Wireless Pressure Sensor

EMC Test Report

Model No.: WPS1B121AGP1A1N

Date: 09/06/2014

Report Prepared By: Gulshan Kumar. B

Report Number	EMC -0055-3
EUT Nomenclature	Wireless Pressure Sensor
Sample Identification	EMC-0055-1
Number of Samples	1
Date of receipt of Sample	20/10/2013
Condition of Sample on receipt	Good
Client name	Kelly Geiseman
Client Address	Honeywell International Inc 315 E Stephenson St, Plant 1 A2-148, Freeport, IL, USA Zip code 61032-4353
Testing Laboratory	EMC Lab, Honeywell Technology Solutions Lab Pvt Ltd
Address	RMZ ECOWORLD INFRASTRUCTURE PVT. LTD., Survey # 19/2, Devarabisanahalli Village, Varthur Hobli, Bangalore East Taluk, Bangalore – 560103
Test Dates	20/03/2014 - 21/04/2014
Applicable Standard	RSS210 Issue 6, RSS-Gen Issue 3
Test Results	PASS

Prepared By: Technical Lead Name : Gulshan Kumar. B Signature: Gulshan Date : 15-07-14	Reviewed By: Deputy Technical Manager Name : Gulshan Kumar. B Signature: Gulshan Date : 15-07-14
Authorized By: Quality Manager Name : Prasanna Kumar BT Signature: B Prasanna Kumar Date : 16/7/14	Authorized By: Lab Manager Name : Ananth Krishna Signature: Date : 17/07/2014

This Report relates to the above mentioned test sample only. Without the approval of Lab manager, this report shall not be reproduced except in full.

TEST SUMMARY						
#	Name	Specification	Test Method	Pass	Fail	NA
Transmitter Tests						
1	*Occupied Bandwidth (OBW)	RSS Gen Issue 3 RSS-210, Issue 6	RSS Gen Issue 3	☐	☐	☐
2	Duty cycle	RSS Gen Issue 3 FCC Part 15.247	DA 00-705	☒	☐	☐
3	Transmitter Output Power	RSS Gen Issue 3 RSS-210, Issue 6	RSS Gen Issue 3	☒	☐	☐
4	Transmitter Frequency Stability	RSS Gen Issue 3 RSS-210, Issue 6	RSS Gen Issue 3	☐	☐	☒
5	+AC Power line Conducted Emissions	RSS Gen Issue 3 RSS-210, Issue 6	RSS Gen Issue 3	☐	☐	☒
6	Transmitter Spurious Emissions	RSS Gen Issue 3 RSS-210, Issue 6	RSS Gen Issue 3	☒	☐	☐
7	*Band Edge Measurements	RSS Gen Issue 3 RSS-210, Issue 6	RSS Gen Issue 3	☐	☐	☐
*Note: Occupied Bandwidth and Band Edge Measurements are not performed as these are covered in Radio Module Testing. + Since EUT is Battery powered, AC power line Conducted Emission Test is Not applicable						
Receiver Tests						
EUT is only a Transmitter. Receiver Tests are not applicable.						

MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels has been estimated for tests performed on the EUT as specified in CISPR 16-4

The Expanded measurement uncertainty (K=2) is provided below

#	Name	Value
1	AC Power line Conducted Emission	3.5 dB
2	Radiated Spurious Emission < 1GHz	4.9dB
3	Radiated Spurious Emission > 1GHz	6.3dB
4	Transmitter Output Power	6.3dB

1 PRODUCT DETAILS

PRODUCT OPERATION AND INTENDED USE
Wireless pressure sensor used for industrial purpose, operates in ISM band with operating frequency 2.4GHz.

RATINGS AND SYSTEM DETAILS	
Operating Frequency	2405MHz to 2475MHz
Number of Channels	15
Channel Bandwidth (20dB)	3MHz
Transmitted Power	15dBm
Modulation Type	DTS
Data Rate	250kbps
Antenna Type	Omni directional
No. of Antenna	One
Antenna Gain	2.0dBi peak
Supply Voltage	7.2VDC (Battery operated)
Dimensions	L x W x H = 256 x 99 x 95 (all dimensions in mm)
Environmental Conditions	-40°C to +85°C

TEST CONFIGURATION	
Config #	**Description**
1	Configured in continuous transmission mode with transmission power level of 15dBm

OPERATING MODES	
Mode #	**Description**
1	Product will be operating in Low Channel with 2405Mhz operating frequency(channel 1)
2	Product will be operating in Mid Channel with 2440Mhz operating frequency (channel 7)
3	Product will be operating in High Channel with 2475Mhz operating frequency(channel 15)

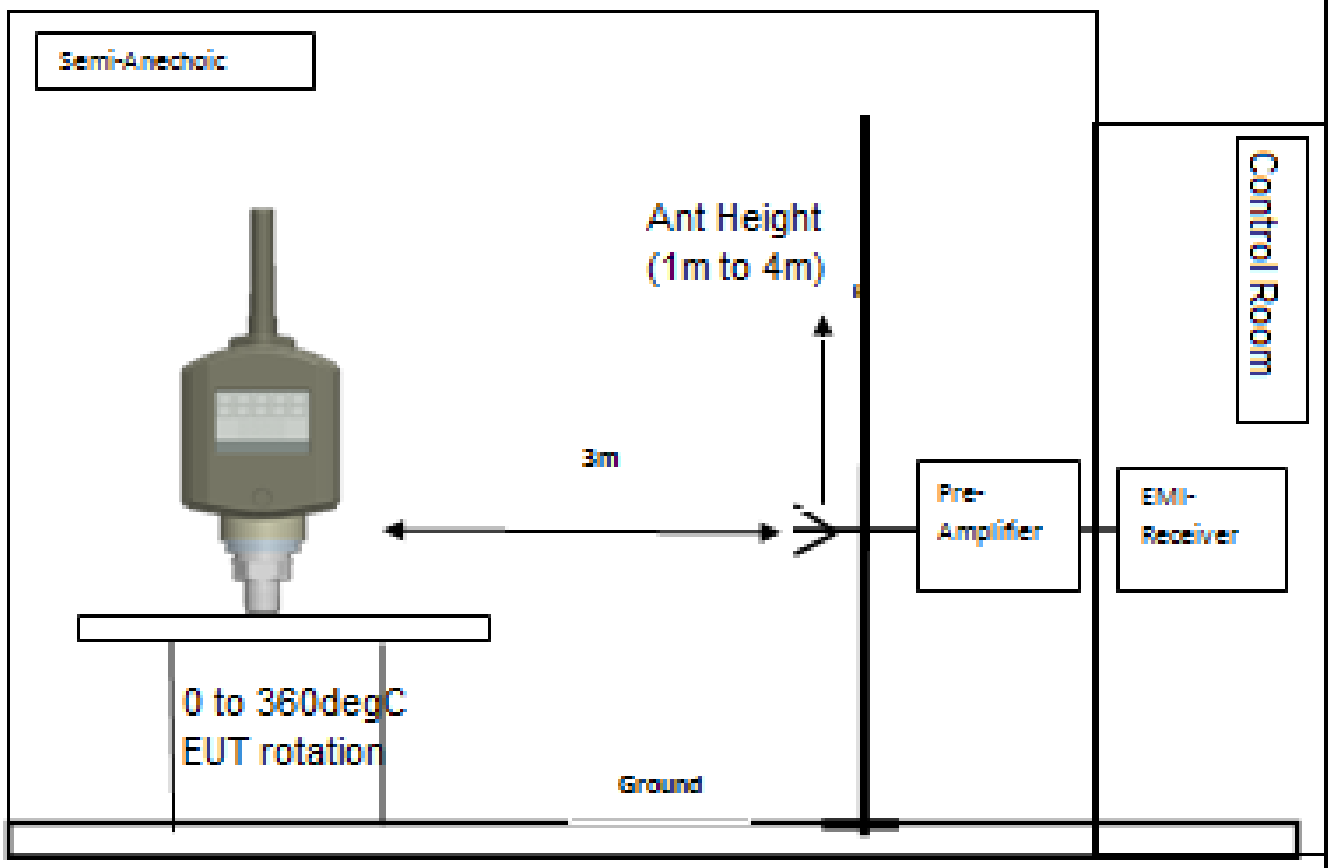
INPUT AND OUTPUT CABLES					
Port #	**Name**	**Port Type**	**Cable Length**	**Cable type Shielded/ Unshielded**	**Comments**
	Not applicable				

*Note :
AC = AC Power Port
TP = Telecommunication Ports (E.g. Ethernet)
N /E = Non Electrical
DC = DC Power Port
DI / DO = Digital Input / Output
AI / AO = Analog Input / Output

SUPPORT EQUIPMENTS AND ACCESSORIES USED					
#	**Item Description**	**Make**	**Model**	**Part No. / Sl. No**	**Cal Due Date**
	Not applicable				

CONNECTION DIAGRAM AND SETUP DIAGRAM

WPS TEST SETUP FOR EMC TESTING



Note: WPS tested in Standalone mode.

Absrobers are placed on the floor for Freq > 1GHz

2 Transmitter Tests

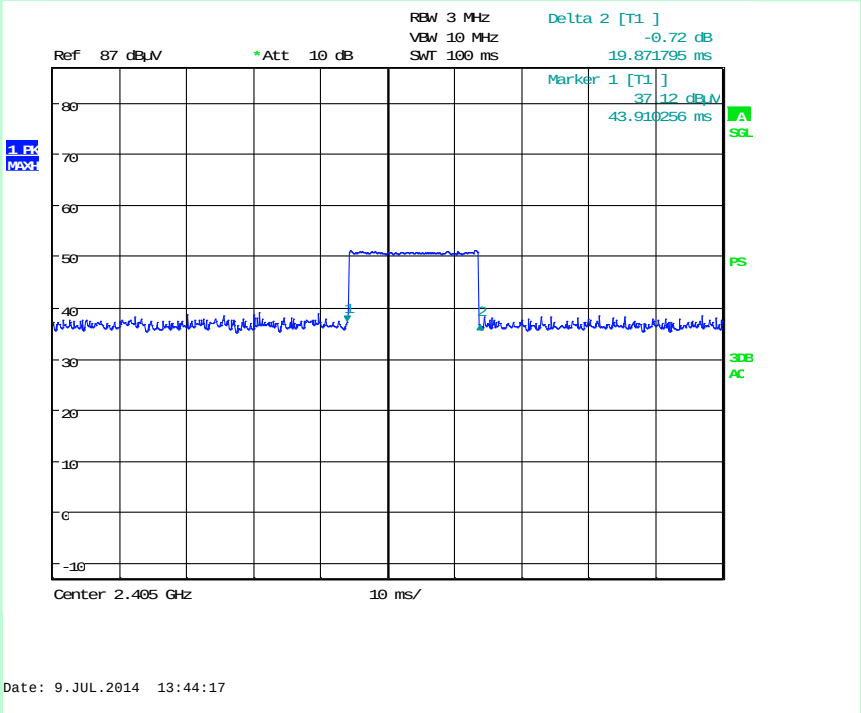
2.1 Duty Cycle

EUT Nomenclature	Wireless Pressure Sensor	**Test Report No.**	EMC -0055-3
Model No.	WPS1B121AGP1A1N	**Serial No.**	EMC-55-1
Test Start Date	21/04/2014	**Temperature (˚C)**	22˚C
Test End Date	21/04/2014	**Humidity RH (%)**	52%
Tested By	Gulshan Kumar	**Pressure (mbar)**	NR
Input Voltage / Freq	24 Vdc		
Operating Mode	Refer Page 5 for Operating Mode Table		
Test configuration	Refer Page 5 for Test Configuration Table		
Deviation from Std	NA		
Applicable standard	FCC Part 15.247 & RSS Gen Issue 3		
Test Method	DA 00-705		
Comment			
TEST DETAILS			
Method	☐ Conducted ☒ Radiated		
TEST PARAMETERS			
Antenna Height	1m to 4m	**Turntable Rotation**	0 to 360°C
Equipment Class	NA	**Measurement Distance**	NA

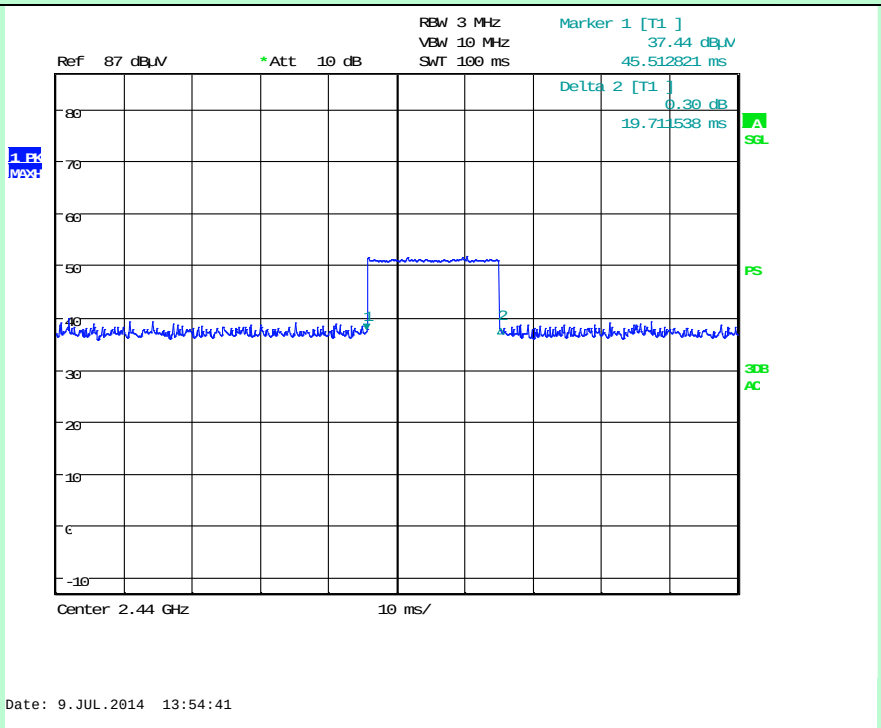
TEST EQUIPMENT					
Y/N	**Equipment**	**Make**	**Model**	**Sl. No.**	**Cal Due Date**
Y	EMI Test Receiver	R&S	ESU26	100525	7-Oct-14
Y	3m Semi Anechoic Chamber	ETS Lindgren	DKE 6X7 DBL.DR	1625	31-Dec-2015
Y	Double Ridge Guide Horn Antenna	ETS Lindgren	3117	00064055	14-Nov-2014
N	Bilog Antenna	ETS Lindgren	HLP3003C	130525	16-Nov-2014
N	Loop Antenna	ETS Lindgren	6507	00154266	23-Sep-14
N	RF cable (9KHz to 1GHz)	COLEMAN	RG214	RE-1A	09-May-2014
N	RF cable (9KHz to 1GHz)	COLEMAN	RG214	RE-1B	09-May-2014
Y	RF cable (1GHz to 18GHz)	AH Systems	SAC-18G-06	RE-2A	09-May-2014
Y	RF cable (1GHz to 18GHz)	AH Systems	SAC-18G-06	RE-2B	09-May-2014
N	Signal Conditioning unit	R&S	SCU-18	10178	13-June-2014
N	High Pass Filter	Micro tronics	BRM50702-01	1	NA
Y	EMC32 Software	R&S	8.30.0	820-OT101248	NA

Note: Switch ON /OFF the Internal Preamplifier based on carrier level and or noise floor without overloading the receiver

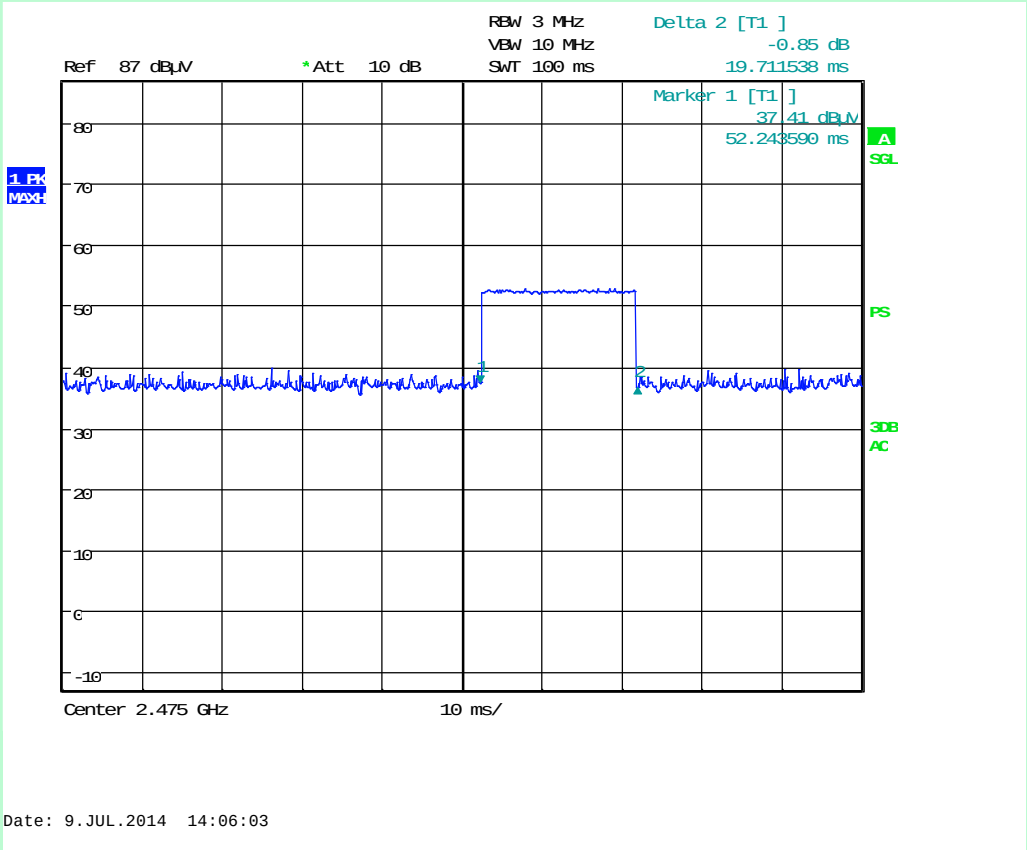
TEST GRAPHS



Channel 1 (2405MHz)



Channel 7 (2440MHz)



Channel 15 (2475MHz)

TEST RESULT

Channel	Channel Frequency	Measured Duty Cycle	No. of bursts	Total Duty cycle for 100ms
#	MHz	ms	#	ms
1	2405	19.87	1	19.87
7	2440	19.71	1	19.71
15	2475	19.71	1	19.71

TEST SETUP PHOTOGRAPHS

Refer Annexure-1

Duty Cycle

2.2 SPURIOUS RADIATED EMISSIONS

EUT Nomenclature	Wireless Pressure Sensor	**Test Report No.**	EMC -0055-3
Model No.	WPS1B121AGP1A1N	**Serial No.**	EMC-55-1
Test Start Date	20/03/14	**Temperature (˚C)**	22˚C
Test End Date	4/04/14	**Humidity RH (%)**	52%
Tested By	Nishanth	**Pressure (mbar)**	91
Input Voltage / Freq	7.2VDC (battery operated)		
Operating Mode	Refer Page 5 Operating Modes Table		
Test configuration	Refer Page 5 Test Configuration Table		
Deviation from Std	NA		
Comment	Nil		
TEST FREQUENCY RANGE			
Start Frequency	9KHz	**Stop Frequency**	18GHz

MAXIMUM OPERATING FREQUENCY

2.4GHz

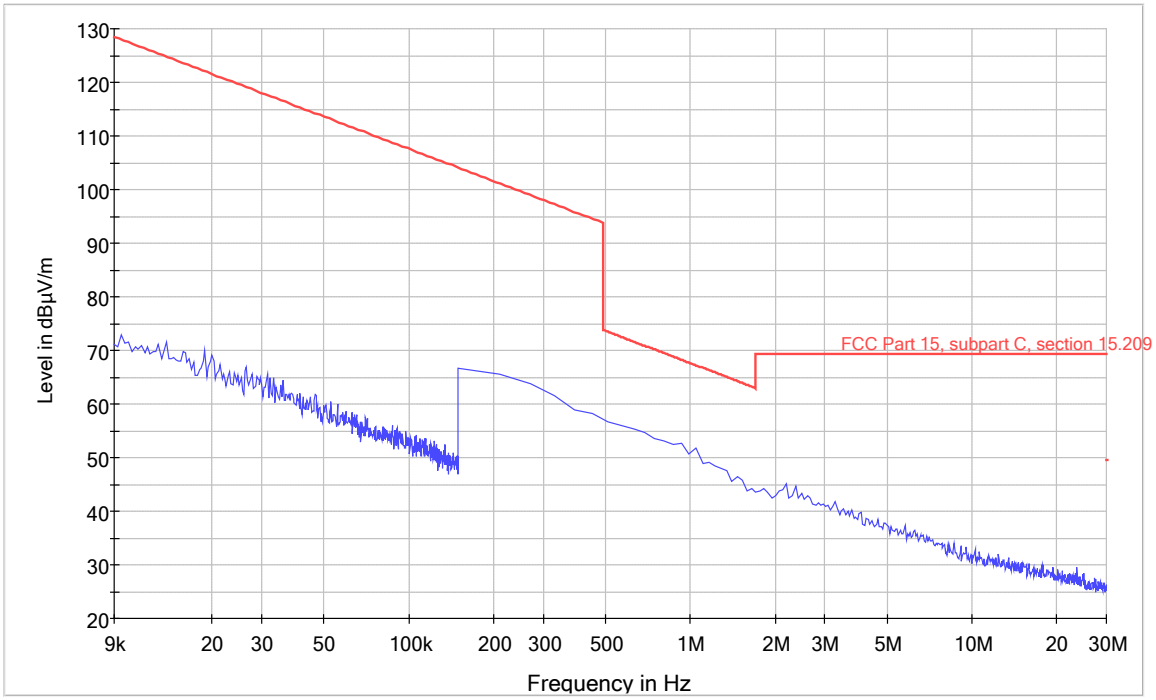
TEST PARAMETERS			
Antenna Height	1m to 4m	**Turntable Rotation**	0° to 360°
Applicable standard	FCC Part 15.209	**Test Method**	KDB 558074
Equipment Class	NA	**Measurement Distance**	3m

TEST EQUIPMENT

Y/N	Equipment	Make	Model	Sl. No.	Cal Due Date
Y	EMI Test Receiver	R&S	ESU26	100525	7-Oct-14
Y	3m Semi Anechoic Chamber	ETS Lindgren	DKE 6X7 DBL.DR	1625	31-Dec-2015
Y	Double Ridge Guide Horn Antenna	ETS Lindgren	3117	00064055	14-Nov-2014
Y	Bilog Antenna	ETS Lindgren	HLP3003C	130525	16-Nov-2014
Y	Loop Antenna	ETS Lindgren	6507	00154266	23-Sep-14
Y	RF cable (9KHz to 1GHz)	COLEMAN	RG214	RE-1A	09-May-2014
Y	RF cable (9KHz to 1GHz)	COLEMAN	RG214	RE-1B	09-May-2014
Y	RF cable (1GHz to 18GHz)	AH Systems	SAC-18G-06	RE-2A	09-May-2014
Y	RF cable (1GHz to 18GHz)	AH Systems	SAC-18G-06	RE-2B	09-May-2014
Y	Signal Conditioning unit	R&S	SCU-18	10178	13-June-2014
Y	High Pass Filter	Micro tronics	BRM50702-01	1	NA
Y	EMC32 Software	R&S	8.30.0	820-OT101248	NA

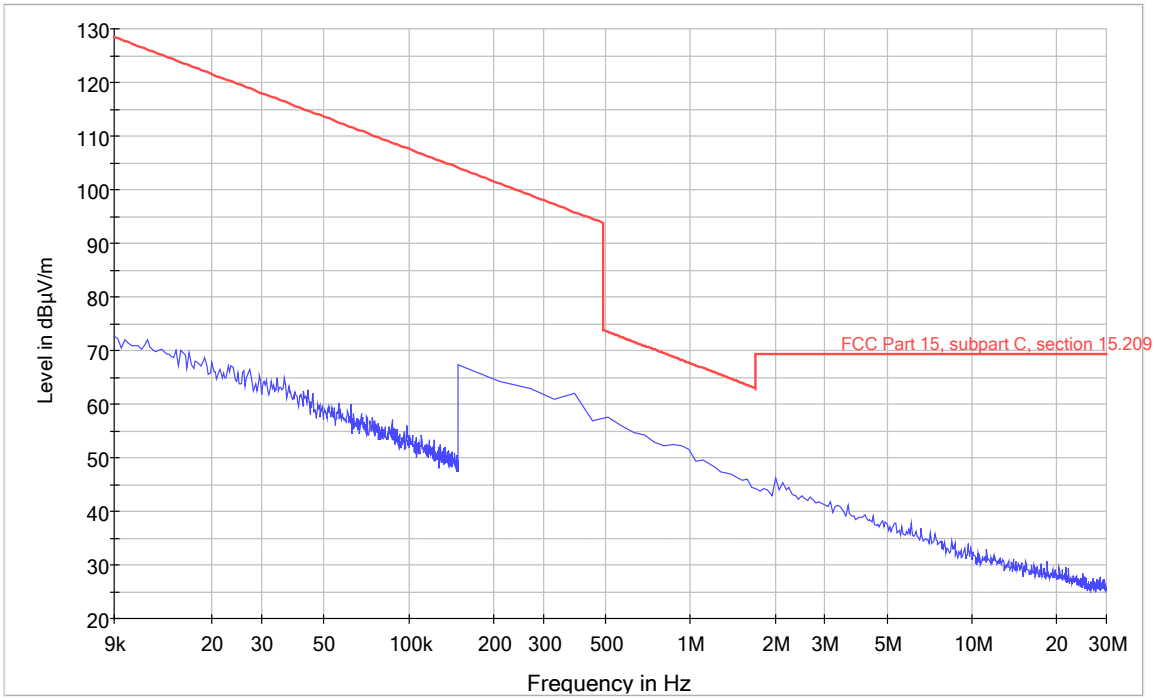
Note: Switch ON /OFF the Internal Preamplifier based on carrier level and or noise floor without overloading the receiver

TEST GRAPHS – 9 KHz to 30 MHz



Note : **Ch 01** Peak Graph - Parallel

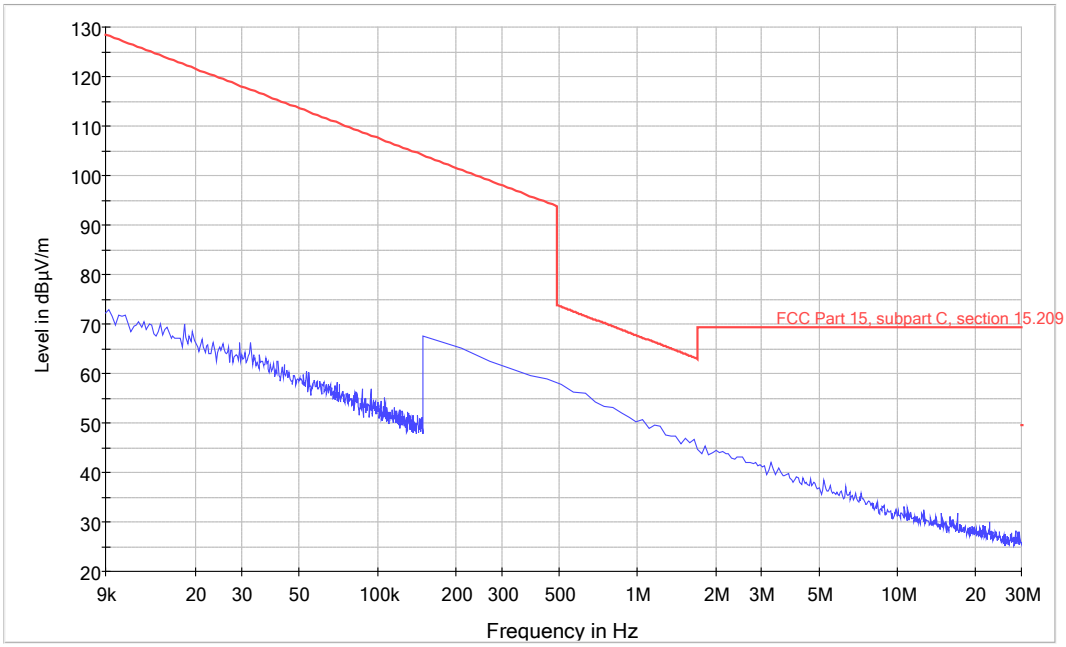
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same



Note : **Ch 01** Peak Graph - Perpendicular

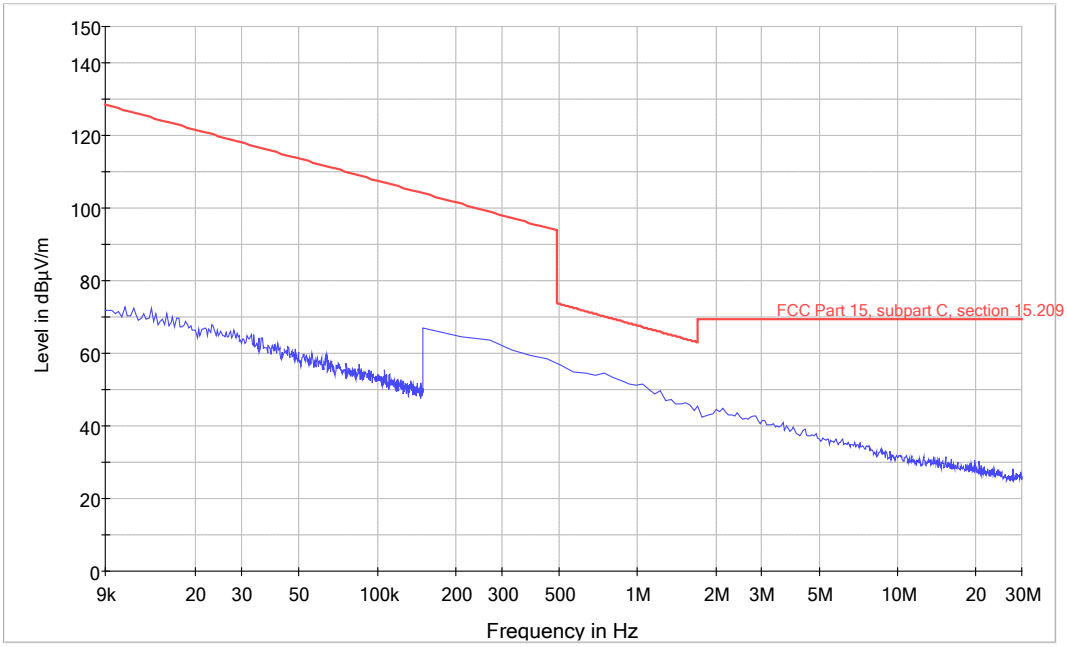
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same.

TEST GRAPHS – 9 KHz to 30 MHz



Note : **Ch 07** Peak Graph - Parallel

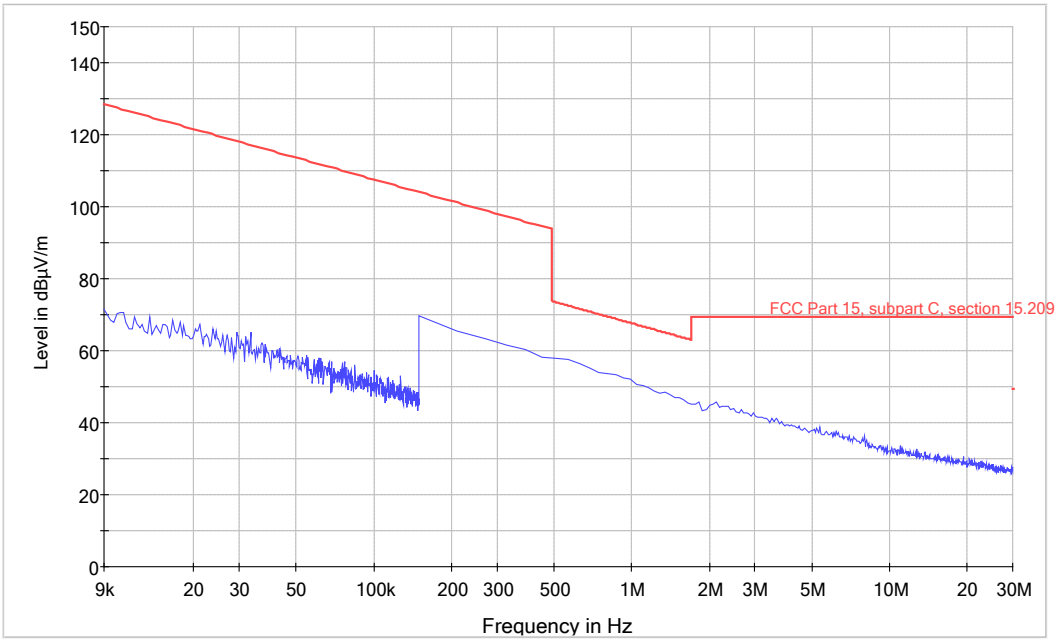
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same



Note : **Ch 07** Peak Graph - Perpendicular

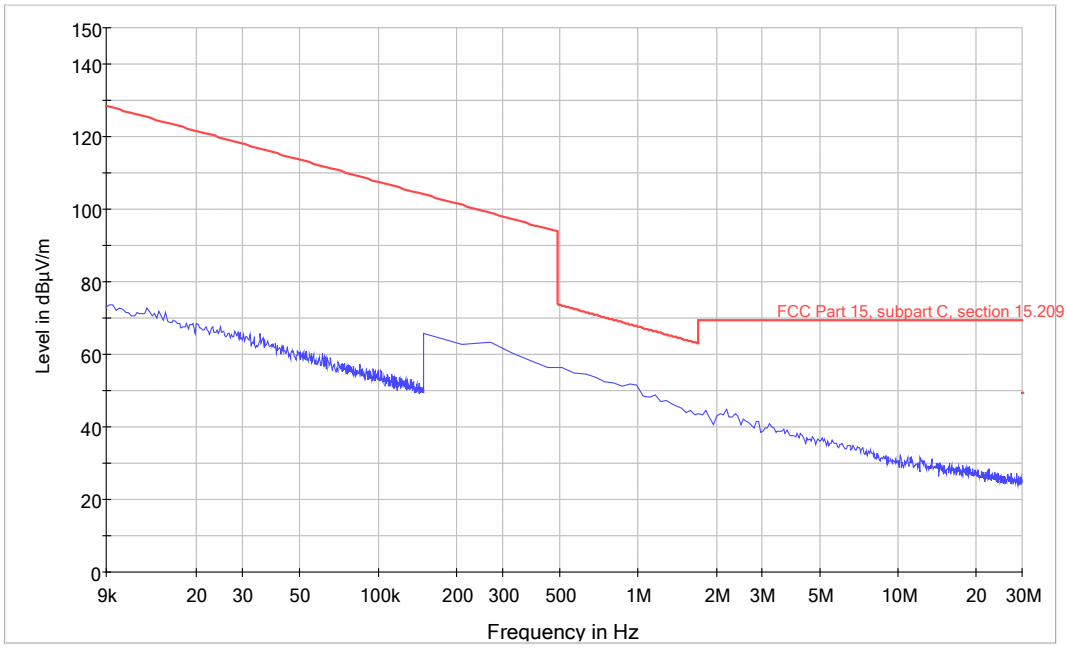
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same.

TEST GRAPHS – 9 KHz to 30 MHz



Note : **Ch 15** Peak Graph - Parallel

Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same

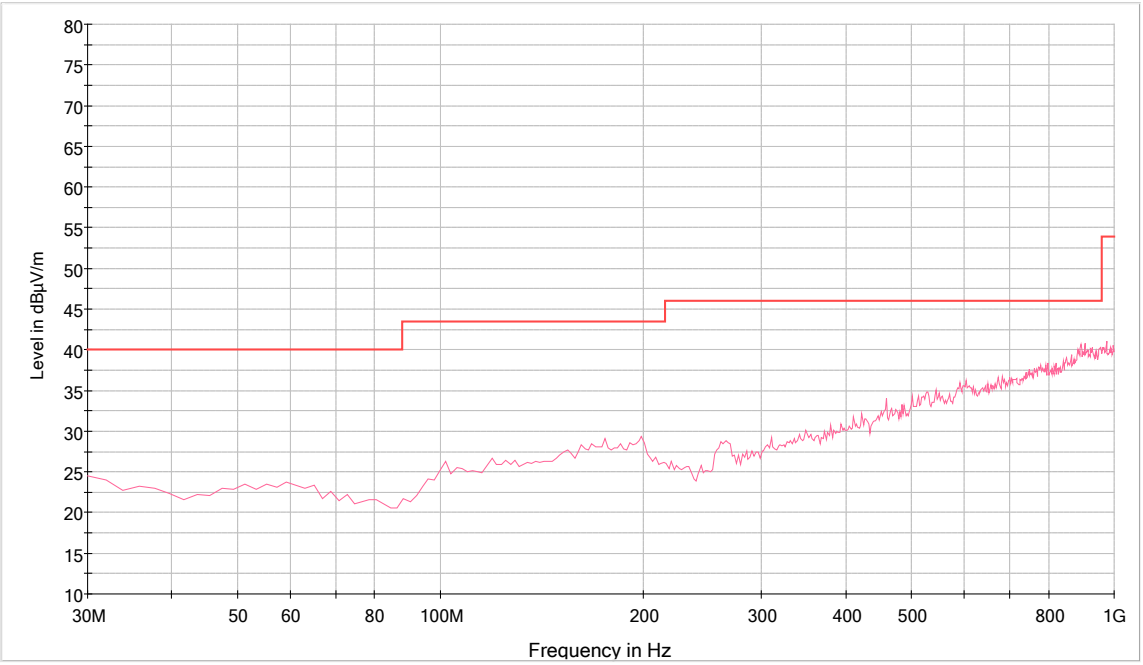


Note : **Ch 15** Peak Graph - Perpendicular

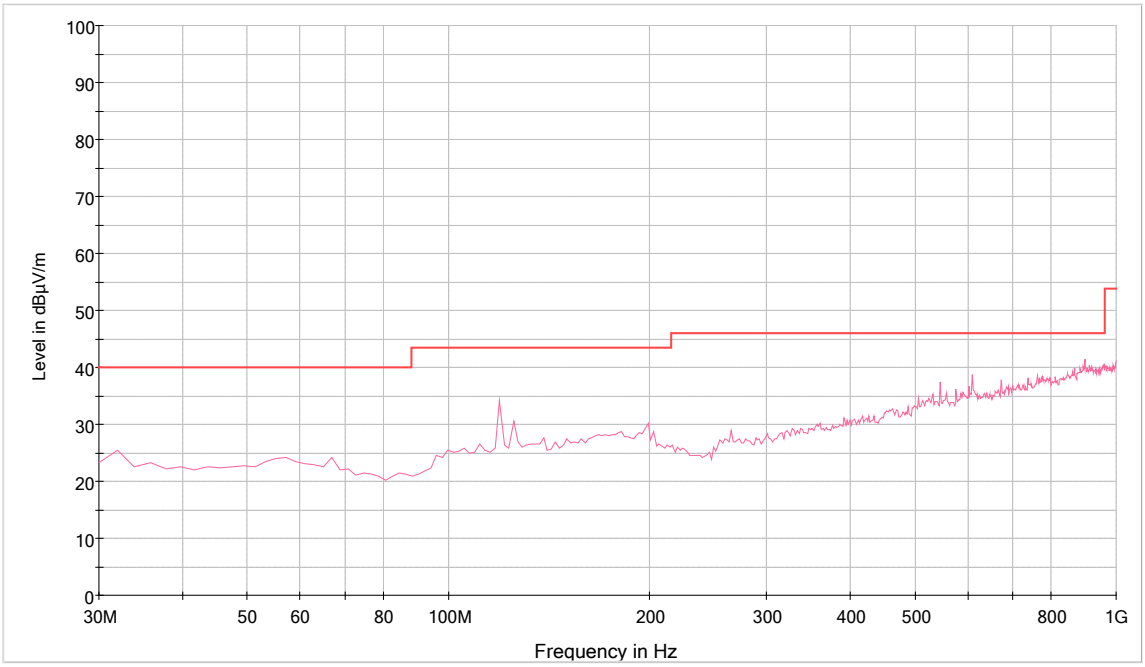
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same.

TEST RESULT – 9 KHz to 30 MHz									
Channel	Channel Frequency	Measured Spurious	Quasi Peak	Height	Ant Pol	Azimuth	Margin	Limit @ 3m Distance	Results
#	MHz	MHz	dBµV/m	cm	Parallel / Perpendicular	deg	dB	dBµV/m	
1	No Emissions found								
7									
15									

TEST GRAPHS – 30 MHz to 1 GHz

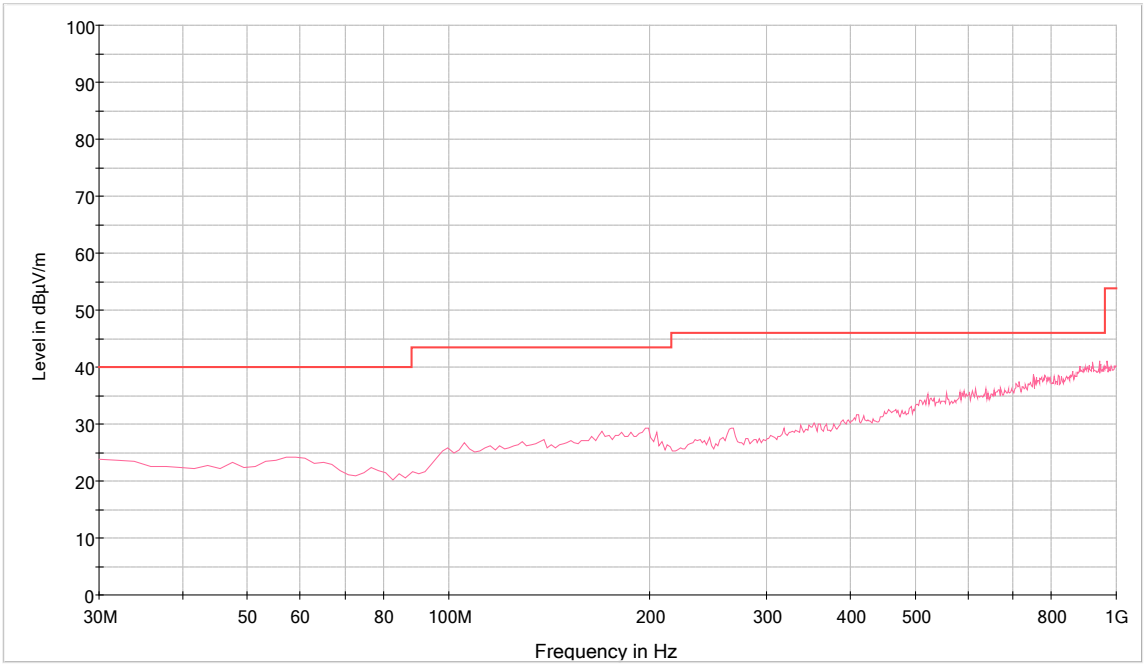


Note : **Ch 01** Peak Graph - Horizontal

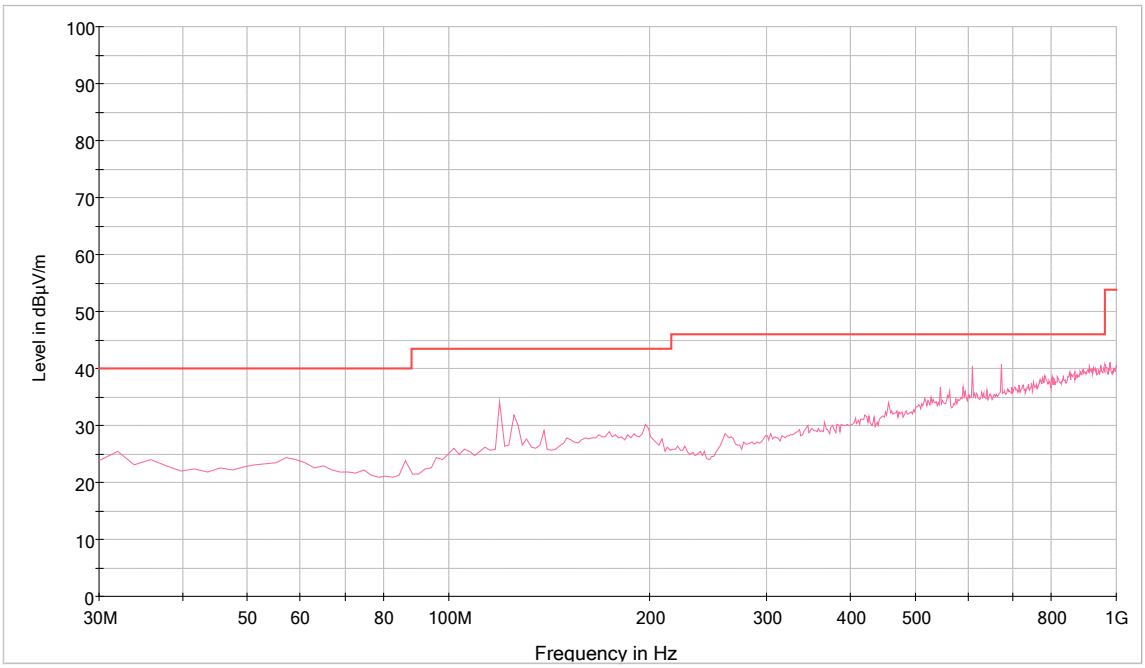


Note : **Ch 1** Peak Graph - Vertical

TEST GRAPHS – 30 MHz to 1 GHz

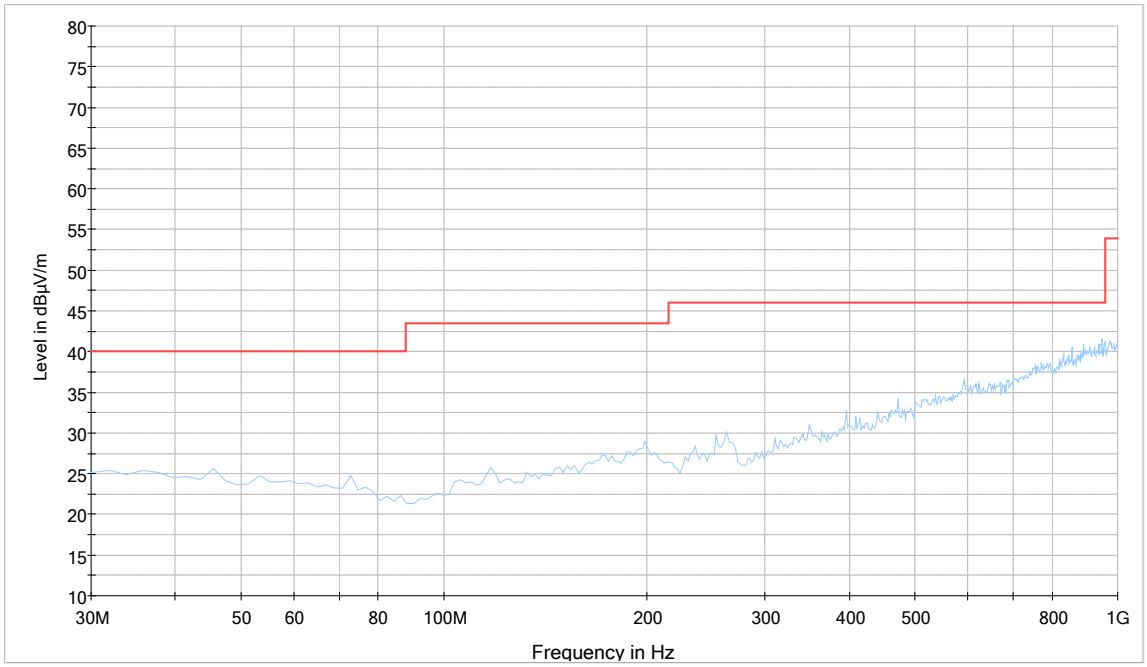


Note : **Ch 07** Peak Graph - Horizontal

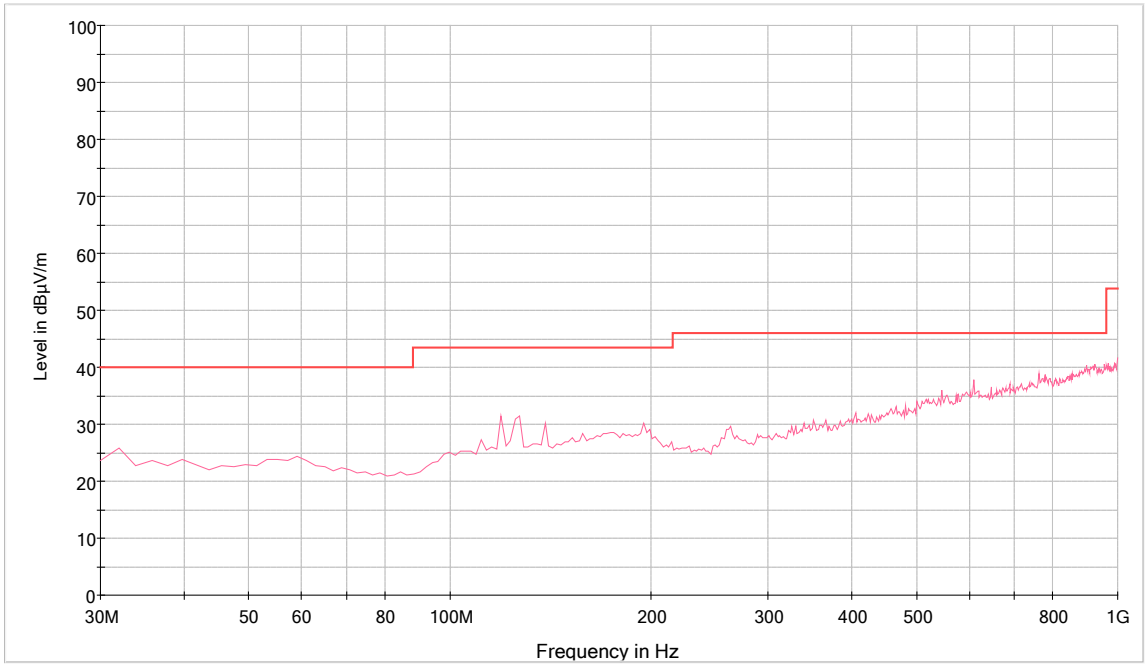


Note : **Ch 07** Peak Graph - Vertical

TEST GRAPHS – 30 MHz to 1 GHz



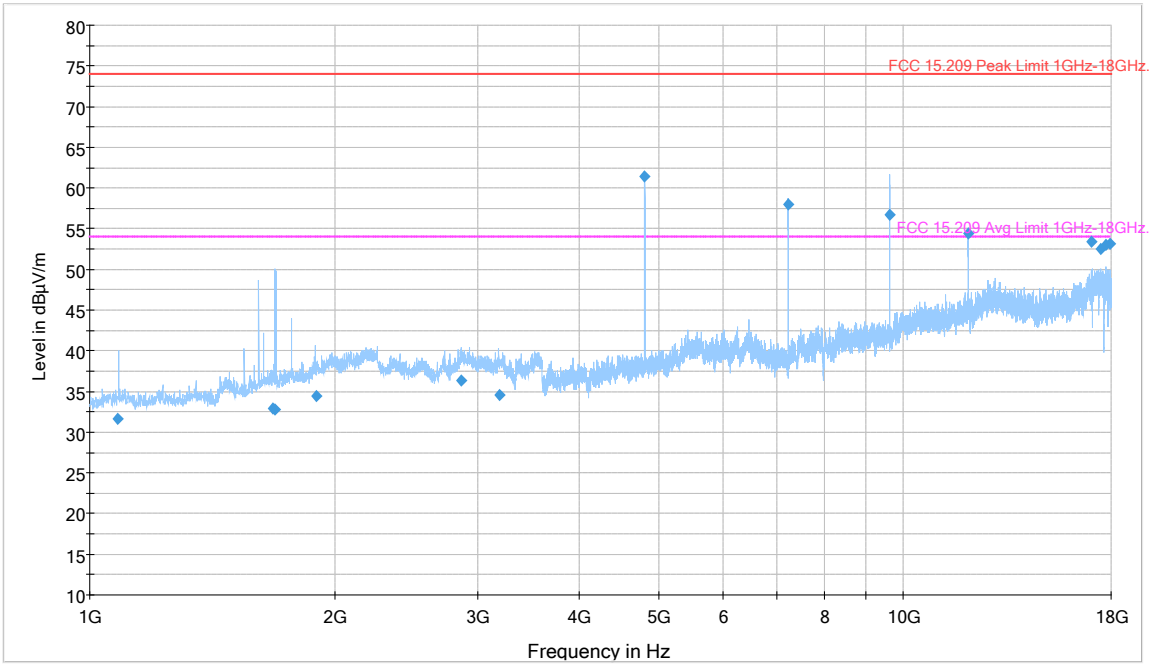
Note : **Ch 15** Peak Graph - Horizontal



Note : **Ch 15** Peak Graph - Vertical

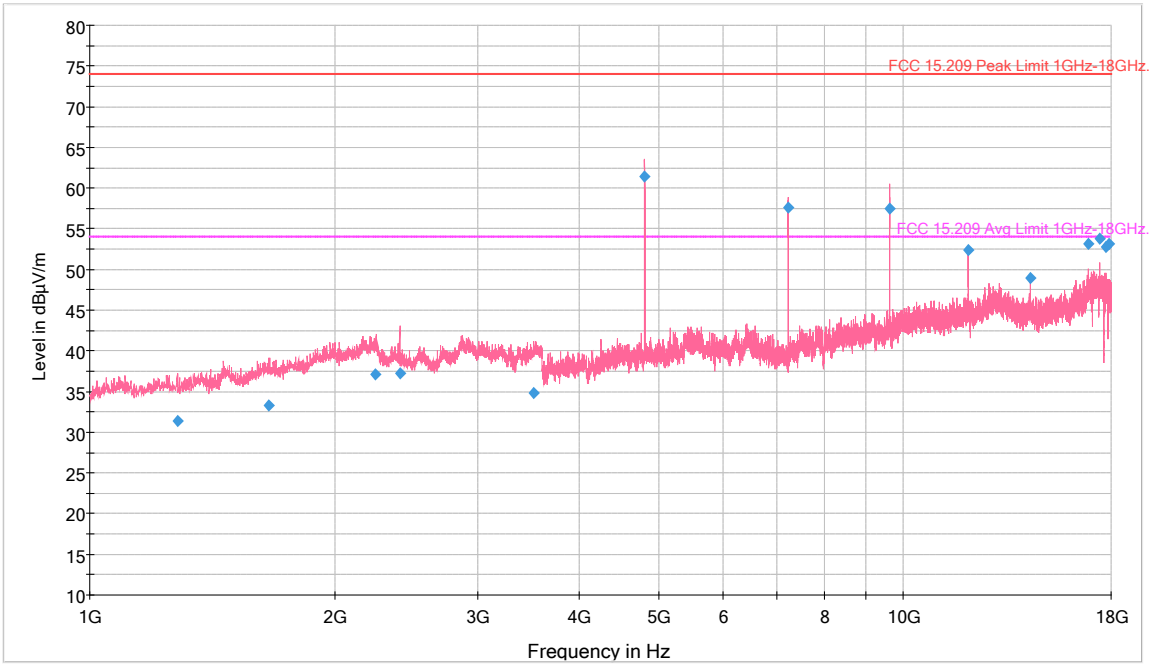
TEST RESULT – 30 MHz to 1 GHz								
Channel	Freq	Measured Quasi Peak	Height	Ant Pol	Azimuth	Margin	Limit @ 3m Distance	Results
#	MHz	dBµV/m	cm	H / V	deg	dB	dBµV/m	
CH1	185.39	21.92	150	H	90	21.58	43.5	Pass
	191.76	22.08	98	H	0	21.42	43.5	Pass
	701.09	30.30	98	H	0	15.70	46	Pass
	778.16	31.88	99	H	270	14.12	46	Pass
	904.93	33.81	98	H	0	12.19	46	Pass
	928.36	33.81	99	H	90	12.19	46	Pass
	974.84	33.92	150	H	120	20.08	54	Pass
	119.08	23.81	100	V	120	19.69	43.5	Pass
	897.11	33.83	100	V	240	12.17	46	Pass
	957.21	34.04	100	V	180	11.96	46	Pass
	962.78	34.17	100	V	240	19.84	54	Pass
	999.98	34.44	100	V	30	19.56	54	Pass
CH7	197.23	22.95	79	H	180	20.55	43.5	Pass
	615.49	29.39	100	H	300	16.61	46	Pass
	638.53	29.12	100	H	330	16.88	46	Pass
	671.23	29.59	100	H	240	16.41	46	Pass
	696.39	30.26	100	H	240	15.74	46	Pass
	947.51	33.56	150	H	270	12.44	46	Pass
	125.66	27.53	100	V	0	15.97	43.5	Pass
	608.98	29.33	100	V	30	16.67	46	Pass
	672.94	29.60	100	V	120	16.41	46	Pass
	832.54	31.92	100	V	270	14.08	46	Pass
	912.61	33.84	150	V	30	12.16	46	Pass
	949.51	33.64	150	V	60	12.36	46	Pass
CH15	702.92	30.58	100	H	60	15.42	46	Pass
	770.89	32.26	150	H	0	13.74	46	Pass
	819.28	32.56	100	H	0	13.44	46	Pass
	823.51	32.52	150	H	120	13.48	46	Pass
	830.39	32.67	150	H	0	13.33	46	Pass
	836.99	32.75	100	H	0	13.25	46	Pass
	762.89	31.57	150	V	150	14.43	46	Pass
	778.35	31.94	150	V	210	14.06	46	Pass
	782.29	31.98	150	V	210	14.02	46	Pass
	807.94	31.68	100	V	0	14.32	46	Pass
	838.31	32.18	100	V	300	13.82	46	Pass
	924.00	33.99	100	V	90	12.01	46	Pass
NOTE: Measured Field Strength –dBuV/m (30 MHz to 1 GHz) = Receiver Readings (dBuV) + Antenna Factor (dB/m) + Cable loss (dB)								

TEST GRAPHS – 1 GHz to 18 GHz



Note : **Ch 01** Peak Graph - Horizontal

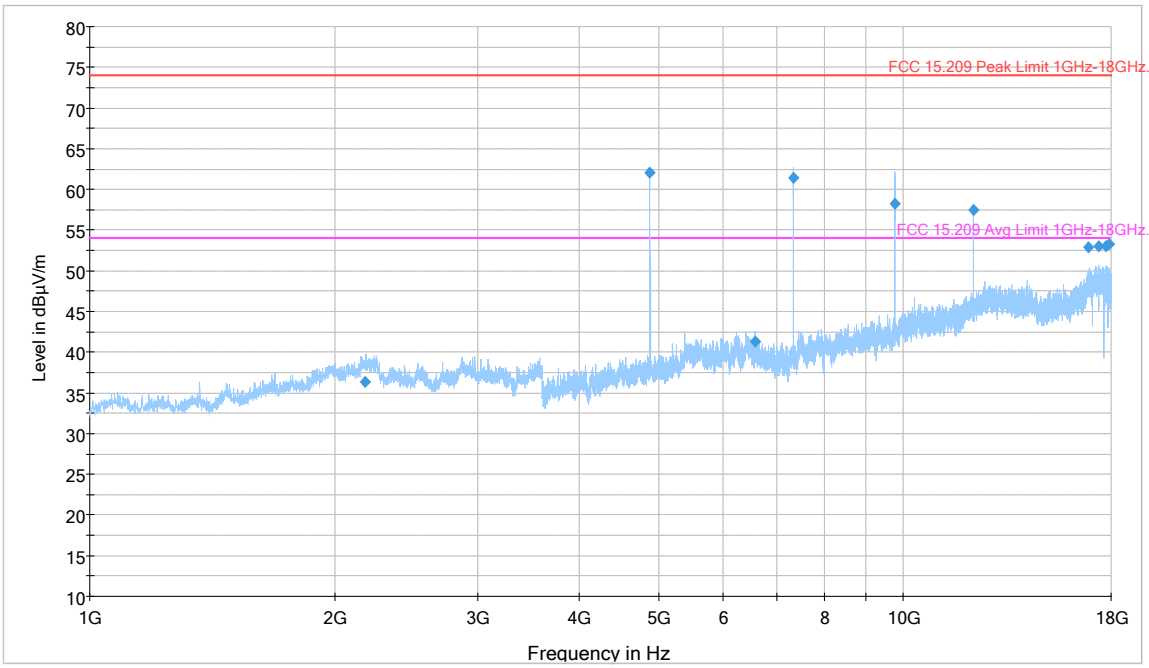
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same



Note : **Ch 01** Peak Graph - Vertical

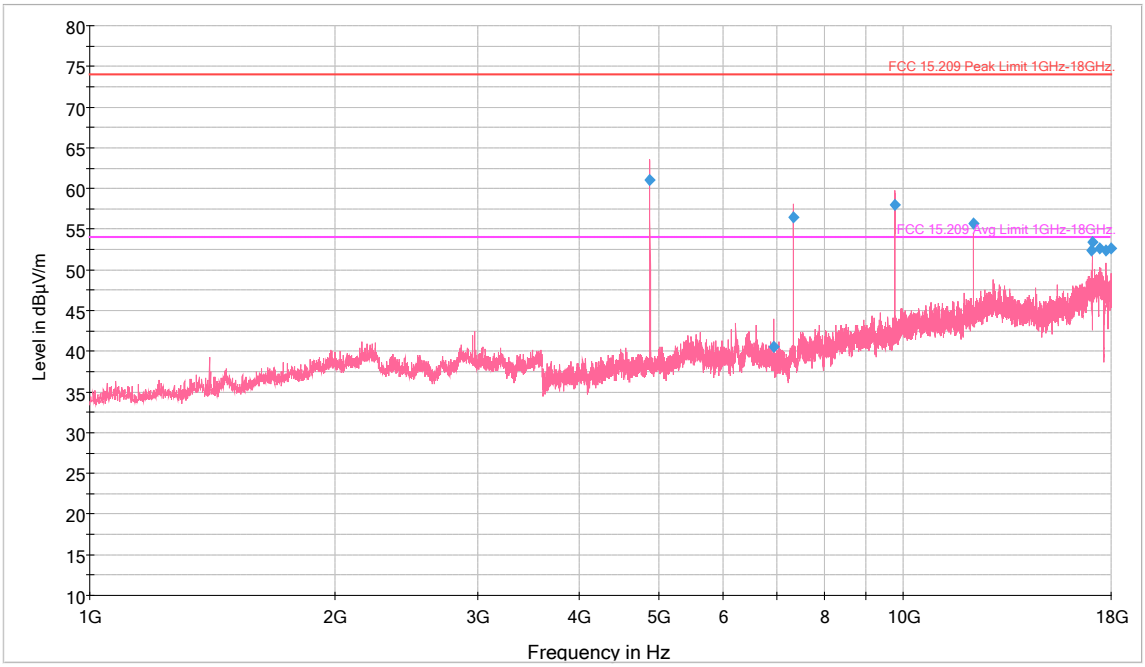
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same.

TEST GRAPHS – 1 GHz to 18 GHz



Note : **Ch 07** Peak Graph - Horizontal

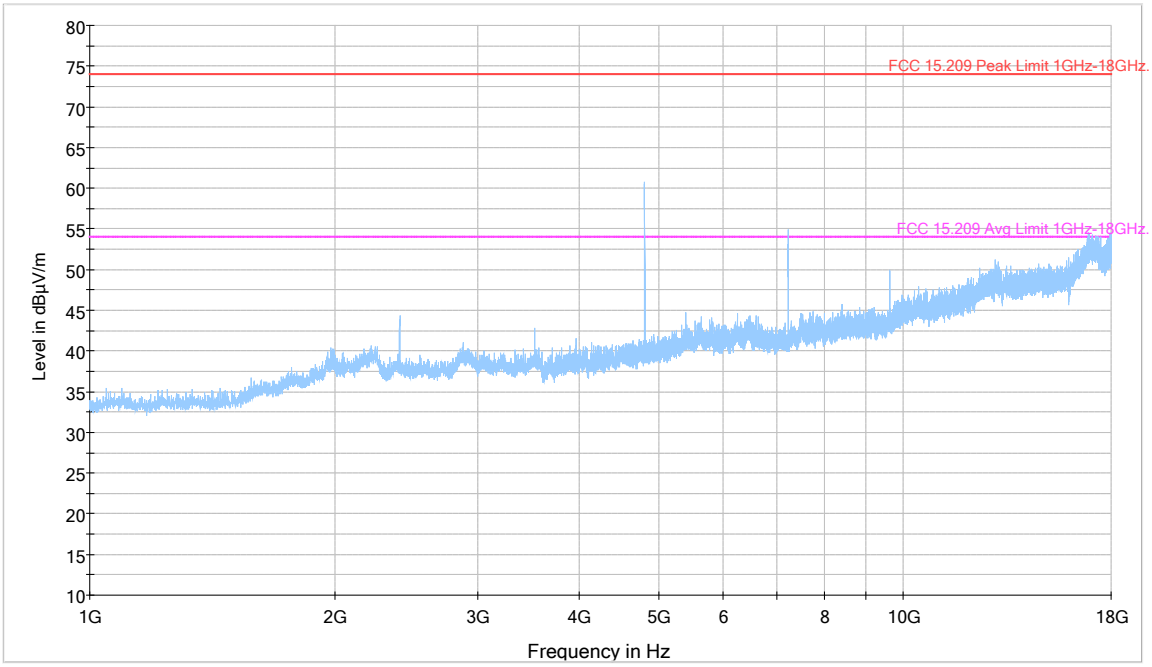
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same



Note : **Ch 07** Peak Graph - Vertical

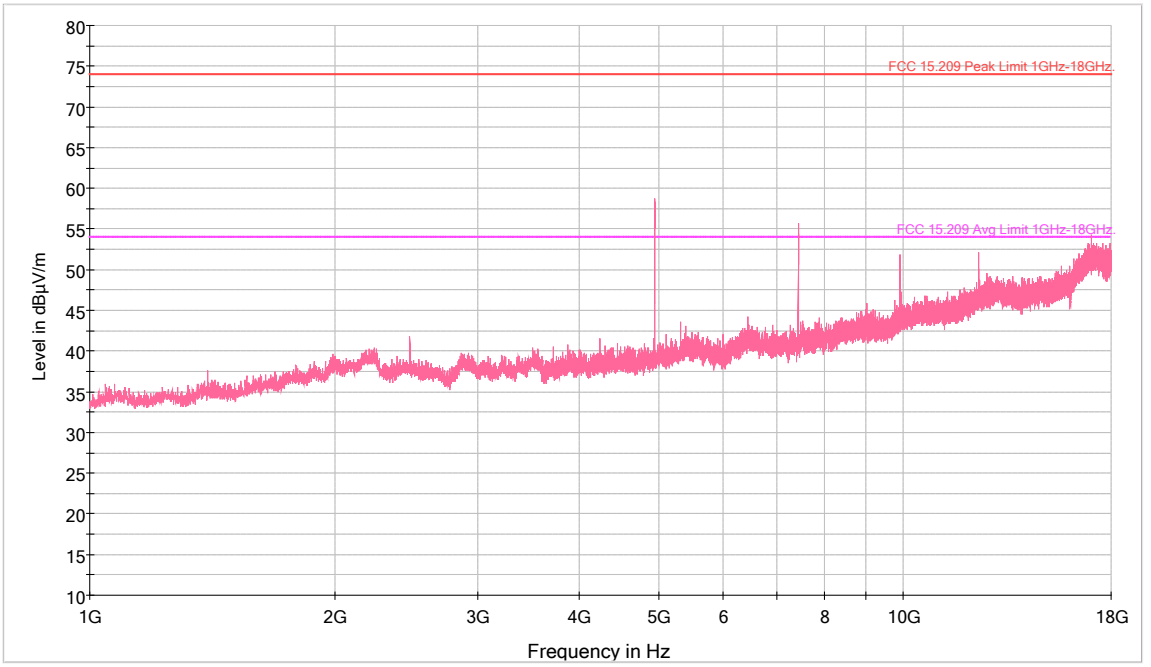
Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same.

TEST GRAPHS – 1 GHz to 18 GHz



Note : **Ch 15** Peak Graph - Horizontal

Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same



Note : **Ch 15** Peak Graph - Vertical

Note: FCC part 15, Subpart C -15.209 Limits and RSS Gen Issue 3 Limits are same.

TEST RESULT – 1 GHz to 18 GHz									PEAK & Average	
Channel	Frequency	Measured Max Peak	Calculated Average	Height	Ant Pol	Azimuth	Peak limit	Avg Limit	Peak Margin	Avg Margin
#	(MHz)	(dBµV/m)	(dBµV/m)	(cm)	H / V	(deg)	(dBµV/m)	(dBµV/m)	(dB)	(dB)
CH1	3187.54	34.6	14.6	300	H	286	74	54	39.4	39.4
	4811.02	61.4	41.4	200	H	88	74	54	12.6	12.6
	7213.31	58	38	100	H	132	74	54	16	16
	9617.67	56.7	36.7	100	H	132	74	54	17.3	17.3
	12027.78	54.4	34.4	100	H	66	74	54	19.6	19.6
	3509.32	34.8	14.8	100	V	176	74	54	39.2	39.2
	4808.96	61.4	41.4	100	V	220	74	54	12.6	12.6
	7213.45	57.6	37.6	100	V	286	74	54	16.4	16.4
	9617.67	57.5	37.5	100	V	44	74	54	16.5	16.5
	12027.7	52.4	32.4	100	V	132	74	54	21.6	21.6
	14330.84	49	29	100	V	132	74	54	25	25
	16854.63	53.1	33.1	200	V	220	74	54	20.9	20.9
CH7										
	2178.25	36.4	16.4	300	H	242	74	54	37.6	37.6
	4880.98	62.1	42.1	200	H	88	74	54	11.9	11.9
	6566.99	41.3	21.3	300	H	0	74	54	32.7	32.7
	7318.52	61.4	41.4	100	H	132	74	54	12.6	12.6
	9761.86	58.2	38.2	100	H	132	74	54	15.8	15.8
	12202.24	57.4	37.4	100	H	66	74	54	16.6	16.6
	16898.29	52.9	32.9	200	H	220	74	54	21.1	21.1
	4879.04	61	41	100	V	220	74	54	13	13
	6923.81	40.5	20.5	100	V	44	74	54	33.5	33.5
	7321.18	56.5	36.5	100	V	286	74	54	17.5	17.5
	9761.72	58	38	100	V	132	74	54	16	16
CH15	12202.05	55.7	35.7	200	V	110	74	54	18.3	18.3
	4949.1	63.4	43.4	100	H	198	74	54	10.6	10.6
	4951.37	60.7	40.7	100	H	154	74	54	13.3	13.3
	7423.73	55.7	35.7	100	H	66	74	54	18.3	18.3
	7426.57	56	36	100	H	66	74	54	18	18
	9897.8	54	34	100	H	88	74	54	20	20
	9902.33	53.2	33.2	100	H	88	74	54	20.8	20.8
	4949.1	57.3	37.3	100	V	66	74	54	16.7	16.7
	4950.8	57	37	100	V	66	74	54	17	17
	7424.3	52.4	32.4	100	V	242	74	54	21.6	21.6
	7426.57	55.9	35.9	100	V	242	74	54	18.1	18.1
	9898.93	48.6	28.6	100	V	132	74	54	25.4	25.4
	9901.77	51.8	31.8	100	V	176	74	54	22.2	22.2
	17024.2	54.5	34.5	400	V	132	74	54	19.5	19.5

Note : Peak Measured Field Strength –dBuV/m = Receiver Readings (dBuV) + Antenna Factor (dB/m) + Cable loss (dB)+ Notch Filter Insertion loss (dB) – Pre amplifier Gain (dB)

Considering worst case duty cycle = 20msec

Calculated Average readings = Peak readings in dBuV/m – Duty cycle Correction Factor (dB)

Duty Cycle Correction Factor = 20 log (20 /100) = -13.98 (Duty Cycle Correction Factor)

Where, 20ms= Max. Pulse ON Time during 100msec

2.3 TRANSMITTER OUTPUT POWER

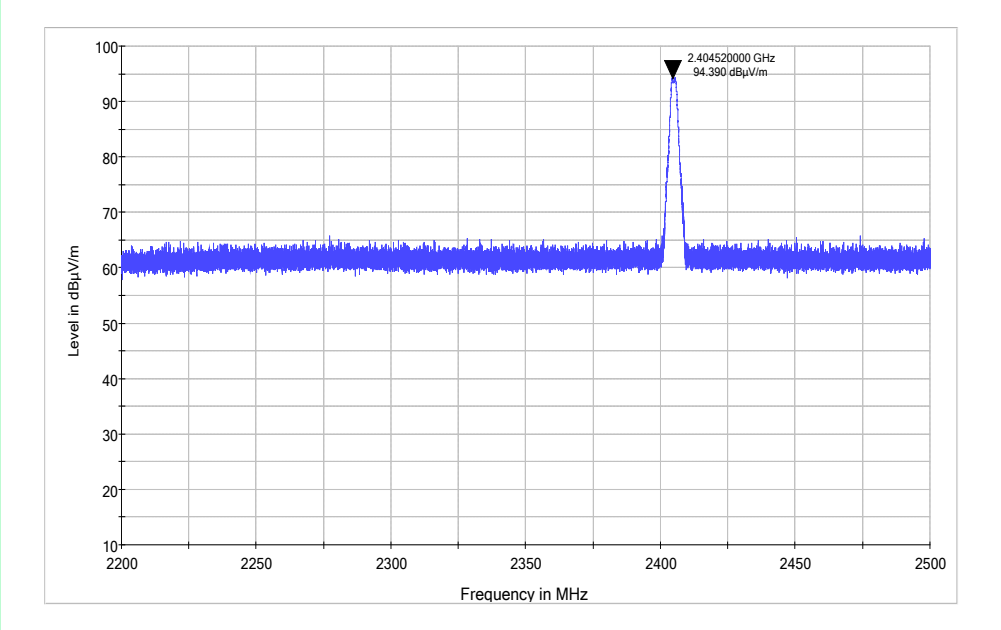
EUT Nomenclature	Wireless Pressure Sensor	**Test Request No.**	EMC -0055-3
Model No.	WPS1B121AGP1A1N	**Serial No.**	EMC-55-1
Test Start Date	21/04/2014	**Temperature (˚C)**	22˚
Test End Date	21/04/2014	**Humidity RH (%)**	52%
Tested By	Gulshan Kumar	**Pressure (mbar)**	NR
Input Voltage / Freq	24 Vdc		
Operating Mode	Refer Page 5 for Operating Mode Table		
Test configuration	Refer Page 5 for Test Configuration Table		
Deviation from Std	NA		
Applicable standard	RSS Gen Issue 3 RSS-210, Issue 6		
Test Method	RSS Gen Issue3		
Comment			
TEST DETAILS			
Method	☐ Conducted ☒ Radiated		
TEST PARAMETERS			
Antenna Height	1m to 4m	**Turntable Rotation**	0 to 360°C
Equipment Class	NA	**Measurement Distance**	NA

TEST EQUIPMENT

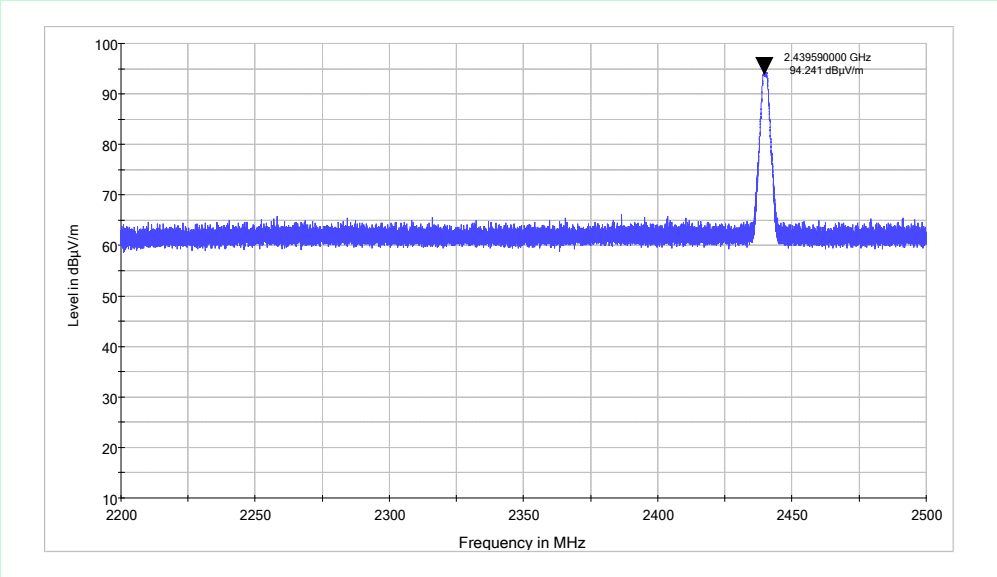
Y/N	Equipment	Make	Model	Sl. No.	Cal Due Date
Y	EMI Test Receiver	R&S	ESU26	100525	7-Oct-14
Y	3m Semi Anechoic Chamber	ETS Lindgren	DKE 6X7 DBL.DR	1625	31-Dec-2015
Y	Double Ridge Guide Horn Antenna	ETS Lindgren	3117	00064055	14-Nov-2014
Y	RF cable (1GHz to 18GHz)	AH Systems	SAC-18G-06	RE-2A	09-May-2014
Y	RF cable (1GHz to 18GHz)	AH Systems	SAC-18G-06	RE-2B	09-May-2014
N	Signal Conditioning unit	R&S	SCU-18	10178	13-June-2014
Y	EMC32 Software	R&S	8.30.0	820-OT101248	NA
Y	20dB Attenuator	EM TEST	09 015 200 S11	CS-ATT-1	06-May-2014

Note: Switch ON /OFF the Internal Preamplifier based on carrier level and or noise floor without overloading the receiver

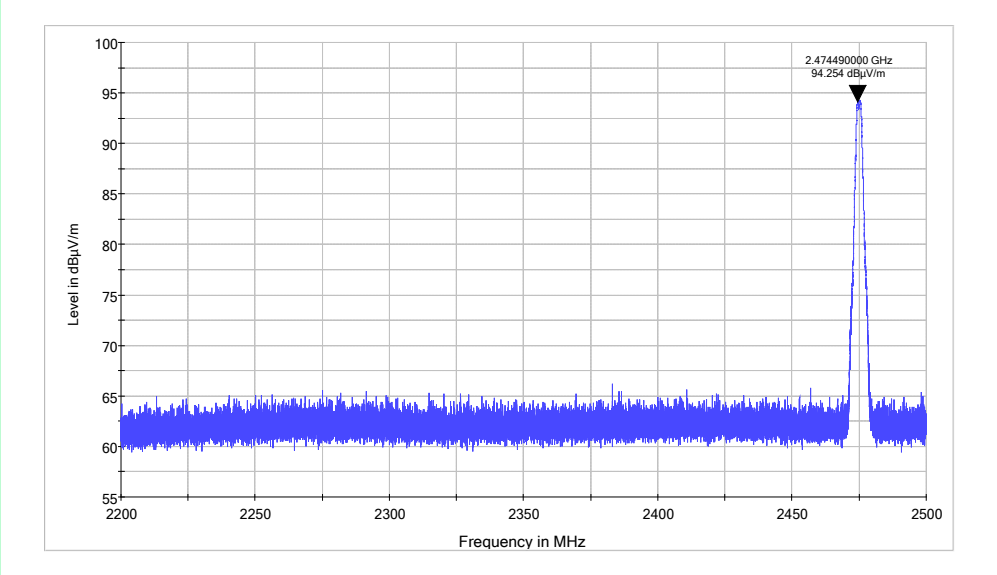
TEST GRAPHS



Channel 1 (2405MHz)



Channel 7 (2440MHz)



Channel 15 (2475MHz)

TEST RESULT						
Channel	**Channel Frequency**	**Measured Field Strength**	**External Attenuator**	***Calculated Field Strength**	**Measurement distance**	**Transmitter Output Power in Watts**
#	**MHz**	**dBµV/m**	**dB**	**V/m**	**m**	**mW**
1	2405	94.39	20	0.524	3	50.26
7	2440	94.24	20	0.515	3	48.56
15	2475	94.25	20	0.515	3	48.67

STEP 1 : Convert the measured field strength (dBuV/m) to V/m using below formula

$$V/m = 10^{(((dB\mu V/m) - 120) / 20)}$$

STEP 2 : use below formula for Transmitter Output Power in watts

$$TP = (FS \times D)^2 / (30 \times G)$$

where:

TP = transmitter output power in watts,
G = numeric gain of the transmitting antenna in Numeric
FS = electric field strength in V/m,
D = measurement distance in meters (m).

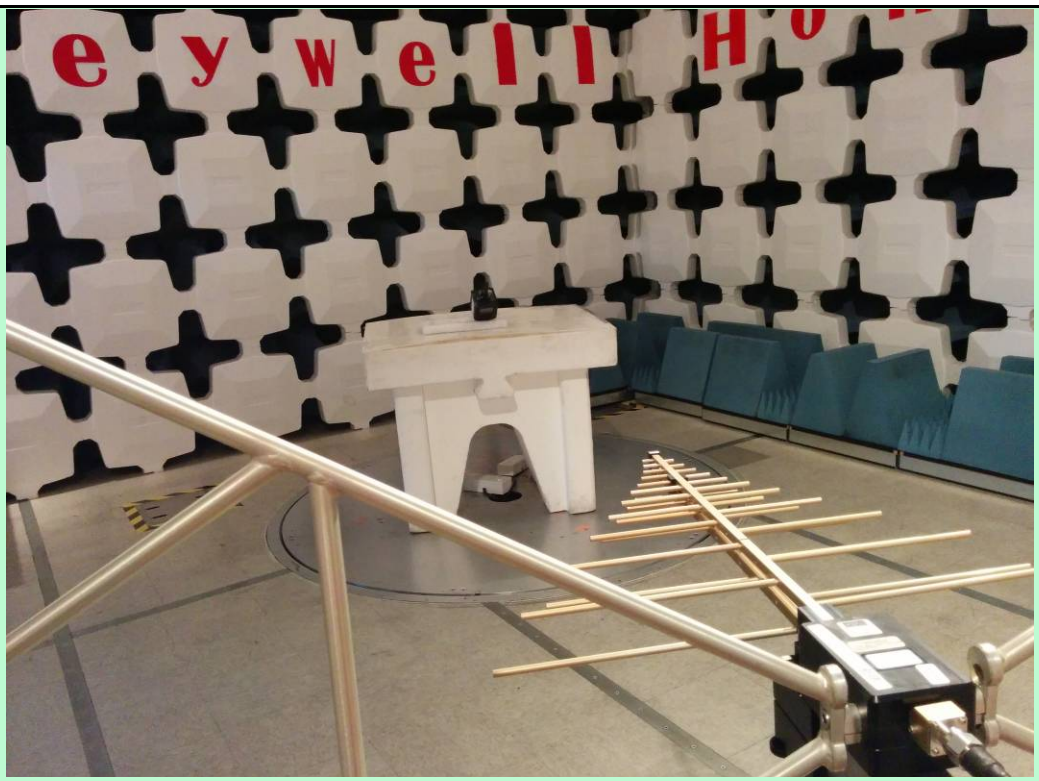
TEST SETUP PHOTOGRAPHS
Refer Annexure-1 **Transmitter Output Power**

Annexure – 1

RADIATED EMISSION SETUP

Radiated Emission Setup – 9 KHz to 30 MHz [Parallel]

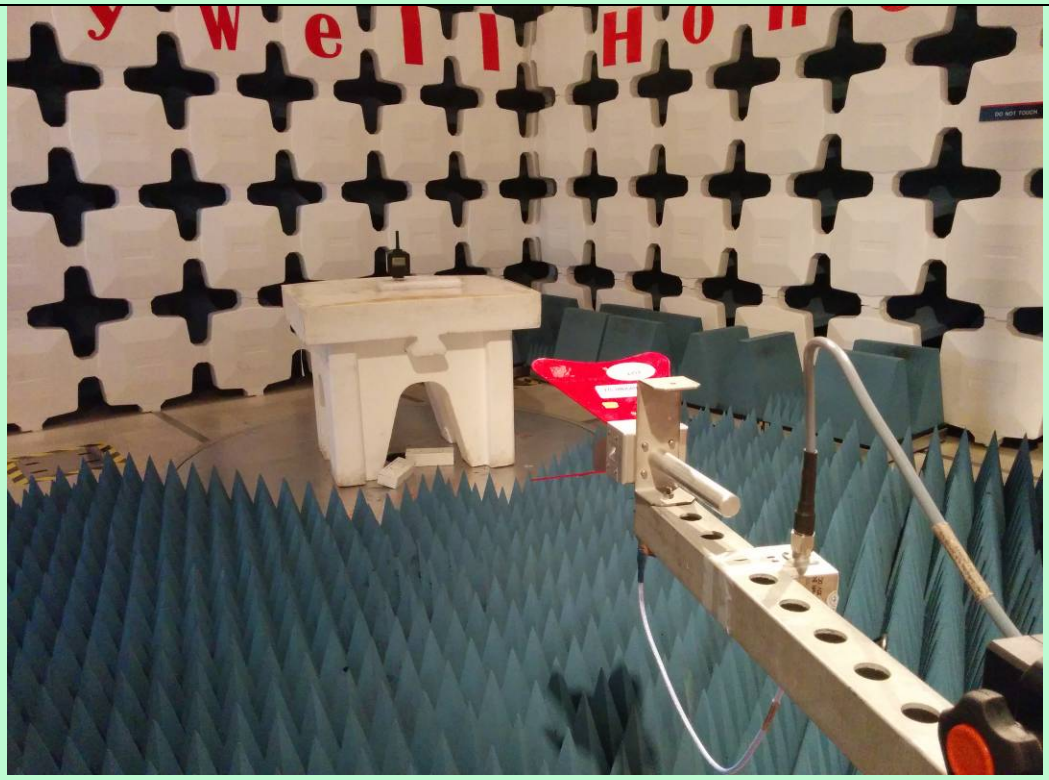
Radiated Emission Setup – 9 KHz to 30 MHz [Perpendicular]



Radiated Emission Setup –30 MHz to 1GHz [Horizontal Polarization]

Radiated Emission Setup –30 MHz to 1GHz [Vertical Polarization]

Radiated Emission Setup –1 GHz to 18GHz [Horizontal Polarization]



Radiated Emission Setup –1 GHz to 18GHz [Vertical Polarization]

Test Setup : Transmitter Output Power and Dwell Time