

DIY KIT 111. SIMPLE SQUARE WAVE OSCILLATOR

A square wave generator is one of those pieces of equipment that has many uses in the workshop yet few hobbyists actually have. This simple kit, based on the popular 555 timer IC, generates six preset frequencies from 1Hz to 100kHz. It has a wide operating voltage range and even provides visual indication of the output.

The kit is constructed on a single-sided printed circuit board (PCB). The PCB measures 78 x 50mm and will mount on a small plastix "Jiffy" box. Protel Autotrax & Schematic were used to design the PCB.

ASSEMBLY INSTRUCTIONS

Follow the component overlay on the PCB, starting with the lowest height components first. Make sure that the electrolytic capacitors are inserted the correct way around. The positive lead is marked on the overlay. The negative is marked on the body of the capacitor. The LED has a flat spot on the body which lines up with the line on the overlay. Cut the 2x6 terminal strip into 6 individual 2-pin units to fit into positions J1 to J6. Try to keep them at right-angles to the PCB before soldering. Insert the IC into the socket. Note that pin 1 is facing down.

CIRCUIT DESCRIPTION

The circuit is straight out of the 555 data book. The 555 is configured for astable operation, meaning that it will trigger itself and free run as a multivibrator.

The timing elements are resistors R1, R2 and one of the capacitors (C1-6). The capacitor is selected by placing a shorting plug on one of the jumpers J1-6.

The selected capacitor (C) is charged through R1 + R2 and discharged through R2. This allows the duty cycle (on/off ratio) to be precisely set.

The charge time (output high) is given by:
 $t_1 = 0.693 (R1 + R2) C$

The discharge time (output low) is given by:
 $t_2 = 0.693 (R2) C$

The total period is:
 $T = t_1 + t_2 = 0.693 (R1 + 2R2) C$

The frequency of oscillation is:

$$f = \frac{1}{T} = \frac{1.44}{(R1 + 2R2)C}$$

The duty cycle is: $D = \frac{R2}{R1 + 2R2}$

For the values shown, the six frequencies generated are 1Hz, 10Hz, 100Hz, 1kHz, 10kHz and 100kHz. However, due to component tolerances in the capacitors, these frequencies can vary by as much as 10 percent. The duty cycle is approximately 50%. Capacitors C8 and C9 provide power supply decoupling.

TESTING

Before applying power, check that all parts are inserted in the correct position. Make sure that the electrolytic capacitors are the right way around.

The kit has an operating voltage range of 5 to 18VDC.

Insert the shorting plug on jumper J1. This gives an operating frequency of 1Hz. Apply power. The LED should be flashing at this 1Hz rate (0.5 seconds on, 0.5 seconds off).

As the shorting plug is moved to each of the next jumpers in turn the output frequency will jump by a factor of 10 each time. This will make the LED appear to be "on" all the time. Use an oscilloscope or frequency meter to verify the output.

IF IT DOES NOT WORK

Poor soldering ("dry joints") is the most common reason for the circuit not working. Check all soldered joints carefully under a good light. Re-solder any that look suspicious. Check that all components are in their correct position on the PCB. Are the electrolytic capacitors the right way round? have you inserted the shorting plug?

PARTS LIST - KIT 111

Resistors (0.25W carbon)

1K	R3	1
3K9	R1	1
68K	R2	1

Capacitors

100pF ceramic	C6	1
1nF mylar	C5	1
10nF .01J63 polyester	C4,7	2
100nF .1J63 polyester	C3	1
100nF monobloc	C9	1
1uF 25V electrolytic	C2	1
10uF 25V electrolytic	C1,8	2

Semiconductors

LM/NE555 Timer IC	IC1	1
LED, 5mm, red	LED	1

Miscellaneous

8 pin IC socket	1
2 way header blocks	6
Jumper	1
9V battery snap	1
PCB, K111	1
Box & screws	1

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