

SEMI E107-1101

PROVISIONAL SPECIFICATION OF ELECTRIC FAILURE LINK DATA FORMAT FOR YIELD MANAGEMENT SYSTEM

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1 Purpose

1.1 The objective of this document is standardization of the specific data format passed from the test equipment to the Yield Management System. The Yield Management System is a kind of data server for detail test data and geometrical defect data of patterns on a wafer as described in the Terminology section of this document.

1.2 This document assumes a Yield Management System in which test equipment electrical failure information is managed and analyzed in an integrated manner. Examples of test equipment failure information include bit map data, bin data, and inspection information obtained by devices such as wafer inspection equipment and review tools. Standardization of the data file format helps to reduce the development burden on customers and related vendors.

2 Scope

2.1 This document specifies the data file format for transferring from test equipment to a Yield Management System.

2.2 This document is an extension of the general map data item standard, i.e. SEMI G81, and the general map data format document, currently under development. This document does not redefine the general specification.

2.3 The scope of this document is just defining data items and their formats. Data file creation methods, data creating environments and file naming conventions are outside of the scope of this document. Also, communication protocols to transfer the data are beyond the scope of this document.

2.4 This standard does not purport to address safety issues, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety health practices and determine the applicability or regulatory limitations prior to use.

3 Limitations

3.1 This document has provisional status because the common Specification for Map Data Format and a

general map data format document are currently under development. Data format is related to YMS Link and this needs to be completed in Section 8.1.6, Map Data Format for YMS Link to be in conformance. In addition, the example of data file in Related Information must be revised and the idea of Map Data Format for YMS Link Data should be removed.

NOTE 1: A standard for Map Data Format is currently under development.

4 Referenced Standards

4.1 SEMI Standards

SEMI E5 — SEMI Equipment Communication Standard 2 Message Content (SECS-II).

SEMI E30.1 — Inspection and Review Specific Equipment Model (ISEM).

SEMI G81 — Specification for Map Data Items

NOTE 2: Unless otherwise indicated, all documents cited shall be the latest published versions.

5 Terminology

5.1 *analog data* — One of three categories of data: measured values such as voltage or current obtained when test equipment measures a semiconductor device's electrical characteristics, parameter values which are test parameters when measuring, and limit values which are decision parameters if test results are pass or fail.

5.2 *bin data* — same as Category below.

5.3 *fail bit map data* — data representing memory cell electrical failure information according to its location information, in units of the die or wafer.

5.4 *category* — data indicating the type of electric failure or rank of characteristics of die tested by the test equipment. Used in the same manner as Bin Data in this standard.

5.5 *cell-logical-address* — gives the electrical location of a memory cell in a die.

5.6 *cell-logical-io-number* — number identifying the IO data which can be simultaneously electrically accessed within a memory device.

5.7 *cell-physical-address* — gives location of a memory cell in a die on two-dimensional plane.

5.8 *die* — a unit equivalent to one die on a wafer. Also known as Chip.

5.9 *electrical failure information* — failure information generated by test equipment; e.g. Bit Map Data, Bin Data and Analog Data.

5.10 *error class* — specifies the type of electrical failure configuration in a memory cell group. Bit-fail, line-fail and block-fail are examples.

5.11 *inspection information* — inspection results for a wafer, indicating defect location and defect details obtained as the result of inspection used in wafer fabrication and the inspection process, such as appearance inspection, contaminant inspection, etc.

5.12 *test equipment* — equipment which tests the electrical characteristics and functions of semiconductor devices.

5.13 *test program name* — name of program used on test equipment when testing a die electrically.

5.14 *yield management system (YMS)* — a system that stores visual inspection data of geometrical defects on wafer and electrical test data of each die. The system processes those data statistically to discover correlation between them. Correlation leads to discovery the cause of failures and understanding of production situation in order to help improve yield. Defect data is standardized in SEMI E30.1 (ISEM).

6 Requirements

6.1 *Map Data Item* — All map data items appear in map data except those standardized in this document shall be specified in the common map data item document, SEMI G81.

6.2 *Map Data Format* — All map data formats appear in map data except those standardized in this document shall be specified in a common map data format document currently under development.

7 General

7.1 General File Format

NOTE 3: A standard for Data representation is currently under development.

8 Description

8.1 The fail-bit map data item specifications defined in this document are shown in Table 2. The columns in this table are described in the following sections.

8.1.1 *Item Name Column* — The name by which the data item is referenced.

8.1.2 *Data Type Column* — The type of the data as defined in Table 1.

Table 1 Data Types and Sizes

Type	Definition
String	A string of ASCII characters from zero to "Size" characters in length.
Integer	A string of numeric characters (0..9) that represent an integer value.
Float	A string representing a floating point value in exponent format.

8.1.3 *Size Column* — See SEMI G81.

8.1.4 *Description Column* — See SEMI G81.

8.1.5 *Coordinate System Conventions* — See SEMI G81.

Table 2 Data Items for YMS Link

Item Name	Data Type	Size	Description
Comment	String	256	Comment Area. [Comment] = 'Engineering Test'
TestProgramName	String	256	Name of test program when test equipment obtains test data. [TestProgramName] = 'pro123a'
TestEquipmentId	String	256	Test equipment identification code. [TestEquipmentId] = 'tester1'
DieCoordinate	String	13	The die coordinates' origin location and coordinate axis direction for expressing location coordinates within a die. See Figure 2 and Table 7. [DieCoordinate] = 'TopLeftXY' [DieCoordinate] = 'BottomLeftXY' [DieCoordinate] = 'TopLeftYX'

Item Name	Data Type	Size	Description
			[DieCoordinate] = 'BottomLeftYX' [DieCoordinate] = 'TopRightXY' [DieCoordinate] = 'BottomRightXY' [DieCoordinate] = 'TopRightYX' [DieCoordinate] = 'BottomRightYX'
ErrorClassList	String	---	Error type category list, per error class definition. See Figure 2.
ErrorClassNumber	String	3	Error class number from 0 to 255.
ErrorQuality	String	16	Describes the quality of the specified [ErrorClassNumber]. This may be "bit-fail" or "line-fail" or some other value defined by an application.
ErrorDescription	String	256	A description of the specified [ErrorClassNumber], e.g. "100MHz".
FailBitDataTemplate	String	---	Defines the data items and order for expressing the fail bit error class data analyzed within a die by die address and coordinate values within the die. See Figure 2. Defines the items and order for outputting the following fail bit data. See Table 3.
FailBitData	String	---	The list of data expressing the fail bit error class. Data analyzed within a die in accordance with the fail bit data definition. Expresses it as die address and coordinates within a die. See Figure 2.
AnalogDataTemplate	String	---	Defines analog data items and order. These are measured values such as voltage, current, etc. on measuring semiconductor device's electrical characteristics by the test equipment, setting values which are test parameters when measuring, and limit values which are decision parameters if test results are pass or fail. See Table 4.
Invalid	String	14	Defined to indicate invalid data for Analog Data field.
AnalogData	String	---	List of analog data, per analog data definition. These are the semiconductor device's electrical characteristics measured by the test equipment.
ErrorTotal	Integer	10	Total number of electrical errors in the tested/analyzed substrate, by error class type.
TestDie	Integer	10	Total number of dies which were tested/analyzed on the substrate.

Table 3 Data Items for FailBitDataTemplate

Item Name	Data Type	Size	Description
Seq	Integer	10	Sequential number assigned in ascending order, starting with 1.
XAddress	Integer	5	X address of defective die with fail bit data.
YAddress	Integer	5	Y address of defective die with fail bit data.
XMin	Float	14	X minimum coordinate value of fail bit data's error range. Unit 'um'.
XMax	Float	14	X maximum coordinate value of fail bit data's error range. Unit 'um'.
YMin	Float	14	Y minimum coordinate value of fail bit data's error range. Unit 'um'.
YMax	Float	14	Y maximum coordinate value of fail bit data's error range. Unit 'um'.
XCenter	Float	14	X-direction center point coordinate value of fail bit data's error range. Unit 'um'.
YCenter	Float	14	Y-direction center point coordinate value of fail bit data's error range. Unit 'um'.
XSize	Float	14	X-direction size of fail bit data's error range. Unit 'um'.
YSize	Float	14	Y-direction size of fail bit data's error range. Unit 'um'.
Area	Float	14	Area of fail bit data's error range. Unit 'um'.
DefectCate	String	16	Category name of fail bit data.
XMinPhysic	Integer	10	X minimum cell physical address of fail bit data's error range.
XMaxPhysic	Integer	10	X maximum cell physical address of fail bit data's error range.
YMinPhysic	Integer	10	Y minimum cell physical address of fail bit data's error range.

Item Name	Data Type	Size	Description
YMaxPhysic	Integer	10	Y maximum cell physical address of fail bit data's error range.
IoNumber	Integer	10	Cell logical IO number of fail bit data's error range.
XMinLogic	Integer	10	X minimum cell logical address of fail bit data's error range.
XMaxLogic	Integer	10	X maximum cell logical address of fail bit data's error range.
YMinLogic	Integer	10	Y minimum cell logical address of fail bit data's error range.
YMaxLogic	Integer	10	Y maximum cell logical address of fail bit data's error range.

Table 4 Data Items for AnalogDataTemplate

Item Name	Data Type	Size	Description
XAddress	Integer	5	X address of die with analog data.
YAddress	Integer	5	Y address of die with analog data.
TestNumber	Integer	7	Test number corresponding to analog data.
Note	String	256	Note
Measure	Float	14	Analog data measured value.
MeasureUnit	String	4	Unit of above. See Tables 5 and 6.
Std	Float	14	Standard deviation, etc., for measuring analog data.
Parameter	Float	14	Analog data measurement parameter value.
ParameterUnit	String	4	Unit of above. See Tables 5 and 6.
UpperLimitData	Float	14	Upper limit of first type of parameter for judging analog data.
LowerLimitData	Float	14	Lower limit of first type of parameter for judging analog data.
TestResult	String	256	Analog data PASS/FAIL or decision result such as category type number, etc.

Table 5 Unit Table

Unit Code	Description
s	Seconds
Hz	Hertz
A	Amperes
V	Volts
Ohm	Ohms
W	Watts
F	Farad
H	Henry
%	Percent
dB	Decibel
lsb	Least Significant Bit
rad	Radian
deg	Degree

Table 6 Prefix Symbol Table

Prefix Symbol	Multiplicative
T	10^{12}
G	10^9
M	10^6
k	10^3
m	10^{-3}
u (micro)	10^{-6}
n	10^{-9}
p	10^{-12}

Example:

[MeasureUnit] = 'V' or 'mV'

[ParameterUnit] = 'A' or 'uA'

The units above are a subset of those in Section 9 ("Units of Measure") of SEMI E5 (SECS-II).

8.1.6 Map Data Format of YMS Link — This section is reserved for data format of above items.

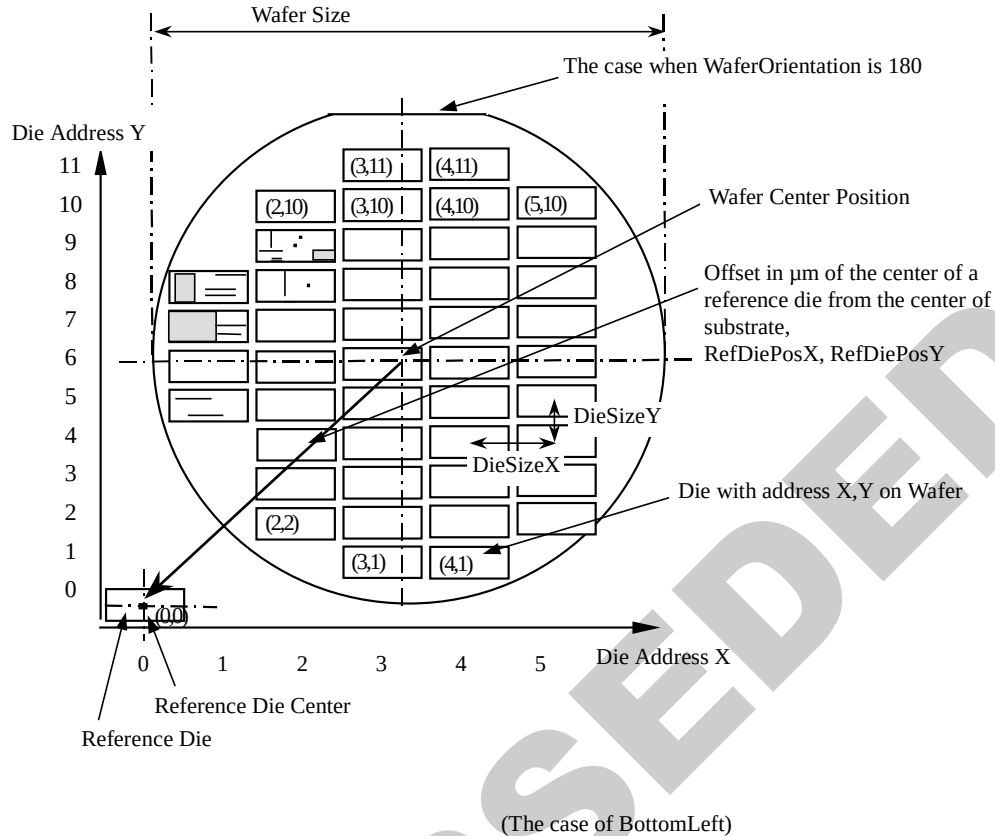


Figure 1
Wafer Coordinates

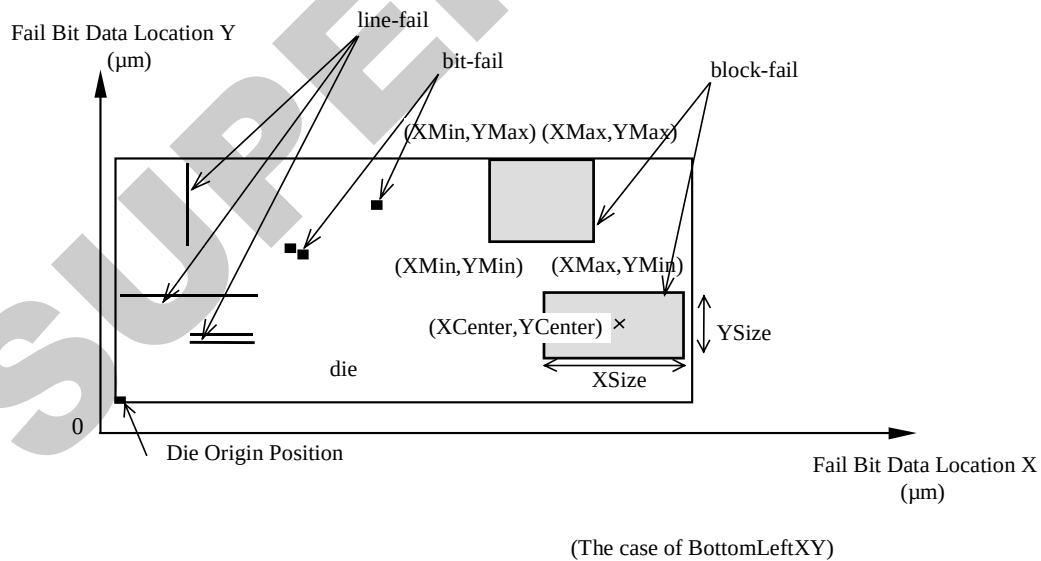
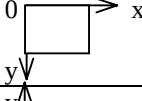
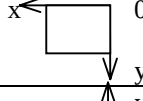
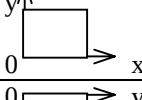
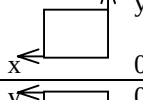
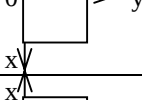
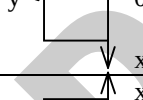
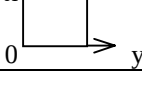
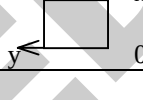


Figure 2
Die Coordinates

Table 7 Die Coordinates

<i>Coordinate Information</i>	<i>Meaning</i>	<i>Coordinate Information</i>	<i>Meaning</i>
TopLeftXY		TopRightXY	
BottomLeftXY		BottomRightXY	
TopLeftYX		TopRightYX	
BottomLeftYX		BottomRightYX	

9 Map Data Format for YMS Link Data

9.1 This section is reserved for future standardization of the separate document for Map Data Format currently under development. Format definition will be added with conformance to the standard.

NOTICE: SEMI makes no warranties or representations as to the suitability of the standard set forth herein for any particular application. The determination of the suitability of the standard is solely the responsibility of the user. Users are cautioned to refer to manufacturer's instructions, product labels, product data sheets, and other relevant literature respecting any materials or equipment mentioned herein. These standards are subject to change without notice.

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