dSPIN Future in motion

L6470
dSPIN: breakthrough in motor control

- ST is universally acknowledged as one of the leading semiconductor suppliers for motor control applications
- ST is a pioneer and leader in smart power monolithic and integrated solutions for motor driver applications

dSPIN represents the breakthrough solution for stepper motors in terms of performance with fast & easy design
The 3 key benefits of dSPIN

Voltage mode driving

Outstanding position accuracy & smooth motion:
- Resolution up to 128 microsteps/step
- Very accurate sine-wave profile

Digital core

Fully digital motion management:
- User-defined motion profiles easily programmable through SPI interface
- No need of complex MCU routines

Full set of protection features

High level of robustness against system faults:
- Thermal, low bus voltage, overcurrent, stall detection
- Easy design, reduced external components
Monolithic digital microstepping driver

BCD 0.35 μm, multi-power technology

- 3V voltage regulator
- ADC
- Charge pump
- 16MHz oscillator
- Power stage
- SPI
- Thermal protection
- DAC and comparator
- Current sensing
Driving multi-purpose bipolar stepper motors

- Factory automation, sewing machine
- Stage lighting
- Professional and label printers
- ATM, POS, vending machines, gaming
- Medical, security
- Consumer, toys & robotics
Voltage driving versus current driving

**Without dSPIN**

- Noisy and jerky motion
  - Mechanical vibrations from abrupt current changes
- Inaccurate positioning
  - Peak current different from target
- Torque ripple and EMI difficult to control
  - Non constant switching frequency

**Standard current mode driving**

**With dSPIN**

- Resolution up to 128 μsteps/step
- Very accurate and smooth sine-wave profile
- Reduced resonances, mechanical noise and vibrations at low speed
- Reduced torque and speed ripple at low speeds

**Innovative voltage mode driving**

Outstanding position resolution and smooth motion
Standard current mode – more details

1. Abrupt current changes cause high mechanical vibrations
   Current mode tries to follow even non–ideal steps (reference voltage quantization and sampling)
   Noisy and jerky motion

2. Peak current is controlled; average current value is different from target
   Inaccurate positioning

3. Non-constant switching frequency
   Torque ripple and EMI are difficult to control
dSPIN innovative control – more details

Smooth current transient reduces mechanical vibrations
Motor movement is soft and silent

Average current is controlled
Accurate positioning

Constant switching frequency
Torque ripple and EMI are controlled
Digital core

Without dSPIN

- Speed and position profiles required complex MCU routines

With dSPIN

- dSPIN does the tricky part, following simple high-level SPI commands

Fully digital motion management with simple commands
Integration of digital core

dSPI\textsuperscript{N} manages the full motion profile

Target speed, acceleration, deceleration

- Maximum speed:
  - from 15.25 to 15610 step/s
  - (15.25 step/s resolution)

Absolute/relative positioning

- Integrated 22-bit register:
  - For up to 32768 full steps
  - @128 \( \mu \)step

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Acceleration and deceleration:
- from 14.55 to 59590 step/s\(^2\)
- (14.55 step/s\(^2\) resolution)
Advanced set of protection features

- Programmable non dissipative overcurrent protection
- Internal sensing of high- and low-side power
- Two levels of over-temperature protection
- Under voltage protection
- Stall detection

High level of robustness against system faults
High configurability for easy design

- 3 slew-rate levels programmable through SPI
  - 180 V/μs, 290 V/μs and 530 V/μs
- SPI daisy-chain configuration
- 4 clock configurations
- Logic supply management

![Diagram of configuration options](image)
Fully-digital control through SPI

Absolute-position register can be set

Motor electrical position (current microstep) can be set

Speed profile parameters

Torque control parameters

BEMF compensation

Phase resistance drift compensation

ADC conversion result

Overcurrent threshold

Stall detection threshold

Device configuration and status
L6470 - Benefits summary

- **128 µsteps/ step** is the best motion resolution ever reached in monolithic stepper motor drivers
- **Smoothness** of motion is like never before
- All with a **single chip**, avoiding more expensive and space consuming discrete solutions

- Fully **digital motion control** allows the user to set a variety of features: target speed, acceleration/ deceleration, absolute and relative position, just to name a few
- **SPI interface** allows user to easily insert desired parameters with **no need for external microcontroller**

- A full set of **protection functions** confers **robustness** to the system and helps to further reduce the number of external components, the cost and complexity

Outstanding performance with fast & easy design
Motor control ICs

Motor control system-on-chip

Advanced control driving

C-SPIN digital controller + driver

conceived to enable a wide variety of implementations

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Making your designs easier

**Packages**

HTSSOP28 package (H type) – mass production

PowerSO36 (PD Type) – samples already available

**Support**

Full design support: evaluation board, software, USB and IBU interface boards, application notes, available at:  
[www.st.com/dspin](http://www.st.com/dspin)
Tools and documentation

- **Sales codes**
  - L6470H - HTSSOP28 - Tray
  - L6470HTR - HTSSOP28 - Tape & Reel
  - L6470PD - PowerSO36 (Samples available now)

- **L6470 Documentation:**
  - [L6470 webpage](#)
  - Datasheet
  - Application Note (AN3103)

- **Software:** [L6470 Evaluation tool software](#)

- **Evaluation boards**
  - [EVAL6470H](#)
  - [EVAL6470PD](#)

- **Control boards**
  - [STEVAL-PCC009V2](#) (and –V1)

- **dSPIN firmware library**
  - Available at [http://www.st.com/dspin](http://www.st.com/dspin)