AT32F403标准库使用简述

AT32F403_StdPeriph_Lib_V1.0.2

库结构

●Libraries

- AT32F403_StdPeriph_Driver：at32f403外设驱动库。
- CMSIS：
  1. CM4：内核相关，包括Cortex-M4库文件，at32f403系统初始化文件、启动代码等。
  2. Documentation:相关文档。

●Middlewares

第三方软件包，如FreeRTOS等。

库结构

- Project
  - Examples： at32f403相关的应用案列。
  - Templates： at32f403工程模板。

库的使用

1. 在创建工程时，需要根据MCU型号，选择正确的启动代码，MCU型号与启动代码对应关系如下表。

MCU型号	启动代码	PINs	Flash大小(KB)
AT32F403CC/E	startup_at32f403cx_hd.s	48	256/512
AT32F403CG	startup_at32f403cx_xl.s	48	1024
AT32F403RC/E	startup_at32f403rx_hd.s	64	256/512
AT32F403RG	startup_at32f403rx_xl.s	64	1024
AT32F403VC/E	startup_at32f403vx_hd.s	100	256/512
AT32F403VG	startup_at32f403vx_xl.s	100	1024
AT32F403ZC/E	startup_at32f403zx_hd.s	144	256/512
AT32F403ZG	startup_at32f403zx_xl.s	144	1024

库的使用

2. 在at32f403.h中，是通过宏定义的方式选择MCU型号，如下图

```
/* Uncomment the line below according to the target AT32 device used in your
   application
  */
#if !defined (AT32F403Cx_HD) && !defined (AT32F403Cx_XL) && \
    !defined (AT32F403Rx_HD) && !defined (AT32F403Rx_XL) && \
    !defined (AT32F403Vx_HD) && !defined (AT32F403Vx_XL) && \
    !defined (AT32F403Zx_HD) && !defined (AT32F403Zx_XL)
/* #define AT32F403Cx_HD */   /*!< AT32F403Cx_HD: LQFP48, High density devices: AT32F403CC, AT32F403CE */
/* #define AT32F403Cx_XL */   /*!< AT32F403Cx_XL: LQFP48, XL-density devices: AT32F403CG */
/* #define AT32F403Rx_HD */   /*!< AT32F403Rx_HD: LQFP64, High density devices: AT32F403RC, AT32F403RE */
/* #define AT32F403Rx_XL */   /*!< AT32F403Rx_XL: LQFP64, XL-density devices: AT32F403RG */
/* #define AT32F403Vx_HD */   /*!< AT32F403Vx_HD: LQFP100, High density devices: AT32F403VC, AT32F403VE */
/* #define AT32F403Vx_XL */   /*!< AT32F403Vx_XL: LQFP100, XL-density devices: AT32F403VG */
/* #define AT32F403Zx_HD */   /*!< AT32F403Zx_HD: LQFP144, High density devices: AT32F403ZC, AT32F403ZE */
/* #define AT32F403Zx_XL */   /*!< AT32F403Zx_XL: LQFP144, XL-density devices: AT32F403ZG */
#endif
/*  Tip: To avoid modifying this file each time you need to switch between these
        devices, you can define the device in your toolchain compiler preprocessor.

 - High-density devices are at32f403xx microcontrollers where
   the Flash memory density ranges between 256 and 512 Kbytes.
 - XL-density devices are at32f403xx microcontrollers where
   the Flash memory density ranges between 512 and 1024 Kbytes.
  */

#if !defined (AT32F403Cx_HD) && !defined (AT32F403Cx_XL) && \
    !defined (AT32F403Rx_HD) && !defined (AT32F403Rx_XL) && \
    !defined (AT32F403Vx_HD) && !defined (AT32F403Vx_XL) && \
    !defined (AT32F403Zx_HD) && !defined (AT32F403Zx_XL)
#error "Please select first the target at32f403 device used in your application (in at32f403.h file)"
#endif
```

库的使用

所以，在Code编译之前，需要根据MCU型号，打开对应的宏定义，MCU型号与宏定义的对应关系如下表。

MCU型号	宏定义	PINs	Flash大小(KB)
AT32F403CC/E	AT32F403Cx_HD	48	256/512
AT32F403CG	AT32F403Cx_XL	48	1024
AT32F403RC/E	AT32F403Rx_HD	64	256/512
AT32F403RG	AT32F403Rx_XL	64	1024
AT32F403VC/E	AT32F403Vx_HD	100	256/512
AT32F403VG	AT32F403Vx_XL	100	1024
AT32F403ZC/E	AT32F403Zx_HD	144	256/512
AT32F403ZG	AT32F403Zx_XL	144	1024

库的使用

3. 在at32f403.h中，通过宏定义LIBRARY_VERSION可以选择是否“包含”MCU外设相关的头文件，如下图。

```
7692 #ifdef LIBRARY_VERSION
7693   #include "at32f403_conf.h"
7694 #endif
```

at32f403_conf.h“包含”了所有外设头文件，如下图。

```
28 #include "at32f403_adc.h"
29 #include "at32f403_bkp.h"
30 #include "at32f403_can.h"
31 #include "at32f403_crc.h"
32 #include "at32f403_dac.h"
33 #include "at32f403_dbgmcu.h"
34 #include "at32f403_dma.h"
35 #include "at32f403_exti.h"
36 #include "at32f403_flash.h"
37 #include "at32f403_xmc.h"
38 #include "at32f403_gpio.h"
39 #include "at32f403_i2c.h"
40 #include "at32f403_iwdg.h"
41 #include "at32f403_pwr.h"
42 #include "at32f403_rcc.h"
43 #include "at32f403_rtc.h"
44 #include "at32f403_sdio.h"
45 #include "at32f403_spi.h"
46 #include "at32f403_tim.h"
47 #include "at32f403_usart.h"
48 #include "at32f403_wwdg.h"
49 #include "misc.h" /* High level fu
```

库的使用

4. System_at32f403.c系统时钟初始化，如下图，需要打开一个宏定义选择初始化时钟。

```
86
87  /* #define SYSCLK_FREQ_HSE          HSE_VALUE */
88  /* #define SYSCLK_FREQ_24MHz        24000000 */
89  /* #define SYSCLK_FREQ_36MHz        36000000 */
90  /* #define SYSCLK_FREQ_48MHz        48000000 */
91  /* #define SYSCLK_FREQ_56MHz        56000000 */
92  /* #define SYSCLK_FREQ_72MHz        72000000 */
93  /* #define SYSCLK_FREQ_96MHz        96000000 */
94  /* #define SYSCLK_FREQ_108MHz       108000000 */
95  /* #define SYSCLK_FREQ_120MHz       120000000 */
96  /* #define SYSCLK_FREQ_144MHz       144000000 */
97  /* #define SYSCLK_FREQ_168MHz       168000000 */
98  /* #define SYSCLK_FREQ_176MHz       176000000 */
99  #define SYSCLK_FREQ_192MHz       192000000
100 /* #define SYSCLK_FREQ_200MHz       200000000 */
101 /* #define SYSCLK_FREQ_24MHz_HSI    24000000 */
102 /* #define SYSCLK_FREQ_36MHz_HSI    36000000 */
103 /* #define SYSCLK_FREQ_48MHz_HSI    48000000 */
104 /* #define SYSCLK_FREQ_56MHz_HSI    56000000 */
105 /* #define SYSCLK_FREQ_72MHz_HSI    72000000 */
106 /* #define SYSCLK_FREQ_96MHz_HSI    96000000 */
107 /* #define SYSCLK_FREQ_108MHz_HSI   108000000 */
108 /* #define SYSCLK_FREQ_120MHz_HSI   120000000 */
109 /* #define SYSCLK_FREQ_144MHz_HSI   144000000 */
110 /* #define SYSCLK_FREQ_168MHz_HSI   168000000 */
111 /* #define SYSCLK_FREQ_176MHz_HSI   176000000 */
112 /* #define SYSCLK_FREQ_192MHz_HSI   192000000 */
113 /* #define SYSCLK_FREQ_200MHz_HSI   200000000 */
```

库的使用

系统时钟初始化结果如下图：

```
1. After each device reset the HSI is used as System clock source.

2. Please make sure that the selected System clock doesn't exceed your device's
   maximum frequency.

3. If none of the define below is enabled, the HSI is used as System clock
 source.

4. The System clock configuration functions provided within this file assume that:
     - For at32f403 devices, an external 8MHz crystal is used to drive the System clock.
  If you are using different crystal you have to adapt those functions accordingly.

   Clock (MHz)
       PLL from HSE or HSI
       SYSCLK      HCLK  PCLK2 PCLK1
       24          24      24      24
       36          36      36      36
       48          48      48      24
       56          56      56      28
       72          72      72      36
       96          96      96      48
       108         108     108     54
       120         120     60      60
       144         144     72      72
       168         168     84      84
       176         176     88      88
       192         192     96      96
       200         200     100     100
```

Thank you!