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Achieving Optimum PIM in Wireless Networks

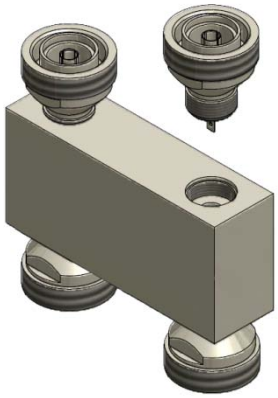
Using the Appropriate Torque to Tighten Type-N and 7-16 mm DIN Connectors

One of the most critical parameters in today's congested wireless networks is Passive Inter-Modulation or as it is commonly known, PIM. Not only is it necessary to select properly designed and tested low PIM components, but they must also be connected to the interconnecting coaxial cable with the appropriate torque. This means using a calibrated torque wrench.

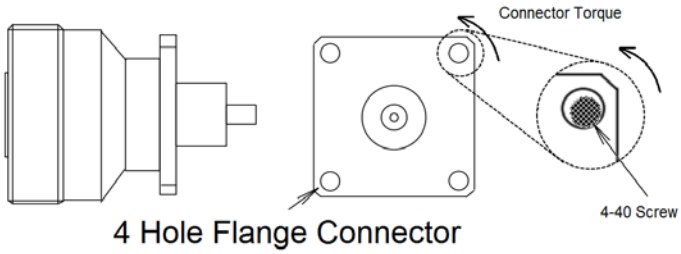
If the amount of torque applied is insufficient, the connector may not be completely seated; poor contact creates poor PIM performance. A more severe case is if the applied torque is excessive, the connector threads begin to grind together forming loose particles or even cold welding, making them impossible to undo at a later date. Although an over-torqued connector might look mechanically sound it becomes a source of unwanted PIM.

Microlab uses a threaded plug style connector on many of its low PIM designed components. This type of connector provides the most reliable mechanical and electrical connection for low PIM when torqued to the proper specification for the connector type.

Plug Style Connector



An alternate connector configuration is the 4-hole flange mount, (shown below). This is assembled by butting the back of the flange against the component body. The connector is secured using 4 cap screws or pan head screws. For a 7-16 DIN connector #4-40 screws are used. There is a mechanical disadvantage in using this type of connector compared to the plug style, due to the clearance between the flange through-hole and screw. There is a small rotation of the connector as the coupling connector is torqued to the optimum force. For a typical 7-16 DIN connector using #4-40 stainless steel screws the recommended torque force is 5.5 in-lbs for the mounting screws. This may not be



4 Hole Flange Connector

enough force to keep the connector from moving when a coupling torque of 22 ft-lbs is applied. Movement of the connector can occur with this applied torque force. This movement can permanently damage the center conductor thereby creating PIM and other detrimental electrical characteristics.

Because of this Microlab uses the plug style connector in its high performance components. The plug style connector is threaded to the component body and is torqued to a force greater than the coupling torque that would be used on a mating connector. The plug is further secured to the component body using a thread adhesive. No movement of the connector will occur when the coupling torque force is less than the maximum recommended torque force.

The recommended coupling torque is very different for Type-N and 7-16 mm DIN connectors. It unfortunately further varies between connector manufacturers, because there is no generally agreed industry standard. Below we reference the IEC standard which is rather dated for the Type-N connector but reasonably current for the 7-16 mm DIN.

Microlab has incorporated the different suggested values into the following recommendation:

Connector Type	**7-16 mm DIN**		**Type N (brass based)**	
	IEC Specification	Microlab recommends	IEC Specification	Microlab recommends
Metric Torque	35 N m	24 - 30 N m	1.1 Nm	1.4 Nm
Imperial Torque	25 ft-lb	18- 22 ft-lb	9.7 in-lb	12 in-lb
Why?	The IEC specification is based on the size of the nut, and in Microlab's estimation is excessive. With a quality 7-16 mm DIN connector, excellent PIM and a secure connection is made with less than the IEC recommended torque.		Microlab recommends a higher torque than the IEC standard, because it is based on a 60 year old intention that N connectors were to be hand tightened, a practice that does not meet today's PIM requirements. To facilitate proper torquing of connectors Microlab uses hex nuts.	

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