Chaotic Lock-in Amplifier Circuit Descriptions.

See Brian Spears and Nicholas Tufillaro, '*A chaotic lock-in amplifier,'* **American Journal of Physics**, for more details.

Preprint at: syn_3.pdf

The chaotic lock-in amplifier is constructed from a light-emitting diode and photo detector. The photo-detector used is the Sharp OPT101 which also includes a amplifier in a DIP package. The data sheet is easily found on-line. For instance see:

http://doc.chipfind.ru/burr-brown/opt101.htm

(the above link was checked on 13 September 2007, in general a search for Sharp OPT101 should turn up similar results).

A picture of the transmitter and receiver together are shown in Fig 1.

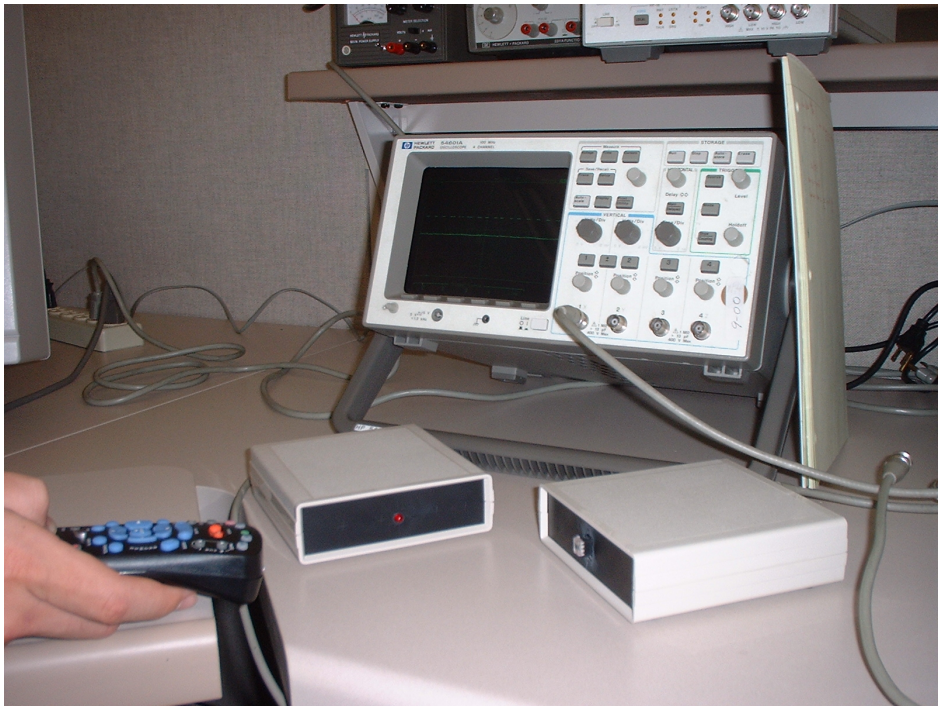


Figure 1. --- Typical set up of 'chaotic lock-in' with transmitter on the left and receiver on the right.

The transmitter is on the left with the 'one red light' Cylon configuration, and the receiver is on the right with DIP package mounted on the front of the box.

Figure 2 --- Back of transmitter (left) and receiver (right).

Figure 3 --- Close up of front of transmitter (left) and receiver (right).

The back of the boxes are shown in Figure 2 The transmitter is on the left and the receiver is on the right.

A closer view of the front of the boxes is shown in Figure 3.

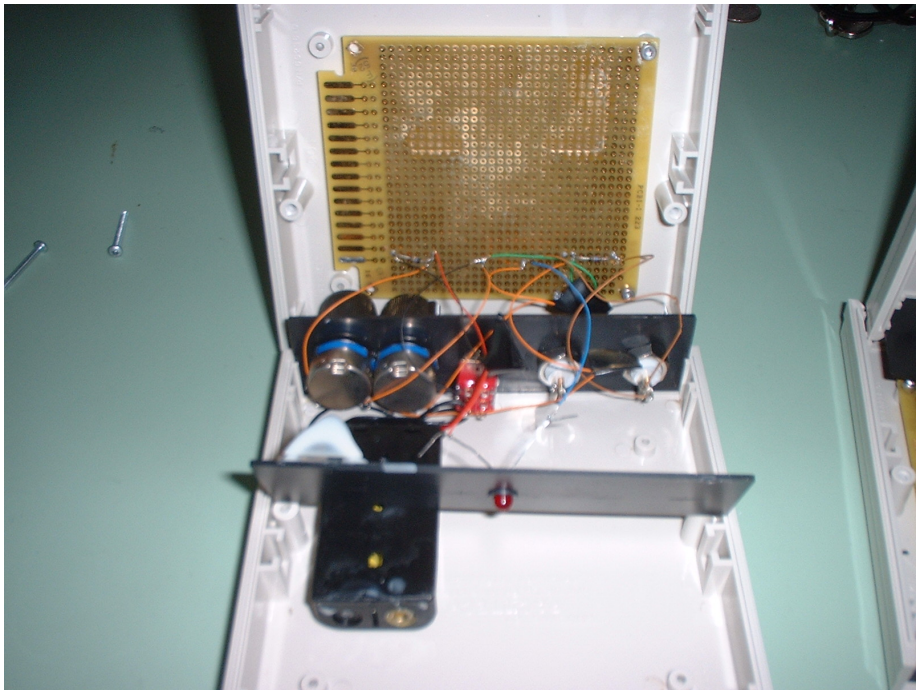


Figure 4 --- Inside of Transmitter (LED drive circuit)

The inside wiring of the transmitter is shown in Figure 4. It is simply an LED with two variable resistors used to control the offset and gain of the LED. This allows us to set a median brightness for the LED and a minimum and maximum brightness for typical voltage swings. Power is supplied by a 9V battery shown on the lower left. A switch is also provided for turning the circuit on and off.

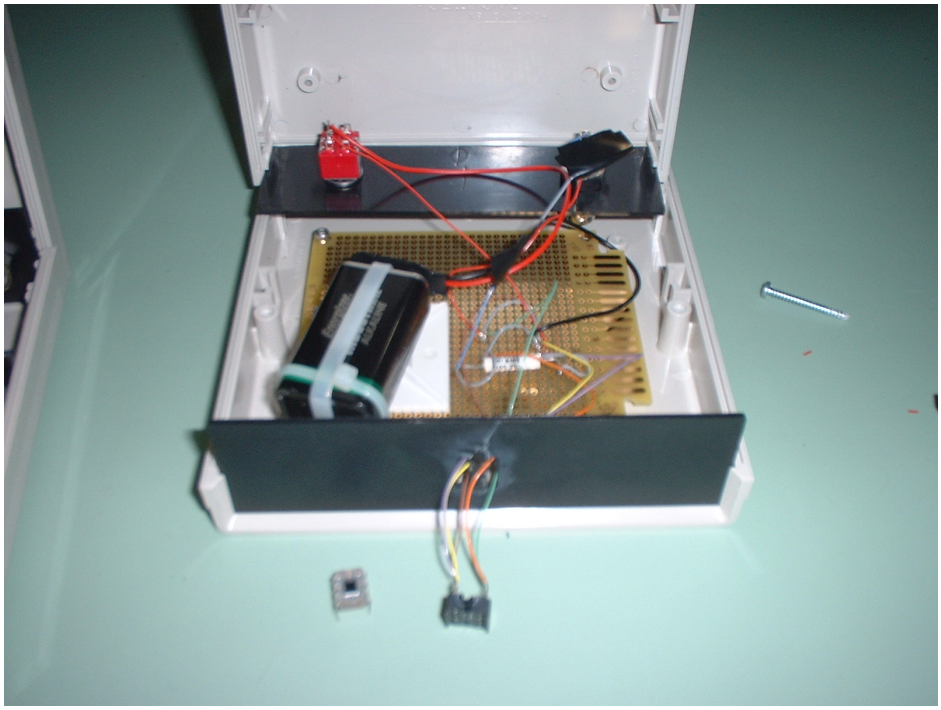


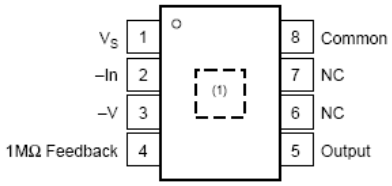
Figure 5 --- Photo detector receiver based on Sharp OPT101. DIP package containing the photo-detector is shown in the clear package on the left.

The receiver is shown in Figure 5. It is built from a Sharp (manufacture) monolithic photodiode and single supply amplifier (similar IC's are available from other manufactures). The data sheet is attached also as a PDF. Here is a quick summary of its pin-out and drive circuits.

Pin outs are:

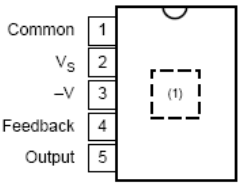
PIN CONFIGURATIONS

Top View DIP



NOTE: (1) Photodiode location.

Top View SIP



ABSOLUTE MAXIMUM RATINGS

Supply Voltage (V_S to *"Common"* or pin 3)	0 to +36V
Output Short-Circuit (to ground)	Continuous
Operating Temperature	–25°C to +85°C
Storage Temperature	–25°C to +85°C
Junction Temperature	+85°C
Lead Temperature (soldering, 10s)	+300°C
(Vapor-Phase Soldering Not Recommended)	

PACKAGE INFORMATION

PRODUCT	COLOR	PACKAGE	PACKAGE DRAWING NUMBER(1)
OPT101P	Clear	8-Pin Plastic DIP	006-1
OPT101P-J	Clear	8-Lead Surface Mount (2)	006-4
OPT101W	Clear	5-Pin Plastic SIP	321

NOTE: (1) For detailed drawing and dimension table, please see end of data sheet, or Appendix C of Burr-Brown IC Data Book. (2) 8-pin DIP with J-formed leads for surface mounting.

Figure 6 --- Pin out of Sharp OPT101 Photo-detector/amplifier IC.

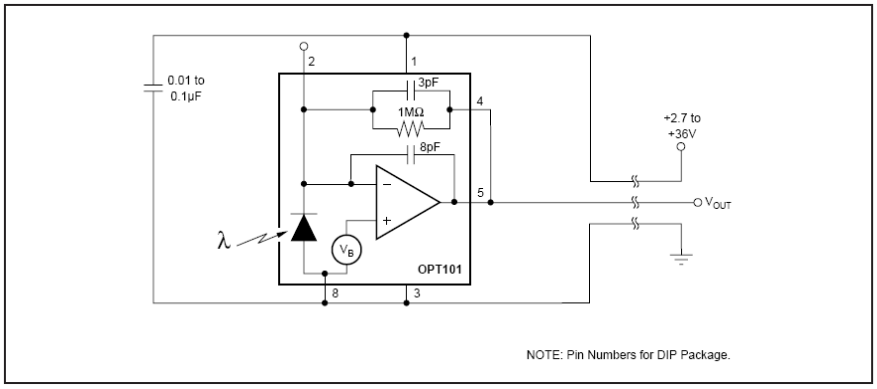


Figure 7 --- Drive circuit for OPT101 photo detector.

The basic circuit diagram for the detector is shown in Figure 7. The supply is also provided by a 9 V battery seen in the left of Figure 5.

The transmission circuit is shown in Figure 8. Variable resistances allow us to set the offset and gain of the signal supplied to the BNC allowing us to operate the LED in a linear regime.

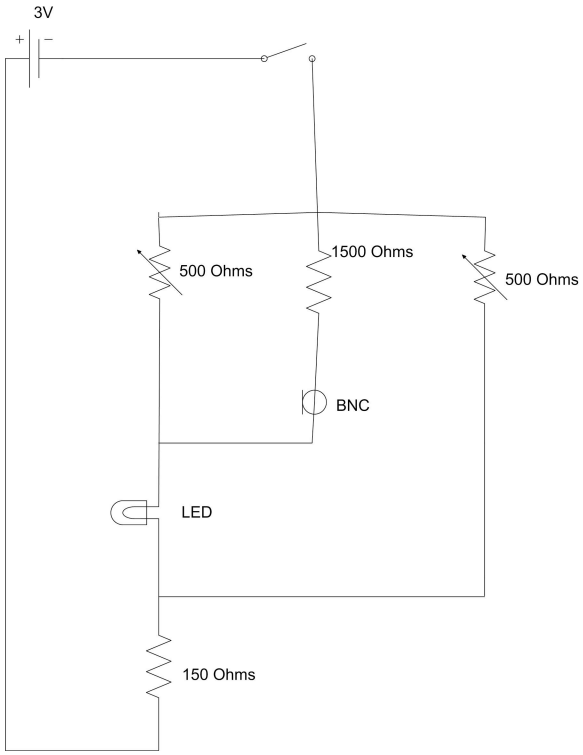


Figure 8. Drive circuit for transmitter Light Emitting Diode. The drive signal is supplied directly from an digital to analog converter directly to the BNC.