WT32i RANGE TESTS

APPLICATION NOTE

Wednesday, 11 September 2013

Version 1.0

VERSION HISTORY

Version	Comment
1.0	Release

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1 Introduction

2.4 GHz RF signal is strongly impacted by any obstacles within the RF path. Thus defining a range for a Bluetooth device is more or less question of how to determine the range. For example a radio located in a headset has much shorter range than a radio that is “floating” in free space because human head has an impact on the RF field. A person usually doesn’t keep his head so that the antenna is pointing directly towards the transmitter so occasionally the head is within the RF path and will attenuate the received RF signal.

To determine the range for WT32i, it was tested in an airfield using an A2DP connection between two DKWT32i boards. The result does not guarantee practical range for real application. The result should be considered as maximum theoretical range. In a practical application the range can be much shorter because the orientation and height of the antenna can’t be controlled and also typically there are obstacles within the RF path which will attenuate the signal significantly.

In practical application the range is impacted by:

- Persons / obstacles moving close to the antenna. This is because of multipath propagation and will have an impact even if the person is not in line of sight between the two radios.
- Any obstacles within the RF path
- PCB layout around the antenna
- The shape of the PCB
- The mechanical design of the end product

Because the range is impacted by many factors which are difficult to control, the practical range must be tested with the end product and the application should not be design based on the maximum theoretical range because the practical range will always be shorter.

2 Test Setup

WT32i range was tested in an open airfield by creating an A2DP link between two DKWT32i boards and by streaming music from one board to another. The setup is shown in Figure 1. The boards were at 1.2 meter height from the ground. The range was determined at the distance where the audio quality was starting to reduce significantly.

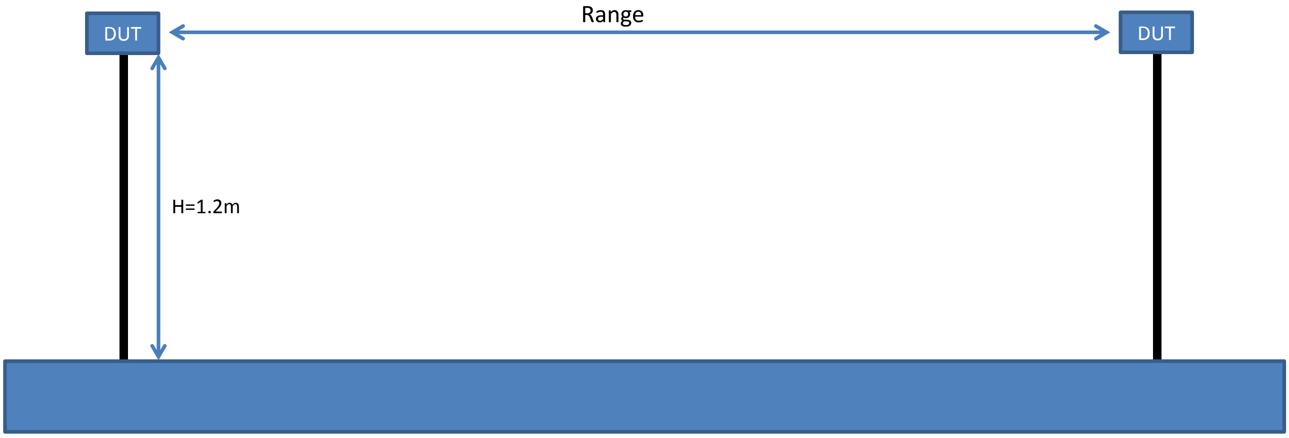

Figure 1: Range test setup for WT32i

3 Results and Analysis

3.1 Test Results

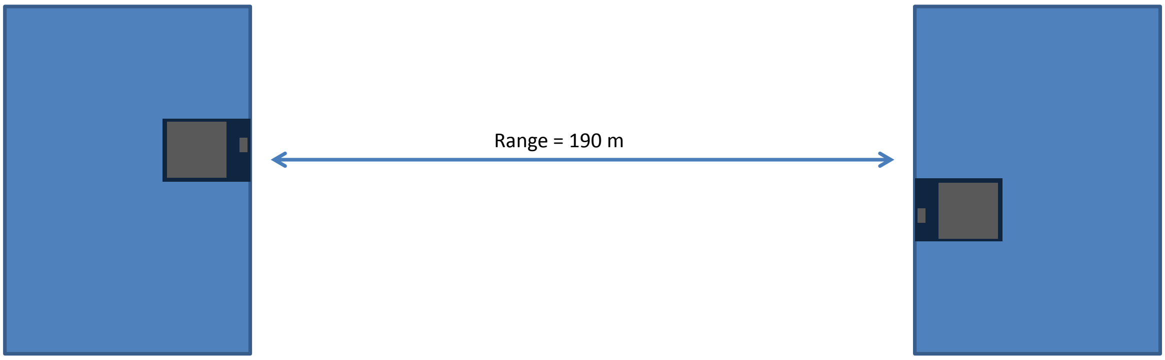

Figure 2: Range front to front direction

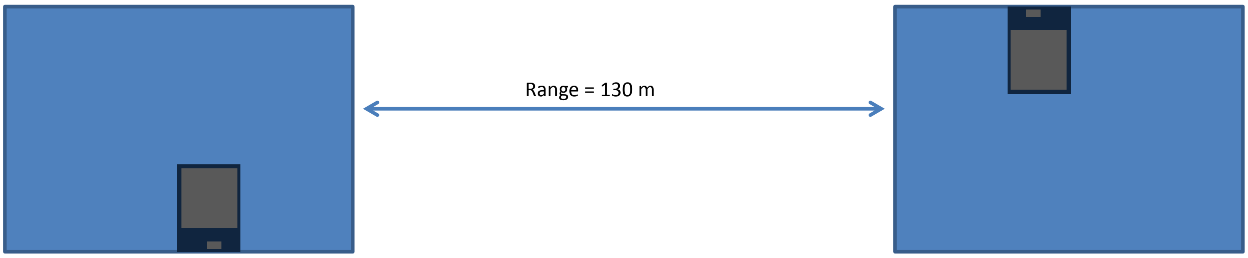

Figure 3: Range left to left direction

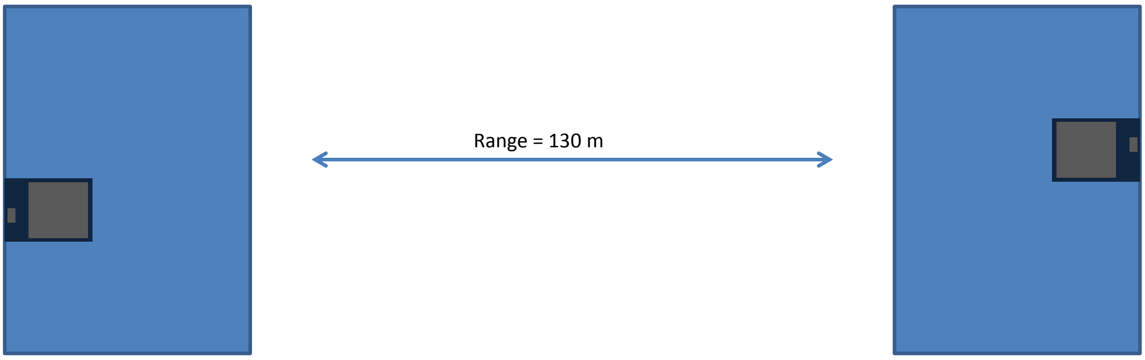

Figure 4: Range back to back direction

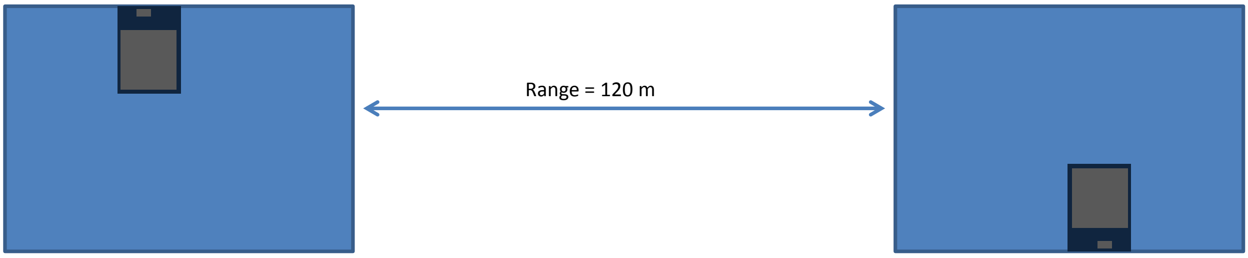

Figure 5: Range right to right direction

3.2 Analysis

The radiation pattern of DKWT32i is shown in the Figure 6. The radiation patterns of DKWT32i can be found in the datasheet of WT32i. The radiation patterns show the antenna attenuation -3 dB in the front direction and about -5…-10 dB in left and right side and back directions.

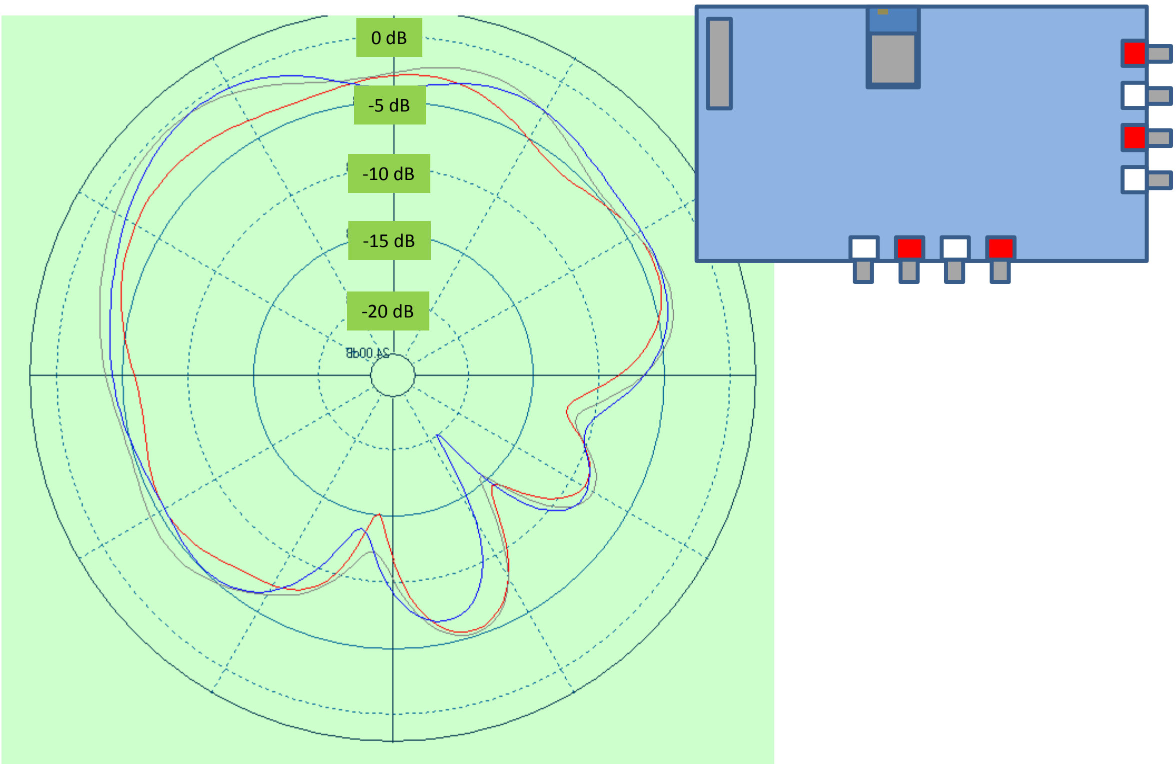

Figure 6: Radiation pattern of WT32i

By taking into account the antenna attenuation the RF link budget becomes:

- Front: 6 dBm (TXP) + 89 dBm (RX sensitivity) – 6 dB (antenna attenuation for both TX and RX) = 89 dB
- Sides @ -5 dB attenuation: 6 dBm + 89 dBm – 10 dB = 85 dB
- Sides @ 10 dB attenuation: 6 dBm + 89 dBm – 20 dB = 75 dB

The theoretical RF path loss in an open field is shown in the Figure 7. Reading from the figure the maximum theoretical range for WT32i when the antennas are 1.1 meters above ground is:

- Front: 200m
- Side @ -5 dB antenna attenuation: 150m
- Side @ -10 dB antenna attenuation: 80m

Thus the tested range is well in line with the theoretical range estimated based on the measured antenna radiation pattern.

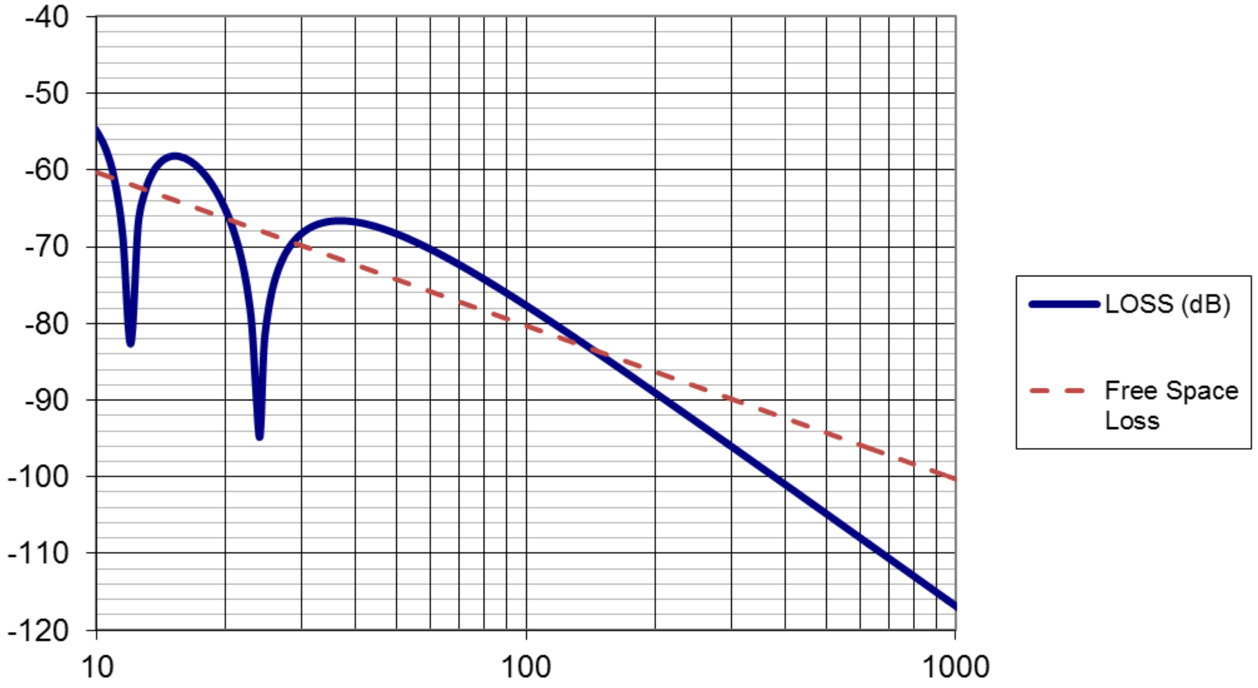

Figure 7: RF path loss in an open field with antennas 1.2 meters above ground

3.3 Conclusions

The range of DKWT32i vs DKWT32i was tested in a controlled environment in an open field with antennas located 1.1 meters above ground. The results were compared to theoretical range based on the measured TX power, RX sensitivity and the antenna radiation pattern.

The measured range was well in line with the theoretical range and thus the range of DKWT32i can be estimated accurately based on the given TX power, RX sensitivity and the antenna radiation pattern. Looking at the radiation pattern shown in the Figure 6 and the other radiation pattern shown in the datasheet of WT32i, one can see that the attenuation is less than 10 dB to almost any direction. Thus, in line of sight, 80 meter range can be considered to be reliable to any direction.

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