Permanent Magnet Motor Kit, Magnetic Reed Type

(SKY-ReedMotorKit)

Instructions

This kit contains powerful permanent magnets. Exercise caution when handling them as they can pull on iron tools and snap together with significant force if brought together. Also, keep magnetic field sensitive cards and devices away from the magnets. It is recommended not to power this motor above 4.5VDC in order to keep the rotor speeds within a safe range.

Assembling the motor:

The motor comes pre-assembled and pre-wired with the 4 magnets in position 90 degrees apart, but requires the placement of the stator coil and reed switch in the desired positions on the outer ring. The assembled parts are shown in Fig. 1

These are:

1) The main motor assembly, which includes the rotor, the stator, and the mounted magnets/magnet holders.
2) The stator coil assembly, with its on/off switch.
3) The reed switch assembly.
4) The battery pack (shown with 3 AA cells, not included).
Step 1: Mounting the stator coil.

The stator coil should be placed first, and can be mounted in any position on the stator portion of the main rotor assembly. This is the grey plastic ring with the ¼-20 screw holes, 20 positions being available in all. The stator coil has two oval holes in its base that can be positioned over two of the stator screw holes as shown below in Fig. 2. Then use two of the ¼-20 screws supplied to screw the coil assembly down to the stator ring. A Robertson screwdriver will be required for this step. Note that if the rotor is in place, the magnets on the rotor may be attracted to the iron screw driver or screws, so it is recommended to remove the rotor temporarily while completing this step. The rotor can simply be lifted off its axle and put aside temporarily, as shown below.

Fig. 2: Attaching the stator coil to the main motor assembly using ¼-20 screws.

The edge of the stator coil should be about 1/8th inch (3mm) back from the inner rim of the stator ring. This will put the coil head about 3/8” (9mm) from the magnets as they rotate past.

Step 2: Positioning the reed switch:

Once the stator coil is in place, you can then position the reed switch. The two are attached together by red and black wires, since the reed switch serves to turn the stator coil on and off as the magnets pass by. The red wires always connect to the red terminals, the black to the black terminals.
The position chosen for the reed switch depends on which way you would like the motor to rotate. If clockwise, then the reed switch should be less than 90 degrees of angle from the stator coil so that it is triggered as one of the magnets approaches the 3 o’clock position. The exact position for maximum rotation rate can be determined by holding the reed switch assembly firmly by hand on the stator ring and moving it around the ring in either direction with the motor switch ON (do not allow the reed switch to come too close to the rotating magnets!). Since this motor is not always self-starting, the rotor may require a gentle push in the clockwise direction to get started. As a guideline, one good position for the reed switch is shown in Fig. 3 below, and is a little past the 3 o’clock position. If this position is chosen, then the reed switch can be screwed into the nearest placement hole using a ¼-20 screw provided. It is best to move the magnets away from the reed switch when screwing it in, otherwise they may be attracted to the screw driver or screw. Also, take care not to allow the reed switch to make contact with a magnet, as it has a fragile glass envelope and may break.

**Fig. 3: Placement of the reed switch for clockwise rotation.**

Similarly, the reed switch can be placed in a good position for counter-clockwise rotation as shown below in Fig. 4. In this case, the reed switch assembly should be at the 3 o’clock position or a little before. The best position can be determined by trial and error. As before, once the position is selected, simply screw down the read switch assembly at that place using a ¼-20 screw provided, taking care to keep the magnets away from the screw driver and screw while you are doing this. The reed shich itself should be about flush with the inner edge of the stator ring, which is about ¼ inch (6-7mm) from the closest approach of a given magnet.
Fig. 4: Best position of the reed switch for counter-clockwise rotation.

Once completed, the motor should look something like this in Fig. 5 below (clockwise version). The relevant controls and outputs are as labelled.

Fig. 5: The completed motor
Operation of the motor and details of the circuit:

In order to operate motor, simply place the ON/OFF switch in the ON position (up) and give the rotor a gentle push in the chosen direction (clockwise or counter-clockwise). If the reed switch position is chosen carefully, the motor can be self-starting. It will then rotate up to speed in a few seconds, which depending on the placement of the parts will be about 150-250 RPM at 4.5VDC.

The motor works as follows:

1) The permanent magnet closest to the stator is attracted to the iron core until it reaches a position directly opposite.
2) At this moment of closest approach, the reed switch is activated by the magnet in the 3 o’clock position, changing it’s state from open to closed.
3) This energizes the stator coil with the same magnetic field polarity as the magnet facing it at the 6 o’clock position, leading to repulsion. Since the magnet is already in motion, it is propelled in the same direction that it is already rotating.
4) The reed switch then opens. As it does so, the magnetic field of the stator coil collapses, inducing a secondary transient electrical pulse in the generator coil.

Fig. 6: Monitoring the drive coil and generator coil outputs on an oscilloscope.
The process repeats four times per rotation. The transient voltage output can be monitored on the generator coil terminals either with a multimeter or more preferably an oscilloscope (not included). This output can also be used to drive other circuits as per the preference of the experimenter. An example of the generator output on an oscilloscope is shown in figure 6. A 10X probe was used and is recommended to protect the oscilloscope circuit.

**Schematics for the drive coil/generator coil circuit**

Below is provided a schematic of the drive coil/generator coil circuit.

![Schematic Diagram]

This motor is also intended to be a universal platform for experimenting with permanent magnet motor designs. It has thereby been fitted with 20 placement positions on both the stator and rotor for putting magnets and coils in different configurations. The rotor typically takes a 6-32 screw mount, whereas the stator takes a ¼-20 screw mount. This allows for a good deal of flexibility in coming up with new designs.