Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

TEST REPORT

FCC Part 90

Report Reference No.....:	**GTS20191021009-1-9-16**
FCC ID..... :	**2AUUB-S900PLUS**
Compiled by (position+printed name+signature)..:	File administrators Jimmy Wang
Supervised by (position+printed name+signature)..:	Test Engineer Aaron Tan
Approved by (position+printed name+signature)..:	Manager Jason Hu
Date of issue.....:	Oct. 24, 2019
Representative Laboratory Name .:	**Shenzhen Global Test Service Co., Ltd.**
Address.....:	No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong
Applicant's name.....:	**BOXCHIP CO.,LTD**
Address .....:	Room 302, Building A, Huahan Technology, No. 16 Langshan Road, Nanshan District, Shenzhen, China
Test specification .....:	
Standard .....:	**FCC Part 90/FCC Part 2**
TRF Originator.....:	Shenzhen Global Test Service Co.,Ltd.
Master TRF.....:	Dated 2014-12

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Test item description .....:	Smart Terminal
Trade Mark .....:	BOXCHIP
Manufacturer.....:	**BOXCHIP CO.,LTD**
Model/Type reference.....:	S900Plus
Listed Models .....:	S900A_Plus, S900B_Plus, S1000, TVX-588d
Ratings .....:	DC 3.8V from battery
Modulation .....:	FM/4FSK
Hardware version .....:	TVH30_S900+_MB_V2.0
Software version .....:	V1.0
Frequency.....	136MHz-174MHz
Result.....:	**PASS**

TEST REPORT

Test Report No. :	GTS20191021009-1-9-16	Oct. 24, 2019 Date of issue

Equipment under Test	:	Smart Terminal
Model /Type	:	S900Plus
Listed Models	:	S900A_Plus, S900B_Plus, S1000, TVX-588d
Applicant	:	**BOXCHIP CO.,LTD**
Address	:	Room 302, Building A, Huahan Technology, No. 16 Langshan Road, Nanshan District, Shenzhen, China
Manufacturer	:	**BOXCHIP CO.,LTD**
Address	:	Room 302, Building A, Huahan Technology, No. 16 Langshan Road, Nanshan District, Shenzhen, China

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1 SUMMARY

1.1 Test Standards

The tests were performed according to following standards:
FCC Rules Part 90 : PRIVATE LAND MOBILE RADIO SERVICES.
FCC Part 24 Subpart E: PUBLIC MOBILE SERVICES
ANSI/TIA-603-E-2016: Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI C63.10:2013 : American National Standard for Testing Unlicensed Wireless Devices

1.2 Test Description

Test specification clause	Test case	Verdict
FCC Part 90.205	Maximum Transmitter Power	PASS
FCC Part 90.207	Modulation Characteristic	PASS
FCC Part 90.209	Occupied Bandwidth	PASS
FCC Part 90.210	Emission Mask	PASS
FCC Part 90.213	Frequency Stability	PASS
FCC Part 90.214	Transmitter Frequency Behavior	PASS
FCC Part 90.210	Transmitter Radiated Spurious Emssion	PASS
FCC Part 90.210	Spurious Emssion On Antenna Port	PASS

Remark: The measurement uncertainty is not included in the test result.

1.3 Address of the test laboratory

Shenzhen Global Test Service Co.,Ltd.
No.7-101 and 8A-104, Building 7 and 8, DCC Cultural and Creative Garden, No.98, Pingxin North Road, Shangmugu Community, Pinghu Street, Longgang District, Shenzhen, Guangdong

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.4 Test Facility

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

FCC-Registration No.: 165725

Shenzhen Global Test Service 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.

A2LA-Lab Cert. No.: 4758.01

Shenzhen Global Test Service Co.,Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

CNAS-Lab Code: L8169

Shenzhen Global Test Service Co.,Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories. Date of Registration: Dec. 11, 2015. Valid time is until Dec. 10, 2024.

1.5 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the Shenzhen Global Test Service Co.,Ltd quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for Shenzhen GTS laboratory is reported:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10 dB	(1)
Radiated Emission	1~18GHz	4.32 dB	(1)
Radiated Emission	18-40GHz	5.54 dB	(1)
Conducted Disturbance	0.15~30MHz	3.12 dB	(1)
Conducted Power	9KHz~18GHz	0.61 dB	(1)
Spurious RF Conducted Emission	9KHz~40GHz	1.22 dB	(1)
Band Edge Compliance of RF Emission	9KHz~40GHz	1.22 dB	(1)
Occupied Bandwidth	9KHz~40GHz	-	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

2 GENERAL INFORMATION

2.1 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Normal Temperature:	25°C
Relative Humidity:	55 %
Air Pressure:	101 kPa

2.2 General Description of EUT

Name of EUT	Smart Terminal
Model Number	S900Plus
Power Supply	DC 3.8V from battery
Frequency Range	From 136 MHz to 174 MHz
Rate Power	High power 5W and Low power 1W
Modulation Type	FM/4FSK
Channel Separation	Analog:12.5KHz&25KHz Digital: 12.5KHz
Antenna Type	External antenna

Note: For more details, please refer to the user's manual of the EUT.

2.3 Description of Test Modes and Test Frequency

The EUT has been tested under typical operating condition. As, test modes selected as below by the technical parameters of the EUT:

Operation Mode No.	Modulation		Channel Separation		Power level
	FM	4FSK	12.5KHz	25KHz	
Mode 1	☒		☒		High
Mode 2	☒		☒		Low
Mode 3	☒			☒	High
Mode 4	☒			☒	Low
Mode 5		☒	☒		High
Mode 6		☒	☒		Low

Test frequency list:

Modulation Type	Channel Separation	Test Frequency (MHz)
Analog/FM	12.5KHz	136.0125 MHz
		155.0125 MHz
		173.9875 MHz
	25KHz	136.0125 MHz
		155.0125 MHz
		173.9875 MHz
Digital/4FSK	12.5KHz	136.0125 MHz
		155.0125 MHz
		173.9875 MHz

2.4 Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	3560.6550.08	2019/09/20	2020/09/19
LISN	R&S	ESH2-Z5	893606/008	2019/09/20	2020/09/19
Bilog Antenna	Schwarzbeck	VULB9163	976	2019/09/20	2020/09/19
Bilog Antenna	Schwarzbeck	VULB9163	979	2019/09/20	2020/09/19

EMI Test Receiver	R&S	ESCI7	101102	2019/09/20	2020/09/19
Spectrum Analyzer	Agilent	N9020A	MY48010425	2019/09/20	2020/09/19
Spectrum Analyzer	R&S	FSP40	100019	2019/09/20	2020/09/19
RF COMMUNICATION TEST SET	HP	8920A	3813A10206	2019/09/20	2020/09/19
Controller	EM Electronics	Controller EM 1000	N/A	N/A	N/A
Horn Antenna	Schwarzbeck	BBHA 9120D	01622	2019/09/20	2020/09/19
Horn Antenna	Schwarzbeck	BBHA 9120D	01652	2019/09/20	2020/09/19
Active Loop Antenna	SCHWARZBEC K	FMZB1519	1519-037	2019/09/20	2020/09/19
Broadband Horn Antenna	SCHWARZBEC K	BBHA 9170	971	2019/09/20	2020/09/19
Amplifier	Schwarzbeck	BBV 9743	#202	2019/09/20	2020/09/19
Amplifier	EMCI	EMC051845B	980355	2019/09/20	2020/09/19
Temperature/Humidi ty Meter	Gangxing	CTH-608	02	2019/09/20	2020/09/19
High-Pass Filter	K&L	9SH10-2700/X12750-O/O	KL142031	2019/09/20	2020/09/19
High-Pass Filter	K&L	41H10-1375/U12750-O/O	KL142032	2019/09/20	2020/09/19
RF Cable(below 1GHz)	HUBER+SUHNE R	RG214	RE01	2019/09/20	2020/09/19
RF Cable(above 1GHz)	HUBER+SUHNE R	RG214	RE02	2019/09/20	2020/09/19
Data acquisition card	Agilent	U2531A	TW53323507	2019/09/20	2020/09/19
Power Sensor	Agilent	U2021XA	MY5365004	2019/09/20	2020/09/19
EMI Test Software	R&S	ES-K1	V1.7.1	2019/09/20	2020/09/19
EMI Test Software	JS Tonscend	JS32-RE	2.0.1.5	2019/09/20	2020/09/19
EMI Test Software	Audix	E3	2..1.1	2019/09/20	2020/09/19

The calibration interval was one year

2.5 Special Accessories

Follow auxiliary equipment(s) test with EUT that provided by the manufacturer or laboratory is listed as follow:

Description	Manufacturer	Model	Technical Parameters	Certificate	Provided by
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/
/	/	/	/	/	/

2.6 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended to comply with FCC Part 90 Rules.

2.7 Modifications

No modifications were implemented to meet testing criteria.

3 TEST CONDITIONS AND RESULTS

3.1 Maximum Transmitter Power

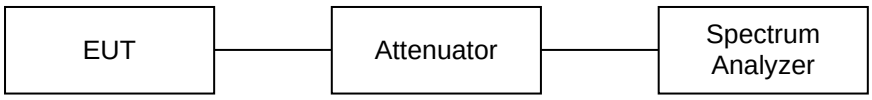
TEST APPLICABLE

Per FCC Part 2.1046 and Part 90.205: Maximum ERP is dependent upon the station's antenna HAAT and required service area.

TEST PROCEDURE

The transmitter output was connected to the spectrum analyzer through an 20dB attenuator. The out put was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW.

TEST CONFIGURATION



TEST RESULTS

Modulation Type	Channel Separation (kHz)	Power Level	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Test result
Analog/FM	12.5KHz	High	136.0125	36.25	4.22	Pass
			155.0125	36.62	4.59	Pass
			173.9875	36.14	4.11	Pass
		Low	136.0125	30.15	1.04	Pass
			155.0125	30.44	1.11	Pass
			173.9875	30.36	1.09	Pass
	25KHz	High	136.0125	36.45	4.42	Pass
			155.0125	36.58	4.55	Pass
			173.9875	36.36	4.33	Pass
		Low	136.0125	30.21	1.05	Pass
			155.0125	30.32	1.08	Pass
			173.9875	30.24	1.06	Pass
Digital/4FSK	12.5KHz	High	136.0125	36.25	4.22	Pass
			155.0125	36.35	4.32	Pass
			173.9875	36.21	4.18	Pass
		Low	136.0125	30.21	1.05	Pass
			155.0125	30.43	1.10	Pass
			173.9875	30.35	1.08	Pass

3.2 Occupied Bandwidth and Emission Mask

TEST APPLICABLE

(a) Occupied Bandwidth: The EUT was connected to the audio signal generator and the spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the bandwidth of 99% power can be measured by the spectrum analyzer.

(b) Emission Mask B: For transmitters that are equipped with an audio low-pass filter pursuant to §90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

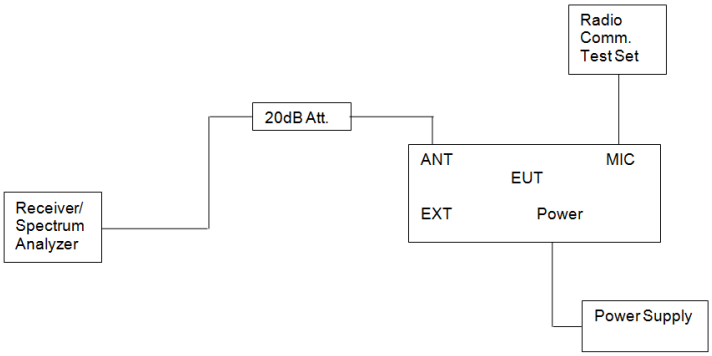
(c) Emission Mask D, 12.5 kHz channel bandwidth equipment: For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d -2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

TEST CONFIGURATION



TEST PROCEDURE

1 The EUT was modulated by 2.5 KHz Sine wave audio signal; the level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing) and 5 kHz (25 kHz channel spacing).

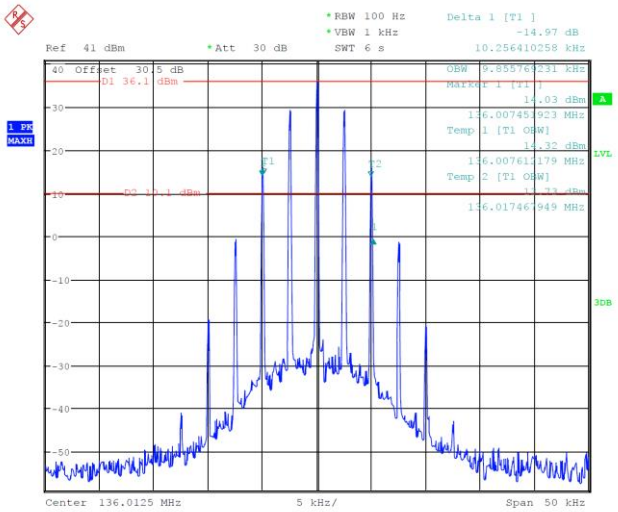
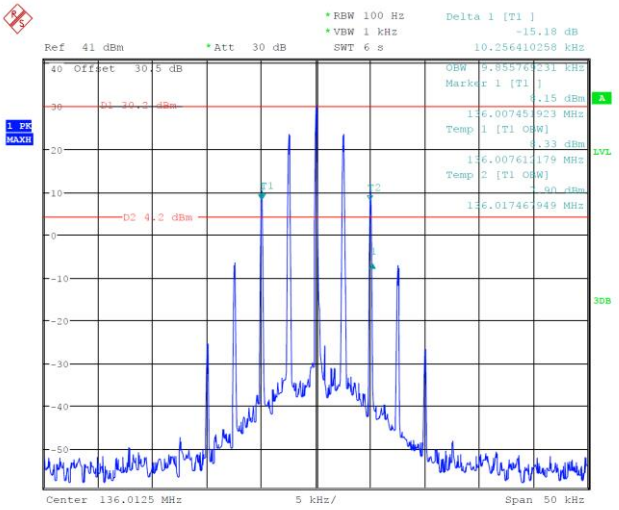
2 Set SPA Center Frequency = fundamental frequency, set RBW=100Hz, VBW= 1 KHz, span =50 KHz for 12.5KHz mode and RBW=300Hz, VBW= 3 KHz for 25KHz mode.

3 Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth.

TEST RESULTS

Occupied Bandwidth:

Modulation Type	Channel Separation (kHz)	Power Level	Frequency (MHz)	99% OBW (kHz)	26dB bandwidth (kHz)	Limit (KHz)	Test result
Analog/FM	12.5KHz	High	136.0125	9.856	10.256	11.25	Pass
			155.0125	9.936	10.256		Pass
			173.9875	9.936	10.337		Pass
		Low	136.0125	9.856	10.256		Pass
			155.0125	9.936	10.256		Pass
			173.9875	9.936	10.256		Pass
	25KHz	High	136.0125	14.824	15.625	20.0	Pass
			155.0125	14.824	15.625		Pass
			173.9875	14.824	15.625		Pass
		Low	136.0125	14.824	15.625		Pass
			155.0125	14.904	15.625		Pass
			173.9875	14.824	15.625		Pass
Digital/4FSK	12.5KHz	High	136.0125	6.731	8.413	11.25	Pass
			155.0125	7.131	8.814		Pass
			173.9875	6.891	8.574		Pass
		Low	136.0125	6.811	8.734		Pass
			155.0125	6.651	8.173		Pass
			173.9875	6.971	8.894		Pass

Analog/FM 12.5KHz, High power	Analog/FM 12.5KHz, Low power
	
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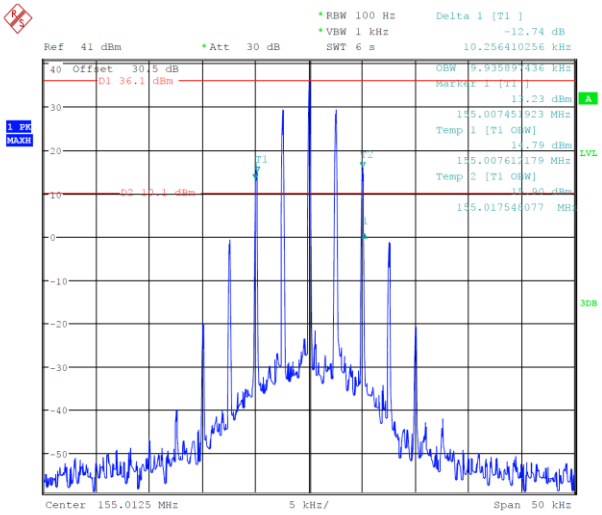
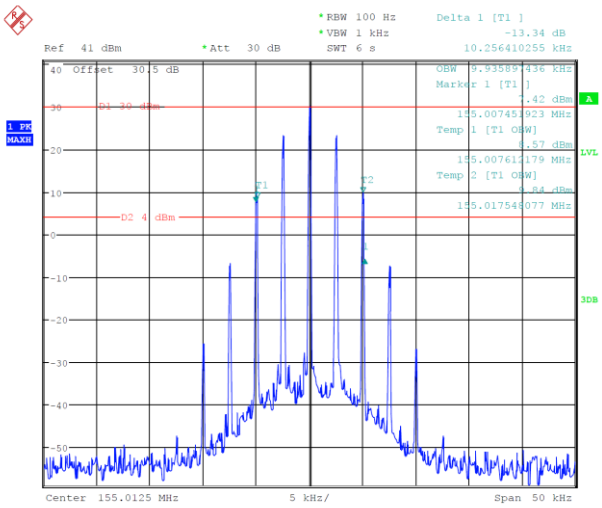
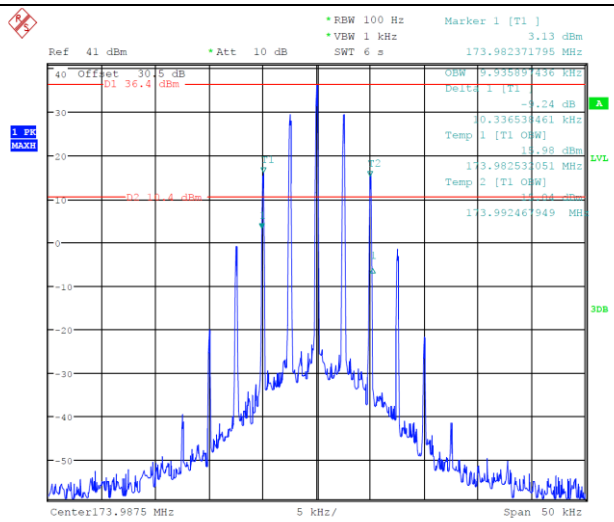
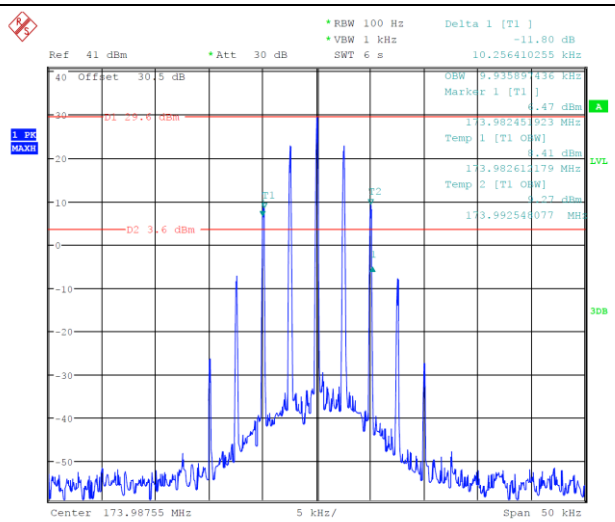
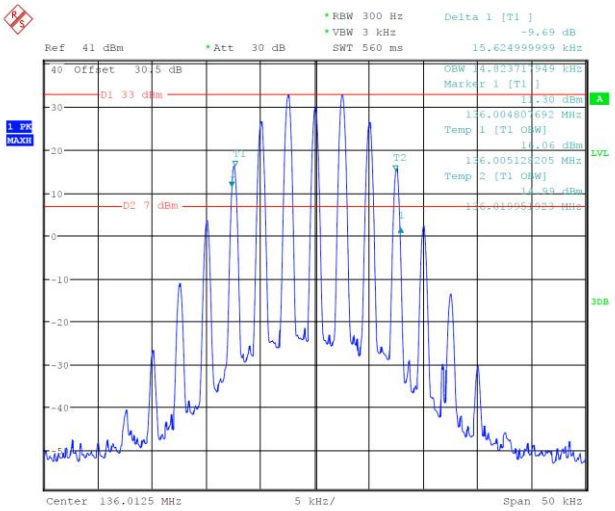
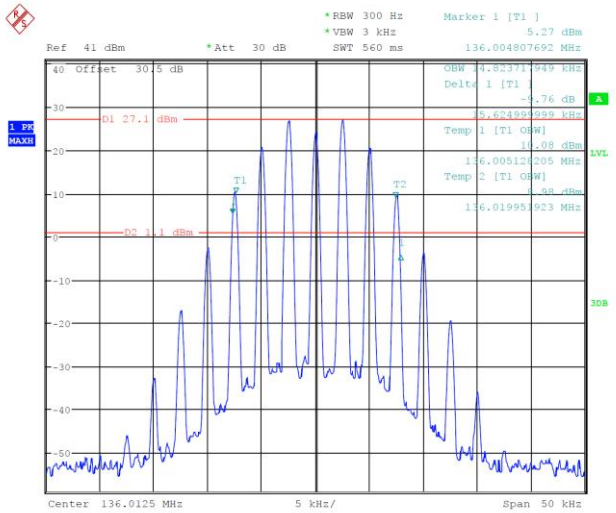
	
155.0125MHz	155.0125MHz
	
173.9875MHz	173.9875 MHz

Analog/FM 25KHz, High power	Analog/FM 25KHz, Low power
	
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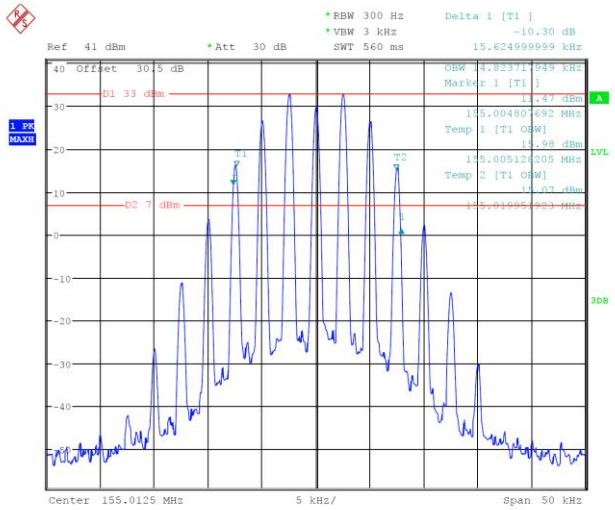
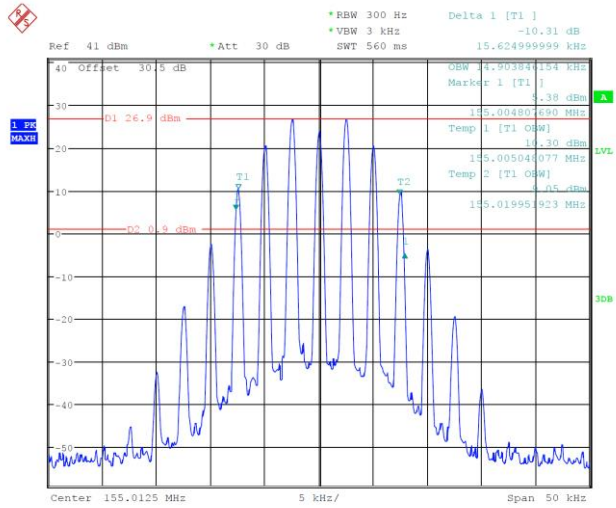
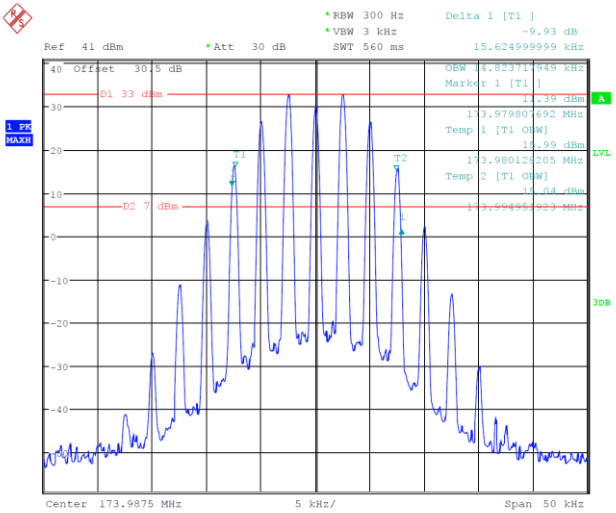
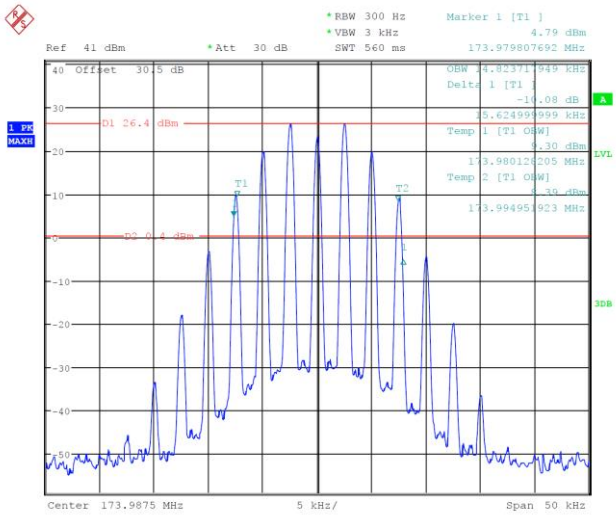
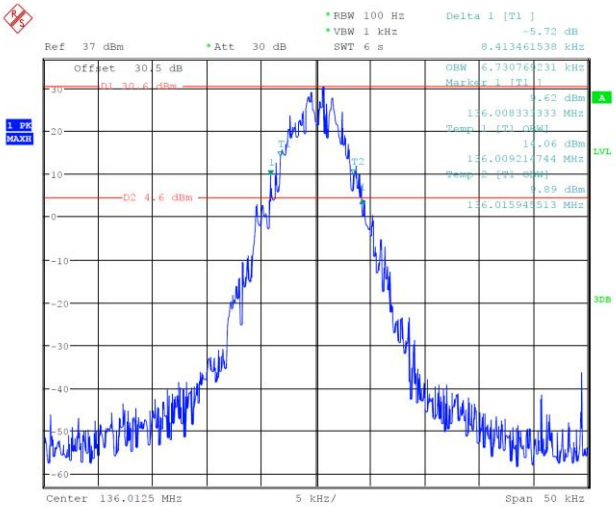
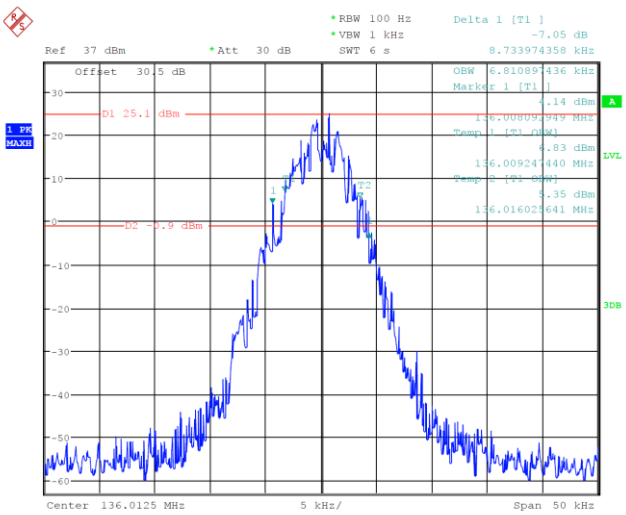
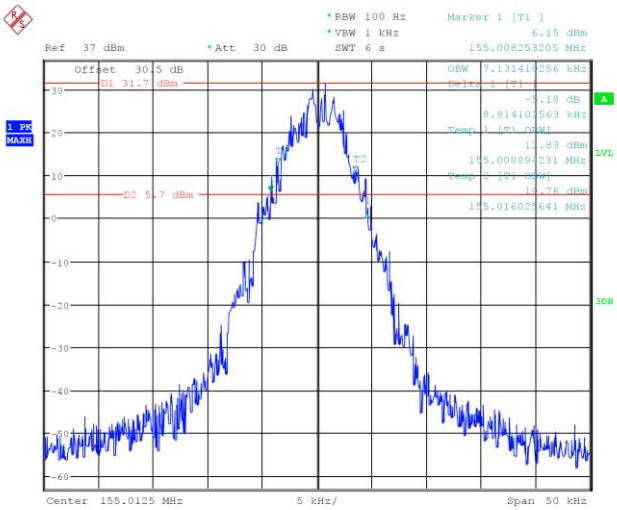
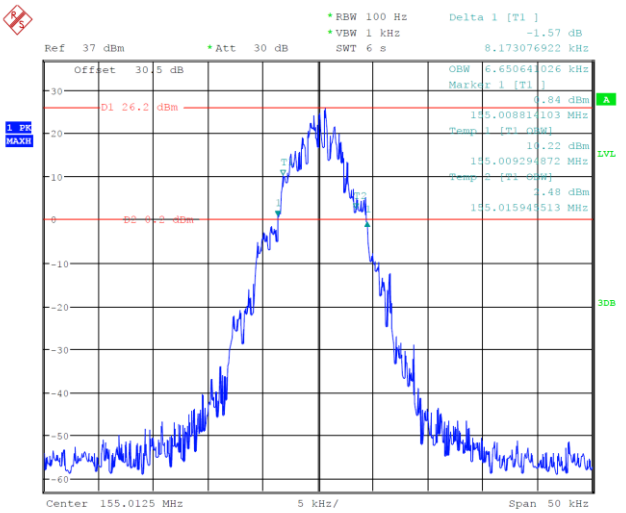
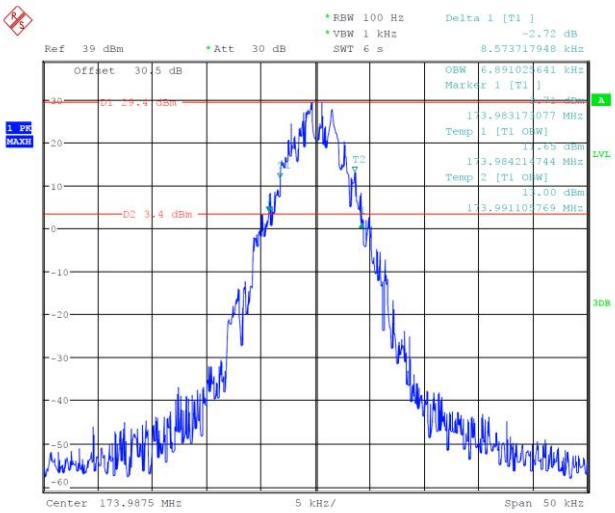
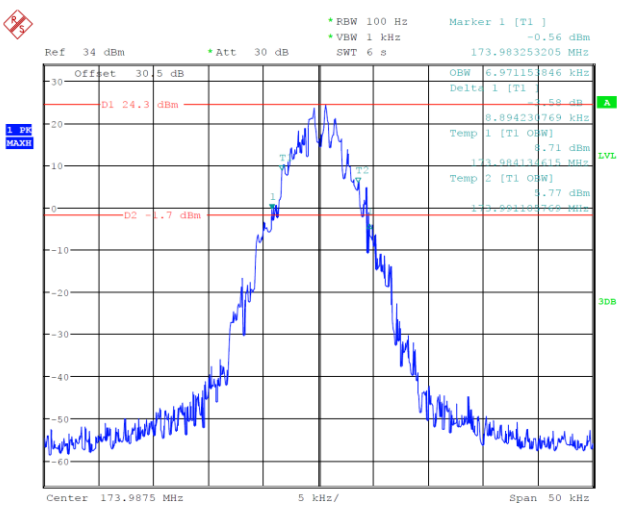
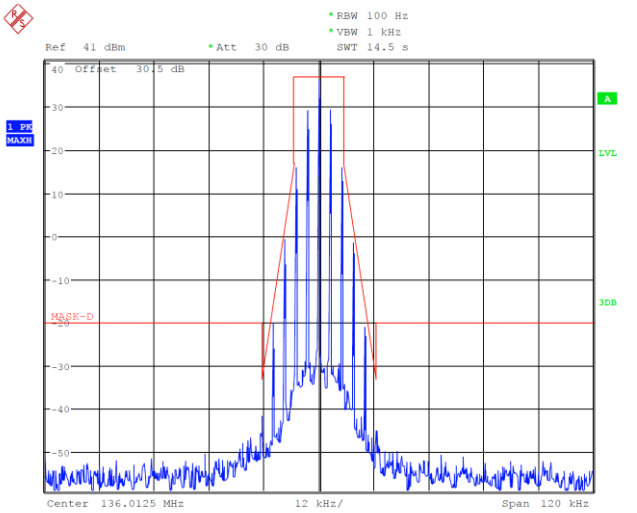
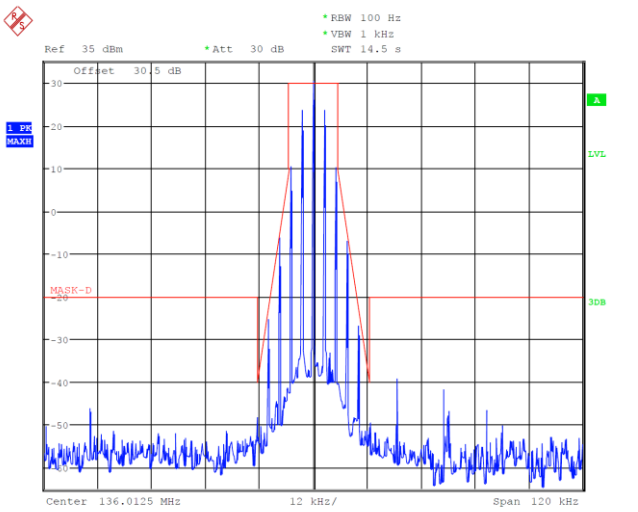
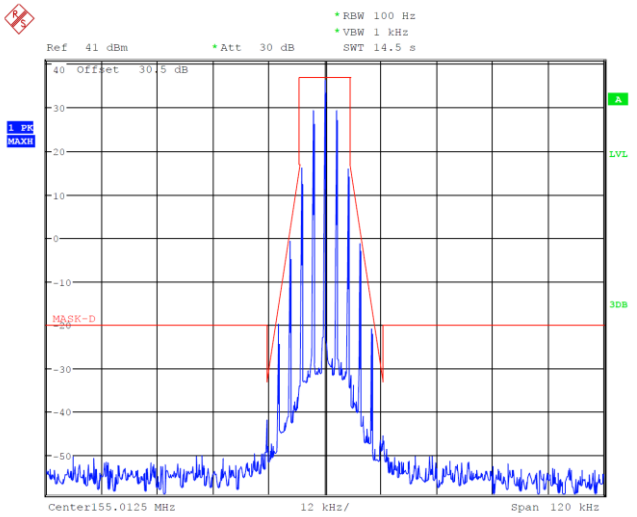
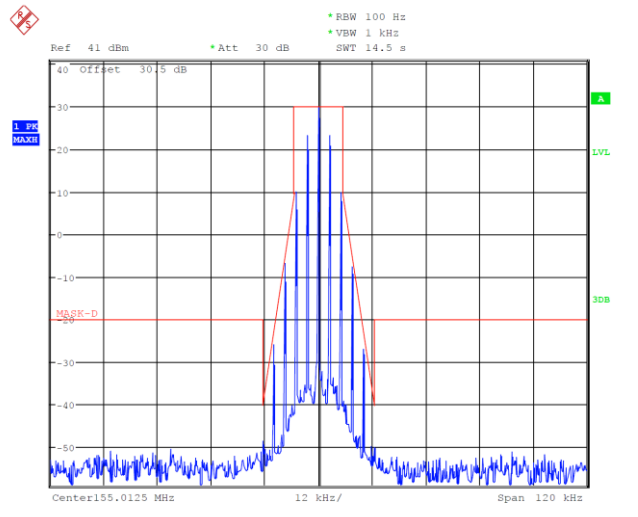
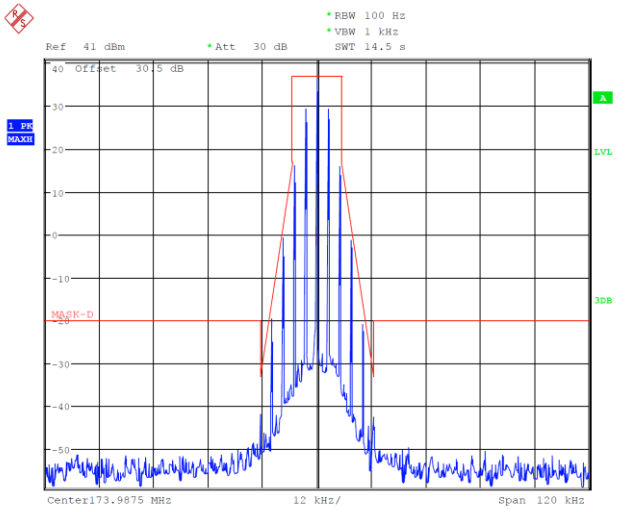
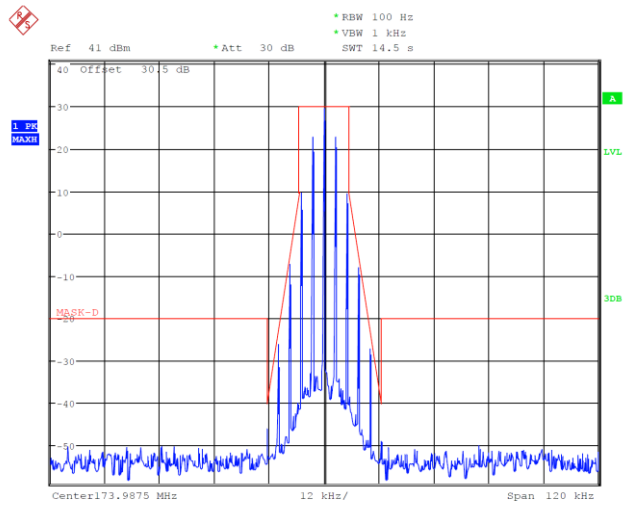
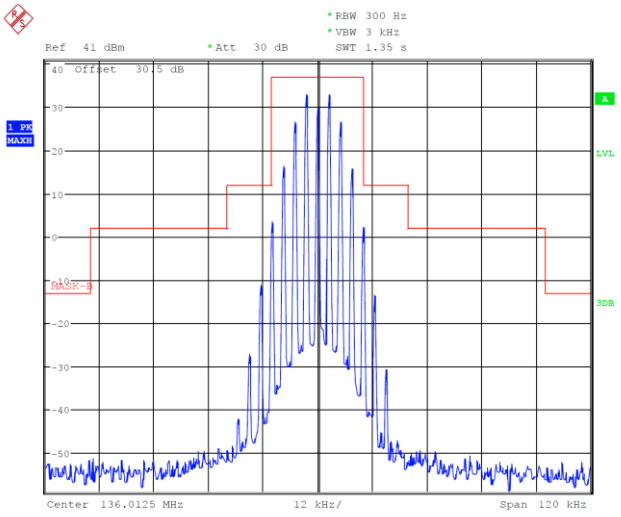
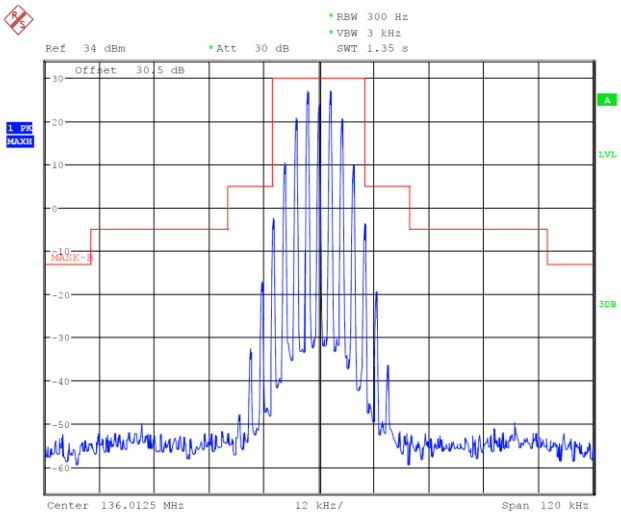
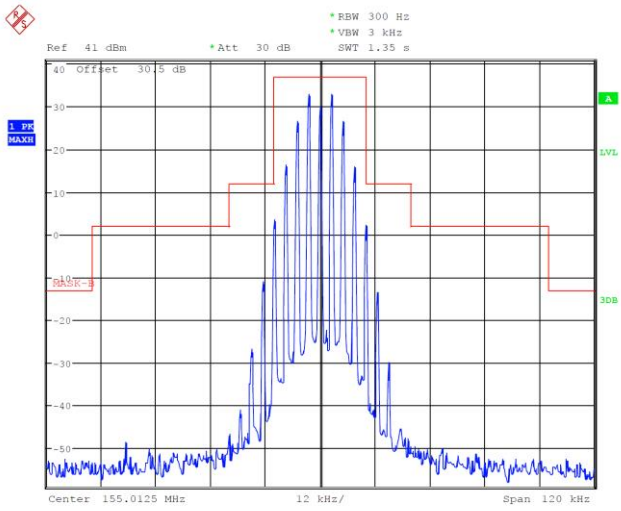
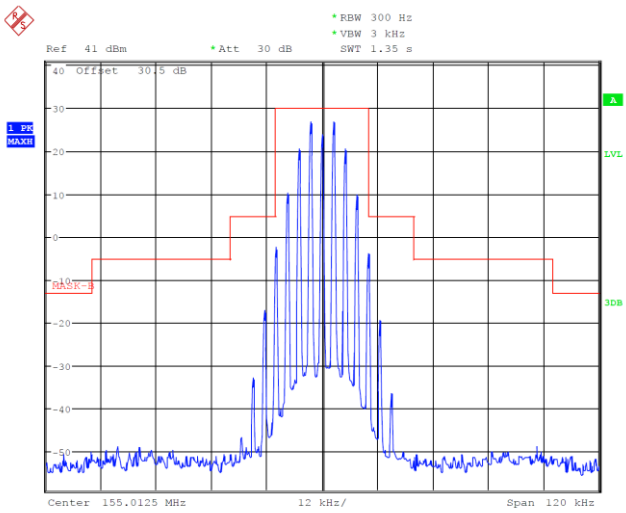
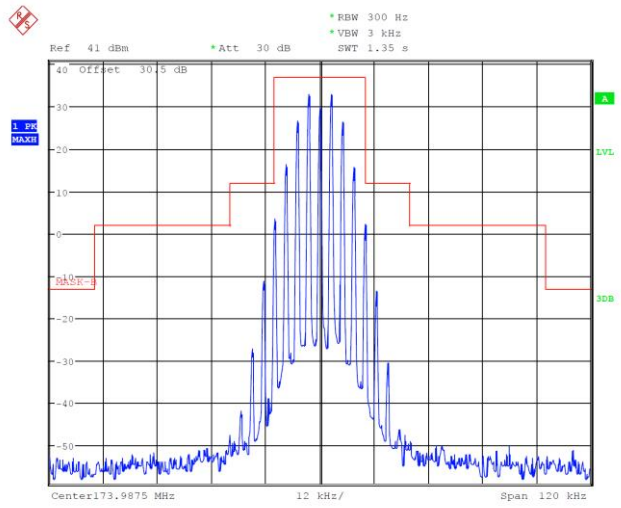
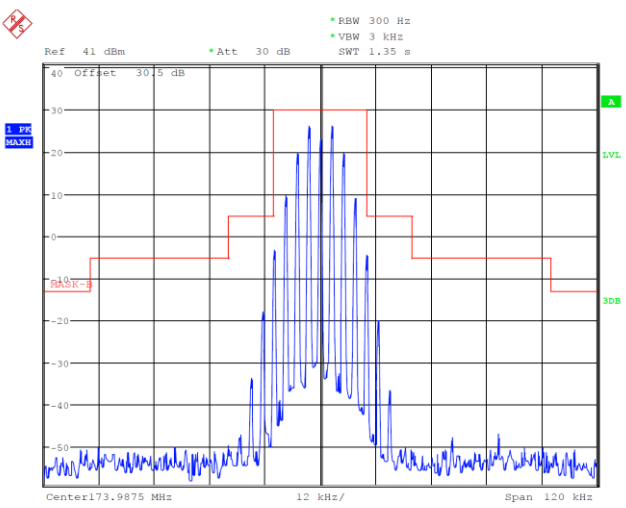
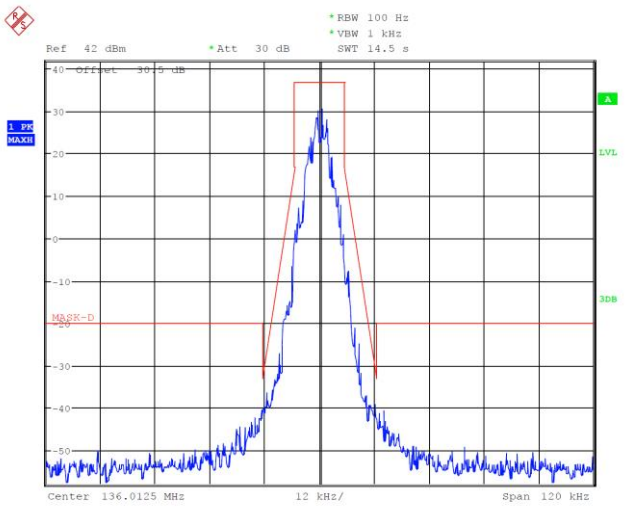
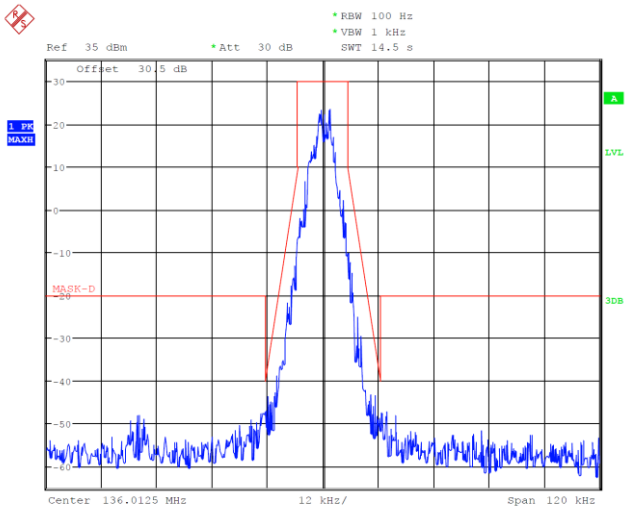
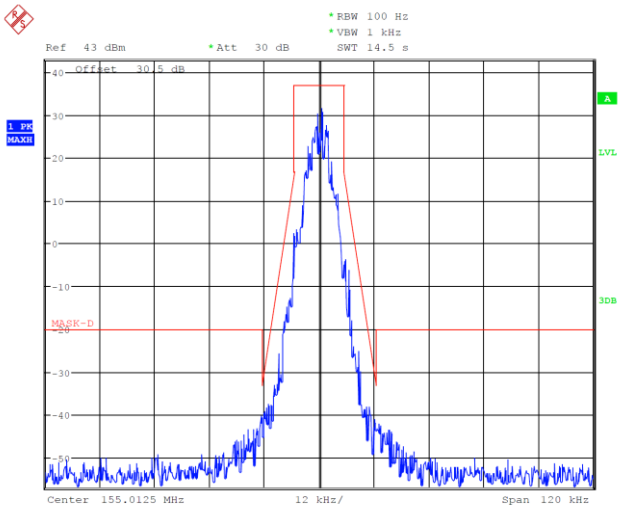
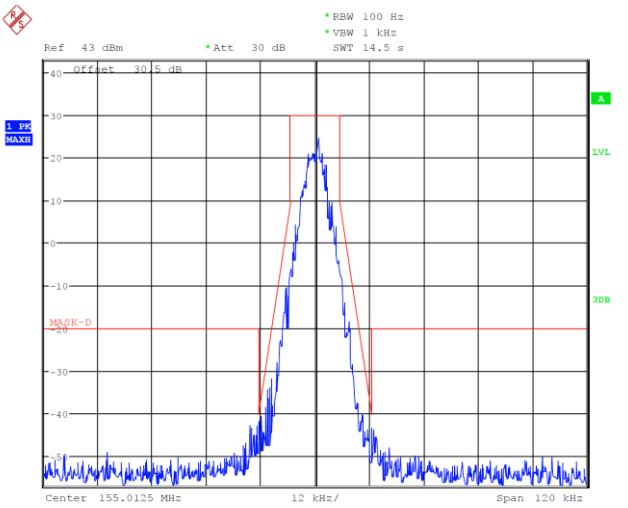
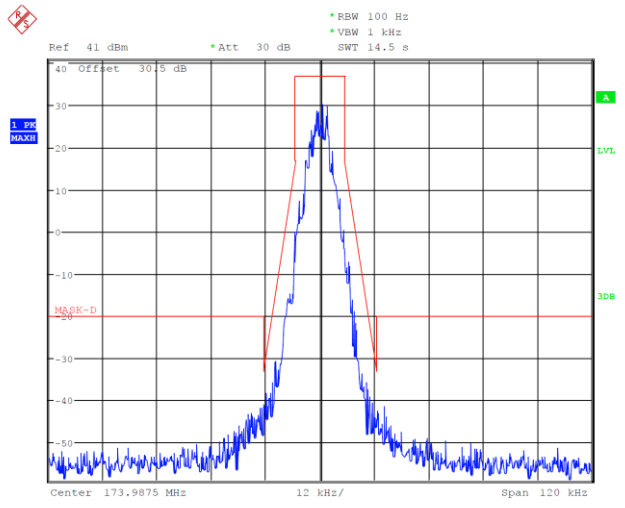
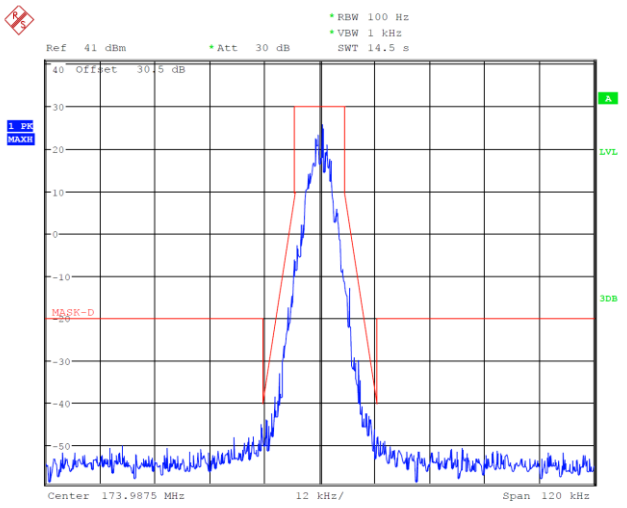
	
155.0125MHz	155.0125MHz
	
173.9875MHz	173.9875 MHz

Digital/4FSK 12.5KHz, High power	Digital/4FSK 12.5KHz, Low power
	
136.0125MHz	136.0125MHz
	
155.0125MHz	155.0125MHz
	
173.9875MHz	173.9875 MHz

Emission Mask:

Analog/FM 12.5KHz, High power	Analog/FM 12.5KHz, Low power
	
136.0125MHz	136.0125MHz
	
155.0125MHz	155.0125MHz
	
173.9875MHz	173.9875 MHz

Analog/FM 25KHz, High power	Analog/FM 25KHz, Low power
	
136.0125MHz	136.0125MHz
	
155.0125MHz	155.0125MHz
	
173.9875MHz	173.9875 MHz

Digital/4FSK 12.5KHz, High power	Digital/4FSK 12.5KHz, Low power
	
136.0125MHz	136.0125MHz
	
155.0125MHz	155.0125MHz
	
173.9875MHz	173.9875 MHz

3.3 Modulation Characteristic

TEST APPLICABLE

According to CFR47 section 2.1047(a), for Voice Modulation Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000Hz shall be measured.

TEST PROCEDURE

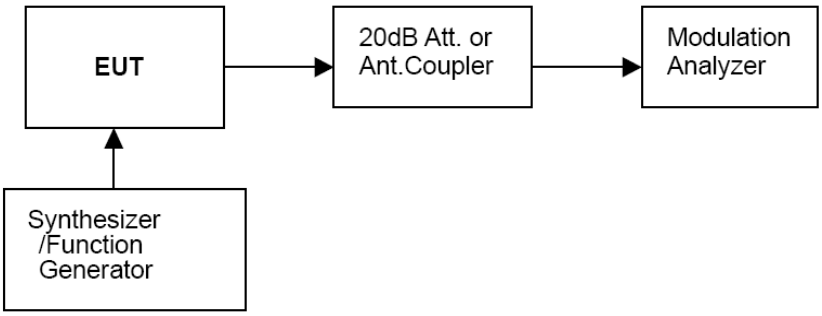
Modulation Limit

1 Configure the EUT as shown in figure 1, adjust the audio input for 60% of rated system deviation at 1 KHz using this level as a reference (0dB) and vary the input level from –20 to +20dB. Record the frequency deviation obtained as a function of the input level.
2 Repeat step 1 with input frequency changing to 300, 1004, 1500 and 2500Hz in sequence.

Audio Frequency Response

1 Configure the EUT as shown in figure 1.
2 Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0dB).
3 Vary the Audio frequency from 100 Hz to 3 KHz and record the frequency deviation.
4 Audio Frequency Response =20log10 (Deviation of test frequency/Deviation of 1 KHz reference).

TEST CONFIGURATION



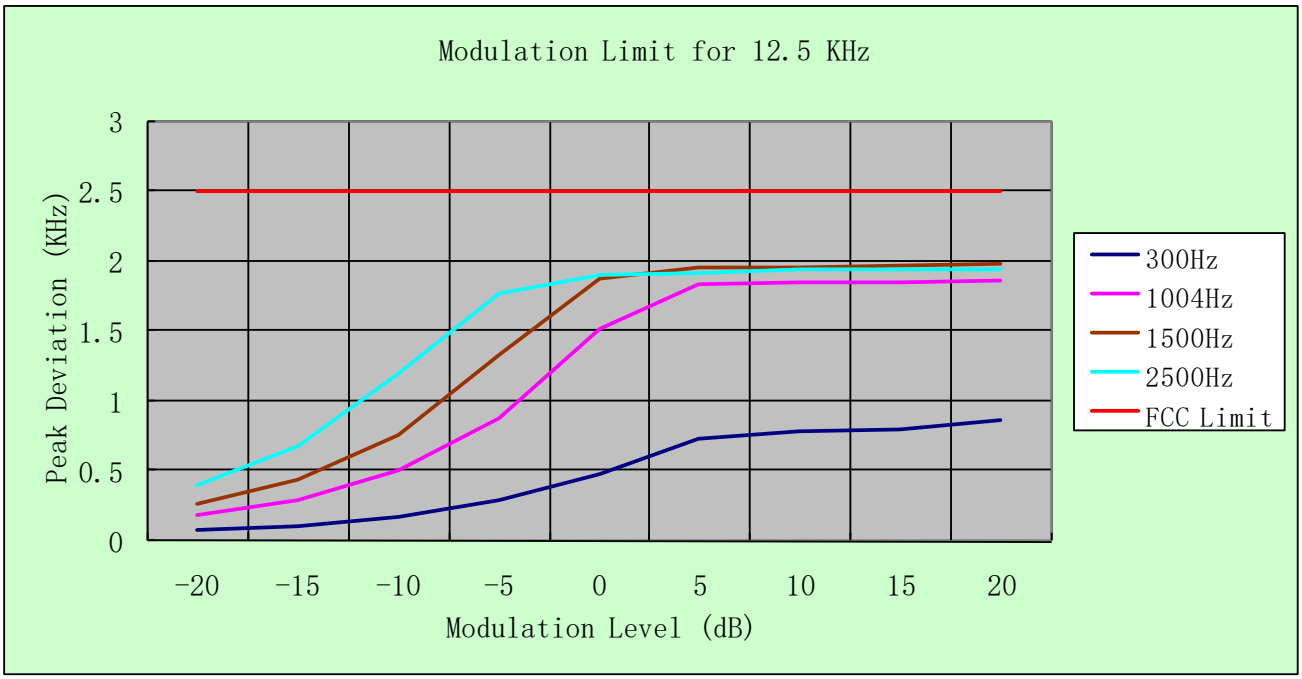
TEST RESULTS

Remark:Test performed from test mode 1 to the mode 4, the worst case of test mode 1 and test mode 3.

Modulation Limit:

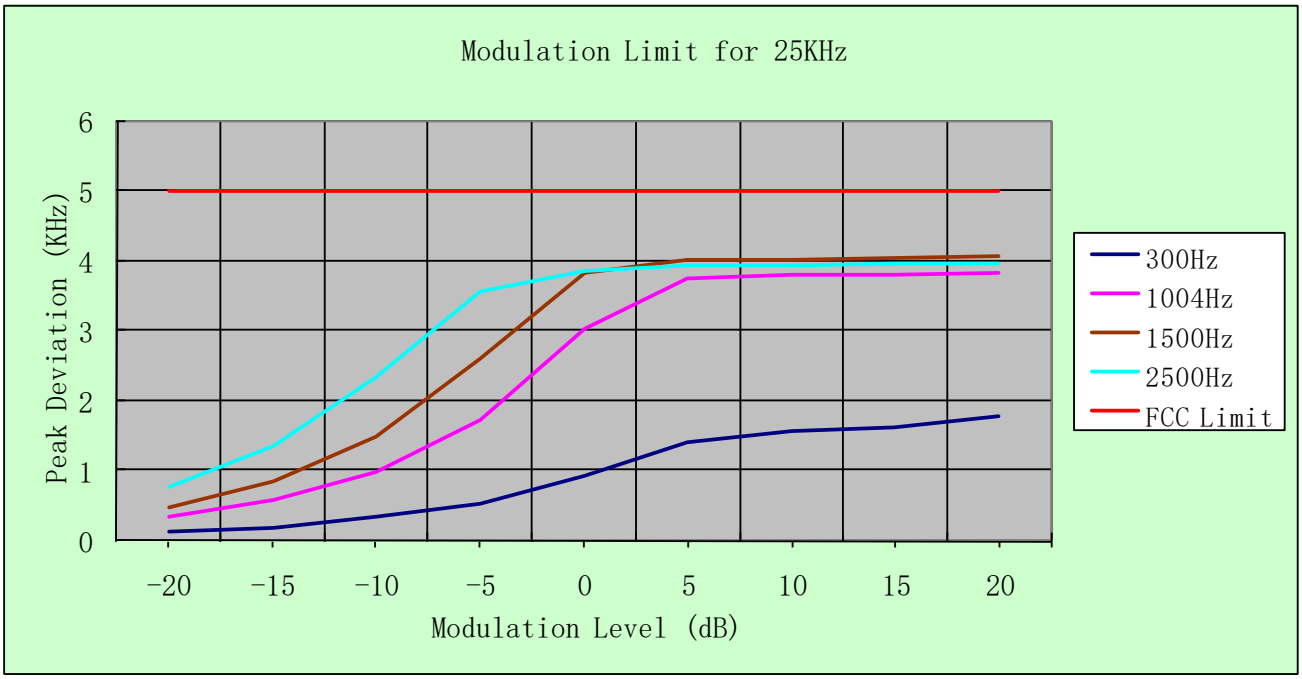
12.5 KHz Channel Separation Test mode 1

Modulation Level (dB)	Peak Freq. Deviation At 300 Hz (KHz)	Peak Freq. Deviation At 1004 Hz (KHz)	Peak Freq. Deviation At 1500 Hz (KHz)	Peak Freq. Deviation At 2500 Hz (KHz)
-20	0.08	0.19	0.26	0.40
-15	0.11	0.30	0.44	0.68
-10	0.18	0.51	0.76	1.19
-5	0.29	0.88	1.33	1.77
0	0.48	1.52	1.87	1.90
+5	0.74	1.83	1.95	1.92
+10	0.79	1.85	1.96	1.94
+15	0.80	1.85	1.97	1.94
+20	0.87	1.86	1.98	1.94



25 KHz Channel Separation Test mode 3

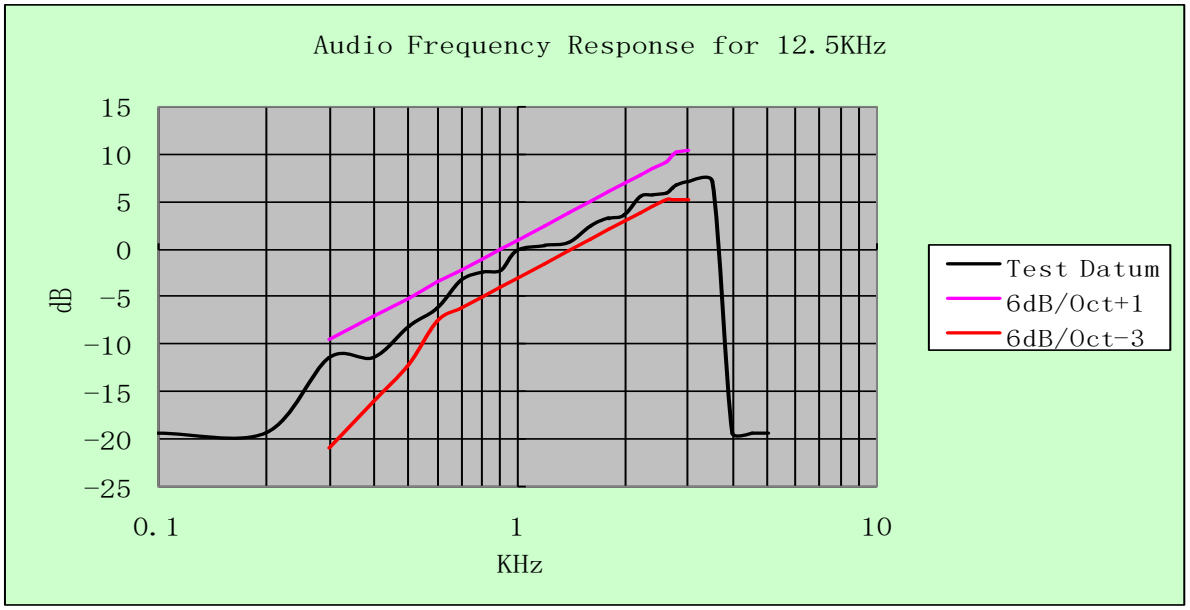
Modulation Level (dB)	Peak Freq. Deviation At 300 Hz (KHz)	Peak Freq. Deviation At 1004 Hz (KHz)	Peak Freq. Deviation At 1500 Hz (KHz)	Peak Freq. Deviation At 2500 Hz (KHz)
-20	0.14	0.34	0.49	0.77
-15	0.2	0.58	0.85	1.36
-10	0.34	0.98	1.49	2.35
-5	0.55	1.72	2.61	3.58
0	0.94	3.03	3.83	3.87
+5	1.42	3.76	4.01	3.94
+10	1.58	3.81	4.02	3.95
+15	1.62	3.82	4.05	3.97
+20	1.78	3.84	4.07	3.98



Audio Frequency Response:

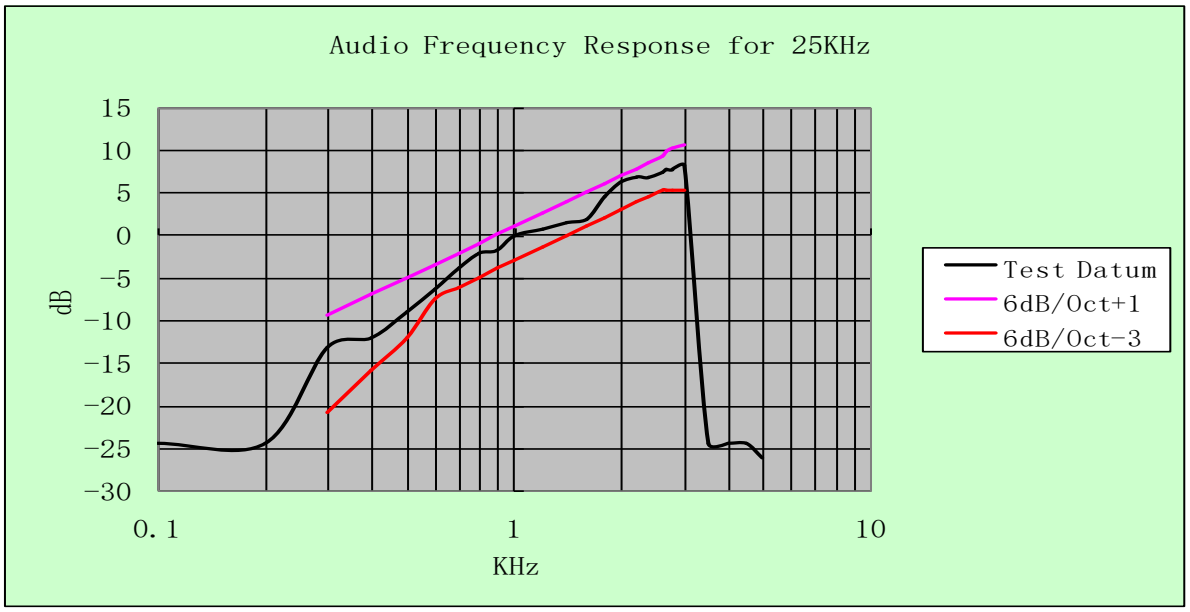
12.5 KHz Channel Separation Test mode 1

Frequency (KHz)	Frequency Deviation (KHz)	1KHz Refenerce Deviation (KHz)	Audio Frequency Response (dB)
0.1	0.06	0.55	-19.24
0.2	0.06	0.55	-19.24
0.3	0.15	0.55	-11.29
0.4	0.15	0.55	-11.29
0.5	0.22	0.55	-7.96
0.6	0.27	0.55	-6.18
0.7	0.38	0.55	-3.21
0.8	0.42	0.55	-2.34
0.9	0.43	0.55	-2.14
1.0	0.55	0.55	0.00
1.2	0.58	0.55	0.46
1.4	0.6	0.55	0.76
1.6	0.74	0.55	2.58
1.8	0.81	0.55	3.36
2.0	0.84	0.55	3.68
2.2	1.05	0.55	5.62
2.4	1.07	0.55	5.78
2.6	1.1	0.55	6.02
2.7	1.17	0.55	6.56
2.8	1.2	0.55	6.78
3.0	1.25	0.55	7.13
3.5	1.25	0.55	7.13
4.0	0.06	0.55	-19.24
4.5	0.06	0.55	-19.24
5.0	0.06	0.55	-19.24



25 KHz Channel Separation Test mode 3

Frequency (KHz)	Frequency Deviation (KHz)	1KHz Reference Deviation (KHz)	Audio Frequency Response (dB)
0.1	0.06	1.01	-24.52
0.2	0.06	1.01	-24.52
0.3	0.22	1.01	-13.24
0.4	0.25	1.01	-12.13
0.5	0.36	1.01	-8.96
0.6	0.49	1.01	-6.28
0.7	0.65	1.01	-3.83
0.8	0.79	1.01	-2.13
0.9	0.82	1.01	-1.81
1.0	1.01	1.01	0.00
1.2	1.10	1.01	0.74
1.4	1.19	1.01	1.42
1.6	1.26	1.01	1.92
1.8	1.70	1.01	4.52
2.0	2.06	1.01	6.19
2.2	2.21	1.01	6.80
2.4	2.20	1.01	6.76
2.6	2.35	1.01	7.33
2.7	2.45	1.01	7.70
2.8	2.45	1.01	7.70
3.0	2.60	1.01	8.21
3.5	0.06	1.01	-24.52
4.0	0.06	1.01	-24.52
4.5	0.06	1.01	-24.52
5.0	0.05	1.01	-26.11



3.4 Frequency Stability

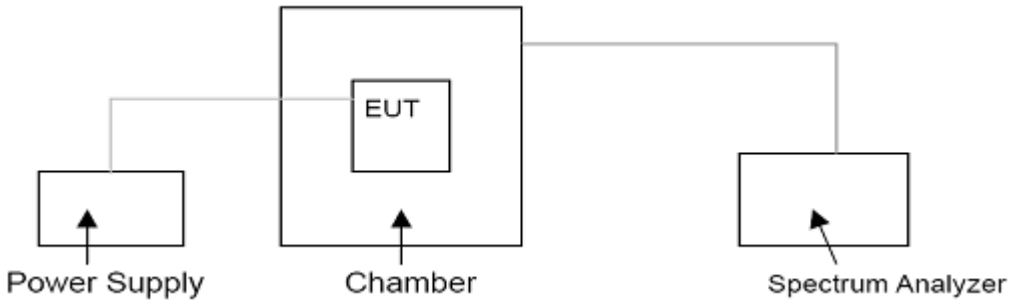
LIMITS

According to 90.213, Transmitters used must have minimum frequency stability as specified in the following table.

Frequency Range (MHz)	Channel Bandwidth (KHz)	Frequency Tolerance (ppm)		
		Fixed and Base Stations	Mobile Stations	
			> 2 W	≤ 2 W
150-174 MHz	6.25 12.5 25	1.0 2.5 5.0	2.0 5.0 5.0	2.0 5.0 50.0*
421-512 MHz	6.25 12.5 25	0.5 1.5 2.5	1.0 2.5 5.0	1.0 2.5 5.0

- Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
- Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

TEST CONFIGURATION



TEST PROCEDURE

The EUT was set in the climate chamber and connected to an external DC power supply. The RF output was directly connected to Spectrum Analyzer. The coupling loss of the additional cables was recorded and taken in account for all the measurements. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded.

TEST RESULTS

Remark:Test performed from test mode 1 to the mode 6, record the worst case of test mode 1, mode 3 and test mode 5.

FM 12.5 KHz Channel Separation Test mode 1

Test conditions		Frequency error (ppm)			Limit (ppm)	Result
Voltage(V)	Temp(℃)	136.0125	155.0125	173.9875		
3.80	-30	1.03	1.05	1.11	5.0	Pass
	-20	0.55	0.76	0.99		
	-10	0.77	0.80	0.87		
	0	0.65	0.82	0.81		
	10	0.80	0.76	0.75		
	20	0.60	0.65	0.71		
	30	0.72	0.70	0.65		
	40	0.53	0.52	0.45		
	50	0.64	0.60	0.55		
4.37 (85% Rated)	20	0.72	0.61	0.63		
3.23 (115% Rated)	20	0.78	0.72	0.70		

FM 25 KHz Channel Separation Test mode 3

Test conditions		Frequency error (ppm)			Limit (ppm)	Result
Voltage(V)	Temp(℃)	136.0125	155.0125	173.9875		
3.80	-30	1.05	1.10	1.07	5.0	Pass
	-20	0.75	0.76	0.75		
	-10	0.80	0.76	0.78		
	0	0.79	0.65	0.65		
	10	0.68	0.75	0.73		
	20	0.55	0.61	0.58		
	30	0.87	0.83	0.81		
	40	0.69	0.66	0.68		
	50	0.95	0.92	0.91		
4.37 (85% Rated)	20	0.81	0.86	0.82		
3.23 (115% Rated)	20	0.74	0.75	0.79		

Digital 12.5 KHz Channel Separation Test mode 5

Test conditions		Frequency error (ppm)			Limit (ppm)	Result
Voltage(V)	Temp(℃)	136.0125	155.0125	173.9875		
3.80	-30	1.20	1.11	0.92	5.0	Pass
	-20	0.75	0.83	0.87		
	-10	0.76	0.77	0.79		
	0	0.70	0.76	0.76		
	10	0.80	0.74	0.70		
	20	0.68	0.63	0.63		
	30	0.70	0.76	0.68		
	40	0.89	0.82	0.94		
	50	1.01	1.02	1.01		
4.37 (85% Rated)	20	0.84	0.89	0.84		
3.23 (115% Rated)	20	0.69	0.72	0.79		

3.5 Transmitter Frequency Behavior

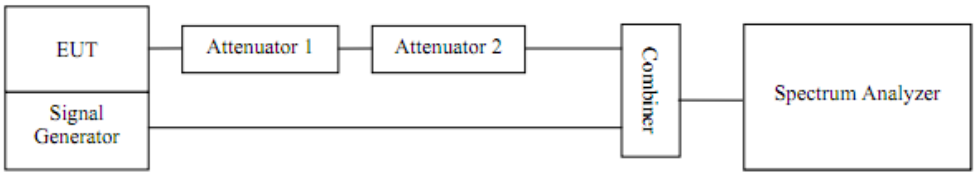
TEST APPLICABLE

Section 90.214
Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1, 2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 KHz Channels			
t_1 [4]	± 25.0 KHz	5.0 ms	10.0 ms
t_2	± 12.5 KHz	20.0 ms	25.0 ms
t_3 [4]	± 25.0 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 KHz Channels			
t_1 [4]	± 12.5 KHz	5.0 ms	10.0 ms
t_2	± 6.25 KHz	20.0 ms	25.0 ms
t_3 [4]	± 12.5 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 KHz Channels			
t_1 [4]	±6.25 KHz	5.0 ms	10.0 ms
t_2	±3.125 KHz	20.0 ms	25.0 ms
t_3 [4]	±6.25 KHz	5.0 ms	10.0 ms

1. t_{on} is the instant when a 1 KHz test signal is completely suppressed, including any capture time due to phasing.
   t_1 is the time period immediately following t_{on}.
   t_2 is the time period immediately following t_1.
   t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
   t_{off} is the instant when the 1 KHz test signal starts to rise.
2. During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
3. Difference between the actual transmitter frequency and the assigned transmitter frequency.
4. If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

TEST CONFIGURATION



TEST PROCEDURE

1. Connect the EUT and test equipment as shown in the test configuration.
2. Set Spectrum Analyzer to measure FM deviation, and tune the RF frequency to transmitter assigned frequency.
3. Set the signal generator to the assigned transmitter frequency and modulate it with a 1KHz tone at ± 12.5Khz deviation and set its output level to -100dBm.
4. Turn on the transmitter.
5. Supply sufficient attenuation via RF attenuator to provide an input level to the Spectrum Analyzer that is 40dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on Spectrum Analyzer as P_0.
6. Turn off the transmitter.
7. Adjust the RF level of the signal generator to provide RF power equal to P_0. This signal generator RF level shall be maintained throughout the rest of the measurement.
8. Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30dB when the transmitter is turned on.
9. Adjust the vertical amplitude control of the spectrum analyzer to display the 1000Hz at ±4 divisions vertically centered on display. Set trigger mode of the Spectrum Analyzer to “Video”, and tune the “trigger

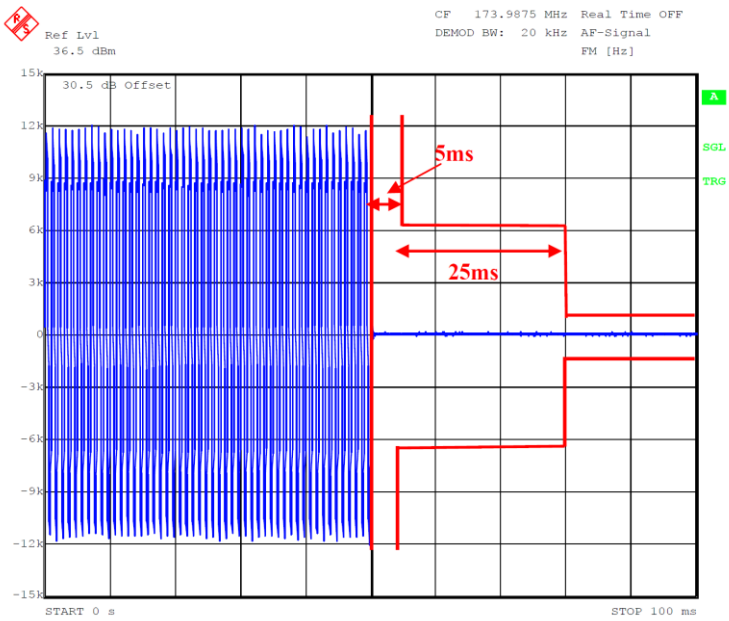
level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.

10. Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 KHz test signal is completely suppressed is considered to be t_{on}. The trace should be maintained within the allowed divisions during the period t_1 and t_2.
11. Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period t_3.

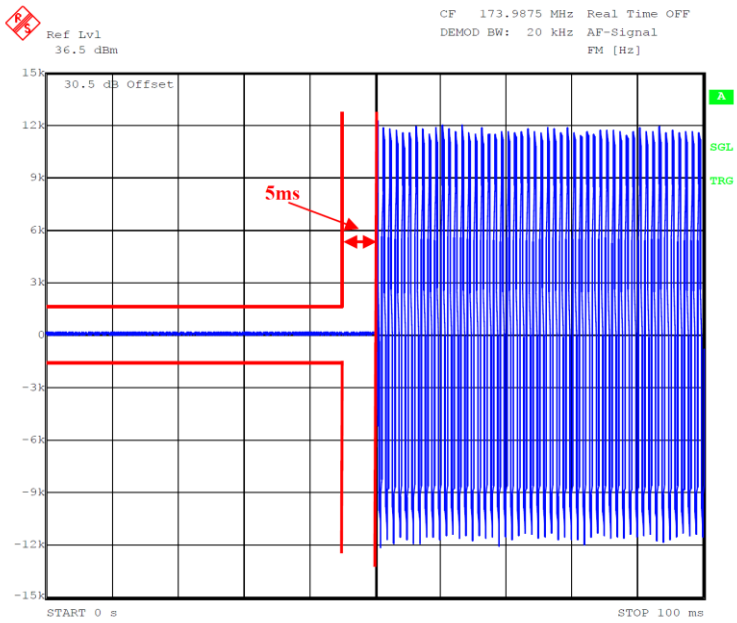
TEST RESULTS

Modulation Type: FM

Transmitter Frequency Behavior @ 12.5 KHz Channel Separation------Off – On



Transmitter Frequency Behavior @ 12.5 KHz Channel Separation------On – Off



3.6 Transmitter Radiated Spurious Emission

Limit

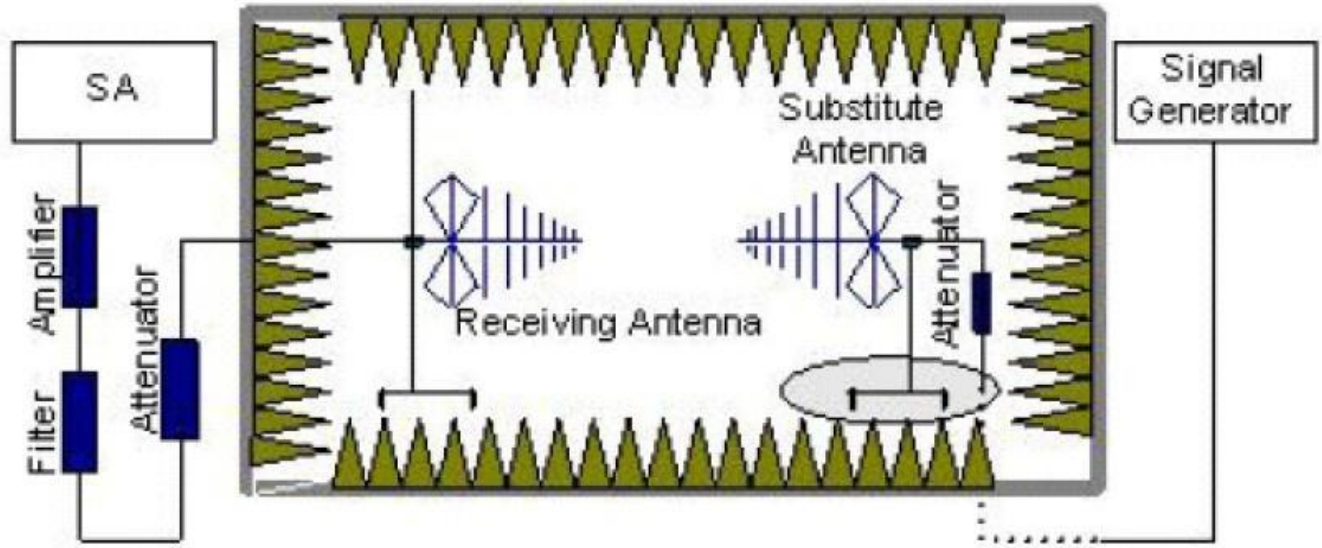
According to the TIA/EIA 603 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

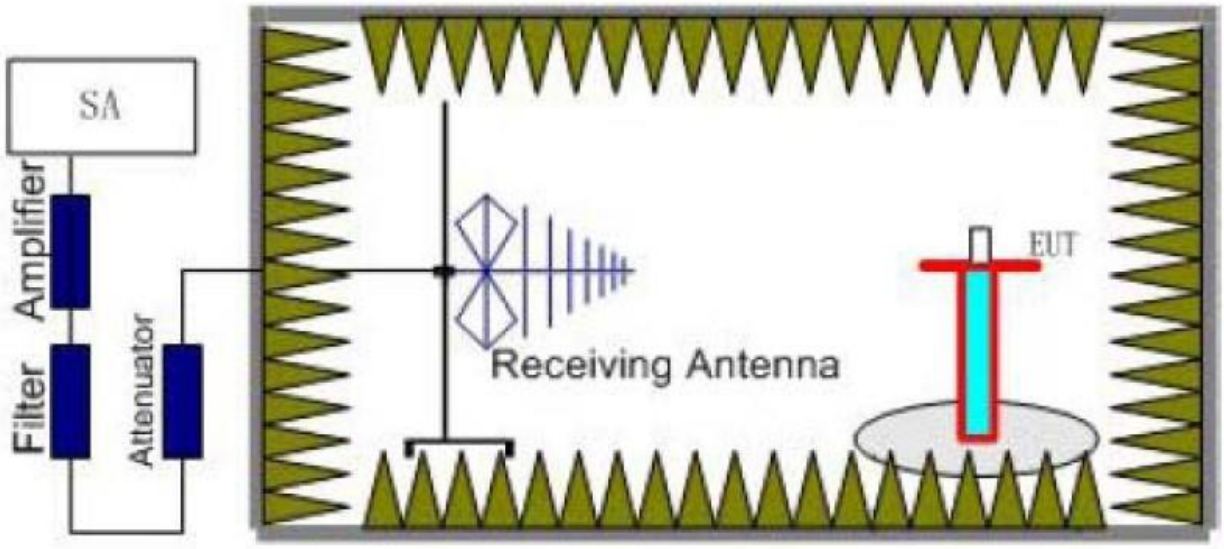
1 On any frequency removed from the center of the authorized bandwidth fo to 5.625 KHz removed from fo: Zero dB
2 On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) fo of more than 5.625 KHz but no more than 12.5 KHz: At least 7.27dB
3 On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in KHz) fo of more than 12.5 KHz: At least 50+10 log (P) dB or 70 dB, which ever is lesser attenuation.

For transmitters designed to transmit with 25 KHz channel separation and equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as following:

1 On any frequency removed from the assigned frequency by more than 50 percent, but no more than 100 percent of the authorized bandwidth: At least 25 dB.
2 On any frequency removed from the assigned frequency by more than 100 percent, but no more than 250 percent of the authorized bandwidth: At least 35 dB.
3 On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43+10Log (P) dB.

TEST CONFIGURATION





TEST PROCEDURE

a. EUT was placed on a 0.8 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.0m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all test transmit frequencies were measured with peak detector.
b. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
c. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum 100 kHz below 1GHz and 1MHz above 1GHz, Sweep from 30MHz to the 10th harmonic of the fundamental frequency; and recorded the level of the concerned spurious emission point as (P_r).
d. The EUT then replaced by a substitution antenna. In the chamber, an substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.
The measurement results are obtained as described below:

$$\text{Power}_{(EIRP)} = P_{Mea} - P_{cl} + G_a$$

Where;
P_{Mea} is the recorded signal generator level
P_{cl} is the cable loss connect between instruments
G_a Substitution Antenna Gain
e. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
f. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP -2.15dBi.
g. Test site anechoic chamber refer to ANSI C63.

TEST RESULTS

Remark: Test performed from test mode 1 to the mode 6,record the worst case of test mode 1,mode 3 and test mode 5.

FM 12.5 KHz Channel Separation Test mode 1

Test Frequency (MHz)	Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	Distance (m)	G_a Antenna Gain(dBi)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Pol.
136.0125	272.0250	-34.80	0.87	3.00	6.42	-29.25	-20.00	9.25	V
	408.0375	-38.02	1.02	3.00	7.35	-31.69	-20.00	11.69	V
	544.0500	-42.63	1.10	3.00	8.26	-35.47	-20.00	15.47	V
	--	--	--	--	--	--	--	--	--
155.0125	310.0250	-34.75	0.92	3.00	6.80	-28.87	-20.00	8.87	V
	465.0375	-37.19	1.06	3.00	7.89	-30.36	-20.00	10.36	V
	620.0500	-42.10	1.12	3.00	8.12	-35.10	-20.00	15.10	V
	--	--	--	--	--	--	--	--	--
173.9875	347.9750	-35.72	0.95	3.00	6.80	-29.87	-20.00	9.87	V
	521.9625	-39.17	1.10	3.00	7.91	-32.36	-20.00	12.36	V
	695.9500	-43.25	1.21	3.00	8.25	-36.21	-20.00	16.21	V
	--	--	--	--	--	--	--	--	--

Remark:
1. *EIRP=P_{Mea}(dBm)-P_{cl}(dB) +G_a(dBi)*
2. *-- Means other points for values lower than limits and not recorded.*
3. *Margin = Limit – EIRP*

FM 25 KHz Channel Separation Test mode 3

Test Frequency (MHz)	Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	Distance (m)	G_a Antenna Gain(dBi)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Pol.
136.0125	272.0250	-36.11	0.87	3.00	6.42	-30.56	-13.00	17.56	V
	408.0375	-39.69	1.02	3.00	7.35	-33.36	-13.00	20.36	V
	544.0500	-45.94	1.10	3.00	8.26	-38.78	-13.00	25.78	V
	--	--	--	--	--	--	--	--	--
155.0125	310.0250	-35.86	0.92	3.00	6.80	-29.98	-13.00	16.98	V
	465.0375	-39.37	1.06	3.00	7.89	-32.54	-13.00	19.54	V
	620.0500	-43.21	1.12	3.00	8.12	-36.21	-13.00	23.21	V
	--	--	--	--	--	--	--	--	--
173.9875	347.9750	-36.21	0.95	3.00	6.80	-30.36	-13.00	17.36	V
	521.9625	-40.86	1.10	3.00	7.91	-34.05	-13.00	21.05	V
	695.9500	-44.91	1.21	3.00	8.25	-37.87	-13.00	24.87	V
	--	--	--	--	--	--	--	--	--

Remark:
1. *EIRP=P_{Mea}(dBm)-P_{cl}(dB) +G_a(dBi)*
2. *-- Means other points for values lower than limits and not recorded.*
3. *Margin = Limit – EIRP*

Digital 12.5 KHz Channel Separation Test mode 5

Test Frequency (MHz)	Frequency (MHz)	P_{Mea} (dBm)	P_{cl} (dB)	Distance (m)	G_a Antenna Gain(dBi)	Peak ERP (dBm)	Limit (dBm)	Margin (dB)	Pol.
136.0125	272.0250	-35.79	0.87	3.00	6.42	-30.24	-20.00	10.24	V
	408.0375	-38.66	1.02	3.00	7.35	-32.33	-20.00	12.33	V
	544.0500	-44.14	1.10	3.00	8.26	-36.98	-20.00	16.98	V
	--	--	--	--	--	--	--	--	--
155.0125	310.0250	-36.09	0.92	3.00	6.80	-30.21	-20.00	10.21	V
	465.0375	-40.08	1.06	3.00	7.89	-33.25	-20.00	13.25	V
	620.0500	-44.54	1.12	3.00	8.12	-37.54	-20.00	17.54	V
	--	--	--	--	--	--	--	--	--
173.9875	347.9750	-37.06	0.95	3.00	6.80	-31.21	-20.00	11.21	V
	521.9625	-41.39	1.10	3.00	7.91	-34.58	-20.00	14.58	V
	695.9500	-44.98	1.21	3.00	8.25	-37.94	-20.00	17.94	V
	--	--	--	--	--	--	--	--	--

Remark:

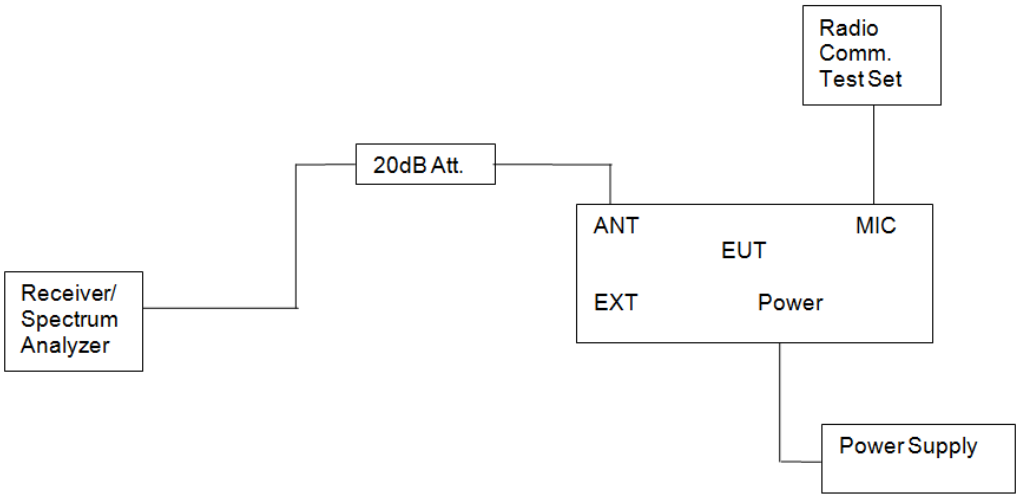
1. *ERP=P_{Mea}(dBm)-P_{cl}(dB) +G_a(dBi)*
2. *-- Means other points for values lower than limits and not recorded.*
3. *Margin = Limit – EIRP*

3.7 Spurious Emission on Antenna Port

Limit

The same as Section 3.6

TEST CONFIGURATION



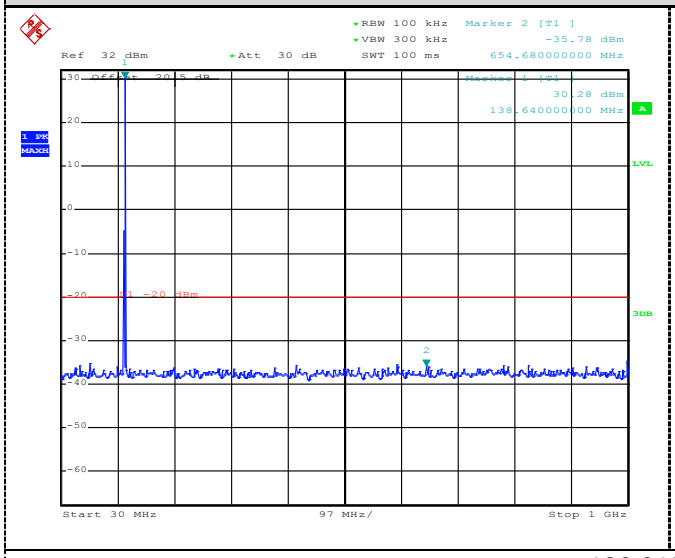
TEST PROCEDURE

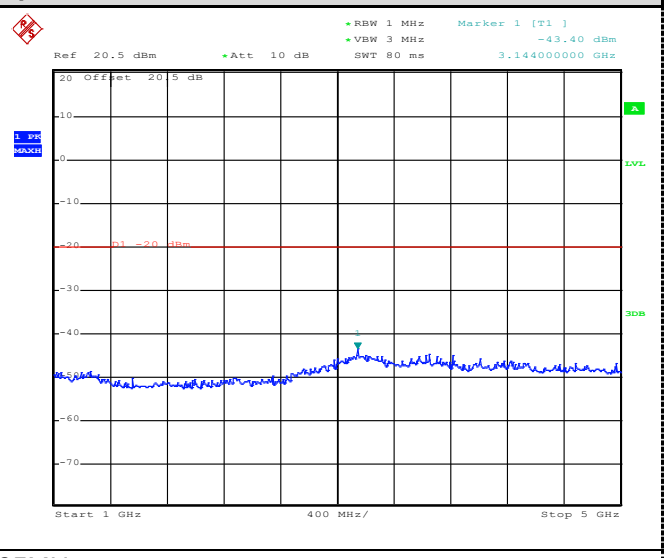
The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range. Set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz,while set RBW=1MHz.VBW=3MHz from the 1GHz to 10th Harmonic.

TEST RESULTS

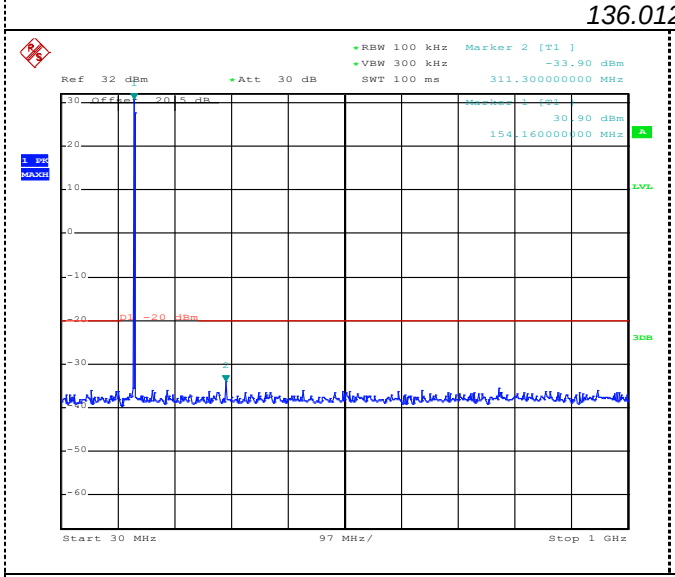
Remark: Test performed from test mode 1 to the mode 6,record the worst case of test mode 1,mode 3 and test mode 5.

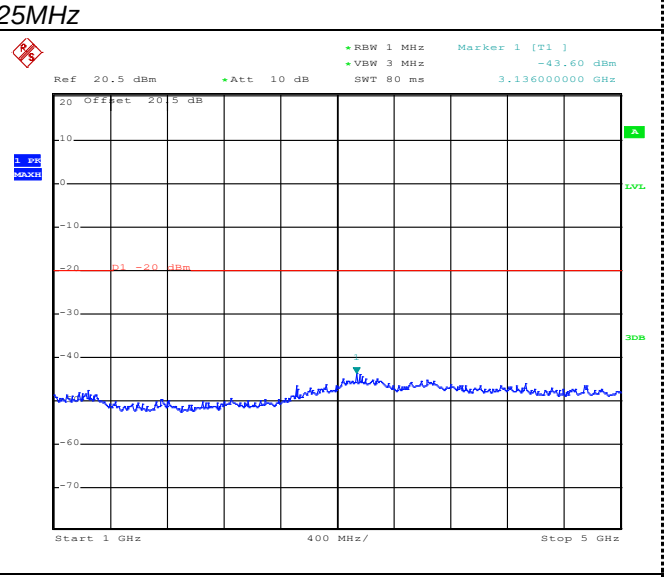
FM 12.5 KHz Channel Separation Test mode 1



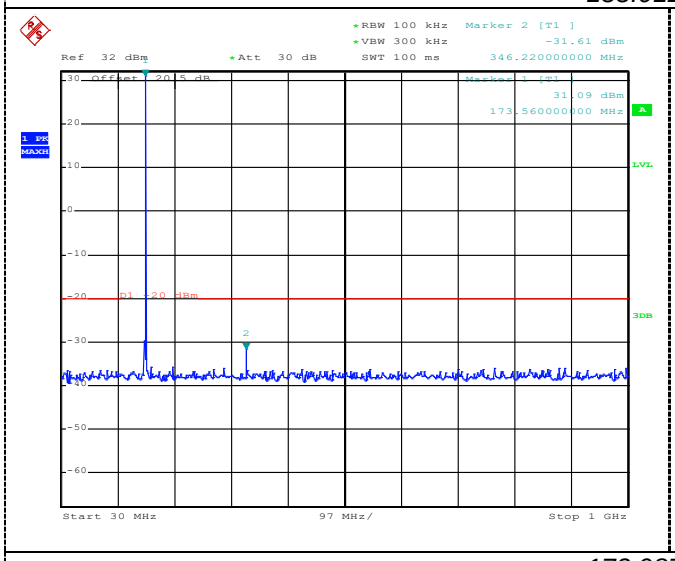


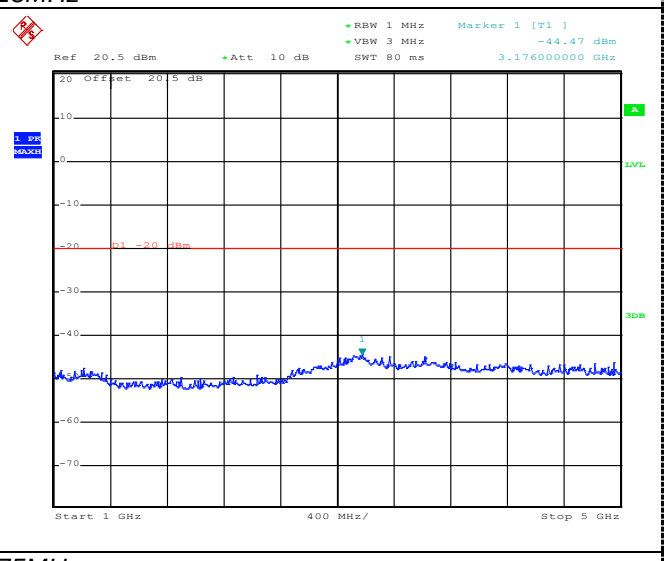
136.0125MHz





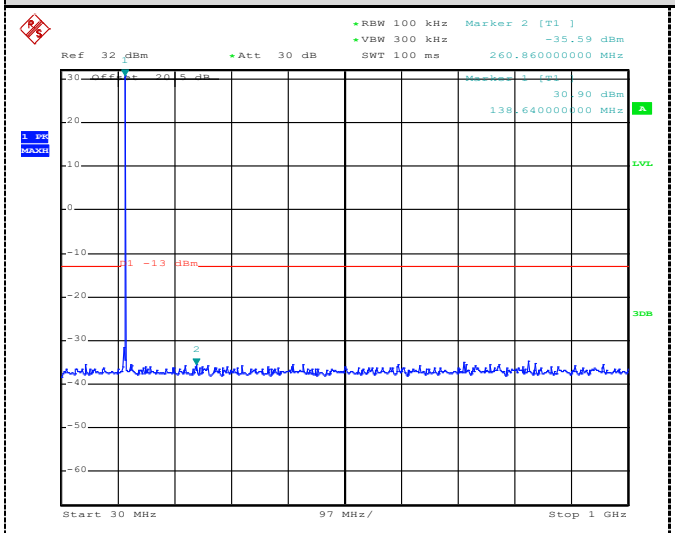
155.0125MHz

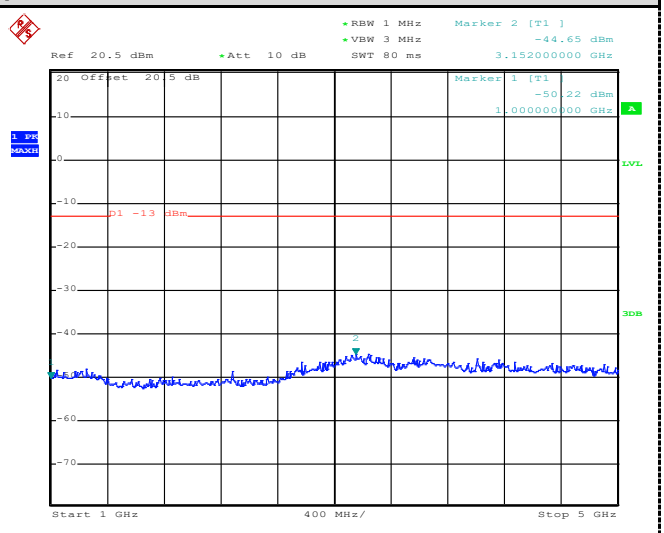




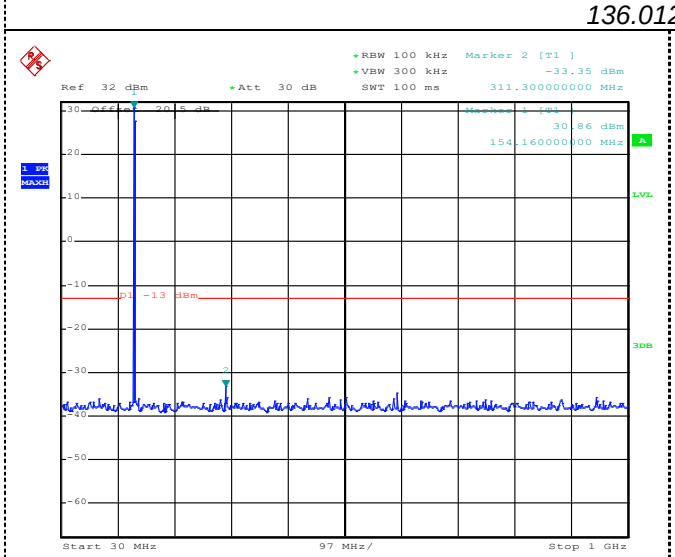
173.9875MHz

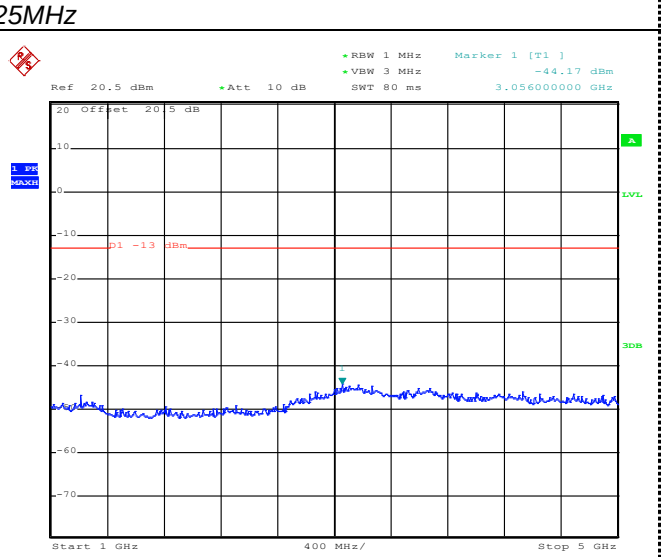
FM 25 KHz Channel Separation Test mode 3



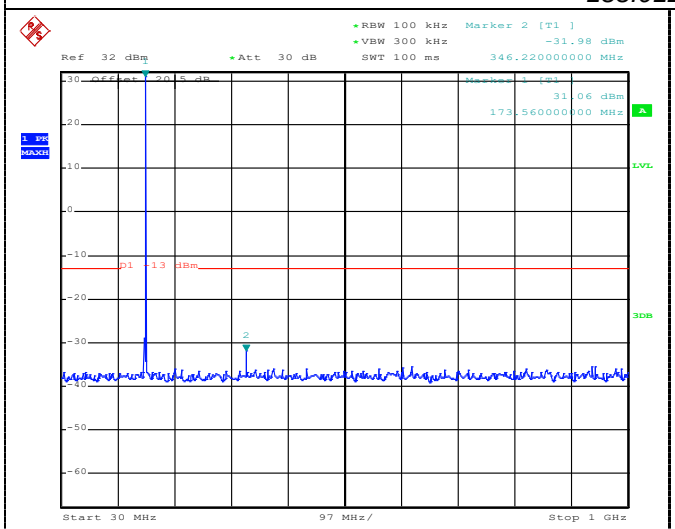


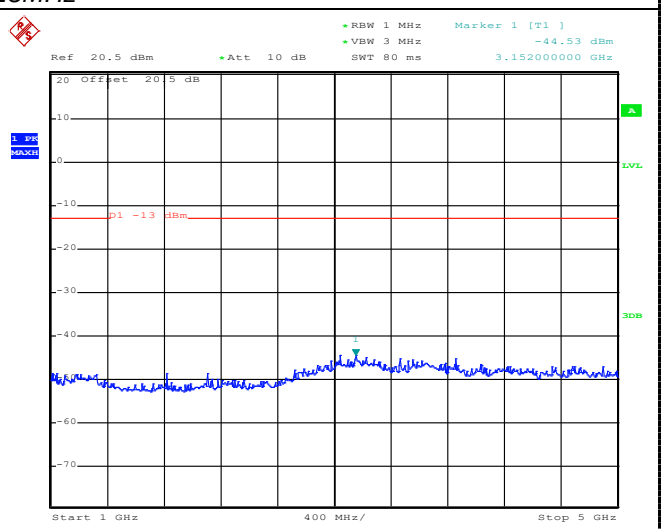
136.0125MHz





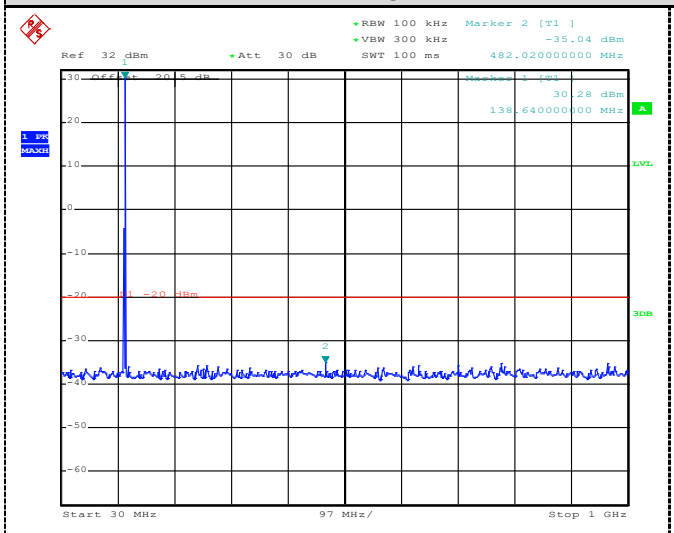
155.0125MHz

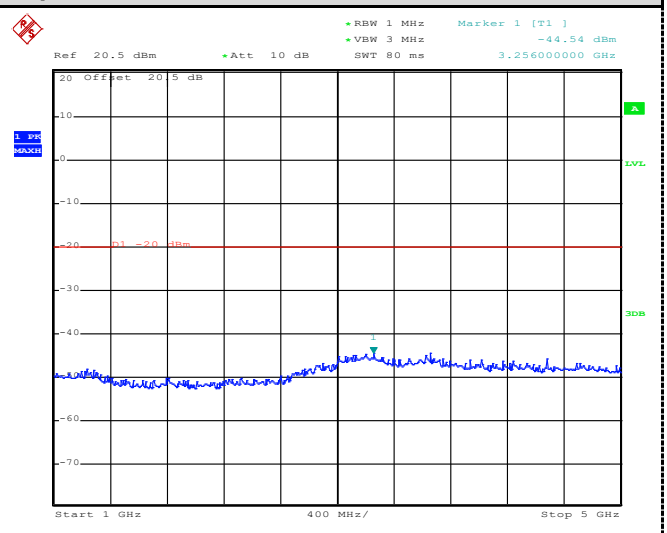




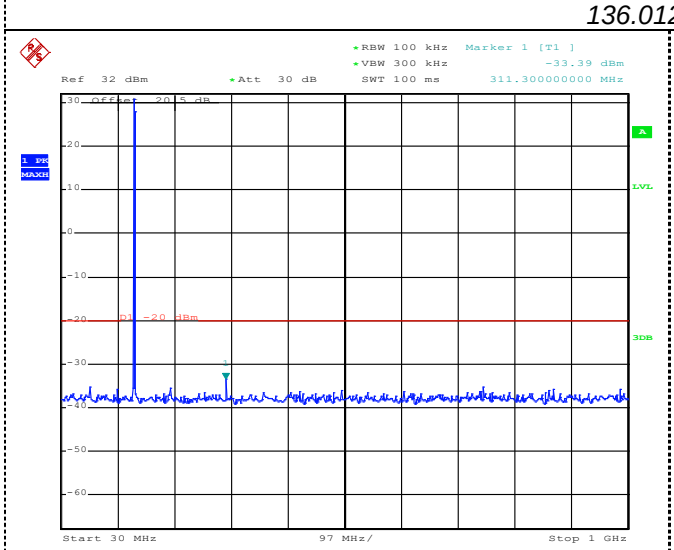
173.9875MHz

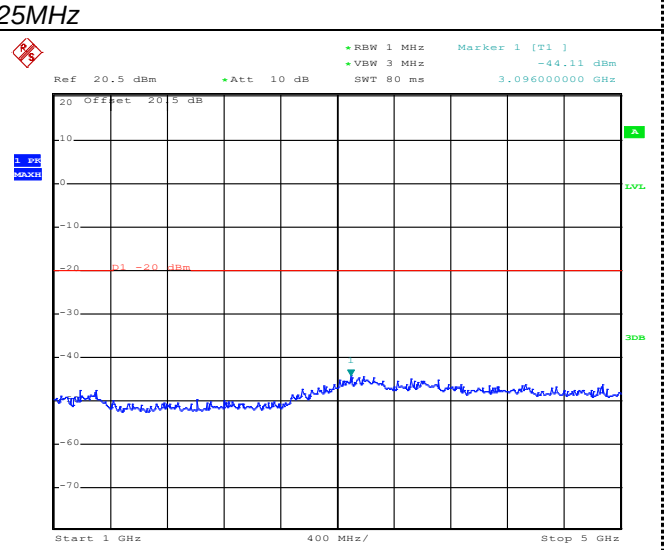
Digital 12.5 KHz Channel Separation Test mode 5



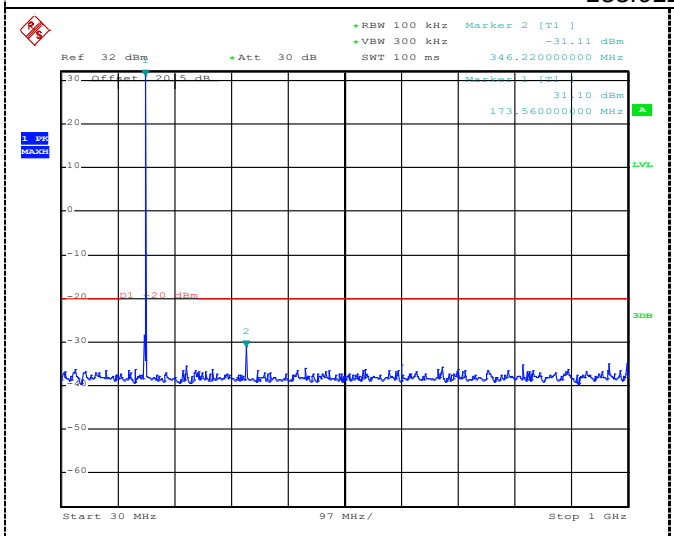


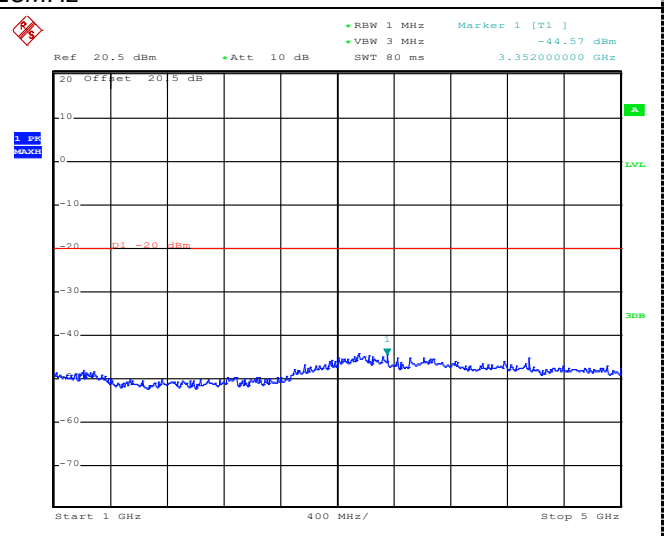
136.0125MHz





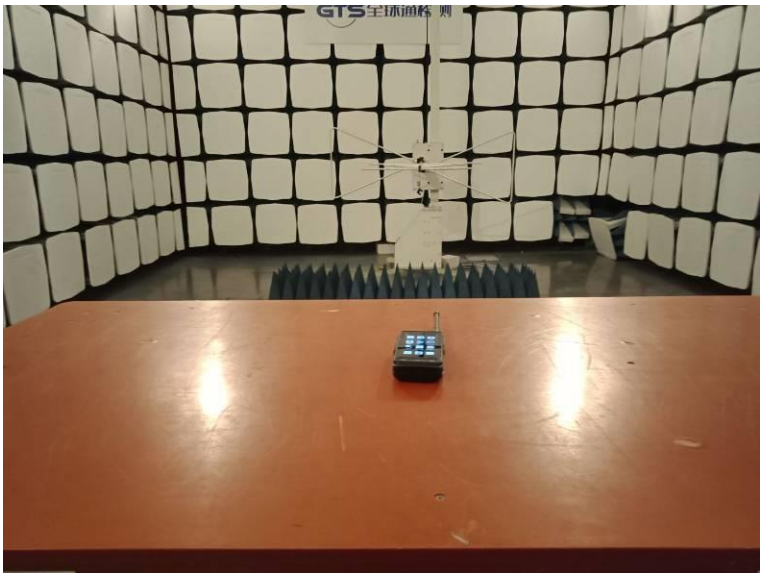
155.0125MHz

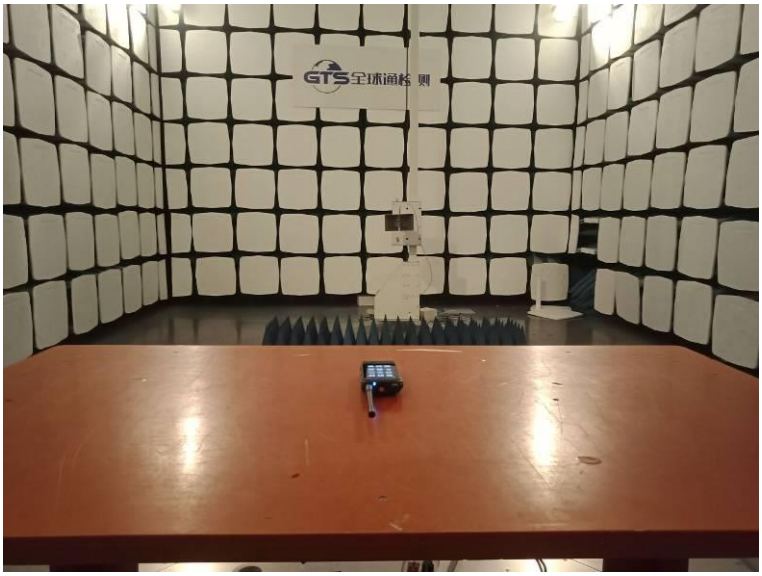




173.9875MHz

4 5 Test Setup Photos of the EUT





5 Photos of the EUT

Reference to the test report No. GTS20191021009-1-9-1

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