



# IPC-1782A

2020 - November

## Standard for Manufacturing and Supply Chain Traceability of Electronic Products

Supersedes IPC-1782

October 2016

*An international standard developed by IPC*



BUILD ELECTRONICS BETTER



Standard

---

**The Principles of Standardization**

In May 1995 the IPC's Technical Activities Executive Committee (TAEC) adopted Principles of Standardization as a guiding principle of IPC's standardization efforts.

**Standards Should:**

- Show relationship to Design for Manufacturability (DFM) and Design for the Environment (DFE)
- Minimize time to market
- Contain simple (simplified) language
- Just include spec information
- Focus on end product performance
- Include a feedback system on use and problems for future improvement

**Standards Should Not:**

- Inhibit innovation
- Increase time-to-market
- Keep people out
- Increase cycle time
- Tell you how to make something
- Contain anything that cannot be defended with data

**Notice**

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 his particular need. Existence of such Standards and Publications shall not in any respect preclude any member or nonmember of IPC from manufacturing or selling products not conforming to such Standards and Publication, nor shall the existence of such Standards and Publications preclude their voluntary use by those other than IPC members, whether the standard is to be used either domestically or internationally.

Recommended Standards and Publications are adopted by IPC without regard to whether their adoption may involve patents on articles, materials, or processes. By such action, IPC does not assume any liability to any patent owner, nor do they assume any obligation whatever to parties adopting the Recommended Standard or Publication. Users are also wholly responsible for protecting themselves against all claims of liabilities for patent infringement.

**IPC Position Statement on Specification Revision Change**

It is the position of IPC's Technical Activities Executive Committee that the use and implementation of IPC publications is voluntary and is part of a relationship entered into by customer and supplier. When an IPC publication is updated and a new revision is published, it is the opinion of the TAEC that the use of the new revision as part of an existing relationship is not automatic unless required by the contract. The TAEC recommends the use of the latest revision. Adopted October 6, 1998

**Why is there a charge for this document?**

Your purchase of this document contributes to the ongoing development of new and updated industry standards and publications. Standards allow manufacturers, customers, and suppliers to understand one another better. Standards allow manufacturers greater efficiencies when they can set up their processes to meet industry standards, allowing them to offer their customers lower costs.

IPC spends hundreds of thousands of dollars annually to support IPC's volunteers in the standards and publications development process. There are many rounds of drafts sent out for review and the committees spend hundreds of hours in review and development. IPC's staff attends and participates in committee activities, typesets and circulates document drafts, and follows all necessary procedures to qualify for ANSI approval.

IPC's membership dues have been kept low to allow as many companies as possible to participate. Therefore, the standards and publications revenue is necessary to complement dues revenue. The price schedule offers a 50% discount to IPC members. If your company buys IPC standards and publications, why not take advantage of this and the many other benefits of IPC membership as well? For more information on membership in IPC, please visit [www.ipc.org](http://www.ipc.org) or call 847/597-2809.

Thank you for your continued support.



IPC-1782A

# 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-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 IPC extend their gratitude.

<b>Electronic Product Data Description Committee</b>	<b>Critical Components Traceability Task Group</b>	<b>Technical Liaison of the IPC Board of Directors</b>
Chair Michael Ford Aegis Software	Co-Chairs Radu Diaconescu Swissmic  Michael Ford Aegis Software	Bob Neves Microtek (Changzhou) Laboratories

### Critical Components Traceability Task Group

Jimmy Baccam, Lockheed Martin Missiles & Fire Control	Joel Heebink, Honeywell International	Karen McConnell, Northrop Grumman Corporation
Gerald Bogert, Bechtel Plant Machinery, Inc.	Joe Heery, TTM Technologies, Inc. Ife Hsu, Intel Corporation	Thi Nguyen, Lockheed Martin Missile & Fire Control
Chris Butler, Analog Technologies Corporation	Constantin Hudon, Varitron Technologies Inc.	Jan Pedersen, Elmatica AS Ray Prasad, Ray Prasad Consultancy Group
Radu Diaconescu, Swissmic Don Dupriest, Lockheed Martin Missiles & Fire Control	David Huntley, PDF Solutions Robert Kinyanjui, John Deere Electronic Solutions	David Reichert, DuPont Jake Sedlock, Alitheon
Bradley Fern, Entrust Datacard Corporation Michael Ford, Aegis Software Curtis Grosskopf, IBM Corporation	Nick Koop, TTM Technologies Craig Lax, Septillion Technologies Thomas Marktscheffel, ASM (Assembly Systems) GmbH & Co. KG	Aimee Siegler, Benchmark Electronics Inc.

### Special Recognition

IPC recognizes the following group of people who showed exceptional leadership and effort in the development of IPC-1782A. Their efforts accelerated the process of publishing this much needed revision.

Radu Diaconescu, Swissmic Michael Ford, Aegis Software	Curtis Grosskopf, IBM Corporation Joel Heebink, Honeywell International	Ife Hsu, Intel Corporation Craig Lax, Septillion Technologies
---	---	--

This Page Intentionally Left Blank

# Table of Contents

<b>1</b>	<b>SCOPE</b>	1	1.6.27	Serialization	5
1.1	Purpose	1	1.6.28	Subassembly	5
1.1.1	About This Standard and the Concept of Traceability	1	1.6.29	Traceability	5
1.1.2	Internal and External Traceability	2	1.6.30	Unique Assembly ID	5
1.1.3	Application of This Standard	2	1.6.31	Unique Materials	5
1.1.4	Sectional Traceability Standards and the Maintenance of This Standard	2	1.6.32	Work-Order	5
1.2	Classification	2	<b>2</b>	<b>APPLICABLE DOCUMENTS</b>	5
1.3	Definition of Requirements	3	2.1	IPC	5
1.4	Order of Precedence	3	2.2	Joint Industry Standards	5
1.4.1	Conflict	3	2.3	Electrostatic Discharge Association (ESD)	5
1.4.2	Clause References	3	2.4	International Organization for Standardization (ISO)	5
1.4.3	Appendices	3	2.5	JEDEC	5
1.5	Abbreviations and Acronyms	3	<b>3</b>	<b>GENERAL REQUIREMENTS</b>	6
1.6	Terms and Definitions	3	3.1	Guidance on the Use of This Standard	6
1.6.1	As Agreed Between User and Supplier (AABUS)	3	3.1.1	Conduct Risk Assessment	6
1.6.2	Authorized Supplier	3	3.1.2	Determine Traceability Level	6
1.6.3	Automated Data Collection / Data-Gathering Automation	4	3.1.3	Document Action in User Agreement	6
1.6.4	Batch Code	4	3.1.4	Monitor Risk / Update Traceability Level	6
1.6.5	Cell	4	3.2	Nonconforming Items	6
1.6.6	Cell Structure	4	3.3	Scope and Application of Traceability Recording	7
1.6.7	Common Materials	4	3.4	Requirement for Computerized Systems	7
1.6.8	Component	4	3.4.1	Internal Traceability Computerized System	7
1.6.9	Dashboard	4	3.4.2	External Traceability Computerized System	7
1.6.10	Data Integrity	4	<b>4</b>	<b>LEVELS OF TRACEABILITY</b>	8
1.6.11	Date Code	4	4.1	Levels of Internal Traceability	8
1.6.12	Lot Number	4	4.1.1	Material and Process Traceability Levels	8
1.6.13	Manual Data Management	4	4.2	Levels of External Traceability	9
1.6.14	Material Traceability	4	4.2.1	Material and Process Traceability Levels	10
1.6.15	Materials	4	4.3	Guideline for Anti-counterfeit Use	10
1.6.16	Mechanical Assembly	4	4.4	Guidelines for Classification and Internal Traceability Levels	10
1.6.17	Process Identification (ID)	4	4.5	Guidelines for Classification and External Traceability Levels	11
1.6.18	Process Traceability	4	<b>5</b>	<b>CELL STRUCTURE AND CONTENTS</b>	12
1.6.19	Product Build Records	4	5.1	Assembly Cell	13
1.6.20	Production Lot	4	5.2	Work-Order Information Cell	15
1.6.21	Raw Materials	4	5.3	Bill of Materials Cell	15
1.6.22	Risk	4	5.4	Material Traceability Cell	15
1.6.23	Risk Analysis	4	5.4.1	Unique Material/Subassembly Traceability Cell	16
1.6.24	Risk Assessment	4			
1.6.25	Risk Management	5			
1.6.26	Serial Number	5			

5.4.2	Software/Firmware Material Traceability Cell .....	16	Table 4-8	Traceability Levels to IPC Product Classification System Matrix .....	11
5.4.3	Packing and Shipping Material Traceability Cell .....	17	Table 4-9	Internal vs. External Traceability Levels .....	11
5.4.4	Label Material Traceability Cell .....	17	Table 5-1	Abbreviated Process Traceability Level Matrix .....	13
5.4.5	Hazardous Substance Cell .....	17	Table 5-2	Assembly Cell Material Traceability .....	14
5.4.6	Material Test Cell .....	17	Table 5-3	Assembly Cell Process Traceability .....	14
5.5	Process Traceability Data Cell .....	18	Table 5-4	Work-Order Information Cell Process Traceability .....	15
5.5.1	Common Process Traceability Data Cell .....	18	Table 5-5	Bill of Materials Cell Traceability .....	15
5.5.2	Unique Process Traceability Data Cell .....	18	Table 5-6	Materials Traceability Cell .....	16
5.6	Process Maintenance Cell .....	27	Table 5-7	Unique Material/Subassembly Traceability Cell .....	16
<b>6</b>	<b>EXTERNAL TRACEABILITY (SECURE SUPPLY CHAIN)</b> .....	<b>27</b>	Table 5-8	Software/Firmware Material Traceability Cell .....	16
6.1	Supply Chain Event .....	27	Table 5-9	Packaging and Shipping Material Traceability Cell .....	17
6.1.1	Event Types .....	28	Table 5-10	Label Material Traceability Cell .....	17
6.1.2	Packages .....	28	Table 5-11	Common Process Traceability Cell .....	18
6.1.3	Unique ID .....	28	Table 5-12	Common Process Traceability Cell .....	18
6.1.4	Material Information .....	29	Table 5-13	Product Routing Station, Printed Board Flip/Turn, Storage/Stock/Waiting Area Traceability Cell .....	19
6.1.5	Process Information .....	29	Table 5-14	Screen Printer Traceability Cell .....	19
6.1.6	Asset Owner .....	29	Table 5-15	Automated Paste Inspection Traceability Cell .....	19
6.1.7	Process Owner .....	30	Table 5-16	Glue Dispenser Traceability Cell .....	19
6.1.8	Event Location .....	30	Table 5-17	SMT Placement Traceability Cell .....	20
6.1.9	Event Processing Tasks .....	30	Table 5-18	Pin Through-Hole Insertion (Automated and Manual) Traceability Cell .....	20
6.2	Secure Supply Chain Database .....	31	Table 5-19	Manual Printed Board Assembly Traceability Cell .....	20
6.2.1	Database Structure .....	32	Table 5-20	Reflow Traceability Cell .....	21
6.2.2	Access to External Traceability Data .....	32	Table 5-21	Wave Solder/Selective Solder/Wash Traceability Cell .....	21
<b>APPENDIX A</b>	<b>Acronym Index</b> .....	<b>34</b>	Table 5-22	Manual Visual Inspection Traceability Cell .....	21
	<b>Figures</b>		Table 5-23	Automated Optical Inspection (AOI) and X-Ray Inspection Traceability Cell .....	21
Figure 1-1	Typical Supply-Chain .....	2	Table 5-24	In-Circuit Test (ICT) Traceability Cell .....	22
Figure 5-1	Traceability Cell Structure .....	12	Table 5-25	Press-Fit Operations Traceability Cell .....	22
Figure 6-1	The Secure Supply-Chain Event Elements ....	27	Table 5-26	Touch-Up Operations Traceability Cell .....	22
Figure 6-2	Architecture of External Traceability Data In The Secure Supply-Chain Database .....	32	Table 5-27	Encapsulation Traceability Cell .....	22
	<b>Tables</b>		Table 5-28	System/Sub/Final Assembly (Mechanical Assembly by Robot or Manually) Traceability Cell .....	23
Table 3-1	Typical Risk Assessment Matrix .....	6	Table 5-29	Software/Firmware Programming Traceability Cell .....	23
Table 4-1	Internal Traceability Levels .....	8	Table 5-30	Quality Assurance Check/Test/Inspection Traceability Cell .....	23
Table 4-2	External Traceability Levels .....	10	Table 5-31	Repair/Rework Station Traceability Cell .....	23
Table 4-3	Traceability Levels to IPC Product Classification System Matrix .....	10	Table 5-32	Functional Test (FT) Traceability Cell .....	24
Table 4-4	Traceability Level Recommendations for IPC Product Class 1 .....	10	Table 5-33	Burn-In/Extended Test Traceability Cell .....	24
Table 4-5	Traceability Level Recommendations for IPC Product Class 2 .....	11	Table 5-34	Shipping/End-User/Post-Manufacturing Environment Test Traceability Cell .....	24
Table 4-6	Traceability Level Recommendations for IPC Product Class 3 .....	11			
Table 4-7	Traceability Level Recommendations for IPC Product Class 3 (Space/Defense/Medical) .....	11			

---

Table 5-35	Packing and Shipping Traceability Cell .....	24	Table 5-44	Process Maintenance Traceability Cell .....	27
Table 5-36	Process Deviations Traceability Cell .....	25	Table 6-1	Packages External Traceability Cell .....	28
Table 5-37	Labeling Traceability Cell .....	25	Table 6-2	Packages Unique ID External Traceability Cell .....	28
Table 5-38	Printed Board Etching Process Traceability Cell .....	25	Table 6-3	Material Information External Traceability Cell .....	29
Table 5-39	Printed Board Oxide Process Traceability Cell .....	25	Table 6-4	Process Information External Traceability Cell .....	29
Table 5-40	Printed Board Plating Process Traceability Cell .....	25	Table 6-5	Process Owner External Traceability Cell .....	30
Table 5-41	Printed Board Developer Process Traceability Cell .....	26	Table 6-6	Event Location External Traceability Cell .....	30
Table 5-42	Other Printed Board Wet Process Traceability Cell .....	26	Table 6-7	Data Creator Access Rights .....	33
Table 5-43	Exceptions Traceability Cell .....	26	Table 6-8	Data Consumer Access Rights .....	33

This Page Intentionally Left Blank

---

# 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. 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.