

**Yi Tunnel (Beijing) Technology  
Co., Ltd.**

# **TEST REPORT**

**SCOPE OF WORK**

FCC Testing –Venus 20-US-4G-PCIE-M2, Venus 20-CN-4G-NA-M2,  
Venus 20-US-4G-NA-M2

**REPORT NUMBER**

211110029SZN-001

**ISSUE DATE**

January 12, 2022

**PAGES**

32

**DOCUMENT CONTROL NUMBER**

FCC ID 22/24/27/90\_a  
© 2017 INTERTEK



# FCC

# RF Test Report

*For*

**Yi Tunnel (Beijing) Technology Co., Ltd.**

**Product Name: Venus**

**Model Number: Venus 20-US-4G-PCIE-M2,  
Venus 20-CN-4G-NA-M2, Venus 20-US-4G-NA-M2**

**FCC ID: 2A36J-VENUS20**

**Report No: 211110029SZN-001**

Tested and Prepared by:

---

*Jeff Liang*  
Project Engineer

Approved by:

---

*Sewen Guo*  
Senior Project Engineer  
Date: January 12, 2022

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

**Intertek Testing Service Shenzhen Ltd. Longhua Branch**

101, 201, Building B, No. 308 Wuhe Avenue, Zhangkengjing Community GuanHu Subdistrict, LongHua District, Shenzhen, People's Republic of China

Tel: (86 755) 8601 6288 Fax: (86 755) 8601 6751

Version: 01-November-2017

Page: 1 of 32

FCC ID 22/24/27/90\_a

**Table of Contents**

<b>1. Summary of Test Result.....</b>	<b>3</b>
1.1 Cellular Band (824-849MHz paired with 869-894MHz) .....	4
1.2 PCS Band (1850-1910MHz paired with 1930-1990MHz) .....	4
1.3 AWS Band (1710-1755MHz paired with 2110-2155MHz).....	5
1.4 Band12 (699-716MHz paired with 729-746 MHz) .....	5
1.5 BRS&EBS Band (2500-2570 MHz paired with 2620-2690 MHz).....	6
1.6 Band13 (777-787MHz paired with 746-756 MHz) .....	7
1.7 Band25 (1850-1915MHz paired with 1930-1995 MHz) .....	7
1.8 Band26 (814-824MHz paired with 859-869 MHz) .....	8
1.9 Band38 (2570-2620 MHz paired with 2570-2620 MHz) .....	9
1.10 Band41 (2496-2690 MHz paired with 2496-2690 MHz).....	10
<b>2. General Description.....</b>	<b>11</b>
2.1 Product Description .....	11
2.2 Test Facility .....	11
2.3 Test Environment Condition .....	11
2.4 Sub-Assembly.....	11
2.5 Technical Specification.....	12
<b>3. General Test Conditions/Configuration .....</b>	<b>16</b>
3.1 Test Modes.....	16
3.2 Test Environment.....	16
3.3 Test Frequency.....	16
<b>4. DESCRIPTION OF TESTS.....</b>	<b>22</b>
4.1 Radiated Power and Radiated Spurious Emissions.....	22
4.2 Peak-Average Ratio .....	23
4.3 Occupied Bandwidth.....	24
4.4 Band Edge Compliance.....	24
4.5 Spurious and Harmonic Emissions at Antenna Terminal .....	25
4.6 Frequency Stability / Temperature Variation .....	26
<b>5. Test Setups .....</b>	<b>27</b>
5.1 Test Setup 1 .....	27
5.2 Test Setup 2 .....	27
5.3 Test Setup 3 .....	28
5.4 Test Conditions .....	29
<b>6. Main Test Instruments .....</b>	<b>31</b>
<b>7. Measurement Uncertainty .....</b>	<b>32</b>
<b>8. Appendixes .....</b>	<b>32</b>

## 1. Summary of Test Result

Applicant:	Yi Tunnel (Beijing) Technology Co., Ltd.
Address:	R1511,Block B,SOHO Shangdu North Tower,Dongdaqiao Road 8#,Chaoyang District,Beijing,China,100020
Product name:	Venus
Model Number:	Venus 20-US-4G-PCIE-M2, Venus 20-CN-4G-NA-M2, Venus 20-US-4G-NA-M2
FCC ID:	2A36J-VENUS20
Report number:	211110029SZN-001
Date of Test	20 October 2021 to 15 November 2021

The models have the same schematics. The only difference is as follows:

Production name	Trade name	Model no.	Description
Venus	SANDSTAR	Venus 20-US-4G-PCIE-M2	Add one more PCIE chip 2 USB2.0 ports are native ports Among them, the 2 USB3.0 interfaces are transferred by a native USB3.0 through the HUB, and the 2 USB3.0 interfaces share a native USB3.0 bandwidth. Two of the USB3.0 interfaces are transferred by PCIE, and each channel can fully use the bandwidth of USB3.0
Venus	SANDSTAR	Venus 20-US-4G-NA-M2	2 USB2.0 ports are native ports The 4-channel USB3.0 interface is transferred from a native USB3.0 through the HUB, and the 4-channel USB3.0 interface shares a native USB3.0 bandwidth
Venus	SANDSTAR	Venus 20-CN-4G-NA-M2	2 USB2.0 ports are native ports The 4-channel USB3.0 interface is transferred from a native USB3.0 through the HUB, and the 4-channel USB3.0 interface shares a native USB3.0 bandwidth

The above equipment was tested by Beijing Tairuite Inspection&Testing Technology Service Co.,Ltd Shenzhen Branch. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI 63.26:2015 and KDB 971168 D01. This device is in compliance with FCC rules as following:

47 CFR FCC Part 02:2020  
47 CFR FCC Part 22:2020  
47 CFR FCC Part 24:2020  
47 CFR FCC Part 27:2020  
47 CFR FCC Part 90:2020

The test results of this report relate only to the tested sample identified in this report.

## 1.1 Cellular Band (824-849MHz paired with 869-894MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §2.913	FCC: ERP $\leq$ 7 W.	Appendix A	Pass
Peak-Average Ratio	--	--	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §2.917	$\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §2.917	FCC: $\leq$ -13 dBm/100 kHz, from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §2.917	FCC: $\leq$ -13 dBm/100 kHz.	Appendix G	Pass
Frequency Stability	§2.1055, §2.355	$\leq$ $\pm$ 2.5ppm.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

## 1.2 PCS Band (1850-1910MHz paired with 1930-1990MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §24.232	EIRP $\leq$ 2 W	Appendix A	Pass
Peak-Average Ratio	§2.1046, §24.232	Limit $\leq$ 13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §24.238	$\leq$ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §24.238	$\leq$ -13 dBm/1 MHz, from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §24.238	$\leq$ -13 dBm/1 MHz.	Appendix G	Pass
Frequency Stability	§2.1055, §24.235	$\leq$ $\pm$ 2.5 ppm.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

### 1.3 AWS Band (1710-1755MHz paired with 2110-2155MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(d)	EIRP ≤ 1 W	Appendix A	Pass
Peak-Average Ratio	§2.1046, §27.50(d)	Limit≤13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(h)	≤ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(h)	≤ -13 dBm/1 MHz, from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(h)	≤ -13 dBm/1 MHz.	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	≤ ±2.5 ppm.	Appendix H	Pass

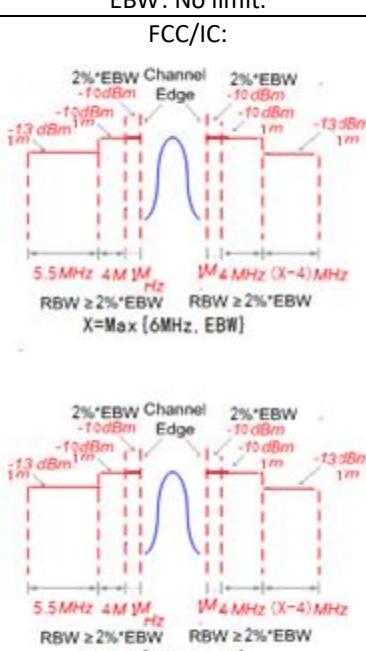
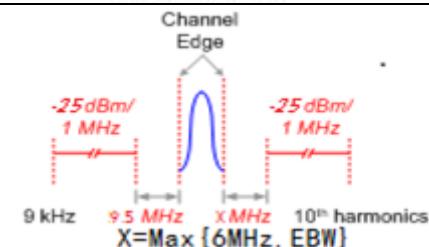
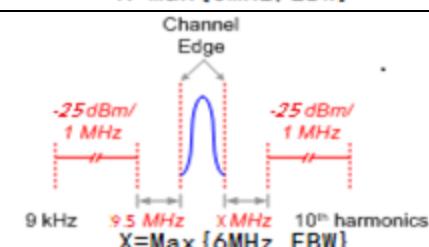
Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

### 1.4 Band12 (699-716MHz paired with 729-746 MHz)

Test Item	FCC Rule No	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§27.50(c)	FCC: ERP ≤ 3 W.	Appendix A	Pass
Peak-Average Ratio	--	--	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1047	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1049,	≤ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(g)	FCC: ≤ -13 dBm/100 kHz, from 9 kHz to 10th harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1051, §27.53(g)	FCC: ≤ -13 dBm/100 kHz.	Appendix G	Pass
Frequency Stability	§2.1053, §27.53(g)	≤ ±2.5ppm.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

## 1.5 BRS&EBS Band (2500-2570 MHz paired with 2620-2690 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	EIRP ≤ 2W	Appendix A	Pass
Peak-Average Ratio	§27.50(a)	Limit≤13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(m4)	<p>FCC/IC:</p>  <p>Two diagrams illustrating band edge compliance. Each diagram shows a central channel edge with a 2%*EBW width. The channel is divided into 5.5 MHz, 4 MHz, and 4 MHz (X-4) MHz segments. The channel edge is at -10 dBm, and the 2%*EBW is at -13 dBm. The 4 MHz segments are at -10 dBm, and the 4 MHz (X-4) MHz segments are at -13 dBm. The RBW is ≥ 2%*EBW, and X = Max [6MHz, EBW].</p>	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)	 <p>Diagram showing spurious emission at antenna terminals. The channel edge is at -25 dBm/1 MHz. The 9 kHz and 10<sup>th</sup> harmonics are at -25 dBm/1 MHz. The 9.5 MHz and X MHz are at -25 dBm/1 MHz. X = Max [6MHz, EBW].</p>	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(m)	 <p>Diagram showing field strength of spurious radiation. The channel edge is at -25 dBm/1 MHz. The 9 kHz and 10<sup>th</sup> harmonics are at -25 dBm/1 MHz. The 9.5 MHz and X MHz are at -25 dBm/1 MHz. X = Max [6MHz, EBW].</p>	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "NIT" denotes "not tested".

## 1.6 Band13 (777-787MHz paired with 746-756 MHz)

Test Item	FCC Rule No	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§27.50(c)	FCC: ERP ≤ 3 W.	Appendix A	Pass
Peak-Average Ratio	--	--	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1047	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1049,	≤ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(g)	FCC: ≤ -13 dBm/100 kHz, from 9 kHz to 10th harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1051, §27.53(g)	FCC: ≤ -13 dBm/100 kHz.	Appendix G	Pass
Frequency Stability	§2.1053, §27.53(g)	≤ ±2.5ppm.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

## 1.7 Band25 (1850-1915MHz paired with 1930-1995 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §24.232	EIRP ≤ 2 W	Appendix A	Pass
Peak-Average Ratio	§2.1046, §24.232	Limits≤13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §24.238	≤ -13 dBm/1%*EBW, in 1 MHz bands immediately outside and adjacent to the frequency block.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §24.238	≤ -13 dBm/1 MHz, from 9 kHz to 10 <sup>th</sup> harmonics but outside authorized operating frequency ranges.	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §24.238	≤ -13 dBm/1 MHz.	Appendix G	Pass
Frequency Stability	§2.1055, §24.235	≤ ±2.5 ppm.	Appendix H	Pass

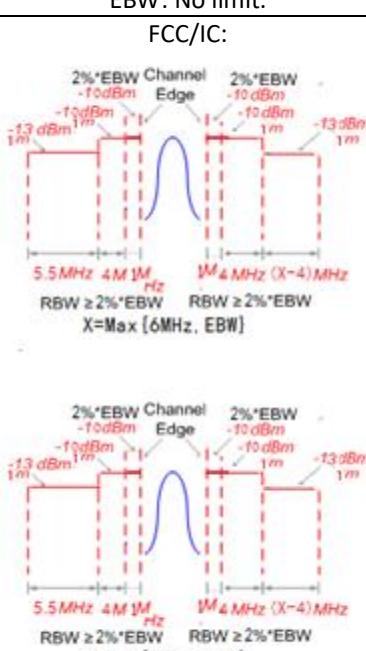
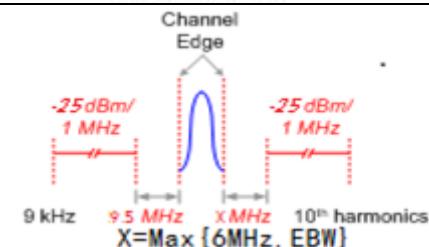
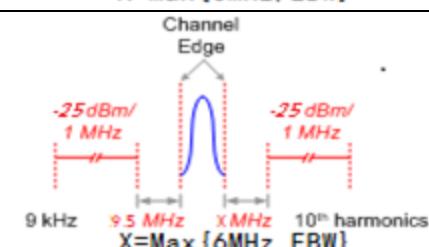
Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

## 1.8 Band26 (814-824MHz paired with 859-869 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Transmitter Conducted Power Output	§2.1046, §290.635	ERP ≤ 100 W	Appendix A	Pass
Peak-Average Ratio	--	Limits≤13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Emission Mask	§2.1051, §90.691	For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \text{ Log10}(f/6.1)$ decibels or $50+10\text{Log10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §90.691	< $43 + 10\text{Log10}(P[\text{Watts}])$ for all out-ofband emissions	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §90.691	< $43 + 10\text{Log10}(P[\text{Watts}])$ for all out-ofband emissions	Appendix G	Pass
Frequency Stability	§2.1055, §90.213	< $\pm 2.5\text{ppm}$ .	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "N/T" denotes "not tested".

## 1.9 Band38 (2570-2620 MHz paired with 2570-2620 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	EIRP ≤ 2W	Appendix A	Pass
Peak-Average Ratio	§27.50(a)	Limit≤13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(m4)	<p>FCC/IC:</p>  <p>The diagram shows two plots of power spectral density (PSD) in dBm/Hz versus frequency in MHz. Each plot has a central channel edge and two sidebands. The top plot shows a 5.5 MHz channel with a 4 MHz RBW, and the bottom plot shows a 5.5 MHz channel with a 4 MHz RBW. Both plots show a central channel edge with a 2% EBW and two sidebands with 2% EBW. The sidebands are centered at 9.5 MHz and 10.5 MHz relative to the channel edge. The plots also show -10 dBm and -13 dBm levels, and 1 MHz bandwidth markers.</p>	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)	 <p>The diagram shows a plot of power spectral density (PSD) in dBm/Hz versus frequency in MHz. It features a central channel edge and two sidebands. The sidebands are centered at 9.5 MHz and 10.5 MHz relative to the channel edge. The plots show -25 dBm/1 MHz and 9 kHz bandwidth markers. The text "X=Max {6MHz, EBW}" is present.</p>	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(m)	 <p>The diagram shows a plot of power spectral density (PSD) in dBm/Hz versus frequency in MHz. It features a central channel edge and two sidebands. The sidebands are centered at 9.5 MHz and 10.5 MHz relative to the channel edge. The plots show -25 dBm/1 MHz and 9 kHz bandwidth markers. The text "X=Max {6MHz, EBW}" is present.</p>	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "NIT" denotes "not tested".

## 1.10 Band41 (2496-2690 MHz paired with 2496-2690 MHz)

Test Item	FCC Rule No.	Requirements	Test Result	Verdict (Note1)
Effective (Isotropic) Radiated Power Output Data	§2.1046, §27.50(h)	EIRP $\leq$ 2W	Appendix A	Pass
Peak-Average Ratio	§27.50(a)	Limit $\leq$ 13 dB	Appendix B	Pass
Modulation Characteristics	§2.1047	Digital modulation	Appendix C	Pass
Bandwidth	§2.1049	OBW: No limit. EBW: No limit.	Appendix D	Pass
Band Edges Compliance	§2.1051, §27.53(m4)	<p>FCC/IC:</p> <p>2%*EBW Channel Edge</p> <p>5.5 MHz 4 MHz 5.5 MHz</p> <p>RBW <math>\geq</math> 2%*EBW</p> <p>X=Max {6MHz, EBW}</p> <p>2%*EBW Channel Edge</p> <p>5.5 MHz 4 MHz 5.5 MHz</p> <p>RBW <math>\geq</math> 2%*EBW</p> <p>X=Max {6MHz, EBW}</p>	Appendix E	Pass
Spurious Emission at Antenna Terminals	§2.1051, §27.53(m)	<p>Channel Edge</p> <p>-25 dBm/1 MHz</p> <p>9 kHz 9.5 MHz X MHz 10<sup>th</sup> harmonics</p> <p>X=Max {6MHz, EBW}</p>	Appendix F	Pass
Field Strength of Spurious Radiation	§2.1053, §27.53(m)	<p>Channel Edge</p> <p>-25 dBm/1 MHz</p> <p>9 kHz 9.5 MHz X MHz 10<sup>th</sup> harmonics</p> <p>X=Max {6MHz, EBW}</p>	Appendix G	Pass
Frequency Stability	§2.1055, §27.54	Within authorized bands of operation/frequency block.	Appendix H	Pass

Note1: For the verdict, the "N/A" denotes "not applicable", the "NIT" denotes "not tested".

## 2. General Description

### 2.1 Product Description

Venus 20-US-4G-PCIE-M2, Venus 20-CN-4G-NA-M2, and Venus 20-US-4G-NA-M2 are Engineering control equipments in the GSM/UMTS/LTE system. The GSM frequency band includes GSM850 and GSM900 and DCS1800 and PCS1900. but only GSM850/1900 test data included in this report. The UMTS frequency band are band I /II /IV/V/VI/VIII/XVIII, but only band II and Band IV and Band V test data included in this report. The LTE frequency band is Band I/II/III/IV /V/VII/VIII/XII/XIII/XVIII/XVII/XVIII/XX/XXV/XXVI/XXVIII/XXXVIII/XXXVII/XXXX/XXXXI, but only Band II/IV /V/VII/XII/XIII/XXV/XXVI/XXXVIII/XXXXI test data included in this report. The Engineering control equipments implements such functions as RF signal receiving/transmitting, LTE/UMTS and GPRS/EDGE protocol. Externally it provides micro SD card interface and USIM card interface. The EUT is powered by DC 12V/12.5A. For more detailed features description, please refer to the user's manual.

### 2.2 Test Facility

Company Name:	Beijing Tairuite Inspection&Testing Technology Service Co.,Ltd Shenzhen Branch
Address:	101, 3 # Factory Building, Gongjin Electronics, Shatin Community, Kengzi Street, Pingshan District, Shenzhen City,Guangdong province China
FCC Registration Number:	6049.01

### 2.3 Test Environment Condition

Ambient Temperature:	19.5 to 25 °C
Ambient Relative Humidity:	40 to 55 %
Atmospheric Pressure:	Not applicable

### 2.4 Sub-Assembly

Description	Manufacturer	Description
Power Adapter	MEAN WELL	Model: LRS-150-12 Input: 100-120V~ 3.0A 200-240V~ 1.7A Output: DC12V 12.5A

## 2.5 Technical Specification

Characteristics	Description	
Radio System Type	GSM UMTS LTE	
Supported Frequency Range	GSM850/ WCDMA850	Transmission (TX): 824 to 849 MHz Receiving (RX): 869 to 894 MHz
	GSM1900/ WCDMA1900	Transmission (TX): 1850 to 1910 MHz Receiving (RX): 1930 to 1990 MHz
	WCDMA1700	Transmission (TX): 1710 to 1755 MHz
		Receiving (RX): 2110 to 2155 MHz
	LTE BAND2	Transmission (TX): 1850 to 1910 MHz
		Receiving (RX): 1930 to 1990 MHz
	LTE BAND4	Transmission (TX): 1710 to 1755 MHz
		Receiving (RX): 2110 to 2155 MHz
	LTE BAND5	Transmission (TX): 824 to 849 MHz
		Receiving (RX): 869 to 894 MHz
	LTE BAND7	Transmission (TX): 2500 to 2570 MHz
		Receiving (RX): 2620 to 2690 MHz
	LTE BAND12	Transmission (TX): 699 to 716 MHz
		Receiving (RX): 729 to 746 MHz
	LTE BAND13	Transmission (TX): 777 to 787 MHz
		Receiving (RX): 746 to 756 MHz
	LTE BAND25	Transmission (TX): 1850 to 1915 MHz
		Receiving (RX): 1930 to 1995 MHz
	LTE BAND26(814-824 MHz)	Transmission (TX): 814 to 824 MHz
		Receiving (RX): 859 to 869 MHz
	LTE BAND26(824-849 MHz)	Transmission (TX): 824 to 849 MHz
		Receiving (RX): 869 to 894 MHz
	LTE BAND38	Transmission (TX): 2570 to 2620 MHz
		Receiving (RX): 2570 to 2620 MHz
	LTE BAND41	Transmission (TX): 2496 to 2690 MHz
		Receiving (RX): 2496 to 2690 MHz
TX and RX Antenna Ports	TX & RX port:	1
	TX-only port:	0
	RX-only port:	1
Target TX Output Power	GSM850: 30dBm GSM1900: 30dBm UMTS850: 25dBm UMTS1900: 25dBm UMTS1700: 25dBm LTE BAND2: 25dBm LTE BAND4: 25dBm LTE BAND5: 25dBm LTE BAND7: 25dBm LTE BAND12: 25dBm LTE BAND13: 25dBm LTE BAND25: 25dBm LTE BAND26(814-824MHz): 25dBm LTE BAND26(824-849MHz): 25dBm LTE BAND38: 25dBm LTE BAND41: 25dBm	
Antenna Gain:	GSM850: 4.04dBi GSM1900: 3.14dBi UMTS850: 4.04dBi UMTS1900: 3.14dBi UMTS1700: 3.75dBi LTE BAND2: 3.14dBi LTE BAND4: 3.75dBi LTE BAND5: 4.04dBi LTE BAND7: 4.79dBi LTE BAND12: 2.82dBi LTE BAND13: 3.80dBi	

Characteristics	Description	
	LTE BAND25: 3.21dBi LTE BAND26(814-824MHz):3.80dBi LTE BAND26(824-849MHz):4.04dBi LTE BAND38: 4.40dBi LTE BAND41: 4.79dBi	
Supported Channel Bandwidth	GSM system:	200 kHz
	UMTS system:	5 MHz
	LTE band 2	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
	LTE band 4	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
	LTE band 5	1.4 MHz, 3 MHz, 5 MHz, 10 MHz
	LTE band 7	5MHz, 10MHz, 15MHz, 20MHz
	LTE band 12	1.4 MHz, 3 MHz, 5 MHz, 10 MHz
	LTE band 13	5 MHz, 10 MHz
	LTE band 25	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz
	LTE BAND26(814-824 MHz)	1.4 MHz, 3 MHz, 5 MHz, 10 MHz
	LTE BAND26(824-849 MHz)	1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz,
	LTE BAND38	5MHz, 10MHz, 15MHz, 20MHz
	LTE BAND41	5MHz, 10MHz, 15MHz, 20MHz
(Note: the necessary bandwidth of which is the worst value from the measured occupied bandwidths for each type of channel bandwidth configuration.)	GSM850:	246KGXW, 249KG7W
	GSM1900:	244KGXW, 245KG7W
	UMTS1900:	4M12F9W
	UMTS1700:	4M13F9W
	UMTS850:	4M14F9W
	LTE BAND2:	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M70W7D (3 MHz 16QAM modulation) 4M50G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M96G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation) 13M45G7D (15 MHz QPSK modulation), 13M43W7D (15 MHz 16QAM modulation) 17M92G7D (20 MHz QPSK modulation), 17M92W7D (20 MHz 16QAM modulation)
	LTE BAND4:	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M69W7D (3 MHz 16QAM modulation) 4M50G7D (5 MHz QPSK modulation), 4M50W7D (5 MHz 16QAM modulation) 8M96G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation) 13M44G7D (15 MHz QPSK modulation), 13M43W7D (15 MHz 16QAM modulation) 17M91G7D (20 MHz QPSK modulation), 17M92W7D (20 MHz 16QAM modulation)
	LTE BAND5:	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M70W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M97G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation)
	LTE BAND7:	4M50G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation)

Characteristics	Description
	8M97G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation) 13M44G7D (15 MHz QPSK modulation), 13M43W7D (15 MHz 16QAM modulation) 17M91G7D (20 MHz QPSK modulation), 17M90W7D (20 MHz 16QAM modulation)
LTE BAND12:	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M69W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M97G7D (10 MHz QPSK modulation), 8M97W7D (10 MHz 16QAM modulation)
LTE BAND13:	4M50G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M97G7D (10 MHz QPSK modulation), 8M98W7D (10 MHz 16QAM modulation)
LTE BAND25:	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M69W7D (3 MHz 16QAM modulation) 4M50G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M98G7D (10 MHz QPSK modulation), 8M97W7D (10 MHz 16QAM modulation) 13M45G7D (15 MHz QPSK modulation), 13M44W7D (15 MHz 16QAM modulation) 17M92G7D (20 MHz QPSK modulation), 17M91W7D (20 MHz 16QAM modulation)
LTE BAND26(814-824 MHz) :	1M09G7D (1.4 MHz QPSK modulation), 1M09W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M70W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M97G7D (10 MHz QPSK modulation), 8M97W7D (10 MHz 16QAM modulation)
LTE BAND26(824-849 MHz) :	1M10G7D (1.4 MHz QPSK modulation), 1M10W7D (1.4 MHz 16QAM modulation) 2M70G7D (3 MHz QPSK modulation), 2M70W7D (3 MHz 16QAM modulation) 4M51G7D (5 MHz QPSK modulation), 4M51W7D (5 MHz 16QAM modulation) 8M98G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation) 13M47G7D (15 MHz QPSK modulation), 13M45W7D (15 MHz 16QAM modulation)
LTE BAND38 :	4M51G7D (5 MHz QPSK modulation), 4M50W7D (5 MHz 16QAM modulation) 8M96G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation) 13M45G7D (15 MHz QPSK modulation), 13M46W7D (15 MHz 16QAM modulation) 17M91G7D (20 MHz QPSK modulation), 17M89W7D (20 MHz 16QAM modulation)
LTE BAND41 :	4M50G7D (5 MHz QPSK modulation), 4M50W7D (5 MHz 16QAM modulation)

Characteristics	Description
	8M97G7D (10 MHz QPSK modulation), 8M96W7D (10 MHz 16QAM modulation) 13M45G7D (15 MHz QPSK modulation), 13M43W7D (15 MHz 16QAM modulation) 17M90G7D (20 MHz QPSK modulation), 17M89W7D (20 MHz 16QAM modulation)

### 3. General Test Conditions/Configuration

#### 3.1 Test Modes

Test Mode	Test Modes Description
GSM/TM1	GSM system, GPRS, GMSK modulation
GSM/TM2	GSM system, EDGE, 8PSK modulation
UMTS/TM1	WCDMA system, QPSK modulation
UMTS/TM2	HSDPA system, QPSK modulation
UMTS/TM3	HSUPA system, QPSK modulation
LTE/TM1	LTE system, QPSK modulation
LTE/TM2	LTE system, 16QAM modulation

#### 3.2 Test Environment

Environment Parameter	Selected Values During Tests	
Relative Humidity	Ambient	
Temperature	TN	Ambient
Voltage	VL	10.2V
	VN	12.0V
	VH	13.8V

NOTE: VL= lower extreme test voltage, VN= nominal voltage, VH= upper extreme test voltage

TN= normal temperature

#### 3.3 Test Frequency

Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
GSM850	TX	Channel 128	Channel 190	Channel 251
		824.2MHz	836.6MHz	848.8MHz
	RX	Channel 128	Channel 190	Channel 251
		869.2MHz	881.6MHz	893.8MHz
WCDMA850	TX	Channel 4132	Channel 4182	Channel 4233
		826.4MHz	836.4MHz	846.6MHz
	RX	Channel 4357	Channel 4407	Channel 4458
		871.4MHz	881.4MHz	891.6MHz
Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
GSM1900	TX	Channel 512	Channel 661	Channel 810
		1850.2MHz	1880.0MHz	1909.8MHz
	RX	Channel 512	Channel 661	Channel 810
		1930.2 MHz	1960.0 MHz	1989.8 MHz
WCDMA1900	TX	Channel 9262	Channel 9400	Channel 9538
		1852.4MHz	1880.0MHz	1907.6MHz
	RX	Channel 9662	Channel 9800	Channel 9938
		1932.4 MHz	1960.0 MHz	1987.6 MHz

Test Mode	TX / RX	RF Channel		
		Low (L)	Middle (M)	High (H)
WCDMA1700	TX	Channel1312	Channel1413	Channel1513
		1712.4MHz	1732.6MHz	1752.6MHz
	RX	Channel 1537	Channel 1638	Channel 1738
		2112.4 MHz	2132.6 MHz	2152.6 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 2	TX(1.4M)	Channel 18607	Channel 18900	Channel 19193
		1850.7 MHz	1880 MHz	1909.3 MHz
	TX(3M)	Channel 18615	Channel 18900	Channel 19185
		1851.5 MHz	1880 MHz	1908.5 MHz
	TX(5M)	Channel 18625	Channel 18900	Channel 19175
		1852.5 MHz	1880 MHz	1907.5 MHz
	TX(10M)	Channel 18650	Channel 18900	Channel 19150
		1855 MHz	1880 MHz	1905 MHz
	TX(15M)	Channel 18675	Channel 18900	Channel 19125
		1857.5 MHz	1880 MHz	1902.5 MHz
	TX(20M)	Channel 18700	Channel 18900	Channel 19100
		1860 MHz	1880 MHz	1900 MHz
	RX(1.4M)	Channel 607	Channel 900	Channel 1193
		1930.7 MHz	1960 MHz	1989.3 MHz
	RX(3M)	Channel 615	Channel 900	Channel 1185
		1931.5 MHz	1960 MHz	1988.5 MHz
	RX(5M)	Channel 625	Channel 900	Channel 1175
		1932.5 MHz	1960 MHz	1987.5 MHz
	RX(10M)	Channel 650	Channel 900	Channel 1150
		1935 MHz	1960 MHz	1985 MHz
	RX(15M)	Channel 675	Channel 900	Channel 1125
		1937.5 MHz	1960 MHz	1982.5 MHz
	RX(20M)	Channel 700	Channel 900	Channel 1100
		1940 MHz	1960 MHz	1980 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 4	TX(1.4M)	Channel 19957	Channel 20175	Channel 20393
		1710.7 MHz	1732.5 MHz	1754.3 MHz
	TX(3M)	Channel 19965	Channel 20175	Channel 20385
		1711.5 MHz	1732.5 MHz	1753.5 MHz
	TX(5M)	Channel 19975	Channel 20175	Channel 20375
		1712.5 MHz	1732.5 MHz	1752.5 MHz
	TX(10M)	Channel 20000	Channel 20175	Channel 20350
		1715 MHz	1732.5 MHz	1750 MHz
	TX(15M)	Channel 20025	Channel 20175	Channel 20325
		1717.5 MHz	1732.5 MHz	1747.5 MHz
	TX(20M)	Channel 20050	Channel 20175	Channel 20300
		1720 MHz	1732.5 MHz	1745 MHz
	RX(1.4M)	Channel 1975	Channel 2175	Channel 2375

	RX(3M)	2112.5 MHz	2132.5MHz	2152.5 MHz
		Channel 2000	Channel 2175	Channel 2350
		2115 MHz	2132.5MHz	2150 MHz
	RX(5M)	Channel 1975	Channel 2175	Channel 2375
		2112.5 MHz	2132.5MHz	2152.5 MHz
	RX(10M)	Channel 2000	Channel 2175	Channel 2350
		2115 MHz	2132.5MHz	2150 MHz
	RX(15M)	Channel 2025	Channel 2175	Channel 2325
		2117.5 MHz	2132.5MHz	2147.5 MHz
	RX(20M)	Channel 2050	Channel 2175	Channel 2300
		2120 MHz	2132.5MHz	2145 MHz
LTE Band 5	Test Mode	TX / RX	RF Channel	
			Low (B)	Middle (M)
			High (T)	
	TX(1.4M)	Channel 20407	Channel 20525	Channel 20643
		824.7 MHz	836.5 MHz	848.3 MHz
	TX(3M)	Channel 20415	Channel 20525	Channel 20635
		825.5 MHz	836.5 MHz	847.5 MHz
	TX(5M)	Channel 20425	Channel 20525	Channel 20625
		826.5 MHz	836.5 MHz	846.5 MHz
	TX(10M)	Channel 20450	Channel 20525	Channel 20600
		829 MHz	836.5 MHz	844 MHz
	RX(1.4M)	Channel 2407	Channel 2525	Channel 2643
		869.7 MHz	881.5 MHz	893.3 MHz
	RX (3M)	Channel 2415	Channel 2525	Channel 2635
		870.5 MHz	881.5 MHz	892.5 MHz
	RX(5M)	Channel 2425	Channel 2525	Channel 2625
		871.5 MHz	881.5 MHz	891.5 MHz
	RX (10M)	Channel 2450	Channel 2525	Channel 2600
		874 MHz	881.5 MHz	889 MHz
LTE Band 7	Test Mode	TX / RX	RF Channel	
			Low (B)	Middle (M)
			High (T)	
	TX (5M)	Channel 20775	Channel 21100	Channel 21425
		2502.5 MHz	2535 MHz	2567.5 MHz
	TX (10M)	Channel 20800	Channel 21100	Channel 21400
		2505 MHz	2535 MHz	2565 MHz
	TX (15M)	Channel 20825	Channel 21100	Channel 21375
		2507.5 MHz	2535 MHz	2562.5 MHz
	TX (20M)	Channel 20850	Channel 21100	Channel 21350
		2510 MHz	2535 MHz	2560 MHz
	RX (5M)	Channel 2775	Channel 3100	Channel 3425
		2622.5 MHz	2655 MHz	2687.5 MHz
	RX (10M)	Channel 2800	Channel 3100	Channel 3400
		2625 MHz	2655 MHz	2685 MHz
	RX (15M)	Channel 2825	Channel 3100	Channel 3375
		2627.5 MHz	2655 MHz	2682.5 MHz
	RX (20M)	Channel 2850	Channel 3100	Channel 3350
		2630 MHz	2655 MHz	2680 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 12	TX(1.4M)	Channel 23017	Channel 23095	Channel 23173
		699.7 MHz	707.5 MHz	715.3 MHz
	TX(3M)	Channel 23025	Channel 23095	Channel 23165
		700.5 MHz	707.5 MHz	714.5 MHz
	TX(5M)	Channel 23035	Channel 23095	Channel 23155
		701.5 MHz	707.5 MHz	713.5 MHz
	TX(10M)	Channel 23060	Channel 23095	Channel 23130
		704 MHz	707.5 MHz	711 MHz
	RX(1.4M)	Channel 5017	Channel 5095	Channel 5173
		729.7 MHz	737.5 MHz	745.3 MHz
	RX (3M)	Channel 5025	Channel 5095	Channel 5165
		730.5 MHz	737.5 MHz	744.5 MHz
	RX(5M)	Channel 5035	Channel 5095	Channel 5155
		731.5 MHz	737.5 MHz	743.5 MHz
	RX (10M)	Channel 5060	Channel 5095	Channel 5130
		734 MHz	737.5 MHz	741 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 13	TX (5M)	Channel 23205	Channel 23230	Channel 23255
		779.5 MHz	782 MHz	784.5 MHz
	TX (10M)	Channel 23230	Channel 23230	Channel 23230
		782 MHz	782 MHz	782 MHz
	RX (5M)	Channel 5205	Channel 5230	Channel 5255
		748.5 MHz	751 MHz	753.5 MHz
	RX (10M)	Channel 5230	Channel 5230	Channel 5230
		751 MHz	751 MHz	751 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 25	TX(1.4M)	Channel 26047	Channel 26365	Channel 26683
		1850.7 MHz	1882.5 MHz	1914.3 MHz
	TX(3M)	Channel 26055	Channel 26365	Channel 26675
		1851.5 MHz	1882.5 MHz	1913.5 MHz
	TX(5M)	Channel 26065	Channel 26365	Channel 26665
		1852.5 MHz	1882.5 MHz	1912.5 MHz
	TX(10M)	Channel 26090	Channel 26365	Channel 26640
		1855 MHz	1882.5 MHz	1910 MHz
	TX(15M)	Channel 26115	Channel 26365	Channel 26615
		1857.5 MHz	1882.5 MHz	1907.5 MHz
	TX(20M)	Channel 26140	Channel 26365	Channel 26590
		1860 MHz	1882.5 MHz	1905 MHz
	RX(1.4M)	Channel 8046	Channel 8365	Channel 8683
		1930.7 MHz	1962.5MHz	1994.3 MHz
	RX(3M)	Channel 8055	Channel 8365	Channel 2675
		1931.5 MHz	1962.5MHz	1993.5 MHz
	RX(5M)	Channel 8065	Channel 8365	Channel 8665

	RX(10M)	1932.5 MHz	1962.5MHz	1992.5 MHz
		Channel 8090	Channel 8365	Channel 8640
		1935 MHz	1962.5MHz	1990 MHz
	RX(15M)	Channel 8115	Channel 8365	Channel 8615
		1937.5 MHz	1962.5MHz	1987.5 MHz
	RX(20M)	Channel 8140	Channel 8365	Channel 8590
		1940 MHz	1962.5MHz	1985 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 26 (814-824MHz)	TX(1.4M)	Channel 26697	Channel 26740	Channel 26783
		814.7 MHz	819 MHz	823.3 MHz
	TX(3M)	Channel 26705	Channel 26740	Channel 26775
		815.5 MHz	819 MHz	822.5 MHz
	TX(5M)	Channel 26715	Channel 26740	Channel 26765
		816.5 MHz	819 MHz	821.5 MHz
	TX(10M)	Channel 26740	Channel 26740	Channel 26740
		819 MHz	819 MHz	819 MHz
	RX(1.4M)	Channel 8697	Channel 8740	Channel 8783
		859.7 MHz	864 MHz	868.3 MHz
	RX (3M)	Channel 8705	Channel 8740	Channel 8775
		860.5 MHz	864 MHz	867.5 MHz
	RX(5M)	Channel 8715	Channel 8740	Channel 8755
		861.5 MHz	864 MHz	866.5 MHz
	RX (10M)	Channel 8740	Channel 8740	Channel 8740
		864 MHz	864 MHz	864 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 26 (824-849MHz)	TX(1.4M)	Channel 26797	Channel 26915	Channel 27033
		824.7 MHz	836.5 MHz	848.3 MHz
	TX(3M)	Channel 26805	Channel 26915	Channel 27025
		825.5 MHz	836.5 MHz	847.5 MHz
	TX(5M)	Channel 26815	Channel 26915	Channel 27015
		826.5 MHz	836.5 MHz	846.5 MHz
	TX(10M)	Channel 26840	Channel 26915	Channel 26990
		829 MHz	836.5 MHz	844 MHz
	TX(15M)	Channel 26865	Channel 26915	Channel 26965
		831.5 MHz	836.5 MHz	841.5 MHz
	RX(1.4M)	Channel 2407	Channel 8915	Channel 9033
		869.7 MHz	881.5 MHz	893.3 MHz
	RX (3M)	Channel 2415	Channel 8915	Channel 9025
		870.5 MHz	881.5 MHz	892.5 MHz
	RX(5M)	Channel 2425	Channel 8915	Channel 9015
		871.5 MHz	881.5 MHz	891.5 MHz
	RX (10M)	Channel 2450	Channel 8915	Channel 8990
		874 MHz	881.5 MHz	889 MHz
	RX (15M)	Channel 20450	Channel 8915	Channel 8965
		829 MHz	881.5 MHz	886.5 MHz

Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 38	TX/RX (5M)	Channel 37775 2572.5 MHz	Channel 38000 2595 MHz	Channel 38225 2617.5 MHz
	TX/RX (10M)	Channel 37800 2575 MHz	Channel 38000 2595 MHz	Channel 38200 2615 MHz
	TX/RX (15M)	Channel 37825 2577.5 MHz	Channel 38000 2595 MHz	Channel 38175 2612.5 MHz
	TX/RX (20M)	Channel 37850 2580 MHz	Channel 38000 2595 MHz	Channel 38150 2610 MHz
Test Mode	TX / RX	RF Channel		
		Low (B)	Middle (M)	High (T)
LTE Band 41	TX/RX (5M)	Channel 39675 2498.5 MHz	Channel 40620 2593 MHz	Channel 41565 2687.5 MHz
	TX/RX (10M)	Channel 39700 2501 MHz	Channel 40620 2593 MHz	Channel 41540 2685 MHz
	TX/RX (15M)	Channel 39725 2503.5 MHz	Channel 40620 2593 MHz	Channel 41515 2682.5 MHz
	TX/RX (20M)	Channel 39750 2506 MHz	Channel 40620 2593 MHz	Channel 41490 2680 MHz

## 4. DESCRIPTION OF TESTS

### 4.1 Radiated Power and Radiated Spurious Emissions

Radiated spurious emissions are investigated indoors in a semi-anechoic chamber to determine the frequencies producing the worst case emissions. Final measurements for radiated power and radiated spurious emissions are performed on the 3 meter OATS per the guidelines of ANSI/TIA-603-C-2004. The equipment under test was transmitting while connected to its integral antenna and is placed on a wooden turntable 80cm above the ground plane and 3 meters from the receive antenna. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic. The receive antenna height is adjusted between 1 and 4 meter height, the turntable is rotated through 360 degrees, and the EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest reading on the receive spectrum analyzer. Emissions are also investigated with the receive antenna horizontally and vertically polarized.

A portable or small unlicensed wireless device shall be placed on a non-metallic test fixture or other non-metallic support during testing. The supporting fixture shall permit orientation of the EUT in each of three orthogonal (x, y, z) axis positions such that emissions from the EUT are maximized. Measure the EUT maximum RF power and record the result.

A half-wave dipole is then substituted in place of the EUT. For emissions above 3GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator with the level of the signal generator being adjusted to obtain the same receive spectrum analyzer level previously recorded from the spurious emission from the EUT.

The power of the emission is calculated using the following formula:

$$P_d \text{ [dBm]} = P_g \text{ [dBm]} - \text{cable loss [dB]} + \text{antenna gain [dBd/dBi]}$$

Where,  $P_d$  is the dipole equivalent power,  $P_g$  is the generator output into the substitution antenna, and the antenna gain is the gain of the substitute antenna used relative to either a half-wave dipole (dBd) or an isotropic source (dBi). The substitute level is equal to  $P_g$  [dBm] – cable loss [dB].

The calculated  $P_d$  levels are then compared to the absolute spurious emission limit of -13dBm which is equivalent to the required minimum attenuation of  $43 + 10\log_{10}(\text{Power [Watts]})$ .

#### Test Procedures Used

KDB 971168 v02r02-Section 5.2.1 / KDB 971168 v02R02-Section 5.8

ANSI/TIA-603-C-2004-Section 2.2.17 / ANSI/TIA-603-C-2004-Section 2.2.12

Note: Reference test setup 3

## 4.2 Peak-Average Ratio

A peak to average ratio measurement is performed at the conducted port of the EUT. For WCDMA signals, the spectrum analyzers Complementary Cumulative Distribution Function (CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The percent of time the signal spends at or above the level defines the probability for that particular power level. For GSM signals, an average and a peak trace are used on a spectrum analyzer to determine the largest deviation between the average and the peak power of the EUT in a bandwidth greater than the emission bandwidth. The traces are generated with the spectrum analyzer set to zero span mode.

### **Test Procedures Used**

KDB 971168 v02r02-Section 5.7.1

### **Test Settings**

1. The signal analyzer's CCDF measurement profile enabled
2. Frequency= carrier center frequency
3. Measurement BW > EBW of signal
4. for continuous transmissions, set to 1ms
5. Record the maximum PAPR level associated with a probability of 0.1%. Note: Reference test setup 1

## 4.3 Occupied Bandwidth

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual. The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded. The span between the two recorded frequencies is the occupied bandwidth.

### Test Procedures Used

KDB 971168 v02r02-Section 4.2

### Test Settings

1. SET RBW=1-5% of OBW
2. SET VBW  $\geq$  3\*RBW
3. Detector: Peak
4. Trace mode= max hold.
5. Sweep= auto couple
6. Steps 1-5 were repeated after it is stable

Note: Reference test setup 1.

## 4.4 Band Edge Compliance

the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission power must be attenuated below the transmitting power (P) by a factor of at least  $43+10\log_{10}P$  dB.

### Test Procedures Used

KDB 971168 v02r02-Section 6.0

### Test Settings

1. SET RBW  $\geq$  1% of Emission BW.
2. SET VBW about three times of RBW
3. Detector: RMS
4. Trace mode= max hold.
5. Span= 2MHz

Note: Reference test setup 1.

## 4.5 Spurious and Harmonic Emissions at Antenna Terminal

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10<sup>th</sup> harmonic. On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least

$43 + 10 \log(P)$  dB. Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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 emission are attenuated at least 26 dB below the transmitter power.

### Test Procedures Used

KDB 971168 v02r02-Section 6.0

### Test Settings

1. 9kHz~150kHz, RBW = 1KHz, VBW  $\geq 3 \times$  RBW,  
150kHz~30MHz, RBW = 10KHz, VBW  $\geq 3 \times$  RBW,  
30MHz~1GHz, RBW = 100 kHz, VBW = 300 kHz.  
Above 1GHz, RBW = 1 MHz, VBW = 3 MHz.
2. Detector: Peak
3. Trace mode= max hold.

Note: Reference test setup 1.

## 4.6 Frequency Stability / Temperature Variation

Frequency stability testing is performed in accordance with the guidelines of ANSI/TIA-603-C-2004. The frequency stability of the transmitter is measured by:

- a.) **Temperature:** The temperature is varied from -20°C to +60°C in 10°C increments using an environmental chamber.
- b.) **Primary Supply Voltage:** The primary supply voltage is varied from 85% to 115% of the nominal value for non hand-carried battery and AC powered equipment. For hand-carried, battery-powered equipment, primary supply voltage is reduced to the battery operating end point which shall be specified by the manufacturer.

Specification – The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within  $\pm 0.00025\%$  ( $\pm 2.5 \text{ ppm}$ ) of the center frequency.

**Time Period and Procedure:**

1. The carrier frequency of the transmitter is measured at room temperature (20°C to provide a reference).
2. The equipment is turned on in a “standby” condition for fifteen minutes before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -20°C to +60°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

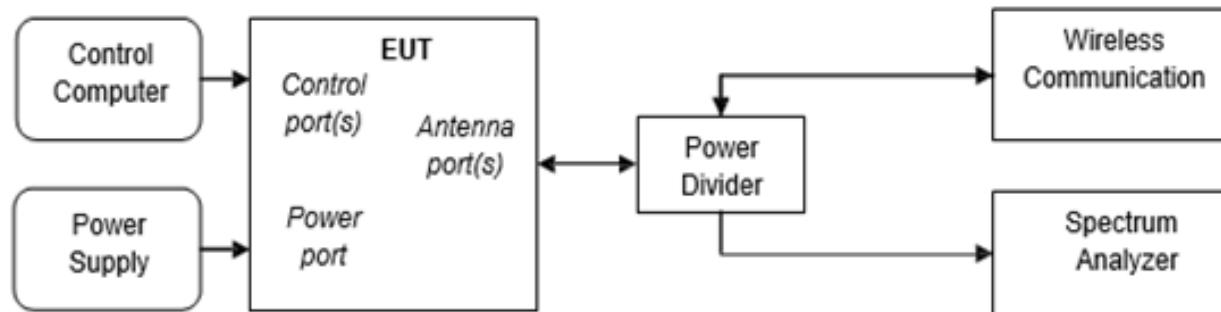
**Test Procedures Used**

ANSI/TIA-603-C-2004

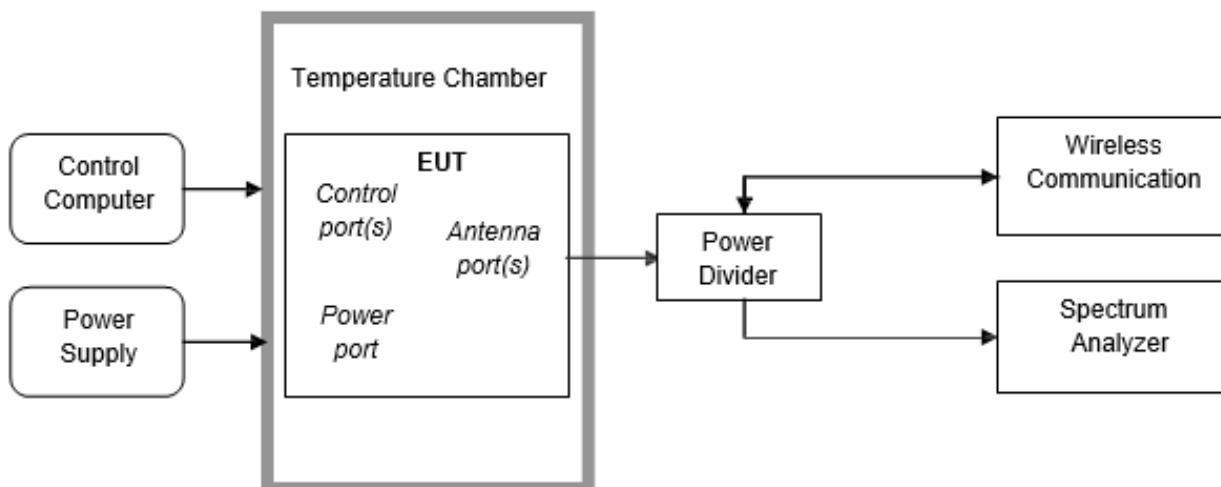
Note: Reference test setup 2.

## 5. Test Setups

### 5.1 Test Setup 1



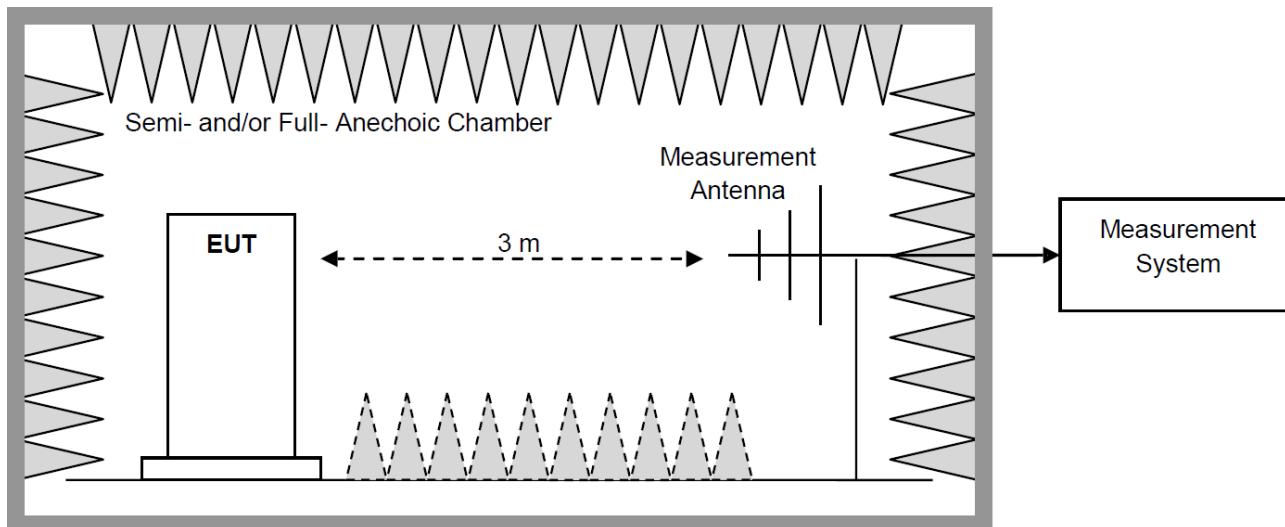
### 5.2 Test Setup 2



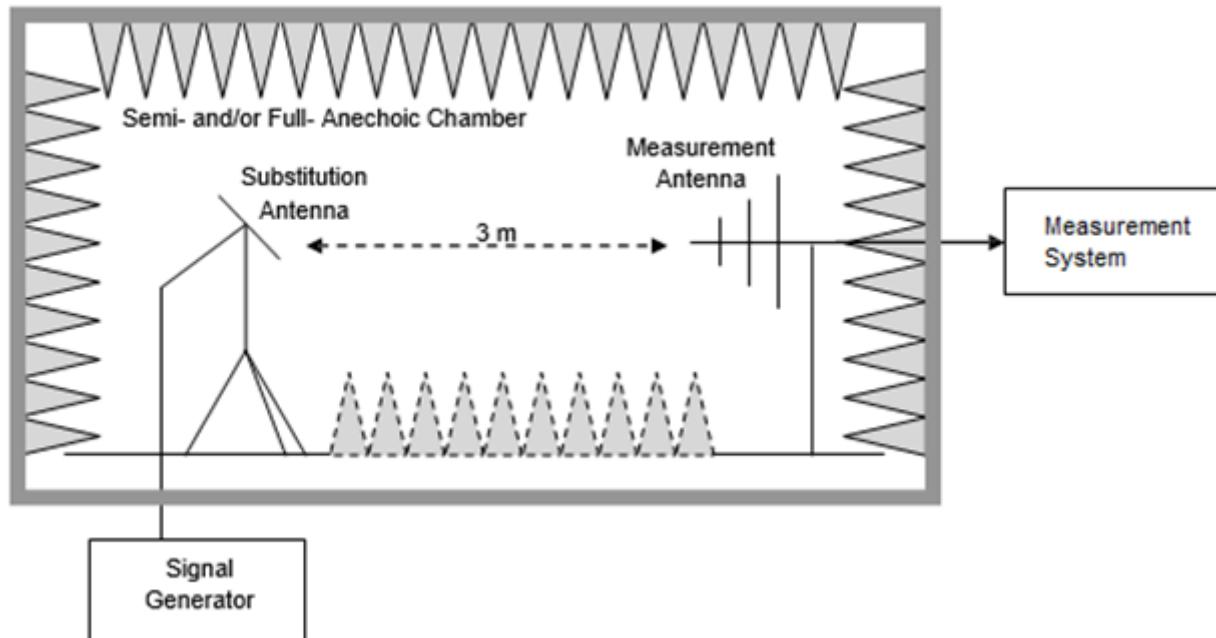
## 5.3 Test Setup 3

NOTE: Effective radiated power (ERP) and Equivalent Isotropic Radiated Power (EIRP) refers to the radiation power output of the EUT, assuming all emissions are radiated from half-wave dipole antennas.

### 5.3.1 Step 1: Pre-test



### 5.3.2 Step 2: Substitution method to verify the maximum ERP/EIRP



## 5.4 Test Conditions

Test Case		Test Conditions		
Transmit Output Power Data	Average Power, Total	Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1, LTE/TM1, LTE/TM2	
	Average Power, Spectral Density (if required)	Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1, LTE/TM1,LTE/TM2	
Peak-to-Average Ratio (if required)		Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1, LTE/TM1,LTE/TM2	
Modulation Characteristics		Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	M (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1, LTE/TM1,LTE/TM2	
Bandwidth	Occupied Bandwidth	Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1, LTE/TM1,LTE/TM2	
	Emission Bandwidth (if required)	Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2	
Band Edges Compliance		Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2	
Spurious Emission at Antenna Terminals		Test Env.	Ambient Climate & Rated Voltage	
		Test Setup	Test Setup 1	
		RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)	
		Test Mode	GSM/TM1,GSM/TM2,UMTS/TM1,LTE/TM1,LTE/TM2	

Test Case	Test Conditions	
Field Strength of Spurious Radiation	Test Env.	Ambient Climate & Rated Voltage
	Test Setup	Test Setup 3
	Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1/TM2/TM3, LTE/TM1, LTE/TM2 NOTE: If applicable, the EUT conf. that has maximum power density (based on the equivalent power level) is selected.
	RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
Frequency Stability	Test Env.	(1) 0 °C to +50 °C with step 10 °C at Rated Voltage; (2) VL, VN and VH of Rated Voltage at Ambient Climate.
	Test Setup	Test Setup 2
	RF Channels (TX)	L, M, H (L= low channel, M= middle channel, H= high channel)
	Test Mode	GSM/TM1, GSM/TM2, UMTS/TM1, LTE/TM1, LTE/TM2

## 6. Main Test Instruments

Main Test Equipment					
Equip No.	Equipment Name	Manufacturer	Model	Cal Date	Cal- Due
JL 290	DC Power Supply	Keysight	E3642A	2021-09-02	2022-09-01
JL 107	Wideband Radio Communication Tester	R & S	CMW 500	2021-01-05	2022-01-04
JL 292	Wideband Radio Communication Tester	R & S	CMW 500	2021-09-02	2022-09-01
JL 265	MXA Signal Analyzer	Keysight	N9020B	2021-03-17	2022-03-16
JL 222	Programmable Temperature & Humidity Chamber	ETMOA	NTH1100-30A	2021-05-22	2022-05-21
JL 253	Temperature&Humidity Recorder	Anymetre	JR900	2021-01-06	2022-01-05
JL 199	Integral Antenna	SCHWARZBECK	VULB9163	2021-09-02	2022-09-01
JL 200	Loop Antenna	SCHWARZBECK	FMZB1519B	2021-09-02	2022-09-01
JL 198	Horn Antenna	SCHWARZBECK	BBHA 9170	2021-09-02	2022-09-01
JL 102	Double Ridged Broadband Horn Antenna	SCHWARZBECK	BBHA 9120D	2021-09-02	2022-09-01
JL 207	Spectrum Analyzer	R & S	FSV30	2021-03-17	2022-03-16
JL 092	EMI Receiver	R & S	ESR	2021-03-17	2022-03-16
JL 108	Broadband amplifier	SCHWARZBECK	BBV9718	2021-09-02	2022-09-01
JL 196	Broadband amplifier	SCHWARZBECK	BBV9721	2021-09-02	2022-09-01
JL 246	Anechoic Chamber	ZHONGSHUO	FSAC318	2021-07-18	2024-07-16
JL 212	RF Cable	Top Precision	BLU18A-Sm-2m	2021-09-02	2022-09-01
JL 213	RF Cable	Top Precision	BLU18A-Sm-2m	2021-09-02	2022-09-01
JL 245	RF Cable	ZDECL	ZT40-2.92J-6M	2021-09-02	2022-09-01
JL 294	Band Reject Filter Group	Tonscend	JS0806-F	NA	NA

Software Information			
Test Item	Software Name	Manufacturer	Version
RSE	EZ-EMC	EZ-EMC	TW-03A2
Conducted RF	JS1120 RF Test System	Shenzhen JS tonscrend co., Ltd	2.6.9.0826

## 7. Measurement Uncertainty

For a 95% confidence level ( $k = 2$ ), the measurement expanded uncertainties for defined systems, in accordance with

the recommendations of ISO 17025 as following:

Test Item		Extended Uncertainty
Transmit Output Power Data	Power [dBm]	$U = 0.42$ dB
Bandwidth	Magnitude [%]	$U = 0.12\%$
Band Edge Compliance	Disturbance Power [dBm]	$U = 1.24$ dB
Spurious Emissions, Conducted	Disturbance Power [dBm]	$U = 1.78$ dB
Field Strength of Spurious Radiation	ERP [dBm]	For 3 m Chamber: $U = 4.86$ dB (30 MHz to 26.5GHz)
Frequency Stability	Frequency Accuracy [ppm]	$U = 0.012$ ppm

## 8. Appendixes

Appendix No.	Description
211110029SZN-001-Appendix A	Appendix for GSM
211110029SZN-001-Appendix B	Appendix for WCDMA
211110029SZN-001-Appendix C	Appendix for LTE B2
211110029SZN-001-Appendix D	Appendix for LTE B4
211110029SZN-001-Appendix E	Appendix for LTE B5
211110029SZN-001-Appendix F	Appendix for LTE B7
211110029SZN-001-Appendix G	Appendix for LTE B12
211110029SZN-001-Appendix H	Appendix for LTE B13
211110029SZN-001-Appendix I	Appendix for LTE B25
211110029SZN-001-Appendix J	Appendix for LTE B26 (814-824MHz)
211110029SZN-001-Appendix K	Appendix for LTE B26 (824-849MHz)
211110029SZN-001-Appendix L	Appendix for LTE B38
211110029SZN-001-Appendix M	Appendix for LTE B41

\*\*\*\*\*End of Report\*\*\*\*\*