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FGM-series
Magnetic Field Sensors

Application Note

SCL002 - Integrated Circuit - Vehicle Detector

This integrated circuit chip is intended to provide most of the electronic functions to convert a single, stationary FGM-3 or FGM-1 field sensor into a vehicle detector. Two types of operation are provided for, to give detection of substantially stationary vehicles in storage or parking situations and also dynamic detection for moving vehicle counting, etc. Both types of operation can be used in temporary or portable applications as well as permanent installations since the system is fitted with automatic power-up set-up and calibration features.

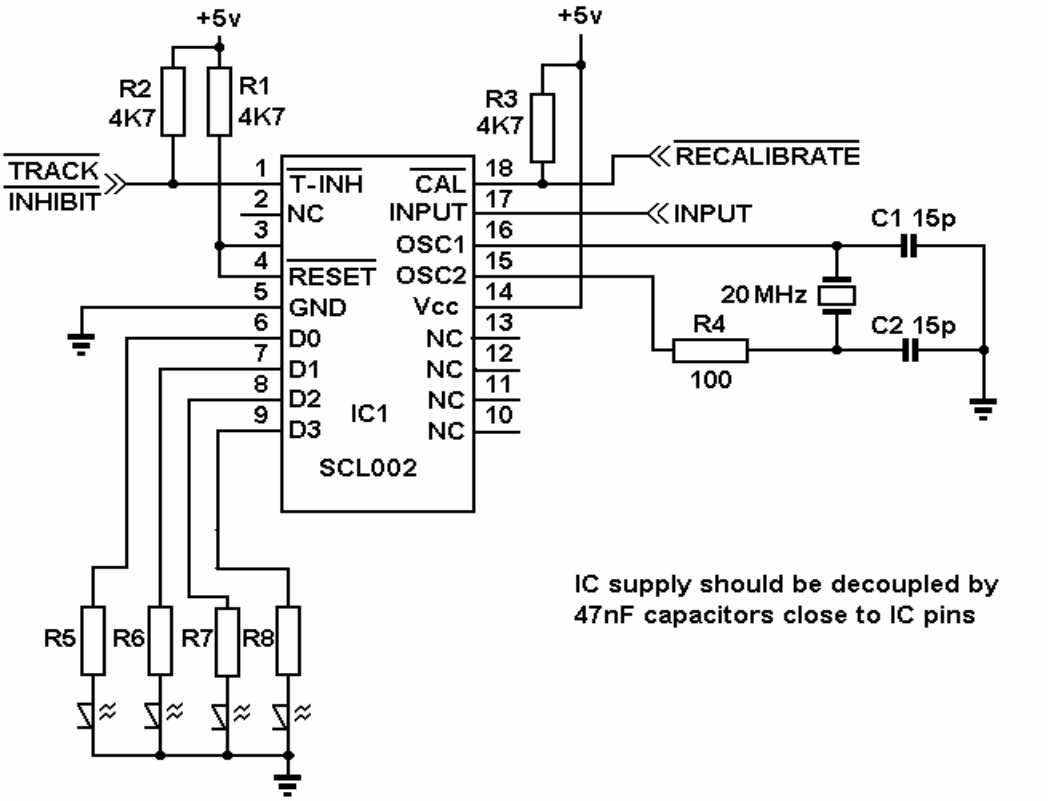
In the dynamic mode of operation the background magnetic field is continuously tracked and averaged over a short period, so as to provide a reference level from which the brief anomalies caused by passing vehicles can be measured. This serves two principal functions, one to give an automatic start-up shortly after the device is switched on (or moved) and another to automatically remove the effect of a large anomaly appearing unexpectedly after set-up. This can occur, for example if during a vehicle census operation one of the vehicles chooses to stop close to the sensor. After a brief period, its effect will be cancelled out, simply because it remains stationary.

In the static mode of operation, selected by changing the level on one pin of the IC, the background tracking process is stopped and replaced by an initial, fixed background determination on power-up or on demand at any time by using the reset pin. This type of use includes for example the determination of slot occupancy in car parks or as a theft alarm in private garages, where a large threshold can be set to establish the presence of the vehicle parked directly over or beside the sensor. A minimum number of external components are required to produce a detection system to the level of providing four different threshold levels arranged in approximately logarithmic scale on four separate output pins. These levels are TTL compatible and can also provide sufficient power to directly drive high intensity LED indicators with up to 10 mA each, if required.

Pins 15 and 16 are used to connect an external crystal to give the IC a timing reference for the measurement of the field sensor's period. It is also used to set the background average timing. The sensor's output can be connected directly to the IC's input pin 17.
Pin 18 is used as a calibration input, forcing a new background average cycle whenever it is taken low **for at least one second**. This is normally used in the static operation, but does function in dynamic mode too.
Pin 1 is an input pin which permits background tracking when high, inhibiting it when taken low, thereby providing the distinction between static and dynamic modes of operation.
Pin 4 is normally taken high but will act as a master reset when taken low and then high again, forcing the chip to repeat its initialising sequence as on normal power-up.
Pins 6 to 9 are the output pins in order of increasing threshold, pin 6 being the most sensitive, with a response triggered by a change in field strength of approximately 50 nanoteslas over a one tenth second period. This is close to the minimum that can be used at this speed without detecting the normal continuously occurring micro fluctuations of the earth's field itself.

Although the sensor has been designed to minimise RF harmonic radiation, it is advisable to use screened (shielded) cable between the sensor and the IC. In addition, decouple the power supply with a 10 to 47 uF tantalum or electrolytic capacitor between the +5V and Ground pins at the sensor to avoid potential harmonic pickup in radio receivers. If the sensor is to be located outdoors or buried, suitable weather and moisture protection may be obtained by sealing the sensor inside a length of plastic pipe.

A typical application circuit is shown below:



Main Circuit - Typical LED type Display

Track inhibit and recalibrate can be taken high through resistors to +5 volts if these features are not required, or used in conjunction with push buttons or switches to ground if needed.

It should be remembered that this system is not actually a vehicle detector, but rather a magnetic field fluctuation detector and some interpretation of the results is required in practice. Vehicles do not all have the same magnetic moment and occasionally seem to have none at all. Some also seem to have multiple magnetic moments and for example an aluminium-bodied bus may produce two outputs in rapid succession as the axles pass the sensor.

Also a magnetic moment produces field strengths which vary inversely as the cube of the distance from it, which means that the apparent sensitivity of the system tends to fall off rapidly with distance for small vehicles, less rapidly for the larger ones. Combinations of sensors on both sides of the road may be needed to resolve some of these interpretations, depending on the requirements of the operation.

Another effect which can occur is caused by the slow passage of a large vehicle close to the sensor. This can have a sufficiently large influence on the running average of the background readings to make the low threshold output persist for a longer period than normal as the average adjusts itself again. This effect is a function of the number of readings used in the average determination. When a large number is used the effect more or less disappears, but the time taken to settle initially (or after a disturbance) increases. The performance is thus a compromise between sensitivity and settling or tracking time. For this reason the chip is made available in several versions which differ only in the number of readings used in the initial and running background averages. For example the SCL002/64 uses 64 readings in its averaging process.

The effect described above does not necessarily mean that signals will be missed, but calls for a more sophisticated interpretation of the outputs. If a large vehicle produces the low threshold persistence and is followed rapidly by a smaller one, the low threshold output will still reverse as the vehicle passes. In other words an erroneously high output will go low if a small change in field does occur.