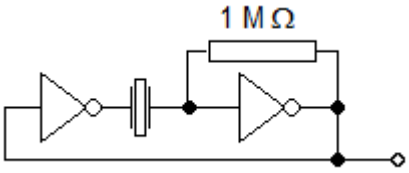
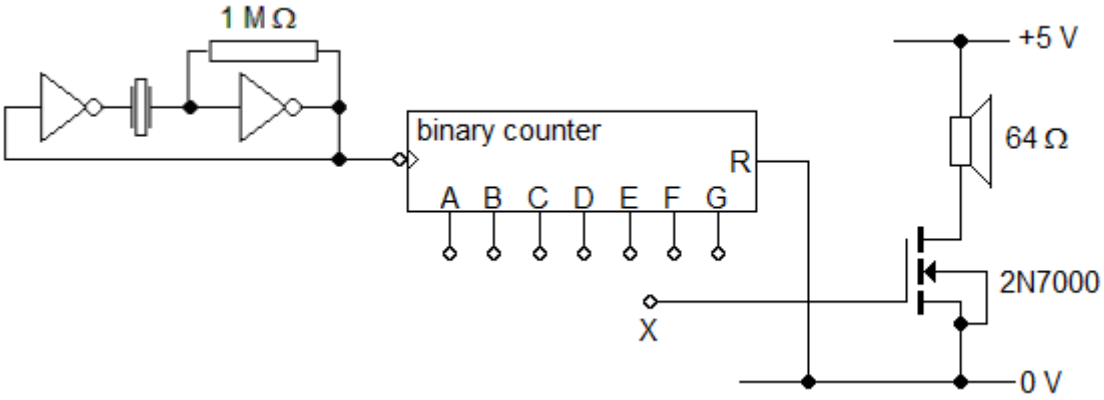
Timing circuits

You are going to find out how counters can be used to change the frequency of an oscillator.

1 Assemble this oscillator circuit with a 32768 Hz crystal. Use an oscilloscope to verify that the output is a square wave with the required frequency.



2 Add a 4024 seven-bit binary counter, driver and loudspeaker as shown below.



3 Use an oscilloscope to display the signal at X, the driver input. Connect X to each output of the binary counter in turn. Record the period of the waveform at X each time. Enter each result into the table and calculate the frequency.

counter output	period	frequency
A		
B		
C		
D		
E		
F		
G		

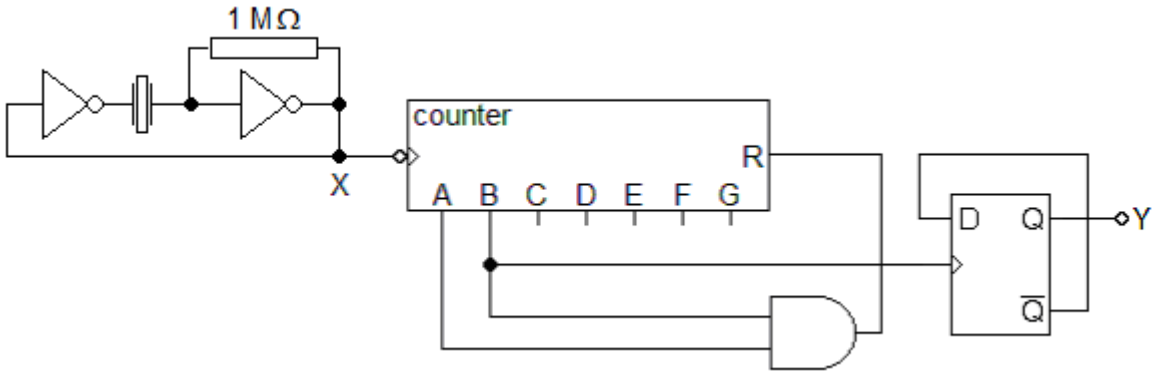
4 Add another 4024 i.c. and arrange for the loudspeaker to be fed a signal at 2 Hz, so that it makes four clicks every second.

5 Adapt the system so that the loudspeaker clicks once every second.

Frequency division

You are going to investigate a system for frequency division.

1 Assemble this circuit. Use a 4024 seven-bit counter i.c. and a D flip-flop in a 4013 i.c.



2 Connect one beam of an oscilloscope to X and the other to Y. Verify that for every cycle of the signal at Y, there are exactly six cycles of the signal at X. In other words, the frequency at Y is 32768 ÷ 6 = 5461 Hz.

3 Adapt the circuit so that there are exactly ten cycles at X for each cycle at Y, giving Y a frequency of 32768 ÷ 10 = 3277 Hz.

4 Arrange for the frequency at Y to be 1490 Hz.

5 The system can only divide the frequency of the oscillator by an even number. Incorporate the simple frequency doubler shown below so that the system can generate frequencies divided by odd numbers as well. Use division by 5 to get 6554 Hz at Y.