TSSM Receiver Theory of Operation

The Turn Signal Security System Module (TSSM) is intended for commercial use in various vehicle platforms of Harley Davidson motorcycles starting in model year 2001. This system is comprised of two components. The TSSM receiver module and a hand-held transmitter (FOB). The TSSM system provides several functions on the motorcycle such as turn signal control and cancellation, engine immobilization, security alarm functions including a remote arm /disarm feature.

Remote System Functionality

The TSSM system consists of a hand-held fob transmitter used by the driver and a TSSM receiver box located on the motorcycle. The transmitter emits RF signals in response to the activation the button on the fob. Upon activation of a fob button, a message is formed and then transmitted.

This FOB has been designed to automatically deactivate the transmitter within 5 seconds of the manual switch being released. (see 47 CFR - Part 15.231 (a) 1.)

The receiver periodically checks for the presence of a transmission. When a valid a message is received, the receiver performs the requested function; either arming or disarming the security syste.

The TSSM receiver features a super-regenerative AM receiver. The receiver is tuned to a center frequency of 315 MHz. RF messages are received via an internal wire antenna. The software periodically polls for a message. If a valid RF message is not detected, the RF receiver is switched to a sleep mode to conserve conserve parasitic current.

The super-regenerative receiver is composed of an antenna, RF power switching transistor, front end 315 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 315 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 315 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 315 Mhz. The output of the amplifier is AC coupled to the superregenerative circuit.

Superregenerative Circuit

The superregenerative circuit is used to demodulate the incoming 315 Mhz signal to a baseband format. The circuit is consists of an RF oscillator operating at 315 Mhz which alternates between an oscillating and non-oscillating condition at a rate known as the quench frequency. When an RF signal (315 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 315 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