

# RF Connector Myths You Need to Know

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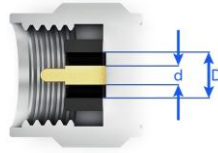
Often the most overlooked part of any RF measurement is the high-frequency interconnections, including connectors, cables, and adapters. In this article, we will refer to the entire family as RF connectors. By exploring misconceptions about RF connectors, we can improve the overall quality of our RF measurements.

To that end, let's dispel a few common myths about RF connector care:

## **Myth #1: Connectors last forever.**

- In actuality, even the best-made, most expensive connectors have a finite lifetime.
- RF connectors should be inspected regularly and disposed of when wear begins to affect measurements. Back in the day, it was recommended that damaged or worn connectors be repaired or replaced. At the same time, people with the skills to repair connectors are few and far between.
- And though the attempt may be admirable, an untrained person's attempt to repair a connector usually causes more damage.
- As a result, it is strongly recommended that worn or damaged connectors be thrown away. They are disposable.

## Myth #2: Dimensions don't matter.

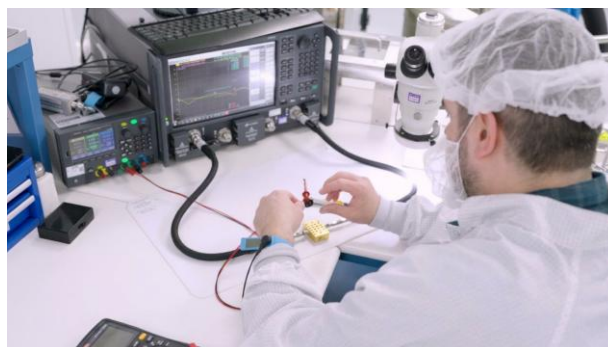


- Matching the impedance is essential to the performance of RF connectors.
- The number one factor that determines the impedance (at high frequencies) of an RF connector (or any RF device, for that matter) is its mechanical dimensions.
- For instance, the ratio of the radius of the inner and outer conductors determines the impedance of a coax cable.
- Firmly zip-tying a group of coaxial cables together, tight radius bends, 90-degree connectors, and an excessive amount of through-hole vias in an RF PCB are examples of unintentionally altering the dimensions and hence the impedance.
- Further, 50- and 75-ohm connectors used interchangeably will result in a poor connection or damage to the center pin or both.
- Not to mention the inherent, loose, inexact fit of BNC and F connectors. All are examples of poor mechanics that cause impedance changes, resulting in significant measurement errors.

## Myth #3: If tight is good, then tighter is better.

If you work in an RF environment long enough, you will find examples similar to these...or they will find you.

- Locking pliers to secure an RF cable to a network analyzer, resulting in thousands of dollars of damage, not to mention downtime. The old “finger tight plus a quarter turn” may have a place in auto mechanics lore, but not in RF test and measurement. Hopefully, you have the appropriate torque wrench that is periodically calibrated for the connector type in use. And, if you have the misfortune of not having such a torque wrench, finger tight is better than over tight. It's not a policy to endorse, but it will keep your connectors safe in a pinch.
- And remember, if you connect a damaged connector to a good connector, you end up with two damaged connectors.



#### **Myth #4: I don't have time to waste on regular maintenance.**

If you require excellent accuracy and repeatability, pay attention to this one:

- Periodic care and maintenance of RF connectors help extend their lifespan (see myth #1) and provide more consistent, repeatable measurement results. So, inspect and clean connectors regularly. Not with soap and water or off-the-shelf rubbing alcohol (usually 30-50% water). Instead, 100% isopropyl alcohol works well. Cotton swabs tend to hang on coaxial center pins, so use foam swabs and/or a lint-free cloth. After cleaning, periodically gauge your connectors, followed by a thorough visual inspection.
- Remember, changes in geometry can result in changes in impedance, connector damage, or both.
- Keep your torque wrenches, connector gages, and other precision RF tools well-maintained, in a safe place, and know how to use them.

#### **Myth #5: I can cascade RF connectors as a workaround.**

- When connecting RF Device-A to RF Device-B, it is not okay to cascade as many adapters as needed to match the required connector types. For instance, Device-A is N-type....N-type to SMA...SMA to 2.4mm....2.4mm to APC-7....APC-7 to 3.5mm....Device-B is 3.5mm. In this example, it is best to use a high-quality N-type-to-3.5 mm adapter to connect Device-A to Device-B. Even if these are all of the best quality, they are not perfect.
- The measurement errors will add up, resulting in poor accuracy and poor repeatability.
- Minimizing the number of RF connectors required to make a connection is essential.

#### **Myth #6: Vocabulary doesn't matter.**

- How we describe the performance of RF circuits is essential to ensuring the information is properly communicated.
- Accuracy, resolution, linearity, stability, uncertainty, and traceability are important parameters to consider when making RF measurements. For instance, accuracy is an instrument's ability to measure the actual value within a stated error specification. This implies that any statement of accuracy is incomplete without being accompanied by error limits, such as "+/-2 dB".
- Further, care should be taken to avoid confusing similar terms. For instance, stability can describe short-term or long-term drift.
- High resolution does not assure high accuracy. Regardless of how many digits are provided on the instrument display, it guarantees nothing about the actual resolution of the measurement. Put another way, a 10-digit display is not the same as 10 digits of resolution.

## Myth #7: All connectors are the same.

- Connectors can be categorized into three grades: production, instrument, and metrology, from lowest to highest quality, respectively.
- The SMA is compatible with the 3.5mm. However, SMA is only made in production grade, while 3.5mm is available in all three grades.
- N-type is available in all three grades. And a production-grade N-type connector usually has a circular rubber gasket between the outer shield and outer mechanical ring.
- Even within a grade, there are differences in quality and performance. So always choose the appropriate connector for your needs. Is the shielding smooth and bright? Is it of quality construction? Is the knurling sharp and clean? Is the dielectric in good shape? What are the requirements of my measurement? A proper visual inspection will reveal much about the connector quality.



## Myth #8: I can save money by spending less on RF connectors.

- A chain is only as strong as its weakest link.
- This also applies to assembling RF systems. The cost of instrumentation, software and other components needs to be understood and balanced against the overall cost and performance requirements of the system.
- Overpaying for performance that isn't needed or underpaying for performance that is required can lead to poor budgeting and inconsistent results.
- The cost/performance of the RF connectors should be considered with equal weight to other major components of the system.

- RF connector care plays a significant role in assuring quality, consistent RF measurements. Careful attention to best practices helps dispel these myths and ensures optimal performance of RF connections.

Finally, avoiding these RF connector myths relies on your own reason and common sense. Following best practices will result in better, more consistent results.

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