

Infrared Communication Concepts

Infrared remote control devices are abundant in today's gadget-filled world. From the television and video recorder, through the Hi-Fi and on to the garage door that thankfully opens remotely on a rainy day, a remote controller of one form or another is never far from reach.

Why use infrared light to send the control signals? Two reasons in particular stand out. The first is that the diodes used to emit infrared light are quite inexpensive and readily available. The second is the fact that infrared light is at a wavelength outside of the spectrum of visible light – so we can point and shoot our controllers and not get blinded in the process!

So how exactly does infrared remote control work? At the most basic level, the remote controller contains a transmitter circuit, part of which will be an Infrared Light Emitting Diode (IRLED). When a key is pressed on the controller, the command is sent as an IR signal to the device which you are aiming the controller at. The device being controlled will have a receiver circuit, part of which will be a photodiode with which to detect the IR signal and convert it into an electric current.

That's a very simplistic view of IR RC communications. However, when you factor in background infrared "noise" emitted by other heat-generating objects and multiple IR remote-controlled devices located in close proximity to each other, things quickly become more complicated. With simple infrared light, there is now potential for the command not getting to the receiver at all, let alone the receiver in the intended device.

Modulation and Methods of Encoding

To ensure a transmitted IR signal gets to its correct destination, or conversely the target device receives only the signal it is meant to, modulation is used. IR remote control systems utilize Pulse Code Modulation (PCM), where the modulating carrier frequency typically resides in the range 30kHz to 58kHz.

In terms of transmission, modulation means turning the IRLED on and off rapidly in bursts of the carrier frequency. The receiver will typically be tuned to this carrier frequency, ensuring that it receives only the signal required. It then uses this frequency to demodulate the signal.

When the IRLED is not emitting light, the transmitter is in the OFF state, which in terms of the signal is referred to as a 'space'. During IRLED activity, where the light is emitted in pulsed fashion at the carrier frequency, the transmitter is in the ON state, which is referred to as a pulse or 'mark'. At the receiver, a 'space' is output as a High, while a mark is output as a Low.

These spaces and marks are not the '0's and '1's of the command being transmitted, however. The actual data to be sent from the controller is encoded. The method of encoding used determines how to represent the '1's and '0's in terms of the marks and spaces. The following three methods of encoding are typically used in IR remote control systems.

Pulse Distance Encoding

In this method of encoding, the length of the pulse burst (mark) is always the same, but the time between consecutive bursts differs, depending on whether a logical '0' or logical '1' is being transmitted. The time taken to transmit a logical '1' is longer (i.e. transmitter OFF for longer time after the IR burst).

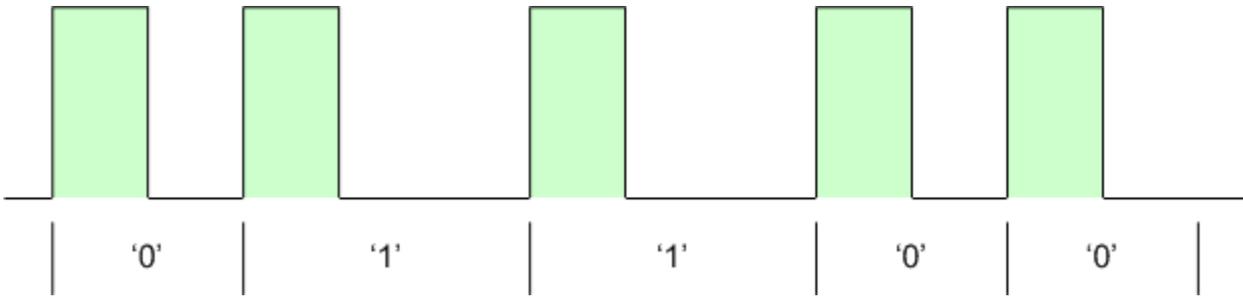


Figure 1. Example of pulse distance encoding.

Pulse Length Encoding

In this method of encoding, the length of the pulse burst (mark) is different for a logical '0' and a logical '1', with logical '1' requiring a longer burst.

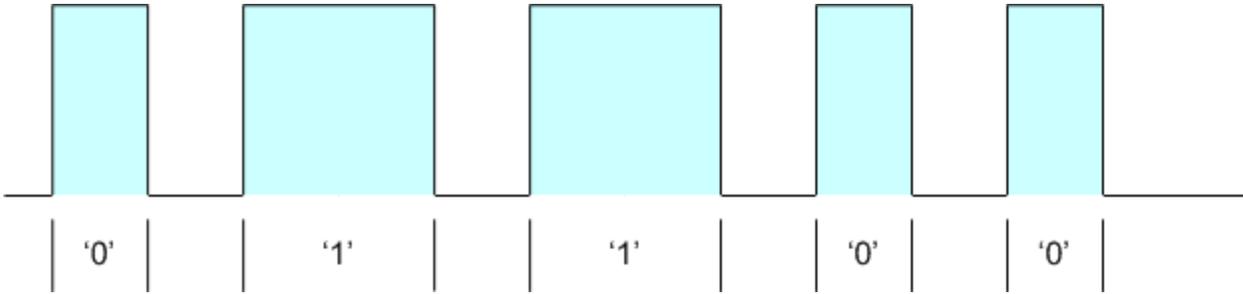


Figure 2. Example of pulse length encoding.

Manchester Encoding

In this method of encoding, all bits are of equal length, with half of the bit-period being a pulse burst (mark) and the other half being a space. A logical '0' is represented by a burst in the first half of the bit-period and a space in the second, giving a mid-period transition from High to Low. A logical '1' is represented by a space in the first half of the bit-period and a burst in the second, giving a mid-period transition from Low to High.

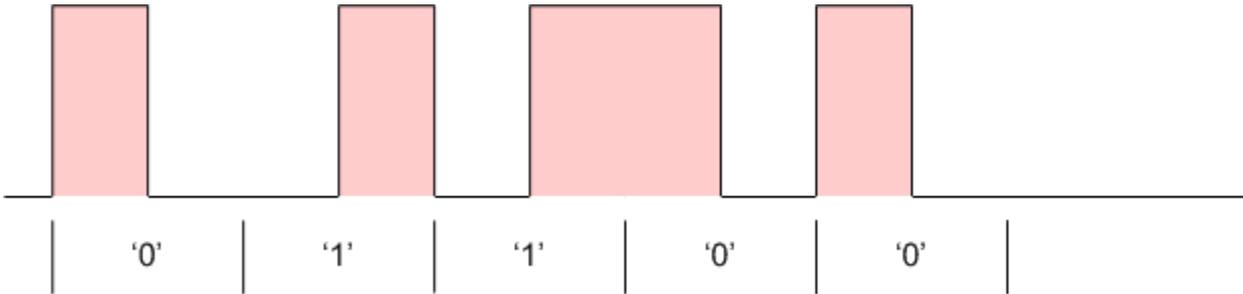


Figure 3. Example of Manchester (or Bi-phase) encoding.

The modulating carrier frequency and method of encoding are a base consideration for any IR RC transmission. The actual format of the transmitted message frame itself varies between manufacturers however. For example, there may be differing numbers of address and command bits, additional pulse bursts before and/or after the address and command bits, built-in error-checking, and so on.

Each of these different encoded message formats can be referred to as distinct infrared transmission protocols. Use

the following linked pages to take a closer look at the NEC and Philips RC5 infrared transmission protocols. The former is the protocol used for transmission of commands by the WB_IRRC, as well as the Altium Remote Controller. In terms of reception, the WB_IRRC has built-in decoding for both NEC and Philips RC5 protocols.

[NEC Infrared Transmission Protocol](#)

[Philips RC5 Infrared Transmission Protocol](#)