



IPC-1782B

2023 - September

Standard for Manufacturing and Supply Chain Traceability of Electronic Products

Supersedes IPC-1782A
November 2020

An international standard developed by IPC



BUILD ELECTRONICS BETTER

IPC Mission

IPC is a global trade association dedicated to furthering the competitive excellence and financial success of its members, who are participants in the electronics industry.

In pursuit of these objectives, IPC will devote resources to management improvement and technology enhancement programs, the creation of relevant standards, protection of the environment, and pertinent government relations.

IPC encourages the active participation of all its members in these activities and commits to full cooperation with all related organizations.

About IPC Standards

IPC 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 their particular need. Existence of such IPC standards and publications shall not in any respect preclude any entity from manufacturing or selling products not conforming to such IPC standards and publication, nor shall the existence of such IPC standards and publications preclude their voluntary use.

IPC standards and publications are approved by IPC committees without regard to whether the IPC standards or publications may involve patents on articles, materials or processes. By such action, IPC does not assume any liability to any patent owner, nor does IPC assume any obligation whatsoever to parties adopting an IPC standard or publication. Users are wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

IPC Position Statement on Specification Revision Change

The use and implementation of IPC standards and publications are voluntary and part of a relationship entered into by customer and supplier. When an IPC standard or publication is revised or amended, the use of the latest revision or amendment as part of an existing relationship is not automatic unless required by the contract. IPC recommends the use of the latest revision or amendment.

Standards Improvement Recommendations

IPC welcomes comments for improvements to any standard in its library. All comments will be provided to the appropriate committee.

If a change to technical content is requested, data to support the request is recommended. Technical comments to include new technologies or make changes to published requirements should be accompanied by technical data to support the request. This information will be used by the committee to resolve the comment.

To submit your comments, visit the IPC Status of Standardization page at www.ipc.org/status.



IPC-1782B

Standard for Manufacturing and Supply Chain Traceability of Electronic Products

Developed by the Critical Components Traceability Task Group (2-19a)
of the Electronic Product Data Description Committee (2-10) of IPC

Supersedes:

IPC-1782A - November 2020
IPC-1782 - October 2016

Users of this publication are encouraged to participate in the
development of future revisions.

Contact:

IPC
3000 Lakeside Drive, Suite 105N
Bannockburn, Illinois
60015-1249
Tel 847 615.7100
Fax 847 615.7105

This Page Intentionally Left Blank

Acknowledgment

Any document involving a complex technology draws material from a vast number of sources across many continents. While the principal members of the Critical Components Traceability Task Group (2-19a) of the Electronic Product Data Description Committee (2-10) are shown below, it is not possible to include all of those who assisted in the evolution of this standard. To each of them, the members of the IPC extend their gratitude.

Electronic Product Data Description Committee

Chair

Michael Ford
Aegis Software

Critical Components Traceability Task Group

Chair

Michael Ford
Aegis Software

Technical Liaison of the IPC Board of Directors

Bob Neves

Microtek (Changzhou)
Laboratories

The Total Recallers A-Team

IPC recognizes this A-Team for their exceptional leadership and effort in the development of this standard.

Randy Bremner
Northrop Grumman Corporation

Claire Dvorak
Northrop Grumman Corporation

Thomas Marktscheffel
ASMPT GmbH & Co. KG

Tim Burke
Arch Systems

Michael Ford
Aegis Software

Critical Components Traceability Task Group

Randy Bremner
Northrop Grumman Corporation

Feng Gao
ZHUZHOU CRRC TIMES
ELECTRIC CO., LTD.

Jan Pedersen
NCAB Group AB

Tim Burke
Arch Systems

Curtis Grosskopf
IBM Corporation

David Reichert
DuPont

Ilya Chaykovskiy
Red Brick Technologies LLC

Joel Heebink
Aerocyonics

Cameron Shearon
Raytheon Company

Zhiman Chen
ZHUZHOU CRRC TIMES
ELECTRIC CO., LTD

Ife Hsu
Intel

Forest Sheehan
Northrop Grumman Corporation

Michael Durkan
Mentor Graphics Corporation

Kunbin Huang
APCB Electronics
(KunShan) Co., Ltd.

Dmitry Sobyenin
J.R. Strickland
Motorola Solutions

Claire Dvorak
Northrop Grumman Corporation

Asaf Jivilik
Cybord

Jesse Vaughan
Summit Interconnect - Anaheim

Alexa Fisher
Northrop Grumman Corporation

Chuck LePard
DXC Technology

Hiroyuki Watanabe
NEC Platforms

Michael Ford
Aegis Software

Thomas Marktscheffel
ASMPT GmbH & Co. KG

Eyal Weiss
Cybord

Dennis Fritz
Dennis Fritz Consulting

Colin Williams
Northrop Grumman Corporation

This Page Intentionally Left Blank

Table of Contents

1	SCOPE	1	1.6.22	Raw Materials.....	4
1.1	Purpose.....	1	1.6.23	Risk	4
1.1.1	About This Standard and the Concept of Traceability.....	1	1.6.24	Risk Analysis.....	5
1.1.2	Internal and External Traceability	2	1.6.25	Risk Assessment	5
1.1.2.1	Application of This Standard	2	1.6.26	Risk Management.....	5
1.1.3	Sectional Traceability Standards and the Maintenance of This Standard	2	1.6.27	Serial Number.....	5
1.2	Classification.....	3	1.6.28	Serialization.....	5
1.3	Definition of Requirements	3	1.6.29	Subassembly	5
1.4	Order of Precedence	3	1.6.30	Traceability.....	5
1.4.1	Conflict.....	3	1.6.31	Unique Assembly ID.....	5
1.4.2	Clause References.....	3	1.6.32	Unique Materials.....	5
1.4.3	Appendices.....	3	1.6.33	Work-Order	5
1.5	Abbreviations and Acronyms	3	2	APPLICABLE DOCUMENTS	5
1.6	Terms and Definitions.....	3	2.1	IPC	5
1.6.1	As Agreed Between User and Supplier (AABUS).....	3	2.2	Joint Industry Standards	5
1.6.2	Authorized Supplier.....	4	2.3	Electrostatic Discharge Association (ESD)....	5
1.6.3	Automated Data Collection / Data- Gathering Automation	4	2.4	International Organization for Standardization (ISO).....	5
1.6.4	Batch Code.....	4	2.5	JEDEC	5
1.6.5	Cell.....	4	3	GENERAL REQUIREMENTS	6
1.6.6	Cell Structure	4	3.1	Guidance on the Use of This Standard.....	6
1.6.7	Common Materials.....	4	3.1.1	Conduct Risk Assessment.....	6
1.6.8	Component.....	4	3.1.2	Determine Traceability Level.....	6
1.6.9	Dashboard.....	4	3.1.3	Document Action in User Agreement.....	6
1.6.10	Data Integrity	4	3.1.4	Monitor Risk / Update Traceability Level	6
1.6.11	Date Code.....	4	3.2	Nonconforming Items.....	6
1.6.12	Individual Material Traceability	4	3.3	Scope and Application of Traceability Recording	7
1.6.13	Lot Number	4	3.4	Requirement for Computerized Systems	7
1.6.14	Manual Data Management.....	4	3.4.1	Internal Traceability Computerized System	7
1.6.15	Material Traceability.....	4	3.4.2	External Traceability Computerized System	7
1.6.16	Materials	4	4	LEVELS OF TRACEABILITY	8
1.6.17	Mechanical Assembly.....	4	4.1	Levels of Internal Traceability	8
1.6.18	Process Identification (ID).....	4	4.1.1	Material and Process Traceability Levels....	8
1.6.19	Process Traceability.....	4	4.1.1.1	Level 1 Traceability: Basic.....	8
1.6.20	Product Build Records	4	4.1.1.2	Level 2 Traceability: Standard.....	9
1.6.21	Production Lot	4			

4.1.1.3	Level 3 Traceability: Advanced.....	9	5.5.2.8	Manual Printed Board Assembly Traceability Cell	21
4.1.1.4	Level 4 Traceability: Comprehensive.....	9	5.5.2.9	Reflow Traceability Cell	21
4.1.1.5	Individual Material Traceability	9	5.5.2.10	Wave Solder/Selective Solder/Wash Traceability Cell	22
4.2	Levels of External Traceability	10	5.5.2.11	Manual Visual Inspection Traceability Cell	22
4.2.1	Material and Process Traceability Levels...	10	5.5.2.12	Automated Optical Inspection (AOI) and X-Ray Inspection Traceability Cell	22
4.3	Guideline for Anticounterfeit Use	10	5.5.2.13	In-Circuit Test (ICT) Traceability Cell.....	22
4.4	Guidelines for Classification and Internal Traceability Levels.....	10	5.5.2.14	Press-Fit Operations Traceability Cell	23
4.5	Guidelines for Classification and External Traceability Levels.....	11	5.5.2.15	Touch-Up Operations Traceability Cell.....	23
5	CELL STRUCTURE AND CONTENTS	12	5.5.2.16	Encapsulation Traceability	23
5.1	Assembly Cell.....	12	5.5.2.17	System/Sub/Final Assembly (Mechanical Assembly by Robot or Manually) Traceability Cell	23
5.2	Work-Order Information Cell.....	15	5.5.2.18	Software/Firmware Programming Traceability Cell	24
5.3	Bill of Materials Cell.....	15	5.5.2.19	Quality Assurance Check/Test/Inspection Traceability Cell	24
5.4	Material Traceability Cell.....	15	5.5.2.20	Repair/Rework Station Traceability Cell ...	24
5.4.1	Unique Material/Subassembly Traceability Cell	16	5.5.2.21	Functional Test Traceability Cell	24
5.4.2	Individual Material Traceability Cell	16	5.5.2.22	Burn-In/Extended Test Traceability Cell....	25
5.4.3	Software/Firmware Material Traceability Cell.....	17	5.5.2.23	Shipping/End-User/Postmanufacturing Environment Test Traceability Cell.....	25
5.4.4	Packing and Shipping Material Traceability Cell	17	5.5.2.24	Packing and Shipping Traceability Cell	25
5.4.5	Label Material Traceability Cell	17	5.5.2.25	Process Deviations Traceability Cell	25
5.4.6	Hazardous Substance Cell	17	5.5.2.26	Labeling Traceability Cell	26
5.4.7	Material Test Cell	18	5.5.2.27	Printed Board Etching Process Traceability Cell	26
5.5	Process Traceability Data Cell	18	5.5.2.28	Printed Board Oxide Process Traceability Cell.....	26
5.5.1	Common Process Traceability Data Cell ...	18	5.5.2.29	Printed Board Plating Process Traceability Cell.....	26
5.5.2	Unique Process Traceability Data Cell	19	5.5.2.30	Printed Board Developer Process Traceability Cell	26
5.5.2.1	Unique Printed Board Marking Traceability Cell	19	5.5.2.31	Other Printed Board Wet Process Traceability Cell	27
5.5.2.2	Product Routing Station, Printed Board Flip/Turn, Storage/Stock/Waiting Area Traceability Cell	19	5.5.2.32	Exceptions Cell	27
5.5.2.3	Screen Printer Traceability Cell.....	19	5.6	Process Maintenance Cell.....	27
5.5.2.4	Automated Paste Inspection Traceability Cell.....	19	6	EXTERNAL TRACEABILITY (SECURE SUPPLY CHAIN)	28
5.5.2.5	Glue Dispenser Traceability Cell	20			
5.5.2.6	SMT Placement Traceability Cell.....	20			
5.5.2.7	Pin Through-Hole Insertion (Automated and Manual) Traceability Cell	21			

6.1	Supply Chain Event	28	Table 5-2	Assembly Cell Material Traceability	14
6.1.1	Event Types	28	Table 5-3	Assembly Cell Process Traceability	14
6.1.2	Packages	28	Table 5-4	Work-Order Information Cell Process Traceability.....	15
6.1.3	Unique ID	29	Table 5-5	Bill of Materials Cell Traceability	15
6.1.4	Material Information.....	29	Table 5-6	Materials Traceability Cell	16
6.1.5	Process Information.....	30	Table 5-7	Unique Material/Subassembly Traceability Cell	16
6.1.6	Asset Owner	30	Table 5-8	Individual Material Traceability Cell	16
6.1.7	Process Owner	30	Table 5-9	Software/Firmware Material Traceability Cell.....	17
6.1.8	Event Location.....	30	Table 5-10	Packaging and Shipping Material Traceability Cell	17
6.1.9	Event Processing Tasks	31	Table 5-11	Label Material Traceability Cell	17
6.1.9.1	Material Packing (MP).....	31	Table 5-12	Common Process Traceability Cell	18
6.1.9.2	Material Package Logistics (MPL)	31	Table 5-13	Common Process Traceability Cell	19
6.1.9.3	Material Package Processing (MPP).....	31	Table 5-14	Product Routing Station, Printed Board Flip/Turn, Storage/Stock/Waiting Area Traceability Cell	19
6.1.9.4	Material Package Consumption (MPC).....	32	Table 5-15	Screen Printer Traceability Cell.....	19
6.2	Secure Supply Chain Database	32	Table 5-16	Automated Paste Inspection Traceability Cell.....	19
6.2.1	Database Structure	32	Table 5-17	Glue Dispenser Traceability Cell	20
6.2.1.1	Tamper-Proof Event Records	33	Table 5-18	SMT Placement Traceability Cell.....	20
6.2.1.2	Tamper-Evident Shared Data	33	Table 5-19	Pin Through-Hole Insertion (Automated and Manual) Traceability Cell	21
6.2.1.3	Updating the Shared Data.....	33	Table 5-20	Manual Printed Board Assembly Traceability Cell	21
6.2.2	Access to External Traceability Data	33	Table 5-21	Reflow Traceability Cell.....	21
Tables			Table 5-22	Wave Solder/Selective Solder/Wash Traceability Cell	22
Table 3-1	Typical Risk Assessment Matrix.....	6	Table 5-23	Manual Visual Inspection Traceability Cell.....	22
Table 4-1	Internal Traceability Levels	8	Table 5-24	Automated Optical Inspection (AOI) and X-Ray Inspection Traceability Cell.....	22
Table 4-2	External Traceability Levels	10	Table 5-25	In-Circuit Test (ICT) Traceability Cell.....	22
Table 4-3	Traceability Levels to IPC Product Classification System Matrix	10	Table 5-26	Press-Fit Operations Traceability Cell.....	23
Table 4-4	Traceability Level Recommendations for IPC Product Class 1	11	Table 5-27	Touch-Up Operations Traceability Cell.....	23
Table 4-5	Traceability Level Recommendations for IPC Product Class 2	11	Table 5-28	Encapsulation Traceability Cell.....	23
Table 4-6	Traceability Level Recommendations for IPC Product Class 3	11	Table 5-29	System/Sub/Final Assembly (Mechanical Assembly by Robot or Manually) Traceability Cell	23
Table 4-7	Traceability Level Recommendations for IPC Product Class 3 Plus Market Addenda.....	11			
Table 4-8	Traceability Levels to IPC Product Classification System Matrix	11			
Table 4-9	Internal vs. External Traceability Levels	11			
Table 5-1	Abbreviated Process Traceability Level Matrix	13			

This Page Intentionally Left Blank

This Page Intentionally Left Blank

IPC-1782B

Standard for Manufacturing and Supply Chain Traceability of Electronic Products

1 SCOPE

This standard establishes minimum requirements for manufacturing and supply chain traceability based on perceived risk. This standard applies to all products, processes, assemblies, parts, components, equipment used and other items as defined by users and suppliers in the manufacture of printed board assemblies, as well as mechanical assembly and printed board fabrication. This standard is applicable both for internal traceability (i.e., traceability within the environment in which the product is assembled) and external traceability (i.e., as products and materials are moved between locations as part of their supply chain).

Minimum requirements are based on four levels of traceability for materials and processes. These levels can correlate to the IPC Product Classification System (Class 1, Class 2, Class 3 and Space/Defense/Medical) and/or another set of categories of compliance, based on the business model/economic needs of the end-use market for the final product (e.g., telecom, aerospace, automotive, medical device, consumer electronics) or a subassembly within that product.

1.1 Purpose Historically, the lack of a uniform component traceability standard has caused an unnecessary consumption of resources (e.g., time, people, money) to track events or parts to their sources and to remedy any quality, reliability, etc., issues. Lack of a standard has also made it difficult to uniformly create and appropriately enforce the necessary contracts.

The traceability information detailed in this standard is intended to improve operational efficiency and productivity, quality and reliability as well as to enable activities such as predictive maintenance in the manufacturing environment but not necessarily to be distributed outside of the organization. This standard can help organizations more easily ensure end users / consumers will receive products and services that meet or exceed their expectations in the timeliest and most economically viable method.

This standard can also aid in reducing counterfeit components in an organization's supply chain, whether using an authorized supplier or not.

1.1.1 About This Standard and the Concept of Traceability Traceability has grown from being a specialized need for safety-critical segments of industry to a recognized tool that adds value to industry as a whole. Disparate standards that have evolved, mainly dictated by large original equipment manufacturers (OEMs), can create confusion in the market, as a multitude of requirements and definitions proliferate. The intent of this standard is to bring the whole principle of traceability up to date. Traceability, as further described in this standard, represents both the most effective quality tool available internally within assembly operations, which can become an intrinsic part of best-practice operations, as well as the traceability of packages between locations of material manufacture and product assembly, ensuring contents of transported items are not compromised (i.e., by ingress of counterfeit materials). This is accomplished with the encouragement of automated data collection from systems already integrating quality, manufacturing, engineering and supply chain, thus reducing cost of ownership and ensuring timeliness and accuracy.

The wealth of analysis data accessible from traceability can yield information that can raise expectations for very significant quality and performance improvements, as well as provide the necessary protection against the costs in the market as a result of adverse issues.

This standard creates a flexible data architecture that can be adopted to represent all levels of traceability that are required across industry. This includes support for the most demanding instances for detail and integrity (e.g., critical-safety systems) through to situations in which only basic traceability may be needed (e.g., simple consumer products). This standard presents a cellular-based structure to provide required flexibility and create an efficient format in which unnecessary duplication of data is avoided. The format also allows data to be added after the completion of production, enabling further detail to be added as it becomes available.

Throughout the design of this standard, different key usage models of traceability were considered. It is written to explain how access to critical data, when needed to identify the exact scope of any market issues, can be ensured, while also being capable of providing "live" access to detailed product-build records for advanced quality analysis.

This standard also demonstrates the benefits of best-practice data collection through automated means. This is reflected in the definitions of the different levels of traceability.