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EIA/JEDEC STANDARD

Standard for Failure Analysis Report Format

EIA/JESD38

DECEMBER 1995

**ELECTRONIC INDUSTRIES ASSOCIATION
ENGINEERING DEPARTMENT**



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Published by

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2500 Wilson Boulevard
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STANDARD FOR FAILURE ANALYSIS REPORT FORMAT

(From JEDEC Council Ballot JCB-94-04A, formulated under the cognizance of JC-14.6 Committee on Failure Analysis)

1 Introduction

1.1 Purpose

The purpose of this standard is to promote unification of content and format of semiconductor device failure-analysis reports so that reports from diverse laboratories may be easily read, compared, and understood by customers. Additional objectives are to ensure that reports can be easily read by users, satisfactorily reproduced on copying machines, adequately transmitted by telefax, and conveniently stored in standard filing cabinets.

1.2. Scope

This document specifies content and format of reports describing failure analyses of semiconductor devices. For purposes of this document, destructive physical analyses (DPAs), construction analyses, and single analytical service requests are not regarded as failure analysis.

1.3 Application

When specified in a contract between a customer and failure analysis laboratory, this standard shall be used in preparation of all semiconductor-device failure-analysis reports generated under said contract. Of course, in the interest of promoting community-wide uniformity in failure-analysis reporting, this standard may be voluntarily adopted and used even when not specifically required by a contract.

1.4 Definitions

For purposes of this standard, the following terms have the following meanings:

- a) **analyst:** The specific person who performs the failure analysis; if more than one analyst is associated with a particular analysis, then one such person is designated as the principal analyst.
- b) **laboratory:** The organization or specific physical facility in which the failure analysis is performed.

c) **customer:** The organization or person that originally request the failure analysis and received the failure analysis report.

1.5 Applicable documents

ANSI/IEEE Std 268, **American National Standard for Metric Practice.**

ANSI/IEEE Std 260, **IEEE Standard Letter Symbols for Units of Measure.**

The University of Chicago Press, Chicago, IL, **The Chicago Manual of Style.**

US Government Printing Office, Washington, DC, **Government Printing Office Style Manual.**

Gramercy Publishing Company, New York, NY, **A Manual of Style.** (Identical to the Government Printing Office Style Manual.)

2 General requirements

2.1 Page and text formats

Paper shall be white and shall be of the standard size for the country in which the report originates (e.g., 8 1/2-inch by 11-inch in the United States, A4 [210 by 297-mm] in some European countries, etc.) Both sides of the paper may be used, but if this option is selected, paper stock must be sufficiently heavy and opaque that printed, typewritten, or handwritten material on one side does not adversely affect readability or reproducibility of similar material on the other side.

Black is preferred for all text and tables, but color is acceptable if routinely used by the failure-analysis laboratory; however, because many failure-analysis reports are reproduced on black-and-white copying machines or are transmitted by black-and-white facsimile, value of color will be lost to readers of second-generation copies.

The type style is used in the report shall be legible and suitable for copying-machine reproduction and telefax transmission; to this end, type size shall be in the range of 10 to 14 points.

Reports shall be bound so that all pages are kept together and in correct order; staple, plastic multifinger, wire spiral, looseleaf notebook, and other binding systems that achieve this are acceptable. Binding shall be at the left with the long dimension of the paper vertical. Margin on the binding edge of each page shall be one inch (25 mm) minimum; margins on all other sides of each page shall be at least 0.75 inch (19 mm).

All report pages shall be numbered and shall be identified by the report serial number. Special markings (e.g., a logotype or confidentiality notice) may be included on all or selected pages.

2.2 Graphics format

Photographs, radiographs, scanning-electron micrographs, energy-dispersive x-ray spectra, illustrations, data sheets, graphs, chemical-analysis reports, printouts, and other relevant graphic items that support the conclusions shall be bound at the end of the failure-analysis report. Graphic images shall be of good quality and suitable for illustrating the desired point. The image area shall not be cropped, but borders surrounding the image area may be removed. If an image is too wide to be mounted horizontally, it may be rotated 90° so that its bottom edge is parallel to the righthand edge of the page.

Each graphic item shall be accompanied by a brief descriptive caption that includes the failed-part serial number, if applicable, and important test conditions (e.g., magnification and, for scanning-electron micrographs, tilt angle). All photographs and other images shall be mentioned in the report-body text, and they shall be presented at the end of the report in the same order that they are referenced in the text.

When a high-magnification micrograph is used to illustrate a failure site or other key feature of the device being analyzed, at least one lower-magnification "locator" micrograph shall be included. Split-image, dual magnification scanning-electron micrographs satisfy this requirement.

Arrows used to point out specific features shall have good contrast with the background. Color graphics are acceptable if routinely used by the failure-analysis laboratory or if a relevant detail is more easily recognizable in color; however, because many failure-analysis reports are reproduced on black-and-white copying machines or are transmitted by black-and-white facsimile, value of color will be lost to readers of second-generation copies.

Laboratory data sheets (e.g., bond-wire pull-strength data) may be on printed forms with typewritten or legible handwritten entries.

2.3 Acronyms and abbreviations

Definitions of all acronyms and abbreviations shall be spelled out at first usage; exceptions are 1) Abbreviations of units of measure defined in American National Standards Institute (ANSI) and Institute of Electrical and Electronics Engineers (IEEE) Standard No. 268, American National Standard for Metric Practice and ANSI/IEEE Standard No. 260, IEEE Standard Letter Symbols for Units of Measure and 2) U.S. Postal Service official abbreviations for state names. Preferred format is the spelled-out name followed by the acronym or abbreviation in parentheses as indicated above with the institute names.

2.4 Grammar and spelling

Primary purposes of a failure-analysis report are to convey information to the customer and simultaneously to imply competence of the analyst and excellence of the analytical laboratory. To achieve this end, correct grammatical construction and spelling are essential. Widely available guides to proper grammatical usage include the The Chicago Manual of Style, the Government Printing Office Style Manual, and A Manual of Style.

3 Content and arrangements

3.1 Purpose

At minimum, a failure analysis report shall include 1) succinct statements of observations with enough support (e.g., photographs, analysis printouts, electrical-test data, etc.) to clearly and credibly identify and illustrate the failure mechanism and 2) concisely stated conclusions; "bullet" structure is the preferred format. Key elements of the report shall be in consistent locations so that readers can quickly determine the principal points of the analysis. The report may be expanded to accommodate special requirements.

3.2 Content

Minimum elements in a failure analysis report shall be the following in the specified order:

- a) Cover sheet (refer to 3.3)
- b) Summary page (refer to 3.4)
- c) Analysis (refer to 3.5)
- d) Supporting graphics and data (refer to 3.6)

Additional elements and subelements that may be optionally incorporated in a failure analysis report include the following:

- a) Discussion (refer to 3.5.4)
- b) Recommendations (refer to 3.5.5)
- c) References (refer to 3.5.6)
- d) Annexes (refer to 3.7)

3.3 Cover sheet

Each failure analysis report shall have a cover sheet on which only the following information shall appear:

- a) Failure analysis laboratory name, location (street address, city, state, and zip code or equivalent outside of the United States), telephone number, and telefax number.

NOTE — These items may be at the top or bottom of the cover sheet.

- b) A descriptive title

EXAMPLE — "FAILURE ANALYSIS OF GENERIC SEMICONDUCTOR
TYPE XDQ1234 MICROPROCESSOR" or "YIELD ANALYSIS OF
WAFER LOT X9876"

- c) An identifier (e.g., a project, job, report serial number, or other unique code)
- d) Date
- e) Name of customer organization

3.4 Summary page

The following items shall appear on the summary page in the specified order:

- a) Component identification including, as applicable, manufacturer's name, type number, functional description, date code, package type, and other relevant information.

b) Summary (An abstract of the analysis, not to exceed one-half page in length, containing essences of the background information, conclusions, and, if applicable, recommendations.)

c) Name of the principal analyst

NOTE — If desired, names of the approver and/or other analysts may be included also.

3.5 Analysis

The Analysis Section shall contain subsections on background information, laboratory observations, and conclusion in that order. Optionally, the Analysis Section may also contain discussion, recommendations, and references subsections.

3.5.1 Background information

Background data provided by the customer shall be summarized; included, for example, should be brief descriptions of the complaint that led to failure analysis, specific failure mode reported by the customer, and other relevant information (e.g., electrical data, environmental, and operational conditions existing prior to and at the time of failure, constancy or intermittency of the failure, coincident failures, etc.)

3.5.2 Laboratory observations

Specific laboratory observations that led directly to identification of the failure site and failure mechanism shall be described briefly, preferably in "bullet" format; although it is not necessary to describe observations that did not contribute directly to the conclusion, it may be desirable to do so for completeness or to emphasize a specific point. Typical subheadings that may be used, as applicable, in the Laboratory Observations Subsection include the following:

a) **Preliminary analysis:** Covers, for example, external visual inspection, x-radiography, hermeticity tests, particle-impact-noise detection, acoustic microscopy in any of its various embodiments, electrical verification test, stabilization bake, etc.

b) **Decapsulation and internal visual inspection:** Mentions decapsulation method and briefly describes internal appearance of decapsulated device, observed damage sites, etc.

c) **Failure isolation:** May include, for example, liquid-crystal hot-spot detection, scanning-electron microscopy, voltage contrast, electron-beam induced current, optical-beam induced current, light-emission microscopy, deprocessing, microprobing, microsectioning, comparative analysis, simulation, etc.

3.5.3 Conclusions

In the Conclusions Subsection, the failure site, if applicable, shall be identified. Additionally, relevant failure mechanisms shall be described briefly and related to reported failure modes or device operational discrepancies. Other significant factors that relate the failure to external stresses or causes should be included. Speculation should be avoided, but if used, shall be explicitly identified.

3.5.4 Discussion

The optional Discussion Subsection should be a technical explanation relating laboratory observations and other relevant information to the conclusions. This explanation should briefly outline the logic leading to the conclusions and should show how data other than laboratory observations affected the conclusions. Risk assessment may be discussed also.

3.5.5 Recommendations

A Recommendations Subsection is not required; however, if there is a way to prevent future failures of the same type, then relevant information may be given to the customer in this subsection. Also, if the failure was caused by a manufacturing defect or process problem, then the Recommendation Subsection may suggest initiation of corrective action; details of corrective action and closure of the problem may be presented in a separate report or may be appended to the failure-analysis report.

3.5.6 References

References to the open literature may be included in support of a particular conclusion or interpretation of observations. Bibliographical references, if presented, shall be sequentially numbered, and each citation shall include authors' names, article, title, complete name of journal, proceedings or book, name and location (i.e., city and state) of book publisher, volume and number of a periodical, a date appropriate to the type of reference (e.g., copyright date of a book, date of a symposium proceedings, issue date of a journal, etc.) and page numbers. Typical formats for references are given in The Chicago Manual of Style, the Government Printing Office Style Manual, and A Manual of Style.

3.6 Graphic support data

Graphic support data, such as photographs, radiographs, scanning-electron micrographs, energy-dispersive x-ray spectra, illustrations, data sheets, graphs, chemical-analysis reports, printouts, and other relevant items that support the conclusions, shall be presented at the end of the report. In the interest of report brevity, no divider page or heading for the graphic support data is required.

3.7 Annexes

Optional annexes, located after the graphic supporting data, may be devoted to explanations of failure mechanisms, tutorial discussions, additional information or data not specifically allocated space in the body of the report, and/or acknowledgements required to better explain and illustrate the failure or to satisfy specific laboratory or customer requirements.

