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Certification Test Report

For a Class II Permissive Change: 2010 05149168 FCC

Project number: 45143-1

Equipment Under Test (EUT): Keyfob
Models: TST-5223, TST-5224, TST-5225

FCC ID: EZSAESTG34
IC: 1513A-ASTG34

In Accordance With: FCC Part 15 Subpart C, 15.247
RSS-210, Issue 7 June 2007

For: Directed Electronics, Inc.
One Viper Way
Vista, CA 92081
USA

Tested By: Nemko USA Inc.
11696 Sorrento Valley Road, Suite F
San Diego, CA 92121

Authorized By: Alan Laudani, EMC/RF Test Engineer

Date: MAY 4, 2010
Total Number of Pages: 23

2.1. Section 1. Summary of Test Results

General

All measurements are traceable to national standards

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15; Subpart C and RSS-210, Issue 7 June 2007. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC and IC.

The assessment summary is as follows:

Apparatus Assessed:	Keyfob
Model:	TST-5223, TST-5224, TST-5225
Specifications:	FCC Part 15 Subpart C, 15.247 RSS-210, Issue 7 June 2007
Date Received in Laboratory:	MAY 4, 2010
Compliance Status:	Complies
Exclusions:	None
Non-compliances:	None

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Specification: FCC Part 15 Subpart C, 15.247

Report Release History:

REVISION	DATE	COMMENTS
-	MAY 4, 2010	Prepared By: Alan Laudani
-	MAY 4, 2010	Initial Release: F. Fleury

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025.

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TESTED BY:  Date: MAY 4, 2010
Alan Laudani, EMC Test Engineer

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Section 2: Equipment Under Test

2.1 Product Identification

The EUT is a hand held transmitter used as a remote control for vehicle security/convenience systems. It's comprised of a PCB which has an MCU, Battery, user interface (switches and LED display) and RF circuitry. When a user activates a command with one of the EUT switches, the command is interpreted by the MCU which generates the data packets to be transmitted and controls the RFIC to generate the hopping sequence for as long as the user presses the button. When there are no buttons pressed, the EUT goes into sleep mode waiting for the next user switch press to wake-up and begin the code hopping transmission again. This design employs 25 channels which operate in the 902MHz to 928MHz band. Each channel has a 20dB BW greater than 250KHz but less than 500KHz.

This test report is for a Class II Permissive Change requested as the frequencies changed slightly, therefore tests were accomplished to indicate compliance were limited to parameters directly affected by a change in frequency. The hardware and controlling firmware were not changed in design or execution. Another model number TST-5225 is added to provide another configuration based on brand name, housing styling and color.

2.2 Technical Specifications of the EUT

Manufacturer:	Directed Electronics, Inc.
Operating Frequency:	909.440 to 918.500 MHz in the 902-928 MHz Band
Output Power:	98.5 dBuV/m @ 3m; 0.0021 W
Number of Operating Frequencies:	25
Modulation:	FSK
Antenna Data:	Integral antenna trace on circuit board
Antenna Connector:	None
Power Source:	3 V battery

Section 3: Test Conditions

3.1 Specifications

The apparatus was assessed against the following specifications:

FCC Part 15 Subpart C, 15.247

Operation within the bands 902-928 MHz, 2400-2483.5 MHz, 5725-5850 MHz and 24.0-24.25 GHz bands.

IC RSS-210 Issue 7 June 2007

Low-power Licence-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment. Annex 8 - Frequency Hopping and Digital Modulation Systems Operating in the Bands 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz

IC RSS-Gen Issue 2 June 2007

General Requirements and Information for the Certification of Radio-communication Equipment

3.2 Deviations From Laboratory Test Procedures

No deviations from Laboratory Test Procedure

3.3 Test Environment

All tests were performed under the following environmental conditions:

Temperature range	:	15.6 – 23.3 °C
Humidity range	:	26 - 65 %
Pressure range	:	86 - 106 kPa

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3.4 Test Equipment

Nemko ID	Device	Manufacturer	Model	Serial Number	Cal Date	Cal Due Date
111	Antenna, LPA	EMCO	3146	1382	10/20/2008	10/20/2010
128	Antenna	Electro-Metrics	3104	2882	2/9/2009	2/9/2011
625	Antenna, Dbl Ridge Horn	EMCO	3116	2325	2/1/2010	2/1/2012
752	Antenna, DRWG	EMCO	3115	4943	11/12/2008	11/12/2010
911	Spectrum Analyzer	Agilent	E4440A	US41421266	12/17/2009	12/17/2010
919	Preamplifier	Spacek Labs MM-Wave Technology	1000 MHz to 40 GHz	3M12 (SLK-35-3) and 3M13 (SLKa-35-4)	11/30/2009	11/30/2010

Registration of the OATS are on file with the Federal Communications Commission, under Registration Number 90579, the VCCI under registration number R-3027, and are also registered with Industry Canada under Site Numbers 2040B-1 and 2040B-2.

Section 4: Observations

4.1 Modifications Performed During Assessment

No modifications were performed during assessment.

4.2 Record Of Technical Judgements

No technical judgements were made during the assessment.

4.3 EUT Parameters Affecting Compliance

The user of the apparatus could not alter parameters that would affect compliance.

4.4 Test Deleted

No Tests were deleted from this assessment. It was decided that as the firmware controls number of hopping channels and dwell time, these tests would not need to be repeated. As the 20 dB Bandwidth was proved not to change and the frequency channel distribution is similar, the frequency separation would be the same.

4.5 Additional Observations

There were no additional observations made during this assessment.

Section 5: Results Summary

This section contains the following:

Test Results

The column headed “Required” indicates whether the associated clauses were invoked for the apparatus under test. The following abbreviations are used:

- N No: not applicable / not relevant
- Y Yes: Mandatory i.e. the apparatus shall conform to these test.
- N/T Not Tested, mandatory but not assessed. (See section 4.4 Test deleted)

The results contained in this section are representative of the operation of the apparatus as originally submitted.

5.1 Test Results

This test report is for a Class II Permissive Change requested as the frequencies changed slightly, therefore tests were accomplished to indicate compliance were limited to parameters directly affected by a change in frequency. The hardware and controlling firmware were not changed in design or execution.

Part 15	FCC Test Description	RSS-210 IC Test Description Annex 8: Frequency Hopping and Digital Modulation Systems Operating in the 902—928 MHz Band	Required	Result
15.247 a1i	20dB Bandwidth	A81(c) The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.	Y	Pass
12.247a1	Channel Separation	A81(b) If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 10 second period.	N*	
15.247a1i	Number of Hopping Channels	A8.4(c)	Y	Pass
15.247 b2	Peak Output Power	A8.4(1)	Y	Pass
15.209 a 15.247d	Radiated Emissions within Restricted Bands	2.2, A8.5	Y	Pass
15.247d	Bandedge	2.2	Y	Pass
15.109	Receiver Spurious Emissions	RSS-GEN	NA	

Channel separation not a function of center frequencies, not tested.*

Appendix A: Test Results

20 dB Bandwidth

Clause 15.247(a)(1)(i)

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; **if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500kHz.**

Test Conditions:

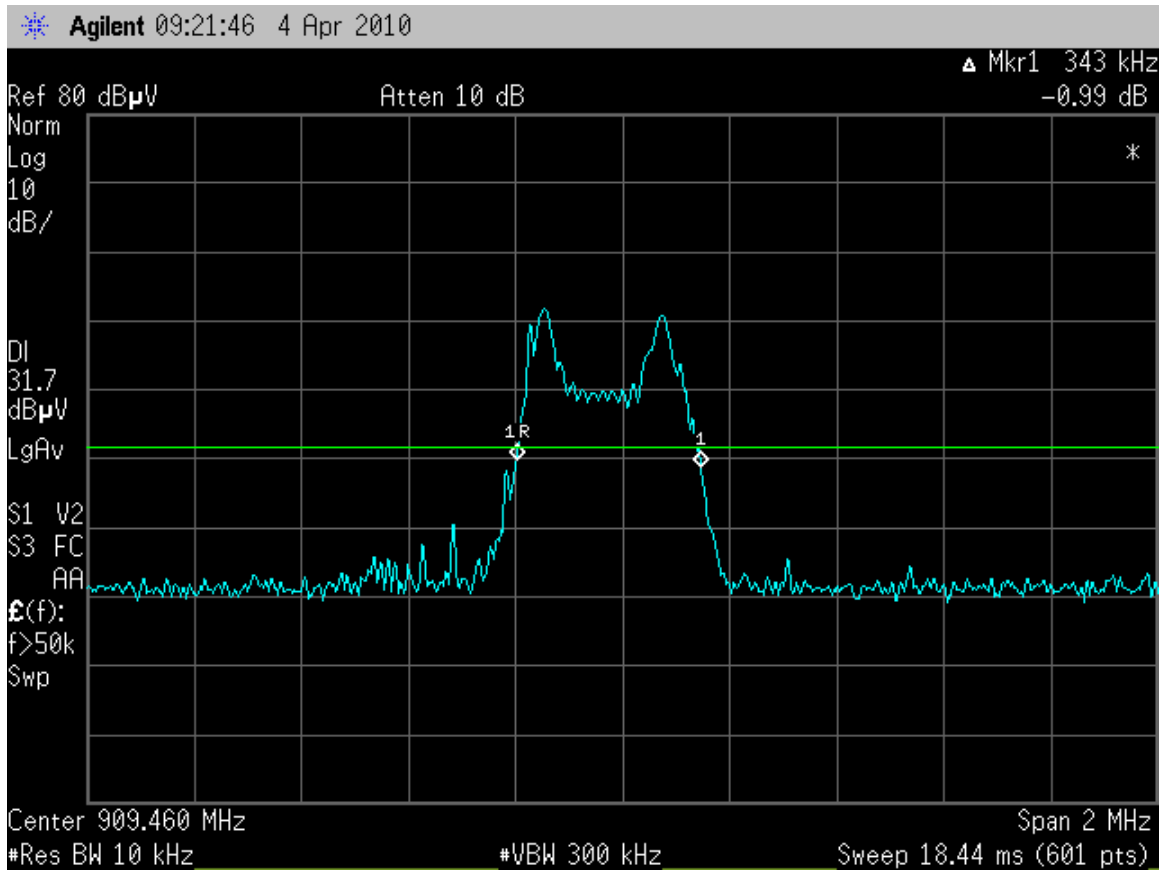
Sample Number:	TST-5224	Temperature:	22°C
Date:	4-4-2010	Humidity:	35%
Modification State:	Lo/Mid/High Channels	Tester:	Alan Laudani
		Laboratory:	Nemko NOATS

Test Results:

The EUT was placed <1m from the receiving antenna to allow a representative signal to fill the display > 30dB from the noise floor. The Spectrum Analyzer RES BW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 20 dB lower than PEAK level. The 20 dB bandwidth was determined from where the channel output spectrum intersected the display line.

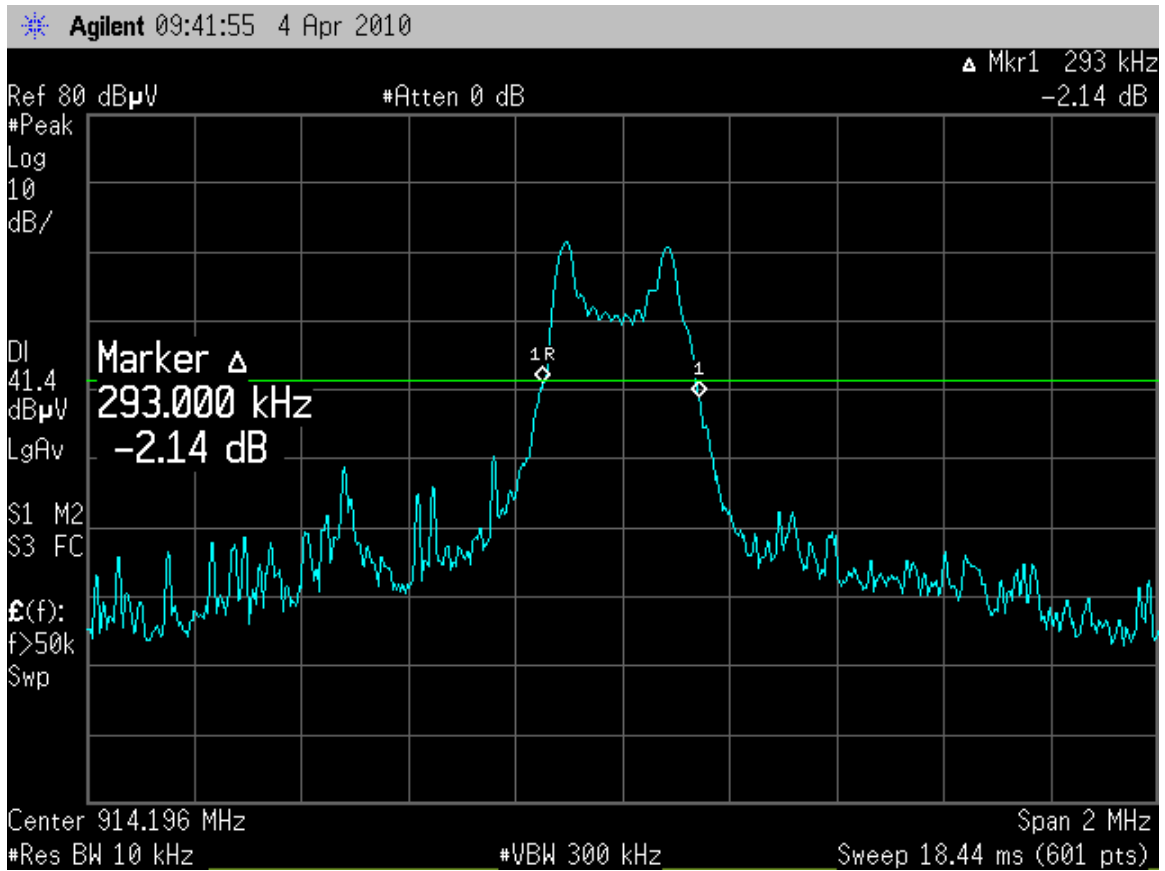
Channel Range	20dB Bandwidth
Low (909.440 MHz)	343 kHz
Mid (914.196 MHz)	293 kHz
High (918.500 MHz)	297 kHz

Low Channel 909.440 MHz

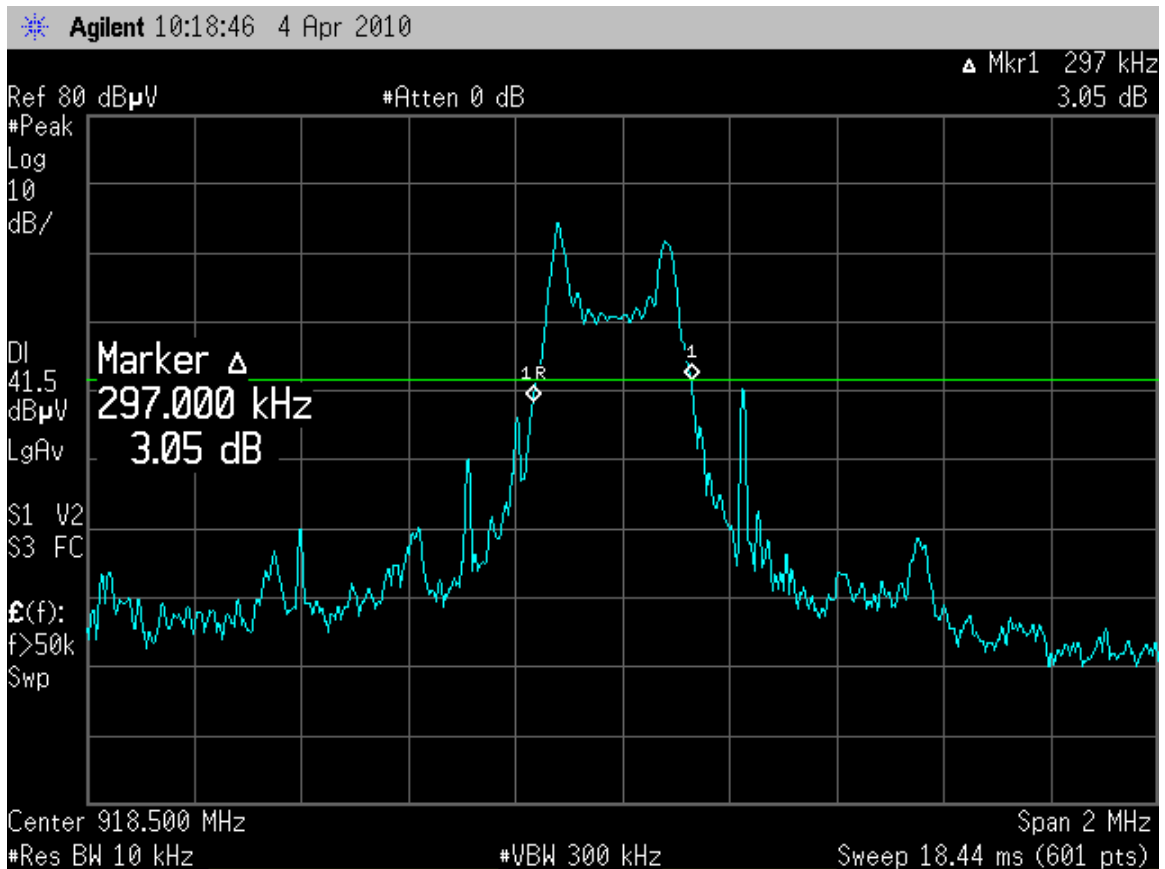


Date not correct in spectrum analyzer memory.

Mid Channel 914.196 MHz



High Channel 918.500 MHz



Duty Cycle

Test Conditions:

Sample Number:	TST-5224	Temperature:	22°C
Date:	4-4-2010	Humidity:	35%
Modification State:	Single Channel test mode	Tester:	Alan Laudani
		Laboratory:	Nemko

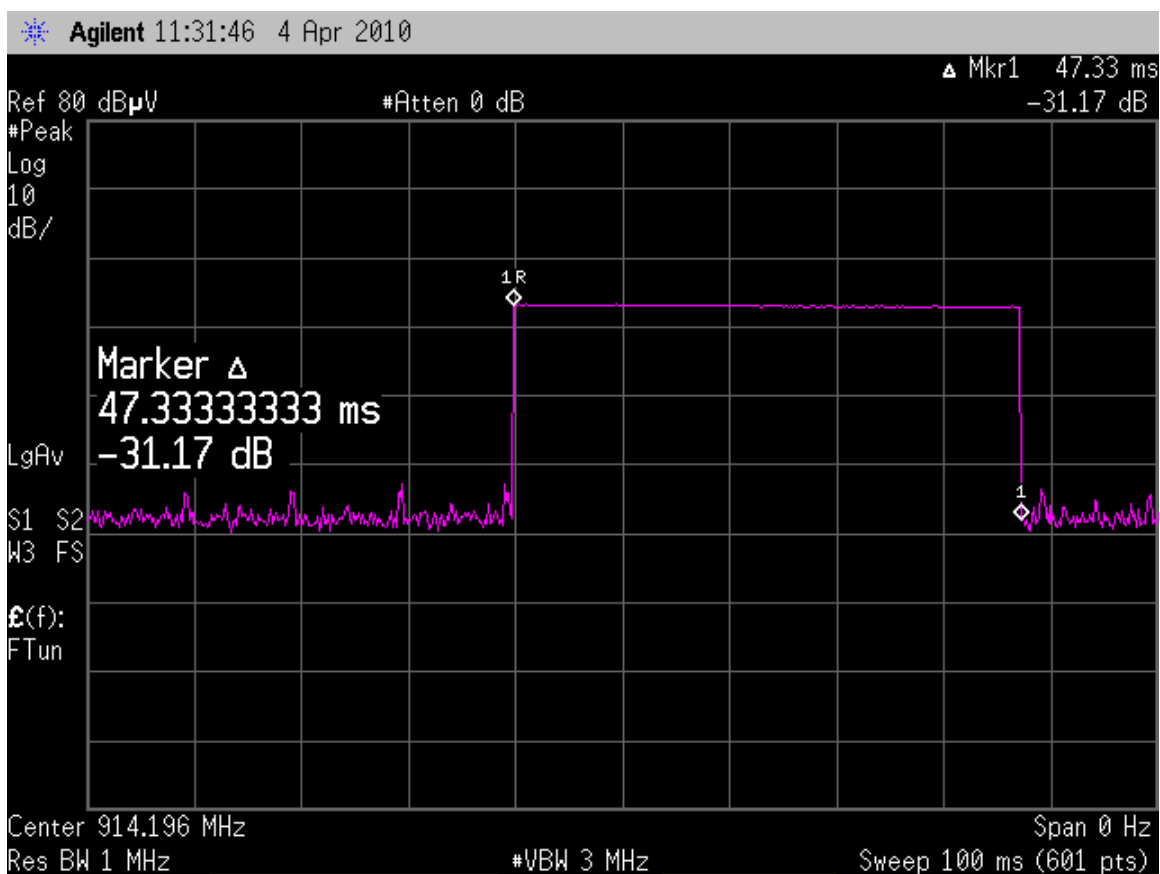
Test Results:

The EUT was placed 3m from the receiving antenna to allow a representative signal to fill the display > 30dB from the noise floor. The Spectrum Analyzer RES BW was set to 1 MHz.

Duty Cycle Factor Calculation
 Measured 47.3 ms in 100 ms

Duty cycle factor is $20 \times \text{Log}(\text{duty cycle}) = 20 \times \text{log} (.473) = -6.5$.

This channel was on 47.3 ms.



Frequency Plan

Clause 15.247(a)(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. **The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.**

Test Conditions:

Sample Number:	TST-5224	Temperature:	
Date:		Humidity:	
Modification State:	Lo/Mid/High Channels	Tester:	Alan Laudani
		Laboratory:	Nemko

Test Results:

The Frequency Plan is discussed in the Technical Description exhibit and was reviewed by this test engineer and was found to comply.

Radiated Emissions within Restricted Bands

Clause 15.209(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (uV/meter)	Measurement Distance (meter)
0.009-0.490	2400/F (kHz)	300
0.490-1.705	24000/F (kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Sec. 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a) must also comply with the radiated emission limits specified in Sec. 15.209(a) (see Sec. 15.205(c)).

Test Conditions:

Sample Number:	TST-5224	Temperature:	22°C
Date:	5-4-2010	Humidity:	35 %
Modification State:	Lo/Mid/High Channels	Tester:	A. Laudani
		Laboratory:	NEMKO NOATS

Test Results:

See Table Below.

Additional Observations:

The Spectrum was searched from 30 MHz to the 10th Harmonic.

Three orthogonal axes were tried to maximize emissions. Worst case was used in measurements presented. A new battery was installed initially and replaced every 30 minutes of test time.

There are no emissions found that apply to the restricted bands defined in FCC Part 15 Subpart C, 15.205. The EUT was measured on three orthogonal axes. Worst case measured with antenna horizontal and vertical. Spurious Measurements below 1 GHz were performed at 3m with a Quasi-Peak detector while Peak and Average detectors were used above 1GHz.

Radiated Output Power (ERP) measured with RBW > 20 dB BW.

Band Edge measured with orientation of greatest power output relative to lowest and highest channel frequency.

As the emission is pulsing, a duty cycle factor was added to spurious harmonics.

Radiated Emissions 30 MHz to 1000 MHz

No emissions found within 20 dB of the limits of Part 15, Subpart C 15.209 and 15.205. in a 1m prescan in an enclosed shielded room.

Math: Corrected Reading =

Max of Vertical or Horizontal measured + Antenna Factor + Cable Loss – preamplifier (if used). – Duty Cycle Factor

CR/SL Dif = Limit – Corrected Reading. Pass if result is negative.

Radiated Emissions: Output Power and Spurious to 10th Harmonic

An example:

Math: Corrected Reading =

Max of Vertical or Horizontal measured + Antenna Factor + Cable Loss – preamplifier (if used). +Duty Cycle Factor

CR/SL Dif = Limit – Corrected Reading. Pass if result is negative.

At 1818.8 MHz: $43.0 = 42.0 + 25.4 + 10.3 - 34.8 - 6.5$; $43.0 - 54 = -11.0$

Radiated Emissions Data

Job #: 45143-1 Date: 5-4-2010 Page 1 of 1
 NEX #: 149168 Time: 0900
 Staff: AAL

Client Name: Directed Electronics, Inc. EUT Voltage: 3VD
 EUT Name: Keyfob EUT Frequency: -
 EUT Model #: TST-5223, TST-5224 Phase: 1
 EUT Serial #: NA NOATS X
 EUT Config.: Single Channel transmitting except for SOATS
 repeat of bandedge when hopping. Distance < 1000 MHz: 3 m
 Distance > 1000 MHz: 3 m

Specification: CFR47 Part 15, Subpart B, Class B
 Loop Ant. #: NA
 Bicon Ant. #: 128 Temp. (°C): 22
 Log Ant. #: 111 3M Humidity (%): 35
 DRG Ant. #: 752 Spec Analyzer #: 911
 Cable LF#: NOATS Analyzer Display #: 911
 Cable HF#: NOATS Quasi-Peak Detector #: 911
 Preamp LF#: NA Preselector #: NA
 Preamp HF#: 919

Quasi-Peak	RBW: 120 kHz
	Video Bandwidth 300 kHz
Peak	RBW: 1 MHz
	Video Bandwidth 3 MHz
Average = 10 Video BW + DCF	
	RBW: 1 MHz
	Video Bandwidth 10 Hz

Measurements below 1 GHz are Quasi-Peak values, unless otherwise stated.
 Measurements above 1 GHz are Average values, unless otherwise stated.

Meas. Freq. (MHz)	Meter Reading Vertical	Meter Reading Horizontal	Det.	EUT Side F/L/R/B	Ant. Height m	Max. Reading (dBµV)	Corrected Reading (dBµV/m)	Spec. limit (dBµV/m)	CR/SL Diff. (dB)	Pass Fail	Comment
											500 KHz RBW
909.440	49.4	63.2	P	-	1.0	63.2	92.8	119.2	-26.4	Pass	LAYING DOWN
909.440	61.4	58.1	P	-	1.1	61.4	91.0	119.2	-28.2	Pass	ON EDGE
909.440	69.0	56.9	P	-	1.2	69.0	98.6	119.2	-20.6	Pass	STANDING UP
914.196	67.2	58.4	P	-	1.1	67.2	96.7	119.2	-22.5	Pass	STANDING UP
914.196	57.9	67.6	P	-	1.2	67.6	97.1	119.2	-22.1	Pass	ON EDGE
914.196	60.1	62.0	P	-	1.3	62.0	91.5	119.2	-27.7	Pass	LAYING DOWN
918.500	66.4	57.9	P	-	1.1	66.4	95.9	119.2	-23.3	Pass	STANDING UP
918.500	59.7	66.3	P	-	1.2	66.3	95.8	119.2	-23.4	Pass	ON EDGE
918.500	58.7	66.6	P	-	1.3	66.6	96.1	119.2	-23.1	Pass	LAYING DOWN
											120 kHz RBW
902.0	8.9	8.8	Q	-	1.1	8.9	38.5	46.0	-7.5	Pass	BAND EDGE
902.0	8.9	8.8	Q	-	1.1	8.9	38.5	46.0	-7.5	Pass	HOPPING
928.0	8.8	8.7	Q	-	1.0	8.8	38.3	46.0	-7.7	Pass	BAND EDGE
928.0	8.8	8.7	Q	-	1.0	8.8	38.3	46.0	-7.7	Pass	HOPPING
											1 MHz RBW
1818.8	54.0	52.4	P	-	1.0	54.0	55.0	74.0	-19.0	Pass	STANDING UP
1818.8	42.0	38.9	A	-	1.0	42.0	43.0	54.0	-11.0	Pass	
2728.3	54.9	44.7	P	-	1.0	54.9	59.1	74.0	-14.9	Pass	
2728.3	43.4	29.3	A	-	1.0	43.4	47.6	54.0	-6.4	Pass	
3637.8	46.9	47.6	P	-	1.0	47.6	58.9	74.0	-15.1	Pass	
3637.8	27.4	27.4	A	-	1.0	27.4	38.7	54.0	-15.3	Pass	
1828.4	54.1	52.0	P	-	1.0	54.1	55.1	74.0	-18.9	Pass	ON EDGE
1828.4	42.6	38.9	A	-	1.0	42.6	43.6	54.0	-10.4	Pass	
2742.6	53.9	49.4	P	-	1.0	53.9	58.1	74.0	-15.9	Pass	
2742.6	43.2	33.8	A	-	1.0	43.2	47.4	54.0	-6.6	Pass	
3656.8	47.3	46.6	P	-	1.0	47.3	58.6	74.0	-15.4	Pass	
3656.8	27.0	27.3	A	-	1.0	27.3	38.6	54.0	-15.4	Pass	
1837.0	59.3	53.7	P	-	1.0	59.3	60.3	74.0	-13.7	Pass	LAYING DOWN
1837.0	48.9	40.7	A	-	1.0	48.9	49.9	54.0	-4.1	Pass	
2755.5	52.5	46.5	P	-	1.0	52.5	56.7	74.0	-17.3	Pass	
2755.5	40.0	30.8	A	-	1.0	40.0	44.2	54.0	-9.8	Pass	
3674.0	44.7	43.3	P	-	1.0	44.7	56.0	74.0	-18.0	Pass	
3674.0	27.1	27.7	A	-	1.0	27.7	39.0	54.0	-15.0	Pass	

Bandedge Measurements

Test Conditions:

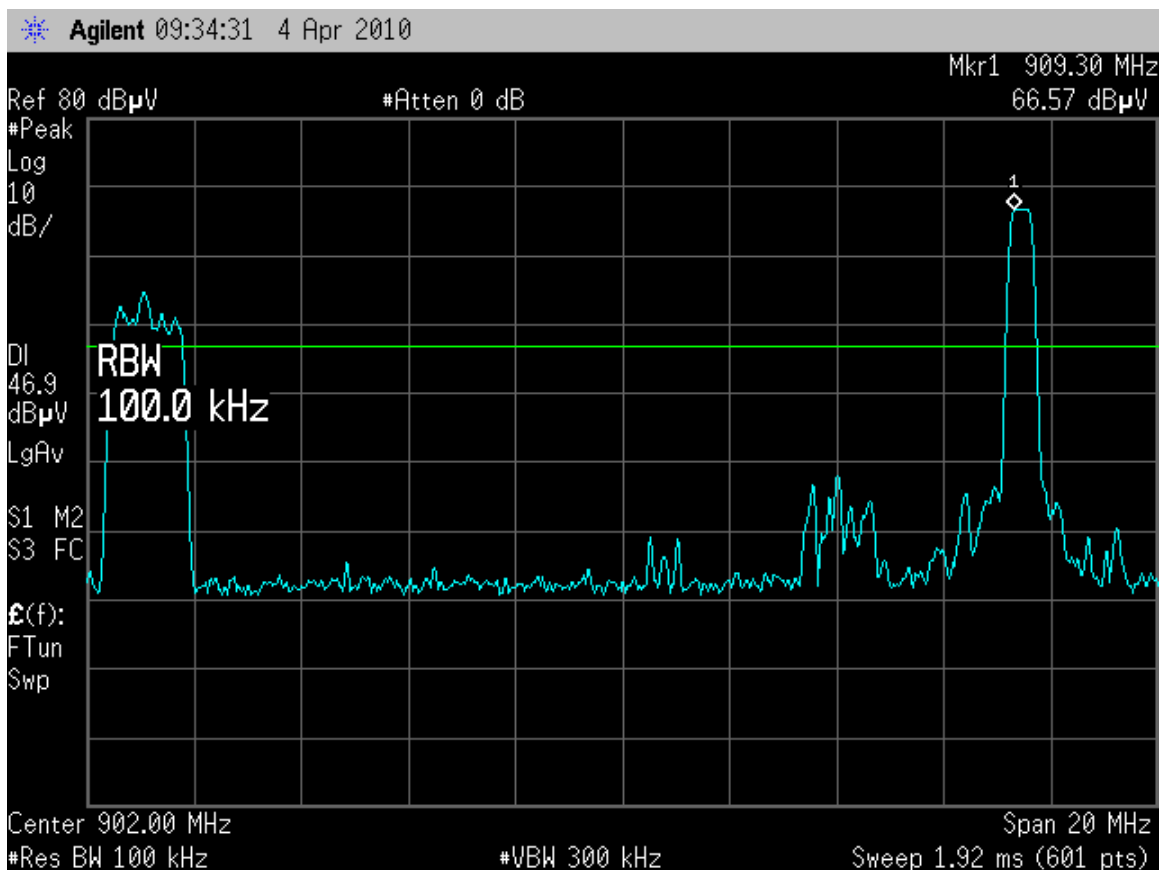
Sample Number:	TST-5224	Temperature:	84°F
Date:	4-4-2010	Humidity:	45%
Modification State:	Lo/Mid/High Channels	Tester:	Alan Laudani
		Laboratory:	Nemko

Test Results:

3m site SOATS, equipment used: 835, 110, Peak hold three sweeps and view.

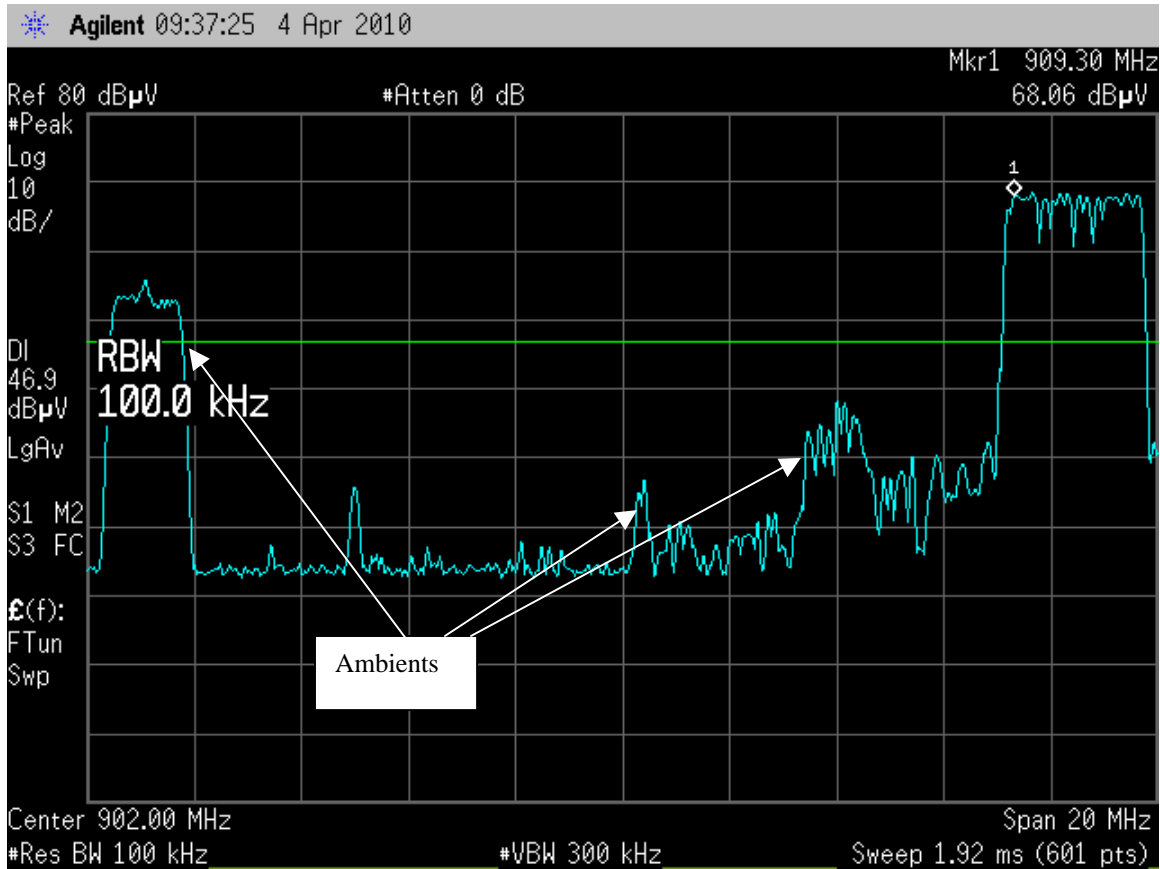
Low Channel Not Hopping Mode

Frequency Line F1 is 902 MHz
 Display Line D2 is 20 dBc



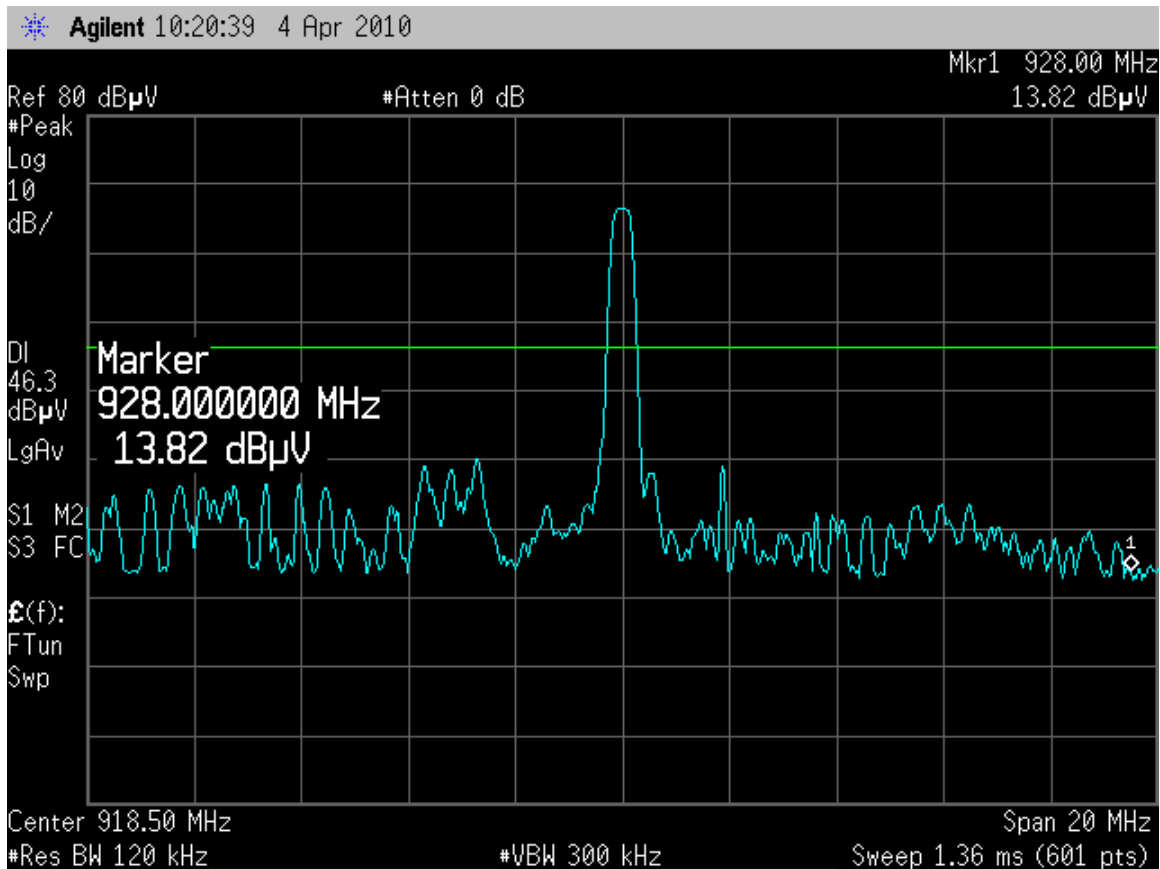
Low Channel Hopping Mode

Frequency Line F1 is 902 MHz
Display Line D2 is 20 dBc



High Channel Not Hopping Mode

Frequency Line F1 is 928 MHz
Display Line D2 is 20 dBc



High Channel Hopping Mode

Frequency Line F1 is 928 MHz
Display Line D2 is 20 dBc



Peak Output Power

Clause 15.247(b)(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, **0.25 watts for systems employing less than 50 hopping channels**, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Conditions:

Sample Number:	TST-5224	Temperature:	22°C
Date:	May 4, 2010	Humidity:	35%
Modification State:	Lo/Mid/High Channels	Tester:	Alan Laudani
		Laboratory:	Nemko NOATS

Test Results:

Limit = 0.25 W

The equivalent power of the field strength is 2.2 mW therefore the EUT complies.

This is within the uncertainty of measurement of the Granted output power of 2.1 mW

Radiated Peak Output Power:

ERP

Channel	Frequency	Corrected Field Strength dBuV/m	Calculated Output Power (W)
Low	909.546 MHz	98.6	0.0022
Mid	914.439 MHz	97.1	0.0015
High	918.780 MHz	96.1	0.0012

$10^{((\text{dBuV/m}-120)/20)} = \text{Volts/m}$

Field Strength in Volts/m = 5.5 x Square Root (Power in W)/3m

Power in Watts = (Field Strength x 3/5.5)²

98.6 dBuV/m = 0.08511 V/m

Field Strength of 0.08511 V/m = 0.00217 W.