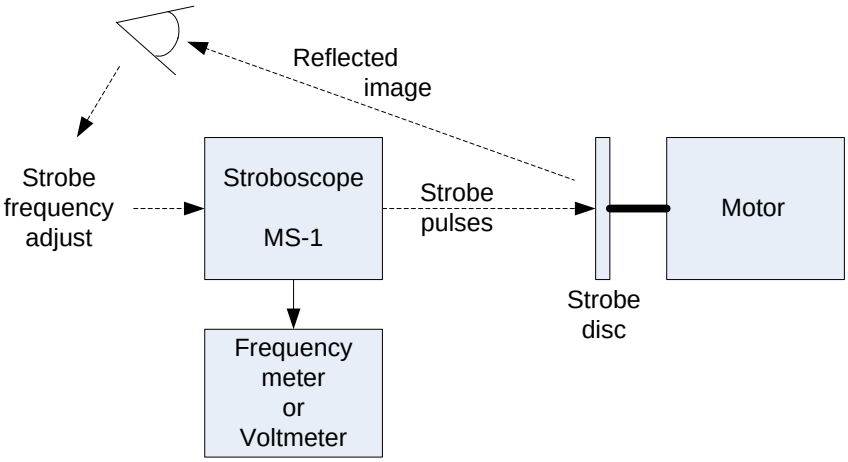
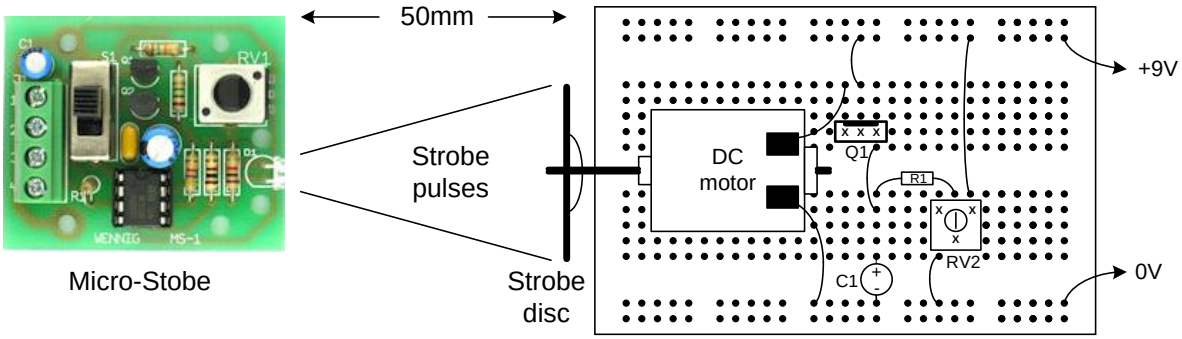
Motor speed measurement

Block diagram



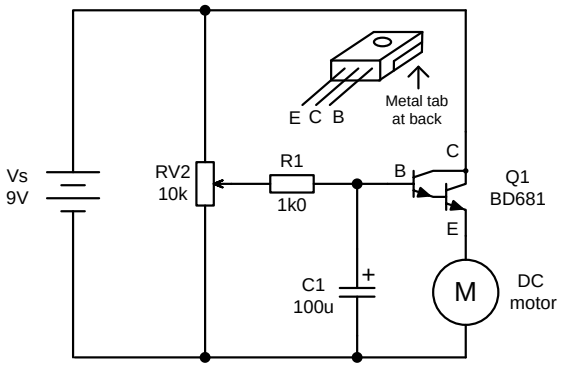
Hardware setup



Motor speed controller

The electric motor can be powered directly from a battery or a variable DC voltage source such as this.

The DC motor used in this example is a 12V unit from an automotive electric side-view mirror.

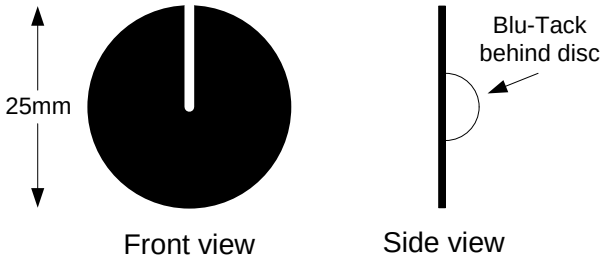


The strobe disc can be made from card and held to the motor shaft with Blu-Tack as follows:

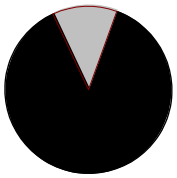
Strobe disc

Cut a 25mm diameter disc from dark-coloured paper or card, and add a thin stripe of white paint or tape as shown.

Open a 2mm hole in the centre of the disc, place a small quantity of Blu-Tack behind the hole, and push the disc onto the motor shaft. This is only for low shaft speeds!



Observations and measurements

Actions	Observations / measurements
• Adjust RV1 (on the MS-1) fully anti-clockwise • Switch ON the MS-1 and motor	• The MS-1 flashes at 1Hz • The illuminated stripe appears at random positions around the disc because the flash rate and shaft speed are not synchronised
Slowly increase the strobe frequency until the stripe appears at the same position with each flash. Delicate frequency adjustment is required to maintain a stationary image. 	• Measure and record the strobe frequency using the frequency meter (or voltmeter and voltage-to-frequency conversion factor) F_o = ……..Hz • This frequency may be an integer fraction of the shaft speed, because the shaft could be rotating several times between flashes. This ambiguity can be resolved as follows:

- Estimate the angle (in degrees or radians) within the wedge-shaped reflected image.
- Divide this angle by 360 degrees (or 2π radians) to find the fraction of one revolution
- Divide this fraction of a revolution by the time duration of the strobe flash (3.3ms) to estimate the shaft speed in hertz:

F_{est} = ...

- Compare this estimate with the strobe frequency F_o measured and recorded above. If the two values are close, then the measured F_o will be correct. If the two values differ significantly, move the strobe frequency to the estimated value (F_{est}), and adjust it for a stationary reflected image. The strobe frequency (F_o) should now indicate the shaft speed in hertz – but check this again using the 'blurred sector angle' method
- Convert from hertz (Hz) to revolutions per minute (rpm) by multiplying by 60:

$$F_o(rpm) = F_o(Hz) \cdot (60\,s/\min)$$

$$= (\ldots\ldots\ldots\ldots\ Hz) \cdot (60 s/\min)$$

$$= \ldots\ldots\ldots\ldots\ rpm$$