



中认信通

CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



TEST REPORT

Applicant: Long Range Solutions, LLC

Address: 9525 Forrest View Street, Dallas, Texas 75243, United States

FCC ID: 2AB6OTX9561

IC: 5501A-T9561

HVIN: TX-9561EZ

Product Name: TX9561

Standard(s): 47 CFR Part 2

47 CFR Part 90

RSS-119, ISSUE 12 MAY 2015

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AMENDMENT 2

ANSI C63.26-2015

ANSI/TIA 603-E-2016

The above equipment has been tested and found compliance with the requirement of the relative standards by China Certification ICT Co., Ltd (Dongguan)

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Test Facility

The Test site used by China Certification ICT Co., Ltd (Dongguan) to collect test data is located on the No. 113, Pingkang Road, Dalang Town, 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. : 442868, the FCC Designation No. : CN1314.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0123.

Declarations

China Certification ICT Co., Ltd (Dongguan) 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 “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	TX9561
EUT Model:	TX-9561EZ
Multiple Model:	TX-9561MT
Operation Frequency:	467.75 MHz
Modulation Type:	2GFSK
Rated Input Voltage:	DC 4.8V from battery
Serial Number:	CR21110009-RF-S1
EUT Received Date:	2021.10.18
EUT Received Status:	Good
Note: The Multiple model is electrically identical with test model, please refer to the declaration letter for more detail, which was provided by manufacturer.	

1.1.1 Accessory Information:

Accessory Description	Manufacturer	Model	Parameters
Adapter	Shenzhen SOY Technology Co., Ltd	SUN-1200100-090	Input: AC 100-240V 50/60Hz 0.5A Max Output: DC 12.0V 1.0A 12.0W
Charger Base	UNIMO Technology Co., Ltd	CHNZ-260S	INPUT: 12VDC,1000mA Output: DC 8.4V, 850mA

1.1.2 Antenna Information Detail▲:

Antenna Manufacturer	Model	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range	Requirement
Long Range Solutions, LLC	Unknown	Monopole	50	-1.5dBi/ 400-470MHz	Compliance

1.1.3 Impedance Information Detail▲:

Item	Impedance (Ohm)	Requirement
Audio frequencies impedance	600	Compliance
radio frequencies impedance	50	Compliance

1.1.4 Test Frequency Detail:

Per C63.26-2015, section 5.1, the below frequency was performed the test:

Modulation/ Channel Bandwidth	Test Channel	Frequency (MHz)
2GFSK/12.5kHz	Middle	467.75

1.2 Description of Test Configuration

1.2.1 EUT Operation Condition:

EUT Operation Mode:	The system was configured for testing in Engineering Mode, which was provided by the manufacturer.
Equipment Modifications:	No
EUT Exercise Software:	No

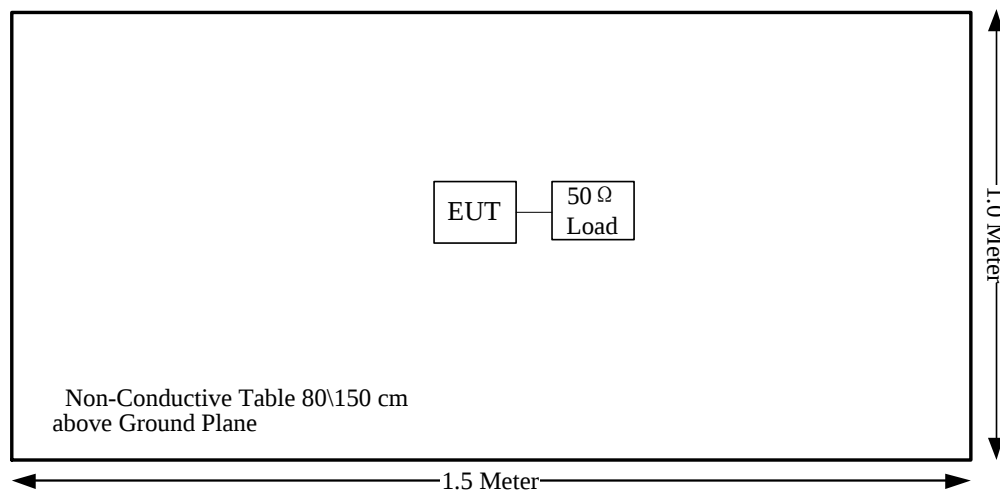
1.2.2 Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

1.2.3 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
/	/	/	/	/	/

1.2.4 Block Diagram of Test Setup



1.3 Measurement Uncertainty

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.

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	$\pm 5\%$
RF output power, conducted	$\pm 0.61\text{dB}$
Power Spectral Density, conducted	$\pm 0.61\text{ dB}$
Unwanted Emissions, radiated	30M~200MHz: 4.15 dB, 200M~1GHz: 5.61 dB, 1G~6GHz: 5.14 dB, 6G~18GHz: 5.93 dB, 18G~26.5G: 5.47 dB, 26.5G~40G: 5.63 dB
Unwanted Emissions, conducted	$\pm 1.26\text{ dB}$
Temperature	$\pm 1^\circ\text{C}$
Humidity	$\pm 5\%$
DC and low frequency voltages	$\pm 0.4\%$
Duty Cycle	1%

2. SUMMARY OF TEST RESULTS

Standard/Rule(s)	Description Of Test	Result
RSS-119 Clause 5.1	Interface Impedance	Compliance
RSS-119 Clause 5.2	Type of Modulation	Not Applicable
FCC §2.1055, §90.213 RSS-119 Clause 5.3	Transmitter Frequency stability	Compliance
FCC §2.1046, §90.205 RSS-119 Clause 5.4	Transmitter output power	Compliance
FCC §2.1049, §90.209, §90.210 RSS-119 Clause 5.5 & 5.8	Occupied Bandwidth & Emission Mask	Compliance
FCC §2.1053, §90.210 RSS-119 Clause 5.8	Unwanted Emissions (Radiated)	Compliance
FCC §2.1051, §90.210 RSS-119 Clause 5.8	Unwanted Emissions (Conducted)	Compliance
FCC §90.214 RSS-119 Clause 5.9	Transient Frequency Behavior	Compliance
FCC §2.1047	Modulation characteristics	Not Applicable
RSS-GEN Clause 6.8	Antenna Requirement	Compliance

3. REQUIREMENTS AND TEST PROCEDURES

3.1 Interface Impedance

3.1.1 Applicable Standard

RSS-119 Clause 5.1

The preferred impedance is 600 ohms resistive for audio frequencies, and 50 ohms for radio frequencies. This product has complied with this requirement

3.1.2 Judgment

Compliance. Please refer to the Information detail in Section 1.1.3.

3.2 Types Of Modulation

3.2.1 Applicable Standard

RSS-119 Clause 5.2

Equipment that operates in the bands 768-776 MHz and 798-806 MHz shall use digital modulation. Mobile and portable transmitters that operate in these bands may have analogue modulation capability only as a secondary mode in addition to their primary digital mode. However, mobile and portable transmitters that operate only on the low-power channels as defined in SRSP-511 may employ any type of modulation.

3.1.2 Judgment

Not Applicable. The device is not operated in the frequency 768-776 MHz or 798-806 MHz

3.3 Transmitter Frequency Stability

3.3.1 Applicable Standard

FCC §90.213

In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

RSS-119 Clause 5.3

The carrier frequency shall not depart from the reference frequency in excess of the values given in Table 1. For transmitters that have an output power of less than 120 mW, the frequency stability shall comply with the limits listed in Table 1 or, alternatively, with the conditions in Section 5.10. For fixed and base station equipment, in lieu of meeting the frequency stability limit specified in Table 1, the test report can show that the frequency stability is met by demonstrating that the unwanted emission limits, related to the equipment's nominal carrier frequency measured under normal operation, are met when the equipment is tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

Table 1 – Transmitter Frequency Stability

Frequency Band (MHz)	Channel Bandwidth (kHz)	Frequency Stability (ppm)		
		Base/Fixed	Mobile Station	
			Output Power > 2 W	Output Power ≤ 2 W
27.41-28 and 29.7-50	20	20	20	50
72-76	20	5	20	50
138-174	30	5	5	5
	15	2.5	5	5
	7.5	1	2	5
217-218 and 219-220	12.5	1	5	5
220-222 (Note 1)	5	0.1	1.5	1.5
406.1-430 and 450-470 (Note 6)	25 (Note 2)	0.5	1	1
	25	2.5	5	5
	12.5	1.5	2.5	2.5
	6.25	0.5	1	1
768-776 and 798-806 (Note 3)	25	0.1	0.4 (Note 4)	0.4 (Note 4)
	12.5			
	6.25	1	1.25 (Note 5)	1.25 (Note 5)
	50			
806-821/851-866 and 821-824/866-869 (Note 6)	25 (Note 2)	0.1	0.1	0.1
	25	1.5	2.5	2.5
	12.5	1	1.5	1.5
	6.25	0.1	0.4	0.4
896-901/935-940 (Note 6)	12.5	0.1	1.5	1.5
929-930/931-932	25	1.5	N/A	N/A
928-929/952-953 and 932-932.5/941-941.5	25	1.5	N/A	N/A
	12.5	1	³ (for remote station)	N/A
932.5-935/941.5-944	25	2.5	N/A	N/A
	12.5	2.5	N/A	N/A

3.3.2 Test Procedure

RSS-Gen Clause 6.11

Frequency stability is a measure of frequency drift due to temperature and supply voltage variations, with reference to the frequency measured at an appropriate reference temperature and the rated supply voltage.

When the measurement method of transmitter frequency stability is not stated in the applicable RSS or reference standards, the following conditions apply:

(a) The reference temperature for radio transmitters is +20 °C (+68 °F).

(b) A hand-held device that is only capable of operating using internal batteries shall be tested at the

battery's nominal voltage, and again at the battery's operating end-point voltage, which shall be specified by the equipment manufacturer. For this test, either a battery or an external power supply can be used.

(c) The operating carrier frequency shall be set up in accordance with the manufacturer's published operation and instruction manual prior to the commencement of these tests. No adjustment of any frequency-determining circuit element shall be made subsequent to this initial set-up.

With the transmitter installed in an environmental test chamber, the unmodulated carrier frequency and frequency stability shall be measured under the conditions specified below for licensed and licence-exempt devices, unless specified otherwise in the applicable RSS. A sufficient stabilization period at each temperature shall be used prior to each frequency measurement.

For licensed devices, the following measurement conditions apply:

- (a) at the temperatures of -30 °C (-22 °F), +20 °C (+68 °F) and +50 °C (+122 °F), and at the manufacturer's rated supply voltage
- (b) at the temperature of +20 °C (+68 °F) and at $\pm 15\%$ of the manufacturer's rated supply voltage

For licence-exempt devices, the following conditions apply:

- (a) at the temperatures of -20 °C (-4 °F), +20 °C (+68 °F) and +50 °C (+122 °F), and at the manufacturer's rated supply voltage
- (b) at the temperature of +20 °C (+68 °F) and at $\pm 15\%$ of the manufacturer's rated supply voltage

If the frequency stability limits are only met within a temperature range that is smaller than the range specified in (a) for licensed or licence-exempt devices, the frequency stability requirement will be deemed to be met if the transmitter is automatically prevented from operating outside this smaller temperature range and if the published operating characteristics for the equipment are revised to reflect this restricted temperature range.

If the device contains both licence and licence-exempt transmitter modules, the device's frequency stability shall be measured under the most stringent condition specified in the applicable RSS of the transmitter module.

In addition, if an unmodulated carrier is not available, the method used to measure frequency stability shall be described in the test report.

3.4 Transmitter Output Power

3.4.1 Applicable Standard

FCC §90.205

(h) 450-470 MHz.

(1) The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2.

Applicants requesting an ERP in excess of that listed in table 2 must submit an engineering analysis based upon generally accepted engineering practices and standards that includes coverage contours to demonstrate that the requested station parameters will not produce coverage in excess of that which the applicant requires.

(2) Applications for stations where special circumstances exist that make it necessary to deviate from the ERP and antenna heights in Table 2 will be submitted to the frequency coordinator accompanied by a technical analysis, based upon generally accepted engineering practices and standards, that demonstrates that the requested station parameters will not produce a signal strength in excess of 39 dBu at any point along the edge of the requested service area. The coordinator may then recommend any ERP appropriate to meet this condition.

(3) An applicant for a station with a service area radius greater than 32 km (20 mi) must justify the requested service area radius, which may be authorized only in accordance with table 2, note 4. For base stations with service areas greater than 80 km, all operations 80 km or less from the base station will be on a primary basis and all operations outside of 80 km from the base station will be on a secondary basis and will be entitled to no protection from primary operations.

RSS-119 Clause 5.4

The output power shall be within ± 1 dB of the manufacturer's rated power listed in the equipment specifications.

The transmitter output power limits set forth in Table 2 will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

Table 2 – Transmitter Output Power

Frequency Bands (MHz)	Transmitter Output Power (W)	
	Base/Fixed Equipment	Mobile Equipment
27.41-28 and 29.7-50	300	30
72-76	No limit	1
138-174	110	60
217-218 and 219-220	110	30*
220-222	See SRSP-512 for ERP limit	50
406.1-430 and 450-470	110	60
768-776 and 798-806	See SRSP-511 for ERP limit	30 3 W ERP for portable equipment
806-821/851-866 and 821-824/866-869	110	30
896-901/935-940	110	60
929-930/931-932	110	30
928-929/952-953 and 932-932.5/941-941.5	110	30
932.5-935/941.5-944	110	30

*Equipment is generally authorized for effective radiated power (ERP) of less than 5 W.

3.4.2 Test Procedure

Before performing this measurement, the power of the EUT shall be set or controlled to the maximum rating of the range for which equipment certification or verification is sought.

Except where otherwise specified, tests shall be performed at the ambient temperature, at the manufacturer's rated supply voltage, and with the transmitter modulating signal representative (i.e. typical) of those encountered in a real system operation.

The spectrum analyzer shall be configured with a resolution bandwidth that encompasses the entire occupied bandwidth (see section 6.7) of the EUT. If the spectrum analyzer's largest available resolution bandwidth is smaller than the occupied bandwidth of the EUT, it is permitted to use a narrower resolution bandwidth plus numerical integration, in linear power terms, over the occupied bandwidth of the transmitter in order to measure its output power, except when the emission is a wideband noise-like signal and being measured for peak power. For transmitters with constant envelope modulation, RF output power and field strength measurements performed on the fundamental frequency can be carried out with an unmodulated carrier. The method used shall be described in the test report.

3.5 Occupied Bandwidth & Emission Mask

3.5.1 Applicable Standard

FCC §90.209

(a) Each authorization issued to a station licensed under this part will show an emission designator representing the class of emission authorized. The designator will be prefixed by a specified necessary bandwidth. This number does not necessarily indicate the bandwidth occupied by the emission at any instant. In those cases where §2.202 of this chapter does not provide a formula for the computation of necessary bandwidth, the occupied bandwidth, as defined in part 2 of this chapter, may be used in lieu of the necessary bandwidth.

(b) (5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table: STANDARD CHANNEL SPACING/BANDWIDTH

FCC §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) 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 compliance 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 compliance 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.

RSS-119 Clause 5.4

For the purpose of this document, channel bandwidth is the channel width in which the equipment is designed to operate.

The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified in Table 3 for the equipment's frequency band. The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licences.

The channel bandwidths, authorized bandwidths and spectrum masks are given in Table3 for equipment having an output power greater than 120 mW. For equipment with an output power that does not exceed 120 mW, Section 5.10 applies.

Table 3 – Channel Bandwidths, Authorized Bandwidths and Spectrum Masks

Frequency Band (MHz)	Related SRSP for Channelling Plan and ERP	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Spectrum Masks for Equipment With Audio Filter	Spectrum Masks for Equipment Without Audio Filter
27.41-28 and 29.7-50	N/A	20	20	B	C
72-76	N/A	20	20	B	C
138-144, 148-149.9 and 150.05-174	SRSP-500	30	20	B	C
		15	11.25	D	D
		7.5	6	E	E
217-218 and 219-220	N/A	12.5	11.25	D or I	D or J
220-222	SRSP-512	5	4	F	F
406.1-430 and 450-470	SRSP-501	25	20	B	C (G) (Note 1)
			22	Y	Y
		12.5	11.25	D	D
		6.25	6	E	E

3.5.2 Test Procedure

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

Emission Mask D for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table 7.

Table 7 – Emission Mask D

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	$7.27(f_d - 2.88)$	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser: 70 or $50 + 10 \log_{10}(p)$	Specified in Section 4.2.2

In order to show compliance 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 mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz. However, for emission mask F, at a displacement frequency of less than 3.75 kHz, the resolution bandwidth shall be 30 Hz.

3.6 Transmitter Unwanted Emissions(Conducted)

3.6.1 Applicable Standard

FCC §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:

- (5) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (6) 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.
- (7) 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.
- (8) The reference level for showing compliance 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 compliance 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.

RSS-119 Clause 5.8

The spectrum plots of the unwanted emissions shall comply with the masks specified in Table 3. Descriptions of these permissible emission masks are given in the sections that follow. The term *displacement frequency*, f_d , used in these sections refers to the difference between the channel frequency and the emission component frequency expressed in kilohertz, and p is the transmitter output power in Watts.

Emission Mask D for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table 7.

Table 7 – Emission Mask D

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	$7.27(f_d - 2.88)$	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser: 70 or $50 + 10 \log_{10}(p)$	Specified in Section 4.2.2

3.6.2 Test Procedure

In order to show compliance 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 mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz. However, for emission mask F, at a displacement frequency of less than 3.75 kHz, the resolution bandwidth shall be 30 Hz.

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated or used in the equipment, whichever is lower, without going below 9 kHz, up to at least the applicable frequency given below:

- (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- (b) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
- (c) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise in the applicable RSS.
- (d) If the equipment contains a digital device that is exclusively used for enabling the operation of the radio apparatus: the spectrum shall be investigated according to the conditions specified in paragraphs (a) through (c) of this section or the range applicable to the digital device, as shown in table 2, whichever is the higher frequency range of investigation.

Table 2 – Frequency range for radiated measurement for equipment with a digital device

Highest frequency generated, operated or used in the equipment (MHz)	Upper frequency limit of measurement range (MHz)
< 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
> 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

It is not necessary to report the amplitude of spurious emissions attenuated more than 20 dB below the permissible value

3.7 Transmitter Unwanted Emissions(Radiated)

3.7.1 Applicable Standard

FCC §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:

- (9) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0 : Zero dB.
- (10) 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.
- (11) 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.
- (12) The reference level for showing compliance 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 compliance 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.

RSS-119 Clause 5.8

The spectrum plots of the unwanted emissions shall comply with the masks specified in Table 3. Descriptions of these permissible emission masks are given in the sections that follow. The term *displacement frequency*, f_d , used in these sections refers to the difference between the channel frequency and the emission component frequency expressed in kilohertz, and p is the transmitter output power in Watts.

Emission Mask D for Transmitters Equipped With or Without an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table 7.

Table 7 – Emission Mask D

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$5.625 < f_d \leq 12.5$	$7.27(f_d - 2.88)$	Specified in Section 4.2.2
$f_d > 12.5$	Whichever is the lesser: 70 or $50 + 10 \log_{10}(p)$	Specified in Section 4.2.2

3.7.2 Test Procedure

In measuring unwanted emissions, the spectrum shall be investigated from 30 MHz or the lowest radio frequency signal generated or used in the equipment, whichever is lower, without going below 9 kHz, up to at least the applicable frequency given below:

- (a) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.
- (b) If the equipment operates at or above 10 GHz and below 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 100 GHz, whichever is lower.
- (c) If the equipment operates at or above 30 GHz: to the fifth harmonic of the highest fundamental frequency or to 200 GHz, whichever is lower, unless specified otherwise in the applicable RSS.
- (d) If the equipment contains a digital device that is exclusively used for enabling the operation of the radio apparatus: the spectrum shall be investigated according to the conditions specified in paragraphs (a) through (c) of this section or the range applicable to the digital device, as shown in table 2, whichever is the higher frequency range of investigation.

Table 2 – Frequency range for radiated measurement for equipment with a digital device

Highest frequency generated, operated or used in the equipment (MHz)	Upper frequency limit of measurement range (MHz)
< 1.705	30
1.705-108	1000
108-500	2000
500-1000	5000
> 1000	5 th harmonic of the highest frequency or 40 GHz, whichever is lower

It is not necessary to report the amplitude of spurious emissions attenuated more than 20 dB below the permissible value

3.8 Transient Frequency Behavior

3.8.1 Applicable Standard

FCC §90.214

Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

Time intervals ^{1 2}	Maximum frequency difference ³	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t ₁ ⁴	±12.5 kHz	5.0 ms	10.0 ms
t ₂	±6.25 kHz	20.0 ms	25.0 ms
t ₃ ⁴	±12.5 kHz	5.0 ms	10.0 ms

RSS-119 Clause 5.9

When a transmitter is turned on, the radio frequency may take some time to stabilize. During this initial period, the frequency error or frequency difference (*i.e.*, between the instantaneous and the steady state frequencies) shall not exceed the limits specified in Table 18. Any suitable method of measurement can be used provided that it is fully described in the test report. A suitable and recommended method is given in TIA Standard 603.

Table 18 – Transient Frequency Behaviour

Channel Bandwidth (kHz)	Time Intervals (Notes 1, 2)	Maximum Frequency Difference (kHz)	Transient Duration Limit (ms)	
			138-174 MHz	406.1-512 MHz
25	t ₁	±25	5	10
	t ₂	±12.5	20	25
	t ₃	±25	5	10
12.5	t ₁	±12.5	5	10
	t ₂	±6.25	20	25
	t ₃	±12.5	5	10
6.25	t ₁	±6.25	5	10
	t ₂	±3.125	20	25
	t ₃	±6.25	5	10

Notes:

1. t_{on}: the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

t₁: the time period immediately following t_{on}.

t_2 : the time period immediately following t_1 .

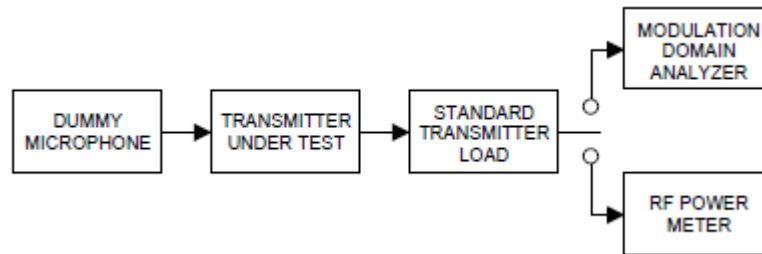
t_3 : the time period from the instant when the transmitter is turned off until t_{off} .

t_{off} : the instant when the 1 kHz test signal starts to rise.

2. If the transmitter carrier output power rating is 6 W or less, the frequency difference during the time periods t_1 and t_3 may exceed the maximum frequency difference for these time periods. The corresponding plot of frequency versus time during t_1 and t_3 shall be recorded in the test report.

3.8.2 Test Procedure

TIA-603-E Clause 2.2.19



- a) Connect the equipment as illustrated.
- b) Connect the output of the standard transmitter load to the RF power meter. Supply sufficient attenuation via the RF attenuator to provide a level that is approximately 40 dB below the maximum allowable input to the modulation domain analyzer.
- c) Unkey the transmitter.
- d) Disconnect the RF power meter and connect the modulation domain analyzer in its place. Set the envelope trigger of the modulation domain analyzer to the minimum level that will trigger when the transmitter is keyed.
- e) Reduce the attenuation of the RF attenuator so that the input to the modulation domain analyzer is increased by 30 dB when the transmitter is keyed.
- f) Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signal.
- g) Adjust the display of the modulation domain analyzer for proper viewing of the transmitter transient behavior. Set the timebase reference to the left for observing the transmitter turn-on transient.
- h) Key the transmitter.
- i) Observe the stored display of the modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t_1 and t_2 , and shall also remain within limits following t_2 .
- j) Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transient of the transmitter signal.
- k) Adjust the display of the modulation domain analyzer for proper viewing of the transmitter transient behavior. Set the timebase reference to the right for observing the transmitter turn-off transient.
- l) Unkey the transmitter.
- m) Observe the stored display of the modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the period t_3 .

3.9 Modulation characteristics.

3.9.1 Applicable Standard

FCC §2.1047

(a) Voice modulated communication equipment. A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

(b) Equipment which employs modulation limiting. A curve or family of curves showing the percentage of modulation versus the modulation input voltage shall be supplied. The information submitted shall be sufficient to show modulation limiting capability throughout the range of modulating frequencies and input modulating signal levels employed.

(c) Single sideband and independent sideband radiotelephone transmitters which employ a device or circuit to limit peak envelope power. A curve showing the peak envelope power output versus the modulation input voltage shall be supplied. The modulating signals shall be the same in frequency as specified in paragraph (c) of §2.1049 for the occupied bandwidth tests.

(d) Other types of equipment. A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

3.9.2 Judgment

Not Applicable for Digital modulation.

3.10 Antenna Requirement

3.10.1 Applicable Standard

According to RSS-Gen Clause 6.8

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer. The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

3.10.2 Judgment

Please refer to the Antenna Information detail in Section 1.1.2.

4. Test DATA AND RESULTS

4.1 Transmitter Frequency Stability

Serial Number:	CR21110009-RF-S1	Test Date:	2021-12-21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Chuck Li	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	23	Relative Humidity: (%)	41	ATM Pressure: (kPa)	100.9
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41010013	Each time	N/A
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005011	Each time	N/A
Pro instrument	DC Power Supply	pps3300	3300012	N/A	N/A
BACL	TEMP&HUMI Test Chamber	BTH-150	30026	2021-07-22	2022-07-21
UNI-T	Multimeter	UT39A+	C210582554	2021-09-30	2022-09-30
HP	RF Communications Test Set	8920A	3438A05201	2021-07-07	2022-07-07
Weinschel	Power splitter	1515	RA915	Each time	N/A

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

2GFSK, 12.5kHz, $f_c = 467.75$ MHz,				
Temperature	Voltage	Measured	Frequency Error	Limit
°C	V _{DC}	MHz	ppm	ppm
-30	4.8	467.750350	0.75	2.5
-20		467.750351	0.75	
-10		467.750315	0.67	
0		467.750345	0.74	
10		467.750352	0.75	
20		467.750351	0.75	
30		467.750335	0.72	
40		467.750335	0.72	
50		467.750345	0.74	
20	6.0	467.750322	0.69	
20	4.0	467.750315	0.67	

4.2 Transmitter Output Power

Serial Number:	CR21110009-RF-S1	Test Date:	2021-12-21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Chuck Li	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	23	Relative Humidity: (%)	41	Temperature: (°C)	100.9
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Signal Analyzer	FSIQ26	831929/006	2021-07-22	2022-07-21
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41010013	Each time	N/A
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005011	Each time	N/A
Weinschel	Power splitter	1515	RA915	Each time	N/A

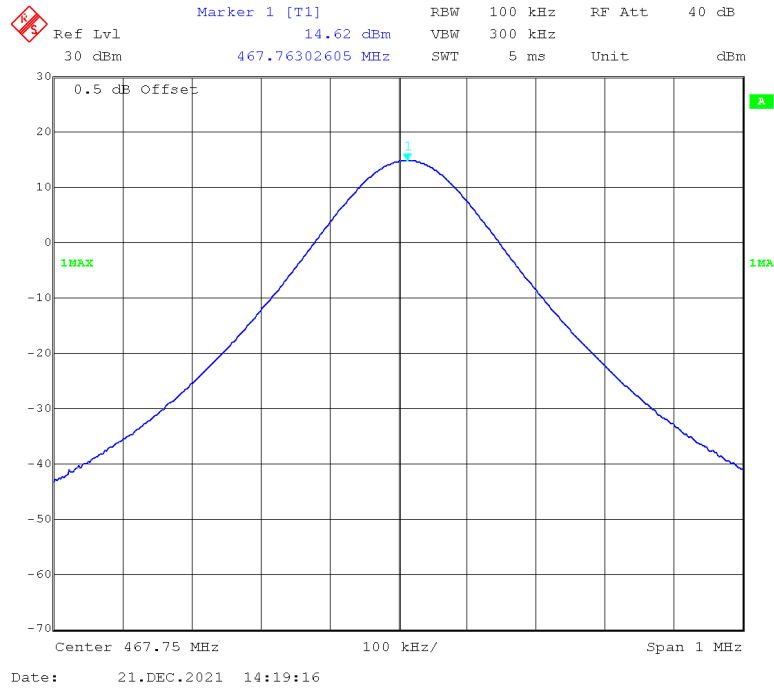
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Test Frequency (MHz)	Conducted Output Power (dBm)	Limit(dBm)	
		FCC	ISED
467.75	14.620	<14.77	13~15

Note: The rated power is 25mW (14dBm)

467.75 MHz



4.3 Occupied Bandwidth & Emission Mask

Serial Number:	CR21110009-RF-S1	Test Date:	2021-12-21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Chuck Li	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	23	Relative Humidity: (%)	41	Temperature: (°C)	100.9
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Signal Analyzer	FSIQ26	831929/006	2021-07-22	2022-07-21
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41010013	Each time	N/A
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005011	Each time	N/A
Weinschel	Power splitter	1515	RA915	Each time	N/A

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Test Frequency (MHz)	99% Occupied Bandwidth (KHz)	26 dB Emission Bandwidth (MHz)
467.75	7.315	9.719

Emission Mask please refer to the plots.

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

$$BW = 2M + 2D$$

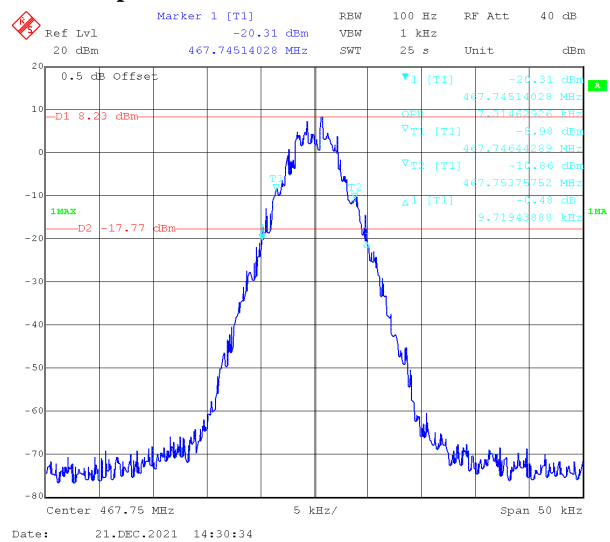
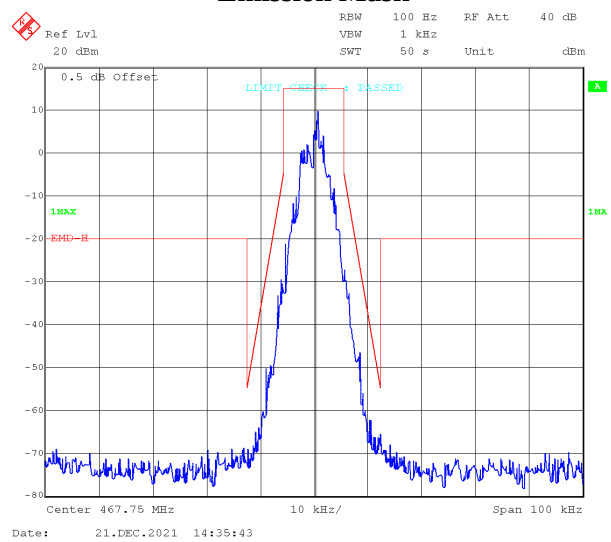
For Digital Mode (Channel Spacing: 12.5 kHz)

Emission Designator 7K60F1D

The 99% energy rule was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz.

F1D portion of the designator indicates digital information.

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

99% Occupied Bandwidth&26 dB Emission Bandwidth**Emission Mask**

4.4 Transmitter Unwanted Emissions (Conducted)

Serial Number:	CR21110009-RF-S1	Test Date:	2021-12-21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Chuck Li	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	23	Relative Humidity: (%)	41	Temperature: (°C)	100.9
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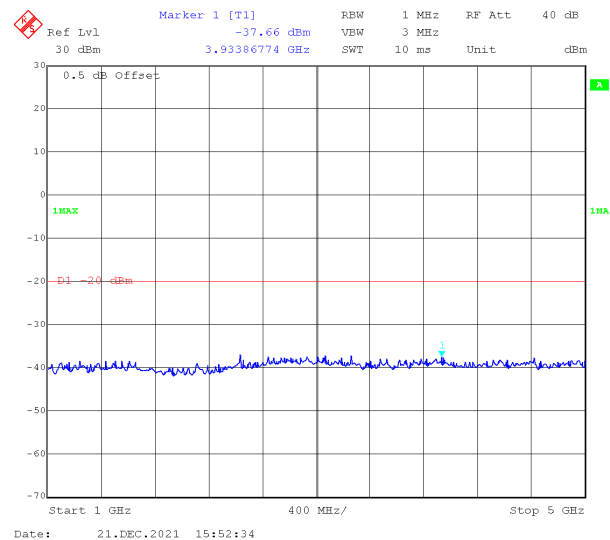
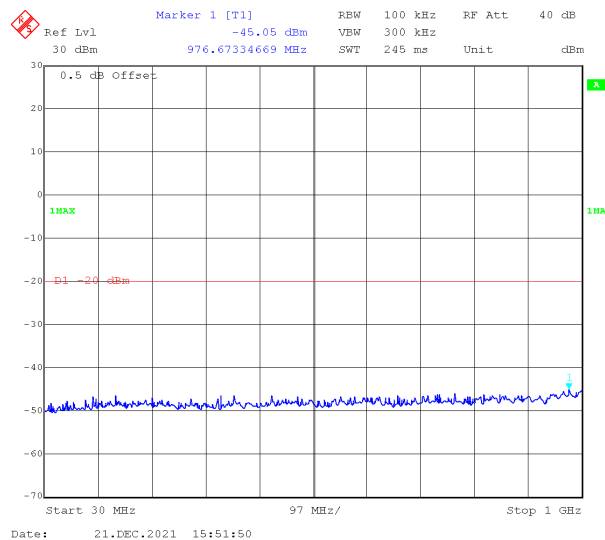
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Signal Analyzer	FSIQ26	831929/006	2021-07-22	2022-07-21
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41010013	Each time	N/A
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005011	Each time	N/A
Weinschel	Power splitter	1515	RA915	Each time	N/A
E-Microwave	Band Rejector Filter	OBF-ZP-400-470-NF	OE0120256	2022-01-23	2023-01-22

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

(Note: Test with Band Rejector Filter)



4.5 Transient Frequency Behavior

Serial Number:	CR21110009-RF-S1	Test Date:	2021-12-21
Test Site:	RF	Test Mode:	Transmitting
Tester:	Chuck Li	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	23	Relative Humidity: (%)	41	Temperature: (°C)	100.9
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Signal Analyzer	FSIQ26	831929/006	2021-07-22	2022-07-21
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41010013	Each time	N/A
yzjingcheng	Coaxial Cable	KTRFBU-141-50	41005011	Each time	N/A
Weinschel	Power splitter	1515	RA915	Each time	N/A

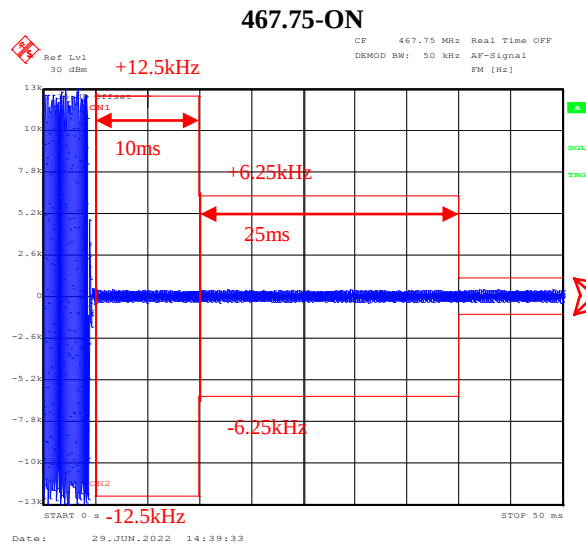
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

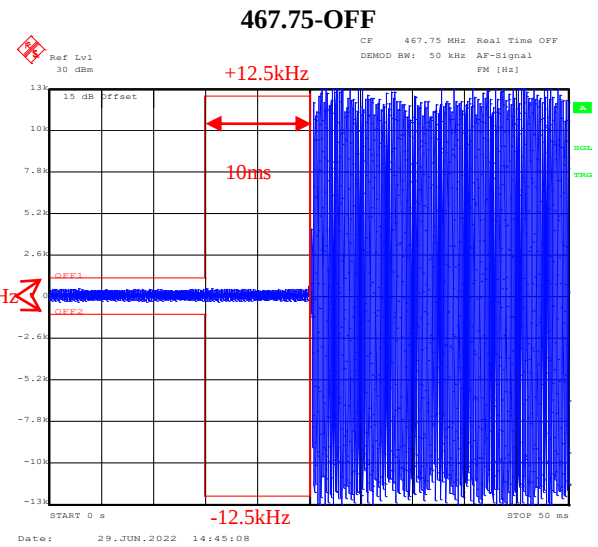
Channel Spacing (kHz)	Transient Period (ms)	Transient Frequency	Result
12.5	10(t ₁)	±12.5 kHz	Pass
	25(t ₂)	±6.25 kHz	
	10(t ₃)	±12.5 kHz	

Note: During the time from the end of t₂ to the beginning of t₃, the frequency difference must not exceed the limits specified in RSS-119 Clause 5.3/:

For 467.75 MHz 12.5kHz mode, limit is: 467.75 MHz* 2.5ppm = 1.169kHz



±1169Hz



4.6 Transmitter Unwanted Emissions (Radiated)

Serial Number:	CR21110009-RF-S1	Test Date:	2021-12-10
Test Site:	966-2, 966-1	Test Mode:	Transmitting
Tester:	Carl Liang	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	22.4	Relative Humidity: (%)	46	ATM Pressure: (kPa)	101.6
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Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Sunol Sciences	Antenna	JB6	A082520-5	2020-10-19	2023-10-18
R&S	EMI Test Receiver	ESR3	102724	2021-07-22	2022-07-21
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2021-07-18	2022-07-17
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2021-07-18	2022-07-17
Sonoma	Amplifier	310N	186165	2021-07-18	2022-07-17
EMCO	Adjustable Dipole Antenna	3121C	9109-753	N/A	N/A
MICRO-COAX	Coaxial Cable	UFA210B-0-0720-300300	99G1448	2021-07-25	2022-07-24
Agilent	Signal Generator	E8247C	MY43321350	2021-04-25	2022-04-24
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020-10-13	2023-10-12
R&S	Spectrum Analyzer	FSV40	101591	2021-07-22	2022-07-21
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2021-08-08	2022-08-07
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2021-08-08	2022-08-07
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2021-11-10	2022-11-09
AH	Double Ridge Guide Horn Antenna	SAS-571	1396	2021-10-18	2024-10-17
MICRO-COAX	Coaxial Cable	UFA210B-0-0720-300300	99G1448	2021-07-25	2022-07-24

* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Test only performed with High power level. The device can be mounted in multiple orientations, test was performed with X,Y, Z Axis according to C63.26 Figure 5, the worst orientation was photographed and it's data was recorded.

30MHz-5GHz

FORM 531E

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)			
Test Frequency: 467.75 MHz								
935.50	H	19.58	-48.32	0.00	0.66	-48.98	-20.00	28.98
935.50	V	19.26	-46.17	0.00	0.66	-46.83	-20.00	26.83
1403.25	H	36.20	-67.50	8.23	0.71	-59.98	-20.00	39.98
1403.25	V	37.10	-66.64	8.23	0.71	-59.12	-20.00	39.12
1871.00	H	36.61	-66.51	8.95	0.89	-58.45	-20.00	38.45
1871.00	V	37.18	-65.76	8.95	0.89	-57.70	-20.00	37.70
2338.75	H	35.72	-65.86	9.30	0.97	-57.53	-20.00	37.53
2338.75	V	36.32	-65.03	9.30	0.97	-56.70	-20.00	36.70
2806.50	H	35.09	-64.81	9.89	1.04	-55.96	-20.00	35.96
2806.50	V	35.39	-64.40	9.89	1.04	-55.55	-20.00	35.55
3274.25	H	35.54	-61.25	10.31	1.16	-52.10	-20.00	32.10
3274.25	V	34.50	-62.04	10.31	1.16	-52.89	-20.00	32.89
3742.00	H	34.91	-61.77	10.64	1.23	-52.36	-20.00	32.36
3742.00	V	35.64	-60.96	10.64	1.23	-51.55	-20.00	31.55
4209.75	H	35.69	-60.28	10.77	1.33	-50.84	-20.00	30.84
4209.75	V	35.42	-60.51	10.77	1.33	-51.07	-20.00	31.07
4677.50	H	34.89	-60.07	10.81	1.41	-50.67	-20.00	30.67
4677.50	V	35.23	-59.72	10.81	1.41	-50.32	-20.00	30.32

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

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