



Article Number - 00047-2013

Date - 14<sup>th</sup> February 2013

Article applies to - All Products

## **ISSUE: RF Connector Types Explained**

Many Digital Yacht products operate using Radio Frequencies (RF). All our AIS and Wi-Fi products use special RF connectors and this document shows the different types used. Recognising and correctly using the different types of connectors, is very useful and avoids mistakes and confusion during installation.

### **VHF Frequency Connectors**

The following connectors are used to connect a VHF antenna to a VHF radio. Sometimes referred to as UHF connectors, the PL259 (plug) and SO239 (socket) are probably the most common RF connectors on boats.



PL259



SO239

Some AIS units use the same PL259/SO239 connectors, but the majority use BNC connectors to differentiate them from VHF radios. BNC stands for “Bayonet Neill-Concelman” where Neill and Concelman were the two inventors of the connector and the “Bayonet” refers to the fact that you only have to turn the locking nut 90 degrees to lock it in place.



BNC Male



BNC Female

Some antennas fit neat little FME connectors that are almost as small in diameter as the coax cable. On a boat this makes routing the cable through decking, conduit, etc. much easier. If you are having trouble routing an antenna cable through a boat, consider fitting an FME connector. The additional benefit is that you can get lots of adaptors; FME to BNC, FME to PL259, etc. so you can quickly switch the AIS antenna to be an emergency VHF antenna in the event of a demast, by just changing the adaptor.



FME Male



FME Female

AIS Splitters, because they are connected between the VHF antenna and the VHF radio and AIS, have a couple of the SO239 connectors on them and one BNC connector to go to the AIS. They will also be supplied with a short PL259 to PL259 cable and a short BNC to BNC cable.

## GPS Connectors

The most common marine GPS antenna connector is the TNC connector which stands for “Threaded Neill-Concelman” and as the name suggests, the locking nut is threaded.



TNC Male



TNC Female

Most GPS antennas have a small pre-amplifier inside them which requires a 3v or 5v DC supply in order to power the amplifier. This DC voltage is applied down the coax cable and then the small AC signals from the GPS “sit on top” of the DC voltage and are separated and processed by the GPS receiver.

For this reason, it is very important that GPS antenna connections are well made and no strands of the outer shield are allowed to short to the inner connector otherwise damage to the GPS receiver can occur.

All AIS transponders have their own GPS and so you will always find a TNC connector on these devices along with a BNC connector for the VHF/AIS antenna.

## TV Connectors

The traditional TV antenna connector that you will be use to seeing on your home TV is often found on boats, as the TVs used are more often than not normal commercial off the shelf TVs and have the normal TV antenna connections. This type of connector is actually called a Belling & Lee connector after the original designer but most people call them TV Aerial Connectors.



TV Aerial Male



TV Aerial Female

A much better connector for use on boats, that will withstand vibration and shocks better is the F-Type. This connector is found on more expensive TVs designed for non-home use and also on satellite decoders and antennas. It features a screw on locking nut that makes a much stronger connection that will withstand the stresses found on a boat.



F-Type Male



F-Type Female

## Wi-Fi Connectors

Where as VHF and GPS are both in the MHz range, Wi-Fi is in the higher GHz range where RF signals become more “difficult”. Cables have to be larger and every meter of cable introduces significant signal loss, so make sure you keep cable runs to a minimum and if you have to make a join in the cable, ensure the connections are very well made.

On Wi-Fi routers and other devices, you will often see a small 3db or 5db antenna which will have an SMA male RP (reverse polarity) connector on it. If your device has a 3dB antenna and you are having problems with Wi-Fi reception, you can easily replace it with a 5dB model.



3dB Antenna  
Supplied with  
iAIS + WLN10

SMA RP Connector  
(reverse polarity)



5dB Antenna  
costs just a few  
pounds on-line

The reverse polarity connectors create a great deal of confusion as the male has a socket and the female has a plug, so always pay particular attention to these SMA RP connectors if you are buying adaptor cables or replacements.



SMA RP Male



SMA RP Female

If you are going to have a larger external Wi-Fi Antenna, like the Digital Yacht WL510, then you will need to use thick LMR400 coax cable. This 50ohm cable is nearly half an inch in diameter and quite difficult to install, but it is very low loss (0.22dB per meter) and is the only cable that should be used if your cable run is more than a meter or two.

Most larger Wi-Fi antennas use N-Type connectors like the ones shown below.



N-Type Male



N-Type Female

## RF Connector Adaptors

There are a whole series of different RF Connector Adaptors available that will allow you to join together two different types of connectors. They usually cost just a couple of pounds and it is certainly worth having a few in your tool box, as they may just get you out of trouble if a cable fails at sea. For instance a PL259 to BNC adaptor would allow you to connect an emergency VHF antenna to your AIS or a BNC to PL259 to connect your AIS antenna as an emergency VHF antenna.



## Assembling RF Connectors

If you are going to attempt to assemble your own RF cables and connectors, then you must invest in the right tools. You will need a good cable stripper that will remove the outer cable without damaging or cutting the shield conductor and you will need a proper ratchet crimp tool with the right size bits for the cable/connector you are using.



Coax Stripper



Coax Crimp Tool (Ratchet)

Each RF connector is different and usually the data sheet for the connector will give details of how much insulation you have to remove from the outer and inner conductors. Then it is simply a case of working out which hole in the crimp tool you have to use to crimp the inner and outer connections.

It is recommended that for all marine RF connectors that you apply some heat shrink sleeving to the outside of the connector to keep moisture out. Glue lined heat shrink sleeving is the best to use as the glue creates a good seal.



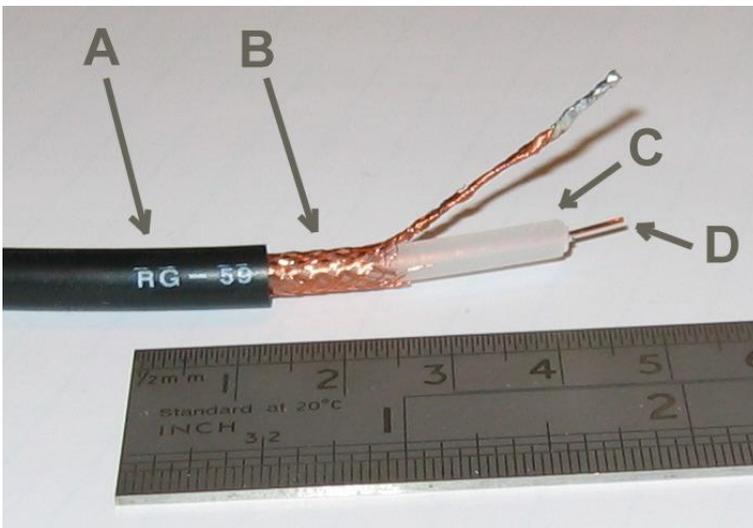
## Coax Cable Explained

A coax cable is a special type of cable for radio frequency AC signals, that provides a low loss path for the often small and complex radio signals.

A coax cable has two conductors; the inner and the outer. If you were to measure the DC resistance between the inner and outer with a normal multimeter, then you should measure infinite resistance (open circuit). However, at high radio frequencies things change and signals start to radiate through the air or in this case through the insulator between the inner and outer. To the RF signals the cable appears to have a fairly low resistance between the inner and outer wires.

On boats coax cables come in two resistance types; 50ohm and 75ohm. All VHF, AIS and Wi-Fi cables are 50ohm coax cables, while the cables used with TVs and Satellite TV antennas are 75ohm.

If you decide to extend or make up your own cables, it is important that you use the correct 50ohm coax (referred to as RG58) and that the connectors you use are also 50ohm versions and not the 75ohm versions used on higher frequency TV equipment.



A= Outer plastic insulation

B= Woven copper shield

C = Inner Insulator

D = Inner Copper wire

The cable in the image above is RG59 which is the 75ohm equivalent of RG58.