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TAG-X Frequency Hopping Spread Spectrum description

This document outlines the frequency hopping mechanism and scheme use in the tag transceiver (C001). Herein is described how the following FCC requirements 15.247(a) (1), 15.247(g), 15.247(h) are met and adhered to.

Packet timing and ON/OFF cycle information:

Packet timing and on/off cycles are controlled by the device's firmware. It is not user definable. The minimum sleep cycle timing in the firmware instruction set is 2000ms between on and off states. Therefore the maximum on air (transmit) duty cycle is 15ms transmit at every 2000ms.

Furthermore the C001 adheres to the FCC requirements under section 15.249 whereby the C001 transceiver is capable of transmitting with its hopping mechanism turned off in this specific mode of operation. In this mode of operation the C001 device will transmit on one frequency at a maximum output power of -1.5dBm still using a 2FSK modulation.

1) 15.247 (a) (1)

The system is a frequency hopping spread spectrum transceiver. The system channel hopping scheme is selected and determined by and from a pseudo randomly ordered list of hopping frequencies. Each frequency is used equally on the average.

The system utilizes a pseudo randomly generated list that is stored in a memory based lookup table. Each transmission event is started on the next channel in the table. (See channel selection table below...)

TX TABLE:

TAG_TX_channel_01	DB 0x09, 0x77, 0x46, 0xC0	;923.280 MHz
TAG_TX_channel_10	DB 0x09, 0x77, 0x6C, 0x40	;923.640 MHz
TAG_TX_channel_21	DB 0x09, 0x77, 0x9A, 0x00	;924.080 MHz
TAG_TX_channel_33	DB 0x09, 0x77, 0xCB, 0xF0	;924.560 MHz
TAG_TX_channel_40	DB 0x09, 0x77, 0xE9, 0x20	;924.840 MHz
TAG_TX_channel_49	DB 0x09, 0x78, 0x0E, 0x90	;925.200 MHz
TAG_TX_channel_51	DB 0x09, 0x78, 0x16, 0xE0	;925.280 MHz
TAG_TX_channel_44	DB 0x09, 0x77, 0xF9, 0xC0	;925.000 MHz
TAG_TX_channel_29	DB 0x09, 0x77, 0xBB, 0x50	;924.400 MHz
TAG_TX_channel_20	DB 0x09, 0x77, 0x95, 0xE0	;924.040 MHz
TAG_TX_channel_14	DB 0x09, 0x77, 0x7C, 0xE0	;923.800 MHz
TAG_TX_channel_03	DB 0x09, 0x77, 0x4F, 0x10	;923.360 MHz
TAG_TX_channel_08	DB 0x09, 0x77, 0x63, 0xE0	;923.560 MHz
TAG_TX_channel_19	DB 0x09, 0x77, 0x91, 0xB0	;924.000 MHz
TAG_TX_channel_25	DB 0x09, 0x77, 0xAA, 0xB0	;924.240 MHz
TAG_TX_channel_37	DB 0x09, 0x77, 0xDC, 0xA0	;924.720 MHz
TAG_TX_channel_45	DB 0x09, 0x77, 0xFD, 0xF0	;925.040 MHz
TAG_TX_channel_50	DB 0x09, 0x78, 0x12, 0xC0	;925.240 MHz
TAG_TX_channel_43	DB 0x09, 0x77, 0xF5, 0x90	;924.960 MHz
TAG_TX_channel_34	DB 0x09, 0x77, 0xD0, 0x20	;924.600 MHz



TAG_TX_channel_28	DB 0x09, 0x77, 0xB7, 0x20	;924.360 MHz
TAG_TX_channel_16	DB 0x09, 0x77, 0x85, 0x30	;923.880 MHz
TAG_TX_channel_06	DB 0x09, 0x77, 0x5B, 0x90	;923.480 MHz
TAG_TX_channel_13	DB 0x09, 0x77, 0x78, 0xB0	;923.760 MHz
TAG_TX_channel_24	DB 0x09, 0x77, 0xA6, 0x80	;924.200 MHz
TAG_TX_channel_36	DB 0x09, 0x77, 0xD8, 0x70	;924.680 MHz
TAG_TX_channel_41	DB 0x09, 0x77, 0xED, 0x40	;924.880 MHz
TAG_TX_channel_53	DB 0x09, 0x78, 0x1F, 0x40	;925.360 MHz
TAG_TX_channel_46	DB 0x09, 0x78, 0x02, 0x10	;925.080 MHz
TAG_TX_channel_38	DB 0x09, 0x77, 0xE0, 0xC0	;924.760 MHz
TAG_TX_channel_27	DB 0x09, 0x77, 0xB3, 0x00	;924.320 MHz
TAG_TX_channel_17	DB 0x09, 0x77, 0x89, 0x60	;923.920 MHz
TAG_TX_channel_09	DB 0x09, 0x77, 0x68, 0x10	;923.600 MHz
TAG_TX_channel_04	DB 0x09, 0x77, 0x53, 0x40	;923.400 MHz
TAG_TX_channel_12	DB 0x09, 0x77, 0x74, 0x90	;923.720 MHz
TAG_TX_channel_18	DB 0x09, 0x77, 0x8D, 0x80	;923.960 MHz
TAG_TX_channel_30	DB 0x09, 0x77, 0xBF, 0x80	;924.440 MHz
TAG_TX_channel_39	DB 0x09, 0x77, 0xE4, 0xF0	;924.800 MHz
TAG_TX_channel_52	DB 0x09, 0x78, 0x1B, 0x10	;925.320 MHz
TAG_TX_channel_48	DB 0x09, 0x78, 0x0A, 0x70	;925.160 MHz
TAG_TX_channel_32	DB 0x09, 0x77, 0xC7, 0xD0	;924.520 MHz
TAG_TX_channel_15	DB 0x09, 0x77, 0x81, 0x10	;923.840 MHz
TAG_TX_channel_02	DB 0x09, 0x77, 0x4A, 0xF0	;923.320 MHz
TAG_TX_channel_07	DB 0x09, 0x77, 0x5F, 0xC0	;923.520 MHz
TAG_TX_channel_22	DB 0x09, 0x77, 0x9E, 0x30	;924.120 MHz
TAG_TX_channel_31	DB 0x09, 0x77, 0xC3, 0xA0	;924.480 MHz
TAG_TX_channel_42	DB 0x09, 0x77, 0xF1, 0x70	;924.920 MHz
TAG_TX_channel_47	DB 0x09, 0x78, 0x06, 0x40	;925.120 MHz
TAG_TX_channel_35	DB 0x09, 0x77, 0xD4, 0x50	;924.640 MHz
TAG_TX_channel_26	DB 0x09, 0x77, 0xAE, 0xD0	;924.280 MHz
TAG_TX_channel_23	DB 0x09, 0x77, 0xA2, 0x50	;924.160 MHz
TAG_TX_channel_11	DB 0x09, 0x77, 0x70, 0x60	;923.680 MHz
TAG_TX_channel_05	DB 0x09, 0x77, 0x57, 0x70	;923.440 MHz

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RX TABLE:

TAG_RX_channel_01	DB 0x01, 0x6F, 0x2F, 0xE0	;903.280 MHz
TAG_RX_channel_10	DB 0x01, 0x6F, 0x55, 0x50	;903.640 MHz
TAG_RX_channel_21	DB 0x01, 0x6F, 0x83, 0x20	;904.080 MHz



TAG_RX_channel_33	DB 0x01, 0x6F, 0xB5, 0x10	;904.560 MHz
TAG_RX_channel_40	DB 0x01, 0x6F, 0xD2, 0x30	;904.840 MHz
TAG_RX_channel_49	DB 0x01, 0x6F, 0xF7, 0xB0	;905.200 MHz
TAG_RX_channel_51	DB 0x01, 0x70, 0x00, 0x00	;905.280 MHz
TAG_RX_channel_44	DB 0x01, 0x6F, 0xE2, 0xE0	;905.000 MHz
TAG_RX_channel_29	DB 0x01, 0x6F, 0xA4, 0x70	;904.400 MHz
TAG_RX_channel_20	DB 0x01, 0x6F, 0x7E, 0xF0	;904.040 MHz
TAG_RX_channel_14	DB 0x01, 0x6F, 0x66, 0x00	;903.800 MHz
TAG_RX_channel_03	DB 0x01, 0x6F, 0x38, 0x30	;903.360 MHz
TAG_RX_channel_08	DB 0x01, 0x6F, 0x4D, 0x00	;903.560 MHz
TAG_RX_channel_19	DB 0x01, 0x6F, 0x7A, 0xD0	;904.000 MHz
TAG_RX_channel_25	DB 0x01, 0x6F, 0x93, 0xC0	;904.240 MHz
TAG_RX_channel_37	DB 0x01, 0x6F, 0xC5, 0xC0	;904.720 MHz
TAG_RX_channel_45	DB 0x01, 0x6F, 0xE7, 0x00	;905.040 MHz
TAG_RX_channel_50	DB 0x01, 0x6F, 0xFB, 0xD0	;905.240 MHz
TAG_RX_channel_43	DB 0x01, 0x6F, 0xDE, 0xB0	;904.960 MHz
TAG_RX_channel_34	DB 0x01, 0x6F, 0xB9, 0x40	;904.600 MHz
TAG_RX_channel_28	DB 0x01, 0x6F, 0xA0, 0x40	;904.360 MHz
TAG_RX_channel_16	DB 0x01, 0x6F, 0x6E, 0x50	;903.880 MHz
TAG_RX_channel_06	DB 0x01, 0x6F, 0x44, 0xB0	;903.480 MHz
TAG_RX_channel_13	DB 0x01, 0x6F, 0x61, 0xD0	;903.760 MHz
TAG_RX_channel_24	DB 0x01, 0x6F, 0x8F, 0xA0	;904.200 MHz
TAG_RX_channel_36	DB 0x01, 0x6F, 0xC1, 0x90	;904.680 MHz
TAG_RX_channel_41	DB 0x01, 0x6F, 0xD6, 0x60	;904.880 MHz
TAG_RX_channel_53	DB 0x01, 0x70, 0x08, 0x50	;905.360 MHz
TAG_RX_channel_46	DB 0x01, 0x6F, 0xEB, 0x30	;905.080 MHz
TAG_RX_channel_38	DB 0x01, 0x6F, 0xC9, 0xE0	;904.760 MHz
TAG_RX_channel_27	DB 0x01, 0x6F, 0x9C, 0x20	;904.320 MHz
TAG_RX_channel_17	DB 0x01, 0x6F, 0x72, 0x80	;903.920 MHz
TAG_RX_channel_09	DB 0x01, 0x6F, 0x51, 0x30	;903.600 MHz
TAG_RX_channel_04	DB 0x01, 0x6F, 0x3C, 0x60	;903.400 MHz
TAG_RX_channel_12	DB 0x01, 0x6F, 0x5D, 0xB0	;903.720 MHz
TAG_RX_channel_18	DB 0x01, 0x6F, 0x76, 0xA0	;903.960 MHz
TAG_RX_channel_30	DB 0x01, 0x6F, 0xA8, 0x90	;904.440 MHz
TAG_RX_channel_39	DB 0x01, 0x6F, 0xCE, 0x10	;904.800 MHz
TAG_RX_channel_52	DB 0x01, 0x70, 0x04, 0x30	;905.320 MHz
TAG_RX_channel_48	DB 0x01, 0x6F, 0xF3, 0x80	;905.160 MHz
TAG_RX_channel_32	DB 0x01, 0x6F, 0xB0, 0xF0	;904.520 MHz
TAG_RX_channel_15	DB 0x01, 0x6F, 0x6A, 0x20	;903.840 MHz
TAG_RX_channel_02	DB 0x01, 0x6F, 0x34, 0x10	;903.320 MHz
TAG_RX_channel_07	DB 0x01, 0x6F, 0x48, 0xE0	;903.520 MHz

TAG_RX_channel_22	DB 0x01, 0x6F, 0x87, 0x50	;904.120 MHz
TAG_RX_channel_31	DB 0x01, 0x6F, 0xAC, 0xC0	;904.480 MHz
TAG_RX_channel_42	DB 0x01, 0x6F, 0xDA, 0x90	;904.920 MHz
TAG_RX_channel_47	DB 0x01, 0x6F, 0xEF, 0x60	;905.120 MHz
TAG_RX_channel_35	DB 0x01, 0x6F, 0xBD, 0x60	;904.640 MHz
TAG_RX_channel_26	DB 0x01, 0x6F, 0x97, 0xF0	;904.280 MHz
TAG_RX_channel_23	DB 0x01, 0x6F, 0x8B, 0x70	;904.160 MHz
TAG_RX_channel_11	DB 0x01, 0x6F, 0x59, 0x80	;903.680 MHz
TAG_RX_channel_05	DB 0x01, 0x6F, 0x40, 0x80	;903.440 MHz

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The associated system receiver has a compliant input bandwidth and has the ability to hop in synchronization with the transmitter. Synchronization is achieved by decoding packet headers and position pointers within the packets. The receiver interprets the packet headers and position markers and determines the next receive and transmit channel assignment that is in the pseudo randomly ordered channel selection table.

2) 15.247 (g)

When presented with a continuous data stream the system will continue to operate using its pseudo randomly generated hopping scheme. A data stream which requires the use of all of the hopping channels in order to be completely received will be received using a pseudo random sequence.

During a short transmission or burst the system will select the next channel in its pseudo randomly ordered channel selection table. The last used position in the table is indexed in the memory and is incremented by one in order to select the next channel in the pseudo randomly ordered channel selection table for the next transmission event.

3) 15.247 (h)

The system does not incorporate any means for intelligent coordination other than a means for synchronization of the transmitter and the receiver. This synchronization does not take into account any interference or channel occupancy but other systems. Both the transmitter and the receiver synchronize to each other by decoding packet headers and position pointers within the packets. These serve to enable the system to know when to hop to the next channel in the pseudo randomly ordered channel selection table and to stay synchronized.