FCC PART 22, 74, 80 and 90

TEST REPORT

For

Hytera Communications Corporation Limited

Hytera Tower, Hi-Tech Industrial Park North, 9108# Beihuan Road, Nanshan District, Shenzhen, 518057 China

FCC ID: YAMRD98XSIU1

Report Type:	**Product Type:**
Original Report	Digital Repeater

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

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *Hytera Communications Corporation Limited's* product, model number: *RD982Si U(1) (FCC ID: YAMRD98XSIU1)* in this report is a *Digital Repeater,* which was measured approximately: 366 mm (L) x 483 mm (W) x 88 mm (H), rated input voltage: DC 13.6 V.

Type	Parameter	
Frequency Range(MHz)	400-470	
Rated Output power(Watts)	50 (High) / 5(Low)	
Modulation	FM/4FSK	
Channel Spacing(kHz)	FM	12.5/25
	4FSK	12.5

Notes: This series products model: RD985Si U(1), RD986Si U(1), RD988Si U(1) and RD982Si U(1) are identical schematics, and only are different for model number. Model RD982Si U(1) was selected for fully testing, the detailed information can be referred to the declaration which was stated and guaranteed by the applicant.

** All measurement and test data in this report was gathered from production sample serial number: 171207018 (Assigned by BACL, Shenzhen). The EUT supplied by the applicant was received on 2017-12-07.*

Objective

This test report is prepared on behalf of *Hytera Communications Corporation Limited* in accordance with Part 2, and Part 22, 74, 80, 90 of the Federal Communication Commissions rules.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s).

Test Methodology

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

Part 22 – Public Mobile Service
Part 74 – Experimental Radio, Auxiliary, Special Broadcast and other Program Distributonal Service
Part 80 – Stantions in the Maritme Service
Part 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Parameter		uncertainty
Occupied Channel Bandwidth		±5%
RF output power, conducted		±1.5dB
Unwanted Emission, conducted		±1.5dB
Emissions, Radiated	Below 1GHz	±4.75dB
	Above 1GHz	±4.88dB
Temperature		±1
Supply voltages		±0.4%

Test Facility

The test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 6/F., West Wing, Third Phase of Wanli Industrial Building, Shihua Road, Futian Free Trade Zone, Shenzhen, Guangdong, China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 382179, the FCC Designation No.: CN5001.

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

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

EUT Exercise Software

No exercise software was used.

Special Accessories

No special accessory was used.

Equipment Modifications

No modification was made to the EUT tested.

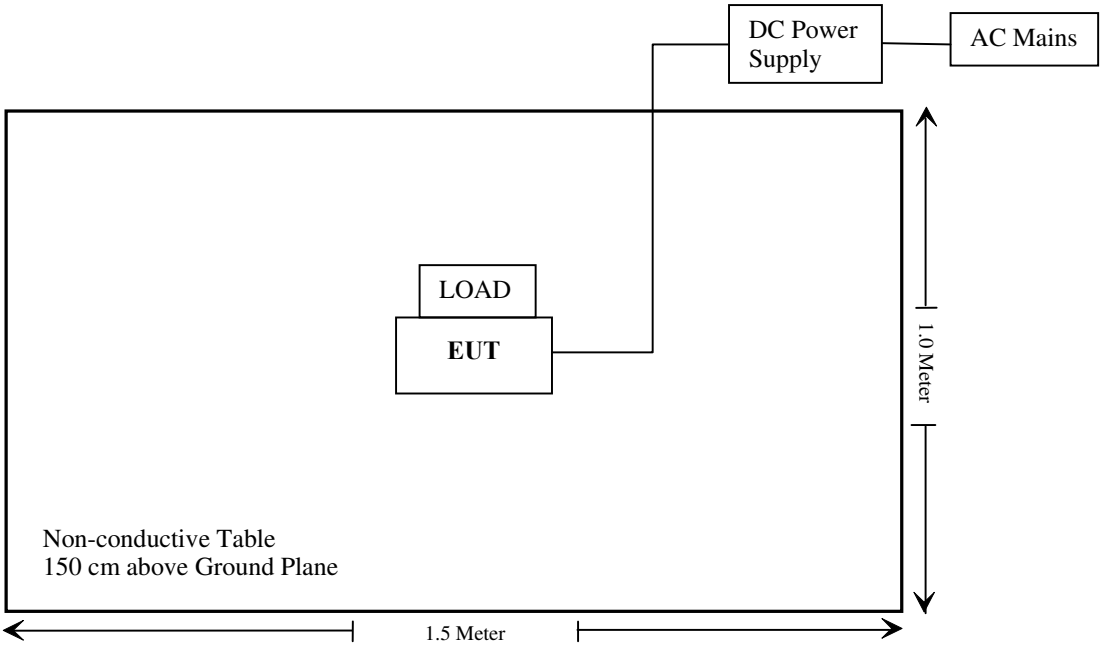
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
N/A	Load	N/A	N/A
TDK-Lambda	DC Power Supply	Z60-14-L-C	N/A

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shileding Detachable DC Cable	2.5	EUT	DC Power Supply

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§1.1307(b), §2.1091	Maximum Permissible exposure (MPE)	Compliance
§2.1046; § 22.727; §74.461; § 80.215; §90.205	RF Output Power	Compliance
§2.1047	Modulation Characteristic	Compliance
§2.1049;§22.357;§ 22.731; §74.462; § 80.205; § 80.207;§90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliance
§2.1051; §22.861; §74.462; § 80.211;§90.210	Spurious Emission at Antenna Terminal	Compliance
§2.1053; §22.861; §74.462; § 80.211;§90.210	Spurious Radiated Emissions	Compliance
§2.1055; § 22.355; §74.464; § 80.209;§90.213	Frequency Stability	Compliance
§90.214	Transient Frequency Behavior	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Sunol Sciences	Horn Antenna	DRH-118	A052604	2014-12-29	2017-12-28
Rohde & Schwarz	Signal Generator	FSIQ26	8386001028	2017-04-24	2018-04-24
Sunol Sciences	Bi-log Antenna	JB1	A040904-2	2014-12-17	2017-12-16
Mini	Pre-amplifier	ZVA-183-S+	5969001149	2017-05-21	2018-05-21
HP	Amplifier	HP8447E	1937A01046	2017-11-19	2018-05-17
Anritsu	Signal Generator	68369B	004114	2017-12-05	2018-12-05
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2017-12-07	2018-12-07
COM POWER	Dipole Antenna	AD-100	041000	NCR	NCR
A.H. System	Horn Antenna	SAS-200/571	135	2015-08-18	2018-08-17
Ducommun technologies	RF Cable	UFA210A-1-4724-30050U	MFR64369 223410-001	2017-11-19	2018-05-17
Ducommun technologies	RF Cable	104PEA	218124002	2017-11-19	2018-05-17
Ducommun technologies	RF Cable	RG-214	1	2017-11-19	2018-05-17
Ducommun technologies	RF Cable	RG-214	2	2017-11-22	2018-05-22
RF Conducted Test					
Rohde & Schwarz	Signal Analyzer	FSW13	103533	2017-06-15	2018-06-14
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2017-11-22	2018-11-22
Long Wei	DC Power Supply	TPR-6420D	398363	NCR	NCR
Rohde & Schwarz	Vector Signal Generator	SMW200A	102522	2017-06-15	2018-06-14
BEW	Coaxial Attenuator	TS300-6-40	N/A	2017-06-15	2018-06-14
MICABLE	RF Cable	D02	N/A	2017-06-15	2018-06-14
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2017-12-05	2018-12-05
Rohde & Schwarz	Signal Analyzer	FSIQ26	837405/023	2017-04-24	2018-04-24

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

FCC §1.1307 (b) (1) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 1.1307 (b)(1), 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 Occupational/Controlled Exposure

Limits for occupational/Controlled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (Minutes)**
0.3-1.34	614	1.63	*(100)	6
1.34-30	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	/	/	5.0	6

f = frequency in MHz
* = Plane-wave equivalent power density

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm^2)
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, the power gain factor, is normally numeric gain.
R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For worst case:

Frequency (MHz)	Antenna Gain		Max average output power	Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
	(dBi)	(numeric)	(mW)			
400-470	5.5	3.55	28117	80	1.24	1.33

Note: Max tune-up output power is 47.5dBm (56234 mW), the duty cycle is 50%. So the average power is 28117 mW.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 80cm from nearby persons.

Result: Compliance

FCC §2.1046 & § 22.727 & §74.461 & §80.215 & §90.205 - RF OUTPUT POWER

Applicable Standard

FCC §2.1046, § 22.727, §74.461, § 80.215 and §90.205

Test Procedure

Conducted RF Output Power:

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

Spectrum Analyzer Setting:

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

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Xiangguang Kong on 2017-12-30.

Test Mode: Transmitting

Test Result: Compliance. Please refer to following table.

Modulation	Channel Separation (kHz)	Frequency (MHz)	Power Level	Output Power (dBm)	Output Power (W)	Note
Analog	12.5	400.0125	High	47.25	53.09	For Federal
			Low	37.40	5.50	
	12.5	450.0125	High	47.19	52.36	For Part 74
			Low	37.31	5.38	
	12.5	454.025	High	47.30	53.70	For Part 22
			Low	37.32	5.40	
	12.5	458.2125	High	47.34	54.20	For Part 90
			Low	37.41	5.51	
	12.5	469.9875	High	47.31	53.83	For Federal
			Low	37.38	5.47	
	25	400.0125	High	47.31	53.83	For Federal
			Low	37.38	5.47	
	25	450.0125	High	47.18	52.24	For Part 74
			Low	37.29	5.36	
	25	454.025	High	47.29	53.58	For Part 22
			Low	37.33	5.41	
	25	463.0125	High	47.25	53.09	For Part 80
			Low	37.34	5.42	
	25	469.9875	High	47.31	53.83	For Federal
			Low	37.39	5.48	
Digital	12.5	400.0125	High	47.25	53.09	For Federal
			Low	37.40	5.50	
	12.5	450.0125	High	47.18	52.24	For Part 74
			Low	37.32	5.40	
	12.5	454.025	High	47.34	54.20	For Part 22
			Low	37.32	5.40	
	12.5	458.2125	High	47.39	54.83	For Part 90
			Low	37.40	5.50	
	12.5	469.9875	High	47.32	53.95	For Federal
			Low	37.38	5.47	

Note: The high rated power is 50 W, limit is 40 W - 60 W
The low rated power is 5 W, limit is 4 W - 6 W

FCC §2.1047 - MODULATION CHARACTERISTIC

Applicable Standard

FCC§2.1047:

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

Test Procedure

Test Method: TIA/EIA-603 2.2.3

Test Data

Environmental Conditions

Temperature:	25℃
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Xiangguang Kong on 2017-12-28.

Test Mode: Transmitting

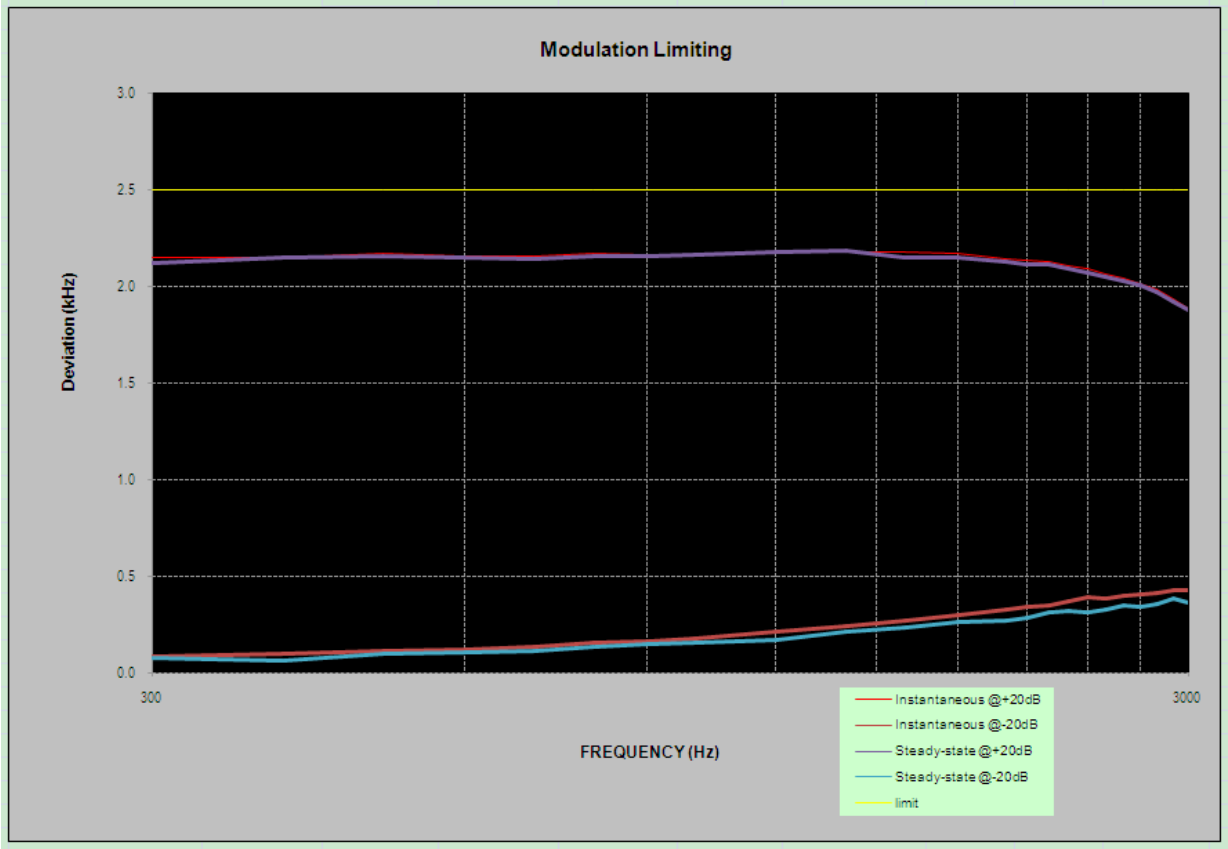
Result: Compliance.

Analog Modulation:

MODULATION LIMITING

Carrier Frequency: 450.0125 MHz, Channel Separation=12.5 kHz

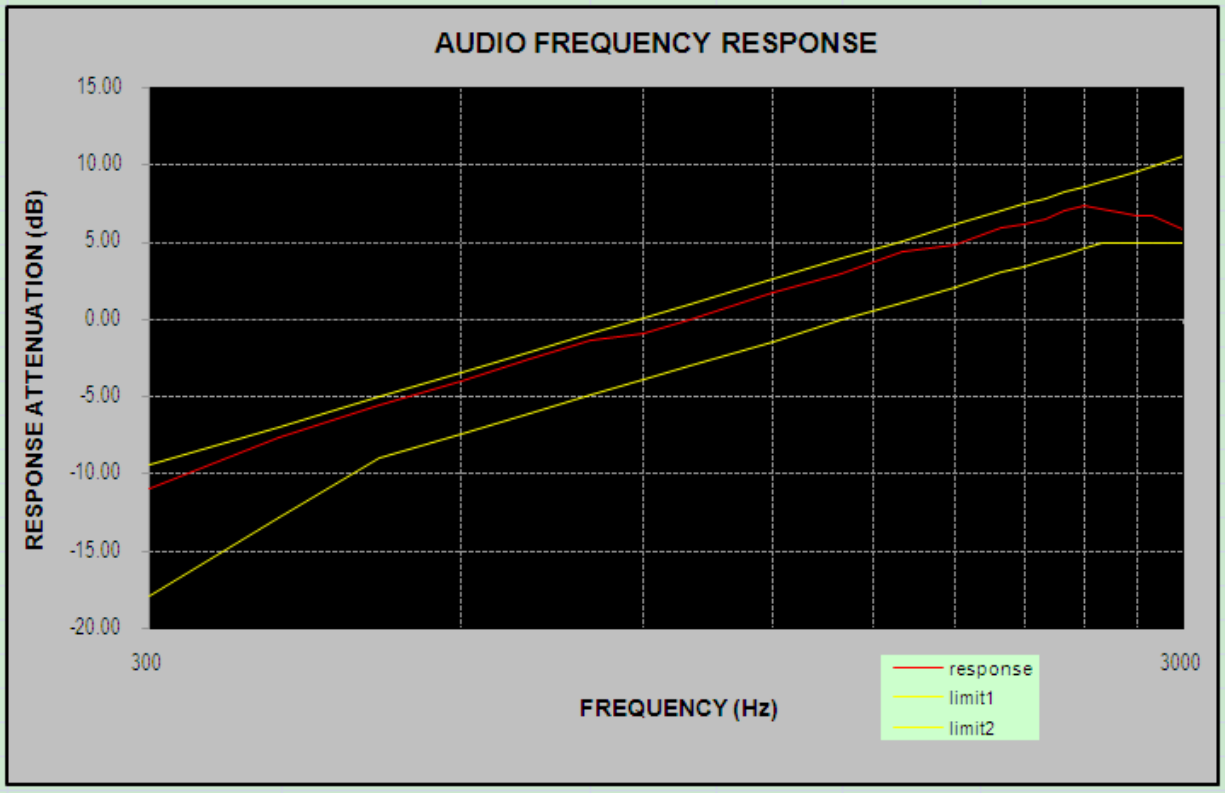
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	2.147	0.085	2.121	0.076	2.5
400	2.152	0.099	2.146	0.068	2.5
500	2.170	0.113	2.155	0.099	2.5
600	2.153	0.125	2.150	0.108	2.5
700	2.153	0.138	2.145	0.112	2.5
800	2.168	0.160	2.159	0.139	2.5
900	2.166	0.167	2.155	0.147	2.5
1000	2.165	0.182	2.161	0.159	2.5
1200	2.178	0.215	2.174	0.175	2.5
1400	2.178	0.245	2.176	0.217	2.5
1600	2.175	0.275	2.149	0.236	2.5
1800	2.171	0.302	2.152	0.263	2.5
2000	2.144	0.332	2.126	0.269	2.5
2100	2.136	0.341	2.116	0.286	2.5
2200	2.125	0.353	2.111	0.312	2.5
2300	2.104	0.371	2.093	0.321	2.5
2400	2.089	0.391	2.071	0.312	2.5
2500	2.066	0.384	2.051	0.332	2.5
2600	2.043	0.398	2.030	0.348	2.5
2700	2.016	0.409	2.004	0.342	2.5
2800	1.987	0.418	1.971	0.356	2.5
2900	1.937	0.426	1.923	0.385	2.5
3000	1.882	0.432	1.875	0.367	2.5


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 @+20dB
Steady-state @-20dB
limit

Audio Frequency Response

Carrier Frequency: 450.0125 MHz, Channel Separation=12.5 kHz

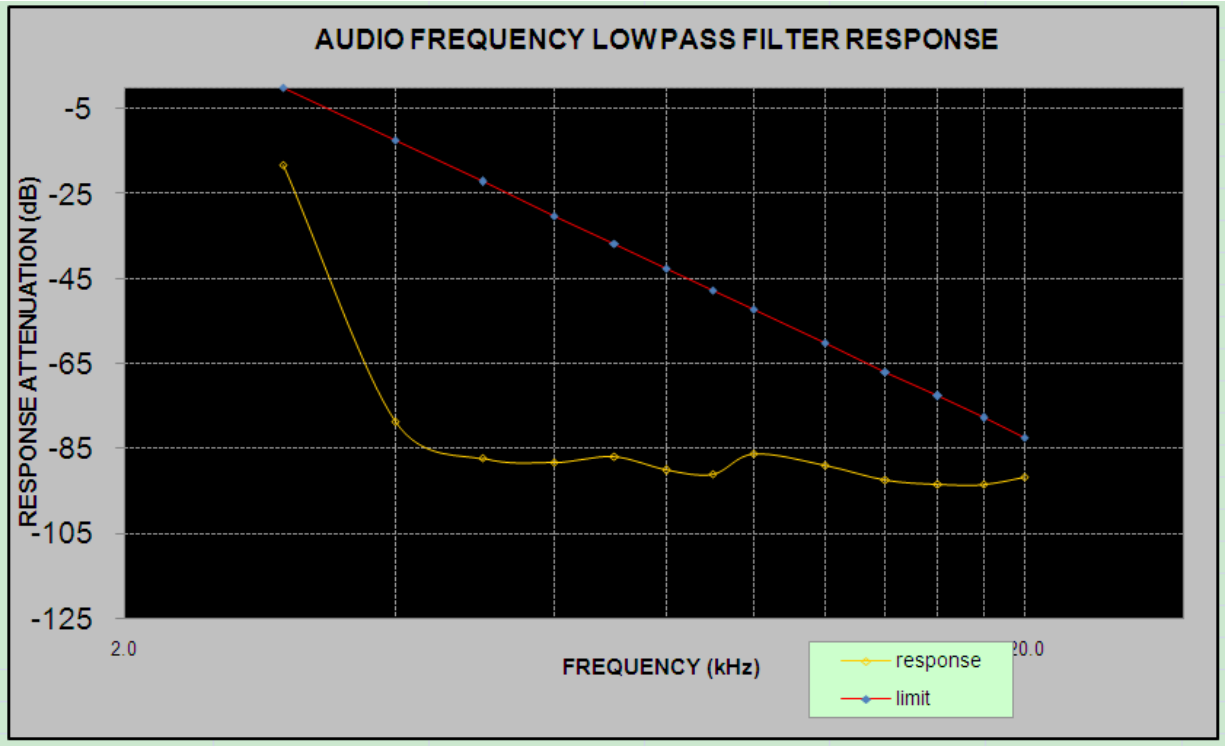
Audio Frequency (Hz)	Response Attenuation (dB)
300	-11.00
400	-7.66
500	-5.51
600	-3.96
700	-2.57
800	-1.37
900	-0.88
1000	0
1200	1.68
1400	2.98
1600	4.34
1800	4.85
2000	5.94
2100	6.17
2200	6.46
2300	6.99
2400	7.37
2500	7.11
2600	6.87
2700	6.70
2800	6.71
2900	6.27
3000	5.83


AUDIO FREQUENCY RESPONSE
RESPONSE ATTENUATION (dB)
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
300
3000
FREQUENCY (Hz)
response
limit1
limit2

Audio frequency lows pass filter response

Carrier Frequency: 450.0125 MHz, Channel Separation=12.5 kHz

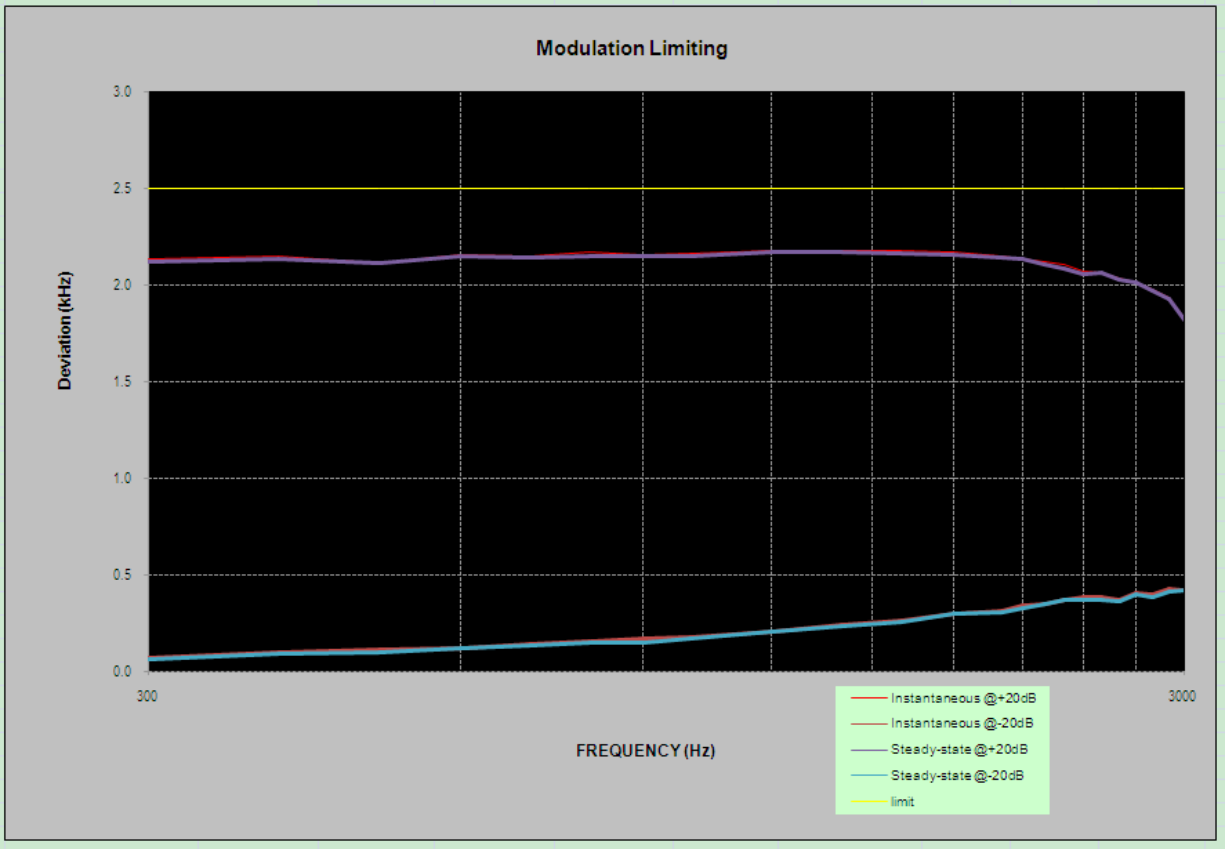
Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-18.2	0
4.0	-78.6	-12.5
5.0	-87.4	-22.2
6.0	-88.3	-30.1
7.0	-86.9	-36.8
8.0	-90.2	-42.6
9.0	-91.2	-47.7
10.0	-86.3	-52.3
12.0	-88.9	-60.2
14.0	-92.4	-66.9
16.0	-93.5	-72.7
18.0	-93.6	-77.8
20.0	-91.8	-82.5



MODULATION LIMITING

Carrier Frequency: 454.0250 MHz, Channel Separation=12.5 kHz

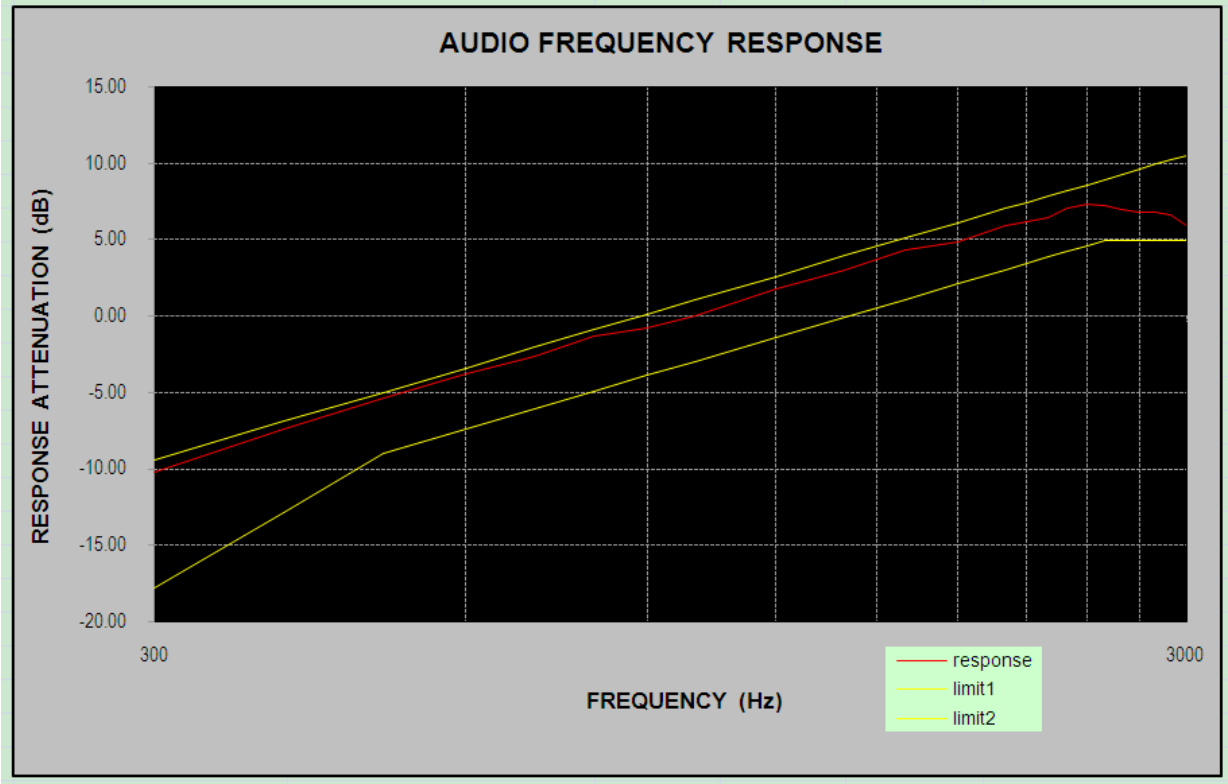
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	2.136	0.075	2.122	0.062	2.5
400	2.152	0.099	2.138	0.091	2.5
500	2.114	0.113	2.112	0.098	2.5
600	2.153	0.125	2.147	0.120	2.5
700	2.148	0.142	2.140	0.134	2.5
800	2.168	0.160	2.152	0.152	2.5
900	2.159	0.171	2.147	0.154	2.5
1000	2.165	0.182	2.151	0.174	2.5
1200	2.181	0.208	2.170	0.205	2.5
1400	2.178	0.245	2.167	0.236	2.5
1600	2.176	0.268	2.160	0.261	2.5
1800	2.171	0.302	2.156	0.301	2.5
2000	2.152	0.316	2.142	0.311	2.5
2100	2.136	0.341	2.132	0.332	2.5
2200	2.123	0.351	2.106	0.350	2.5
2300	2.104	0.371	2.085	0.369	2.5
2400	2.069	0.387	2.058	0.370	2.5
2500	2.066	0.384	2.062	0.372	2.5
2600	2.032	0.369	2.028	0.365	2.5
2700	2.016	0.409	2.012	0.402	2.5
2800	1.978	0.401	1.973	0.388	2.5
2900	1.937	0.426	1.926	0.416	2.5
3000	1.825	0.425	1.818	0.421	2.5


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 @+20dB
Steady-state @-20dB
limit

Audio Frequency Response

Carrier Frequency: 454.0250 MHz, Channel Separation=12.5 kHz

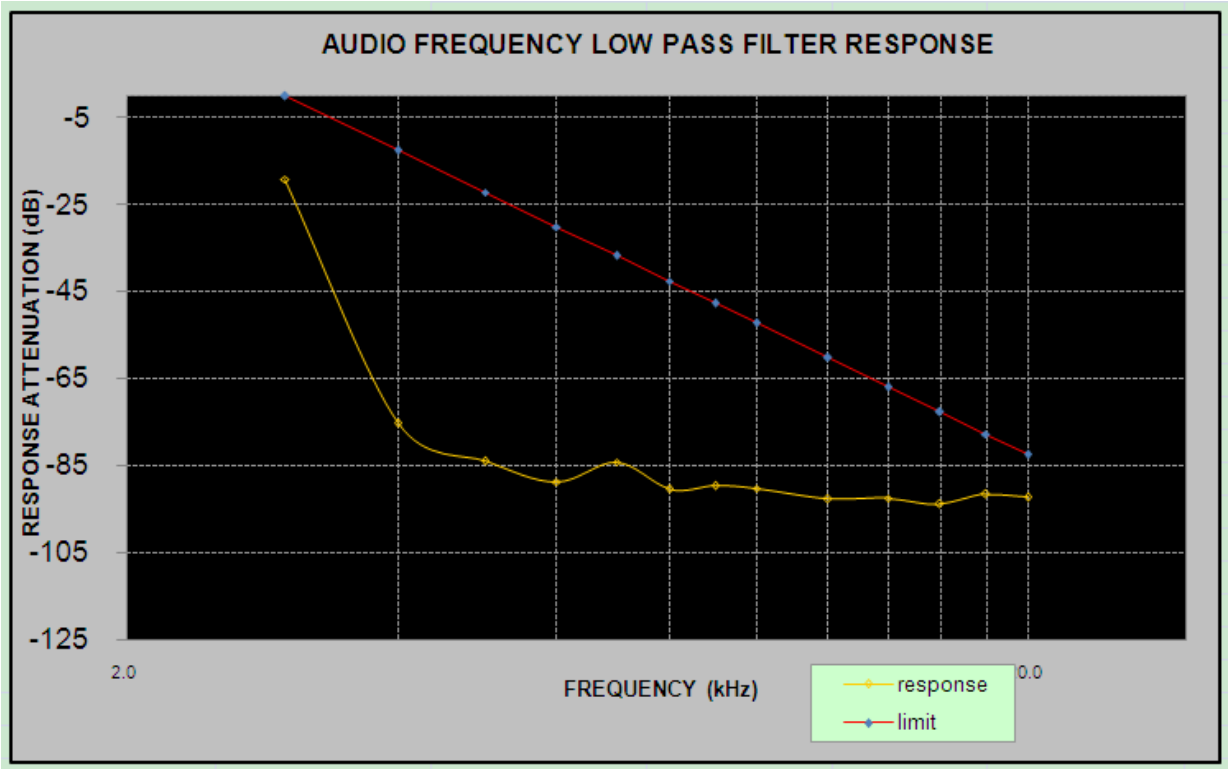
Audio Frequency (Hz)	Response Attenuation (dB)
300	-10.23
400	-7.45
500	-5.38
600	-3.82
700	-2.64
800	-1.37
900	-0.80
1000	0
1200	1.76
1400	2.98
1600	4.29
1800	4.85
2000	5.91
2100	6.17
2200	6.43
2300	7.03
2400	7.28
2500	7.17
2600	6.91
2700	6.74
2800	6.75
2900	6.60
3000	5.90


AUDIO FREQUENCY RESPONSE
RESPONSE ATTENUATION (dB)
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
300
3000
FREQUENCY (Hz)
response
limit1
limit2

Audio frequency lows pass filter response

Carrier Frequency: 454.0250 MHz, Channel Separation=12.5 kHz

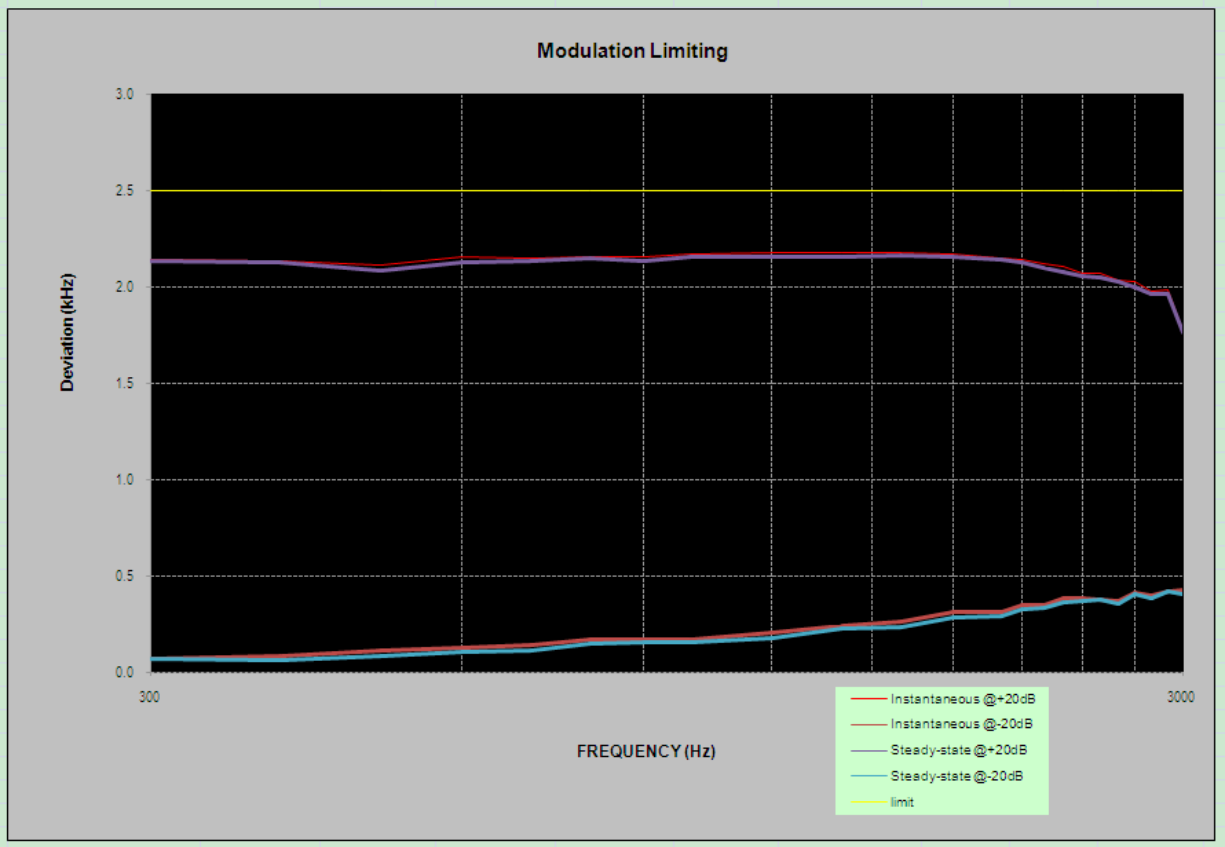
Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-19.1	0
4.0	-75.3	-12.5
5.0	-83.9	-22.2
6.0	-88.7	-30.1
7.0	-84.2	-36.8
8.0	-90.4	-42.6
9.0	-89.6	-47.7
10.0	-90.2	-52.3
12.0	-92.7	-60.2
14.0	-92.5	-66.9
16.0	-93.8	-72.7
18.0	-91.6	-77.8
20.0	-92.3	-82.5



MODULATION LIMITING

Carrier Frequency: 458.2125 MHz, Channel Separation=12.5 kHz

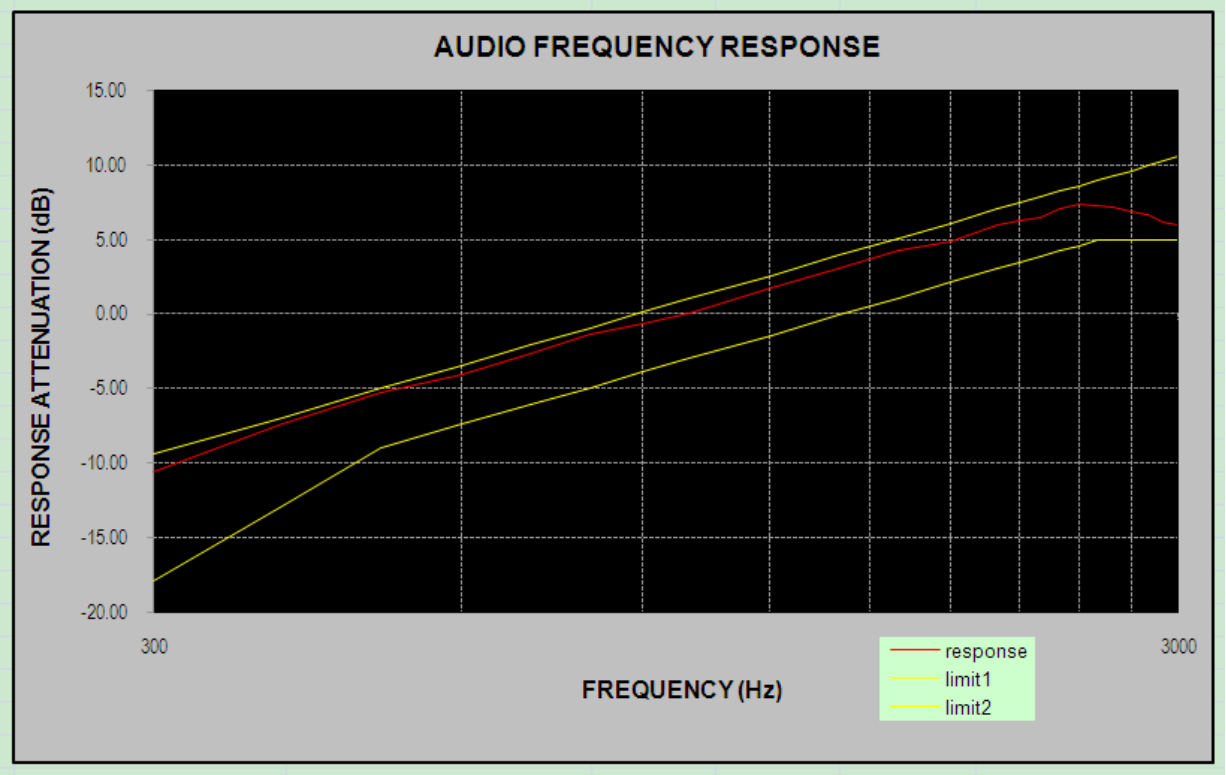
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	2.145	0.075	2.137	0.069	2.5
400	2.136	0.087	2.127	0.063	2.5
500	2.114	0.113	2.087	0.089	2.5
600	2.153	0.132	2.131	0.110	2.5
700	2.148	0.142	2.134	0.113	2.5
800	2.159	0.172	2.146	0.153	2.5
900	2.159	0.171	2.137	0.159	2.5
1000	2.168	0.175	2.155	0.155	2.5
1200	2.181	0.208	2.159	0.180	2.5
1400	2.179	0.246	2.154	0.231	2.5
1600	2.176	0.268	2.161	0.239	2.5
1800	2.168	0.312	2.159	0.287	2.5
2000	2.152	0.316	2.143	0.293	2.5
2100	2.142	0.352	2.125	0.327	2.5
2200	2.123	0.351	2.097	0.334	2.5
2300	2.108	0.383	2.080	0.363	2.5
2400	2.069	0.387	2.057	0.374	2.5
2500	2.067	0.378	2.051	0.376	2.5
2600	2.032	0.369	2.030	0.361	2.5
2700	2.031	0.412	2.001	0.406	2.5
2800	1.978	0.401	1.965	0.387	2.5
2900	1.986	0.425	1.964	0.422	2.5
3000	1.769	0.432	1.762	0.410	2.5


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 @+20dB
Steady-state @-20dB
limit

Audio Frequency Response

Carrier Frequency: 458.2125 MHz, Channel Separation=12.5 kHz

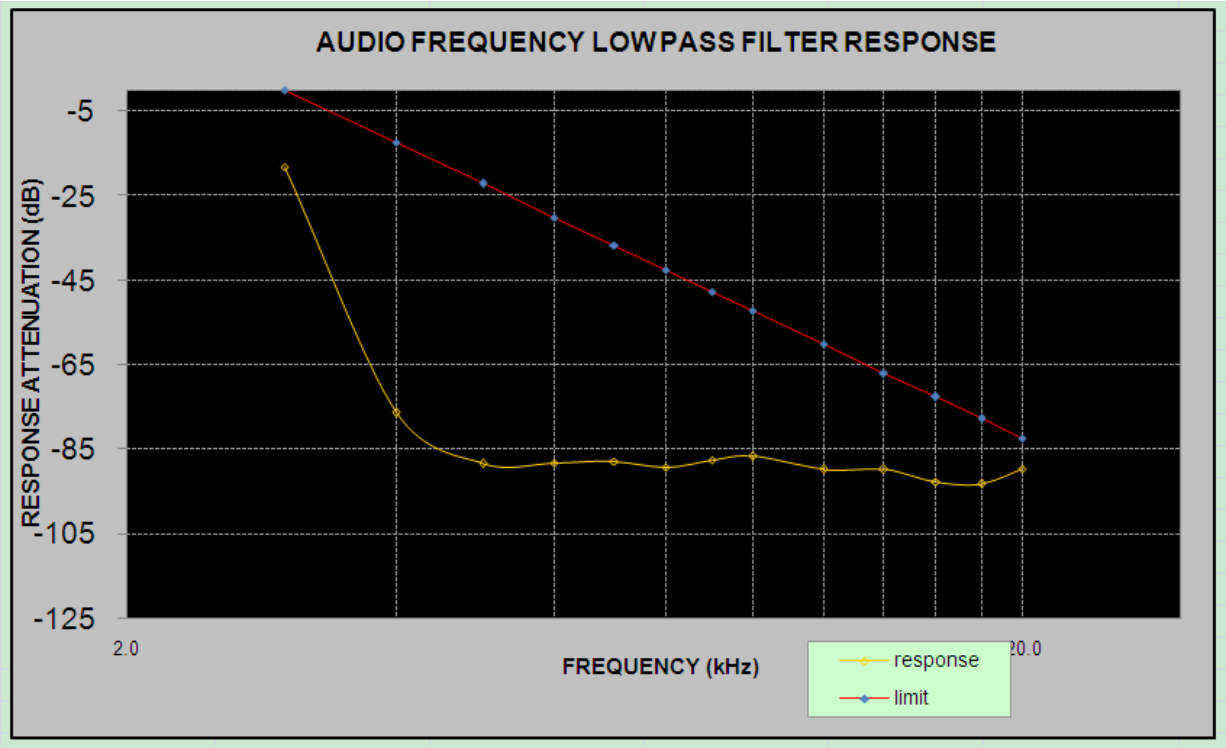
Audio Frequency (Hz)	Response Attenuation (dB)
300	-10.57
400	-7.33
500	-5.32
600	-4.10
700	-2.66
800	-1.37
900	-0.69
1000	0
1200	1.76
1400	3.06
1600	4.29
1800	4.80
2000	5.91
2100	6.20
2200	6.43
2300	7.04
2400	7.38
2500	7.26
2600	7.17
2700	6.83
2800	6.68
2900	6.12
3000	5.92


AUDIO FREQUENCY RESPONSE
RESPONSE ATTENUATION (dB)
15.00
10.00
5.00
0.00
-5.00
-10.00
-15.00
-20.00
300
3000
FREQUENCY (Hz)
response
limit1
limit2

Audio frequency lows pass filter response

Carrier Frequency: 458.2125 MHz, Channel Separation=12.5 kHz

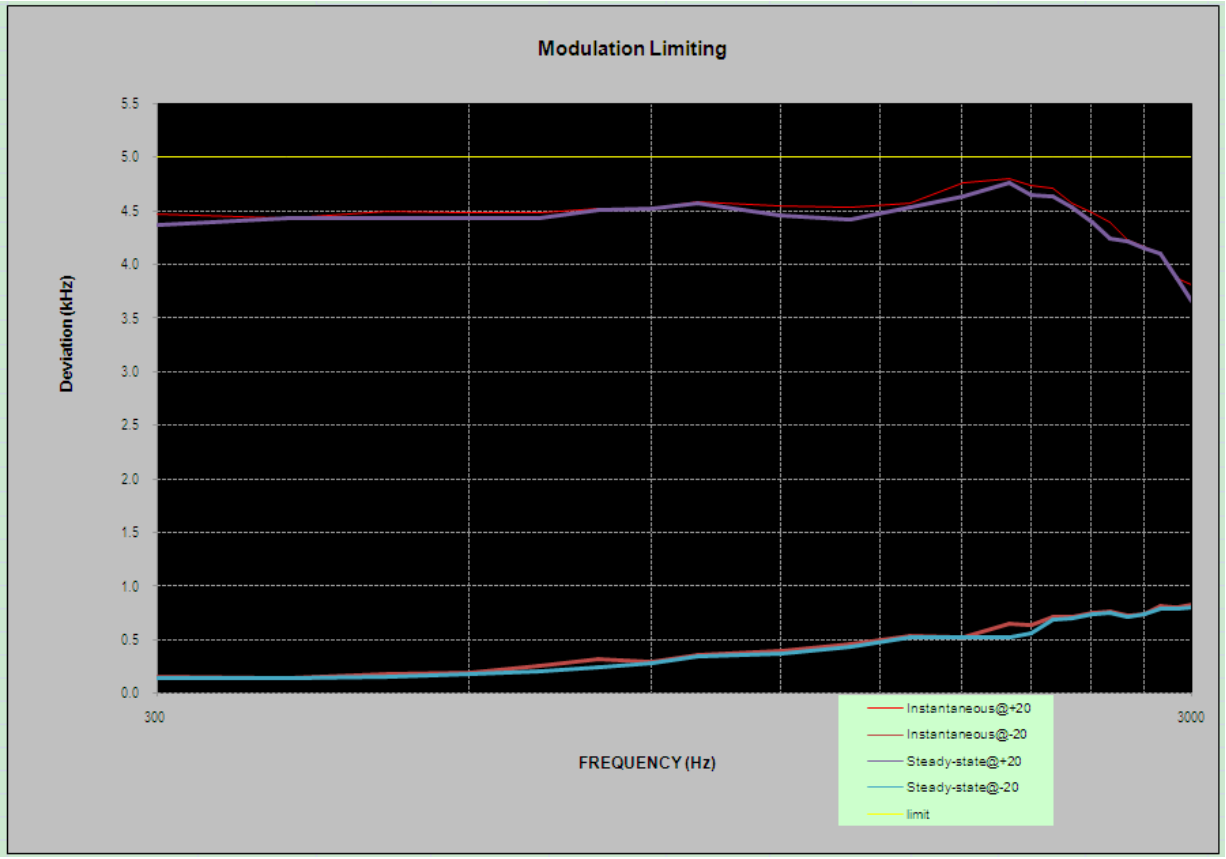
Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-18.3	0
4.0	-76.5	-12.5
5.0	-88.5	-22.2
6.0	-88.3	-30.1
7.0	-87.9	-36.8
8.0	-89.4	-42.6
9.0	-87.6	-47.7
10.0	-86.8	-52.3
12.0	-89.9	-60.2
14.0	-89.9	-66.9
16.0	-92.8	-72.7
18.0	-93.3	-77.8
20.0	-89.6	-82.5



MODULATION LIMITING

Carrier Frequency: 463.0125 MHz, Channel Separation=25 kHz

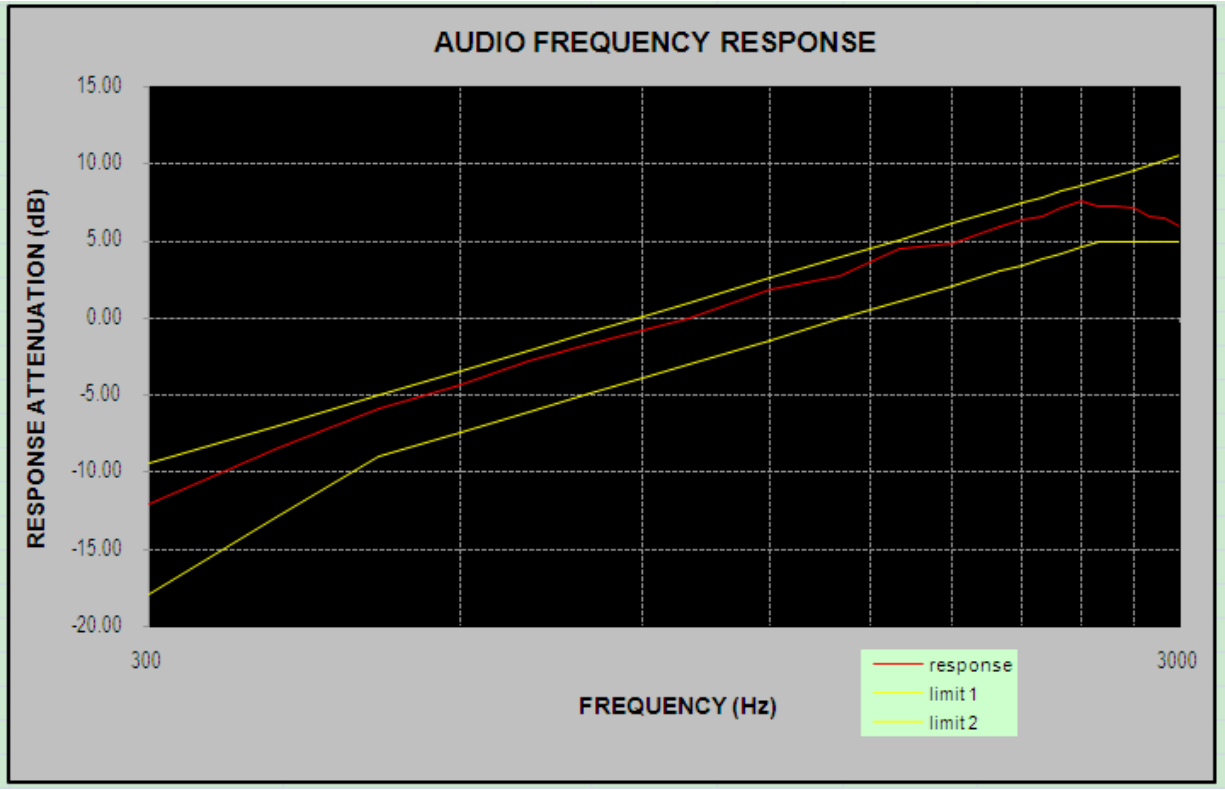
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	4.465	0.163	4.367	0.138	5
400	4.435	0.145	4.428	0.143	5
500	4.502	0.187	4.426	0.152	5
600	4.487	0.201	4.435	0.182	5
700	4.488	0.263	4.428	0.213	5
800	4.526	0.321	4.513	0.247	5
900	4.527	0.298	4.516	0.287	5
1000	4.587	0.356	4.568	0.345	5
1200	4.542	0.397	4.462	0.375	5
1400	4.528	0.458	4.425	0.431	5
1600	4.567	0.542	4.528	0.521	5
1800	4.765	0.524	4.639	0.521	5
2000	4.800	0.653	4.763	0.526	5
2100	4.738	0.645	4.647	0.569	5
2200	4.707	0.714	4.639	0.695	5
2300	4.568	0.721	4.529	0.705	5
2400	4.482	0.752	4.396	0.735	5
2500	4.396	0.768	4.237	0.748	5
2600	4.234	0.731	4.214	0.715	5
2700	4.165	0.745	4.152	0.735	5
2800	4.105	0.814	4.102	0.796	5
2900	3.879	0.809	3.869	0.788	5
3000	3.815	0.825	3.659	0.805	5


Modulation Limiting
Deviation (kHz)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
3000
FREQUENCY (Hz)
Instantaneous@+20
Instantaneous@-20
Steady-state@+20
Steady-state@-20
limit

Audio Frequency Response

Carrier Frequency: 463.0125 MHz, Channel Separation=25 kHz

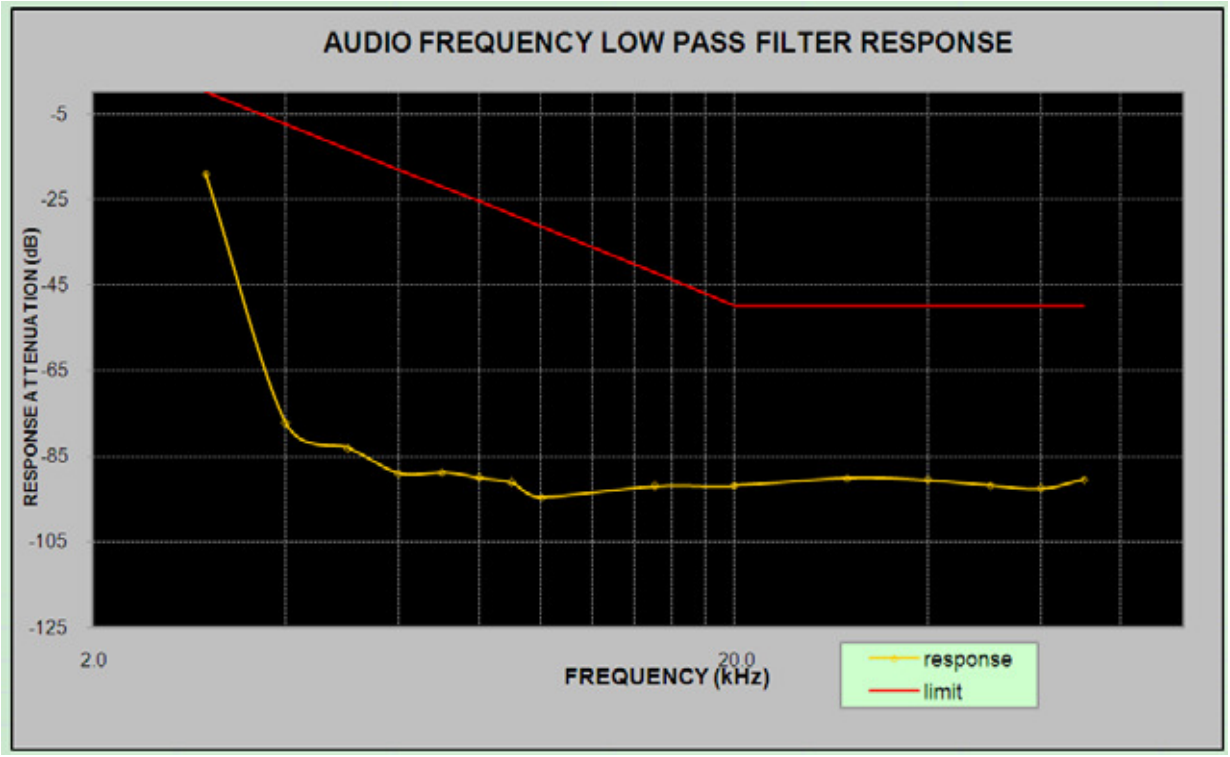
Audio Frequency (Hz)	Response Attenuation (dB)
300	-12.01
400	-8.45
500	-5.83
600	-4.31
700	-2.75
800	-1.68
900	-0.77
1000	0
1200	1.81
1400	2.70
1600	4.54
1800	4.84
2000	5.96
2100	6.34
2200	6.64
2300	7.18
2400	7.55
2500	7.28
2600	7.23
2700	7.11
2800	6.63
2900	6.43
3000	5.96


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

Audio frequency lows pass filter response

Carrier Frequency: 463.0125 MHz, Channel Separation=25 kHz

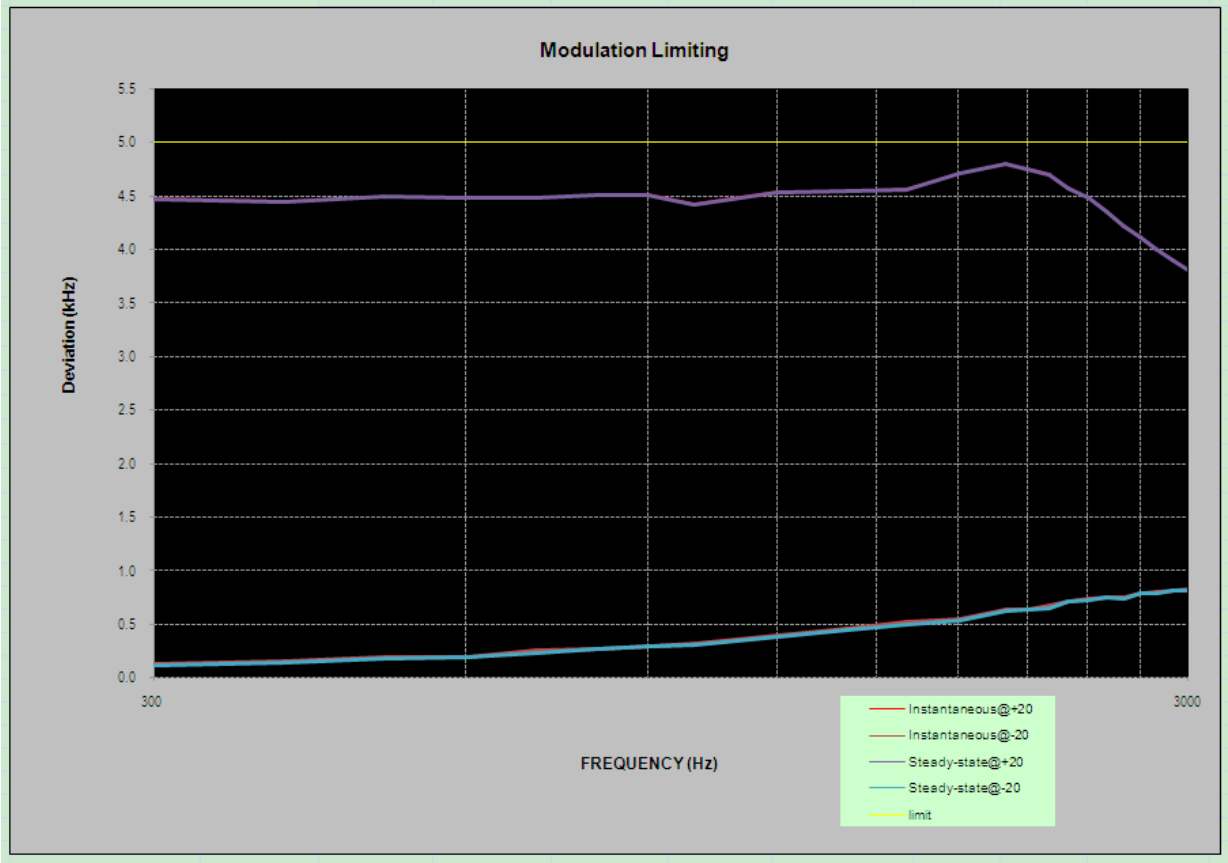
Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-19.1	0
4.0	-77.4	-7.5
5.0	-83.1	-13.3
6.0	-89.0	-18.1
7.0	-88.8	-22.1
8.0	-90.0	-25.6
9.0	-91.2	-28.6
10.0	-94.6	-31.4
15.0	-92.0	-41.9
20.0	-91.9	-50.0
30.0	-90.1	-50.0
40.0	-90.6	-50.0
50.0	-91.8	-50.0



MODULATION LIMITING

Carrier Frequency: 450.0125 MHz, Channel Separation=25 kHz

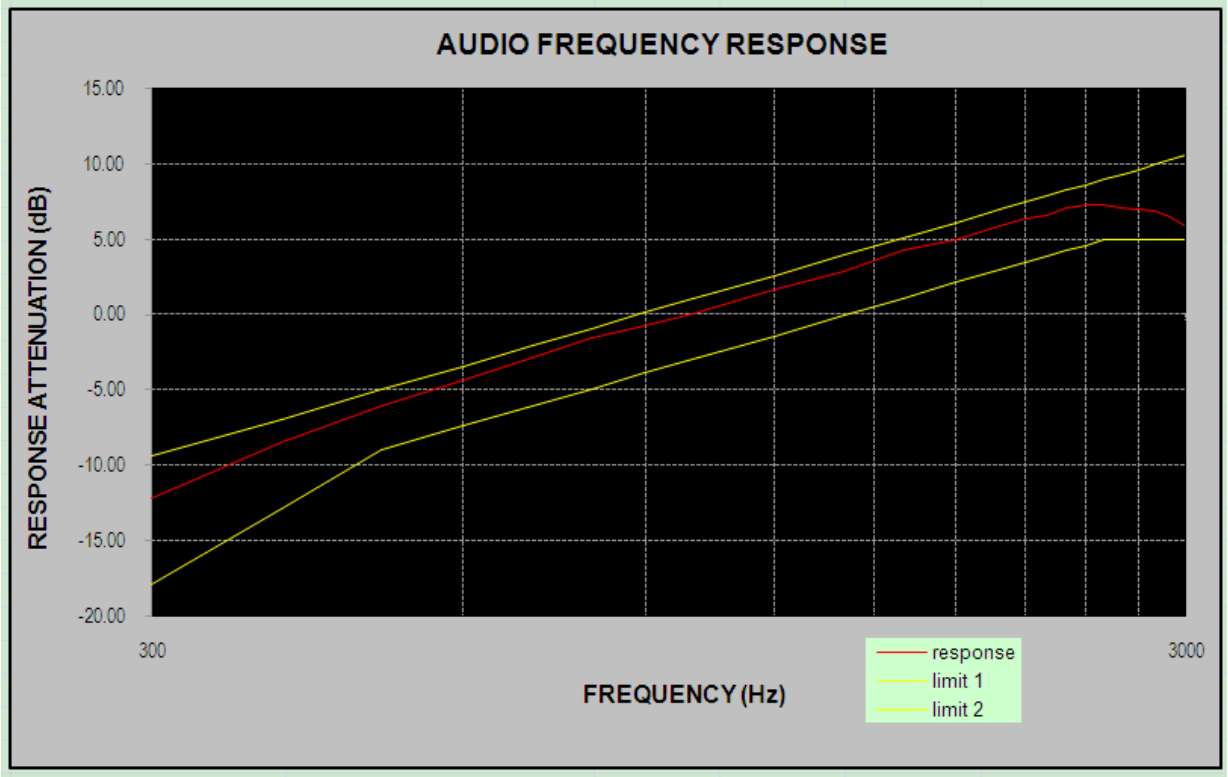
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	4.481	0.127	4.473	0.116	5
400	4.458	0.151	4.444	0.148	5
500	4.502	0.194	4.492	0.177	5
600	4.489	0.198	4.483	0.197	5
700	4.488	0.257	4.486	0.238	5
800	4.512	0.277	4.510	0.268	5
900	4.527	0.300	4.513	0.294	5
1000	4.434	0.321	4.418	0.315	5
1200	4.542	0.396	4.532	0.384	5
1400	4.552	0.462	4.541	0.448	5
1600	4.567	0.521	4.554	0.503	5
1800	4.715	0.550	4.709	0.541	5
2000	4.800	0.634	4.798	0.624	5
2100	4.764	0.645	4.750	0.640	5
2200	4.707	0.673	4.701	0.653	5
2300	4.588	0.710	4.577	0.709	5
2400	4.482	0.745	4.480	0.728	5
2500	4.374	0.757	4.359	0.752	5
2600	4.234	0.758	4.221	0.746	5
2700	4.132	0.795	4.118	0.788	5
2800	4.005	0.805	4.005	0.786	5
2900	3.900	0.818	3.898	0.814	5
3000	3.815	0.823	3.810	0.816	5


Modulation Limiting
Deviation (kHz)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
3000
FREQUENCY (Hz)
Instantaneous@+20
Instantaneous@-20
Steady-state@+20
Steady-state@-20
limit

Audio Frequency Response

Carrier Frequency: 450.0125 MHz, Channel Separation=25 kHz

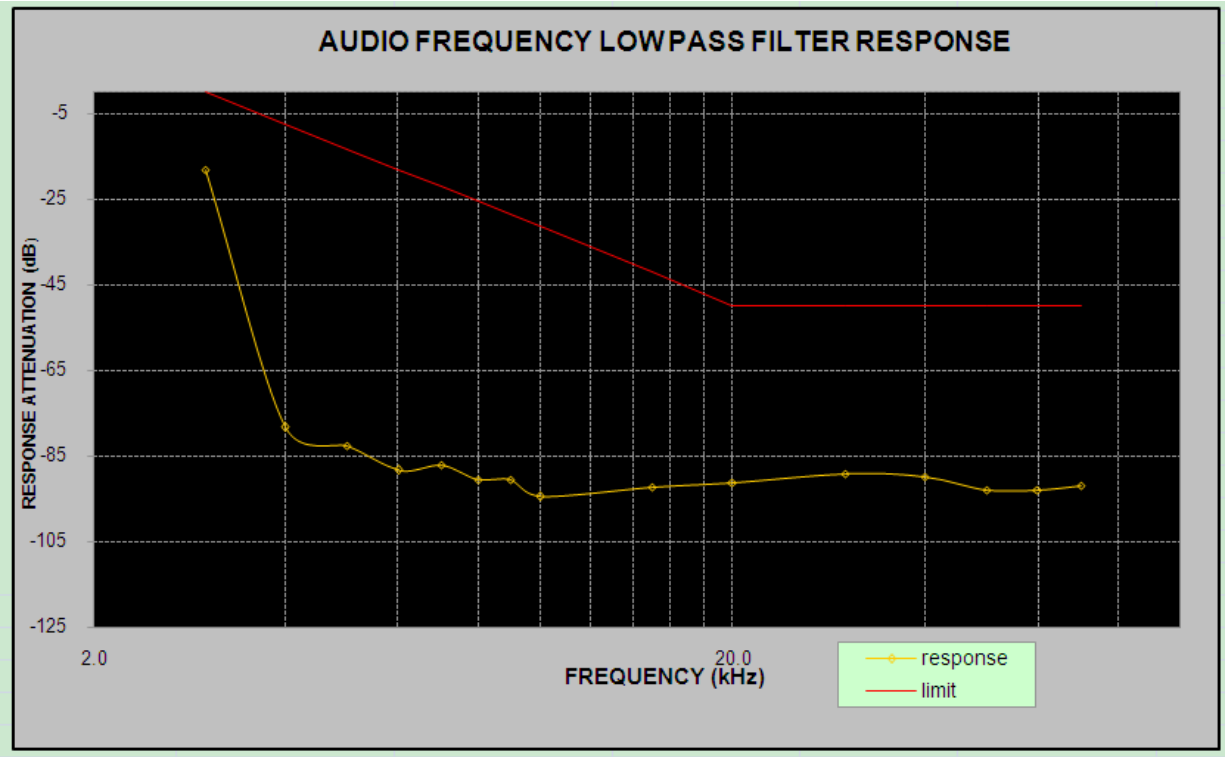
Audio Frequency (Hz)	Response Attenuation (dB)
300	-12.22
400	-8.47
500	-6.09
600	-4.41
700	-2.83
800	-1.60
900	-0.77
1000	0.00
1200	1.68
1400	2.87
1600	4.27
1800	4.97
2000	5.92
2100	6.31
2200	6.59
2300	7.07
2400	7.27
2500	7.20
2600	7.02
2700	6.93
2800	6.83
2900	6.40
3000	5.89


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

Audio frequency lows pass filter response

Carrier Frequency: 450.0125 MHz, Channel Separation=25 kHz

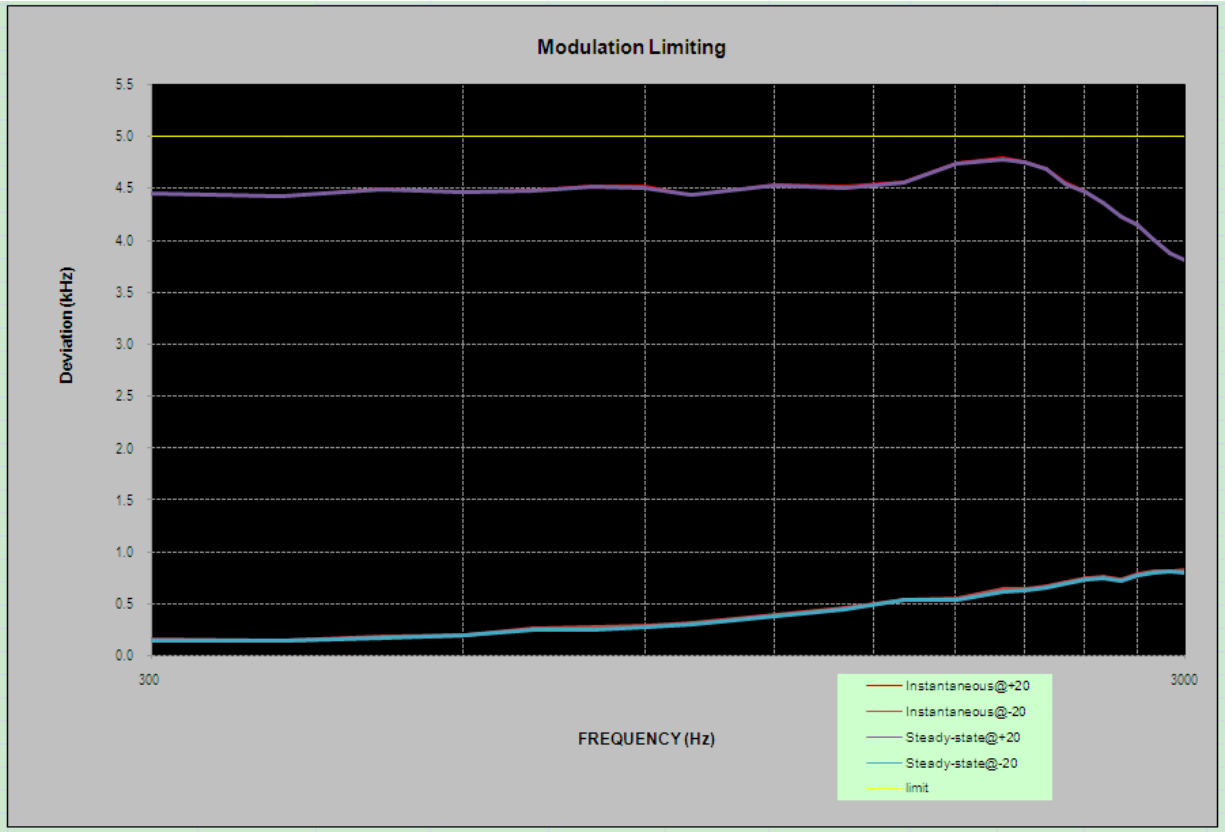
Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-18.3	0
4.0	-78.4	-7.5
5.0	-82.8	-13.3
6.0	-88.4	-18.1
7.0	-87.3	-22.1
8.0	-90.5	-25.6
9.0	-90.6	-28.6
10.0	-94.6	-31.4
15.0	-92.3	-41.9
20.0	-91.2	-50.0
30.0	-89.3	-50.0
40.0	-89.9	-50.0
50.0	-92.9	-50.0



MODULATION LIMITING

Carrier Frequency: 454.0250 MHz, Channel Separation=25 kHz

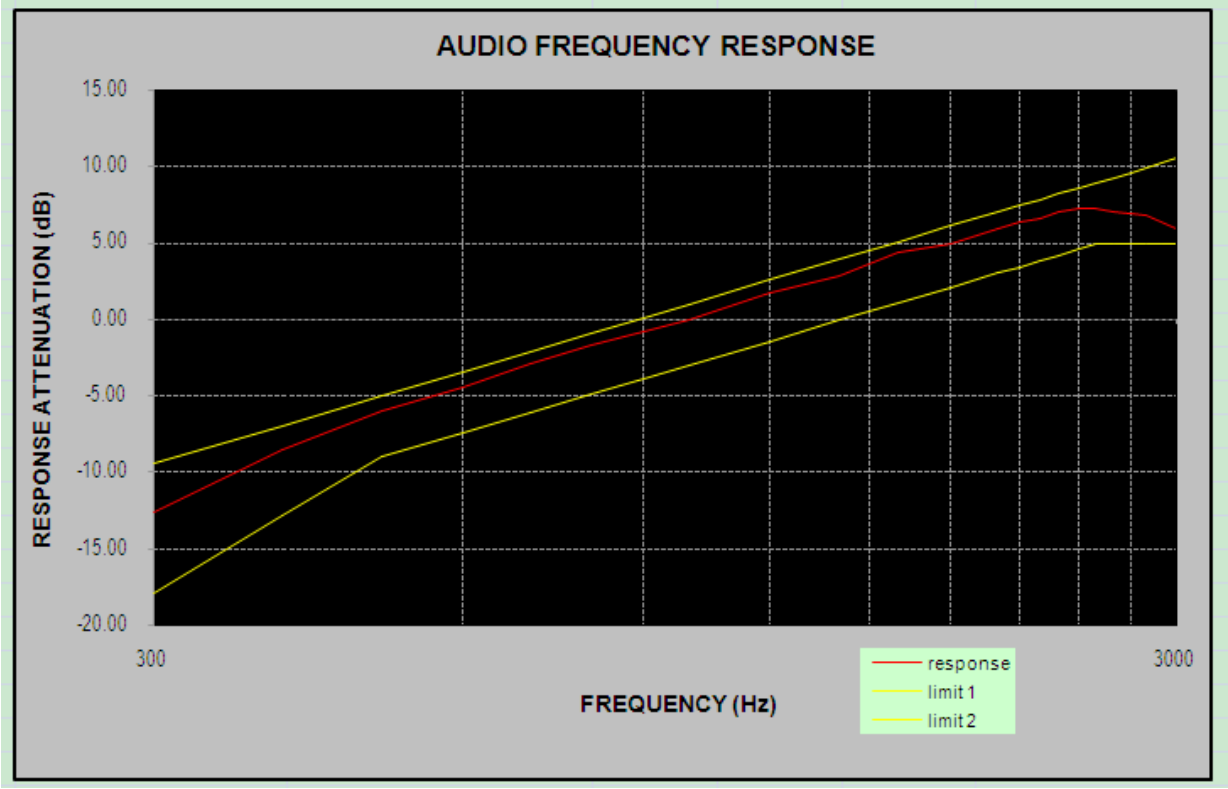
Audio Frequency (Hz)	Instantaneous		Steady-state		FCC Limit [kHz]
	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	DEVIATION (@+20dB) [kHz]	DEVIATION (@-20dB) [kHz]	
300	4.456	0.163	4.454	0.148	5
400	4.428	0.151	4.426	0.146	5
500	4.502	0.187	4.494	0.174	5
600	4.469	0.198	4.463	0.195	5
700	4.488	0.263	4.478	0.247	5
800	4.526	0.277	4.522	0.259	5
900	4.527	0.298	4.508	0.283	5
1000	4.436	0.321	4.435	0.303	5
1200	4.542	0.397	4.532	0.387	5
1400	4.526	0.462	4.507	0.445	5
1600	4.567	0.542	4.552	0.534	5
1800	4.751	0.550	4.745	0.547	5
2000	4.800	0.642	4.781	0.623	5
2100	4.768	0.645	4.760	0.638	5
2200	4.707	0.668	4.691	0.661	5
2300	4.568	0.710	4.549	0.700	5
2400	4.482	0.752	4.468	0.738	5
2500	4.365	0.757	4.362	0.750	5
2600	4.234	0.731	4.227	0.721	5
2700	4.165	0.795	4.151	0.778	5
2800	4.005	0.814	4.002	0.808	5
2900	3.896	0.818	3.880	0.817	5
3000	3.815	0.825	3.809	0.806	5


Modulation Limiting
Deviation (kHz)
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
300
3000
FREQUENCY (Hz)
Instantaneous@+20
Instantaneous@-20
Steady-state@+20
Steady-state@-20
limit

Audio Frequency Response

Carrier Frequency: 454.0250 MHz, Channel Separation=25 kHz

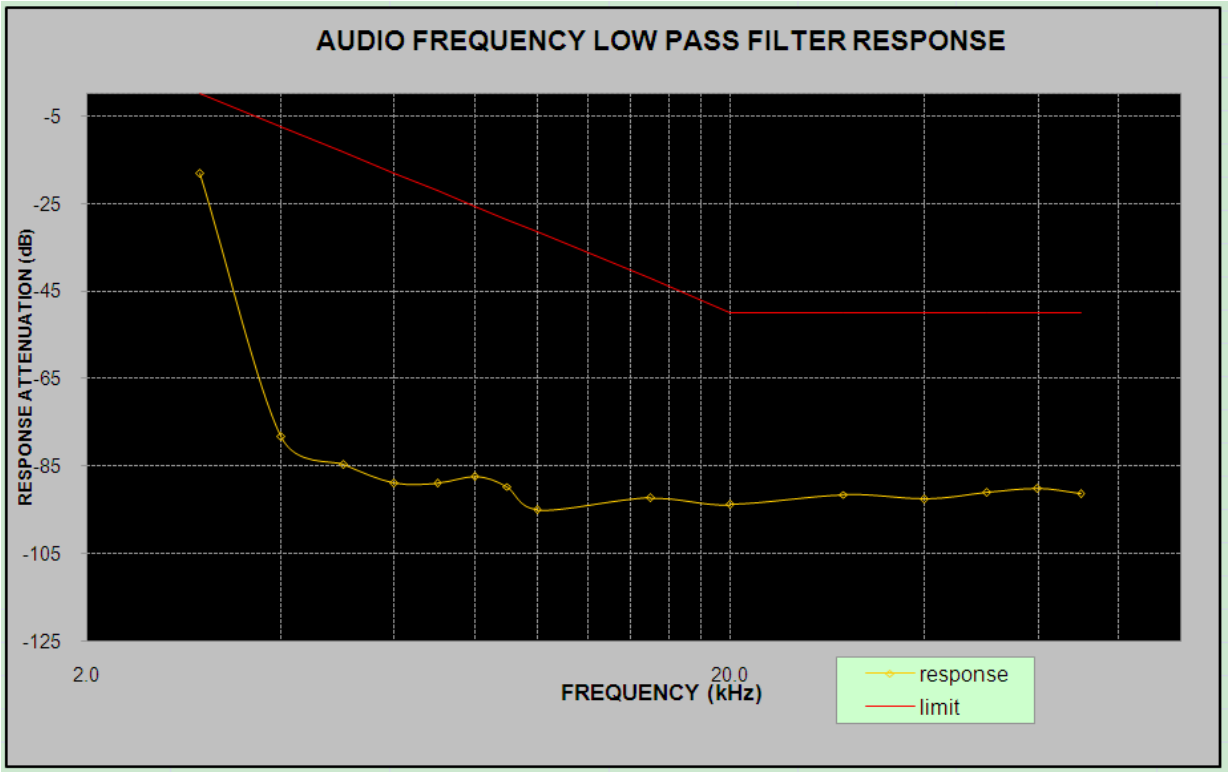
Audio Frequency (Hz)	Response Attenuation (dB)
300	-12.62
400	-8.57
500	-6.04
600	-4.42
700	-2.94
800	-1.67
900	-0.77
1000	0
1200	1.68
1400	2.87
1600	4.37
1800	4.97
2000	5.88
2100	6.31
2200	6.58
2300	7.07
2400	7.28
2500	7.22
2600	7.00
2700	6.93
2800	6.83
2900	6.33
3000	5.92


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

Audio frequency lows pass filter response

Carrier Frequency: 454.025 MHz, Channel Separation=25 kHz

Audio Frequency (kHz)	Response Attenuation (dB)	Limit (dB)
1.0	0	/
3.0	-18.2	0
4.0	-78.3	-7.5
5.0	-84.7	-13.3
6.0	-88.8	-18.1
7.0	-88.9	-22.1
8.0	-87.4	-25.6
9.0	-89.6	-28.6
10.0	-95.0	-31.4
15.0	-92.2	-41.9
20.0	-93.8	-50.0
30.0	-91.4	-50.0
40.0	-92.5	-50.0
50.0	-91.0	-50.0



FCC §2.1049 & §22.357 & § 22.731 & §74.462 & § 80.205 & § 80.207 & §90.209 & §90.210 – OCCUPIED BANDWIDTH & EMISSION MASK

Applicable Standard

FCC §2.1049, §22.357, § 22.731, §74.462, § 80.205, § 80.207, §90.209 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.

Emission Mask B - 25 kHz channel bandwidth equipment. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 30 kHz or more. In the 60 kHz bands immediately outside and adjacent to the authorized frequency range or channel, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e., 30 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

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 or 300 Hz and the span of spectrum was set for enough to view sideband spectrum.

Test Data

Environmental Conditions

Temperature:	24~26 ℃
Relative Humidity:	50~57 %
ATM Pressure:	100.0~101.0 kPa

The testing was performed by Xiangguang Kong from 2017-12-13 to 2017-12-14.

Test mode: transimitting

Modulation	Channel Separation (kHz)	Frequency (MHz)	Power Level	99% Occupied Bandwidth (kHz)	26 dB Emissions Bandwidth (kHz)	Note
Analog	12.5	450.0125	High	9.936	10.337	For Part 74
			Low	9.936	10.337	
	12.5	454.025	High	9.936	10.337	For Part22
			Low	9.936	10.337	
	12.5	458.2125	High	9.936	10.337	For Part 90
			Low	9.936	10.337	
Digital	12.5	450.0125	High	7.933	9.776	For Part 74
			Low	7.772	9.375	
	12.5	454.025	High	7.772	9.856	For Part22
			Low	7.692	9.215	
	12.5	458.2125	High	7.772	9.135	For Part 90
			Low	7.612	9.776	

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

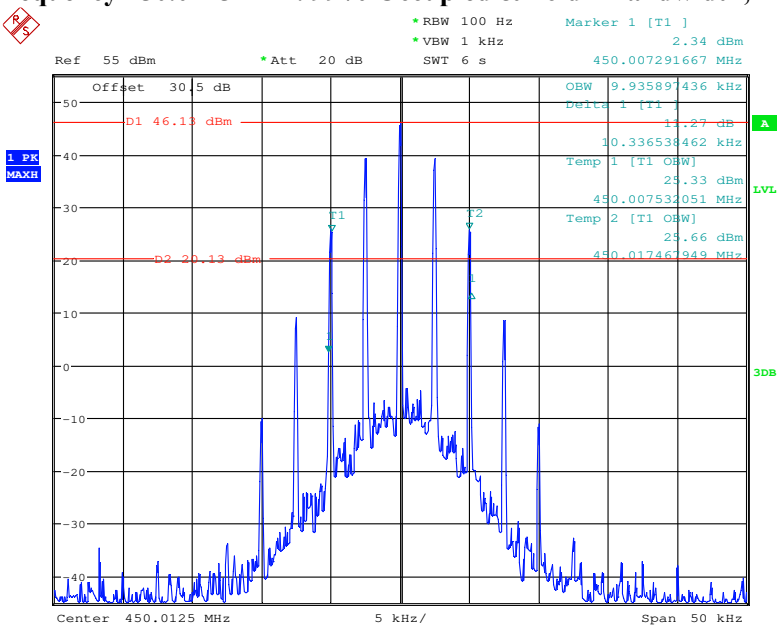
Emission Designator Per CFR 47 §2.201& §2.202&, Bn = 2M + 2D

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, 7.93 kHz. The emission mask was obtained from 47CFR 90.210(d).
F1D and F1E portion of the designator indicates digital information.
Therefore, the entire designator for 12.5 kHz channel spacing digital mode is 7K60F1D and 7K60F1E.

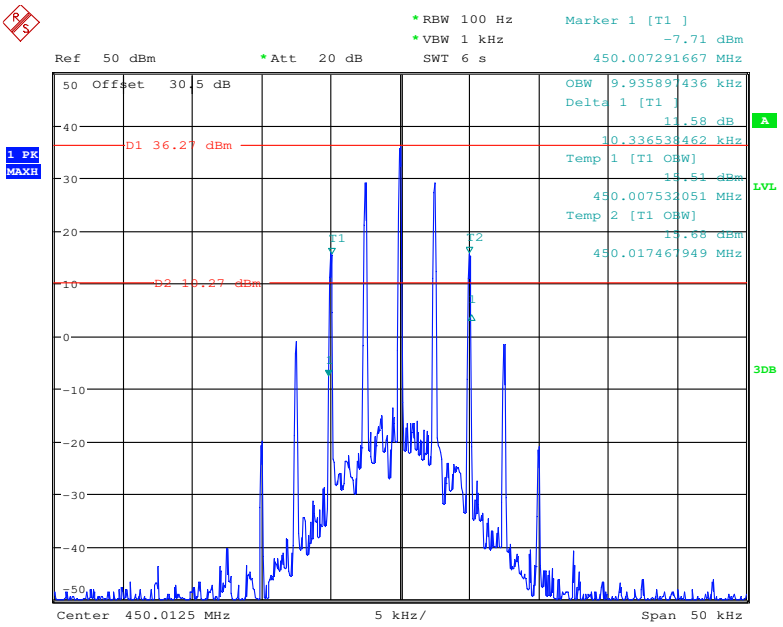
Analog Modulation:

Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



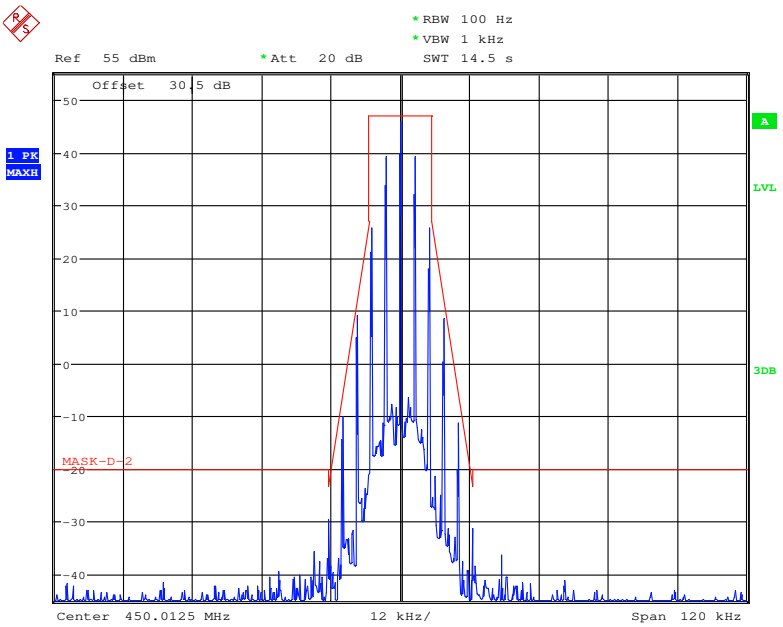
Date: 13.DEC.2017 22:42:44

Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



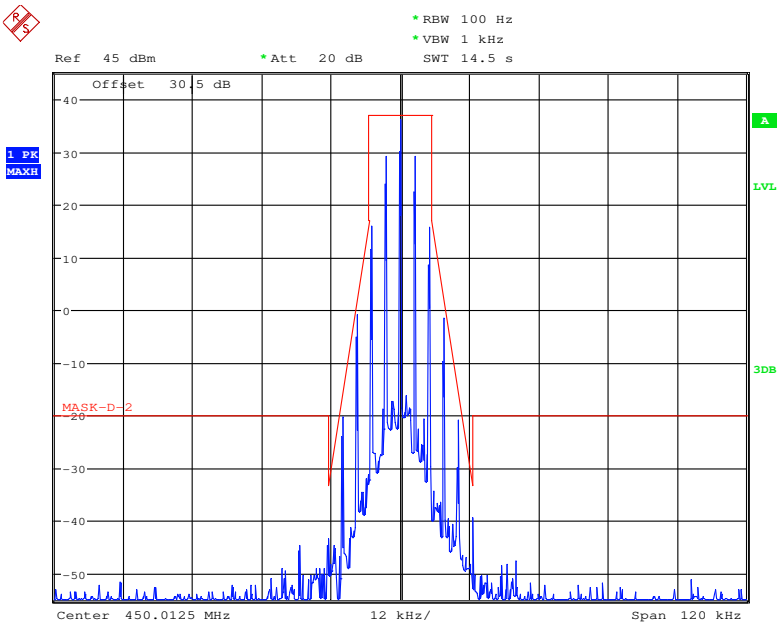
Date: 13.DEC.2017 22:35:52

Frequency 450.0125 MHz: Emission Mask, High Power, FCC part 74.462



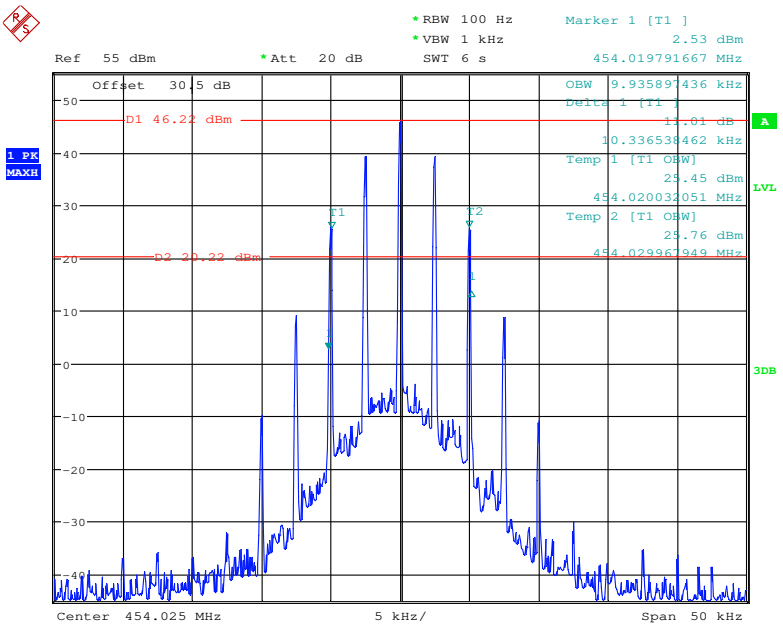
Date: 13.DEC.2017 23:59:14

Frequency 450.0125 MHz: Emission Mask, Low Power, FCC part 74.462



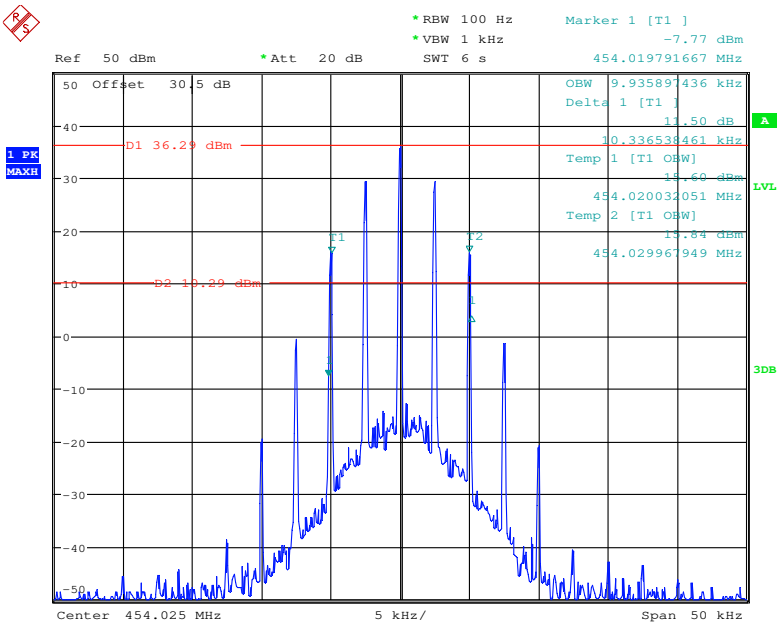
Date: 14.DEC.2017 00:27:05

Frequency 454.025 MHz: 99% Occupied & 26 dB Bandwidth, High Power



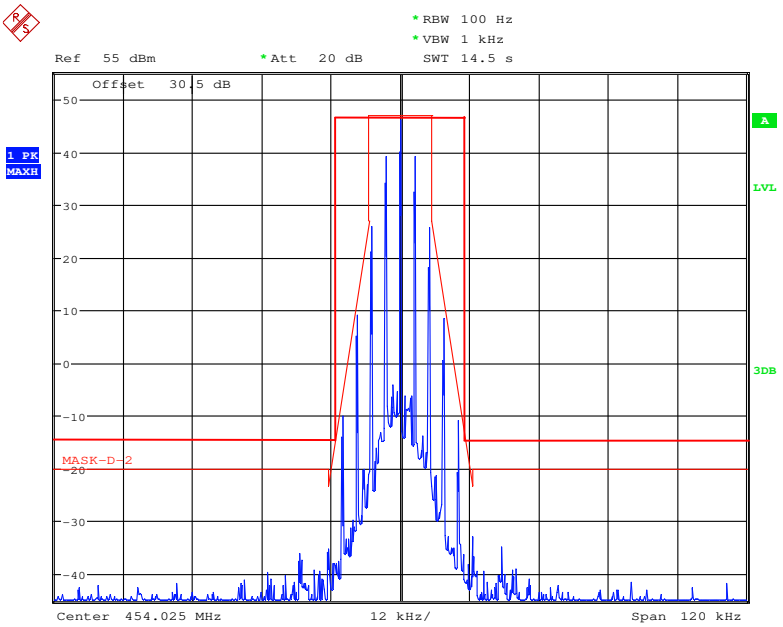
Date: 13.DEC.2017 22:45:59

Frequency 454.025 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



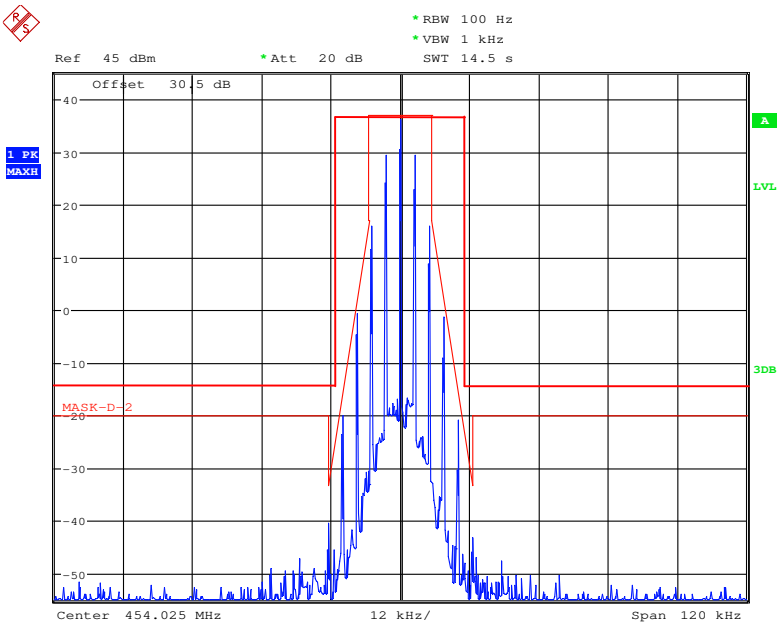
Date: 13.DEC.2017 22:47:14

Frequency 454.025 MHz: Emission Mask, High Power, FCC part 22.359



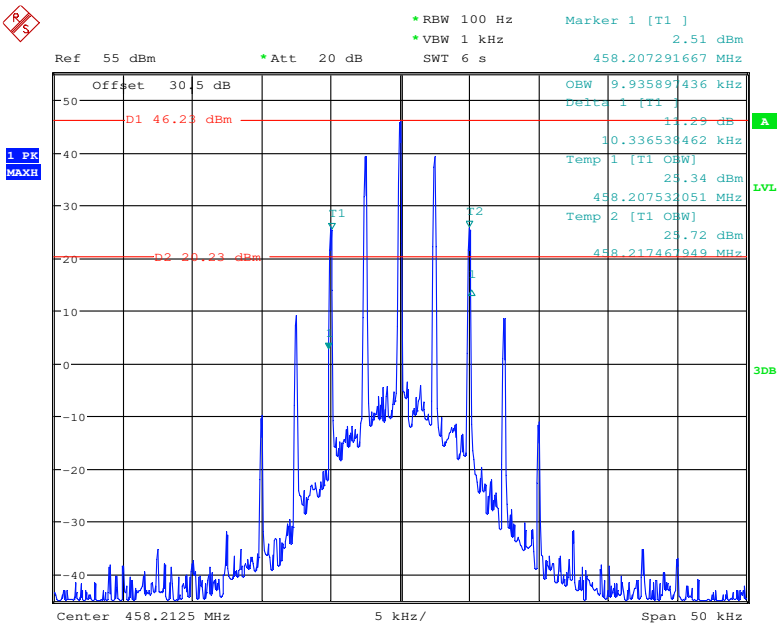
Date: 13.DEC.2017 23:57:26

Frequency 454.025 MHz: Emission Mask, Low Power, FCC part 22.359



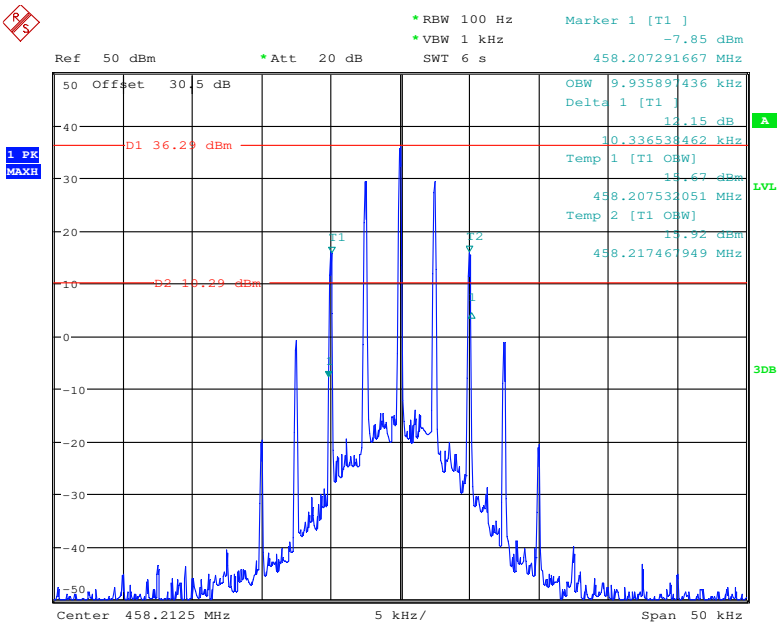
Date: 14.DEC.2017 00:28:41

Frequency 458.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



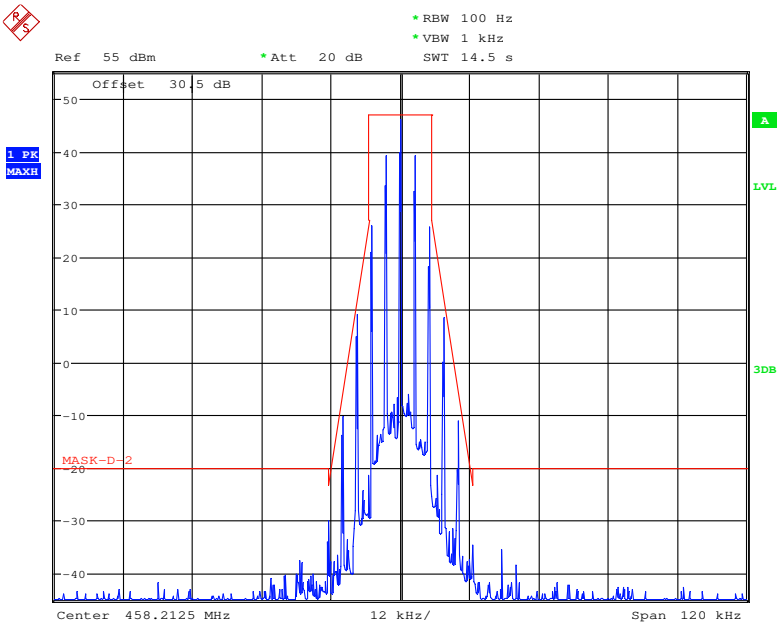
Date: 13.DEC.2017 22:49:35

Frequency 458.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



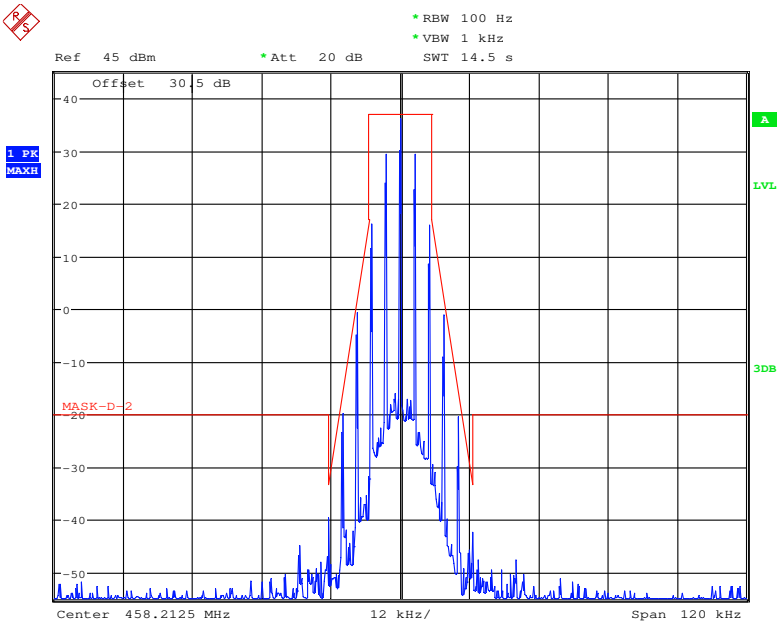
Date: 13.DEC.2017 22:48:21

Frequency 458.2125 MHz: Emission Mask D, High Power



Date: 14.DEC.2017 00:01:10

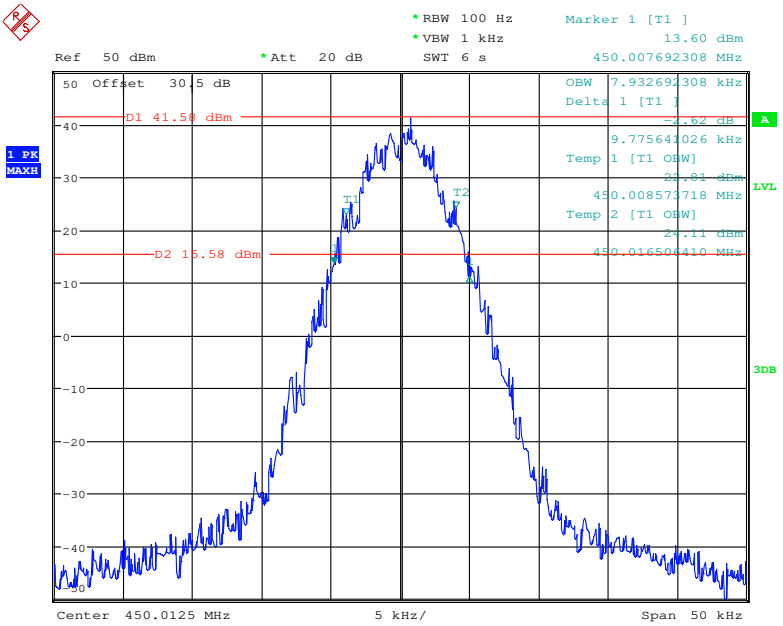
Frequency 458.2125 MHz: Emission Mask D, Low Power



Date: 14.DEC.2017 00:24:46

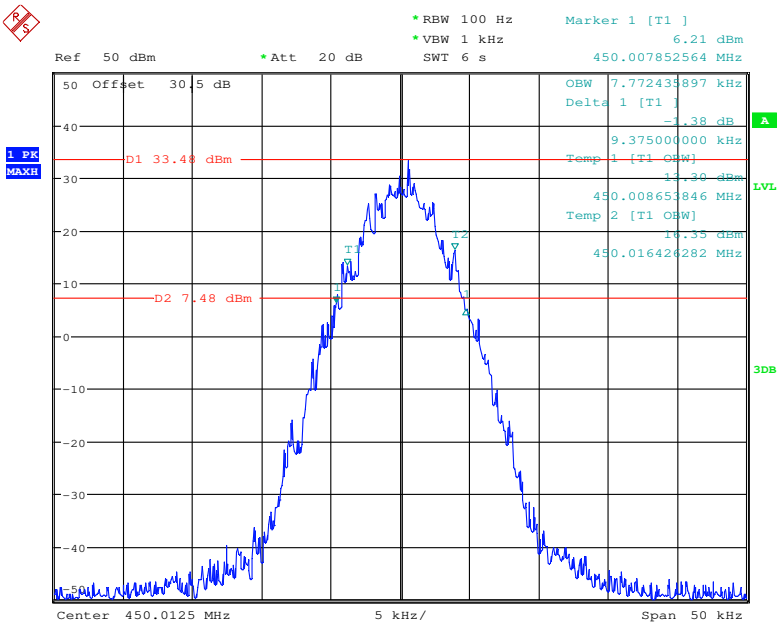
Digital Modulation:

Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



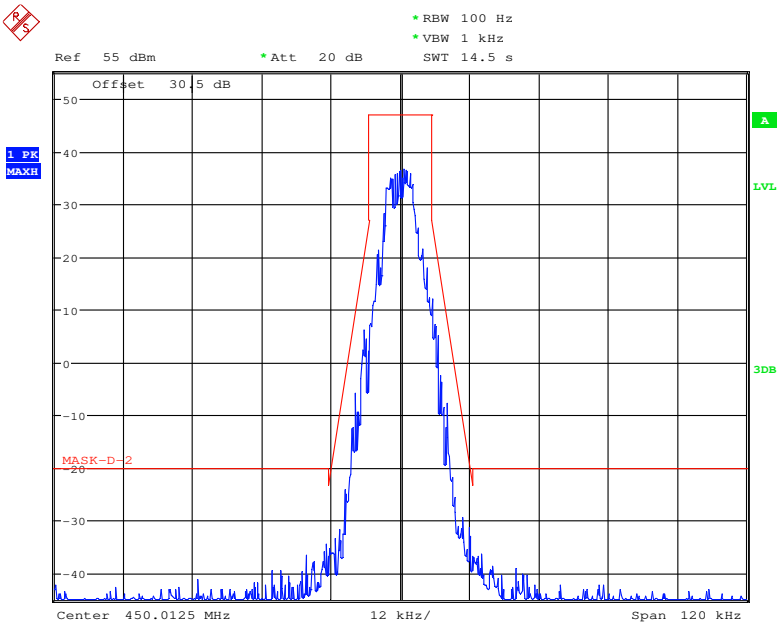
Date: 13.DEC.2017 22:03:49

Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



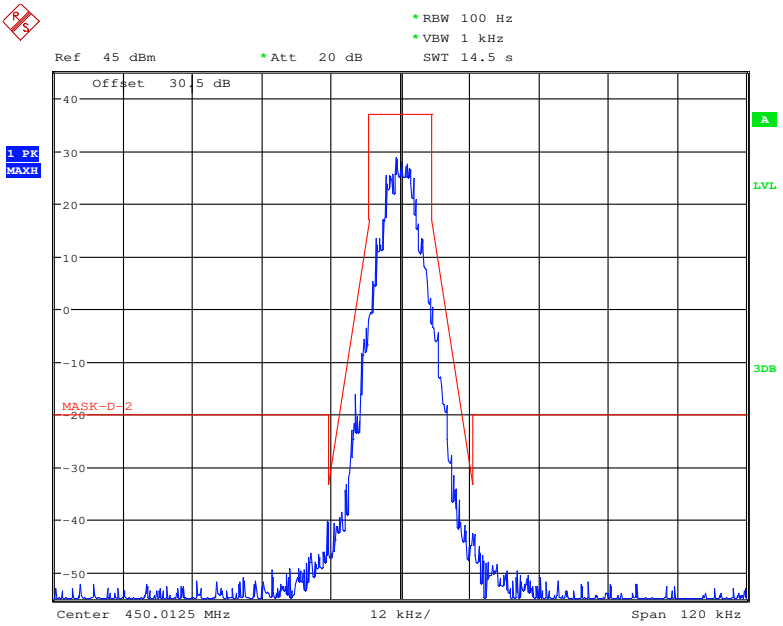
Date: 13.DEC.2017 22:08:49

Frequency 450.0125 MHz: Emission Mask, High Power, FCC part 74.462



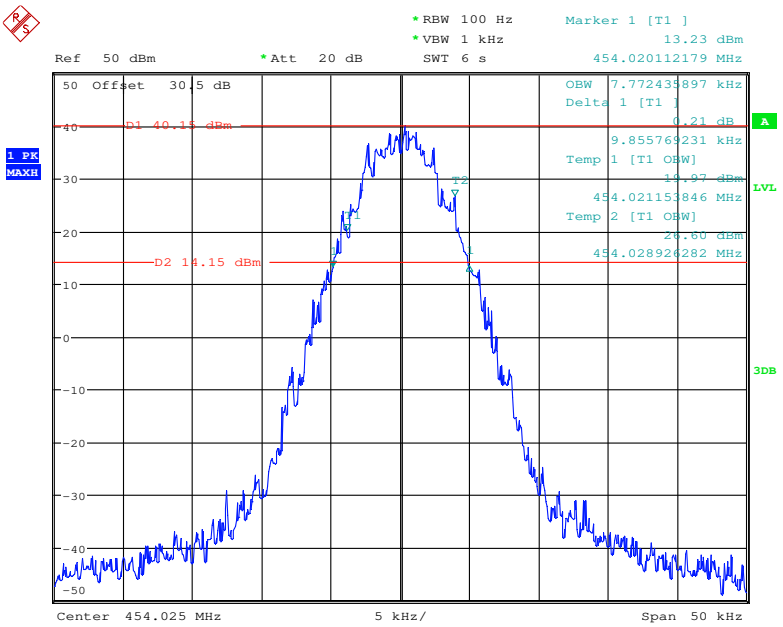
Date: 14.DEC.2017 00:07:43

Frequency 450.0125 MHz: Emission Mask, Low Power, FCC part 74.462



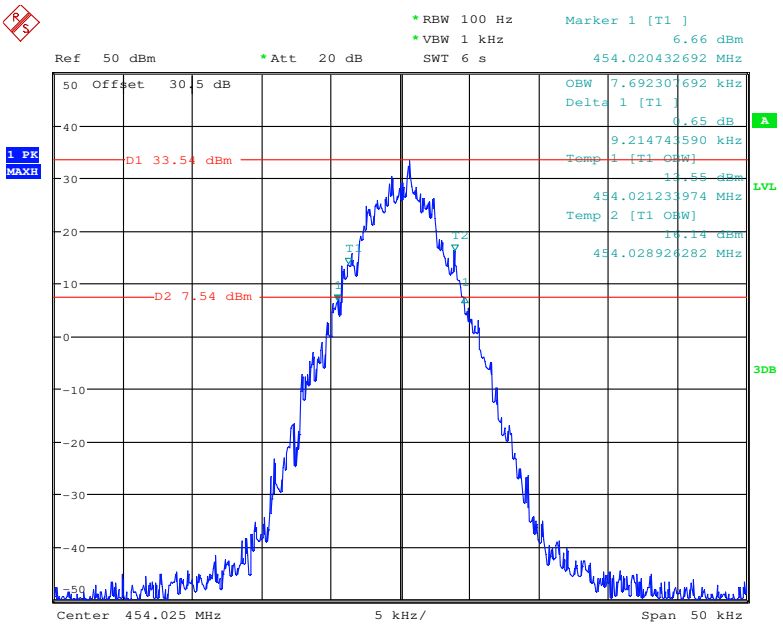
Date: 14.DEC.2017 00:16:50

Frequency 454.025 MHz: 99% Occupied & 26 dB Bandwidth, High Power



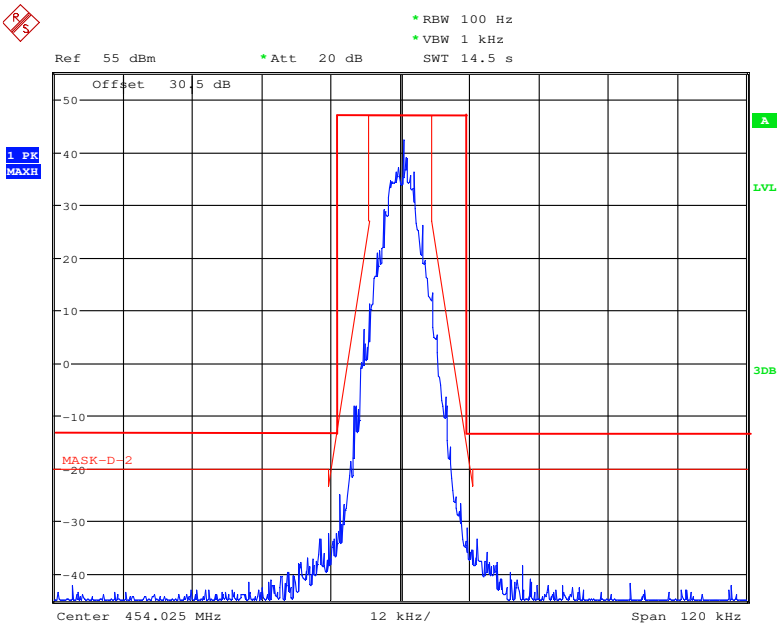
Date: 13.DEC.2017 22:13:24

Frequency 454.025 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



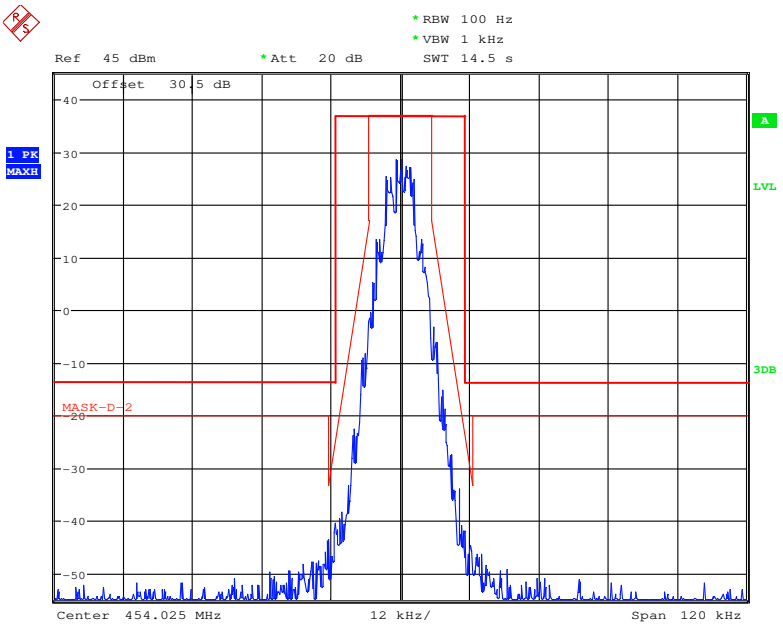
Date: 13.DEC.2017 22:11:16

Frequency 454.025 MHz: Emission Mask, High Power, FCC part 22.359



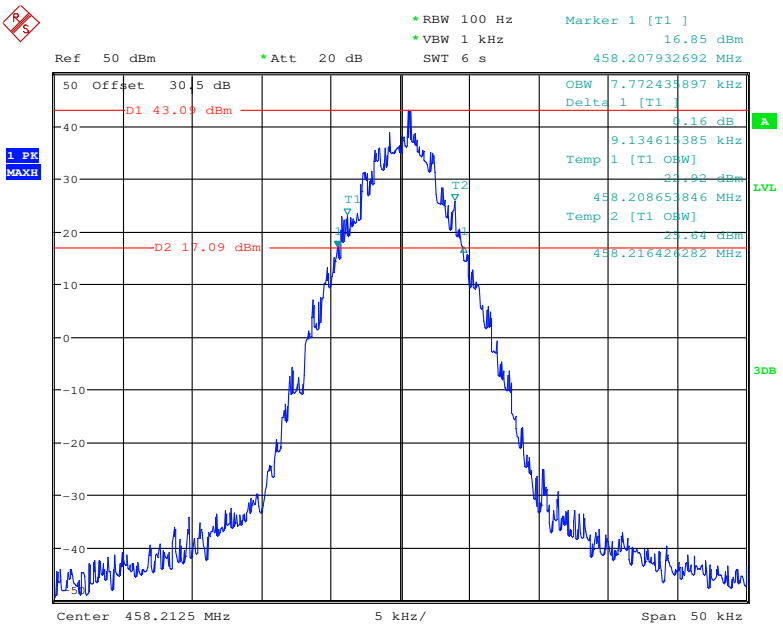
Date: 14.DEC.2017 00:09:01

Frequency 454.025 MHz: Emission Mask, Low Power, FCC part 22.359



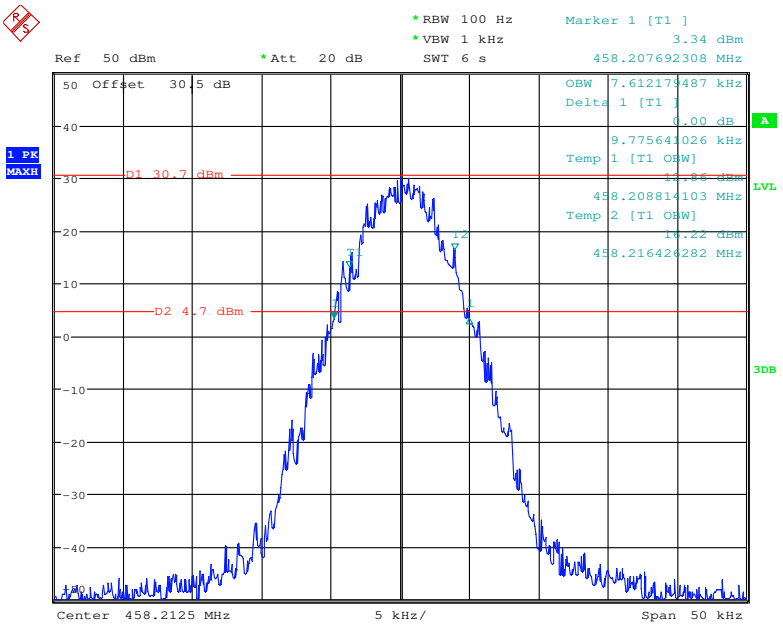
Date: 14.DEC.2017 00:13:50

Frequency 458.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



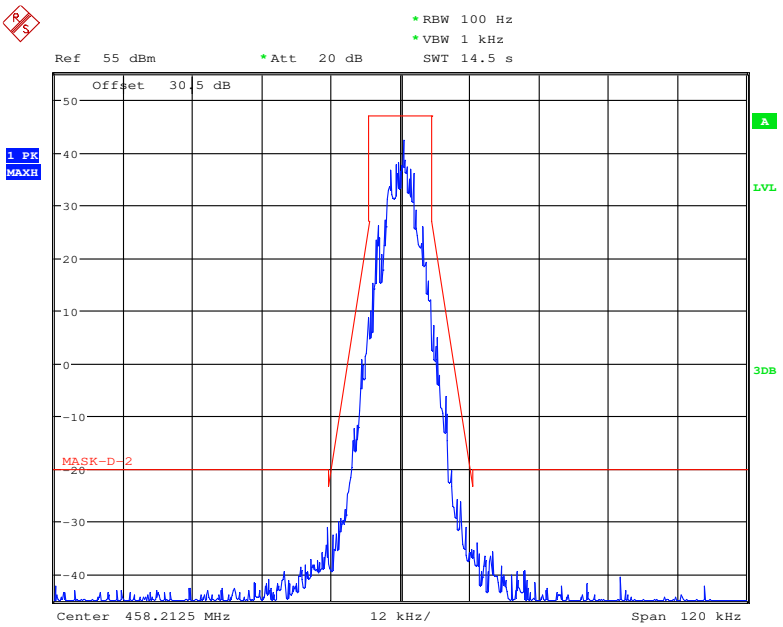
Date: 13.DEC.2017 22:17:38

Frequency 458.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



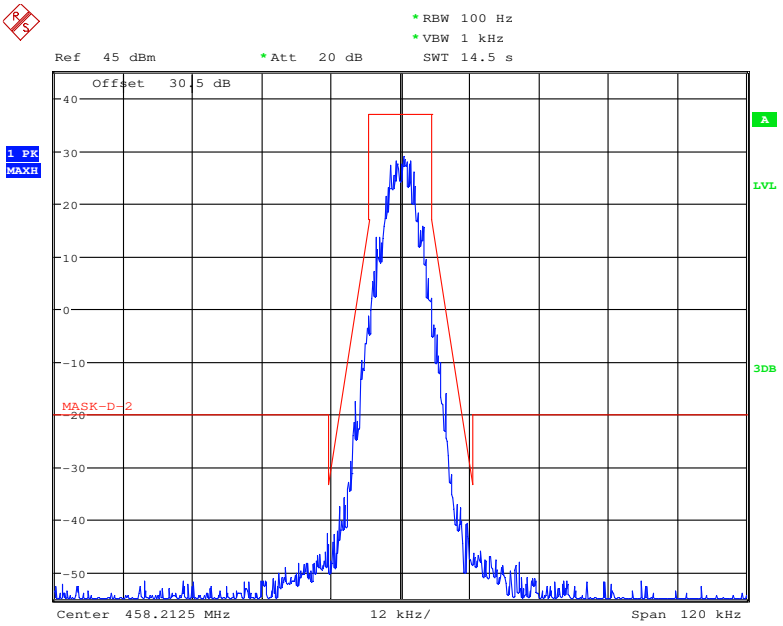
Date: 13.DEC.2017 22:15:31

Frequency 458.2125 MHz: Emission Mask D, High Power



Date: 14.DEC.2017 00:05:57

Frequency 458.2125 MHz: Emission Mask D, Low Power



Date: 14.DEC.2017 00:19:07

Modulation	Channel Separation (kHz)	Frequency (MHz)	Power Level	99% Occupied Bandwidth (kHz)	26 dB Emissions Bandwidth (kHz)	Note
Analog	25	450.0125	High	14.984	15.705	For Part 74
	25		Low	14.984	15.705	
	25	454.025	High	14.984	15.705	For Part22
	25		Low	14.984	15.705	
	25	463.0125	High	14.984	15.705	For Part 80
	25		Low	14.984	15.705	

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

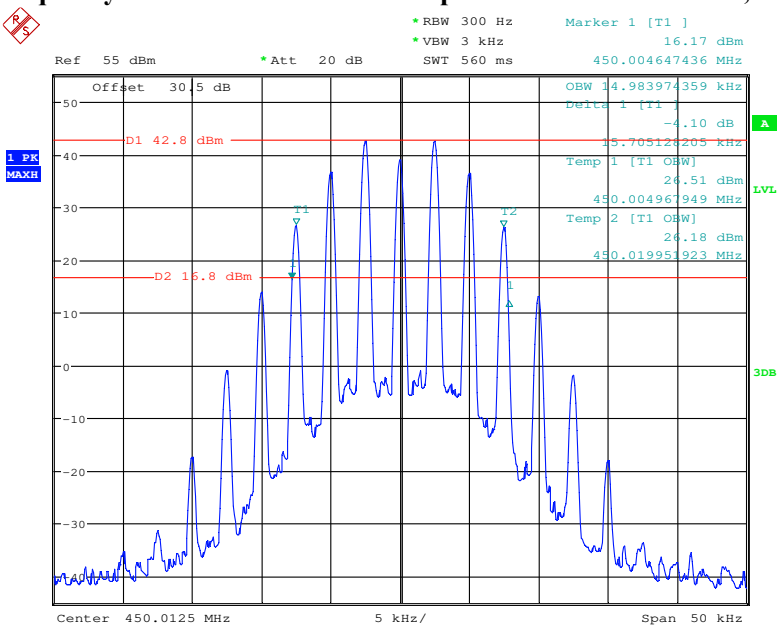
Emission Designator Per CFR 47 §2.201& §2.202&, Bn = 2M + 2D

For FM Mode (Channel Spacing: 25 kHz)

Emission Designator 16K0F3E In this case, the maximum modulating frequency is 5.0 kHz with a 3 kHz deviation. BW = 2(M+D) = 2(5 kHz + 3 kHz) = 16 kHz 16K0*
F3E portion of the designator represents an FM voice transmission Therefore, the entire designator for 25 kHz channel spacing FM mode is 16K0F3E.

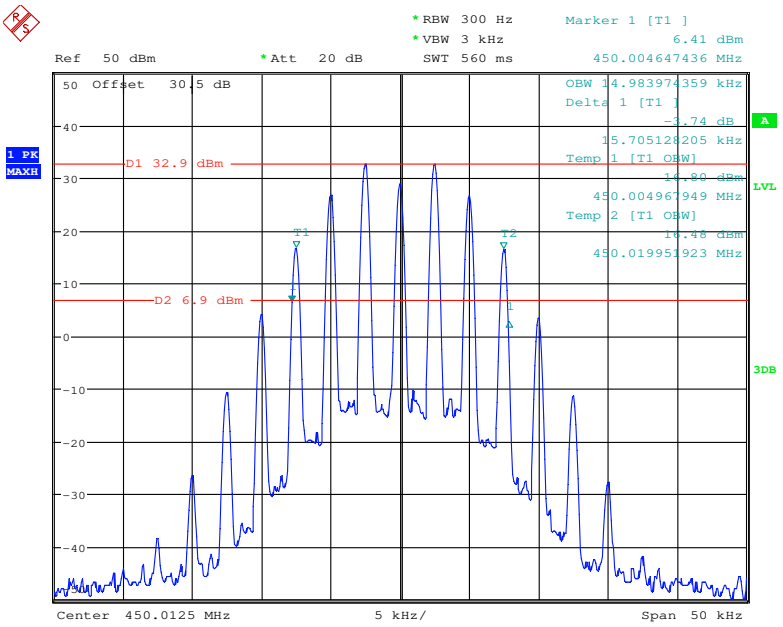
Analog Modulation

Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



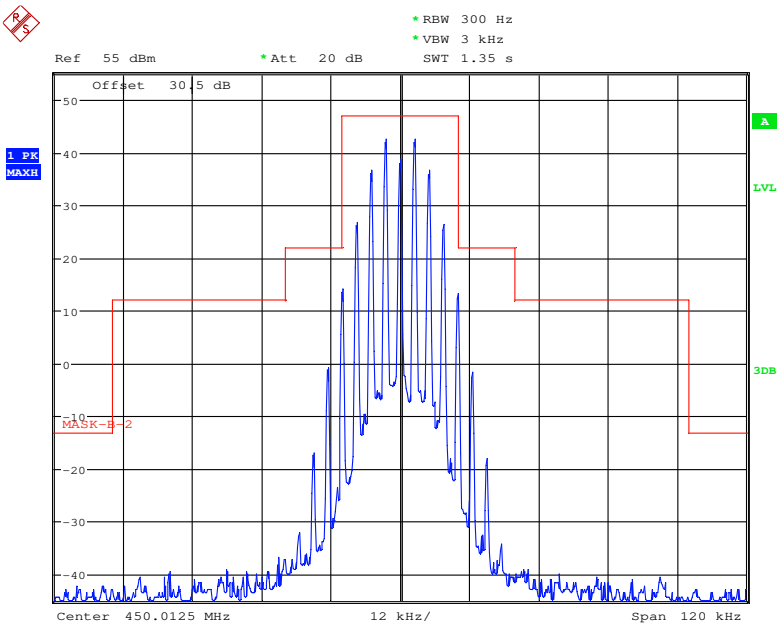
Date: 13.DEC.2017 22:57:24

Frequency 450.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



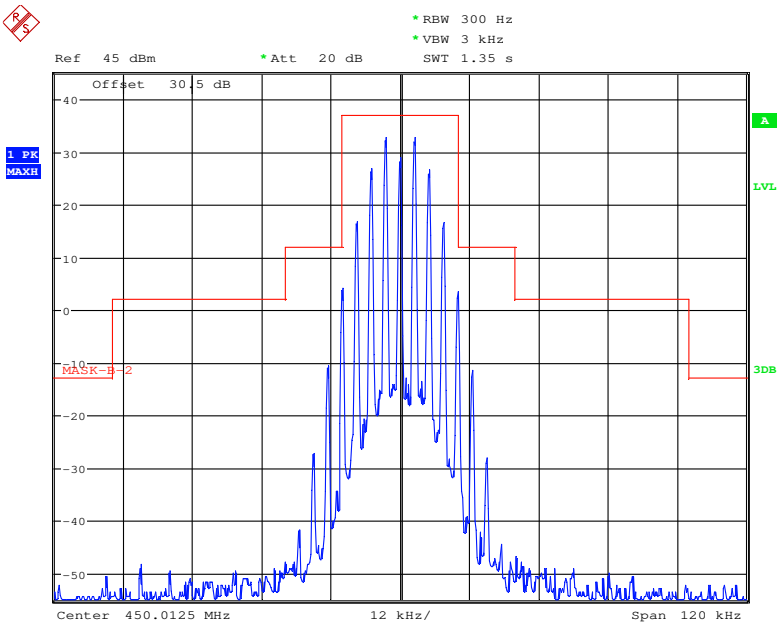
Date: 13.DEC.2017 22:58:24

Frequency 450.0125 MHz: Emission Mask, High Power, FCC part 74.462



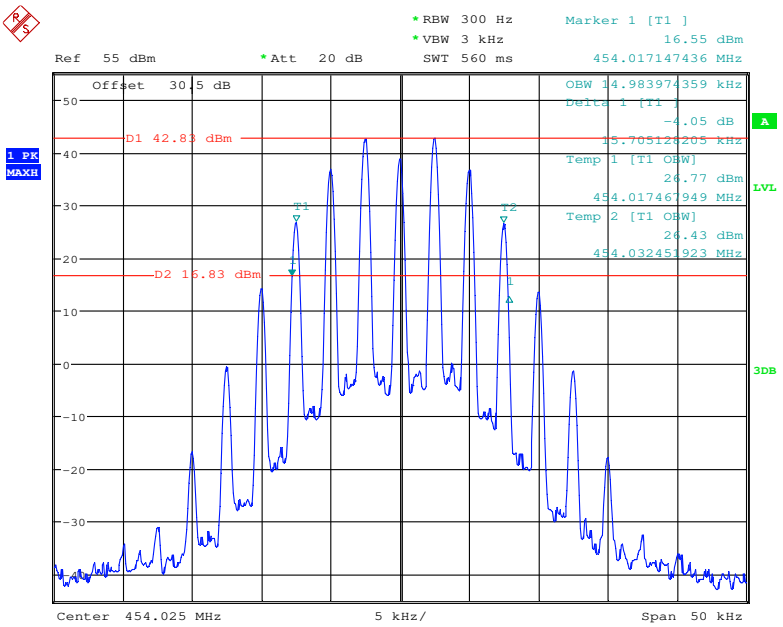
Date: 13.DEC.2017 23:31:57

Frequency 450.0125 MHz: Emission Mask, Low Power, FCC part 74.462



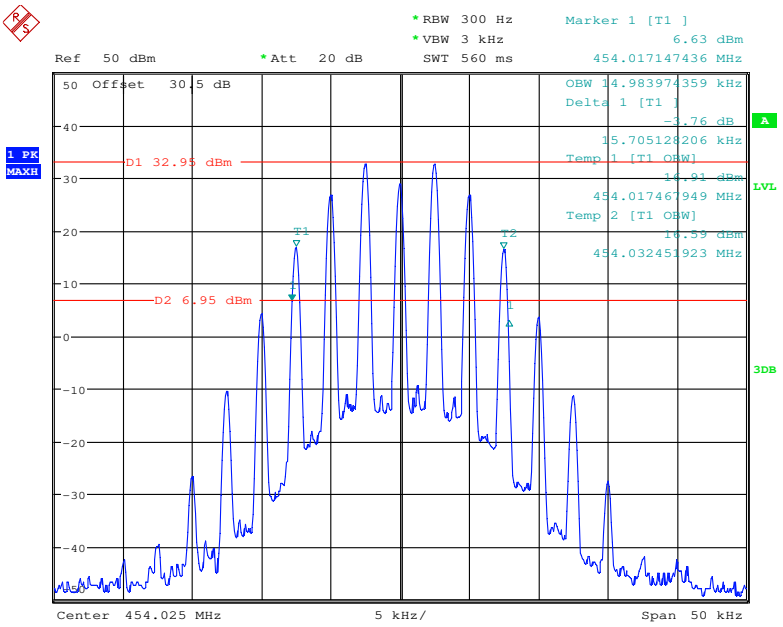
Date: 13.DEC.2017 23:46:55

Frequency 454.025 MHz: 99% Occupied & 26 dB Bandwidth, High Power



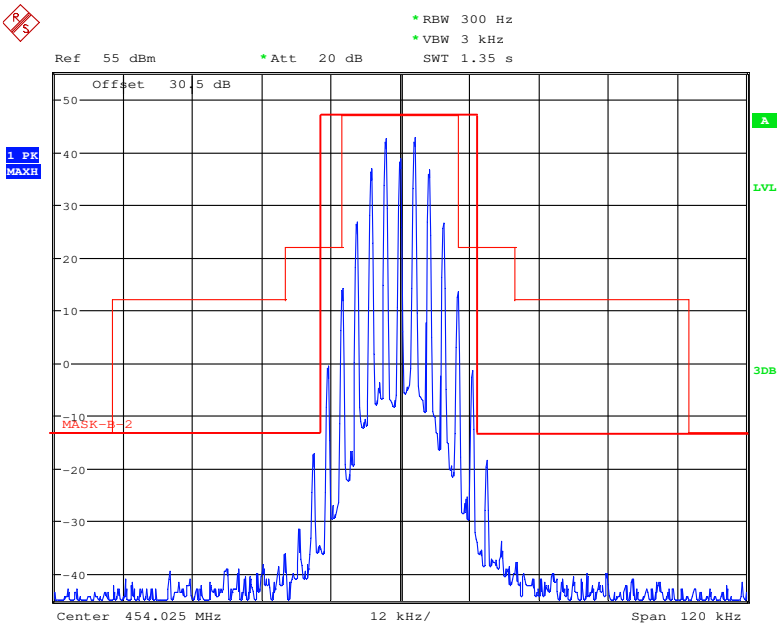
Date: 13.DEC.2017 23:00:44

Frequency 454.025 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



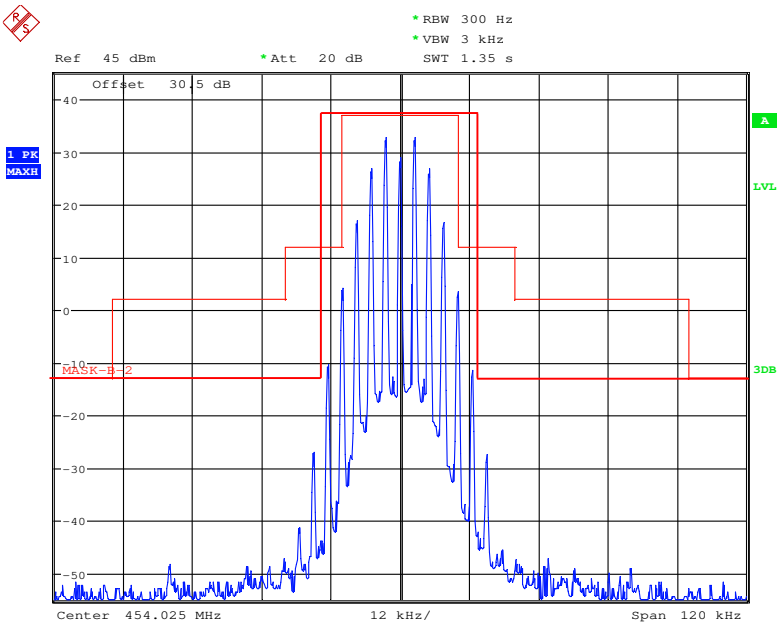
Date: 13.DEC.2017 22:59:35

Frequency 454.025 MHz: Emission Mask, High Power, FCC part 22.359



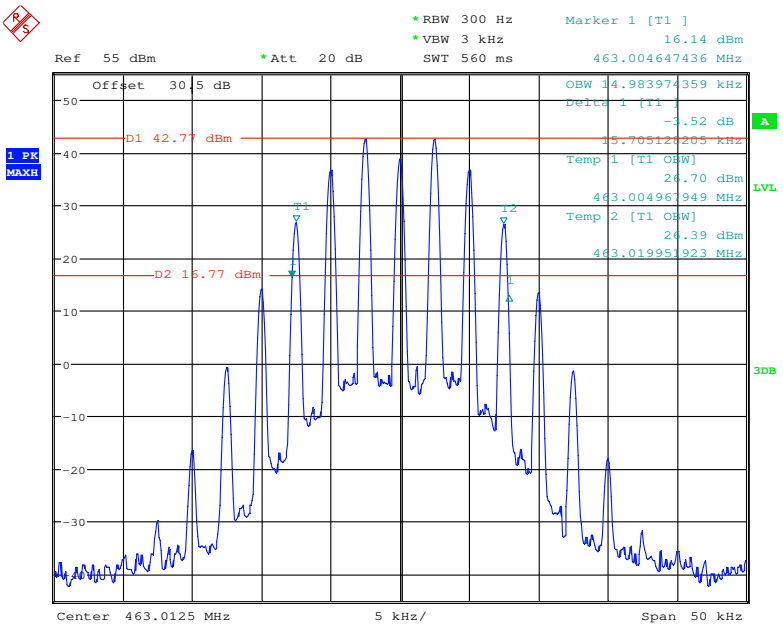
Date: 13.DEC.2017 23:33:33

Frequency 454.025 MHz: Emission Mask, Low Power, FCC part 22.359



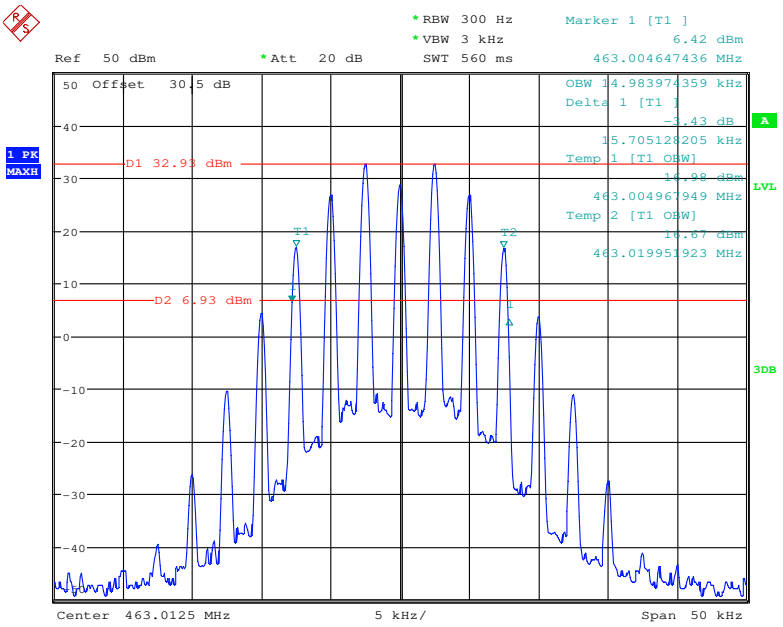
Date: 13.DEC.2017 23:48:09

Frequency 463.0125 MHz: 99% Occupied & 26 dB Bandwidth, High Power



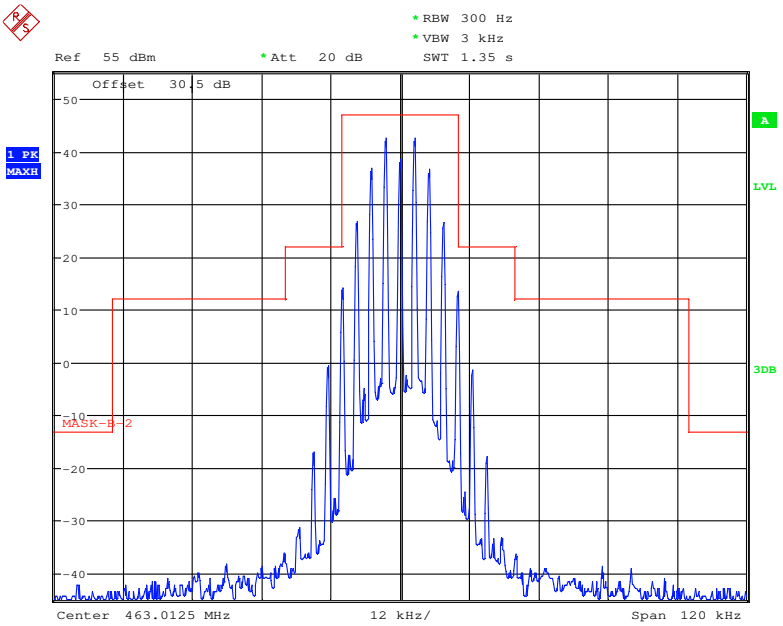
Date: 13.DEC.2017 23:06:54

Frequency 463.0125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power



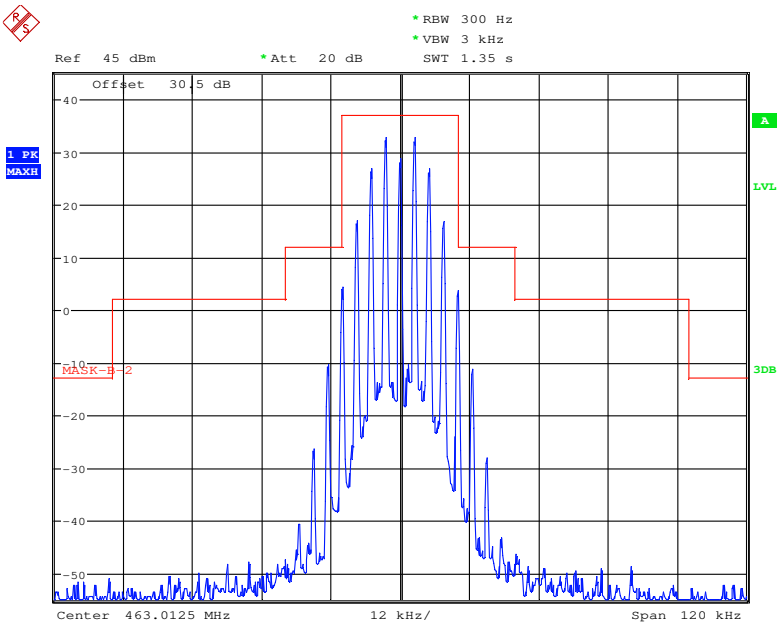
Date: 13.DEC.2017 23:04:53

Frequency 463.0125 MHz: Emission Mask, High Power, FCC Part 80.211



Date: 13.DEC.2017 23:37:47

Frequency 463.0125 MHz: Emission Mask, Low Power, FCC Part 80.211



Date: 13.DEC.2017 23:43:40

FCC §2.1051 & §22.861 & §74.462 & § 80.211 & §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.

Emission Mask B - 25 kHz channel bandwidth equipment. For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	24~25 ℃
Relative Humidity:	52~56 %
ATM Pressure:	100.6~101.0 kPa

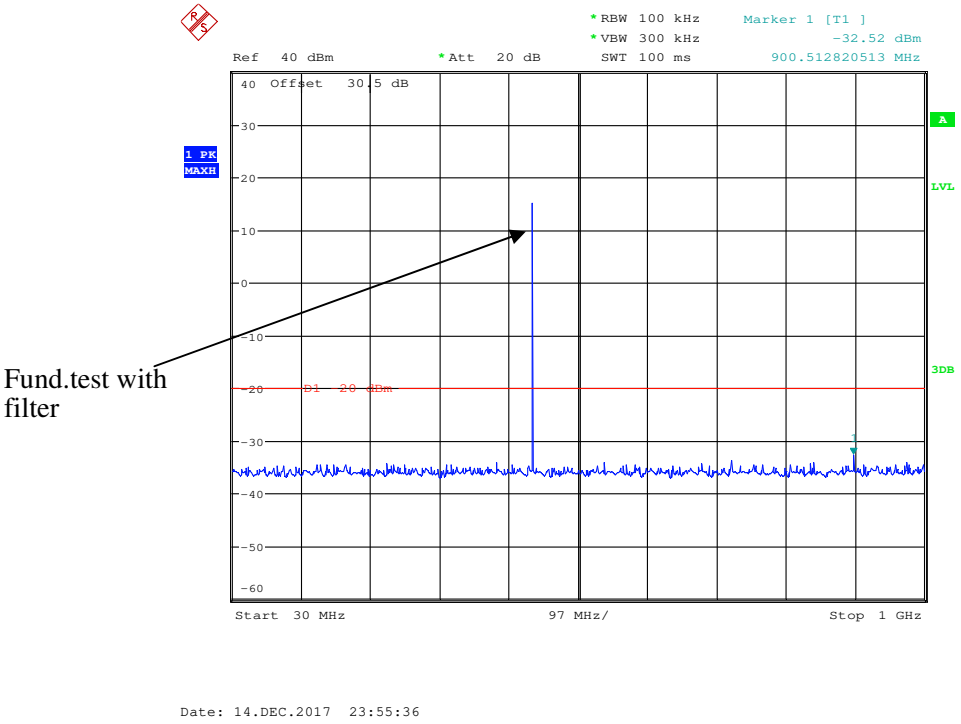
The testing was performed by Xiangguang Kong from 2017-12-14 to 2017-12-15.

Test Mode: Transmitting

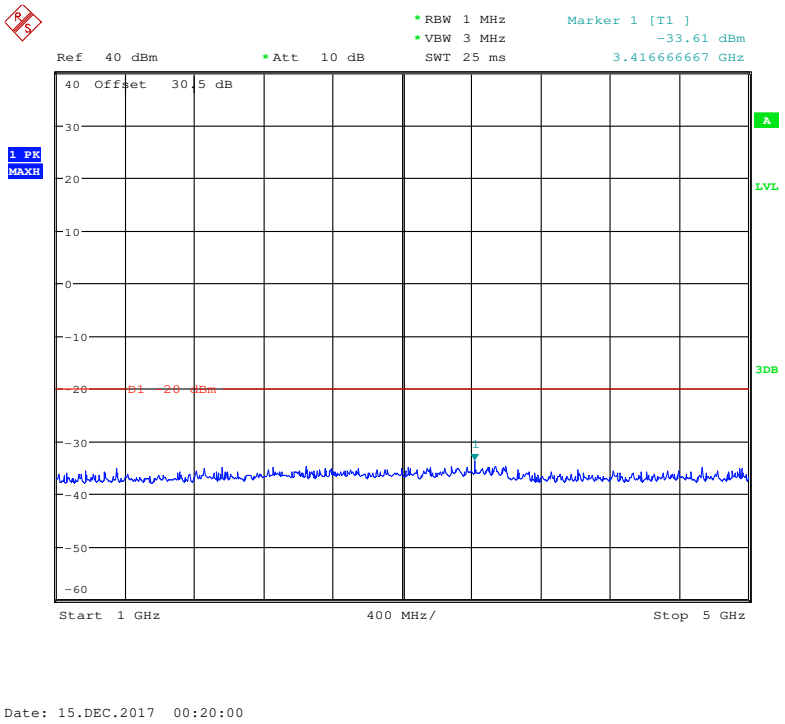
Note: Worst case at High power level, and please refer to the following plots.

Analog Modulation:

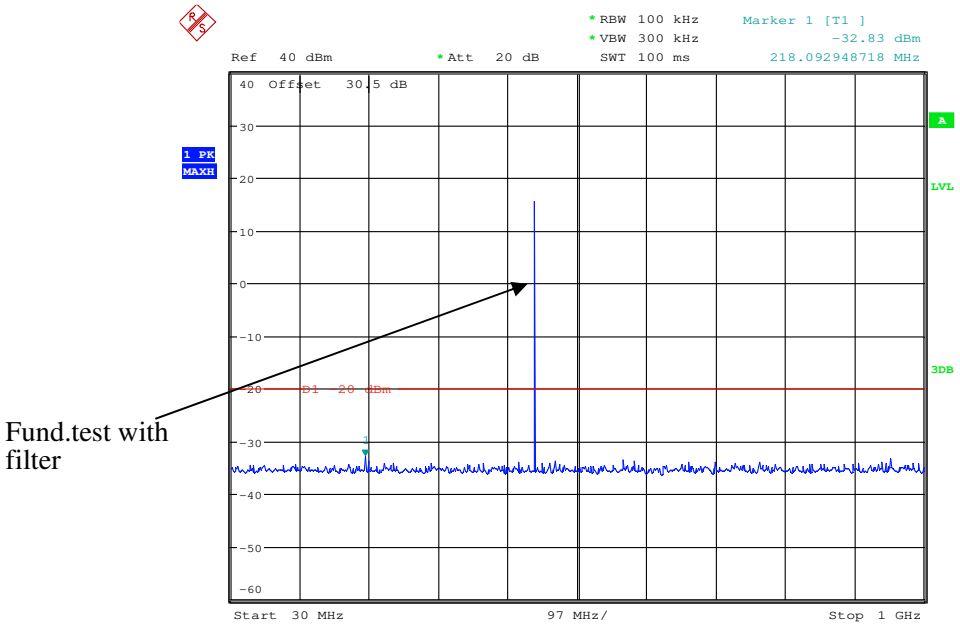
30MHz – 1 GHz, Channel Spacing 12.5 kHz, 450.0125 MHz



1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 450.0125 MHz

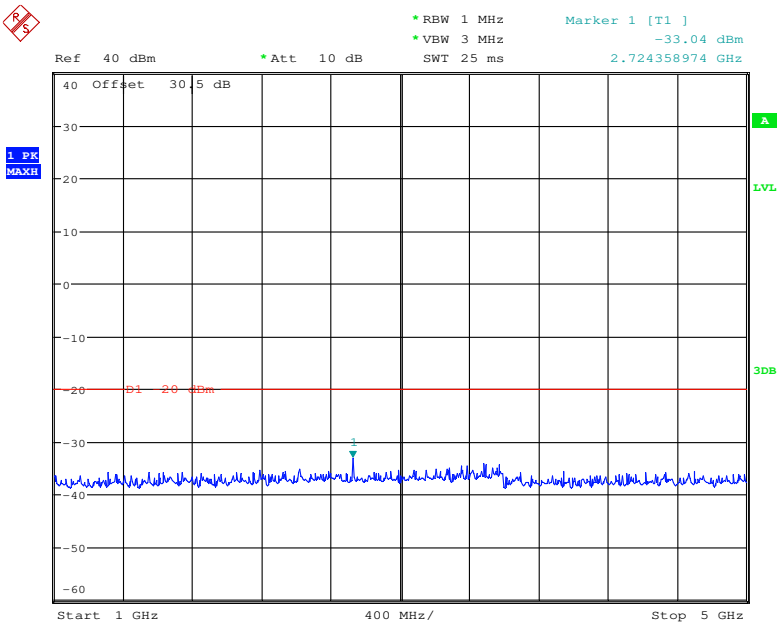


30MHz – 1 GHz, Channel Spacing 12.5 kHz, 454.025 MHz



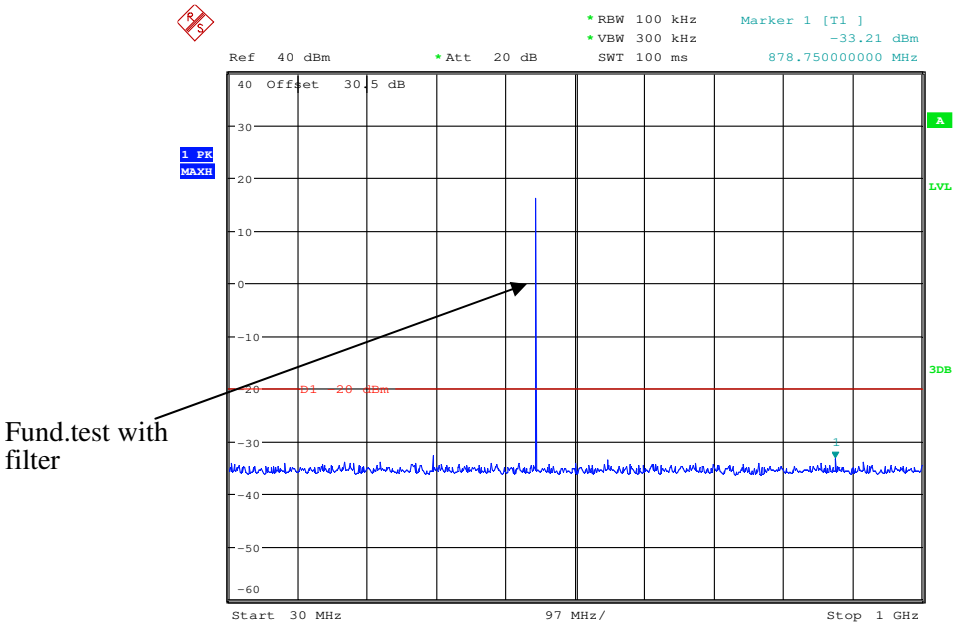
Date: 14.DEC.2017 23:57:23

1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 454.025 MHz



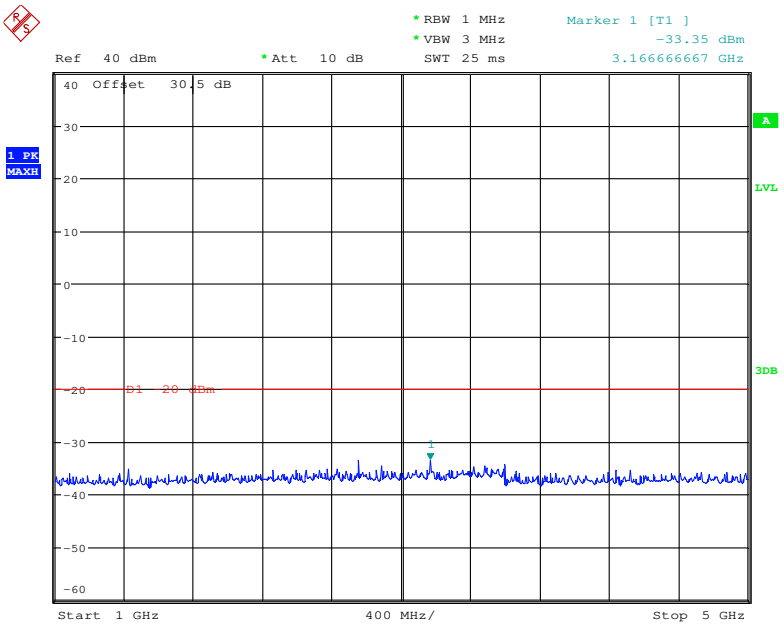
Date: 15.DEC.2017 00:19:33

30MHz – 1 GHz, Channel Spacing 12.5 kHz, 458.2125 MHz



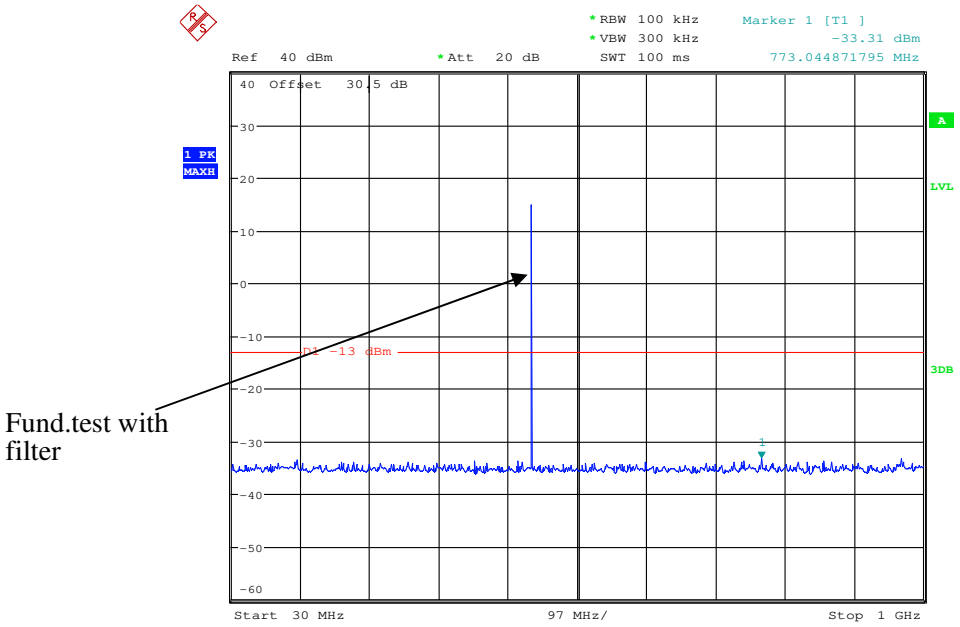
Date: 14.DEC.2017 23:58:50

1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 458.2125 MHz



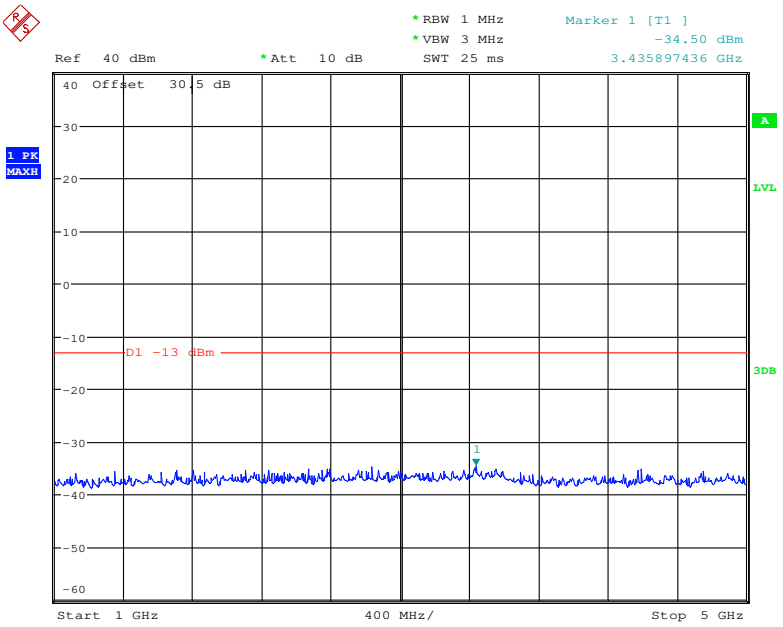
Date: 15.DEC.2017 00:19:09

30MHz – 1 GHz, Channel Spacing 25 kHz, 450.0125 MHz



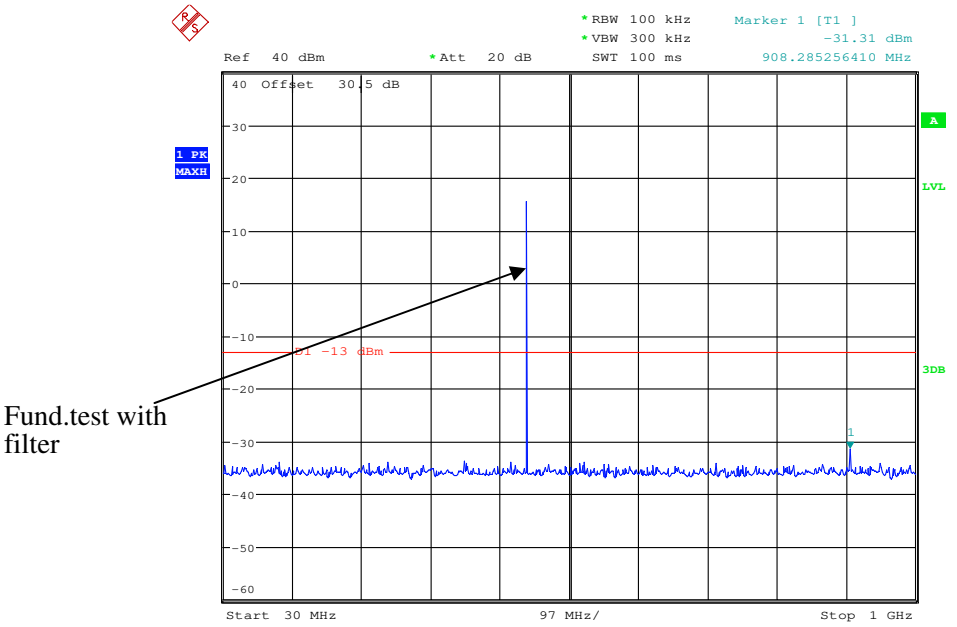
Date: 15.DEC.2017 00:03:29

1 GHz – 5 GHz, Channel Spacing 25 kHz, 450.0125 MHz



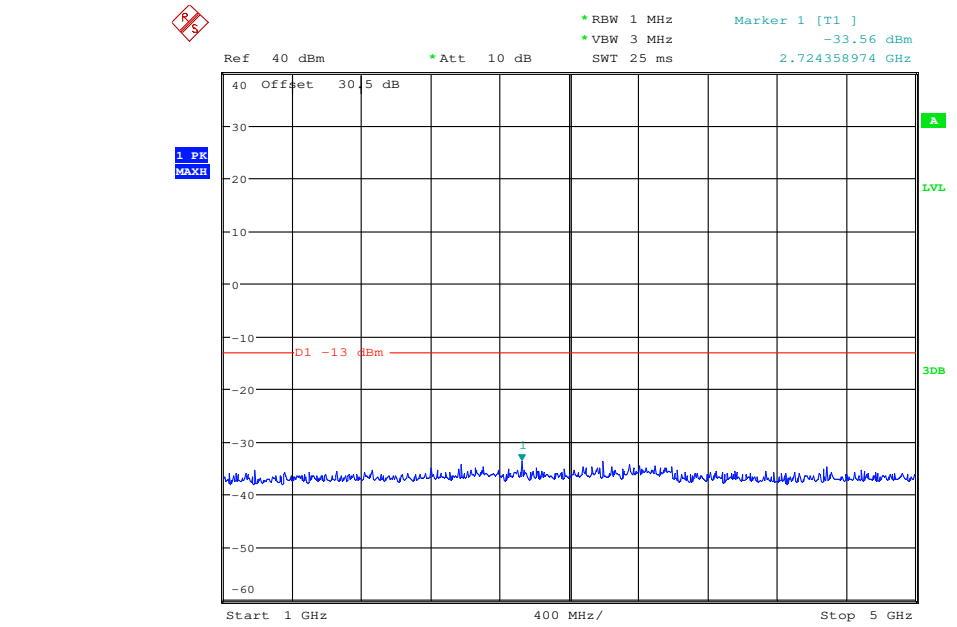
Date: 15.DEC.2017 00:17:44

30MHz – 1 GHz, Channel Spacing 25 kHz, 454.025 MHz



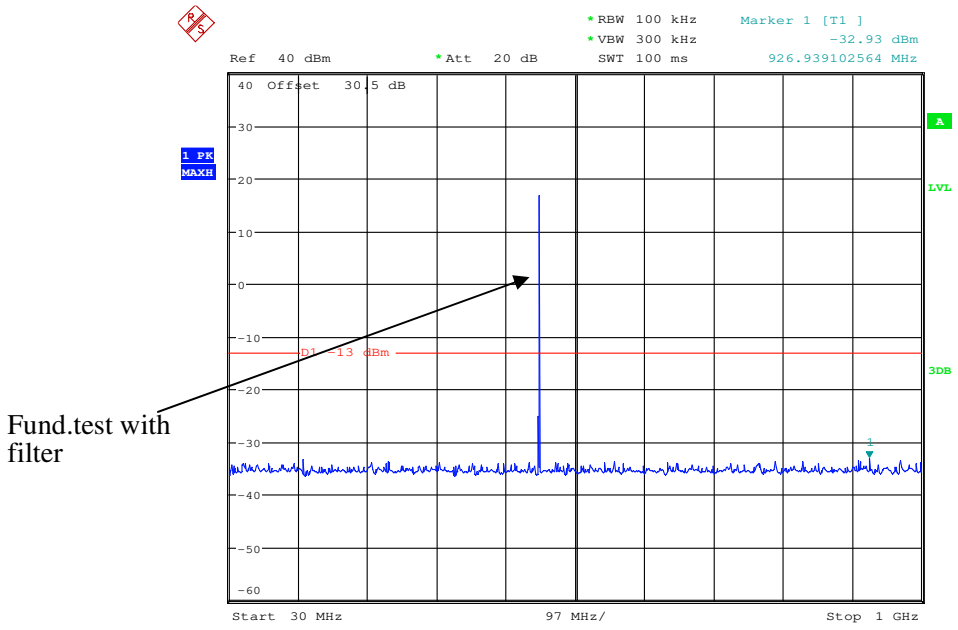
Date: 15.DEC.2017 00:04:20

1 GHz – 5 GHz, Channel Spacing 25 kHz, 454.025 MHz



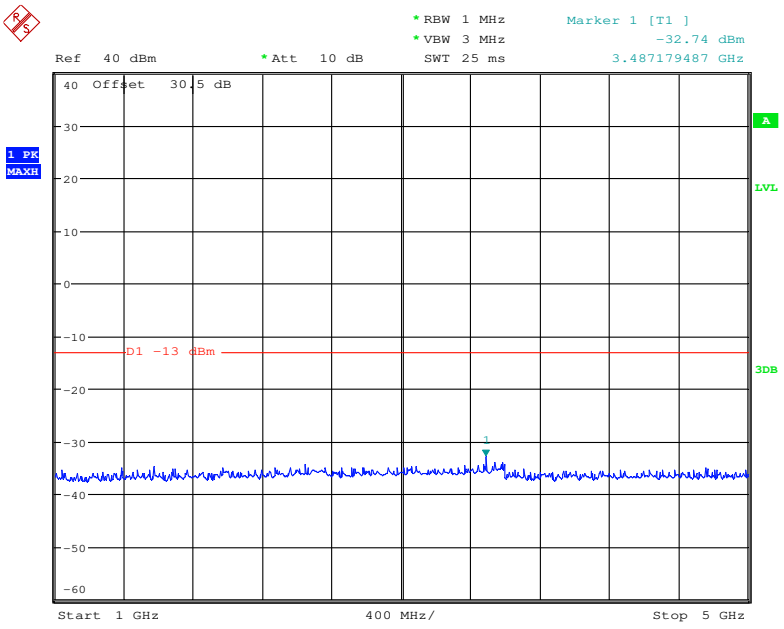
Date: 15.DEC.2017 00:17:16

30MHz – 1 GHz, Channel Spacing 25 kHz, 463.0125 MHz



Date: 15.DEC.2017 00:07:26

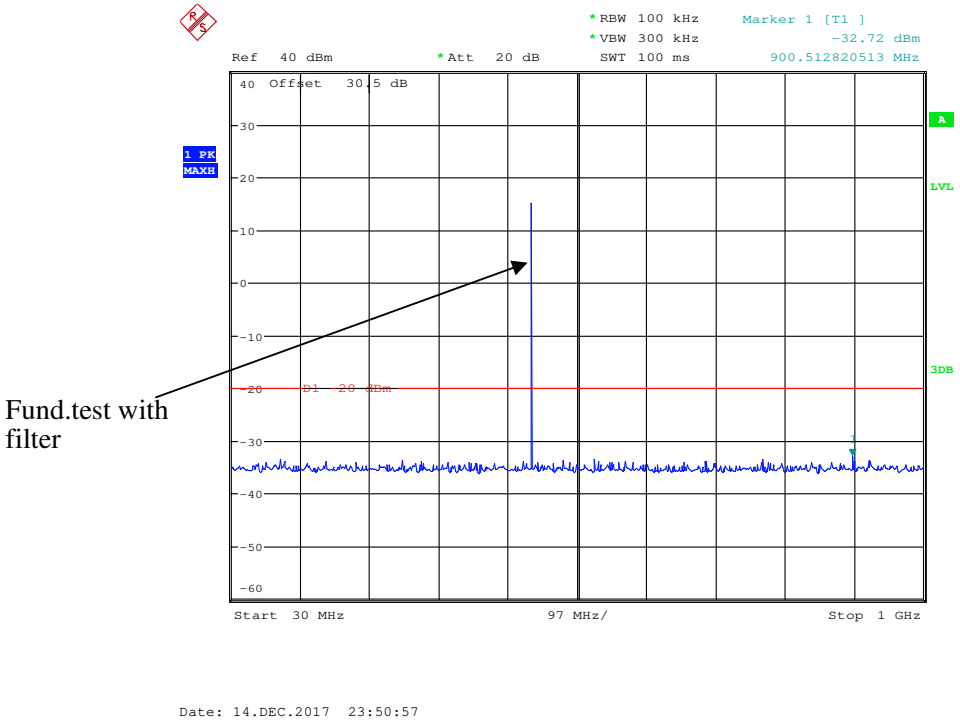
1 GHz – 5 GHz, Channel Spacing 25 kHz, 463.0125 MHz



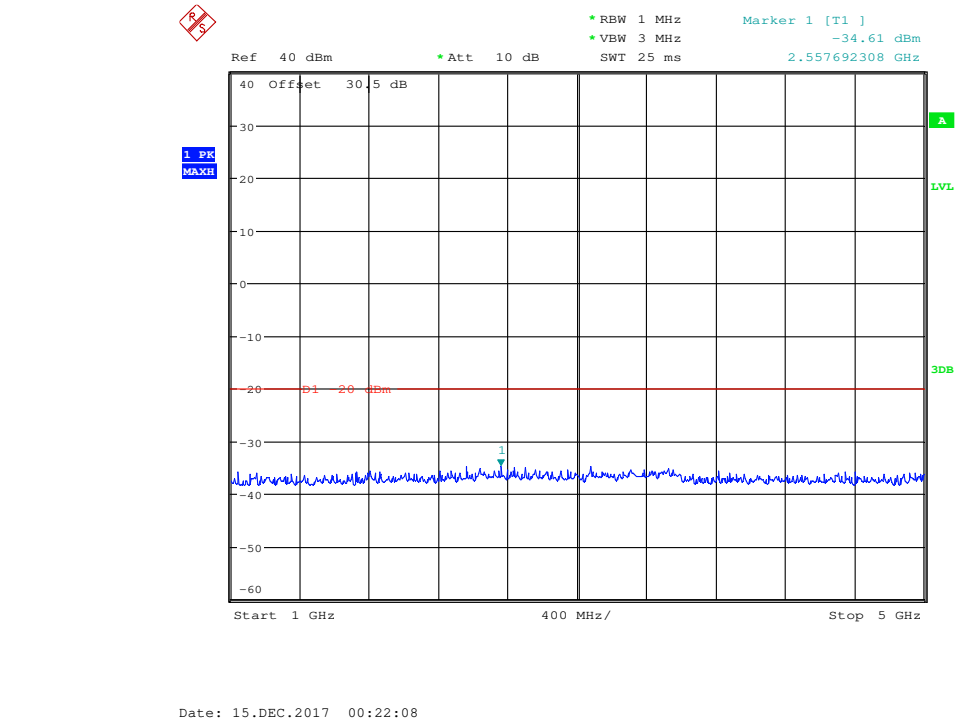
Date: 15.DEC.2017 00:16:02

Digital Modulation:

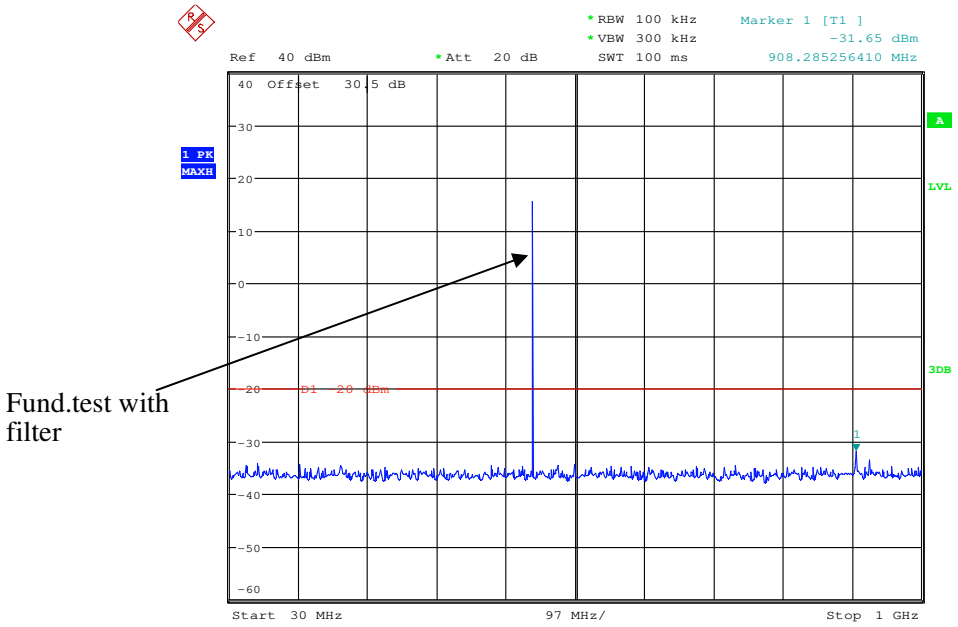
30MHz – 1 GHz, Channel Spacing 12.5 kHz, 450.0125 MHz



1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 450.0125 MHz

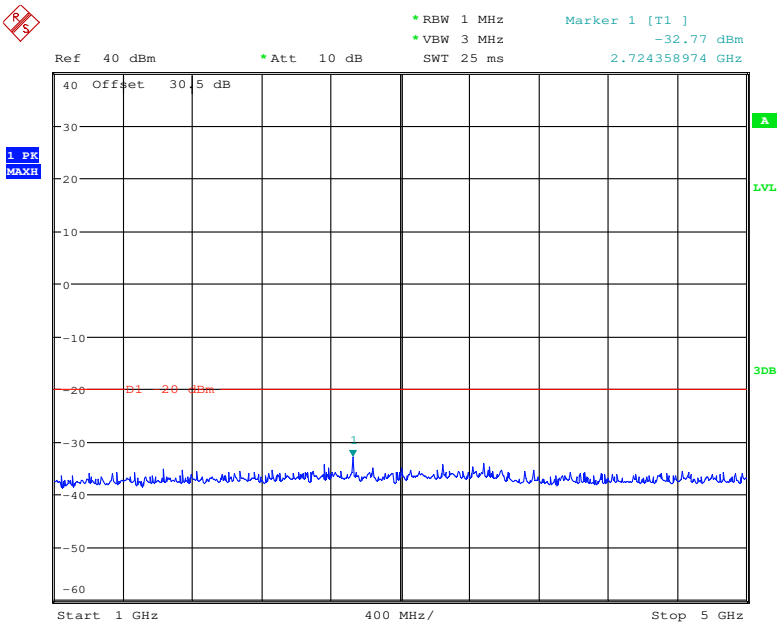


30MHz – 1 GHz, Channel Spacing 12.5 kHz, 454.025 MHz



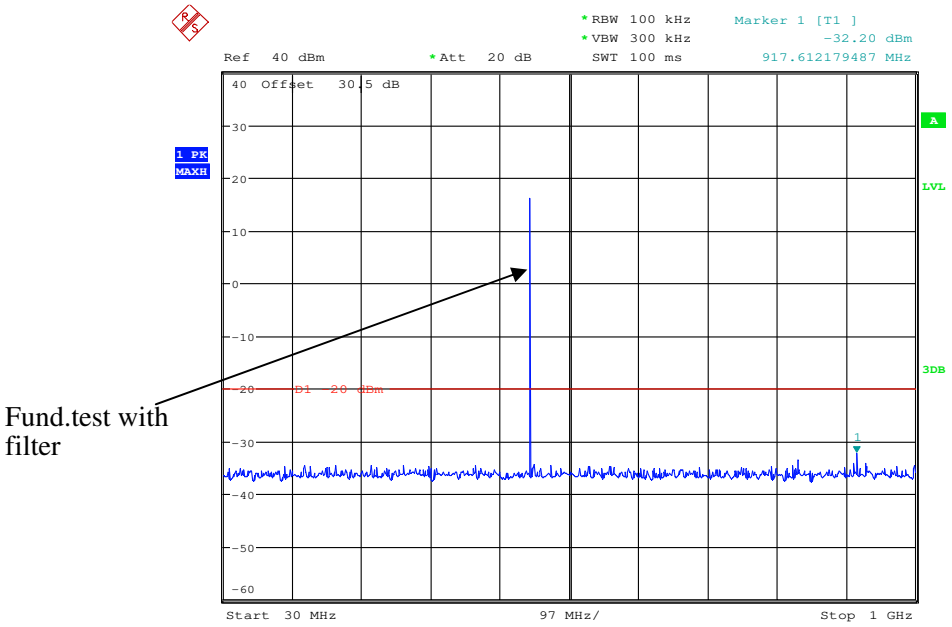
Date: 14.DEC.2017 23:51:20

1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 454.025 MHz



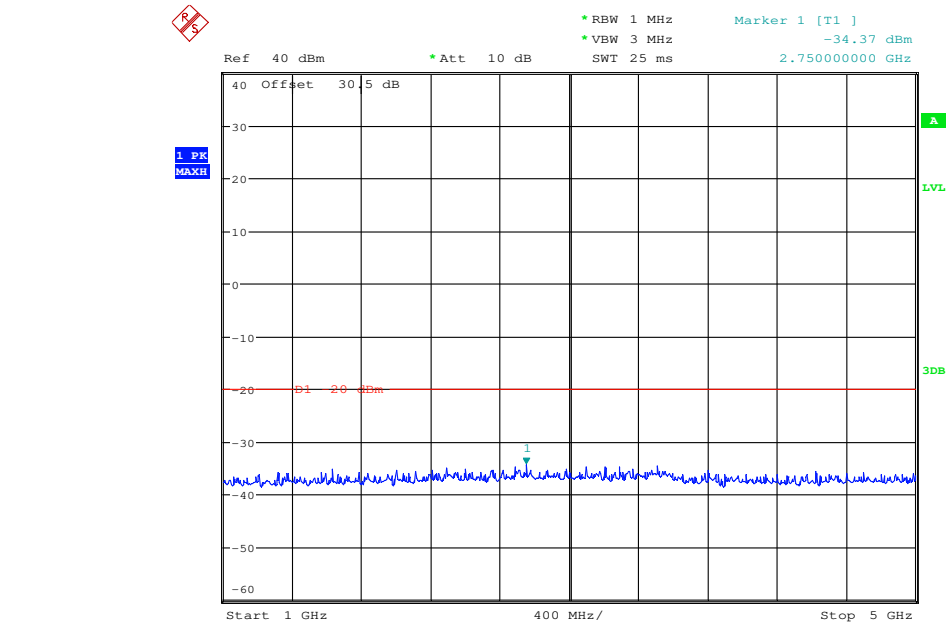
Date: 15.DEC.2017 00:21:48

30MHz – 1 GHz, Channel Spacing 12.5 kHz, 458.2125 MHz



Date: 14.DEC.2017 23:51:53

1 GHz – 5 GHz, Channel Spacing 12.5 kHz, 458.2125 MHz



Date: 15.DEC.2017 00:21:20

FCC §2.1053 & §22.861 & §74.462 & § 80.211 & §90.210 - RADIATED SPURIOUS EMISSIONS

Applicable Standard

FCC §2.1053, §22.861, §74.462, § 80.211 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.

Spurious attenuation limit in dB =43+10 Log_{10} (power out in Watts) for EUT with a 25 kHz channel bandwidth.

Test Data

Environmental Conditions

Temperature:	25 □
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Xiangguang Kong on 2017-12-13.

Test Mode: Transmitting

30MHz - 5GHz:

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)	Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)			
Analog Modulation 450.0125 MHz-12.5 kHz										
900.03	63.04	185	1.2	H	-32.0	0.70	0.0	-32.70	-20	12.70
900.03	54.75	204	2.1	V	-40.3	0.70	0.0	-41.00	-20	21.00
3600.10	52.16	193	1.1	H	-49.8	1.50	9.80	-41.50	-20	21.50
3600.10	53.46	194	2.0	V	-48.0	1.50	9.80	-39.70	-20	19.70
4050.11	52.98	232	2.1	H	-48.4	1.40	10.00	-39.80	-20	19.80
4050.11	51.92	235	2.4	V	-48.4	1.40	10.00	-39.80	-20	19.80
Analog Modulation 454.025 MHz-12.5 kHz										
908.05	62.07	336	2.5	H	-32.9	0.70	0.0	-33.60	-13	20.60
908.05	51.42	122	2.3	V	-43.6	0.70	0.0	-44.30	-13	31.30
3632.20	52.45	96	1.7	H	-49.5	1.50	9.80	-41.20	-13	28.20
3632.20	51.16	227	1.4	V	-50.3	1.50	9.80	-42.00	-13	29.00
4086.23	54.29	4	1.4	H	-47.1	1.40	10.00	-38.50	-13	25.50
4086.23	57.47	103	1.9	V	-42.8	1.40	10.00	-34.20	-13	21.20
Analog Modulation 458.2125 MHz-12.5 kHz										
916.43	61.75	43	1.2	H	-33.3	0.70	0.0	-34.00	-20	14.00
916.43	51.14	46	2.1	V	-43.9	0.70	0.0	-44.60	-20	24.60
3665.70	57.79	297	1.2	H	-44.3	1.60	9.80	-36.10	-20	16.10
3665.70	54.11	261	2.4	V	-47.4	1.60	9.80	-39.20	-20	19.20
4123.91	53.25	183	1.8	H	-48.1	1.40	10.00	-39.50	-20	19.50
4123.91	53.87	332	2.1	V	-46.4	1.40	10.00	-37.80	-20	17.80
Analog Modulation 450.0125 MHz-25 kHz										
900.025	66.26	85	1.6	H	-28.7	0.70	0.0	-29.40	-13	16.40
900.025	52.27	258	1.2	V	-42.7	0.70	0.0	-43.40	-13	30.40
3600.10	50.88	146	1.6	H	-51.1	1.50	9.80	-42.80	-13	29.80
3600.10	50.44	103	1.8	V	-51.0	1.50	9.80	-42.70	-13	29.70
4050.11	53.04	331	1.1	H	-48.4	1.40	10.00	-39.80	-13	26.80
4050.11	49.59	298	1.7	V	-50.7	1.40	10.00	-42.10	-13	29.10
Analog Modulation 454.025 MHz-25 kHz										
908.05	64.22	137	1.5	H	-30.8	0.70	0.0	-31.50	-13	18.50
908.05	54.25	50	1.0	V	-40.8	0.70	0.0	-41.50	-13	28.50
3632.20	55.32	152	1.0	H	-46.6	1.50	9.80	-38.30	-13	25.30
3632.20	54.91	3	1.2	V	-46.5	1.50	9.80	-38.20	-13	25.20
4086.23	57.62	317	2.3	H	-43.8	1.40	10.00	-35.20	-13	22.20
4086.23	56.73	88	1.1	V	-43.6	1.40	10.00	-35.00	-13	22.00

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)	Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)			
Analog Modulation 463.0125 MHz-25 kHz										
926.025	69.25	157	2.0	H	-25.8	0.70	0.0	-26.50	-13	13.50
926.025	52.39	233	1.5	V	-42.6	0.70	0.0	-43.30	-13	30.30
3241.09	52.21	244	1.2	H	-47.6	1.60	9.60	-39.60	-13	26.60
3241.09	49.12	202	2.1	V	-50.9	1.60	9.60	-42.90	-13	29.90
3704.10	52.91	221	2.2	H	-49.1	1.60	9.80	-40.90	-13	27.90
3704.10	53.58	72	1.6	V	-47.9	1.60	9.80	-39.70	-13	26.70
Digital Modulation 450.0125 MHz-12.5 kHz										
900.03	60.79	203	1.9	H	-34.2	0.70	0.0	-34.90	-20	14.90
900.03	51.56	32	2.1	V	-43.4	0.70	0.0	-44.10	-20	24.10
1350.04	47.97	260	2.4	H	-60.0	1.60	8.30	-53.30	-20	33.30
1350.04	46.65	142	1.4	V	-61.6	1.60	8.30	-54.90	-20	34.90
3600.10	54.16	149	1.9	H	-47.8	1.50	9.80	-39.50	-20	19.50
3600.10	55.92	174	2.4	V	-45.5	1.50	9.80	-37.20	-20	17.20
Digital Modulation 454.025 MHz-12.5 kHz										
908.05	58.20	196	1.6	H	-36.8	0.70	0.0	-37.50	-20	17.50
908.05	51.26	262	1.6	V	-43.7	0.70	0.0	-44.40	-20	24.40
3632.20	53.41	69	1.6	H	-48.5	1.50	9.80	-40.20	-20	20.20
3632.20	56.93	273	1.5	V	-44.5	1.50	9.80	-36.20	-20	16.20
4086.23	58.99	233	1.2	H	-42.4	1.40	10.00	-33.80	-20	13.80
4086.23	60.31	1	1.7	V	-40.0	1.40	10.00	-31.40	-20	11.40
Digital Modulation 458.2125 MHz-12.5 kHz										
916.43	58.52	318	1.7	H	-36.5	0.70	0.0	-37.20	-20	17.20
916.43	51.36	59	1.5	V	-43.6	0.70	0.0	-44.30	-20	24.30
3665.70	58.21	185	1.5	H	-43.8	1.60	9.80	-35.60	-20	15.60
3665.70	56.26	146	1.9	V	-45.2	1.60	9.80	-37.00	-20	17.00
4123.91	55.74	204	2.3	H	-45.7	1.40	10.00	-37.10	-20	17.10
4123.91	54.56	274	1.3	V	-45.8	1.40	10.00	-37.20	-20	17.20

Note:
Absolute Level = Substituted Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

FCC §2.1055 & § 22.355 & §74.464 & § 80.209 & §90.213 - FREQUENCY STABILITY

Applicable Standard

FCC §2.1055, § 22.355, §74.464, § 80.209 and §90.213

Test Procedure

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

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

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

The testing was performed by Xiangguang Kong on 2017-12-13.

Test Mode: Transmitting

Note: This device is a Base station.

For 12.5 kHz:

Analog Modulation, Reference Frequency: 450.0125 MHz, Limit: ±1.5 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (□)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	13.60	450.012555	0.1222
40	13.60	450.012483	-0.0378
30	13.60	450.012544	0.0978
20	13.60	450.012527	0.0600
10	13.60	450.012556	0.1244
0	13.60	450.012566	0.1467
-10	13.60	450.012498	-0.0044
-20	13.60	450.012489	-0.0244
-30	13.60	450.012545	0.1000
Frequency Stability versus Input Voltage			
20	15.64	450.012553	0.1178
20	11.56	450.012517	0.0378

Digital Modulation, Reference Frequency: 450.0125 MHz, Limit: ±1.5 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (□)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	13.60	450.012511	0.0244
40	13.60	450.012495	-0.0111
30	13.60	450.012542	0.0933
20	13.60	450.012519	0.0422
10	13.60	450.012469	-0.0689
0	13.60	450.012479	-0.0467
-10	13.60	450.012535	0.0778
-20	13.60	450.012530	0.0667
-30	13.60	450.012521	0.0467
Frequency Stability versus Input Voltage			
20	15.64	450.012514	0.0311
20	11.56	450.012545	0.1000

Analog Modulation, Reference Frequency: 454.025 MHz, Limit: ±2.5 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (□)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	13.60	454.024965	-0.0771
40	13.60	454.024994	-0.0132
30	13.60	454.025030	0.0661
20	13.60	454.025021	0.0463
10	13.60	454.024996	-0.0088
0	13.60	454.025005	0.0110
-10	13.60	454.025015	0.0330
-20	13.60	454.025009	0.0198
-30	13.60	454.025048	0.1057
Frequency Stability versus Input Voltage			
20	15.64	454.025031	0.0683
20	11.56	454.025057	0.1255

Digital Modulation, Reference Frequency: 454.025 MHz, Limit: ±2.5 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (□)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	13.60	454.025003	0.0066
40	13.60	454.024998	-0.0044
30	13.60	454.025049	0.1079
20	13.60	454.025033	0.0727
10	13.60	454.024991	-0.0198
0	13.60	454.024983	-0.0374
-10	13.60	454.025047	0.1035
-20	13.60	454.025015	0.0330
-30	13.60	454.025027	0.0595
Frequency Stability versus Input Voltage			
20	15.64	454.025021	0.0463
20	11.56	454.025049	0.1079

Analog Modulation, Reference Frequency: 458.2125 MHz, Limit: ±1.5 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (□)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	13.60	458.212517	0.0371
40	13.60	458.212493	-0.0153
30	13.60	458.212535	0.0764
20	13.60	458.212530	0.0655
10	13.60	458.212512	0.0262
0	13.60	458.212519	0.0415
-10	13.60	458.212527	0.0589
-20	13.60	458.212538	0.0829
-30	13.60	458.212551	0.1113
Frequency Stability versus Input Voltage			
20	15.64	458.212561	0.1331
20	11.56	458.212515	0.0327

Digital Modulation, Reference Frequency: 458.2125 MHz, Limit: ±1.5 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (□)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	13.60	458.212531	0.0677
40	13.60	458.212543	0.0938
30	13.60	458.212559	0.1288
20	13.60	458.212522	0.0480
10	13.60	458.212519	0.0415
0	13.60	458.212507	0.0153
-10	13.60	458.212489	-0.0240
-20	13.60	458.212504	0.0087
-30	13.60	458.212526	0.0567
Frequency Stability versus Input Voltage			
20	15.64	458.212542	0.0917
20	11.56	458.212504	0.0087

For 25 kHz:

Analog Modulation, Reference Frequency: 450.0125 MHz, Limit: ±2.5 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (□)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	13.60	450.012556	0.1244
40	13.60	450.012497	-0.0067
30	13.60	450.012537	0.0822
20	13.60	450.012516	0.0356
10	13.60	450.012541	0.0911
0	13.60	450.012540	0.0889
-10	13.60	450.012509	0.0200
-20	13.60	450.012503	0.0067
-30	13.60	450.012530	0.0667
Frequency Stability versus Input Voltage			
20	15.64	450.012511	0.0244
20	11.56	450.012498	-0.0044

Analog Modulation, Reference Frequency: 454.025 MHz, Limit: ±2.5 ppm			
Test Environment		Frequency Measure with Time Elapsed	
Temperature (□)	Voltage Supplied (V_{DC})	Measured Frequency (MHz)	Frequency Error (ppm)
Frequency Stability versus Input Temperature			
50	13.60	454.025072	0.1586
40	13.60	454.025034	0.0749
30	13.60	454.025069	0.1520
20	13.60	454.025029	0.0639
10	13.60	454.024986	-0.0308
0	13.60	454.024994	-0.0132
-10	13.60	454.025046	0.1013
-20	13.60	454.025008	0.0176
-30	13.60	454.025075	0.1652
Frequency Stability versus Input Voltage			
20	15.64	454.025005	0.0110
20	11.56	454.025022	0.0485

Analog Modulation, Reference Frequency: 463.0125 MHz, Limit: ±5 ppm			
Test Environment		**Frequency Measure with Time Elapsed**	
Temperature (□)	**Voltage Supplied (V_{DC})**	**Measured Frequency (MHz)**	**Frequency Error (ppm)**
Frequency Stability versus Input Temperature			
50	13.60	463.012486	-0.0302
40	13.60	463.012525	0.0540
30	13.60	463.012511	0.0238
20	13.60	463.012517	0.0367
10	13.60	463.012538	0.0821
0	13.60	463.012549	0.1058
-10	13.60	463.012509	0.0194
-20	13.60	463.012521	0.0454
-30	13.60	463.012555	0.1188
Frequency Stability versus Input Voltage			
20	15.64	463.012546	0.0993
20	11.56	463.012495	-0.0108

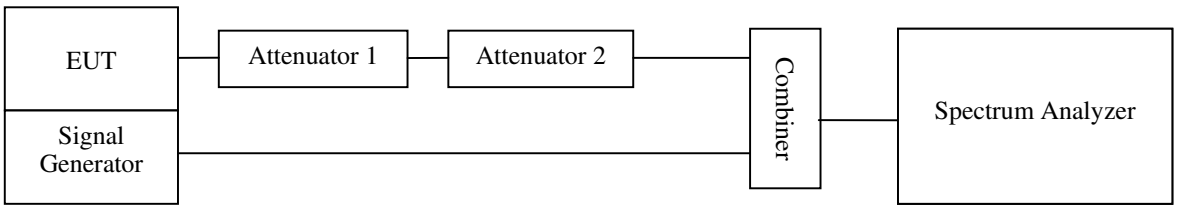
FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

Applicable Standard

Regulations: FCC §90.214
Test method: ANSI/TIA-603-D 2010, section 2.2.19.3

Test Procedure

a) Connect the EUT and test equipment as shown on the following block diagram.
b) Set the Spectrum Analyzer to measure FM deviation, and tune the RF frequency to the transmitter assigned frequency.
c) Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at ±12.5 kHz deviation and set its output level to -100dBm.
d) Turn on the transmitter.
e) Supply sufficient attenuation via the RF attenuator to provide an input level to the Spectrum Analyzer that is 40 dB below the maximum allowed input power when the transmitter is operating at its rated power level. Note this power level on the Spectrum Analyzer as P_0.
f) Turn off the transmitter.
g) Adjust the RF level of the signal generator to provide RF power equal to P_0. This signal generator RF level shall be maintained throughout the rest of the measurement.
h) Remove the attenuation 1, so the input power to the Spectrum Analyzer is increased by 30 dB when the transmitter is turned on.
i) Adjust the vertical amplitude control of the spectrum analyzer to display the 1000 Hz at ±4 divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "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:	25 ℃
Relative Humidity:	56 %
ATM Pressure:	101.0 kPa

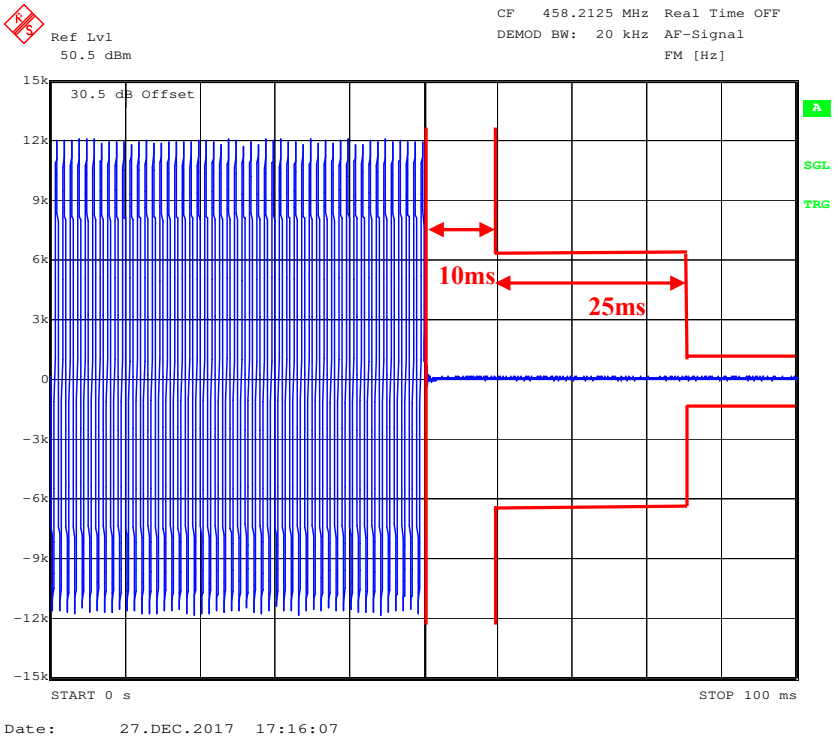
The testing was performed by Xiangguang Kong on 2017-12-27.

Frequency(MHz)	Channel Separation(kHz)	Transient Period(ms)	Transient Frequency
458.2125	12.5	10(t1)	< ▯ 12.5KHz
		25(t2)	< ±6.25KHz
		10(t3)	< ±12.5KHz

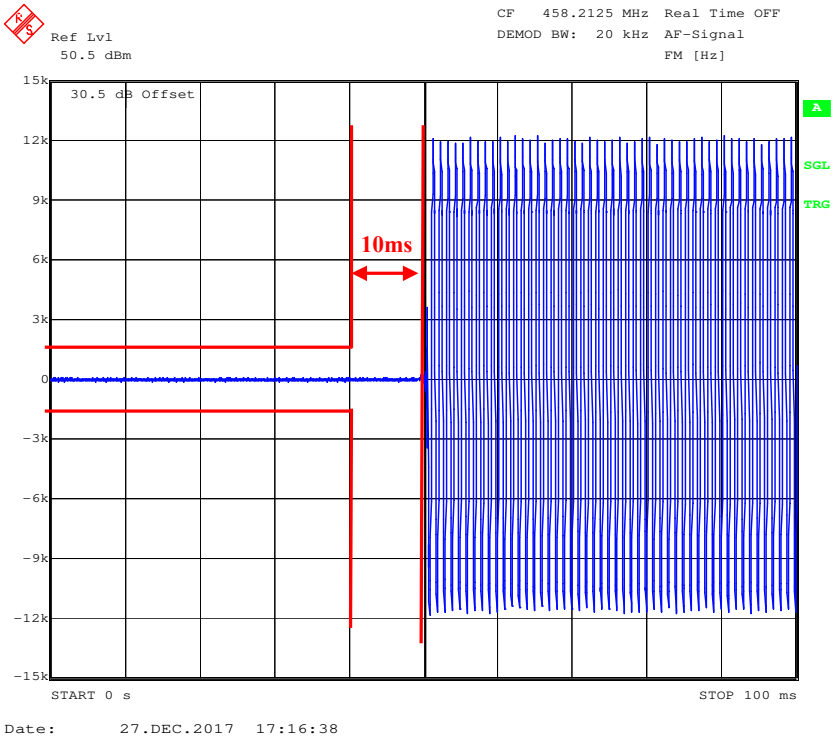
Please refer to the following plots.

Channel: 458.2125 MHz

Turn on



Turn off



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