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05 March, 2015

TIMCO Engineering Inc.
849 N.W. State Road 45
P.O. Box 370
Newberry, FL 32669

SUBJECT:

UTC FIRE & SECURITY AMERICAS CORPORATION - FCC ID: QPY-SA915FFH - JOB #: 1807AUC14
Compliance to FCC DA 00-705, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

To Whom It May Concern,

Pertaining to FCC ID: QPY-SA915FFH - JOB #: 1807AUC14, additional information was requested of UTC with regard to our submission. The following two items, received through earlier communications, state the information requests from TIMCO:

1. **Equal Hopping Frequency Use / DA 00-705:** Pursuant to a very intense study of the "QPY-SA915FFH Description rev c" document, we cannot find any verbiage that contains the expression, "equal usage" or any synonyms that would provide the same meaning. Please again refer to DA 00-705 under the heading "Equal Hopping Frequency Use" and provide evidence that "each of its hopping channels is used equally on average". This could be a separate signed attestation document or a statement in the signed Test Report.
2. **Pseudorandom Frequency Hopping Sequence / DA 00-705:** We note the explanation in the above referenced document that is titled "Theory of Operation / SA915FFH" that provides information about how the pseudorandom channel list is generated". However, we could not locate any example of the hopping sequence channels. The FCC Public Notice DA 00-705 specifically requires such an example to confirm that the hopping sequence follows the FCC rules, namely Part 2.1 under the definition of *Frequency Hopping Systems*. According to the FCC, "The test of a frequency hopping system is that the near term distribution of hops appears random, the long term distribution appears evenly distributed over the hop set, and sequential hops are randomly distributed in both direction and magnitude of change in the hop set". Please note that we do not need the complete sequence of the hopping sequence; however, an adequate number of channels that show compliance to this rule would suffice. The list could contain the actual channel frequencies, or channel numbers if this is more convenient; however, we must inspect the example of the pseudorandom hopping sequence as part of our review.

For context purposes, the Federal Communications Commission (FCC) Public Notice DA 00-705, March 30, 2000, "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems" sections referenced above state the following:

Pseudorandom Frequency Hopping Sequence

Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1.

Equal Hopping Frequency Use

Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).

To address the issues raised by TIMCO, UTC would like to reference pages 223-226, the section entitled “915 MHz Frequency Hopping” in the attachment, “ATT AFM Detailed Spec (02 Mar 2015).pdf”.

Pertaining to TIMCO request for information item #1, “Equal Hopping Frequency Use / DA 00-705” - hopping channels are distributed equally at 249.664307 KHz as identified in Table 1, “Channel Spacing”.

Table 1. 915 MHz Frequency Hopping Parameters

Base Frequency	902.249725 MHz
Channel Spacing	0.249664307 MHz
Channel Base	0
Upper Exclusion	0x00000000
Lower Exclusion	0x1C003800

Pertaining to TIMCO request for information item #2, “Pseudorandom Frequency Hopping Sequence / DA 00-705” - Table 2 on the following pages provides a complete list of the frequency hopping channels for examination purposes.

The hopping sequence is created using a 16-bit Galois Linear Feedback Shift Register as a pseudorandom number generator. This results in a random 65535 hop set of evenly distributed channels. The initial seed value is set to the Home ID of the network. The next channel in the hop sequence is determined as follows:

$$\begin{aligned} \text{lfsr} &= (\text{lfsr} \gg 1) \wedge \neg(\text{lfsr} \& 1) \& 0\text{xB400}; \\ \text{channel} &= \text{lfsr} \% \text{NUM_CHANNELS}; \end{aligned}$$

The following is a 100 hop snippet from a sample hop set (initial seed value of 0xACE1):

82,41,72,36,18,8,39,8,4,2,36,18,9,56,15,3,53,3,53,78,39,58,76,38,47,74,37,7,54,55,79,91,29,66,13,57,80,40,20,10,4,37,70,63,82,6
9,86,71,74,65,76,38,59,68,62,31,95,86,71,79,71,87,95,99,100,97,37,50,5,46,23,0,90,73,88,44,22,11,56,63,83,18,9,36,5,94,47,75,2
1,62,11,56,68,26,96,40,20,50,25,44.

Please let us know if further clarification is required. We thank you in advance for your consideration of this information.

Sincerely,



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Attachment: ATT AFM Detailed Spec (02 Mar 2015).pdf
CC: Mr. Steve Hoke, EMC Site Manager, Product Safety Engineering



Table 2. 915 MHz Frequency Hopping Channel List

Channel	Frequency (MHz)	Upper Exclusion	Lower Exclusion	Exclude	Reason
0	902.249725	0x00000000	0x00000001		
1	902.4993893	0x00000000			
2	902.7490536	0x00000000	0x00000002		
3	902.9987179	0x00000000			
4	903.2483822	0x00000000	0x00000004		
5	903.4980465	0x00000000			
6	903.7477108	0x00000000	0x00000008		
7	903.9973751	0x00000000			
8	904.2470395	0x00000000	0x00000010		
9	904.4967038	0x00000000			
10	904.7463681	0x00000000	0x00000020		
11	904.9960324	0x00000000			
12	905.2456967	0x00000000	0x00000040		Home Channel A
13	905.495361	0x00000000			Not Used
14	905.7450253	0x00000000	0x00000080		
15	905.9946896	0x00000000			
16	906.2443539	0x00000000	0x00000100		
17	906.4940182	0x00000000			
18	906.7436825	0x00000000	0x00000200		
19	906.9933468	0x00000000			
20	907.2430111	0x00000000	0x00000400		
21	907.4926754	0x00000000			
22	907.7423398	0x00000000	0x00000800	Yes	Z-Wave (908.40 MHz and 908.42 MHz)
23	907.9920041	0x00000000			
24	908.2416684	0x00000000	0x00001000	Yes	Z-Wave (908.40 MHz and 908.42 MHz)
25	908.4913327	0x00000000			
26	908.740997	0x00000000	0x00002000	Yes	Z-Wave (908.40 MHz and 908.42 MHz)
27	908.9906613	0x00000000			
28	909.2403256	0x00000000	0x00004000		
29	909.4899899	0x00000000			
30	909.7396542	0x00000000	0x00008000		
31	909.9893185	0x00000000			
32	910.2389828	0x00000000	0x00010000		
33	910.4886471	0x00000000			
34	910.7383114	0x00000000	0x00020000		
35	910.9879757	0x00000000			
36	911.2376401	0x00000000	0x00040000		
37	911.4873044	0x00000000			



Table 2. 915 MHz Frequency Hopping Channel List (cont.)

Channel	Frequency (MHz)	Upper Exclusion	Lower Exclusion	Exclude	Reason
38	911.7369687	0x00000000	0x00080000		
39	911.986633	0x00000000			
40	912.2362973	0x00000000	0x00100000		
41	912.4859616	0x00000000			
42	912.7356259	0x00000000	0x00200000		
43	912.9852902	0x00000000			
44	913.2349545	0x00000000	0x00400000		
45	913.4846188	0x00000000			
46	913.7342831	0x00000000	0x00800000		
47	913.9839474	0x00000000			
48	914.2336117	0x00000000	0x01000000		
49	914.483276	0x00000000			
50	914.7329404	0x00000000	0x02000000		
51	914.9826047	0x00000000			
52	915.232269	0x00000000	0x04000000	Yes	Z-Wave 916.00 MHz
53	915.4819333	0x00000000			
54	915.7315976	0x00000000	0x08000000	Yes	Z-Wave 916.00 MHz
55	915.9812619	0x00000000			
56	916.2309262	0x00000000	0x10000000	Yes	Z-Wave 916.00 MHz
57	916.4805905	0x00000000			
58	916.7302548	0x00000000	0x20000000		
59	916.9799191	0x00000000			
60	917.2295834	0x00000000	0x40000000		
61	917.4792477	0x00000000			
62	917.728912	0x00000000	0x80000000		
63	917.9785763	0x00000000			
64	918.2282406	0x00000001	0x00000000		
65	918.477905		0x00000000		
66	918.7275693	0x00000002	0x00000000		
67	918.9772336		0x00000000		
68	919.2268979	0x00000004	0x00000000		
69	919.4765622		0x00000000		
70	919.7262265	0x00000008	0x00000000		
71	919.9758908		0x00000000		
72	920.2255551	0x00000010	0x00000000		Home Channel B
73	920.4752194		0x00000000		Not Used
74	920.7248837	0x00000020	0x00000000		
75	920.974548		0x00000000		
76	921.2242123	0x00000040	0x00000000		
77	921.4738766		0x00000000		
78	921.7235409	0x00000080	0x00000000		
79	921.9732053		0x00000000		
80	922.2228696	0x00000100	0x00000000		



Table 2. 915 MHz Frequency Hopping Channel List (cont.)

Channel	Frequency (MHz)	Upper Exclusion	Lower Exclusion	Exclude	Reason
81	922.4725339		0x00000000		
82	922.7221982	0x00000200	0x00000000		
83	922.9718625		0x00000000		
84	923.2215268	0x00000400	0x00000000		
85	923.4711911		0x00000000		
86	923.7208554	0x00000800	0x00000000		
87	923.9705197		0x00000000		
88	924.220184	0x00001000	0x00000000		
89	924.4698483		0x00000000		
90	924.7195126	0x00002000	0x00000000		
91	924.9691769		0x00000000		
92	925.2188412	0x00004000	0x00000000		
93	925.4685056		0x00000000		
94	925.7181699	0x00008000	0x00000000		
95	925.9678342		0x00000000		
96	926.2174985	0x00010000	0x00000000		
97	926.4671628		0x00000000		
98	926.7168271	0x00020000	0x00000000		
99	926.9664914		0x00000000		
100	927.2161557	0x00040000	0x00000000		
101	927.46582		0x00000000		
102	927.7154843	0x00080000	0x00000000		