

FINAL UNIT TEST FOR RADIO PERFORMANCE – How to verify your final unit radio performance

1. ABSTRACT

The proposed test procedure helps to verify your final unit radio performance. Three different product types are considered:

1. **Transmitter unit test, unidirectional only (Tx-DUT)**
2. **Receiver unit test, unidirectional only (Rx-DUT)**
3. **Transceiver unit test, bi-directional (TxRx-DUT)**

This test is easy to handle and should not require sophisticated tools, or RF anechoic chamber, only an EDK 300(C) and an EPM 300(C). It should be a basic assessment method to quickly estimate radio performance and should be performed on your final product before going into field tests and or certification.

Please note:

- *The DolphinView RSSI level indication tool does not replace calibrated "measurement tools"! The basic final unit assessment described hereby has nothing to do with laboratory "measurements" and does not replace any sophisticated radio lab tests and approvals! However, it is a good indicator of relative performance.*
- *Radio performance depends on antenna type, final housing material, near-field installation environment (recessed in-wall mounted is worse than surface-mounted), and obstacles and reflections in the radio path strongly define results, as will building architecture, furniture, people (that's why these basic tests are based more on unit comparison under real-world situations). Physics dictates that we can't expect a small sized receiver unit with internal antenna to perform as good as another unit with external antenna. With any RF device, environmental metal and concrete surfaces can strongly influence the radio performance.*

1.1. Related documents

1. [AN005 RADIO SYSTEM DEBUGGING](#)
2. [AN101 POWER SUPPLY LAYOUT](#)
3. [AN102 ANTENNA DESIGN](#)
4. [AN507 Radio approval](#), [AN507SW.zip](#)



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Up-to-date documentation <http://www.enocean.com/>

1.2. Revision History

No	Major Changes
Dec. 11	Initial version

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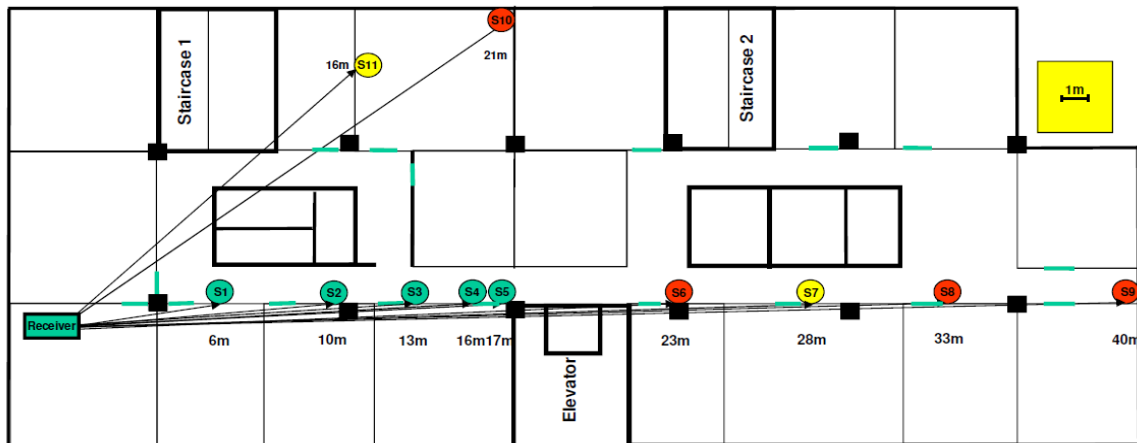
2. TEST SETUP – WHAT’S REQUIRED?

- DUT “Device Under Test” (Tx-DUT, Rx-DUT or Tx/Rx-DUT)
- EPM 300(C) as reference Tx = EPM1 (alternatively PTM based reference Tx, see 3.1.1)
- EVA 300(C) with TCM 3x0(C) as reference Rx using DolphinView = EVA1
- Reference TEST PATHS with different “reference locations”, see following description.

2.1. Defining representative “TEST PATHS”

Define several in-building “radio test paths” between both Tx / Rx units. Because relative tests will be processed, the path selection is not critical but should be representative for environments where the device will typically be used, see Figure 1.

Figure 1 Office example, reference locations for range evaluation, only as orientation



LEGEND: S1...S11 = orientation marks e.g. for Tx (transmitters), e.g. green good RSSI, yellow less good and red poor received RSSI levels.

Place first the EVA1 (as reference receiver) in the desired receiver reference location and connect to a PC for visualization and start DolphinView. Take the EPM1 (as reference sender) and set it into mode “Radio Link Test” which transmits a reference telegram every 2 seconds. Identify and select its ID on DolphinView. Now walk through the floor holding the EPM1 and locate several reference locations with very good to poor or no RSSI at the EVA1 receiver. Record and mark those reference values and locations on the building floor plan. Please note that locally strongly different values can be indicated for multi path effects, so for test interpretation please consider a statistical clear majority.

Important note:

Please take care that no active radio repeaters are in the test area. Having repeaters active would lead to false test results. Please use e.g. DolphinView to identify repeated telegrams! Always refer to the actual measurements since propagation conditions, interference noise level are never constant at your location (no laboratory conditions)

Please note that the performance of the DUTs strongly depends on the local installation (in-wall, on-wall, near metal, on-to metal, etc.), holding position and so on. So the reference locations should be placed similar to expected field installations for this particular product.

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3. TEST PROCEDURE FOR RX/TX DUT (DEVICE UNDER TEST)

Please note that test values can be influenced by multi path effects, persons etc. So for test interpretation please consider a statistical clear majority (after e.g. 30 measurements). Also please don't hold the EPM1 or Tx device in your hand during these evaluations to avoid any external influences of the body (near field) on the antenna.

3.1. Receiver Unit Test

- 3.1.1. If the Rx-DUT is a gateway (serial interface device) install the Rx-DUT on the receiver reference location and connect to a PC, similar to EVA1, while operating reference sender EPM1 e.g. in Radio Link Test mode from different reference locations. It is sufficient to visualize now the received EPM1 Telegrams on PC e.g. using the DolphinView.
- 3.1.2. If the Rx-DUT is e.g. an actuator, please modify first the RX-DUT FW (for Test only) to understand / indicate EPM cyclic Tx signals (sent from EPM1 in Radio Link Test mode) Alternatively you could use therefore a reference PTM xx0(C) based radio switch transmitter with well defined antenna shape and known performance.

If the Rx-DUT misses telegrams from locations which could before be received by the EVA1 reference receiver, this does indicate need for improvement.

Important note: especially for receivers, a poor receiver performance is not always an antenna issue, it could also be a self induced interference issue due to insufficient power line/digital noise filtering (own noise). With increasing noise levels emanating from other components within your own device it's possible the radio will no longer recognize radio signals. In this case, you will not be able to see ANY EnOcean telegrams with a RSSI of less than e.g. -72 dBm instead of <-92 dBm, see Figure 2 and 3.

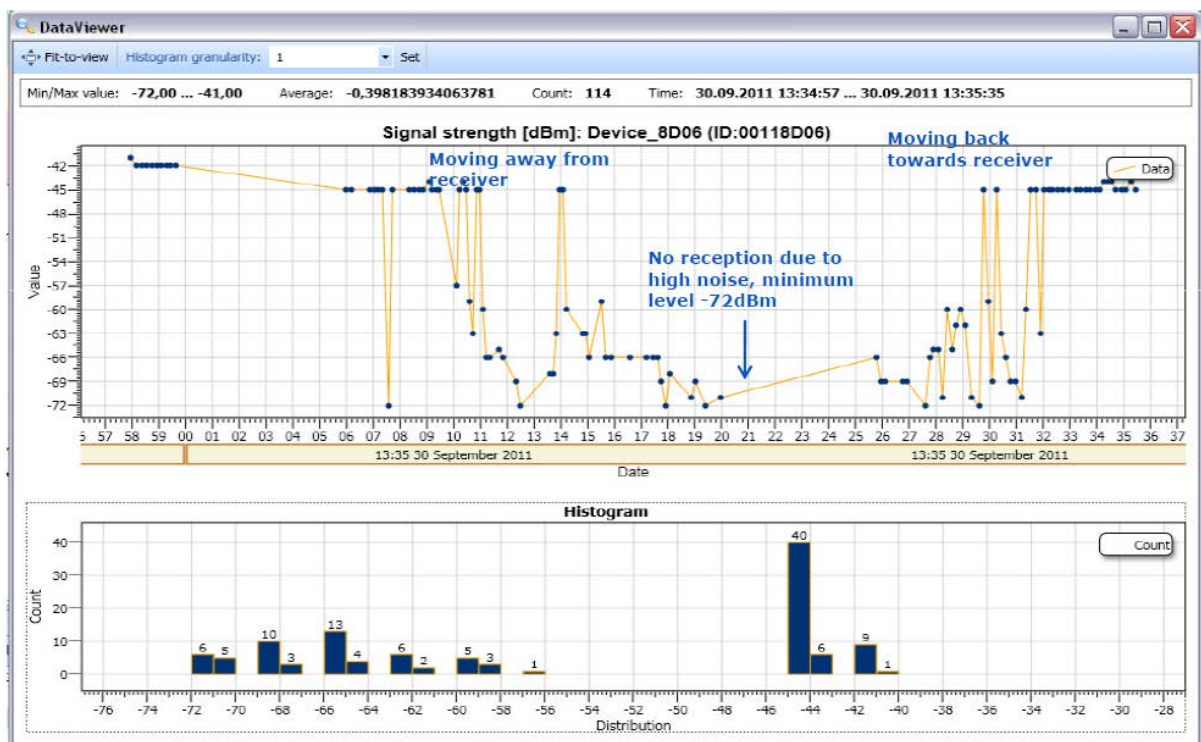


Figure 2

FINAL UNIT TEST FOR RADIO PERFORMANCE

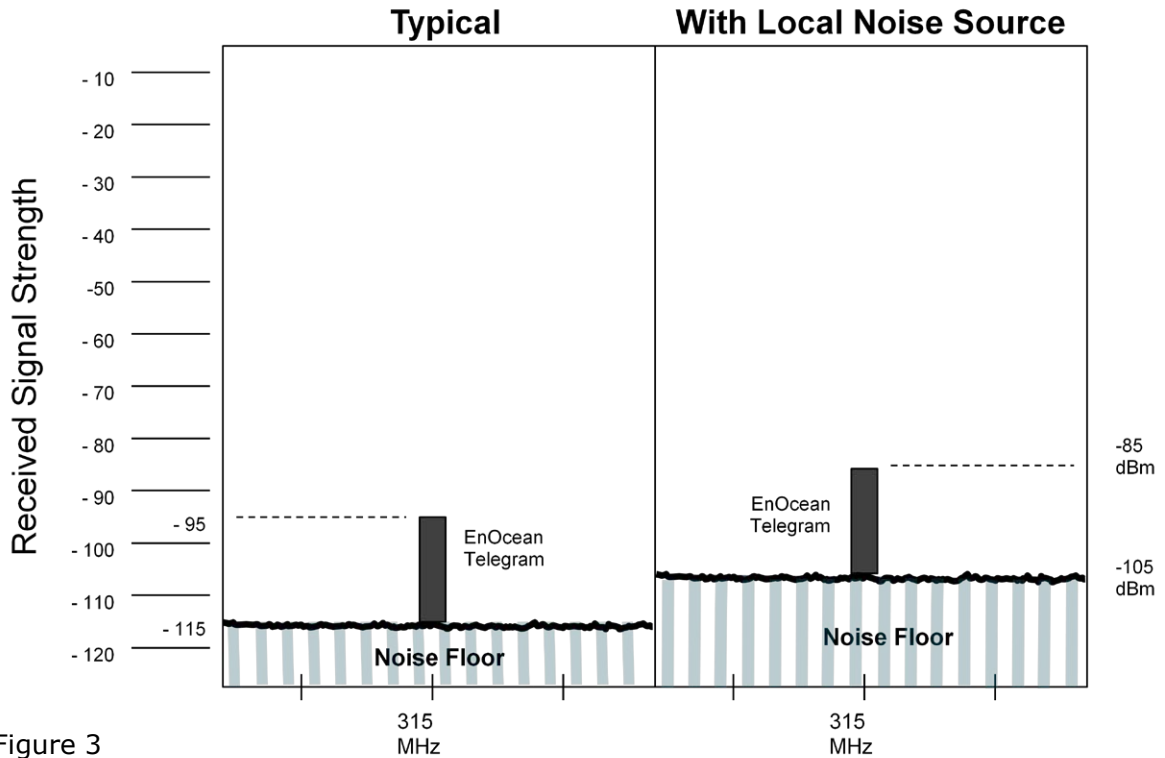


Figure 3

EnOcean Telegram Detected At:	-95 dBm Maximum Range	-85 dBm 10 dB loss of Range
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3.2. Transmitter Unit Test

Replace reference sender EPM1 Tx by the Tx-DUT. Test the received signal strength with EVA1 at the predefined reference receiver location. If there is significant range loss or lower RSSI values of the Tx-DUT compared to the EPM1-reference-transmitter you need to improve the radio performance of your Tx-DUT (Please consider therefore possible improvements regarding antenna, noise filtering and/or radio settings, see related documents).

3.3. Transceiver Unit Test

To determine the performance of each single function on their own merits, please test the transmitter and receiver separately. This will allow you to better isolate single potential RF trouble sources (e.g. own noise issues).

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