1.0 Introduction

The OEM-900 is a frequency hopped spread spectrum transceiver designed to be compatible with US (FCC Part 15.247) and Canadian (RSS-210) regulations for license free use in the 902-928 MHz band.

The transceiver will typically be used for the remote monitoring of levels in petroleum/water storage tanks, and the remote control of pumps, valves etc. The transceiver is supplied at circuit board level with the enclosure to be supplied by the end user. A connector is provided for power connection as well serial data in and out. An external antenna is required, and is connected to an on-board MCX connector. An external 12-24VDC power supply is required to power the device.

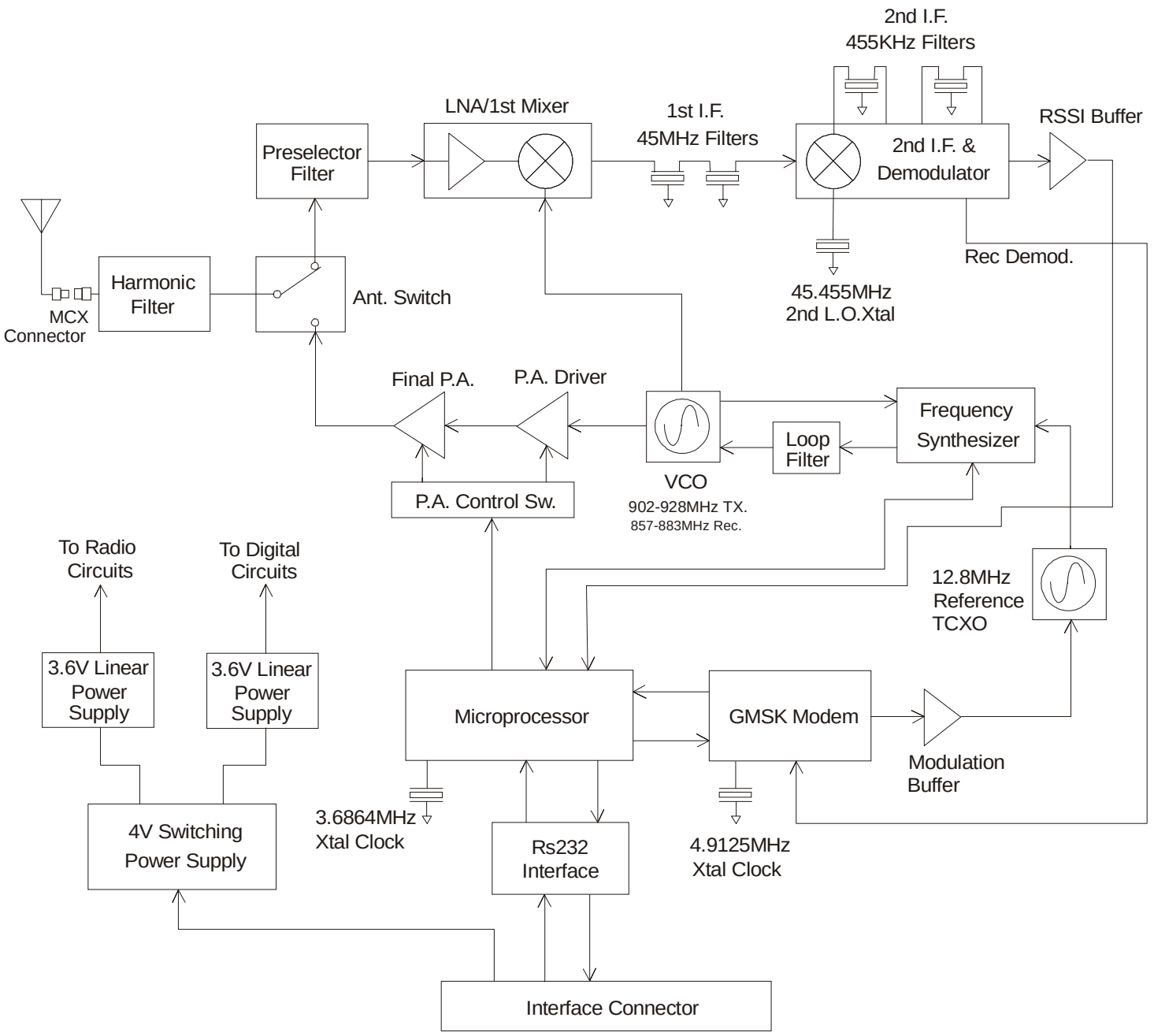
2.0 Specifications

Parameter	MIN	TYP	MAX	UNITS
Frequency Range	902		928	MHz
DC Supply Voltage	10	12	34	VAC
Frequency Stability (synthesized with TCXO reference)		+/- 2.5		PPM
Operating Temperature	-30		+70	°C
Transmitter R.F. Power Output		0.75	1.0	Watts
Receiver Sensitivity (12db Sinad)		0.50		uV

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

3.0 Technical Description

3.1 System Block Diagram:



3.2 System General Description:

The OEM-900 is a frequency hopping spread spectrum (FHSS) transceiver 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, narrow band R.F. transmitter and receiver, and an embedded microprocessor for frequency hopping sequence generation and data generation. Packets of telemetry and control data are transmitted to, and received from, a mating TPCB-2139 transceiver.

One packet is sent on each frequency in the hop sequence. A data packet consists of six bytes. This includes radio ID, data, and a CRC-16 word. The embedded microprocessor generates a digital bit stream that is sent to a GMSK modem, which in turn modulates the transmit VCO. The microprocessor 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.

3.3 Power Supply:

Refer schematic diagram DSCH-2139-01 sheet 2 & 3.

The transceiver requires an external 12-24VDC power supply connected to pins 1 and 2 of CN1. Protected by fuse F3 and diode D1, the external voltage is regulated to 4.0VDC by switching regulator U12. After further filtering by L22 and C126, the 4.0VDC output is again regulated by linear voltage regulators U19 and U20, which provide the final 3.6VDC supply for the microprocessor and radio circuitry respectively.

3.4 Microprocessor:

Refer to schematic diagram DSCH-2139-01 sheet 4.

An Atmel GA103L microprocessor, U16, is employed to handle frequency synthesis control, frequency hopping and data packet formatting. Crystal X5 provides the 3.6 MHz clock.

3.5 GMSK Modem:

Refer to schematic diagram DSCH-2139-01sheets 1 & 2.

The transceiver employs an MX-COM MX909A data pump, U11, for modulation. The MX909 assembles the data received from the microprocessor, adds forward error correction, and error detection codes, time-spreads the data by interleaving and scrambles the bit pattern. After automatically adding bit and frame sync codewords, the data packet is converted into analog GMSK signals for modulating the transmitter. The output of the MX909 is buffered by op amp U13A, and FM modulation is achieved by applying the signal to a voltage controlled tuning pin on the synthesizer TCXO reference oscillator, X4. Potentiometer R66 sets the FM deviation level, which is set to +/- 5KHz. In the receive mode, the MX909A performs the reverse function using the analog signal from the receivers discriminator. After error correction and removal of the packet overhead, the recovered data is supplied to the microprocessor.

3.6 VCO and Synthesizer:

Refer to schematic diagram DSCH-2139-01 sheet 1.

The frequency synthesizer is the heart of the transceiver hardware. The RF oscillator is provided by a Maxim 2620 VCO IC, U3. The resonant tank circuit is comprised of L24, C50, C140 and varactor diode D4. D4 provides the necessary frequency pulling capability. U3 contains separate output buffers for the R.F. and synthesizer drive. The frequency synthesizer is a Philips SA7025, U4, which is programmed by the microprocessor with the frequency hopping sequence. The synthesizer loop filter consists of R17-R20 and C40-C43. A 12.8MHz TCXO, X4, provides a stable reference oscillator as well a method of modulating the transmitter by means of a voltage controlled tuning pin.

3.7 R.F. P.A Driver & Final Amplifier & /Harmonic Filter:

See schematic diagram DSCH-2139-01 sheet 2.

The output of the VCO is applied to R.F driver amplifier , U9 via resistor pad R102-R104. U9 then drives R.F. final amplifier U4. The driver and final amplifier stages are enabled the microprocessor. The R.F. output is routed through a solid state switch, U7, followed by a 7-pole harmonic filter consisting of inductors L10-L13 and C55-C58, before being applied to an MCX antenna connector, J1. Maximum R.F. output is 1.0 watts into 50 ohms, typical 0.75 watts.

3.8 Receiver Preselector, LNA & 1st Mixer:

See schematic diagram DSCH-2139-01 sheet 1.

The received signal is routed through antenna switch, U7, to preselector SAW filter, F4, before being applied to the LNA and first mixer. Both LNA and mixer are combined in IC U2. The output from the VCO, U3, is also applied to the mixer resulting in a first I.F. output frequency of 45MHz.

3.9 Receiver I.F. & Demodulator

See schematic diagram DSCH-2139-01 sheets 1 & 2.

The 45MHz 1st I.F. is passed through crystal filters X3 and X2 before being applied to 2nd I.F. and demodulator, U1. The 2nd mixer/L.O., I.F. amplifiers and quadrature detector are all contained within U1. The 2nd local oscillator is stabilized by crystal X1 at 45.455MHz, and results in a 2nd mixer output of 455KHz which passes through ceramic filters F1 and F2. U1 also provides an RSSI output which is buffered by op amp U13:B. The demodulated baseband output is applied to the GMSK modem, U11.

3.10 Emission Types

The transceiver contains the following "fixed" frequency sources:

X5 – 3.6864MHz Microprocessor clock crystal.
Y1 – 4.9125MHz GMSK modem clock crystal.
X1 - 45.455MHz **r**eceiver 2nd L.O. crystal.
X4 - 12.8MHz crystal controlled TCXO synthesizer reference oscillator.

The transceiver contains the following "variable" frequency source:

U3- 902-928 MHz (transmit) 857-883 MHz (receive) Voltage controlled oscillator. Phase locked to reference TCXO.

3.11 Antenna

The antenna consists of a 1/4 wave whip attached to a length of RG-174 coaxial cable, and terminated at the transceiver with an MCX connector.

4.0 Spread Spectrum Operation

4.1 Frequency Plan

The transceiver can be set to operate on any one of 256 frequency channels in the 902-928MHz 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 in a pseudo random sequence. 63 different sequences are available for use in each frequency group. Each channel is 30KHz wide.

FREQUENCY PLAN

HOP FREQ. NUMBER	GROUP #1 (MHz)	GROUP #2 (MHz)	GROUP #3 (MHz)	GROUP #4 (MHz)
0	902.3	902.4	902.5	902.6
1	902.7	902.8	902.9	903.0
2	903.1	903.2	903.3	903.4
3	903.5	903.6	903.7	903.8
4	903.9	904.0	904.1	904.2
5	904.3	904.4	904.5	904.6
6	904.7	904.8	904.9	905.0
7	905.1	905.2	905.3	905.4
8	905.5	905.6	905.7	905.8
9	905.9	906.0	906.1	906.2
XX	**Add 400 KHz per Frequency Hop Number**			
54	923.8	923.9	924.0	924.1
55	924.2	924.3	924.4	924.5
56	924.6	924.7	924.8	924.9
57	925.0	925.1	925.2	925.3
58	925.4	925.5	925.6	925.7
59	925.8	925.9	926.0	926.1
60	926.2	926.3	926.4	926.5
61	926.6	927.7	926.8	926.9
62	927.0	927.1	927.2	927.3
63	927.4	927.5	927.6	927.7

4.2 Per Hop Activities

The transceiver operates on a different frequency every 37.6 ms. A full hop cycle takes 2.369 sec. The transmitter ON time is approximately 35.2 ms per frequency, and the remaining time is used to switch frequency and to key the transmit power amplifier on and off.

A data packet is constructed by a number of data bits assembled by the microprocessor as follows:

64 bits preamble	240 bits user data	16 bits CRC	8 bits postamble

Data is sent at a rate of 9600 bits per second.

5.0 FCC / ISC Identification Labeling

5.1 FCC and ISC Identification Label

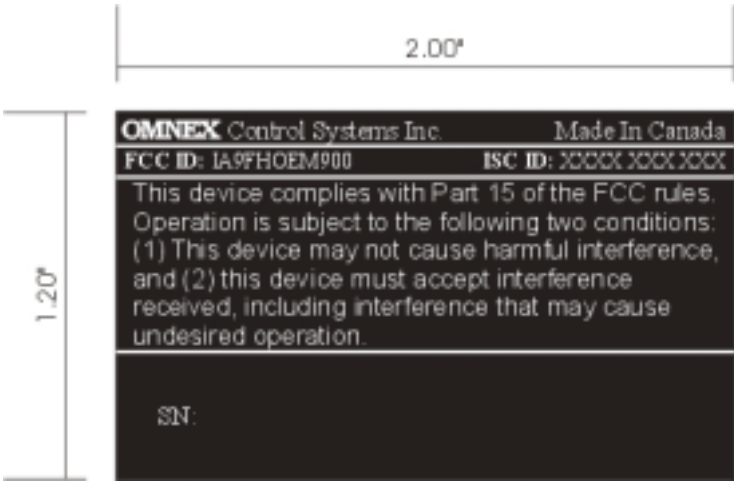
The FCC ID number will be IA9FHOEM900.
The ISC number to be assigned.

A single label will be used for both FCC and ISC (Industry Canada) identification numbers.

Material: Metal Foil

Adhesive: SCOTCH - 3M 486MP High Performance Adhesive.

Color: White lettering on a black background.



5.2 FCC and ISC Identification Label Placement

The FCC / ISC identification label will be placed on the top shield of the device as indicated in the picture.