Freescale **Analog Product Overview**: Making Embedded Systems Better with Robust Reliable Performance

EUF-IND-T0662

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J A N . 2 0 1 5

External Use

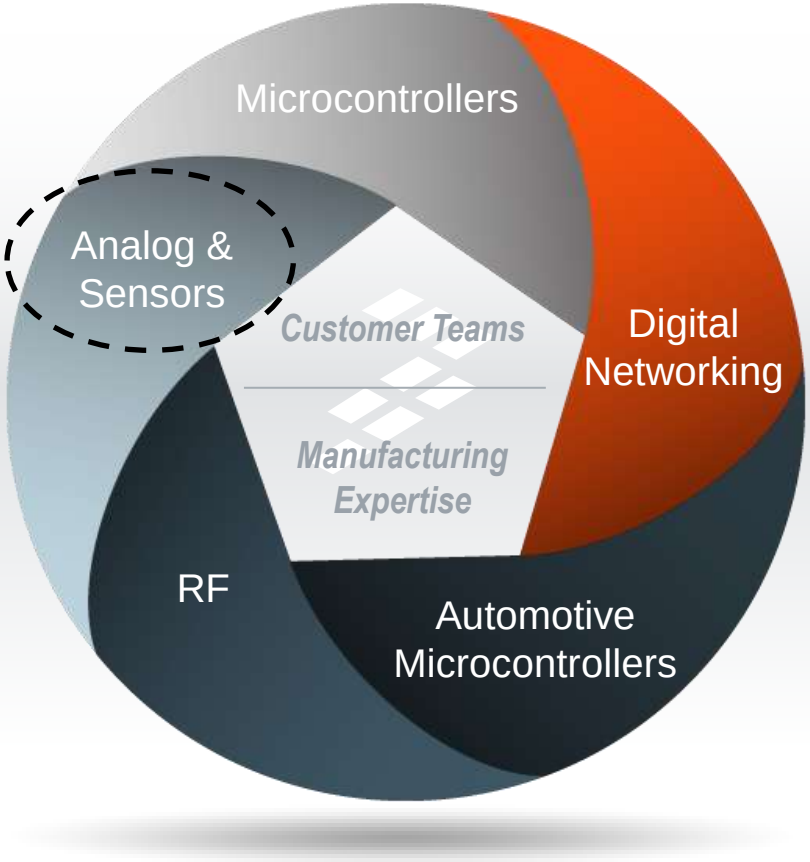
Agenda

- **Introduction**
- **Analog product differentiation, applications & enablement tools**
  - **System Power Management & Interface**
    - PMIC and System Basis Chip solutions
  - **Power Drivers and Switches**
    - High-side and low-side solutions
    - H-bridges and 3-phase pre-driver solutions
  - **Battery Management**
    - Battery cell controller solutions
  - **Analog System Solution**
    - Valves and pump controller

We Are a Global Leader in Embedded Processing Solutions

Automotive

Networking



Industrial

Consumer

Five Core Product Groups

>50 Year Legacy

>6,000 Patent Families*

Four Primary Markets

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* a set of patents taken in various countries to protect a single invention

Analog and Sensors

Making Embedded Systems Real

#2 merchant auto MEMS
#3 inertial + pressure MEMS
#4 merchant auto analog

Complete Embedded
System Solutions + Automation

Preferred MCU partner

Bridges real-world to digital

Value add system integration

Differentiated
Robust, Reliable Performance

Thermal and energy **efficient**

Precision sense and control

Extreme **harsh** environments

Leadership in
Functional Safety

30+ years auto experience

System **monitoring** and failsafe

Revolutionized “Safe” systems

Low Power, Small Size, High Precision

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Analog Portfolio

Bridging Real-World Physics to Connected Digital Intelligence

System Power Management and Interface

- Power Management IC
- System Basis Chip
- Physical Layer Transceiver
- Input Monitoring

LDO – DC/DC
Safety – Monitoring
CAN – LIN – TPL – DSI

Power Drivers and Switches

- Gate Driver
- Power Driver
- eXtreme Switch

Low R_{DSon} – SPI
High Side – Low Side
Diag. & Protection

Battery Management

- Intelligent Battery Sensor
- Battery Cell Controller
- Li-Ion Battery Charger
- Alternator Regulator

System in Package
800V – Balancing
LIN – CAN – TPL

Analog System Solution

- 77 GHz Radar
- Airbag
- Valve Controller
- Programmable Solenoid Controller
- Small Engine Controller

System On Chip
Safety
Diag. & Protection

Growing Analog Leadership in Automotive

Powertrain & Hybrid

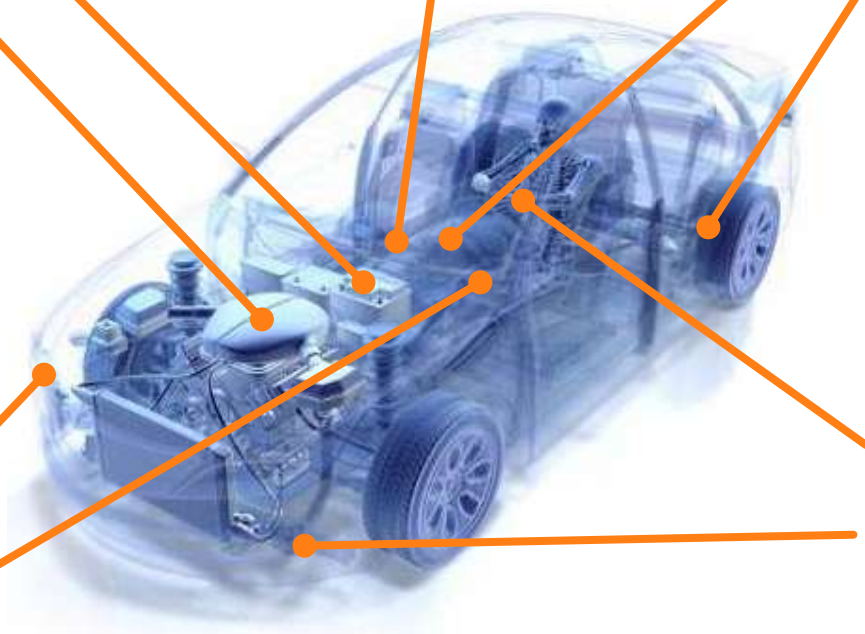
Alternator regulators
Stop/Start MOSFETs
Intelligent battery sensors & cell controller
DFI Solenoid Controller
System Basis Chip
H-Bridge DC & BLDC motor drivers

Driver Infotainment

Power Management IC
CAN Transceiver

Chassis

Braking: ABS, ESC, WSS control
System Basis Chip
BLDC motor pre-drivers
CAN Transceiver



Body Electronics

eXtreme power switches
CAN / LIN transceivers
System Basis Chip
I/O switch detectors
H-Bridge DC motor drivers
BLDC motor pre-drivers
IDC/MagniV relay drivers

Safety

ADAS 77GHz radar transceivers
Airbag SBC & Squib Driver
System basis chip
CAN / DSI transceivers

Expand Analog in Industrial and Multi Market

Wearables & IoT (health & fitness, ePOS, smart watch,…)

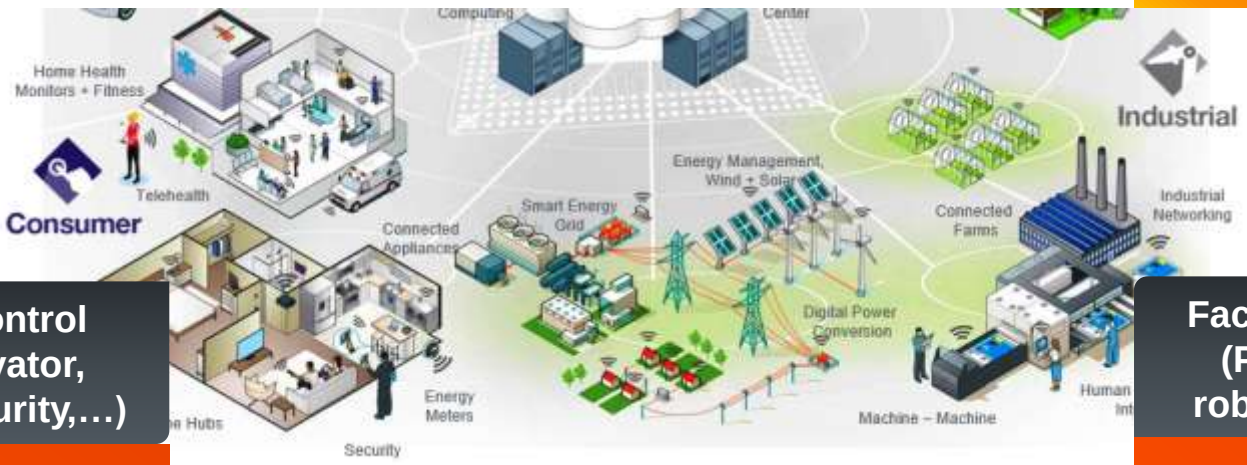
Power Management IC
Battery charger
Audio Codec
Backlight LED driver

Industrial Transportation (heavy machinery, forklift, RV,…)

Small Engine Control IC
Gate & Power driver
Valve System Controler
eXtreme power switches
System Basis Chip
CAN transceiver
H-Bridge DC & BLDC motor drivers
Input Interface IC

Energy Management (energy storage, UPS, converters, eBike,…)

Intelligent battery sensors & cell controller
Gate & Power driver
eXtreme power switches
System Basis Chip
CAN transceiver



Building Control (HVAC, elevator, access & security,…)

Power Management IC
Gate & Power driver
eXtreme power switches
System Basis Chip
CAN transceiver
H-Bridge DC & BLDC motor drivers
Input Interface IC

Factory Automation (PLC I/O, safety, robotics, drives,…)

Power Management IC
Gate & Power driver
eXtreme power switches
System Basis Chip
CAN transceiver
H-Bridge DC & BLDC motor drivers
Input Interface IC

New Strategy for Analog Enablement Tool

Analog Toolbox	Easy MCU attach development with Freedom and Tower systems ***www.freescale.com/analogtools***
Sensor Toolbox	Freedom reference designs - Customizable tools for easy MCU attach development ***www.freescale.com/sensortoolbox***
Freedom Platform	Environment for Kinetis MCU attach evaluation and development ***www.freescale.com/freedom***
Tower System	MCU attach modular development platform for rapid prototyping ***www.freescale.com/tower***
Technical Collateral	• Application notes, datasheets and user guides • Hardware, software and functional safety reference manuals ***compass.freescale.net/go/ciaproject***
Ongoing Developments	• **MCU attach reference designs for target applications** • **Processor Expert library elements for key products** • **Drivers and target application example code**

System Power Management and Interface Key Products

System Power Management and Interface

Power Management IC

System Basis Chip

Physical Layer Transceiver

Input Monitoring

LDO – DC/DC
Safety – Monitoring
CAN – LIN – TPL – DSI

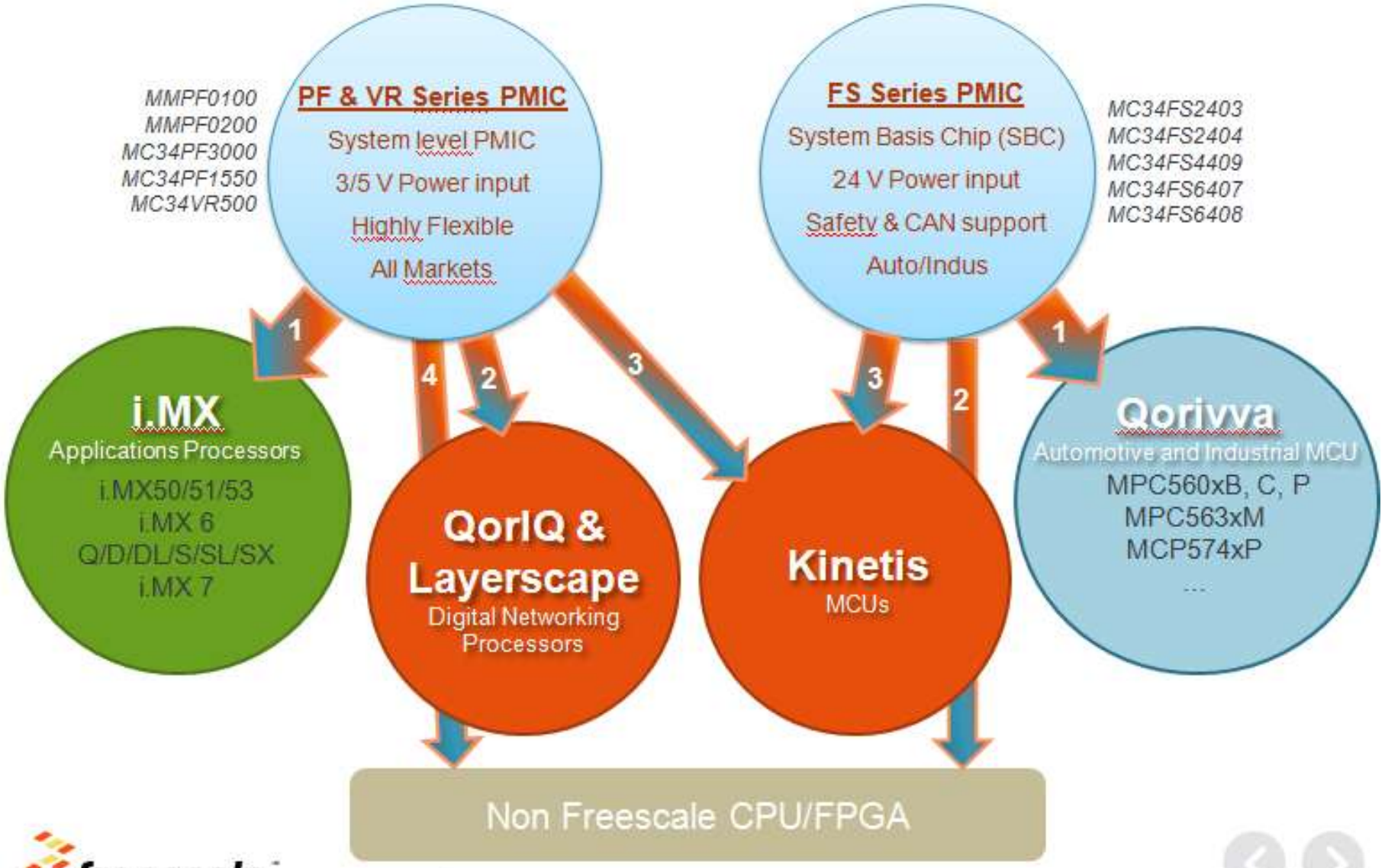
Power Management IC	Automotive	Industrial / Consumer
I.MX 6, 7 & FPGA	MMPF0100xxAZ MMPF0200xxAZ - -	MMPF0100xxAN MMPF0200xxAN MC32PF3000 MC34PF3000
QorIQ and LayerScape	-	MC34VR500

System Basis Chip	Automotive	Industrial / Consumer
LDO Based architecture	MC33910/11/ 12 MC33903/4/5	- MC34903/4/5
DC/DC Based architecture	MC33907 MC33908 MC33909	MC34FS6407 MC34FS6408 MC34FS4409

Physical Layer Transceiver	Automotive	Industrial / Consumer
CAN	MC33897 MC33901 MC33CM0902	- MC34901 MC34CM0902
LIN	MC33662/3	-
TPL	MC33664	-
DSI	MC33781/4 MC33AS0528	- -
ISOLINK	MC33660	-

Input Monitoring	Automotive	Industrial / Consumer
Switch Interface	MC33972/5/8	MC34972/5/8

Freescale PMICs & Processors mapping



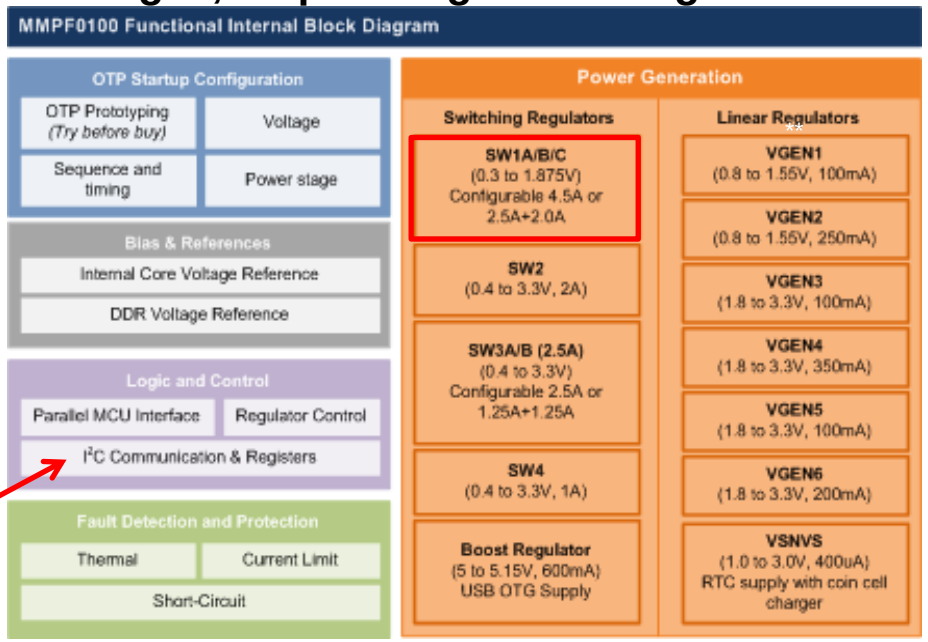
Power Management Devices for i.MX & QorIQ Layerscape Processors

MMPF0100/0200 Quick-turn Programmable System PMIC

Most economical quick-turn programmable 14-ch/11.7 A system power management solution with fully configurable voltages, sequencing and timings

Differentiating Points

- Optimized to work with **i.MX 6** processors
- Quick-turn **customizable** output voltages, sequencing and timings
- **Boost** regulator to 5.0 V out for USB
- Field programmable **OTP** memory
- Power control logic with processor interface and event detection



I²C bus

Product Features

- **2.8 V to 4.5 V** input voltage
- **14-ch,11.7 A** (PF0100); **12-ch, 7.5 A** (PF0200)
- 4 to 6 Channel configurable **buck** converters
- 6 user programmable **LDO**
- Forced PWM or automatic operation
- **Boost** regulator, **coin cell charger**, DDR reference
- Programmable output voltage, current limit, soft-start, frequency switching, OTP fault interrupt
- High power **8x8 mm** 56-lead E-QFN or WF-QFN

Applications

- Performance tablets, eReaders, Navigation
- Industrial Single Board Computers
- Point of Sale (POS) terminals
- Automotive infotainment
- Human-machine interface, Home Automation
- Portable Medical

PF0200 is lower featured version of the PF0100. SW1C and SW4 regulators are removed in MMPF0200 and SW2's current rating is reduced to 1.5 A

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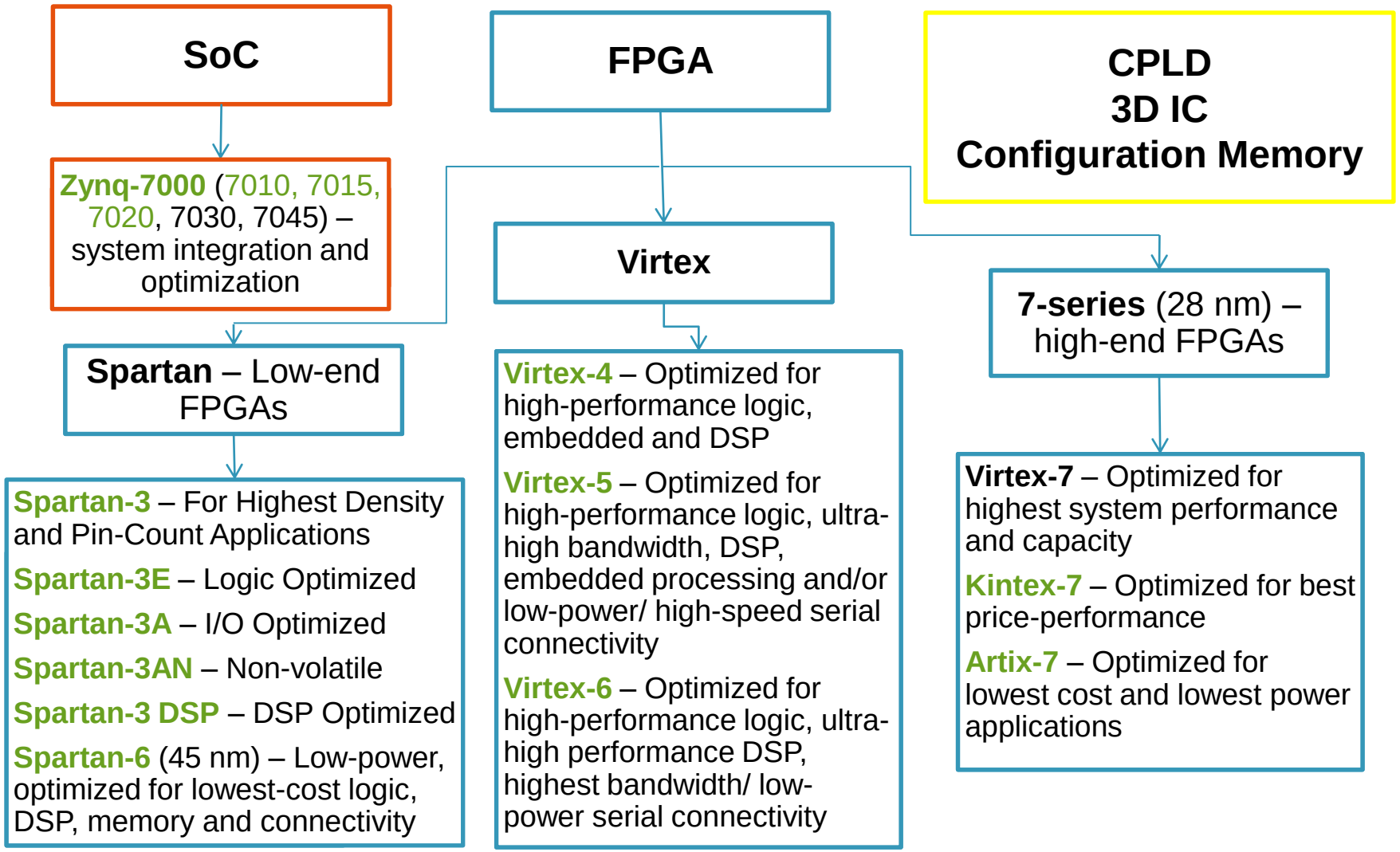
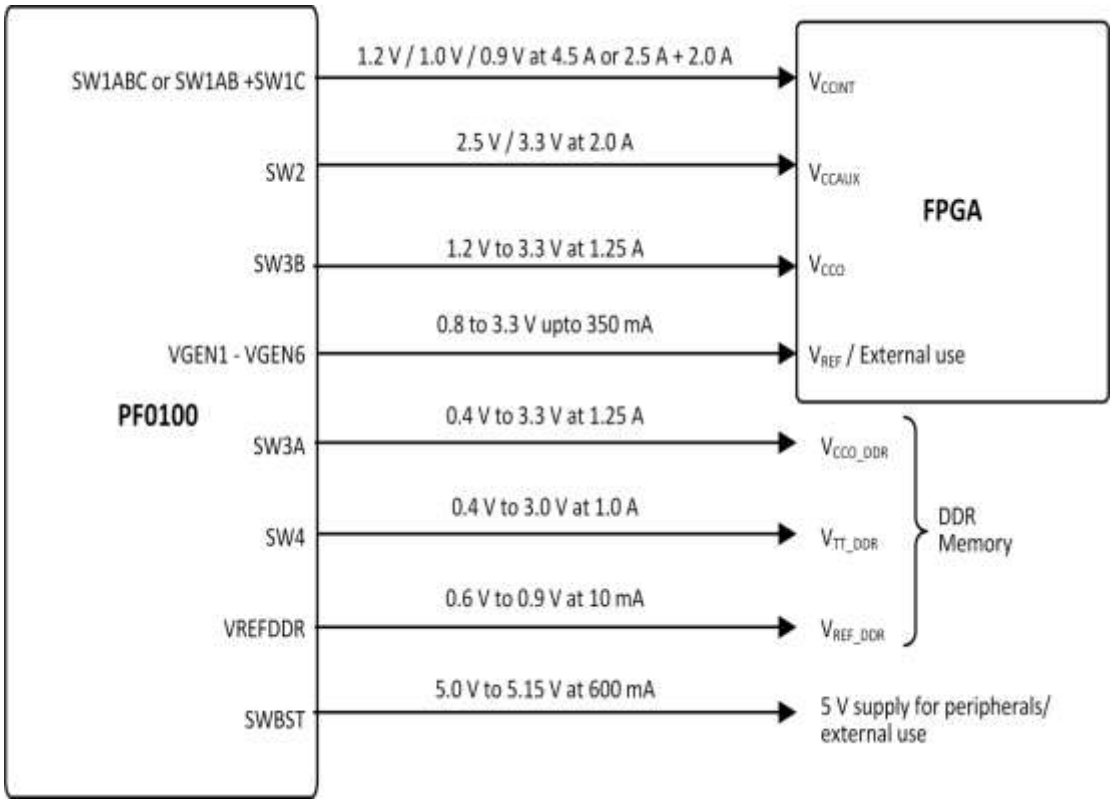
Xilinx Products Mapping With PMIC



Compatible supply from MMPF0100

PF0100 Supplying a FPGA System – Application Example

- Multiple PF0100s may be used simultaneously in systems where it is deemed necessary or appropriate.
- The PF0200, sister IC to the PF0100, may also be operated in conjunction with a PF0100/ individually, when the demand for the number of rails/ output capacity is not high.

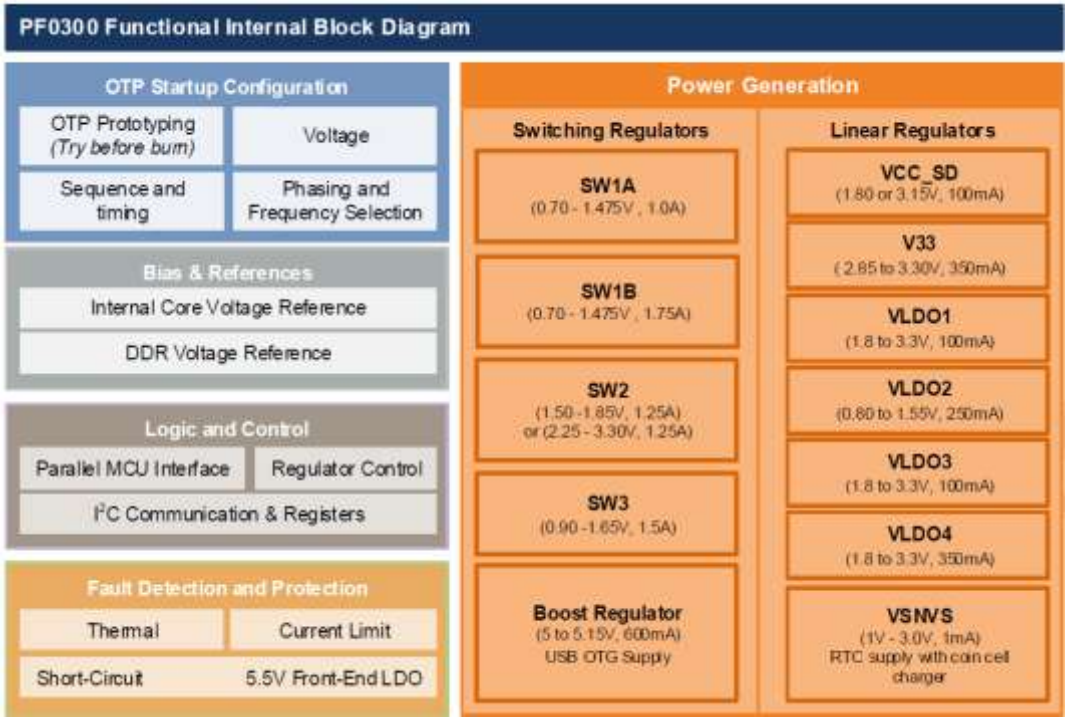


See AN4991

MMPF3000 : 12 Channel Configurable PMIC

Differentiating Points

- Compatibility **with i.MX 6DL, S, SL, SX, UL & i.MX7 S, D** processors, BSP in development
- **Boost regulator** to 5.0 V out for USB
- **OTP** memory to configure the start sequencing (**less programmability than the PF0100/200**), ideal balance between configurability and complexity
- **Custom** pre-programmed output voltages, sequencing, and timing available
- Power control logic with processor interface and event detection



Product Features

- **Vin up to 5.5 V Supply** (optional Front-End LDO)
- **4** Channel configurable **buck** converters
- **6 user programmable LDOs**
- Boost regulator, **Coin cell charger**, DDR reference
- Programmable output voltage, current limit, soft-start, Fsw, OTP fault interrupt
- High power **7x7 mm,** 48 E-QFN
- **Smaller die** for smaller package and cost optimization

Samples availability: Jan 2015 & SOP June 2015

Typical Applications

- Tablets, eReaders, Smartbooks, Navigation
- IPTV, IP Phone
- Automotive infotainment
- Human-machine interface, Home Automation
- Portable Medical

MC34VR500: Power Solution for Network Processor Systems

High Efficiency, Quad Buck regulator with up to 4.5A output

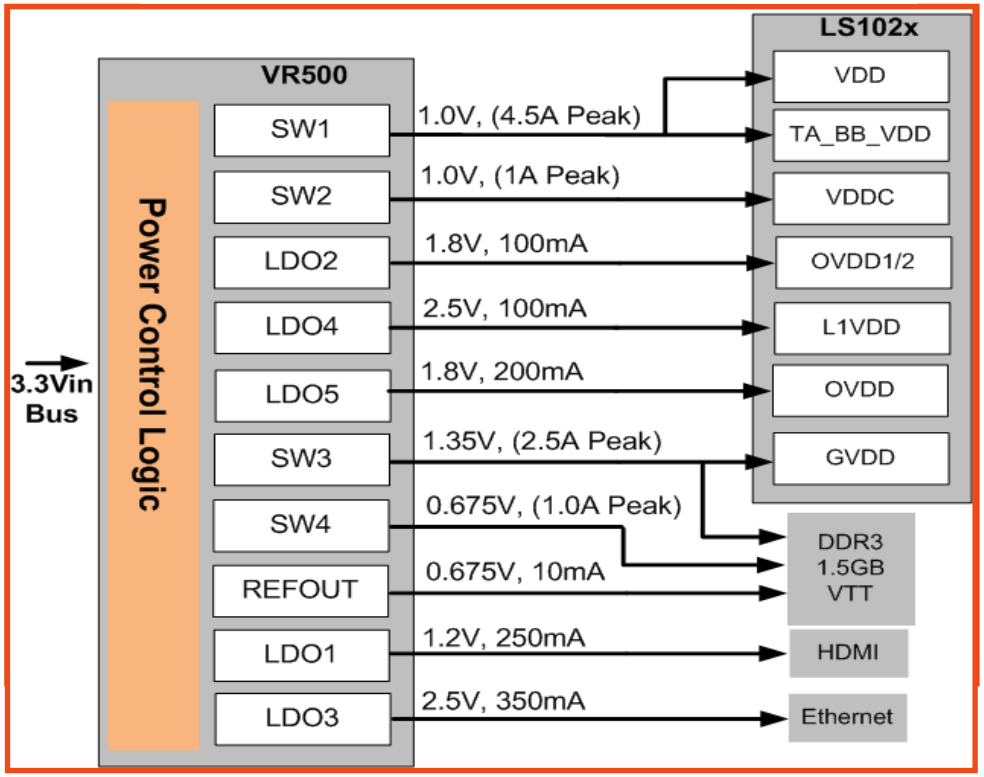
Differentiating Points

- **Optimized to work with LS102x network processor systems**
- **High** (3% better vs comp) full load **efficiency** with **92%** peak
- **Pre-programmed** output voltages, sequencing, and timing available
- **Dynamic** regulator **control** via **I2C**
  - Voltage, Current Limit, Frequency, Low power Mode
- Power control logic with processor interface and event detection

Product Features

- **Vin 2.8 V to 4.5 V** Supply
- **4 independent buck converters**
- **5 user programmable LDOs**
- Forced PWM/PFM or APS operation
- **DDR** memory reference voltage LDO
- High power **8x8 mm** QFN **Wettable Flank** package

VR500 Powers IoT Gateway



Typical Applications

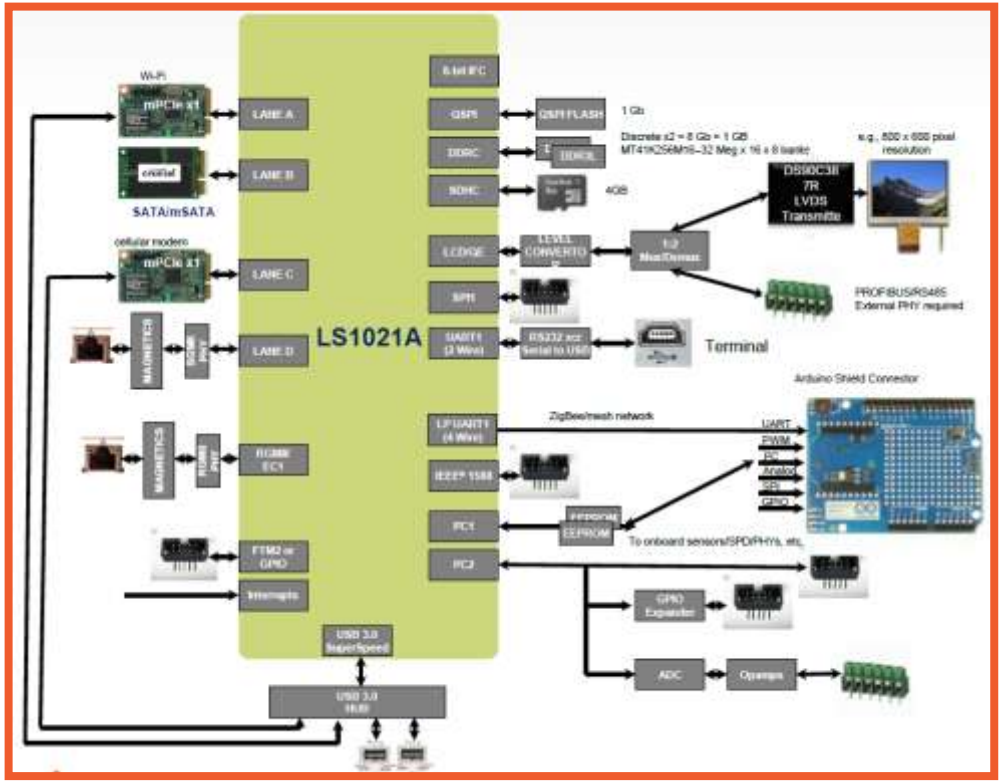
- IoT Gateway
- Mobile Wireless Router
- MFP Printer
- Network Attached Storage
- Automatic Teller Machine

VR500 Line up for Networking Processors

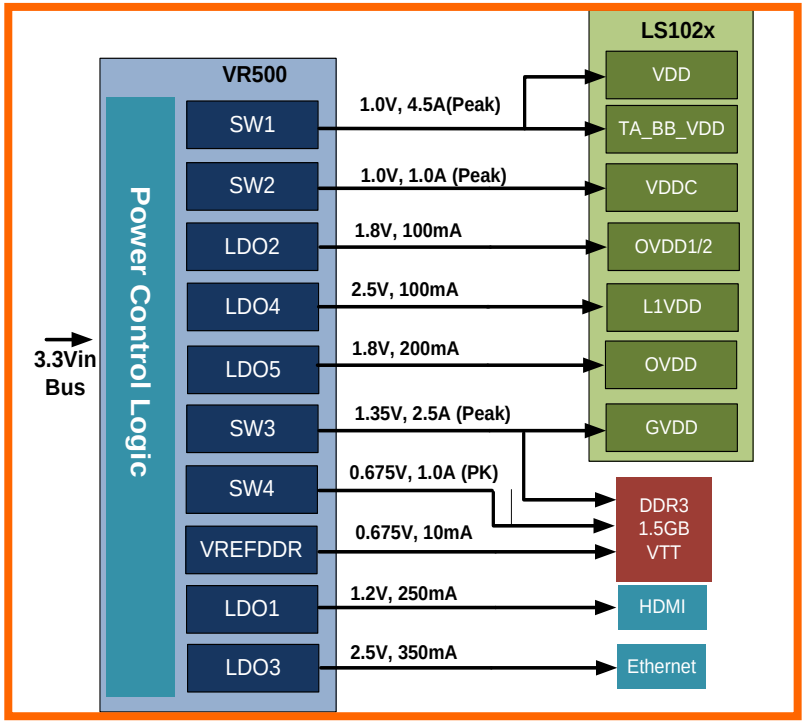
MC34VR500VxES							
Processor Attach	**LS1020A**	**LS1021A** TWR-LS1021A LS1021A IOTGWY	**LS1022A**	**LS1024A** IoT GTW - Avnet TWN	**LS1043A / LS1023A** LS1043RDB	**T1023 / T1013** T1023RDB	**T1024 / T1014**
Registers/Part Numbers	**MC34VR500V1ES/V2**	**MC34VR500V1ES/V2**	**MC34VR500V1ES/V2**	**MC34VR500V3ES**	**MC34VR500V4ES**	**MC34VR500V4ES**	From the power number we can power this processor
Default I2C address	0x08	0x08	0x08	0x08	0x08	0x08	
LDO2_VOLT	1.8 V	1.8 V	1.8 V	1.8 V	2.5 V	2.5 V	
LDO2_SEQ	1	1	1	5	2	2	
LDO3_VOLT	2.5 V	2.5 V	2.5 V	3.3 V	2.5 V	2.5 V	
LDO3_SEQ	1	1	1	5	2	2	
LDO4_VOLT	2.5 V	2.5 V	2.5 V	3.3 V	1.8 V	1.8 V	
LDO4_SEQ	1	1	1	5	3	3	
LDO5_VOLT	1.8 V	1.8 V	1.8 V	2.5 V	3.3 V	3.3 V	
LDO5_SEQ	1	1	1	4	3	3	
SW1_VOLT	1.0 V	1.0 V	1.0 V	1.2 V	1.5 V	1.5 V	
SW1_SEQ	2	2	2	2	2	2	
SW2_VOLT	1.0 V	1.0 V	1.0 V	1.5 V	1.8 V	1.8 V	
SW2_SEQ	2	2	2	3	1	1	
SW3_VOLT	1.35 V	1.35 V	1.35 V	1.1 V	1.2 V	1.2 V	
SW3_SEQ	3	3	3	1	12	12	
SW4_VOLT	VTT / 1.8V for V2	VTT / 1.8V for V2	VTT / 1.8V for V2	1.1 V	VTT	VTT	
SW4_SEQ	3 / 4 for V2	3 / 4 for V2	3 / 4 for V2	1	12	12	
REFOUT_SEQ	3	3	3	3	12	12	
LDO1_VOLT	1.2 V	1.2 V	1.2 V	-	1.35 V	1.35 V	
LDO1_SEQ	4	4	4	-	1	1	
PU CONFIG, SEQ_CLK_SPEED	1 ms	1 ms	1 ms	1 ms	1 ms	1 ms	
PU CONFIG, SWDVS_CLK	6.25 mV/us	6.25 mV/us	6.25 mV/us	6.25 mV/µs	6.25 mV/µs	6.25 mV/µs	
SW1 CONFIG	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	
SW2 CONFIG	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	
SW3 CONFIG	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	
SW4 CONFIG	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	2.0 MHz	

MC34VR500 IoT Gateway Power Solution

IoT Gateway - LS1021A Power Proposal



VR500 Power Solution



MC34VR500 EcoSystem

Fast Evaluation of VR500 performance

- Generic Family Evaluation Platform kit
- **EVB of VR500**
  - Friendly Graphical Interface
  - USB interface

IoT Gateway Reference Board

LS1021 TWR (In Works)
T1023RDB (In Works)
LS1043RDB (In Works)

Ecosystem partners –

- TechNexion
- SysTech
- Analogue and Micro
- E14

Complete technical documentation to assist design

- Datasheet, EVB user guide
- Schematic and Layout application notes

Graphical Interface

Evaluation Board

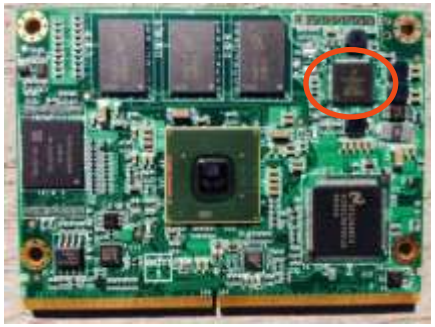
LS1021A IoT Gateway

LS1021A TWR

MC34VR500 Powers LS1021A Devices

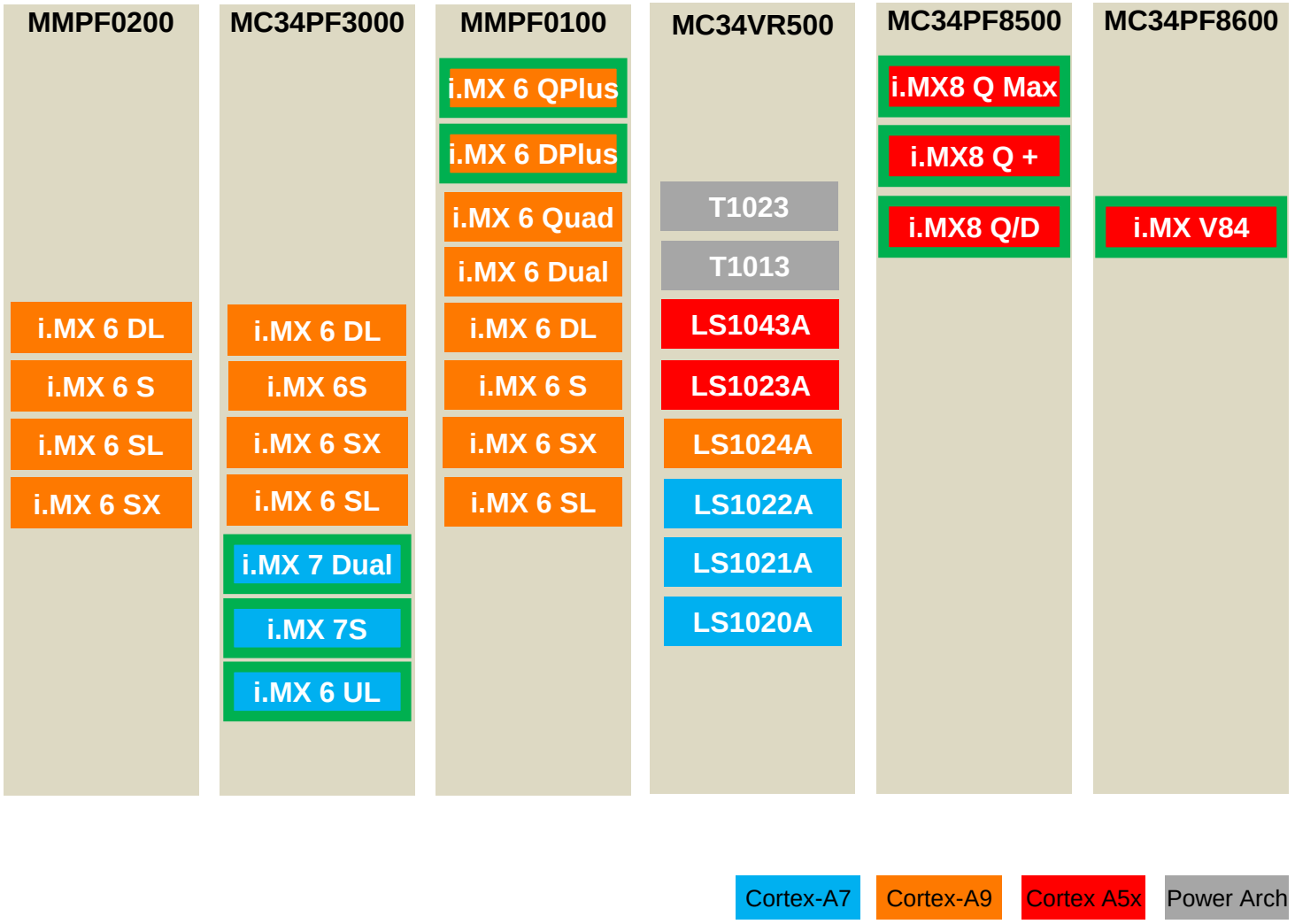
LS1021A IOTGWY
IoT Gateway by Freescale

AMLS1021-01 Module By A&M



EDM1-CF-LS1021A System-on-Module by TechNexion

PMICs for Medium & High Power Embedded & IoT



Safety Power Management Devices With Integrated Physical Layers

Connected Intelligence

Industrial Target Markets & Values

Leverage standard automotive values **to grow in industrial** Market

- Functional **Safety**
- Energy **Efficiency**
- **Connectivity**
- **Attach Strategy**

SBC Industrial Focus on

- **Inverters** and **Battery Management** Safety Critical
- **Motor Control** Safety Critical
- Transportations Systems (Mobile **Machines**, Trucks …)
- Factory Automation (**PLC** with Safety needs)
- **Robotics** – Internet of Things

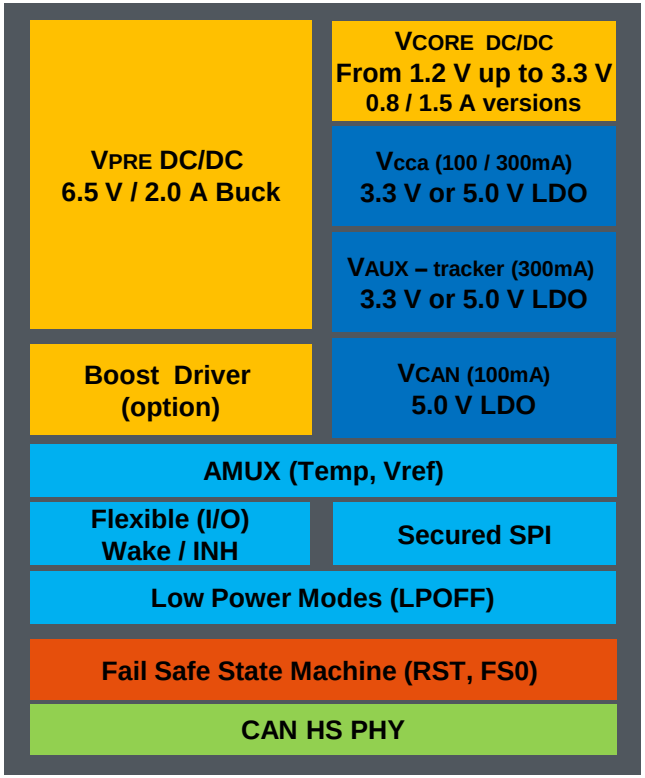
MC34FS6407 and FS6408 – SBC Key Features

Differentiating Points

- **Availability :** wide voltage operation range from 2.7V to 36V
- **Efficiency** of a Dual DC/DC converter topology
- **Safety :** Innovative architecture allowing **independent** monitoring of safety critical parameters
- **Scalable** family of products supporting a wide range of MCU and power segmentation architectures

Product Features

- **Bundles with** MCUs below **4 W** of power dissipation
- Flexible DC/DC Buck pre regulator with optional Boost to fit with **Low Voltage requirements**
- Multiple supplies up to **1.5 A** (up to 36 V operating voltage)
- Low Power Modes (**30 µA**)
- Analog Multiplexer & Battery sensing
- **Independent fail safe state machine** supporting functional safety standards
- Secure SPI interface
- Robust CAN physical layer with superior EMI/ESD performance
- LQFP48 with Exposed Pad (7 x 7mm)



Applications

- Automation (Safe PLC, Robotics)
- Building control (Elevator, Gas furnace)
- Transportation (Mobile machine, Military)
- Medical (Infusion pump, monitoring)

Industrial & Automotive Specific SBC Solutions

Change item	MC33907 / 908	MC34FS6407 / 6408
Voltage Operating Range	2.7 V to 28 V	4.6 V to **36 V**
Vpre	Buck – Boost (optional)	Buck only (recommended)
Ipre max	2.0 A	**1.7 A**
AMUX	Vsense, Vi/o0&1, Temp, Vref	Temp, Vref
PHY	CAN & LIN	**CAN only**
Temperature	-40°C / 125°C	-40°C / **105°C**
Market Target	Automotive	Industrial

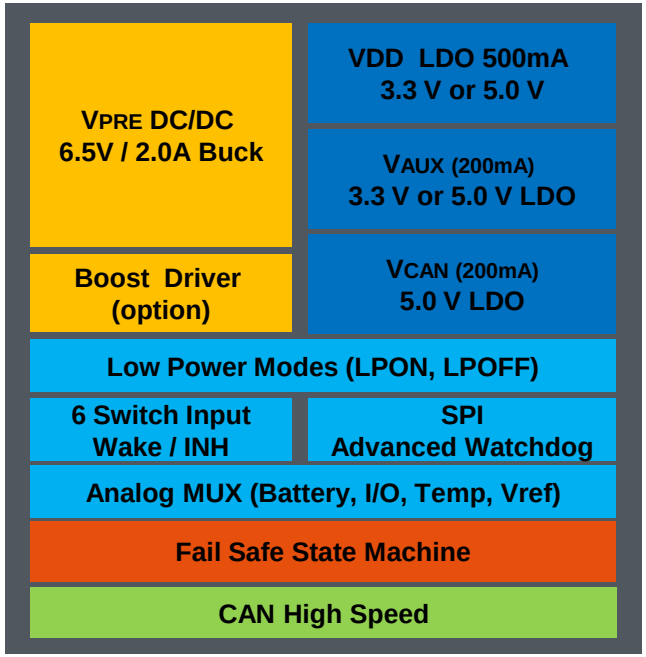
MC34FS4409 – SBC Key Features

Differentiating Points

- **Energy Management :** 36 V DC/DC Supply combined with 3 LDOs that can be switched in Low Power Mode
- **Integration** of 6 I/Os with Switch Inputs & Single CAN
- **Availability :** Ultra low voltage operation down to 2.5 V input voltage
- **Sense** of critical analog signals (Battery, Temp ..)

Product Features

- Efficient 2.0A DC/DC Buck pre regulator with optional Boost
- Advanced Low Power Modes (DC/DC, 6 I/Os, 1 CAN)
- Single CAN HS
- Safety Features
  - SAFE pin to drive external ICs in MCU fail mode
  - Secured critical changes of state machine with Programmable FS state
  - Configurable watchdog (timeout, window) & Secured SPI (parity checks, 8clk count…)
- LQFP48eP Package (7x7mm size)



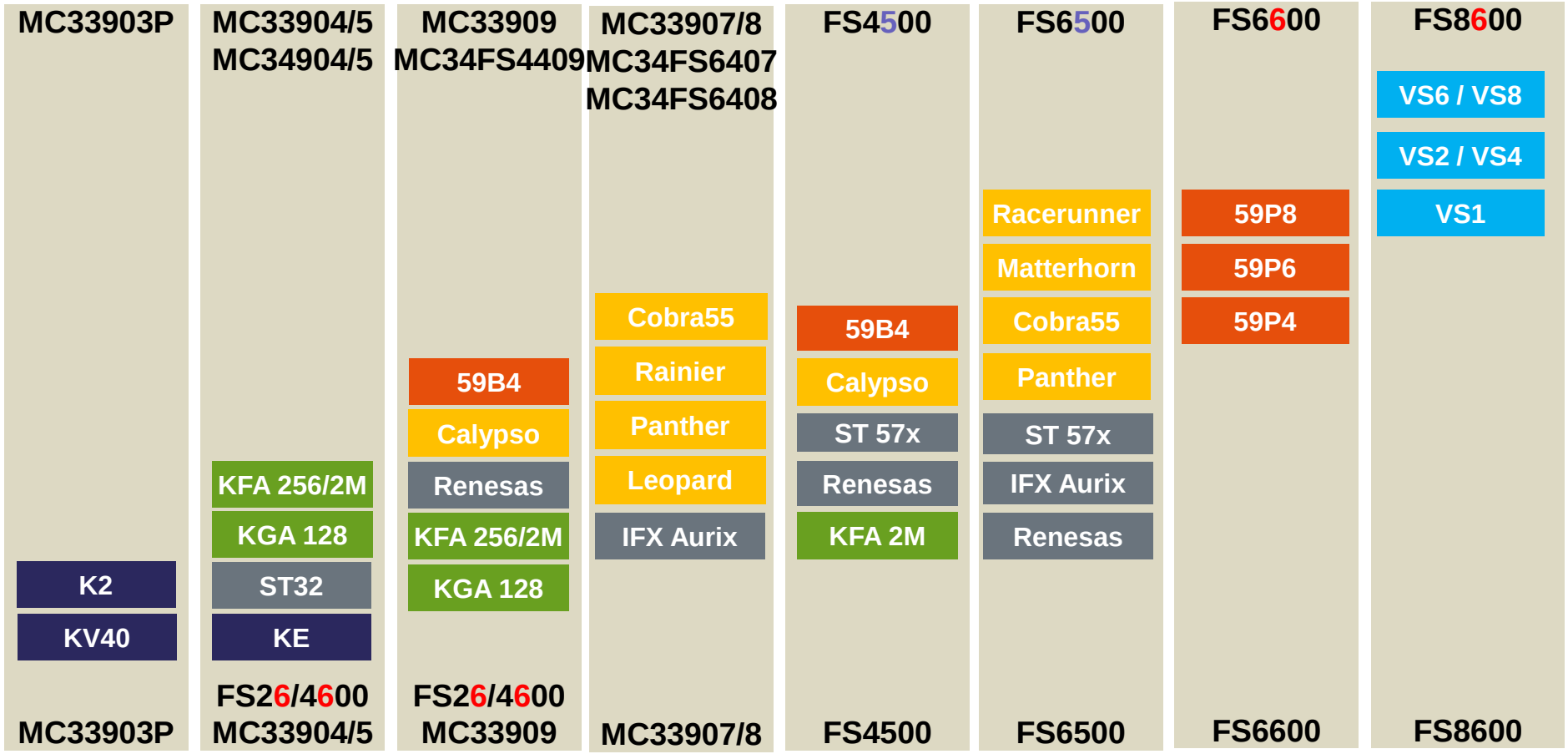
Applications

- Automation (Safe PLC, Robotics)
- Building control (Elevator, Gas furnace)
- Transportation (Mobile machine, Military)
- Medical (Infusion pump, monitoring)

SBC Portfolio Overview

Part Number Box & internal name	MC33910, 911, 912	MC33903/4/5 MC34903/4/5	MC33909	MC34FS4409	MC33907/8	MC34FS6407 MC34FS6408
Target Market	Auto	Auto / IMM	Auto	IMM	Auto	IMM
Product Status	Production	Production	Feb 2015	Feb 2015	PPAP	Mar 2015
6.5 V Pre-regulator	N/A	N/A	2.0A B/B 440 kHz 2.7 / 28 V input	2.0A B/B 440 kHz 2.7 / 32 V input	2.0A B/B 440 kHz 2.7 / 28 V input	2.0A B/B 440 kHz 2.7 / 36 V input
VCore / (MCU core)	60 mA (LDO)	0.4 A (LDO) with ballast	0.5 A (LDO)	0.5 A (LDO)	0.8 A / 1.5 A (B_2.4 MHz)	0.8 A / 1.5 A (B_2.4 MHz)
VCCA (I/O / ATD)	N/A	N/A	N/A	N/A	100 mA (int) +/-1% 300mA (wPNP) +/-3%	100 mA (int) +/-1% 300mA (wPNP) +/-3%
Auxiliary Supply Vaux	N/A	N/A (903) Yes (904/5)	200mA (Tracker)	200mA (Tracker)	*Up to 300 mA Tracker*	*Up to 300 mA Tracker*
Can_5V Supply -- VCAN	N/A	100mA	200mA	200mA	100mA	100mA
CAN Interfaces	0	1	1	1	1	1
LIN Interfaces	1	0 / 1 / 2	0 / 1/ 2 / 3 / 4	0	0 / 1	0
IOs	4 W/U 2 LS drv (opt) Op Amp (opt)	2 / 4	6	6	6 (incl. F/S inputs)	6 (incl. F/S inputs)
Watchdog	TO, Wdw	TO, Wdw, Random	TO, Wdw, Random	TO, Wdw, Random	Challenger	Challenger
Fit for ASIL	QM	B	B	B	D	D
LowQ LPOFF	32µA	15µA	100µA	100µA	30µA	30µA
AMUX & Batt.Sense	Yes	Yes	Yes	Yes	Yes	Yes
Fail Safe	RST	Safe	Safe	Safe	Independ. I/O	Independ. I/O
Package	LQFP32	SOI32eP	LQFP48eP	LQFP48eP	LQFP48eP	LQFP48eP

SBC - Processor Attach



PowerSBC Safety Features & Enablement Tools MC33907& MC33908

MC33907 / MC33908 EcoSystem

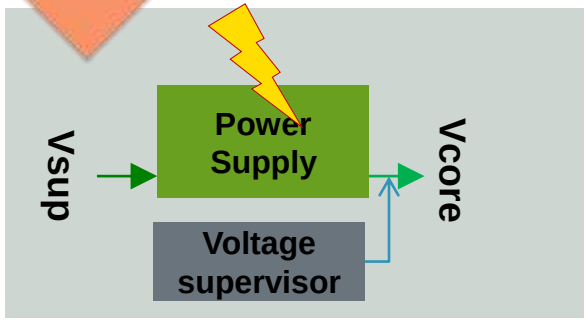
- **Quick performance Evaluation Board (EVB)**
  - Easy-to-use EVB for MC33907AE and MC33908AE
  - **KIT33908AEEVB and KIT33907AEEVB (with GUI) – 150$**
- **Attach Strategy : Easy to Design Evaluation Module (EVM)**
  - Mother Board MC33908 - **KIT33908MBEVBE – 350$**
  - Daughter Board MPC5643L - **KITMPC5643DBEVM (+ SW) – 150$**
  - **Complete kit part number – KIT908-5643EVM (+ SW) – 550$**
  - Panther Daughter board coming soon
- **Technical support**
  - Datasheet
  - EMC/ESD, compliance reports
  - Apps Notes (AN4442, AN4661, AN4843, AN4766, MPC5744PEV144UG)
  - SafeAssure Documentation (**FMEDA**, **Safety Manual**)
- **Tools:**
  - **Power Dissipation** prediction tool
  - Friendly **Graphical Interface**
  - SW example code
  - FAQ
  - Training
  - Complete support team here in Toulouse

MC33907/8: Functional Safety Strategy

Safety Hardware

Single Point Failure (SPF)

- Fail Safe State Machine as **Independent** checker
- Physical and electrical independance
- Own Reference, clock, Supply

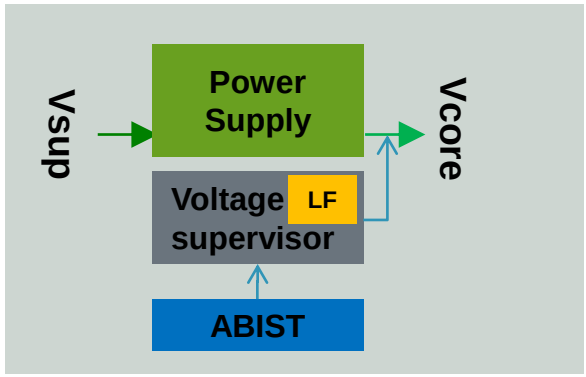


Latent Failure (LF)

"Failure that results from a single point fault and leads directly to the violation of a safety goal"
Requires a Quick detection

Built-In Self Test
- Analog (**ABIST**)
- Logic (LBIST) – covering 90%

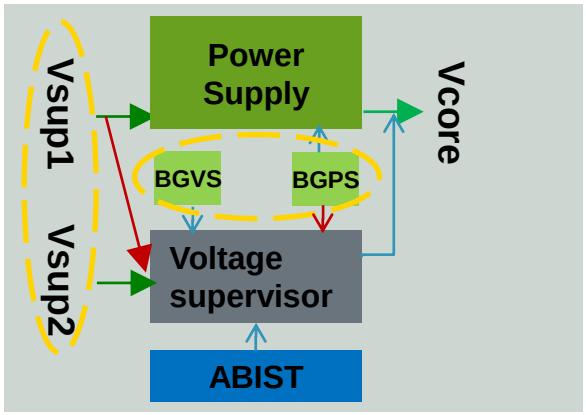
Checker activated at each init phase



"Failure, resulting from the combination of several independent faults, which leads directly to the violation of a safety goal"
Can become dangerous in conjunction with a second fault
Periodic detection necessary

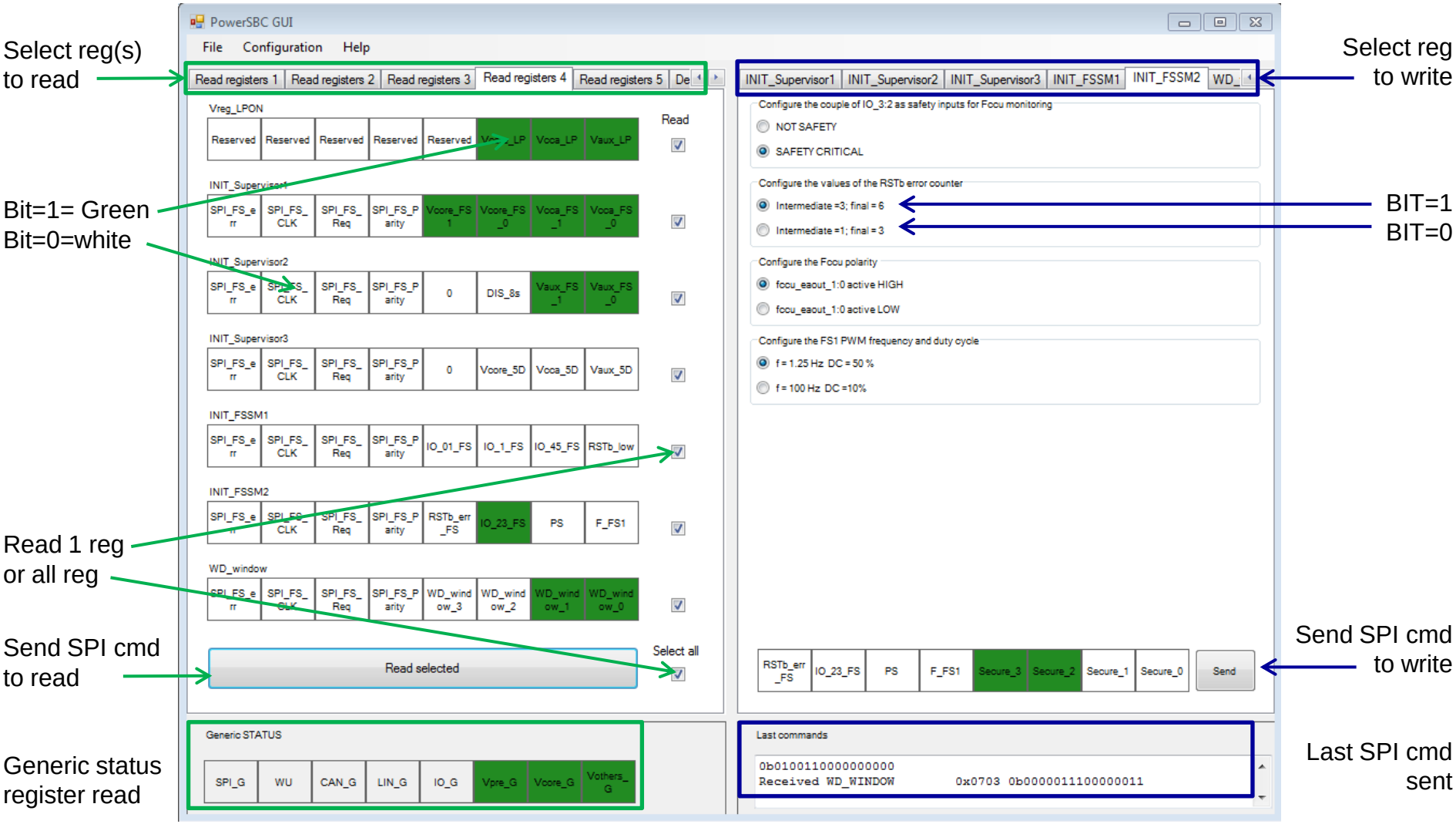
Common Cause Failure (CCF)

Independent Failure Monitoring Machine covering
- **Independant Vsup, Reference Voltage and current, Clock**
- Fail Safe Signal Monitoring
- Fail Safe Output Management



"Failure that results either in the loss of a safety function or in the loss of a Safety Detection Mechanism"

MC33907_8: EVB / EVM Graphical User Interface



MC33907_8: Thermal Tool

Max output current	Vcore	Vcca	Vaux	Vcan
Internal Regulator	1.50 A	100.0 mA	-	100.0 mA
External PNP	-	300.0 mA	300.0 mA	-

Package maximum Pdis : 2.00 W

FILL YELLOW CELLS ONLY

Vpre = Buck operation only

SMPS equations valid in CCM only (Continuous Current Mode)

Vpre SMPS

Ext. Devices		MOSFET switch		Converter	
Cin		Rdson	200.0 mΩ	Vsup	13.50 V
ESR Cin		Cg	600 pF		
Cout	57 µF	Tsw_on	30.00 ns	Vpre	6.50 V
ESR Cout	100.0 mΩ	Tsw_off	30.00 ns		
L coil	22.0 µH	Overdrive	10.0 V	Ipre	0.70 A
DCR coil	60.0 mΩ				
Vdiode	0.35 V			Freq	440 kHz

Vdrop_MOS	141 mV	duty cycle	50.0%	Pout	4.6 W
P_Cin		ton	1.136 µs		
P_cond	0.050 W	toff	1.137 µs		
P_sw	0.152 W				
P_diode	0.123 W				
P_Cout	0.001 W	I_Cout_rms	0.102 A		
P_L	0.030 W	I_L_rms	0.712 A		
Pdis_tot	0.357 W	ΔIL	0.35 A	CCM	
Pdis_IC	0.202 W	Ipeak	0.88 A		
η Vpre	92.8%	Vout_ripple	38.93 mV		

Vpre ext. adder

Supply current of external device(s) connected to Vpre (option)

Ipre_adder 0.00 A

Pout 0.00 W

Vcore SMPS

Ext. Devices		MOSFET		Converter	
Cin	1 µF	Rdson	200.0 mΩ	Vpre	6.50 V
ESR Cin	2.0 mΩ	Cg	300 pF		
Cout	20 µF	Tsw_on	12.00 ns	Vcore	3.30 V
ESR Cout	5.0 mΩ	Tsw_off	12.00 ns		
L coil	2.2 µH	Overdrive	10.0 V	Icore	0.50 A
DCR coil	20.0 mΩ				(≤ 1.5 A)
Vdiode	0.35 V			Freq	2400 kHz

Vdrop_MOS	100 mV	duty_cycle	54.1%	Pout	1.7 W
P_Cin		ton	0.225 µs		
P_cond	0.027 W	toff	0.191 µs		
P_sw	0.166 W				
P_diode	0.080 W				
P_Cout	0.000 W	I_Cout_rms	0.092 A		
P_L	0.005 W	I_L_rms	0.508 A		
Pdis_tot	0.278 W	ΔIL	0.32 A	CCM	
Pdis_IC	0.193 W	Ipeak	0.66 A		
η Vcore	85.6%	Vout_ripple	3.38 mV		

Vcca

Vcca	5.00 V
Internal PMOS	0.0 mA
	(≤ 100 mA)
PNP β averag	100
External PNP	200.0 mA
	(≤ 300 mA)
Pout	1.00 W
Pdis_IC	0.013 W
η	98.7%

Vaux

Vaux	3.30 V
Ron internal	0.70 Ω
PNP β averag	100
External PNP	200.0 mA
	(≤ 300 mA)
Pout	0.66 W
Pdis_IC	0.041 W
η	94.2%

Vcan

Vcan	5.00 V
Iout	0.0 mA
	(≤ 100 mA)
Pout	0.00 W
Pdis_IC	0.000 W
η	-

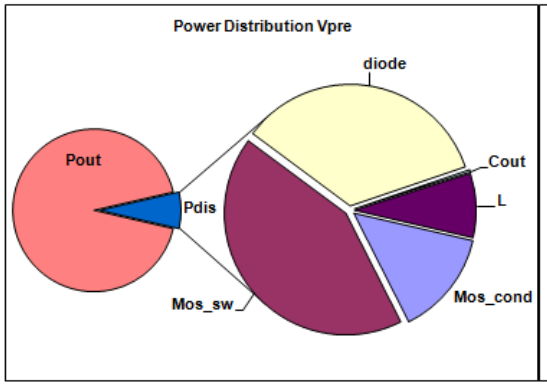
CAN transceiver

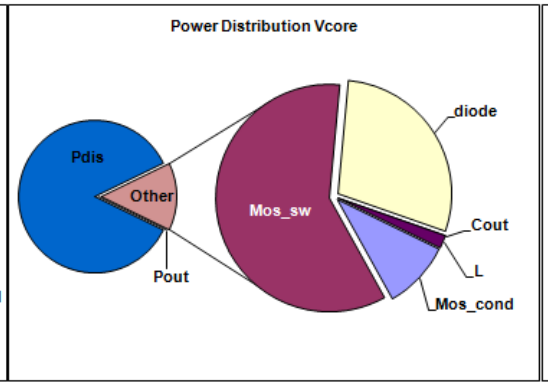
SLEEP mode	N
CAN frame	50%
CAN bit	50%
CAN traffic	25%
CAN cell current	3.0 mA
Bus impedance	60.0 Ω
CANL/H driver	45.0 Ω
Bus current	33.3 mA
Pdis_IC	0.057 W

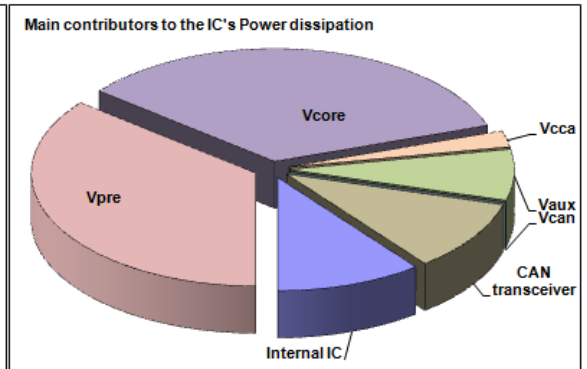
IC power dissipation summary :

	Pdis	η
Vpre	0.202 W	92.8%
Vcore	0.193 W	85.6%
Vcca	0.013 W	98.7%
Vaux	0.041 W	94.2%
Vcan	0.000 W	-
CAN transceiver	0.057 W	-
Internal IC bias current : 4.4 mA	Internal IC	0.059 W -

TOTAL PDIS = 0.565 W

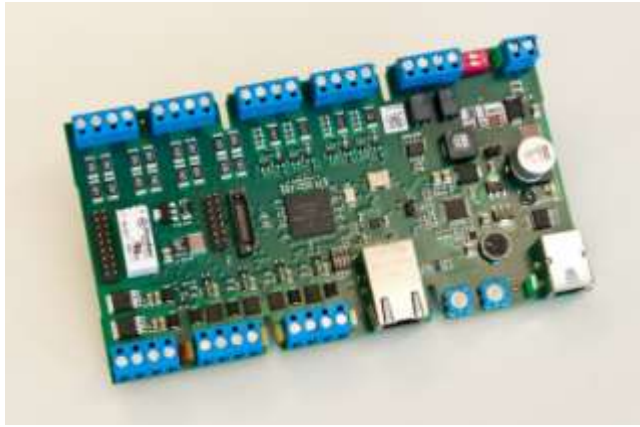






SafeAssure KIT – EK5744

- Partnership by **Freescale** and **MicroSys**
- Based on Freescale Solutions
  - Qorivva **MPC5744P** MCU
  - **MC33907** System Basis Chip
- Safety Standards addressed
  - **IEC61508** (2010), **ISO13849** (2008), **IEC62061** (2005)
- **TUV Sud** will review the KITs and capabilities
- SafeAssure KIT
  - **Will be orderable on Freescale.com (miriac-EK5744)**
  - **Support will be from Freescale (at MPC5744P and MC33907 level) and from MicroSys at system level**
- **1st KIT** to provide an **industrial** safety solution using an MCU and SBC with an integrated safety architecture (MPC5744P and MC33907)



SAFE ASSURE™ by Freescale

freescale™

MicroSys

System Power Management Solutions

System power management solutions for Freescale processors and microcontrollers

freescale Automotive	freescale i.MX	Layerscape	freescale Kinetis
SBCs with Functional Safety	PMICs	VR500 IoT Gateway	Battery Chargers



Physical Layers

MC33901/34901 Single CAN High Speed Transceiver

Differentiating Points

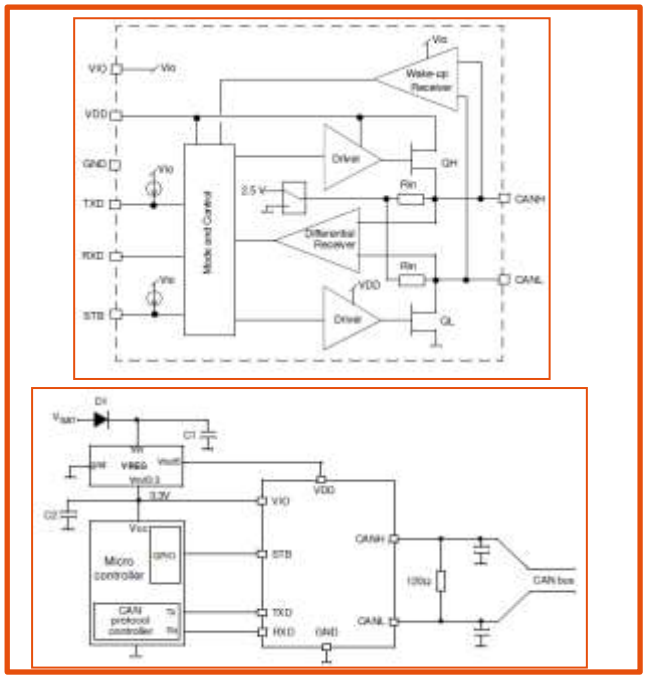
- **System Performance and Cost:**
  High **1 Mbit/sec** EMC performance **without choke**
- **Efficient:** Low quiescent current in low power modes (down to **8 µA**)
- **Scalable**: Family of four products supporting automotive and industrial, with and without wake up

Product Features

- Pinout and function **compatible** with CAN ISO11898-2 and -5 standards
- I/O **compatible** with both 5 V and 3.3 V MCU digital levels
- **Tx dominant timeout** for automotive (MC33901) which is **removed** for industrial (MC34901) and **low baud rate** applications
- Low power modes and wake up capability

Robustness

- **ESD without choke**: **+-6 kV** ESD contact discharge according to IEC61000-4-2, 150 pF-330 ohms
- **Noise Immunity without choke**: Meets **36 dBm DPI** without external protection and 39 dBm DPI with additional capacitors
- Bus pins protected against automotive transients
- **SOIC-8** Package



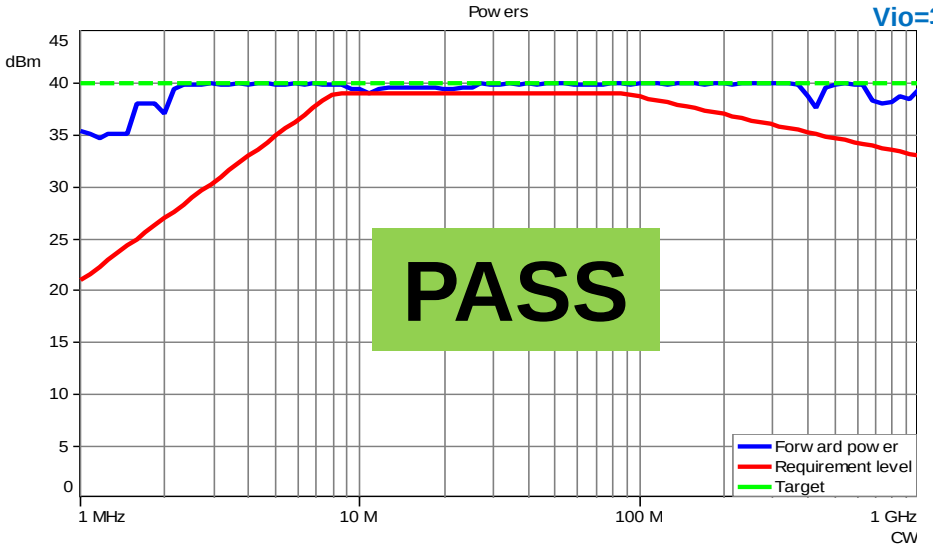
	Automotive Timeout	Industrial No Timeout
Wake Up	MC33901W	MC34901W
Standard	MC33901S	MC34901S

MC33x901 CAN High Speed Physical Layer
Chokeless High EMC Performance

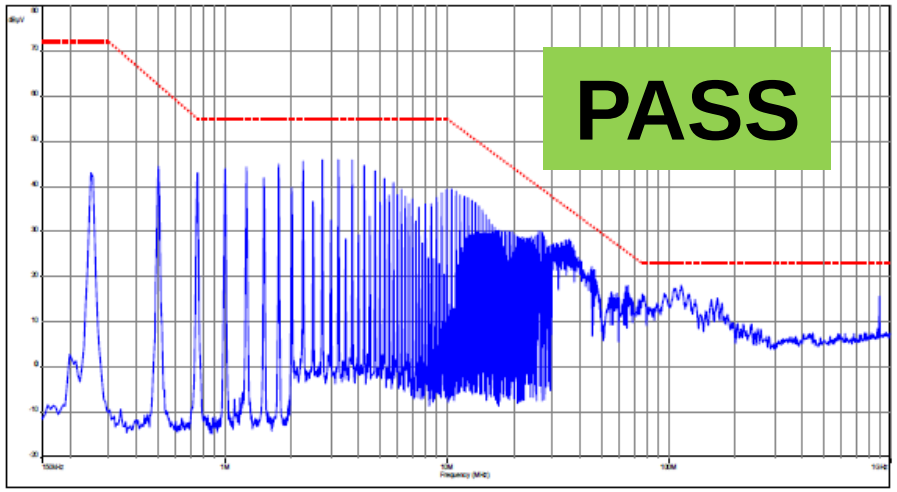
High EMC performance without common mode choke filter

- Target DPI (Direct Power Injection) 39 dBm immunity and CE (Conducted Emission) limit
- Emission performance exceeds industry standard
- Standard 500Kbps data rate and also 1Mbps data rate (2x standard)

DPI immunity without common mode choke (with 30pF filter)



Conducted Emission without common mode choke filter .



33902 Dual CAN High Speed Transceiver

Robust, system-cost effective CAN High Speed Physical Layer offering low quiescent current while exceeding stringent EMC/ESD requirements, without added circuitry

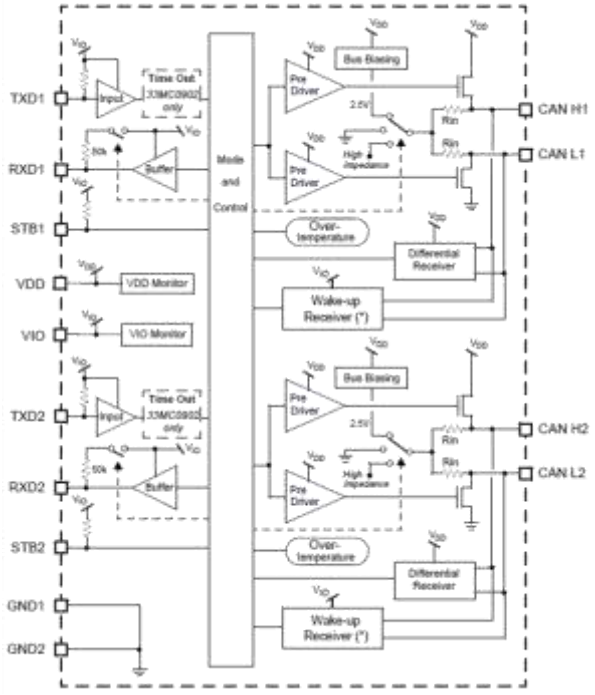
Differentiating Points

- **System Performance/Cost:** **500kbit/sec** EMC compliant **w/o Common Mode Choke**
- **Scalable System Solution:** Seamless attach to Freescale MCUs
- **Robustness:** Automotive OEM certified (MC33CM0902)

Product Features

- Pinout and function compatible w/CAN ISO11898-2 and -5 standard products
- I/O (SPI) is compatible with both 5 V and 3.3 V MCU digital levels
- Vdd and IO voltage monitoring, ability to respond in 'fail-safe' manner
- Low power modes and wake up capability
- **15 uA quiescent** current in low power mode
- **Robustness**:
  - **ESD without choke** : +-6 kV ESD contact discharge according to IEC61000-4-2, 150 pF-330 ohms
  - **Noise Immunity without choke :** Meet 36 dBm DPI without external protection and 39dBm DPI with additional capacitors
  - Bus pins protected against Automotive Transients
- Automotive (AEC-Q100) and Industrial versions available
  - Automotive: MC33CM0902 (Tx Dominant Timeout)
  - Industrial: MC34CM0902 (No Timeout - Low baud rate applications)
- **SOIC-14** and DFN14eP (planned)

MCU



SO14 DFN14eP

Typical Applications

- Auto Powertrain & Safety
- Motor control - Safety Critical
- Robotics
- Factory Automation

Samples and EVB: Now
Production Release: Q1 2015

Input Monitoring

3978 Configurable I/O

Analog switch interface multiplexer for translating 22 I/Os onto a single MCU SPI bus with low power auto-wake modes and configurable wetting currents

Differentiating Points

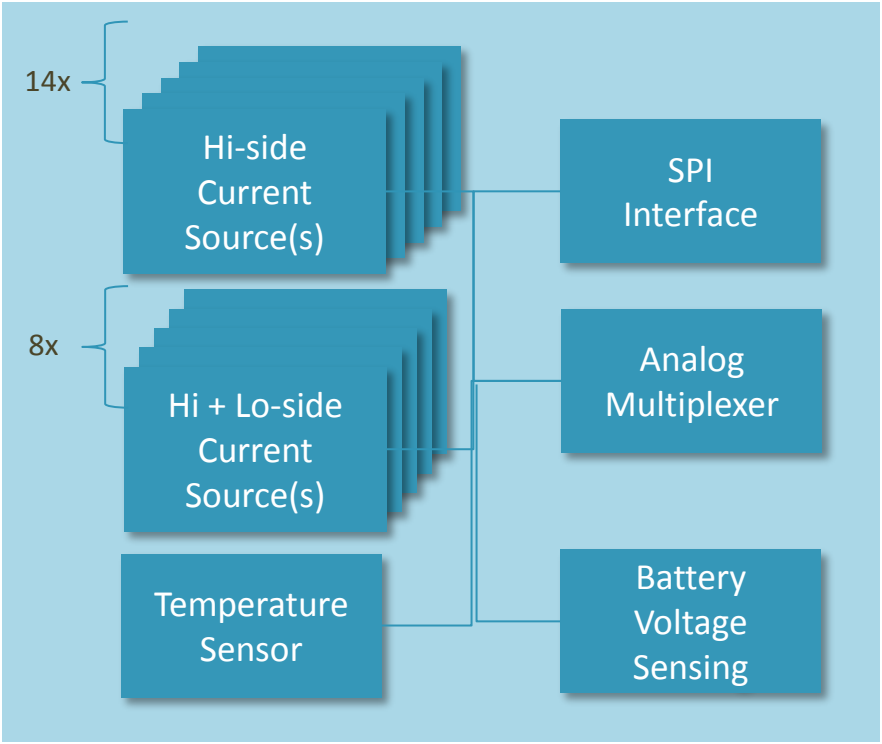
- Proven performance & robust ESD above 15 kV
- Quiescent current of **30 uA**; 1/3rd that of competitors and 1/100th that of discrete solutions
- Operating voltage range: **4.5 V-36 V** to meet auto load dump
  - 48% better than competition
- 5*5 mm **QFN** available compared to 6*6 mm for competition
- Integrated **battery sense**

Product Features

- **22 inputs:**
  - 14 switch-to-ground
  - 8 programmable switch to battery or ground
- Wake-up upon signal detection
- 24-1 analog multiplexer
- **Programmable wetting current** from 2 mA to 20 mA
- Integrated **temperature sensor**

Preliminary Schedule

- **Samples: Now**
- **Production: 1Q 2015**



Applications

- Multiple switch detect in Body-Control modules
- Engine Control Modules
- Front-of-Dash Modules
- Wire Harness
- Junction Box

Power Drivers and Switches Key Products

Power Drivers and Switches

Gate Driver

Power Driver

eXtreme Switch

Low R_{DSon} – SPI
High Side – Low Side
Diag. & Protection

Gate Driver	Automotive	Industrial / Consumer
H-Bridge Pre-Driver	MC33883	-
BLDC Pre-Driver	MC33937	MC34937 – MC34GD3000

Power Driver	Automotive	Industrial / Consumer
H-Bridge & DC Motor Driver	- MC33886 – MC33926 MC33931/2 MC33HB2000/1	MPC155xx – MC34933 - MC34931/2 MC34HB2000/1
BLDC Driver	-	MC34929
Low / High Side Switch	MC33882 MC33880 – MC33879 MC33996 – MC33999	- - -

eXtreme Switch Family	Automotive	Industrial / Consumer
Low R_{DSON}	MC33981/2/4/8	MC34981/2/4/8
Medium R_{DSON}	MC12XS6 MC24XS4	MC12XSF MC36XSD

eXtreme Switches

eXtreme Switch Composition

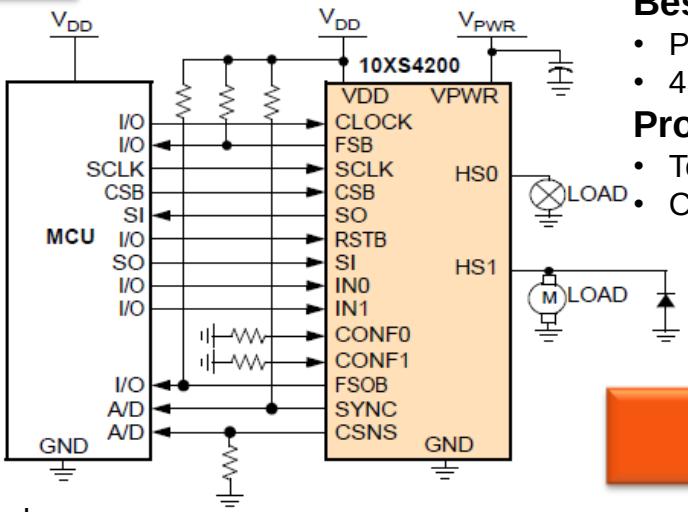
SMARTMOS™

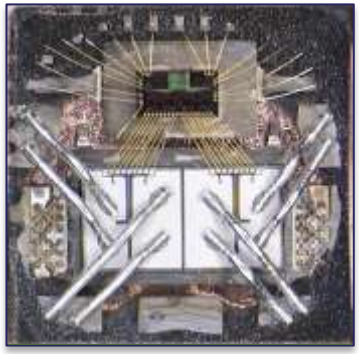
Protection and diagnostic

- Over temperature (175°C)
- Over current shutdown
- 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
- Embedded PWM module





Vertical Power stage

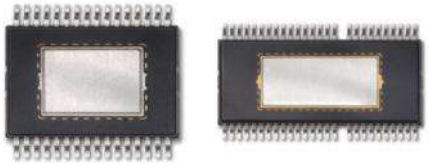
Best-in-class Technology

- Planar HD5 and TrenchFet LFET
- 45 V & 65 V BV

Protection in the power stage

- Temperature sensor
- Current sensor

Power package



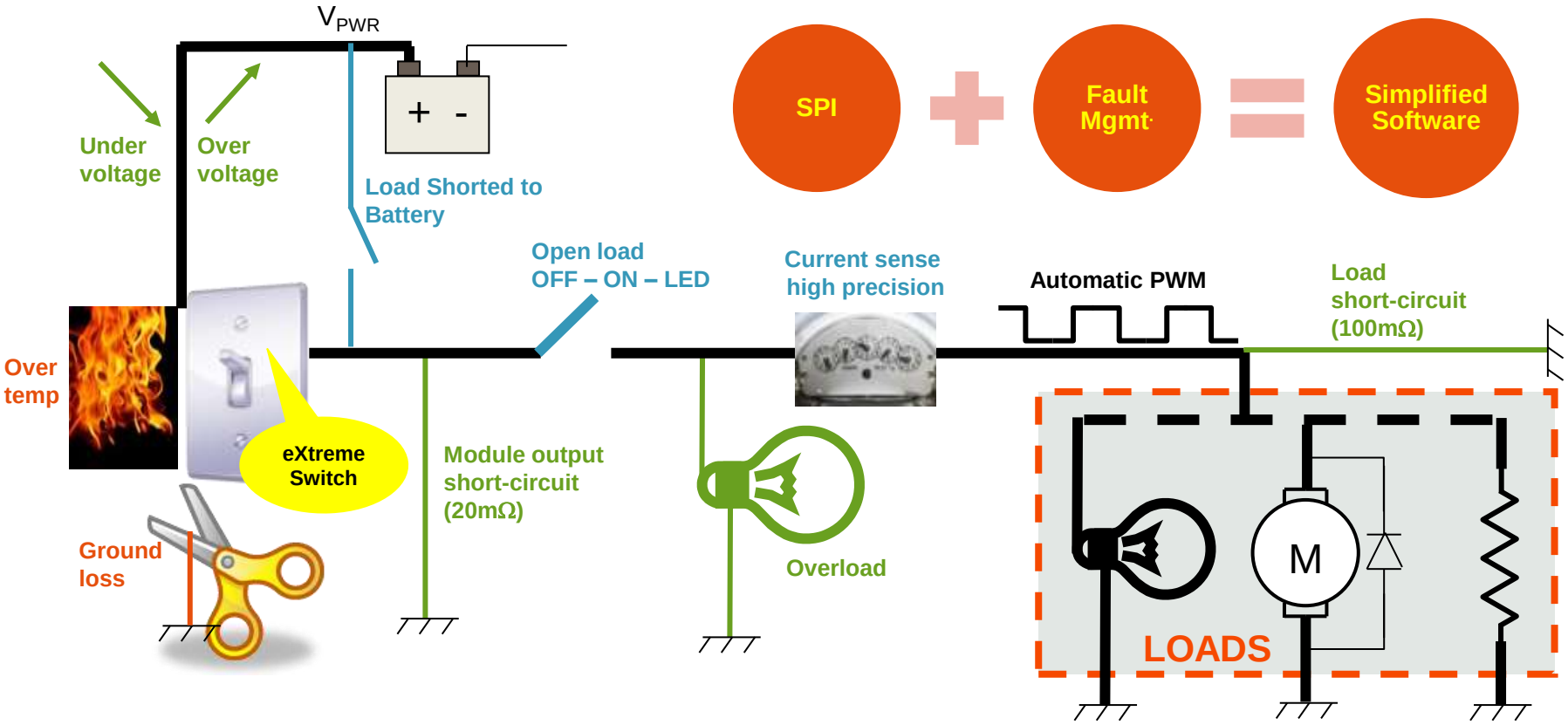
PQFN low cost power package

- 0.5 mm thick lead frame
- Die soldered attached
- Rthj-c < 0.5°C/W

SOICeP32 and 54

- designed for high power
- Large AL wire capability
- Pb-free compliancy

What are the Primary eXtreme Switch Features?



System Diagnostic
- ✓Open load ON – OFF – LED
- ✓Load Shorted to Battery
- ✓Current sense

Switch Protection
- ✓Over temp
- ✓Ground loss
- ✓Reverse Battery

System Protection
- ✓Over-under voltage
- ✓Module output short-circuit
- ✓Load short-circuit
- ✓Overload

24 A / 36 V eXtreme Switch

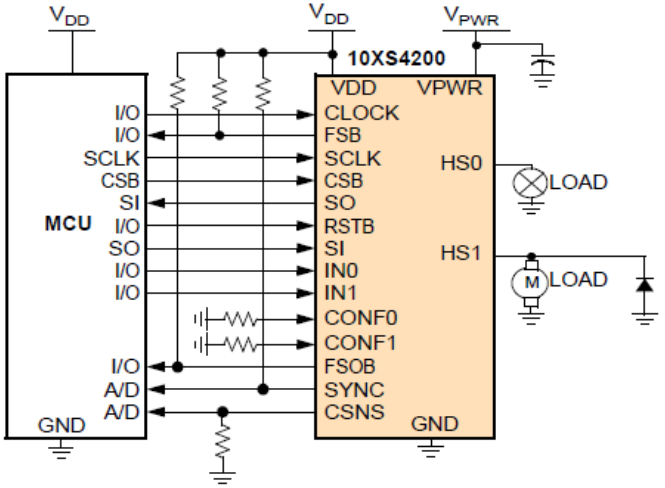
MC06XSD200 – MC10XSD200 – MC16XSD200 – MC22XSD200 – MC50XSD200

Dual 6mΩ Dual 10mΩ Dual 16mΩ Dual 22mΩ Dual 50mΩ

Scalable, programmable family of 24 A/36 V SPI-driven, dual-channel, smart high-side switches with lowest RDSon for up to a 30% board reduction

Differentiating Points

- **Robustness:** Unique over-current latch-off protection, full digital & analog diagnostic and protection features with embedded failsafe mode
- **Integration:** Unique daisy-chainable SPI control for dual low RDSon channels in a single package
- **Accuracy:** 5X better current sensing accuracy over temperature & supply voltage range with unique accurate temperature sensing capability
- **Scalable:** Compatible PCB foot print and SPI software driver among the 24 A/36 V product family
- **Lowest RDSon in Dual Configuration:** 20% smaller PCB due to lower power dissipation when using 12 A/channel or 24 A/dual in a thermally enhanced package



Product Features

- Dual 24 A/36 V high side switch with 6, 10, 16, 22 or 50 mΩ RDSon channels
- Normal operating range: **8.0 – 36 V**, extended range: **6.0 – 58 V**
- Flexible load management **1-24 A** with possible **parallel output** operating modes
- **Programmable dynamic threshold over current protection** and over-temperature protection with programmable auto-retry functions
- 3.3 V and 5.0 V compatible **16-bit Daisy chainable SPI control**
- ±5°C temperature and synchronous / asynchronous current (±10%) sensing
- Individually programmable internal/external PWM clock signals

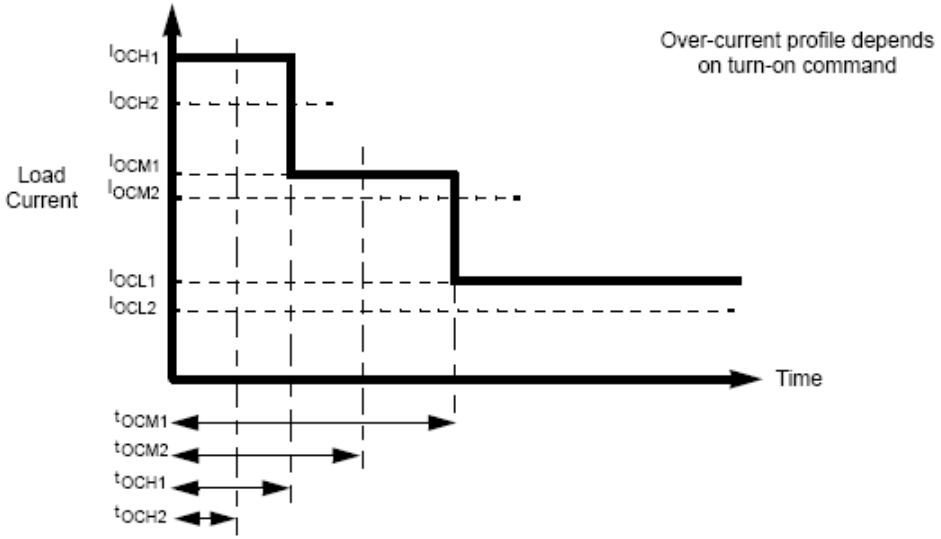
Typical Applications

Transportation 12 / 24 V
- 24 V Lighting and capacitive loads
- Valves
- DC motors

Industrial
- High current / highly inductive loads (solenoids)
- DC Motor control
- Factory automation

Configurable & Programmable Over-Current Detection Profiles

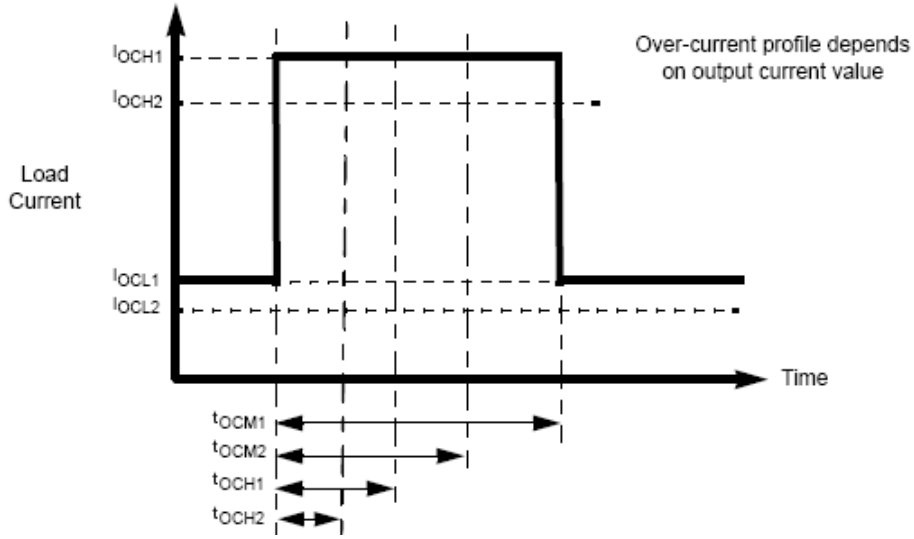
CONF bit = 0
Static Bulb lamp over-current protection profile activated



Static multi-stage over current protection profile protects lamps without shutting down the supply during inrush current

Activation by a turn-ON event

CONF bit = 1
Dynamic DC Motor over current protection profile activated



Dynamic over current protection window protects DC motors without shutting down the supply during short stall-periods

Activation by I(load) > I(OCL)

22 A / 18 V Gen4 Penta eXtreme Switches
MC07XSF517 / MC17XSF500

Scalable family of 22 A/18 V programmable penta high-side switches with wide range diagnostic current sensing and lowest RDSon for up to 30% smaller PCB and 50% lower component count

Differentiating Points

- **Robustness:** Unique over-current latch-off protection, full digital and accurate analog diagnostics, and protection features with embedded failsafe mode
- **Integration:** 5 configurable low RDSon channels with daisy-chainable SPI
- **Density:** Thermally enhanced package for affordable high switch count modules with up to 30% lower power, 30% smaller PCB footprint and 50% fewer components
- **Accuracy**: Advanced current sensing over temperature and supply voltage range allowing accurate current monitoring from 25 mA to 22 A
- **Scalability:** Pin and SW driver compatible family
- **Best thermal efficiency**: Lowest RDSon in penta configuration

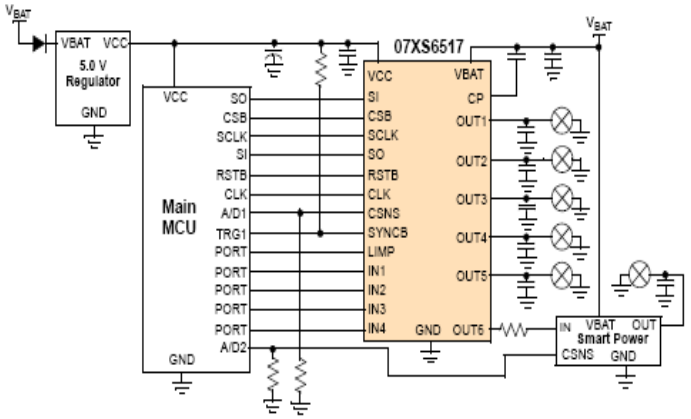


Figure 1. Penta High Side Simplified Application Diagram

Product Features

- Penta 5x 17mΩ and penta 3x 7mΩ + 2x 17mΩ configurations
- Operating voltage range from **6 – 18 V with sleep current < 5.0 µA**
- **Flexible** load management up to **11 A**, 22 A with enhanced thermal management
- Enhanced output **current sense (down to 27.5 mA)** with programmable synchronization signal, ±5°C temperature and **± 1%** battery voltage feedback
- **5.0 MHz 16-bit daisy chainable SPI control**
- Full **diagnostic** and **protection** including over-current profiles, output-ON and –OFF open load detections, thermal shut-down, pre-warning, and fault reporting
- Individually programmable internal/external **PWM signals with 8 bit duty cycle** control
- **Watchdog** and **failsafe** mode
- External smart power switch control

Typical Applications

Transportation
- 12 V Lighting from High beam to LEDs
- Valves
- DC motors

Industrial
- High current / highly inductive loads (solenoids)
- DC motor control
- Factory automation PLC

eXtreme Switch Product Family

12V Family Devices

Generation	Part Number	Outputs # and On-Resistance	Total Outputs #	Package	Low Operating Voltage	High Operating Voltage	Max PWM frequency	Pin to Pin Compatibility	SW Compatibility
MC12XSC	MC07XSC200EK	Dual 7mΩ	2	32-pin SOICEP	6V	20V	1 kHz	-	√
	MC10XSC425EK	Dual 10mΩ, Dual 25mΩ	4	32-pin SOICEP	6V	20V	1 kHz	-	
MC12XSF	MC07XSF517EK	Triple 7mΩ, Dual 17mΩ	5	54-pin SOICEP	7V	18V	400 Hz	√	√
	MC17XSF500EK	Penta 17mΩ	5	32-pin SOICEP	7V	18V	400 Hz		
	MC40XSF500	Penta 40mΩ	5	32-pin SOICEP	7V	18V	400 Hz		
	MC08XSF421	Dual 08mΩ, Dual 21mΩ	4	32-pin SOICEP	7V	18V	400 Hz		
	MC17XSF400	Quad 17mΩ	4	32-pin SOICEP	7V	18V	400 Hz		

36V Family Devices

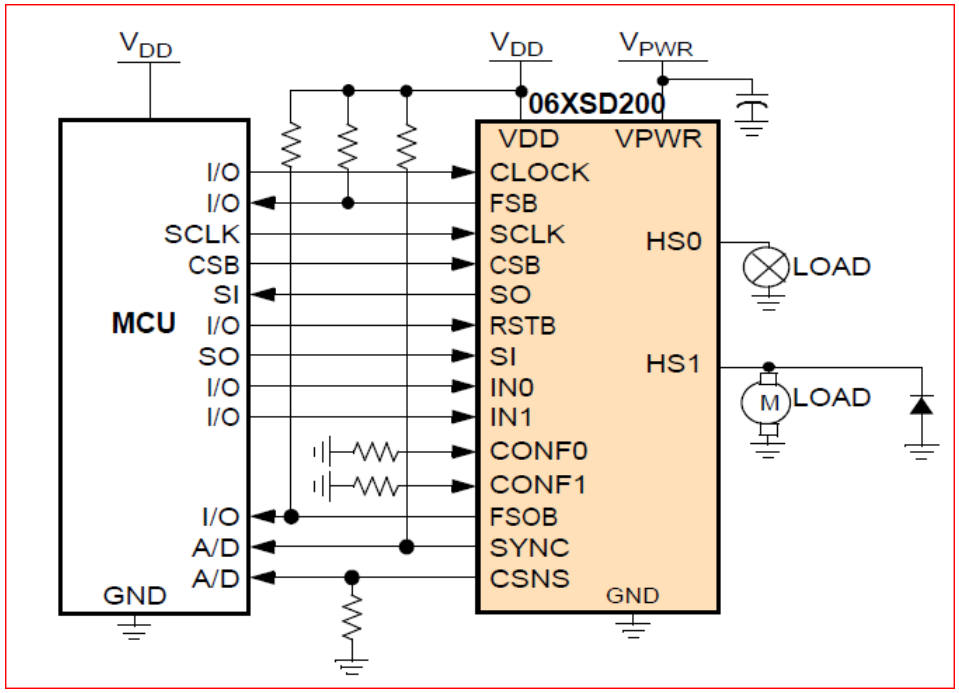
Generation	Part Number	Outputs # and On-Resistance	Total Outputs #	Package	Low Operating Voltage	High Operating Voltage	Max PWM frequency	Pin to Pin Compatibility	SW Compatibility
MC36XSD	MC06XSD200FK	Dual 6mΩ	2	24-pin PQFN	8V	36V	1 kHz	√	√
	MC10XSD200FK	Dual 10mΩ	2	24-pin PQFN	8V	36V	1 kHz		
	MC16XSD200FK	Dual 16mΩ	2	24-pin PQFN	8V	36V	1 kHz		
MC36XSD	MC22XS4200BEK	Dual 22mΩ	2	32-pin SOICEP	8V	36V	1 kHz	√	√
	MC50XS4200BEK	Dual 50mΩ	2	32-pin SOICEP	8V	36V	1 kHz		

Main Switch Devices

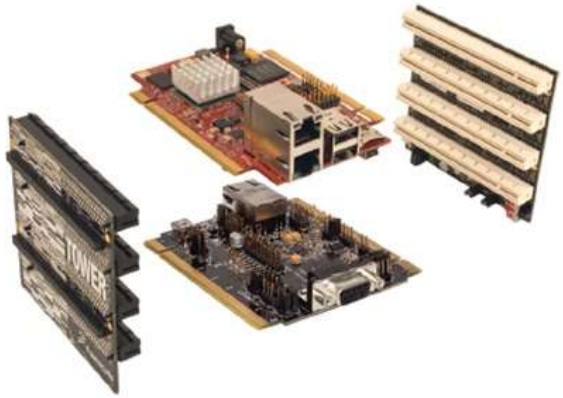
Generation	Part Number	Outputs # and On-Resistance	Total Outputs #	Package	Low Operating Voltage	High Operating Voltage	Max PWM frequency	Pin to Pin Compatibility	SW Compatibility
MC12XSB	MC34981ABHFK	Single 4mΩ	1	16-pin PQFN	6V	27V	60kHz	-	-
	MC34982CHFK	Single 2mΩ	1	16-pin PQFN	6V	27V	1 kHz	√	√
	MC34984CHFK	Dual 4mΩ	2	16-pin PQFN	6V	27V	1 kHz		
	MC34988CHFK	Dual 8mΩ	2	16-pin PQFN	6V	27V	1 kHz		

eme Switch Tower Board and Processor Expert SW Driver Enablement Tools

- MC06XSD200,MC10XSD200, MC16XSD200, MC22XSD200 & MC50XSD200



eXtreme Switch Analog Tower System Plug-In Modules



Available Nov. 2014

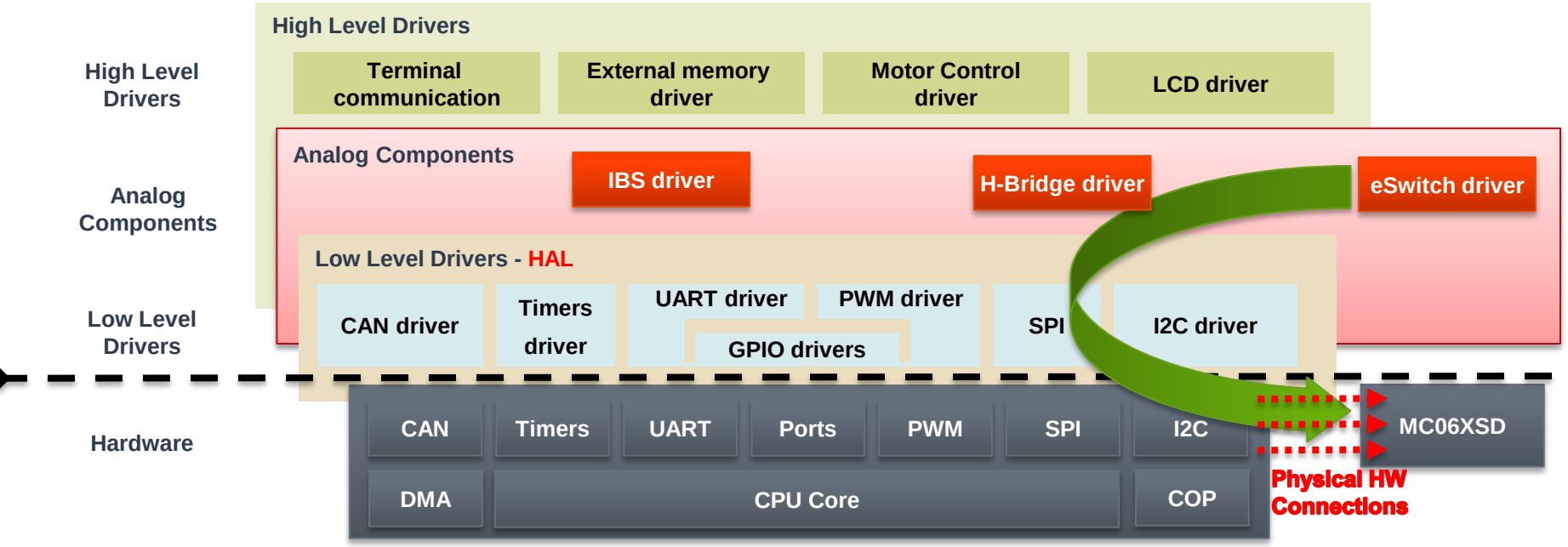
Development KIT for devices compatible with industrial application requirements:

Interact, Explore, Create with Tower Geeks Online Community (www.towergeeks.org)

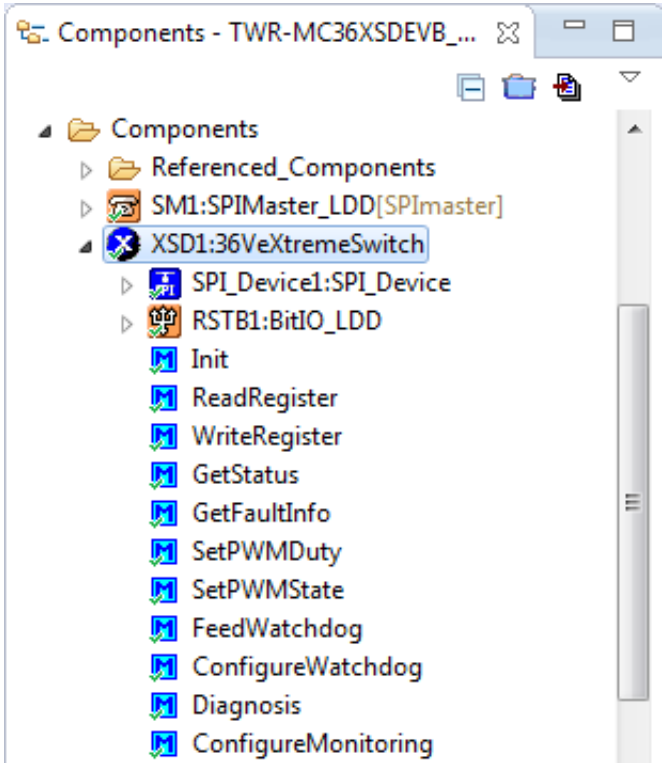
Supported Software Design Resource: Processor Expert (MCU Driver Suite)

PEx for Analog Components Philosophy

- PEx provides an interface between hardware and software so applications can be MCU independent / agnostic
  - **Hardware Abstraction Layer** (**HAL**) encapsulates peripherals of MCU
  - PEx analog components attach analog devices to MCU



PEx eSwitch Component Methods



Methods	
	Global Methods
	bool **XSD1_Init()**
	XSD1_result **XSD1_GetStatus(uint16_t *statusData)**
	XSD1_result **XSD1_GetFaultInfo(uint16_t channel, uint16_t *faultInfo)**
	XSD1_result **XSD1_Diagnosis(uint16_t *diagData)**
	Generic register access
	bool **XSD1_WriteRegister(uint8_t regAddr, uint16_t *regVal)**
	bool **XSD1_ReadRegister(uint8_t regAddr, uint16_t *regVal)**
	WatchDog
	XSD1_result **XSD1_ConfigureWatchdog(bool state, uint32_t deviceMask)**
	XSD1_result **XSD1_FeedWatchdog()**
	Output control with PWM
	XSD1_result **XSD1_SetPWMDuty(uint8_t channel, uint16_t *dutyValues)**
	XSD1_result **XSD1_SetPWMState(uint8_t *channelStates)**
	Current/Temp monitoring (SPI , ADC depend)
	XSD1_result **XSD1_ConfigureMonitoring(uint16_t *selection)**

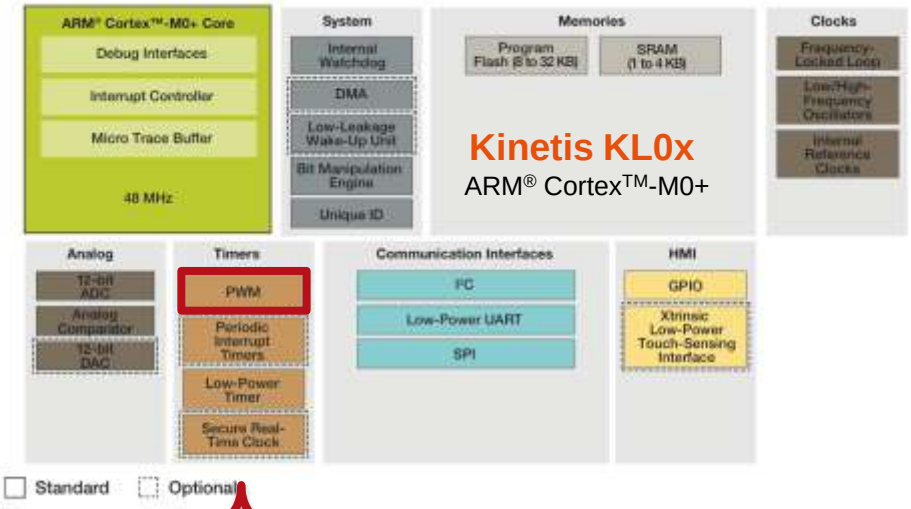
Power Driver & Gate Driver

7.0 Volt 1.4 Amp Platform for DC Motors

and Bipolar Stepper Micro Motor

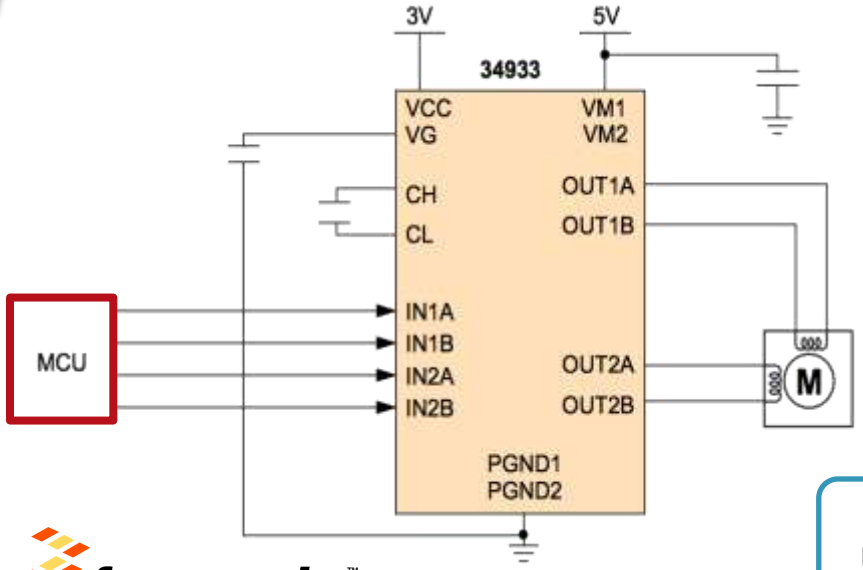
Applications

- Small and portable applications
- Home Care products
- Lens focus systems
- Card readers
- Micropumps
- Low power actuators



MCU Features

- Ultra low power, and low voltage operation
- 16-bit Timer/PWM
- 12-bit ADC
- Up to 32 KB Flash
- Single cycle I/O access.
- HW Bit Manipulation



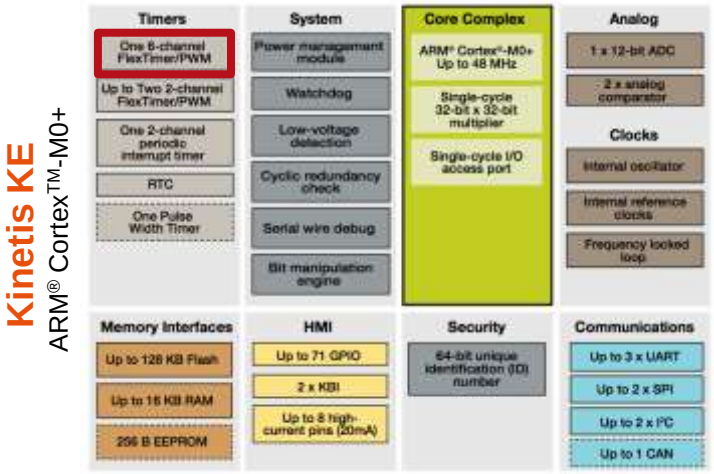
MC34933

- 7.0 V, 1.4 A Protected dual H-Bridge driver
- 2.7 to 5.5 V logic operation with charge pump
- Typ 186 µA operating current
- PWM up to 200 kHz
- Shoot through prevention
- Low voltage and thermal detection
- Stepper or dual DC motor drive
- 3 x 3 mm QFN-16 package

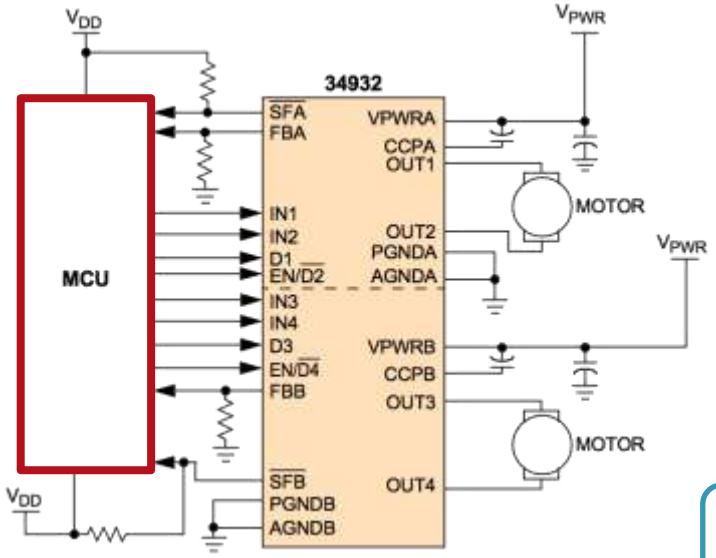
MC34933EP
USD 0.50 @ 1Ku

28 Volt 5.0 Amp Platform for Dual DC Servo Motor

Applications
- Small and portable applications
- Home Care products
- Lens focus systems
- Card readers
- Ticket systems
- Actuators
- Robotics



MCU Features
- True 5 V low power
- EMI/EMC robust
- SIL Safety support
- 16-bit Timer/PWM
- 12-bit ADC
- Single cycle I/O access.
- HW Bit Manipulation

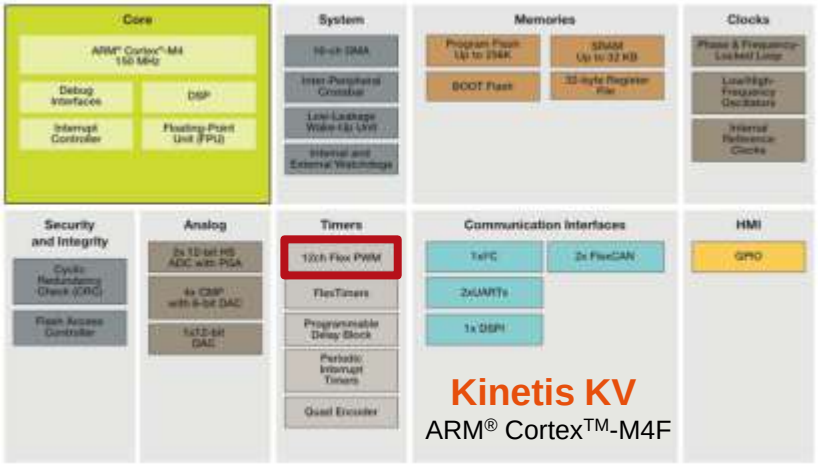


MC34932
- Dual 28 V, 5.0 A Protected H-Bridge driver
- 3.3 V and 5.0 V TTL/CMOS compatible
- Built-in charge pump for level shifter
- PWM up to 11 kHz
- Load current feedback signal
- Fault status flag: Undervoltage, Overcurrent and Overtemperature
- 10 x 18 mm SOIC-54

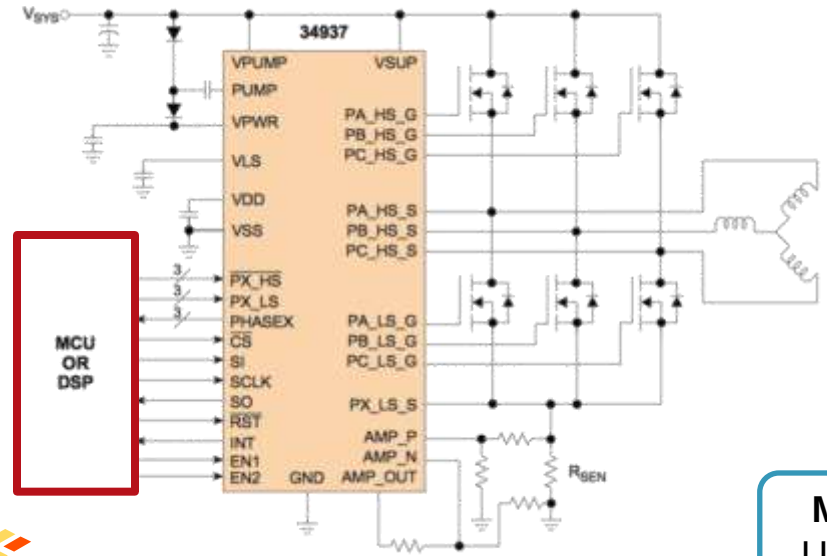
MC34932EK
USD 2.57 @ 1Ku

58 Volt 3-Phase Servo Motor Control Platform

Applications
- BLDC and PMSM motor drives
- E-Bike, Scooters
- Traction systems
- Hospital beds
- Electric chairs
- Power tools
- Robotics



Features
- 150 MHz CPU with DSP/FPU support
- 12 channel
- eFlexPWM timer
- Dual 1.9 MSPS ADC
- Cyclic Redundancy Check (CRC)
- SIL Safety Support



MC34937
- 6.0 V...58 V MOS FET pre-driver
- 3.3 V and 5.0 V TTL/CMOS compatible
- FET gate drive capability of >1.0 A
- Dead time control with shoot-through protection
- Reverse charge protection
- Overcurrent, desaturation, and phase fault-detection
- 10 x 18 mm SOIC-54

MC34937APEK
USD 2.24 @ 1Ku

Motor Driver IC Line-up (Excerpt)

MC33...- Automotive | MC34...- Industrial | MC17 - Consumer

Type	Configuration	Logic Volt	Motor Volt	I_{DD} Amp	R_{DSon25} mΩ	PWM KHz	Charge Pump	Current Feedback	Package
Low Voltage, Small Signal									
34933	Dual H, Stepper	2.7...5.5	2.0...7.0	**1.4**	400	200	**Yes**	No	QFN-16
17510	H-Bridge & HS Switch	4.0...5.5	2.0...**15**	1.2	450	200	**Yes**	No	TSSOP-24
17511	H-Bridge & **HS Switch**	2.7...5.7	2.0...6.8	1.0	460	200	**Yes**	No	QFN-24 SOIC-16
17529	Dual H, Stepper	2.7...5.6	2.0...6.8	0.7	700	200	**Yes**	No	SOIC-20
17531A	Dual H, Stepper	2.7...3.6	2.0...8.6	0.7	800	200	**Yes**	No	SOIC-20 QFN-24
17533	Dual H, Stepper	2.7...5.7	2.0...6.8	0.7	800	200	No	No	SOIC-16
17C724	Dual H, Stepper **I_{OP} 100 µA**	2.7...5.5	2.7...5.5	0.4	1000	200	No	No	QFN-16
Medium Power up to 28 Volt									
33926	H-Bridge, Servo	3/5V Logic	5.0...28	5.0	120	**20**	**Yes**	**Yes**	QFN-32
34931	**H-Bridge, Servo**	3/5V Logic	5.0...28	5.0	120	11	**Yes**	**Yes**	SOIC-32
34932	**Dual** H, Servo	3/5V Logic	5.0...28	5.0	120	11	**Yes**	**Yes**	SOIC-54
Pre Driver for 3-Phase High Power Inverters									
34937A	**3-phase** Pre-driver	3/5V Logic	6.0...**58**	>1.0	-	20	**Yes**	**Yes**	SOIC-54

H-Bridge Motor Drivers for DC Brushed Applications

MC33HB2000 (235 mΩ) & MC33HB2001 (120 mΩ)

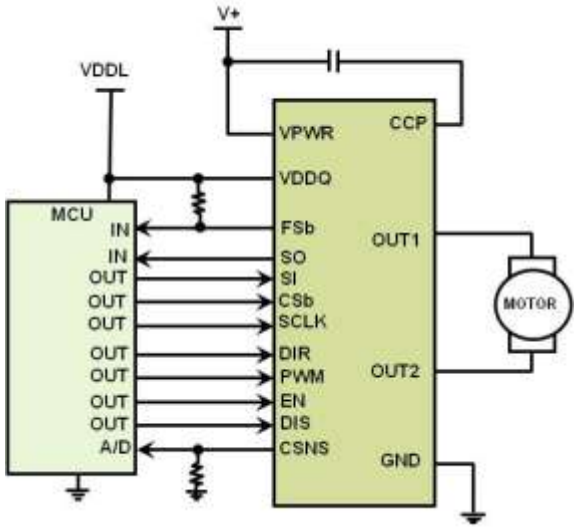
The MC33HB2000/1 are advanced H-Bridge Motor Drivers designed to provide enhanced safety features for high safety integrity, thermal management for continuous operation and SPI control for increased flexibility

Product Highlights:

- **Enhanced Safety features: ISO26262 ASIL B/C**
- **Thermal Management**: best-in-class package thermal resistance, lowest RDS(ON), temperature dependent current limit for continuous operation
- **Greater Flexibility**: slew rate & current limit programmability, status flag and/or SPI diagnostics, configurable as two Half Bridges, PWM input or SPI control, **daisy chainable, real time current mirror with +/- 5% accuracy**, and **drop-in replacements, no need to change pin-out or software** when changing motor drive power requirement.

Features/Benefits:

- **Diagnostic reporting via SPI**: short to PWR & GRND, over current & temperature, over & under voltage, open & short load
- **Safe shutdown**: outputs can be disabled for safe shutdown
- **ESD 4 kV** at outputs, **I/0 Pins 18 V** proof to protect against accidental shorts
- **Low RDS(ON) outputs: < 235 mΩ** & < 120 mΩ @ TA = 150°C, VG = 6.0 V
- **4 selectable Current Limits via SPI**: 5 / 6.5 / 8.1 / 10 Amp typical
- **8 selectable Slew Rates via SPI**: 0.25 V/µs to 40 V/µs for EMI vs. efficiency
- **Half-Bridge independently via SPI**: to drives inductive loads in a full H-Bridge and half-bridge configuration
- **High side recirculation:** (braking) mode during over current protection
- **Two Packages**: SOIC-EP / PQFN for low thermal resistance **< 1°C/Watt**
- **Operation Voltage:** 4.3-28 Volts

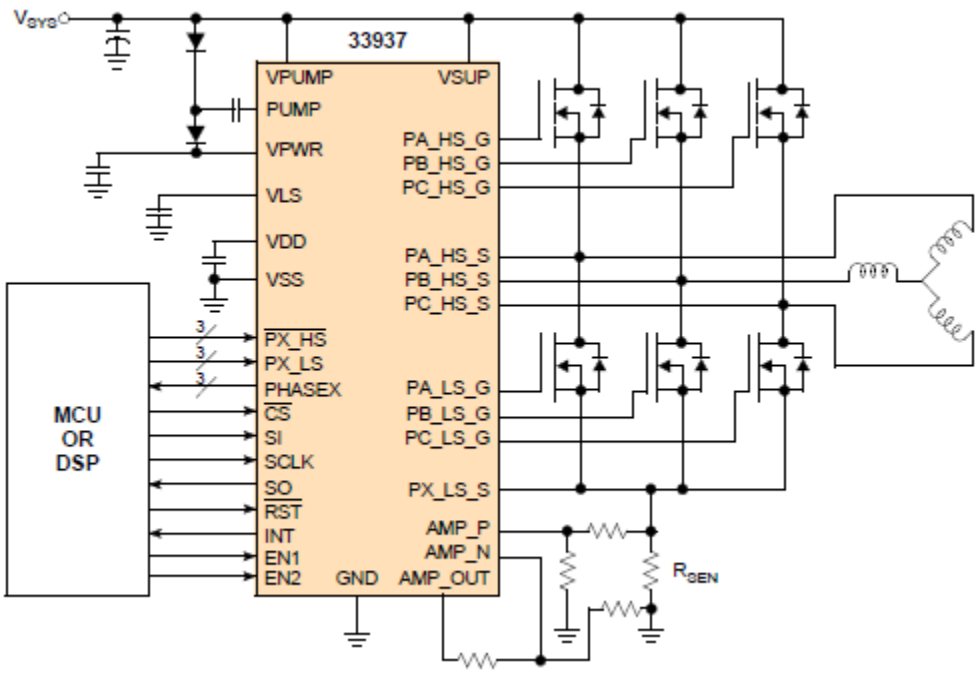


32-Pin, SOIC-EP
10x11 mm

32-Pin, PQFN
8x8 mm

SAMPLES*: NOV, 2014
***MC33HB2001EK, SOIC-EP 32, 10A max**
PRODUCTION: Q3 2015

MC34GD3000 3-phase Pre-drive IC



56-lead, QFN-EP
8x8 mm

Product Options

-40 to 125°C	MC34GD3000EP/R2

Availability

Samples: March, 2015
Production: June, 2015

Features

- Small package: 8x8mm
- 6.75x6.75mm exposed pad
- Up to 58 V operating voltage range
- PWM to 20 kHz
- > 1.0 A peak gate drive current
- Wide SPI programmable dead time
- Protection against transient spikes and reverse charge injection

Typical Applications

- Drones
- E-Bikes
- Power Tools
- Robotics
- Fans

Power Driver & Gate Driver Enablement Tools MC33931, MC33932, MPC175xx, MC34933 & MC34937

Medium Voltage Motor Drivers EcoSystem

Development Kits with Evaluation Board

- Evaluation boards drive from PC using USB to SPI interface board
- Tower System modular development system board for MC33/34926 & MC33/34931*
- Process Expert Software in development

Complete Technical Documentation avalable to ease Design

- Datasheets and Application notes
- Power Dissipation prediction tool
- Technical Training and hands on training on demand

FSL part	Kit name	Associated boards
MC33887EK	KIT33887EKEVBE	KITUSBSPIDGLEVE
MC33936PNB	KIT33936PNBEVBE	KITUSBSPIDGLEVE
MC33931EK*	KIT33931EKEVBE	KITUSBSPIDGLEVE
MC34931EK*	KIT33931EKEVBE	KITUSBSPIDGLEVE
MC33932EK	KIT33932EKEVBE	KITUSBSPIDGLEVE
MC34932EK	KIT33932EKEVBE	KITUSBSPIDGLEVE

Production: NOW

Evaluation Boards: NOW

*** Tower System Plug-in module: Q1/15 release**

Low Voltage Motor Drivers
EcoSystem

Development Kits with Evaluation Board

- Freescale Freedom development platform for Kinetis KL02 MCUs with Motor drive evaluation board for all nine parts
- Tower System plug-in module for MPC17510 & MPC34933*
- Process Expert Software in development

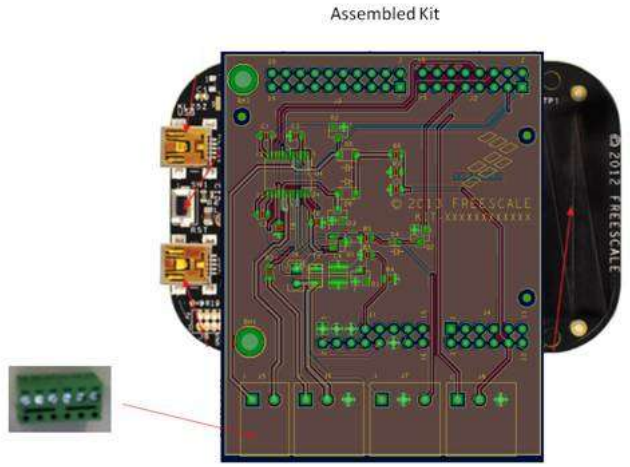
Complete Technical Documentation avalable to ease Design

- Datasheets and Application notes
- Power Dissipation prediction tool
- Technical Training and hands on training on demand

Production: NOW

FRDM EVBs: Nov. 2014

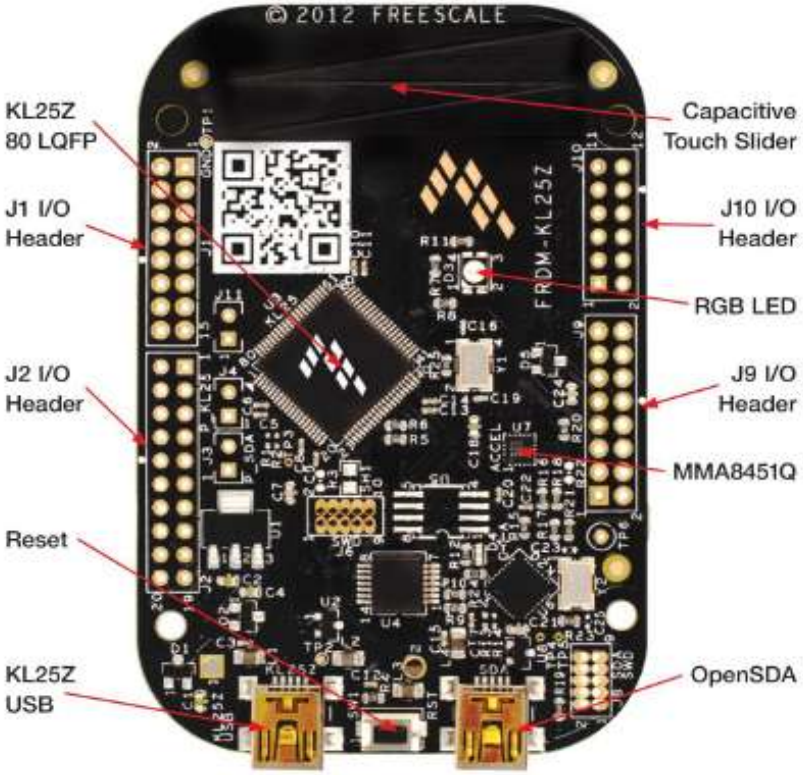
***Tower System plug-in module: Q1/15 release**

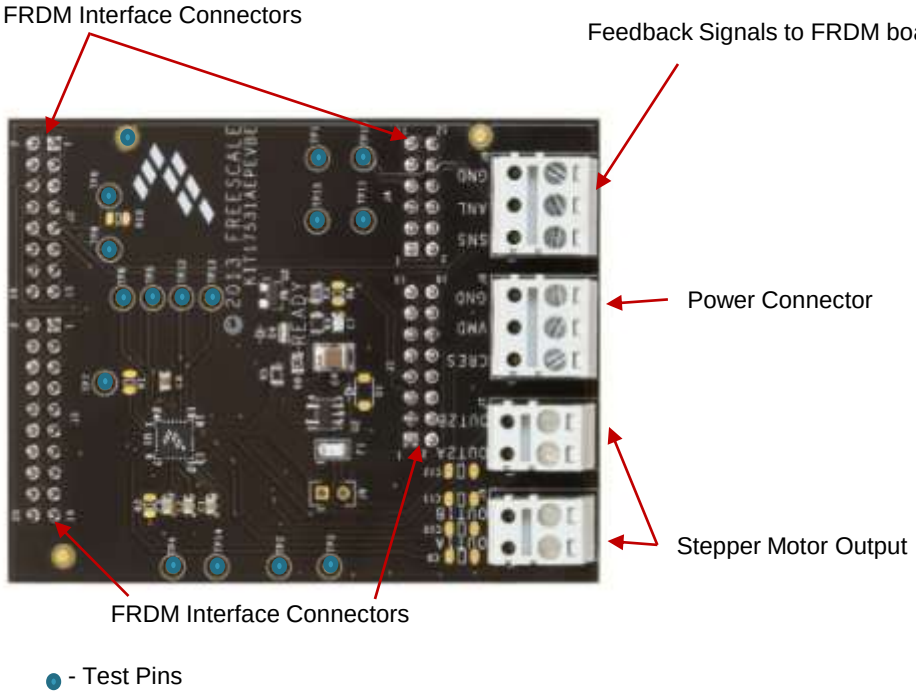


FSL part	Kit name	Associated boards
MPC17510EJ	FRDM-17510EJ-EVB	FRDM - KL25Z
MPC17511EP	FRDM-17511EP-EVB	FRDM - KL25Z
MPC17511EV	FRDM-17511EV-EVB	FRDM - KL25Z
MC34933EP	FRDM-34933EP-EVB	FRDM - KL25Z
MPC17529EV	FRDM-17529EV-EVB	FRDM - KL25Z
MPC17531ATEV	FRDM-17531EV-EVB	FRDM - KL25Z
MPC17531ATEP	FRDM-17531EP-EVB	FRDM - KL25Z
MPC17533EV	FRDM-17533EV-EVB	FRDM - KL25Z
MPC17C724EP	FRDM-17C724EP-EVB	FRDM - KL25Z

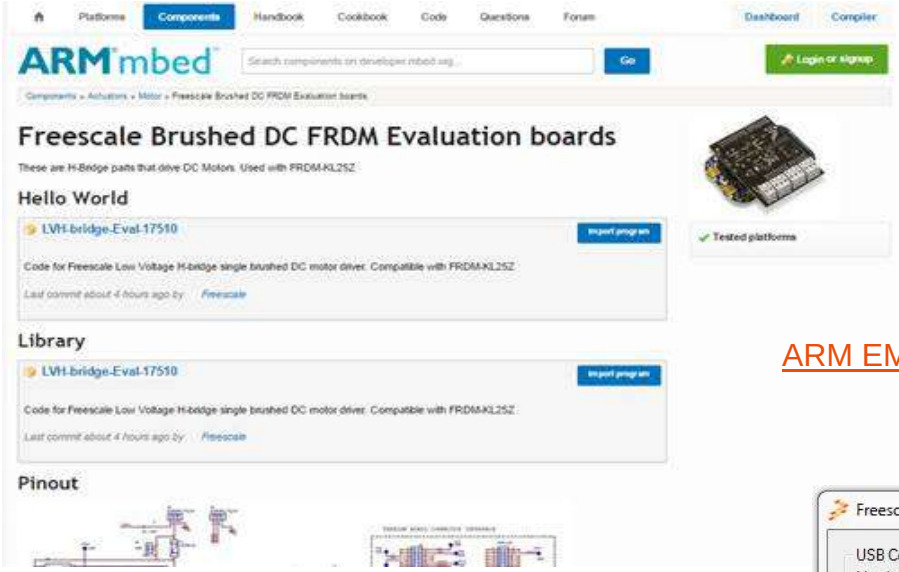
Freescale Freedom Development Platform Connectivity with H-Bridge EVBs

FRDM Board





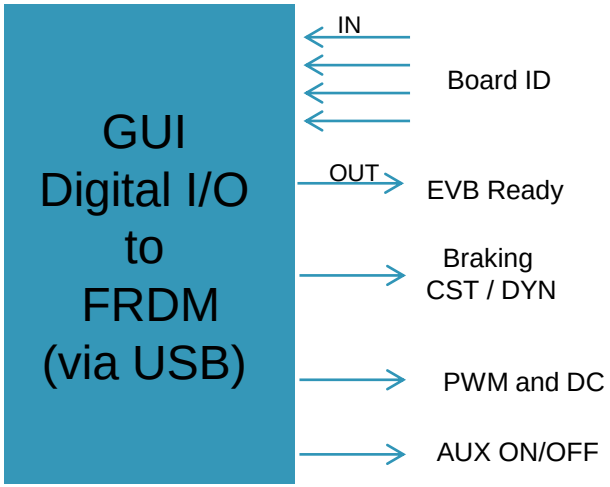
Freescale Freedom Development Platform GUI Interface

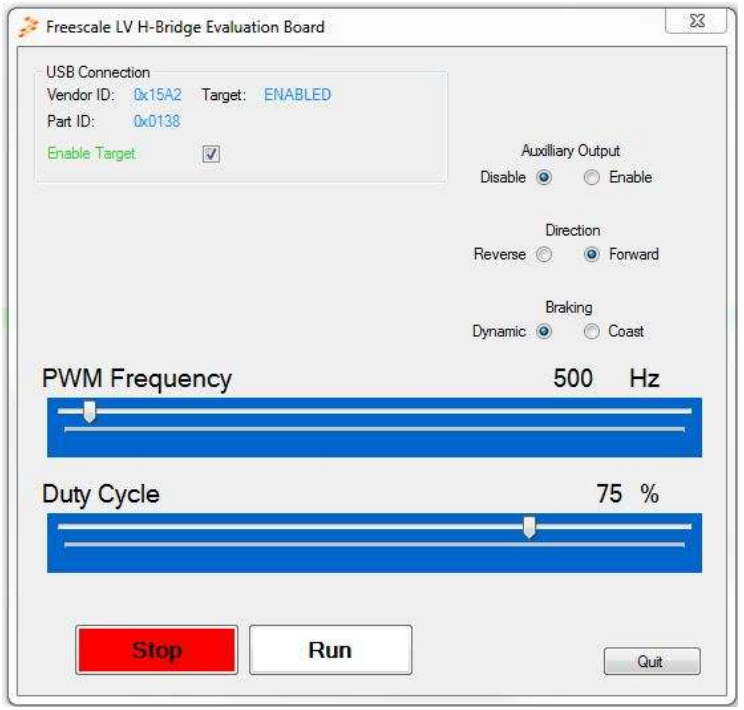


Sample GUI

Supported Firmware only for **FRDM KL25Z**

ARM EMBED Freescale-Brushed-DC-FRDM-Evaluation





Configurable Octal Switch EcoSystem

Development Kit with Evaluation Board

- MC33879A evaluation board*
- Compatible with all current FRDM boards (14 total)
- SPIGen configuration file**
- KL25Z CodeWarrior sample code**
- Mbed sample code**

Complete Technical Documentation available for EZ Design

- Datasheet, user guide, software documentation

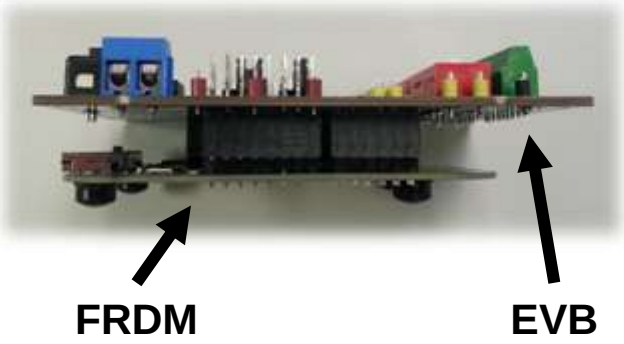
Production: NOW

Evaluation Boards: *Q1/15

****Q1 release**

EVB Top

EVB Side with FRDM



FSL part	Kit name	Associated boards
MC33879A	KIT33879AEKEVB	All FRDM boards (as of 2014.12.11

MC34937 EcoSystem

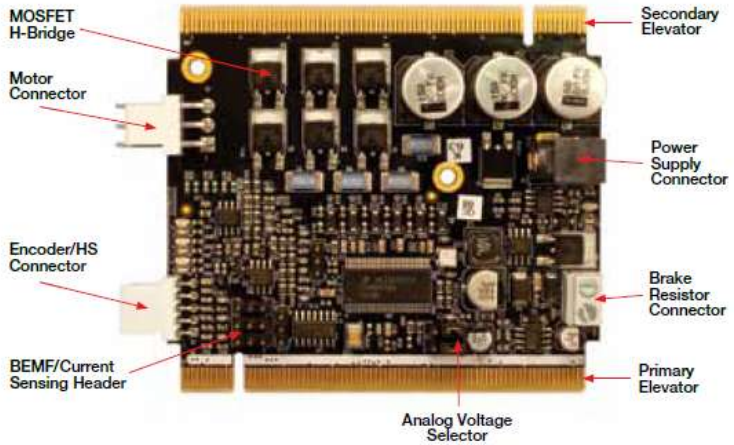
KIT33937AEKEVBE

3PHASELV

MC34937 EVAL Board: KIT33937AEKEVBE

Tower LV Motor Control Board:TWR-MC-LV3PH

3-Phase LV Motor Control Kit: 3PHASELV



TWR-MC-LV3PH

ORDERABLE PARTS		
Parts Number	**Temp. Range**	**Package**
MC34937APEK	-40°C to 125°C	54 pin SOICW-EP
MC34937APEKR2 *(tape & reel)*	-40 C to 125 C	54 pin SOICW-EP

Battery Management Key Products

Battery Management

Intelligent Battery Sensor

Battery Cell Controller

Li-Ion Battery Charger

Alternator Regulator

System in Package
800V – Balancing
LIN – CAN – TPL

Intelligent Battery Sensor	Automotive	Industrial / Consumer
LIN-Based	MM912_637	-
CAN-Based	MM9Z1_638	

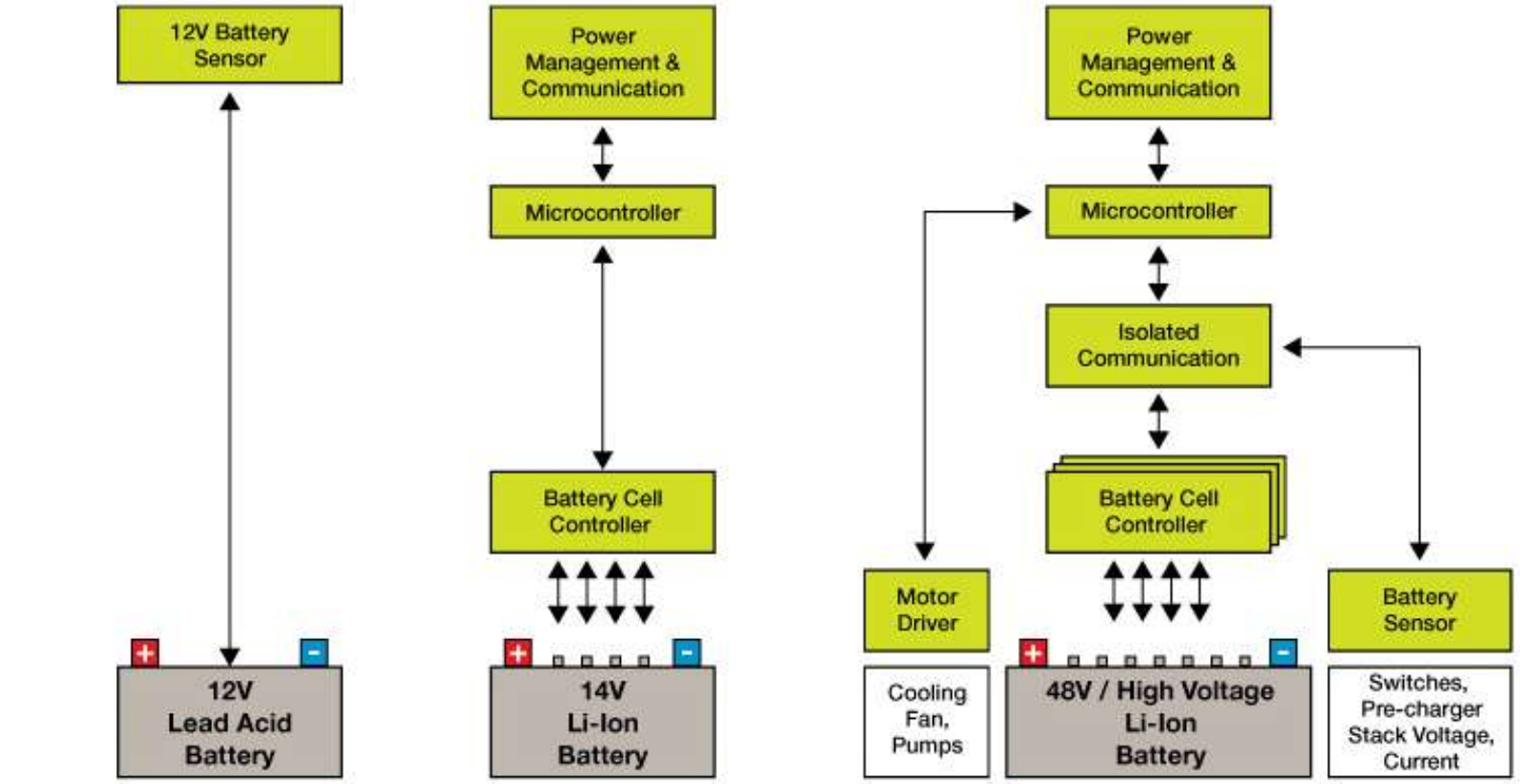
Battery Cell Controller	Automotive	Industrial / Consumer
14-Cell	MC33771	-
Isolated Physical Layer	MC33664	-

Li-Ion Battery Charger	Automotive	Industrial / Consumer
Linear Charger	-	MC34671/3/4/5
Switching Charger	-	MC32BC3770

Alternator Regulator	Automotive	Industrial / Consumer
No-Protocol	TC80500 (Die)	-
LIN-Based	TC80600 (Die & TO220)	-

Freescale Battery Management System Solutions

Battery Management



Freescale Technology

Battery Cell Controller

MC33771 14 Cell Li-ion Battery Cell Controller

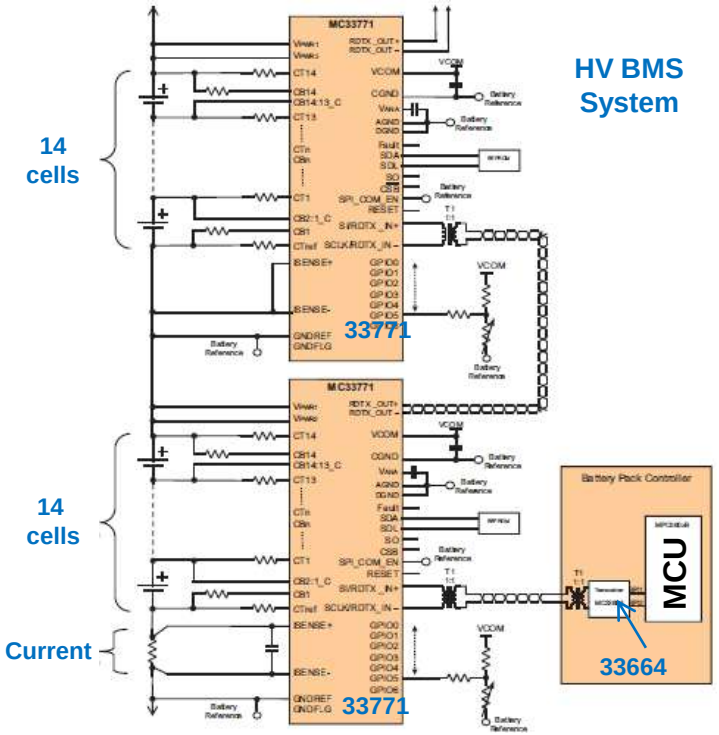
Scalable ISO26262 ASIL-C compliant controller for 48 to >1000 V packs with 2 Mbps transformer coupled daisy chain transceivers, cell balancing FETs and current sensors reducing BOM cost 50%

Differentiating Points

- **Single chip** 48 V battery control scalable to > 1000 V
- **ASIL-C** functional safety compliant at **50%** system BOM cost
- **300 mA** cell balancing transistors and 0.5% current sensors
- **2 Mbps** differential communication transceiver
- >2.5x higher transformer coupled daisy chain isolation (3750 V)
- Companion communication interface IC for MCU SPI isolation
- **2 mV** voltage measurement accuracy
- 65µs one shot synchronized cell impedance determination
- **Fast data acquisition**: 3.6 ms for 96 cells, 4.5 ms for 112 cells
- Functional verification & **diagnostics** supporting ISO26262
- Automotive robustness: ESD, EMC, **Hot plug**, AEC Q-100

Product Features

- **9.6 V ≤ V_{PWR} ≤ 61.6 V** operation, 70V transient
- **14x** differential cell voltage + stack voltage measurement
- **7x** ADC + GPIO + temperature sensor Inputs
- Low power modes
- 64 pin QFP package
- Low-level drivers to simplify SW development



Typical Applications

Automotive hybrid and electric vehicles

- 48 V BMS and HV BMS (>1000V)

Industrial

- Energy storage systems (ESS)
- Uninterrupted power supply (UPS)
- E-bikes, E-scooters

Battery Cell Controller (BCC) | Isolated Communication Overview

Premium BCC

MC33771ASP (SPI comm)
MC33771ATP (TPL comm)

- Precise differential cell voltage measurement
- Cell OV/UV, O/U temperature
- Synchronized current measurement
- Coulomb Count
- Cell balancing
- Temp measurement
- Functional verification and diagnostics
- Communication:
  - 2 MHz half duplex differential
  - SPI 4 MHz
- Package: 64-lead LQFP EP
- Temp range: -40 C to +105 C

Advanced BCC

MC33771ASA (SPI comm)
MC33771ATA (TPL comm)

- Precise differential cell voltage measurement
- Cell OV/UV, O/U temperature
- Cell Balancing
- Temp Measurement
- **Functional verification and diagnostics**
- Communication:
  - 2 MHz half duplex differential
  - SPI 4 MHz
- Package: 64-lead LQFP EP
- Temp range: -40 C to +105 C

Basic BCC

MC33771ASB (SPI comm)
MC33771ATB (TPL comm)

- Precise differential cell voltage measurement,
- Cell OV/UV
- Communication:
  - 2 MHz half duplex differential
  - SPI 4 MHz
- Package: 64-lead LQFP EP
- Temp range: -40 C to +105 C

BCC Samples: Now
Production: Q4 2015

Transformer Physical Layer MC33664ATL1

- Differential transformer driver / receiver
- Bus and MCU wake-up
- SAFE output (Fail-Safe implementation)
- Operating voltage down to 3.5 V (cranking)
- On-board oscillator
- Analog bit filter
- Package: 16-lead SOIC
- Temp range: -40 C to +105 C

TPL Samples: Now
Production: Q1 2015

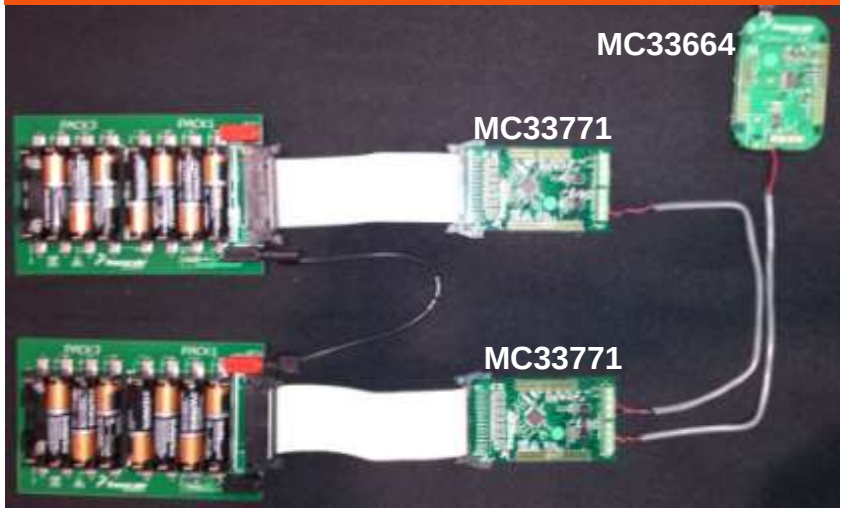
MC33771 | MC33664 Battery Cell Controller Enablement

- **Fast Evaluation of device performance**
  - Evaluation boards for MC33771 and MC33664
    - KIT33771ASP1EVB
    - KIT33664EVB
- **Reference Designs**
  - 48 V battery management systems (BMS)
- **Technical Documentation for ease with design**
  - Data sheets
  - EVB user guide content
  - Safety assessment / FMEDA in development
  - EMC/DPI reports

Orderable at freescale.com/analogtools

KIT33771ASP1EVB and KIT33664EVB

High voltage battery management system
Freedom Platform + MC33664 + daisy chain MC33771



Analog System Solution Key Products

Analog System Solution

- 77 GHz Radar
- Airbag
- Valve Controller
- Programmable Solenoid Controller
- Small Engine Controller

System On Chip
Safety
Diag. & Protection

77 GHz Radar	Automotive	Industrial / Consumer
VCO, TX, RX Packaged chipset	MC33MR2001V/T/R	-

Airbag	Automotive	Industrial / Consumer
	MC33789 – MC33797	-
Reference Platform	RDAIRBAGPSI5	-

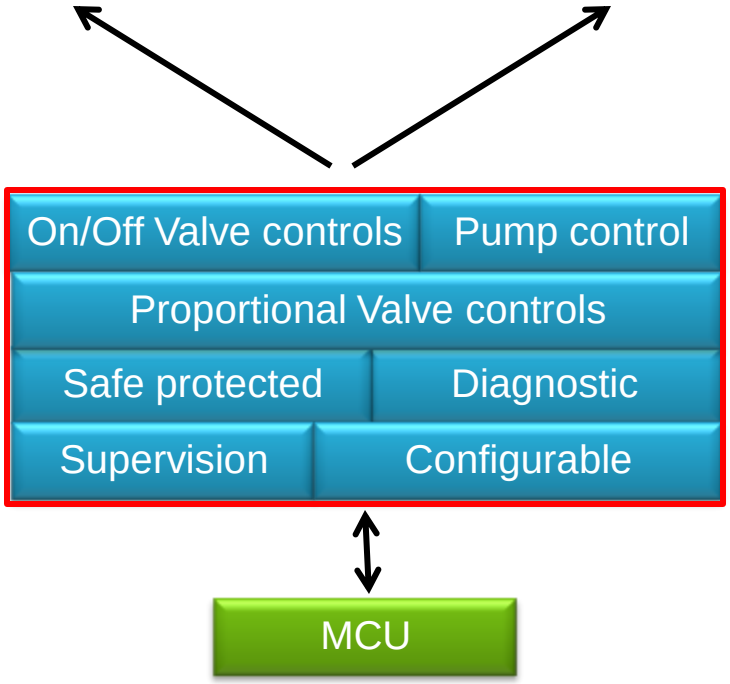
Valve Controller	Automotive	Industrial / Consumer
Octal SoC	-	MC34SB0800
Quad SoC	-	MC34SB0410

Programmable Solenoid	Automotive	Industrial / Consumer
Direct Fuel Injection up to 6-cyl.	MC33816	-

Small Engine Controller	Automotive	Industrial / Consumer
Engine control for 1-to-4 cylinder	MM912_812 MC33813 – MC33814	

Valve and Pump Controller

MC34SB0800 / MC34SB0410 Integration Solution



VAPS System-on-Chip
up to 36 V

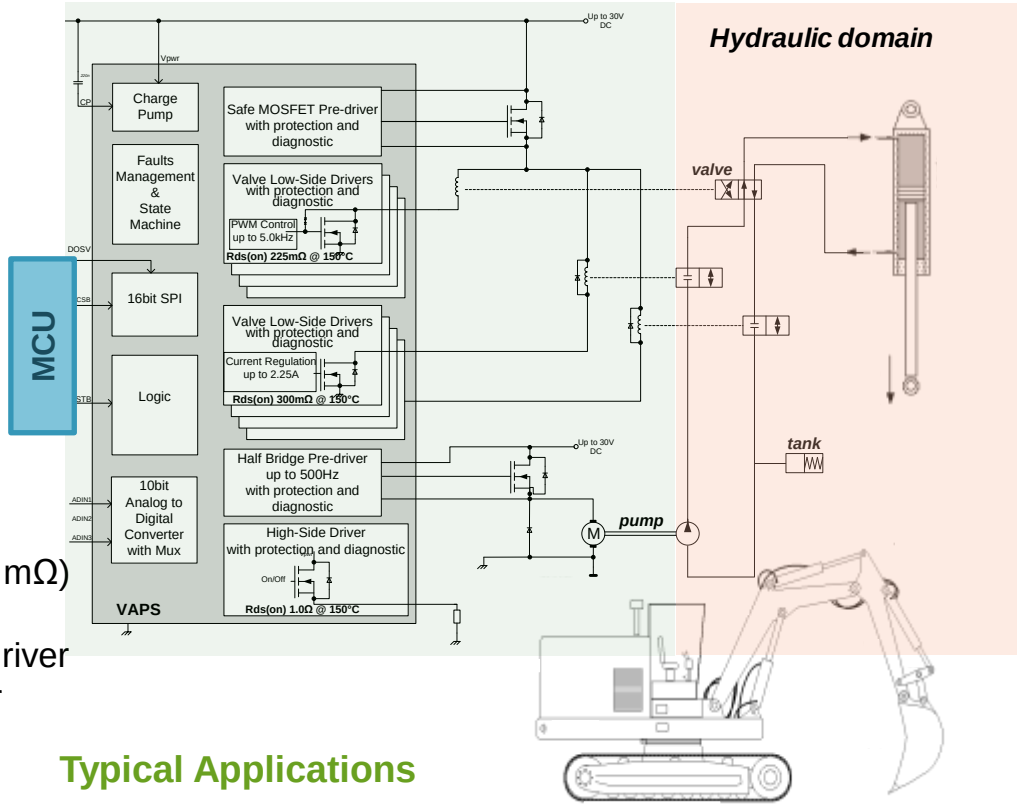
MC34SB0800 / MC34SB0410 – Valves and Pump Controller

Differentiating Points

- Best thermal efficiency due to exposed pad (<2°/W) and low Rds(on) (<300 mΩ)
- Design-in simplicity thanks to **SPI** interface
- **Real-time** valve **current regulation**
- Robust and **secure solution** thanks to safe MOSFET switching off all the valves in case of issue

Product Features

- **8 x valve drivers**
  - 4 x **PWM** or precision **current regulated** **+/- 6% w/o calibration** up to 2.25 A (300 mΩ)
  - 4 x **PWM** up to 5 kHz, 5 A (225 mΩ)
- Integrated valve **protection** including HS pre-driver
- Integrated DC pump motor pre-driver controller 500Hz PWM
- Self protected high-side driver (1.0 Ω)
- Self protected low-side drivers (14 Ω)
- Die temperature warning
- Fault management & State Machine
- 6 V to **36 V continuous operation**, 40 V transient
- **10-bit A**nalog-to-**D**igital **C**onverter
- 16-bit **SPI** interface with watchdog
- 3.3 V & 5.0 V TTL/CMOS compatible



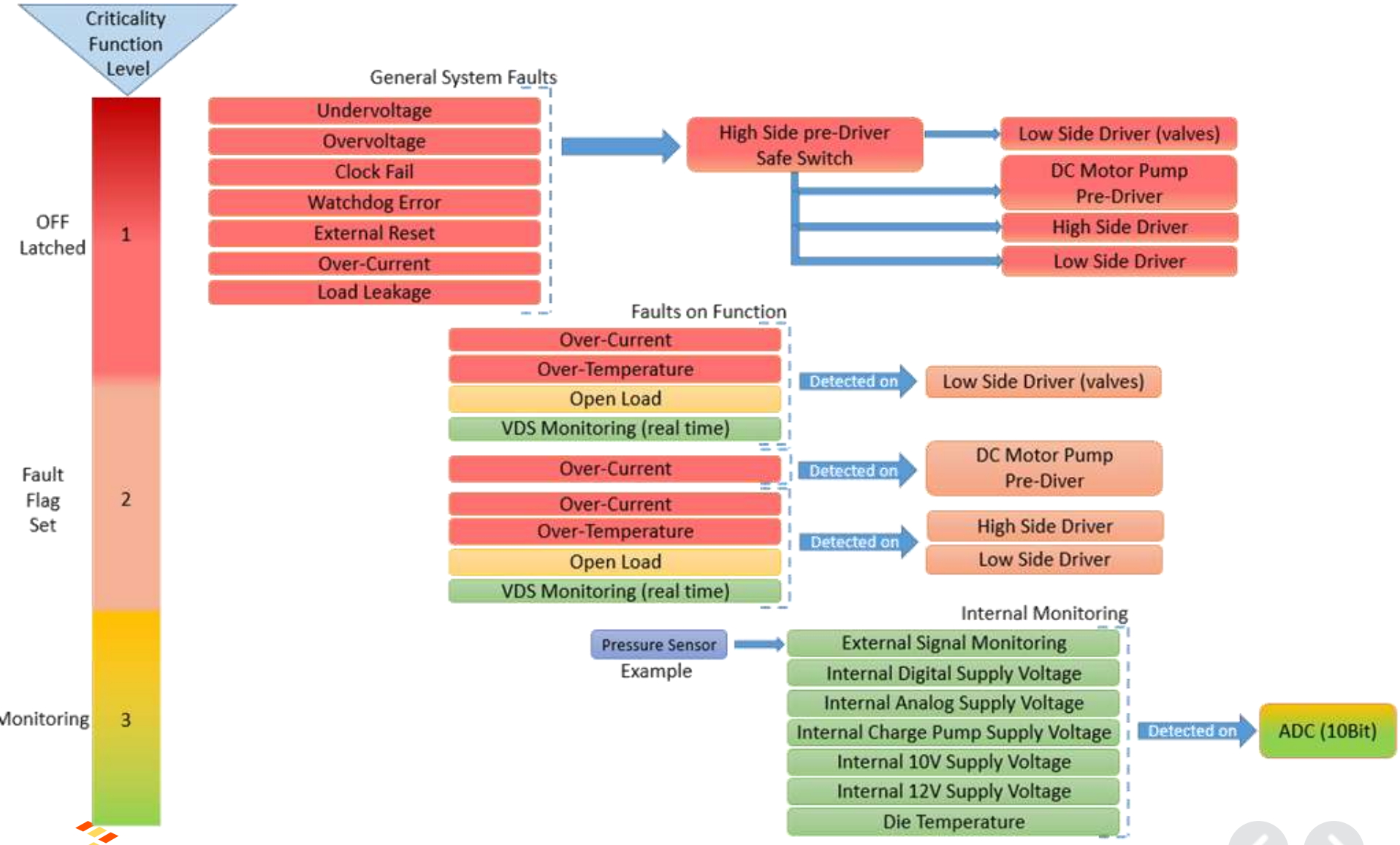
Typical Applications

- Hydraulic & Pneumatic systems
- Motor pump control
- Safe systems (agricultural, pharmaceutics, cryogenics…)

LQFP64 10x10

Samples / EVB availability: Now

MC34SB0800 – Supervision Embedded



Conclusion

Making …

Embedded …

Systems …

Better !

Freescale Analog MCU Attach

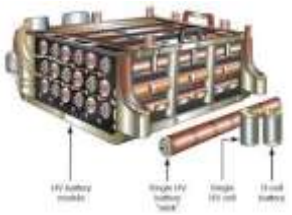
Making embedded systems better

Power Driver

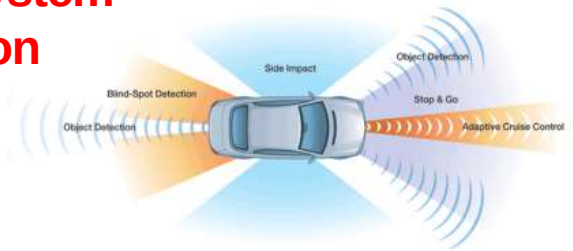
Power Switch

System Power Management & Interface

Battery Management



Analog System Solution



Analog and Sensor Summary

- Bridging real world physics to connected processors
- Preferred partner for complete embedded system solutions
- Leveraging MCU attach to diversify customers and markets
- Expanding strong automotive position
- Extending leadership with differentiated products

Robust Reliable Performance

Freescale.com/analog
Freescale.com/sensor

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