Data transceiving by XTR-434 transceiver

Introduction

The exigency to transfer information at high speed between two points hardly linkable by cable, has brought to the realization of a 100 kbps capacity XTR-434 transceiver. Such potentiality, together with a very fast switching-on time, opens new utilization sceneries for the RF data transmission field: it is possible, in fact, to realize radio linkages useful for telemetry, remote ambiences monitoring, domotic, entrances watching, etc.... For all these usages, thanks to its transmission speed and communication channel clearing quickness, the XTR-434 is the ideal candidate to the achievement of the desired results.

Technical features

The XTR-434 transceiver operates at 433.92 MHz with 5V (± 0.5V) supply and at an almost null current consumption in case the module is disabled (TX ENABLE = 1, RX ENABLE = 1); during transmission phase, instead, its average current consumption is 28 mA while in reception phase is 11 mA.
Its –100 dBm sensitivity is obtained by utilizing a 150 kHz intermediate frequency filter. The module emits a 10 dBm R.F. power and utilizes a ± 25 KHz. frequency deviation.
The receiver as well as transmitter switching times are 1ms.

Serial data transceiving by the XTR-434

To interface the transceiver with a serial gate in RS-232 logic, it is necessary to have, first of all, an integrated, that operates the conversion of the electric levels between the RS-232 of the serial gate and the TTL of the XTR-434: the RS-232 in fact, foresees a –12V tension for the 1 logic and a +12V for the 0; the TTL instead works with 5V for the 1 and with 0V for the 0.
The transmitter can also be enabled by bringing to 0 the pim 15 of the XTR-434 (in stand-by conditions pin 15 as well as 16 are at high level) and, 1 ms after the switching, it suffices to send a preamble, which consists in a square wave with a 50% duty-cycle, of more than a millisecond duration; from now on the transceiver's entry pin can be modulated by a square wave with a frequency between 10 and 50 kHz.
Due to the alternative current coupling almost always present in the reception stages of RF operating sets the following three limitations must be satisfied:

1. the impulse's width time must remain between 10 and 200 µs;
2. settling-down time, before the received data are validated, of at least 1ms;
3. bit ON / bit OFF unbalanced ratio no more than 30:70 or 70:30.

The first limitation is imposed toward the low value by the filter in the base band: by a 10 µs impulse a square wave period of 20 µs is obtained, to which corresponds a 50 KHz frequency which

is effectively the amplitude of the base band filter; toward the high value instead, the limitation is given by the coupling time constant which is, for the XTR-434, about 200 μs.
The second limitation becomes necessary in order that the data slicer, which is inside the receiver, is allowed to stabilize on an intermediate value between the high and the low logic state: under such conditions only the data which exit from RXD pin can be considered reliable.
At the end, the last recommendation is to assure an optimum operation of the data slicer during the communication: to assure that this effectivelly happens, a perfect balancing of the duty-cycle (50:50) is required, in order not to declass the receiver sensitivity.
In case of communication by an RS-232, since this foresees, in the most unfortunate case, a duty-cycle of the 90%, it is necessary to apply a coding system to the data to be transferred, that balances the signal. Among the most used techniques, there is the Manchester coding, which transmits the datum's bit and its complementary (100% redundancy) and the coding 8:12 bits that introduces a 50% redundancy.
In case it is decided not to apply any coding, it is recommended to transmit a byte and its complementary to follow, at a speed not less than 57600 bps: below this value, in fact, 9 bits, at the same logic state, would exceed the 200 μs limit imposed upon an impulse duration.

Synchronization techniques

Counting from the very moment when the pin 16, which enables the receiver, is brought to logic level 0, the device takes 1 ms before it switches from the stand-by to the operating condition or commutates, though, from the transmission phase: such commutation speed is obtained by the low coupling time constant, in alternate current, available in the XTR-434. During this millisecond the device switches on and from RXD pin nothing significant comes out.
Once the reception is enabled, what can be detected on the output pin, in lack of an RF transmission, is nothing but a digitalized noise, or rather the input noise that randomly generates a square wave.
The problem now raises to understand whether what witnessed in the output is noise or the datum coming from a transmitter, and when it started, now raises. It is clear that, to do so, it is not possible to measure the preamble length, since there is no guaranty at all, that the latter's first bits are correctly recognized.
A possible solution consists in verifying the pin 11 (CD, Carrier Detect) of the XTR-434 which reaches a low level when the receiver detects an RF carrier with at least –96 dBm of power.
Supposing even a CD's ideal behavior, (not true thing due to the not eliminable tolerances) it should be impossible to think that the pin reaches the low level as soon as the transmitter starts the communication: a time delay is always present and, therefore, the first bits would not be recognized as such. To this, it should be added the fact that, initially, the data slicer requires a settling time during which it must stabilize itself upon an intermediate value between the two logic states, therefore, with great probability, the first bits would be lost anyhow.
From what just said it derives that to realize an optimum communication during which no data are lost, it is necessary to implement, via software, the synchronization process between transmitter and receiver.

Protocol example

By way of example a simple communication protocol is given that allows, in short times, to establish a radio link between two micro controllers, by using the UART (if this is not already in use for other purposes) for the RF transmission and reception.
The millisecond required by the XTR module to switch-on, elapsed, the transmitting micro controller modulates the transceiver by a 55H sequence whose duration is, at least, one millisecond (the preamble), to which follows a byte with all “1” (FFH) bits and in sequence a byte with all “0” (00H) bits. From now on the data transmission starts, with the precaution to send each byte followed by its complementary byte in order to balance the signal; the bit-rate must be over 57600 bps. In this way there is no need to codify the data.
The XTR transceiver on reception mode, once is fed, supplies to the UART’s input of the receiving micro controller, a square wave which is, at first, the digitalized noise and subsequently the preamble. Any incoming sequence, even if validated by the UART (a start bit, 8 bits and a stop bit), is discarded by the micro controller, until the last incoming byte contains a part of the FFH byte. From this very moment a sequence of undetermined length of stop bit, enters the UART, interrupted by the start bit of the 00H byte. This last byte, differently from the previous one, is certainly recognized, as well as the first information byte and its complementary: this 3 bytes sequence indeed (00H, first datum byte, complementary to the first datum byte) constitutes the communication opening key and from now on the receiving micro controller expects that each byte is followed by its own complementary. When this condition does not occur it assumes that an information destructive noise took place or that the transmitting party has terminated its communication: in both cases the conversation is considered closed and sets itself back to listening for the next opening sequence.