

# XC800 Family

## AP08124

XC82/83x Design Guidelines for Electrical Fast Transient  
(EFT) Protection in Touch-Sense Applications

### Application Note

V1.0, 2011-11

**Edition 2011-11**

**Published by  
Infineon Technologies AG  
81726 Munich, Germany**

**© 2011 Infineon Technologies AG  
All Rights Reserved.**

## **LEGAL DISCLAIMER**

THE INFORMATION GIVEN IN THIS APPLICATION NOTE IS GIVEN AS A HINT FOR THE IMPLEMENTATION OF THE INFINEON TECHNOLOGIES COMPONENT ONLY AND SHALL NOT BE REGARDED AS ANY DESCRIPTION OR WARRANTY OF A CERTAIN FUNCTIONALITY, CONDITION OR QUALITY OF THE INFINEON TECHNOLOGIES COMPONENT. THE RECIPIENT OF THIS APPLICATION NOTE MUST VERIFY ANY FUNCTION DESCRIBED HEREIN IN THE REAL APPLICATION. INFINEON TECHNOLOGIES HEREBY DISCLAIMS ANY AND ALL WARRANTIES AND LIABILITIES OF ANY KIND (INCLUDING WITHOUT LIMITATION WARRANTIES OF NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF ANY THIRD PARTY) WITH RESPECT TO ANY AND ALL INFORMATION GIVEN IN THIS APPLICATION NOTE.

## **Information**

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office ([www.infineon.com](http://www.infineon.com)).

## **Warnings**

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

---

**Device1****Revision History: V1.0 2011-11**

Previous Version(s):

Page	Subjects (major changes since last revision)
–	This is the first release ...

**We Listen to Your Comments**

Is there any information in this document that you feel is wrong, unclear or missing? Your feedback will help us to continuously improve the quality of this document. Please send your proposal (including a reference to this document) to:

[ipdoc@infineon.com](mailto:ipdoc@infineon.com)

## Table of Contents

<b>1</b>	<b>Overview</b>	<b>5</b>
<b>2</b>	<b>Case Study</b>	<b>5</b>
<b>3</b>	<b>Recommendations - Low Cost Counter Measures</b>	<b>7</b>
3.1	External ESD Structure	7
3.2	Spikes on VDDP	7
3.3	MCU Board PCB Layout	7
3.4	De-coupling the MCU Board from the Power Board	8
<b>4</b>	<b>References</b>	<b>8</b>

## 1 Overview

Electrical Fast Transients (EFT) are caused by transient currents (commonly called 'arcing') during a make or break of contact. An EFT test simulates high-frequency disturbances on AC and I/O cables.

Common home appliance electronic products are tested for EFT immunity to ensure their reliability when subjected to certain levels of fast transients, and also for the Industry standards compliance testing, based on the IEC standard; "EMC Immunity standard IEC 61000-4-4: Electrical Fast Transient".

Touch-sense based applications are most commonly used in Human Machine Interface (HMI) products, and these are subject to EFT testing. Infineon's XC82/83x 8-bit family of products support touch-sense functionality.

This application note offers recommendations on practical design techniques that provide cost-effective protection against EFT for a typical touch-sense application system based on the XC82x or XC83x, to help withstand the high frequency EFT noise tests. Recommendations are also given on avoiding unforeseen system malfunctions (abnormal rest/hang), during standards compliance testing at high EFT voltages. These malfunctions could be due to hardware design issues in the system.

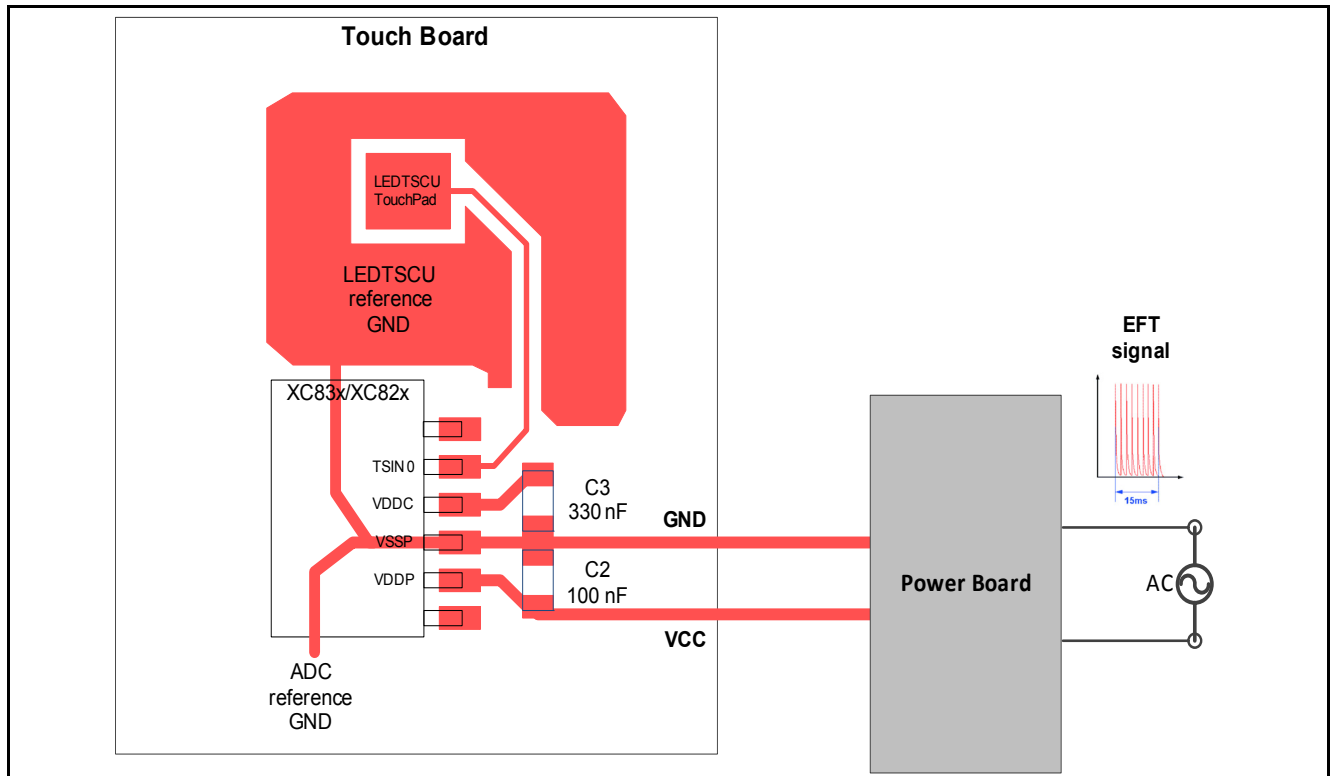
Microcontroller (MCU) Immunity performance is classified into four categories, from Class A to D. Common home appliance electronic products fall under Class B, which covers a temporary degradation or loss of performance or function that is recoverable after the transient is removed. Reset is another form of MCU performance degradation.

## 2 Case Study

During the hardware system design implementation phase, there are some EFT related precautions that should be taken into account.

The designer must ensure for example, that the EFT noise injected through the supply lines of the system has the proper conduction path via external ground or via 5V, away from the microcontroller. The noise from ground is critical, as in general the whole circuit refers to it. The layout of capacitive touch-sense boards is also very significant in noisy environments.

The circuit diagram in Figure 1 shows a typical XC82x/XC83x touch-sense based application system. A human interface touch board is used in this example. The power board converts the power from AC mains to the MCU board voltage level.



**Figure 1 XC83x/XC82x Touch-Sense Application Example**

In the example system shown in Figure 1, the EFT is injected at the AC line. It appears in ground and the DC bus after the power board converts the mains voltage to the MCU voltage levels.

When the pads are left untouched, the whole circuit floats with the ground, even if EFT noise is injected, as there is no conduction path to earth.

When the pad is touched, the EFT flows through capacitance between the finger and the perspex of the device and the impedance of the human body. When a pad is touched during EFT, voltage surges at the touched pad pin and swings above 5V and below ground. The surges flow to the internal MCU ground and VDDP and may cause internal malfunction.

Common practice is to omit the input filter (common-mode choke) from the power board to cut costs. This leaves the touch board without noise filtering at the input. Touching the pads couples the touch board to earth, and without filtering the noise directly enters the VDDP/VSSP pins for example. This type of implementation is therefore not very robust.

### 3 Recommendations - Low Cost Counter Measures

This section offers guidelines that should be considered in XC82x/XC83x touch-sense application hardware design, to avoid the problems identified in the Case Study. The following are low cost solutions to overcoming the possible system malfunctions that may occur during EFT testing.

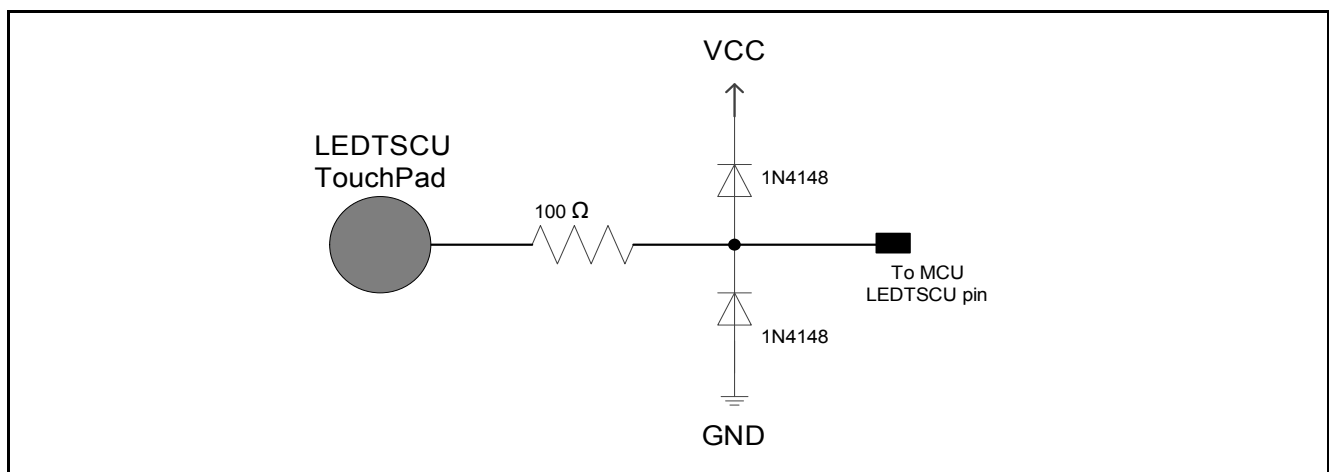
- External ESD Structure
- Spikes on VDDP
- MCU Board PCB Layout
- De-coupling the MCU Board from the Power Board

#### 3.1 External ESD Structure

Build an external ESD structure (with low capacitance) using a series of resistors on the sensitive pads to reduce the noise that enters the MCU.

ESD circuit Setup:

- External ESD structures and 100 ohm resistors at sensitive pins.
- ESD structure built with a pair of 1N4148 diodes



**Figure 2 External ESD Structure at Sensitive Pins**

**Attention:** Touch sensitivity may be reduced by the external ESD structure, due to the extra capacitance of the 1N4148 diodes. The diodes used must be of low capacitance.

#### 3.2 Spikes on VDDP

To guard against EFT noise spikes on VDDP on the touch board, put a 5.1V Zener diode parallel to the filtering capacitor on VDDP.

#### 3.3 MCU Board PCB Layout

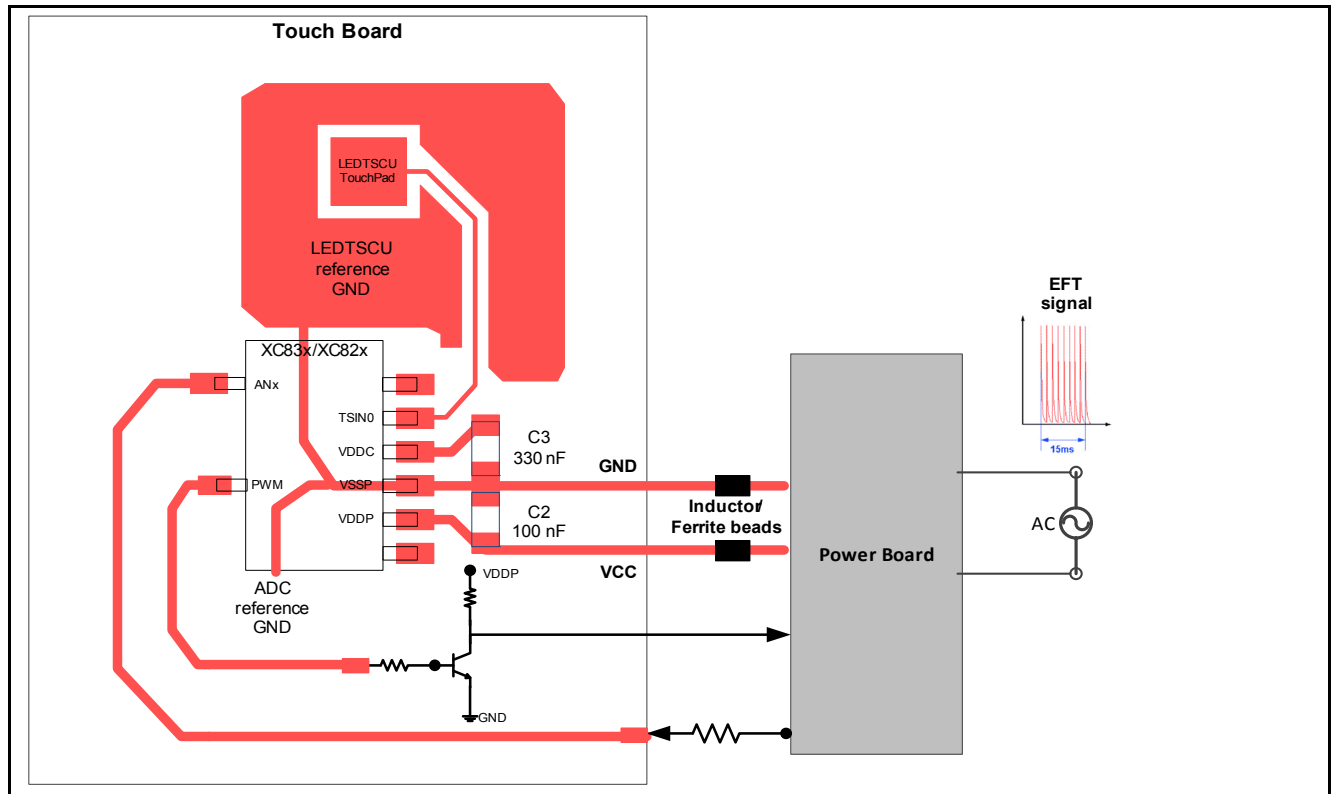
The designer should always consider the following points when designing the PCB layout of touch application system hardware:

- Use separate signal domains with separate reference ground domains.
- Surround traces and pads with a ground plane from respective domains.
- Connect all ground domains in a star connection near the VSSP pin, otherwise keep the grounds away from each other to minimize coupling. [See Figure 3]
- The ground and VCC in the touch board should be de-coupled from the MCU's ground domains with a C2 de-coupling capacitor [See Figure 3], so that noise is directed away from the MCU.

### 3.4 De-coupling the MCU Board from the Power Board

To avoid EFT noise entering the MCU board, some general guidelines are suggested:

- Put inductors or ferrite-beads in the ground and VCC paths at the connector to de-couple the two boards [See Figure 3].
- A resistor/transistor should be put in other signal paths between the power board and the MCU board. This helps guard against all types of conducted noise [See Figure 3].



**Figure 3 De-couple the MCU Board and Power Board**

## 4 References

Application Note – AP08100 – Configuration for Capacitive Touch-Sense Application

Application Note – AP08115 – Design Guideline for Capacitive Touch-Sensing Application



[www.infineon.com](http://www.infineon.com)