



中认信通

CHINA CERTIFICATION ICT CO., LTD (DONGGUAN)



TEST REPORT

Applicant: Aqua Broadcast Limited

Address: FCC:Unit 7,First Quarter, Blenheim Road, Epsom, KT199QN,
United Kingdom

IC: Unit 7,First Quarter, Blenheim Road,Epsom,Surrey KT19
9QN,United Kingdom Of Great Britain And Northern Ireland

FCC ID: 2A9RR-COBALT300

IC: 30007-COBALT300

HVIN: COBALT300

Product Name: Cobalt FM Transmitter

Standard(s): FCC Part 73

ISED BETS-6 Issue 2 August 2005

ANSI C63.26-2015

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

Report Number: CR230529306-00BM1

Date Of Issue: 2023/8/18

Reviewed By: Sun Zhong

Sun Zhong

Title: Manager

Test Laboratory: China Certification ICT Co., Ltd (Dongguan)

No. 113, Pingkang Road, Dalang Town, Dongguan,
Guangdong, China

Tel: +86-769-82016888

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.

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

This report cannot be reproduced except in full, without prior written approval of the Company.

This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report may contain data that are not covered by the accreditation scope and shall be marked with an asterisk “★”.

CONTENTS

TEST FACILITY	2
DECLARATIONS.....	2
DOCUMENT REVISION HISTORY	5
1. GENERAL INFORMATION.....	6
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	6
1.2 DESCRIPTION OF TEST CONFIGURATION.....	7
1.2.2 Support Equipment List and Details	7
1.2.3 Support Cable List and Details	7
1.2.4 Block Diagram of Test Setup.....	8
1.3 MEASUREMENT UNCERTAINTY	9
2. SUMMARY OF TEST RESULTS	10
3. REQUIREMENTS AND TEST PROCEDURES	11
3.1 TRANSMITTER FREQUENCY STABILITY	11
3.1.1 Applicable Standard.....	11
3.1.2 Test Procedure	11
3.1.3 EUT Setup Block Diagram	11
3.2 TRANSMITTER OUTPUT POWER	12
3.2.1 Applicable Standard.....	12
3.2.2 Test Procedure	13
3.3 OCCUPIED BANDWIDTH & EMISSION MASK.....	13
3.3.1 Applicable Standard.....	13
3.5.2 Test Procedure	14
3.4 SPURIOUS EMISSION AT ANTENNA TERMINAL	15
3.4.1 Applicable Standard.....	15
3.4.2 Test Procedure	15
3.5 SPURIOUS RADIATED EMISSIONS.....	16
3.5.1 Applicable Standard.....	16
3.5.2 Test Procedure	16
3.6 MODULATION CHARACTERISTICS.	17
3.6.1 Applicable Standard.....	17
3.6.2 Test Procedure	17
3.6.2.1.1 Modulation limiting	17
3.6.2.1.2 EUT Setup Block Diagram	18
3.6.2.2.1 Audio frequency response.....	18
3.6.2.2.2 EUT Setup Block Diagram	18
4. Test DATA AND RESULTS.....	19
4.1 TRANSMITTER FREQUENCY STABILITY	19
4.2 TRANSMITTER OUTPUT POWER	22
4.3 OCCUPIED BANDWIDTH & EMISSION MASK.....	25

4.4 SPURIOUS EMISSION AT ANTENNA TERMINAL	30
4.5 SPURIOUS RADIATED EMISSIONS.....	32
4.6 MODULATION CHARACTERISTIC.....	35
5 MAXIMUM PERMISSIBLE EXPOSURE (MPE)	39
5.1 APPLICABLE STANDARD.....	39

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
1.0	CR230529306-00B	Original Report	2023/7/19
2.0	CR230529306-00BM1	Update Section 4.1	2023/8/18

1. GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

EUT Name:	Cobalt FM Transmitter
Trade Name:	Aqua Broadcast
EUT Model:	COBALT300
Operation Frequency:	88-108 MHz
Modulation Type:	FM
Rated Input Voltage:	120Vac
Serial Number:	2680-1
EUT Received Date:	2023/5/30
EUT Received Status:	Good

1.1.1 Test Frequency Detail:

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

Test Channel	Frequency (MHz)
Low	88.1
Middle	98.1
High	107.9

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

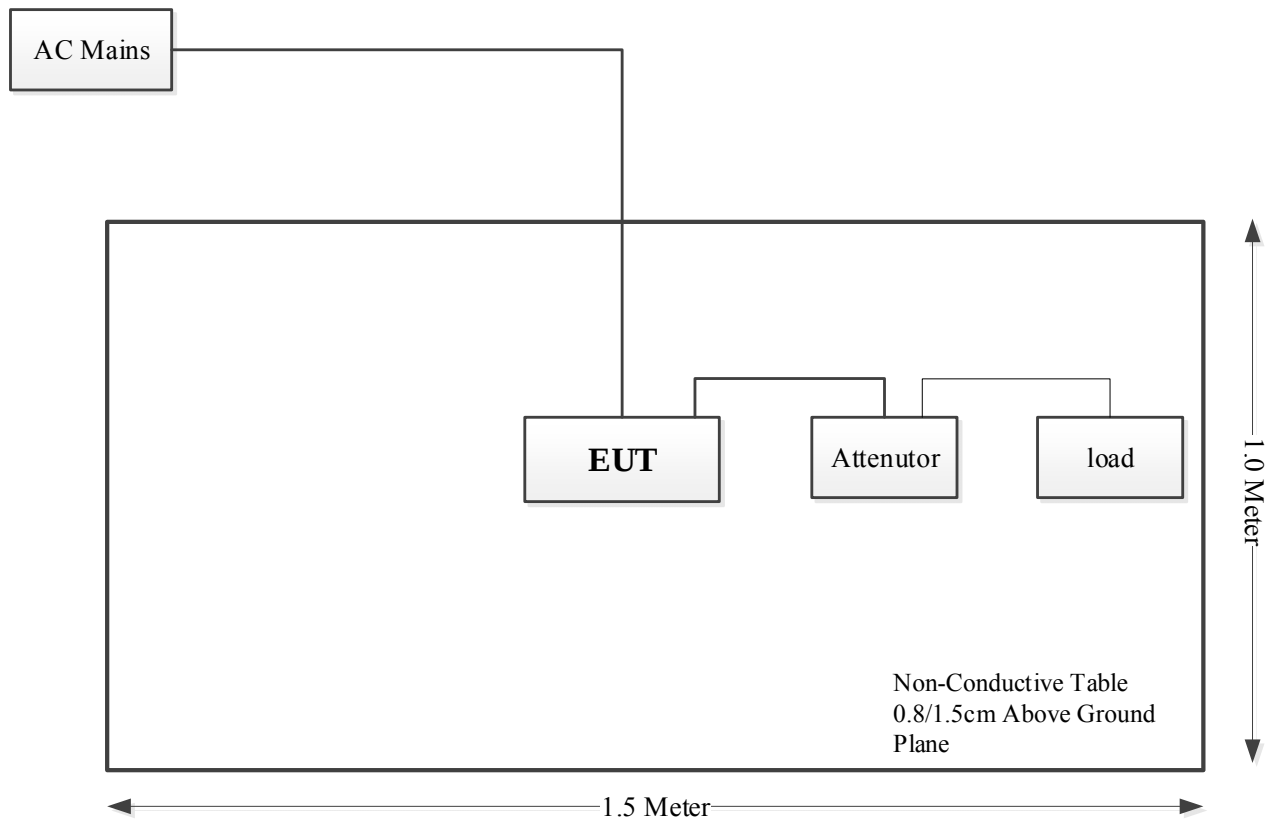
1.2.2 Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Unknown	Attenuator	Unknown	Unknown
Bew	Load	TF300-6-B	Unknown

1.2.3 Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
L29 Cable	No	No	1.2	EUT	Attenuator
Coaxial Cable	No	No	0.5	Attenuator	Load

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	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 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	±1.26 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%

2. SUMMARY OF TEST RESULTS

Standard/Rule(s)	Description Of Test	Result
FCC §2.1055, §73.1545 BETS-6 Clause 6.2.3	Frequency Stability	Compliance
FCC §2.1046, §73.267, §73.811(a), §73.812(a), §73.840, BETS-6 Clause 6.1.3	RF Output Power	Compliance
FCC §2.1049, §73.317, BETS-6 Clause 6.3.3	Occupied Bandwidth & Emission Mask	Compliance
FCC §2.1051, §73.317 BETS-6 Clause 6.3.3	Spurious Emission at Antenna Terminal	Compliance
FCC §2.1053, §73.317 BETS-6 Clause 6.3.3	Spurious Radiated Emissions	Compliance
FCC §2.1047, BTES-6 Clause 4.2	Modulation Characteristics	Compliance
FCC §1.1310 & §2.1091 RSS-102 Clause 4	Maximum Permissible Exposure (MPE)	Compliance

3. REQUIREMENTS AND TEST PROCEDURES

3.1 Transmitter Frequency Stability

3.1.1 Applicable Standard

FCC §73.1545

(b) FM stations.

(1) The departure of the carrier or center frequency of an FM station with an authorized transmitter output power more than 10 watts may not exceed ± 2000 Hz from the assigned frequency.

(2) The departure of the carrier or center frequency of an FM station with an authorized transmitter output power of 10 watts or less may not exceed ± 3000 Hz from the assigned frequency.

BETS-6 Clause 6.2.3

The frequency of the carrier shall remain within ± 1 kHz of the mean test frequency.

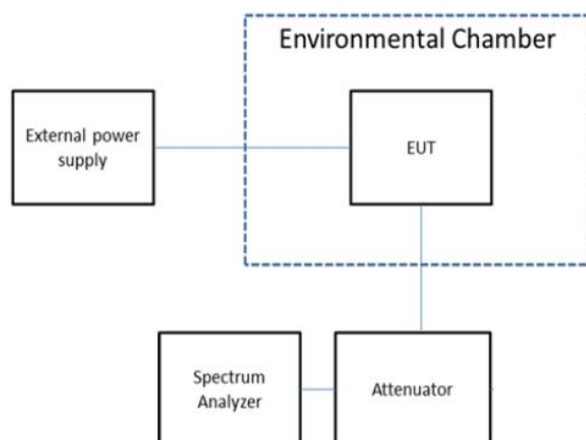
3.1.2 Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external power supply and the RF output was connected to a spectrum analyzer via feed-through attenuators. The EUT was placed inside the temperature chamber. The DC or AC 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 spectrum analyzer.

Frequency Stability vs. Voltage: An external variable AC power supply Source. The voltage was set to the equipment under test. The output frequency was recorded for each voltage.

3.1.3 EUT Setup Block Diagram



3.2 Transmitter Output Power

3.2.1 Applicable Standard

FCC §73.267

(b) Direct method. The direct method of power determination for an FM station uses the indications of a calibrated transmission line meter (responsive to relative voltage, current, or power) located at the RF output terminals of the transmitter. This meter must be calibrated whenever there is any indication that the calibration is inaccurate or whenever any component of the metering circuit is repaired or replaced. The calibration must cover, as a minimum, the range from 90% to 105% of authorized power. The meter calibration may be checked by measuring the power at the transmitter terminals while either:

(1) Operating the transmitter into the transmitting antenna, and determining actual operating power by the indirect method described in § 73.267(c); or

(2) Operating the transmitter into a load (of substantially zero reactance and a resistance equal to the transmission line characteristic impedance) and using an electrical device (within $\pm 5\%$ accuracy) or temperature and coolant flow indicator (within $\pm 4\%$ accuracy) to determine the power.

(3) The calibration must cover, as a minimum, the range from 90% to 105% of authorized power and the meter must provide clear indications which will permit maintaining the operating power within the prescribed tolerance or the meter shall be calibrated to read directly in power units.

FCC §73.811(a)

(a) Maximum facilities. LPFM stations will be authorized to operate with maximum facilities of 100 watts ERP at 30 meters HAAT. An LPFM station with a HAAT that exceeds 30 meters will not be permitted to operate with an ERP greater than that which would result in a 60 dBu contour of 5.6 kilometers. In no event will an ERP less than one watt be authorized. No facility will be authorized in excess of one watt ERP at 450 meters HAAT.

FCC §73.812(a)

(a) Effective radiated power (ERP) will be rounded to the nearest watt on LPFM authorizations.

FCC §73.840

The transmitter power output (TPO) of an LPFM station must be determined by the procedures set forth in § 73.267 of this part. The operating TPO of an LPFM station with an authorized TPO of more than ten watts must be maintained as near as practicable to its authorized TPO and may not be less than 90% of the minimum TPO nor greater than 105% of the maximum authorized TPO. An LPFM station with an authorized TPO of ten watts or less may operate with less than the authorized power, but not more than 105% of the authorized power.

BETS-6 Clause 6.1.3

The standard rating of power output for the transmitting equipment shall be as specified by the individual manufacturer. The transmitting equipment shall be capable of being adjusted to deliver the rated power output when the AC input voltage varies by 5% from the rated value.

The test report shall state the power output limits over which the transmitting equipment complies

with this specification.

Adjustment of the power output of the transmitting equipment shall permit operation over a range of at least from 50% to rated power output.

3.2.2 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.

3.3 Occupied Bandwidth & Emission Mask

3.3.1 Applicable Standard

FCC §73.317

(b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

(c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.

BETS-6 Clause 6.3.3

Spurious emissions of the transmitting equipment shall not exceed the values given below:

Spurious Emission	Maximum Value
Between 120 kHz and 240 kHz from the carrier frequency	-25 dB*
More than 240 kHz and up to and including 600 kHz from the carrier frequency	-35 dB*
More than 600 kHz from the carrier frequency, whichever is the stronger	$-(43 + 10 \log P)^*$ or -80 dB* P = power in watts

* Referred to the power level of the unmodulated carrier.

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).

3.4 Spurious Emission at Antenna Terminal

3.4.1 Applicable Standard

FCC §73.317

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least $43 + 10 \log_{10}(\text{Power, in watts})$ dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

BETS-6 Clause 6.3.3

Spurious emissions of the transmitting equipment shall not exceed the values given below:

Spurious Emission	Maximum Value
Between 120 kHz and 240 kHz from the carrier frequency	-25 dB*
More than 240 kHz and up to and including 600 kHz from the carrier frequency	-35 dB*
More than 600 kHz from the carrier frequency, whichever is the stronger	$-(43 + 10 \log P)^*$ or -80 dB* P = power in watts

* Referred to the power level of the unmodulated carrier.

3.4.2 Test Procedure

For emissions beyond 600 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

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.

3.5 Spurious Radiated Emissions

3.5.1 Applicable Standard

FCC §73.317

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least $43 + 10 \log_{10}(\text{Power, in watts})$ dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

BETS Clause 6.3.3

Spurious emissions of the transmitting equipment shall not exceed the values given below:

Spurious Emission	Maximum Value
Between 120 kHz and 240 kHz from the carrier frequency	-25 dB*
More than 240 kHz and up to and including 600 kHz from the carrier frequency	-35 dB*
More than 600 kHz from the carrier frequency, whichever is the stronger	$-(43 + 10 \log P)^*$ or -80 dB* P = power in watts

* Referred to the power level of the unmodulated carrier.

3.5.2 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.

3.6 Modulation characteristics.

3.6.1 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.

BETS-6 Clause 4.2

The designation of modulation and emission refers to the manner in which the carrier is modulated and transmitted. The transmitting equipment shall produce F3EGN emission for monophonic operation and F8EHF emission for stereophonic operation. The transmitting equipment shall be capable of operating with a frequency deviation of ± 75 kHz, which is equivalent to 100% modulation.

3.6.2 Test Procedure

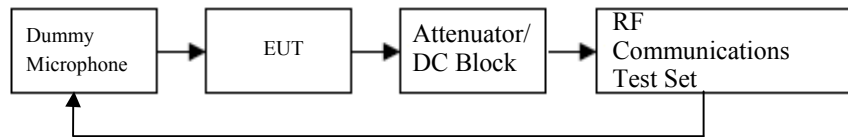
3.6.2.1.1 Modulation limiting

C63.26-2015, Clause 5.3.2 Modulation limiting test methodology

Modulation limiting is the ability of a transmitter circuit to limit the transmitter from producing deviations in excess of a rated system deviation.

- a) Connect the equipment as illustrated in Figure 1.
- b) Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- c) Set the test RF Communications Test Set to measure peak positive deviation. Set the audio bandwidth for ≤ 0.25 Hz to ≥ 15000 Hz. Turn the de-emphasis function off.
- d) Apply a 1000 Hz modulating signal to the transmitter from the RF Communications Test Set, and adjust the level to obtain 60% of full rated system deviation. This is the 0 dB reference level.
- e) Increase the level from the audio generator by 20 dB in 5 dB increments recording the deviation as measured from the RF Communications Test Set in each step. Verify that the audio level used to make the OBW measurement is included in the sweep.
- f) Repeat for step e) at 300 Hz, 2500 Hz and 3000 Hz at a minimum using the 0 dB reference level obtained in step d).
- g) Set the RF Communications Test Set to measure peak negative deviation and repeat step d) through step f).
- h) The values recorded in step f) and step g) are the modulation limiting.
- i) Plot the data set as a percentage of deviation relative to the 0 dB reference point versus input voltage.

3.6.2.1.2 EUT Setup Block Diagram

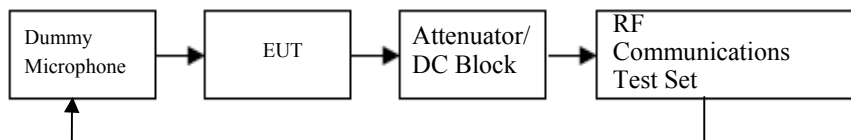


3.6.2.2.1 Audio frequency response

C63.26-2015, Clause 5.3.3.2 Audio frequency response test methodology—Constant Input

- Connect the equipment as illustrated in Figure 3.
- Set the RF Communications Test Set to measure peak positive deviation. Set the audio bandwidth for ≤ 50 Hz to $\geq 15\,000$ Hz. Turn the de-emphasis function off.
- Adjust the transmitter per the manufacturer's procedure for full rated system deviation.
- Apply a 1000 Hz tone and adjust the RF Communications Test Set to produce 20% of the rated system deviation.
- Set the RF Communications Test Set to measure rms deviation and record the deviation reading as DEVREF.
- Set the RF Communications Test Set to the desired test frequency between 300 Hz and 3000 Hz.

3.6.2.2.2 EUT Setup Block Diagram



4. Test DATA AND RESULTS

4.1 Transmitter Frequency Stability

Serial Number:	2680-1	Test Date:	2023/6/2~2023/8/17
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	22.1~25.6	Relative Humidity: (%)	52~61	ATM Pressure: (kPa)	99.9~100
----------------------	-----------	------------------------------	-------	------------------------	----------

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/03/31	2024/03/30
BED	Coaxial Attenuator	DLCP-1000W	100002P	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100001	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100002	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:

$f_c = 88.1 \text{ MHz}$				
Temperature	Voltage	Measured	Frequency Error	Part 73 Limit
$^{\circ}\text{C}$	V_{AC}	MHz	Hz	Hz
0	120	88.100152	152	± 2000
10		88.100154	154	
20		88.100128	128	
30		88.100143	143	
40		88.100154	154	
50		88.100164	164	
20	102	88.100166	166	
20	138	88.100167	167	

$f_c = 98.1 \text{ MHz}$				
Temperature	Voltage	Measured	Frequency Error	Part 73 Limit
$^{\circ}\text{C}$	V_{AC}	MHz	Hz	Hz
0	120	98.100166	166	± 2000
10		98.100167	167	
20		98.100128	128	
30		98.100157	157	
40		98.100158	158	
50		98.100156	156	
20	102	98.100157	157	
20	138	98.100160	160	

$f_c = 107.9 \text{ MHz}$				
Temperature	Voltage	Measured	Frequency Error	Part 73 Limit
$^{\circ}\text{C}$	V_{AC}	MHz	Hz	Hz
0	120	107.900158	157	± 2000
10		107.900168	168	
20		107.900128	128	
30		107.900155	155	
40		107.900175	175	
50		107.900167	167	
20	102	107.900169	169	
20	138	107.900168	168	

$f_c = 88.1 \text{ MHz}$				
Temperature	Voltage	Measured	Frequency Error	BETS-6 Limit
$^{\circ}\text{C}$	V_{AC}	MHz	Hz	Hz
20(reference)	120	88.100131	0	± 1000
5	120	88.100154	23	
5	102	88.100165	34	
5	138	88.100168	37	
45	120	88.100153	22	
45	102	88.100161	30	
45	138	88.100158	27	

$f_c = 98.1 \text{ MHz}$				
Temperature	Voltage	Measured	Frequency Error	BETS-6 Limit
$^{\circ}\text{C}$	V_{AC}	MHz	Hz	Hz
20(reference)	120	98.100131	0	± 1000
5	120	98.100164	33	
5	102	98.100165	34	
5	138	98.100153	22	
45	120	98.100157	26	
45	102	98.100159	28	
45	138	98.100156	25	

$f_c = 107.9 \text{ MHz}$				
Temperature	Voltage	Measured	Frequency Error	BETS-6 Limit
$^{\circ}\text{C}$	V_{AC}	MHz	Hz	Hz
20(reference)	120	107.900131	0	± 1000
5	120	107.900151	20	
5	102	107.900165	34	
5	138	107.900162	31	
45	120	107.900161	30	
45	102	107.900160	29	
45	138	107.900153	22	

4.2 Transmitter Output Power

Serial Number:	2680-1	Test Date:	2023/6/26~2023/7/19
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	24.1~25.5	Relative Humidity: (%)	45.2~52	ATM Pressure: (kPa)	99.9~100.5
----------------------	-----------	------------------------------	---------	------------------------	------------

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/03/31	2024/03/30
BED	Coaxial Attenuator	DLCP-1000W	100002P	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100001	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100002	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).

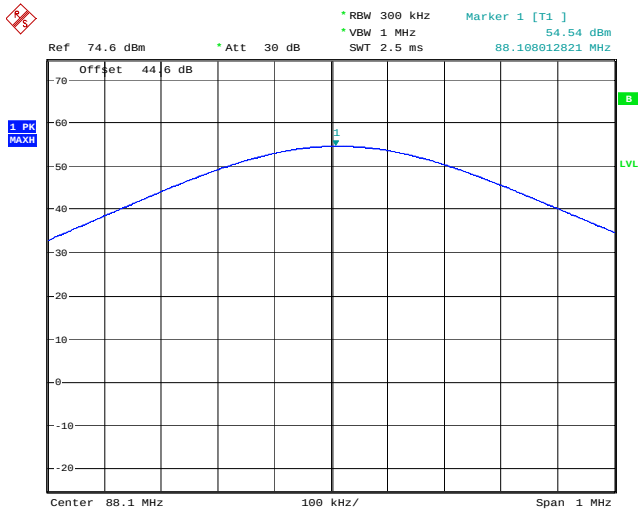
Test Data:

Power Level	Frequency (MHz)	Output Power		Limit (Watts)
		dBm	Watts	
Maximum	88.1	54.54	284	<315
	98.1	54.71	296	<315
	107.9	54.62	290	<315
Minimum	88.1	46.70	46.77	>45
	98.1	46.84	48.31	>45
	107.9	47.33	54.08	>45

Note: The maximum rated power is 300 Watts and minimum rated power is 50 Watts.

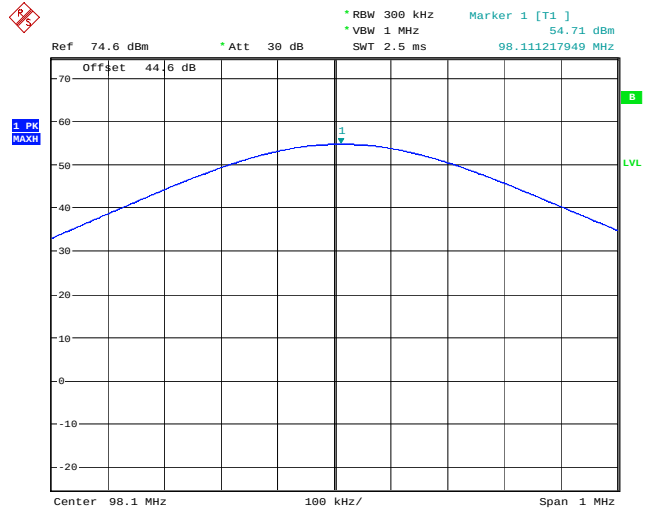
Maximum rated power:

Low Channel



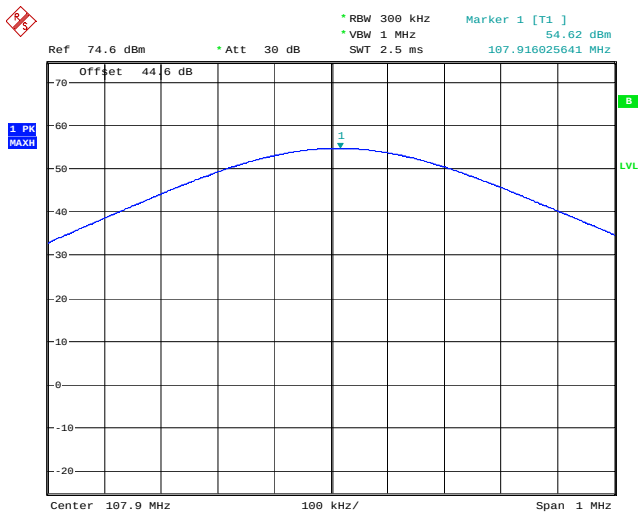
Date: 26.JUN.2023 23:16:27

Middle Channel



Date: 26.JUN.2023 23:15:12

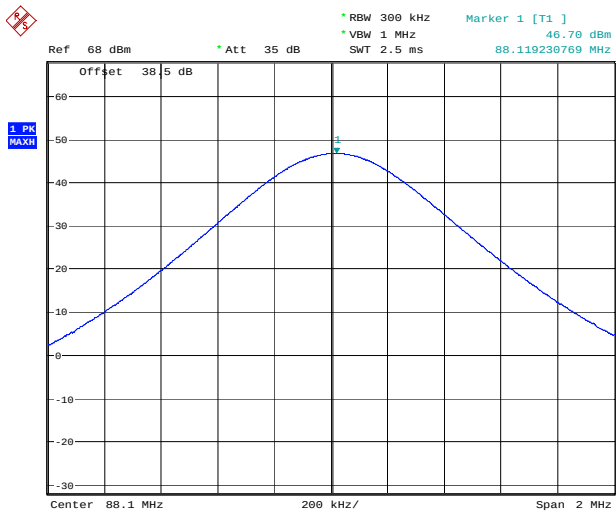
High Channel



Date: 26.JUN.2023 23:09:11

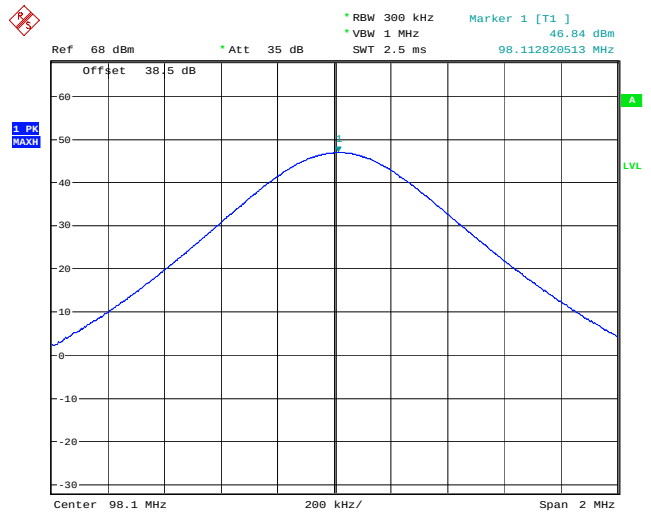
Minimum rated power:

Low Channel



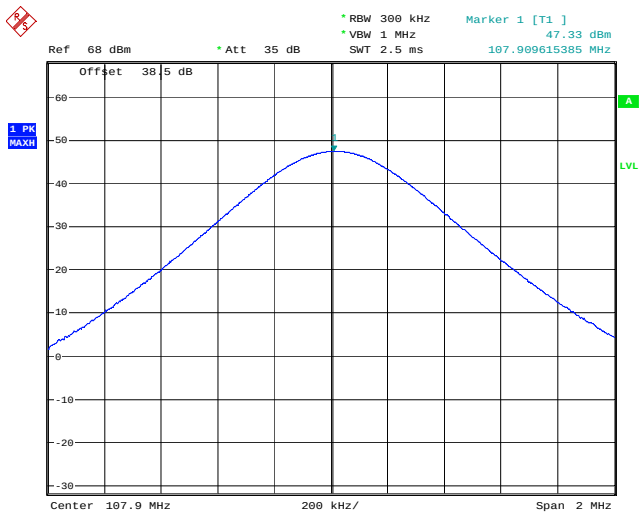
Date: 19.JUL.2023 23:08:01

Middle Channel



Date: 19.JUL.2023 23:10:22

High Channel



Date: 19.JUL.2023 23:11:30

4.3 Occupied Bandwidth & Emission Mask

Serial Number:	2680-1	Test Date:	2023/6/26
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	22.1	Relative Humidity: (%)	52	ATM Pressure: (kPa)	99.9
----------------------	------	------------------------------	----	------------------------	------

Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/03/31	2024/03/30
BED	Coaxial Attenuator	DLCP-1000W	100002P	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100001	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100002	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:

Mode	Test Frequency (MHz)	99% Occupied Bandwidth (kHz)	20 dB Bandwidth (kHz)
Mono	88.1	105.481	114.992
	98.1	105.481	114.127
	107.9	105.481	114.992
Stereo	88.1	105.481	114.992
	98.1	105.481	114.127
	107.9	105.481	114.127

Emission Mask please refer to the plots.

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

$$BW = 2M + 2DK$$

Where M = Baud Rate, D = Deviation and K= Constant

Calculation:

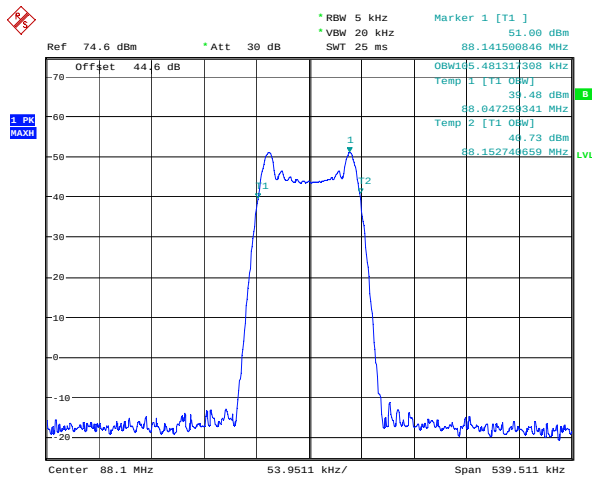
$$M = 15 \text{ kHz}$$

$$\text{Peak Deviation of Carrier (D)} = 75 \text{ kHz}$$

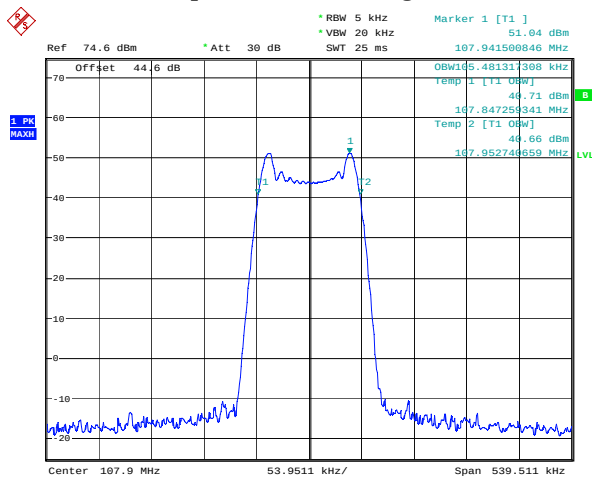
$$K = 1$$

$$BW = 2 * 15 \text{ kHz} + 2 * 75 \text{ kHz} * 1 = 180 \text{ kHz}$$

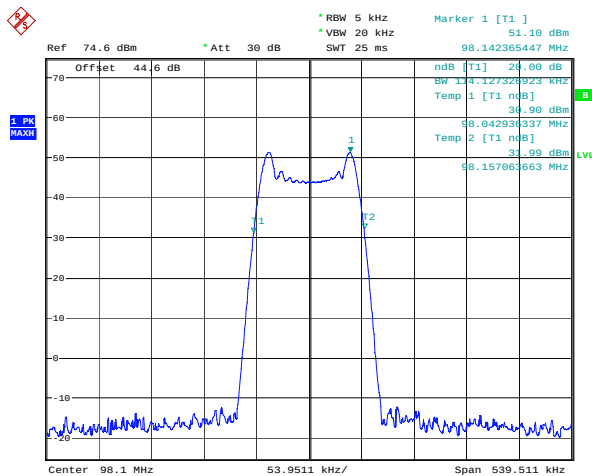
Emission Designator: 180KF3E

Mono:**99% Occupied Bandwidth Low Channel**

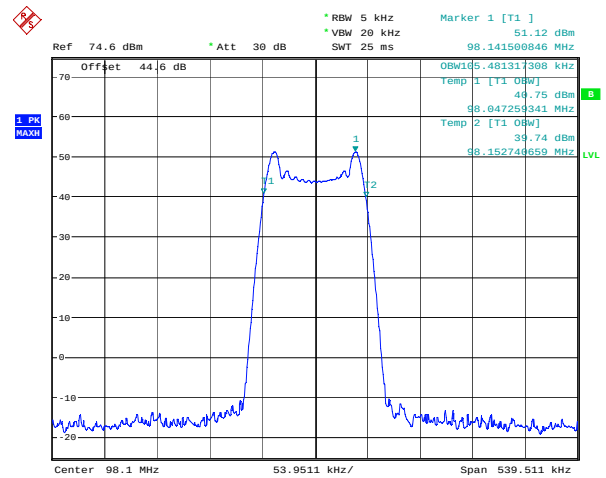
Date: 26 JUN. 2023 23:52:40

99% Occupied Bandwidth High Channel

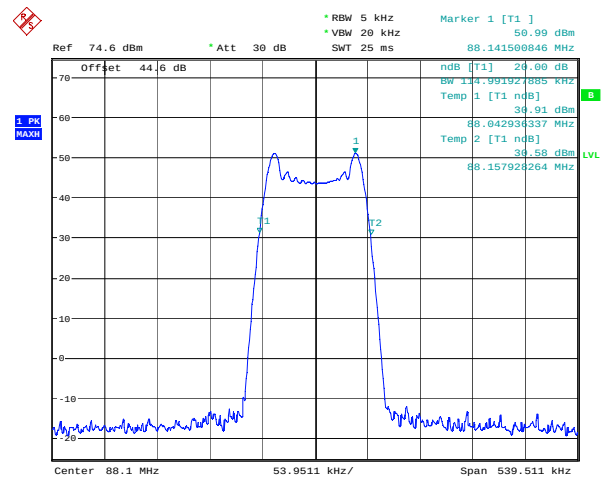
Date: 26 JUN. 2023 23:47:04

20 dB Bandwidth Middle Channel

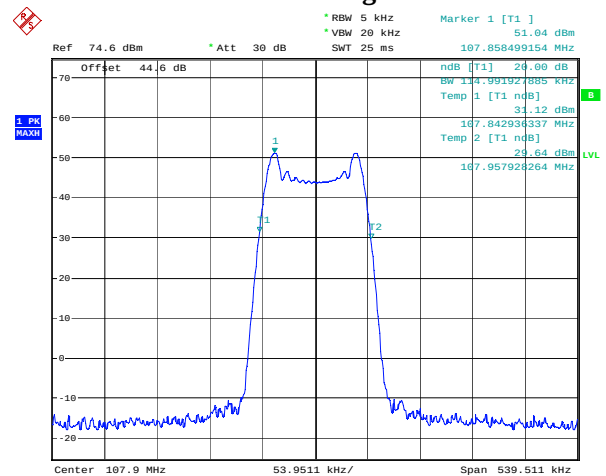
Date: 26 JUN. 2023 23:48:39

99% Occupied Bandwidth Middle Channel

Date: 26 JUN. 2023 23:48:19

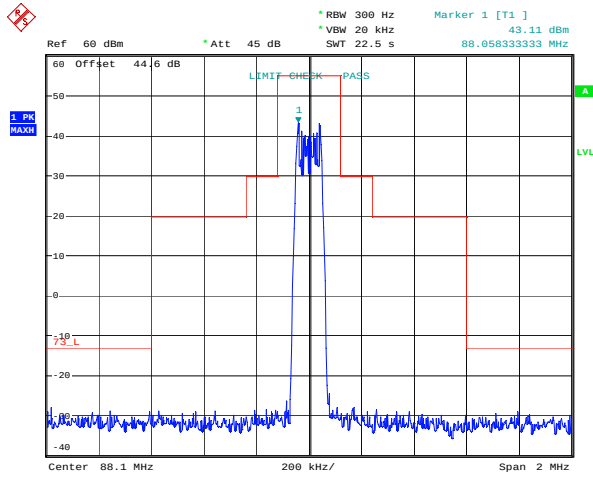
20 dB Bandwidth Low Channel

Date: 26 JUN. 2023 23:52:13

20 dB Bandwidth High Channel

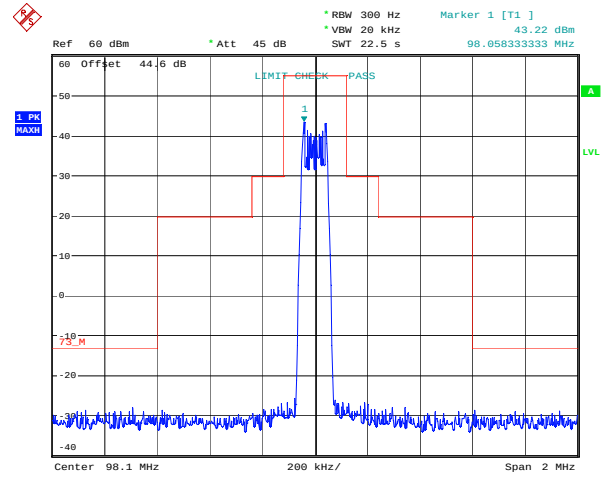
Date: 26 JUN. 2023 23:45:38

Emission Mask Low Channel



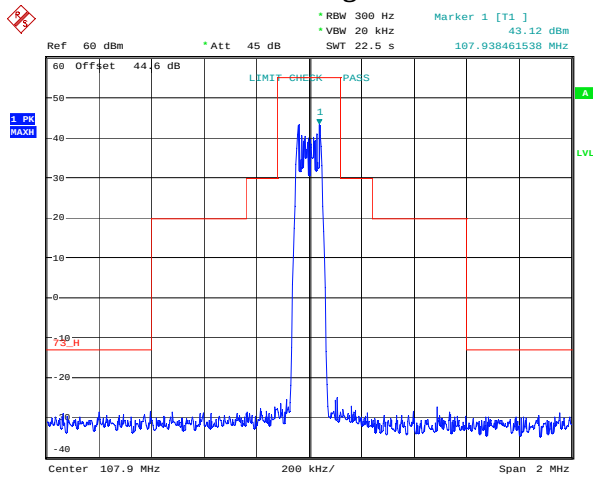
Date: 26.JUN.2023 23:51:49

Emission Mask Middle Channel



Date: 26.JUN.2023 23:50:10

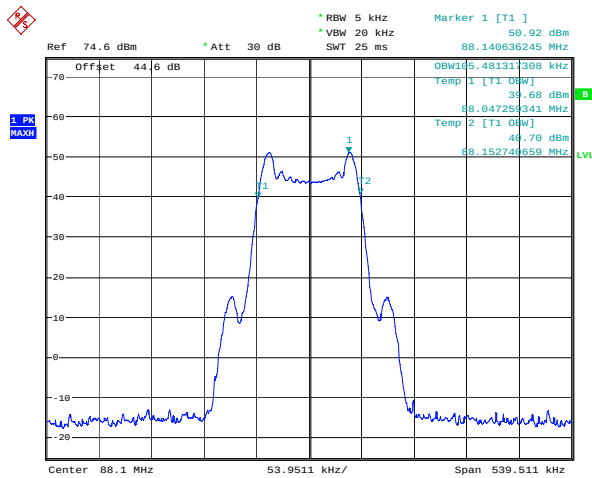
Emission Mask High Channel



Date: 26.JUN.2023 23:43:57

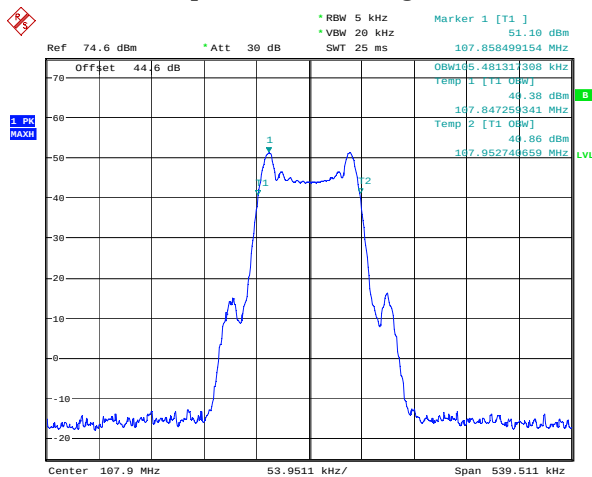
Stereo:

99% Occupied Bandwidth Low Channel



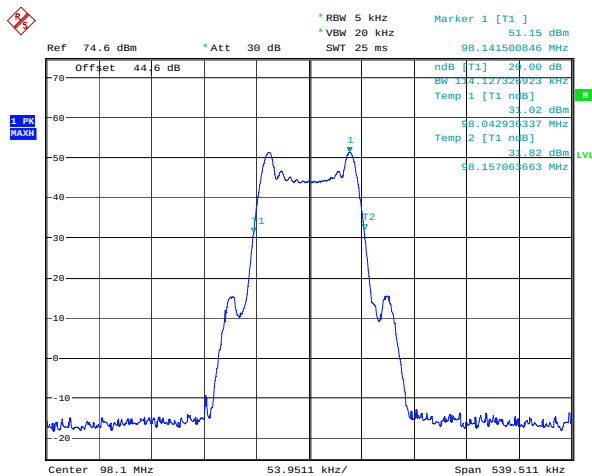
Date: 26 JUN. 2023 23:19:34

99% Occupied Bandwidth High Channel



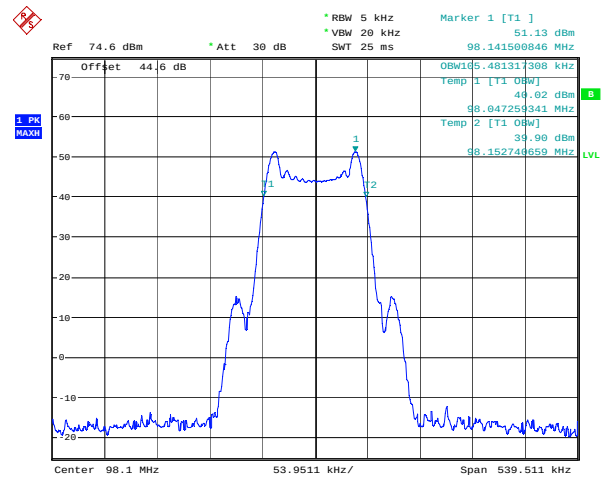
Date: 26 JUN. 2023 23:40:35

20 dB Bandwidth Middle Channel



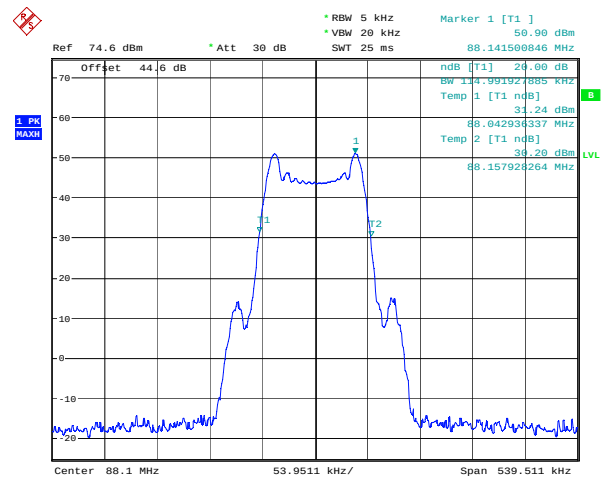
Date: 26 JUN. 2023 23:39:10

99% Occupied Bandwidth Middle Channel



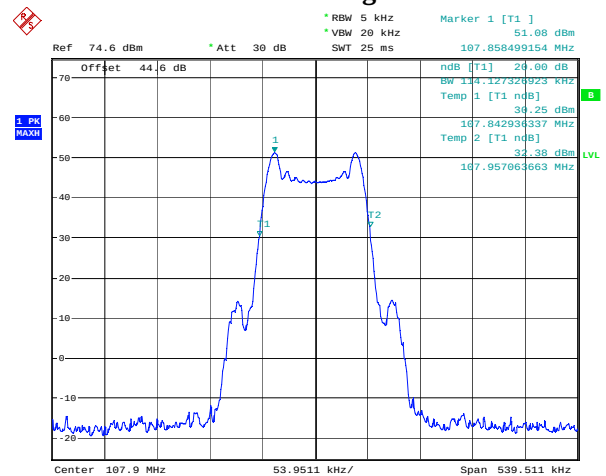
Date: 26 JUN. 2023 23:39:36

20 dB Bandwidth Low Channel



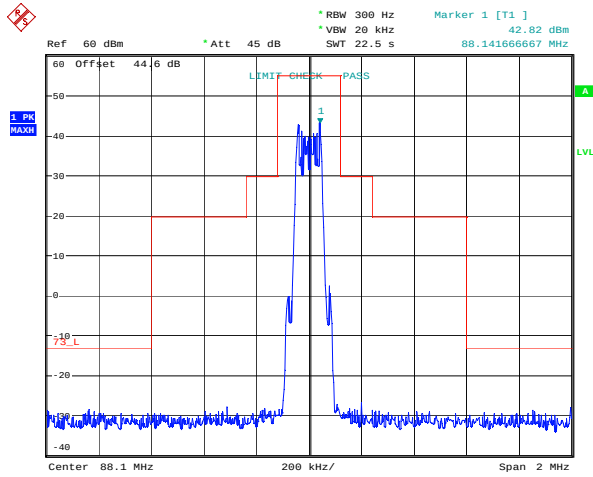
Date: 26 JUN. 2023 23:20:13

20 dB Bandwidth High Channel



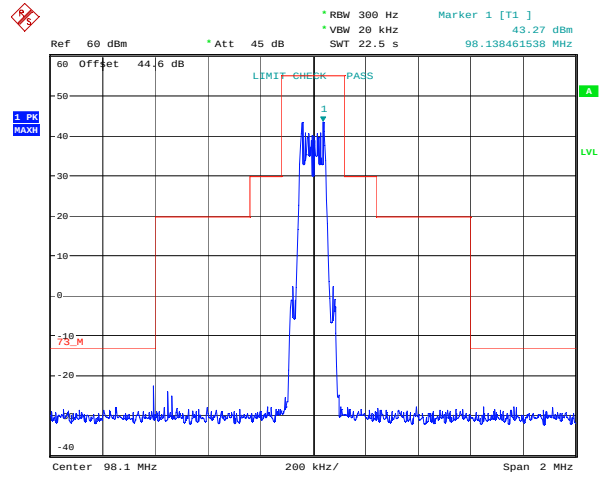
Date: 26 JUN. 2023 23:40:56

Emission Mask Low Channel



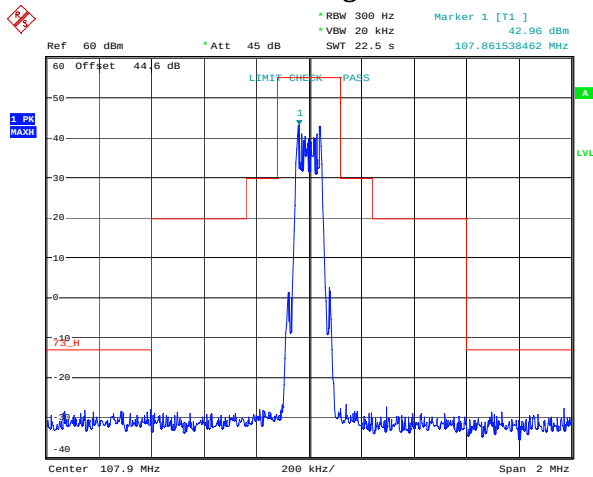
Date: 26 JUN 2023 23:26:09

Emission Mask Middle Channel



Date: 26 JUN 2023 23:38:25

Emission Mask High Channel



Date: 26 JUN 2023 23:42:10

4.4 Spurious Emission at Antenna Terminal

Serial Number:	2680-1	Test Date:	2023/6/2
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	22.1	Relative Humidity: (%)	52	ATM Pressure: (kPa)	99.9
----------------------	------	------------------------------	----	------------------------	------

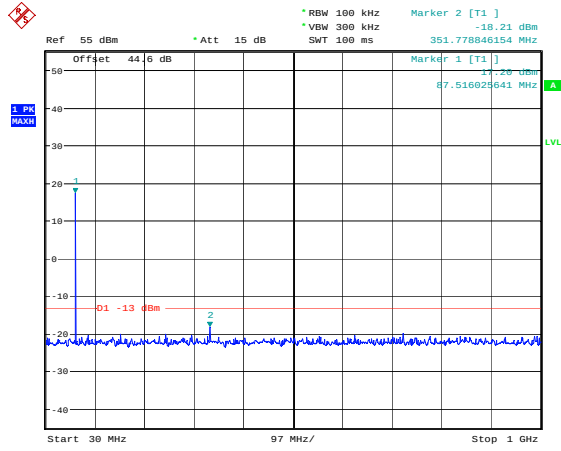
Test Equipment List and Details:

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSU26	100147	2023/03/31	2024/03/30
YINSAIGE	Coaxial Cable	LMR300	NJ0100001	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100002	Each time	N/A
BED	Coaxial Attenuator	DLCP-1000W	100002P	Each time	N/A
Unknown	Broadcast FM Reject Filter	88-108MHz	88108026	Each time	N/A
HP	RF Communications Test Set	8920A	3438A05209	2022/07/15	2023/07/14

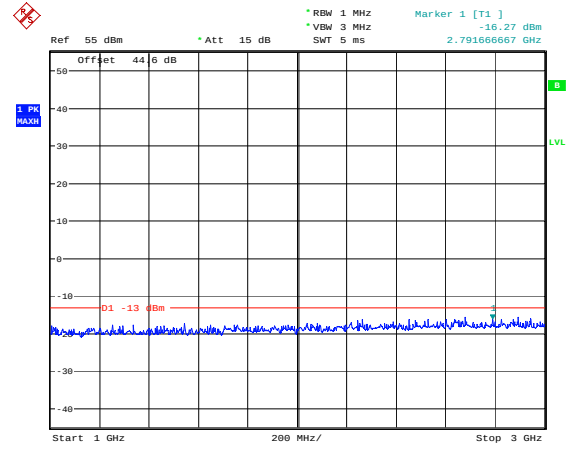
* Statement of Traceability: China Certification ICT Co., Ltd (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data:

Low Channel

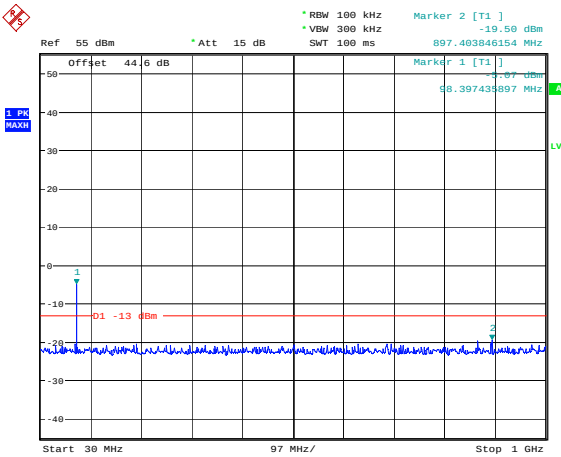


Date: 2.JUN.2023 21:56:57

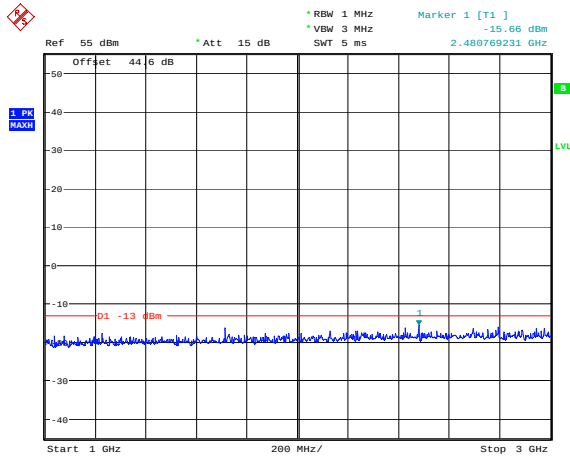


Date: 2.JUN.2023 21:47:57

Middle Channel

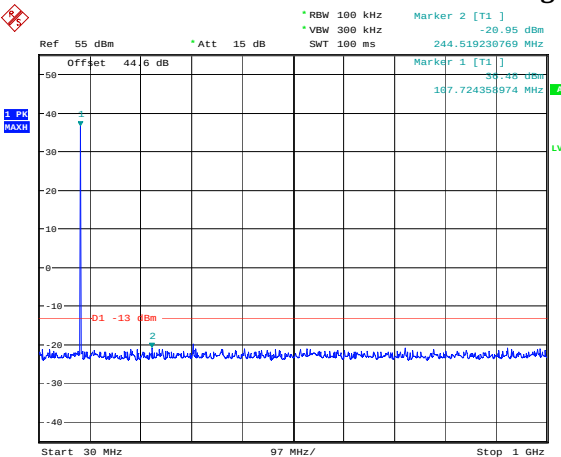


Date: 2.JUN.2023 22:01:13

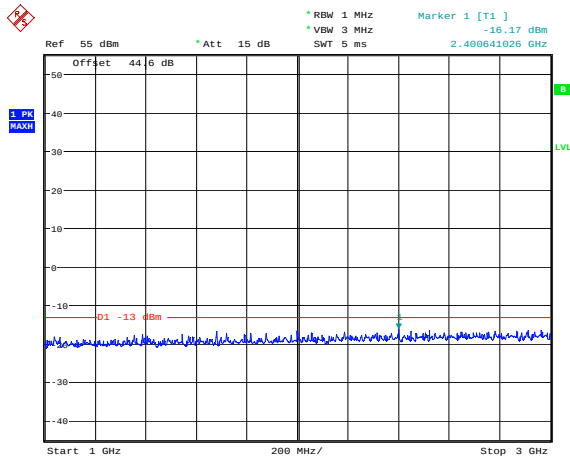


Date: 2.JUN.2023 22:03:04

High Channel



Date: 2.JUN.2023 22:07:47



Date: 2.JUN.2023 22:03:37

4.5 Spurious Radiated Emissions

Serial Number:	2680-1	Test Date:	2023/5/30~2023/6/1
Test Site:	966-1,966-2	Test Mode:	Transmitting
Tester:	Mack Huang, Vic Du	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	21.8~27	Relative Humidity: (%)	56~64	ATM Pressure: (kPa)	99.8~100
----------------------	---------	---------------------------	-------	------------------------	----------

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	2022/07/15	2023/07/14
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0470-02	2022/07/17	2023/07/16
TIMES MICROWAVE	Coaxial Cable	LMR-600-UltraFlex	C-0780-01	2022/07/17	2023/07/16
EMCO	Adjustable Dipole Antenna	3121C	9109-756	N/A	N/A
MICRO-COAX	Coaxial Cable	UFA210B-0-0720-300300	99G1448	2022/07/17	2023/07/16
Agilent	Signal Generator	E8247C	MY43321352	2022/11/18	2023/11/17
ETS-Lindgren	Horn Antenna	3115	9912-5985	2020/10/13	2023/10/12
R&S	Spectrum Analyzer	FSV40	101591	2022/07/15	2023/07/14
MICRO-COAX	Coaxial Cable	UFA210A-1-1200-70U300	217423-008	2022/08/07	2023/08/06
MICRO-COAX	Coaxial Cable	UFA210A-1-2362-300300	235780-001	2022/08/07	2023/08/06
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2022/11/09	2023/11/08
AH	Double Ridge Guide Horn Antenna	SAS-571	1396	2021/10/18	2024/10/17

* 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:

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: 88.1 MHz								
176.200	H	17.56	-63.35	0.00	0.25	-63.60	-13.00	50.60
176.200	V	17.24	-60.75	0.00	0.25	-61.00	-13.00	48.00
264.300	H	17.99	-62.39	0.00	0.31	-62.70	-13.00	49.70
264.300	V	17.35	-61.88	0.00	0.31	-62.19	-13.00	49.19
352.400	H	26.37	-52.23	0.00	0.36	-52.59	-13.00	39.59
352.400	V	25.05	-51.46	0.00	0.36	-51.82	-13.00	38.82
440.500	H	45.30	-31.74	0.00	0.42	-32.16	-13.00	19.16
440.500	V	40.02	-33.92	0.00	0.42	-34.34	-13.00	21.34
528.600	H	28.94	-46.33	0.00	0.44	-46.77	-13.00	33.77
528.600	V	34.29	-37.33	0.00	0.44	-37.77	-13.00	24.77
616.000	H	18.91	-54.86	0.00	0.48	-55.34	-13.00	42.34
616.000	V	19.61	-51.83	0.00	0.48	-52.31	-13.00	39.31
704.000	H	19.80	-53.44	0.00	0.55	-53.99	-13.00	40.99
704.000	V	19.82	-50.01	0.00	0.55	-50.56	-13.00	37.56
792.000	H	19.76	-51.70	0.00	0.61	-52.31	-13.00	39.31
792.000	V	19.09	-48.82	0.00	0.61	-49.43	-13.00	36.43
880.000	H	20.16	-49.12	0.00	0.59	-49.71	-13.00	36.71
880.000	V	21.40	-45.05	0.00	0.59	-45.64	-13.00	32.64
968.000	H	20.07	-47.03	0.00	0.59	-47.62	-13.00	34.62
968.000	V	20.19	-44.61	0.00	0.59	-45.20	-13.00	32.20
Frequency: 98.1 MHz								
196.200	H	18.50	-62.80	0.00	0.26	-63.06	-13.00	50.06
196.200	V	19.02	-59.06	0.00	0.26	-59.32	-13.00	46.32
294.300	H	17.54	-62.02	0.00	0.33	-62.35	-13.00	49.35
294.300	V	17.86	-59.97	0.00	0.33	-60.30	-13.00	47.30
392.400	H	22.57	-55.42	0.00	0.38	-55.80	-13.00	42.80
392.400	V	22.67	-53.03	0.00	0.38	-53.41	-13.00	40.41
490.500	H	42.13	-33.89	0.00	0.44	-34.33	-13.00	21.33
490.500	V	46.33	-25.63	0.00	0.44	-26.07	-13.00	13.07
588.600	H	19.53	-54.55	0.00	0.47	-55.02	-13.00	42.02
588.600	V	21.20	-50.51	0.00	0.47	-50.98	-13.00	37.98
686.700	H	19.36	-54.03	0.00	0.53	-54.56	-13.00	41.56
686.700	V	18.96	-51.20	0.00	0.53	-51.73	-13.00	38.73
784.000	H	19.12	-52.50	0.00	0.56	-53.06	-13.00	40.06
784.000	V	19.69	-48.40	0.00	0.56	-48.96	-13.00	35.96
882.000	H	19.35	-49.88	0.00	0.59	-50.47	-13.00	37.47
882.000	V	19.20	-47.22	0.00	0.59	-47.81	-13.00	34.81
980.000	H	19.70	-47.11	0.00	0.65	-47.76	-13.00	34.76
980.000	V	19.71	-44.85	0.00	0.65	-45.50	-13.00	32.50

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:107.9 MHz								
215.800	H	19.77	-61.40	0.00	0.27	-61.67	-13.00	48.67
215.800	V	20.05	-58.57	0.00	0.27	-58.84	-13.00	45.84
323.700	H	18.26	-60.78	0.00	0.34	-61.12	-13.00	48.12
323.700	V	17.89	-59.19	0.00	0.34	-59.53	-13.00	46.53
431.600	H	31.91	-45.32	0.00	0.40	-45.72	-13.00	32.72
431.600	V	27.87	-46.43	0.00	0.40	-46.83	-13.00	33.83
539.500	H	25.43	-49.62	0.00	0.46	-50.08	-13.00	37.08
539.500	V	30.62	-41.02	0.00	0.46	-41.48	-13.00	28.48
647.400	H	19.77	-53.83	0.00	0.52	-54.35	-13.00	41.35
647.400	V	18.76	-52.11	0.00	0.52	-52.63	-13.00	39.63
755.300	H	19.14	-53.06	0.00	0.52	-53.58	-13.00	40.58
755.300	V	19.76	-48.95	0.00	0.52	-49.47	-13.00	36.47
863.200	H	22.12	-47.58	0.00	0.57	-48.15	-13.00	35.15
863.200	V	25.17	-41.55	0.00	0.57	-42.12	-13.00	29.12
972.000	H	20.53	-46.48	0.00	0.59	-47.07	-13.00	34.07
972.000	V	20.40	-44.32	0.00	0.59	-44.91	-13.00	31.91
1079.000	H	40.54	-61.55	7.32	0.66	-54.89	-13.00	41.89
1079.000	V	37.35	-65.17	7.32	0.66	-58.51	-13.00	45.51

4.6 Modulation Characteristic

Serial Number:	2680-1	Test Date:	2023/6/2
Test Site:	RF	Test Mode:	Transmitting
Tester:	Arthur Su	Test Result:	Pass

Environmental Conditions:

Temperature: (°C)	22.1	Relative Humidity: (%)	52	ATM Pressure: (kPa)	99.9
----------------------	------	------------------------------	----	------------------------	------

Test Equipment List and Details:

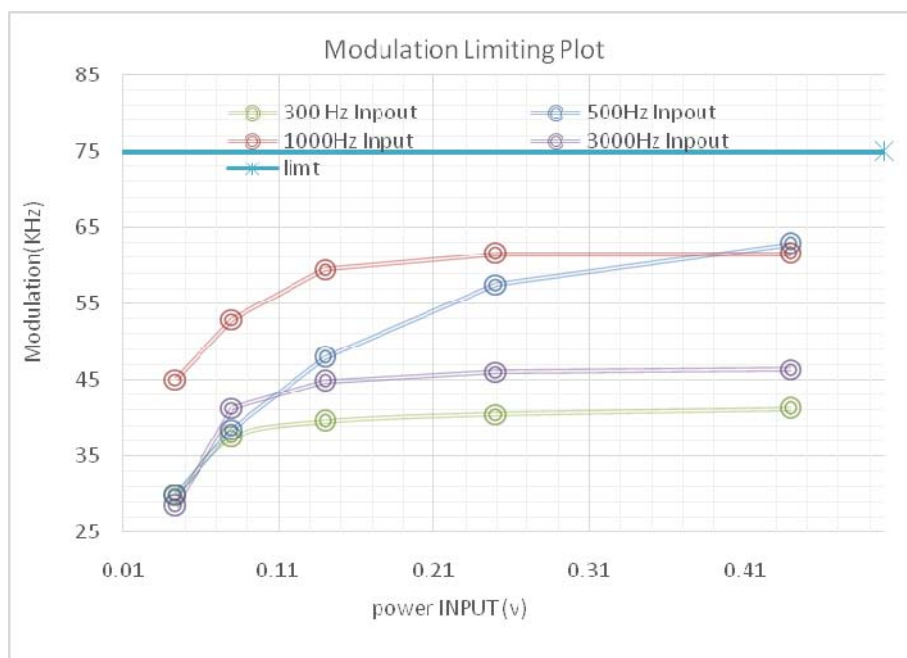
Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
HP	RF Communications Test Set	8920A	3438A05209	2022/07/15	2023/07/14
BED	Coaxial Attenuator	DLCP-1000W	100002P	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100001	Each time	N/A
YINSAIGE	Coaxial Cable	LMR300	NJ0100002	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:

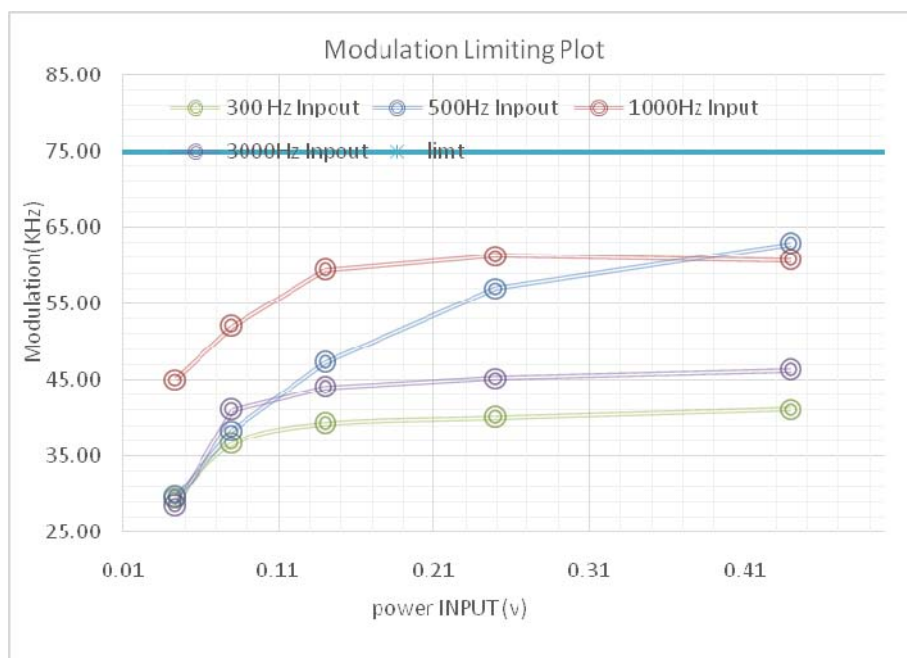
Modulation Limiting Peak MAX +:

Carrier Frequency: 98.1 MHz		
Power Input(Vpp)	Modulation (kHz)	Audio Frequency
0.044	29.73	300Hz
0.08	37.38	
0.14	39.52	
0.25	40.47	
0.44	41.17	
0.044	29.95	500Hz
0.08	38.47	
0.14	47.93	
0.25	57.52	
0.44	62.85	
0.044	45.00	1000Hz
0.08	52.94	
0.14	59.47	
0.25	61.51	
0.44	61.52	
0.044	28.38	3000Hz
0.08	41.22	
0.14	44.81	
0.25	46.01	
0.44	46.36	



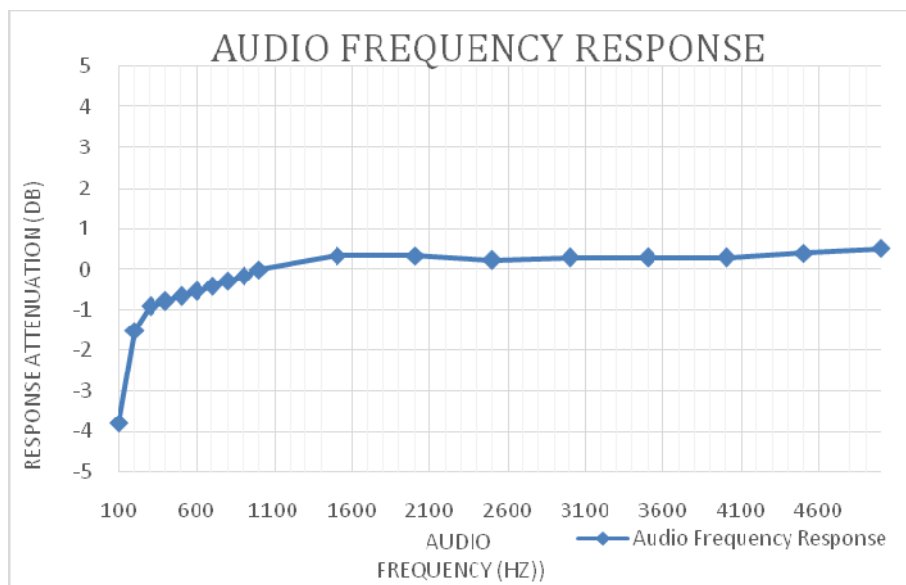
Peak MAX :-

Carrier Frequency: 98.1 MHz		
Power Input(Vpp)	Modulation (kHz)	Audio Frequency
0.044	29.44	300Hz
0.08	36.54	
0.14	39.23	
0.25	40.06	
0.44	41.12	
0.044	29.50	500Hz
0.08	38.32	
0.14	47.28	
0.25	57.01	
0.44	62.80	
0.044	45.00	1000Hz
0.08	51.98	
0.14	59.42	
0.25	61.26	
0.44	60.73	
0.044	28.38	3000Hz
0.08	41.02	
0.14	43.92	
0.25	45.19	
0.44	46.26	



Audio Frequency Response:

Carrier Frequency: 98.1 MHz	
Audio Frequency (Hz)	Response Attenuation(dB)
100	-3.79
200	-1.51
300	-0.92
400	-0.79
500	-0.66
600	-0.54
700	-0.42
800	-0.29
900	-0.18
1000	0.00
1500	0.34
2000	0.34
2500	0.23
3000	0.28
3500	0.28
4000	0.28
4500	0.40
5000	0.51



5 MAXIMUM PERMISSIBLE EXPOSURE (MPE)

5.1 Applicable Standard

According to FCC 1.1310, 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

Limits for Maximum Permissible Exposure (MPE)

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

f = frequency in MHz;

* = Plane-wave equivalent power density;

According to RSS-102 § 4Table 6, RF Field Strength Limits for Devices Used by the General Public (Controlled Environment)

Table 6: RF Field Strength Limits for Controlled Use Devices (Controlled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²³	170	180	-	Instantaneous*
0.1-10	-	1.6/ f	-	6**
1.29-10	193/ f ^{0.5}	-	-	6**
10-20	61.4	0.163	10	6
20-48	129.8/ f ^{0.25}	0.3444/ f ^{0.25}	44.72/ f ^{0.5}	6
48-100	49.33	0.1309	6.455	6
100-6000	15.60 f ^{0.25}	0.04138 f ^{0.25}	0.6455 f ^{0.5}	6
6000-15000	137	0.364	50	6
15000-150000	137	0.364	50	616000/ f ^{1.2}
150000-300000	0.354 f ^{0.5}	9.40 x 10 ⁻⁴ f ^{0.5}	3.33 x 10 ⁻⁴ f	616000/ f ^{1.2}
Note: f is frequency in MHz. *Based on nerve stimulation (NS). ** Based on specific absorption rate (SAR).				

5.2 MPE Calculation

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

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

Where: S = power density (in appropriate units, e.g. mW/cm²);

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

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

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

5.3 MPE Results

For FCC:

Frequency (MHz)	Antenna Gain		Maximum Average output power including Tune-up Tolerance (W)	Operation Duty Cycle (%)	Evaluation Distance (cm)	Power Density (mW/cm ²)	Power Density Limit (mW/cm ²)
	(dBi)	(numeric)					
88-108	0	1.0	300	100	200	0.5968	1

Note: the maximum power including Tune-up Tolerance is 300 Watts.

Result: The device meet FCC MPE at 200 cm distance

For IC:

Frequency (MHz)	Antenna Gain		Maximum Average output power including Tune-up Tolerance (W)	Operation Duty Cycle (%)	Evaluation Distance (cm)	Power Density (W/m ²)	Power Density Limit (W/m ²)
	(dBi)	(numeric)					
88-108	0	1.0	300	100	200	5.968	6.455

Result: The device meet ISED MPE at 200 cm distance

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