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Sectional Design Standard for High Frequency (RF/Microwave) Printed Boards

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Sectional Design Standard for High Frequency (RF/Microwave) Printed Boards

Developed by the High Speed/High Frequency Design Subcommittee (D-21) of the High Speed/High Frequency Committee (D-20) of IPC

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

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Sectional Design Standard for High Frequency (RF/Microwave) Printed Boards

1 SCOPE

This standard establishes the specific requirements for the design of rigid, flexible and rigid-flexible printed boards utilizing radio frequency (RF) and/or Microwave circuity and/or high frequency laminates where RF transmission lines and related passive metal layers are considered as distributed circuits, instead of conventional lumped circuit elements. This standard is used to support product typically requiring materials meeting the requirements of IPC-4103 and fabricated to the requirements of IPC-6018.

1.1 Purpose The requirements contained herein are intended to establish specific design details that **shall** be used in conjunction with IPC-2221 to produce designs intended to mount and attach components. The components may be through-hole, surface mount, fine pitch, ultra-fine pitch, array mounting or unpackaged bare die.

The base organic materials used may be homogeneous, reinforced, or used in combination with inorganic materials; the interconnections may be on single layers, double layers, or multilayered conductors. They may be any combination able to perform the desired physical, thermal, environmental, and electronic functions.

It is incumbent upon the printed board design engineer to work with material suppliers and to initiate a dialogue with a fabricator who has experience with specialty materials and fabrication processes required for manufacturing RF/Microwave designs. The designer should solicit feedback regarding producibility of design attributes to ensure design intent is achievable.

1.2 Document Hierarchy Document hierarchy **shall** be in accordance with the generic standard IPC-2221.

1.3 Presentation Presentation **shall** be in accordance with the generic standard IPC-2221.

1.4 Interpretation Interpretation **shall** be in accordance with the generic standard IPC-2221.

1.5 Definition of Terms The definition of all terms used herein **shall** be in accordance with IPC-T-50 and as defined herein.

1.5.1 Anisotropy The condition for a substance having differing values for properties, such as permittivity, depending on the direction within the material. Isotropy describes the case where a property is the same in all directions. Isotropy may exist in non-crystalline homogeneous (single phase) substances. In a microwave laminate based on a polymer composite, anisotropy of the dielectric layer exists.

1.5.2 Directional Coupler A device or structure which causes some of the energy propagating along one transmission line to be transferred to a second transmission line so that most of the transferred energy propagates in a specific direction along the second line. The other direction is considered isolated. At lower frequencies this function can be accomplished in a design with lumped capacitive and inductive elements while at microwave frequencies two stripline or microstrip traces that run parallel to each other for a certain distance can serve the purpose. One use for such devices is to sample amplitude or phase of a signal traveling in a specific direction.

1.5.3 Directivity The difference between the isolation and the coupling values of a directional coupler.

1.5.4 Distributed Component An electrical component with dimensions greater than or on the order of the wavelength of the propagating signal. The reactive and resistive electrical characteristics of such a component are said to be distributed.

1.5.5 Ground-to-Ground-Spacing Distance between ground planes in a stripline circuit.

1.5.6 Ground-to-Signal-Spacing Distance between ground and signal planes or conductors in a transmission line.

1.5.7 Impedance A measure of the opposition to the flow of alternating current in a circuit, equal to the ratio of the RMS electromotive force in the circuit to the RMS current produced by it. Impedance is usually represented in complex notation as $Z = R + jX$, where R is the ohmic resistance, X is the reactive, either inductive or capacitive, and j is $\sqrt{-1}$.

1.5.8 Lumped Circuit elements that are not distributed.

1.5.9 Open Circuit A high impedance condition that ideally exhibits 0 dB return loss and a reflection coefficient of 1.0.

1.5.10 Static Relative Permittivity The ratio of the capacitance (C_X) of a given configuration of electrodes with a specified dielectric, filling all the region of electro potential field, to the capacitance (C_V) of the same electrode configuration with a vacuum (or air) as the dielectric.