EXPERIMENT : 93

IC REGULATED POWER SUPPLY

Aim :

To construct an IC regulated power supply and study its regulation properties.

Apparatus and Components:

A (0 – 12) step down transformer, 4 diodes IN4001, IC7805, 1000μF/24V electrolytic capacitor, etc

Procedure :

A bridge rectifier is constructed as shown in Fig.93.1. The ac is converted to dc using the bridge rectifier and smoothened by the 1000μF filter capacitor. The dc across the filter capacitor is directly connected as input to the regulator IC 7805. The IC 7805 has three pins, namely, input, output and common ground (Fig. 93.2). The input to IC 7805 can be between 8V to 25V. All the necessary circuits are built in and the output will be exactly 5V. The output will remain constant as long as the current drawn from it does not exceed about 800mA. A small value capacitor, 0.1μF is connected between the output and ground to remove high frequency noise with in the IC.

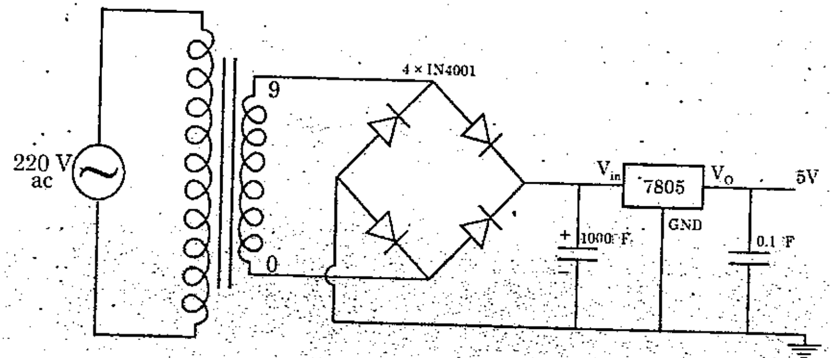

Fig. 93.1

The dc voltage across the filter condenser and the voltage at the output terminal of IC 7805 are measured. The pin configuration is shown in Fig.93.2. A heat sink is provided for the IC to dissipate heat generated.

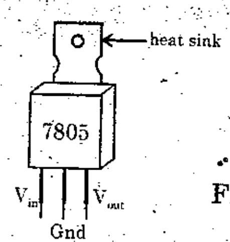

Fig. 93.2

Variation of output voltage with load current:

To study the regulation property, the load current is changed to different values and in each case the output voltage is measured. A resistance box R_L is connected across the output of IC 7805 through a milli ammeter as shown in Fig. 93.1.

With out connecting the load resistance R_L, the output voltage is measured. The load current I_L now is zero and let the output voltage will be equal to 5V. Now the resistance box R_L is connected and a resistance of 10KΩ is included in R_L. The load current now will be nearly 0.5mA (5V/10KΩ). The value in R_L is reduced to 1KΩ. The load current now will be nearly 5 mA. The load current I_L and the output voltage V_L are noted. The value in R_L is reduced in steps and in each case the load current I_L is noted. The voltage with load V_L for different values of I_L are tabulated as in Table 93.1.

A graph is drawn connecting the load current I_L and the output voltage V_L. The output voltage remains constant upto certain value of load current, indicating good regulation. When the load current increases further, the output voltage will come down indicting the power supply goes out of regulation for larger load currents as shown in Fig.93.3.

Table 93.1

R_L Ω	I_L mA	V_L V
10K	-	5
1K	.	
500	-	-
200	-	-
100	-	
50	-	
20	-	
10	-	

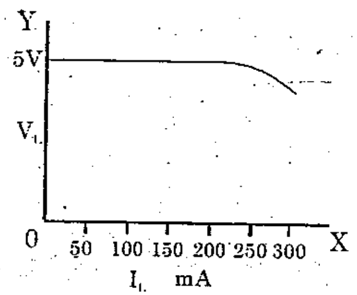

Fig.93.3

Result :

An IC regulated power supply is constructed and its regulation characteristics with load current is studied.

Note :

There are different voltage regulators available to give fixed, constant voltages. For example, 7806 - 6V, 7809 - 9V, 7812 - 12V, etc. Negative voltage regulators like 7905, 7912, etc are also available.

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EXPERIMENT : 123

555 TIMER – SCHMITT TRIGGER

Aim:

To construct Schmitt trigger using 555 timer and study its performance.

Apparatus and Components :

555 timer, 0.01 μF, 10 K linear potentiometer, 6 Volts power supply, multimeters, etc.

Procedure :

555 timer is a highly stable integrated circuit capable of functioning as an accurate time delay generator and as a free running multivibrator. The pin configuration for IC 555 is shown in Fig.123.1.

The 555 can be operated with a power supply of 5V to 18V. For convenience a 6V power supply is suggested here.

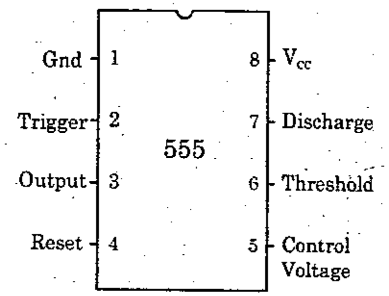

Fig. 123.1

The basic operation of 555 can be understood by connecting it as a Schmitt trigger. The connections are made as shown in Fig.123.2. The 555 timer contains a threshold comparator which will trip at 2/3 Vcc and a trigger comparator which will trip at 1/3 Vcc.

The input voltage is increased from 0V to Vcc. The output voltage remains high until the input voltage reaches 2/3 Vcc. On just crossing 2/3 Vcc the output voltage drops to 0V. This point is called as upper trip point (UTP). For further increase of the input voltage, the output continues to remain low till the input voltage reaches maximum, Vcc.

In the next part of the experiment input voltage is decreased from Vcc. The output voltage continues to remain low until the input voltage reaches 1/3 Vcc. On just crossing below 1/3 Vcc, the output voltage goes high to Vcc. This point is called lower trip point (LTP). After that the output continues to remain high for further decrease in the input voltage.

The readings or recorded as in Table 123.1a and 123.1b.

Table 123.1a

Increasing	
V_i Volts	V_o Volts
0	High
1	–
2	–
3	–
4(UTP)	Low
5	–
6	–

Table 123.1b

Decreasing	
V_i Volts	V_o Volts
6	Low
5	–
4	–
3	–
2(LTP)	High
1	–
0	–

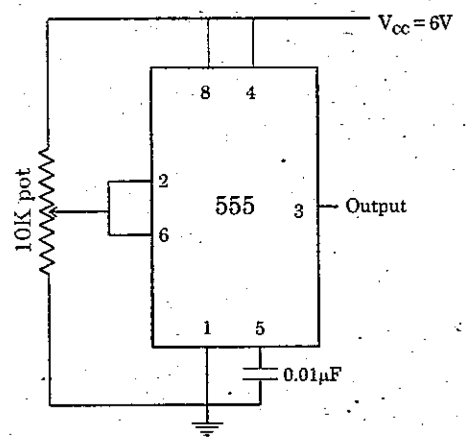

Fig. 123.2

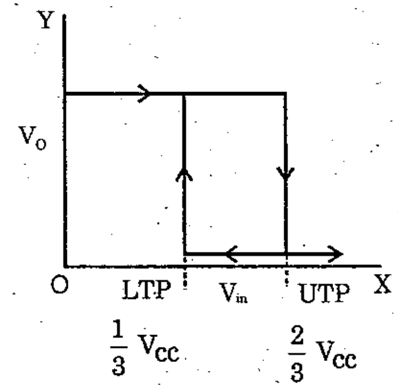

Fig. 123.3

The response of the Schmitt trigger is shown in Fig.123.3. The hysteresis of the circuit is found by drawing a graph between the input and the output voltages. This hysteresis (UTP – LTP) is shown in the graph.

If we apply a sine wave as the input, then the output is a square wave. This can be seen through CRO.

Result :

The Schmitt trigger is constructed using 555 timer and its performance is studied.

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EXPERIMENT : 117

OPAMP – PHASE SHIFT OSCILLATOR
(SINE WAVE GENERATOR)

Aim:

To construct a phase shift oscillator using operational amplifier.

Apparatus and Components :

IC 741, capacitors, resistors, 1MΩ linear potentiometer, dual regulated power supply, CRO, etc.

Procedure:

The phase shift network consists of three resistors (R) and three capacitors (C) as shown in Fig.117.1a. The frequency response of the phase shift network can be studied by applying an ac signal at the input and measuring the output. At low frequencies, the output and hence the gain is low. As the frequency increases, the output also increases and behaves as a high pass filter. The frequency response of the network will be as shown in Fig. 117.1b.

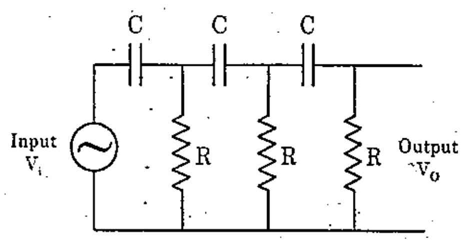

Fig. 117.1a

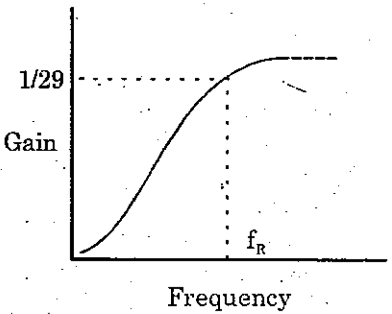

Fig. 117.1b

It can be theoretically shown, that the network produces a phase shift of 180 degrees at a frequency given by

$$f = \frac{1}{2\pi\sqrt{6}\,RC}$$

Also, at this frequency, the gain of the network, $V_0 / V_i = 1/29$

Since the output is less than the input, we can also say that the network gives an attenuation of 29.

To this three-stage phase shift network, an op-amp inverting amplifier is added to get the phase shift oscillator. The output of the inverting amplifier is fed back as input to the phase shift network. The Op-Amp phase shift oscillator is shown in Fig. 117.2. Since the network produces an attenuation of 29, to overcome the attenuation, the gain of the amplifier has to be 29. The inverting amplifier has R_i as input resistance and R_f as feedback resistance and the gain of the inverting amplifier is given by

$$A = -(R_f / R_i)$$

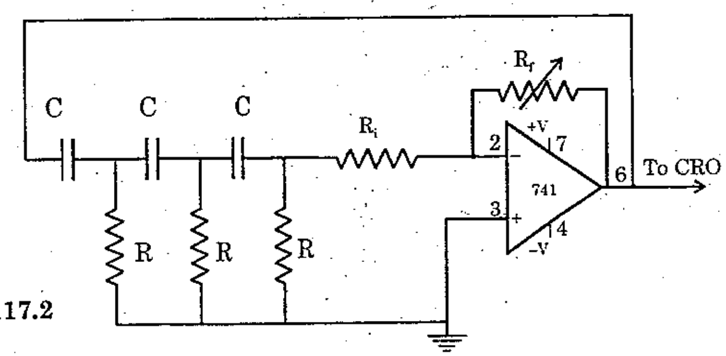

Fig. 117.2

For different combinations of R and C the sine wave is produced (by adjusting R_f) and the frequency is measured using CRO. The reading can be tabulated as in Table 117.1.For a fixed value of R_i, the feedback resistor R_f can be adjusted to be more than 29 times R_i to produce undistorted sine waves.

Table 117.1

R KΩ	C pF	f Hz
10	1000	–
10	2200	–
15	1000	

R_f required may be large and therefore 1MΩ pot or a resistance box having 100KΩ dial can be used. Let R_i = 4.7K.

Result :

The phase shift oscillator is constructed using opamp and its frequency of oscillations is determined for different combinations of R and C.

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EXPERIMENT : 118

OPAMP – WIEN'S BRIDGE OSCILLATOR

(SINE WAVE GENERATOR)

Aim:

To construct a Wien's bridge oscillator using operational amplifier and measure its frequency using CRO.

Apparatus and Components :

IC 741, capacitors, resistors, 10 K linear potentiometer, dual regulated power supply, CRO, etc.

Procedure:

The Wien's bridge oscillator uses a feedback circuit called a lead-lag network (also called Wien's bridge network). At very low frequencies, the series capacitor offers high reactance to the input signal and thus very low output is obtained. At very high frequencies, the shunt capacitor offers very low reactance and again very low output is obtained. In between these two frequency ranges, the output voltage from the lead-lag network reaches a maximum value. The frequency at which the output is maximum is called resonant frequency. At this frequency, the feedback fraction reaches a maximum value of 1/3. That is, the output voltage is one-third of the input voltage.

The resonant frequency is given by,

$$f = \frac{1}{2\pi RC}$$

The Wien's network consists of a R and C in series followed by Rand C in parallel. The frequency response of the Wien's network can be studied by applying an ac signal across the entire network and measuring the output across the R and C parallel combination. The arrangement is shown in Fig. 118.1a.

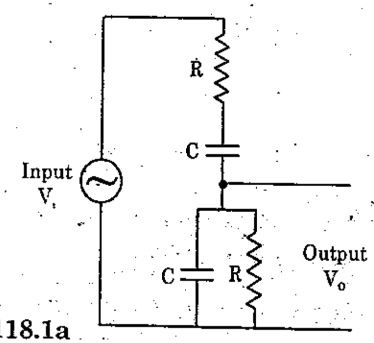

Fig. 118.1a

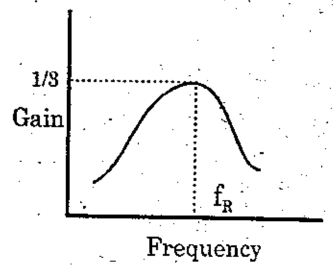

Fig. 118.1b

Keeping the input voltage constant, the output is measured by varying the frequency. It can be seen that the output increases with increase in frequency, reaches a maximum value and then decreases. At resonant frequency, the output is maximum and is equal to (1/3) V_{in}. Refer Fig. 118.1b. The Wien's network can be connected to a non-inverting amplifier (which gives a gain of 3) and we get a Wien's bridge oscillator that produces continuous sine waves.

The Fig.118.2 shows a Wien's bridge oscillator. The Wien's network produces an attenuation of 3. The non-inverting amplifier should give a gain of 3. The voltage gain of the non-inverting amplifier is given by,

$$A = \left(1 + \frac{R_f}{R_i}\right)$$

Let R_i = 3.3 KΩ, R_f = 3.3KΩ + 10 KΩ potentiometer.

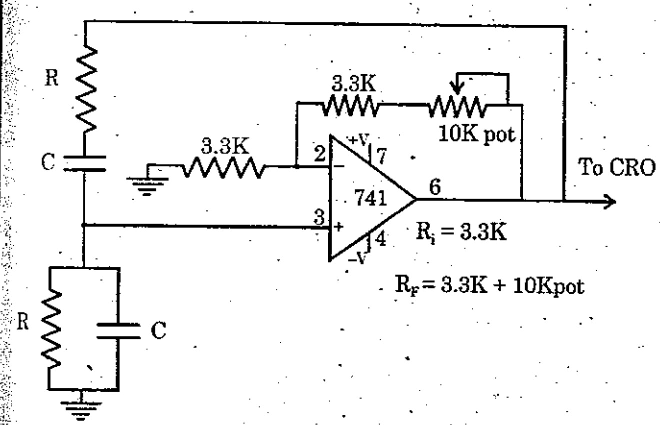

Fig. 118.2

Table 118.1

R KΩ	C μF	f Hz
10	0.01	–
16	0.01	–

A perfect sine wave is obtained at the output by adjusting the 10K linear potentiometer which serves as a wave shaper. The frequency of oscillations is measured using CRO. The experiment is repeated for different values of R and C and tabulated as in Table.118.1.

Result :

The Wien's bridge oscillator is constructed using opamp and its frequency of oscillation is determined.

EXPERIMENT : 124

555 TIMER – ASTABLE OPERATION

Aim:

To construct an astable multivibrator using 555 timer.

Apparatus and Components :

555 timer, capacitors, resistors, 6 Volts power supply, CRO, etc.

Procedure :

The connections are made as shown in Fig. 124.1. Initially when the voltage across the capacitor C is zero, the output of 555 timer is high. The capacitor starts charging through the resistors R_A and R_B. When the voltage across the capacitor crosses 2/3 Vcc, the output voltage goes low. Now the capacitor starts discharging through R_B only. When its voltage goes below 1/3 Vcc, the output once again goes high. The charging and discharging is repeated and square waves are obtained at the output and observed using a CRO.

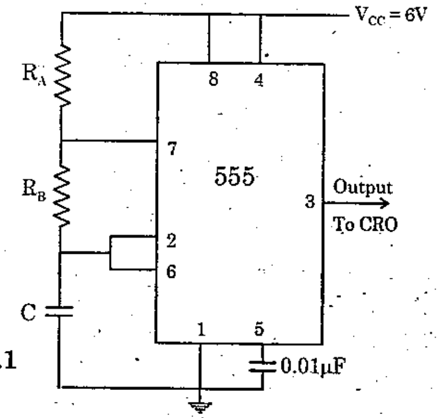

Fig. 124.1

Table 124.1

R_B KΩ	C μF	f Hz
10	0.01	–
10	0.02	–
20	0.03	–

Note : *In 555, since charging and discharging periods are not equal the output will not be a perfect square wave.*

The frequency of the square waves is given by

$$f = \frac{1.44}{(R_A + 2R_B)C}$$

The value of R_A is kept constant as 330 Ω. The experiment may be repeated for different values of R_B and C and tabulated as in Table 124.1.

Result :

The astable multivibrator is constructed using 555 timer.

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EXPERIMENT : 125

555 TIMER – MONOSTABLE OPERATION

Aim:

To construct a monostable multivibrator using 555 timer.

Apparatus and Components :

555 timer, variable capacitors, resistors, 6 Volts power supply, AFO, CRO,etc.

Procedure:

555 timer can function as a one shot multivibrator. The connections are made as shown in Fig.125.1. The external timing capacitor C is initially discharged. Upon application of negative pulse to pin 2, the internal flip-flop is set which releases the short circuit across the external capacitor and drives the output high. The voltage across the capacitor rises exponentially with time constant RC. When the voltage across the capacitor reaches 2/3 Vcc, the threshold comparator resets the flip-flop, which in turn discharges the capacitor rapidly and drives the output to low state. The circuit is reset in this state and remains reset till the arrival of the next pulse. This circuit once triggered will remain in this stage until the set time is elapsed even if it is triggered again during this interval.

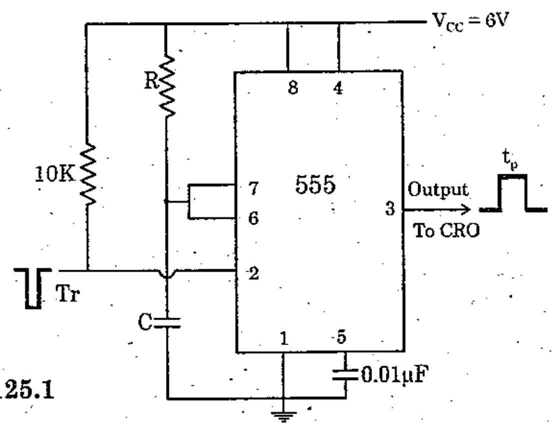

Fig. 125.1

As discussed in op-amp monostable, here also trigger pulse must be applied repeatedly so that we get the output pulse repeatedly to be seen on the CRO. The TTL output of the audio oscillator can be used to trigger 555. The frequency of the TTL square wave output can be kept around 500Hz. Every time the TTL wave goes down, the output of the 555 monostable should go high. The input TTL wave and the output of the 555 monostable is shown in Fig.125.1.

The pulse is given by,

$$t_p = 1.1\,RC.$$

The experiment may be repeated for different values of R and C and tabulated as in Table.125.1.

Table 125.1

R KΩ	C μF	t_p ms
10	0.01	–
10	0.02	–
20	0.03	–

Result :

The monostable multivibrator is constructed using 555 timer and the pulse width is measured for different combinations of R and C.

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DIGITAL CIRCUITS