TÜVRheinland®

Produkte
Products

Prüfbericht - Nr.: *Test Report No.:*	**14035812 001**	**Seite 1 von 17** *Page 1 of 17*
Auftraggeber: *Client:*	**AAMP of America** **13190 56th Court, Suite 401,** **33760 Clearwater, Fl, USA**	
Gegenstand der Prüfung: *Test Item:*	**Bluetooth Car Kit Gateway**	
Bezeichnung: *Identification:*	**ISFM-2202**	**Serien-Nr.:** *Serial No.:* **Engineering sample**
Wareneingangs-Nr.: *Receipt No.:*	**A000087283-001,** **A000076797-001**	**Eingangsdatum:** *Date of Receipt:* **19.07.2014,** **23.06.2014**
Prüfort: *Testing Location:*	**TÜV Rheinland Hong Kong Ltd.** 8/F, First Group Centre, 14 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong **Global United Technology Services Co., Ltd.** 2nd Floor, Block No.2, Laodong Industrial Zone, Xixiang Road Baoan District, Shenzhen, China	
Zustand des Prüfgegenstandes bei Anlieferung: *Condition of test item at delivery:*	Test samples are not damaged and suitable for testing.	
Prüfgrundlage: *Test Specification:*	**FCC Part 15 Subpart C** **ANSI C63.4-2003**	
Prüfergebnis: *Test Results:*	**Das vorstehend beschriebene Gerät wurde geprüft und entspricht oben genannter Prüfgrundlage.** The above mentioned product was tested and **passed**.	
Prüflaboratorium: *Testing Laboratory:*	**TÜV Rheinland Hong Kong Ltd.** 8 - 10/F., Goldin Financial Global Square, 7 Wang Tai Road, Kowloon Bay, Kowloon, Hong Kong	

geprüft/ *tested by:*			**kontrolliert/** *reviewed by:*		
25.08.2014	Joey Leung Project Engineer		25.08.2014	Sharon Li Section Manager	
Datum *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*	**Datum** *Date*	**Name/Stellung** *Name/Position*	**Unterschrift** *Signature*

Sonstiges:
Other Aspects **FCC ID: XBD-ISFM2202**

Abkürzungen:				*Abbreviations:*			
	P(ass)	=	*entspricht Prüfgrundlage*		*P(ass)*	=	*passed*
	F(ail)	=	*entspricht nicht Prüfgrundlage*		*F(ail)*	=	*failed*
	N/A	=	*nicht anwendbar*		*N/A*	=	*not applicable*
	N/T	=	*nicht getestet*		*N/T*	=	*not tested*

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Product information

Manufacturers declarations

	Transceiver
Operating frequency range	2402 - 2480 MHz
Type of modulation	GFSK
Number of channels	79
Channel separation	1 MHz
Type of antenna	Chip Antenna
Antenna gain (dBi)	0 dBi
Power level	fix
Type of equipment	stand alone radio device
Connection to public utility power line	No
Nominal voltage	V_{nor}: 5.0 Vdc (USB) and/ or 12 Vdc (Vehicle power)
Independent Operation Modes	Transmitting Receiving

Product function and intended use

The equipment under test (EUT) is a Bluetooth Car kit Gateway which integrates with the steering wheel control to access music, calls, texts from the mobile phone at the car. It receives the audio information from the paired Bluetooth device, modulate the audio signal into FM signal and streaming music to the vehicle's FM radio by conduction. The frequency of the conducted FM signal is from 88MHz to 107.9MHz. It can be connected to PC in which the application software assigns steering wheel control button functionality. It is powered by 5.0 Vdc (USB) and/ or 12Vdc (Vehicle power).

FCC ID: XBD-ISFM2202

Models	**Product description**
ISFM-2202	Bluetooth Car kit Gateway

Submitted documents

Circuit Diagram
Block Diagram
Bill of material
User manual
Rating Label

Independent Operation Modes

The basic operation modes are:

- Bluetooth transmit mode.

For further information refer to User Manual

Related Submittal(s) Grants

This is a single application for certification of the transmitter.
The Personal Computers peripherals function is authorized under the certification procedure (refer test report 14035815 001).

Remark

Nil

Test Set-up and Operation Mode

Principle of Configuration Selection

Emission: The equipment under test (EUT) was configured to measure its highest possible radiation level. The test modes were adapted accordingly in reference to the instructions for use.

Test Operation and Test Software

Test operation should refer to test methodology.

- There was no special software to exercise the device. The EUT was tested under test mode provided by client directly.

Special Accessories and Auxiliary Equipment

The product has been tested together with the following additional accessories:

- none

Supporting equipment:
- Car Radio (provided by the applicant)
- Car FM Antenna (provide by TUV)

Countermeasures to achieve EMC Compliance

- none

Test Methodology

Radiated Emission

The radiated emission measurements were performed according to the procedures in ANSI C63.4-2003.

The equipment under test (EUT) was placed at the middle of the 80 cm height turntable, and the turntable is 3 meters far from the measuring antenna. During the testing, the EUT was operated standalone and arranged for maximum emissions. The EUT was tested in three orthogonal planes.

The investigation is performed with the EUT rotated 360 °, the antenna height scanned between 1m and 4m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations. Repeat the measurement steps until the maximum emissions were obtained.

All radiated tests were performed at an antenna to EUT with 3 meters distance, unless stated otherwise in particular parts of this test report.

Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

FS = R + AF + CF + FA – PA

Where FS = Field Strength in dBuV/m at 3 meters.
R = Reading of Spectrum Analyzer in dBuV.
AF = Antenna Factor in dB.
CF = Cable Attenuation Factor in dB.
FA = Filter Attenuation Factor in dB.
PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

List of Test and Measurement Instruments

Hong Kong Productivity Council (Registration number: 90656)

Radiated Emission

Equipment	Manufacturer	Type	S/N	Cal. Due Date
Semi-anechoic Chamber	Frankonia	Nil	Nil	14 Apr 2015
Cable	Hubersuhner	SUCOFLEX 104	72799 /6	31 Mar 2016
Test Receiver	R & S	ESU40	100190	20 Jun 2015
Bi-conical Antenna	R & S	HK116	100241	11 Jun 2015
Log Periodic Antenna	R & S	HL223	841516/017	10 Jun 2015
Coaxial cable	Harbour	LL335	N/A	10 Jun 2016
Microwave amplifer 0.5-26.5GHz, 25dB gain	HP	83017A	3950M00241	17 Jul 2016
High Pass Filter (cutoff freq. =1000MHz)	Trilithic	23042	9829213	28 Oct 2015
Horn Antenna	EMCO	3115	9002-3347	11 Jun 2015
Active Loop Antenna	EMCO	6502	9107-2651	17 May 2015

TÜV Rheinland Hong Kong Ltd (Registration number: 250690)

Radio Test

Equipment	Manufacturer	Type	S/N	Cal Due Date
Spectrum Analyzer	R & S	FSP30	100007	03 Dec 2014

Results FCC Part 15 – Subpart C

FCC 15.203 – Antenna Requirement 1	**Pass**
FCC Requirement:	No antenna other than that furnished by the responsible party shall be used with the device
Verdict:	Pass

FCC 15.204 – Antenna Requirement 2		**Pass**
FCC Requirement:	Provide information for every antenna proposed for the use with the EUT	
Results:	a) Antenna type:	Chip Antenna
	b) Manufacturer and model no:	Walsin RFANT5220110A2T
	c) Gain with reference to an isotropic radiator:	0 dBi
Verdict:	Pass	

FCC 15.207 – Disturbance Voltage on AC Mains	**N/A**
The EUT does not have AC mains power input power, hence this test is not applicable.	

FCC 15.247 (a)(1) – Carrier Frequency Separation	**Pass**
FCC Requirement:	Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 2/3*20dB bandwidth of the hopping channel, whichever is greater.
Test Specification :	FCC Part 15 Subpart A – Subclause 15.31
Mode of operation :	Tx mode (hopping on)
Port of testing :	Temporary antenna port
Detector :	Peak
RBW/VBW :	100 kHz / 300 kHz
Supply voltage :	12VDC
Temperature :	23ºC
Humidity :	50%
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. The centre frequencies of the hopping channels are separated by more than the 2/3*20dB bandwidth. For test Results plots refer to Appendix 1, page 2.
Verdict:	Pass

FCC 15.247 (a)(1)(iii) – Number of hopping channels	Pass
FCC Requirement:	Frequency hopping systems operating in the 2400MHz-2483.5MHz bands shall use at least 15 hopping frequencies.
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (hopping on) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 12VDC Temperature : 23ºC Humidity : 50%	
Results:	The total number of hopping frequencies is more than 15. For test Results plots refer to Appendix 1, page 3.
Verdict:	Pass

FCC 15.247 (a)(1)(iii) – Time of Occupancy (Dwell Time)	Pass
FCC Requirement:	Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (hopping on), DH5 packet Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 1 MHz / 3 MHz Supply voltage : 12VDC Temperature : 23ºC Humidity : 50%	
Results:	Time period calculation = 0.4 x 79 = 31.6s Dwell time = 64 x 2.92 x 10^{-3} = 186.88 x 10^{-3} s <= 400 x 10^{-3} s For test protocols please refer to Appendix 1, page 4.
Verdict:	Pass

FCC 15.247 (a) – 20 dB Bandwidth	**Pass**

FCC Requirement: N/A

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 30 kHz / 100 kHz
Supply voltage : 12VDC
Temperature : 23ºC
Humidity : 50%

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.

For test protocols refer to Appendix 1, page 5-6.

GFSK Modulation

Frequency (MHz)	20 dB left (MHz)	20 dB right (MHz)	20dB bandwidth (MHz)
2402	0.474	0.486	0.960
2441	0.468	0.480	0.966
2480	0.474	0.480	0.954

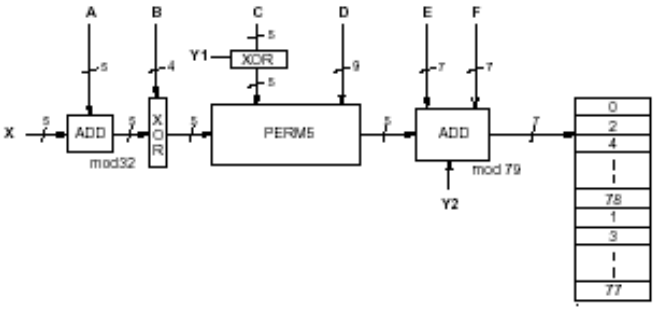
FCC 15.247 (a) – Hopping Sequence	**Pass**

FCC Requirement: The hopping sequence is generated and provided with an example.

The system radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, while the long-term distribution appears evenly distributed.

Hopping sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master. The X input determines the phase in the 32-hop segment, whereas Y1 and Y2 selects between master-to-slave and slave-to-master transmission. The inputs A to D determine the ordering within the segment, the inputs E and F determine the mapping onto the hop frequencies.



Example data:

Hop sequence {k} for CONNECTION STATE:
CLK start: 0x0000010
ULAP: 0x00000000

#ticks:	00 02	04 06	08 0a	0c 0e	10 12	14 16	18 1a	1c 1e
0x0000010:	08 66	10 70	12 19	14 23	16 01	18 05	20 33	22 37
0x0000030:	24 03	26 07	28 35	30 39	32 72	34 76	36 25	38 29
0x0000050:	40 74	42 78	44 27	46 31	48 09	50 13	52 41	54 45
0x0000070:	56 11	58 15	60 43	62 47	32 17	36 19	34 49	38 51
0x0000090:	40 21	44 23	42 53	46 55	48 33	52 35	50 65	54 67
0x00000b0:	56 37	60 39	58 69	62 71	64 25	68 27	66 57	70 59
0x00000d0:	72 29	76 31	74 61	78 63	01 41	05 43	03 73	07 75
0x00000f0:	09 45	13 47	11 77	15 00	64 49	66 53	68 02	70 06
0x0000110:	01 51	03 55	05 04	07 08	72 57	74 61	76 10	78 14
0x0000130:	09 59	11 63	13 12	15 16	17 65	19 69	21 18	23 22
0x0000150:	33 67	35 71	37 20	39 24	25 73	27 77	29 26	31 30
0x0000170:	41 75	43 00	45 28	47 32	17 02	21 04	19 34	23 36
0x0000190:	33 06	37 08	35 38	39 40	25 10	29 12	27 42	31 44
0x00001b0:	41 14	45 16	43 46	47 48	49 18	53 20	51 50	55 52
0x00001d0:	65 22	69 24	67 54	71 56	57 26	61 28	59 58	63 60
0x00001f0:	73 30	77 32	75 62	00 64	49 34	51 42	57 66	59 74
0x0000210:	53 36	55 44	61 68	63 76	65 50	67 58	73 03	75 11
0x0000230:	69 52	71 60	77 05	00 13	02 38	04 46	10 70	12 78
0x0000250:	06 40	08 48	14 72	16 01	18 54	20 62	26 07	28 15
0x0000270:	22 56	24 64	30 09	32 17	02 66	06 74	10 19	14 27
0x0000290:	04 70	08 78	12 23	16 31	18 03	22 11	26 35	30 43
0x00002b0:	20 07	24 15	28 39	32 47	34 68	38 76	42 21	46 29
0x00002d0:	36 72	40 01	44 25	48 33	50 05	54 13	58 37	62 45
0x00002f0:	52 09	56 17	60 41	64 49	34 19	36 35	50 51	52 67
0x0000310:	38 21	40 37	54 53	56 69	42 27	44 43	58 59	60 75
0x0000330:	46 29	48 45	62 61	64 77	66 23	68 39	03 55	05 71
0x0000350:	70 25	72 41	07 57	09 73	74 31	76 47	11 63	13 00
0x0000370:	78 33	01 49	15 65	17 02	66 51	70 67	03 04	07 20
0x0000390:	68 55	72 71	05 08	09 24	74 59	78 75	11 12	15 28
0x00003b0:	76 63	01 00	13 16	17 32	19 53	23 69	35 06	39 22
0x00003d0:	21 57	25 73	37 10	41 26	27 61	31 77	43 14	47 30
0x00003f0:	29 65	33 02	45 18	49 34	19 04	21 08	23 20	25 24

FCC 15.247 (a) – Equal Hopping Frequency Use	**Pass**
FCC Requirement: Each of the transmitter's hopping channels is used equally on average. The system radio frequency (RF) bandwidth is equal to the channel bandwidth multiplied by the number of channels in the hopset. The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, while the long-term distribution appears evenly distributed.	
Equal hopping frequency use The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.	

FCC 15.247 (a) – Receiver Input Bandwidth	**Pass**
FCC Requirement: The associated receiver(s) complies with the requirement that its input bandwidth matches the bandwidth of the transmitted signal.	

Receiver input bandwidth The receiver bandwidth is equal to the receiver bandwidth in the 79 hopping channel mode, which is 1 MHz. The receiver bandwidth was verified during Bluetooth RF conformance testing.

FCC 15.247 (a) – Receiver Hopping Capability	**Pass**
FCC Requirement: The associated receiver has the ability to shift frequencies in synchronisation with the transmitted signals.	
Receiver hopping Capability The EUT complies with the Bluetooth RF specifications. For details refer to the Bluetooth standard.	

FCC 15.247 (b)(1) – Peak Output Power	**Pass**

Test Specification : FCC Part 15 Subpart A – Subclause 15.31 / RSS-Gen
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 3 MHz / 10 MHz
Supply voltage : 12VDC
Temperature : 23ºC
Humidity : 50%

FCC Requirement at the : For frequency hopping systems operating in the 2400-2483.5 MHz band employing least 75 non-overlapping hopping channels, and all frequency hopping systems in 5725-5850 MHz band: 1 Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watts.

Results: For test protocols please refer to Appendix 1, page 7-8. For RF exposure information please refer to Appendix 6.

GFSK Modulation

Frequency (MHz)	Maximum peak output power (dBm)	Cable attenuation (dB)	Output power (dBm)	Limit (W/dBm)	Verdict
2402	9.08	0.00	9.08	0.125 / 21.0	Pass
2441	9.21	0.00	9.21	0.125 / 21.0	Pass
2480	9.18	0.00	9.18	0.125 / 21.0	Pass

FCC 15.247 (d) – Band edge compliance of conducted emissions	**Pass**

Test Specification : FCC Part 15 Subpart A – Subclause 15.31
Mode of operation : Tx mode (2402MHz, 2480MHz)
Port of testing : Temporary antenna port
Detector : Peak
RBW/VBW : 100 kHz / 300 kHz
Supply voltage : 12VDC
Temperature : 23ºC
Humidity : 50%

FCC Requirement: 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.

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.

There is no peak found outside any 100 kHz bandwidth of the operating frequency band. For test protocols refer to Appendix 1, page 9-10.

FCC 15.205 (a) – Restricted Bands next to Band-edge	**Pass**
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (2402MHz, 2480MHz) Port of testing : Enclosure Detector : a) Peak, b) Average RBW/VBW : a) 1 MHz / 3 MHz (Peak), b) 1MHz / 10Hz (Average) Supply voltage : 12VDC Temperature : 23ºC Humidity : 50%	
FCC Requirement:	Radiated emissions which fall in the restricted bans, as defined in 15.205 (a), must also comply with the radiated emission limits specified in 15.209(a).
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. There is no peak found in the restricted bands. For test protocols refer to Appendix 1, page 11-16.

FCC 15.247 (d) – Spurious Conducted Emissions	**Pass**
Test Specification : FCC Part 15 Subpart A – Subclause 15.31 Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz) Port of testing : Temporary antenna port Detector : Peak RBW/VBW : 100 kHz / 300 kHz Supply voltage : 12VDC Temperature : 23 ºC Humidity : 50 %	
FCC Requirement:	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.
Results:	Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types. There is no peak found outside any 100kHz bandwidth of the operating frequency band in the three transmit frequency. All three transmit frequency modes comply with the limit stated in subclause 15.247(d). For test protocols refer to Appendix 1, page 17-18.

Operating frequency (MHz)	Spurious frequency (MHz)	Spurious Level (dBm)	Reference value (dBm)	Delta (dB)	Verdict
2402	4800	-34.13	4.18	38.31	Pass
2441	4850	-31.06	7.46	38.52	Pass
2480	4950	-30.74	7.60	38.34	Pass

FCC 15.247 (c) – Spurious Radiated Emissions **Pass**

Test Specification : ANSI C63.4 – 2003
Mode of operation : Tx mode (2402MHz, 2441MHz, 2480MHz)
Port of testing : Enclosure
Detector : Peak
RBW/VBW : 100 kHz / 300 kHz for f < 1 GHz
1 MHz / 3 MHz for f > 1 GHz
Supply voltage : 12VDC
Temperature : 23ºC
Humidity : 50%

*Average reading using duty cycle correction factor on peak measurement:

Devices transmitting pulsed emissions and subject to a limit requiring an average detector function for radiated emissions shall initially be measured with an instrument that uses a peak detector. A radiated emission measured with a peak detector may then be corrected to a true average using the appropriate factor for emission duty cycle. This correction factor relates the measured peak level to the average limit and is derived by averaging absolute field strength over one complete pulse train that is 0.1 s, or less, in length.

Duty cycle correction factor calculation:

Total on time in 100ms = 2.92 ms

Number of pulse found in 100ms = 1

Duty cycle factor = 20 x log ((on time in 100ms x no. of pulse) / 100ms)
= -30.7 dB

FCC Requirement: In any 100kHz bandwidth outside the frequency band at least 20dB below the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands, as defined in section15.205(a), must also comply with the radiated emission limits specified in section 15.205(c).

Results: Pre-scan has been conducted to determine the worst-case mode from all possible combinations between available modulations and packet types.

All three transmit frequency modes comply with the field strength within the restricted bands. There is no spurious found below 30MHz.

Tx frequency 2402MHz Vertical Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
4804.263	57.70	74.0 / PK
4804.263	27.00*	54.0 / AV
7206.506	66.51	74.0 / PK
7206.506	35.81*	54.0 / AV

Tx frequency 2402MHz Horizontal Polarization

Freq MHz	Level dBuV/m	Limit/ Detector dBuV/m
7206.599	62.86	74.0 / PK
7206.599	32.16*	54.0 / AV
12010.936	63.95	74.0 / PK
12010.936	33.25*	54.0 / AV

Tx frequency 2441MHz	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4881.952	59.61	74.0 / PK
4881.952	28.91*	54.0 / AV
7322.968	61.54	74.0 / PK
7322.968	30.84*	54.0 / AV
Tx frequency 2441MHz	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4881.987	60.69	74.0 / PK
4881.987	29.99*	54.0 / AV
7323.115	65.28	74.0 / PK
7323.115	34.58*	54.0 / AV
12204.737	63.77	74.0 / PK
12204.737	33.07*	54.0 / AV
Tx frequency 2480MHz	Vertical Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4960.256	67.37	74.0 / PK
4960.256	36.67*	54.0 / AV
Tx frequency 2480MHz	Horizontal Polarization	
Freq MHz	**Level dBuV/m**	**Limit/ Detector dBuV/m**
4960.320	64.78	74.0 / PK
4960.320	34.08*	54.0 / AV
7440.048	63.66	74.0 / PK
7440.048	32.96*	54.0 / AV

* Duty cycle correction factor applied