

## Application Bulletin AB-22

### *IsoLoop Isolators Have Best-in-Class Transient Immunity*

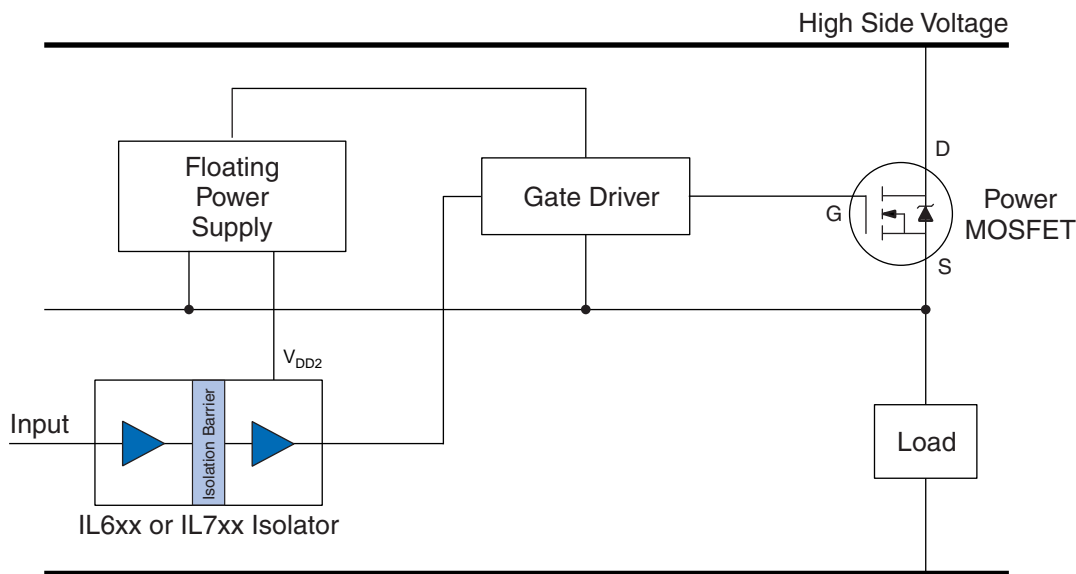
#### Introduction

Transient immunity is an important specification for isolators operating in noisy environments. But it is also important in floating supply applications such as power control gate drivers, where the change in the common-mode power supply voltage can exceed  $dV/dt$  tolerance for the isolator and cause spurious switching.

This bulletin focuses on isolator transient immunity in floating supply applications, practical measurement techniques for this important parameter, and even how to increase transient immunity for IsoLoop Isolators.

#### 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. This 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 such cancellation is not perfect, which is the reason for  $dV/dt$  specifications.

#### Available Devices

IsoLoop Isolators are ideal for gate-drive applications because of their small packages, high  $dV/dt$  tolerance, and best-in-class pulse width distortion. Table 1 shows several unidirectional IsoLoop Isolators popular for floating drive level shifting:

Part	Channel Configuration	Input Configuration	Output Configuration	Available Packages	Typical Transient Immunity
IL710	Single Channel	Digital		PDIP8, SOIC8, MSOP8	50 kV/μs
IL711	Dual Channel	Digital		PDIP8, SOIC8, MSOP8	50 kV/μs
IL610	Single Channel	Passive	DC Correct/Failsafe	PDIP8, SOIC8, MSOP8	20 kV/μs
IL611	Dual Channel	Passive	DC Correct/Failsafe	PDIP8, SOIC8, MSOP8	20 kV/μs
IL613	Triple Channel	Passive	DC Correct/Failsafe	SOIC16	20 kV/μs

**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.

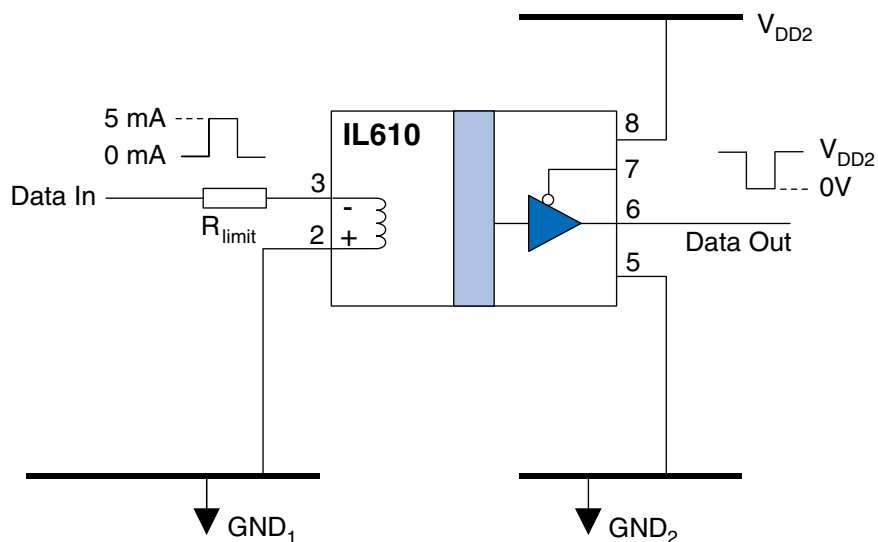
**Output Configuration**

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 especially popular for gate-drive applications.

**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 limits the input current to the specified 5 mA.



**Figure 2. IL600-Series passive input isolator.**

As noted in the IL600-Series datasheet, for a  $V_{DD2}$  power supply of 3.3 V rather than 5 V, the minimum coil current for failsafe operation is 8 mA rather than 5 mA.

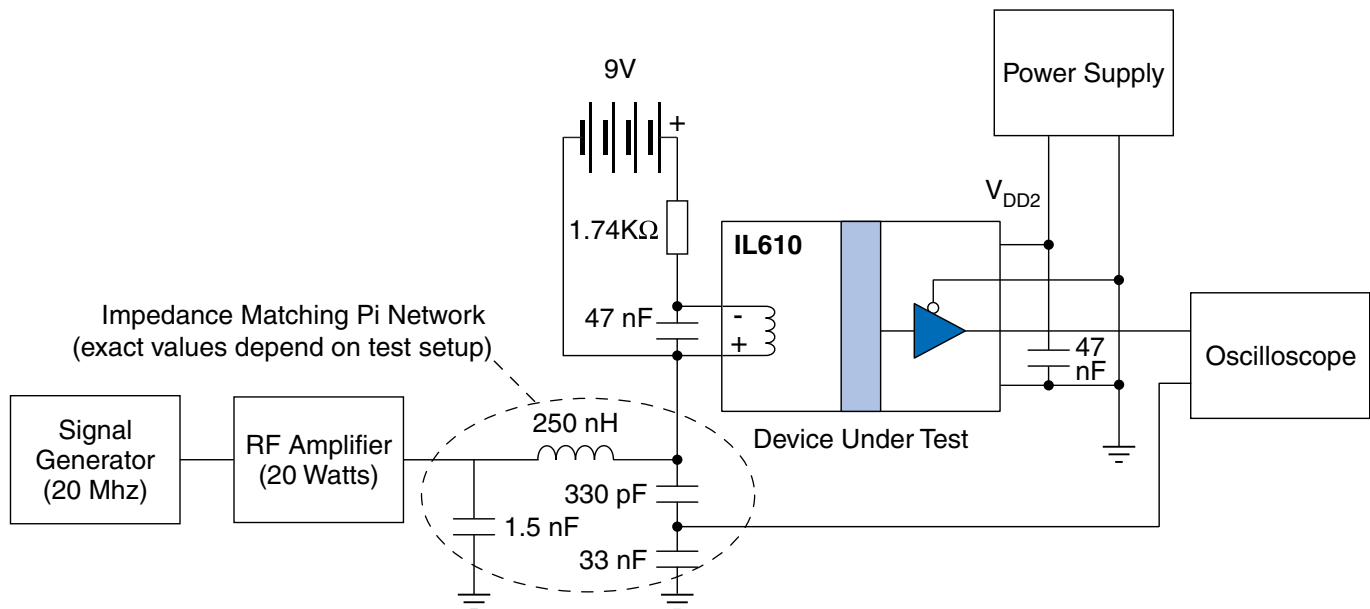
**Increasing IL600 Transient Immunity**

IL600-Series transient immunity increases significantly with increased input drive current by driving the device farther into saturation. For example, increasing the input drive to 10 mA from the 5 mA minimum can increase immunity from the specified typical of 20 kV/ $\mu$ s to as much as 70 kV/ $\mu$ s or more.

**Practical Transient Immunity Characterization**

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 3 shows a practical test setup to measure dV/dt in specific devices. The setup is used to determine the maximum sinusoidal amplitude the isolator can tolerate without spurious switching:



**Figure 3. Practical transient immunity test setup.**

The circuit is typical, with exact values depending on the test setup. The 20 Mhz signal generator frequency is within the capabilities of most signal generators, and provides a reasonable dV/dt for practical amplitudes.

A readily available 20 watt linear RF amplifier provides enough amplitude to subject the device to high simulated transients.

The oscilloscope monitors the amplitude of the driving sine wave, as well as the isolator output. The signal generator amplitude is gradually increased until spurious isolator outputs occur as shown in Figure 4:



**Figure 4. Transient immunity test oscilloscope traces.**

The green trace is the pi network output and the purple trace is the isolator output. The applied  $dV/dt$  can be estimated on the oscilloscope, or calculated from amplitude and frequency. The test voltage is calculated from the oscilloscope voltage by giving effect to the 100:1 capacitive voltage divider in the pi network.

### Test Setup Considerations

The pi network in Figure 3 matches the 50 ohm output impedance of the RF amplifier to the device under test. The values may need to be optimized to maximize power transfer. There are many resources for designing pi networks, but experimenting with different capacitors and inductors may be the simplest approach.

The 330 pF and 33 nF capacitors in the network also form a 100:1 capacitive voltage divider to bring the voltage into the same range for the oscilloscope as the isolator output.

A battery drives the isolator input, with a current-limiting resistor of 1740 ohms to provide a 5 mA input coil current. A suitable floating power can be used in place of the battery, but most laboratory supplies do not have enough ground isolation for this test.

As noted previously in this bulletin, increased coil current increases transient immunity. While it is also possible for  $dV/dt$  to disrupt the zero coil input state, the coil-driven state is more susceptible.

Decoupling capacitors on the input and the power supply damp high-frequency noise, which would confound the test. The capacitors should be 47 nF low-ESR ceramic capacitors, placed as close as possible to the appropriate device pins.