



AN2499

Application note

ST10 electric motor control library:
PWM driver

Introduction

STMicroelectronics provides a library of electric motor control functions that can be used as base blocks for motor control applications.

This application note describes the set of API to manage PWM signals to drive a 3-phase electric motor with the desired voltage with ST10 microcontrollers.

Contents

- 1 **Functions set overview 5**
- 2 **PWM overview 6**
- 3 **API specification 7**
 - 3.1 Functions definition 8
 - 3.1.1 PWM_Init 8
 - 3.1.2 PWM_start 9
 - 3.1.3 PWM_Register 10
 - 3.2 Resource 11
- 4 **Revision history 12**

List of tables

Table 1. PWM_Init Parameters: 8

Table 2. PWM_start Parameters: 9

Table 3. PWM_Register Parameters:..... 10

Table 4. Required library resources 11

Table 5. Document revision history 12

List of figures

Figure 1. ST10 EMCL structure 5

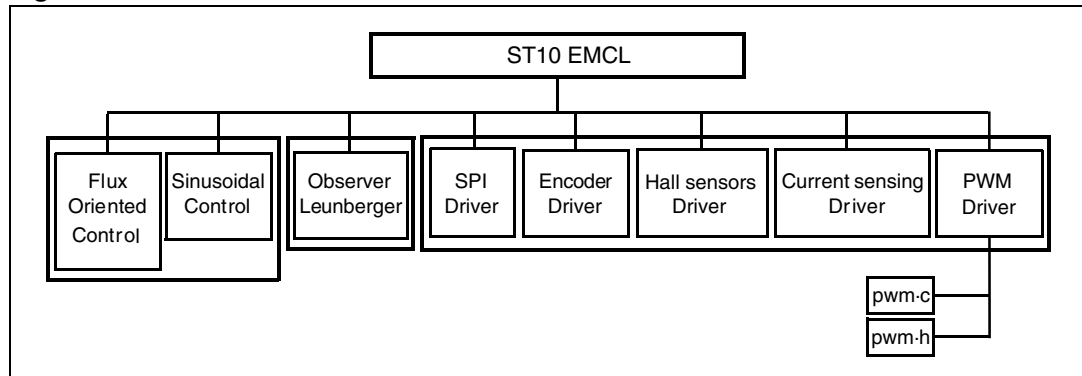
Figure 2. Inverter 6

Figure 3. Output waveforms. 6

1 Functions set overview

The PWM driver is a set of functions included in ST10 Electric Motor Control Library (EMCL) (see [Figure 1](#)) useful to generate six PWM signals to drive a 3-phase electric motor by inverter in electric motor control applications. The document explains how to use and configure ST10 peripherals in order to produce PWM signals with adjustable pulse width at the beginning of each new PWM period.

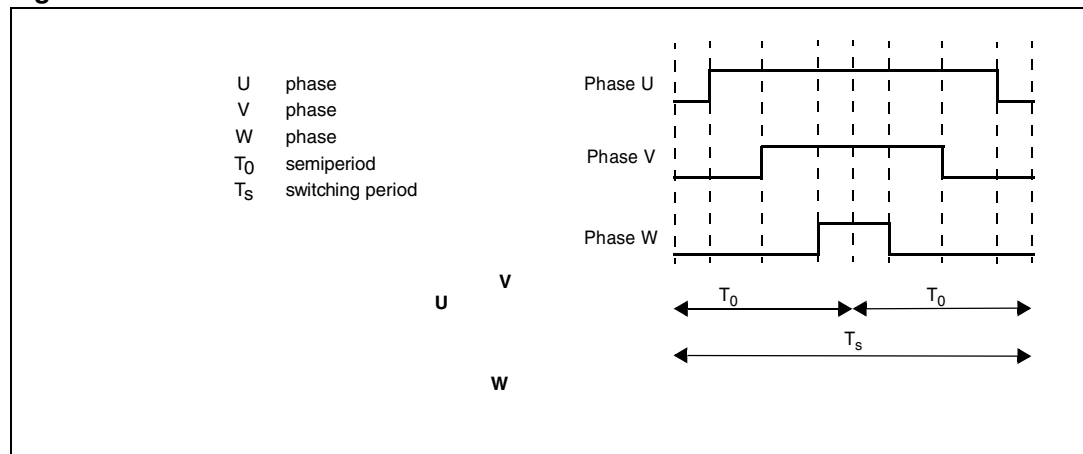
Figure 1. ST10 EMCL structure



2 PWM overview

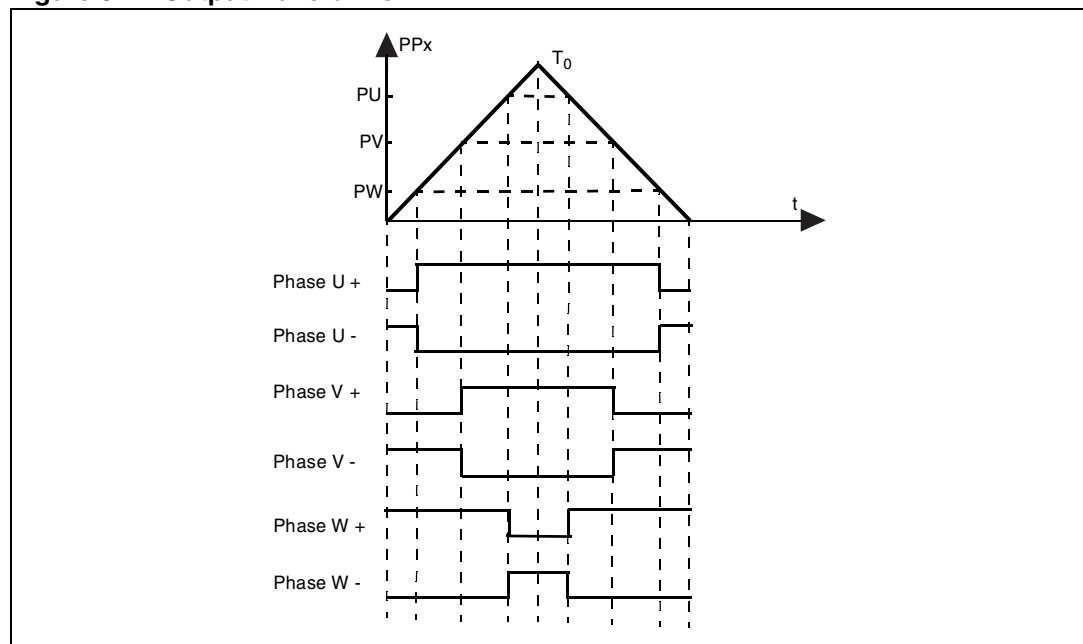
A power inverter is a d.c. to a.c. converter used to apply the desired voltage across the motor phases. In particular for a 3-phase electric motor it is used an 3-phase full bridge inverter with 6 switches, MOSFETs in low-voltage applications (i.e. automotive field). The components of the inverter are impulsed, following a specific switching pattern, producing the symmetric waveforms necessary to drive the motor (see [Figure 2](#)).

Figure 2. Inverter



To obtain the waveforms of [Figure 2](#), it is used the ST10 PWM and XPWM Modules channels configuring their pulse width (PW) registers with the values calculated by control algorithm and updated at every PWM period. The upper and lower switches of the same leg of inverter are driven with two complementary pulsed signals (see [Figure 3](#)) with a so called dead-time to avoid shortcut.

Figure 3. Output waveforms



3 API specification

The following API allows easy access to the set of functions to configure the PWM and XPWM modules channels in Center Aligned Mode and to change the pulse width of each signal simultaneously at every PWM period.

The use of these functions eliminates the need to access directly ST10 registers.

Available functions:

1. void PWM_Init(void);
2. void PWM_start(void);
3. void PWM_Register(PWMFUNCTION pwmfunction);

see file pwm.c in the EMSW_PWM Library.

3.1 Functions definition

This section describes the functions used by the implemented control algorithm in order to:

- - configure the PWM and XPWM modules;
- - start the PWM and XPWM timers;
- - and change the pulse width of the output signals.

3.1.1 PWM_Init

Prototype definition:

void PWM_Init(void)

Table 1. PWM_Init Parameters:

Configuration Parameters	Description
none	
Global Parameters	
PU	variable to store current PWM U phase value
PV	variable to store current PWM V phase value
PW	variable to store current PWM W phase value
pwmFunction	pointer to the control algorithm function
Function Parameters	
none	

Description:

The PWM_Init function is used to initialize the Pulse Width Modulation (PWM) Module and the XPWM Module selecting three channels for each module in Center Aligned Mode with the default values of semi period (PP) and pulse width (PW) and enables interrupt from PWM channel 0 at the beginning of each new PWM cycle.

PWM	pin (output)
channel 0	P7.0
channel 1	P7.1
channel 2	P7.2
XPWM	
channel 0	P8.0
channel 1	P8.1
channel 2	P8.2

3.1.2 PWM_start

Prototype definition:

```
void PWM_start(void)
```

Table 2. PWM_start Parameters:

Configuration Parameters	Description
none	
Global Parameters	
PU	variable to store current PWM U phase value
PV	variable to store current PWM V phase value
PW	variable to store current PWM W phase value
pwmFunction	pointer to the control algorithm function
Function Parameters	
none	

Description:

The PWM_start function starts the PWM and XPWM timers simultaneously.

3.1.3 PWM_Register

Prototype definition:

```
void PWM_Register(PWMFUNCTION pwmfunction)
```

Table 3. PWM_Register Parameters:

Configuration Parameters	Description
none	
Global Parameters	
PU	variable to store current PWM U phase value
PV	variable to store current PWM V phase value
PW	variable to store current PWM W phase value
pwmFunction	pointer to the control algorithm function
Function Parameters	
none	

Description:

The PWM_Register function points to the control algorithm function. It is needed to declare in the main a user function with the algorithm control and to register it so that the algorithm can be executed at every occurrence of PWM interrupt.

3.2 Resource

For the use of the library the needed resources are:

Table 4. Required library resources

3 PWM channels	PWM
3 XPWM channels	XPWM
1 Bank register (RB10)	interrupt

4 Revision history

Table 5. Document revision history

Date	Revision	Changes
29-Mar-2007	1	Initial release.

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