The PHASE-SHIFTER is basically a device that allows you to add or subtract RF signals.

This can be useful in several cases:

- interference due to local stations, even out of band (120 – 150 MHz) which can cause disturbances in 144 MHz due to intermodulations (private repeaters (interesting the use in the mountains from repeater stations), local FM stations at 145 MHz, noises etc. etc.)
- Simultaneous listening in another direction
- Reduction of generic local noise (switching, lamps and all electronic equipments)

Although the subtraction method seems to be the only way to cancel certain types of disturbance (nearby stations, noises that the noise blanker cannot trigger, etc.), the application of this method in the real field necessarily has some limitations on the expected results.

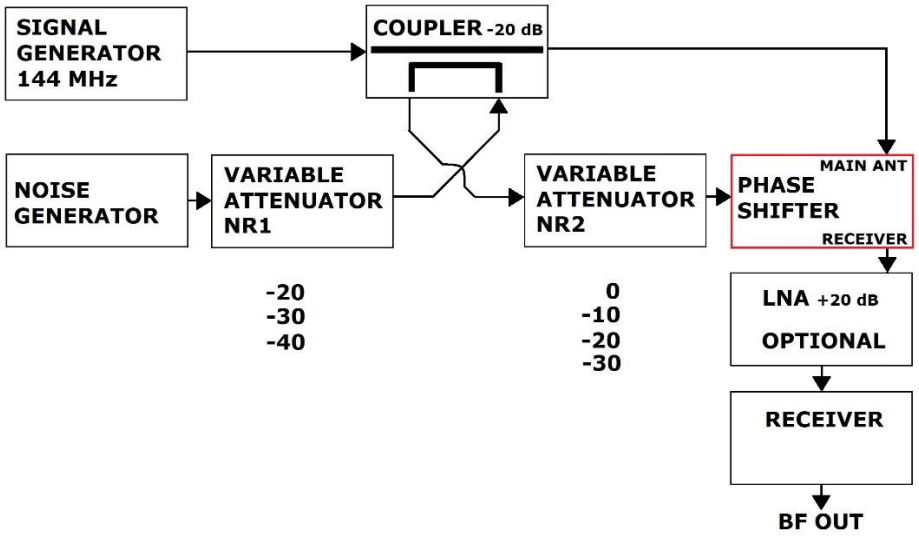
The PHASE-SHIFTER manages all the signals in the best possible way and if on the one hand canceling a fixed signal (beacon, other nearby station, etc.) is easy, on the other hand canceling a random noise can give more attenuated results due to the complex nature of noise. Therefore, special attention is needed in this case.

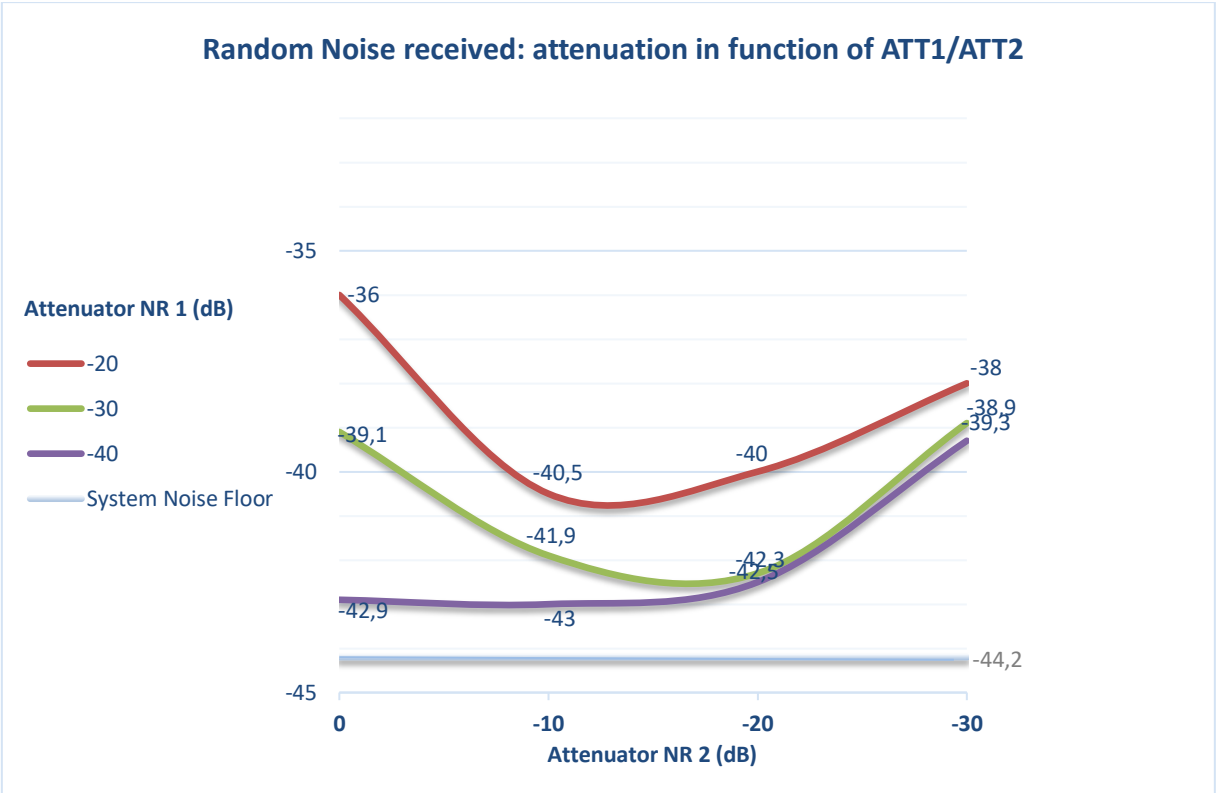
The study of interfering noises in the various locations is quite complex and requires critical analytical skills in order to be able to evaluate each single situation and/or source. More often than what happens we tend to think that the interfering noise can be unique, in practice often we are subject to multiple sources (with related reflections) that are more difficult to treat.

Effect of random noise on weak signals:

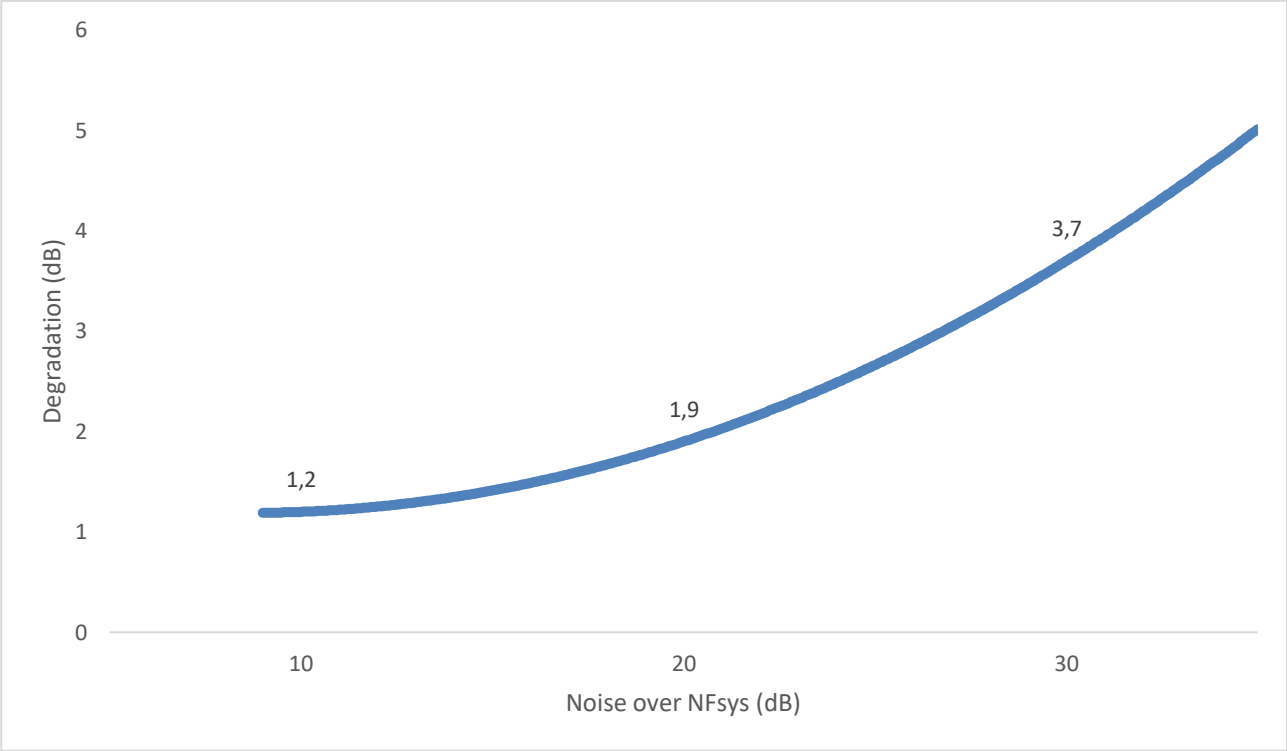
Managing noise levels up to +30 dB compared to the system Noise Floor (system background noise) is easy. Here is an example of real performance measurements obtainable based on the ratio between received random noise and background noise of the receiving system:

Schematic of the test set used for the measurements:





Random noise over the NF system (-44.2 dB)	Best degradation over the NF system (dB)
+10	-1.2
+20	-1.9
+30	-3.7



Examples:

in case of EME reception with random noise of 10 dB above the normal level (0 dB) a degradation of up to 1.2 dB can be obtained. In this case, reception improves by 8.8 dB in the direction of the disturbance.

In case of reception with random noise 30 dB over the normal level (0 dB) a degradation of up to 3.7 dB can be obtained. In this case the reception improves by 26.3 dB.

Two tests can be seen at my web page

https://iz3kgj.jimdofree.com/projects/144-mhz-phase-shifter-noise-cancel/

VHF Phase Shifter by IZ3KGJ - Test #1 (20/03/2021)

VHF Phase Shifter by IZ3KGJ - Test #2 (20/03/2021)

Below you will find some pointers that can help maximize the result:

1. AUX ANT: the antenna's main lobe must bust be the narrowest possible (in my case 3 mt of boom are enough) in order to pick up the noise source with the best possible S/N.
   Beam the antenna towards the disturbance but pay attention to the reflections that the disturbing signal could encounter and which could frustrate the action of the shifter.

2. Initially tune a fixed carrier to be canceled for testing (for example a beacon that can be received with both the main system and the auxiliary antenna). Adjust the GAIN and PHASE until the total elimination of the carrier is obtained.

   In case of random noise due to weak signal reception:

3. The board has high gain excursion in order to handle a wide range of signals (40dB). In case of difficulty dealing with an unknown random noise at the beginning it is useful to have a variable attenuator inserted on the AUX ANT socket in order to be able to understand (based on your system and the noise situation) which is the best solution to adopt. Usually a 0 to 20 dB attenuator should be sufficient to inject the correct level of noise (now the card excursion goes from about 0 to 60 dB). When the right levels between the signal from the main antenna and the signal from the secondary antenna has been established, the value of the external attenuator can be reported on the internal fixed attenuator set up before the directional coupler (at the moment it is 0 dB) [Attenuator R1, R2, R3].

4. Once you have found the DIP with the PHASE and GAIN controls, adjust the temporary variable attenuator at point no. 2 so that the GAIN pot is near the start of rotation (approximately 9 o'clock). This is useful to minimize the noise contribution of the card and to obtain the maximum absolute intervention especially in the case of random noise.

The more marked the DIPs (with the GAIN and PHASE knobs), the better the level of the noise on the AUX ANT connector, the better the quality of unwanted signal cancellation.

Improving the quality level of the pick-up antenna is essential: it must be remembered that if the AUX ANT listens to other disturbances (not heard by the main antenna), these will be added!

The most satisfactory results are obtained when the source of the disturbance is close (no reflections) and the intensity of the disturbance is strong enough (good S/N of the interfering signal).

73, Stefano IZ3KGJ

Rev. 1.3