RF TEST REPORT

FCC Part 90

Applicant	iSmartWays Technology Inc.
FCC ID	2AQQ3IM2RSE
Product	Road Side Equipment
Brand	Mokar
Model	I-Master
Report No.	R1808A0352-R5V1
Issue Date	October 9, 2018

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **FCC CFR47 Part 2 (2018)/ FCC CFR 47 Part 90 (2018)/ ASTM E2213-03**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Peng Tao	Kai Xu
Performed by: Peng Tao	*Approved by: Kai Xu*

TA Technology (Shanghai) Co., Ltd.

No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China

TEL: +86-021-50791141/2/3

FAX: +86-021-50791141/2/3-8000

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Summary of measurement results

No.	Test Type	Clause in FCC rules	Verdict
1	RF Power Output	ASTM E2213-03 §8.9.1 FCC §90.377	PASS
2	Transmit Spectrum Mask	ASTM E2213-03 §8.9.1 FCC §90.379	PASS
3	Emission Bandwidth	FCC §2.1049, §90.209	PASS
4	Frequency Tolerance	ASTM E2213-03 §8.9.5 FCC §2.1055	PASS
5	Conducted Spurious Emission	ASTM E2213-03 §8.9.2 FCC §2.1051	PASS
6	Field Strength of Spurious Emission	ASTM E2213-03 §8.9.2 FCC §2.1053	PASS
Date of Testing: July 18, 2018 ~ August 15, 2018			
Note: PASS: The EUT complies with the essential requirements in the standard. FAIL: The EUT does not comply with the essential requirements in the standard.			

1. Test Laboratory

1.1. Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

1.2. Test facility

CNAS (accreditation number:L2264)

TA Technology (Shanghai) Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (Designation number: CN1179, Test Firm Registration Number: 446626)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

IC (recognition number is 8510A)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement.

VCCI (recognition number is C-4595, T-2154, R-4113, G-10766)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Japan to perform electromagnetic emission measurement.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3. Testing Location

Company:	TA Technology (Shanghai) Co., Ltd.
Address:	No.145, Jintang Rd, Tangzhen Industry Park, Pudong
City:	Shanghai
Post code:	201201
Country:	P. R. China
Contact:	Xu Kai
Telephone:	+86-021-50791141/2/3
Fax:	+86-021-50791141/2/3-8000
Website:	http://www.ta-shanghai.com
E-mail:	xukai@ta-shanghai.com

2. General Description of Equipment under Test

Client Information

Applicant	iSmartWays Technology Inc.
Applicant address	1-500, 10230 Jasper Ave, Edmonton
Manufacturer	iSmartWays Technology Inc.
Manufacturer address	B101, Building B1, Chuanggu, 18 Shenlong Ave, Wuhan Economic Development Zone, Wuhan, Hubei, China

General Information

EUT Description			
Model	I-Master		
IMEI	861107033430761		
Hardware Version	V1.0		
Software Version	V3.8		
Power Supply	External Power Supply		
Antenna Type	External Antenna		
Test Mode(s)	DSRC		
Maximum E.R.P.	26.26dBm		
Rated Power Supply Voltage	48V		
Extreme Voltage	Minimum: 44V Maximum: 57V		
Extreme Temperature	Lowest: -30°C Highest: +75°C		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	DSRC	5860~5920	5860~5920
EUT Accessory			
GPS+Bdexternal antenna	Manufacturer: Wuhan WeiAnTong Model: 1575.42/1561MHz		
DSRC Omnidirectional antenna	Manufacturer: Tianmin Communication Model: TMQ5850-05V50G		
LTE Omnidirectional antenna	Manufacturer: Tianmin Communication Model: TMQ6927-02.5V70A		
WIFI Omnidirectional antenna	Manufacturer: Tianmin Communication Model: TMQ8027-02V70A		
Waterproof Ethernet Connector	Manufacturer: LINKO Model: YT-RJ45-CPE-10-001		
Mounting Bracket	Manufacturer: Easylinkin Model: RSE-V4-JG-AZ-01		
Screw	Manufacturer: / Model: M6*20		
Mounting Hoop	Manufacturer: XingWangWuJin Model: HG-12*1000		
Note: The information of the EUT is declared by the manufacturer.			

3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC CFR47 Part 2 (2018)

FCC CFR 47 Part 90 (2018)

ASTM E2213-03

ANSI/TIA-603-E (2016)

4. Test Configuration

Radiated measurements are performed by rotating the EUT in three different orthogonal test planes. EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical), the worst emission was found in position (X axis, horizontal polarization) and the worst case was recorded.

All mode and data rates and positions were investigated.
The following testing is set based on the maximum RF Output Power.

Worst-case data rates are shown as following table.

Band	Data Rate	Channel
RF Power Output	3 Mbps	CH172/ CH178/ CH180/ CH182/ CH184
	27 Mbps	CH172/ CH178/ CH180/ CH182/ CH184
Transmit Spectrum Mask	3 Mbps	CH172/ CH178/ CH184
Emission Bandwidth	3 Mbps	CH172/ CH178/ CH184
Frequency Tolerance	3 Mbps	CH172/ CH178/ CH184
Conducted Spurious Emission	3 Mbps	CH172/ CH178/ CH184
Field Strength of Spurious Emission	3 Mbps	CH172/ CH178/ CH184

5. Test Case Results

5.1. RF Output Power

Ambient condition

Temperature	Relative humidity	Pressure
22 ~26°C	42~46%	101-102 kPa

Methods of Measurement

Public Safety and Private RSU installations operating in Channels 172, 174, 175, and 176 are used to implement small and medium range operations. RSU installation transmissions in Channels 172,174, and 176 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP. RSU installation transmissions in Channel 175 shall not exceed 10 dBm antenna input power and 23 dBm EIRP. Public Safety RSU installation transmissions in Channel 178 shall not exceed 28.8 dBm antenna input power and 44.8 dBm EIRP. Private RSU installation transmissions in Channel 178 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP.

The DSRC Channels 180, 181, and 182 are used to implement small zone operations. Public Safety and Private RSU installation in these channels shall not exceed 10 dBm antenna input power and 23 dBm EIRP. These installations shall also use an antenna with a minimum 6 dBi gain. Public Safety RSU and OBU operations in Channel 184 shall not exceed 28.8 dBm antenna input power and 40 dBm EIRP. Private RSU operations in Channel 184 shall not exceed 28.8 dBm antenna input power and 33 dBm EIRP.

Test Results

Data Rate	CH	Frequency (MHz)	Power (dBm)		Total Power (dBm)	Conducted Power Limit (dBm)	EIRP (dBm)	EIRP Limit (dBm)	TP Set
			RF1	RF2					
3Mbps	CH172	5860	18.37	16.82	20.67	28.8	25.67	33	40
	CH178	5890	18.88	17.52	21.26	28.8	26.26	44.8	40
	CH180	5900	7.33	5.74	9.62	10	14.62	23	18
	CH182	5910	7.02	5.43	9.31	10	14.31	23	18
	CH184	5920	18.47	16.93	20.78	28.8	25.78	40	40
27Mbps	CH172	5860	18.45	16.77	20.70	28.8	25.70	33	40
	CH178	5890	18.86	17.5	21.24	28.8	26.24	44.8	40
	CH180	5900	7.53	5.98	9.83	10	14.83	23	18
	CH182	5910	7.78	5.87	9.94	10	14.94	23	18
	CH184	5920	18.56	16.85	20.80	28.8	25.80	40	40

5.2. Transmit Spectrum Mask

Ambient condition

Temperature	Relative humidity	Pressure
22 ~26°C	42~46%	101-102 kPa

Methods of Measurement

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by 55 + 10log(P) dB, where P is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

Limit

TABLE 9 DSRC Device Classes and Transmit Power Levels[A]

Device Class	Maximum Device Output Power, dBm
A	0
B	10
C	20
D	28.8 or more

[A] From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

TABLE 10 DSRC Spectrum Mask[A]

NOTE—Reduction in Power Spectral Density, dBr.

Class	± 4.5-MHz Offset	± 5.0-MHz Offset	± 5.5-MHz Offset	± 10-MHz Offset	± 15-MHz Offset
Class A	0	-10	-20	-28	-40
Class B	0	-16	-20	-28	-40
Class C	0	-26	-32	-40	-50
Class D	0	-35	-45	-55	-65

[A] From IEEE 802.11a. Copyright 1999 IEEE. All rights reserved.

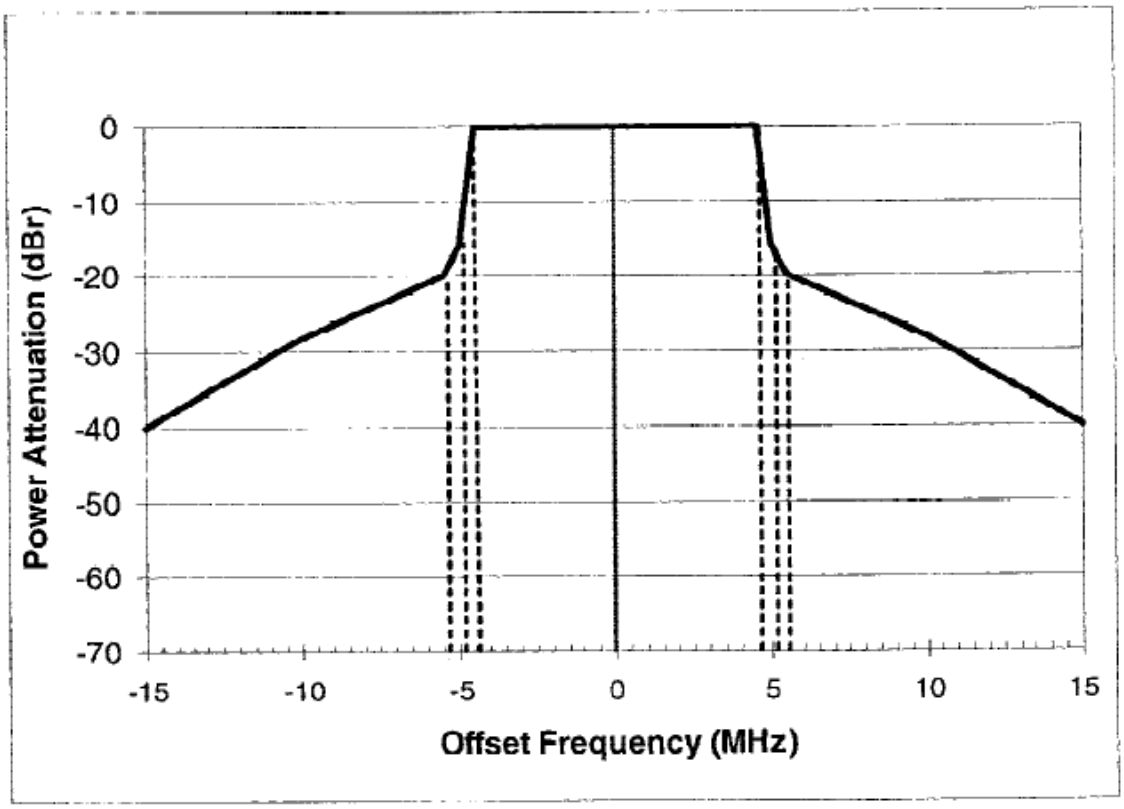
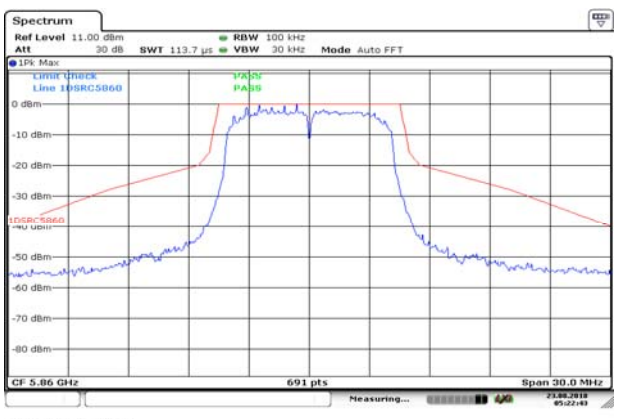


FIG. 13 Class B Transmit Spectrum Mask

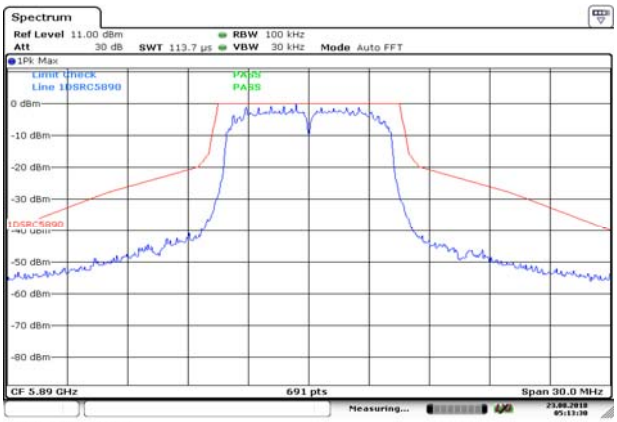
Test Results:

Low Channel, 5860 MHz, RF1

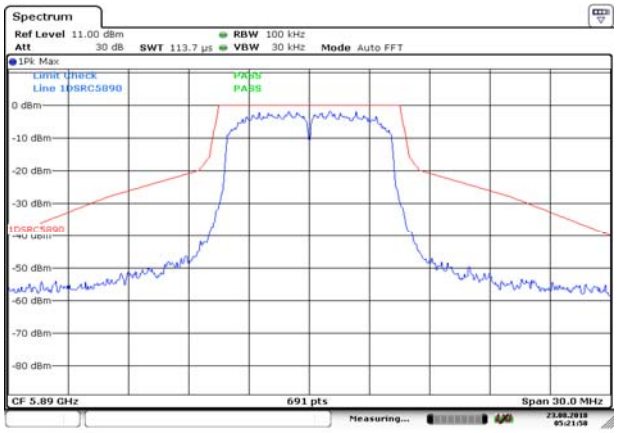
Low Channel, 5860 MHz, RF2



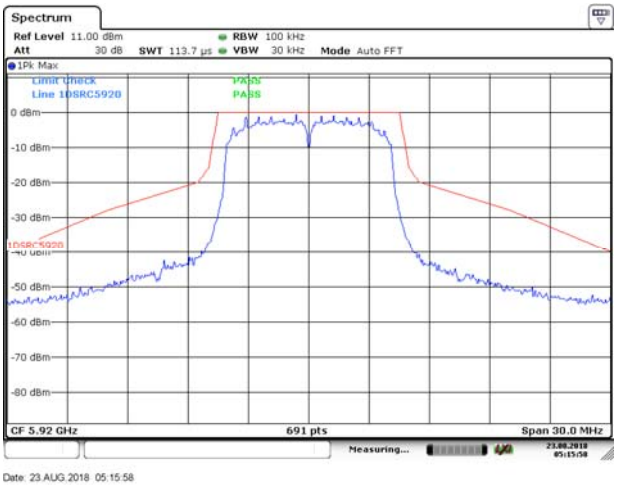
Middle Channel, 5890 MHz, RF1



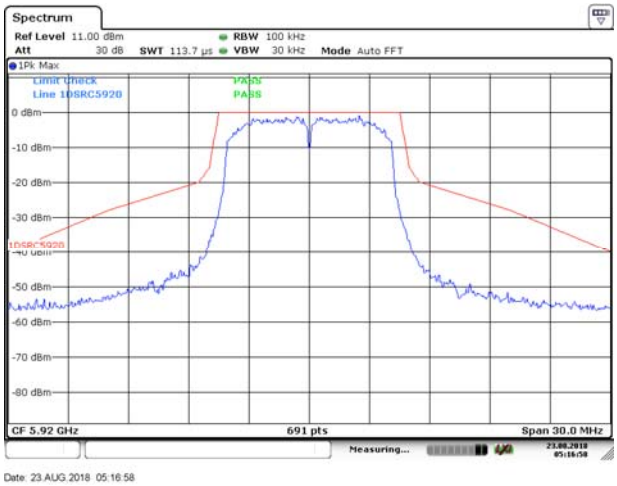
Middle Channel, 5890 MHz, RF2



High Channel, 5920 MHz, RF1



High Channel, 5920 MHz, RF2



5.3. Emission Bandwidth

Ambient condition

Temperature	Relative humidity	Pressure
22 ~26°C	42~46%	101-102 kPa

Method of Measurement

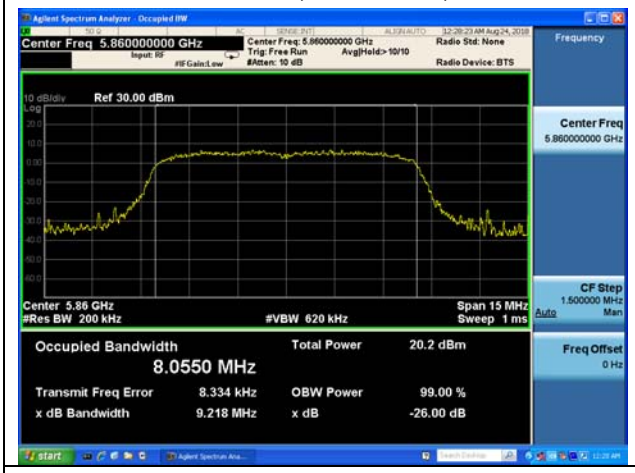
The transmitter shall be operated at its maximum carrier power measured under normal test conditions. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used given that a peak or peak hold my produce a wider bandwidth than actual.

The trace data points are recovered and directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between two recorded frequencies is the occupied bandwidth.

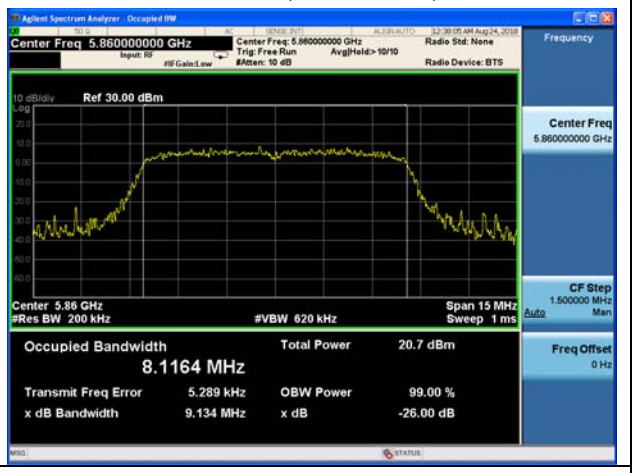
Test Result

Channel	Frequency (MHz)	99%OBW (MHz)	
		RF1	RF2
Low	5860	8.0550	8.1164
Middle	5890	8.0557	8.1211
High	5920	8.0445	8.1018

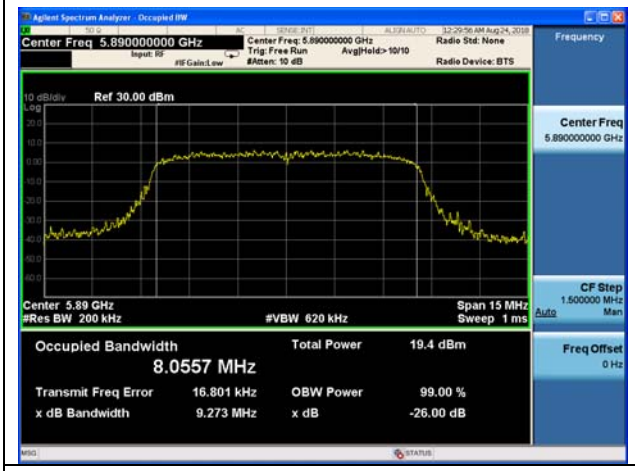
Low Channel, 5860 MHz, RF1



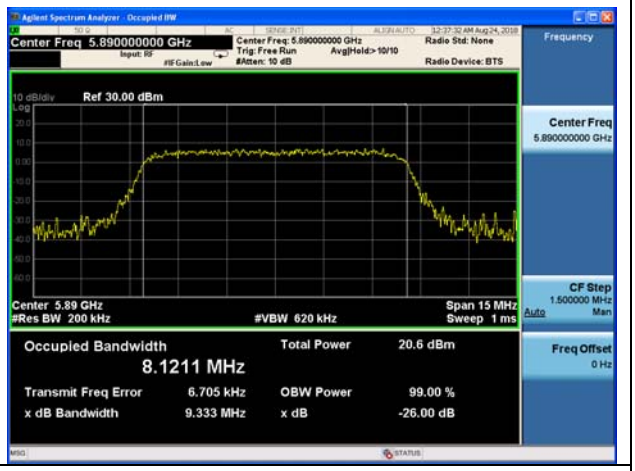
Low Channel, 5860 MHz, RF2



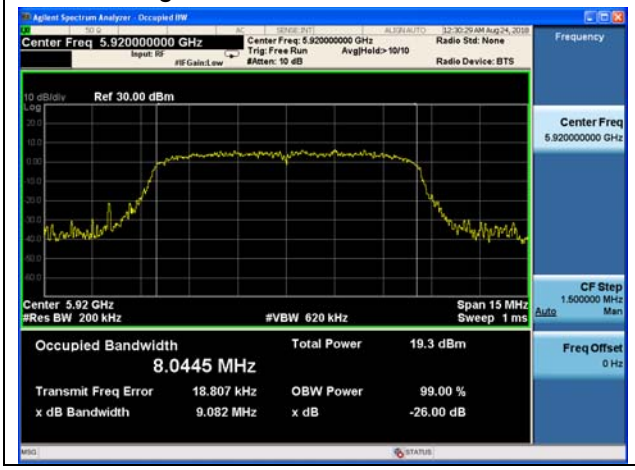
Middle Channel, 5890 MHz, RF1



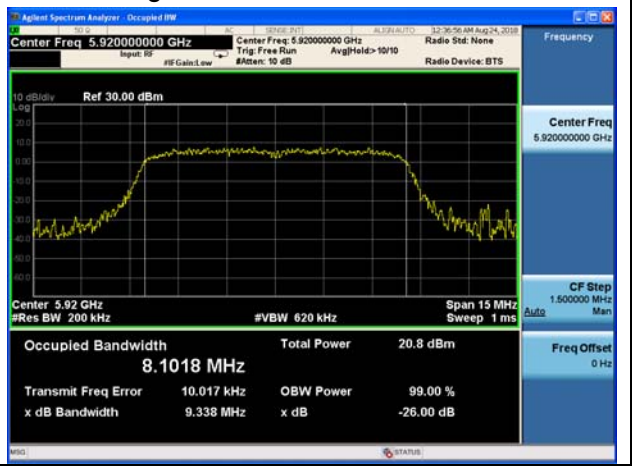
Middle Channel, 5890 MHz, RF2



High Channel, 5920 MHz, RF1



High Channel, 5920 MHz, RF2



5.4. Frequency Tolerance

Ambient condition

Temperature	Relative humidity	Pressure
22 ~26°C	42~46%	101-102 kPa

Measurement Procedure

According to ANSI/TIA-D 2010 section 2.2.2, the carrier frequency stability is the ability of the transmitter to maintain an assigned carrier frequency.

The measurement method is as following:

- Operate the equipment in standby conditions for 15 minutes before proceeding.

- Record the carrier frequency of the transmitter as MCF MHz.

- Calculate the ppm frequency error by the following:

Ppm error = ((MCF/ACF) - 1) * 10^6

Where

MCF is the Measured Carrier Frequency in MHz

ACF is the Assigned Carrier Frequency in MHz

- The value recorded above is the carrier frequency stability

Test Result:

Test is based on RF1, which is the worst case.

Low Channel, 5860 MHz				
Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Result (ppm)	Limit (ppm)
48	-30	5860.000369	-0.063024	±10
48	-20	5860.004981	-0.849955	±10
48	-10	5859.995644	0.743394	±10
48	0	5859.995405	0.784133	±10
48	10	5859.991247	1.493635	±10
40.8	20	5859.981961	3.078419	±10
48	20	5859.980243	3.371430	±10
55.2	20	5859.977779	3.791926	±10
48	30	5859.977758	3.795570	±10
48	40	5859.977758	3.795570	±10
48	50	5859.974459	4.358622	±10

Middle Channel, 5890 MHz				
Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Result (ppm)	Limit (ppm)
48	-30	5890.000983	-0.166817	±10
48	-20	5890.010255	-1.741063	±10
48	-10	5890.005684	-0.964972	±10
48	0	5890.005366	-0.911041	±10
48	10	5889.995964	0.685164	±10
40.8	20	5889.991864	1.381244	±10
48	20	5889.986394	2.309959	±10
55.2	20	5889.979891	3.414060	±10
48	30	5889.978964	3.571498	±10
48	40	5889.978964	3.571498	±10
48	50	5889.975258	4.200652	±10

High Channel, 5920 MHz				
Temperature (°C)	Voltage (Vdc)	Frequency (MHz)	Result (ppm)	Limit (ppm)
48	-30	5920.005250	-0.886855	±10
48	-20	5920.012598	-2.127967	±10
48	-10	5920.009342	-1.577972	±10
48	0	5920.005757	-0.972540	±10
48	10	5920.003718	-0.628067	±10
40.8	20	5920.001480	-0.249967	±10
48	20	5919.995198	0.811226	±10
55.2	20	5919.986133	2.342454	±10
48	30	5919.980701	3.260032	±10
48	40	5919.980701	3.260032	±10
48	50	5919.979799	3.412361	±10

5.5. Conducted Spurious Emission

Ambient condition

Temperature	Relative humidity	Pressure
22 ~26°C	42~46%	101-102 kPa

Measurement Procedure

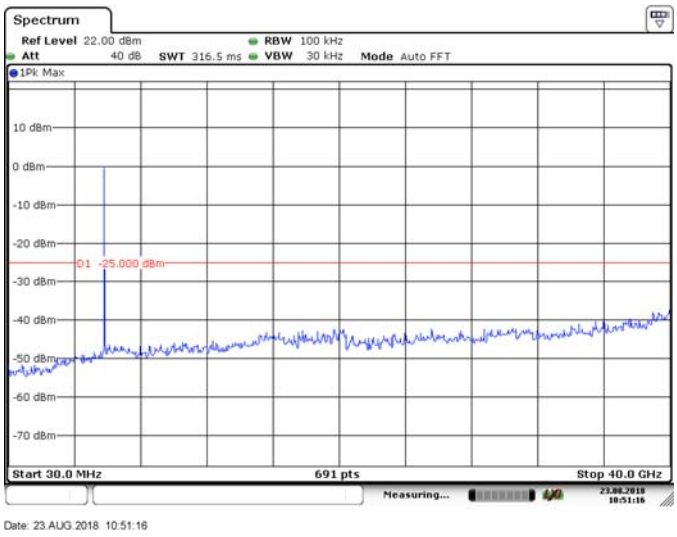
The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by55 + 10log(*P*) dB, where *P* is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth.

Limit

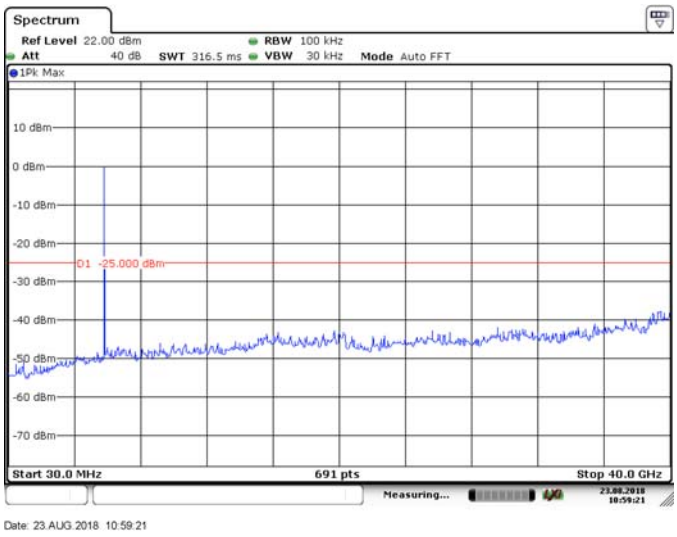
According to ASTM EN2213-03 § 8.9.2:
8.9.2.2 The transmitted spectral mask for class A, B, C, and D devices are shown in Figs. 12-15. In addition, all DSRC site installations shall limit the EIRP in the transmitted spectrum to −25 dBm or less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna/transmitter combinations.

Test Results

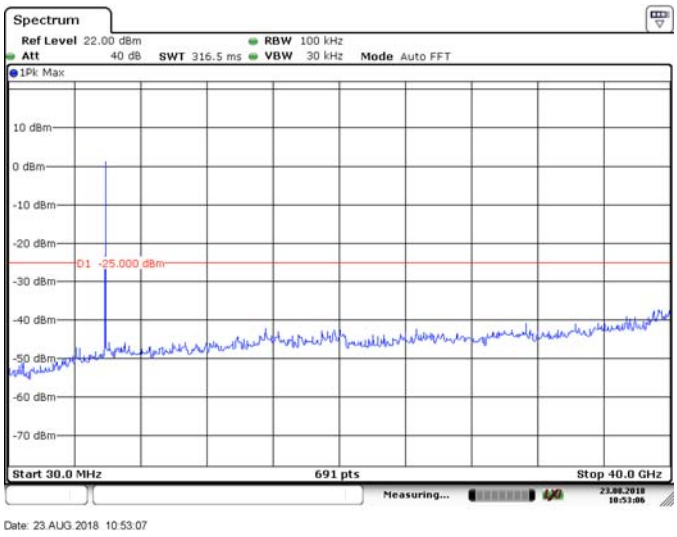
5860 MHz RF1 30MHz – 40GHz



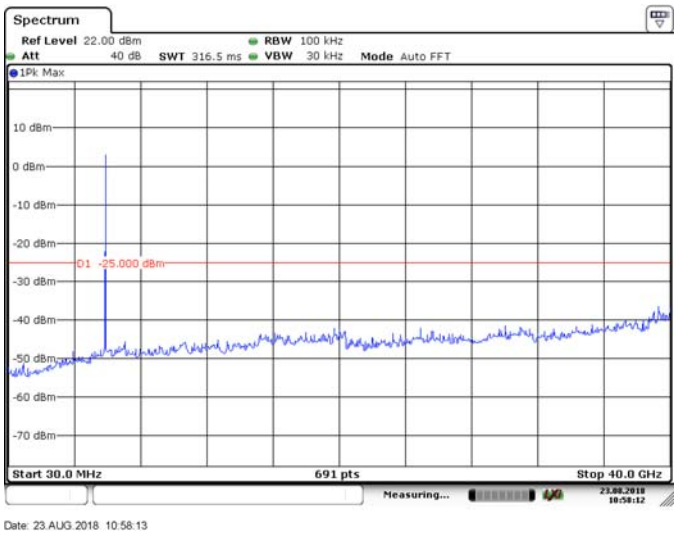
5860 MHz RF2 30MHz – 40GHz



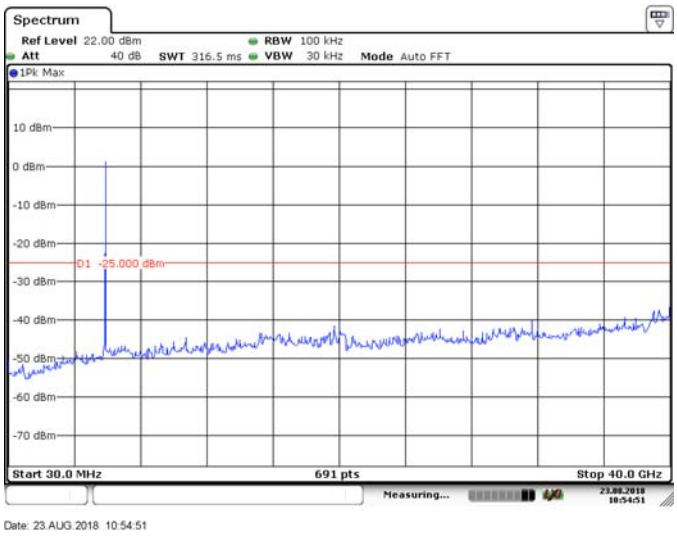
5890 MHz RF1 30MHz – 40GHz



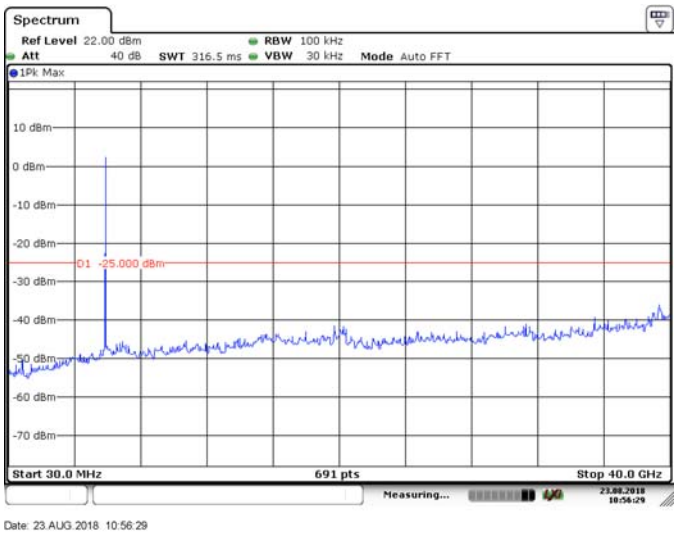
5890 MHz RF2 30MHz – 40GHz



5920 MHz RF1 30MHz – 40GHz



5920 MHz RF2 30MHz – 40GHz



5.8. Field Strength of Spurious Emission

Ambient condition

Temperature	Relative humidity	Pressure
22 ~26°C	42~46%	101-102 kPa

Measurement Procedure

The DSRC transmitted spectrum mask is relative to the device class of operation. The power in the transmitted spectrum for all DSRC devices shall be −25 dBm or less within 100 kHz outside all channel and band edges. This will be accomplished by attenuating the transmitted signal 100 kHz outside the channel and band edges by55 + 10log(P) dB, where P is the total transmitted power in watts. The transmitted spectral density of the transmitted signal for all devices shall fall within the spectral mask, as detailed in Table 10.5 The measurements shall be made using a 100 kHz resolution bandwidth and a 30 kHz video bandwidth test 10^{th} harmonic, but not excess 40GHz

Limit

According to ASTM EN2213-03 8.9.2:

8.9.2.2 The transmitted spectral mask for class A, B, C, and D devices are shown in Figs. 12-15. In addition, all DSRC site installations shall limit the EIRP in the transmitted spectrum to −25 dBm or less in the 100 kHz at the channel edges and the band edges. Additional filtering that supplements the filtering provided by the transmitter may be needed for some antenna/transmitter combinations.

Test Result

Test is based on RF1, which is the worst case.

DSRC CH172 Rate 3Mbps

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	11720.0	-63.05	2.00	10.15	Horizontal	-54.9	-25.0	29.9	45
3	17580.0	-61.85	2.50	11.35	Horizontal	-53.0	-25.0	28.0	135
4	23440.0	-	-	-	-	-	-	-	-
5	29300.0	-	-	-	-	-	-	-	-
6	35160.0	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

DSRC CH178 Rate 3Mbps

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	11780.0	-63.75	2.00	10.75	Horizontal	-55.0	-25.0	30.0	90
3	17670.0	-61.74	2.51	11.05	Horizontal	-53.2	-25.0	28.2	0
4	23560.0	-	-	-	-	-	-	-	-
5	29450.0	-	-	-	-	-	-	-	-
6	35340.0	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

DSRC CH184 Rate 3Mbps

Harmonic	Frequency (MHz)	SG (dBm)	Cable Loss (dB)	Gain (dBi)	Antenna Polarization	ERP Level (dBm)	Limit (dBm)	Margin (dB)	Azimuth (deg)
2	11840.0	-63.35	2.00	10.15	Horizontal	-55.2	-25.0	30.2	315
3	17760.0	-61.04	2.51	11.05	Horizontal	-52.5	-25.0	27.5	90
4	23680.0	-	-	-	-	-	-	-	-
5	29600.0	-	-	-	-	-	-	-	-
6	35520.0	-	-	-	-	-	-	-	-
Note: 1.The other Spurious RF Radiated emissions level is no more than noise floor. 2. The worst emission was found in the antenna is Horizontal position.									

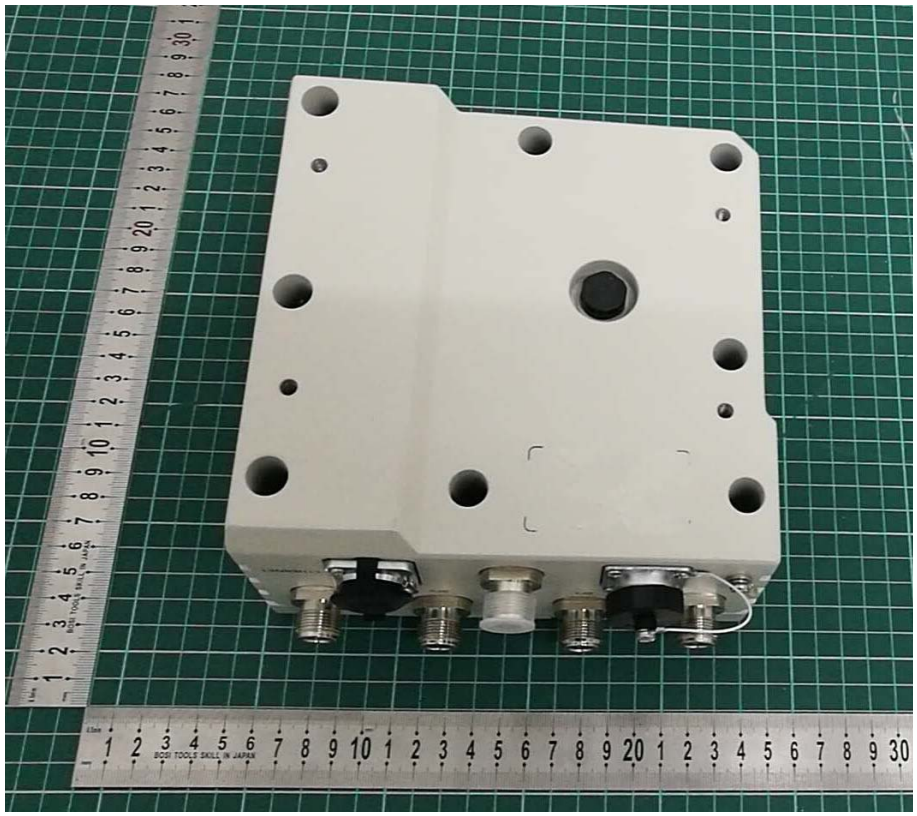
6. Main Test Instruments

Name	Manufacturer	Type	Serial Number	Calibration Date	Expiration Date
Base Station Simulator	R&S	CMW500	113645	2018-05-14	2019-05-13
Power Splitter	Hua Xiang	SHX-GF2-2-13	10120101	NA	NA
Spectrum Analyzer	Agilent	N9010A	MY47191109	2018-05-20	2019-05-19
Universal Radio Communication Tester	Agilent	E5515C	MY48367192	2018-05-20	2019-05-19
Spectrum Analyzer	R&S	FSV40	15195-01-00	2018-05-20	2019-05-19
Signal Analyzer	R&S	FSV30	100815	2017-12-17	2018-12-16
EMI Test Receiver	R&S	ESCI	100948	2018-05-20	2019-05-19
Trilog Antenna	SCHWARZBECK	VUBL 9163	9163-201	2017-11-18	2020-11-17
Horn Antenna	R&S	HF907	100126	2014-12-06	2019-12-05
Signal generator	R&S	SMB 100A	102594	2018-05-14	2019-05-13
Climatic Chamber	Re Ce	PT-30B	20101891	2018-07-18	2020-07-17
RF Cable	Agilent	SMA 15cm	0001	2017-08-04	2019-02-03

*******END OF REPORT *******

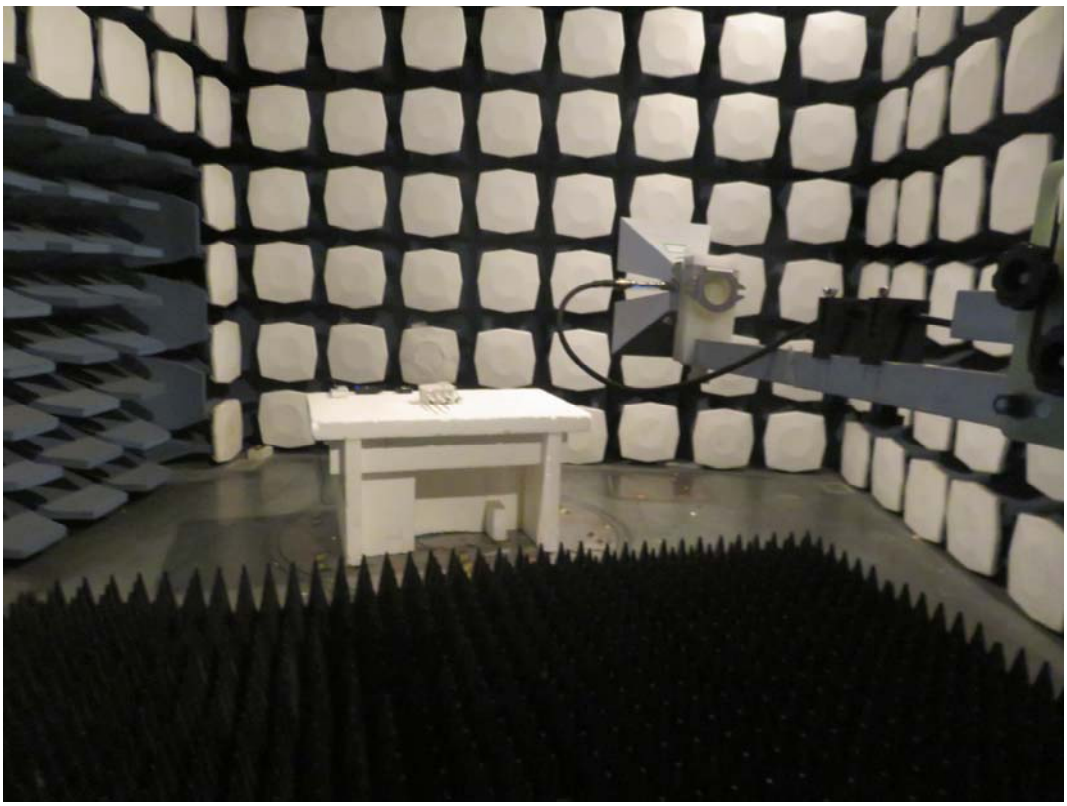
ANNEX A: EUT Appearance and Test Setup

A.1 EUT Appearance



Picture 1 EUT and Accessory

A.2 Test Setup



Picture 2: Radiated Spurious Emissions Test setup