IR Data Communication

Component Evaluation

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Using readily-available components, it's easy to set up an infrared data link. A large quantity of LiteON LTE-5208A infrared LED emitters and LTM-8834-2 infrared receiver modules was recently donated to our electronics laboratory. These are the same components used in television and VCR remote controls. The components were evaluated to determine optimum operating conditions.

Theory

Most infrared remote controls operate by mixing the transmitted serial data stream with a 30 to 40 KHz carrier signal. Thus, a logic "1" condition is represented by no light being emitted (the "idle" condition), and a logic "0" state is represented by steady 30-40 KHz pulses of light. The IR receiver contains a bandpass filter tuned to receive in the 30-40 KHz range, thus the receiver rejects most noise. The photodiode at the IR receiver is enclosed in a package material that is opaque to visible light, yet transparent to IR wavelengths. This measure greatly reduces interference from visible light sources.

Setup

Figure 1 shows the circuit setup. It's quite simple! Two signal generators were used to provide the transmitted data stream. One generator provided the 34 KHz carrier pulses, and the other provided a 100 Hz TTL signal to simulate a data stream. Q1 provides the "mixing" action, inverting the data in the process. D1 protects the IR LED from reverse bias in case the carrier generator swings negative.

The resulting modulated 34 KHz carrier leaves D2 as a series of light pulses, which arrive at U1, the IR receiver module. U1 demodulates the digital data stream from the carrier, resulting in a copy of the data signal at the RECOVERED DATA port.

Data rates should practically be kept below about 500 bps. The measured jitter at the RECOVERED DATA port was 50 uS, which will give 2.5% clock timing error for 10-bit frames (8,N,1) at 500 bps. For 10-bit frames, 5% clock error is the theoretical limit of inaccuracy, beyond which errors may be introduced.

In order to determine the optimal carrier frequency (since device data for the LTM-8834-2 receiver wasn't available), the CARRIER amplitude was carefully lowered until errors appeared in the demodulated data. The carrier frequency was then adjusted until the errors became minimum; then the carrier frequency was adjusted upward and downward to find the upper and lower limit points where the error rate began to increase again. The carrier amplitude was kept low to facilitate the adjustment process. Table 1 shows the measurement results obtained for five different LTM-8834-2 receiver units.

Unit Number	F (min) KHz	F (max) KHz
1	30.25	39.60
2	30.10	38.80
3	32.00	35.80
4	32.40	37.10
5	32.70	36.20

Table 1: LTM-8834-2 Frequency response testing results

The drive level required for the IR emitter depends upon the desired range of the device. A range of 20 feet was easily obtained with a peak drive level of 30 mA. Resistor R2, in combination with the carrier generator amplitude, sets the drive level.

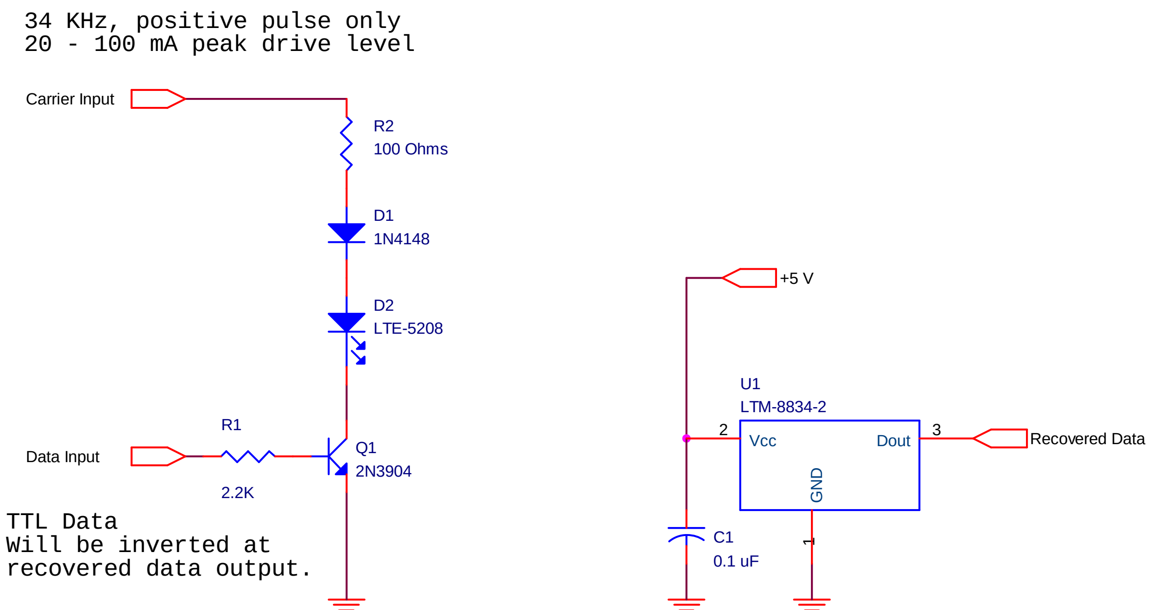

Figure 1: IR Data Test Setup

Practical Application

The IR transmitter circuitry can easily be implemented at the output port pin of a microcontroller. The microcontroller software can provide the 34 KHz carrier for modulating the data, as well as formatting the data stream.

For simple or hard-wired application, a 32.768 KHz clock oscillator can be used to provide the carrier signal. UART asynchronous-formatted data will directly pass through this system with no restrictions other than data rate.