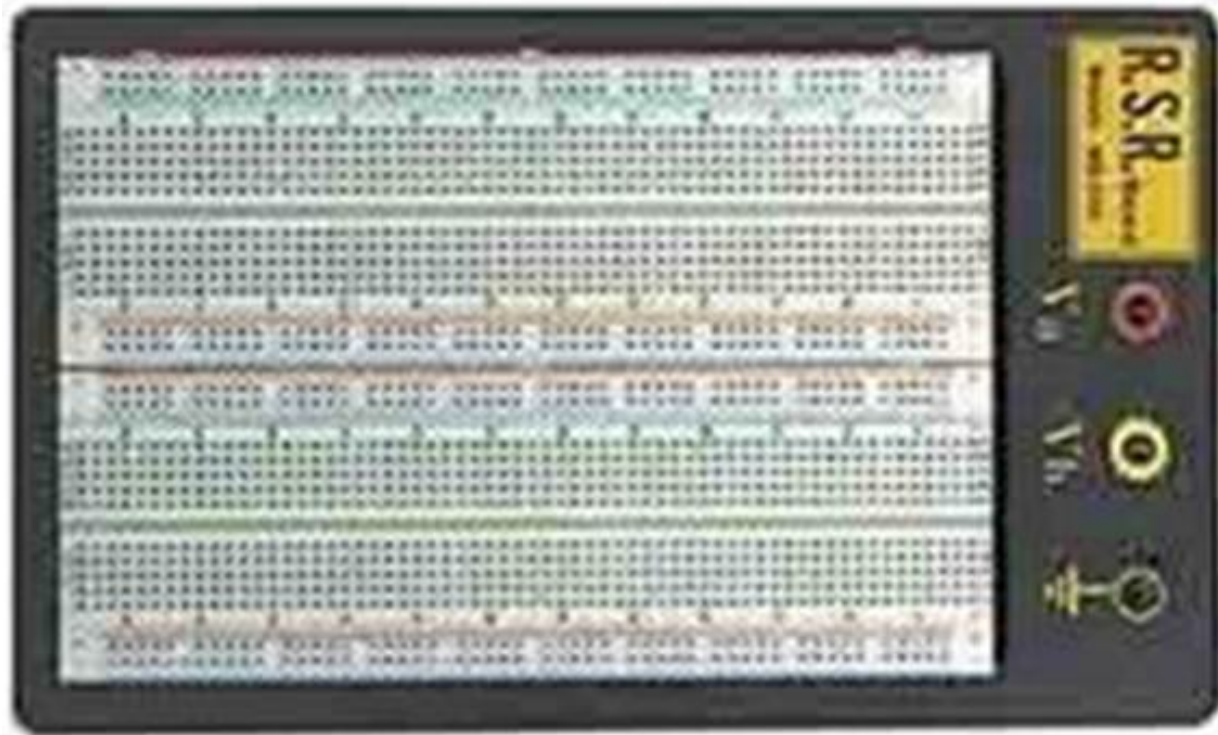


16.312
Electronics Lab.
Experiments

Solderless Prototyping Board
top half for **test devices**
bottom half for **Device Under Test**
jacks for **power connections**



Experiment 5/6

Device Under Test

XR4151 V/F & F/V
converter

- - - - Remote Data Collection - - - -

- Transmit voltage points from a remote site to Data collection point

Problem

- At a remote oil well site a sensor measuring levels in a storage tank needs to communicate with a central Data site on status of the oil level in the storage tank.
- Full tank = sensor output is + 5 volts DC
- Empty tank = sensor output is + 1 volt DC
- Because of the long distance between the sites the standard 20mA.-Loop, will not work because of voltage drop in the resistance of the long connection wires.

Possible solution

- Change the voltage to a frequency that will not change with signal voltage loss over long wire runs because of wire resistance. Then convert back to a voltage for measurement.
- The two required voltage points are +1 & +5 volts.
- The frequency range depends on the design.
- The same device needs to be used on each end.

The DAY of DESIGN

- As students enter the lab. BL424 they will pick out of a hat their assignment.
- You will design a Data Transmitter .
- Or design a Data Receiver.
- Your team member will be selected by the hat drawing also.
- **Come prepared to do either design.**
- You will work as a team and both voltages must be transmitter and received to get credit.

XR 4151 V/F & F/V conv.

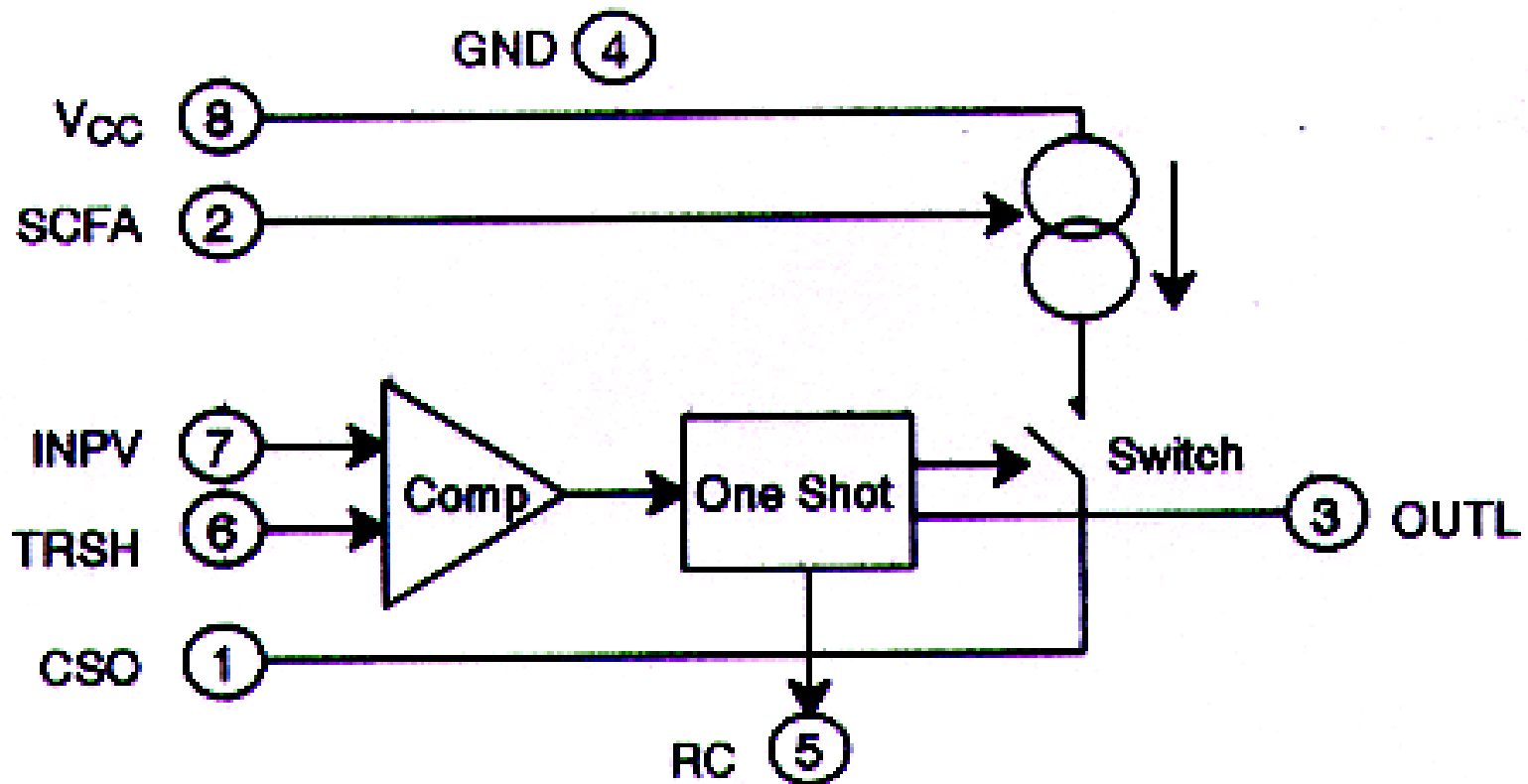
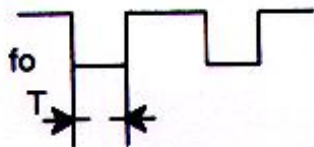
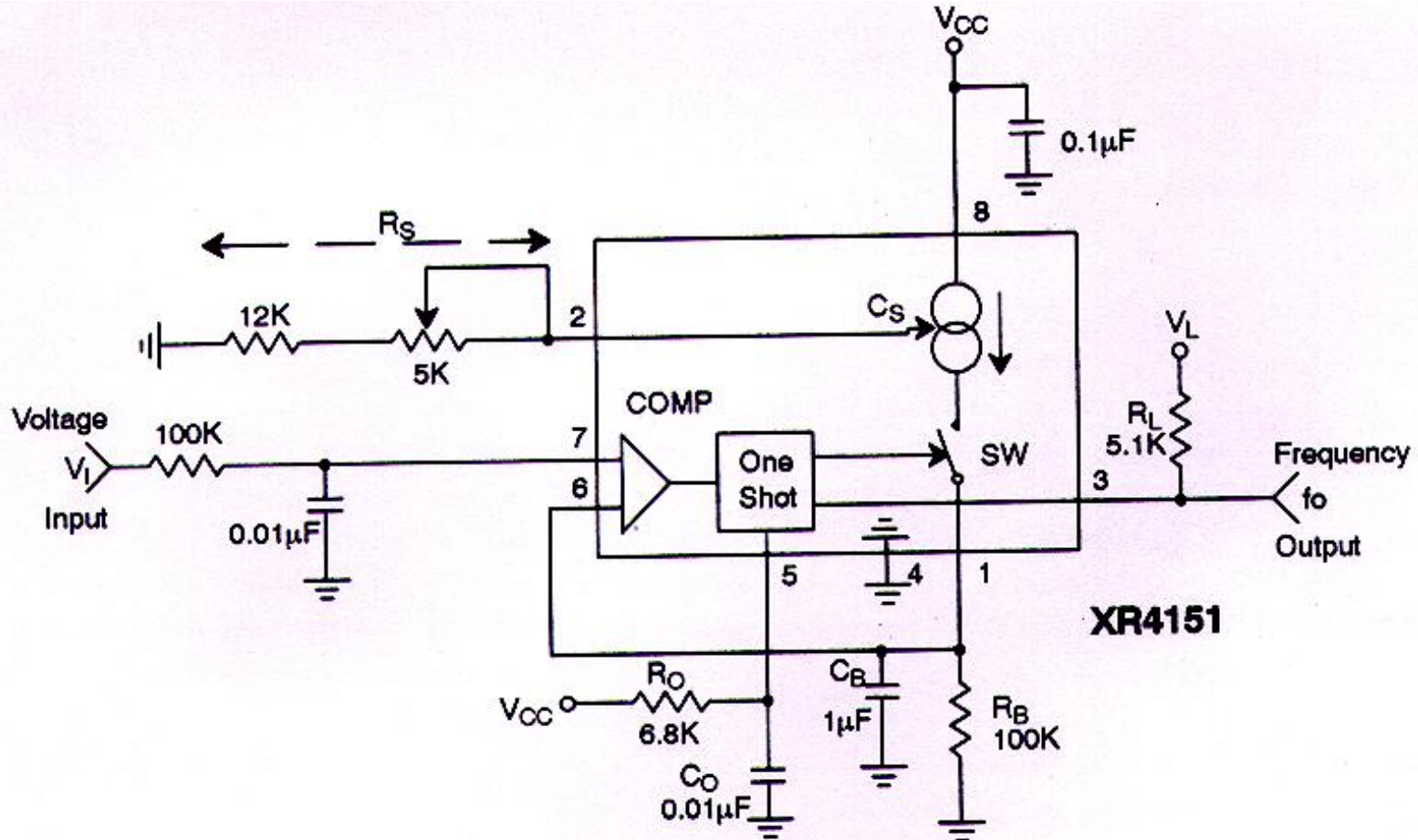


Figure 1. Block Diagram

Voltage to Frequency converter

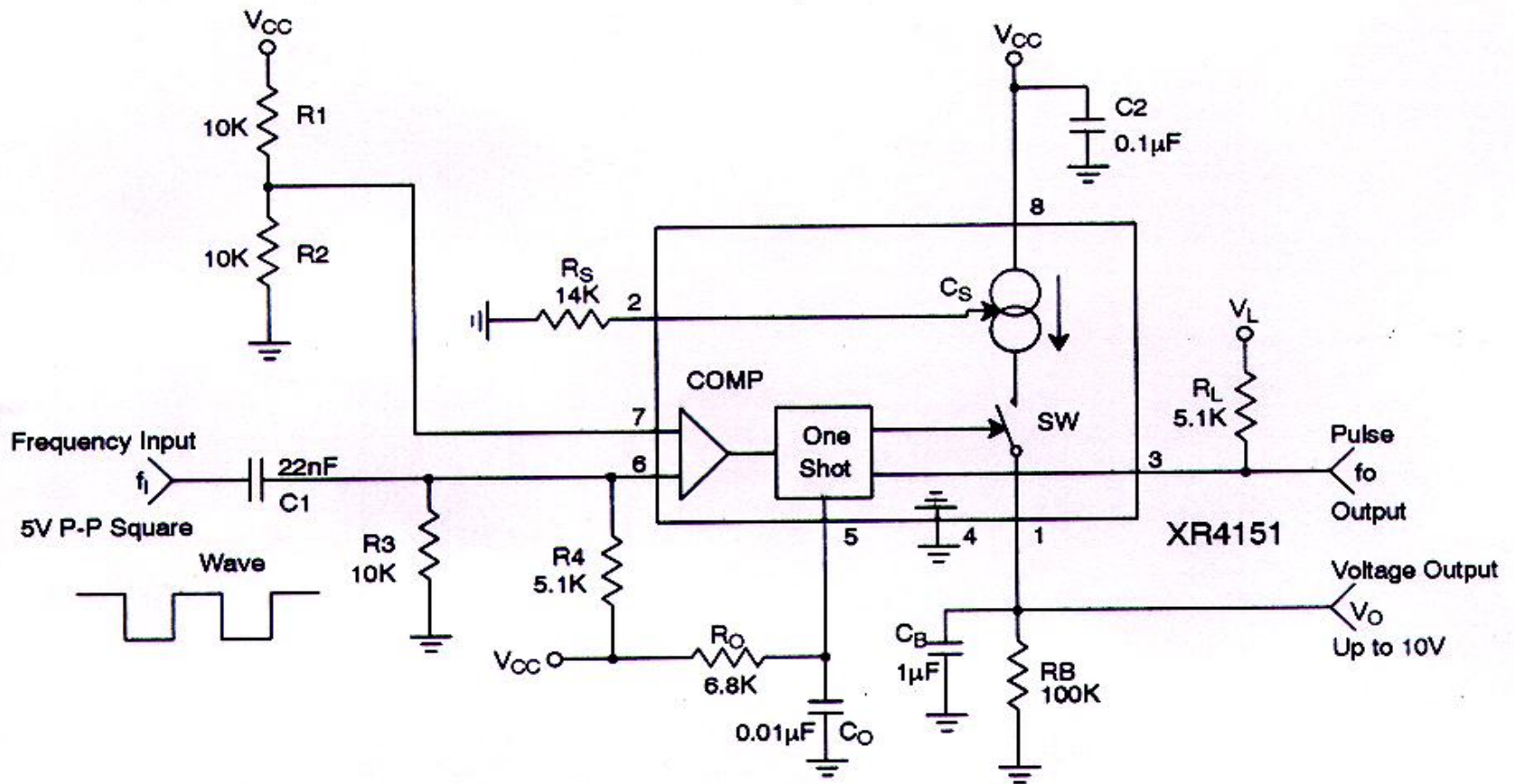


$$f_o = K V_I, \text{ Where } K = 0.486$$

$$T = 1.1 \cdot R_O \cdot C_O$$

$$\frac{R_s}{R_B \cdot R_O \cdot C_O} \quad \frac{\text{kHz}}{\text{V}}$$

Frequency to Voltage converter



Design Equations
 $V_O = f_i/K$, Where $K=0.486$
 $T = 1.1 \cdot R_O/C_O$

$$\frac{R_S}{R_B \cdot R_O \cdot C_O} \quad \frac{\text{Hz}}{\text{V}}$$

Supplied Components

- 1 ea. XR4151 IC, 8 pin DIP
- Resistors (free stock)
- Capacitors (free stock)
- 24 awg. solid wire from cat-5 cable
- LM741 if needed

Electrical Characteristics

- $V_{cc} = 15$ volts DC single supply voltage
- Voltage linearity to be checked and recorded
- Frequency to be checked and recorded
- Connection between stations, 2 wires
- Record Supply Current required
- Frequency to be 10 volts p-p or less
- LM741 op-amp may be used to replace LM747 if precision converter is required

Notebooks

- Everything should be in your notebook
- Parts list with component cost both designs
- Schematics / block diagrams/component layouts
- Data tables data points every .5 volts .5 to 7volts
- Test layout diagram, both sides
- Result conclusions, team member's name
- Scope print-outs to back-up data & conclu.
- In ink !!!!!

Grading

- Preparation before entering the lab (in the notebook) 30%
 - Schematic of the design
- Final design schematic 10%
- Parts list 5%
- Circuit description (how it works) 15%
- Neat circuit wiring on board 10%
- Scope pictures 10%
- Bench quiz 10%
- Clean up the work space 10%