



Freescale Technology Forum - 2008



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Future Electronics - System Design Center

Future Solutions on Automotive & Industrial Application

For Internal Use Only

**Making the Difference
Daily**



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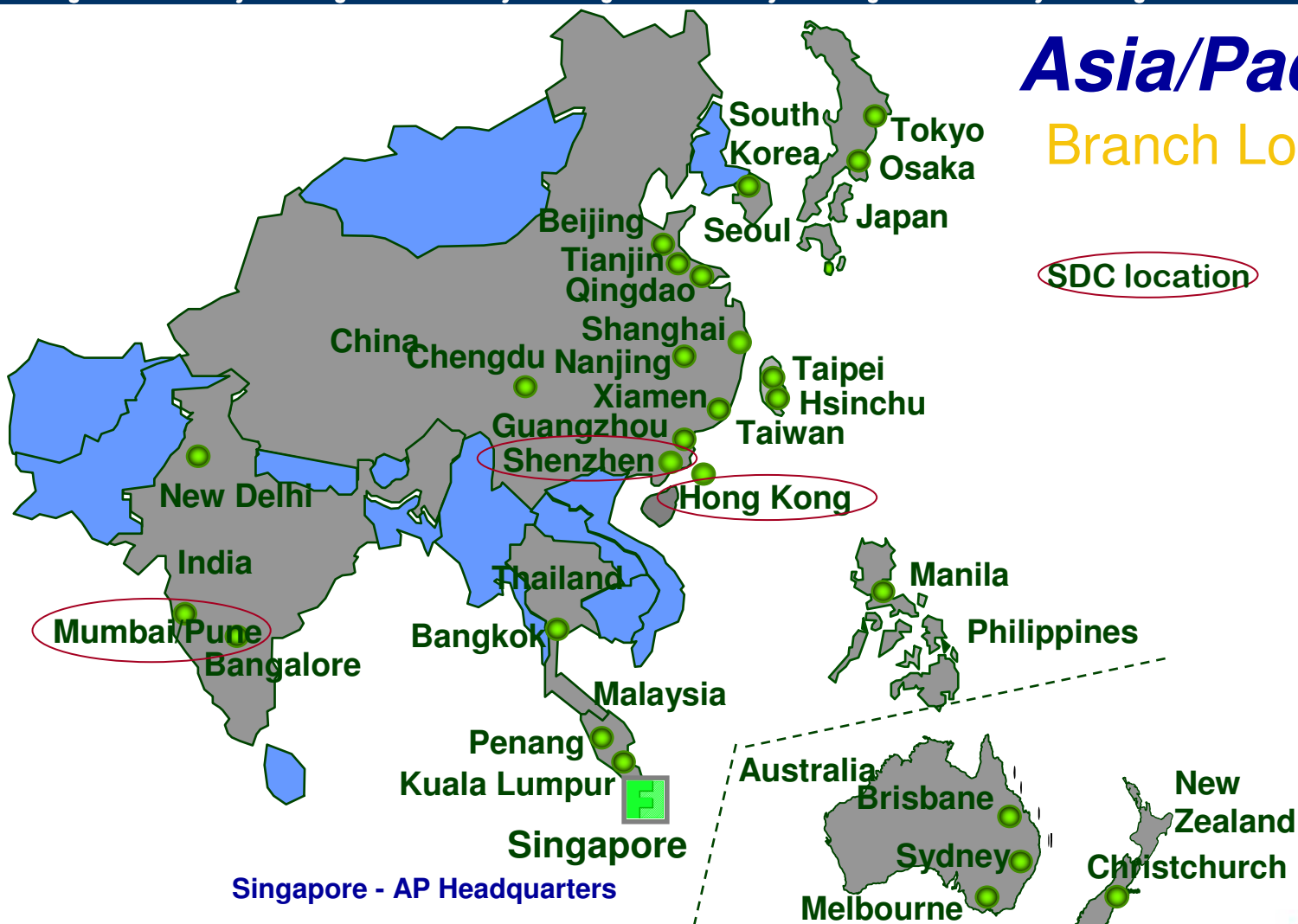
Introduction to Future SDC

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Branch Locations

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Asia/Pacific Branch Locations

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Three Locations

- **Hong Kong**
 - * Operations & management office
- **Shenzhen**
 - * NPI, customer project development
 - * Focus on digital consumer, industrial, automotive, High power LED lighting and power management applications
- **Mumbai/Pune**
 - * Focus on automotive solution
 - * Software development center

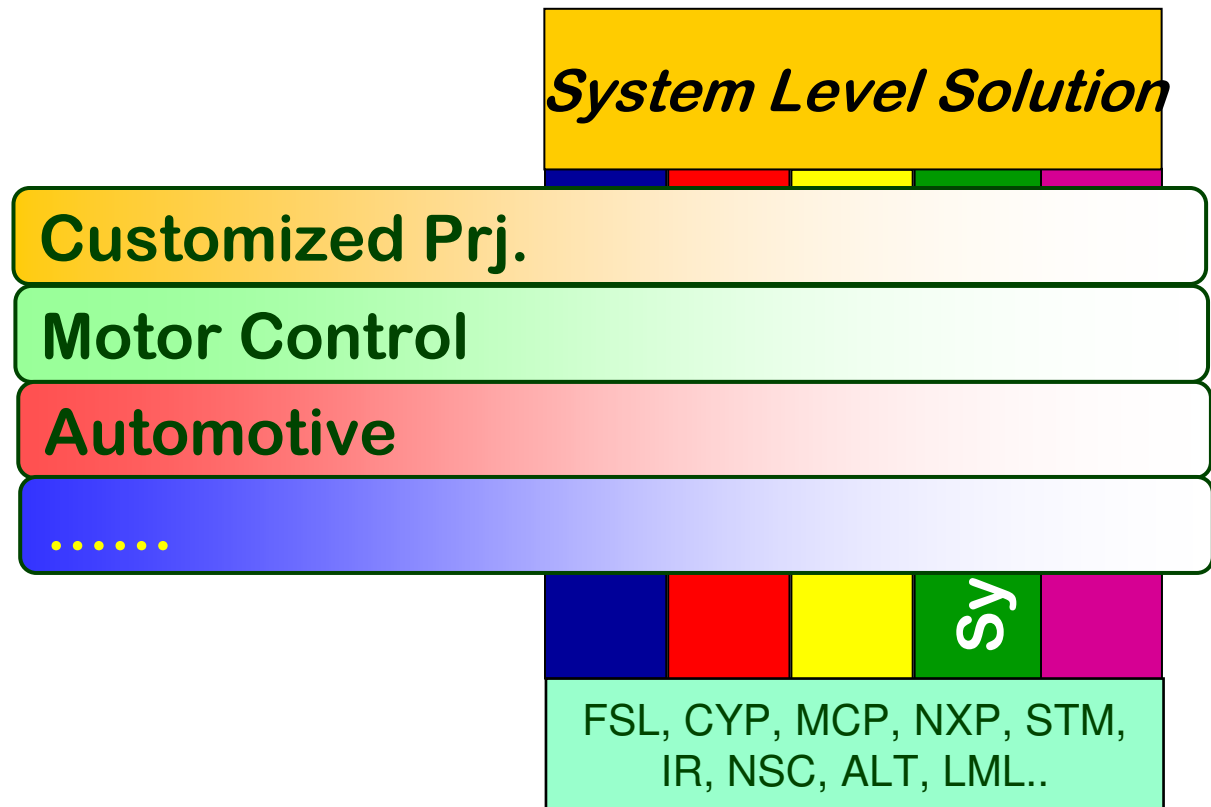


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Various Services

- **Customer Specific Projects**
 - * Provide fast, time-to-market solutions according to customer specifications
- **End System Development**
 - * Target applications with multi-customer markets
 - * Support customers with turnkey designs
- **Supplier New Products Introduction (NPI)**
 - * Focus on key suppliers' newly introduced product devices family
 - * To be the premier product launch program in the industry
 - * Reference design, badge board/demo board and promotional flier

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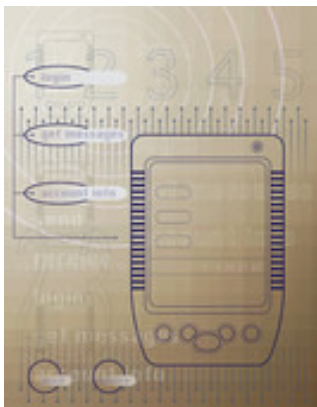


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Market Focus

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Digital Consumer



Industrial



Automotive



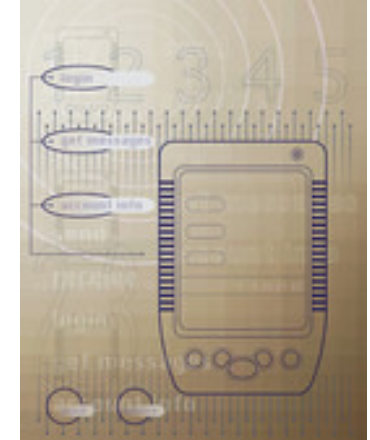
Lighting

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Digital Consumer Applications

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- White goods – Capsense
- Photo Frame - Capsense
- Speaker System (Class-D)
- Telephone Voice Recorder
- Battery Chargers
 - * NiMH / NiCd,
 - * Li-ion
 - * Lead Acid



Digital Consumer



White Goods



Speaker System



Battery Charger



Photo Frame - Capsense



Telephone Voice Recorder

- **Industrial Power Supply**
 - * AC – DC (500W-2000W)
 - * DC – DC (5W-150W)
- **Motor Control System**
 - * AC Induction Motor Control
 - * BLDC Motor Control
 - * PMSM Motor Control



Industrial



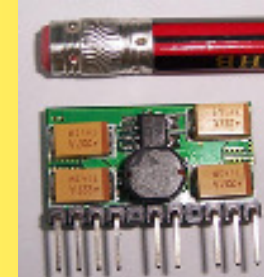
500W SMPS with PFC



Motor Control



MC control board



DC-DC Module



SMPS for Sub Woofer

- Digital CDI, DCI
- Digital Dashboard
- Engine Monitoring System
- Window Lift Control with Anti-Pinch
- Car Reverse Parking Sensor System
- Passive Keyless Entry (PKE)



Automotive



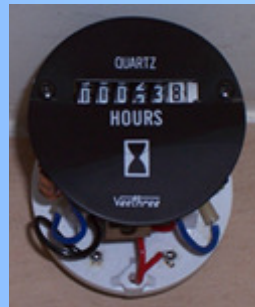
WL



Dashboard



CDI



Hour Meter



Car Reverse sys



Dashboard

Lighting Applications

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- LED backlighting
- Digital Lighting Control System
 - * DMX512
- LED Wall
- Luxeon Driver
 - * AC/DC
 - * DC/DC
- Table Lamp
- Street Lamp
- DRL, Fog Lamp
- MR16, GU10..



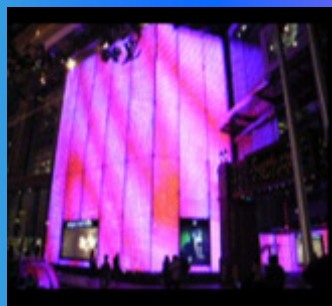
Lighting



LUMILEDS
FUTURE ELECTRONICS



LED Backlighting



Exterior Lighting



Table Lamp



DRL



GU10



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Automotive Electronics

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There are four major segments are classified in automotive electronics :

- Powertrain System
- Body and Chassis
- Safety
- Infotainment



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Future Technical Supporting for Automotive customers

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Technical support for customers' automotive projects

- Internal TSM support
 - * Project is developed by customer.
- Internal SDC support
 - * Project is developed by Future SDC team.
- External Design House support
 - * Limited resource inside SDC team or new technology project needs external resource support.



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Future Automotive Solutions

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New focus automotive projects

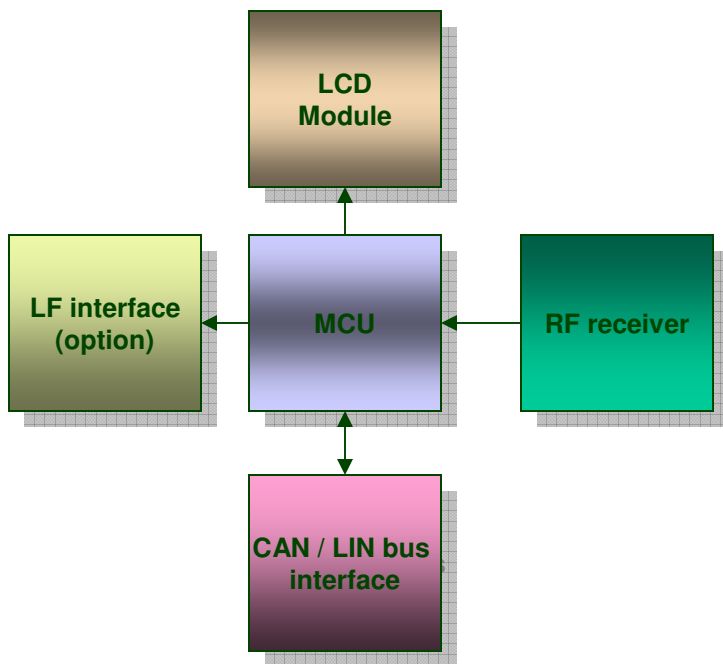
- Tire Pressure Monitoring System (TPMS)
- Infotainment
- Body Control Module
- Passive Keyless Entry (PKE)

- **Market demand will be increase very fast in 2008.**
- **Market expected high integrated solution in TPMS which included Motion sensor, pressure sensor, temperature sensor, 8-bit MCU and RF chip.**
- **Few suppliers with high integrated TPMS solution in market, Freescale MPXY8300 series is high integrated solution.**

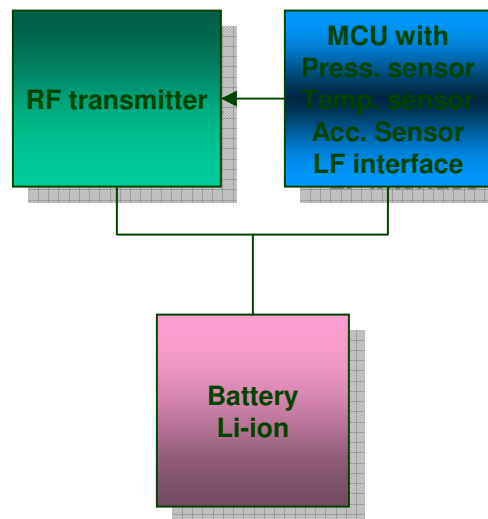


TPMS System Block Diagram

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TPMS Receiver



TPMS Transmitter

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Body Control Modules (BCM)

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- **Based on MCU, driver, interface and analog products**
 - Freescale 8 bits, 16 bits micro-controller and IDC
 - Power Actuator - HS SW, LS SW and H-bridge
 - Integrated interface drivers
- **BCM products with CAN / LIN bus interface:**
 - Mirror
 - Power window with Anti-pinch
 - Power lock
 - Sunroof
 - HVAC with IR control
 - Auto Front-lighting System (AFS)
 - Intelligent wiper
 - Advanced Dashboard

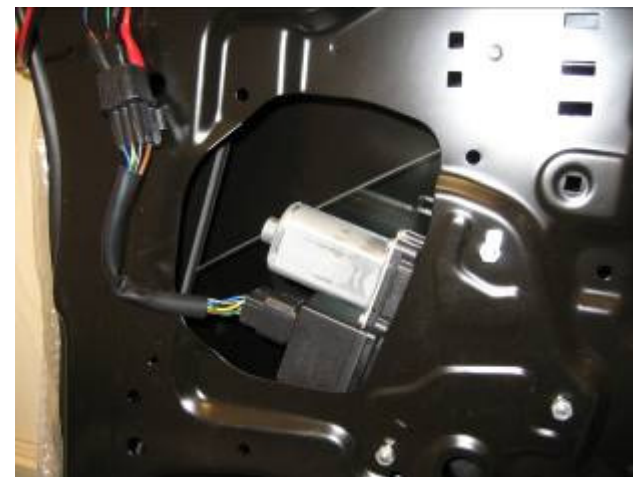


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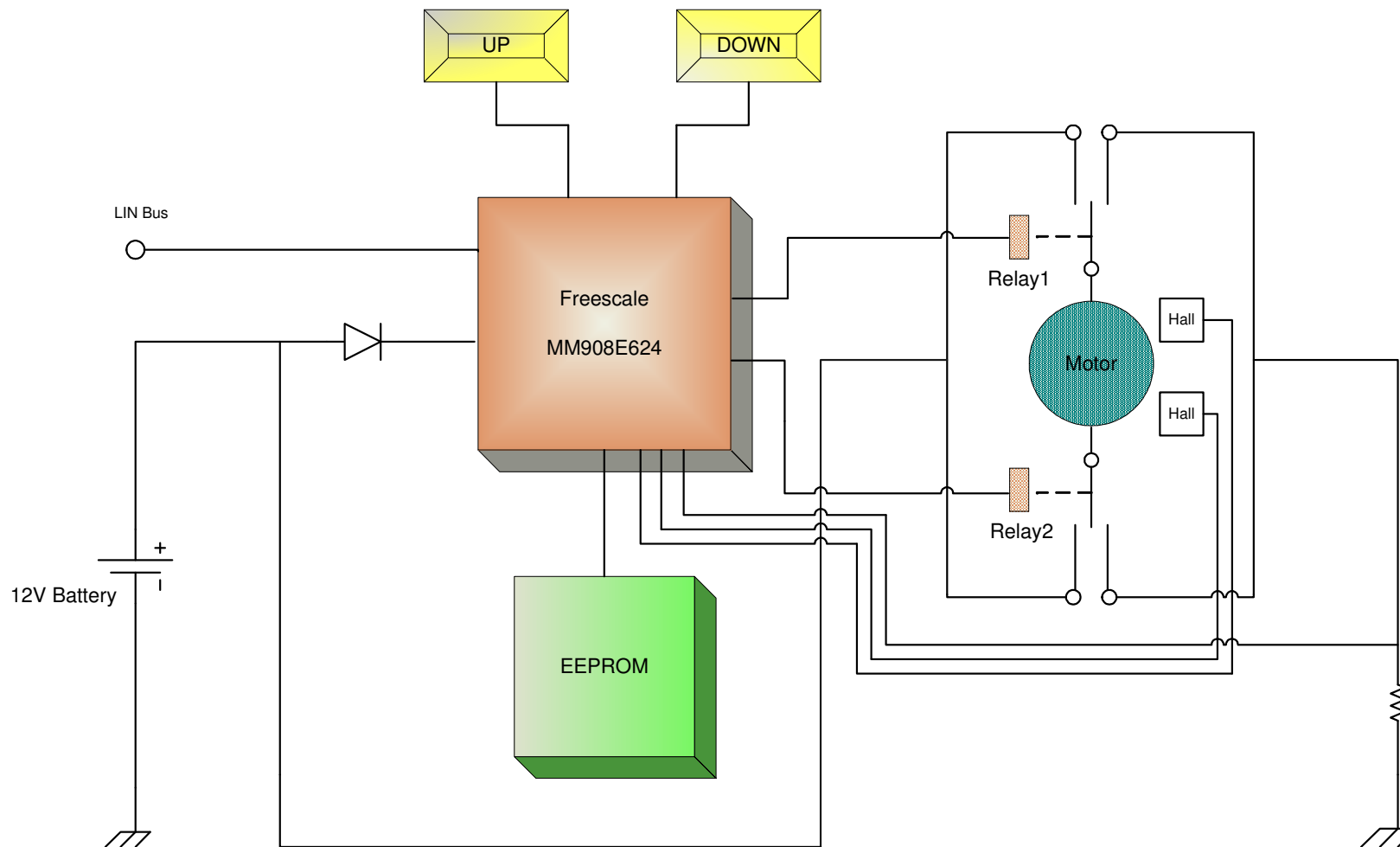
BCM- Anti-pinch Power Window

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- Using Freescale IDC chip MM908E624
- Simplest solution only has two chips, another is memory chip only for parameters storage.
- Employed two Hall Effect switches and a resistive current sensor as the position and motor current detection devices.
- Most of the Automotive requested protections are implemented into the circuitry.



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Block Diagram for the Anti-pinch Power Window

BCM- Rain Sensor

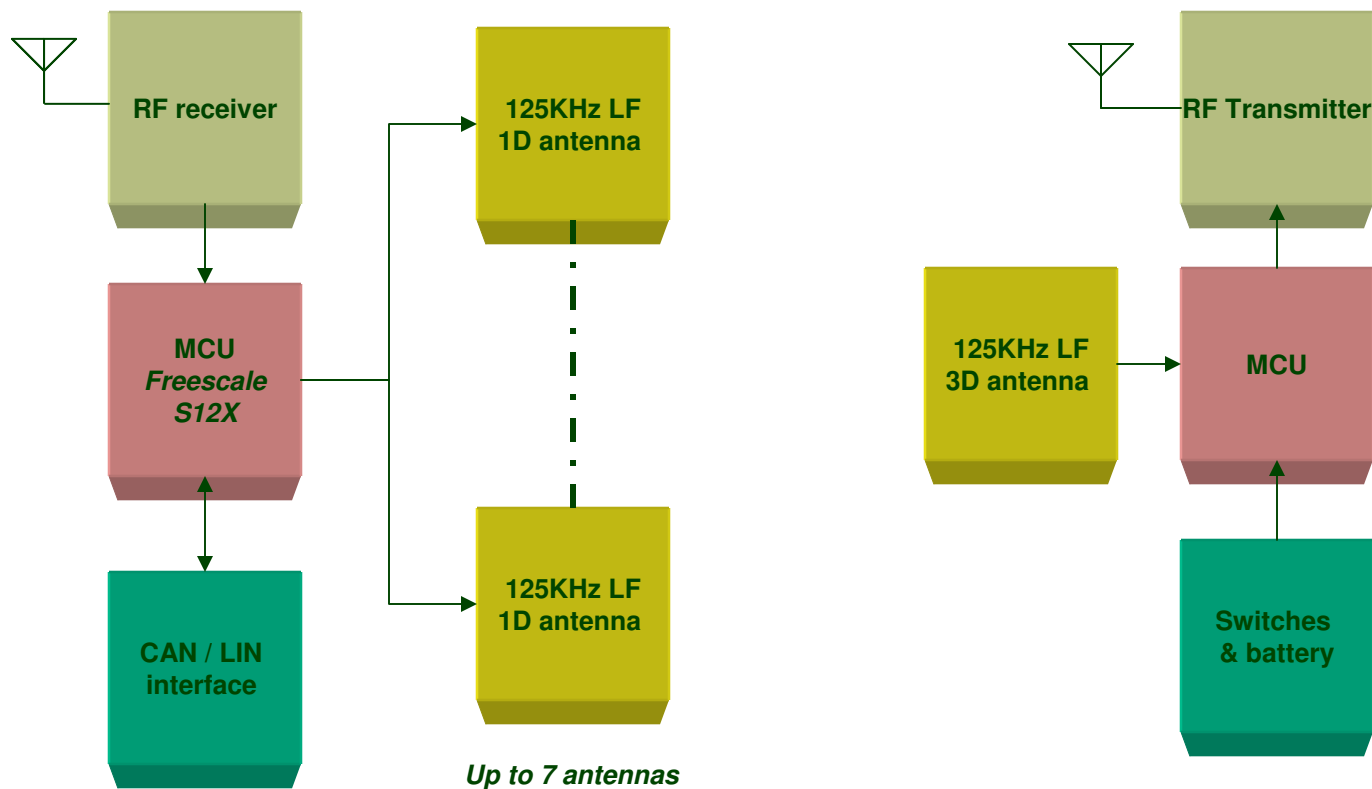
- **Designed with Freescale 9S08EL microcontroller**
- **Using High power IR emitters and IR sensors.**
- **Built-in with LIN bus 2.0 interface which link up with wiper control.**
- **Required optical design the for both rain sensing and light sensing.**
- **Performance depend on the software algorithm according to the data from IR detectors and light detectors.**



Passive Keyless Entry (PKE)

- Based on RFIC and RFID chips with Future's In-house development.
- Included RF and LF technologies.
- Encryption is used for ID code and data security.
- Work with some potential customers to develop the PKE project.





PKE Block Diagram

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Freescale S12X MCU is employed

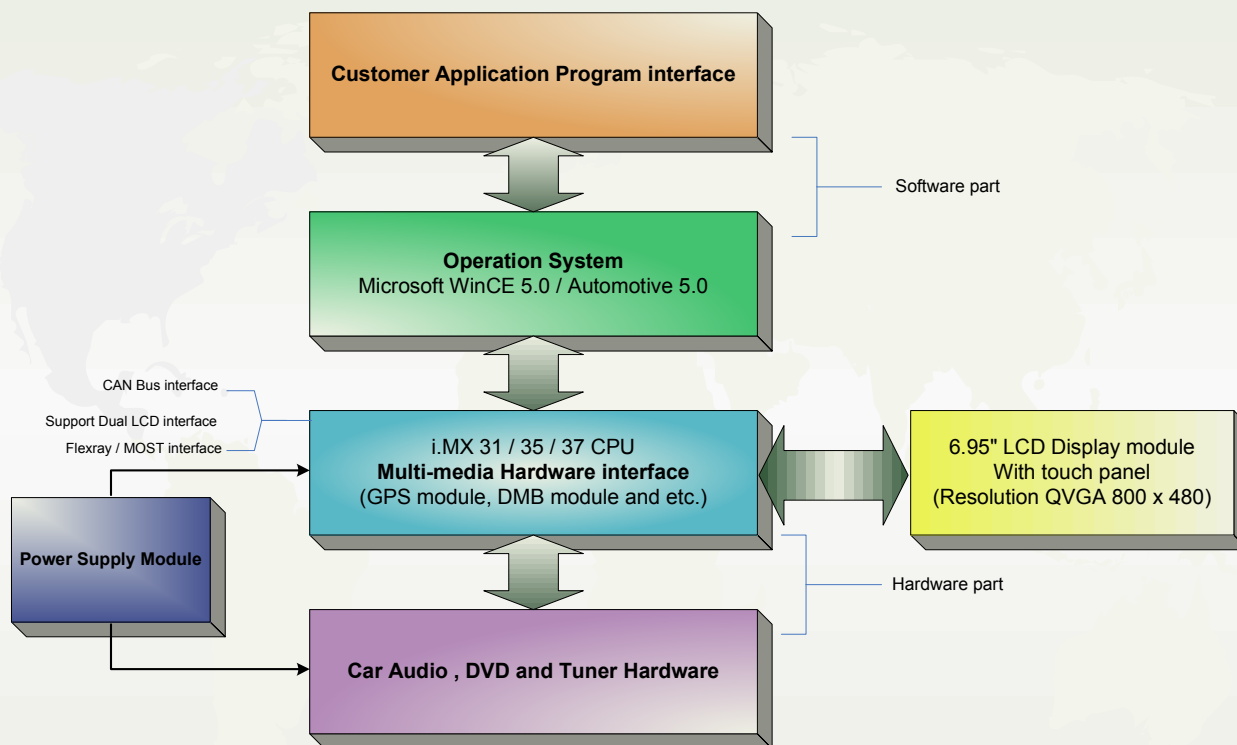
PKE Receiver

- *16 bits Freescale 9S12X control the performance.*
- *Operation Voltage : 10V ~ 16V DC*
- *Operation Temperature : -40°C ~ 85°C*
- *With seven 125KHz LF interface transceivers.*
- *1D 125KHz LF antenna located at different locations,*
- *RF receiver with ISM band frequency range.*
- *Optional with CAN Bus which interface with Engine Control Module (ECM) for Start/Stop button interface.*



- Use Freescale ARM base processors as HW platform.
- Target Microsoft Automotive O/S to develop the automotive Infotainment solution.
- Add advanced automotive features into one platform.
- Included Navigation, TMC, Video, Audio, Vehicle information, Safety information and communication.
- Easy to add new features on the platform by software.





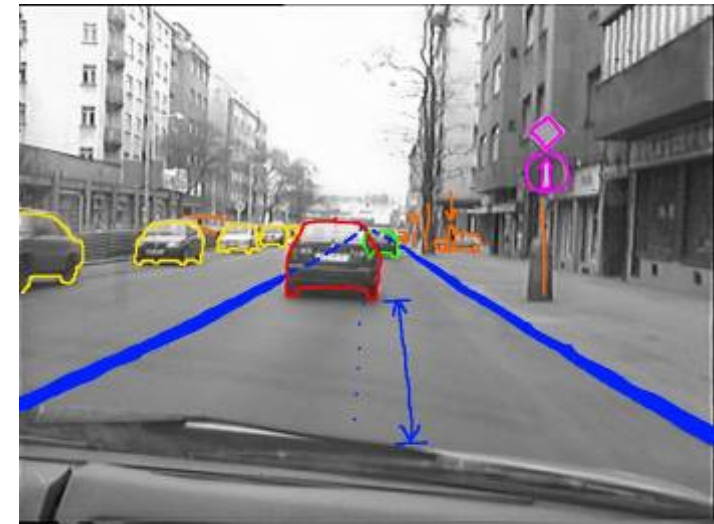
Functional block diagram of Car Infotainment System

IDH solution

- Future's IDH has a completed prototype based on Freescale i-MX31 and WinCE5.0
- The car infotainment prototype included:
 - Navigation - GPS
 - Mobile TV – DMB
 - Multimedia – MP3, MP4, JPEG playback
 - DVD playback
 - Car Audio and sound DSP control
 - Feature Setting
- With 6.95" LCD display



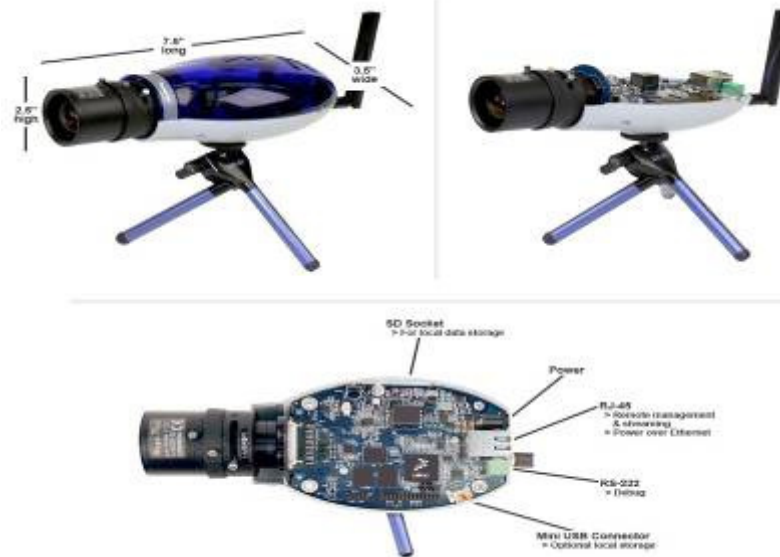
- Rear Parking Camera with parking assistance
- Night Vision
- Airbag with seat occupant
- Driver assistance system
-



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Future i.MX Solution Support



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Consumer and Automotive Convergence

<p>Mobile Consumer</p> <ul style="list-style-type: none"> ▶ Anytime, anywhere access to content and information ▶ High quality audio and multimedia ▶ Small form factor & low power requirement 		<p>Automotive Infotainment</p> <ul style="list-style-type: none"> ▶ Audio, video and navigation ▶ Free-to-air and subscription content models ▶ Mobile consumer connectivity
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Proven platforms for mass market consumer

High Performance Silicon

- i.MX, Symphony™

Broad OS Support

- WinCE, Linux, QNX

Middleware

- Multimedia Codecs, Filesystems

Hardened Solutions for automotive

Zero Defect Designs

- AEC-Q100 qual, 5-10 yr life cycle

Software Upgradeability

- Performance headroom for new multimedia standards
- S/W drops on consumer cycles

Freescal*e* i.MX Application

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i.MX31/32 enabled devices



Harmon Kardon
GPS 810 WVGA LCD



Thinkware
GPS+T-DMB Player



Toshiba
gigabeat



Toshiba
Mobile TV
player



Microsoft
Zune



Ford Sync
In-car
Communication and
Entertainment
System

SYNC
Microsoft



SONY
Mylo 2 Personal
Communicator



Sagem
AW5080w PotoFrame



Microsoft
Zune 2



Microsoft
Zune 2 Flash



Haier AOL
WiFi PMP



Aigo
P881+ PMP

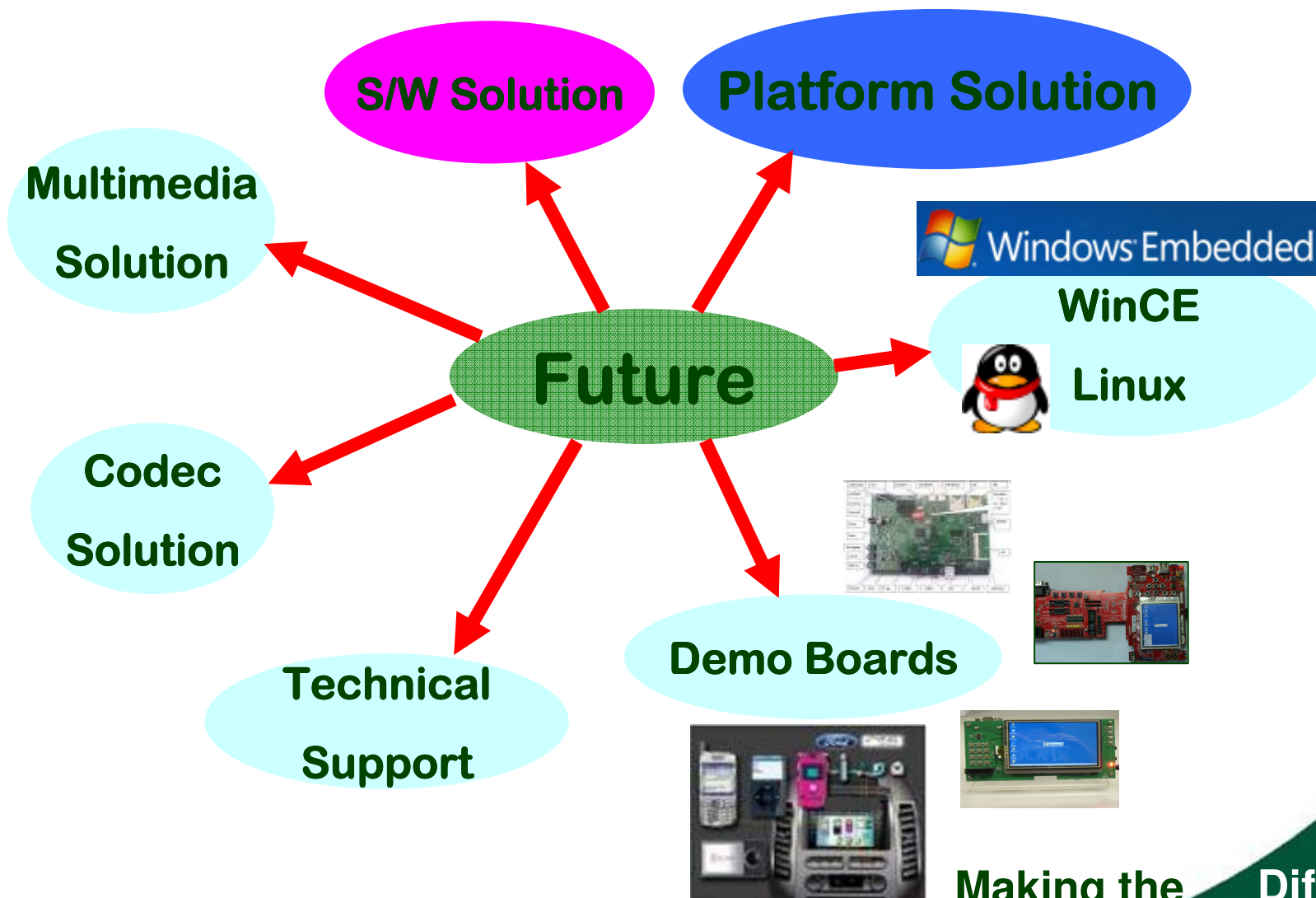


Aigo
P339 PMP



Favicon
TN1000 GPS+DMB
Player

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Supported System

- i.MX27/31/32
- WinCE 5.0 & 6.0 O/S
- Linux 2.6 O/S

Communication

- Support Video & Audio Codec
- T-DMB, CMMB, TVB-T

Supported Codec

- Video codec: DivX 3/4/5
- MPEG1/2/4, H.264
- Still image: JPG/BMP, GIF
- Audio codec:
MP3, AC3, WMA, WMV, AAC
- Multimedia files:
AVI, WMV, ASF etc.

VPU codec software package - with standard c-callable API

WinCE Platform:

- DShow filter wrapper for H.264 BP decoder
- DShow filter wrapper for H.264 BP encoder
- DShow filter wrapper for MPEG-4 SP/H.263 P3 decoder
- DShow filter wrapper MPEG-4 SP/H.263 P3 encoder
- MP4 demuxer that supports H.264 or MPEG-4 and AAC or MP3 streams.

Linux Platform:

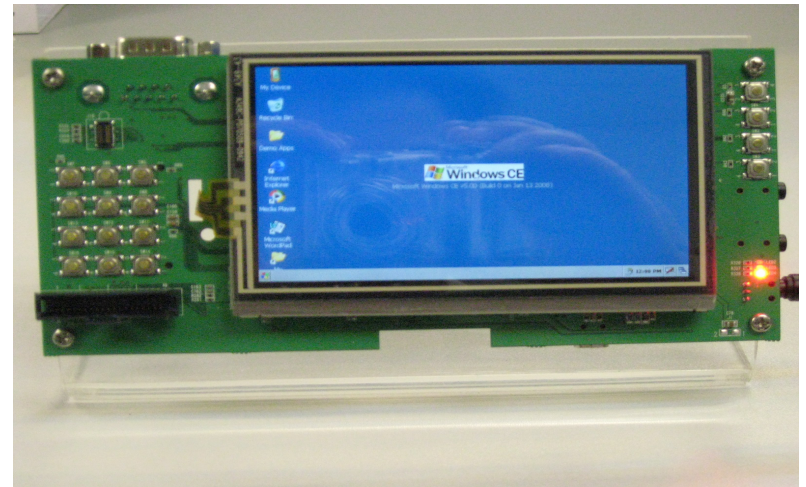
- Gstreamer plugin for H.264 BP decoder
- GStreamer plugin for H.264 BP encoder
- GStreamer plugin for MPEG-4 SP/H.263 P3 decoder
- GStreamer plugin for MPEG-4 SP/H.263 P3 encoder
- AVI demuxer that supports H.264 or MPEG-4 and MP3 streams
- MP4 demuxer that supports H.264 or MPEG-4 and AAC or MP3 streams

MM SOFTWARE CODECS - SDK DEVELOPMENT PLAN				
		LINUX 2.6 MX31	WinCE 5.0 MX31	WinCE 6.0 MX31
A/V releases		ADS/PDK	ADS/PDK	ADS/PDK
Release 2		21-Dec-07	21-Dec-07	21-Dec-07
SDK 1.2	AAC LC playback	AAC LC playback	AAC LC playback	AAC LC playback
	Enhanced aacPlus playback	Enhanced aacPlus playback	Enhanced aacPlus playback	Enhanced aacPlus playback
	MP3 playback	MP3 playback	MP3 playback	MP3 playback
	MP3 record	MP3 record	MP3 record	MP3 record
	WMA Standard playback	WMA Standard playback	WMA Standard playback	WMA Standard playback
	WMA Lossless playback	WMA Lossless playback	WMA Lossless playback	WMA Lossless playback
	WMAPro playback	WMAPro playback	WMAPro playback	WMAPro playback
	MP4 (MPEG-4+AAC) playback	MP4 (MPEG-4+AAC) playback	MP4 (MPEG-4+AAC) playback	MP4 (MPEG-4+AAC) playback
	MP4 (H.264+AAC) playback	MP4 (H.264+AAC) playback	MP4 (H.264+AAC) playback	MP4 (H.264+AAC) playback
	AVI (H.264+MP3) playback	AVI (H.264+MP3) playback	AVI (H.264+MP3) playback	AVI (H.264+MP3) playback
	AVI (MPEG-4+MP3) playback	AVI (MPEG-4+MP3) playback	AVI (MPEG-4+MP3) playback	AVI (MPEG-4+MP3) playback
	MP4 (MPEG-4+MP3) playback	MP4 (MPEG-4+MP3) playback	MP4 (MPEG-4+MP3) playback	MP4 (MPEG-4+MP3) playback
	M4A playback	M4A playback	M4A playback	M4A playback
	M4V playback	M4V playback	M4V playback	M4V playback
	MPEG-4/H.263 record	MPEG-4/H.263 record	MPEG-4/H.263 record	MPEG-4/H.263 record
	WMV/ASF playback	WMV/ASF playback	WMV/ASF playback	WMV/ASF playback
	MPEG-2 MP playback	JPEG display	JPEG display	JPEG display
	JPEG display			
	BMP display			
	PNG display			
GIF display				
V4L Source				
V4L Sink (Display)				
Release 2.1	1-Feb-08	1-Feb-08	1-Feb-08	
	Same as Release 2 (improved)	Same as Release 2 (improved)	Same as Release 2 (improved)	

i.MX31 Demo Specification

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- Support Wince 5.0&6.0 platform.
- Support DDR,SLC NAND.
- Support MC13783 power management.
- Support HDD,SD.
- Support USB OTG&HOST
- Support CMOS sensor, TV in/out, DMB.
- Support MPEG4,H.264, AVI,WMV, WMA,MP3 etc. video & audio Codec.
- Support to play TDMB contents.
- Support to develop application programs base Wince5.0 & 6.0



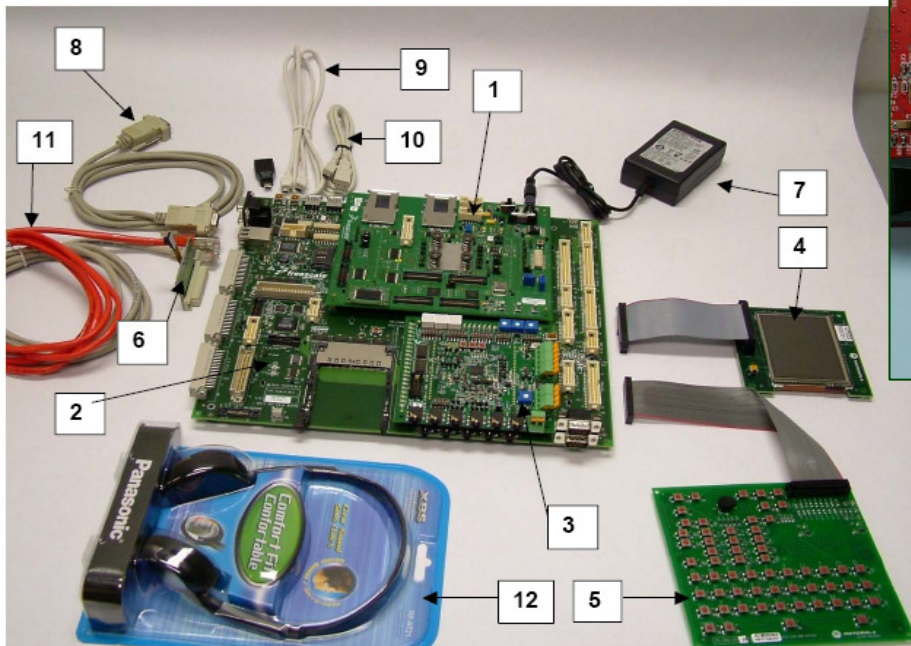
i.MX32 Demo Specification

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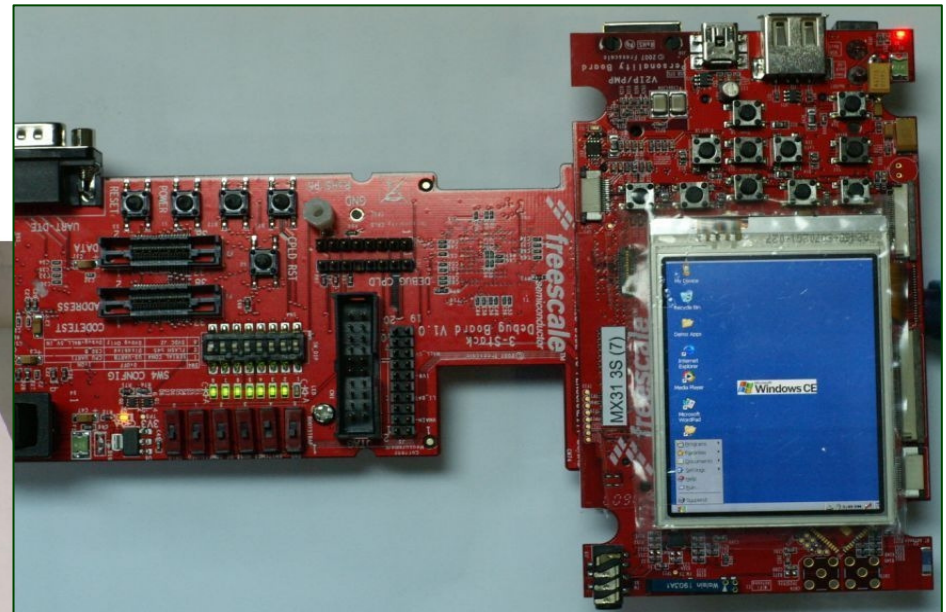
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- Support USB OTG&HOST
- Support CMOS sensor, TV in/out, DMB.
- Support MPEG4,H.264, AVI,WMV, WMA,MP3 etc. video & audio Codec.
- Support to play TDMB contents.
- Support application program developing base Wince5.0&6.0



Freescale PDK Development Platform



Freescale ADS Development Platform



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Freescal*e* i.MX BSP Status



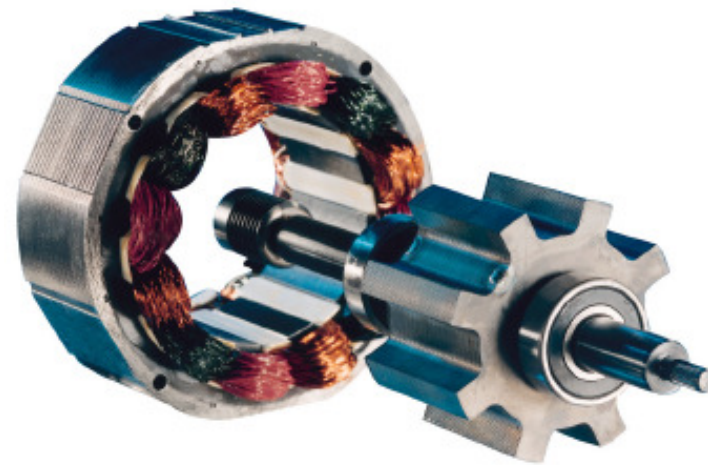
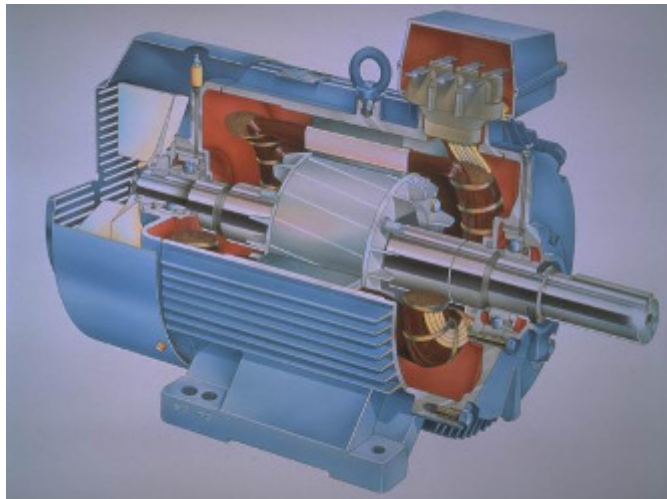
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Device	Tool	Win CE 4.2	WinCE5.0	WinCE6.0	Linux
MXS	ADS	Available			2.4
MXL	ADS	Available			2.4
MX21	ADS	Available	Available		2.4
MX21S	ADS	Available	Available		2.4
MX27 (Rev 2.1)	ADS		Available	Available	2.6
MX27 (Rev 2.1)	ADS/D501		Available	Available	2.6
MX31 (Rev 2.0)	ADS/PDK		Available	Available	2.6
MX32	ADS		Available	Available	2.6

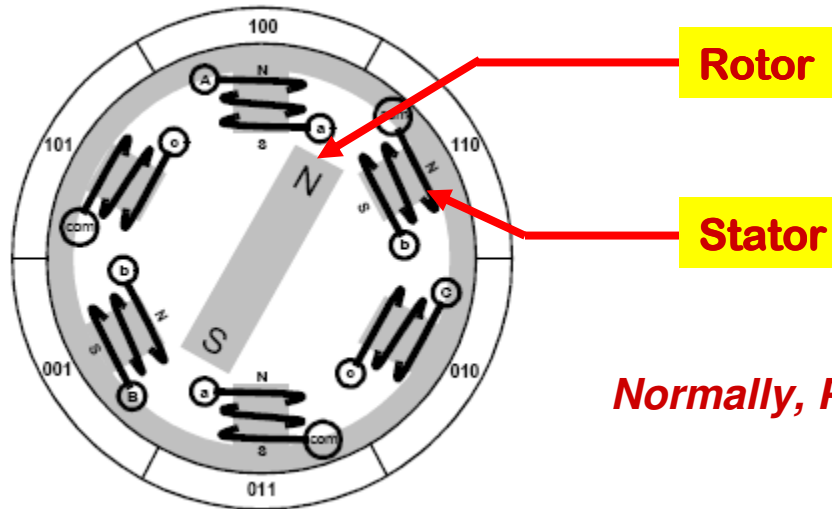
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Future Industrial Application on BLDC Motor Control



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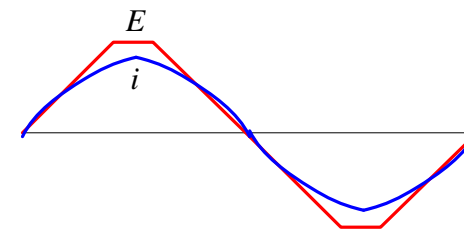
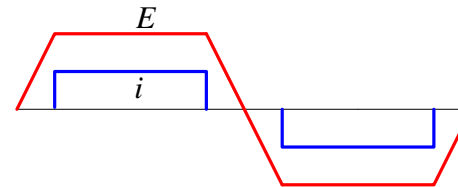
Key Characteristics:

- High ratio of torque and inertia
- High power density
- High efficiency
- Easy maintenance etc.

Normally, PM motor are classified into BLDC and PMSM

Difference:

- BLDC has trapezoid Back EMF & square waveform drive current
- PMSM has approximately sinusoid Back EMF & sinusoid drive current



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PM Motor Control

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BLDC key Characteristics:

- *Clean, fast, no sparks*
- *Smoother acceleration*
- *A longer life than brushed dc motor*

BLDC Motor principle:

- *Detecting rotor position*
- *Two phases stator windings are fed by dc voltage*
- *Two phases stator current produce stator flux*
- *Rotor flux interacts with stator flux to produce torque*

PMSM key Characteristics:

- *Lower noise*
- *Greater efficiency*

PMSM Motor principle:

- *Detecting rotor position*
- *Stator windings are fed by 3-phase AC voltage*
- *Stator current produce rotating stator flux*
- *Rotor flux interacts with stator flux to produce torque*
- *Rotor does keep up with stator rotating flux*

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56F8000 Series

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Freescal Digital Signal Controller Roadmap

56850 Series
120 MMACS
20-128KB RAM
81-144 Pins
-40°C to +85°C

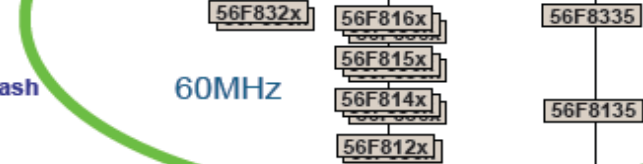


56F8400 Series
60 - 120 MMACS
Up to 1MB Program Flash
-40°C to +125°C

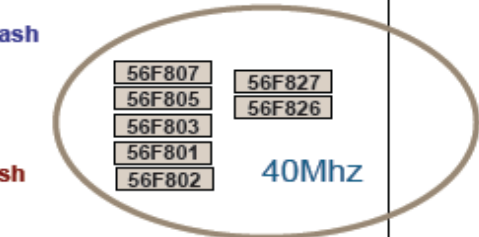


56F8300 Series
60 MMACS
32-512KB Program Flash
48-160 Pins
-40°C to +125°C

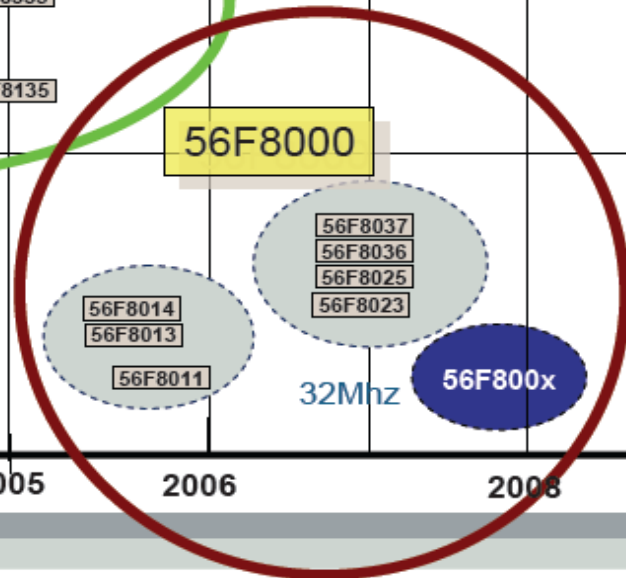
56F8100 Series
40 MMACS
32-512KB Program Flash
48-160 Pins
-40°C to +105°C



56F800 Series
30/40 MMACS
16-128KB Program Flash
32-160 Pins
-40°C to +85°C



56F8000 Series
32MMACS
12-64KB Program Flash
32 - 64 Pins
-40°C to +125°C



2005 2006 2008 2010

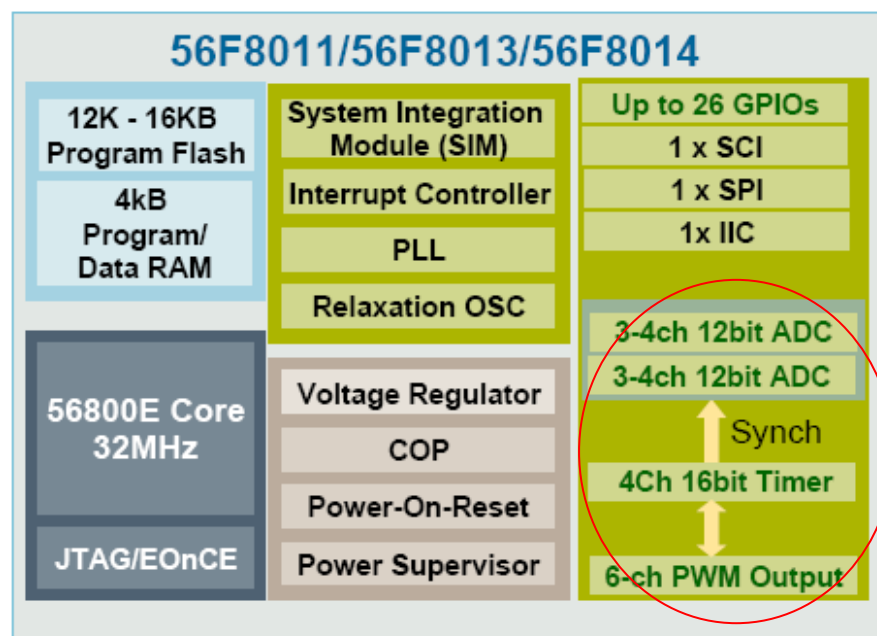
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56F8000 Series

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Cost Effective 56F8000 Solutions 56F8011/56F8013/56F8014

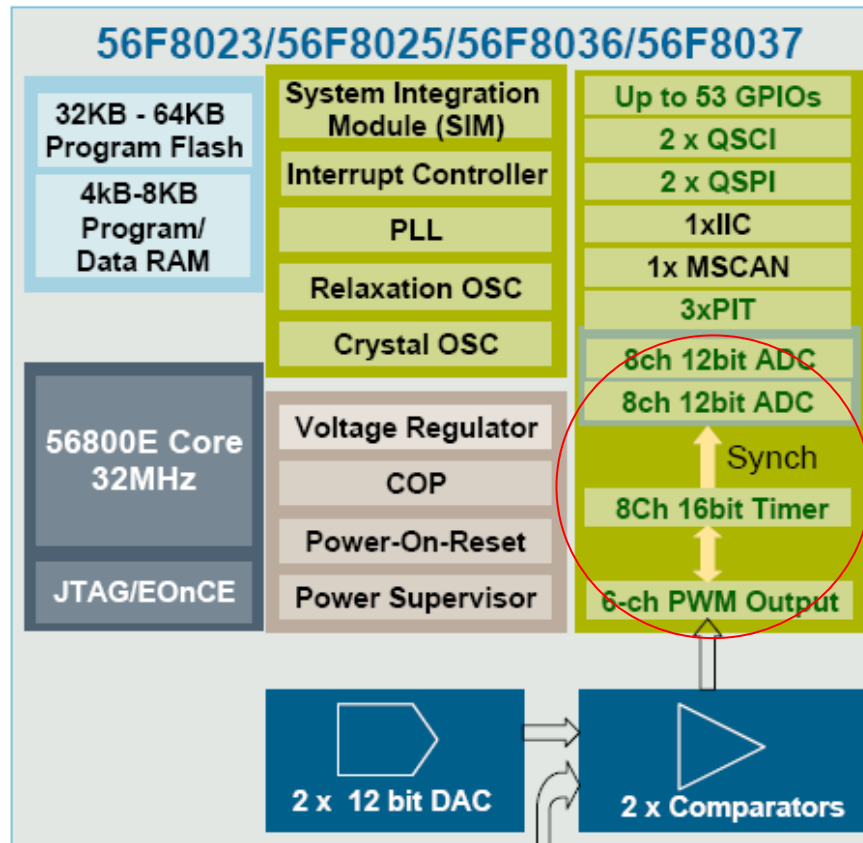


► Package: 32LQFP

- 32 MIPS Performance
- 12K - 16 K Bytes Program FLASH
- 4 K Bytes Program/Data RAM
- Tunable Internal Relaxation Oscillator
- Software Programmable Phase Locked Loop
- **Up to 96 MHz Peripherals – Timers and PWMs**
- Up to 6-Output PWM Module with up to 4 Programmable Fault Inputs
- **Selectable PWM frequency for each complementary PWM signal pair**
- **Two 12-bit ADCs with up to 8 Inputs , 1.125us conversion rate**
- Synchronization between PWM and ADC
- Four 16-bit General Purpose Programmable Timers
- Computer Operating Properly Timer
- Serial Ports: SCI, SPI, I2C
- **Up to 26 GPIOs – Versatile pin usage**
- **Low Power Consumption – 59mA Max and .026mA Min**
- JTAG/EOnCE™ Debug Port
- Industrial & Automotive temp
- **Cost Effective**

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56F8000 Family Expansion 56F8023/56F8025/56F8036/56F8037 Features



► Package 32 LQFP, 44LQFP, 48LQFP, 64LQFP

- 32 MHz/32 MIPS 56800E Core
- 3.0-3.6V Operation
- 32K-64K Bytes Program FLASH
- 4K-8K Bytes Program/Data RAM
- Flash security
- Tunable Internal Relaxation Oscillator
- Software Programmable Phase Locked Loop
- **Up to 96 MHz Peripherals – Timers and PWMs**
- 6 Output PWM Module with 4 Programmable Fault Inputs
- **Selectable PWM frequency for each complementary PWM signal pair**
- **Two 12-bit ADCs with up to 16 Inputs , 1.125us conversion rate**
- **Up to Two 12-bit Digital to Analog Converters**
- **Two Analog Comparators**
- Synchronization between PWM and ADC
- 4 or 8 16-bit General Purpose Programmable Timers
- **1 or 3 Programmable Interval Timers (PIT)**
- Computer Operating Properly Timer
- **2-Queued Serial Communications Interface**
- **2-Queued Serial Peripheral Interface**
- **Optional MSCAN**
- I²C Communications Interface
- **Up to 53 GPIOs – Versatile pin usage**
- JTAG/EOnCE™ Debug Port
- Lead Free "Green" Packages
- Industrial & Automotive temp

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56F8000 Series

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56F8000 Series Feature Summary

	56F8011	56F8013	56F8014	56F8023	56F8025	56F8036	56F8037
Performance	32MHz/MIPs	32MHz/MIPs	32MHz/MIPs	32MHz/MIPs	32MHz/MIPs	32MHz/MIPs	32MHz/MIPs
Temperature Range (V)	-40C to 105C	-40C to 105C	-40C to 105C	-40C to 105C	-40C to 105C	-40C to 105C	-40C to 105C
Voltage Range	3.0V - 3.6V	3.0V - 3.6V	3.0V - 3.6V	3.0V - 3.6V	3.0V - 3.6V	3.0V - 3.6V	3.0V - 3.6V
Voltage Regulator	On-Chip	On-Chip	On-Chip	On-Chip	On-Chip	On-Chip	On-Chip
Program/Data Flash	12KB	16KB	16KB	32KB	32KB	64KB	64KB
Program/Data RAM	2KB	4KB	4KB	4KB	4KB	8KB	8KB
Program Security	Yes	Yes	Yes	Yes	Yes	Yes	Yes
On Chip Relaxation Osc.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PLL	Yes	Yes	Yes	Yes	Yes	Yes	Yes
COP	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PWM	1 x 6ch	1 x 6ch	1 x 5ch	1 x 6ch	1 x 6ch	1 x 6ch	1 x 6ch
PWM Fault Inputs	4	4	3	4	4	4	4
12-bit ADCs	2 x 3ch	2 x 3ch	2 x 4ch	2 x 3ch	2 x 4ch	2 x 5ch	2 x 8ch
12-bit DACs	No	No	No	2	2	2	2 (Pinned out)
Analog Comparator	No	No	No	2	2	2	2
16-bit Timers	4	4	4	4	4	4	8
Prog. Interval Timers	No	No	No	1	3	3	3
GPIO (max)	26	26	26	26	35	39	53
IIC	1	1	1	1	1	1	1
SCI (UART) / LIN Slave	1 - SCI	1 - SCI	1 - SCI	1 - QSCI	1 - QSCI	1 - QSCI	2 - QSCI
SPI (Synchronous)	1 - SPI	1 - SPI	1 - SPI	1 - QSPI	1 - QSPI	1 - QSPI	2 - QSPI
CAN						MSCAN	MSCAN
JTAG/EOnCE	JTAG/EOnCE	JTAG/EOnCE	JTAG/EOnCE	JTAG/EOnCE	JTAG/EOnCE	JTAG/EOnCE	JTAG/EOnCE
Package (V) - Industrial	32LQFP (.8p)	32LQFP (.8p)	32LQFP (.8p)	32LQFP (.8p)	44LQFP (.8p)	48LQFP (.5p)	64LQFP (.5p)

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BLDC & PMSM Motor Control Applications:

- BLDC Motor Control for Industrial Fan System
- Portable Sensorless BLDC Motor Control
- Sensorless PMSM for Air-conditioner Fan Control

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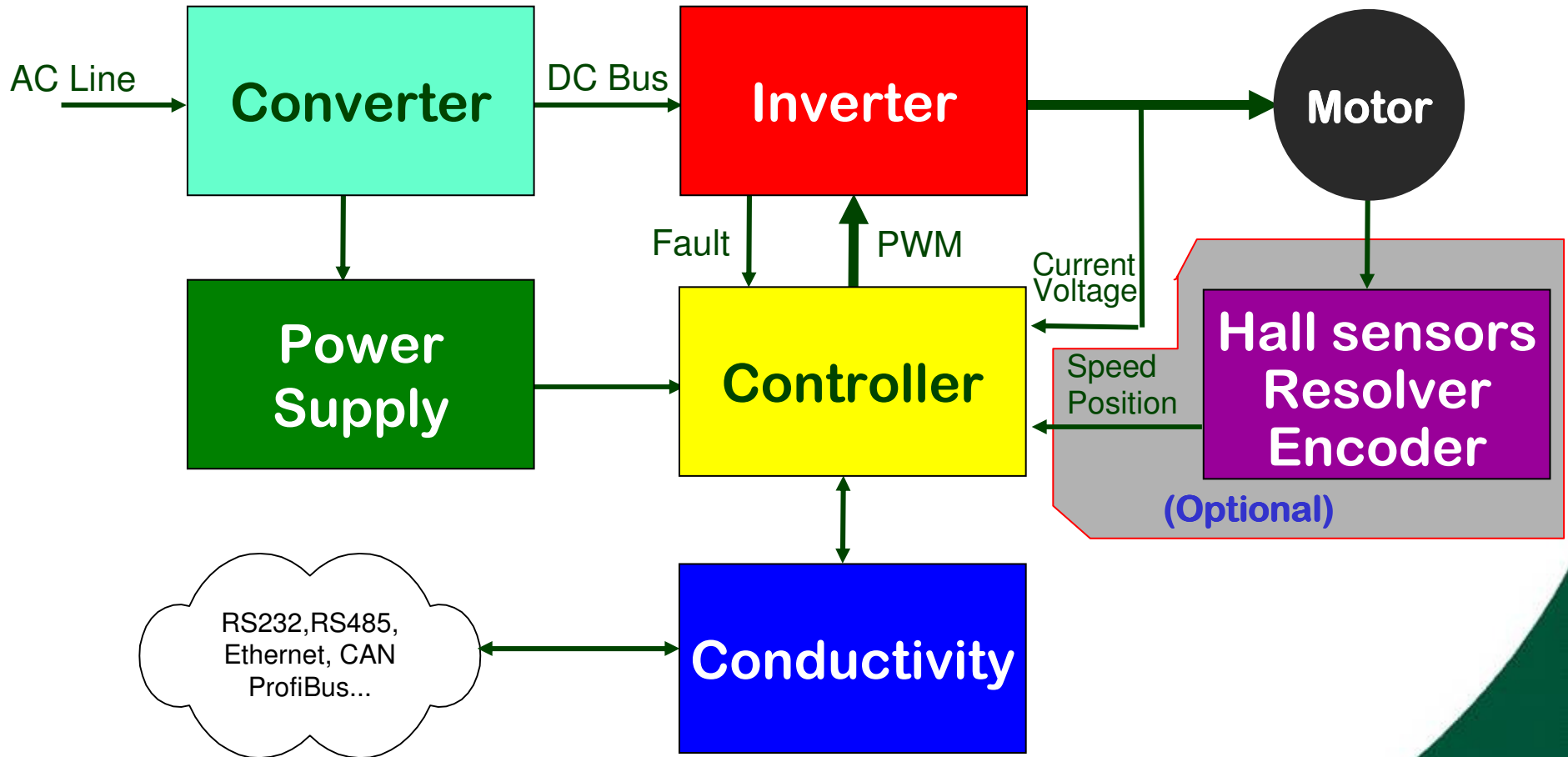
Drive Characteristics:

- *Wide range I/P: 86~275Vac*
- *Power factor: >0.99 under full load condition*
- *DC Bus Voltage: 400Vdc*
- *Control Algorithm: six step commutation control
Closed loop (speed loop and current loop)*
- *Accuracy: high*

Motor Characteristics:

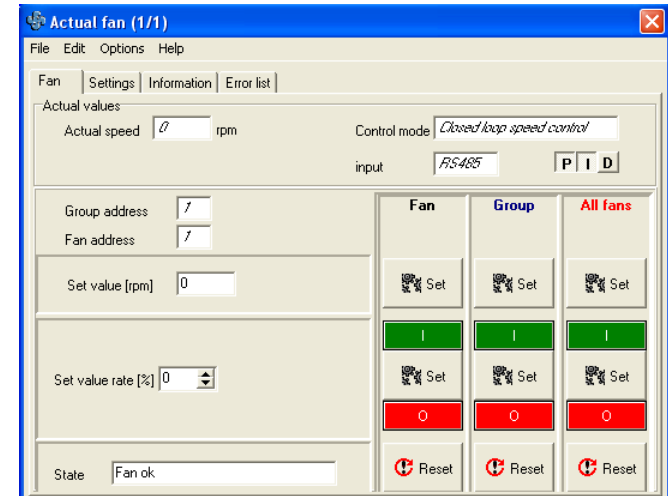
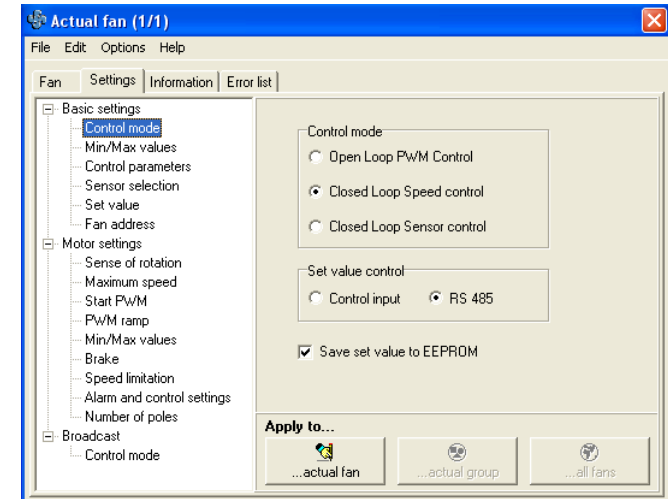
- *Motor Type: 3-phase BLDC motor*
- *Speed range: 0 ~ 1,500 rpm*
- *Power rating: 250 Watt*
- *Rated voltage: 380Vdc*

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Remote Control Software Features:

- *Set the Operating Fan Motor Speed*
- *Set the Maximum Fan Motor Speed*
- *Set the motor direction (Clockwise or counter clockwise)*
- *Set PWM parameters*



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Sensorless PMSM Solution for Air-conditioning Fan Control

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Hardware Features:

- 800~1000W PFC Power
- 400Vdc BUS Voltage
- Sensorless DTC control
- Closed loop speed control
- Remote control through RS232

Remote Software Features:

- Operating Speed Setting
- Start/Stop Control
- Actual Speed Feedback
- Protection State Display
- Serial Interface Setting



Air Conditioner Fan Speed Control

Actual Fan Speed: rpm

Status

Normal
 Overcurrent
 Lost Sync
 Overheat
 Overvoltage
 Undervoltage
 Overload

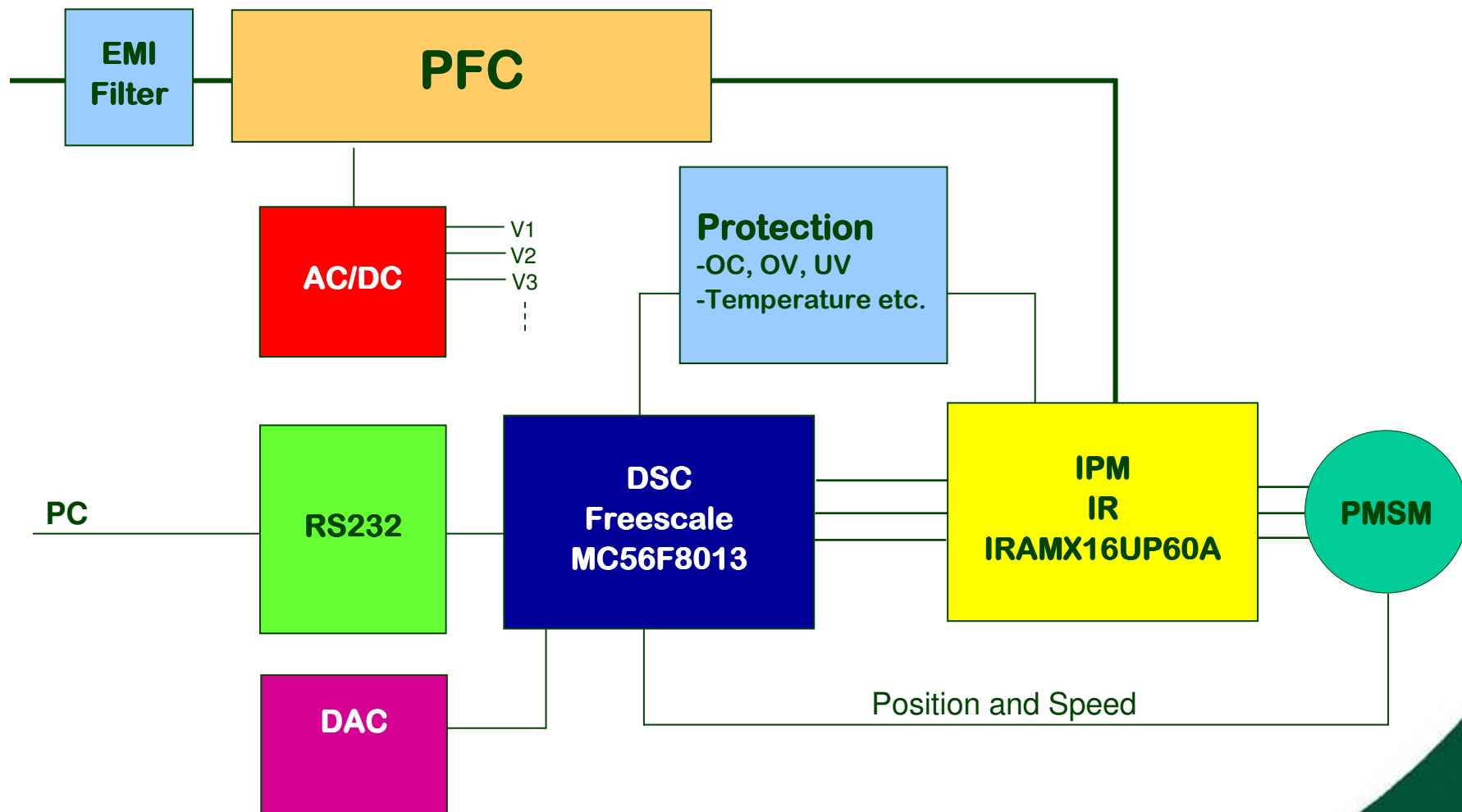
Enter Speed: rpm

Serial Port Configure

Select RS232 Port

Baud Rate

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Motor Characteristics:

- Rated voltage :24Vdc
- Power :26W
- Rated current: <1.7A
- Rated speed: 10000RPM

Drive Characteristics:

- Sensorless control with speed and torque closed loop
- BEMF zero-crossing sensing
- Clockwise and counterclockwise
- Manual interface
- PC software remote monitor
- Fault protection: under/over-voltage, over-current



Future Portable BLDC Motor Control Evaluation Platform

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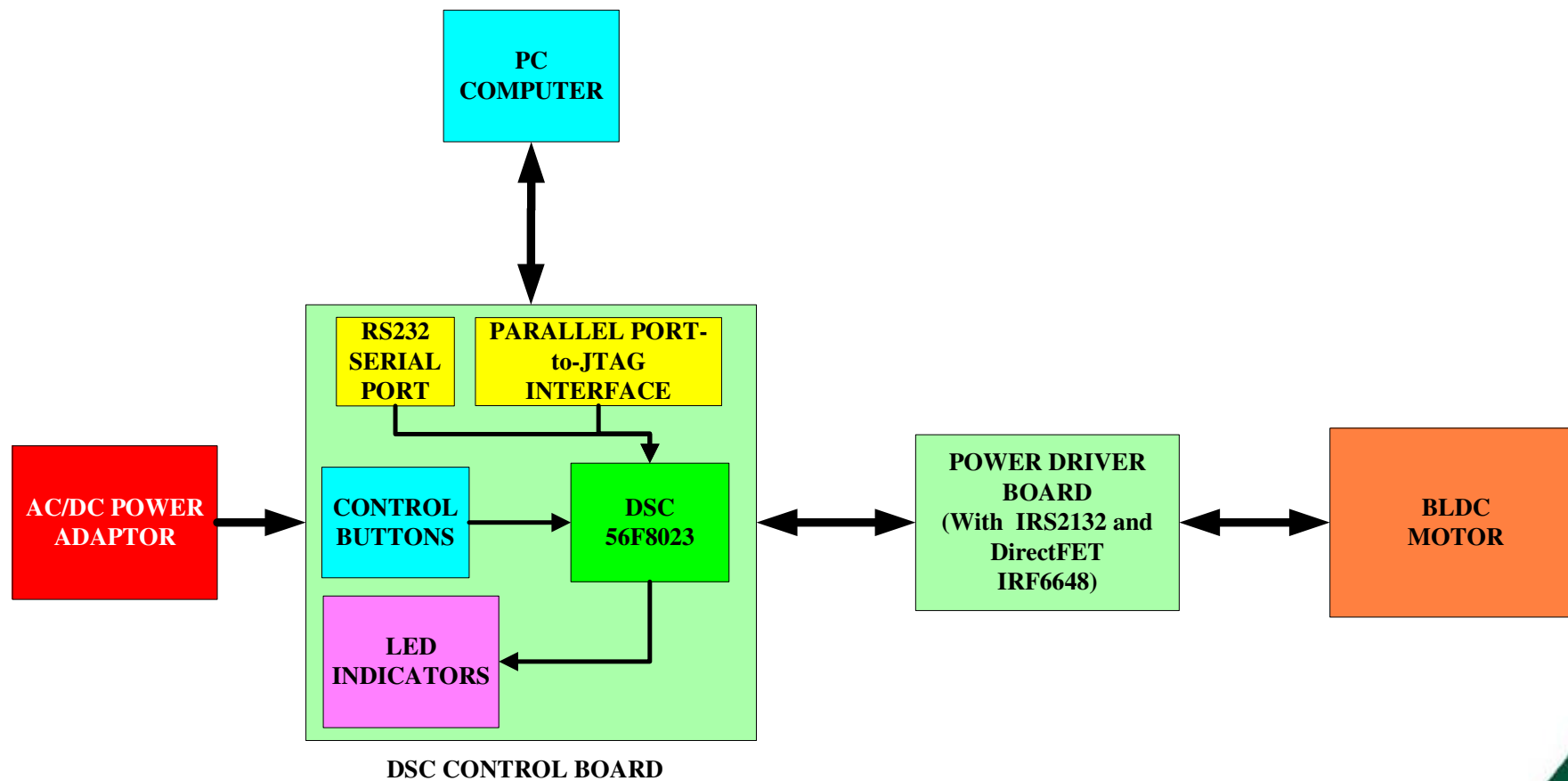


FIG-1: BLOCK DIAGRAM FOR THE BLDC MOTOR CONTROL DEMO KIT

Motor Control Application Summary

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Area	ACIM	BLDC	PMSM	SR
Appliance and Consumer	Refrigerators, Freezers, Dishwashers, Microwave Oven Turntables, Clothes Washers/Dryers, Fans, A/C Compressors, Evaporative Coolers, Roof Ventilators, Air Cleaners/Purifiers, Hair Dryers	Air Conditioner Compressors, Refrigerators, Fitness Equipment	Air Conditioner Compressors, Refrigerators, Fitness Equipment	Vacuum Cleaning System, Washing Machine
Industrial	Food Preparation Machines, Pumps (fuel, liquids), Large Movement Control/Conveyer Belts	Large Movement Control/Hoist, Crane, Elevator, Precision Movement Control: Printers, Robots, Milling; Medical Equipment; Servo Control	Large Movement Control/Hoist, Crane, Elevator, Precision Movement Control: Printers, Robots, Milling; Medical Equipment; Servo Control	Blower, Compressor, Fans, Cranes, Mills, Pumps, Weaving Machine, Sliding Door

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Thanks !!!

Q & A

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