Dipole Amplifier of AAA-1 Active Antenna

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The dipole part of AAA-1 is a balanced high input impedance JFET design. It uses 2 monolithic JFET in a single case in order to have a matched pair which is needed for good balance in wide temperature and frequency range. The input stage is a source follower and after it there is an output power amplifier with highly linear VHF medium power bipolar transistors. The voltage gain is 2 dB in the flat frequency range. The noise floor of the dipole amp. is lower with 2 to 4 dB compared to the loop amplifier. Look at Fig. 1.6 in *http://active-antenna.eu/tech-docs/1_ActiveAA_DandS_20.pdf* .

IP2 performance

The output IP2 of this amplifier is very high and usually it is around 100 dBm. The output IP2 is measured in production stage as described in https://active-antenna.eu/tech-docs/aaa-1c-addendum.pdf

The IP2 parameter is very important in wideband designs. Low IP2 leads to numerous spurious signals. Usually there is a bandpass filter at the input of the narrow band designs, and these spurious signals are usually non -existent since the filter effectively reduces the signal amplitudes out of its band. But in wideband design, such a high IP2 figure is a must. Without balanced circuit, the output IP2 is usually in 60 – 70 dBm range. Additional 30 dB are added with the balanced circuit. In http://www.lz1aq.signacor.com/docs/wsml/wideband-active-sm-loop-antenna.htm ” Non-linear distortions” section the user can read how to check for 2nd order distortions with his RX.

No need for Symmetric Antenna

In order to reach a balance, the source (antenna) also must be symmetric to feed both sides of the amplifier with equal signals. The dipole amplifier design is balanced but not differential so this input balance is important. The differential amplifier is a self balanced circuit but has inferior performance for strong signals so the symmetric 2-channel non-differential circuit is chosen. A small symmetric dipole is the best solution for antenna, but in vertical dipole position it is difficult to reach precise balance due to different capacitive coupling to the environment, e.g. the lower arm has higher capacitance to ground. For this reason there is an input balun which can be switched on/off by means of jumpers J3,J4. It is described in L8 https://active-antenna.eu/tech-docs/adding-input-balun-11.pdf . When the balun is on, the frequency response is changed and is shown on ***Fig.1.*** The lower cutoff frequency of the amplifier is moved to higher values and this is one of the drawbacks of this approach. But from the other hand we gain a very well auto-balanced input and even extremely non-symmetrical antennas such as GP can be used as input source. Careful measurements show that even with single ended source the balance in both arms of the amplifier is preserved and the IP2 is > 90dBm. For the cases where higher sensitivity in LF region is needed or there is no sign of 2nd order spurious signals the balun can be removed by the same jumpers. The balun adds 1.5 dB additional attenuation and degrades with the same extent the noise floor of the amplifier but in most cases this will be not noticed since the band noise is much higher.

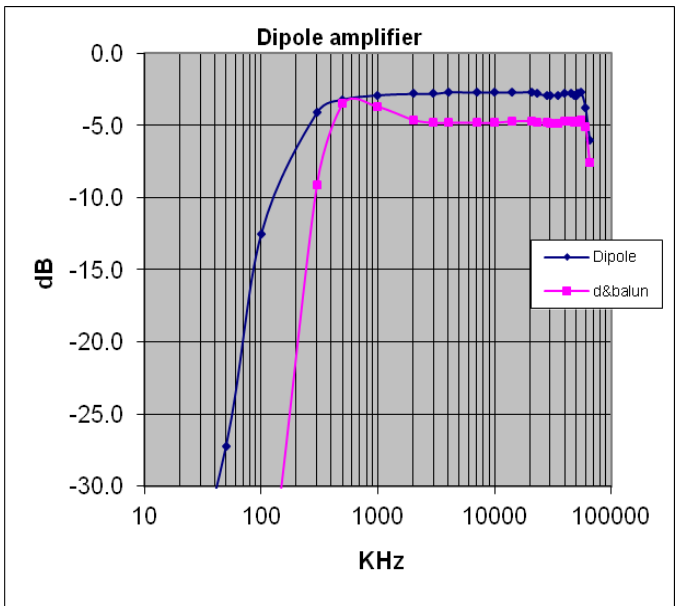

Fig.1 *Measured frequency response of AAA-1 high-Z amplifier with and without input balun.*

Typical Antennas

The easiest way to use the dipole amplifier is to use the loops as dipole arms. With appropriate jumper settings (J1a,J1b) the user can use the following dipole arms : 2 loops, or 1 loop and additional wire, or two separate wires. The sensitivity can be increased by using separate dipole arms with 2 to 3 m length of wire each placed parallel to the loops. Look at the antenna part https://active-antenna.eu/tech-docs/2_ActiveAA_Mount_21.pdf
Also any asymmetric antenna can be used e.g. ground plane. In this case the input CM balun must be inserted by connecting jumpers J3 and J4 in order to feed the balanced amplifier with symmetric voltages. For example the lower arm of the dipole can be connected to a metal rod (approximately 0.5 to 1 m long) inserted into the soil. In such a setup the signal levels are increased with 4 to 6 dB compared to a dipole with arms with the same size as GP. Another example of a small active vertical can be get from http://www.lz1aq.signacor.com/docs/vert_hat_1.pdf where a small metal plate placed on the earth was used as ground counterpoise. Since the input impedance of amplifier is high there is no need for extensive ground radials and a capacitive coupling to ground of tens of picofarads is usually sufficient.

Common mode signal rejection

This good balance is not only needed for reduction of spurious responses, but also to reduce common mode (CM) sensitivity of the circuit. The additional CM attenuation compared to unbalanced circuit is in order of 30 dB. A very important point is to reduce additionally the conducted CM noise with cable baluns as described in https://active-antenna.eu/tech-docs/comm-filter-ftp-10.pdf The dipole mode in noisy urban environment is much more noisy compared to loop mode due to high CM impedance of the high Z amplifier and this is the reason why CM cable balun is not so effective compared to the loop mode.

Using Horizontal Dipole

The horizontal dipole placed at sufficient height has good directivity for horizontally polarized waves which might give another dB of noise attenuation in some directions. The directivity of the horizontal dipole is an equivalent to a small vertical loop – just the polarization is swapped. A separate horizontal dipole can be connected to V1 and V2 terminals and J1a and J1b must be off. Look at http://www.lz1aq.signacor.com/docs/hpsra/horizontally-polarized-small-active-receiving-antennas7.htm for more details.

Loop or Dipole in Heavy Urban location

I have made a lot of efforts to reduce the noise in vertical dipole mode with my AAA-1 loop/dipole amplifier on my balcony. The flat is in the city of Sofia on the second floor of a six store building. The building construction is concrete and bricks. All my neighbors are solidly equipped with numerous switching power supplies. The I-net provider signal is coming via optical cable but the inside cables are copper.

One of the problems which exists is that there is no ”grounding” point. A current CM balun in the cable without grounding point has almost no effect for dipole mode. If I power everything from a battery and switch off all other computers, the noise drops down with several dB but still is above that in the loop mode. My LAN cables are approximately 1 - 2 m away from the antenna and I can hear many carriers in SW band. The loop mode is much better regarding man made noise. Above 20 MHz this difference is not so high and the dipole mode is acceptable. Both modes are very poor when placing the active antenna inside the apartment. In any case the balcony antenna is far from what I can hear at my village house where everything is made as it should be – cables on the ground, good grounding points, FTP cable CM balun and 15 m distance from the house. In such a case the small vertical dipole (or GP) is an excellent antenna.

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