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IPC-4811

Specification for Embedded Passive Device Resistor Materials for Rigid and Multilayer Printed Boards

IPC-4811

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A standard developed by IPC

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Developed by the Embedded Component Materials Subcommittee (D-52)
of the Embedded Components Committee (D-50) of IPC

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

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Foreword:

IPC-4811 was developed based on industry knowledge at the time. Embedded passive devices may be made with a large variety of materials and cover a wide range of fabrication processes. At the time of writing this specification, use of these materials was not widespread. As such, it is anticipated that updates to this document will be needed in the future. In the meantime, the customer and supplier should work together to set the criteria for acceptance of embedded passive material products.



Acknowledgment

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Specification for Embedded Passive Device Resistor Materials for Rigid and Multilayer Printed Boards

1 SCOPE

This document describes materials that can be used for the fabrication of embedded resistor devices within the finished printed circuit board substrate. It provides information on general classifications and associated characteristics of embedded passive device (EPD) materials. This document **shall** be used as a qualification and conformance standard for designers and users when designing or constructing printed circuit boards containing EPD materials. For this document, embedded passive devices and the phrase embedded passives are considered to be equivalent.

This document contains embedded resistor material designation, conformance (requirements), qualification (characterization) and quality assurance specifications. IPC-4811 should be used in conjunction with IPC-2000 series design standards and IPC-6010 series qualification and performance standards.

Embedded capacitor material designation, conformance (requirements), qualification (characterization) and quality assurance specifications are contained in IPC-4821.

1.1 General This document covers the requirements for resistive materials that are used with conventional core materials for the manufacture of printed circuit boards containing embedded resistor functionality. Figures 1-1a & b show representations of how embedded resistors may appear in a PWB. The embedded resistor material spans the opening between conductors. The opening between conductors may actually be any shape. Figures 1-1a & b show a rectangular shape to the resistor material but other shapes are common such as serpentine, top-hat, and annular.

Embedded passive materials have advantages over typical leaded and surface mount passives such as:

- Embedded passives are used to enhance high speed, high frequency performance.
- Embedded passives are used to increase circuit density and simplify design of circuitry features such as decoupling capacitance and terminating resistors.
- Embedded passives are used to simplify assembly by mounting fewer components, thereby increasing functionality and/or reducing total board area.

1.2 Designation System The following system identifies materials used for EPD resistor structures. This is a general identification system and does not in any way imply that all the permutations of properties and forms exist. See the series of specification sheets at the end of this document

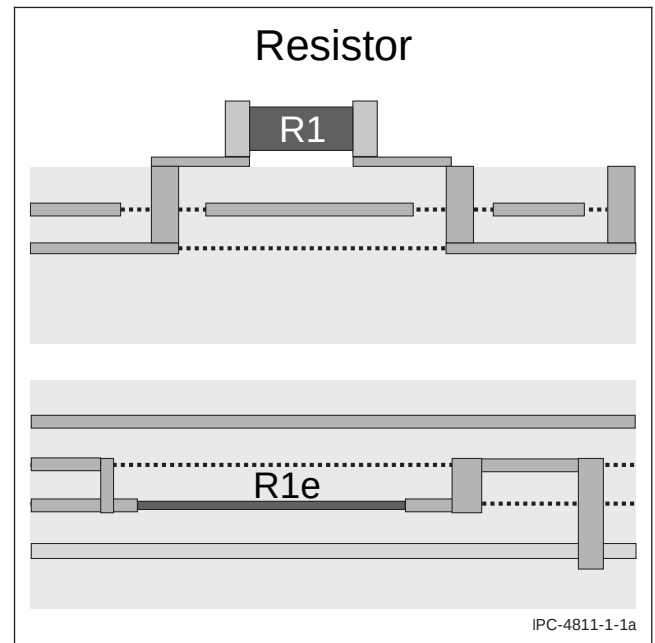


Figure 1-1A Embedded Passive Resistor Saves Valuable Surface Real Estate

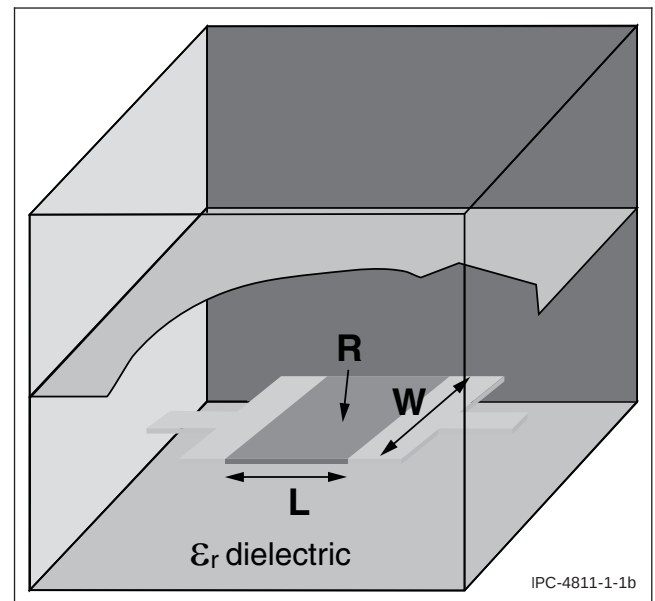


Figure 1-1B Embedded Resistor (R) Defined by Number of Squares = [Length (L) / Width (W)]

for the specific materials available. Each specification sheet outlines engineering and performance data for materials that can be used to manufacture printed boards incorporating EPD resistor materials. These materials include thin film resistor layers supplied as laminate, material applied to conductor foil, high and low viscosity pastes, and printing

chemistry combinations. The specification sheets are provided with letters and numbers for identification and ordering purposes. For example, a user wishing to order from specification sheet 1 would substitute the number “1” for the “S” in the designation examples (i.e., IPC-4811/1) shown in 1.2.1 through 1.2.3. To start the ordering process, one can use the specification sheets in this document in combination with relevant IPC documents for each material set (i.e., IPC-4101, IPC-4104, IPC-4562 or IPC-4563).

The materials contained in this standard represent general material categories. As new materials become available, they will be added to future revisions. Users and material developers are encouraged to supply information on new materials for review by the IPC Embedded Component Materials Subcommittee (D-52). Users who wish to invoke this specification for materials not listed **shall** list a zero for the specification sheet number (IPC-4811/0).

The committee may approve new or revised specification sheets independent from revision of the document text. When this occurs, the new or revised specification sheet **shall** be printed and made available through IPC-4811. The effective date of the new or revised sheet **shall** be clearly indicated on the individual sheet. Specification sheets **shall** be transferred from IPC-4811 to the appropriate parent document whenever that document is revised.

Because there are embedded capacitor and inductor materials specified in other documents, the designation system recognizes them by using a first level of designation as shown in Level 1 below.

The first level of the designations system is the passive device type.

Level 1: Passive device type

Capacitor = C
Resistor = R
Inductor = L

(**Note:** For purposes of this specification only Level 1 “R” materials are included.)

Table 1-1 illustrates the designation system for the resistor device types. The remaining designation levels are listed in 1.2.1.

1.2.1 Resistor Passive Device Designations

- Level 1 Passive Type = R
- Level 2 Form of Resistor Material
Sheet = 1
Paste = 2
Liquid = 3
Other = 9
- Level 3 Chemistry
Metal Film = A
Ceramic = B
Conductive Polymer = C
Organometallic = D
Conductive particles in Organic Matrix = E
Other = O
- Level 4 Termination (Conductor) Type (For the two terminations of the resistor the lowest will be considered Termination #1 and the second number will be considered Termination #2. For example, the level 4 designation of 1/2 signifies that one termination is copper foil and the other is a copper particle paste.)
Termination #1
Copper foil = 1
Copper Particle Paste = 2
Silver finish = 3
Silver Particle Paste = 4
Other Particle Paste = 5
Transient Liquid Phase Sintering = 6
Organometallic = 7
Conductive Polymer = 8
Other = 9
- Level 5 Encapsulant Chemistry
Organic = A
Inorganic = B
Mixed = C
None = N

2 APPLICABLE DOCUMENTS

The following documents of the issue in effect at the time of order form a part of this specification to the extent specified herein. If a conflict exists between IPC-4811 and the listed applicable documents, IPC-4811 **shall** take precedence.

Table 1-1 Sample Resistor Passive Device Designation

IPC-4811	Level 1	Level 2	Level 3	Level 4	Level 5
4811/S	R	1	A	1/1	N
Where S is specification (slash) sheet number	Passive Type	Form of Resistor Material	Chemistry	Conductor Type	Encapsulant

Example: The sample from Table 1-1 **shall** be written as R 1 A 1/1 N.

Note: The letter “X” **shall** be entered into the designation where an item is not specified and does not matter.