Microwave Journal

QMA Connectors with Improved Frequency Response, Durability and Variety

Two years ago a major US maker of two-way radios approached Times with this request: "Can you produce a cost-effective, fast mating, durable, long-life coax connector that offers steady RF performance if a mated pair is physically stressed?" The application is a high volume radio production final test. It is a controlled environment.

Objectives such as these are common across many users and markets that deal with RF communications. Through the years many schemes have been tried, but the attributes sought were not easily embodied in one product. "Fast mating" usually meant compromising on RF stability. "Durable and long life" meant being cost effective was unlikely. Trade-offs on one or more of the desired traits was inevitable, until today.

Times Microwave took a fresh look at the request, reasoning a solution would have broad appeal. The strategy was to improve upon an existing mating interface to save time and cost, and because the industry has accepted it. Several coax connector series were considered, but all failed at least one major hurdle until the QMA. The QMA plug incorporates the push-on, pull-off coupling action one associates more closely with pneumatics. This makes operation intuitive and easily mastered. The potential for cross threading, the need for wrenches and torque specs are now a thing of the past.

This user was concerned with frequencies below 2 GHz. While the industry standard for QMAs is 6 GHz, its size makes it a good candidate for improved frequency response and thus potentially attractive to users whose products operate at higher frequencies.

Size also plays a role in durability and cost. BNCs (the current choice) are of poor quality, not durable and vary electrically when stressed. The QMA is a good compromise between the MCX series, which is too small and delicate for production test, and the much larger, heavier and more costly to machine Type N. Most coax connectors ultimately need to attach to coax cable. The QMA's size keeps material costs, machining time and attachment design complexity for most popular coax cables within reason.

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IMPROVEMENTS THAT MATTER

The first step was to improve durability to achieve a longer mating life for the QMA plug. The industry standard is 100 to 500 mates for OEM applications, beyond which (depending on manufacturer) the retention force of a mated pair is reduced to unacceptable levels. In this production test application 500 mates would be reached in a few days. Therefore, the smaller spring fingers or tines within the male were replaced with fewer, but larger heat-treated tines. A special plating and polishing operation results in a smooth coupling nut action that lasts for 5000 mates when properly used. ***Figure 1*** shows the un-plated, industry standard tines on the left, and the un-plated Times Microwave Systems new design on the right.

Tolerances were tightened in several areas within the interface and compensation dimensions changed to increase the frequency response to 18 GHz and still achieve a return loss better than 18 dB in the straight configuration and approximately 17 dB in right angle configuration (Type N—QMA plug equipped cable assembly plus a QMA jack—SMA plug adaptor mated together).

The new tine design requires more push-on force. There is a very distinctive "snap" when Times QMAs are mated. However, this solved another issue: RF measurement variations from lateral force or side load were eliminated or significantly reduced because a mated pair is held so tightly together. Well in excess of 20 lbs of pull force are required to pull a new pair apart if the coupling nut is not used to spread the tines before de-mating.

▲ *Fig. 1 The unplated industry-standard tines (right) and the unplated Times new design (left).*

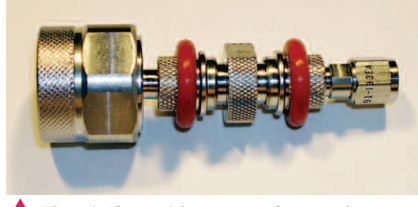
▲ *Fig. 2 The Times Microwave Systems' SureGrip coupling nut and its soft ergonomic ring.*

However, an unavoidable result was that a mated pair became very difficult to un-mate. To solve this problem, Times Microwave Systems developed its SureGrip™ coupling nut (see ***Figure 2***). Instead of smooth ridges it uses a sharp knurl. More importantly it employs a soft ergonomic ring. Together with the knurl it makes the coupling nut much easier to grip for retraction. Un-mating is now an easy task. The ring is quickly removed for tight, on-center applications, but a large machined ridge still exists that can be used to actuate the coupling nut.

Times Microwave Systems now offers both tine designs. Depending on the tine design, retentive force has been increased to over 40 lbs. Both carry the 5000 mate life cycle guarantee. Times QMAs will mate and un-mate 5000 times, remain within electrical specifications as stated on the data sheet and remain within a minimum of 2 lbs of retention force provided they are operated in accordance with recommendations. Should the need arise, Times designed a unique release tool to aid un-mating. It is compact to fit in tight areas. The double end fits various Times QMA adaptors.

Since this was a high volume production test application, Times Microwave Systems fitted the new, more robust QMA plug to its highly popular SilverLine series of RF and microwave test cables. SilverLine Test Cables are highly durable, very stable with flexure and cost effective. This solved the issue of connectivity to radio test equipment on the production line.

▲ *Fig. 3 A sample of the SilverLine-QMA test cable and adaptor systems.*



▲ *Fig. 4 Times Microwave Systems' part no. 3191-197EA adaptor for making virtually any connector combination.*

Users who are considering adopting another connector series are also concerned with how to adapt to and from the new series without suffering significant RF degradation. The ability to accommodate a multitude of coax connector applications and even price and availability clearly enter into the decision-making process. To address these issues, Times Microwave Systems designed and built 28 unique QMA jack adaptors for the two-way, RF and microwave markets. This includes but is not limited to QMA jack to UHF and mini-UHF, BNC, Type N, SMA, TNC and others in both male and female. To eliminate that all-too-familiar performance degradation that comes from plating wear issues, all adaptors are US-made stainless steel. ***Figure 3*** displays a sample selection of Times Microwave Systems' new SilverLine-QMA test cable and adaptor systems.

Popular reverse polarity adaptors for wireless Internet and Cisco router applications also exist. Several between series adaptors outfitted with QMA plugs were designed and built that are useful for changing the ports on test equipment to a fast mating system, or simply to protect the original port connector from damage. Having tried and proven Times's QMAs, some popular test equipment manufacturers are now considering the QMA jack as an option that can be ordered for the RF port to eliminate damage from applying excessive torque, a main reason test equipment is returned for repair.

Two within-series adaptors have been developed that allow the user to create literally dozens or perhaps hundreds of coax series combinations or to connect multiple cables together, all through the QMA interface system (see ***Figure 4***).

Times now offers a two-watt QMA termination for amplifier and other test situations. To hold and protect all the new, high performance QMA adaptors, tools and termination, Times sells both a soft pouch and a hard case.

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