

X-Ray Inspection Test Conditions for NOR/SPI/NAND Flash

About this document

Scope and purpose

AN98527 discusses the X-ray inspection test conditions and recommendations for NOR/SPI/NAND Flash products that should be used to prevent damage to ICs.

Table of contents

About this document.....	1
Table of contents.....	1
1 Introduction	2
2 X-ray Qualification Test Conditions	3
3 X-ray Inspection Recommendations	4
Revision history.....	5

Introduction

1 Introduction

It has been well established that semiconductor ICs can suffer damage caused by X-ray inspection. While this phenomenon does not always result in a system level failure, customers might have no means to recover from the effects of the X-ray exposure if data corruption or other failure mode occurs. Infineon studies have shown that programmed cells within a flash array may experience a change in threshold voltage (V_t) as a result of certain X-ray inspection conditions. Any significant negative perturbation in the V_t of a programmed cell will result in incorrect sensing of the programmed bit logic state during a read operation, resulting in such bits incorrectly reading in the unprogrammed logic state.

X-ray Qualification Test Conditions

2 X-ray Qualification Test Conditions

Below are the test conditions and equipment parameters that employs when conducting X-ray inspection as part of the product qualification process. Infineon can guarantee that its products will suffer no damage when these conditions are applied:

- X-ray Inspection Test Equipment
 - Shimadzu (Model SMX-160GT) ^[1]
 - Dosimeter: High Dose LiF TLD
 - 300- μ m thick Zn Filter
- X-ray Inspection System Conditions
 - Tube Voltage: 110 kV
 - Tube Current: 40 μ A
 - Center Distance to Source: 40 mm
 - Exposure Time: 240 seconds
- X-ray Inspection Test Procedure
 - Products are functionally tested and programmed to a known data pattern containing both programmed '0' and unprogrammed '1' logic states prior to X-ray inspection.
 - Products are arranged in a circular pattern around the center of the X-ray system stage to insure uniform exposure.
 - The Zn filter is placed between the X-ray source and the products being inspected.
 - A dosimeter is included in each batch of units to record the X-ray dose absorbed during inspection.
 - Products are exposed to the X-ray beam for 240 seconds (4 minutes), which corresponds to the worst-case inspection time of most circuit board inspection systems and has been determined to be adequate to assess any board assembly issues.
 - After exposure, products are retested to insure there is no loss of functionality or change in pre-programmed data pattern has occurred.
 - With this test procedure, X-ray dose received by the products will not exceed 10 rads, while still enabling adequate imaging and resolution required for circuit board inspection.

¹ **Note:** Equipment is mentioned as a point of information and not as a product endorsement.

X-ray Inspection Recommendations

3 X-ray Inspection Recommendations

There are many commercially available circuit board inspection systems and each employs different X-ray set up conditions and exposure doses. It is not possible to provide a single set of recommendations that will apply to all inspection systems. However, in order of effectiveness, the following are the mitigation techniques Infineon recommends minimizing the effects of any potential damage resulting from X-ray inspection:

1. If X-ray inspection is performed after the flash has been programmed, consider erasing and reprogramming the flash data.
2. Use a 300- μ m thick Zn filter; 1-mm thick Al or Brass filters are also effective.
3. Use the smallest X-ray tube kV-peak possible that still produces adequate images during board inspection.
4. Use the smallest X-ray tube current possible that produces adequate images.
5. Use the largest X-ray tube to sample distance (i.e. lowest magnification) possible.
6. Use the shortest inspection time possible, preferably on a sampling basis rather than 100% board inspection.

Revision history

Revision history

Document version	Date of release	Description of changes
**	2012-07-11	Initial version
*A	2015-10-12	Updated to template
*B	2017-08-02	Updated logo and Copyright
*C	2018-08-02	Updated Document Title to read as “AN98527 - X-Ray Inspection Test Conditions for NOR/SPI/NAND Flash” Updated Abstract Removed “X-ray Inspection References” Updated to new template Completing Sunset Review
*D	2021-03-19	Updated to Infineon template

Trademarks

All referenced product or service names and trademarks are the property of their respective owners.

Edition 2021-03-19

Published by

Infineon Technologies AG

81726 Munich, Germany

© 2021 Infineon Technologies AG.

All Rights Reserved.

Do you have a question about this document?

Go to www.cypress.com/support

Document reference

001-98527 Rev. *D

IMPORTANT NOTICE

The information contained in this application note is given as a hint for the implementation of the product only and shall in no event be regarded as a description or warranty of a certain functionality, condition or quality of the product. Before implementation of the product, the recipient of this application note must verify any function and other technical information given 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.

The data contained in this document is exclusively intended for technically trained staff. It is the responsibility of customer's technical departments to evaluate the suitability of the product for the intended application and the completeness of the product information given in this document with respect to such application.

For further information on the product, technology, delivery terms and conditions and prices please contact your nearest Infineon Technologies office (www.infineon.com).

WARNINGS

Due to technical requirements products may contain dangerous substances. For information on the types in question please contact your nearest Infineon Technologies office.

Except as otherwise explicitly approved by Infineon Technologies in a written document signed by authorized representatives of Infineon Technologies, Infineon Technologies' products may not be used in any applications where a failure of the product or any consequences of the use thereof can reasonably be expected to result in personal injury.