Description of Operation

The remote keyless entry system (RKE) is intended for commercial use in various vehicle platforms of General Motors (GM). The remote keyless entry system is comprised of two components. The Body Computer Module (BCM) and a hand-held transmitter (FOB). The RKE system gives the vehicle driver the ability to lock and unlock doors from a distance. The average RF range is 10 meters.

RKE System Functionality

The RKE system consists of a hand-held fob transmitter used by the vehicle driver and a receiver box located within the vehicle. The transmitter emits RF signals in response to the activation of one or more buttons. Upon activation of a fob button, a message is formed and then transmitted. A message consists of a preamble that indicates the start of a transmission, a unique transmitter ID, a function code and a sophisticated encryption field that prevents recording and subsequent playback of legitimate messages.

The receiver periodically checks for the presence of a transmission. When a valid a message is received, the receiver signals the BCM to perform the requested function. The RKE functions are locking/unlocking the car doors, opening the trunk/hatch, and activating the panic alert.

The BCM features a super-regenerative AM receiver. The receiver is tuned to a center frequency of 433 MHz. RF messages are received via an internal wire antenna. The software polls for a message every 100ms. If a valid RF message is not received, the receiver goes back to sleep to conserve parasitic current.

The super-regenerative receiver is composed of an antenna, RF power switching transistor, front end 433 MHz tuned amplifier, super-regenerative stage, diode detector, backend amplifier, and data slice waveshaper. The backend amplifier and waveshaper are implemented using two halves of a dual LM2904 op amp package.

Receiver Overview

The RF receiver receives and demodulates the incoming 433 Mhz amplitude modulated (AM) RF signals. An internal antenna receives the incoming signals from the transmitter, the signals are amplified through a tuned amplifier, the superregenerative circuit demodulates the 433 Mhz signal and an audio amplifier amplifies the signal which is then sent to the RF microprocessor for data processing (decoding). The receiver has a direct inject sensitivity of approximately 2 uV. Refer to the RF receiver block diagram. The data sent to the RF microprocessor uses a rolling code algorithm for security.

RF Front End Amplifier

The RF amplifier is mechanized using a transistor in a common emitter configuration with a tuned LC circuit in the collector path to provide selectivity at 433 Mhz. The output of the amplifier is AC coupled to the superregenerative circuit.

Superregenerative Circuit

The superregenerative circuit is used to demodulate the incoming 433 Mhz signal to a baseband format. The circuit is consists of an RF oscillator operating at 433 Mhz which alternates between an oscillating and non-oscillating condition at a rate known as the quench frequency. When an RF signal (433 Mhz) is applied to the superregenerative circuit, the RF oscillator reaches an oscillating condition faster than when an RF signal is not applied, effectively increasing the quench frequency. The stronger the RF signal, the faster the RF oscillator begins operating. The output of the superregenerative circuit is essentially the variable quench frequency, nominally 600 Khz. The RF oscillator is tuned with a variable inductor which is part of a LC tank circuit. The inductor is adjusted to get maximum sensitivity at 433 Mhz. Nominal bandwidth of the superregenerative circuit id 2.5 Mhz (+/- 3dB).

Peak Detect/Low Pass Filter Circuit

The output of the superregenerative circuit is sent to the peak detect/low pass filter circuit to demodulate the variable frequency quench oscillation. The output of this circuit is the basedband data (nominally 2 Khz) transmitted by the FOB.

Audio Amplifier

The low level output of the peak detect/low pass filter circuit is amlified by the audio amplifier comparator circuit. The output of the comparator is sent to the RF uP for signal processing.

RF Receiver Block Diagram