Power Meter R&S®NRP

Fixed Noise: fast power measurement with defined accuracy

Interference such as signal noise, beating and display noise in power measurements can only be effectively eliminated by filters. However, the filters in many commercial power meters are based on classic averaging filter technology, a compromise between measurement speed and high S/N ratio. The R&S®NRP now provides a far better solution: an integrated Fixed Noise filter offering a variety of advantages.

Filters: indispensable for power measurements

Interference in the signal chain can be critical when measuring lower powers. The inherent noise of the measuring instrument, the modulation of the test signal or beating caused by adjacent carriers are significant impairments [1]. But also the noise of the digital display causing the numeric values to flicker is an additive interference parameter and is independent of the power to be measured.

To minimize such impairment, the R&S®NRP uses an averaging filter as standard, which effectively limits the variations of the measurement results. To obtain a flicker-free display, you must set an averaging filter that is able to handle the low signal level. With a lower measurement limit specified for the Power Sensors R&S®NRP-Z11/-Z2x yielding excellent 200 pW (–67 dBm) in the Continuous Average mode, you cannot obtain useful results unless the noise is extremely filtered. The reason: the lower the power of the signal to be measured, the higher the relative noise component. To considerably minimize this noise component, the R&S®NRP provides the measurement result by a two-stage averaging process. Depending on the selected measurement mode, you can use either a weighted summation of samples in a fixed time window or the integration of samples over the fixed time window. The measurement result is obtained by averaging the measured values of the last 2N time windows (N = filter length) [2]. Although the measurement time will significantly increase, the dynamic range will be widened by a sizeable 15 dB if the filter is optimally set. With the following rule of thumb you can roughly estimate the ratio between averaging filtering and measurement time: If the noise is reduced by a factor of 10, the measurement time will be increased by a factor of 100 [3]. For this reason it is quite important to consider what matters more: a flicker-free display or a high measurement speed.

Normal – the conventional filter mode in the R&S®NRP

The Normal filter mode is based on a complex, intelligent automatic filter function that can determine the power value as exactly as possible. The automatic filter function gradually adapts the filter value if the powers become lower and lower. If you want to measure close to the inherent noise of the sensor, the measurement time is shorter than with conventional filters. If the measurement time is more important, as is often the case in production, you can manually set the filter in such a way that the short measurement time required will be obtained. Low powers in the vicinity of the inherent noise of the sensor may clearly differ from the expected measurement value, since the inherent noise component of the sensor may play a major role and overlap the signal. The drawback of conventional averaging filters is that you can hardly estimate the permissible noise component, which may be of vital importance during fast measurements. And this is where the R&S®NRP's Fixed Noise filter makes your life a lot easier.

Fixed Noise makes estimating the inherent noise component much simpler

The Fixed Noise filter is a novelty in the world of power meters. In the R&S®NRP,

More information and data sheet at www.rohde-schwarz.com (search term: NRP)

REFERENCES
[1] Voltage and Power Measurements: Fundamentals, Definitions, Products. PD 757.0835, Rohde & Schwarz 1999
[2] Operating manual on Power Meter R&S®NRP
[3] Data sheet on Power Meter R&S®NRP

it is offered in addition to the Normal filter. Its operational principle is based on the fact that a noise component set by the user – this value is entered as "Noise Content" in the R&S®NRP – will be allowed for the measurement. The time required for filtering has to be such that the inherent noise of the sensor (two standard deviations) will not exceed the value set in Noise Content. Imagine that two threshold values define a maximum permissible width and that the inherent noise of the power sensor must be within this width before a measurement result is output (FIG 1). The clear advantage of this method is that you can determine the permissible threshold range for the noise still acceptable from your point of view. The power meter continues averaging until this criterion is fulfilled. To avoid very long filter settling times at low powers, the filter length in the R&S®NRP can be limited with the parameter "Max Settling Time". This parameter is used as termination criterion for the measurement. If, in case of very low powers, the inherent noise component of the sensor cannot fall below the specified threshold value, the measurement is terminated after Max Settling Time has been reached and the current power value is output. This is indicated by S/N on the R&S®NRP display. FIG 2 shows the differences of the filters in the R&S®NRP with reference to the influence of the noise component on the measurement and the measurement time.

Special advantages in remote control mode

The Fixed Noise mode is unbeatable, especially if the power meter is operated by remote control. The practicability of this mode becomes clear when you have to estimate the degree of permissible inherent noise during a measurement. Elaborate calculations or trying out the correct averaging filter are no longer necessary. You can optimally set the power meter manually or by remote control in next to no time. In production, you can thus easily program the R&S®NRP via remote control so that it responds to a short measurement time. Just define a maximum permissible noise as measurement criterion. If a higher inherent noise component of the sensor is permissible, the measurement time can be significantly reduced and the throughput in production considerably increased.

You will discover further advantages if you also start dealing with measurement uncertainties and measurement errors in power measurement. Data sheets provide correction values for a wide variety of cases and allow you to estimate measurement uncertainties and measurement errors. The R&S®NRP will definitely support you in this respect, for it will help you to define the deviations in the Fixed Noise mode yourself.

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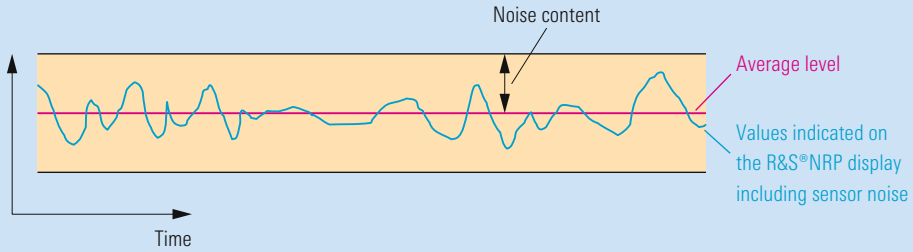

FIG 1 The noise content in the R&S®NRP defines the threshold ranges of the permissible inherent noise component of the sensor.

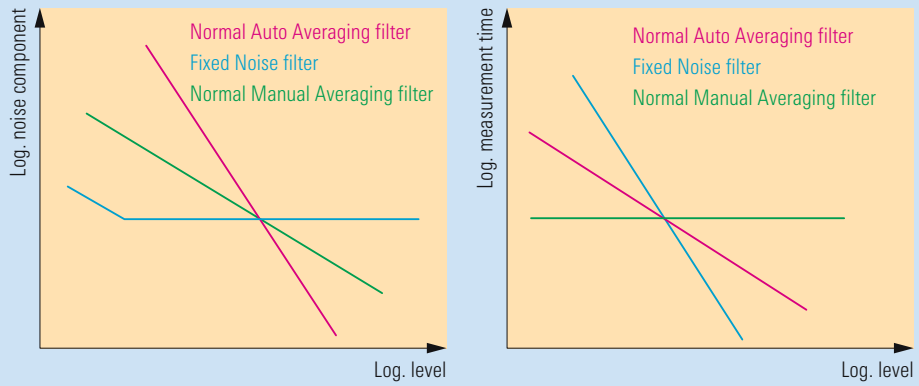

FIG 2 Influence of the Normal and Fixed Noise filters. You can clearly see the advantages of the Fixed Noise filter with respect to noise component for lower powers. The advantages of the filter with respect to measurement time are also obvious.