



## FCC PART 90 TEST REPORT

For

### QUANZHOU CITY NEW CENTURY COMMUNICATION ELECTRONICS CO., LTD.

NO.1 FENGSHOU RD., ZHAOFENG IND. ZONE FENGZE DISTRICT, QUANZHOU, FUJIAN, CHINA.

**FCC ID: VO6TR-6000DM**

<b>Report Type:</b> Original Report	<b>Product Name:</b> DMR Repeater
<i>Kevin Hu</i>	
<b>Test Engineer:</b> Kevin Hu	
<b>Report Number:</b> RXM161227052	
<b>Report Date:</b> 2017-05-31	
<i>Henry Ding</i>	
<b>Reviewed By:</b>	EMC Leader
<b>Test Laboratory:</b>	Bay Area Compliance Laboratories Corp. (Chengdu) No.5040, Hui long wan Plaza, No.1, Shawan Road, Jinniu District, Chengdu, Sichuan, China Tel: 028-65523123, Fax: 028-65525125 <a href="http://www.baclcorp.com">www.baclcorp.com</a>

**Note:** This test report was prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Chengdu). Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. This report was valid only with a valid digital signature.

## **TABLE OF CONTENTS**

<b>GENERAL INFORMATION .....</b>	<b>4</b>
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....	4
OBJECTIVE.....	4
RELATED SUBMITTAL(S)/GRANT(S).....	4
TEST METHODOLOGY.....	4
TEST FACILITY.....	5
<b>SYSTEM TEST CONFIGURATION .....</b>	<b>6</b>
DESCRIPTION OF TEST CONFIGURATION.....	6
SUPPORT EQUIPMENT LIST AND DETAILS.....	6
BLOCK DIAGRAM OF TEST SETUP .....	6
<b>SUMMARY OF TEST RESULTS.....</b>	<b>8</b>
<b>FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE) .....</b>	<b>9</b>
APPLICABLE STANDARD .....	9
<b>FCC §2.1046 &amp; §90.205- RF OUTPUT POWER.....</b>	<b>10</b>
APPLICABLE STANDARD .....	10
TEST PROCEDURE .....	10
TEST EQUIPMENT LIST AND DETAILS .....	10
TEST DATA .....	10
<b>FCC §2.1047 &amp; §90.207 - MODULATION CHARACTERISTIC .....</b>	<b>12</b>
APPLICABLE STANDARD .....	12
TEST PROCEDURE .....	12
TEST EQUIPMENT LIST AND DETAILS .....	12
TEST DATA .....	12
<b>FCC §2.1049&amp;§90.209 &amp; §90.210 – OCCUPIED BANDWIDTH &amp; EMISSION MASK.....</b>	<b>16</b>
APPLICABLE STANDARD .....	16
TEST EQUIPMENT LIST AND DETAILS .....	17
TEST PROCEDURE .....	17
TEST DATA .....	17
<b>FCC §2.1051&amp; §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS.....</b>	<b>23</b>
APPLICABLE STANDARD .....	23
TEST EQUIPMENT LIST AND DETAILS .....	23
TEST PROCEDURE .....	24
TEST DATA .....	24
<b>FCC §2.1053 &amp; §90.210 - RADIATED SPURIOUS EMISSIONS .....</b>	<b>27</b>
APPLICABLE STANDARD .....	27
TEST EQUIPMENT LIST AND DETAILS .....	27
TEST PROCEDURE .....	27
TEST DATA .....	28
<b>FCC §2.1055 &amp; §90.213- FREQUENCY STABILITY .....</b>	<b>30</b>
APPLICABLE STANDARD .....	30
TEST EQUIPMENT LIST AND DETAILS .....	30
TEST PROCEDURE .....	30
TEST DATA .....	30
<b>FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR .....</b>	<b>32</b>

APPLICABLE STANDARD .....	32
TEST EQUIPMENT LIST AND DETAILS .....	32
TEST PROCEDURE .....	32
TEST DATA .....	33

## GENERAL INFORMATION

---

### Product Description for Equipment under Test (EUT)

The **QUANZHOU CITY NEW CENTURY COMMUNICATION ELECTRONICS CO., LTD.**'s product, model: **TR-6000DM (FCC ID:VO6TR-6000DM)** (the "EUT") in this report is a **DMR Repeater**, which was measured approximately: 48.3 cm (L) x 36.6 cm (W) x 8.8 cm (H), rated input voltage: AC110V~240V.

*\*All measurement and test data in this report was gathered from final production sample, serial number: 161227052, (assigned by the BACL, Chengdu). It may have deviation from any other sample. The EUT supplied by the applicant was received on 2017-01-03, and EUT conformed to test requirement.*

### Objective

This test report is prepared on behalf of **QUANZHOU CITY NEW CENTURY COMMUNICATION ELECTRONICS CO., LTD.** in accordance with Part 2, Part 90 of the Federal Communications Commission rules.

### Related Submittal(s)/Grant(s)

No related submittal(s).

### Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – PRIVATE LAND MOBILE RADIO SERVICES

Applicable Standards: TIA-603-D.

All of the measurements detailed in this Test Report were performed by Bay Area Compliance Laboratories Corp. (Chengdu).

## **Test Facility**

The test site used by BACL to collect test data is located in the No.5040, Huilongwan Plaza, No.1, Shawan Road, Jinniu District, Chengdu, Sichuan, China.

Test site at BACL has been fully described in reports submitted to the Federal Communication Commission (FCC). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on April 24, 2015. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2014.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 560332. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

## SYSTEM TEST CONFIGURATION

### Description of Test Configuration

The system was configured for testing in a test mode.

### EUT Specification:

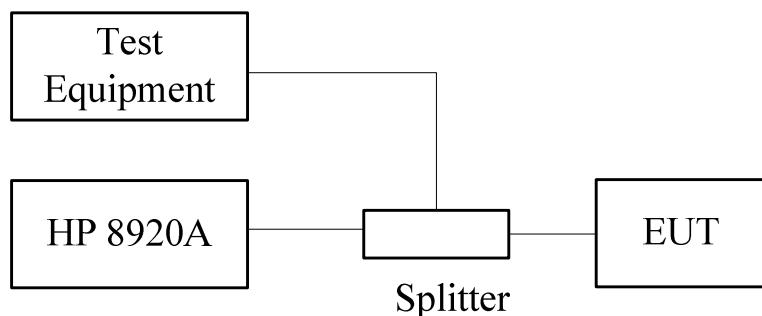
Frequency Band	UHF: 400-480MHz
Modulation Mode	FM/4FSK
Channel Spacing	12.5kHz
Output Power	High: 40W, Low:5W

### Support Equipment List and Details

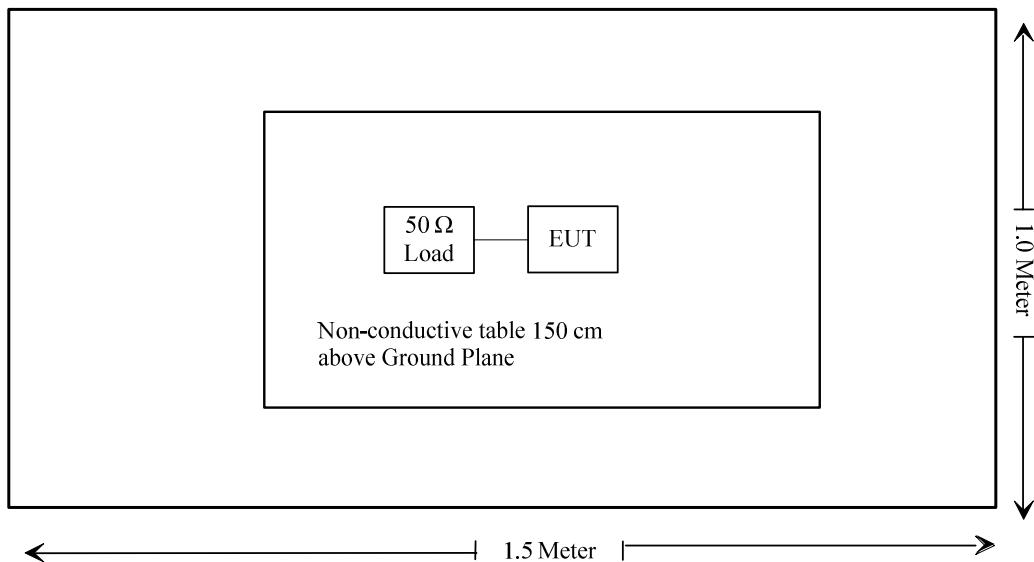
Manufacturer	Description	Model	Serial Number
Unknown	Terminal Load (50 Ω)	50Ω	Load-1
HP	RF Communications Test Set	8920A	00 247
Unknown	Splitter	Unknown	Splitter-1

### Block Diagram of Test Setup

Conducted:



Radiated:



## **SUMMARY OF TEST RESULTS**

FCC Rules	Description of Test	Results
FCC§1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliant
§2.1046;§90.205	RF Output Power	Compliant
§2.1047;§90.207	Modulation Characteristic	Compliant
§2.1049;§90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliant
§2.1051;§90.210	Spurious Emission at Antenna Terminal	Compliant
§2.1053;§90.210	Spurious Radiated Emissions	Compliant
§2.1055; §90.213	Frequency Stability	Compliant
§90.214	Transient Frequency Behavior	Compliant

## FCC §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

### Applicable Standard

According to 1.1307 (b)(1), 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for Maximum Permissible Exposure (MPE)

Limits for Occupational/Controlled Exposure				
Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time  E ,  H  or S (minutes)
0.3- 3.0	614	1.63	(100)*	6
3.0 - 30	1842/f	4.89/f	(900/f <sup>2</sup> )*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	f/300	6
1500-100,000	/	/	5	6

f = frequency in MHz;

\* = Plane-wave equivalent power density;

### MPE Calculation

Prediction of power density at the distance of the applicable MPE limit

$$S = PG/4\pi R^2$$

Where: S = power density (in appropriate units, e.g. mW/cm<sup>2</sup>);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

### MPE Results

Frequency (MHz)	Antenna Gain		Maximum output power including Tune-up Tolerance (mW)	Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)				
400-480	12.8	19.05	40000	250	0.97	1.33

**Result:** The device meet FCC MPE at 250 cm distance.

## FCC §2.1046 & §90.205- RF OUTPUT POWER

### Applicable Standard

FCC §2.1046 and §90.205.

### Test Procedure

Conducted RF Output Power:

TIA-603-D section 2.2.1

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

Spectrum Analyzer setting:

RBW	VBW
100 kHz	300 kHz

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

**\* Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

### Test Data

#### Environmental Conditions

Temperature:	22.9 °C
Relative Humidity:	45.4 %
ATM Pressure:	100.6 kPa

The testing was performed by Kevin Hu on 2017-04-12.

Test Result: Compliant. Please refer to following tables.

Modulation Mode	Channel Separation	$f_c$	Reading (dBm)		Note
		MHz	High Power Level	Low Power Level	
FM	12.5kHz	400.0125	45.94	36.90	Not for FCC Review
		453.2125	45.86	37.08	/
		479.9875	45.91	37.01	/
4FSK	12.5kHz	400.0125	45.86	37.01	Not for FCC Review
		453.2125	45.92	37.08	/
		479.9875	45.97	37.04	/

Note: The Maximum power is 40W(46dBm) for high power level, 5W(37dBm) for low Power level.

## FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC

### Applicable Standard

FCC§2.1047 & §90.207:

- (a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
- (b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

### Test Procedure

Test Method: TIA/EIA-603D 2.2.3

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	RF Communications Test Set	8920A	00 247	2016-08-10	2017-08-09
LEADER	Millivoltmeter	LMV-181A	601561	2016-08-10	2017-08-09
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

**\* Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

### Test Data

#### Environmental Conditions

Temperature:	22.9 °C
Relative Humidity:	45.4 %
ATM Pressure:	100.6 kPa

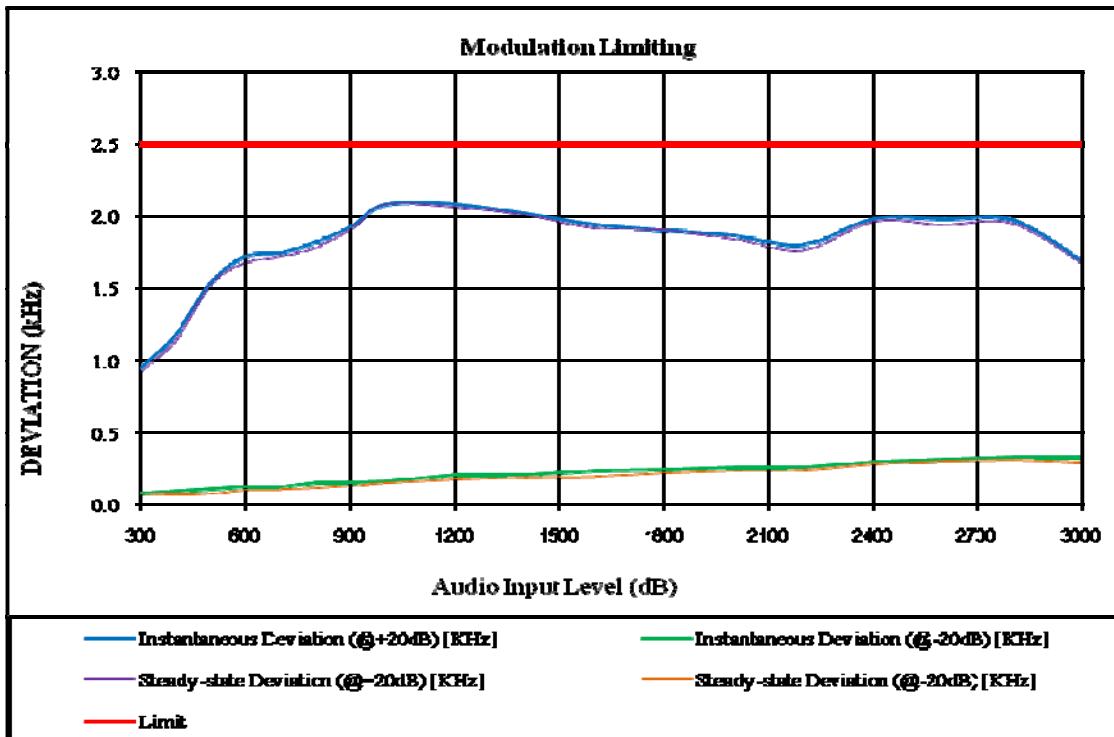
The testing was performed by Kevin Hu on 2017-04-12.

Test Result: Compliant. Please refer to following table and plots.

**MODULATION LIMITING**

Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

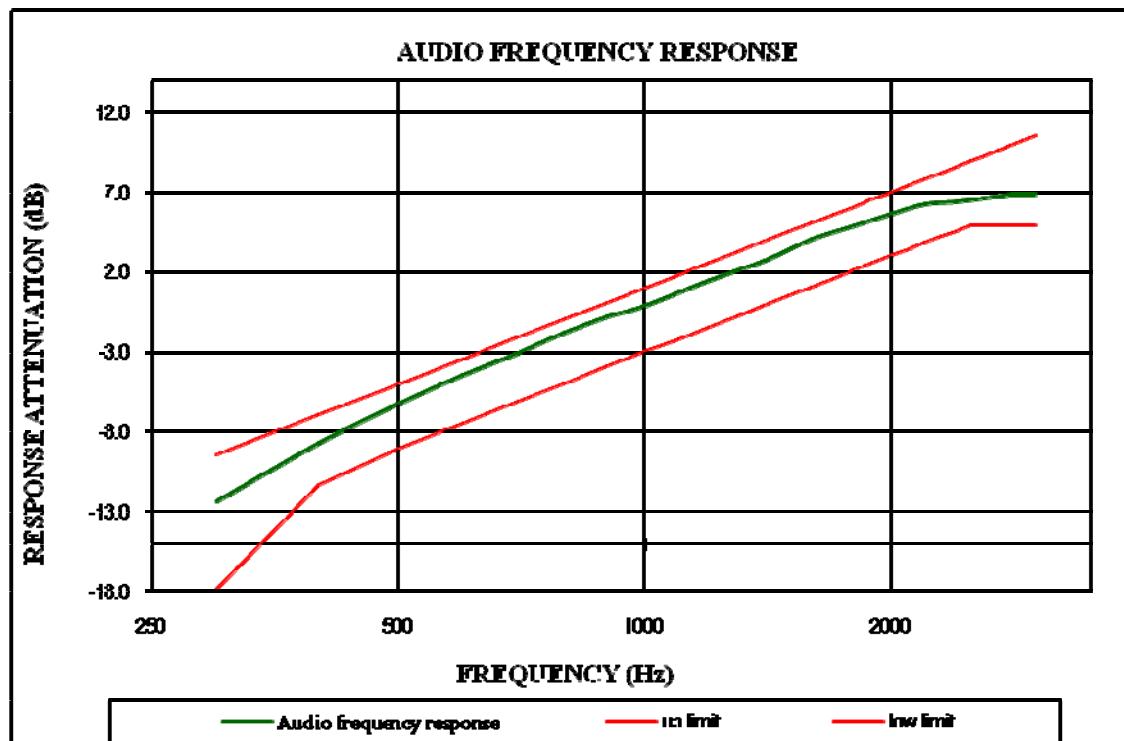
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	0.953	0.083	0.933	0.083	2.5
400	1.184	0.097	1.153	0.075	2.5
500	1.544	0.111	1.537	0.08	2.5
600	1.723	0.13	1.679	0.108	2.5
700	1.751	0.124	1.723	0.109	2.5
800	1.826	0.157	1.789	0.119	2.5
900	1.928	0.155	1.914	0.134	2.5
1000	2.081	0.168	2.078	0.154	2.5
1200	2.084	0.21	2.063	0.177	2.5
1400	2.019	0.21	2.012	0.198	2.5
1600	1.946	0.242	1.926	0.201	2.5
1800	1.908	0.248	1.905	0.223	2.5
2000	1.87	0.26	1.848	0.243	2.5
2200	1.806	0.266	1.768	0.249	2.5
2400	1.982	0.304	1.967	0.287	2.5
2600	1.982	0.315	1.946	0.308	2.5
2800	1.974	0.33	1.952	0.315	2.5
3000	1.693	0.33	1.681	0.301	2.5



### Audio Frequency Response

Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

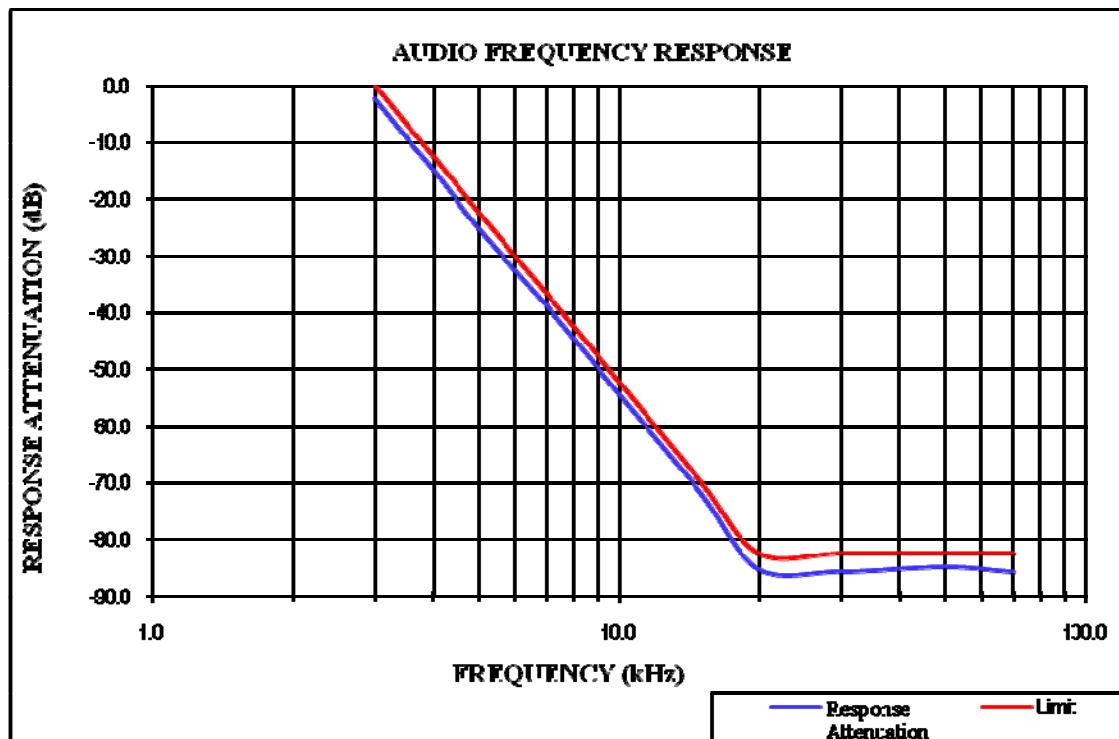
Audio Frequency (Hz)	Response Attenuation (dB)
300	-12.34
400	-8.70
500	-6.30
600	-4.46
700	-3.06
800	-1.81
900	-0.84
1000	-0.15
1200	1.50
1400	2.68
1600	4.03
1800	4.87
2000	5.67
2200	6.28
2400	6.41
2600	6.62
2800	6.83
3000	6.88



### Audio Frequency Low Pass Filter Response

Carrier Frequency: 453.2125 MHz, Channel Spacing = 12.5 kHz

Audio Frequency	Response Attenuation	Limit
kHz	dB	dB
3.0	-2.4	0.0
3.5	-9.1	-6.7
4.0	-14.7	-12.5
5.0	-25.1	-22.2
7.0	-38.9	-36.8
10.0	-54.4	-52.3
15.0	-72.0	-69.9
20.0	-85.3	-82.5
30.0	-85.7	-82.5
50.0	-85.0	-82.5
70.0	-85.7	-82.5



## FCC §2.1049&§90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

### Applicable Standard

FCC §2.1049, §90.209 and §90.210

Applicable Emission Masks		
Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
Below 25	A or B	A or C
25-50	B	C
72-76	B	C
150-174	B, D, or E	C, D or E
150 paging only	B	C
220-222	F	F
421-512	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854	B	H
809-824/854-869	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M
5850-5925		
All other bands	B	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  $7.27(f_d - 2.88)$  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.

(4) The reference level for showing Compliant with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show Compliant with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile

is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

## Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
HP	RF Communications Test Set	8920A	00 247	2016-08-10	2017-08-09
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

\* **Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

## Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

## Test Data

### Environmental Conditions

<b>Temperature:</b>	19.9~22.9 °C
<b>Relative Humidity:</b>	45.4~47.3 %
<b>ATM Pressure:</b>	100.6~100.7 kPa

*The testing was performed by Kevin Hu on 2017-04-11&2017-04-12.*

*Test Result: Compliant. Please refer to the following tables and plots.*

Modulation Mode	Channel Separation	$f_c$	99% Occupied Bandwidth	26 dB Bandwidth	Emission Power
		MHz	kHz	kHz	
FM	12.5kHz	453.2125	5.311	10.120	High power level
			5.210	10.321	Low Power Level
4FSK	12.5kHz	453.2125	7.816	9.619	High power level
			7.816	9.820	Low Power Level

Note: Emission bandwidth was based on calculation method instead of measurement.

Emission Designator

Per CFR 47 §2.201& §2.202, BW = 2M + 2D

#### **For FM Mode (Channel Spacing: 12.5 kHz)**

Emission Designator 11K0F3E

In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.

$BW = 2(M+D) = 2*(3.0 \text{ kHz} + 2.5 \text{ kHz}) = 11 \text{ kHz} = 11K0$

F3E portion of the designator represents an FM voice transmission

Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

#### **For Digital Mode (Channel Spacing: 12.5 kHz)**

Emission Designator 7K60F1D and 7K60F1E

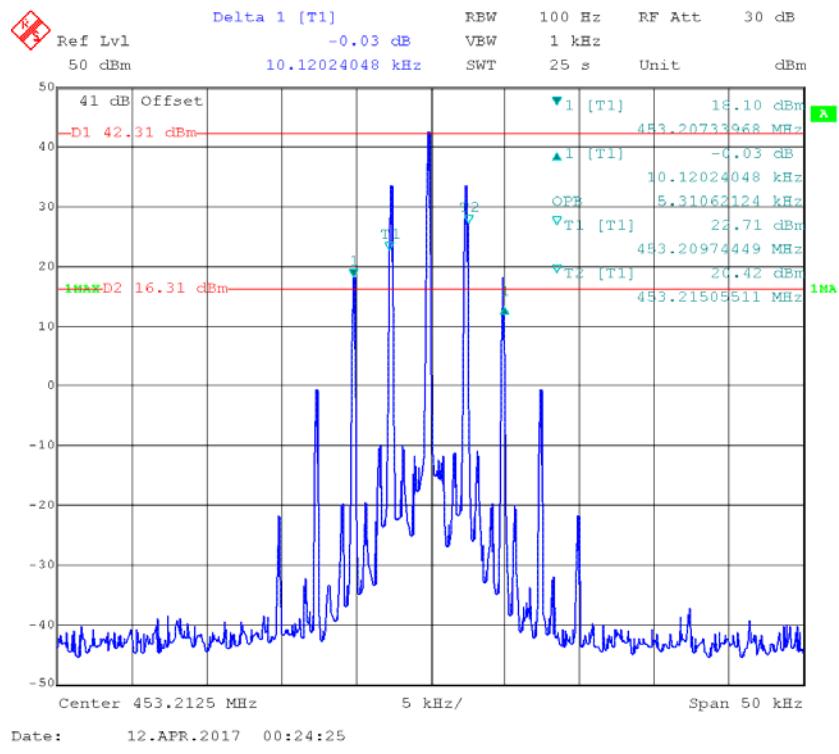
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz. The emission mask was obtained from 47CFR 90.210(d).

F1D and F1E portion of the designator indicates digital information.

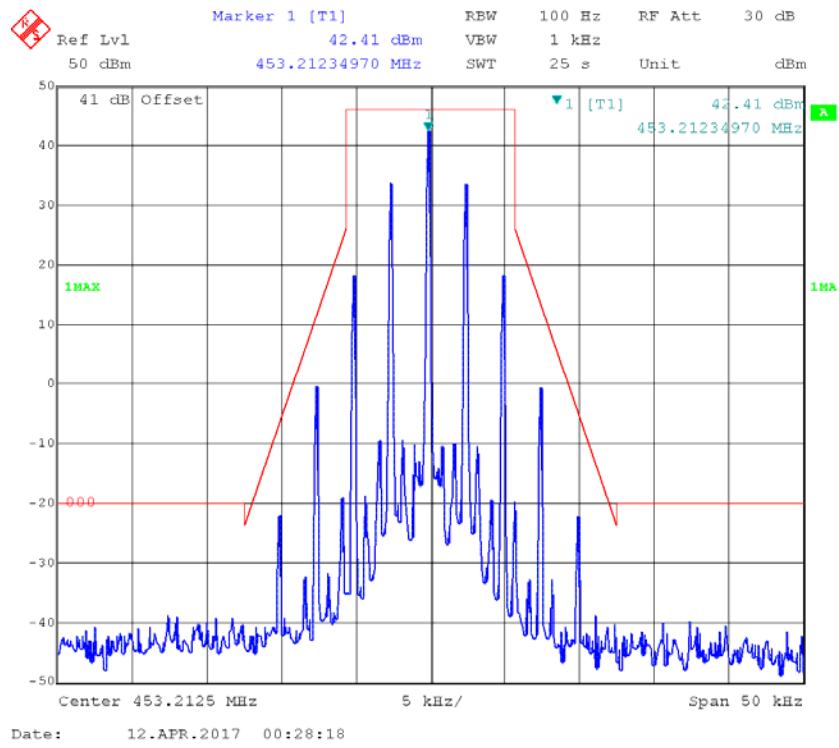
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

**FM Mode**

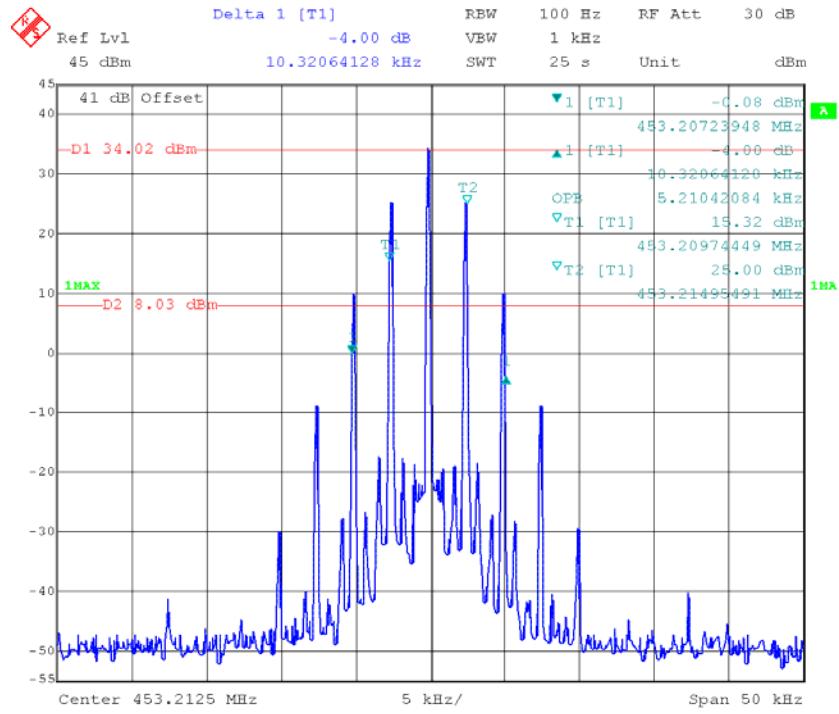
**Occupied Bandwidth -12.5kHz, 453.2125 MHz, High Power Level**



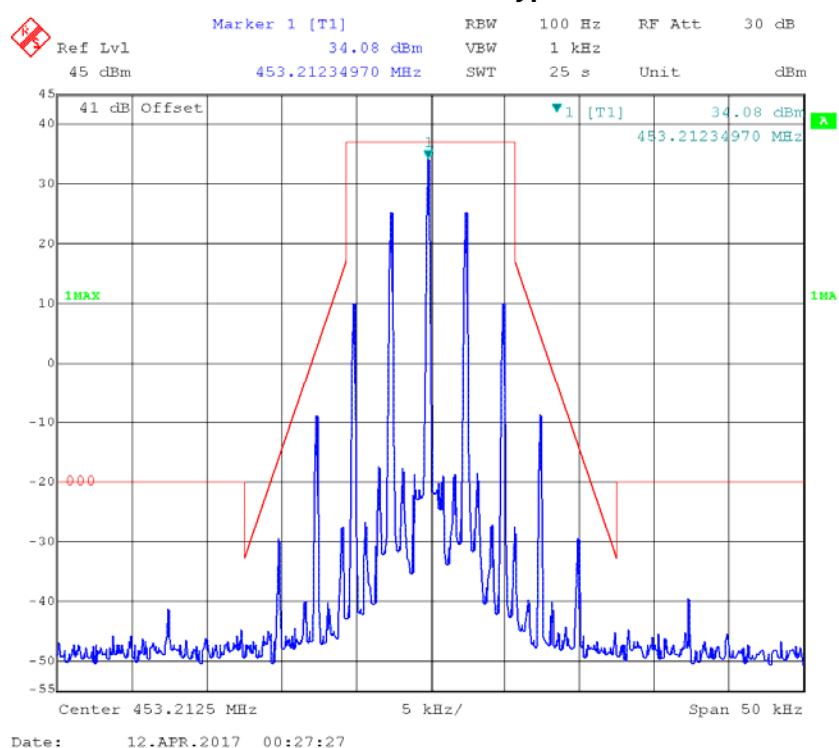
**Emission Mask - Type D**



**Occupied Bandwidth -12.5kHz, 453.2125 MHz, Low Power Level**

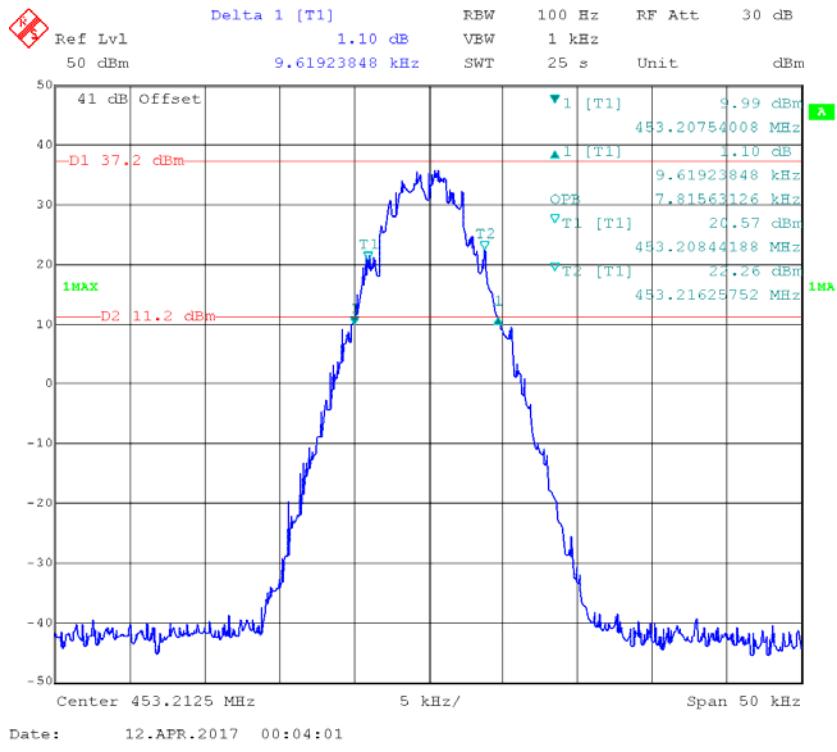


**Emission Mask - Type D**

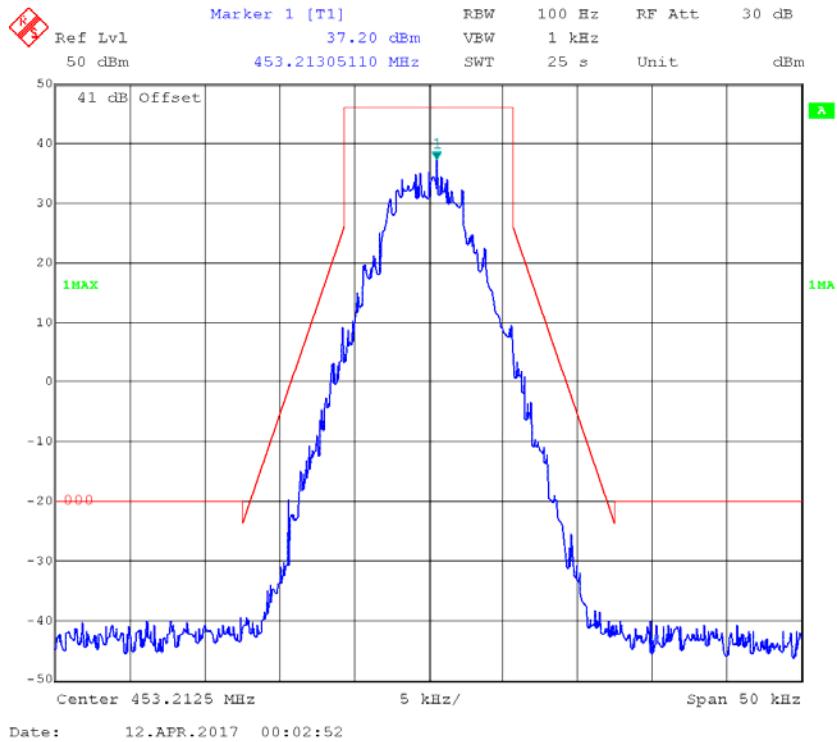


**4FSK Mode**

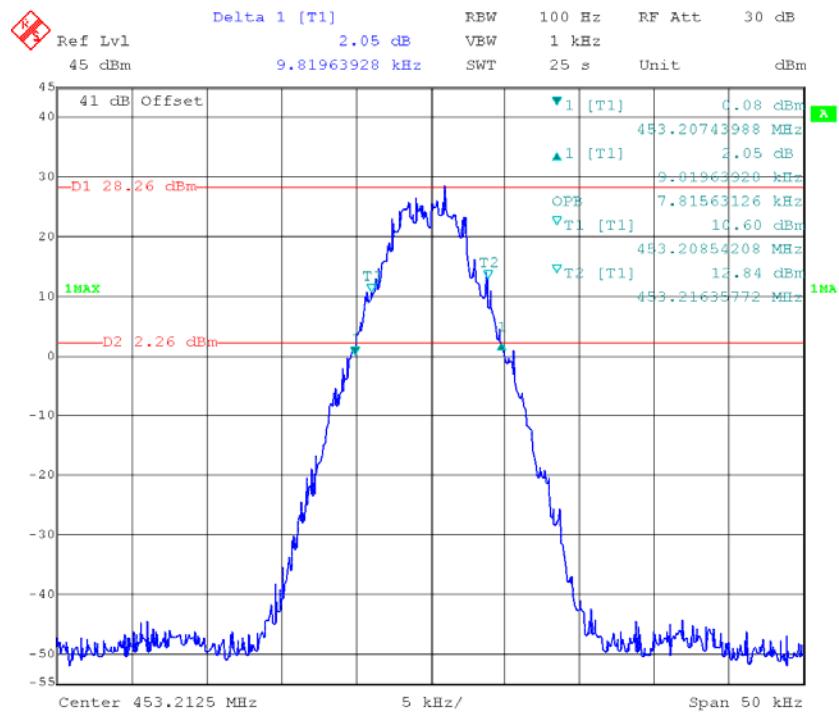
**Occupied Bandwidth – 12.5kHz, 453.2125 MHz, High Power Level**



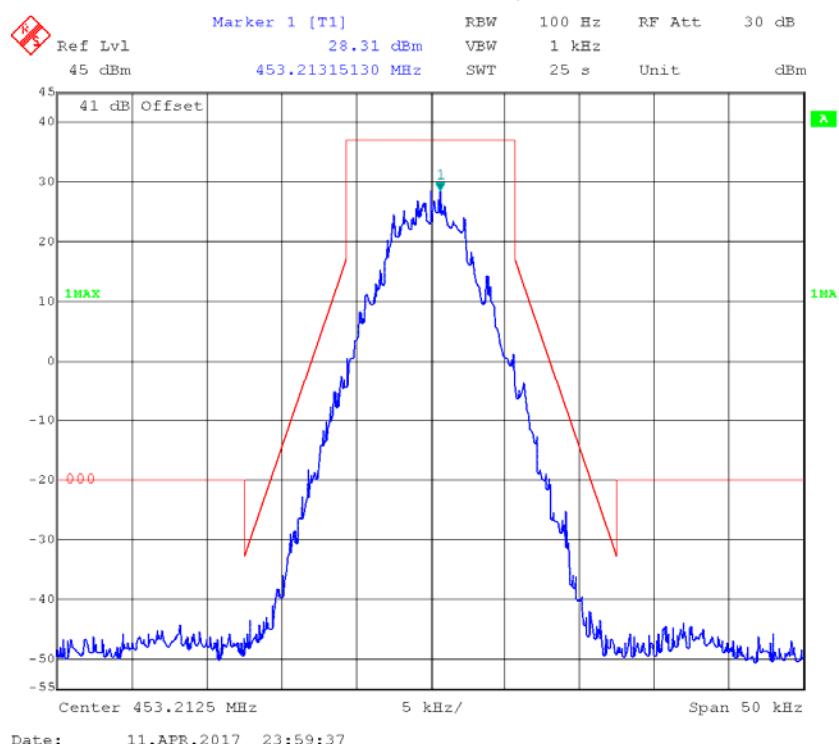
**Emission Mask - Type D**



**Occupied Bandwidth -12.5kHz, 453.2125 MHz, Low Power Level**



**Emission Mask - Type D**



## FCC §2.1051 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS

### Applicable Standard

**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.
- (4) The reference level for showing Compliant with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show Compliant with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2016-12-02	2017-12-01
Oulitong	band rejection filter	400-520	8	Each Time	/
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

**\* Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

## Test Procedure

Adjust the spectrum analyzer for the following settings:

- 1) Resolution Bandwidth = 100 kHz for spurious emissions below 1 GHz, and 1 MHz for spurious emissions above 1 GHz.
- 2) Video Bandwidth  $\geq 3$  times the resolution bandwidth.
- 3) Sweep Speed  $\leq 2000$  Hz per second.
- 4) Detector Mode = mean or average power.

## Test Data

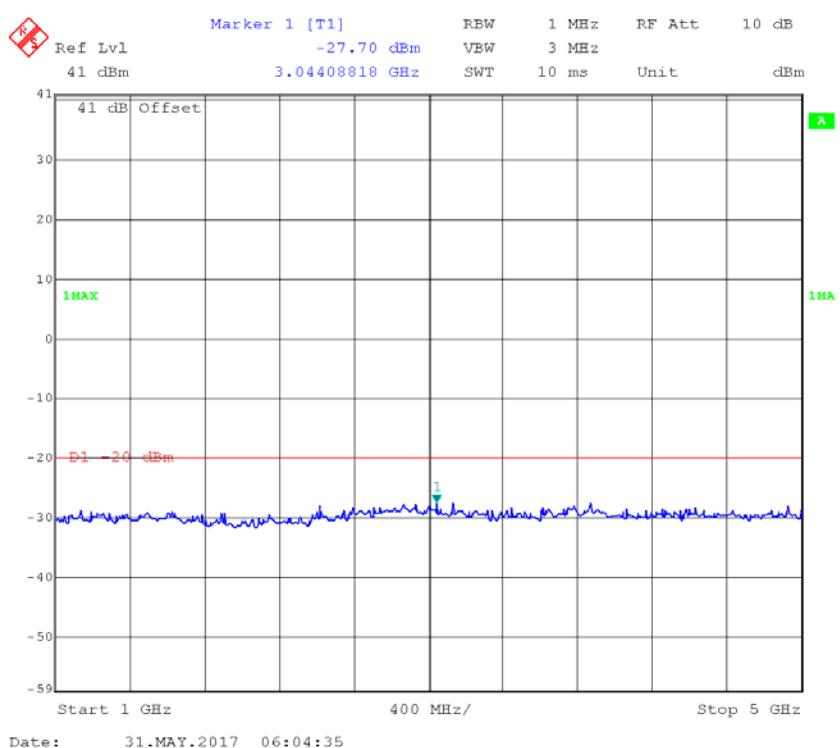
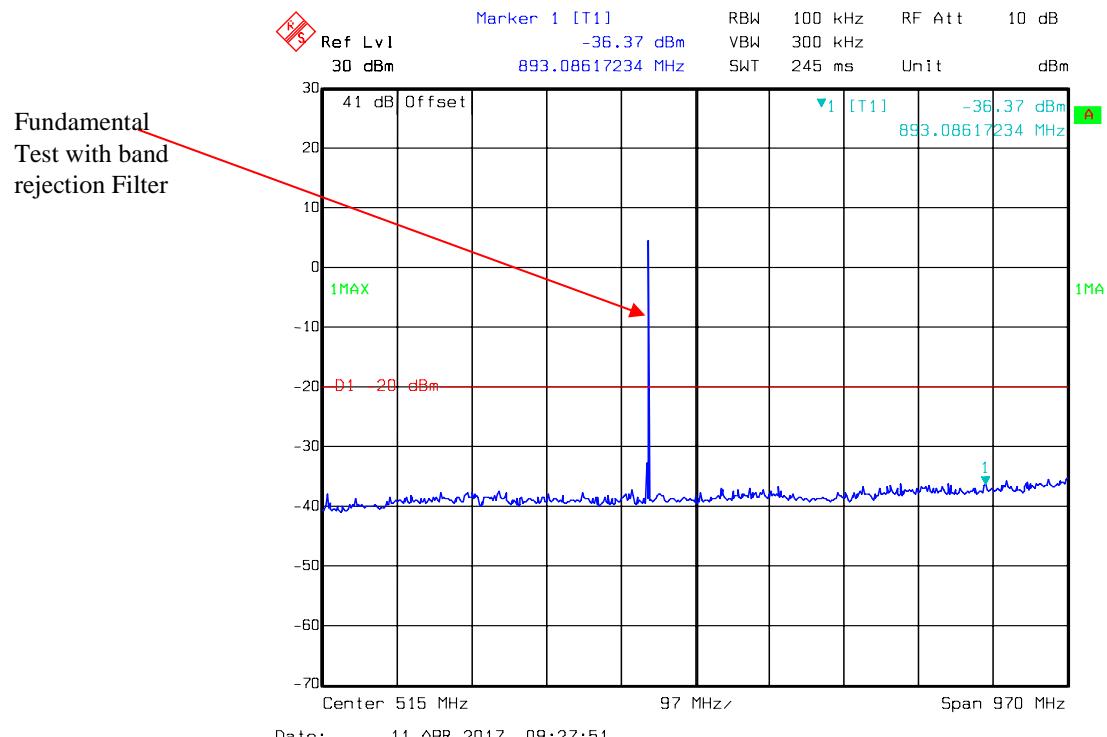
### Environmental Conditions

Temperature:	19.9 °C~20.1 °C
Relative Humidity:	47.3 %~47.3 %
ATM Pressure:	100.7 kPa~100.8 kPa

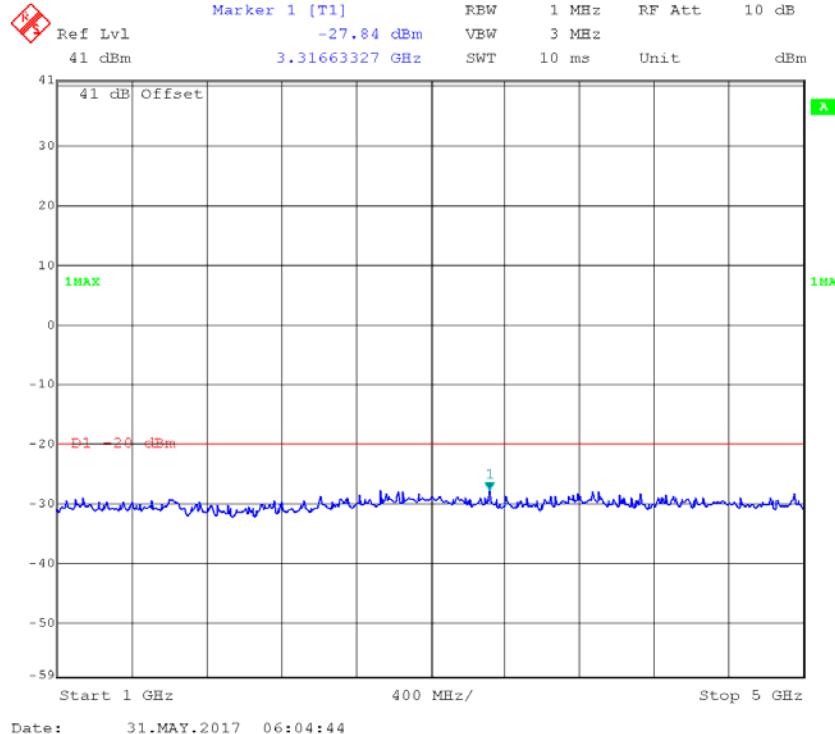
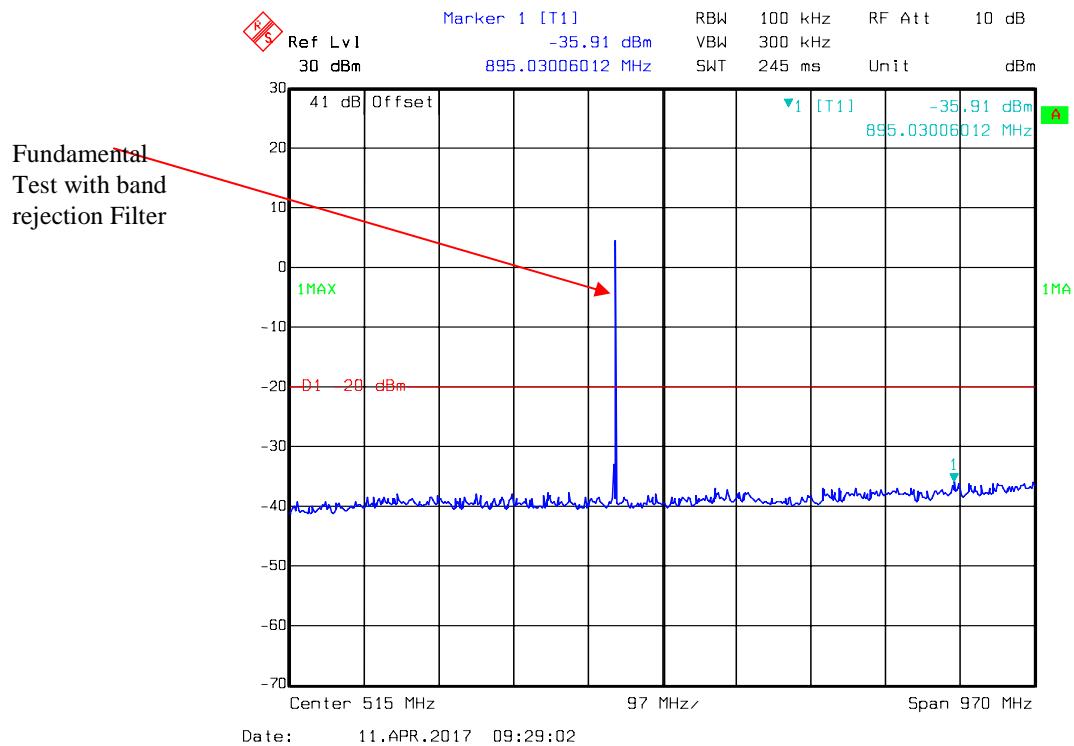
*The testing was performed by Kevin Hu on 2017-04-11 and 2017-05-31.*

Note: For conducted spurious emissions were tested at high rated power, which was the worst case.

**453.2125 MHz – FM Mode, 12.5 kHz**



**453.2125 MHz – 4FSK Mode, 12.5 kHz**



## FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

### Applicable Standard

FCC §2.1053 and §22.359 and §90.210

### Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Agilent	Amplifier	8447D	2944A10442	2016-12-02	2017-12-01
Rohde & Schwarz	EMI Test Receiver	ESCI	100028	2016-12-02	2017-12-01
Sunol Sciences	Broadband Antenna	JB3	A121808	2016-04-10	2019-04-09
Rohde & Schwarz	Spectrum Analyzer	FSEM30	100018	2016-12-02	2017-12-01
ETS	Horn Antenna	3115	003-6076	2016-12-02	2017-12-01
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-0113024	2014-06-16	2017-06-15
EMCO	Adjustable Dipole Antenna	3121C	9109-258	N/A	N/A
HP	Signal Generator	8648C	3623A04150	2016-05-23	2017-05-22
WILTRON	SWEPT FREQUENCY SYNTHESIZER	6737	213001	2016-05-23	2017-05-22
Mini-circuits	Amplifier	ZVA-183-S+	771001215	2016-05-20	2017-05-19
EMCT	Semi-Anechoic Chamber	966	966-1	2015-04-24	2018-04-23
Unknown	RF Cable (below 1GHz)	Unknown	NO.1	2016-11-10	2017-11-09
Unknown	RF Cable (below 1GHz)	Unknown	NO.4	2016-11-10	2017-11-09
Unknown	RF Cable (above 1GHz)	Unknown	NO.2	2016-11-10	2017-11-09

\* **Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

### Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to tenth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

For part 90:

Spurious emissions in dB =  $10 \log_{10} (\text{TXpwr in Watts}/0.001)$ -the absolute level

Spurious attenuation limit in dB =  $50 + 10 \log_{10}$  (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

## Test Data

### Environmental Conditions

<b>Temperature:</b>	24.9 °C
<b>Relative Humidity:</b>	54.2 %
<b>ATM Pressure:</b>	100.6 kPa

*The testing was performed by Kevin Hu on 2017-04-05.*

*Test Mode: Transmitting (High power level is the worst case)*

## 30MHz-5GHz:

Frequency (MHz)	Polar (H/V)	Receiver Reading (dB $\mu$ V)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			S.G. Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
<b>FM, frequency: 453.2125 MHz</b>								
1359.638	H	43.19	-57.2	8.7	1.4	-49.9	-20.0	29.9
1359.638	V	45.28	-55.1	8.7	1.4	-47.8	-20.0	27.8
1812.850	H	43.42	-56.6	11.1	1.3	-46.8	-20.0	26.8
1812.850	V	46.05	-54.3	11.1	1.3	-44.5	-20.0	24.5
2266.063	H	40.20	-55.8	11.1	2.2	-46.9	-20.0	26.9
2266.063	V	43.13	-52.6	11.1	2.2	-43.7	-20.0	23.7
2719.275	H	40.03	-56.8	13.1	2.3	-46.0	-20.0	26.0
2719.275	V	41.52	-56.8	13.1	2.3	-46.0	-20.0	26.0
2456.700	H	36.01	-61.8	12.8	2.6	-51.6	-20.0	31.6
2456.700	V	37.69	-58.9	12.8	2.6	-48.7	-20.0	28.7
1894.200	H	34.35	-64.9	11.8	1.4	-54.5	-20.0	34.5
1995.200	V	37.99	-59	12.0	1.4	-48.4	-20.0	28.4
1879.800	H	36.37	-63	11.7	1.4	-52.7	-20.0	32.7
1923.000	V	37.86	-60.4	11.9	1.4	-49.9	-20.0	29.9
3149.000	H	34.27	-63.5	13.4	2.3	-52.4	-20.0	32.4
3149.000	V	35.83	-61.3	13.4	2.3	-50.2	-20.0	30.2
906.425	H	44.12	-48.6	0.0	1	-49.6	-20.0	29.6
906.425	V	46.39	-48.3	0.0	1	-49.3	-20.0	29.3
<b>4FSK, frequency: 453.2125 MHz</b>								
1359.638	H	42.68	-57.7	8.7	1.4	-50.4	-20.0	30.4
1359.638	V	45.34	-55	8.7	1.4	-47.7	-20.0	27.7
1812.850	H	43.59	-56.5	11.1	1.3	-46.7	-20.0	26.7
1812.850	V	45.78	-54.6	11.1	1.3	-44.8	-20.0	24.8
2266.063	H	40.21	-55.8	11.1	2.2	-46.9	-20.0	26.9
2266.063	V	42.58	-53.2	11.1	2.2	-44.3	-20.0	24.3
2719.275	H	39.72	-57.1	13.1	2.3	-46.3	-20.0	26.3
2719.275	V	41.69	-56.7	13.1	2.3	-45.9	-20.0	25.9
3172.488	H	35.87	-61.7	13.5	2.3	-50.5	-20.0	30.5
3172.488	V	37.42	-59.5	13.5	2.3	-48.3	-20.0	28.3
3625.700	H	34.63	-60.9	14.1	2.2	-49.0	-20.0	29.0
3625.700	V	38.25	-56.8	14.1	2.2	-44.9	-20.0	24.9
4078.913	H	36.54	-57.8	13.8	3.1	-47.1	-20.0	27.1
4078.913	V	37.69	-56.1	13.8	3.1	-45.4	-20.0	25.4
906.425	H	44.36	-48.3	0.0	1	-49.3	-20.0	29.3
906.425	V	45.82	-48.8	0.0	1	-49.8	-20.0	29.8

Note1: For radiated spurious emissions were tested at high rated power, which was the worst case.

Note2: The unit of Antenna Gain is dBd for frequency below 1GHz, and the unit of Antenna Gain is dBi for frequency above 1GHz.

Note3: Absolute Level = SG Level - Cable loss + Antenna Gain

Margin = Limit-Absolute Level

## FCC §2.1055 & §90.213- FREQUENCY STABILITY

### Applicable Standard

FCC §2.1055, §90.213

### Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
BACL	High Temperature Test Chamber	BTH-150	30024	2016-12-02	2017-12-01
FLUKE	Multimeter	1587	27870099	2016-12-30	2017-12-29
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

\* **Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

### Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to DC power supply and the RF output was connected to a frequency counter via feed-through attenuators. The EUT was placed inside the temperature chamber. The power leads and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

The frequency stability shall be measured with variation of primary supply voltage as follows:

- (1) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

### Test Data

#### Environmental Conditions

Temperature:	22.9 °C
Relative Humidity:	45.4 %
ATM Pressure:	100.6 kPa

*The testing was performed by Kevin Hu on 2017-04-12.*

*Test Mode: Transmitting*

<b>Reference Frequency: 453.2125 MHz, 12.5 kHz, Limit: 2.5ppm</b>			
<b>Temerature</b>	<b>V<sub>AC</sub></b>	<b>Reading</b>	<b>Frequency Error</b>
<b>°C</b>		<b>MHz</b>	<b>ppm</b>
-30	120	453.212424	-0.17
-20		453.212457	-0.09
-10		453.212440	-0.13
0		453.212460	-0.09
10		453.212423	-0.17
20		453.212433	-0.15
30		453.212433	-0.15
40		453.212443	-0.13
50		453.212442	-0.13
60		453.212437	-0.14
25	102	453.212410	-0.20
25	138	453.212436	-0.14

## FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

### Applicable Standard

Regulations: FCC §90.214

Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

### Test Equipment List and Details

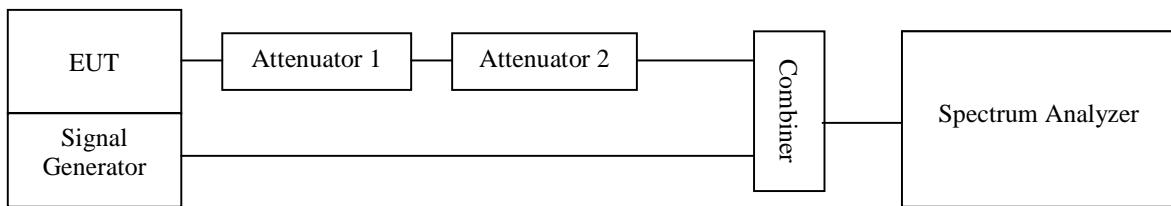
Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2016-09-21	2017-09-20
HP	RF Communications Test Set	8920A	00 247	2016-08-10	2017-08-09
Unknown	RF Attenuator	Unknown	20dB	Each Time	/

**\* Statement of Traceability:** BACL(Chengdu) attests that all of the calibrations on the equipment items listed above were traceable to NIM or to another internationally recognized National Metrology Institute (NMI), and were compliant with the NIST HB 150-2016 Normative Annex B "Implementation of traceability policy in accredited laboratories".

### Test Procedure

- a) Connect the EUT and test equipment as shown on the following block diagram.
- b) Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
- c) Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at  $\pm 12.5$  kHz deviation and set its output level to -100dBm.
- d) Turn on the transmitter.
- e) Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as  $P_0$ .
- f) Turn off the transmitter.
- g) 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.
- h) Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
- i) Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at  $\pm 4$  divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "tiger offset" to -10ms for turn on and -15ms for turn off.
- j) 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  $t_2$ .

k) 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 Data

### Environmental Conditions

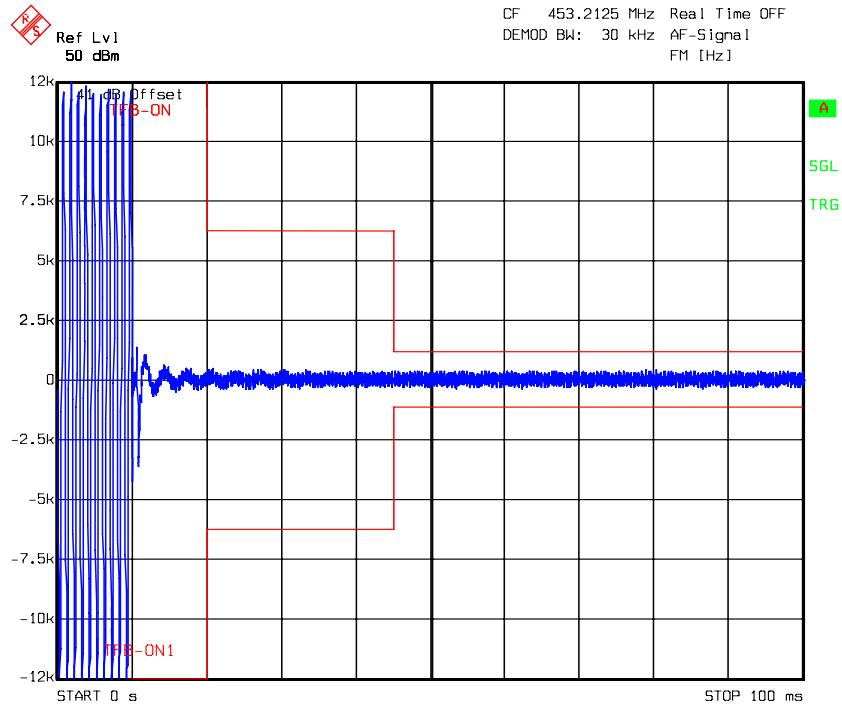
<b>Temperature:</b>	19.9 °C
<b>Relative Humidity:</b>	47.3 %
<b>ATM Pressure:</b>	100.7 kPa

The testing was performed by Kevin Hu on 2017-04-11.

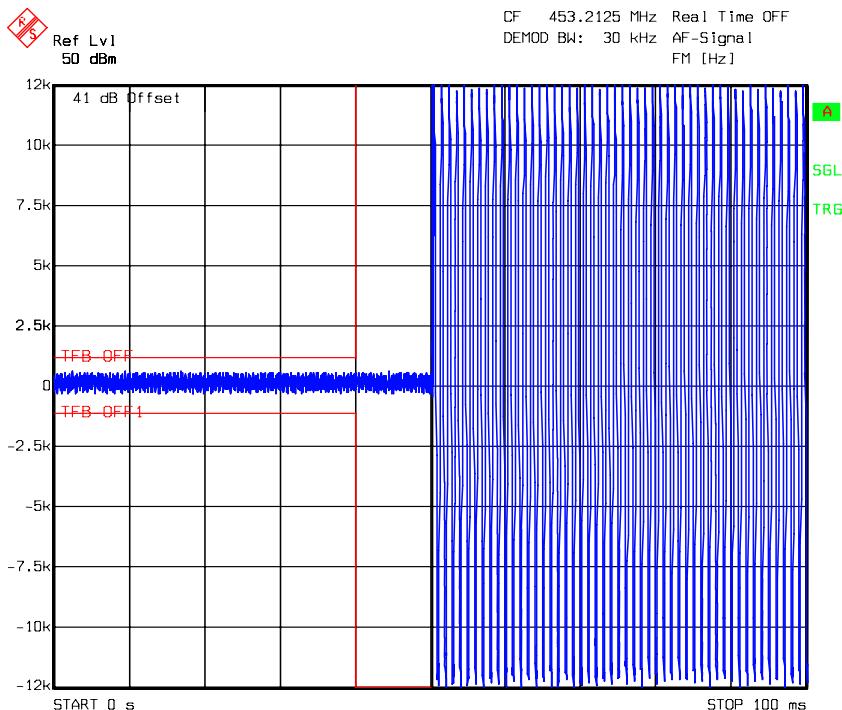
Channel Spacing (kHz)	Transient Period (ms)	Maximum frequency difference	Result
12.5	10( $t_1$ )	±12.5 kHz	Pass
	25( $t_2$ )	±6.25 kHz	
	10( $t_3$ )	±12.5 kHz	

Please refer to the following plots.

**Turn on – 453.2125 MHz**



**Turn off – 453.2125 MHz**



\*\*\*\*\* **END OF REPORT** \*\*\*\*\*