



Shenzhen CTA Testing Technology Co., Ltd.

Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

FCC TEST REPORT

FCC Part 90

Report Reference No.: CTA22070500310

FCC ID.: O39VRTK

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Date of issue: Aug. 01, 2022



Eric Wang

Testing Laboratory Name: Shenzhen CTA Testing Technology Co., Ltd.

Address: Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

Applicant's name: Hi-Target Surveying Instrument Co., Ltd

Address: 202, BLDG 13, Tian'An HQ Center, No.555 North Panyu RD. Donghuan Block, Panyu District, 511400 Guangzhou, China.

Test specification:

Standard: FCC Part 90/FCC Part 2

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Equipment description: GNSS RTK Receiver

Trade Mark:  **Hi-Target**

Manufacturer: Hi-Target Surveying Instrument Co., Ltd

Model/Type reference: vRTK

Listed Models: N/A

Modulation: 4FSK

Frequency: 410-470MHz

Ratings: DC 7.2V From Battery and DC 5.0-5.5V From external circuit

Result: **PASS**

Shenzhen CTA Testing Technology Co., Ltd.

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TEST REPORT

Equipment under Test : GNSS RTK Receiver

Model /Type : vRTK

Listed Models : N/A

Applicant : **Hi-Target Surveying Instrument Co., Ltd**

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Donghuan Block, Panyu District, 511400 Guangzhou, China

Manufacturer : **Hi-Target Surveying Instrument Co., Ltd**

Address : 202, BLDG 13, Tian'An HQ Center, No.555 North Panyu RD.
Donghuan Block, Panyu District, 511400 Guangzhou, China

Test Result:	PASS
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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 TEST STANDARDS

The tests were performed according to following standards:

[FCC Rules Part 90 :2017: PRIVATE LAND MOBILE RADIO SERVICES.](#)

[ANSI C63.26:2015](#): American National Standard of procedures for compliance testing of transmitters used in licensed radio services.

[FCC Part 2: FREQUENCY ALLOCATIONS AND RADIO TREATY MATTERS; GENERAL RULES AND REGULATIONS](#)

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	Jul.02, 2022
Testing commenced on	:	Jul.02, 2022
Testing concluded on	:	Aug.01, 2022

2.2 Product Description

Name of EUT:	GNSS RTK Receiver
Model Number	vRTK
Power supply:	DC 7.2V From Battery and DC 5.0-5.5V From external circuit
Adapter information (Auxiliary test supplied by test Lab):	Model: HAD-0530B-EU Input:AC 100-240V 50/60Hz Output:DC 5.3V 2.8A
Hardware version:	V1.0
Software version:	V1.0
Frequency Range:	From 410 MHz to 470 MHz
Modulation Type:	4FSK
Channel Separation:	12.5KHz
Rated Output Power:	2 Watts(33dBm)/1.0 Watts(30dBm)/0.5Wattes(27dBm)
Support data rate:	9.6kbps
Antenna Type:	External antenna
Antenna Gain:	2.21dBi

2.3 Equipment Under Test

Power supply system utilised

Power supply voltage	:	<input type="radio"/>	230V / 50 Hz	<input type="radio"/>	120V / 60Hz
		<input type="radio"/>	12 V DC	<input type="radio"/>	24 V DC
		<input checked="" type="radio"/>	Other (specified in blank below)		

DC 7.2V From Battery and DC 5.3V From external circuit

2.4 Short description of the Equipment under Test (EUT)

This is a GNSS RTK Receiver.

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

2.5 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	Condition		
			High Power	Middle power	Low Power
1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		
2	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
3	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>

Test Frequency list:

Modulation Type	Test Channel	Channel Separation	Test Frequency (MHz)
4FSK	Ch1	12.5KHz	410.125
	Ch2		440.000
	Ch3		469.875

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 ENVIRONMENT

3.1 Address of the test laboratory

Shenzhen CTA Testing Technology Co., Ltd.

Room 106, Building 1, Yibaolai Industrial Park, Qiaotou Community, Fuhai Street, Bao'an District, Shenzhen, China

3.2 Test Facility

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

FCC-Registration No.: 517856 Designation Number: CN1318

Shenzhen CTA Testing Technology Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

A2LA-Lab Cert. No.: 6534.01

Shenzhen CTA Testing Technology Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3.3 Environmental conditions

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

Radiated Emission:

Temperature:	23 ° C
Humidity:	44 %
Atmospheric pressure:	950-1050mbar

AC Main Conducted testing:

Temperature:	24 ° C
Humidity:	47 %
Atmospheric pressure:	950-1050mbar

Conducted testing:

Temperature:	24 ° C
Humidity:	46 %
Atmospheric pressure:	950-1050mbar

3.4 Summary of measurement results

Description of Test Item	Standard clause	Verdict
Maximum Transmitter Power	FCC Part 90.205	PASS
Modulation Characteristic	FCC Part 90.207	N/A
Occupied Bandwidth	FCC Part 90.209	PASS
Emission Mask	FCC Part 90.210	PASS
Frequency Stability	FCC Part 90.213	PASS
Transmitter Frequency Behavior	FCC Part 90.214	PASS
Transmitter Radiated Spurious Emssion	FCC Part 90.210	PASS
Spurious Emssion On Antenna Port	FCC Part 90.210	PASS

Remark:

1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report

3.5 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 TR-100028-01 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the Shenzhen CTA Testing Technology 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 CTA Testing Technology Co., Ltd. :

Test Items	Measurement Uncertainty	Notes
Frequency error	25 Hz	(1)
Transmitter power conducted	0.57 dB	(1)
Transmitter power Radiated	2.20 dB	(1)
Adjacent and alternate channel power Conducted	1.20 dB	(1)
Conducted spurious emission 9KHz-12.75 GHz	1.60 dB	(1)
Radiated spurious emission 9KHz-12.75 GHz	2.20 dB	(1)
Intermodulation attenuation	1.00 dB	(1)
Maximum useable receiver sensitivity	2.80 dB	(1)
Co-channel rejection	2.80 dB	(1)
Adjacent channel selectivity	2.80 dB	(1)
Spurious response rejection	2.80 dB	(1)
Intermodulation response rejection	2.80 dB	(1)
Blocking or desensitization	2.80 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.6 Equipments Used during the Test

Test Equipment	Manufacturer	Model No.	Equipment No.	Calibration Date	Calibration Due Date
LISN	R&S	ENV216	CTA-308	2021/08/06	2022/08/05
LISN	R&S	ENV216	CTA-314	2021/08/06	2022/08/05
EMI Test Receiver	R&S	ESPI	CTA-307	2021/08/06	2022/08/05
EMI Test Receiver	R&S	ESCI	CTA-306	2021/08/06	2022/08/05
Spectrum Analyzer	Agilent	N9020A	CTA-301	2021/08/06	2022/08/05
Spectrum Analyzer	R&S	FSP	CTA-337	2021/08/06	2022/08/05
Vector Signal generator	Agilent	N5182A	CTA-305	2021/08/06	2022/08/05
Analog Signal Generator	R&S	SML03	CTA-304	2021/08/06	2022/08/05
Universal Radio Communication	CMW500	R&S	CTA-302	2021/08/06	2022/08/05
Temperature and humidity meter	Chigo	ZG-7020	CTA-326	2021/08/06	2022/08/05
Ultra-Broadband Antenna	Schwarzbeck	VULB9163	CTA-310	2021/08/07	2022/08/06
Horn Antenna	Schwarzbeck	BBHA 9120D	CTA-309	2021/08/07	2022/08/06
Loop Antenna	Zhinan	ZN30900C	CTA-311	2021/08/07	2022/08/06
Horn Antenna	Beijing Hangwei Dayang	OBH100400	CTA-336	2021/08/06	2022/08/05
Amplifier	Schwarzbeck	BBV 9745	CTA-312	2021/08/06	2022/08/05
Amplifier	Taiwan chengyi	EMC051845B	CTA-313	2021/08/06	2022/08/05
Directional coupler	NARDA	4226-10	CTA-303	2021/08/06	2022/08/05
High-Pass Filter	XingBo	XBLBQ-GTA18	CTA-402	2021/08/06	2022/08/05
High-Pass Filter	XingBo	XBLBQ-GTA27	CTA-403	2021/08/06	2022/08/05
Automated filter bank	Tonscend	JS0806-F	CTA-404	2021/08/06	2022/08/05
Power Sensor	Agilent	U2021XA	CTA-405	2021/08/06	2022/08/05
Amplifier	Schwarzbeck	BBV9719	CTA-406	2021/08/06	2022/08/05

4 TEST CONDITIONS AND RESULTS

4.1 Maximum Transmitter Power

TEST APPLICABLE

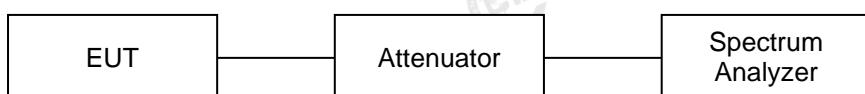
Per FCC Part 2.1046 and Part 90.205: Maximum ERP is dependent upon the station's antenna HAAT and required service area.

TEST PROCEDURE

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted below:

If the power output is adjustable, measurements shall be made for the highest and lowest power levels. The EUT connect to the Spectrum Analyzer through 20 dB attenuator.

TEST CONFIGURATION



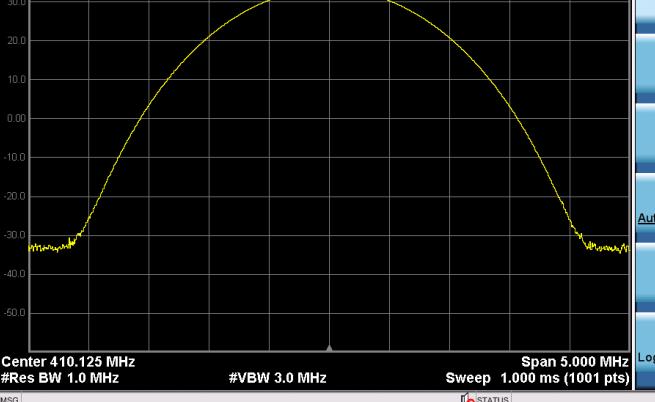
TEST RESULTS

Modulation Type	Channel Spairation	Power Level	Test Channel	Test Frequency (MHz)	Test Results (dBm)
4FSK	12.5KHz	High	Ch1	410.125	33.312
			Ch2	440.000	32.797
			Ch3	469.875	32.682
		Middle	Ch1	410.125	30.315
			Ch2	440.000	30.224
			Ch3	469.875	29.897
		Low	Ch1	410.125	25.362
			Ch2	440.000	26.856
			Ch3	469.875	24.166

Remark:By pre-scan,only worst result is reported.

Modulation Type:	4FSK	Operation Mode:	Mode 1
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Ch1



Center Freq 410.125000 MHz, Mkr1 410.120 MHz, 33.312 dBm

10 dB/div, Ref Offset 10 dB, Ref 40.00 dBm

Center 410.125 MHz, #Res BW 1.0 MHz, #VBW 3.0 MHz, Sweep 1.000 ms (1001 pts)

Frequency

Auto Tune

Center Freq 410.125000 MHz

Start Freq 407.625000 MHz

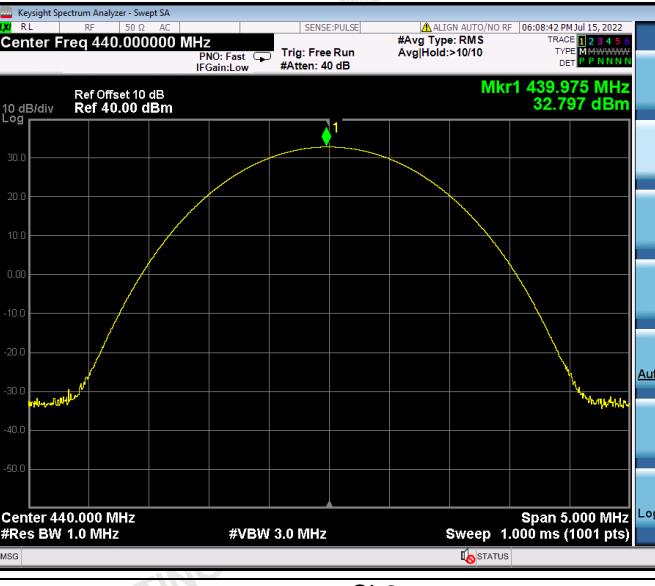
Stop Freq 412.625000 MHz

CF Step 500.000 kHz Man

Freq Offset 0 Hz

Scale Type Log Lin

Ch2



Center Freq 440.000000 MHz, Mkr1 439.975 MHz, 32.797 dBm

10 dB/div, Ref Offset 10 dB, Ref 40.00 dBm

Center 440.000 MHz, #Res BW 1.0 MHz, #VBW 3.0 MHz, Sweep 1.000 ms (1001 pts)

Frequency

Auto Tune

Center Freq 440.000000 MHz

Start Freq 437.500000 MHz

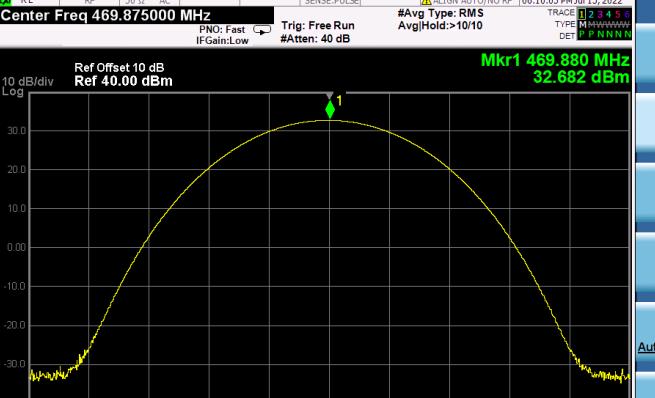
Stop Freq 442.500000 MHz

CF Step 500.000 kHz Man

Freq Offset 0 Hz

Scale Type Log Lin

Ch3



Center Freq 469.875000 MHz, Mkr1 469.880 MHz, 32.682 dBm

10 dB/div, Ref Offset 10 dB, Ref 40.00 dBm

Center 469.875 MHz, #Res BW 1.0 MHz, #VBW 3.0 MHz, Sweep 1.000 ms (1001 pts)

Frequency

Auto Tune

Center Freq 469.875000 MHz

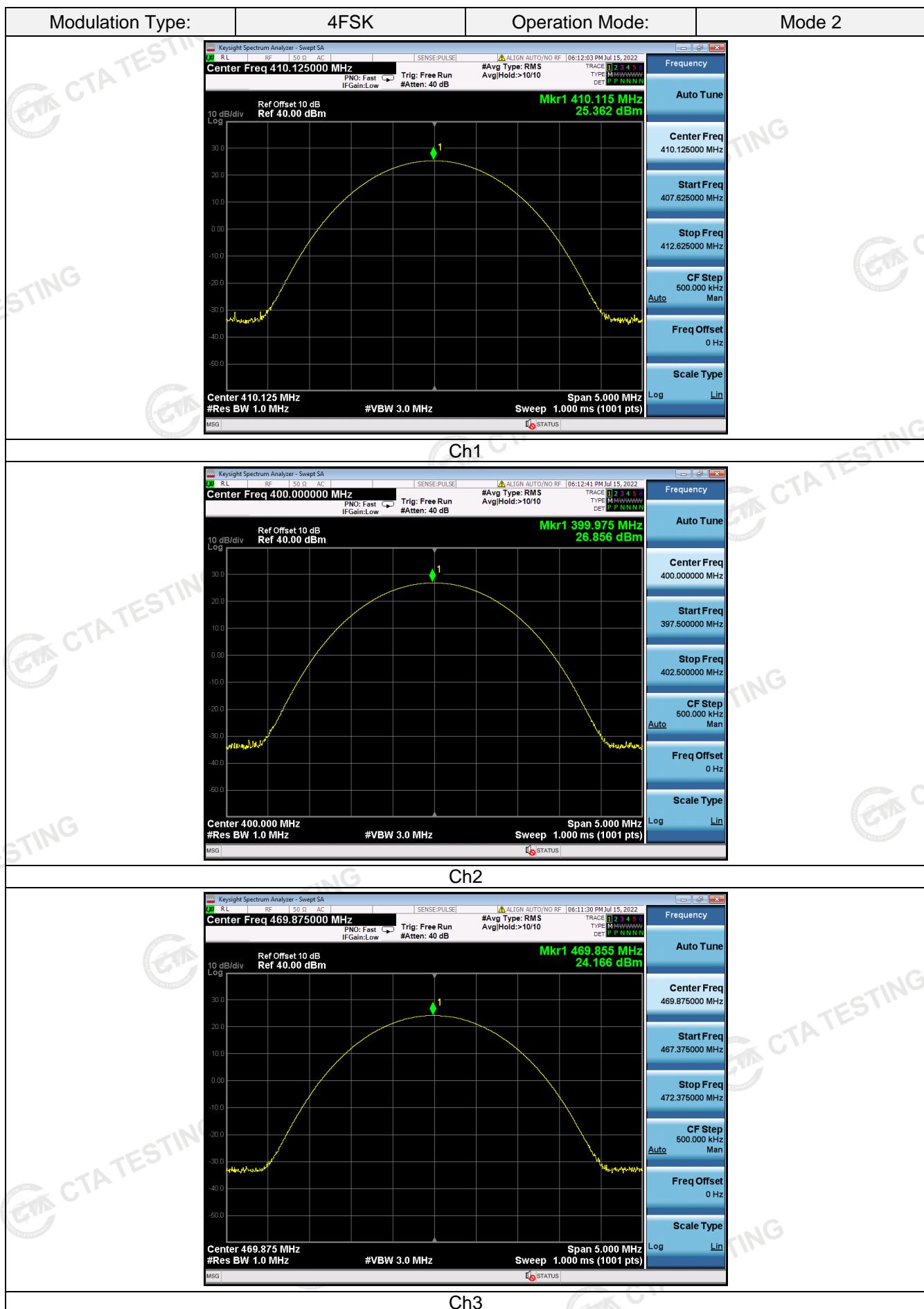
Start Freq 467.375000 MHz

Stop Freq 472.375000 MHz

CF Step 500.000 kHz Man

Freq Offset 0 Hz

Scale Type Log Lin

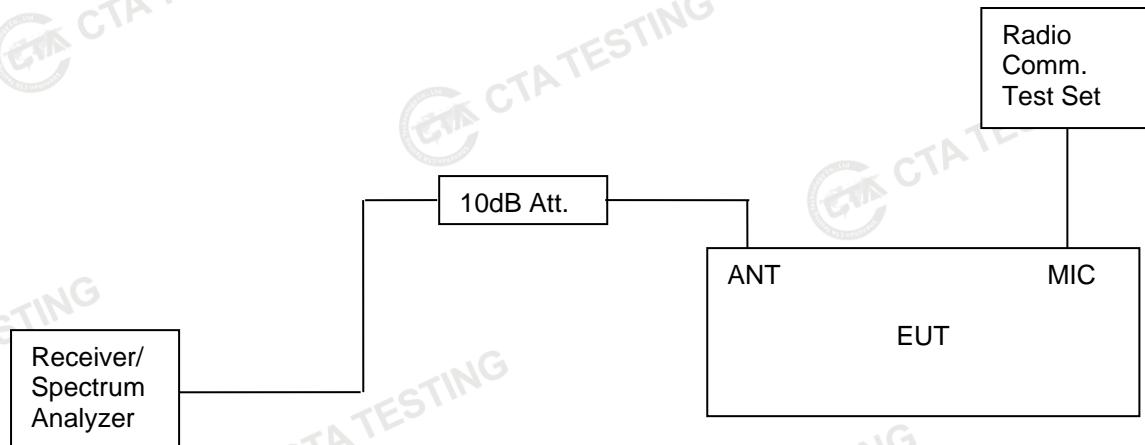


4.2 Occupied Bandwidth and Emission Mask Test

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 $7.27(f_d - 2.88 \text{ kHz})$ 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

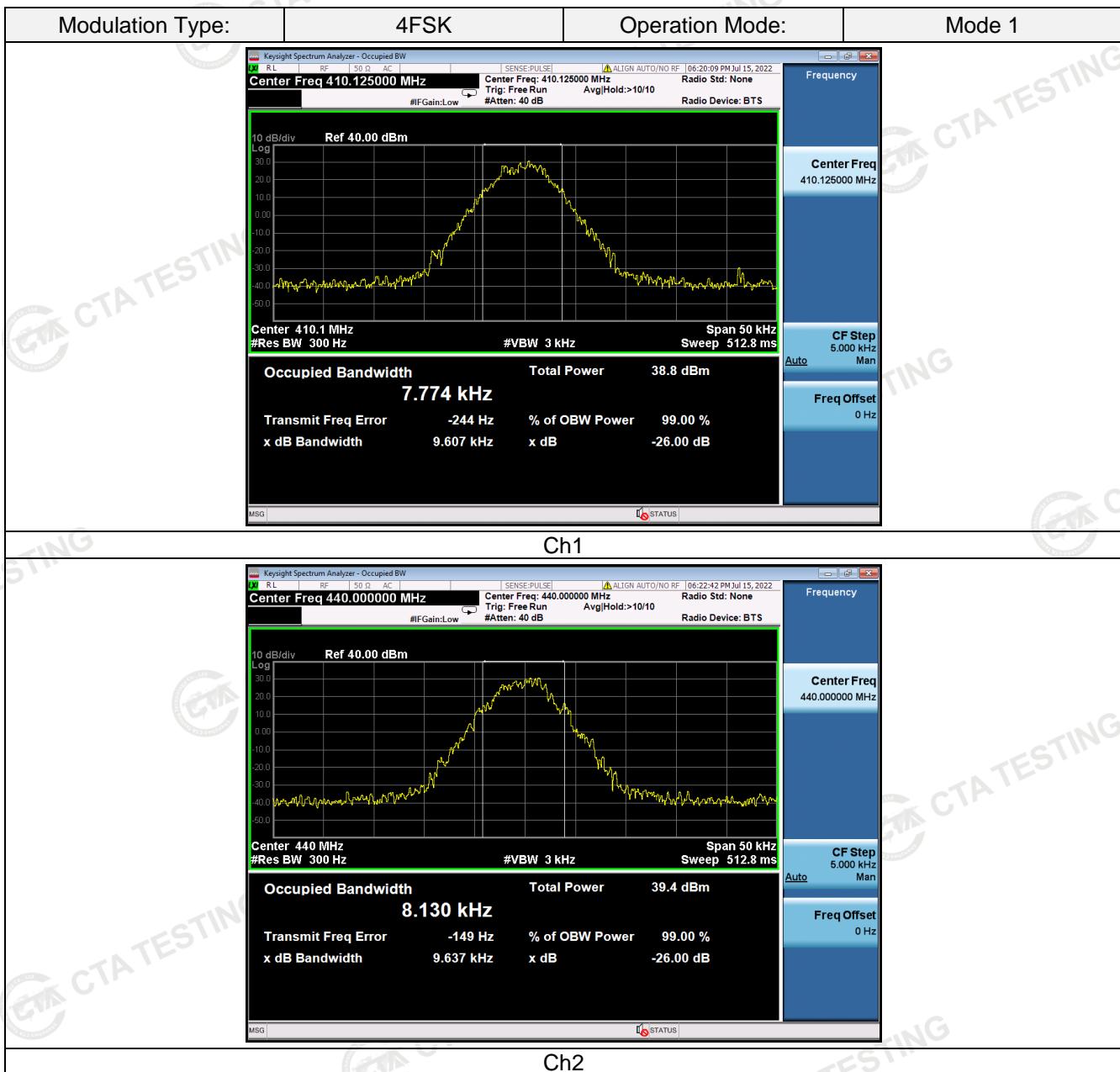


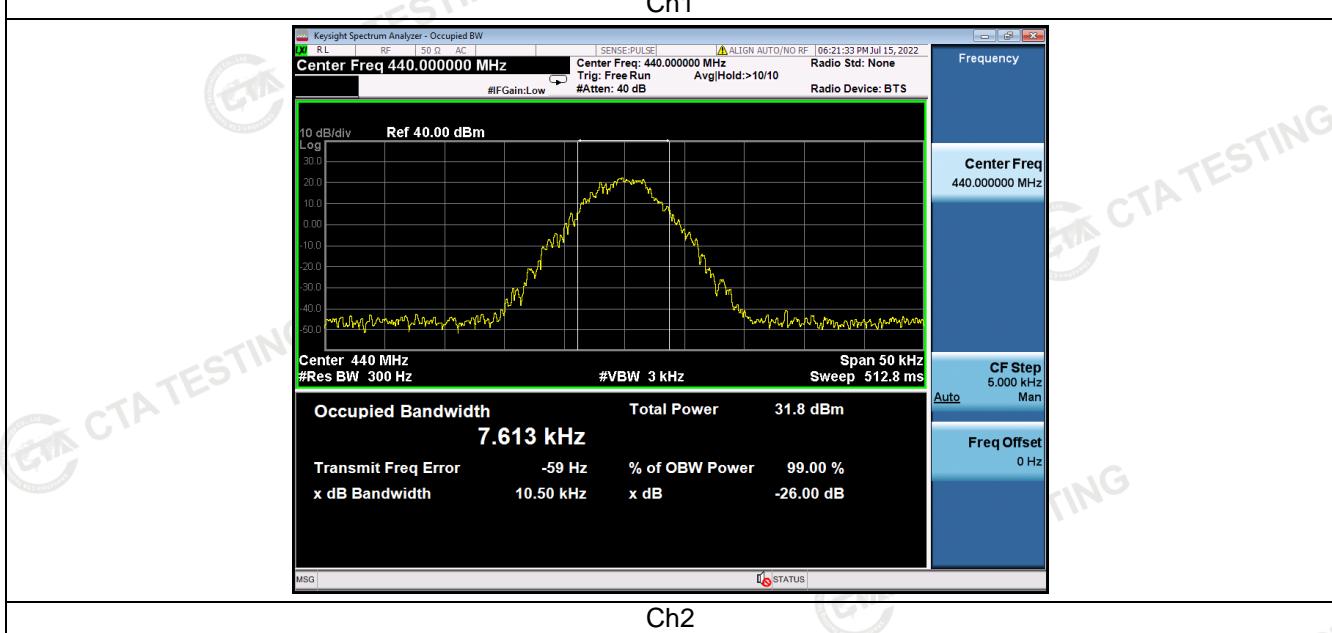
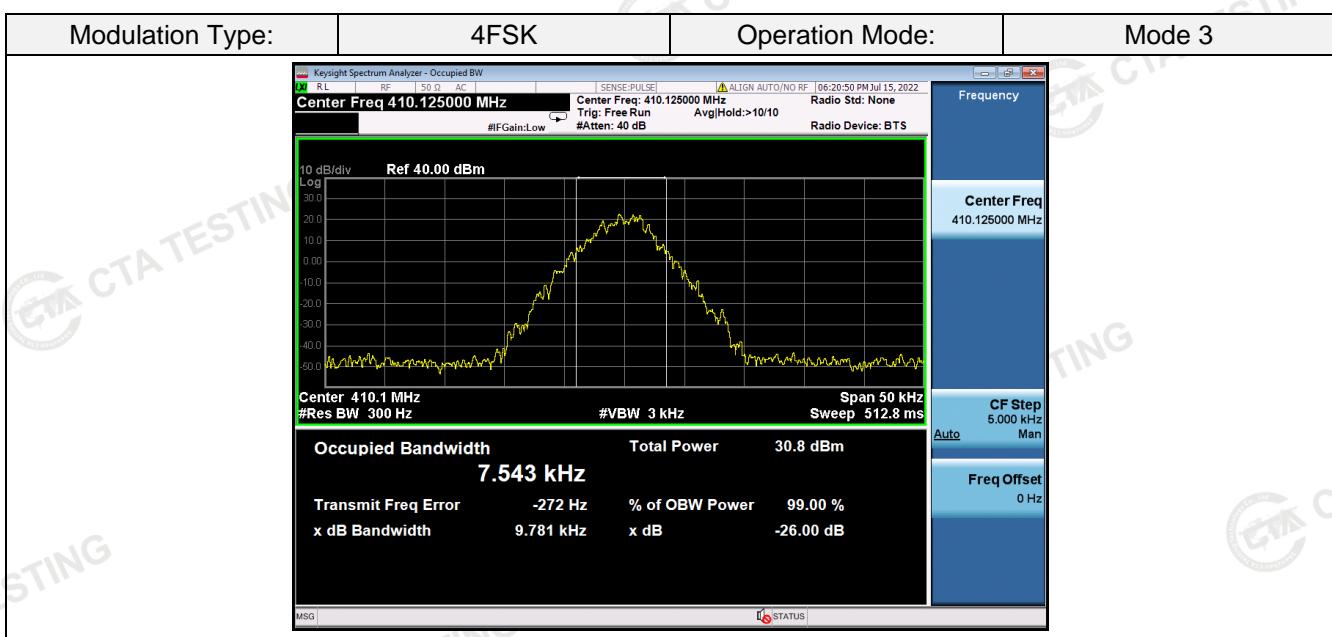
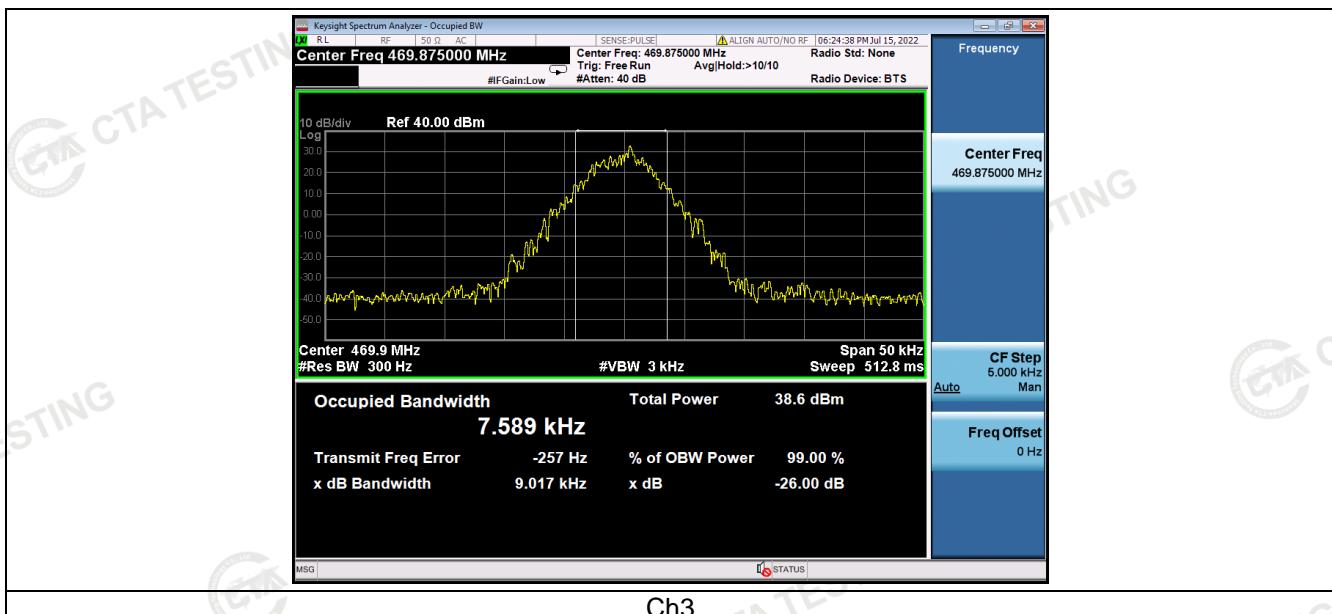
TEST PROCEDURE

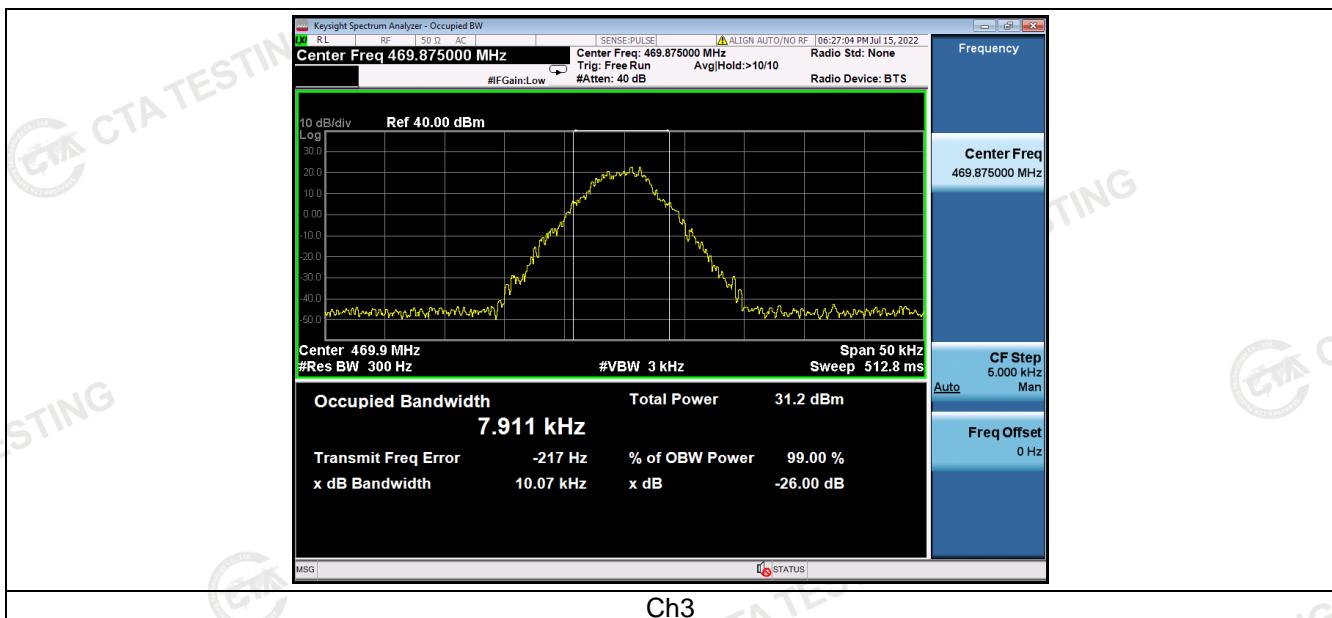
- 1 The EUT was placed on a turn table which is 0.8m above ground plane.
- 2 The EUT was modulated by 2.5 KHz Sine wave audio signal; the level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing) and 5 kHz (25 kHz channel spacing).
- 3 Set EUT as normal operation.
- 4 Set SPA Center Frequency = fundamental frequency, RBW=300Hz, VBW= 3 KHz, span =50 KHz.
- 5 Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth.
- 6 Set SPA Center Frequency=fundamental frequency, set =300Hz, VBW=1 KHz, span=50 KHz for 12.5 channel spacing.

TEST RESULTS**Occupied Bandwidth**

Modulation Type	Channel Separation (kHz)	Power Level	Frequency (MHz)	99% OBW (kHz)	26dB bandwidth (kHz)	Limit (KHz)	Test result
Digital/4FSK	12.5KHz	High	410.125	7.774	9.607	11.25	Pass
			440.000	8.130	9.637		Pass
			469.875	7.589	9.107		Pass
		Low	410.125	7.543	9.781		Pass
			440.000	7.613	10.50		Pass
			469.875	7.911	10.07		Pass



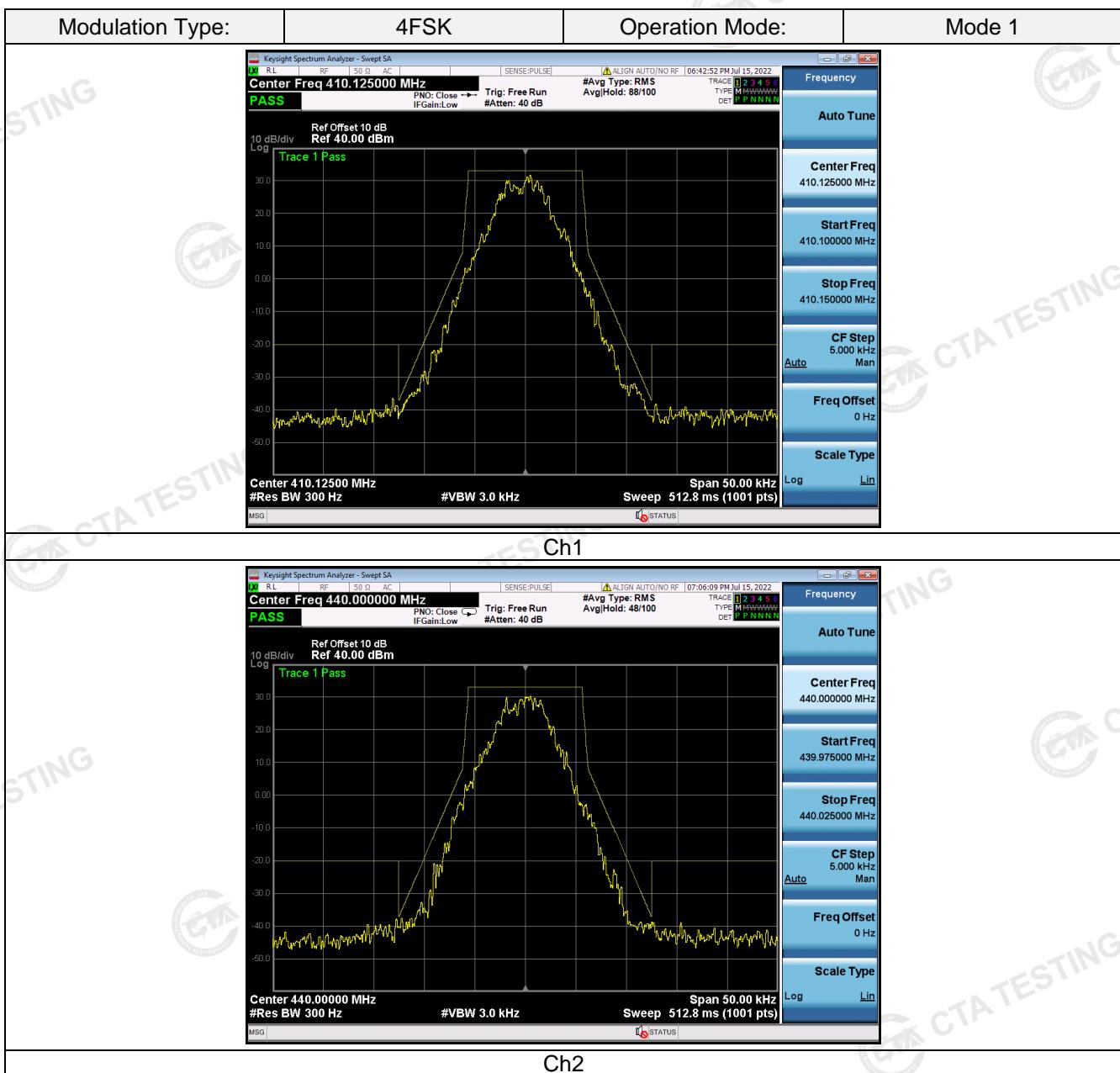


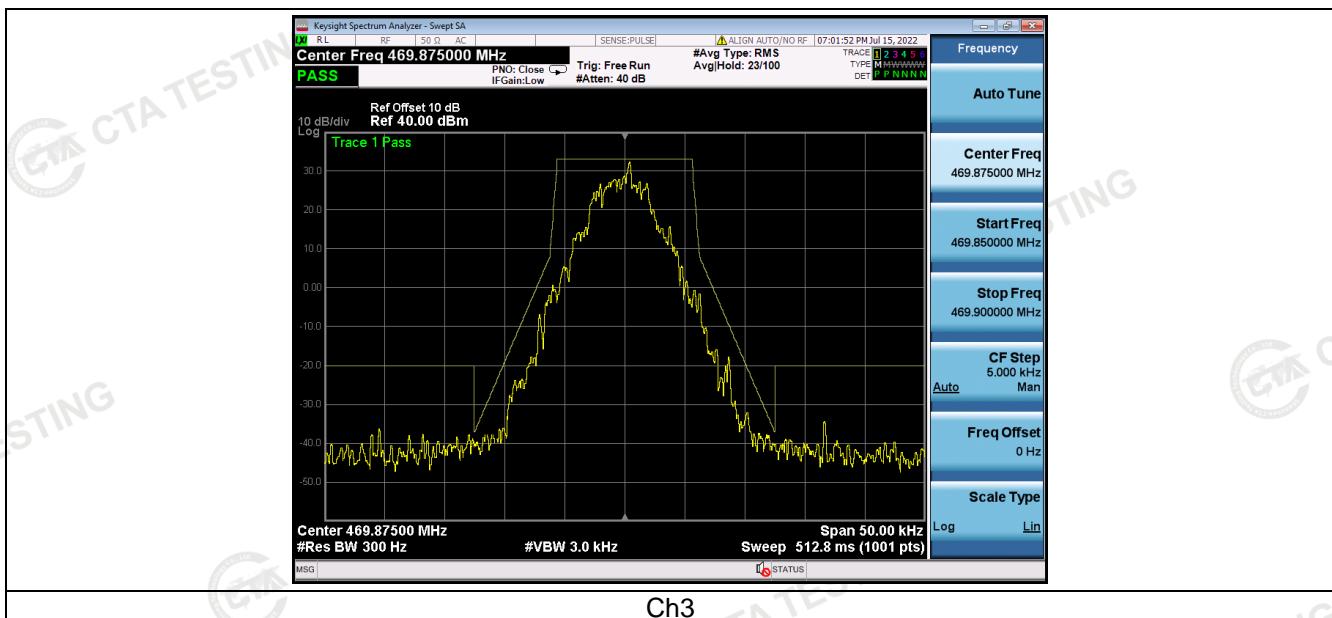


Emission Mask

Remark: All models were tested, only worst case at Mode 1 was recorded.

Modulation Type	Channel Spairation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)
4FSK	12.5KHz	Mode1	Ch1	410.125	D	300
			Ch2	440.000	D	300
			Ch3	469.875	D	300
Test Results			PASS			





Ch3

4.3 Transmitter Radiated Spurious Emissions

TEST APPLICABLE

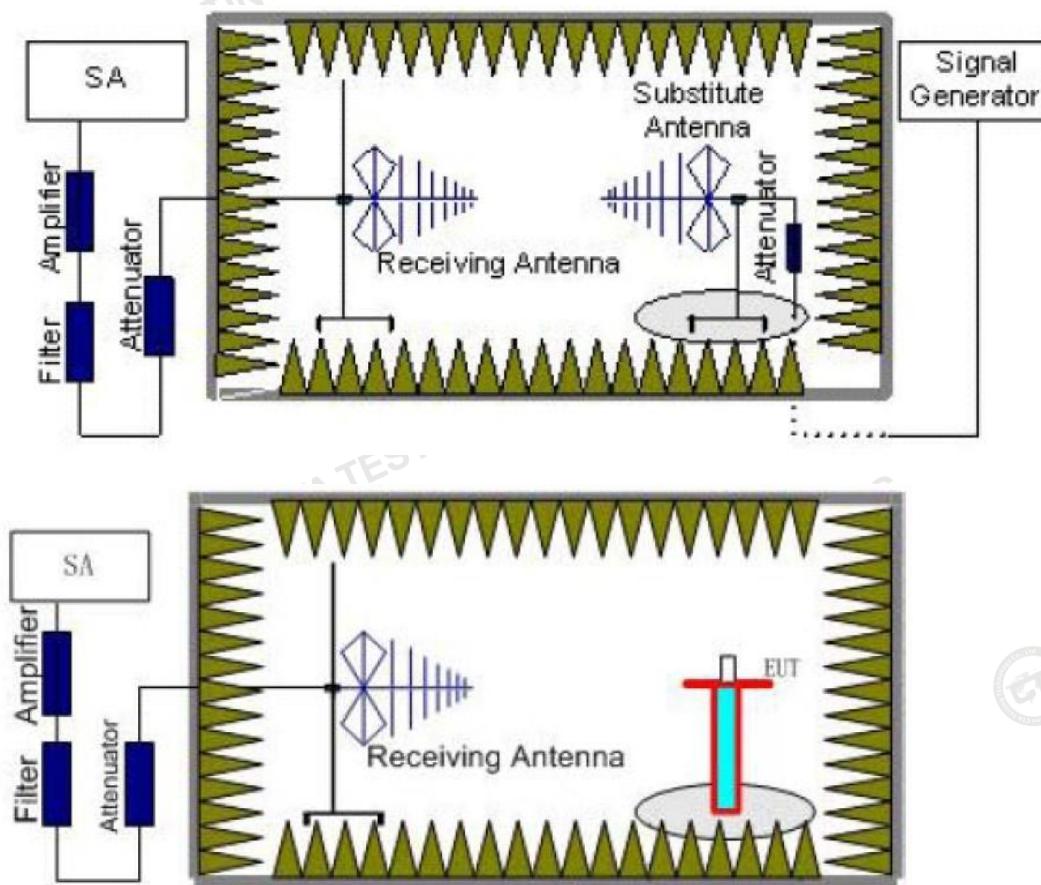
According to the ANSI C63.26 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

- 1 On any frequency removed from the center of the authorized bandwidth 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) f_0 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 (f_d in KHz) f_0 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 $43+10\log (P)$ dB.

TEST CONFIGURATION



TEST PROCEDURE

1. EUT was placed on a 1.50 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 1.50 m. Detected emissions were maximized at each

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frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.

2. 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.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz,VBW=3MHz for above 1GHz and RBW=100KHz,VBW=300KHz for 30MHz to 1GHz, And the maximum value of the receiver should be recorded as (P_r).
4. The EUT shall be 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.
5. A amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
The measurement results are obtained as described below:

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

We used SMF100A microwave signal generator which signal level can up to 33dBm, so we not used power Amplifier for substitution test; The measurement results are amend as described below:

$$\text{Power(EIRP)} = P_{Mea} - P_{cl} - G_a$$
6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7. ERP can be calculated from EIRP by subtracting the gain of the dipole, $ERP = EIRP - 2.15\text{dBi}$.

Limit

Modulation Type: FM

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz bandwidth only): 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:

Low: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (28.12) = 64.49 \text{ dB}$

High: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (29.85) = 64.75 \text{ dB}$

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) = $EL - 50 - 10 \log_{10} (TP)$

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is 43.98 dBm.

Limit (dBm) = $43.98 - 50 - 10 \log_{10} (29.85) = -20 \text{ dBm}$

Modulation Type: 4FSK

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz Bandwidth only): 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:

Low: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (28.58) = 54.56 \text{ dB}$

High: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (29.85) = 64.75 \text{ dB}$

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) = $EL - 50 - 10 \log_{10} (TP)$

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is 43.98 dBm.

Limit (dBm) = $43.98 - 50 - 10 \log_{10} (29.85) = -20 \text{ dBm}$

Note: 1. In general, the worse case attenuation requirement shown above was applied.

2. The measurement frequency range from 30 MHz to 5 GHz.

3. *** means that the emission level is too low to be measured or at least 20 dB down than the limit.

TEST RESULTS

Remark: All models were tested, only worst case at Mode 1 was recorded..

Test Frequency (MHz)	Frequency (MHz)	P _{Mea} (dBm)	P _{cl} (dB)	Distance (m)	G _a Antenna Gain (dBd/dBi)	Peak EIRP (dBm)	Limit (dBm)	Margin (dB)	Pol.
410.125	820.25	-23.42	0.87	3.00	6.42	-28.97	-20	8.97	V
	1230.38	-21.11	1.02	3.00	10.24	-30.33	-20	10.33	V
	1640.50	-25.28	1.10	3.00	11.25	-35.43	-20	15.43	V
	--	--	--	--	--	--	--	--	--
	820.25	-21.89	0.87	3.00	6.42	-27.44	-20	7.44	H
	1230.38	-20.46	1.02	3.00	10.24	-29.68	-20	9.68	H
	1640.50	-23.1	1.10	3.00	11.25	-33.25	-20	13.25	H
	--	--	--	--	--	--	--	--	--
440.000	880.00	-23.8	0.92	3.00	6.47	-29.35	-20	9.35	V
	1320.00	-22.22	1.06	3.00	10.41	-31.57	-20	11.57	V
	1760.00	-26.06	1.12	3.00	11.38	-36.32	-20	16.32	V
	--	--	--	--	--	--	--	--	--
	880.00	-22.86	0.92	3.00	6.47	-28.41	-20	8.41	H
	1320.00	-20.7	1.06	3.00	10.41	-30.05	-20	10.05	H
	1760.00	-23.79	1.12	3.00	11.38	-34.05	-20	14.05	H
	--	--	--	--	--	--	--	--	--
469.875	939.75	-24.61	0.95	3.00	6.55	-30.21	-20	10.21	V
	1409.63	-21.46	1.10	3.00	10.89	-31.25	-20	11.25	V
	1879.50	-25.83	1.21	3.00	11.73	-36.35	-20	16.35	V
	--	--	--	--	--	--	--	--	--
	939.75	-23.64	0.95	3.00	6.55	-29.24	-20	9.24	H
	1409.63	-20.24	1.10	3.00	10.89	-30.03	-20	10.03	H
	1879.50	-24.81	1.21	3.00	11.73	-35.33	-20	15.33	H
	--	--	--	--	--	--	--	--	--

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

4.4 Spurious Emissions on Antenna Port

TEST APPLICABLE

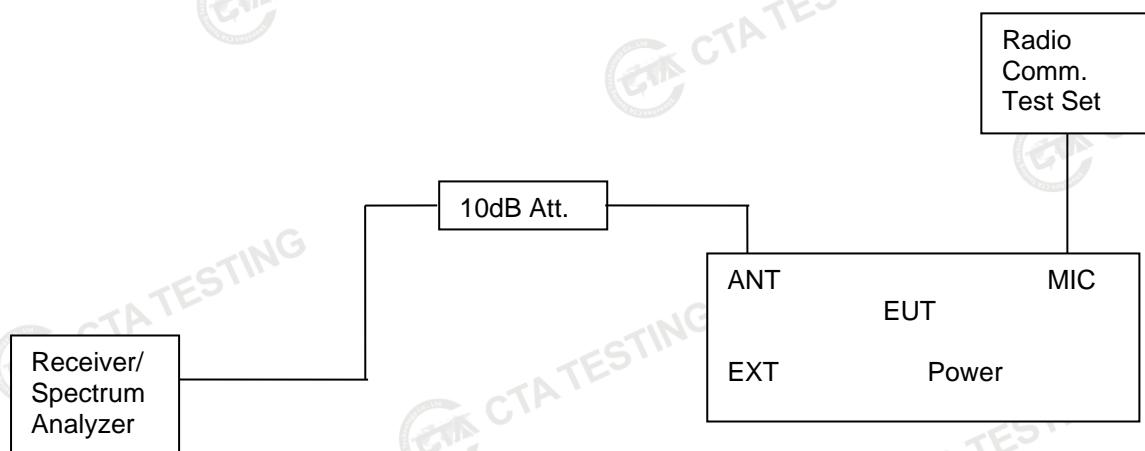
The same as Section 4.3

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.

The audio input was set to 0 to get the unmodulated carrier, the resulting picture is print out for each channel separation.

TEST CONFIGURATION



Limit

Modulation Type: FM

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz bandwidth only): 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:

Low: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (28.12) = 64.49 \text{ dB}$

High: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (29.85) = 64.75 \text{ dB}$

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) = $EL - 50 - 10 \log_{10} (TP)$

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is 43.98 dBm.

Limit (dBm) = $43.98 - 50 - 10 \log_{10} (29.85) = -20 \text{ dBm}$

Modulation Type: 4FSK

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz Bandwidth only): 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:

Low: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (28.58) = 54.56 \text{ dB}$

High: $50 + 10 \log (P_{\text{watts}}) = 50 + 10 \log (29.85) = 64.75 \text{ dB}$

Note: In general, the worse case attenuation requirement shown above was applied.

Calculation: Limit (dBm) = $EL - 50 - 10 \log_{10} (TP)$

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is 43.98 dBm.

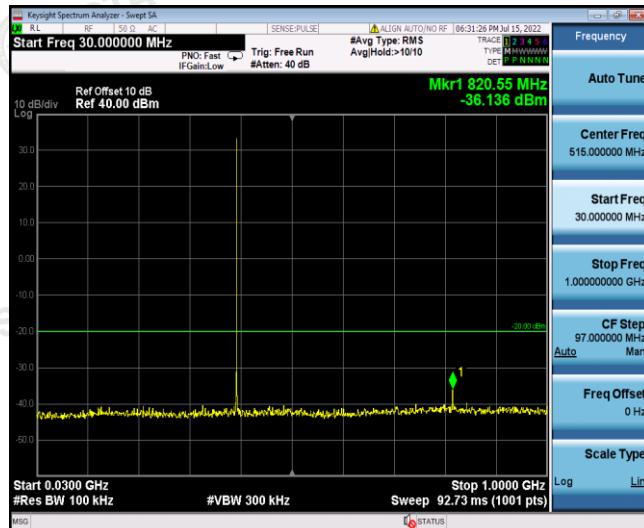
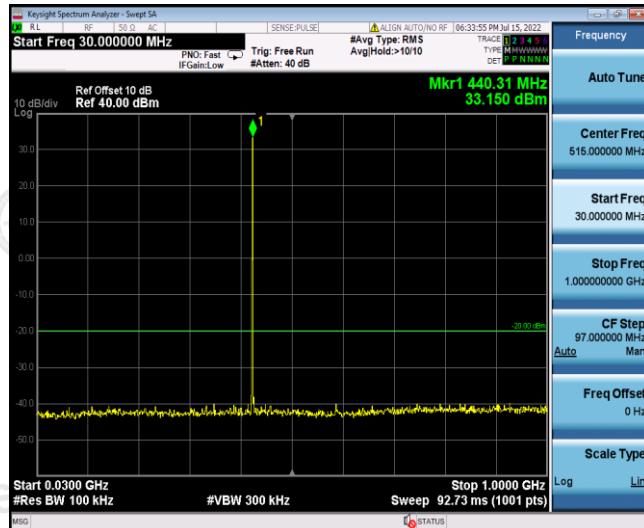
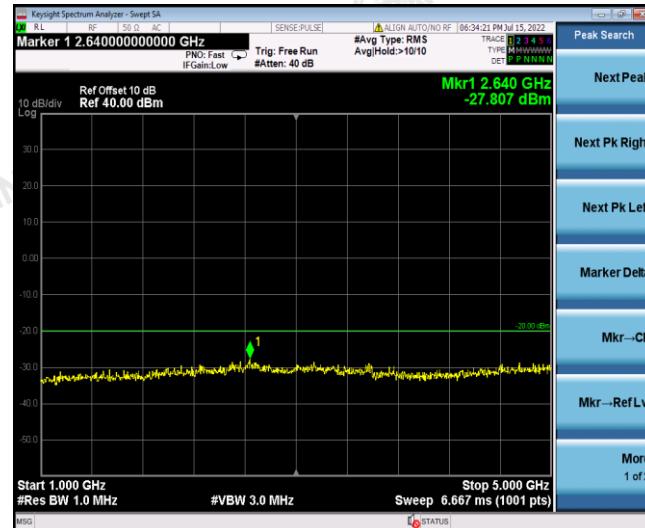
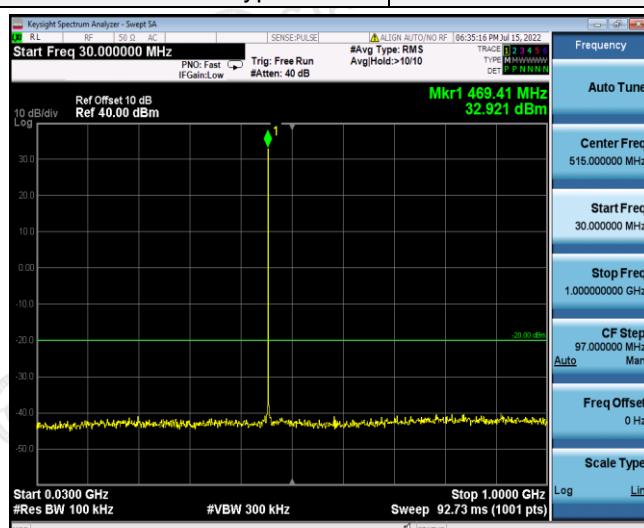
Limit (dBm) = $43.98 - 50 - 10 \log_{10} (29.85) = -20 \text{ dBm}$

Note: 1. In general, the worse case attenuation requirement shown above was applied.

2. The measurement frequency range from 30 MHz to 5GHz.

TEST RESULTS

Remark: All models were tested, only worst case at Mode 1 was recorded.

Modulation Type:	4FSK	Channel:	Ch1
			
30MHz~1GHz			1GHz-5GHz
Modulation Type:	4FSK	Channel:	Ch2
			
30MHz~1GHz			1GHz-5GHz
Modulation Type:	4FSK	Channel:	Ch3
			
30MHz~1GHz			1GHz-5GHz

4.5 Frequency Stability Test

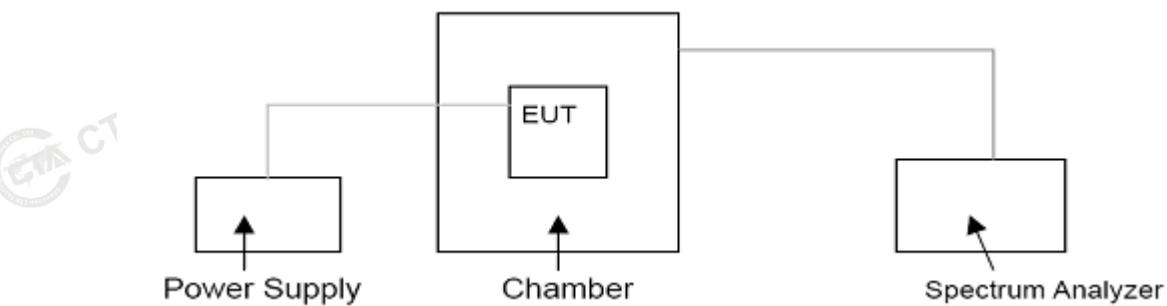
TEST APPLICABLE

- 1 According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -30°C to +60°C centigrade.
- 2 According to FCC Part 2 Section 2.1055 (a) (2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacturer.
- 3 Vary primary supply voltage from 85 to 115 percent of the nominal value.
- 4 According to §90.213, the frequency stability limit is 1.5 ppm for 12.5KHz channel separation

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 ESI 26. 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 CONFIGURATION



TEST 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	1.0	2.0	2.0
	12.5	2.5	5.0	5.0
	25	5.0	5.0	50.0*
421-512 MHz	6.25	0.5	1.0	1.0
	12.5	1.5	2.5	2.5
	25	2.5	5.0	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 RESULTS

Remark:4FSK , All models were tested,only worst case at Mode 1 was recorded.

Operation Mode	Channel Separation	Test conditions		Frequency error (ppm)			
		Voltage(V)	Temp(°C)	410.125	440.000	469.875	
Mode1	12.5KHz	7.20	-30	0.116	0.214	0.210	
			-20	0.143	0.153	0.208	
			-10	0.088	0.196	0.153	
			0	0.195	0.196	0.180	
			10	0.100	0.111	0.180	
			20	0.172	0.077	0.113	
			30	0.146	0.196	0.130	
			40	0.231	0.201	0.191	
			50	0.159	0.203	0.174	
			6.12	20	0.228	0.191	
			8.28	20	0.180	0.162	
Limit				2.5 ppm			
Test Results				PASS			

4.6 Transmitter Frequency Behaviour

TEST APPLICABLE

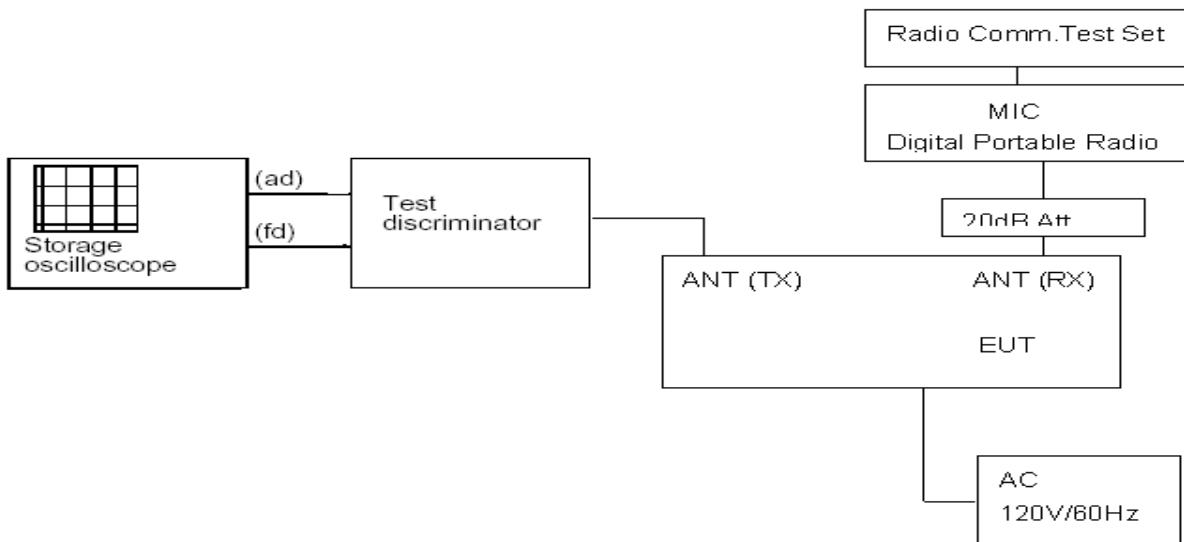
Section 90.214

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



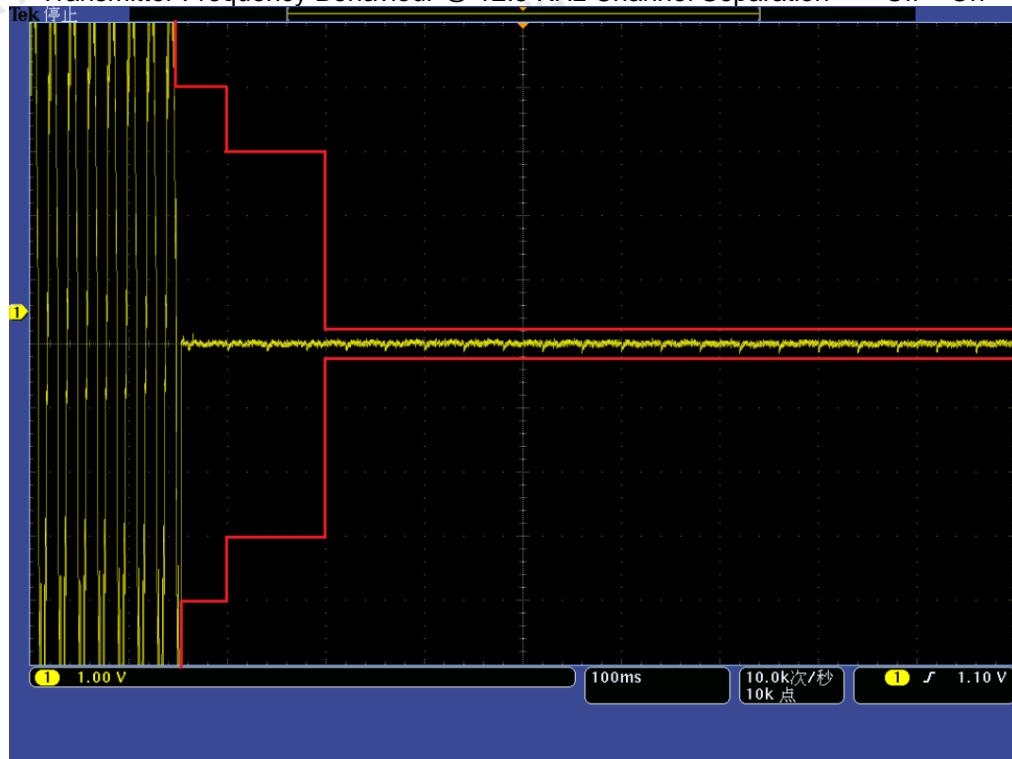
TEST PROCEDURE

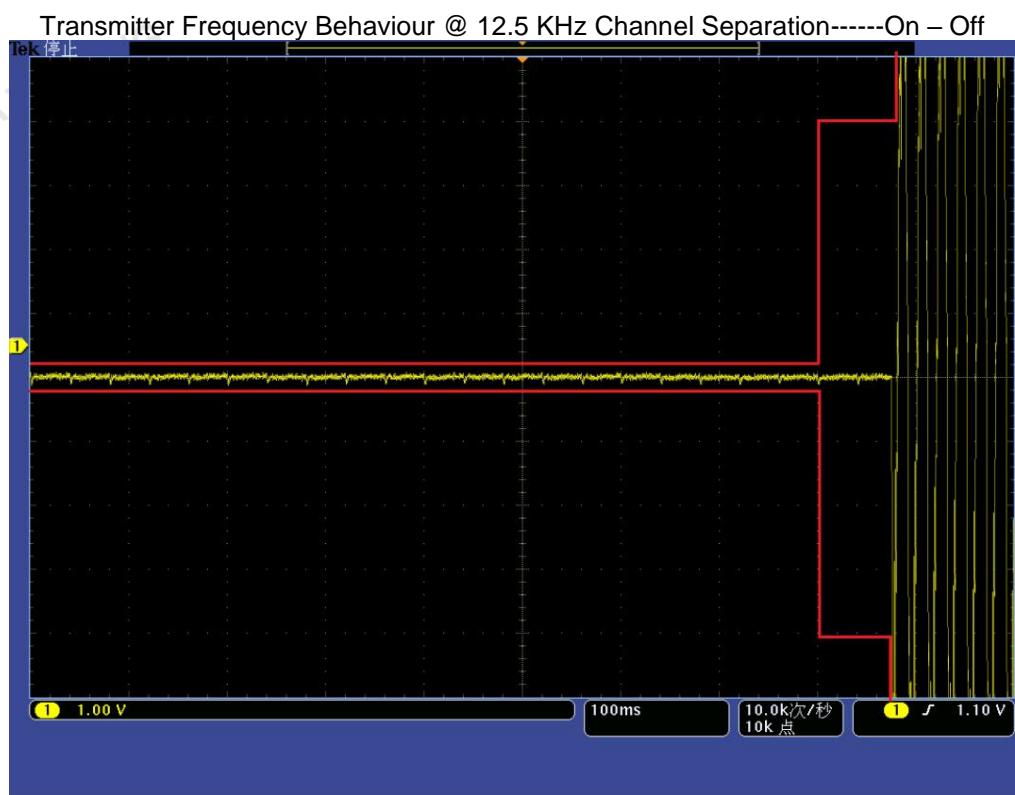
1. Connect the EUT and test equipment as shown in the test configuration.
2. Set Spectrum Analyzer to measure FM deviation, and tune the RF frequency to transmitter assigned frequency.
3. Set the signal generator to the assigned transmitter frequency and modulate it with a 1KHz tone at \pm 12.5Khz deviation 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 \pm 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

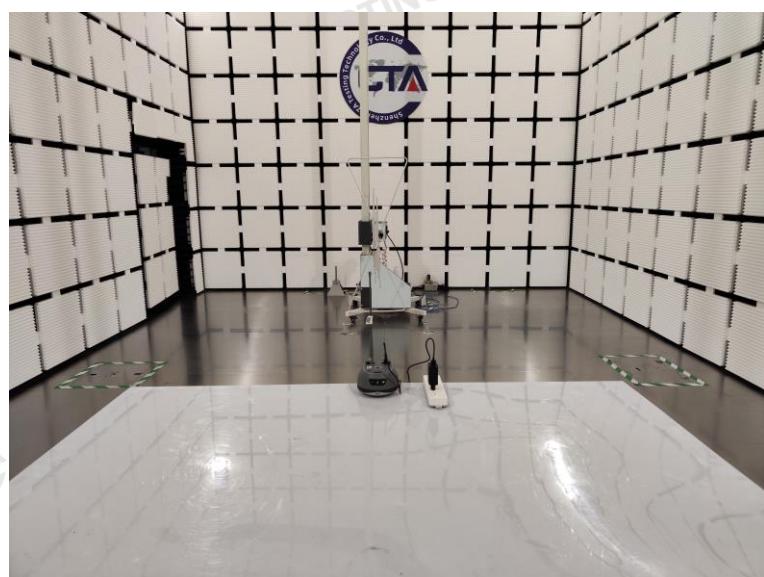
Modulation Type: 4FSK

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





5 Test Setup Photos of the EUT



6 Photos of the EUT

Reference to the test report No. CTA22070500301.

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