

Application Hints for using external ESD protection of TH808x

1. Scope

This application note describes the possibility to increase the ESD robustness level of TH8080x by using different external protection elements.

To verify different external circuitries it was applied the standard LIN ESD test method described in the LIN EMC Test Specification Rev. 2.0 (DIN 61000-4-2). This test method is used for the IC related ESD verification of LIN devices.

The value of this test method can correlate with the behaviour on module level, but in general the test conditions, pulse forms, rise times and the energy of the applied pulses are much different.

Fig.1 shows the improvement of the ESD protection on TH808x by using different ESD protection elements.

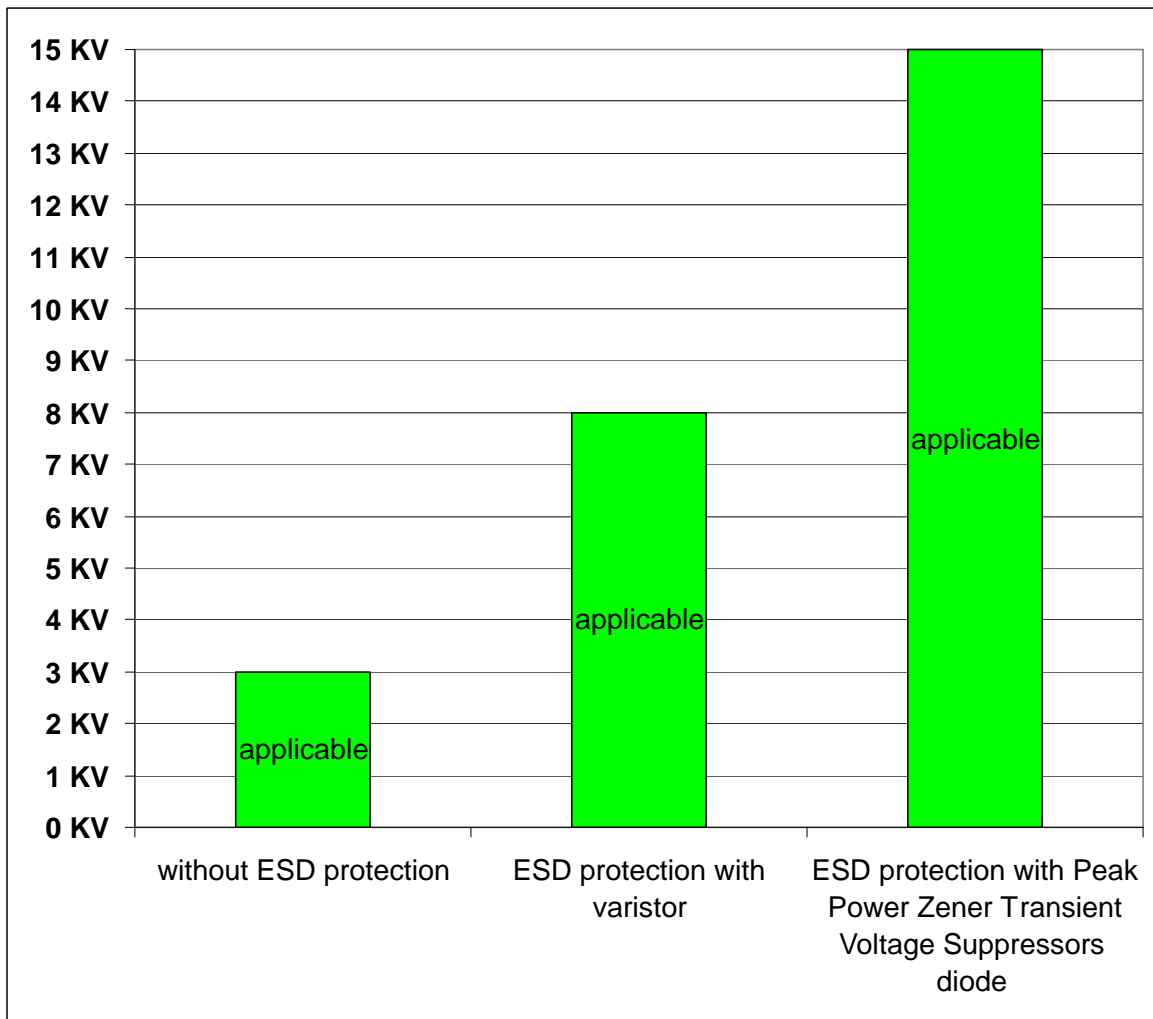


Figure 1 – Results of ESD test of Th808x with different external ESD protection elements

2. Description of the ESD test according to DIN 61000-4-2

For the test according to DIN 61000-4-2 was used the following equipment:

ESD simulator EM Test ESD 30C
 Discharge module P 30C (150pF/ 330Ω, 150pF/2000Ω or 330pF/2000Ω)
 Oscilloscope Tektronix TDS 544A
 Function generator HAMEG HM8130

Fig.2 shows the schematic of the ESD test setup and Fig.3 shows the test PCB.

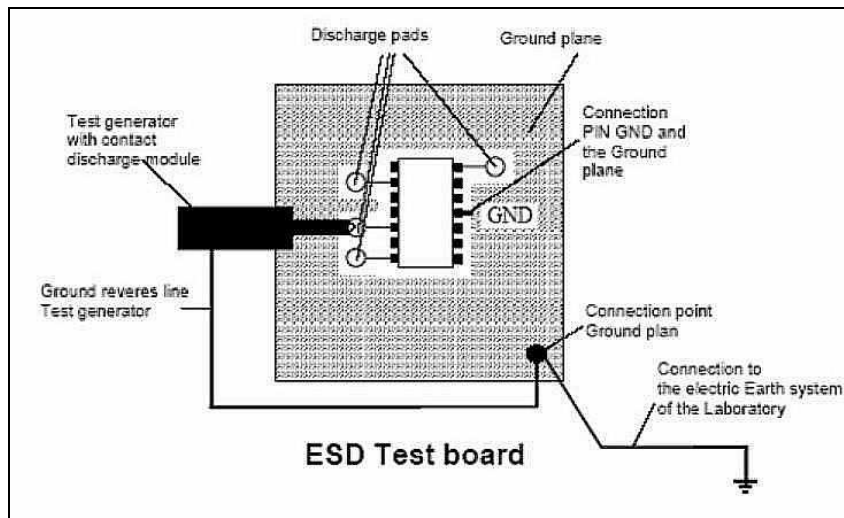


Figure 2 - Schematic of the ESD test setup

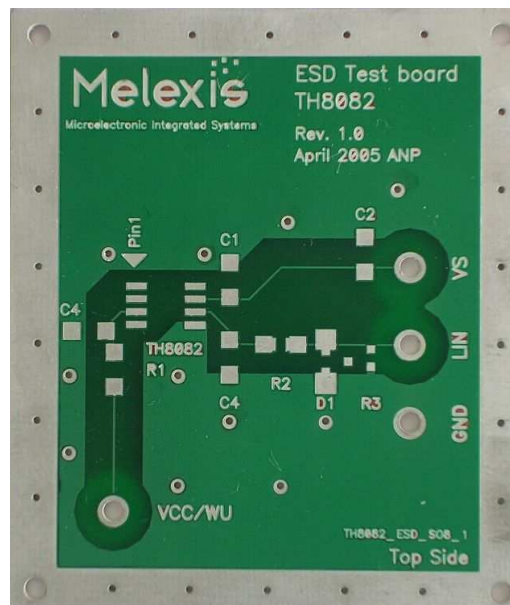


Figure 3 - ESD test PCB TH808x

3. Test Results

In order to check to the device after applying the ESD stress it was monitored the pin I/V characteristics. With this pin characteristic measurement it is possible to detect already a pre-damaging caused by ESD, also if the IC functional is still OK.

3.1 ESD protection using Varistor (TDK AVR-M1608C270MBABB 15pF), bus capacitor 180pF (Slave Module) and resistor 10Ω ESD protection using varistor

Protection elements:

Varistor: TDK AVR-M1608C270MBABB (15pF)
 Bus Capacitor: 180pF (slave module)
 Bus serial Element: 10 Ω

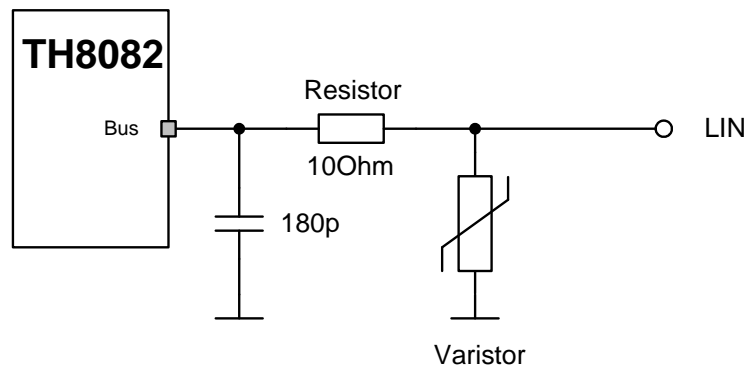


Figure 4 - Schematic of the ESD protection with varistor

The damage limit by using varistor and serial resistor as protection elements is **9 to 15kV**. The result is sufficient for a robustness level of 8kV.

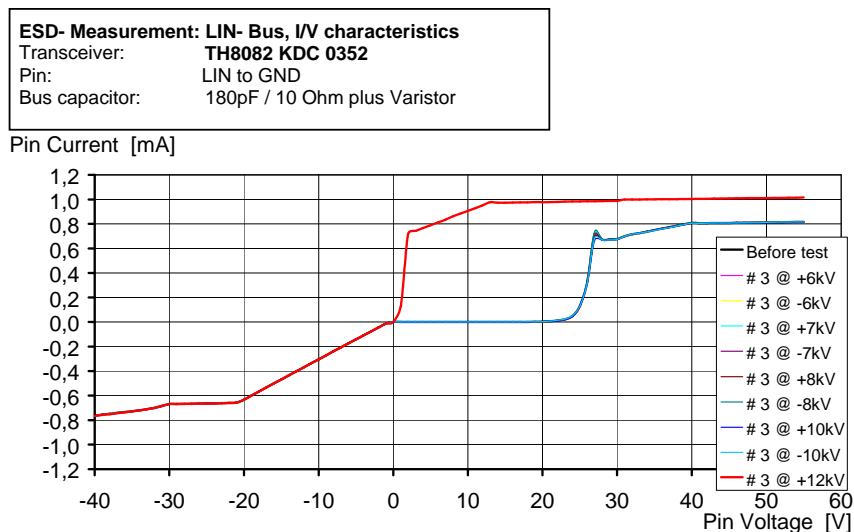


Figure 5 - I/V pin characteristic after applying different ESD pulses

3.2 ESD protection using Back-to-Back Zener Diode (Onsemi MMB27VCLT1 30pF), bus capacitor 180pF (Slave Module) and resistor 10Ω

Protection elements:

Diode: ON-Semi MMBZ27VCLT1 (30pF)
 Bus Capacitor: 180pF (slave module)
 Bus serial Element: 10 Ω

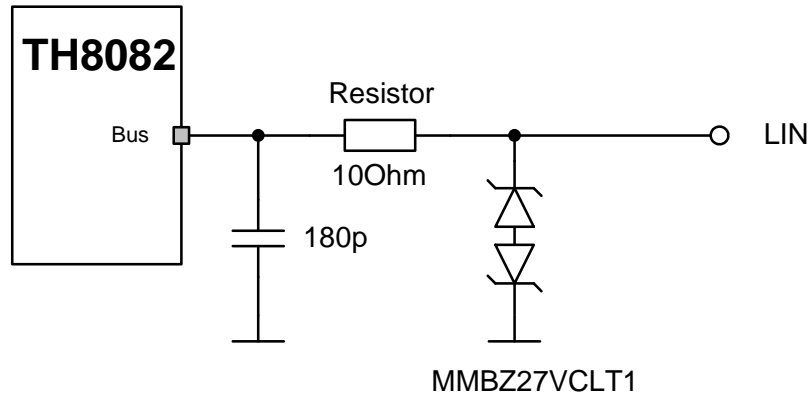


Figure 6 - Schematic of the ESD protection with Back-to-Back Zener Diode

The damage limit by using Back-to-back zener diode and serial resistor as protection elements is **>15kV**.

The result is sufficient for a robustness level of 15kV.

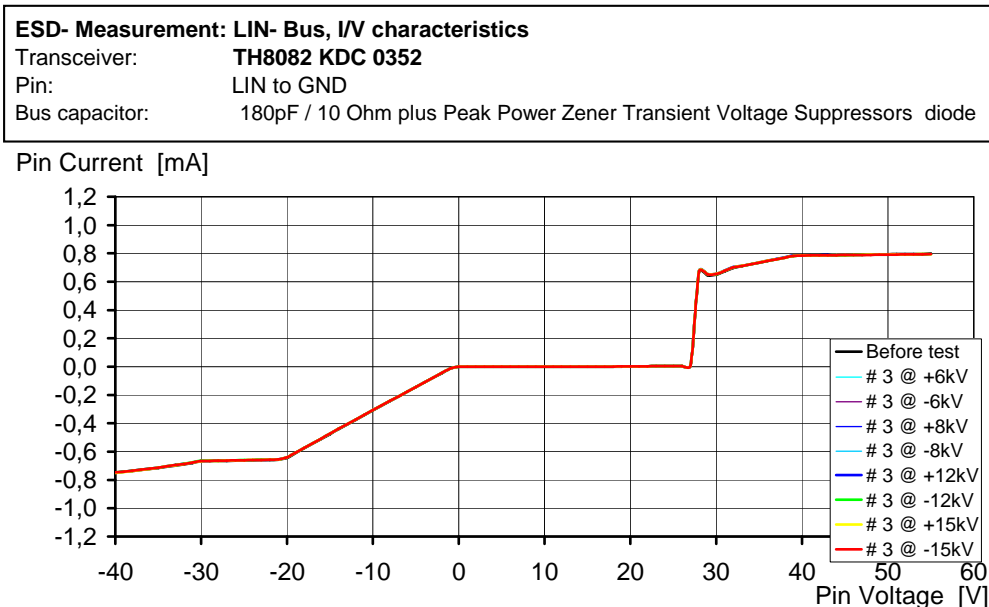


Figure 7 - I/V pin characteristic after applying different ESD pulses

3.3 ESD protection using Back-to-Back Zener Diode (Onsemi MMB27VCLT1 30pF), bus capacitor 1nF (Master Module) and SMD-ferrite (Würth: 742 792 097)

Protection elements:

- Diode: ON-Semi MMBZ27VCLT1 (30pF)
- Bus Capacitor: 1nF (master module)
- Bus serial Element: SMD-ferrite Würth 742 792 097

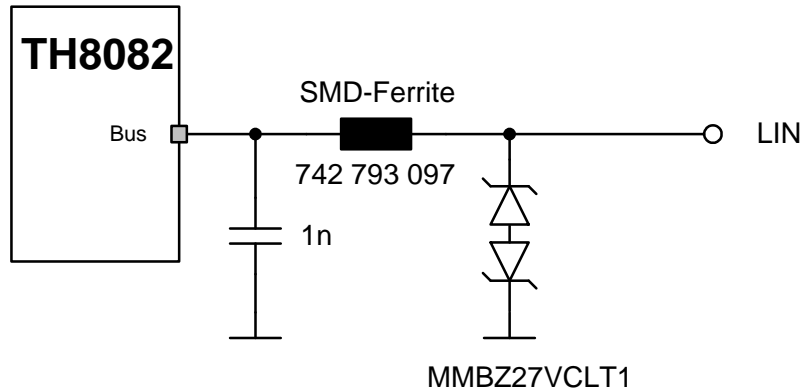


Figure 8 - Schematic of the ESD protection with Back-to-Back Zener Diode

The damage limit by using Back-to-back zener diode and serial SMD-ferrite as protection elements is **>15kV**.

The result is sufficient for a robustness level of 15kV.

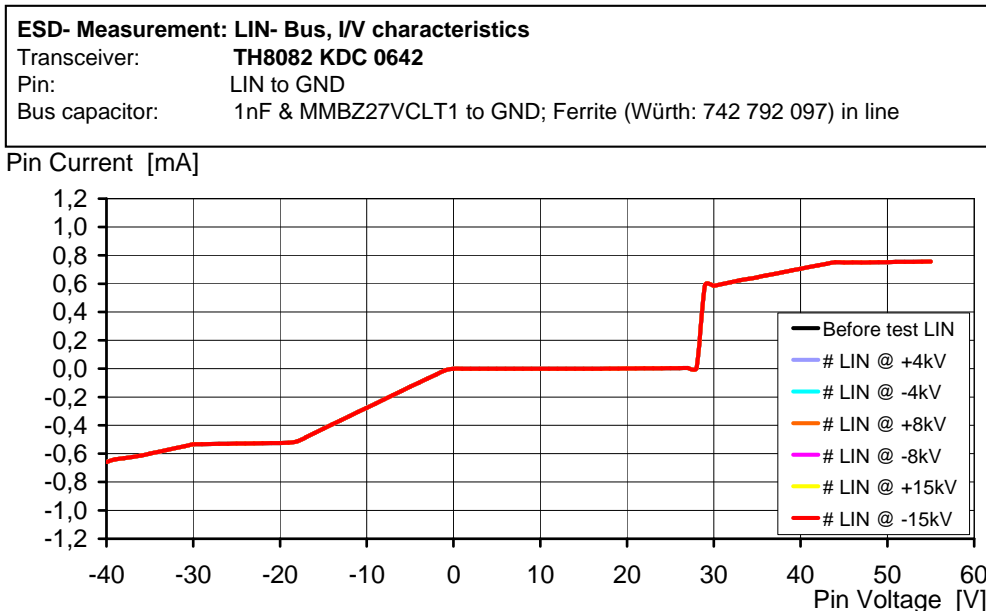


Figure 9 - I/V pin characteristic after applying different ESD pulses

3.4 ESD protection using Back-to-Back Zener Diode (Onsemi MMB27VCLT1 30pF), bus capacitor 2,7nF (Master Module) and SMD-ferrite (Würth: 742 792 097)

Protection elements:

- Diode: ON-Semi MMBZ27VCLT1 (30pF)
- Bus Capacitor: 2,7nF (master module)
- Bus serial Element: SMD-ferrite Würth 742 792 097

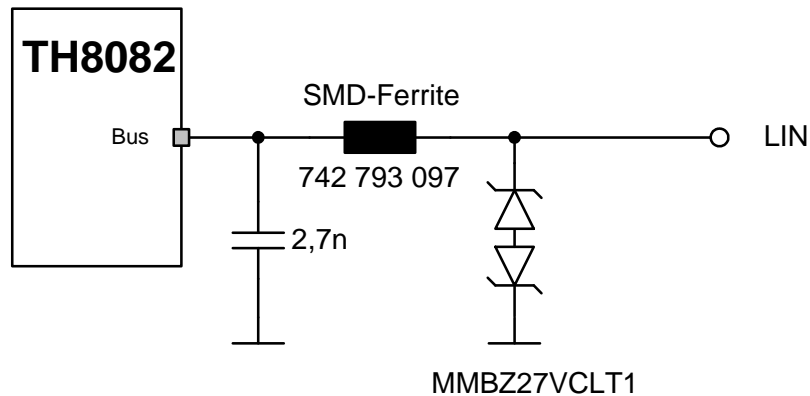


Figure 10 - Schematic of the ESD protection with Back-to-Back Zener Diode

The damage limit by using Back-to-back zener diode and serial SMD-ferrite as protection elements is **>15kV**.

The result is sufficient for a robustness level of 15kV.

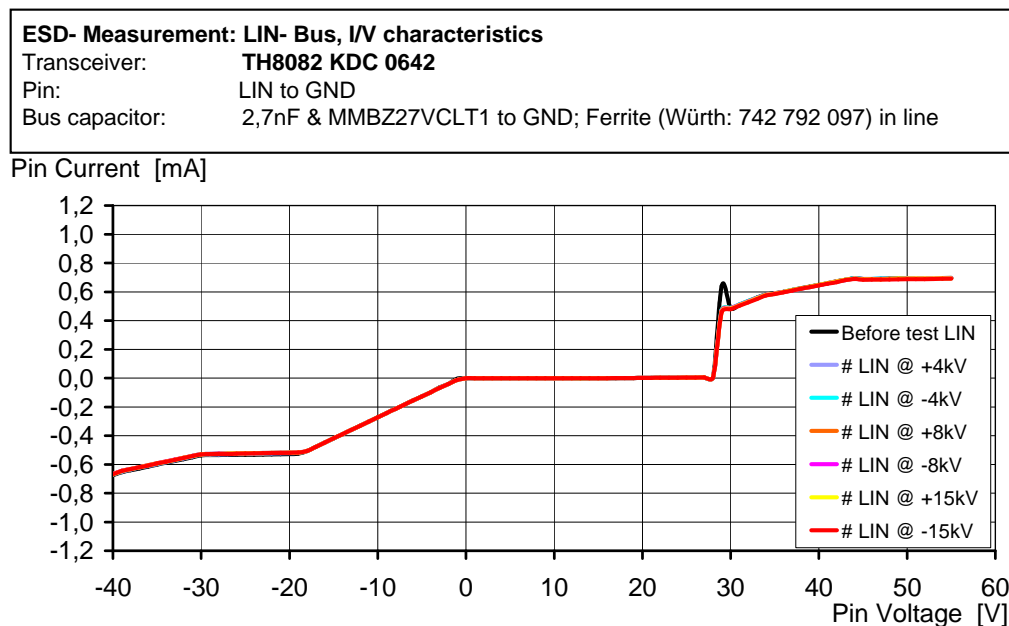


Figure 11 - I/V pin characteristic after applying different ESD pulses

4. Summary

The recommended protection elements for the TH8080/82 LIN transceiver in order to guarantee an ESD robustness level of 8kV at module level is:

Transceiver with external protection element varistor TDK AVR-M1608C270MBABB (15pF) or similar, 180pF Bus capacitor and 10Ω series resistor.

In order to confirm the results and to check the influence of the external protection circuitry regarding the EMC behaviour (DPI and emission), the test was done by IBEE, please see EMC Test report Nr. 01-05-05 and 02-05-05.

External protection devices can decrease the EMC performance due to additional resonances, clamping and demodulation effects! Both devices show an excellent EMC behaviour with the recommended circuitry.

In applications with higher requirements to the ESD severity level (15kV pass), the varistor can be replaced by an MMB27VCLT1 (On semiconductor Peak Power Zener Transient Voltage Suppressor diode), or similar device.

In some cases the 10Ω series resistor is not approved to ESD protection. In this case the 10Ω series resistor can be replaced by an SMD ferrite, for instance an 1800Ω@100MHz SMD ferrite (Würth: 742 792 097) with the same package.

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