

FCC PART 95
MEASUREMENT AND TEST REPORT

For

Sam Radios Ltd.

No.18 Daxiamei Industrial Park, Nan'an, Quanzhou, Fujian, 362300, China

FCC ID: 2AGPQ-FRS18

Report Type: Original Report	Product Type: Family Radio Transceiver
Report Number: <u>RXM200310052-00</u>	
Report Date: <u>2020-04-22</u>	
Reviewed By: <u>Ivan Cao</u> 	
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TABLE OF CONTENTS

GENERAL INFORMATION.....	3
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	3
OBJECTIVE	3
RELATED SUBMITTAL(S)/GRANT(S).....	3
TEST METHODOLOGY	3
MEASUREMENT UNCERTAINTY.....	4
TEST FACILITY	4
DECLARATIONS.....	4
SYSTEM TEST CONFIGURATION.....	5
DESCRIPTION OF TEST CONFIGURATION	5
EQUIPMENT MODIFICATIONS	5
EUT EXERCISE SOFTWARE	5
BLOCK DIAGRAM OF TEST SETUP	6
SUMMARY OF TEST RESULTS	7
FCC §2.1093 - RF EXPOSURE INFORMATION	8
APPLICABLE STANDARD	8
TEST RESULT	8
FCC §2.1046, §95.567 - RF OUTPUT POWER.....	9
APPLICABLE STANDARD	9
TEST PROCEDURE	9
TEST EQUIPMENT LIST AND DETAILS.....	9
TEST DATA	9
FCC §2.1047 & §95.575 - MODULATION CHARACTERISTIC	11
APPLICABLE STANDARD	11
TEST EQUIPMENT LIST AND DETAILS.....	11
TEST PROCEDURE	11
TEST DATA	11
FCC §2.1049, §95.573, §95.579 - AUTHOURIZED BANDWIDTH AND EMISSION MASK	15
APPLICABLE STANDARD	15
TEST PROCEDURE	15
TEST EQUIPMENT LIST AND DETAILS.....	15
TEST DATA	16
FCC §2.1053 & §95.579 - RADIATED SPURIOUS EMISSION	19
APPLICABLE STANDARD	19
TEST PROCEDURE	19
TEST EQUIPMENT LIST AND DETAILS.....	19
TEST DATA	20
FCC§2.1055 (d), §95.565- FREQUENCY STABILITY	22
APPLICABLE STANDARD	22
TEST PROCEDURE	22
TEST EQUIPMENT LIST AND DETAILS.....	22
TEST DATA	23

GENERAL INFORMATION

Product Description for Equipment Under Test (EUT)

EUT Name:	Family Radio Transceiver
EUT Model:	FT-18
Multiple Models:	FT-18S, FT-28, FT-28S
Operation Frequency:	462.5500-462.7250MHz; 467.5625-467.7125MHz
Modulation Mode:	FM
Channel Spacing:	12.5kHz
Emission Designator:	11K0F3E
Maximum Output Power: (ERP)	462.5500-462.7250MHz: 23.21dBm 467.5625-467.7125MHz: 16.86 dBm
Rated Input Voltage:	DC 3.7V from battery or DC 5V from adapter
Serial Number:	RXM200310051-RF-S1
EUT Received Date:	2020.3.10
EUT Received Status:	Good

Note: The series product, models FT-18, FT-18S, FT-28, FT-28S are electrically identical, we selected FT-18 for fully testing, the details of the differences between them were explained in the following form.

Objective

This report is prepared on behalf of **Sam Radios Ltd.** in accordance with Part 2 and Part 95, Subpart A and B of the Federal Communication Commissions 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 Part 95 Subpart A and Subpart B of the Federal Communication Commissions rules with TIA-603-D, Land Mobile FM or PM-Communications Equipment-Measurement and Performance Standards.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

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 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval.

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 lab has been recognized as the FCC accredited lab 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 lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier : CN0022.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “ Δ ”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a typical fashion (as normally used by a typical user).

The device uses total 22 FRS channels as below:

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	462.5625	12	467.6625
2	462.5875	13	467.6875
3	462.6125	14	467.7125
4	462.6375	15	462.5500
5	462.6625	16	462.5750
6	462.6875	17	462.6000
7	462.7125	18	462.6250
8	467.5625	19	462.6500
9	467.5875	20	462.6750
10	467.6125	21	462.7000
11	467.6375	22	462.7250

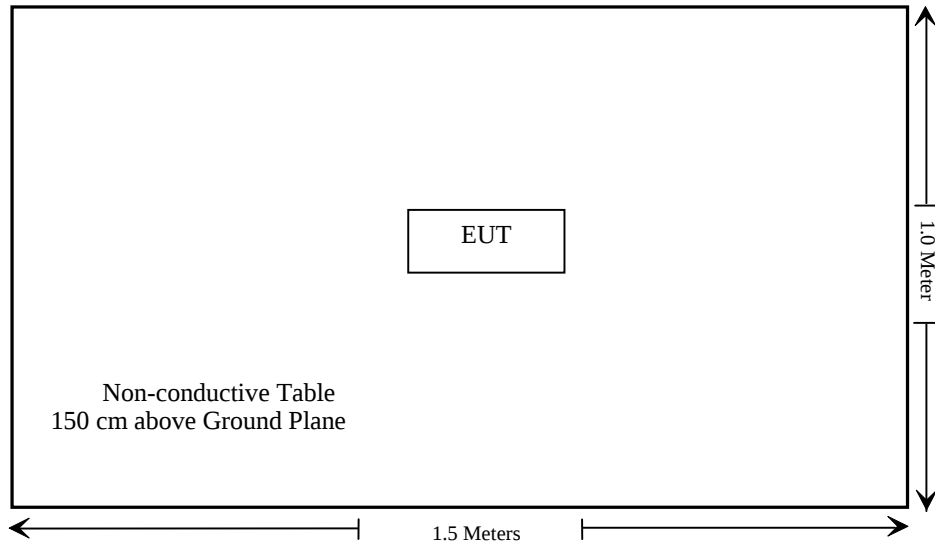
Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

No software was used during test.

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§2.1093	RF Exposure	Compliance
§2.1046, §95.567	RF Output Power	Compliance
§2.1047, §95.575	Modulation Characteristic	Compliance
§2.1049, §95.573, §95.579	Authorized Bandwidth & Emission Mask	Compliance
§2.1053, §95.579	Spurious Radiated Emissions	Compliance
§2.1055(d), §95.565	Frequency Stability	Compliance

FCC §2.1093 - RF EXPOSURE INFORMATION

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

Test Result

Please refer to SAR Report Number: RXM200310052-20.

FCC §2.1046, §95.567 - RF OUTPUT POWER

Applicable Standard

According to FCC §95.567

Each FRS transmitter type must be designed such that the effective radiated power (ERP) on channels 8 through 14 does not exceed 0.5 Watts and the ERP on channels 1 through 7 and 15 through 22 does not exceed 2.0 Watts.

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.

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 emissions were measured by the substitution.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102453	2019-06-26	2020-06-26
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
Agilent	Signal Generator	E8247C	MY43321350	2019-12-10	2020-12-10

* **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).

Test Data

Environmental Conditions

Temperature:	23.2~26 °C
Relative Humidity:	50~54%
ATM Pressure:	100.8~101.9kPa
Test by:	Jalon Liu, Felix Wang
Test Date:	2020.03.26-2020.04.11

Test Mode: Transmitting

ERP:

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)			
Frequency:462.6375MHz								
462.6375	H	93.42	12.09	0.00	0.67	11.42	33.00	21.58
462.6375	V	102.26	23.88	0.00	0.67	23.21	33.00	9.79
Frequency:467.6375MHz								
467.6375	H	86.96	5.76	0.00	0.68	5.08	27.00	21.92
467.6375	V	95.77	17.54	0.00	0.68	16.86	27.00	10.14

Test Result: Compliance.

FCC §2.1047 & §95.575 - MODULATION CHARACTERISTIC**Applicable Standard**

Per FCC §2.1047 and §95.575:

Each FRS transmitter type must be designed such that the peak frequency deviation does not exceed 2.5 kHz, and the highest audio frequency contributing substantially to modulation must not exceed 3.125 kHz.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005012	Each Time	/
E-Microwave	Blocking Control	EMDCB-00036	0E01201047	Each Time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	Each Time	/
HP	RF Communications Test Set	8920A	3438A05201	2019-05-09	2020-05-09
UNI-T	Multimeter	UT39A	M130199938	2019-07-23	2020-07-23

* **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).

Test Procedure

Test Method: TIA/EIA-603-D

Test Data**Environmental Conditions**

Temperature:	24.6 °C
Relative Humidity:	51%
ATM Pressure:	101.4kPa
Test by:	Gavin Xu
Test Date:	2020.03.27

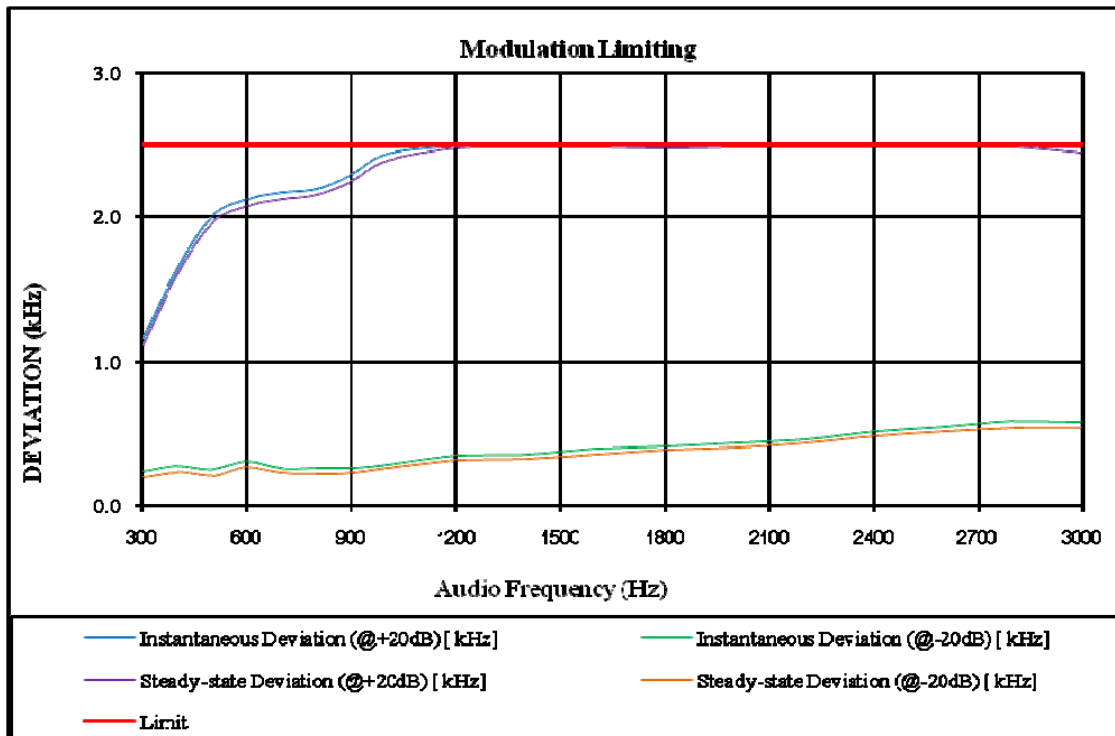
Please refer to the following tables and plots.

Test Mode: Transmitting

MODULATION LIMITING

Carrier Frequency: 467.6375 MHz

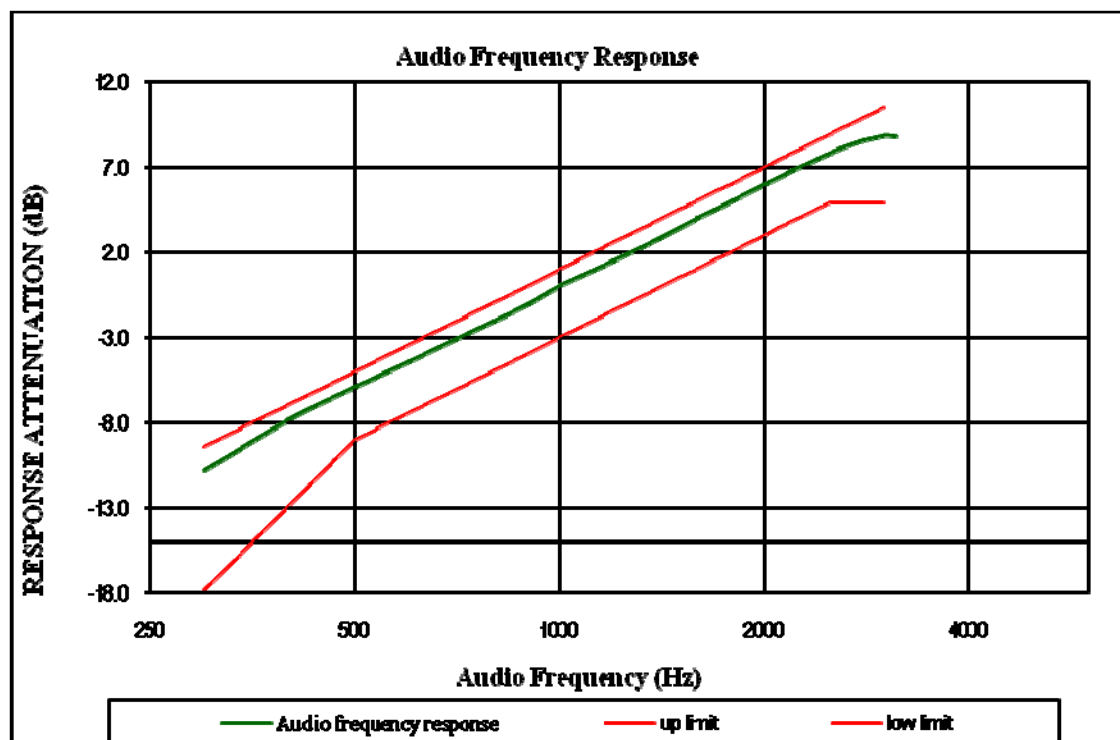
Audio Frequency (Hz)	Instantaneous		Steady-state		Limit [kHz]
	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	Deviation (@+20dB) [kHz]	Deviation (@-20dB) [kHz]	
300	1.148	0.240	1.105	0.202	2.5
400	1.643	0.275	1.603	0.235	2.5
500	2.007	0.252	1.962	0.211	2.5
600	2.123	0.312	2.076	0.269	2.5
700	2.170	0.259	2.128	0.228	2.5
800	2.196	0.265	2.156	0.224	2.5
900	2.295	0.266	2.249	0.229	2.5
1000	2.436	0.287	2.392	0.259	2.5
1200	2.492	0.346	2.475	0.314	2.5
1400	2.495	0.356	2.483	0.327	2.5
1600	2.493	0.393	2.485	0.359	2.5
1800	2.495	0.413	2.481	0.385	2.5
2000	2.493	0.435	2.485	0.404	2.5
2200	2.495	0.462	2.487	0.434	2.5
2400	2.494	0.511	2.486	0.484	2.5
2600	2.492	0.542	2.483	0.513	2.5
2800	2.493	0.582	2.485	0.541	2.5
3000	2.488	0.576	2.447	0.543	2.5



Audio Frequency Response

Carrier Frequency: 467.6375 MHz

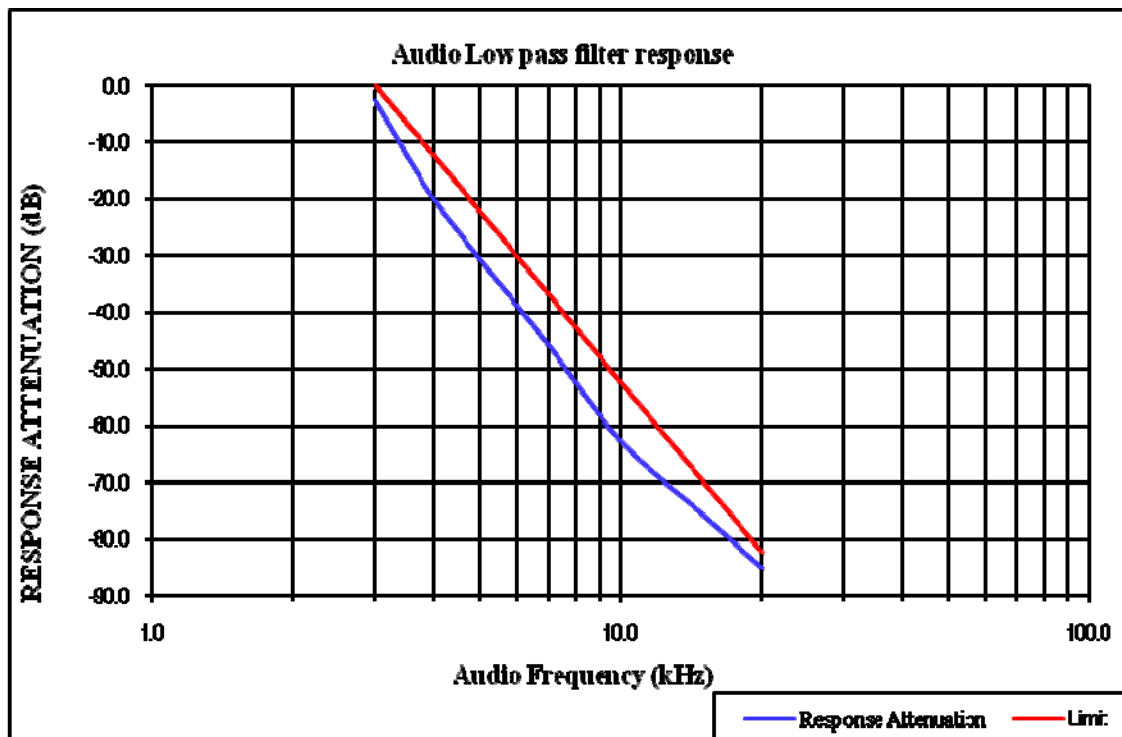
Audio Frequency (Hz)	Response Attenuation (dB)
300	-10.79
400	-7.78
500	-5.90
600	-4.41
700	-3.09
800	-2.02
900	-1.00
1000	0.00
1200	1.51
1400	2.82
1600	4.00
1800	5.05
2000	5.96
2200	6.78
2400	7.49
2600	8.10
2800	8.58
3000	8.82
3125	8.78



Audio Low Pass Filter Response

Carrier Frequency: 467.6375 MHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
3.0	-2.7	0.0
3.5	-12.4	-6.7
4.0	-20.3	-12.5
5.0	-30.5	-22.2
7.0	-45.6	-36.8
10.0	-62.7	-52.3
15.0	-75.9	-69.9
20.0	-85.2	-82.5



FCC §2.1049, §95.573, §95.579 - AUTHORIZED BANDWIDTH AND EMISSION MASK**Applicable Standard**

According to §95.573

Each FRS transmitter type must be designed such that the occupied bandwidth does not exceed 12.5 kHz.

According to §95.579

Each FRS transmitter type must be designed to satisfy the applicable unwanted emissions limits in this paragraph.

(a) Attenuation requirements. The power of unwanted emissions must be attenuated below the carrier power output in Watts (P) by at least:

- (1) 25 dB (decibels) in the frequency band 6.25 kHz to 12.5 kHz removed from the channel center frequency.
- (2) 35 dB in the frequency band 12.5 kHz to 31.25 kHz removed from the channel center frequency.
- (3) $43 + 10 \log (P)$ dB in any frequency band removed from the channel center frequency by more than 31.25 kHz.

Test Procedure

TIA-603-D, section 2.2.11

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2019-09-12	2020-09-12
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005012	Each Time	/
E-Microwave	Blocking Control	EMDCB-00036	0E01201047	Each Time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	0E01203239	Each Time	/

*** 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).

Test Data**Environmental Conditions**

Temperature:	24.6 °C
Relative Humidity:	51%
ATM Pressure:	101.4kPa
Test by:	Gavin Xu
Test Date:	2020.03.27

Test Mode: Transmitting

fc (MHz)	99% Occupied Bandwidth (kHz)	Limit (kHz)
462.6375	10.22	12.50
467.6375	10.02	12.50

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.

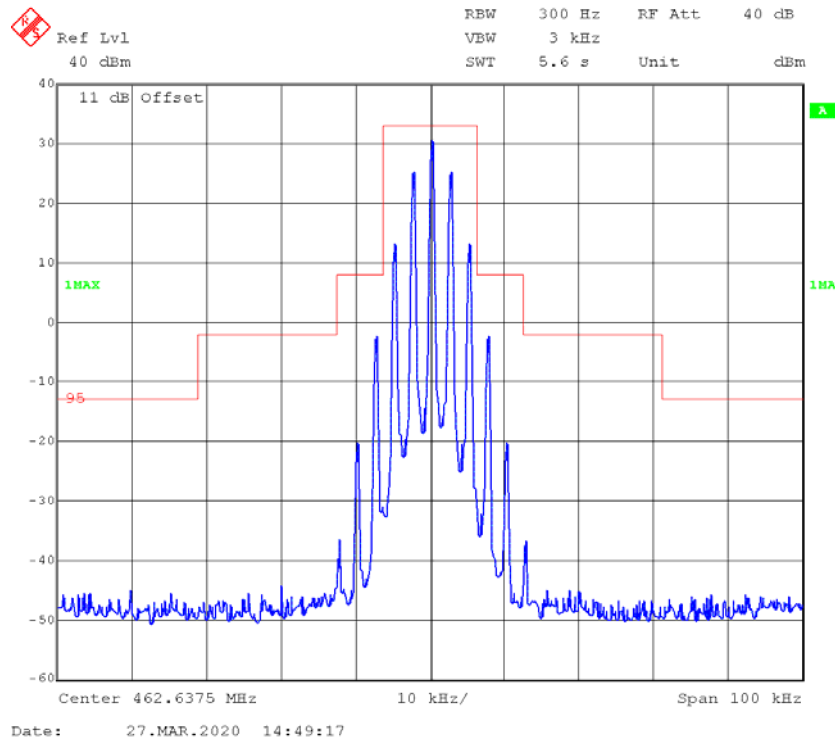
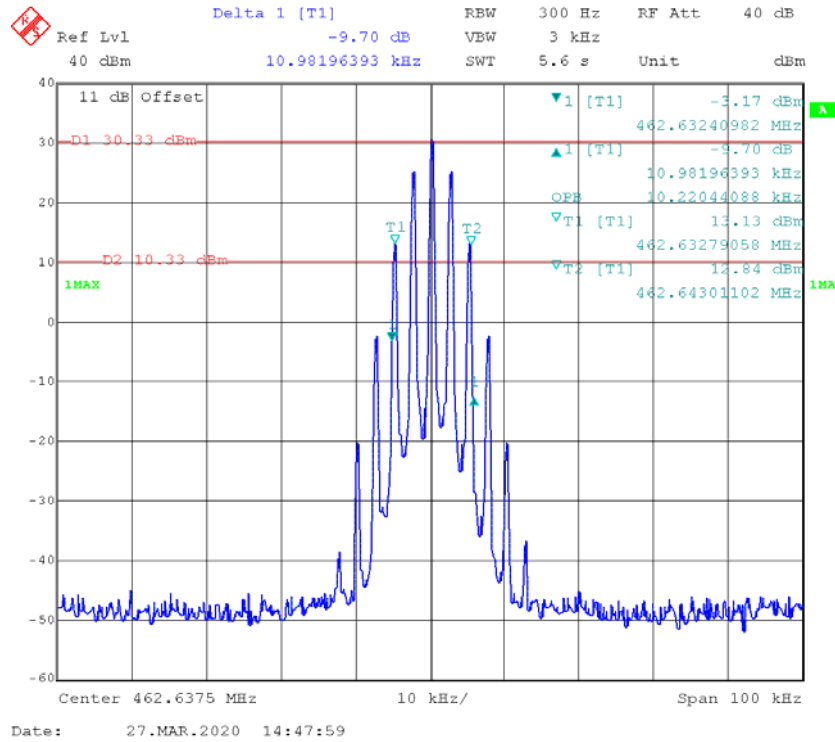
 $BW = 2(M+D) = 2*(3.0 \text{ kHz} + 2.5 \text{ kHz}) = 11 \text{ kHz} = 11K0$

F3E portion of the designator represents an FM voice transmission

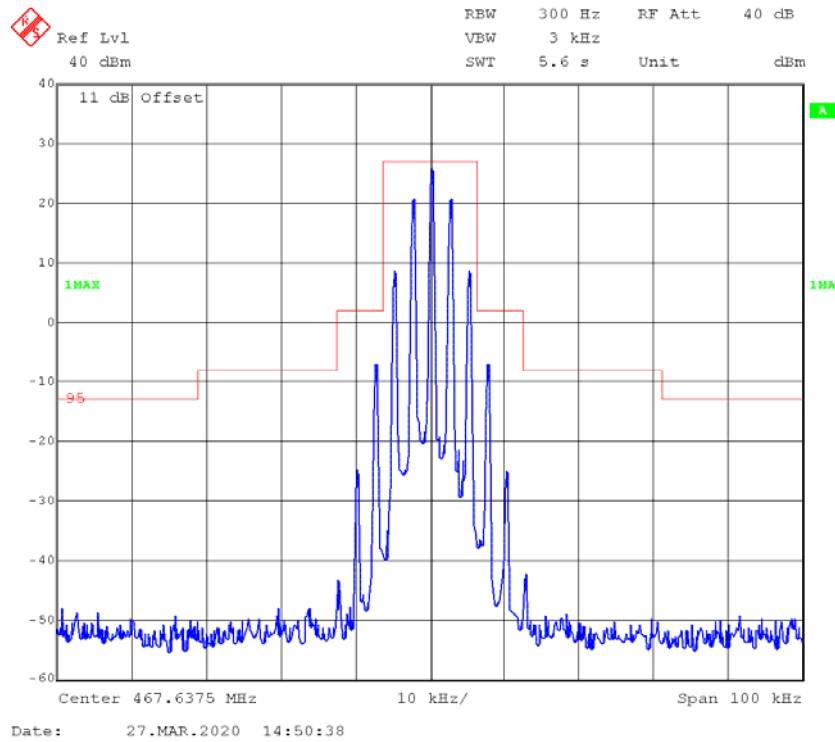
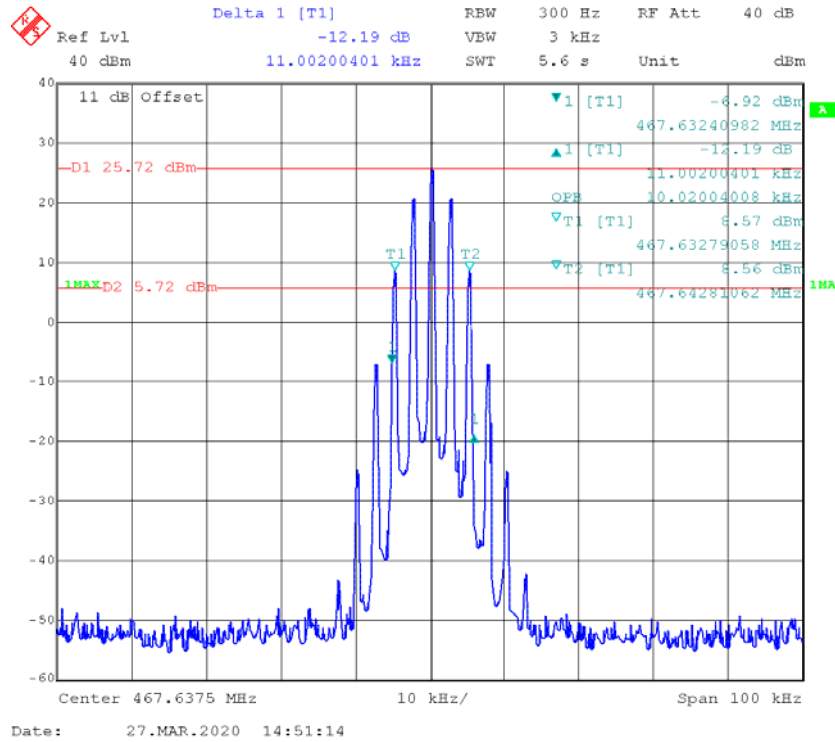
Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

FM:

462.6375 MHz



467.6375 MHz



FCC §2.1053 & §95.579 - RADIATED SPURIOUS EMISSION

Applicable Standard

FCC §2.1053 and §95.579

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.

Spurious emissions in dB = 10 lg (TXpwr in Watts/0.001)-the absolute level
Spurious attenuation limit in dB = 43+10 Log₁₀ (power out in Watts)

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB3	A060611-1	2017-11-10	2020-11-10
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2019-09-05	2020-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2019-05-06	2020-05-06
Unknown	Coaxial Cable	C-NJNJ-50	C-0200-02	2019-09-05	2020-09-05
HP	Amplifier	8447D	2727A05902	2019-09-05	2020-09-05
Agilent	Signal Generator	E8247C	MY43321350	2019-12-10	2020-12-10
Agilent	Spectrum Analyzer	E4440A	SG43360054	2019-05-09	2020-05-09
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2019-09-05	2020-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2019-09-05	2020-09-05

*** 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).

Test Data**Environmental Conditions**

Test Items	Radiation Below 1GHz	Radiation Above 1GHz
Temperature:	25.5 °C	23.4 °C
Relative Humidity:	50%	53 %
ATM Pressure:	101.4 kPa	101.2 kPa
Tester:	Jalon Liu	Felix Wang
Test Date:	2020.03.26	2020.04.11

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:462.6375MHz								
1387.91	H	37.61	-65.83	8.92	1.20	-58.11	-13.00	45.11
1387.91	V	37.14	-66.94	8.92	1.20	-59.22	-13.00	46.22
1850.55	H	36.42	-67.13	11.45	0.85	-56.53	-13.00	43.53
1850.55	V	36.01	-67.99	11.45	0.85	-57.39	-13.00	44.39
2313.19	H	36.79	-65.40	11.35	1.24	-55.29	-13.00	42.29
2313.19	V	37.24	-64.89	11.35	1.24	-54.78	-13.00	41.78
2775.83	H	36.69	-65.09	13.10	1.33	-53.32	-13.00	40.32
2775.83	V	37.03	-64.92	13.10	1.33	-53.15	-13.00	40.15
3238.46	H	36.65	-62.46	13.60	1.58	-50.44	-13.00	37.44
3238.46	V	36.48	-62.67	13.60	1.58	-50.65	-13.00	37.65
3701.10	H	47.83	-50.15	14.00	1.83	-37.98	-13.00	24.98
3701.10	V	44.79	-53.17	14.00	1.83	-41.00	-13.00	28.00
4163.74	H	40.02	-57.80	13.89	1.51	-45.42	-13.00	32.42
4163.74	V	43.67	-54.18	13.89	1.51	-41.80	-13.00	28.80
4626.38	H	36.85	-60.26	14.25	1.80	-47.81	-13.00	34.81
4626.38	V	40.00	-57.21	14.25	1.80	-44.76	-13.00	31.76
925.28	H	56.90	-39.19	0.00	0.97	-40.16	-13.00	27.16
925.28	V	56.29	-41.63	0.00	0.97	-42.60	-13.00	29.60

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:467.6375MHz								
1387.91	H	52.59	-50.85	8.92	1.20	-43.13	-13.00	30.13
1387.91	V	42.79	-61.29	8.92	1.20	-53.57	-13.00	40.57
1870.55	H	36.82	-66.43	11.59	0.92	-55.76	-13.00	42.76
1870.55	V	39.59	-64.05	11.59	0.92	-53.38	-13.00	40.38
2338.19	H	36.80	-65.47	11.62	1.25	-55.10	-13.00	42.1
2338.19	V	36.06	-66.22	11.62	1.25	-55.85	-13.00	42.85
2805.83	H	36.87	-64.79	13.15	1.36	-53.00	-13.00	40
2805.83	V	37.03	-64.84	13.15	1.36	-53.05	-13.00	40.05
3273.46	H	36.45	-63.06	13.60	1.58	-51.04	-13.00	38.04
3273.46	V	36.54	-62.99	13.60	1.58	-50.97	-13.00	37.97
3741.10	H	36.78	-60.97	13.84	1.69	-48.82	-13.00	35.82
3741.10	V	36.83	-60.82	13.84	1.69	-48.67	-13.00	35.67
4208.74	H	36.30	-61.36	13.99	1.53	-48.90	-13.00	35.9
4208.74	V	35.99	-61.63	13.99	1.53	-49.17	-13.00	36.17
4676.38	H	36.03	-61.16	14.35	1.71	-48.52	-13.00	35.52
4676.38	H	36.01	-61.18	14.35	1.71	-48.54	-13.00	35.54
935.28	H	57.06	-38.61	0.00	0.94	-39.55	-13.00	26.55
935.28	V	56.83	-40.60	0.00	0.94	-41.54	-13.00	28.54

Note 1:The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.

Note 2:

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

FCC §2.1055 (d), §95.565- FREQUENCY STABILITY**Applicable Standard**

According to FCC §2.1055(a) (1),

The frequency stability shall be measured with variation of ambient temperature from –30 °C to +50 °C, and according to FCC 2.1055(d) (2), the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point which is specified by the manufacturer.

According to FCC §95.565

Each FRS transmitter type must be designed such that the carrier frequencies remain within ± 2.5 parts-per-million of the channel center frequencies specified in § 95.563 during normal operating conditions.

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 Frequency Counter.

Frequency Stability vs. Voltage:

1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

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

The output frequency was recorded for each voltage.

Test Equipment List and Details

Manufacturer	Description	Model No.	Serial No.	Calibration Date	Calibration Due Date
Rohde & Schwarz	Signal Analyzer	FSIQ26	831929/005	2019-09-12	2020-09-12
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005012	Each Time	/
E-Microwave	Blocking Control	EMDCB-00036	0E01201047	Each Time	/
E-Microwave	Coaxial Attenuators	EMCA10-5RN-6	OE01203239	Each Time	/
HP	RF Communications Test Set	8920A	3438A05201	2019-05-09	2020-05-09
UNI-T	Multimeter	UT39A	M130199938	2019-07-23	2020-07-23
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).

Test Data**Environmental Conditions**

Temperature:	24.6 °C
Relative Humidity:	51%
ATM Pressure:	101.4kPa
Test by:	Gavin Xu
Test Date:	2020.03.27

Test Mode: Transmitting

Reference Frequency: 462.6375 MHz				
Temperature	Voltage	Reading	Frequency Error	Limit
°C	Vdc	MHz	ppm	ppm
-30	3.7	462.6377545	0.55	2.5
-20		462.6377572	0.56	
-10		462.6377561	0.55	
0		462.6377626	0.57	
10		462.6377463	0.53	
20		462.6377505	0.54	
30		462.6377543	0.55	
40		462.6377474	0.53	
50		462.6377379	0.51	
20	3.0	462.6377589	0.56	
20	4.2	462.6377646	0.57	

Reference Frequency: 467.6375 MHz				
Temperature	Voltage	Reading	Frequency Error	Limit
°C	Vdc	MHz	ppm	ppm
-30	3.7	467.63776760	0.57	2.5
-20		467.63776810	0.57	
-10		467.63777930	0.60	
0		467.63778360	0.61	
10		467.63778180	0.60	
20		467.63775040	0.54	
30		467.63776250	0.56	
40		467.63774740	0.53	
50		467.63778250	0.60	
20	3.0	467.63778630	0.61	
20	4.2	467.63774960	0.53	

Note: The extreme voltage was declared by applicant.

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