

SATELLINE-3AS Radio Data Modem

Operational Description of Electrical Circuitry

Ref: FCC ID: MRBSATEL-3AS-125

1. General

SATELLINE-3AS radio data modem comprises a microcontroller operated modem logic board and a synthesised 1W UHF radio transceiver module. DC power supply circuitry is located mainly at the modem logic board but many of the internal voltage regulators are situated close to each circuit block.

All the electrical circuit boards are enclosed in an aluminium casing sealed with an RF gasket. Filtered D15 connector is acting as a physical interface for the RS-232/422 serial port and the voltage supply. The antenna port is terminated with a coaxial TNC connector.

SATELLINE-3AS radio modems offer a wireless data communication link for the terminal units implementing a serial data interface.

2. Radio Transceiver

The operating frequency range of the radio transceiver is from 380 MHz up to 470 MHz. It works on a single 12.5 kHz or 25 kHz radio channel in a half-duplex mode.

2.1. Synthesizer

A common synthesizer circuit provides a local oscillator signal to the transmitter and to the receiver. The serial input synthesizer and prescaler IC (LMX1511) controls the output frequency of the coaxial resonator based voltage controlled oscillator (VCO). The synthesised frequency is locked to the 12.8 MHz temperature compensated crystal oscillator (TCXO) to ensure high stability over the whole operating temperature range. Before conducting the output signal to the Tx and Rx mixers, the signal is amplified by the buffer circuit providing the isolation for impedance variations. The metal cover shields the VCO from the interfering radiation of the other radio circuitry. The frequency of the synthesizer is controlled by the microcontroller through the Clock, Data and Enable lines. To avoid any kind of interference due to the variations of the main supply voltage, all the supply voltages of the synthesizer circuitry are regulated and filtered.

2.2. Transmitter

The transmitted data input is connected to a base band amplifier for deviation adjustment. The data signal modulates the 25.85 MHz crystal oscillator. The modulated signal is multiplied by three, and a narrow 77.55 MHz crystal filter selects the correct signal for the mixer. The signal is mixed up to the operating RF frequency ($F_{synt} + 77.55$ MHz). Before the amplification, the other mixing products are filtered out by a pair of band pass helical filters. IC amplifier and two power stages boost the Tx signal up to 1W.

All the supply voltages of the transmitter circuits are regulated.

2.3. Receiver

Initially the radio modem is working in the receiving mode, and the antenna port is switched to the Rx section. After the low pass and image frequency filter, there is a low noise amplifier (LNA) and a band pass filter. The LNA is optimised for not only low noise but also high linearity operation for to maintain sufficient intermodulation rejection. The signal path is then conducted to the first mixer followed by a buffer amplifier. A crystal filter pair selects the intermediate 77.55 MHz frequency for the input of the receiver IC (SA606). SA606 is a monolithic FM IF system incorporating a mixer/oscillator, two limiting intermediate frequency amplifiers, quadrature detector, logarithmic receiver signal strength indicator, voltage regulator and audio and RSSI op amps. Together with external crystal oscillator of 77.095 MHz, ceramic high selectivity IF filters, quadrature coil and buffer amplifiers, SA606 IF circuit mixes the signal down to the second intermediate frequency 455 kHz and after filtering and limiting, performs the data signal detection. All the supply voltages of the receiver circuits are regulated.

3. Modem

All the functions of the SATELLINE-3AS radio modem are supervised by the Hitachi H8/3048F microcontroller. The radio modem reacts automatically to the data flow at the serial interface or to the radio signal indicators at the transceiver interface. A crystal oscillator generates the clock signal for the microcontroller.

The radio modem works in a half duplex mode. Either it recognises data on the serial interface, and transfers the message further to the radio interface for transmission. Or the radio modem detects radio signal and identified data on the channel, and transfers the message to the serial interface. If data appears on the both interfaces simultaneously, the radio modem decides the direction of data transfer depending on the priority setting.

The serial interface can be set to work as RS-232 or RS-422/485. The microcontroller controls the lines of the serial interface through the LT1334CSW line driver circuit. RS-232 interface uses CTS, CD and RTS lines for handshaking if needed, in addition to the lines RD, TD and SGND, which are used for normal data transmission. Because the TX mode is triggered by data, no additional control signals are needed to control the radio transceiver externally. Status of the lines at the serial interface is indicated by three-colour LEDs.

Four-level FSK is used as a modulation method of the radio signal. An FX919B integrated circuit (for TxD/RxD) has been implemented on the board to perform, not only the modulation/demodulation, but also other base band signal processing and MAC protocol functions, like error correction (FEC), error detection (CRC), bit interleaving and frame synchronisation coding.

Watchdog functions implemented in software and hardware, ensure that the operation of the radio modem will be reset whenever an abnormal state of operation occurs.

4. Power Supply

The operating voltage range of SATELLINE-3AS radio modem is 9 to 30 Vdc. The voltage is supplied through the D15 connector into the modem. Internally it is wired via a 1A multifuse to the main switching voltage regulator. The output of the regulator is connected further to the local voltage regulators of the different circuit blocks. All the internal voltages are filtered locally to avoid any EMC problems.