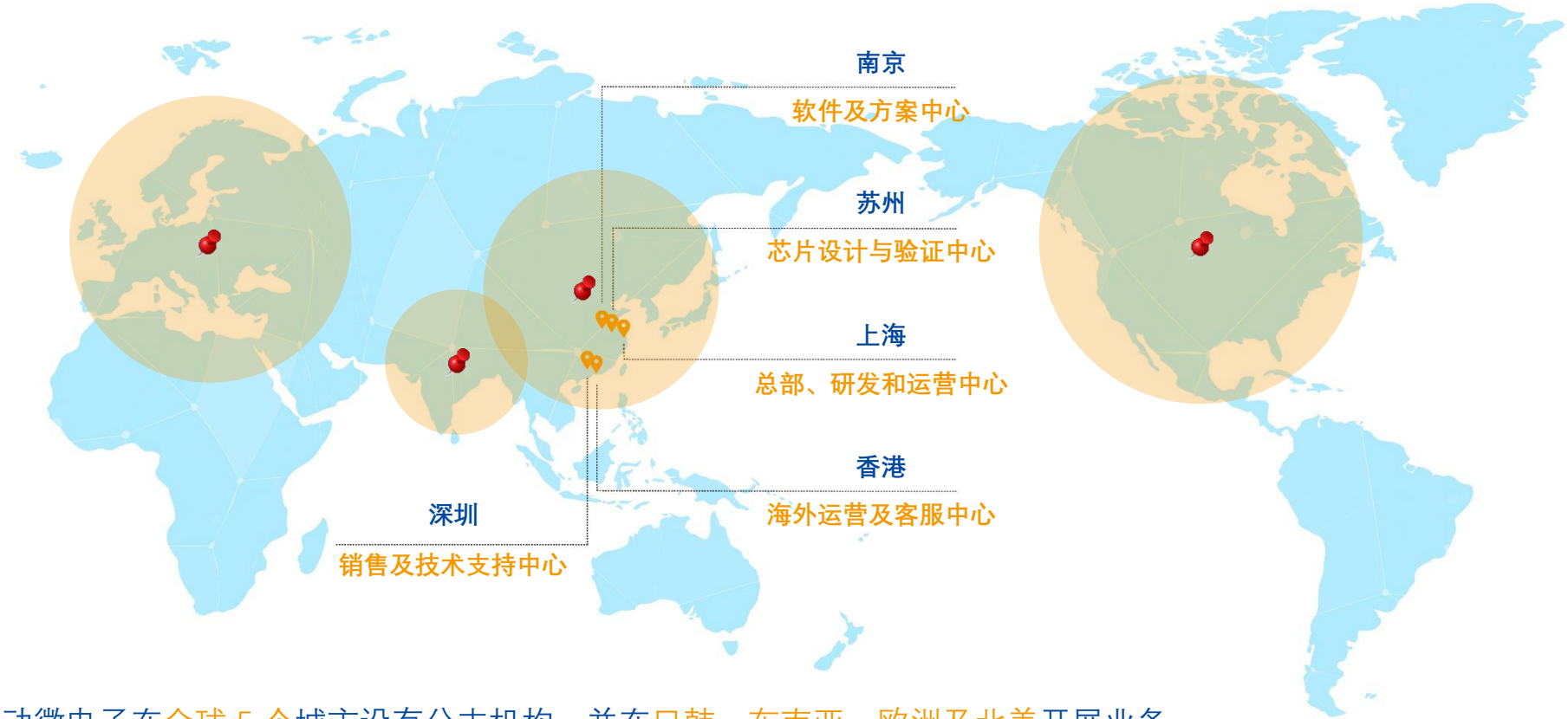
MindMotion
SoC Solutions

20.05.2021

基于灵动MM32 MCU的
高能效三合一家用空调解决方案与MindSPIN平台介绍

MM32 INSIDE

扎根本土，布局全球



灵动微电子在全球 5 个城市设有分支机构，并在日韩、东南亚、欧洲及北美开展业务，更好的利用全球技术及人力资源，完善产品研发，为客户提供销售和技术支持服务。

灵动产品能力布局

品质可靠性

自主创新

软件生态

长期供货

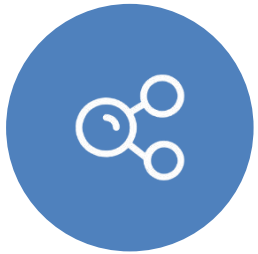
核心技术

安全

MCU及其系统级安全

可靠

品质保障，供应链保障



开放

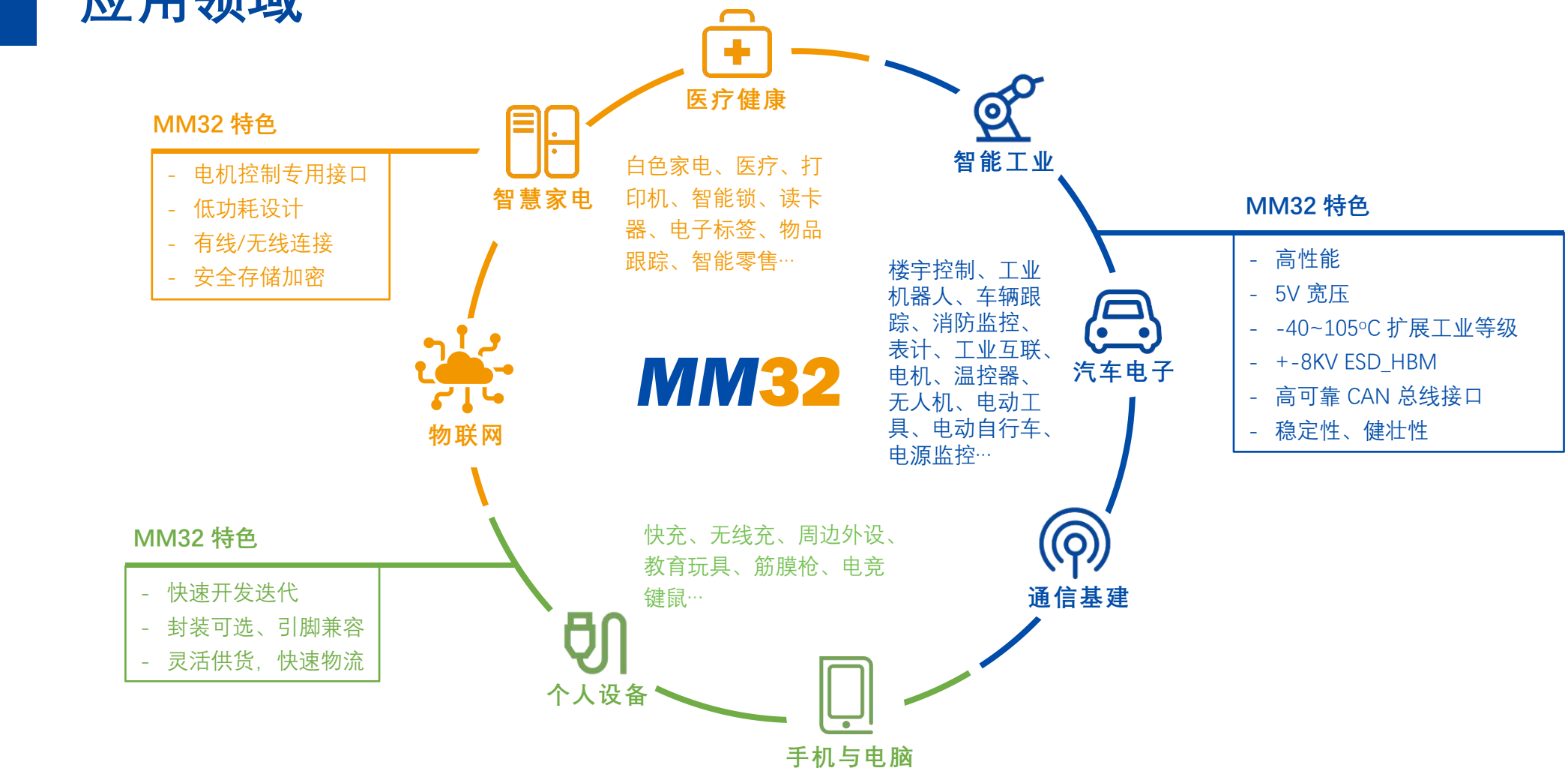
合作伙伴的可访问性

能效

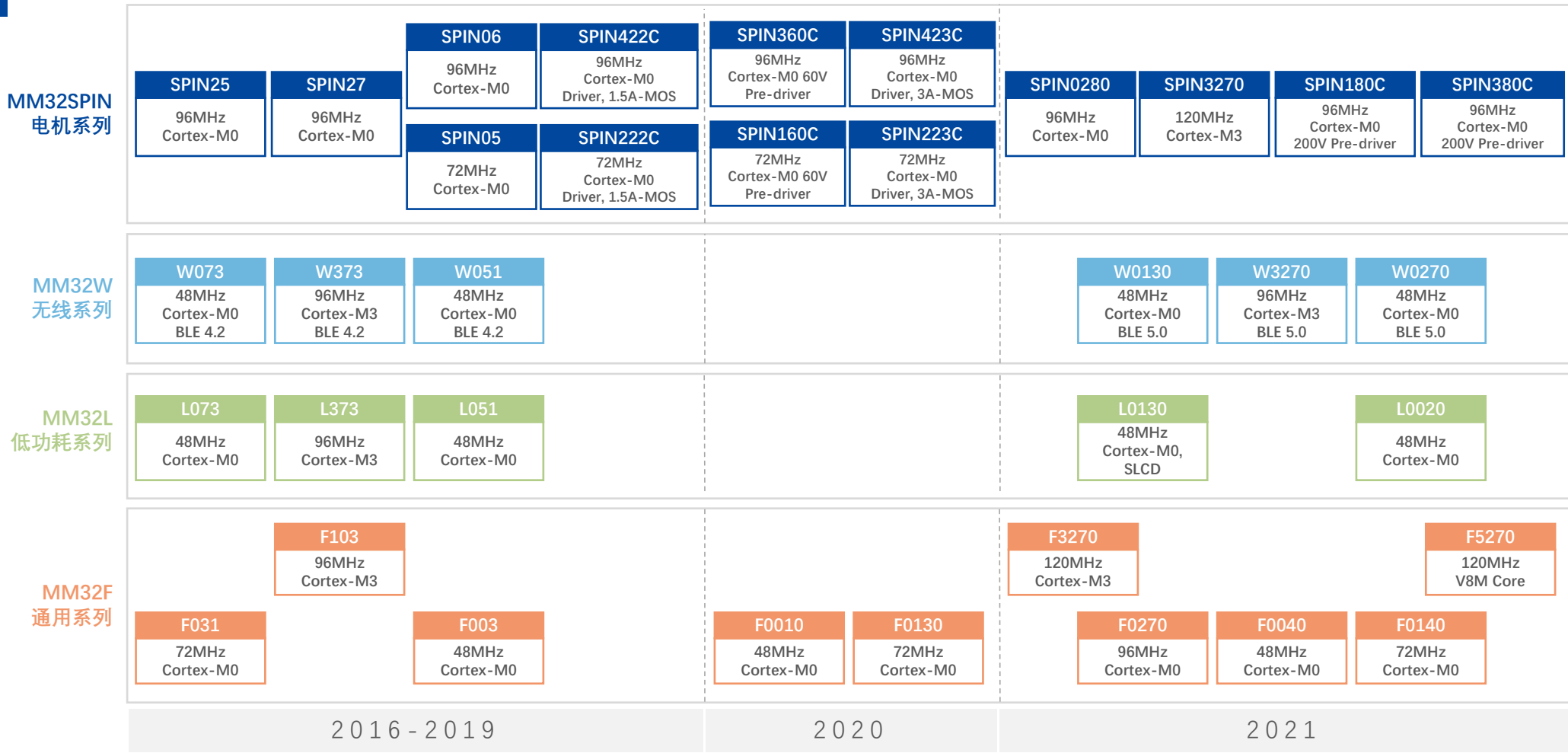
符合应用场景的
可配置化能效管理策略

灵动MM32 MCU产品家族

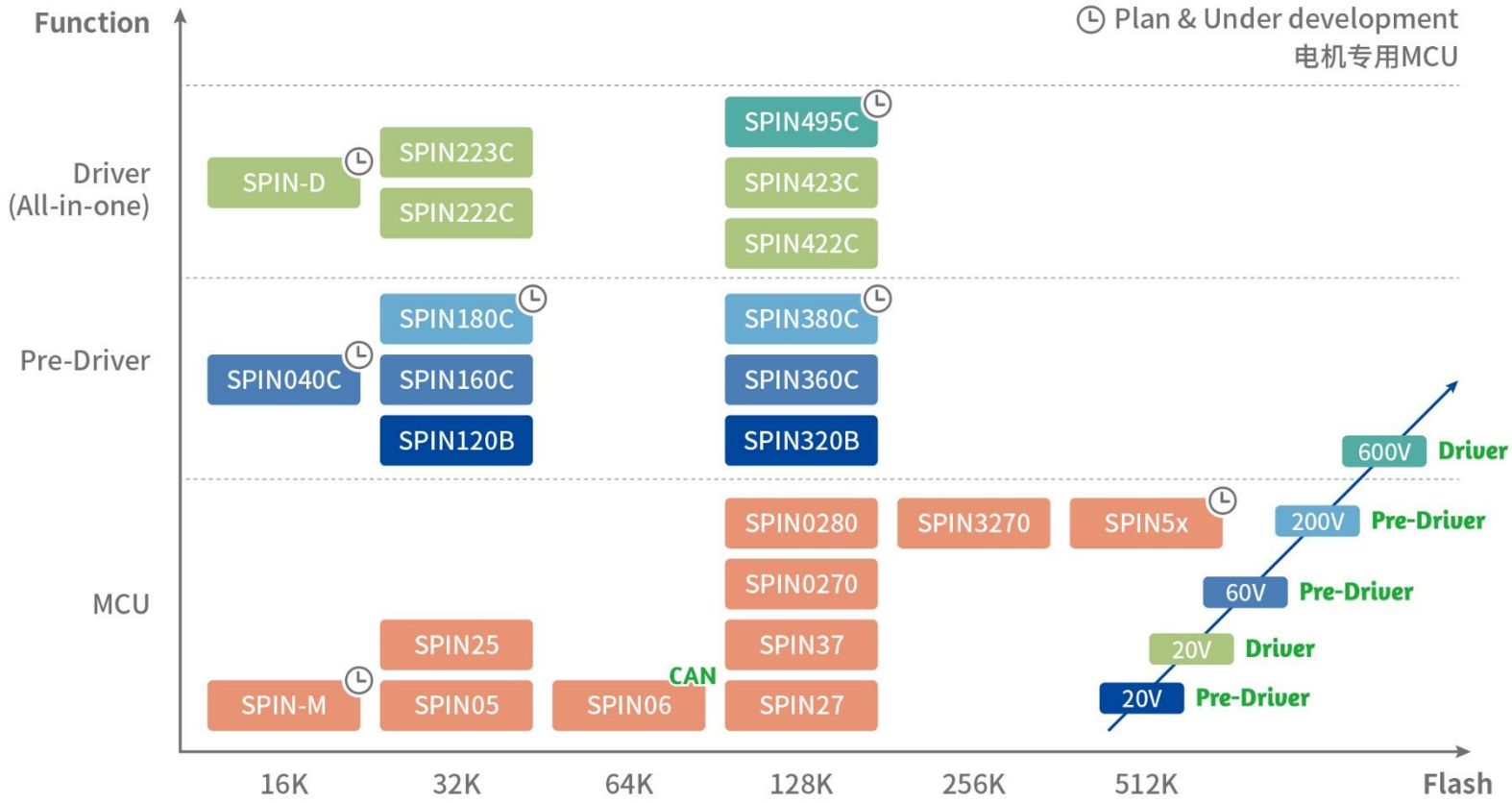
应用领域


医疗健康
智能工业
智慧家电
白色家电、医疗、打印机、智能锁、读卡器、电子标签、物品跟踪、智能零售…
楼宇控制、工业机器人、车辆跟踪、消防监控、表计、工业互联、电机、温控器、无人机、电动工具、电动自行车、电源监控…
MM32
汽车电子
物联网
通信基建
个人设备
快充、无线充、周边外设、教育玩具、筋膜枪、电竞键鼠…
手机与电脑
MM32 特色
- 电机控制专用接口
- 低功耗设计
- 有线/无线连接
- 安全存储加密
MM32 特色
- 高性能
- 5V 宽压
- -40~105°C 扩展工业等级
- +-8KV ESD_HBM
- 高可靠 CAN 总线接口
- 稳定性、健壮性
MM32 特色
- 快速开发迭代
- 封装可选、引脚兼容
- 灵活供货，快速物流

MM32 产品路线图


MM32SPIN
电机系列
SPIN25
96MHz
Cortex-M0
SPIN27
96MHz
Cortex-M0
SPIN06
96MHz
Cortex-M0
SPIN422C
96MHz
Cortex-M0
Driver, 1.5A-MOS
SPIN05
72MHz
Cortex-M0
SPIN222C
72MHz
Cortex-M0
Driver, 1.5A-MOS
SPIN360C
96MHz
Cortex-M0 60V
Pre-driver
SPIN423C
96MHz
Cortex-M0
Driver, 3A-MOS
SPIN160C
72MHz
Cortex-M0 60V
Pre-driver
SPIN223C
72MHz
Cortex-M0
Driver, 3A-MOS
SPIN0280
96MHz
Cortex-M0
SPIN3270
120MHz
Cortex-M3
SPIN180C
96MHz
Cortex-M0
200V Pre-driver
SPIN380C
96MHz
Cortex-M0
200V Pre-driver
MM32W
无线系列
W073
48MHz
Cortex-M0
BLE 4.2
W373
96MHz
Cortex-M3
BLE 4.2
W051
48MHz
Cortex-M0
BLE 4.2
W0130
48MHz
Cortex-M0
BLE 5.0
W3270
96MHz
Cortex-M3
BLE 5.0
W0270
48MHz
Cortex-M0
BLE 5.0
MM32L
低功耗系列
L073
48MHz
Cortex-M0
L373
96MHz
Cortex-M3
L051
48MHz
Cortex-M0
L0130
48MHz
Cortex-M0,
SLCD
L0020
48MHz
Cortex-M0
MM32F
通用系列
F103
96MHz
Cortex-M3
F031
72MHz
Cortex-M0
F003
48MHz
Cortex-M0
F0010
48MHz
Cortex-M0
F0130
72MHz
Cortex-M0
F3270
120MHz
Cortex-M3
F5270
120MHz
V8M Core
F0270
96MHz
Cortex-M0
F0040
48MHz
Cortex-M0
F0140
72MHz
Cortex-M0
2016-2019
2020
2021

MM32 SPIN 系列产品组合



生态系统

产品选型 → 开发设计 → 样机测试 → 量产升级

选型手册

在线服务

QQ　微信　论坛

应用方案

IDE、调试器

arm KEIL　IAR SYSTEMS　GCC

开发板评估套件

RTOS 支持

AWorks　Cneos　AliOS　arm MBED　Lite　Microsoft Azure　RT-Thread　RTOS

编程下载器

小批量样片采购

$$$

FAE线上线下支持

可靠性测试服务

量产烧录工具

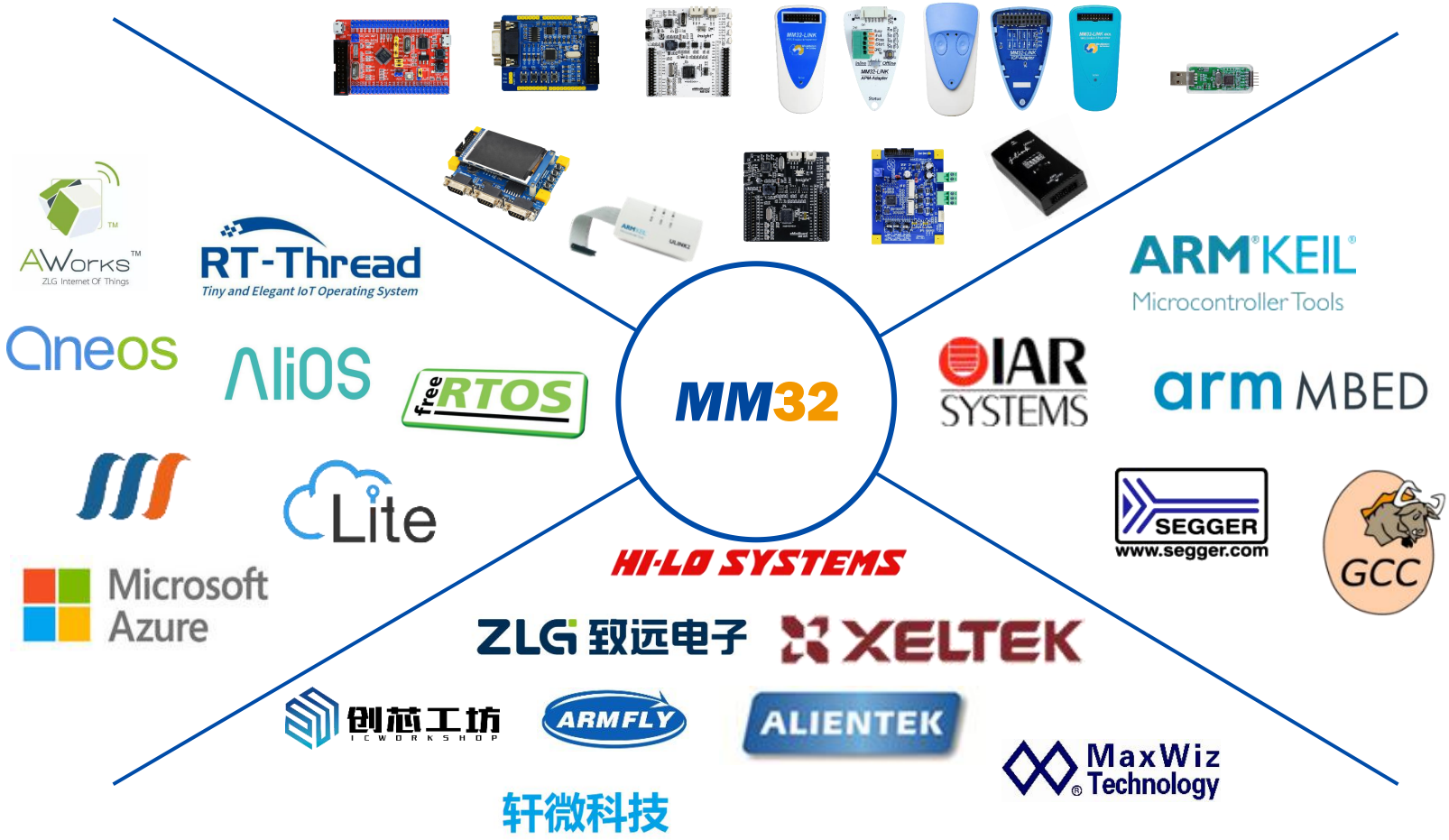
HI-LO SYSTEMS　创芯工坊　ZLG 致远电子　XELTEK

用户固件保护

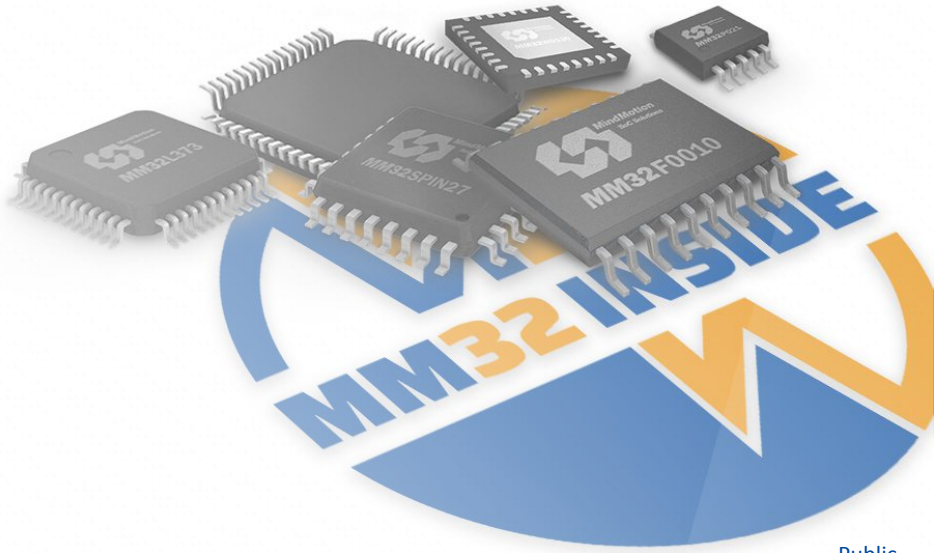
安全升级服务

MindSafe™

MM32 生态合作伙伴


AWorks
ZLG Internet Of Things
RT-Thread
Tiny and Elegant IoT Operating System
ARM KEIL
Microcontroller Tools
Aneos
AliOS
freeRTOS
MM32
IAR SYSTEMS
arm MBED
Lite
SEGGER
www.segger.com
GCC
Microsoft Azure
HI-LO SYSTEMS
ZLG 致远电子
XELTEK
创芯工坊
ICWORKSHOP
ARMFLY
ALIENTEK
MaxWiz Technology
轩微科技

空调室内外机控制器设计

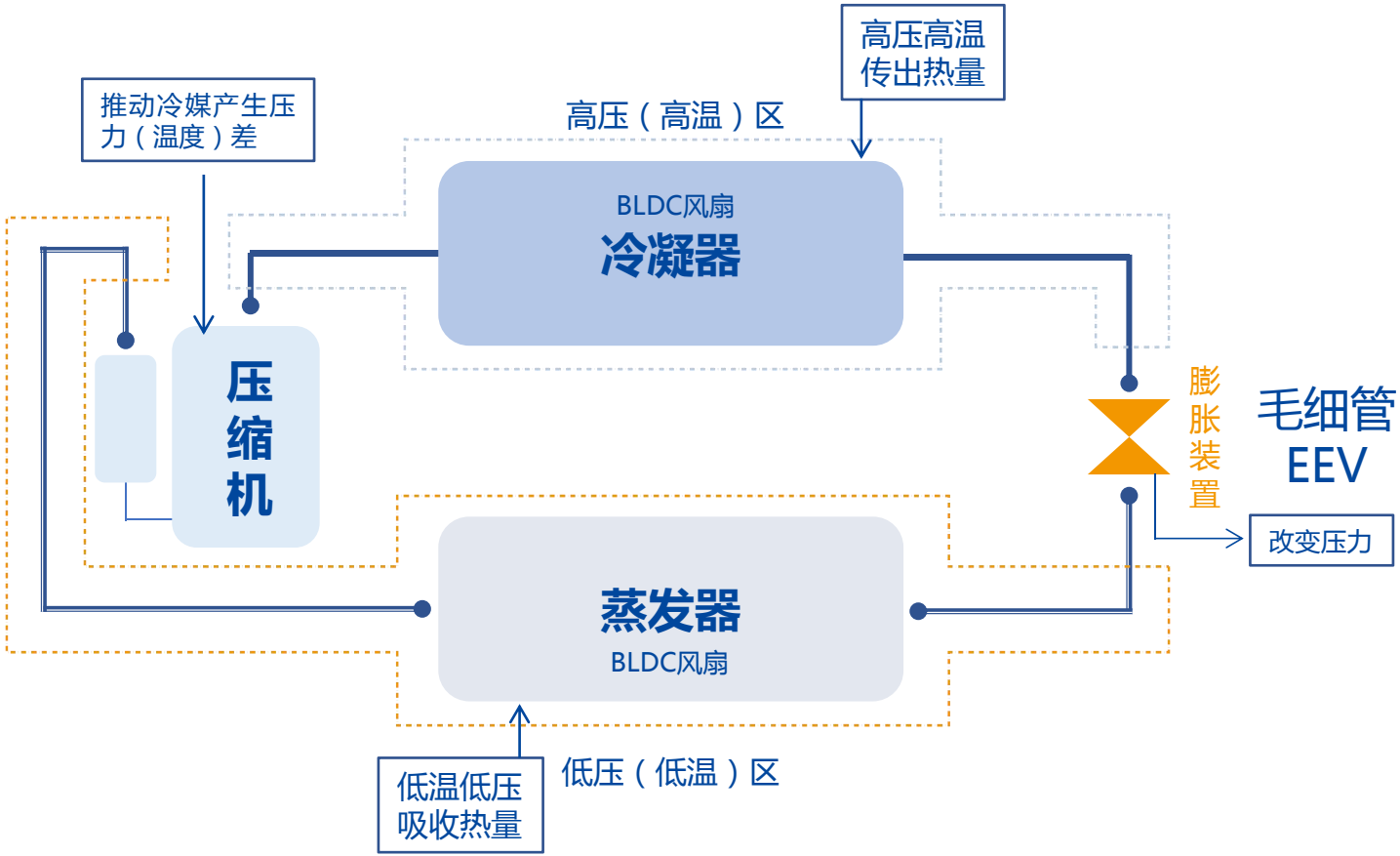


MCU应用方案组合(Y2021, MindSPIN SDK- Motor V3)

L ---------- MCU ---------- H Gate Driver　　All-in-one

	SPIN05/OP	SPIN06	SPIN27	SPIN3270	SPIN160C	SPIN360C	SPIN222C/223C	SPIN422C/423C
2轮/3轮电动自行车	●		○					
平衡车/滑板车	●	●	○					
空气净化器	○				●			
服务器风机	○				●			
印度吊扇	○				●			
吊扇灯	●				○			
落地扇	●				○			
电动手工具	○					●		
吸尘器		○				●		
无人机电调		○				●		
水泵	○				●			
冰箱压缩机	●							
室内空调风机	●	○						
室外空调板			○	●				
DD洗衣机			○	●				
机器人				●				
工业变频器				●				
冰箱风机							●	
伺服舵机							●	●
云台							●	●
筋磨枪	●							

空调机结构图


推动冷媒产生压力（温度）差
高压高温传出热量
高压（高温）区
BLDC风扇
冷凝器
压缩机
膨胀装置
毛细管
EEV
改变压力
蒸发器
BLDC风扇
低温低压吸收热量
低压（低温）区

空调机室外机板

MM32 MCU Parts

MM32SPIN06

MM32SPIN37

Features

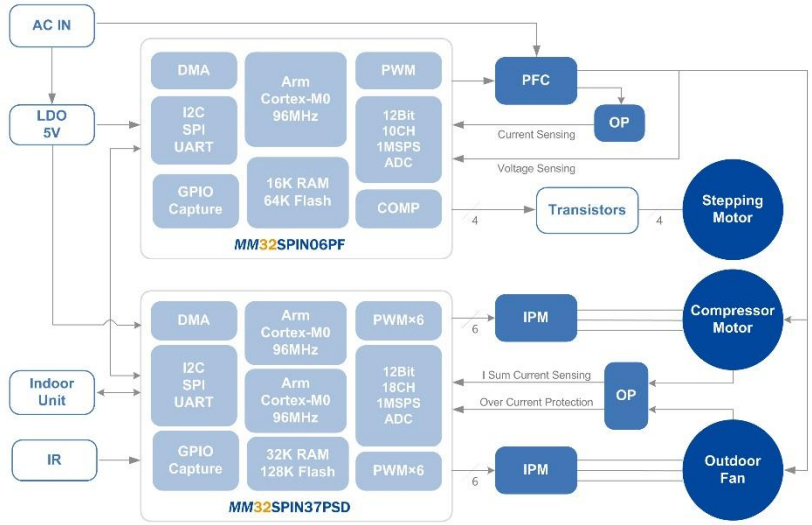
- FOC, 单电阻
- 1Hz超低转速
- 弱磁控制

Specification

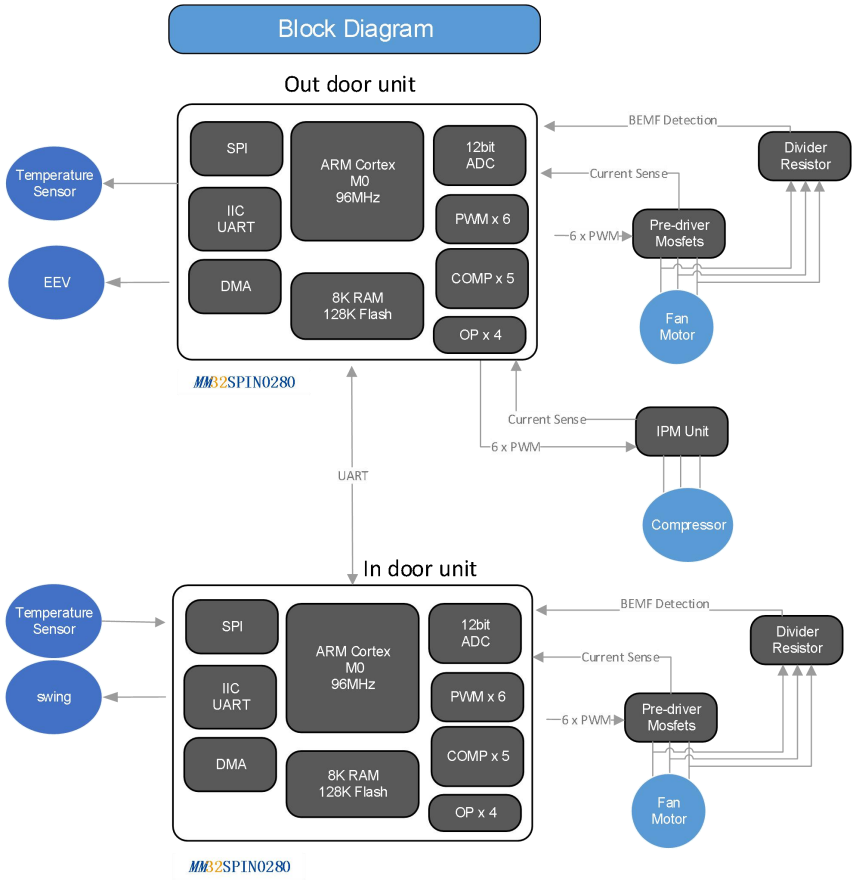
Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	96MHz	180~260VAC180~260VAC	300~7200RPM (6poles)

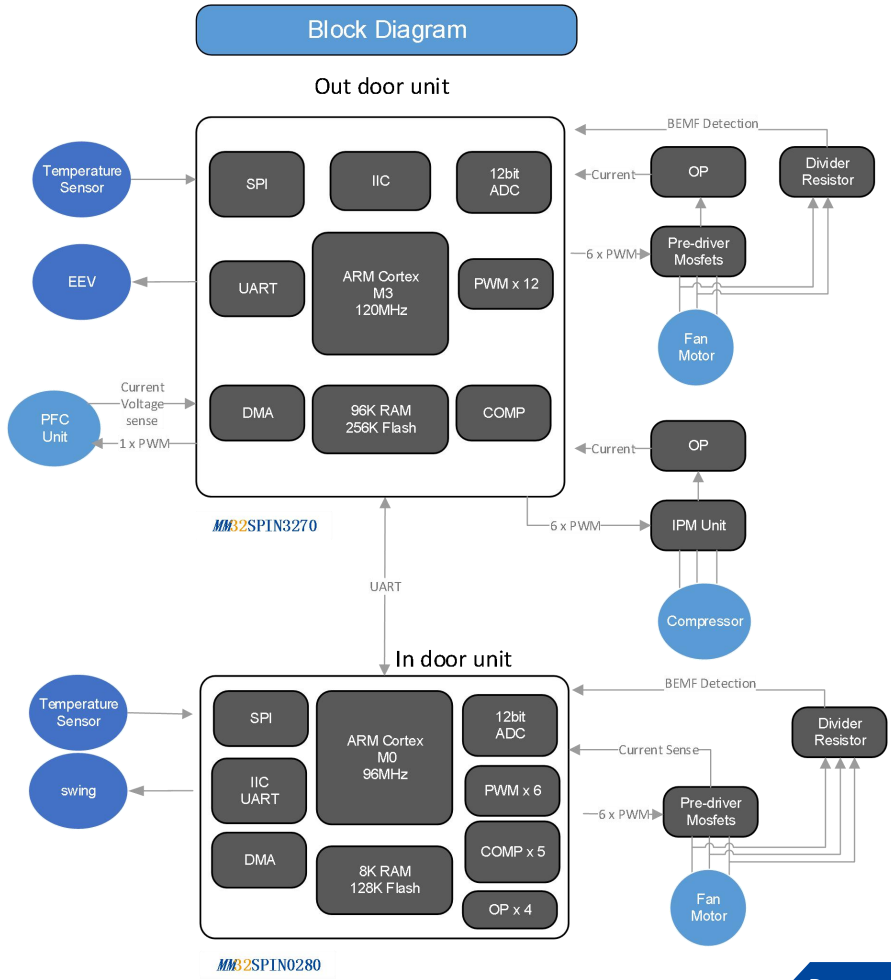
- Sensor-less FOC control
- SMO methodology for the rotor angle detection
- Dual resister third phases current sensing
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block

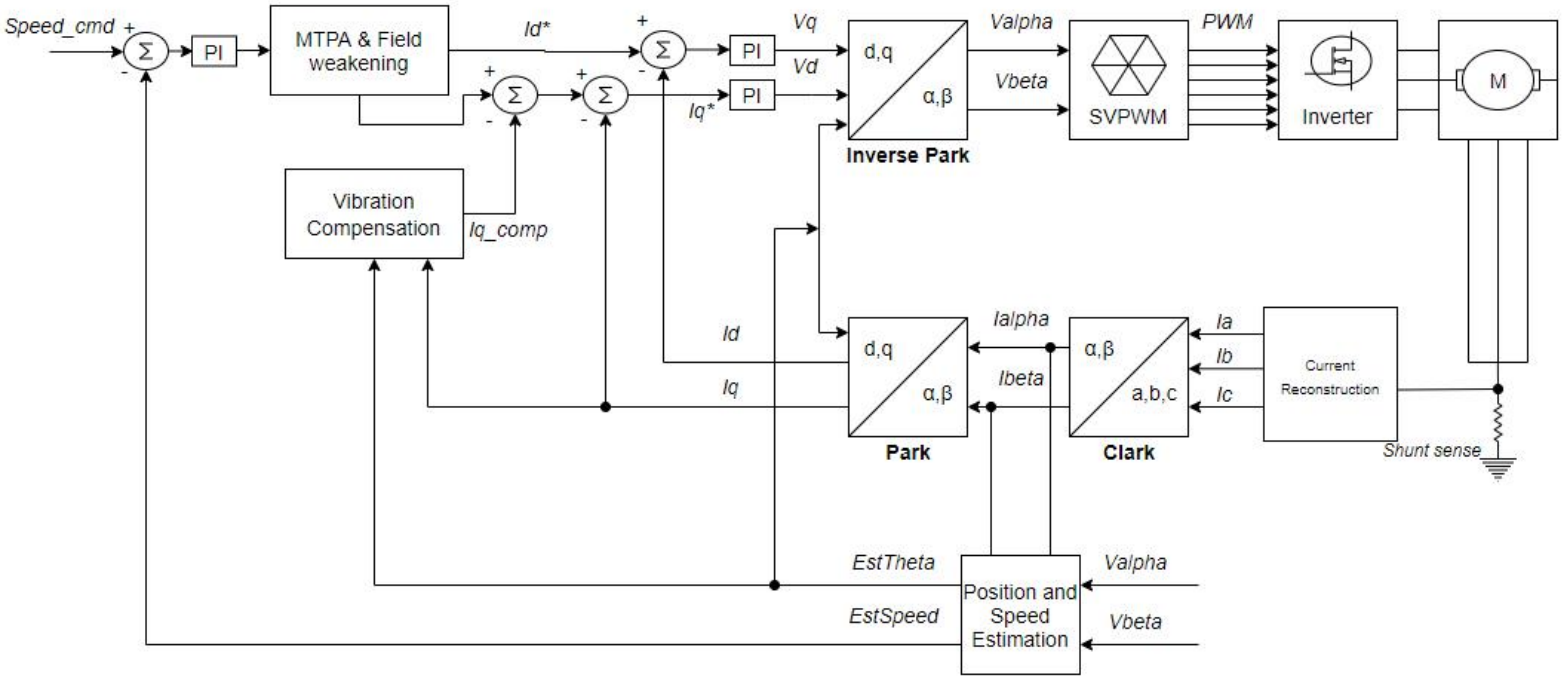


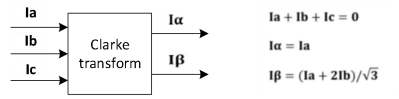
空调解决方案框图

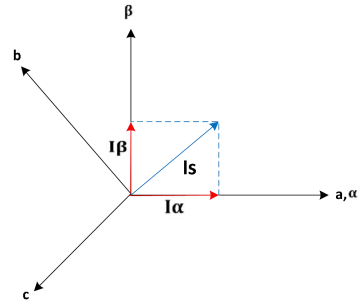

Block Diagram
Out door unit
Temperature Sensor
EEV
SPI
IIC UART
DMA
ARM Cortex M0 96MHz
8K RAM 128K Flash
12bit ADC
PWM x 6
COMP x 5
OP x 4
BEMF Detection
Divider Resistor
Current Sense
6 x PWM
Pre-driver Mosfets
Fan Motor
MM32SPIN0280
Current Sense
6 x PWM
IPM Unit
Compressor
UART
In door unit
Temperature Sensor
swing
SPI
IIC UART
DMA
ARM Cortex M0 96MHz
8K RAM 128K Flash
12bit ADC
PWM x 6
COMP x 5
OP x 4
BEMF Detection
Divider Resistor
Current Sense
6 x PWM
Pre-driver Mosfets
Fan Motor
MM32SPIN0280

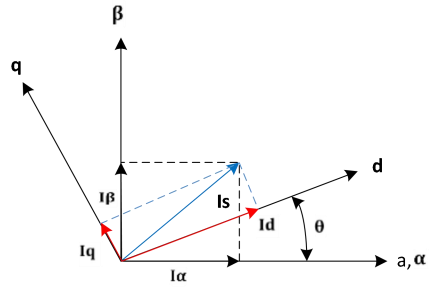

Block Diagram
Out door unit
Temperature Sensor
EEV
PFC Unit
Current
Voltage
sense
1 x PWM
SPI
IIC
12bit ADC
UART
ARM Cortex M3 120MHz
PWM x 12
DMA
96K RAM 256K Flash
COMP
BEMF Detection
Current
OP
Divider Resistor
6 x PWM
Pre-driver Mosfets
Fan Motor
MM32SPIN3270
Current
OP
6 x PWM
IPM Unit
Compressor
UART
In door unit
Temperature Sensor
swing
SPI
IIC UART
DMA
ARM Cortex M0 96MHz
8K RAM 128K Flash
12bit ADC
PWM x 6
COMP x 5
OP x 4
BEMF Detection
Divider Resistor
Current Sense
6 x PWM
Pre-driver Mosfets
Fan Motor
MM32SPIN0280

FOC Block Diagram

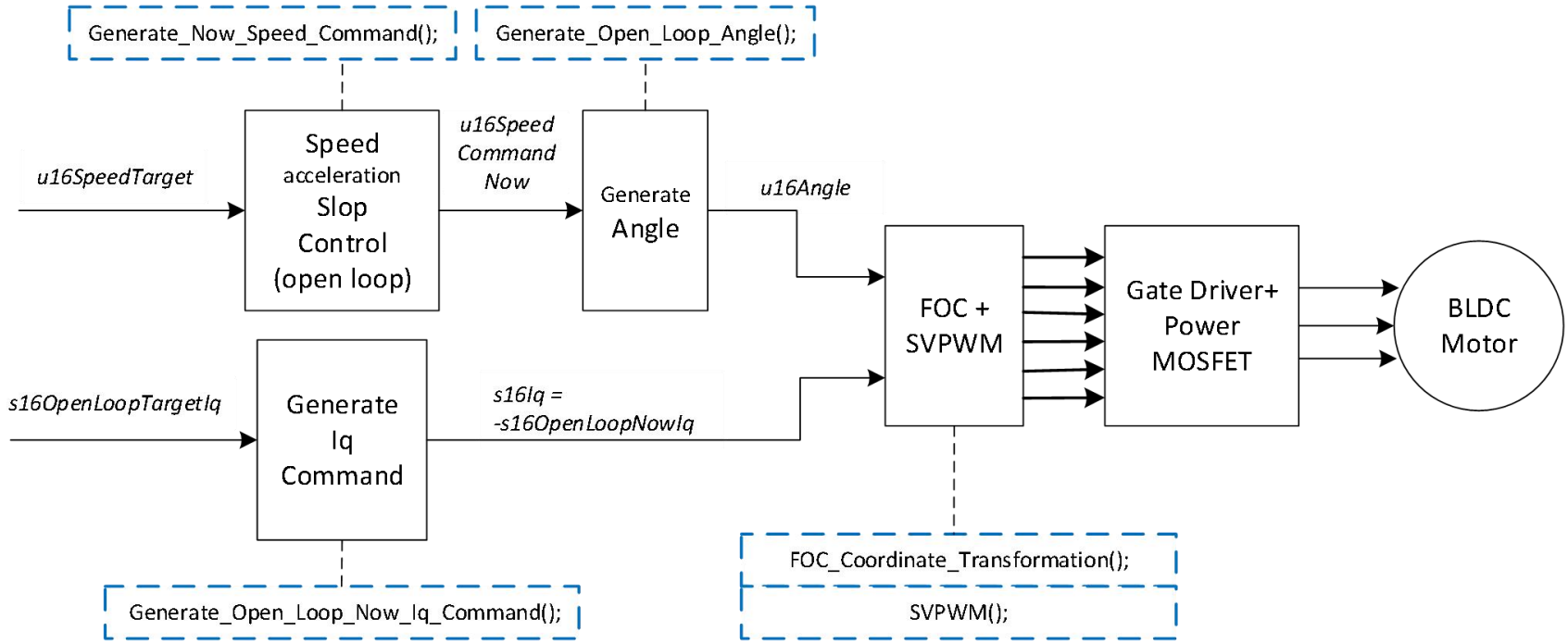




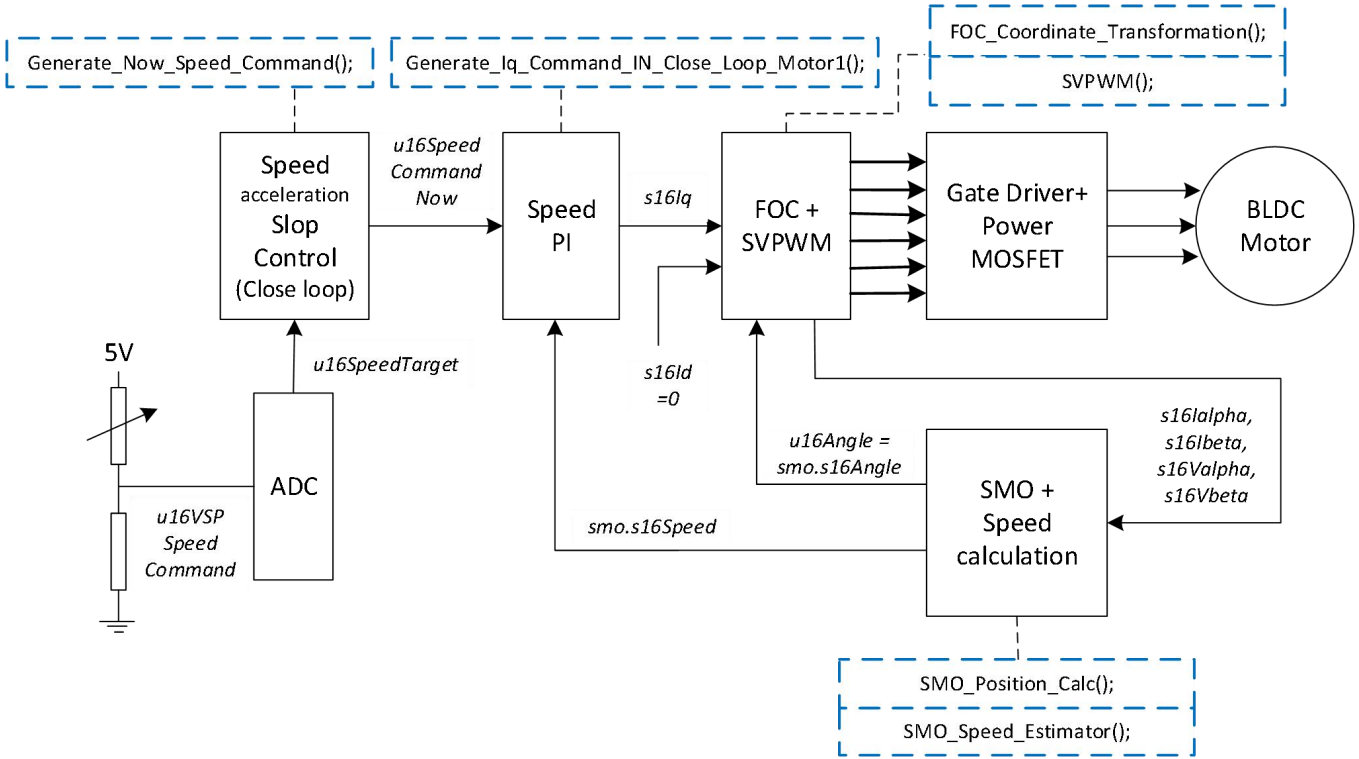




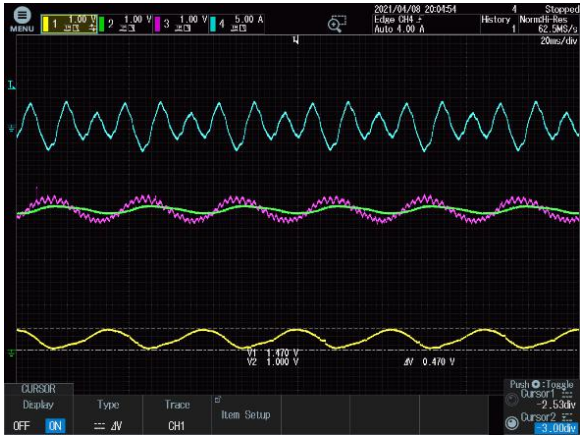
Sensorless FOC- Open Loop



Sensorless FOC- Close Loop



压缩机30RPS/震动抑制



Iu

Iq*/Iq

Wr

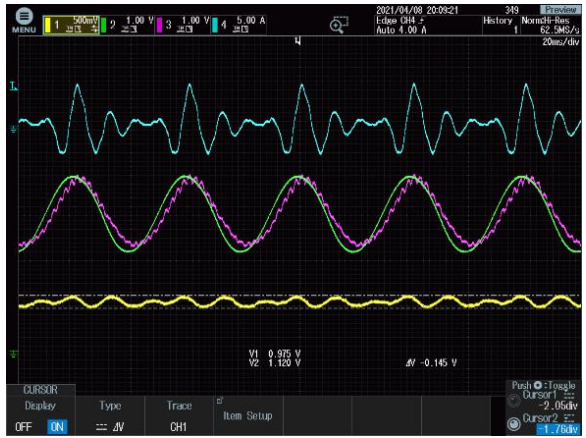
Gain: 0
Wr (P-P): 705 RPM
Vib(P-P): 217 μm

Gain: 3500
Wr (P-P): 420 RPM
Vib(P-P): 135 μm

Gain: 7000
Wr (P-P): 255 RPM
Vib(P-P): 8 μm

30RPS/angle14000

压缩机25RPS/震动抑制



Iu

Iq*/Iq

Wr

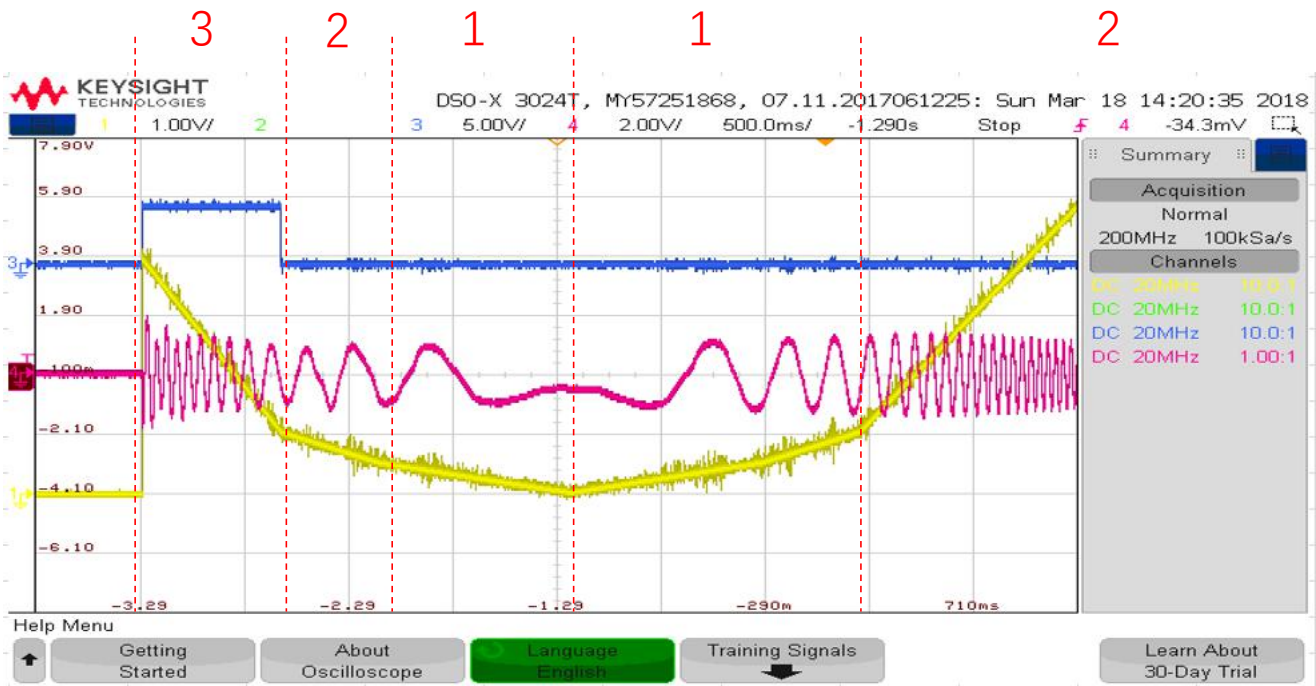
Gain: 0
Wr (P-P): 585 RPM
Vib(P-P): 280 μm

Gain: 3500
Wr (P-P): 345 RPM
Vib(P-P): 147 μm

Gain: 7000
Wr (P-P): 218 RPM
Vib(P-P): 42 μm

25RPS/angle14000

室外风机逆风启动开回路三段减速度波形



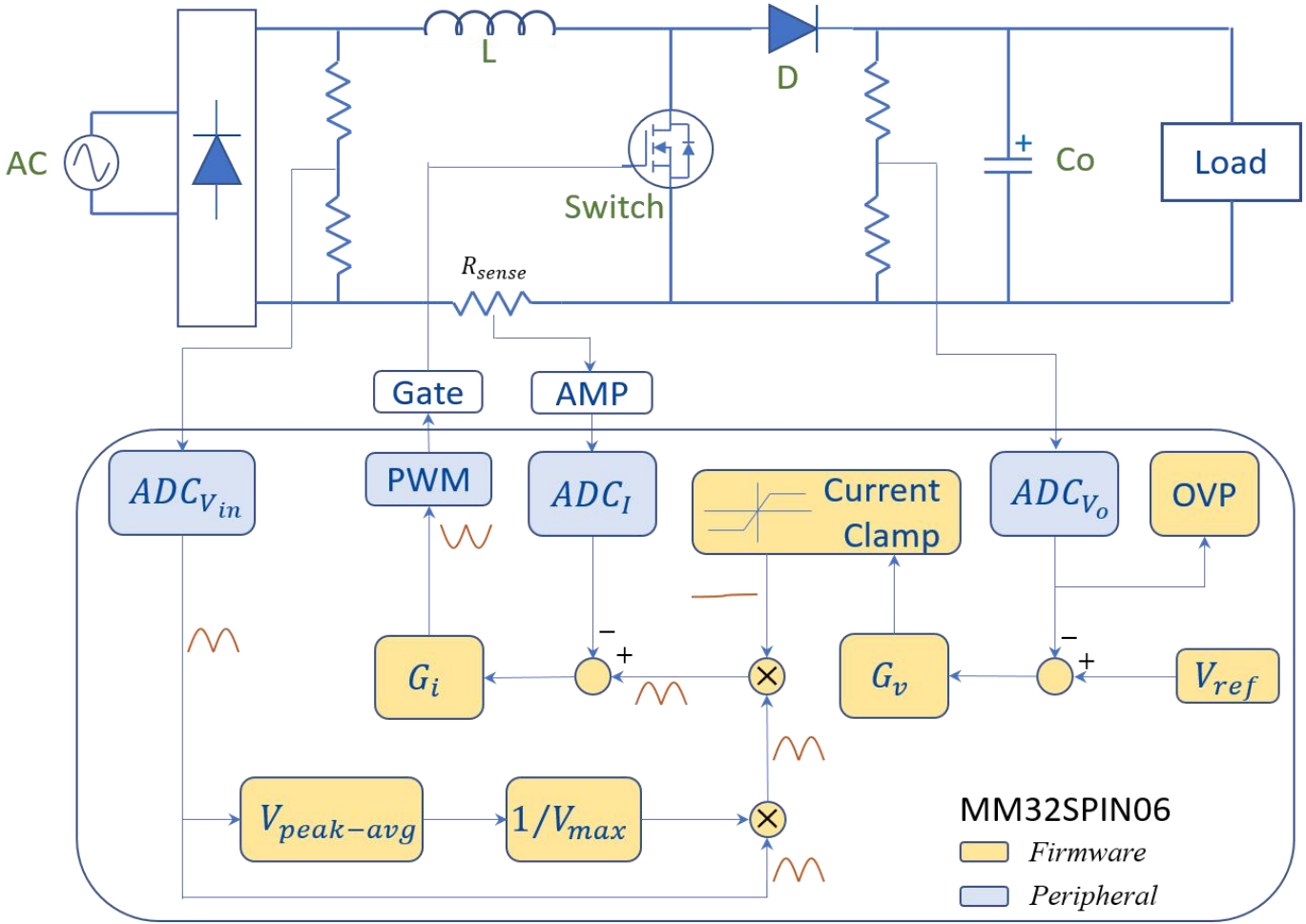
藍色 : 高電平 表在降速斜率三區間, 降速斜率三設定為 200RPM/Sec 減速度, 速度由200RPM 下降至50RPM

紅色 : W相電流 (電流探棒 1A/1V)

黃色 : 開環速度 (10RPM/0.20V)(由DAC 輸出至示波器上)

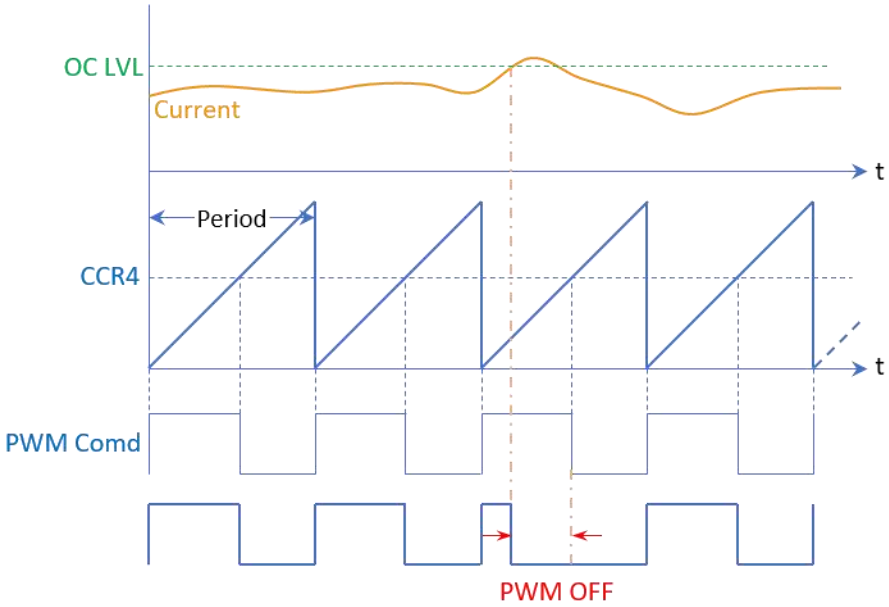
測試結果 : PASS

数字PFC控制架构


L
D
AC
Switch
Co
Load
R_{sense}
Gate
AMP
$ADC_{V_{in}}$
PWM
ADC_I
Current Clamp
ADC_{V_o}
OVP
G_i
G_v
V_{ref}
$V_{peak-avg}$
$1/V_{max}$
MM32SPIN06
Firmware
Peripheral

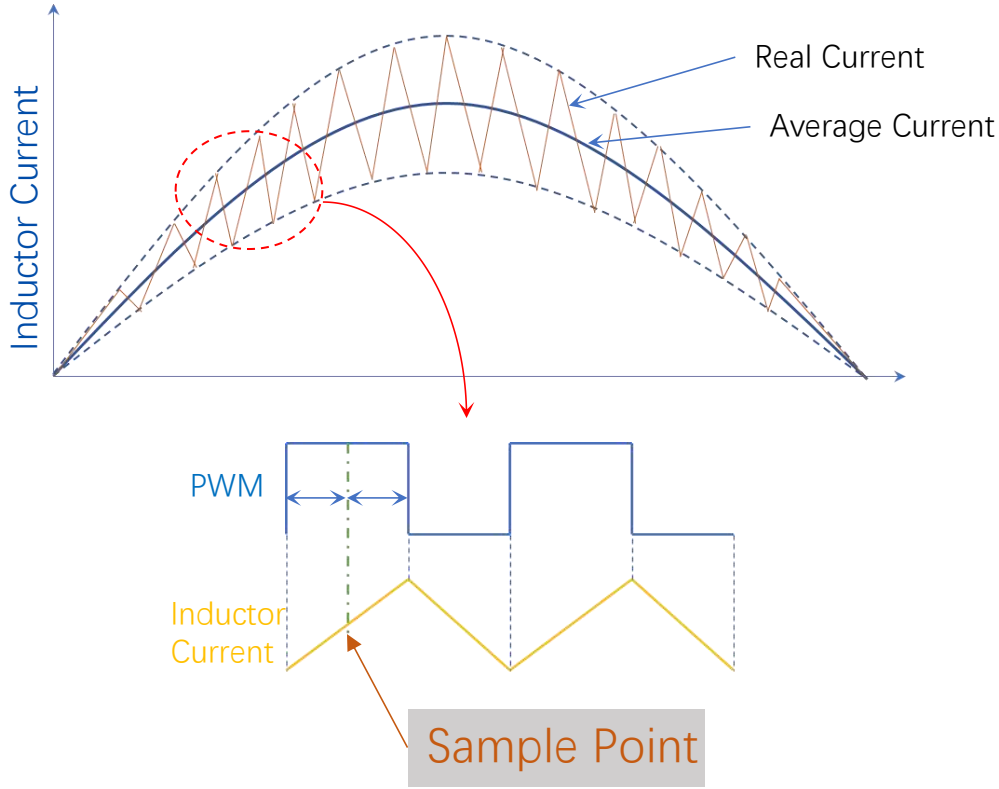
电流保护与采样

Cycle by Cycle PWM

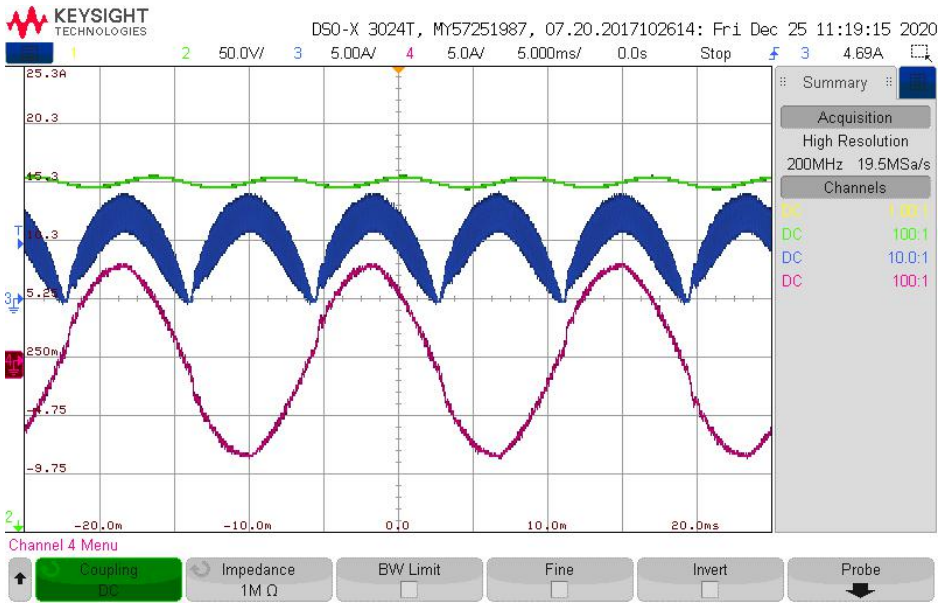


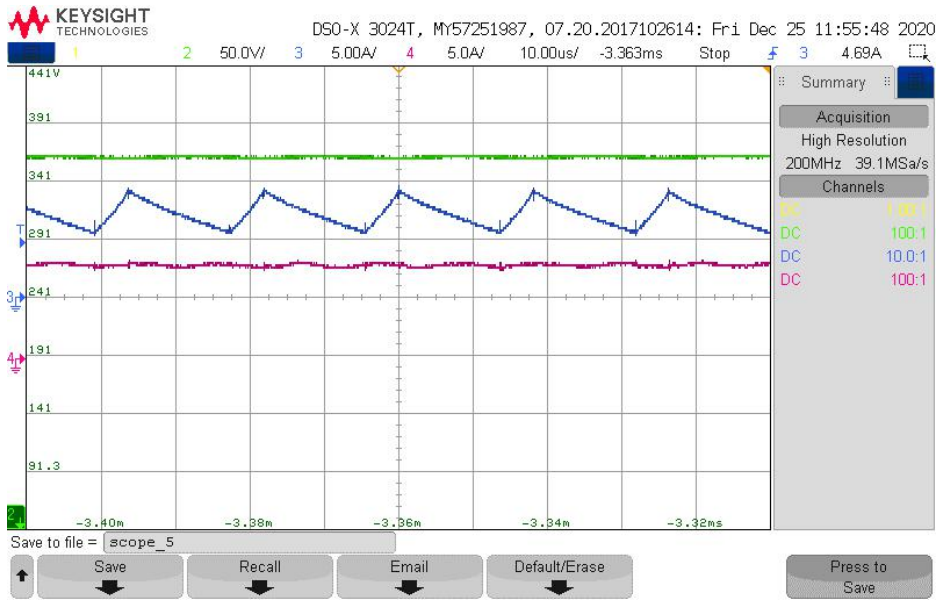
MCU settings :
Comparator -> TIM3_OCref_clr

Average Current sampling



实际测试波形





電感波形細節

Test Condition:
Input Voltage : 220VAC
Output Voltage : 396VDC
Input power : 1186W
PF : 0.987
Eff : 95%up

Green : Bus Voltage
Blue : Inductor Current
Red : AC input line Current

采样补偿

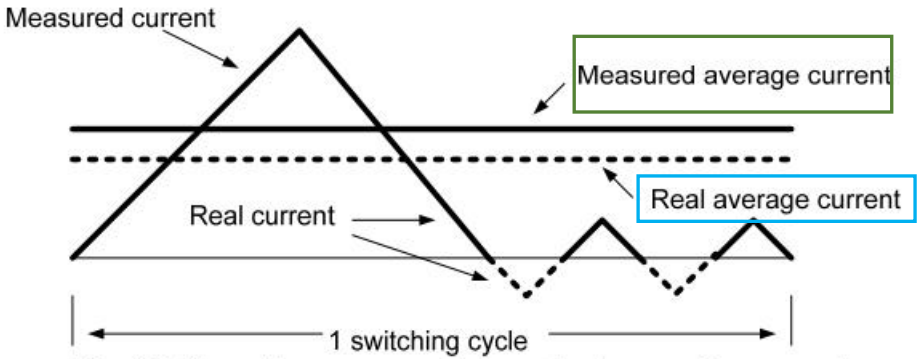
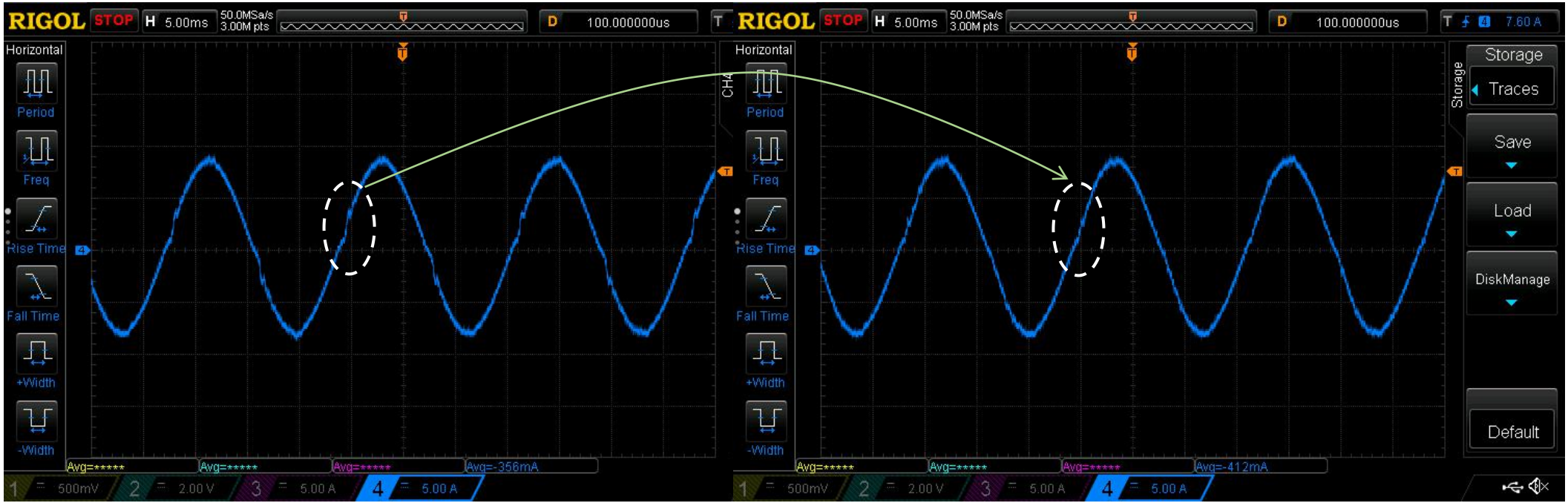


Fig. 19. Current measurement error due to negative current

采样补偿

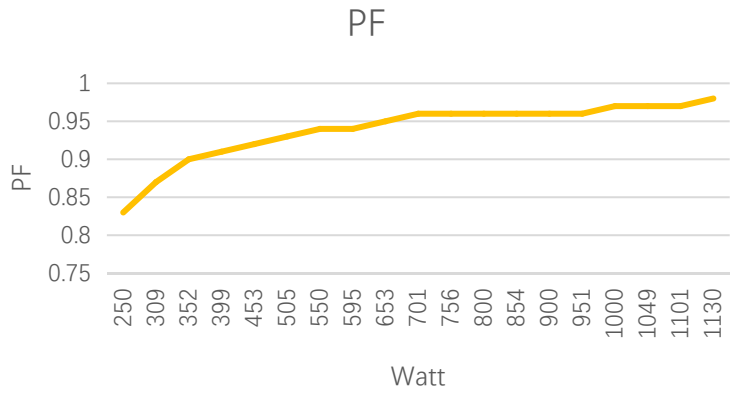


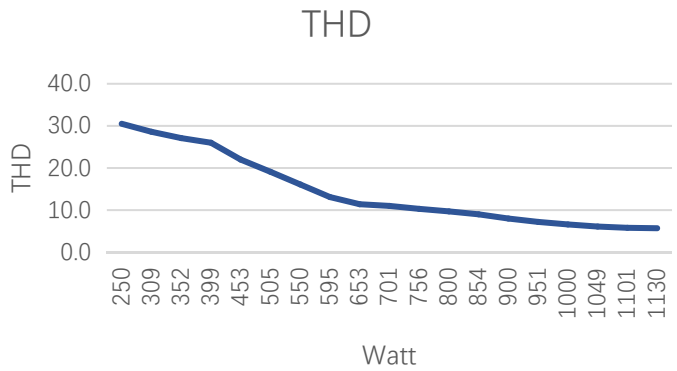
Blue : AC input line Current

PFC测试结果

Test Equipment	Yokogawa WT330	
Input Voltage	220	VAC
Frequency	60	Hz

Input Watt	Input Current(A)	PF	THD
250	1.3	0.83	30.5
309	1.6	0.87	28.6
352	1.8	0.9	27.1
399	2.0	0.91	26.0
453	2.2	0.92	22.0
505	2.4	0.93	19.1
550	2.6	0.94	16.1
595	2.8	0.94	13.1
653	3.1	0.95	11.4
701	3.3	0.96	11.0
756	3.6	0.96	10.3
800	3.8	0.96	9.7
854	4.0	0.96	9.0
900	4.2	0.96	8.0
951	4.4	0.96	7.2
1000	4.7	0.97	6.6
1049	4.8	0.97	6.1
1101	5.1	0.97	5.8
1130	5.2	0.98	5.7



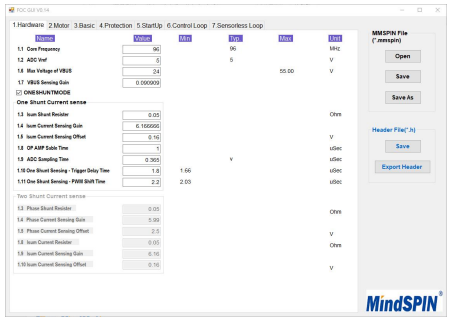


MM32SPIN SDK – Sensorless FOC

*.mmspin Parameters file

```
21021010            // Version
0                   // One shunt mode
96                  // Core Frequency
5                   // ADC Vref
0.05                // Isum Shunt Resister
6.166666            // Isum Current Sensing Gain
0.16                // Isum Current Sensing Offset
24                  // Max Voltage of VBUS
0.090909            // VBUS Sensing Gain
1                   // OP AMP Sable Time
0.365               // ADC Sampling Time
1.8                 // One Shunt Sensing - Trigger Delay Time
2.2                 // One Shunt Sensing - PWM Shift Time
0.05                // Phase Shunt Resister
5.99                // Phase Current Sensing Gain
2.5                 // Phase Current Sensing Offset
0.05                // Isum Current Resister
6.16                // Isum Current Sensing Gain
0.16                // Isum Current Sensing Offset
4                   // Motor Poles
0.2                 // R(Phase)
0.09                // Ld(Phase)
0.13                // Lq(Phase)
2000                // Min Motor Speed
10000               // Max Motor Speed
60                  // Max Input Power
0                   // PWM Mode
20                  // PWM Frequency
91                  // PWM Max Duty
0.66                // Dead Time
1                   // DIR
0                   // SPEEDMODE
```

MMSpin GUI

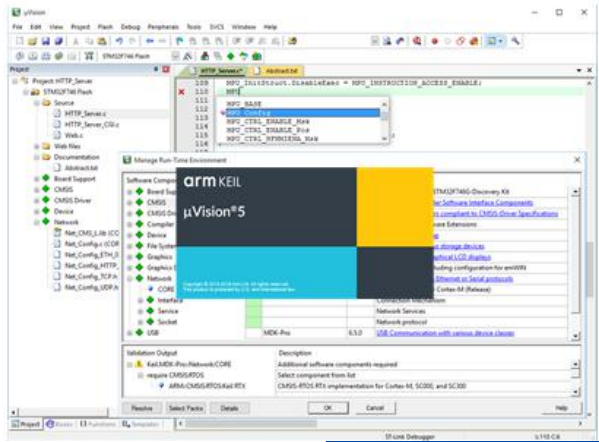


Parameters_table.h

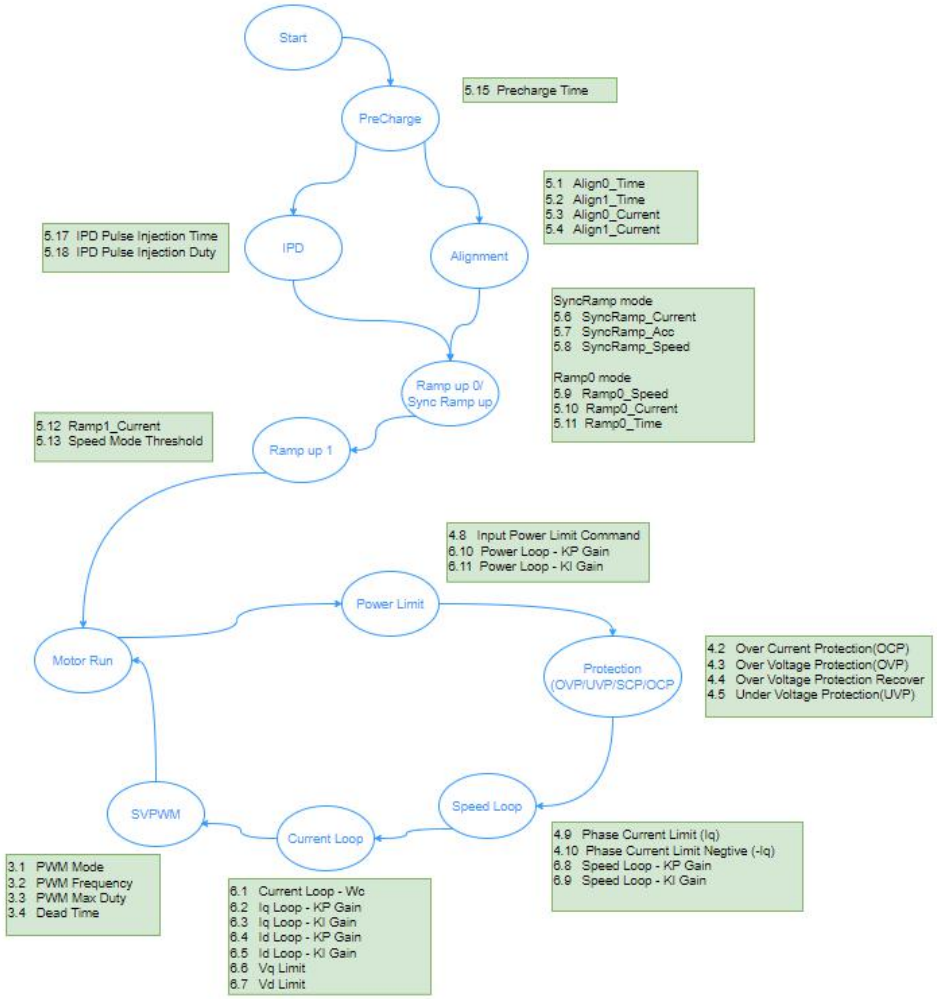
```
#ifndef __PARAMETER_TABLE_H_
#define __PARAMETER_TABLE_H_

uint16_t ul6ParameterSet[] =
{
    0,                          //0,
    0,                          //1,
    0,                          //2,
    3926,                       //3, ul6FOC_Current_PU
    200,                        //4, ul6FOC_Voltage_PU
    364,                        //5, ul6FOC_Power_PU
    0,                          //6,
    20000,                      //7, ul6PWMFreq
    91,                         //8, ul6MaxDuty
    63,                         //9, ul6DeadTime
    0,                          //10,
    80000,                      //11, ul6LockTimeCmd
    23554,                      //12, sl6OCPCMD
    2234,                       //13, ul6OVPCmd
    2085,                       //14, ul6OVPCmdRecover
    894,                        //15, ul6UVPCmd
    968,                        //16, ul6UVPCmdRecover
    1787,                       //17, ul6VbusRated
    0,                          //18,
    15702,                      //19, ul6IqLimitCmd
    3926,                       //20, ul6IqLimitCmdNeg
    0,                          //21,
    0,                          //22,
    19,                         //23, sl6SpdGainQFormat
    26214,                      //24, sl6SpdGain
```

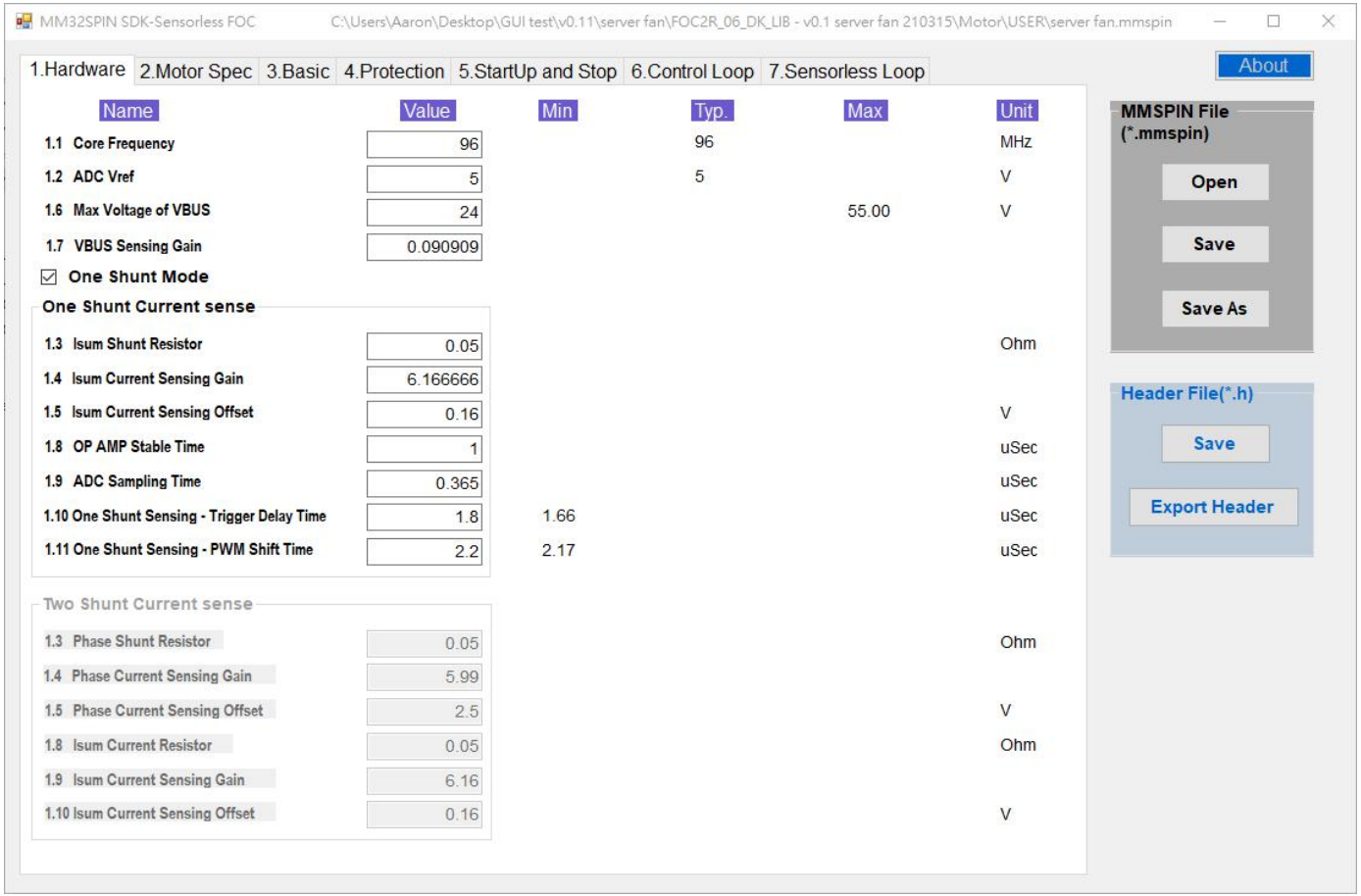
Keil MDK version 5



MMSPIN Sensorless FOC solution flow



MM32SPIN SDK GUI



Project List and Version

Project

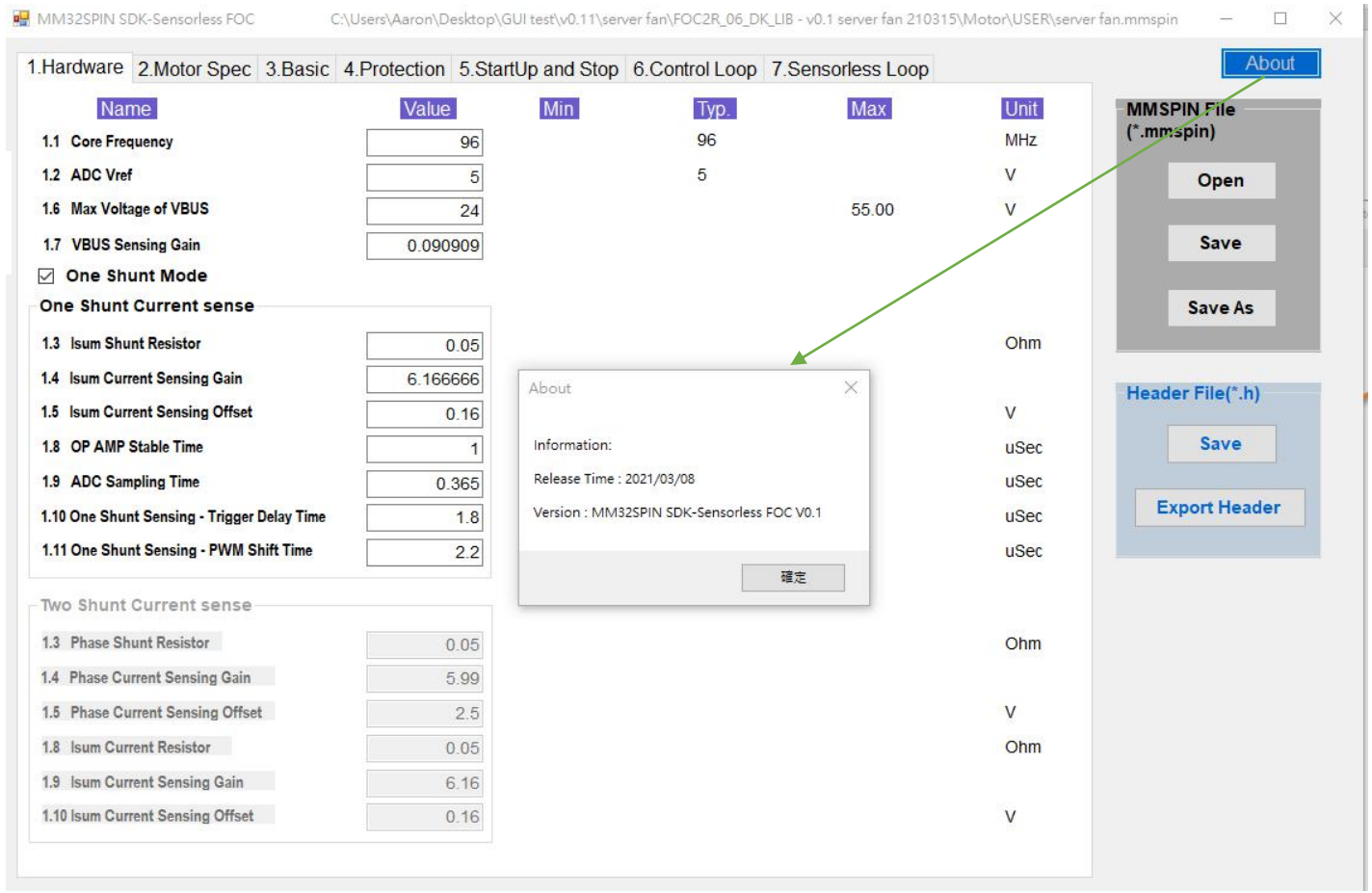
FOC1R_06_DK_LIB - v0.1

FOC2R_06_DK_LIB - v0.1

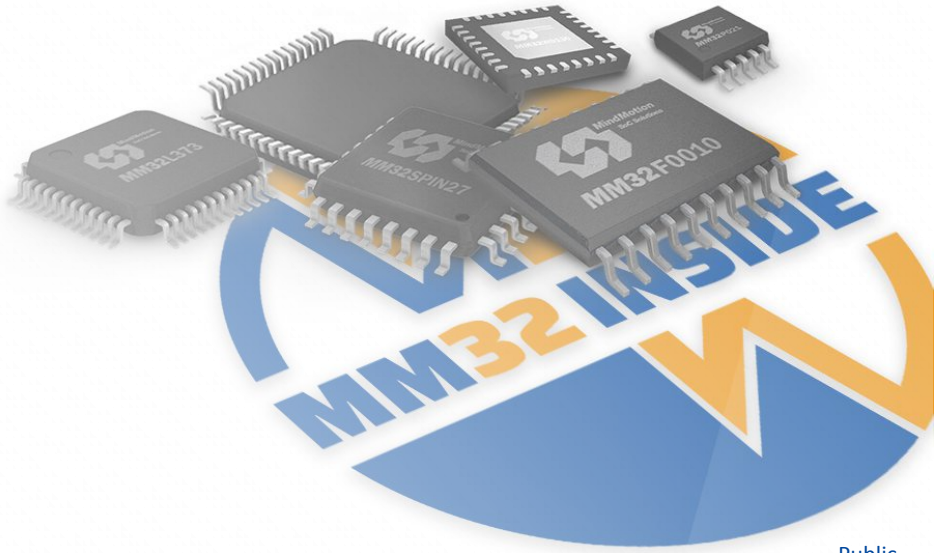
One shunt or Two shunt

SPIN06

Version 0.1

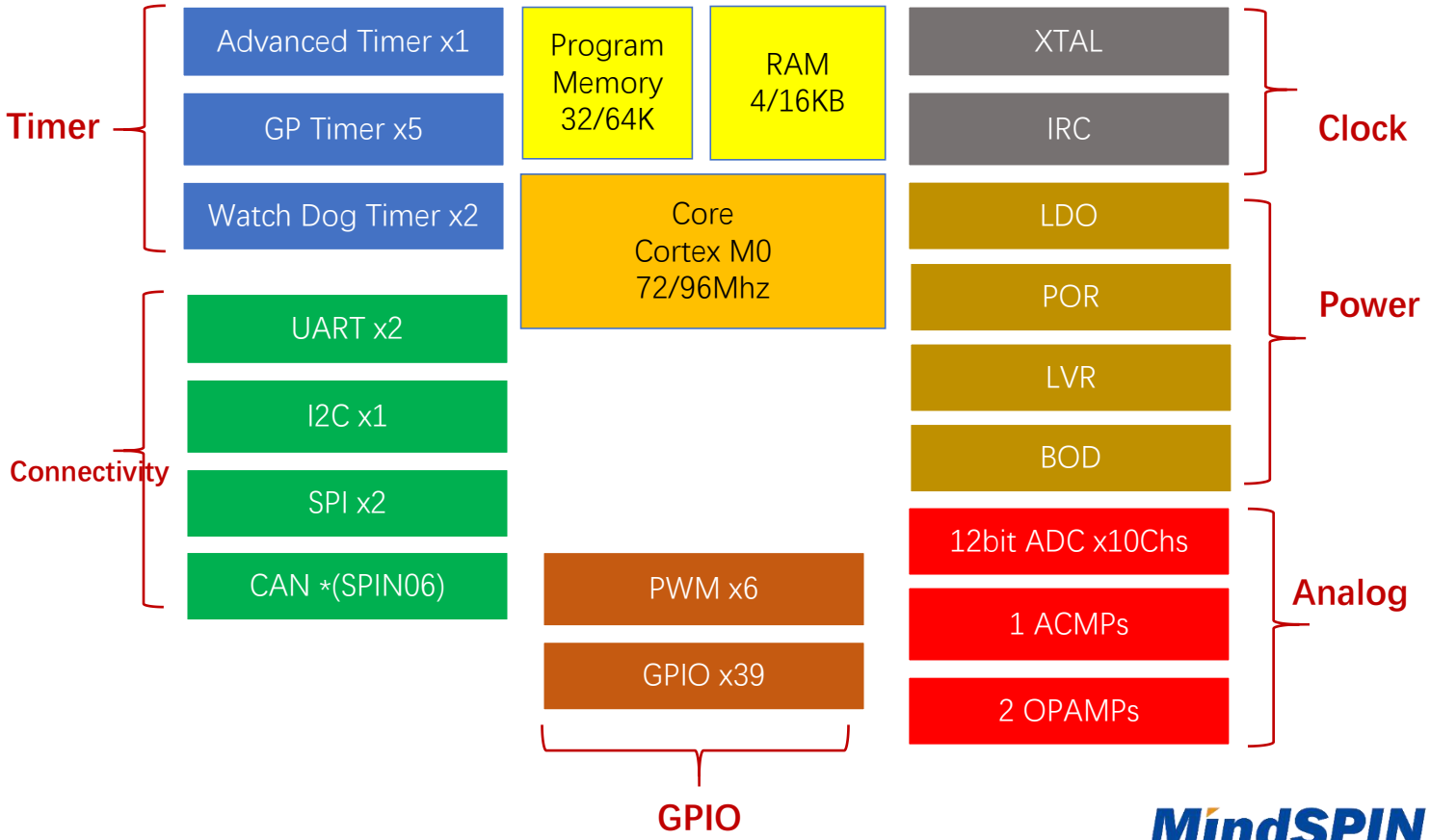


灵动MindSPIN MCU介绍



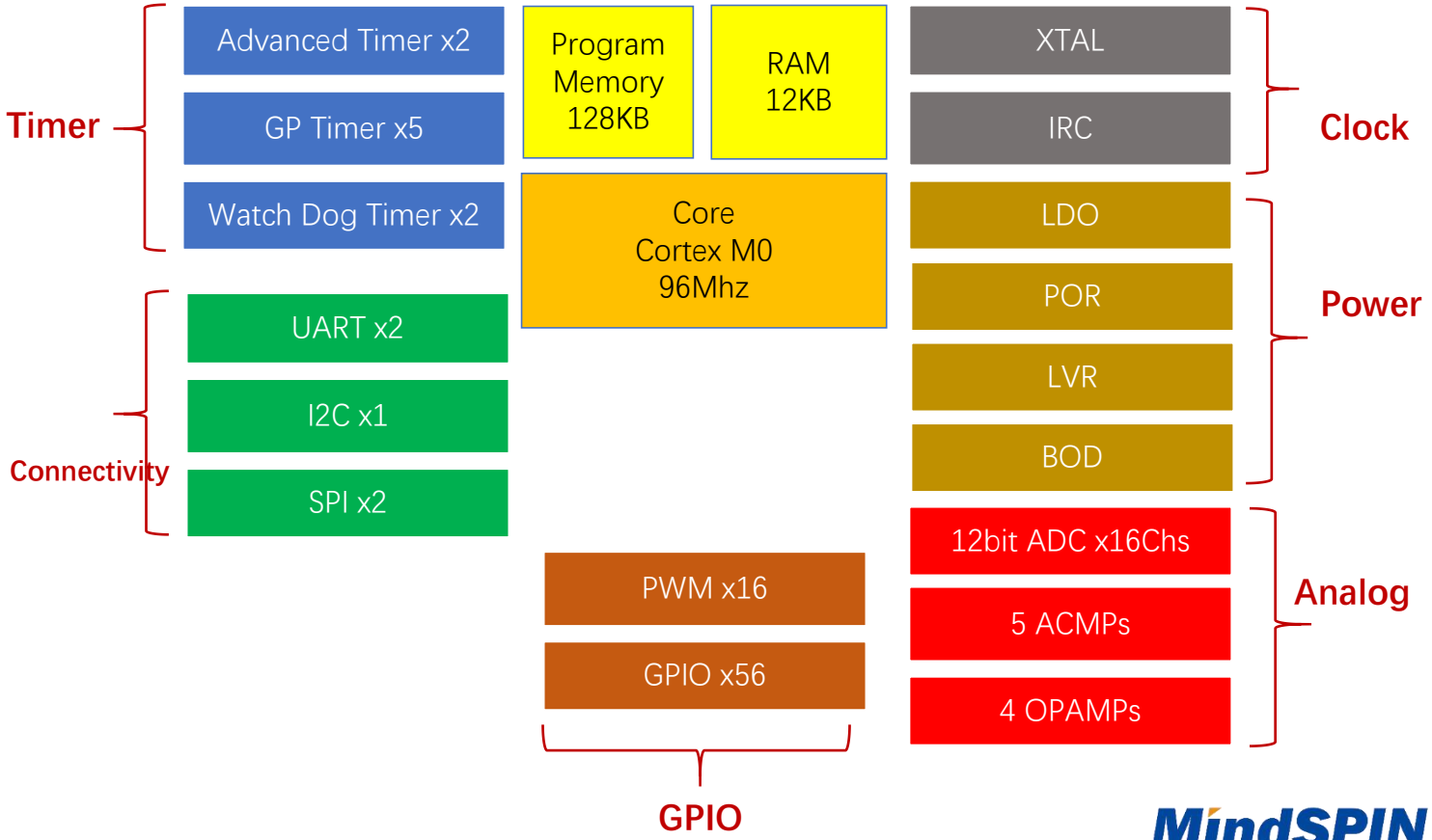
1. MM32SPIN05/06 (2xOP)

- 性价比首选，8位替代的最佳方案
- 主频最高至96Mhz
- 硬件除法器，USB-PD
- 支援CAN总线
- 20, 28, 32, 48 封装，支持六路PWM
- 电机专用的单电阻采样模式
- 集成双路轨对轨运放



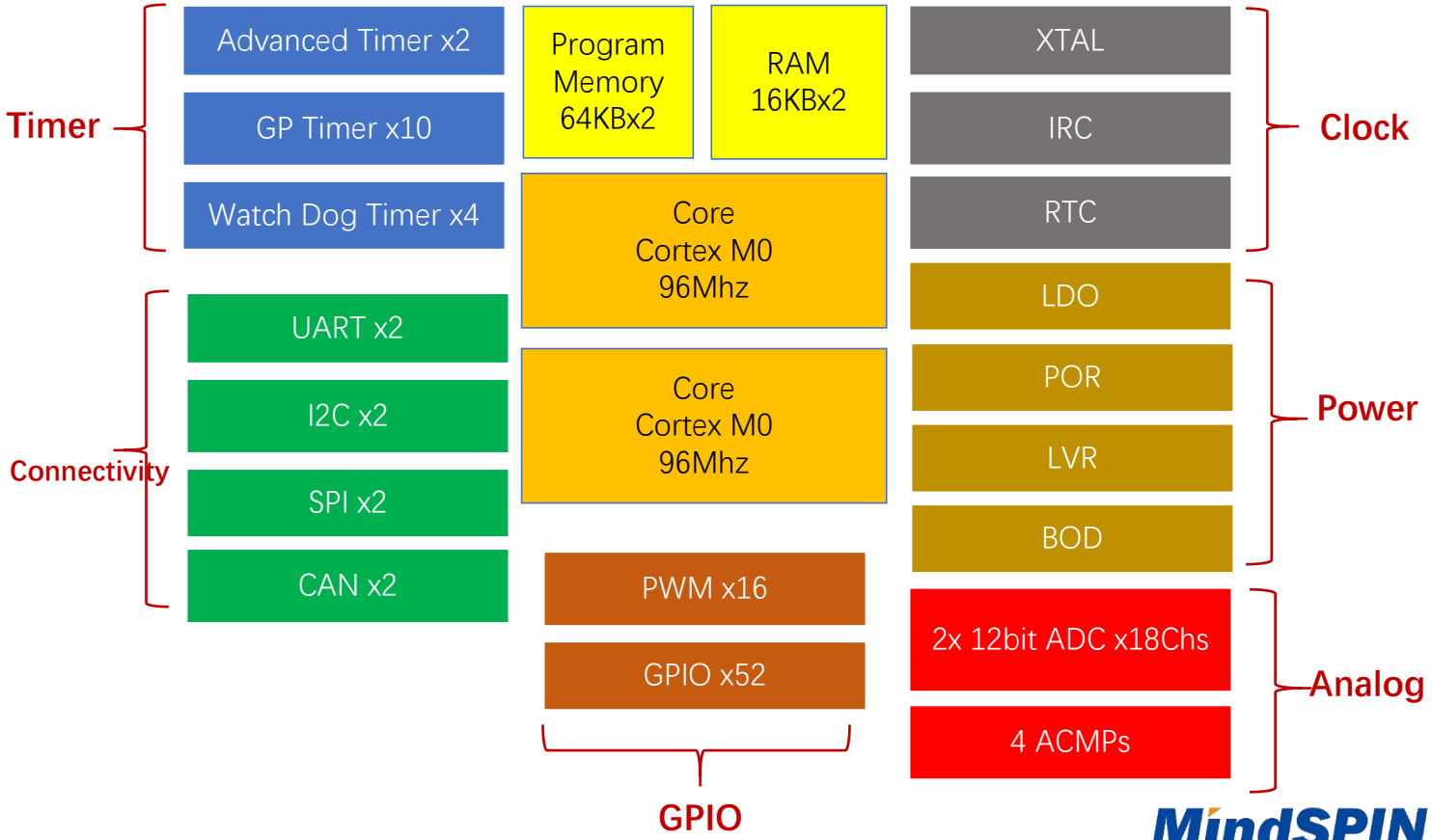
2. MM32SPIN25/27

- 电机专用高性能MCU
- 硬件除法器与开根号
- 双路独立ADC，16通道
- 双马达驱动，192Mhz PWM主频
- 四路运算放大器，五个比较器
- 支持IEC60730-1
- 32, 44, 48, 64 多种封装的选择



3. MM32SPIN37

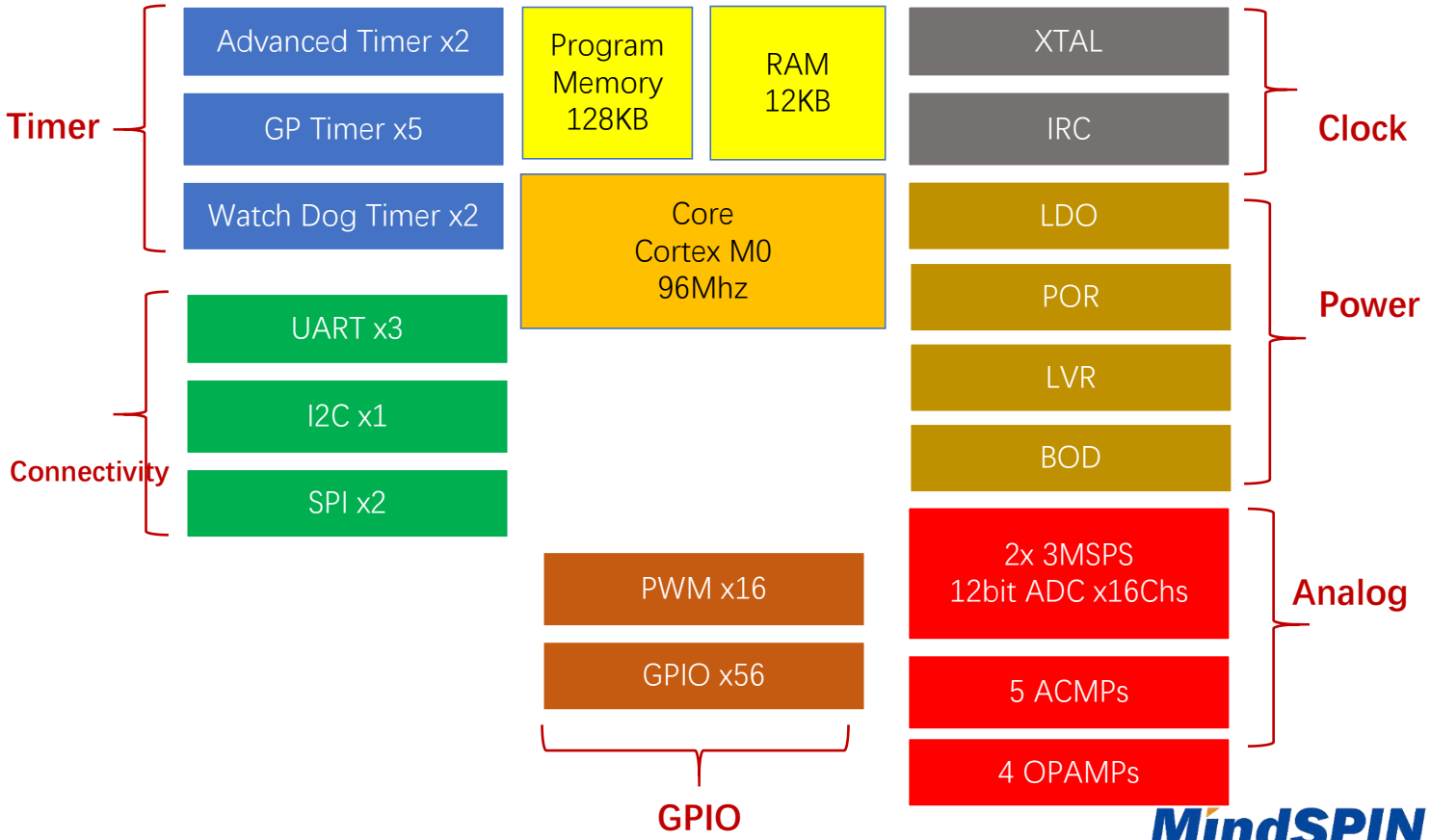
- 国产领先双M0设计，效能加倍
- 丰富的RAM资源以及96M主频
- 丰富的外设，双路CAN与I2CC
- 双电机驱动
- RTC时钟源
- 高精度ADC，多达18通道
- 64PIN大封装，管脚资源丰富



4. MM32SPIN0280

Coming Soon

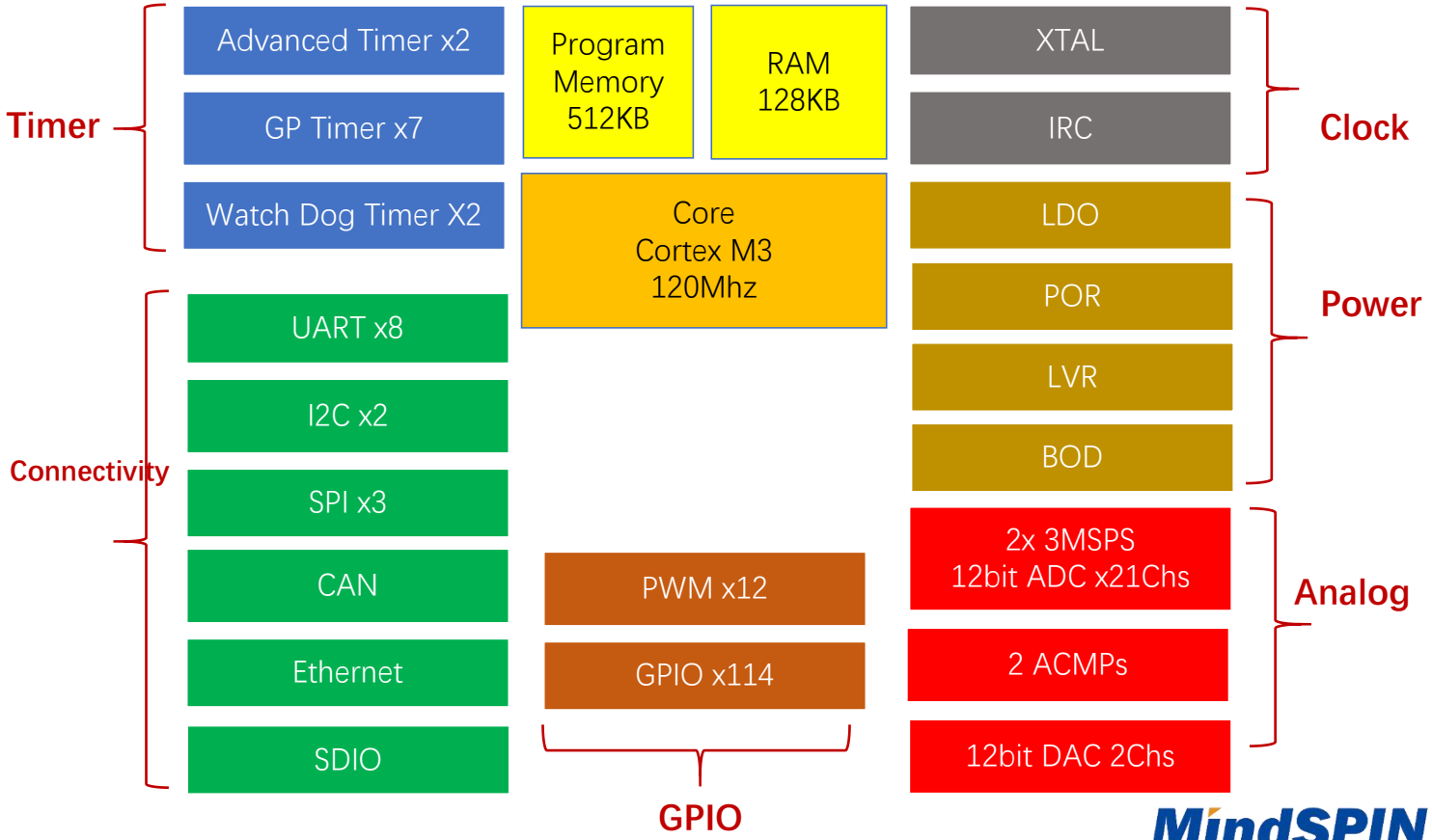
- 电机专用高性能MCU
- 数学专用运算核心
- 双路独立高速3M ADC，多达16通道
- 四路独立运放，五组比较器
- 192Mhz PWM主频，
- 0.8mm 大间距引脚封装
- 支援IEC 60730-1



5. MM32SPIN3270

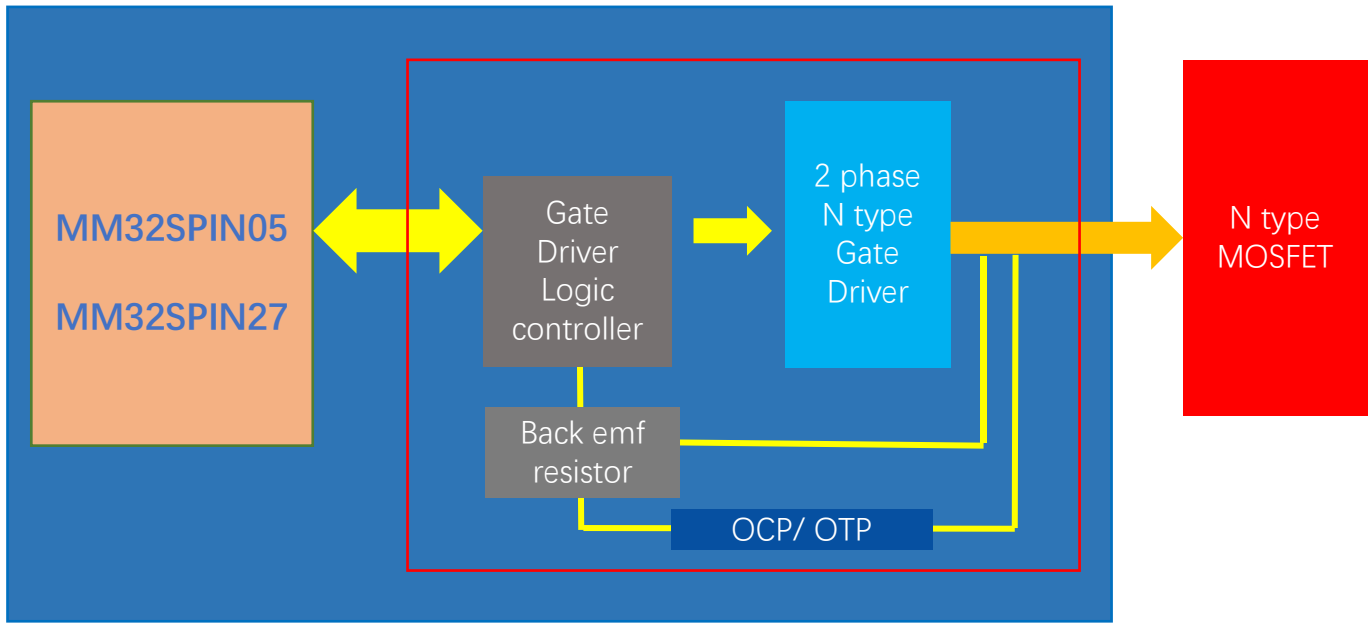
Coming Soon

- 工业与空调高性能MCU
- 144PIN 大封装
- 三组独立高速3MADC，两通道DAC
- 大容量，代码发展空间大
- RTC，ACMP内建，节省BOM
- 接口资源丰富，支援乙太网
- 双电机同步驱动，定位控制



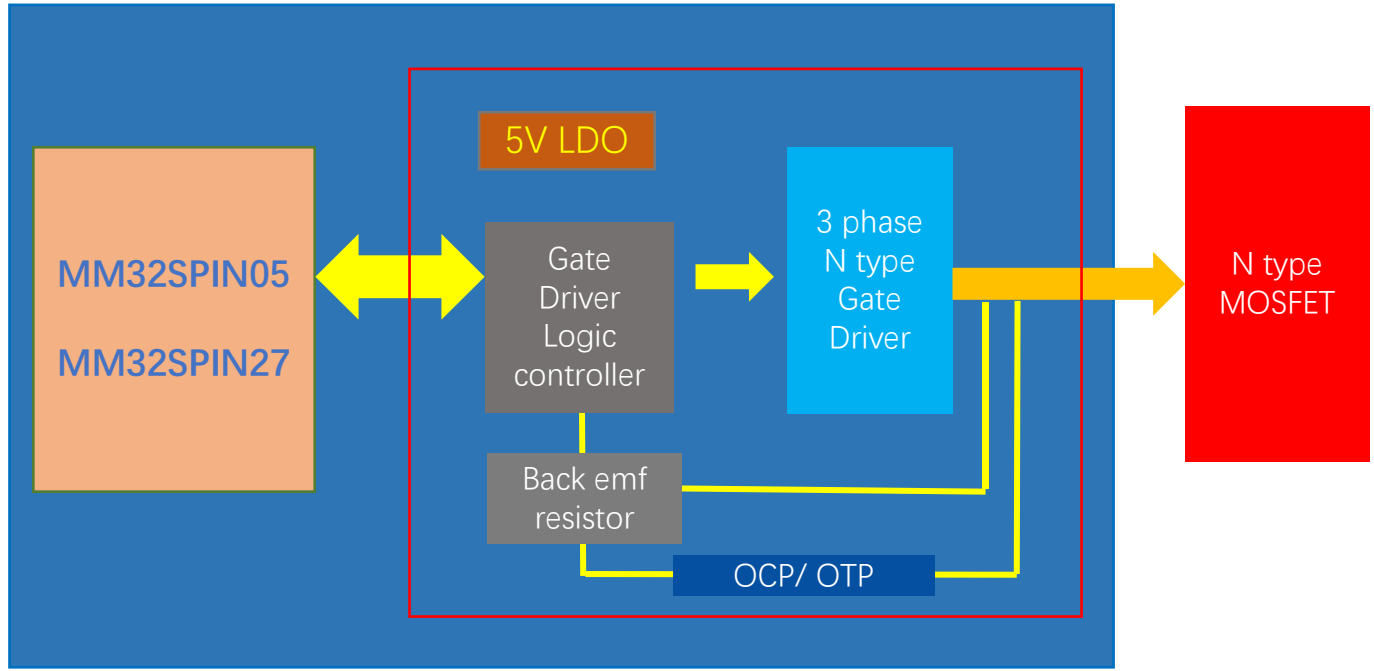
6. MM32SPIN120B/320B

- 集成4N驱动
- 自调适PWM死区控制
- 超小封装，大电流驱动
- 使用SPIN05与SPIN27内核
- 代码兼容性高，SPIN系列内核
- 耐压30V
- 超高性价比



7. MM32SPIN160C/360C

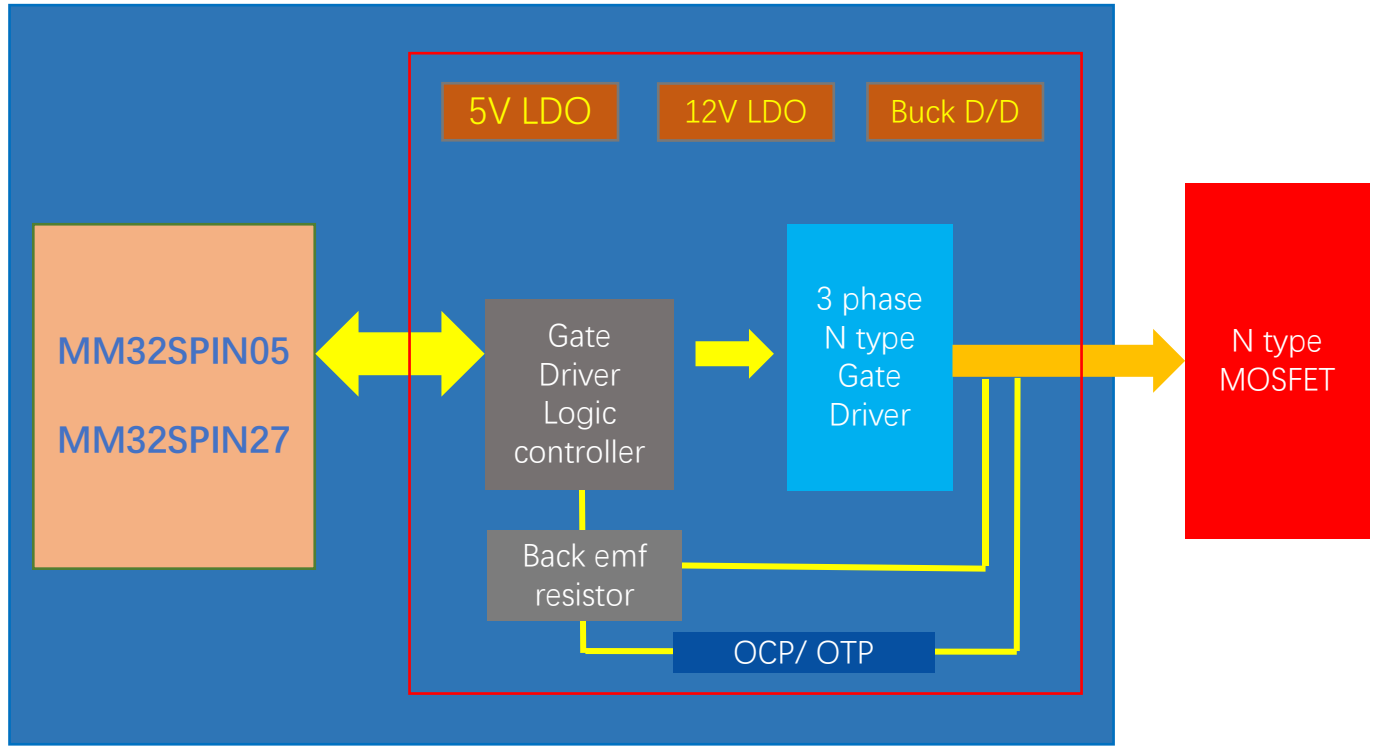
- 集成6N驱动与5V LDO
- 60V 耐压
- 节省HVIC，OPA，比较器 等元件
- 性价比首选
- 省PCB面积
- Low drop voltage LDO
- 集成自举二极管



8. MM32SPIN180C/380C

Coming Soon

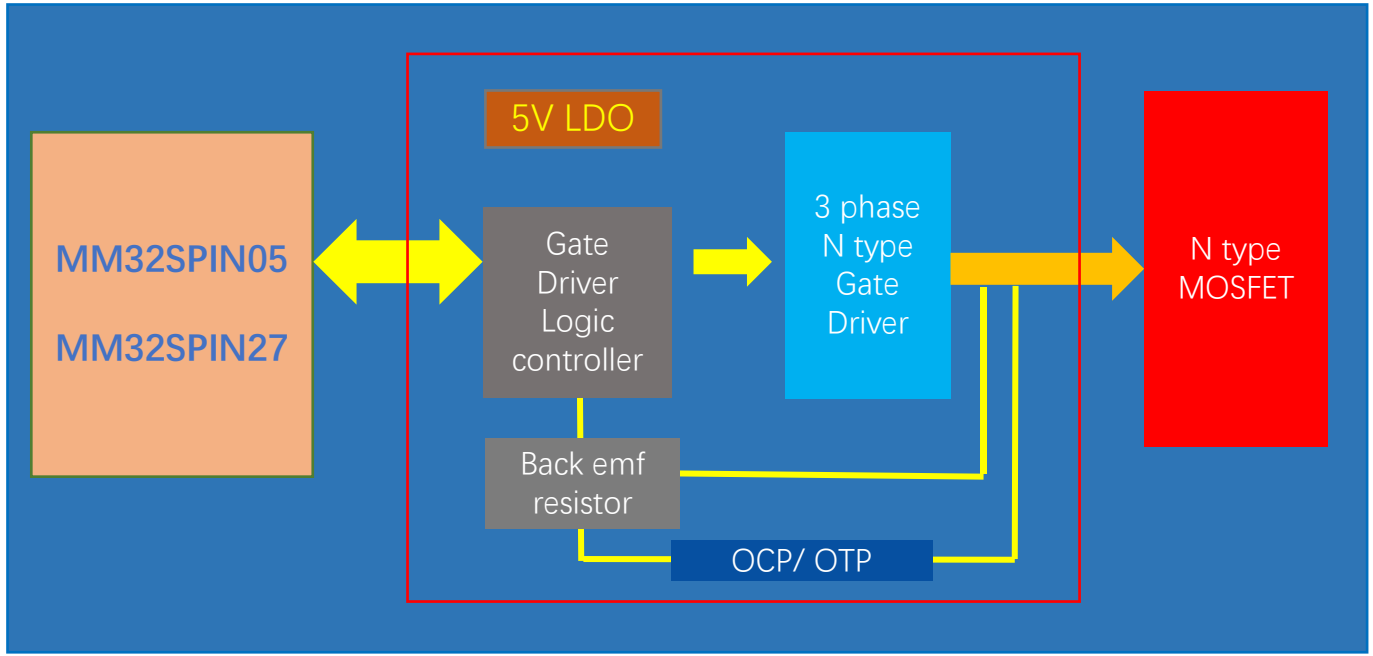
- 集成6N驱动，耐压200V
- 集成Buck D/D 与Mosfet
- **集成5V，12V LDO**
- 内建自举二极管
- 4x4 超小封装
- 超小PCB封装
- Low drop voltage LDO



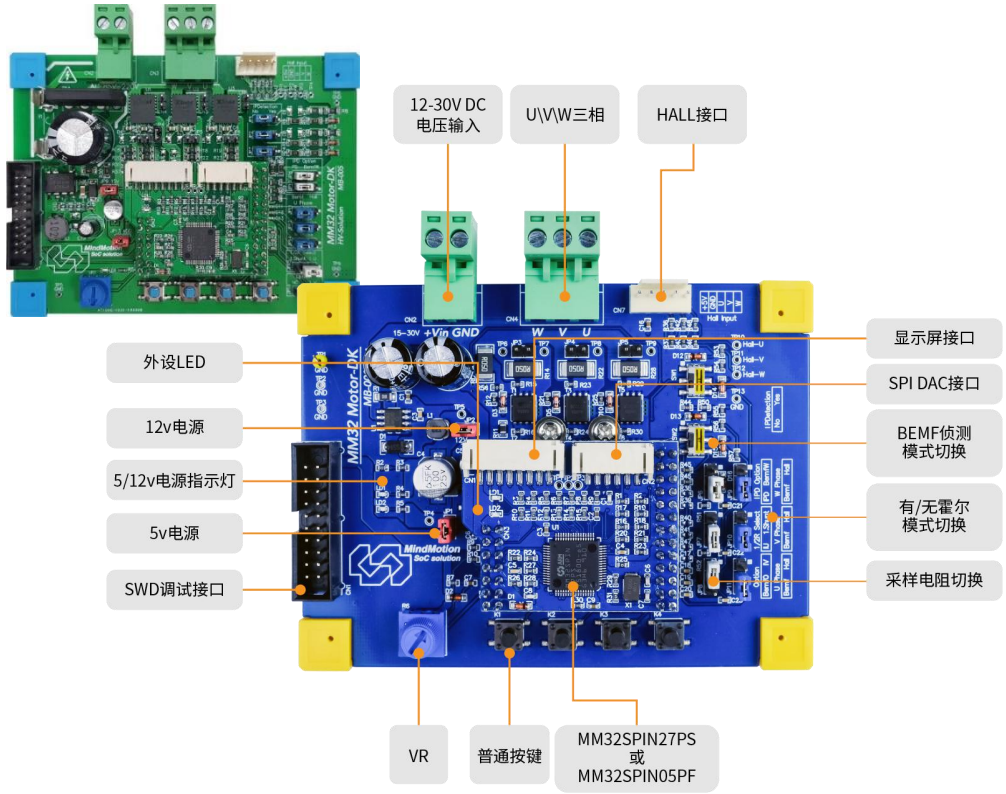
9. MM32SPIN22xC/42xC

Coming Soon

- 三相all in one全集成
- 3A大电流 N通道MOSFET
- 可支援100%占空比
- 代码兼容性高，SPIN系列内核
- 4x4 超小封装，超小PCB面积
- 高速内核，支援高转速电机
- 集成反电势采样电阻



电机开发板- Motor DK



支援全系列MM32 SPIN系列 MCU

过压与欠压保护

反接线保护

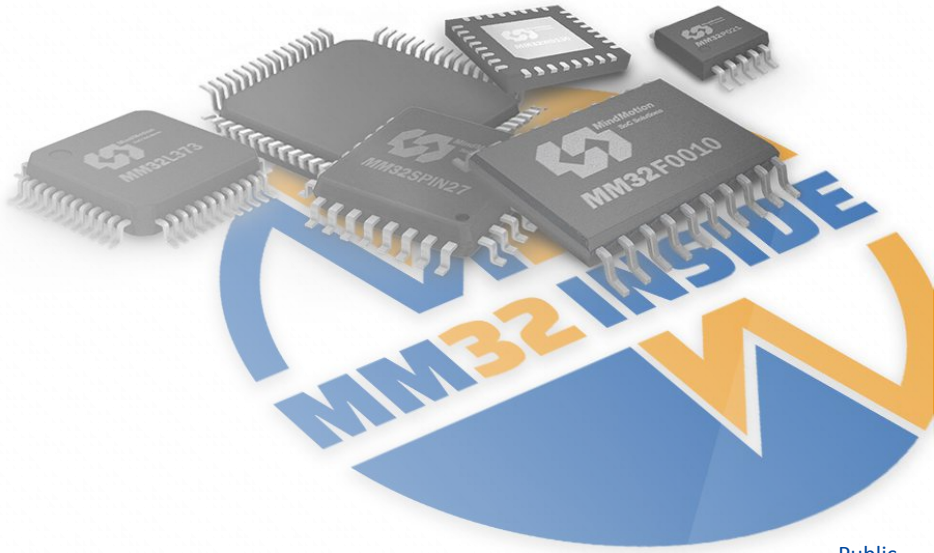
可变电阻与多种输入模式

支援MindSPIN SDK-

上手容易，维护简单

技术支援

灵动MindSPIN 成功案例介绍



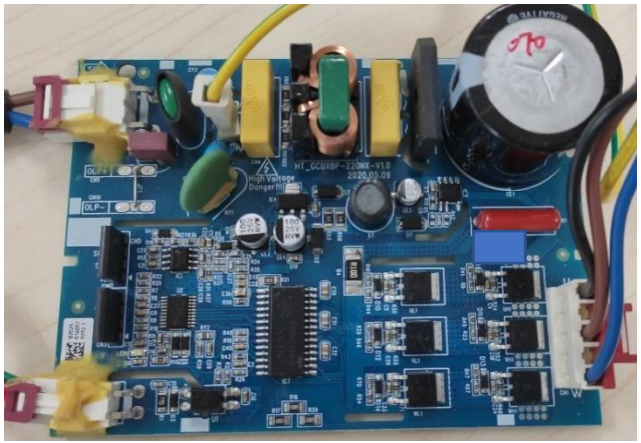
冰箱压缩机驱动板

MM32 MCU Parts

MM32SPIN05

Features

- FOC, 单电阻
- 1Hz超低转速
- 弱磁控制

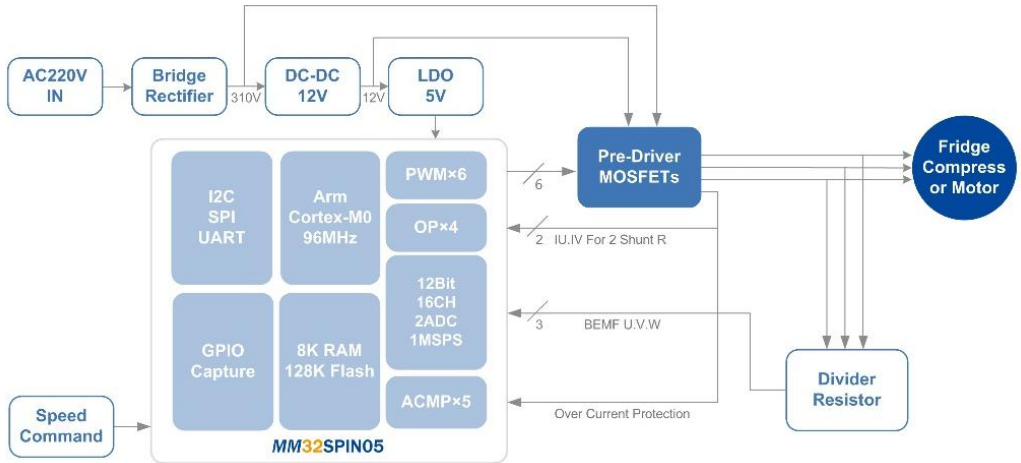


Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	96MHz	180~260VAC180~260VAC	300~7200RPM (6poles)

- Sensor-less FOC control
- SMO methodology for the rotor angle detection
- Dual resister third phases current sensing
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block



洗衣机驱动板

MM32 MCU Parts

MM32SPIN05

Features

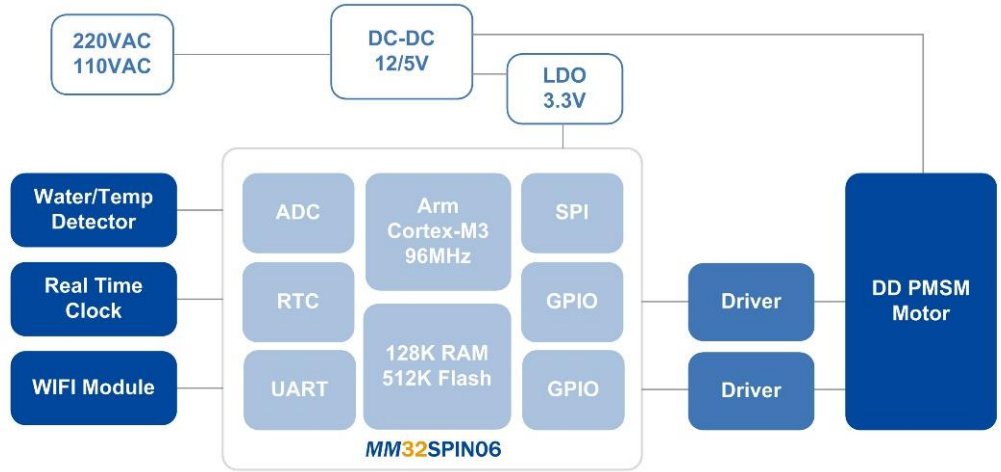
- FOC, 单电阻
- 1Hz超低转速
- 弱磁控制

Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	96MHz	180~260VAC180~260VAC	300~7200RPM (6poles)

- Sensor-less FOC control
- SMO methodology for the rotor angle detection
- Dual resister third phases current sensing
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block



高压风机

MM32 MCU Parts

MM32SPIN27

Features

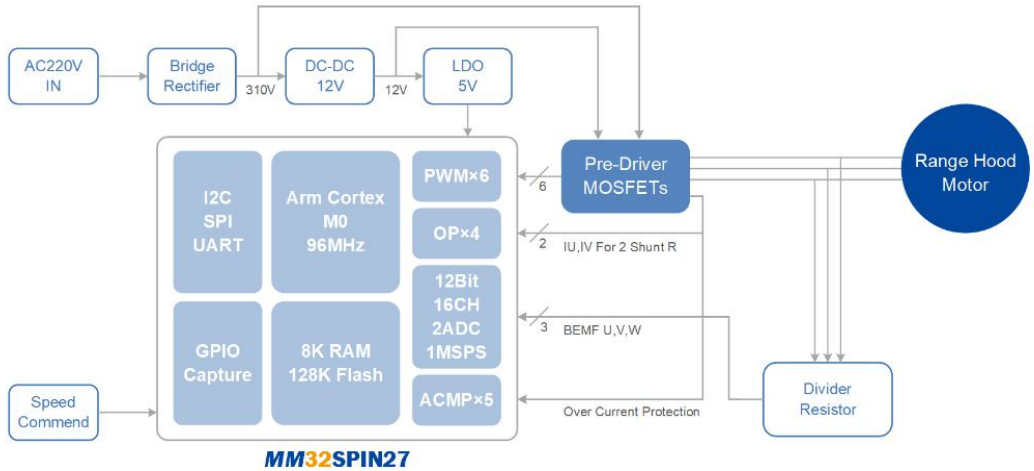
- High efficiency
- Constant power control

Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	96MHz	180~260VAC180~260VAC	300~1800RPM (8poles)

- Sensor-less FOC control
- SMO methodology for the rotor angle detection
- Dual resister third phases current sensing
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block



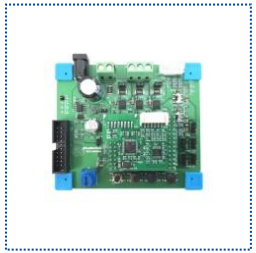
低压风机

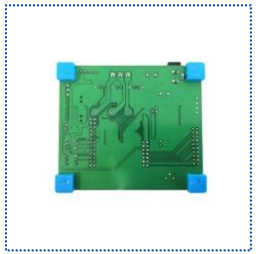
MM32 MCU Parts

MM32SPIN360C

Features

- High efficiency
- Quietly operation
- Continuously variable speed adjustment
- Constant power control



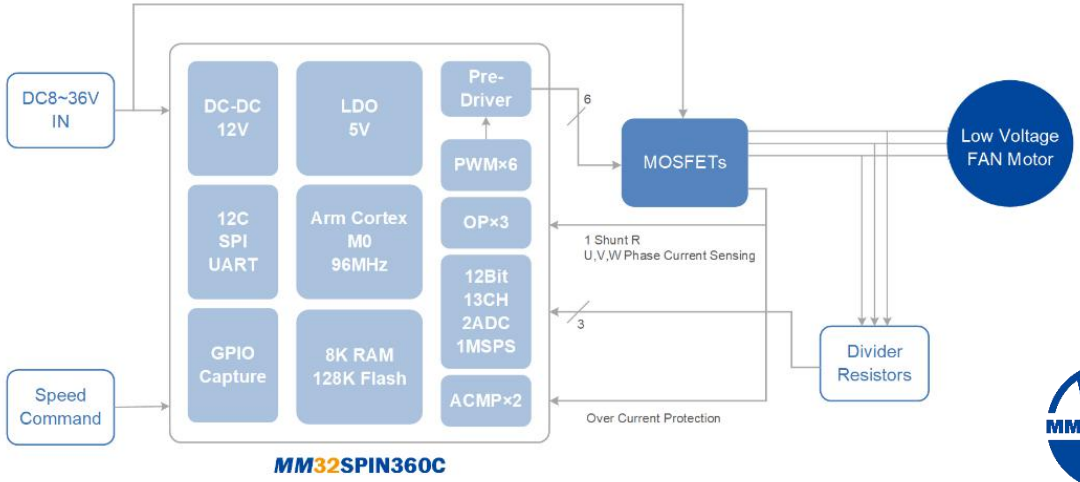


Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	96MHz	8~36V	100~28800RPM (2poles)

- FOC control
- SMO methodology for the rotor angle detection
- Single/Dual resister third phases current sensing
- Support initial localization
- Support forward/backward start, with or w/o loading start
- Over current, voltage and block rotor protection.

Function Block



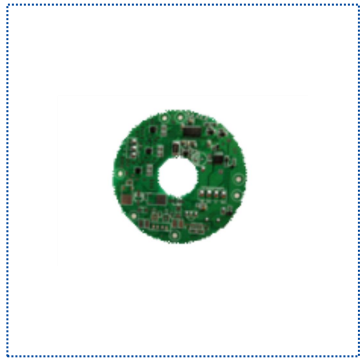
吊扇

MM32 MCU Parts

MM32SPIN05TUOP
MM32SPIN160C

Features

- High efficiency
- Quietly operation
- Continuously variable speed adjustment
- Constant power/speed control

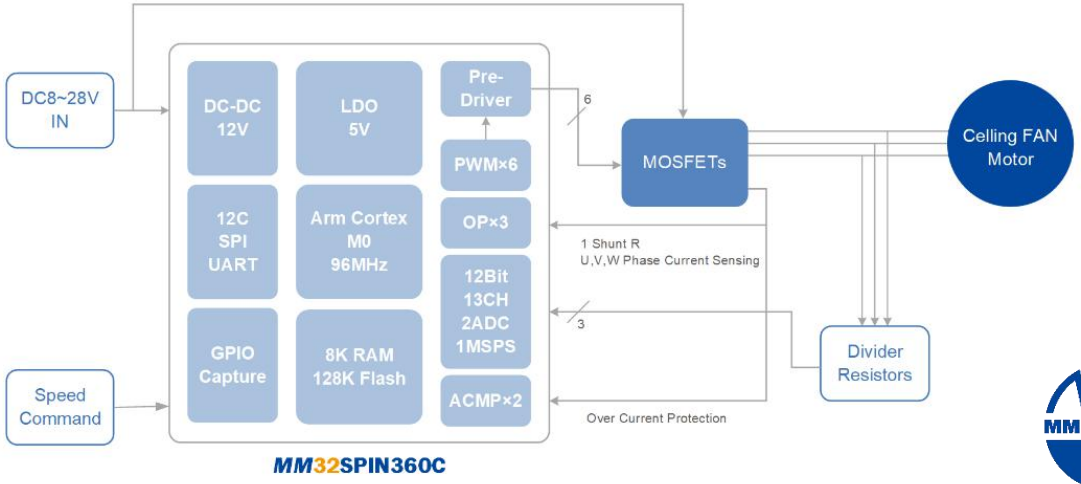


Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	96MHz	8~36V	100~360RPM

- Hall sensor less FOC control
- SMO methodology for the rotor angle detection
- Single resister third phase current sensor
- Support initial localization
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block



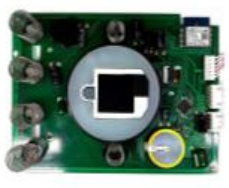
破壁机

MM32 MCU Parts

MM32F103

Features

- OLED Display
- WIFI remote control
- Programmable cooking methods presetting
- Touch control panel

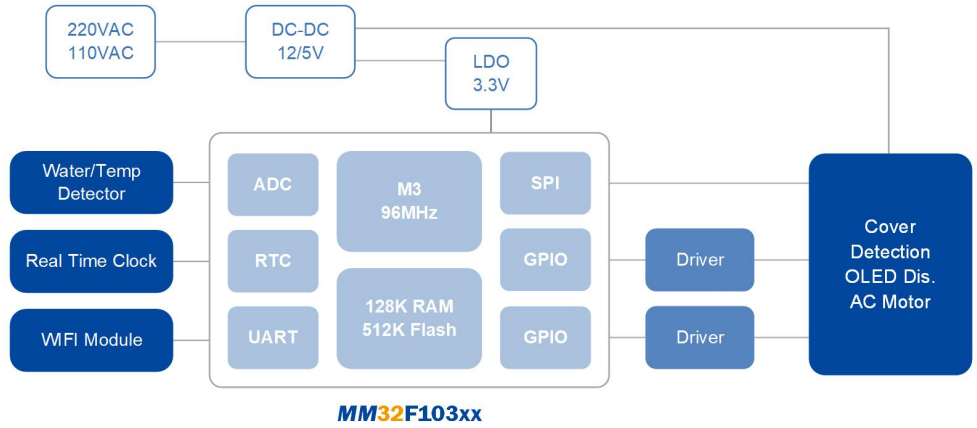


Specification

Core	Computing power	Flash ROM	SRAM
Arm Cortex-M3	96MHz	128KB	20KB

- Support UART In Application Programming (IAP) / In System Programming (ISP)

Function Block



MM32F103xx

吸尘器

MM32 MCU Parts

MM32SPIN06

MM32SPIN360C

Features

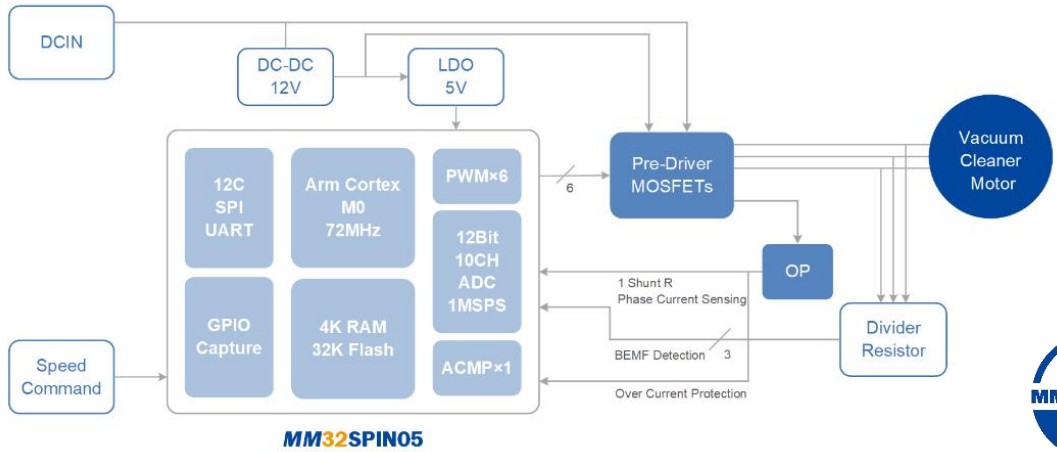
- High efficiency
- High rotating speed
- Constant power，rotating speed control

Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	72MHz	18~32V	Up to 120000RPM (2poles)

- Sensor-less FOC control
- SMO methodology for the rotor angle detection
- Single resister third phases current sensing
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block



电动工具

Power Tool

MM32 MCU Parts

MM32SPIN05

Features

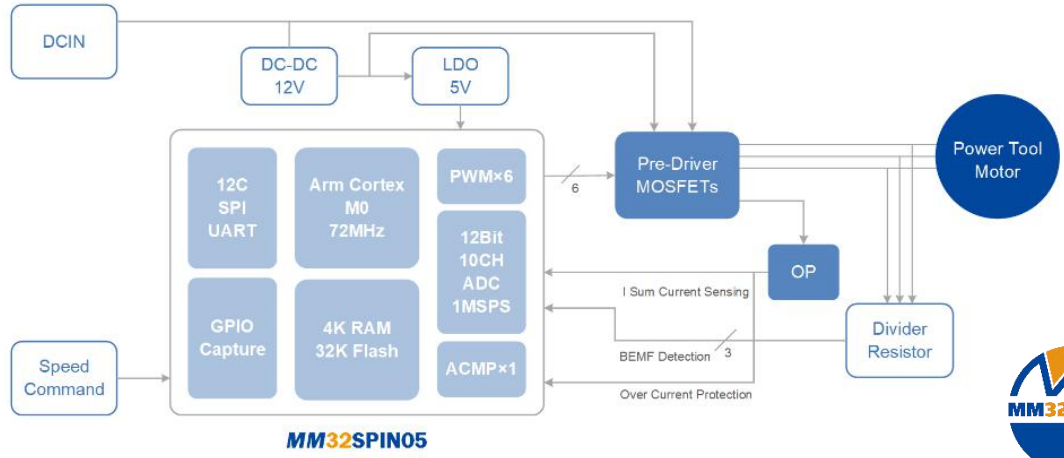
- High rotating speed
- Embedded comparator
- Fast boot up

Specification

Core	Computing power	Supply Voltage
Arm Cortex-M0	72MHz	24V

- Hall sensor less square wave driving methodology
- Over current, voltage and block rotor protection

Function Block



电动车

E-Bike

MM32 MCU Parts

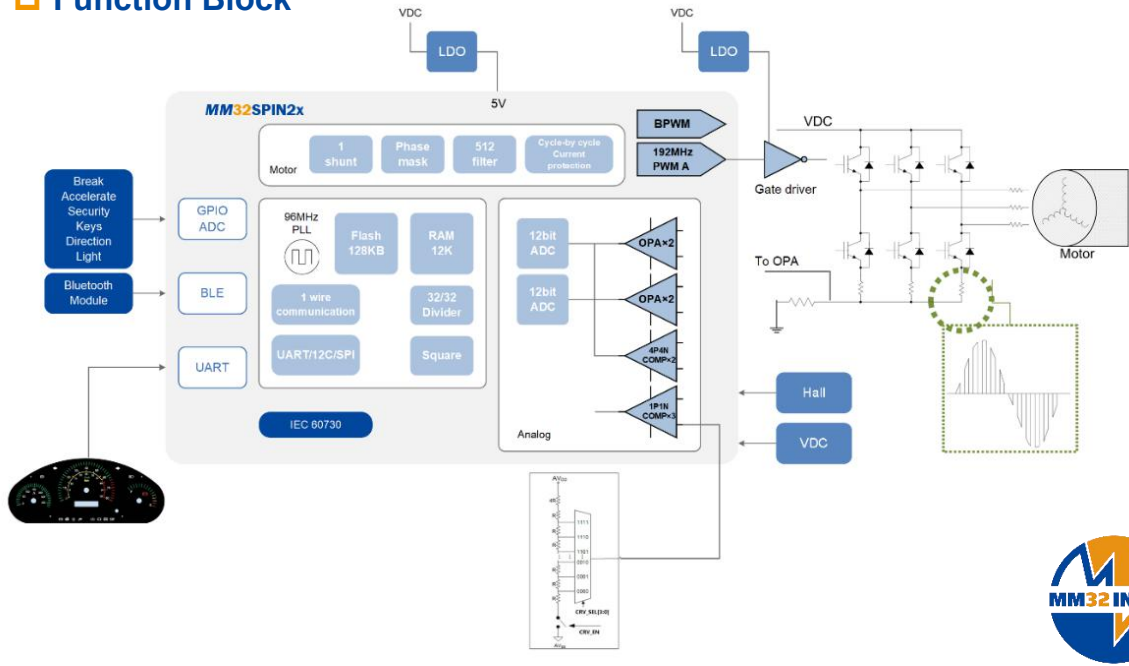
MM32SPIN27PS

Features

- Extreme Speed : 100km/h
- Accelerate performance : 0~100km @ 17s
- 32-bits MCU used for main controller and dash board
- High torque Center motor system
- TFT-LCD dash board
- Cooling system is unnecessary
- High quality parking stand
- Dual disc brakes

- MOSFET : 18 x 100A N type
- 64V, 72V Voltage Supply
- Security
- Third-way driving support
- ABS breaks system control
- Self detection and recover for Hall sensor
- Over current, voltage and block rotor protection
- Single resister third phases current sensing
- Hall sensor less FOC control

Function Block



教育机器人

MM32 MCU Parts

MM32F031K8U6

MM32SPIN120B

Specification

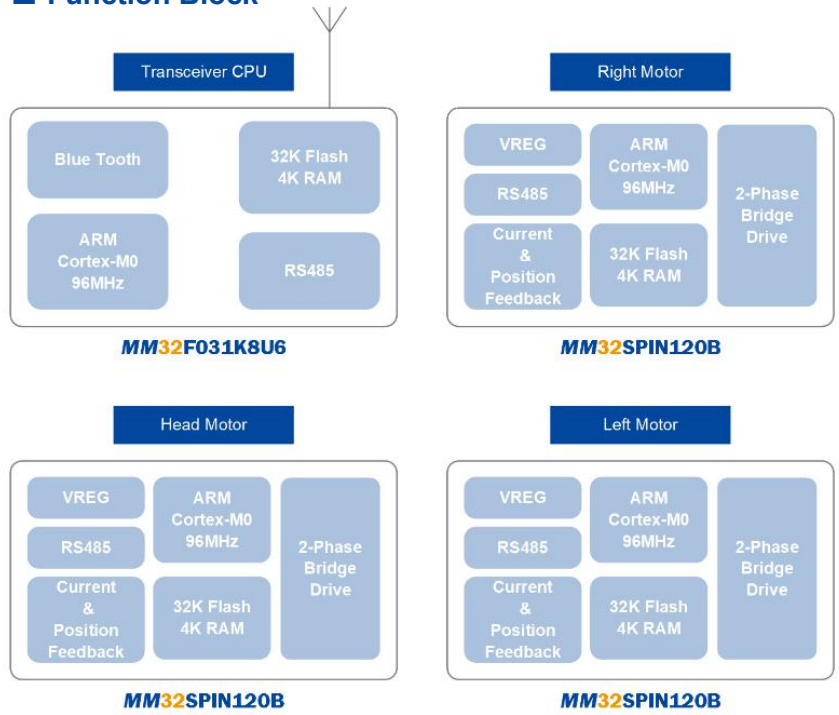
Core	Computing power	Spin torque	Block torque
Arm Cortex-M0	72MHz	0.05N*M	0.25N*M

Features

- Close-loop BLDC control
- On line programmable
- Suitable for the education propose
- Integrated touch sensor, IR sensor
- Easy to install
- BLE connectivity

- Embedded Gate driver
- Embedded 5V LDO
- Rotating speed at 420rpm w/o loader

Function Block



智能机器人

MM32 MCU Parts

MM32SPIN222C
Joint control module

MM32F103x8
Display & Interactive

MM32F103xE
Central Control board

MM32W051NTB
BLE module

Features

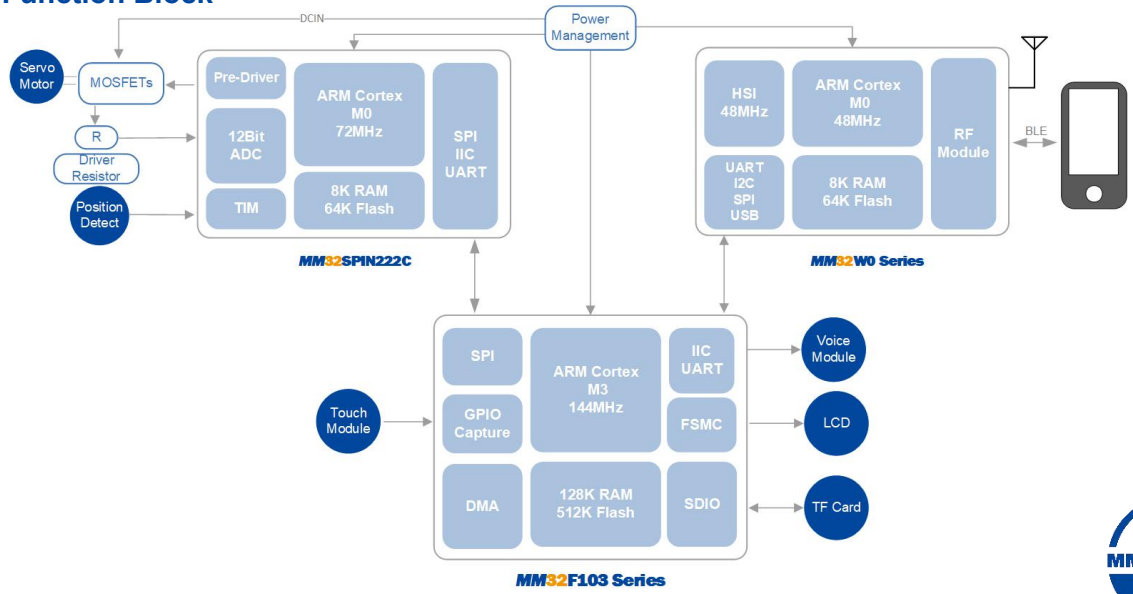
- High efficiency
- High integration

Specification

Core	Computing power	Voltage range
Arm Cortex-M0	96MHz	5~15V

- Embedded Gate driver And six 20V/2A MOS
- Supported single wire Half-Duplex UART transmission
- Embedded 5V LDO
- Position/Speed control
- Over current protection

Function Block



高速电调

MM32 MCU Parts

MM32SPIN05

Features

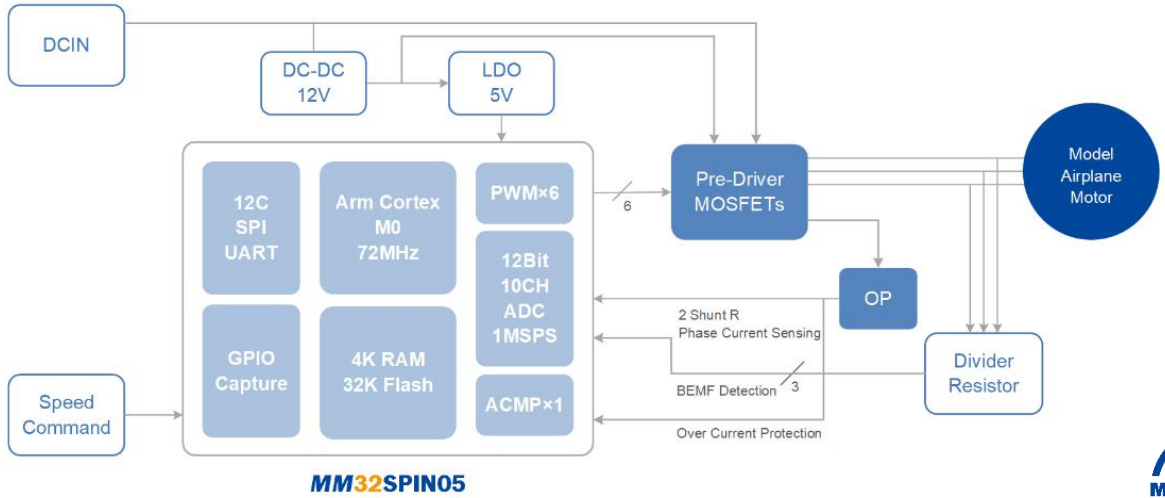
- High efficiency
- High integration
- Constant power/rotating speed control

Specification

Core	Computing power	Voltage range	Rotating speed
Arm Cortex-M0	72MHz	12~18V	100000RPM (2poles)

- Hal sensor less FOC control
- SMO methodology for the rotor angle detection
- Single/Dual resister third phases current sensor supported
- Support forward/backward start, with or w/o loading start.
- Over current, voltage and block rotor protection

Function Block



水泵

Water Pump

MM32 MCU Parts

MM32SPIN05

Features

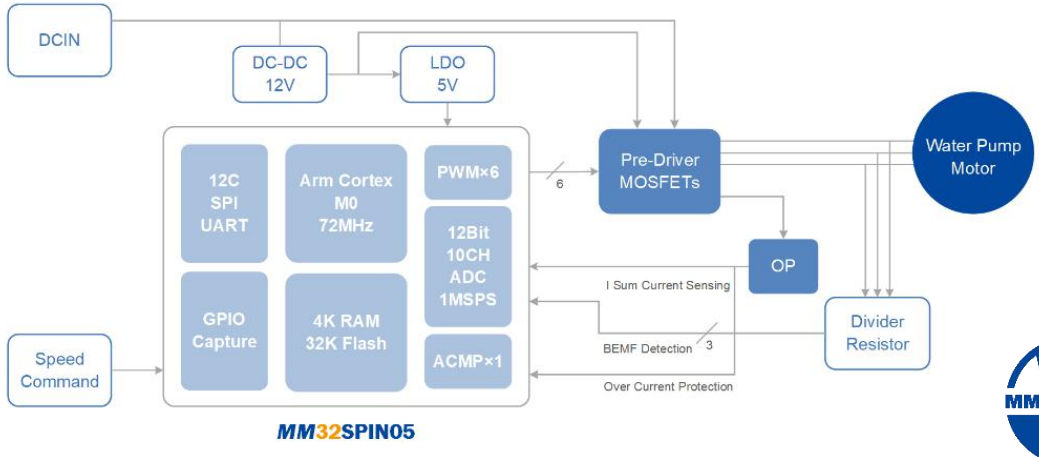
- High rotating speed
- Embedded comparator
- Fast boot up

Specification

Core	Computing power	Voltage range
Arm Cortex-M0	72MHz	7~28V

- Hall sensor less square wave driving
- Over current, voltage and block rotor protection

Function Block



筋磨枪

Fascia Gun

MM32 MCU Parts

MM32F003TW

Features

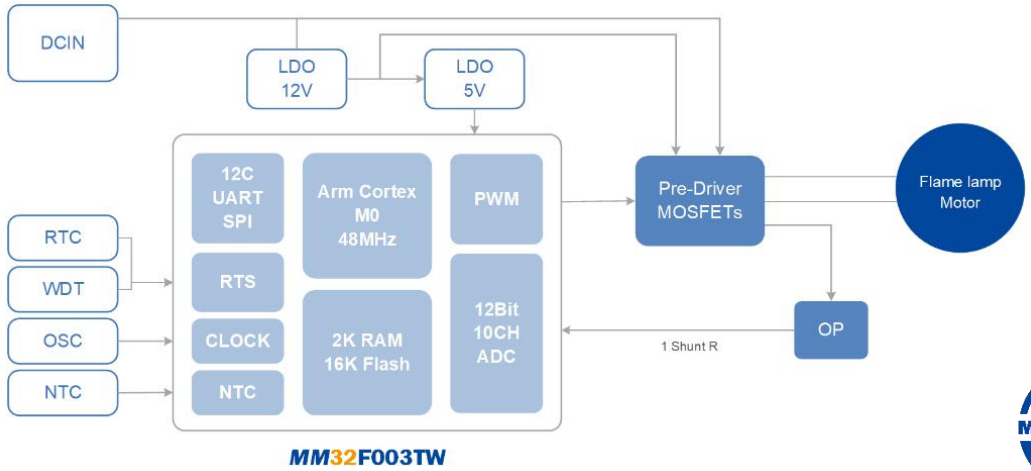
- Multiple massage mode selection
- Low battery alarm
- Capacitive Touch switch
- Higher stability and opinions

Specification

Core	Computing power
Arm Cortex-M0	48MHz

- Hall sensor less square wave driving method
- Powerful initiate torque and fast response

Function Block



谢谢！

MM32MCU 微信公众号

MM32 QQ 技术交流群

www.mm32mcu.com