Application Note

Ref. : ARF Low Level Radio Protocol

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LOW LEVEL RADIO PROTOCOL

1 - PRESENTATION OF THE DOCUMENT

The purpose of this document is to illustrate the electrical format (voltage, frequency) of the data bits according to the restrictions encountered when radio transmission takes place.

This format is to be applied to transmission on the TXD pin of the transmitter. The data thus transmitted will be retrieved on the RXD pin of the receiver.

2 - LIMITATIONS

A complete transmission system comprises a transmitter, a channel and a receiver. The most limiting element is, as far as we are concerned, the receiver.

Demodulation is performed by changing frequency. In this operation, a filter limits the high frequency of the data[1]. When this frequency change has been performed, reconstruction of the data, in 0-5V format, is performed according to the following wiring diagram:

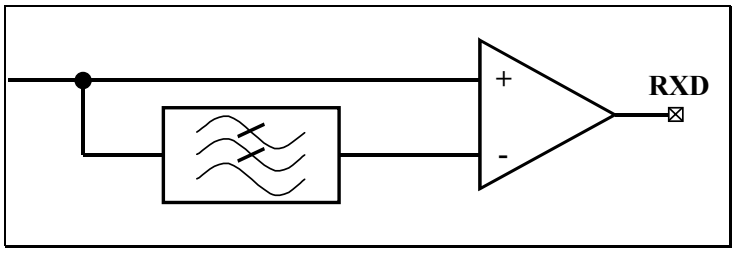


Figure 1 : Data retrieval principle

After demodulation the signal is compared to its mean value. Establishing and keeping this value impose:

- a settling time before correct data is obtained on RXD,
- keeping this value throughout transmission.

[1] See ARF AN1 "SuperRegen vs SuperHeterodyne"

The second point means that a minimum frequency for the data and a continuous data flow are required.

3 - USING A PRELUDE

The prelude is a particular signal which enables the mean value to be established. It has a duration greater than the settling time of this value, and it has a mean value identical to that of the signal which follows it.

This signal is a square signal of 2.5 kHz frequency of a duration of about 5 to 10 ms depending on the products.

4 - BIT ENCODING

Conventional NRZ encoding is not suitable as certain ASCII characters or data sequences, such as Ç [80h] do not enable the mean value of the signal to be kept:

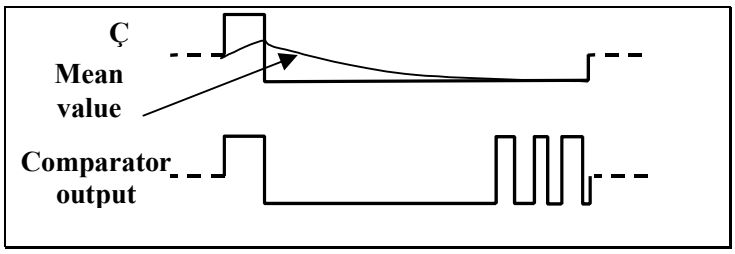


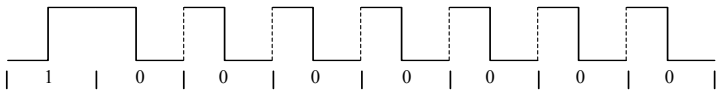
Figure 2 : Data retrieval principle

This example clearly illustrates the risks involved in passing a too low frequency.

An encoding which by construction keeps its mean value is two-phase or Manchester encoding. Each bit, whether it is at 0 or at 1, in fact has the same mean value. A falling edge represents a 0, a rising edge a 1.

Figure 3 : Bits in Manchester format

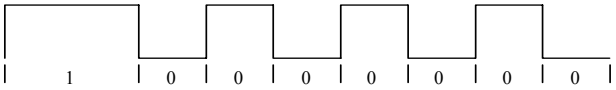
The above example then becomes:



The dotted fronts are insignificant fronts, they complexify decoding on receipt.

Differential Manchester encoding also exists which is simpler to decode notably due to the "capture" units of the microcontrollers. The 0's are represented by a time T, the 1's by a time 2T. The electrical level changes at each bit regardless of the value of the bit.

The above example then becomes:



5 - NOISE

In the absence of transmission, a non-null signal is still present on the RXD pin due to the surrounding electromagnetic noise.

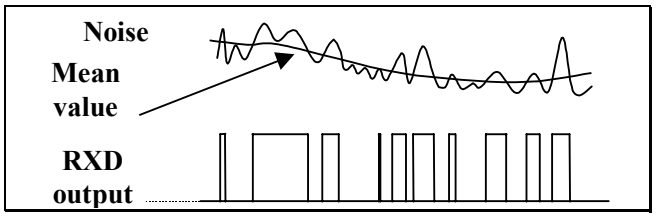


Figure 4 : Presence of noise

Although the signal on output is of correct amplitude, it does not correspond to any transmission. To differentiate a receipt from noise, it is recommended to insert a particular pattern called synchronisation pattern between the prelude and the data.

This pattern must be recognised by the decoder on receipt, but must not be able to be interpreted as transmitted data. It must respect the mean value of the prelude and of the data. This can be a change of rhythm of the prelude, or a characteristic sequence whose timing differs from that of the data. The longer this sequence, the lesser the probability of recognising it in the noise.

6 - RADIO FRAME

Due to the necessity of maintaining a continuous transmission, the data is transmitted in packets called frames. The transmission rate is thus improved, the prelude and synchronisation pattern only being sent once for several data bytes.

On receipt the voltage on the RXD pin will have the following aspect:

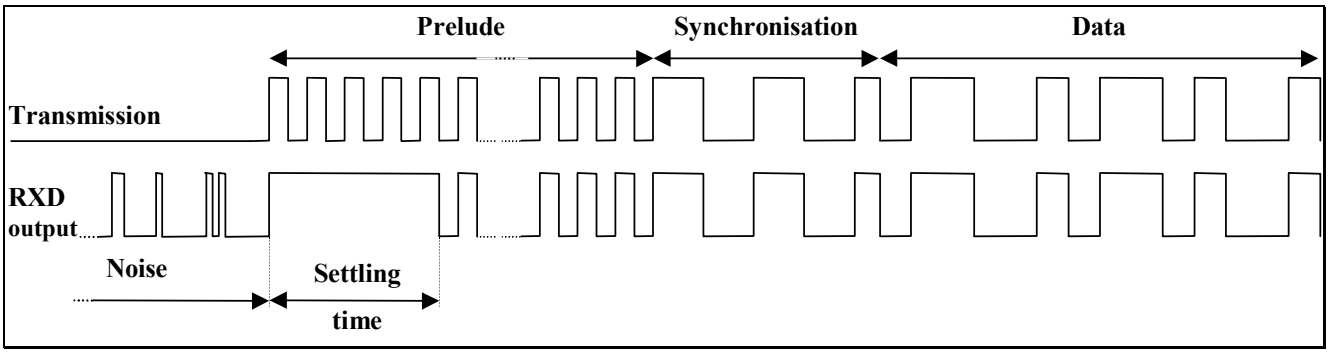


Figure 5 : Complete radio frame