Some Notes about CAT Cables Used in AAA-1 Amplifiers

Revision 13

Here is my experience collected from several years using CATxx cable as antenna feeder:

Use only cables with pure copper conductors. On the market, there are copper clad aluminum cables – avoid them. Check that the conductor diameter is at least AVG 24 (0.51 mm). If it is different then the crimping to the connector might not be reliable. I have met cables with 0.28 mm conductor diameter! There are FTP cables for external wiring and it is better to use those. Usually they are with black coating for UV protection. The standard cables for internal wiring (usually grey color) can also be used but their life in external environment is somewhat limited – 3 to 4 years. I have checked standard grey FTP cable after 6 years in external environment. It still works. The main problem was not UV but water - probably the water penetrates through the PVC coating and the internal conductors have changed their copper color to something between brown and black. But the PVC coating was still uninterrupted. The UV damage is evident only for these parts of the cables which are exposed on direct sunlight during all the day.

Use only good crimping tool if you are using RJ45 plugs. After crimping check the contact pins of the plug to be on the same level. If some pins are higher or lower discard the connector and tool. Also there should be no deep traces on the pin's surface from the tool after crimping the pins (they are with golden clad). Use the color of the pairs as described in the manual. Pins 7 and 8 are used in AAA-1 to carry RF signals so they must be a pair. In LAN applications orange and green pairs are used for data so it is expected to be twisted most tightly. The pairs in the cable have different level of twisting in order to reduce the crosstalk. In our service cable the orange pair is used for RF signal.

CAT6 and CAT6a are specified up to 250 and 500 MHz respectively (CAT5E is specified up to 100 MHz). The category 6 specification requires conductors to be pure copper AWG23 (d=0.57mm) or 24 (0.51 mm). CAT6 type cable does not have any advantages compared to CAT5e in frequencies up to 50 MHZ. It can be used for AAA-1 since the same connectors 8p8c RJ45 connectors are used. CAT6 cables are also produced in FTP variant (externally shielded).

CAT7 (and CAT8) is specified for Gigabit Ethernet and consists of 4 separately shielded pairs. CAT7 type cable does not have any advantages compared to CAT5e in frequencies up to 50 MHZ. The extra shielding and twisting does not have any advantage in our case. The problem is that it is more difficult to be used with standard RJ45 connectors and sometimes it can not fit properly into standard 8P8C connector. We do not recommend to use CAT7 moreover that it is more expensive. If it is already available you can use it just be careful in crimping.

To check the cable you need only 1cm not 1 m. It is enough to check for copper conductor and wire diameter - you do not need to measure the DC resistance of a long piece. The best cable external coating is polyethylene and these are cables for outdoor wiring. The cables with PVC coating are usually for indoor applications but I have used them successively for several years without any problems. Be aware that only the external coating is PVC. The individual wire coating is a good RF polyethylene. Check also the shield drain wire – it must be also copper usually tinned. Do not rely on the mechanical contact between FTP shield and RJ45 shield but solder the drain wire to the connector shield. The cable must be marked every meter and there must be marked the name of the producer so you can go to his site and get the cable parameters.

You do not need to measure it - the specifications are widely available. This cable is not a telephone cable and has very good parameters up to GHz region. Bear in mind that this cable is designed to transfer data at 100 Mbits/s and above. As a balanced line it has certain advantages which will benefit the noise immunity of the receiving system. The only questionable parameter is the delay (which is important when building phased arrays). I have measured the difference in the signal delay between two 30 m cables from the same manufacturer. Using the same colored pairs, the difference is below 1 -2 ns. The accuracy was limited by my measuring equipment. These cables are marked in factory at each meter and for the experiment were cut precisely at the corresponding markings.

Ready made so called patch cables can be used but be aware to check them. Ready made cables have perfect external appearance but the internal content is not known. It will work perfectly for LAN applications even if it is with aluminum conductor but is not good for antenna feeder. The wiring must be straight – the same color to the same pin on both sides. (usually white brown and brown pair in pins 7 and 8 (RF pair) is wired in commercial LAN cables). Do not use readymade LAN cross-wired cables!

Unshielded UTP cable can be used but shielded FTP is better since the shield can be grounded at some point to good earth thus reducing conducted noise substantially. Also when there is a nearby transmitting antenna (with high power TX) the shielding is helpful to minimize the TX influence.

The AAA-1 system is symmetrical and balanced so the natural choice is the twisted pair. The coaxial cable does not give better noise immunity compared to FTP cable . The only advantage is the attenuation when RG6 or better cable is used. In the excel worksheet *Max_Cable_Len_12.xls* in *https://active-antenna.eu/application-notes/* the user can calculate the maximal cable lengths, voltage drops etc. In this worksheet there is an example of RG6 use and how to modify the AAA-1 in order to use extremely long feeders above 100 – 200 m of length. For low frequencies below 4 MHz FTP cable lengths up to 250 m can be used without degradation of the performance.

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