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FCC 15.247
2.4 GHz Report

for

Elitegroup Computer Systems Co., Ltd.

No. 239, Sec. 2., TiDing Blvd., Taipei, Taiwan 11493

Product : Ruggedized Intelligent Gateway
Model : GWS-BTI2
Brand : ECS
FCC ID : WL6-GWS-BTI2

Prepared by : AUDIX Technology Corporation,
EMC Department

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TEST REPORT CERTIFICATION

Applicant	:	Elitegroup Computer Systems Co., Ltd.
EUT Description		
(1) Product	:	Ruggedized Intelligent Gateway
(2) Model	:	GWS-BTI2
(3) Brand	:	ECS

Applicable Standards:

47 CFR FCC Part 15 Subpart C
ANSI C63.10:2013
KDB 558074 D01 DTS Meas Guidance v04

Audix Technology Corp. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.
Audix Technology Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens and samples.

Date of Report: 2017. 03. 30

Reviewed by: Sabrina Wang (Sabrina Wang /Administrator)

Approved by: Ben Cheng (Ben Cheng/Manager)

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1. REVISION RECORD OF TEST REPORT

Edition No	Issued Data	Revision Summary	Report Number
0	2017. 03. 30	Original Report	EM-F170185

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2. SUMMARY OF TEST RESULTS

Rule	Description	Results
15.207	Conducted Emission	**PASS**
15.247(d)/15.205	Radiated Band Edge and Radiated Spurious Emission	**PASS**
15.247(a)(2)	6dB Bandwidth	**PASS**
15.247(b)(3)	Maximum Peak Output	**PASS**
15.247(d)	Conducted Band Edges and Conducted Spurious Emission	**PASS**
15.247 (e)	Peak Power Spectral Density	**PASS**
15.203	Antenna Requirement	**PASS**

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3. GENERAL INFORMATION

3.1. Description of Application

Applicant	Elitegroup Computer Systems Co., Ltd. No. 239, Sec. 2., TiDing Blvd., Taipei, Taiwan 11493
Product	Ruggedized Intelligent Gateway
Model	GWS-BTI2
Brand	ECS

3.2. Description of EUT

Test Model	GWS-BTI2
Serial Number	N/A
Power Rating	9-36Vdc, 7.2-1.8A (65W)
Equipment Type	IEEE802.15.4g **(**LoRa™ - Ultimate Long Range Solutions)
Sample Status	Mass-production
Date of Receipt	2017. 03. 20
Date of Test	2017. 03. 24 ~ 28
I/O Ports List	• Antenna Ports (BNC Type) x4 • DC In Port (BNC Type) x1 • USB 2.0 Port (BNC Type) x1 • USB 3.0 Port (BNC Type) x1 • RS232/RS485 Port (BNC Type) x1 • VGA Port (BNC Type) x1 • RJ45 Ports (BNC Type) x2

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3.3. EUT Specifications Assessed in Current Report

Mode	Fundamental Range (MHz)	Channel Number	Modulation	Data Rate
LoRa	904-926	13	(G)FSK	980bps to 21.9kbps

Channel List			
Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
00	904.00	07	918.20
01	905.24	08	920.33
02	907.40	09	922.52
03	909.56	10	924.68
04	911.72	11	926.00
05	913.88	12	915.00
06	916.04		

3.4. Antenna Information

No.	Antenna Part Number	Manufacture	Antenna Type	Frequency (MHz)	Max Gain (dBi)
1	A40815-10	Auden	Dipole Antenna	860-960	1.67

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3.5. Description of Key Component Lists

Item	Supplier	Model / Type	Character
Mother Board	ECS	GWB-BTI2	---
Carrier Board	ECS	BTI2-CB	---
LoRa Board	ECS	BTI2-LRC	---
LoRa Card	ECS	BTI2-LR01	---
Chassis	KG	SILVER GRAY	Top, Bottom Cover
CPU [BGA393]	Intel	ATOM E3825	1.6GHz, 7.5W
SDRAM	Kingston	D2516EC4BXGGB	256MB*16*4 (2GB)
EMMC	Sandisk	SDINADF4-32G-H.. TFBGA 153P	32GB
Wi-Fi + BT Combo Module	Realtek (AzureWave)	RTL8723BE (AW-NB159H)	IEEE 802.11 b/g/n + 802.15 BT Combo card FCC ID: TX2-RTL8723BE
Dipole Antenna	Auden	Wifi T-0211 TNC_RP	2.4-2.5GHz 3dBi/5.1-5.8GHz 5dBi
Dipole Antenna	Auden	LoRa T-0211 TNC_RP	860-960 MHz/2dBi
Cable	Fenying	T-FY-M1210M-200-DB09M	M12 to RS232/RS485
		T-FY-M1217M-200-DB15F	M12 to VGA
		T-FY-M1205M-200-DCM	M12 to DC in
		T-FY-M1205M-200-U2F	M12 to USB2.0 Type-A
		T-FY-M1210M-200-U3F	M12 to USB3.0 Type-A
		T-FY-M1208M-200-RJF	M12 to LAN1
		T-FY-M1208M-200-RJF	M12 to LAN2

Remark: For more detailed features description, please refer to the manufacturer's specifications or the user manual.

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3.6. Test Configuration

Mode	Duty Cycle (x)	Duty Cycle Factor (dB)
LoRa	1	0

Note: When duty cycle is less than 98% (0.98) that duty cycle factor 10log(1/x) is needed to add in conducted test items measured in average detector.

AC Conduction	
Test Case	Normal operation

Item		Mode	Test Channel
Radiated Test Case	Spurious Emission Note1 & 2	LoRa	00/12/11
	6dB Bandwidth	LoRa	00/12/11
	Peak Output Power	LoRa	00/12/11
	Band Edge	LoRa	00/11
	Peak Power Spectral Density	LoRa	00/12/11

Note 1:

■Mobile Device: Device was pre-assessed with docking and portable (3 axis), the worst case is tested with docking.

□Portable Device, and 3 axis were assessed.

- □ Lie
- □ Side
- □ Stand

Note 2: Low, mid, and high channels were measured, only the worst channel of each modulation was presented in this report.

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3.7. Tested Supporting System List

3.7.1. Support Peripheral Unit

No.	Product	Brand	Model No.	Serial No.	Approval	Remarks
A	LCD Monitor	Lenovo	LT2452P	VNA9XVX	FCC By DoC	Provided by LAB
B	Modem	ACEEX	DM-1414	980034384	FCC ID: IFAXDM1414	Provided by LAB
C	Modem	ACEEX	DM-1414	980034393	FCC ID: IFAXDM1414	Provided by LAB
D	Hard Drive	WD	WDBUZG5000ABK-05	WXS1EC3ADYTE	FCC By DoC	Provided by LAB
E	Hard Drive	BUFFALO	HD-LBU3	55292020409790	FCC By DoC	Provided by LAB
F	AC Adapter	APD	WA-65V19R	N/A	N/A	Supplied by Client

3.7.2. Cable Lists

No.	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	D-Sub Cable	1	1.8	Yes	2	Provided by LAB
2	RS232 Cable	1	1.8	No	1	Provided by LAB
3	RS485 Cable	1	1.8	No	1	Provided by LAB
4	USB 2.0 Cable	1	1.0	Yes	0	Provided by LAB
5	USB 3.0 Cable	1	1.0	Yes	0	Provided by LAB
6	LAN Cable	1	1.8	No	0	Provided by LAB
7	DC Power Cord	1	1.8	No	1	Supplied by Client
8	AC Power Cord	1	1.8	No	0	Provided by LAB
9	AC Power Cord	3	1.8	No	0	Provided by LAB for Support Units A,B,C

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3.8. Setup Configuration

3.8.1. EUT Configuration for Power Line & Radiated Emission

3.8.2. EUT Configuration for RF Conducted Test Items

3.9. Operating Condition of EUT

Test program installed in EUT is used for enabling EUT RF function under continues transmitting and choosing channel.

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3.10.Description of Test Facility

Name of Test Firm	Audix Technology Corporation / EMC Department No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan No. 67-4, Dingfu, Linkou Dist., New Taipei City 244, Taiwan Tel: +886-2-26092133 Fax: +886-2-26099303 Website : www.audixtech.com Contact e-mail: sales@audixtech.com
Accreditations	The laboratory is accredited by following organizations under ISO/IEC 17025:2005 (1) NVLAP(USA) NVLAP Lab Code 200077-0 (2) TAF(Taiwan) No. 1724 (3) FCC OET Designation No. TW1004 & TW1090
Test Facilities	(1) No. 3 Shielding Room (2) Semi-Anechoic Chamber (3) Fully Anechoic Chamber

3.11.Measurement Uncertainty

Test Item	Frequency Range	Uncertainty
Conduction Test	150kHz~30MHz	±3.50dB
Radiation Test (Distance: 3m)	30MHz~1000MHz	± 3.68dB
	Above 1GHz	± 5.82dB

Remark：Uncertainty = $ku_c(y)$

Test Item	Uncertainty
6dB Bandwidth	± 0.05kHz
Maximum peak output power	± 0.33dB
Power spectral density	± 0.13dB
Conducted Emission Limitations	± 0.13dB

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4. MEASUREMENT EQUIPMENT LIST

4.1. Conducted Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
1.	Test Receiver	R&S	ESR3	101772	2017. 01. 18	2018. 01. 17
2.	A.M.N.	R&S	ENV4200	100169	2016. 11. 11	2017. 11. 10
3.	L.I.S.N.	Kyoritsu	KNW-407	8-1370-9	2017. 02. 20	2018. 02. 19
4.	Pulse Limiter	R&S	ESH3-Z2	100041	2017. 01. 16	2018. 01. 15
5.	Signal Cable	CDM	RG-142	CE-05	2017. 02. 15	2018. 02. 14
6.	Test Software	Audix	e3	V.120703a	N.C.R.	N.C.R.

4.2. Radiated Emission Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
1.	Spectrum Analyzer	Agilent	N9010A-526	MY53400071	2016. 09. 19	2017. 09. 18
2.	Spectrum Analyzer	Agilent	N9010A-526	MY52220368	2016. 12. 01	2017. 11. 30
3.	Test Receiver	R & S	ESCS30	100338	2016. 06. 22	2017. 06. 21
4.	Amplifier	HP	8447D	2944A06305	2017. 02. 16	2018. 02. 15
5.	Amplifier	Sonoma	310N	187161	2016. 06. 14	2017. 06. 13
6.	Bilog Antenna	CHASE	CBL6112D	33821	2017. 01. 21	2018. 01. 20
7.	Loop Antenna	R&S	HFH2-Z2	891847/27	2016. 12. 23	2017. 12. 22
8.	Double-Ridged Waveguide Horn	ETS-Lindgren	3117	00135902	2017. 03. 08	2018. 03. 07
9.	Tunable Notch Filter	K&L	3TNF-800/1000-0.2-N/N0	498	2017. 01. 27	2018. 01. 26
10.	High-Pass Filter	Microware Circuits	H1G013G1	459777	2016. 06. 18	2017. 06. 17
11.	Test Software	Audix	e3	V.6.110601	N.C.R.	N.C.R.

4.3. RF Conducted Measurement

Item	Type	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
1.	Spectrum Analyzer	Agilent	N9010A-507	MY52220264	2016. 08. 09	2017. 08. 08
2.	Spectrum Analyzer	Agilent	N9010A-526	MY52220368	2016. 12. 01	2017. 11. 30

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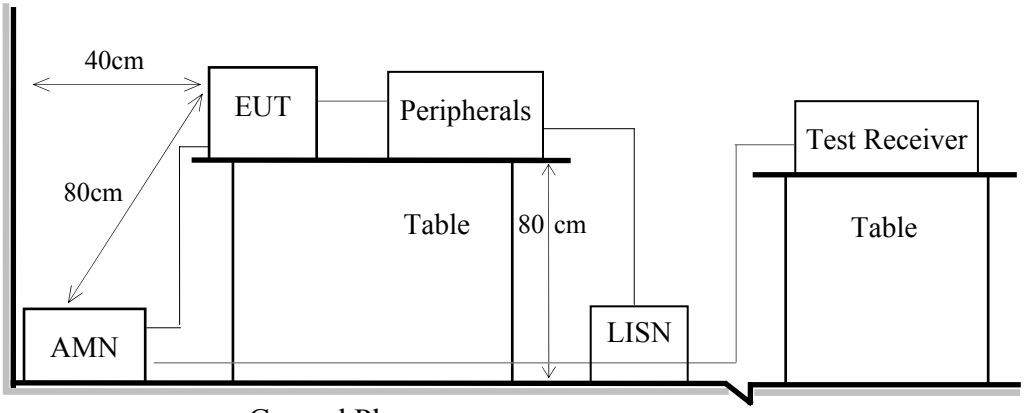
5. CONDUCTED EMISSION

5.1. Block Diagram of Test Setup

5.1.1. Block Diagram of EUT

Indicated as section 3.8

5.1.2. Shielded Room Setup Diagram



5.2. Conducted Emission Limit

Frequency	Conducted Limit	
	Quasi-Peak Level	Average Level
150kHz ~ 500kHz	66 ~ 56 dBμV	56 ~ 46 dBμV
500kHz ~ 5MHz	56 dBμV	46 dBμV
5MHz ~ 30MHz	60 dBμV	50 dBμV

Remark 1.: If the average limit is met when using a Quasi-Peak detector, the measurement using the average detector is not required.
2.: The lower limit applies to the band edges.

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5.3. Test Procedure

5.3.1. To set up the EUT as indicated in ANSI C 63.10. The EUT was placed on the table which has 80 cm height to the ground and 40 cm distance to the conducting wall.

5.3.2. Power supplier of the EUT was connected to the AC mains through an Artificial Mains Network (A.M.N.).

5.3.3. The AC power supplies to all peripheral devices must be provided through line impedance stabilization network (L.I.S.N.)

5.3.4. Checking frequency range from 150 kHz to 30 MHz and record the emission which does not have 20 dB below limit.

5.4. Test Results

Please refer to Appendix A.

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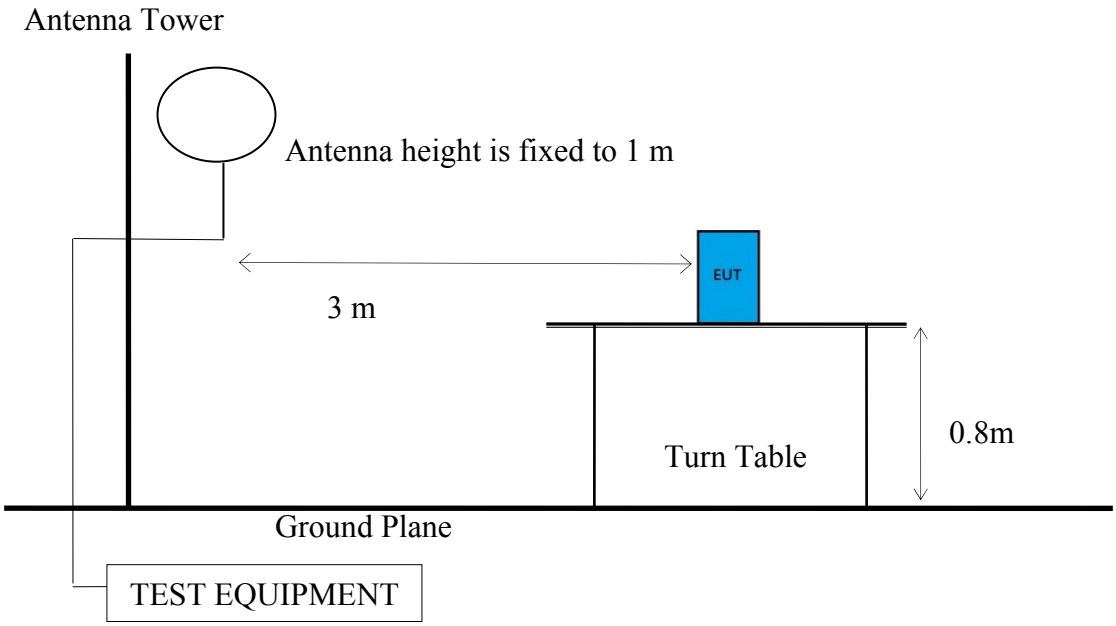
6. RADIATED EMISSION

6.1. Block Diagram of Test Setup

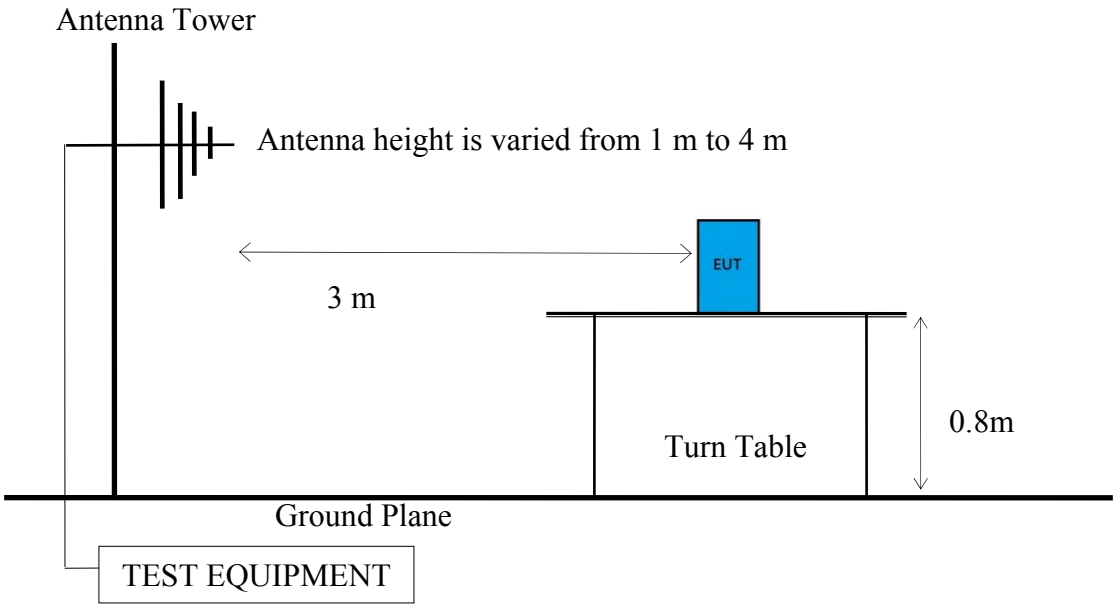
6.1.1. Block Diagram of EUT

Indicated as section 3.8

6.1.2. Setup Diagram for 9kHz-30MHz



6.1.3. Setup Diagram for 30-1000 MHz



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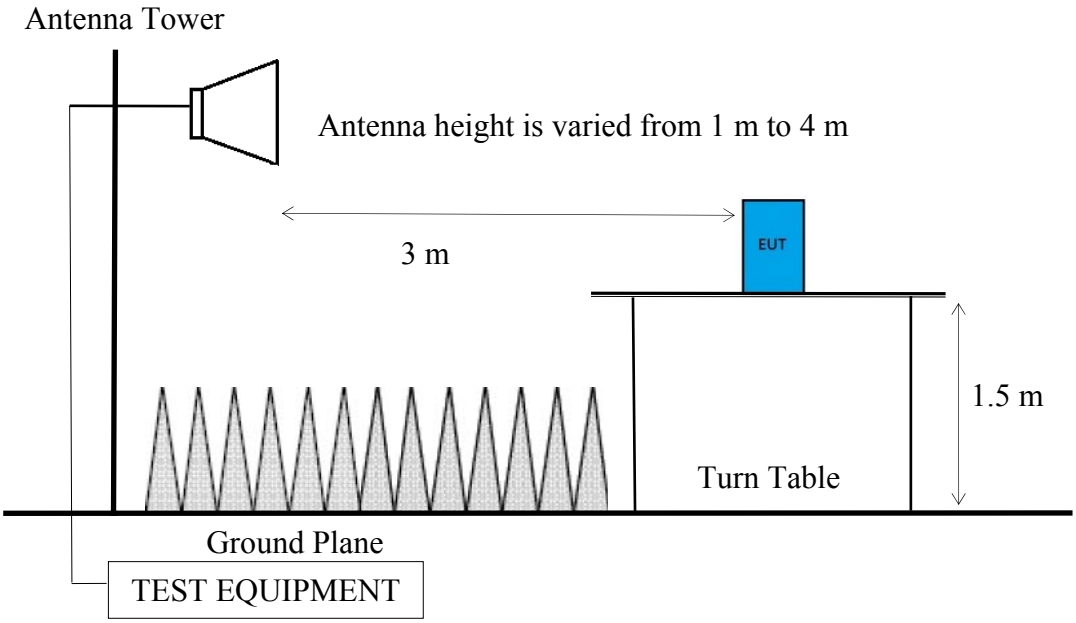
6.1.4. Setup Diagram for above 1GHz



6.2. Radiated Emission Limits

In any 100kHz bandwidth outside the frequency band, the radio frequency power produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205 must also comply with the radiated emission limits specified as below.

Frequency (MHz)	Distance (m)	Limits	
		dBμV/m	μV/m
0.009 - 0.490	300	67.6	2400/kHz
0.490 - 1.705	30	87.6	24000/kHz
1.705 - 30	30	29.5	30
30 - 88	3	40.0	100
88- 216	3	43.5	150
216- 960	3	46.0	200
Above 960	3	54.0	500
Above 1000	3	74.0 dBμV/m (Peak) 54.0 dBμV/m (Average)	

Remark：(1) dBμV/m = 20 log (μV/m)
(2) The tighter limit applies to the edge between two frequency bands.
(3) Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.
(4) Fundamental and emission fall within operation band are exempted from this section.
(5) Pursuant to ANSI C63.10: 6.6.4.3, if the maximized peak measured value complies with the average limit, then it is unnecessary to perform an average measurement.

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6.3. Test Procedure

Frequency Range 9kHz~30MHz:
The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level.
In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

(1) RBW = 9kHz with peak and average detector.
(2) Detector: average and peak (9kHz-490kHz)
Q.P. (490kHz-30MHz)

Frequency Range 30MHz ~ 10GHz:
The EUT setup on the turn find table which has 80 cm (for 30-1000 MHz) and 1.5m (for above 1GHz) height to the ground. The turn table rotated 360 degrees and antenna varied from 1 m to 4 m to find the maximum emission level. Both horizontal and vertical polarization are required. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10-2013 regulation.

Frequency below 1 GHz:
Spectrum Analyzer is used for pre-testing with following setting:
(1)RBW = 120KHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
(7)When peak-detected value is lower than limit that the measurement using the Q.P. detector is not required. Otherwise using Q.P. for finally measurement.

Frequency above 1GHz to 10th harmonic (up to 10 GHz):
Peak Detector:
(1)RBW = 1MHz
(2)VBW ≥ 3 x RBW.
(3)Detector = Peak.
(4)Sweep time = auto.
(5)Trace mode = max hold.
(6)Allow sweeps to continue until the trace stabilizes.
(7)When peak-detected value is lower than limit that the measurement using the average detector is not required. Otherwise using average detector for finally measurement.

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Average Detector:

☐**Option 1:**

(1)RBW = 1MHz

(2)VBW ≥ 1/ T.

Modulation Type	T (ms)	1/ T (kHz)	VBW Setting (kHz)
LoRa			

N/A: 1/ T is not implemented when duty cycle presented in section 3.6 is ≥98 %.

(1)Detector = Peak.

(2)Sweep time = auto.

(3)Trace mode = max hold.

(4)Allow sweeps to continue until the trace stabilizes.

☐**Option 2:**

Average Emission Level= Peak Emission Level+ D.C.C.F.

6.4. Measurement Result Explanation

■Peak Emission Level=Antenna Factor + Cable Loss + Meter Reading

☐Average Emission Level l=Antenna Factor + Cable Loss + Meter Reading

☐Average Emission Level= Peak Emission Level+ DCCF

Duty Cycle Correction Factor (DCCF)= 20log (TX_{on}/TX_{on+off}) presented in section 3.6

■ERP= Peak Emission Level-95.2dB-2.14dB-4.7 dB

6.5. Test Results

Please refer to Appendix A.

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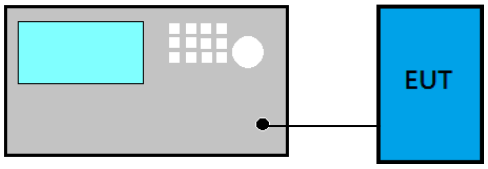
7. 6dB BANDWIDTH

7.1. Block Diagram of Test Setup



7.2. Specification Limits

The minimum 6dB bandwidth shall be at least 500kHz.

7.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

(1) Set RBW = 100 kHz.
(2) Set the video bandwidth (VBW) ≥ 3 × RBW.
(3) Detector = Peak.
(4) Trace mode = max hold.
(5) Sweep = auto couple.
(6) Allow the trace to stabilize.
(7) Setting channel bandwidth function x dB to -6 dB to record the final bandwidth.

7.4. Test Results

Please refer to Appendix A

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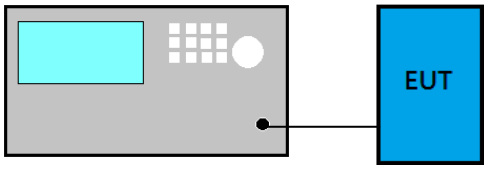
8. MAXIMUM PEAK OUTPUT POWER

8.1. Block Diagram of Test Setup

8.1.1. For WLAN Function

8.1.2. For BLE Function



8.2. Specification Limits

The Limits of maximum Peak Output Power for digital modulation in 902-928MHz is : 1Watt. (30dBm)

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8.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

■PKPM1 Peak power meter method:

EUT is connected to power sensor and record the maximum output power.

□Method AVGPM (Measurement using an RF average power meter):

EUT is connected to power sensor and record the maximum average output power and duty cycle factor is added when duty cycle presented in section 3.5 is < 98%.

■Method AVGSA-2 (Spectrum channel power)

(1) Set span to at least 1.5 times the OBW
(2) Set RBW = 1 -5% of OBW
(3) Set the video bandwidth (VBW) ≥ 3 × RBW.
(4) Detector = RMS.
(5) Trace mode = trace average at least 100 traces
(6) Sweep = auto couple.
(7) Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges.
(8) Duty cycle factor is added when duty cycle presented in section 3.6 is < 98%.

8.4. Test Results

Please refer to Appendix A

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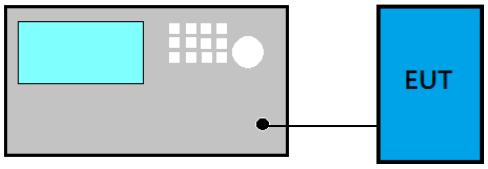
9. EMISSION LIMITATIONS

9.1. Block Diagram of Test Setup



9.2. Specification Limits

In any 100kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, that the required attenuation shall be 30 dB instead of 20 dB.

Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (See Section 15.205(c)).

9.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

■Reference Level

(1) Set analyzer center frequency to DTS channel center frequency.
(2) Set the span to 1.5 times the DTS bandwidth.
(3) Set the RBW to: 100 kHz.
(4) Set the VBW ≥ 3 × RBW.
(5) Detector = peak.
(6) Sweep time = auto couple.
(7) Trace mode = max hold.
(8) Allow trace to fully stabilize to find the max PSD as reference level.

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■Emission Level Measurement

(1) Set analyzer center frequency to DTS channel center frequency.
(2) Set the span to 1.5 times the DTS bandwidth.
(3) Set the RBW to: 100 kHz.
(4) Set the VBW ≥ 3 × RBW.
(5) Detector = peak.
(6) Sweep time = auto couple.
(7) Trace mode = max hold.
(8) Allow trace to fully stabilize to find the max level.

9.4. Test Results

Please refer to Appendix A

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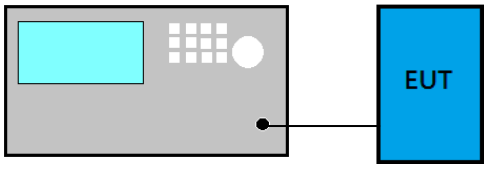
10. POWER SPECTRAL DENSITY

10.1. Block Diagram of Test Setup



10.2. Specification Limits

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band.

10.3. Test Procedure

Following measurement procedure is reference to KDB 558074 D01 DTS Meas Guidance v04:

■Method PKPSD (peak PSD)

(1) Set analyzer center frequency to DTS channel center frequency.
(2) Set the span to 1.5 times the DTS bandwidth.
(3) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
(4) Set the VBW ≥ 3 × RBW.
(5) Detector = peak.
(6) Sweep time = auto couple.
(7) Trace mode = max hold.
(8) Allow trace to fully stabilize.
(9) Use the peak marker function to determine the maximum amplitude level.
(10) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

□Method AVGPSD-2

(1) Using peak PSD procedure step 1 to step 4.
(2) Detector= RMS detector
(3) Sweep time = auto couple
(4) Trace mode = trace averaging over a minimum of 100 traces
(5) Use the peak marker function to determine the maximum amplitude level.
(6) Duty cycle factor is added when duty cycle presented in section 3.6 < 98%.
(7) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

10.4. Test Results

Please refer to Appendix A

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11. DEVIATION TO TEST SPECIFICATIONS

【NONE】

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APPENDIX A

TEST DATA AND PLOTS

(Model: GWS-BTI2)

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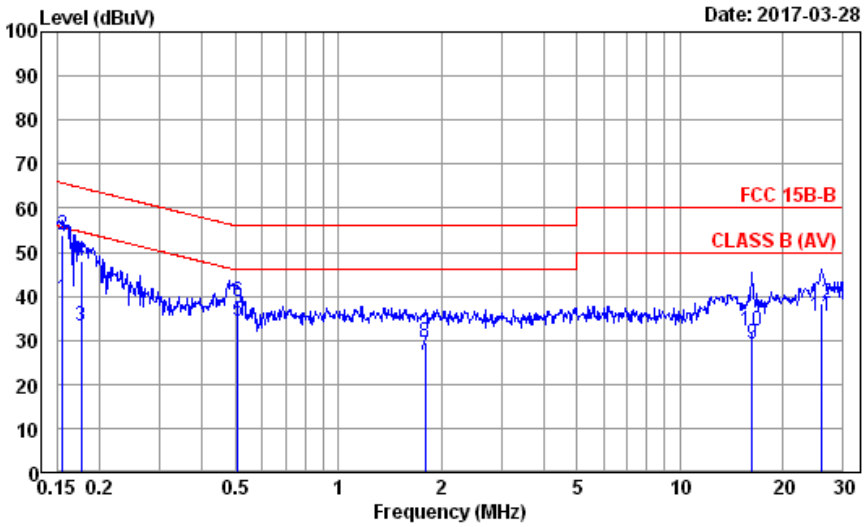
A.1 CONDUCTED EMISSION

Test Date	2017/03/28	Temp./Hum.	22℃/53%
Test Voltage	AC 120V, 60Hz (Via AC Adapter)		



Site no. : No.3 Shielded Room Data no. : 2
Condition : ENV4200 100169 LISN Phase : NEUTRAL
Limit : FCC 15B-B
Env. / Ins. : 22°C / 53% ESR3 (101772) Engineer : Ghost
EUT : GWS-BT12
Power Rating : 120Vac / 60Hz
Test Mode : Link (Operating)

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.156	10.56	0.02	9.87	18.88	39.33	55.69	16.36	Average
2	0.156	10.56	0.02	9.87	33.46	53.91	65.69	11.78	QP
3	0.177	10.54	0.01	9.88	12.90	33.33	54.64	21.31	Average
4	0.177	10.54	0.01	9.88	27.53	47.96	64.64	16.68	QP
5	0.507	10.43	0.01	9.89	14.12	34.45	46.00	11.55	Average
6	0.507	10.43	0.01	9.89	18.55	38.88	56.00	17.12	QP
7	1.800	10.45	0.04	9.88	6.36	26.73	46.00	19.27	Average
8	1.800	10.45	0.04	9.88	9.06	29.43	56.00	26.57	QP
9	16.226	12.84	0.16	9.91	6.28	29.19	50.00	20.81	Average
10	16.226	12.84	0.16	9.91	9.28	32.19	60.00	27.81	QP
11	26.001	15.29	0.21	9.94	10.08	35.52	50.00	14.48	Average
12	26.001	15.29	0.21	9.94	13.05	38.49	60.00	21.51	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

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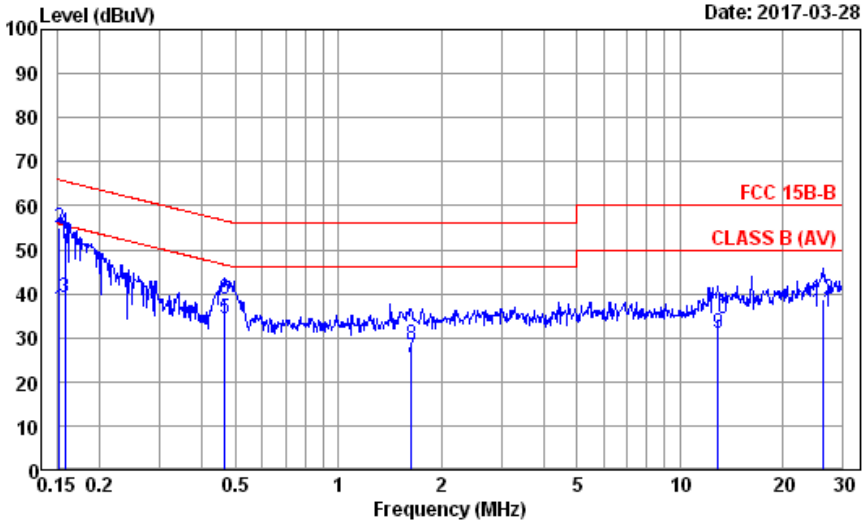
Test Date	2017/03/28	Temp./Hum.	22℃/53%
Test Voltage	AC 120V, 60Hz (Via AC Adapter)		



Site no. : No.3 Shielded Room Data no. : 1
Condition : ENV4200 100169 LISN Phase : LINE
Limit : FCC 15B-B
Env. / Ins. : 22°C / 53% ESR3 (101772) Engineer : Ghost
EUT : GWS-BT12
Power Rating : 120Vac / 60Hz
Test Mode : Link (Operating)

	Freq. (MHz)	AMN Factor (dB)	Cable Loss (dB)	Pulse Att. (dB)	Reading (dBµV)	Emission Level (dBµV)	Limits (dBµV)	Margin (dB)	Remark
1	0.152	10.63	0.02	9.87	16.10	36.62	55.87	19.25	Average
2	0.152	10.63	0.02	9.87	34.38	54.90	65.87	10.97	QP
3	0.158	10.62	0.02	9.87	18.54	39.05	55.56	16.51	Average
4	0.158	10.62	0.02	9.87	33.25	53.76	65.56	11.80	QP
5	0.466	10.45	0.01	9.89	13.82	34.17	46.58	12.41	Average
6	0.466	10.45	0.01	9.89	18.25	38.60	56.58	17.98	QP
7	1.636	10.46	0.03	9.88	5.18	25.55	46.00	20.45	Average
8	1.636	10.46	0.03	9.88	8.09	28.46	56.00	27.54	QP
9	12.920	12.13	0.14	9.90	8.64	30.81	50.00	19.19	Average
10	12.920	12.13	0.14	9.90	12.07	34.24	60.00	25.76	QP
11	26.139	15.40	0.21	9.94	10.26	35.81	50.00	14.19	Average
12	26.139	15.40	0.21	9.94	13.35	38.90	60.00	21.10	QP

Remarks: 1. Emission Level= AMN Factor + Cable Loss + Pulse Att. + Reading.

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A.2 RADIATED EMISSION

Test Date	2017/03/28	Temp./Hum.	23℃/53%
Test Voltage	AC 120V, 60Hz (Via AC Adapter)		

A.2.1 Emissions within Restricted Frequency Bands

A.2.1.1 Frequency 9kHz~30MHz

The emissions (9kHz~30MHz) not reported for there is no emission be found.

A.2.1.2 Frequency Below 1 GHz

Mode	LoRa	Frequency	TX 904MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Field Strength (dBuV/m)	ERP (dBm)	Limits (dBm)	Margin (dB)	Detector
807.94	51.38	-50.66	-12.9	37.76	Peak
871.96	57.64	-44.4	-12.9	31.50	Peak
920.46	50.68	-51.36	-12.9	38.46	Peak
931.13	53.94	-48.1	-12.9	35.20	Peak
935.98	60.42	-41.62	-12.9	28.72	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Field Strength (dBuV/m)	ERP (dBm)	Limits (dBm)	Margin (dB)	Detector
638.19	47.75	-54.29	-12.9	41.39	Peak
665.35	47.35	-54.69	-12.9	41.79	Peak
798.24	46.06	-55.98	-12.9	43.08	Peak
807.94	53.19	-48.85	-12.9	35.95	Peak
871.96	57.46	-44.58	-12.9	31.68	Peak
931.13	51.65	-50.39	-12.9	37.49	Peak
935.98	58.40	-43.64	-12.9	30.74	Peak

Remark: 1. ERP = Peak Field Strength-95.2-2.14-4.7

2. Limit = Peak Output Power -20dB (Peak Output Power see section A.4)

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Mode	LoRa	Frequency	TX 915MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Field Strength (dBuV/m)	ERP (dBm)	Limits (dBm)	Margin (dB)	Detector
786.6	52.23	-45.11	-4.81	40.30	Peak
803.09	48.94	-48.40	-4.81	43.59	Peak
818.61	61.91	-35.43	-4.81	30.62	Peak
935.1	50.76	-46.58	-4.81	41.77	Peak
850.62	54.94	-42.40	-4.81	37.59	Peak
867.11	53.27	-44.07	-4.81	39.26	Peak
882.63	69.24	-28.10	-4.81	23.29	Peak
898.15	56.71	-40.63	-4.81	35.82	Peak
932.1	60.15	-37.19	-4.81	32.38	Peak
946.65	71.04	-26.30	-4.81	21.49	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Field Strength (dBuV/m)	ERP (dBm)	Limits (dBm)	Margin (dB)	Detector
648.86	51.54	-45.8	-4.81	40.99	Peak
787.57	52.92	-44.42	-4.81	39.61	Peak
803.09	50.13	-47.21	-4.81	42.40	Peak
819.58	60.80	-36.54	-4.81	31.73	Peak
835.10	48.09	-49.25	-4.81	44.44	Peak
850.62	53.70	-43.64	-4.81	38.83	Peak
867.11	54.05	-43.29	-4.81	38.48	Peak
882.63	67.16	-30.18	-4.81	25.37	Peak
899.12	55.61	-41.73	-4.81	36.92	Peak
931.13	56.51	-40.83	-4.81	36.02	Peak
946.65	68.15	-29.19	-4.81	24.38	Peak

Remark: 1. ERP = Peak Field Strength-95.2-2.14-4.7

2. Limit = Peak Output Power -20dB (Peak Output Power see section A.4)

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Mode	LoRa	Frequency	TX 926MHz

Antenna at Horizontal Polarization

Emission Frequency (MHz)	Field Strength (dBuV/m)	ERP (dBm)	Limits (dBm)	Margin (dB)	Detector
798.24	46.67	-50.67	-17.72	32.95	Peak
894.27	48.78	-48.56	-17.72	30.84	Peak
931.13	53.86	-43.48	-17.72	25.76	Peak
958.29	48.03	-49.31	-17.72	31.59	Peak

Antenna at Vertical Polarization

Emission Frequency (MHz)	Field Strength (dBuV/m)	ERP (dBm)	Limits (dBm)	Margin (dB)	Detector
665.35	48.28	-49.06	-17.72	31.34	Peak
798.24	46.34	-51.00	-17.72	33.28	Peak
984.27	48.41	-48.93	-17.72	31.21	Peak
931.13	53.35	-43.99	-17.72	26.27	Peak
958.29	46.15	-51.19	-17.72	33.47	Peak

Remark: 1. ERP = Peak Field Strength-95.2-2.14-4.7

2. Limit = Peak Output Power -20dB (Peak Output Power see section A.4)

A.2.2 Emissions outside the frequency band:

The emissions (up to 10GHz) not reported for there is no emission be found.

A.2.3 Emissions in Non-restricted Frequency Bands:

Pursuant to KDB 558074 D01 DTS Meas Guidance v03r05 that emission levels below the 15.209 general radiated emissions limits is not required.

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A.3 6dB BANDWIDTH

Test Date	2017/03/24	Temp./Hum.	23℃/56%
Cable Loss	---	Test Voltage	AC 120V, 60Hz (Via AC Adapter)

A.3.1 6dB Bandwidth Result

Mode	Centre Frequency (MHz)	6 dB Bandwidth (MHz)	Limit
LoRa	904	0.5632	>500kHz
	915	0.5773	
	926	0.5355	

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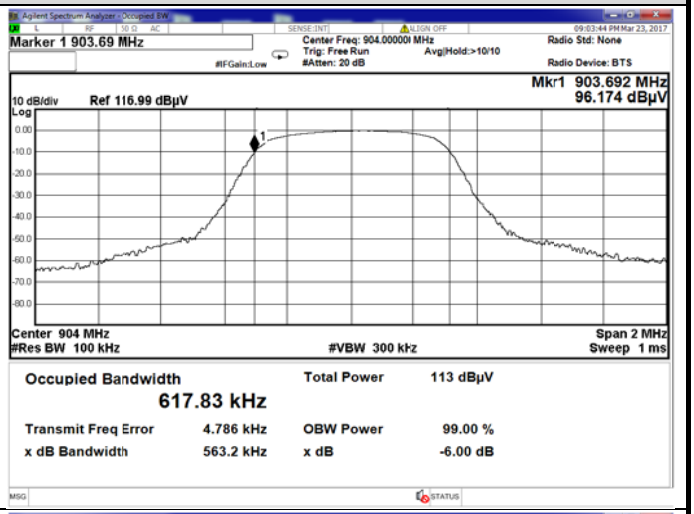
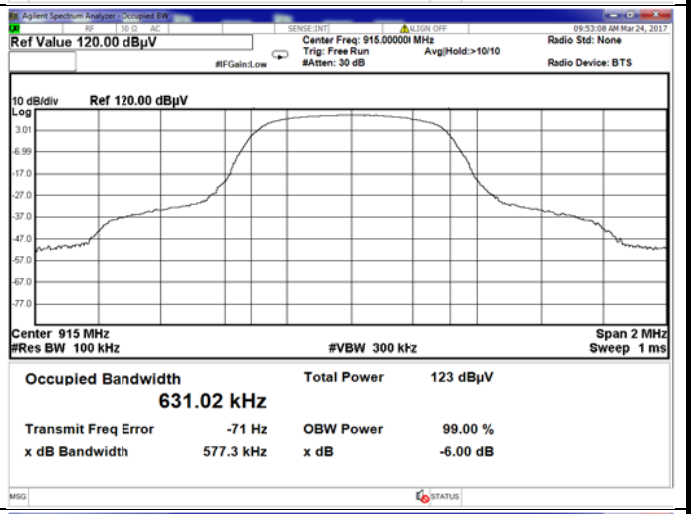
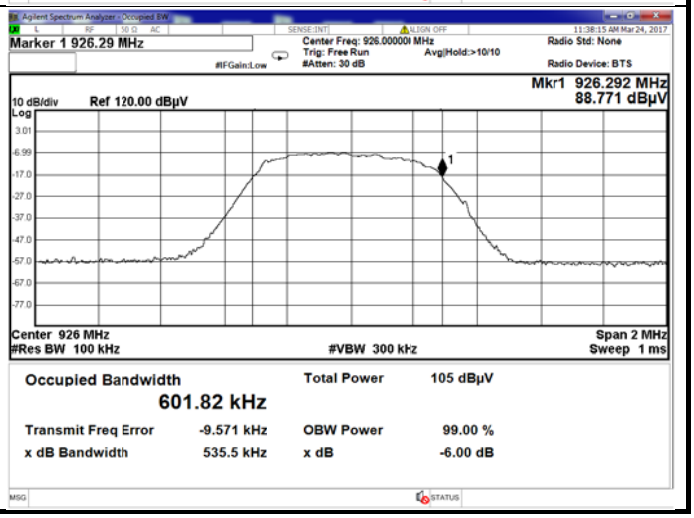
A.3.2 Measurement Plots

LoRa




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A.4 MAXIMUM PEAK OUTPUT POWER

Test Date	2017/03/24	Temp./Hum.	23℃/56%
Mode	LoRa	Test Voltage	AC 120V, 60Hz (Via AC Adapter)

A.4.1 Peak Output Power

Mode	Centre Frequency (MHz)	MAX Output Power		Limit
		(dBm)	(W)	
LoRa	904	7.10	0.005129	< 30dBm (1W)
	915	15.19	0.033037	
	926	2.28	0.001690	

Note: The results have been included cable loss.

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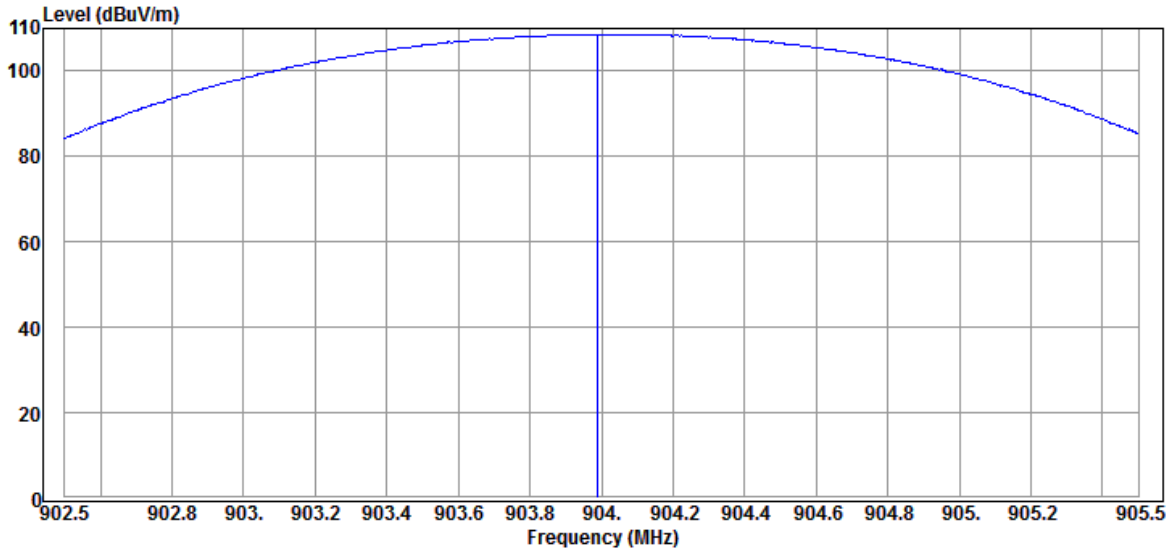
A.4.2 Measurement Plots

Mode	LoRa	Centre Frequency	TX 904 MHz



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBµV)	Emission Level @3m (Vertical) (dBµV/m)	Detector
903.99	20.47	8.19	80.01	108.67	Peak

Test Frequency (MHz)	Emission Level (dBµV/m)	Factor (dB/m)	EIRP (dBm)	ERP (dBm)	Antenna Gain
903.99	108.67	99.9	8.77	7.10	1.67

Pursuant to KDB558074 D01,
ERP (peak output power) = Emission Level-95.2-4.7- Antenna Gain
Where Emission Level=electric field strength in dBµV/m.

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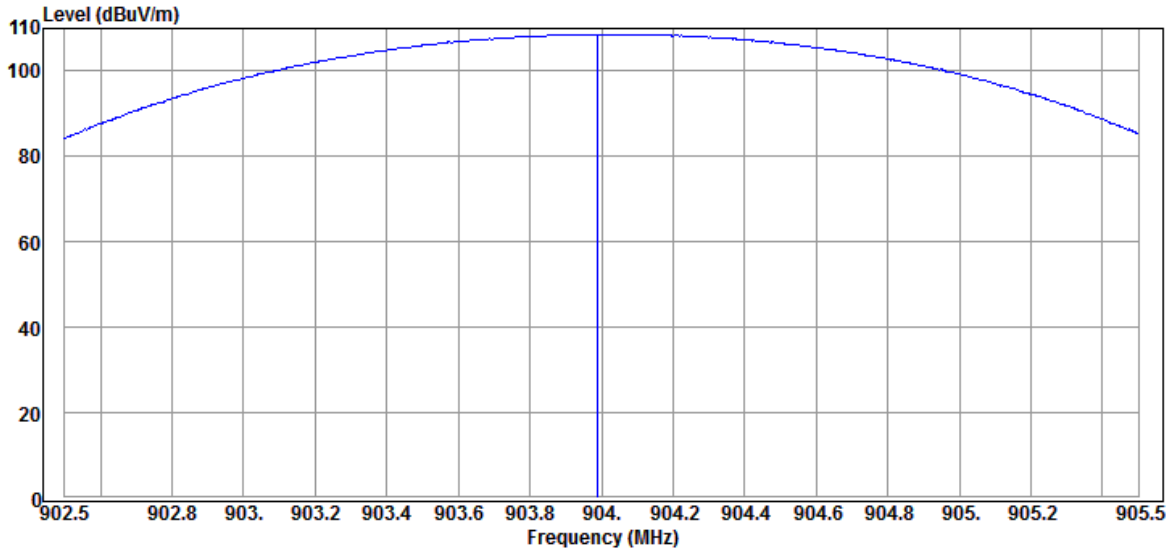
Mode	LoRa	Centre Frequency	TX 915 MHz



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBµV)	Emission Level @3m (Vertical) (dBµV/m)	Detector
915.02	20.58	8.28	87.90	116.76	Peak

Test Frequency (MHz)	Emission Level (dBµV/m)	Factor (dB/m)	EIRP (dBm)	ERP (dBm)	Antenna Gain
915.02	116.76	99.9	16.86	15.19	1.67

Pursuant to KDB558074 D01,
ERP (peak output power) = Emission Level-95.2-4.7- Antenna Gain
Where Emission Level=electric field strength in dBµV/m.

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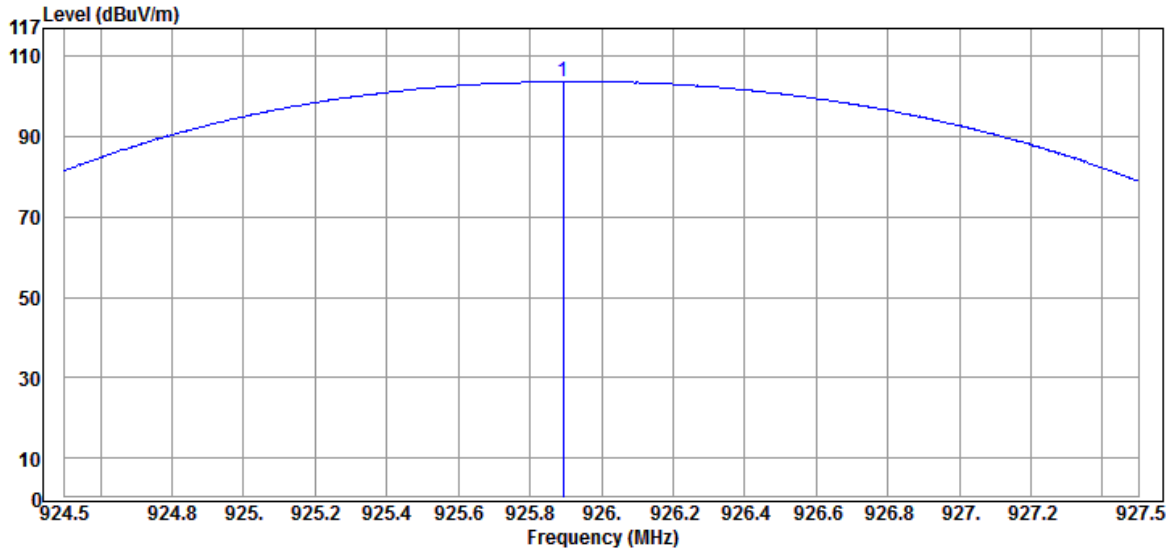
Mode	LoRa	Centre Frequency	TX 926 MHz



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBμV)	Emission Level @3m (Vertical) (dBμV/m)	Detector
925.89	20.66	8.35	74.84	103.85	Peak

Test Frequency (MHz)	Emission Level (dBμV/m)	Factor (dB/m)	EIRP (dBm)	ERP (dBm)	Antenna Gain
925.89	103.85	99.9	3.95	2.28	1.67

Pursuant to KDB558074 D01,
ERP (peak output power) = Emission Level-95.2-4.7- Antenna Gain
Where Emission Level=electric field strength in dBμV/m.

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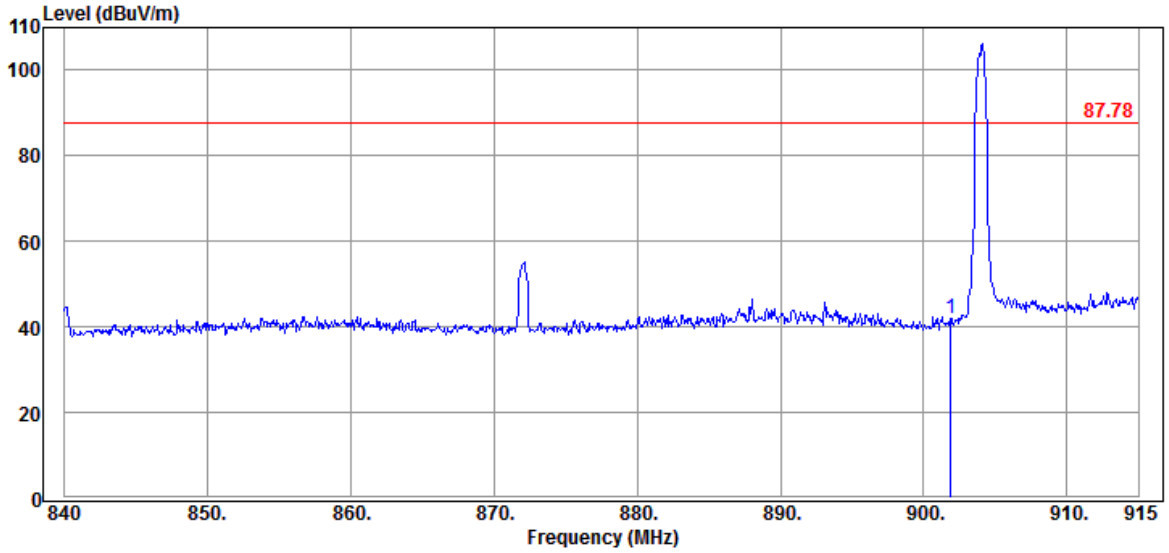
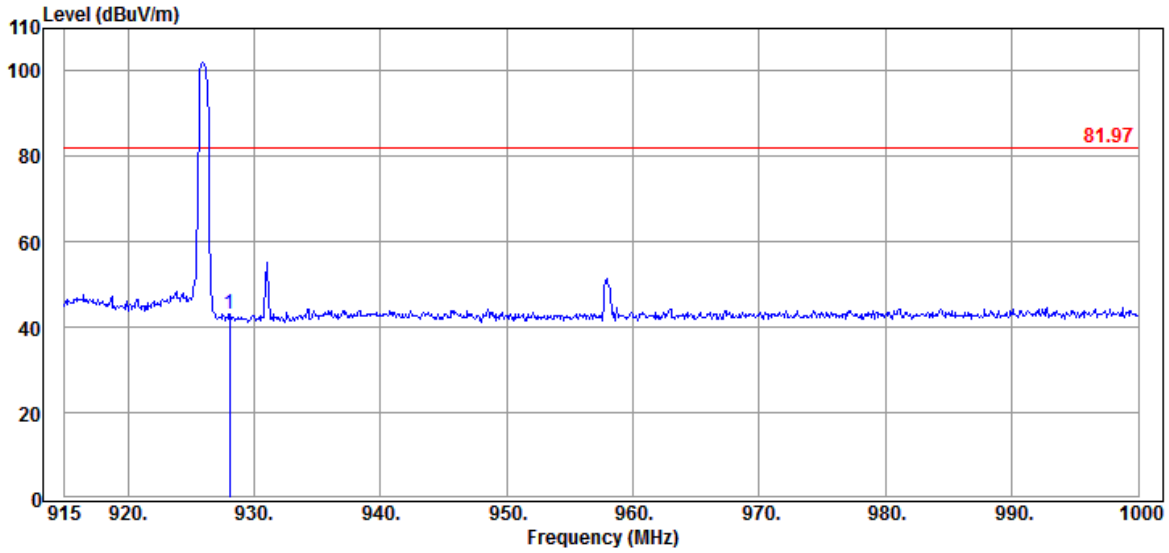
A.5 EMISSION LIMITATIONS (BAND EDGE)

Test Date	2017/03/24	Temp./Hum.	23℃/56%
Mode	LoRa	Test Voltage	AC 120V, 60Hz (Via AC Adapter)

A.5.1 Measurement Plots





Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBμV)	Emission Level @3m (Vertical) (dBμV/m)	Detector
901.88	20.47	8.19	13.42	42.08	Peak
928.09	20.69	8.37	14.22	43.28	Peak

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A.6 POWER SPECTRAL DENSITY

Test Date	2017/03/24	Temp./Hum.	23℃/56%
Mode	LoRa	Test Voltage	AC 120V, 60Hz (Via AC Adapter)

A.6.1 Power Spectral Density Result

Mode	Centre Frequency (MHz)	Power Spectral Density (dBm)	Limit
LoRa	904	-4.08	< 8 dBm/100kHz
	915	4.51	
	926	-10.25	

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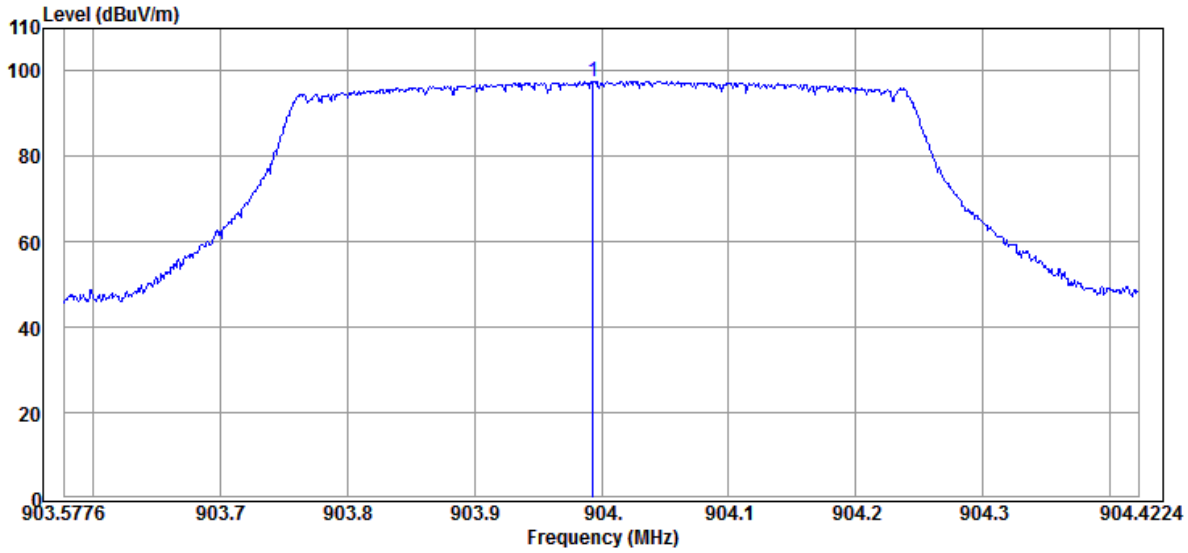
A.6.2 Measurement Plots

Mode	LoRa	Centre Frequency	TX 904 MHz



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBµV)	Emission Level @3m (Vertical) (dBµV/m)	Detector
903.99	20.47	8.19	68.83	97.49	Peak

Test Frequency (MHz)	Emission Level (dBµV/m)	Factor (dB/m)	Power Spectral Density (dBm/100kHz)	Antenna Gain
903.99	97.49	99.9	-4.08	1.67

Pursuant to KDB558074 D01,
Power Spectral Density =Emission Level-95.2-4.7- Antenna Gain
Where Emission Level=electric field strength in dBµV/m.

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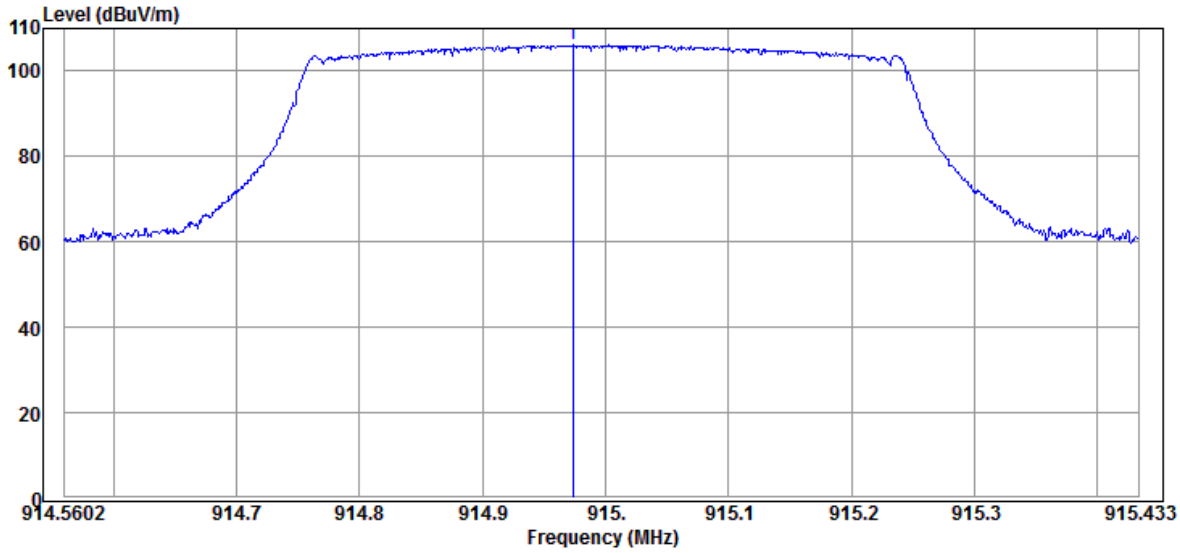
Mode	LoRa	Centre Frequency	TX 915 MHz



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBµV)	Emission Level @3m (Vertical) (dBµV/m)	Detector
914.97	20.58	8.28	77.22	106.08	Peak

Test Frequency (MHz)	Emission Level (dBµV/m)	Factor (dB/m)	Power Spectral Density (dBm/100kHz)	Antenna Gain
914.97	106.08	99.9	4.51	1.67

Pursuant to KDB558074 D01,
Power Spectral Density =Emission Level-95.2-4.7- Antenna Gain
Where Emission Level=electric field strength in dBµV/m.

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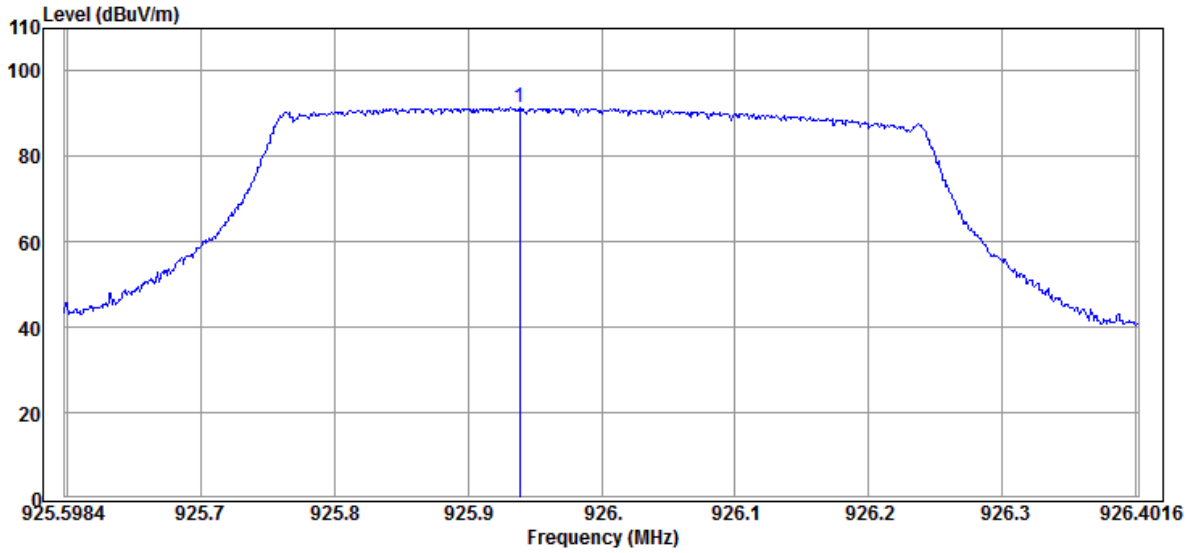
Mode	LoRa	Centre Frequency	TX 926 MHz



Emission Frequency (MHz)	Antenna Factor (dB/m)	Cable Loss (dB)	Meter Reading @3m (Vertical) (dBμV)	Emission Level @3m (Vertical) (dBμV/m)	Detector
925.94	20.66	8.35	62.31	91.32	Peak

Test Frequency (MHz)	Emission Level (dBμV/m)	Factor (dB/m)	Power Spectral Density (dBm/100kHz)	Antenna Gain
925.94	91.32	99.9	-10.25	1.67

Pursuant to KDB558074 D01,
Power Spectral Density =Emission Level-95.2-4.7- Antenna Gain
Where Emission Level=electric field strength in dBμV/m.