Error prformance of the BiM Tranceiver with RPC & Effects of Frequency Error on receiver Sensitivity

Application Note: 100

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Introduction

The Radiometrix Radio Packet Controller (RPC-000) is designed to give maximum bit rate communications through a BiM-UHF Transceiver at 40 kbits/s. It is designed to have High Receiver Sensitivity with Wide Frequency Tolerance. This experiment was carried out to prove its performance quantitatively.

Test Setup

RPC Packet Generator produces a stream of data packets with fixed interval between them. These packets are taken out from TXD output and fed to Filter circuit to get the right signal level & frequency needed by the Signal Generator to generate a Frequency Modulated RF output which is fed to the BIM Transceiver. If the check sum succeeds, the RXR is set LOW, which discharges the Capacitor. It is reset to HIGH when a corrupted data packet is received, which charges up the capacitor. RF Output Level was varied, which effectively varied the Signal to Noise ratio. The Voltage across the capacitor gives the Average Percentage of Packet Error

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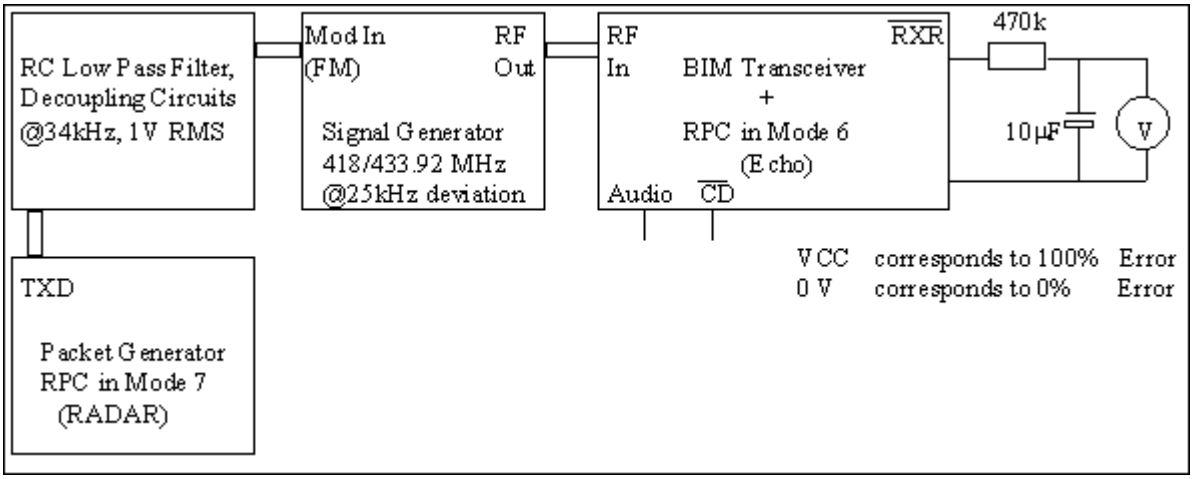
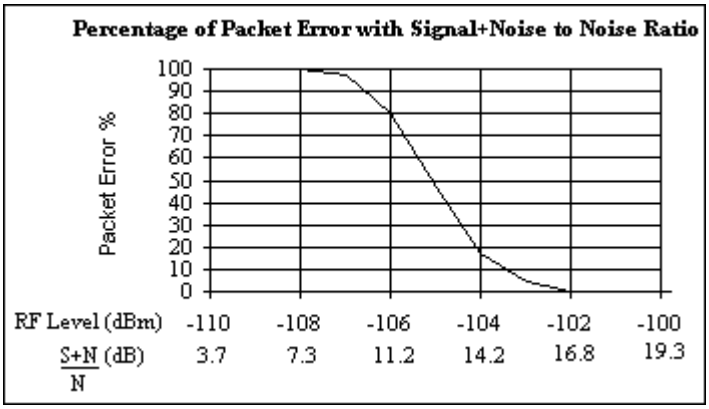
Figure 1



(S+N)/N was measured by taking the ratio of the Audio output level with & without FM deviation.

Figure 2.

The graph on the right shows the result obtained. RPC can receive data packets without any Packet Error above an RF level of -101dBm (2µV). This corresponds to Signal+Noise to Noise ratio of 18 dB.



Percentage Error graph was given here instead of Bit Error Rate (BER) graph because it is more practical and convenient to interpret the performance of RPC.

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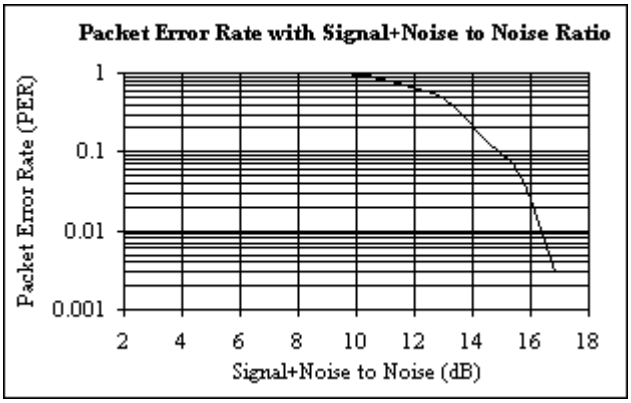
Figure 3.

Note:

1 Test Packet is 13.8ms long, consisting of 5ms of preamble

and 8.8ms of data & check sum code. Each data/checksum code bit is 25µs (40 kbits/s) wide.



Number of data & checksum bit per packet is 352 bits/packet

$$PER = \frac{\text{Packet Error \%}}{100} \quad BER = \frac{PER}{352} \quad \text{For } PER < 1$$

For example 10% Packet Error (PER=0.1) is equivalent to $BER = 0.3 \times 10^{-3}$ or 1 Bit Error in 3520 bits!

Effect of Frequency Error on Sensitivity of Receiver

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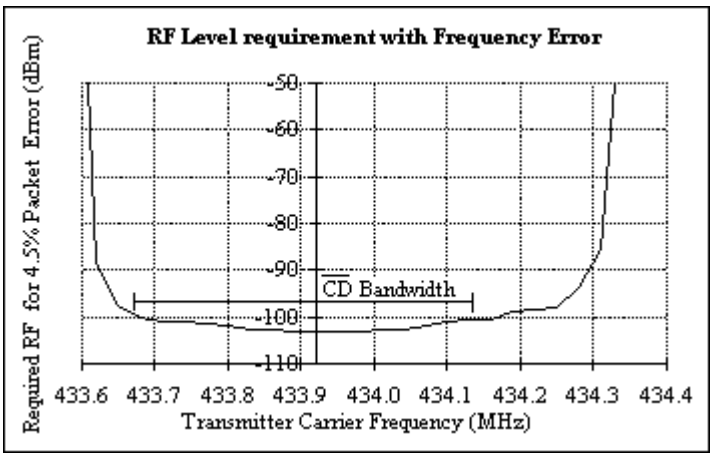
Test Setup

The same setup was used but this time the Signal Generator Frequency was varied and the RF level was adjusted to get same voltage on the voltmeter.

Figure 4.

The graph on the right shows the RF level required for a constant 4.5% Packet Error when the Transmitter Carrier Frequency drifts. RPC receiver has a frequency tolerance greater than 200 kHz.



Note:

The Carrier Detect has a smaller bandwidth compared to the actual RPC receiver bandwidth.

Conclusion.

For reliable data communication using RPC Signal+Noise to Noise ratio should be above 18dB or the RF power level at the RF input should be greater than -101 dBm (2µV).

The frequency error tests demonstrate negligible loss of sensitivity under worst case TX & RX frequency tolerance.

References

[1] Radiometrix BIM-UHF Data Sheet
[2] Radiometrix RPC Data Sheet
[3] Bernard Sklar, Digital Communications-Fundamentals and Applications, Prentice-Hall, 1988.

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