FCC Test Report

FCC ID	:	**PPQ-WSG309S**
Equipment	:	**Sigfox Monarch Module**
Brand Name	:	**LITE-ON**
Model Name	:	**WSG309S**
Applicant	:	**Lite-On Technology Corp. Bldg. C, 90, Chien 1 Road, Chung Ho, New Taipei City 23585, Taiwan, R.O.C**
Manufacturer	:	**LITE-ON Technology (Changzhou) Co., Ltd. A9 Building,No.88 Yanghu Road, Wujin Hi-Tech Industrial Development Zone ,Changzhou City,Jiangsu Province 213100 China**
Standard	:	**47 CFR FCC Part 15.247**

The product was received on Nov. 01, 2019, and testing was started from Sep. 09, 2019 and completed on Nov. 15, 2019. We, SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in ANSI C63.10-2013 and shown compliance with the applicable technical standards.

The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any agency of government.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory, the test report shall not be reproduced except in full.

Approved by: Allen Lin

SPORTON INTERNATIONAL INC. EMC & Wireless Communications Laboratory

No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)

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History of this test report

Report No.	Version	Description	Issued Date
FR930617-02AF	01	Initial issue of report	Nov. 21, 2019

Summary of Test Result

Report Clause	Ref. Std. Clause	Test Items	Result (PASS/FAIL)	Remark
1.1.2	15.203	Antenna Requirement	PASS	FCC 15.203
3.1	15.207	AC Power-line Conducted Emissions	PASS	FCC 15.207
3.2	15.247(a)	20dB Bandwidth	PASS	15.247(a)
3.2	15.247(a)	Carrier Frequency Separation	PASS	15.247(a)
3.3	15.247(b)	Maximum Conducted Output Power	PASS	15.247(b)
3.4	15.247(a)	Number of Hopping Frequencies and Hopping Bandedge	PASS	15.247(a)
3.5	15.247(a)	Time of Occupancy (Dwell Time)	PASS	15.247(a)
3.6	15.247(d)	Emissions in Non-restricted Frequency Bands	PASS	15.247(d)
3.7	15.247(d)	Emissions in Restricted Frequency Bands	PASS	Restricted Bands: FCC 15.209

Declaration of Conformity:
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.
Comments and Explanations:
None.

Reviewed by: Sam Tsai

Report Producer: Kate Lo

1 General Description

1.1 Information

1.1.1 RF General Information

Frequency Range (MHz)	Modulation	Ch. Frequency (MHz)	Channel Number
902 ~ 928 MHz	DBPSK	902.1375~904.6625	54

Band	Mode	BWch (MHz)	Nant
902-928MHz	Sigfox	0.025	1TX

Micro Channel / Groups	Micro ch.1	Micro ch.2	Micro ch.3	Micro ch.4	Micro ch.5	Micro ch.6
1	902.1375	902.1625	902.1875	902.2125	902.2375	902.2625
2	902.4375	902.4625	902.4875	902.5125	902.5375	902.5625
3	902.7375	902.7625	902.7875	902.8125	902.8375	902.8625
4	903.0375	903.0625	903.0875	903.1125	903.1375	903.1625
5	903.3375	903.3625	903.3875	903.4125	903.4375	903.4625
6	903.6375	903.6625	903.6875	903.7125	903.7375	903.7625
7	903.9375	903.9625	903.9875	904.0125	904.0375	904.0625
8	904.2375	904.2625	904.2875	904.3125	904.3375	904.3625
9	904.5375	904.5625	904.5875	904.6125	904.6375	904.6625

Note:
- Sigfox uses as a system using DBPSK modulation.
- BWch is the nominal channel bandwidth.

1.1.2 Antenna Information

Ant.	Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	1	Walsin	RFDPA870900SBAB815	Dipole	I-PEX	2.3
2	1	Walsin	RFPCA431015IMAB301	PIFA	I-PEX	2.69
3	1	Walsin	RFDPA131015IMRB301	Dipole	I-PEX	3.01
4	1	Walsin	RGFRA1204011DCT	Chip	I-PEX	1
5	1	Ethertronics	M620720	Chip	I-PEX	0.75
6	1	TEKFUN	IO4-2	Dipole	I-PEX	1.2

Note 1: The EUT has six antennas.
Note 2: The antenna gain with cable loss and was used to perform the worst configuration and result of that was recorded as the final test result.

For BT function:
For IEEE 802.15.1 Bluetooth mode (1TX/1RX)
Ant. 1 (port 1) or Ant. 2 (port 1) could transmit/receive.

For Sigfox function:
For Sigfox mode (1TX/1RX)
Ant. 3 (port 1) or Ant. 4 (port 1) or Ant. 5 (port 1) or Ant. 6 (port 1) could transmit/receive.

1.1.3 Type of EUT

Operational Condition		
EUT Power Type	From host system(NB)	
Type of EUT		
☒	Stand-alone	
☐	Combined (EUT where the radio part is fully integrated within another device)	
	Combined Equipment - Brand Name / Model No.:	…
☐	Plug-in radio (EUT intended for a variety of host systems)	
	Host System - Brand Name / Model No.:	…
☐	Other:	

1.1.4 Test Signal Duty Cycle

Mode	DC	DCF(dB)	T(s)	VBW(Hz) ≥ 1/T
DBPSK	0.979	0.09	49.313m	30

1.1.5 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FR930617-01AF

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
Ant. 4, Ant. 5 and Ant.6 are added.	Chip Antenna was evaluated.

1.2 Testing Applied Standards

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

- 47 CFR FCC Part 15
- ANSI C63.10-2013
- KDB 558074 D01 v05

1.3 Testing Location Information

Testing Location			
☒	HWA YA	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.)	
		TEL : 886-3-327-3456	FAX : 886-3-327-0973
Test site Designation No. TW1190 with FCC.			
☐	JHUBEI	ADD : No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County, Taiwan (R.O.C.)	
		TEL : 886-3-656-9065	FAX : 886-3-656-9085
Test site Designation No. TW0006 with FCC.			

Test Condition	Test Site No.	Test Engineer	Test Environment	Test Date
AC Conduction	CO04-HY	Edward	22.6~24.8°C / 65~69%	04/Nov/2019
RF Conducted	TH01-HY	Barry	24.9~25.3°C / 48~54%	09/Sep/2019~ 18/Sep/2019
Radiated	03CH01-HY	Edward	24.5~26.7°C / 63~66%	05/Nov/2019

1.4 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Test Items	Uncertainty	Remark
Conducted Emission (150kHz ~ 30MHz)	3.54 dB	Confidence levels of 95%
Radiated Emission (9kHz ~ 30MHz)	1.6 dB	Confidence levels of 95%
Radiated Emission (30MHz ~ 1,000MHz)	4.3 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.9 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Conducted Emission	1.3 dB	Confidence levels of 95%
Temperature	0.7 ℃	Confidence levels of 95%
Humidity	4 %	Confidence levels of 95%

2 Test Configuration of EUT

2.1 Test Condition

RF Conducted	Abbreviation	Remark
TnomVnom	Tnom	20°C
-	Vnom	120V

2.2 Test Channel Mode

Test Software	DoS

Mode	Power Setting
DBPSK	-
902.1375MHz	5
904.6625MHz	5

2.3 The Worst Case Measurement Configuration

The Worst Case Mode for Following Conformance Tests	
Tests Item	AC power-line conducted emissions
Condition	AC power-line conducted measurement for line and neutral Test Voltage: 120Vac / 60Hz
Operating Mode	CTX
1	USB mode

The Worst Case Mode for Following Conformance Tests	
Tests Item	RF Output Power, 20dB Bandwidth, Carrier Frequency Separation (ChS) Number of Hopping Frequencies (N), Hopping Bandedge Time of Occupancy (Dwell Time) Emissions in Non-restricted Frequency Bands
Test Condition	Conducted measurement at transmit chains

The Worst Case Mode for Following Conformance Tests			
Tests Item	Emissions in Restricted Frequency Bands		
Test Condition	Radiated measurement If EUT consist of multiple antenna assembly (multiple antenna are used in EUT regardless of spatial multiplexing MIMO configuration), the radiated test should be performed with highest antenna gain of each antenna type.		
Operating Mode < 1GHz	CTX		
1	USB mode		
Operating Mode > 1GHz	CTX		
Orthogonal Planes of EUT	**X Plane**	**Y Plane**	**Z Plane**
			
Worst Planes of EUT			V

The Worst Case Mode for Following Conformance Tests	
Tests Item	Simultaneous Transmission Analysis
Operating Mode	CTX
1	Sigfox+Bluetooth
Refer to Sporton Test Report No.: FA930617-01 for Co-location RF Exposure Evaluation.	

2.4 Support Equipment

Support Equipment – AC Conduction and Radiated Emission				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	Power Cable	Power sync	PW-GPC180-3	-
2	Notebook	DELL	PP27L	-
3	Adapter for NB	DELL	LA90PM111	-
4	Fixture	LITEON	WSG303S_EVB	-
5	USB Cable	-	-	-

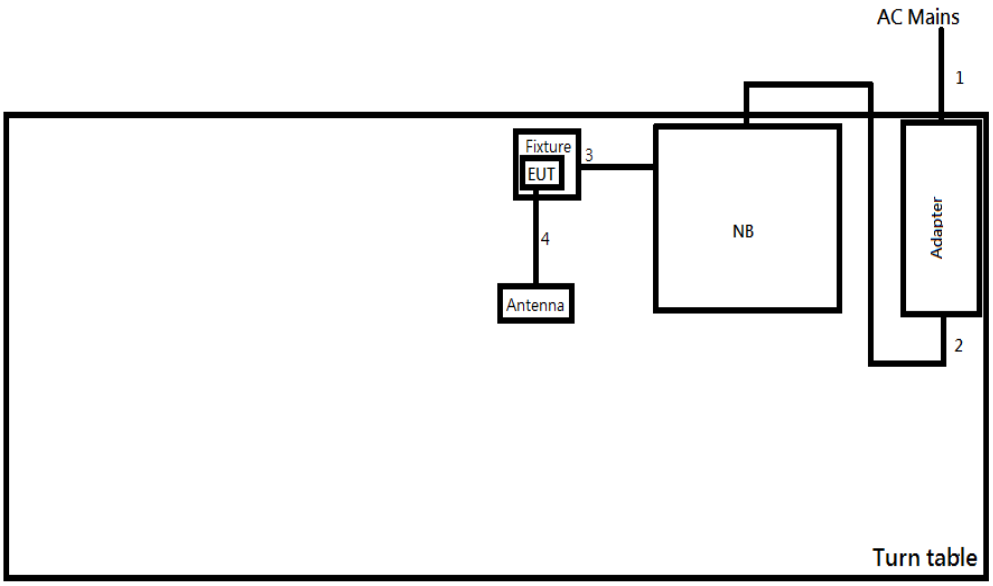
Note: Support equipment No.4 was provided by customer.

Support Equipment – RF Conducted				
No.	**Equipment**	**Brand Name**	**Model Name**	**FCC ID**
1	Notebook	DELL	E5410	DoC
2	Adapter for NB	DELL	HA65NM130	DoC
3	DC Power Supply	GW	GPS-3030DD	-
4	Fixture	-	-	-

Note: Support equipment No.4 was provided by customer.

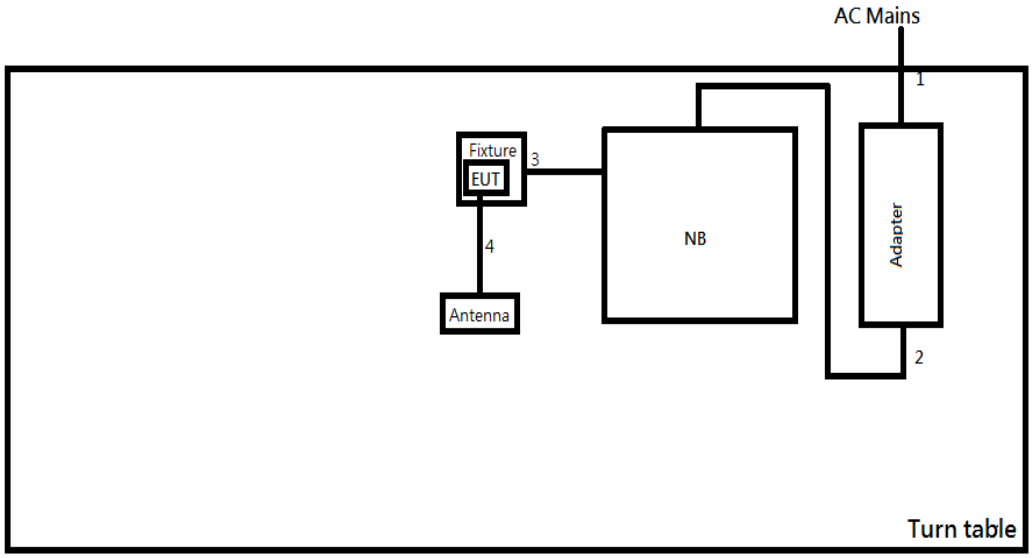
2.5 Test Setup Diagram

Test Setup Diagram – AC Line Conducted Emission Test



Item	Connection	Shielded	Length(m)	Remark
1	AC Power Cable	No	1.8	-
2	DC Power Cable	No	2.0	-
3	USB Cable	No	0.3	-
4	RF Cable	No	0.15	-

Test Setup Diagram - Radiated Test



Item	Connection	Shielded	Length(m)	Remark
1	AC Power Cable	No	1.8	-
2	DC Power Cable	No	2.0	-
3	USB Cable	No	0.3	-
4	RF Cable	No	0.15	-

3 Transmitter Test Result

3.1 AC Power-line Conducted Emissions

3.1.1 AC Power-line Conducted Emissions Limit

AC Power-line Conducted Emissions Limit		
Frequency Emission (MHz)	**Quasi-Peak**	**Average**
0.15-0.5	66 - 56 *	56 - 46 *
0.5-5	56	46
5-30	60	50
Note 1: * Decreases with the logarithm of the frequency.		

3.1.2 Measuring Instruments

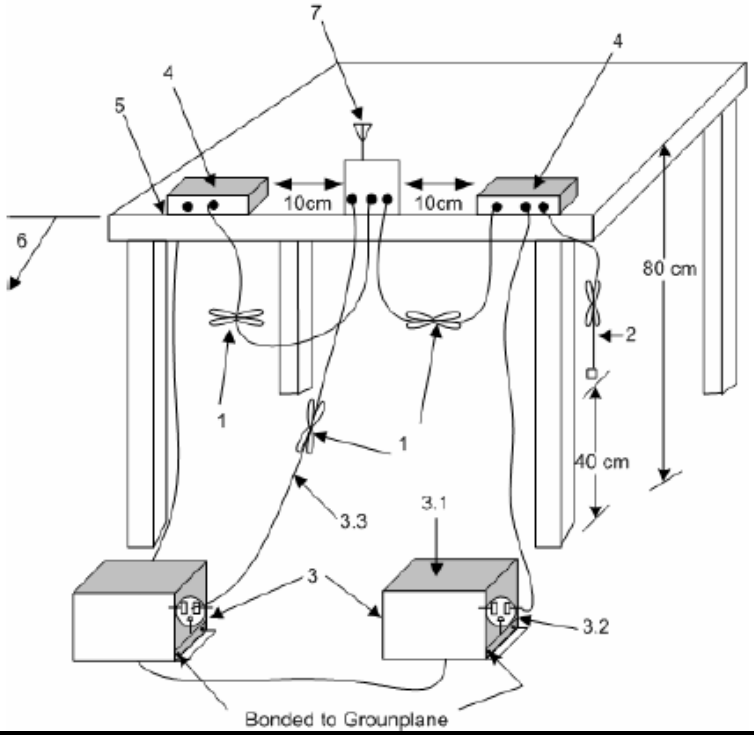
Refer a test equipment and calibration data table in this test report.

3.1.3 Test Procedures

Test Method
☒ Refer as ANSI C63.10-2013, clause 6.2 for AC power-line conducted emissions.

3.1.4 Test Setup

AC Power-line Conducted Emissions



Test Result of AC Power-line Conducted Emissions

Refer as Appendix A

3.2 20dB Bandwidth and Carrier Frequency Separation

3.2.1 20dB Bandwidth and Carrier Frequency Separation Limit

20dB Bandwidth and Carrier Frequency Separation Limit for Frequency Hopping Systems	
▪ 902-928 MHz Band:	
	▪ N ≥50 and ChS ≥ MAX (20 dB bandwidth, 25 kHz); 20 dB bandwidth≤ 250 kHz.
	▪ 50 >N≥25 and ChS ≥ MAX (20 dB bandwidth, 25 kHz); 20 dB bandwidth>250 kHz.
N: Number of Hopping Frequencies; **ChS**: Hopping Channel Separation	

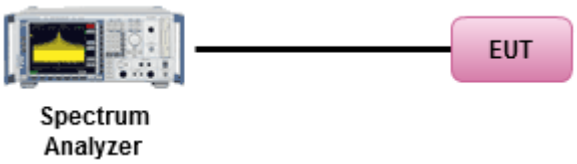
3.2.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.2.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10, clause 6.9.2 for 20 dB bandwidth measurement.
☒	Refer as ANSI C63.10, clause 7.8.2 for carrier frequency separation measurement.

3.2.4 Test Setup

20dB Bandwidth and Carrier Frequency Separation


3.2.5 Test Result of 20dB Bandwidth

Refer as Appendix B

3.2.6 Test Result of Carrier Frequency Separation

Refer as Appendix B

3.3 Maximum Conducted Output Power

3.3.1 Maximum Conducted Output Power Limit

Maximum Conducted Output Power Limit	
▪ 902-928 MHz Band:	
	▪ N ≥50; Power 30dBm; EIRP 36dBm
	▪ 50 >N≥ 25; Power 24dBm; EIRP 30dBm
N:Number of Hopping Frequencies	

3.3.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.3.3 Test Procedures

Test Method
▪ Refer as ANSI C63.10-2013, clause 7.8.5 for output power measurement.

3.3.4 Test Setup

Maximum Conducted Output Power (Peak Power Meter)


3.3.5 Test Result of Maximum Conducted Output Power

Refer as Appendix C

3.4 Number of Hopping Frequencies and Hopping Bandedge

3.4.1 Number of Hopping Frequencies Limit

Number of Hopping Frequencies Limit for Frequency Hopping Systems	
▪ 902-928 MHz Band:	
	▪ N ≥50 and ChS ≥ MAX (20 dB bandwidth, 25 kHz); 20 dB bandwidth≤ 250 kHz.
	▪ 50 >N≥ 25 and ChS ≥ MAX (20 dB bandwidth, 25 kHz); 20 dB bandwidth>250 kHz.
N: Number of Hopping Frequencies; **ChS**: Hopping Channel Separation	

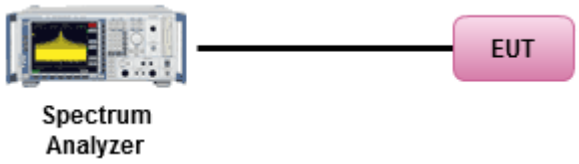
3.4.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.4.3 Test Procedures

Test Method	
☒	Refer as ANSI C63.10, clause 7.8.3 for number of hopping frequencies measurement.
☒	Refer as ANSI C63.10, clause 7.8.6 for hopping frequencies Bandedge measurement.

3.4.4 Test Setup

Number of Hopping Frequencies


3.4.5 Test Result of Number of Hopping Frequencies

Refer as Appendix D

3.4.6 Test Result of Number of Hopping Frequencies Bandedge

Refer as Appendix D

3.5 Time of Occupancy (Dwell Time)

3.5.1 Time of Occupancy (Dwell Time) Limit

Time of Occupancy (Dwell Time) Limit for Frequency Hopping Systems	
▪ 902-928 MHz Band:	
	▪ N ≥50; 0.4s in 20s period
	▪ 50 >N≥ 25; 0.4s in 10s period
N:Number of Hopping Frequencies	

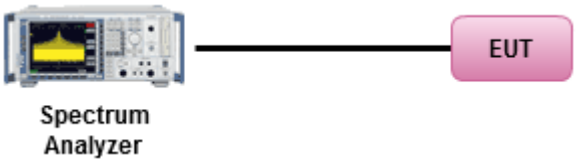
3.5.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.5.3 Test Procedures

Test Method
▪ Refer as ANSI C63.10, clause 7.8.4 for dwell time measurement.

3.5.4 Test Setup

Time of Occupancy (Dwell Time)


3.5.5 Test Result of Time of Occupancy (Dwell Time)

Refer as Appendix E

3.6 Emissions in Non-restricted Frequency Bands

3.6.1 Emissions in Non-restricted Frequency Bands Limit

Un-restricted Band Emissions Limit	
RF output power procedure	**Limit (dB)**
Peak output power procedure	20
Note 1: If the peak output power procedure is used to measure the fundamental emission power to demonstrate compliance to requirements, then the peak conducted output power measured within any 100 kHz outside the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum measured in-band peak PSD level.	

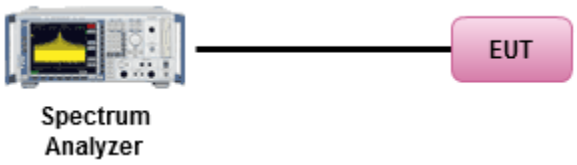
3.6.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

3.6.3 Test Procedures

Test Method
▪ Refer as ANSI C63.10-2013, clause 7.8.8 for unwanted emissions into non-restricted bands.

3.6.4 Test Setup

Emissions in Non-restricted Frequency Bands


3.6.5 Transmitter Radiated Bandedge Emissions

Refer as Appendix F

3.7 Emissions in Restricted Frequency Bands

3.7.1 Emissions in Restricted Frequency Bands Limit

Restricted Band Emissions Limit			
Frequency Range (MHz)	**Field Strength (uV/m)**	**Field Strength (dBuV/m)**	**Measure Distance (m)**
0.009~0.490	2400/F(kHz)	48.5 - 13.8	300
0.490~1.705	24000/F(kHz)	33.8 - 23	30
1.705~30.0	30	29	30
30~88	100	40	3
88~216	150	43.5	3
216~960	200	46	3
Above 960	500	54	3

Note 1: Test distance for frequencies at or above 30 MHz, measurements may be performed at a distance other than the limit distance provided they are not performed in the near field and the emissions to be measured can be detected by the measurement equipment. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse of linear distance for field-strength measurements, inverse of linear distance-squared for power-density measurements).

Note 2: Test distance for frequencies at below 30 MHz, measurements may be performed at a distance closer than the EUT limit distance; however, an attempt should be made to avoid making measurements in the near field. When performing measurements below 30 MHz at a closer distance than the limit distance, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two or more distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). The test report shall specify the extrapolation method used to determine compliance of the EUT.

Note 3: Using the distance of 1m during the test for above 18 GHz, and the test value to correct for the distance factor at 3m.

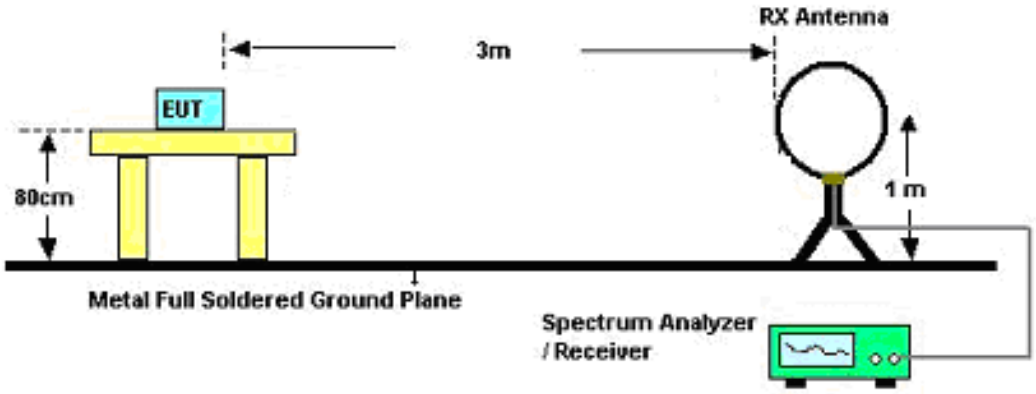
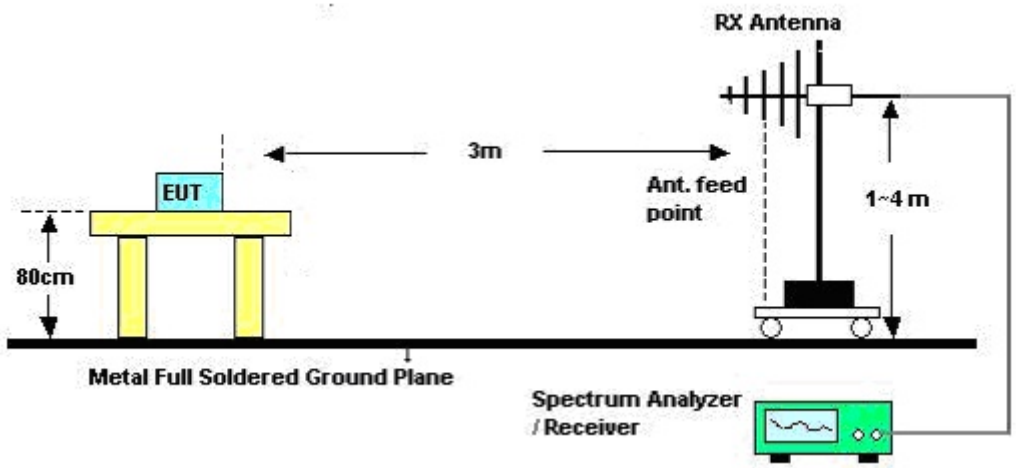
3.7.2 Measuring Instruments

Refer a test equipment and calibration data table in this test report.

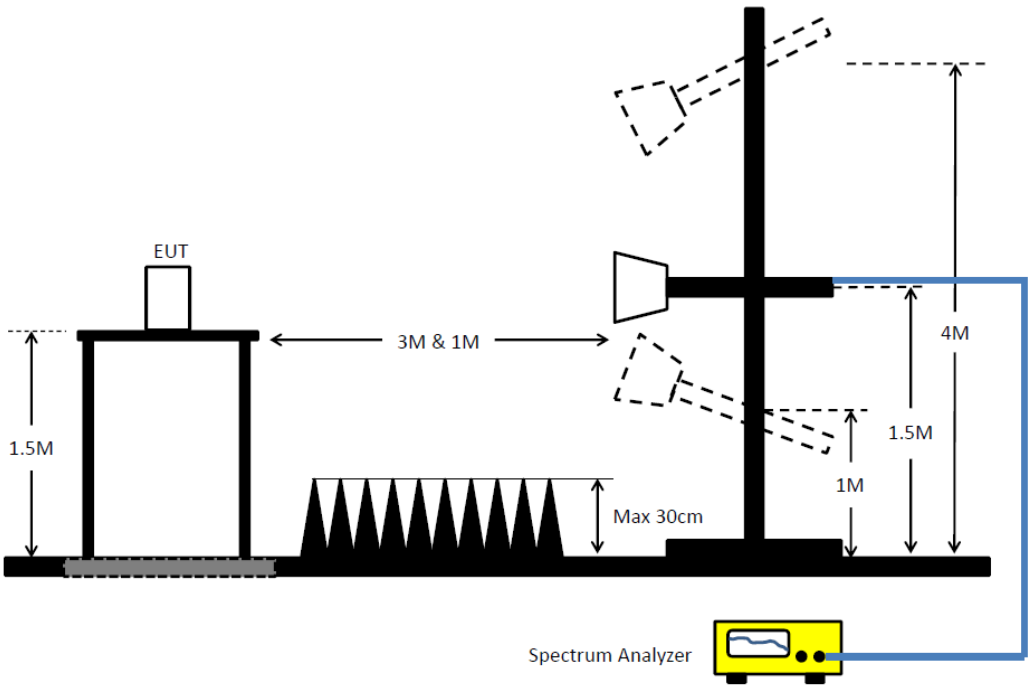
3.7.3 Test Procedures

Test Method	
▪ The average emission levels shall be measured in [hopping duty factor].	
▪ Refer as ANSI C63.10; clause 6.9.2.2 band-edge testing shall be performed at the lowest frequency channel and highest frequency channel within the allowed operating band.	
▪ For the transmitter unwanted emissions shall be measured using following options below:	
	▪ Refer as ANSI C63.10, clause 4.1.4.2.1 QP value.
	▪ Refer as ANSI C63.10, clause 4.1.4.2.2 measurement procedure peak.
	▪ Refer as ANSI C63.10, clause 4.1.4.2.4 average value of hopping pulsed emissions.

3.7.4 Test Setup

Emissions in Restricted Frequency Bands
9kHz ~30MHz

30MHz~1GHz


Above 1GHz



3.7.5 Test Result of Emissions in Restricted Frequency Bands (Below 30MHz)

All amplitude of spurious emissions that are attenuated by more than 20 dB below the permissible value has no need to be reported.

3.7.6 Test Result of Emissions in Restricted Frequency Bands

Refer as Appendix G

4 Test Equipment and Calibration Data

Instrument for AC Conduction

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
EMC Receiver	R&S	ESR3	102052	9kHz~3.6GHz	09/Apr/2019	08/Apr/2020
LISN	R&S	ENV216	101295	9kHz~30MHz	08/Nov/2018	07/Nov/2019
RF Cable-CON	MTJ	RG142	CB002-CO	9kHz~200MHz	12/Sep/2019	11/Sep/2020
AC POWER	APC	AFC-11005G	F310050055	47Hz~63Hz 5~300V	NCR	NCR
Impuls Begrenzer Pulse Limiter	SCHWARZBECK	VTSD 9561-F	9561-F041	9kHz~30MHz	24/Sep/2019	23/Sep/2020

NCR : Non-Calibration Require

Instrument for Radiated Test

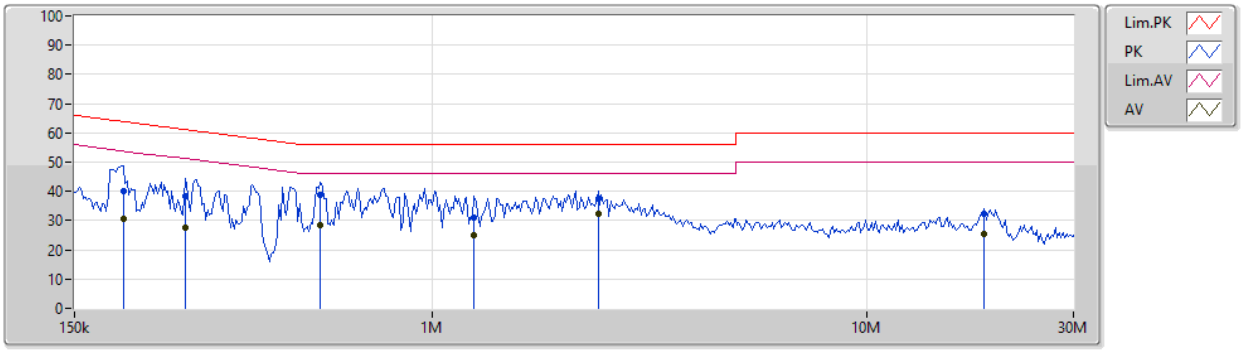
Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
3m Semi Anechoic Chamber	Riken	SAC-3M	03CH01-HY	30MHz~1GHz 3m	11/Jan/2019	10/Jan/2020
3m Semi Anechoic Chamber	Riken	SAC-3M	03CH01-HY	1GHz~18GHz 3m	09/Jan/2019	08/Jan/2020
PreAmplifier	COM-POWER	PA-103	161050	1MHz~1.0GHz	17/Jul/2019	16/Jul/2020
Microwave Preamplifier	Agilent	8449B	3008A02602	1GHz~26.5GHz	27/Mar/2019	26/Mar/2020
Spectrum Analyzer	R&S	FSV40	101407	10Hz~40GHz	10/Sep/2019	09/Sep/2020
RF Cable-R03m	Jye Bao	RG142	CB019	9kHz~1GHz	14/Dec/2018	13/Dec/2019
RF Cable-HIGH	SUHNER	SUCOFLEX 104	SN805196/4+MY 39495	1GHz~18GHz	13/Mar/2019	12/Mar/2020
Bilog Antenna & 5db Attenuator	SCHAFFNER/MTJ	CBL6112D / MTJ6102-05	2678 / 001	30MHz~2GHz	06/Jul/2019	05/Jul/2020
EMI Test Receiver	R&S	ESU-26	100422	20Hz~26.5GHz	24/Oct/2019	23/Oct/2020
Loop Antenna	TESEQ	HLA 6120	31244	9k~30MHz	15/Mar/2019	14/Mar/2020
Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	BBHA9170339	18GHz~40GHz	19/Apr/2019	18/Apr/2020
Horn Antenna	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D-1130	1GHz~18GHz	25/Oct/2019	24/Oct/2020

Instrument for Conducted Test

Instrument	Manufacturer	Model No.	Serial No.	Spec.	Calibration Date	Calibration Due Date
Spectrum Analyzer	R&S	FSV 40	101013	10Hz~40GHz	13/Mar/2019	12/Mar/2020
SMB100A Signal Generator	R&S	SMB100A03	181147	100kHz~40GHz	12/Nov/2018	10/Nov/2020
Power Sensor	Anritsu	MA2411B	0917017	300MHz~40GHz	19/Feb/2019	18/Feb/2020
Power Meter	Anritsu	ML2495A	0949003	300MHz~40GHz	19/Feb/2019	18/Feb/2020
Cable 0.2m	HUBER	MY329022/4	RF Cable - 02	30MHz~18G	10/Jan/2019	09/Jan/2020
Cable 0.2m	HUBER	MY329033/4	RF Cable - 03	30MHz~18G	10/Jan/2019	09/Jan/2020
Cable 1.5m	HUBER	MY37973/4	RF Cable – 16	30MHz~18G	10/Jan/2019	09/Jan/2020

AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Neutral
Operating Function	USB mode		

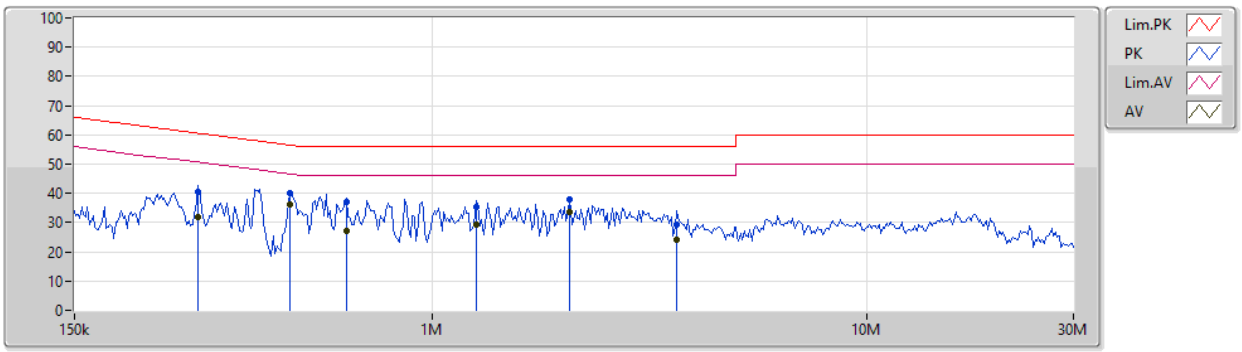
04/11/2019



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	194.288k	39.89	63.86	-23.97	19.47	Neutral	-	20.42	9.59	0.01	9.87
AV	194.288k	30.77	53.86	-23.09	19.47	Neutral	-	11.30	9.59	0.01	9.87
QP	269.806k	38.33	61.12	-22.79	19.47	Neutral	-	18.86	9.59	0.01	9.87
AV	269.806k	27.80	51.12	-23.32	19.47	Neutral	-	8.33	9.59	0.01	9.87
QP	552.321k	38.87	56.00	-17.13	19.48	Neutral	-	19.39	9.59	0.01	9.88
AV	552.321k	28.30	46.00	-17.70	19.48	Neutral	-	8.82	9.59	0.01	9.88
QP	1.249M	30.98	56.00	-25.02	19.50	Neutral	-	11.48	9.60	0.02	9.88
AV	1.249M	25.03	46.00	-20.97	19.50	Neutral	-	5.53	9.60	0.02	9.88
QP	2.409M	37.52	56.00	-18.48	19.54	Neutral	-	17.98	9.61	0.04	9.89
AV	2.409M	32.37	46.00	-13.63	19.54	Neutral	"Worst"	12.83	9.61	0.04	9.89
QP	18.705M	32.41	60.00	-27.59	19.69	Neutral	-	12.72	9.68	0.11	9.90
AV	18.705M	25.56	50.00	-24.44	19.69	Neutral	-	5.87	9.68	0.11	9.90

AC Power-line Conducted Emissions Result			
Operating Mode	1	**Power Phase**	Line
Operating Function	USB mode		

04/11/2019



Type	Freq	Level	Limit	Margin	Factor	Condition	Comment	Raw	LISN	CL	AT
	(Hz)	(dBuV)	(dBuV)	(dB)	(dB)			(dBuV)	(dB)	(dB)	(dB)
QP	289.269k	40.64	60.55	-19.91	19.48	Line	-	21.16	9.59	0.01	9.88
AV	289.269k	32.07	50.55	-18.48	19.48	Line	-	12.59	9.59	0.01	9.88
QP	471.031k	40.07	56.50	-16.43	19.48	Line	-	20.59	9.59	0.01	9.88
AV	471.031k	36.27	46.50	-10.23	19.48	Line	"Worst"	16.79	9.59	0.01	9.88
QP	634.878k	36.89	56.00	-19.11	19.49	Line	-	17.40	9.60	0.01	9.88
AV	634.878k	26.95	46.00	-19.05	19.49	Line	-	7.46	9.60	0.01	9.88
QP	1.261M	35.33	56.00	-20.67	19.51	Line	-	15.82	9.61	0.02	9.88
AV	1.261M	29.12	46.00	-16.88	19.51	Line	-	9.61	9.61	0.02	9.88
QP	2.075M	38.02	56.00	-17.98	19.54	Line	-	18.48	9.62	0.03	9.89
AV	2.075M	33.49	46.00	-12.51	19.54	Line	-	13.95	9.62	0.03	9.89
QP	3.658M	29.29	56.00	-26.71	19.56	Line	-	9.73	9.63	0.04	9.89
AV	3.658M	24.06	46.00	-21.94	19.56	Line	-	4.50	9.63	0.04	9.89

Summary

Mode	Max-N dB (Hz)	Max-OBW (Hz)	ITU-Code	Min-N dB (Hz)	Min-OBW (Hz)
902-928MHz	-	-	-	-	-
DBPSK	7.781k	6.653k	6K65G1D	7.75k	6.622k

Max-N dB = Maximum 20dB down bandwidth; **Max-OBW** = Maximum 99% occupied bandwidth;
Min-N dB = Minimum 20dB down bandwidth; **Min-OBW** = Minimum 99% occupied bandwidth;

Result

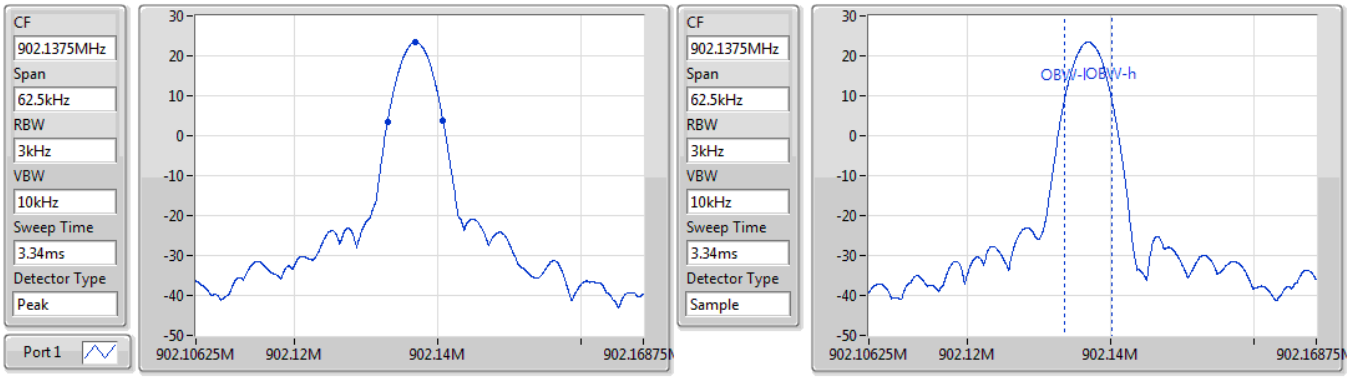
Mode	Result	Limit (Hz)	Port 1-N dB (Hz)	Port 1-OBW (Hz)
DBPSK	-	-	-	-
902.1375MHz	Pass	Inf	7.781k	6.622k
904.6625MHz	Pass	Inf	7.75k	6.653k

Port X-N dB = Port **X** 20dB down bandwidth; **Port X-OBW** = Port **X** 99% occupied bandwidth;

DBPSK **EBW**

902.1375MHz

18/09/2019

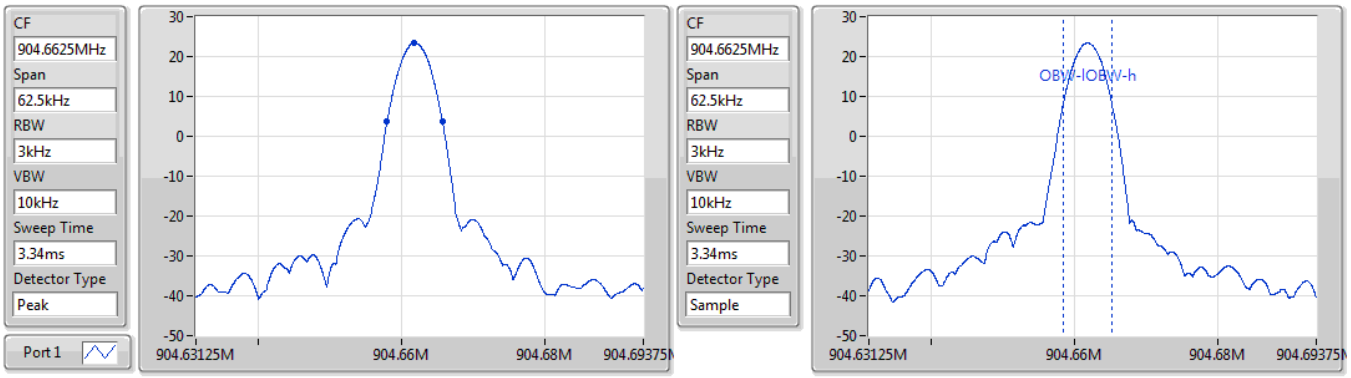


20dB(Hz)	Fl-20dB(Hz)	Fh-20dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
7.781k	902.133M	902.140781M	6.622k	902.133564M	902.140186M	Inf	1

DBPSK **EBW**

904.6625MHz

18/09/2019



20dB(Hz)	Fl-20dB(Hz)	Fh-20dB(Hz)	OBW(Hz)	Fl-OBW(Hz)	Fh-OBW(Hz)	Limit(Hz)	Port
7.75k	904.657938M	904.665688M	6.653k	904.658471M	904.665124M	Inf	1

Summary

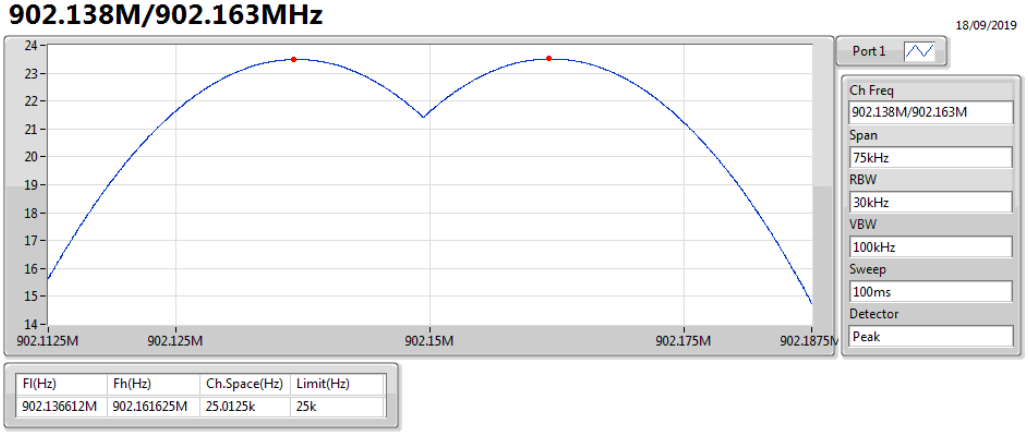
Mode	Max-Space (Hz)	Min-Space (Hz)
902-928MHz	-	-
DBPSK	25.125k	25.0125k

Result

Mode	Result	Fl (Hz)	Fh (Hz)	Ch.Space (Hz)	Limit (Hz)
DBPSK	-	-	-	-	-
902.1375MHz	Pass	902.136612M	902.161625M	25.0125k	25k
904.6625MHz	Pass	904.636388M	904.661512M	25.125k	25k

DBPSK **Channel Separation**

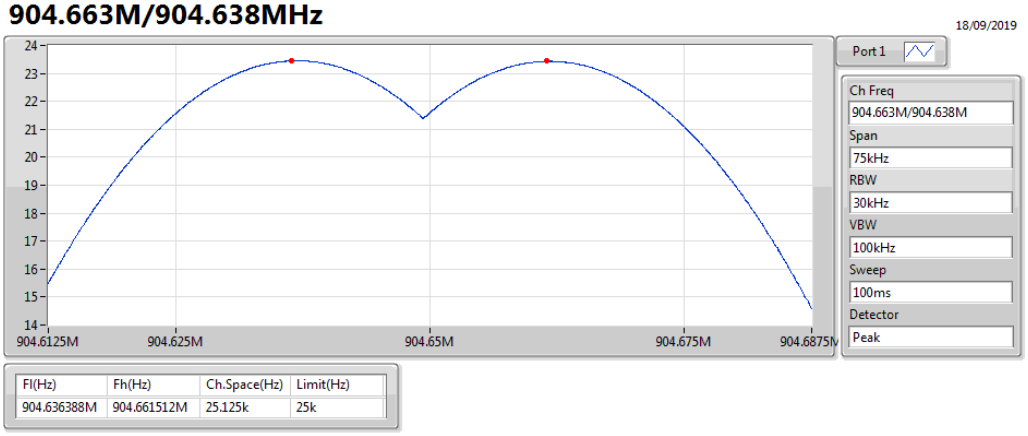
902.138M/902.163MHz



Fl(Hz)	Fh(Hz)	Ch.Space(Hz)	Limit(Hz)
902.136612M	902.161625M	25.0125k	25k

DBPSK **Channel Separation**

904.663M/904.638MHz



Fl(Hz)	Fh(Hz)	Ch.Space(Hz)	Limit(Hz)
904.636388M	904.661512M	25.125k	25k

Summary

Mode	Power (dBm)	Power (W)
902-928MHz	-	-
DBPSK	23.88	0.24434

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
DBPSK	-	-	-	-
902.1375MHz_TnomVnom	Pass	1.06	23.88	30.00
904.6625MHz_TnomVnom	Pass	1.06	23.78	30.00

DG = Directional Gain; **Port X** = Port X output power

Summary

Mode	Power (dBm)	Power (W)
902-928MHz	-	-
DBPSK	22.94	0.19679

Result

Mode	Result	Gain (dBi)	Power (dBm)	Power Limit (dBm)
DBPSK	-	-	-	-
902.1375MHz_TnomVnom	Pass	1.06	22.94	30.00
904.6625MHz_TnomVnom	Pass	1.06	22.91	30.00

DG = Directional Gain; **Port X** = Port X output power

Summary

Mode	Max-Hop No
902-928MHz	-
DBPSK	54

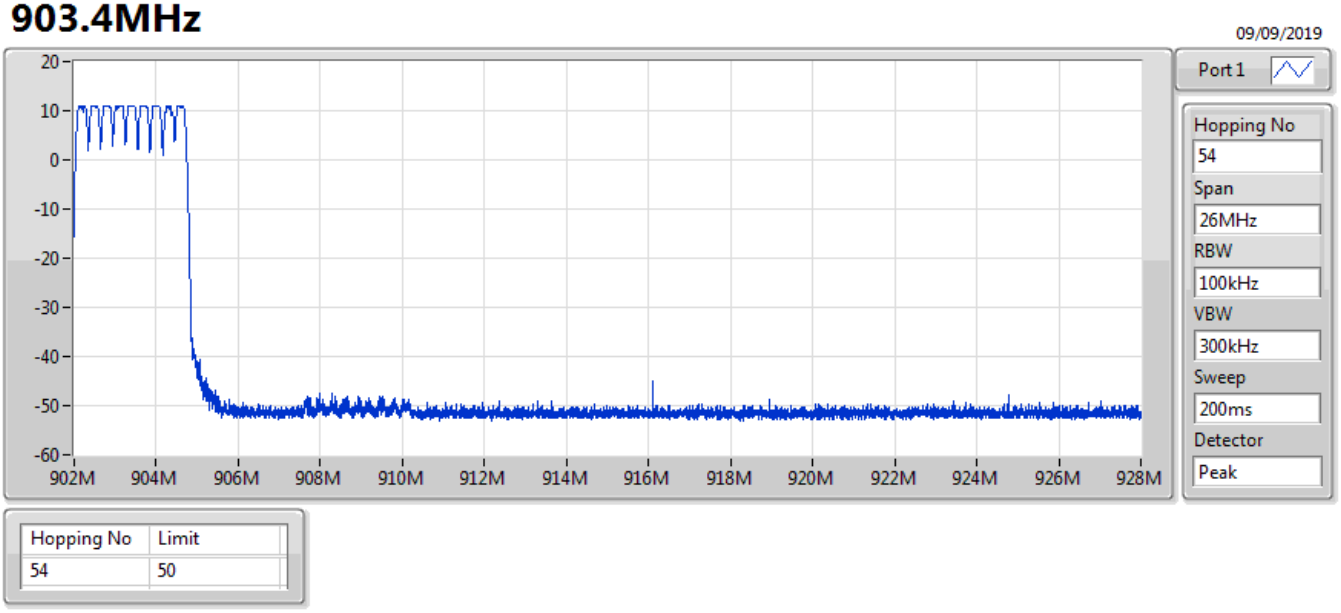
Result

Mode	Result	Hopping No	Limit
DBPSK	-	-	-
903.4MHz	Pass	54	50

DBPSK

Hopping Ch

903.4MHz

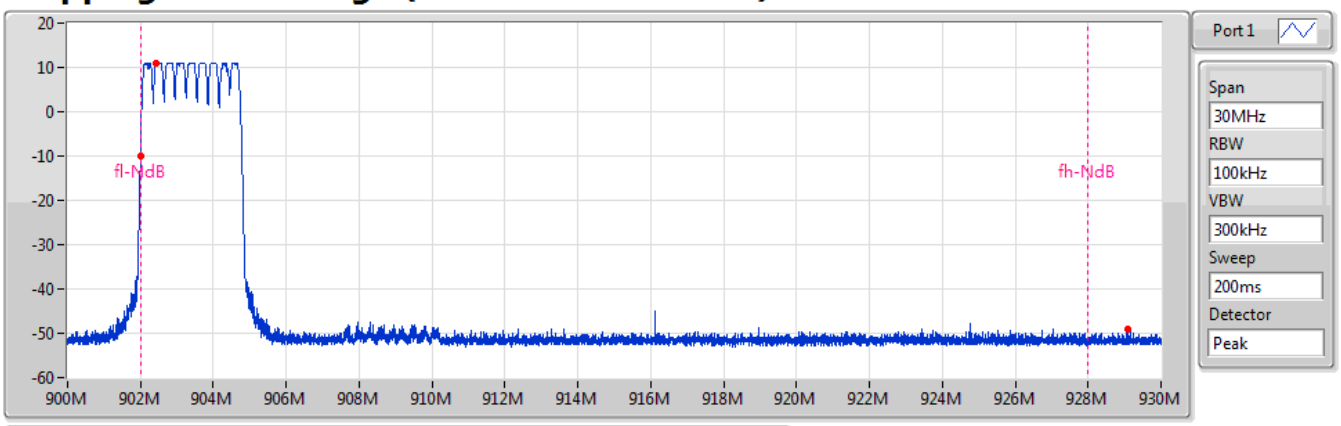


Hopping No	Limit
54	50

DBPSK

903.4MHz

Hopping Ch Bandedge (Non-restricted Band)



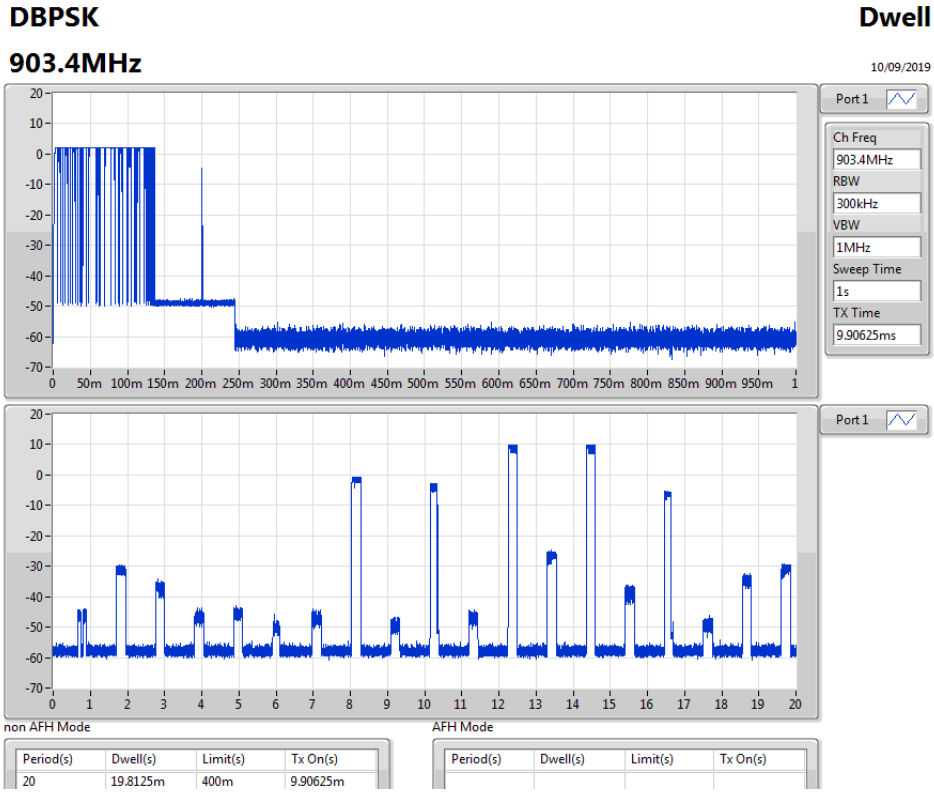
Limit(dBm)	Ref(Hz)	Ref(dBm)	BE-l(Hz)	BE-l(dBm)	BE-h(Hz)	BE-h(dBm)
-8.98	902.4375M	11.02	901.99875M	-10.15	929.1075M	-48.98

Summary

Mode	Max-Dwell (s)
902-928MHz	-
DBPSK	19.8125m

Result

Mode	Result	Period (s)	Dwell (s)	Limit (s)	Tx On (s)
DBPSK	-	-	-	-	-
903.4MHz_TnomVnom	Pass	20	19.8125m	400m	9.90625m



Period(s)	Dwell(s)	Limit(s)	Tx On(s)
20	19.8125m	400m	9.90625m

Period(s)	Dwell(s)	Limit(s)	Tx On(s)

Summary

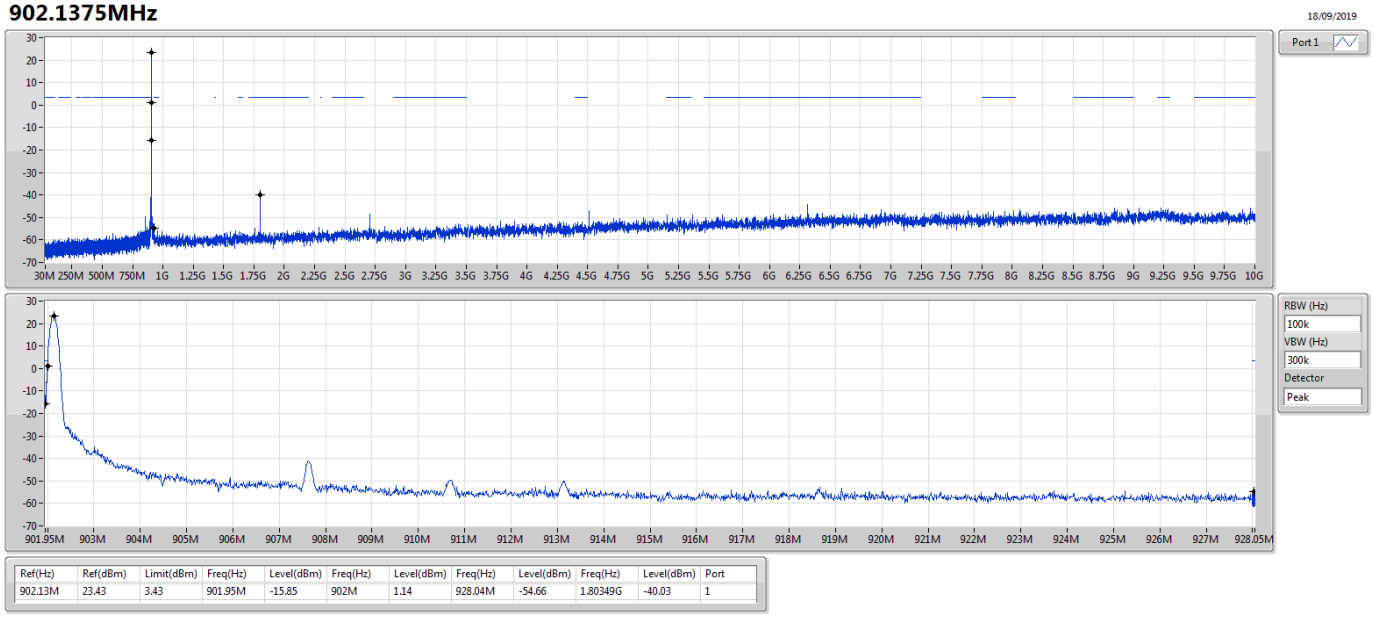
Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Port
902-928MHz	-	-	-	-	-	-	-	-	-	-	-	-	-
DBPSK	Pass	902.13M	23.43	3.43	901.95M	-15.85	902M	1.14	928.04M	-54.66	1.80349G	-40.03	1

Result

Mode	Result	Ref (Hz)	Ref (dBm)	Limit (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Freq (Hz)	Level (dBm)	Port
DBPSK	-	-	-	-	-	-	-	-	-	-	-	-	-
902.1375MHz	Pass	902.13M	23.43	3.43	901.95M	-15.85	902M	1.14	928.04M	-54.66	1.80349G	-40.03	1
904.6625MHz	Pass	904.65M	23.38	3.38	899.23M	-41.48	901.96M	-45.74	928.01M	-54.18	1.80916G	-41.61	1

DBPSK **CSE NdB**

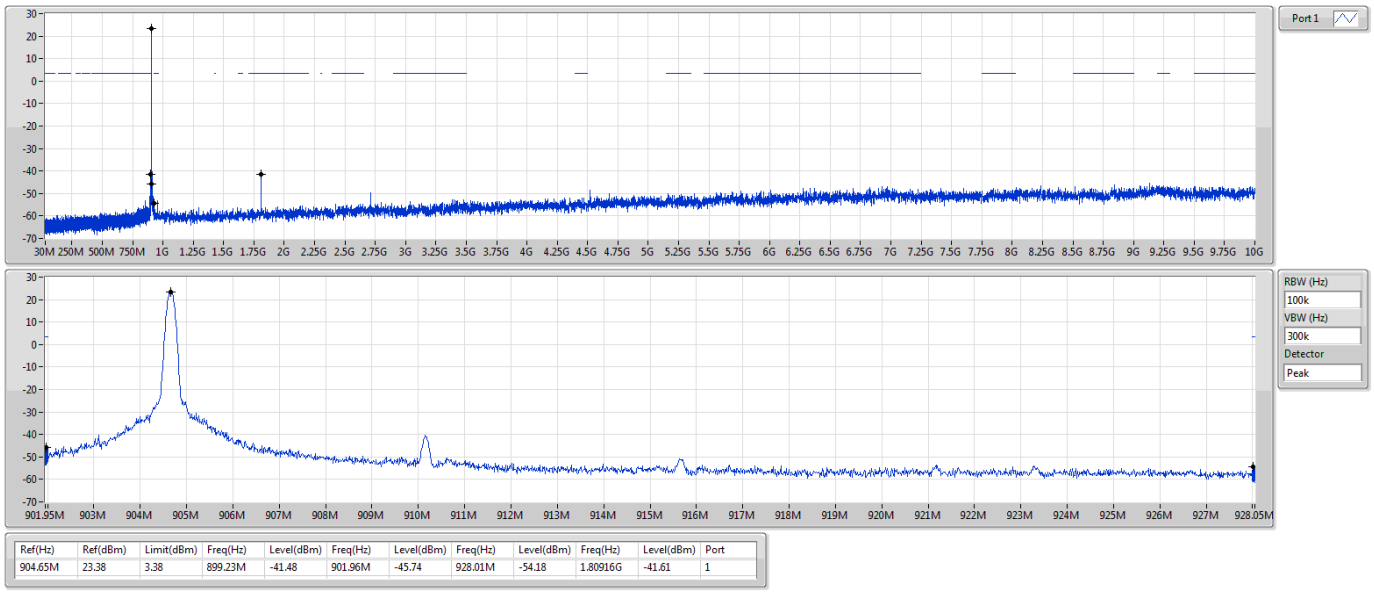
902.1375MHz



Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
902.13M	23.43	3.43	901.95M	-15.85	902M	1.14	928.04M	-54.66	1.80349G	-40.03	1

DBPSK **CSE NdB**

904.6625MHz



Ref(Hz)	Ref(dBm)	Limit(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Freq(Hz)	Level(dBm)	Port
904.65M	23.38	3.38	899.23M	-41.48	901.96M	-45.74	928.01M	-54.18	1.80916G	-41.61	1

Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
902-928MHz	-	-	-	-	-	-	-	-	-	-	-
DBPSK	Pass	PK	531.87M	42.75	46.00	-3.25	3	Horizontal	0	1.00	-

Result

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
DBPSK	-	-	-	-	-	-	-	-	-	-	-
904.6625MHz	Pass	PK	34.22M	35.21	40.00	-4.79	3	Horizontal	0	1.00	-
904.6625MHz	Pass	PK	114.35M	30.71	43.50	-12.79	3	Horizontal	0	1.00	-
904.6625MHz	Pass	PK	193.07M	35.04	43.50	-8.46	3	Horizontal	0	1.00	-
904.6625MHz	Pass	PK	305.54M	32.84	46.00	-13.16	3	Horizontal	0	1.00	-
904.6625MHz	Pass	PK	531.87M	42.75	46.00	-3.25	3	Horizontal	0	1.00	-
904.6625MHz	Pass	PK	852.39M	33.25	46.00	-12.75	3	Horizontal	0	1.00	-
904.6625MHz	Pass	PK	119.97M	30.87	43.50	-12.63	3	Horizontal	360	1.00	-
904.6625MHz	Pass	PK	188.86M	38.89	43.50	-4.61	3	Horizontal	360	1.00	-
904.6625MHz	Pass	PK	440.49M	33.36	46.00	-12.64	3	Horizontal	360	1.00	-
904.6625MHz	Pass	PK	530.46M	33.57	46.00	-12.43	3	Horizontal	360	1.00	-
904.6625MHz	Pass	PK	800.38M	34.40	46.00	-11.60	3	Horizontal	360	1.00	-
904.6625MHz	Pass	QP	242.28M	40.36	46.00	-5.64	3	Horizontal	327	1.37	-

DBPSK

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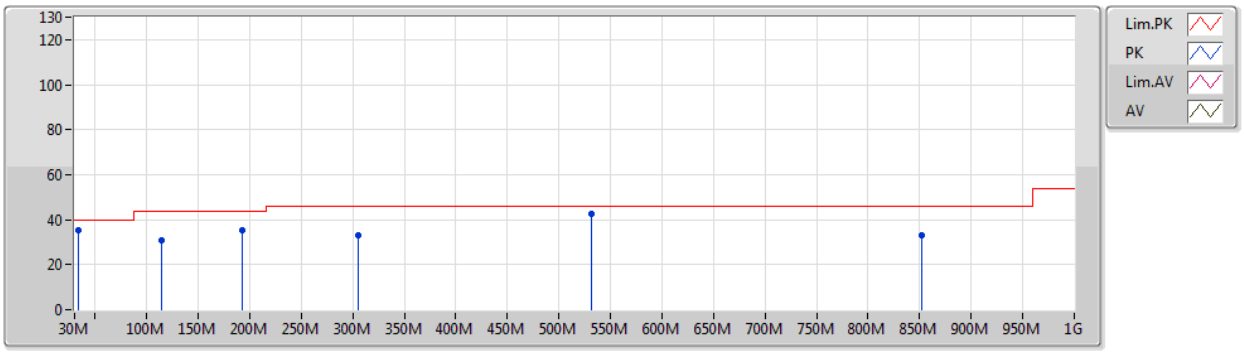
904.6625MHz_USB



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	34.22M	35.21	40.00	-4.79	-9.85	3	Horizontal	0	1.00	-	45.06	21.26	0.98	32.09
PK	114.35M	30.71	43.50	-12.79	-13.38	3	Horizontal	0	1.00	-	44.09	17.07	1.66	32.11
PK	193.07M	35.04	43.50	-8.46	-16.00	3	Horizontal	0	1.00	-	51.04	14.12	1.95	32.07
PK	305.54M	32.84	46.00	-13.16	-11.13	3	Horizontal	0	1.00	-	43.97	18.42	2.40	31.95
PK	531.87M	42.75	46.00	-3.25	-5.17	3	Horizontal	0	1.00	-	47.92	23.23	3.26	31.66
PK	852.39M	33.25	46.00	-12.75	-1.88	3	Horizontal	0	1.00	-	35.13	25.27	3.97	31.12

DBPSK

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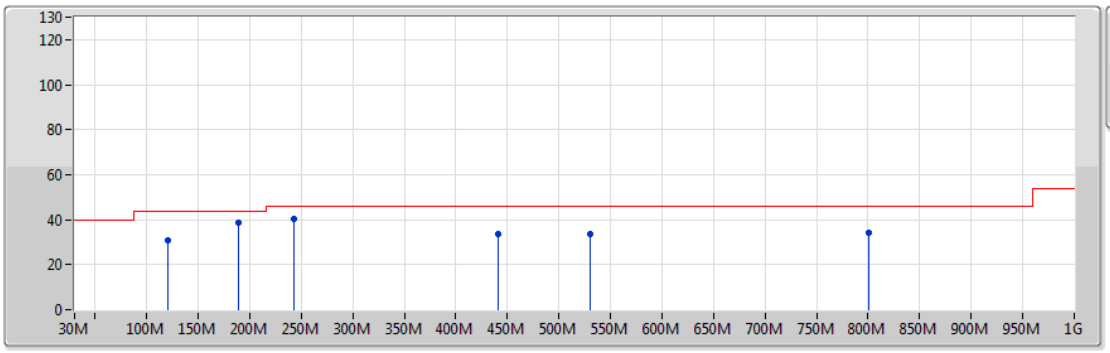
904.6625MHz_USB



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
PK	119.97M	30.87	43.50	-12.63	-11.77	3	Horizontal	360	1.00	-	42.64	16.97	1.71	30.45
PK	188.86M	38.89	43.50	-4.61	-14.41	3	Horizontal	360	1.00	-	53.30	14.04	1.94	30.39
PK	440.49M	33.36	46.00	-12.64	-5.22	3	Horizontal	360	1.00	-	38.58	21.84	2.91	29.97
PK	530.46M	33.57	46.00	-12.43	-3.39	3	Horizontal	360	1.00	-	36.96	23.16	3.26	29.81
PK	800.38M	34.40	46.00	-11.60	-0.49	3	Horizontal	360	1.00	-	34.89	24.95	3.95	29.39
QP	242.28M	40.36	46.00	-5.64	-11.45	3	Horizontal	327	1.37	-	51.81	16.74	2.12	30.31

Summary

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
902-928MHz	-	-	-	-	-	-	-	-	-	-	-
DBPSK	Pass	AV	3.60849G	31.70	54.00	-22.30	3	Horizontal	16	1.13	-

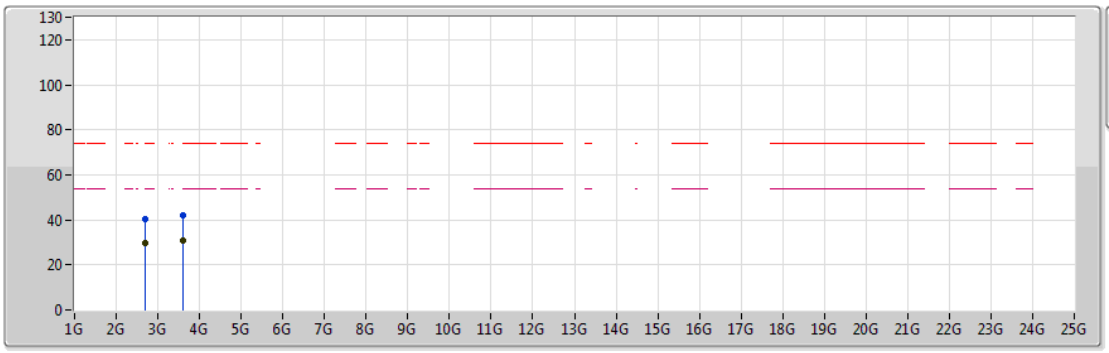
Result

Mode	Result	Type	Freq (Hz)	Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Dist (m)	Condition	Azimuth (°)	Height (m)	Comments
DBPSK	-	-	-	-	-	-	-	-	-	-	-
902.1375MHz	Pass	AV	2.70647G	29.65	54.00	-24.35	3	Vertical	284	3.00	-
902.1375MHz	Pass	AV	3.6085G	30.69	54.00	-23.31	3	Vertical	360	2.79	-
902.1375MHz	Pass	PK	2.70677G	40.41	74.00	-33.59	3	Vertical	284	3.00	-
902.1375MHz	Pass	PK	3.60903G	42.23	74.00	-31.77	3	Vertical	360	2.79	-
902.1375MHz	Pass	AV	2.70628G	27.73	54.00	-26.27	3	Horizontal	360	2.87	-
902.1375MHz	Pass	AV	3.60849G	31.70	54.00	-22.30	3	Horizontal	16	1.13	-
902.1375MHz	Pass	PK	2.70625G	40.07	74.00	-33.93	3	Horizontal	360	2.87	-
902.1375MHz	Pass	PK	3.60896G	42.61	74.00	-31.39	3	Horizontal	16	1.13	-
904.6625MHz	Pass	AV	2.71408G	27.67	54.00	-26.33	3	Vertical	307	2.85	-
904.6625MHz	Pass	AV	3.61829G	28.79	54.00	-25.21	3	Vertical	65	1.50	-
904.6625MHz	Pass	PK	2.71402G	40.98	74.00	-33.02	3	Vertical	307	2.85	-
904.6625MHz	Pass	PK	3.61898G	41.29	74.00	-32.71	3	Vertical	65	1.50	-
904.6625MHz	Pass	AV	2.71356G	27.47	54.00	-26.53	3	Horizontal	185	1.45	-
904.6625MHz	Pass	AV	3.61901G	28.79	54.00	-25.21	3	Horizontal	159	1.50	-
904.6625MHz	Pass	PK	2.71394G	40.29	74.00	-33.71	3	Horizontal	185	1.45	-
904.6625MHz	Pass	PK	3.61826G	41.62	74.00	-32.38	3	Horizontal	159	1.50	-

DBPSK

05/11/2019

902.1375MHz_TX

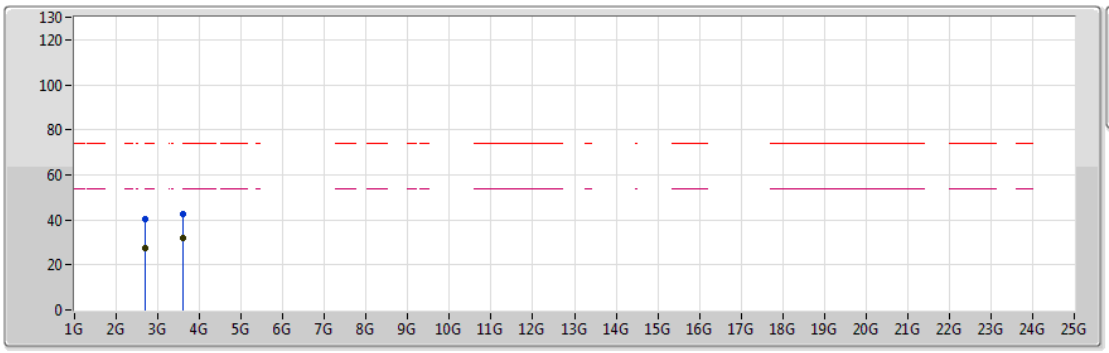


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
AV	2.70647G	29.65	54.00	-24.35	-3.40	3	Vertical	284	3.00	-	33.05	27.92	3.99	35.31
AV	3.6085G	30.69	54.00	-23.31	-0.96	3	Vertical	360	2.79	-	31.65	29.12	5.09	35.17
PK	2.70677G	40.41	74.00	-33.59	-3.40	3	Vertical	284	3.00	-	43.81	27.92	3.99	35.31
PK	3.60903G	42.23	74.00	-31.77	-0.96	3	Vertical	360	2.79	-	43.19	29.12	5.09	35.17

DBPSK

05/11/2019

902.1375MHz_TX

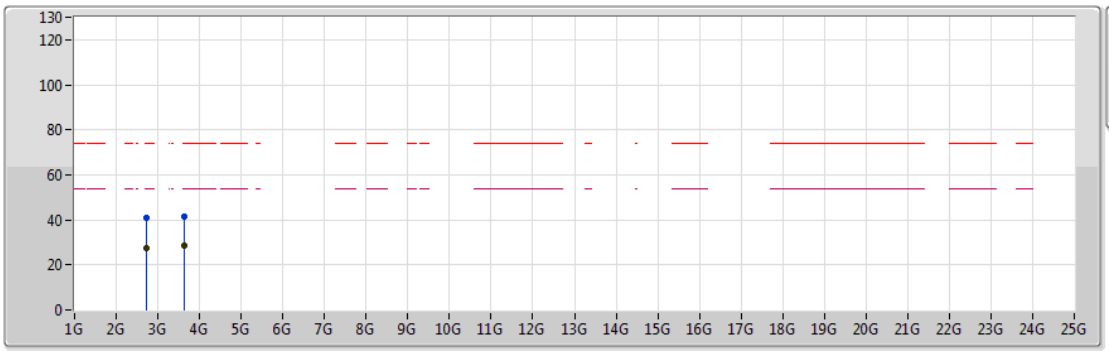


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
AV	2.70628G	27.73	54.00	-26.27	-3.40	3	Horizontal	360	2.87	-	31.13	27.92	3.99	35.31
AV	3.60849G	31.70	54.00	-22.30	-0.96	3	Horizontal	16	1.13	-	32.66	29.12	5.09	35.17
PK	2.70625G	40.07	74.00	-33.93	-3.40	3	Horizontal	360	2.87	-	43.47	27.92	3.99	35.31
PK	3.60896G	42.61	74.00	-31.39	-0.96	3	Horizontal	16	1.13	-	43.57	29.12	5.09	35.17

DBPSK

05/11/2019

904.6625MHz_TX

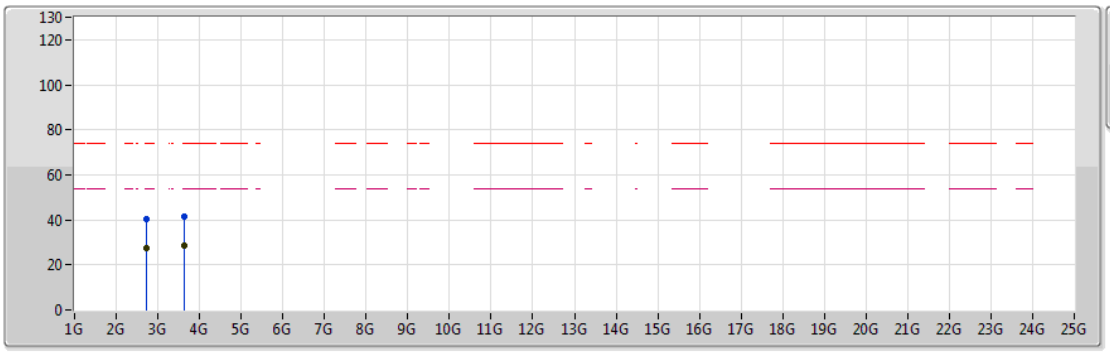


Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
AV	2.71408G	27.67	54.00	-26.33	-3.37	3	Vertical	307	2.85	-	31.04	27.94	4.00	35.31
AV	3.61829G	28.79	54.00	-25.21	-0.93	3	Vertical	65	1.50	-	29.72	29.14	5.10	35.17
PK	2.71402G	40.98	74.00	-33.02	-3.37	3	Vertical	307	2.85	-	44.35	27.94	4.00	35.31
PK	3.61898G	41.29	74.00	-32.71	-0.93	3	Vertical	65	1.50	-	42.22	29.14	5.10	35.17

DBPSK

05/11/2019

904.6625MHz_TX



Type	Freq	Level	Limit	Margin	Factor	Dist	Condition	Azimuth	Height	Comment	Raw	AF	CL	PA
	(Hz)	(dBuV/m)	(dBuV/m)	(dB)	(dB)	(m)		(°)	(m)		(dBuV)	(dB)	(dB)	(dB)
AV	2.71356G	27.47	54.00	-26.53	-3.37	3	Horizontal	185	1.45	-	30.84	27.94	4.00	35.31
AV	3.61901G	28.79	54.00	-25.21	-0.93	3	Horizontal	159	1.50	-	29.72	29.14	5.10	35.17
PK	2.71394G	40.29	74.00	-33.71	-3.37	3	Horizontal	185	1.45	-	43.66	27.94	4.00	35.31
PK	3.61826G	41.62	74.00	-32.38	-0.93	3	Horizontal	159	1.50	-	42.55	29.14	5.10	35.17