TESTING LABORATORY
CERTIFICATE #4820.01

FCC PART 90

TEST REPORT

For

Tekk International Inc.

1916 Linn St, North Kansas City, Missouri, United States

FCC ID: U59D-150

Report Type:	**Product Type:**
Original Report	DMR Digital Radio

Report Number: RXM180813050-00A

Report Date: 2018-09-07

Reviewed By: Dean Lau
RF Supervisor

Prepared By: Bay Area Compliance Laboratories Corp. (Dongguan)
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:		DMR Digital Radio
EUT Model:		D-150
FCC ID:		U59D-150
Rated Input Voltage:		3.7VDC from battery or 4.2VDC from adapter
Adapter Information	**Model:**	DZ0420500US
	Input:	AC 100-240V
	Output:	DC 4.2V
External Dimension:		90mm(L)*61mm(W)*30mm(H)
Serial Number:		180813050
EUT Received Date:		2018.8.14

Objective

This test report is prepared on behalf of *Tekk International Inc.* in accordance with Part 2, and Part 90 of the Federal Communication Commissions rules.

Related Submittal(s)/Grant(s)

No related submittal(s)/grant(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 Service

Applicable Standards: TIA 603-D.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Dongguan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Unwanted Emissions, radiated	30MHz ~ 1GHz:5.85 dB 1G~26.5GHz: 5.23 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industry Area, Tangxia, Dongguan, Guangdong, China

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218,the FCC Designation No. : CN1220.

The test site has been registered with ISED Canada under ISED Canada Registration Number 3062D.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The frequencies were configured for testing in engineering mode, which was provided by manufacturer.

Test Software Version	D-100 V1.0		
Frequency (MHz)	136.0125	155	173.9875

EUT Specification:

Operating Frequency Band:	136-174MHz
Modulation Mode:	FM/4FSK
Channel Spacing:	12.5kHz
Rated Output Power:	High: 2W Low: 0.5W

EUT Exercise Software

The “D-100 V1.0” was used for testing.

Special Accessories

No special accessory was used.

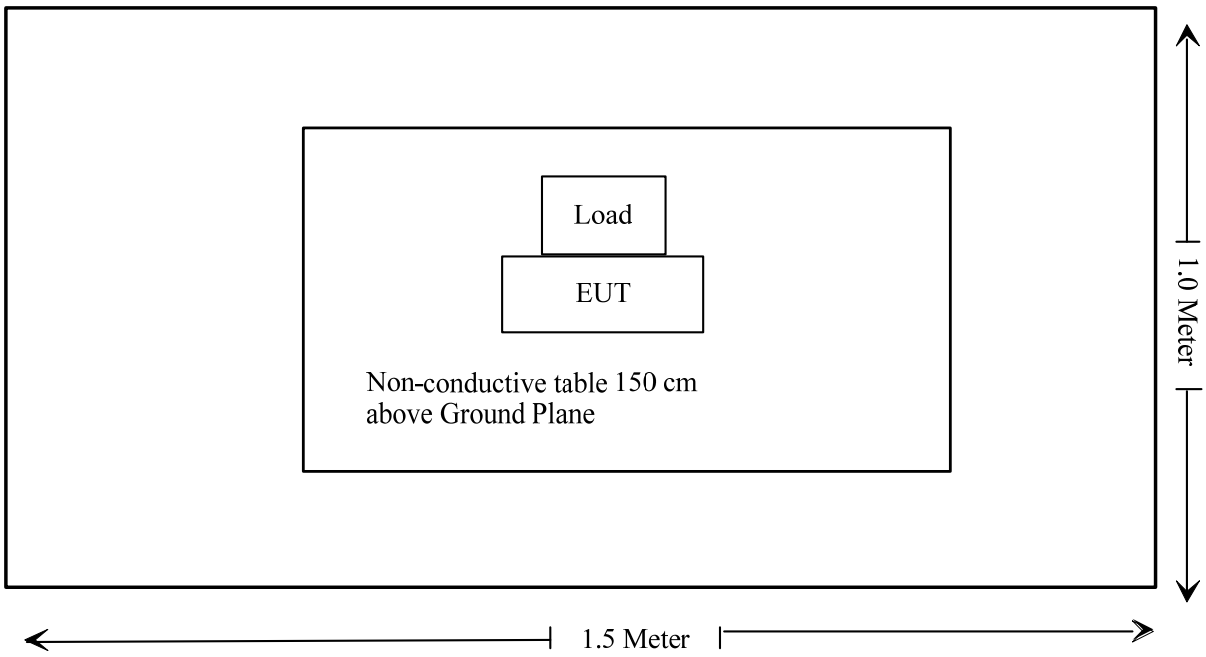
Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	Load(50 ohm)	/	/

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§1.1310 and §2.1093	RF Exposure	Compliance
§2.104;§90.205	RF Output Power	Compliance
§2.1047	Modulation Characteristic	Compliance
§2.1049; §90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliance
§2.1051; §90.210	Spurious Emission at Antenna Terminal	Compliance
§2.1053; §90.210	Spurious Radiated Emissions	Compliance
§2.1055; §90.213	Frequency Stability	Compliance
§90.214	Transient Frequency Behavior	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
R&S	EMI Test Receiver	ESCI	100224	2017-12-11	2018-12-11
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2017-09-05	2018-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-02	2017-09-05	2018-09-05
HP	Amplifier	8447D	2727A05902	2017-09-05	2018-09-05
Agilent	Signal Generator	E8247C	MY43321350	2017-12-11	2018-12-11
R&S	EMI Test Receiver	ESCI	100224	2017-12-11	2018-12-11
R&S	Spectrum Analyzer	FSU 26	200256	2018-01-04	2019-01-04
TDK RF	Horn Antenna	HRN-0118	130 084	2016-01-05	2019-01-04
ETS-Lindgren	Horn Antenna	3115	000 527 35	2016-01-05	2019-01-04
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-02	2017-09-05	2018-09-05
MICRO-COAX	Coaxial Cable	UFA147-1-2362-100100	64639 231029-001	2018-02-24	2019-02-28
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-09-05	2018-09-05
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2018-08-03	2019-08-03
Unknown	Coaxial Cable	C-SJ00-0010	C0010/02	Each time	N/A
Weinschel	Coaxial Attenuators	53-20-34	LN749	2017-09-05	2018-09-05
Weinschel	Coaxial Attenuators	53-20-34	LN749	2018-09-06	2019-09-06
HP	RF Communications Test Set	8920A	00 235	2018-01-04	2019-01-04
Dongzhixu	High Temperature Test Chamber	DP1000	201105083-4	2018-08-25	2019-08-25
UNI-T	Multimeter	UT39A	M130199938	2018-05-09	2019-05-09
Pro instrument	DC Power Supply	pps3300	3300012	N/A	N/A

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

FCC §1.1310 & §2.1093 - RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093.

Test Result

Compliance, please refer to the SAR report: RXM180813050-20.

FCC §2.1046 & §90.205 - RF OUTPUT POWER

Applicable Standard

FCC §2.1046, §90.205

Test Procedure

Conducted RF Output Power:

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

Spectrum Analyzer Setting:

R B/W	Video B/W
100 kHz	300 kHz

Test Data

Environmental Conditions

Temperature:	27.1℃
Relative Humidity:	59 %
ATM Pressure:	100.2 kPa

The testing was performed by Swim Lv on 2018-08-27.

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table.

Modulation Mode	Channel Separation (kHz)	f_c (MHz)	Reading (W)	
			High Power Level	Low Power Level
FM	12.5	136.0125	1.98	0.51
		155	2.18	0.58
		173.9875	2.03	0.57
4FSK	12.5	136.0125	1.84	0.51
		155	2.02	0.57
		173.9875	2.02	0.54

Note: The high rated power is 2W, low rated power is 0.5W.

FCC §2.1047 - MODULATION CHARACTERISTIC

Applicable Standard

FCC §2.1047

(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-603 2.2.3

Test Data

Environmental Conditions

Temperature:	27.1℃
Relative Humidity:	59 %
ATM Pressure:	100.2 kPa

The testing was performed by Swim Lv on 2018-08-27.

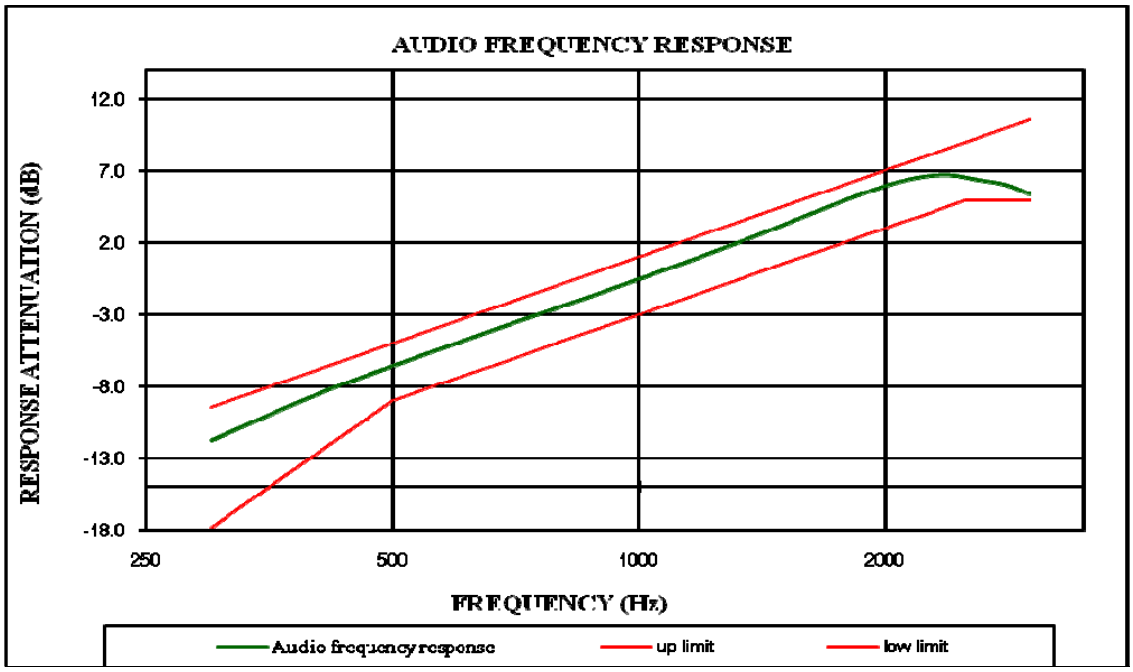
Test Mode: Transmitting

Result: Compliance.

Audio Frequency Response – High Power,12.5kHz

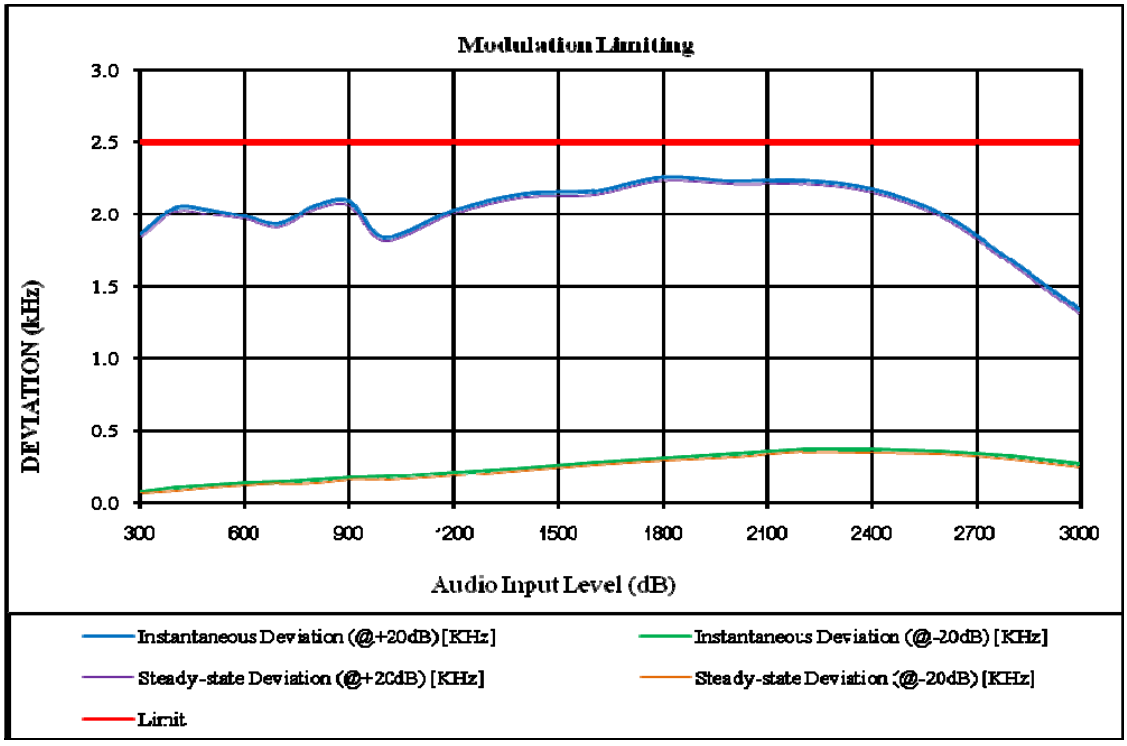
Carrier Frequency: 155 MHz, Channel Separation:12.5kHz

Modulation Frequency (Hz)	Response data (dB)
300	-11.78
400	-8.68
500	-6.61
600	-5.00
700	-3.64
800	-2.51
900	-1.50
1000	-0.57
1200	1.06
1400	2.51
1600	3.83
1800	4.99
2000	5.90
2200	6.50
2400	6.66
2600	6.32
2800	6.01
3000	5.35



MODULATION LIMITING – High Power
Carrier Frequency:155 MHz, Channel Separation:12.5kHz

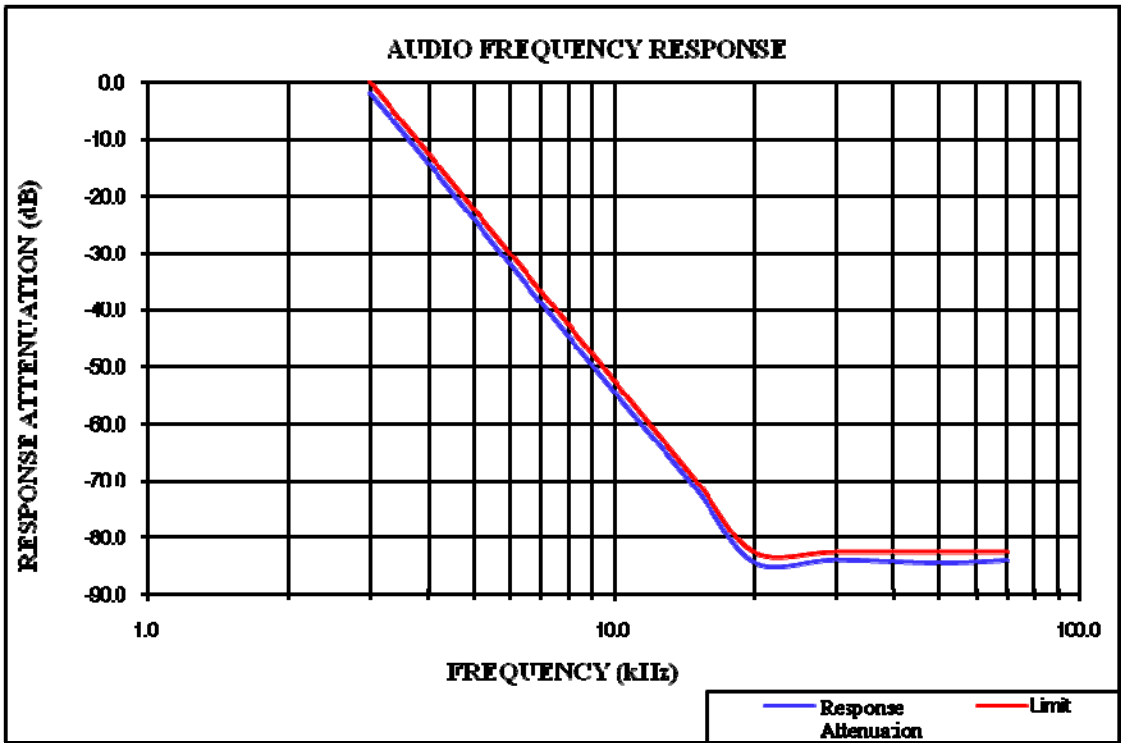
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [KHz]
	Deviation (@+20dB) [KHz]	Deviation (@-20dB) [KHz]	Deviation (@+20dB) [KHz]	Deviation (@-20dB) [KHz]	
300	1.862	0.076	1.839	0.063	2.5
400	2.046	0.101	2.018	0.083	2.5
500	2.025	0.116	1.996	0.103	2.5
600	1.986	0.133	1.966	0.123	2.5
700	1.936	0.146	1.913	0.132	2.5
800	2.056	0.154	2.033	0.135	2.5
900	2.089	0.170	2.059	0.159	2.5
1000	1.842	0.181	1.820	0.161	2.5
1200	2.031	0.211	2.006	0.191	2.5
1400	2.140	0.243	2.116	0.229	2.5
1600	2.160	0.278	2.137	0.263	2.5
1800	2.252	0.307	2.230	0.297	2.5
2000	2.227	0.337	2.207	0.320	2.5
2200	2.230	0.366	2.208	0.351	2.5
2400	2.172	0.367	2.151	0.349	2.5
2600	2.001	0.356	1.979	0.336	2.5
2800	1.670	0.321	1.646	0.305	2.5
3000	1.329	0.268	1.302	0.252	2.5



Audio Frequency Low Pass Filter Response – High Power

Carrier Frequency: 155 MHz, Channel Spacing = 12.5 kHz

Audio Frequency	Response Attenuation	Limit
kHz	dB	dB
3.0	-1.8	0.0
3.5	-8.3	-6.7
4.0	-14.1	-12.5
5.0	-23.9	-22.2
7.0	-38.8	-36.8
10.0	-54.3	-52.3
15.0	-71.4	-69.9
20.0	-84.4	-82.5
30.0	-84.0	-82.5
50.0	-84.5	-82.5
70.0	-84.1	-82.5



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

Applicable Standard

FCC §2.1049, §90.209 and §90.210

Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 100 Hz or 300 Hz and the spectrum was recorded in the frequency band.

Test Data

Environmental Conditions

Temperature:	26.4~26.5 ℃
Relative Humidity:	57~58 %
ATM Pressure:	99.9~100.3 kPa

The testing was performed by Swim Lv on 2018-08-25& 2018-09-06.

Test mode: transimitting

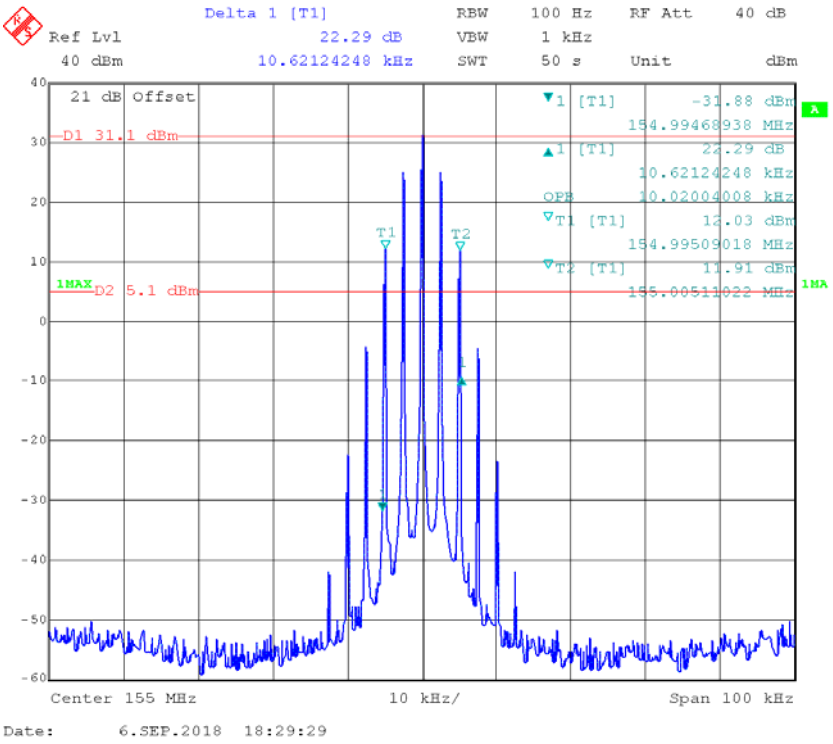
Modulation Mode	Channel Spacing	f_c	99% Occupied Bandwidth	26 dB Bandwidth	Power Level
	kHz	MHz	kHz	kHz	
FM	12.5 kHz	155	10.020	10.621	High
			10.020	10.421	Low
4FSK	12.5 kHz	155	7.415	10.020	High
			7.415	9.419	Low

Note: Emission bandwidth was based on calculation method instead of measurement.
Emission Designator
Per CFR 47 §2.201& §2.202, BW = 2M + 2D

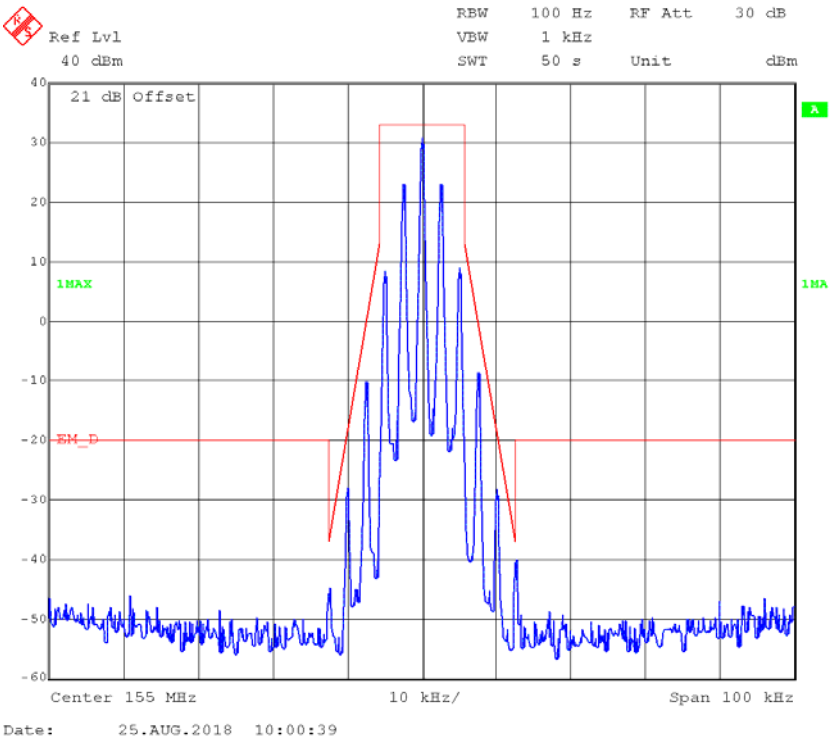
For FM Mode (Channel Spacing: 12.5 kHz)
Emission Designator 11K0F3E
In this case, the maximum modulating frequency is 3.0 kHz with a 2.5 kHz deviation.
BW = 2(M+D) = 2*(3.0 kHz + 2.5 kHz) = 11 kHz = 11K0
F3E portion of the designator represents an FM voice transmission
Therefore, the entire designator 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.

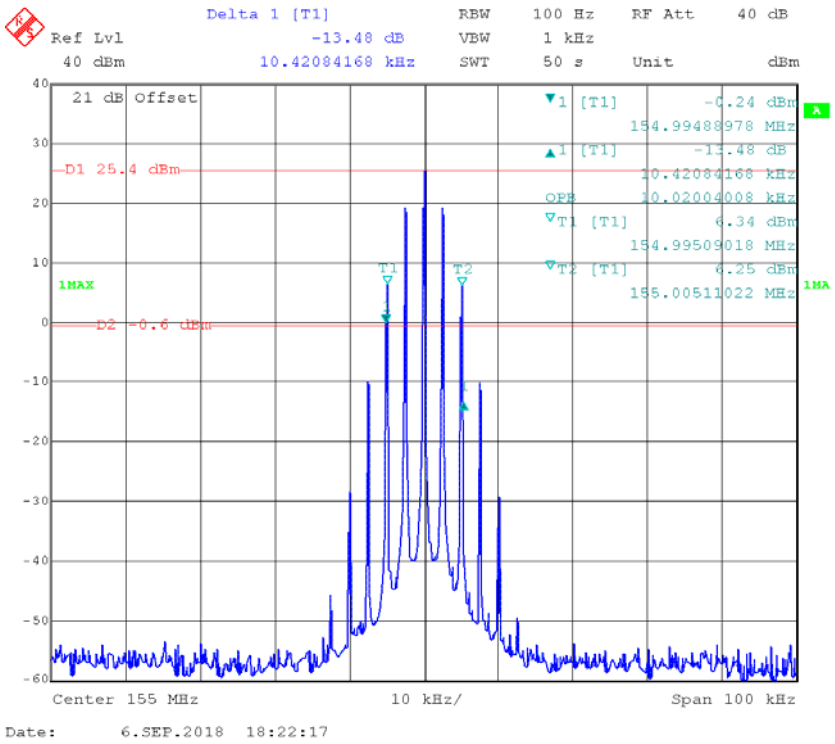
Occupied Bandwidth – FM, 155 MHz, High Power Level



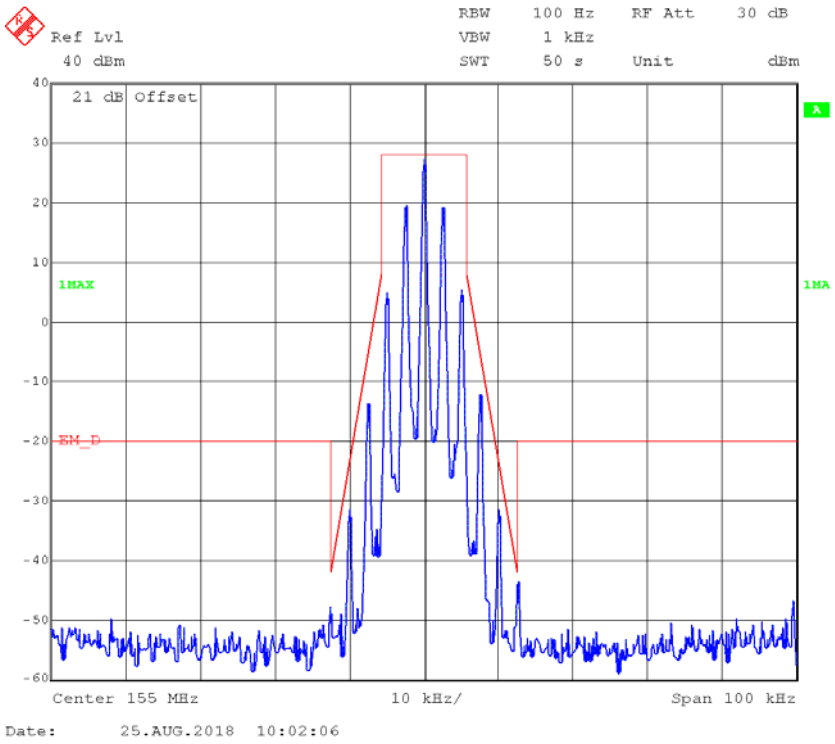
Emission Mask - Type D



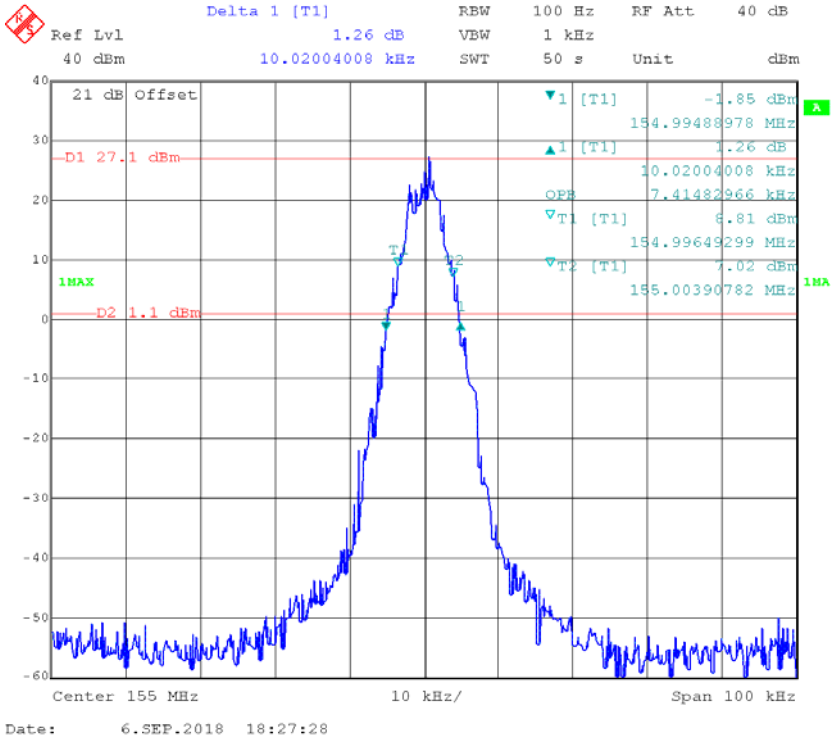
Occupied Bandwidth – FM, 155 MHz, Low Power Level



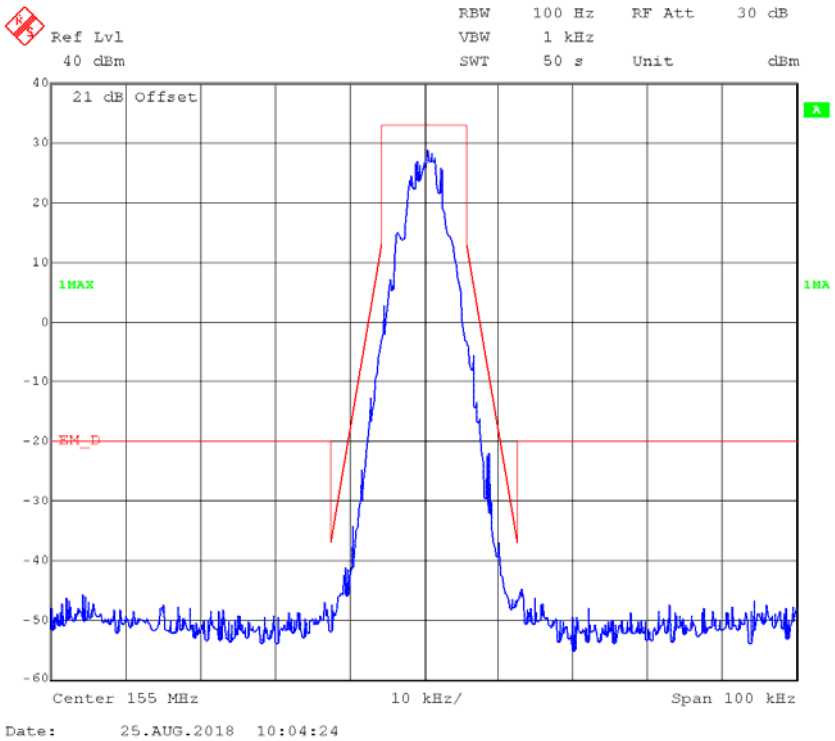
Emission Mask - Type D



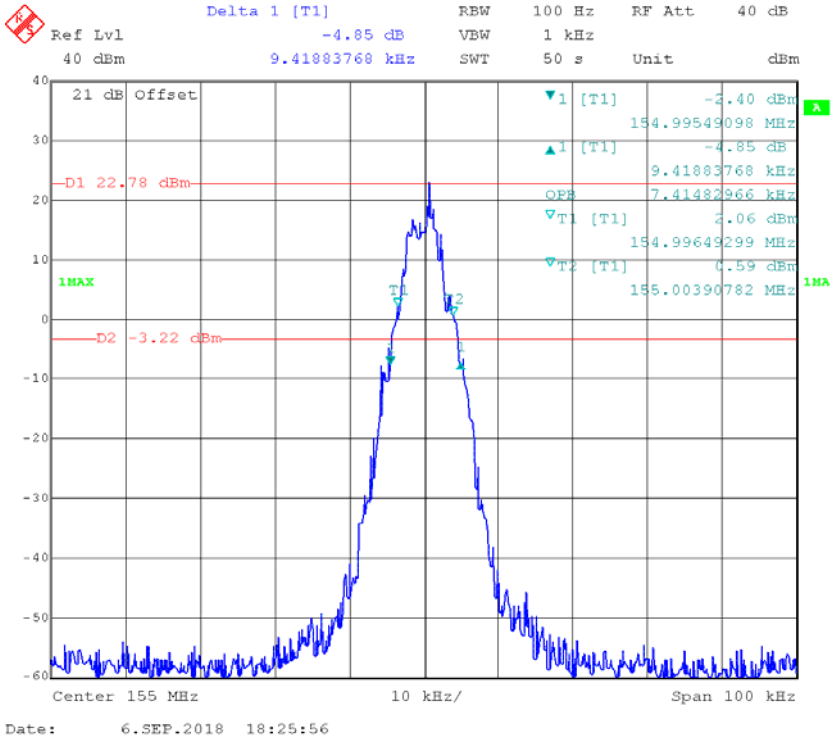
Occupied Bandwidth – 4FSK, 155 MHz, High Power Level



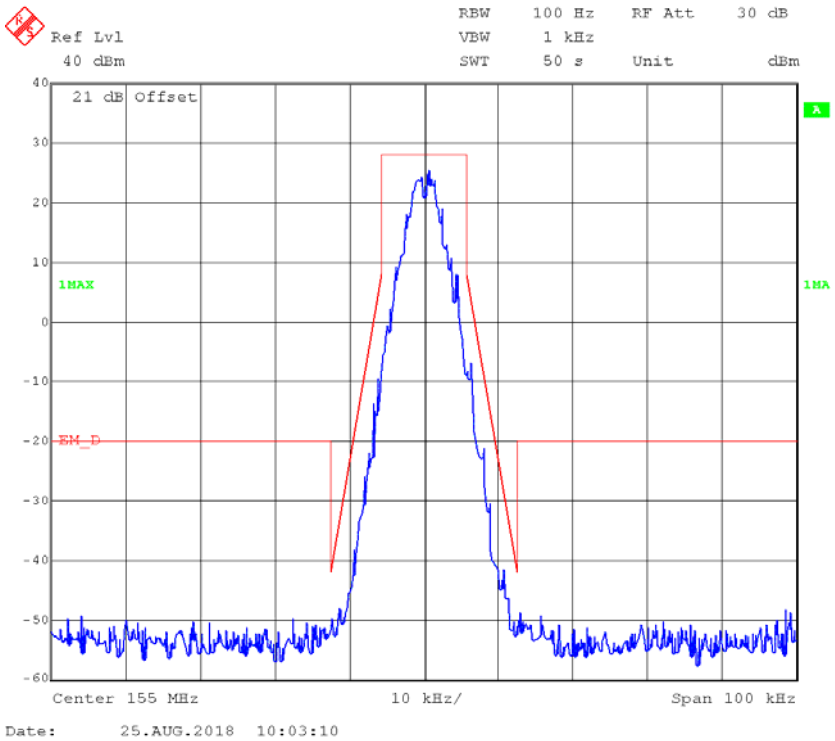
Emission Mask - Type D



Occupied Bandwidth – 4FSK, 155 MHz, Low Power Level



Emission Mask - Type D



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

Applicable Standard

FCC §2.1051, §90.210

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 at 100 kHz for below 1GHz, and 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Data

Environmental Conditions

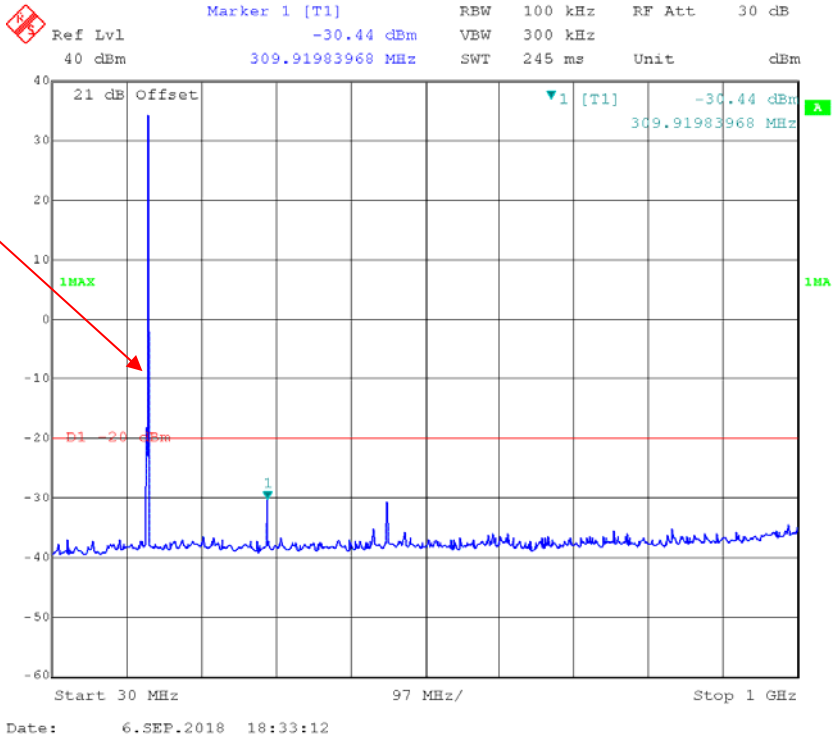
Temperature:	26.4℃
Relative Humidity:	57 %
ATM Pressure:	100.3 kPa

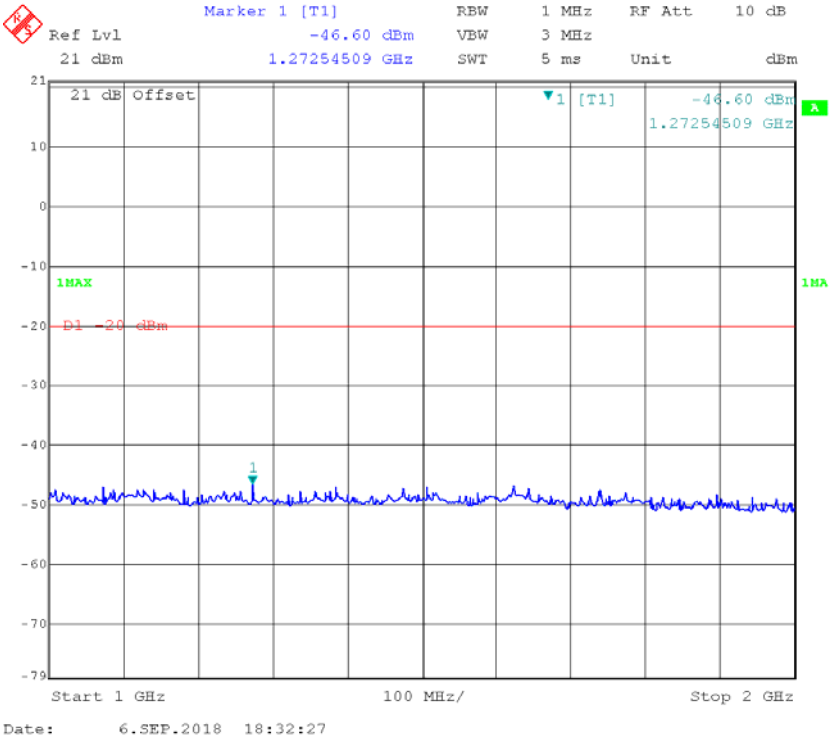
The testing was performed by Swim Lv on 2018-09-06.

Test Mode: Transmitting, please refer to the following plots.

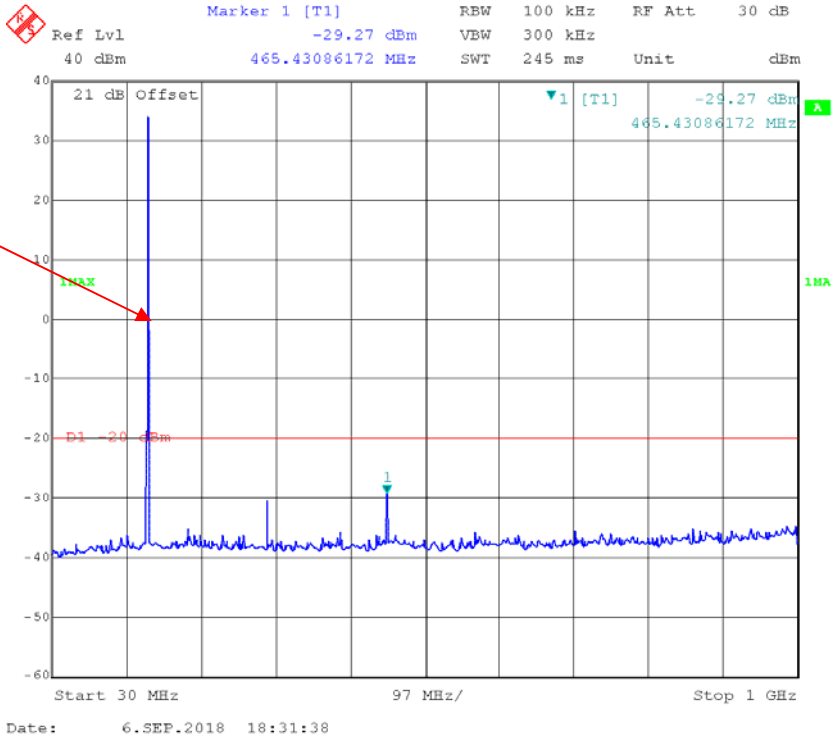
155 MHz – FM Mode,High Power

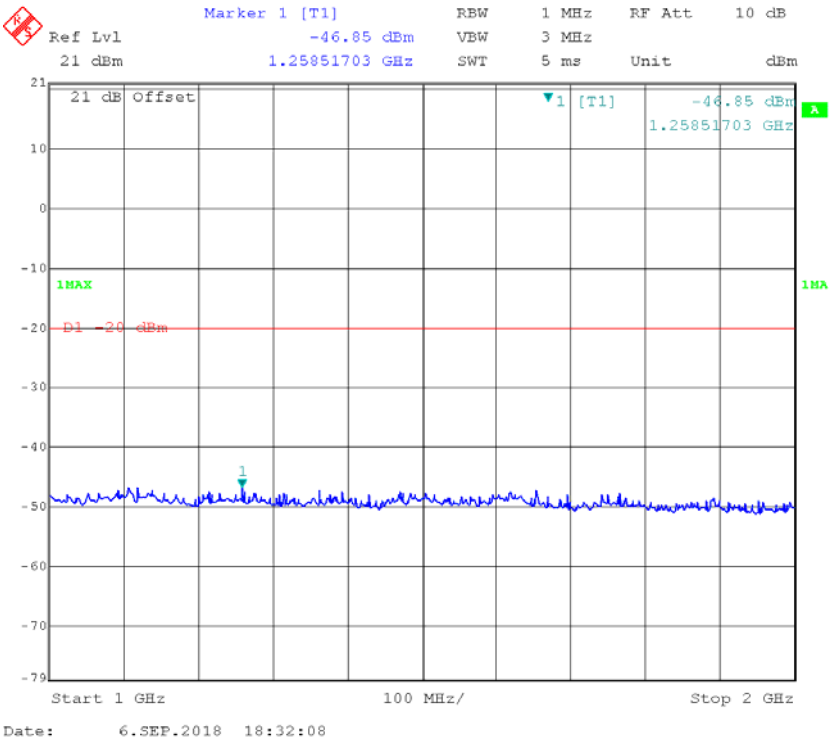
Fundamental





155 MHz –4FSK Mode,High Power





FCC §2.1053 §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, §90.210

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 teeth 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.

Spurious emissions in dB =10 1g (TXpwr in Watts/0.001)-the absolute level

Test Data

Environmental Conditions

Temperature:	27.6 ℃
Relative Humidity:	56 %
ATM Pressure:	99.7kPa

The testing was performed by Vern Shen and Sunny Cen on 2018-08-24.

Test Mode: Transmitting

Frequency (MHz)	Polar (H/V)	Receiver Reading (dBµV)	Substituted Method			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Substituted Level (dBm)	Antenna Gain (dBd/dBi)	Cable Loss (dB)			
FM,Frequency: 155MHz-12.5 kHz								
310.00	H	27.30	-80.96	0.00	0.53	-81.49	-20.00	61.49
310.00	V	38.47	-71.33	0.00	0.53	-71.86	-20.00	51.86
465.00	H	24.85	-79.58	0.00	0.68	-80.26	-20.00	60.26
465.00	V	31.54	-76.04	0.00	0.68	-76.72	-20.00	56.72
620.00	H	26.47	-75.52	0.00	0.80	-76.32	-20.00	56.32
620.00	V	31.83	-73.26	0.00	0.80	-74.06	-20.00	54.06
775.00	H	26.62	-72.73	0.00	0.93	-73.66	-20.00	53.66
775.00	V	31.75	-71.03	0.00	0.93	-71.96	-20.00	51.96
930.00	H	24.11	-71.78	0.00	0.96	-72.74	-20.00	52.74
930.00	V	35.07	-62.62	0.00	0.96	-63.58	-20.00	43.58
1085.00	H	38.51	-75.02	7.48	0.98	-68.52	-20.00	48.52
1085.00	V	36.67	-77.29	7.48	0.98	-70.79	-20.00	50.79
1240.00	H	46.27	-66.73	7.70	1.13	-60.16	-20.00	40.16
1240.00	V	44.53	-69.49	7.70	1.13	-62.92	-20.00	42.92
4FSK,Frequency: 155MHz-12.5 kHz								
310.00	H	30.33	-77.93	0.00	0.53	-78.46	-20.00	58.46
310.00	V	37.26	-72.54	0.00	0.53	-73.07	-20.00	53.07
465.00	H	25.73	-78.70	0.00	0.68	-79.38	-20.00	59.38
465.00	V	32.86	-74.72	0.00	0.68	-75.40	-20.00	55.40
620.00	H	28.63	-73.36	0.00	0.80	-74.16	-20.00	54.16
620.00	V	31.19	-73.90	0.00	0.80	-74.70	-20.00	54.70
775.00	H	30.60	-68.75	0.00	0.93	-69.68	-20.00	49.68
775.00	V	32.95	-69.83	0.00	0.93	-70.76	-20.00	50.76
930.00	H	25.11	-70.78	0.00	0.96	-71.74	-20.00	51.74
930.00	V	30.16	-67.53	0.00	0.96	-68.49	-20.00	48.49
1085.00	H	38.52	-75.01	7.48	0.98	-68.51	-20.00	48.51
1085.00	V	38.12	-75.84	7.48	0.98	-69.34	-20.00	49.34
1240.00	H	44.75	-68.25	7.70	1.13	-61.68	-20.00	41.68
1240.00	V	43.62	-70.40	7.70	1.13	-63.83	-20.00	43.83

Note:
Absolute Level = Substituted Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

FCC §2.1055 & §90.213 - FREQUENCY STABILITY

Applicable Standard

FCC §2.1055, §90.213

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external 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 DC 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.

Test Data

Environmental Conditions

Temperature:	26.5 ℃
Relative Humidity:	58 %
ATM Pressure:	99.9 kPa

The testing was performed by Swim Lv on 2018-08-25.

Test Mode: Transmitting

FM,12.5kHz, Reference Frequency: 155 MHz, Limit: ±5 ppm			
Temperature (℃)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
-30	3.7	154.999971	-0.19
-20		154.999973	-0.17
-10		154.999979	-0.14
0		154.999970	-0.19
10		154.999985	-0.10
20		154.999965	-0.23
30		154.999980	-0.13
40		154.999988	-0.08
50		154.999974	-0.17
60		154.999979	-0.14
25	3.5	154.999979	-0.14
25	4.2	154.999986	-0.09

4FSK, 12.5kHz, Reference Frequency: 155 MHz, Limit: ±5 ppm			
Temperature (℃)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
-30	3.7	154.999993	-0.05
-20		154.999991	-0.06
-10		154.999986	-0.09
0		154.999982	-0.12
10		154.999997	-0.02
20		154.999975	-0.16
30		154.999998	-0.01
40		154.999996	-0.03
50		155.000000	0.00
60		154.999993	-0.05
25	3.5	154.999983	-0.11
25	4.2	154.999993	-0.05

Note: the operation voltage is declared by manufacturer.

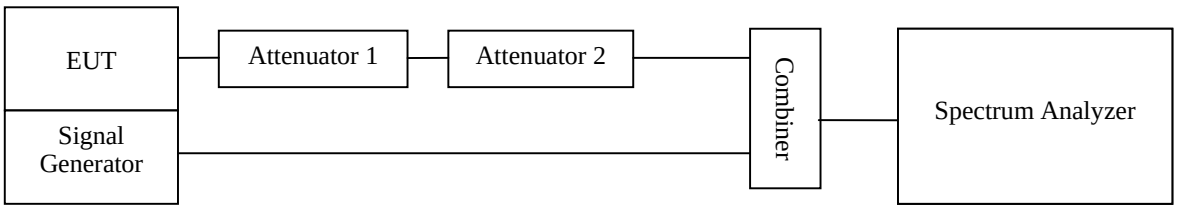
FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214
Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

Test 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 ±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 ±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

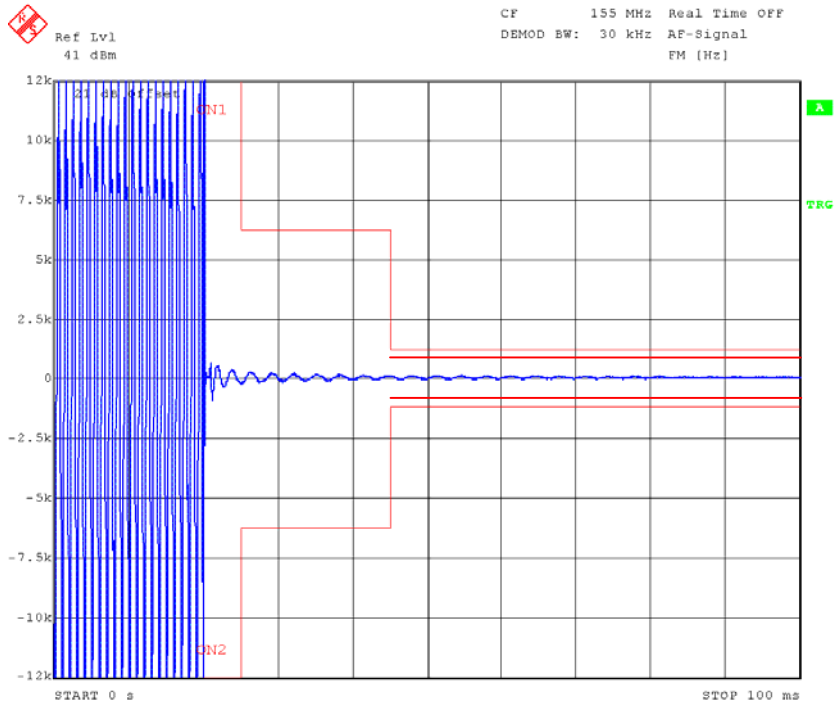
Temperature:	26.5 ℃
Relative Humidity:	58 %
ATM Pressure:	99.9 kPa

The testing was performed by Swim Lv on 2018-08-25.

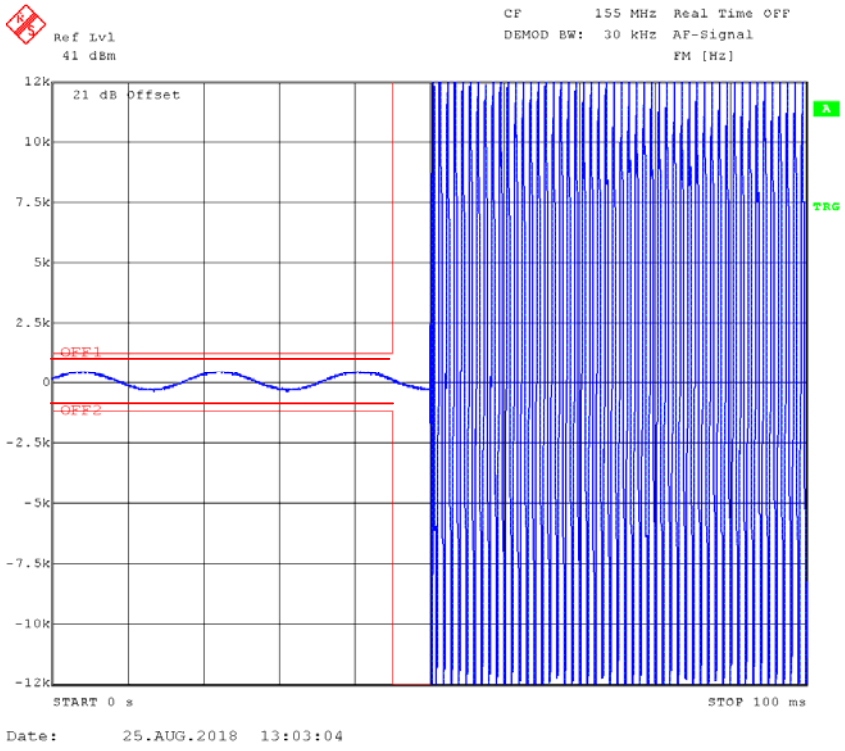
Channel Spacing (kHz)	Transient Period (ms)	Transient Frequency	Result
12.5	<5(t_1)	±12.5 kHz	Pass
	<20(t_2)	±6.25 kHz	
	<5(t_3)	±12.5 kHz	

Please refer to the following plots.

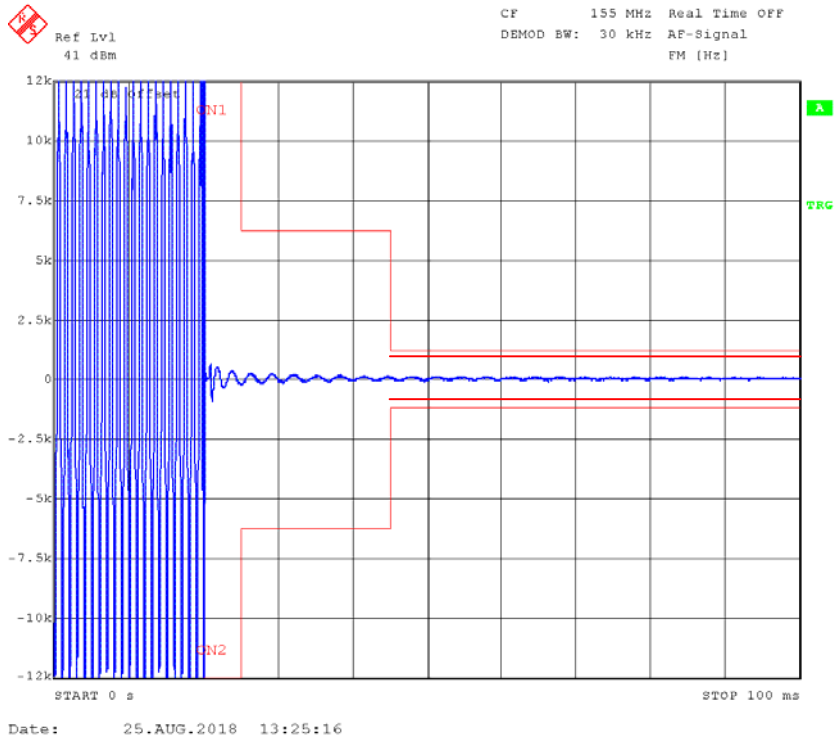
Turn on – 155 MHz, High power level



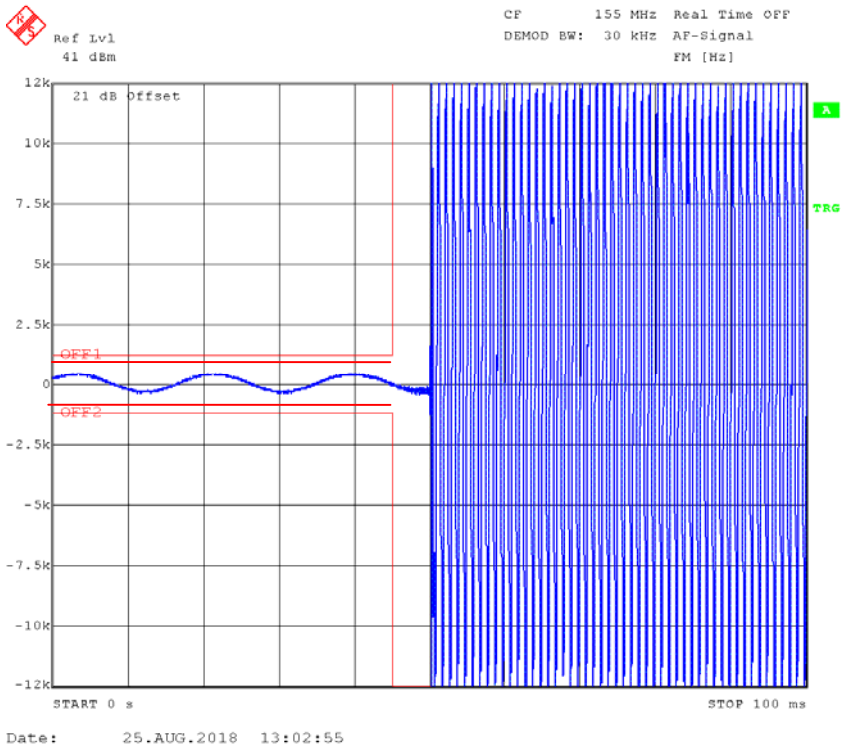
Turn off – 155 MHz, High power level



Turn on – 155 MHz, Low power level



Turn off – 155 MHz, Low power level



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