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New Connector Field Installations Improve System Reliability

By Kevin Moyher
Times Microwave Systems

Here is a short case history demonstrating a solution for reliable field-installed connectors use in high reliability wireless E911 systems

Across the country, CDMA, TDMA and GSM wireless communication sites are being upgraded to meet the requirements of the FCC's Enhanced 911, or E911, mandate. Phase II of this ruling requires that network-based wireless location systems locate a wireless phone user to within 100 meters 67 percent of the time, and to within 300 meters 95 percent of the time. The quality and reliability of these systems is paramount; people's lives may depend on it. Applications for this system are personal security, medical alerts, child tracking and accident response.

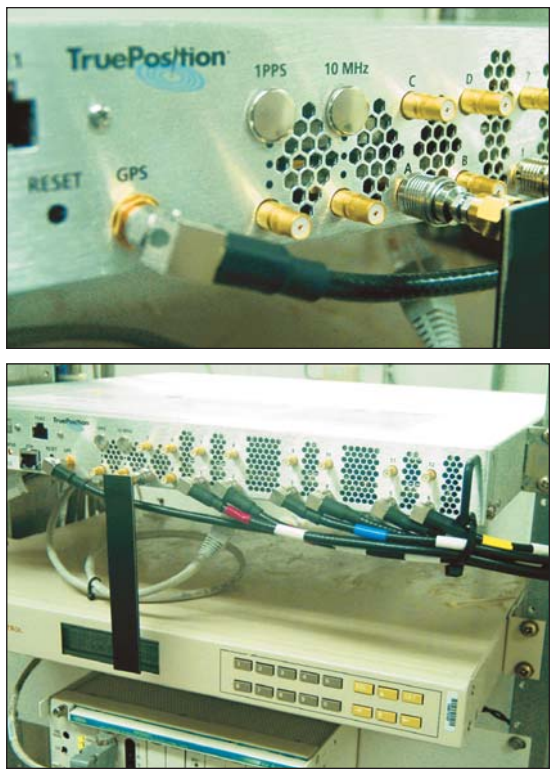

Figure 1 · E911 location determination equipment must be reliably connected to the wireless system equipment.

An Example of E911 Equipment

True Position is a leading supplier of the complex equipment that is integrated into cellular and PCS base stations to give them user location capability. True Position utilizes U-TDOA (Uplink Time Difference of Arrival) technology to locate a subscriber's cell phone. The LMU (Location Measurement Unit) is installed at each cell site. This equipment passively overlays the existing wireless network, sending critical data back to the operator's Mobile Switching Centers where LCs (Location Calculators) perform the multipath mitigation algorithms. When a wireless phone user whose carrier employs True Position's equipment dials 911 and activates the E911 network, the equipment in the area surrounding the caller is activated and begins to perform the complex calculations necessary to pinpoint the caller.

The reliability of this equipment is critical, and it has been optimized and ruggedized to perform with high reliability. However, there are only so many safe guards and safety measures that can be incorporated into the components themselves. The ultimate reliability of this system depends on the quality of the interconnecting cable runs. As shown in the photos of Figure 1, the E911 hardware has to be connected to each of the transmit and receive antenna runs, requiring multiple short

interconnect cables. These cables are built from small core low-loss, flexible 50 ohm coaxial cable. True Position minimized some of the installation variables by using the QMA interface for these interconnecting runs. This interface can best be described as a high performance, quick connect SMA. The adoption of this interface eliminates the need for threading of small coupling nuts and the concern for achieving the proper mating torque.

Times Microwave has contributed to high performance and reliability of these systems, starting with the basic requirements of high quality cable and connectors with very good return loss. However, since the layout of every base station is different and the lengths of the interconnect cables vary accordingly, the cables must be cut and terminated in the field. This reality prompted the design of a series of EZ (spring finger center contact) connectors that interface with Times' LMR-240 cable (Figure 2). Though QMAs are the dominant interface in the system, SMA and Type N connectors are also widely used. These EZ connectors eliminate the need for soldering in the field and solve the issues of pin height and pin to core gap. These three variables are often the largest contributors to inconsistency in the performance of field terminated interconnect cables.

The right angle EZs employ a unique design. Many spring finger right angle connectors have a 90° swept center pin with a mitered outer conductor. This design offers ease of termination at the expense of return loss. Times has taken the typical soldered right angle design and improved upon it. The straight brass center pin has been replaced by a straight berylium copper pin that is bifurcated at the back end with a lead-in for the cable center conductor. This configuration has the ability to fine tune the impedance across the right angle. Where typical EZ right angles have a return loss weakness

Figure 2 · The EZ connector hardware includes the connector body, crimping ferrule and a heat-shrink covering.

over a properly designed right angle solder connector, this new design actually has an advantage: excess solder build-up is no longer an issue. Going a step further with this design, a stop is placed inside the connector so that the pin can not be over extended beyond the center pin.

Optimization of the field terminated cables goes beyond connector design and includes the development of two easy-to-use termination tools. The first of these is a "one-step" cable stripping tool (ST-240EZ). Many small coaxial cable prepping tools are generic tools which are completely adjustable. These tools are capable of being adjusted to work with different cables but can be a real minefield in terms of potential termination problems (i.e., nicked outer braids, nicked center conductor, crushed core, improper strip lengths, etc.). The ST-240 is a completely customized tool. The cable slides into a cable slot until it hits a stop. The blade package, containing two hardened alloy blades, is then released onto the cable, the index finger is placed through the loop at the end of the tools handle and the tool is spun clockwise around the cable for three to four full revolutions. The tool is then grasped as close to the cable as possible and pulled away from the cable, exposing the center conductor and tinned copper round wire braid.

This tool assures that the cable is stripped to the proper dimensions every time. It preps the core square and clean without crushing it or ripping the outer conductor and it preps the center conductor clean without nicking. The most important function which the tool performs is to expose the braid without nicking it. This is a very important requirement in the termination process that often gets overlooked. The braids on these small core flexible cables are of a very small diameter and a slight miscalculation with the pressure applied to a knife or a slight misadjustment of a variable stripping tool could effectively wipe out half or more of the braid, resulting in poor connector retention.

The introduction of these EZ connectors for LMR-240, and the simple tools to assist with their termination, has created a nearly foolproof choice for the field assembly of short low-loss interconnect cables.

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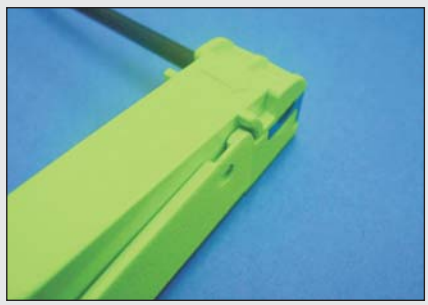
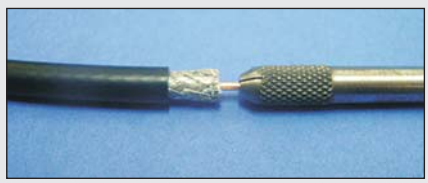
Termination Procedure for EZ Connectors

1. Flush cut the cable squarely without crushing the core. A TMS CCT-01 cable cutting tool will easily accomplish this.

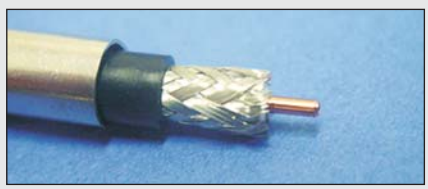
2. Slide the cable into the cutting slot of the stripping tool until it hits the stop. Place a finger into the finger loop at the end of the handle and spin two full turns (clockwise). Grasp your right hand over the blade section of the tool and remove the stripped core and jacket material.



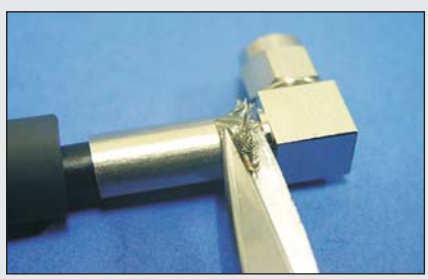
3. Debur the center conductor using the debur tool. A half dozen back and forth motions by hand or 3 seconds of clockwise motion in a low speed drill will be sufficient.



4. Place the shrink boot and ferrule over the end of the cable and fold the round wire braid away from the outer conductor.



5. Place the connector onto the cable. Twist the connector back and forth as it is pushed onto the cable. Push the connector until it comes to a hard stop. Slide the ferrule up and make an impression in the excess braid as a mark for trimming.



6. Using a 0.255 inch hex crimp die, crimp the ferrule as close to the connector body as possible. Do not double crimp.

7. Slide the shrink boot towards the connector as far as it will go, and shrink it down using a heat gun until a lip of adhesive is visible at each end of the boot.