Application Note for TDA5240/35/25:
Usage of Digital RSSI (RSSIRX) as Noise Threshold in Mass Production

v1.0
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Motivation:

This document describes a method to find a threshold value for the RSSI level to identify good (above noise level) and bad receive signals.
As end-of-line trimming of each mass production module is often not desired (due to calibration time and costs), this method just requires the trimming of one or better more test module(s).
The RSSI threshold level to be used in the application is then calculated based on these measurements and certain offsets to allow for tolerances of the part. These offsets allow the usage of the threshold level without trimming of each board in mass production.
Trimming of test module(s) needs to be done according IFX's AppNote on RSSI trimming (downloadable from our product homepage).

Important Note: Variation of influencing factors of external components (like insertion loss variations of matching network, SAW-filter, antenna, CER-filter, …) are not cover by this procedure and need to be kept in mind additionally.

Procedure:

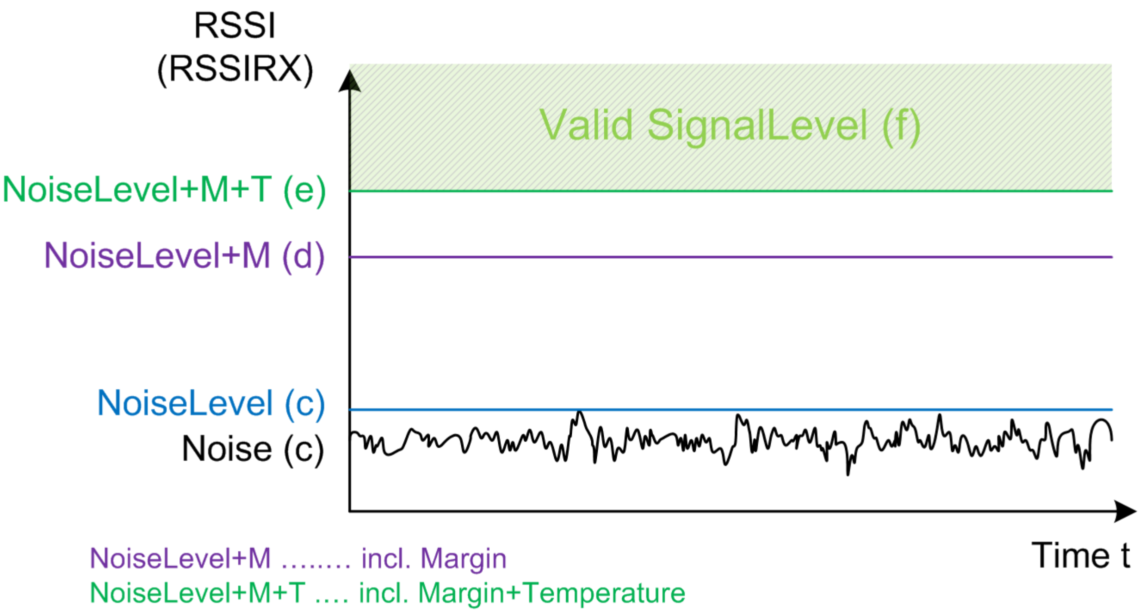

Figure 1: Graphical Overview

a) RSSI trimming procedure (according to IFX's AppNote on RSSI trimming) was already applied to the test module.
b) Test module is used for further measurements now.
c) Noise amplitude is varying, so the noise level does not have a fixed value. Therefore the digital RSSI register (e.g. RSSIRX) should be readout from the calibrated test module several times (at least 10-times or even more often), then calculate AVERAGE and STANDARD_DEVIATION. Now you can calculate either:
    1. **NoiseLevel** = AVERAGE + 2*STANDARD_DEVIATION or
    2. **NoiseLevel** = MAX value of these 10 readouts
d) The test module was already calibrated, so we know the actual position of the readouts from step c) within the -4dB .. +2dB window (see Reference item G2.7 in the datasheet). The worst case in comparison with a mass production module would mean to use a margin of 4dB. The worst case digital RSSI slope of an untrimmed mass production module is 3LSB/dB (see Reference item G2.9 in datasheet). This means 4dB * 3LSB/dB = 12LSB = 12 digits of the RSSIRX readout register. So these 12 digits shall be added to the NoiseLevel
   => **NoiseLevel_inclMargin** = NoiseLevel + 12.
   This result is valid for room temperature.
e) For including temperature an additional margin needs to be added. We assume the customer wants to use one RSSI threshold value, which is same for all temperatures.
    1. The temperature drift range is -2.5 … +1.5 dB (see Reference item G2.3 in datasheet), where:
        i. +1.5dB means +temperature (=> +105° and +85°C)
        ii. -2.5dB means –temperature (=> -40°C)
    2. Using 3LSB/dB of an untrimmed mass production module, this results in:
        i. +1.5dB * 3LSB/dB = +4.5LSB => rounded => +5 digits (for the +temperature area => +105 and +85°C)
        ii. -2.5dB * 3LSB/dB = -7.5LSB => rounded => -8 digits (for the -temperature area => -40°C)

   So the case when the actual RSSI SignalLevel gets smaller (-2.5dB = -8digits) needs to be taking into account, so that the Threshold value gets increased by exactly this value (=> add +8digits to the value of NoiseLevel_inclMargin =>
   NoiseLevel_inclMargin_inclTemp = NoiseLevel_inclMargin + 8.
f) So the actual measured RSSI value in the application would need to be larger than **NoiseLevel_inclMargin_inclTemp** (see Figure1).
g) As mentioned above, insertion loss variations of external components need to be added on top.

Information:

- In case the RSSI decision threshold in the application is set lower than **NoiseLevel_inclMargin_inclTemp**, undesired wake-ups can occur. This means the False Alarm Rate (FAR) can increase.
- An RSSI decision threshold in the application, which is set larger than **NoiseLevel_inclMargin_inclTemp,** can lead to ignoring of detectable signal levels and this means the Missed Message Rate (MMR) can increase.