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Error Performance of BIM Transceiver with RS232 Interfac

Application Note: 101

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Date: 10 November 1997

Introduction

The Radiometrix Bi-directional Module (BiM-UHF) is designed to enable communication 38400 bps including the common baud rates of 4800, 7200, 9600, 19200, 38400 bps. Thi experiment was carried to prove its performance and to stress the importance of using a ***b*** data packet.

Test Set-up

A simple C program (using Turbo C++ 3.0) was written to generate test packets and trans through the RS232 COM port of PC with BiM-UHF Interface. The data has to be formatte packets before transmitting it through the BiM-UHF.

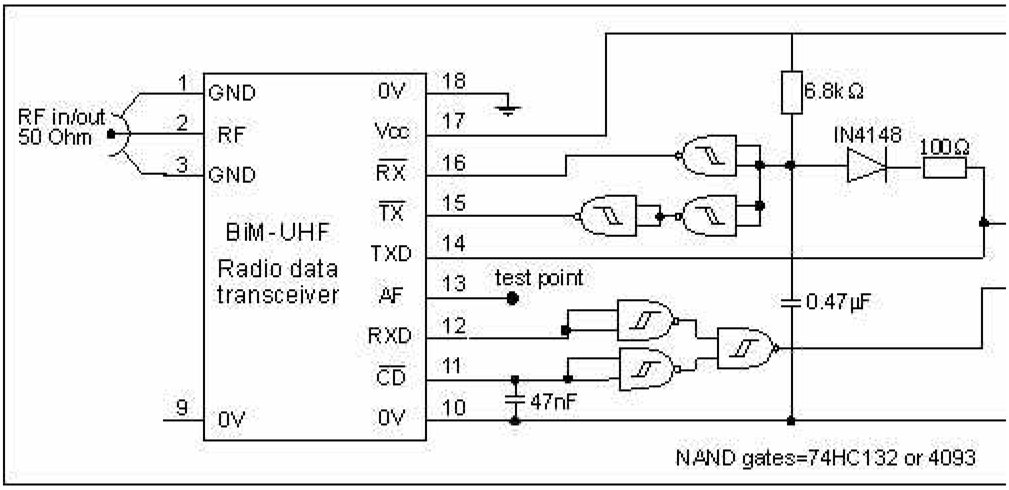

Figure 1: Simple BiM-UHF to COM Port Interface

Data Packet Format

Preamble

This is essential to settle the data slicer in BiM-UHF at the correct slicing point by sendir of preamble prior to the actual data, 3 ms is the minimum requirement, we recommend tha preamble is optimum. Either 55h or AAh can be used as preamble. But 55h gives better b compared to AAh.

UART SYNC Byte (FFh)

This is used to stabilise the UART, so it can detect a clean start bit after the numerous co transitions in the preamble. UART always waits for 1->0 transition then start reading the r 8-bits, (9 bits if parity is used) and stop bit. If it started on the wrong transition, it will not correct data, parity and stop bits. This will result in parity and framing errors. When the r turned on it may not land in the proper start bit of the 55h. So, when errors occur the softv forces it to ignore it. By putting an FFh, the UART will be made to think there is a break stop bit of the last byte. So, it waits for the next 1->0 transition which will be the actual s the next byte.

Start Byte

This is used to identify the start of the data and to start the software to decode the next in data stream. When in Receive Mode, the software looks for a valid 01h. Sometimes, nois interference from other sources could contain a wave form equivalent to 01h and trigger t software decoding. To prevent this an additional 7Fh is used as a secondary check. These bytes are purposely made almost complementary to each other so that they maintain the c in the middle and maintain the mark to space balancing.

Data Length Byte

The least significant 7 bits is used to identify the number of data bytes or Manchester enc words in the packet. This value is used by the software to read in the next number of byte into an memory array. MSB can be used to identify whether the data is encoded or not.

Data Bytes or Manchester Encoded Data Words

A maximum of 128 data bytes or data words are sent one after another from the transmitt receiver. If it is not Manchester encoded, the data bytes will be in exact form as original b on transmission, LSB is transmitted first and MSB last.

Some data streams may contain long string of 00h or FFh, these are averaged by the slice to either Low or High level. i.e. the slicer will not slice symmetrically. Because the data t over radio is ac coupled, constant 00h or FFh behave like dc voltage and these will be att This could be clearly be observed on the **Audio (pin 13)** output (Test Point)**.** Because the always a transition in the start/stop bit, these transition may be missed by the comparator long Low or High. Comparator has an input offset which have to be overcome.

Manchester or Bi-phase coding avoids this problem by forcing symmetry (50:50 mark:spa data stream.

Data can also be encoded into 12-bit code like the RPC code. Each 8-bit byte is mapped 12-bit RPC code (RPC Data Sheet).

16-bit Cyclic Redundancy Code (CRC)

This is used to check for any errors in the data packet. 16-bit (2 bytes) CRC is generated bytes in the data packets and appended to the end of the packet. On the receiver, another bytes) CRC is generated from the bytes in the received packet. If both CRC word are sam the packet received is assumed to be correct. If Parity is used, CRC acts as a Secondary Checking (or Double Check).

Test Packets

These are purposely made to test the BiM under unbalanced, worst data conditions. Thes packets have continuous Low bytes (00h), continuous High bytes (FFh) and a few transiti following types:

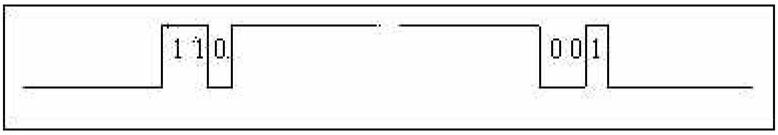

Figure: 2 Worst possible transition

Packet Error Rate with Mark to Space

The *balance* of the code is the ratio of 1's to 0's in a given period. (i.e. there should appro equal number of bits which are 1's & 0's over 3ms time period for BiM). To test the effec balancing we sent Test Packet 2 (please refer to UART_send_test_packet2 function). Nu 1's in the byte (8 bits) was varied from 0 to 8.

The graphs below show how Packet Error Rate (PER) varies with Baud Rate and Mark to The graph clearly shows that better performance is obtained with 50:50 mark to space.

It also shows that there is a small imbalance in the performance between two extremes of space. (i.e. between 0/8 for 00h and 8/8 for FFh). This is due to inherent property of inter components in the BiM.

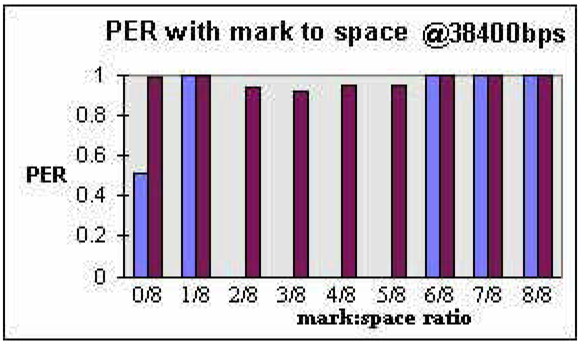

Figure 3:

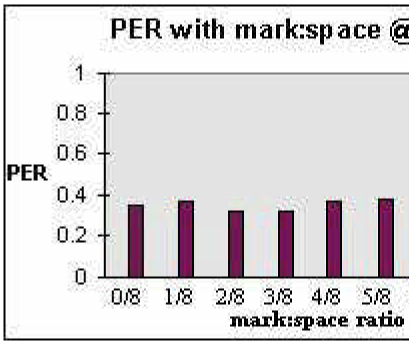

Figure 4:

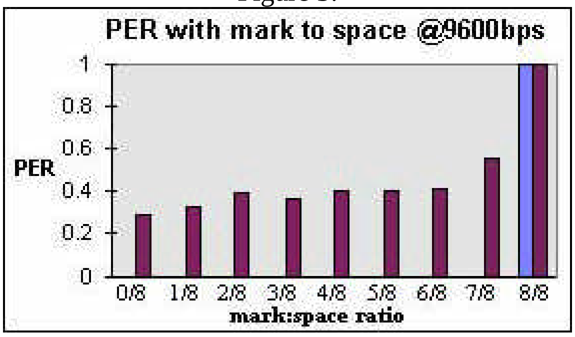

Figure 5:

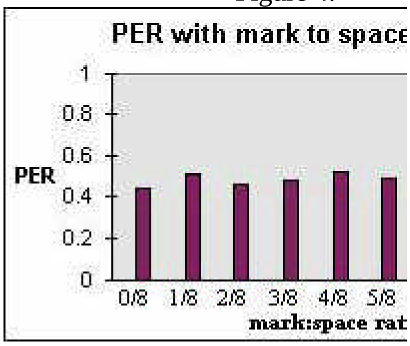

Figure 6:

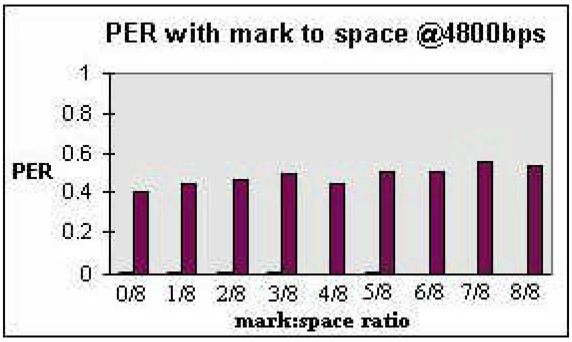

Figure 7:

-80dBm is a strong signal -10 is a weak signal near the thres sensitivity of the BiM receive

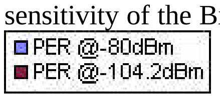

Figure 3 clearly shows that Unbalanced Data will not pass through radio at all at 38400b however stronger the signal is.
Figure 4 shows that unbalanced data will not reliably pass through radio at 19200bps, if l of FFh are present

Percentage Error with Parity

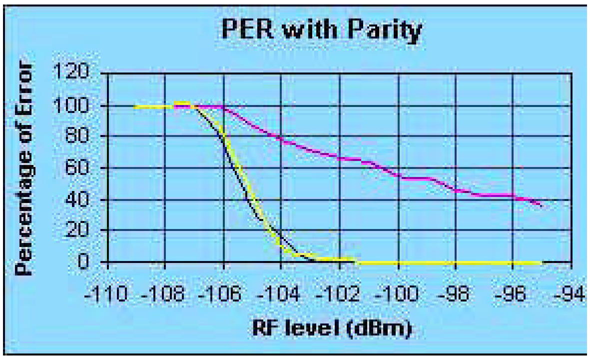

Figure 8:

The Test Packet 1 (UART_send_test_pack1) was us for this. Packet content was not changed, only the parity type was changed in UART LCR.

The graph on the left shows how t parity affects the error performan

It clearly shows that worst error performance is obtained for Even Parity. This is due to tl transition to 0, just before the stop bit. After a long logic High (e.g. 11111111_2) the capac slicer circuit is biased towards a Logic High, however, Even Parity for this will be 0 (Logi while Stop Bit is Logic High. Therefore, this sudden logic transition of the parity will be r high speed (high baud rates).

The graph proves that for reliable transmission through BiM, Odd parity should be used.

Percentage Error with Baud Rate

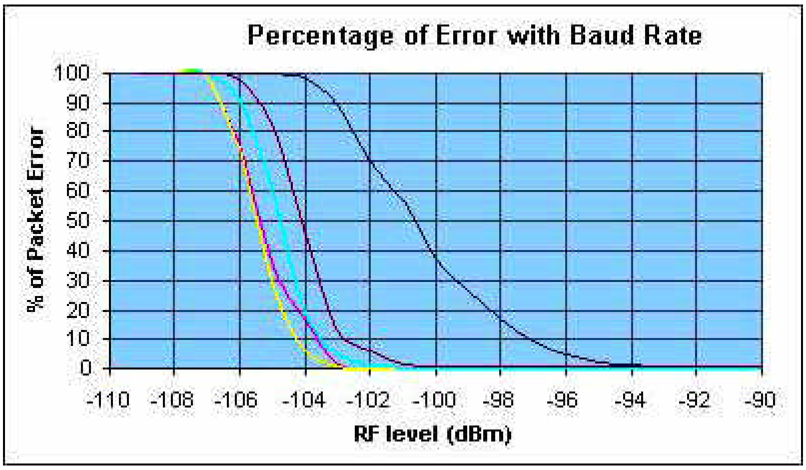

Figure 9:

The graph on the left shows the Error Performance of BiM with Baud Rate. Optimum Error Performance is RS232 baud ra 9600 to 19200l

Simple Protocol

It is better to implement a protocol to send back an acknowledgement to transmitting DCE acknowledgement is received by the transmitting DCE, it can be made to re-transmit the c packet again. This process can be repeated 20 times until an acknowledgement is receive acknowledgement is received after 20 tries, the transmitting modem can abandon the proc give an error message to the host DTE.

Sometimes the receiving DCE may have sent back an acknowledgement and this may not arrived at the transmitting DCE properly. Therefore, transmitting DCE will assume that it not received properly and it will try to retransmit the same message again. Receiving DCI receive a repeated packet which could be mistaken for another packet. This problem can avoided by putting a counter or some sort of identifier to indicate that it is a repeated pac Therefore, the receiver will know that it is a repeated message and it can ignore it if it has received it correctly. It can also retransmit the acknowledgement.

The second start byte can be used for this purpose.

Conclusion

Note: All these results were obtained for a set of unbalanced, worst data packet conditio
will perform better than these results for ordinary data packets. However it is very import
balance every data packet for reliable data communications over radio.

Three important conclusions from the experiment are

1. Data packet should be balanced to have a mark to space of 50:50 over a 3ms peri
   Unbalanced data cannot be sent at 38400bps however stronger the signal is.
2. Optimum Baud Rate for RS232 transmission through BiM is 9600-19200bps.
3. If Parity is to be used, Odd parity should be used.

References

[1] Radiometrix BIM-UHF Data Sheet
[2] Herbert Schildt, *C: the Complete Reference*, Third Edition, Osborne McGraw-Hill
[3] National Semiconductors, *PC16550D Universal Asynchronous Receiver/Transmitter FIFOs*
[4] Maxim Interface Products http://www.maxim-ic.com/efp/Interfac.htm