

Radio circuit theory of operation

Transmitter

General:

This section will detail in brief terms the actual operation of the Nu-Metrics 2.45 GHz radio transmitter. A comprehensive functional schematic diagram is included in this document package and will provide any component level detail necessary. A basic understanding of RF circuitry and electronics is assumed.

Description:

The RFM2450 radio transmitter module has been developed using the latest in surface mount technologies. A complex design approach using strip line theory for microwave frequency distribution and a stage by stage shielding plan has evolved this radio into a robust, solid configuration that survives through large temperature extremes and the punishment of in ground traffic monitoring. Techniques involving miniaturization and complete use of available space for components has resulted in a compact reliable design that is easily manufactured.

Power for this transmitter is always provided by a 3.6 volt battery. A series of processor input decisions allows the transmitter to be normally left in a sleep mode totally unpowered and awoken only during a period where a transmission is required. Battery life is usually over 24 months with extended life being capable if transmitter periods between transmissions are lengthened.

Spread spectrum modulation is done via a matched stripline transformer and diode pair providing Bi-Phase Shift Keyed (BPSK) information impressed onto a carrier set for 2.451 GHz. A careful matched filter section then suppresses the carrier thereby maximizing energy into the upper and lower sideband envelopes. Data is prefixed at a rate of 5.25 MHz and completely contains all spreading code information.

The modulated carrier is presented to another matched filter/amplifier then is again amplified at a maximum level of +10 dBm or 10 mW. RF level control is completed by a potentiometer controlled amplifier that is designed for a maximum level of +10dBm.

This module is permanently mounted to the G1 245 PCB via solder pins and a complete RF shield covers this transmitter to eliminate any stray signals from being emitted.

Receiver description:

Spread spectrum receiving is accomplished via a superheterodyne conversion process with state of the art amplification and filtering. Information modulated into a BPSK carrier is received, despread and passed to a processor for storage. Any time the receiver

unit is active it will detect any signals in the band of operation (2450 MHz). The Intellon chipset actually despreads the baseband data and passes digitized serial data to the local microprocessor. Several novel techniques have been employed in the VCO and PLL sections of this receiver, with these enhancements over standard configurations this unit has been able to extend its receiving range well beyond into the background noise.

The module is permanently mounted to the RFM 245 PCB via solder pins and a complete RF shield covers this receiver to eliminate any stray signals from being emitted.

G1 245 application (transmitter only):

The G1 Groundhog is a typical Vehicle Magnetic Sensor (VMI) system produced by Nu-Metrics. Using advanced magnetic detection sensors, and complex detection algorithms coupled with a complete microprocessor allows this remote detection package to collect and then transmit data to a base station. Collected data includes information such as traffic volume, average speeds, occupancy levels and battery voltage. This data is transferred via the spread spectrum radio link and is normally stored in a data base at the host computer and is used for archiving purposes.

Power for this unit is supplied via a parallel combination of two lithium batteries that provide years of life due to the limited transmission rate.

RFM application (transmitter and receiver):

Nu-Metrics RFM 245 is a complete spread spectrum modem that receives despreads and stores the G1 245 data for eventual transfer via a radio transmitter or into a host via a serial port. Standard configurations use the RFM 245 as a receiver only, although several applications require the unit to be used in a repeater mode which extends the range of the system when no other means are available. Information that is transferred into the host is eventually used to develop a master database. This database typically is used to describe the traffic flow parameters previously discussed.

Power for RFM245 is always with a 6.0 CE approved Gel pack. Typically solar power options are employed for battery recharge reasons.