FCC PART 15.247
RSS-GEN, ISSUE 4, NOVEMBER 2014
RSS-247, ISSUE 2, FEBRUARY 2017

TEST REPORT

For

SZ DJI Osmo Technology Co.,Ltd.

12th floor,West Wing,Skyworth Semiconductor Design Building NO.18 Gaoxin South 4th Ave, Nanshan District,Shenzhen,China

FCC ID: 2ANDR-MST11804
IC: 23060-MST11804

Report Type:	**Product Name:**
Original Report	Master Wheels

Report Number:	RDG180410002-00B
Report Date:	2018-04-17
Reviewed By:	Jerry Zhang EMC Manager Jerry Zhang
Test Laboratory:	Bay Area Compliance Laboratories Corp. (Dongguan) No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China Tel: +86-769-86858888 Fax: +86-769-86858891 www.baclcorp.com.cn

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		Master Wheels
EUT Model:		MST1
FCC ID:		2ANDR-MST11804
IC:		23060-MST11804
Rated Input Voltage:		DC 22.8V from battery DC 12-27V from DC-in Port
Adapter Information	**Model:**	IN2C180
	UP/N:	A180A007L
	Input:	100-240V~2.5A, 50-60Hz
	Output:	DC 26.1V, 6.9A(Total) DC 26.1V, 0-5A(Output 1) DC 26.1V, 0-6.9A(Output 2)
External Dimension:		440 mm (L) x 365 mm (W) x 225 mm (H)
Serial Number:		180410002
EUT Received Date:		2018-04-11

Objective

This report is prepared on behalf of ***SZ DJI Osmo Technology Co.,Ltd.*** in accordance with Part 2, Subpart J, Part 15, Subparts A, and C of the Federal Communications Commission's rules and RSS-247, Issue 2, February 2017 of the Innovation, Science and Economic Development Canada, RSS-Gen Issue 4, November 2014 of the Innovation, Science and Economic Development Canada.

The tests were performed in order to determine the compliance of the EUT with FCC Rules Part 15-Subpart C, section 15.203, 15.205,15.207, 15.209, 15.247 rules and RSS-247, Issue 2, February 2017, RSS-Gen Issue 4, November 2014 of the Innovation, Science and Economic Development Canada.

The device`s main board is identical with the certified device: Force Pro, model: P1F1, FCC ID: 2ANDR-P1F11803, IC: 23060-P1F11803, and the changes not related with the RF parameters. All antenna port conducted tests were reduced, and please refer to the P1F1 report.

Related Submittal(s)/Grant(s)

FCC submissions with Part 15B JAB, FCC ID: 2ANDR-MST11804.
FCC submissions with Part 15E NII, FCC ID: 2ANDR-MST11804.
ISEDC submissions with RSS-247 LE-LAN, IC: 23060-MST11804.
Part of system submissions with FCC ID: 2ANDR-R21708, IC: 23060-R21708.

Test Methodology

All measurements detailed in this Test Report were performed in accordance with ANSI C63.10-2013 "American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices". And RSS-247, Issue 2, February 2017 of the Innovation, Science and Economic Development Canada, RSS-Gen Issue 4, November 2014 of the Innovation, Science and Economic Development Canada.

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

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
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
Unwanted Emissions	±1.5 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

Description of Test Configuration

The system was configured for testing in engineering mode, which was provided by manufacuter.

The system employed FHSS technology in 2.4GHz band, total 46 channels was used:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2408	24	2442.5
2	2409.5	…	…
…	…	…	…
…	…	…	…
…	…	45	2474
23	2441	46	2475.5

3 channels were tested: 2408MHz, 2442.5MHz and 2475.5MHz

EUT Exercise Software

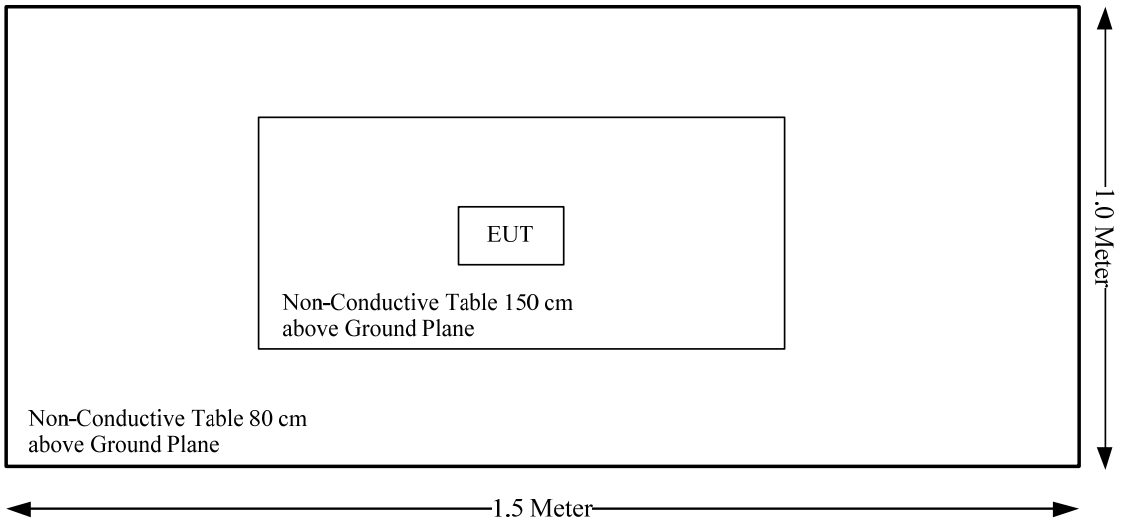
The software “Certification_HG330.exe” was used for testing, which was provided by manufacturer. The maximum power level was configured as below table:

Test Software Version	Certification_HG330.exe		
Test Frequency	2408MHz	2442.5MHz	2475.5MHz
Power Level Setting	45	45	45

Equipment Modifications

No modification was made to the EUT.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
FCC §15.247 (i) & §1.1310 & §2.1091	Maximum Permissable Exposure (MPE)	Compliance
RSS-102 § 2.5.2	Exemption Limits For Routine Evaluation-RF Exposure Evaluation	Compliance
FCC§15.203 RSS-Gen Clause 8.3	Antenna Requirement	Compliance
FCC§15.207 (a) RSS-Gen Clause 8.8	Conducted Emissions	Not applicable*
FCC§15.205, §15.209, FCC §15.247(d) RSS-247 Clause 5.5, RSS-Gen Clause 8.10	Spurious Emissions	Compliance
FCC§15.247 (a)(1) RSS-247 Clause 5.1 b) RSS-Gen Clause 6.6	Emission Bandwidth	Compliance*
FCC§15.247(a)(1) RSS-247 Clause 5.1 b)	Channel Separation Test	Compliance*
FCC§15.247(a)(1)(iii) RSS-247 Clause 5.1 d)	Time of Occupancy (Dwell Time)	Compliance*
FCC§15.247(a)(1)(iii) RSS-247 Clause 5.1 d)	Quantity of hopping channel Test	Compliance*
FCC§15.247(b)(1) RSS-247 Clause 5.4 b)	Peak Output Power Measurement	Compliance*
FCC§15.247(d) RSS-247 Clause 5.5	Band Edges	Compliance*

Note:
Not applicable*: The device was powered by battery.
Compliance*: For the antenna port conducted tests, please refer to the report NO. RDG180325002-00B, FCC ID: 2ANDR-P1F11803, which was issued on 2018-04-03 by Bay Area Compliance Laboratories Corp. (Dongguan).

FCC §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i)and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (minutes)**
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*($180/f^2$)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit
$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm^2);
P = power input to the antenna (in appropriate units, e.g., mW);
G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

Calculated Data:

Frequency (MHz)	**Antenna Gain**		**Conducted output power including Tune-up Tolerance**		**Evaluation Distance (cm)**	**Power Density (mW/cm^2)**	**MPE Limit (mW/cm^2)**
	(dBi)	**(numeric)**	**(dBm)**	**(mW)**			
2408-2475.5	2.18	1.65	21	125.89	20.00	0.04	1.0

Note: 2.4GHz and 5GHz can`t transmit simultaneously

Result: The device meet FCC MPE at 20 cm distance

RSS-102 § 2.5.2 - EXEMPTION LIMITS FOR ROUTINE EVALUATION – RF EXPOSURE EVALUATION

Applicable Standard

According to RSS-102 § (2.5.2):

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

Calculated Data:

The maximum power including tune-up tolerance is 21dBm@ 2.4GHz band, the maximum antenna gain is 2.18 dBi, so the maximum e.r.i.p. is 23.18 dBm (0.208W)

Exemption from Routine Evaluation Limit is:
$1.31 \times 10^{-2} f^{0.6834} = 1.31 \times 10^{-2} \times 2408^{0.6834} = 2.68 > 0.208$W

So the device is compliance exemption from Routine Evaluation Limits –RF exposure Evaluation.

Result: Compliance

FCC §15.203& RSS-GEN CLAUSE 8.3 - ANTENNA REQUIREMENT

Applicable Standard

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 with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

a. Antenna must be permanently attached to the unit.
b. Antenna must use a unique type of connector to attach to the EUT.

Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

According to RSS-Gen §8.3, The applicant for equipment certification, as per RSP-100, must provide a list of all antenna types that may be used with the licence-exempt transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna.
Licence-exempt transmitters that have received equipment certification may operate with different types of antennas. However, it is not permissible to exceed the maximum equivalent isotropically radiated power (e.i.r.p.) limits specified in the applicable standard (RSS) for the licence-exempt apparatus.

Testing shall be performed using the highest gain antenna of each combination of licence-exempt transmitter and antenna type, with the transmitter output power set at the maximum level.9 When a measurement at the antenna connector is used to determine RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna manufacturer.

User manuals for transmitters equipped with detachable antennas shall also contain the following notice in a conspicuous location:

This radio transmitter (identify the device by certification number or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types approved for use with the transmitter, indicating the maximum permissible antenna gain (in dBi).

Antenna Connector Construction

The EUT has two external antenna arrangement use a unique type of connector to attach to the unit, Antenna 0 for tranceiving and antenna 1 only for receiving, both antenna gain is 2.18 dBi in 2.4GHz band and 4.5 dBi in 5.8GHz band, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliance.

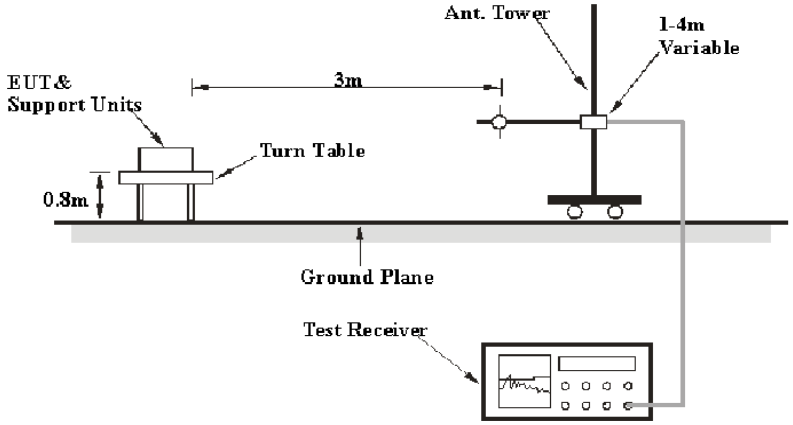
FCC §15.209, §15.205 & §15.247(d) & RSS-247 CLAUSE 5.5, RSS-GEN CLAUSE 8.10- SPURIOUS EMISSIONS

Applicable Standard

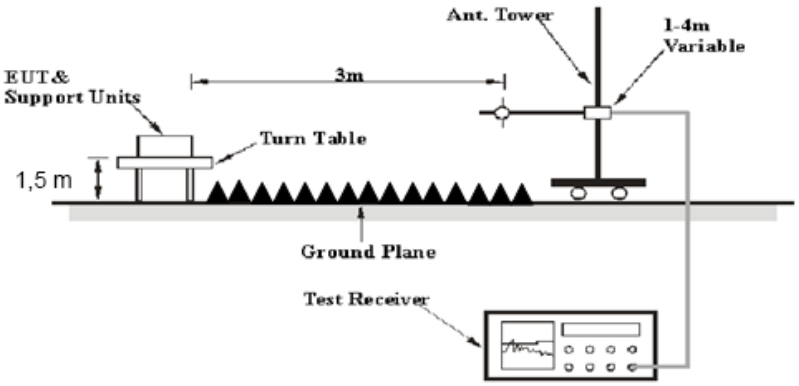
FCC §15.247 (d); §15.209; §15.205; RSS-247 Clause 5.5, RSS-GEN Clause 8.10

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters distance, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, 15.247 and RSS-247 Clause 5.5, RSS-GEN Clause 8.10 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 25 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.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz - 1 GHz, peak and average detection modes for frequencies above 1 GHz.

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	A060611-2	2017-08-25	2020-08-25
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Unknown	Coaxial Cable	4m	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	0.75m	C-0075-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	10m	C-1000-01	2017-09-05	2018-09-05
Agilent	Spectrum Analyzer	E4440A	SG43360054	2018-01-04	2019-01-04
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-05
MITEQ	Amplifier	AFS42-00101800-25-S-42	2001271	2017-09-05	2018-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2017-06-27	2018-06-27
Ducommun Technolagies	Horn Antenna	ARH-4223-02	1007726-01 1304	2016-11-18	2019-11-18
Unknown	Coaxial Cable	8m	C-0800-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2017-06-27	2018-06-27
Chengdu OuLi	Bandrejector Filter	2400-2483.5	001	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).

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:

Corrected Amplitude = Meter Reading + Antenna Factor + Cable Loss - 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:

Margin = Limit – Corrected Amplitude

Test Data

Environmental Conditions

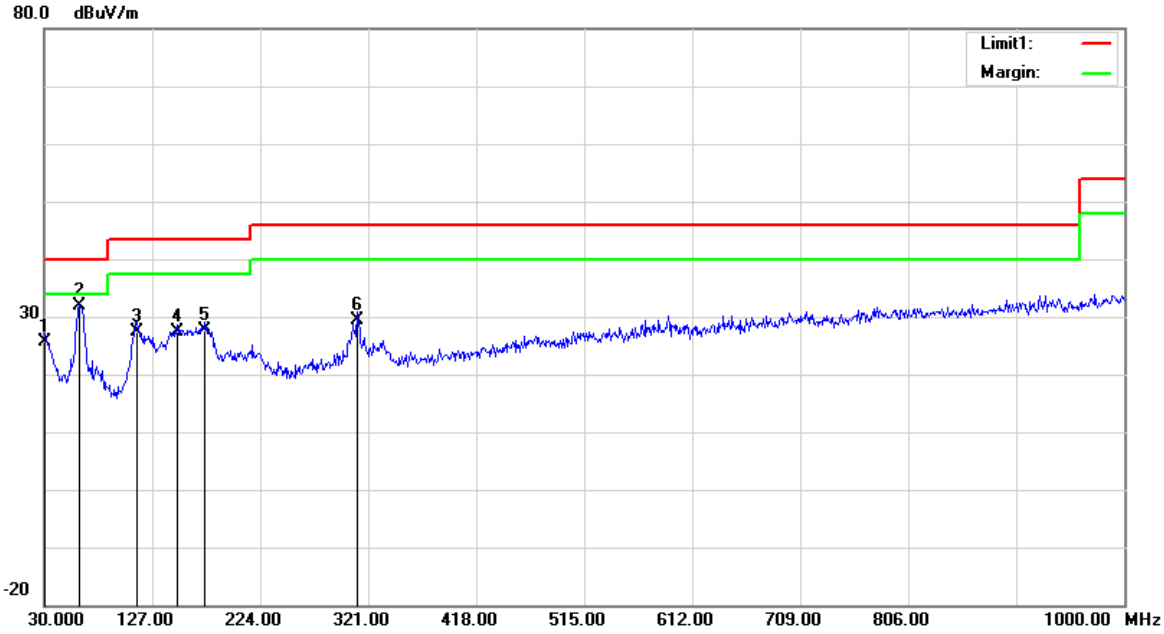
Temperature:	24.3 °C
Relative Humidity:	40 %
ATM Pressure:	100.6 kPa

** The testing was performed by Sunny Cen on 2018-04-14.*

Test Mode: Transmitting

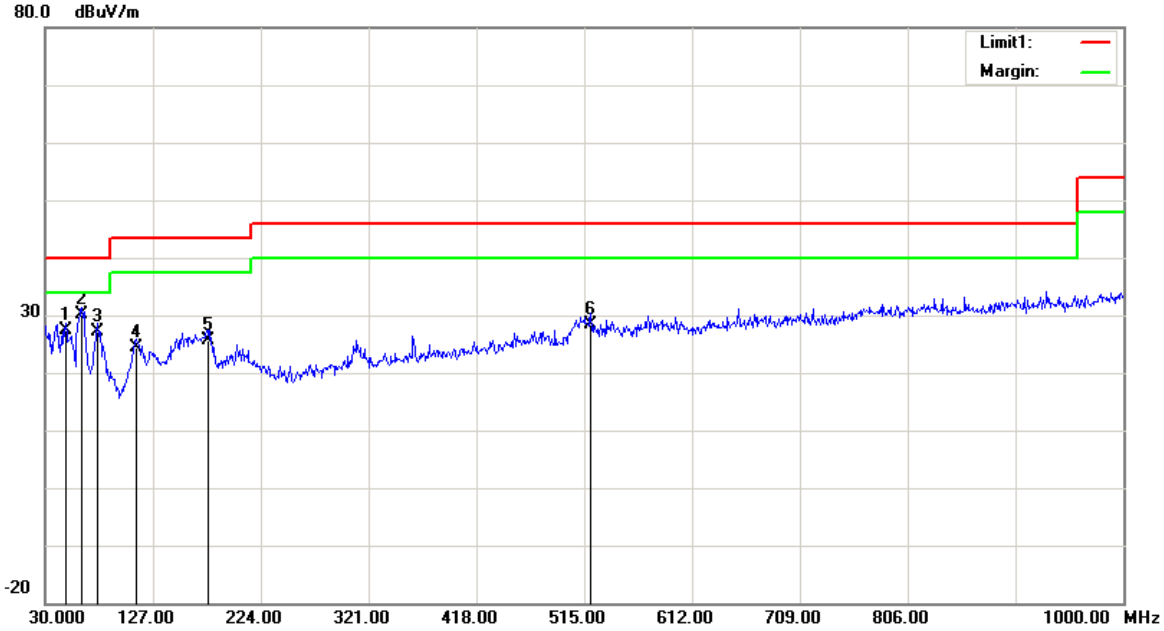
1) 30MHz-1GHz(High Channel was the worst):

Horizontal:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
30.0000	24.06	QP	1.54	25.60	40.00	14.40
61.0400	43.99	QP	-12.19	31.80	40.00	8.20
113.4200	33.22	QP	-5.72	27.50	43.50	16.00
149.3100	33.29	QP	-5.99	27.30	43.50	16.20
174.5300	34.81	QP	-7.21	27.60	43.50	15.90
311.3000	33.09	QP	-3.79	29.30	46.00	16.70

Vertical:



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
48.4300	38.10	QP	-10.80	27.30	40.00	12.70
62.9800	42.14	QP	-12.04	30.10	40.00	9.90
76.5600	38.43	QP	-11.23	27.20	40.00	12.80
111.4800	30.51	QP	-6.21	24.30	43.50	19.20
176.4700	32.87	QP	-7.27	25.60	43.50	17.90
520.8200	28.50	QP	0.00	28.50	46.00	17.50

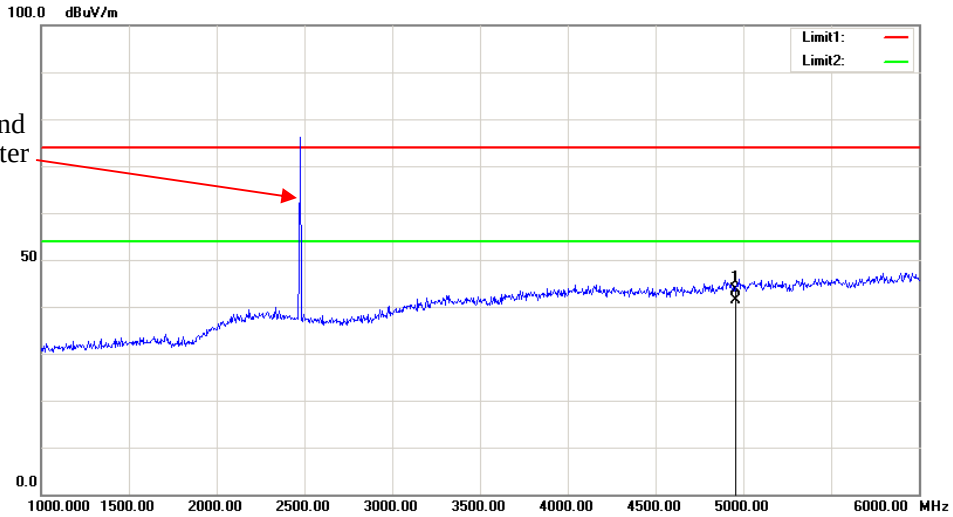
2) 1-25GHz:

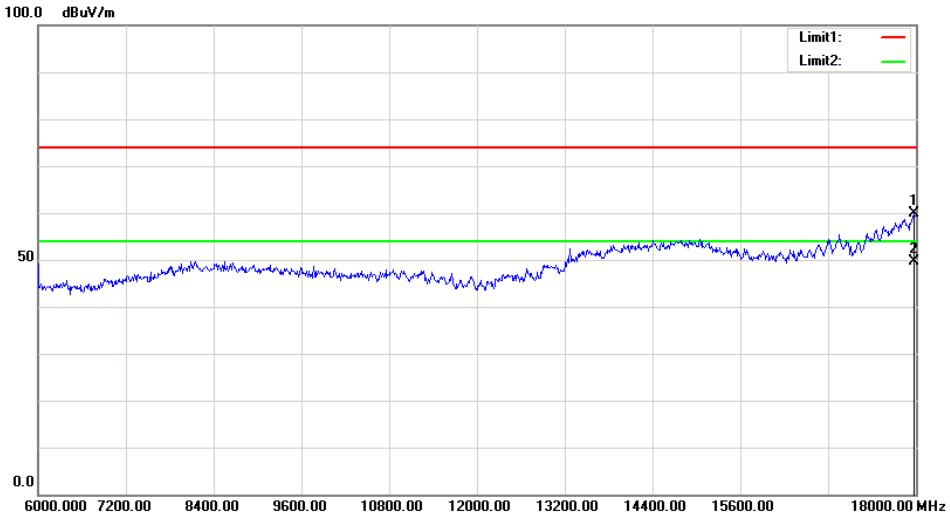
Frequency	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
(MHz)	Reading (dBμV)	Detector	Polar (H/V)	Factor (dB/m)					
Low Channel: 2408 MHz									
2408.00	81.05	PK	H	28.12	1.80	0.00	110.97	N/A	N/A
2408.00	65.11	AV	H	28.12	1.80	0.00	95.03	N/A	N/A
2408.00	87.84	PK	V	28.12	1.80	0.00	117.76	N/A	N/A
2408.00	71.07	AV	V	28.12	1.80	0.00	100.99	N/A	N/A
2390.00	25.42	PK	V	28.08	1.80	0.00	55.30	74.00	18.70
2390.00	14.75	AV	V	28.08	1.80	0.00	44.63	54.00	9.37
4816.00	46.72	PK	V	32.93	3.18	37.20	45.63	74.00	28.37
4816.00	45.42	AV	V	32.93	3.18	37.20	44.33	54.00	9.67
7224.00	44.14	PK	V	35.78	4.79	37.25	47.46	74.00	26.54
7224.00	42.72	AV	V	35.78	4.79	37.25	46.04	54.00	7.96
Middle Channel: 2442.5 MHz									
2442.50	82.47	PK	H	28.19	1.82	0.00	112.48	N/A	N/A
2442.50	67.74	AV	H	28.19	1.82	0.00	97.75	N/A	N/A
2442.50	87.46	PK	V	28.19	1.82	0.00	117.47	N/A	N/A
2442.50	70.71	AV	V	28.19	1.82	0.00	100.72	N/A	N/A
4885.00	46.27	PK	V	33.07	3.28	37.21	45.41	74.00	28.59
4885.00	44.55	AV	V	33.07	3.28	37.21	43.69	54.00	10.31
7327.50	45.85	PK	V	36.05	4.61	37.38	49.13	74.00	24.87
7327.50	43.24	AV	V	36.05	4.61	37.38	46.52	54.00	7.48
High Channel: 2475.5 MHz									
2475.50	78.75	PK	H	28.25	1.84	0.00	108.84	N/A	N/A
2475.50	63.11	AV	H	28.25	1.84	0.00	93.20	N/A	N/A
2475.50	87.74	PK	V	28.25	1.84	0.00	117.83	N/A	N/A
2475.50	70.51	AV	V	28.25	1.84	0.00	100.60	N/A	N/A
2483.50	29.64	PK	V	28.27	1.84	0.00	59.75	74.00	14.25
2483.50	15.47	AV	V	28.27	1.84	0.00	45.58	54.00	8.42
4951.00	47.57	PK	V	33.20	3.24	37.24	46.77	74.00	27.23
4951.00	45.72	AV	V	33.20	3.24	37.24	44.92	54.00	9.08
7426.50	45.34	PK	V	36.31	4.44	37.51	48.58	74.00	25.42
7426.50	43.77	AV	V	36.31	4.44	37.51	47.01	54.00	6.99

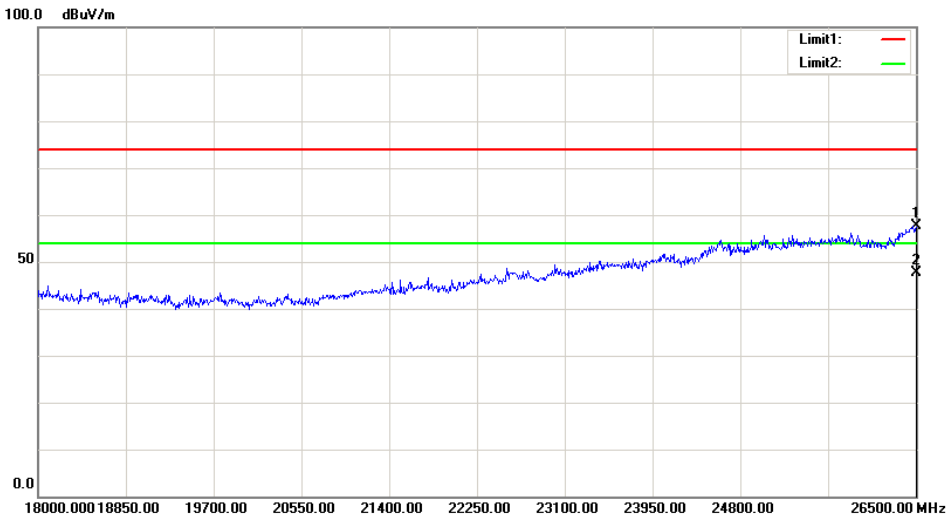
Worst mode Plots(High channel)

Horizontal:

Fundamental Test with Band Rejection Filter

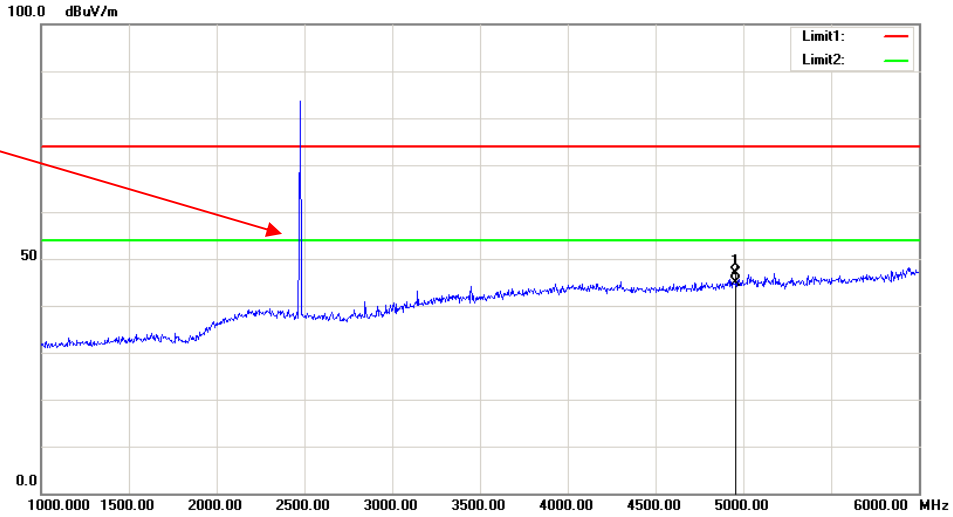


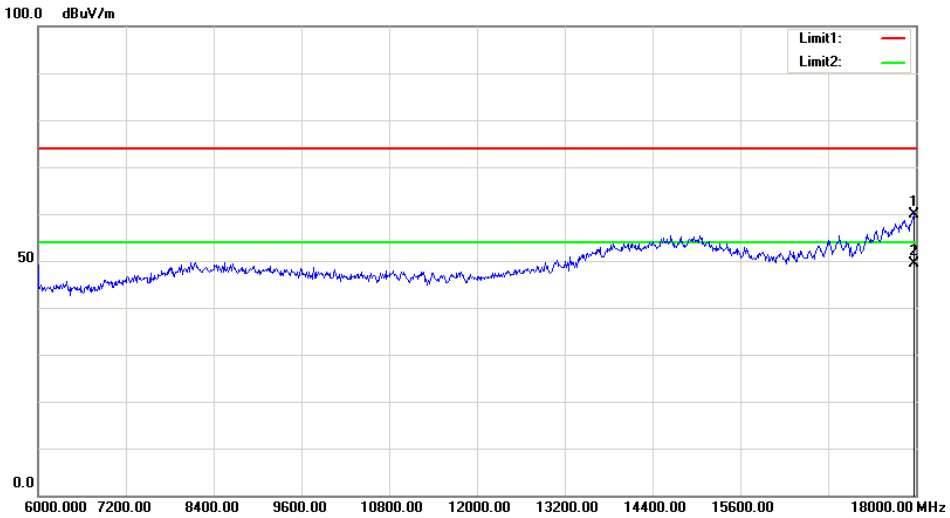


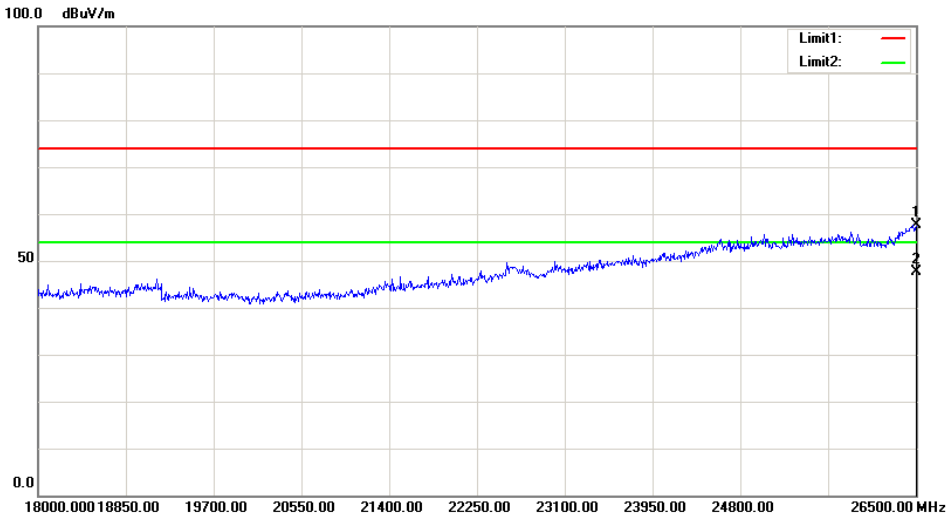


Vertical:

Fundamental Test with Band Rejection Filter







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