TEST REPORT

No. I21Z61038-WMD01

for

Gabb Wireless Inc.

Watch Lite

Model Name: UT310AG

FCC ID: 2AZDOUT310AG

with

Hardware Version: V0.30

Software Version: V1.3

Issued Date: 2021-07-26

Note:

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
I21Z61038-WMD01	Rev.0	1st edition	2021-07-15
I21Z61038-WMD01	Rev.1	2nd edition Add the results for BPSK modulation.	2021-07-26

Note: the latest revision of the test report supersedes all previous version.

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1. Test Laboratory

1.1. Introduction & Accreditation

Telecommunication Technology Labs, CAICT is an ISO/IEC 17025:2017 accredited test laboratory under NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) with lab code 600118-0 and is also an FCC accredited test laboratory (CN5017), and ISED accredited test laboratory (CN0066). The detail accreditation scope can be found on NVLAP website.

1.2. Testing Location

Location 1: CTTL (huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing, P. R. China 100191

Location 2: CTTL(Shouxiang)

Address: No. 51 Shouxiang Science Building, Xueyuan Road, Haidian District, Beijing, P. R. China 100191

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1.3. Testing Environment

Normal Temperature: 15-35℃

Relative Humidity: 20-75%

1.4. Project Data

Testing Start Date: 2021-05-25

Testing End Date: 2021-07-25

1.5. Signature

Dong Yuan

(Prepared this test report)

Zhou Yu

(Reviewed this test report)

Zhao Hui Lin

Deputy Director of the laboratory

(Approved this test report)

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2. Client Information

2.1. Applicant Information

Company Name:	Gabb Wireless Inc.
Address /Post:	4101 N Thanksgiving Way , Unit 300 , Lehi , UTAH , 84043
Contact:	Colin Cole
Email:	colin.cole@gabbwireless.com
Telephone:	385 248 7798

2.2. Manufacturer Information

Company Name:	Shenzhen Tinno Mobile Technology Corp.
Address /Post:	Building, No.33, Xiandong Rd, Xili, Nanshan District, Shenzhen, PRC
Contact:	xiaoping.li
Email:	xiaoping.li@tinno.com
Telephone:	0755-86095550

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3. Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1. About EUT

Description	Watch Lite
Model Name	UT310AG
FCC ID	2AZDOUT310AG
Antenna	Embedded
Output power	20.59dBm maximum EIRP measured for LTE Band 13
Extreme vol. Limits	3.5VDC to 4.35VDC (nominal: 3.85VDC)
Extreme temp. Tolerance	-10°C to +55°C

Note: Components list, please refer to documents of the manufacturer; it is also included in the original test record of CTTL.

3.2. Internal Identification of EUT used during the test

EUT ID*	IMEI	HW Version	SW Version	Date of receipt
UT03a	866368050000706	V0.30	V1.3	2021-05-25
UT04a	866368050000243	V0.30	V1.3	2021-06-02
UT09a	866368050000037	V0.30	V1.3	2021-07-02

*EUT ID: is used to identify the test sample in the lab internally.

3.3. Internal Identification of AE used during the test

AE ID*	Description
AE1	Battery

AE1

Model	ZWD382025V
Manufacturer	ZHONGSHAN ZHONGWANGDE NEW ENERGY TECHNOLOGY Co.,LTD
Capacitance	210mAh

*AE ID: is used to identify the test sample in the lab internally.

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4. Reference Documents

4.1. Documents supplied by applicant

EUT parameters, referring to Annex A for detailed information, is supplied by the client or manufacturer, which is the basis of testing.

4.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

Reference	Title	Version
FCC Part 27	MISCELLANEOUS WIRELESS COMMUNICATIONS SERVICES	10-1-20 Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards	2016
ANSI C63.26	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services	2015
KDB 971168 D01	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS	v03r01

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5. Laboratory Environment

Control room / conducted chamber did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 35 ℃
Relative humidity	Min. =20 %, Max. = 80 %
Shielding effectiveness	> 110 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 0.5 Ω

Fully-anechoic chamber 2 (8.6 meters×6.1 meters×3.85 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 30 ℃
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 110 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 1 Ω
Site voltage standing-wave ratio (S_{VSWR})	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

Semi-anechoic chamber 2 / Fully-anechoic chamber 3 (10 meters×6.7 meters×6.15 meters) did not exceed following limits along the EMC testing:

Temperature	Min. = 15 ℃, Max. = 30 ℃
Relative humidity	Min. = 35 %, Max. = 60 %
Shielding effectiveness	> 100 dB
Electrical insulation	>2 MΩ
Ground system resistance	< 0.5 Ω
Normalised site attenuation (NSA)	<±3.5 dB, 3 m distance
Site voltage standing-wave ratio (S_{VSWR})	Between 0 and 6 dB, from 1GHz to 18GHz
Uniformity of field strength	Between 0 and 6 dB, from 80 to 6000 MHz

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6. Summary Of Test Result

LTE Band 13

Items	Test Name	Clause in FCC rules	Verdict
1	Output Power	27.50	P
2	Emission Limit	2.1051/27.53	P
3	Frequency Stability	2.1055	P
4	Occupied Bandwidth	2.1049	P
5	Emission Bandwidth	27.53	P
6	Band Edge Compliance	27.53	P
7	Conducted Spurious Emission	27.53	P
8	Peak-to-Average Power Ratio	27.50	P

Terms used in Verdict column

P	Pass. The EUT complies with the essential requirements in the standard.
NP	Not Performed. The test was not performed by CTTL.
NA	Not Applicable.The test was not applicable.
BR	Re-use test data from basic model report.
F	Fail. The EUT does not comply with the essential requirements in the standard.

Explanation of worst-case configuration

The worst-case scenario for all measurements is based on the conducted output power measurement investigation results. Output power was measured on BPSK, QPSK modulations. It was found that QPSK was the worst case. All testing was performed using QPSK modulations to represent the worst case unless otherwise stated. The test results shown in the following sections represent the worst case emission.

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7. Test Equipment Utilized

Description	Type	Series Number	Manufacture	Cal Due Date	Calibration Interval
Wideband Radio Communication Tester	CMW500	159082	R&S	2021-12-17	1 year
Spectrum Analyzer	FSU	200030	R&S	2022-06-02	1 year
Radio Communication Analyzer	MT8821C	6201763159	Anritsu	2021-08-12	1 year
Climate Chamber	SH-242	93008556	ESPEC	2023-12-23	3 years
EMI Antenna	3117	00058889	ETS-Lindgren	2021-10-11	1 year
EMI Antenna	3117	00119021	ETS-Lindgren	2022-02-02	1 year
Signal Generator	N5183A	MY49060052	Agilent	2021-07-29	1 year
Test Receiver	E4440A	MY48250642	Agilent	2022-03-04	1 year
Universal Radio Communication Tester	CMW500	166204	R&S	2021-10-29	1 year
EMI Antenna	VULB9163	9163-301	Schwarzbeck	2021-08-04	1 year

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Annex A: Measurement Results

A.1 Output Power

A.1.1 Summary

During the process of testing, the EUT was controlled via communication tester to ensure max power transmission and proper modulation.

In all cases, output power is within the specified limits.

A.1.2 Conducted

A.1.2.1 Method of Measurements

The EUT was set up for the max output power with pseudo random data modulation.

These measurements were done at 3 frequencies (bottom, middle and top of operational frequency range) for each bandwidth.

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A.1.2.2 Measurement Result

NB-IoT band 13 standalone

Subcarrier Spacing	Subcarrier number/offset	Frequency (MHz)	Power(dBm)	
			BPSK	QPSK
3.75kHz	1@47	786.90	23.71	23.41
		782.00	23.68	23.67
		777.10	23.63	23.36
	1@0	786.90	23.73	23.48
		782.00	23.68	23.69
		777.10	23.60	23.39
15kHz	1@11	786.90	23.86	23.87
		782.00	23.87	23.85
		777.10	23.84	23.78
	1@0	786.90	23.87	23.88
		782.00	23.80	23.79
		777.10	23.85	23.79
	12@0	786.90	-	22.25
		782.00	-	22.11
		777.10	-	22.04

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NB-IoT band 13 guard-band

Subcarrier Spacing	LTE Bandwidth	Subcarrier number/offset	Frequency (MHz)	Power(dBm)	
				BPSK	QPSK
3.75kHz	5MHz	1@47	786.885	23.48	23.46
			779.615	23.39	23.37
			777.115	23.35	23.33
		1@0	786.885	23.46	23.44
			779.615	23.34	23.31
			777.115	23.41	23.38
	10MHz	1@47	786.885	23.44	23.41
			786.615	23.46	23.44
			777.115	23.42	23.39
		1@0	786.885	23.47	23.43
			786.615	23.44	23.41
			777.115	23.42	23.35
15kHz	5MHz	1@11	786.885	23.82	23.83
			779.615	23.74	23.73
			777.115	23.79	23.80
		1@0	786.885	23.83	23.81
			779.615	23.75	23.76
			777.115	23.81	23.79
		12@0	786.885	-	22.13
			779.615	-	22.06
			777.115	-	22.15
	10MHz	1@11	786.885	23.81	23.80
			786.615	23.81	23.82
			777.115	23.76	23.75
		1@0	786.885	23.82	23.81
			786.615	23.84	23.82
			777.115	23.77	23.78
		12@0	786.885		22.14
			786.615		22.08
			777.115		22.01

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NB-IoT band 13 in-band-same PCI NB-IoT band 13 in-band-same PCI

Subcarrier Spacing	LTE Bandwidth	Subcarrier number/offset	Frequency (MHz)	Power(dBm)	
				BPSK	QPSK
3.75kHz	5MHz	1@47	786.30	23.52	23.49
			781.10	23.47	23.41
			777.70	23.39	23.37
		1@0	786.30	23.57	23.53
			781.10	23.45	23.37
			777.70	23.36	23.35
	10MHz (PRB 30)	1@47	782.99	23.54	23.51
		1@0	782.99	23.48	23.44
	10 MHz (PRB 35)	1@47	783.89	23.57	23.52
		1@0	783.89	23.56	23.53
15kHz	5MHz	1@11	786.30	23.80	23.81
			781.10	23.78	23.76
			777.70	23.72	23.71
		1@0	786.30	23.85	23.81
			781.10	23.79	23.76
			777.70	23.74	23.72
		12@0	786.30	-	22.16
			781.10	-	22.08
			777.70	-	22.04
	10MHz (PRB 30)	1@11	782.99	23.85	23.84
		1@0	782.99	23.84	23.81
		12@0	782.99	-	22.14
	10 MHz (PRB 35)	1@11	783.89	23.84	23.84
		1@0	783.89	23.86	23.85
		12@0	783.89	-	22.21

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NB-IoT band 13 in-band-different PCI

Subcarrier Spacing	LTE Bandwidth	Subcarrier number/offset	Frequency (MHz)	Power(dBm)	
				BPSK	QPSK
3.75kHz	5MHz	1@47	786.30	23.48	23.44
			781.10	23.43	23.40
			777.70	23.38	23.33
		1@0	786.30	23.50	23.48
			781.10	23.44	23.39
			777.70	23.37	23.31
	10MHz (PRB 30)	1@47	782.99	23.51	23.47
		1@0	782.99	23.46	23.43
	10 MHz (PRB 35)	1@47	783.89	23.51	23.48
		1@0	783.89	23.50	23.46
15kHz	5MHz	1@11	786.30	23.84	23.82
			781.10	23.78	23.79
			777.70	23.73	23.72
		1@0	786.30	23.87	23.84
			781.10	23.79	23.77
			777.70	23.74	23.72
		12@0	786.30	-	22.16
			781.10	-	22.09
			777.70	-	22.03
	10MHz (PRB 30)	1@11	782.99	23.85	23.84
		1@0	782.99	23.87	23.81
		12@0	782.99	-	22.13
	10 MHz (PRB 35)	1@11	783.89	23.85	23.84
		1@0	783.89	23.87	23.85
		12@0	783.89	-	22.16

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A.1.3 Radiated

A.1.3.1 Description

Part 27.50(b) specifies "Portable stations(hand-held devices) transmitting in the 746–757 MHz, 776–788 MHz, and 805–806 MHz bands are limited to 3 watts ERP".

A.1.3.2 Method of Measurement

According to KDB 412172 D01 and ANSI C63.26 the relevant equation for determining the maximum ERP or EIRP from the measured RF output power is given in Equation as follows:

ERP or EIRP = $P_T + G_T – L_C$, ERP = EIRP -2.15, where

ERP or EIRP effective radiated power or equivalent isotropically radiated power, respectively (expressed in the same units as P_{Mea} , e.g., dBm or dBW)

P_T = transmitter output power in dBm;

G_T = gain of the transimitting antenna, in dBd(ERP) or dBi(EIRP);

L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

A.1.3.3 Measurement result

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NB-IoT band 13 standalone

Subcarrier Spacing	Subcarrier number/offset	Frequency (MHz)	Conducted Power(dBm)		Radiated Power(dBm) (Gt-Lc = -1.2)	
			BPSK	QPSK	BPSK	QPSK
3.75kHz	1@47	786.90	23.71	23.41	20.36	20.06
		782.00	23.68	23.67	20.33	20.32
		777.10	23.63	23.36	20.28	20.01
	1@0	786.90	23.73	23.48	20.38	20.13
		782.00	23.68	23.69	20.33	20.34
		777.10	23.60	23.39	20.25	20.04
15kHz	1@11	786.90	23.86	23.87	20.51	20.52
		782.00	23.87	23.85	20.52	20.50
		777.10	23.84	23.78	20.49	20.43
	1@0	786.90	23.87	23.88	20.52	20.53
		782.00	23.80	23.79	20.45	20.44
		777.10	23.85	23.79	20.50	20.44
	12@0	786.90	-	22.25	-	18.90
		782.00	-	22.11	-	18.76
		777.10	-	22.04	-	18.69

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NB-IoT band 13 guard-band

Subcarrier Spacing	LTE Bandwidth	Subcarrier number/offset	Frequency (MHz)	Conducted Power(dBm)		Radiated Power(dBm) (Gt-Lc = -1.2)	
				BPSK	QPSK	BPSK	QPSK
3.75kHz	5MHz	1@47	786.885	23.48	23.46	20.13	20.11
			779.615	23.39	23.37	20.04	20.02
			777.115	23.35	23.33	20.00	19.98
		1@0	786.885	23.46	23.44	20.11	20.09
			779.615	23.34	23.31	19.99	19.96
			777.115	23.41	23.38	20.06	20.03
	10MHz	1@47	786.885	23.44	23.41	20.09	20.06
			786.615	23.46	23.44	20.11	20.09
			777.115	23.42	23.39	20.07	20.04
		1@0	786.885	23.47	23.43	20.12	20.08
			786.615	23.44	23.41	20.09	20.06
			777.115	23.42	23.35	20.07	20.00
15kHz	5MHz	1@11	786.885	23.82	23.83	20.47	20.48
			779.615	23.74	23.73	20.39	20.38
			777.115	23.79	23.80	20.44	20.45
		1@0	786.885	23.83	23.81	20.48	20.46
			779.615	23.75	23.76	20.40	20.41
			777.115	23.81	23.79	20.46	20.44
		12@0	786.885	-	22.13	-	18.78
			779.615	-	22.06	-	18.71
			777.115	-	22.15	-	18.80
	10MHz	1@11	786.885	23.81	23.80	20.46	20.45
			786.615	23.81	23.82	20.46	20.47
			777.115	23.76	23.75	20.41	20.40
		1@0	786.885	23.82	23.81	20.47	20.46
			786.615	23.84	23.82	20.49	20.47
			777.115	23.77	23.78	20.42	20.43
		12@0	786.885	-	22.14	-	18.79
			786.615	-	22.08	-	18.73
			777.115	-	22.01	-	18.66

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NB-IoT band 13 in-band-same PCI

Subcarrier Spacing	LTE Bandwidth	Subcarrier number/offset	Frequency (MHz)	Conducted Power(dBm)		Radiated Power(dBm) (Gt-Lc = -1.2)	
				BPSK	QPSK	BPSK	QPSK
3.75kHz	5MHz	1@47	786.30	23.52	23.49	20.17	20.14
			781.10	23.47	23.41	20.12	20.06
			777.70	23.39	23.37	20.04	20.02
		1@0	786.30	23.57	23.53	20.22	20.18
			781.10	23.45	23.37	20.10	20.02
			777.70	23.36	23.35	20.01	20.00
	10MHz (PRB 30)	1@47	782.99	23.54	23.51	20.19	20.16
		1@0	782.99	23.48	23.44	20.13	20.09
	10 MHz (PRB 35)	1@47	783.89	23.57	23.52	20.22	20.17
		1@0	783.89	23.56	23.53	20.21	20.18
15kHz	5MHz	1@11	786.30	23.80	23.81	20.45	20.46
			781.10	23.78	23.76	20.43	20.41
			777.70	23.72	23.71	20.37	20.36
		1@0	786.30	23.85	23.81	20.50	20.46
			781.10	23.79	23.76	20.44	20.41
			777.70	23.74	23.72	20.39	20.37
		12@0	786.30	-	22.16	-	18.81
			781.10	-	22.08	-	18.73
			777.70	-	22.04	-	18.69
	10MHz (PRB 30)	1@11	782.99	23.85	23.84	20.50	20.49
		1@0	782.99	23.84	23.81	20.49	20.46
		12@0	782.99	-	22.14	-	18.79
	10 MHz (PRB 35)	1@11	783.89	23.84	23.84	20.49	20.49
		1@0	783.89	23.86	23.85	20.51	20.50
		12@0	783.89	-	22.21	-	18.86

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NB-IoT band 13 in-band-different PCI

Subcarrier Spacing	LTE Bandwidth	Subcarrier number/offset	Frequency (MHz)	Conducted Power(dBm)		Radiated Power(dBm) (Gt-Lc = -1.2)	
				BPSK	QPSK	BPSK	QPSK
3.75kHz	5MHz	1@47	786.30	23.48	23.44	20.13	20.09
			781.10	23.43	23.40	20.08	20.05
			777.70	23.38	23.33	20.03	19.98
		1@0	786.30	23.50	23.48	20.15	20.13
			781.10	23.44	23.39	20.09	20.04
			777.70	23.37	23.31	20.02	19.96
	10MHz (PRB 30)	1@47	782.99	23.51	23.47	20.16	20.12
		1@0	782.99	23.46	23.43	20.11	20.08
	10 MHz (PRB 35)	1@47	783.89	23.51	23.48	20.16	20.13
		1@0	783.89	23.50	23.46	20.15	20.11
15kHz	5MHz	1@11	786.30	23.84	23.82	20.49	20.47
			781.10	23.78	23.79	20.43	20.44
			777.70	23.73	23.72	20.38	20.37
		1@0	786.30	23.87	23.84	20.52	20.49
			781.10	23.79	23.77	20.44	20.42
			777.70	23.74	23.72	20.39	20.37
		12@0	786.30	-	22.16	-	18.81
			781.10	-	22.09	-	18.74
			777.70	-	22.03	-	18.68
	10MHz (PRB 30)	1@11	782.99	23.85	23.84	20.50	20.49
		1@0	782.99	23.87	23.81	20.52	20.46
		12@0	782.99	-	22.13	-	18.78
	10 MHz (PRB 35)	1@11	783.89	23.85	23.84	20.50	20.49
		1@0	783.89	23.87	23.85	20.52	20.50
		12@0	783.89	-	22.16	-	18.81

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A.2 Emission Limit

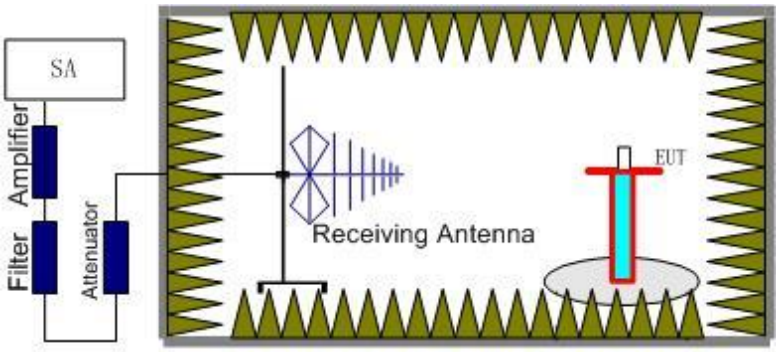
A.2.1 Measurement Method

The measurements procedures in TIA-603E-2016 are used. This measurement is carried out in fully anechoic chamber FAC-3.

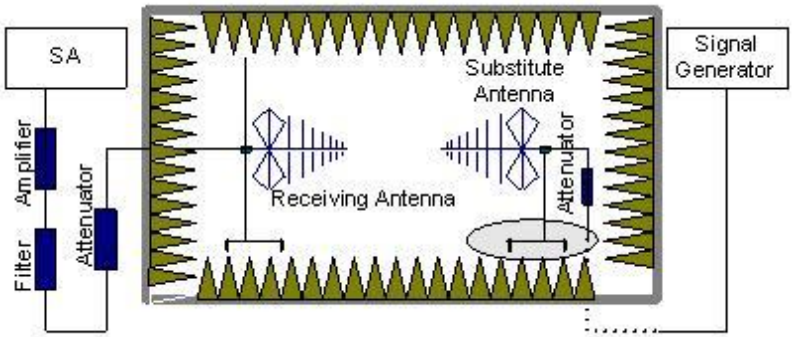
The spectrum was scanned from 30 MHz to the 10th harmonic of the highest frequency generated within the equipment, which is the transmitted carrier. The resolution bandwidth is set 1MHz. The spectrum was scanned with the mobile station transmitting at carrier frequencies that pertain to low, mid and high channels of each LTE Band.

The procedure of radiated spurious emissions is as follows:

1. EUT was placed on a 1.5-meter-high non-conductive stand at a 3-meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.5m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the EUT through 360 and adjusting the receiving antenna polarization. The radiated emission measurements of all non-harmonic and harmonics of the transmit frequency through the 10th harmonic were measured with peak detector.



2. The EUT is then put into continuously transmitting mode at its maximum power level during the test. And the maximum value of the receiver should be recorded as (Pr).
3. The EUT shall be replaced by a substitution antenna. The test setup refers to figure below.



In the chamber, a substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere

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with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna. Adjust the level of the signal generator output until the value of the receiver reaches the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

4. The Path loss (P_{pl}) between the Signal Source with the Substitution Antenna and the Substitution Antenna Gain (G_a) should be recorded after test.
   An amplifier should be connected in for the test.
   The Path loss (P_{pl}) is the summation of the cable loss and the gain of the amplifier.
   The measurement results are obtained as described below:
   Power (EIRP)=P_{Mea} - P_{pl} + G_a
5. This value is EIRP since the measurement is calibrated using an antenna of known gain (unit: dBi) and known input power.
6. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP - 2.15dB.

A.2.2 Measurement Limit

Part 27.53(g) states for operations in the 600 MHz band and the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 log (P) dB. Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kilohertz or greater. However, in the 100 kilohertz bands immediately outside and adjacent to a licensee's frequency block, a resolution bandwidth of at least 30 kHz may be employed.

A.2.3 Measurement Results

Radiated emissions measurements were made only at the upper, middle, and lower carrier frequencies of each LTE Band. It was decided that measurements at these three carrier frequencies would be sufficient to demonstrate compliance with emissions limits because it was seen that all the significant spurs occur well outside the band and no radiation was seen from a carrier in one block of each LTE Band into any of the other blocks. The equipment must still, however, meet emissions requirements with the carrier at all frequencies over which it is capable of operating and it is the manufacturer's responsibility to verify this. The range of evaluated frequency is from 30MHz to 26GHz.

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NB-IoT band 13 standalone, 3.75KHz , QPSK, Channel 23181

Frequency (MHz)	SG (dBm)	CableLoss (dB)	AntennaGain (dBi)	Correction	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polorization
1558.97	-55.37	3.47	5.39	2.15	-55.60	-13.00	42.60	H
2338.29	-53.82	4.44	5.61	2.15	-54.80	-13.00	41.80	H
3117.52	-49.99	5.38	7.28	2.15	-50.24	-13.00	37.24	H
3897.02	-38.91	6.11	8.76	2.15	-38.41	-13.00	25.41	V
4672.52	-53.12	6.48	9.57	2.15	-52.18	-13.00	39.18	V
5451.51	-53.96	6.88	10.53	2.15	-52.46	-13.00	39.46	V

NB-IoT band 13 standalone, 3.75KHz , QPSK, Channel 23230

Frequency (MHz)	SG (dBm)	CableLoss (dB)	AntennaGain (dBi)	Correction	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polorization
1564.00	-44.60	3.48	5.38	0.00	-44.85	-40.00	4.85	V
2346.01	-50.88	4.45	5.64	2.15	-51.84	-13.00	38.84	H
3127.52	-48.88	5.40	7.31	2.15	-49.12	-13.00	36.12	V
3910.02	-37.76	6.12	8.77	2.15	-37.26	-13.00	24.26	V
4694.02	-54.58	6.50	9.59	2.15	-53.64	-13.00	40.64	H
5475.51	-54.97	6.97	10.57	2.15	-53.52	-13.00	40.52	H

NB-IoT band 13 standalone, 3.75KHz , QPSK, Channel 23279

Frequency (MHz)	SG (dBm)	CableLoss (dB)	AntennaGain (dBi)	Correction	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Polorization
1569.19	-47.93	3.48	5.38	0.00	-48.18	-40.00	8.18	V
2359.68	-54.22	4.47	5.68	2.15	-55.16	-13.00	42.16	V
3137.52	-50.39	5.39	7.33	2.15	-50.60	-13.00	37.60	H
3922.02	-45.13	6.12	8.79	2.15	-44.61	-13.00	31.61	H
4693.02	-54.12	6.50	9.59	2.15	-53.18	-13.00	40.18	V
5492.51	-54.40	7.03	10.59	2.15	-52.99	-13.00	39.99	V

Note: The maximum value of expanded measurement uncertainty for this test item is U = 5.16 dB, k = 2.

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A.3 Frequency Stability

A.3.1 Method of Measurement

Frequency stability is a measure of the frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at +20 °C and rated supply voltage. Two reference points are established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation shall be identified as F_L and F_H respectively.

In order to measure the carrier frequency under the condition of AFC lock, it is necessary to make measurements with the EUT in a “call mode”. This is accomplished with the use of CMW500.

1. Measure the carrier frequency at room temperature.
2. Subject the EUT to overnight soak at -30℃.
3. With the EUT, powered via nominal voltage, connected to the CMW500, and in a simulated call on middle channel for each LTE band, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
4. Repeat the above measurements at 10℃ increments from -30℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
5. Re-measure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments re-measuring carrier frequency at each voltage. Pause at nominal voltage for 1.5 hours unpowered, to allow any self-heating to stabilize, before continuing.
6. Subject the EUT to overnight soak at +50℃.
7. With the EUT, powered via nominal voltage, connected to the CMW500 and in a simulated call on the center channel, measure the carrier frequency. These measurements should be made within 2 minutes of Powering up the EUT, to prevent significant self-warming.
8. Repeat the above measurements at 10 ℃increments from -30℃ to +50℃. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
9. At all temperature levels hold the temperature to +/- 0.5℃ during the measurement procedure.

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. As this transceiver is considered "Hand carried, battery powered equipment" Section 2.1055(d)(2) applies. This requires that the lower voltage for frequency stability testing be specified by the manufacturer. This transceiver is specified to operate with an input voltage of the lower, higher and nominal voltage. Operation above or below these voltage limits is prohibited by transceiver software in order to prevent improper operation as well as to protect components from overstress.

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A.3.2 Measurement results

NB-IoT band 13 standalone 15kHz subcarrier spacing

Frequency Error vs Temperature

Temperature(℃)	Voltage(V)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
20	3.85	777.002	786.999		
50				3.10	0.0040
40				1.30	0.0017
30				2.50	0.0032
10				5.10	0.0065
0				2.80	0.0036
-10				1.10	0.0014
-20				2.30	0.0029
-30				3.50	0.0045

Frequency Error vs Voltage

Voltage(V)	Temperature(℃)	F_L(MHz)	F_H(MHz)	Offset(Hz)	Frequency error(ppm)
3.50	20	777.002	786.999	1.70	0.0022
4.35				4.50	0.0058

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A.4 Occupied Bandwidth

Occupied bandwidth measurements are only provided for selected frequencies in order to reduce the amount of submitted data. Data were taken at the mid frequencies frequency. The table below lists the measured 99% BW. Spectrum analyzer plots are included on the following pages.
The measurement method is from ANSI C63.26:
a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts.
b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.
c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.
d) Set the detection mode to peak, and the trace mode to max-hold.

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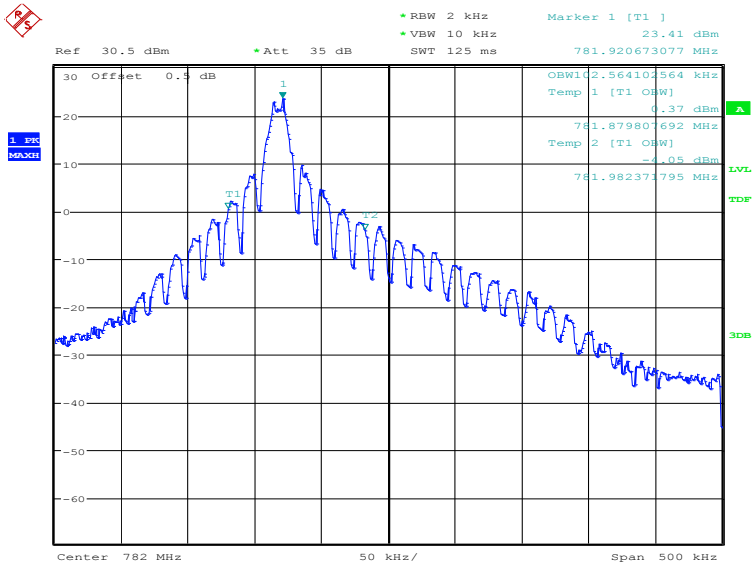
NB-IoT band 13 standalone (99%)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (99%)(kHz)
782.00	10MHz	15kHz	1@0	BPSK	102.56
		15kHz	12@0	QPSK	182.69

NB-IoT band 13 standalone Bandwidth, BPSK_15kHz_1@0 (99% BW)



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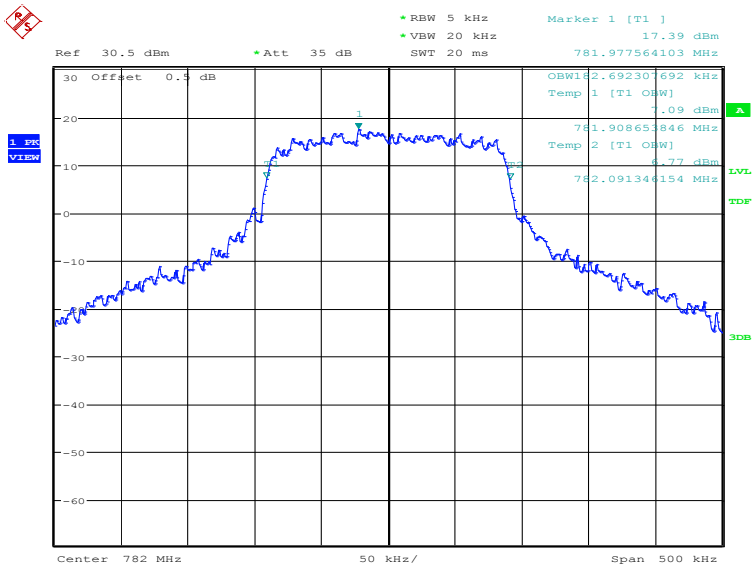
NB-IoT band 13 standalone Bandwidth, QPSK_15kHz_12@0 (99% BW)



Date: 26.MAY.2021 08:58:58

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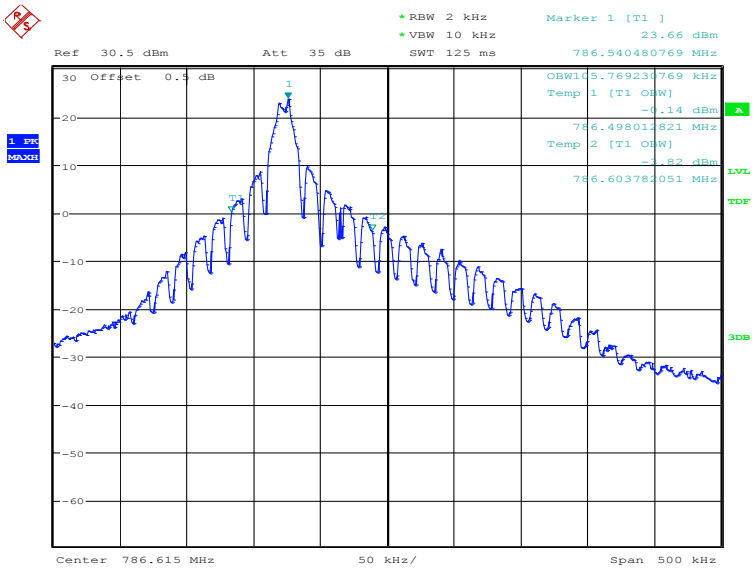
NB-IoT band 13 guard-band (99%)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (99%)(kHz)
786.615	10MHz	15kHz	1@0	BPSK	105.77
		15kHz	12@0	QPSK	184.29

NB-IoT band 13 guard-band Bandwidth, BPSK_15kHz_1@0 (99% BW)



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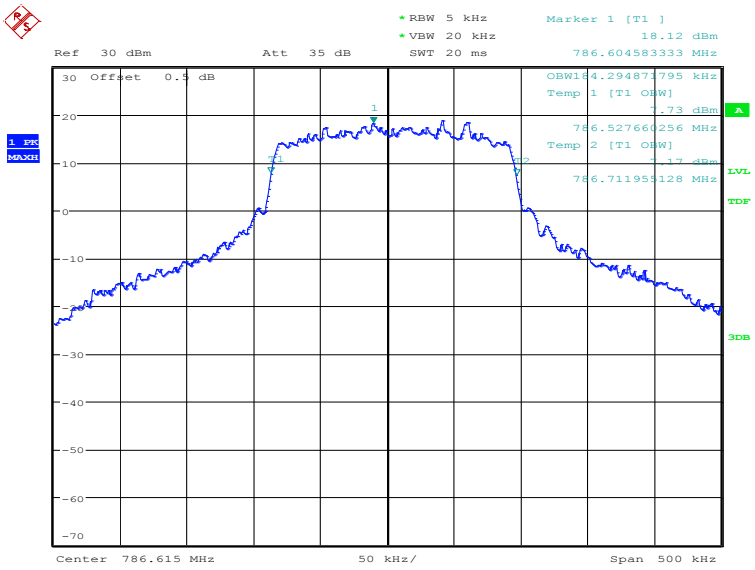
NB-IoT band 13 guard-band Bandwidth, QPSK_15kHz_12@0 (99% BW)



Date: 22.JUL.2021 08:41:23

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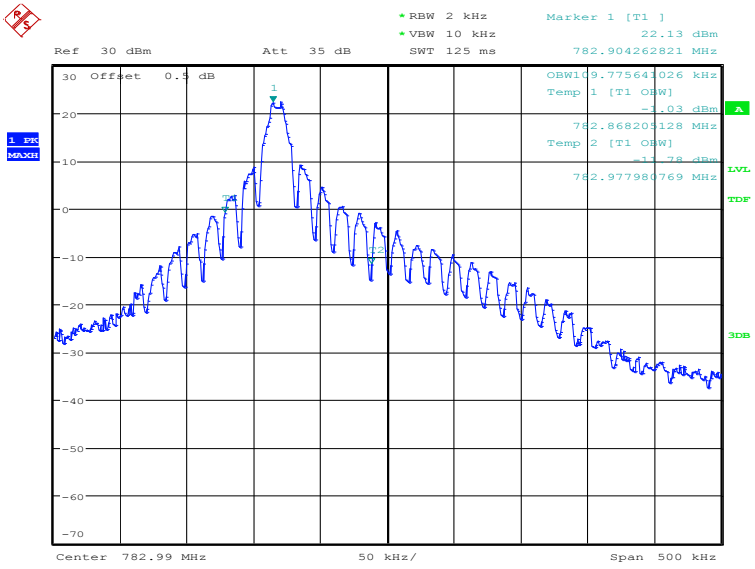
NB-IoT band 13 in-band-same PCI (99%)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (99%)(kHz)
782.99	10MHz (PRB 30)	15kHz	1@0	BPSK	109.45
		15kHz	12@0	QPSK	184.29

NB-IoT band 13 in-band-same PCI Bandwidth, BPSK_15kHz_1@0 (99% BW)



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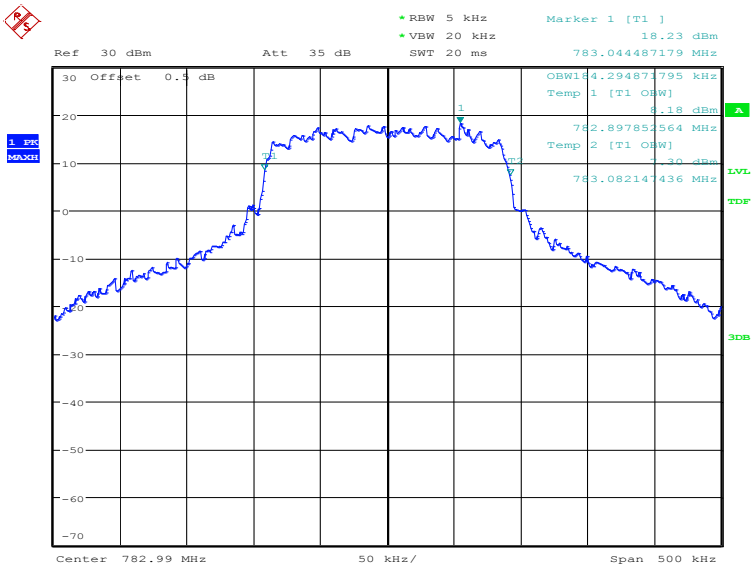
NB-IoT band 13 in-band-same PCI Bandwidth, QPSK_15kHz_12@0 (99% BW)



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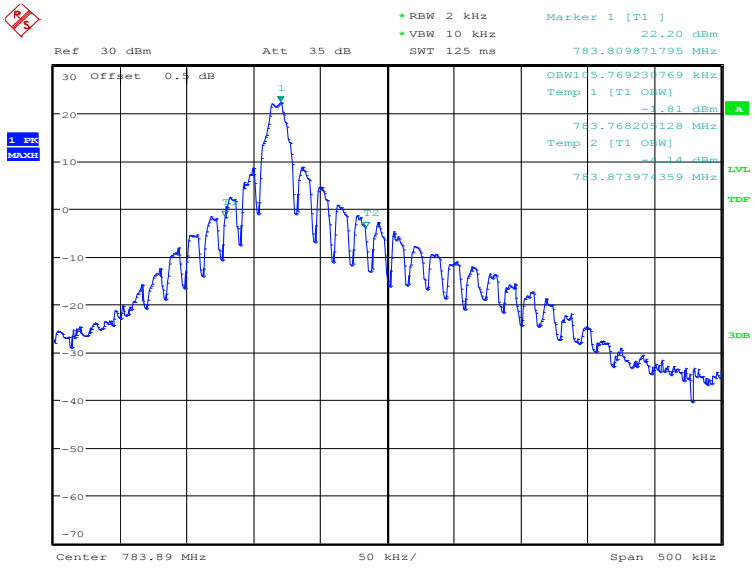
NB-IoT band 13 in-band-same PCI (99%)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (99%)(kHz)
783.89	10MHz (PRB 35)	15kHz	1@0	BPSK	105.77
			12@0	QPSK	184.29

NB-IoT band 13 in-band-same PCI Bandwidth, BPSK_15kHz_1@0 (99% BW)



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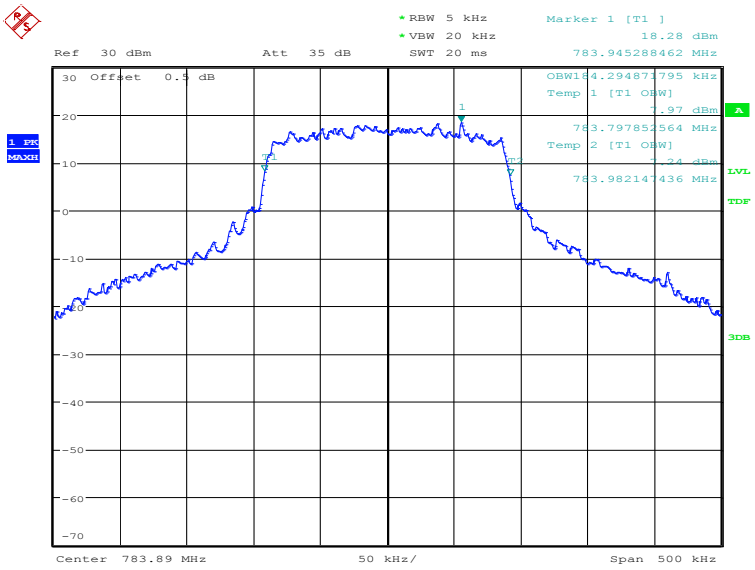
NB-IoT band 13 in-band-same PCI Bandwidth, QPSK_15kHz_12@0 (99% BW)



Date: 22.JUL.2021 08:58:33

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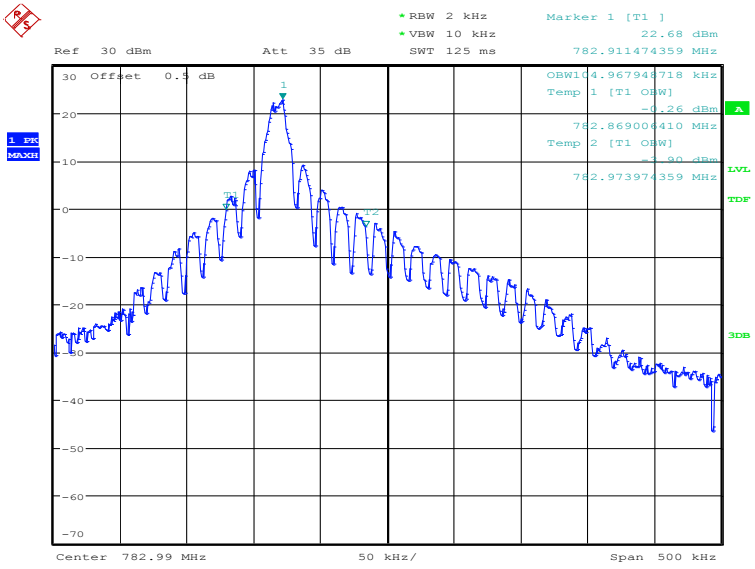
NB-IoT band 13 in-band-different PCI (99%)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (99%)(kHz)
782.99	10MHz (PRB 30)	15kHz	1@0	BPSK	104.97
			12@0	QPSK	184.29

NB-IoT band 13 in-band-different PCI Bandwidth, BPSK_15kHz_1@0 (99% BW)



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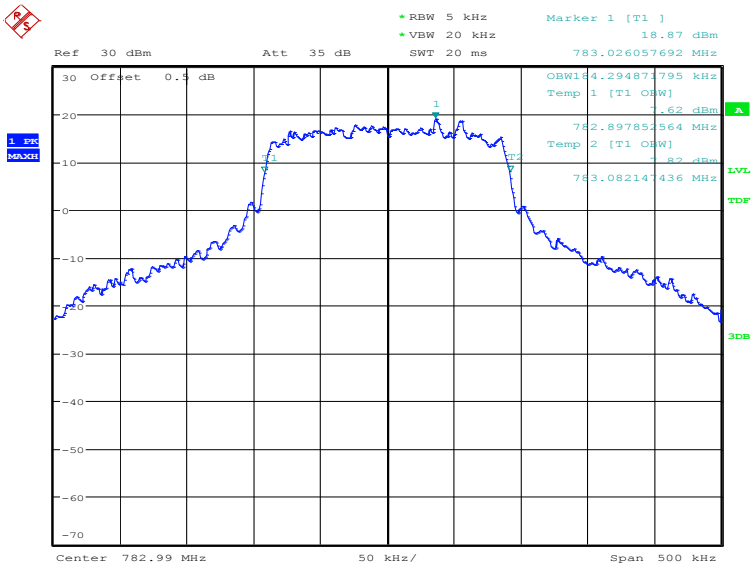
NB-IoT band 13 in-band-different PCI Bandwidth, QPSK_15kHz_12@0 (99% BW)



Date: 22.JUL.2021 09:12:20

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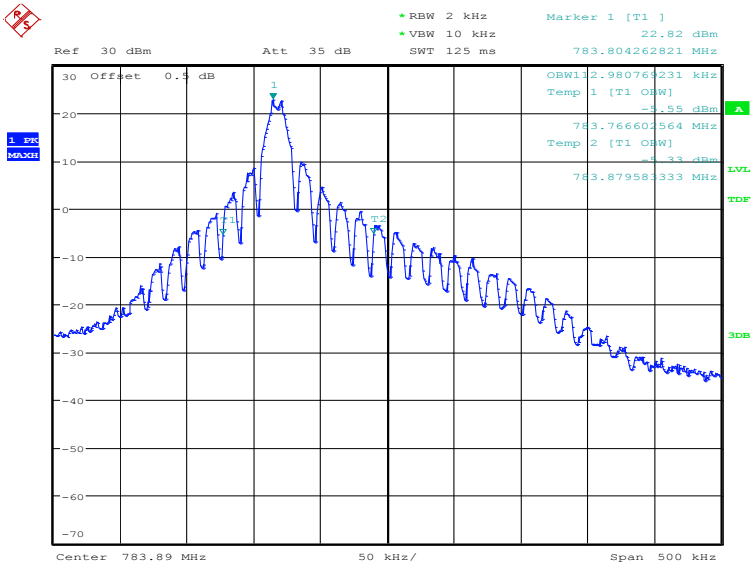
NB-IoT band 13 in-band-different PCI (99%)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (99%)(kHz)
783.89	10MHz (PRB 35)	15kHz	1@0	BPSK	112.98
			12@0	QPSK	185.10

NB-IoT band 13 in-band-different PCI Bandwidth, BPSK_15kHz_1@0 (99% BW)



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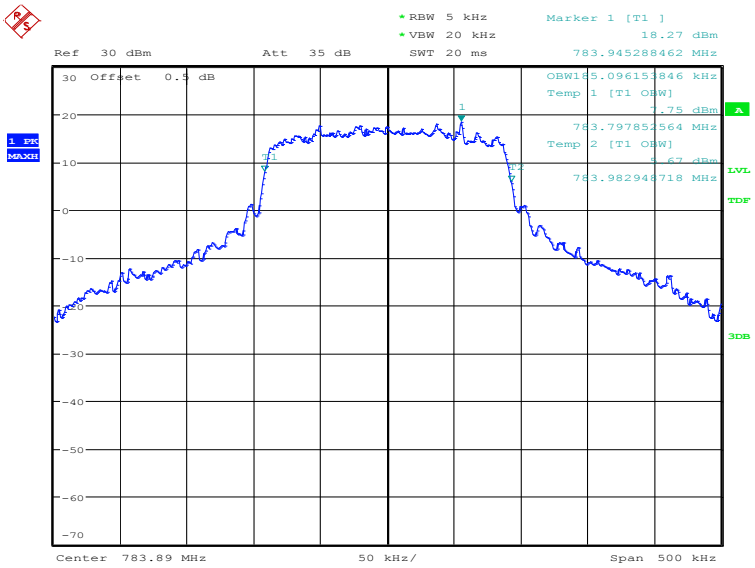
NB-IoT band 13 in-band-different PCI Bandwidth, QPSK_15kHz_12@0 (99% BW)



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A.5 Emission Bandwidth

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power. Table below lists the measured -26dBc BW. Spectrum analyzer plots are included on the following pages.

The measurement method is from ANSI C63.26:

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the spectrum analyzer shall be wide enough to see sufficient roll off of the signal to make the measurement.

b) The nominal RBW shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set ≥ 3 × RBW.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation.

d) The dynamic range of the spectrum analyzer at the selected RBW shall be more than 10 dB below the target "−X dB" requirement, i.e., if the requirement calls for measuring the −26 dB OBW, the spectrum analyzer noise floor at the selected RBW shall be at least 36 dB below the reference level.

e) Set spectrum analyzer detection mode to peak, and the trace mode to max hold.

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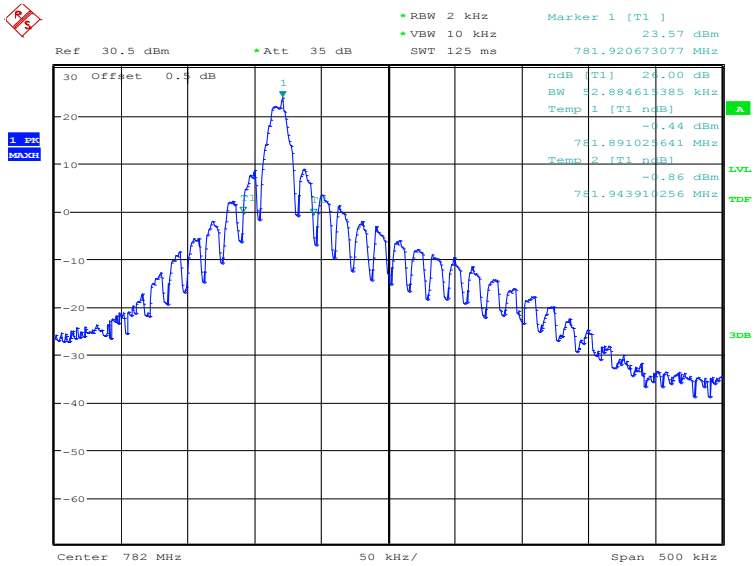
NB-IoT band 13 standalone (-26dBc)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (-26dBc)(kHz)
782.00	10MHz	15kHz	1@0	BPSK	52.88
			12@0	QPSK	244.39

NB-IoT band 13 standalone Bandwidth, BPSK_15kHz_1@0 (-26dBc BW)



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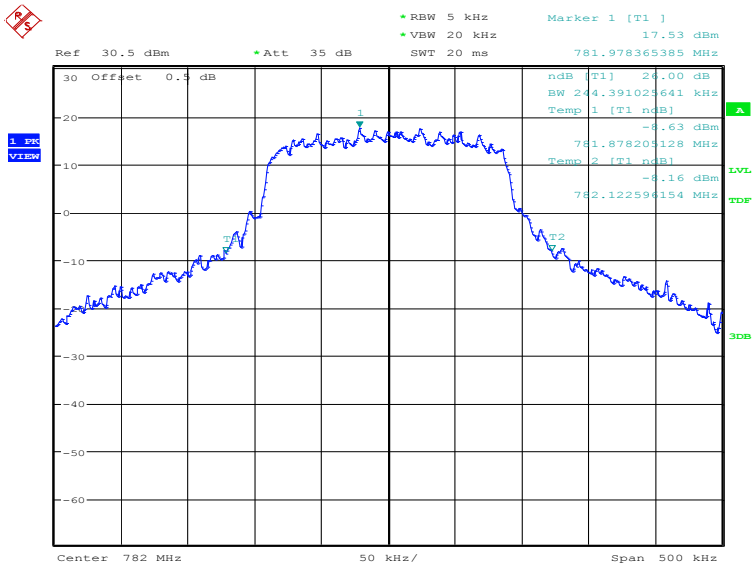
NB-IoT band 13 standalone Bandwidth, QPSK_15kHz_12@0 (-26dBc BW)



Date: 26.MAY.2021 09:02:32

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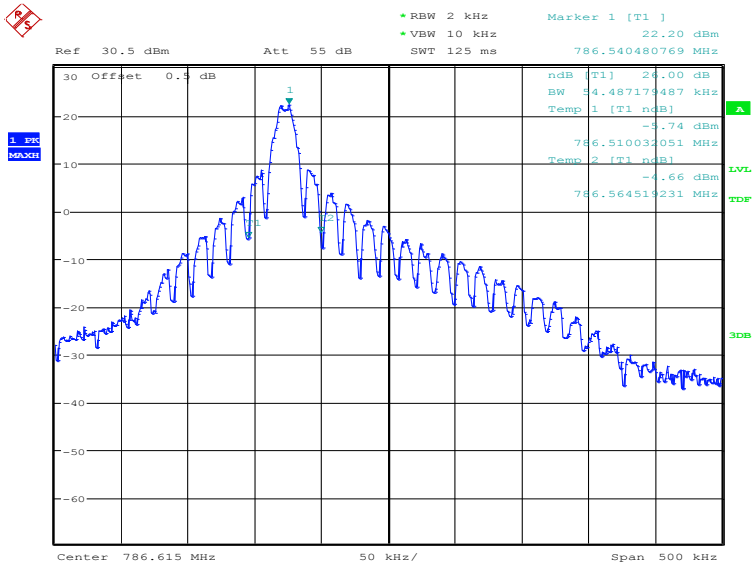
NB-IoT band 13 guard-band (-26dBc)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (-26dBc)(kHz)
786.615	10MHz	15kHz	1@0	BPSK	54.49
			12@0	QPSK	245.99

NB-IoT band 13 guard-band Bandwidth, BPSK_15kHz_1@0 (-26dBc BW)



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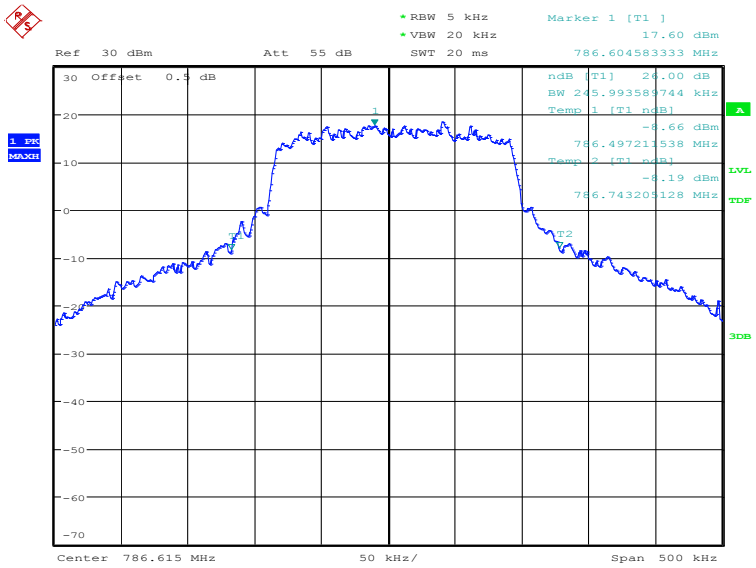
NB-IoT band 13 guard-band Bandwidth, QPSK_15kHz_12@0 (-26dBc BW)



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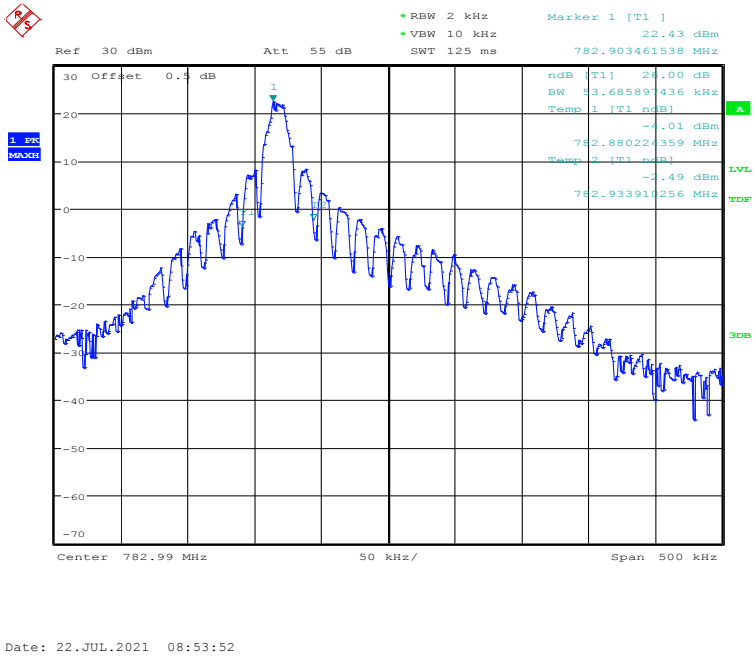
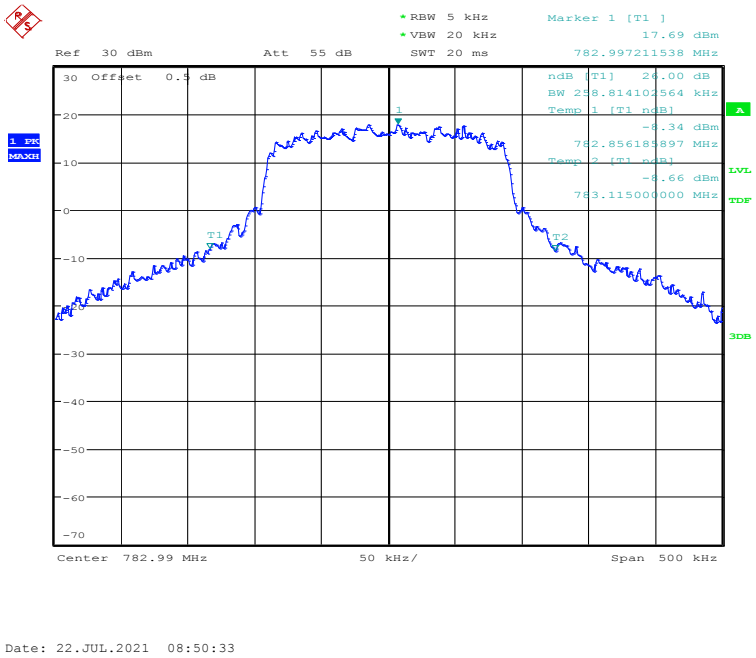
NB-IoT band 13 in-band-same PCI (-26dBc)

Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (-26dBc)(kHz)
782.99	10MHz (PRB 30)	15kHz	1@0	BPSK	53.69
			12@0	QPSK	258.81

NB-IoT band 13 in-band-same PCI Bandwidth, BPSK_15kHz_1@0 (-26dBc BW)



NB-IoT band 13 in-band-same PCI Bandwidth, QPSK_15kHz_12@0 (-26dBc BW)



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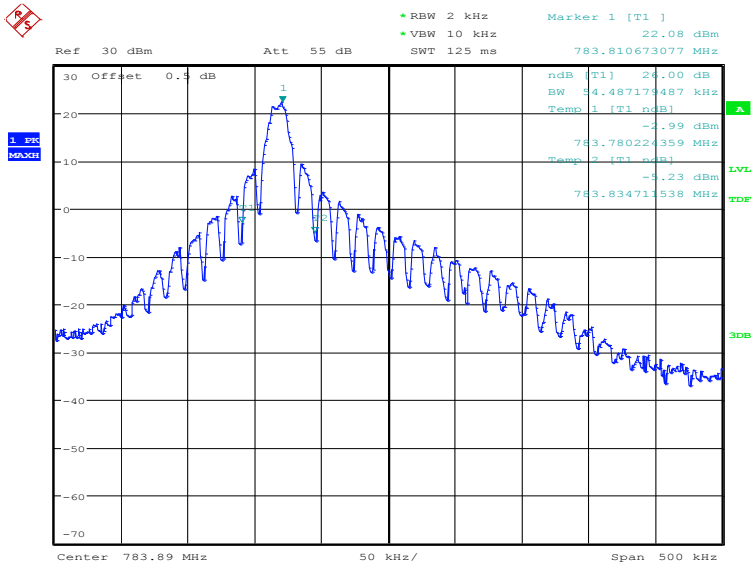
NB-IoT band 13 in-band-same PCI (-26dBc)

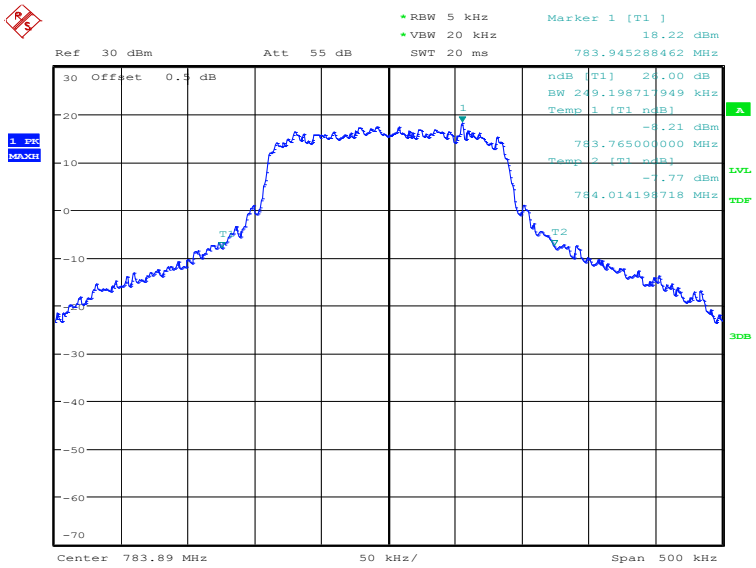
Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (-26dBc)(kHz)
783.89	10MHz (PRB 35)	15kHz	1@0	BPSK	53.49
			12@0	QPSK	249.20

NB-IoT band 13 in-band-same PCI Bandwidth, BPSK_15kHz_1@0 (-26dBc BW)



Date: 22.JUL.2021 08:55:27

NB-IoT band 13 in-band-same PCI Bandwidth, QPSK_15kHz_12@0 (-26dBc BW)



Date: 22.JUL.2021 08:59:10

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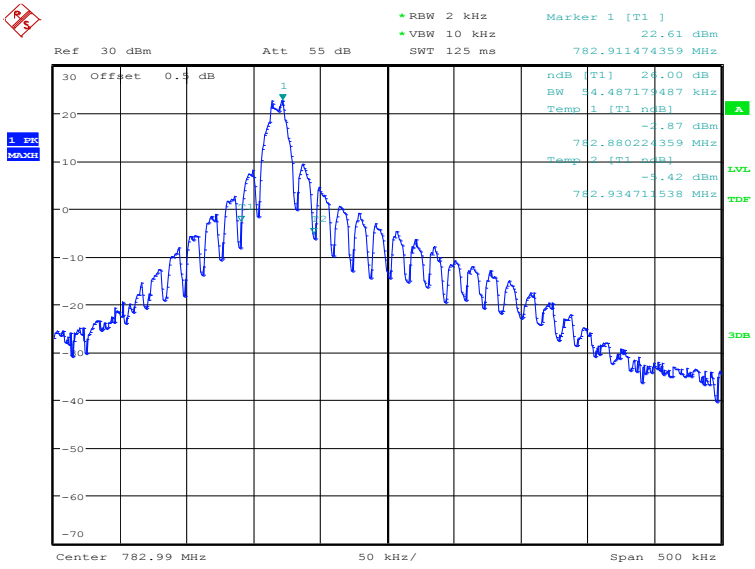
NB-IoT band 13 in-band-different PCI (-26dBc)

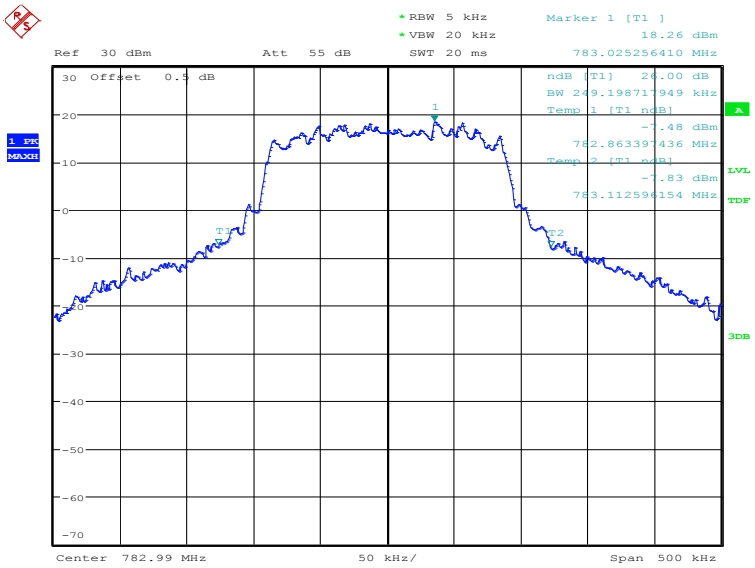
Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (-26dBc)(kHz)
782.99	10MHz (PRB 30)	15kHz	1@0	BPSK	54.49
			12@0	QPSK	249.20

NB-IoT band 13 in-band-different PCI Bandwidth, BPSK_15kHz_1@0 (-26dBc BW)



Date: 22.JUL.2021 09:09:53

NB-IoT band 13 in-band-different PCI Bandwidth, QPSK_15kHz_12@0 (-26dBc BW)



Date: 22.JUL.2021 09:13:47

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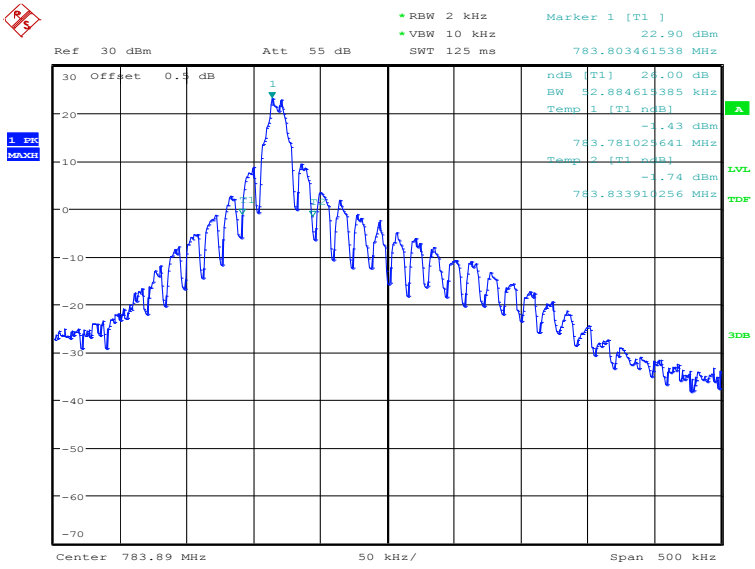
NB-IoT band 13 in-band-different PCI (-26dBc)

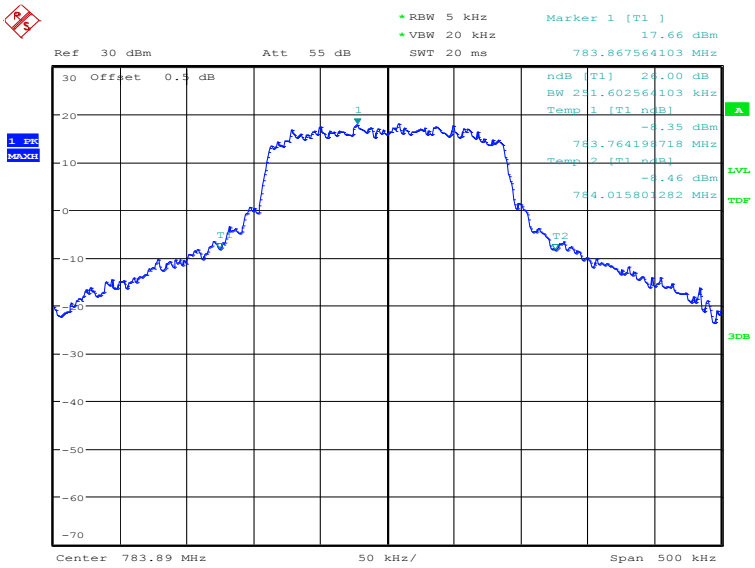
Frequency(MHz)	LTE Bandwidth	Subcarrier Spacing	Subcarrier number/offset	Modulation	Occupied Bandwidth (-26dBc)(kHz)
783.89	10MHz (PRB 35)	15kHz	1@0	BPSK	52.88
			12@0	QPSK	251.60

NB-IoT band 13 in-band-different PCI Bandwidth, BPSK_15kHz_1@0 (-26dBc BW)



Date: 22.JUL.2021 09:06:32

NB-IoT band 13 in-band-different PCI Bandwidth, QPSK_15kHz_12@0 (-26dBc BW)



Date: 22.JUL.2021 09:02:11

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A.6 Band Edge Compliance

A.6.1 Measurement limit

Part 27.53(c) states for operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

The spectrum analyzer readings are corrected by [10 log (1/duty cycle)] for the non-continuous transmitting scenario.

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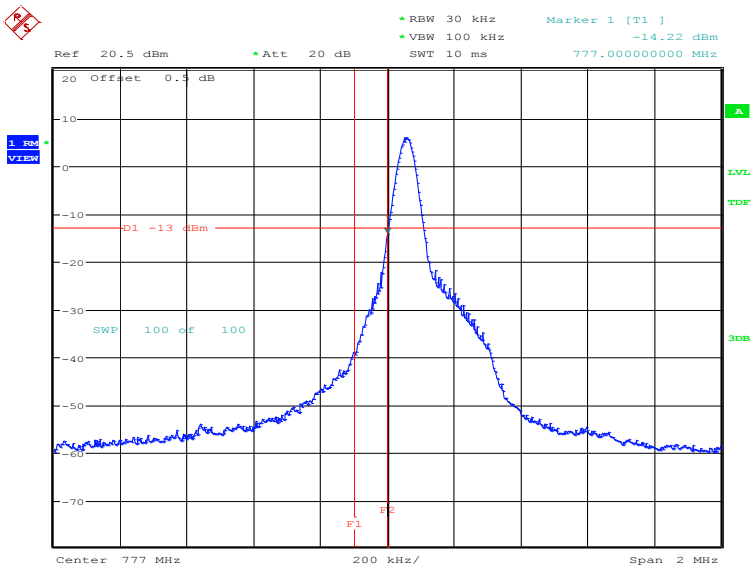
A.6.2 Measurement result

Only the worst case result is given below

NB-IoT band 13

LOW BAND EDGE BLOCK-1RB-low_offset



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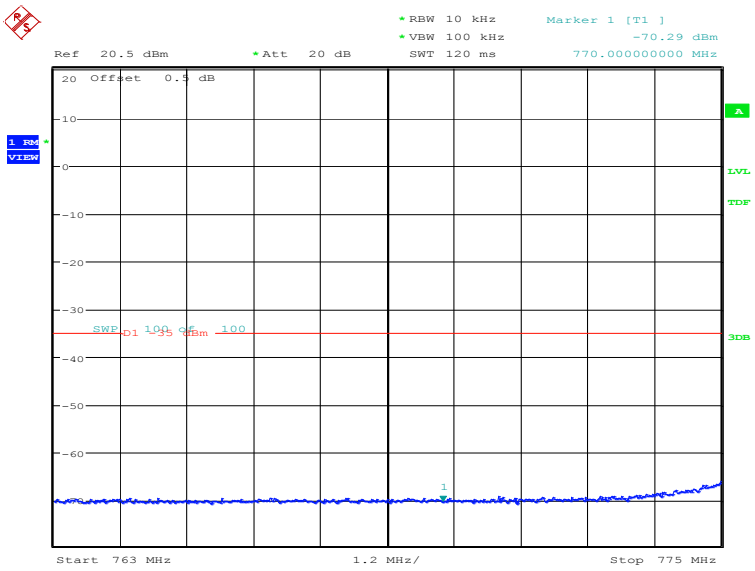

Date: 25.MAY.2021 17:34:43

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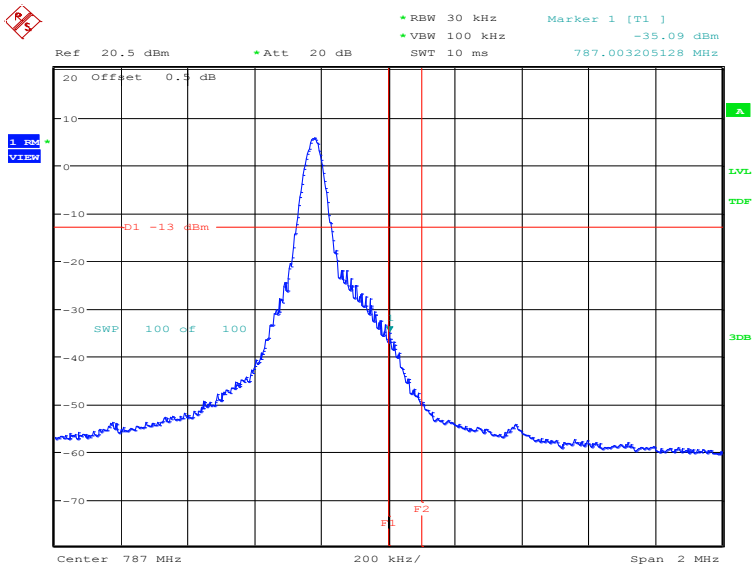
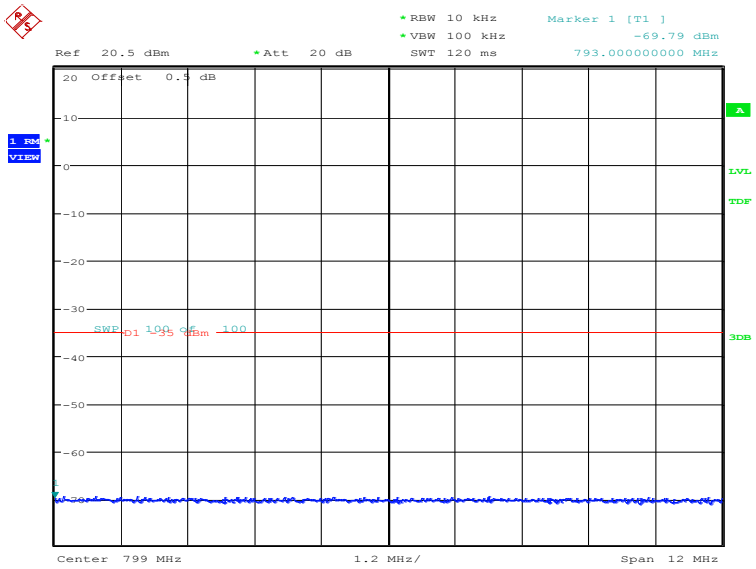
HIGH BAND EDGE BLOCK-1RB-high_offset





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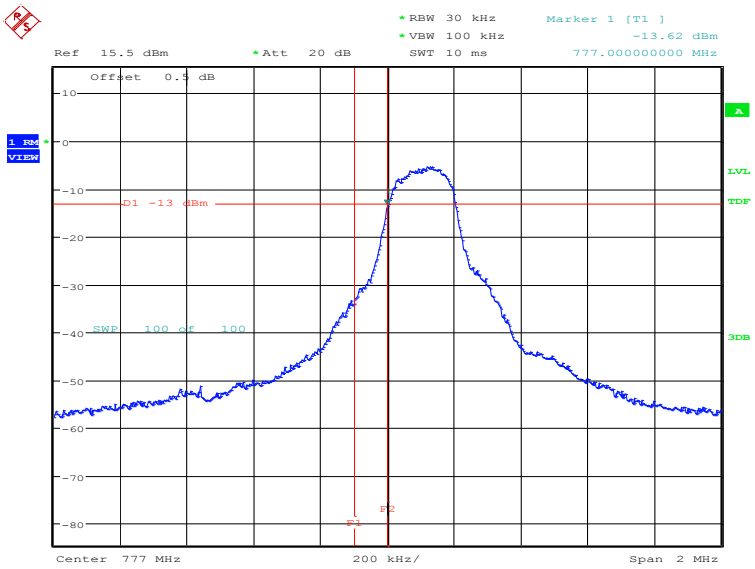
LOW BAND EDGE BLOCK-100%RB



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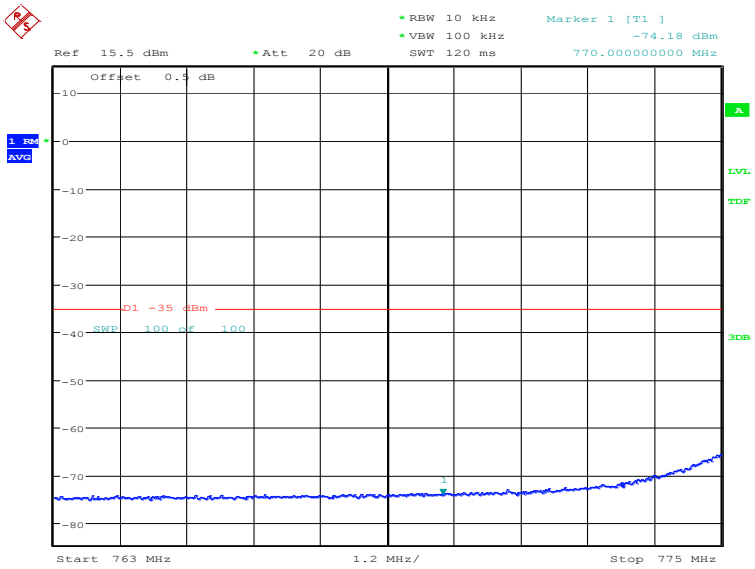

Date: 25.MAY.2021 16:53:26

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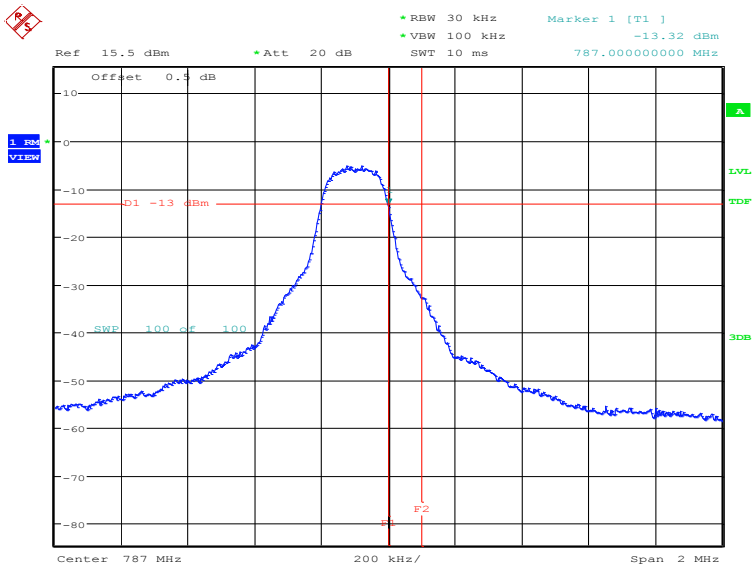
HIGH BAND EDGE BLOCK-100%RB



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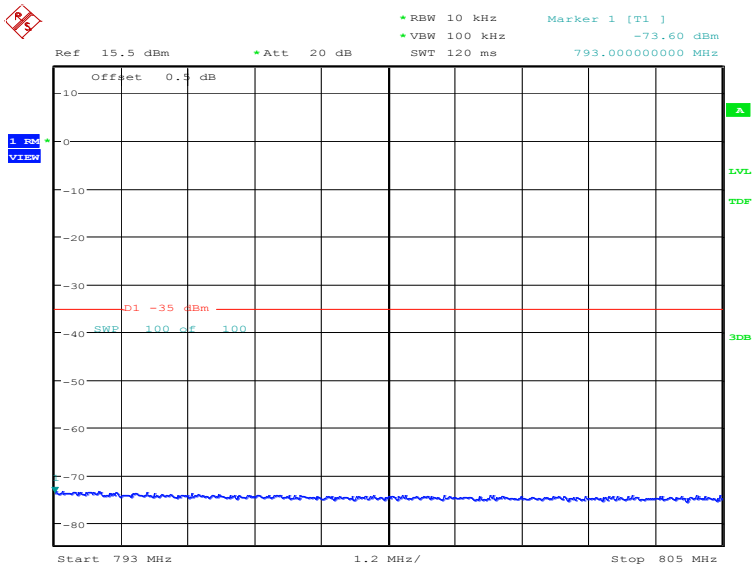

Date: 25.MAY.2021 16:57:07

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A.7 Conducted Spurious Emission

A.7.1 Measurement Method

The following steps outline the procedure used to measure the conducted emissions from the EUT.

1. In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated in the equipment, whichever is lower, without going below 9 kHz, up to at least the frequency given below:
   (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
   (b) If the equipment operates at or above 10 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
2. Determine EUT transmit frequencies: below outlines the band edge frequencies pertinent to conducted emissions testing.
3. The number of sweep points of spectrum analyzer is greater than 2×span/RBW.

A. 7.2 Measurement Limit

Part 27.53(c) states for operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:(1) On any frequency outside the 746-758 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;(2) On any frequency outside the 776-788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least 43 + 10 log (P) dB;(4) On all frequencies between 763-775 MHz and 793-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.
Part 27.53(f) states for operations in the 746–758 MHz,775–788 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to -70dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals.

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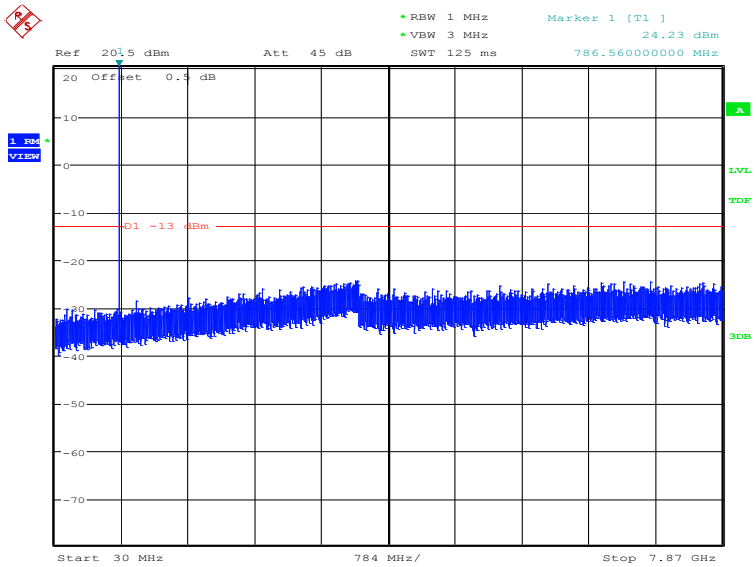
A. 7.3 Measurement result

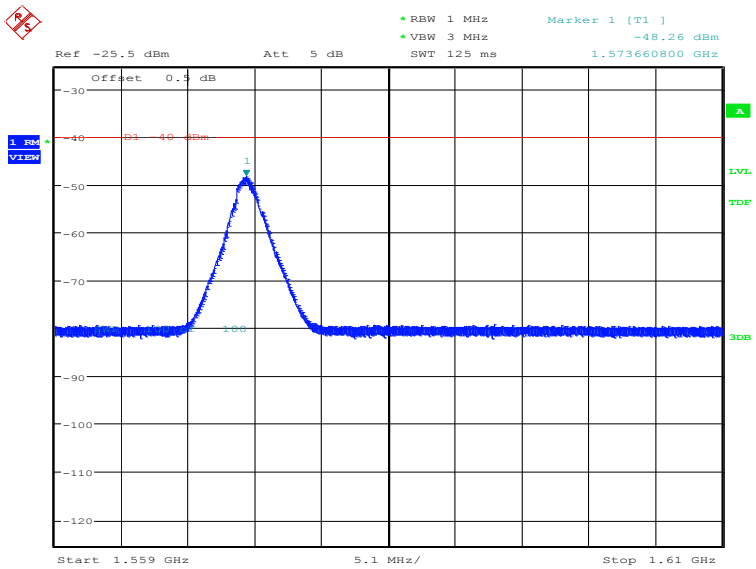
Only worst case result is given below

NB-IoT band 13 : 30MHz – 7.87GHz



Date: 25.MAY.2021 17:46:55

NB-IoT band 13: 1559MHz – 1610MHz



Date: 25.MAY.2021 17:53:12

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A.8 Peak-to-Average Power Ratio

The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB

a) Refer to instrument's analyzer instruction manual for details on how to use the power statistics/CCDF function;

b) Set resolution/measurement bandwidth ≥ signal's occupied bandwidth;

c) Set the number of counts to a value that stabilizes the measured CCDF curve;

d) Record the maximum PAPR level associated with a probability of 0.1%.

NB-IoT band 13, standalone

Frequency (MHz)	PAPR (dB)	
782.0	BPSK	QPSK
	7.69	4.29

NB-IoT band 13, 10MHz guard-band

Frequency (MHz)	PAPR (dB)	
786.615	BPSK	QPSK
	7.66	4.49

NB-IoT band 13, 10MHz in-band-same PCI-PRB 30

Frequency (MHz)	PAPR (dB)	
782.99	BPSK	QPSK
	7.92	4.42

NB-IoT band 13, 10MHz in-band-same PCI-PRB 35

Frequency (MHz)	PAPR (dB)	
783.89	BPSK	QPSK
	7.95	4.49

NB-IoT band 13, 10MHz in-band-different PCI-PRB 30

Frequency (MHz)	PAPR (dB)	
782.99	BPSK	QPSK
	7.88	4.46

NB-IoT band 13, 10MHz in-band-different PCI-PRB 35

Frequency (MHz)	PAPR (dB)	
783.89	BPSK	QPSK
	7.72	4.42

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Annex B: Accreditation Certificate

United States Department of Commerce
National Institute of Standards and Technology

NVLAP®

ilac-MRA

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 600118-0

Telecommunication Technology Labs, CAICT
Beijing
China

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communique dated January 2009).

2020-09-29 through 2021-09-30
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program

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

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