

基于ST官方电机开发套件 FOC5.3库调试经验分享

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FOC5.3和FOC5.0、FOC5.1、FOC5.2等区别:

- 1、支持更多型号的芯片和板子，比如开始支持STM32G的芯片和对应板子；
- 2、软件界面上有些变化，更简洁。

FULL库版本和普通版本的区别:

full版本区别:开放了弱磁，mtpa及前馈的源代码。

FULL版本申请:

到ST官网，用企业邮箱申请。

实验平台

硬件: P-NUCLEO-IHM001或P-NUCLEO-IHM002开发套件；

请事先下载安装软件：

- 1) STM32 PMSM FOC Software Development Kit - MC library (5.3.2及以上版本)；
- 2) STM32CubeMX 4.26及以上版本；
- 3) KEIL MDK 5.0 及以上版本。

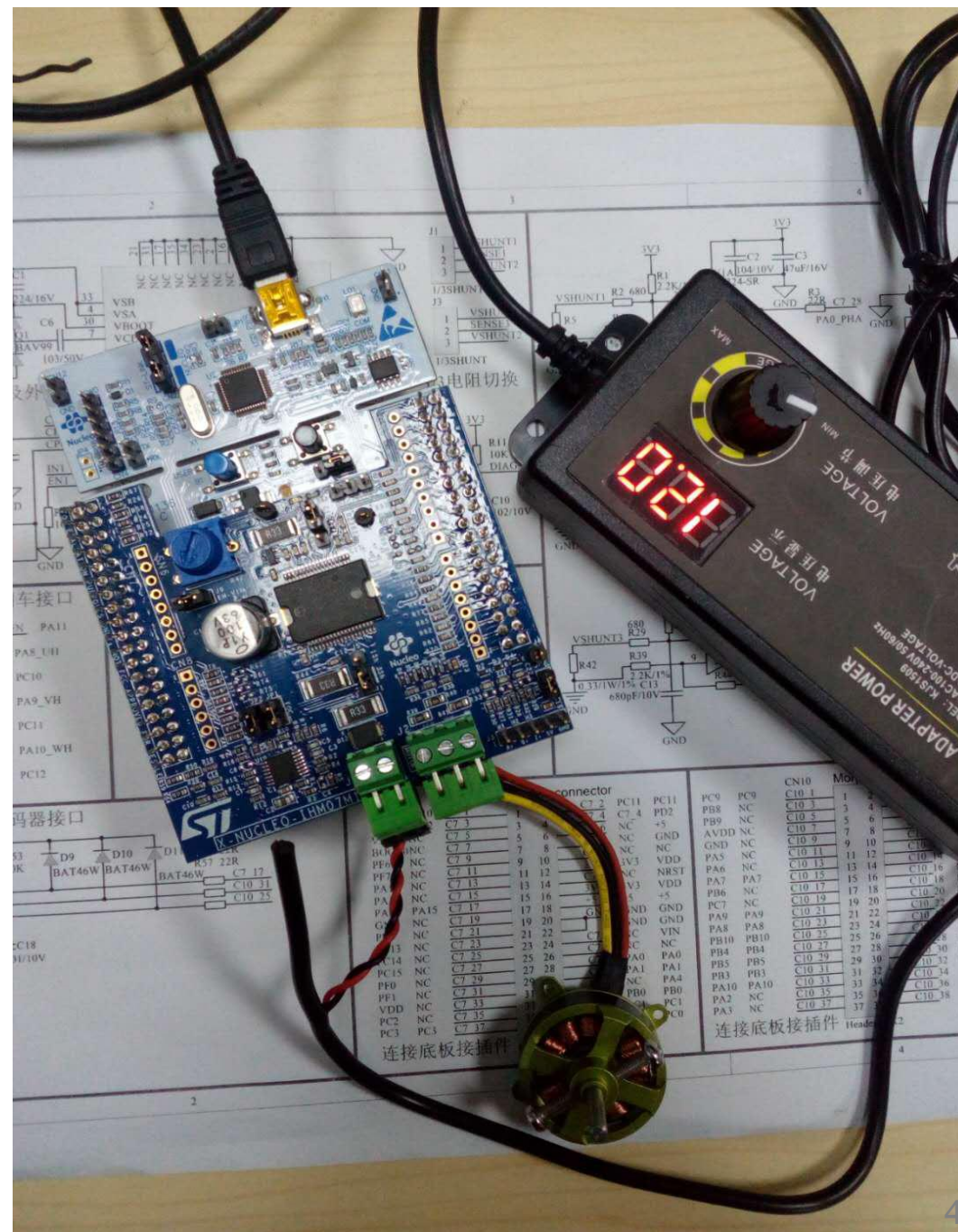


按照图示接线：

左边接插件接电源（左正右负），
接电源之前最好将电源调整到
12V左右；

右边接插件：接电机线（电机线
任意接，接错的话电机正反转方
向可能是反的）；

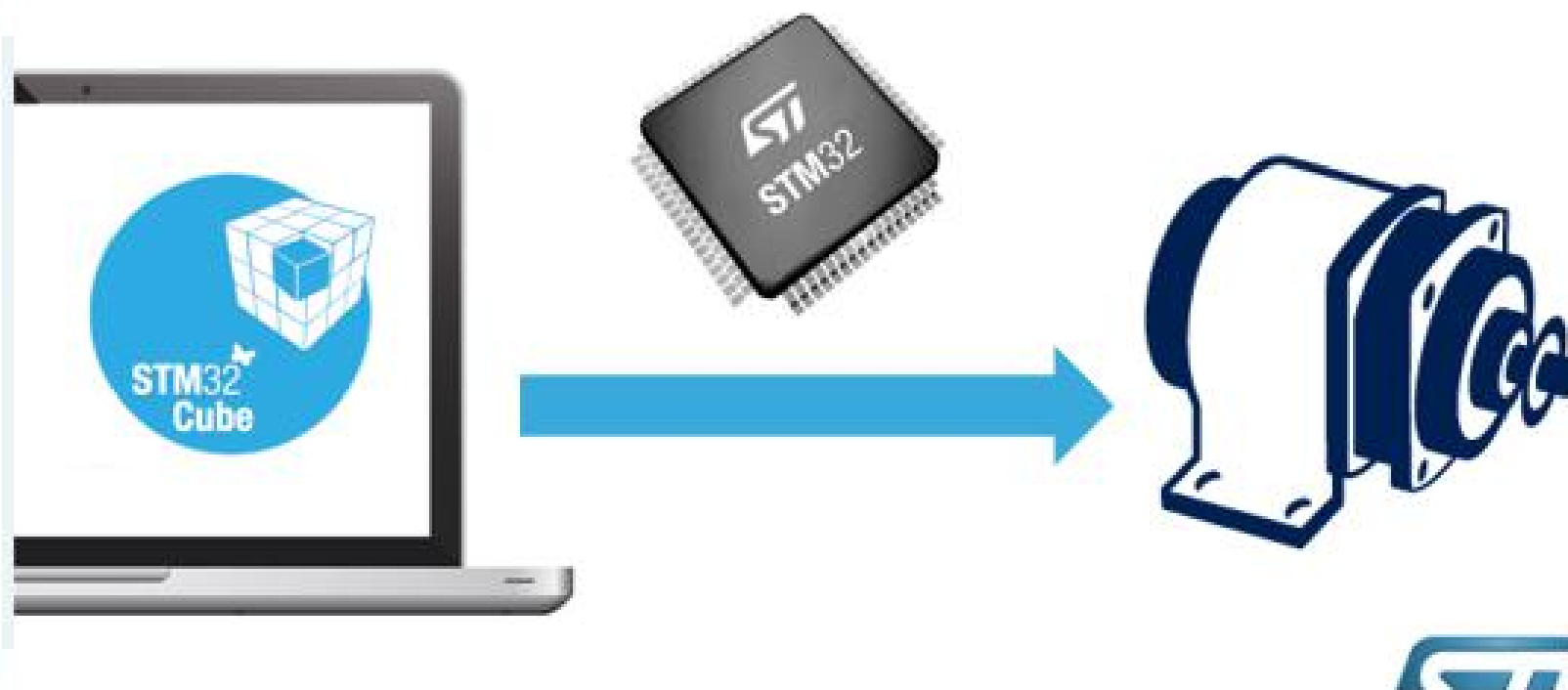
首次拆开开发套件（板子已预装
程序）：上电后且接上USB线，
按套件底板的蓝色按钮，电机
会正常转，再按下电机停止运行
（如果电机不能转，请先按下黑
色复位按钮，再按蓝色运行按
钮）。



打开MotorControl Workbench软件

ST Motor Control Workbench

STM32™ Motor Control SDK v5.3
plug-and-spin with STM32Cube™



打开如下图所示

ST Motor Control Workbench

File Tools Help Documentation

New Project Load Project About Help

Motor Profiler
Motion Control Suite

Recent Projects

Filename	Type	SDK	MCUs	control board	power board	motor
Noname003.stmcx	SINGLE	4.2.0	STM32F103 High Density	Custom	Custom	Custom
Noname003.stmcx	SINGLE	4.2.0	STM32F103 High Density	Custom	Custom	Custom
two motor foc4 hall.stmcx	DUAL	4.2.0	STM32F103 High Density	STEVAL-IHM039V1	MB459	Shinano Motor
two motor foc4 hall.stmcx	DUAL	4.2.0	STM32F103 High Density	STEVAL-IHM039V1	MB459	Shinano Motor
Noname003.stmcx	SINGLE	4.2.0	STM32F103 High Density	Custom	Custom	Custom
two motor foc4 hall.stmcx	DUAL	4.2.0	STM32F103 High Density	STEVAL-IHM039V1	MB459	Shinano Motor

Example Projects

Filename	Type	SDK	MCUs	control board	power board	motor
P-NUCLEO-IHM001 BullRunning kit, 3-Shunt, Sensorless	SINGLE	5.1.0	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-IHM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-IHM001 3Sh - board: X-NUCLEO-IHM07M1	Bull Running E
NUCLEO-F303RE + IHM07M1 + BullRunning motor	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	Bull Running E
NUCLEO-F303RE + IHM08M1 + Shinano motor	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM08M1	Shinano LA05
STEVAL-IHM042V1 inverter + 2 Shinano motors	DUAL	5.3.0	STM32F303CC	STEVAL-IHM042V1	STEVAL-IHM042V1	Shinano LA05
Speed ramp with Potentiometer on P-NUCLEO-IHM001 kit	SINGLE	5.1.0	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-IHM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-IHM001 3Sh - board: X-NUCLEO-IHM07M1	Bull Running E
Speed ramp with Potentiometer on P-NUCLEO-IHM001 kit -- Advanced	SINGLE	5.1.2	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-IHM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-IHM001 3Sh - board: X-NUCLEO-IHM07M1	Bull Running E
Gimbal motor	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM16M1	GimBal motor, GBM2804H-10
Saw tooth speed ramp	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	Bull Running E
Speed ramp and CCMRAM	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	Bull Running E
Dual Drive and CCMRAM	DUAL	5.1.0	STM32F303xE	STM32303E-EVAL	STEVAL-IHM045V1	Shinano LA05
Free RTOS on P-NUCLEO-IHM001 kit	SINGLE	5.2.0	STM32F301x6/8 - STM32F302x6/8	NUCLEO-F302R8	X-NUCLEO-IHM07M1	BullRunning
Power Factor Correction	SINGLE	5.1.0	STM32F103 High Density	STEVAL-IHM034V2	STEVAL-IHM034V2	Allen Bradley TL-A220P-HJ
STM32G081 based Single-Shunt configuration using HAI	SINGLE	5.3.0	STM32G081RR	STM32G081R-EVAL	STEVAL-IHM023V3	Shinano LA05


life. augmented





MC SDK5.3电机参数识别


使用ST MC Workbench GUI上的专用按钮（Motor Profiler）或
直接打开安装文件运行ST的电机参数测量工具。


FileToolsHelpDocumentation

 New Project

 Load Project

 About

 Help

 Motor Profiler
Motion Control Suite

Recent Projects

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two motor foc4 hall.stmcx	DUAL	4.2.0	STM32F103 High Density	STEVAL-IHM039V1	MB459	Shinano Motor
two motor foc4 hall.stmcx	DUAL	4.2.0	STM32F103 High Density	STEVAL-IHM039V1	MB459	Shinano Motor
Noname003.stmcx	SINGLE	4.2.0	STM32F103 High Density	Custom	Custom	Custom
two motor foc4 hall.stmcx	DUAL	4.2.0	STM32F103 High Density	STEVAL-IHM039V1	MB459	Shinano Motor

Example Projects

Filename	Type	SDK	MCUs	control board	power board	motor
P-NUCLEO-IHM001 BullRunning kit, 3-Shunt, Sensorless	SINGLE	5.1.0	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-IHM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-IHM001 3Sh - board: X-NUCLEO-IHM07M1	Bull Running E
NUCLEO-F303RE + IHM07M1 + BullRunning motor	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM07M1	Bull Running E
NUCLEO-F303RE + IHM08M1 + Shinano motor	SINGLE	5.1.0	STM32F303xE	NUCLEO-F303RE	X-NUCLEO-IHM08M1	Shinano LA05
STEVAL-IHM042V1 inverter + 2 Shinano motors	DUAL	5.3.0	STM32F303CC	STEVAL-IHM042V1	STEVAL-IHM042V1	Shinano LA05
Speed ramp with Potentiometer on P-NUCLEO-IHM001 kit	SINGLE	5.1.0	STM32F301x6/8 - STM32F302x6/8	P-NUCLEO-IHM001 3Sh - board: NUCLEO-F302R8	P-NUCLEO-IHM001 3Sh - board: X-NUCLEO-IHM07M1	Bull Running E

打开后如下图所示











点击SelectBoards选择相应的板子，选择：NUCLEO-F302R8+X-NUCLEO-IHM07M1 3Sh

ST Motor Profiler

☒ Hide obsolete boards Search Control board by name Search Power board by name


☐ Hide boards with warning Control Board Power Board Cancel

Control Board	Power Board
<p>NUCLEO-F302R8 STM32F302R8T6</p>  <p>● Active</p> <p>One Motor Control connector ST-LINK/V2 Embedded</p> <p>Product Web Page</p>	<p>STEVAL-IPM05F 3Sh STGIF5CH60</p>  <p>● Active</p> <p>Bus voltage : 125 - 400 Vdc DC Input voltage : 125 - 400 Vdc Output peak current : 0.8 - 8 A</p> <p>Product Web Page</p>
<p>NUCLEO-F302R8 STM32F302R8T6</p>  <p>● Active</p> <p>One Motor Control connector ST-LINK/V2 Embedded</p> <p>Product Web Page</p>	<p>STEVAL-IPM10B 3Sh STGIB10CH60T S-L</p>  <p>● Active</p> <p>Bus voltage : 125 - 400 Vdc DC Input voltage : 125 - 400 Vdc Output peak current : 1.5 - 13 A</p> <p>Product Web Page</p>
<p>NUCLEO-F302R8 STM32F302R8T6</p>  <p>● Active</p> <p>One Motor Control connector ST-LINK/V2 Embedded</p> <p>Product Web Page</p>	<p>STEVAL-IPM15B 3Sh STGIB15CH60T S-L</p>  <p>● Active</p> <p>Bus voltage : 125 - 400 Vdc DC Input voltage : 125 - 400 Vdc Output peak current : 2 - 20 A</p> <p>Product Web Page</p>
<p>NUCLEO-F302R8 STM32F302R8T6</p>  <p>● Active</p> <p>One Motor Control connector ST-LINK/V2 Embedded</p> <p>Product Web Page</p>	<p>X-NUCLEO-IHM07M1 3Sh L6230PD</p>  <p>● Active</p> <p>Bus voltage : 8 - 48 Vdc DC Input voltage : 8 - 48 Vdc Output peak current : 0.28 - 2.8 A</p> <p>Product Web Page</p>

打开后如下图，请选择Connect先连接（如连接不上则按下板子的黑色复位按钮）

Motor Profiler
Motion Control Suite


NUCLEO-F302R8
STM32F302R8T6



One Motor Control connector
ST-LINK/V2 Embedded

[Product Web Page](#)

X-NUCLEO-IHM07M1 3Sh
L6230PD



Bus Voltage: 8 - 48 Vdc
Output peak current: 0.28 - 2.8 A

[Product Web Page](#)

Pole Pairs: [how to detect...](#)

Speed and Current limits

Max Speed: RPM

Max Current: Apk 0.28 - 2.8 Apk

VBus: V 8 - 48 V

Magnetic: ☒ SM-PMSM ☐ I-PMSM

i Remember to properly configure the boards in Motor Control mode

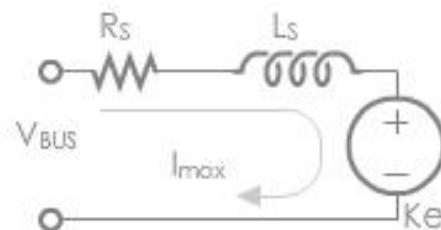
[Connect...](#)

[Start Profile](#)

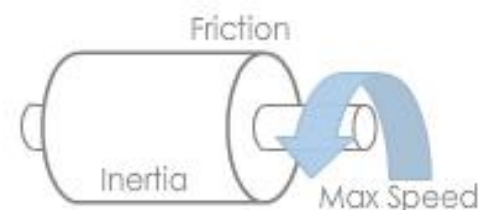
[Save...](#)

[Play](#)

Electrical Model



Mechanical Model



点击连接后，出现如下图是否需要升级固件（可以选择升级）

Warning: Firmware upgrade required

In order to proceed, I need to upgrade the firmware of the connected Control Board.

Upgrade Firmware

Cancel

点升级固件后，如下图并等待升级完成（升级完成后后自动关闭）

ST-Link

- ✓ ST-Link Connection ⓘ
- ✓ Executes a Full chip erase operation ⓘ
- ✓ Load binary and Verifies programming operation ⓘ
- ✓ Reset ⓘ

升级完后如下图所示，将鼠标放到Disconnect上即可看到版本号，在Pole Pairs处输入电机极对数7，其它参数默认（也可修改）

Motor Profiler

Motion Control Suite

NUCLEO-F302R8
STM32F302R8T6



One Motor Control connector
ST-LINK/V2 Embedded

[Product Web Page](#)

X-NUCLEO-IHM07M1 3Sh
L6230PD



Bus Voltage: 8 - 48 Vdc
Output peak current: 0.28 - 2.8 A

[Product Web Page](#)

Pole Pairs: [how to detect...](#)

Speed and Current limits

Max Speed: RPM

Max Current: Apk 0.28 - 2.8 Apk

VBus: V 8 - 48 V

Magnetic: ☒ SM-PMSM ☐ I-PMSM

Remember to properly configure the boards in Motor Control mode

☒ Disconnect

▶ Start Profile

Save...

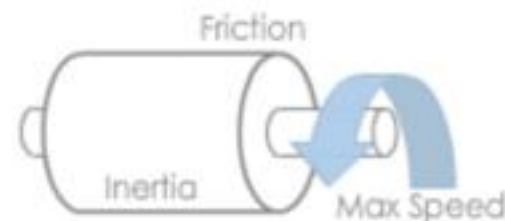
Play

Version: Firmware Version: 5.3.2 ST MC SDK

Electrical Model



Mechanical Model



SM-PMSM参数示例

Pole Pairs: [how to detect...](#) ← 电机极对数 (必填)

Speed and Current limits

Max Speed: RPM ← 电机最大转速 (可选)

Max Current: Apk *0.28 - 2.8 Apk* ← 电机允许的最大电流 (可选)

VBus: V *8 - 48 V* ← 额定总线电压 (可选)

Magnetic: ☒ SM-PMSM ☐ I-PMSM ← 磁体内置类型 (必填)

输入电机极对数7后， Start Profile按钮有效点击即可测试电机参数

Motor Profiler

Motion Control Suite

⊗ NUCLEO-F302R8
STM32F302R8T6



One Motor Control connector
ST-LINK/V2 Embedded

[Product Web Page](#)

⊗ X-NUCLEO-IHM07M1 3Sh
L6230PD



Bus Voltage: 8 - 48 Vdc
Output peak current: 0.28 - 2.8 A

[Product Web Page](#)

Pole Pairs: [how to detect...](#)

Speed and Current limits

Max Speed: RPM

Max Current: Apk 0.28 - 2.8 Apk

VBus: V 8 - 48 V

Magnetic: ☒ SM-PMSM ☐ I-PMSM

ⓘ Remember to properly configure the boards in Motor Control mode

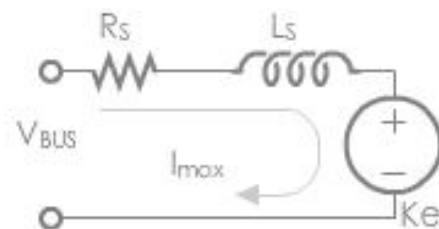
☒ Disconnect

☒ Start Profile

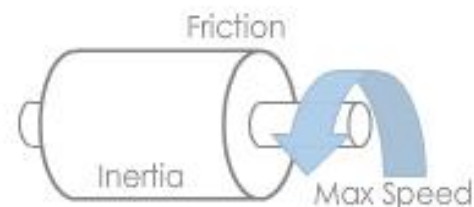
☐ Save...

☐ Play

Electrical Model



Mechanical Model



点击测试电机参数后等待测试完成（也可停止测试）

Motor Profiler

Motion Control Suite

④ NUCLEO-F302R8
STM32F302R8T6



One Motor Control connector
ST-LINK/V2 Embedded

[Product Web Page](#)

④ X-NUCLEO-IHM07M1 3Sh
L6230PD



Bus Voltage: 8 - 48 Vdc
Output peak current: 0.28 - 2.8 A

[Product Web Page](#)

Pole Pairs: [how to detect...](#)

Speed and Current limits

Max Speed: RPM

Max Current: Apk 0.28 - 2.8 Apk

VBus: V 8 - 48 V

Magnetic: ☒ SM-PMSM ☐ I-PMSM

ⓘ Remember to properly configure the boards in Motor Control mode

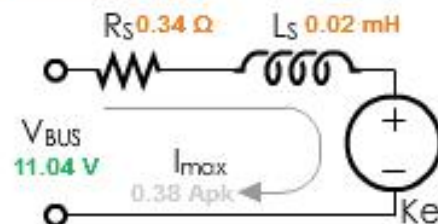
☒ Disconnect

☐ Stop Profile

☐ Save...

☐ Play

ⓘ **Electrical Model** 44%



Mechanical Model



Faults ⓘ

- Over voltage ☐
- Under voltage ☐
- Overheat ☐
- Startup failure ☐
- Speed feedback ☐
- Over current ☐

测试完成后如下图所示（测试不成功的话就重新测试下），测试成功的话Save和Play按钮功能有效，测试完成后同个电机每次的参数有有些差异，但差别不大

Motor Profiler

Motion Control Suite

② NUCLEO-F302R8
STM32F302R8T6



One Motor Control connector
ST-LINK/V2 Embedded

[Product Web Page](#)

② X-NUCLEO-IHM07M1 3Sh
L6230PD



Bus Voltage: 8 - 48 Vdc
Output peak current: 0.28 - 2.8 A

[Product Web Page](#)

Pole Pairs: [how to detect...](#)

Speed and Current limits

Max Speed: RPM

Max Current: Apk 0.28 - 2.8 Apk

VBus: V 8 - 48 V

Magnetic: ☒ SM-PMSM ☐ I-PMSM

i Remember to properly configure the boards in Motor Control mode

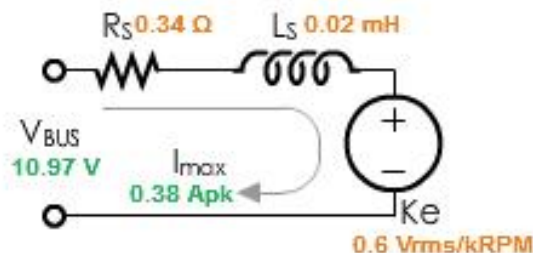
☒ Disconnect

☒ Start Profile

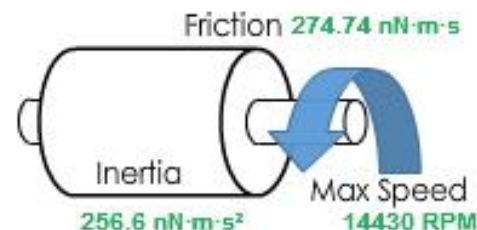
☒ Save...

☒ Play

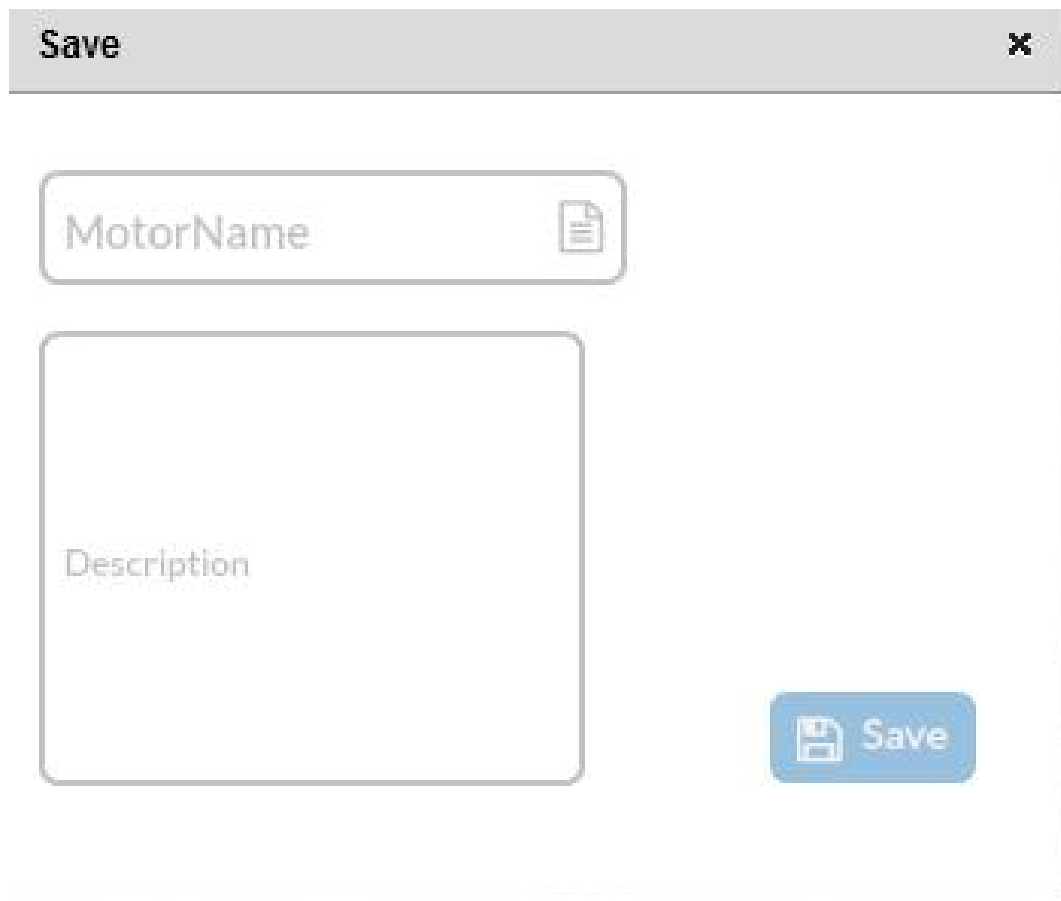
Electrical Model



Mechanical Model



点击Save保存电机参数后如下图，输入名字后保存即可（路径不可选，保存在默认路径下），通过MotorControl Workbench生成库的电流环PID参数相关根据电机参数算出来的



The image shows a 'Save' dialog box with a title bar containing 'Save' and a close button. Inside the dialog, there is a text input field labeled 'MotorName' with a document icon to its right. Below this is a large text area labeled 'Description'. In the bottom right corner of the dialog, there is a blue button with a document icon and the text 'Save'.

点击Play后，再点击Start即可让电机转动，通过调节中间箭头调节转速，点Stop按钮停止转动，点Done按钮关闭界面（如电机在转动则停止转动），如遇干扰等原因连接不成功，可点左下角按钮重新连接。由于是高速电机，加速度和目标转速不要设置过低，否则转不起来。

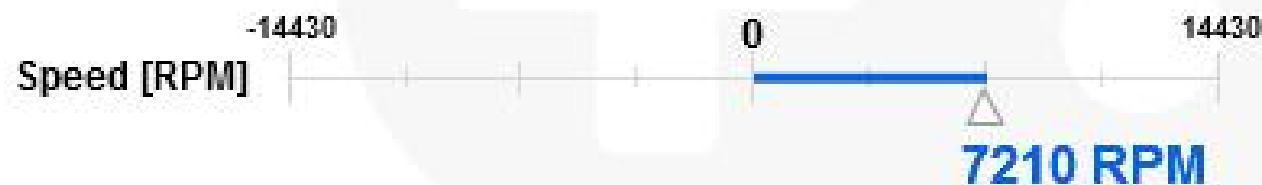
Play with Motor

×

▶ Start

■ Stop

Maximum Acceleration RPM/s



Faults ⓘ

Over voltage ☐

Under voltage ☐

Overheat ☐

Startup failure ☐

Speed feedback ☐

Over current ☐

● Connected

✕ Done

关闭电机并退出电机测试回到Workbench主界面，点击New Project新建工程，选MC Kit并选择相应的板子和配套的电机参数（也可自定义）

New Project

1 Application type
Custom

2 System
☒ Single Motor ☐ Dual Motors

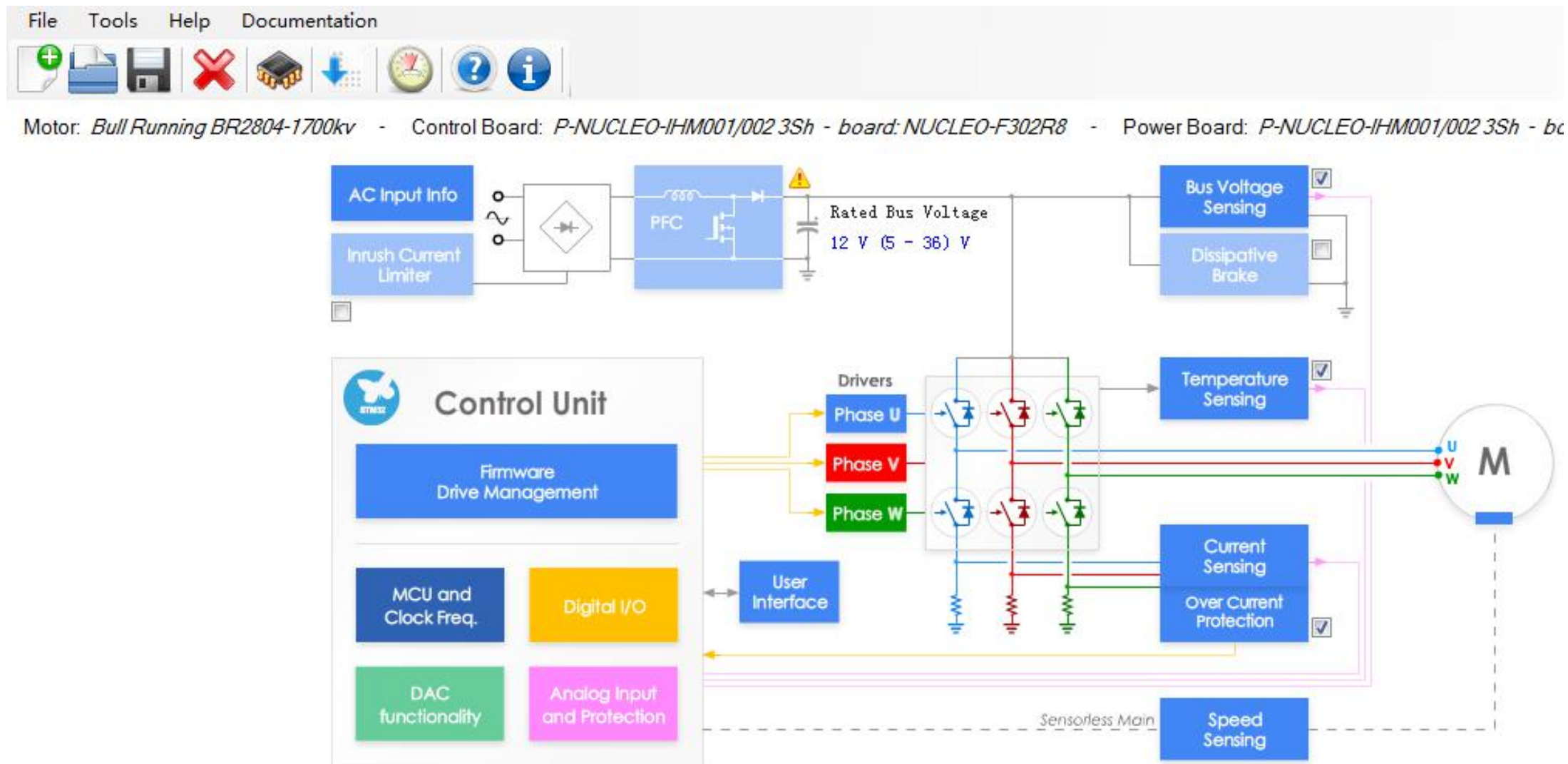
3 Select Boards: ☐ Inverter ☒ MC Kit ☐ Power & Control

Motor Control Kit
P-NUCLEO-IH001/002 3Sh
Control: NUCLEO-F302R8
based on STM32F302R8
ST-LINK/V2 Embedded
Active

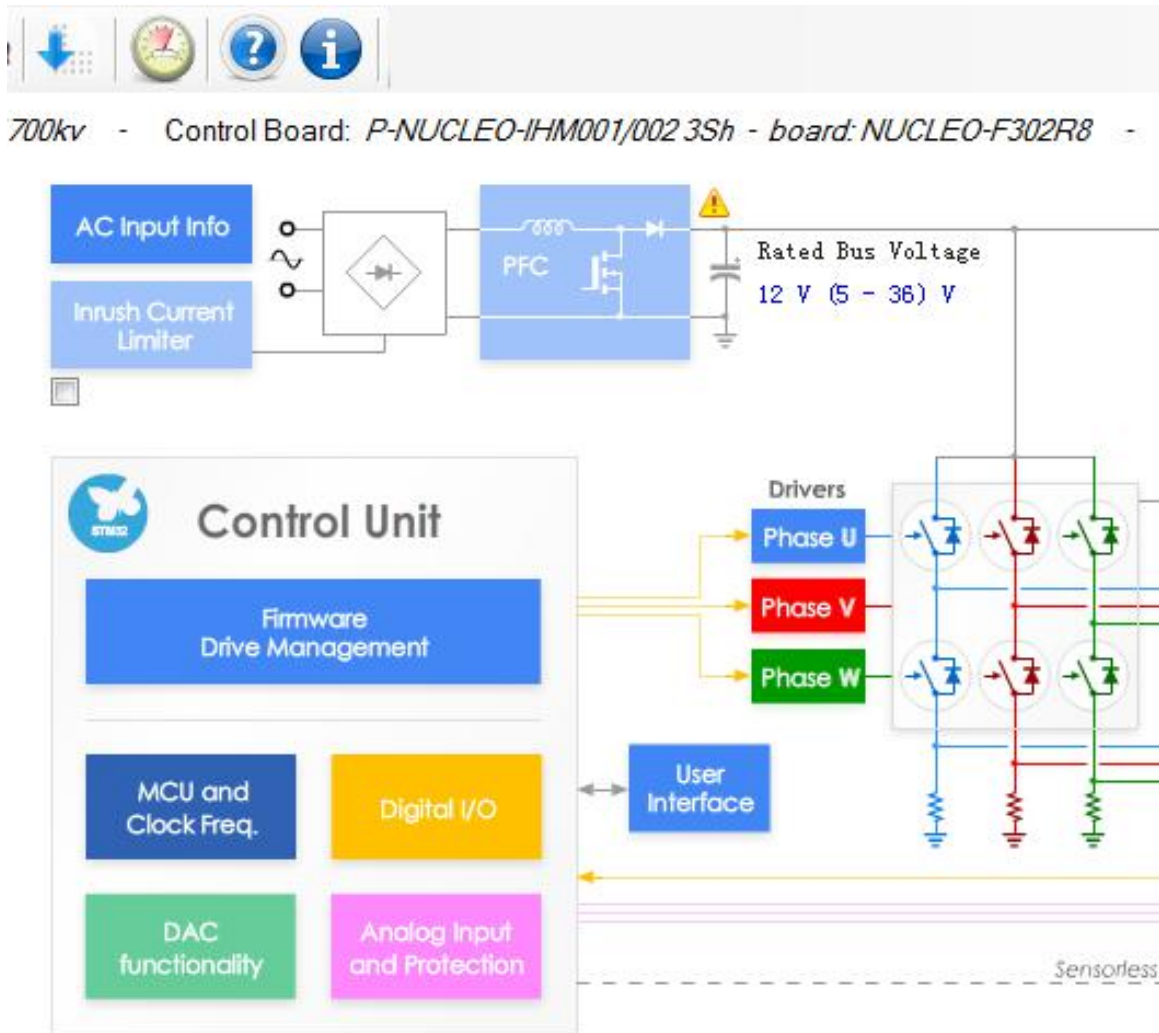
Power: X-NUCLEO-IH007M1 3Sh
based on L6230PD
DC Input voltage 8 - 48 Vdc
Output pk current up to 2.8 Apk
Nominal Power up to 40 W
Active

4 Motor
Full Running BR2804-1700kv
External rotor type - 7 poles pairs
brushless - DC motor
Magnetic structure Surface Mounted
Pole Pairs 7
Nominal Speed 15000 rpm
Nominal Voltage 12 V
Nominal Current 1.2 Apk

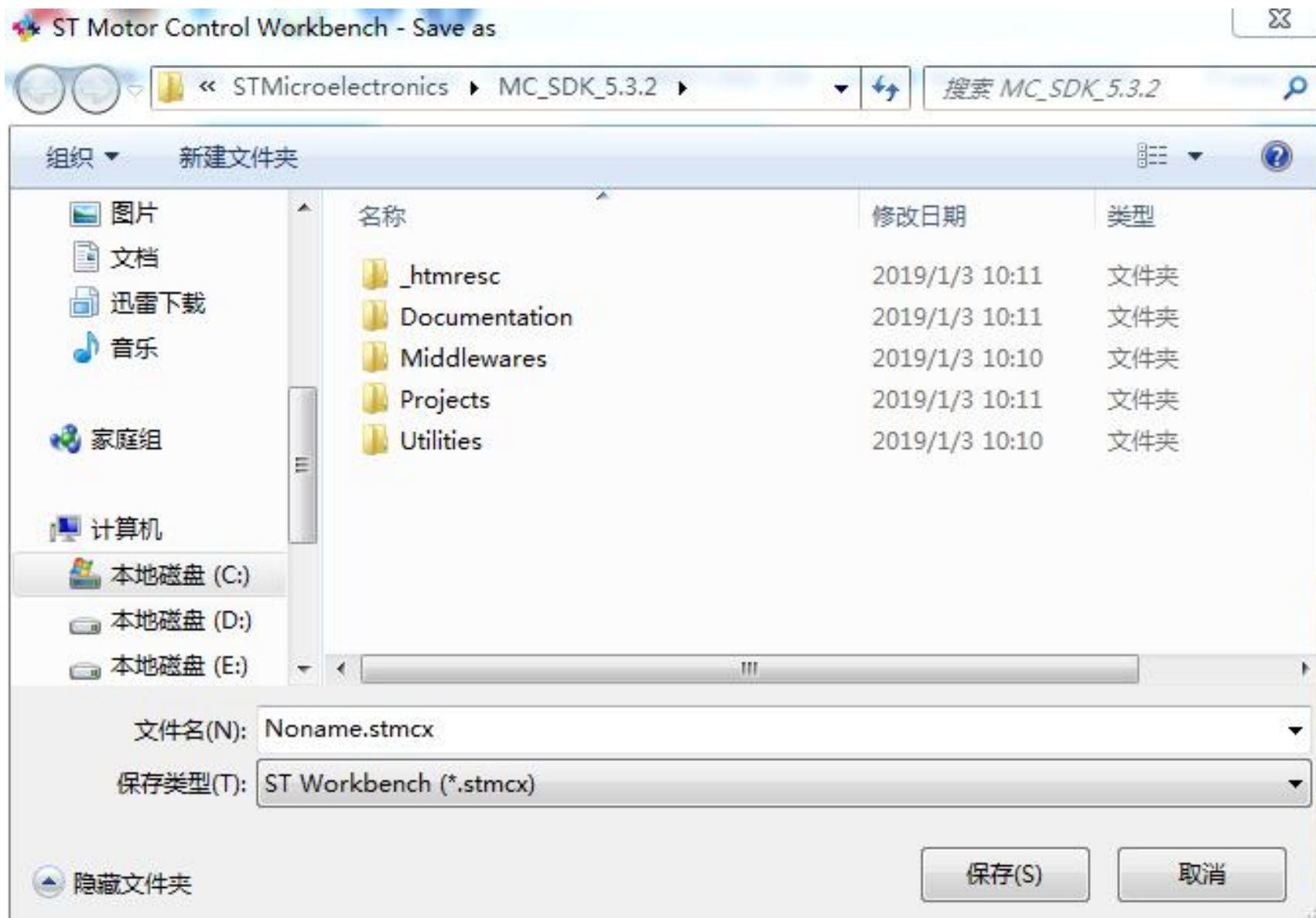
点击OK跳到工程硬件配置窗口界面，如下图所示，可更改相关默认参数



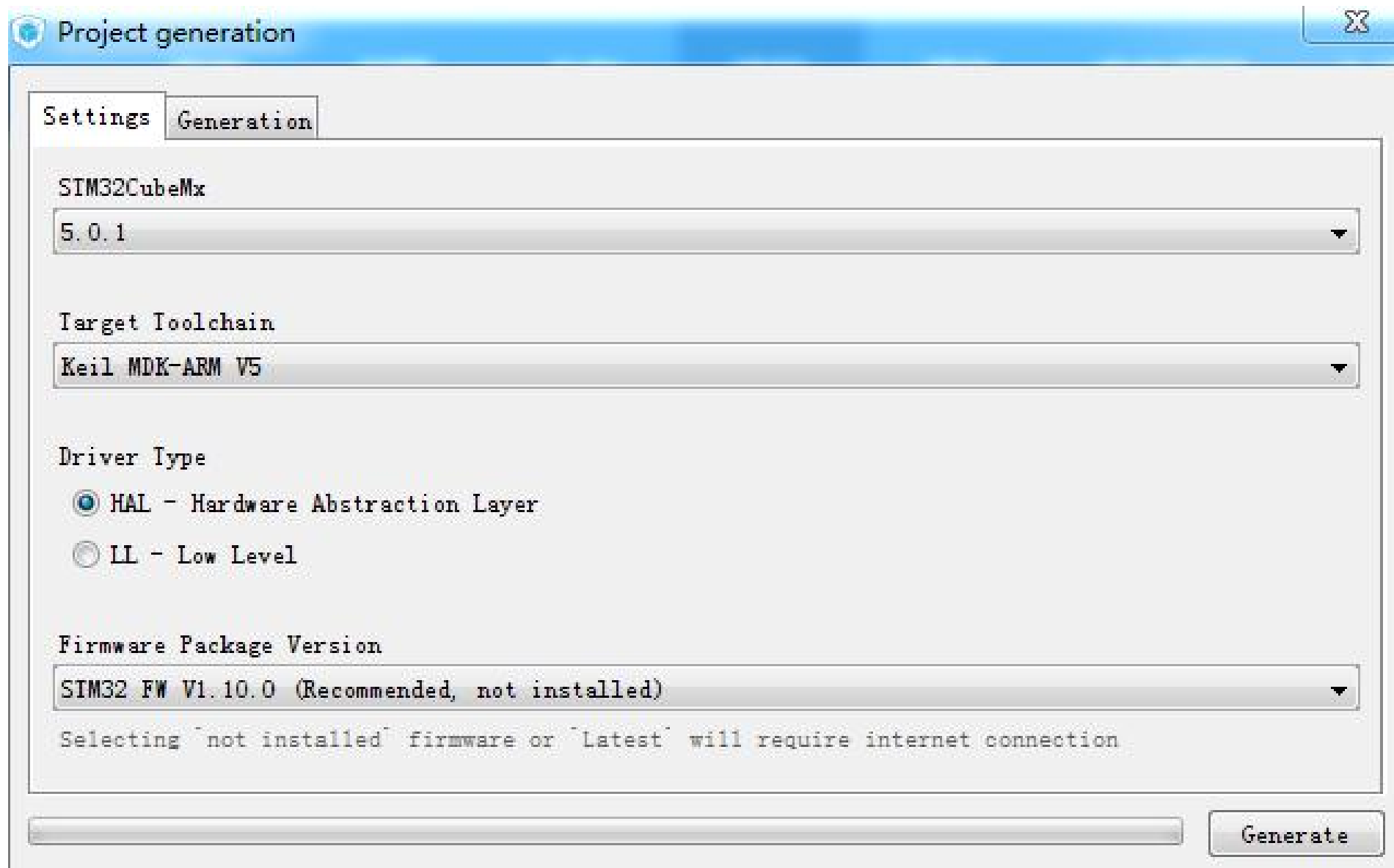
所有参数设置完成后或不设置， 点击生成按钮生成相应的工程文件
(向下箭头)



点击OK按钮后如下图所示，可修改工程名和选型路径等



点击保存按钮后如下图所示，可生成相关的软件工程（MDK或IAR）

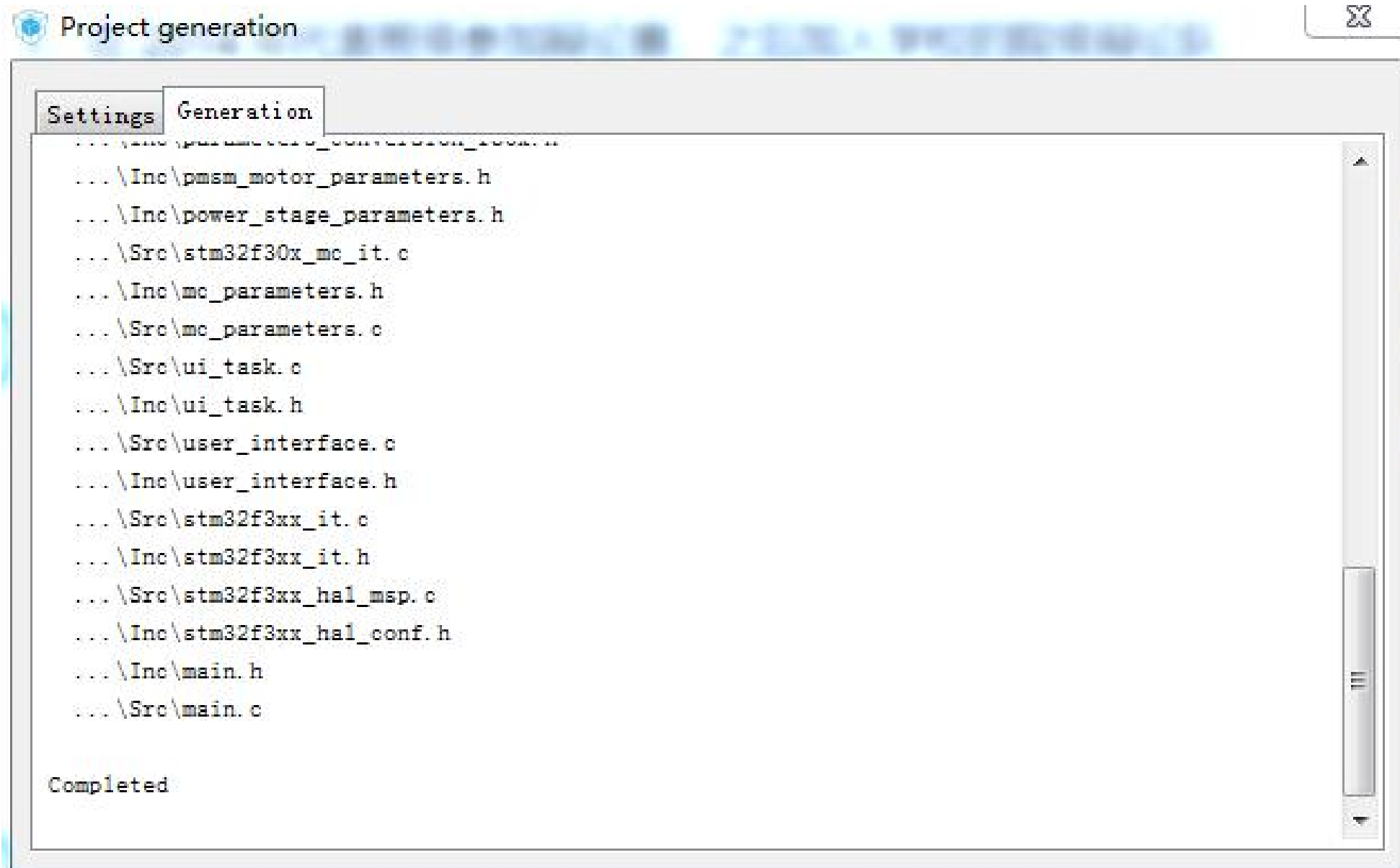


The screenshot shows a 'Project generation' dialog box with a blue title bar and a close button. It has two tabs: 'Settings' and 'Generation', with 'Settings' currently selected. The dialog contains several configuration options:

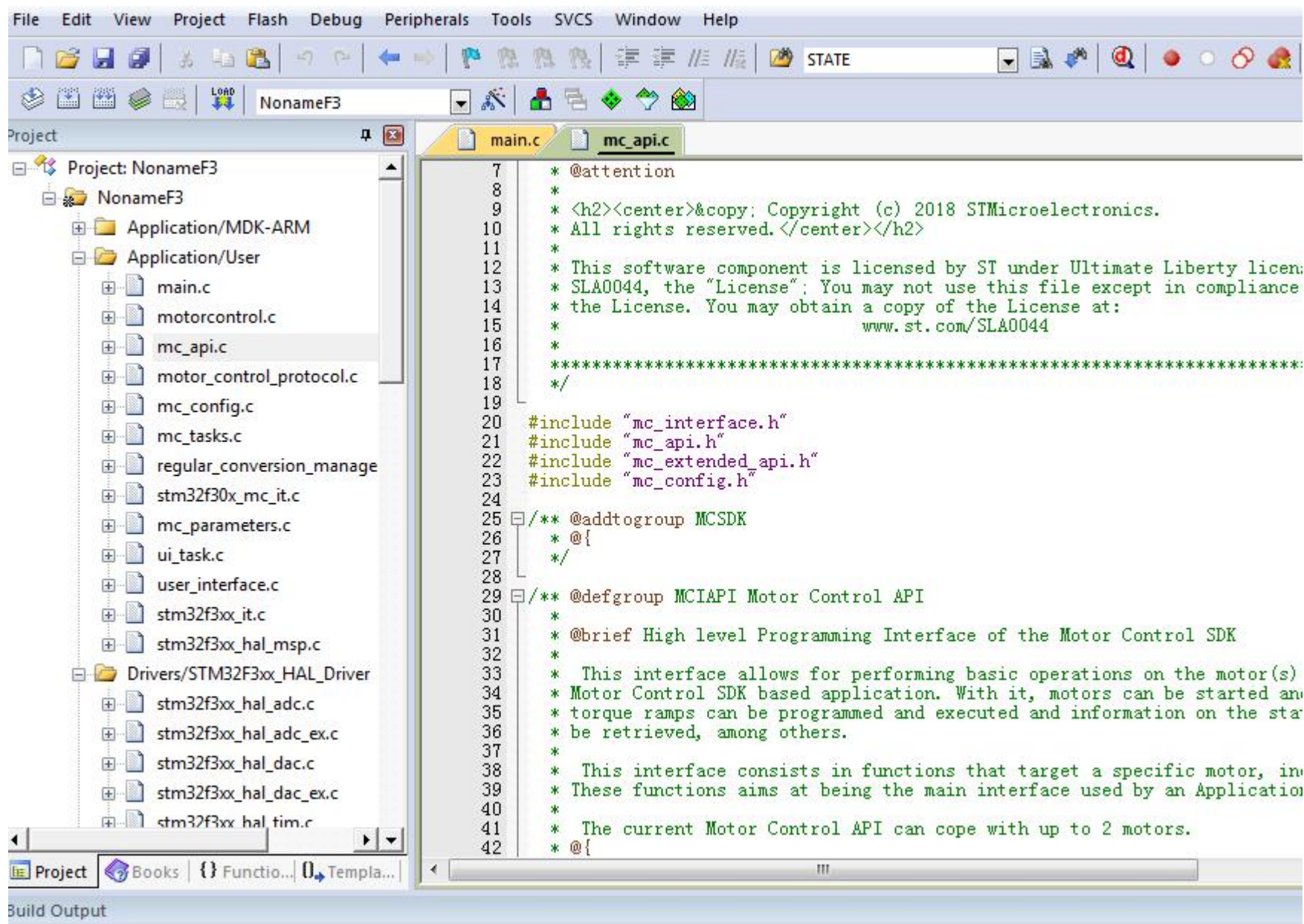
- SIM32CubeMx**: A dropdown menu showing '5.0.1'.
- Target Toolchain**: A dropdown menu showing 'Keil MDK-ARM V5'.
- Driver Type**: Two radio button options: 'HAL - Hardware Abstraction Layer' (which is selected) and 'LL - Low Level'.
- Firmware Package Version**: A dropdown menu showing 'SIM32 FW V1.10.0 (Recommended, not installed)'.

Below these options, a note states: 'Selecting 'not installed' firmware or 'latest' will require internet connection'. At the bottom right, there is a 'Generate' button. A progress bar is visible at the bottom left.

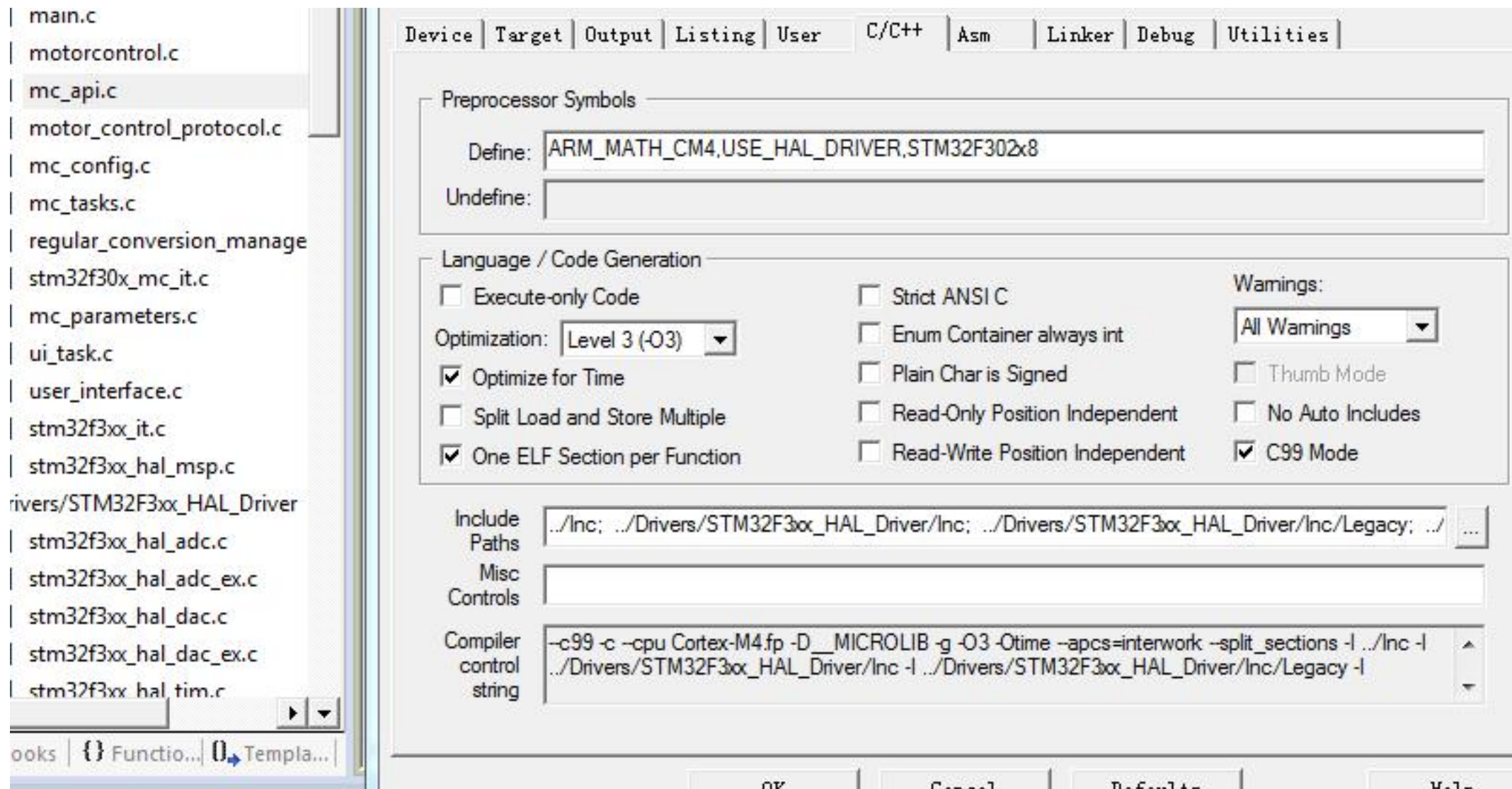
生成完后如下图所示，会显示Completed



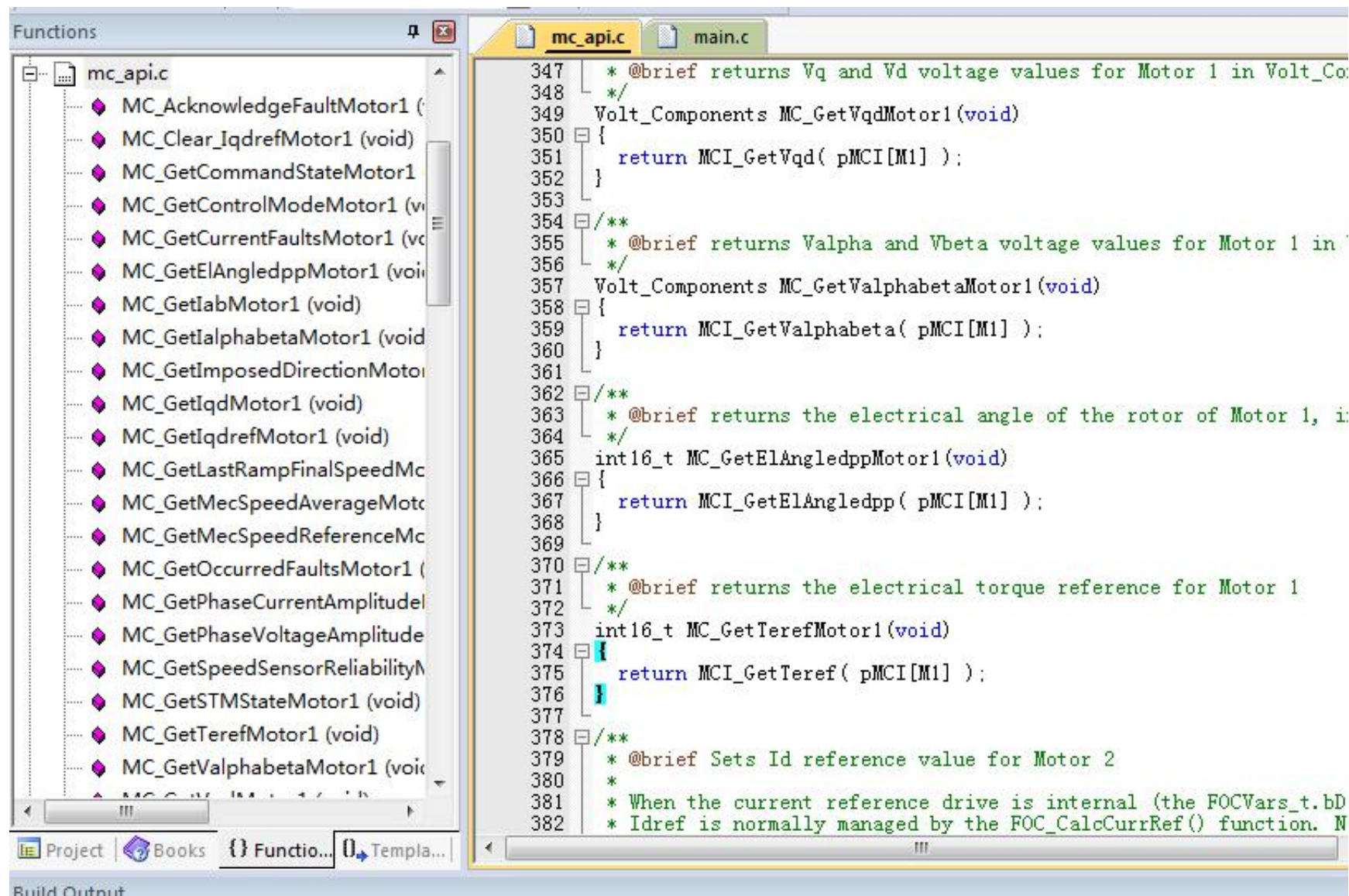
找到刚才生成的文件夹下的工程文件，打开MDK工程，如下图所示



优化等级设置成最高（设的太低，FOC库会运行报错，导致电机转不起来），并编译下工程



在mc_api.c中有一系列函数来实现对电机的控制，主要调用mc_api.c里的一些函数



```
347  * @brief returns Vq and Vd voltage values for Motor 1 in Volt_Co
348  */
349  Volt_Components MC_GetVqdMotor1(void)
350  {
351      return MCI_GetVqd( pMCI[M1] );
352  }
353
354  /**
355   * @brief returns Valpha and Vbeta voltage values for Motor 1 in
356   */
357  Volt_Components MC_GetValphabetaMotor1(void)
358  {
359      return MCI_GetValphabeta( pMCI[M1] );
360  }
361
362  /**
363   * @brief returns the electrical angle of the rotor of Motor 1, i
364   */
365  int16_t MC_GetElAngledppMotor1(void)
366  {
367      return MCI_GetElAngledpp( pMCI[M1] );
368  }
369
370  /**
371   * @brief returns the electrical torque reference for Motor 1
372   */
373  int16_t MC_GetTerefMotor1(void)
374  {
375      return MCI_GetTeref( pMCI[M1] );
376  }
377
378  /**
379   * @brief Sets Id reference value for Motor 2
380   *
381   * When the current reference drive is internal (the FOCVars_t.bD
382   * Idref is normally managed by the FOC_CalcCurrRef() function. N
```

mc_api.c中常用函数

- ◆MC_StartMotor1
- ◆MC_StopMotor1
- ◆MC_ProgramSpeedRampMotor1
- ◆MC_ProgramTorqueRampMotor1
- ◆MC_GetMecSpeedReferenceMotor1
- ◆MC_GetMecSpeedAverageMotor1
- ◆MC_GetSTMStateMotor1
- ◆MC_GetOccurredFaultsMotor1
- ◆MC_AcknowledgeFaultMotor1
- ◆MC_GetImposedDirectionMotor1

MC_StartMotor1(); //电机启动

如果Motor1为IDLE状态，该命令立即执行启动电机，返回值true，反之返回命令丢弃返回false。

```
bool MC_StartMotor1(void)
{
    return MCI_StartMotor( pMCI[M1] );
}
```

MC_StopMotor1(); //电机停止

如果Motor1为RUN或START状态，该命令立即执行停止电机，反之被丢弃。

```
bool MC_StopMotor1(void)
{
    return MCI_StopMotor( pMCI[M1] );
}
```


MC_ProgramSpeedRampMotor1(3000/6,2000); //设置为速度模式，设置速度指令
调用此函数后hDurationms设置时间内当前速度变化到hFinalSpeed设置的目标速度

```
void MC_ProgramSpeedRampMotor1( int16_t hFinalSpeed, uint16_t  
hDurationms )  
{  
    MCI_ExecSpeedRamp( pMCI[M1], hFinalSpeed, hDurationms );  
}
```

MC_ProgramTorqueRampMotor1(2000,2000); //设置为转矩模式，设置转矩指令
调用此函数后hDurationms设置时间内当前转矩变化到hFinalTorque设置的目标转矩

```
void MC_ProgramTorqueRampMotor1( int16_t hFinalTorque, uint16_t  
hDurationms )  
{  
    MCI_ExecTorqueRamp( pMCI[M1], hFinalTorque, hDurationms );  
}
```

Motor1Speed=MC_GetMecSpeedReferenceMotor1(); //获取Motor1
当前指令的机械转速，数字量1代表0.1HZ

```
int16_t MC_GetMecSpeedReferenceMotor1(void)
{
    return MCI_GetMecSpeedRef01Hz( pMCI[M1] );
}
```

Motor1SpeedAverage=MC_GetMecSpeedAverageMotor1(); //获取
Motor1当前指令的平均机械转速，数字量1代表0.1HZ

```
int16_t MC_GetMecSpeedAverageMotor1(void)
{
    return MCI_GetAvrgMecSpeed01Hz( pMCI[M1] );
}
```

Motor1State=MC_GetSTMStateMotor1(); //获取Motor1状态机的电机状态

```
State_t MC_GetSTMStateMotor1(void)
{
    return MCI_GetSTMState( pMCI[M1] );
}
```

Frequently used state

State	Code	Simple Description
IDLE	0	Idle
START	4	In start up process
START RUN	5	In start up process
RUN	6	Run normal
ANY_STOP	7	Stop
STOP	8	Stop
STOP IDLE	9	Stop
FAULT_NOW	10	Fault
FAULT_OVER	11	Fault

Motor1Faults=MC_GetOccurredFaultsMotor1();//获取Motor1发生过的故障代码

```
uint16_t MC_GetOccurredFaultsMotor1(void)
```

```
{
```

```
    return MCI_GetOccurredFaults( pMCI[M1] );
```

```
}
```

Fault List

State	Code	Simple Description
MC_NO_ERROR	0x0000	No fault
MC_NO_FAULTS	0x0000	No fault
MC_FOC_DURATION	0x0001	FOC calculation time out
MC_OVER_VOLT	0x0002	Bus over voltage
MC_UNDER_VOLT	0x0004	Bus under voltage
MC_OVER_TEMP	0x0008	Over temperature
MC_START_UP	0x0010	Start up failure
MC_SPEED_FDBK	0x0020	Speed feedback is not reliable
MC_BREAK_IN	0x0040	Hardware break in
MC_SW_ERROR	0x0080	Software fault

MC_AcknowledgeFaultMotor1();//清除电机故障错误
调用此函数前，如果电机发生故障。电机停留在FAULT_OVER状态，并保留故障代码。调用后，状态机清除故障代码记录，并恢复到IDLE状态。

```
bool MC_AcknowledgeFaultMotor1( void )  
{  
    return MCI_FaultAcknowledged( pMCI[M1] );  
}
```

Motor1Dir=MC_GetImposedDirectionMotor1();//返回最后一个指令设置的电机方向，如果最终的速度或转矩指令为负数返回-1，否则返回1

```
int16_t MC_GetImposedDirectionMotor1(void)  
{  
    return MCI_GetImposedMotorDirection( pMCI[M1] );  
}
```


main函数while循环代码示例：

- 1、电机以3000rpm运行，加速时间为2S；
- 2、程序启动电机运行，运行速度为3000rpm，在10S后停止转动；
- 3、电机停止前，读取电机相关参数（方向、速度、故障等）；
- 4、电机故障处理；
- 5、停止1S后电机重新运行，速度依然是3000rpm，不过速度为-3000rpm；
- 6、以上过程重复操作。

参考代码截图

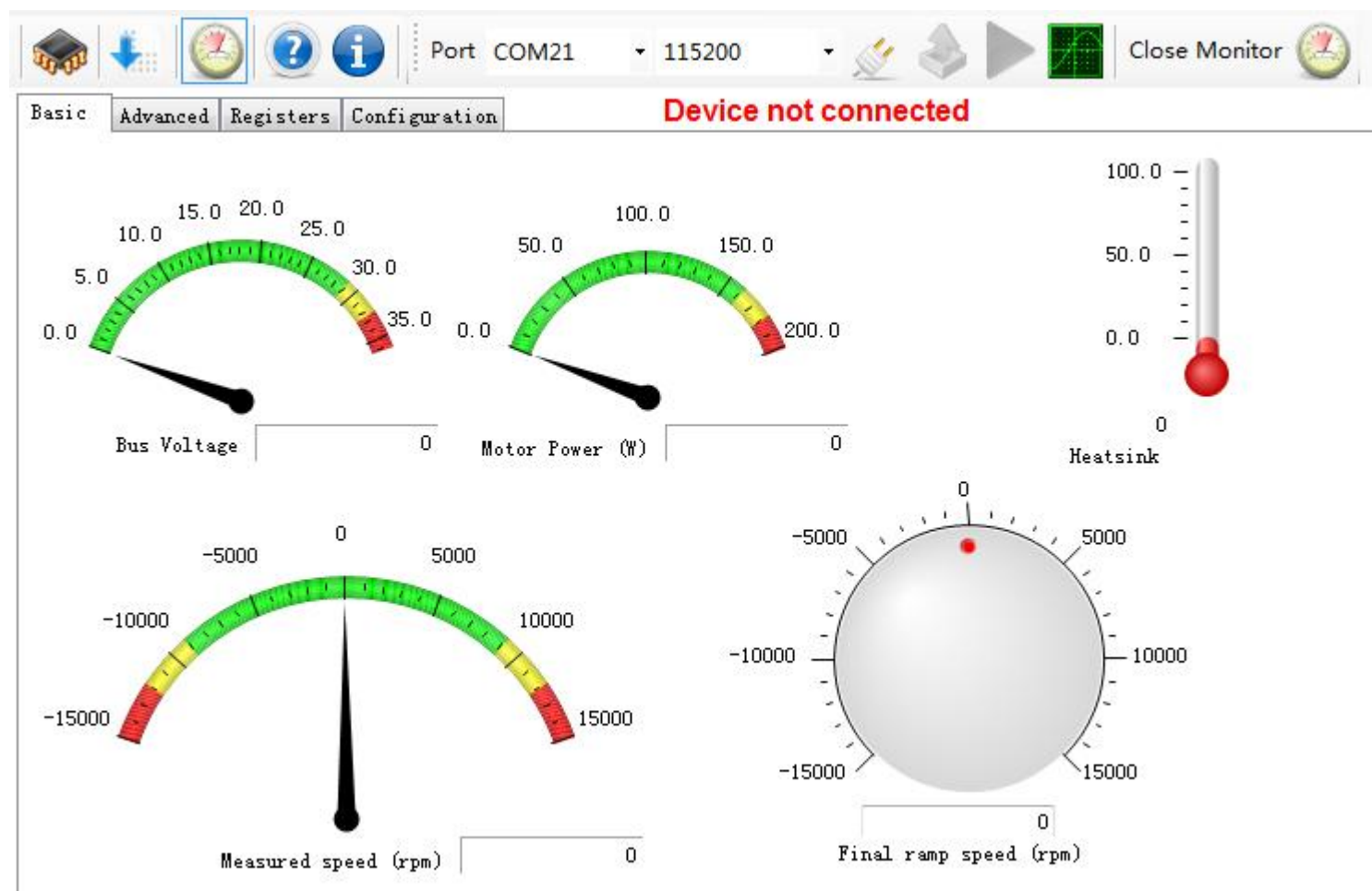
```
/* USER CODE BEGIN 3 */
MC_ProgramSpeedRampMotor1(3000/6,2000); //速度模式，设定电机速度为3000转（单位0.1HZ），加速度为2S
MC_StartMotor1(); //电机启动-----mc_api.c
HAL_Delay(2000); //延时2S
//MC_ProgramTorqueRampMotor1(2000,2000); //力矩模式，设定时间2S内，当前转矩变换为目标转矩
HAL_Delay(8000); //延时8S
Motor1Speed=
    MC_GetMecSpeedReferenceMotor1(); //获取当前指令的机械转速
Motor1SpeedAverage=
    MC_GetMecSpeedAverageMotor1(); //获取当前指令的平均机械转速
Motor1Dir=MC_GetImposedDirectionMotor1(); //返回最后一个指令设置的电机方向
Motor1State=MC_GetSTMStateMotor1(); //MOTOR状态机的电机状态
Motor1Faults=MC_GetOccurredFaultsMotor1(); //MOTOR发生过的故障代码
if((Motor1State==10)|| (Motor1State==11))
{
    MC_AcknowledgeFaultMotor1(); //出错的话先清除电机错误
}
else;
MC_StopMotor1(); //电机停止
HAL_Delay(1000); //延时1S

MC_ProgramSpeedRampMotor1(-3000/6,2000); //速度模式，设定电机速度为-3000转（单位0.1HZ），加速度为2S
MC_StartMotor1(); //电机启动-----mc_api.c
HAL_Delay(2000); //延时2S
//MC_ProgramTorqueRampMotor1(2000,2000); //力矩模式，设定时间2S内，当前转矩变换为目标转矩
HAL_Delay(8000); //延时8S
Motor1Speed=
    MC_GetMecSpeedReferenceMotor1(); //获取当前指令的机械转速
Motor1SpeedAverage=
    MC_GetMecSpeedAverageMotor1(); //获取当前指令的平均机械转速
Motor1Dir=MC_GetImposedDirectionMotor1(); //返回最后一个指令设置的电机方向
    Motor1State=MC_GetSTMStateMotor1(); //MOTOR状态机的电机状态
Motor1Faults=MC_GetOccurredFaultsMotor1(); //MOTOR发生过的故障代码
if((Motor1State==10)|| (Motor1State==11))
{
```

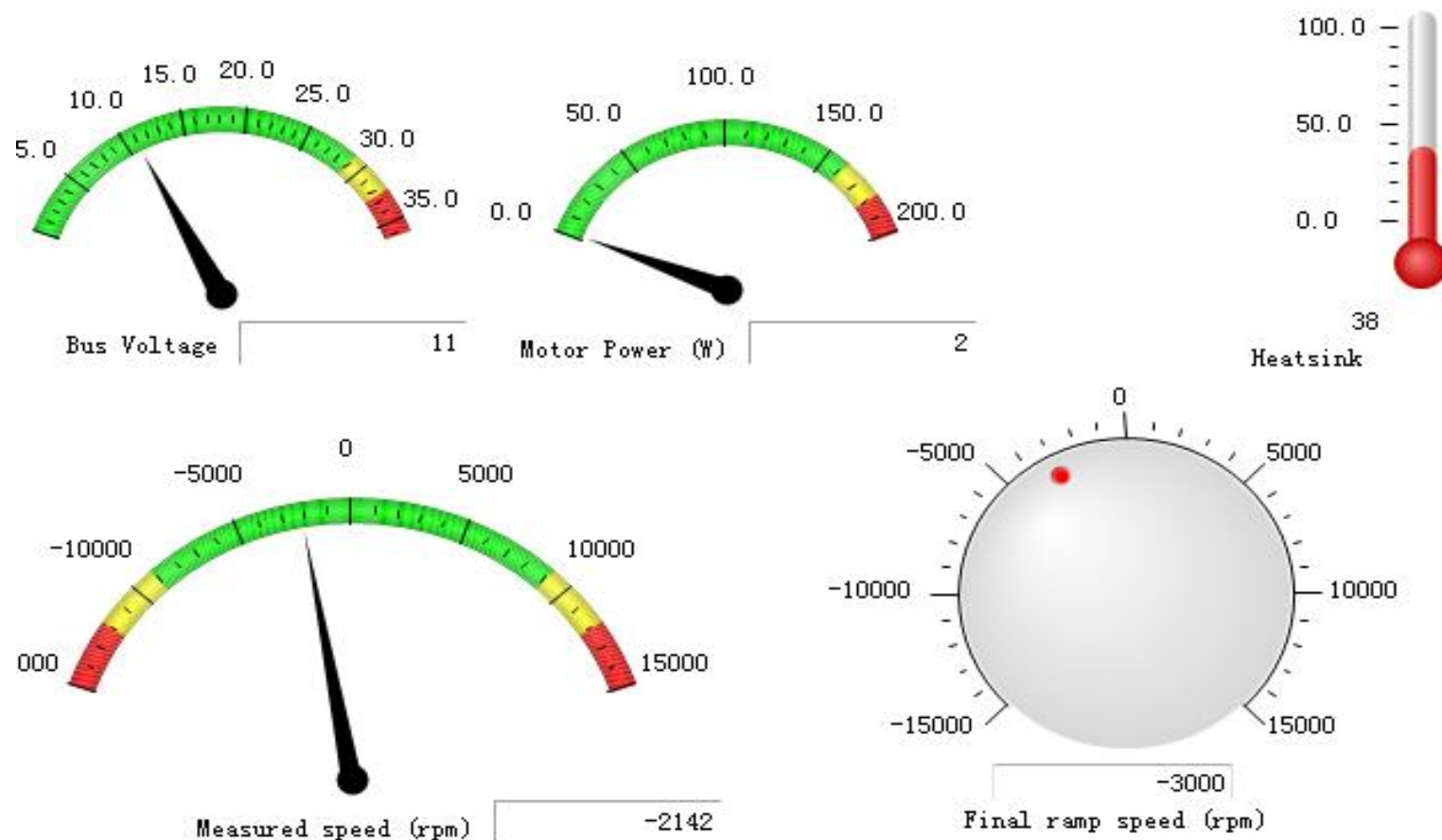
打开MotorControl Workbench观察相关参数和电机运行曲线

点Monitor按钮观察电机相关参数

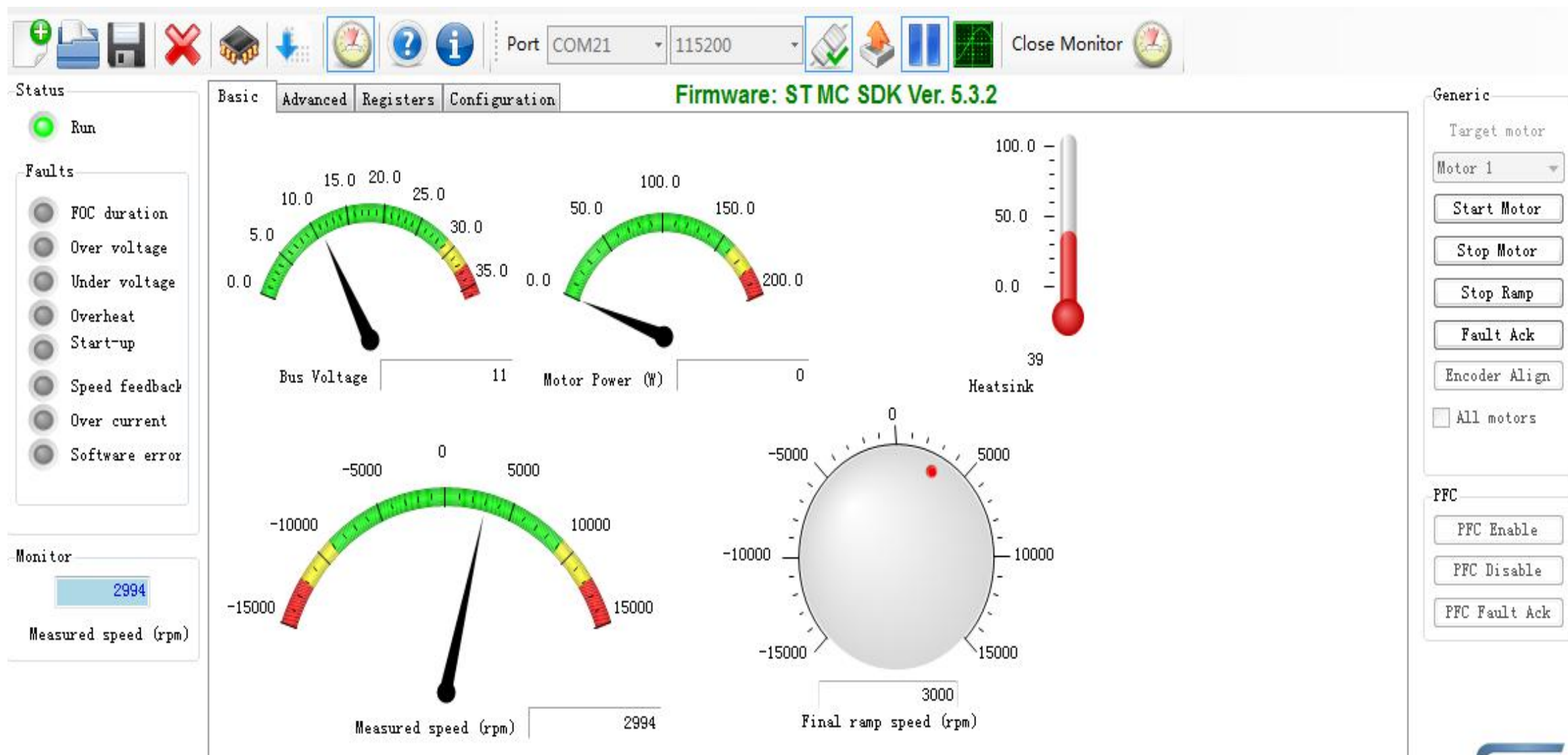
点开后如下图所示



点击connect按钮先进行连接，如连接不上按下板上黑色复位按钮或更换串口端口号先进行测试。连接后如下图所示（可以看到SDK 5.3版本）



点Basic界面，可以看到板子的一些参数，也可以对板子进行启动、停止、清除故障等操作



点Advanced界面，可以看到PID一些参数以及速度或转矩模式，也可以对板子进行启动、停止、清除故障及模式切换等操作

The screenshot displays the 'Advanced' configuration tab of the STM32CubeIDE. The top bar shows the port as COM21 and the baud rate as 115200. The firmware version is ST MC SDK Ver. 5.3.2. The interface is divided into several sections:

- Configuration and debug:** Control mode is set to Speed. Power Board Status shows BUS Voltage at 11 Volt and Heatsink temp. at 39 °C. DAC Settings show Ch1 as Ia and Ch2 as Ib.
- Current controller:** Set current reference in speed mode. Torque ref (I_q) is 986. Flux ref (I_d) is 0.
- Measured currents:** Torque (I_q) is -799. Flux (I_d) is 0.
- I_q PID Gains:** K_p is 964, K_i is 196.
- I_d PID Gains:** K_p is 964, K_i is 196.
- Speed controller:** Speed ramp. Target speed is 3000 rpm. Duration is 1000 millise. There is an 'Exec ramp' button.
- PID Gains:** K_p is 3955, K_i is 1271.
- Sensor-less Observer+PLL:** Observer is -1380. PLL K_p is 1862, PLL K_i is 44.
- Sensor-less Observer+Cordic:** Observer is 0.
- Flux weakening tuning:** K_p is 0, K_i is 0. BUS Voltage allowed: Ref is 0 %, Meas is 0 %.

点Registers界面，可以看到PID、寄存器等相关参数以及最后读取参数时间等

Firmware: ST MC SDK Ver. 5.3.2											
Basic	Advanced	Registers	Configuration								
	Id	Name	Unit	Value	Min	Max	Period	Type	Mode	Enable	Last read
▶	0x00	Target motor		0	0	255	0	U8	RW	<input checked="" type="checkbox"/>	never
	0x01	Flags		0	0	4294967...	200	U32	R	<input checked="" type="checkbox"/>	2019-01-06 14:1...
	0x02	Status		4	0	255	200	U8	R	<input checked="" type="checkbox"/>	2019-01-06 14:1...
	0x03	Control mode		1	0	255	500	U8	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x04	Speed reference	RPM	-3000	-15000	15000	200	S32	R	<input checked="" type="checkbox"/>	2019-01-06 14:1...
	0x05	Speed Kp		3955	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x06	Speed Ki		1271	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x07	Speed Kd		0	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	never
	0x08	Torque reference (Iq)		986	-32768	32767	0	S16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x09	Torque Kp		964	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x0A	Torque Ki		196	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x0B	Torque Kd		0	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	never
	0x0C	Flux reference (Id)		0	-32768	32767	0	S16	RW	<input checked="" type="checkbox"/>	never
	0x0D	Flux Kp		964	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x0E	Flux Ki		196	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x0F	Flux Kd		0	0	65535	0	U16	RW	<input checked="" type="checkbox"/>	never
	0x10	Observer C1		-1380	-32768	32767	0	S16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...
	0x11	Observer C2		3473	-32768	32767	0	S16	RW	<input checked="" type="checkbox"/>	2019-01-06 14:0...

点Configuration界面，可以对一些参数进行重新配置及重新装载

Port: COM21 115200

Close Monitor

Firmware: ST MC SDK Ver. 5.3.2

Basic Advanced Registers Configuration

Board Configuration

Import from

Motor available: Single Mot

Motor 1 or any motor

- ☒ Sensor-less (Obs+PLL)
- ☐ Sensor-less (Obs+Cordic)
- ☐ Sensor-less (HFI+Obs)
- ☐ Quadrature encoder
- ☐ Hall sensors
- ☐ Flux weakening
- ☒ DAC channels

Control mode: Speed

Min speed: -15000

Max speed: 15000

Max bus: 36.0

Motor 2 (if available)

- ☐ Sensor-less (Obs+PLL)
- ☐ Sensor-less (Obs+Cordic)
- ☐ Sensor-less (HFI+Obs)
- ☐ Quadrature encoder
- ☐ Hall sensors
- ☐ Flux weakening

Control mode: none

Min speed: -5000

Max speed: 5000

Max bus: 500.0

Revup Configuration

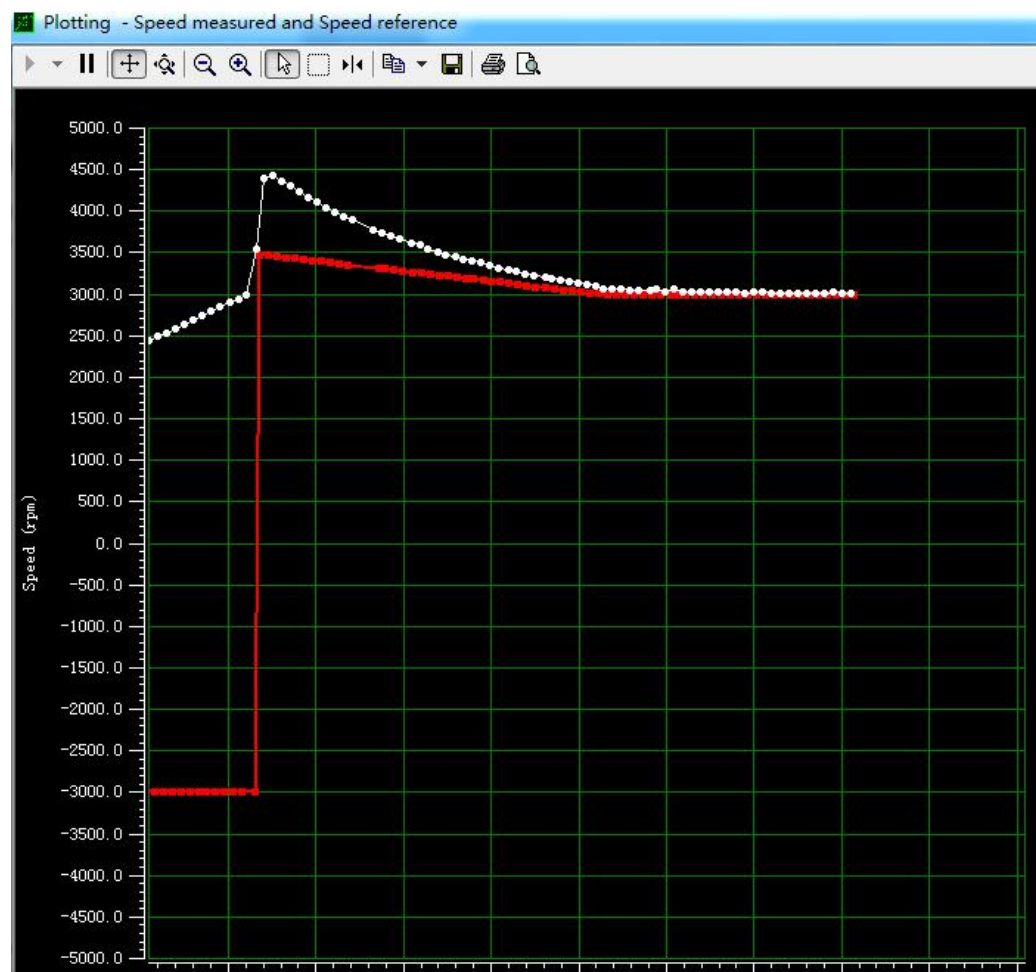
	Num	Final Speed (rpm)	Final Torque	Duration (ms)	Last read	Last write
▶	1	0	12032	1000	2019-01-06 14:00:49.601	never
	2	3330	12032	3333	2019-01-06 14:00:49.609	never
	3	3330	12032	0	2019-01-06 14:00:49.617	never
	4	3330	12032	0	2019-01-06 14:00:49.625	never
	5	3330	12032	0	2019-01-06 14:00:49.633	never

Reload

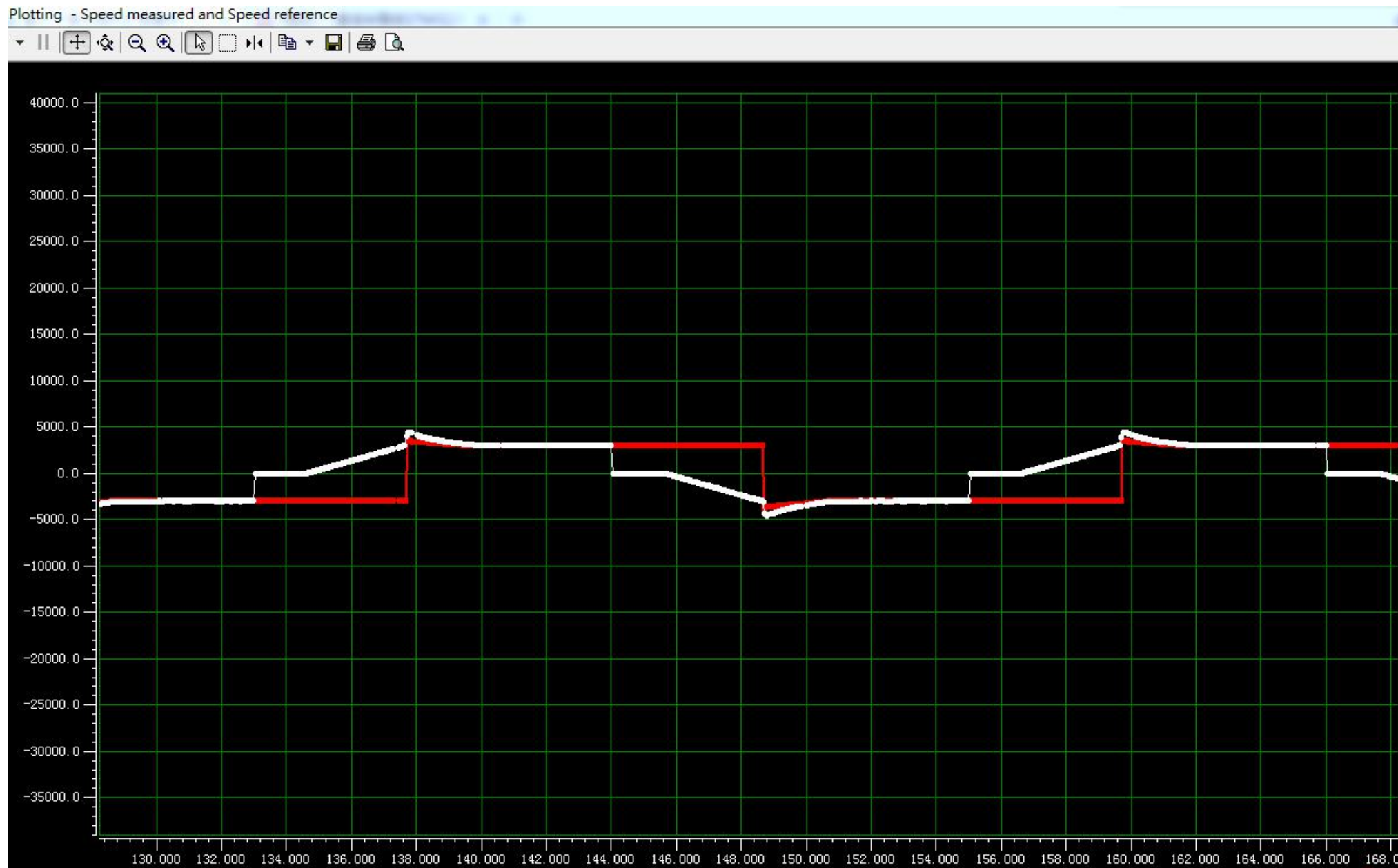
点Plotter按钮，观察电机的转速运行曲线



打开后如下图所示



可以通过放大、缩小、拖动等操作对电机的运行曲线看的更清晰些





以上内容仅供参考

感谢观看

技术交流QQ群：123768874