

Frequency Hopping Spread Spectrum Transmitter

Certification Test Report

FCC ID: R7XTPM2

ACS Report Number: 04-0189-15C

**Manufacturer: Test Point Tech, LLC
Equipment Type: Transceiver
Model: TPM2**

Theory of Operation

CONFIDENTIAL

TPM Remote Reading Voltmeter Principles of Operation

The TPM is a remote reading voltmeter that incorporates a frequency hopping spread spectrum transceiver. The frequency hopping spread spectrum data transceiver operates in the 902 MHz to 928 MHz frequency band. The modulation used is binary frequency shift keying with a deviation of 100 KHz. The RF data rate is 76.8 Kbps yielding a modulation index of 1.28. The TPM uses a previously certified RF device with the FCC ID QLBPTSS2003 as its interrogator and utilizes the same communication protocol as that device.

The frequency of the transmitter is generated by a delta sigma phase locked loop synthesizer that is capable of 500 Hz frequency steps. The transceiver uses a hop table with 50 entries. Frequencies from 903.0 MHz to 927.0 MHz are allowed in the hop table. The table is generated based on a configurable 16-bit register. The setting in this register is used as the seed for a random number generator and each entry in the hop table is derived from the sequence of the random number generator. Thus there are a total of 65,536 possible hop tables although these will share some frequencies. Each entry in the hop table has a center frequency that is at least 465 KHz away from any of the other entries.

The receiver portion of the TPM uses the identical microcontroller code to generate its hop table so that the transmitting module and the receiving module can stay synchronized. The receiver portion of the TPM has a bandwidth of 200 KHz which is narrow enough to reject other hop channels.

The TPM always uses the “next” entry in its hop table to transmit or receive. When the end of the hop table is reached it starts at the beginning of the table. In this manner, the TPM will always use each entry in its table with an equal probability.

The communication between a TPM and a transceiver module occurs in several stages. The first stage is synchronization. During this phase the unit that is transmitting sends a preamble on the next hop table entry. This preamble is long enough for a receiver that has the same hop table to scan through all 50 channels. The TPM then sends a message header and the data payload. The message header indicates if an acknowledgement reply is expected.

The next stage is the acknowledgement from the target receiver. If the receiver received the message with no errors it sends an ACK packet using the frequency of the next hop table entry. If additional data is needed to be sent the transmitter and receiver will then hop to the next frequency and communicate the next portion of the packet. This sequence will repeat until the transmitter is through sending its data.

The transmitter is limited by its buffer size to a maximum duration of transmission of 40mS. At the completion of a transmission, a timer prevents another transmission for 1.5 times the last transmission duration. For the maximum length transmission of 40 mS this will hold off the next transmission for 60 mS. This will yield a maximum duty cycle of 40%.

Sample Hop Tables:

Hop Seed 1

924439000 910024000 913279000 923044000 910954000 907234000 914209000
923974000 905839000 923509000 926299000 925369000 911419000 920719000
917464000 917929000 915139000 924904000 911884000 909559000 904909000
914674000 918394000 908164000 922114000 908629000 922579000 921184000
903979000 921649000 909094000 906304000 918859000 916999000 905374000
913744000 910489000 906769000 912814000 920254000 916069000 915604000
903514000 919324000 903049000 925834000 904444000 919789000 907699000
916534000

Hop Seed is 16391

904131500 918546500 909246500 912036500 905526500 913896500 917616500
921336500 915756500 918081500 904596500 921801500 922266500 914361500

907851500 911571500 919476500 914826500 920406500 923661500 919941500
916221500 905991500 926451500 903201500 925521500 923196500 906921500
903666500 913431500 912501500 925986500 915291500 909711500 908781500
906456500 922731500 905061500 925056500 910641500 919011500 911106500
920871500 924126500 917151500 910176500 916686500 908316500 924591500
907386500

Hop Seed 32761

918341000 919736000 906716000 905786000 914156000 911366000 917411000
921596000 903461000 921131000 908111000 915086000 909971000 916481000
912296000 916016000 922991000 918806000 923456000 913691000 912761000
913226000 916946000 926246000 911831000 904856000 920666000 903926000
925781000 907646000 922061000 923921000 905321000 909041000 910436000
924386000 904391000 924851000 908576000 922526000 920201000 915551000
910901000 919271000 907181000 914621000 917876000 906251000 926711000
925316000