STM32 F1 firmware library for ***easySPIN*** (L6474) motor driver

Quick guide

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STM32 F1 firmware library for ***easy*SPIN**

- The firmware library allows you to control the L6474 ***easy*SPIN** microstepping motor driver using **STM32 F1** microcontrollers
- In addition to basic ***easy*SPIN** low-level configuration functions, the library contains a set of handy motion control routines that help to reduce your programming effort when writing an application
(e.g. acceleration/deceleration patterns and user-defined speed profiling)
- Designed for STEVAL-PCC009V1/2 and STM32VLDISCOVERY demonstration control boards, but can be easily configured to suit any STM32-based application

***easy*SPIN evaluation hardware**

- ***easy*SPIN** features can be explored using the EVAL6474H board
  - Direct connection to STEVAL-PCC009V1/2 demonstration boards
  - Voltage range from 8 to 45 V
  - Phase current up to 3 A
  - SPI interface with daisy chain feature allows evaluation of the L6474 in multi-motor applications
  - Status LED

EVAL6474H

Development tools supported

- Project files are available for the following development environments:
  - Keil µVision v4.50
  - IAR EWARM 6.30
  - Atollic TrueSTUDIO 2.3.0
- By default, all demo projects are configured to use the ST-LINK in-circuit debugger
- The configuration can be easily changed if another tool is used for application debugging

ST-LINK

STEVAL-PCC009V2

Project setup customization

When using the library with non-default tools/settings, the following points need to be checked/modified

- Configure debugger options in *Project settings* for the in-circuit debugger used (type, debugging interface, etc.)
- Select appropriate control board and/or define proper MCU pin mapping (**`easyspin_target_config.h`**, **`easyspin.h`**)
- easySPIN configuration values can be tuned in order to suit particular stepper motor characteristics (**`easyspin_target_config.h`**, **`main.c`**) :

```
/* Customize target stepper-motor specific registers at easySPIN module level */
/* TVAL register setup */
easySPIN_SetParam(easySPIN_TVAL, 0x00);

/* T_FAST register setup */
easySPIN_SetParam(easySPIN_STEP_MODE, easySPIN_STEP_SEL_1
                  | easySPIN_SYNC_SEL_1_2);
                                        .
                                        .
                                        .
```

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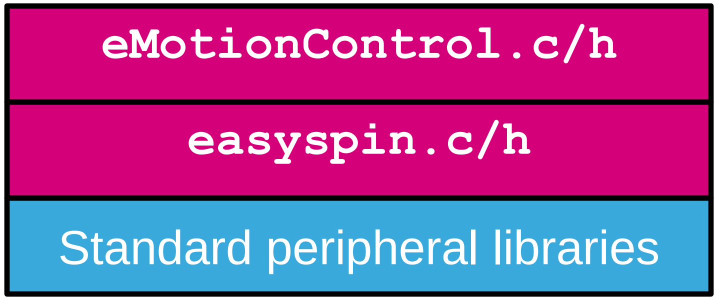
STM32 firmware library structure

The key library components are the following

- **easyspin_target_config.h**
  - Application specific settings
  - Motion dynamics configuration
  - Target board selection
- **easyspin.c/h**
  - Contains definitions of L6474 internal registers, its options and masks
  - Microcontroller peripheral initialization routines
  - ***easySPIN*** *Application commands* implementation
  - SPI communication
- **eMotionControl.c/h**
  - Implementation of complex motion control commands
  - Runtime motion control mechanism (step generation)
  - Motion speed profile computation (smooth motion) according to the application needs
- **main.c**
  - Demo program code
- **clock.c/h**
  - System clock setup routines

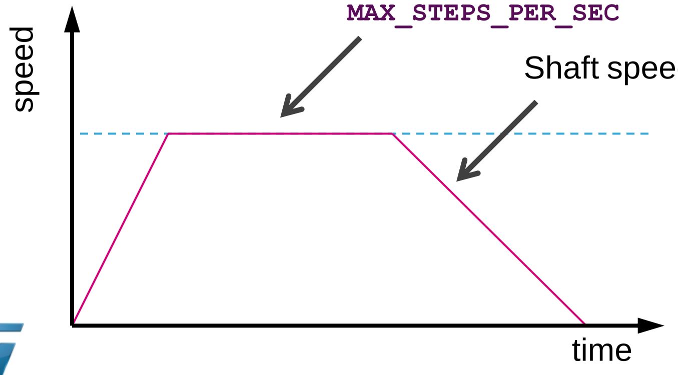


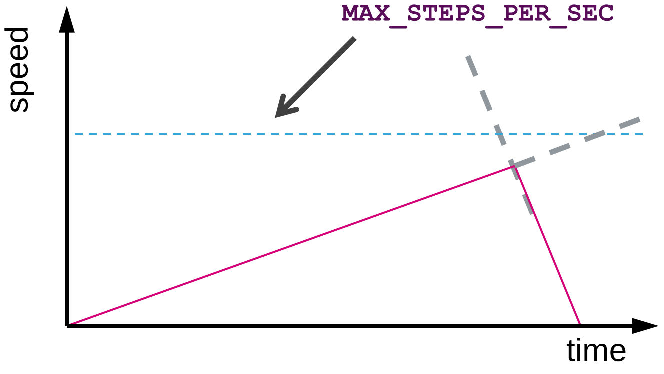
Speed profile computation

- The firmware library computes speed profiles for smooth motor motion suitable to the application needs (jerky motion prevention)
- User defines motion parameters (acceleration/deceleration, max speed):

```
#define MIN_STEPS_PER_SEC               10        /* [steps/sec] */
#define MAX_STEPS_PER_SEC               200       /* [steps/sec] */
#define ACCELERATION_RATE               40        /* [steps/sec^2] */
#define DECELERATION_RATE               40        /* [steps/sec^2] */
```

- Motion control module works to keep the above settings satisfied
  - The appropriate speed profile (step timing sequence) is computed every time a motion command arrives
  - In some cases, a steady speed may not be achieved (see below) to keep motion parameters defined and to avoid rippling in shaft rotation





Motion control API

- System initialization

```
eMotionControl_Init()

eMotionControl_ResetDevice()
```

- Motion commands

```
eMotionControl_Run(direction, speed)

eMotionControl_Move(direction, stepCount)

eMotionControl_GoTo(targetPosition)

eMotionControl_GoHome()

eMotionControl_GoMark()

eMotionControl_ResetPos()
```

- Program control

```
eMotionControl_WaitWhileActive()

eMotionControl_GetState()
```

Brief explanation of commands

- **`eMotionControl_Move(DIR_Forward, 200)`**
  - Produces given number of steps in given direction
  - The steps are performed providing that the speed profile meets the settings

Library defined constant for motion direction

Motion speed parameter
[(micro)steps per second]

- **`eMotionControl_Run(DIR_Reverse, 200)`**
  - This command produces a motion in a given direction at speed (steps per second) given by function parameter
  - If the speed value exceeds the maximum speed defined, then it is clamped accordingly
  - Starting phase of the motion corresponds to the motion dynamics settings

Target position

- **`eMotionControl_GoTo(65)`**
  - Produces steps to reach given absolute position (ABS_POS register value)
  - The steps are performed providing that the speed profile meets the settings

Demo program code sample

- The initialization of the motion control module is straightforward

```
void main() {
  /* Configure the System clock frequency */
  SetSysClock();

  /* eMotionControl module initialization */
  eMotionControl_Init();

  /* Motion parameters customization can be done here… */

  /* Move command example */
  eMotionControl_Move(DIR_Forward, 200);
  eMotionControl_WaitWhileActive();

  /* GoTo command example */
  eMotionControl_GoTo(65);
  eMotionControl_WaitWhileActive();
  currentPosition = easySPIN_GetParam(easySPIN_ABS_POS);

  /* … */
}
```