

FCC PART 15.249

TEST REPORT

For

RunCam Technology (Shenzhen) Co., Ltd.

Room 16E, Building B, World Trade Plaza, 9 Fuhong Rd, Futian District, Shenzhen, Guangdong, China.

FCC ID: 2AK4W-TX200

Report Type: Original Report	Product Name: Transmitter TX200
Report Number: RDG171225003-00	
Report Date: 2018-02-09	
Reviewed By:	Jerry Zhang EMC Manager
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	Transmitter TX200
EUT Model:	TX200
Multiple Models:	TX25,TX200U,TX500,TX600,TX800
FCC ID:	2AK4W-TX200
Rated Input Voltage:	DC 3.5 ~5.5V
External Dimension:	Length (19mm)*Width (19mm)
Serial Number:	171225003
EUT Received Date:	2017.12.25

Note: The series product, models TX200, TX25,TX200U,TX500,TX600,TX800 are electrically identical, the differences between them just the model name for marketing purpose, we selected TX200 for full test , and please refer to the declaration letter for details.

Objective

This type approval report is prepared on behalf of **RunCam Technology (Shenzhen) Co., Ltd.** in accordance with Part 2-Subpart J, and Part 15-Subparts A and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

N/A

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
Unwanted Emissions, radiated	30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical 1G~6GHz: 4.45 dB, 6G~26.5GHz: 5.23 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218,the FCC Designation No. : CN1220.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062D.

SYSTEM TEST CONFIGURATION

Justification

The EUT was configured for testing in an engineering mode which was provided by the manufacturer.

For 5.8GHz band, 25 channels are provided:

Band	CH1 Frequency (MHz)	CH2 Frequency (MHz)	CH3 Frequency (MHz)	CH4 Frequency (MHz)	CH5 Frequency (MHz)	CH6 Frequency (MHz)	CH7 Frequency (MHz)	CH8 Frequency (MHz)
Band A	5865	5845	5825	5805	5785	5765	5745	/
Band B	5733	5752	5771	5790	5809	5828	5847	5866
Airwave	5740	5760	5780	5800	5820	5840	5860	/
Race Band	/	/	/	5769	5806	5843	/	/

3 channels were tested: 5733MHz, 5805MHz and 5866MHz.

EUT Exercise Software

No software was used in test the power was setting as default.

Equipment Modifications

No modifications were made to the EUT.

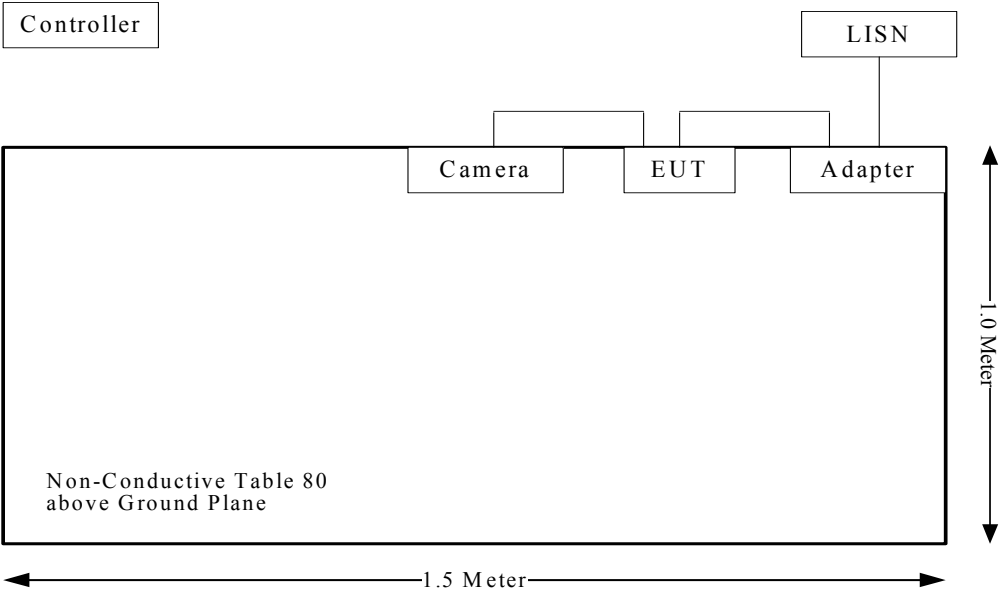
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Runcam	Camera	Micro Swift	N/A
Runcam	Controller	N/A	N/A
ZMI	mobile power	PLM01ZM	N/A

External Cable

Cable Description	Shielding Type	Ferrite Core	Length (cm)	From Port	To
Data Cable	No	No	5	Camera	EUT
DC Cable	No	No	20	Adapter	EUT

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used.

Antenna Connector Construction

The EUT has one antenna for IPEX connector, and the antenna gain is 2dBi, fulfill the requirement of this section. Please refer to the EUT photos.

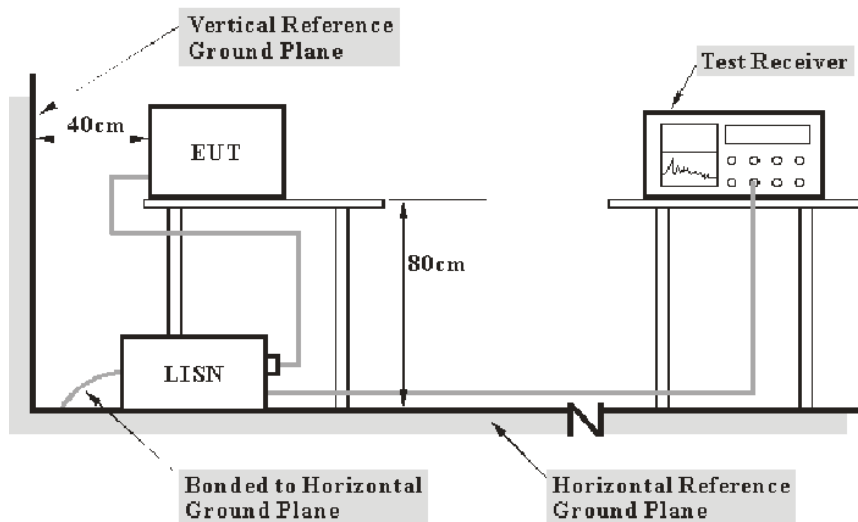
Result: Compliant.

FCC §15.207 (a)– AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a)

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207.

The spacing between the peripherals was 10 cm.

The adapter was connected to the main LISN with a 120 V/60 Hz AC power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the first LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2017-12-08	2018-12-08
R&S	L.I.S.N	ESH2-Z5	892107/021	2017-09-25	2018-09-25
R&S	Test Software	EMC32	Version8.53.0	N/A	N/A
N/A	Coaxial Cable	C-NJNJ-50	C-0200-01	2017-09-05	2018-09-05

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

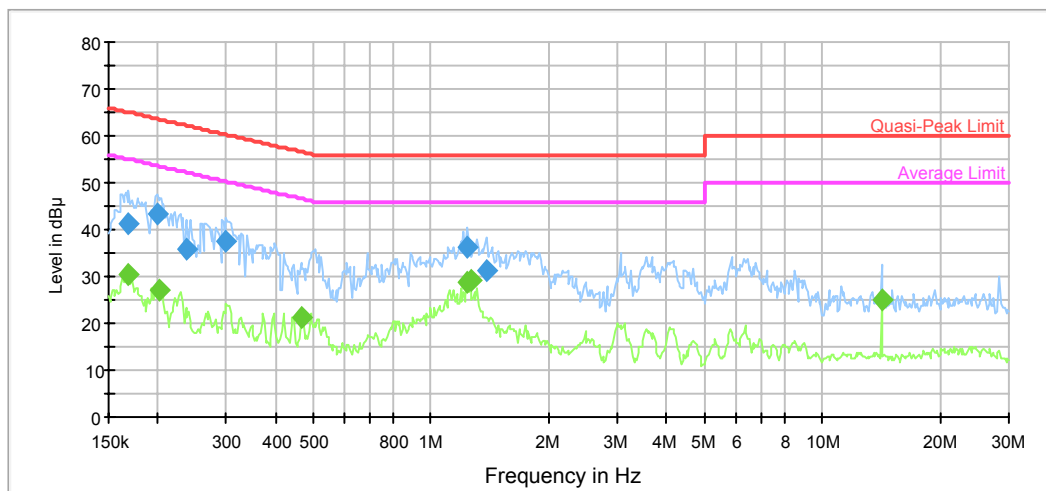
Test Data**Environmental Conditions**

Temperature:	21.4 °C
Relative Humidity:	35 %
ATM Pressure:	101.4 kPa

The testing was performed by Jim Zhang on 2018-02-09.

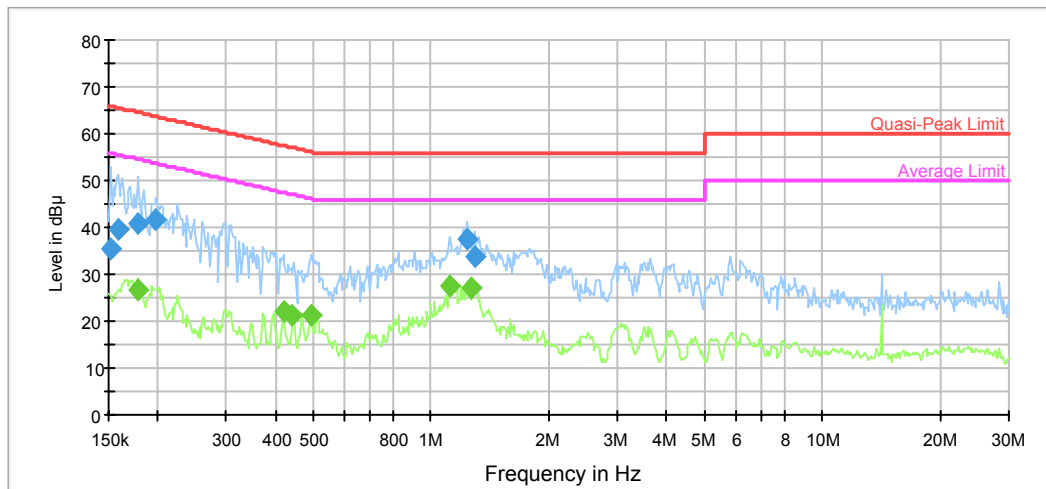
Test Mode: Transmitting

AC120V, 60 Hz, Line:



Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.169044	41.3	9.000	L1	10.9	23.7	65.0	Compliance
0.199835	43.2	9.000	L1	10.6	20.4	63.6	Compliance
0.236234	35.9	9.000	L1	10.4	26.3	62.2	Compliance
0.300025	37.6	9.000	L1	10.1	22.6	60.2	Compliance
1.239175	36.1	9.000	L1	9.8	19.9	56.0	Compliance
1.385415	31.2	9.000	L1	9.7	24.8	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.167702	30.3	9.000	L1	10.9	24.8	55.1	Compliance
0.201433	26.9	9.000	L1	10.6	26.7	53.6	Compliance
0.468757	21.2	9.000	L1	9.9	25.3	46.5	Compliance
1.239175	28.7	9.000	L1	9.8	17.3	46.0	Compliance
1.259081	29.3	9.000	L1	9.8	16.7	46.0	Compliance
14.192385	25.1	9.000	L1	9.9	24.9	50.0	Compliance

AC120V, 60 Hz, Neutral:

Frequency (MHz)	QuasiPeak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.152410	35.3	9.000	N	11.1	30.6	65.9	Compliance
0.158604	39.5	9.000	N	11.1	26.0	65.5	Compliance
0.178741	40.8	9.000	N	10.8	23.7	64.5	Compliance
0.198249	41.7	9.000	N	10.6	22.0	63.7	Compliance
1.239175	37.6	9.000	N	9.8	18.4	56.0	Compliance
1.289541	33.9	9.000	N	9.8	22.1	56.0	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.178741	26.8	9.000	N	10.8	27.7	54.5	Compliance
0.419276	21.9	9.000	N	10.0	25.6	47.5	Compliance
0.443327	21.4	9.000	N	9.9	25.6	47.0	Compliance
0.491712	21.3	9.000	N	9.9	24.8	46.1	Compliance
1.117238	27.5	9.000	N	9.8	18.5	46.0	Compliance
1.259081	27.2	9.000	N	9.8	18.8	46.0	Compliance

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS**Applicable Standard**

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

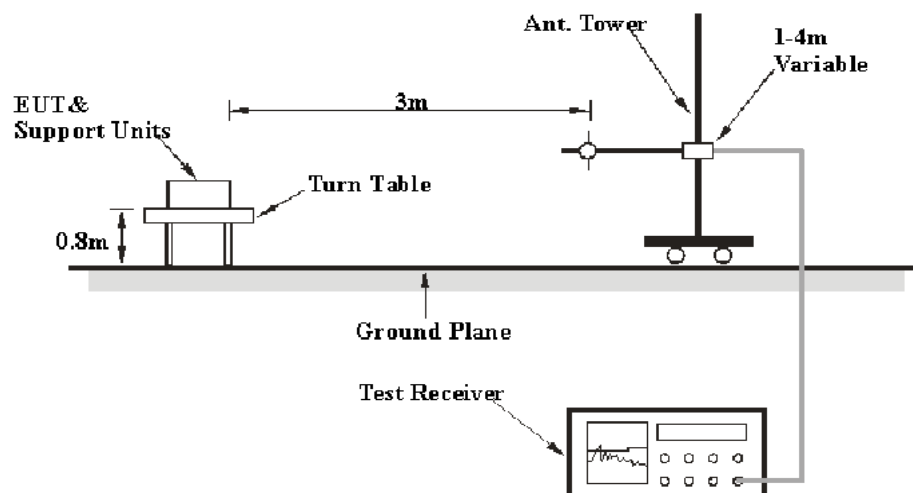
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

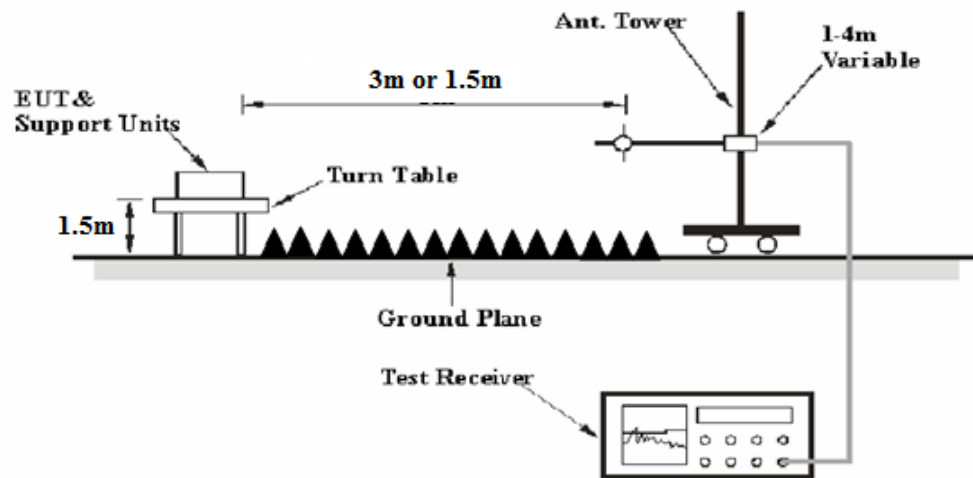
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission below 1GHz tests was performed in the 3 meters distance, above 1GHz tests was performed in the 1.5 meters distance, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

Test Equipment Setup

The system was investigated from 30 MHz to 40 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	120 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All data was recorded in the Quasi-peak detection mode from 30 MHz to 1GHz, peak detection mode above 1 GHz.

Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2017-09-01	2018-09-01
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2018-11-10
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2017-12-08	2018-12-08
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
N/A	Coaxial Cable	C-SJSJ-50	C-0800-01	2017-09-05	2018-09-05
R&S	Spectrum Analyzer	FSU 26	200256	2017-12-08	2018-12-08
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Ducommun	Horn Antenna	ARH-4223-02	1007726-021304	2016-11-18	2019-11-18
Ducommun	Horn Antenna	ARH-2823-02	1007726-011302	2016-11-18	2019-11-18
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2017-06-27	2018-06-27
R&S	Spectrum Analyzer	FSP 38	100478	2017-12-08	2018-12-08
Chengdu OuLi	Band Reject Filter	5725-5850	005	2017-09-05	2018-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data

Environmental Conditions

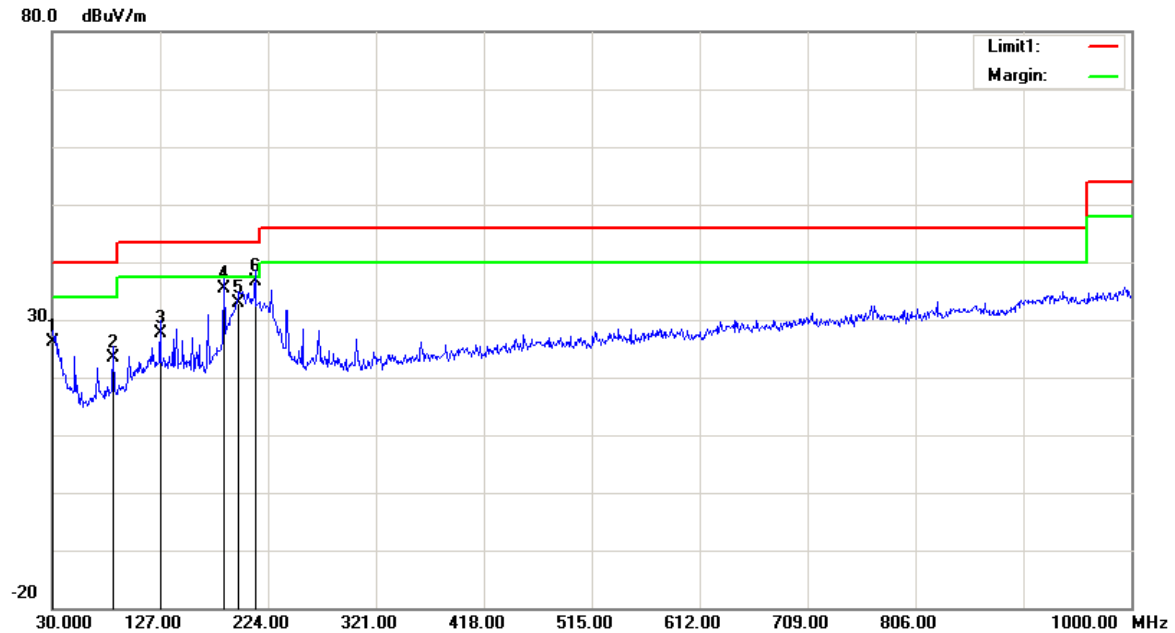
Temperature:	21.8~25.8 °C
Relative Humidity:	30.8~50 %
ATM Pressure:	100.8~101.5 kPa

The testing was performed by Steven Zuo & Blake Yang on 2017-12-29 and 2018-01-08.

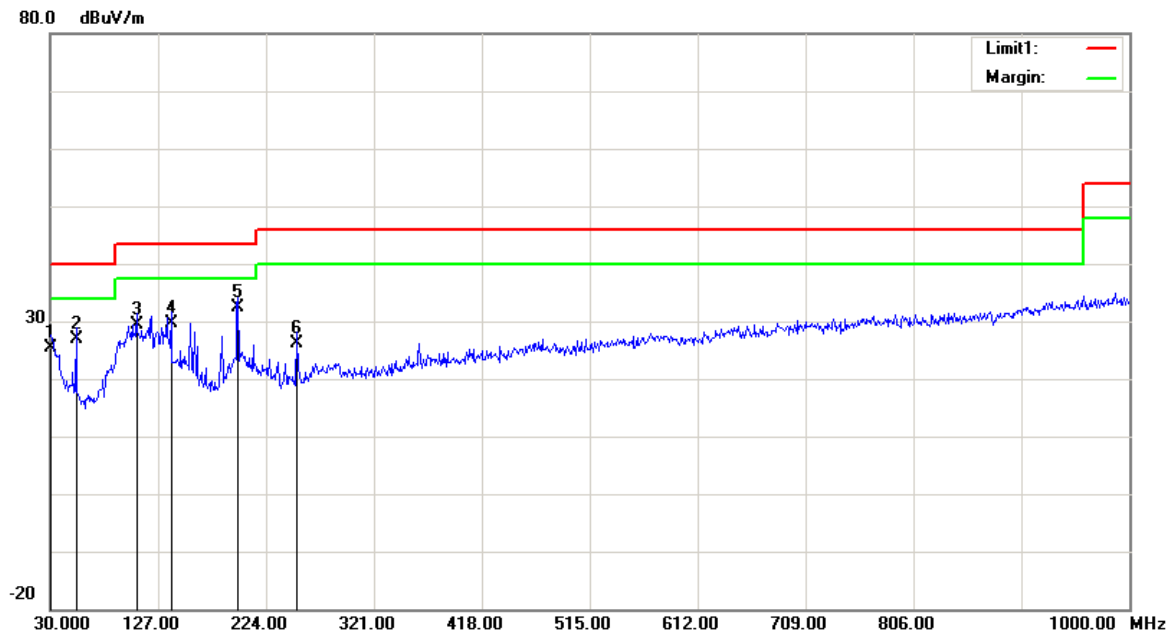
Test Mode: Transmitting

1) 30MHz-1GHz: (Worst Case at Low Channel)

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.9700	25.75	QP	0.35	26.10	40.00	13.90
84.3200	34.44	QP	-11.14	23.30	40.00	16.70
127.0000	32.55	QP	-4.95	27.60	43.50	15.90
184.2300	43.41	QP	-8.01	35.40	43.50	8.10
197.8100	39.54	QP	-6.64	32.90	43.50	10.60
212.3600	43.90	QP	-7.30	36.60	43.50	6.90

Vertical:

Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.9700	25.05	QP	0.35	25.40	40.00	14.60
53.2800	39.07	QP	-12.27	26.80	40.00	13.20
107.6000	35.97	QP	-6.57	29.40	43.50	14.10
138.6400	35.57	QP	-5.97	29.60	43.50	13.90
198.7800	38.85	QP	-6.45	32.40	43.50	11.10
251.1600	32.49	QP	-6.39	26.10	46.00	19.90

2) 1GHz-40GHz:

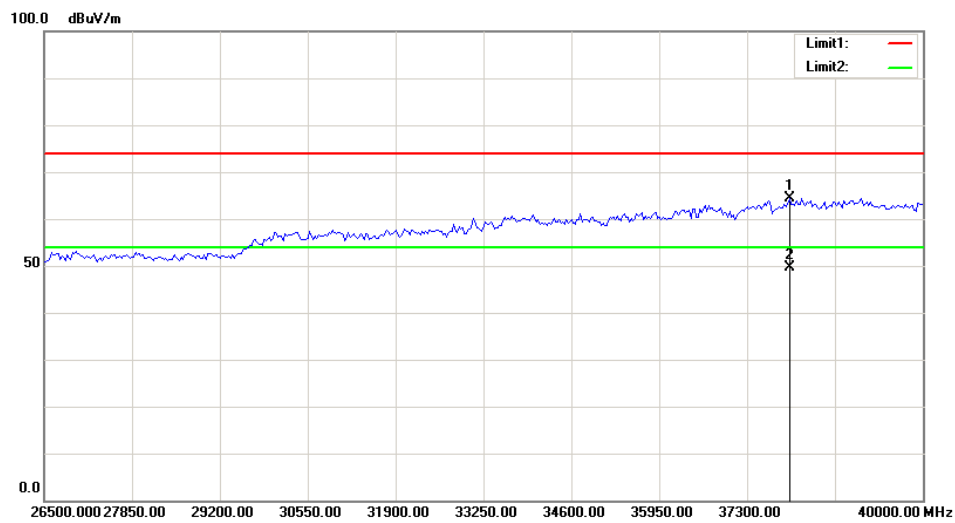
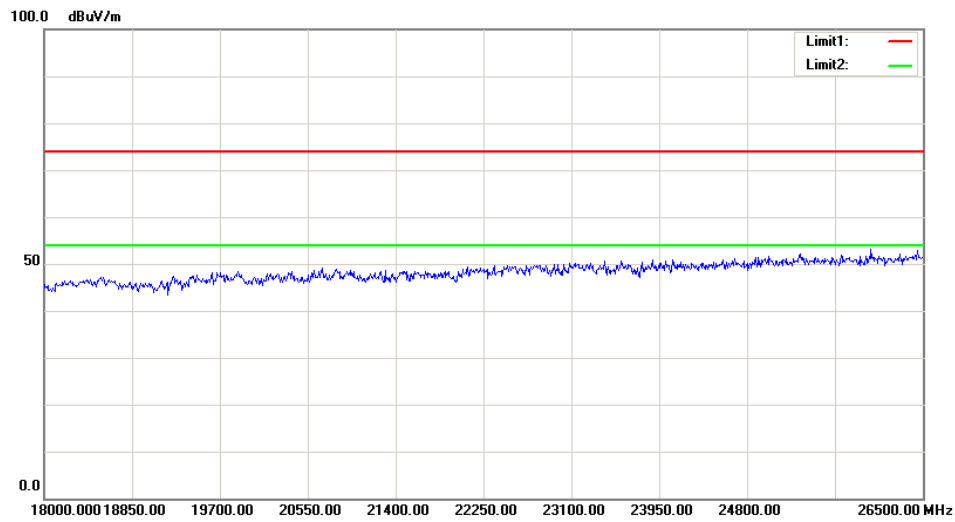
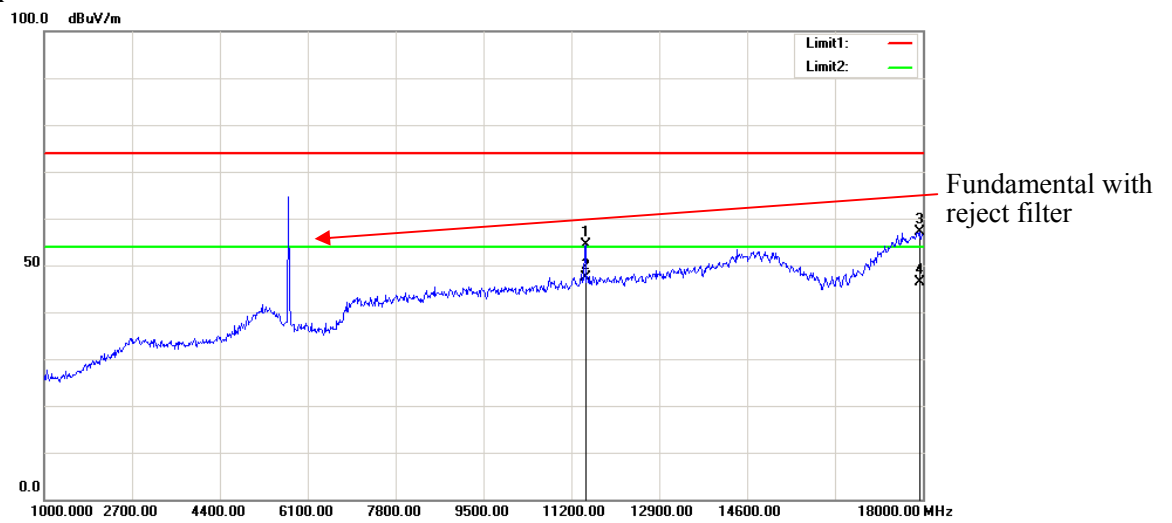
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Extrapolation Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)						
5733 MHz										
5733	57.73	PK	H	34.19	3.69	0.00	95.61	89.59	113.98	24.39
5733	53.00	AV	H	34.19	3.69	0.00	90.88	84.86	93.98	9.12
5733	66.29	PK	V	34.19	3.69	0.00	104.17	98.15	113.98	15.83
5733	61.05	AV	V	34.19	3.69	0.00	98.93	92.91	93.98	1.07
5725	34.16	PK	V	34.19	3.69	0.00	72.04	66.02	74.00	7.98
5725	17.26	AV	V	34.19	3.69	0.00	55.14	49.12	54.00	4.88
11466	55.34	PK	V	38.97	6.59	37.34	63.56	57.54	74.00	16.46
11466	48.17	AV	V	38.97	6.59	37.34	56.39	50.37	54.00	3.63
17199	46.31	PK	V	41.35	8.77	38.63	57.80	51.78	74.00	22.22
17199	38.69	AV	V	41.35	8.77	38.63	50.18	44.16	54.00	9.84
17855.5	47.87	PK	V	45.30	8.87	38.07	63.97	57.95	74.00	16.05
17855.5	35.79	AV	V	45.30	8.87	38.07	51.89	45.87	54.00	8.13
37948	39.56	PK	H	39.34	28.31	36.82	70.37	64.35	74.00	9.65
37948	24.86	AV	H	39.34	28.31	36.82	55.67	49.65	54.00	4.35
37624	38.45	PK	V	39.26	28.10	36.96	68.83	62.81	74.00	11.19
37624	23.61	AV	V	39.26	28.10	36.96	53.99	47.97	54.00	6.03
5805 MHz										
5805	58.17	PK	H	34.22	3.71	0.00	96.10	90.08	113.98	23.90
5805	53.55	AV	H	34.22	3.71	0.00	91.48	85.46	93.98	8.52
5805	66.37	PK	V	34.22	3.71	0.00	104.30	98.28	113.98	15.70
5805	60.19	AV	V	34.22	3.71	0.00	98.12	92.10	93.98	1.88
11610	49.86	PK	V	39.00	6.63	37.49	58.00	51.98	74.00	22.02
11610	44.75	AV	V	39.00	6.63	37.49	52.89	46.87	54.00	7.13
17415	46.37	PK	V	42.61	8.83	38.48	59.33	53.31	74.00	20.69
17415	40.28	AV	V	42.61	8.83	38.48	53.24	47.22	54.00	6.78
5866 MHz										
5866	55.07	PK	H	34.25	3.76	0.00	93.08	87.06	113.98	26.92
5866	50.17	AV	H	34.25	3.76	0.00	88.18	82.16	93.98	11.82
5866	63.95	PK	V	34.25	3.76	0.00	101.96	95.94	113.98	18.04
5866	59.44	AV	V	34.25	3.76	0.00	97.45	91.43	93.98	2.55
5875	34.67	PK	V	34.25	3.77	0.00	72.69	66.67	74.00	7.33
5875	16.47	AV	V	34.25	3.77	0.00	54.49	48.47	54.00	5.53
11732	55.26	PK	V	39.00	6.66	37.62	63.30	57.28	74.00	16.72
11732	47.60	AV	V	39.00	6.66	37.62	55.64	49.62	54.00	4.38
17598	46.75	PK	V	43.71	8.86	38.32	61.00	54.98	74.00	19.02
17598	44.47	AV	V	43.71	8.86	38.32	58.72	52.70	54.00	1.30

Note: According to C63.4, the above 1G test result shall be extrapolated to the specified distance using an extrapolation factor of 20dB/decade from 3m to 1.5m.

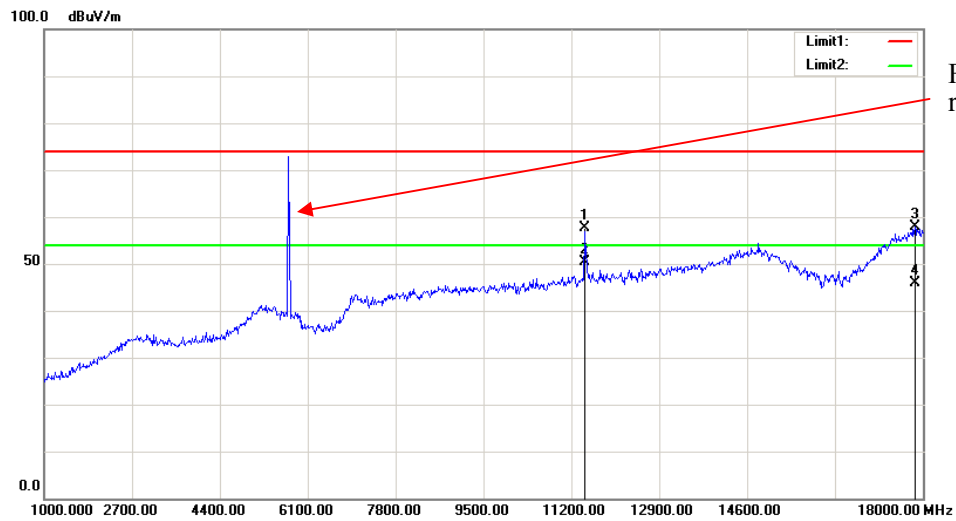
Distance extrapolation factor = $20 \log (\text{specific distance [3m]}/\text{test distance [1.5m]})$ dB

Extrapolation result = Corrected Amplitude (dBμV/m) - distance extrapolation factor (6.02dB)

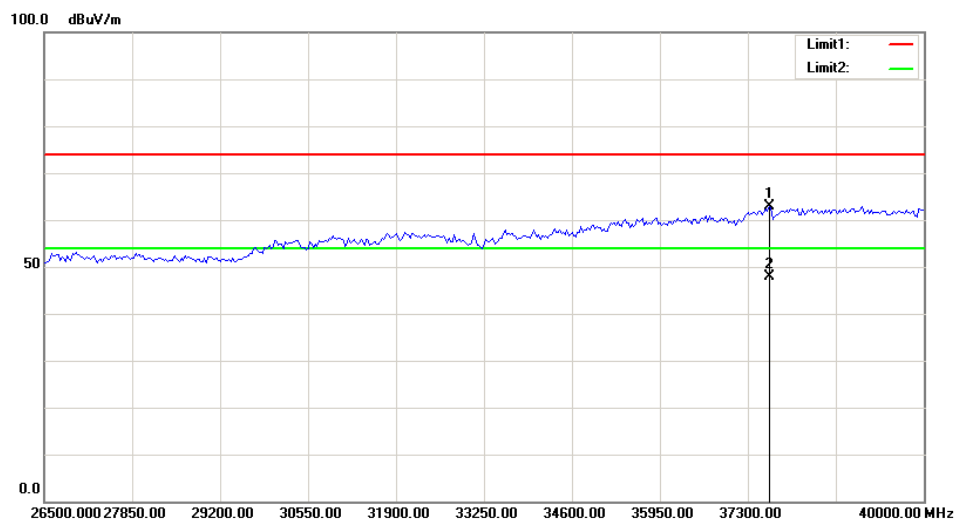
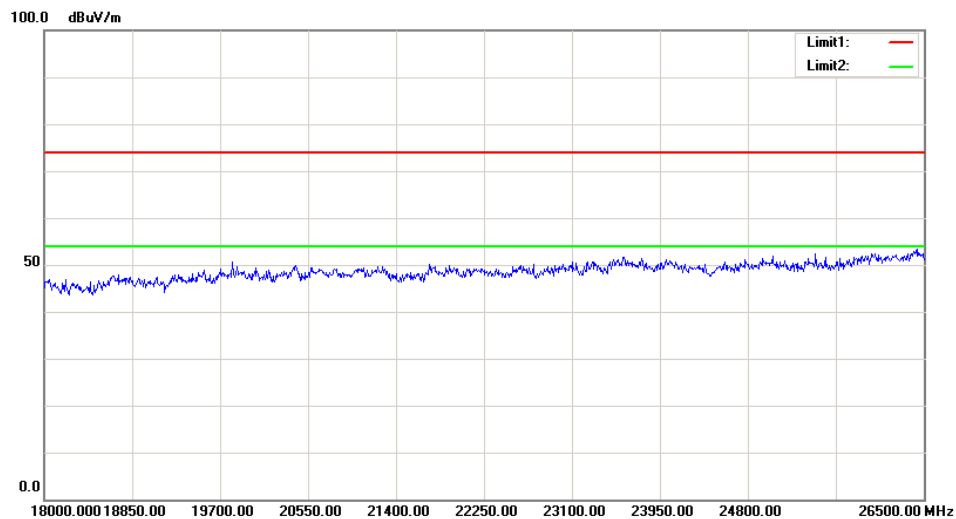
Test plots at Low Channel Horizontal



Vertical



Fundamental with reject filter



FCC §15.215(c) – 20 dB BANDWIDTH TESTING**Applicable Standard**

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
3. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU 26	200256	2017-12-08	2018-12-08
N/A	Coaxial Cable	C-SJ00-0010	C0010/01	Each Time	/

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	23.3 °C
Relative Humidity:	41 %
ATM Pressure:	101.1 kPa

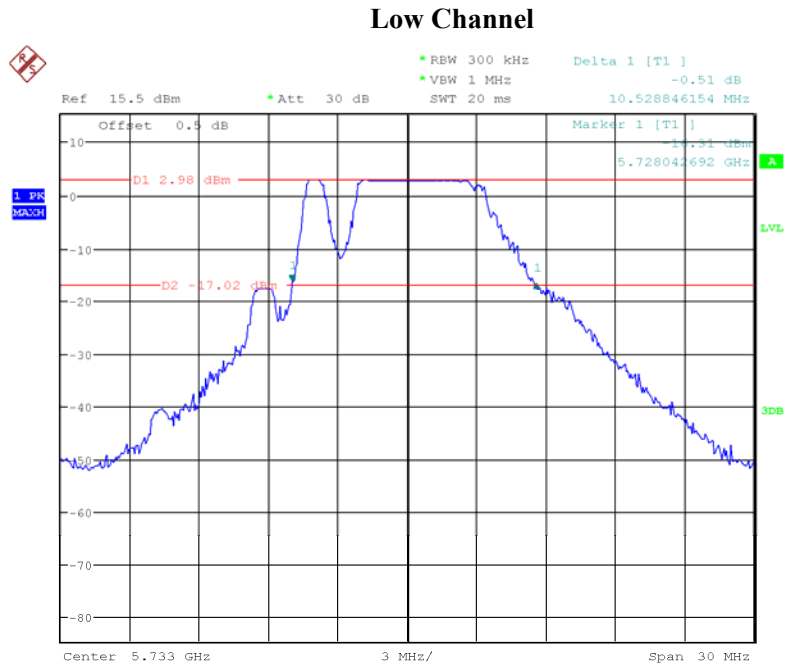
The testing was performed by Calvin Chen on 2018-01-25.

Test Result: Compliant.

Please refer to following tables and plots

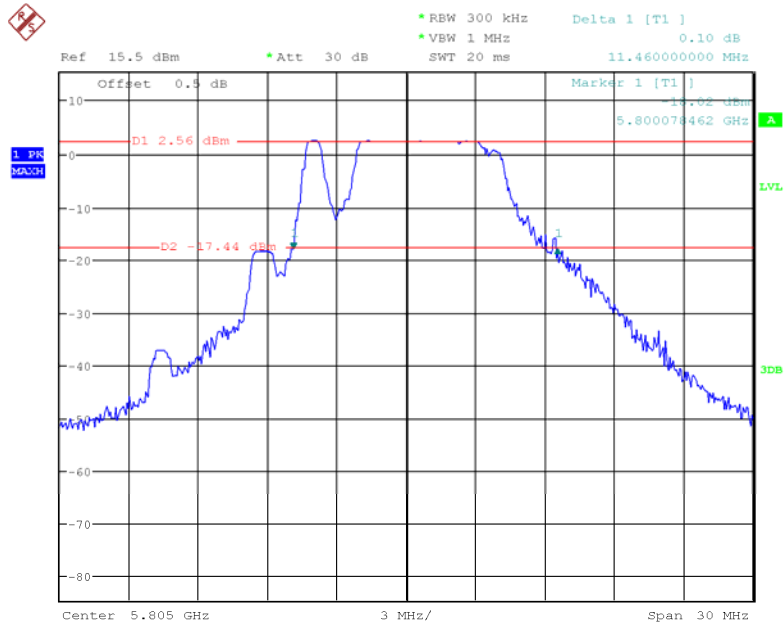
Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	5733	10.53
Middle	5805	11.46
High	5866	11.08



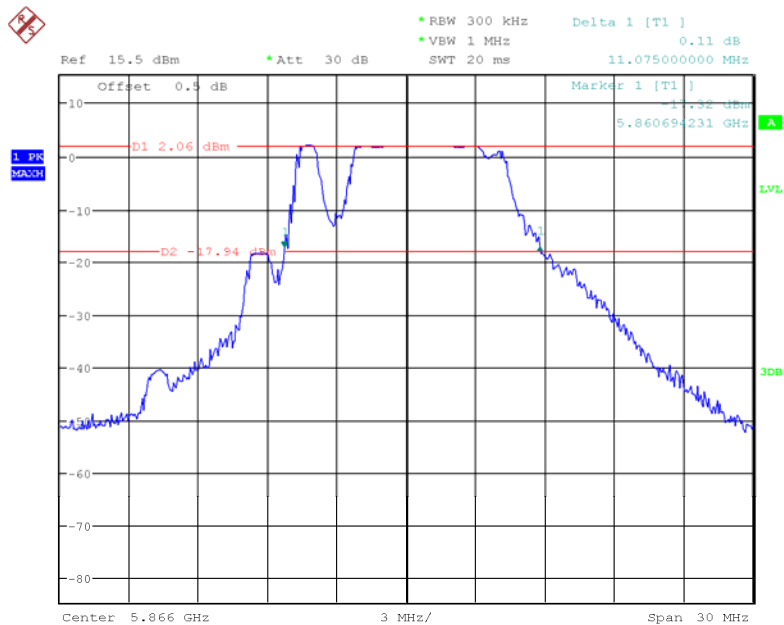
Date: 25.JAN.2018 09:30:24

Middle Channel



Date: 25.JAN.2018 09:34:40

High Channel



Date: 25.JAN.2018 09:32:32

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