RF/Microwave Coaxial Connector Care

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1. How Important Is Connector Care?

An RF/Microwave measurement is only as good as the connections made in that measurement. Cleanliness and careful handling of RF/Microwave coaxial connectors are critical for making repeatable and reliable measurements.

2. Interface Cleanliness

2.1 Clean interfaces prolong connector life and produce more accurate, repeatable measurements. The use of connector end-caps to protect test cables, passive devices, and adapters when not in use is recommended.

2.2 Inspect connectors for dirt before they are to be mated to one another. Dirt may be found in the connector threads as well as the actual mating surfaces. The accumulation of dirt can change the capacitance of a connector, thus leading to poor repeatability and/or an adverse change in SWR.

2.3 What is dirt? How do connectors get dirty? Factors that contribute to a dirty connector include airborne contaminants, metal shavings, and skin oil.

2.4 Don't "borrow" adapters from calibration kits. These types of kits were designed for use with specific suites of test equipment or standards. They are not for "general lab use."

3. Cleaning the Connector Interface

3.1 Solvents: Connector insulators, dielectrics, support beads, and seals are susceptible to solvent damage. Solvents can produce permanent physical and electrical damage. Distilled alcohol is recommended for cleaning interfaces. It should be noted that connector interfaces should not be immersed in solvents of any kind because solvents can become trapped within the connector assembly. Trapped fluids can cause SWR, phase, and insertion loss problems. Do not use chlorinated solvents, particularly those packaged in pressurized cans. These solvents are extremely penetrating and sometimes may ruin otherwise good devices.

3.2 Applicators: Fibrous or abrasive applicators may contaminate and even damage interface surfaces. Clean lint-free swabs should be used. They need to be sharp enough and hard enough to remove dirt and debris without damaging surfaces and/or dislodging center pins.

3.3 Method: Dip a clean lint-free swab in clean distilled alcohol. Press excess alcohol out of swab on a clean lint-free towel. Wipe the interface components as required to clean the interface. Don't forget to clean the connector threads – they may be the source of the problem. When satisfied that the interfaces are clean, blow them dry with dry compressed air or, preferably, dry nitrogen (pressurized spray cans work well). Do not use your breath – it is moisture-laden. Moisture leads to corrosion and alcohol absorbs moisture. Re-inspect the connector to verify that the interface is clean and ready for additional inspection procedures and interface dimension gauging prior to use.

4. Connector Mating Surface Dimensions

4.1 Always ensure that connectors meet proper mating specifications prior to use. There are several schools regarding mating dimensions – be sure you comply with your particular governing body.

5. Initial Connector Mating

5.1 Never attempt to mate connectors before first aligning their center pins when applicable. Because of necessary play in the coupling mechanism, it is often possible to mate connectors when the pins are not aligned. This may result in bent pins, broken female pin segments, or destroyed dielectrics.

5.2 Depending on the connector type, you often can feel whether or not the pins are aligned. If the nut is difficult to turn, it may be due to one of the following problems:

- The pins are not aligned.
- The connectors are cross-threaded.
- The connector (or its mate) has been damaged by excessive torque.

5.3 Stop and determine the reason. You may destroy the assembly and/or the mating connectors if one of these conditions exists.

5.4 Never hold a coupling nut stationary while screwing body of its mate into it. This will ultimately destroy both connectors. This rotation wears away plating and scores both the outer interface rim and the pin. If the pins lock together, serious damage can occur within the device and/or the assembly. Also, rotation of the connector body transfers unwanted torque to the cable assembly. This is a very common form of damage, since it seems like a natural way to mount an adapter to an assembly.

6. Connector Torque

6.1 Always use a torque wrench that is permanently set to the correct torque to mate a connector with flat sides. Tighten slowly until the wrench 'snaps.' (Fast tightening overrides the torque-limiting capability of the wrench.) To avoid over-torquing, do not snap the wrench more than once.

6.2 To mate connectors with knurled nuts, use only your fingers. Never use pliers to tighten any connector.

6.3 Depending on the connector, over-torque may cause damage to connectors in a variety of ways:

- Mushroomed outer interface shells
- Mushroomed pin shoulders
- "Birdcaged" female pin
- Recessed or protruding pins
- Recessed or protruding dielectrics
- Bent pins
- Chipped plating
- Damage to the coupling nut retaining ring
- Damage to connector threads

6.4 When a connector has been over-torqued or otherwise damaged, it damages every connector to which it is mated. In most cases, it also causes poor system performance, erroneous data, etc.

7. How to Deal With Stuck Connectors

7.1 The female-to-female SMA adapter can be the cause of stress and dread in the microwave laboratory. Why? It tends to get stuck. The Figure 1 photo of a "bullet" illustrates the problem. It doesn't have a useful place to grip it with a wrench – just two tiny flat spots. Notice the damaged threads due to a helpful person that used pliers to remove it. This connector will damage every male connector that it mates with – and get stuck every time it is used.

7.2 To avoid this phenomenon, obtain adapters that can accommodate a wrench. One inexpensive answer is to buy a bulkhead-mount, female-to-female adapter (similar to the one shown in Figure 2). Such an adapter is designed to be used to pass signals through a panel. It makes a great adapter because of the hex nut built-in.

7.3 How do you deal with a stuck connector? You should have on hand a pair of soft-jaw pliers (sweetlips). You'll give a sigh of relief each time you remove a stuck connector without damaging it.

Figure 1. Threads Damaged by Pliers

Figure 2. Barrel Adapter with Hex Nut

Figure 3. 3.5-mm female connector with missing plating.

Figure 4. 7-mm connector with missing plating.

Figure 5. 7-mm connector with gouges.

Figure 6. Type-N female connector with missing pin segment.

Figure 7. Type-N male connector with pin wear.

8. Consequences

8.1 Figures 3 through 7 are photos of connectors that have been poorly cared for.

9. Effects of Connector Dimension on VSWR

9.1 An 8510C Vector Network Analyzer was the standard utilized to perform the VSWR measurements on the test instrument, in this case a Weinschel attenuator model 44-30. The tests were conducted on the male end of the connector.

9.2 Figures 8 through 12 show the resultant effects of the VSWR measurements as the connector dimension of the male end of the 44-30 attenuator is changed.

Conclusion

RF/Microwave coaxial components perform better, last longer, and provide more accurate, repeatable measurements when properly used and cared for.

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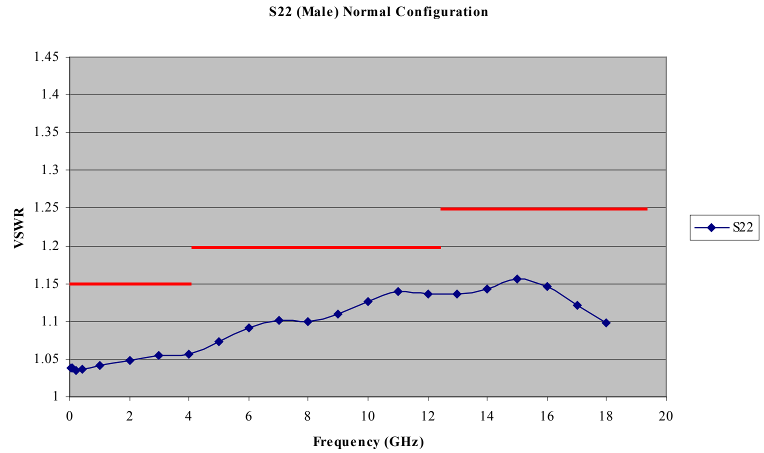

Figure 8. VSWR normal configuration.

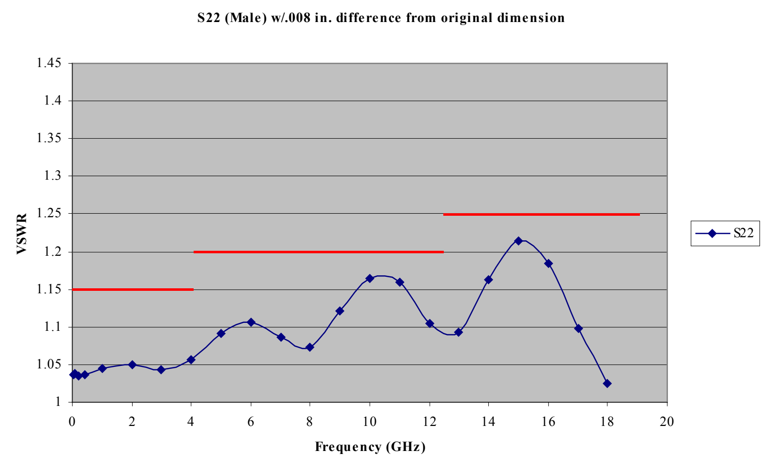

Figure 9. VSWR w/0.008 in. difference from original dimension.

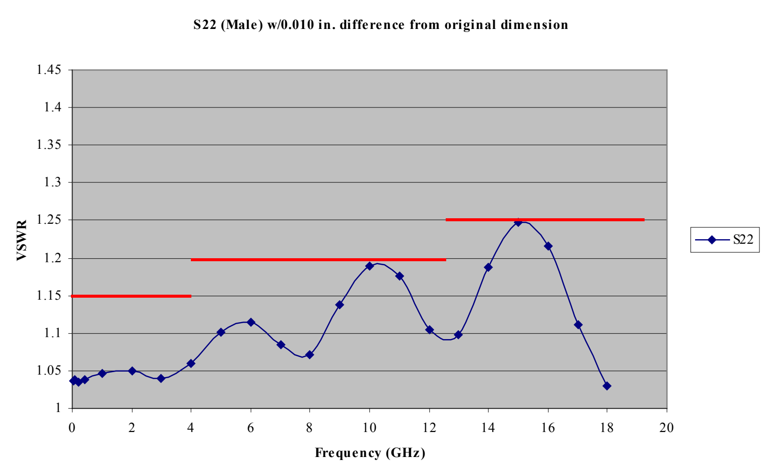

Figure 10. VSWR w/0.010 in. difference from original dimension.

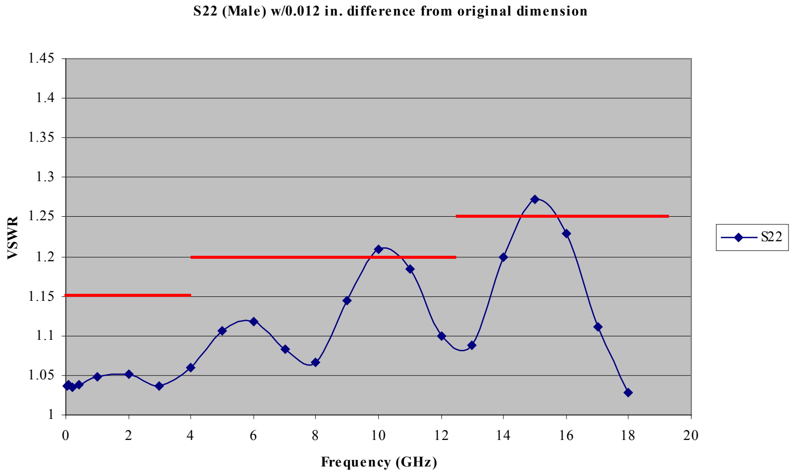

Figure 11. VSWR w/0.012 in. difference from original dimension.

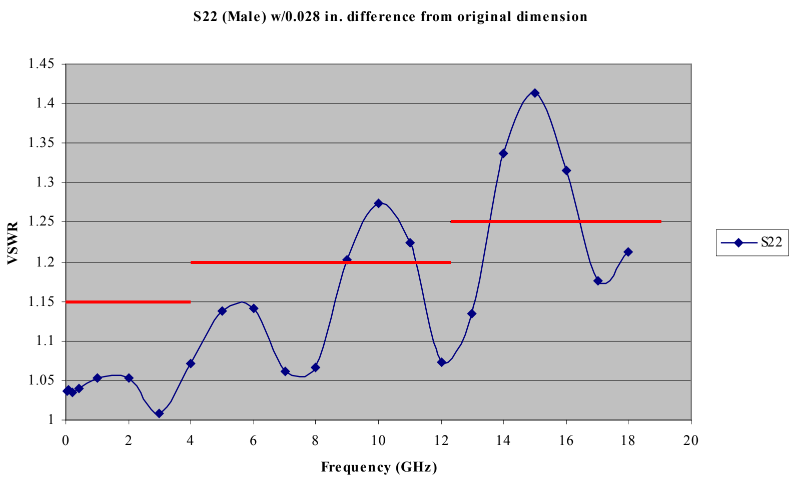

Figure 12. VSWR w/0.028 in. difference from original dimension.