life.augmented

ST家电电机控制解决方案及应用

2020年9月24日

Frank Cai

Motor Control Competence Center
Asia Pacific Region

Industrial
Motor Control
Competence Center

Industrial Motor Control Competence Center

议程

1 ST亚太电机控制创新技术中心

2 ST电机控制生态系统

3 STM32 MC SDK v5.4.4 新特点

4 ST电机控制家电应用及IPs

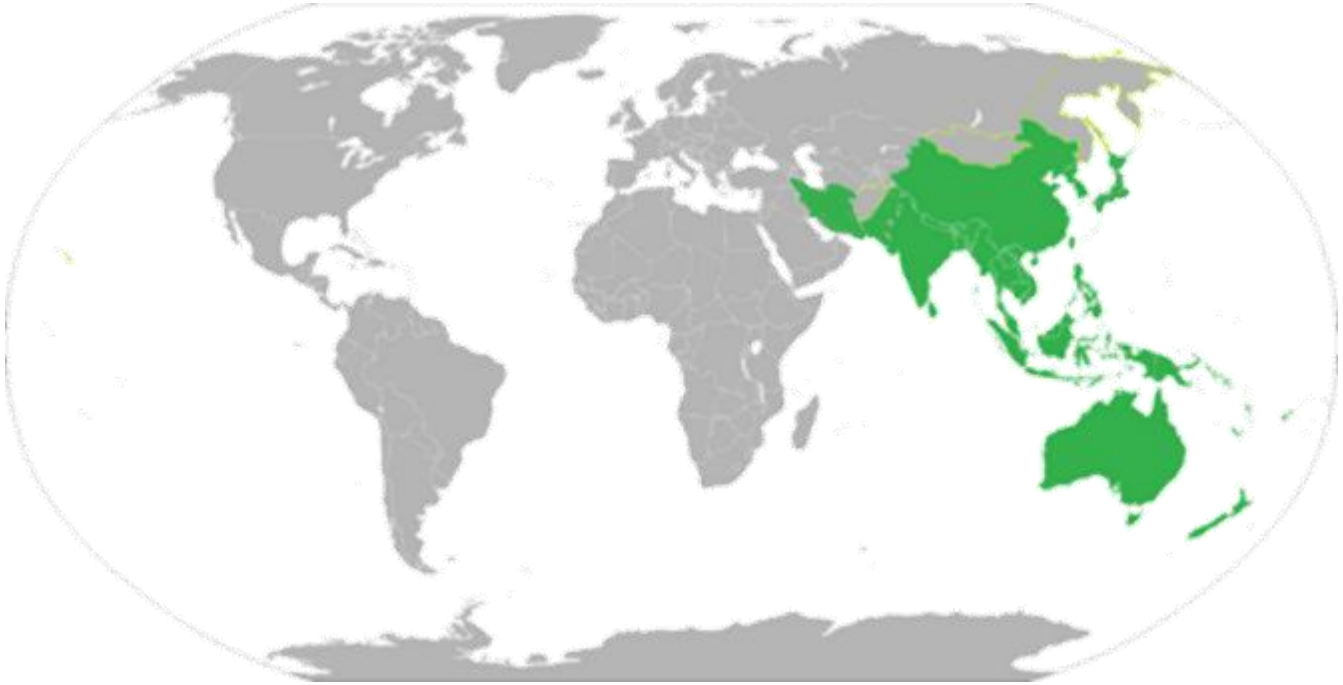
5 ST电机控制硬件工具

life.augmented

Industrial Motor Control Competence Center

电机控制创新技术中心功能

- 设计
  - 硬件参考设计, 应用开发板
  - 用于ST电机库的软件应用模块设计
  - 系统级解决方案
- 客户支持
  - 评估和培训（使用ST工具）
  - ST套件及产品的选择(in cooperation with TM)
  - 原理图
  - Layout 检查
  - 调试 (in cooperation with FAE)
  - 性能提升
- 咨询
  - 全面的电机控制系统专业知识
  - 伙伴关系和新算法;
  - 客户Ips移植到ST平台



life.augmented

ST电机控制生态系统
三相电机 PMSM FOC SDK

技术支持(全球层面)

MCUs for Motor Control (8-32 bit)

STM8 STM32 STSPIN

IPM, Power transistors, AC switches, Motor Driver ICs

STPOWER

电机
控制
生态系统

ST MC Workbench
STM32 Cube Mx

PC SW GUI
Full customization and real time communication

HW Boards

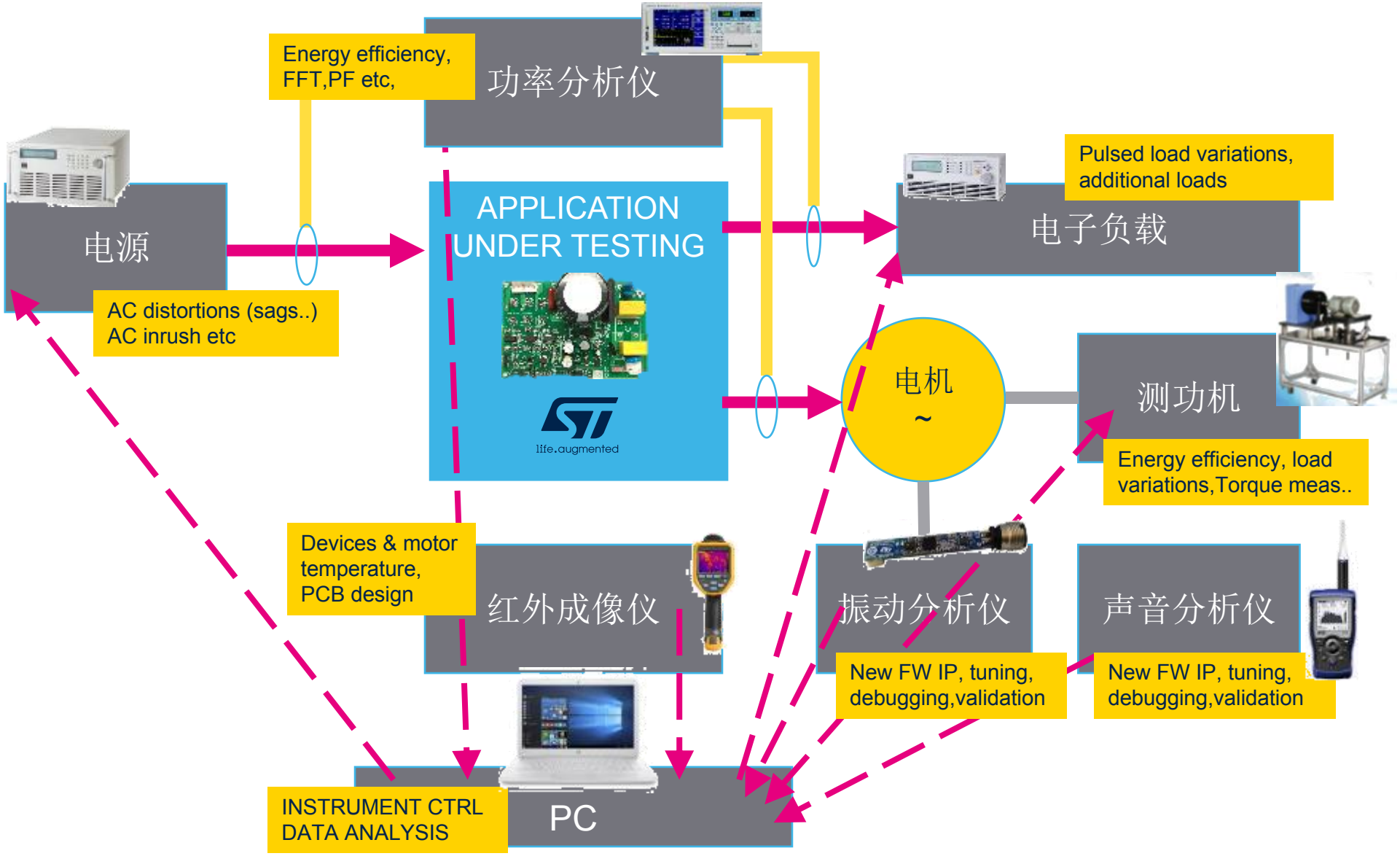
FW library
wide range of features & algorithms (FOC – 6step)

Software Development Kit (SDK)

life.augmented

Industrial Motor Control
Competence Center

电机控制实验室



life.augmented

Industrial Motor Control
Competence Center

电机控制
工业应用

家用和专业电器

电动工具

电机控制

工厂自动化

工业驱动器

电机

- 三相 BLDC or ACIM
- 步进电机
- 直流电机

设计

- 架构
- 功率

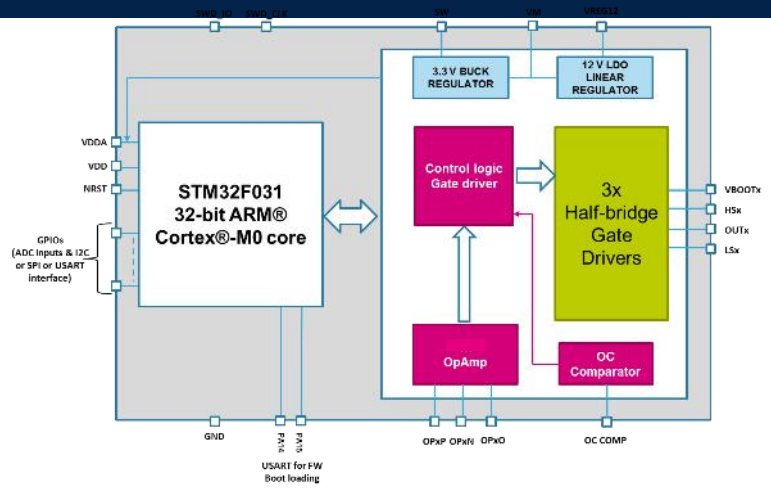
行为

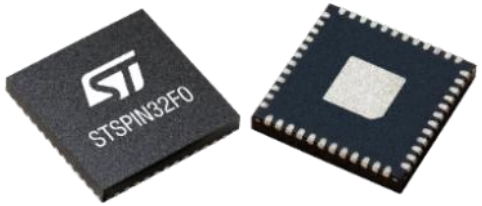
- 能源效率
- 动态性能
- 安全性 – 可靠性

life.augmented

STSPIN32F0 / A / B概述

Advanced 3-phase BLDC driver + STM32 – from 2 Li-Po Cells to 45V





主要特性和优点：

STM32 Cortex M0 + 3-phase Gate Driver

Fully compatible with STM32 ecosystem

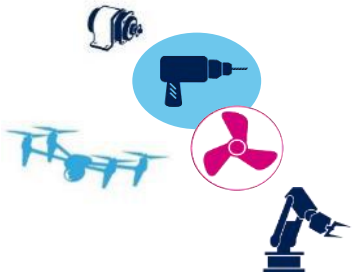
12V LDO & 3.3V DCDC regulators integrated

6 step & FOC sensorless / sensored algorithms

- VS = 6.6V–45V (A version), Igate = 600mA sink / source current
- 48 MHz, 32k Flash & 4k SRAM
- 12 bit ADC , I2C / UART / SPI
- **FW boot loader support** (A version)
- Fully protected (UVLO, Short-circuit, OCP, OTP)
- 3 Op-Amps & 1 Comparator (A version) ,
- **Compact design** with 7x7 mm QFN
- Extended temp range: -40 to 125°C

主要应用:

- 电池供电家用电器
- 电动工具
- 风扇
- 工业自动化
- 机器人
- 无人机和航模

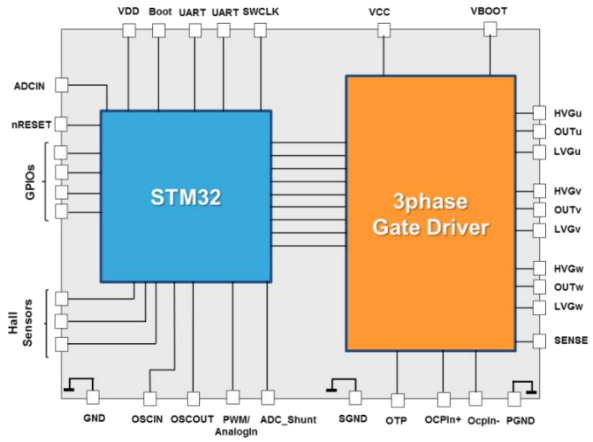


life.augmented

NEW

STSPIN32F060x/25x 概述

Advanced 250V & 600V 3-phase BLDC Drivers with embedded STM32 MCU



KEY APPLICATIONS

- 36V – 120V 电动和花园工具
- 空调压缩机和风扇
- 家用和工业用冰箱压缩机
- 工业水泵
- 大功率电动工具
- 工业自动化

Key Features

- STM32 Cortex M0 + 3-phase Driver
- Fully compatible with STM32 ecosystem
- 6step & FOC sensorless / sensored algorithms
- 0.35A & 1A I capability
- All devices P2P among them

Value & Benefit

- Extremely compact & flexible solution
- Exaustive ecosystem for fast design
- High below-ground robustness
- High immunity / Low EMI Noise

life.augmented

STM32 G4
G4 = F3系列下一代

F3 series

- **Gain in robustness, Safety, Security**
  - EMC (EMI, EMS) → continuous improvement
  - **Dual Bank** Flash w/ ECC (Live FW Upgrade)
  - HW encryption AES
  - **Securable Memory Area**
- **Gain in Performance**
  - **170MHz** even from internal oscill. (**213DMIPS**)
    - ART accelerator (~dynamic cache)
    - CCM-SRAM Routine Booster (~static cache)
    - **Mathematical accelerator** (Trigo, Filtering)
  - Better dynamic power conso (160µA/Mhz) = ~2.7 times lower than F3 series
- **Gain in Peripheral set and Architecture**
  - **1%** RC accuracy [-5°..90°C], 2% full range
  - ADC with HW oversampling = 16-bit resolution
  - Renewed Op-Amp, DAC, Comparator
  - New HR timer features (digital part)
  - MC timer improvements (encoder mode…)
  - USB type-C with Power Delivery incl. PHY
  - 85° up to **125°C** (limited condition)
- **STM32 F3 portfolio extension**
  - D-Power portfolio (STM32F334) extension
  - **NEW 128pin** and **80pin** packages (LQFP)

G4 series

life.augmented

STM32 G4
升级版模拟外设

New design

Op-Amp	F3	G4	Comment
Power supply (V)	2.4 .. 3.6V	2.0 .. 3.6V @ functional 2.2 .. 3.6V @ full perf.	Only PGA gain error is improved from 2.2V
GBW (MHz)	8.2 MHz	**13 MHz**	Typ. value
Slew rate (V/µs)	4.7 us	**45 V/µs** (high speed mode) **6.5 V/µs** (normal mode)	Typ. value
Offset (full temp range) (mV)	3 mV	3mV (full temperature range)	1.5mV @ 25°C
	Rail to rail input/output	Rail to rail input/output	
PGA Gain	x2, x4, x8, x16	2, 4, 8, 16, 32, 64,	1% accuracy

New design

Comparator	F3	G4	Comment
Power supply (V)	1.8 .. 3.6V	1.62 .. 3.6V @ full perf.	
Propagation delay	25ns	**16.7ns**	Typ. value
Offset (mV)	+/-4mV	-6 .. +2 mV (typ.)	Max. -9 .. +3 mV
Hysteresis	No (except 256, 128KB version)	8 steps: 0,9,18,27,36,45,54,63 mV	Programmable with step 9mV

New concept

DAC	F3	G4	Comment
Power supply (V)	2.4 .. 3.6V	1.8 .. 3.6V @ functional 2.7 .. 3.6V @ full perf.	
Sampling rate	1MSps	**15Msps** (internal use only → DAC connected to COMP input)	Settling time: 16ns (10%-90%) 64ns (1LSB)

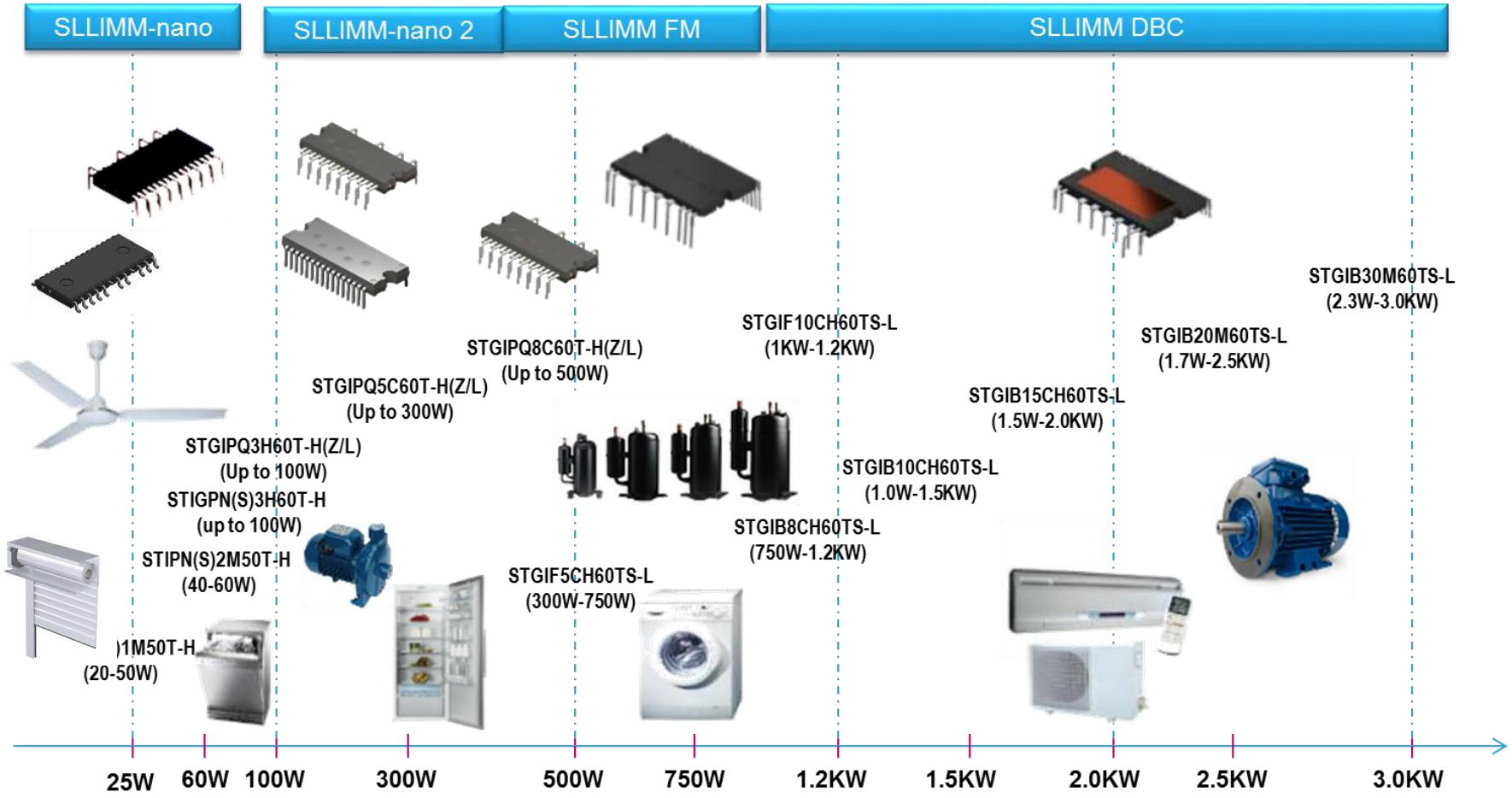
G4 includes 3xDAC 1Msps (same as in F3) and 4xDAC 15Msps (internal only)

life.augmented

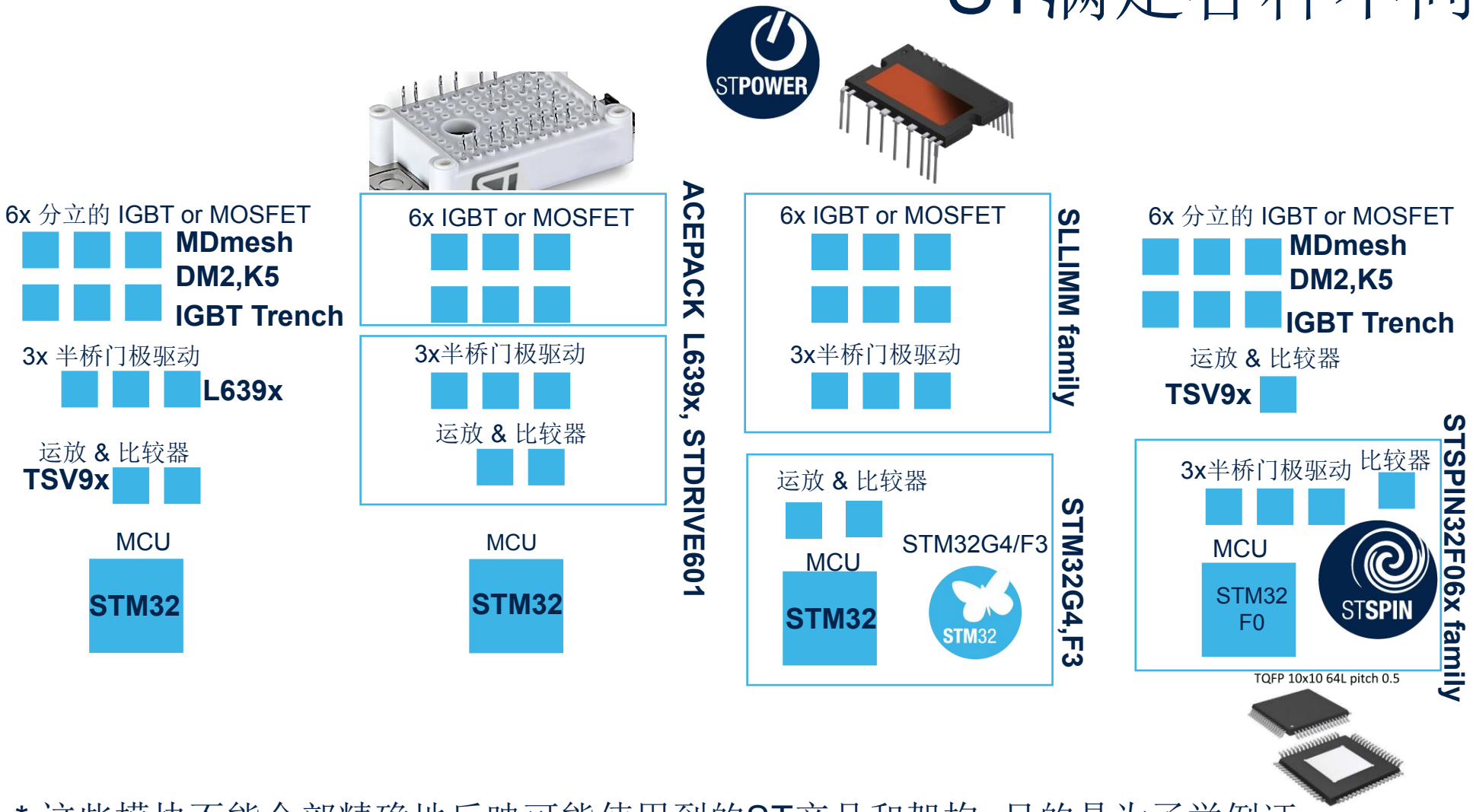
SLLIMM™ 家族定位

Target applications

- Motor control
- Washing Machine
- Air Conditioning
- Pumps
- Compressor
- Industrial drives



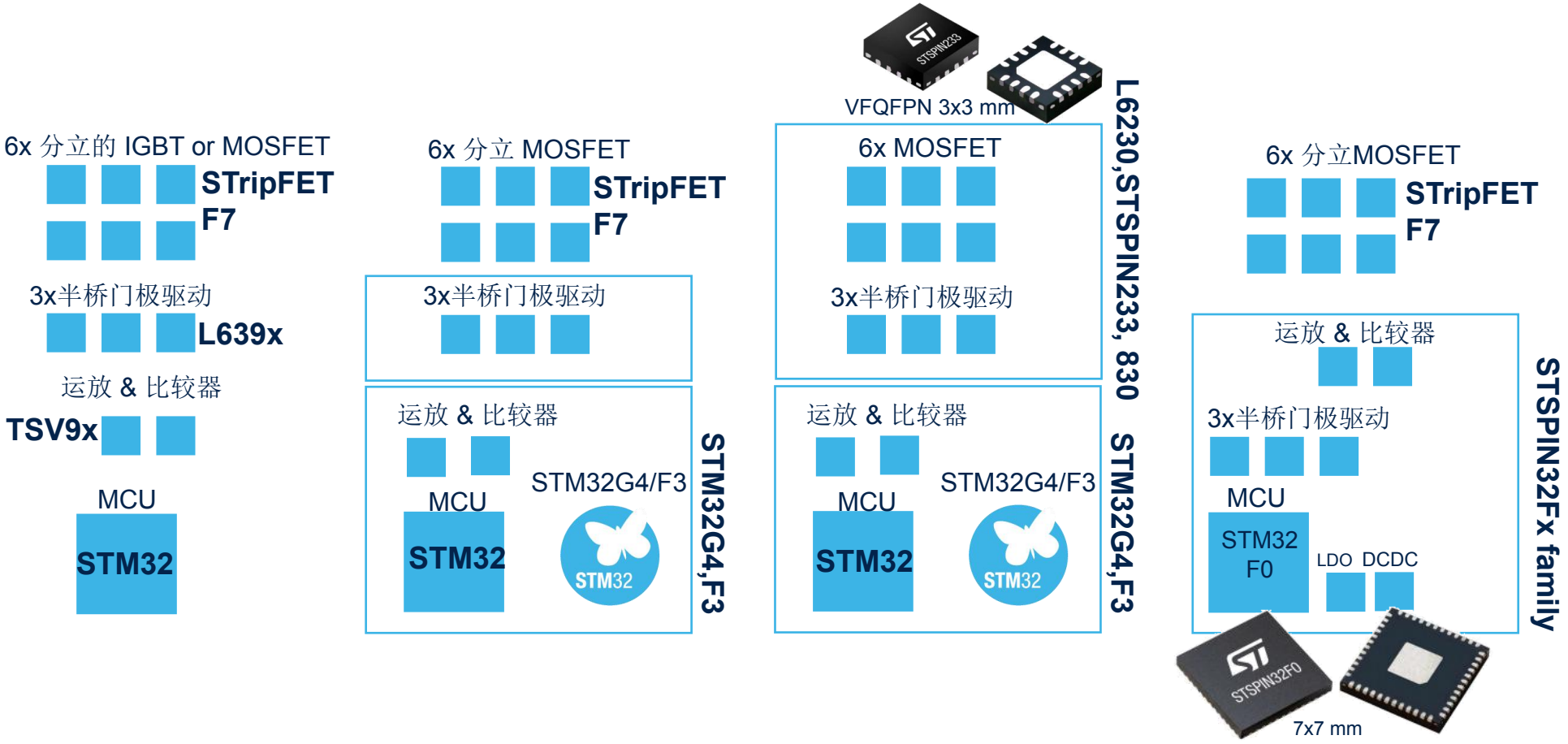
高压电机控制方案架构
ST满足各种不同需求*



* 这些模块不能全部精确地反映可能使用到的ST产品和架构. 目的是为了举例证明ST产品可以涵盖不同架构和应用。

life.augmented

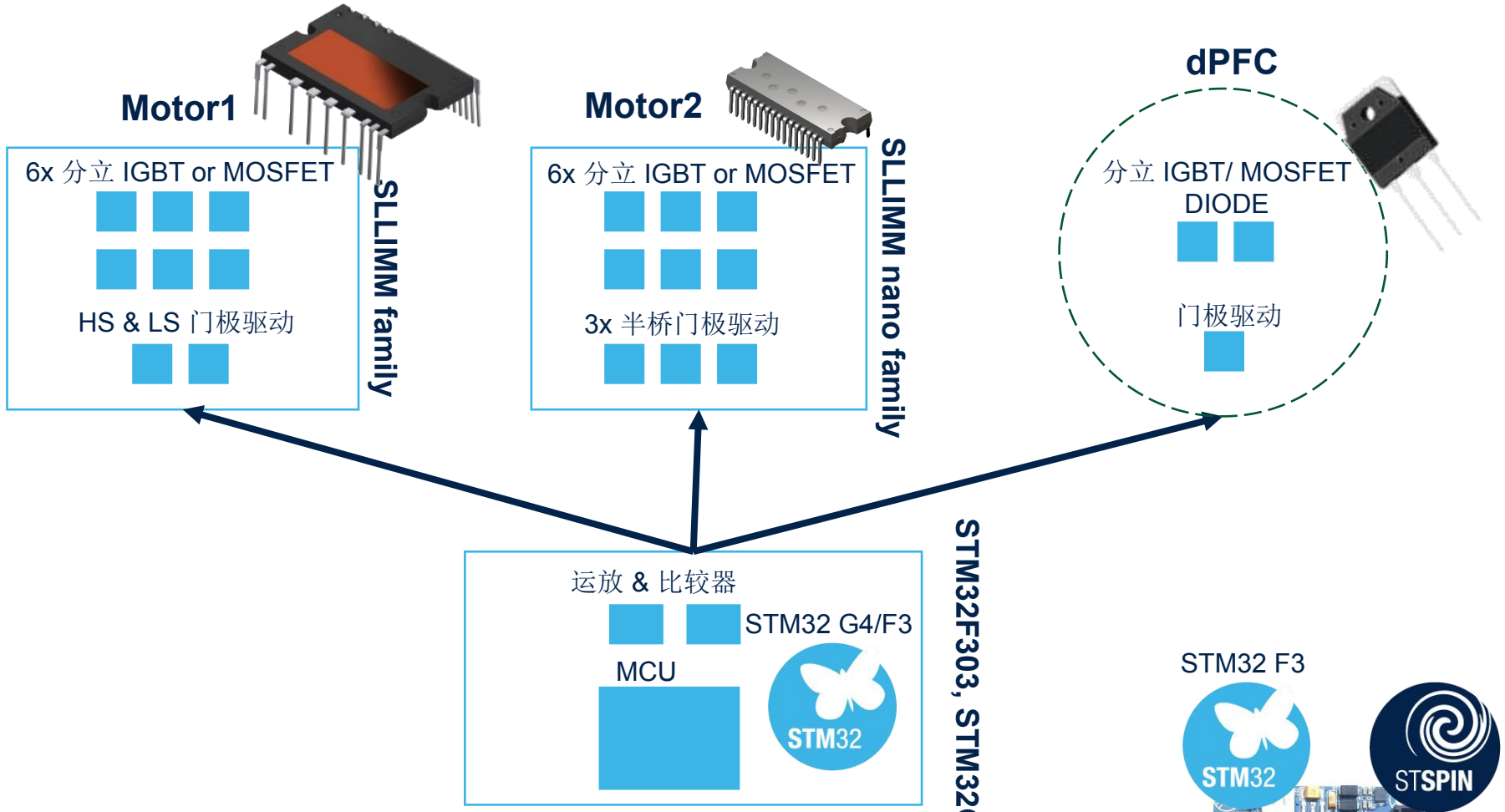
低压电机控制方案架构
ST满足各种不同需求*:



* 这些模块不能全部精确地反映可能使用到的ST产品和架构. 目的是为了举例证明ST产品可以涵盖不同架构和应用

life.augmented

双电机控制&数字PFC方案架构



可支持 3 FOC 参考设计 (云台控制) !!
STEVAL-GMBL02V1
STM32F303 + 3pcs STSPIN233

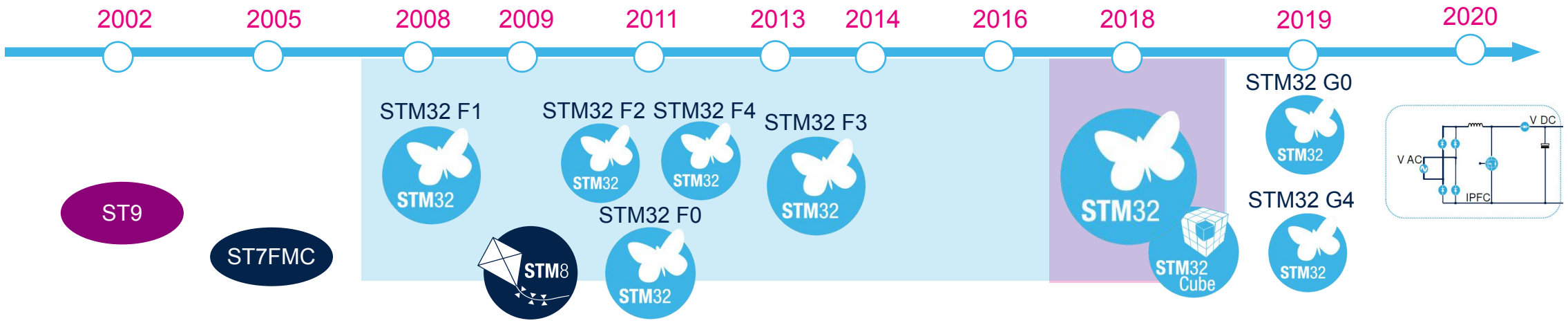
STM32 F3

life.augmented

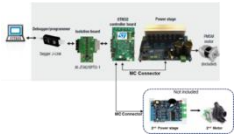
STM32 电机控制SDK
电机控制软件开发套件

life.augmented

十八年三相电机控制
FOC MCSDK

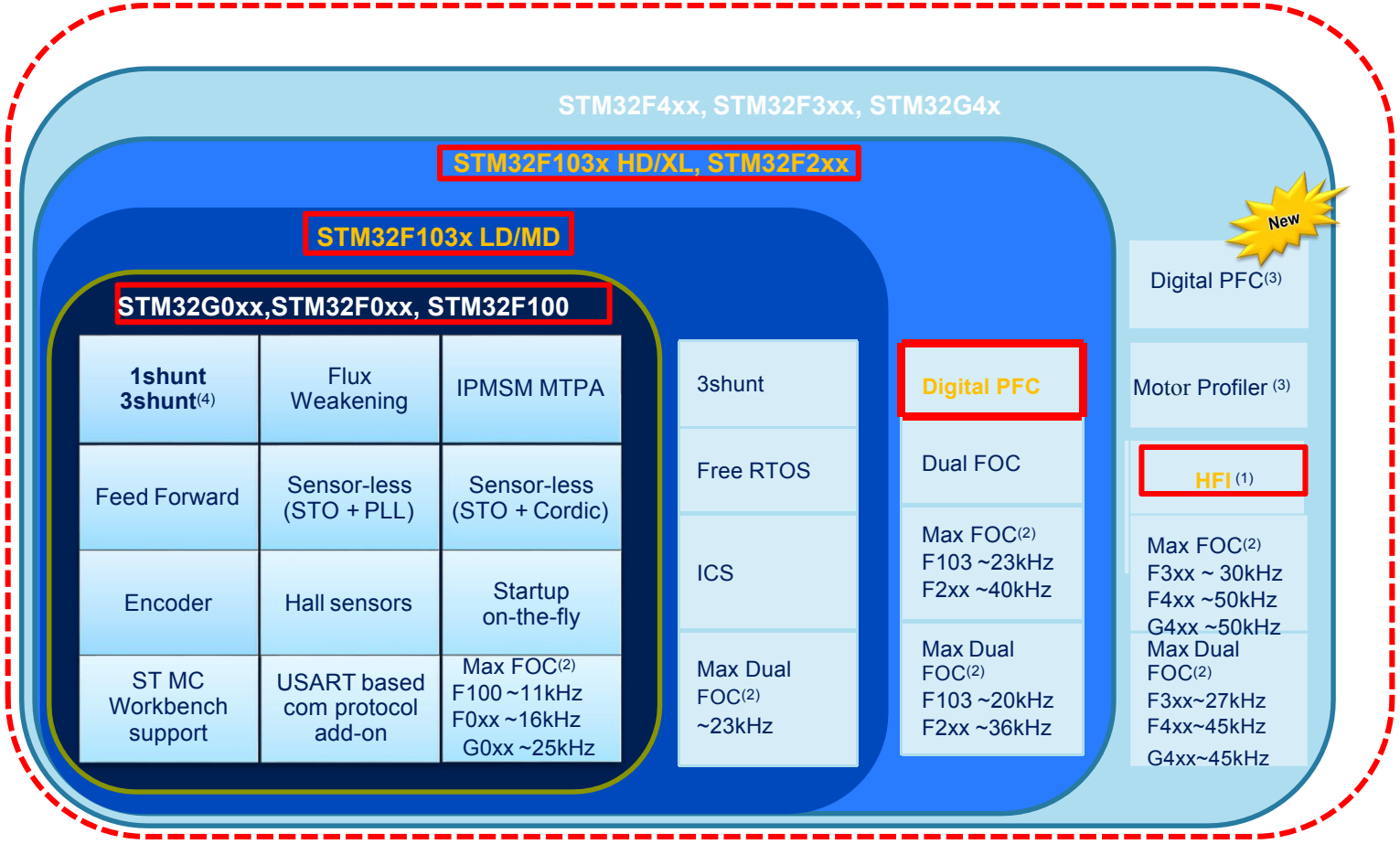


2002	2005	2008	2009	2011	2013	2014	2016	2018	2019	2020
8/16-bit MCU for ACIM with dedicated library	8-bit MCU for MC scalar and 6-step control with MC HW & SW kit	32-bit CM3 MCU & sensor-less FOC library v1.0	8-bit MCU & MC kit for scalar and 6-step control	FOC SDK v3.0 - dual motor FOC control & MCWB	FOC SDK v3.4 - new analog & HW accelerator	FOC SDK v4.0 - high frequency Injection, MTPA	FOC SDK v4.3 - Motor Profiler, One Touch Tuning, Start-up on the fly	FOC SDK v5.0 - STM32Cube compatible & Simplified FW architecture	FOC SDK v5.4.3 Dual Motor Position loop G0/G4 support	**FOC SDK v5.4.4** PFC on STM32F3 STEVAL-CTM010V1



life.augmented

STM32 电机控制软件开发套件 5.4.4 概览-软件库功能



XXX 待加入软件开发套件的功能

(1)High Frequency Injection高频注入

(2)Max FOC estimated in sensor-less mode

(3)For STM32F30x

(4)Not for STM32F100

life.augmented

STM32 电机控制软件开发套件 5.x 概览-性能测试数据

测试条件: PWM 频率20KHz / 10KFOC 电流环控制频率

			MCSDK5.0					
	MCU	Config	Workload (%).	Total Code size (kB).	ro data (B).	RAM (B).	FOC Lib (kB).	HAL (kB).
第一行	F072RB	1 Shunt	44.3	18.8	609	3126	12.8	5.1
第二行	F072RB	3 Shunt	39.4	19.5	653	2910	12.9	4.5
第三行	F303RE	1 Shunt	20.4	22.3	4427	2940	14.4	7.8
第四行	F303RE	3 Shunt	18.1	23.6	4179	2884	16.1	7.5
第五行	F446RE	1 Shunt	10.2	19.7	625	3122	14.4	5.3
第六行	F446RE	3 Shunt	8.2	17.8	603	2840	13.1	4.7
第七行	F303VE	DUAL/3S	38.2	20.8	4449	4724	13.1	7.7
第八行	F415ZG	DUAL/3S	18.3	19.3	761	4484	14.7	4.6

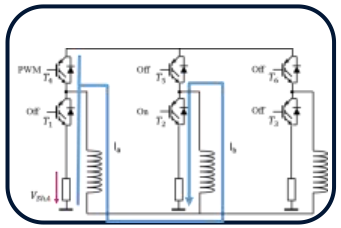
life.augmented

电机参数自识别

60秒内即插即转电机

电机静止

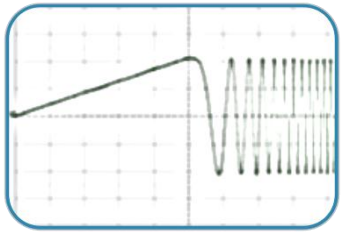
- Ls 测量
- Rs测量
- 电流校准设定



10 sec

开环运行

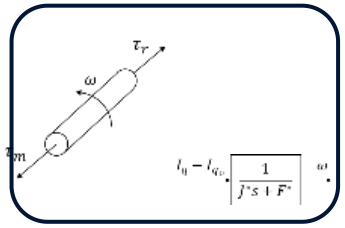
- Ke 测量
- 无传感器状态观测器设定
- 切到闭环



5 sec

闭环运行

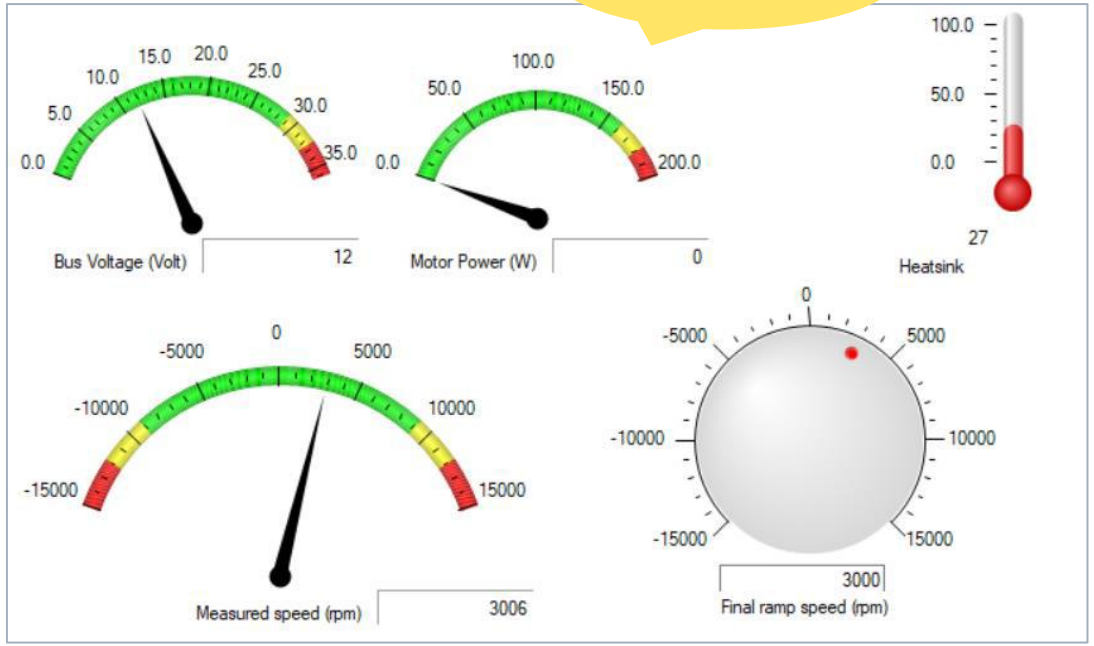
- 摩擦系数测量
- 动惯量测量
- 速度校准



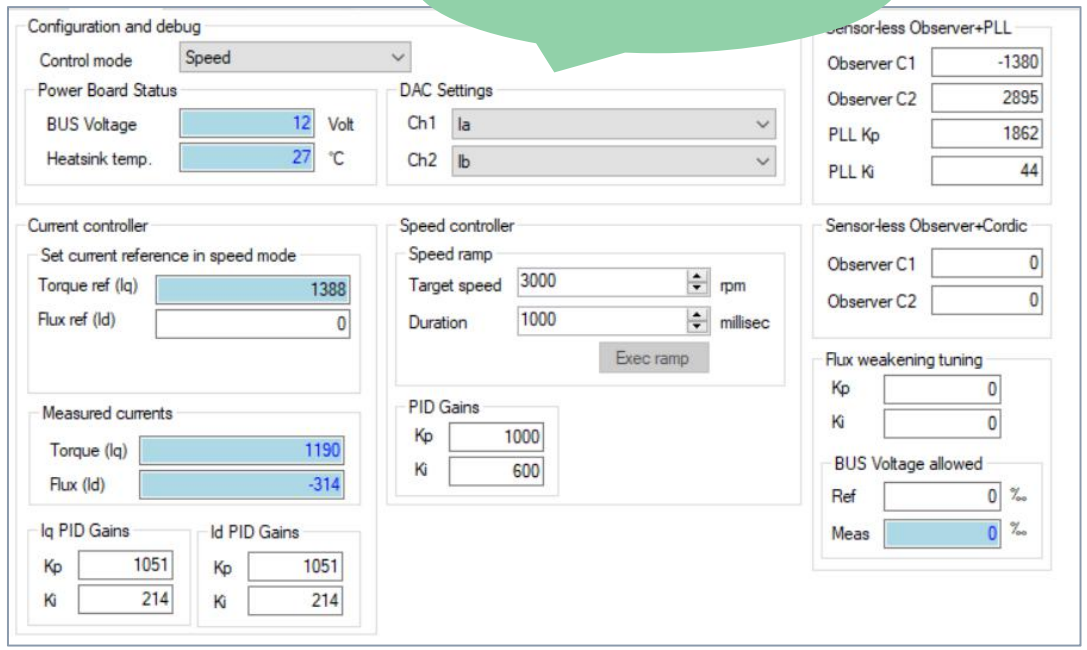
45 sec

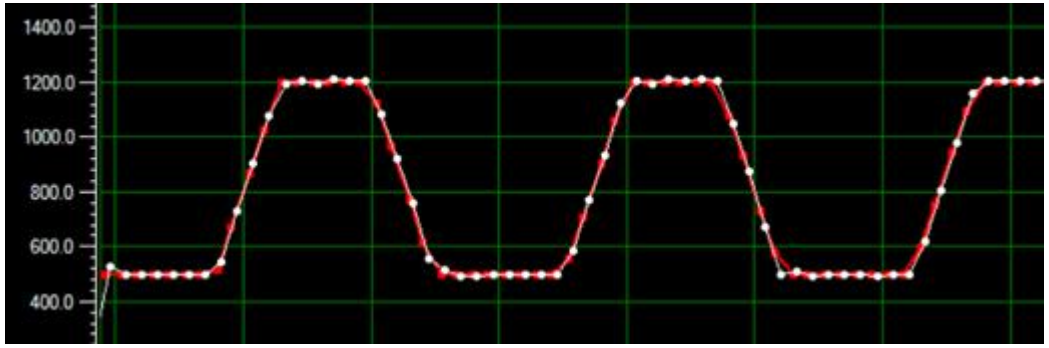
电机实时交互控制

仪表盘



实时参数调整





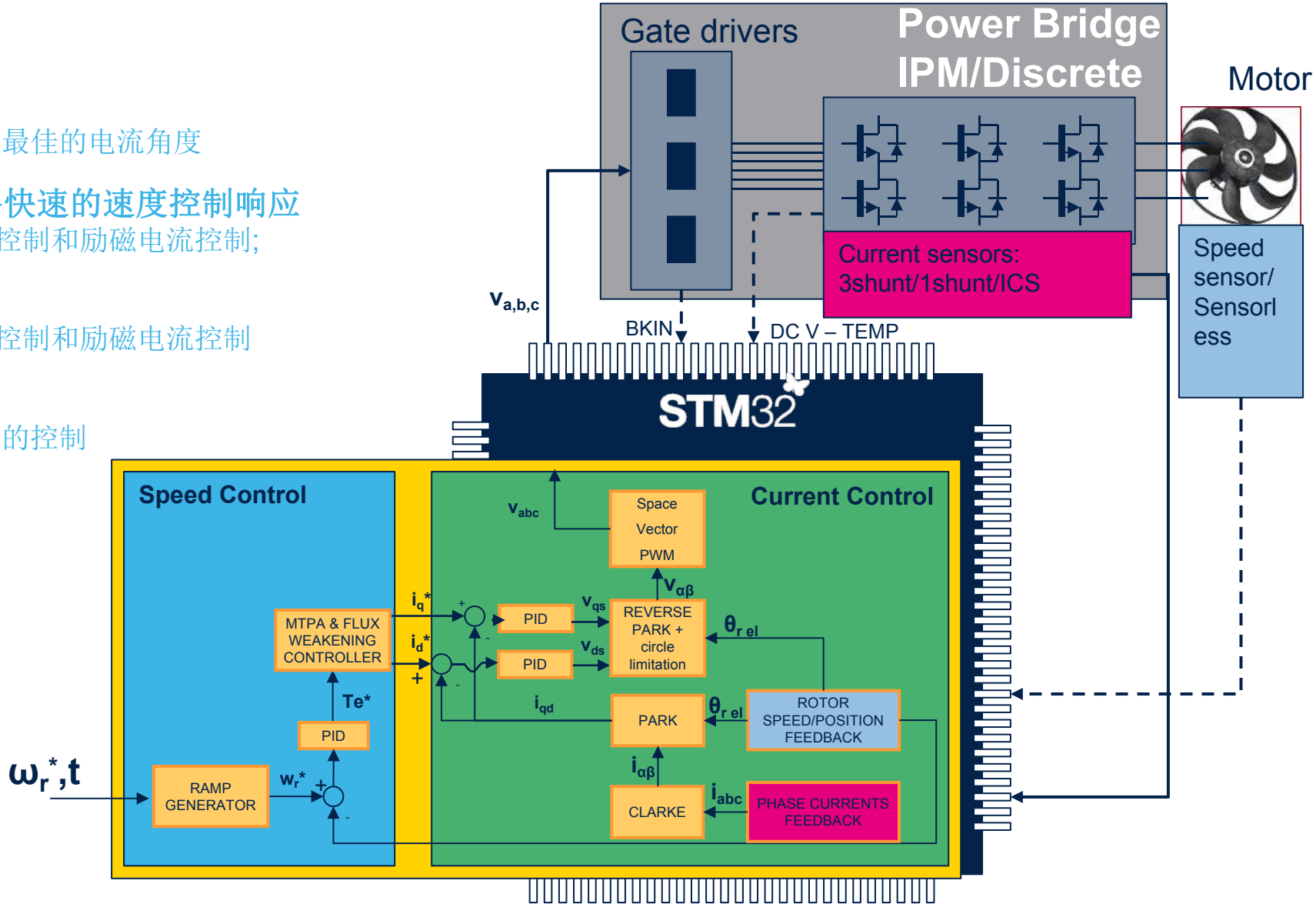
速度示波器

life.augmented

PMSM FOC – 框图

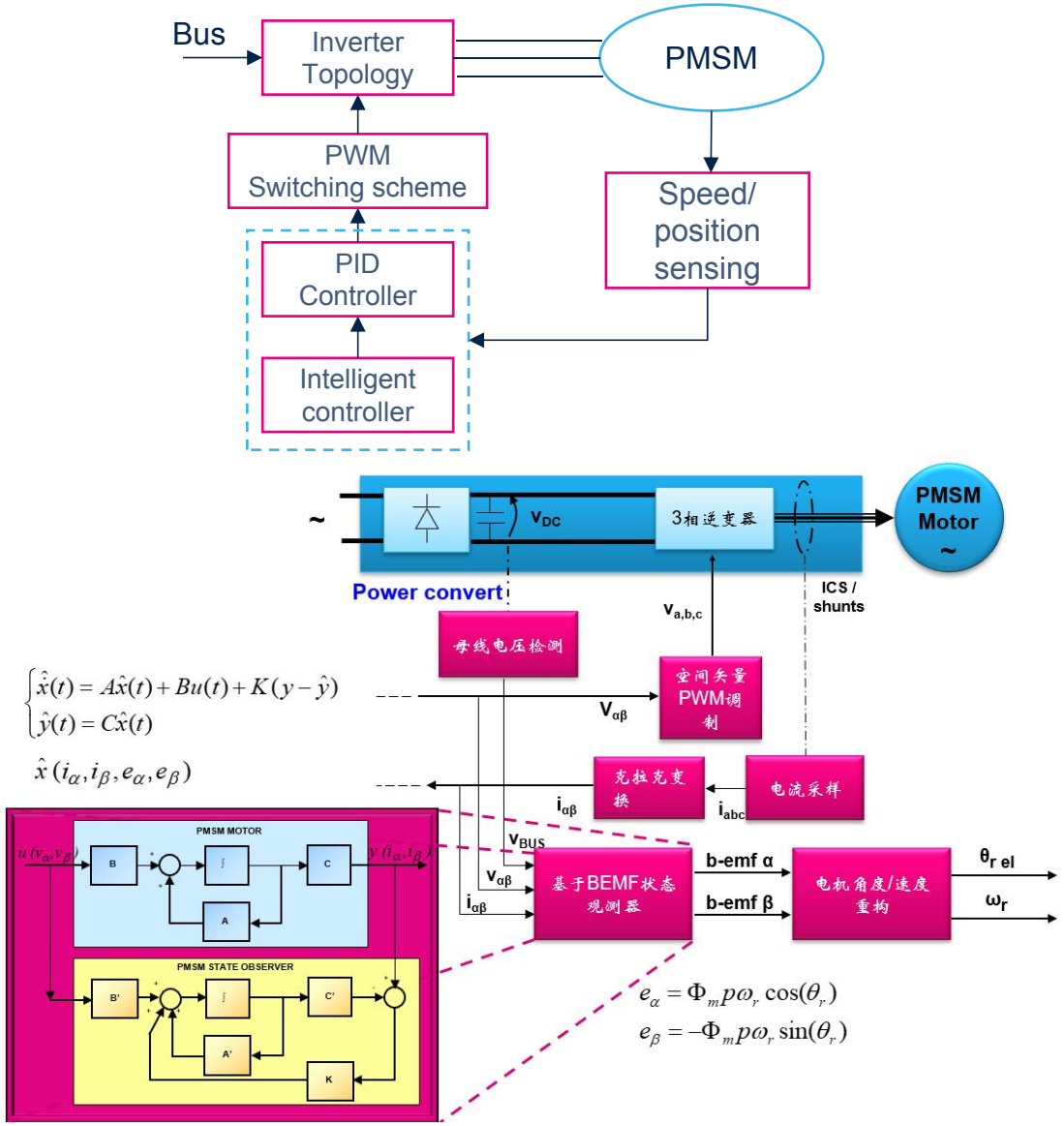
FOC的优势:

- **最好的能效**
  甚至是过渡工况,归功于最佳的电流角度
- **对于负载的变化具备快速的速度控制响应**
  归功于直接的转矩电流控制和励磁电流控制;
- **精准的位置控制**
  归功于直接的转矩电流控制和励磁电流控制
- **噪音的减少**
  归功于正弦波驱动/最佳的控制



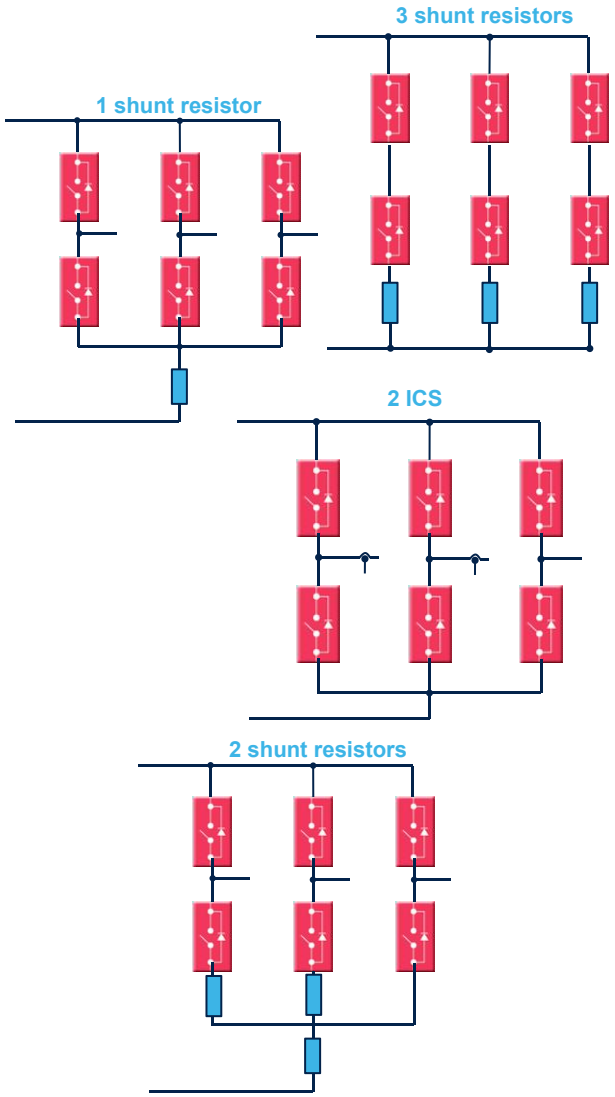
速度/位置 反馈 架构&软件模块

- **正交编码器**
  - 器件昂贵，通常应用在工业领域，如机器人等
- **霍尔传感器**
  - 便宜的传感器，通常应用在低速大扭距的场合
- **无传感器**
  - 状态观测器+锁相环
    - 使用电气工程量 (主要是电流反馈) 估计转子位置
    - 应用于很多场合,但不适合0速满扭矩和低速运行(< 3-5%额定转速)
  - 状态观测器 + 坐标旋转数字计算



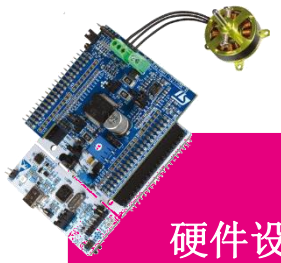
电流采样
架构&软件模块

- **单电阻采样**
  - ST 专利算法
  - 只需要一个采样电阻和运放成本最低
  - 电流采样算法可能导致扭矩控制精确度不高
- **2 + 1 电阻采样**
  - 电流采样准确性: 高
  - 最优的折中：成本/性能
- **3 电阻采样**
  - 电流采样比较精确
  - 最佳的成本 / 性能组合
- **2隔离电流传感器(ICS)**
  - 不需要损耗电流的采样方式 当电流比较大时（几十安培）采用的方式
  - 昂贵

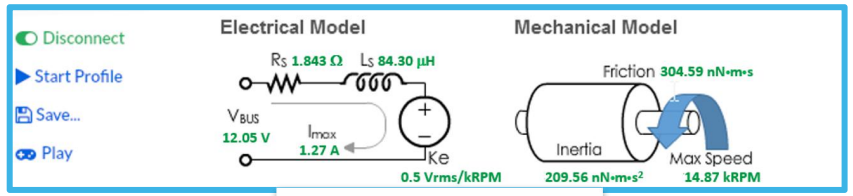


电机库支持任意的电流采样组合(2 种电机x 4种电流采样x 3种速度采样类型)

MCSDK工作流程



硬件设置

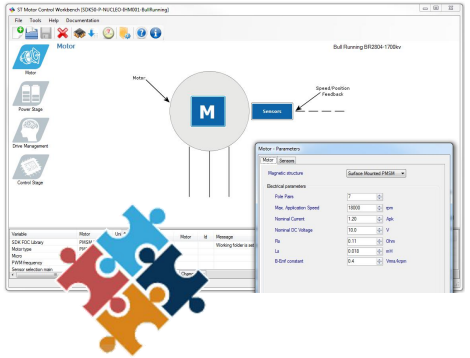


Motor Profiler
Motion Control Suite

电机参数测试

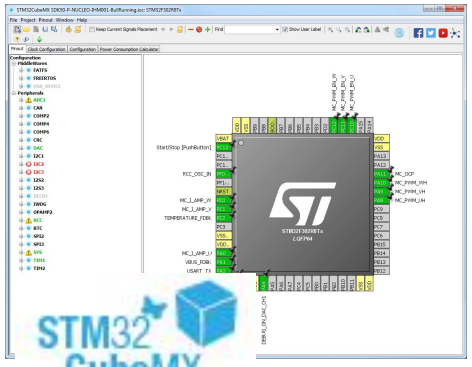
系统配置GUI

Motor Control Workbench



项目配置

CubeMX & IDE



STM32 CubeMX

IAR SYSTEMS TrueSTUDIO for STM32

KEIL Tools by ARM

电机控制

调试 GUI

Motor Control Workbench

最终

应用

开发

Keil is free for STM32 F0/G0/L0

life.augmented

支持的 MCU 系列
until X-CUBE-MCSDK 5.4.4

STM32 系列	F0	F1	F3	F4	F7	L4	G0	G4
• 1 电阻采样	✓	✓	✓	✓	✓/×	✓	✓	✓
• 3 电阻采样	✓	✓	✓	✓	✓	✓	✓	✓
• 霍尔传感器	✓	✓	✓	✓	✓	✓	✓	✓
• 隔离电流传感器	×	✓	✓	✓	✓	✓	×	✓
• 弱磁	✓	✓	✓	✓	✓	✓	✓	✓
• 最大转矩每安培	✓	✓	✓	✓	✓	✓	✓	✓
• 无传感器 (PLL / Cordic)	✓	✓	✓	✓	✓	✓	✓	✓
• 前馈	✓	✓	✓	✓	✓	✓	✓	✓
• 单 FOC	✓	✓	✓	✓	✓	✓	✓	✓
• 双 FOC	×	✓/×	✓	✓	✓/×	×	×	✓
• 位置控制	✓	✓	✓	✓	✓	✓	✓	✓
• 单相数字PFC	✓/×	✓/×	✓	✓/×	✓/×	✓/×	✓/×	✓/×

NEW

✓/×: MCU supports but SDK does not support so far.

life.augmented

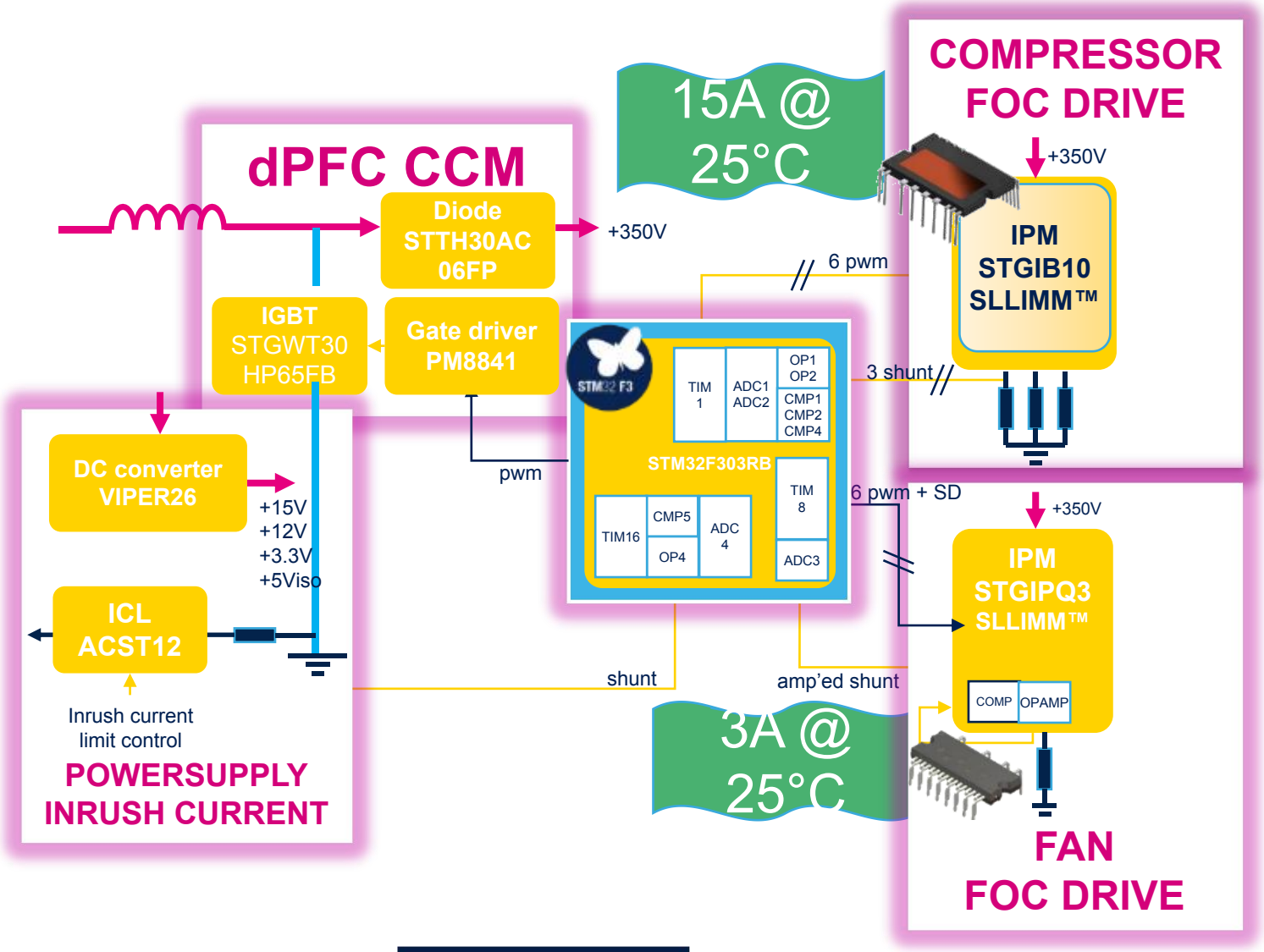
家电具体应用

life.augmented

ST空调室外机Gen2
架构：双电机 FOC + DPFC

ST Products (1.5HP example)

- STM32F303RBT6
- STGIB10CH60TS-L
- STGIPQ3H60T-HZ
- STGWT30HP65FB
- STTH30AC06FP
- VIPER26LD
- PM8841D
- T1235T-8FP
- ST3232BDR

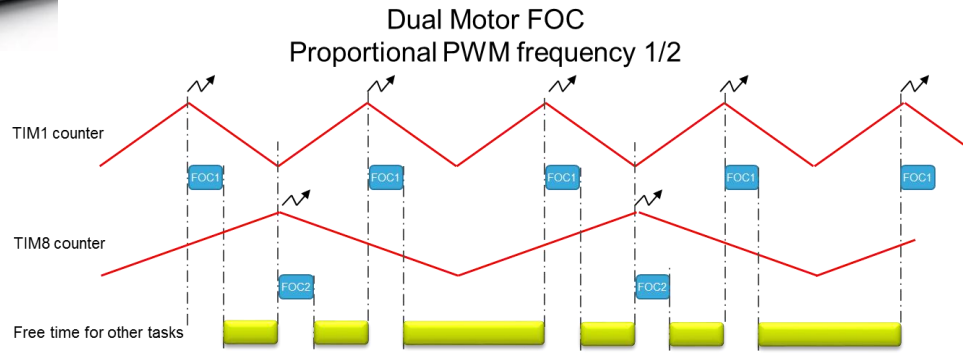


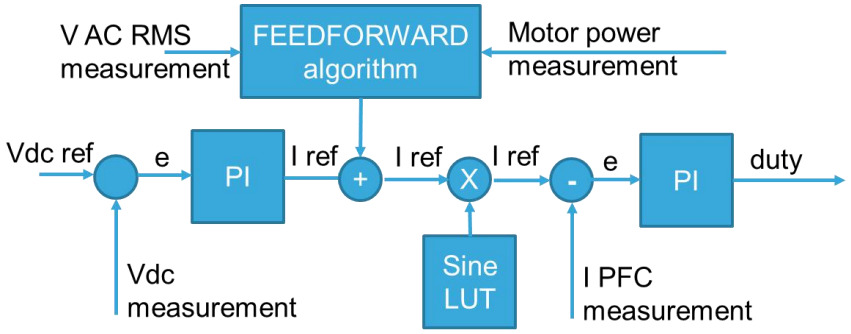
- Compressor Protections: OC, OT, UVLO
- Fan Protections: OC, OT, UVLO
- PFC Protections: OC, UVLO, OV
- Power scalability 1 HP – 3HP
- Small BOM High Integration

STEVAL-CTM010V1

life.augmented

ST空调室外机Gen2 STM32F3 CPU负载 (<56% !)



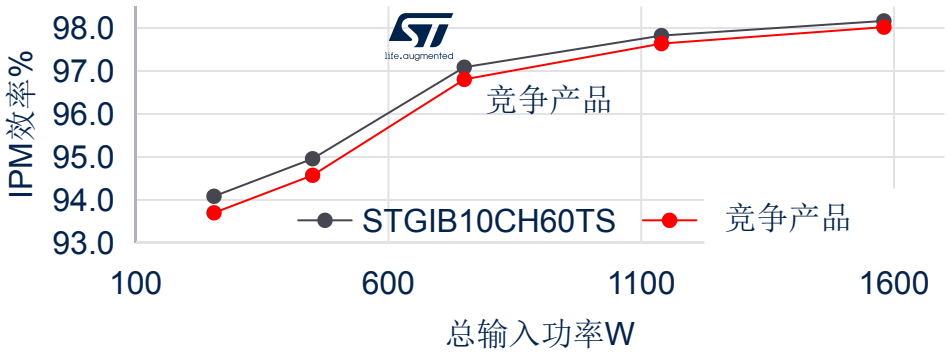


工作	PWM频率	控制频率	任务时间	CPU负荷
压缩机FOC（无传感器，1个分流电阻）	6 kHz	6 kHz	22 us	13.2 %
风扇FOC（无传感器，1个分流电阻）	18 kHz	9 kHz	22 us	19.8 %
PFC电流调节	40 kHz	40 kHz	4.39 us	17.56 %
PFC电压调节		2 kHz	4.095 us	0.82 %
压缩机，速度循环和其它任务		0.5 kHz	42 us	2.1 %
风扇，速度循环和其它任务		0.5 kHz	42 us	2.1 %
总计				55.6 %

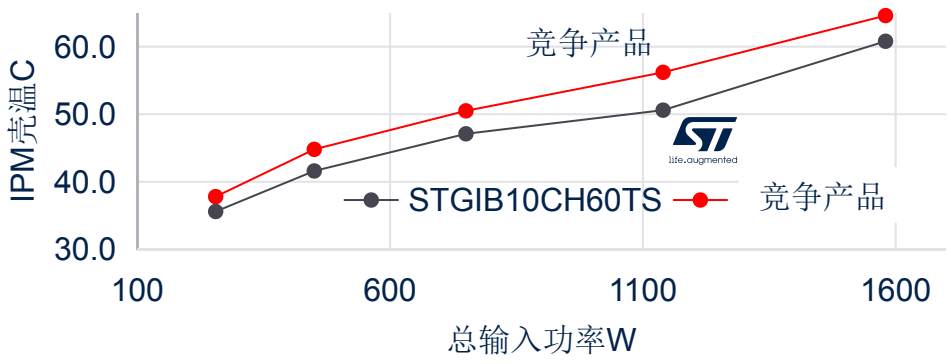
life.augmented

ST空调室外机Gen2 SLLIMM® IPM最佳能效

能效



壳温



在IPM的IN/OUT上测量效率，使用ST MC SDK v4.3 的FOC驱动BLDC电机，
在空调上实际应用上测试所得。

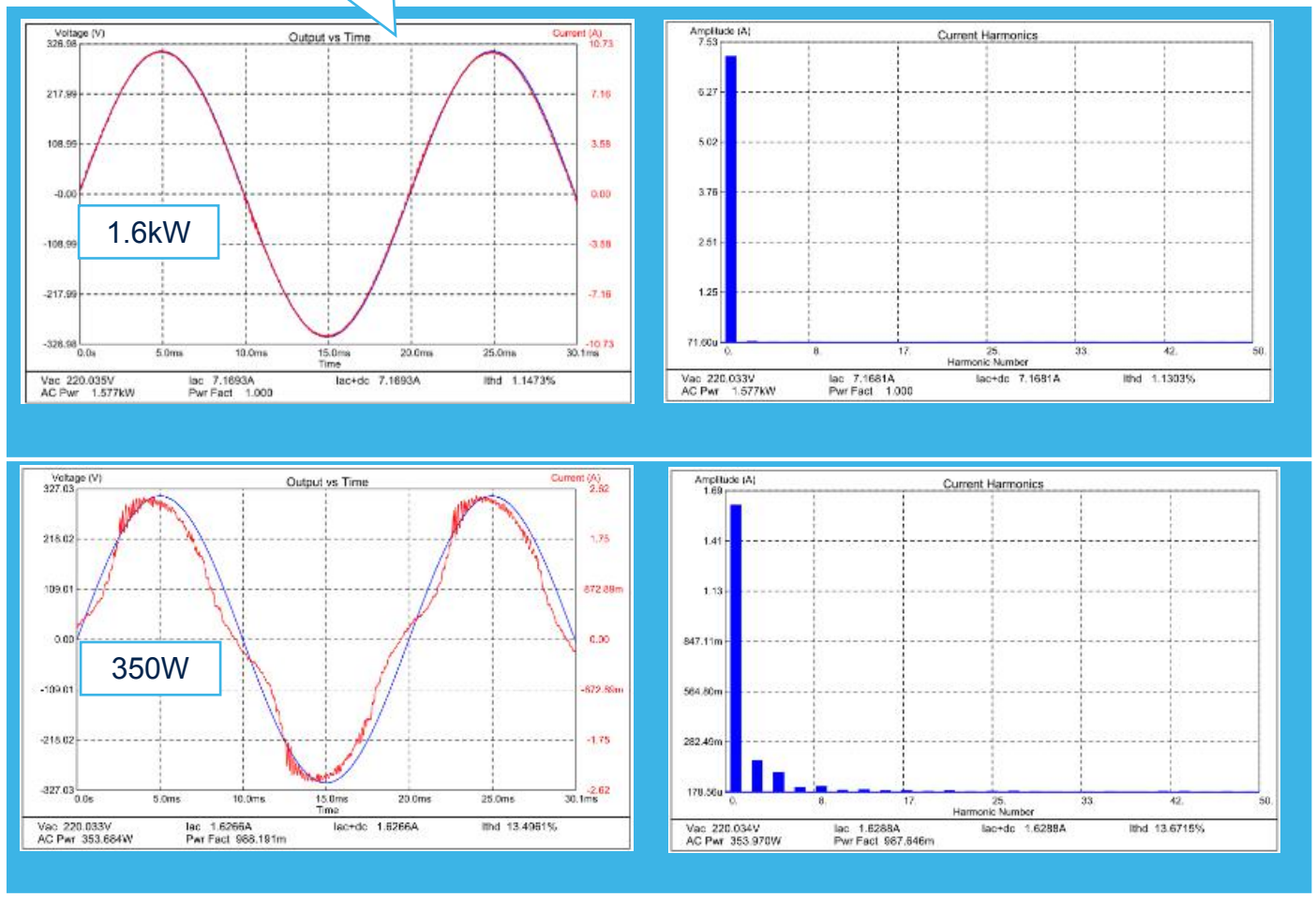
ST的IPM的效率比竞争对手高0.15%~0.38%

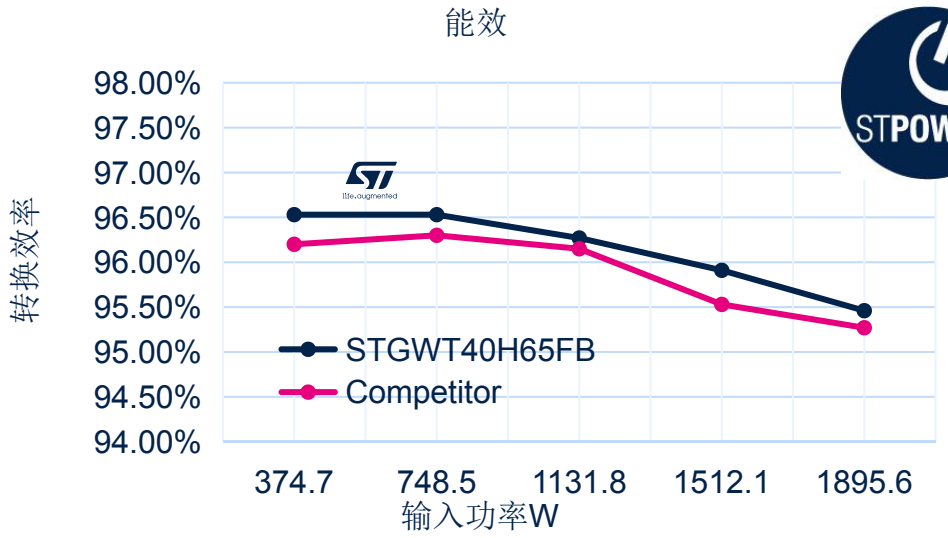
** 有功功率 P = AVG[u(n)·i(n)]

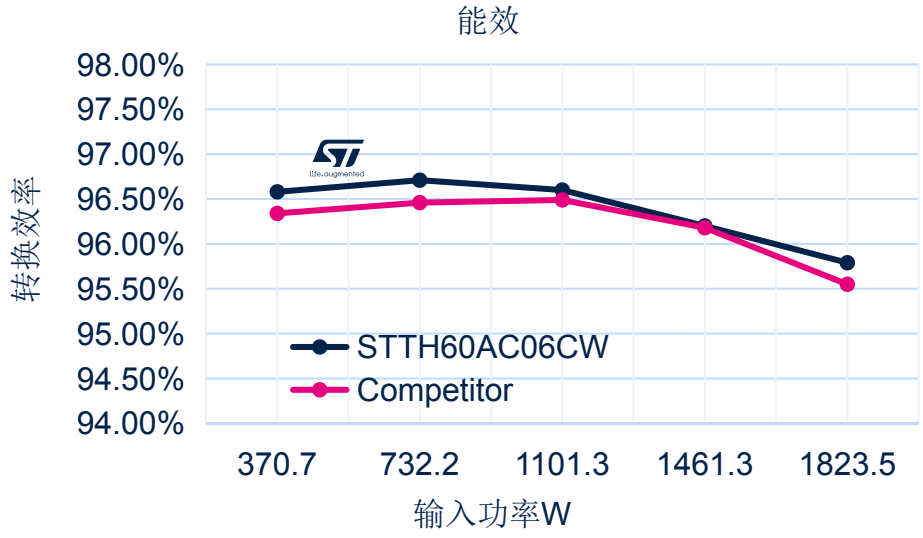
ST空调室外机Gen2 DPFC THD & PF

dPFC被
STM32F3
ST MC SDK v4.3驱动；
接电子负载

杰出的 PF, THD, @ 40kHz
Ton/Toff 延迟补偿
350uH/10A 电感







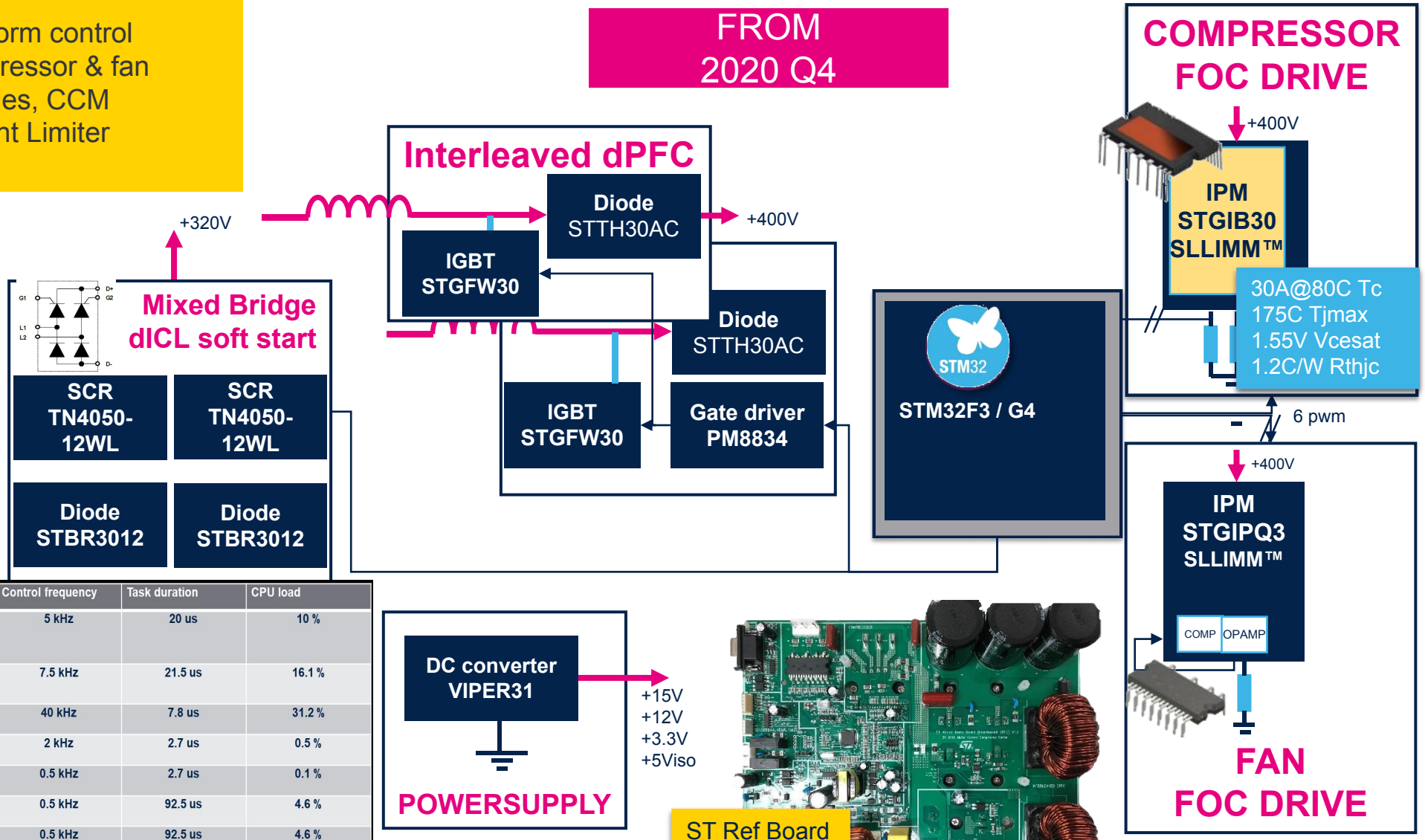
Motor Control Competence Center

4kW空调、热泵解决方案
室外机---双电机和交错式数字PFC

Key Features

- STM32F3 /G4 based full platform control
- Dual BLDC motor FOC, compressor & fan
- Digital Interleaved PFC, 2stages, CCM
- Digital Soft Start Inrush Current Limiter no relay, no NTC

FROM 2020 Q4



Task	PWM frequency	Control frequency	Task duration	CPU load
Compressor FOC (sensorless, 2shunt)	5 kHz	5 kHz	20 us	10 %
Fan FOC (sensorless, 1shunt)	15 kHz	7.5 kHz	21.5 us	16.1 %
iPFC current regulation	40 kHz	40 kHz	7.8 us	31.2 %
iPFC voltage regulation		2 kHz	2.7 us	0.5 %
iPFC load balance regulation		0.5 kHz	2.7 us	0.1 %
Compressor, speed loop and other tasks		0.5 kHz	92.5 us	4.6 %
Fan, speed loop and other tasks		0.5 kHz	92.5 us	4.6 %
TOTAL				67.1 %

ST冰箱解决方案
250w / 300w（650L）

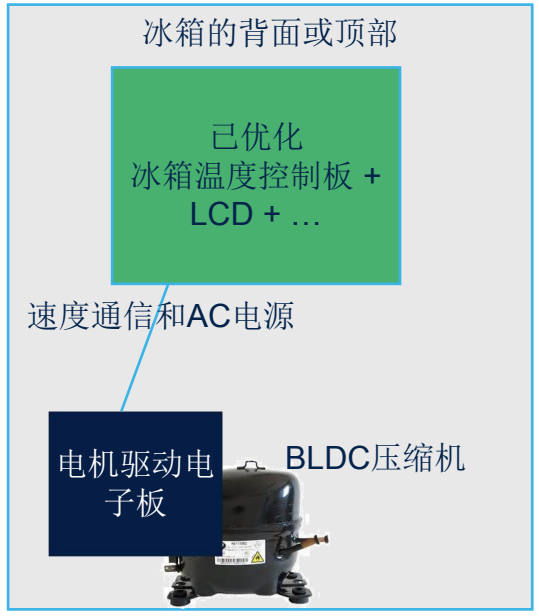
与传统单相感应电机相比，具有逆变器解决方案的三相BLDC电机压缩机已成为新的市场趋势。

得益于高性能和高价值的产品，ST解决方案脱颖而出

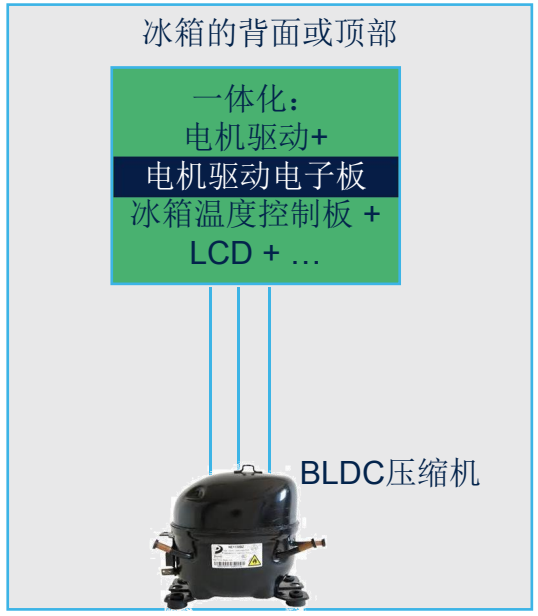
电机驱动电子部分可以与板子分开或合并使用。
对于不同的MC部分没有区别，ST解决方案都能正常工作

解决方案1：替代

解决方案2：替代
冰箱温度优化



解决方案3：一体化



250W冰箱
不同硬件架构，电机驱动板

BOM value

Available

STM32F0
3xL638x + analog
TGFS IGBT/DM2 MOS

14 IC

Available

STM32F0
3x L639x
TGFS IGBT/DM2 MOS

12 IC

NEW !

STSPIN32F0601
TGFS IGBT/DM2 MOS

10 IC

NEW !

STM32G0
SLLIMM™ nano IPM

5 IC

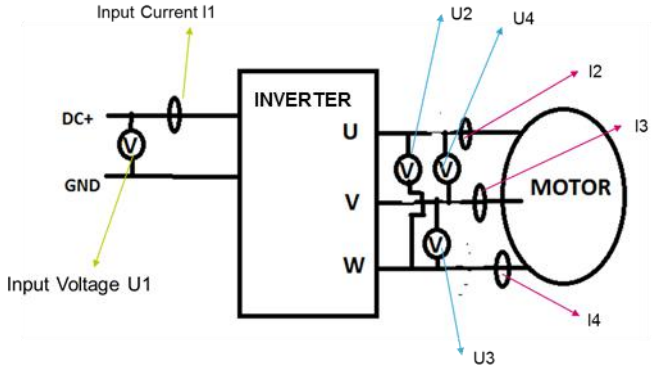
Completed
Available solution & kit

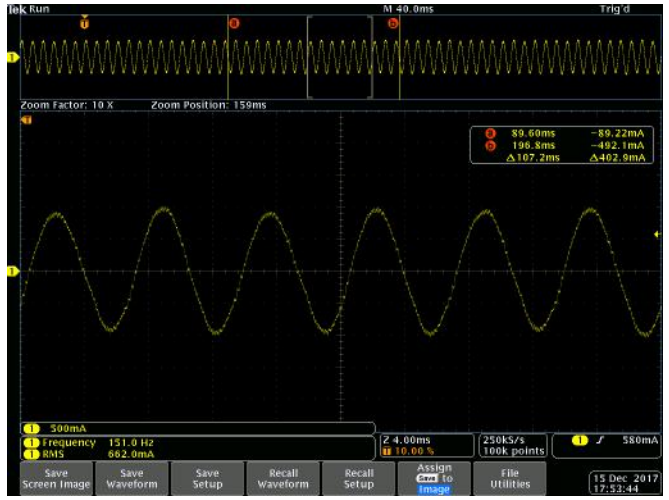
Integration

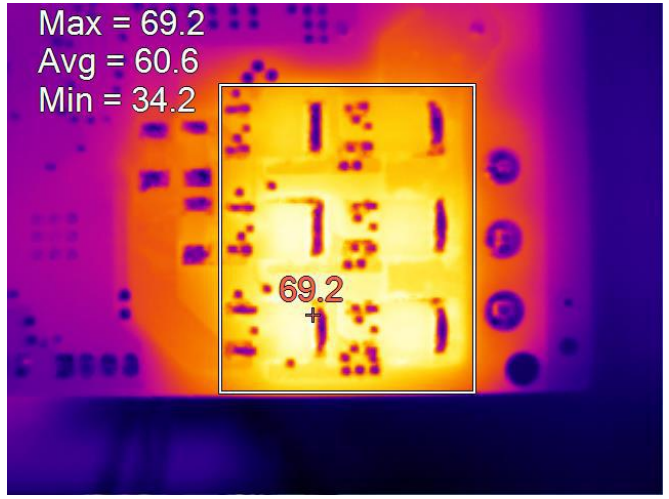
ST冰箱解决方案
能源效率

STD8N60DM2

No.	Input Voltage	Phase current	Input Power	Output power	Efficiency(%)
1	320 V	1A	224 W	219.65 W	98.06







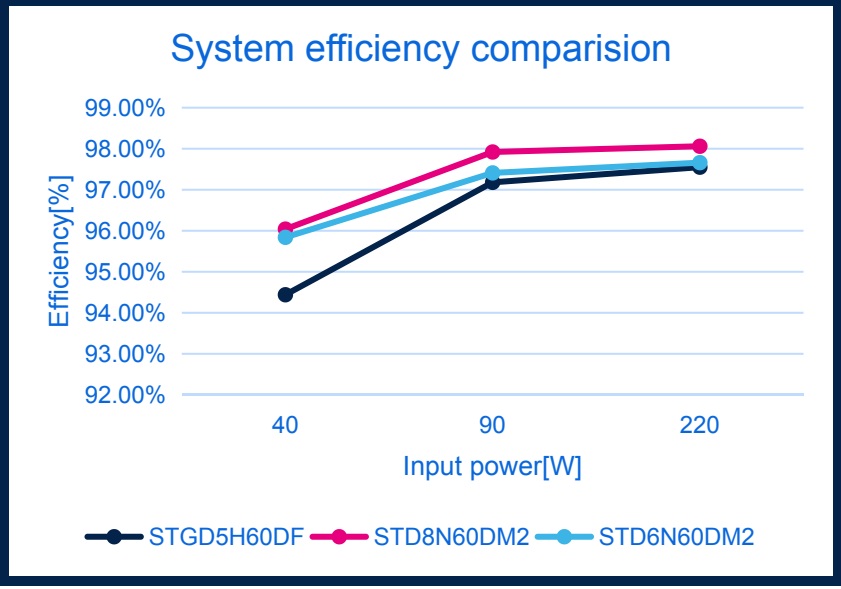
Temperature measurement at 220W steady state

Highest temperature: 69.2C

Average highest: 60.6C

STGD5H60DF & STD8N60DM2 & STD6N60DM2
Comparison at different power

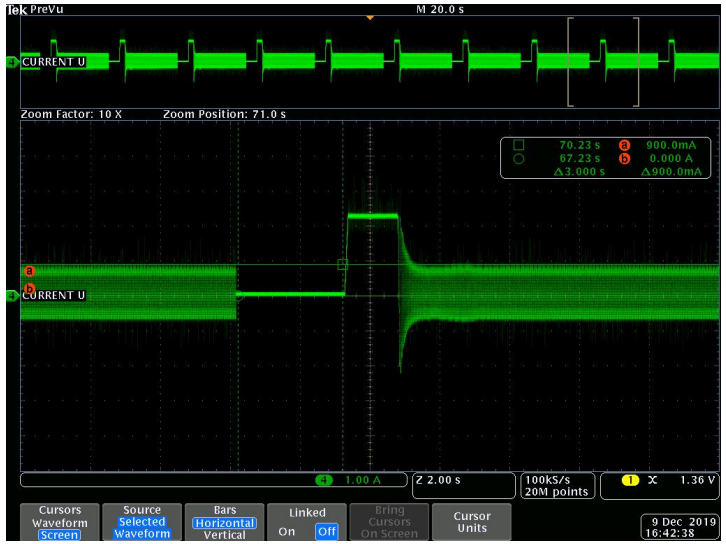
Device	Input Power		
	40[W]	90[W]	220[W]
STGD5H60DF	94.44%	97.18%	97.55%
STD8N60DM2	96.04%	97.92%	98.06%
STD6N60DM2	95.84%	97.41%	97.66%



压缩机启动可靠性

Example of performance obtained
Result is function of testing equipment

- 测试条件 电压: 220V, 环温: 22°C
  - 持续运转15 秒
  - 停止运行3 秒
  - 重复开停实验, 50万次



- 重载启动电压: 176V,环温: 22°C

6. 压缩机启动性能测试

项目	吸气表压	排气表压	电源电压	环境温度	测试结果		
平衡压启动	0.45Mpa	0.45Mpa	176V	22℃	√	√	√
背压启动	0Mpa	0.45Mpa	176V	22℃	√	√	√

速度稳定性测试
测功机

Example of performance obtained
Result is function of testing equipment

3. 电机转速稳定性测试

（1）测功机上测试，负载 0.23N.m

频率(Hz)	40	53.3	60	80	100	120	140	150
目标转速(rpm)	1200	1600	1800	2400	3000	3600	4200	4500
平均转速(rpm)	1206	1603	1807	2407	3009	3608	4211	4510
最大转速(rpm)	1208	1605	1808	2409	3011	3610	4213	4513
最小转速(rpm)	1204	1602	1806	2405	3008	3607	4209	4508
转速差(rpm)	4	3	2	4	3	3	4	5

压缩机寿命测试
ST FOC 驱动板; 500hrs

Example of performance obtained
Result is function of testing equipment

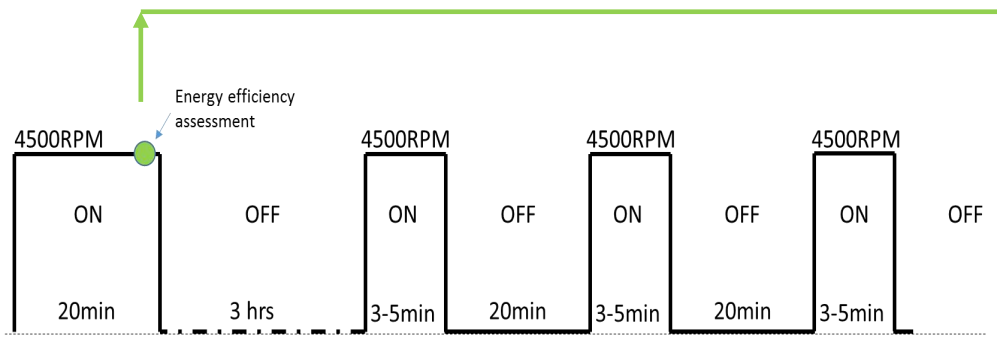
实验类型: 500h连续4500rpm 压缩机型号: L 压缩机编号: 11

项 目	试验前	试验后	试验前后差值标准	实际差值	评判
制冷量/W	86.26	86.24	下降≤ 5 %	下降 0.20 %	合格
输入功率/W	48.3	48.13	上升≤ 5 %	下降 0.35 %	合格
噪音/dB(A)	38.5	37.6	上升≤ 3 dB(A)	下降 0.90 dB(A)	合格
冷冻油色度/SH	2	6	上升≤ 11 SH	上升 4 SH	合格

Example of performance obtained
Result is function of testing equipment

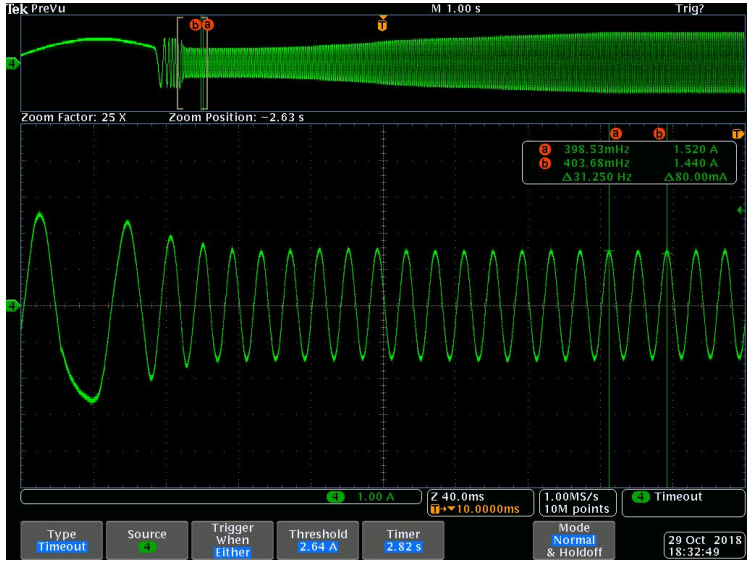
恒温室
43°C – 187V

- **Long Run, 6 fridges in parallel: PASSED**



	life.augmented	Competitor R
Power measurement at time of assessment	237 W	254 W

- **Restart test after 5 minutes stop: PASSED**



声学噪音测试 – 振动测试
消声实验室

Example of performance obtained
Result is function of testing equipment

"Fridge 1"	Target	1200	1600	2500	3300	3900	4200	4500	Avg.	Better than competitor
	分贝	**42.44	39.51	39.72	39.8	40.36	40.85	42.18	40.69	**4/7**
	加速度	992.86	451.29	839.34	710.23	722.85	892.43	922.37	790.20	**6/7**
	分贝	39.35	39.31	40.11	39.98	39.83	41.51	43.04	40.45	**3/7**
其它方案 1(Rxx)		875.52	528.53	1050	770.97	818.84	988.6	1030	866.07	1/7
"Fridge 2"										
	分贝	39.87	38.75	40.8	40.6	42.34	42.7	43.8	41.27	3/7
	加速度	2180	460	627	619	692	802	915.5	899.36	6/7
	分贝	40.38	38.44	42.8	41.11	40.76	42.59	43.14	41.32	4/7
其它方案2 (Rxx)	加速度	2040	518	705	639	888	952	933.92	953.70	1/7

ST洗衣机硬件架构

500/700W IPM - ST的IGBT Trench Gate技术 – STM32G030K6/8

保护：OC，UVLO

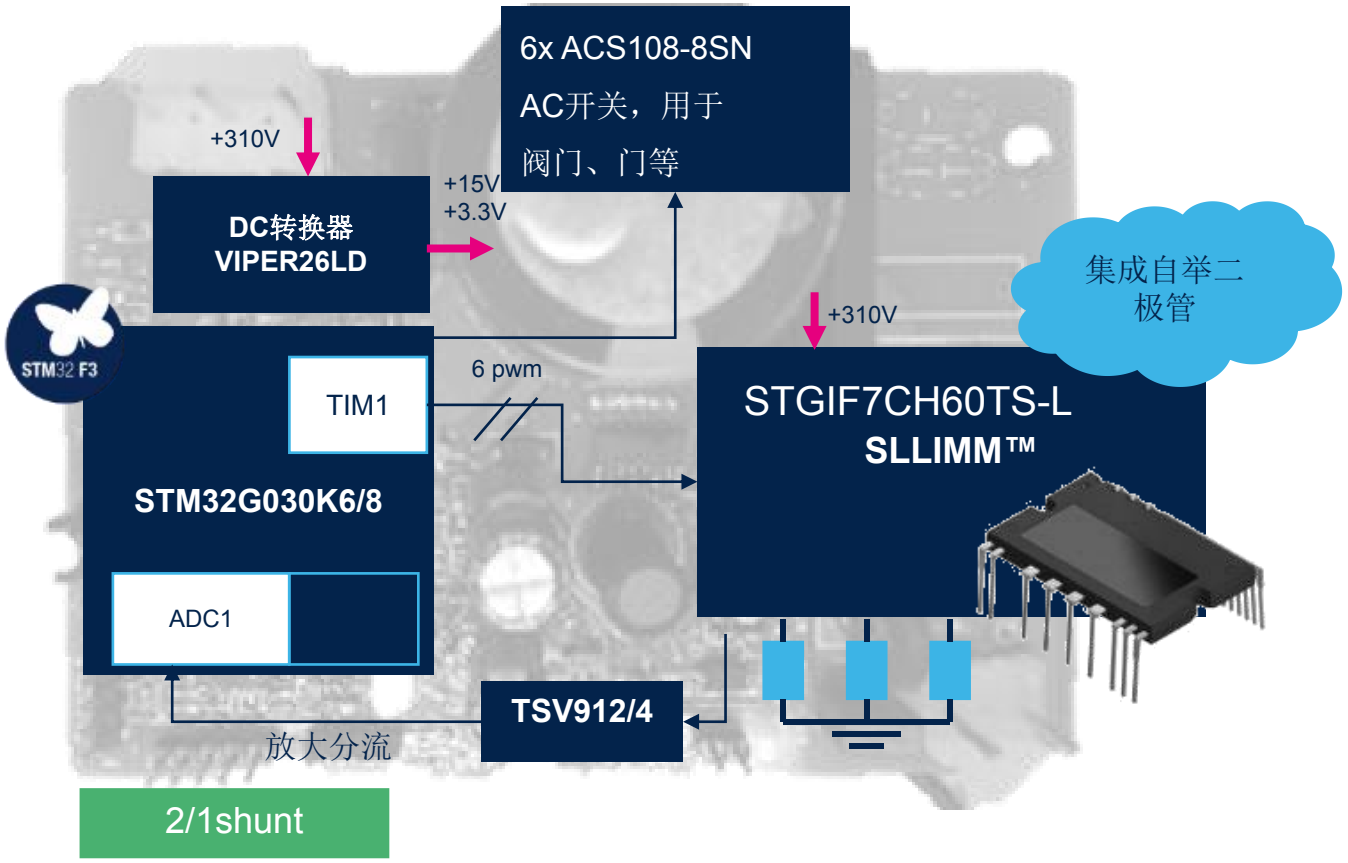
极大地减小了尺寸

开发时间短

高性能

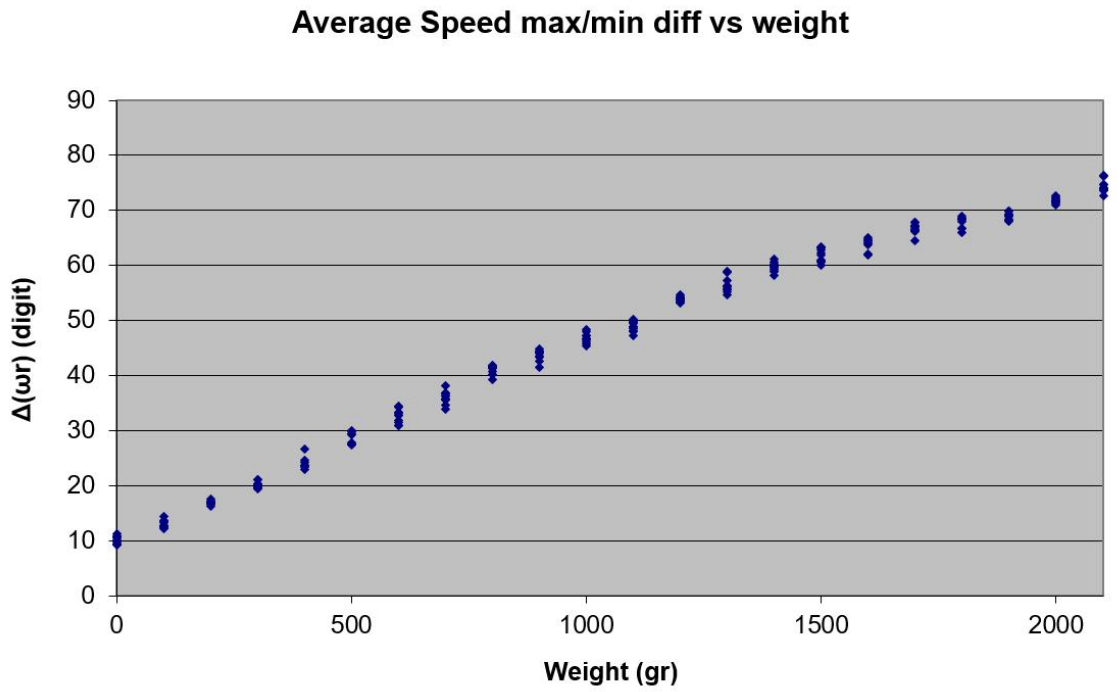
ST产品：

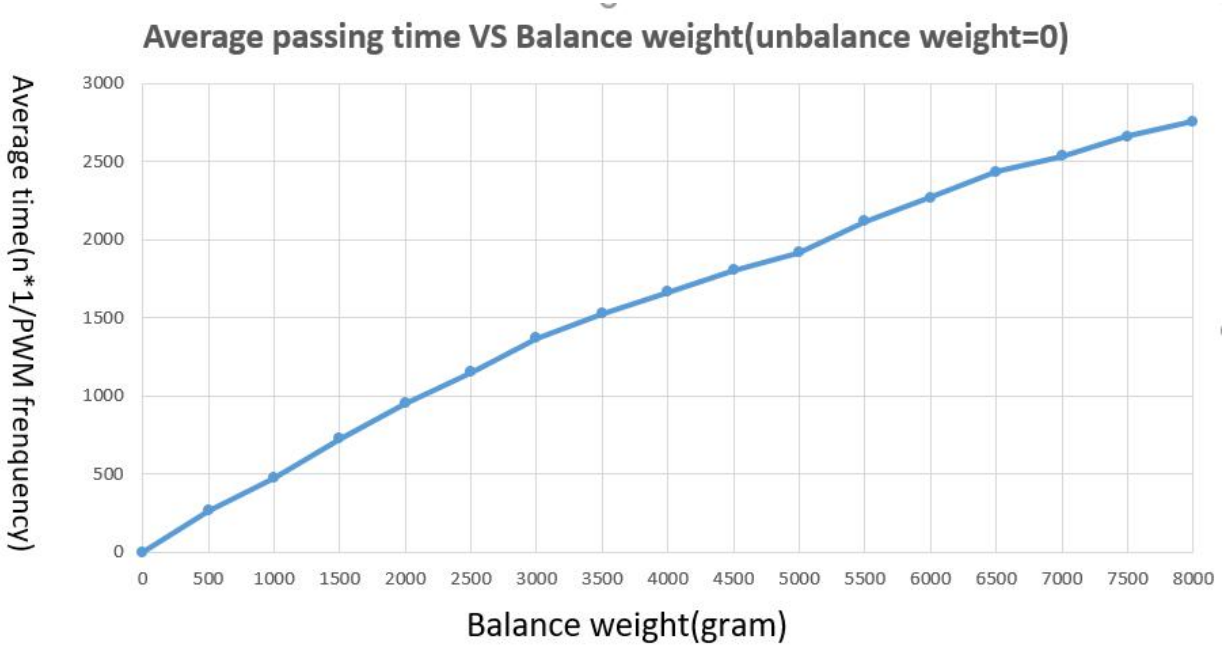
- STM32G030K6/8
- STGIF5CH60TS-L
- STGIF7CH60TS-L
- TSV912/4
- VIPER26LD
- ACS108-8SN



滚筒洗衣机称重算法

- 不平衡负载检测精度达到200g
- 整体负载精度达到500g(不平衡负载< 500g)

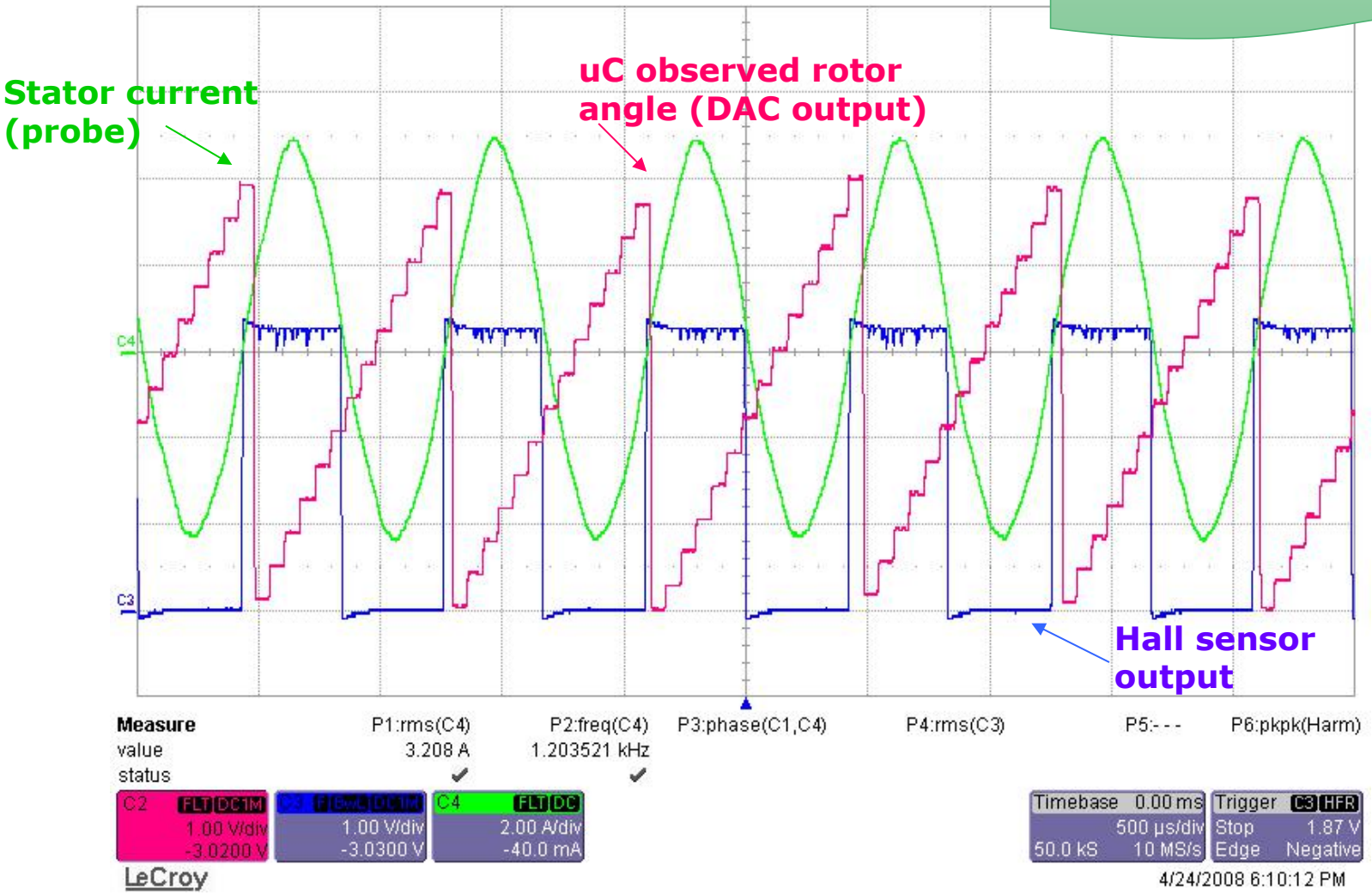




弱磁性能

- 可达5倍电机额定转速
- 每个电周期13 FOC 计算周期!

- **18045 RPM, 0.33 Nm, control freq @ 16kHz**
- AC mains: 230V, 50Hz

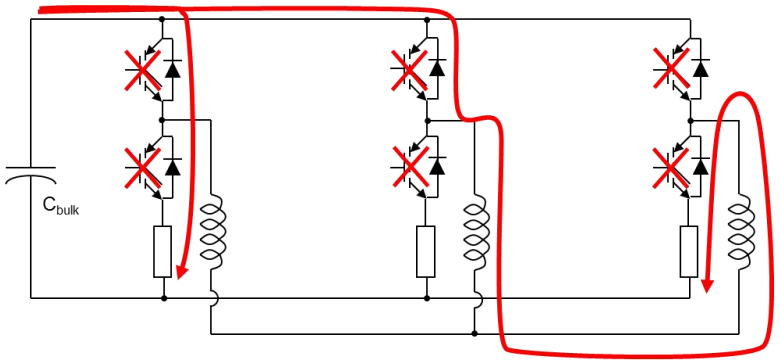


紧急事件处理

不同的行为响应不同的事件

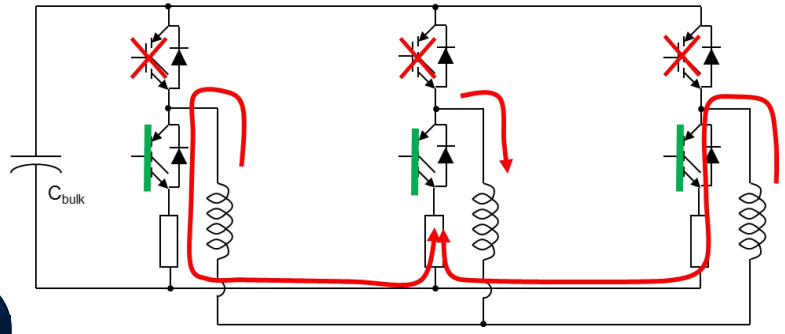
过流保护

BKIN2 → PWM TIMER



过压保护

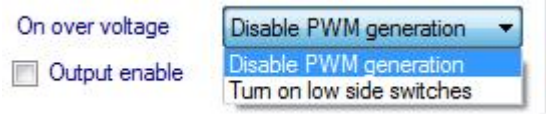
BKIN → PWM TIMER



特性

- Two different inputs programmable
- Digital filters
- Polarity
- Active on CSS, PDV, SRAM parity error, Core Hard fault

ST MC Workbench



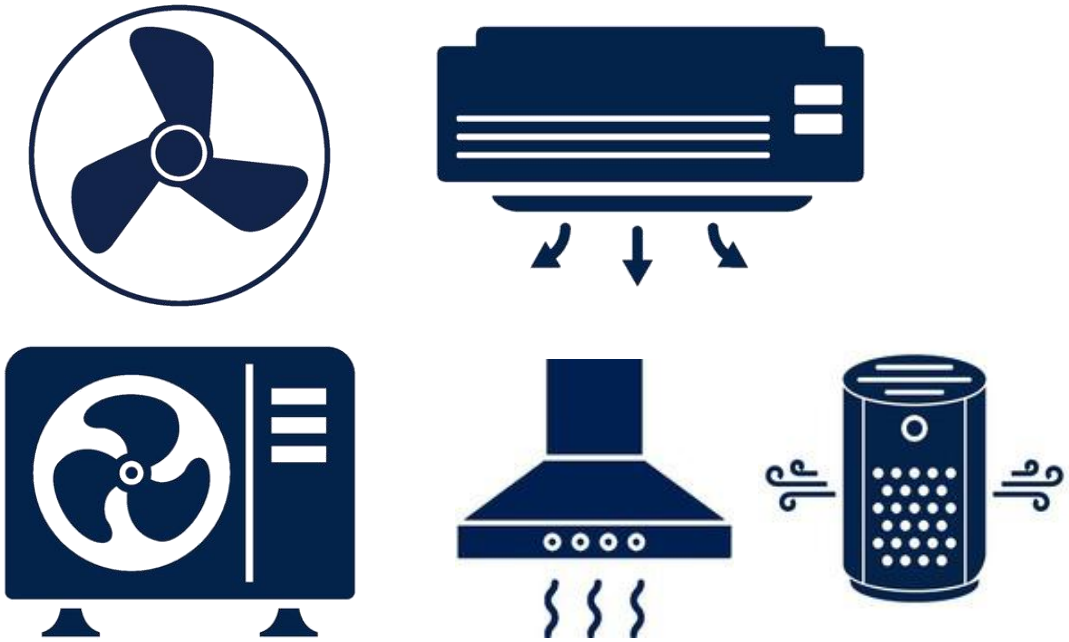
life.augmented

Motor Control Competence Center

风机类参考解决方案
室内风机, 油烟机, 吊扇, 工业风机等.

主要特性

- 全速度范围运行的风机驱动解决方案
  (空调室外风机、室内风机, 风扇, 吊扇, 工业风扇)
- 初始位置检测Initial Angle Detection (IAD)
- 带BEMF检测的顺风、逆风启动 (32ms)
  电频率可到1.6HZ
- 100% 成功率 - 30万次 顺风、逆风启动
- 反转刹车制动
- 降低听觉噪音



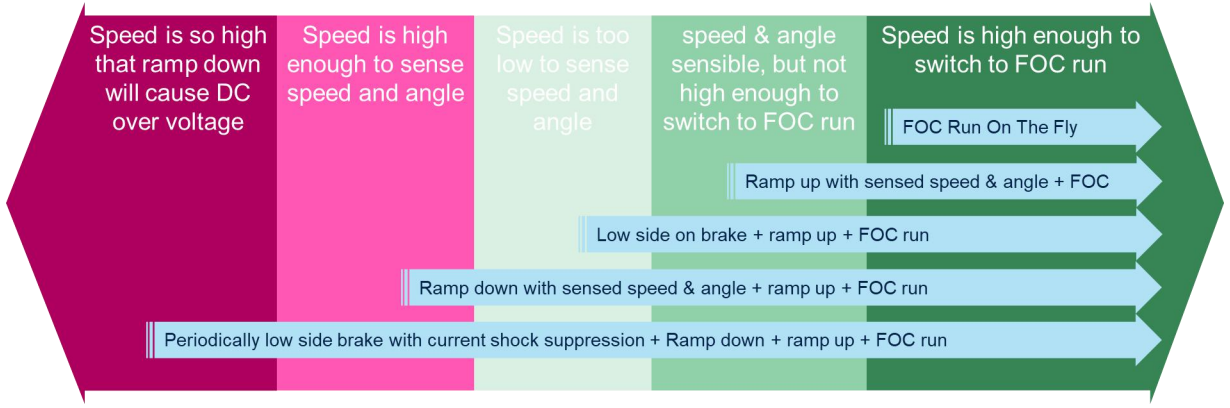
(12) **United States Patent**
Costanzo et al.

(10) **Patent No.: US 8,816,616 B2**
(45) **Date of Patent: Aug. 26, 2014**

(54) **METHOD OF CONTROLLING A THREE-PHASE PERMANENT MAGNET SYNCHRONOUS MOTOR FOR REDUCING ACOUSTIC NOISE**

FOREIGN PATENT DOCUMENTS

EP	1870680	12/2007	G01D 21/02
EP	2012425	1/2009	H02P 21/00

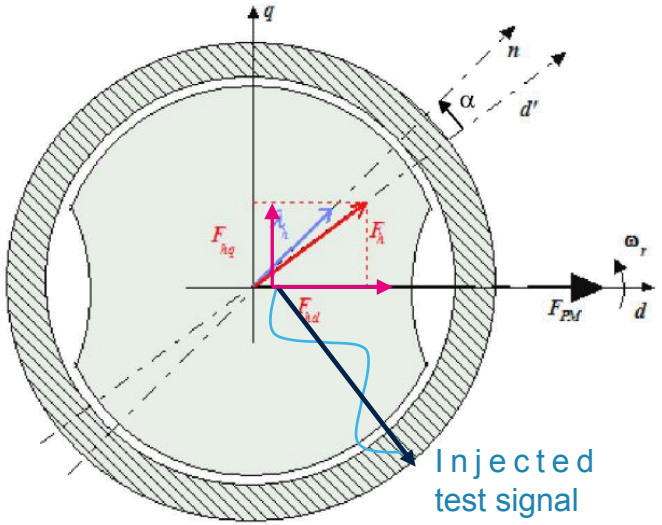


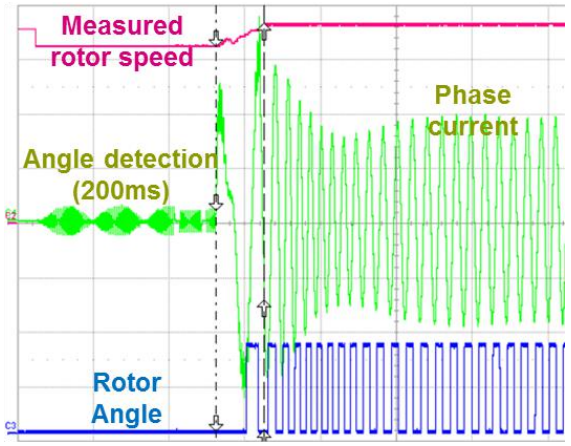
life.augmented

高频注入无传感器算法

- ST 专利算法 “HFI”, 可以通过连续扫描I-PMSM电机的磁场的凸极特性， 在低速和零速时发挥出全部力矩.

- 在d-q坐标系一个假定的位置, 沿着假定的d’轴注入一个高频 (200Hz-1kHz) 正弦测试信号 (电压或电流)





- 产生力F_h; 由于转子的凸极特性，d轴方向上的磁阻R_d大于q轴方向上的磁阻R_q， 可以得到F_{hd} (在实际d轴上的分量) 大于F_{hq}（在实际q轴上的分量）

- 产生的结果是, 所产生的磁场λ_h 方向和F_h的方向之间出现一个相位移角α, 和一个小的分量（λ_h 在q’轴上）
  → 磁偏差

(12) **United States Patent**
Costanzo et al.

(10) Patent No.: US 9,325,263 B1
(45) Date of Patent: Apr. 26, 2016

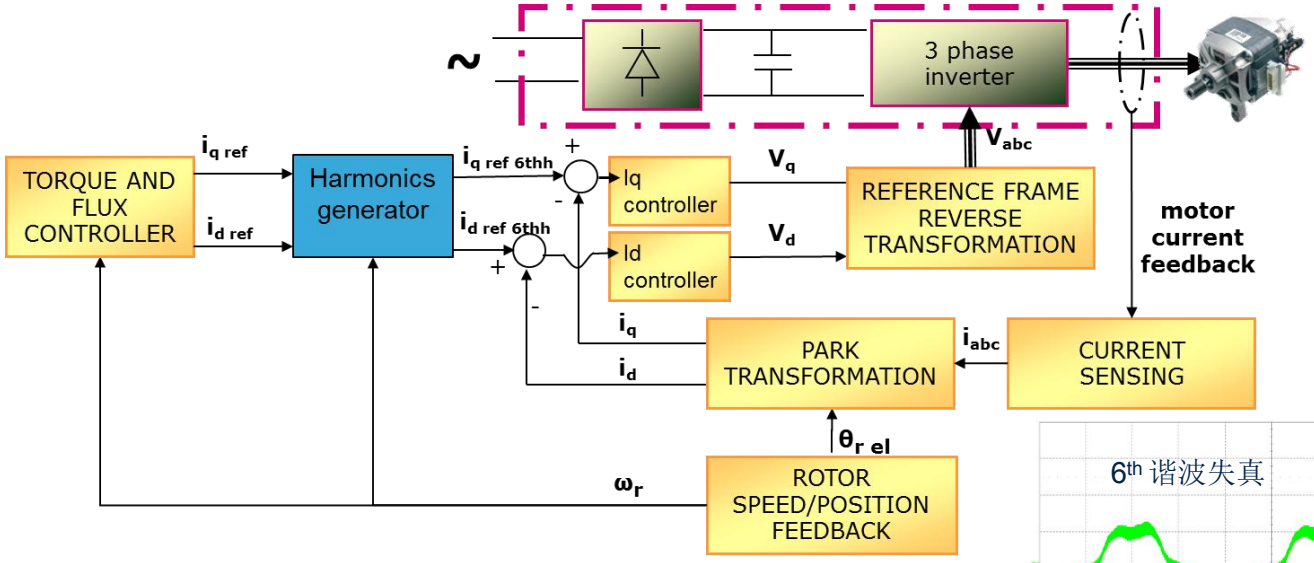
(54) SENSORLESS ROTOR ANGLE DETECTION

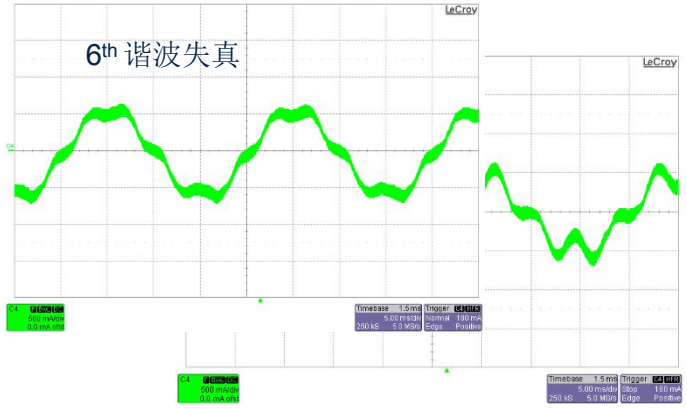
SPEEDAM 2008, International Symposium on Power Electronics,

life.augmented

听觉噪声减少 (风机 / 泵 / 压缩机 等)

- 为了减少听觉噪声， 可以注入五次和七次谐波参考量到电机相电流中来抵消六次谐波转矩波动
- 根据如下框图（ST 专利），在PARK变换参考系中，足以产生一个基于电机电气频率的六次谐波





(12) **United States Patent**
Costanzo et al.

(10) Patent No.: US 8,816,616 B2
(45) Date of Patent: Aug. 26, 2014

(54) METHOD OF CONTROLLING A THREE-PHASE PERMANENT MAGNET SYNCHRONOUS MOTOR FOR REDUCING ACOUSTIC NOISE

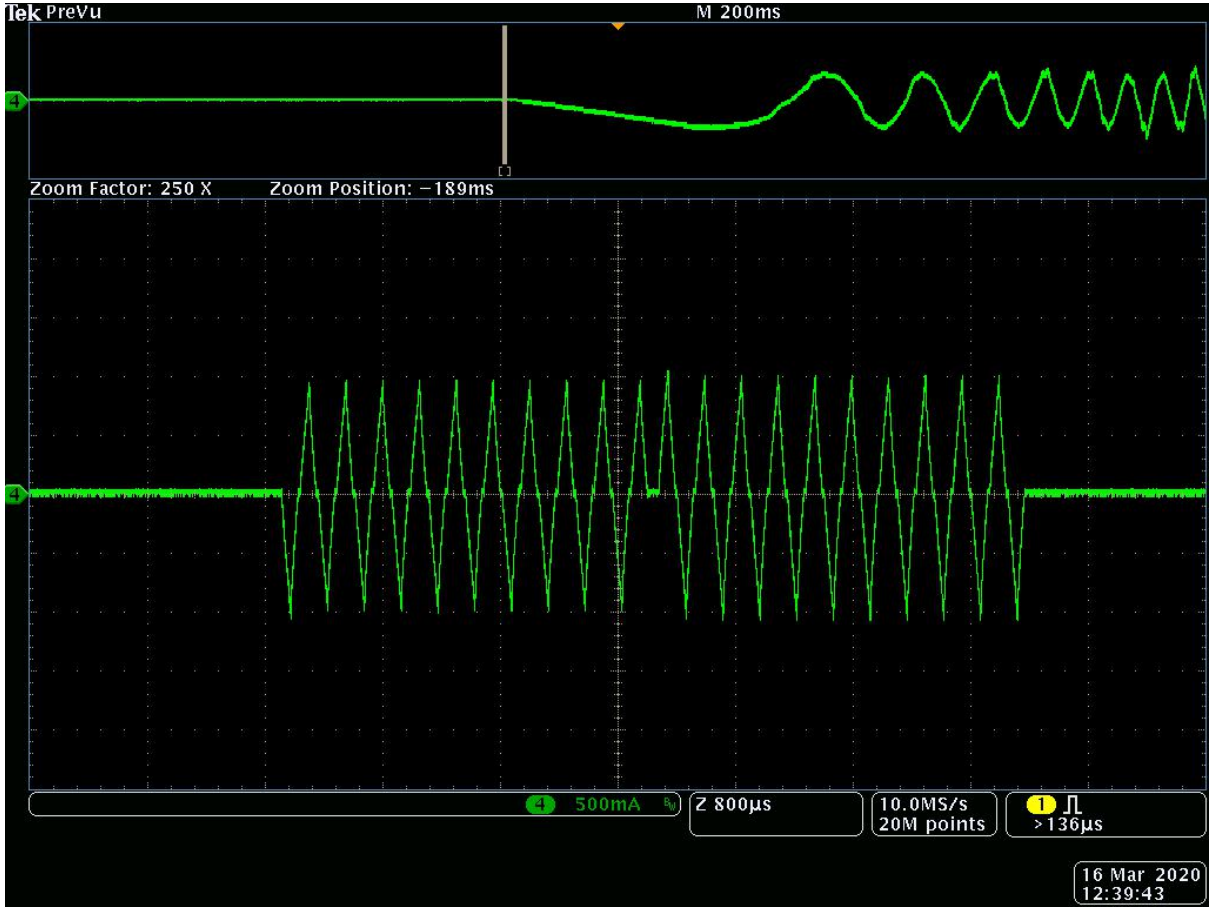
FOREIGN PATENT DOCUMENTS

EP	1870680	12/2007	G01D 21/02
EP	2012425	1/2009	H02P 21/00
EP	2043255	4/2009	H02P 21/00

初始位置检测IAD (initial angle detection)

- 在静止和极低的速度下，几十毫秒可以得到转子的初始位置（角度），电机启动时不需要定位，不会出现逆转
- 应用场合（无感）：

  1. 启动时不允逆转、定位：吊扇、风扇、ATM等
  2. 快速启动：风扇类、制冷类（压缩机)等



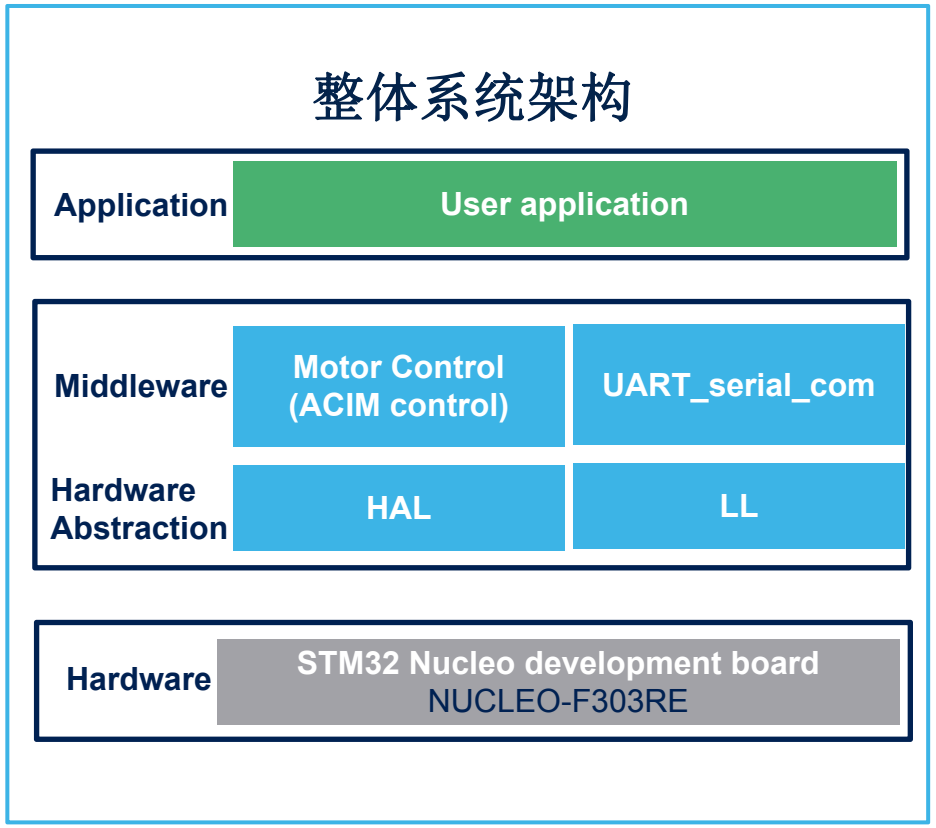
矢量和标量控制软件感应电机软件概述

ACIM SDK 描述

- ACIM SDK 是一个基于交流感应电机开发应用的软件库. 这个库包含了一个驱动高压感应电机的应用实例，基于NUCLEO-F303RE 和 STEVAL-IPM10B 的硬件评估平台(连接部分使用 X-NUCLEO-IHM09M1扩展板)
- 基于**X-CUBE-MCSDK**但不是其中的一部分

主要特征

- 基于STM32 F3的感应电机方案
- 高性能的矢量控制驱动方式
  - 带速度传感器的FOC控制 (I-FOC)
  - 自检测的FOC控制 (LSO-FOC)
- 高性价比的标量控制驱动方式
  - 开环 V/f 控制
  - 闭环 V/f 控制
- 使用ST 电机控制 Workbench 工具生成由应用调配的API函数来与电机驱动底层进行交互
- 提供图形化的软件配置器来配置感应电机的专用参数(**ACIM GUI**)



电机控制硬件板

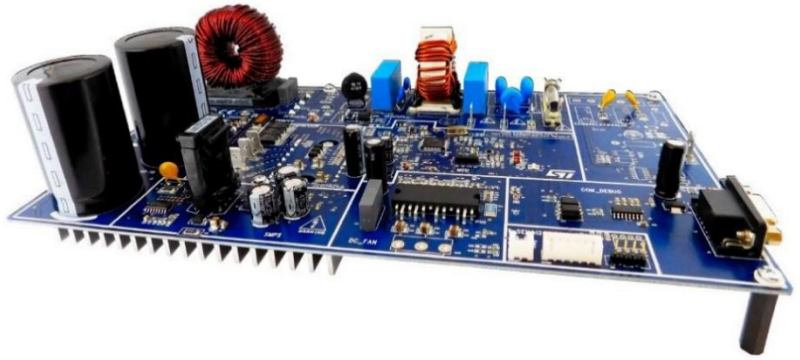
Control + Power

Eval/Nucleo + Power/Expension

Control stages

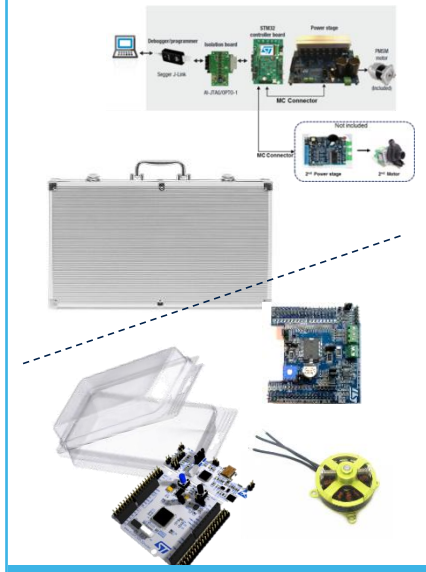
Power stages

Inverter (Complete Drive)



STEVAL-CTM010V1

MC Kits



P-NUCLEO-IHM001 IHM002 or IHM03

life.augmented

MC套件

板上ST-Link

硬件板
电机控制套件

P-NUCLEO-IHM001 , IHM002或IHM03

Support: FOC & 6-step

- 低成本MC套件
  - 可以评估BLDC电机控制应用（高达36V，1.4 A rms）的STM32
- 内容：
  - NUCLEO-F302R8
    - 基于STM32F302的微控制器板
  - X-NUCLEO-IHM07M1
    - 基于L6230的驱动器板
- BLDC电机

STM32 F3 series

- 低成本MC套件
  - 可以评估BLDC电机控制应用（7~45V，1.5 A rms）的STM32
- 内容：
  - NUCLEO-G431RB
    - 基于STM32G431的微控制器板
  - X-NUCLEO-IHM16M1
    - 基于STSPIN830的驱动器板
  - BLDC电机

STM32 G4 series

life.augmented

life.augmented

扫描以下二维码
获得功率及模拟产品更多资讯

PDSA 微信公众号

能以致动子网站

谢谢您的参与

© STMicroelectronics - All rights reserved.
The STMicroelectronics corporate logo is a registered trademark of the STMicroelectronics group of companies. All other names are the property of their respective owners.

life.augmented