TEST REPORT

Applicant Name :	Kirisun Communication Co., Ltd.
Address :	3rd Floor, Building A, Tongfang Information Habour, No.11 Langshan Road Nanshan District, Shenzhen 518057 China
Report Number :	SZNS220415-14493E-RF-00
FCC ID:	Q5EDP68002

Test Standard (s)

FCC PART 90

Sample Description

Product Type:	DMR Two Way Radio
Model No.:	DP680
Multiple Model(s) No.:	N/A
Trade Mark:	Kirisun
Date Received:	2022/04/15
Report Date:	2022/06/13

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Black Ding
EMC Engineer

Approved By:

Candy Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
Shenzhen Accurate Technology Co., Ltd. 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 an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	400-470MHz
Rated Transmit Power	4Watts(High), 1Watt(Low)
Channel separation	12.5kHz
Modulation Technique	4FSK/FM
Antenna Specification*	2dBi (provided by the applicant)
Voltage Range	DC 7.4V from battery or DC12V from adapter
Sample serial number	SZNS220415-14493E-RF-S1 (Assigned by ATC)
Sample/EUT Status	Good condition
Adapter information	Model: FJ-SW126K1201000DU Input: 100-240V~ 50/60Hz 0.4A mAX Output: DC 12.0V, 1000mA

Objective

This test report is in accordance with Part 2, and Part 90 of the Federal Communication Commissions rules.

Test Methodology

All tests and measurements indicated in this document were performed in accordance with the Code of federal Regulations Title 47 Part 2, Sub-part J as well as the following individual parts:

Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-E, ANSI C63.26-2015.

All emissions measurement was performed at Shenzhen Accurate Technology Co., Ltd. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Audio Frequency Response		0.1dB
Low Pass Filter Response		1.2dB
Modulation Limiting		1%
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

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

Test Facility

The Test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Justification

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

Equipment Modifications

No modification was made to the EUT.

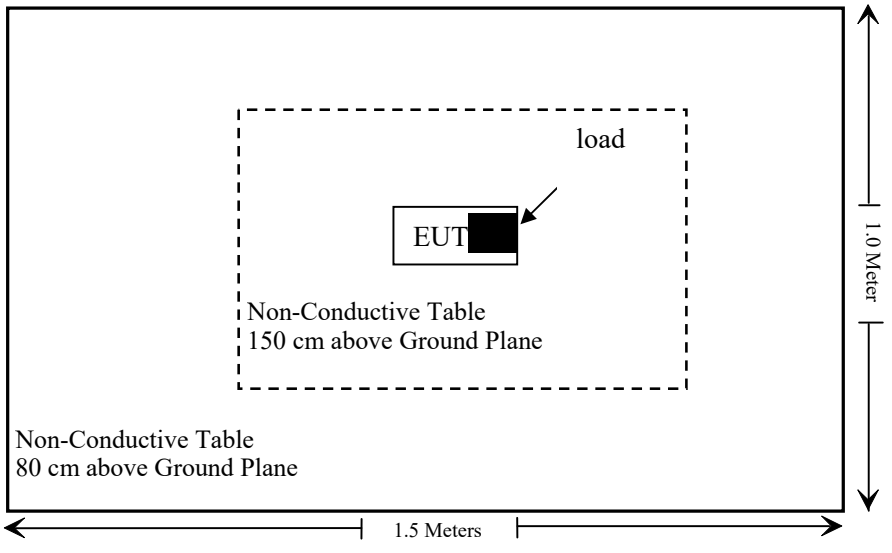
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Unknown	Load	Unknown	Load

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§1.1307, §2.1093	RF Exposure (SAR)	Compliant
§2.1046; §90.205	RF Output Power	Compliant
§2.1047; §90.207	Modulation Characteristic	Compliant
§2.1049; §90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliant
§2.1051;§90.210	Spurious Emission at Antenna Terminal	Compliant
§2.1053;§90.210	Spurious Radiated Emissions	Compliant
§2.1055;§90.213	Frequency Stability	Compliant
§90.214	Transient Frequency Behavior	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	Pass filter	NHP-600+	F-03-EM131	2021/11/28	2022/11/27
Schwarzbeck	Bilog Antenna	VULB9163	9163-194	2020/01/05	2023/01/04
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-655	2020/01/05	2023/01/04
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Unknown	RFCoaxialCable	No.16	N200	2021/12/14	2022/12/13
Agilent	Signal Generator	N5183A	MY51040755	2021/12/13	2022/12/12

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
SPECTRUM ANALYZER	Rohde & Schwarz	FSU26	200982	2021/07/06	2022/07/05
HP Agilent	RF Communication test set	8920B	3325U00859	2021/12/14	2022/12/13
Aeroflex/Weinschel	30dB Attenuator (Input 250W/Output 50W)	58-30-33	PS467	2021/12/14	2022/12/13
Gongwen	Temp. & Humid. Chamber	HSD-500	109	2021/10/14	2022/10/13
Unknown	Pass filter	NHP-600+	F-03-EM131	2021/11/28	2022/11/27
R&S	SPECTRUM ANALYZER	FSIQ26	837405/023	NCR	NCR
Mini-Circuits	Power Splitter	DC-18000MHz	SF10944151S	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.31	RF-01	Each time	/
Unknown	RF Coaxial Cable	No.32	RF-02	Each time	/
Fluke	Digital Multimeter	287	19000011	2022/02/21	2023/02/20
instek	DC Power Supply	GPS-3030DD	EM832096	NCR	NCR

* Statement of Traceability: Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §1.1307&§2.1093 - RF EXPOSURE

Applicable Standard

FCC§1.1310 and §2.1093.

Test Result

Compliance, please refer to the SAR report: CR22040023-20A.

FCC §2.1046 & §90.205 - RF OUTPUT POWER

Applicable Standard

FCC §2.1046 and §90.205

Test Procedure

Conducted RF Output Power:

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

Spectrum Analyzer Setting:

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

Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang on 2022-05-12.

Test Mode: Transmitting

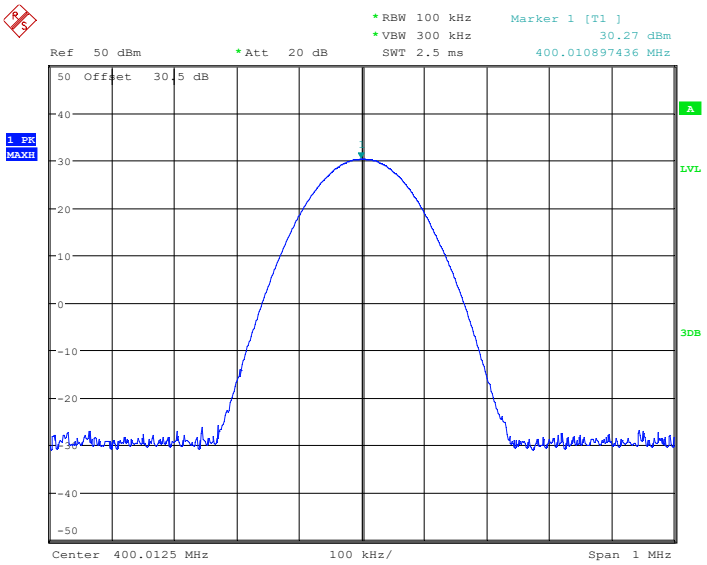
Test Result: *Pass. Please refer to following table and plots.*

Mode	Frequency Spacing (kHz)	Frequency (MHz)	Power level	Output (dBm)	Output Power (W)	Note
Digital	12.5	400.0125	L	30.27	1.06	FCC 90
			H	36.48	4.45	
	12.5	429.9875	L	29.51	0.89	
			H	35.96	3.94	
	12.5	469.9875	L	30.21	1.05	
			H	36.11	4.08	
Analog	12.5	400.0125	L	30.31	1.07	
			H	36.19	4.16	
	12.5	429.9875	L	29.68	0.93	
			H	35.91	3.90	
	12.5	469.9875	L	30.17	1.04	
			H	36.07	4.05	

Rated high power: 1W (0.8W~1.2W)
Rated low power: 4W (3.2W~4.8W)

Digital**:**

Frequency 400.0125 MHz, Low Power



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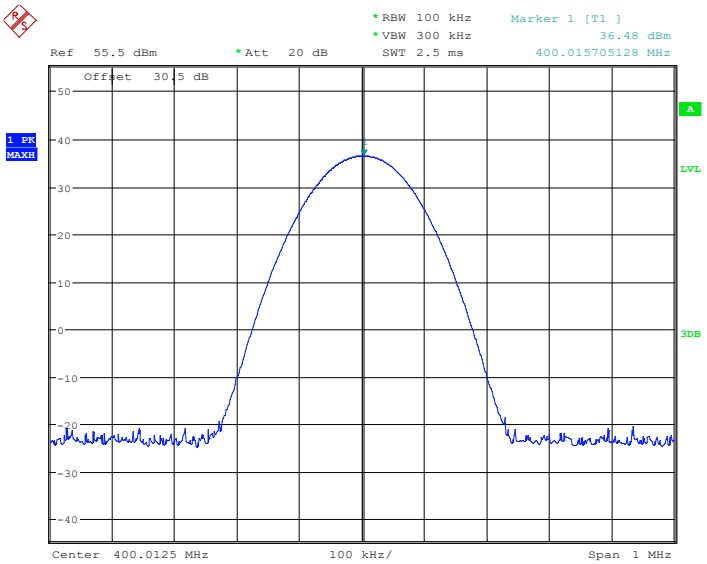
Frequency 400.0125 MHz, High Power



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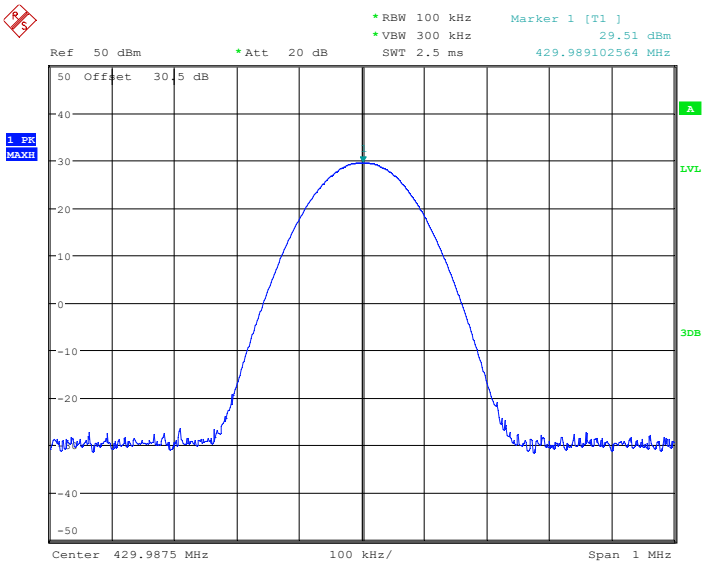
Frequency 429.9875MHz, Low Power



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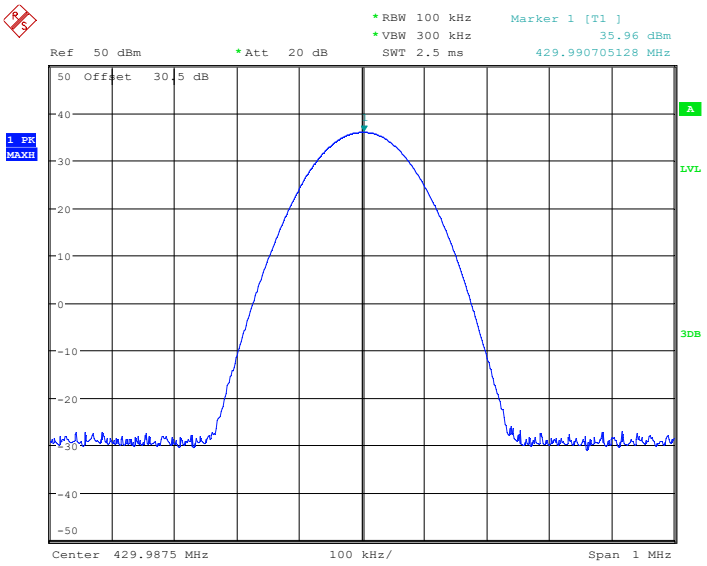
Frequency 429.9875MHz, High Power



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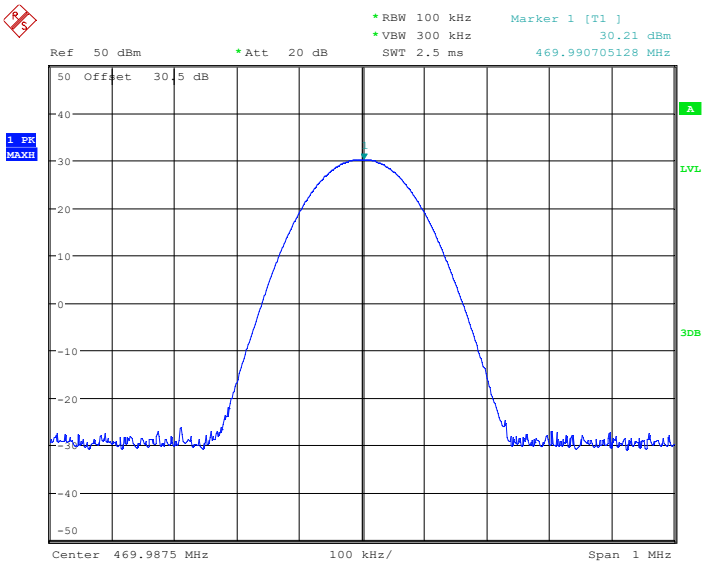
Frequency 469.9875 MHz, Low Power



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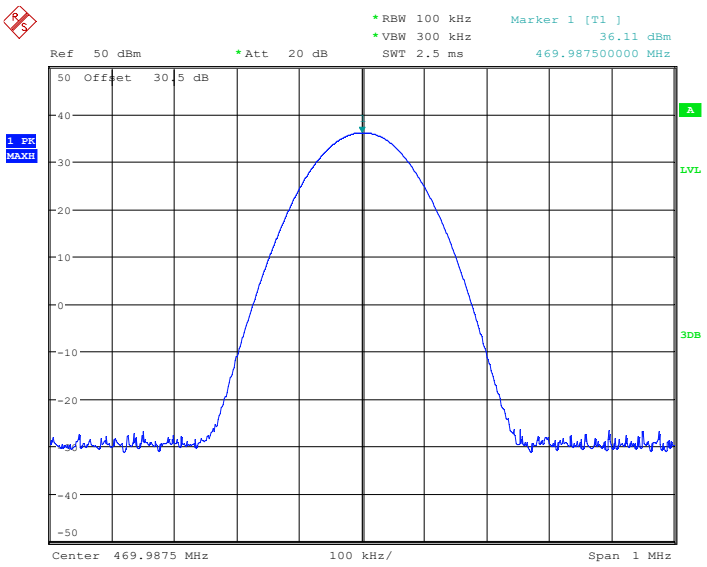
Frequency 469.9875 MHz, High Power



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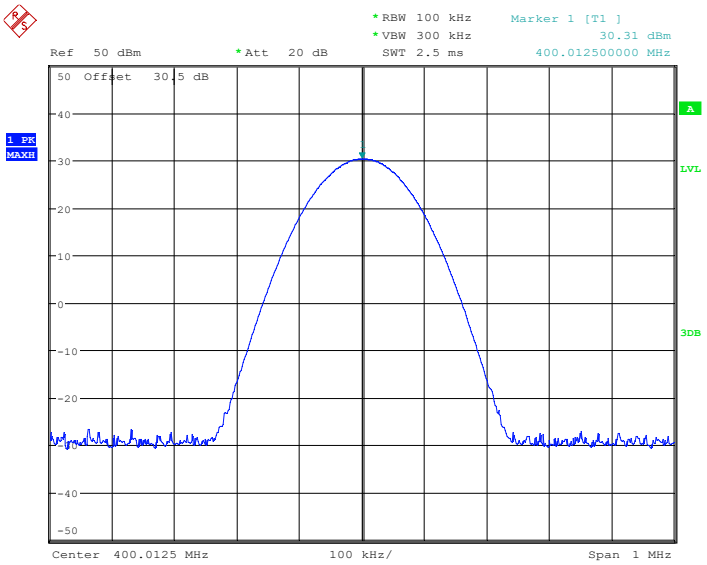
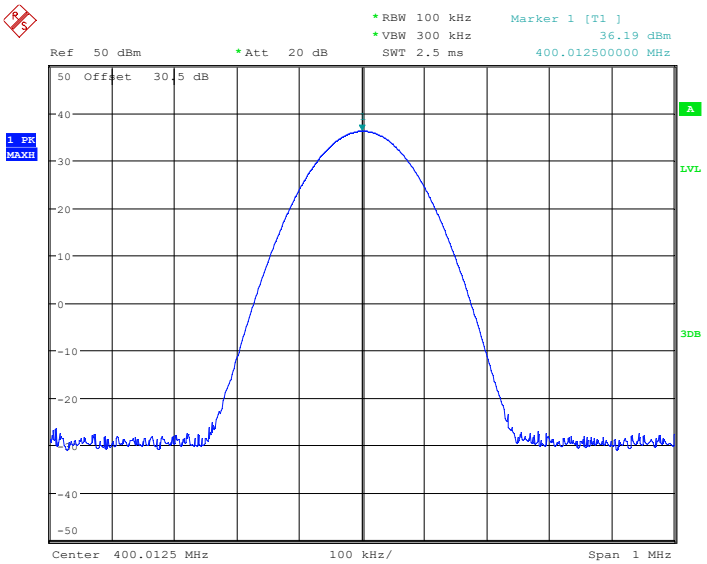
Analog

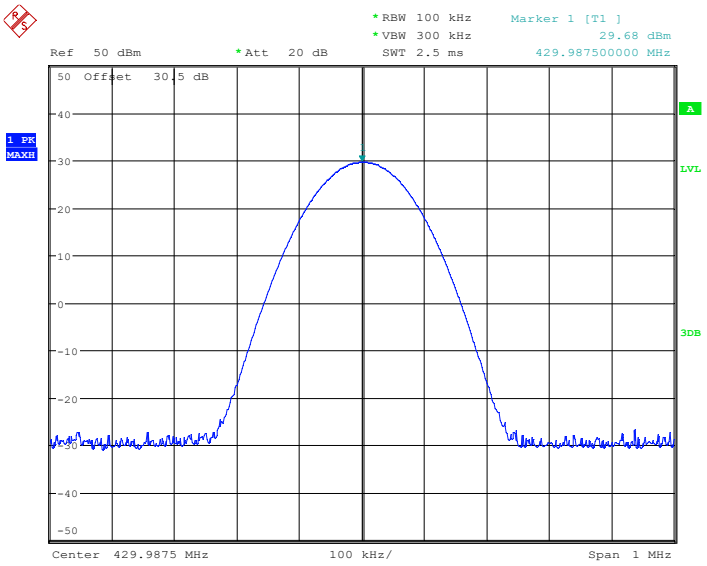
Frequency 400.0125 MHz, Low Power



Frequency 400.0125 MHz, High Power



Frequency 429.9875MHz, Low Power



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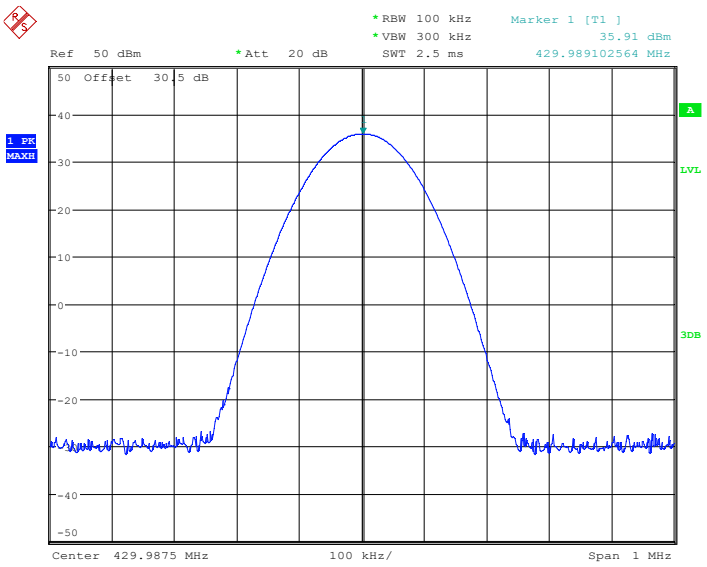
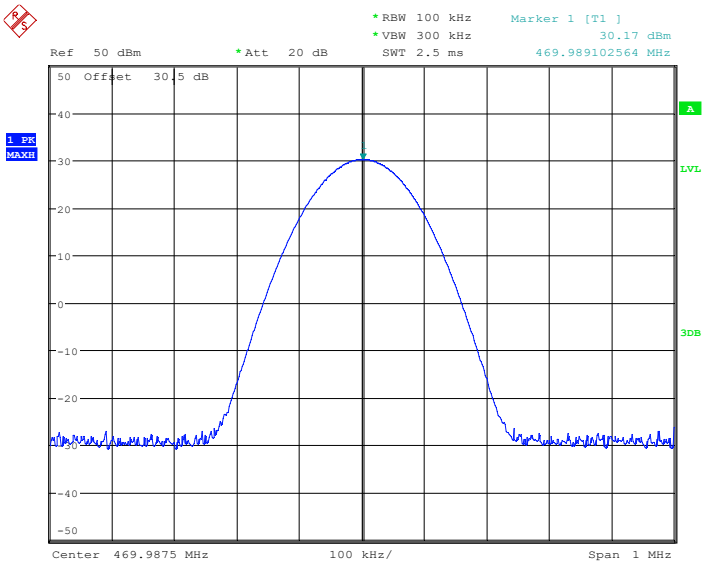
Frequency 429.9875MHz, High Power



Date: 12.MAY.2022 20:46:24

Frequency 469.9875 MHz, Low Power



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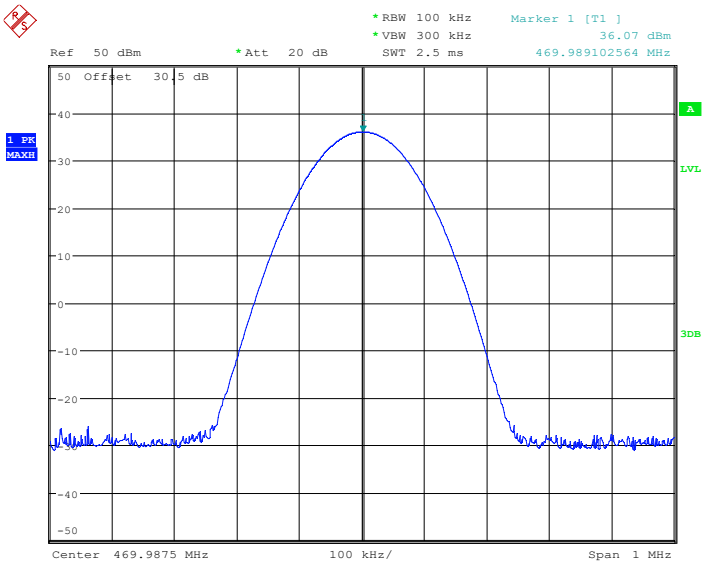
Frequency 469.9875 MHz, High Power



Date: 12.MAY.2022 20:46:52

FCC §2.1047 & §90.207 - MODULATION CHARACTERISTIC

Applicable Standard

FCC§2.1047 and §90.207:

(a) Equipment which utilizes voice modulated communication shall show the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz. for equipment which is required to have a low pass filter, the frequency response of the filter, or all of the circuitry installed between the modulation limited and the modulated stage shall be supplied.
(b) Equipment which employs modulation limiting, a curve showing the percentage of modulation versus the modulation input voltage shall be supplied.

Test Procedure

Test Method: ANSI C63.26-2015

Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang from 2022-05-12 to 2022-05-13.

Test Mode: Transmitting

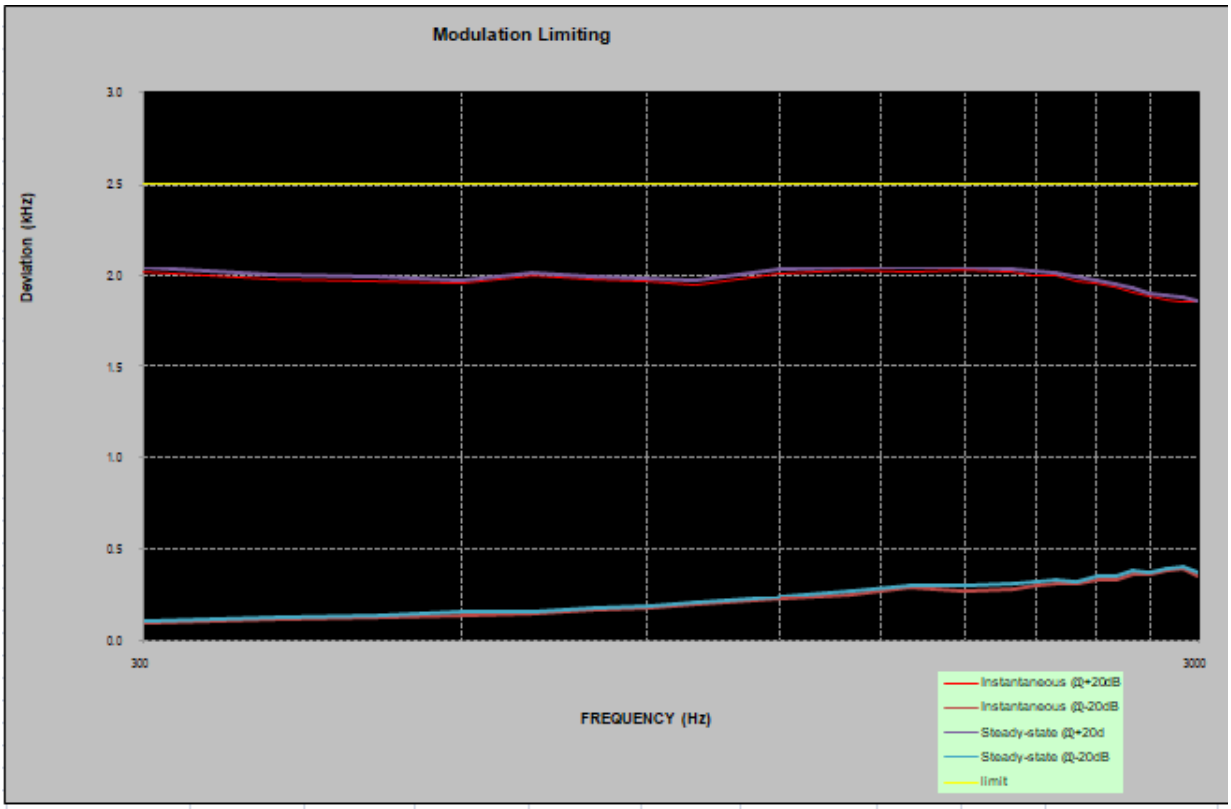
Test Result: *Pass. Please refer to the following tables and plots.*

Analog Modulation:

MODULATION LIMITING

Carrier Frequency: 429.9875MHz, Channel Separation=12.5 kHz

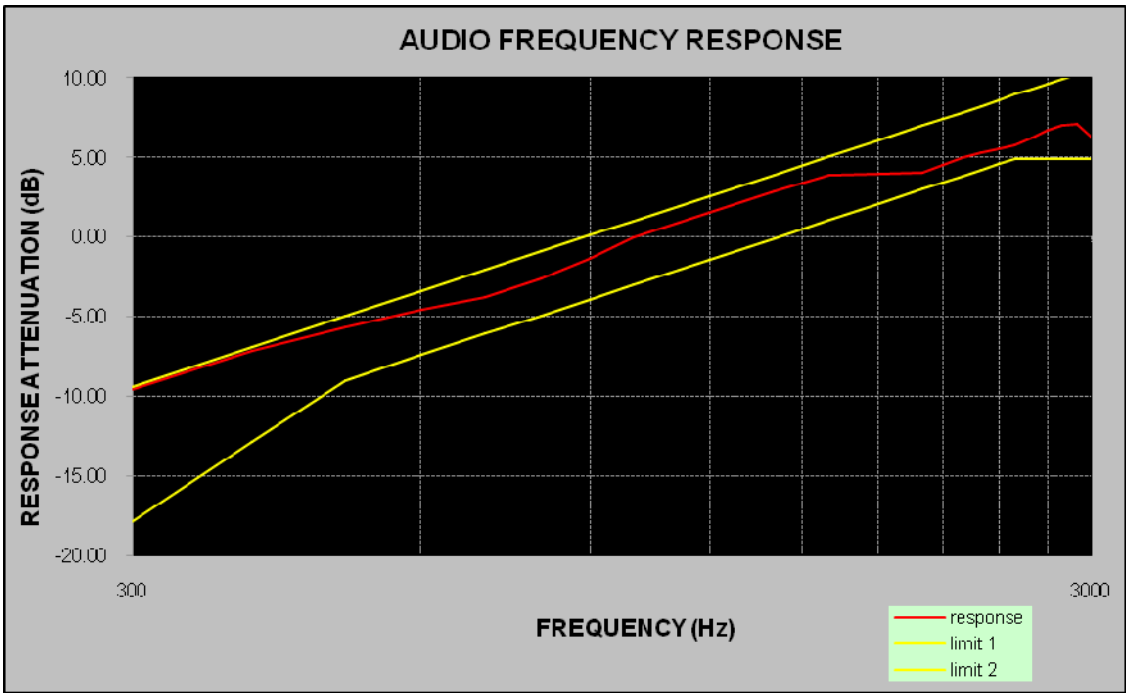
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	2.020	0.096	2.040	0.104	2.500
400	1.983	0.111	2.001	0.123	2.500
500	1.970	0.120	1.991	0.132	2.500
600	1.959	0.134	1.978	0.151	2.500
700	1.996	0.141	2.012	0.154	2.500
800	1.976	0.162	1.995	0.173	2.500
900	1.964	0.178	1.984	0.189	2.500
1000	1.952	0.192	1.974	0.205	2.500
1200	2.013	0.226	2.032	0.238	2.500
1400	2.027	0.252	2.041	0.274	2.500
1600	2.023	0.286	2.041	0.304	2.500
1800	2.029	0.270	2.045	0.295	2.500
2000	2.019	0.282	2.035	0.306	2.500
2100	2.001	0.297	2.021	0.321	2.500
2200	1.999	0.308	2.014	0.328	2.500
2300	1.970	0.313	1.995	0.324	2.500
2400	1.958	0.327	1.972	0.347	2.500
2500	1.935	0.335	1.954	0.354	2.500
2600	1.911	0.360	1.935	0.386	2.500
2700	1.882	0.362	1.903	0.376	2.500
2800	1.869	0.381	1.886	0.391	2.500
2900	1.858	0.392	1.879	0.405	2.500
3000	1.852	0.350	1.863	0.369	2.500


Modulation Limiting
Deviation (kHz)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
3000
FREQUENCY (Hz)
Instantaneous @+20dB
Instantaneous @-20dB
Steady-state @+20d
Steady-state @-20dB
limit

Audio Frequency Response

Carrier Frequency: 429.9875MHz, Channel Separation=12.5 kHz

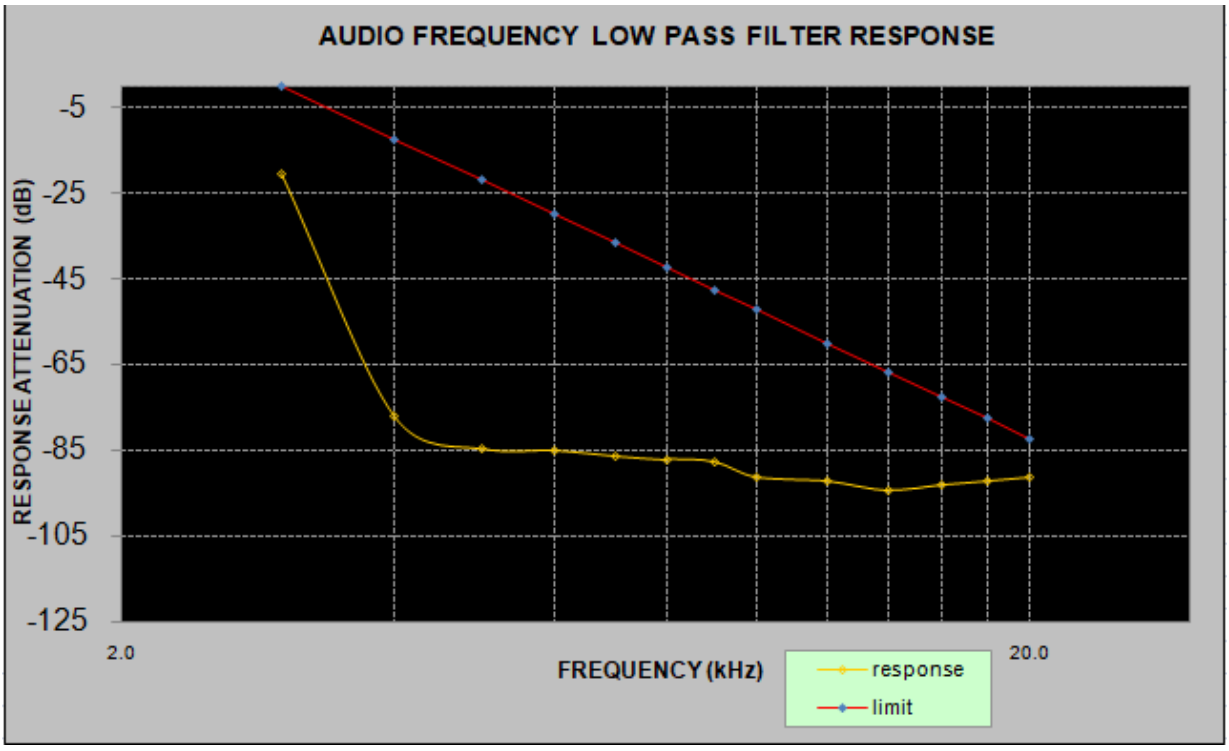
Audio Frequency (Hz)	Response Attenuation (dB)
300	-9.58
400	-7.13
500	-5.65
600	-4.61
700	-3.77
800	-2.59
900	-1.35
1000	0.00
1200	1.54
1400	2.89
1600	3.90
1800	3.98
2000	4.01
2100	4.49
2200	4.95
2300	5.27
2400	5.51
2500	5.75
2600	6.23
2700	6.70
2800	7.04
2900	7.11
3000	6.29


AUDIO FREQUENCY RESPONSE
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
RESPONSE ATTENUATION (dB)
300
3000
FREQUENCY (Hz)
response
limit 1
limit 2

Audio frequency lows pass filter response

Carrier Frequency: 429.9875MHz, Channel Separation=12.5 kHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0.0	/
3.0	-20.8	0.0
4.0	-77.3	-12.5
5.0	-84.9	-22.2
6.0	-85.3	-30.1
7.0	-86.4	-36.8
8.0	-87.2	-42.6
9.0	-87.8	-47.7
10.0	-91.2	-52.3
12.0	-92.3	-60.2
14.0	-94.4	-66.9
16.0	-93.2	-72.7
18.0	-92.1	-77.8
20.0	-91.2	-82.5



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

Applicable Standard

FCC §2.1049 and §90.210

Emission Mask D - 12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1) For any frequency removed from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0, 0dB.

2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least 7.27 (f_d –2.88 kHz) dB.

3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

Test Procedure

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

The resolution bandwidth of the spectrum analyzer was set at 100 Hz and the spectrum was recorded in the frequency band ±50 kHz from the carrier frequency.

Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang on 2022-05-12.

Test mode: transimitting

Test Result: *Pass. Please refer to the following tables and plots.*

Modulation	Channel Separation (kHz)	Frequency (MHz)	Power Level	99% Occupied Bandwidth (kHz)	26 dB Emissions Bandwidth (kHz)
Analog	12.5	400.0125	L	7.612	10.176
	12.5		H	7.612	10.176
	12.5	429.9875	L	7.612	10.176
	12.5		H	7.612	10.176
	12.5	469.9875	L	5.208	10.176
	12.5		H	5.208	10.144
Digital	12.5	400.0125	L	6.891	9.375
	12.5		H	6.971	9.215
	12.5	429.9875	L	6.971	9.215
	12.5		H	7.131	9.455
	12.5	469.9875	L	6.891	9.038
	12.5		H	7.051	9.439

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

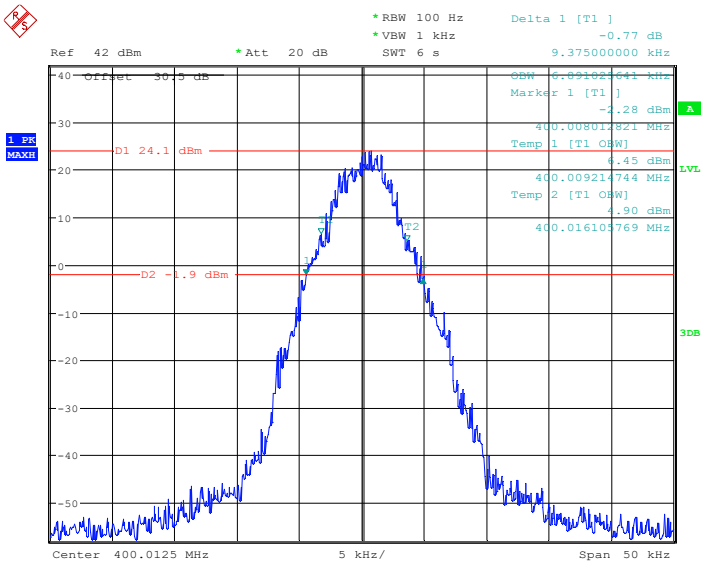
Emission Designator Per CFR 47 §2.201& §2.202&, Bn = 2M + 2D

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

For Digital Mode (Channel Spacing: 12.5 kHz)
Emission Designator 7K60F1D and 7K60F1E
The 99% energy rule (title 47CFR 2.1049) was used for digital mode. It basically states that 99% of the modulation energy falls within X kHz, in this case, 7.60 kHz. The emission mask was obtained from 47CFR 90.210(d).
F1D and F1E portion of the designator indicates digital information.
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

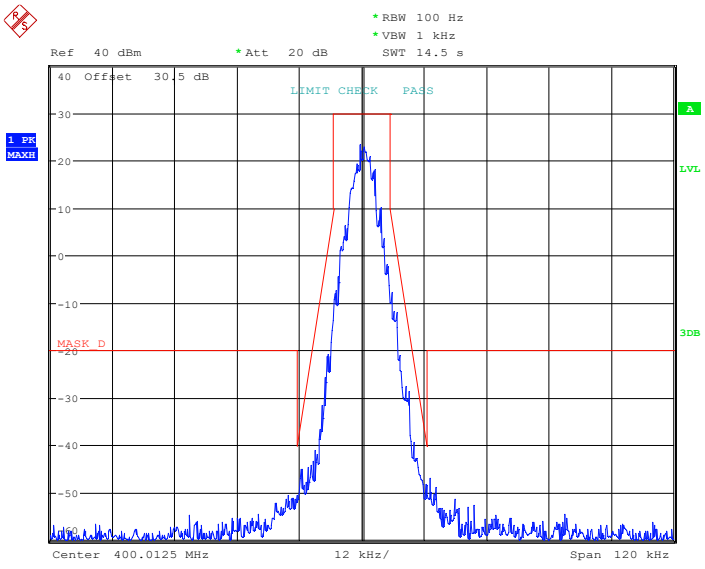
Digital**:**

Frequency 400.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



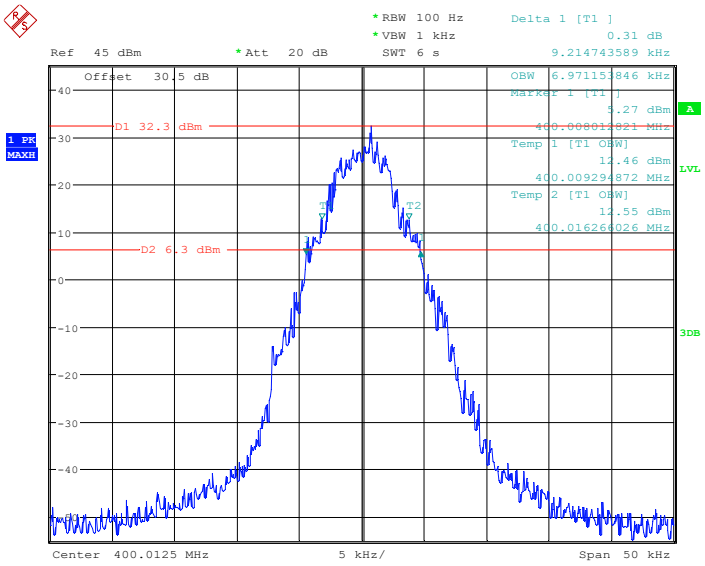
Date: 12.MAY.2022 19:45:12

Frequency 400.0125 MHz: Emission Mask D, Low Power



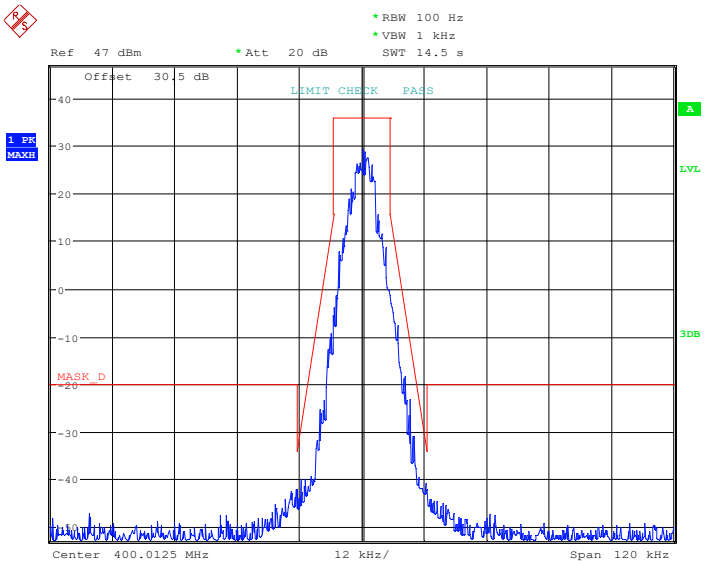
Date: 12.MAY.2022 21:42:45

Frequency 400.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



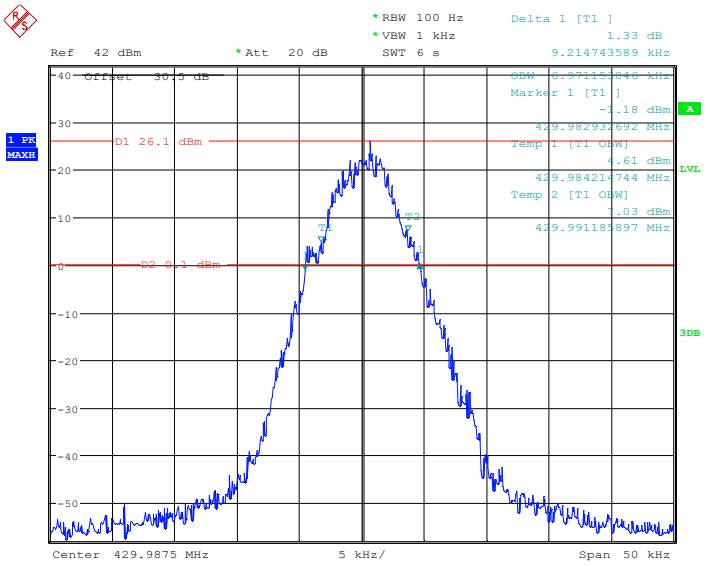
Date: 12.MAY.2022 19:42:33

Frequency 400.0125 MHz: Emission Mask D, High Power



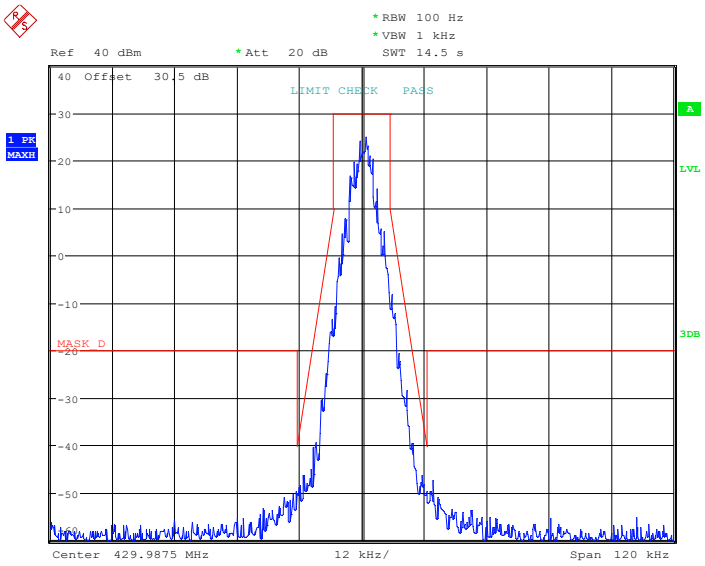
Date: 12.MAY.2022 21:12:08

Frequency 429.9875MHz: 99% Occupied & 26 dB Bandwidth, Low Power



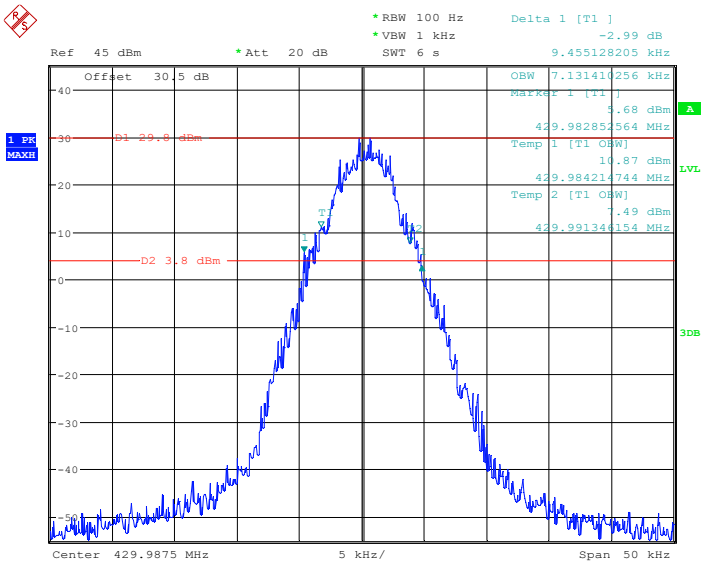
Date: 12.MAY.2022 19:58:09

Frequency 429.9875MHz: Emission Mask D, Low Power



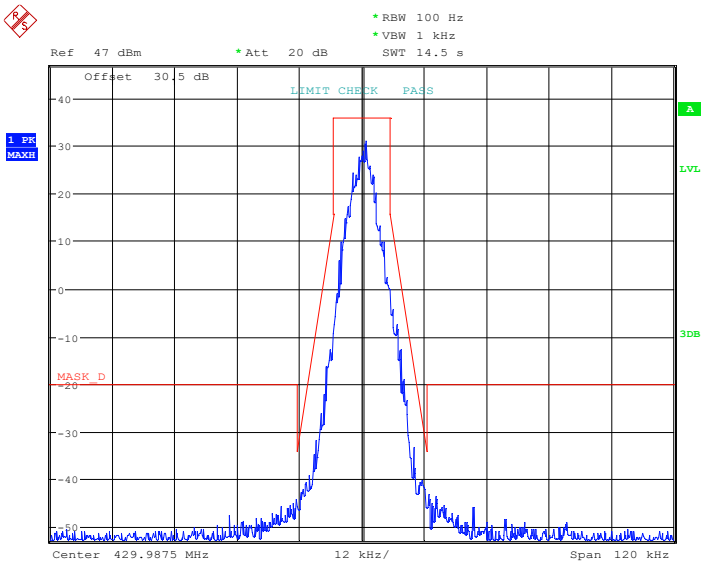
Date: 12.MAY.2022 21:38:50

Frequency 429.9875MHz: 99% Occupied & 26 dB Bandwidth, High Power



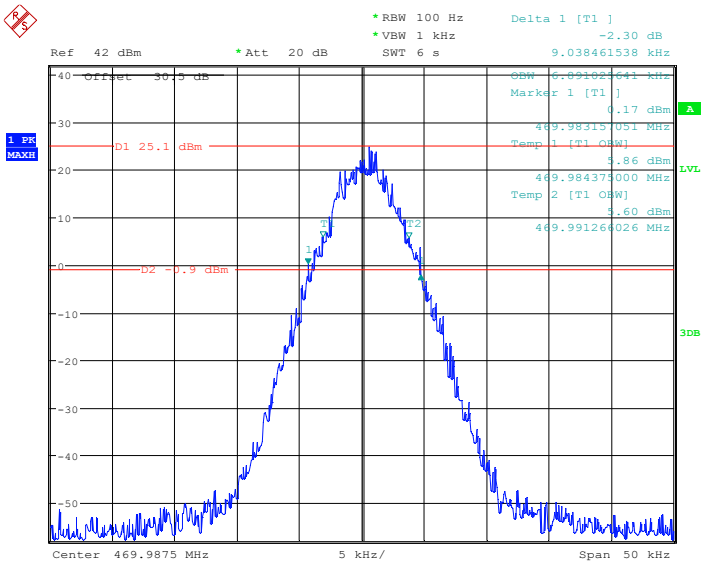
Date: 12.MAY.2022 19:54:32

Frequency 429.9875MHz: Emission Mask D, High Power



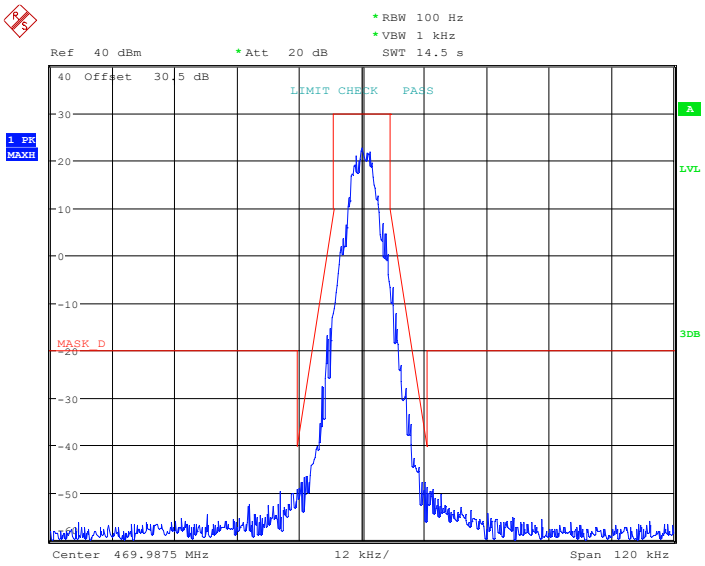
Date: 12.MAY.2022 21:17:46

Frequency 469.9875 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



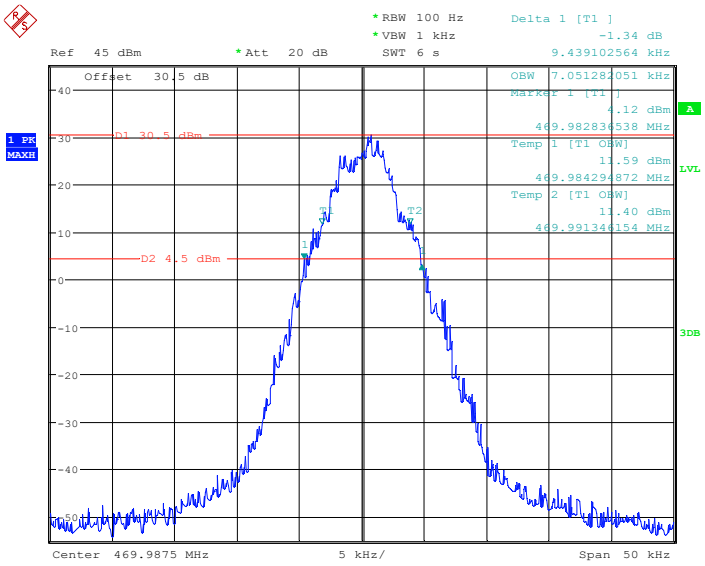
Date: 12.MAY.2022 20:00:07

Frequency 469.9875 MHz: Emission Mask D, Low Power



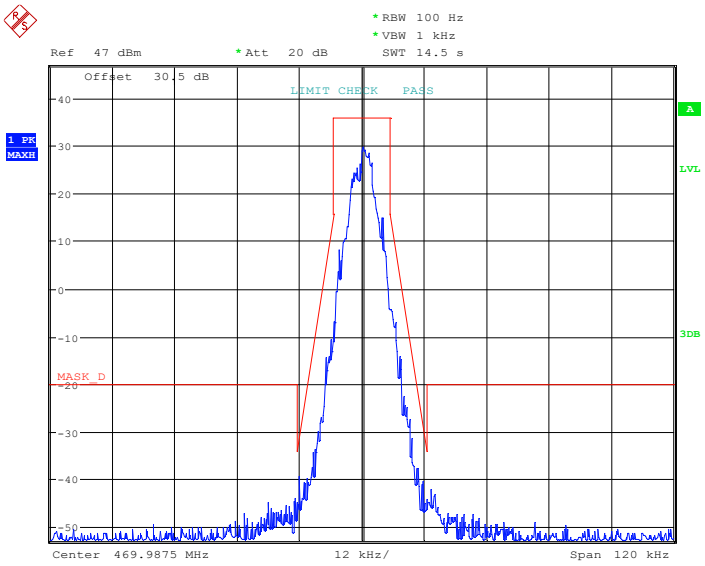
Date: 12.MAY.2022 21:35:20

Frequency 469.9875 MHz: 99% Occupied & 26 dB Bandwidth, High Power



Date: 12.MAY.2022 20:03:43

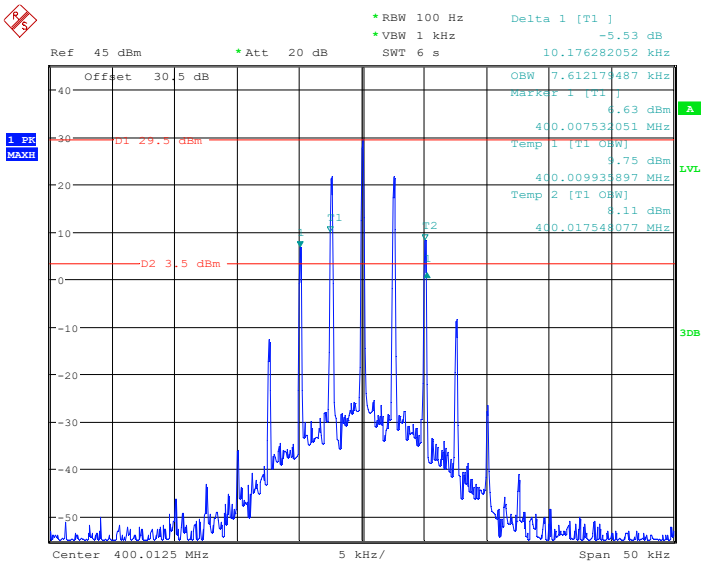
Frequency 469.9875 MHz: Emission Mask D, High Power



Date: 12.MAY.2022 21:20:00

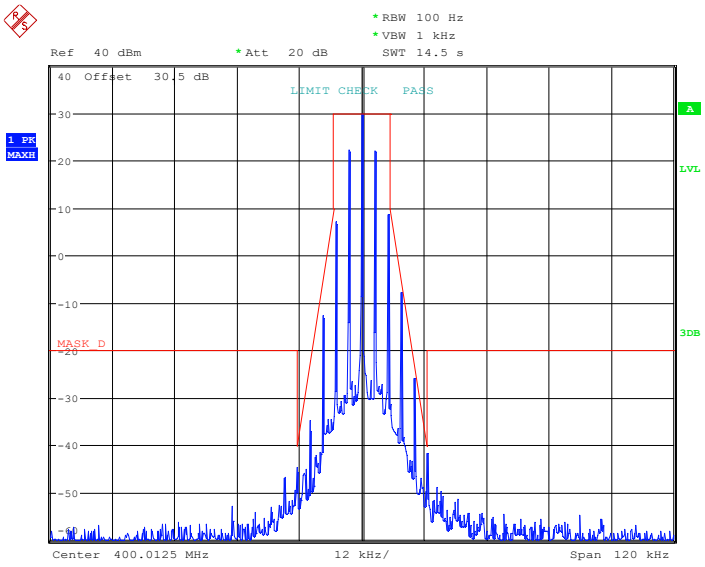
Analog

Frequency 400.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



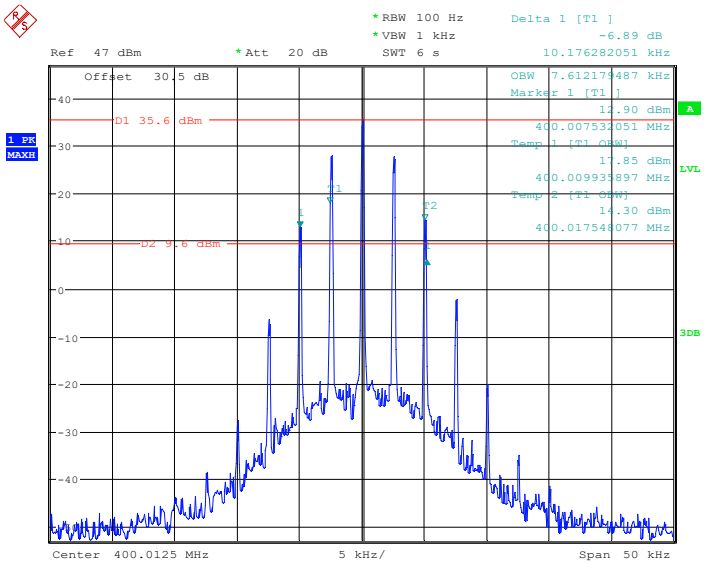
Date: 12.MAY.2022 22:45:58

Frequency 400.0125 MHz: Emission Mask D, Low Power



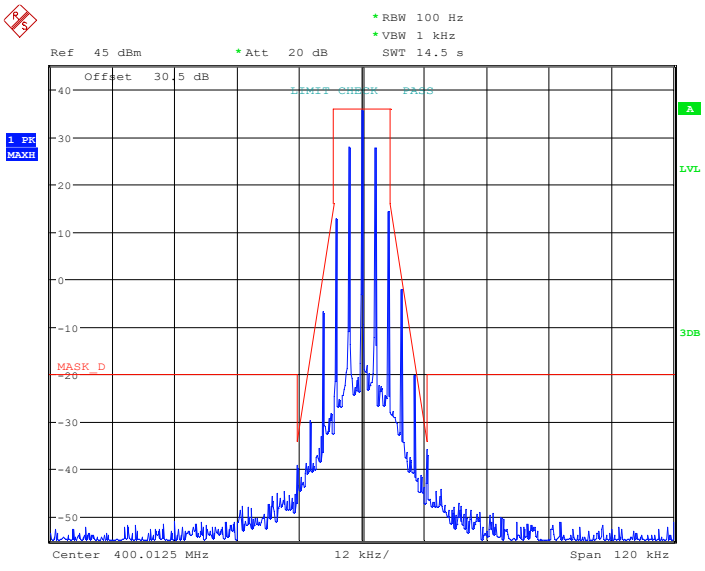
Date: 12.MAY.2022 21:51:56

Frequency 400.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



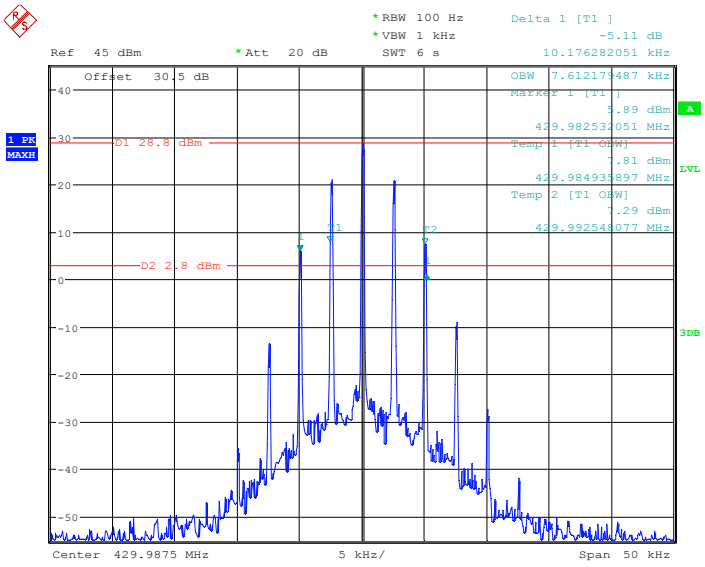
Date: 12.MAY.2022 22:30:40

Frequency 400.0125 MHz: Emission Mask D, High Power



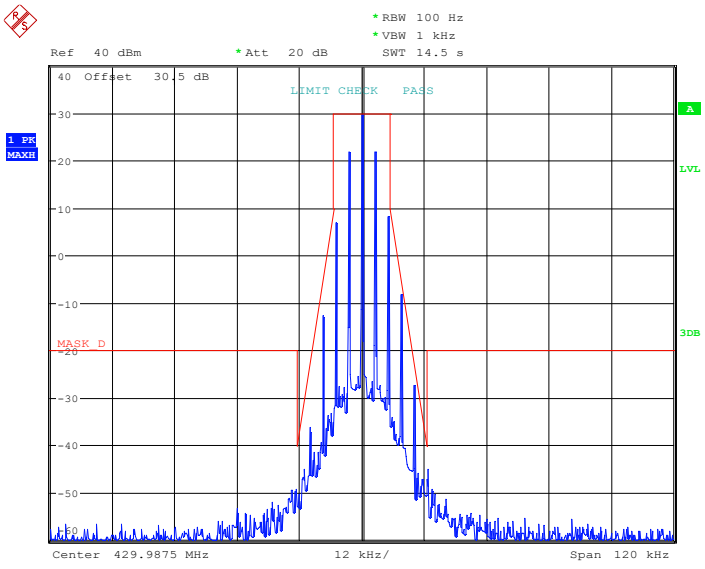
Date: 12.MAY.2022 22:08:07

Frequency 429.9875MHz: 99% Occupied & 26 dB Bandwidth, Low Power



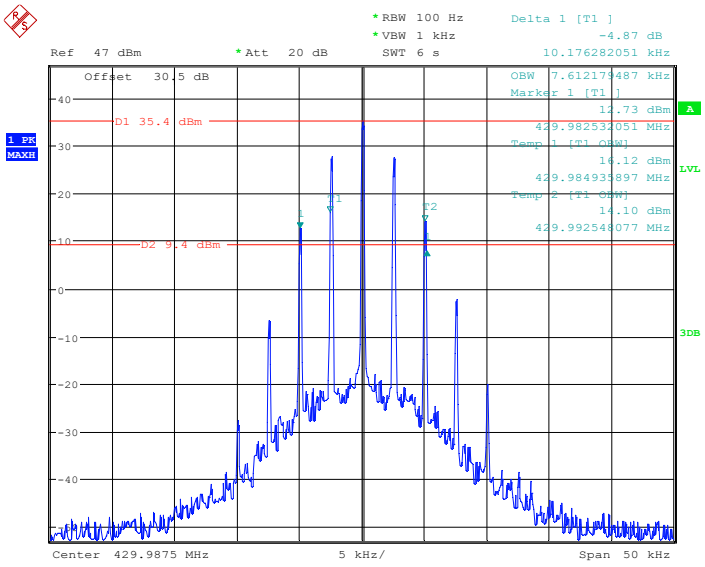
Date: 12.MAY.2022 22:43:15

Frequency 429.9875MHz: Emission Mask D, Low Power



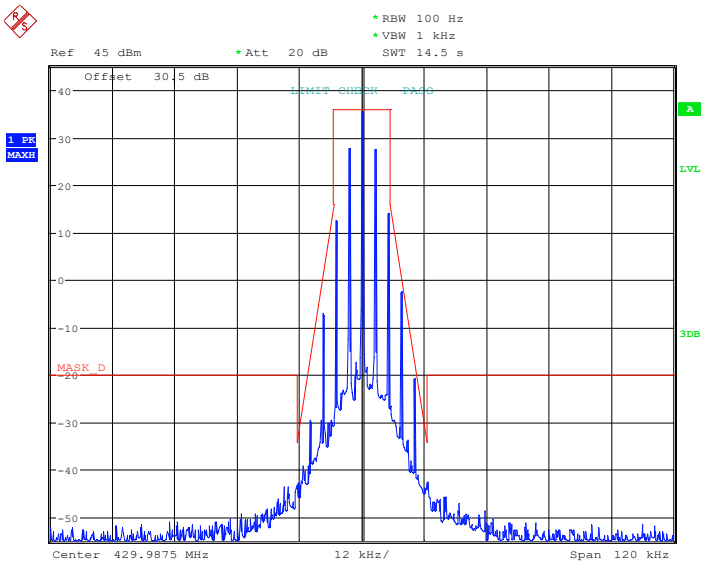
Date: 12.MAY.2022 21:54:23

Frequency 429.9875MHz: 99% Occupied & 26 dB Bandwidth, High Power



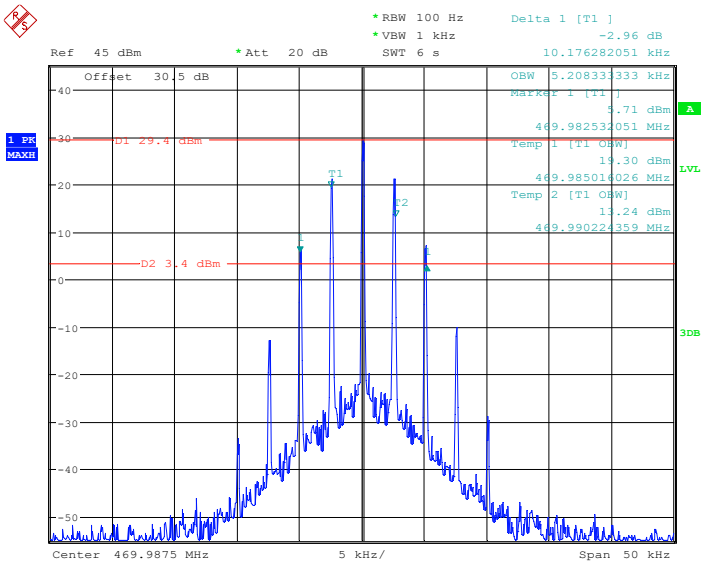
Date: 12.MAY.2022 22:34:32

Frequency 429.9875MHz: Emission Mask D, High Power



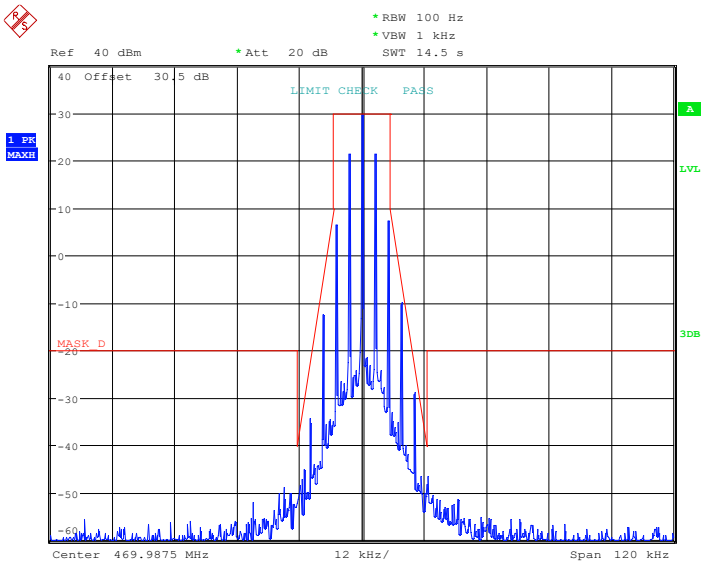
Date: 12.MAY.2022 22:05:31

Frequency 469.9875 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



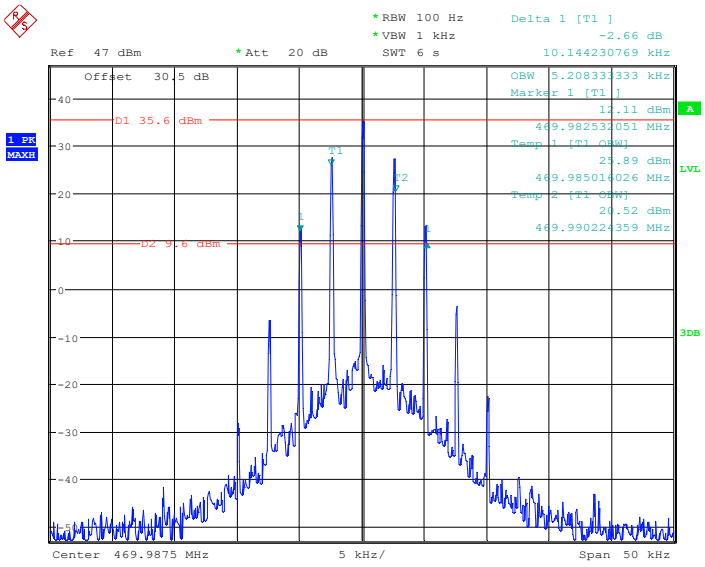
Date: 12.MAY.2022 22:41:52

Frequency 469.9875 MHz: Emission Mask D, Low Power



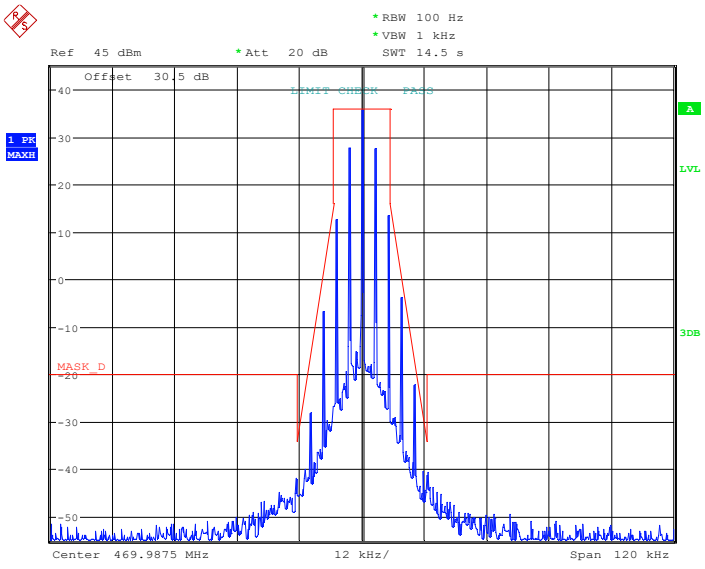
Date: 12.MAY.2022 21:59:36

Frequency 469.9875 MHz: 99% Occupied & 26 dB Bandwidth, High Power



Date: 12.MAY.2022 22:37:10

Frequency 469.9875 MHz: Emission Mask D, High Power



Date: 12.MAY.2022 22:04:17

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

Applicable Standard

Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

1) For any frequency removed from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0, 0 dB.

2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.626 kHz but no more than 12.5 kHz, at least 7.27 (f_d –2.88 kHz) dB.

3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

Test Procedure

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set at 100kHz for below 1GHz, and 1MHz for above 1GHz. Sufficient scans were taken to show any out of band emissions up to 10th harmonic.

Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang on 2022-05-12.

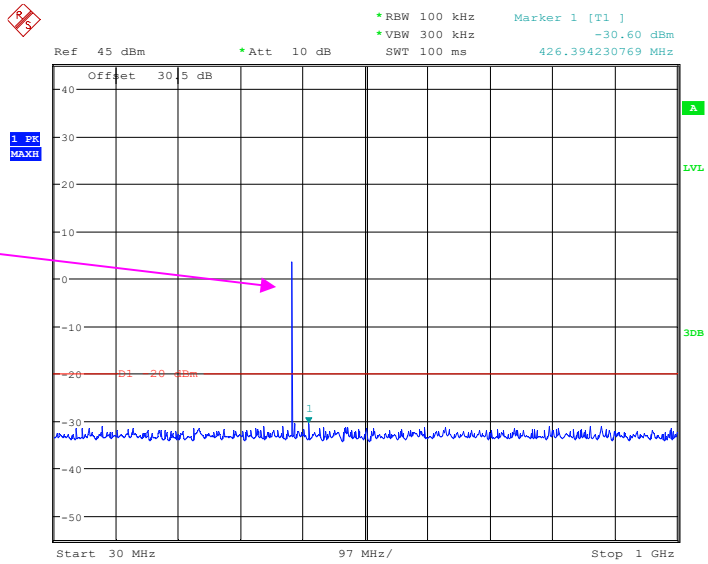
Test Mode: Transmitting, worst case for high power level.

Test Result: *Pass. Please refer to the following plots.*

Digital

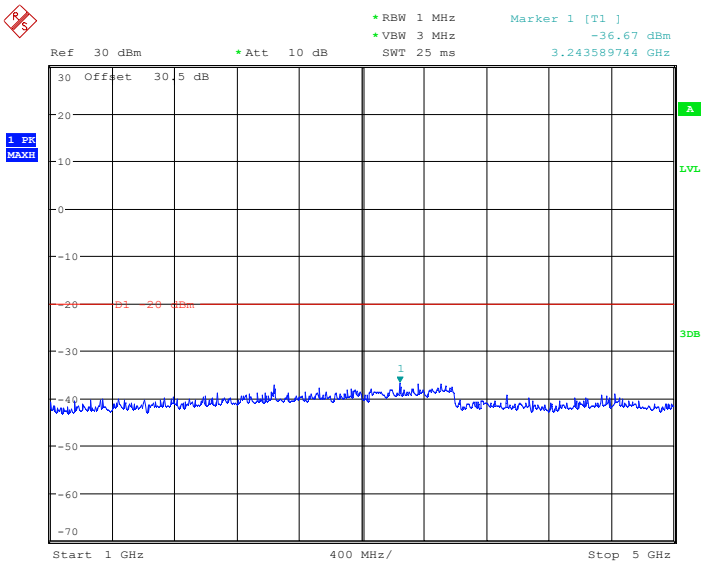
30MHz – 1 GHz, - Low Channel

Fundamental test with notch filter



Date: 12.MAY.2022 22:50:54

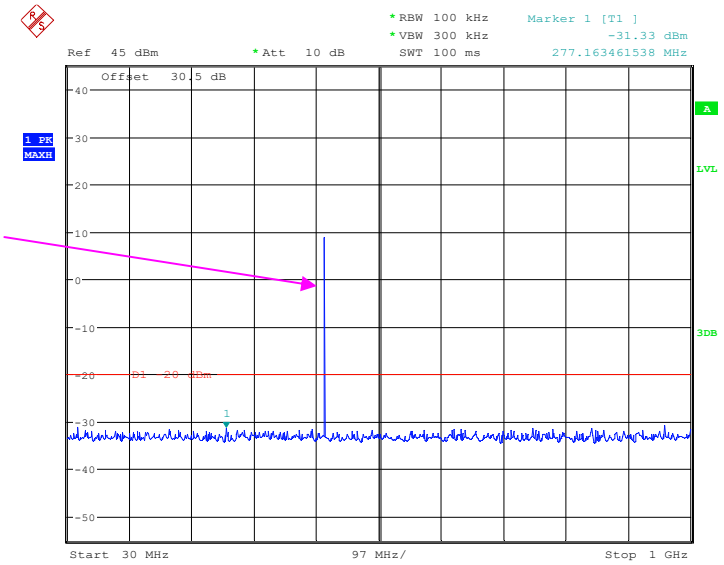
1 GHz – 5 GHz, - Low Channel



Date: 12.MAY.2022 23:00:18

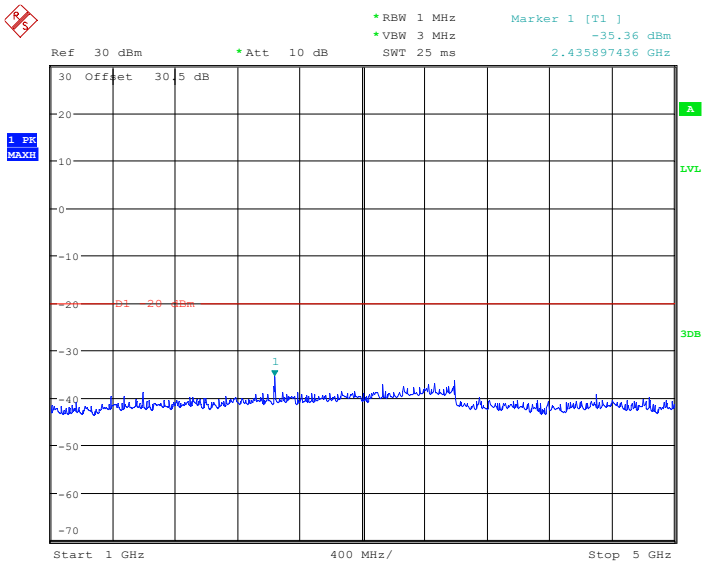
30MHz – 1 GHz, - Middle Channel

Fundamental test with notch filter



Date: 12.MAY.2022 22:52:36

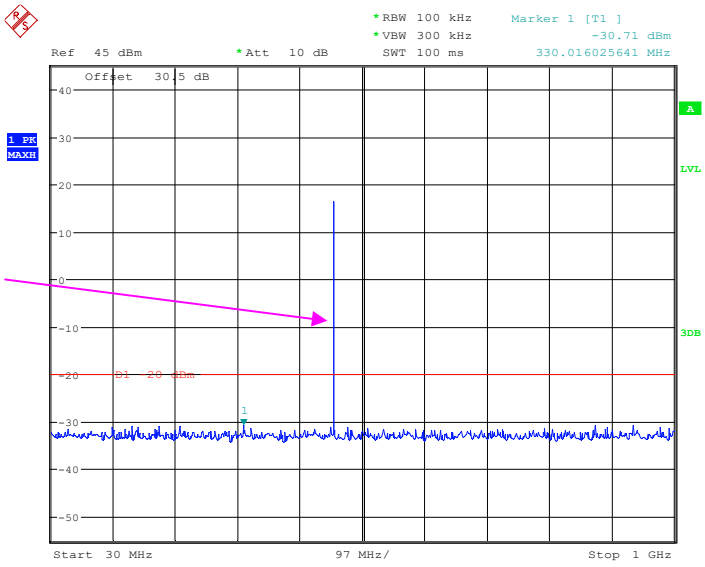
1 GHz – 5 GHz, Middle Channel



Date: 12.MAY.2022 23:00:49

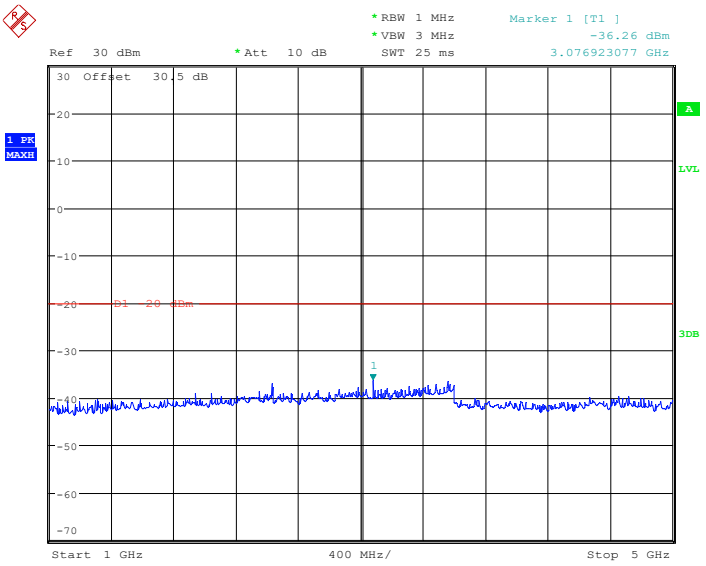
30MHz – 1 GHz, - High Channel

Fundamental test with notch filter



Date: 12.MAY.2022 22:53:14

1 GHz – 5 GHz, High Channel

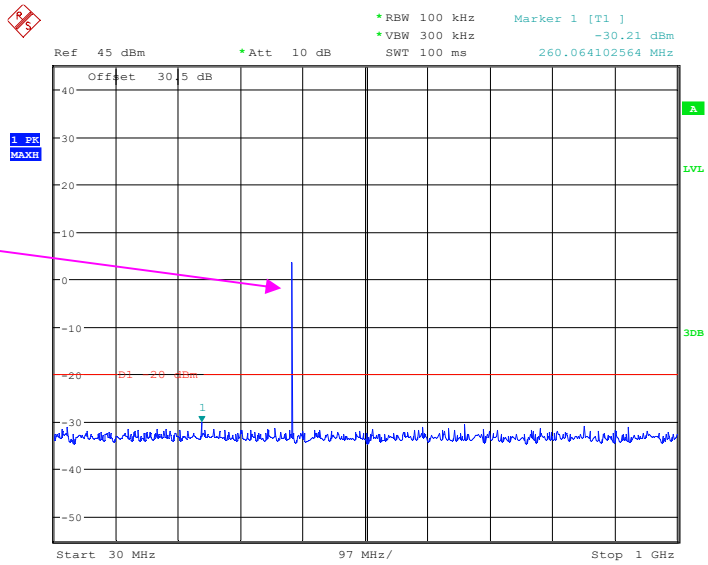


Date: 12.MAY.2022 23:01:10

Analog

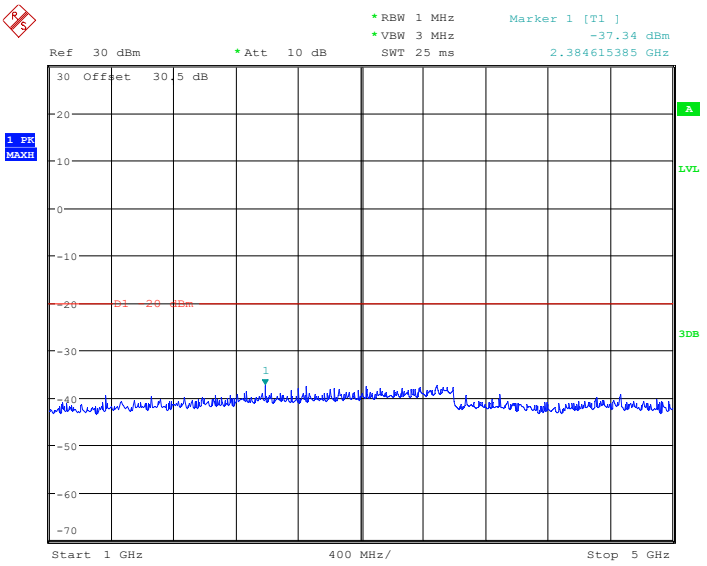
30MHz – 1 GHz, - Low Channel

Fundamental test with notch filter



Date: 12.MAY.2022 22:54:03

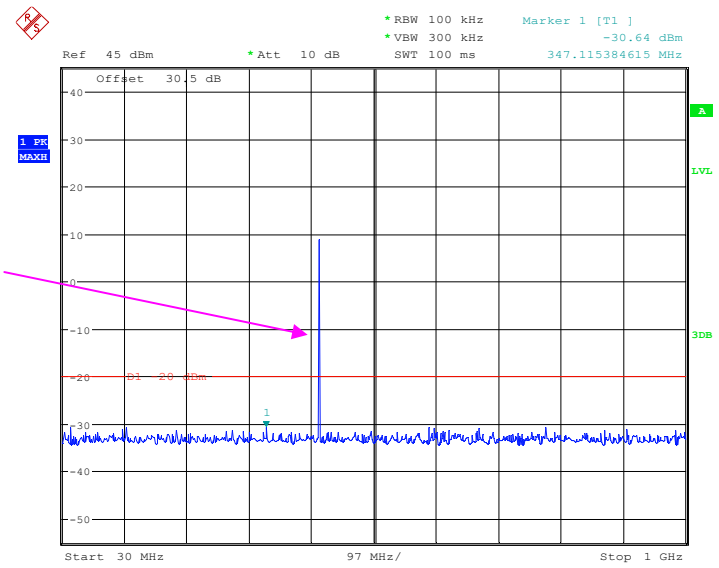
1 GHz – 5 GHz, - Low Channel



Date: 12.MAY.2022 23:00:00

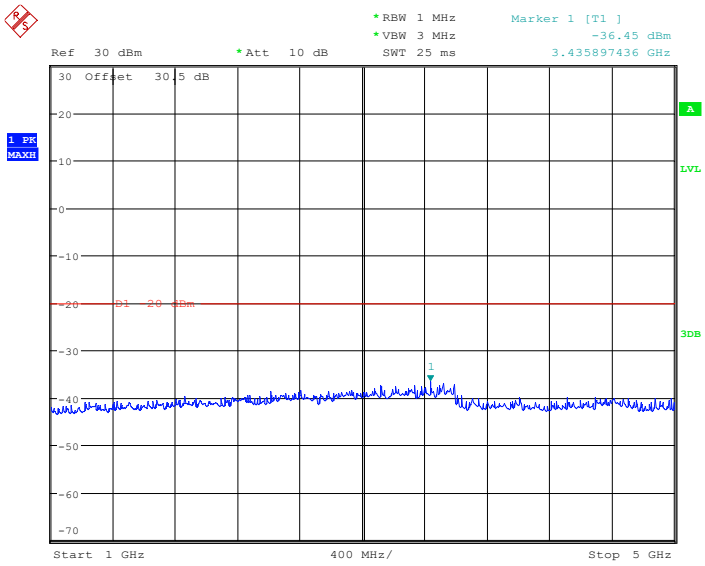
30MHz – 1 GHz, - Middle Channel

Fundamental test with notch filter



Date: 12.MAY.2022 22:54:54

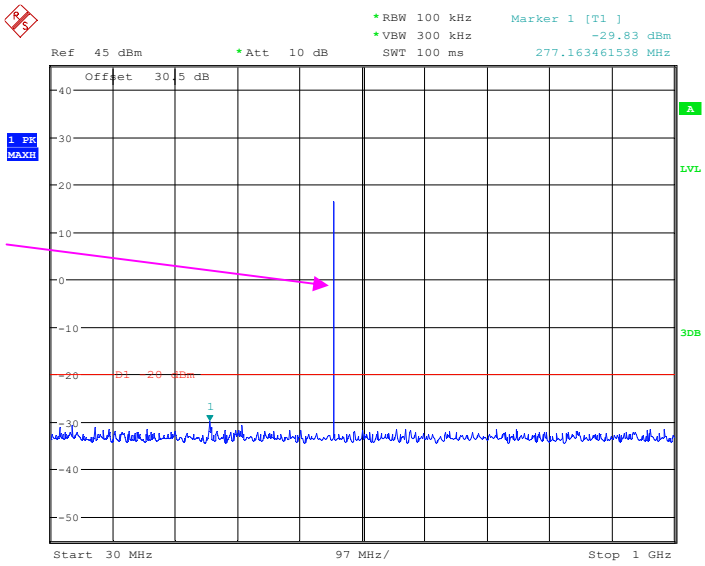
1 GHz – 5 GHz, Middle Channel



Date: 12.MAY.2022 22:58:01

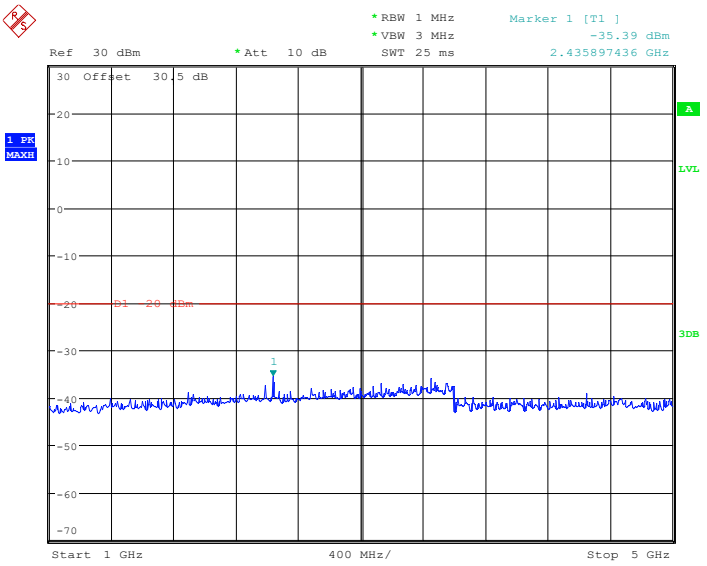
30MHz – 1 GHz, - High Channel

Fundamental test with notch filter



Date: 12.MAY.2022 22:55:18

1 GHz – 5 GHz, High Channel



Date: 12.MAY.2022 22:57:41

FCC §2.1053 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053 and §90.210

Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into a non-radiating load, which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT .The test was performed by placing the EUT on 3-orthogonal axis.

The frequency range up to teeth harmonic of the fundamental frequency was investigated.

Remove the EUT and replace it with substitution antenna. A signal generator was connected to the substitution antenna by a non-radiating cable. The absolute levels of the spurious emissions were measured by the substitution.

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

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

Test Data

Environmental Conditions

Temperature:	21~24.7 ℃
Relative Humidity:	52~54 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Fang on 2022-05-06 for below 1GHz and Jeff Jing on 2022-05-08 for above 1GHz.

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

Note: Scan with X-AXIS, Y-AXIS, Z-AXIS, the worst case Y-AXIS was recorded

Test Result: *Pass. Please refer to the following tables.*

Digital:

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
400.0125MHZ								
800.025	-75.02	8	1.4	H	10.62	-64.4	-20	44.4
800.025	-73.45	256	1.1	V	12.05	-61.4	-20	41.4
1200.04	-54.23	121	1.6	H	-1.97	-56.2	-20	36.2
1200.04	-53.91	181	2	V	-1.79	-55.7	-20	35.7
1600.05	-51.69	348	1.9	H	-2.81	-54.5	-20	34.5
1600.05	-52.61	286	1.5	V	-2.89	-55.5	-20	35.5
2000.06	-45.15	92	1.2	H	-1.25	-46.4	-20	26.4
2000.06	-46.14	73	1.8	V	-1.56	-47.7	-20	27.7
2400.08	-51.22	197	1.6	H	1.32	-49.9	-20	29.9
2400.08	-51.56	54	2	V	1.36	-50.2	-20	30.2
2800.09	-52.39	34	1.4	H	2.79	-49.6	-20	29.6
2800.09	-52.73	45	2.2	V	2.93	-49.8	-20	29.8
3200.1	-42.09	209	1.3	H	2.79	-39.3	-20	19.3
3200.1	-43.33	134	1.4	V	2.93	-40.4	-20	20.4
429.9875 MHZ								
859.975	-75.59	316	1.4	H	11.07	-64.52	-20	44.52
859.975	-72.57	277	1.6	V	12.25	-60.32	-20	40.32
1289.96	-54.27	227	1.4	H	-0.53	-54.8	-20	34.8
1289.96	-54.46	202	2.1	V	-0.74	-55.2	-20	35.2
1719.95	-49.53	310	1.1	H	-2.47	-52	-20	32
1719.95	-49.91	187	1.6	V	-2.49	-52.4	-20	32.4
2149.94	-43.45	19	1.4	H	-1.25	-44.7	-20	24.7
2149.94	-45.94	22	1.8	V	-1.56	-47.5	-20	27.5
2579.93	-50.92	29	1.1	H	1.32	-49.6	-20	29.6
2579.93	-51.96	87	1.7	V	1.36	-50.6	-20	30.6
3009.91	-45.29	235	1.5	H	2.79	-42.5	-20	22.5
3009.91	-47.33	244	1.5	V	2.93	-44.4	-20	24.4
3439.90	-45.94	340	1.4	H	3.54	-42.4	-20	22.4
3439.90	-47.77	20	1.5	V	3.47	-44.3	-20	24.3

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
469.9875 MHZ								
939.975	-75.92	59	1.5	V	11.79	-64.13	-20	44.13
939.975	-73.91	166	1.8	H	12.48	-61.43	-20	41.43
1409.96	-53.47	148	1.3	H	-0.53	-54	-20	34
1409.96	-55.66	172	1.7	V	-0.74	-56.4	-20	36.4
1879.95	-46.55	293	1.4	H	-1.25	-47.8	-20	27.8
1879.95	-48.34	12	1.1	V	-1.56	-49.9	-20	29.9
2349.94	-50.12	31	1.2	H	1.32	-48.8	-20	28.8
2349.94	-50.36	211	1.7	V	1.36	-49	-20	29
2819.93	-49.52	91	1	H	1.32	-48.2	-20	28.2
2819.93	-51.76	314	1.4	V	1.36	-50.4	-20	30.4
3289.91	-40.84	336	1	H	3.54	-37.3	-20	17.3
3289.91	-44.07	275	1	V	3.47	-40.6	-20	20.6
3759.90	-50.49	112	1.8	H	6.39	-44.1	-20	24.1
3759.90	-51.78	144	1.7	V	6.28	-45.5	-20	25.5

Analog:

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
400.0125MHZ								
800.025	-75.62	217	1.2	H	10.62	-65	-20	45.00
800.025	-73.25	348	1.2	V	12.05	-61.2	-20	41.20
1200.04	-53.83	41	1.4	H	-1.97	-55.8	-20	35.8
1200.04	-54.51	208	1.4	V	-1.79	-56.3	-20	36.3
1600.05	-52.09	26	1.1	H	-2.81	-54.9	-20	34.9
1600.05	-52.91	255	1.3	V	-2.89	-55.8	-20	35.8
2000.06	-44.85	102	2	H	-1.25	-46.1	-20	26.1
2000.06	-46.04	336	1.3	V	-1.56	-47.6	-20	27.6
2400.08	-51.02	117	2	H	1.32	-49.7	-20	29.7
2400.08	-51.36	255	1.7	V	1.36	-50	-20	30
2800.09	-52.59	310	2.2	H	2.79	-49.8	-20	29.8
2800.09	-52.43	336	1.6	V	2.93	-49.5	-20	29.5
3200.1	-40.79	223	1.8	H	2.79	-38	-20	18
3200.1	-43.73	275	1.8	V	2.93	-40.8	-20	20.8

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
429.9875 MHZ								
859.975	-75.69	314	1.9	H	11.07	-64.62	-20	44.62
859.975	-72.17	79	1.3	V	12.25	-59.92	-20	39.92
1289.96	-53.47	26	1.1	H	-0.53	-54	-20	34
1289.96	-54.26	58	1.8	V	-0.74	-55	-20	35
1719.95	-49.13	150	1.4	H	-2.47	-51.6	-20	31.6
1719.95	-49.41	196	1	V	-2.49	-51.9	-20	31.9
2149.94	-43.85	17	2	H	-1.25	-45.1	-20	25.1
2149.94	-44.34	130	1.1	V	-1.56	-45.9	-20	25.9
2579.93	-50.22	251	1.6	H	1.32	-48.9	-20	28.9
2579.93	-51.76	228	1.7	V	1.36	-50.4	-20	30.4
3009.91	-45.89	92	1.1	H	2.79	-43.1	-20	23.1
3009.91	-47.63	154	1.3	V	2.93	-44.7	-20	24.7
3439.90	-46.14	152	1.3	H	3.54	-42.6	-20	22.6
3439.90	-47.57	25	1.3	V	3.47	-44.1	-20	24.1
469.9875 MHZ								
939.975	-76.52	139	1.4	V	11.79	-64.73	-20	44.73
939.975	-73.11	59	1.5	H	12.48	-60.63	-20	40.63
1409.96	-54.27	149	1.3	H	-0.53	-54.8	-20	34.8
1409.96	-56.06	331	1.6	V	-0.74	-56.8	-20	36.8
1879.95	-45.95	42	1.5	H	-1.25	-47.2	-20	27.2
1879.95	-48.34	337	1.5	V	-1.56	-49.9	-20	29.9
2349.94	-51.52	58	1	H	1.32	-50.2	-20	30.2
2349.94	-51.96	160	1.6	V	1.36	-50.6	-20	30.6
2819.93	-49.22	63	1.4	H	1.32	-47.9	-20	27.9
2819.93	-50.06	271	1.9	V	1.36	-48.7	-20	28.7
3289.91	-41.84	275	1.3	H	3.54	-38.3	-20	18.3
3289.91	-45.17	11	2.1	V	3.47	-41.7	-20	21.7
3759.90	-52.79	95	2.1	H	6.39	-46.4	-20	26.4
3759.90	-52.48	207	1.1	V	6.28	-46.2	-20	26.2

Note:
Absolute Level = Reading Level + Substituted Factor
Substituted Factor contains: SG Level - Cable loss+ Antenna Gain
Margin = Limit- Absolute Level

FCC §2.1055 & §90.213 - FREQUENCY STABILITY

Applicable Standard

FCC §2.1055 and §90.213

Test Procedure

Frequency Stability vs. Temperature: The equipment under test was connected to an external AC/DC power supply and the RF output was connected to communication test set via feed-through attenuators. The EUT was placed inside the temperature chamber. The power cable and RF output cable exited the chamber through an opening made for the purpose.

After the temperature stabilized for approximately 20 minutes, the frequency output was recorded from the counter.

Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang from 2022-05-12 to 2022-05-13.

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

Test Result: *Pass. Please refer to the following tables.*

For Analog Modulation

Reference Frequency:429.9875MHz, Limit:2.5 ppm，12.5kHz			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	7.4	429.987502	0.005
40	7.4	429.987512	0.028
30	7.4	429.987423	-0.179
20	7.4	429.987523	0.053
10	7.4	429.987521	0.049
0	7.4	429.987496	-0.009
-10	7.4	429.987487	-0.030
-20	7.4	429.987522	0.051
-30	7.4	429.987529	0.067
Frequency Stability Versus Input Voltage			
20	6.8	429.987489	-0.026
20	8.4	429.987501	0.002

For DIGITAL

Reference Frequency:429.9875MHz, Limit:2.5 ppm，12.5kHz			
Environment Temperature (°C)	Power Supplied (Vdc)	Frequency Measure with Time Elapsed	
		MCF (MHz)	PPM Error
50	7.4	429.987495	-0.012
40	7.4	429.987486	-0.033
30	7.4	429.987474	-0.060
20	7.4	429.987486	-0.033
10	7.4	429.987512	0.028
0	7.4	429.987487	-0.030
-10	7.4	429.987503	0.007
-20	7.4	429.987492	-0.019
-30	7.4	429.987481	-0.044
Frequency Stability Versus Input Voltage			
20	6.8	429.987483	-0.040
20	8.4	429.987499	-0.002

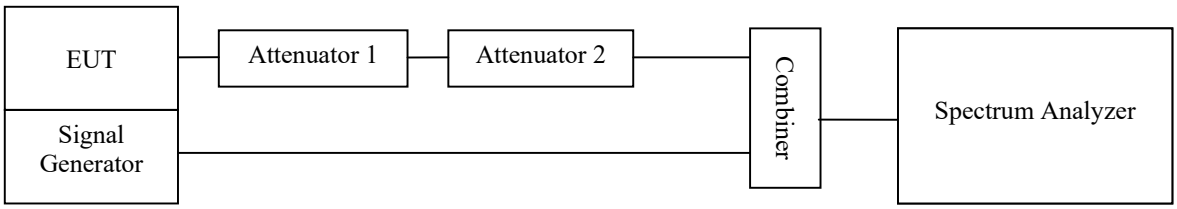
FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214
Test method: ANSI C63.26-2015

Test Procedure

a) Connect the EUT and test equipment as shown on the following block diagram.
b) Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
c) Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±12.5 kHz deviation and set its output level to -100dBm.
d) Turn on the transmitter.
e) Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as P_0.
f) Turn off the transmitter.
g) Adjust the RF level of the signal generator to provide RF power equal to P_0. This signal generator RF level shall be maintained throughout the rest of the measurement.
h) Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
i) Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at ±4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "tiger offset" to -10ms for turn on and -15ms for turn off.
j) Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be t_{on}. The trace should be maintained within the allowed divisions during the period t_1 and t_2.
k) Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period t_3.



Test Data

Environmental Conditions

Temperature:	28 ℃
Relative Humidity:	51 %
ATM Pressure:	101.0 kPa

The testing was performed by Nick Fang on 2022-05-13.

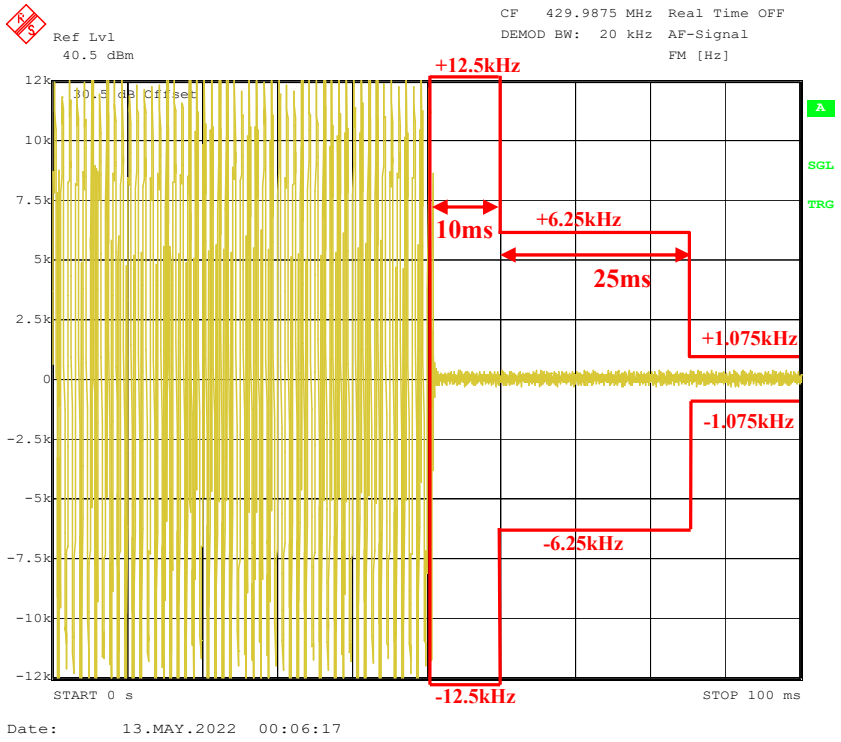
Test Result: *Pass. Please refer to the following tables and plots.*

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

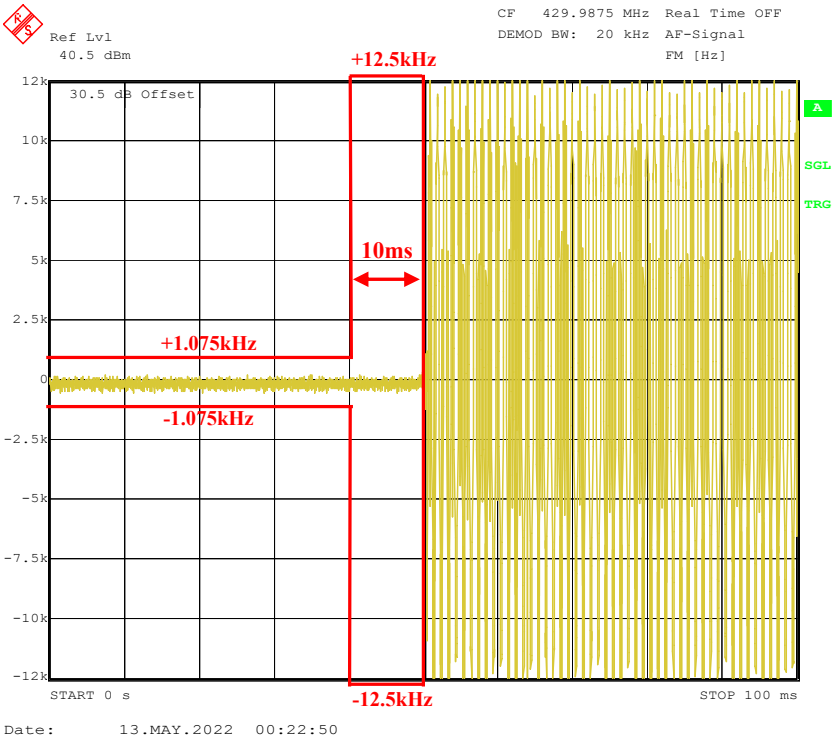
Note: During the time from the end of t_2 to the beginning of t_3, the frequency difference not exceed the limits specified in §90.213

For 429.9875MHz 12.5kHz mode, the limit is 429.9875MHz*2.5ppm=1.075kHz

Turn on



Turn off



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