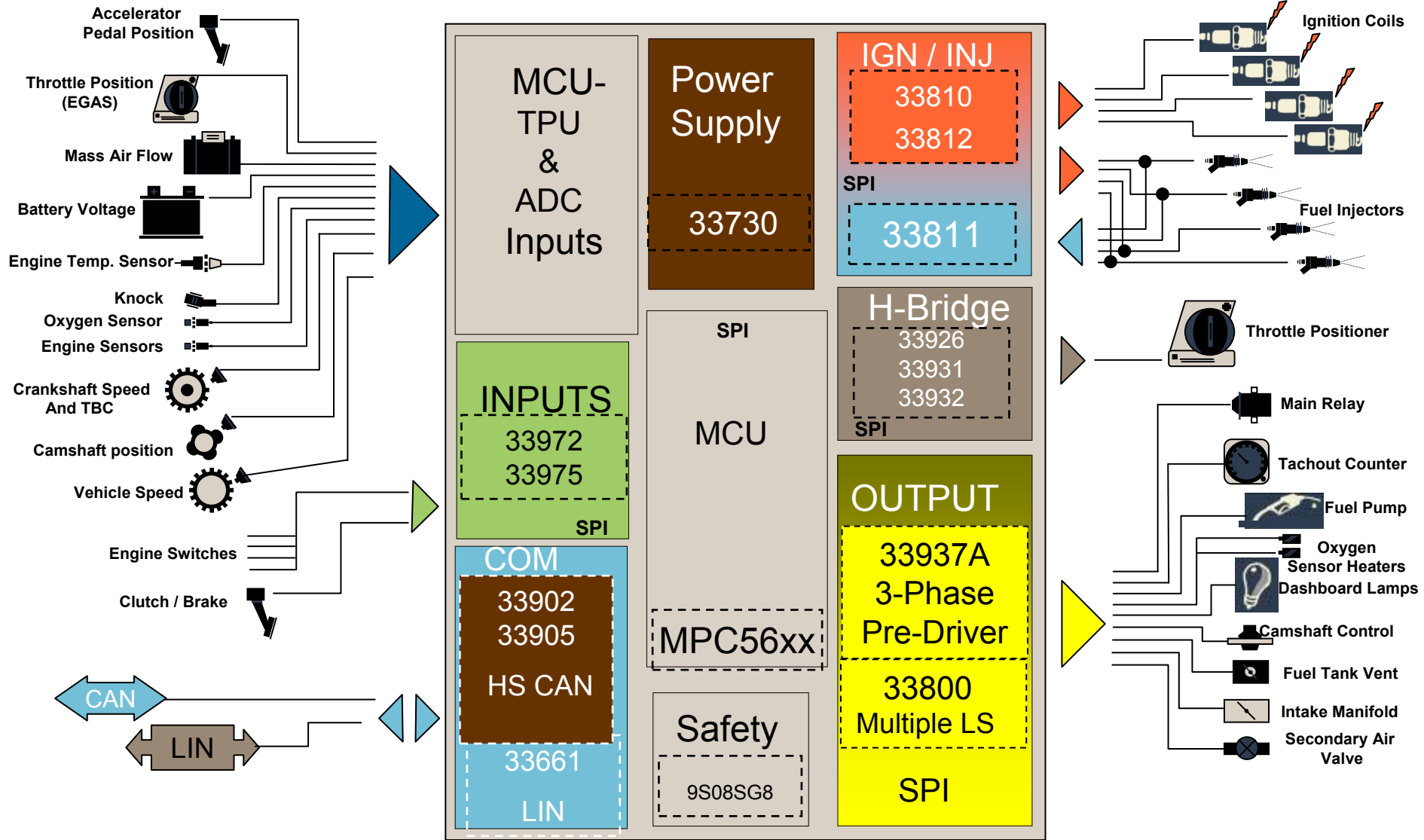
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Powertrain Systems Product Offering



MC33810: Eight Channel Ignition and Injector Driver

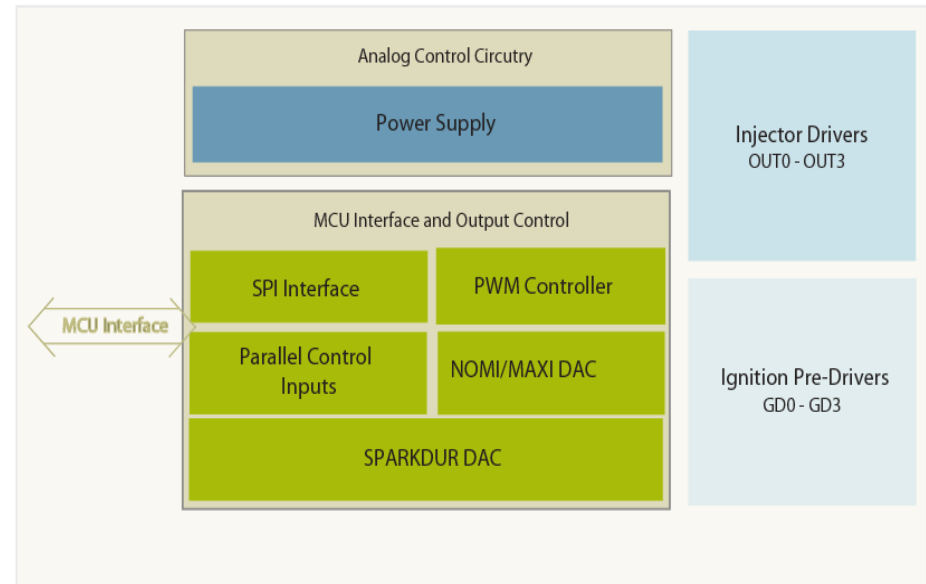
► Features

- 8-channels with 4 low-side drivers & 4 pre-drivers
- Pre-drivers with three different modes:
 - Ignition
 - General purpose gate drive
 - Ten cylinders
- Ignition current & spark detection with programmable thresholds
- MCU SPI and parallel interface
- Power supply/oscillator/band gap reference/POR
- Diagnostic and error detection logic
- Self protection for:
 - Shorts to battery
 - Over current
 - Over temperature
- Low power (30 μ A) “sleep mode”

► Benefits

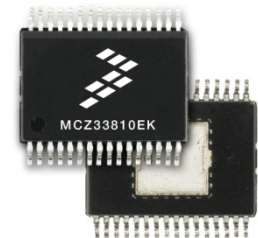
- Highly integrated solution minimizes the need for additional external discrete components
- Reduced parts count
- Reduced manufacturing and test cost
- Improved reliability
- Reduced current consumption lowers battery drain during key off
- Small footprint, reduces printed circuit board area
- Simple MCU parallel interface
- Protected against common failure conditions

MC33810 - Functional Block Diagram



► Applications

- Engine control for:
 - Automobiles
 - Motorcycles
 - Industrial engines
 - Generators
 - Marine systems
 - Recreational vehicles

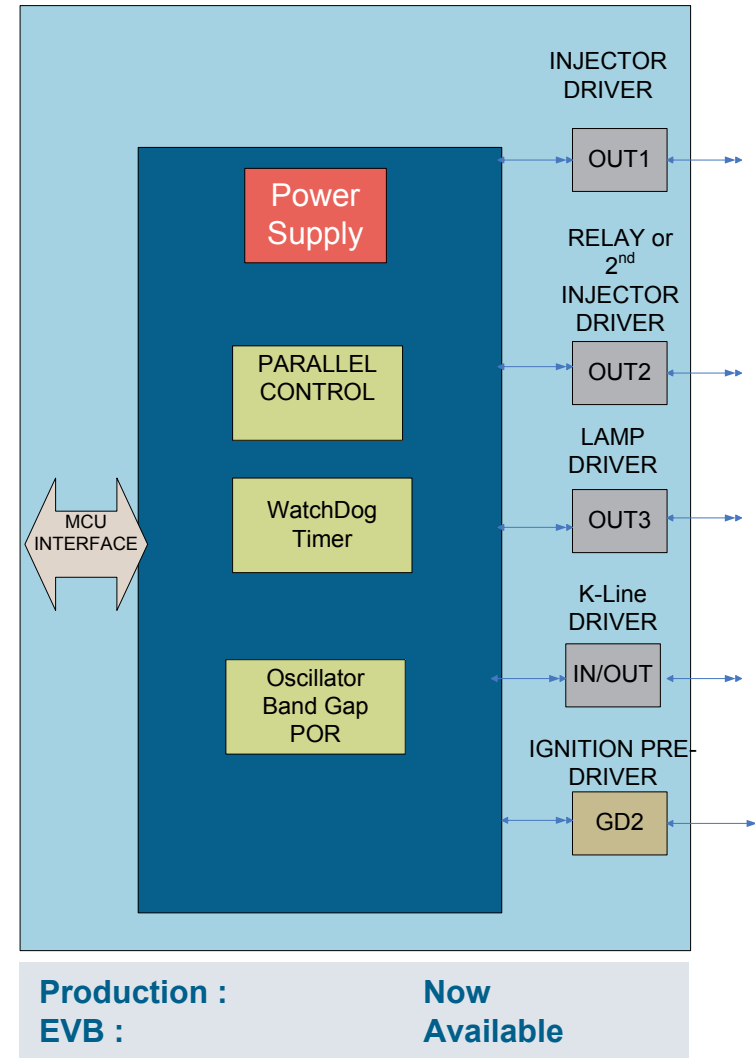


EK (Pb-FREE) SUFFIX
32-PIN SOICW EP

MC33812 Small Engine Control Overview

► Block Diagram

- 1 Injector, low side driver
- 1 Relay or 2nd Injector, low side driver
- 1 Lamp, low side driver
- 1 Ignition, pre-driver
 - Two different modes:
 - IGBT
 - Darlington BJT
- Parallel MCU Interface
- +5 V Regulator with ext. PNP
- Oscillator/Band Gap Reference/POR
- Programmable Watchdog Timer.
 - Can be enabled/disabled
- Diagnostic and error detection logic
 - Self protection for:
 - Shorts to battery
 - Over current
 - Over Temperature

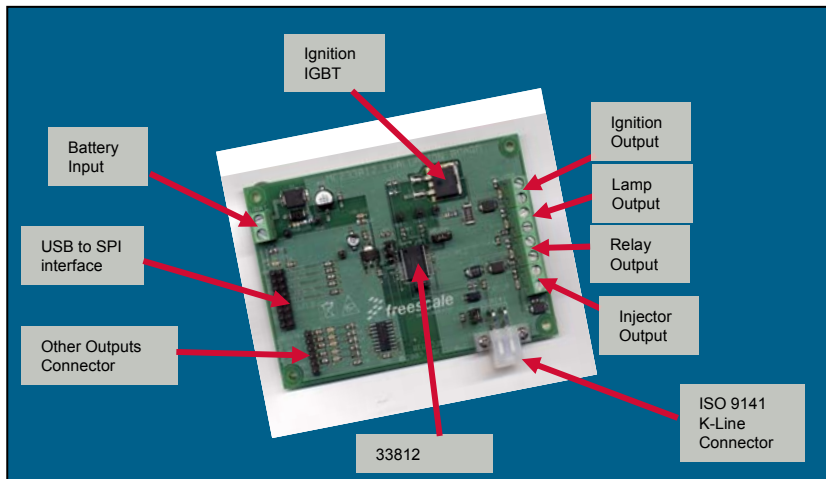
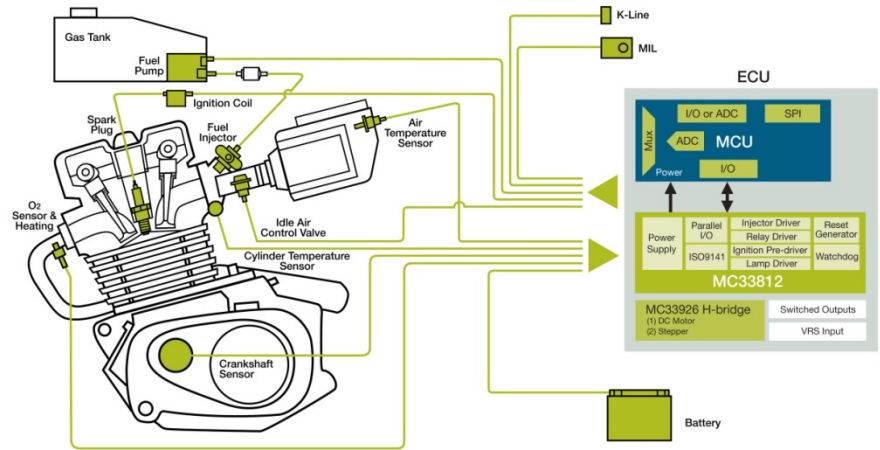


MC33812 Small Engine Control EVB and Reference Design

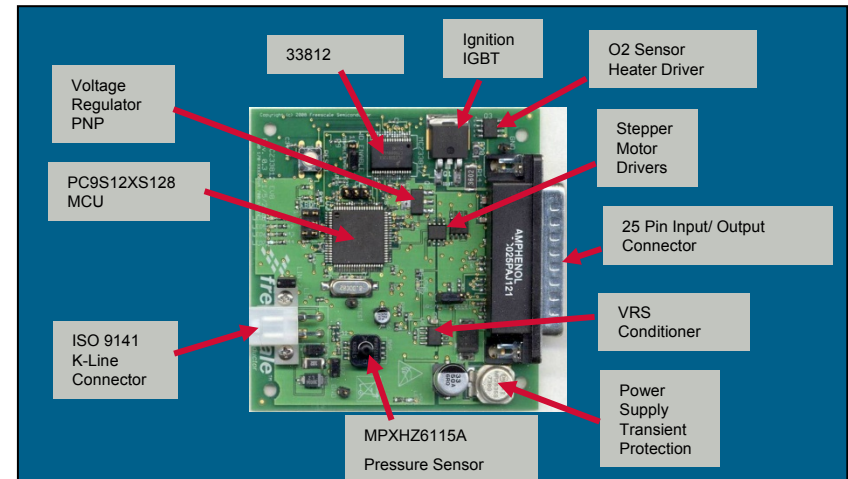
▶ Small Engine Applications:

- Scooters
- Motorcycles
- Snowmobiles
- Hybrid car charging engines
- Generators
- Personal water craft
- Riding mowers

Helps you meet the new small engine emissions mandates



MC33812 EVB



MC33812 Reference Design

MC33899: Programmable H-Bridge Motor Driver

► Features

- H-Bridge configuration for bi-directional motors
- Low RDSON outputs (150 mΩ @ 125°C)
- Current mirror output signal (gain selectable via external resistor)
- Short circuit current limiting
- Thermal shutdown (outputs latched off until reset via SPI)
- Internal charge pump circuit MOSFETs
- SPI selectable slew rate control and current limit
- Detailed fault diagnostics via SPI

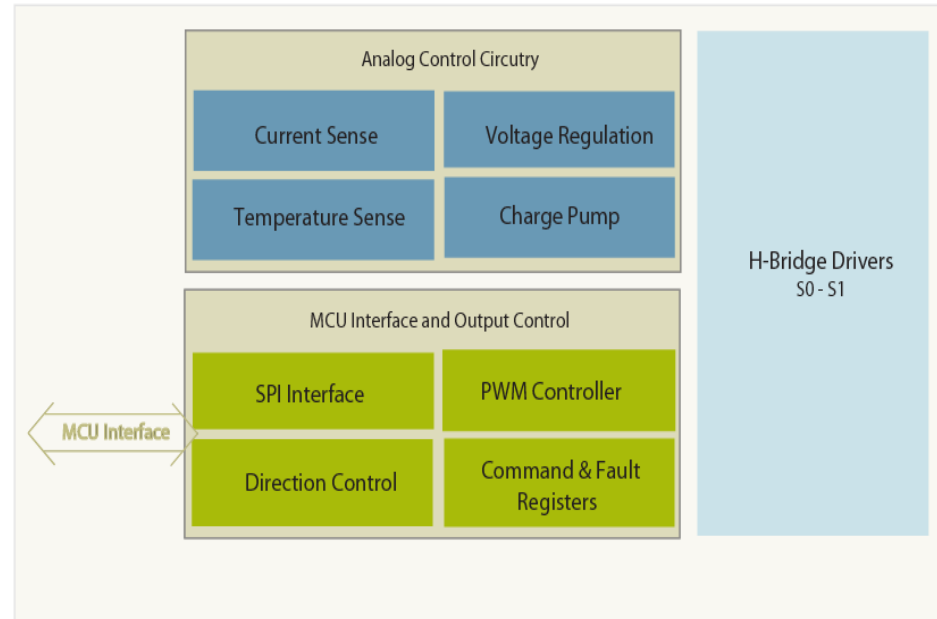
► Benefits

- Configurability and programmability make this DC motor driver very versatile
- Unique fault restart
- Highly integrated solution
- Robust solution for harsh environment
- Improved reliability

► Applications

- Electronic throttle control
- DC motor control
- Industrial motors and actuators

MC33899 - Functional Block Diagram



VW SUFFIX (Pb-FREE)
30-pin HSOP

MC33937A – 3-Phase Pre-driver

► Overview

The 33937 device is a FET pre-driver for controlling three-phase motors with stable digital accuracy. It is easily configured for systems driving brushless DC (BLDC), permanent magnet (PM) or switched reluctance (SR) motors with or without sensors.

► Features

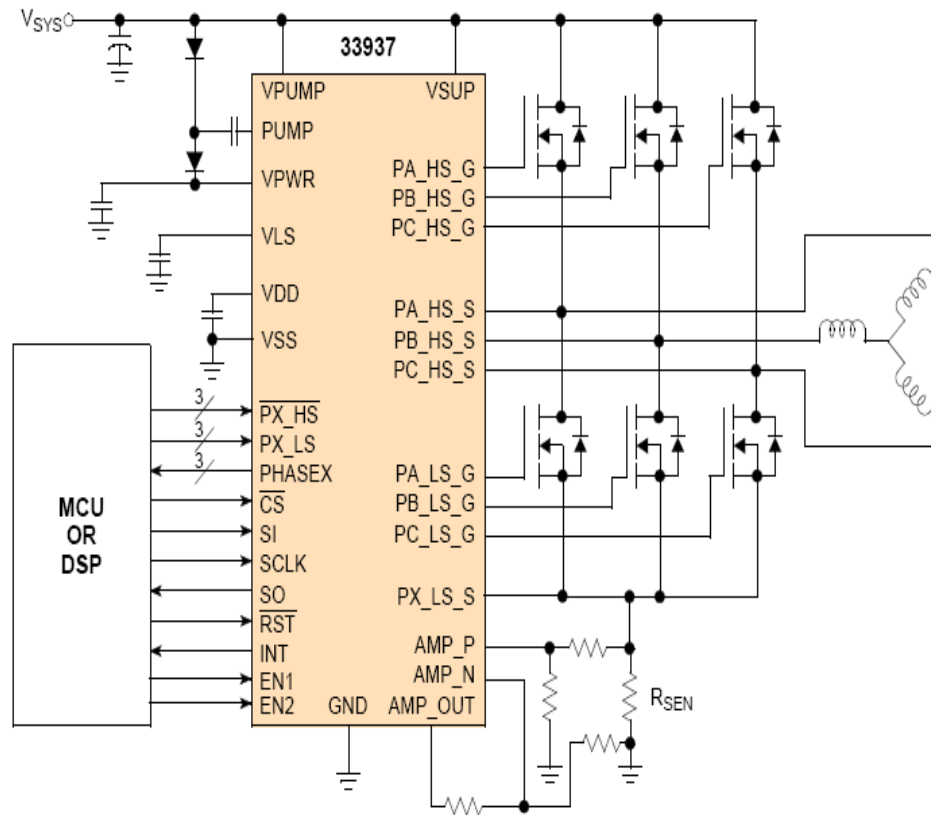
- Extended operating range from 6.0V to 58V
- Protection from reverse charge injection from external FETs
- Charge pump to support full FET drive at low battery voltages
- Programmable dead time via the SPI port
- Simultaneous output capability via safe SPI command

► Benefits

- Precise, complete control of speed, torque and power
- Explicit control of each driver
- Increased diagnostic and fault reporting that protects the driver and load
- Highly integrated solution
- Robust for harsh environments
- Improved reliability

► Applications

- Cooling fan
- Water pump
- Actuator controls
- Fuel pump
- Electro-hydraulic and electric power steering





Agenda

1 System Basis Chips

2 Intelligent Distributed Control

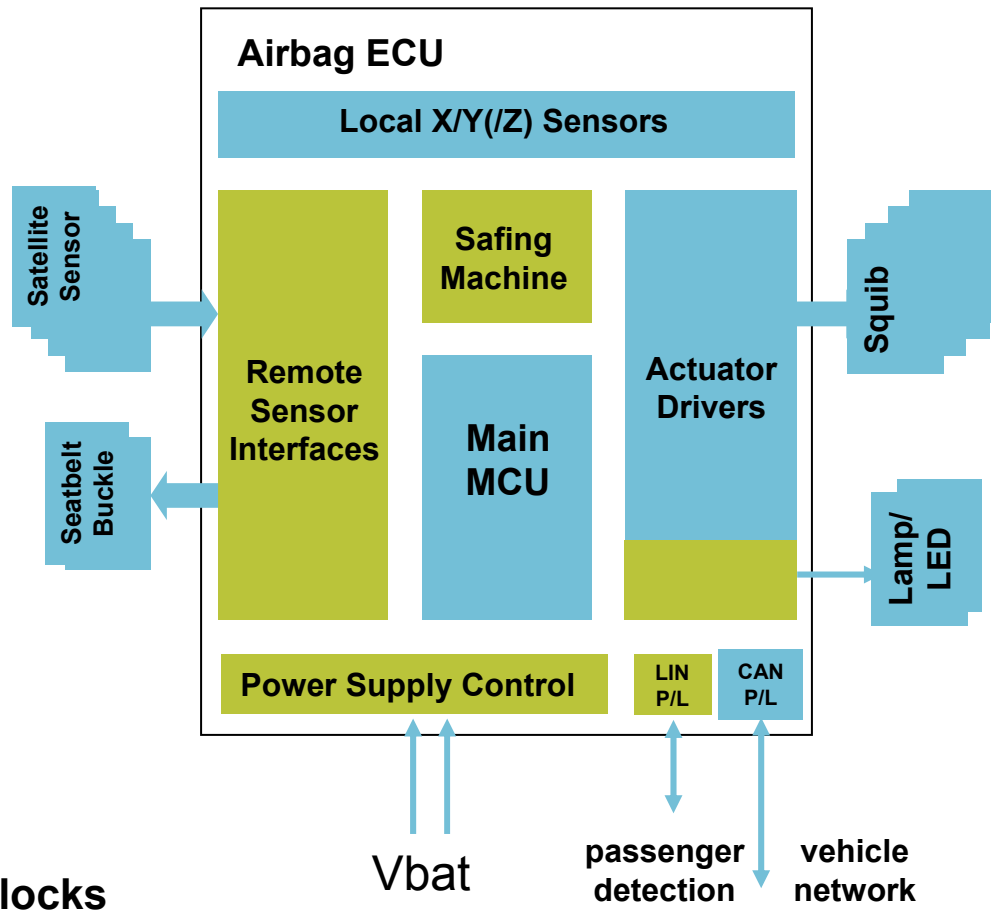
3 eXtreme Switch

4 Powertrain Products

5 Safety Products

Typical Airbag System Block Diagram

- ▶ A Complete Silicon Solution is Available from Freescale



MC33789 Analog Airbag System Basis Chip (SBC)

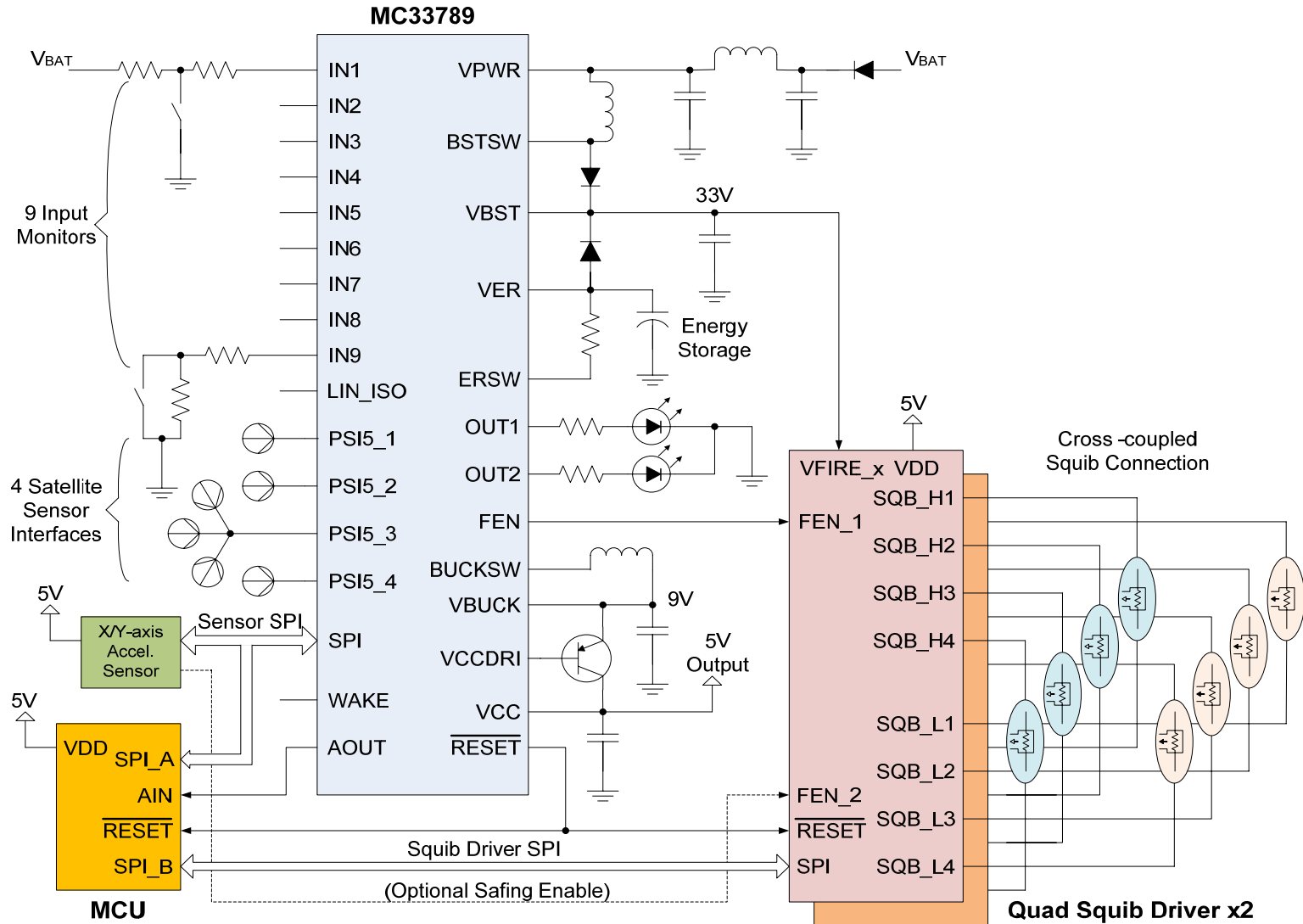
▶ Key Product Features:

- 4 Satellite Interfaces (PSI5 V1.3 compliant)
- Boost Regulator
- Buck Regulator
- Linear Regulator with external Power Bipolar Transistor
- Slave - mode Serial Peripheral Interface
- LIN2.1/ISO9141 interface
- Reset/Power mode control module (Includes Watchdog and Vcc monitoring)
- 9 DC sensor interfaces with programmable voltage scaling
- Analog Diagnostics Interface
- Safing state machine with programmable sensor configuration and thresholds (includes ADC)
- 2 General purpose driver interfaces

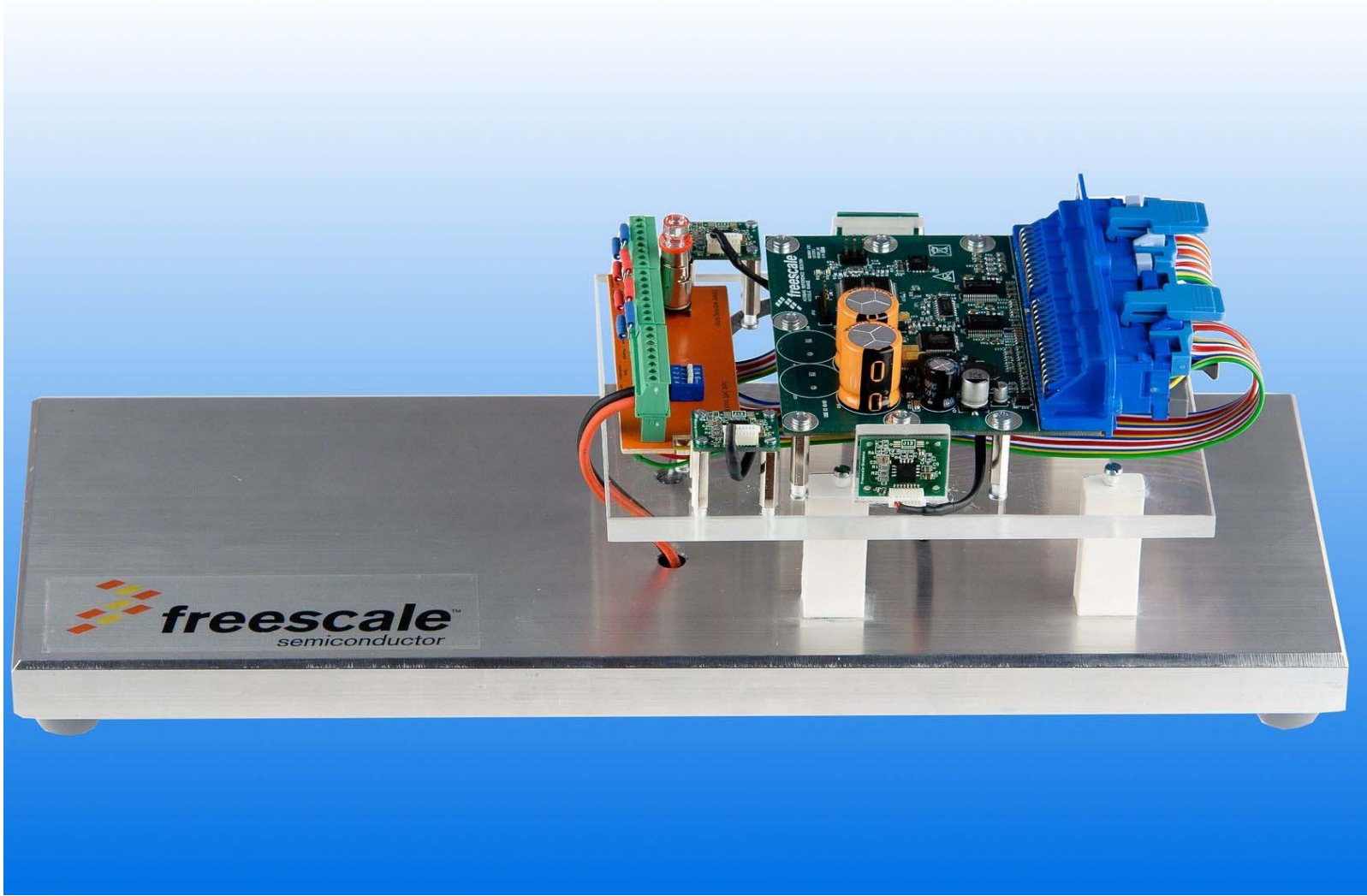
▶ Product Availability:

- **Launching Q2 2010 at the PSI5 Forum along with the SASD Oroya Product Launch**

Simplified MC33789 Application Drawing



Freescale Airbag Reference Demonstrator (ARD)



Distributed Systems Interface Consortium Update



DSI Consortium Home Page

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Welcome to the DSI Consortium Home Page

The **Distributed Systems Interface (DSI)** is a flexible and powerful bus protocol designed to interconnect multiple remote sensor and actuator devices to a central control module. The principal target application for the network is automotive airbag systems.



The **DSI Consortium** is an organization dedicated to the promotion and development of DSI in both automotive and non-automotive applications. The founding members of the Consortium are TRW Automotive, DENSO CORPORATION, and Freescale Semiconductor.

Other interested parties have the opportunity to become members of the Consortium at various levels. Benefits include the chance to influence future development of the specification and participation in various DSI-related activities.

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<http://www.dsiconsortium.org/>

▶ Reduced Cost

- Optimize bus architecture and scale implementation while maintaining existing system cost competitive advantage

▶ Increased Performance

- Increase slave-to-master channel capacity to support high-end safety applications and enable expansion into other applications
- Optimize master-to-slave channel capacity to support emerging functional safety requirements and enable expansion into other applications
- Improve EM Compatibility to meet increasingly stringent customer requirements while maintaining a system cost advantage

▶ Maintain DSI prominence as an Open Standard

- DSI is proven as an open standard with multiple suppliers of components and systems

► Organization:

- Founders : DENSO, Freescale, TRW
- New Member Recruitment: Beginning Jan. 2010

► Specification Status:

- DSI2 Available now for download
-
- DSI3 Founders Draft in Dec.2009
 - DSI3 Members Draft in Q1-Q2 2010
 - DSI3 Approval & Formal Release in Q2 2010

Automotive Analog Mixed Signal and Power Products

► By now, you should be able to:

- Name the key product features and differentiators of our new products in the following families:
- System Basis Chips
- Intelligent Distributed Control
- eXtreme Switch
- Powertrain Products
- Safety Products

