



ITCR 1.0 BER and PER Performance vs. Locomotive Speed

Test Summary Report

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Revision History

Revision	Date	Summary of Changes
1.0	12/13/2012	First draft for FRA.

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1. Executive summary

There is a pending requirement to increase the maximum train speed specification in the ITC requirements from 110 mph to 125 mph. A locomotive with Rel. 1.0 software was tested at various speeds to determine impact on physical layer performance. Uncoded performance at target error rates was very similar at all speeds, whereas coded performance demonstrates a measurable *advantage* at higher speeds.

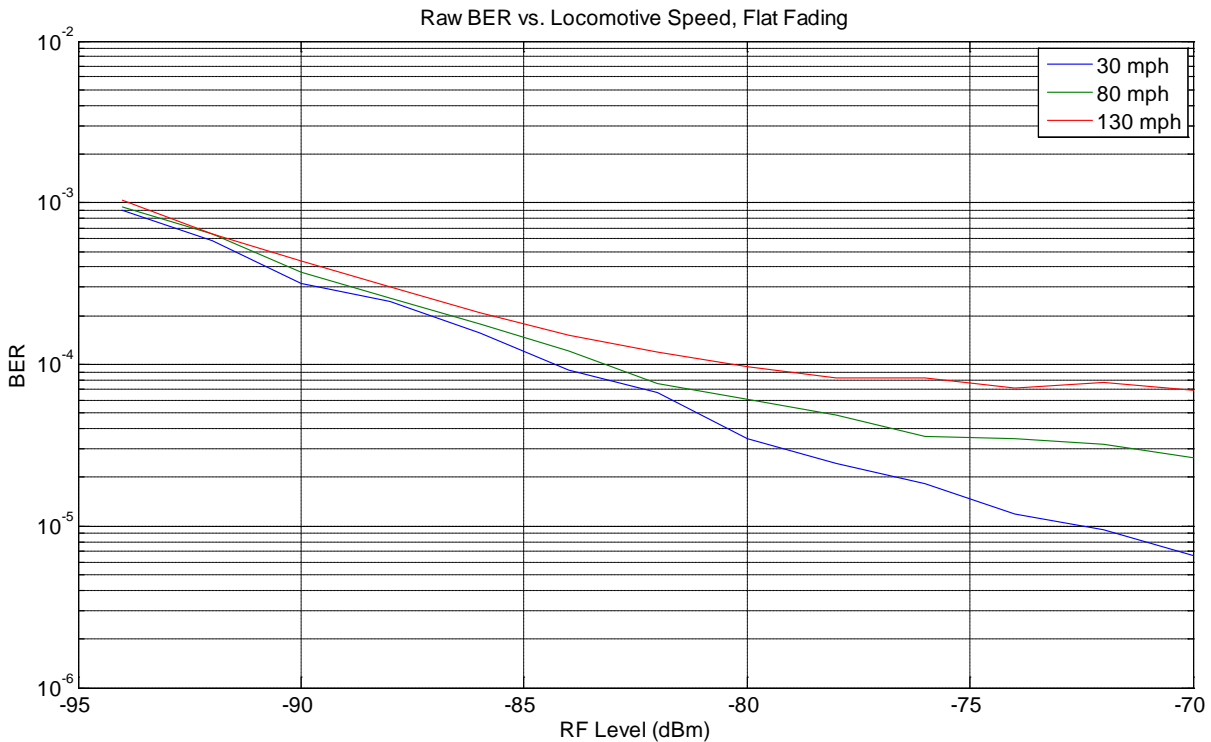
1.1 Overview

This document contains BER and PER plots displaying performance at simulated speeds from 30 mph to 130 mph. Signal strength at the RF input connector was varied from -80 to -105 dBm.

Each data point represents the average of approximately 20,000 packets at full rate DQPSK. The test packets were generated by an R&S SMU200A signal generator with Rayleigh fading envelope and Doppler shift parameterized for vehicle speed.

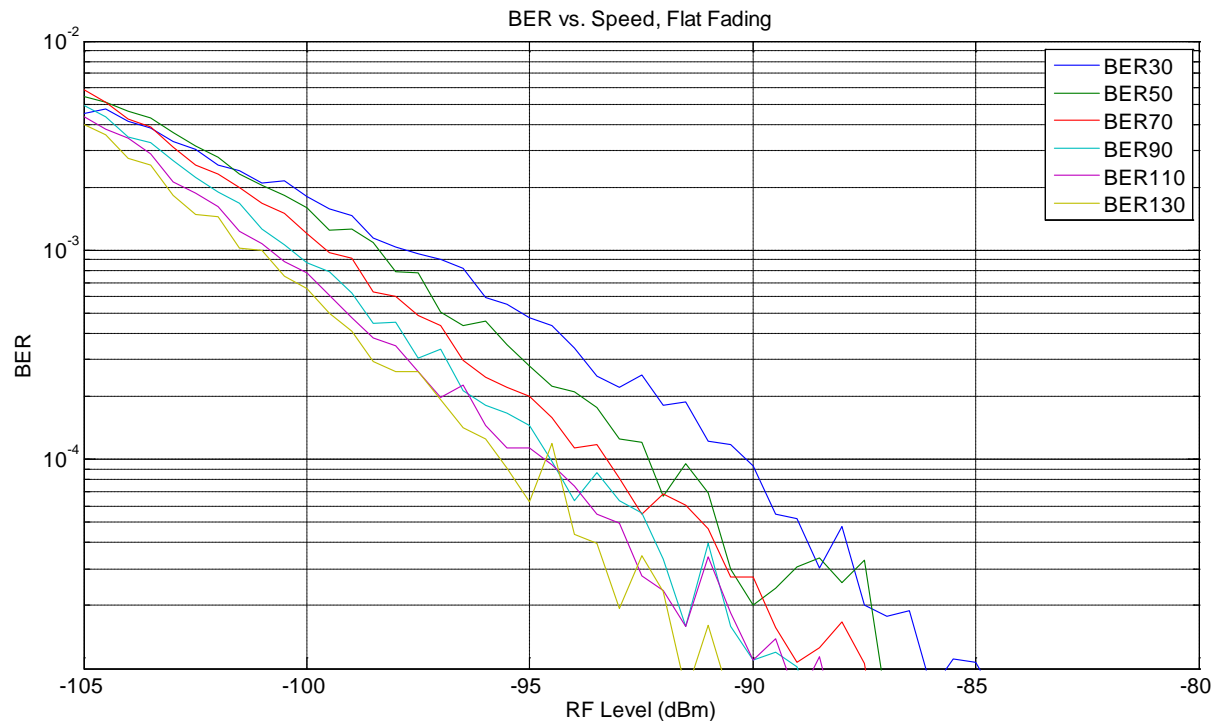
2. Bit Error Rate

2.1 Raw Bit Error Rate (no Forward Error Correction)



At BER levels of $4\text{E-}4$ or above, the performance at different speeds is not significantly different. However, increased Doppler shift results in phase differences between symbols and the effect on error rate can be observed at high signal to noise levels. At 130 mph there is an error floor of $7\text{E-}5$.

2.2 Residual Bit Error Rate (FEC enabled)

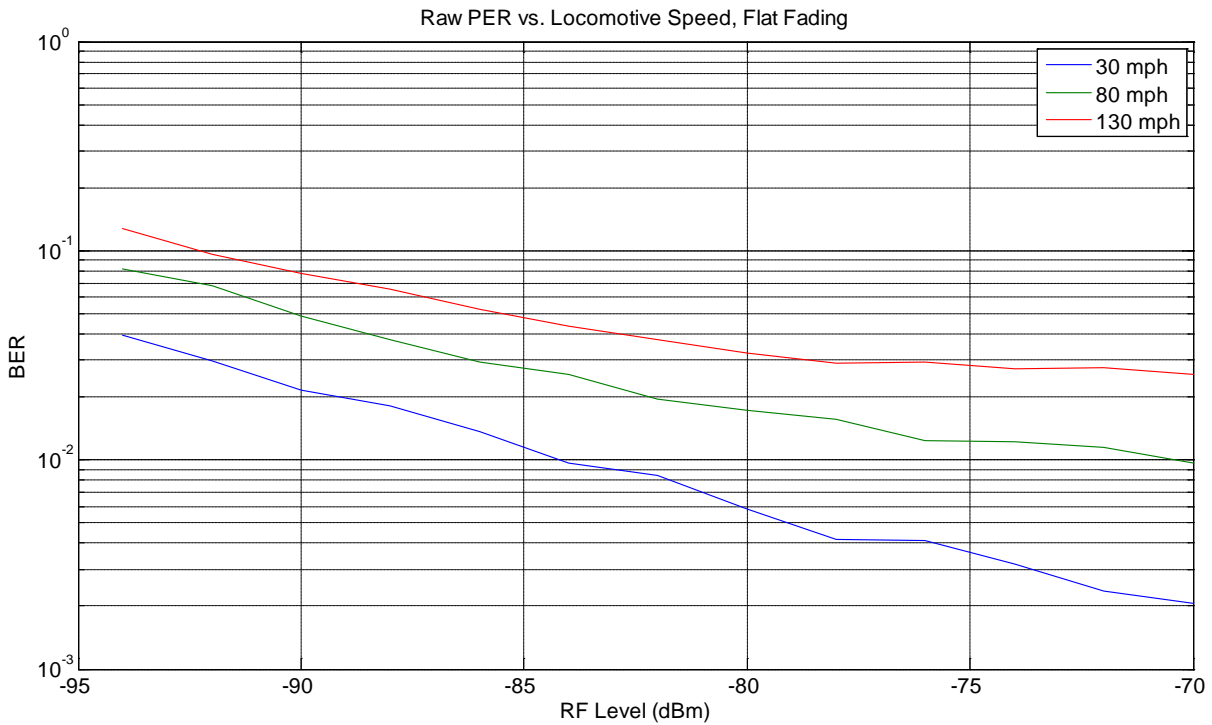


With block error correction in place, however, higher speeds have a noticeable advantage in performance. This can be understood qualitatively by looking at the sample packet amplitude plots in section 4. At slow speeds, fades cause lengthy sections of packets or entire packets to be attenuated. Reed-Solomon FEC cannot correct for more than two blocks in error.

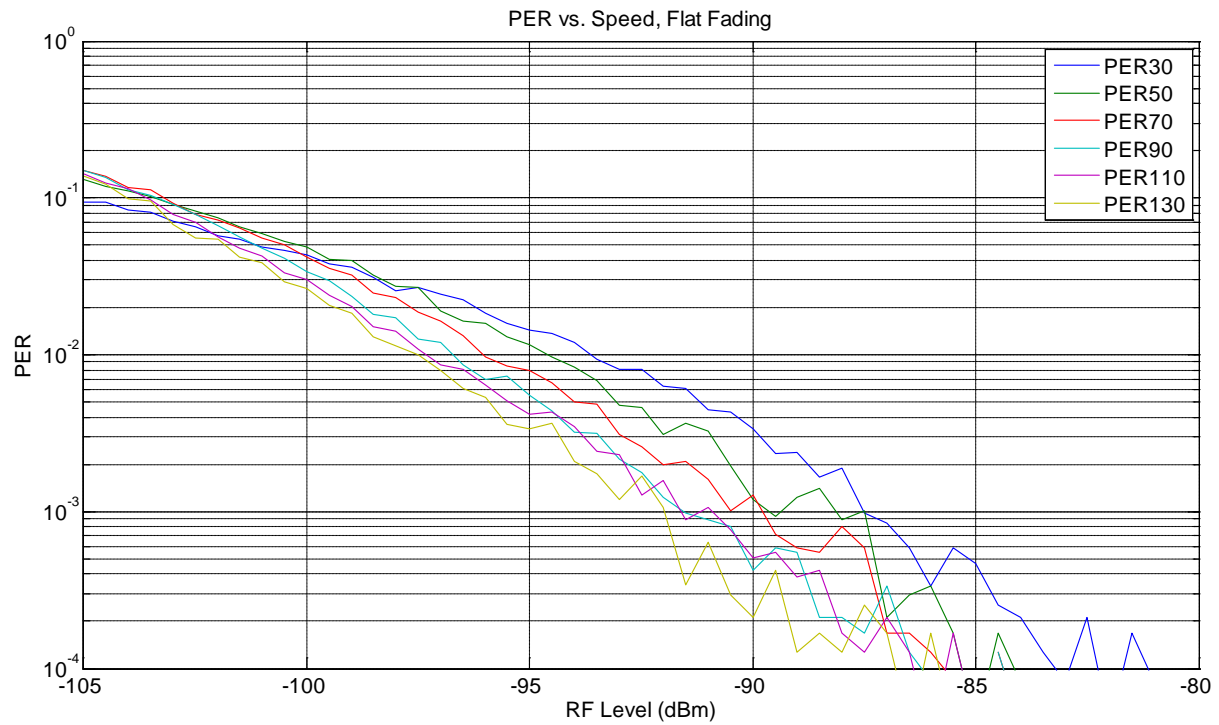
At higher speeds, the fades are much shorter and as a result most of the packet is left intact. FEC is more effective under these conditions.

3. Packet Error Rate

3.1 Raw Packet Error Rate (no FEC)

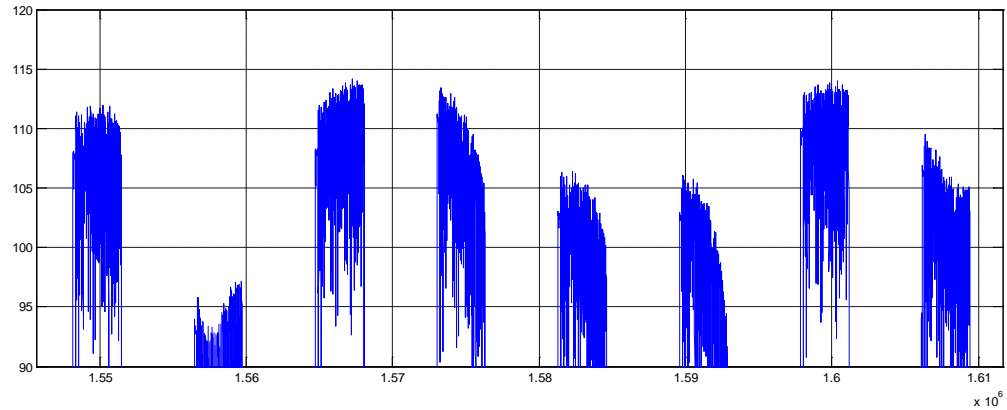


3.2 Residual Packet Error Rate (FEC enabled)



4. Packet Envelope

4.1 30 mph



4.2 130 mph

