

INTERNATIONAL STANDARD

IEC
62014-1

First edition
2001-05

Electronic design automation libraries –

Part 1: Input/output buffer information specifications (IBIS version 3.2)

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRONIC DESIGN AUTOMATION LIBRARIES-**Part 1: Input/output buffer information specifications
(IBIS version 3.2)****FOREWORD**

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
- 3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
- 4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
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- 6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62014-1 has been prepared by IEC technical committee 93: Design Automation

This standard is based on ANSI-EIA-656-A (September 1999): I/O buffer information specifications (IBIS) version 3.2

The text of this standard is based on the following documents:

FDIS	Report on voting
93/129/FDIS	93/136/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This standard does not follow the rules for the structure of international standards given in Part 3 of the ISO/IEC Directives.

IEC 62014 consists of the following parts:

IEC 62014-1, *Electronic design automation libraries – Part 1: Input/Output buffer information specifications (IBIS version 3.2)*

IEC 62014-2, *Electronic design automation libraries – Part 2: Library standard architectures (TR)(under consideration)*

IEC 62014-3, *Electronic design automation libraries – Part 3: Modules of integrated circuits for EMI Behavioural simulation (under consideration)*

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

Withdrawn

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INTRODUCTION

Background of IBIS

IBIS was first developed at Intel Corporation and has been expanded to its current form (Version 3.2) through the cooperative efforts of additional analog simulator vendors, computer manufacturers, IC vendors, commercial users, and universities. In May 1993, the group formed itself into the IBIS Open Forum, an open, voluntary, cooperative association. In March 1995, the group affiliated with the EIA (now the Electronic Industries Alliance) as the EIA IBIS Open Forum.

The Forum has been and continues to meet via teleconference approximately every third week to propose updates to the IBIS standard, to help new participants, and to advance the standard. The Forum also meets in person about four times a year to exchange ideas and conduct official business.

Most of the Forum activities are handled through e-mail discussions using a reflector "ibis@eda.org." A users group reflector "ibis-users@eda.org" is also supported for users of IBIS. One can get more information on subscribing to the reflectors and to other ongoing Forum activities through the official web page: "<http://www.eigroup.org/ibis/ibis.htm>". The process of making changes and improvements to IBIS is through a "BIRD" (Buffer Issue Resolution

Document) process involving approval by the Forum voting members. Over the years the Forum has grown to over thirty voting members (requiring a modest yearly fee for administrative support), but the Forum also maintains an open, public communications policy and welcomes all interested participants regardless of membership status.

Through official EIA and ANSI (American National Standards Institution) public letter ballot processes, IBIS Version 2.1 was ratified as ANSI/EIA-656 in December 13, 1995. Version 1.1 of IBIS focused on TTL and CMOS logic components. Although never officially ratified as a national standard, IBIS Version 1.1 served as a basis for advances in Version 2.1 to increase its accuracy and number of device types that are supported.

Version 2.1 contains the following advances:

- Controlled slew rate devices
- ECL and PECL technologies
- Independent control over power rails so RS232 and other types of devices with multiple rails can be modeled
- Differential drivers and devices
- Open-drain I/O devices such as open drain and open collector devices
- Expanded package model definitions to include coupling between pins.

The Forum also voluntarily funded a parser development activity through the sale of source code licenses of "ibischk2" and has made executables of the parser code freely and publicly available to enable IBIS model checking.

Industrial advances associated with new semiconductor topologies, package design and measurement needs kept the Forum busy proposing new capabilities, eventually leading to IBIS Version 3.2. Again through official EIA and ANSI public letter ballot processes, IBIS Version 3.2 was ratified as ANSI/EIA-656-A on September 21, 1999.

Its advances include the following:

- Series and series switch models
- Multi-stage driver capability for phased stages

- Submodel capability supporting dynamic clamps and bus hold functions for active and dynamic terminations
- More specification values for overshoot and pulse immunity
- Uncoupled packages with sections and forks
- Uncoupled advanced packages known as electrical board descriptions with sections, forks and on-board components.

IBIS Version 3.2 has complied with an original Forum objective that all subsequent versions of IBIS be backward compatible with previous versions.

The Forum funded through voluntary source code license purchases the corresponding "ibishk3" parser and has made its executables freely available.

The IBIS Standard has achieved wide spread national and international support and recognition as indicated by over 40 semiconductor vendors providing IBIS models freely from their web sites. Many more IBIS models and libraries are available from commercial vendors and directly through IC vendor sales organizations. While IBIS models can be of value in all phases of a design and analysis process, they are particularly suitable for printed circuit board design tools used in conjunction with the corresponding physical and mechanical data bases describing the boards.

Future IBIS Directions

Technology continues to advance, forcing more stringent electrical requirements and newer ways of doing things. The Forum is keeping up with such advances. However, its strategy has shifted. Up to now the Forum has been adding to the existing fixed-format IBIS document. Such a process is slow and subject to unexpected interactions with existing capability. The newer approach is to create a compatible macro-language that allows more rapid reconfiguration and response to changing needs.

While the Forum has not yet ratified any of these approaches, it is pursuing these projects:

- A macro-language that fully supports IBIS Version 3.2 but can also support more advanced features and nodal component structures
- A separate Connector Specification with advanced coupled stages to support key component used to connect printed circuit boards (and possibly be used for more advanced package models)
- Some further advances in specification details beyond IBIS Version 3.2.

These projects advance the capability of IBIS in a manner that supports the existing IBIS Version 3.2 functionality, but also allows for much more rapid implementation of new requirements.

References

ANSI/EIA-656: IBIS Version 2.1 released December 13, 1995

ANSI/EIA-656-A: IBIS Version 3.2 released September 21, 1999

ELECTRONIC DESIGN AUTOMATION LIBRARIES –**Part 1: Input/output buffer information specifications
(IBIS version 3.2)****Scope and object**

This standard gives specifications for electronic behavioral of digital integrated circuit input/ output analog characteristics. It specifies a consistent software-parsable format for essential behavioral information.

The goal of this standard is to support all simulators of all degrees of sophistication.

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Section 1

GENERAL INTRODUCTION

This section gives a general overview of the remainder of this document.

Sections 2 and 3 contain general information about the IBIS versions and the general rules and guidelines. Several progressions of IBIS documents are referenced in Section 2 and in the discussion below. They are IBIS Version 1.1 (ratified August, 1993), IBIS Version 2.1 (ratified as ANSI/EIA-656 in December, 1995), and IBIS Version 3.2 (this document ratified in August, 1999).

The functionality of IBIS follows in Sections 4 through 8. Sections 4 through 6 describe the format of the core functionality of IBIS Version 1.1 and the extensions in later versions. The data in these sections are contained in .ibs files. Section 7 describes the package model format of IBIS Version 2.1 and a subsequent extension. Package models can be formatted within .ibs files or can be formatted (along with the Section 4 file header keywords) as .pkg files. Section 8 contains the Electrical Board Description format of IBIS Version 3.2. Along with Section 4 header information, electrical board descriptions must be described in separate .ebd files.

Section 9 contains some notes regarding the extraction conditions and data requirements for IBIS files. This section focuses on implementation conditions based on measurement or simulation for gathering the IBIS compliant data.

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Section 2

S T A T E M E N T O F I N T E N T

In order to enable an industry standard method to electronically transport IBIS Modeling Data between semiconductor vendors, simulation vendors, and end customers, this template is proposed. The intention of this template is to specify a consistent format that can be parsed by software, allowing simulation vendors to derive models compatible with their own products.

One goal of this template is to represent the current state of IBIS data, while allowing a growth path to more complex models / methods (when deemed appropriate). This would be accomplished by a revision of the base template, and possibly the addition of new keywords or categories.

Another goal of this template is to ensure that it is simple enough for semiconductor vendors and customers to use and modify, while ensuring that it is rigid enough for simulation vendors to write reliable parsers.

Finally, this template is meant to contain a complete description of the I/O elements on an entire component. Consequently, several models will need to be defined in each file, as well as a table that equates the appropriate buffer to the correct pin and signal name.

Version 3.2 of this electronic template was finalized by an industry-wide group of experts representing various companies and interests. Regular "EIA IBIS Open Forum" meetings were held to accomplish this task.

Commitment to Backward Compatibility. Version 1.0 is the first valid IBIS ASCII file format. It represents the minimum amount of I/O buffer information required to create an accurate IBIS model of common CMOS and bipolar I/O structures. Future revisions of the ASCII file will add items considered to be "enhancements" to Version 1.0 to allow accurate modeling of new, or other I/O buffer structures. Consequently, all future revisions will be considered supersets of Version 1.0, allowing backward compatibility. In addition, as modeling platforms develop support for revisions of the IBIS ASCII template, all previous revisions of the template must also be supported.

Version 1.1 update. The file "ver1_1.ibs" is conceptually the same as the 1.0 version of the IBIS ASCII format (ver1_0.ibs). However, various comments have been added for further clarification.

Version 2.0 update. The file "ver2_0.ibs" maintains backward compatibility with Versions 1.0 and 1.1. All new keywords and elements added in Version 2.0 are optional. A complete list of changes to the specification is in the IBIS Version 2.0 Release Notes document ("ver2_0.rn").

Version 2.1 update. The file "ver2_1.ibs" contains clarification text changes, corrections, and two additional waveform parameters beyond Version 2.0.

Version 3.0 update. The file "ver3_0.ibs" adds a number of new keywords and functionality. A complete list of functions can be found on eda.org under /pub/ibis/birds/birddir.txt showing the approved Buffer Issue Resolution Documents (BIRDS) that have been approved for Version 3.0.

Version 3.1 update. The file "ver3_1.ibs" contains a major reformatting of the document and a simplification of the wording. It also contains some new technical enhancements that were unresolved when Version 3.0 was approved.

Version 3.2 update. The file "ver3_2.ibs" adds more technical advances and also a number of editorial changes documented in 12 BIRDS and also in responses to public letter ballot comments.

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Section 3

GENERAL SYNTAX RULES AND GUIDELINES

This section contains general syntax rules and guidelines for ASCII IBIS files:

- 1) The content of the files is case sensitive, except for reserved words and keywords.
- 2) The following words are reserved words and must not be used for any other purposes in the document:
 - POWER - reserved model name, used with power supply pins,
 - GND - reserved model name, used with ground pins,
 - NC - reserved model name, used with no-connect pins,
 - NA - used where data not available.
- 3) To facilitate portability between operating systems, file names used in the IBIS file must only have lower case characters. File names should have a basename of no more than twenty characters followed by a period ('.') , followed by a file name extension of no more than three characters. The file name and extension must use characters from the set (space, ' ', 0x20 is not included):

```
a b c d e f g h i j k l m n o p q r s t u v w x y z
0 1 2 3 4 5 6 7 8 9 _ ^ $ % & - { } ) ( @ ' `
```

The file name and extension are recommended to be lower case on systems that support such names.

- 4) A line of the file may have at most 80 characters, followed by a line termination sequence. The line termination sequence must be one of the following two sequences: a linefeed character, or a carriage return followed by linefeed character.
- 5) Anything following the comment character is ignored and considered a comment on that line. The default "|" (pipe) character can be changed by the keyword [Comment Char] to any other character. The [Comment Char] keyword can be used throughout the file as desired.
- 6) Keywords must be enclosed in square brackets, [], and must start in column 1 of the line. No space or tab is allowed immediately after the opening bracket '[' or immediately before the closing bracket ']'. If used, only one space (' ') or underscore ('_') character separates the parts of a multi-word keyword.
- 7) Underscores and spaces are equivalent in keywords. Spaces are not allowed in subparameter names.

8) Valid scaling factors are:

T = tera	k = kilo	n = nano
G = giga	m = milli	p = pico
M = mega	u = micro	f = femto

When no scaling factors are specified, the appropriate base units are assumed. (These are volts, amperes, ohms, farads, henries, and seconds.) The parser looks at only one alphabetic character after a numerical entry, therefore it is enough to use only the prefixes to scale the parameters. However, for clarity, it is allowed to use full abbreviations for the units, (e.g., pF, nH, mA, mOhm). In addition, scientific notation IS allowed (e.g., 1.2345e-12).

- 9) The I-V data tables should use enough data points around sharply curved areas of the I-V curves to describe the curvature accurately. In linear regions there is no need to define unnecessary data points.
- 10) The use of tab characters is legal, but they should be avoided as much as possible. This is to eliminate possible complications that might arise in situations when tab characters are automatically converted to multiple spaces by text editing, file transferring and similar software. In cases like that, lines might become longer than 80 characters, which is illegal in IBIS files.
- 11) Currents are considered positive when their direction is into the component.
- 12) All temperatures are represented in degrees Celsius.
- 13) Important supplemental information is contained in the last section, "NOTES ON DATA DERIVATION METHOD", concerning how data values are derived.
- 14) Only ASCII characters, as defined in ANSI Standard X3.4-1986, may be used in an IBIS file. The use of characters with codes greater than hexadecimal 07E is not allowed. Also, ASCII control characters (those numerically less than hexadecimal 20) are not allowed, except for tabs or in a line termination sequence. As mentioned in item 10 above, the use of tab characters is discouraged.

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