2. Theory

1). An elastic spring impacted by an external force is subject to deformation (elongation or compression). Within its elastic limit, it is known from Hooke's law that the deformation amount Δy is proportional to the applied force F, i.e.

$$F = K \cdot \Delta y \tag{1}$$

where K is the stiffness coefficient of the spring. It depends on the shape and the nature of the material of the spring. Through the measurement of the relationship between Δy and F, the spring stiffness coefficient K can be calculated from Eq. (1).

2). Hanging an object of mass M under the lower end of a spring whose upper end is fixed on a post, a spring vibrator is built. If the object is exerted by an external force (such as pulled down or pushed up) and then is released, the object will undertake a harmonic vibration around its balance location. Its period is:

$$T = 2\pi\sqrt{\frac{M + PM_0}{K}} \tag{2}$$

where P is a constant ($\approx 1/3$), M_0 is the mass of the spring, and PM_0 is called the effective mass of the spring. By measuring the vibration period T of the spring vibrator, the spring stiffness coefficient K can be calculated from Eq. (2).

3). Magnetic switch (magnetic controlled switch)

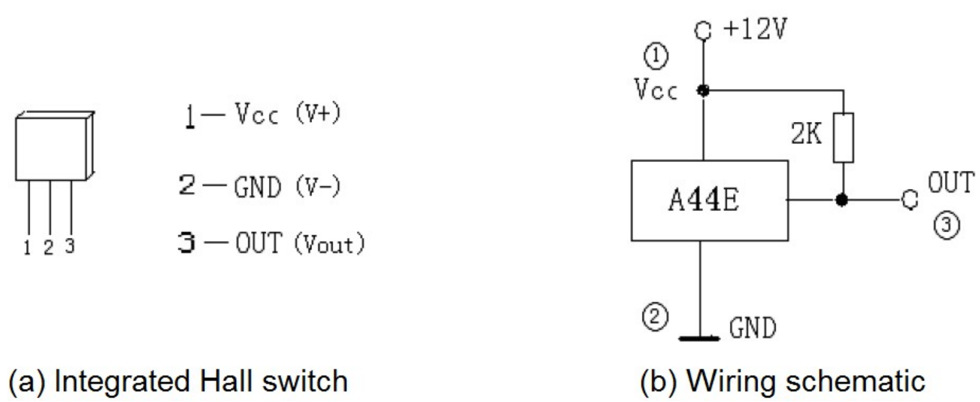

Figure 1 Schematic of integrated Hall switch

An integrated Hall sensor is a magnetic switch, as shown in Figure 1. A reference voltage is applied between "V+" and "V-". When the strength of a magnetic field perpendicularly applied to the sensor exceeds a certain value *Bop*, the output voltage between "Vout" and "V-" is minimum (≈ 0). When the magnetic field strength is less than a certain value *Brp* ($Brp < Bop$), the output voltage between "Vout" and "V-" is maximum, i.e. equal to the applied reference voltage.

Thus, the Hall sensor can be used with a timing device to measure the period of object rotation or the time of object motion.