News

New Motor-Driver ICs Beg the Question, What On Earth Are FREDFETs?

3 days ago by Robert Keim

The new BridgeSwitch motor drivers from Power Integrations stand out for several reasons, like its package and system monitoring. But what do we make of their fundamental label as "FREDFETs?"

Two years ago, Power Integrations released a family of brushless DC motor drive ICs that, according to the company, achieved a conversion efficiency as high as 98.5% in brushless DC (BLDC) motor drive applications of up to 300 W.

This article examines the recently-released BridgeSwitch family from Power Integrations, which includes ten devices whose integrated FREDFETs have DC current ratings from 1 A to 11.5 A.

If you're wondering what a FREDFET is, we'll address that issue as well.

The following diagram conveys the general functionality of the BridgeSwitch motor drivers.

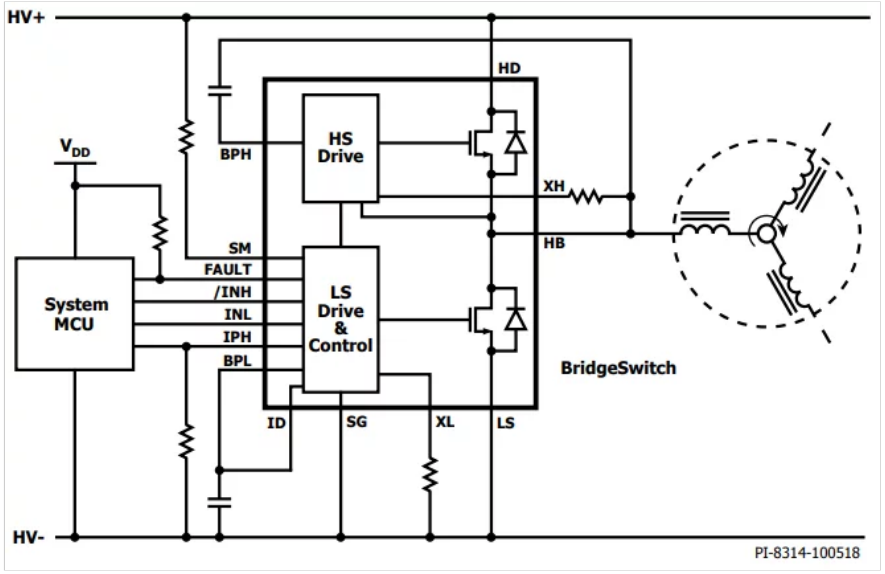


Diagram of a typical three-phase inverter. Image used courtesy of Power Integrations

A logic or processor device (in most cases this will be a microcontroller) is in charge, and the BridgeSwitch IC responds to signals on the logic-level high-side and low-side control inputs by activating the corresponding drive transistors.

Some motor-driver ICs include control and interface circuitry but not the actual transistors that drive current into the motor windings. This arrangement is more flexible since it allows us to fine-tune transistor selection according to the needs of the application.

In general, though, motor drivers with internal FETs simplify the design process; the integrated-FET approach is definitely my preference if the specs indicate that critical performance requirements will be met.

What Is a FREDFET?

The drive transistors in the BridgeSwitch ICs are FREDFETs. Field-effect transistors are not a homogenous lot, and manufacturers can emphasize specific characteristics of a given device category by coming up with new names.

"FREDFET" would probably qualify as one of the more amusing of these FET appellations. English speakers will observe that "Fred" is also a name for humans, and if anybody from *els Països Catalans* is reading this, we might wonder if these semiconductor devices are in need of some warm clothing.

A FREDFET is a fast-recovery (or fast-reverse) epitaxial diode field-effect transistor, and the non-abbreviated name indicates the most important characteristic: these transistors have body diodes that exhibit fast recovery characteristics.

Diode recovery is an important issue in switching applications. It influences the dynamic performance of the system, and the current associated with reverse recovery causes power losses that reduce overall efficiency.

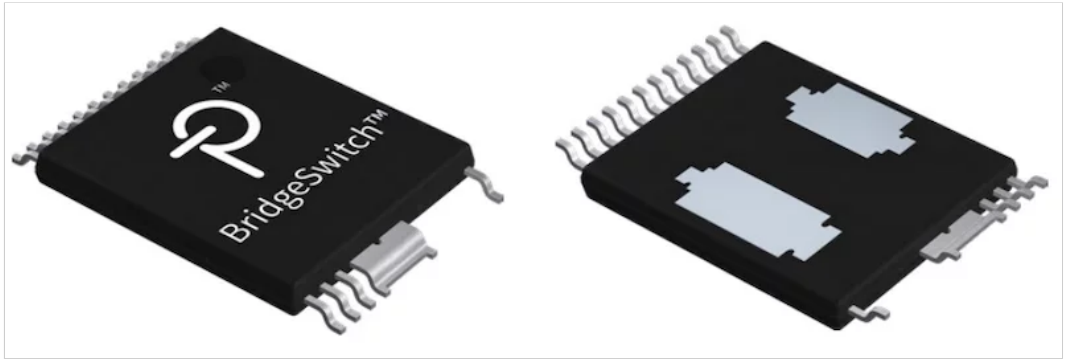
You can read much more about this topic in a two-part series written by AAC contributor Lonne Mays; the first article discusses recovery and its importance, and the second explores the difference between soft and abrupt recovery.

I don't know when FREDFETs were first introduced, but this IEEE conference paper shows that they've been around at least since 1988. The authors describe the FREDFET as a MOSFET with a very fast body diode that has properties similar to those of a "discrete fast epitaxial rectifier."

FREDFETs achieve low losses in switching applications and are advantageous for driving inductive loads.

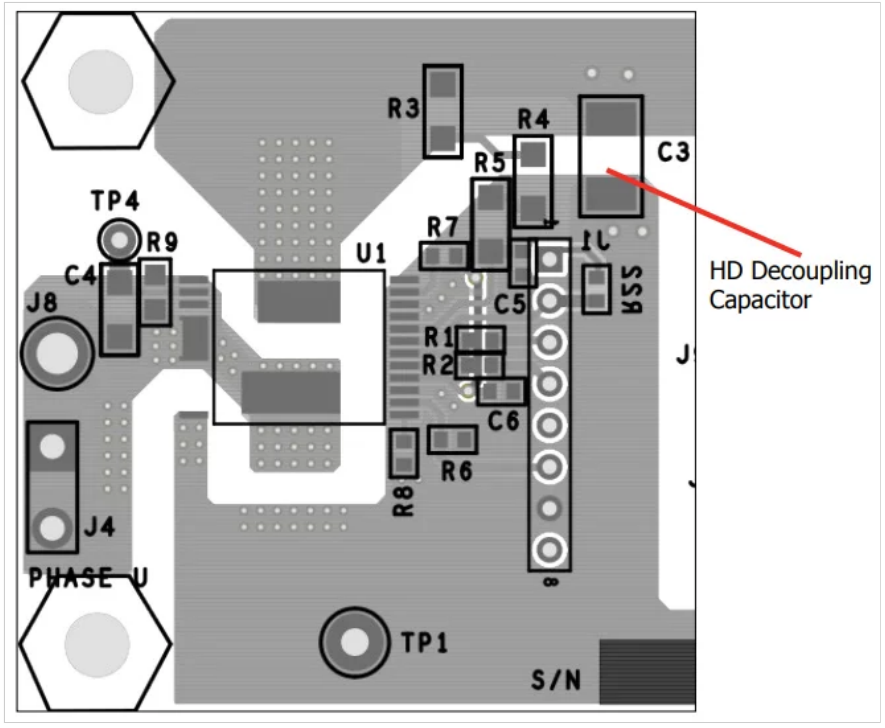
Integrated Half-Bridges for Efficient Motor Control

Power Integrations recommends the BridgeSwitch family for driving two-phase and three-phase permanent magnet motors and brushless DC motors. One thing I like about these parts is the interesting package design, which provides separate heat-sinking junctions for the two integrated FREDFETs:



They call this the InSOP-24C package. Image used courtesy of Power Integrations

While we're on the subject of the package, I should mention that the datasheet offers an extensive discussion of PCB layout for these devices (refer to pages 16–19). In the example below, you can see how they configure their thermal vias in relation to those exposed pads.



"HD" stands for "high-side drain." Image used courtesy of Power Integrations

The intended applications appear to be mostly within the consumer and household category (e.g., dishwashers, air conditioners), but these devices seem like they could find a place in many industrial applications as well. The integrated transistors can handle 600 V, and as mentioned above, the highest-power member of the series can deliver 11.5 A into a motor coil.

These chips have quite a few noteworthy features, so be sure to take a look at the datasheet if you want a more complete picture.

System Monitoring

Power Integrations emphasizes the BridgeSwitch family's supervisory and fault-protection functionality. This includes cycle-by-cycle current limit, thermal-overload protection, undervoltage and overvoltage sensing for the DC bus, and protection against simultaneous conduction of the two FETs.

A communication interface allows the system controller to query device status, receive status updates, and reset the BridgeSwitch device in response to a fault.

The following diagram gives you an idea of how the bidirectional status interface is implemented.

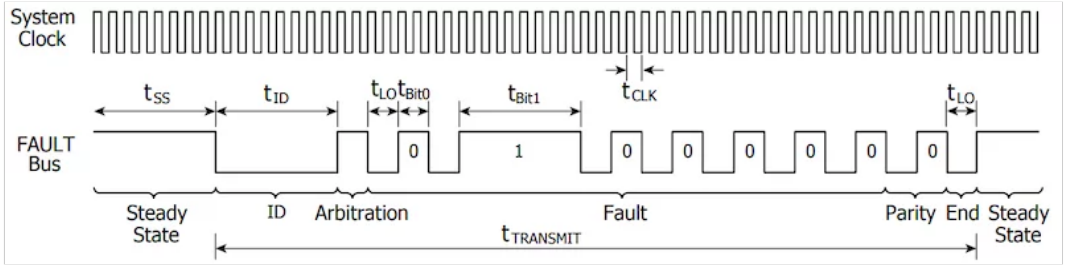


Diagram of status communication bit stream. Image used courtesy of Power Integrations

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What do you think about motor control with integrated FETs vs. motor control with external FETs? Have you found that external FETs tend to offer superior overall switching performance? Feel free to share your thoughts in a comment.

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