Theory of Operation

The PD310 is a Frequency Modulated Continuous-wave (FMCW) radar operating on 24.125 GHz. It is nominally powered by a 12V DC supply but can operate from any 5.5V-18V DC source. The power input is protected from over-voltage, reverse voltage and over-current by a combination of a poly-fuse and a parallel uni-directional TVS diode. PD310 can monitor its own power consumption via a highside current sense circuit and input voltage through input divider that brings the voltage down to the level that can be safely measured by a microcontroller unit (MCU). Input voltage is further regulated down to 5V and 3.3V DC by two high-efficiency switching regulators operating at 250 KHz. The 5V DC rail is used to power a microwave sensor, audio frequency preamplifier and a varactor driver. The 3.3V DC regulator provides power to MCU and associated digital electronics such as RS232 transceiver and serial FLASH memory. The front end of the PD310 is an encapsulated purchased component that is comprised of PHEMT oscillator, direct down-converting I/Q mixer, preamplifier, power control circuit and varactor circuit for tuning oscillator frequency. Microwave oscillator generates an FM signal and sends it continuously out of the transmit portion of the patch antenna. The beam width of the patch antenna is 60 by 20 degrees with side lobe suppression of 12 dB. This signal is also used in the I/Q mixer as local oscillator signal. Return signal is accepted by the receiving portion of the patch antenna and is mixed down to the audio range. The audio signal frequency is proportional to the speed of the target and target range. This signal is first amplified by the pre-amplifier built into the sensor and further by the on-board second stage amplifier. Amplified I/Q signal is digitized and processed by an MCU. The target information is available via the asynchronous serial port (UART) and/or six open-drain drivers. An LED circuit is used for indicating that the unit is powered up and is taking measurements. It will blink with a low duty cycle when unit is operational. PD310 is equipped with a silicon ID that allows to uniquely identify each unit. MCU is clocked from two crystals. High-frequency 16 MHz crystal is used when maximum computational performance is required and low-frequency crystal is used for power-saving sleep modes. PD310 modulates the frequency of the transmit signal in a linear fashion. The difference between the frequencies of the local oscillator and the return signal is proportional to the time delay between these signals and thus is proportional to range. In case of a moving target we also take into account Doppler shift of the return signal. PD310 employs a double linear ramp modulation, first increasing and then decreasing the frequency of the signal. Additional information derived from both ramps allows the radar to measure both the range to target and target velocity. The PD310 utilizes advanced target tracking technique based on a proprietary algorithm that allows it to detect, measure and track multiple targets simultaneously. It also features advanced “application filters” pre-configured to optimize performance for a variety of applications. The PD310 radar may be deployed as a complete product without any further requirements for signal processing.

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