

Microwave Sensor

..... for Motion Detection - The Technology Behind it

Microwave motion sensors that operate at lower power and shorter range of Doppler radars are emerging in recent years. Agilis Communication Technologies (ACT), being one of the leading manufacturers of Doppler Motion Detectors has developed 9.9GHz, 10.525GHz and 10.687 GHz versions of the detectors. The wide ranging microwave sensors are designed to match the regulatory requirements of different countries. Microwave sensors are used in applications such as intrusion alarm, speed camera, occupancy detectors, life detectors, etc.

Features

The microwave sensors have been designed to suit the environmental needs mentioned below:

- "See Through" - microwave sensors have the capability to see through non-metallic material, eg. plastics, wool, fiberglass and even brick walls.
- Environmental insensitivity - microwave sensors are insensitive to most environmental factors, like ambient temperature, light, dust, dirt and ambient noise.
- Long range - capable of detecting movement, eg. an arm swing of a human at a distance of up to 30 meters. The range can be much longer for larger object, e.g. vehicle,

Operation

Microwave motion sensors are electronic transceivers, which utilize electromagnetic energy to detect certain movement of objects within a detection zone (Figure 1).

The transceiver emits low power microwave energy through a built-in transmit antenna to a detection zone. The shape of the detection zone is determined by the radiation pattern of the antenna or array. Depending on the radar cross section (RCS) of target, a portion of transmitted energy is being reflected by the target and collected by the receive antenna of the transceiver. Due to the Doppler effect, the audio frequency signal (Doppler shift) output from the transceiver is represented by its amplitude (Receive Signal Strength i.e. R.S.S) which is proportional to the magnitude of the returned energy and its frequency is associated with the movement velocity. The motion of an object can be detected by analysing the frequency and amplitude of the Doppler shift. The faster the movement, the higher the frequency of the Doppler shift. The closer the target to the sensor, the higher the amplitude of the Doppler shift (Figure 2).

Amplification and Filtering

The amplitude of the Doppler signal output from microwave sensor is in the range of microvolts. Therefore amplification is necessary to lift the Doppler signal up to a processible level.

One important consideration of designing signal processing circuit for microwave sensor is to determine the input impedance, bandwidth and gain required.

Noise

Noise is generated from internal electronic components, as well as picked up from the environment. Special attention to the interference picked up from 1001120 Hz noise is close to the Doppler frequency generated by human movement.

Power Supply

A regulated power supply is important to the performance of the microwave sensor. Lower DC voltage will reduce transmitted power and result in shorter detection range, The sensor may also be damaged by over-voltage or transient spikes.

The microwave sensor can be operated in Continuous Wave (CW) by applying continuous power. Alternatively, low duty cycle pulses can bias the sensor. Pulse mode operation requires complex signal processing circuitry but is essential for applications where lower power consumption is critical.

Conclusion

The microwave motion sensor is useful for non-contact, environment in-sensitive, long range applications. It is also ideal for use in hostile environment. It is rugged, and has no moving parts.

Other than motion detection, the microwave sensor is also a viable tool to be considered by engineers for applications involving obstacle, presence and range detection.

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