

IMD Distortions in MW Band of AAA-1 Active Antenna Amplifier

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Rev.1 April 2024

Here are presented the measurements of output IMD spurs in medium wave (MW) band: An extremely strong signal F1 and very strong signal F2. Two signal generators are combined and fed to the input of AAA-1 active antenna amplifier in small loop mode.

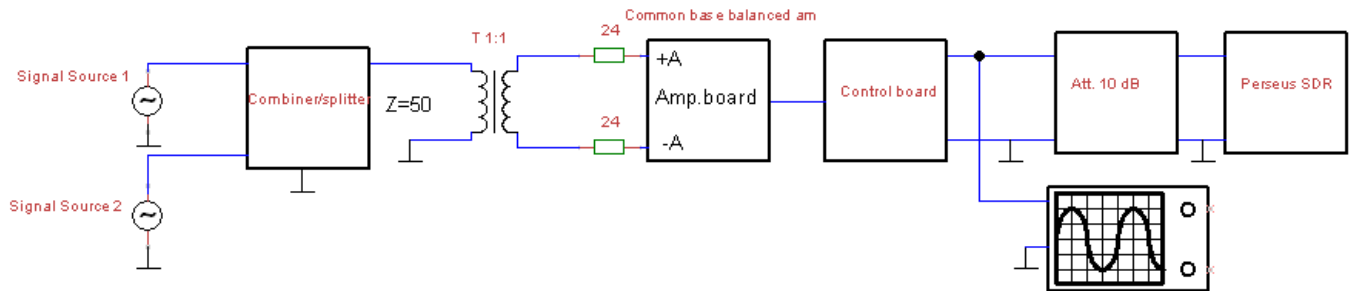


Fig.1 Measurement setup. The amplifier is AAA-1C random sample

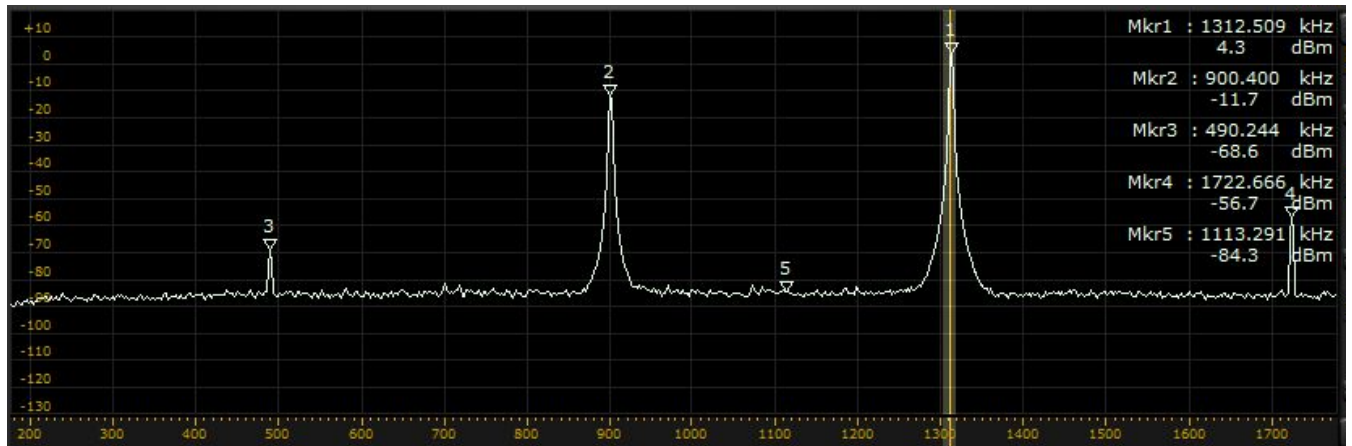


Fig.2 AAA-1 third order output IMD products of $F1 = 1312 \text{ KHz}$ (+14.3 dBm) and $F2 = 900 \text{ KHz}$ (-1.7 dBm) . Mrk 3 is $2 * F2 - F1$ and Mrk 4 is $2 * F1 - F2$. There is a 10 dB external attenuator in front of Perseus SDR so the displayed values must be increased with 10 dB. The spectrum analyzer is Perseus SDR at 2000 KHz s/rate with -20 db internal attenuator switched on . The displayed levels in Perseus do not depend on the internal attenuator position. Noise level is -74 dBm due to the noise generated by one of the signal generators. The 2nd order products $F1 + F2$ and $F1 - F2$ are below the noise level of -74 dBm and cannot be detected.

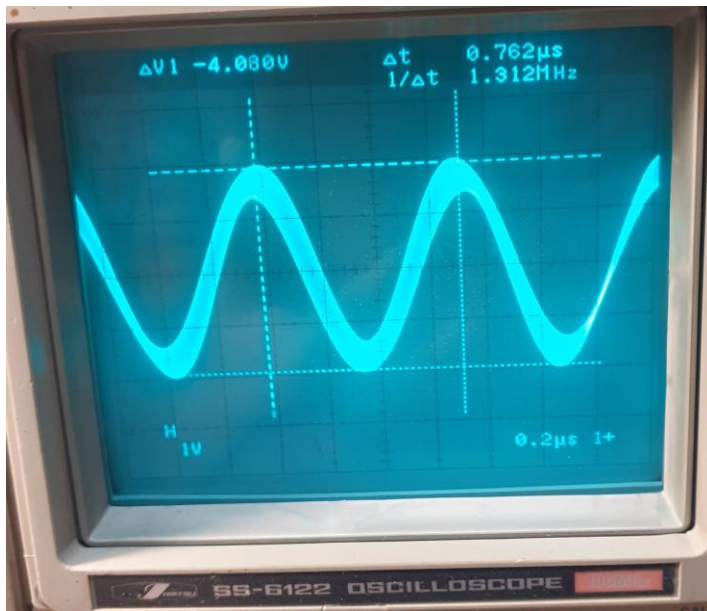


Fig.4 Oscilloscope at the AAA-1 output (50 ohms output at Control board) with the above signal levels. The output voltage is 4 V pp (+16 dBm) which is an extreme case. This level might destroy some SDR inputs if a limiter is not used. Even at these levels the AAA-1 functions pretty well.

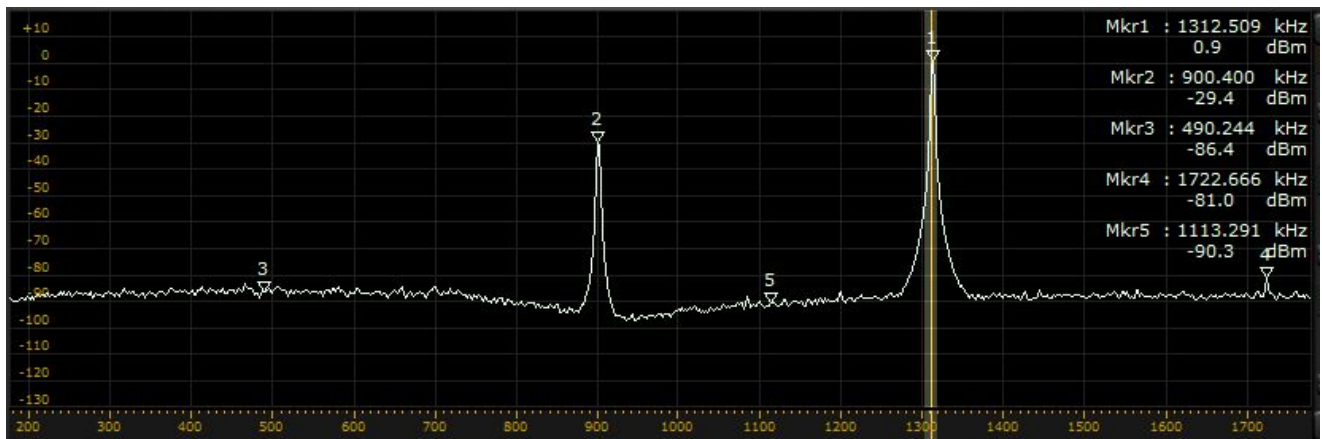


Fig.4 Third order IMD products of $F1 = 1312$ KHz (+14.3 dBm) and $F2 = 900$ KHz (-1.7 dBm) when a reject filter ($f_r = 900$ KHz) is connected parallel to the input of the loop antenna. The reject filter must be connected between points +A and -A on **Fig.1**. The amplitude of 900 KHz TX is reduced with 17 dB and 3-d order IMD spurs disappear. The reject filter is as described in [1], $L=1.5$ uH (commercial choke, $Q>20$, S.R.F 150 MHz) and 20 nF X7R smd capacitor. The reject frequency must be tuned to the strongest TX but in this example it is tuned to the lower power TX due to measurement setup limitations.

Bear in mind that level of +14 dBm might be induced by tens of kilowatts very near to the TX antenna. I have a record (**Fig.3**) of a 40 KW transmitter at 864 KHz approximately 2.5 km away from the TX antenna with level of +10.3 dBm. The loop was two crossed coplanar loops each with 70 cm diameter. The loop was oriented at maximal signal level.

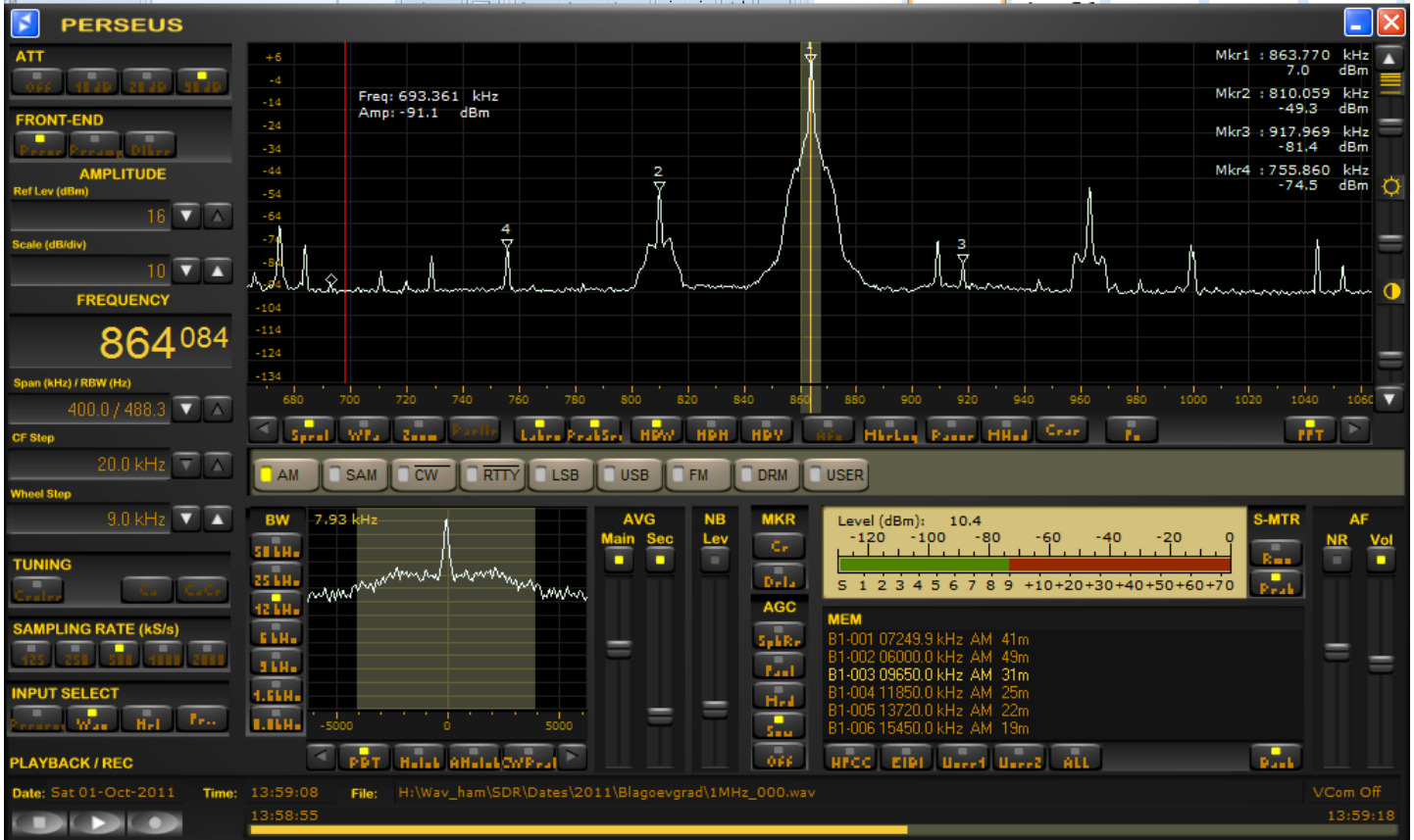


Fig.3 IMD products of AAA-1 from 40 KW transmitter at 2.5 Km away from the tx antenna. No reject filters are included. Receiving of other stations are not influenced. The BC stations are at 864 KHz (+7dBm, Mkr1) and 810 KHz (-49 dBm, Mkr2). Their 3d order product is seen at 918 KHz Mkr3 with -81 dBm level. The other product at 756 KHz (Mkr4) is masked by another MW station with -74 dBm level. The difference between power levels on the spectrum mark (+7 dBm) and on S-meter (+10.4 dBm) are due to the bandwidth. RBW on spectrum is 488 Hz. The S-meter measures it at 8 KHz bandwidth.

As a conclusion: reject filters are needed when the location is electromagnetically very quiet and even very weak spurs can be heard. The other case is when the signal levels reach or exceed the amplifier 1 dB compression point which for AAA-1 is +19 dBm.

Links:

[1] "Filters for Wideband Active Antennas to Reject Strong Input Signals from Broadcasting Stations in LW, MW and FM Bands"

<https://active-antenna.eu/application-notes/filters-to-reject-strong-input-signals/>