Application Brief

IEC60601-1-2 Compliant Digital Isolation Design With 16-kV Contact Discharge ESD Protection

Christian Greeff, Koteshwar Rao

Introduction

Medical end-equipment often requires protection from transient spikes, lightning, and other high-voltage conditions. 15-kV ESD testing (air discharge) for isolated systems is needed as part of electromagnetic disturbance requirements to meet IEC60601-1-2 and provide confidence for system reliability.

The IEC 61000-4-2 document referenced in the IEC60601-1-2 standard, has been recently updated in the 4th edition to include higher requirements for contact and air ESD protection. Due to the trend for increased ESD protection requirements, it is important to have a robust method to protect against these types of discharges. Table 1 details the ESD testing requirements.

Table 1. IEC 61000-4-2: Electrostatic Discharge Testing Requirements

Test Type	3rd Edition	4th Edition
Contact Discharge	±2, 4, 6 kV	±2, 4, 8 kV
Air Discharge	±2, 4, 8 kV	±2, 4, 8, 15 kV

Device Selection Consideration

ISO77xx in the wide-body SOIC package (DW-16) digital isolator family is certified by CSA with 2 MOPP (Means of Patient Protection) per IEC 60601-1 Ed 3.1 with 250 V_{RMS} working voltage rating. This makes the ISO77xx digital isolator family the best isolator for medical applications. The most commonly available digital isolator package, DW-16, offers a clearance of 8 mm while 15-kV ESD supports requirements for the package to have a creepage of > 12 mm. Protection devices like Gas Discharge Tubes (GDT) can be used across the device to support the 15-kV ESD requirement without the need of increased clearance of 12 mm.

GDT Device Selection for ESD

Gas Discharge Tube (GDT) is a 2-terminal non-polarized protection device that serves as a controlled gas mixture air gap that behaves in a predictable manner regardless of external factors such as humidity and surrounding atmospheric mixture. When selecting a GDT for a high-voltage isolation application, some important parameters include DC and impulse breakdown voltages. One of the drawbacks of GDTs is that they are relatively slow to trigger when compared to the ESD transient. This issue can be addressed by choosing a GDT with a much lower breakdown and accelerating the breakdown process. For this reason, when selecting the breakdown voltage, select a GDT with the lowest value that is greater than the working voltage requirement of the end-equipment.

ISO77xx With Bourns 2093-250-SM GDT

Consider testing ISO7741 with a GDT from Bourns (2093-250-SM) as an example for testing for 15-kV contact discharge ESD. A 2.5-kV GDT is selected to allow ISO7741 to be used up to its rated working voltage of 2-kV DC according to IEC 60747-17. The DW-16 SOIC package with 8-mm clearance is capable of supporting an ESD of up to 12 kV and the protection required is only during the duration when ESD is between 12 kV to 15 kV. The Bourns 2093-250-SM 2.5-kV GDT has an impulse sparkover of 3.1 kV. This means that the duration of ESD pulse from 3.1 kV to 12 kV allows for more time for the GDT to fully trigger and protect the device. Figure 1 illustrates the ISO7741 with GDT.

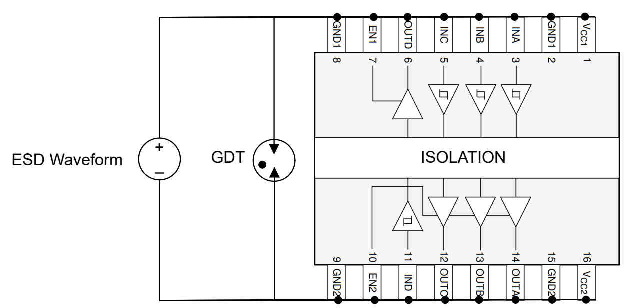

Figure 1. ISO7741 With GDT

Testing

To test the ESD performance of the solution with the ISO77xx device and the GDT, these devices were assembled onto the evaluation module ISO7741EVM as shown in Figure 2. To truly test the isolation barrier, all the pins on one side of isolation barrier are shorted together to form a single terminal and similarly, all the pins on the other side are shorted to form another terminal. The ESD pulse was applied to these two terminals. As required by the ESD standard, the board was tested with 10 positive pulses and 10 negative pulses for the stated voltages. The time duration maintained between pulses was one second.

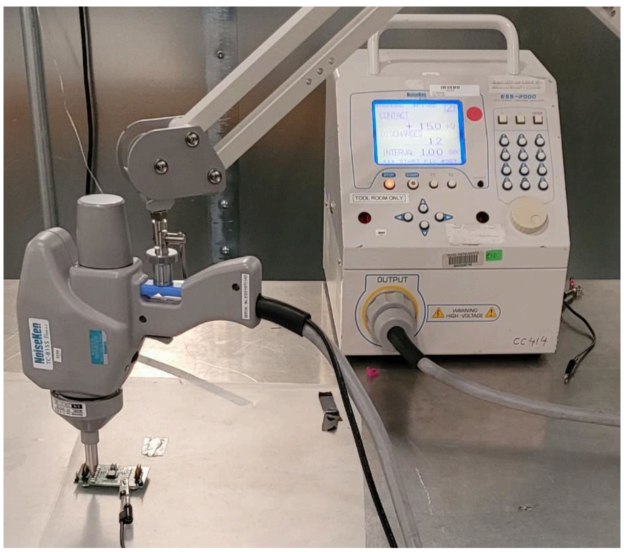

Figure 2. Testing Setup

Test Results

Test results were captured for GDTs with 3-kV and 2.5-kV breakdown voltages. For all 3-kV GDT setups, an ESD voltage of ±15 kV was tested. For the 2.5-kV GDT setups, voltages up to 16 kV were tested. After stressing the designs with ESD pulses, the ISO77xx devices were run through production tests to verify their full functionality benchmarking against a production-level device. Table 2 lists the results from these tests and shows that all ISO77xx devices tested have successfully passed production-level testing.

Table 2. Test Result Data

Board #	GDT DC Breakover Voltage (kV)	ESD Contact Discharge (±kV)	Device Test Results
1	3	15	All Tests Pass
2	3	15	All Tests Pass
3	3	15	All Tests Pass
4	3	15	All Tests Pass
5	3	15	All Tests Pass
6	2.5	15	All Tests Pass
7	2.5	15	All Tests Pass
8	2.5	16	All Tests Pass
9	2.5	16	All Tests Pass
10	2.5	16	All Tests Pass

Conclusion

With the need for increasing levels of ESD protection, the test results show that Texas Instruments isolation devices with GDT help meet isolation and ESD protection requirements of medical and other industrial end-equipment standards.

References

1. Texas Instruments, *Distance Through Insulation: How Digital Isolators Meet Certification Requirements* technical white paper
2. Bourns, First Principles of a Gas Discharge Tube white paper technical white paper