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Precision Coaxial Connectors for CATV Application (75 Ohms)

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(From Standards Proposal No. 2209 formulated under the cognizance of the EIA P-5.3 Subcommittee on R.F. Connectors.)

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PRECISION COAXIAL CONNECTOR FOR
CATV APPLICATION (75 OHMS)

FOREWORD

Members of the P-5.3.1 Working Group have long known the need for the provision of accurate impedance standards in 75-ohm coaxial measurements. These standards will be necessary for the qualification of the connectors, standards for which are now being prepared by P-5.3.1. The only practical means for obtaining these standards is by constructing them with precision coaxial connectors. This opens the door for more precise instrumentation and for certification by the National Institute of Standards and Technology. Precisely calibrated adaptors shall therefore permit conclusive qualification and testing of the field connectors to be specified in forthcoming P-5.3.1 standards documents. The precision connector facilities will also permit conclusive calibration of the various equipment and components employed in the communication industry.

The purpose of this standard is to describe the requirements for the precision impedance standards to be specified for 75 Ohm coaxial measurements in standards for R.F. connectors.

1. PART I

1.1 GENERAL REQUIREMENTS AND DEFINITIONS

1.1.1 MECHANICAL

1.1.1.1 Types of Precision Connectors.

In each coaxial line size, two types of precision connectors shall be specified: 1) a general precision connector (GPC) having a self-contained dielectric support, and 2) a laboratory precision connector (LPC) using only air dielectric. The laboratory precision connector shall be used where the electrical length and characteristic impedance of the connector must be known to the highest accuracy. Provision shall be made for support of the center conductor of a laboratory precision connector.

1.1.1.2 Connector Sex.

The connector shall be "sexless," except for the inner conductor of the LPC. Any two connectors of the same line size shall be capable of being mated to each other without adapters, or to any other connector of the same line size.

1.1.1.3 Mechanical and Electrical Joining Plane.

The contact surfaces of a mated pair of connectors must join in the same mechanical plane. The mechanical plane must also be coincident with the electrical reference plane.

1.1.1.4 Coupling Mechanism.

A standard coupling mechanism shall be specified for each coaxial line size.

1.1.1.5 Mating with 50-Ohm Counterpart.

In a given line size the 75-ohm GPC must mate nondestructively with the 50-ohm GPC.

1.1.1.6 Components Captive to the Connector.

All components of the general precision connector shall be captive to the connector. The coupling mechanism of both types of connectors (GPC and LPC) shall be detachable.

1.1.1.7 Protection of Butting Electric Surfaces.

Provision shall be made to protect the unmated butting electric surfaces.

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1.1.1.8 Subjection to Axial Forces and Bending Moments.

During and after mating the front-end butting electrical surfaces of the inner conductors of the general precision connector shall be subjected to axial forces only. The general precision connector inner-conductor dielectric support must withstand specified axial forces and bending moments*. The coupling mechanism must withstand the application of the specified axial force and bending moment applied to the outer conductor without exceeding specified limits of standing-wave ratio, insertion loss and leakage.

1.1.1.9 Mating to Transmission Line.

The interface to the rigid line, to which the connector is to be installed, shall be specified. To connect the rear of the connector to a transmission line, the manufacturer of the connector shall supply a drawing showing the form, dimensions, tolerances, recommended materials and finishes for the mating portion of the transmission line.

*Note that the document does not require that the inner conductor be keyed to the outer conductor through the dielectric support to prevent possible rotation.

1.1.2 ELECTRICAL

1.1.2.1 Reflection Coefficient Magnitudes, $|S_{ii}|$.

The reflection coefficient magnitude of a mated connector pair, relative to the nominal characteristic impedance (75-ohms) of a coaxial line, shall not exceed limits specified over the frequency range of the line size. After the connectors are rotated (axially) with respect to one another, the reflection coefficient shall not exceed the specified limits.

Note: The SWR of the connector pair is related to $|S_{ii}|$ as follows:

$$SWR = \frac{1 + |S_{ii}|}{1 - |S_{ii}|}$$

The scattering parameters are described in the Appendix.

The measurement error shall not exceed 30 percent and the imprecision shall not exceed 10 percent of the specified reflection coefficient.

1.1.2.2 Repeatability.

The repeatability, defined as the change in specified characteristic of the connector for a given connect-disconnect sequence, shall be specified as follows. The repeatability shall not exceed the specified values, for:

(a) Reflection Coefficient Magnitude, $\Delta |S_{ii}|$.

(b) Reflection Coefficient Phase, $\pm \Delta / S_{ii}$

Average with connector pair terminated with open and short circuit.

(c) Insertion Loss Magnitude, $\Delta |S_{ij}|$.

(d) Insertion Phase, Δ / S_{ij} .

1.1.2.3 Insertion Loss.

The insertion loss of a mated connector pair shall not exceed specified limits over the frequency range of the coaxial line size. The insertion loss is defined as the attenuation of a connector pair when inserted into a 75-ohm measurement system.

1.1.2.4 Direct-Current Contact Resistance.

The direct-current resistance of the inner- and outer-conductor joints of a mated connector pair shall not exceed their respective specified limits.

1.1.2.5 Radio-Frequency Leakage.

The leakage shall not exceed specified limits. See Figure 1 for leakage equations and a sketch of the measurement cavity.

1.1.2.6 Electrical Length.

The tolerance limits for the electrical length of a mated connector pair in air shall be specified as a function of frequency at the specified operating environmental conditions.

1.1.2.7 Characteristic Impedance.

The inner and outer conductors used in constructing a general precision connector shall have diameter and eccentricity tolerances such that the most adverse tolerance combination shall not cause an error in the nominal characteristic impedance of more than ± 0.2 percent for connectors with an outer-conductor inside diameter larger than 10 millimeters and ± 0.4 percent for connectors with an outer-conductor inside diameter less than 10 millimeters.

The inner and outer conductors used in constructing a laboratory precision connector shall have diameter and eccentricity tolerances such that the most adverse tolerance combination shall not cause an error in the nominal characteristic impedance of more than ± 0.1 percent for connectors with an outer-conductor inside diameter larger than 10 millimeters and ± 0.2 percent for connectors with an outer-conductor inside diameter less than 10 millimeters.