Reducing EMI Radiated Emissions with TI Smart Gate Drive

James Lockridge, Analog Motor Drive

Introduction

Radiated emissions testing for electromagnetic interference (EMI) can reveal issues that send engineers back to the drawing board to revise their product. Design revisions and additional test time increase product costs and delay schedules while engineers debug and solve EMI issues.

Smart Gate Drive technology in TI motor drivers helps customers solve their radiated EMI issues without costly board revisions or extra test time. With selectable IDRIVE currents for driving external FETs, EMI emissions from the motor-driver section of a system can be minimized by a simple serial interface (SPI) command or resistor change.

Radiated EMI from FET driving

With any motor system that uses gate drivers and external FETs, designers must balance the tradeoff between FET switching time and EMI emissions. Typically designers want FET switching time to be as fast as possible to minimize power losses due to FET switching. However, fast switching time can also cause the parasitic components around the FET (Figure 1) to ring and to radiate EMI.

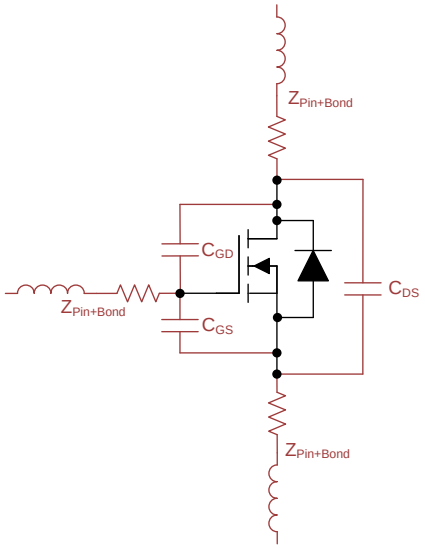

Figure 1. Parasitics around a MOSFET

Figure 2 shows how fast transitions on the switching node cause these parasitc components to ring. Rather than choosing alternate FETs or redesigning the board with extra components, Smart Gate Drive allows designers to control the gate drive current with a register setting or single resistor value. Figure 3 illustrates how using lower current for slower FET switching eliminates ringing on the switching node.

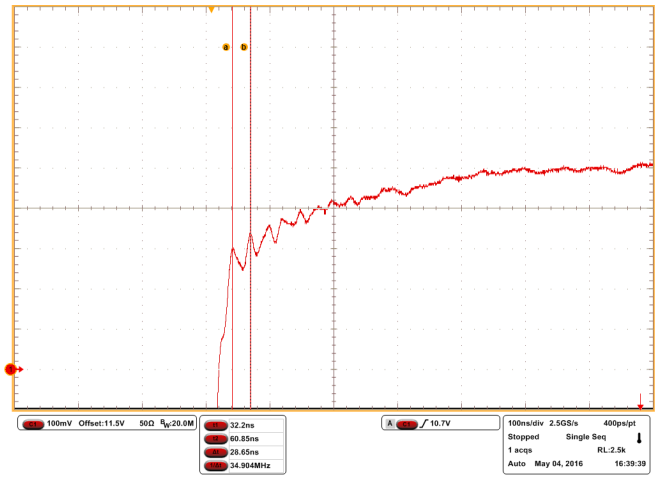

Figure 2. Ringing on switch node with IDRIVE setting of 250/500-mA

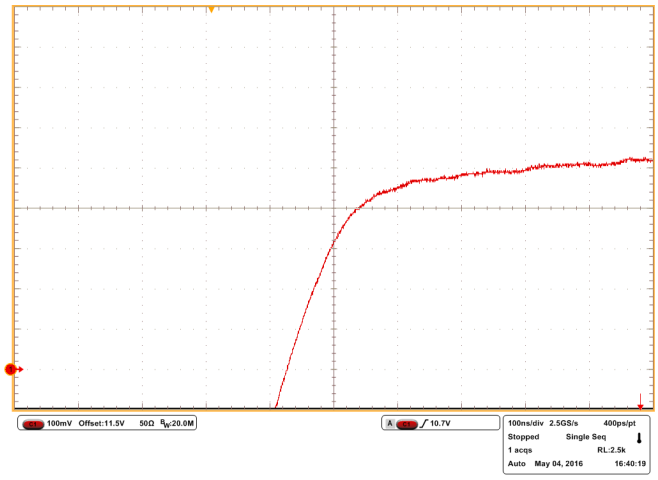

Figure 3. No ringing on switch node with IDRIVE setting of 10/20-mA

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Figure 4 shows the radiated emissions of the system using the 250/500-mA IDRIVE current setting. Figure 5 shows that reducing the IDRIVE current to 10/20 mA brings the emissions spectra well below any of the EMI thresholds.

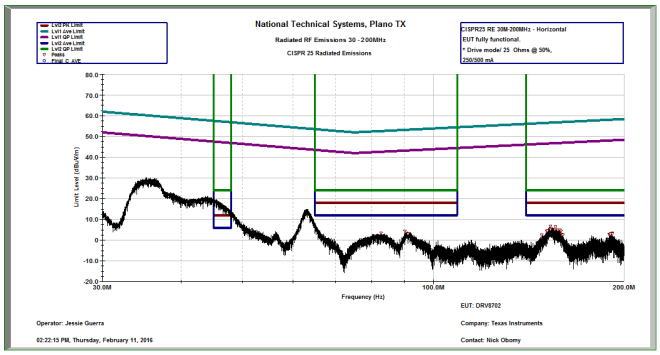

Figure 4. 250/500-mA EMI scan

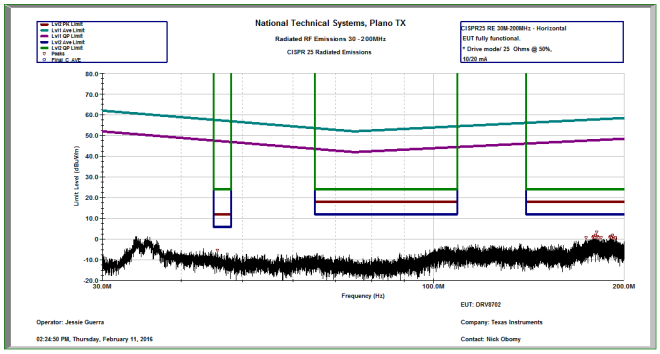

Figure 5. 10/20-mA EMI scan

Fine-tuning for radiated EMI

To achieve a good balance between switching time and EMI performance, Smart Gate Drive offers a variety of settings to control the slew rate and transition time of the switching node. Figure 6 demonstrates how these IDRIVE settings impact the transition times of the switching node.

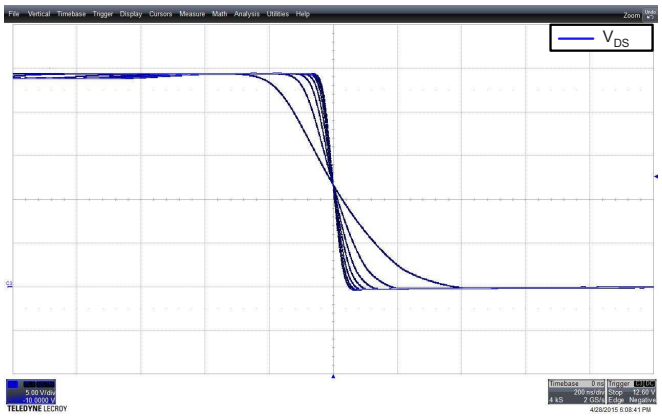

Figure 6. V_{DS} Persistence plot across IDRIVE settings

Some TI devices offer up to *sixteen* IDRIVE settings. These IDRIVE settings can be configured independently for high-side FETs, low-side FETS, source current, and sink current. This totals to *sixty-four* different Smart Gate Drive settings to fine-tune the transition times on the switching nodes to balance the tradeoff between fast switching time and EMI performance.

Conclusion

For more information on Smart Gate Drive, visit the TI Motor Drivers technology page. For more information on TI products with Smart Gate Drive, see the links in the following table and list.

Table 1. Smart Gate Drive Devices

Brushless DC Gate Drivers	Stepper Gate Driver	Brush DC Gate Drivers
DRV8304, DRV8305, DRV8305-Q1, DRV8320, DRV8320R, DRV8323, DRV8323R DRV8350, DRV8350R, DRV8353, DRV8353R	DRV8711	DRV8701, DRV8702-Q1, DRV8702D-Q1, DRV8703-Q1, DRV8703D-Q1

Related Documentation

- *Understanding IDRIVE and TDRIVE in TI Smart Gate Drivers*
- *Field Oriented Control (FOC) Made Easy for Brushless DC (BLDC) Motors Using TI Smart Gate Drivers*
- *Reduce Motor Drive BOM and PCB Area with TI Smart Gate Drive*

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