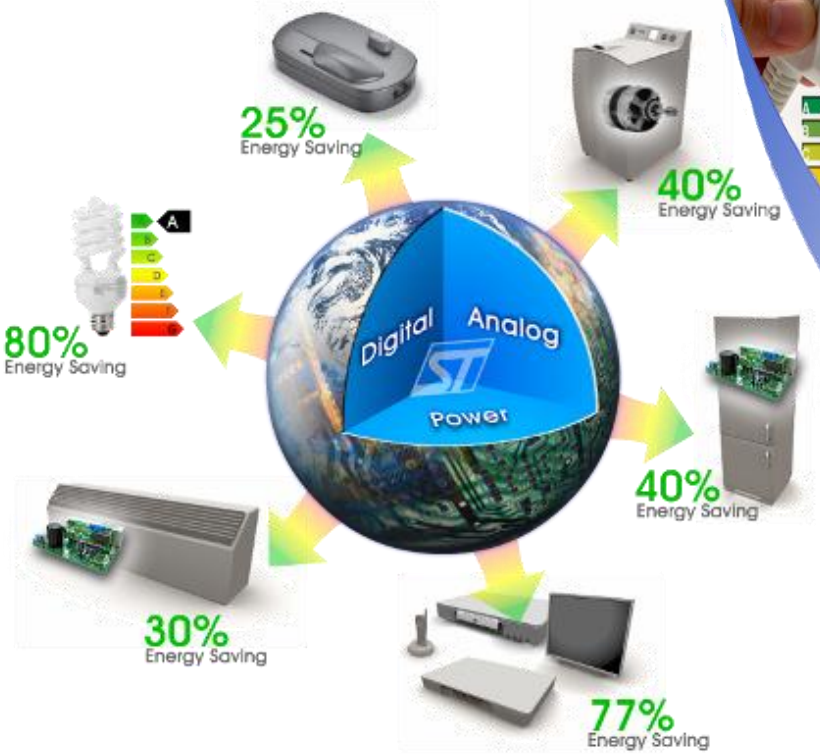


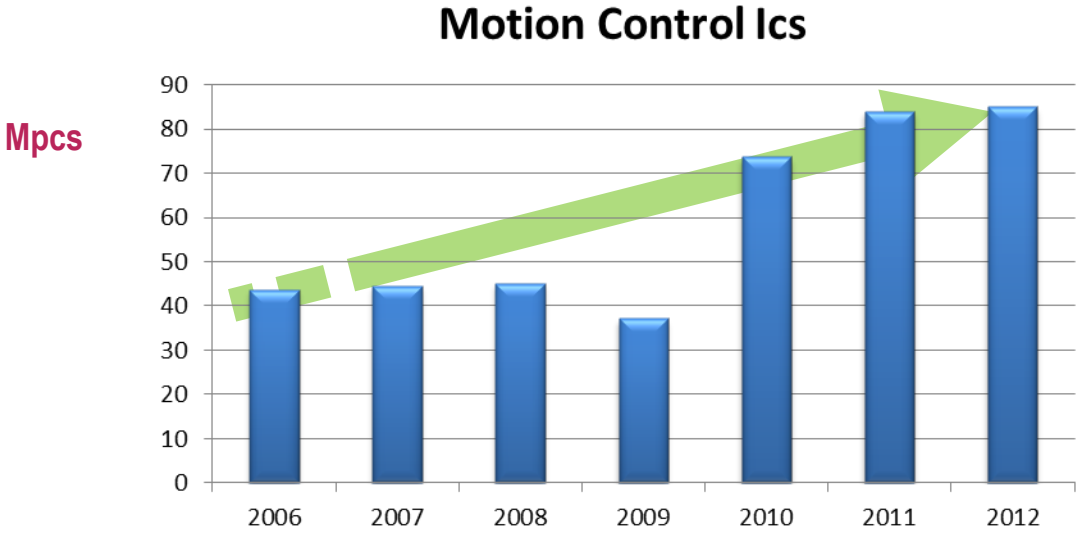
Microelectronics

Stepper Driver ICs

ST Motion Control

Our strengths

- ✓ *Pioneer in BCD and BCDoff-line technology, sold today in Millions pcs in many different application segments*
- ✓ *Skills in mixing of power, analog and digital structures in a single IC*
- ✓ *Strong expertise in systems and application requirements*
- ✓ *Strong skills on "design for robustness" thanks to the continuous improvement over 20 years of experience in the field*



Applications addressed

Industrial

- X-Y Position and Rotation systems
- PCB assembly (Pick & Place)
- Robotics & NC machines
- Textile industry
  (Sewing / Spinning machines)
- Professional printers
- Stage lighting

Point Of Sale

- ATM systems
- Vending machines

Gaming

- Casino machine
- Toys

Medical

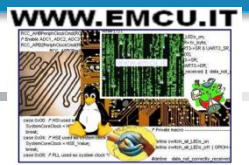
- Diagnostic Equipment
- Pumps
- cPAP

Office equipment

- Shredders

Intelligent buildings

- Security systems
- Antenna / satellite positioning



Wherever stepper motors are used!

xSPIN Product Family Overview

Fully integrated drivers with DMOS power stage

Advanced controller

L62xx, L62xQ

- DC, BLDC and stepper motor driver
- Full set of protections

New

L6474

- Microstepping driver
- Adaptive decay
- SPI-programmable, diagnostics

L6460

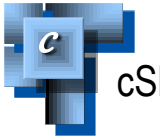
- DC and Microstepping driver
- 4 configurable full bridge drivers
- DC-DC, GPIO, OP-Amp, DAC, ADC

dSPIN

New

L6470 / L6472

- Digital core for motion control
- Microstepping driver
- SPI-programmable, diagnostics



cSPIN

New

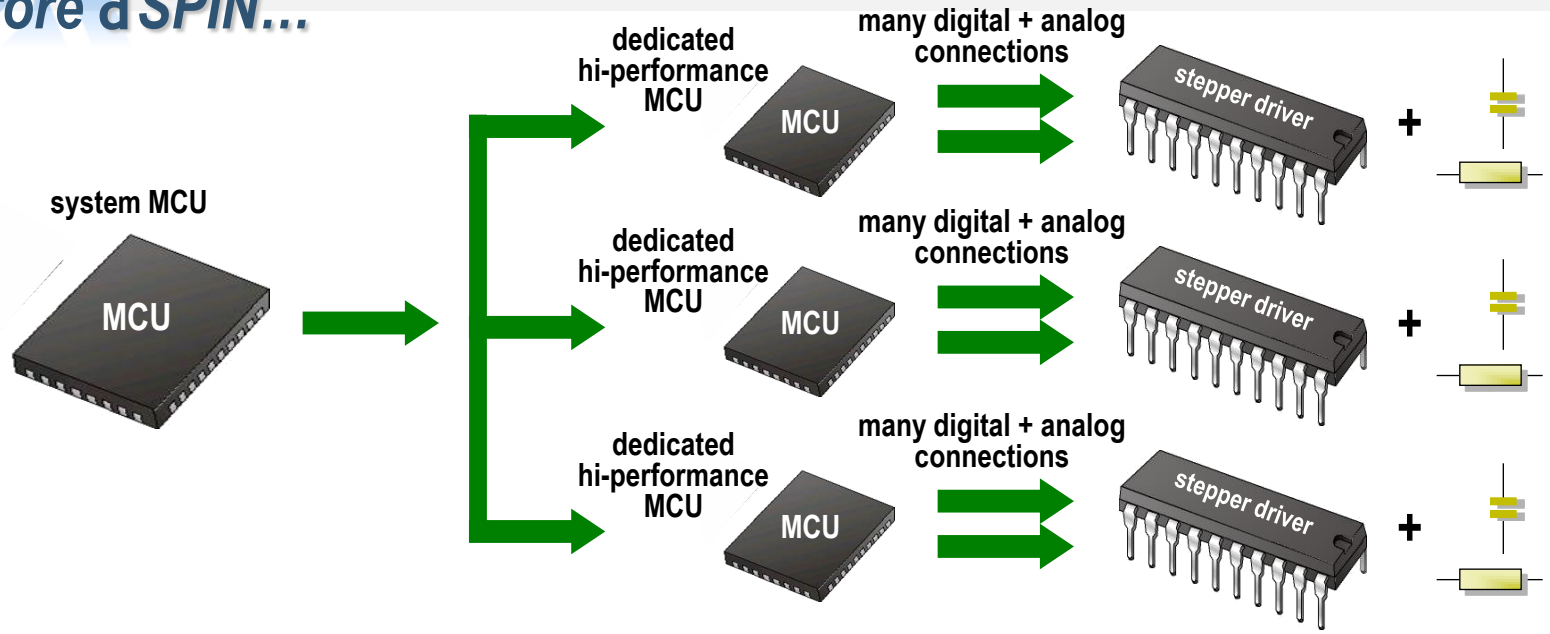
L6480/2

- Digital core for motion control
- Microstepping controller for 8x external MOSFETs, 85V
- SPI-programmable, diagnostics

Performance and integration

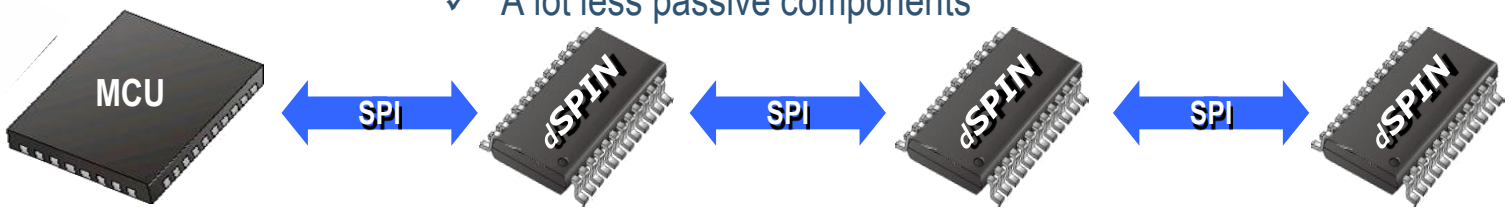
Simplify the System with dSPIN

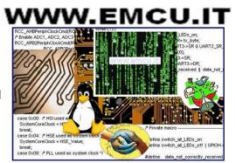
before dSPIN...



with dSPIN...

- ✓ System is heavily simplified
- ✓ No more dedicated µC to perform speed profile and positioning calculations
- ✓ A lot less passive components





and... ***far better performances!***

Current Mode Driver

L6474

L6472

L6482

Current mode driver
L6474 - L6472 - L6482

Common Features

- Operating voltage: 8 – 45V
- 7.0 A output peak current (3.0 A r.m.s.)
- 0.28Ω R_{DSON} power MOSFETs
- Programmable power MOS slew-rate
- Up to 16 µsteps
- SPI interface
  - Access to rich register set
- Low quiescent and standby currents
- Integrated 5bit ADC
- Non dissipative current sensing
- Full set of Protections
  - Programmable non dissipative over current (on all power MOS)
  - Two levels over temperature protection
  - UVLO (Under-voltage lockout)

easySPIN - L6474

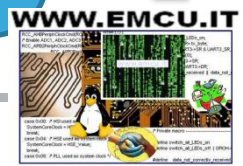
- Current control with adaptive decay
- Configuration through SPI bus
- Control using CLK & DIR pins

dSPIN - L6472

- Adaptive decay control
- Predictive current control
  - Average current is controlled
- speed or positioning commands
  - Programmable speed profile
- Fully controlled over SPI

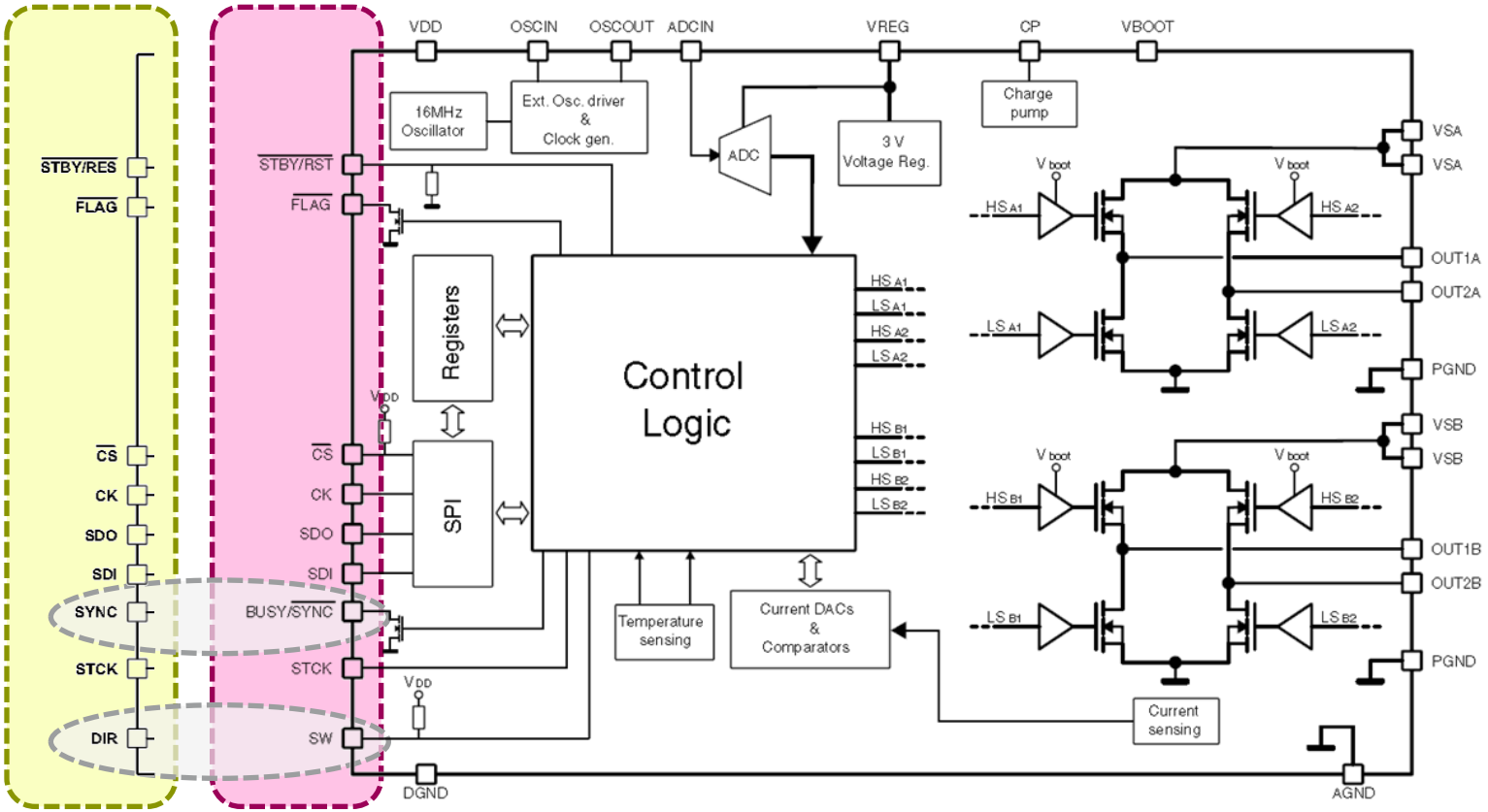
cSPIN - L6482

- External Power stage
- Supply Voltage 7.5V to 85V
- Programmable gate driving



easySPIN - L6474 & dSPIN - L6472

L6474 L6472



easySPIN

dSPIN

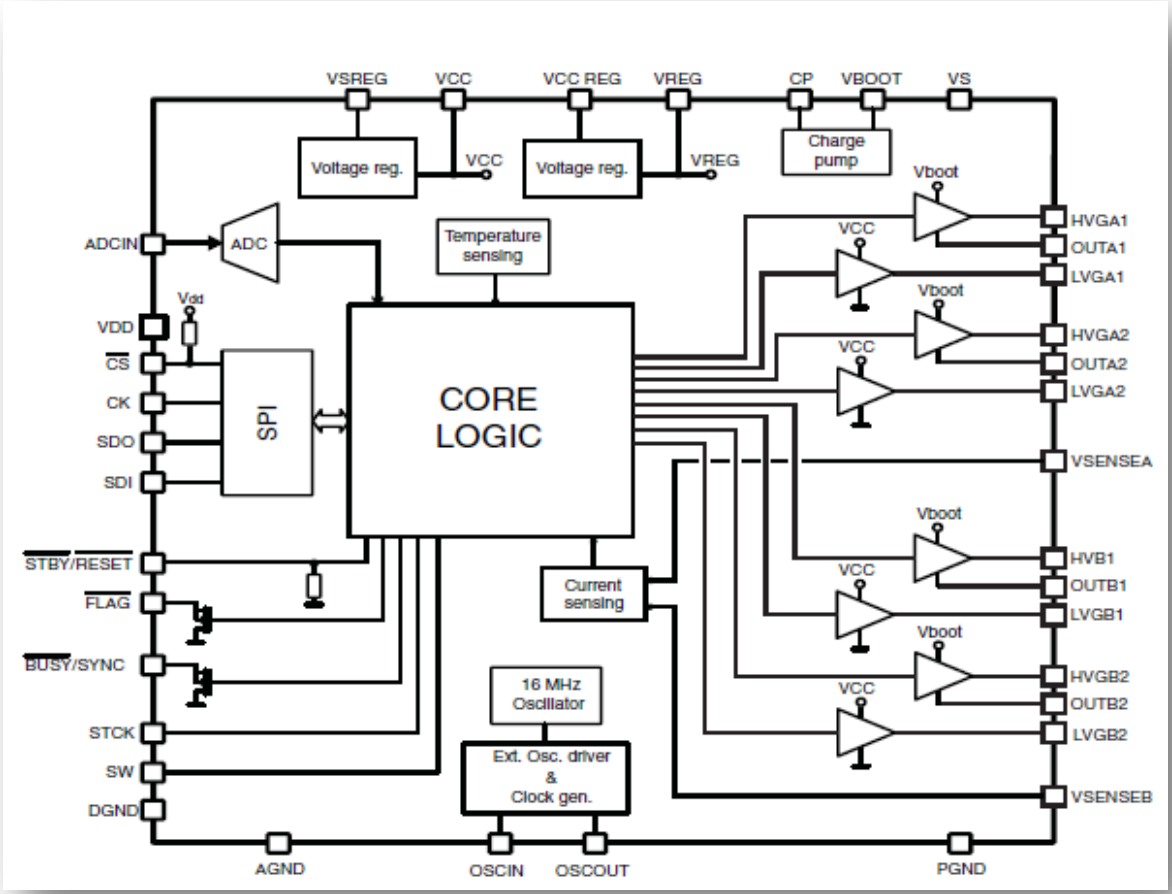
Both products are pin-to-pin compatible!

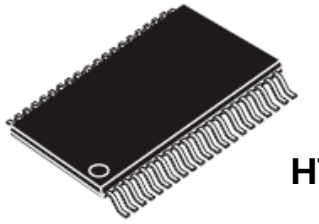
HTSSOP-28

PowerSO-36

cSPIN – L6482

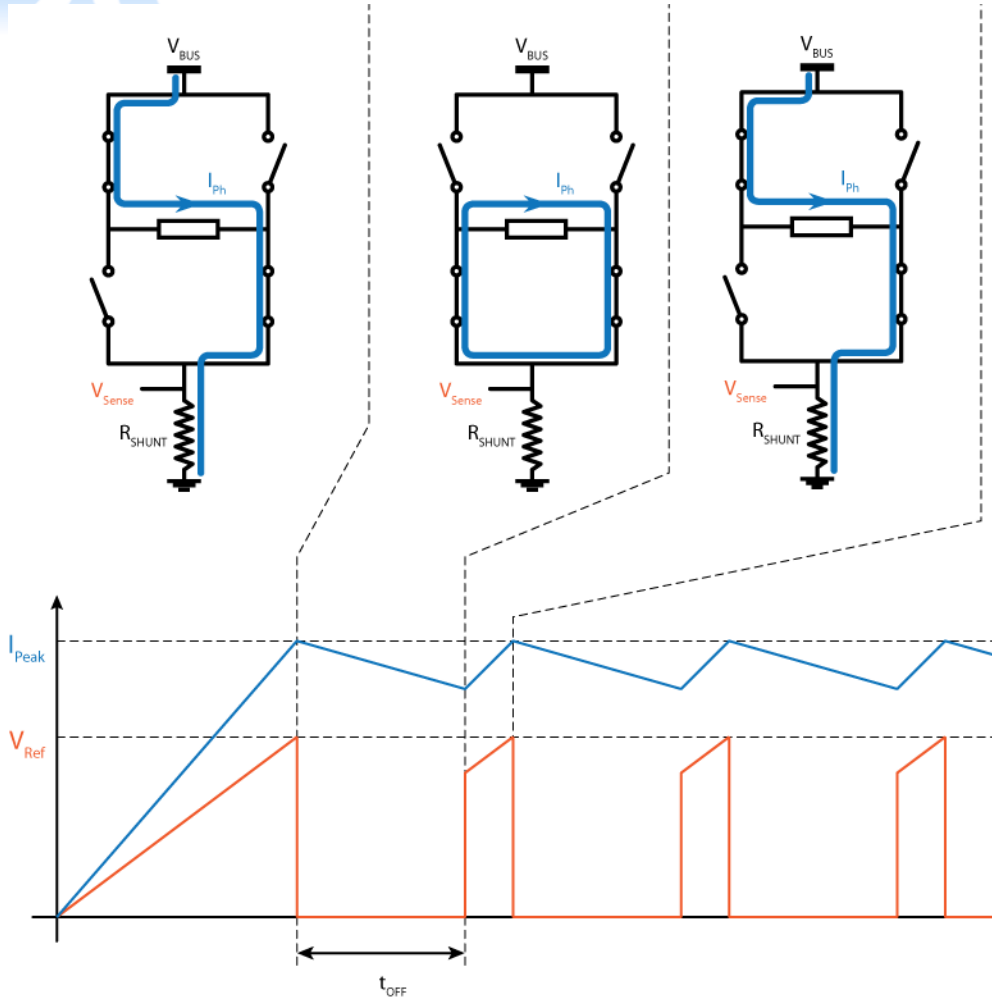
- Supply Voltage 7.5V to 85V
- EXTERNAL MOSFET
- Programmable gate driving
- SPI Interface for Configuration, Control & Diagnostic
- Full set of Integrated Protections (OCD, UVLO, THERMAL)





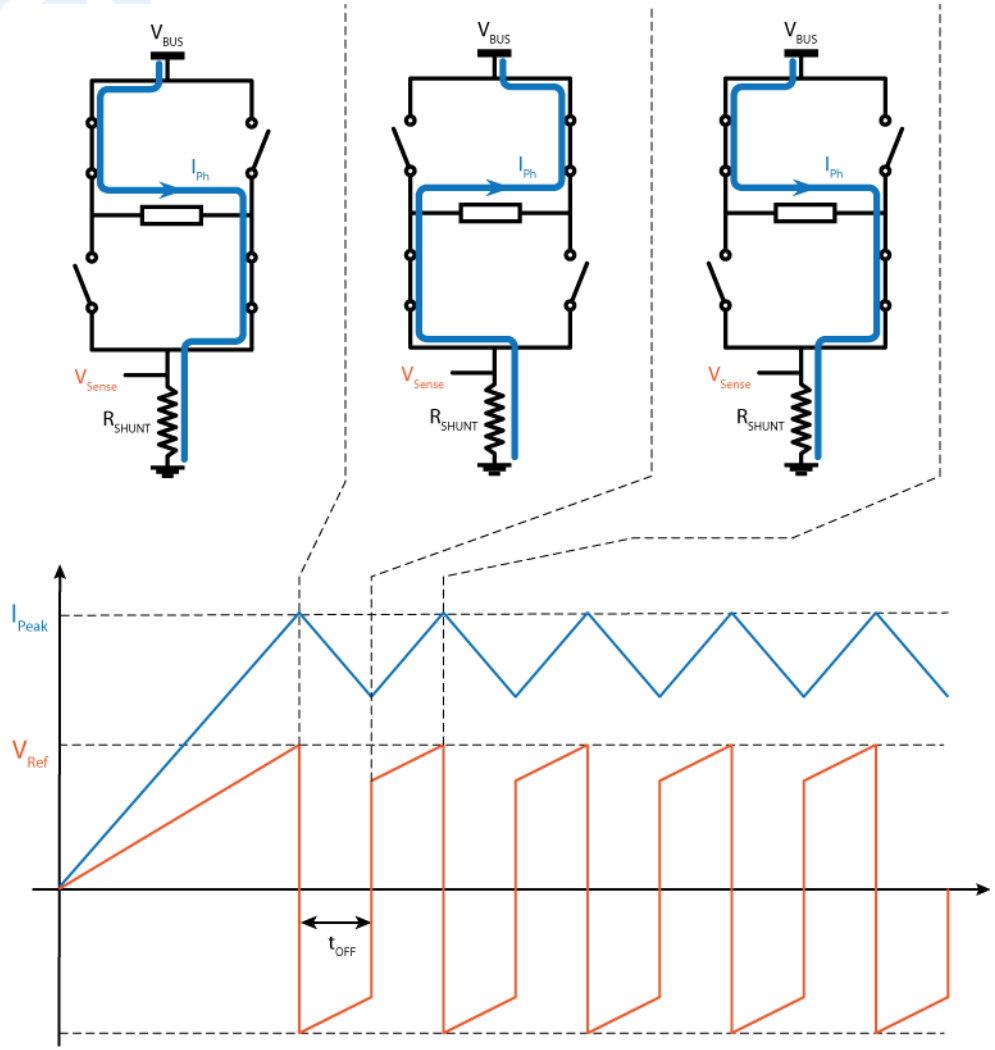
HTSSOP-38

Current control
What decay: slow



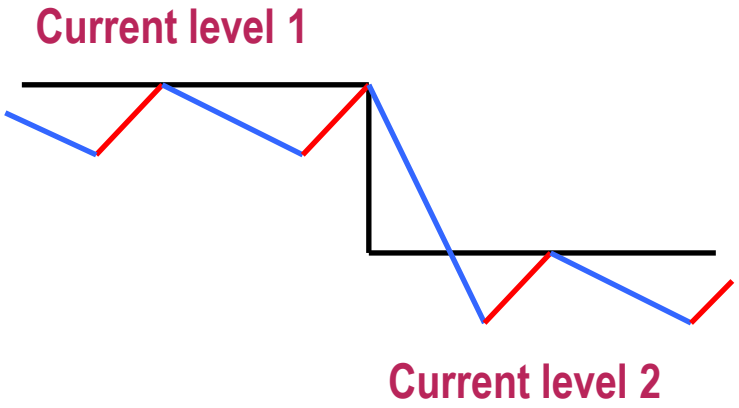
The slow decay dissipates the energy in phase resistance.
The energy is reduced slowly.
The small current drop cause a low current ripple.

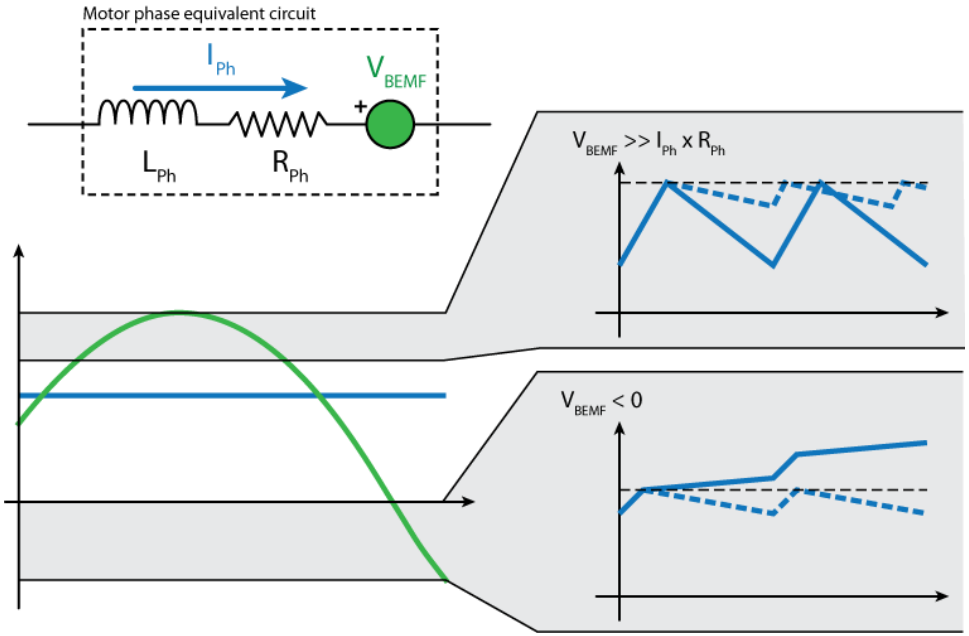
Current control
What decay: fast



The fast decay sink the energy from the phase resistance using the bus voltage.
The energy is reduced quickly.
The large current drop cause a high current ripple.

The right decay

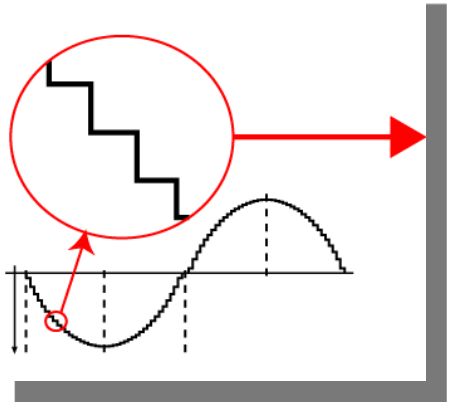


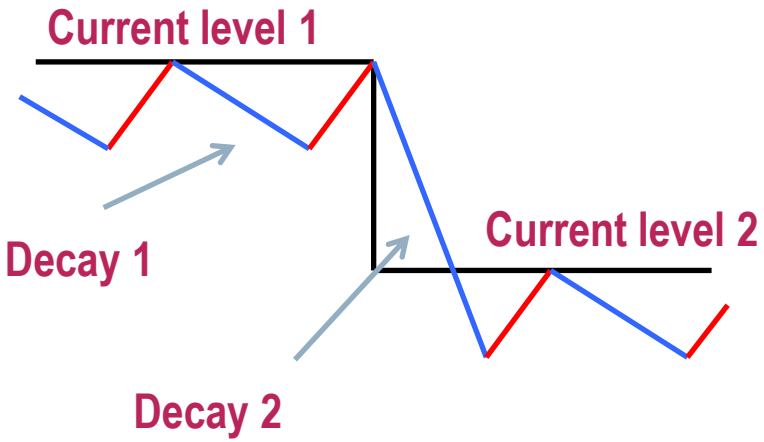


The quantity of energy to removed in decay1 and decay2 are different → must choose the right timing and speed decay

According to conditions (current value, motor Back EMF, etc.) the effectiveness of slow and fast decay could be significantly changed.

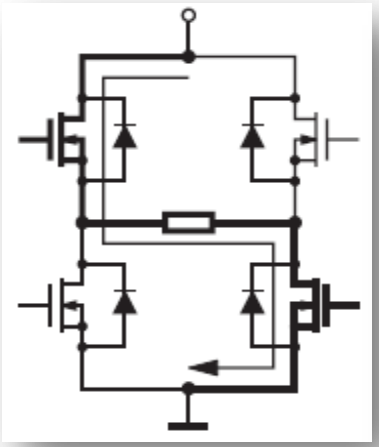
Current control with Adaptive decay control



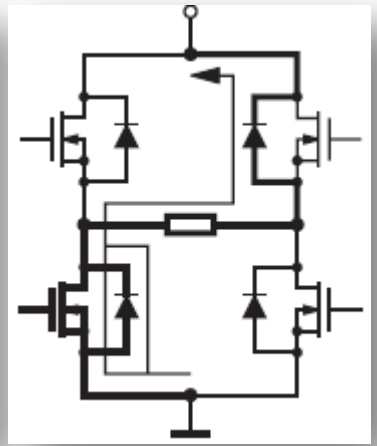


Automatically performs the best decay mode:

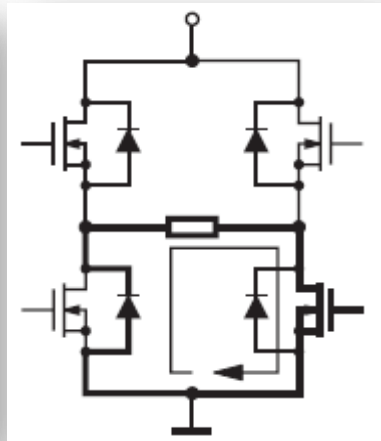
- **Torque ripple reduction**
- **Soft and silent motion**
- **Accurate positioning**



ON State



Fast decay

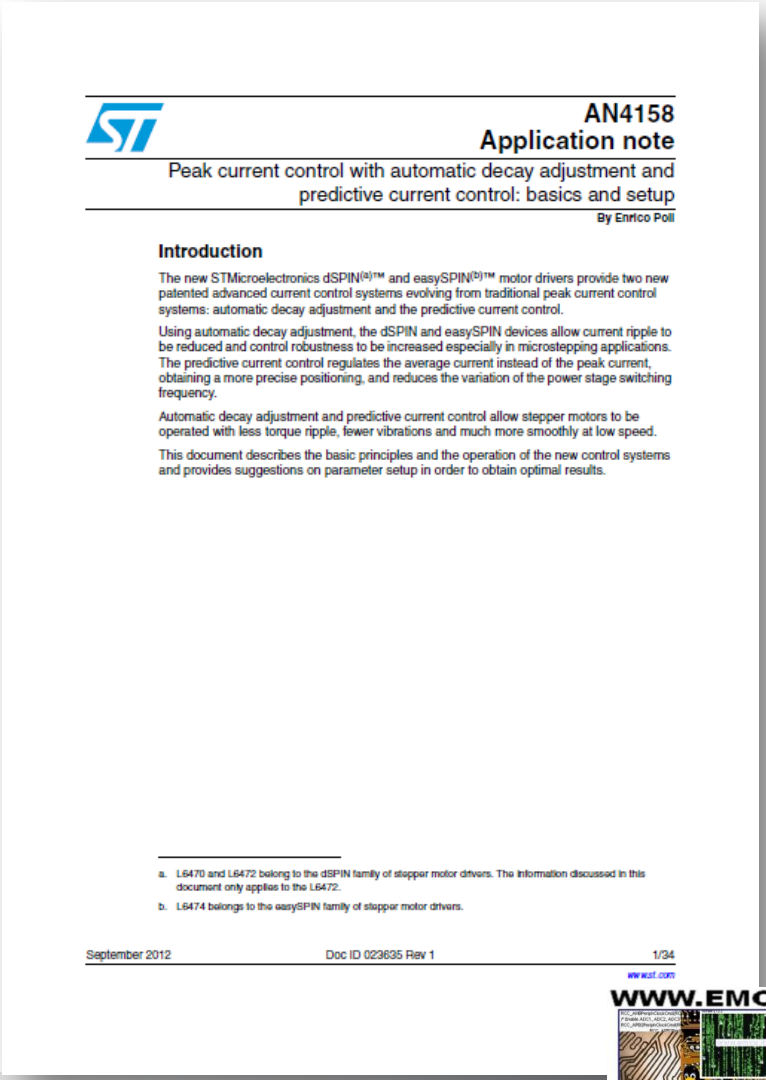


Slow d

Current control with Adaptive decay control

AN4158

Peak current control with automatic decay adjustment and predictive current control



AN4158
Application note

Peak current control with automatic decay adjustment and predictive current control: basics and setup

By Enrico Poli

Introduction

The new STMicroelectronics dSPIN[a]™ and easySPIN[b]™ motor drivers provide two new patented advanced current control systems evolving from traditional peak current control systems: automatic decay adjustment and the predictive current control.

Using automatic decay adjustment, the dSPIN and easySPIN devices allow current ripple to be reduced and control robustness to be increased especially in microstepping applications. The predictive current control regulates the average current instead of the peak current, obtaining a more precise positioning, and reduces the variation of the power stage switching frequency.

Automatic decay adjustment and predictive current control allow stepper motors to be operated with less torque ripple, fewer vibrations and much more smoothly at low speed.

This document describes the basic principles and the operation of the new control systems and provides suggestions on parameter setup in order to obtain optimal results.

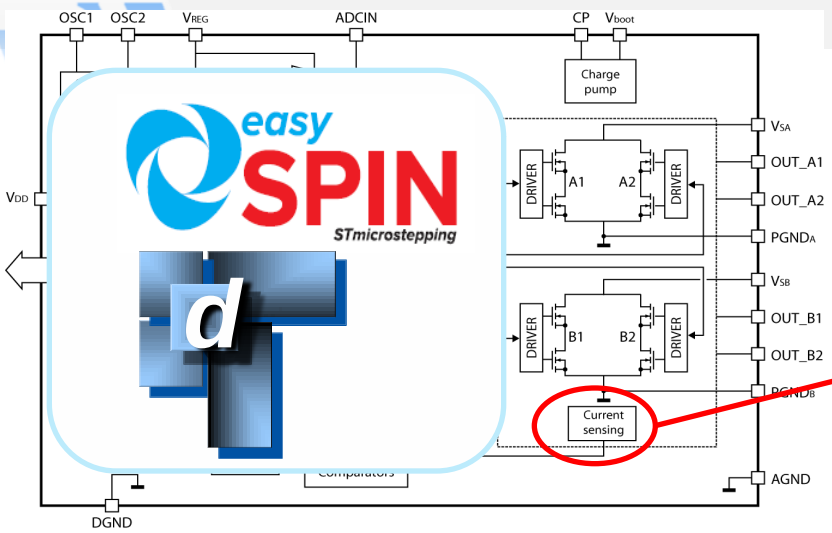
a. L6470 and L6472 belong to the dSPIN family of stepper motor drivers. The information discussed in this document only applies to the L6472.

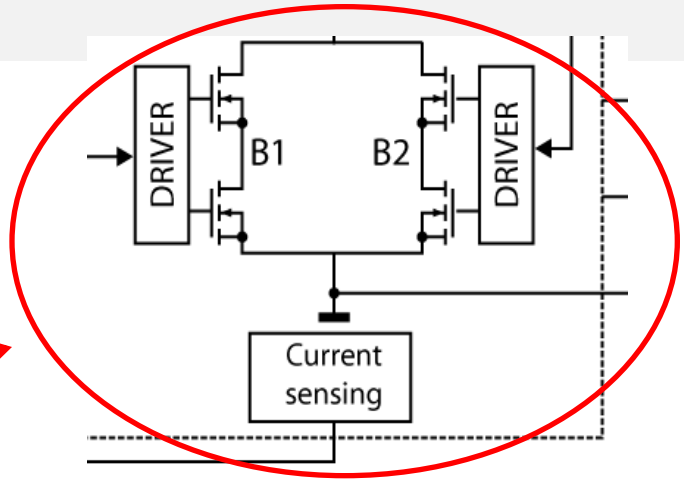
b. L6474 belongs to the easySPIN family of stepper motor drivers.

September 2012 Doc ID 023635 Rev 1 1/34

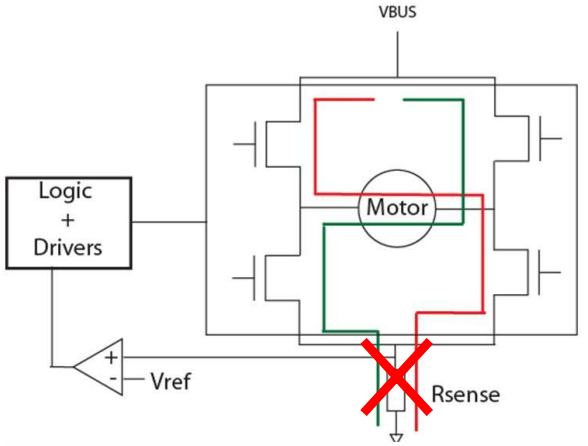
www.st.com

Sensing current





NON Dissipative Current Sensing



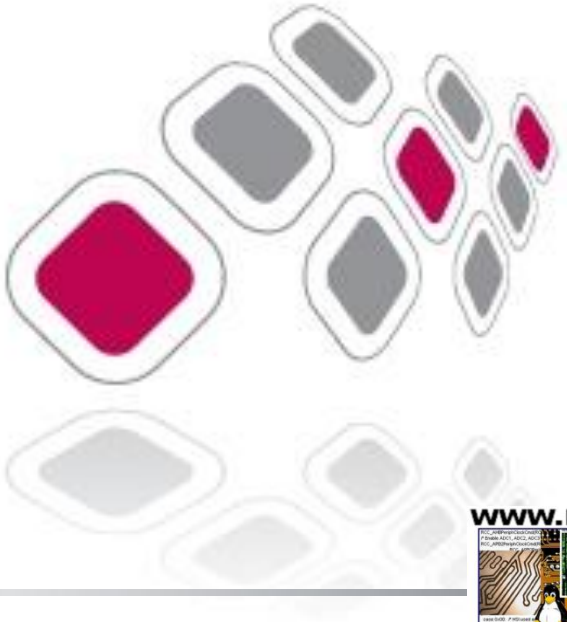
Cost Saving	**Better System Efficiency**
Less Components	**Lower Power Dissipation**

No external high dissipative shunt resistors

Voltage Mode Driver

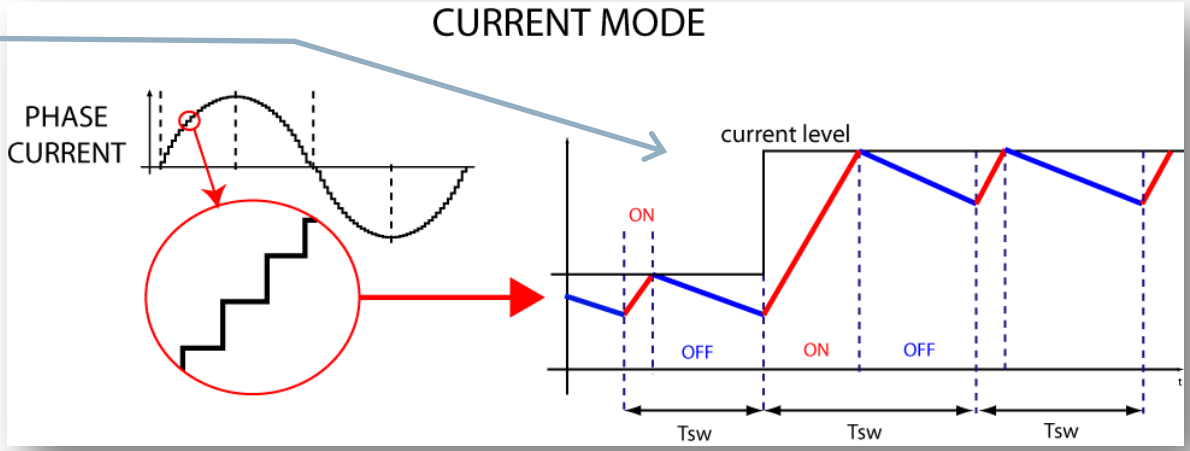
L6470

L6480

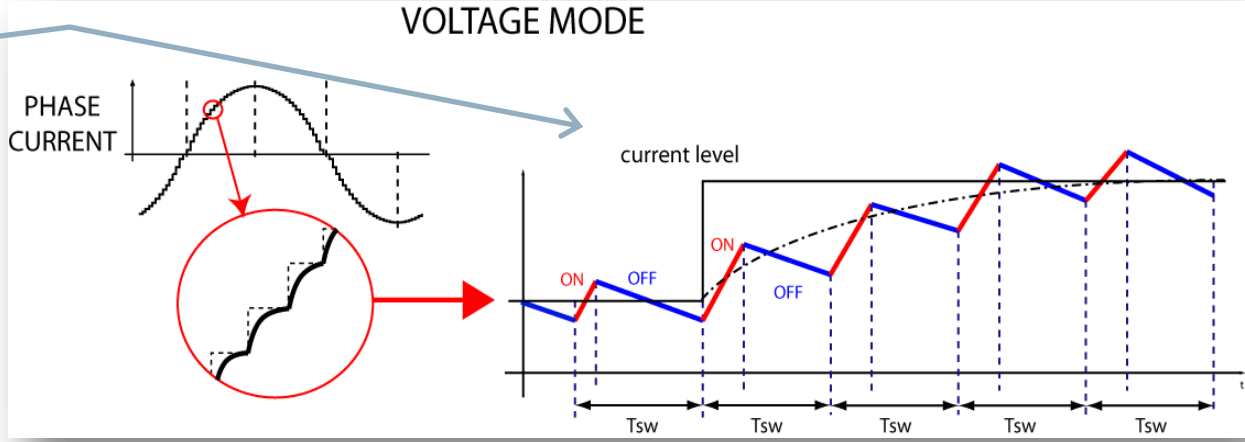


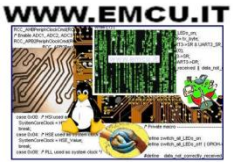
Voltage mode vs. Current mode

- ✓ Abrupt current changes cause strong mechanical vibrations.
- ✓ Peak current is controlled. Average current value is different from target one. Inaccurate positioning
- ✓ Torque ripple and EMI are difficult to control.



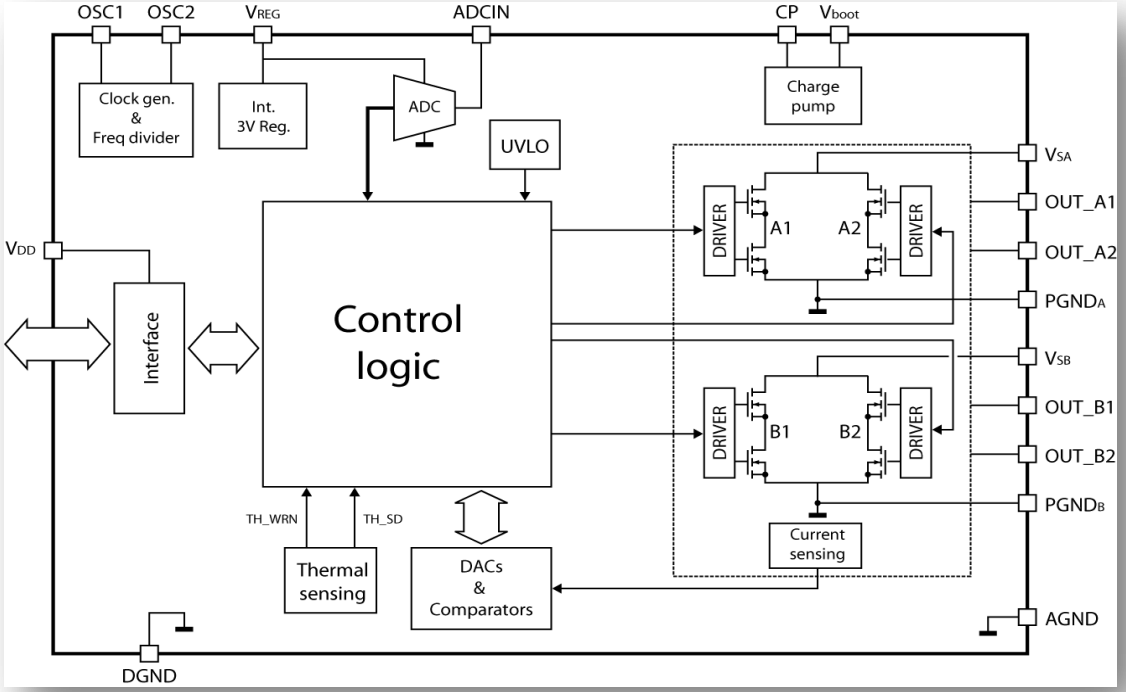
- ✓ Accurate positioning
- ✓ Motor movement is soft and silent!
- ✓ Torque ripple and EMI are under control.





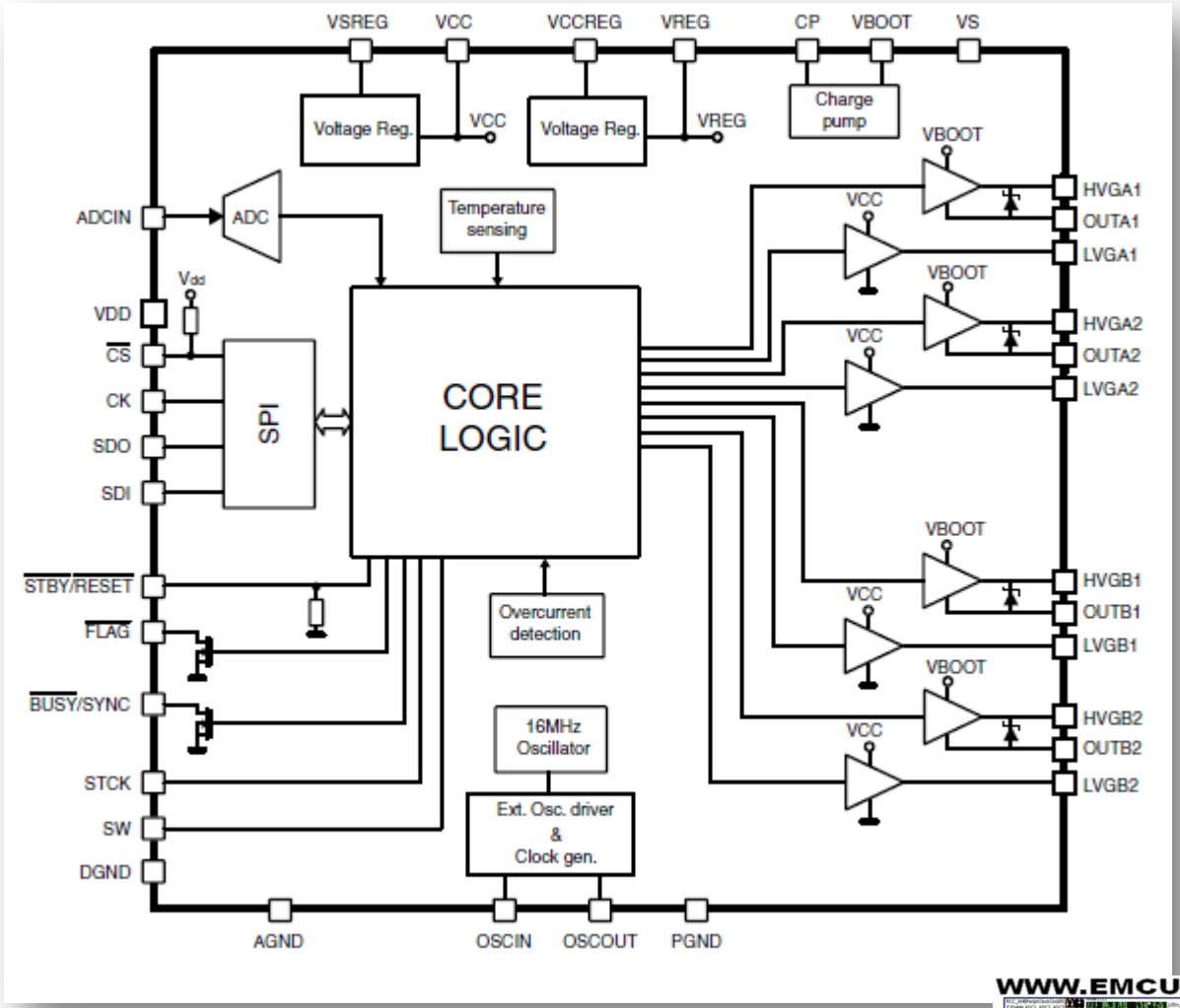
dSPIN L6470 voltage mode Driver

- Supply voltage 8V – 45V
- 3Arms (7A peak)
- $R_{DS,ON}$ = 0.28 Ω
- Up to 128 microsteps
- Voltage mode operation
- Programmable speed profile
- Programmable positioning
- SPI interface
- Daisy Chain compatible
- Integrated 16MHz oscillator
- Integrated 5bit ADC
- Integrated 3V voltage regulator
- Over Current, Over Temperature
- Under Voltage protections
- PowerSO and HTSSOP



cSPIN – L6480

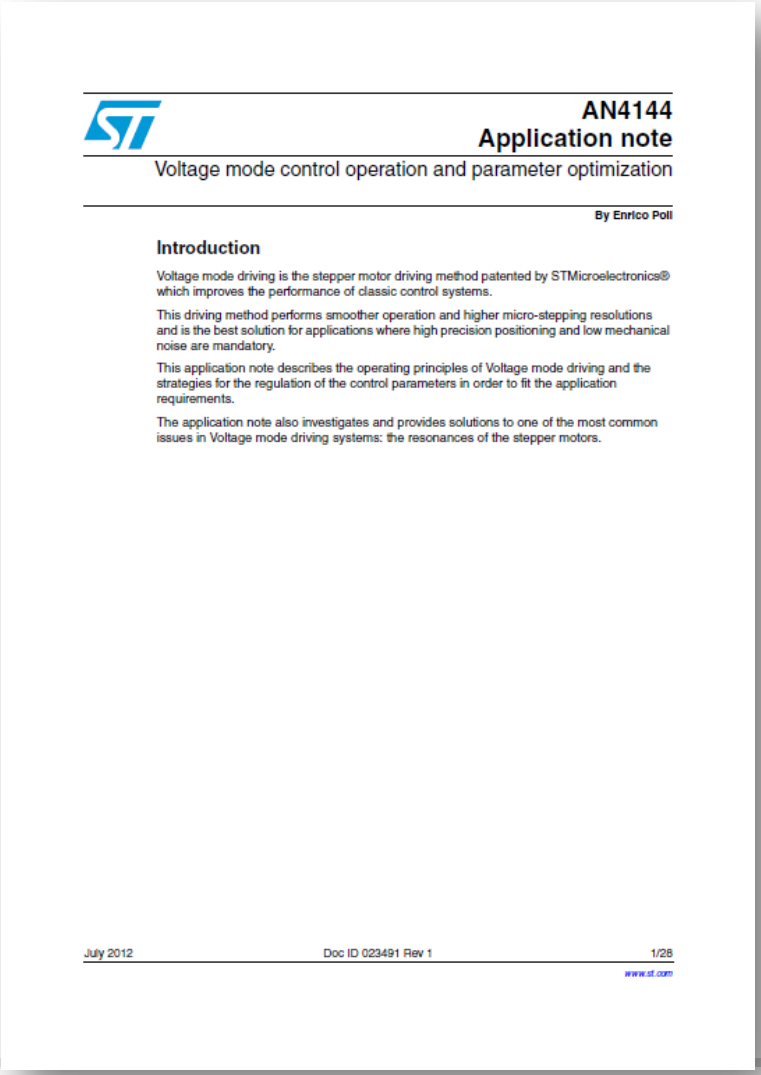
- Supply Voltage 7.5V to 85V
- EXTERNAL MOSFET
- Programmable gate driving
- SPI Interface for Configuration, Control & Diagnostic
- Full set of Integrated Protections (OCD, UVLO, THERMAL)



Voltage mode control

AN4144

Voltage mode control operation and parameter optimization



AN4144
Application note

Voltage mode control operation and parameter optimization

By Enrico Poli

Introduction

Voltage mode driving is the stepper motor driving method patented by STMicroelectronics® which improves the performance of classic control systems.

This driving method performs smoother operation and higher micro-stepping resolutions and is the best solution for applications where high precision positioning and low mechanical noise are mandatory.

This application note describes the operating principles of Voltage mode driving and the strategies for the regulation of the control parameters in order to fit the application requirements.

The application note also investigates and provides solutions to one of the most common issues in Voltage mode driving systems: the resonances of the stepper motors.

July 2012 Doc ID 023491 Rev 1 1/28

www.st.com

SUMMARY

L6472/74

Feature	L6474 / L6472	Comment
Supply Voltage	8V – 45V	Wide range supply
R_{DSON}	**280mΩ**	Lowest R_{DSON}
µsteps	1, 2, 4, 8, 16	Highest resolution
Control mode	**Current predictive current**	Most sophisticated current control
Current sensing	**Non dissipative No ext. shunt**	Fully embedded no dissipative sensing
Decay mode	**Adaptive control (patented)**	Most advanced current decay control
Slope control	**Adjustable (5 options)**	Flexible in slope control to balance EMI & losses
Serial interface	**Yes, multiple devices support**	The only chip supporting multiple nodes on bus

L6470

Feature	L6470	Comment
Supply Voltage	8V – 45V	
R_{DSON}	**280mΩ**	Lowest R_{DSON}
µsteps	**Up to 128**	Highest resolution
Current sensing	**Non dissipative No ext. shunt**	Fully embedded no dissipative sensing
Slope control	**Adjustable (5 options)**	Flexible in slope control to balance EMI & losses
Serial interface	**Yes, multiple devices support**	The only chip supporting multiple nodes on bus

L6480/L6482

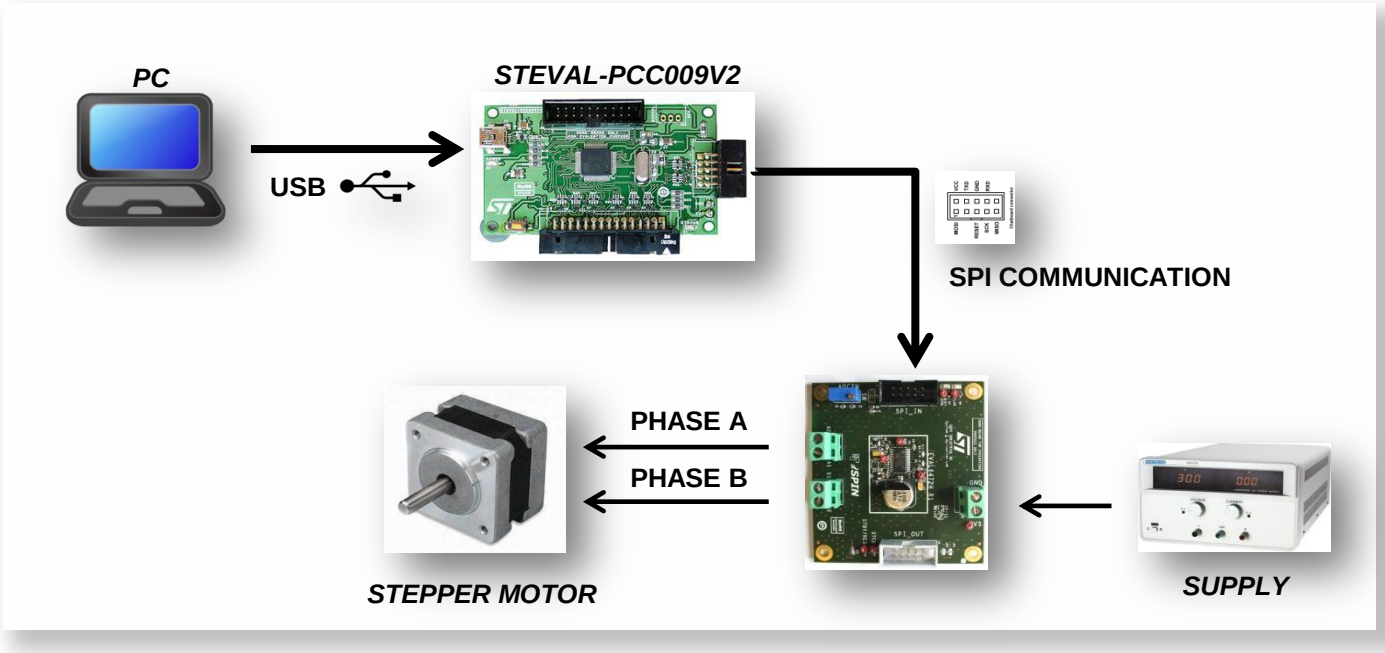
Feature / Chip	L6480	L6482	Comment
Supply Voltage	**10.5V – 85V**	**10.5V – 85V**	Wide motor supply range
Gate drive current	**Configurable**	**Configurable**	Optimal adjustment according to ext. MOS
Miller clamp	**Embedded**	**Embedded**	Immunity to high dV/dt
µsteps	**Up to 128**	Up to 16	Highest resolution
Control mode	**Advanced Voltage Mode**	**Predictive Current with Adaptive Decay**	Voltage mode control / sophisticated current control
Speed / Positioning commands	**Yes, thanks to intelligent core**	**Yes, thanks to intelligent core**	Means much less load for the microcontroller
Current sensing	**Non dissipative No ext. shunt**	**Non dissipative No ext. shunt**	Fully embedded non dissipative sensing
Stall detection	**Sensorless**	N/A	Motor stall detected without ext. components
Serial interface	Yes, multiple devices support	Yes, multiple devices support	One SPI can manage multiple motor control

ST Advantages Summary

Feature	ST Advantage
Current control	Not dissipative. No need of external components
Target current	Digital. Programmed in a register
Decay timing	Digitally auto adjusted. With basic timing programmed in registers
Microstepping configuration	Programmed in a register
Thermal protection	One thermal warning + one thermal shut down threshold
Thermal dissipation	Down to 12°C/W with the power SO package
Daisy Chain	Yes
Speed and position profile generation	Yes
Max µstepping	Up to 128 µsteps with the L6470/L6480

TOOLS

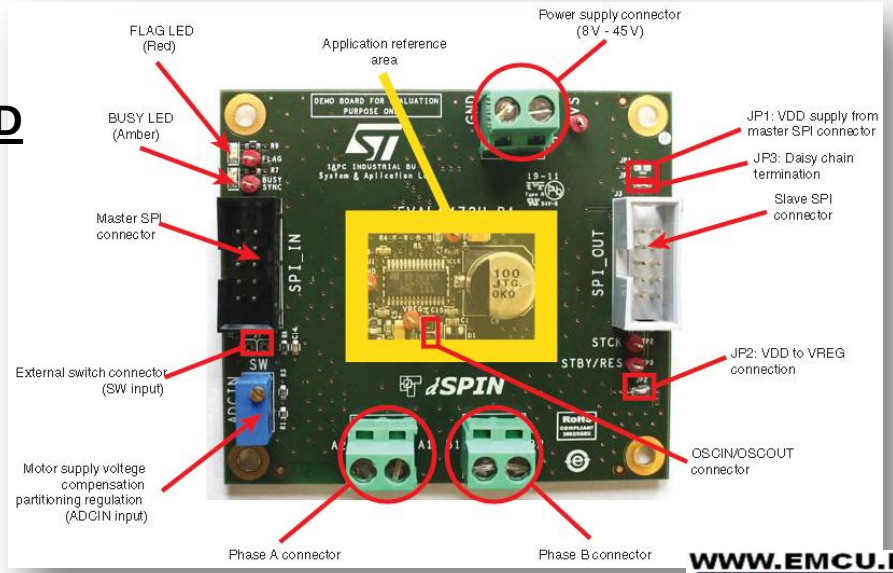
dSPIN - *easy*SPIN Tools & Documentations



- Sales Codes
  - L6474H
  - L6474PD
- Product Page http://www.st.com/easyspin
- Data Sheet
- Easyspin Evaluation Tool Software
- Evaluation Board: EVAL6474H/ EVAL6472PD
- easySPIN Firmware Library
- Control boards STEVAL-PCC009V2

dSPIN – L6472
Tools & Documentations

- **Sales Codes**
  - **L6472H**
  - **L6472HTR**
  - **L6472PD**
- **Product Page http://www.st.com/dspin**
  - **Data Sheet**
  - **dSPIN Evaluation Tool Software**
  - **Evaluation Board: EVAL6472H/ EVAL6472PD**
  - **Control boards STEVAL-PCC009V2**



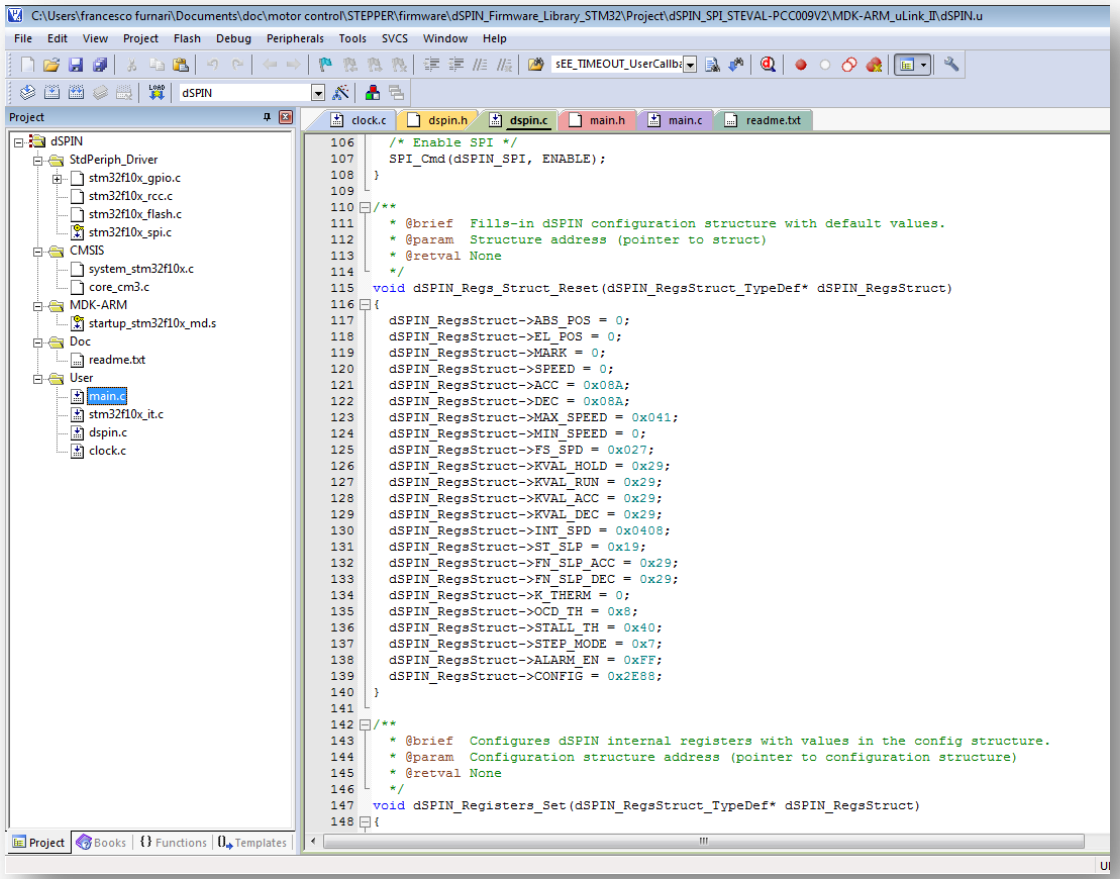
dSPIN – L6470
Tools & Documentations

- **Sales Codes**
  - **L6470H**
  - **L6470HTR**
  - **L6470PD**
- **Product Page http://www.st.com/dspin**
  - **Data Sheet**
  - **Application Note (AN3103)**
  - **d SPIN Evaluation Tool Software**
  - **Evaluation Board: EVAL6470H**
  - **Control boards STEVAL-PCC009V2**
  - **dSPIN Firmware Library**
    - **Available on http://www.st.com/dspin**

dSPIN – L6470
Tools & Documentations

Dspin firmware library contains project folders (files) for development tools:

- IAR –EWARM v5
  - ✓ J-Link for STEVAL-PCC009V2
  - ✓ ST-Link for STM32 VL Discovery
- IAR –EWARM v6
  - ✓ J-Link for STEVAL-PCC009V2
- KEIL –uVisionv4.03, v4.20
  - ✓ uLinkII for STEVAL-PCC009V2
  - ✓ uLinkPro for STEVAL-PCC009V2
  - ✓ ST-Link for STM32 VL Discovery
- Raisonance–RIDE v7
  - ✓ R-Link for STEVAL-PCC009V2



cSPIN – L6480/82
Tools & Documentations

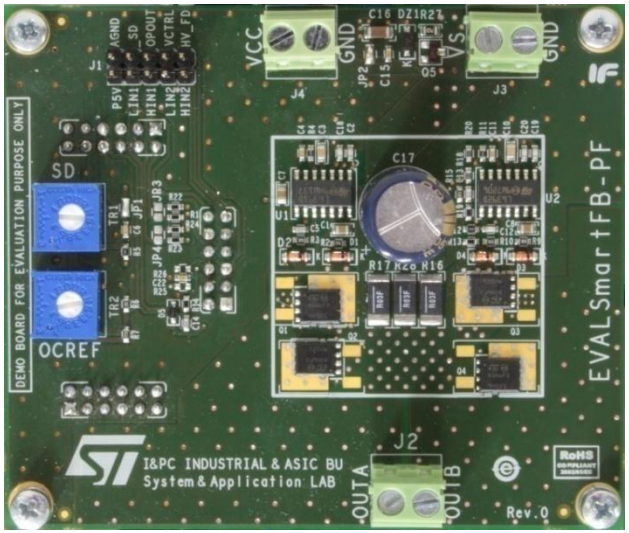
- **Product pages: www.st.com/cspin**
- **cSPIN order codes:**
  - **L6480/82 H (TR) HTSSOP38, Tube (Tape & Re**
- **cSPIN price information:**
  - **L6480/82 are at the same price**
  - **L6480/82 controllers cost approximately 20% less than the fully integrated L6470H (dSPIN) drive**
- **Evaluation boards:**
  - **L6480/82: EVAL6480H & EVAL6482H**
  - **Communication board STEVAL-PCC009V2**
- **PC Application with Graphical User Interface**
  - **Download will be available on the product web page**
  - **First version available on request**

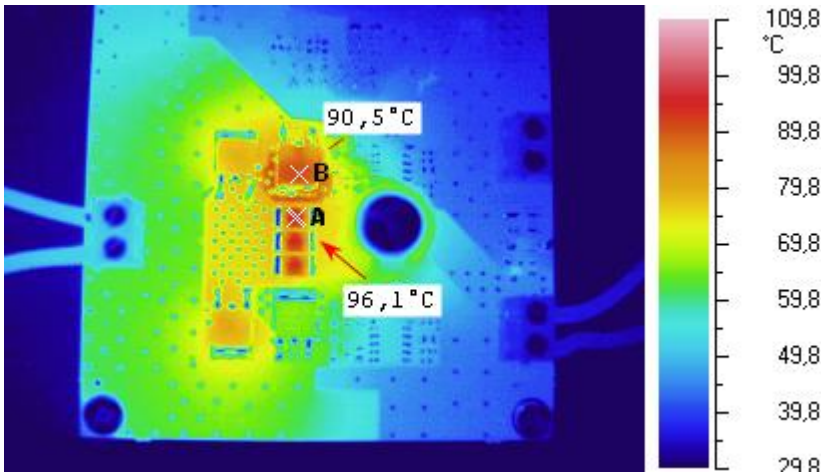
DC Motor Voltage Driver

Gate Opener DC Motor Control 60V-10A
DC motor NEW evalboard

L6391 + L6392
+4 STD60NF06

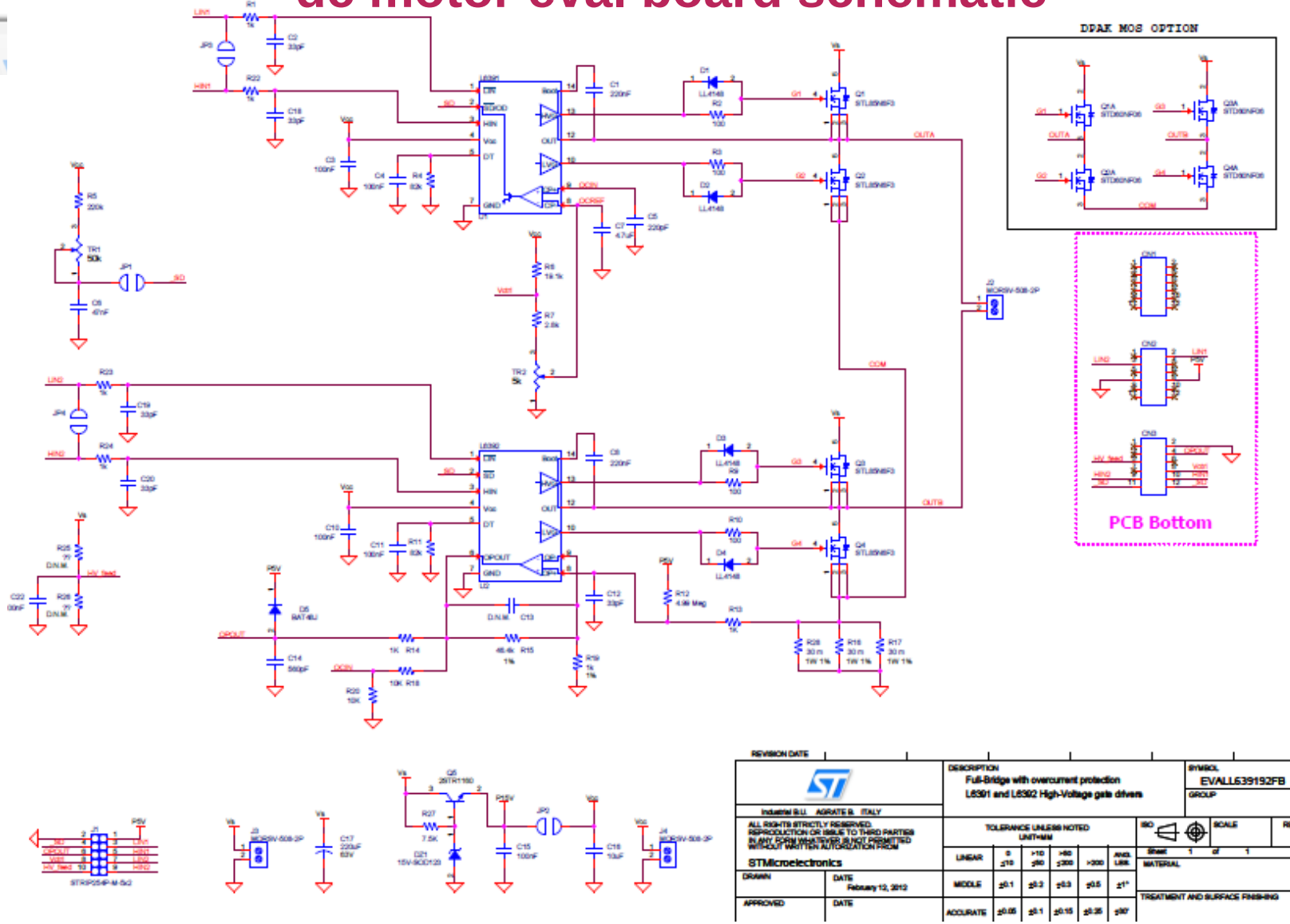
T amb 30°C 10 A
Thermal Measure





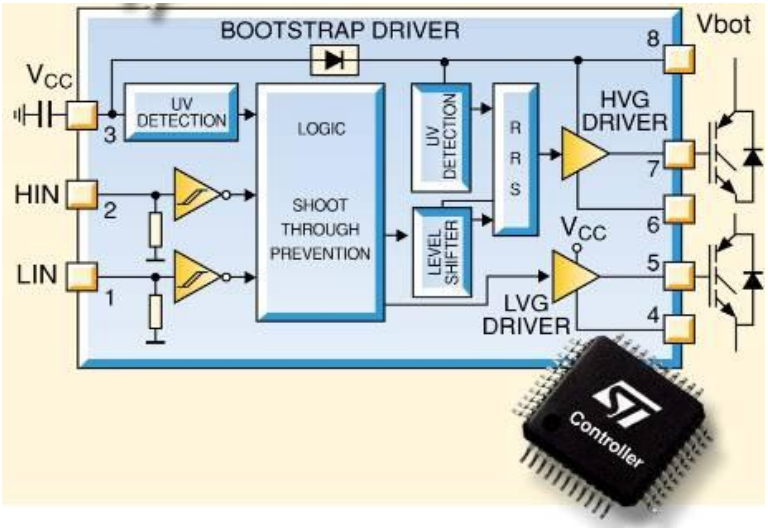
Amplified Current monitoring and short circuit protection

Gate Opener DC Motor Control 60V-10A dc motor eval board schematic



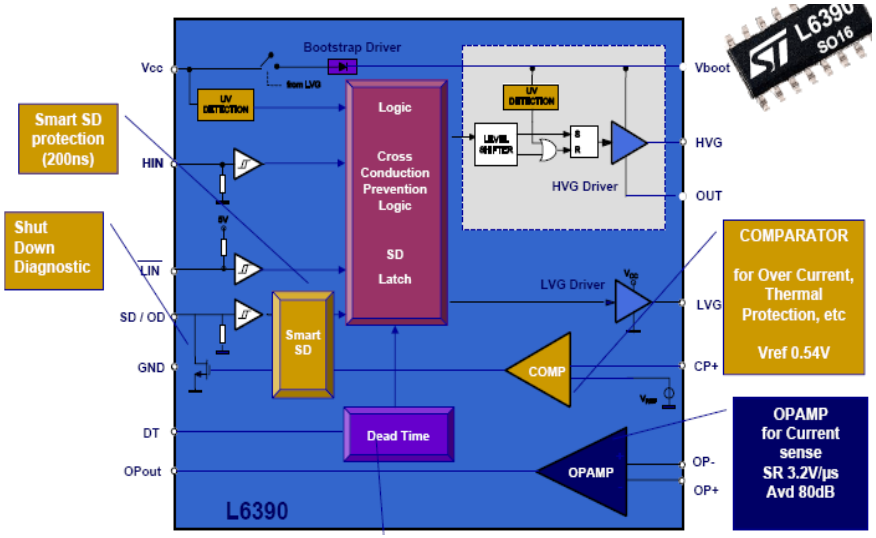
NEW INTELLIGENT POWER MODULE DRIVERS

STGIPS10K60A
HVGD



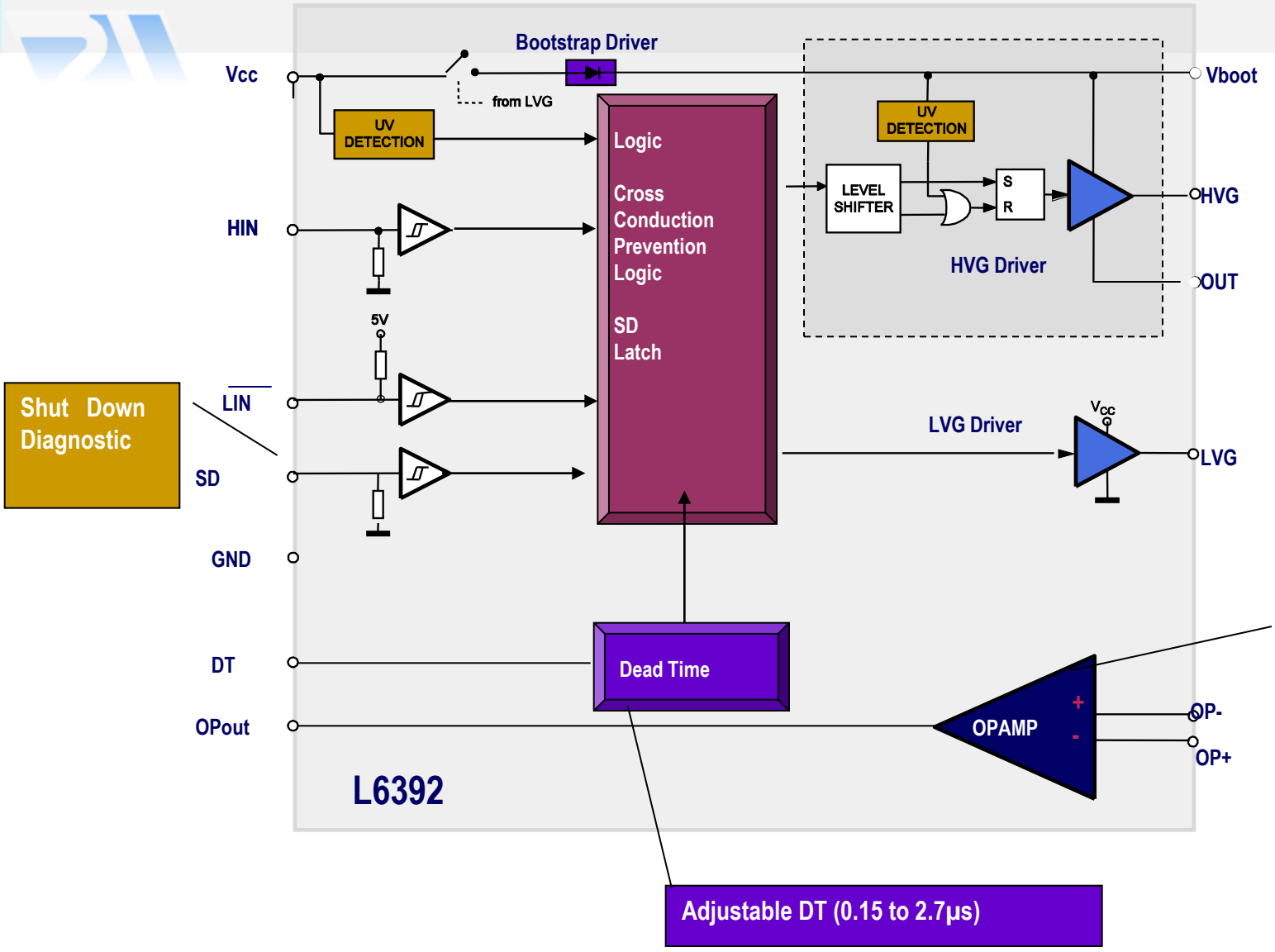
- *Dual Input*
- *CMOS/TTL Schmitt Trigger Inputs*
- *Shoot Through Protection*
- *Under Voltage Lock Out*
- *3.3V Input Logic*

STGIPS14K60 / STGIPL14K60
HVGD



- *Dual Input*
- *Under Voltage Lock Out*
- *OPAMP*
- *Comparator*
- *Dedicated pin for ShutDown*
- *Smart ShutDown*
- *Dead Time*

DRIVERS
Half bridge L6392 main features



LV POWER MOSFET

PowerFlat 5x6 D.I

V_{DS} [V]	Part number	$R_{DS(on)}$ (max) [mΩ]	Automotive grade	Technology	Status
30	**STL40DN3LLH5**	18	_	STripFET V	Active
30	**STL60N32N3LL**	9.2/5.5	_	STripFET V	Active
30	**STL65DN3LLH5**	6.5	_	STripFET V	Active
30	**STL66DN3LLH5**	6.5	Yes	STripFET V	Active
40	**STL15DN4F5**	9	Yes	STripFET V	Active
60	**STL7DN6LF3**	43	Yes	StripFET III	Active
60	**STL8DN6LF3**	30	Yes	StripFET III	Active
100	**STL8DN10LF3**	35	Yes	StripFET III	Active
150	**STL10DN15F3**	220	-	StripFET III	Active

Thanks for your attention

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