

BASIC FINAL UNIT TEST FOR RADIO PERFORMANCE – How to define a major antenna integration problem

Intention of this Application Note

The test procedure proposed in this paper could help to assess whether a final product design has any major issues with 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 very easy to handle and should not require sophisticated tools or knowledge! It should be a very basic assessment method to quickly identify major radio performance problems with a device and **should be performed as minimum radio performance test of the final unit before going into field tests.**

Please note: The EPM level meter is designed to be a low-cost tool for installers but it is not a precision "measurement tool"! The very rough final unit assessment described hereby has nothing to do with "measurement" and does not replace any sophisticated radio lab tests! However, the EPM is a good indicator of relative performance. By establishing a good baseline for RF range using 2 EPMs, one can then alternatively replace a TX or RX device for one of the EPMs and compare performance, if less than that achieved by 2 EPMs, then improvements should be made to the Tx or Rx device.

Please note: Radio performance depends on antenna type (don't expect that a small sized receiver unit with internal antenna will perform as good as another unit with external antenna), on final housing material (perform final tests with final housings), near-field installation environment (recessed in-wall mounted is worse than flush-mounted, metal and concrete surfaces can strongly influence the radio performance) and obstacles and reflections in the radio path strongly define results as building architecture, furniture, people (that's why this basic tests are based on unit comparison).

Test setup – What's required?

- 1) DUT "Device Under Test" (Tx-DUT, Rx-DUT or TxRx-DUT)**
- 2) 2 EPM radio level meters (EPM 1 and EPM 2)**
- 3) For Rx-DUT test: If not given, please modify the RX-DUT to understand / indicate EPM cyclic Tx signals (send from EPM in "radio link test" mode)**
- 4) Reference TEST PATHS with different "Reference Locations" (REF x), see the following description**

Test setup – Defining "TEST PATHS" (that indicate EPM "Low Signal")

- 1) Define several in-building "radio test paths" between both EPM units. Because relative tests will be processed, the path selection is not critical but should be representative of typical environments where the device will be used.

BASIC FINAL UNIT TEST FOR RADIO PERFORMANCE

- 2) **Please take care that no active radio repeaters are in the test area.** Having repeaters around would lead to wrong test results. If not known, please use the telegram visualization software DolphinView (part of the EDK 300 development kit) to identify repeated telegrams.
- 3) Place EPM 1 at a REF 1 location and set it into mode "Radio Link Test", which transmits a cyclic reference telegram every second. Place EPM 2 into 'Hold Short' mode, and walk through the building holding the EPM 2 and locate several "REF x" places with "Low Signal" indication (around 3 of such reference locations is a good number). Please note that locally strongly different values can be indicated for multi path effects, so for test interpretation please consider a statistical clear majority. Mark those REF x places into a building plan.
- 4) Please note that the performance of the DUTs strongly depends on the local installation (in-wall, on-wall, near metal, on-to metal, etc.). So later the DUTs and now the REF x locations should be placed similar to later practical fitting situations. **Place the EPMs in horizontal position and don't hold them in the hand.**

Test procedure for DUT

Please note that test values can be influenced by multi path effects. So for test interpretation please consider a statistical clear majority (after e.g. 30 measurements).

Path direction is not 100% reversible for multi path effects. So please consider the same radio direction as defined during "test setup".

a) TRANSMITTER UNIT TEST (shall conquer the test paths)

Replace REFERENCE sender EPM 1 by the Tx-DUT. Test the received signal strength with EPM 2 (High / Low / No Installation, the latter means this is not a good location for a device to be installed) at the defined REF x locations. If there is significant range loss of the tested transmitter device Tx-DUT compared to the EPM 1 reference sender (for example EPM 2 illuminates the No Installation LED or you miss Tx-DUT Telegrams), you have to improve the radio performance of your TX-DUT.

b) RECEIVER UNIT TEST (shall conquer the test paths)

Install the Rx-DUT at the different REF x receiving locations while operating EPM 1 in Radio Link Test mode. If the Rx-DUT device under test misses telegrams, or otherwise does not receive at the level of the EPM 2, you have to improve the radio performance of your RX-DUT.

c) TRANSCEIVER UNIT TEST

Test receiver and transmitter function of DUT separately

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