NVE CORPORATION

Application Bulletin AB-22

NVE Isolators Have Best-in-Class Common Mode Transient Immunity

Introduction

Common-Mode Transient Immunity (CMTI) is an important specification for isolators operating in noisy environments. It is particularly important in floating supply applications such as power-control gate drivers, where the change in the common-mode power supply voltage can exceed the isolator's CMTI and cause spurious switching.

This bulletin focuses on isolator transient immunity in gate-driver applications, practical measurement techniques for this important parameter, and the unique advantages of NVE Isolators in power control applications.

Typical Floating Supply Applications

Floating gate drive supplies are commonly used to drive power MOSFET gates in full- and half-bridge configurations, as illustrated in Figure 1:

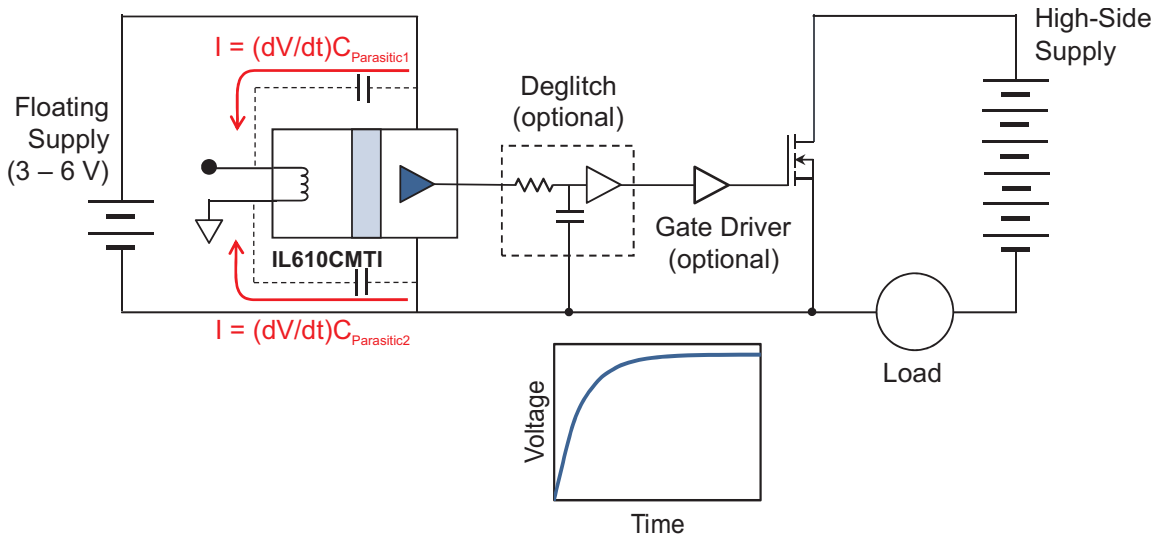

Figure 1. Typical floating gate driver.

As the MOSFET turns on, the floating power reference voltage increases with the voltage on the load. This creates a rapidly changing potential between the isolator output-side supply voltage and the input reference. The changing potential can cause parasitic currents through stray capacitance proportional to dV/dt. Isolators are designed to cancel this type of common-mode currents, but the cancellation is not perfect, which is the reason for CMTI specifications.

NVE's unique spintronic isolators have low stray capacitances and the capacitances are extremely well matched, so spintronic isolators have the highest CMTI in the industry.

Practical Transient Immunity Testing

The governing transient immunity standard is IEC 61000-4-4, *Electromagnetic compatibility (EMC); Part 4: Testing and measurement techniques; Section 4: Electrical fast transient/burst immunity test*. The standard does not provide a practical method for testing devices, however.

Figure 2 shows a simplified schematic of a practical CMTI test setup:

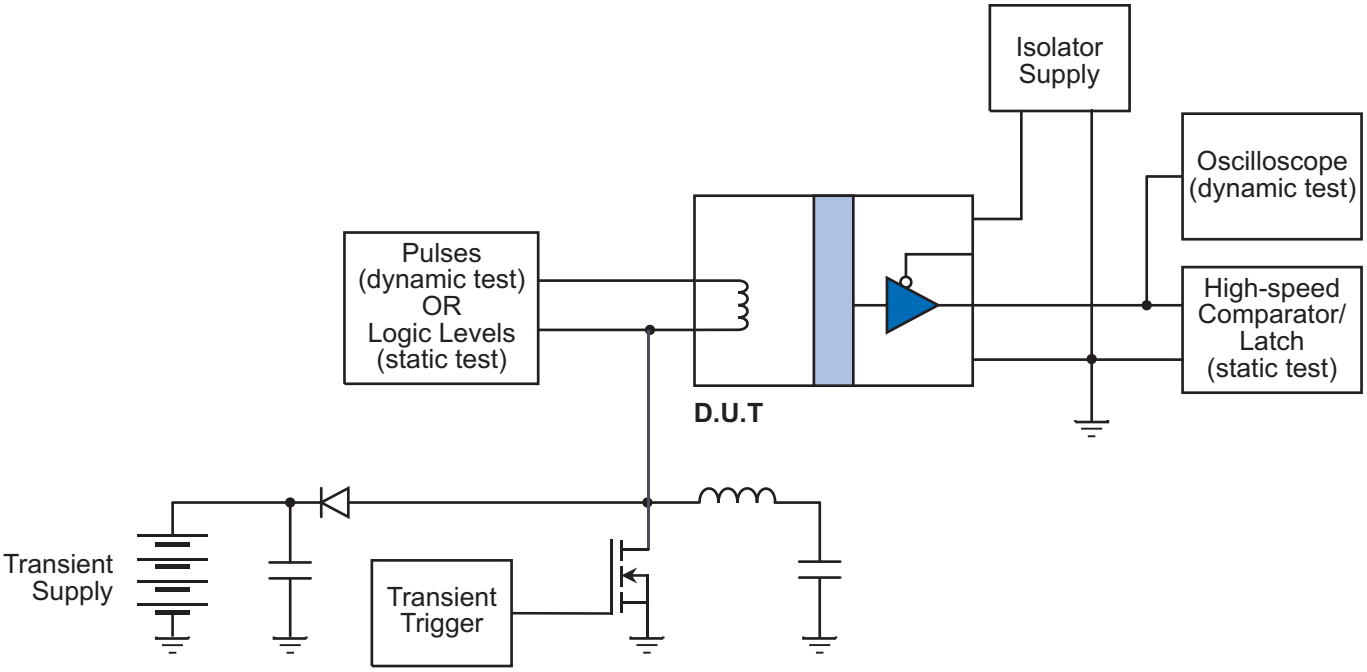

Figure 2. Practical transient immunity test setup.

The circuit in Figure 3 creates a rising-slope transient. A similar circuit is used for the falling transient. When the MOSFET turns off, the inductor current discharges the capacitor, creating a voltage transient, V_{CM}, with a known slope:

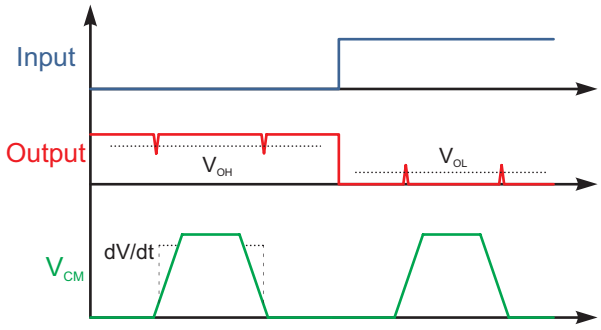

Figure 3. Illustrative static CMTI test waveforms.

The illustrative chart above shows CMTI failures. The CMTI specifications, commonly designated CM_H and CM_L, are the maximum common mode voltage slew rates that can be applied where the outputs remain stable and within the V_{OL} and V_{OH} specifications.

Static vs. Dynamic Tests

CMTI tests can be either static, where the inputs are tied to either logic HIGH or LOW; or dynamic, where the input signal is a pulse stream:

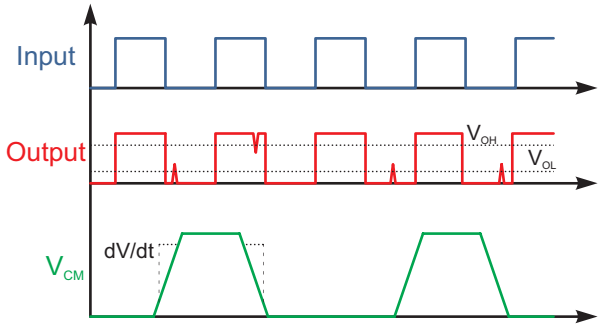

Figure 4. Illustrative dynamic CMTI test waveforms.

The V_{CM} transient pulses are asynchronous with respect to the input signal, and the test is run long enough to exercise all possible phasing for the common-mode transient with respect to the input and with respect to any isolator internal clocks or carriers. As with the static tests, the outputs must follow the input logic states and stay within V_{OL} and V_{OH} specifications to pass the test.

Since they use asynchronous clocks or carriers, dynamic tests should be used for inductive and capacitive isolators to exercise all possible timing combinations. NVE isolators have no clocks or carriers, so static tests provide similar glitch immunity results to dynamic tests.

Dynamic testing also detects effects where the output pulse width changes slightly when the common-mode transient coincides closely to an input transition and cause a pulse-width distortion fail. This is an advantage of dynamic testing for applications where pulse-width distortion is critical.

100% CMTI Testing

Static CMTI tests are easier to implement in production because they're more objective as any glitches outside the V_{OL}/V_{OH} specifications can be latched and fail the part. The IL6xxCMTI family are the only isolators in the industry that are 100% tested for CMTI.

External Deglitch for 300 kV/µs CMTI

The high speed of NVE isolators means any spurious output transients with extremely high common-mode transients tend to be very short and can be easily deglitched. A typical external deglitch circuit is shown below:

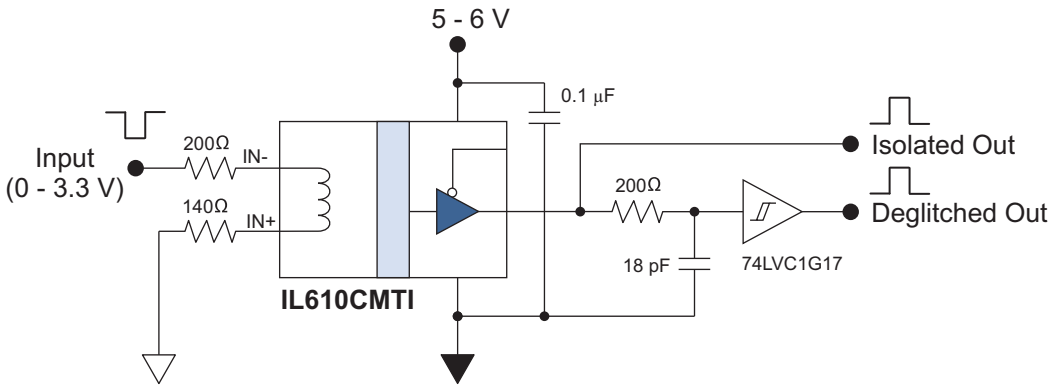

Figure 5. Typical external deglitch circuit for >300 kV/µs CMTI.

Available Devices

NVE Isolators are ideal for gate-drive applications because of their small packages, high CMTI, and best-in-class pulse-width distortion. Table 1 shows popular isolators for gate-drive applications:

Part Number	Channel Configuration	Input Configuration	Output Configuration	Max. VDD2	Available Packages	Min. Transient Immunity
IL710	Single Channel	CMOS	Standard	5.5 V	PDIP8, SOIC8, MSOP8	100 kV/µs
IL711	Dual Channel					
IL610CMTI	Single Channel	Passive	DC Correct / Failsafe	6.6 V	SOIC8, MSOP8	200 kV/µs* (300 kV/µs with ext. deglitch)
IL611CMTI	Dual Channel					

*100% tested.

Table 1. Isolators for floating-drive level shifting.

The typical pulse width distortion for NVE isolators is 1 ns, which minimizes dead time, improves efficiency, and reduces distortion in applications such as audio drivers. Parts are available in MSOP-8 packages to minimize board area.

Input Configurations

IL700-Series Digital-Input Isolators have CMOS inputs, while IL600-Series Passive-Input Isolators have resistive coil inputs. IL600-Series Isolators change state based on the current through a coil, analogous to optocouplers. An external resistor in the coil path typically sets the input current. The parts are guaranteed to switch at 5 mA coil current, and CMTI is maximized with 10 mA coil current.

Output Configuration

IL700-Series Isolators are edge-sensitive and generally need external power-on reset functions. IL600-Series Isolators are DC correct (meaning the output always follows the input) and failsafe (meaning the output goes to a defined state on power-down and returns to that state on power up). These features make IL600-Series Isolators well-suited for directly driving MOSFETs, while IL700-Series Isolators are generally used with gate drivers.

Maximum VDD2

IL6xxCMTI isolators have an extended power supply range up to 6.6 volts, which allows direct drive of MOSFETs with 6-volt nominal gate thresholds.