





NTN TEST REPORT No. 24T04Z102024-022

for

HMD Global Oy

Model Name: TA-1698

FCC ID: 2AJOTTA-1698

with

Hardware Version: V0.21

Software Version: TA1698.GLO 001

Issued Date: 2024-11-06

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of CTTL.

Test Laboratory:

CTTL-Telecommunication Technology Labs, CAICT

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REPORT HISTORY

Report Number	Revision	Description	Issue Date
24T04Z102024-022	Rev.0	1 st edition	2024-11-06

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 American Association for Laboratory Accreditation (A2LA) with lab code 7049.01, and is also an FCC accredited test laboratory (CN1349), and ISED accredited test laboratory (CAB identifier:CN0066). The detail accreditation scope can be found on A2LA website.

1.2. Testing Location

Location 1: CTTL (huayuan North Road)

Address: No. 52, Huayuan North Road, Haidian District, Beijing,

P. R. China 100191

1.3. Testing Environment

Normal Temperature: $15-35^{\circ}$ C Relative Humidity: 20-75%

1.4. Project Data

Testing Start Date: 2024-10-06
Testing End Date: 2024-11-06

1.5. Signature

ANNO

(Prepared this test report)

係新到

(Reviewed this test report)

Mo Fon

(Approved this test report)





2. Client Information

2.1. Applicant Information

Company Name: HMD Global Oy

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2.2. Manufacturer Information

Company Name: HMD Global Oy

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Email reza.serafat@hmdglobal.com

Telephone: +491735287964

Fax: /





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

3.1. About EUT

Description Locator Model Name TA-1698

FCC ID 2AJOTTA-1698 Antenna Embedded

Output power 23.86dBm maximum conducted power for band23

23.08dBm maximum conducted power for band255

3.50VDC to 4.35VDC (nominal: 3.85VDC) Extreme Voltage

-30°C to +50°C Extreme Temperature **NB-IoT NTN** NTN mode

Frequency B23:US/UL:2000.1MHz-2019.9 MHz;DL:2180.1 MHz -2199.9

B255:Global/UL:1626.6 MHz -1660.4 MHz;DL:1525.1 MHz

-1558.9 MHz

BPSK//QPSK Modulation Sub-carrier spacing 15 kHz/3.75kHz Antenna gain B23: 1.17dBi

B255: 0.87 dBi

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*	EUT ID* IMEI		SW Version	
EUT1	TA1698000000199	V0.21	TA1698.GLO_001	
EUT2	TA1698000000180	V0.21	TA1698.GLO_001	

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





4. Reference Documents

4.1. <u>Documents supplied by applicant</u>

EUT parameters are supplied by the customer, which are the bases of testing. CAICT is not responsible for the accuracy of customer supplied technical information that may affect the test results (for example, antenna gain and loss of customer supplied cable).

4.2. Reference Documents for testing

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

Reference	Title	Version
FCC Part 25	Satellite Communications	10-1-23
		Edition
ANSI/TIA-603-E	Land Mobile FM or PM Communications Equipment	2016
	Measurement and Performance Standards	
ANSI C63.26	American National Standard for Compliance Testing of	2015
	Transmitters Used in Licensed Radio Services	
KDB 971168 D01	MEASUREMENT GUIDANCE FOR CERTIFICATION OF	v03r01
	LICENSED DIGITAL TRANSMITTERS	





5. Summary of Test Result

NTN band 23

Items	Test Name	Limit	Clause in FCC rules	EUT ID	Verdict
1	Output Power	-	25.204	EUT1	Information only
2	Frequency Stability	Within 0.001 percent of the reference frequency	25.202/ 2.1055	EUT1	Р
3	Occupied Bandwidth	2.1049	2.1049	EUT1	Р
4	Band Edge Compliance	25.202(f)(1)(2)	25.202	EUT1	Р
5	Conducted Spurious Emission	25.202(f)(3)	25.202/25.216	EUT1	Р
6	Field Strength of Spurious Radiation	25.202	25.202	EUT2	Р

NTN band 255

Items	Test Name	Limit	Clause in FCC rules	EUT ID	Verdict
1	Output Power	-	25.204	EUT1	Information only
2	Frequency Stability	Within 0.001 percent of the reference frequency	25.202/2.1055	EUT1	Р
3	Occupied Bandwidth	2.1049	2.1049	EUT1	Р
4	Band Edge Compliance	25.202(f)(1)(2)	25.202	EUT1	Р
5	Conducted Spurious Emission	25.202(f)(3)	25.202/25.216	EUT1	Р
6	Field Strength of Spurious Radiation	25.202	25.202	EUT2	Р

Terms used in Verdict column

Р	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.				

All the test results are based on normal power.





Measurement uncertainty is not taken into account when stating conformity with a specified requirement.

Explanation of worst-case configuration

The worst-case scenario for all measurements is based on the conducted output power measurement investigation results unless otherwise stated. The test results shown in the following sections represent the worst case emission.





6. Test Equipments Utilized and test setup

Description	Туре	Series Number	Manufacture	Cal Due Date	Calibration Interval
Spectrum Analyzer	FSV	101576	R&S	2025-05-08	1 year
Communication Tester	CMW500	168471	R&S	2024-12-01	1 year
Spectrum Analyzer	FSV30	R&S	101525	2025-01-18	1 year
Antenna	VULB9163	Schwarzbeck	9163-482	2025-05-19	1 year
Antenna	9117	Schwarzbeck	167	2026-10-15	3 year
Antenna	LB-7180-NF	A-INFO	J2030013000005	2025-05-16	1 year
Antenna	3115	ETS-Lindgren	00146404	2025-05-16	1 year
Signal Generator	SMF100A	Agilent	101295	2025-02-04	1 year

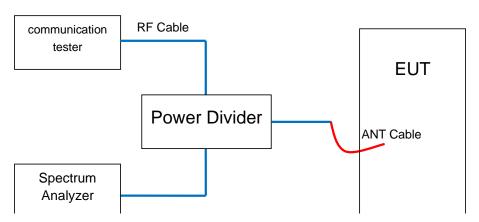


Fig.1 Test Setup Diagram

Conductive testing layout is as Fig. 1:

As shown in Fig. 1, EUT is placed in a chamber. An RF cable is used to forward the testing commands from the communication tester to the EUT via a power divider. The communication tester is responsible to send the RF transmission command in signaling mode. The EUT is connected with a power divider via an RF cable. The Spectrum Analyzer is connected with the power divider and used to test the emission of the EUT in specific frequency range.





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.

Output power is reused and the EIRP is calculated by EIRP=A+G, which A refers to the max power of the transmitter and the G is the antenna gain provided by applicant company.

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.

The results below include a correction factor for cable loss that is provided by the customer.

A.1.2.2 Measurement Result NTN band 23

Sub-carrier	N	Fraguency (MHz)	Peak output power(dBm)		EIRP(dB	EIRP(dBm)	
Spacing N _{tones}		Frequency (MHz)	BPSK	QPSK	BPSK	QPSK	
		2019.90	23.47	23.49	24.64	24.66	
	1SC46	2010.00	22.76	22.77	23.93	23.94	
3.75kHz		2000.10	23.63	23.49	24.80	24.66	
3.75KHZ		2019.90	23.46	23.48	24.63	24.65	
	1SC1	2010.00	22.72	22.76	23.89	23.93	
		2000.10	23.55	23.53	24.72	24.70	
	1SC10	2019.90	23.21	23.17	24.38	24.34	
		2010.00	22.95	23.13	24.12	24.30	
		2000.10	23.86	23.81	25.03	24.98	
		2019.90	23.07	23.17	24.24	24.34	
15kHz	1SC1	2010.00	23.27	23.08	24.44	24.25	
		2000.10	23.76	23.85	24.93	25.02	
	2019.90	2019.90	-	21.52	-	22.69	
	12SC0	2010.00	-	21.12	-	22.29	
		2000.10		21.76	-	22.93	





NTN band 255

Sub-carrier	N	Francisco (MIII-)	Peak output powe	er(dBm)	EIRP(dBm)	
Spacing	N _{tones}	Frequency (MHz)	BPSK	QPSK	BPSK	QPSK
		1660.40	22.51	22.58	23.38	23.45
	1SC46	1643.50	22.75	22.89	23.62	23.76
2.751.11-		1626.60	22.30	22.30	23.17	23.17
3.75kHz		1660.40	22.51	22.53	23.38	23.4
	1SC1	1643.50	22.77	22.81	23.64	23.68
		1626.60	22.34	22.35	23.21	23.22
		1660.40	22.91	23.06	23.78	23.93
	1SC10	1643.50	23.04	23.01	23.91	23.88
		1626.60	22.57	22.56	23.44	23.43
		1660.40	23.06	22.98	23.93	23.85
15kHz	1SC1	1643.50	23.06	23.08	23.93	23.95
		1626.60	22.63	22.70	23.5	23.57
		1660.40	-	21.08		21.95
	12SC0	1643.50	-	20.92		21.79
		1626.60	-	21.04		21.91

Note: Expanded measurement uncertainty is ± 1 dB, k = 2.

A.2 Frequency Stability

A.2.1 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 mid channel of each 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°C increments from -30°C to +50°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
- 5. Remeasure carrier frequency at room temperature with nominal voltage. Vary supply voltage from minimum voltage to maximum voltage, in 0.1Volt increments remeasuring 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 centre 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°C decrements from +50°C to -30°C. Allow at least 1.5 hours at each temperature, unpowered, before making measurements.
- 9. At all temperature levels hold the temperature to +/- 0.5° C 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.



A.2.2 Measurement results

NTN band 23 15kHz Sub-carrier Spacing

Frequency Error vs Temperature

Temperature(°C)	Voltage(V)	F _L (MHz)	F _H (MHz)	Frequency error(Hz)	Deviation(ppm)
20				17.12	0.00856
50				25.47	0.012734
40				26.20	0.013099
30	3.85	2000.1	2019.9	22.02	0.011009
10				2019.9 23.27	23.27
0				26.54	0.013269
-10				24.05	0.012024
-20				27.95	0.013974
-30				20.42	0.010209

Frequency Error vs Voltage

Voltage(V)	Temperature(°C)	F _L (MHz)	F _H (MHz)	Frequency error (Hz)	(ppm)
3.50	20	2000 4	2019.9	21.83	0.010914
4.35		2000.1	2019.9	21.94	0.010969

NTN band 255 15kHz subcarrier spacing

Frequency Error vs Temperature

Temperature(°C)	Voltage(V)	F _L (MHz)	F _H (MHz)	Frequency error (Hz)	(ppm)
20	3.85	1626.6	1660.4	18.87	0.011601
50				20.96	0.012886
40				18.69	0.01149
30				21.50	0.013218
10				18.99	0.011675
0				16.63	0.010224
-10				21.55	0.013248
-20				22.39	0.013765
-30				13.89	0.008539

Frequency Error vs Voltage

Voltage(V)	Temperature(°C)	F _L (MHz) F _H (MHz)		Frequency error (Hz)	(ppm)
3.50	20	1626.6	1660.4	18.01	0.011072
4.35	20			16.54	0.010168

Note: Expanded measurement uncertainty is \leq 20 Hz, k = 2.





A.3 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 extreme and mid 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:

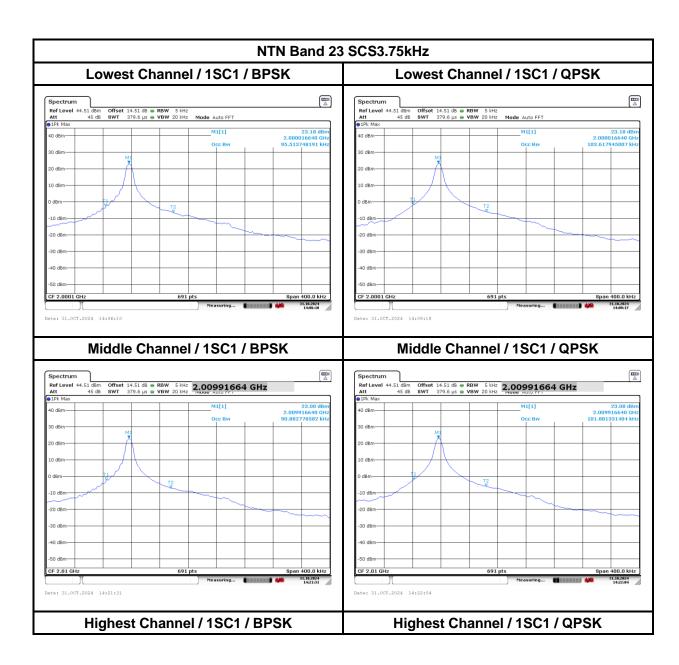
- a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts.
- b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range 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.



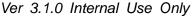


Occupied Bandwidth

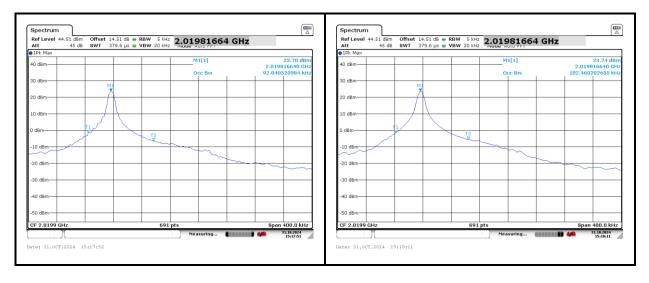
Mode	Band 23: 99%OBW(kHz)							
SCS	3.75kHz		15kHz					
Mod.	BPSK	QPSK	BPSK	QPSK	QPSK	QPSK	QPSK	
SC Size	1SC1	1SC1	1SC1	1SC1	3SC0	6SC0	12SC0	
Lowest CH	95.514	103.618	120.773	123.878	110.564	143.560	181.187	
Middle CH	90.883	101.881	127.352	126.194	114.616	148.770	181.187	
Highest CH	92.041	102.460	126.194	125.615	111.722	150.507	181.187	

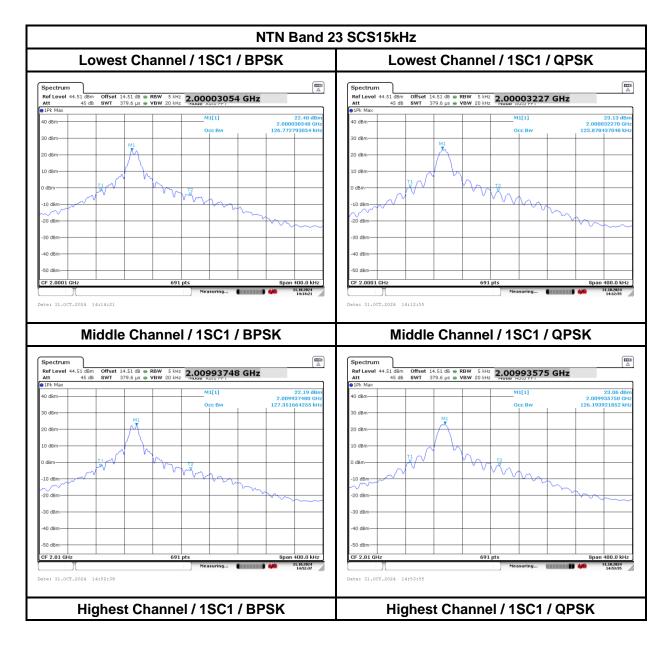




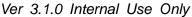




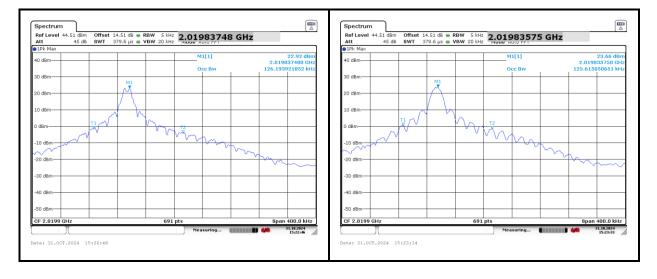








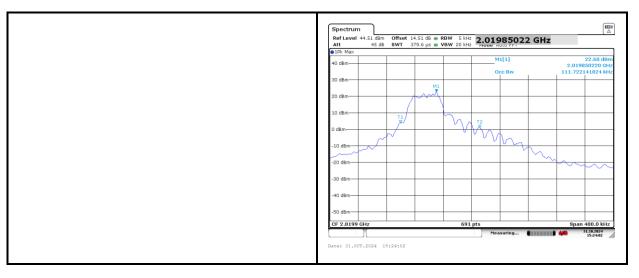


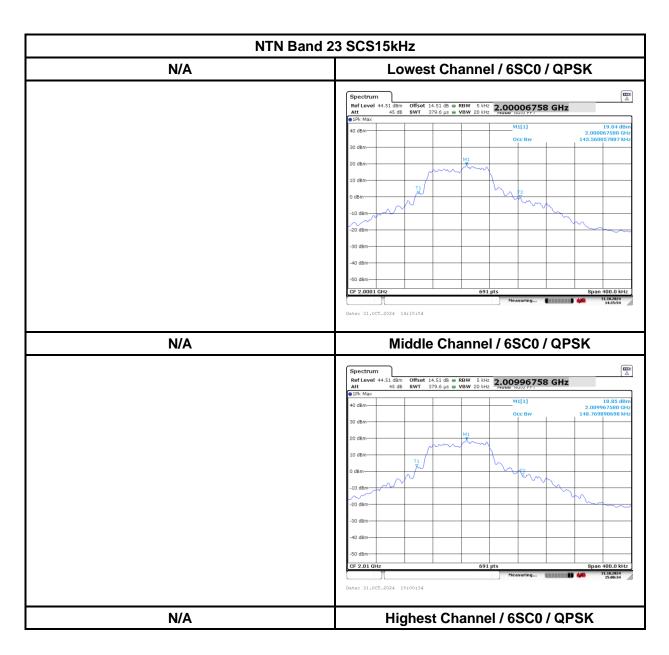






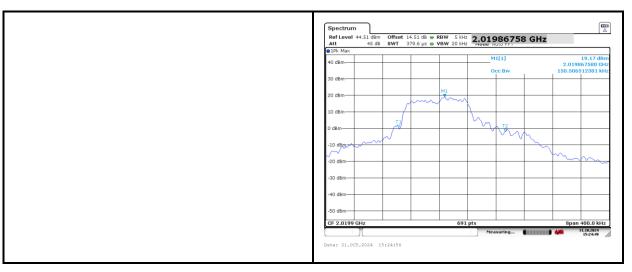








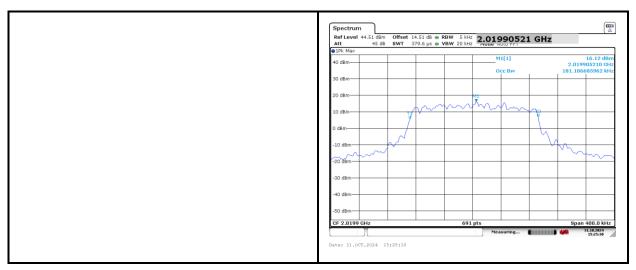






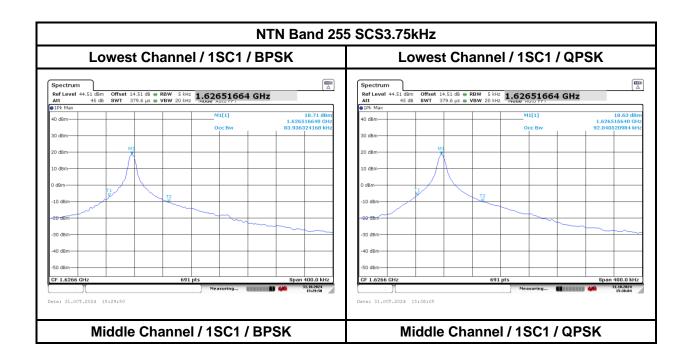




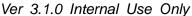


Occupied Bandwidth

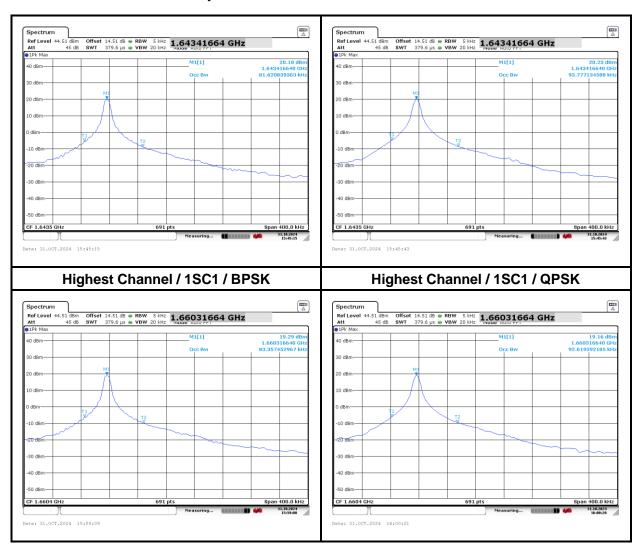
Mode	Band 255: 99%OBW(kHz)							
scs	3.75kHz		15kHz					
Mod.	BPSK	QPSK	BPSK	QPSK	QPSK	QPSK	QPSK	
SC Size	1SC1	1SC1	1SC1	1SC1	3SC0	6SC0	12SC0	
Lowest CH	83.936	92.041	122.142	122.721	107.091	136.634	101.187	
Middle CH	81.621	93.777	121.563	122.721	101.881	133.719	180.608	
Highest CH	83.357	92.619	122.721	121.563	105.355	128.509	181.187	

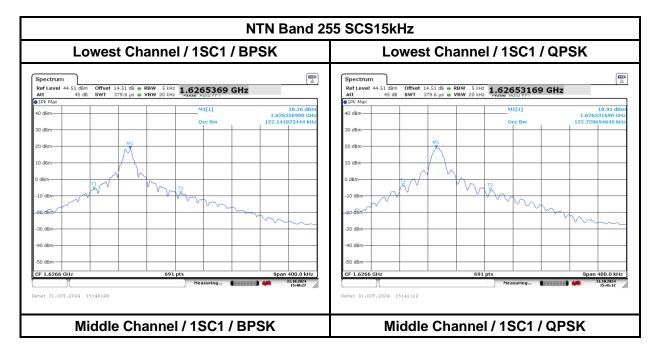




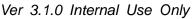




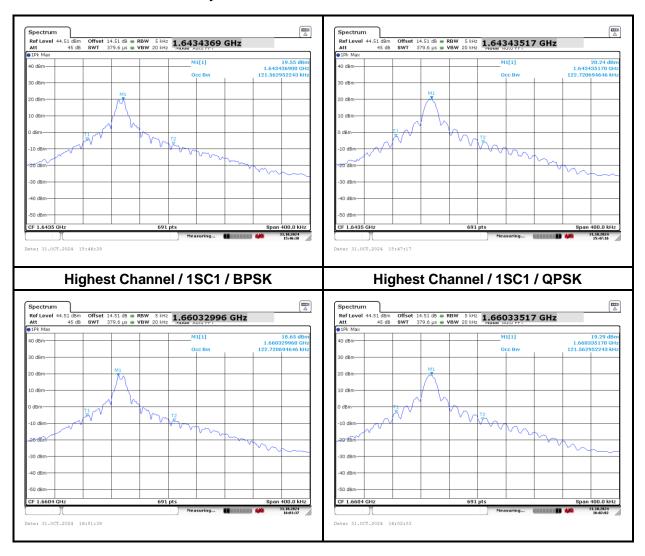


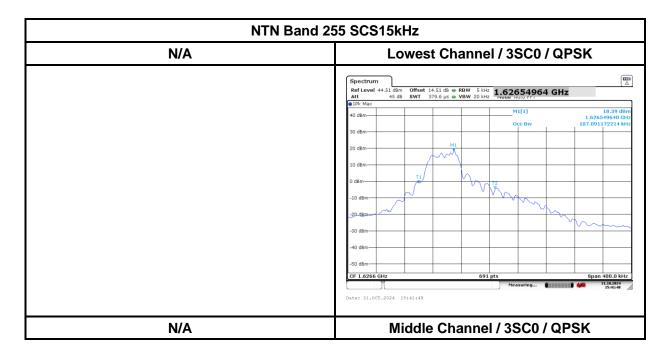






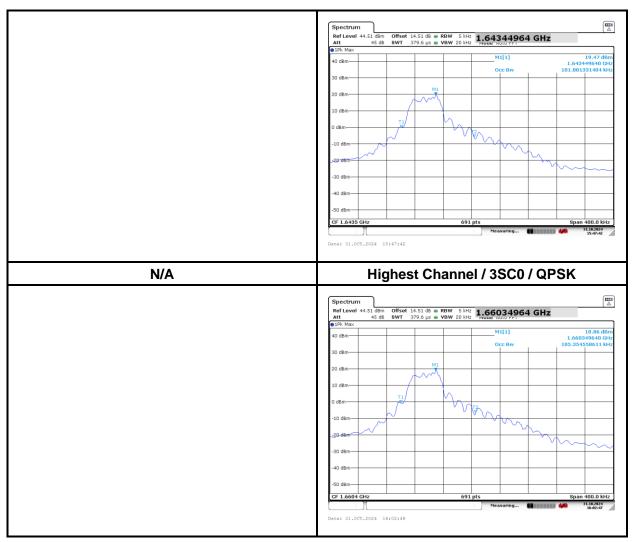


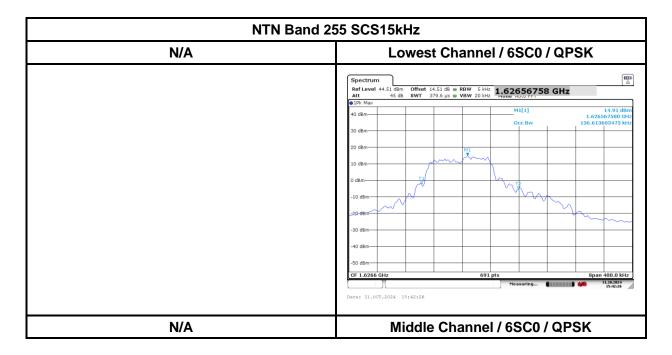






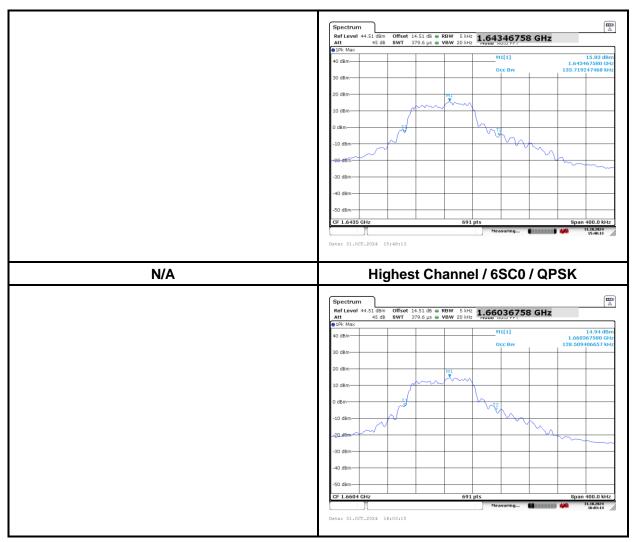


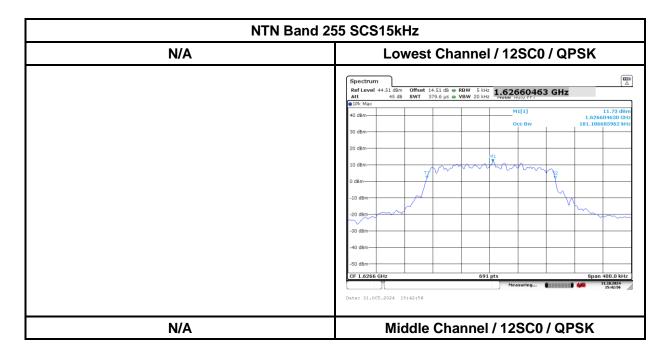






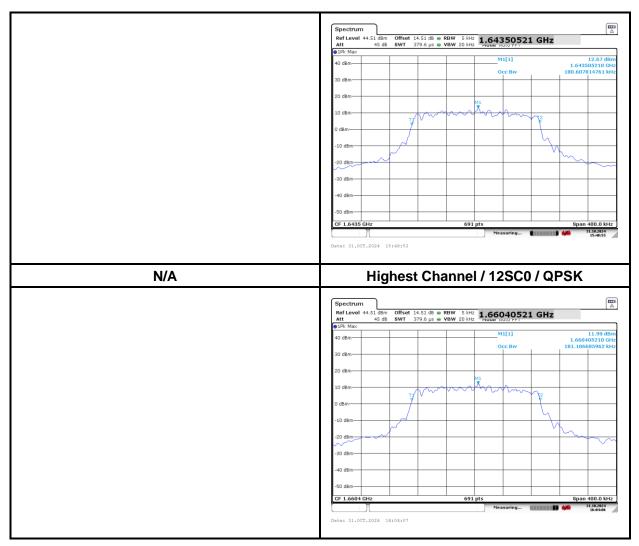












Note: Expanded measurement uncertainty is $\,\leq$ 20 Hz, k = 2 .





A.4 Band Edge Compliance

A.4.1 Measurement limit

Part 25.202(f) specifies The mean power of the emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

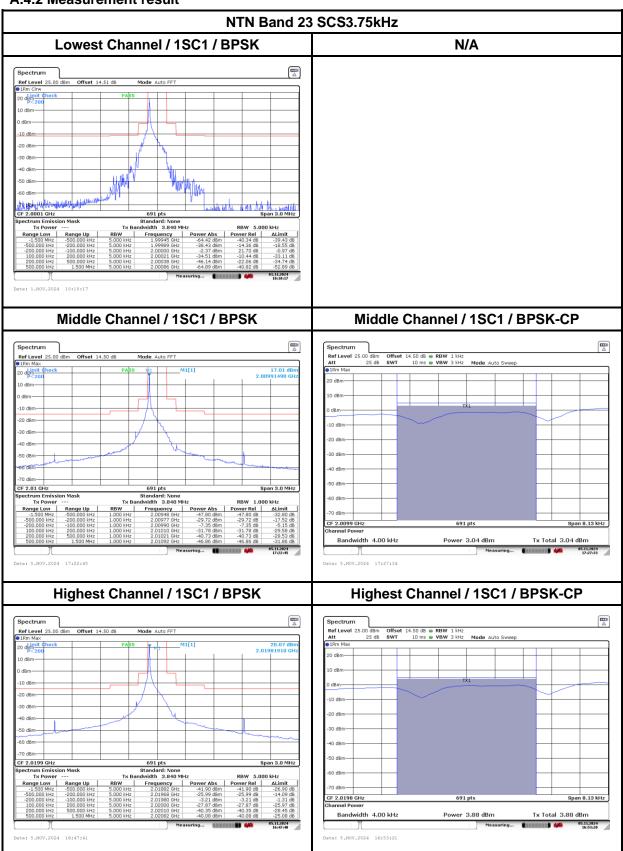
- (1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50% up to and including 100% of the authorized bandwidth: 25dB;
- (2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100% up to and including 250% of the authorized bandwidth: 35dB;
- (3)In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

According to KDB 971168, a relaxation of the reference bandwidth is often provided for measurements within a specified frequency range at the edge of the authorized frequency block/band. This is often implemented by permitting the use of a narrower RBW (typically limited to a minimum RBW of 1% of the OBW) for measuring the out-of-band emissions without a requirement to integrate the result over the full reference bandwidth.

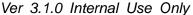




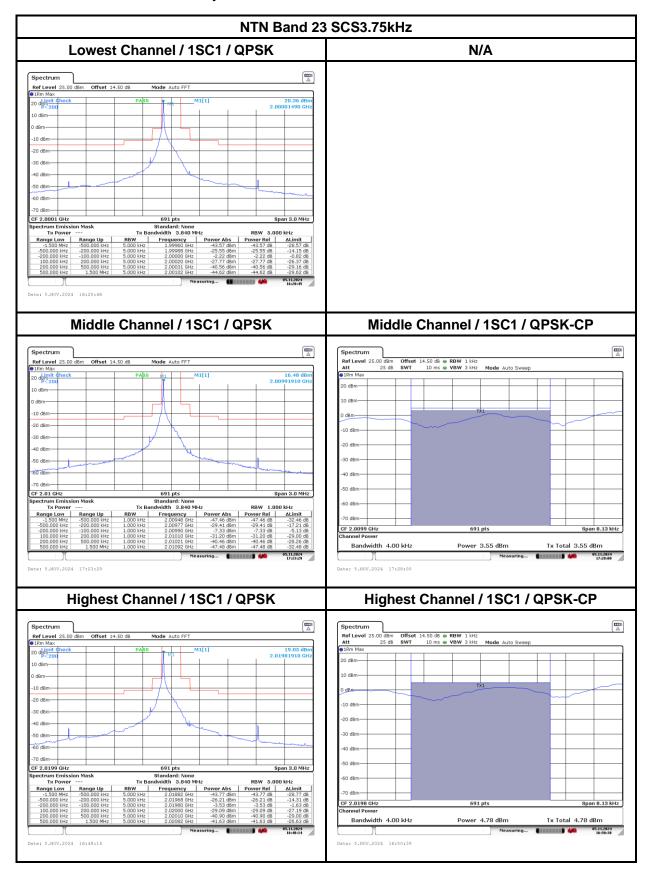
A.4.2 Measurement result



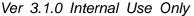




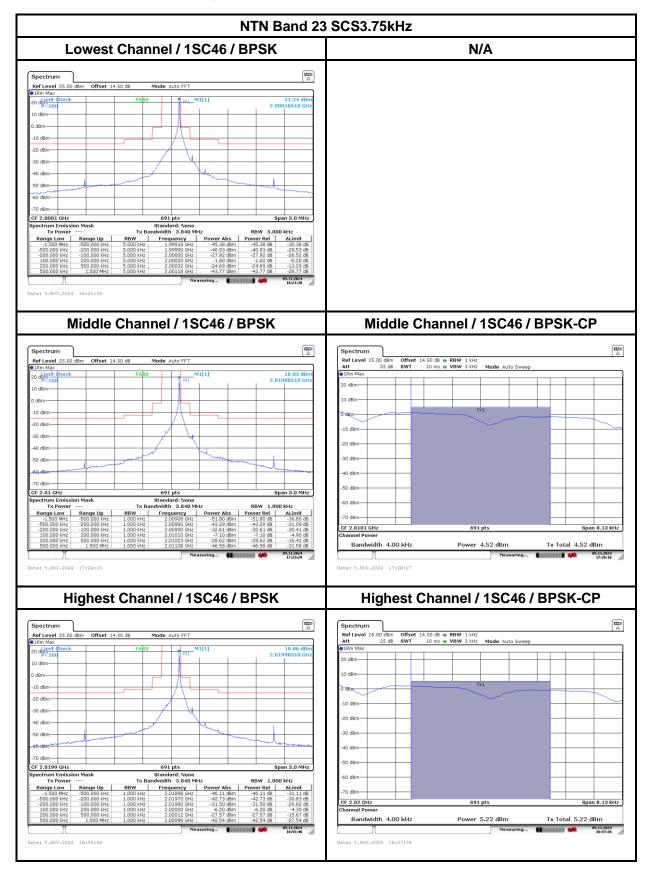




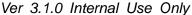




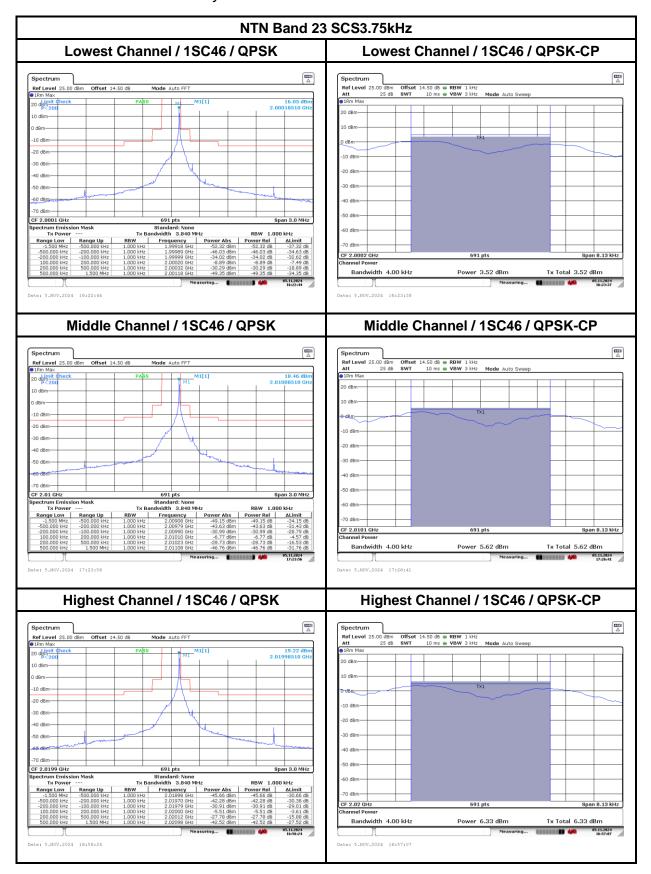














Ver 3.1.0 Internal Use Only



