

FCC RF Test Report

(LTE)

Report No.: JYTSZ-R12-2401065

Applicant: ZillionSource Technologies (Shanghai) Co., Ltd.

Address of Applicant: Room 2207A, 28 Magi Road, China (Shanghai) Pilot Free Trade Zone

Equipment Under Test (EUT)

Product Name: Environmental variable collector for logistics

Model No.: ZT-28S, ZT-28SE, ZT-28S01, ZT-28S02, ZT-28S03, ZT-28L

Trade Mark: ZillionTrace/UBITracer

FCC ID: 2ACRJ-ZT-28S

Applicable Standards: FCC CFR Title 47 Part 2, 27L & H

Date of Sample Receipt: 02 Sep., 2024

Date of Test: 03 Sep., to 10 Sep., 2024

Date of Report Issued: 10 Sep., 2024

Test Result: PASS

Tested by:

Wen Zhang
Project Engineer

W. Zhang
Senior Engineer

James Wei
Manager

Date:

10 Sep., 2024

Reviewed by:

Date:

10 Sep., 2024

Approved by:

Date:

10 Sep., 2024

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in above the application standard version. Test results reported herein relate only to the item(s) tested.

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1 Version

Version No.	Date	Description
00	10 Sep., 2024	Original

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3 General Information

3.1 Client Information

Applicant:	ZillionSource Technologies (Shanghai) Co., Ltd.
Address:	Room 2207A, 28 Magi Road, China (Shanghai) Pilot Free Trade Zone
Manufacturer:	ZillionSource Technologies (Shanghai) Co., Ltd.
Address:	Room 2207A, 28 Magi Road, China (Shanghai) Pilot Free Trade Zone

3.2 General Description of E.U.T.

Product Name:	Environmental variable collector for logistics		
Model No.:	ZT-28S, ZT-28SE, ZT-28S01, ZT-28S02, ZT-28S03, ZT-28L		
Operation Frequency Range:	LTE band 4:	Tx: 1710 MHz - 1755 MHz Rx: 2110 MHz - 2155 MHz	
	LTE band 12:	Tx: 699 MHz - 716 MHz Rx: 729 MHz - 746 MHz	
Modulation Type:	☒ QPSK ☒ 16QAM ☐ 64QAM		
LTE Category:	1bis		
Antenna Type:	Internal Antenna		
Antenna Gain:	LTE band 4:	-0.12 dBi (declare by Applicant)	
	LTE band 12:	-6.39 dBi (declare by Applicant)	
Power Supply:	Rechargeable Li-ion Battery DC3.7V, 1000mAh		
Test Sample Condition:	The test samples were provided in good working order with no visible defects.		
Remark:	Model No.: ZT-28S, ZT-28SE, ZT-28S01, ZT-28S02, ZT-28S03, ZT-28L were identical inside, the electrical circuit design, layout, components used and internal wiring, with only difference being model name.		

3.3 Test Mode and Environment

Test Mode:	
QPSK mode:	Keep the EUT communication with simulated station in QPSK mode
16QAM mode:	Keep the EUT communication with simulated station in 16QAM mode
Remark: 1. The EUT has been tested under continuous transmitting mode. Channel Low, Mid and High for each type band with rated data rate were chosen for full testing. The field strength of spurious radiation emission was measured as EUT stand-up position (H mode) and lie down position (E1, E2 mode) for these modes. Just the worst case position (H mode) shown in report. 2. Only 27 Resource Blocks for 10MHz/15MHz/20MHz when the modulation is 16QAM.	
Operating Environment:	
Temperature:	Normal: 15°C ~ 35°C, Extreme: -30°C ~ +50°C
Humidity:	20 % ~ 75 % RH
Atmospheric Pressure:	1008 mbar
Voltage:	Nominal: 3.70 Vdc, Extreme: Low 3.50 Vdc, High 4.25 Vdc
Test Engineer:	LaoLu (Conducted measurement) Real Chen (Radiated measurement)

3.4 Description of Test Auxiliary Equipment

Test Equipment	Manufacturer	Model No.	Serial No.
Simulated Station	Anritsu	MT8820C	6201026545

3.5 Measurement Uncertainty

Parameter	Expanded Uncertainty (Confidence of 95%(U = 2Uc(y)))
Radiated Emission (30MHz ~ 200MHz) (3m SAC)	4.6 dB
Radiated Emission (200MHz ~ 1000MHz) (3m SAC)	5.8 dB
Radiated Emission (30MHz ~ 1GHz) (3m FAR)	3.43 dB
Radiated Emission (1GHz ~ 6GHz) (3m FAR)	4.95 dB
Radiated Emission (6GHz ~ 18GHz) (3m FAR)	5.23 dB
Radiated Emission (18GHz ~ 40GHz) (3m FAR)	5.32 dB
Note: All the measurement uncertainty value were shown with a coverage k=2 to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.	

3.6 Additions to, Deviations, or Exclusions from the Method

No

3.7 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations: ● FCC - Designation No.: CN1211 JianYan Testing Group Shenzhen Co., Ltd. has been accredited as a testing laboratory by FCC(Federal Communications Commission). The test firm Registration No. is 727551. ● ISED – CAB identifier.: CN0021 The 3m Semi-anechoic chamber and 10m Semi-anechoic chamber of JianYan Testing Group Shenzhen Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1. ● CNAS - Registration No.: CNAS L15527 JianYan Testing Group Shenzhen Co., Ltd. is accredited to ISO/IEC 17025:2017 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L15527. ● A2LA - Registration No.: 4346.01 This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: https://portal.a2la.org/scopepdf/4346-01.pdf
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3.8 Laboratory Location

JianYan Testing Group Shenzhen Co., Ltd.
Address: No.101, Building 8, Innovation Wisdom Port, No.155 Hongtian Road, Huangpu Community, Xinqiao Street, Bao'an District, Shenzhen, Guangdong, People's Republic of China.
Tel: +86-755-23118282, Fax: +86-755-23116366
Email: info-JYTee@lets.com, Website: <http://jyt.lets.com>

3.9 Test Instruments List

Radiated Emission(3m SAC):					
Test Equipment	Manufacturer	Model No.	Manage No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
3m SAC	ETS	9m*6m*6m	WXJ001-1	04-14-2021	04-13-2026
Loop Antenna	Schwarzbeck	FMZB 1519 B	WXJ002-4	01-05-2024	01-04-2025
BiConiLog Antenna	Schwarzbeck	VULB9163	WXJ002	01-09-2024	01-08-2025
Biconical Antenna	Schwarzbeck	VUBA9117	WXJ002-1	07-01-2024	06-30-2027
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-2	01-05-2024	01-04-2025
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-3	12-28-2023	12-27-2024
Horn Antenna	Schwarzbeck	BBHA9170	WXJ002-5	12-28-2023	12-27-2024
Horn Antenna	Schwarzbeck	BBHA9170	WXJ002-6	12-28-2023	12-27-2024
Pre-amplifier (30MHz ~ 1GHz)	Schwarzbeck	BBV9743B	WXJ001-2	12-27-2023	12-26-2024
Pre-amplifier (1GHz ~ 18GHz)	SKET	LNPA_0118G-50	WXJ001-3	12-27-2023	12-26-2024
Pre-amplifier (18GHz ~ 40GHz)	RF System	TRLA-180400G45B	WXJ002-7	12-28-2023	12-27-2024
EMI Test Receiver	Rohde & Schwarz	ESRP7	WXJ003-1	12-27-2023	12-26-2024
Spectrum Analyzer	Rohde & Schwarz	FSP 30	WXJ004	12-27-2023	12-26-2024
Spectrum Analyzer	KEYSIGHT	N9010B	WXJ004-2	09-25-2023	09-24-2024
Coaxial Cable (30MHz ~ 1GHz)	JYTSZ	JYT3M-1G-NN-8M	WXG001-4	01-17-2024	01-16-2025
Coaxial Cable (1GHz ~ 18GHz)	JYTSZ	JYT3M-18G-NN-8M	WXG001-5	01-17-2024	01-16-2025
Coaxial Cable (18GHz ~ 40GHz)	JYTSZ	JYT3M-40G-SS-8M	WXG001-7	01-17-2024	01-16-2025
Band Reject Filter Group	Tonscend	JS0806-F	WXJ089	N/A	
Test Software	Tonscend	TS+	Version: 3.0.0.1		

Radiated Emission(3m FAR):					
Test Equipment	Manufacturer	Model No.	Manage No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
3m FAR	YUNYI	9m*6m*6m	WXJ097	06-15-2023	06-14-2028
BiConiLog Antenna	Schwarzbeck	VULB9163	WXJ097-2	06-26-2024	06-25-2025
Biconical Antenna	Schwarzbeck	VUBA9117	WXJ002-1	07-01-2024	06-30-2027
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ097-3	06-16-2024	06-15-2025
Horn Antenna	Schwarzbeck	BBHA9120D	WXJ002-3	12-28-2023	12-27-2024
Horn Antenna	Schwarzbeck	BBHA9170	WXJ002-5	12-28-2023	12-27-2024
Horn Antenna	Schwarzbeck	BBHA9170	WXJ002-6	12-28-2023	12-27-2024
Pre-amplifier (30MHz ~ 1GHz)	YUNYI	PAM-310N	WXJ097-5	04-24-2024	04-23-2025
Pre-amplifier (1GHz ~ 18GHz)	YUNYI	PAM-118N	WXJ097-6	04-24-2024	04-23-2025
Pre-amplifier (18GHz ~ 40GHz)	RF System	TRLA-180400G45B	WXJ002-7	12-28-2023	12-27-2024
EMI Test Receiver	Rohde & Schwarz	ESCI3	WXJ003	12-27-2023	12-26-2024
Spectrum Analyzer	Rohde & Schwarz	FSP 30	WXJ004	12-27-2023	12-26-2024
Spectrum Analyzer	KEYSIGHT	N9010B	WXJ081-1	06-11-2024	06-10-2025
Coaxial Cable (30MHz ~ 1GHz)	JYTSZ	JYT3M-1G-NN-13M	WXG097-1	08-01-2023	07-31-2024
Coaxial Cable (1GHz ~ 18GHz)	JYTSZ	JYT3M-18G-NN-8M	WXG097-2	08-01-2023	07-31-2024
Coaxial Cable (18GHz ~ 40GHz)	JYTSZ	JYT3M-40G-SS-8M	WXG097-3	08-01-2023	07-31-2024
High Band Reject Filter Group	Tonscend	JS0806-F	WXJ089	N/A	
Low Band Reject Filter Group	Tonscend	JS0806-F	WXJ097-4	N/A	
Test Software	Tonscend	TS+	Version: 5.0.0		

Conducted Method:					
Test Equipment	Manufacturer	Model No.	Manage No.	Cal. Date (mm-dd-yy)	Cal. Due date (mm-dd-yy)
Spectrum Analyzer	Keysight	N9020A	WXJ094	09-25-2023	09-24-2024
Simulated Station	Rohde & Schwarz	CMW500	WXJ081	06-11-2024	06-10-2025
Temperature Humidity Chamber	ZHONG ZHI	CZ-A-80D	WXJ032-3	01-09-2023	01-08-2025
DC Power Supply	Keysight	E3642A	WXJ025-2	N/A	
RF Control Unit	Tonscend	JS0806-1	WXG010	N/A	
Band Reject Filter Group	Tonscend	JS0806-F	WXG010-1	N/A	
Test Software	Tonscend	TS+	Version: 2.6.9.0526		

4 Measurement Setup and Procedure

4.1 Test Channel

According to ANSI C63.26-2015 chapter 5.1.2.1 Table 2 requirement, select lowest channel, middle channel, and highest channel in the frequency range in which device operates for testing. The detailed frequency points are as follows:

LTE band 4					
Channels		Frequency (MHz)	Channels		Frequency (MHz)
1.4 MHz			3 MHz		
Lowest channel	19957	1710.7	Lowest channel	19965	1711.5
Middle channel	20175	1732.5	Middle channel	20175	1732.5
Highest channel	20393	1754.3	Highest channel	20385	1753.5
5 MHz			10 MHz		
Lowest channel	19975	1712.5	Lowest channel	20000	1715.0
Middle channel	20175	1732.5	Middle channel	20175	1732.5
Highest channel	20375	1752.5	Highest channel	20350	1750.0
15 MHz			20 MHz		
Lowest channel	20025	1717.5	Lowest channel	20050	1720.0
Middle channel	20175	1732.5	Middle channel	20175	1732.5
Highest channel	20325	1747.5	Highest channel	20300	1745.0

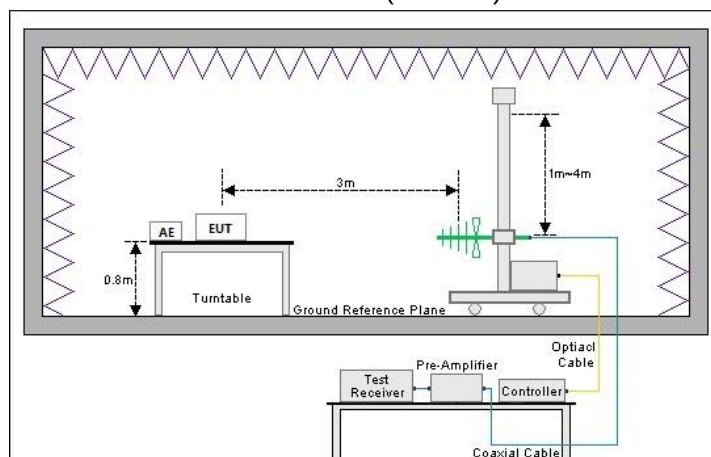
LTE band 12					
Channels		Frequency (MHz)	Channels		Frequency (MHz)
1.4 MHz			3 MHz		
Lowest channel	23017	699.70	Lowest channel	23025	700.50
Middle channel	23095	707.50	Middle channel	23095	707.50
Highest channel	23173	715.30	Highest channel	23165	714.50
5 MHz			10 MHz		
Lowest channel	23035	701.50	Lowest channel	23060	704.00
Middle channel	23095	707.50	Middle channel	23095	707.50
Highest channel	23155	713.50	Highest channel	23130	711.00

Note: Only 27 Resource Blocks for 10MHz/15MHz/20MHz when the modulation is 16QAM.

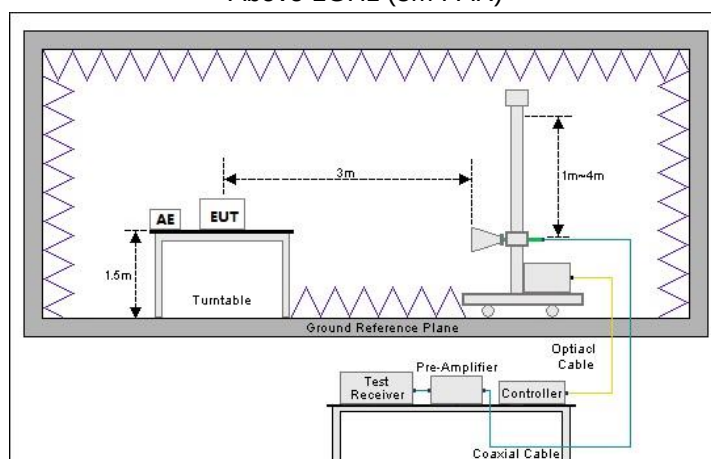
4.2 Test Setup

1) Radiated emission measurement:

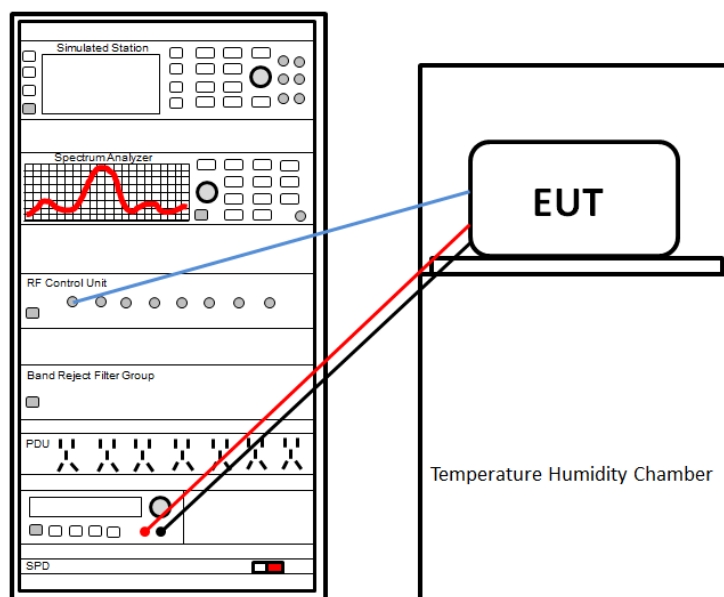
Below 1GHz (3m SAC)



Above 1GHz (3m FAR)



2) Conducted test method



4.3 Test Procedure

Test method	Test step
Radiated emission	For below 1GHz: 1. The EUT was placed on the tabletop of a rotating table 0.8 m the ground at a 3 m semi anechoic chamber. The measurement distance from the EUT to the receiving antenna is 3 m. 2. EUT works in each mode of operation that needs to be tested , and having the EUT continuously working, respectively on 3 axis (X, Y & Z) and considered typical configuration to obtain worst position. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations. 3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data. For above 1GHz: 1. The EUT was placed on the tabletop of a rotating table 1.5 m the ground at a 3 m fully anechoic room. The measurement distance from the EUT to the receiving antenna is 3 m. 2. EUT works in each mode of operation that needs to be tested , and having the EUT continuously working, respectively on 3 axis (X, Y & Z) and considered typical configuration to obtain worst position. The highest signal levels relative to the limit shall be determined by rotating the EUT from 0° to 360° and with varying the measurement antenna height between 1 m and 4 m in vertical and horizontal polarizations. 3. Open the test software to control the test antenna and test turntable. Perform the test, save the test results, and export the test data.
Conducted test method	1. The LTE antenna port of EUT was connected to the test port of the test system through an RF cable. 2. The EUT is keeping in continuous transmission mode and tested in all modulation modes. 3. Open the test software, prepare a test plan, and control the system through the software. After the test is completed, the test report is exported through the test software.

5 Test Results

5.1 Summary

5.1.1 Clause and Data Summary

Test items	Standard clause	Test data	Result
RF Exposure (SAR)	Part 1.1307 Part 2.1091	See Exposure Evaluation Report	Pass
RF Output Power	Part 2.1046 Part 27.50 (c)(10) Part 27.50 (d)(4)	Appendix A– LTE	Pass
Peak-to-Average Power Ratio	Part 24.232 (d) Part 27.50 (d)(5)	Appendix A– LTE	Pass
Modulation Characteristics	Part 2.1047	Appendix A– LTE	Pass
26dB Emission Bandwidth 99% Occupied Bandwidth	Part 2.1049	Appendix A– LTE	Pass
Out of Band Emission at Antenna Terminals	Part 2.1051 Part 27.53 (g) Part 27.53 (h)	Appendix A– LTE	Pass
Field Strength of Spurious Radiation	Part 2.1053 Part 27.53 (g) Part 27.53 (h)	See Section 5.2	Pass
Frequency Stability vs. Temperature	Part 2.1055 (a)(1)(b) Part 22.355 Part 24.235 Part 27.54	Appendix A– LTE	Pass
Frequency Stability vs. Voltage	Part 2.1055 (d)(2) Part 22.355 Part 24.235 Part 27.54	Appendix A– LTE	Pass
Remark: 1. Pass: The EUT complies with the essential requirements in the standard. 2. The cable insertion loss used by “RF Output Power” and other conduction measurement items is 0.5dB (Fundamental Frequency below 1GHz)/1.0dB (Fundamental Frequency above 1GHz) (provided by the customer).			
Test Method:	ANSI/TIA-603-E-2016 ANSI C63.26-2015		

5.1.2 Test Limit

Test items	Limit
RF Output Power	LTE band 4: 1W EIRP LTE band 12: 3W ERP
Peak-to-Average Power Ratio	LTE band 4/12: The peak-to-average ratio (PAR) of the transmission may not exceed 13 dB Other bands: N/A report only
Modulation Characteristics	N/A
26dB Emission Bandwidth 99% Occupied Bandwidth	N/A
Out of Band Emission at Antenna Terminals Field Strength of Spurious Radiation	LTE band 4, 12: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log(P)$ dB.
Frequency Stability vs. Temperature Frequency Stability vs. Voltage	LTE band 4, 12: The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

5.2 Field Strength of Spurious Radiation Measurement

Note: All bandwidths, modulation types and RB configurations were pretested, and it was found that minimum bandwidths, QPSK modulation and 1RB0 were the worst modes, and only the worst modes were reflected in the report.

LTE band 4 – 1.4 MHz bandwidth						
Lowest channel						
Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
3421.40	-53.57	-2.15	-55.72	-13.00	42.72	Vertical
5132.10	-65.55	3.80	-61.75	-13.00	48.75	Vertical
6842.80	-64.89	5.86	-59.03	-13.00	46.03	Vertical
3421.40	-51.74	-2.22	-53.96	-13.00	40.96	Horizontal
5132.10	-64.50	3.86	-60.64	-13.00	47.64	Horizontal
6842.80	-64.88	6.07	-58.81	-13.00	45.81	Horizontal
Middle channel						
Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
3465.00	-52.70	-2.54	-55.24	-13.00	42.24	Vertical
5197.50	-64.54	3.25	-61.29	-13.00	48.29	Vertical
6930.00	-64.36	5.20	-59.16	-13.00	46.16	Vertical
3465.00	-51.49	-2.54	-54.03	-13.00	41.03	Horizontal
5197.50	-63.54	3.17	-60.37	-13.00	47.37	Horizontal
6930.00	-63.89	5.17	-58.72	-13.00	45.72	Horizontal
Highest channel						
Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
3508.60	-53.47	-3.13	-56.60	-13.00	43.60	Vertical
5262.90	-64.61	3.11	-61.50	-13.00	48.50	Vertical
7017.20	-65.08	5.74	-59.34	-13.00	46.34	Vertical
3508.60	-51.56	-2.96	-54.52	-13.00	41.52	Horizontal
5262.90	-64.07	3.46	-60.61	-13.00	47.61	Horizontal
7017.20	-64.00	5.80	-58.20	-13.00	45.20	Horizontal
Remark:						
1. The emission levels of below 1 GHz are lower than the limit 10dB, so not show in test report.						

LTE band 12 – 1.4 MHz bandwidth						
Lowest channel						
Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
1399.40	-40.79	-11.68	-52.47	-13.00	39.47	Vertical
2099.10	-60.24	-9.89	-70.13	-13.00	57.13	Vertical
2798.80	-60.26	-7.09	-67.35	-13.00	54.35	Vertical
1399.40	-43.30	-11.43	-54.73	-13.00	41.73	Horizontal
2099.10	-60.40	-9.44	-69.84	-13.00	56.84	Horizontal
2798.80	-61.60	-6.71	-68.31	-13.00	55.31	Horizontal
Middle channel						
Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
1415.00	-40.17	-11.77	-51.94	-13.00	38.94	Vertical
2122.50	-59.89	-9.58	-69.47	-13.00	56.47	Vertical
2830.00	-59.41	-6.50	-65.91	-13.00	52.91	Vertical
1415.00	-42.44	-11.45	-53.89	-13.00	40.89	Horizontal
2122.50	-59.27	-8.86	-68.13	-13.00	55.13	Horizontal
2830.00	-60.60	-5.97	-66.57	-13.00	53.57	Horizontal
Highest channel						
Frequency (MHz)	Reading Level (dBm)	Factor (dB)	Level (dBm)	Limit (dBm)	Margin (dB)	Polarization
1430.60	-40.68	-11.92	-52.60	-13.00	39.60	Vertical
2145.90	-60.94	-9.51	-70.45	-13.00	57.45	Vertical
2861.20	-60.39	-5.55	-65.94	-13.00	52.94	Vertical
1430.60	-42.82	-11.66	-54.48	-13.00	41.48	Horizontal
2145.90	-60.38	-9.15	-69.53	-13.00	56.53	Horizontal
2861.20	-61.81	-5.44	-67.25	-13.00	54.25	Horizontal
Remark: 1. The emission levels of below 1 GHz are lower than the limit 10dB, so not show in test report.						

-----End of report-----