

FCC PART 90

TEST REPORT

For

RCA Communications Systems

133 West Market Street, Suite 227, Indianapolis, Indiana 46204, United States

FCC ID: XYH-RDR1500U

| | |
|---|---|
| Report Type: Original Report | Product Type: Digital Two-Way Radio |
| Report Number: <u>RSZ190128002-00B</u> | |
| Report Date: <u>2019-02-26</u> | |
| Reviewed By: <u>RF Engineer</u> | <u>Rocky Kang</u> |
| Prepared By: Bay Area Compliance Laboratories Corp. (Shenzhen) 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn | |

Note: This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA* or any agency of the Federal Government. * This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “*”.

The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity.

TABLE OF CONTENTS

| | |
|---|-----------|
| GENERAL INFORMATION..... | 4 |
| PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT) | 4 |
| OBJECTIVE | 4 |
| RELATED SUBMITTAL(S)/GRANT(S) | 4 |
| TEST METHODOLOGY | 4 |
| MEASUREMENT UNCERTAINTY | 5 |
| TEST FACILITY | 5 |
| SYSTEM TEST CONFIGURATION..... | 6 |
| DESCRIPTION OF TEST CONFIGURATION | 6 |
| EUT EXERCISE SOFTWARE | 6 |
| SPECIAL ACCESSORIES | 6 |
| EQUIPMENT MODIFICATIONS | 6 |
| SUPPORT EQUIPMENT LIST AND DETAILS | 6 |
| BLOCK DIAGRAM OF TEST SETUP | 6 |
| SUMMARY OF TEST RESULTS | 7 |
| TEST EQUIPMENT LIST | 8 |
| FCC §1.1307(b) & §2.1093 - RF EXPOSURE..... | 9 |
| APPLICABLE STANDARD | 9 |
| FCC §2.1046 & §90.205 - RF OUTPUT POWER..... | 10 |
| APPLICABLE STANDARD | 10 |
| TEST PROCEDURE | 10 |
| TEST DATA | 10 |
| FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC..... | 12 |
| APPLICABLE STANDARD | 12 |
| TEST PROCEDURE | 12 |
| TEST DATA | 12 |
| FCC §2.1049 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK..... | 18 |
| APPLICABLE STANDARD | 18 |
| TEST PROCEDURE | 18 |
| TEST DATA | 18 |
| FCC §2.1051 & §90.210 - SPURIOUS EMISSIONS AT ANTENNA TERMINALS..... | 24 |
| APPLICABLE STANDARD | 24 |
| TEST PROCEDURE | 24 |
| TEST DATA | 24 |
| FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS..... | 27 |
| APPLICABLE STANDARD | 27 |
| TEST PROCEDURE | 27 |
| TEST DATA | 27 |
| FCC §2.1055 & §90.213 - FREQUENCY STABILITY..... | 29 |
| APPLICABLE STANDARD | 29 |
| TEST PROCEDURE | 29 |
| TEST DATA | 29 |

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR.....31
 APPLICABLE STANDARD31
 TEST PROCEDURE31
 TEST DATA32

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

| | |
|----------------------|---|
| Product | Digital Two-Way Radio |
| Tested Model | RDR1520U |
| Frequency Range | 400-470MHz |
| Transmit Power | Digital: 3W Analog: 2W |
| Channel separation | 12.5kHz |
| Modulation Technique | 4FSK, FM |
| Voltage Range | DC 3.7V from battery or DC 5.0V from adapter or DC 5.0V from charger adapter |
| Date of Test | Jan 29, 2019~ Feb 23, 2019 |
| Sample serial number | 190128002 |
| Received date | Jan 28, 2019 |
| Sample/EUT Status | Good condition |
| Adapter information | Model: NLA100050W1A6 Input: AC 100~240V, 50/60 Hz, 0.2A Max Output: DC 5V, 1A |

Objective

This test report is prepared on behalf of *RCA Communications Systems* in accordance with Part 2, and Part 90 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 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. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

| Parameter | | Uncertainty |
|------------------------------|------------|-------------------------|
| Occupied Channel Bandwidth | | $\pm 5\%$ |
| Frequency stability | | $\pm 150\text{Hz}$ |
| RF output power, conducted | | $\pm 0.5\text{dB}$ |
| Unwanted Emission, conducted | | $\pm 1.5\text{dB}$ |
| Radiated Emissions | Below 1GHz | $\pm 4.75\text{dB}$ |
| | Above 1GHz | $\pm 4.88\text{dB}$ |
| Temperature | | $\pm 3^{\circ}\text{C}$ |
| Supply voltages | | $\pm 0.4\%$ |

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, 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. : 342867, the FCC Designation No. : CN1221.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in a test mode which has been done in the factory.

EUT Exercise Software

No exercise software was used.

Special Accessories

No special accessory was used.

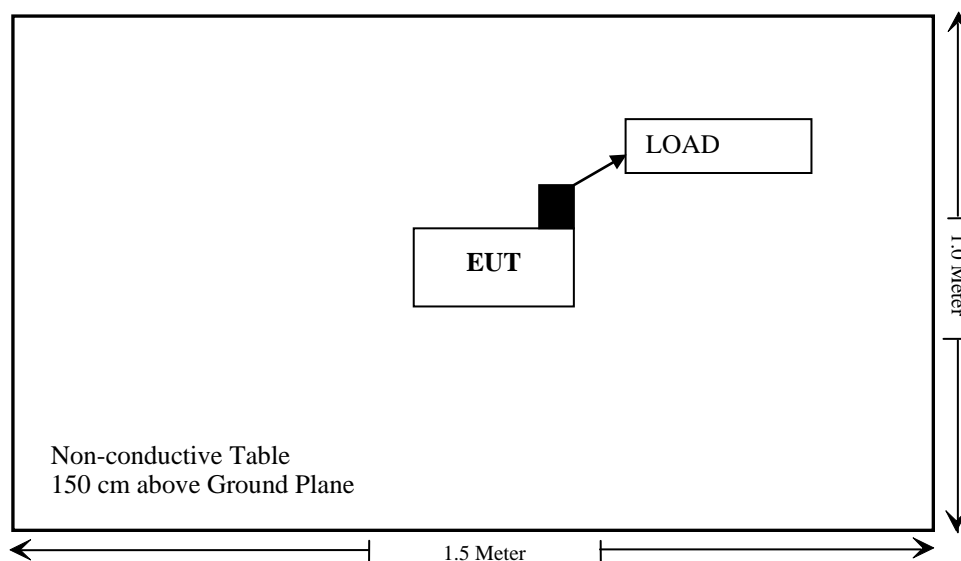
Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|--------------|-------------|----------|---------------|
| Un-known | Load | Un-known | 161714 |

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

| FCC Rules | Description of Test | Results |
|------------------|---------------------------------------|------------|
| §2.1093 | RF Exposure | Compliance |
| §2.1046; §90.205 | RF Output Power | Compliance |
| §2.1047; §90.207 | Modulation Characteristic | Compliance |
| §2.1049; §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 | | | | | |
| Sunol Sciences | Horn Antenna | DRH-118 | A052604 | 2017-12-22 | 2020-12-21 |
| Rohde & Schwarz | Signal Analyzer | FSEM | 845987/005 | 2018-06-23 | 2019-06-23 |
| Sunol Sciences | Broadband Antenna | JB1 | A040904-1 | 2017-12-22 | 2020-12-21 |
| COM-POWER | Pre-amplifier | PA-122 | 181919 | 2018-11-22 | 2019-05-22 |
| Sonoma instrument | Amplifier | 310N | 186238 | 2018-11-12 | 2019-05-12 |
| Anritsu | Signal Generator | 68369B | 004114 | 2018-12-24 | 2019-12-24 |
| Rohde & Schwarz | EMI Test Receiver | ESCI | 101120 | 2019-01-11 | 2020-01-11 |
| COM POWER | Dipole Antenna | AD-100 | 041000 | NCR | NCR |
| A.H. System | Horn Antenna | SAS-200/571 | 135 | 2018-08-18 | 2021-08-17 |
| Ducommun technologies | RF Cable | UFA147A-2362-100100 | MFR64639231029-003 | 2019-02-01 | 2019-08-01 |
| Ducommun technologies | RF Cable | 104PEA | 218124002 | 2018-11-21 | 2019-05-21 |
| Ducommun technologies | RF Cable | RG-214 | 1 | 2018-11-21 | 2019-05-21 |
| Ducommun technologies | RF Cable | RG-214 | 2 | 2018-11-21 | 2019-05-21 |
| RF Conducted Test | | | | | |
| ESPEC | Temperature & Humidity Chamber | EL-10KA | 09107726 | 2018-12-21 | 2019-12-21 |
| Changjiang | Contact Voltage Regulator | TDGC2- | N/A | NCR | NCR |
| Long Wei | DC Power Supply | TPR-6420D | 398363 | NCR | NCR |
| Fluke | Digital Multimeter | 287 | 19000011 | 2018-04-12 | 2019-04-12 |
| HP Agilent | RF Communication test set | 8920B | 3325U00859 | 2018-06-23 | 2019-06-23 |
| Rohde & Schwarz | SPECTRUM ANALYZER | FSU26 | 200120 | 2018-12-24 | 2019-12-24 |
| Rohde & Schwarz | Signal Analyzer | FSIQ26 | 837405/023 | 2018-12-24 | 2019-12-24 |
| Un-known | 30dB Attenuator | 53-30-43 | PG633 | Each Time | |

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

FCC §1.1307(b) & §2.1093 - RF EXPOSURE

Applicable Standard

According to FCC §1.1307(b) and §2.1093, portable device operates Part 90 should be subjected to routine environmental evaluation for RF exposure prior or equipment authorization or use.

Result: Compliance.

Please refer to SAR Report Number: RSZ190128002-20A.

FCC §2.1046 & §90.205 - RF OUTPUT POWER

Applicable Standard

FCC §2.1046 and §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: | 25 °C |
| Relative Humidity: | 56 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Kieron Luo on 2019-02-23.

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table.

| Mode | Frequency Spacing (kHz) | Frequency (MHz) | Power level | Output (dBm) | Output Power(W) |
|---------|-------------------------|-----------------|-------------|--------------|-----------------|
| Analog | 12.5 | 400.0125 | High | 33.21 | 2.09 |
| | | | Low | 26.36 | 0.43 |
| | | 453.2125 | High | 33.37 | 2.17 |
| | | | Low | 26.31 | 0.43 |
| | | 469.9875 | High | 32.37 | 1.73 |
| | | | Low | 26.61 | 0.46 |
| Digital | | 400.0125 | High | 33.86 | 2.43 |
| | | | Low | 26.76 | 0.47 |
| | | 453.2125 | High | 33.87 | 2.44 |
| | | | Low | 25.91 | 0.39 |
| | | 469.9875 | High | 33.82 | 2.41 |
| | | | Low | 26.27 | 0.42 |

Note: For Analog:

Rated high power is 2W, limit is 1.6-2.4W

Rated low power is 0.5W, limit is 0.4-0.6W

For Digital:

Rated high power is 3W, limit is 2.4-3.6W

Rated low power is 0.5W, limit is 0.4-0.6W

FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC

Applicable Standard

FCC§2.1047 and §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-603-D

Test Data**Environmental Conditions**

| | |
|---------------------------|-----------|
| Temperature: | 25 °C |
| Relative Humidity: | 56 % |
| ATM Pressure: | 101.0 kPa |

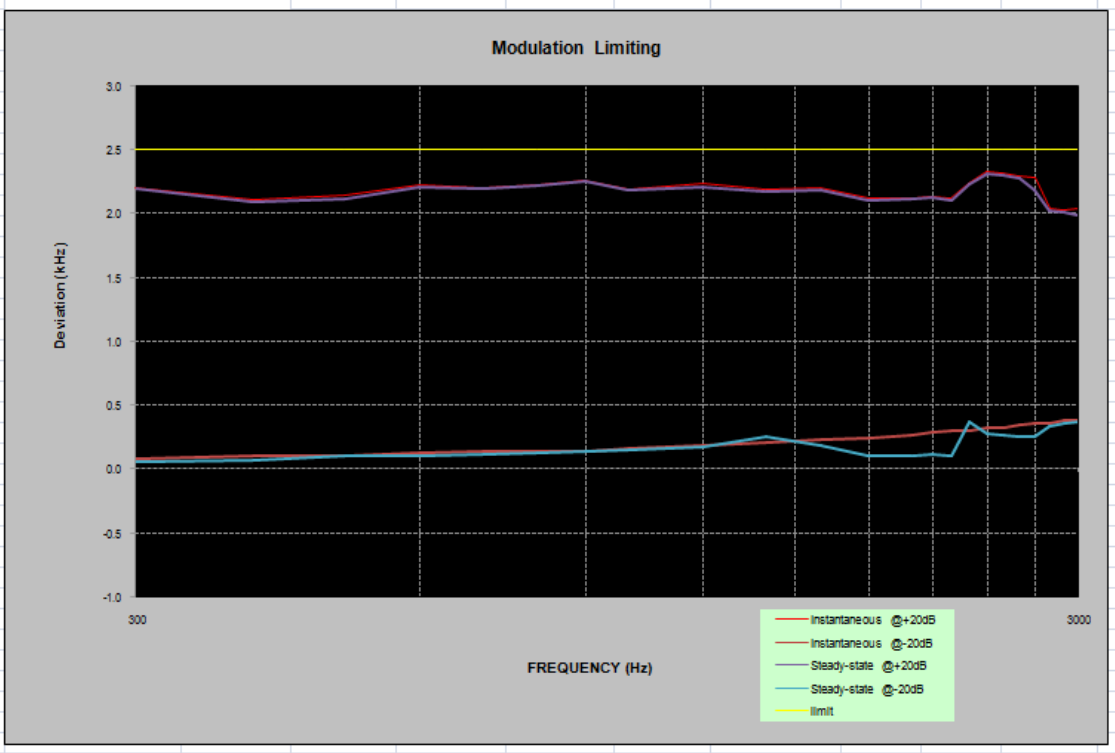
The testing was performed by Kieron Luo on 2019-02-23.

Please refer to the following tables and plots.

Analog Modulation:**MODULATION LIMITING**

Carrier Frequency: 453.2125 MHz, Channel Separation=12.5 kHz

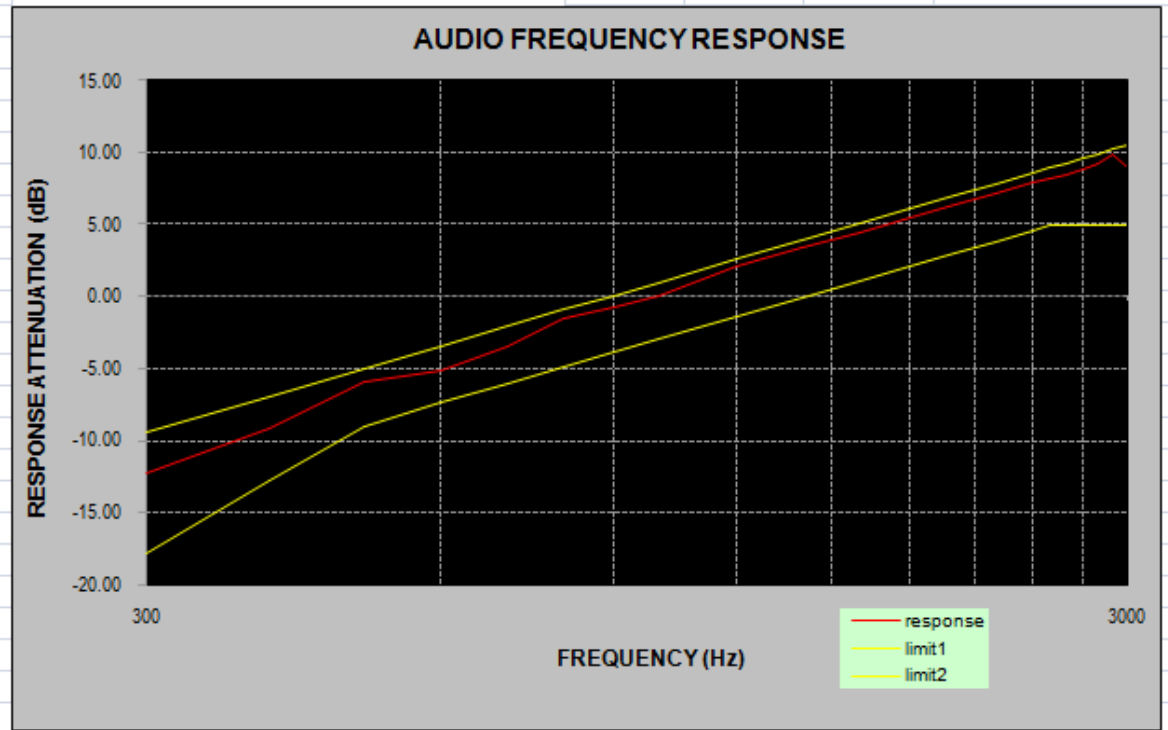
| Audio Frequency (Hz) | Instantaneous | | Steady-state | | FCC Limit [kHz] |
|-------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------|
| | DEVIATION (@+20dB) [kHz] | DEVIATION (@-20dB) [kHz] | DEVIATION (@+20dB) [kHz] | DEVIATION (@-20dB) [kHz] | |
| 300 | 2.203 | 0.084 | 2.196 | 0.053 | 2.500 |
| 400 | 2.106 | 0.099 | 2.089 | 0.068 | 2.500 |
| 500 | 2.138 | 0.103 | 2.114 | 0.098 | 2.500 |
| 600 | 2.218 | 0.121 | 2.205 | 0.102 | 2.500 |
| 700 | 2.204 | 0.132 | 2.193 | 0.116 | 2.500 |
| 800 | 2.225 | 0.132 | 2.218 | 0.124 | 2.500 |
| 900 | 2.253 | 0.141 | 2.248 | 0.132 | 2.500 |
| 1000 | 2.189 | 0.161 | 2.176 | 0.146 | 2.500 |
| 1200 | 2.233 | 0.188 | 2.208 | 0.174 | 2.500 |
| 1400 | 2.186 | 0.203 | 2.173 | 0.256 | 2.500 |
| 1600 | 2.194 | 0.234 | 2.182 | 0.178 | 2.500 |
| 1800 | 2.120 | 0.242 | 2.105 | 0.104 | 2.500 |
| 2000 | 2.123 | 0.269 | 2.109 | 0.108 | 2.500 |
| 2100 | 2.126 | 0.293 | 2.123 | 0.114 | 2.500 |
| 2200 | 2.115 | 0.294 | 2.104 | 0.102 | 2.500 |
| 2300 | 2.239 | 0.303 | 2.225 | 0.364 | 2.500 |
| 2400 | 2.324 | 0.318 | 2.307 | 0.274 | 2.500 |
| 2500 | 2.314 | 0.320 | 2.293 | 0.268 | 2.500 |
| 2600 | 2.295 | 0.343 | 2.275 | 0.247 | 2.500 |
| 2700 | 2.285 | 0.351 | 2.185 | 0.247 | 2.500 |
| 2800 | 2.034 | 0.357 | 2.016 | 0.334 | 2.500 |
| 2900 | 2.024 | 0.375 | 2.014 | 0.357 | 2.500 |
| 3000 | 2.032 | 0.382 | 1.986 | 0.368 | 2.500 |



Audio Frequency Response

Carrier Frequency: 453.2125 MHz, Channel Separation=12.5 kHz

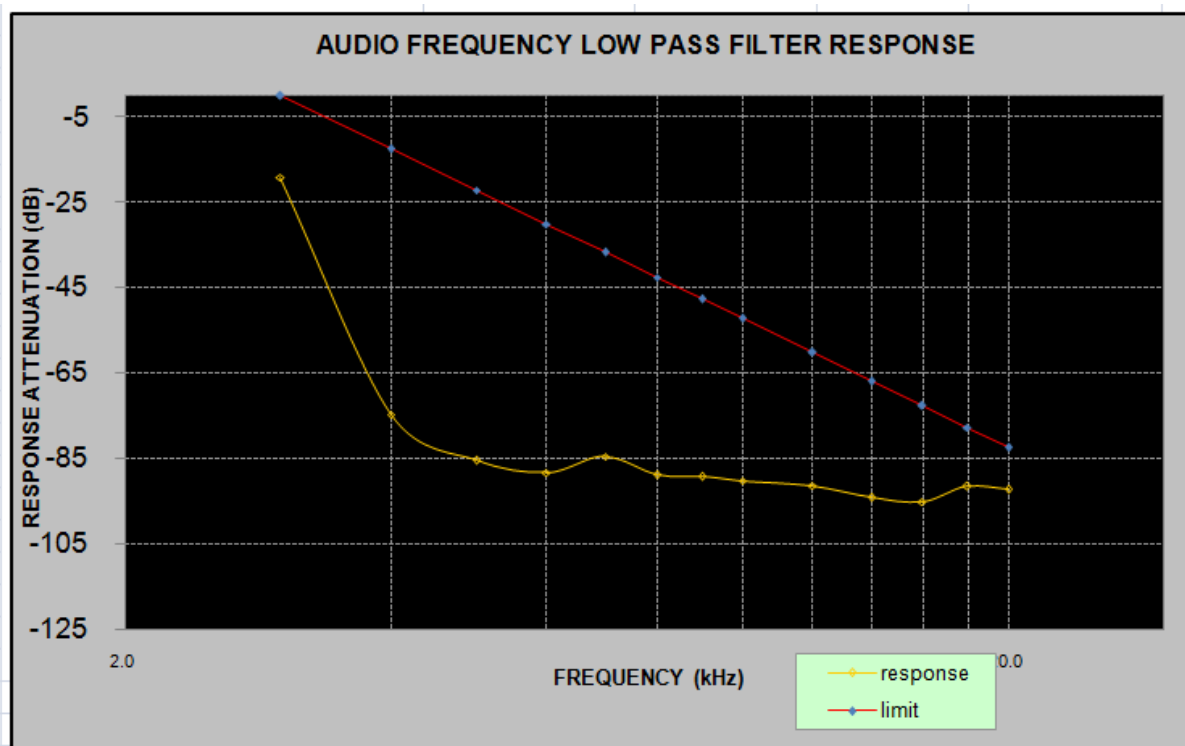
| Audio Frequency (Hz) | Response Attenuation (dB) |
|----------------------|---------------------------|
| 300 | -12.32 |
| 400 | -9.22 |
| 500 | -5.88 |
| 600 | -5.16 |
| 700 | -3.43 |
| 800 | -1.56 |
| 900 | -0.74 |
| 1000 | 0.00 |
| 1200 | 2.10 |
| 1400 | 3.35 |
| 1600 | 4.46 |
| 1800 | 5.43 |
| 2000 | 6.32 |
| 2100 | 6.74 |
| 2200 | 7.12 |
| 2300 | 7.55 |
| 2400 | 7.91 |
| 2500 | 8.19 |
| 2600 | 8.49 |
| 2700 | 8.84 |
| 2800 | 9.28 |
| 2900 | 9.86 |
| 3000 | 8.95 |



Audio frequency lows pass filter response

Carrier Frequency: 453.2125 MHz, Channel Separation=12.5 kHz

| Audio Frequency (kHz) | Response Attenuation (dB) | Limit (dB) |
|-----------------------|---------------------------|------------|
| 1.0 | 0.0 | / |
| 3.0 | -19.2 | 0.0 |
| 4.0 | -74.8 | -12.5 |
| 5.0 | -85.6 | -22.2 |
| 6.0 | -88.3 | -30.1 |
| 7.0 | -84.5 | -36.8 |
| 8.0 | -88.9 | -42.6 |
| 9.0 | -89.4 | -47.7 |
| 10.0 | -90.2 | -52.3 |
| 12.0 | -91.4 | -60.2 |
| 14.0 | -94.3 | -66.9 |
| 16.0 | -95.2 | -72.7 |
| 18.0 | -91.6 | -77.8 |
| 20.0 | -92.3 | -82.5 |



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

Applicable Standard

FCC §2.1049 and §90.210

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) For any frequency removed from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 , 0dB.
- 2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least 7.27 ($f_d - 2.88$ kHz) dB.
- 3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

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 and the spectrum was recorded in the frequency band ± 50 kHz from the carrier frequency.

Test Data

Environmental Conditions

| | |
|--------------------|-----------------|
| Temperature: | 24~27 °C |
| Relative Humidity: | 50~57 % |
| ATM Pressure: | 100.9~101.0 kPa |

The testing was performed by Kieron Luo on 2019-02-23.

Test mode: transimitting

| Modulation | Channel Separation (kHz) | Frequency (MHz) | Power Level | 99% Occupied Bandwidth (kHz) | 26 dB Emissions Bandwidth (kHz) |
|------------|--------------------------|-----------------|-------------|------------------------------|---------------------------------|
| Analog | 12.5 | 453.2125 | High | 9.936 | 10.256 |
| | 12.5 | | Low | 9.936 | 10.256 |
| Digital | 12.5 | 453.2125 | High | 7.692 | 9.615 |
| | 12.5 | | Low | 7.692 | 9.615 |

Note: Emission designator is base on calculation instead of measurement.

Emission Designator Per CFR 47 §2.201& §2.202&, $B_n = 2M + 2D$

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

F3E portion of the designator represents an FM voice transmission Therefore, the entire designator for 12.5 kHz channel spacing FM mode is 11K0F3E.

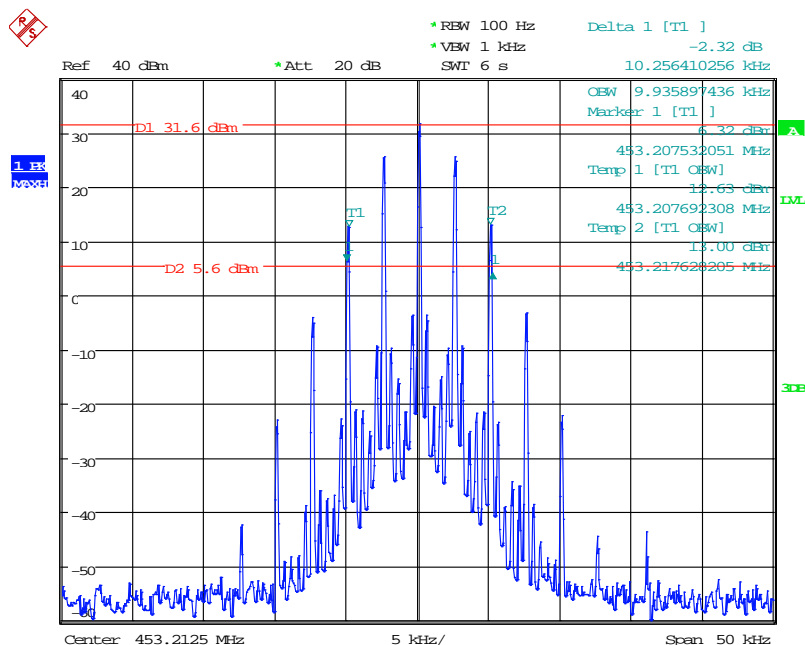
For Digital Mode (Channel Spacing: 12.5 kHz)

Emission Designator 7K60F1D and 7K60F1E

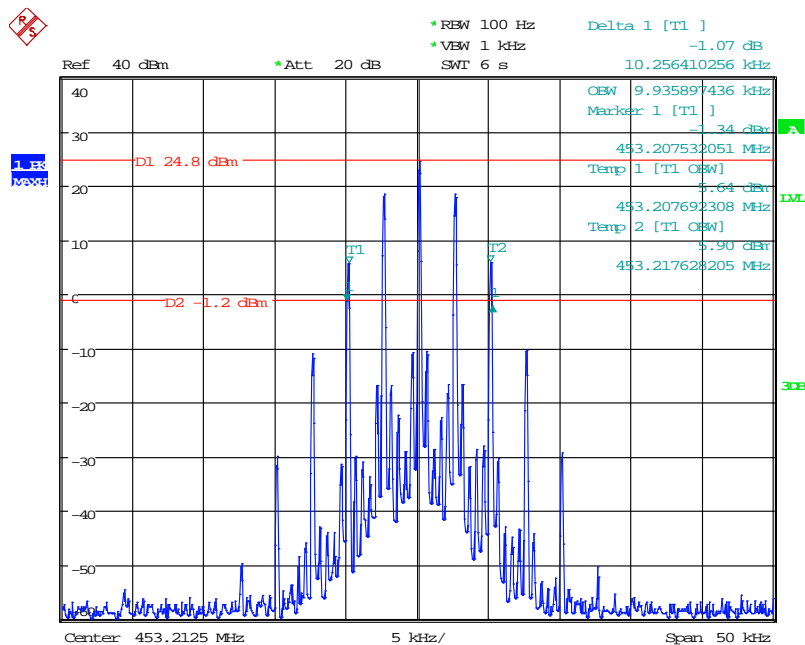
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz. The emission mask was obtained from 47CFR 90.210(d).

F1D and F1E portion of the designator indicates digital information.

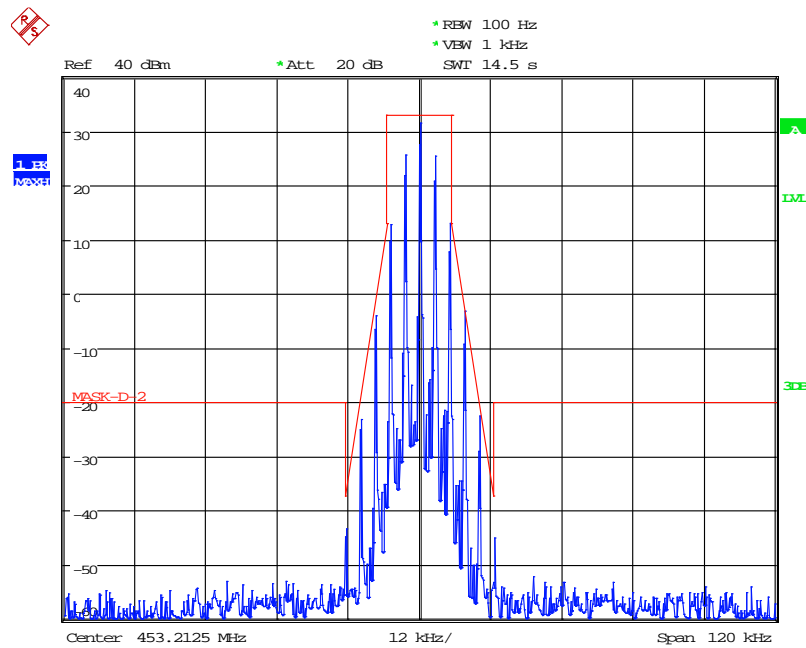
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

Analog Modulation:**Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power**

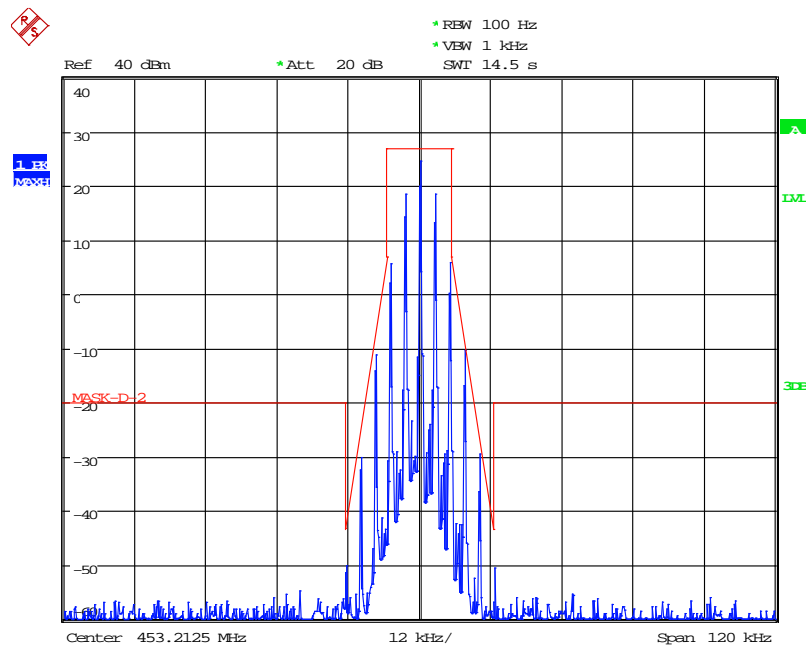
Date: 23.FEB.2019 10:28:44

Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power

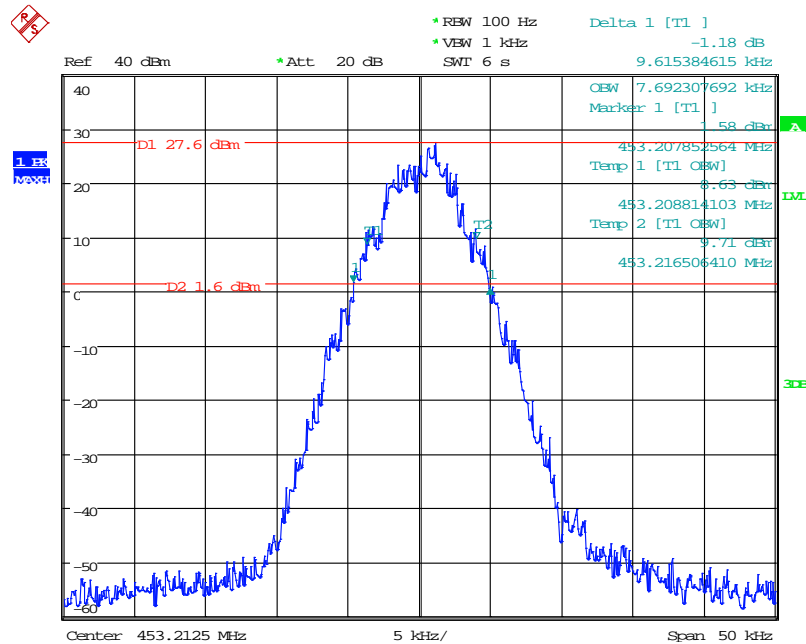
Date: 23.FEB.2019 10:32:25

Frequency 453.2125 MHz: Emission Mask D, High Power

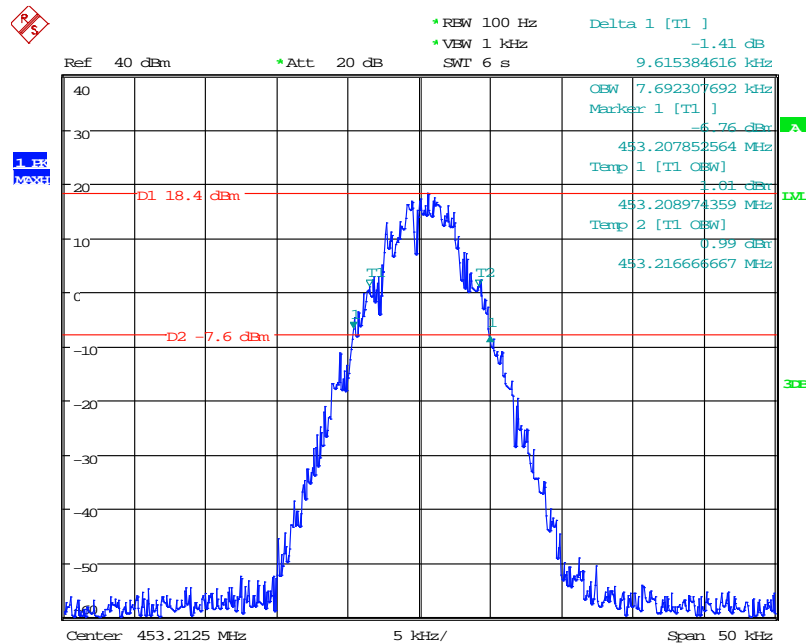
Date: 23.FEB.2019 10:39:12

Frequency 453.2125 MHz: Emission Mask D, Low Power

Date: 23.FEB.2019 10:34:41

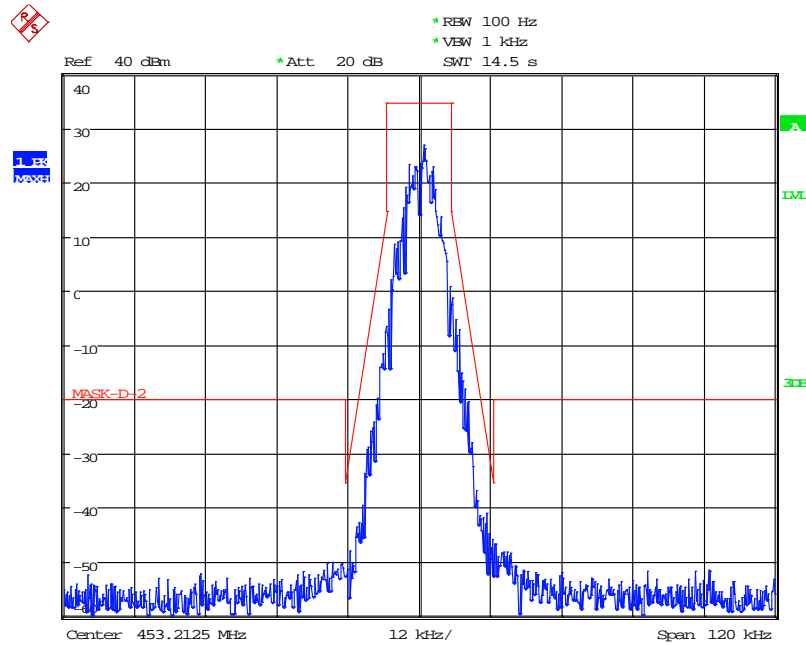
Digital Modulation:**Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power**

Date: 23.FEB.2019 10:14:57

Frequency 453.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power

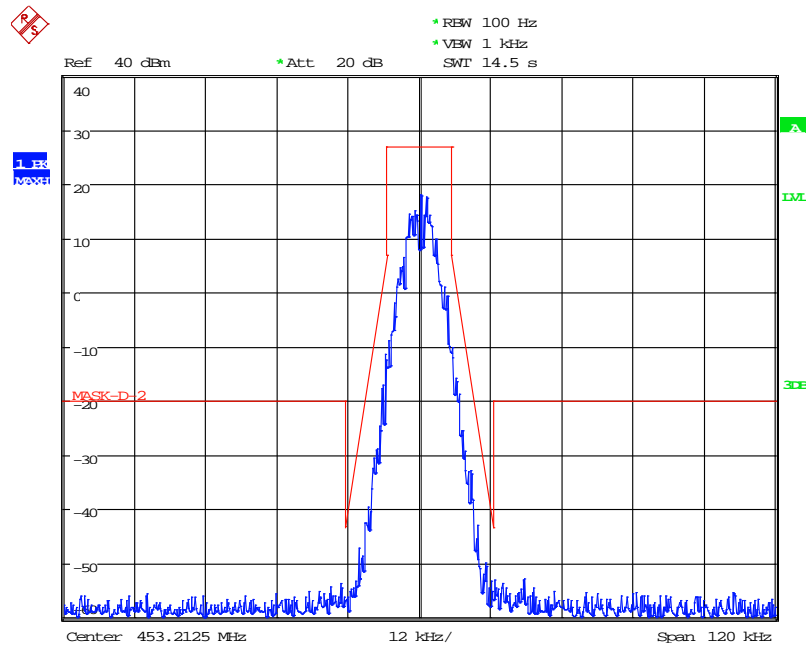
Date: 23.FEB.2019 10:12:06

Frequency 453.2125 MHz: Emission Mask D, High Power



Date: 23.FEB.2019 09:58:38

Frequency 453.2125 MHz: Emission Mask D, Low Power



Date: 23.FEB.2019 10:03:41

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) For any frequency removed from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 , 0 dB.
- 2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least 7.27 ($f_d - 2.88$ kHz) dB.
- 3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

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

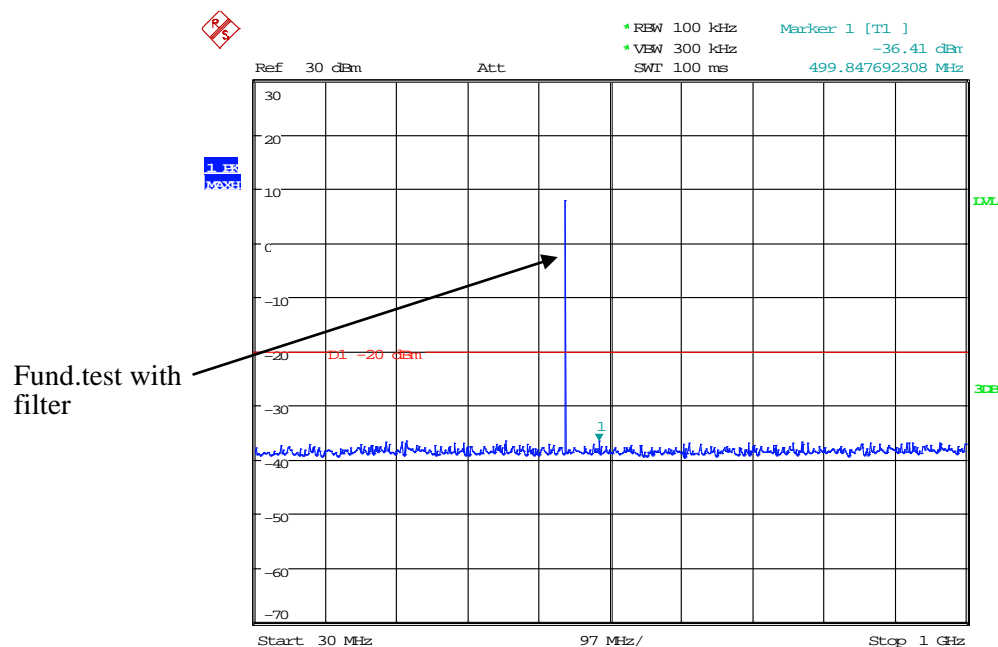
Test Data

Environmental Conditions

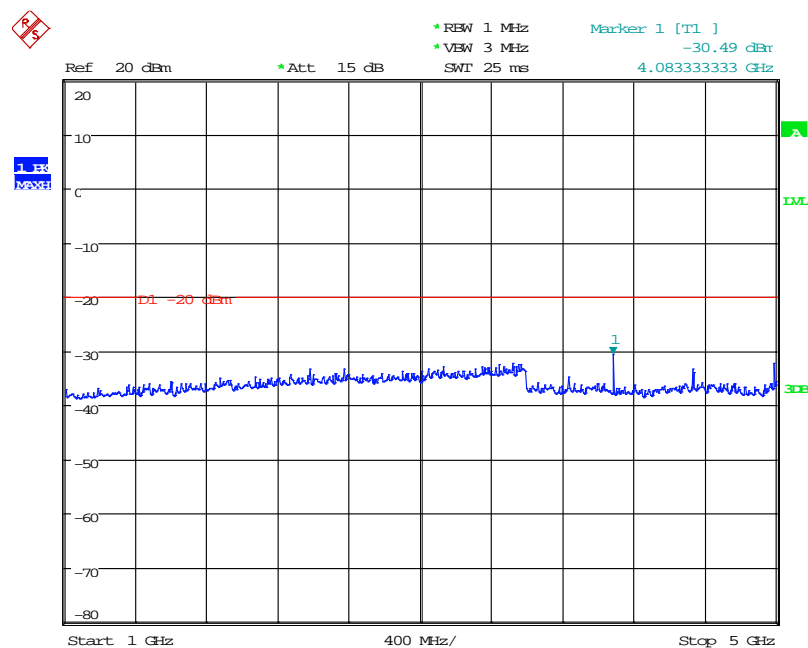
| | |
|--------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 50 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Kieron Luo on 2019-01-30.

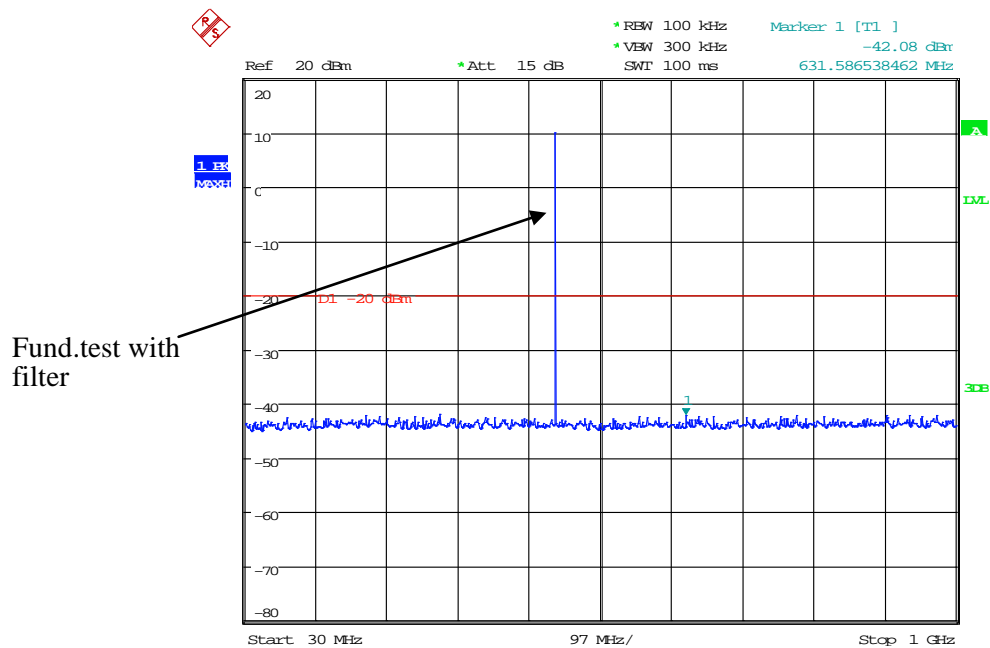
Test Mode: Transmitting, worst case for High power level, please refer to the following plots.

Analog Modulation:**30MHz – 1 GHz, 453.2125 MHz**

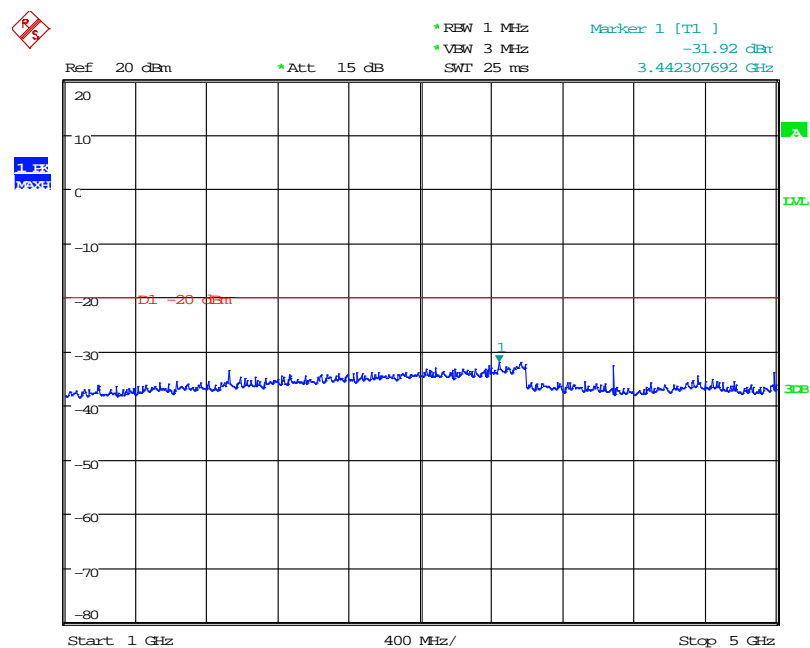
Date: 30.JAN.2019 21:52:53

1 GHz – 5 GHz, 453.2125 MHz

Date: 30.JAN.2019 21:54:08

Digital Modulation:**30MHz – 1 GHz, 453.2125 MHz**

Date: 30.JAN.2019 21:55:54

1 GHz – 5 GHz, 453.2125 MHz

Date: 30.JAN.2019 21:54:54

FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §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 = $10 \lg(\text{TXpwr in Watts}/0.001)$ - the absolute level

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

Test Data**Environmental Conditions**

| | |
|---------------------------|-----------|
| Temperature: | 24 °C |
| Relative Humidity: | 51 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Andy Yu and Yecar Lu on 2019-01-29 and 2019-01-30.

Test Mode: Transmitting, worst case for High power level.

30MHz - 5GHz:

| Frequency (MHz) | Receiver Reading (dBμV) | Turn Table Angle Degree | Rx Antenna | | Substituted | | | Absolute Level (dBm) | Limit (dBm) | Margin (dB) |
|---|-------------------------------|----------------------------------|---------------|----------------|----------------|-----------------------|--------------------------|----------------------------|----------------|----------------|
| | | | Height (m) | Polar (H/V) | Level (dBm) | Cable Loss (dB) | Antenna Gain (dBi) | | | |
| Analog Modulation 453.2125MHz-12.5 kHz | | | | | | | | | | |
| 906.425 | 45.33 | 104 | 1.7 | H | -50.7 | 1.27 | 0.0 | -51.97 | -20 | 31.97 |
| 906.425 | 53.11 | 288 | 1.6 | V | -41.3 | 1.27 | 0.0 | -42.57 | -20 | 22.57 |
| 1359.64 | 61.50 | 106 | 2.4 | H | -46.5 | 1.60 | 7.90 | -40.20 | -20 | 20.20 |
| 1359.64 | 64.60 | 130 | 1.2 | V | -43.6 | 1.60 | 7.90 | -37.30 | -20 | 17.30 |
| 4078.91 | 54.60 | 193 | 2.2 | H | -46.8 | 1.40 | 12.20 | -36.00 | -20 | 16.00 |
| 4078.91 | 52.10 | 186 | 2.4 | V | -48.2 | 1.40 | 12.20 | -37.40 | -20 | 17.40 |
| 4532.13 | 64.07 | 277 | 1.2 | H | -36.9 | 1.50 | 12.10 | -26.30 | -20 | 6.30 |
| 4532.13 | 54.90 | 95 | 1.4 | V | -45.4 | 1.50 | 12.10 | -34.80 | -20 | 14.80 |
| Digital Modulation 453.2125MHz-12.5 kHz | | | | | | | | | | |
| 906.425 | 45.51 | 315 | 1.8 | H | -50.6 | 1.27 | 0.0 | -51.87 | -20 | 31.87 |
| 906.425 | 54.09 | 166 | 1.7 | V | -40.3 | 1.27 | 0.0 | -41.57 | -20 | 21.57 |
| 1359.64 | 58.69 | 277 | 1.3 | H | -49.3 | 1.60 | 7.90 | -43.00 | -20 | 23.00 |
| 1359.64 | 65.36 | 293 | 1.8 | V | -42.9 | 1.60 | 7.90 | -36.60 | -20 | 16.60 |
| 4078.91 | 53.26 | 203 | 1.6 | H | -48.1 | 1.40 | 12.20 | -37.30 | -20 | 17.30 |
| 4078.91 | 56.39 | 142 | 1.5 | V | -43.9 | 1.40 | 12.20 | -33.10 | -20 | 13.10 |
| 4532.13 | 69.31 | 224 | 1.3 | H | -31.6 | 1.50 | 12.10 | -21.00 | -20 | 1.00 |
| 4532.13 | 58.90 | 206 | 1.0 | V | -41.4 | 1.50 | 12.10 | -30.80 | -20 | 10.80 |

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 and §90.213

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external AC/DC power supply and the RF output was connected to communication test set via feed-through attenuators. The EUT was placed inside the temperature chamber. The power cable 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: | 24 °C |
| Relative Humidity: | 51 % |
| ATM Pressure: | 101.0 kPa |

The testing was performed by Kieron Luo on 2019-02-23.

Test Mode: Transmitting

For 12.5 kHz:

| Analog Modulation, Reference Frequency: 453.2125 MHz, Limit: ± 2.5 ppm | | | |
|--|-------------------------------------|-------------------------------------|-----------------------|
| Test Environment | | Frequency Measure with Time Elapsed | |
| Temperature (°C) | Voltage Supplied (V _{DC}) | Measured Frequency (MHz) | Frequency Error (ppm) |
| Frequency Stability versus Input Temperature | | | |
| 50 | 3.7 | 453.212525 | 0.0552 |
| 40 | 3.7 | 453.212516 | 0.0355 |
| 30 | 3.7 | 453.212535 | 0.0771 |
| 20 | 3.7 | 453.212537 | 0.0825 |
| 10 | 3.7 | 453.212523 | 0.0506 |
| 0 | 3.7 | 453.212524 | 0.0529 |
| -10 | 3.7 | 453.212537 | 0.0816 |
| -20 | 3.7 | 453.212540 | 0.0881 |
| -30 | 3.7 | 453.212529 | 0.0646 |
| Frequency Stability versus Input Voltage | | | |
| 20 | 3.3 | 453.212541 | 0.0896 |

| Digital Modulation, Reference Frequency: 453.2125 MHz, Limit: ± 2.5 ppm | | | |
|---|-------------------------------------|-------------------------------------|-----------------------|
| Test Environment | | Frequency Measure with Time Elapsed | |
| Temperature (°C) | Voltage Supplied (V _{DC}) | Measured Frequency (MHz) | Frequency Error (ppm) |
| Frequency Stability versus Input Temperature | | | |
| 50 | 3.7 | 453.212533 | 0.0728 |
| 40 | 3.7 | 453.212544 | 0.0968 |
| 30 | 3.7 | 453.212533 | 0.0725 |
| 20 | 3.7 | 453.212529 | 0.0647 |
| 10 | 3.7 | 453.212529 | 0.0635 |
| 0 | 3.7 | 453.212531 | 0.0673 |
| -10 | 3.7 | 453.212527 | 0.0605 |
| -20 | 3.7 | 453.212545 | 0.1002 |
| -30 | 3.7 | 453.212527 | 0.0606 |
| Frequency Stability versus Input Voltage | | | |
| 20 | 3.3 | 453.212548 | 0.1054 |

FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

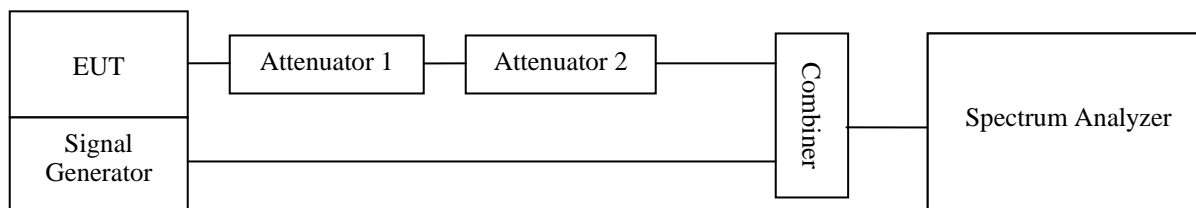
Applicable Standard

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 "trigger 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: | 24 °C |
| Relative Humidity: | 51 % |
| ATM Pressure: | 101.0 kPa |

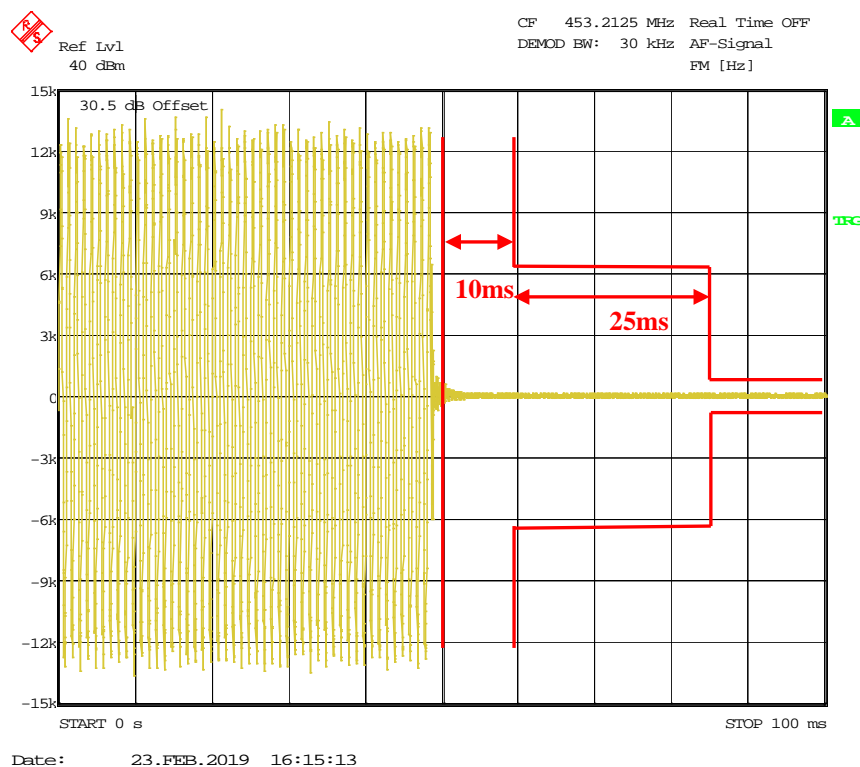
The testing was performed by Kieron Luo on 2019-02-23.

| Channel Separation (kHz) | Transient Period (ms) | Transient Frequency | Result |
|--------------------------|-----------------------|---------------------|--------|
| 12.5 | 10 (t1) | <+/- 12.5 kHz | Pass |
| | 25(t2) | <+/- 6.25 kHz | |
| | 10 (t3) | <+/- 12.5 kHz | |

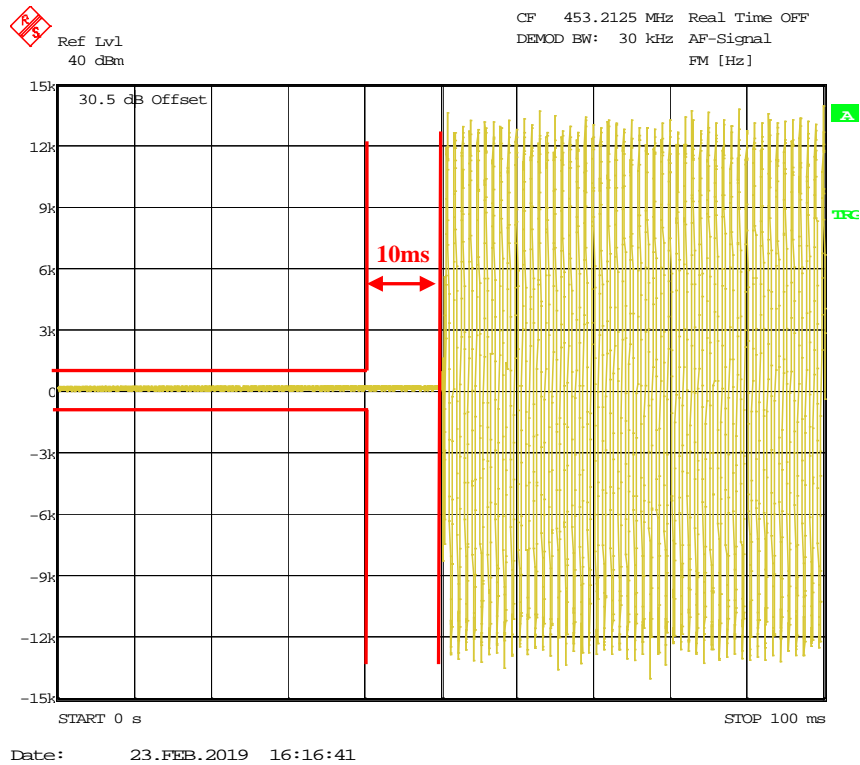
Please refer to the following plots.

Channel: 453.2125 MHz, 12.5 kHz

Turn on



Turn off



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