31234-SC

10.525GHz Motion Sensor
Application Note

Power Supply

The module operates at +5 Vdc for Continious wave (CW) operation at 40mA Max.

The module can be powered by +5V low duty cycle pulsed trains in order to reduce its power consumption. Sample & Hold circuit at the IF output is required for pulse operation (Page 3)

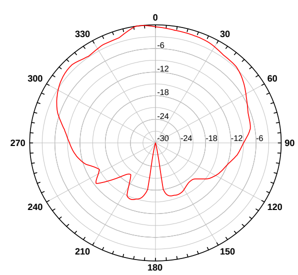
Transmit Frequency

The transmit frequency and power of the module is set by factory at 10.525GHz. There is no user adjustable part in this device.

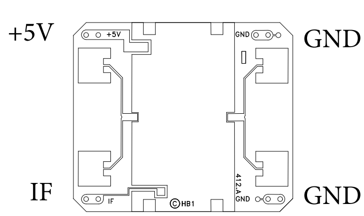
The module is a low power radio device (LPRD) or intended radiator (Transmitter)designed to meet FCC rules Part 15, section. 15.245 (within Building). The FCC regulates use of such a device. Although the user license may be exempted, type approval of equipment or other regulation compliance may be required.

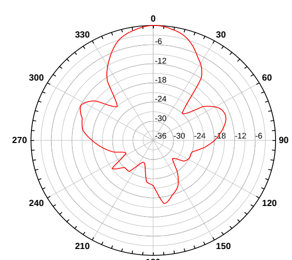
Radiation Pattern

The module to be mounted with the antenna patches facing to the desired detection zone. The user may vary the orientation of the module to get the best coverage. The radiation patterns of the antenna and their half power beam width (HPBW) are shown in below diagram.



Azimuth





Elevation

Output Signals

Doppler shift - Doppler shift output from IF terminal when movement is detected. The magnitude of the Doppler Shift is proportional to reflection of transmitted energy and is in the range of microvolts (µV). A high gain low frequency amplifier is usually connected to the IF terminal in order to amplify the Doppler shift to a processable level (see Annex 1). Frequency of Doppler shift is proportional to velocity of motion. Typical human walking generates Doppler shift below 100 Hz. Doppler frequency can be calculated by Doppler equation shown on Page 4.

The Received Signal Strength (RSS) is the voltage measured of the Doppler shift at the IF output. The RSS figure specified in the technical data sheet is level of a 25 Hz Doppler shift, generate from the modulated microwave signal received at the received antenna, The received microwave signal is attenuated to 93 dB below the transmit microwave signal from the transmit antenna of the same unit. The 93dB loss is the total losses combining two ways free space loss (82.4 dB for 30 meters at 10.525 GHz), reflection less and absorption loss of the target, as well as other losses.

This RSS figure can be view as an approximation of the output signal strength for a human at 15 meters away walking straight to the module at 1.28 km/hour.

Reflection of a human body is varied with the size of the body, clothing, jewelry and other environmental factors; RSS measured for two human bodies may vary by 50%.

The typical Received Signal Strength (RSS) specified is 200uVp/p. When designing the amplifier; differences between modules has to be considered when setting amplifier gain or alarm threshold. Gain adjustment may be necessary if a narrow window for triggering threshold is required.

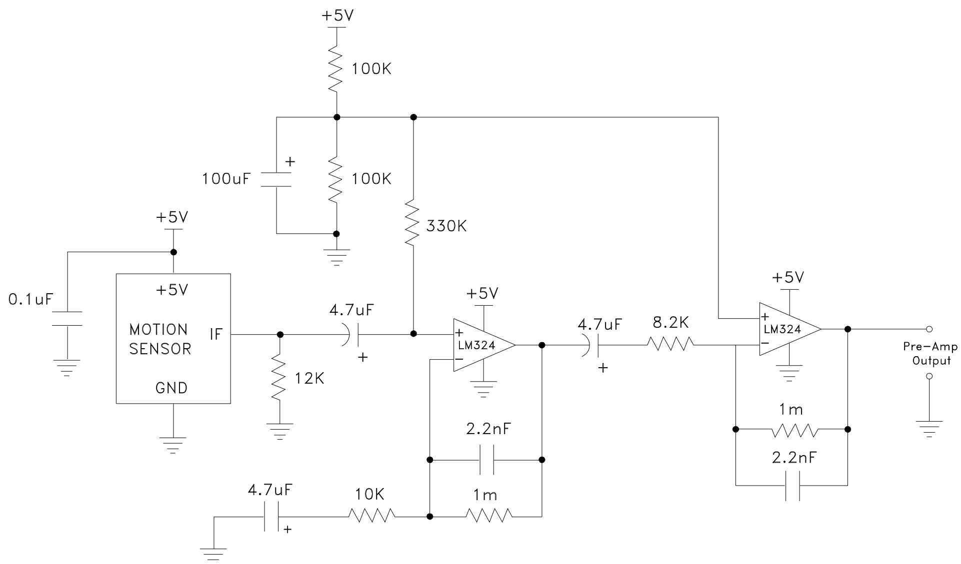
Noise - The noise figure specified is <5uVrms and is measured in an Anechoic chamber that shields the unit from external interference, as well as reflection from surfaces. The figure represents the noise generated by the internal circuit itself.

In actual applications, other noises may be picked up from surrounding area, or other parts of the electronic circuit.

Special attention must be given to the pick up of interference from fluorescent lights, as the 100/120 Hz noise is closed to the Doppler frequency generated by human movement

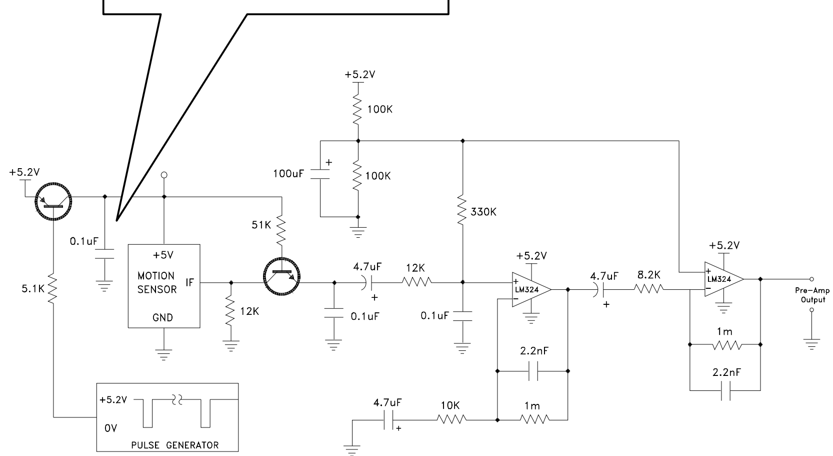
The On and off switching of certain devices (relays, motors etc.) may generate high amounts of transient noise at the IF terminal. Careful PCB layout and time gating may be necessary to prevent false triggering.

Amplifier Circuit (Continious operation)



Amplifier Circuit (Pulse operation) PRF =2 KHz, Duty Cycle = 4%)

For FCC conformance Capacitor is required when operating in Pulse mode



Doppler Equation

$$F_d = 2V\left(\frac{F_t}{c}\right)\mathrm{Cos}\,\theta$$

Where

F_d = Doppler frequency
V = Velocity of the target
F_t = Transmit frequency
c = Speed of light (3 X 10^8m/sec)
θ = The angle between the target moving direction and the axis of the module.

If a target is moving straight toward or away from HB100 (F_t = 10.525 GHz) The formula is simplified to:

F_d = 19.49V (Velocity in km/hour) or 31.36*V* (*V* in mile per hour)

Conversion factor for other frequencies are shown as below:

Frequency	**Fd (V in Km/hr)**	**Fd (*V* in mph)**
9.35 GHz	17.31V	27.85*V*
9.9 GHz	18.33V	29.49*V*
10.525 GHz	19.49V	31.36*V*
10.587 GHz	19.60V	31.54*V*
10.687 GHz	19.79V	31.84*V*
24.125 GHz	44.68V	71.89*V*