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Giant-Magneto-Resistance as Digital Isolation Technology

Introduction

GMR isolators have the best EMC footprint of any isolation technology with low emissions, low EMI susceptibility and excellent magnetic immunity.

Low Emissions

Unlike other isolation technologies, GMR isolators do not need RF carriers or high frequency clocks for stability. Furthermore, they do not include power transfer coils or transformers, which are natural ante

nas. Extensive experience in a variety of applications has demonstrated trouble-free compliance with EN55022-B, FCC Class B, CISPR 22, and similar regulations. Figure 1 shows the virtually undetectable radiated emissions for a GMR Isolator (below the testing laboratory's noise floor), compared to the problematic emission levels of a transformer-based isolator (Figure 2) even with no other system components involved.

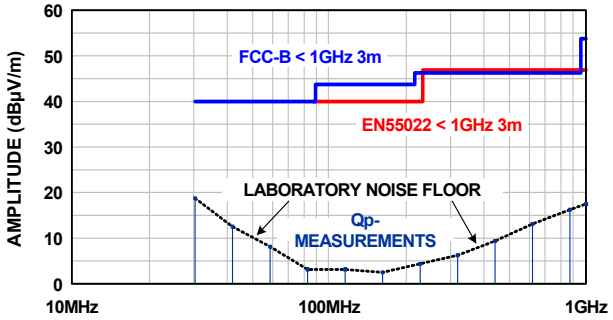

FIGURE 1. A GMR ISOLATOR HAS VIRTUALLY UNDETECTABLE RADIATED EMISSIONS (BLUE DOTS ARE THE TESTING LABORATORY'S NOISE FLOOR)

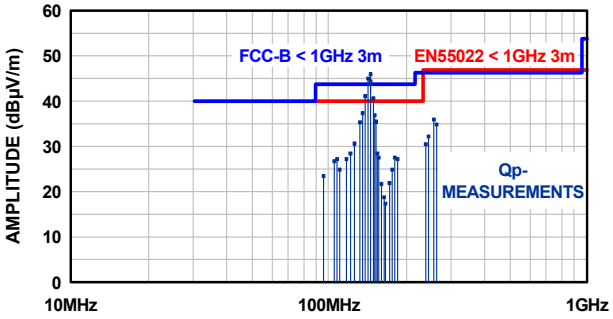

FIGURE 2. A TRANSFORMER-BASED ISOLATOR FAILING EN55022-B AND FCC B

Low EMI Susceptibility

Because they have no pulse trains or carriers to interfere with, GMR Isolators also have low EMI susceptibility. Susceptibility limits for most industrial, commercial, telecom, residential and medical applications are governed by the European Electromagnetic Compliance specifications EN50081, EN50082 and EN600001. GMR isolators are passing compliance tests in the following categories:

- EN50081-1
  - Residential, commercial and light industrial methods EN55022, EN55014
- EN50082-2
  - EN61000-4-2 (Industrial Environment Methods-ESD)
  - EN61000-4-3 (Electromagnetic Field Immunity)
  - EN61000-4-4 (Electrical Transient Immunity)
  - EN61000-4-6 (RFI Immunity)
  - EN61000-4-8 (Power Frequency Field)
  - EN61000-4-9 (Pulsed Magnetic Field)
  - EN61000-4-10 (Damped Oscillatory Magnetic Field)
- ENV50204
  - Radiated Field from Digital Telephones (Immunity Test)

Magnetic Immunity

As shown in Table 1, even at low frequency GMR Isolators provide three times the level of immunity to perturbations required by these standards in the worst-case field orientation. Oriented optimally (cross-axis), immunity jumps to at least several times the standard limits.

TABLE 1. GMR ISOLATOR MAGNETIC IMMUNITY SPECIFICATIONS VERSUS EN STANDARDS

STANDARD	STANDARD LIMIT (A/m)	MINIMUM GMR SPECIFICATION (A/m)	
		CROSS AXIS	ON-AXIS
EN50081-1, Methods EN55022, EN55014	100	2500	1000
EN50082-2, Methods EN61000-4-8 (Power Frequency Magnetic Field Immunity)	1000	2500	1000
EN50082-2, Methods EN61000-4-9 (Pulsed Magnetic Field)	1000	4500	1800
EN50082-2, Methods EN61000-4-10 (Damped Oscillatory Magnetic Field)	100	4500	1800

Fields in the ranges of the Table 1 specifications are unusually high for most circuits, and allow for very high currents close to the part. GMR Isolators are proven in many years of operation in the most demanding applications, including medical devices, military, and aerospace electronics.

Immunity Improves with Frequency

Figure 3 shows the immunity of GMR isolator compared to the frequency-dependent EN standards referenced in Table 1 compared to transformer coupled isolators:

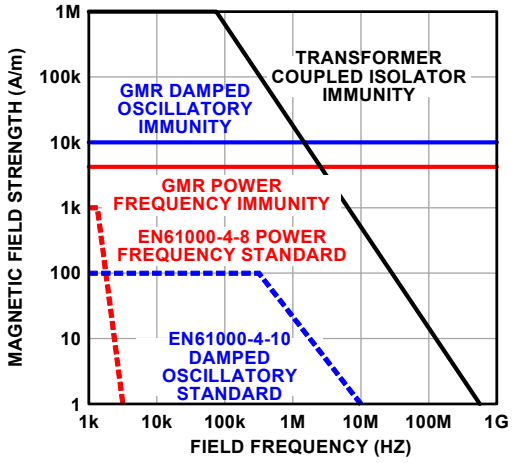

FIGURE 3. MAGNETIC IMMUNITY FREQUENCY DEPENDENCE

GMR shield effectiveness increases with frequency, and because there are no carriers or clocks to be disrupted by AC fields, GMR electromagnetic immunity improves with frequency. Conversely, transformer coupled isolators are inherently susceptible to high frequency energy, and their immunity decreases with frequency.

Bridge Design Cancels External Field

GMR Isolators' EMC advantages can be traced to their revolutionary spintronic GMR technology. The input drives a low-field generator. The field changes the electron spin polarization, which changes the resistance of the Giant Magneto-Resistor (GMR) bridge elements. Unlike transformers or conventional coils, this does not rely on energy transfer, so EMI emissions are minimal. A Wheatstone bridge configuration cancels the ambient common-mode magnetic field, thus resulting in excellent immunity to external magnetic fields (see Figure 4.v

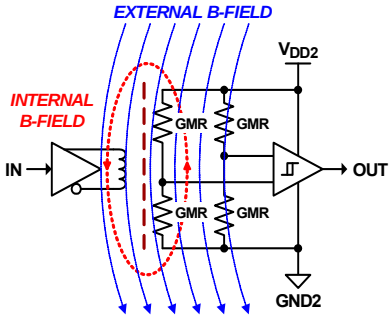

FIGURE 4. A BRIDGE CONFIGURATION CANCELS EXTERNAL FIELDS

Shielding Enhances Immunity

The addition of a DC-restore circuit can reduce all three of the external AC coupling An integrated high-permeability alloy EMI shield over the GMR bridge elements further enhances magnetic immunity (see Figure 5).

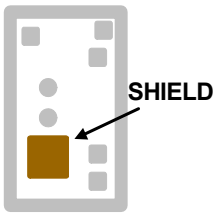

FIGURE 5. ISOLATOR DIE MAGNETIC SHIELD

Orientation to Maximize Immunity

Magnetic immunity depends on the orientation of the package and die with respect to the field. As shown in Table 1, immunity to external magnetic fields is higher if the field direction is end-to-end (cross-axis) as shown in Figure 6 rather than to pin-to-pin.

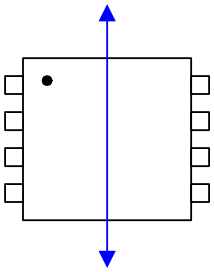

FIGURE 6. DIRECTION OF HIGHEST IMMUNITY (CROSS-AXIS)

Conclusion

Because they do not use RF carriers or refresh pulse trains, GMR isolators inherently have extremely low EMI emissions. Their shielded Wheatstone bridge design provides high magnetic immunity, and unlike transformers, GMR Isolator magnetic immunity improves with frequency, making them ideal for digital circuit isolation. Finally, device orientation can increase immunity even more.

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