SPECTRUM ANALYZER SETTINGS – Professional Interference Measurement

Methods for Interference Measurements

During radio planning or installation a site survey is recommended to identify and avoid possible RF interferences or physical obstructions. Important during the check for environmental noise is to make sure that all representative noise sources are switched on, e.g. all suspicious electronic equipment which may be used day-to-day in this environment.

The easiest method to localize radio disturbances is to use the EnOcean handheld field level indicator EPM XXX(C). This simple tool has been developed to support range planning and to quickly indicate an eventual existence of any harmful radio interference. The EPM device is very easy to operate and usually provides all needed information for a trouble-free installation. Please find more information in "AN001 INSTALLATION NOTES" and in the EPM User Manual.

To evaluate and localize the interference (noise) sources in detail, a Spectrum Analyzer can be used. This Application Note specially refers to the noise measurement settings by using a handheld spectrum analyzer (SA).

Interference measurement with Spectrum Analyzer

1. Basic recommendations and settings by using a Spectrum Analyzer. Please also consult your particular SA operating instructions.
   a. Use always a reference antenna (e.g. λ/4, magnetic base mounted onto a metal ground plate) to obtain accurate results.
   b. For noise floor measurements always use an external preamplifier with a known, higher gain, 20 to 40dB greater, and a lower noise figure. In this case make sure that the internal preamplifier is switched off (Setup/Hardware). Don't forget to take the additional gain into account by evaluating the real noise floor.
   c. Make sure that there is no attenuation switched on at the spectrum analyzer.
   d. Center Frequency (CF) at the working frequency = e.g. 315.0 MHz, 868.3 MHz, 902.28 MHz.
   e. Recommended Resolution Band Width (RBW) = 300 kHz.
   f. Recommended Video bandwidth (VBW) = 300 kHz.
   g. Recommended SPAN = 1 MHz.
   h. Recommended TRACE = MAX HOLD.
   i. REF LEVEL = -40 dBm* (to be optimized according the particular amplifier settings and maximum expected input signal level).
   j. RANGE = 10 dB/div.
   k. DETECTOR = MAX PEAK (AUTO).
   l. Sweep Time (SWT) = AUTO.
   m. The sampling time is subject to personal assessment of the environment and its potential interfering noise sources.

2. Analyze and Evaluation. In the following please see two (Fig. 1 and Fig. 2) typical "uncritical" screen shot examples for comparison:

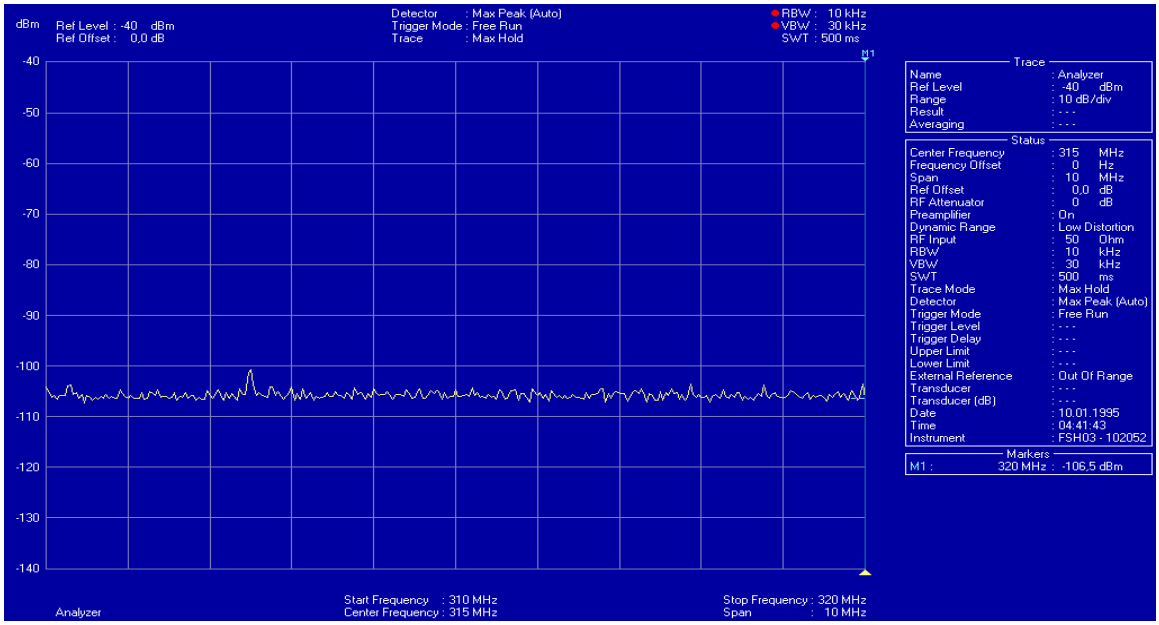

Fig. 1: Typical site survey without preamplifier

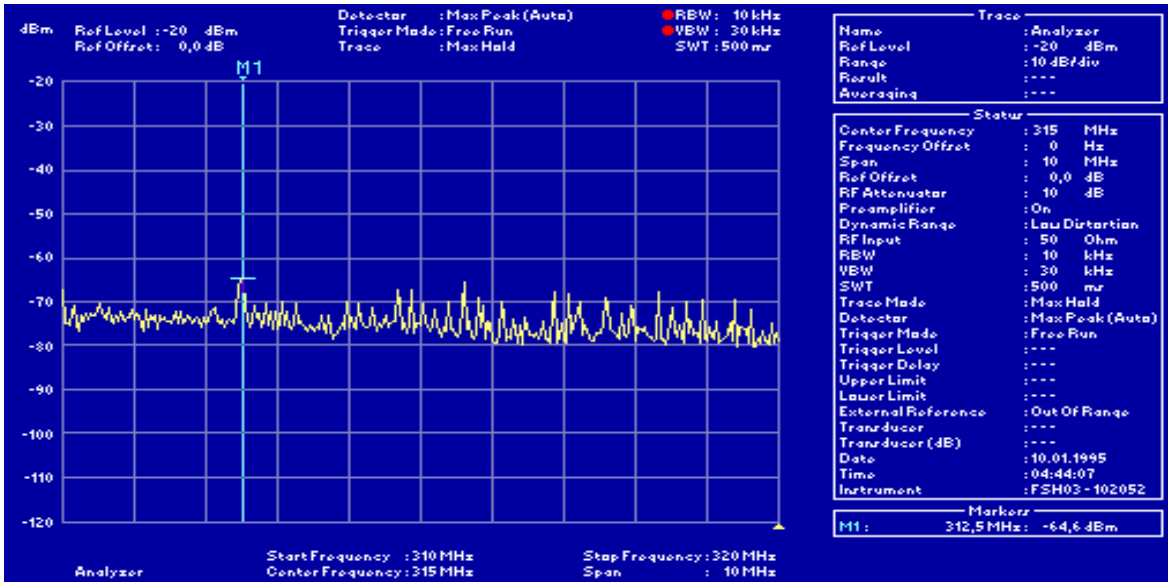

Fig. 2: Same with external preamplifier. Please note the higher floor level due to the additional external preamplifier (preamplifier gain: +37 dB)

Please also check the particular harmonics and "mirror frequencies" caused by intermediate frequencies due to receiver own local oscillators and mixers of the working frequency. Critical noise can be excluded if no peaks higher than typically –100 dBm within ± 1 MHz

range at working frequency and about -60 dBm around the above mentioned additional frequencies, e.g. for 315.0 MHz: at 629.4 MHz and 944.163 MHz, see Fig. 3.

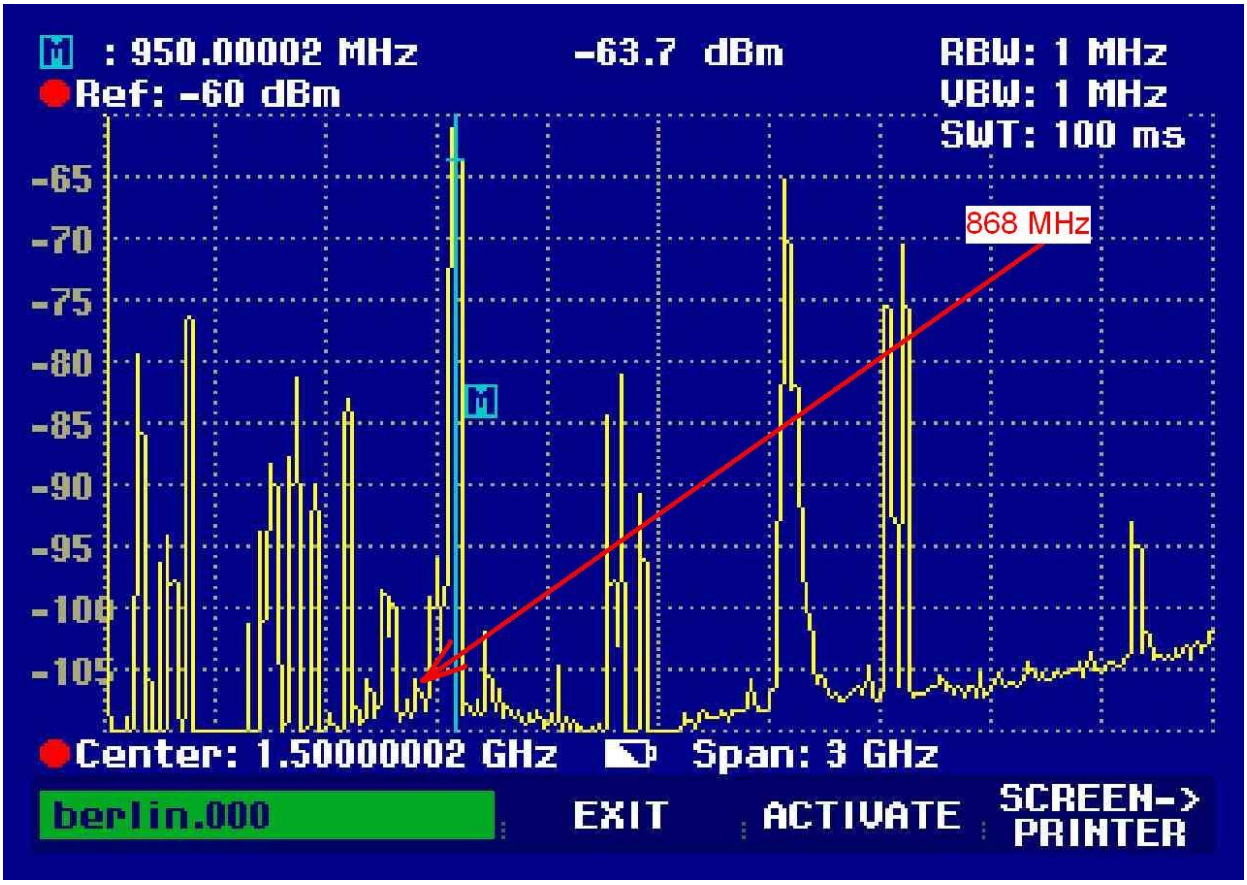

Fig. 3: A Very strong jammer sample was recorded near a wide band power radio transmitter with directive antenna. It is very clear to see here that there are the high levels around the 150, 600, 950, 1400, 1900, 2200 MHz frequency range.

To analyze other perturbations outside of the working frequency, set the spectrum analyzer to the observed peak frequency as CF, in sample mode (not MAX HOLD) and use the time domain setting zero SPAN to analyze the repetition rate and the duration time of the noise source.

Note also that higher noise figures do not typically interfere with EnOcean telegrams. A need to determine the frequency, typically duration and repetition rate of these peaks. Rare noise or RF signals shorter than about 12 ms are not critical. High repetition of these signals will however cause interference on a statistical basis depending on the repetition rate. Conclusions can then only be drawn in terms of averages and probabilities.

Please feel free to call us with questions or for help with an interpretation of your measurements. To help us with the evaluation, please have the following information available: type of antenna and preamplifier (Gain/Noise Figure) as well as screen shots of the spectrum analyzer measurements together with the setup figures and sampling times.

Some Background to EnOcean Telegrams

All EnOcean Telegrams consists out of three to five identical (redundant) sub telegrams which are transmitted within a short time period with varying delays between. The number of sub telegrams and their respective delays were chosen to minimize possible effects of distracting noise and to optimize redundancy. For a proper function it is sufficient the receipt of a single sub telegram.

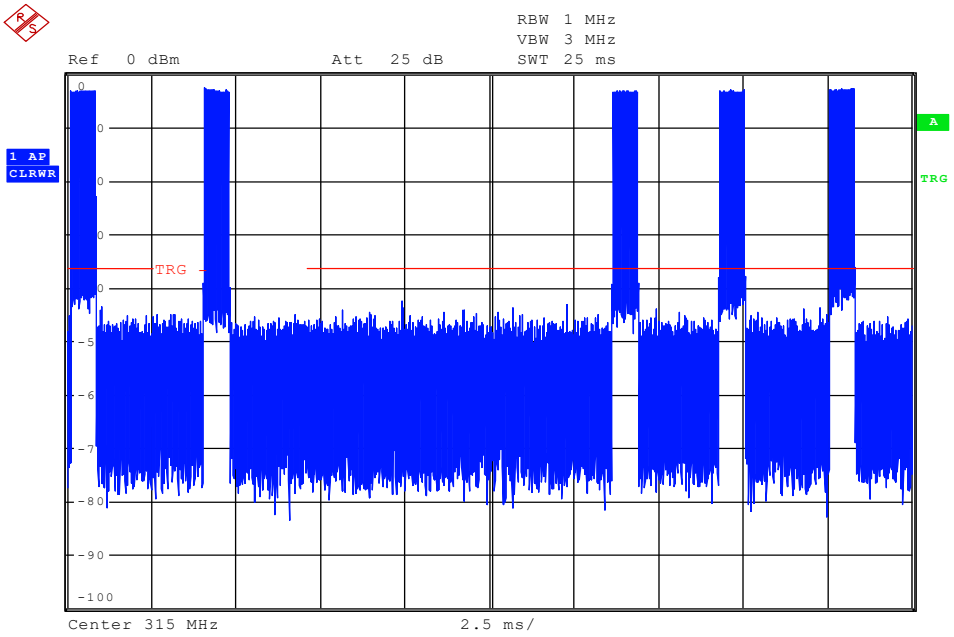

Fig 4: PTM200(C) Sub Telegram Timing

Figure 4 shows the timing sequence of one typical PTM200(C) telegram: each of the five sub telegrams is about 0.7 ms long. The delay between the first and second sub telegram is 4ms. After a minimum delay of 8ms a third sub telegram with an additional pseudorandom delay of 0, 2, 4 or 6ms is sent. After the third sub telegram, up to 2 additional sub telegrams with fixed timing may follow, dependent on the available energy.

Disclaimer
The information provided in this document describes typical features of the EnOcean radio system and should not be misunderstood as specified operating characteristics. No liability is assumed for errors and / or omissions. We reserve the right to make changes without prior notice. For the latest documentation visit the EnOcean website at **www.enocean.com**.