Error Correction in the MU-2-R 434 MHz Modem

The Effect of the Reed-Solomon Code

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The Reed-Solomon Code

The Reed-Solomon code was developed in 1960 by Irving S. Reed and Gustave Solomon. The code is a kind of BCH code based on Galois fields (finite fields). It is currently used in compact discs (CDs), terrestrial digital television broadcasting, satellite communications and other applications. When it was first developed, it could only decode one error, but since then, methods such as Berlekamp decoding and Euclidean decoding have been developed that can correct multiple errors. Since each codeword is processed individually, it is particularly suited to the continuous data errors (burst errors) experienced by mobile radio equipment.

The effects of error correction in the MU-2-R

Figures 1 and 2 show Circuit Design's MU-2 radio module. This module uses a UART interface, so the interface connection between the UART of the CPU (RS-232C) is simple. The MU-2-R uses shortened Reed-Solomon 4-level error correction (RS(40,32;4)), and it also has a mode that, combined with interleaving, raises recovery to 25% (10% with no interleaving).

Figure 3 is an oscilloscope image of the impact of multipath effects when the MU-2 is moved around in a mode without error correction. The signals shown are, from the top, the received analog waveform, the received RSSI, and the received data output (UART). The cursor shown on the location of the RSSI waveform indicates the -130 dBm position.

The transmitter is sending the data repeatedly at regular intervals, so normally, the received data output should be arranged at regular intervals. In this example, in the middle of screens shown in Figures 3 and 4, about 3.1 ms of received data is lost, and during this time, received output is not recovered.

Figure 5 is an oscilloscope image of the impact of multipath effects when the module is moved around in a mode with error correction. In this example, in the middle of screens shown in Figures 5 and 6, about 5.25 ms of received data is lost, but during this time, the received output is recovered normally. This shows the effectiveness of error correction.

These examples show correction of burst errors, but with random errors as well, we have confirmed a coding gain of around 3 dB with a non-interleaved mode and 5 dB with an interleaved mode.

Figure 1

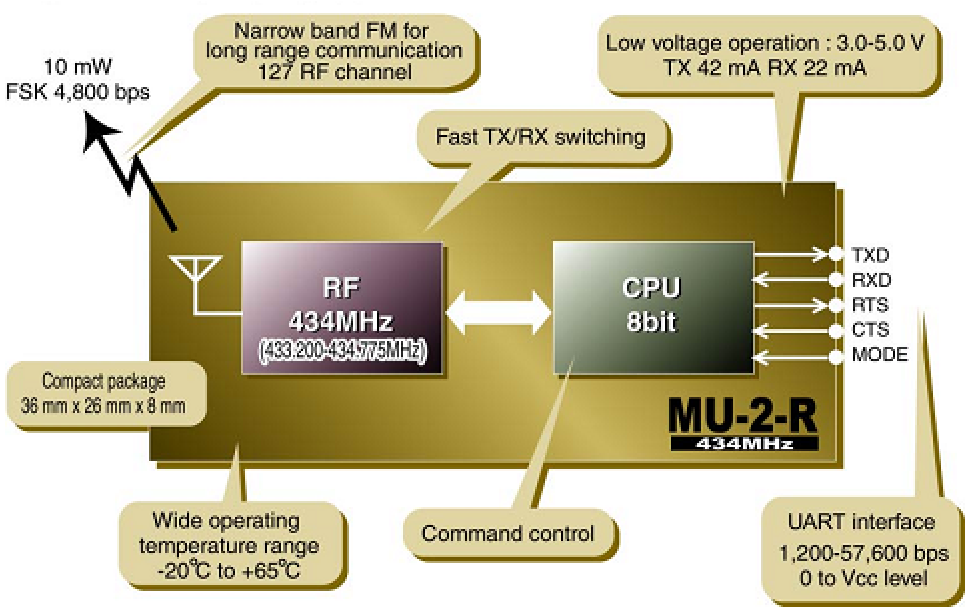

Figure 2

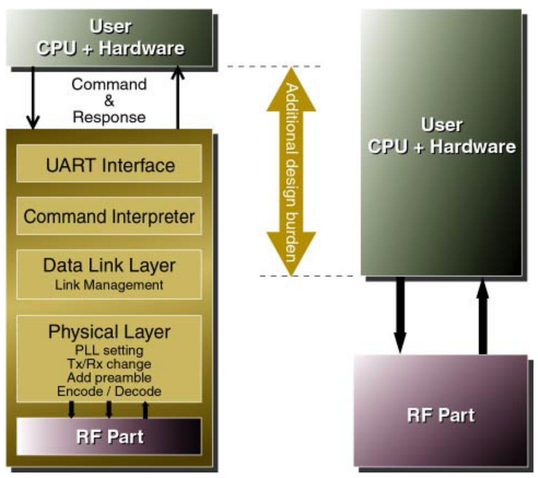

Figure 3 No error correction

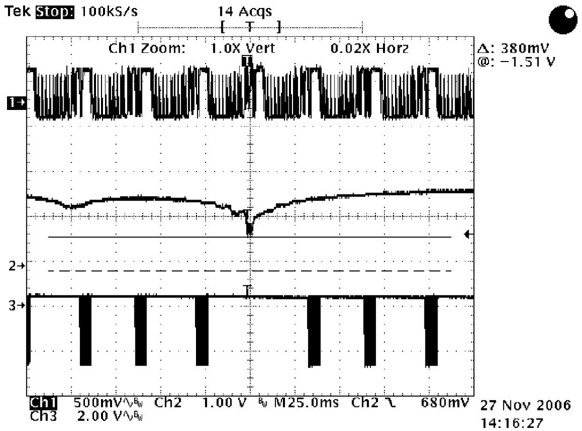

Figure 4 Close up view of the time axis in Figure 3

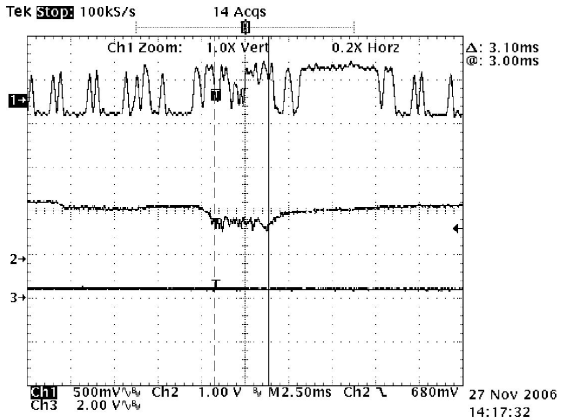

Figure 5 With error correction

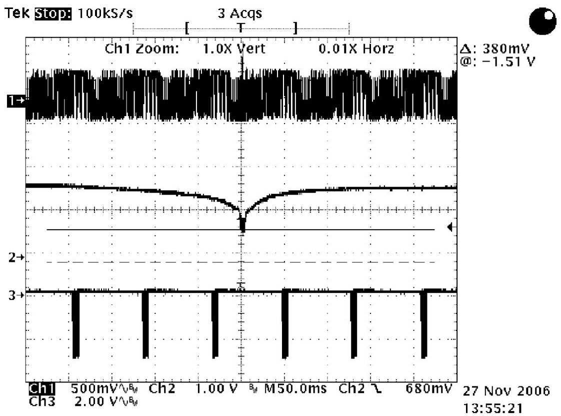

Figure 6 Close up view of the time axis in Figure 5