Spread Spectrum Transmitter
Model T100-900

System Specification and Description

Rev A

1 Introduction

The T100-900 is frequency hopping spread spectrum (FHSS) eight channel transmitter designed to be compatible with FCC Part 15.247 (US) and RSS-210 (Canada) regulations for license free operation in the 902-928 MHz frequency band.

The transmitter will typically be used for remote control of industrial equipment. This includes cranes, line pumps, mixing trucks, conveyors, tow trucks, etc. The transmitter is housed in a plastic case with an internal antenna and powered by four AA alkaline batteries.

2 Specifications

Parameter	MIN	TYP	MAX	UNITS
Frequency Range	902		928	MHz
Supply Voltage	4	6	18	VDC
Frequency Stability (synthesized with TCXO reference)		+/- 2.5		PPM
Operating Temperature	-30		+70	°C
RF Output Power		10	11	dBm
Data throughput		4800		bps

Type of Emission: Frequency Hopping Spread Spectrum
Number of Radio Channels: 256

3 Hardware Description

3.1 General

The T100-900 is frequency hopping spread spectrum (FHSS) eight channel transmitter designed to be compatible with FCC Part 15.247 (US) and RSS-210 (Canada) regulations for license free operation in the 902-928 MHz frequency band. The major elements include a frequency agile, narrowband transmitter, an embedded microcontroller for frequency hopping sequence generation and modulation, and an integrated power supply. The T100-900 is intended for use with a OMNEX R100-900 simplex receiver.

The T100-900 transmitter sends packets of telemetry and control data to a compatible receiver. One packet is sent on each frequency on the hop sequence. A data packet consists of eight bytes. This includes transmit start flag, destination address, header, data, and CRC-16 error detection checksum. The embedded microcontroller generates a digitally filtered packet before FM modulation onto the transmit VCO. The embedded microcontroller also generates a Reed-Solomon pseudo random frequency hop sequence of length 64 based on a pre-programmed seed. The full 902 to 928 MHz band is utilized in equally spaced 100 kHz channels. The hop dwell time is 11 ms for a total sequence repetition of 0.693 seconds.

3.2 System Block Diagram

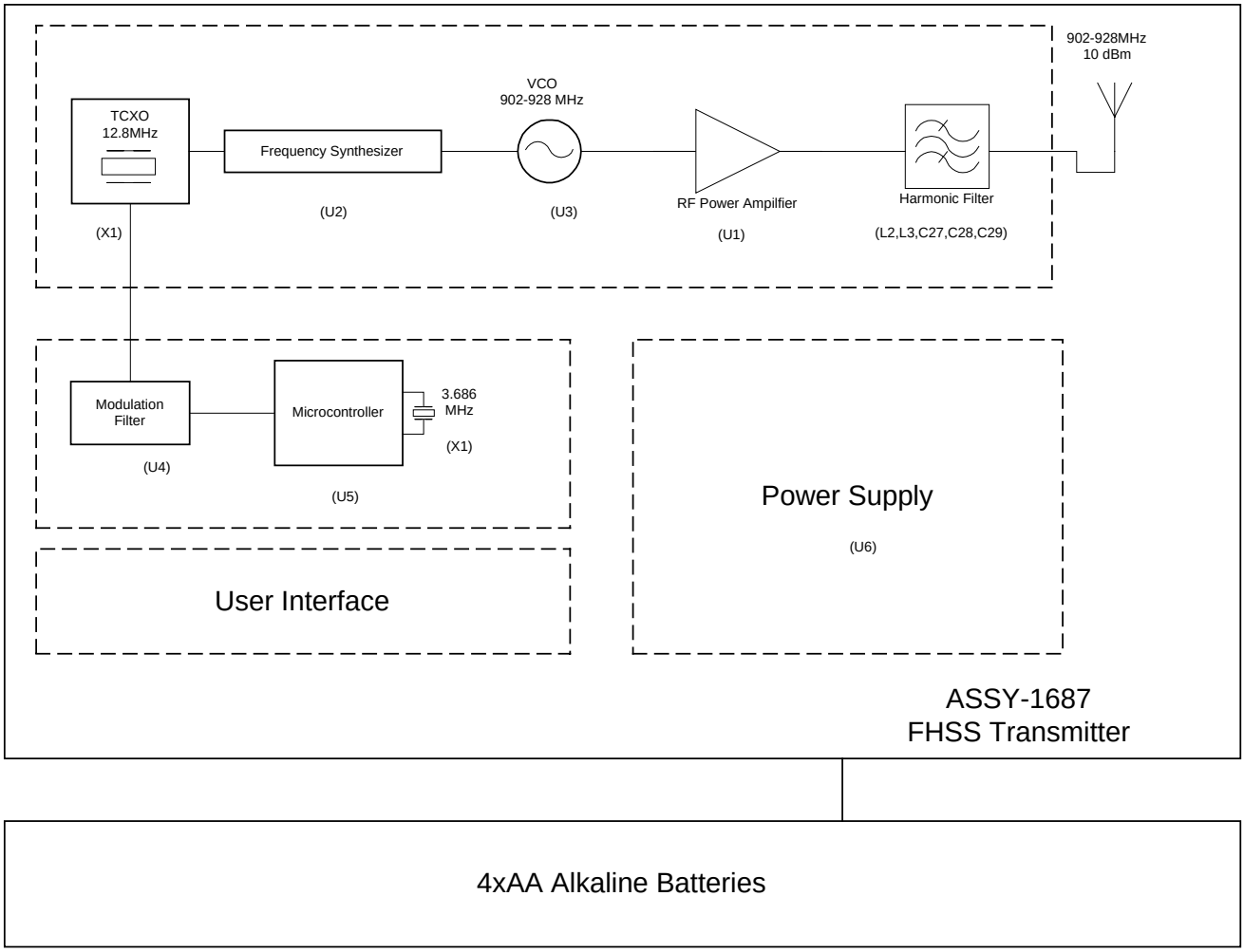

Figure 1. Transmitter System Block Diagram

3.3 Power Supply

Refer to schematic DSCH-1687 sheet 2.

Four standard AA alkaline batteries power the transmitter. Battery voltage is applied to the switching regulator (U6) through CN2. The 3.3VDC regulated output of the switching regulator supplies voltage to all circuitry.

3.4 Microprocessor

Refer to schematic DSCH-1687 sheet 2.

The Atmel AT90LS8535 microprocessor (U5) is employed to handle frequency synthesis control, frequency hopping, data packet formatting and user interface functions. Crystal X2 provides a 3.686 MHz

clock. The microprocessor monitors battery level, frequency lock status, and the user interface. It also controls power-down of the synthesizer (U2), VCO (U3), RF power amplifier (U1), and the switching regulator (U6)

3.5 VCO/Frequency Synthesizer

Refer to schematic DSCH-1687 sheet 1

The frequency synthesizer is Philips SA7025 (U2) is programmed by the microprocessor with the frequency hopping sequence. The RF oscillator is provided by Maxim 2620EUA VCO IC (U3). The resonant tank circuit consists of L4, C17, C21, and varactor diode D1. D1 provides the necessary frequency pulling capability. U3 contains separate output buffers for the RF and synthesize drive. The synthesize loop filter consists of R16, R17, R18, C34, C35, C36. A 12.8 MHz TCXO (X1) provides a stable reference oscillator.

3.6 Modulation Filter

Refer to schematic DSCH-16878-02 sheet 1

The transmitter employs a filtered FSK modulation scheme. Data from the microprocessor is converted to a digitally encoded analog signal using a binary-weighted resistive ladder network. The op amp used here filters the data further before being applied to the tuning pin of the reference oscillator (X2), hence generating FM modulation.

3.7 RF Amplifier

Refer to schematic DSCH-1687 sheet 1

The NEC UPC2771TB Super Minimold Medium Power SI MMIC Amplifier (U1) is used to generate the 10dBm output power. It is designed to be used as a linear amplifier in this frequency range. The output is matched to a 50 Ω load.

3.8 Harmonic Filter

Refer to schematic DSCH-1687 sheet 1

The RF amplifier output is followed by a low pass harmonic filter, which consists of C27, C28, C29 L2, and L3.

3.9 Antenna

The antenna consists of a quarter wavelength wire that is soldered directly to the PC board. The center frequency and input impedance are 915 MHz and 50 Ω respectively. The radiation pattern is omnidirectional along the horizontal plane of the board.

3.10 User Interface

The user interface consists of eight programmable pushbuttons, one power-on button, and one power-off button.

3.11 Emission Types

The transmitter contains the following fixed frequency sources:

- (X1) 12.8MHz TCXO (Temperature compensated crystal oscillator) – synthesizer reference oscillator
- (X2) 3.686MHz crystal – main microprocessor clock

The transmitter contains the following variable frequency source:

- VCO 902-928MHz frequency synthesizer – locked to X1 12.8MHz TCXO

4 Spread Spectrum Operation

By utilizing special firmware in the microprocessor, the frequency-synthesized transmitter becomes a spread spectrum device. This section will describe how the available frequency spectrum is channelized, how data is transmitted, and how the hopping sequences are generated.

4.1 Frequency Plan

The transmitter can be set to operate on any on of 256 frequency channels in the 902-928MHz frequency band. The frequencies are divided into four groups of 64 frequencies; each group using every fourth available frequency. 63 out of 64 frequencies in a group are then used equally by the spread spectrum transmitter in a pseudo random sequence. 63 different sequences are available for use in each frequency group. Each channel is 100kHz wide.

4.2 Per Hop Activities

The transmitter operates in a different frequency every 11ms. A full hop cycle takes 0.693. The transmitter ON time is approximately 2.2 ms per frequency, and the remaining time is used to switch frequency and key the transmit power on and off.

A data packet is constructed by a number of ASCII bytes assembled by the Atmel AT90LS8535 microprocessor.

Preamble	Header	Data	CRC1	CRC2

The data waveform is converted to a digitally encoded analog signal using a 4-bit binary-weighted resistive ladder network. Data is sent at 4800 bps.

5 FCC/ISC Identification and Serial Number Label Placement

5.1 Label Description

Two labels will be used for identification. One label is used for FCC/ISC identification and another label is used for serial number identification. The labels shown below are in actual size. The label is tamper proof and cannot be altered without being destroyed.

Material: Polycarbonate
Adhesive: Scotch – 3M – 486MP High Performance Adhesive
Colour: White lettering on a black background

FCC ID: IA9T100-900
ISC ID: XXXX XXX XXX

OMNEX Control Systems Inc.
Spread Spectrum Transmitter
MODEL: T100-900 S/N: 01234567

5.2 Label Placement

The labels are placed on the bottom of the transmitter enclosure as indicated in figure 2.

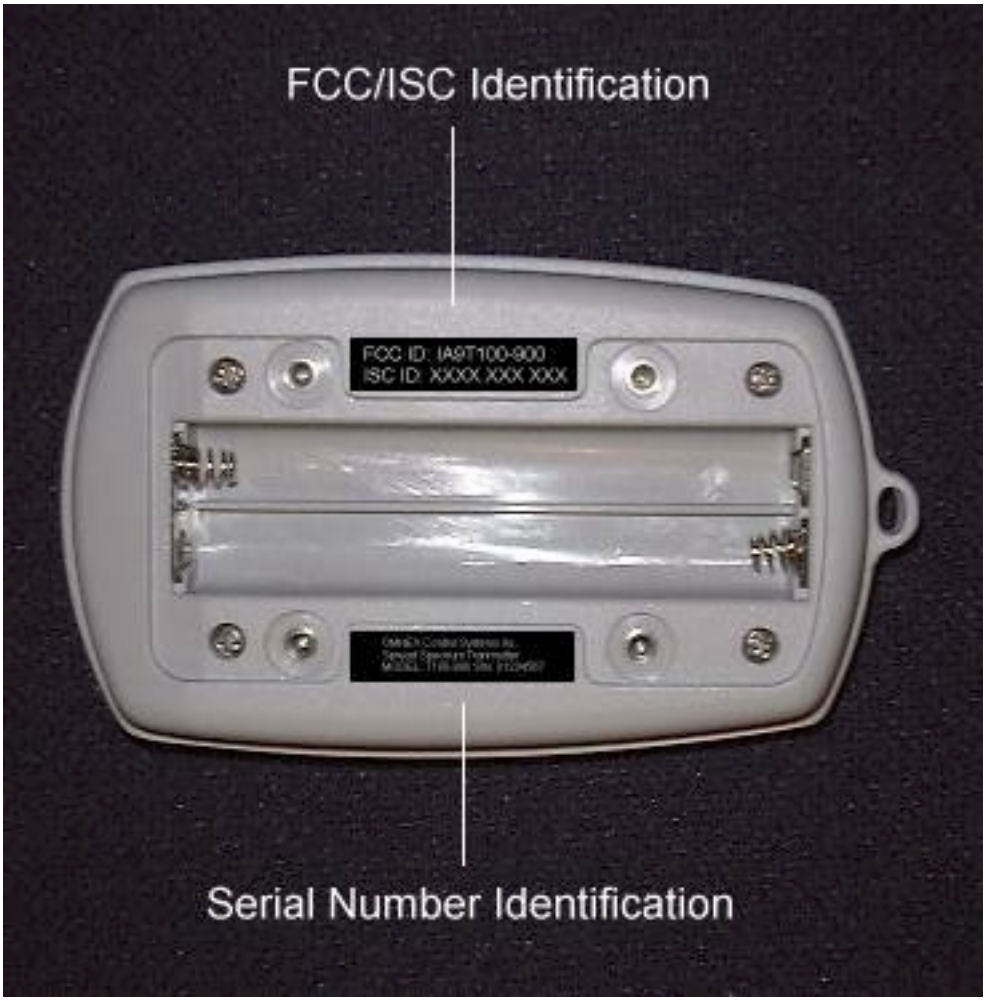

Figure 2. FCC/ISC and Serial Number Identification

6 Schematic Diagrams and Component Layouts