Digital Tachometer

A digital tachometer is a digital device that measures and indicates the speed of a rotating object. A rotating object may be a bike wheel, a car wheel or a ceiling fan, or any other motor, and so on. A digital tachometer circuit comprises LCD or LED read out and a memory for storage. Digital tachometers are more common these days and they provide numerical readings instead of dials and needles.

Digital tachometer is an optical encoder that determines the angular velocity of a rotating shaft or motor. Digital tachometers are used in different applications such as automobiles, aero planes, and medical and instrumentation applications.

What is a Tachometer?

The word tachometer is derived from two Greek words: tachos means “speed” and metron means “to measure”. It works on the principle of a tachometer generator, which means when a motor is operated as a generator, it produces the voltage according to the velocity of the shaft. It is also known as revolution-counter, and its operating principle can be electromagnetic, electronic or optical-based. Power, accuracy, RPM range, measurements and display are the specifications of a tachometer. Tachometers can be analog or digital indicating meters; however, this article focuses only on the digital tachometers.

Digital Tachometer Types

Digital tachometers are classified into four types based on the data acquisition and measurement techniques.

- Based on the data acquisition technique, the tachometers are of the following types:

1. Contact type
2. Non Contact type

- Based on the measurement technique, the tachometers are of the following types:

1. Time measurement
2. Frequency measurement

1. Contact Type Digital Tachometer

A tachometer which is in contact with the rotating shaft is known as contact type tachometer. This kind of tachometer is generally fixed to the machine or electric motor. An optical encoder or magnetic sensor can also be attached to this so that it measures its RPM.

Digital Tachometers are capable of measuring low-speeds at 0.5 rpm and high speed at 10,000 rpm and are equipped with a storage pocket for the circumferential measurement. The specifications of this tachometer are LCD 5 digit display, operational temperature range of 0 to + 40oC, temperature storage range of – 20 to + 55o C and rotating speed of about 0.5 to 10,000 rpm.

2. Non-Contact Type Digital Tachometer

A tachometer that does not need any physical contact with the rotating shaft is called as noncontact digital tachometer. In this type, a laser or an optical disk is attached to the rotating shaft, and it can be read by an IR beam or laser, which is directed by the tachometer.

This type of tachometer can measure from 1 to 99,999 rpm; the measurement angle is less than 120 degrees, and the tachometer has a five-digit LCD display. These types of tachometers are efficient, durable, accurate, and compact, and also visible from long distance.

3. Time Measurement Digital Tachometer

A tachometer that calculates the speed by measuring the time interval between incoming pulses is known as time-based digital tachometer. The resolution of this tachometer is independent of the speed of the measurement, and it is more accurate for measuring low speed.

4. Frequency Measurement Digital Tachometer

A tachometer that calculates the speed by measuring the frequency of the pulses is called as frequency-based digital tachometer. This type of tachometer is designed by using a red LED, and the revolution of this tachometer depends on the rotating shaft, and it is more accurate for measuring high speed. These tachometers are of low-cost and high-efficiency, which is in between 1Hz-12 KHz.

Internal operation of these tachometers can be with the use of tachometer generator or purely with the electronic components that are described below.

Tachometer Generator

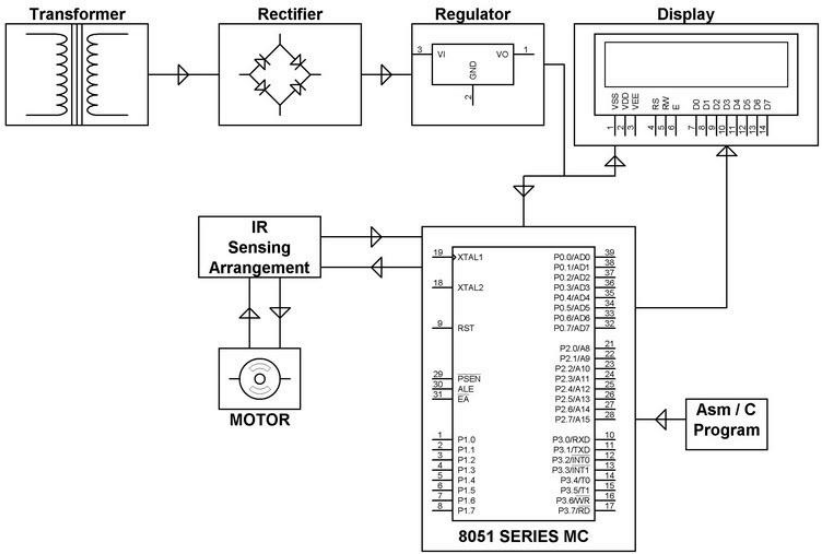
A micro-electric machine that is used to convert, the rotating speed and the shaft values of a machine into an electric signal is known as tachometer generator. The operation of the tachometer generator is based on the principle that the angular velocity of rotor is proportional to the generated EMF if the excitation flux is constant.

These tachometers are specified with generated voltage, accuracy, maximum speed, ripples and operating temperature. This kind of tachometer generators are used as sensors in various automobile and electro-mechanical computer devices. The generators can be AC or DC types.

Electronic Tachometer

A tachometer made purely from electronic components and is used to measure the speed of an engine or any other moving object in revolutions per minute is known as an electronic tachometer. Electronic tachometers are used in the dashboard of a car for measuring the driving speed. These tachometers are light weight, easy to view and accurate under all conditions.

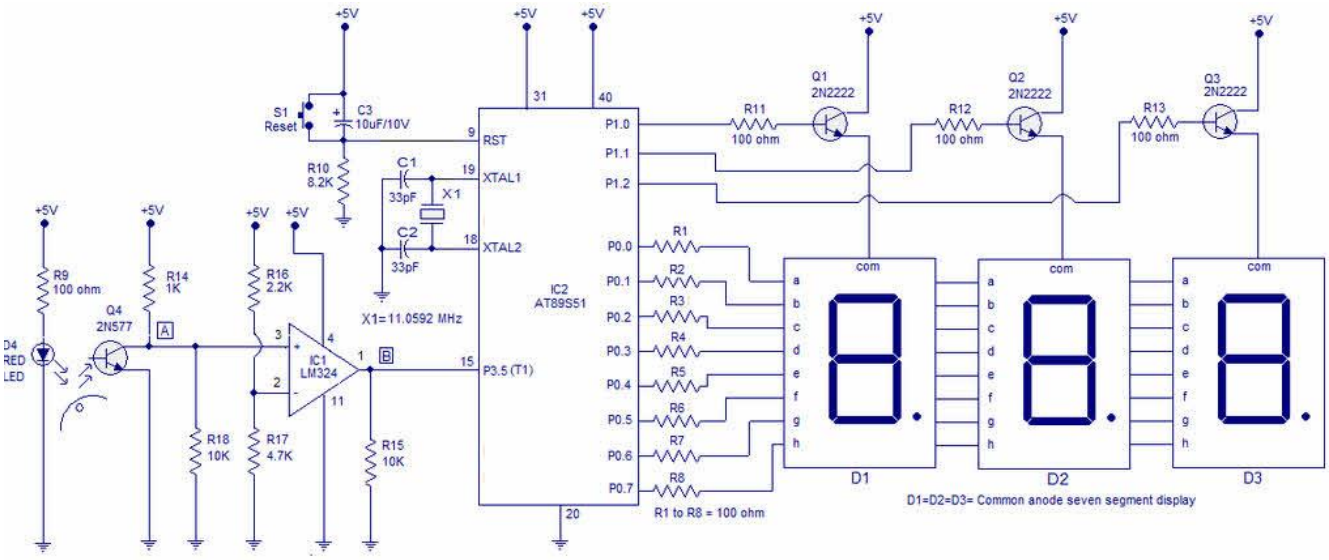
Block Diagram of Digital Tachometer



Optical sensing: An optical sensor consists of an optical disk placed near the motor which generate pulses proportional to the rotating shaft. A slotted disk and IR emitter are used to generate these pulses.

Magnetic sensing: In this type of sensing, there is a possibility to use either Hall Effect sensors or magnetic sensors. Hall Effect principle generates the pulses proportional to the speed of the shaft and magnetic sensors are used to generate pulses by making use of variable reluctance.

Contactless Digital Tachometer by Using 8051



This circuit uses various components, such as microcontroller, photo transistors, op-amps, seven segments LED display, and other miscellaneous components. In addition to this, a sensor is placed near the reflective strip – for instance, an aluminum foil that is fixed on to the rotating surface. The LED directed from this device gets reflected as the strip is detected by the photo transistor.