BLDC 控制
基于XMC1300&APP

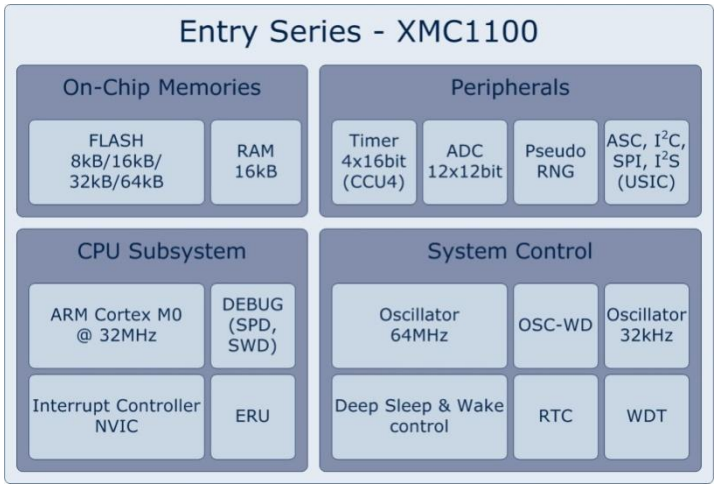
2014英飞凌XMC 微控制器巡回研讨会

infineon

内容

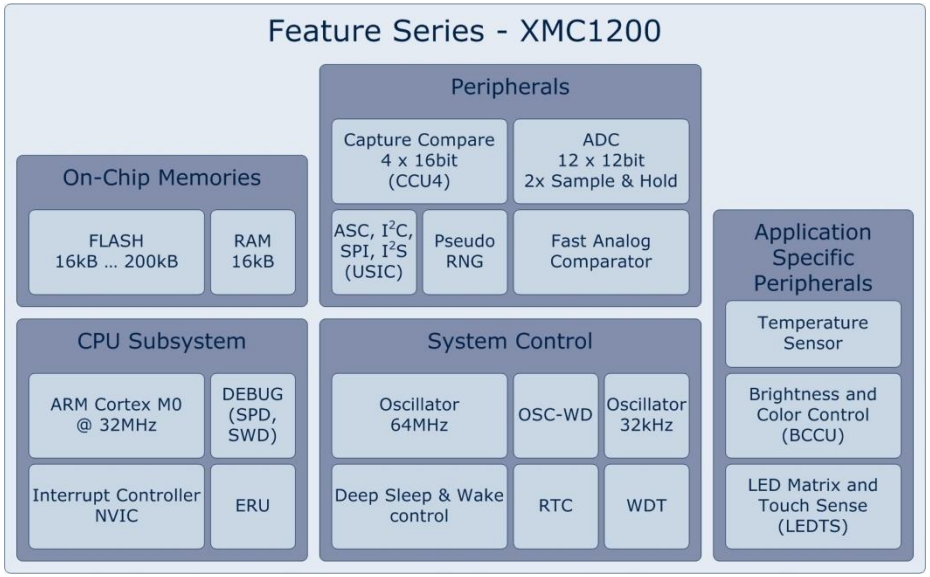
- XMC1300介绍 --- 电机控制相关模块
- BLDC APP使用方法 --- BLDC 3 Hall APP

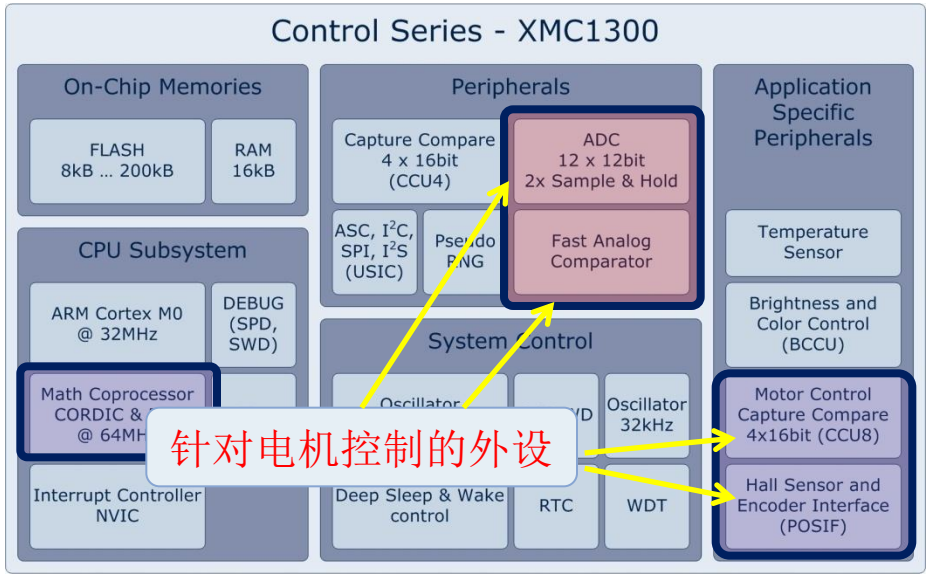
XMC1000系列结构介绍



XMC 1000

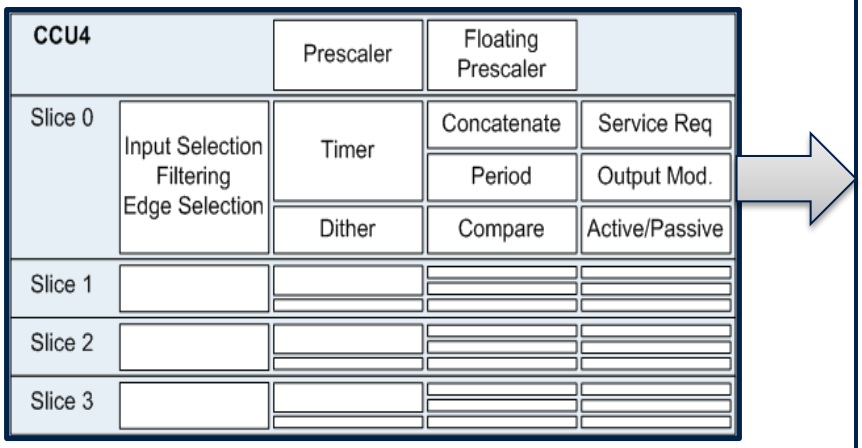
- Entry Series: XMC1100
- Feature Series: XMC1200
- **Control Series: XMC1300**





捕获比较单元4 (CCU4)

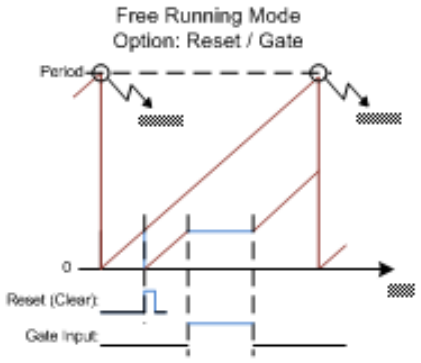
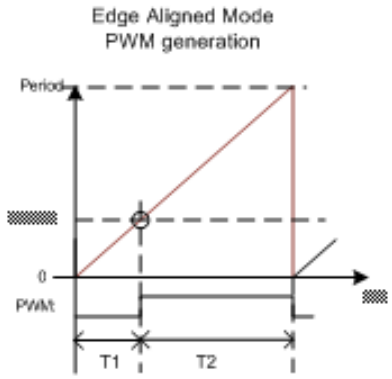
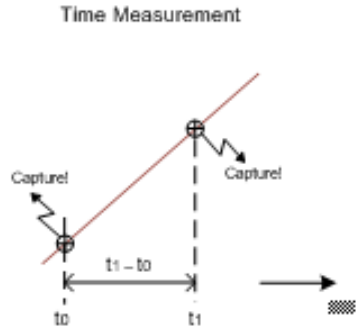
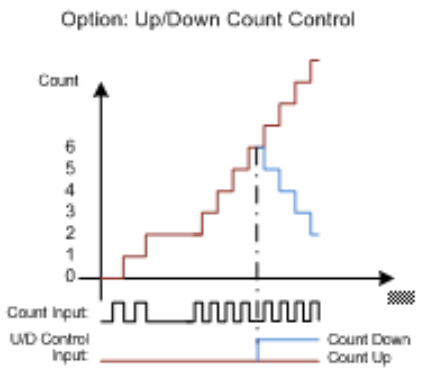
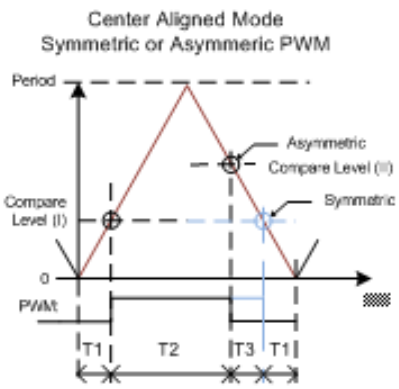
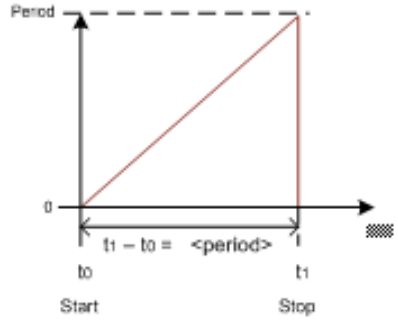
- CCU4
  - 多功能16位定时器组
  - 4 个完全相同、独立运行的子单元
  - 支持定时、比较、捕获操作



- 每个子单元（Slice)包含:
  - 1个16 位定时器
  - 独立的预分频器
    - 支持动态分频
  - 4个捕获寄存器
  - 1个比较寄存器（PWM）
    - 1 路PWM输出
    - 支持抖频控制
  - 16路的外部信号输入
  - 定时器级联单元
  - 灵活的中断生成
  - 信号输出调制

捕获比较单元4 (CCU4)

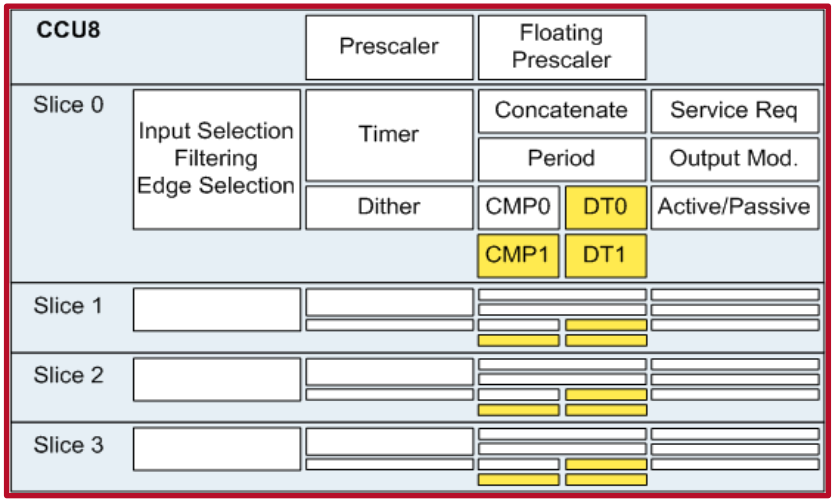
- 灵活的功能配置

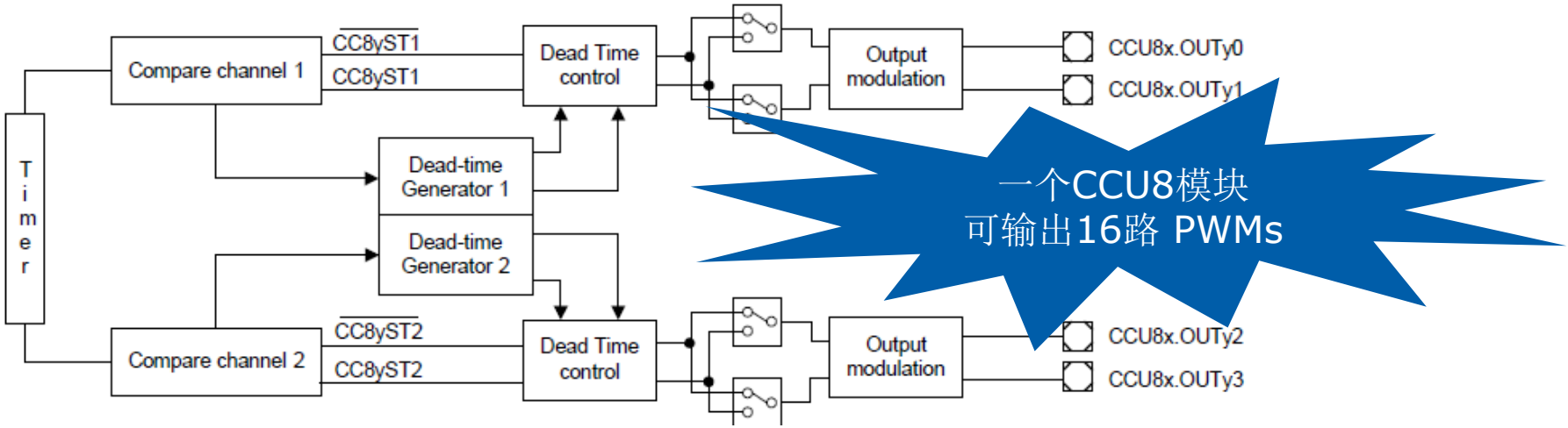
计时功能	比较功能	捕获功能
		
计数功能	**比较功能**	**单次工作**
		

捕获比较单元8 (CCU8)

- CCU8 = CCU4++
  - 集成CCU4所有功能
- 与CCU4相比，每个子单元包含
  - 两路比较单元
  - 四路PWM输出（共两对）
  - 两个死区时间生成单元

（ different for rising & falling edge ）

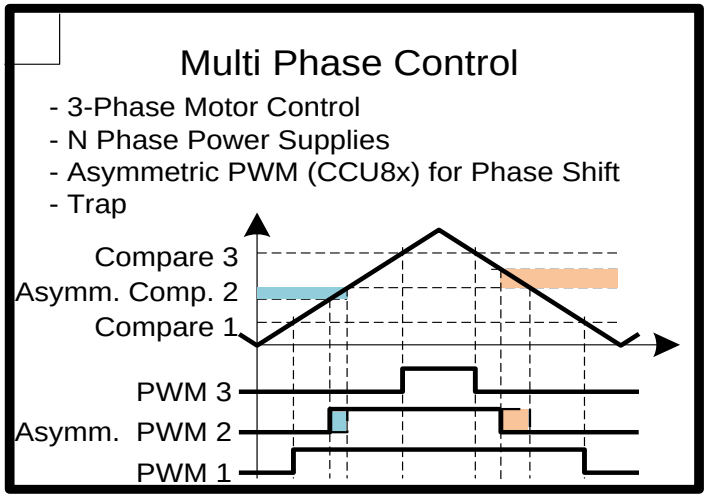




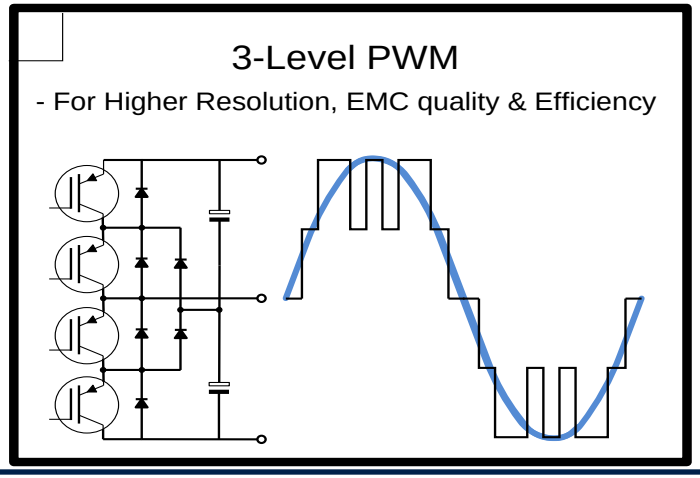
捕获比较单元8 (CCU8)

- CCU8 特色
  - 灵活的比较模式，支持不同形式的PWM生成
    - 对称/非对称PWM，单次/连续PWM，灵活死区时间生成
  - 丰富的比较通道，满足常见的各种应用的需要
    - 半桥、三相全桥、三电平控制等

- 非对称 PWM生成

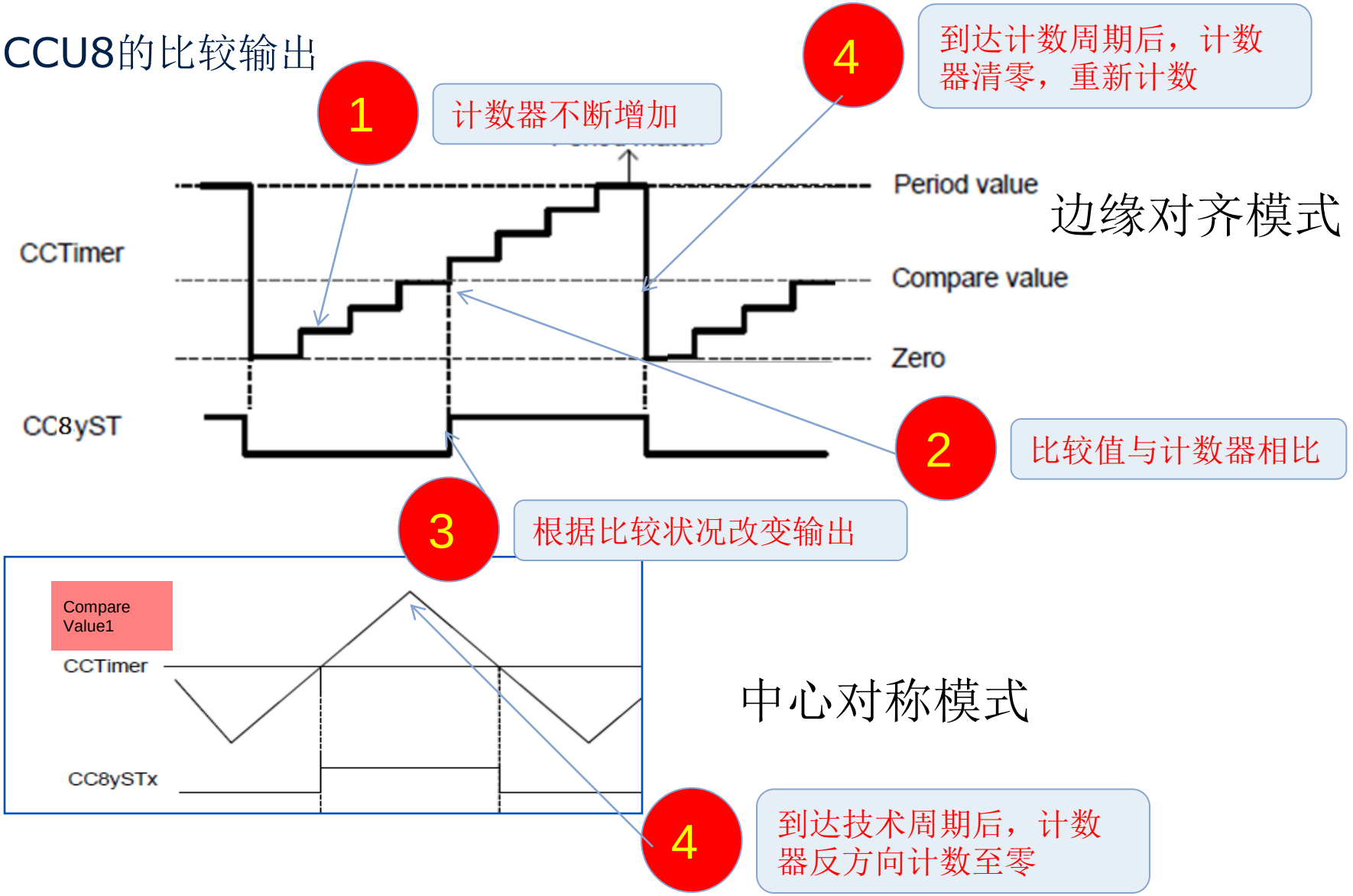


- CCU8 - 业内唯一可直接驱动三电平拓扑的PWM单元



捕获比较单元8 (CCU8)

- CCU8的比较输出

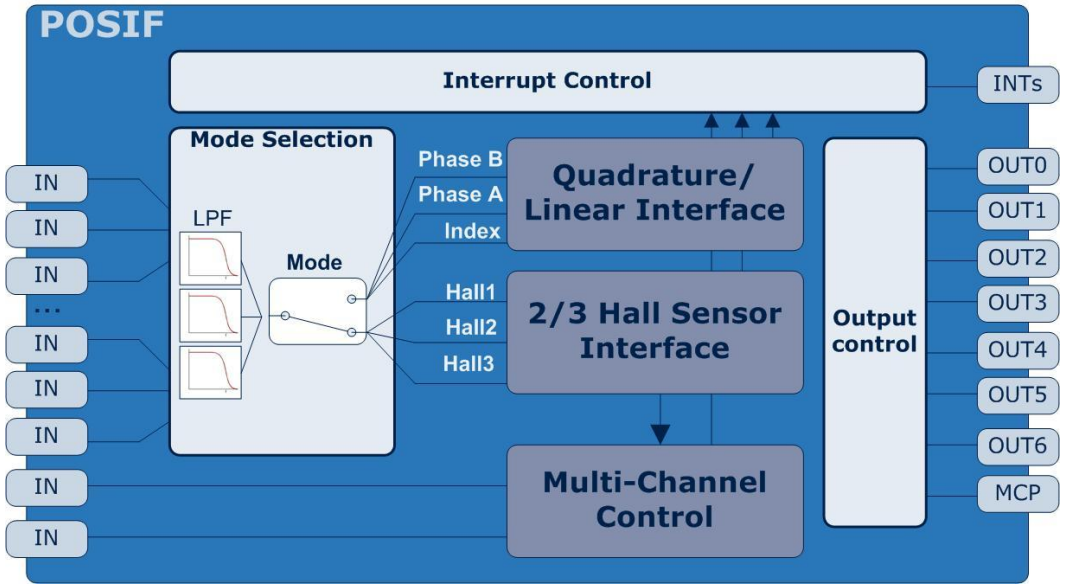


边缘对齐模式

中心对称模式

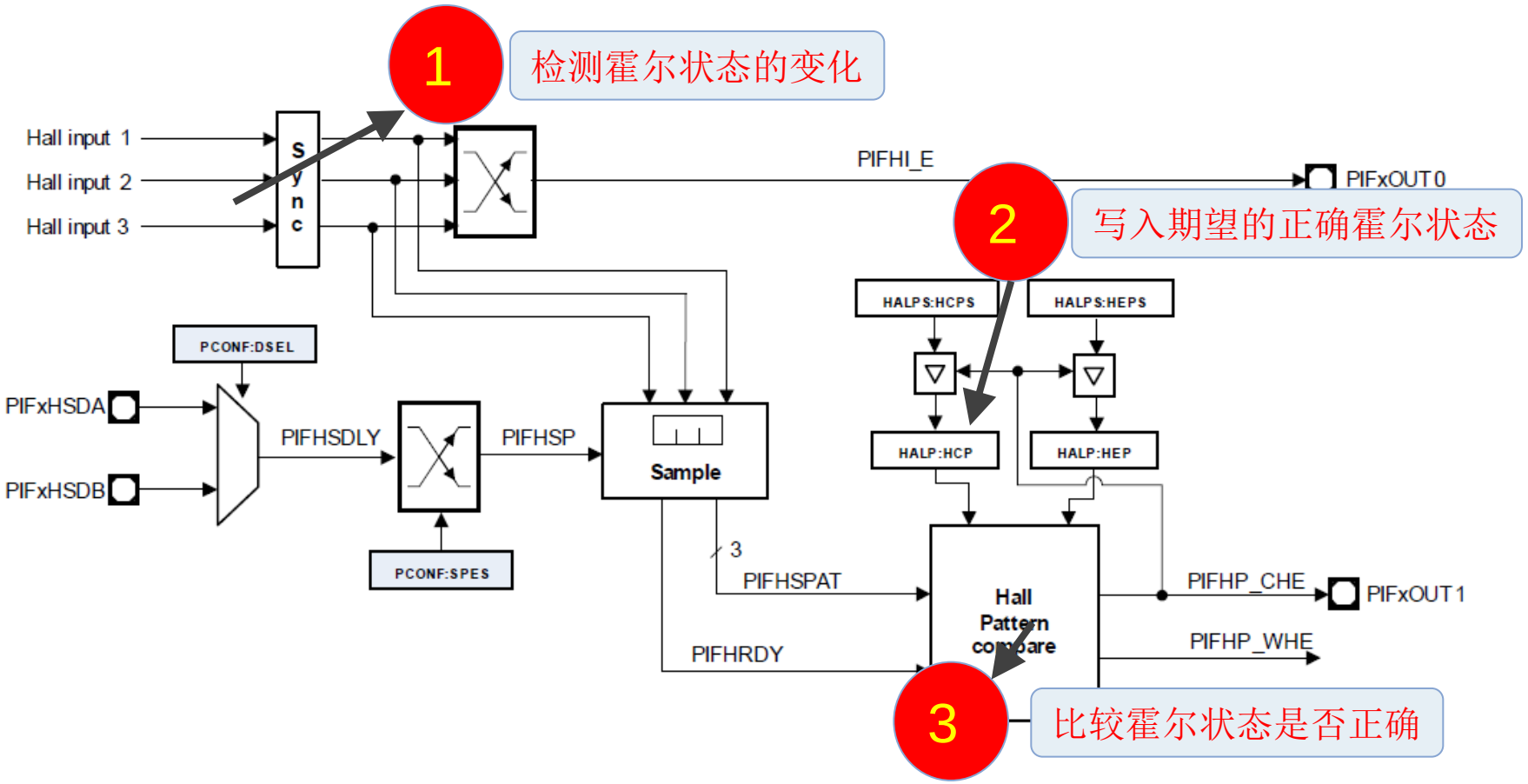
位置传感器接口(POSIF)

- 电机位置信息接口单元
- 工作模式
  - 增量编码器模式
  - 霍尔传感器模式
  - 多通道模式
- 支持输入信号滤波
- 与CCU4/8配合以实现
  - 位置检测
  - 速度捕获
  - BLDC控制
  - ...



POSIF（霍尔传感器模式）

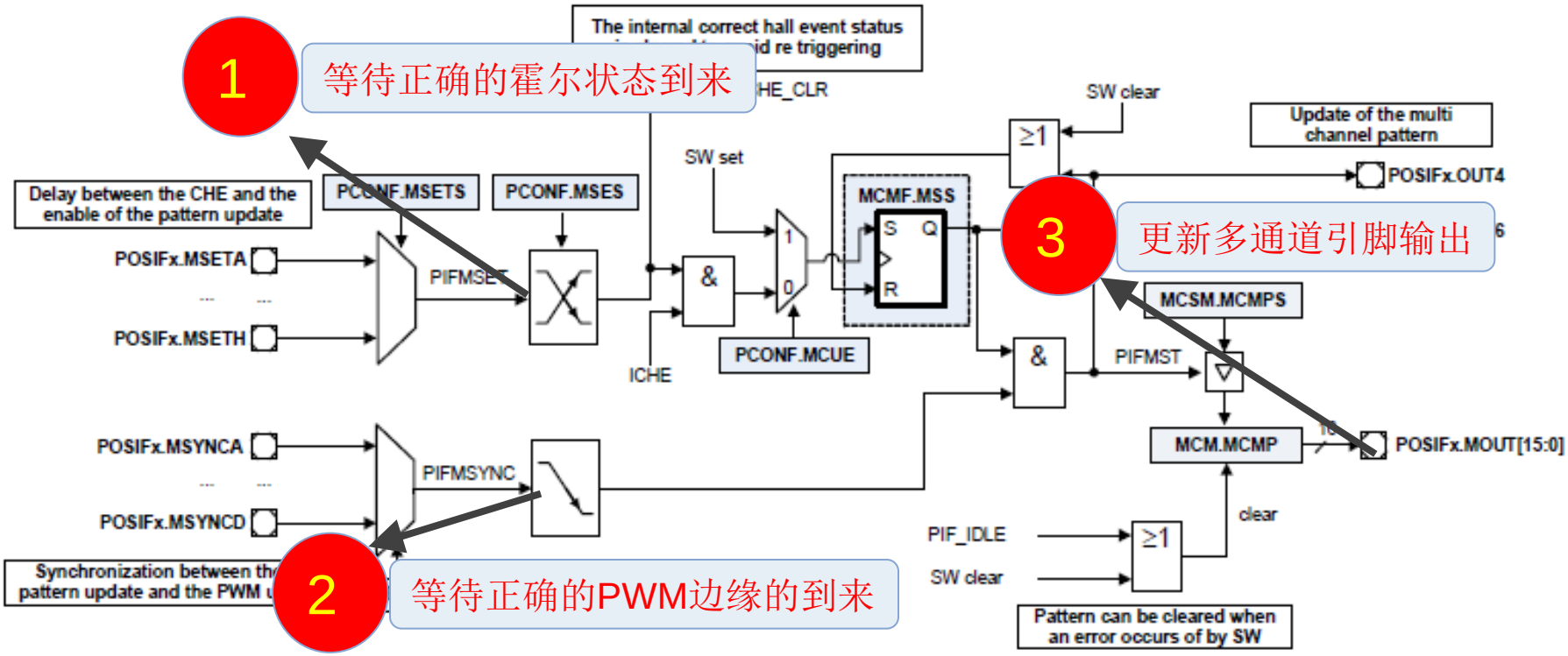
- POSIF的霍尔传感器模式可以检测3个霍尔的变化，并根据直流无刷电机6步工作模式下霍尔状态的变化，确定电机是否正确工作。



POSIF（多通道模式）

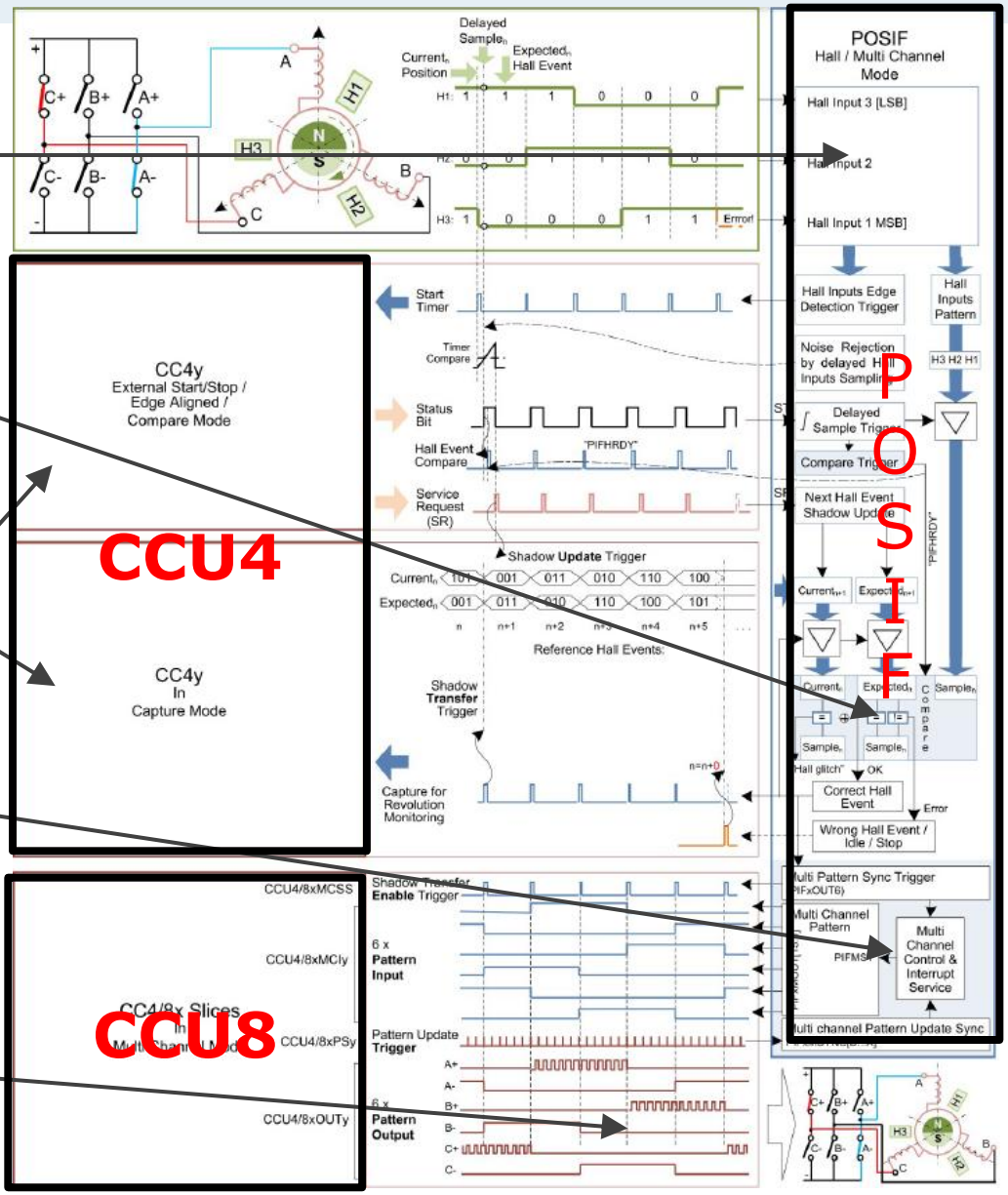
- POSIF的多通道模式用于连接霍尔正确状态输出和CCU8的通道使能。

  可用于在直流无刷电机6步工作模式下根据霍尔状态更新各个桥臂的导通状态。

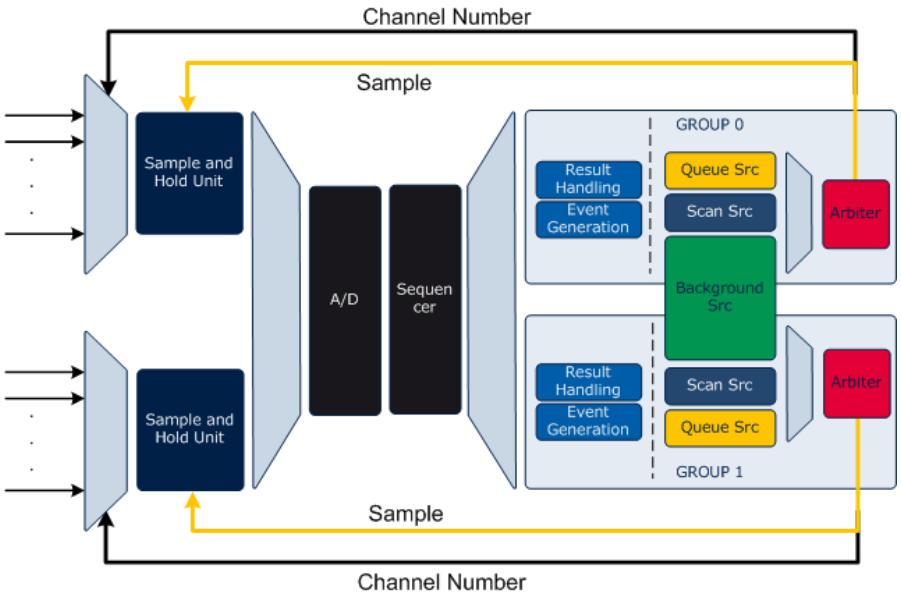


CCU8、CCU4和POSIF应用于直流无刷电机驱动举例

1. POSIF检测霍尔变化
2. POSIF判断霍尔状态
3. 通过CCU4进行速度计算
4. POSIF更新多通道输出状态
5. CCU8控制各个桥臂导通状态

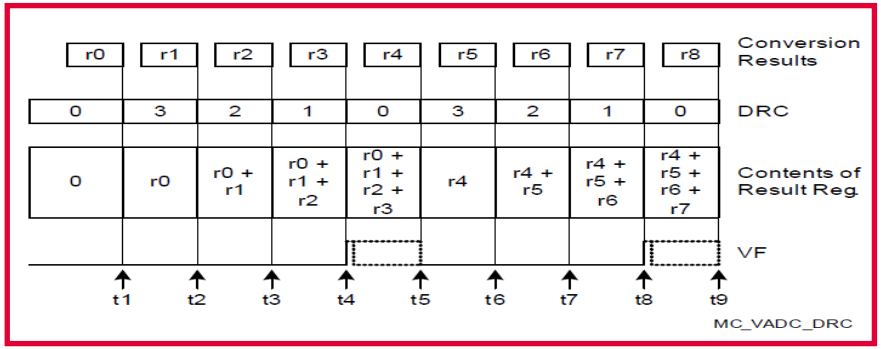


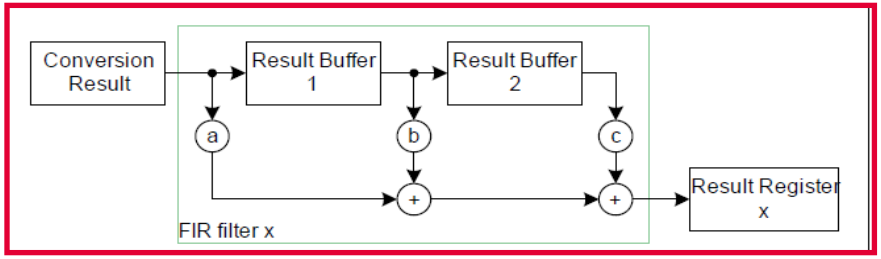
VADC – 多功能模数转换器

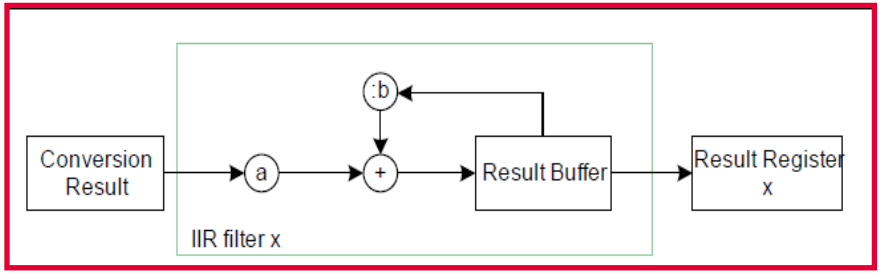


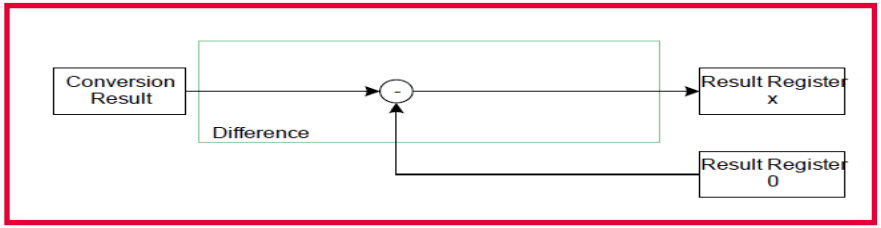
- 多功能ADC模块
  - 12通道，8/10/12位可选ADC
  - 双采样保持单元（双通道同时采样）
    - XMC1200/1300
  - 高转换速
    - 1.28MSPS calibrated
    - 1.88MSPS un-calibrated
  - 增益可调
    - 1x, 3x, 6x, 12x
  - 多种转换请求方式
    - 队列，扫描，Background
  - 灵活的硬件触发机制
    - PWM, I/O 等等
  - 丰富的中断资源

VADC – 多功能模数转换器



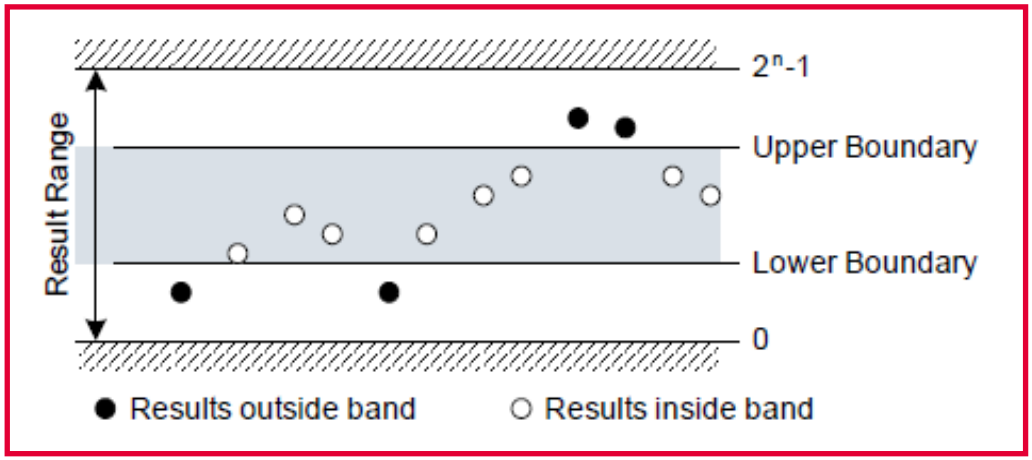






- 16级结果FIFO
- 数据累加模式
- FIR模式
- IIR模式
- 差分模式

VADC – 多功能模数转换器



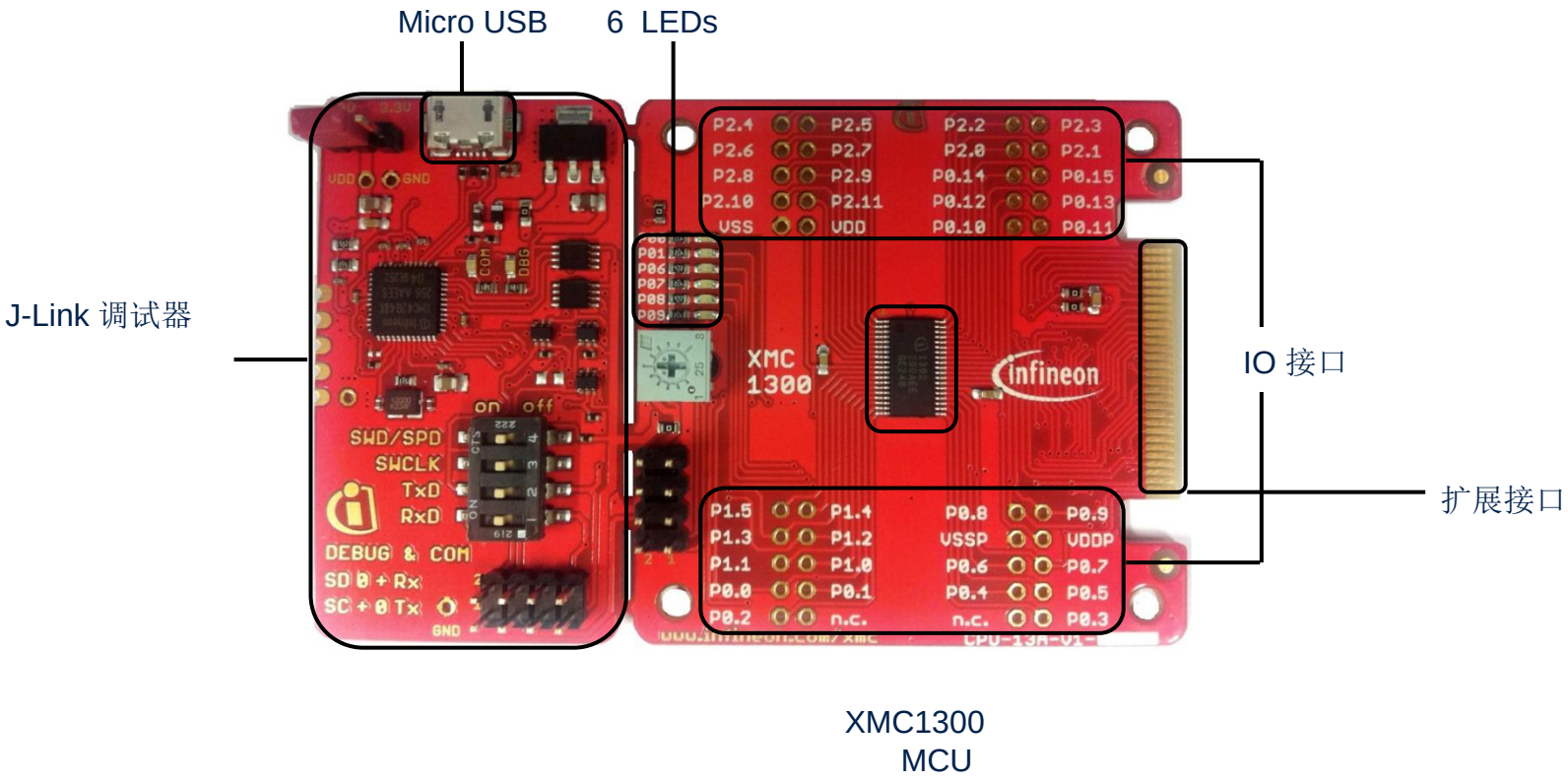
- 快速比较模式
- 结果边界比较模式

内容

- XMC1300介绍 --- 电机控制相关模块
- BLDC APP使用方法 --- BLDC 3 Hall APP

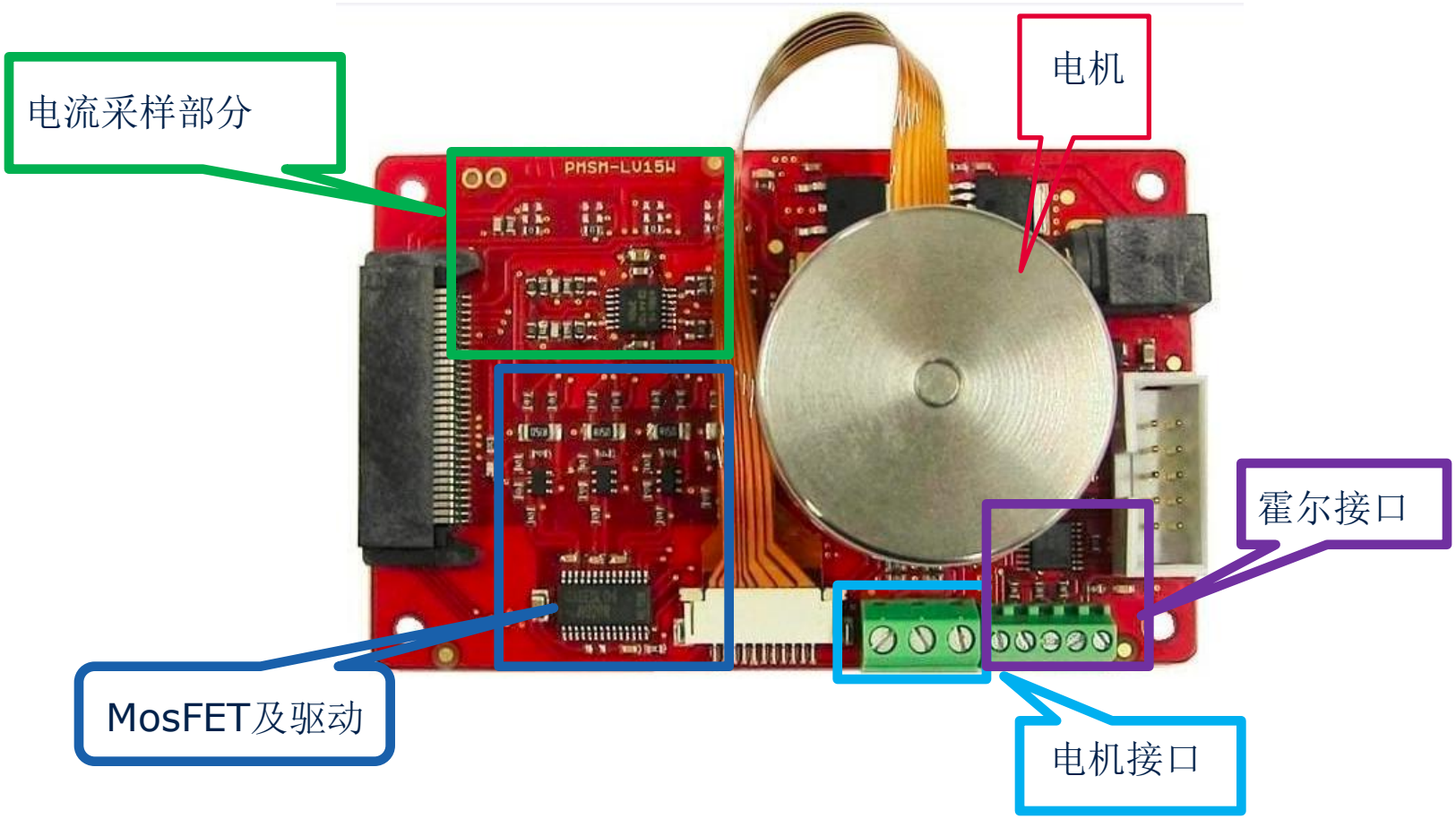
电机驱动板组件

XMC1300 Kit板



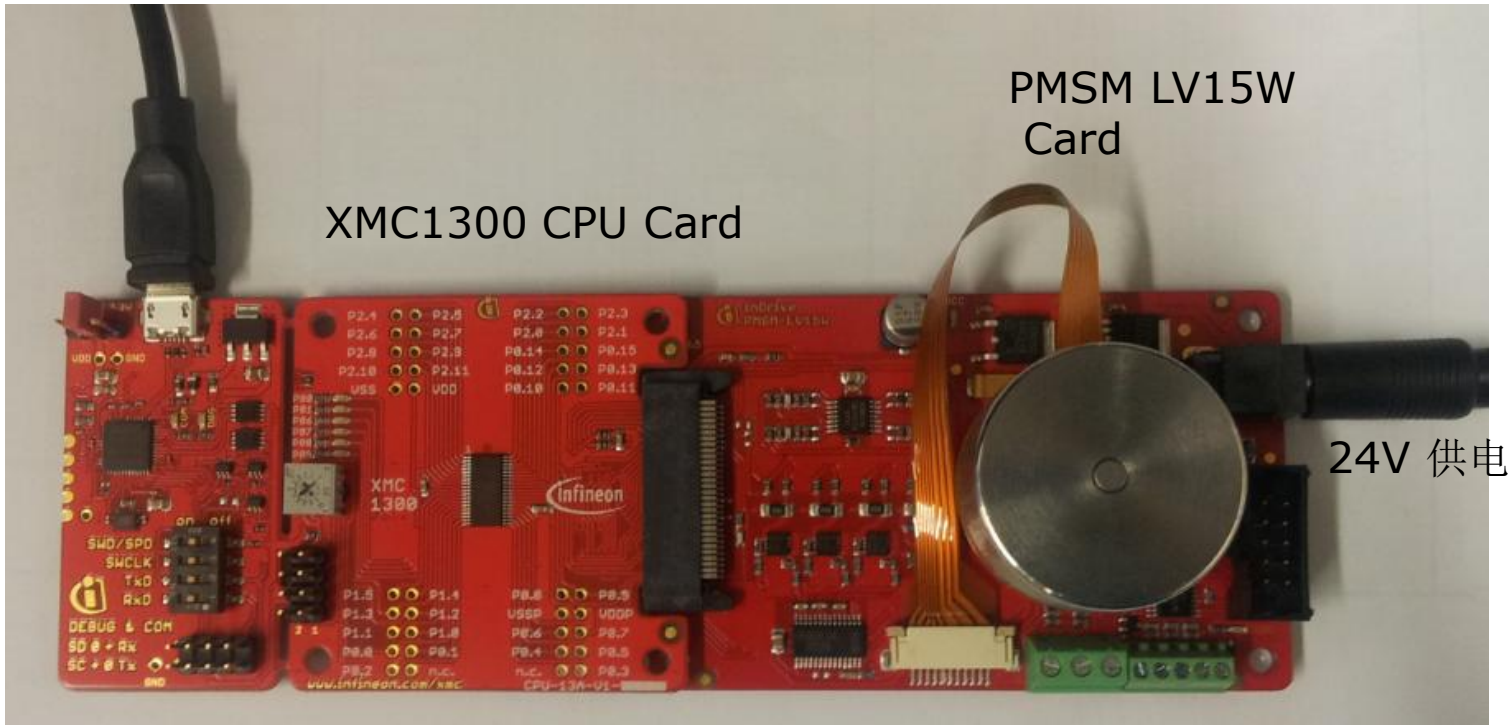
电机驱动板组件

- 电机驱动板

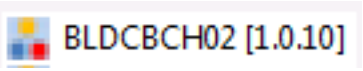


组件连接

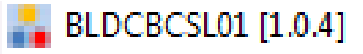
连接到PC



BLDC 控制APP

- 基于XMC1300， Infineon推出了以下APP支持BLDC电机驱动
  - 

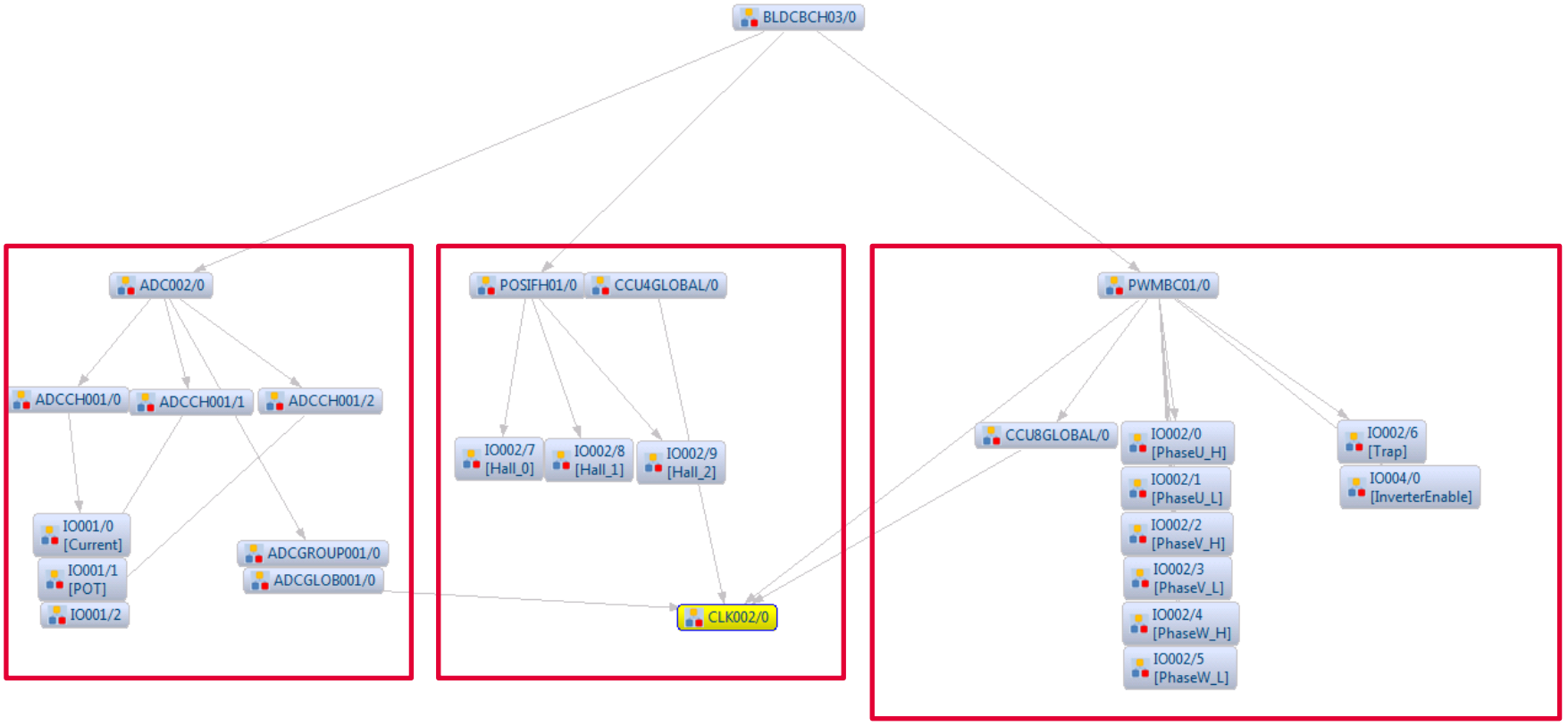
    支持双霍尔传感器的BLDC控制
  - 

    支持3霍尔传感器的BLDC控制
  - 

    支持无霍尔传感器的BLDC控制

BLDC 3霍尔控制

- **BLDCBCH03 软件结构图**

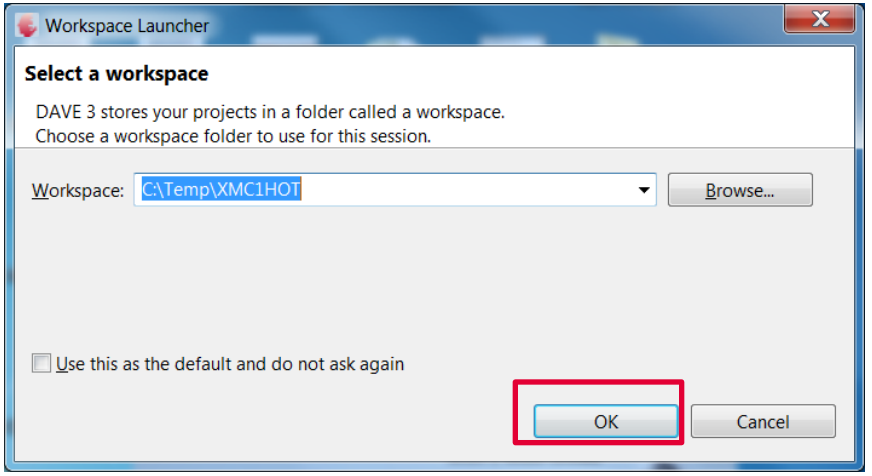


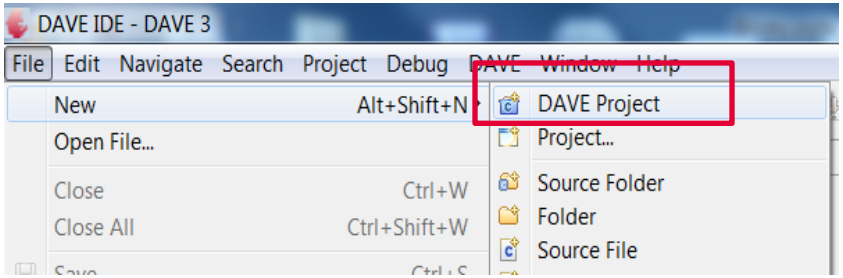
ADC部分　　POSIF&CCU4部分　　CCU8部分

BLDC 3霍尔控制

- 打开 DAVE™

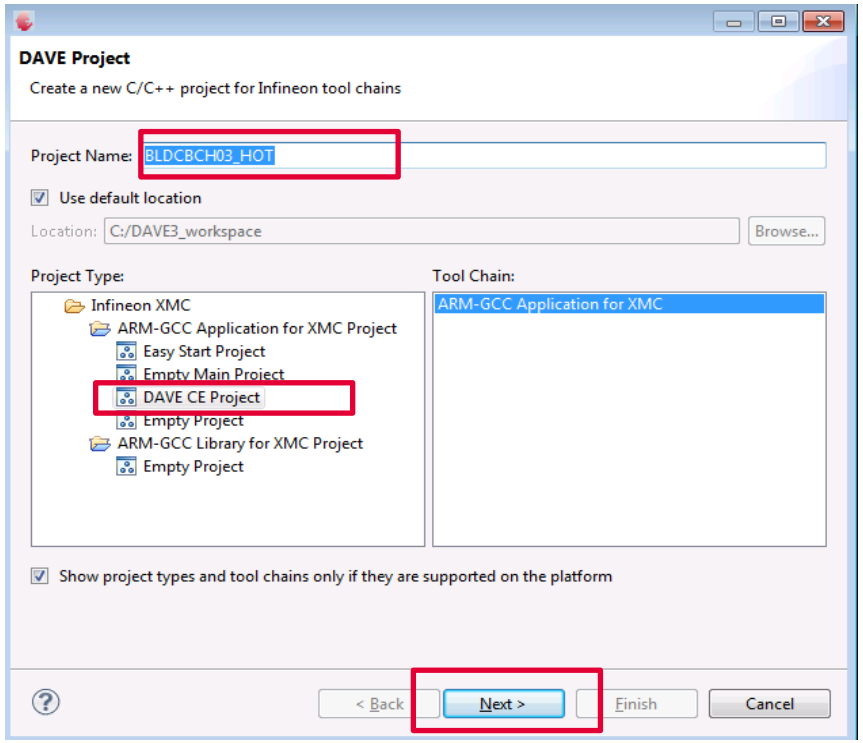
- 选择Workspace
- 点击 **“OK”**
- 点击File →**DAVE Project**

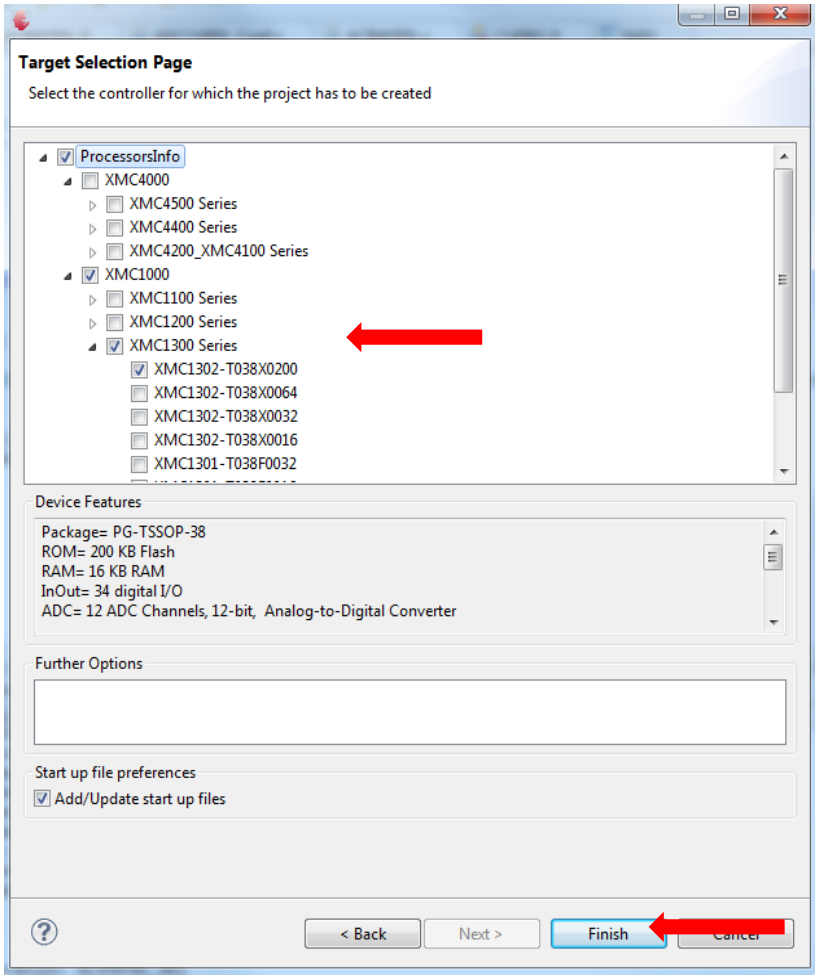




BLDC 3霍尔控制

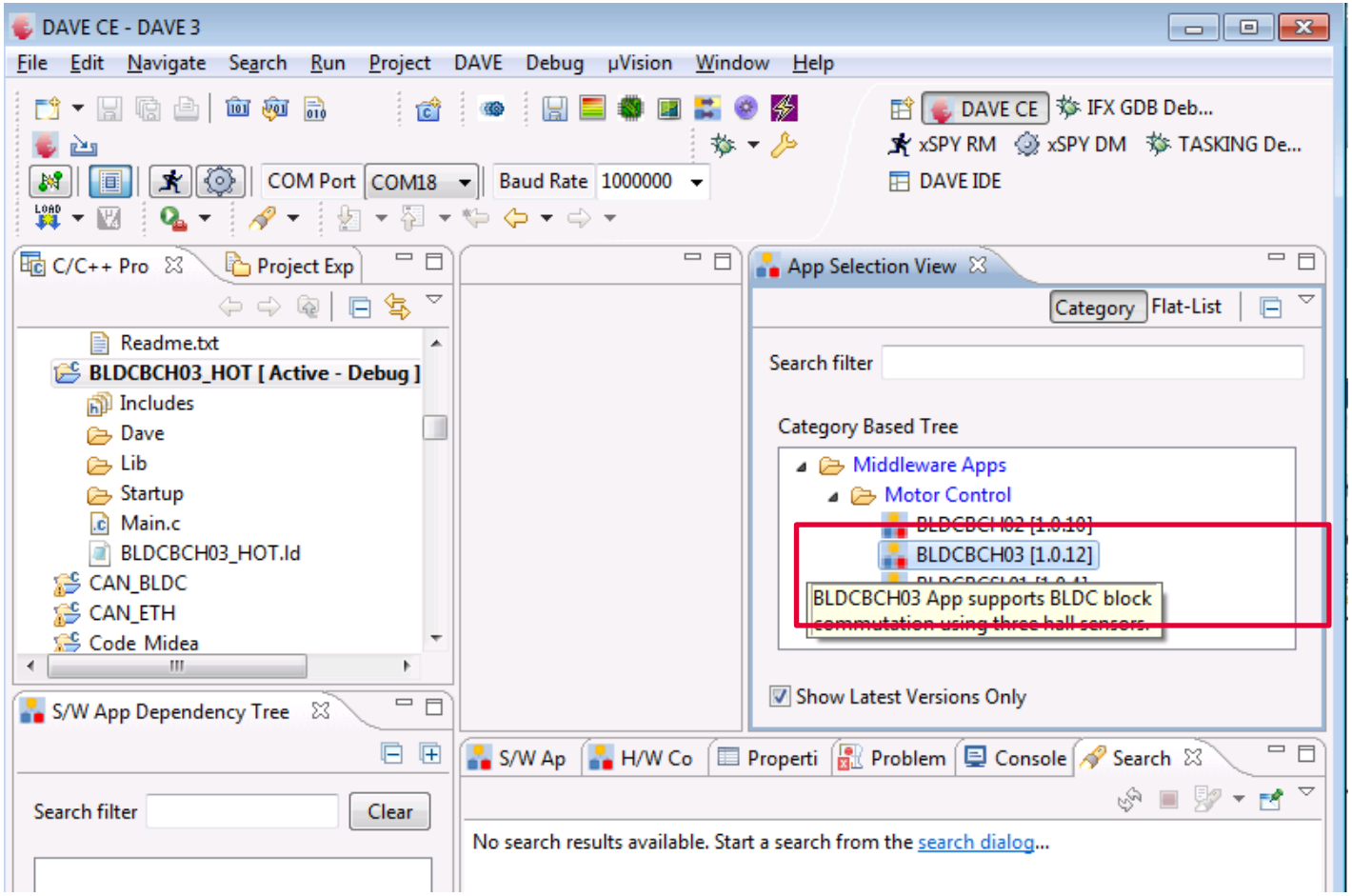
- 输入 “**BLDCBCH03_HOT**”(任意) 作为工程名称
- 选择 “DAVE CE Project”
- 点击 “Next”
- 选择“**XMC1300-TO38X0200**”





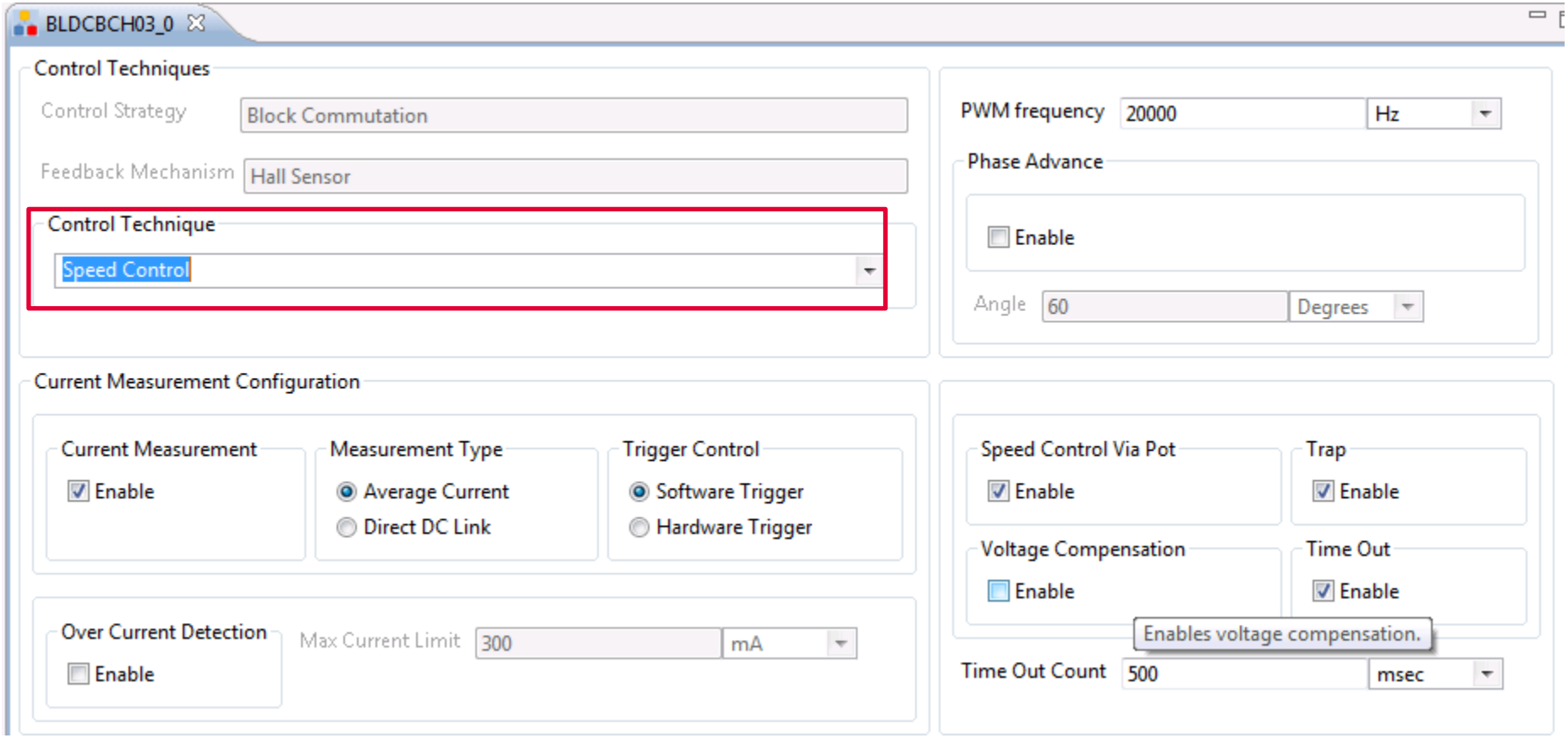
BLDC 3霍尔控制

- 双击 “BLDCBCH03” 加入BLDC控制APP



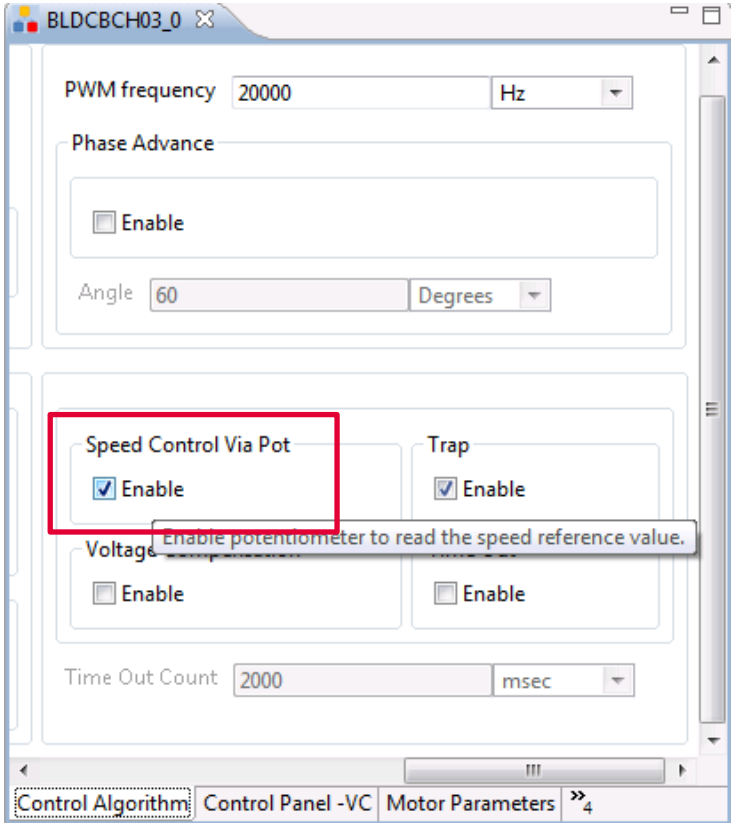
BLDC 3霍尔控制

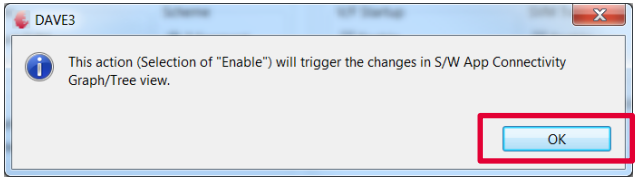
- **Control Algorithm** 页签,
  - 更改**Control Technique**为**Speed Control**, 启动速度闭环控制

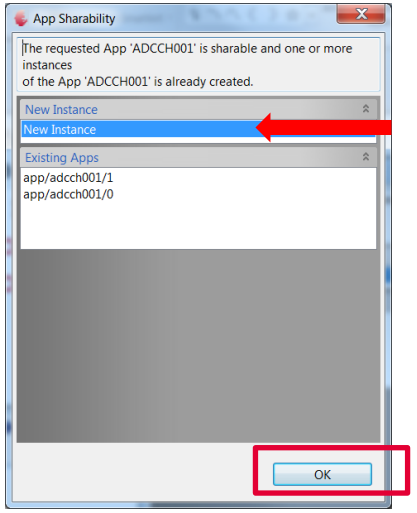


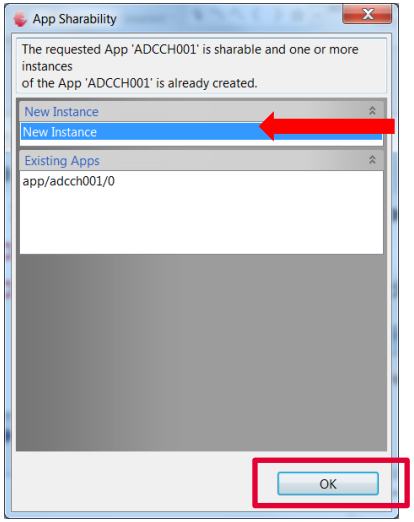
BLDC 3霍尔控制

- **Control Algorithm** 页签,
  - 选中 **Speed Ref Via POT**





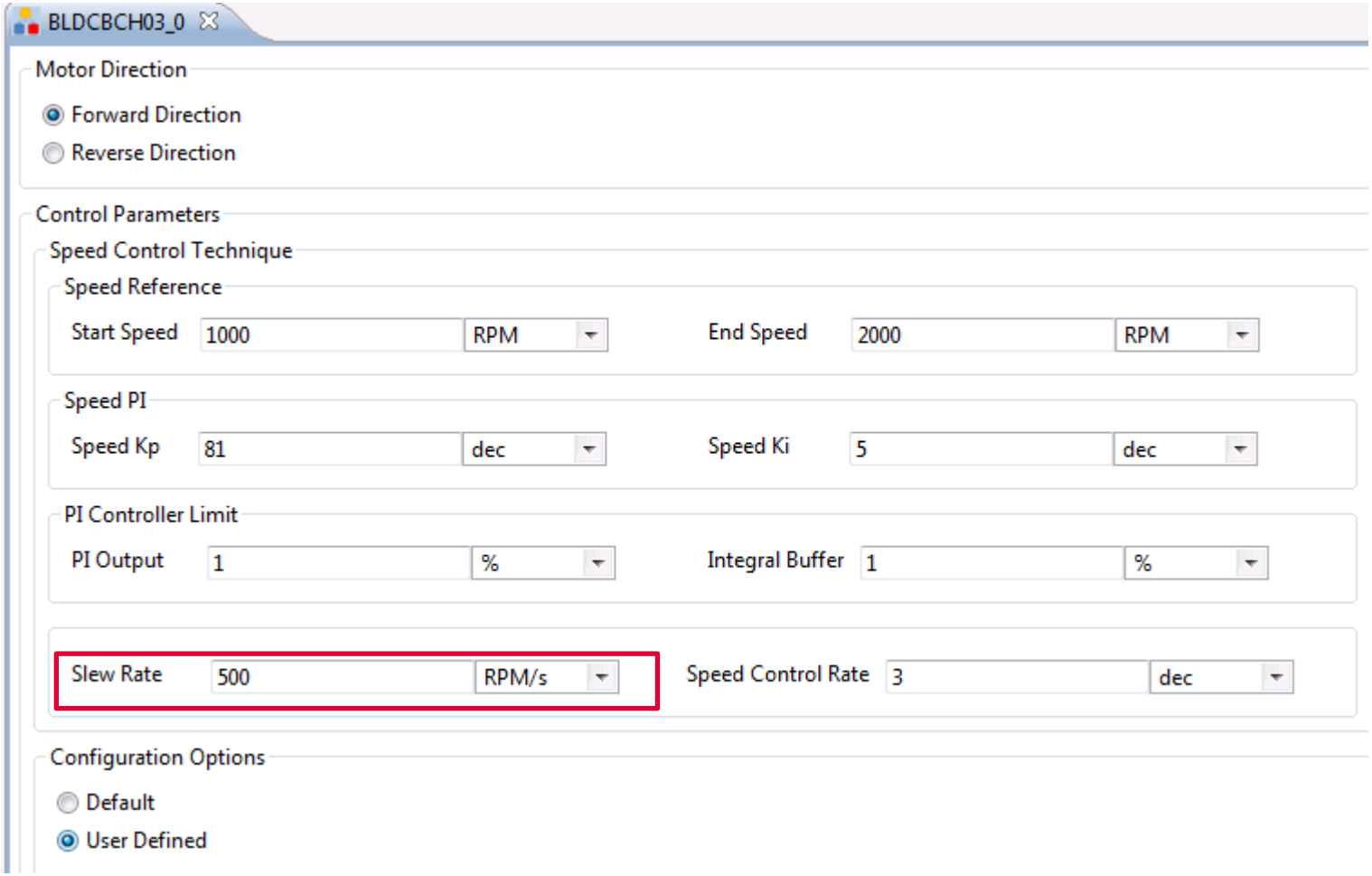




- 点击 “**New Instance**” & “**OK**”

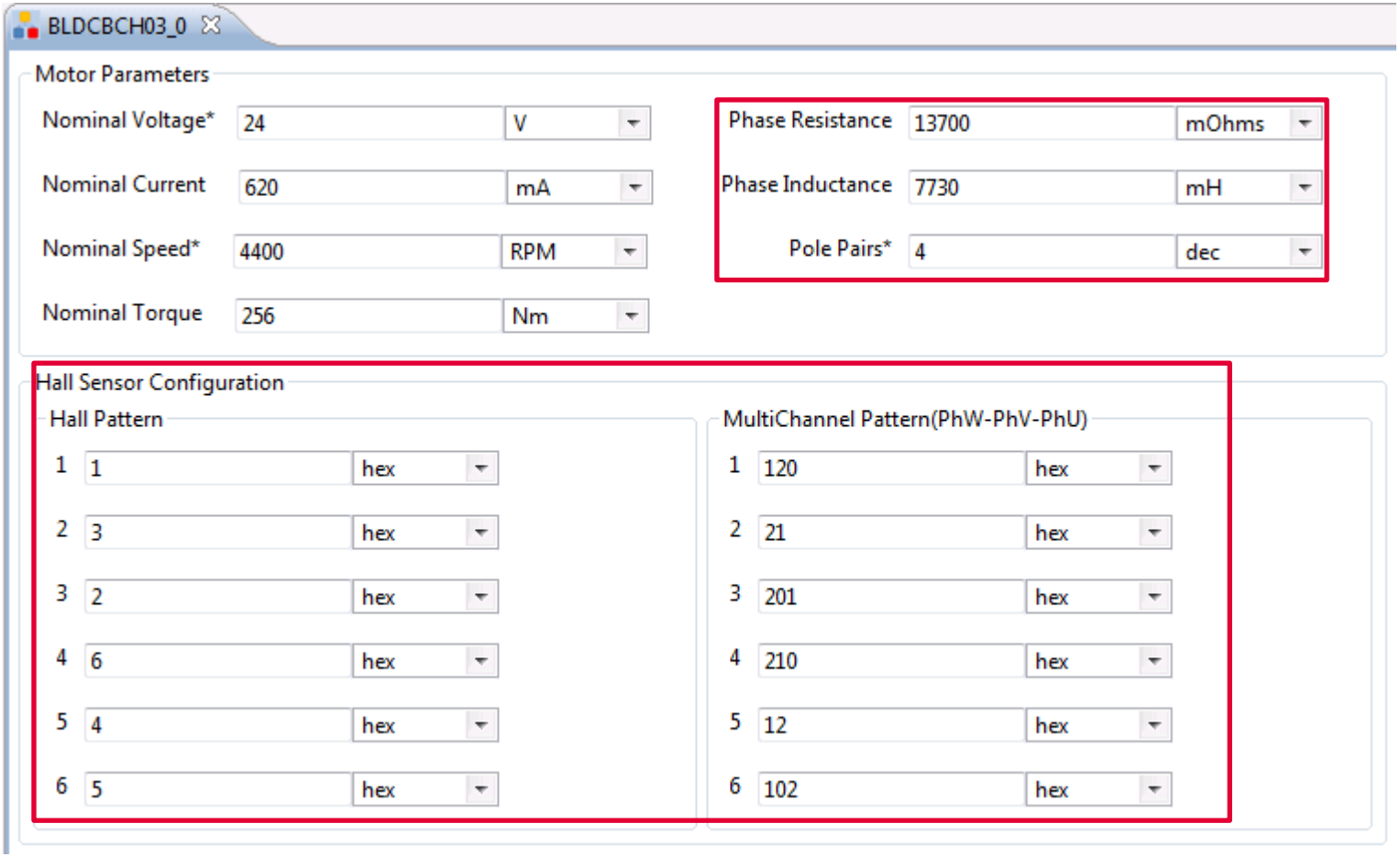
BLDC 3霍尔控制

- **Control Panel** 页签，
  - Change Speed Slew Rate = **10 RPM/s**，防止速度环震荡



BLDC 3霍尔控制

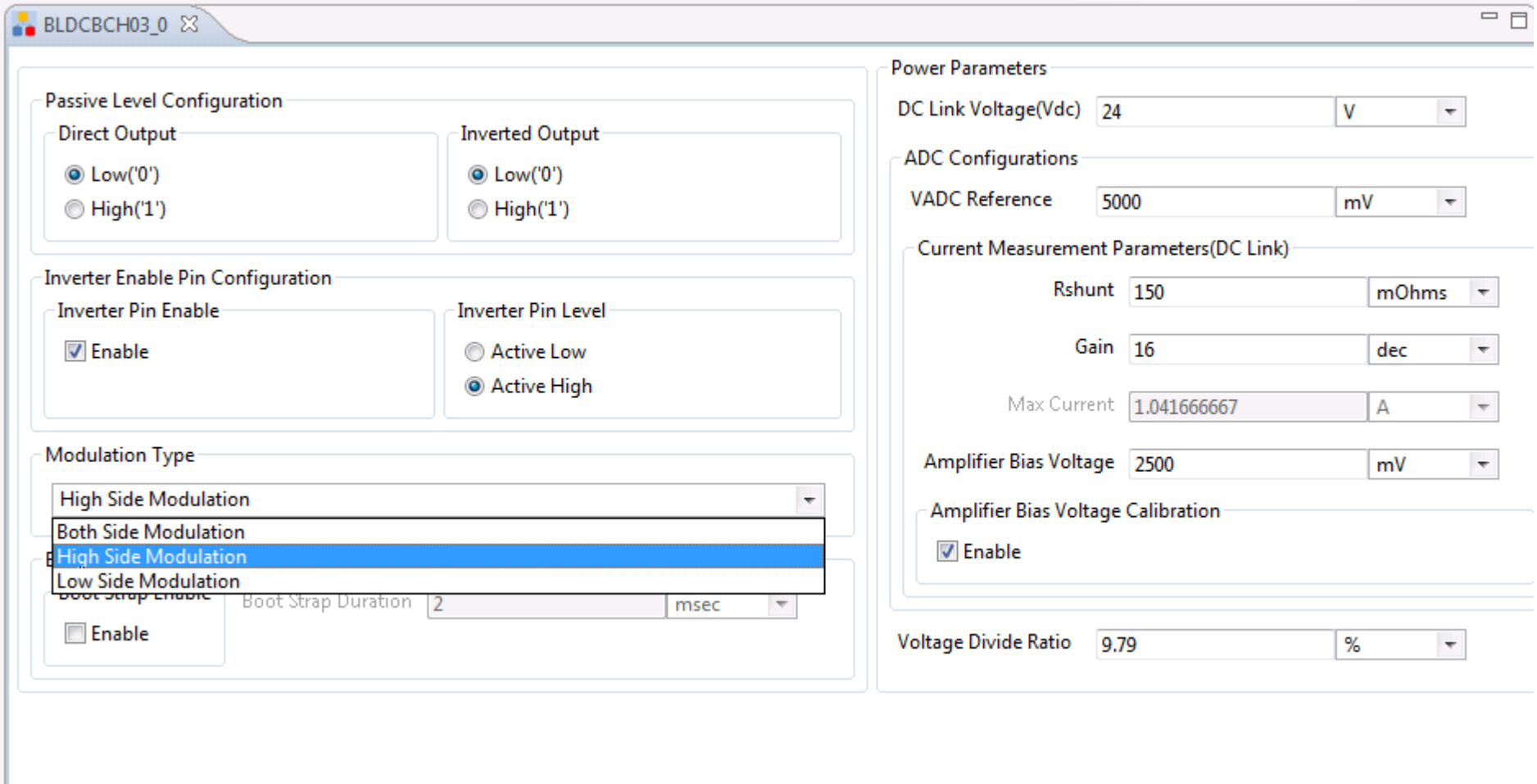
- **Motor Parameters** 页签，
  - Phase Resistance为相电阻/相电感，根据实际情况填写
  - Hall Sensor Configuration为相关霍尔表格的填写处



霍尔信号		
#3	#2	#1
0	0	1
0	1	1
0	1	0
1	1	0
1	0	0
1	0	1

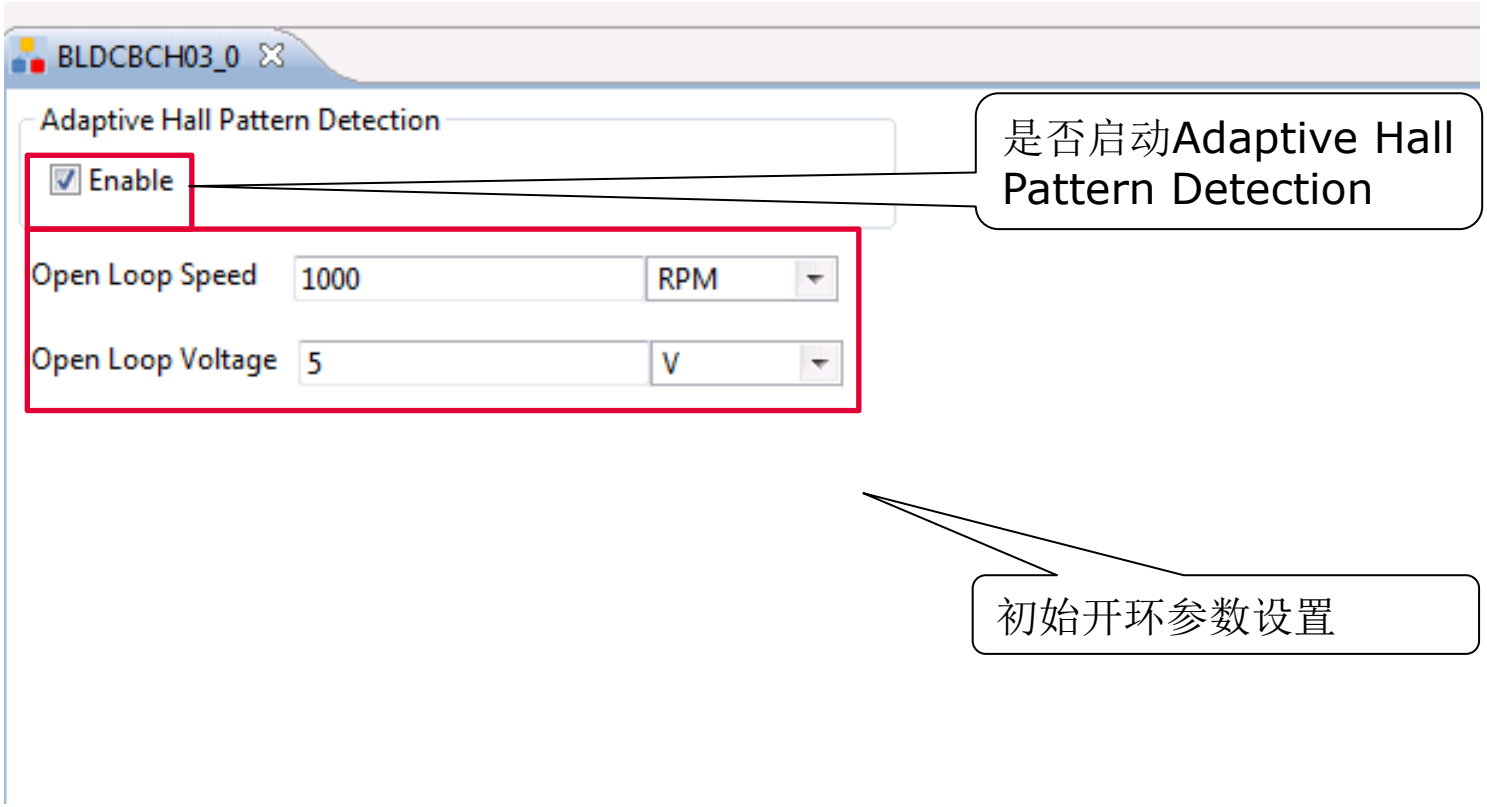
BLDC 3霍尔控制

- **Power Board** 页签，
  - Modulation Type可以根据需要选择
  - Rshunt为相电阻，Gain为放大电路放大系数，根据实际情况填写



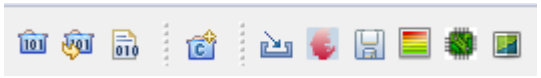
BLDC 3霍尔控制

- **Adaptive HallPattern Detection** 页签,
  - Adaptive Hall Pattern 通过初始的开环工作来获取霍尔信号的顺序



BLDC 3霍尔控制

- 手动分配管脚

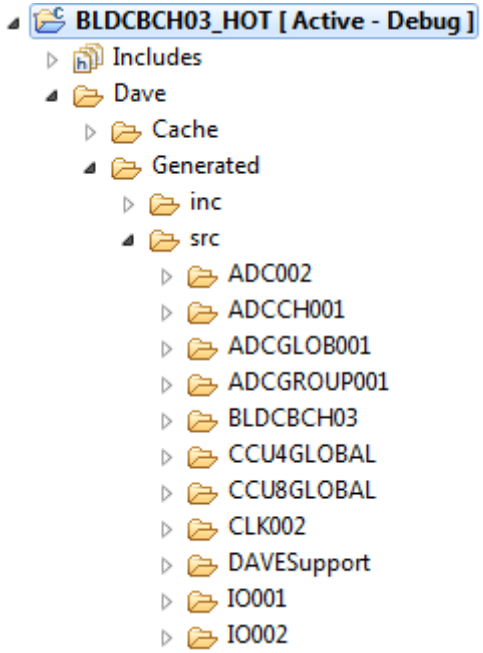


  - 点击  ，按照下表进行管脚分配

App	Pin Number
IO002/0 [U_H]	P0.0
IO002/1 [U_L]	P0.1
IO002/2 [V_H]	P0.7
IO002/3 [V_L]	P0.6
IO002/4 [W_H]	P0.8
IO002/5 [W_L]	P0.9
IO004/0 [Enable_Pin]	P0.11
IO002/6 [Trap_Pin]	P0.12
IO001/0 [I_DC]	P2.7
IO001/1 [POT]	P2.5
IO002/7 [HALL_0]	P0.13
IO002/7 [HALL_1]	P1.1
IO002/7 [HALL_2]	P0.15

BLDC 3霍尔控制

- 点击 **Solve and Save, 点击Close**
- 生成代码
  - 点击 
  - 生成的代码将放在该Project的 ../Dave/Generated 里



BLDC 3霍尔控制

- 在main中调用以下API来启动电机

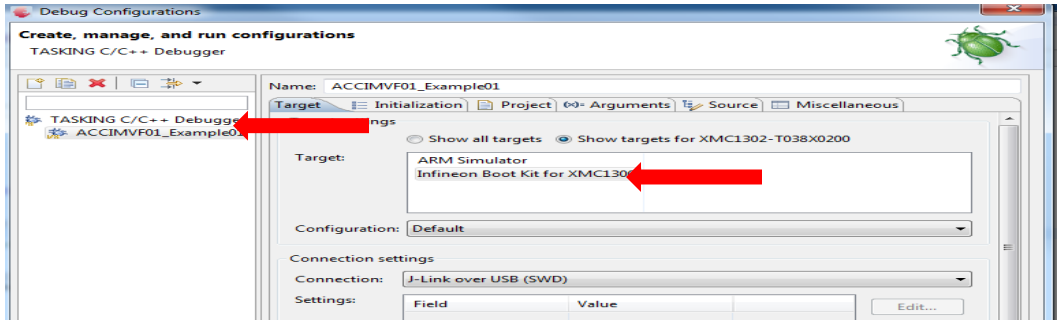
BLDCBCH03_MotorStart(&BLDCBCH03_Handle0)

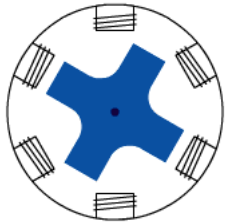
```
#include <DAVE3.h>          //Declarations from DAVE3 Code Generation (includes SFR declaration)

int main(void)
{
//  status_t status;        // Declaration of return variable for DAVE3 APIs (toggle comment if required)

    DAVE_Init();            // Initialization of DAVE Apps

    /* Start the Motor */
    BLDCBCH03_MotorStart(&BLDCBCH03_Handle0);

    while(1)
    {

    }
    return 0;
}
```

BLDC 3霍尔控制

- 编译项目
  1. 单击 
  2. 等待**Build Finished**

- 加载代码
  1. 单击 
  2. 双击**Tasking C/C++ Debugger** in **Debug Configuration**
  3. 选择 **Infineon Boot Kit for XMC1300**，并单击 **Debug**
  4. 单击，  启动程序





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