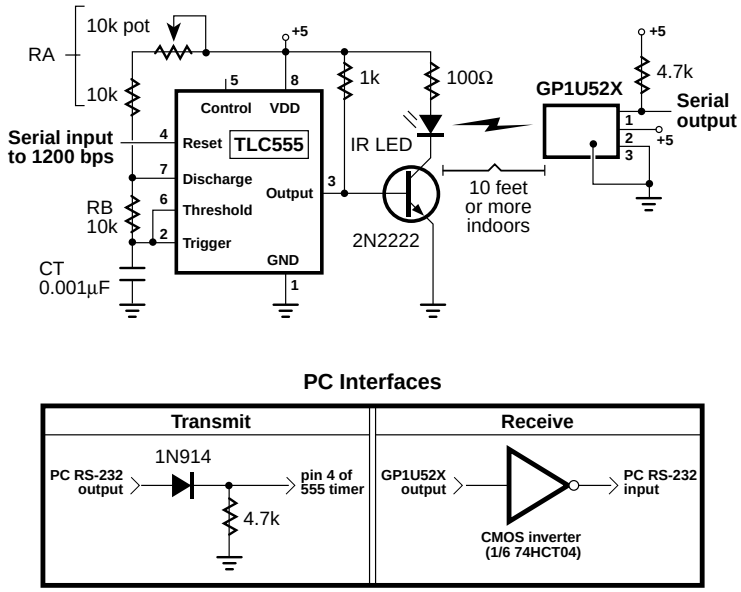
**Introduction.** This application note shows how to build a simple and inexpensive infrared communication interface for the BASIC Stamp.

**Background.** Today's hottest products all seem to have one thing in common; wireless communication. Personal organizers beam data into desktop computers and wireless remotes allow us to channel surf from our couches. Not wanting the BASIC Stamp to be left behind, we devised a simple infrared data link. With a few inexpensive parts from your neighborhood electronics store you can communicate at 1200 baud over distances greater than 10 feet indoors. The circuit can be modified for greater range by the use of a higher performance LED.



**How it works.** As the name implies, infrared (IR) remote controls transmit instructions over a beam of IR light. To avoid interference from other household sources of infrared, primarily incandescent lights, the beam is modulated with a 40-kHz carrier. Legend has it that 40 kHz was selected because the previous generation of ultrasonic remotes worked




Schematic to accompany program IR.BAS.

at this frequency. Adapting their circuits was just a matter of swapping an LED for the ultrasonic speaker.

The popularity of IR remotes has inspired several component manufacturers to introduce readymade IR receiver modules. They contain the necessary IR detector, amplifier, filter, demodulator, and output stages required to convert a 40-kHz IR signal into 5-volt logic levels. One such module is the GP1U52X, available from your local Radio Shack store as part no. 276-137. As the schematic shows, this part is all that's required for the receiving section of our application.

For the transmitting end, all we need is a switchable source of 40-kHz modulation to drive an IR LED. That's the purpose of the timer circuit in the schematic. Putting a 1 on the 555's reset pin turns the 40-kHz modulation on; a 0 turns it off. You may have to fiddle with the values of RA, RB, and CT. The formula is Frequency = 1.44 / ((RA+2*RB)*CT). With RB at 10k, the pot in the RA leg of the circuit should be set to about 6k for 40-kHz operation. However, capacitor tolerances being what they are, you may have to adjust this pot for optimum operation.

To transmit from a Stamp, connect one of the I/O pins directly to pin 4 of the '555 timer. If you use pin 0, your program should contain code something like this:

```
low 0                       ' Turn off pin 0's output latch.
output 0                    ' Change pin 0 to output.
...                         ' other instructions
serout 0,N1200,("X")        ' Send the letter "X"
```

To receive with another Stamp, connect an I/O pin to pin 1 of the GP1U52X. If the I/O pin is pin 0, the code might read:

```
input 0                     ' Change pin 0 to input.
...                         ' other instructions
serin 0,T1200,b2            ' Receive data in variable b2.
```

To receive with a PC, you'll need to verify that the PC is capable of receiving 5-volt RS-232. If you have successfully sent RS-232 from your Stamp to the PC, then it's compatible. As shown in the schematic, you'll need to add a CMOS inverter to the output of the GP1U52X. Don't use

a TTL inverter; its output does not have the required voltage swing. To transmit from a PC, you'll need to add a diode and resistor ahead of the '555 timer as shown in the schematic. These protect the timer from the negative voltage swings of the PC's real RS-232 output.

**Modifications.** I'm sure you're already planning to run the IR link at 2400 baud, the Stamp's maximum serial speed. Go ahead, but be warned that there's a slight detection delay in the GP1U52X that causes the start bit of the first byte of a string to be shortened a bit. Since the serial receiver bases its timing on the leading edge of the start bit, the first byte will frequently be garbled.



If you want more range or easier alignment between transmitter and receiver, consider using more or better LEDs. Some manufacturers' data sheets offer instructions for using peak current, duty cycle, thermal characteristics, and other factors to calculate optimum LED power right up to the edge of burnout. However, in casual tests around the workshop, we found that a garden-variety LED driven as shown could reliably communicate with a receiver more than 10 feet away. A simple reflector or lens arrangement might be as beneficial as an exotic LED for improving on this performance.

If you find that your IR receiver occasionally produces "garbage characters" when the transmitter is off, try grounding the metal case of the GP1U52X. It is somewhat sensitive to stray signals. If you build the transmitter and receiver on the same prototyping board for testing, you are almost certain to have this problem. Bypass all power connections with 0.1-µF capacitors and use a single-point ground. And be encouraged by the fact that the circuit works much better in its intended application, with the transmitter and receiver several feet apart.

**Program listing.** There's no program listing this time; however, you may download programs for other application notes from our Internet ftp site at ftp.parallaxinc.com. The ftp site may be reached directly or through our web site at http://www.parallaxinc.com.