



FCC PART 22, 74 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: YAMEPACK100F4**

<b>Report Type:</b> Original Report	<b>Product Type:</b> Digital WANET Repeater
<b>Report Number:</b>	<u>RDG171107013-00B</u>
<b>Report Date:</b>	<u>2018-03-17</u>
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**Note:** This report must not be used by the customer to claim product certification, approval, or endorsement by A2LA\* or any agency of the Federal Government. \* This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk “\*”.

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## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

The *Hytera Communications Corporation Limited's* product, model number: *E-pack100 F4* (FCC ID: *YAMEPACK100F4*) in this report is a *Digital WANET Repeater*, which was measured approximately: 300 mm (L) x 190 mm (W) x 69 mm(H) for base, 63 mm (L) x 31 mm (W) x 93 mm(H) for handset, rated input voltage: DC 13.6V  $\pm$  15%.

Item	Parameter	
	DMR	GSM / PCS
Frequency Range(MHz)	410-470	824-849 / 1850-1910
Rated Output power(Watts)	20 (High) / 10 (Middle) / 5(Low)	2 / 1
Modulation	4FSK	GMSK
Channel Spacing(kHz)	12.5	200

\* All measurement and test data in this report was gathered from production sample serial number: 171107013. (Assigned by BAACL, Shenzhen). The EUT supplied by the applicant was received on 2017-11-07.

### Objective

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

### Related Submittal(s)/Grant(s)

FCC Part 22H & 24E PCB submissions with FCC ID: YAMEPACK100F4.

### 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 90 – Private Land Mobile Radio Service

Applicable Standards: TIA 603-D.

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

### Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF output power, conducted		±1.5dB
Unwanted Emission, conducted		±1.5dB
Emissions, radiated	Below 1GHz	±4.70dB
	Above 1GHz	±4.80dB
Temperature		±1 °C
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. : 342867, the FCC Designation No. : CN1221.

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

## SYSTEM TEST CONFIGURATION

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### 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.

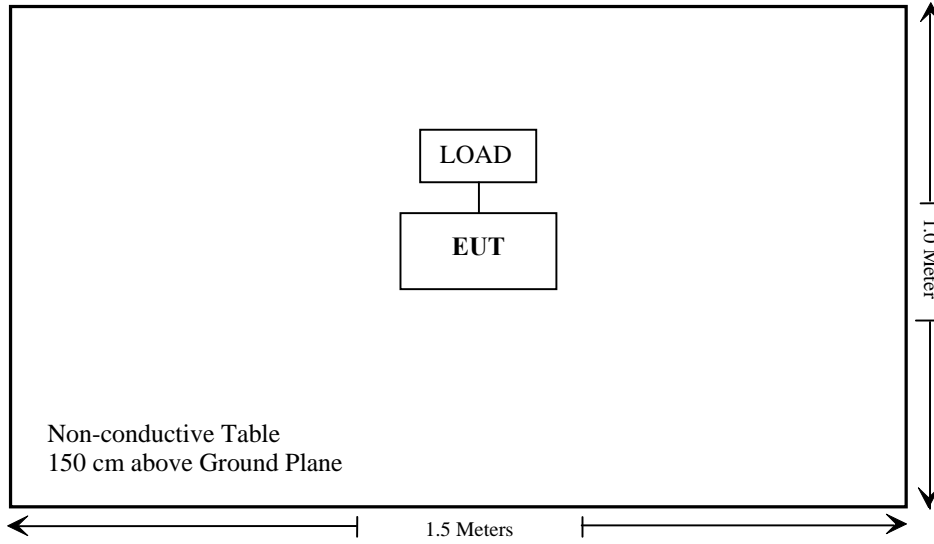
### Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
N/A	Load	100W/50Ohm	N/A

### External I/O Cable

Cable Description	Length (m)	From Port	To
Shielding Detachable RF Cable	0.5	Load	EUT

**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; §90.205	RF Output Power	Compliance
§2.1047; §74.463;§90.207	Modulation Characteristic	Not Applicable
§2.1049;§22.357; §22.731; §74.462; §90.209; §90.210	Occupied Bandwidth & Emission Mask	Compliance
§2.1051; §22.861; §74.462;§90.210	Spurious Emission at Antenna Terminal	Compliance
§2.1053; §22.861; §74.462;§90.210	Spurious Radiated Emissions	Compliance
§2.1055; § 22.355; §74.464;§90.213	Frequency Stability	Compliance
§90.214	Transient Frequency Behavior	Compliance



**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Radiated Emission Test</b>					
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	2017-02-14	2018-02-14
HP	Amplifier	HP8447E	1937A01046	2017-11-19	2018-05-21
Anritsu	Signal Generator	68369B	004114	2016-12-05	2017-12-05
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2016-12-07	2017-12-07
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	2018-05-21
Ducommun technologies	RF Cable	104PEA	218124002	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	1	2017-11-19	2018-05-21
Ducommun technologies	RF Cable	RG-214	2	2017-11-22	2018-05-22
<b>RF Conducted Test</b>					
Frequency Stability					
ESPEC	Temperature & Humidity Chamber	EL-10KA	09107726	2017-11-22	2018-11-22
Fluke	Digital Multimeter	287	19000011	2017-04-09	2018-04-09
Long Wei	DC Power Supply	TPR-6420D	398363	NCR	NCR
Output Power/OBW/Emission Mask/Conducted Emission					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200120	2016-12-05	2017-12-05
Transient Frequency Behavior					
Rohde & Schwarz	Signal Analyzer	FSIQ26	837405/023	2017-04-24	2018-04-24
All items					
N/A	30dB Attenuator	53-30-43	PG633	2017-05-22	2017-11-22
N/A	30dB Attenuator	53-30-43	PG633	2017-11-22	2018-05-22

\* **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 <sup>2</sup> )	Averaging Time (Minutes)
0.3-1.34	614	1.63	*(100)	6
1.34-30	1842/f	4.89/f	*(900/f <sup>2</sup> )	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<sup>2</sup>)

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 simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Worst case as below:

Frequency (MHz)	Antenna Gain		Tune up Conducted Power		Evaluation Distance (cm)	Power Density (mW/cm <sup>2</sup> )	MPE Limit (mW/cm <sup>2</sup> )
	(dBi)	(numeric)	(dBm)	(mW)			
824-849	0	1.00	34	2511.89	42	0.113	2.74
1850-1910	1	1.26	30	1000.00	42	0.057	5.00
410-470	3.5	2.24	43.7	23442.29	42	1.184	1.36

Note:

Duty cycle is 50% about PTT function for DMR mode. So the average tune up conducted power is 11721.15mW for this mode. And this device will be using for Occupational person and must place the equipment at least 42cm from any persons' body to antenna, which is declared by manufacture.

Simultaneous transmitting consideration: GSM850 and DMR, or PCS1900 and DMR

The ratio= $MPE/limit_{824MHz}+MPE/limit_{410MHz}=0.113/2.74+1.184/1.36=0.91 < 1.0$ , simultaneous exposure is not required.

The ratio= $MPE/limit_{1850MHz}+MPE/limit_{410MHz}=0.057/5.00+1.184/1.36=0.88 < 1.0$ , simultaneous exposure is not required.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 42cm from nearby persons to antenna.

**Result: Compliance**

**FCC §2.1046 & § 22.727 & §74.461 & §90.205 - RF OUTPUT POWER****Applicable Standard**

FCC §2.1046, § 22.727, §74.461 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:

<u>R B/W</u>	<u>Video B/W</u>
100 kHz	300 kHz

**Test Data****Environmental Conditions**

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Jacob Kong on 2017-11-10.*

*Test Mode: Transmitting*

**Test Result:** Compliance. Please refer to following table.

Mode	Frequency Spacing (kHz)	Frequency (MHz)	Power level	Output (dBm)	Output Power(W)	Note
Digital	12.5	410.0125	High	43.61	22.96	For Federal
			Middle	40.31	10.74	
			Low	37.33	5.41	
		450.2125	High	43.05	20.18	For Part 74
			Middle	40.10	10.23	
			Low	37.13	5.16	
		453.2125	High	43.28	21.28	For Part 90
			Middle	40.08	10.19	
			Low	37.37	5.46	
		459.9750	High	43.41	21.93	For Part 22
			Middle	40.50	11.22	
			Low	37.66	5.83	
		469.9875	High	43.42	21.98	For Federal
			Middle	40.37	10.89	
			Low	37.70	5.89	

Rated High power is 20W, limit is 16-24 W  
 Rated Middle power is 10W, limit is 8-12 W  
 Rated Low power is 5W, limit is 4-6W

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## **FCC §2.1047 & §74.463 & §90.207 - MODULATION CHARACTERISTIC**

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### **Applicable Standard**

According to FCC § 2.1047(d), Part 22, 74, 90 there is no specific requirement for digital modulation, therefore modulation characteristic is not presented.

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

### Applicable Standard

FCC §2.1049, §22.357, § 22.731, §74.462, §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  $7.27(f_d - 2.88)$  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.

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 and the spectrum was recorded in the frequency band  $\pm 50$  kHz from the carrier frequency.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24~27 °C
<b>Relative Humidity:</b>	50~57 %
<b>ATM Pressure:</b>	100.9~101.0 kPa

*The testing was performed by Jacob Kong from 2017-11-19 to 2017-11-23.*

Modulation	Channel Separation (kHz)	Frequency (MHz)	Power Level	99% Occupied Bandwidth (kHz)	26 dB Emissions Bandwidth (kHz)	Note
Digital	12.5	450.2125	High	7.21	9.29	For Part 74
	12.5		Middle	7.13	9.38	
	12.5		Low	7.13	9.38	
	12.5	453.2125	High	7.29	9.21	For Part90
	12.5		Middle	7.21	8.89	
	12.5		Low	7.37	9.70	
	12.5	459.975	High	7.29	9.78	For Part 22
	12.5		Middle	7.29	9.70	
	12.5		Low	7.13	8.81	

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

***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, 7.37 kHz. The emission mask was obtained from 47CFR 90.210(d).*

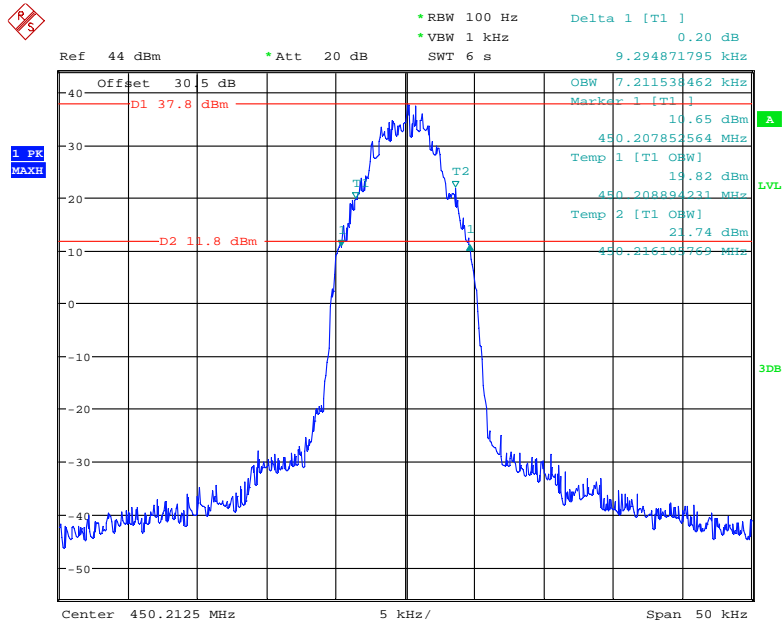
*F1D and F1E portion of the designator indicates digital information.*

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



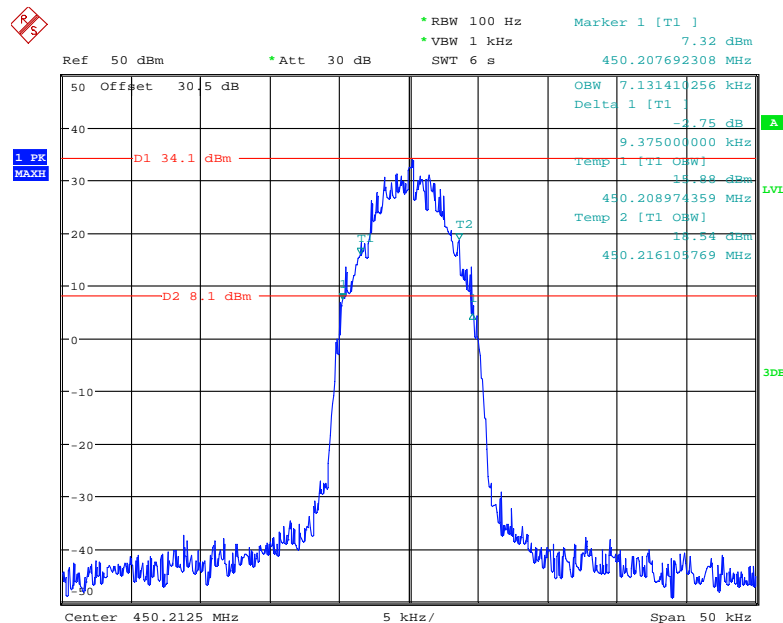
**Digital Modulation:**

**Frequency 450.2125 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



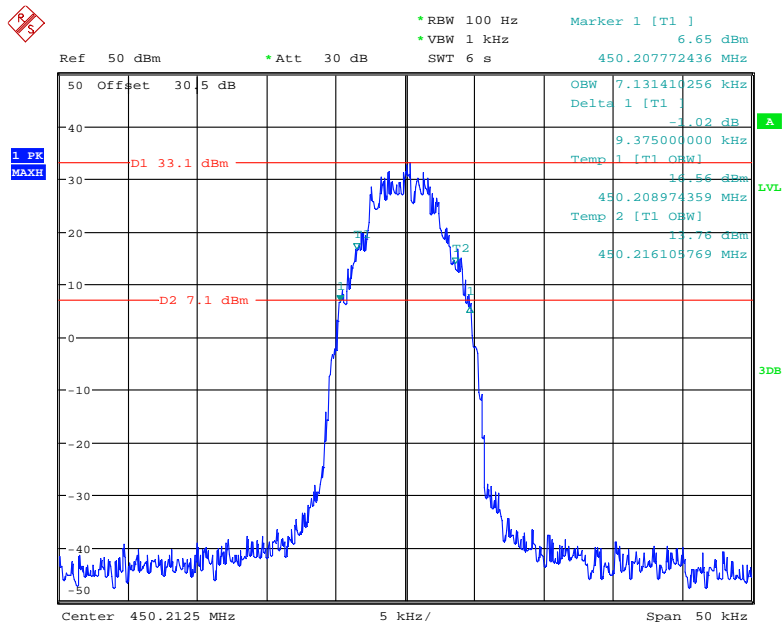
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**Frequency 450.2125 MHz: 99% Occupied & 26 dB Bandwidth, Middle Power**



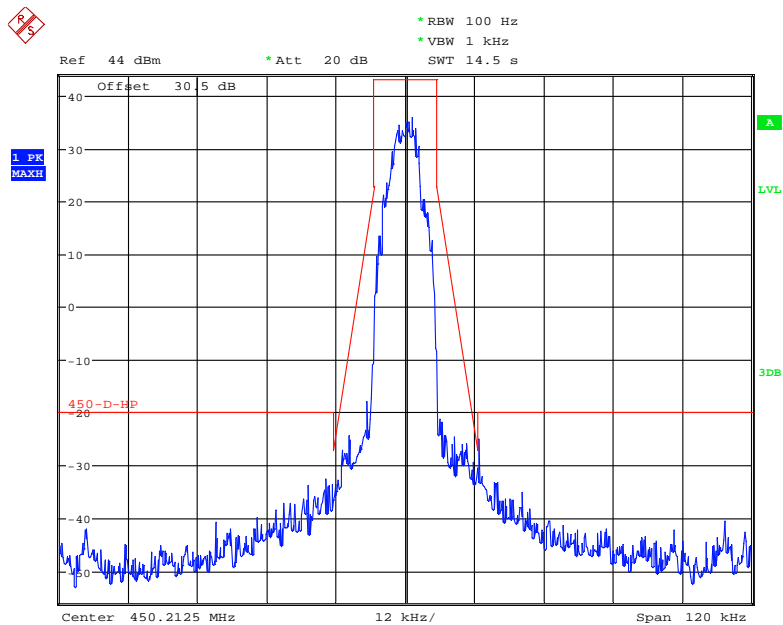
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**Frequency 450.2125 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



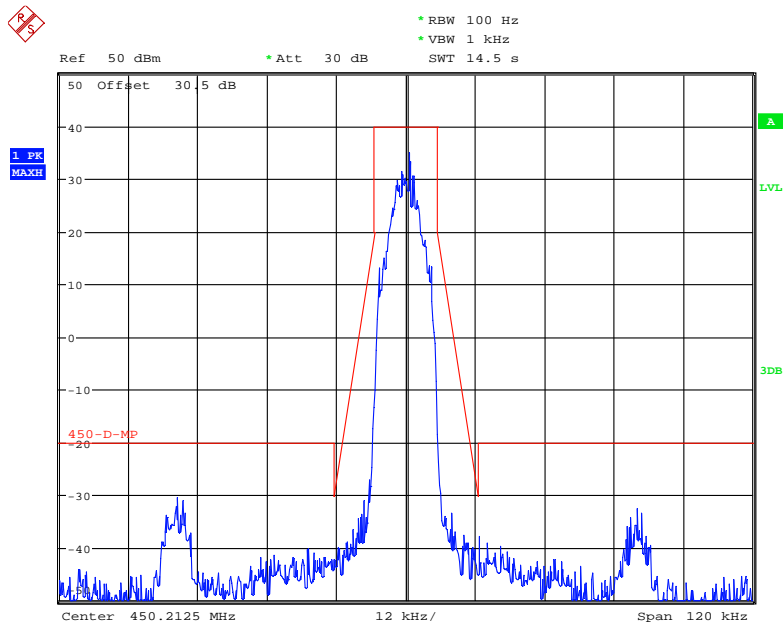
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**Frequency 450.2125 MHz: Emission Mask, High Power**



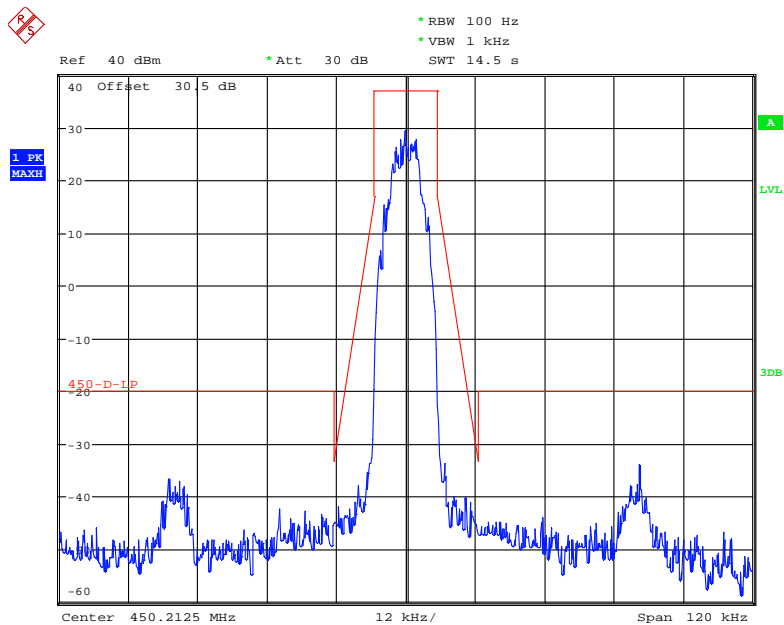
Date: 23.NOV.2017 15:28:08

### Frequency 450.2125 MHz: Emission Mask, Middle Power



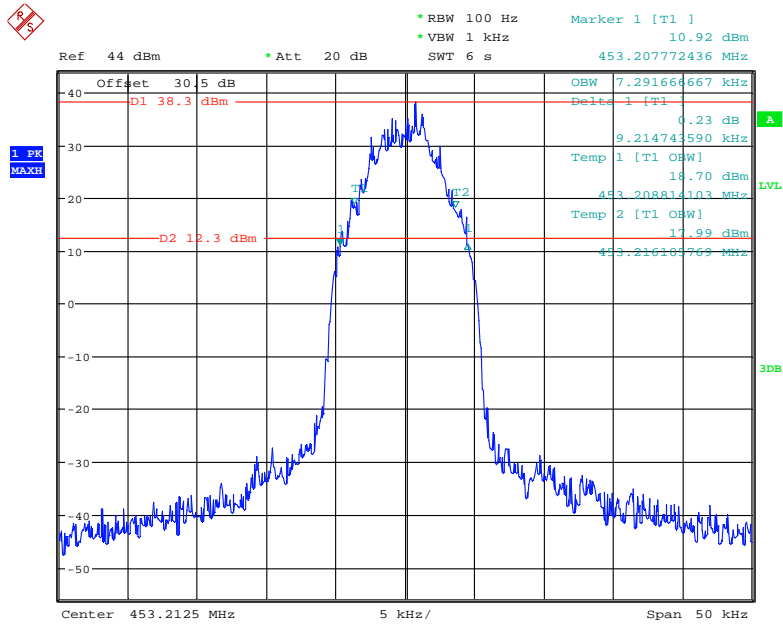
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### Frequency 450.2125 MHz: Emission Mask, Low Power



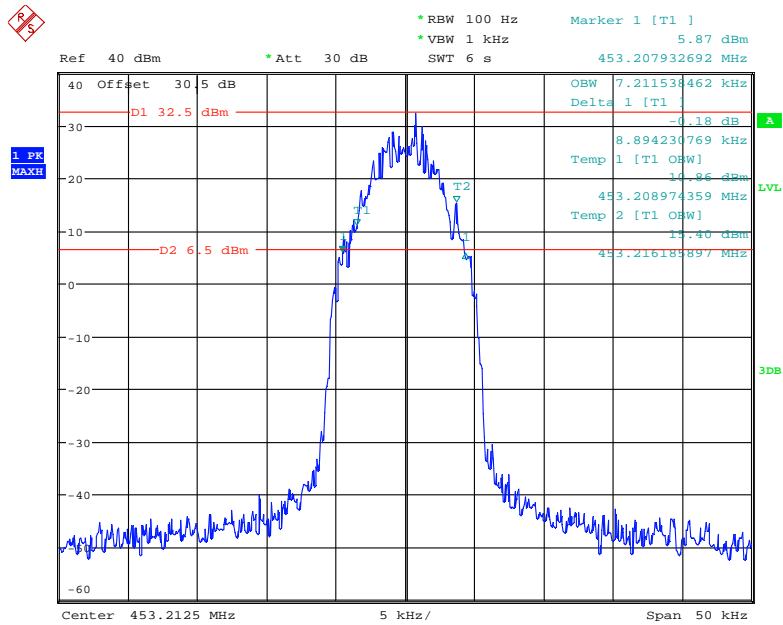
Date: 19.NOV.2017 17:21:03

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



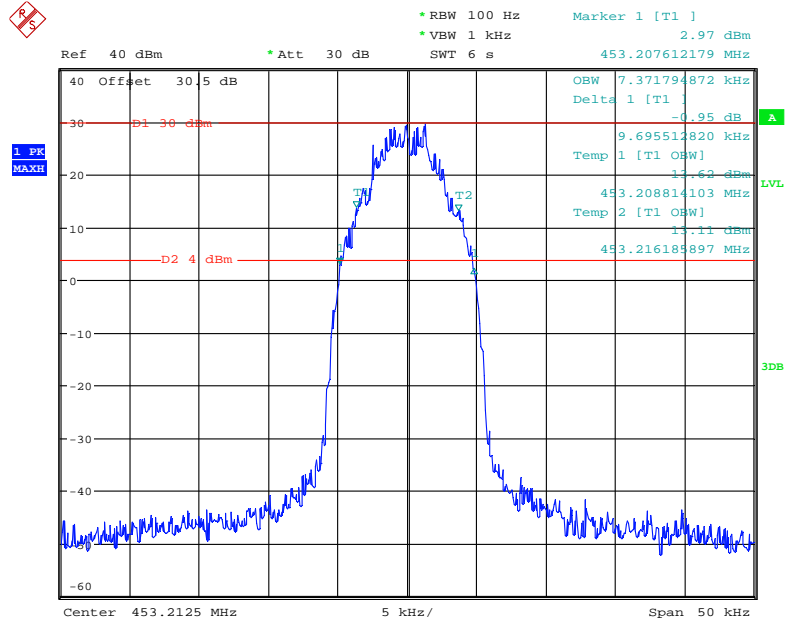
Date: 23.NOV.2017 15:23:59

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



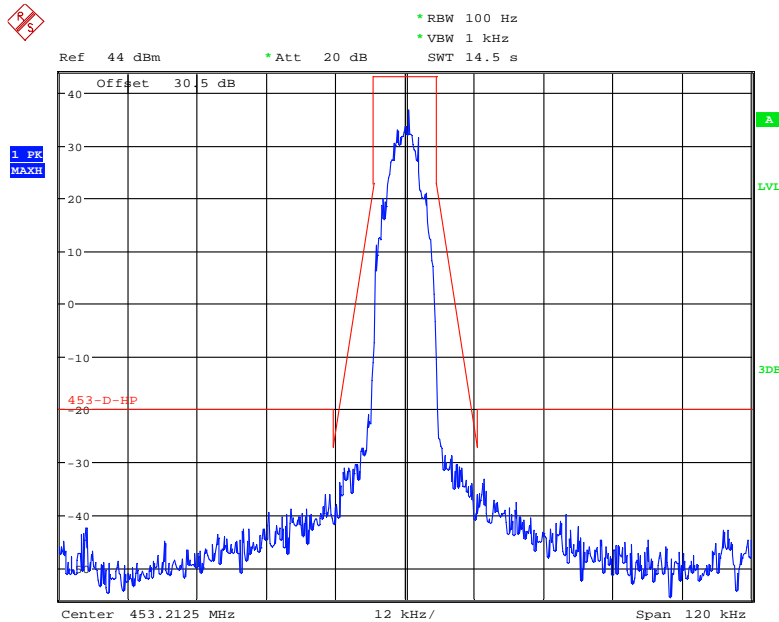
Date: 19.NOV.2017 16:56:45

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



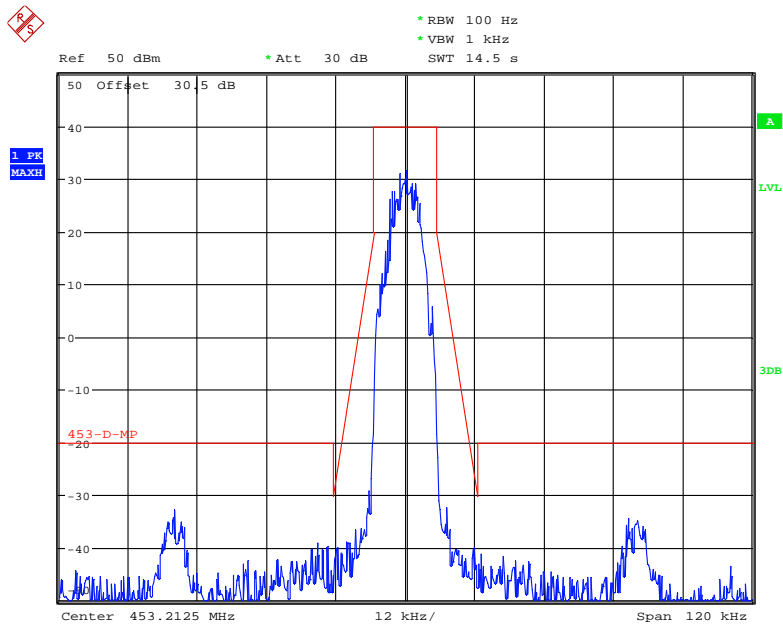
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**Frequency 453.2125 MHz: Emission Mask D, High Power**



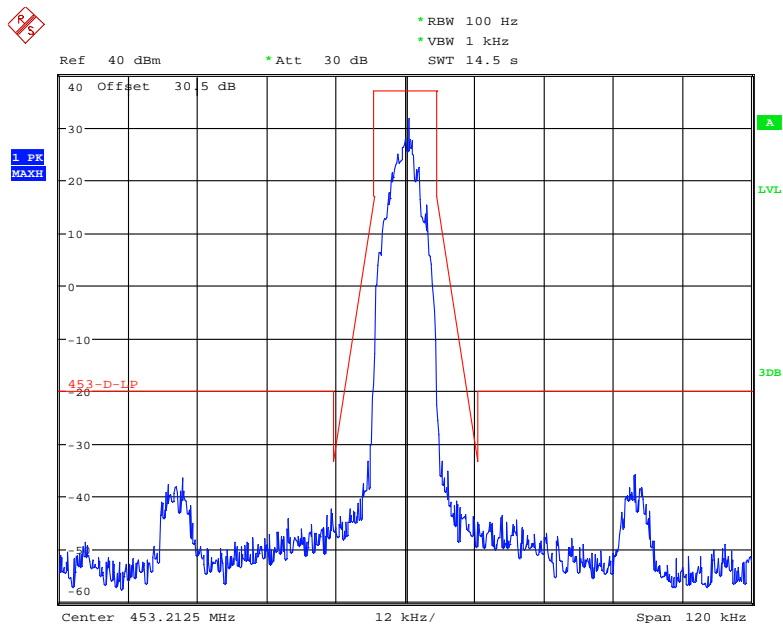
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### Frequency 453.2125 MHz: Emission Mask D, Middle Power



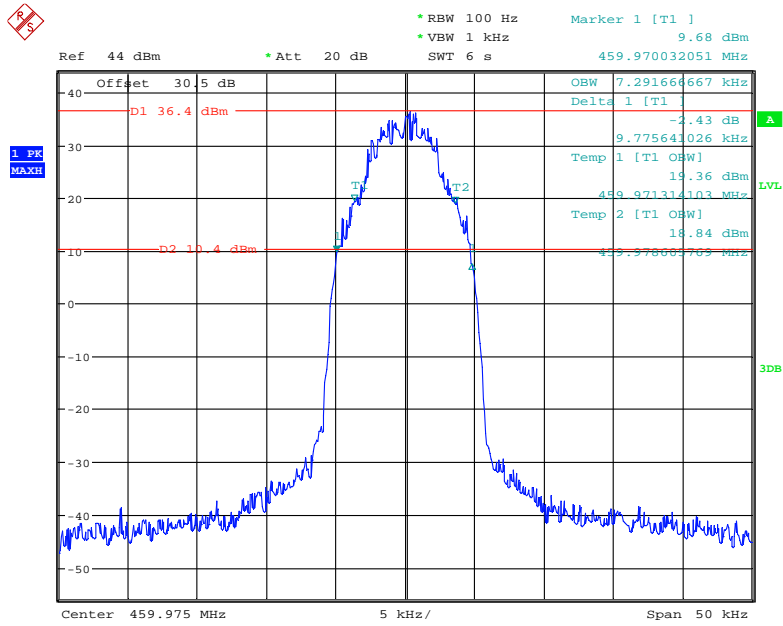
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### Frequency 453.2125 MHz: Emission Mask D, Low Power



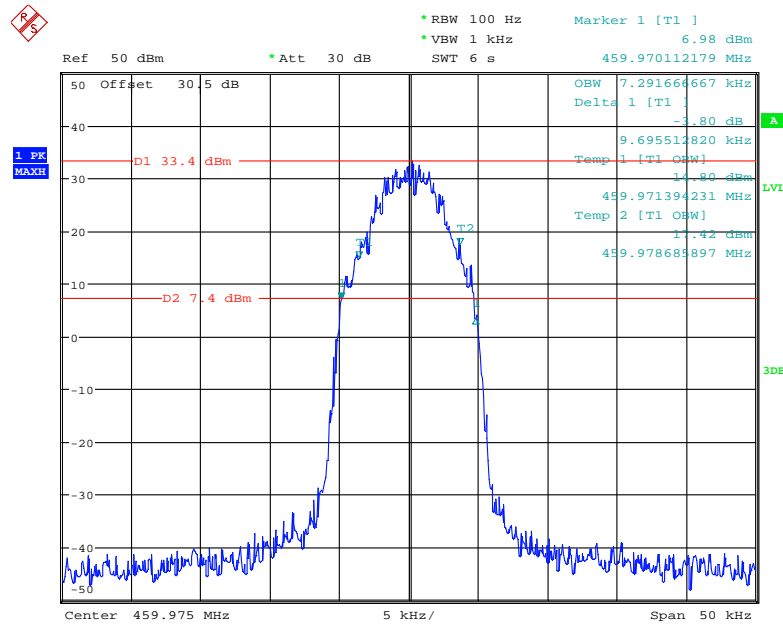
Date: 19.NOV.2017 16:54:22

**Frequency 459.975 MHz: 99% Occupied & 26 dB Bandwidth, High Power**



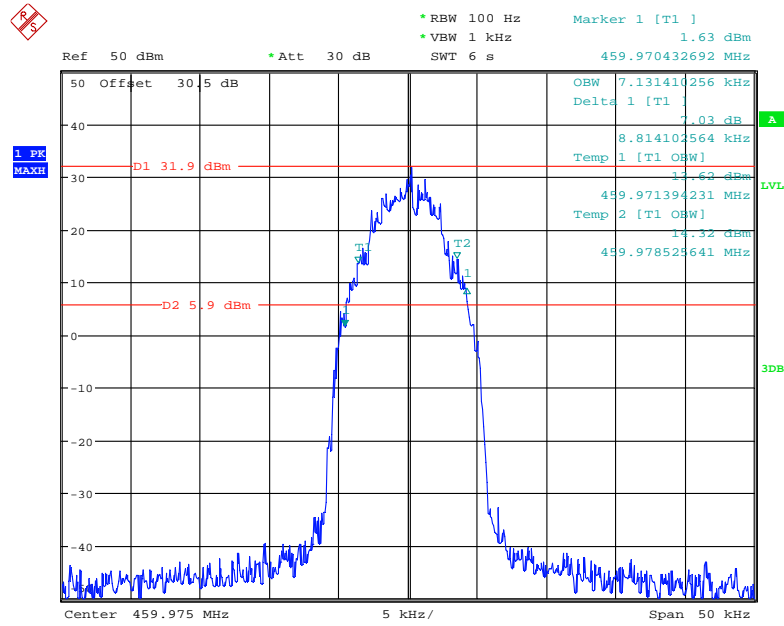
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**Frequency 459.975 MHz: 99% Occupied & 26 dB Bandwidth, Middle Power**



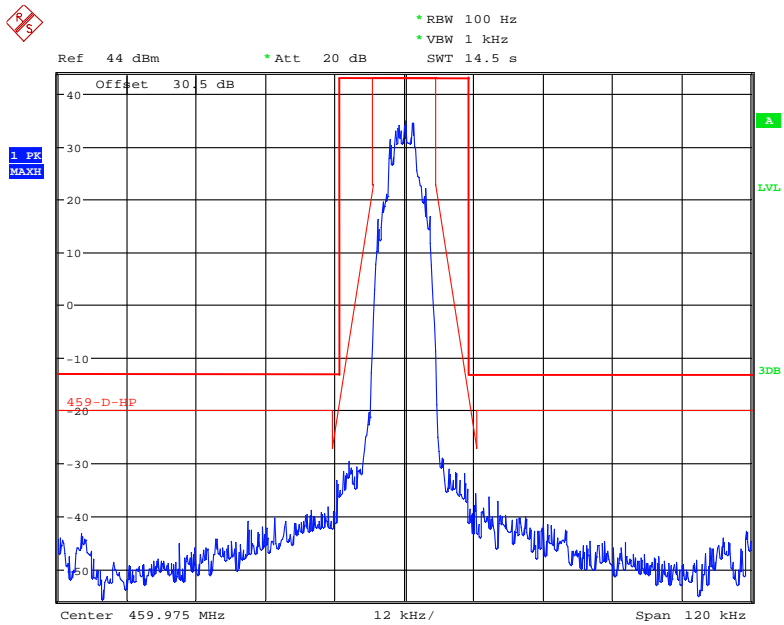
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**Frequency 459.975 MHz: 99% Occupied & 26 dB Bandwidth, Low Power**



Date: 19.NOV.2017 17:09:44

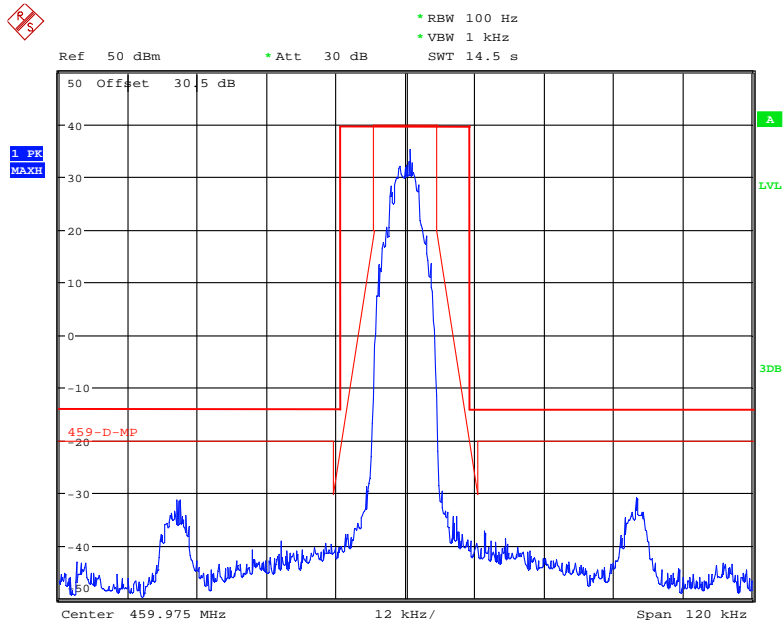
**Frequency 459.975 MHz: Emission Mask, High Power, FCC part 22.359**



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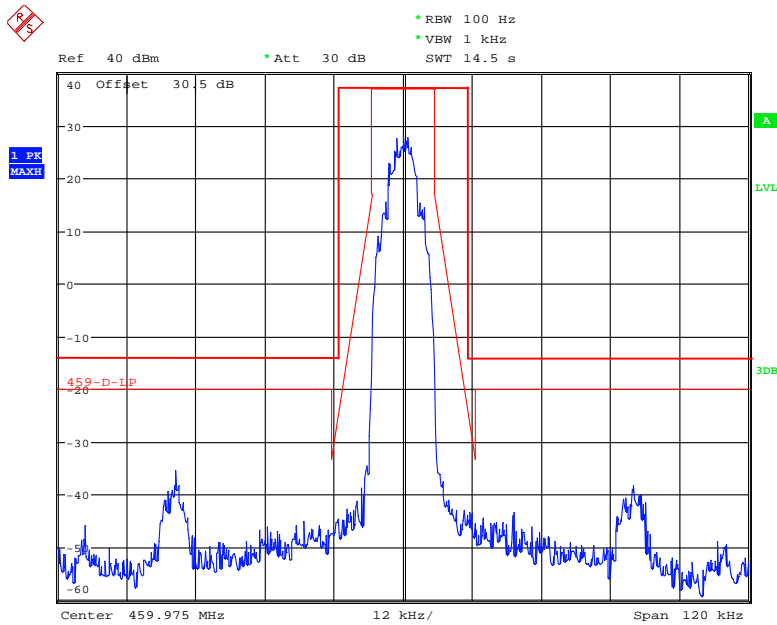


### Frequency 459.975 MHz: Emission Mask, Middle Power, FCC part 22.359



Date: 19.NOV.2017 17:27:57

### Frequency 459.975 MHz: Emission Mask, Low Power, FCC part 22.359



Date: 19.NOV.2017 17:25:04

## FCC §2.1051 & §22.861 & §74.462 & §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  $7.27 (f_d - 2.88 \text{ kHz})$  dB.
- 3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ( $f_d$  in kHz) of more than 12.5 kHz: At least  $50 + 10 \log (P)$  dB or 70 dB, whichever is the lesser attenuation.

### 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 10<sup>th</sup> harmonic.

### Test Data

#### Environmental Conditions

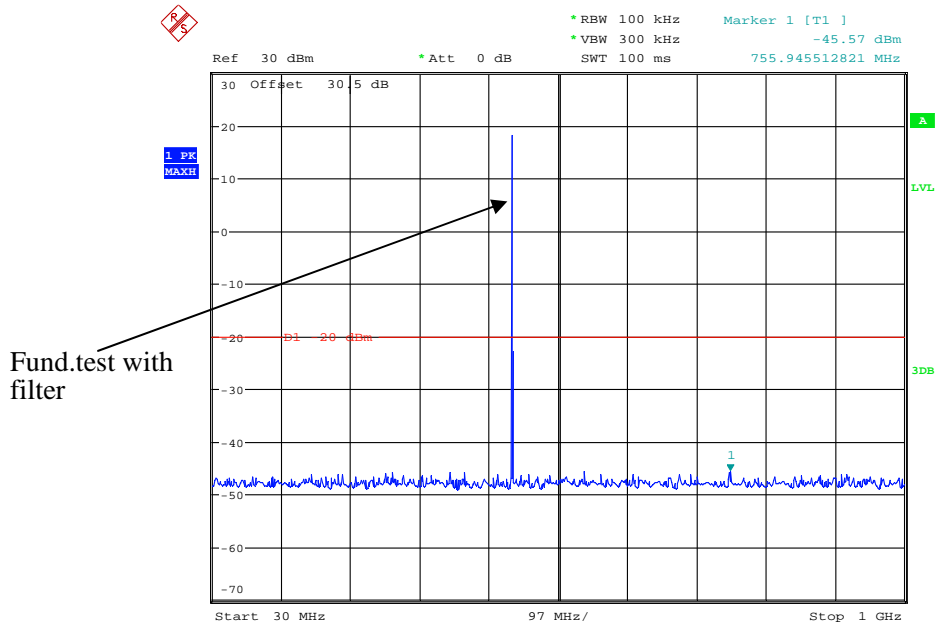
Temperature:	24~25 °C
Relative Humidity:	50~51 %
ATM Pressure:	101.0~101.5 kPa

*The testing was performed by Jacob Kong from 2017-11-19 to 2017-11-20.*

*Test Mode: Transmitting, please refer to the following plots.*

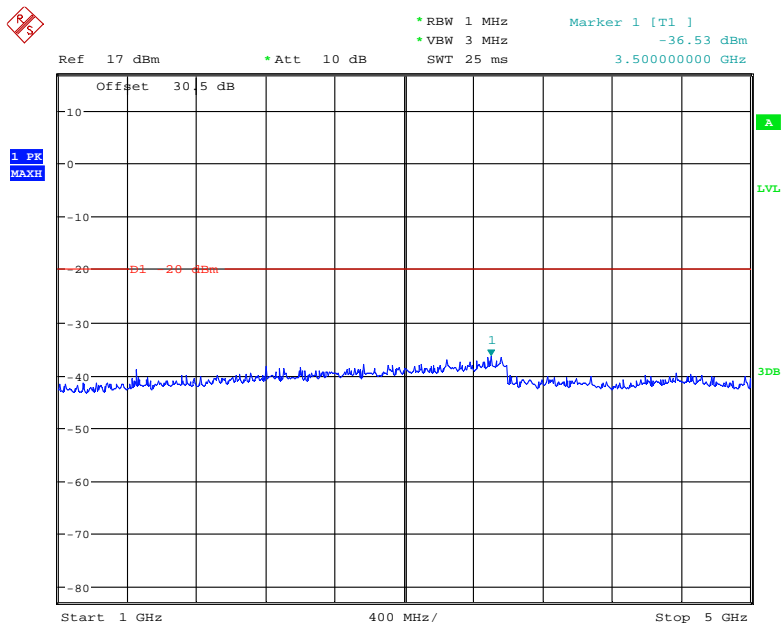
Digital Modulation:

30MHz – 1 GHz, 450.2125 MHz, FCC part 74.462



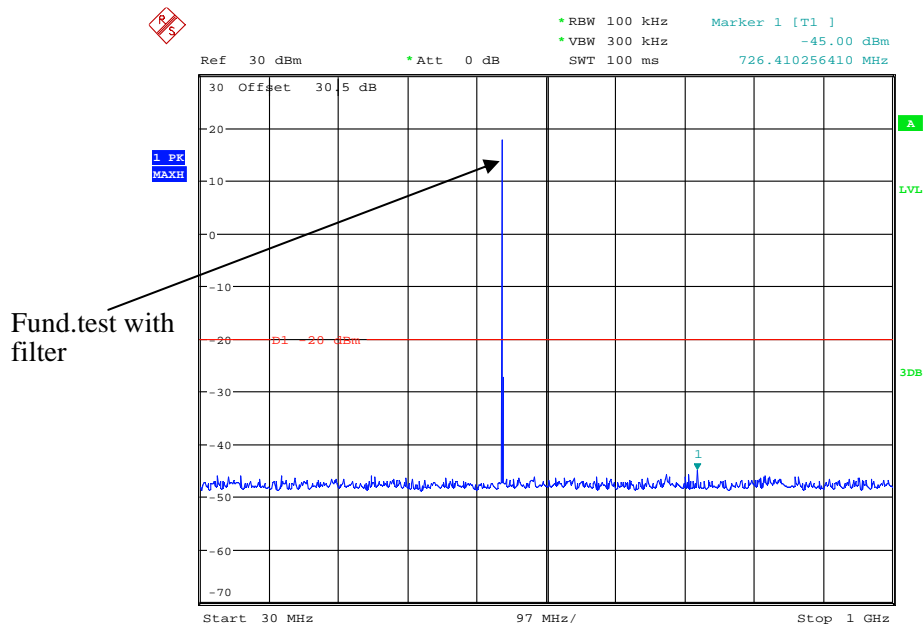
Date: 19.NOV.2017 18:24:04

1 GHz – 5 GHz, 450.2125 MHz, FCC part 74.462



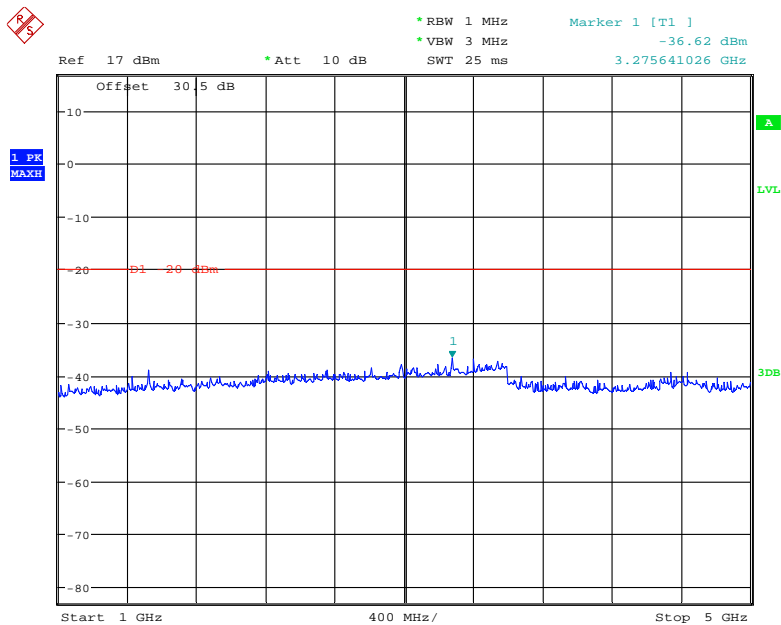
Date: 20.NOV.2017 02:49:28

### 30MHz – 1 GHz, 453.2125 MHz, FCC part 90.210



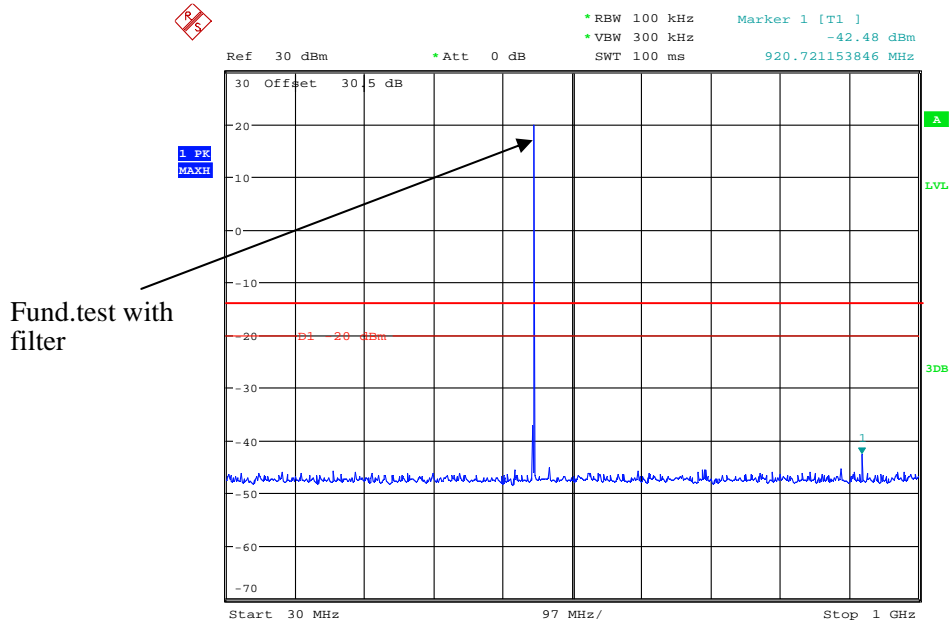
Date: 19.NOV.2017 18:23:18

### 1 GHz – 5 GHz, 453.2125 MHz, FCC part 90.210



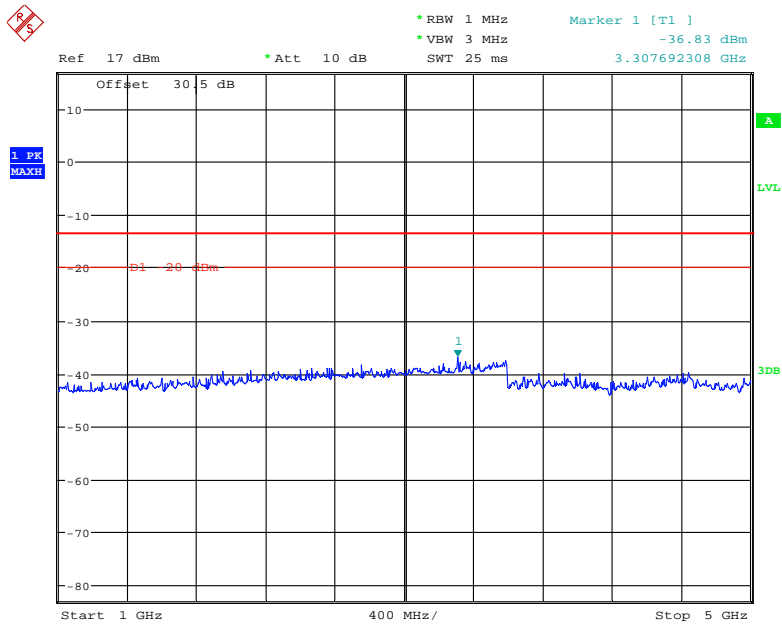
Date: 20.NOV.2017 02:50:10

### 30MHz – 1 GHz, 459.975 MHz, FCC part 22.861



Date: 19.NOV.2017 18:20:57

### 1 GHz – 5 GHz, 459.975 MHz, FCC part 22.861



Date: 20.NOV.2017 02:50:53

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

### Applicable Standard

FCC §2.1053, §22.861, §74.462 and §90.210

### Test Procedure

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

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

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

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

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

Spurious attenuation limit in dB = 50 + 10 Log<sub>10</sub> (power out in Watts) for EUT with a 12.5 kHz channel bandwidth.

### Test Data

#### Environmental Conditions

<b>Temperature:</b>	24 °C
<b>Relative Humidity:</b>	51 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Jacob Kong on 2017-12-04.*

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

**30MHz - 5GHz:**

Frequency (MHz)	Receiver Reading (dBµV)	Turn Table Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)	Level (dBm)	Cable Loss (dB)	Antenna Gain (dB)			
Digital Modulation 450.2125MHz-12.5 kHz, FCC part 74.462										
900.425	44.51	83	2.3	H	-50.5	0.70	0.0	-51.20	-20	31.20
900.425	44.44	193	2.5	V	-49.6	0.70	0.0	-50.30	-20	30.30
1350.04	47.45	30	2.0	H	-60.5	1.60	8.30	-53.80	-20	33.80
1350.04	48.71	70	1.9	V	-59.5	1.60	8.30	-52.80	-20	32.80
1800.05	45.95	167	1.4	H	-60.5	1.30	8.50	-53.30	-20	33.30
1800.05	43.42	75	1.1	V	-62.6	1.30	8.50	-55.40	-20	35.40
Digital Modulation 453.2125MHz-12.5 kHz, FCC part 90.210										
906.425	45.36	298	2.1	H	-49.6	0.70	0.0	-50.30	-20	30.30
906.425	42.56	357	2.1	V	-51.4	0.70	0.0	-52.10	-20	32.10
1359.04	48.28	42	2.4	H	-59.7	1.60	8.30	-53.00	-20	33.00
1359.04	47.2	148	2.3	V	-61.0	1.60	8.30	-54.30	-20	34.30
1812.05	43.85	190	1.4	H	-62.6	1.30	8.50	-55.40	-20	35.40
1812.05	44.07	220	2.0	V	-62.0	1.30	8.50	-54.80	-20	34.80
Digital Modulation 459.975MHz-12.5 kHz, FCC part 22.861										
919.95	43.89	226	1.6	H	-51.1	0.70	0.0	-51.80	-13	38.80
919.95	44.27	178	2.2	V	-49.7	0.70	0.0	-50.40	-13	37.40
1379.93	45.68	220	2.1	H	-62.3	1.60	8.30	-55.60	-13	42.60
1379.93	47.35	322	2.1	V	-60.9	1.60	8.30	-54.20	-13	41.20
1839.90	45.28	69	2.0	H	-61.2	1.30	8.50	-54.00	-13	41.00
1839.90	44.66	153	1.1	V	-61.4	1.30	8.50	-54.20	-13	41.20

**Note:**

Absolute Level = Substituted Level - Cable loss + Antenna Gain

Margin = Limit- Absolute Level

**FCC §2.1055 & § 22.355 & §74.464 & §90.213 - FREQUENCY STABILITY****Applicable Standard**

FCC §2.1055, § 22.355, §74.464 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**

<b>Temperature:</b>	26 °C
<b>Relative Humidity:</b>	56 %
<b>ATM Pressure:</b>	101.0 kPa

*The testing was performed by Jacob Kong on 2017-12-05.*

*Test Mode: Transmitting*

Note: The device is intended for fixed using.



For 12.5 kHz:

<b>Digital Modulation, Reference Frequency: 450.2125 MHz, Limit: ±1.5 ppm</b>			
<b>Test Environment</b>		<b>Frequency Measure with Time Elapsed</b>	
<b>Temperature (°C)</b>	<b>Voltage Supplied (V<sub>DC</sub>)</b>	<b>Measured Frequency (MHz)</b>	<b>Frequency Error (ppm)</b>
Frequency Stability versus Input Temperature			
50	13.6	450.212519	0.0422
40	13.6	450.212495	-0.0111
30	13.6	450.212540	0.0888
20	13.6	450.212522	0.0489
10	13.6	450.212451	-0.1088
0	13.6	450.212429	-0.1577
-10	13.6	450.212537	0.0822
-20	13.6	450.212530	0.0666
-30	13.6	450.212525	0.0555
Frequency Stability versus Input Voltage			
20	11.6	450.212545	0.1000
20	15.6	450.212526	0.0578

<b>Digital Modulation, Reference Frequency: 453.2125 MHz, Limit: ±1.5 ppm</b>			
<b>Test Environment</b>		<b>Frequency Measure with Time Elapsed</b>	
<b>Temperature (°C)</b>	<b>Voltage Supplied (V<sub>DC</sub>)</b>	<b>Measured Frequency (MHz)</b>	<b>Frequency Error (ppm)</b>
Frequency Stability versus Input Temperature			
50	13.6	453.212504	0.0088
40	13.6	453.212535	0.0772
30	13.6	453.212496	-0.0088
20	13.6	453.212512	0.0265
10	13.6	453.212531	0.0684
0	13.6	453.212489	-0.0243
-10	13.6	453.212517	0.0375
-20	13.6	453.212533	0.0728
-30	13.6	453.212556	0.1236
Frequency Stability versus Input Voltage			
20	11.6	453.212529	0.0640
20	15.6	453.212523	0.0507

<b>Digital Modulation, Reference Frequency: 459.975 MHz, Limit: ±2.5 ppm</b>			
<b>Test Environment</b>		<b>Frequency Measure with Time Elapsed</b>	
<b>Temperature (°C)</b>	<b>Voltage Supplied (V<sub>DC</sub>)</b>	<b>Measured Frequency (MHz)</b>	<b>Frequency Error (ppm)</b>
Frequency Stability versus Input Temperature			
50	13.6	459.975020	0.0435
40	13.6	459.975037	0.0804
30	13.6	459.975009	0.0196
20	13.6	459.975016	0.0348
10	13.6	459.975045	0.0978
0	13.6	459.975013	0.0283
-10	13.6	459.974992	-0.0174
-20	13.6	459.975033	0.0717
-30	13.6	459.975024	0.0522
Frequency Stability Versus Input Voltage			
20	11.6	459.974983	-0.0370
20	15.6	459.974975	-0.0544

## FCC §90.214 - TRANSIENT FREQUENCY BEHAVIOR

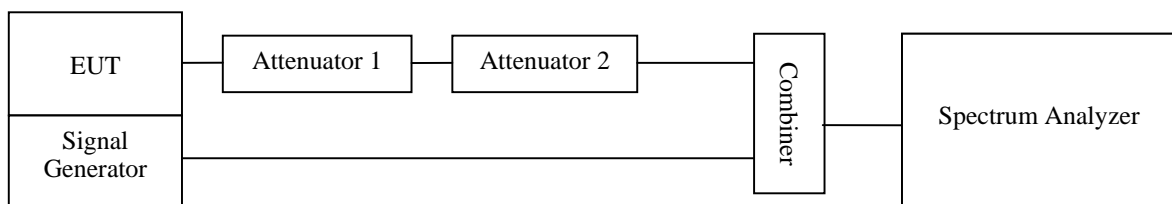
### Applicable Standard

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  $\pm 12.5$  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  $\pm 4$  divisions vertically centered on the display. Set trigger mode of the Spectrum Analyzer to "Video", and tune the "trigger level" on suitable level. Then set the "trigger offset" to -10ms for turn on and -15ms for turn off.
- j) Turn on the transmitter and the transient wave will be captured on the screen of Spectrum Analyzer. Observe the stored display. The instant when the 1 kHz test signal is completely suppressed is considered to be  $t_{on}$ . The trace should be maintained within the allowed divisions during the period  $t_1$  and  $t_2$ .
- k) Then turn off the transmitter, and another transient wave will be captured on the screen of Spectrum Analyzer. The trace should be maintained within the allowed divisions during the period  $t_3$ .



**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	23 °C
<b>Relative Humidity:</b>	54 %
<b>ATM Pressure:</b>	101.1 kPa

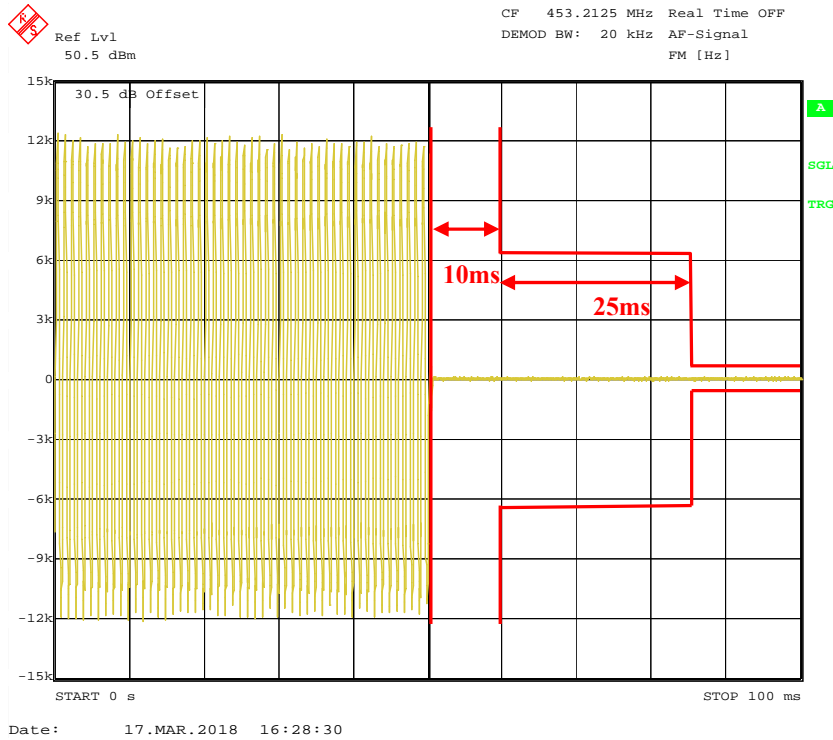
The testing was performed by Jacob Kong on 2018-03-17.

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

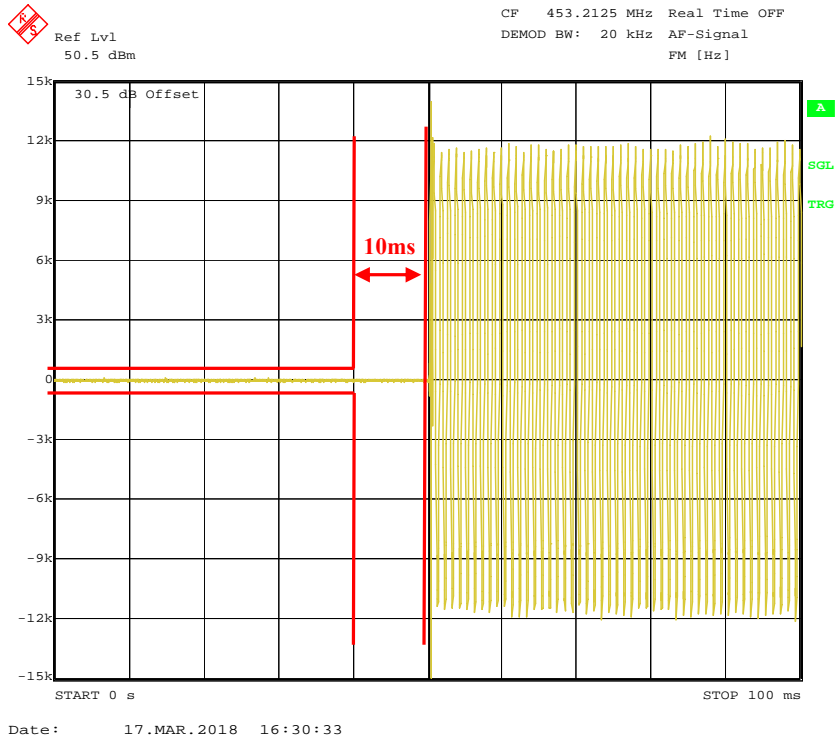
Please refer to the following plots.

**Channel: 453.2125 MHz, 12.5 kHz**

**Turn on**



### Turn off



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