

## PROTECTION PRODUCTS

### Using Integrated Magnetic Connector Assemblies in GR-1089 Ethernet Applications

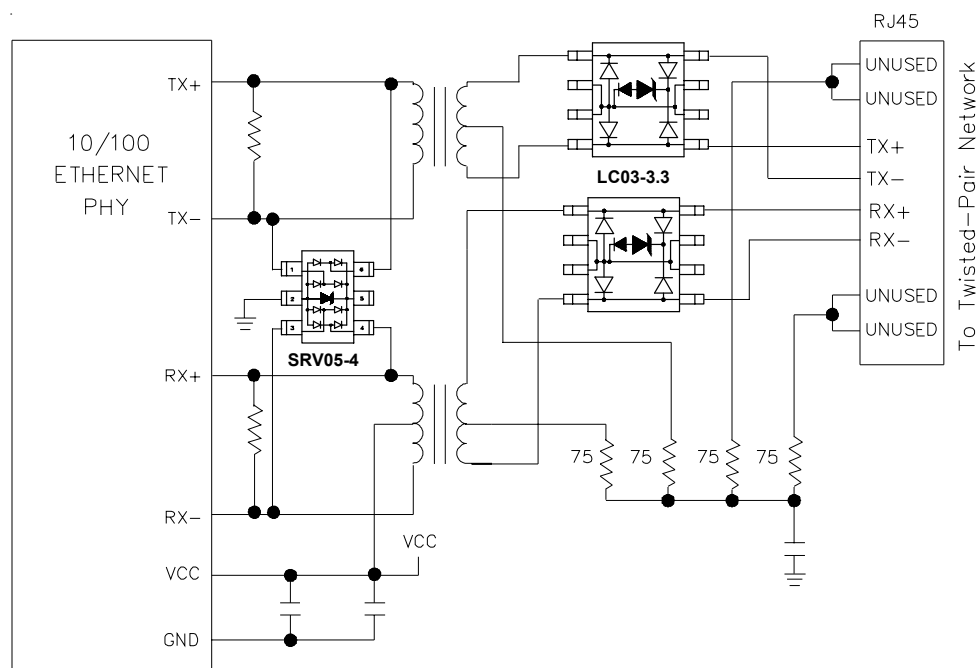
#### Protecting Ethernet Based Systems

High-reliability carrier and enterprise class Ethernet-based systems require robust protection of external ports from transient voltage events such as lightning, electrostatic discharge, and cable discharge events. Each new generation of Ethernet deployment yields higher-density boards that demand protection solutions that occupy less board space. Moreover, many of these systems are required to meet the transient immunity requirements of Telcordia Technologies (formerly Bellcore) GR-1089-CORE. Protection devices need to have low capacitance to prevent signal degradation, high energy handling capability, and low clamping voltage to reduce stress on the protected IC. They are typically placed on the line side and PHY side of the magnetics (Figure 1). The line side devices protect the transformer and the downstream IC by clamping the metallic lightning surge and preventing current from flowing through the transformer windings. The IC side protection clamps common mode surges that exceed the transformer isolation. It will also further reduce metallic surges to an even lower and benign voltage.

Board space constraints have forced many manufacturers to implement RJ-45 connectors with integrated magnetics. Unfortunately, this presents a problem when trying to include surge protection, particularly to the stringent requirements of Telcordia GR-1089. One solution is to integrate the protection into the connector/magnetics assembly. This application note summarizes the clamping performance of one such assembly when subjected to the GR-1089 intra building metallic lightning surge.

#### GR-1089 Intra Building Surge Requirements

The Telcordia Technologies GR-1089-CORE specification defines a set of requirements for lightning and AC power cross immunity for intra building equipment. The lightning tests are applied as metallic (line-to-line) or longitudinal (line-to-ground) waveforms. The metallic mode (Line-to-Line) surge of GR-1089 is defined as 800 volts (open circuit) across 8 Ohms to generate a maximum of 100A short circuit current. The common mode surge is defined as 1500 volts across 15 Ohms generating a 100A short circuit current. The waveform duration in both cases (rise/fall time) is 2/10 $\mu$ s. One surge of positive and one of negative polarity are applied. To pass, the equipment must continue to operate after the test.



**Figure 1 - Typical GR-1089 Compliant Ethernet Protection Circuit**

## PROTECTION PRODUCTS

### Test Set Up

For this evaluation, an EMCPro™/1089 Telecom Surge Test System manufactured by Thermo Keytek is used to generate the double exponential impulse waveform as defined by GR-1089. The surge pulses were applied to the differential pin pairs of the integrated magnetic connector assembly (part number XFATM9DM-CT1-4M) manufactured by XFMRs Inc. This device is designed for 10/100 Ethernet and integrates the Semtech LC03-3.3 transient voltage suppressor differentially across each of the two line pairs (Figure 2). In order to obtain a clamping voltage curve, tests were performed at input voltage magnitudes of 100V, 400V, and 800V. This corresponds to short circuit current magnitudes of 12A, 50A, and 100A respectively. Clamping voltage measurements were taken across the line pairs on the PHY side of the assembly.

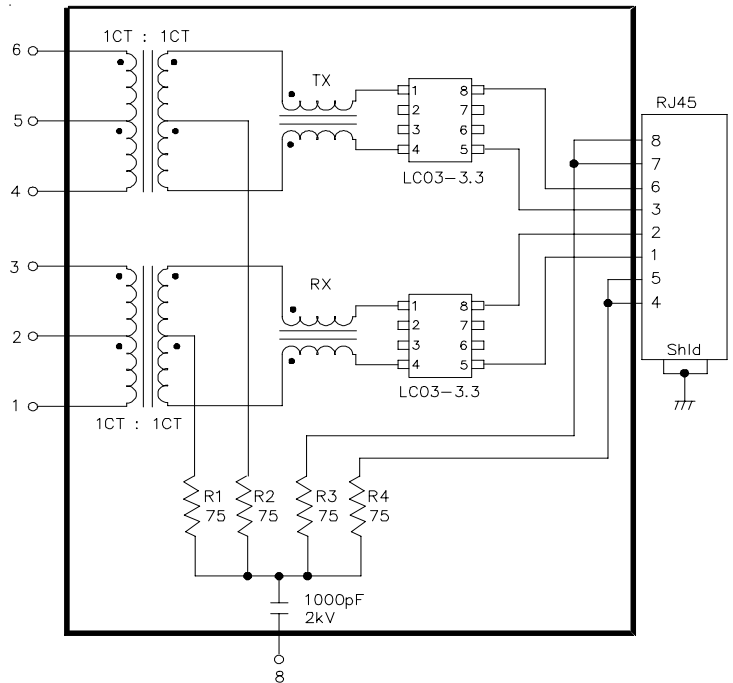
### Test Results

Figure 3 is a graph of mean clamping voltage vs. Peak pulse current taken across the differential pairs at the IC side of the XFATM9DM-CT1-4M assembly. As shown, the 800V, 100A (2/10  $\mu$ s) surge is typically clamped to less than 17 volts. Figure 4 and 5 are oscilloscope plots of the 800 volts surge from the tester and the clamped waveform respectively.

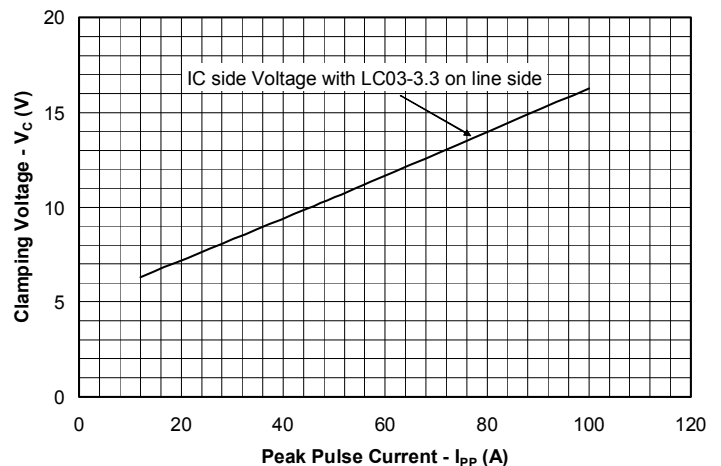
### Conclusion

Integrated magnetic connector assemblies that include internal TVS devices can be used to meet the requirements of GR-1089 in Ethernet applications. Assemblies that do not include internal protection run the risk of being damaged during the high current lightning surge. The internal TVS will clamp the metallic surges while the transformers isolation provides protection to common surges (up to approximately 1500 volts).

This evaluation has shown that the 800V, 100A intra building metallic lightning surge was clamped to less than 17 volts at the PHY side of the XFMRs Inc. assembly. This includes the voltage across the LC03-3.3 as well as the effects of any parasitic inductance that are introduced by the assembly. Results for other manufacturers assemblies may differ slightly due to differences in construction. Further reduction in clamping voltage can be achieved with the addition of an IC side protection device such as the Semtech SRV05-4.

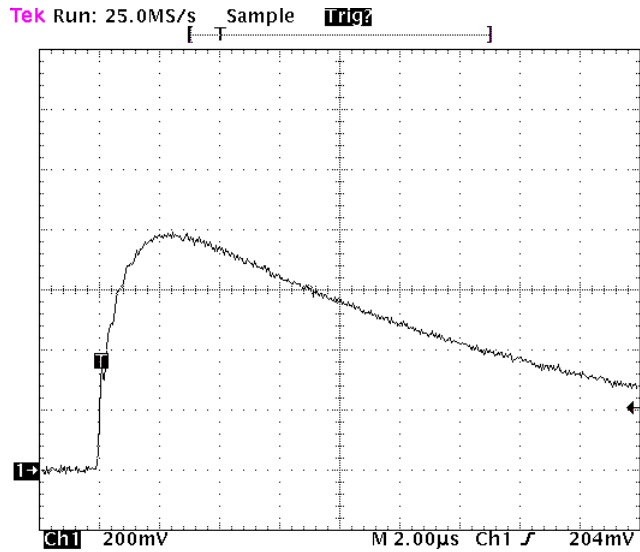


**Figure 2 - XFATM9DM-CT1-4M Magnetic Connector Assembly with Integrated LC03-3.3 (Schematic courtesy of XFMRs Inc.)**

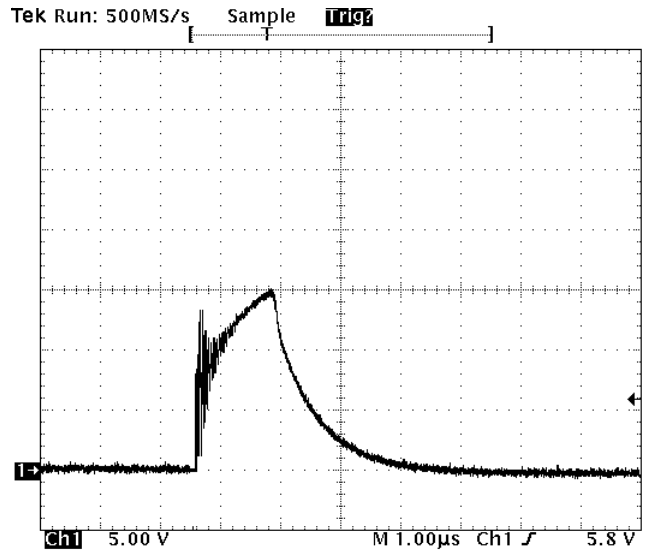


**Figure 3 - Mean Clamping Voltage at the PHY Side of the Magnetic Connector**

**PROTECTION PRODUCTS**



**Figure 4 - 800V Open Circuit Impulse Voltage Waveform**



**Figure 5 - Typical Clamped Voltage Waveform at PHY Side of Magnetic Connector Assembly integrate with LC03-3.3 for a GR-1089 100A 8x20µs pulse**

**Additional Information**

Additional information on the XFMRs Inc. 10/100 XFATM9DM-CT1-4M magnetic connector assembly can be obtained at their web site: [www.xfmrs.com](http://www.xfmrs.com). Note there is also a gigabit Ethernet version available with integrated LC03-3.3 TVS' (part number XFGIG12TVS-CT1-4L).

**Contact Information**

Semtech Corporation  
 Protection Products Division  
 200 Flynn Road, Camarillo, CA 93012  
 Phone: (805)498-2111 FAX (805)498-3804