

# Universal Serial Bus Specification

**Compaq**

**Hewlett-Packard**

**Intel**

**Lucent**

**Microsoft**

**NEC**

**Philips**

**Revision 2.0**

**April 27, 2000**

## Universal Serial Bus Specification Revision 2.0

### Scope of this Revision

The 2.0 revision of the specification is intended for product design. Every attempt has been made to ensure a consistent and implementable specification. Implementations should ensure compliance with this revision.

### Revision History

Revision	Issue Date	Comments
0.7	November 11, 1994	Supersedes 0.6e.
0.8	December 30, 1994	Revisions to Chapters 3-8, 10, and 11. Added appendixes.
0.9	April 13, 1995	Revisions to all the chapters.
0.99	August 25, 1995	Revisions to all the chapters.
1.0 FDR	November 13, 1995	Revisions to Chapters 1, 2, 5-11.
1.0	January 15, 1996	Edits to Chapters 5, 6, 7, 8, 9, 10, and 11 for consistency.
1.1	September 23, 1998	Updates to all chapters to fix problems identified.
2.0 (draft 0.79)	October 5, 1999	Revisions to chapters 5, 7, 8, 9, 11 to add high speed.
2.0 (draft 0.9)	December 21, 1999	Revisions to all chapters to add high speed.
2.0	April 27, 2000	Revisions for high-speed mode.

Universal Serial Bus Specification  
Copyright © 2000, Compaq Computer Corporation,  
Hewlett-Packard Company, Intel Corporation, Lucent Technologies Inc,  
Microsoft Corporation, NEC Corporation, Koninklijke Philips Electronics N.V.  
All rights reserved.

### INTELLECTUAL PROPERTY DISCLAIMER

THIS SPECIFICATION IS PROVIDED TO YOU "AS IS" WITH NO WARRANTIES WHATSOEVER, INCLUDING ANY WARRANTY OF MERCHANTABILITY, NON-INFRINGEMENT, OR FITNESS FOR ANY PARTICULAR PURPOSE. THE AUTHORS OF THIS SPECIFICATION DISCLAIM ALL LIABILITY, INCLUDING LIABILITY FOR INFRINGEMENT OF ANY PROPRIETARY RIGHTS, RELATING TO USE OR IMPLEMENTATION OF INFORMATION IN THIS SPECIFICATION. THE PROVISION OF THIS SPECIFICATION TO YOU DOES NOT PROVIDE YOU WITH ANY LICENSE, EXPRESS OR IMPLIED, BY ESTOPPEL OR OTHERWISE, TO ANY INTELLECTUAL PROPERTY RIGHTS.

All product names are trademarks, registered trademarks, or servicemarks of their respective owners.

*Please send comments via electronic mail to [techsup@usb.org](mailto:techsup@usb.org)  
For industry information, refer to the USB Implementers Forum web page at <http://www.usb.org>*

## Acknowledgement of USB 2.0 Technical Contribution

The authors of this specification would like to recognize the following people who participated in the USB 2.0 Promoter Group technical working groups. We would also like to thank others in the USB 2.0 Promoter companies and throughout the industry who contributed to the development of this specification.

### Hub Working Group

John Garney	Intel Corporation (Chair/Editor)
Ken Stufflebeam	Compaq Computer Corporation
David Wooten	Compaq Computer Corporation
Matt Nieberger	Hewlett-Packard Company
John Howard	Intel Corporation
Venkat Iyer	Intel Corporation
Steve McGowan	Intel Corporation
Geert Knapen	Royal Philips Electronics
Zong Liang Wu	Royal Philips Electronics
Jim Clee	Lucent Technologies Inc
Jim Guziak	Lucent Technologies Inc
Dave Thompson	Lucent Technologies Inc
John Fuller	Microsoft Corporation
Nathan Sherman	Microsoft Corporation
Mark Williams	Microsoft Corporation
Nobuo Furuya	NEC Corporation
Toshimi Sakurai	NEC Corporation
Moto Sato	NEC Corporation
Katsuya Suzuki	NEC Corporation

### Electrical Working Group

Jon Lueker	Intel Corporation (Chair/Editor)
David Wooten	Compaq Computer Corporation
Matt Nieberger	Hewlett-Packard Company
Larry Taugher	Hewlett-Packard Company
Venkat Iyer	Intel Corporation
Steve McGowan	Intel Corporation
Mike Pennell	Intel Corporation
Todd West	Intel Corporation
Gerrit den Besten	Royal Philips Electronics
Marq Kole	Royal Philips Electronics
Zong Liang Wu	Royal Philips Electronics
Jim Clee	Lucent Technologies Inc
Jim Guziak	Lucent Technologies Inc
Par Parikh	Lucent Technologies Inc
Dave Thompson	Lucent Technologies Inc
Ed Giaimo	Microsoft Corporation
Mark Williams	Microsoft Corporation
Toshihiko Ohtani	NEC Corporation
Kugao Ouchi	NEC Corporation
Katsuya Suzuki	NEC Corporation
Toshio Tasaki	NEC Corporation

**Universal Serial Bus Specification Revision 2.0**

# Contents

## CHAPTER 1 INTRODUCTION

1.1	Motivation .....	1
1.2	Objective of the Specification .....	1
1.3	Scope of the Document .....	2
1.4	USB Product Compliance .....	2
1.5	Document Organization .....	2

## CHAPTER 2 TERMS AND ABBREVIATIONS

## CHAPTER 3 BACKGROUND

3.1	Goals for the Universal Serial Bus .....	11
3.2	Taxonomy of Application Space.....	12
3.3	Feature List .....	13

## CHAPTER 4 ARCHITECTURAL OVERVIEW

4.1	USB System Description .....	15
4.1.1	Bus Topology .....	16
4.2	Physical Interface .....	17
4.2.1	Electrical.....	17
4.2.2	Mechanical .....	18
4.3	Power .....	18
4.3.1	Power Distribution .....	18
4.3.2	Power Management.....	18
4.4	Bus Protocol .....	18
4.5	Robustness.....	19
4.5.1	Error Detection.....	19
4.5.2	Error Handling.....	19
4.6	System Configuration.....	19
4.6.1	Attachment of USB Devices.....	20
4.6.2	Removal of USB Devices.....	20
4.6.3	Bus Enumeration .....	20

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.