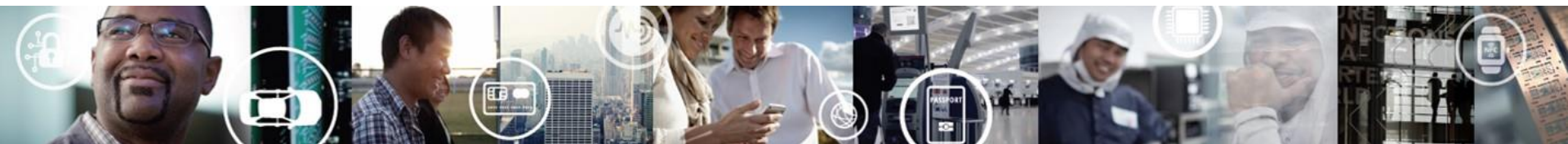


# 恩智浦半导体电机控制解决方案介绍

演讲人：DANSON.LI

恩智浦半导体微控制器产品中国MBD

2016年6月



# 议程安排

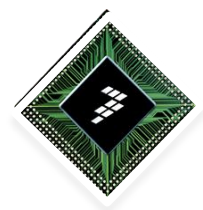
- 恩智浦 电机MCU产品介绍
  - KV
  - DSC
  - Su16
  - KE
- 电机开发套件KMS
- 开发工具
- 解决方案介绍
- Mosfet介绍
- Q&A

# 恩智浦电机控制的多种选择

**KV系列**  
高主频，浮点运算，  
大存储，  
接口丰富

## ARM电机控制 – KV系列

**Position:** M0+ , M4 , M7 跨越多种内核  
**Feature:** 75Mhz ~ 220MHz, 单核/双核，  
浮点运算，USB/以太网，  
**Fit For :** 多电机，复杂伺服电机



**MC56F84xxx**  
**MC56F827xx**  
性能强大，  
灵活易用

## DSC 高性能电机控制

**Position:** 专用高性能电机控制  
**Feature:** 智能化外设，针对电机控制的优化设计，5V兼容，低功耗  
**Fit For :** 无传感器FOC，高动态/安静，高性能及优化

## 基本电机控制 - Kinetis E

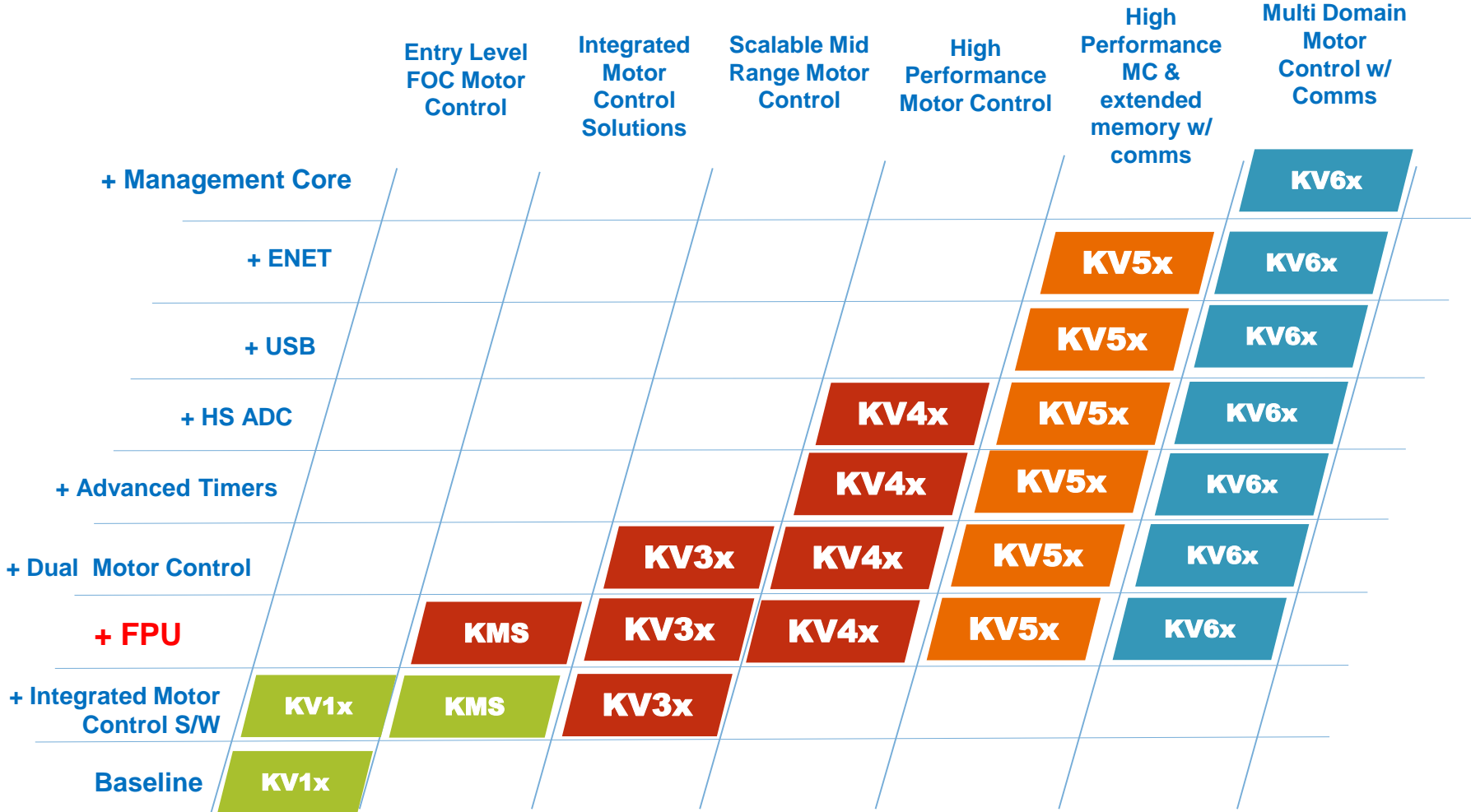
**Position:** 通用型电机控制  
**Feature:** 纯5V ARM，稳定性高，GPIO多，  
更多flash和引脚封装选择  
**Fit For :** KE0x , KE1x

**KE系列**  
5V供电，  
可靠稳定

**高压SOC**  
**MCU+**  
**LDO+OPAMP**  
**+ predriver**



# Kinetis V-Series: Motor Control



**Core:**
■ ARM® Cortex™-M0+ 
 ■ ARM® Cortex™-M7  
■ ARM® Cortex™-M4 
 ■ Dual ARM® Cortex™-M7 & M4 (open to talk)



# KV10 : 基础系列

# KV11 : 大flash, 小引脚, 带CAN

- 75MHz Cortex-M0+
- Hardware Divide & Square Root
- 4ch DMA
- 16/32KB Flash , 8KB SRAM
- 64/128KB Flash , 16KB SRAM
- 2 x 8ch,16-bit ADC
  - 1.2Msps in 12-bit mode (835ns)
- 1 x12-bit DAC
- 2 x ACMP with 6-bit DAC
- 1/2 x 6ch FlexTimer (PWM)
- 2/4 x 2ch FlexTimer (PWM/Quad Dec.)
- Low Power Timer
- Dual Watchdog

## Other

- CAN
- 32-bit CRC
- Up to 54 I/Os
- 1.71V-3.6V; -40 to 105C

## Packages

- 32QFN, 32LQFP, 48LQFP, 64pin

From \$0.9x/\$1.1x at 10k units

| Part Number    | Package | Flash | SRAM | FlexTimers   | CAN |
|----------------|---------|-------|------|--------------|-----|
| MKV11Z128VLH7  | 64LQFP  | 128KB | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z128VLF7  | 48LQFP  | 128KB | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z128VFM7  | 32QFN   | 128KB | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z128VLC7* | *32LQFP | 128KB | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z64VLH7   | 64LQFP  | 64KB  | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z64VLF7   | 48LQFP  | 64KB  | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z64VFM7   | 32QFN   | 64KB  | 16KB | 2x6ch; 4x2ch | 1   |
| MKV11Z64VLC7*  | *32LQFP | 64KB  | 16KB | 2x6ch; 4x2ch | 1   |
| MKV10Z128VLH7  | 64LQFP  | 128KB | 16KB | 2x6ch; 4x2ch | -   |
| MKV10Z128VLF7  | 48LQFP  | 128KB | 16KB | 2x6ch; 4x2ch | -   |
| MKV10Z128VFM7  | 32QFN   | 128KB | 16KB | 2x6ch; 4x2ch | -   |
| MKV10Z64VLH7   | 64LQFP  | 64KB  | 16KB | 2x6ch; 4x2ch | -   |
| MKV10Z64VLF7   | 48LQFP  | 64KB  | 16KB | 2x6ch; 4x2ch | -   |
| MKV10Z64VFM7   | 32QFN   | 64KB  | 16KB | 2x6ch; 4x2ch | -   |
| MKV10Z32VLF7   | 48LQFP  | 32KB  | 8KB  | 1x6ch; 2x2ch | -   |
| MKV10Z32VFM7   | 32QFN   | 32KB  | 8KB  | 1x6ch; 2x2ch | -   |
| MKV10Z32VLC7   | 32LQFP  | 32KB  | 8KB  | 1x6ch; 2x2ch | -   |
| MKV10Z16VLF7   | 48LQFP  | 16KB  | 8KB  | 1x6ch; 2x2ch | -   |
| MKV10Z16VFM7   | 32QFN   | 16KB  | 8KB  | 1x6ch; 2x2ch | -   |
| MKV10Z16VLC7   | 32LQFP  | 16KB  | 8KB  | 1x6ch; 2x2ch | -   |

# KV3x : 性价比最高的CM4

## 第一颗内置KMS器件

### Cortex-M4 @ 100/120MHz with FPU

- 4 or 16ch DMA

- 64/128/256/512KB Flash,
- 16/24/48/96KB SRAM
- FlexBus (512KB version only)
- Bootloader

### Analog

- 2 x16-bit ADC: 1.2Msps in 12-bit mode
- Up to 2 x12-bit DAC
- 2 x ACMP with 6-bit DAC

### Timers

- Up to 2x8ch FTM (PWM)
- 2x2ch FTM (PWM/Quad Dec.)
- Programmable Delay Block
- Low Power Timer

### Other

- Up to 70 I/Os
- 6 high-drive I/Os (20mA) – SPI/I2C
- 1.71V-3.6V; -40 to 105C

### Packages

- 32QFN, \*48LQFP, 64/100LQFP
- \*Alternative, non committed package

From **\$1.19** to **\$2.76** at 10k units

| Part Number    | Max. Freq. | Package LQFP | Flash | SRAM | DMA   | PLL / FLL | FTMs            | DAC | I/O w/ Digital Filters |
|----------------|------------|--------------|-------|------|-------|-----------|-----------------|-----|------------------------|
| MKV31F512VLL12 | 120MHz     | 100          | 512K  | 96KB | 16-ch | PLL       | 2x8ch;<br>2x2ch | 2   | 16                     |
| MKV31F512VLH12 | 120MHz     | 64           | 512K  | 96KB | 16-ch | PLL       | 2x8ch;<br>2x2ch | 2   | 16                     |
| MKV31F256VLL12 | 120MHz     | 100          | 256K  | 48KB | 16-ch | PLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV31F256VLH12 | 120MHz     | 64           | 256K  | 48KB | 16-ch | PLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV31F128VLL10 | 100MHz     | 100          | 128K  | 24KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV31F128VLH10 | 100MHz     | 64           | 128K  | 24KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV30F128VLH10 | 100MHz     | 64           | 128K  | 16KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV30F128VLF10 | 100MHz     | 48           | 128K  | 16KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV30F128VFM10 | 100MHz     | 32QFN        | 128K  | 16KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV30F64VLH10  | 100MHz     | 64           | 64K   | 16KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV30F64VLF10  | 100MHz     | 48           | 64K   | 16KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |
| MKV30F64VFM10  | 100MHz     | 32QFN        | 64K   | 16KB | 4-ch  | FLL       | 1x8ch;<br>2x2ch | 1   | 8                      |



# KV4x : 最佳组合 ( DSC外设 + ARM内核 )

- 168MHz Cortex-M4F, FPU
- 64/128/256KB Flash @ 128bits wide w/ 128Byte cache
- Bootloader
- Up to 2 x CAN
- 2 x 8ch 12-bit ADC
  - Sampling at up to 4.1MS/s
  - PGA x1, x2, x4
- 12-bit DAC
- 4 x ACMP with 6-bit DAC

### Timers

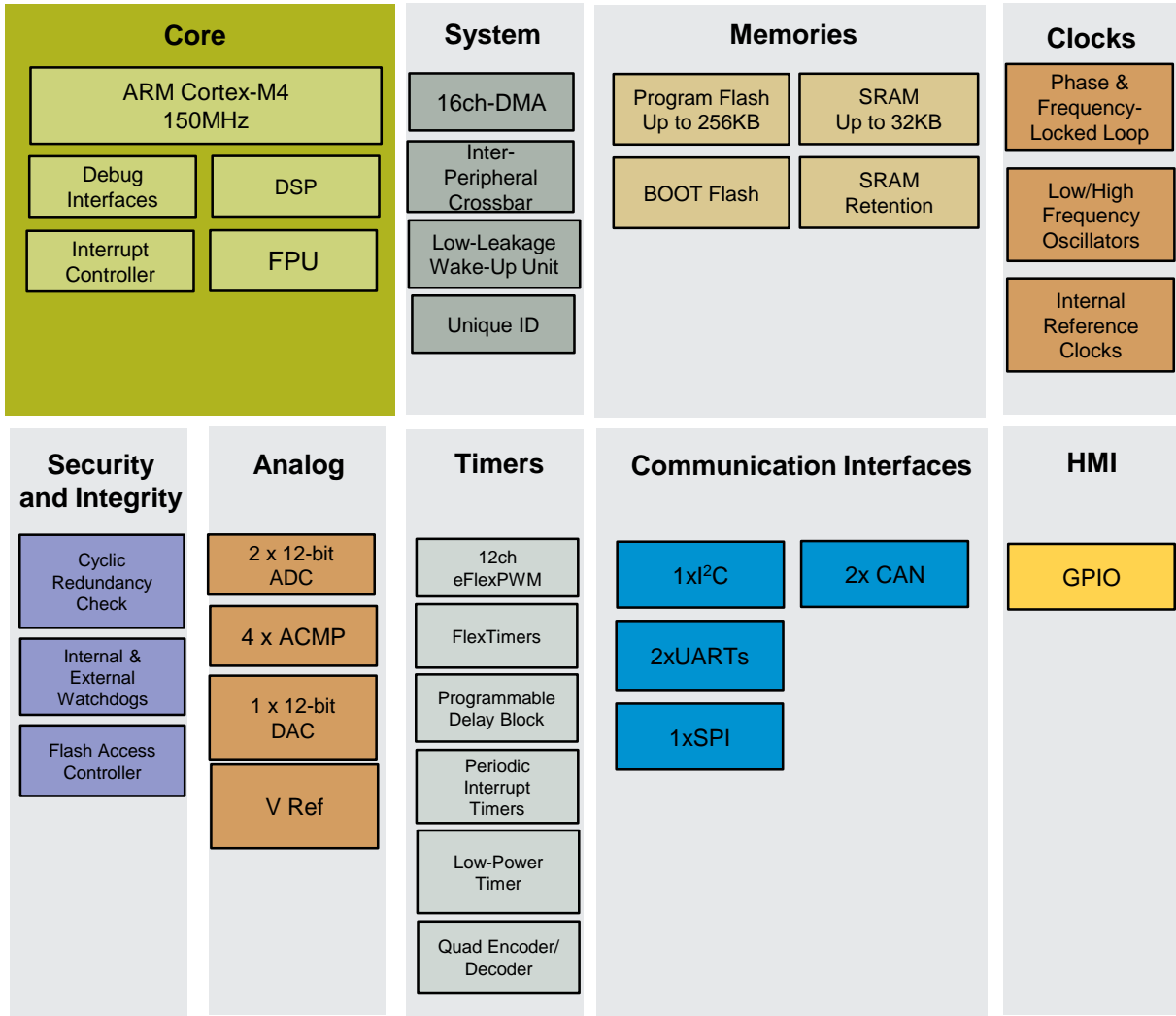
- 12ch eFlexPWM
  - Up to 312ps PWM and PFM
- 2x8ch + 1x2ch FlexTimer (PWM)
- Quadrature Encoder
- 2 x Programmable Delay Blocks
- Dual watchdog

### Other

- 32-bit CRC
- Inter-Peripheral Crossbar with AOI
- Up to 56 I/Os
- 1.71V-3.6V; -40 to 105oC

### Packages

- \*48LQFP, 64 LQFP & 100LQFP
- \*Alternative, non committed package



Availability: production now  
 First MCU of industrial with DSC peripheral + ARM core. **NXP**

# Kinetis V Series KV4x: 系列总览

| Part Number     | Pins | Flash / SRAM (KB) | ADC  |      | PWM eFlexPWM |       | PWM Nano-Edge | PWM FlexTimers |       |       | DAC | FlexCAN |      |
|-----------------|------|-------------------|------|------|--------------|-------|---------------|----------------|-------|-------|-----|---------|------|
|                 |      |                   | ADCA | ADCB | PWMA PWMB    | PWMX  |               | FTM0           | FTM3  | FTM1  |     | CAN0    | CAN1 |
| MKV46F256VLL16  | 100  | 256 / 32          | 18ch | 20ch | 1x8ch        | 1x4ch | Yes           | 1x8ch          | 1x8ch | 1x2ch | 1   | 1       | 1    |
| MKV46F256VLH16  | 64   | 256 / 32          | 13ch | 16ch | 1x8ch        | -     | Yes           | 1x8ch          | 1x8ch | 1x2ch | 1   | 1       | 1    |
| MKV46F128VLL16  | 100  | 128 / 24          | 18ch | 20ch | 1x8ch        | 1x4ch | Yes           | 1x8ch          | 1x8ch | 1x2ch | 1   | 1       | 1    |
| MKV46F128VLH16  | 64   | 128 / 24          | 13ch | 16ch | 1x8ch        | -     | Yes           | 1x8ch          | 1x8ch | 1x2ch | 1   | 1       | 1    |
| MKV44F256VLL16  | 100  | 256 / 32          | 18ch | 20ch | 1x8ch        | 1x4ch | Yes           | -              | -     | -     | 1   | 1       | 1    |
| MKV44F256VLH16  | 64   | 256 / 32          | 13ch | 16ch | 1x8ch        | -     | Yes           | -              | -     | -     | 1   | 1       | 1    |
| MKV44F128VLL16  | 100  | 128 / 24          | 18ch | 20ch | 1x8ch        | 1x4ch | Yes           | -              | -     | -     | 1   | 1       | 1    |
| MKV44F128VLH16  | 64   | 128 / 24          | 13ch | 16ch | 1x8ch        | -     | Yes           | -              | -     | -     | 1   | 1       | 1    |
| MKV44F128VLF16* | 48   | 128 / 24          | 11ch | 10ch | 1x8ch        | -     | Yes           | -              | -     | -     | 1   | 1       | -    |
| MKV44F64VLH16   | 64   | 64 / 16           | 13ch | 16ch | 1x8ch        | -     | Yes           | -              | -     | -     | 1   | 1       | 1    |
| MKV44F64VLF16*  | 48   | 64 / 16           | 11ch | 10ch | 1x8ch        | -     | Yes           | -              | -     | -     | 1   | 1       | -    |
| MKV42F256VLL16  | 100  | 256 / 32          | 18ch | 20ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | 1    |
| MKV42F256VLH16  | 64   | 256 / 32          | 13ch | 16ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | 1    |
| MKV42F128VLL16  | 100  | 128 / 24          | 18ch | 20ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | 1    |
| MKV42F128VLH16  | 64   | 128 / 24          | 13ch | 16ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | 1    |
| MKV42F128VLF16* | 48   | 128 / 24          | 11ch | 10ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | -    |
| MKV42F64VLH16   | 64   | 64 / 16           | 13ch | 16ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | 1    |
| MKV42F64VLF16*  | 48   | 64 / 16           | 11ch | 10ch | -            | -     | -             | 1x8ch          | 1x8ch | 1x2ch | -   | 1       | -    |

\* Package Your Way





# KV5 : 最强电机控制性能MCU

- Upto **220MHz Cortex-M7**  
with FPU and 32ch DMA

## Memory

- 512KB/1MB Flash,  
**256bits wide, 128 Bytes cache**
- 128/256KB SRAM
- Boot Flash

## Communications

- Multiple serial ports
- 3 x FlexCAN,**
- Ethernet**

## Analog

- 4 x 8ch 12-bit ADC -- 5Msps Sample Time**
- 1 x 16-bit SAR ADC
- 1 x12-bit DAC
- 4 x ACMP w/ 6b DAC

## Timers

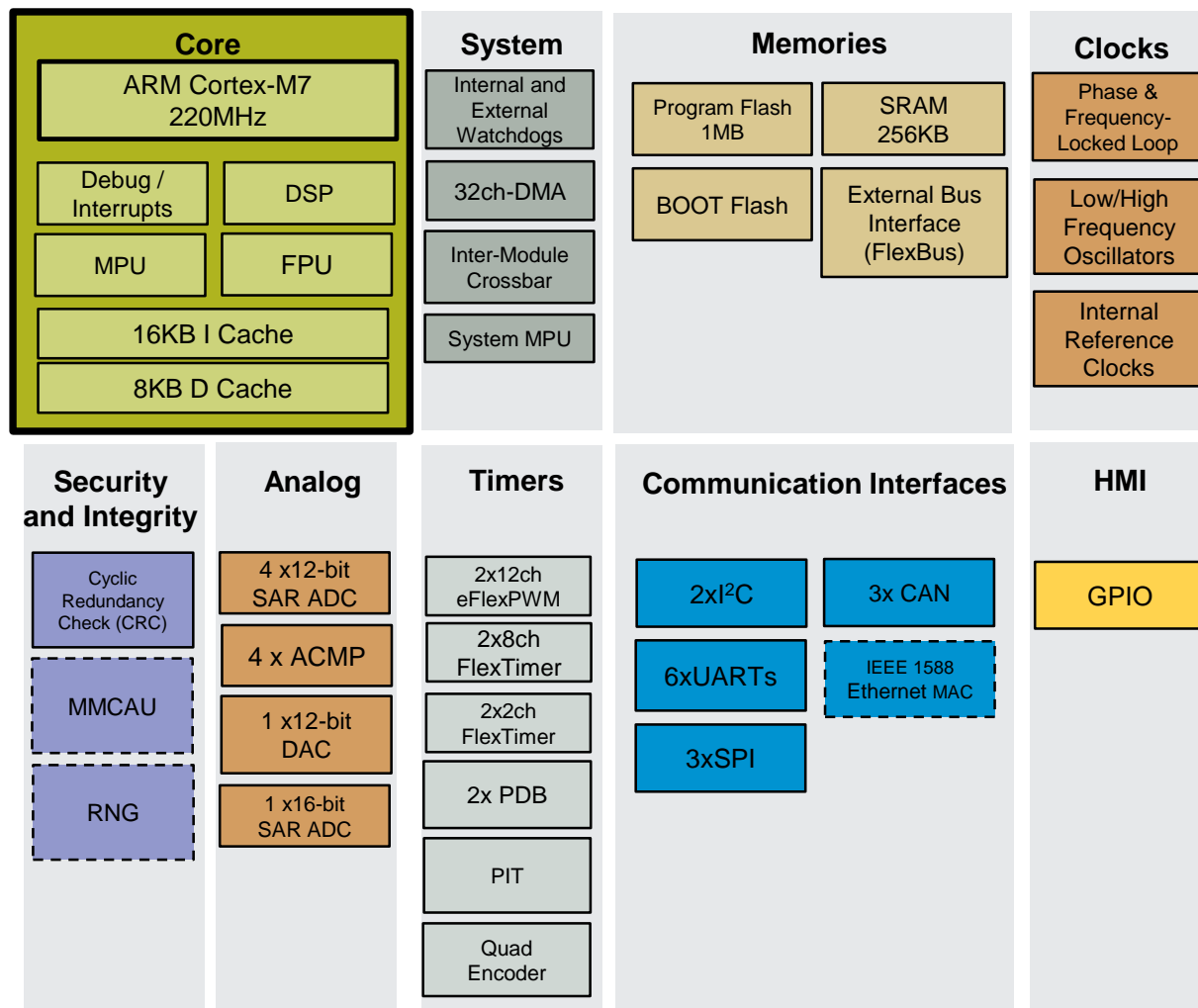
- 1 x 12ch Nano edge timer  
- 312ps PWM and PFM Resolution
- 1 x 12ch eFlexPWM
- 2x8ch + 2x2ch FlexTimer (PWM)
- Quadrature Encoder
- 2 x PDB, Low-Power Timer

## Others

- MMCAU & RNG**
- 32-bit CRC, MPU
- Inter-module Crossbar Switch with AOI**
- 1.71V-3.6V; -40 to 105oC

## Packages

- 100LQFP, 144LQFP, 144MAPBGA





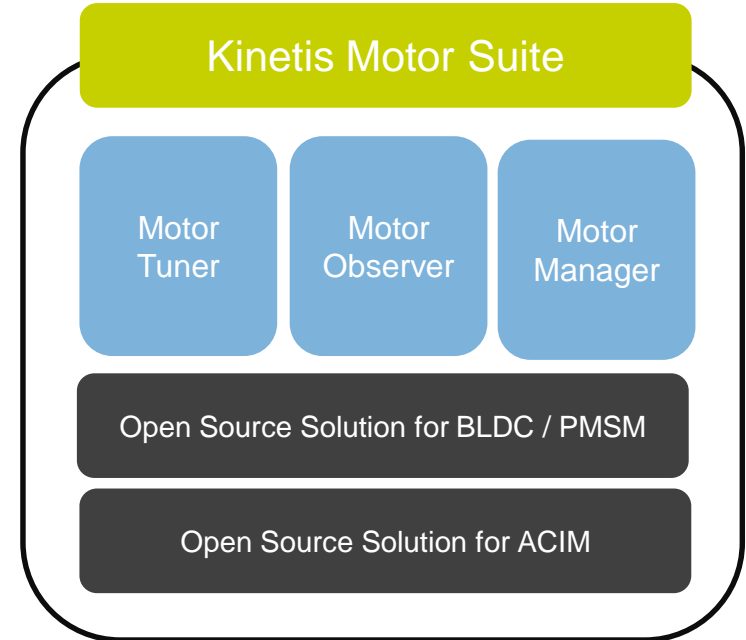
## KMS (电机开发套件) 简介

# New Kinetis Motor Suite

KMS focus's on 2 key areas:

## 1. *Simplicity*

- On-chip expertise eliminates the need for in-depth knowledge of motor control, allowing those with limited experience to develop an application.
- All motor configuration and control carried out through the graphical user interface, or the dedicated API
- Single digit tuning replaces labor-intensive, outdated PID tuning
- State Machine Builder enables you to graphical define the operating states and the conditions that force the transitions between them.

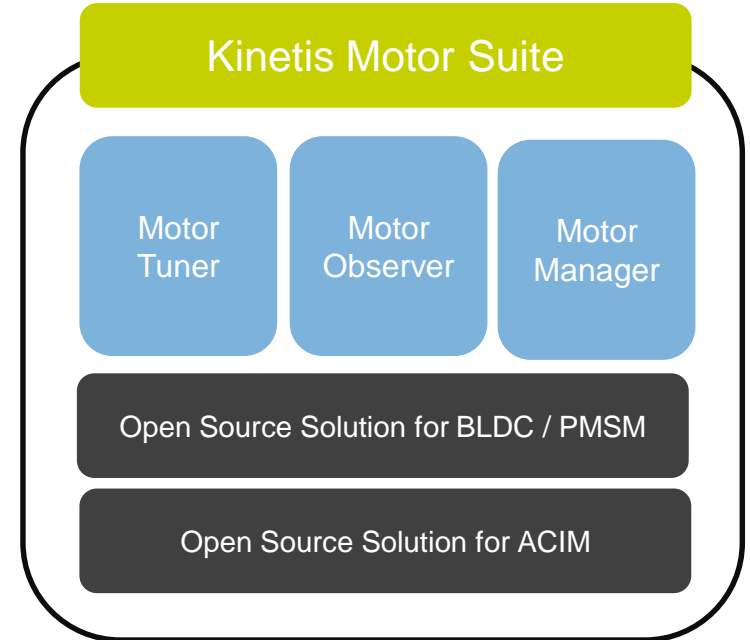


# New Kinetis Motor Suite

KMS focus's on 2 key areas:

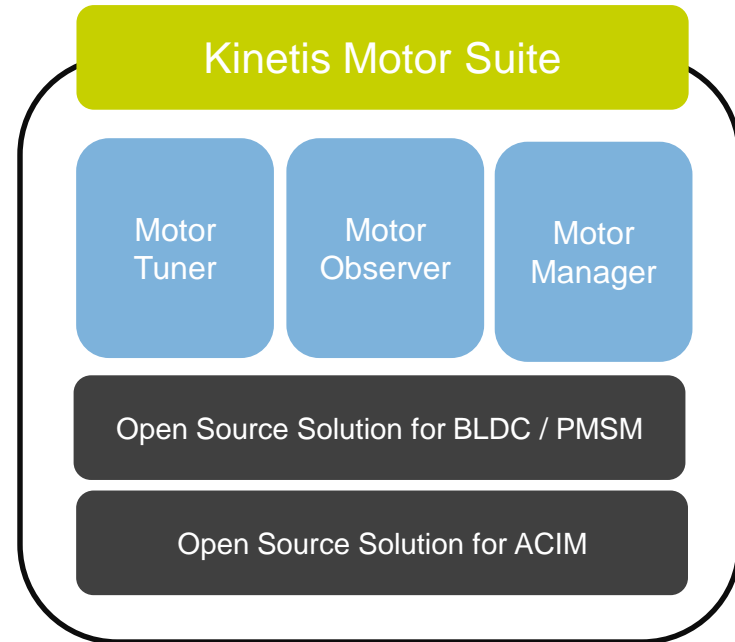
## 2. Performance

- The system can dynamically compensate “on the fly” for changes in load and speed due to wear and tear on the motor or the surrounding mechanical system.
- Extends machine life, improves energy efficiency and performance.
- Compensates for motor variation in mass production, simplifying production process.



# Kinetis Motor Suite - Components

- KMS consists of 4 main components:
- **Motor Tuner:**
  - Wizard for initial motor configuration – gets your motor spinning in 5 steps
- **Motor Manager:**
  - Application development environment where customers access and update real-time system components during their application development.
- **Motor Observer:**
  - Factory programmed flash with embedded motor control firmware for dynamic motor tuning and control.
- **Open Source Solution:**
  - The open source project with the motor control firmware configured via the GUI, and also accessible via an API.



# Design a new application in just 5 Steps !!

2

## Set controller limits

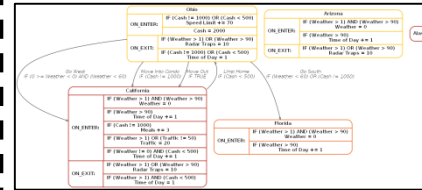
- Single Dial Control to set speed and position



4

## Plan your motion sequence

- Easily define your operating states & transitions



## Build Application

- Build in your motor application profile
- Debug the application

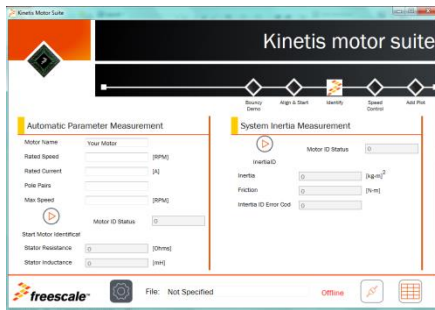


## Application Development Timeline

1

## Identify Motor & Inertia

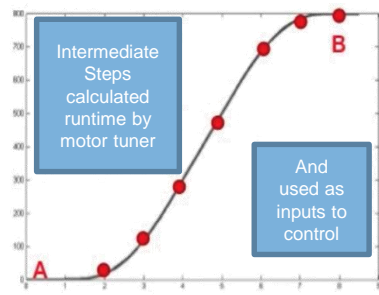
- Spin your motor & automatically measure feedback



3

## Build your trajectories

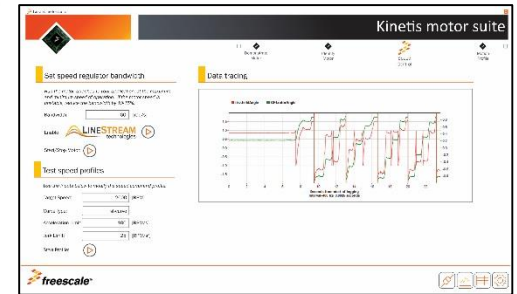
- Set smooth transitions from 1 speed to the next



5

## Fine Tune you setup

- Test reference speeds and bandwidths across range





## DSC 产品特点介绍

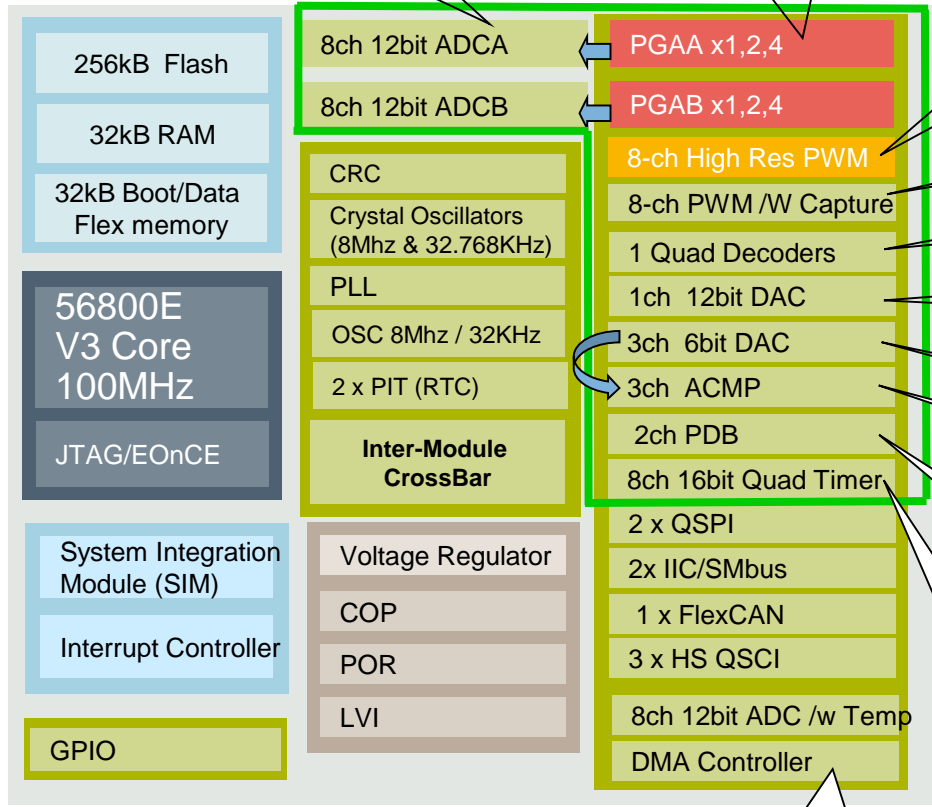
# DSC外设模块 - 控制和测量

56800 V3  
新核提升30%效率

高速ADC，可选采样校正功能，减去一个预设的偏置值

PGA：小信号被放大后给ADC提供更精确的输入

高分辨率PWM：提供更精细的控制，提高系统快速响应性能。  
在电源转换中，频率调制需要精确地频率控制



标准PWM：可以控制第二个无传感器电机，或者作为输入捕获

正交解码用于检测电机的速度，或位置计算

12位DAC带有外部引脚，可以为ADC设置动态调整，或者产生任意模拟波形

6位DAC可以为比较器提供基准

内部比较器：检测过零点，过压过流，重启定时器，紧急情况时可以关断PWM输出

PDB（可编程延迟模块）简化精确延时控制，而无需CPU干预

输入分主和次，功能有：边沿，窗口，正交，带符号，触发，级联，捕获，比较

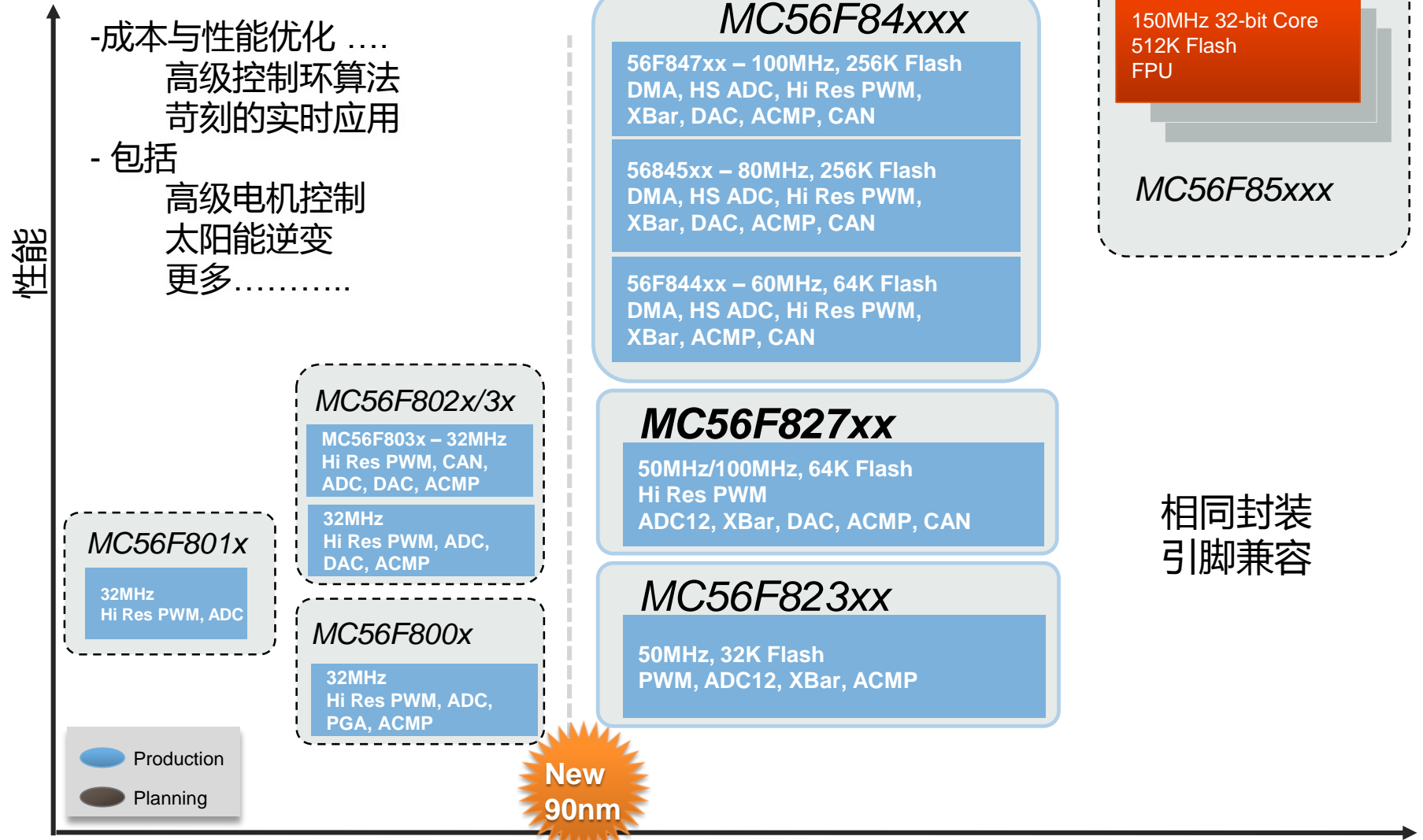
降低中断延迟，中断响应速度提升40%。改善RTOS支持，仅需1个时钟进行场景交换

DMA 增加处理器的吞吐量，使得控制算法更高效

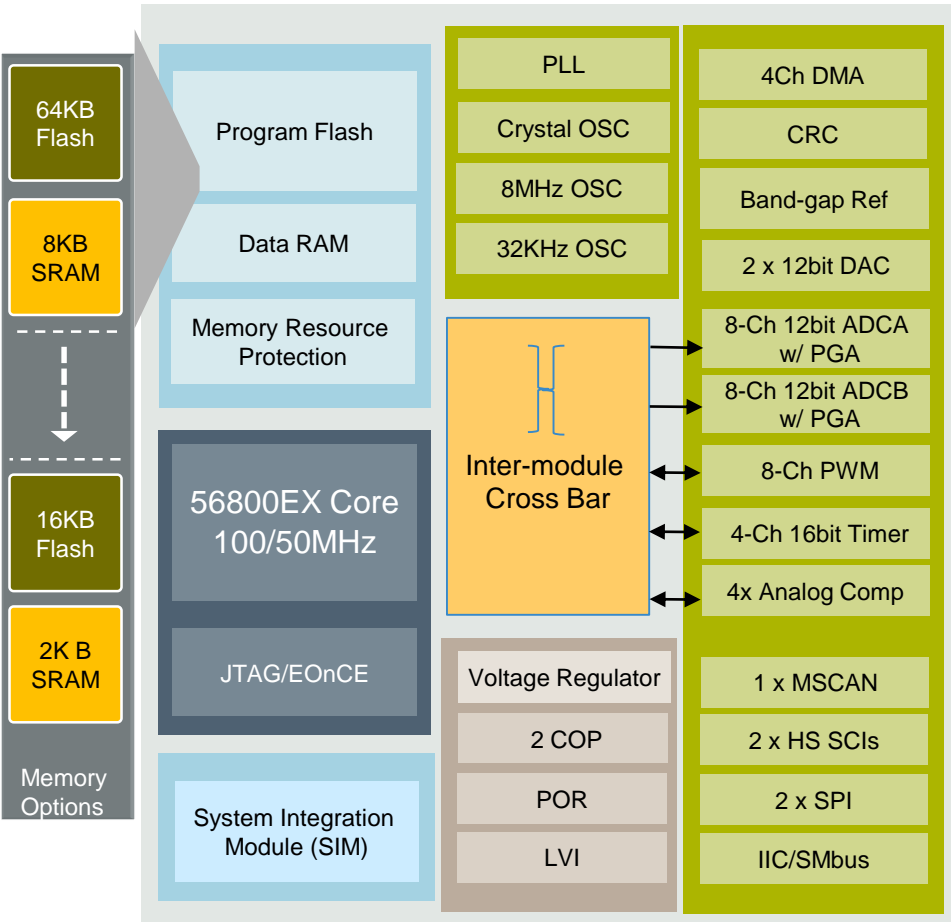




# Freescale DSC Roadmap



# MC56F827xx 特征 ( 50/100MHz )



32QFN, 32LQFP, 48LQFP & 64LQFP

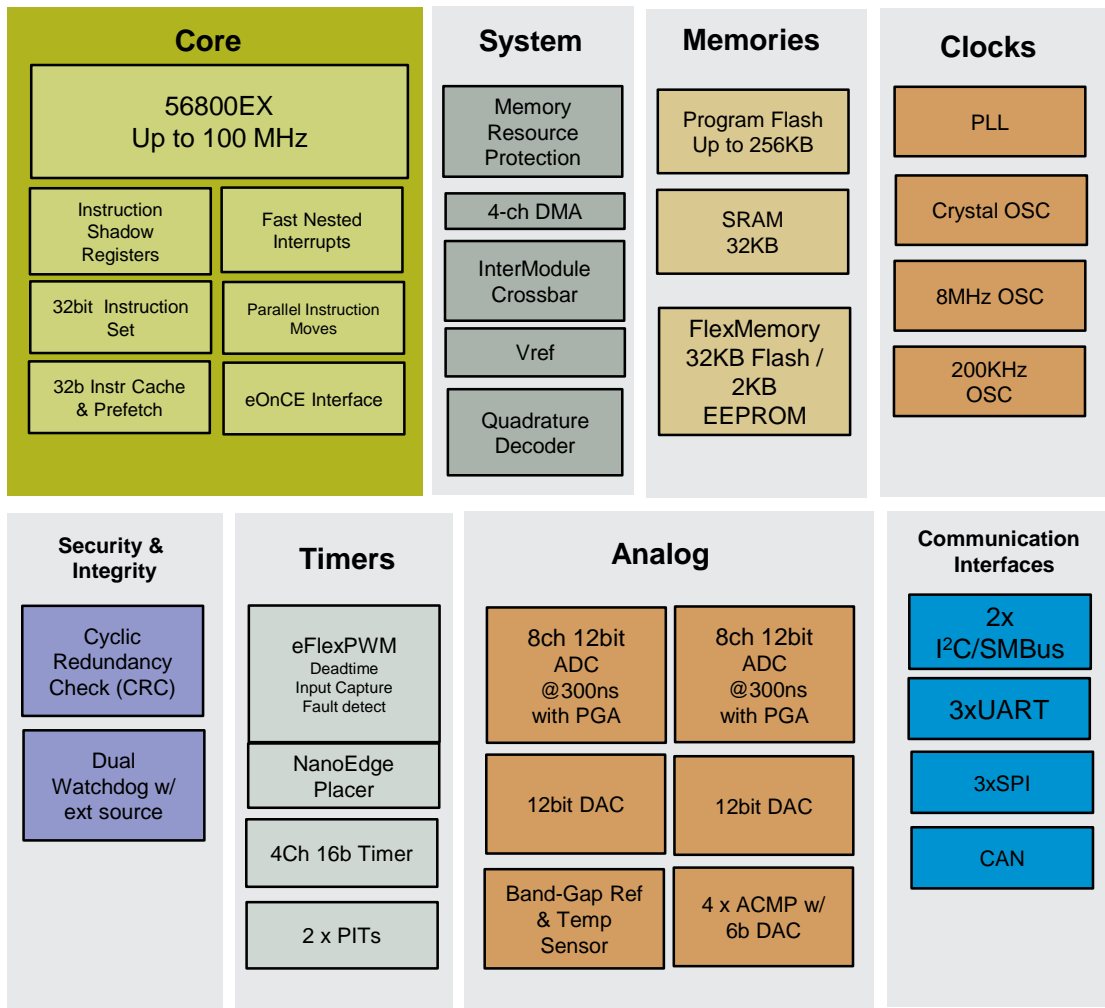
- 2.7~3.6V 操作, **5V IO兼容**
- cache & RAM 100MHz 运行
- 定时器和SCI外设运行于100 MHz
- 最高配置64KB / 8KB
- **2 x 12位 ADC ( 带有 PGA )**
  - 800ns 转换速率
  - 带隙基准参考
- **八通道Nano边沿PWM (312ps)**
  - 最多4路可编程故障保护输入
  - 输入捕获功能
- **内部cross-bar**
- 2 x 窗口看门狗, 外部看门狗监视器
- 4 x 16位增强型多功能定时器
- 2 x 12位 DAC
- **4 x 模拟比较器 ( 带有6位电压参考 )**
- 2 x 高速SCI, 2 x SPI, 1x I<sup>2</sup>C
- 软件可编程PLL
- 多个时钟源
  - 外部晶振/谐振器
  - 8MHz/200KHz 可调内部振荡器
  - 32KHz内部RC 张弛振荡器
- 错误代码纠正
- 存储器资源保护单元

### 其他

- 工业温度等级: **-40C 至 105C** @ 50MHz
- 扩展温度等级: **-40C 至 125C** @ 40MHz



# MC56F84xxx (256kB Flash, 100MHz)



- **运行@100MHz，超快的中断响应**
- 2.7~3.6V 操作，5V IO兼容
- FlexMem灵活的存储方式（额外提供）
- 2 x12位 ADC（带有 PGA）
  - 300ns 转换速率
- **16 x16位 ADC**
  - 连接高精度外部传感器
- **12通道eFlexPWM (312ps) +12ch PWM**
  - 半周期重载和整数重载设置
  - 深受客户好评的多种灵活配置功能
- **内部cross-bar可以连接所有的输入，并支持逻辑功能 (AND/OR/XOR/NOR)**
- 存储器保护单元可以增强安全鉴定
- 2 x 窗口看门狗，外部看门狗监视器
- 8 x 16位增强型多功能定时器
- 2 x 12位 DAC
- **4 x 模拟比较器（带有6位电压参考）**
- 3 x 高速SCI, 3 x SPI, 2x I<sup>2</sup>C, 1xCAN
- 多个时钟源
  - 外部晶振/谐振器
  - 8MHz/200KHz 可调内部振荡器
  - 32KHz内部RC 张弛振荡器
- 错误代码纠正

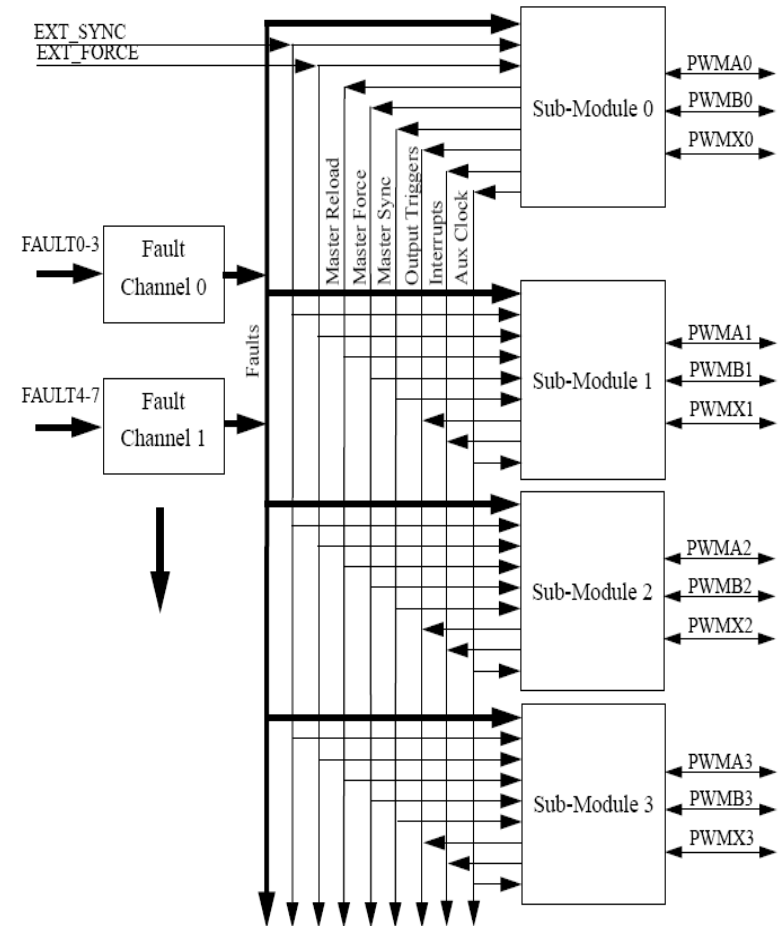
### 其他

- 48LQFP, 64LQFP, 80LQFP, 100LQFP
- 工业温度等级：**-40C 至 105C @ 50MHz**



# 增强型PWM (eFlexPWM)

- 四个独立子模块和一个时钟基准
  - 两个PWM输出 + 一个辅助PWM输入 / 输出
- 每个PWM输出的双沿独立控制
- 增强型双沿捕获功能
- 16位非对称PWM支持中央对齐和边沿对齐
- 精确延时可以增强PWM周期和边沿的分辨率
- 既可以成对互补操作，也可以作为独立操作
- 可以与外部硬件或其他PWM子模块同步
- 整数重载率是1至16，包括半周期重载
- 每个PWM周期可以设置触发多个输出事件
- 支持PWM输出的双切换（周期和占空比）
- 支持PWM输出的double switch（三相电流重构）
- 故障输入可以指定连接控制多个PWM输出
- 故障输入的可编程滤除
- 独立可编程的PWM输出极性
- 独立的上桥/下桥死区时间插入
- 通过FORCE\_OUT事件的软件控制和交换特征



应用笔记 AN4429 -- Using Motor Control eFlexPWM (mcPWM) for BLDC Motors

[http://cache.freescale.com/files/microcontrollers/doc/app\\_note/AN4429.pdf](http://cache.freescale.com/files/microcontrollers/doc/app_note/AN4429.pdf)



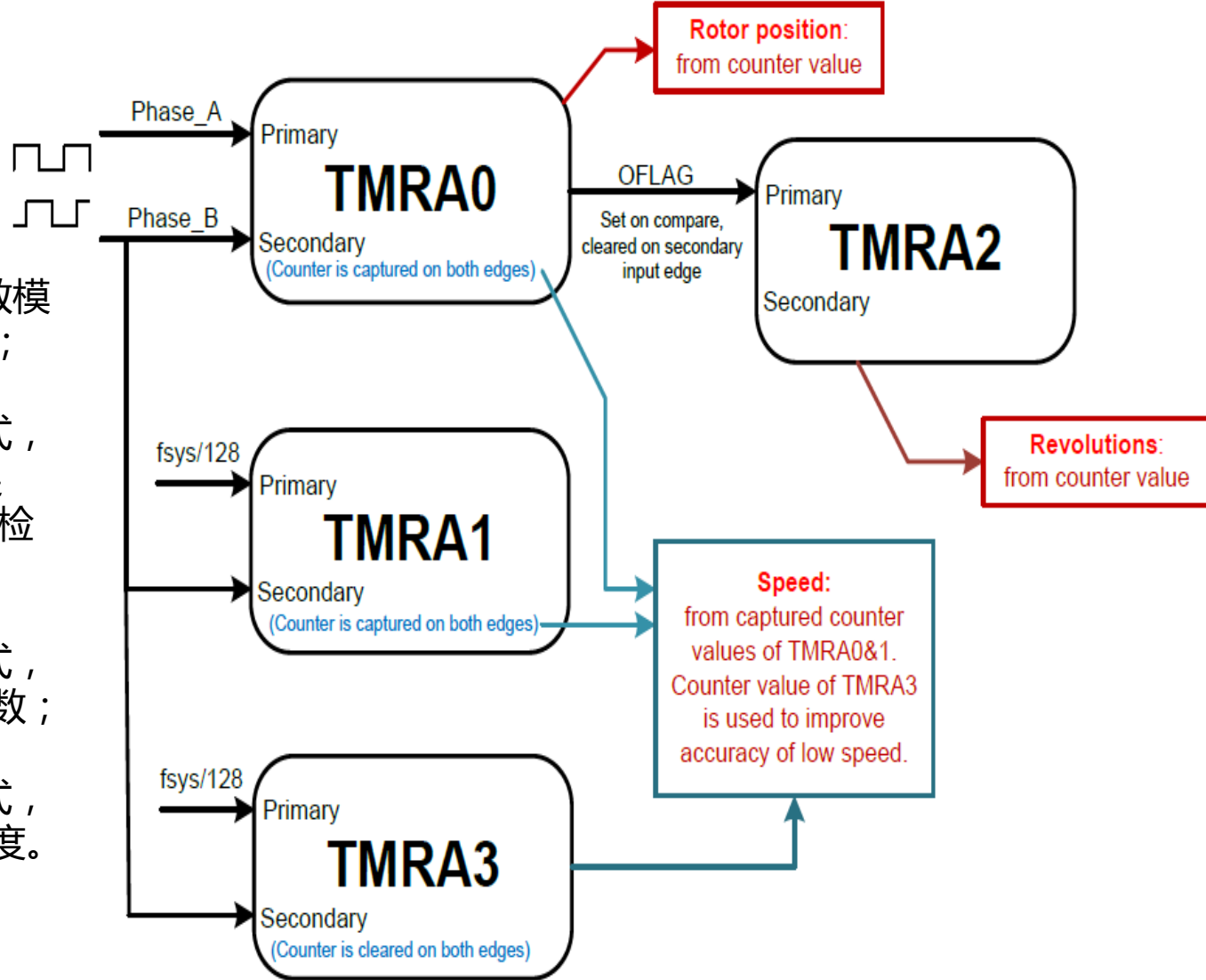
# 用Quad Timer A检测转子位置、转速和旋转圈数

TMRA0工作于正交记数模式，用于检测转子位置；

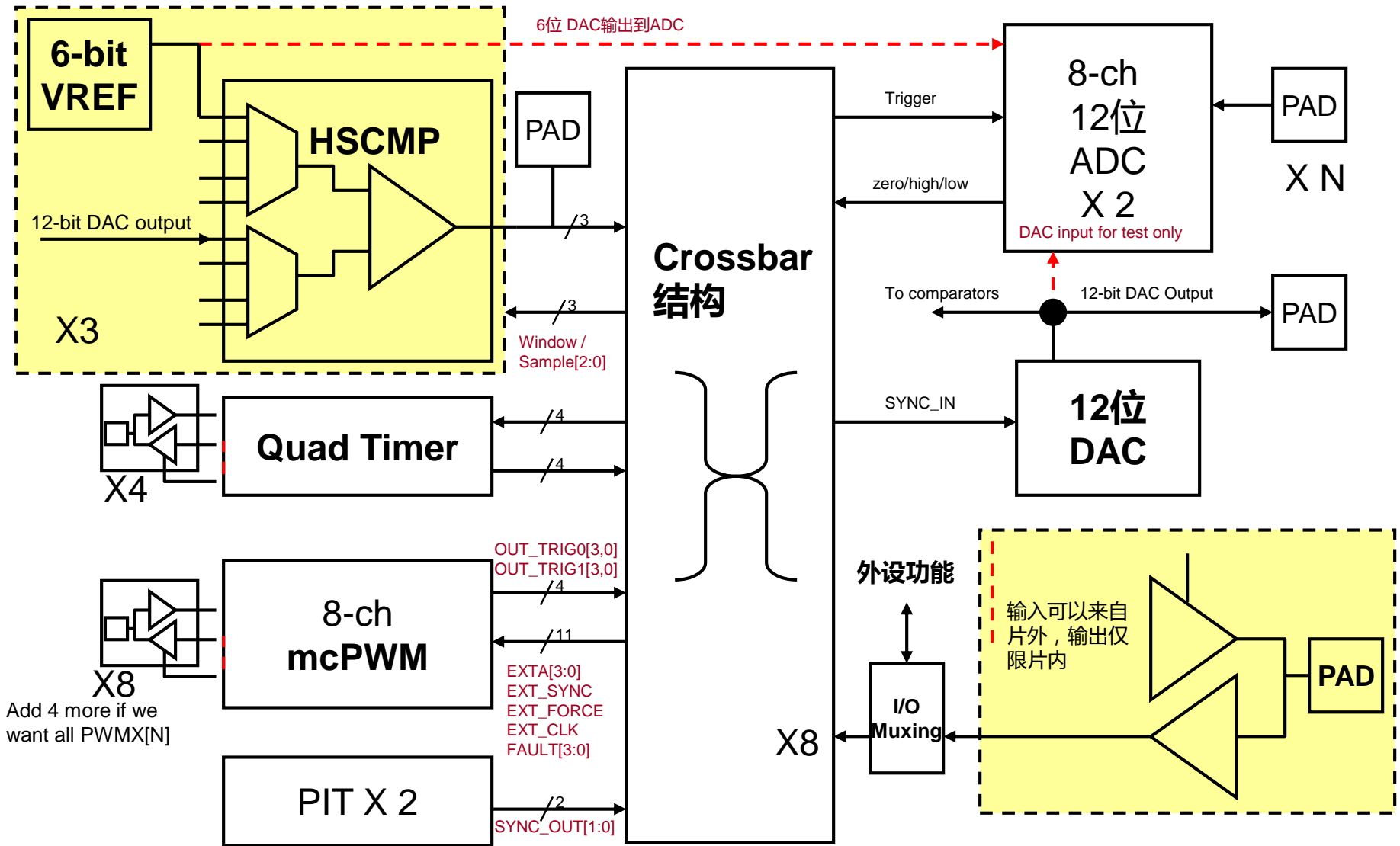
TMRA1工作于记数模式，结合TMRA0，通过捕捉TMRA0/1的计数器值来检测转速；

TMRA2工作于记数模式，用于检测转子旋转的圈数；

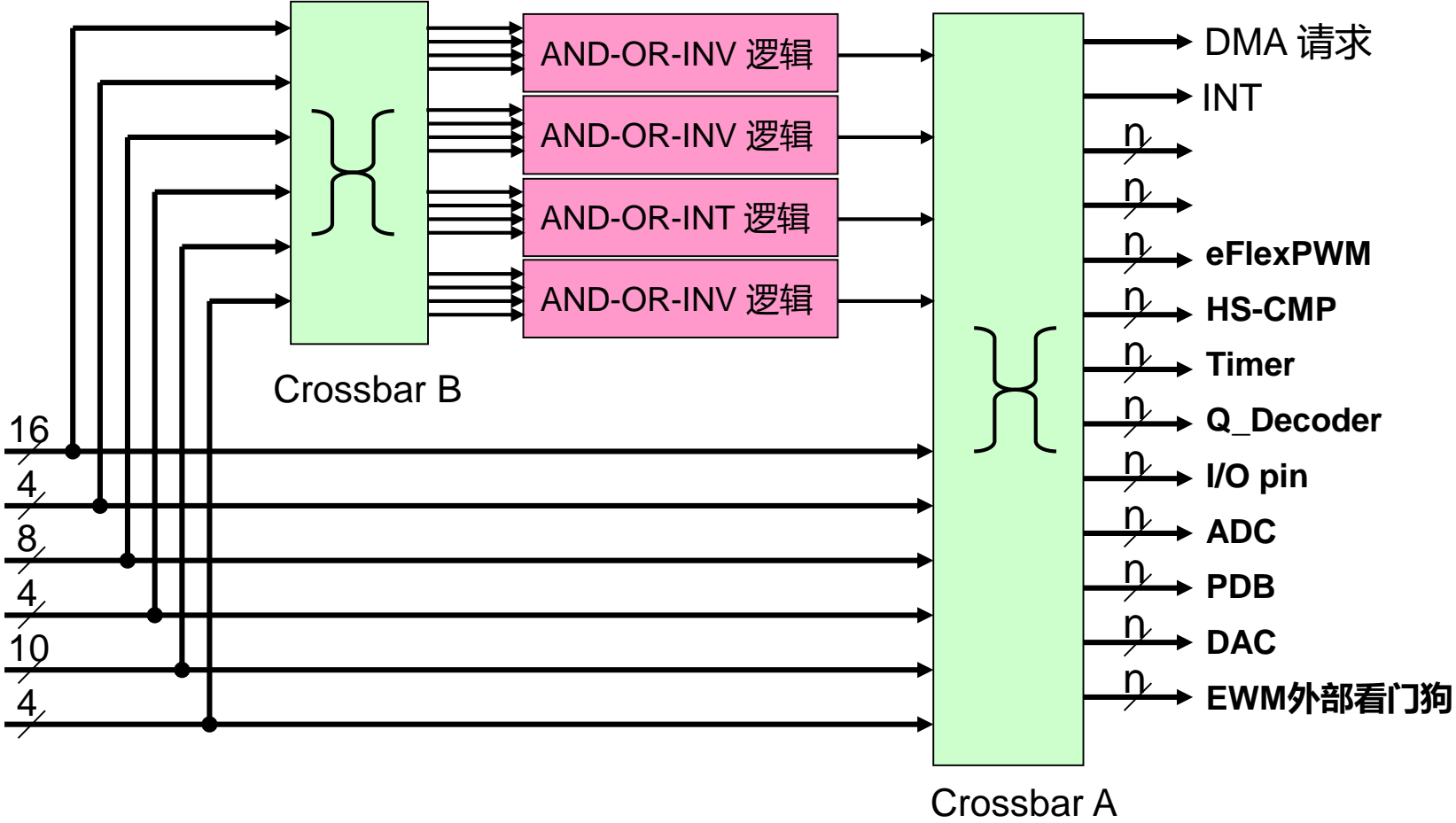
TMRA3工作于记数模式，用于提高低转速检测精度。



# CrossBar – 内部互相连接



# Crossbar的升级- MC56F84xxx



# DSC性能对比- 功耗

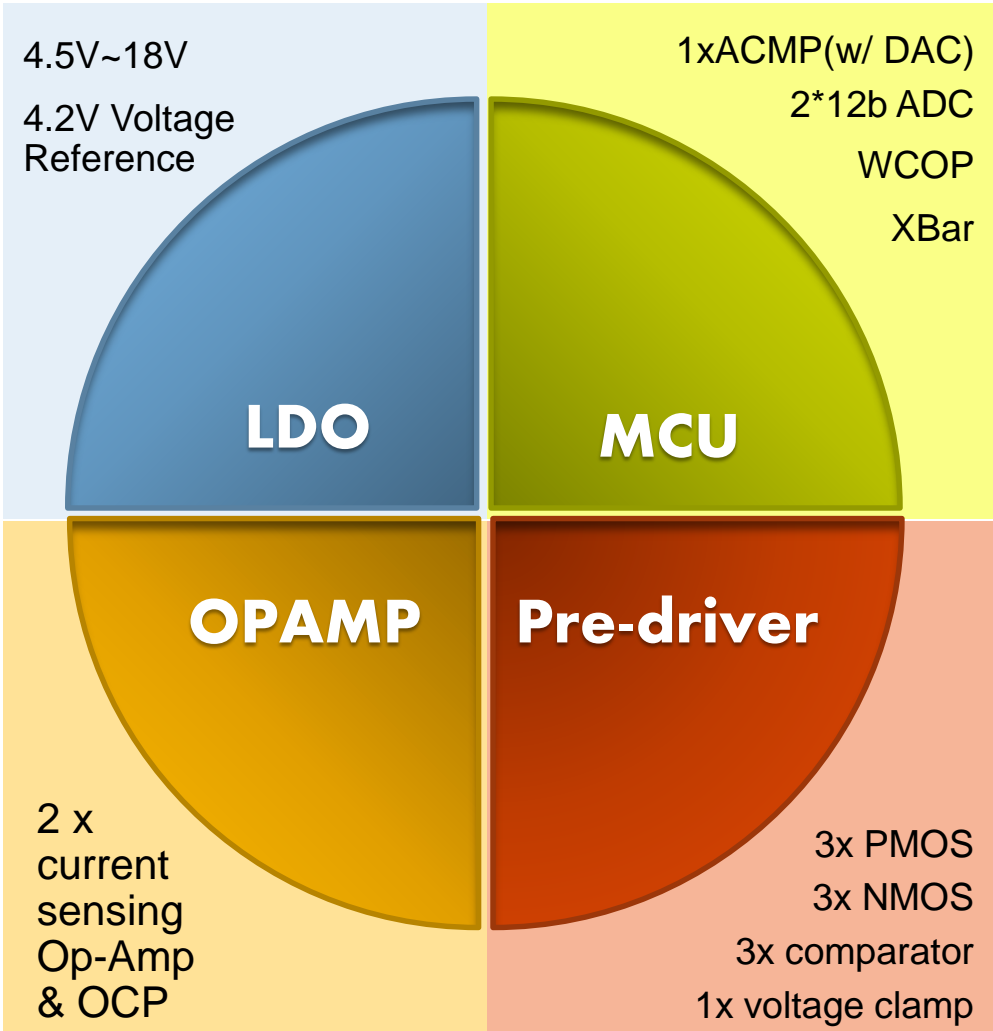
|                         | 56F8002  | 56F82723                                     | 56F84789                                      |
|-------------------------|--|--|---|
| 内核                      | 56800e V2  | 56800ex V3                                   | 56800e V3                                     |
| 总线速度                    | 32MHz  | 50 / 100MHz                                  | 100MHz  |
| Flash/ RAM              | 12K / 2K   | 32K / 6K                                     | 256kB / 32KB                                  |
| EEPROM                  | 仿真   | 无 (FlexMem)                                  | FlexMem 32 / 2kB                              |
| PWM                     | 3* system clock = 96M                                | 312ps 分辨率 , 100MHz                           | 312ps分辨率                                      |
| ADC                     | 2*8ch*12b, 2500ns                                    | 2*8ch*12b, 800ns                             | 2*8ch*12b, 300nS,<br>1*16ch*6b, w/ temp       |
| PGA                     | X32 (max)  | x1, x2, x4 in ADC                            | x1, x2, x4 in ADC                             |
| Timer                   | 2*16 timer   | 4*timer, 1*quad, 2*PIT                       | 2*quad, 1*QEI, 2*PIT                          |
| DAC & CMP               | 3*6b with CMP  | 2*12b + 3*ACMP                               | 1*12b + 4*ACMP                                |
| 接口                      | 1*IIC, 1*SCI, 1*SPI                                  | 1*IIC, 1*SCI, 1*SPI                          | 2*IIC, 3*SCI, 3*SPI,<br>1 FlexCAN             |
| 功耗@3.3V(Run),<br>25 摄氏度 | 41.5mA @32MHz<br>0.34mA @200KHz<br>0.16mA @32.768KHz | 38mA @100MHz<br>27.6mA @50Mhz<br>2.8mA @2Mhz | 64mA @100MHz<br>1.8mA @2Mhz<br>0.57mA @200KHz |

同等性能条件下，功耗仅为友商的50%





# Su16 超强集成, 超小体积

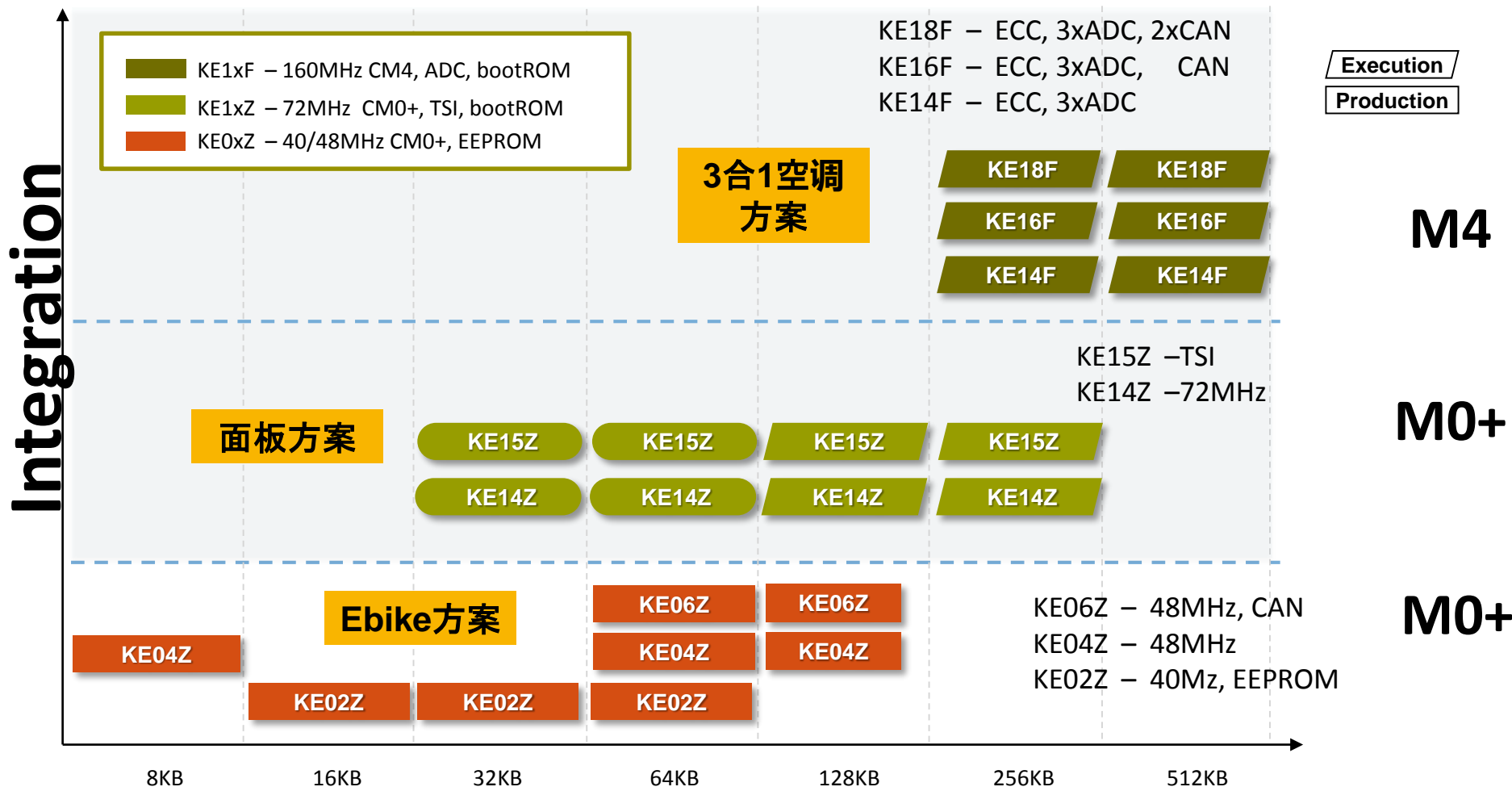


| Su16 MCU                          |
|-----------------------------------|
| S08L                              |
| 40MHz                             |
| 16K Flash                         |
| 768B RAM                          |
| 4.5V ~ 18V                        |
| cpu clk : bus clk<br>- 2:1 or 1:1 |
| MOSFET Pre-driver                 |
| 24 QFN (4*4)                      |



# KE系列

**BME**  
Single cycle GPIO



2.7-5.5V MCUs with high reliability and robustness



# Kinetis E EMC Performance

## Robustness in EFT, PESD and AC Power Relay Tests

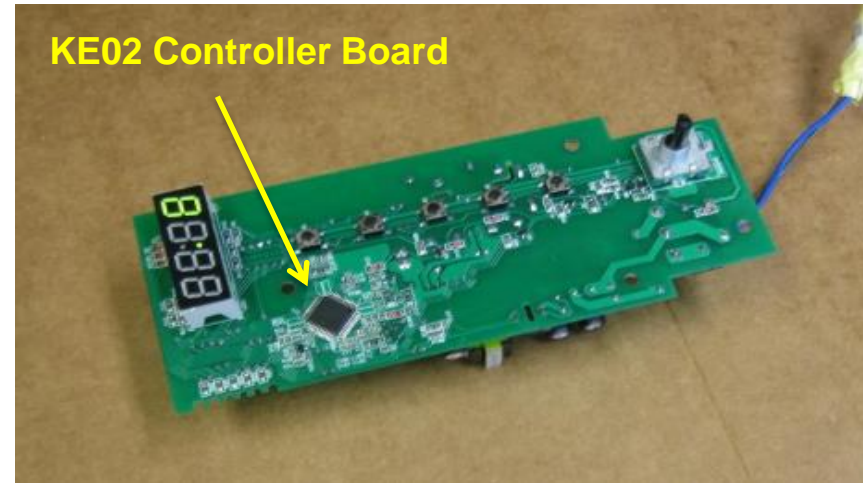
### Test Conditions

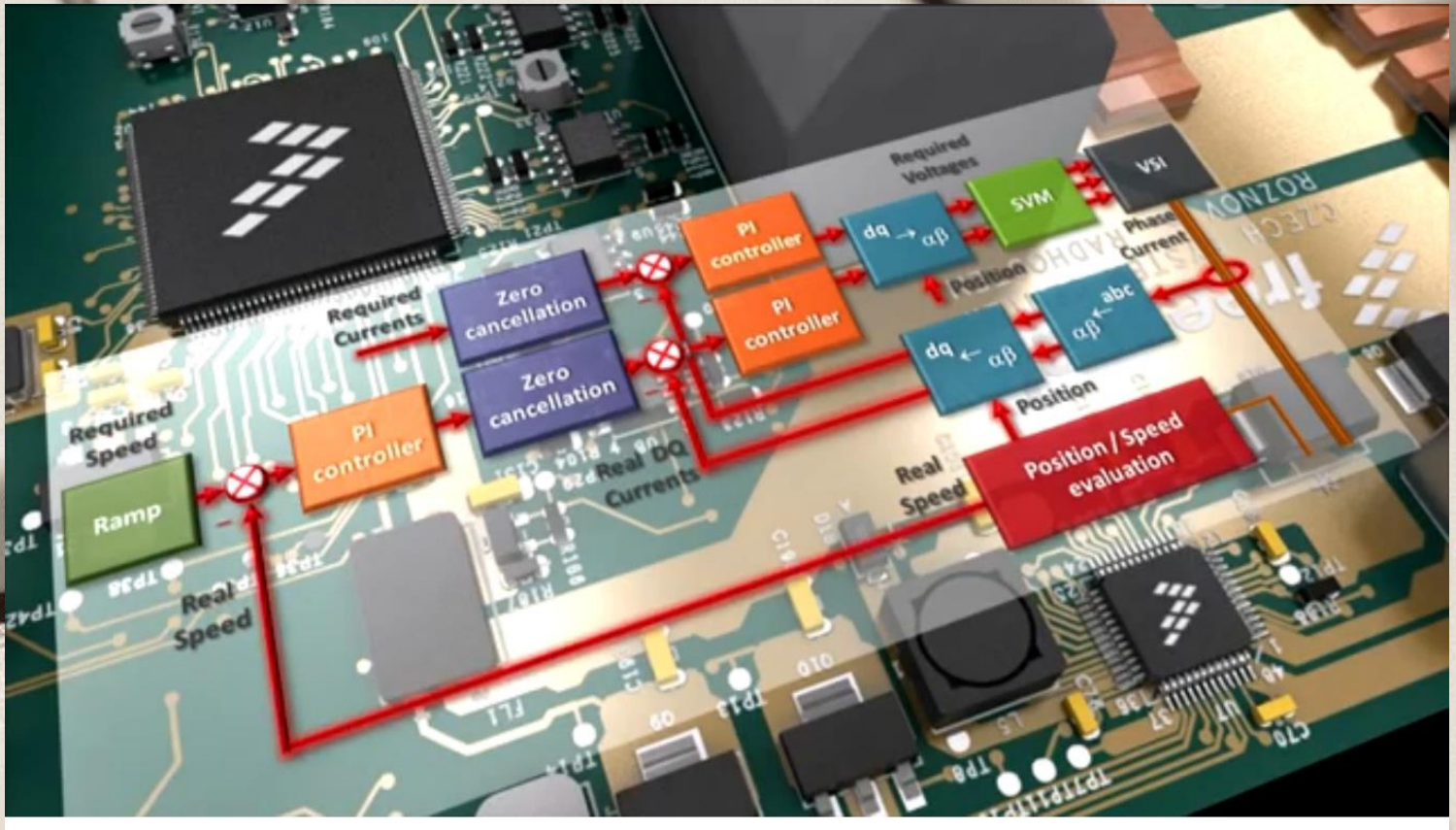
- Microwave Oven Controller board with KE02 as main control MCU
- Board and System level tests based on
  - IEC 61000-4-4(EFT)
  - IEC 61000-4-2(PESD)
  - China Appliance local AC Power Relay test

### Test Results

- Board level
  - IEC 61000-4-4(EFT): +/- 4.4kV\*
  - IEC 61000-4-2(PESD): Indirect Contact Discharge +/- 20kV
  - China Appliance local test on AC Power Relay: 6-turns without Reset
- System level
  - IEC 61000-4-4(EFT): +/- 4.4kV\*
  - IEC 61000-4-2(PESD): Contact Discharge(at the case) +/- 20kV
  - IEC 61000-4-2(PESD): Air Discharge(at the control panel) +/- 15kV

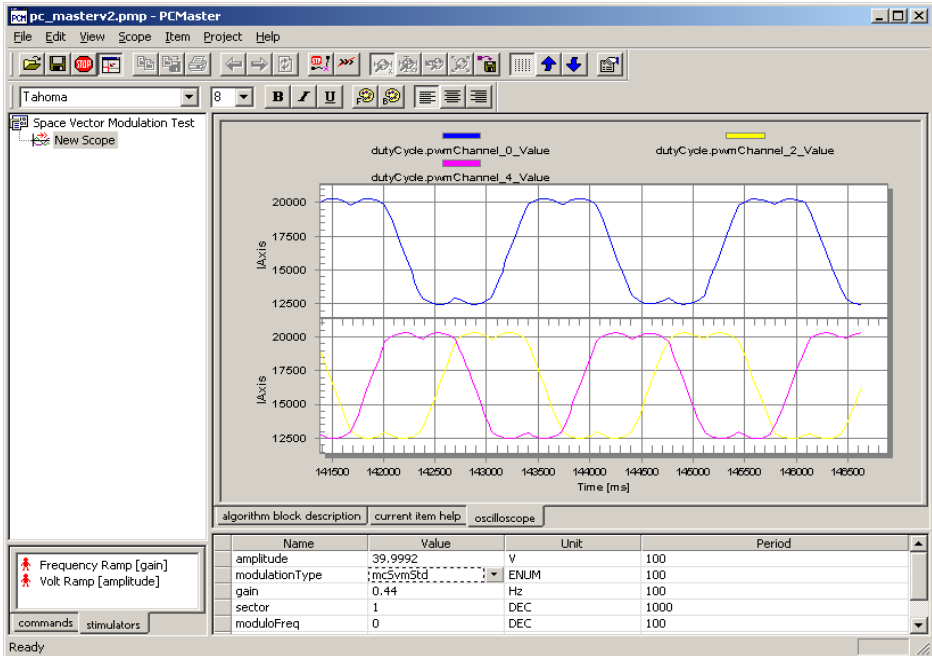
\*Limited by the test equipment max output voltage





## 开发工具简介

# FreeMASTER



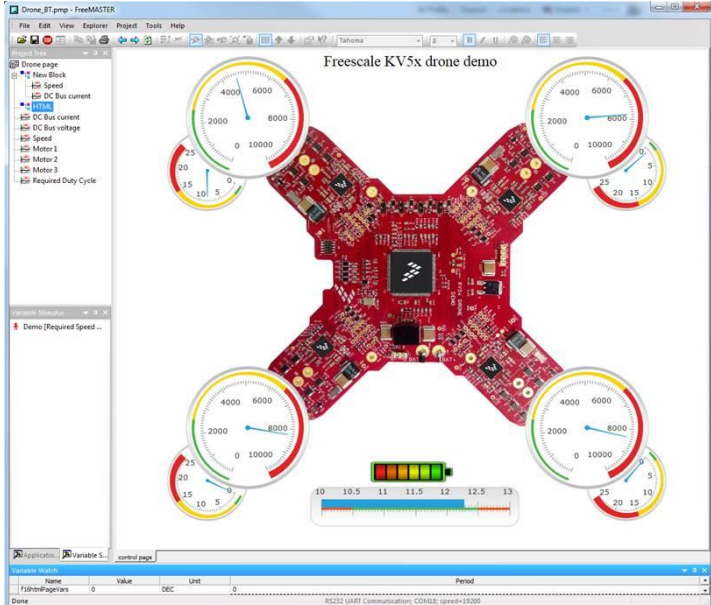
- 读取/写入到目标的任意存储器位置

- 对目标存储器的位操作

- 示波器 – 优化对变量的实时访问 (最多八个变量)。刷新速度由通讯口决定

- 记录仪 – 访问记录目标板上快速瞬变的数据，刷新速度由CPU速度决定。记录的数据长度由可用存储器空间决定，最大64kB

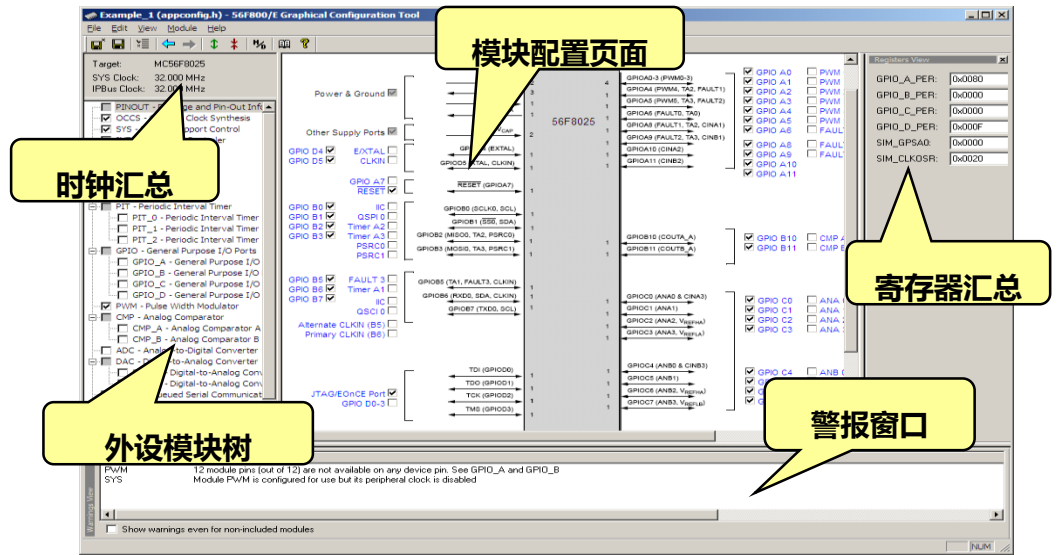
- 应用命令 – 由PC发给具体应用的消息



# What is QuickStart?

**Quick Start :**  
方便使用的DSC软件开发工具  
底层外设配置工具

- **QuickStart 包含**
  - 所有外设模块的底层驱动包
  - 可用的项目模板
  - 图形配置工具
  - 示例应用
- **QuickStart 可以**
  - 根据客户需求来设计
  - 支持所有的DSC设备
  - 是大型家电客户的官方标准开发工具



ioctl(SCI\_0, SCI\_SET\_BAUDRATE, SCI\_BAUD\_9600);

Module identifier      Command to perform      Command Parameter

```

Source: Y:\EMBSW\EMBSW102\stationery\DSP56800E_Quick_Start\MC56F8013\MC56F8013DEMO\C_App...main.c
  • P:000000E5: 8654F0B000D0      move.w #208,x:0x00f0b0
  - P:000000E8: E708              rts
    
```

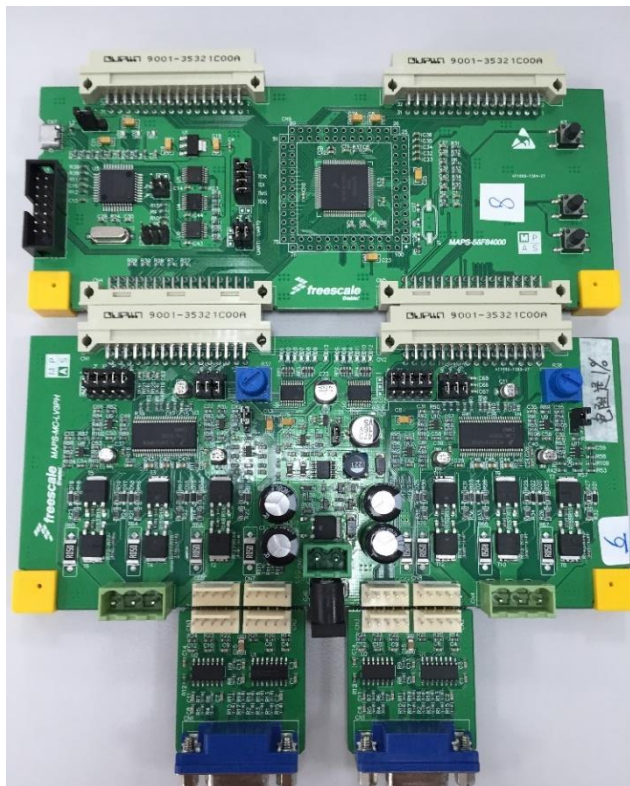
## 介绍文档

- AN4816 -- DSC56800EX Quick Start 开发环境的介绍
- AN4490 -- 如何使用Quick-Start工具来建立基于56F8xxx 的FOC代码结构

**工具下载地址 :** [http://www.freescale.com/zh-Hans/webapp/sps/site/prod\\_summary.jsp?code=DSP56800EQUICKSTART&fosp=1&tab=Design\\_Tools\\_Tab&uc=true&lang\\_cd=zh-Hans](http://www.freescale.com/zh-Hans/webapp/sps/site/prod_summary.jsp?code=DSP56800EQUICKSTART&fosp=1&tab=Design_Tools_Tab&uc=true&lang_cd=zh-Hans)



# MAPS-DSC开发板特点介绍



- 主芯片：MC56F84789
  - 100MHZ, 256Kflash, 56800EX core, 所有引脚引出
- 可以同时驱动两个带增量式编码器/霍尔传感器的三相永磁同步电机的矢量控制伺服，也支持无感BLDC和带传感器的正弦波控制等
- 伺服方案具有定位准确、静态刚度好、节约成本等优点
- 板上自带USB调试器，可以编程烧写，也可以通过FreeMASTER软件在线调试
  
- 24V 直流外部电源接口
- 两组三相电机驱动电路，每组包含：
  - 三相六臂全控桥驱动
  - 预驱动 MC33937
  - 三相电流和电压采样
  - DB15适配器
  - 支持编码器和霍尔传感器

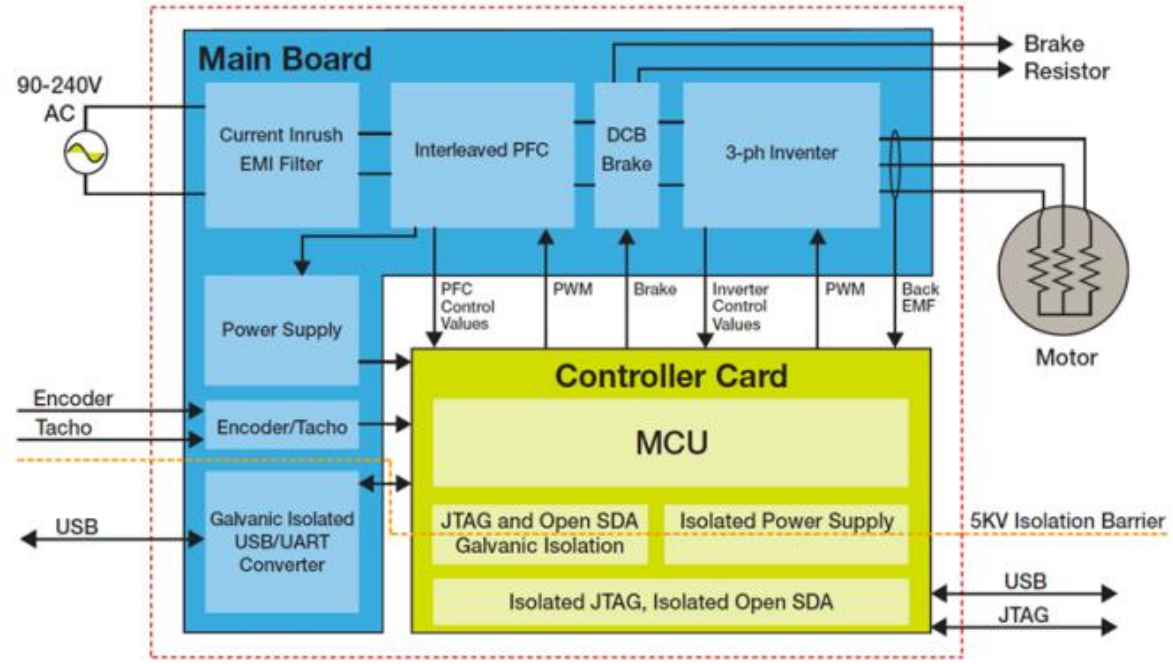
# 三相高压驱动板HVP

## 用途：

- 目前可以支持的KV和DSC  
KV10, KV31, KV46,  
MC56F82748
- BLDC / PMSM / ACIM 驱动
- 白电 / 工业驱动 / 泵 / 风机

## 特征：

- 输出功率：  
1KW无PFC，250VAC，  
800W带PFC，>90VAC
- 最大输出电流8A
- 输入电压：  
交流85-240V或直流110-390V
- 内置PFC功能
- SWD / JTAG / SCI / USB 均有  
5KV 光电隔离
- 支持蓝牙无线模块
- CE / FCC 认证



[www.nxp.com/HVP](http://www.nxp.com/HVP)



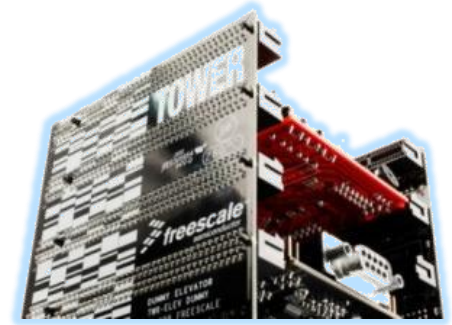
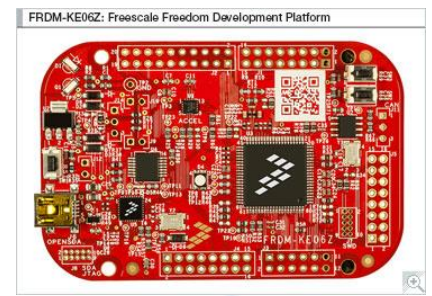


# 文档和工具

## 中文参考设计 (DR) / 应用笔记(AN):

- AN4608 : 利用 MC56F84789 的 PWM 和 ADC 驱动双 PMSM 电机 FOC
- AN4746 : 使用DSC产生高分辨率PWM信号
- AN4870 : 细调三相BLDC电机无感控制应用
- AN4862 : 三相BLDC无感控制
- AN4911 : 三相PMSM无感FOC
- AN4912 : 使用MCAT工具细调三相PMSM无感控制应用
- DRM108 : 采用 MC56F8006 的 BLDC 无传感器参考设计

**更多新的应用笔记在此中文网址 :** [http://www.freescale.com/zh-Hans/webapp/sps/site/overview.jsp?code=KINETIS\\_DOCUMENTATION](http://www.freescale.com/zh-Hans/webapp/sps/site/overview.jsp?code=KINETIS_DOCUMENTATION)



## 软件库

- IEC60730B DSC Safety Routines 1.0;
- IEC60730B Kinetis Safety Household routines



## MCAT (电机控制应用调音师)

- **免费** GUI图形界面插件工具, 可以提供实时监控, 并更新控制参数
- 不提供独立版本, 而是作为FreeMASTER的特殊参考设计插件



## 开发板

- FRDM 开发板, 包含必要的系统组件, 引脚方便引出
- TOWER 开发板, MCU板 / 电源板 / 通讯板 / 扩展板
- MAPS本地化开发板, 自带仿真器,
- 高低压驱动板, 灵活的HVP板

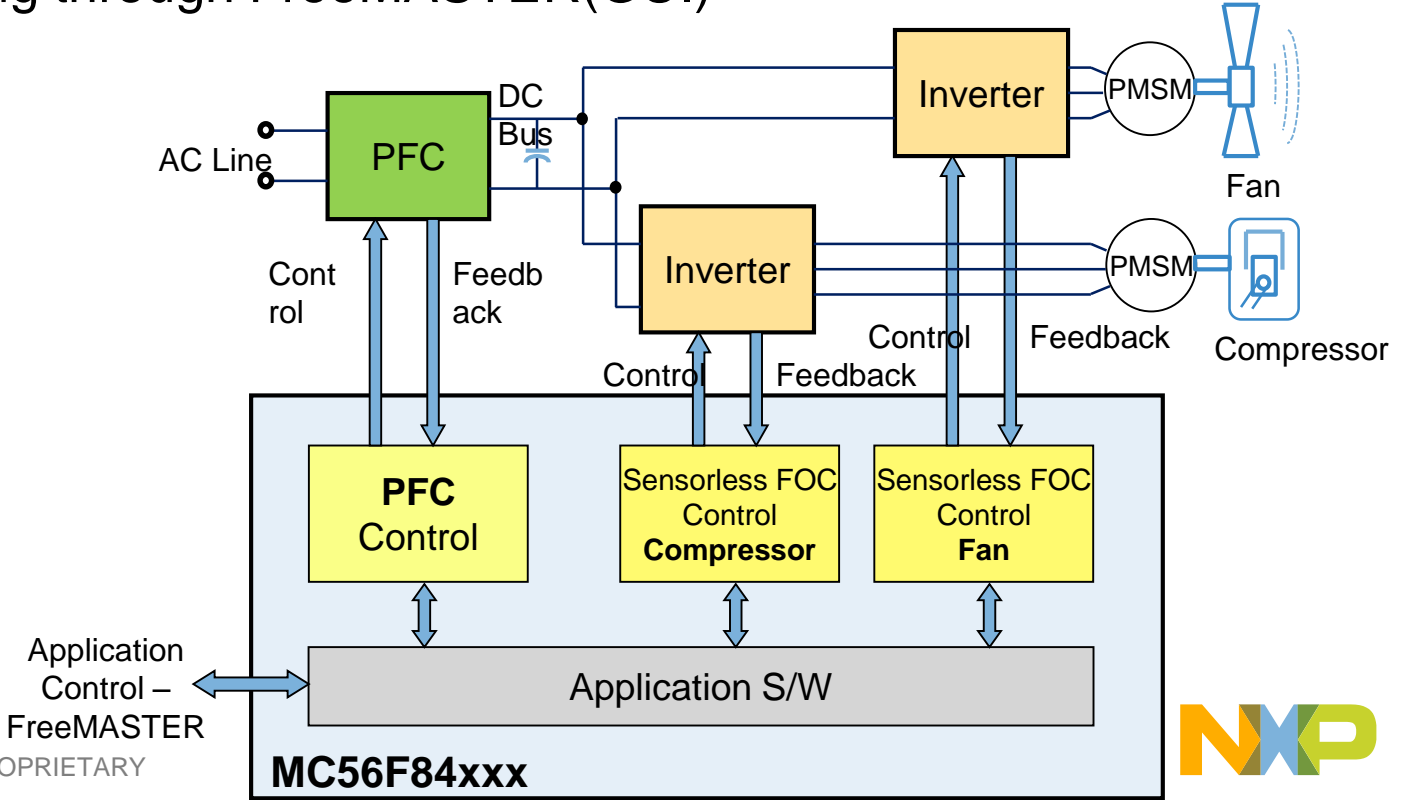
## 电机控制工具箱

- MATLAB™/Simulink™ 模块化环境电机控制插件工具
- 提供自动代码生成, 支持多种编译器, 与FreeMASTER兼容。



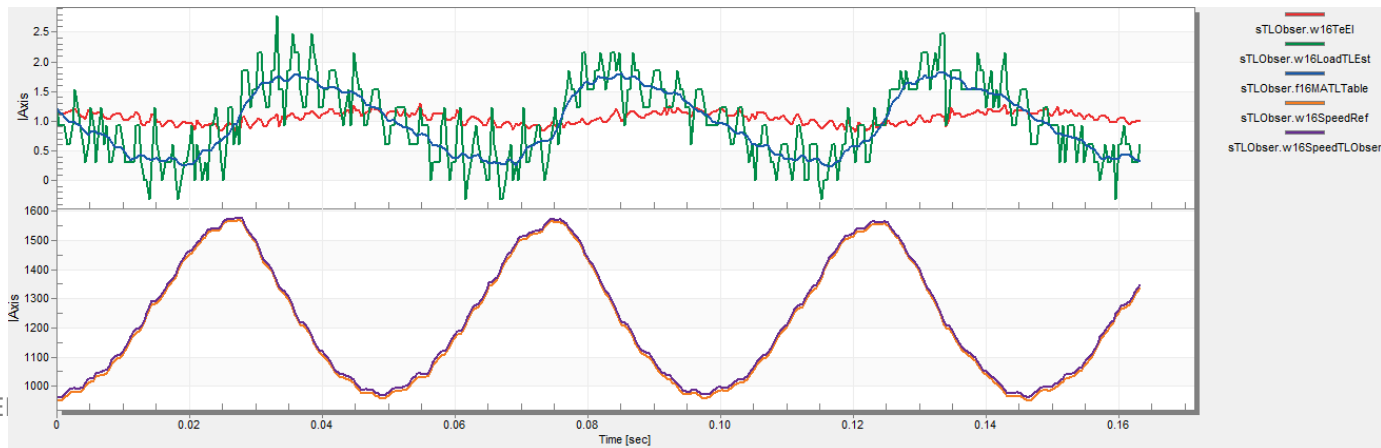
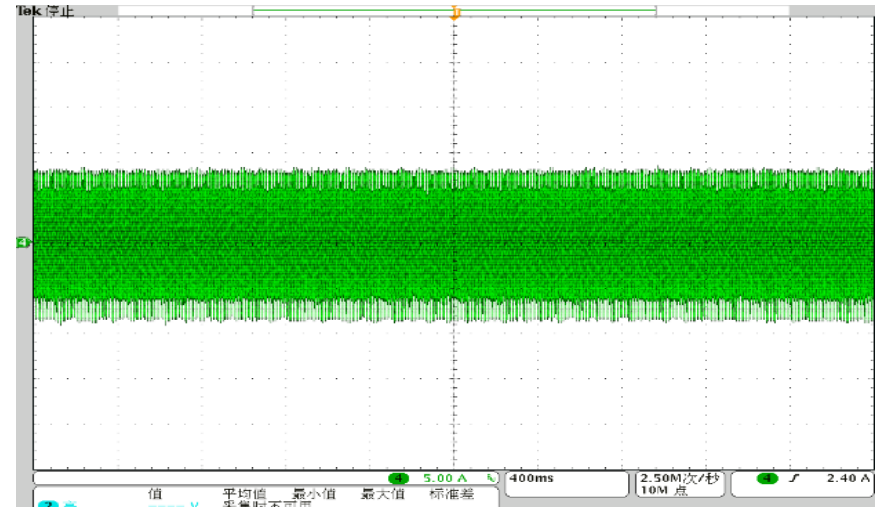
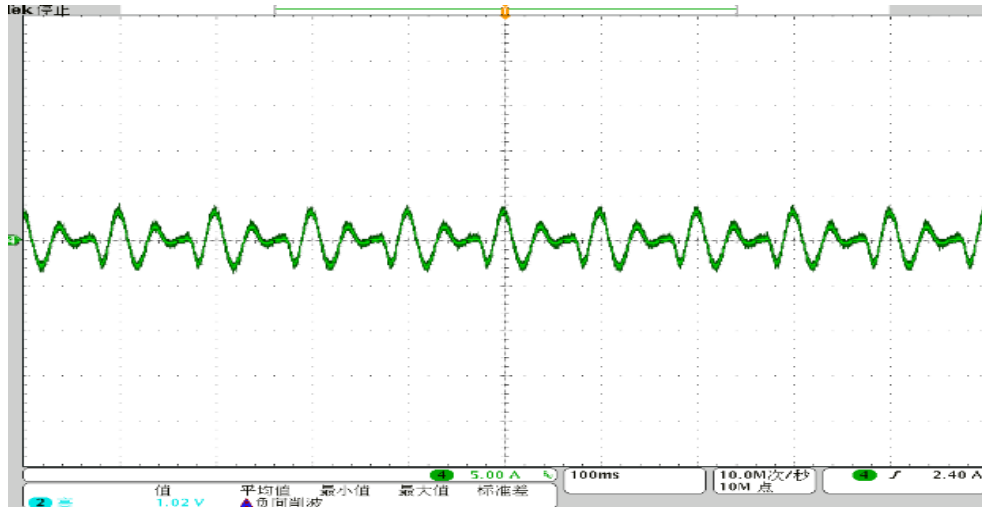
# 三合一空调方案

- Compressor performance
  - ✓ Reliable startup
  - ✓ Wide operation speed range
  - ✓ Online load torque compensation
  - ✓ One shunt current sampling
  - ✓ Easy to debug through FreeMASTER(GUI)



# 方案特色

- 机械频率范围 [1Hz, 150Hz].
- 负载转矩在线补偿，电流随着负载不同时，均可以降低噪声和震动
- 电流包络线在高速时依然稳定





## 功率产品简介

# IGBT & MOSFET Gate Drivers

## GDIC

IGBT  
Single CH



GD3100 / SOIC 32, 10A  
HV Isolation, SPI, I & T sense

**NPI  
Spin-offs**

Stand-alone Isolation  
SOIC-WB package

IGBT GDIC Dual 1/2 Bridge, 3A Out  
Segmented Drive + Isolation

MOSFET  
Half-Bridge  
2 CH



GD3200 / LQFP 48 / 48V / 5A  
Segmented Drive, SPI, I & T sense

MOSFET  
H-Bridge  
4 CH

MC33883  
5-55V / 1A GD  
4 outputs

GD3400  
5-55V / 1A GD / 4 MOSFET drivers

MOSFET  
3-phase  
6 CH

MC33937  
5-55V / > 1A GD  
6 outputs

GD3601 / QFN56, 2A  
3-65V, SPI, CP, BIST, 3 I sense

GD3000  
5-55V / > 1A GD  
6 outputs

GD3600 / 5-75, QFN24, 2A  
5-90V, SPI, PMIC, 3 I sense



Pre-2016

2016

2017

2018

2019

Production

Proposal

Planning

Execution



# IGBT & MOSFET Gate-Driver

Targeting: 12 V to 1500V Motor/Inverter Applications

| Base Part # | Application               | Out | Op Volts (V) | Gate Drive Current (A) | SPI | Sleep (μA) | Freq (kHz) | Temp Range (°C) | Package (LxW mm) Footprint | Release |
|-------------|---------------------------|-----|--------------|------------------------|-----|------------|------------|-----------------|----------------------------|---------|
| MC33GD3100  | IGBT GDIC w/ HV Isolation | 1   | 5.5-90       | 10                     | Yes | 10         | 100        | -40 to 125      | SOICW28                    | Q4'17   |
| MC33GD3200  | MOSFET GDIC 48V Inverters | 2   | 5.5-90       | 5                      | Yes | 10         | 100        | -40 to 125      | LQFP48                     | 2018    |
| MC33GD3601  | MOSFET GDIC               | 6   | 53-65        | 2                      | Yes | 10         | 100        | -40 to 125      | QFN56                      | TBD     |
| MC33883     | H-Bridge / Inverters      | 4   | 5.5-55       | 1                      | No  | 10         | 100        | -40 to 125      | SOIC20 (7.8x7.6)           | Now     |
| MC33937     | Brushless DC              | 6   | 5.5-55       | 1-2.5                  | Yes | 30         | 20         | -40 to 125      | SOIC54 (10X18)             | Now     |
| MC33GD3000  | Brushless DC              | 6   | 5.5-58       | 1-2.5                  | Yes | 30         | 20         | -40 to 125      | QFN56 (8X8)                | Now     |
| MC34GD3000  | Brushless DC              | 6   | 5.5-58       | 1-2.5                  | Yes | 30         | 20         | -20 to 105      | QFN56 (8X8)                | Now     |



SECURE CONNECTIONS  
FOR A SMARTER WORLD