

## Smart solution for high end stepper motor driver: cSpin family of STMicroelectronics

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### ABSTRACT

The applications in which a bipolar stepper motors are used are increasing thanks to the compactness and the precision of these motors as well as their decreasing cost.

But when dedicated controls with speed and position profiles are needed for the final application, usually complex MCU routines become necessary, and so powerful microcontrollers are included into the design, increasing the complexity of the system.

STMicroelectronics has developed a family of innovative devices, including the new xSPIN, that implement a full motion control engine in Hardware, leaving the microcontroller free to perform other operations or allowing the use of a less powerful microcontroller for microstepping applications.

### INTRODUCTION

The high level of integration simplifies motor control design, reduces system BOM and cost, with no compromise on quality, and moreover, the availability of SPI interface (in all the family devices) allows them to work in daisy chain mode, with the result that one microcontroller can control multiple devices, and therefore different motors.

The master MCU only has to send the control commands via SPI in order to program the speed profile and/or the position of the motor; moreover, all the diagnostics and configurations of the devices are managed through the serial channel.

### THE CSPIN

The new cSPIN is a single-chip motion controller that engineers can use to design a variety of equipment with quieter, smaller, and lighter precision movement and position systems. The key benefit is the possibility to implement a high-performance stepper motor driver in a very simple, compact, and inexpensive way, while the state-of-the-art technology avoids the need for several ICs and many passive components.

The digital control core can generate user defined motion profiles with acceleration, deceleration, speed or target position easily programmed through a dedicated register set. All commands and data registers, including those used to set analog values (such as current control value, current protection trip point, dead time, PWM frequency) are sent through a 5 Mbit/s SPI. A rich set of protection features (thermal, low bus voltage, overcurrent,

motor stall) allows the design of fully protected applications, as required by the most demanding motor control applications.

The digital control core, together with the innovative voltage-mode driving operation, result in a position resolution of up to 128 micro-steps and smoother motion. Reduced resonance, noise and vibration at low speed make the overall application much simpler and lighter.

Many current motion controllers include more than one processor, which generally provides more noise and complexity in equipment design. Multi-chip controllers also often require additional motor-control software, as well as for designers to combine calculation control and interfacing functions after they've been developed on separate chips, adding an extra step to the equipment development process.

Because of the integration of the motion engine, cSPIN needs few resources from the host controller (typically a microcontroller): no complex routines need to be implemented in the controller software allowing for faster development cycles and cost savings, especially in multi-motor applications.

Engineers also can develop equipment that is less noisy, which can reduce the environmental impact on people working in places like laboratories and hospitals. The controller's lightweight and compact design also lends itself to the development of systems that overall are lower cost and more efficient, eliminating the inclusion for shunt resistors and therefore reducing the possibility of energy waste. STMicroelectronics has released two versions of the cSPIN controllers, the L6480, which supports microstepping operation at up to 1/128 steps resolution, and the L6482, which includes the predictive control algorithm and the auto-adaptive decay mode.

To overcome the limit of 100 W typical of the monolithic solutions (which embed the power stage), an external power stage has to be used, the cSpin family has been designed for these kind of applications, and this opens the door to use the smart driving also with applications up to 800W.

These devices, unique in the market, can work up to 85V bus voltage having embedded an advanced and fully programmable gate driver with miller clamp features, offering extreme accuracy in the positioning and extreme smoothness in motion

The L6480 is designed for voltage mode controls (offering a microstepping control feature up to 1/128), while the L6482 is designed for current control mode (up to 1/16 microstepping). A dual full-bridge embedded gate driver can drive N-channel MOSFET power stages, delivering up

