JEDEC STANDARD

Temperature Range and Measurement Standards for Components and Modules

JESD402-1A

March 2022

JEDEC SOLID STATE TECHNOLOGY ASSOCIATION

NOTICE

JEDEC standards and publications contain material that has been prepared, reviewed, and approved through the JEDEC Board of Directors level and subsequently reviewed and approved by the JEDEC legal counsel.

JEDEC standards and publications are designed to serve the public interest through eliminating misunderstandings between manufacturers and purchasers, facilitating interchangeability and improvement of products, and assisting the purchaser in selecting and obtaining with minimum delay the proper product for use by those other than JEDEC members, whether the standard is to be used either domestically or internationally.

JEDEC standards and publications are adopted without regard to whether or not their adoption may involve patents or articles, materials, or processes. By such action JEDEC does not assume any liability to any patent owner, nor does it assume any obligation whatever to parties adopting the JEDEC standards or publications.

The information included in JEDEC standards and publications represents a sound approach to product specification and application, principally from the solid state device manufacturer viewpoint. Within the JEDEC organization there are procedures whereby a JEDEC standard or publication may be further processed and ultimately become an ANSI standard.

No claims to be in conformance with this standard may be made unless all requirements stated in the standard are met.

Inquiries, comments, and suggestions relative to the content of this JEDEC standard or publication should be addressed to JEDEC at the address below, or refer to www.jedec.org under Standards and Documents for alternative contact information.

Published by
©JEDEC Solid State Technology Association 2022
3103 North 10th Street
Suite 240 South
Arlington, VA 22201-2108

JEDEC retains the copyright on this material. By downloading this file the individual agrees not to charge for or resell the resulting material.

PRICE: Contact JEDEC

Printed in the U.S.A.
All rights reserved

PLEASE!

DON'T VIOLATE
THE
LAW!

This document is copyrighted by JEDEC and may not be
reproduced without permission.

For information, contact:

JEDEC Solid State Technology Association
3103 North 10th Street
Suite 240 South
Arlington, VA 22201-2107

or refer to www.jedec.org under Standards-Documents/Copyright Information.

This page left intentionally blank

TEMPERATURE RANGE AND MEASUREMENT STANDARDS FOR COMPONENTS AND MODULES

Contents

Page

Foreword iii

Introduction iii

1 Scope 1

2 Normative Reference 1

3 Terms and Definitions 2

3.1 Terms 2

3.2 Keywords 2

3.3 Abbreviations 3

3.4 Conventions 3

4 Temperature Definitions 4

4.1 Package Case Surface Temperature 4

4.2 Operating Case Temperature 4

4.3 Package Ambient Temperature 4

4.4 Operating Ambient Temperature 4

4.5 Storage Temperature 4

5 Operating Temperature Ranges and Abbreviations 5

5.1 Examples of Operating Case Temperature 7

5.2 Examples of Operating Ambient Temperature 8

6 Storage Temperature Ranges and Abbreviations 9

6.1 Examples of Storage Temperature 10

Annex A - (Informative) Differences Between JESD402-1 and JESD402-1A 12

Contents (cont'd)

Tables

Table 5-1 — JEDEC Operating Case Temperature Ranges 5
Table 5-2 — Historical Case Temperature Range Names and Preferred Names 5
Table 5-3 — JEDEC Operating Ambient Temperature Ranges 6
Table 5-4 — Historical Ambient Temperature Range Names and Preferred Names 6
Table 5-5 — (Example) Operating Case Temperature Applied to JEDEC LPDDR5 Standard 7
Table 5-6 — (Example) Operating Case Temperature Applied to UFS 3.1 Standard 7
Table 5-7 — (Example) Operating Case Temperature Applied to JEDEC DDR4 Standard 8
Table 5-8 — (Example) Operating Case Temperature Applied to JEDEC DDR5 SODIMM Standard 8
Table 5-9 — (Example) Operating Ambient Temperature Applied to NOR Flash Devices 8
Table 6-1 — Storage Temperature Ranges 9
Table 6-2 — Historical Range Names and Preferred Names 9
Table 6-3 — (Example) Storage Temperature Applied to JEDEC LPDDR5 Standard 10
Table 6-4 — (Example) Storage Temperature Applied to JEDEC GDDR6 Standard 10
Table 6-5 — (Example) Storage Temperature Applied to JEDEC DDR4 SDRAM Standard 10
Table 6-6 — (Example) Storage Temperature Applied to JEDEC UFS 3.1 Standard 11
Table 6-7 — (Example) Storage Temperature Applied to JEDEC DDR5 SODIMM Standard 11

Foreword

This standard has been prepared by JEDEC. The purpose of this standard is to provide specifications for operating temperature ranges as well as storage temperature ranges which may be referenced and utilized by other standards, specifications, or datasheets of devices or products when defining temperature related specifications.

Introduction

The initial version of this document is based on latest released version of the LPDDR5, DDR4, UFS v3.1, and GDDR6 standards. However, the intent of this standard is to allow any standards, specifications, and/or datasheets developed by JEDEC, other standard bodies or individual manufacturers, to adopt this standard by way of referencing JESD402-1 if and when the responsible parties deem appropriate. Once the reference to JESD402-1 is included in these other standards, the reference values and methods herein establish a required minimum specification. It is also expected that at the early adoption, some standards, specifications or datasheets may prefer to use a more traditional terminology of the temperature ranges. In such case, it is recommended that the standard terminology from JESD402-1 be also noted together with the traditional terminology.

This standard recognizes that some market segments prefer case temperature methods while other markets prefer an ambient temperature method. For example, media applications such as DRAM and managed NAND use package case temperature as the basis for temperature specifications which is widely used in device standards such as LPDDR5, DDR4, UFS v3.1, GDDR6, etc. Other applications, such as microcontrollers, NOR Flash, Serial Flash, and SLC NAND Flash prefer to apply ambient temperature measurement methods. When an emerging application arises which does not apply to existing market standards, the case temperature method is the preferred method due to reduced dependence on external factors such as barometric pressure, humidity, and so forth. Suppliers may also want to consider specifying both case and ambient methods and values, as well as methods specifying, measuring or calculating junction temperature directly. Please refer to supplier datasheets for the supported method.

It is further recognized that many systems applications may mix components from different markets into unique solutions, for example a microcontroller with NOR Flash and DRAM. Since the various components may use different measurement approaches, case versus ambient, guidance is given in this standard regarding correlation of these different methods.

The distinction between case and ambient methods applies only to operating temperature ranges. Storage temperature range measurements apply to all components and assemblies.

This document outlines the full spectrum of temperature ranges defined and available for use. Individual device or product standards, specifications, and datasheets are expected to pick and choose a subset of available ranges as appropriate per the specific device or product being defined.

This page left intentionally blank

TEMPERATURE RANGE AND MEASUREMENT STANDARDS FOR COMPONENTS AND MODULES

From JEDEC Board Ballot JCB-21-24, formulated under the cognizance of the JC-42 Committee on Solid State Memories. This is a combination of four committee ballots, item numbers 1855.13, 1855.16, 1855.22, and 1855.24.

1 Scope

This document specifies standard temperature ranges that may be used, by way of referencing JESD402-1, in other standards, specifications, and datasheets when defining temperature related specifications.

2 Normative Reference

The following normative documents contain provisions that, through reference in this text, constitute provisions of this standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below.

For updated references, the latest edition of the normative document referred to applies.

- [UFS], JESD220E, Universal Flash Storage (UFS), Version 3.1
- [DDR], JESD79-4B, DDR4 SRAM, June 2017
- [LPDDR], JESD209-5, Low Power Double Data Rate 5(LPDDR5), Feb 2019
- [GDDR], JESD250, Graphics Double Data Rate(GDDR6) SGRAM STANDARD, July 2017
- [JESD51-1] Integrated circuit thermal measurement method - electrical test method (single semiconductor device), Dec 1995
- [JESD51-2A] Integrated circuits thermal test method environmental conditions - natural convection (still air), Jan 2007
- [AEC-Q100] Failure Mechanism Based Stress Test Qualification for ICs(base document), Rev H, Sept 2014, AEC(Automotive Electronics Council)
- [AEC-Q104] Failure Mechanism Based Stress Test Qualification For Multichip Modules (MCM) In Automotive Applications, Initial Version,