TEST REPORT

Application No.:	GZEM2006013363CR
Applicant:	Guangzhou Andea Electronics Technology Co., Ltd.
Address of Applicant:	Room 401, Building H, Jingye San Street, Yushu Industrial Park, Economic And Technological Development Zone, Guangzhou
Manufacturer:	Guangzhou Andea Electronics Technology Co., Ltd.
Address of Manufacturer:	Room 401, Building H, Jingye San Street, Yushu Industrial Park, Economic And Technological Development Zone, Guangzhou
Factory:	Guangzhou Andea Electronics Technology Co., Ltd.
Address of Factory:	Room 401, Building H, Jingye San Street, Yushu Industrial Park, Economic And Technological Development Zone, Guangzhou
Equipment Under Test (EUT):	
FCC ID:	2AFI8-RD5230
EUT Name:	HF RFID Reader
Model No.:	RD52XX (XX=01-30, indicates number of antenna interface) ¤
¤	Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
Trademark:	
Standard(s):	47 CFR Part 15, Subpart C 15.225
Date of Receipt:	2020-06-29
Date of Test:	2020-07-08 to 2020-07-22
Date of Issue:	2020-07-27
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Kobe Jian
EMC Laboratory Manager

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Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
01		2020-07-27		Original

Authorized for issue by:				
Tested By		Jackson Yuan **Jackson_Yuan /Project Engineer**		2020-07-08 to 2020-07-22 **Date**
Checked By		Ricky Liu **Ricky_Liu /Reviewer**		2020-07-27 **Date**

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2 Test Summary

Radio Spectrum Technical Requirement				
Item	**Standard**	**Method**	**Requirement**	**Result**
Antenna Requirement	47 CFR Part 15, Subpart C 15.225	N/A	47 CFR Part 15, Subpart C 15.203	Pass

Radio Spectrum Matter Part				
Item	**Standard**	**Method**	**Requirement**	**Result**
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.225	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
20dB Bandwidth	47 CFR Part 15, Subpart C 15.225	ANSI C63.10 (2013) Section 6.9	47 CFR Part 15, Subpart C 15.215	Pass
Emission Mask	47 CFR Part 15, Subpart C 15.225	ANSI C63.10 (2013) Section 6.4	47 CFR Part 15, Subpart C 15.225(a)&(b)&(C)	Pass
Frequency tolerance	47 CFR Part 15, Subpart C 15.225	ANSI C63.10 (2013) Section 6.8	47 CFR Part 15, Subpart C 15.225(e)	Pass
Radiated Emissions(9kHz-30MHz)	47 CFR Part 15, Subpart C 15.225	ANSI C63.10 (2013) Section 6.4&6.5	47 CFR Part 15, Subpart C 15.225(d) & 15.209	Pass
Radiated Emissions(30MHz-1GHz)	47 CFR Part 15, Subpart C 15.225	ANSI C63.10 (2013) Section 6.4&6.5	47 CFR Part 15, Subpart C 15.225(d) & 15.209	Pass

¤ **Declaration of EUT Family Grouping:**

Model No.: RD52XX (XX=01-30, indicates number of antenna interface)

According to the declaration from the applicant, the electrical circuit design, layout, components used and internal wiring were identical for all models, with only difference on model number, number of antenna ports and appearance material and shape.

Therefore only one model RD5230 with maximum number of antenna interface was tested in this report.

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4 General Information

4.1 Details of E.U.T.

Power Supply:	DC 12 V
Rated Power:	13.5W
Test Voltage:	AC 120 V, 60 Hz powered by AC/DC adapter refer to section 4.2
Cable:	DC input ports; RS232 ports; USB ports; LAN ports; GPIO ports for prepare using in future. SMA Antenna interface*30 with dedicated antenna refer to section 4.2*
Antenna Gain:	0dBi
Antenna Type:	Integral Antenna
Channel Spacing:	N/A
Modulation Type:	ASK
Number of Channels:	1
Operation Frequency:	13.56MHz
Function::	13.56MHz RF ID reader
S/N:	1280460008
Hardware Version:	685212_V0202
Firmware:	SV01
Test Software:	R-Tool.exe
Power Setting:	4W
* Remark	The SMA antenna interface should be connected to a dedicated antenna and only one antenna interface is workable at the same time.

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
AC/DC Adapter	Offer by client	EW72-120500-A	None
Laptop	Lenovo	T430u	REF. No.SEA1800
Mouse	Lenovo	M-U0025-O	REF. No.:SEA2400
Network Cable	Offer by client	Unshielded, 5m	None
USB Cable	Offer by client	shielded, 1.5m	None
USB to RS232 Cable	Offer by client	shielded, 1.5m	None
Panel Antenna	Offer by client	None	01903A0013

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4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	±5.5 x 10^{-8}
2	Duty cycle	±0.57%
3	Occupied Bandwidth	±3%
4	RF Conducted power	±0.68dB
5	RF Power Density	±1.50dB
6	Conducted Spurious Emissions	±1.04dB
7	RF Radiated Power	±4.5dB (below 1GHz)
		±4.8dB (above 1GHz)
8	Radiated Spurious Emission Test	±4.5dB (30MHz-1GHz)
		±4.8dB (1GHz-18GHz)
9	Temperature	±0.4℃
10	Humidity	±1.3%
11	Supply Voltages	±1.5%
12	Time	±3%

4.4 Test Location

All tests were performed at:

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198 Kezhu Road, Scientech Park, Guangzhou Economic & Technology Development District, Guangzhou, China 510663

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No tests were sub-contracted.

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4.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **NVLAP (Lab Code: 200611-0)**

SGS-CSTC Standards Technical Services Co., Ltd., Guangzhou EMC Laboratory is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP/NIST). NVLAP Code: 200611-0.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

- **ACMA**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our NVLAP accreditation.

- **SGS UK(Certificate No.: 32), SGS-TUV SAARLAND and SGS-FIMKO**

Have approved SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory as a supplier of EMC TESTING SERVICES and SAFETY TESTING SERVICES.

- **CNAS (Lab Code: L0167)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been assessed and in compliance with CNAS-CL01:2018 accreditation criteria for testing laboratories (identical to

ISO/IEC 17025:2017 General Requirements) for the Competence of Testing Laboratories.

- **FCC Recognized 2.948 Listed Test Firm(Registration No.: 282399)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration 282399, May 31, 2002.

- **FCC Recognized Accredited Test Firm(Registration No.: 486818)**

SGS-CSTC Standards Technical Services Co., Ltd., EMC Laboratory has been accredited and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Designation Number: CN5016, Test Firm Registration Number: 486818, Jul 13, 2017.

- **Industry Canada (Registration No.: 4620B, CAB identifier: CN0052)**

SGS-CSTC Standards Technical Services Co., Ltd., has been registered by Innovation Science and Economic Development Canada for Wireless Device Testing laboratories to test to Canadian radio equipment requirements. Registration No. 4620B, CAB identifier: CN0052.

- **VCCI (Registration No.: R-12460, C-12584, G-10449 and T-11179)**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-12460, C-12584，G-10449 and T-11179 respectively.

- **CBTL (Lab Code: TL129)**

SGS-CSTC Standards Technical Services Co., Ltd., E&E Laboratory has been assessed and fully comply with the requirements of ISO/IEC 17025:2005, the Basic Rules, IECEE 01 and Rules of procedure IECEE 02, and the relevant IECEE CB-Scheme Operational documents.

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4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

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5 Equipment List

Conducted Emissions at AC Power Line (150kHz-30MHz)					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
Shielding Room	ChangZhou ZhongYu	8m x 3m x 3.8m	EMC0306	N/A	N/A
Two-Line V-Network	Rohde & Schwarz	ENV216	EMC0118	2020-01-10	2021-01-09
LISN	Rohde & Schwarz	ENV216	EMC2135	2019-09-16	2020-09-15
EMI Test Receiver	Rohde & Schwarz	ESCS30	EMC0506	2019-11-18	2020-11-17
Coaxial Cable	HangTianXing	2m	EMC0107	2018-09-20	2020-09-19
Voltage Probe	SGS-EMC	N/A	EMC0106	2019-05-10	2021-05-09
Conical Metal Housing	SGS-EMC	N/A	EMC0167	2020-04-19	2022-04-18
Test Software E3c	Audix	Ver. 5.4.1221b	GZE100-62	N/A	N/A

20dB Bandwidth					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
MXA Signal Analyzer	AgilentTechnologies	N9020A	SEM004-10	2020-03-02	2021-03-01
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01
MI CABLE	SGS-EMC	0.8M	EMC2137	2019-11-02	2021-11-01

Frequency tolerance					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
MXA Signal Analyzer	AgilentTechnologies	N9020A	SEM004-10	2020-03-02	2021-03-01
6dB Attenuator	HP	8491A	EMC2062	2020-04-15	2022-04-14
Test Software JS1120-3	HangTianXing	V2.6	GZE100-69	N/A	N/A
MI CABLE	SGS-EMC	0.8M	EMC2136	2019-11-02	2021-11-01
MI CABLE	SGS-EMC	0.8M	EMC2137	2019-11-02	2021-11-01
Temperature Chamber	GZ GongWen Co.Ltd.	GDJW-100	EMC0039	2020-07-01	2021-06-30

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Emission Mask & Radiated Spurious Emissions					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
EMI Test Receiver	Rohde & Schwarz	ESIB26	EMC0522	2020-01-10	2021-01-09
EMI Test Receiver	Rohde & Schwarz	ESCI	EMC0056	2020-01-10	2021-01-09
Chamber cable	HangTianXing	N/A	EMC0542	2019-06-28	2021-06-27
Trilog Broadband Antenna 25MHz-1GHz	SCHWARZBECKMESS-ELEKTRONIK	VULB 9168	EMC2174	2018-09-06	2021-09-05
Trilog Broadband Antenna 30MHz-1GHz	SCHWARZBECKMESS-ELEKTRONIK	VULB 9168	SEM003-18	2019-02-22	2022-02-22
Bi-log Type Antenna	Schaffner Chase	CBL6143	EMC0519	2020-06-08	2023-06-07
Horn Antenna 1GHz-18GHz	Rohde & Schwarz	HF906	EMC0518	2018-09-02	2021-09-01
1GHz-26.5 GHz Pre-Amplifier	Agilent	8449B	EMC0521	2020-01-10	2021-01-09
Amplifier	HP	8447F	EMC2065	2020-05-26	2021-05-25
Pre-Amplifier MH648A	ANRITSU CORP	MH648A	EMC2086	2019-11-18	2020-11-17
Active Loop Antenna	ETS-Lindgren	6502	EMC2190	2019-12-27	2021-12-26
High Pass Filter(915MHz)	FSY MICROWAVE	HM1465-9SS	EMC2079	2020-01-10	2021-01-09
2.4GHz Filter	Micro-Tronics	BRM 50702	EMC2069	2020-01-10	2021-01-09
10m Semi-Anechoic Chamber	ETS	N/A	EMC0530	2019-10-20	2022-10-19
966 Anechoic Chamber	C.R.T	9m x 6m x 6m	EMC2142	2017-12-19	2020-12-18
MXE EMI Receiver	Keysight	N9038A	EMC2139	2019-11-18	2020-11-17
EXA Signal Analyzer	Keysight	N9010A	EMC2138	2019-11-18	2020-11-17
Test Software E3	Audix	Ver.6.120110a	GZE100-61	N/A	N/A

General used equipment					
Equipment	**Manufacturer**	**Model No**	**Inventory No**	**Cal Date**	**Cal Due Date**
DMM	Fluke	73	EMC0006	2020-07-09	2021-07-08
DMM	Fluke	73	EMC0007	2020-07-09	2021-07-08

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6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203

6.1.2 Conclusion

Standard Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit permanently attached antenna or of an so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

EUT Antenna:

The antenna is integrated on the main unit and no consideration of replacement declared by the applicant. The best case gain of the antenna is 0dBi.

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7 Radio Spectrum Matter Test Results

7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207
Test Method: ANSI C63.10 (2013) Section 6.2
Limit:

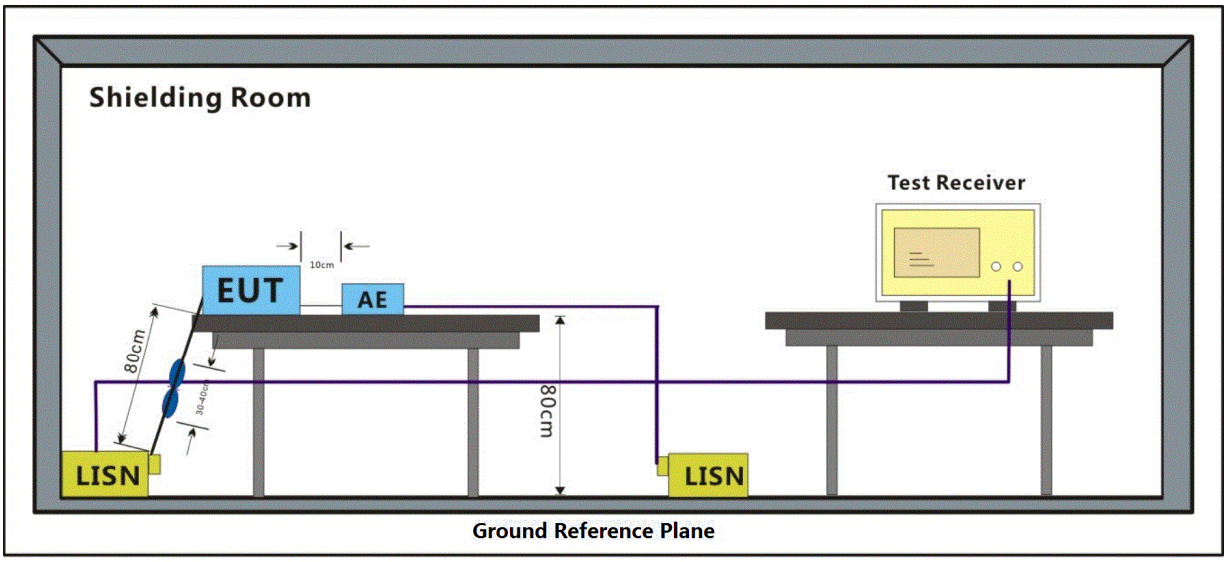
Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

7.1.1 E.U.T. Operation

Operating Environment:
Temperature: 24.7 °C Humidity: 52 % RH Atmospheric Pressure: 1020 mbar
Test Mode: b:TX mode_Keep the EUT in transmitting with modulation mode.

7.1.2 Test Setup Diagram



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7.1.3 Measurement Procedure and Data

1) The mains terminal disturbance voltage test was conducted in a shielded room.

2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.

3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,

4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.

5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

Remark: LISN=Read Level+ Cable Loss+ LISN Factor

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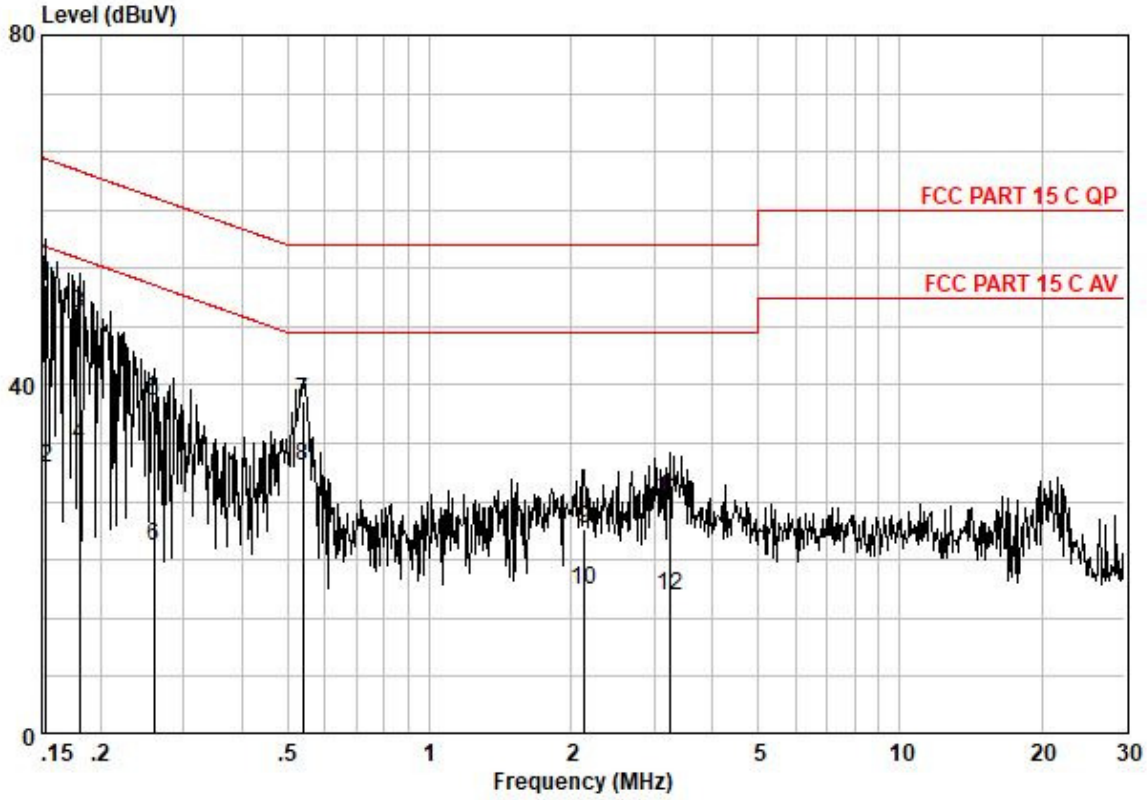
Mode:b; Line:Live Line



Pol :LIVE
No :120V
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuA	Limit Line dBuA	Over limit dB	Remark
0.15	41.81	0.10	9.61	51.52	65.82	-14.30	QP
0.15	20.71	0.10	9.61	30.42	55.82	-25.40	AVERAGE
0.18	38.36	0.10	9.61	48.07	64.46	-16.39	QP
0.18	23.33	0.10	9.61	33.04	54.46	-21.42	AVERAGE
0.26	28.48	0.10	9.61	38.19	61.42	-23.24	QP
0.26	11.84	0.10	9.61	21.55	51.42	-29.88	AVERAGE
0.54	28.48	0.10	9.61	38.19	56.00	-17.81	QP
0.54	21.00	0.10	9.61	30.71	46.00	-15.29	AVERAGE
2.13	13.71	0.12	9.62	23.45	56.00	-32.55	QP
2.13	6.89	0.12	9.62	16.63	46.00	-29.37	AVERAGE
3.24	17.23	0.20	9.63	27.06	56.00	-28.94	QP
3.24	6.00	0.20	9.63	15.83	46.00	-30.17	AVERAGE

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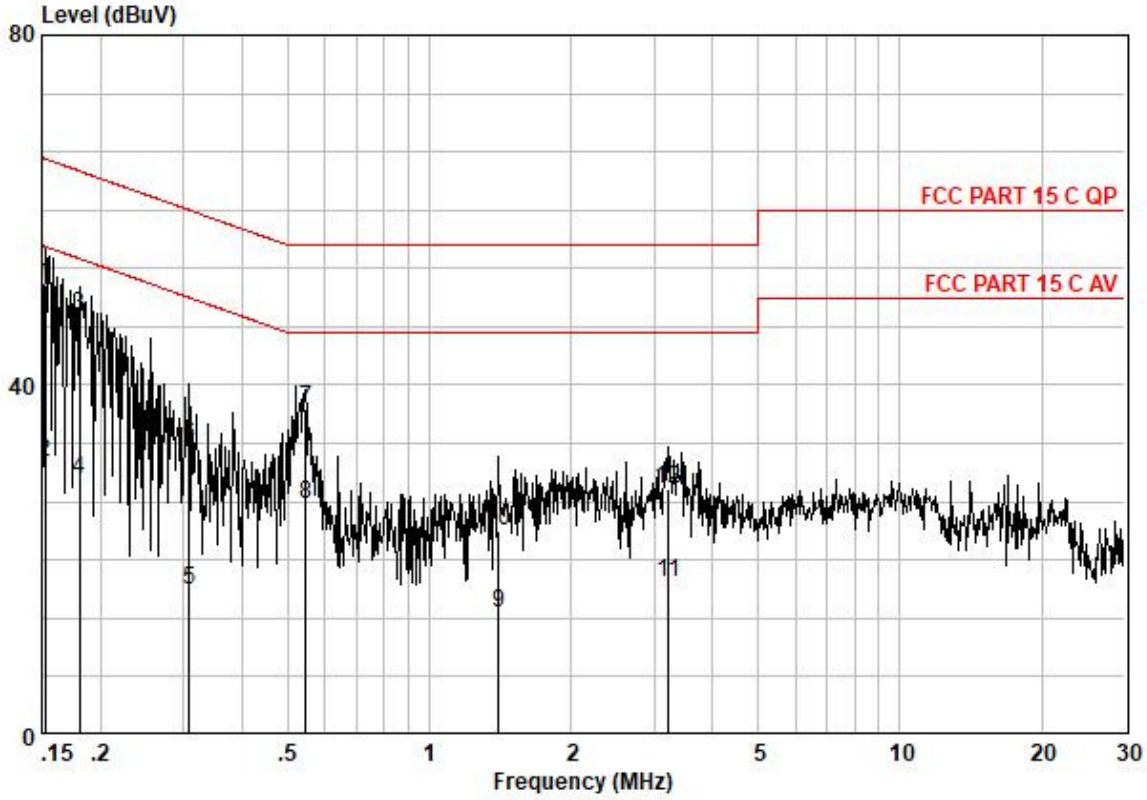
Mode:b; Line:Neutral Line



Pol :NEUTRAL
No :120V
Model :

Frequency MHz	read level dBuV	Cable Loss dB	LISN Factor dB	Measured level dBuA	Limit Line dBuA	Over limit dB	Remark
0.15	41.71	0.10	9.61	51.42	65.87	-14.45	QP
0.15	21.37	0.10	9.61	31.08	55.87	-24.79	AVERAGE
0.18	38.26	0.10	9.62	47.98	64.46	-16.48	QP
0.18	19.46	0.10	9.62	29.18	54.46	-25.28	AVERAGE
0.31	6.85	0.10	9.63	16.58	50.02	-33.44	AVERAGE
0.31	23.51	0.10	9.63	33.24	60.02	-26.78	QP
0.55	27.43	0.10	9.64	37.17	56.00	-18.83	QP
0.55	16.68	0.10	9.64	26.42	46.00	-19.58	AVERAGE
1.40	4.22	0.10	9.70	14.02	46.00	-31.98	AVERAGE
1.40	13.57	0.10	9.70	23.37	56.00	-32.63	QP
3.22	7.37	0.20	9.77	17.34	46.00	-28.66	AVERAGE
3.22	18.05	0.20	9.77	28.02	56.00	-27.98	QP

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7.2 20dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.215
Test Method: ANSI C63.10 (2013) Section 6.9
Limit: N/A

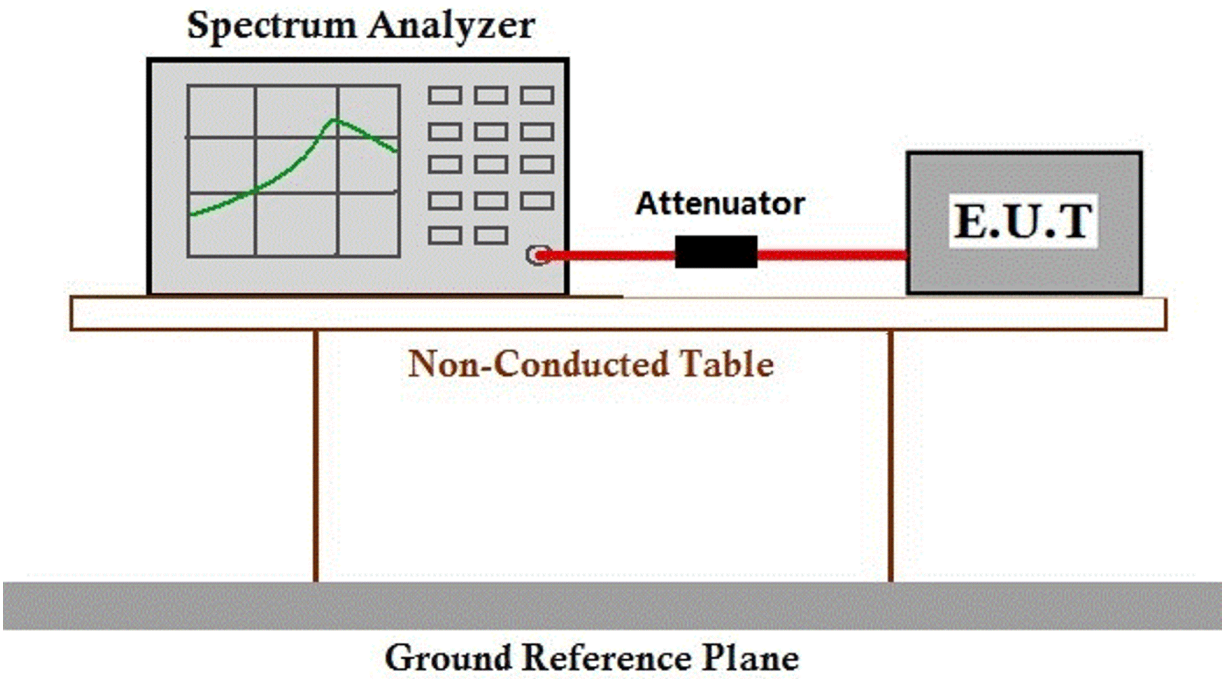
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 26.8 °C Humidity: 58.1 % RH Atmospheric Pressure: 1020 mbar

Test Mode: b:TX mode_Keep the EUT in transmitting with modulation mode.

7.2.2 Test Setup Diagram



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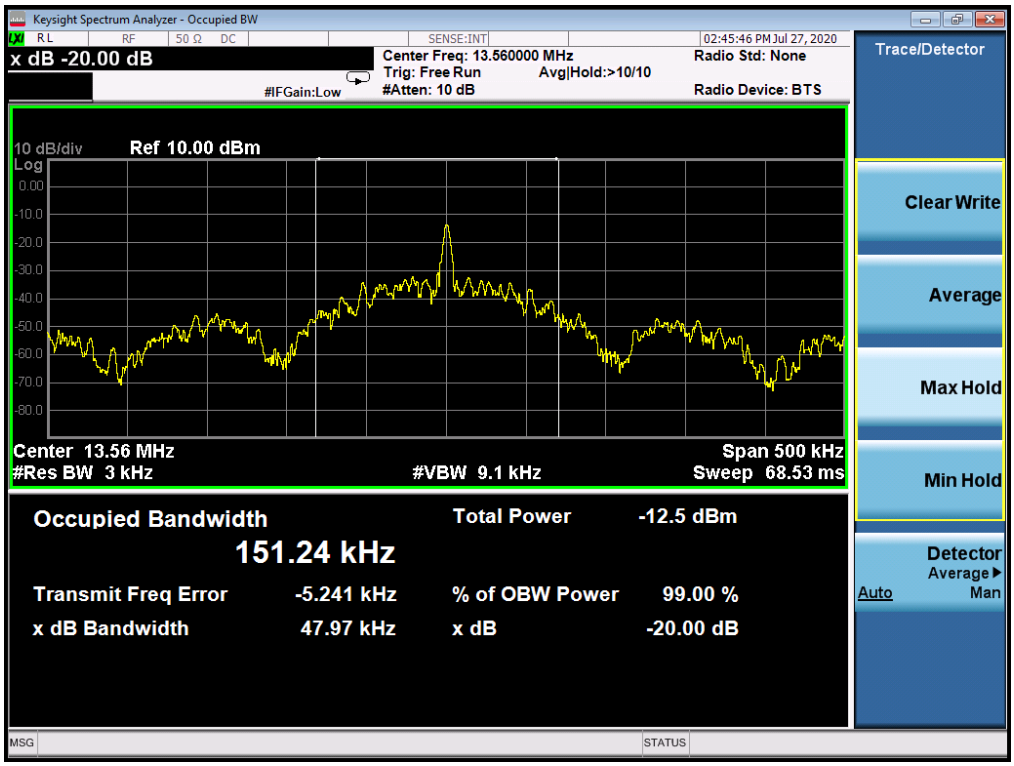
7.2.3 Measurement Procedure and Data



Cable Loss= 0.9dB

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7.3 Emission Mask

Test Requirement 47 CFR Part 15, Subpart C 15.225(a)&(b)&(C)

Test Method: ANSI C63.10 (2013) Section 6.4

Limit:

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15848 microvolts/meter at 30 meters.

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters.

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters.

(d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission limits in § 15.209.

According to ANSI C63.10 Section 6.4, the test data shall convert by below formula:

If both the single point and the limit distance are equal to or closer to the EUT than λ/2π, then extrapolation to the limit distance shall be calculated using Equation (4):

$$FS_{\text{limit}} = FS_{\max} - 40\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right) \quad (4)$$

where

FS_{limit}	is the calculation of field strength at the limit distance, expressed in dBμV/m
$FS_{\max}$	is the measured field strength, expressed in dBμV/m
$d_{\text{near field}}$	is the λ/2π distance
d_{measure}	is the distance of the measurement point from the EUT
d_{limit}	is the reference distance or the distance of the λ/2π point

Table 5—Relationship of frequency and wavelength (informative)

Frequency (MHz)	λ (m)	0.625λ (m)	λ/2π
0.009	33333.3	20833.3	5305.2
0.1	3000.0	1875.0	477.5
0.3	1000.0	625.0	159.2
1	300.0	187.5	47.7
4.76	63.0	39.4	10.0
16	18.8	11.7	3.0
30	10.0	6.3	1.6

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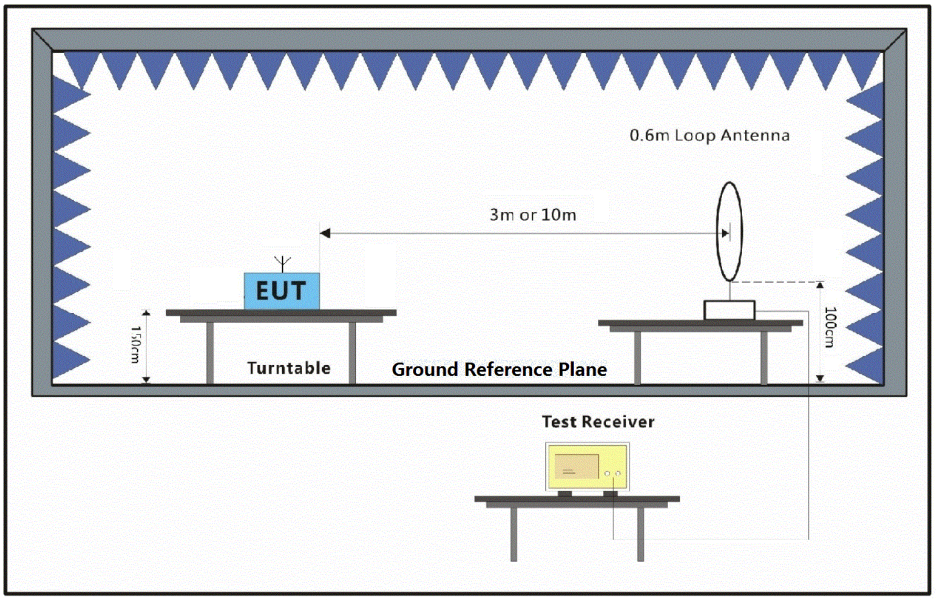
7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 26.8 °C Humidity: 58.1 % RH Atmospheric Pressure: 1020 mbar

Test Mode: b:TX mode_Keep the EUT in transmitting with modulation mode.

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

For testing performed with the loop antenna, the center of the loop was positioned 1 m above the ground and positioned with its plane vertical at the specified distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.

Measured Level l=Read Level + Antenna Factor + Cable Loss - Preamp Factor

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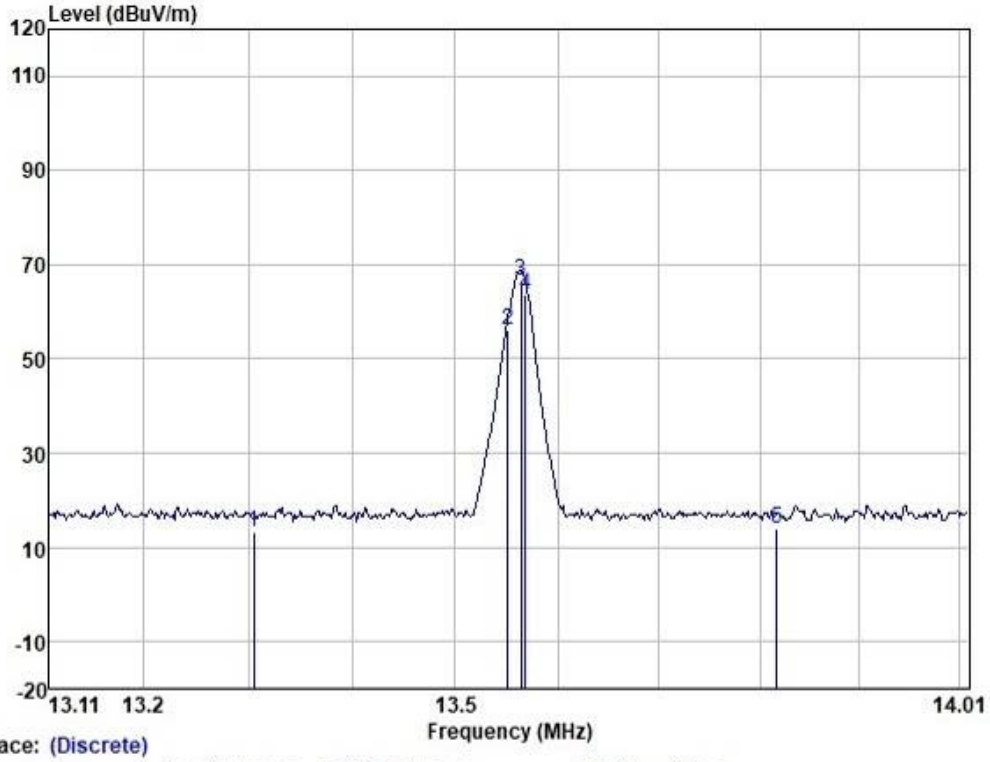
Mode:b; Polarization:X



Trace: (Discrete)

	Freq	ReadLevel	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	13.110	33.19	9.01	0.40	29.27	13.33	------	------	
2	13.410	33.23	9.01	0.40	29.27	13.37	------	------	
3	13.553	75.96	8.96	0.40	29.27	56.05	------	------	
4	13.560	86.64	8.96	0.40	29.27	66.73	------	------	
5	13.567	83.45	8.96	0.40	29.27	63.54	------	------	
6	13.710	34.00	8.91	0.40	29.26	14.05	------	------	
7	14.010	33.97	8.91	0.40	29.26	14.02	------	------	

Frequency (MHz)	Level (dBuV/m) @10m	Limit (dBuV/m) @30m	Convert Factor (dB)	Level (dBuV/m) @ 30m	Over limit (dB)
13.110	13.33	29.54	19.08	-5.75	-35.29
13.410	13.37	40.51	19.08	-5.71	-46.22
13.553	56.05	50.47	19.08	36.97	-13.50
**13.560	66.73	84.00	19.08	47.65	-36.35
13.567	63.54	50.47	19.08	44.46	-6.01
13.710	14.05	40.51	19.08	-5.03	-45.54
14.010	14.02	29.54	19.08	-5.06	-34.60

**Remark: This is the main operating frequency of the EUT.

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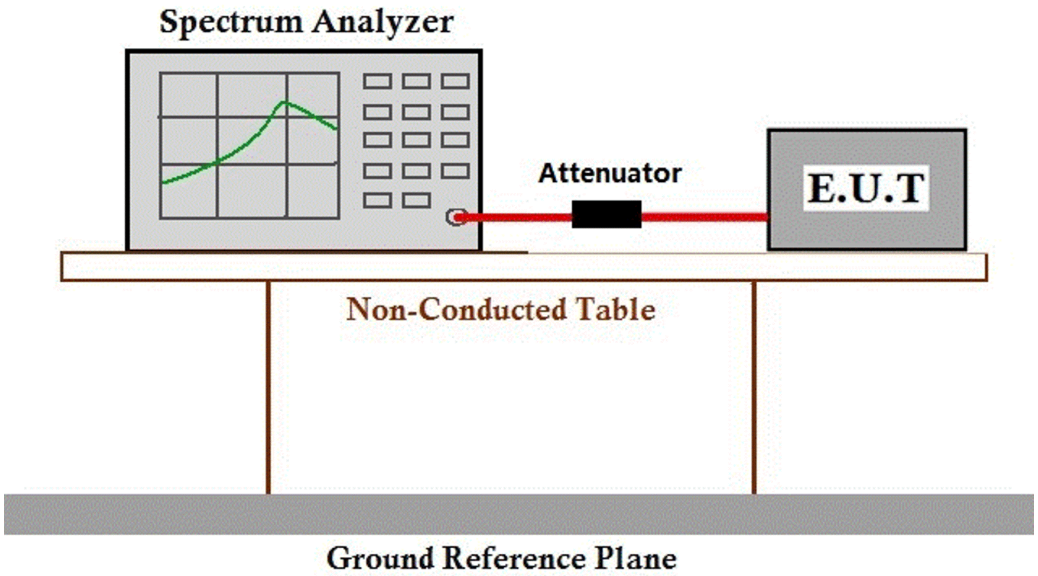
7.4 Frequency tolerance

Test Requirement 47 CFR Part 15, Subpart C 15.225(e)
Test Method: ANSI C63.10 (2013) Section 6.8
Limit: ±0.01%(1.356kHz)

7.4.1 E.U.T. Operation

Operating Environment:
Temperature: 26.8 °C Humidity: 58.1 % RH Atmospheric Pressure: 1020 mbar
Test Mode: b:TX mode_Keep the EUT in transmitting with modulation mode.

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

Measurement Conditions		Limit: ±0.01%(1.356kHz)	
Voltage (V DC)	Temperature (℃)	Frequency Measured (MHz)	Deviation (kHz)
V_{norm} : 12	-20	13.560312	0.312
	-10	13.559742	-0.258
	0	13.560099	0.099
	+10	13.560942	0.942
	T_{normal} : +20	13.558947	-1.053
	+30	13.560524	0.524
	+40	13.559983	-0.017
	+50	13.559830	-0.170
V_{max} : 13.8	T_{normal} : +20	13.559359	-0.641
V_{min} : 10.2		13.559619	-0.381

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7.5 Radiated Emissions(9kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.225(d) & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4&6.5
Measurement Distance: 10m
Limit:

Frequency(MHz)	Field strength (microvolts/meter)	Limit (dBuV/m)	Detector	Measurement Distance (meters)
0.009-0.490	2400/F(kHz)	-	-	300
0.490-1.705	24000/F(kHz)	-	-	30
1.705-30	30	-	-	30
30-88	100	40.0	QP	3
88-216	150	43.5	QP	3
216-960	200	46.0	QP	3
960-1000	500	54.0	QP	3
Above 1000	500	54.0	AV	3

According to ANSI C63.10 Section 6.4, the test data shall convert by below formula:

If both the single point and the limit distance are equal to or closer to the EUT than $\lambda/2\pi$, then extrapolation to the limit distance shall be calculated using Equation (4):

$$FS_{\text{limit}} = FS_{\max} - 40\log\left(\frac{d_{\text{limit}}}{d_{\text{measure}}}\right) \quad (4)$$

where

FS_{limit} is the calculation of field strength at the limit distance, expressed in dBμV/m
$FS_{\max}$ is the measured field strength, expressed in dBμV/m
$d_{\text{near field}}$ is the $\lambda/2\pi$ distance
d_{measure} is the distance of the measurement point from the EUT
d_{limit} is the reference distance or the distance of the $\lambda/2\pi$ point

Table 5—Relationship of frequency and wavelength (informative)

Frequency (MHz)	λ (m)	0.625λ (m)	λ/2π
0.009	33333.3	20833.3	5305.2
0.1	3000.0	1875.0	477.5
0.3	1000.0	625.0	159.2
1	300.0	187.5	47.7
4.76	63.0	39.4	10.0
16	18.8	11.7	3.0
30	10.0	6.3	1.6

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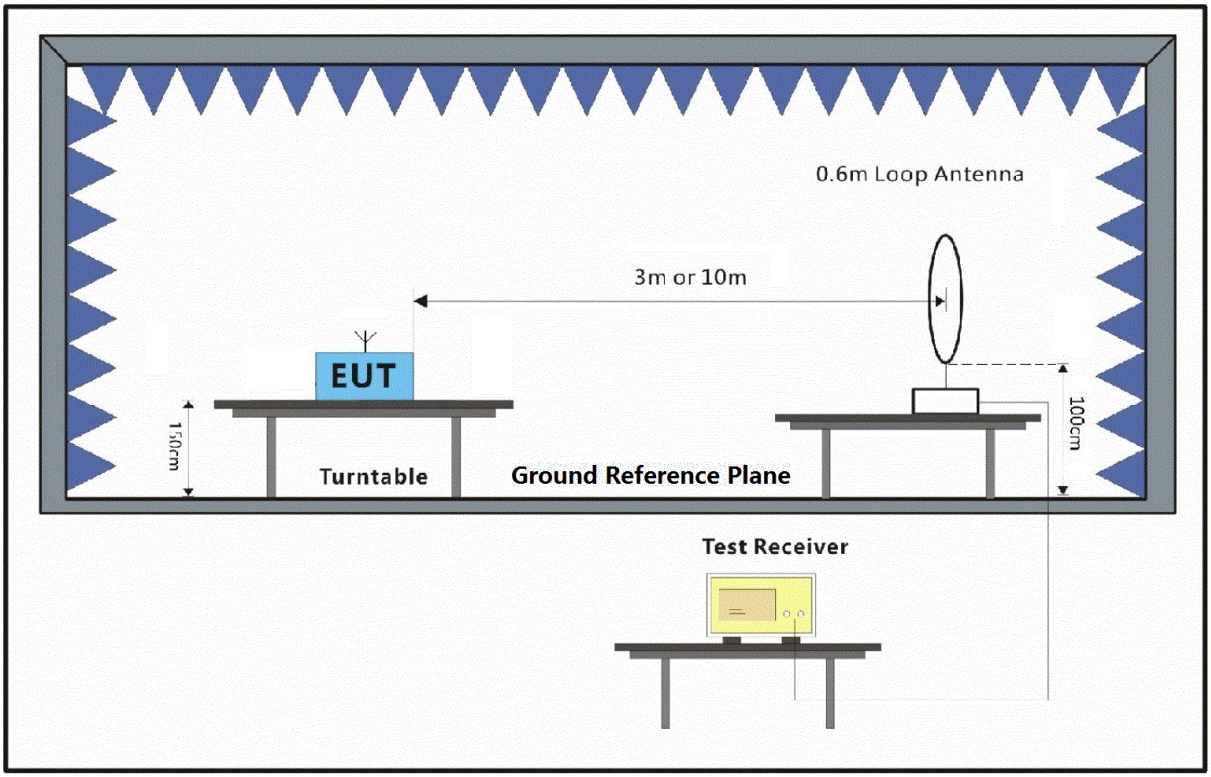
7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 52 % RH Atmospheric Pressure: 1020 mbar

Test Mode: b:TX mode_Keep the EUT in transmitting with modulation mode.

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

For testing performed with the loop antenna, the center of the loop was positioned 1 m above the ground and positioned with its plane vertical at the specified distance from the EUT. During testing the loop was rotated about its vertical axis for maximum response at each azimuth and also investigated with the loop positioned in the horizontal plane.

The radiation measurements are performed in X, Y, Z axis positioning. And found the X axis positioning which it is worse case, only the test worst case mode is recorded in the report.

Measured Level l=Read Level + Antenna Factor + Cable Loss - Preamp Factor

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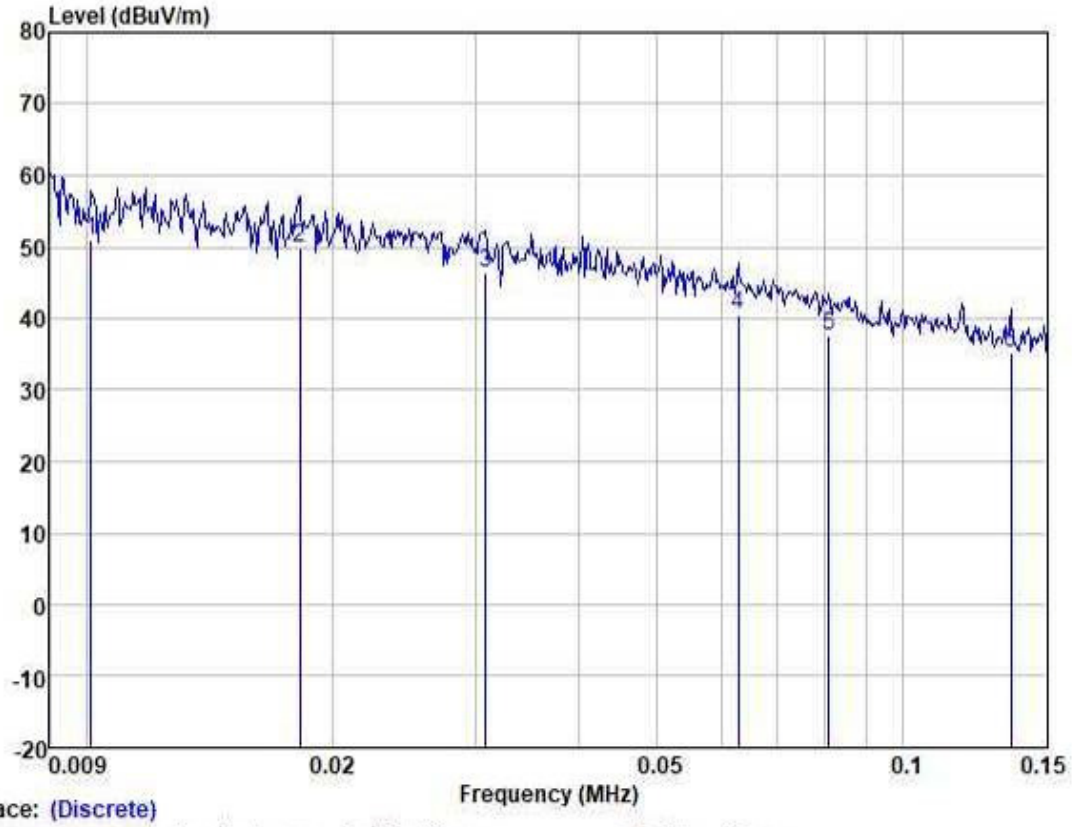
Mode:b; Polarization:X



Trace: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	0.010	63.27	15.77	0.00	28.07	50.97	------	------	
2	0.018	64.99	13.20	0.00	28.25	49.94	------	------	
3	0.031	62.62	12.50	0.00	28.84	46.28	------	------	
4	0.063	58.42	11.54	0.00	29.35	40.61	------	------	
5	0.081	56.24	10.70	0.00	29.41	37.53	------	------	
6	0.136	54.18	10.54	0.00	29.45	35.27	------	------	

Frequency (MHz)	Level (dBuV/m) @10m	Limit (dBuV/m) @30m	Limit (dBuV/m) @300m	Convert Factor (dB)	Level (dBuV/m) @ 30m	Level (dBuV/m) @ 300m	Over limit (dB)
0.010	50.97	-	47.60	59.08	-	-8.11	-55.71
0.018	49.94	-	42.50	59.08	-	-9.14	-51.64
0.031	46.28	-	37.78	59.08	-	-12.8	-50.58
0.063	40.61	-	31.62	59.08	-	-18.47	-50.09
0.081	37.53	-	29.43	59.08	-	-21.55	-50.98
0.136	35.27	-	24.93	59.08	-	-23.81	-48.74

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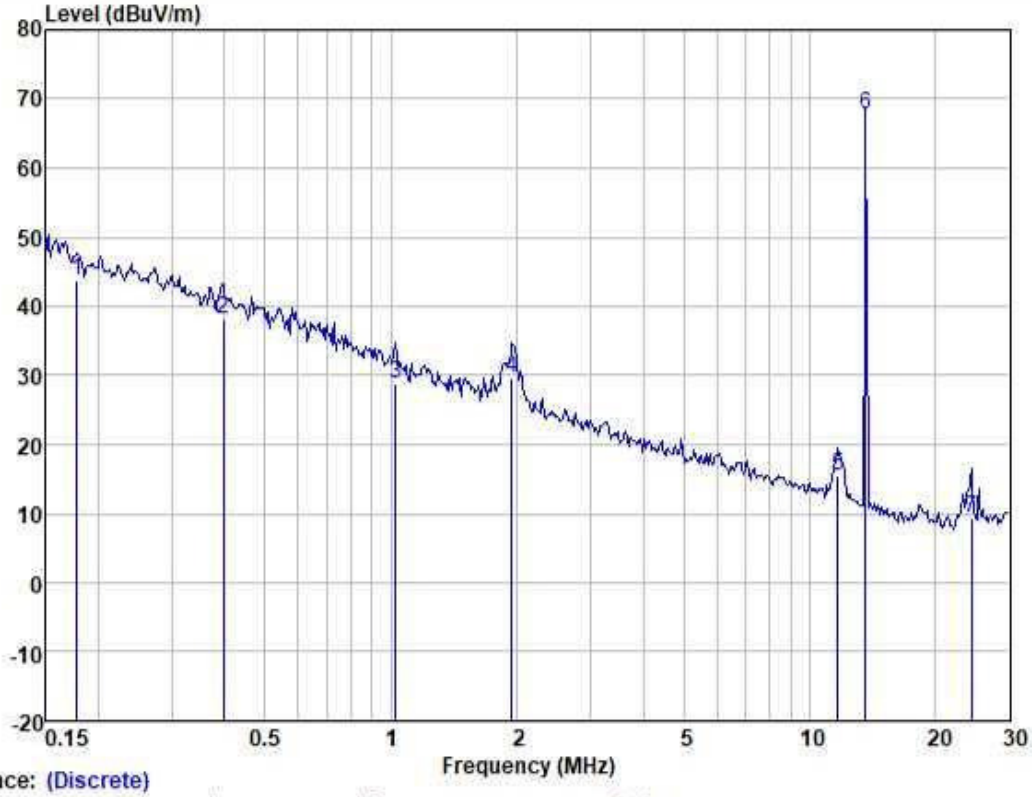
Mode:b; Polarization:X



Trace: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB	
1	0.178	62.38	10.76	0.00	29.43	43.71	------	------	
2	0.398	56.82	10.71	0.10	29.40	38.23	------	------	
3	1.027	47.60	10.41	0.10	29.38	28.73	------	------	
4	1.939	47.96	10.99	0.10	29.36	29.69	------	------	
5	11.683	34.67	9.66	0.37	29.28	15.42	------	------	
6	13.560	87.52	8.96	0.40	29.27	67.61	------	------	
7	24.271	29.69	8.31	0.63	29.20	9.43	------	------	

Frequency (MHz)	Level (dBuV/m) @10m	Limit (dBuV/m) @30m	Limit (dBuV/m) @300m	Convert Factor (dB)	Level (dBuV/m) @ 30m	Level (dBuV/m) @ 300m	Over limit (dB)
0.178	43.71	-	22.60	59.08	-	-15.37	-37.97
0.398	38.23	-	15.61	59.08	-	-20.85	-36.46
1.027	28.73	27.37	-	19.08	9.65	-	-17.72
1.939	29.69	29.54	-	19.08	10.61	-	-18.93
11.683	15.42	29.54	-	19.08	-3.66	-	-33.20
24.271	9.43	29.54	-	19.08	-9.65	-	-39.19

**Remark: The point 6 is the main operating frequency of the EUT and the level please refer to section 7.3.

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7.6 Radiated Emissions(30MHz-1GHz)

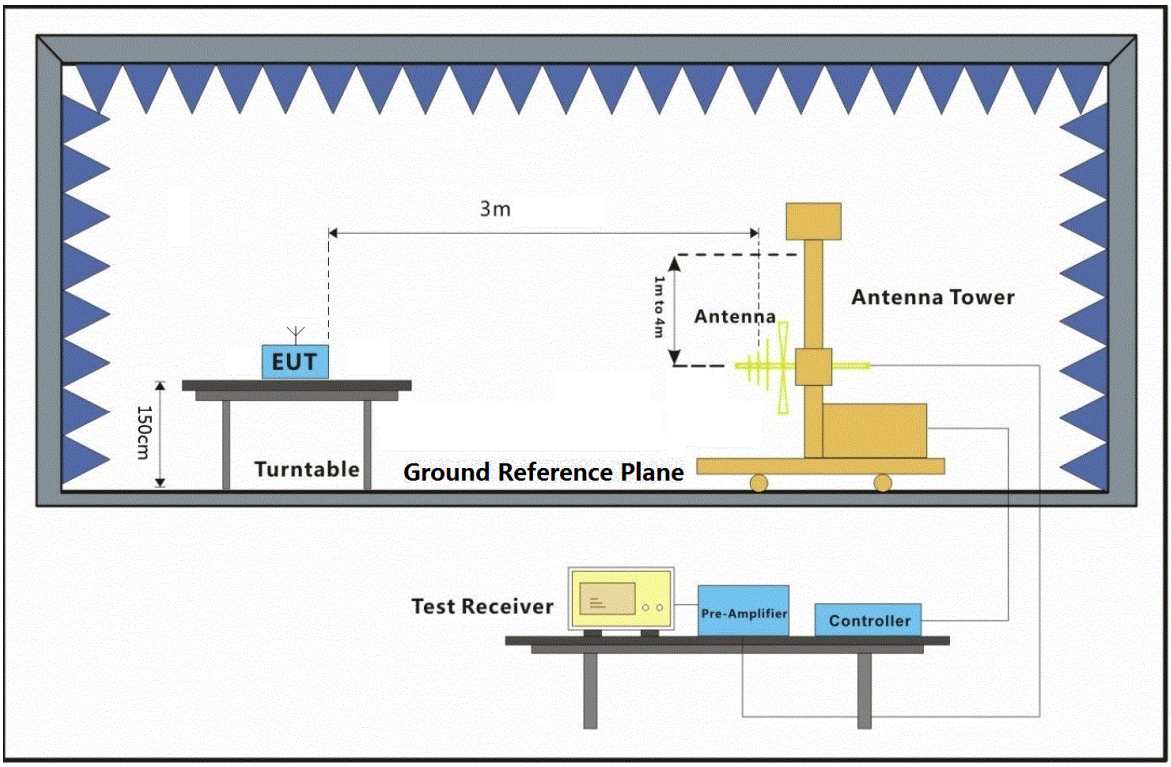
Test Requirement 47 CFR Part 15, Subpart C 15.225(d) & 15.209
Test Method: ANSI C63.10 (2013) Section 6.4&6.5
Measurement Distance: 3m
Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3

7.6.1 E.U.T. Operation

Operating Environment:
Temperature: 22 °C Humidity: 52 % RH Atmospheric Pressure: 1020 mbar
Test Mode: b:TX mode_Keep the EUT in transmitting with modulation mode.

7.6.2 Test Setup Diagram



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7.6.3 Measurement Procedure and Data

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground for below 1GHz at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

Remark: Level= Read Level+ Cable Loss+ Antenna Factor- Preamp Factor

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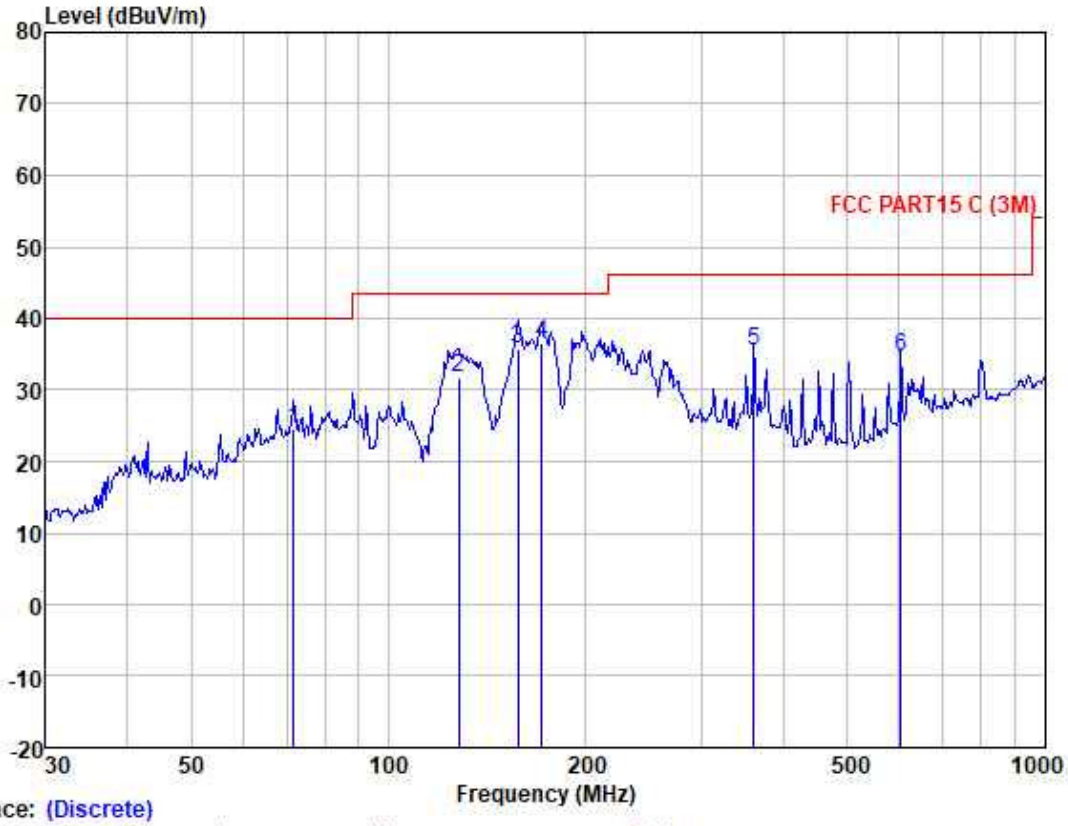
Mode:b; Polarization:Horizontal



Trace: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	71.581	38.72	11.59	1.41	27.13	24.59	40.00	-15.41	HORIZONTAL	QP
2	127.665	45.20	11.75	1.83	27.03	31.75	43.50	-11.75	HORIZONTAL	QP
3	157.559	46.69	13.70	2.12	26.85	35.66	43.50	-7.84	HORIZONTAL	QP
4	171.393	47.96	13.03	2.25	26.82	36.42	43.50	-7.08	HORIZONTAL	QP
5	360.448	45.10	14.90	3.28	27.78	35.50	46.00	-10.50	HORIZONTAL	QP
6	603.539	37.71	20.10	4.84	28.07	34.58	46.00	-11.42	HORIZONTAL	QP

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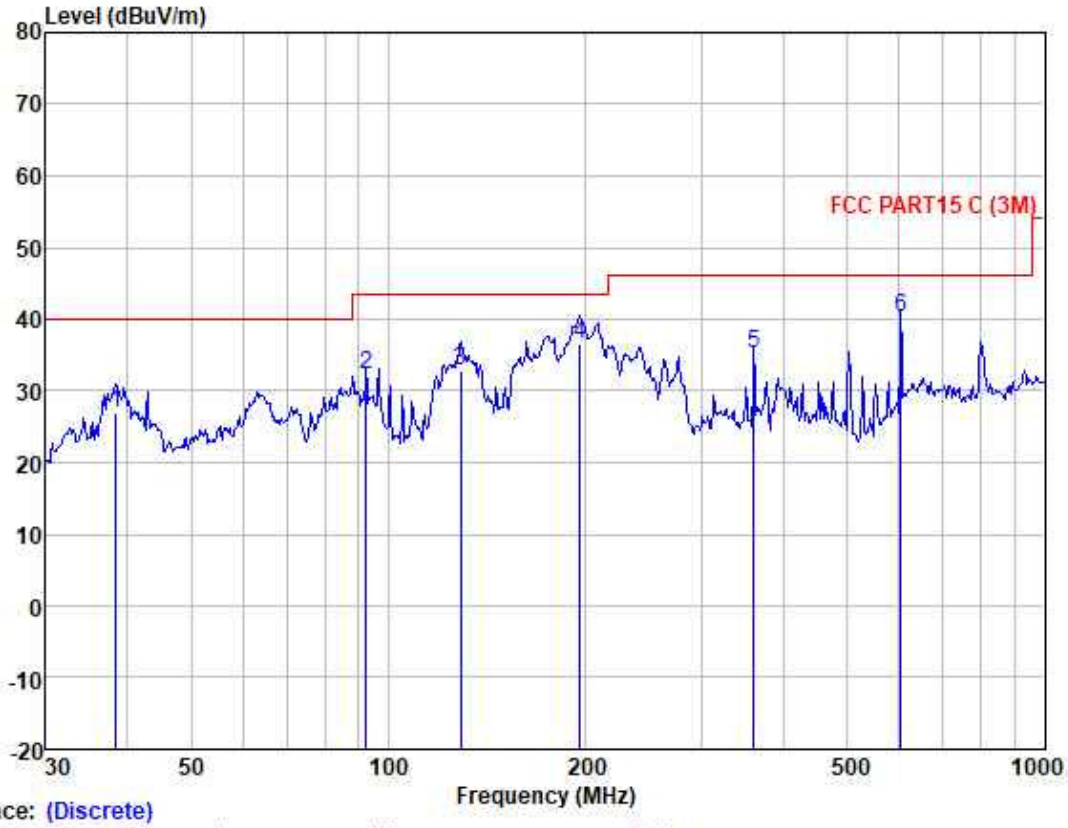
Mode:b; Polarization:Vertical



Trace: (Discrete)

	Freq	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Level	Limit Line	Over Limit	Pol/Phase	Remark
	MHz	dBuV	dB/m	dB	dB	dBuV/m	dBuV/m	dB		
1	38.346	39.75	13.34	1.05	27.18	26.96	40.00	-13.04	VERTICAL	QP
2	92.462	49.59	8.13	1.60	27.10	32.22	43.50	-11.28	VERTICAL	QP
3	128.563	46.14	11.87	1.83	27.03	32.81	43.50	-10.69	VERTICAL	QP
4	195.822	50.27	10.60	2.49	26.79	36.57	43.50	-6.93	VERTICAL	QP
5	360.448	44.78	14.90	3.28	27.78	35.18	46.00	-10.82	VERTICAL	QP
6	603.539	43.43	20.10	4.84	28.07	40.30	46.00	-5.70	VERTICAL	QP

--End of Report--

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