

# IPC-1782A

2020 - November

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

Supersedes IPC-7321

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 publication 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

Currently in preview, click buy full version

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.	Th. Nguyen, Lockheed Martin Missile & Fire Control
Chris Butler, Analog Technologies Corporation	Ife Hsu, Intel Corporation	Jan Pedersen, Elmatica AS
Radu Diaconescu, Swissmic	Constantin Hudon, Varitron Technologies Inc.	Ray Prasad, Ray Prasad Consultancy Group
Don Dupriest, Lockheed Martin Missiles & Fire Control	David Huntley, PDF Solutions	David Reichert, DuPont
Bradley Fern, Entrust Datacard Corporation	Robert Kinyanjui, John Deere Electronic Solutions	Jake Sedlock, Alitheon
Michael Ford, Aegis Software	Nick Koop, TTM Technologies	Aimee Siegler, Benchmark Electronics Inc.
Curtis Grosskopf, IBM Corporation	Craig Lax, Septillion Technologies	
	Thomas Mantschffel, ASM (Assembly Systems)	
	Griffith & Co. KG	

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

This Page Intentionally Left Blank

Currently in preview, click buy full version

# Table of Contents

<b>1 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 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 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 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 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

5.4.3 Packing and Shipping Material Traceability Cell ..... 17

5.4.4 Label Material Traceability Cell ..... 17

5.4.5 Hazardous Substance Cell ..... 17

5.4.6 Material Test Cell ..... 17

5.5 Process Traceability Data Cell ..... 18

5.5.1 Common Process Traceability Data Cell ..... 18

5.5.2 Unique Process Traceability Data Cell ..... 18

5.6 Process Maintenance Cell ..... 27

**6 EXTERNAL TRACEABILITY (SECURE SUPPLY CHAIN) ..... 27**

6.1 Supply Chain Event ..... 27

6.1.1 Event Types ..... 28

6.1.2 Packages ..... 28

6.1.3 Unique ID ..... 28

6.1.4 Material Information ..... 29

6.1.5 Process Information ..... 29

6.1.6 Asset Owner ..... 29

6.1.7 Process Owner ..... 30

6.1.8 Event Location ..... 30

6.1.9 Event Processing Tasks ..... 30

6.2 Secure Supply Chain Database ..... 31

6.2.1 Database Structure ..... 32

6.2.2 Access to External Traceability Data ..... 32

**APPENDIX A Acronym Index ..... 34**

**Figures**

Figure 1-1 Typical Supply-Chain ..... 2

Figure 5-1 Traceability Cell Structure ..... 12

Figure 6-1 The Secure Supply-Chain Elements ..... 27

Figure 6-2 Architecture of External Traceability Data In The Secure Supply Chain Database ..... 32

**Tables**

Table 3-1 Typical Risk Assessment Matrix ..... 6

Table 4-1 Internal Traceability Levels ..... 8

Table 4-2 External Traceability Levels ..... 10

Table 4-3 Traceability Levels to IPC Product Classification System Matrix ..... 10

Table 4-4 Traceability Level Recommendations for IPC Product Class 1 ..... 10

Table 4-5 Traceability Level Recommendations for IPC Product Class 2 ..... 11

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 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

Table 5-2 Assembly Cell Material Traceability ..... 14

Table 5-3 Assembly Cell Process Traceability ..... 14

Table 5-4 Work-Order Information Cell Process Traceability ..... 15

Table 5-5 Bill of Materials Cell Traceability ..... 15

Table 5-6 Materials Traceability Cell ..... 16

Table 5-7 Unique Material/Subassembly Traceability Cell ..... 16

Table 5-8 Software/Firmware Material Traceability Cell ..... 16

Table 5-9 Packaging and Shipping Material Traceability Cell ..... 17

Table 5-10 Label Material Traceability Cell ..... 17

Table 5-11 Common Process Traceability Cell ..... 18

Table 5-12 Common Process Traceability Cell ..... 18

Table 5-13 Product Routing Station, Printed Board Flip/Turn, Storage Rack/Waiting Area Traceability Cell ..... 19

Table 5-14 Screen Printer Traceability Cell ..... 19

Table 5-15 Automated Paste Inspection Traceability Cell ..... 19

Table 5-16 Glue Dispenser Traceability Cell ..... 19

Table 5-17 SMT Placement Traceability Cell ..... 20

Table 5-18 Pin Through-Hole Insertion (Automated and Manual) Traceability Cell ..... 20

Table 5-19 Manual Printed Board Assembly Traceability Cell ..... 20

Table 5-20 Reflow Traceability Cell ..... 21

Table 5-21 Wave Solder/Selective Solder/Wash Traceability Cell ..... 21

Table 5-22 Manual Visual Inspection Traceability Cell ..... 21

Table 5-23 Automated Optical Inspection (AOI) and X-Ray Inspection Traceability Cell ..... 21

Table 5-24 In-Circuit Test (ICT) Traceability Cell ..... 22

Table 5-25 Press-Fit Operations Traceability Cell ..... 22

Table 5-26 Touch-Up Operations Traceability Cell ..... 22

Table 5-27 Encapsulation Traceability Cell ..... 22

Table 5-28 System/Sub/Final Assembly (Mechanical Assembly by Robot or Manually) Traceability Cell ..... 23

Table 5-29 Software/Firmware Programming Traceability Cell ..... 23

Table 5-30 Quality Assurance Check/Test/Inspection Traceability Cell ..... 23

Table 5-31 Repair/Rework Station Traceability Cell ..... 23

Table 5-32 Functional Test (FT) Traceability Cell ..... 24

Table 5-33 Burn-In/Extended Test Traceability Cell ..... 24

Table 5-34 Shipping/End-User/Post-Manufacturing Environment Test Traceability Cell ..... 24

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

Currently in preview, click buy full version

---

# 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.