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Improving Measurement Accuracy for High Frequency RF Connectors

Abstract
Improving the accuracy of your microwave test and measurement equipment becomes increasingly important when high frequency devices are used in the transmission paths of radio, cellular, satellite and digital communications. This discussion helps to solve problems with measurement errors during and after calibration of your microwave test instrument.

Introduction
The wireless communication industry is a giant compared to the early 1980s when analog cellular was all the rage. The advent of digital communications and cellular phones, as well as the infrastructure around it, from mountain top base stations to satellite links, has driven designers to create RF connector products that will meet the demands of increasing electrical performance specifications. RF Precision Products employs engineers with diverse backgrounds in RF connector design. Their design and manufacturing knowledge base includes precision connectors and adapters, coaxial cable assemblies, medical cable assemblies and wireless digital spread spectrum modems. With the latest in design software at their disposal, they ensure that all products meet or exceed customer expectations. These high frequency products need to be verified to performance parameters specified by the design engineer or to customers' specifications. The need for test and measurement equipment that ensure products meet or exceed these expectations is a necessary expense. A Network Analyzer is a microwave test set that is used to characterize an RF device. Network analyzers will transmit a signal or a band of signals through active or passive devices and then project the complex impedance, magnitude and phase onto the analyzer's on-board display.

Some network analyzers have measurement ranges that exceed 100 GHz. The need for measurement accuracy becomes more critical at frequencies above 1 GHz. The test set up and calibration is the most important factors for error corrected measurements when frequencies increase exponentially. Network analyzers were primarily designed to measure insertable devices where one port would have a plug (male) connector and the other port would have a jack (female). During the through[1] transmission step in the calibration procedure, the two ports are connected via test port cables. Challenges exist when testing adapters or cable assemblies with connector ends that do not attach directly to the test ports on the network analyzer.

What is a non-insertable device?
A non-insertable device is a product with interconnecting ends that differ from the analyzer's test port connectors. (Fig.1) They may have the same gender or they may have connectors with differing families, also known as "between-series". In each case, the device under test (DUT) you are attempting to connect to your network analyzer will introduce errors in the measurement plane due to the inability to remove these errors during calibration. With the proliferation of the latest in network analyzer technology, enhanced calibration methods for measuring non-insertable devices were introduced and integrated into the analyzer's software/firmware. Most analyzers today have detailed instructions built into the calibration menus that describe the set up and calibration steps necessary to include error correction for these types of devices. The menus also include instructions for fixed mechanical calibration standards and electronic (Ecal) modules.