1 Introduction — Not in text
Infrared remote controllers are commonly used in many commercial devices. Digital projectors, VCRs, DVD players, and even televisions are controlled through infrared remotes\footnote{http://www.amazon.com/Really-Universal-Jumbo-Remote-Control/dp/B000R7NBIO/ref=pd_cp_a_0}. Figure\ref{fig:universal-remote} shows a universal remote that can communicate with multiple devices, by switching transmission modes.

![Universal remote](image)

Figure 1: Universal remotes can control multiple devices.

2 Hardware — Not in text
The digital logic board used in ECE 272 has a good example of the circuits needed to do infrared transmission. There are two main components, the receiver and the transmitter. Both components are powered only if a jumper is shorting J4. The receiver is just a $1 IR receiver, U5, shown\footnote{http://www.mouser.com/ProductDetail/Vishay/TSOP32138/?qs=IjzJHyN0JljvBCMyzLOjw%3d%3d} in figure\ref{fig:receiver} and figure\ref{fig:receiver-circuit}. The IR LED is turned on by using Q1 and Q2 as an ‘and’ gate. The gate of both transistors must be held to a high in order for current to flow through the IR LED. Q1 is turned on by making porta(4) output 3.3 volts. Q2 is turned on a 38 KHz by U4\footnote{http://www.linear.com/pc/productDetail.jsp?navId=H0,C1,C1010,C1096,P2186}.

3 Waveforms — Not in text
Figure\ref{fig:waveform} shows a waveform of the voltage across the IR LED. Note that the voltage across the IR LED is either pulsing at 38KHz or it is disconnected and floats to an unknown voltage. Figure\ref{fig:received-transmission} shows the received transmission. Note that detecting a 38KHz IR signal causes the receiver output to go low, the detector is active low.
Figure 2: This is the schematic for an IR Transceiver on the ECE 272 Digital Logic Board.

Figure 3: This is the hardware for an IR Transceiver on the ECE 272 Digital Logic Board.
4 Decoding the Waveforms — Not in text

Figure 6 shows how the long pulse train is decoded. The pattern for pushing the zero button on the remote is A857D02F. Note how the 1st and 3rd nibble add to be 15. The 2nd and 4th nibble add to be 15. The 5th and 7th nibble add to be 15, as well as the 6th and 8th nibble. This is specifically designed to be the checksum to insure signal integrity.
Figure 6: This is the decoded signal for pushing the ‘0’ button on the tv remote.