DT0125
Design tip

L647x slew rate control: reduce power losses and operative junction temperature

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Main components	
L6470	Fully integrated microstepping motor driver with motion engine and SPI
L6472	Fully integrated microstepping motor driver with motion engine and SPI
L6474	Stepper motor driver with up to 16 microsteps with SPI and advanced current control

Purpose and benefits

L647x family includes advanced stepper motor drivers that, along with the available software tool, allow power electronic designers to easily perform very complex tasks and achieve optimal performances with just few click of a mouse. These devices are able to perform a very accurate control of the integrated power MOSFET' slew rate. This feature, usually forgotten, can hugely improve the performance of our final application.

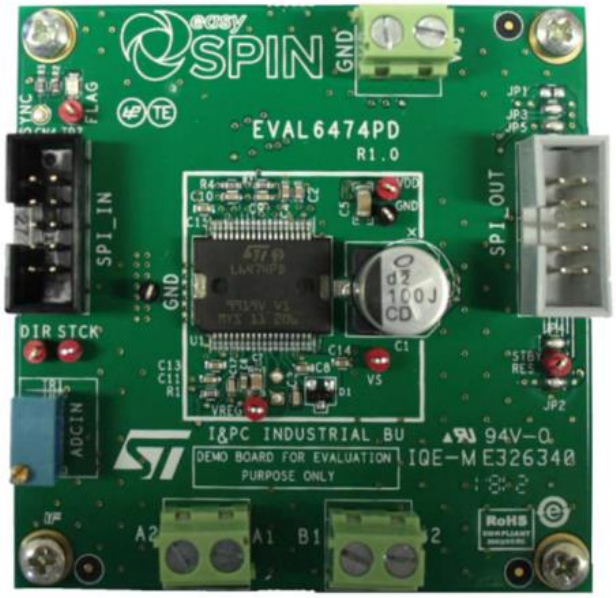
Description

A simple test was performed using the EVAL6474PD board (Stepper motor driver mounting the L6474 in high power PowerSO package) and a commercially available stepper motor, shown in Figure 2. The purpose of this test is to show how the final temperature of the L6474 will change when the SLEW RATE is changed from the default value to the FASTEST one. It is important to keep in mind that changing the SLEW RATE will affect not only the power losses and final temperature of the driver but its EMI as well. As usual in power electronic design, a tradeoff exists between these parameters. However, it is important to understand how beneficial the SLEW RATE control can be to reduce power losses and operative temperatures.

While keeping every other parameter set to its default condition, only the SLEW RATE was changed and the temperature measured on top of the L6474 (as well as the PCB). Ambient temperature was at 25ºC.

Two different steeping mode were tested: FULL STEP and 1/8th steps. Results are showed in the following tables:

Figure 1. EVAL6474PD evaluation board



The EVAL6474PD represents an optimal layout with a proper choice of coppers areas (top and bottom) to help the L6474 dissipate the heat generated during the test.

Figure 2. 1.8° Stepper Motor

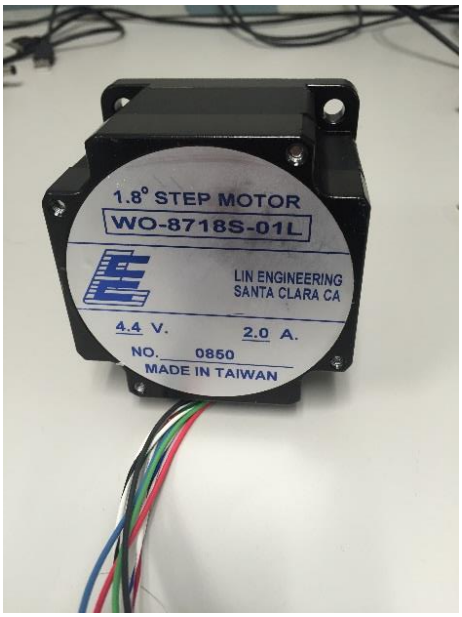


Table 1. FULL STEP results

V_{supply}	I_{load}	Slew rate	T_{pcb}	T_{case} L6474
36V	1.3A	Default	120ºC	144ºC
36V	1.3A	Max	92ºC	109ºC

Table 2. 1/8th STEP results

V_{supply}	I_{peak}	Slew rate	T_{pcb}	T_{case} L6474
36V	1.5A	Max	61ºC	69ºC
36V	2.8A	Max	92ºC	110ºC
36V	3.3A	Max	110ºC	133ºC

Table 1 shows the impact that a changing the SLEW RATE has on the performance of our device. Maximum measured temperature is decreased from 144ºC to 109ºC. As already mentioned, Table 1 refers to a FULL STEP operating mode so, there is no difference between PEAK value or RMS value of the load current (that's why the table only reports I_{Load}).

Table 2 summarizes the results for driving the motor in 1/8th microstep. Of course, now we can achieve a higher load current because of the sinusoidal modulation. For this second test, the SLEW RATE was set to the maximum allowed value and the test were done at different current levels.

Always keep in mind that different control algorithms will have a different impact on total power losses and operating temperatures.

Support material

Please refer to the following table:

Related design support material
Data brief, EVAL6474PD Stepper motor driver mounting the L6474 in a high power PowerSO package
Software Tool, STSW-SPIN002 Evaluation software with graphical user interface for STSPIN motor driver ICs
User Manual, UM2022**:** SPINFamily evaluation tool
Documentation
Datasheet, L6470 Fully integrated microstepping motor driver with motion engine and SPI
Datasheet, L6472 Fully integrated microstepping motor driver with motion engine and SPI
Datasheet, L6474 Stepper motor driver with up to 16 microsteps with SPI and advanced current control

Revision history

Date	Version	Changes
11-12-2018	1	Initial release

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