RF MEASUREMENT REPORT

Applicant:	SIMCom Wireless Solutions Limited
Address:	SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China 200335
Product:	Wireless MODULE
Model No.:	SIM7028
Brand Name:	SIMCOM
Standards:	ETSI TS 136 124 V17.1.0 (2022-07) ETSI TS 136 521-1 V16.9.0 (2021-03) (Testing Standard Sections Refer to Report Section 2)
Result:	Complies
Received Date:	2021-09-07
Test Date:	2021-09-07 ~ 2021-09-30

Reviewed By: Kevin Guo

Approved By: Robin Wu

Revision History

Report No.	Version	Description	Issue Date	Note
2307RSU062-E5	Rev.01	Initial Report	2023-08-03	Valid

Note: this report is based on the "2109RSU011" project, updated the version of the standard, and the test data are quoted from the MRT's report "2109RSU011-E4".

CONTENTS

1. General Information

1.1. Applicant

SIMCom Wireless Solutions Limited

SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China 200335

1.2. Manufacturer

SIMCom Wireless Solutions Limited

SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China 200335

1.3. Testing Facility

☒	**Test Site - MRT Suzhou Laboratory**				
	Laboratory Location (Suzhou - Wuzhong) D8 Building, No.2 Tian'edang Rd., Wuzhong Economic Development Zone, Suzhou, China **Laboratory Location (Suzhou - SIP)** 4b Building, Liando U Valley, No.200 Xingpu Rd., Shengpu Town, Suzhou Industrial Park, China				
	Laboratory Accreditations				
	A2LA: 3628.01		CNAS: L10551		
	FCC: CN1166		ISED: CN0001		
	VCCI:	☐R-20025	☐G-20034	☐C-20020	☐T-20020
		☐R-20141	☐G-20134	☐C-20103	☐T-20104
☐	**Test Site - MRT Shenzhen Laboratory**				
	Laboratory Location (Shenzhen) 1G, Building A, Junxiangda Building, Zhongshanyuan Road West, Nanshan District, Shenzhen, China				
	Laboratory Accreditations				
	A2LA: 3628.02		CNAS: L10551		
	FCC: CN1284		ISED: CN0105		
☐	**Test Site - MRT Taiwan Laboratory**				
	Laboratory Location (Taiwan) No. 38, Fuxing 2nd Rd., Guishan Dist., Taoyuan City 333, Taiwan (R.O.C.)				
	Laboratory Accreditations				
	TAF: L3261-190725				
	FCC: 291082, TW3261		ISED: TW3261		

1.4. Product Information

Product Name	Wireless MODULE
Model No.	SIM7028
Brand Name	SIMCOM
3GPP Specification	LTE Category NB1: Band1/3/5/8/2/28
Operating Temp.	-40 ~ 85°C
Power Type	3.0 ~ 4.3Vdc, typical 3.3Vdc
Note: The information of EUT was provided by the manufacturer, and the accuracy of the information shall be the responsibility of the manufacturer.	

1.5. Radio Specification under Testing

E-UTRA Specification	
Single Band	Category NB1: Band 5
FDD T_X Frequency Range	Band 5: 824 ~ 849 MHz,
FDD R_X Frequency Range	Band 5: 869 ~ 894 MHz
Modulation	BPSK, QPSK

1.6. Frequency Band

LTE Cat NB band channel bandwidth:

Band	Duplex Mode	Uplink (MHz)	Downlink (MHz)	Supported Channel Bandwidth (MHz)
5	FDD	824 ~ 849	869 ~ 894	200KHz

2. Test Configuration

2.1. Applied Standards

Standard Referenced	Standard Title
ETSI TS 136 521 - 1	LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) conformance specification; Radio transmission and reception; Part 1: Conformance testing (3GPP TS 36.521-1 version 16.9.0 Release 16)
ETSI TS 136 124	LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Electromagnetic compatibility (EMC) requirements for mobile terminals and ancillary equipment (3GPP TS 36.124 version 17.1.0 Release 17)
Test Item Standard Referenced	Standard Title
ETSI EN 301 908 - 1	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 1: Introduction and common requirements
ETSI EN 301 908 - 13	IMT cellular networks; Harmonised Standard for access to radio spectrum; Part 13: Evolved Universal Terrestrial Radio Access (E-UTRA) User Equipment (UE)

2.2. Test Environment Condition

Ambient Temp.	15 ~ 35°C
Relative Humidity	20 ~ 75%RH

3. Measuring Instrument

Instrument Name	Manufacturer	Model No.	Asset No.	Cali. Interval	Cal. Due Date	Test Site
EMI Test Receiver	R&S	ESR7	MRTSUE06001	1 year	2022-01-04	WZ-AC1
EXA Signal Analyzer	Keysight	N9010B	MRTSUE06558	1 year	2022-07-21	WZ-AC1
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2021-11-07	WZ-AC1
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2021-11-08	WZ-AC1
Bilog Period Antenna	Schwarzbeck	VULB 9168	MRTSUE06172	1 year	2022-08-05	WZ-AC1
Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06023	1 year	2022-09-26	WZ-AC1
Microwave System Amplifier	Agilent	83017A	MRTSUE06076	1 year	2021-11-14	WZ-AC1
Thermal Hygrometer	testo	608-H1	MRTSUE06403	1 year	2022-07-21	WZ-AC1
Anechoic Chamber	TDK	Chamber-AC1	MRTSUE06212	1 year	2022-04-29	WZ-AC1
MXE EMI Receiver	Keysight	N9038A	MRTSUE06125	1 year	2022-06-22	WZ-AC2
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2021-11-07	WZ-AC2
Loop Antenna	Schwarzbeck	FMZB 1519	MRTSUE06025	1 year	2021-11-08	WZ-AC2
Bilog Period Antenna	Schwarzbeck	VULB 9162	MRTSUE06022	1 year	2022-05-24	WZ-AC2
Broad-Band Horn Antenna	Schwarzbeck	BBHA 9120D	MRTSUE06171	1 year	2021-10-25	WZ-AC2
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	MRTSUE06176	1 year	2021-11-14	WZ-AC2
Thermal Hygrometer	Minggao	ETH529	MRTSUE06170	1 year	2021-12-08	WZ-AC2
Anechoic Chamber	RIKEN	Chamber-AC2	MRTSUE06213	1 year	2022-04-29	WZ-AC2
Tunable Bandreject Filter	Wainwright Instruments GmbH	WTRCTV5-780-980-20-70-60SSK	MRTSUE06133	1 year	2022-06-22	WZ-AC2
Tunable Bandreject Filter	Wainwright Instruments GmbH	WTRCT10-1710-2130-20-40-50SSK	MRTSUE06134	1 year	2022-07-21	WZ-AC2
High-Pass Filter	Wainwright Instruments GmbH	WHKX1.1/15G-10SS	MRTSUE06066	1 year	2022-03-25	WZ-AC2
High pass Filter	Wainwright Instruments GmbH	WHKX10-2501-3050-18000-80SS	MRTSUE06151	1 year	2022-07-21	WZ-AC2
Temperature/Humidity Meter	Minggao	ETH529	MRTSUE06170	1 year	2021-12-13	WZ-AC2

Instrument Name	Manufacturer	Model No.	Asset No.	Cali. Interval	Cal. Due Date	Test Site
Programmable Temperature & Humidity Chamber	BAOYT	BYH-1500L	MRTSUE06051	1 year	2021-11-07	WZ-TR3
Wideband Radio Communication Tester	R&S	CMW 500	MRTSUE06243	1 year	2021-11-07	WZ-TR3 / WZ-SR6
Spectrum Analyzer	Agilent	N9020A	MRTSUE06106	1 year	2022-04-13	WZ-TR3 / WZ-SR6
EXA Signal Analyzer	Keysight	N9010B	MRTSUE06452	1 year	2022-07-07	WZ-TR3 / WZ-SR6
Power Meter	Agilent	U2021XA	MRTSUE06030	1 year	2021-11-18	WZ-TR3 / WZ-SR6
ESG Vector Signal Generator	Agilent	E4438C	MRTSUE06026	1 year	2021-11-07	WZ-TR3 / WZ-SR6
MXG Vector Signal Generator	Keysight	N5182B	MRTSUE06451	1 year	2022-06-24	WZ-TR3 / WZ-SR6
EXA Signal Analyzer	Keysight	N9010A	MRTSUE06195	1 year	2022-04-13	WZ-TR3 / WZ-SR6

Software	Version	Function
Controller_MF 7802	2.03C	RE Antenna & Turntable
EMI Software	V3	EMI Test Software
MRT_intelligence	V1.0.19	license CSE

4. Decision Rules and Measurement Uncertainty

4.1. Decision Rules

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4: 2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.2. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2.

Parameter	Uncertainty
Radiated Spurious Emissions	5.2dB
Control and monitoring functions	1dB
Temperature	0.5°C
Humidity	1%

5. Test Result

5.1. Summary

ETSI TS 136 124

Clause No	Description	Result
8.2 Note 1	Radiated emissions (UE)	Pass

ETSI TS 136 521 - 1 (Category NB1)

Clause No	Description	Result
6.2.2F Note 2	UE Maximum Output Power	Pass
6.2.2F T_H, V_H Note 2	UE Maximum Output Power	Pass
6.2.2F T_H, V_L Note 2	UE Maximum Output Power	Pass
6.2.2F T_L, V_H Note 2	UE Maximum Output Power	Pass
6.2.2F T_L, V_L Note 2	UE Maximum Output Power	Pass
6.3.2F	Minimum Output Power	Pass
6.3.2F T_H, V_H	Minimum Output Power	Pass
6.3.2F T_H, V_L	Minimum Output Power	Pass
6.3.2F T_L, V_H	Minimum Output Power	Pass
6.3.2F T_L, V_L	Minimum Output Power	Pass
6.6.2.1F	Spectrum Emission Mask	Pass
6.6.2.3F	Adjacent Channel Leakage power Ratio	Pass
6.6.2.3F T_H, V_H	Adjacent Channel Leakage power Ratio	Pass
6.6.2.3F T_H, V_L	Adjacent Channel Leakage power Ratio	Pass
6.6.2.3F T_L, V_H	Adjacent Channel Leakage power Ratio	Pass
6.6.2.3F T_L, V_L	Adjacent Channel Leakage power Ratio	Pass
6.6.3F.1	Transmitter Spurious emissions	Pass
6.6.3F.2	Spurious emission band UE co-existence	Pass
7.5F	Adjacent Channel Selectivity (ACS)	Pass
7.6.1F	In-band blocking	Pass
7.6.2F	Out of-band blocking	Pass
7.6.3F	Narrow band blocking	Pass
7.7F	Spurious response	Pass Note 3
7.8.1F	Receiver Intermodulation Characteristics	Pass
7.9F	Receiver Spurious emissions	Pass
7.3F	Receiver Reference Sensitivity Level	Pass
7.3F T_H, V_H	Receiver Reference Sensitivity Level	Pass
7.3F T_H, V_L	Receiver Reference Sensitivity Level	Pass
7.3F T_L, V_H	Receiver Reference Sensitivity Level	Pass
7.3F T_L, V_L	Receiver Reference Sensitivity Level	Pass

5.2. Key to Result Codes

The following terms may be used in the table above

Code	Meaning
Pass	Test result shows that the requirements of the relevant specification have been met.
Fail	Test result shows that the requirements of the relevant specification have not been met.
N/A	Test is either not required/not applicable in the specified frequency band or is not applicable according to the specific for the equipment under test.
V_N	Normal Voltage 3.7V
T_N	Normal Temperature 25°C
V_H	High voltage 4.3V
V_L	Low voltage 3.0V
T_H	High temperature 85°C
T_L	Low temperature -40°C
Note 1	Detail result refers to the section 5.4 of this report.
Note 2	Detail result refers to the section 5.5 of this report.
Note 3	Only apply the out-of-band blocking limit is not met

5.3. Test Engineer performing Accredited Testing

Andy Zhu

Cloud Guo

Candy Luo

Caitlin Chen

Eric Xu

Gordon Qi

Jone Zhang

Larry Yan

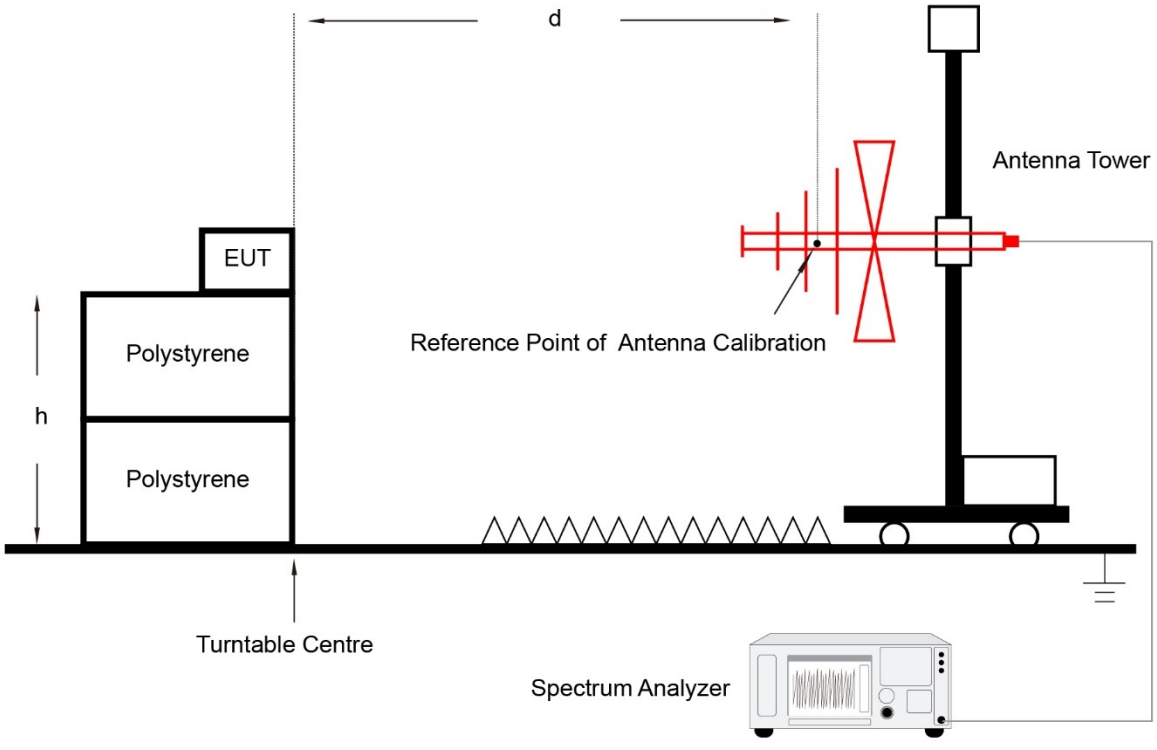
5.4. Radiated Emission (UE)

5.4.1. Test Limit

Frequency	Minimum requirement (e.r.p.) / reference bandwidth	Applicability
Traffic Mode		
30 MHz ≤ f < 1000 MHz	-36 dBm /100 kHz	All
1 GHz ≤ f < 12.75 GHz	-30 dBm /1 MHz	All
Idle Mode		
30 MHz ≤ f < 1000 MHz	-57 dBm /100 kHz	All
1 GHz ≤ f < 12.75 GHz	-47 dBm /1 MHz	All

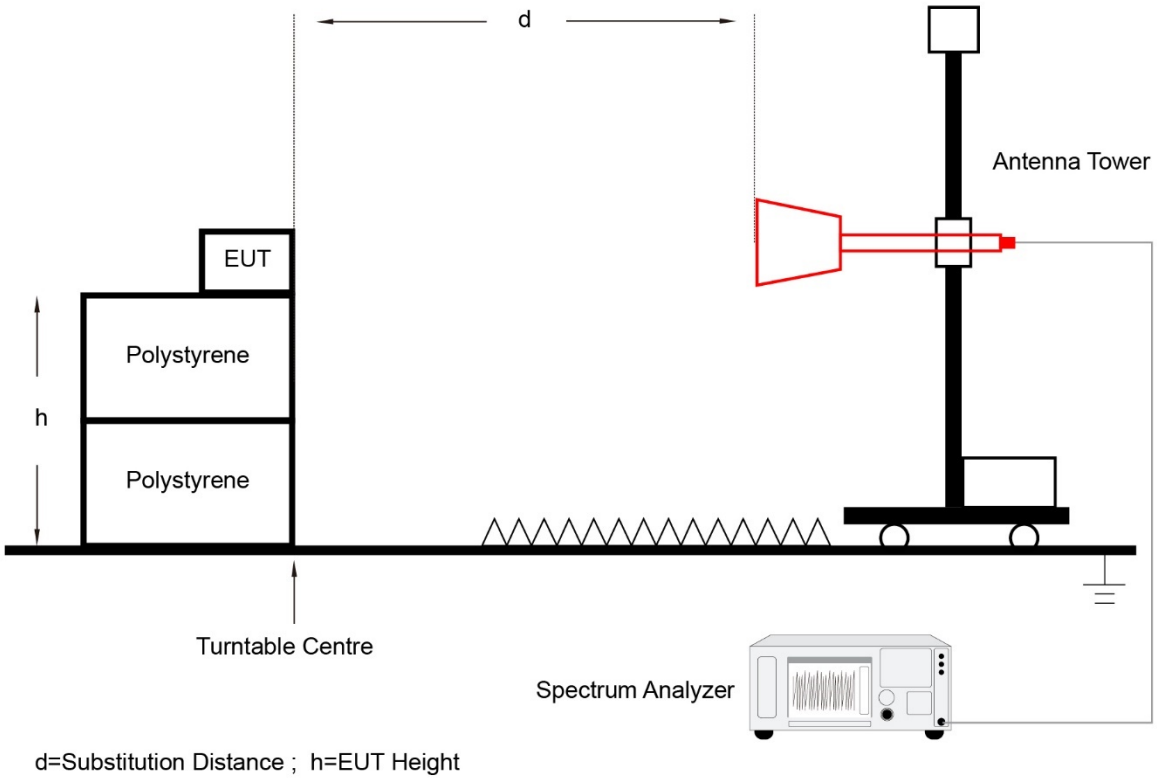
5.4.2. Test Setup

Below 1GHz Test Setup:



d=Substitution Distance ; h=EUT Height

Above 1GHz Test Setup:



d=Substitution Distance ; h=EUT Height

5.4.3. Test Procedure

a) The equipment under test (EUT) was placed on a turntable inside a fully anechoic chamber.

b) Established EUT operate in continuous transmitting signals and allocated a channel with maximum output power.

c) The pre-calibration method has been performed ahead of testing so as to correct the readings from the spectrum analyzer.

d) The NR mode was scanned for harmonics for both horizontal and vertical polarizations, and then the worst mode was performed the full test. The test frequency range is from 30 MHz to 12.75 GHz.

5.4.4. Test Result

Test Site	WZ-AC2	Test Date	2021-09-10
Test Configuration	LTE Category NB1 Band 5 Traffic		

Channel (MHz)	Frequency (MHz)	Reading Level (dBm)	Substitution Factor (dB)	Measure Level (dBm)	Limit (dBm)	Margin (dB)	Detector	Polarization
824.1	213.8	-102.6	31.6	-71.0	-36.0	-35.0	Peak	Horizontal
	842.4	-102.3	39.2	-63.1	-36.0	-27.1	Peak	Horizontal
	56.2	-88.4	27.4	-61.0	-36.0	-25.0	Peak	Vertical
	98.4	-103.5	40.2	-63.3	-36.0	-27.3	Peak	Vertical
	2474.6	-56.8	11.3	-45.5	-30.0	-15.5	Peak	Horizontal
	4119.6	-58.3	14.5	-43.8	-30.0	-13.8	Peak	Horizontal
	2474.6	-50.8	11.1	-39.7	-30.0	-9.7	Peak	Vertical
	4119.6	-54.5	14.3	-40.2	-30.0	-10.2	Peak	Vertical

Note 1: Measure Level (dBm) = Reading Level (dBm) + Substitution Factor (dB)

Note 2: For emission below 1GHz:

Substitution Factor (dB) = Cable Loss (dB) + Space Attenuation (dB) - Antenna Gain (dBi) - 2.15(dB)

For emission above 1GHz:

Substitution Factor (dB) = Cable Loss (dB) + Space Attenuation (dB) - Antenna Gain (dBi) - Pre_Amplifier Gain (dB) - 2.15(dB).

Note 3: Due to peak detection will yield amplitudes equal to or greater than amplitudes measured with the RMS detector. Thus, the data measured using the peak detector of a spectrum analyzer will represent the worst-case results.

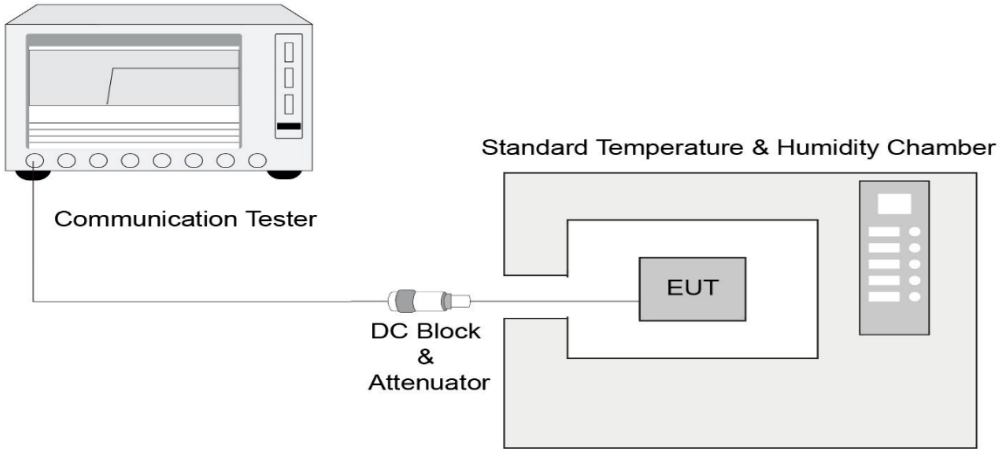
5.5. Transmitter Maximum Output Power

5.5.1. Test Limit

Table 1: LTE Category NB1 Transmitter maximum output power

E-UTRA Band	Power Class (dBm)	Tolerance (dB)
5	23	±2.7

5.5.2. Test Setup



5.5.3. Test Result

Test Site	WZ-TR3	Test Date	2021-09-14
Test Configuration	LTE Category NB1 Band 1		

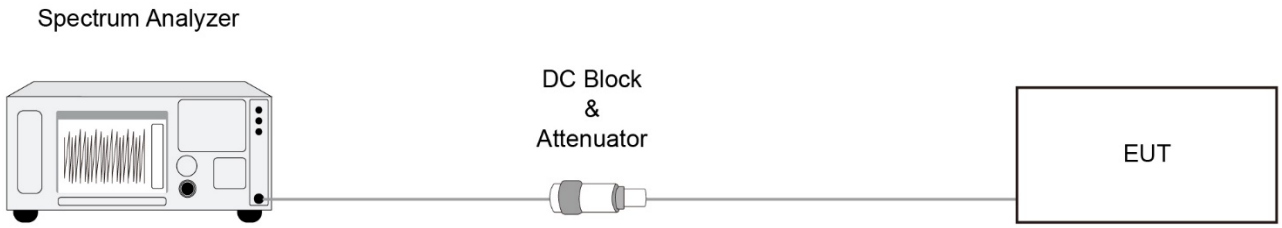
Test Range	Test RB	Output Power with Test Condition (dBm)					Limit (dBm)
		V_N/T_N	V_L/T_L	V_L/T_H	V_H/T_L	V_H/T_H	
3.75kHz_BPSK							
Middle	1@0	22.36	22.17	22.16	22.28	22.40	20.3 ~ 25.7
	1@47	22.30	22.09	22.09	22.23	22.35	20.3 ~ 25.7
15kHz_QPSK							
Middle	1@0	22.55	22.27	22.27	22.45	22.50	20.3 ~ 25.7
	1@11	22.58	22.41	22.40	22.44	22.58	20.3 ~ 25.7
	3@3	22.08	21.39	21.51	21.90	22.03	20.3 ~ 25.7

5.6. Control and monitoring functions (UE)

5.6.1. Test Limit

Band	Frequency (MHz)	Measured power (dBm)	Applicability
Category NB1 Band 5	824 ~ 849	≤ -30	All

5.6.2. Test Setup



5.6.3. Test Procedure

a) At the start of the test, the UE shall be switched off. The UE antenna connector shall be connected to a power measuring equipment.

b) The UE shall be switched on for a period of approximately fifteen minutes, and then switched off.

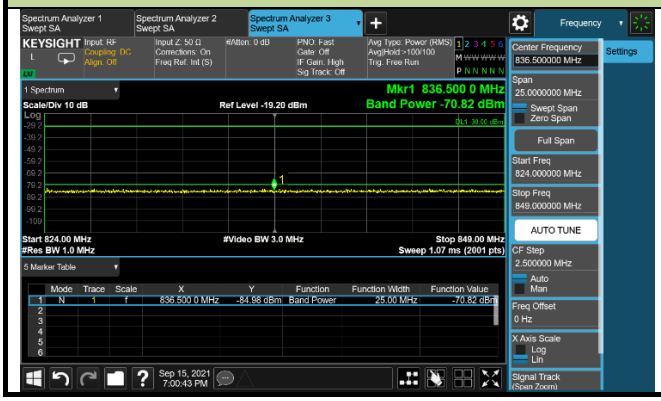
c) The EUT shall remain switched off for a period of at least thirty seconds and shall then be switched on for a period of approximately one minute.

d) The maximum power emitted from the UE throughout the duration of the test shall be recorded.

5.6.4. Test Result

Test Site	WZ-SR6	Test Date	2021-09-15

Band	Frequency (MHz)	Measured power (dBm)	Limit (dBm)	Result
Category NB1 Band 5	824 ~ 849	-70.82	≤ -30.00	Pass

Category NB1 Band 5	
	

Appendix A - Test Setup Photograph

Refer to “2307RSU062-ET” file.

Appendix B - EUT Photograph

Refer to “2307RSU062-EE” file.

The End