FCC TEST REPORT No. 14/386	**2014**
for 47 CFR Part 90	April, 24

Model name:	**ALLEGRO REPEATER**
Product description	The Water Meter
FCC ID	NTA2WREP1
Applicant	Telematics Wireless Ltd., Israel
Manufacturer	Telematics Wireless Ltd., Israel

The results in this report apply only to the samples tested.
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Approved by
Sergey Bogach,
Chief TC of PE TC "OMEGA"

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1 EQUIPMENT UNDER TEST

1.1 Basic description

Equipment Category	**Transceiver**
Model name	**ALLEGRO REPEATER**
Destination	**a compact RF Receiver/Transmitter unit for the Water Meter**
Configuration	**stand-alone device**
Serial numbers	**n/a**

1.2 Technical characteristics declared by manufacturer

Transmit Narrow Channel, complies Part 90

Parameter	Value
Transmit frequency band	450-470MHz
Channel Separation	6.25kHz
Modulation	4GFSK
Max Frequency deviation	±1.2kHz
Max Data rate	4.8kbps
Frequency stability (including initial stability, temperature)	<0.5 ppm
Peak output power	35.2dBm
Antenna	Internal, 1dBi
Harmonics	< -62dBc

Transmit Narrow Channel, complies Part 15.231

Parameter	Value
Transmit frequency band	450-470MHz
Channel Separation	6.25kHz
Modulation	4GFSK
Max Frequency deviation	±1.2kHz
Max Data rate	6kbps
Frequency stability (including initial stability, temperature)	<0.5 ppm
Peak output power	-17dBm
Antenna	Internal, 1dBi
Harmonics	< -62dBc

Receiver

Parameter	Value
Receive frequency	Programmable in the range 450-470MHz
Sensitivity (BER 1E-3)	-120 dBm
Modulation	4GFSK
Frequency deviation	1.2kHz

1.3 Photos

Figure 1.3.1 External photo

Figure 1.3.2 External photo

Figure 1.3.3 Internal photo

2 GENERAL INFORMATION ABOUT TESTS

2.1 Test program and results of the tests

Number of test	FCC rule	Description of test	Result (Pass, Fail, N/A)
1	90.210(e)	Emission Mask	**Pass**
2	90.210(e)	Conducted Spurious Emissions	**Pass**
3	90.210(e)	Radiated Spurious Emissions	**Pass**
4	90.214	Transient Frequency Stability	**Pass**
5	90.213	Frequency Stability with temperature	**Pass**
6	90.213	Frequency Stability with supply voltage	**Pass**
7	15.231a	Conditions for intentional radiators to comply with periodic operation	**Pass**
8	15.231b	Field strength of emissions	**Pass**
9	15.231c	The bandwidth of the emission	**Pass**

Tested by:
tests No. 1,2,4-6: Laboratory engineer Boris Trifonov

tests No. 3: Laboratory engineer Vladimir Osaulko

Checked by:
Leading engineer Fjodor Shubin

2.2 Test conditions and test modes

Operating Temperature: -30 °C to + 85 °C
Storage Temperature: -40 °C to +85 °C
Humidity: Up to 95%

Normal power source:
- Unom = 110 VAC

Extreme temperature:
- minimum temperature Tmin = minus 30 °C;
- maximum temperature Tmax = +85 °C.

Extreme power source:
- minimum voltage Umin: 99 VAC
- maximum voltage Umax : 121 VAC

The frequencies for the testing

Channel, No.	Frequency, MHz
Low	450
Mid	460
High	470

2.3 Test equipment used

№	Name	Model	Inventory or serial No.
1.	EMI Test receiver/spectrum analyzer	R&S ESU-26	100260
2.	Spectrum analyzer	R&S FSV40	105763
3.	Radiocommunication service monitor	R&S CMS-54	100033
4.	Vector Signal Generator	SMBV100A	100216
5.	Signal Generator	SMB100A	100217
6.	Oscilloscope	TDS3052B	100038
7.	Frequency meter	Ч3-64	100056
8.	Dual directional coupler	778D-012	101895
9.	Attenuator	Agilent 8496B	100103
10.	Attenuator	6N25W	100196
11.	Attenuator	PE7014-10	101692
12.	Detector	Agilent 8471E	100104
13.	Climatic chamber	КРК-400V	015
14.	Antenna (30 – 1000) MHz	Schwarzbeck UBAA 9114	9111-214
15.	Antenna (30 – 1000) MHz	Schwarzbeck VULB9163	9163244
16.	Antenna (1000 - 6000) MHz	HP11966 model 3115	9903-5701
17.	Antenna (1000 - 6000) MHz	ETS-Lindgren 3117	100200
18.	Antenna (1000 - 6000) MHz	ETS-Lindgren 3117	100201
19.	Digital multimeter	FLUKE 189	89750179
20.	Preamplifier (0.1-18) GHz	Agilent 87405c	MY47010400
21.	Psychrometer	ВИТ-2	В931
22.	Shielded Semi-Anechoic Chamber	"DON"	1

All listed above test equipment is calibrated and certified in accordance with established procedure. The equipment has certificates currently in force.

Ancillary equipment

№	Name	Model
1.	Transceiver	Telematics Wireless RTU_S
2.	Notebook	IBM ThinkPad
3.	RF Trigger	-

2.4 Measurement uncertainty

Parameter	Maximum uncertainty
Radiated emission	± 4.7 dB
Conducted emission	± 2.7 dB
Frequency	$\pm 1.5 \times 10^{-7}$
Temperature	± 1 °C
Humidity	± 2 %
Voltage supply AC	± 2 %

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level using a coverage factor of k=2.

2.5 Photo of test site

Figure 2.6.1

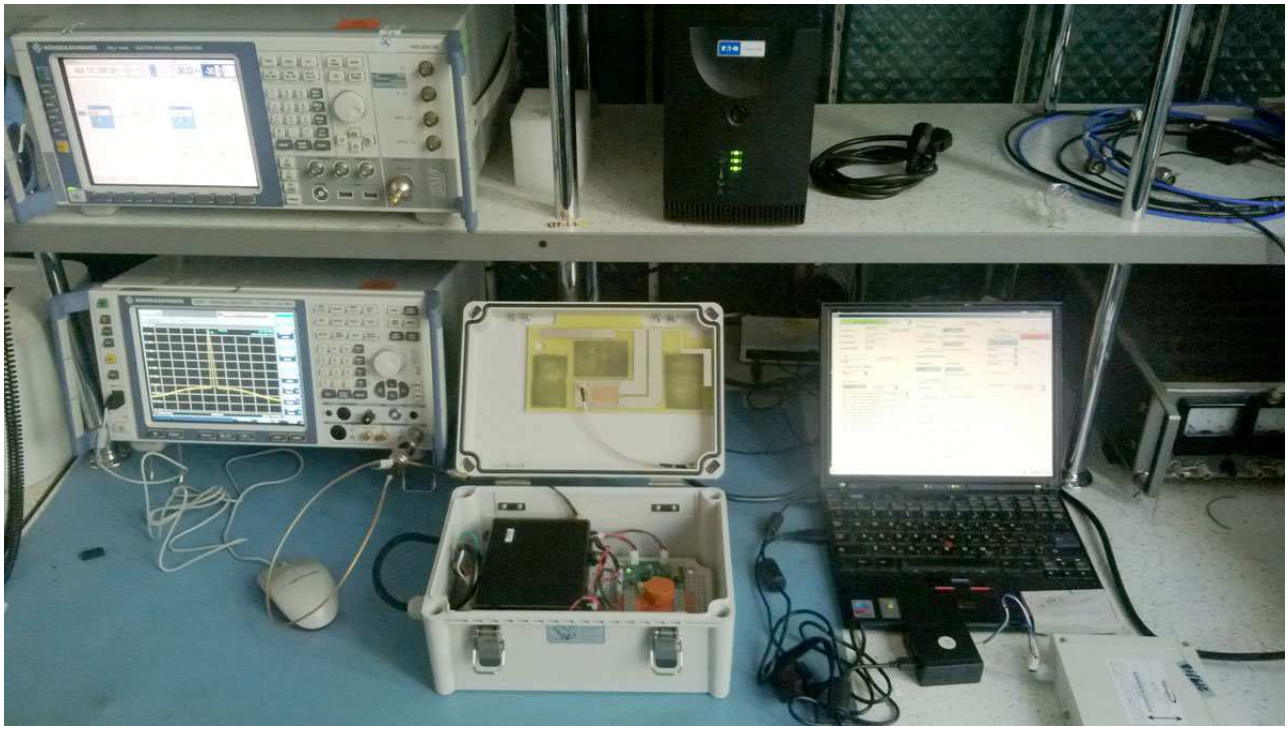


Figure 2.6.2

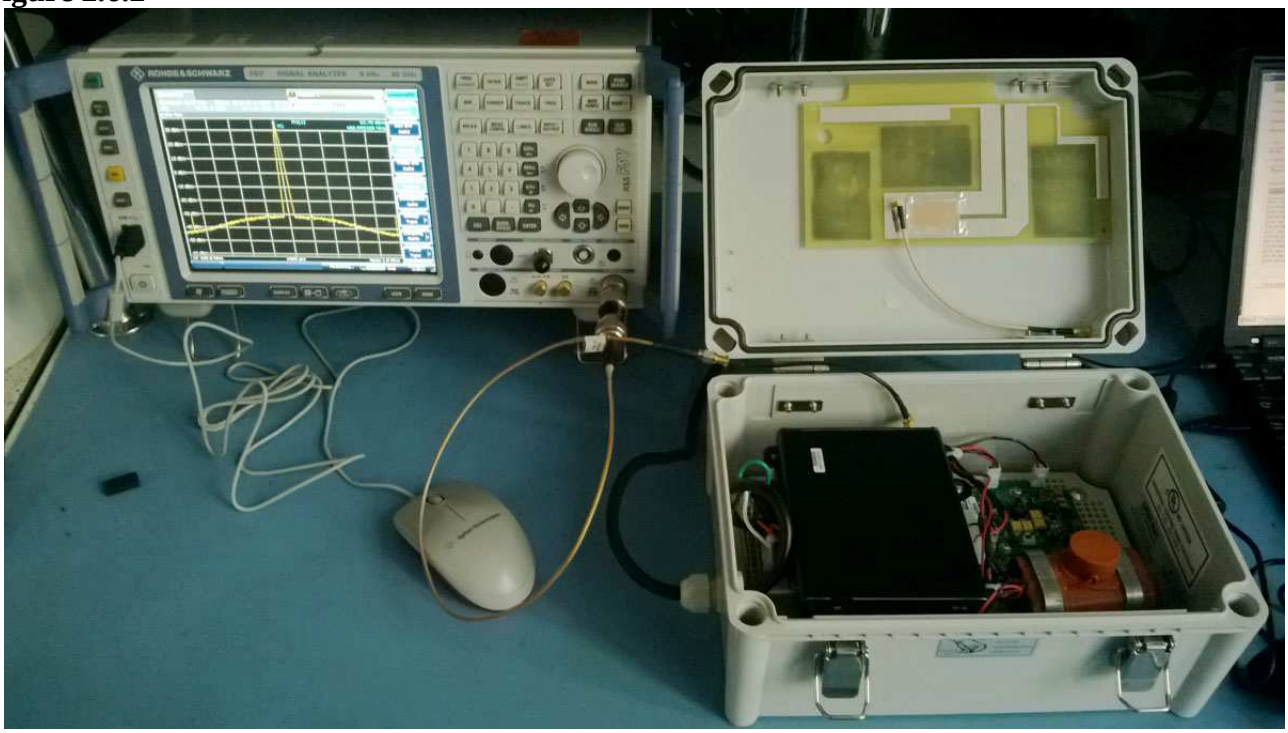


Figure 2.6.3

Figure 2.6.4

3 REPORT OF MEASUREMENTS AND EXAMINATIONS

3.1 Emission mask

3.1.1 Test requirements 90.210(e)

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Table 3.1.1 Limit Emissions Mask

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25 [1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220-222	F	F
421-512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806-809/851-854	B	H
809-824/854-869 [3]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M.
5850-5925 [4]		
All other bands	B	C

[2] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

(e) Emission Mask E—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0 : Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd −3 kHz) or 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

3.1.2 Test procedure

1) The transmitter output was connected to the test load and then to the spectrum analyzer.
2) The transmitter was set up to the normal operational mode with maximum output power.
3) Spectrum analyzer was set to the measurement mode of Spectrum Emission Mask (SEM) with the following settings:

- Centre frequency set to the center frequency of the channel
- The Relative Mask setting was chosen
- RBW=100 Hz, VBW=300 Hz, Video Detector = Peak, Trace = MAX HOLD.

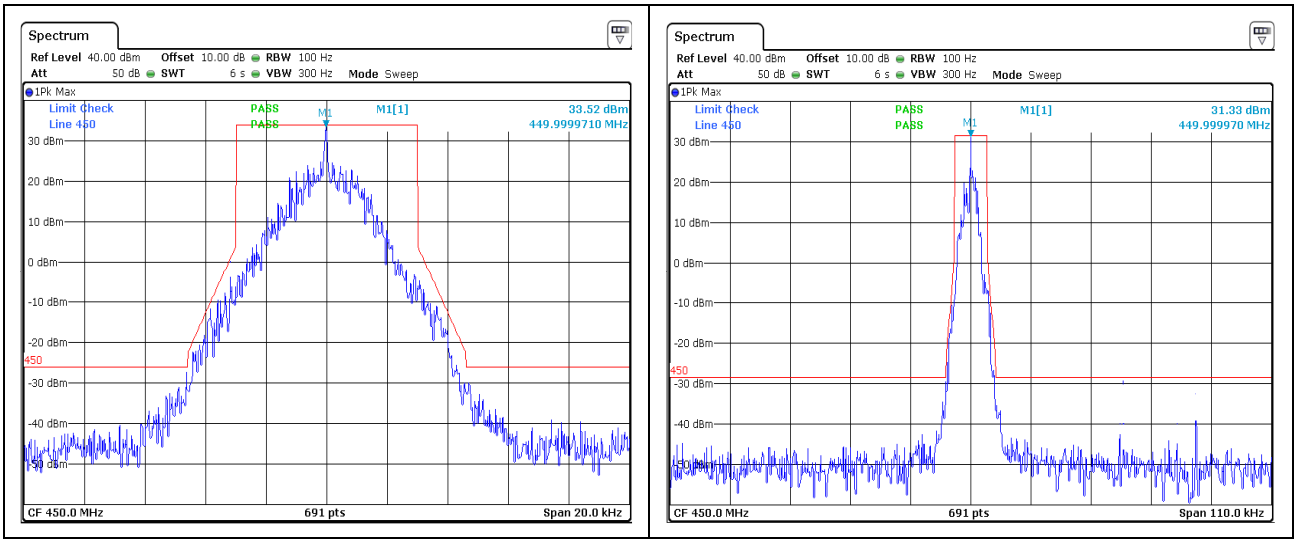
3.1.3 Test setup layout

Figure 3.1.1

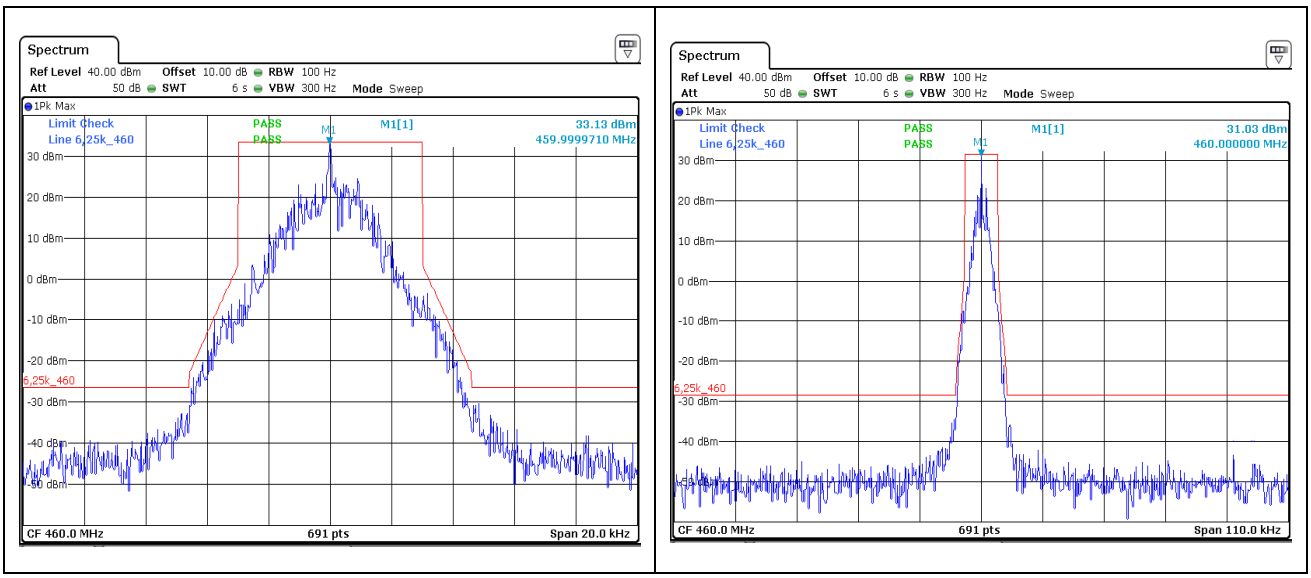
3.1.4 Test result

Temperature: +18 ^{o}C Relative humidity: 60 %

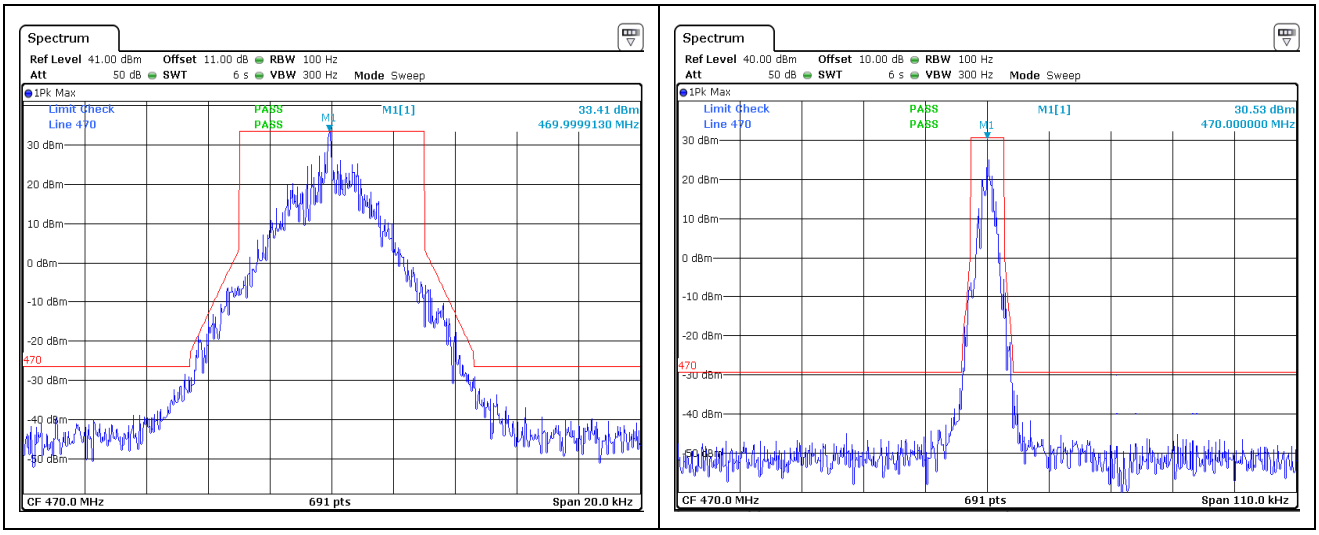
3.1.5 Plots Emissions Mask test result at low frequency



3.1.6 Plots Emissions Mask test result at mid frequency



3.1.7 Plots Emissions Mask test result at high frequency



3.2 Conducted Spurious Emissions

3.2.1 Test requirements 90.210 (e)

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Table 3.1.2 Limits

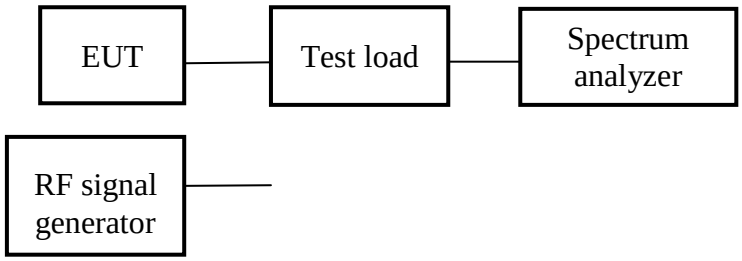
Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25 [1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220-222	F	F
421-512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806-809/851-854	B	H
809-824/854-869 [3]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M.
5850-5925 [4]		
All other bands	B	C

[2] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.
(e) Emission Mask E—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd −3 kHz) or 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.
(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.
(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

3.2.2 Test procedure

The procedure used was ANSI/TIA-603-D:2010. Substitution RF signal generator was used.
1) The transmitter was connected to the spectrum analyzer using the test load.
2) The transmitter was set up to the normal operational mode with maximum output power rating.
3) The spurious emissions were observed in the band of 30 MHz - 10000 MHz excluding the central frequency of transmitter ±53 kHz using following spectrum analyzer settings: RBW= 10 kHz, VBW = 30 kHz, Video Detector = Peak, Trace = Max Hold.

3.2.3 Test setup layout



3.2.4 Test result

Temperature: +18 °C Relative humidity: 50 %

Table 3.2.1

Frequency, MHz	Output Power (dBm)	Gen. Output (dBm)	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
450	34.23	-	-	-	-
450,099	- 28.91	- 28.85	63.08	60	Pass
450.208	- 32.27	- 32.16	66.50	60	Pass
450.443	- 41.19	- 41.12	75.35	60	Pass
460	33.67	-	-	-	-
460.101	- 30.41	- 30.32	63.99	60	Pass
460.149	- 30.71	- 30.63	64.30	60	Pass
460.	- 41.93	- 41.81	75.48	60	Pass
470	32.96	-	-	-	-
470.093	- 30.71	- 30.65	63.61	60	Pass
470.197	- 33.12	- 33.05	66.01	60	Pass
470.301	- 37.75	- 37.64	70.60	60	Pass

Table 3.2.2 Conducted Spurious Emissions (Frequency 450 MHz)

Frequency, MHz	Output Power, dBm	Gen. Output, dBm	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
450	34.23	-	-	-	-
900	- 37.82	- 37.58	71.81	60	Pass
1350	- 37.05	- 36.75	70.98	60	Pass
1800	- 77.65	- 77.54	111.77	60	Pass
2250	- 77.21	- 77.12	111.35	60	Pass
2700	- 58.43	- 57.84	92.07	60	Pass
3150	-	-	-	60	Pass
3600	-	-	-	60	Pass
4050	-	-	-	60	Pass
4500	-	-	-	60	Pass

Table 3.2.3 Conducted Spurious Emissions (Frequency 460 MHz)

Frequency, MHz	Output Power, dBm	Gen. Output dBm	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
460	33.67	-	-	-	-
920	- 44.43	- 44.17	77.84	60	Pass
1380	- 38.97	- 38.62	72.29	60	Pass
1840	- 76.32	- 76.24	109.91	60	Pass
2300	-	-	-	60	Pass
2760	- 65.81	- 64.81	98.48	60	Pass
3220	-	-	-	60	Pass
3680	-	-	-	60	Pass
4140	-	-	-	60	Pass
4600	-	-	-	60	Pass

Table 3.2.4 Conducted Spurious Emissions (Frequency 470 MHz)

Frequency, MHz	Output Power, dBm	Gen. Output (dBm)	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
470	32.96	-	-	-	-
940	- 40.03	- 39.76	72.72	60	Pass
1410	-	-	-	60	Pass
1880	- 77.55	- 77.43	110.39	60	Pass
2350	- 73.79	- 73.68	106.64	60	Pass
2820	- 77.30	- 77.19	110.15	60	Pass
3290	-	-	-	60	Pass
3760	-	-	-	60	Pass
4230	-	-	-	60	Pass
4700	-	-	-	60	Pass

3.3 Radiated Spurious Emissions

3.3.1 Test requirements 90.210 (e)

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (m) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating in the frequency bands governed under this part.

Table 3.3.1

Frequency band (MHz)	Mask for equipment with Audio low pass filter	Mask for equipment without audio low pass filter
Below 25 [1]	A or B	A or C
25-50	B	C
72-76	B	C
150-174 [2]	B, D, or E	C, D, or E
150 Paging-only	B	C
220-222	F	F
421-512 [2]	B, D, or E	C, D, or E
450 Paging-only	B	G
806-809/851-854	B	H
809-824/854-869 [3]	B	G
896-901/935-940	I	J
902-928	K	K
929-930	B	G
4940-4990 MHz	L or M	L or M.
5850-5925 [4]		
All other bands	B	C

[2] Equipment designed to operate with a 25 kHz channel bandwidth must meet the requirements of Emission Mask B or C, as applicable. Equipment designed to operate with a 12.5 kHz channel bandwidth must meet the requirements of Emission Mask D, and equipment designed to operate with a 6.25 kHz channel bandwidth must meet the requirements of Emission Mask E.

(e) Emission Mask E—6.25 kHz or less channel bandwidth equipment. For transmitters designed to operate with a 6.25 kHz or less bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f0 to 3.0 kHz removed from f0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 3.0 kHz but no more than 4.6 kHz: At least 30 + 16.67(fd −3 kHz) or 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(3) On any frequency removed from the center of the authorized bandwidth by more than 4.6 kHz: At least 55 + 10 log (P) or 65 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two to three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emissions mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient

number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (m) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, then an alternate procedure may be used provided prior Commission approval is obtained.

3.3.2 Test procedure

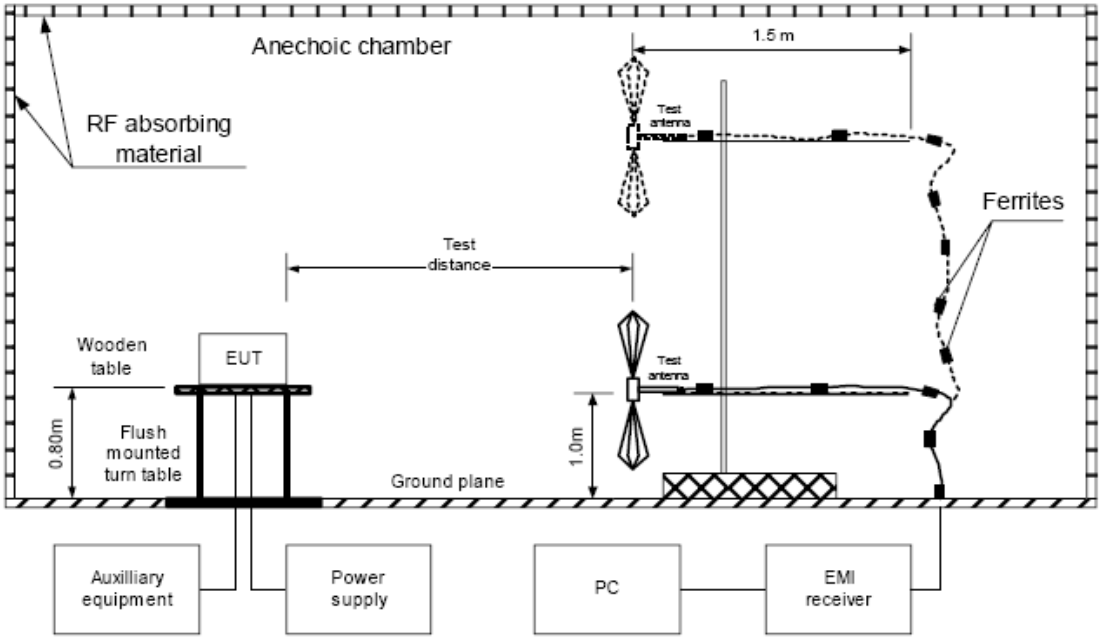
The transmitter was set up to the normal operational mode with maximum output power.

1) Radiated spurious emissions were measured using substitution method for radiated measurements in the anechoic shielded chamber with metal floor in the band of 30 MHz - 1000 MHz and in fully anechoic chamber in the band of 1000 MHz - 10000 MHz. The transmitter was set to the normal operational mode with the maximum output power rating.
2) EUT was placed on the non-conductive surface at the height of 0.8 m above the floor.
3) Measurement antenna was placed at the distance of 3m away from the EUT with vertical polarization.
4) The spurious emissions were observed in the band of 30 MHz - 10000 MHz excluding the central frequency of transmitter ±10 kHz using following spectrum analyzer settings: RBW= 10 kHz, VBW = 300 kHz (range 30 MHz – 1000 MHz) and RBW= 1 MHz, VBW = 3 MHz (range 1000 MHz – 10000 MHz), Video Detector = Peak, Trace = Max Hold.
5) The EUT was rotated around it's axis to obtain maximum result on the spectrum analyzer.
6) The height of measurement antenna was changed from 1m to 4m in 10 cm steps to obtain maximum result on the spectrum analyzer in the chamber with metal floor. In the fully anechoic chamber the height of antenna remained unchanged.
7) Measurement was repeated for horizontal polarization of measurement antenna.
8) Maximum reading of $P_{Gen.\ Output}$ was noted from substitutional generator.
9) Then the EUT was substituted by substitution antenna with it's phase center placed in the middle of the EUT position and the polarization obtained on the step of 8).
10) The Peak output power of each spurious component found was calculated using equation:

$$ERP = P_{Gen.\ Output} + Ga - L \ , \ \text{where}$$

$P_{Gen.\ Output}$ - power obtained on step 8), dBm
Ga - gain of substitution antenna on frequency of interest, dBi
L - attenuation in the substitution cable on the frequency of interest, dB

3.3.3 Test setup layout



3.3.4 Test result

Temperature: +18 °C Relative humidity: 65 %

Table 3.2.4 Radiated Spurious Emissions (Frequency 470 MHz, vertical polarization):

F, MHz	Gen. Output, dBm	Coax Loss, dB	Ant. Gain, dBi	Ant. Gain, dBd	Dipole Eq. Power, dBm	Diffe-rence, dBc	Limit, dBc	Test result (Pass, Fail, N/A)
470					**32.96**			
940	-30.30	3.10	-7.29	-9.44	-42.84	75.80	60	**Pass**
1410	-44.00	3.90	4.80	2.65	-45.25	78.21	60	**Pass**
1880	-48.00	5.40	5.00	2.85	-50.55	83.51	60	**Pass**
2350	-50.50	5.80	5.50	3.35	-52.95	85.91	60	**Pass**
2820	-47.20	7.10	6.50	4.35	-49.95	82.91	60	**Pass**
3290	-46.20	7.50	7.20	5.05	-48.65	81.61	60	**Pass**
3760	-49.50	8.00	7.66	5.51	-51.99	84.95	60	**Pass**
4230	-54.00	8.20	7.62	5.47	-56.73	89.69	60	**Pass**
4700	-62.00	8.70	7.70	5.55	-65.15	98.11	60	**Pass**

Table 3.2.5 Radiated Spurious Emissions (Frequency 460 MHz, vertical polarization):

F, MHz	Gen. Output, dBm	Coax Loss, dB	Ant. Gain, dBi	Ant. Gain, dBd	Dipole Eq. Power, dBm	Diffe-rence, dBc	Limit, dBc	Test result (Pass, Fail, N/A)
460					**33.67**			
920	-28.00	3.10	-7.12	-9.27	-40.37	74.04	60	**Pass**
1380	-45.50	3.90	4.60	2.45	-46.95	80.62	60	**Pass**
1840	-51.20	5.40	5.00	2.85	-53.75	87.42	60	**Pass**
2300	-49.00	5.80	5.40	3.25	-51.55	85.22	60	**Pass**
2760	-50.50	7.10	6.40	4.25	-53.35	87.02	60	**Pass**
3220	-49.50	7.50	7.12	4.97	-52.03	85.70	60	**Pass**
3680	-52.10	8.00	7.60	5.45	-54.65	88.32	60	**Pass**
4140	-53.00	8.20	7.70	5.55	-55.65	89.32	60	**Pass**
4600	-55.00	8.60	7.50	5.35	-58.25	91.92	60	**Pass**

Table 3.2.6 Radiated Spurious Emissions (Frequency 450 MHz, vertical polarization):

F, MHz	Gen. Output, dBm	Coax Loss, dB	Ant. Gain, dBi	Ant. Gain, dBd	Dipole Eq. Power, dBm	Diffe-rence, dBc	Limit, dBc	Test result (Pass, Fail, N/A)
450					**34.23**			
900	-28.00	3.10	-6.90	-9.05	-40.15	74.38	60	**Pass**
1350	-50.30	3.90	4.50	2.35	-51.85	86.08	60	**Pass**
1800	-47.00	5.40	5.50	3.35	-49.05	83.28	60	**Pass**
2250	-48.50	5.80	5.40	3.25	-51.05	85.28	60	**Pass**
2700	-45.00	7.10	6.24	4.09	-48.01	82.24	60	**Pass**
3150	-44.00	7.50	7.10	4.95	-46.55	80.78	60	**Pass**
3600	-45.50	8.00	7.50	5.35	-48.15	82.38	60	**Pass**
4050	-52.00	8.20	7.90	5.75	-54.45	88.68	60	**Pass**
4500	-54.00	8.60	7.30	5.15	-57.45	91.68	60	**Pass**

Table 3.2.7 Radiated Spurious Emissions (Frequency 470 MHz, horizontal polarization):

F, MHz	Gen. Output, dBm	Coax Loss, dB	Ant. Gain, dBi	Ant. Gain, dBd	Dipole Eq. Power, dBm	Diffe-rence, dBc	Limit, dBc	Test result (Pass, Fail, N/A)
470					**32.96**			
940	-35.00	3.10	-7.29	-9.44	-47.54	80.50	60	**Pass**
1410	-56.50	3.90	4.80	2.65	-57.75	90.71	60	**Pass**
1880	-52.50	5.40	5.00	2.85	-55.05	88.01	60	**Pass**
2350	-49.20	5.80	5.50	3.35	-51.65	84.61	60	**Pass**
2820	-50.00	7.10	6.50	4.35	-52.75	85.71	60	**Pass**
3290	-49.00	7.50	7.20	5.05	-51.45	84.41	60	**Pass**
3760	-53.00	8.00	7.66	5.51	-55.49	88.45	60	**Pass**
4230	-48.00	8.20	7.62	5.47	-50.73	83.69	60	**Pass**
4700	-52.50	8.70	7.70	5.55	-55.65	88.61	60	**Pass**

Table 3.2.8 Radiated Spurious Emissions (Frequency 460 MHz, horizontal polarization):

F, MHz	Gen. Output, dBm	Coax Loss, dB	Ant. Gain, dBi	Ant. Gain, dBd	Dipole Eq. Power, dBm	Diffe-rence, dBc	Limit, dBc	Test result (Pass, Fail, N/A)
460					**33.67**			
920	-35.30	3.10	-7.12	-9.27	-47.67	81.34	60	**Pass**
1380	-57.40	3.90	4.60	2.45	-58.85	92.52	60	**Pass**
1840	-53.20	5.40	5.00	2.85	-55.75	89.42	60	**Pass**
2300	-48.50	5.80	5.40	3.25	-51.05	84.72	60	**Pass**
2760	-51.40	7.10	6.40	4.25	-54.25	87.92	60	**Pass**
3220	-50.20	7.50	7.12	4.97	-52.73	86.40	60	**Pass**
3680	-53.30	8.00	7.60	5.45	-55.85	89.52	60	**Pass**
4140	-50.20	8.20	7.70	5.55	-52.85	86.52	60	**Pass**
4600	-50.50	8.60	7.50	5.35	-53.75	87.42	60	**Pass**

Table 3.2.9 Radiated Spurious Emissions (Frequency 450 MHz, horizontal polarization):

F, MHz	Gen. Output, dBm	Coax Loss, dB	Ant. Gain, dBi	Ant. Gain, dBd	Dipole Eq. Power, dBm	Diffe-rence, dBc	Limit, dBc	Test result (Pass, Fail, N/A)
450					**34.23**			
900	-34.00	3.10	-6.90	-9.05	-46.15	80.38	60	**Pass**
1350	-58.50	3.90	4.50	2.35	-60.05	94.28	60	**Pass**
1800	-53.50	5.40	5.50	3.35	-55.55	89.78	60	**Pass**
2250	-51.20	5.80	5.40	3.25	-53.75	87.98	60	**Pass**
2700	-50.50	7.10	6.24	4.09	-53.51	87.74	60	**Pass**
3150	-48.50	7.50	7.10	4.95	-51.05	85.38	60	**Pass**
3600	-49.50	8.00	7.50	5.35	-52.15	86.38	60	**Pass**
4050	-48.60	8.20	7.90	5.75	-51.05	85.28	60	**Pass**
4500	-47.00	8.60	7.30	5.15	-50.45	84.68	60	**Pass**

3.4 Transient stability

3.4.1 Test requirements 90.214

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

Table 3.4.1 Limit Transient Frequency Behavior

Time intervals [1,2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t_1 [4]	±25.0 kHz	5.0 ms	10.0 ms
t_2	±12.5 kHz	20.0 ms	25.0 ms
t_3 [4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t_1 [4]	±12.5 kHz	5.0 ms	10.0 ms
t_2	±6.25 kHz	20.0 ms	25.0 ms
t_3 [4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t_1 [4]	±6.25 kHz	5.0 ms	10.0 ms
t_2	±3.125 kHz	20.0 ms	25.0 ms
t_3 [4]	±6.25 kHz	5.0 ms	10.0 ms

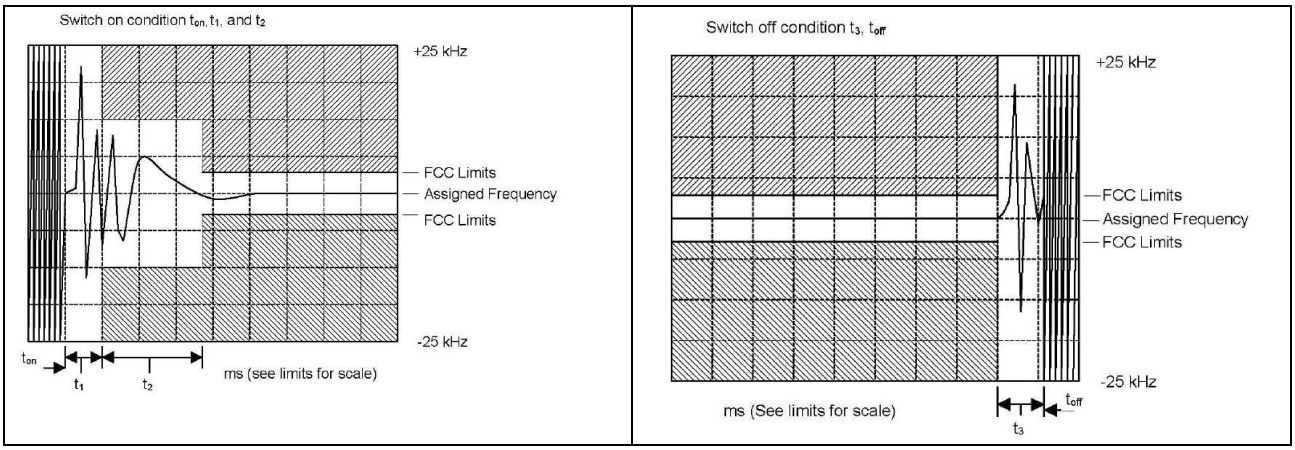
[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

- t_1 is the time period immediately following t_{on}.
- t_2 is the time period immediately following t_1.
- t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
- t_{off} is the instant when the 1 kHz test signal starts to rise.

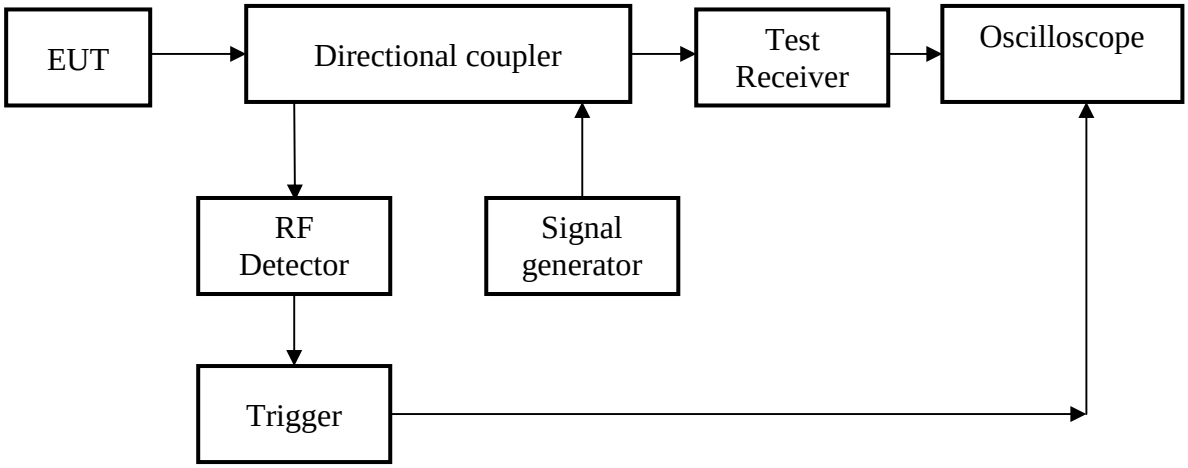
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

3.4.2 Test procedure

1) The transmitter was connected to the universal radio tester CMS54.
2) The transmitter was set up to the normal operational mode with maximum output power.
3) The transient behavior of transmitter was observed in the moment of keying (TX-off to TX-on) and unkeying (TX-on to TX-off) using the special option of the CMS54 radio tester.



3.4.3 Test setup layout

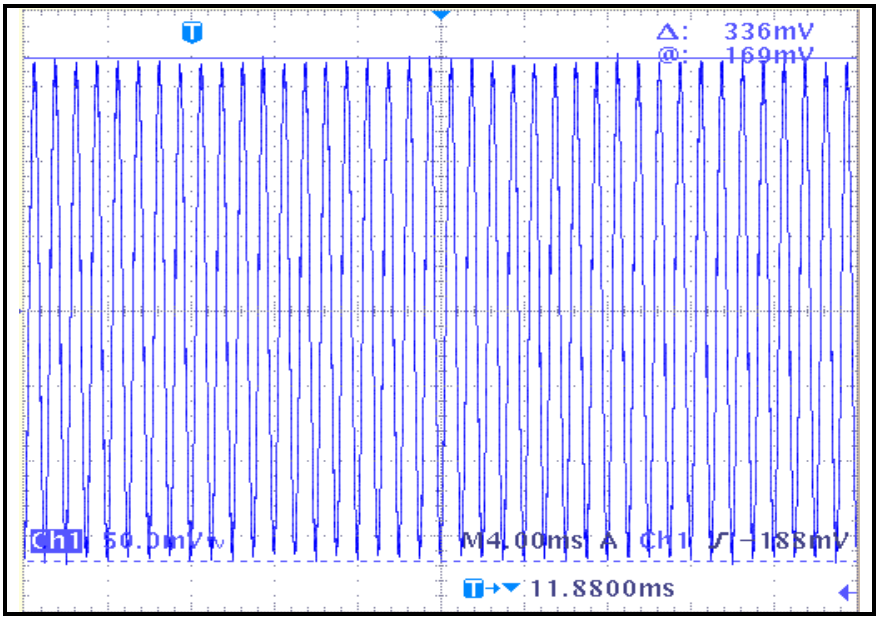


3.4.4 Test result

Temperature: +18 °C Relative humidity: 50 %

3.4.1 Plot

+ 6.25 kHz



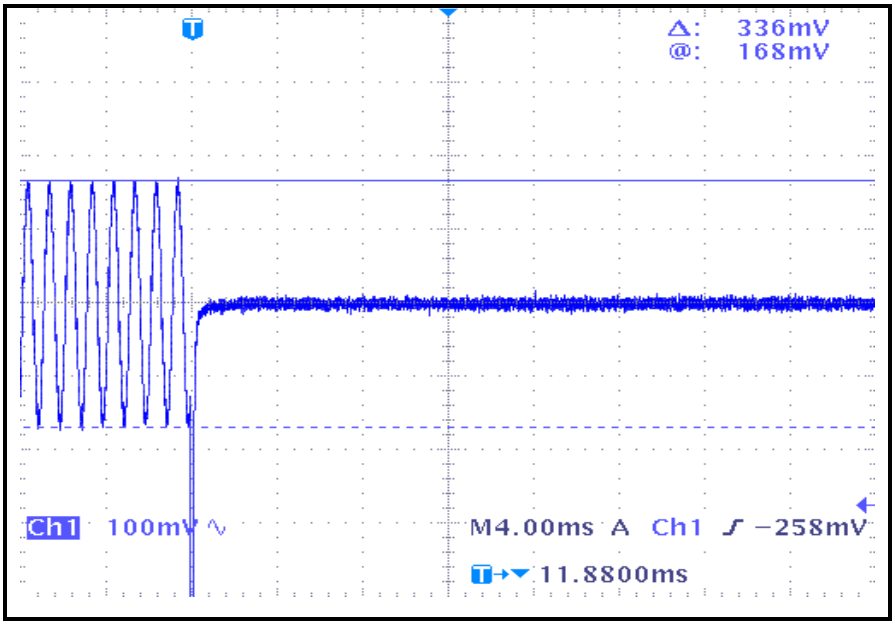
- 6.25 kHz

± 6.25 kHz = 336 mV
± 3.125 kHz = 168 mV
± 225 Hz (±0.5 ppm) = 12 mV

3.4.2 Plot: t_1 time period

+ 6.25 kHz

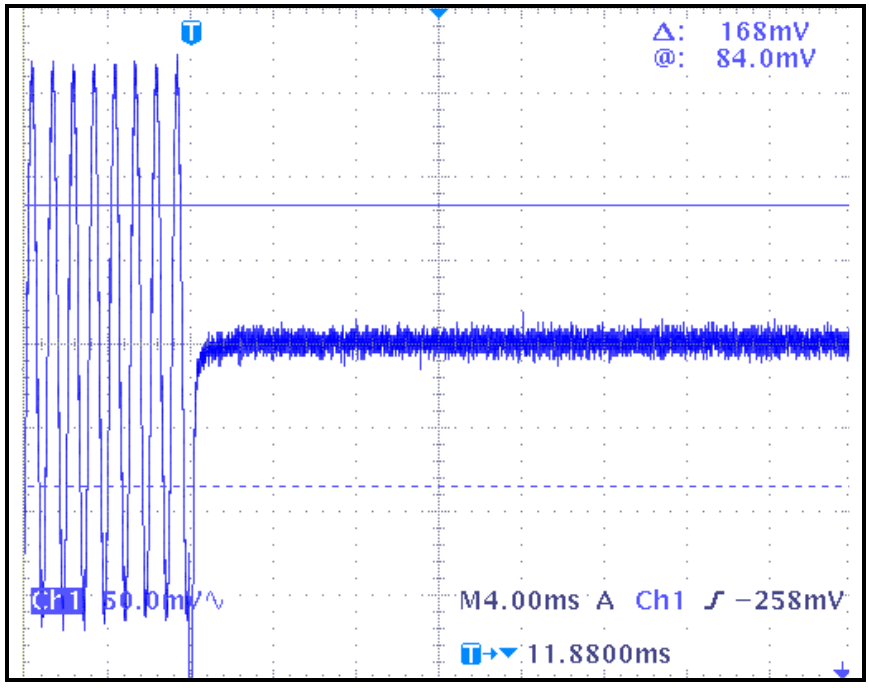
- 6.25 kHz



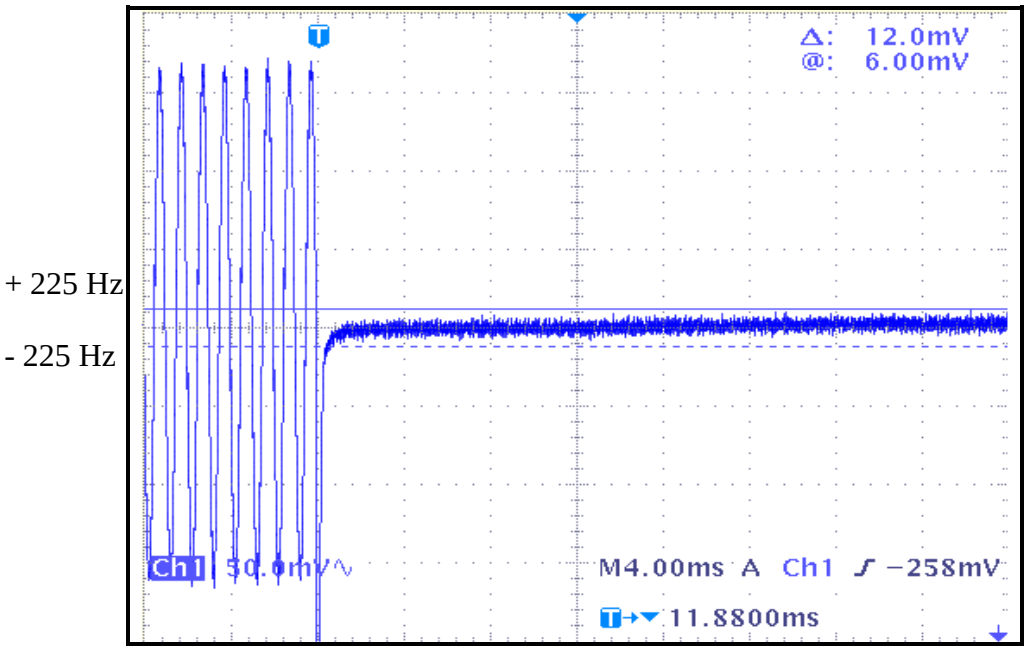
3.4.3 Plot: t_2 time period

+ 3.125 kHz

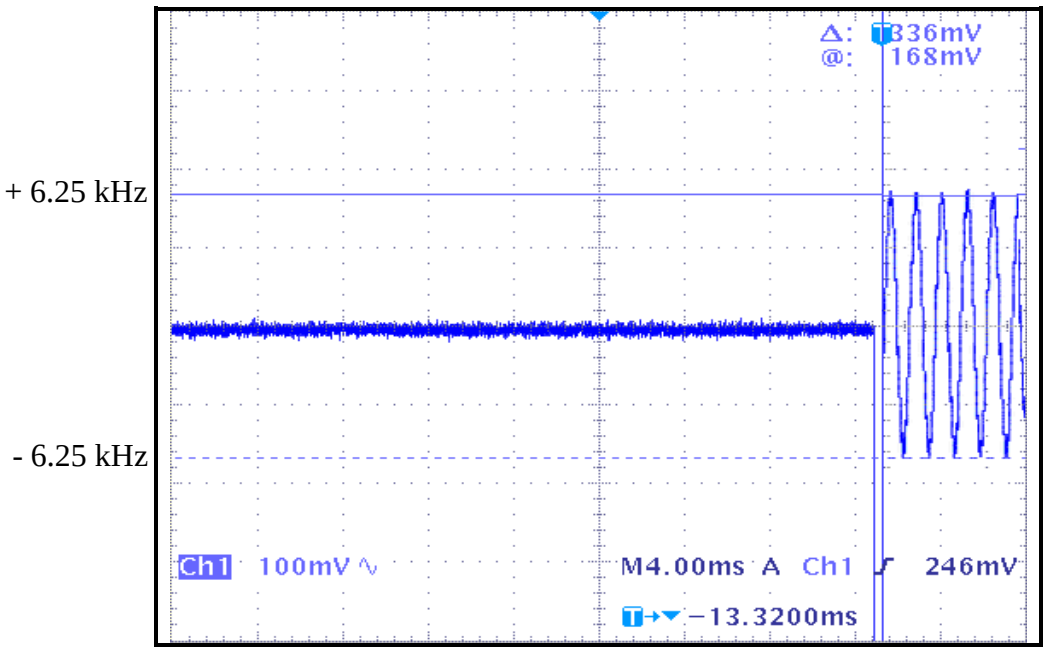
- 3.125 kHz



3.4.4 Plot: t_2 - t_3 time period



3.4.5 Plot: t_3 time period



3.5 Frequency stability vs power supply

3.5.1 Test requirements 90.213

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have minimum frequency stability as specified in the following table.

Table 3.5.1 Limits

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1,2,3] 100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5,11] 5	[6] 5	[4,6] 50
216-220	1.0		1.0
220-222 [12]	0.1	1.5	1.5
421-512	[7,11,14] 2.5	[8] 5	[8] 5
806-809	[14] 1.0	1.5	1.5
809-824	[14] 1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14] 0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928 [13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	[9] 300	300	300
Above 2450 [10]			

[7] In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

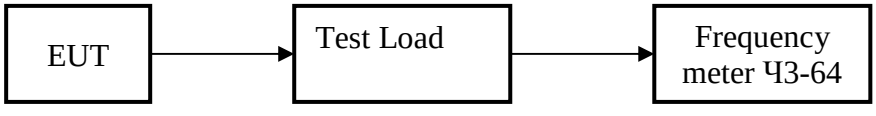
[8] In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

3.5.2 Test procedure

1) The transmitter was set up to the normal operational mode with maximum output power with no modulation signal applied.
2) The transmitter was connected to the frequency meter Ч3-64.
3) Frequency counter of the radio tester was used for measuring the frequency.
4) The supply voltage was changed to observe the frequency stability across the power supply voltage range.

3.5.3 Test setup layout



3.5.4 Test result

Temperature: +18 ^{o}C Relative humidity: 50 %

Power Supply voltage, V	Frequency (MHz)	Deviation (Hz)	Deviation (ppm)	Limit, ppm	Result (Pass, Fail, N/A)
121	449.999892	- 108	- 0.24	0.5	Pass
118	449. 999892	- 108	- 0.24	0.5	Pass
116	449. 999892	- 108	- 0.24	0.5	Pass
114	449. 999892	- 108	- 0.24	0.5	Pass
112	449. 999892	- 108	- 0.24	0.5	Pass
110	449. 999892	- 108	- 0.24	0.5	Pass
108	449. 999892	- 108	- 0.24	0.5	Pass
106	449. 999892	- 108	-0.24	0.5	Pass
104	449. 999892	- 108	- 0.24	0.5	Pass
102	449. 999892	- 108	- 0.24	0.5	Pass
99	449. 999892	- 108	- 0.24	0.5	Pass

Reference frequency = 450.000000 MHz

3.6 Frequency stability vs temperature

3.6.1 Test requirements 90.213

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Table 3.6.1 Limits

Frequency range (MHz)	Fixed and base stations	Mobile stations	
		Over 2 watts output power	2 watts or less output power
Below 25	[1,2,3] 100	100	200
25-50	20	20	50
72-76	5		50
150-174	[5,11] 5	[6] 5	[4,6] 50
216-220	1.0		1.0
220-222 [12]	0.1	1.5	1.5
421-512	[7,11,14] 2.5	[8] 5	[8] 5
806-809	[14] 1.0	1.5	1.5
809-824	[14] 1.5	2.5	2.5
851-854	1.0	1.5	1.5
854-869	1.5	2.5	2.5
896-901	[14] 0.1	1.5	1.5
902-928	2.5	2.5	2.5
902-928 [13]	2.5	2.5	2.5
929-930	1.5		
935-940	0.1	1.5	1.5
1427-1435	[9] 300	300	300
Above 2450 [10]			

[7] In the 421-512 MHz band, fixed and base stations with a 12.5 kHz channel bandwidth must have a frequency stability of 1.5 ppm. Fixed and base stations with a 6.25 kHz channel bandwidth must have a frequency stability of 0.5 ppm.

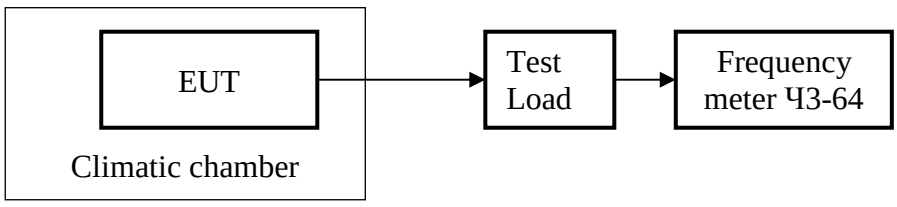
[8] In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

b) For the purpose of determining the frequency stability limits, the power of a transmitter is considered to be the maximum rated output power as specified by the manufacturer.

3.6.2 Test procedure

1) The transmitter was set up to the normal operational mode with maximum output power with no modulation signal applied.
2) The transmitter was connected to the Frequency meter Ч3-64.
3) Frequency counter of the radio tester was used for measuring the frequency.
4) The transmitter was placed in the temperature chamber to observe the frequency stability across the temperature range.

3.6.3 Test setup layout



3.6.4 Test result

Temperature: +18 ^{o}C Relative humidity: 50 %

Temperature (°C)	Frequency (MHz)	Deviation (Hz)	Deviation (ppm)	Limit, ppm	Result (Pass, Fail, N/A)
+85	449.999913	- 87	- 0.19	0.5	Pass
+80	449.999910	- 90	- 0.20	0.5	Pass
+70	449.999899	- 101	- 0.22	0.5	Pass
+60	449.999879	- 121	- 0.27	0.5	Pass
+50	449.999879	- 121	- 0.27	0.5	Pass
+40	449.999862	- 136	- 0.30	0.5	Pass
+30	449.999891	- 109	- 0.24	0.5	Pass
+20	449.999892	- 108	- 0.24	0.5	Pass
+10	449.999871	- 129	- 0.29	0.5	Pass
0	449.999819	- 181	- 0.40	0.5	Pass
-10	449.999801	- 199	- 0.44	0.5	Pass
-20	449.999814	- 186	- 0.41	0.5	Pass
-30	449.999848	- 152	- 0.34	0.5	Pass
-40	No Transmission	-	-	-	-
+20	449.999894	- 106	- 0.24	0.5	Pass

Reference frequency = 450.000000 MHz

3.7 Conditions for intentional radiators to comply with periodic operation

3.7.1 Test requirements Section 15.231a

(a) The provisions of this Section are restricted to periodic operation within the band 40.66 - 40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

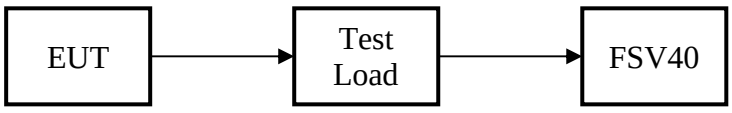
(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmission are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

3.7.2 Test procedure

1) The transmitter was set up to the normal operational mode with maximum output power with no modulation signal applied.
2) The transmitter was connected to the FSV40.

3.7.3 Test setup layout

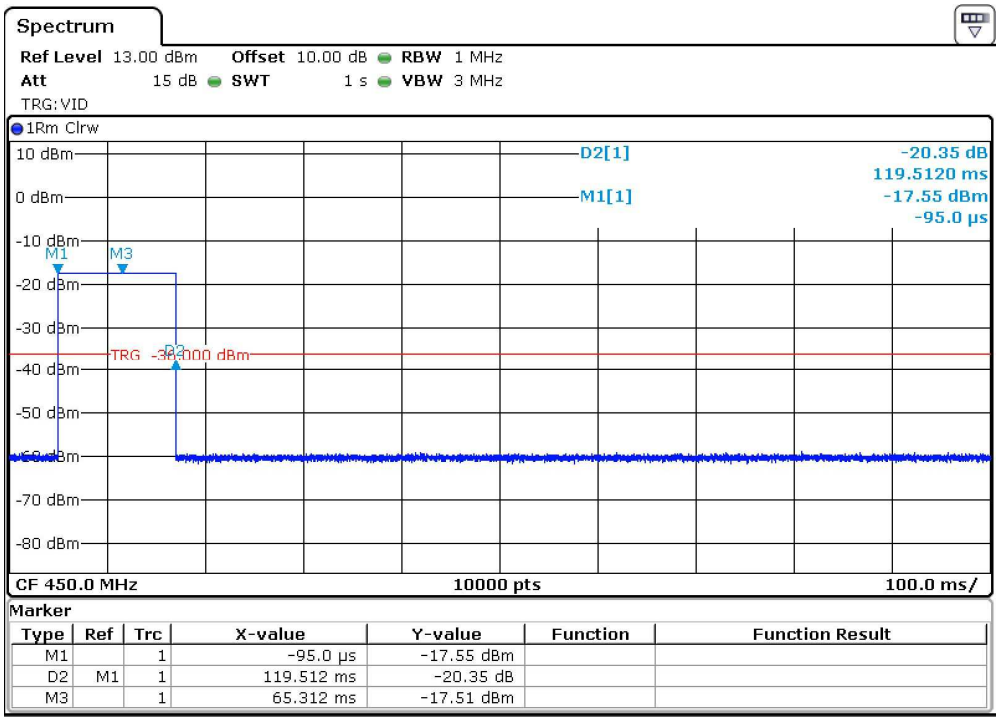


3.7.4 Test result

Temperature: +18 °C Relative humidity: 50 %

Plot Transmit duration

The device does not support manual initiation of wireless transmission. The automatically initiated transmission does not exceed 2 seconds in duration



Transmit duration 119.512 ms
Verdict Pass

3.8 Field strength of emissions

3.8.1 Test requirements § 15.109 Class B

Frequency of emission (MHz)	**Field strength (microvolts/meter)**	**Field Strength (dBµV/m)**
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

3.8.2 Test requirements § 15.231 (b)

Fundamental frequency	Field strength of fundamental		Field strength of spurious emissions	
(MHz)	(µV/m)	(dBµV/m)	(µV/m)	(dBµV/m)
40.66–40.70	2,250	67	225	47
70–130	1,250	61.9	125	41.9
130–174	1,250 to 3,750*	61.9 to 71.5*	125 to 375*	41.9 to 51.5*
174–260	3,750	71.5	375	51.5
260–470	3,750 to 12,500*	71.5 to 81.9*	375 to 1,250*	51.5 to 61.9*
Above 470	12,500	81.9	1,250	61.9
Notes: * Linear interpolations				

3.8.3 Test procedure (ANSI C63.4)

The test was performed to measure radiated emissions from the equipment under test enclosure. The measurement was made in the anechoic chamber at measurement distance of 3m in two bands: (30 - 1000) MHz, (1000 - 6000) MHz.

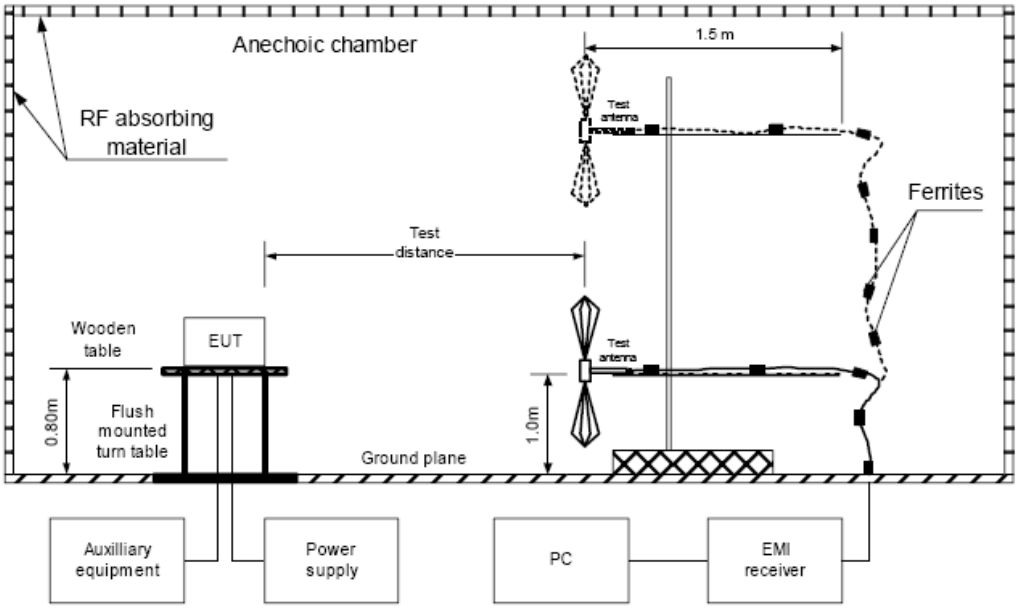
1) The equipment under test was set to transmission mode Pout = - 17 dBm.

2) In the band of (30 - 1000) MHz the measurement was made in anechoic chamber with metal floor. The turntable was rotated, the antenna height was altered in the range of 1m - 4m, the polarization of biconical antenna was changed from horizontal to vertical in a process of seeking for the maximum result. Settings of the test receiver: RBW = 120 kHz; Video Detector = Positive Peak during prequalification measurement, Quasi-Peak - during final measurement.

3) In the band of (1000 - 6000) MHz the measurement was made in fully anechoic chamber. The height of test antenna was fixed while the turntable was rotated and the polarization of horn test antenna was changed from horizontal to vertical in a process of seeking for the maximum result. Settings of the test receiver: RBW = 1000 kHz; Video Detector = Positive Peak during prequalification measurement, Average - during final measurement.

4) The worst test results (the lowest margins) were recorded and shown in the associated plots.

Figure 3.8.1 Test setup layout (above 30 MHz and below 10 GHz)



3.8.4 Test result

Temperature: +18 ^{o}C Relative humidity: 68 %

EUT OPERATING MODE: transmission mode
Pout = - 17 dBm

Table 3.8.1 Radiated emission test result (450 MHz)

Frequency, MHz	Turn-table position, degrees	Antenna height, cm	Antenna polarization	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
40.000000	0	150.0	V	33.1	-	61.0	Pass
60.000000	0	100.0	V	27.6	-	61.0	Pass
69.640000	90	100.0	V	25.0	-	61.0	Pass
120.760000	180	400.0	H	37.6	-	61.0	Pass
122.400000	90	400.0	H	39.0	-	61.0	Pass
205.640000	0	300.0	H	17.7	-	61.0	Pass
328.800000	0	200.0	V	15.9	-	61.0	Pass
394.440000	90	200.0	H	15.7	-	61.0	Pass
408.360000	270	150.0	V	21.8	-	61.0	Pass
435.320000	0	100.0	V	25.1	-	61.0	Pass
450.000000	180	100.0	V	79.5	-	81.0	Pass
470.120000	0	300.0	V	21.9	-	61.0	Pass
571.280000	180	150.0	H	34.1	-	61.0	Pass
774.440000	0	400.0	H	42.8	-	61.0	Pass
792.720000	90	100.0	V	39.2	-	61.0	Pass
941.200000	270	150.0	V	35.7	-	61.0	Pass
947.360000	90	150.0	V	38.4	-	61.0	Pass
1186.800000	90	100.0	V	-	29.3	61.0	Pass
1269.600000	180	100.0	V	-	29.8	61.0	Pass
1673.600000	0	100.0	V	-	31.3	61.0	Pass
2020.400000	0	100.0	H	-	34.9	61.0	Pass

Frequency, MHz	Turn-table position, degrees	Antenna height, cm	Antenna polarization	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
2447.200000	0	100.0	H	-	37.2	61.0	Pass
2894.000000	90	100.0	H	-	39.3	61.0	Pass
3479.200000	270	100.0	H	-	41.9	61.0	Pass
4172.800000	0	100.0	V	-	43.3	61.0	Pass
4665.600000	90	100.0	V	-	44.7	61.0	Pass
5966.800000	0	100.0	H	-	50.4	61.0	Pass

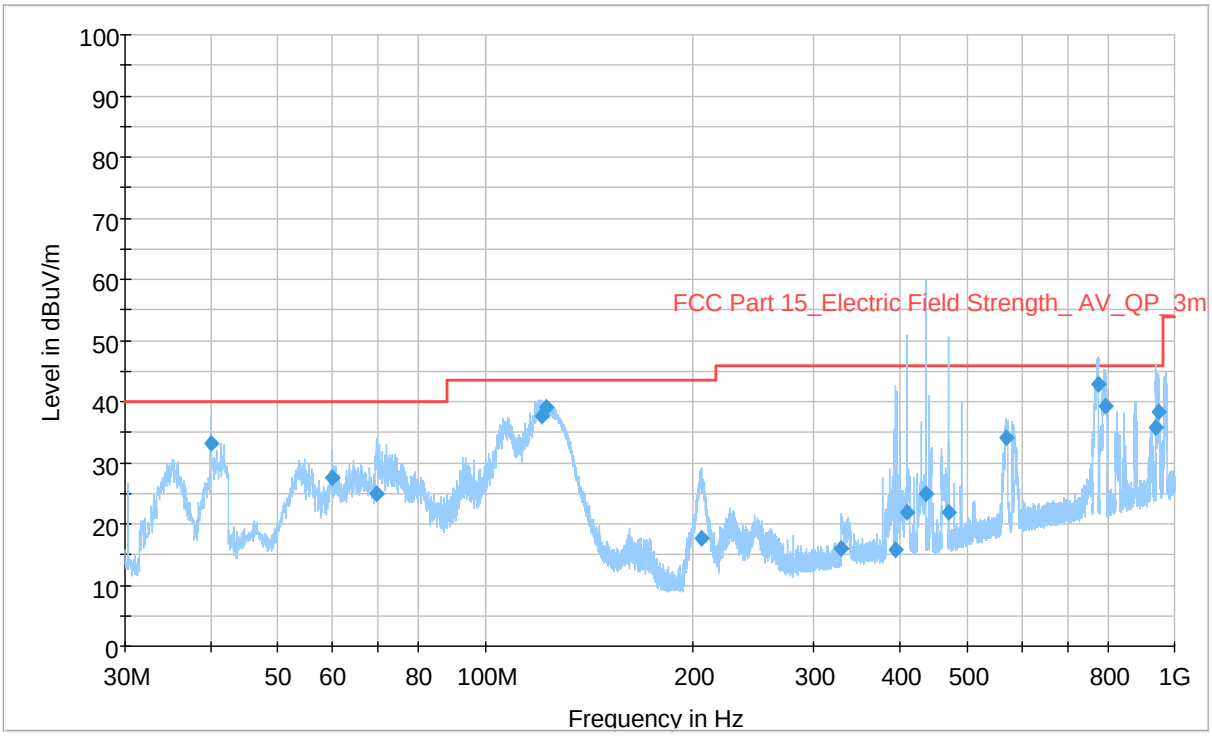
Table 3.8.2 Radiated emission test result (460 MHz)

Frequency, MHz	Turn-table position, degrees	Antenna height, cm	Antenna polarization	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
32.520000	0	150.0	H	11.6	-	61.4	Pass
54.200000	0	100.0	V	27.8	-	61.4	Pass
74.520000	90	150.0	V	24.4	-	61.4	Pass
120.280000	0	400.0	H	40.0	-	61.4	Pass
122.400000	180	400.0	H	36.2	-	61.4	Pass
233.280000	90	300.0	H	18.2	-	61.4	Pass
338.240000	180	150.0	V	20.3	-	61.4	Pass
427.880000	0	200.0	H	25.3	-	61.4	Pass
428.000000	0	250.0	H	24.6	-	61.4	Pass
450.360000	0	400.0	H	28.0	-	61.4	Pass
460.000000	0	150.0	V	78.7	-	81.4	Pass
586.880000	90	150.0	H	32.4	-	61.4	Pass
790.880000	0	250.0	H	42.2	-	61.4	Pass
802.160000	90	400.0	H	41.7	-	61.4	Pass
906.960000	270	100.0	V	33.6	-	61.4	Pass
912.960000	270	300.0	V	30.8	-	61.4	Pass
914.240000	0	100.0	V	38.9	-	61.4	Pass
916.680000	0	350.0	V	26.8	-	61.4	Pass
918.040000	90	100.0	V	37.6	-	61.4	Pass
1120.400000	0	100.0	V	-	29.1	61.4	Pass
1364.000000	0	100.0	V	-	30.1	61.4	Pass
1710.000000	90	100.0	H	-	31.8	61.4	Pass
2000.800000	180	100.0	V	-	34.6	61.4	Pass
2448.800000	270	100.0	H	-	37.1	61.4	Pass
2915.200000	90	100.0	V	-	39.2	61.4	Pass
3437.600000	90	100.0	V	-	41.5	61.4	Pass
4170.800000	0	100.0	V	-	43.2	61.4	Pass
4903.600000	90	100.0	H	-	45.0	61.4	Pass
5966.800000	0	100.0	V	-	50.4	61.4	Pass

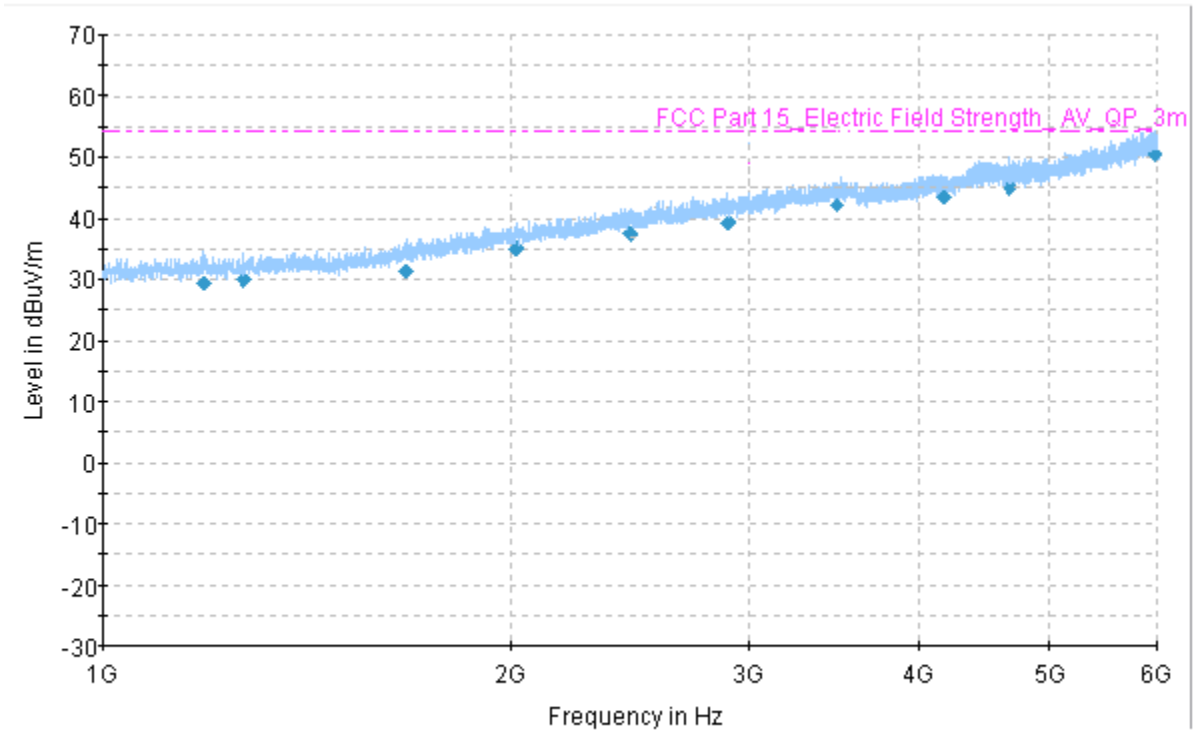
Table 3.8.3 Radiated emission test result (470 MHz)

Frequency, MHz	Turn-table position, degrees	Antenna height, cm	Antenna polarization	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
40.040000	0	300.0	V	14.3	-	61.9	Pass
54.280000	90	100.0	V	27.2	-	61.9	Pass
64.720000	90	100.0	V	25.3	-	61.9	Pass
121.680000	0	250.0	H	39.3	-	61.9	Pass
122.080000	270	250.0	H	37.1	-	61.9	Pass
206.680000	90	250.0	H	22.8	-	61.9	Pass
345.560000	90	150.0	V	15.3	-	61.9	Pass
433.960000	180	150.0	H	18.2	-	61.9	Pass
435.240000	90	200.0	H	25.0	-	61.9	Pass
436.920000	270	100.0	H	23.0	-	61.9	Pass
450.000000	0	400.0	H	41.1	-	61.9	Pass
470.000000	0	150.0	V	78.2	-	81.9	Pass
458.560000	0	400.0	H	29.0	-	61.9	Pass
460.280000	0	350.0	H	25.4	-	61.9	Pass
600.040000	180	250.0	H	37.8	-	61.9	Pass
892.280000	90	150.0	V	21.9	-	61.9	Pass
921.920000	180	100.0	V	33.7	-	81.9	Pass
943.360000	0	300.0	V	33.3	-	61.9	Pass
1086.800000	90	100.0	V	-	28.7	61.9	Pass
1373.200000	180	100.0	H	-	30.3	61.9	Pass
1665.200000	90	100.0	V	-	31.8	61.9	Pass
1988.800000	180	100.0	V	-	34.5	61.9	Pass
2350.000000	180	100.0	V	-	40.6	61.9	Pass
2913.200000	90	100.0	V	-	39.4	61.9	Pass
3459.600000	270	100.0	H	-	42.0	61.9	Pass
4128.000000	0	100.0	H	-	43.0	61.9	Pass
4824.400000	0	100.0	H	-	44.8	61.9	Pass
5988.000000	90	100.0	V	-	49.9	61.9	Pass

Plot 3.8.1 Radiated emission measurements in (30 – 1000) MHz range, vertical and horizontal polarization (450 MHz)

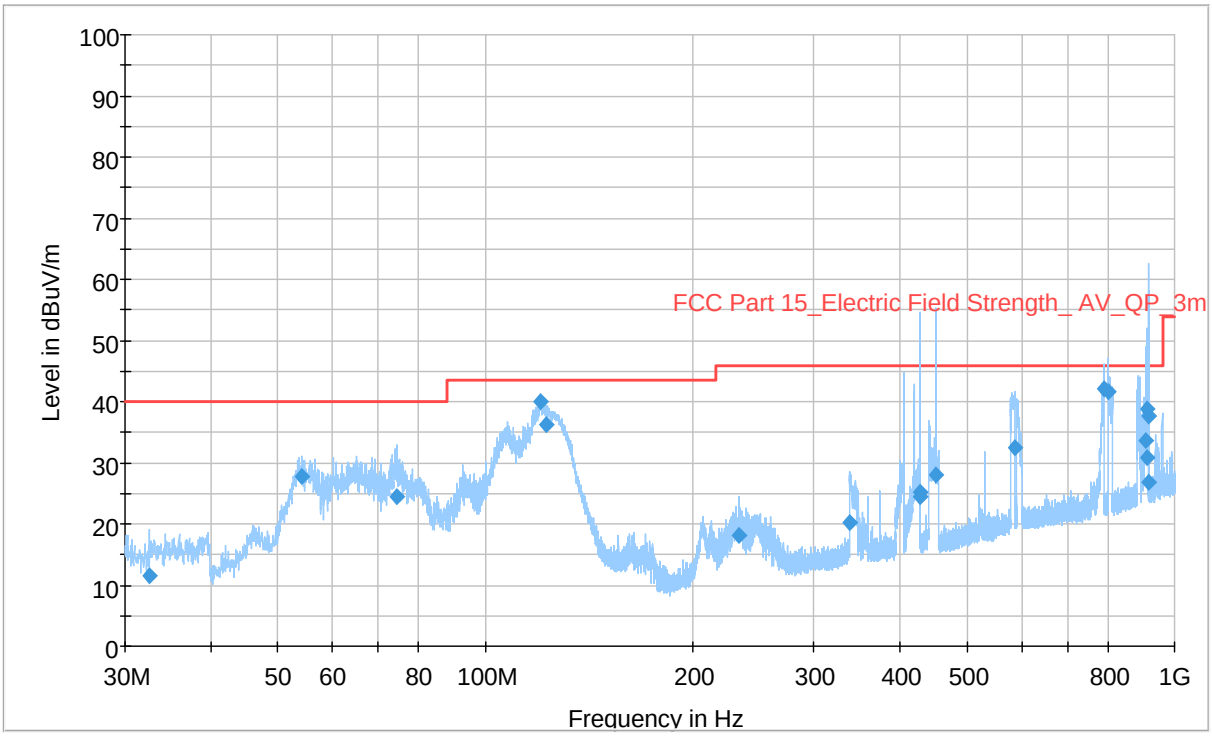


Plot 3.8.2 Radiated emission measurements in (1000 – 6000) MHz range, vertical and horizontal polarization (450 MHz)

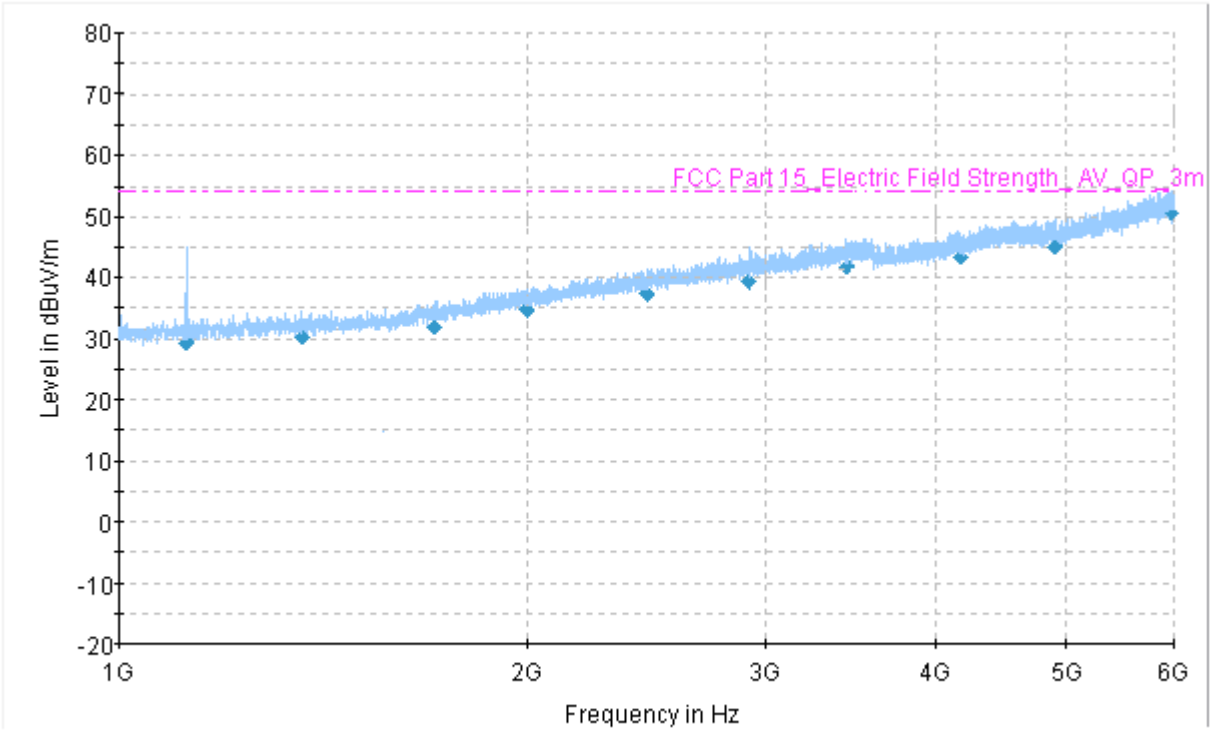


Note: Average values (AV) are below the limit.

Plot 3.8.3 Radiated emission measurements in (30 – 1000) MHz range, vertical and horizontal polarization (460 MHz)

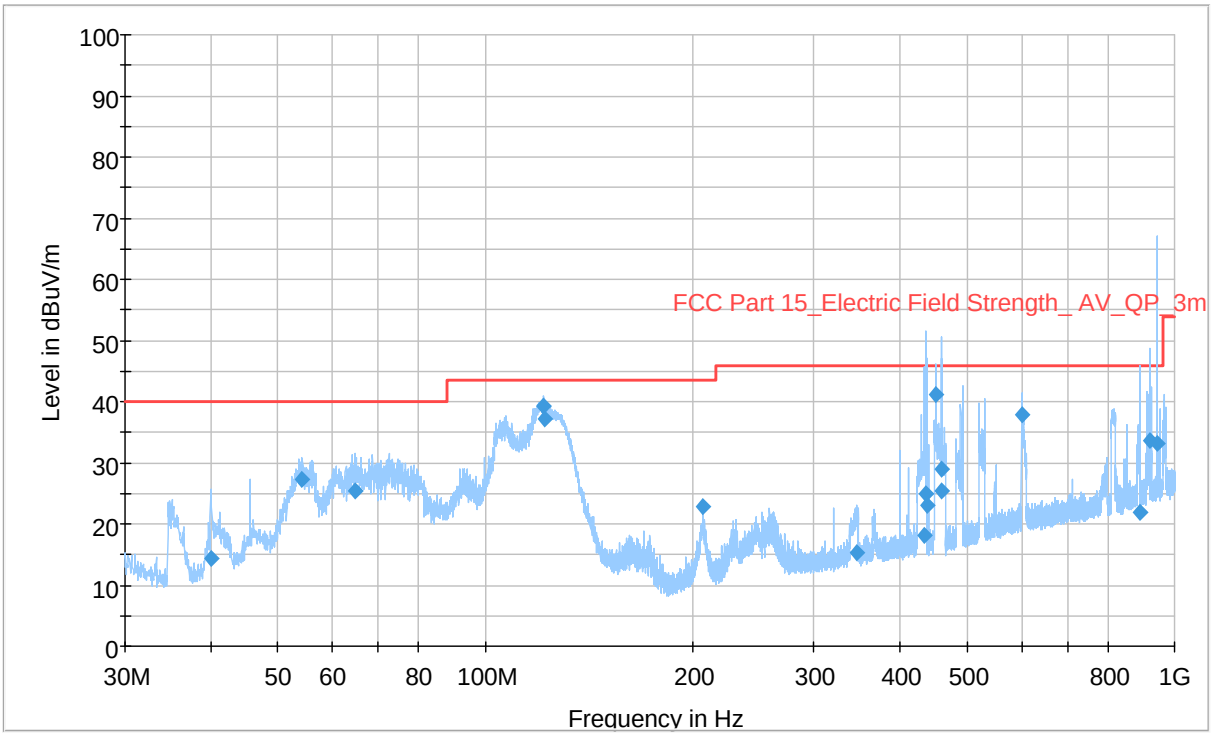


Plot 3.8.4 Radiated emission measurements in (1000 – 6000) MHz range, vertical and horizontal polarization (460 MHz)

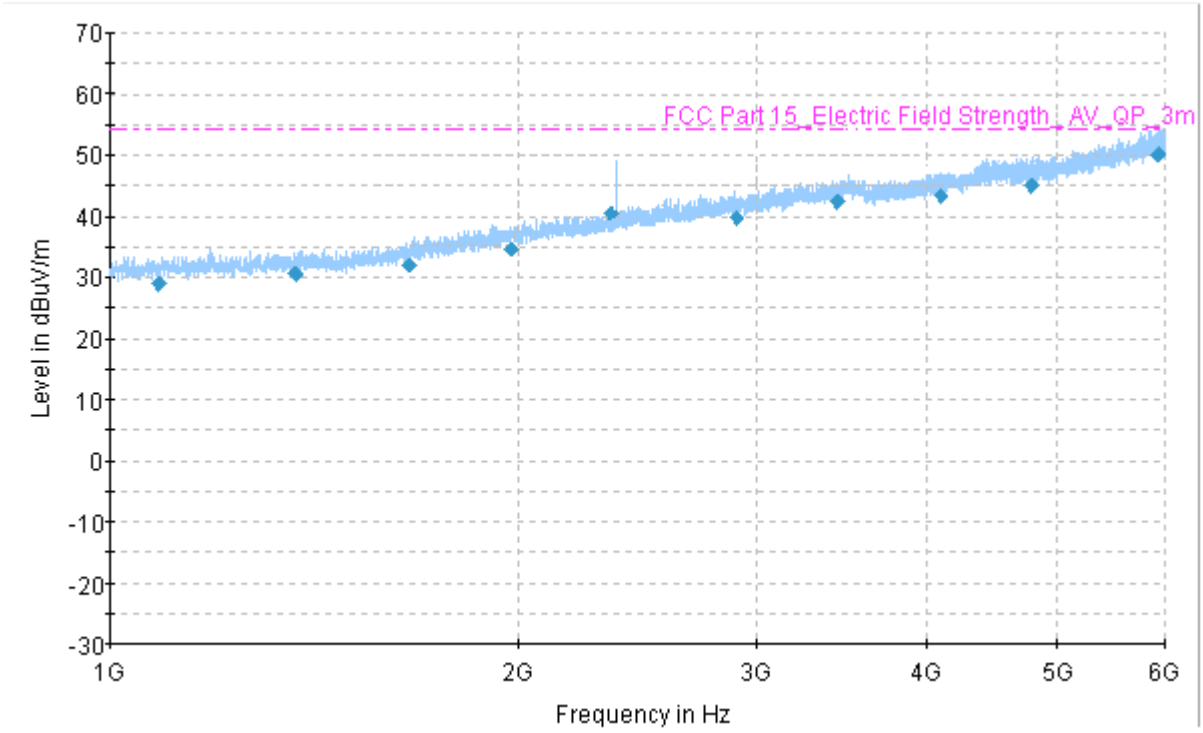


Note: Average values (AV) are below the limit.

Plot 3.8.5 Radiated emission measurements in (30 – 1000) MHz range, vertical and horizontal polarization (470 MHz)



Plot 3.8.6 Radiated emission measurements in (1000 – 6000) MHz range, vertical and horizontal polarization (470 MHz)



Note: Average values (AV) are below the limit.

3.9. The bandwidth of the emission

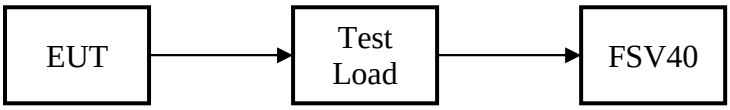
3.9.1 Test requirements Section 15.231c

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier

. 3.9.2 Test procedure

1) The equipment under test was set to transmission mode Pout = - 17 dBm.
2) The transmitter was connected to the FSV40.
3) Spectrum Analyzer was set to the central frequency of channel investigated with the following settings: RBW = 10 kHz; VBW = 30 kHz; Video Detector = Max Peak; Trace mode = MAX HOLD, Span = 1 MHz.
4) Bandwidth of the emission was measured as a bandwidth of signal at points with power -20 dB below the reference point with maximum power of the spectrum.

3.9.3 Test setup layout



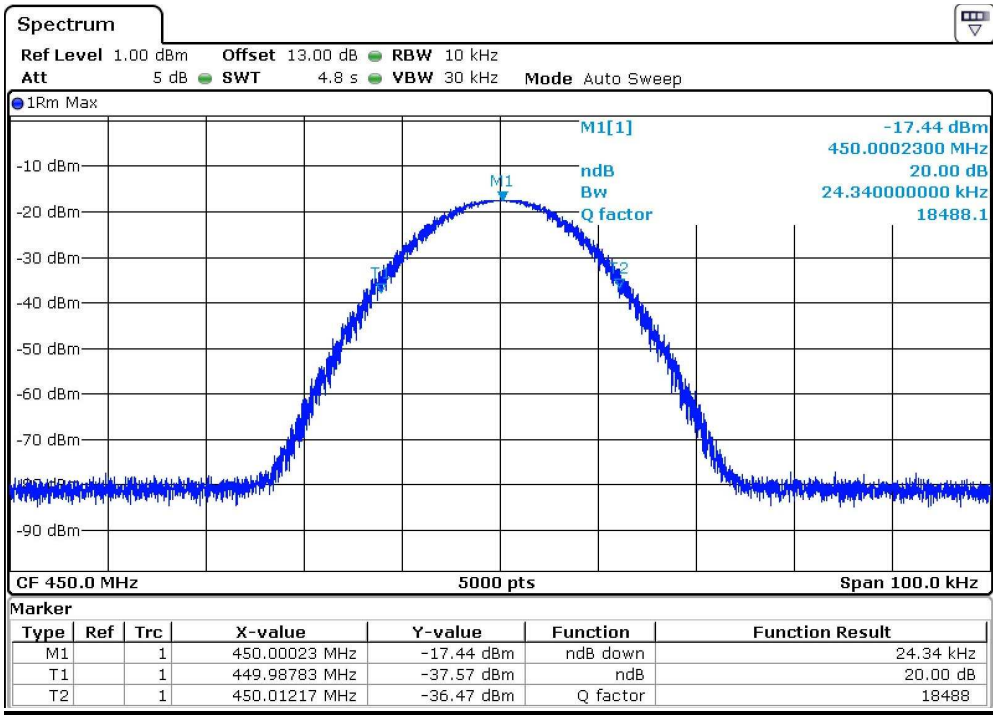
3.9.4 Test result

Temperature: +18 ^{o}C Relative humidity: 50 %

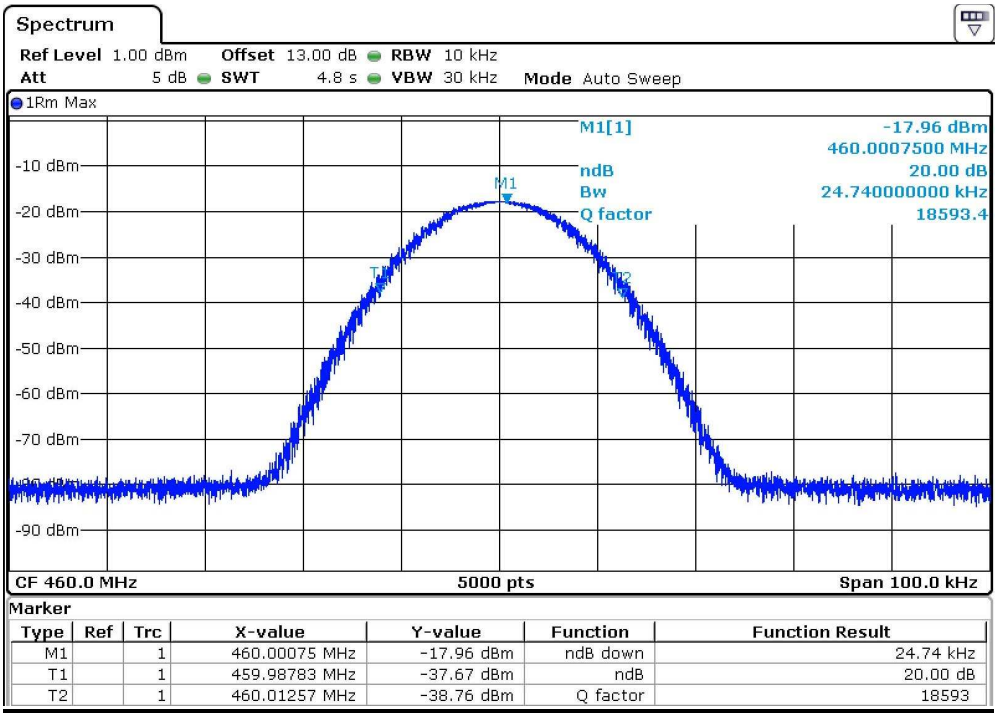
Table 3.9.1 The bandwidth of the emission

Frequency, MHz	Measurement result, kHz	Limit, kHz	Result (Pass, Fail, N/A)
450	24.34	1125	Pass
460	24.74	1150	Pass
470	24.18	1175	Pass

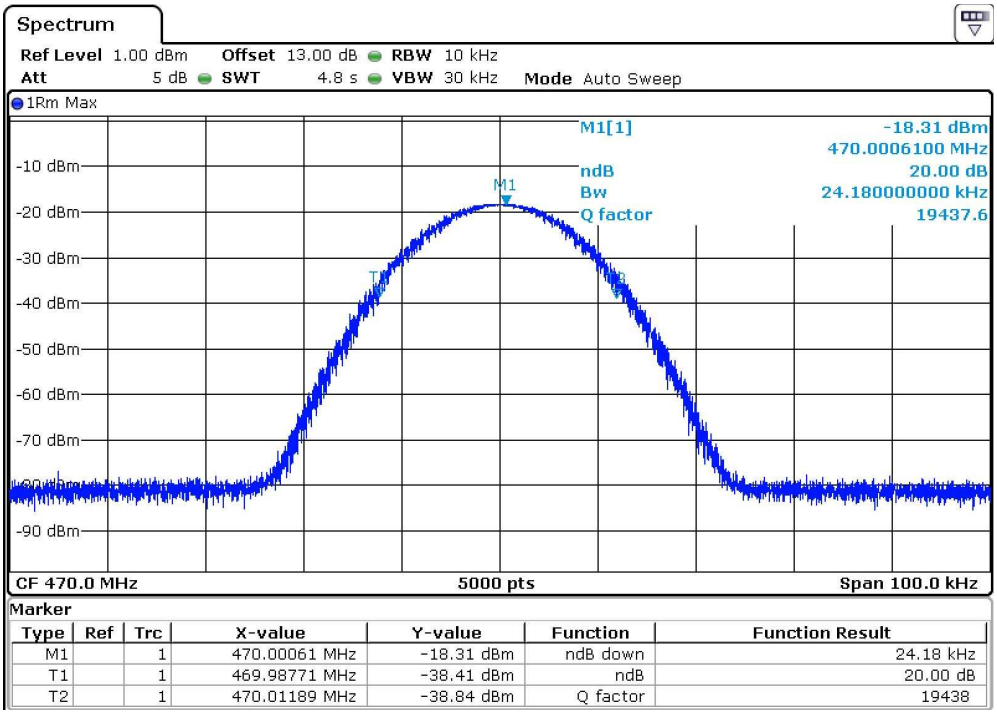
3.9.5 Plot for 450 MHz



3.9.6 Plot for 460 MHz



3.9.7 Plot for 470 MHz



Marker

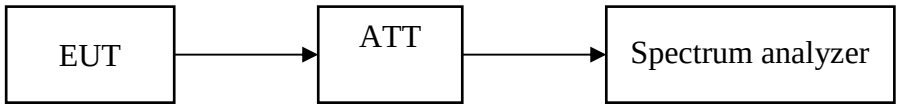
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	470.00061 MHz	-18.31 dBm	ndB down	24.18 kHz
T1		1	469.98771 MHz	-38.41 dBm	ndB	20.00 dB
T2		1	470.01189 MHz	-38.84 dBm	Q factor	19438

3.10 Operating Frequencies

Assignment and use of the frequencies in the band 450-470 MHz for fixed operations regulates by paragraph 47 CFR Part 90.261 and authorized in an individual license for the radio.

3.11 99% Occupied Bandwidth

3.11.1 Test Setup



3.11.2 Limit

According to §90.209(b)(5) the maximum occupied bandwidth for a 6.25 kHz channel spacing is 6 kHz.

3.11.3 Test Procedure

The following procedure according to ANSI C63.10-2013 shall be used for measuring 99% power bandwidth.

Settings for the spectrum analyzer:

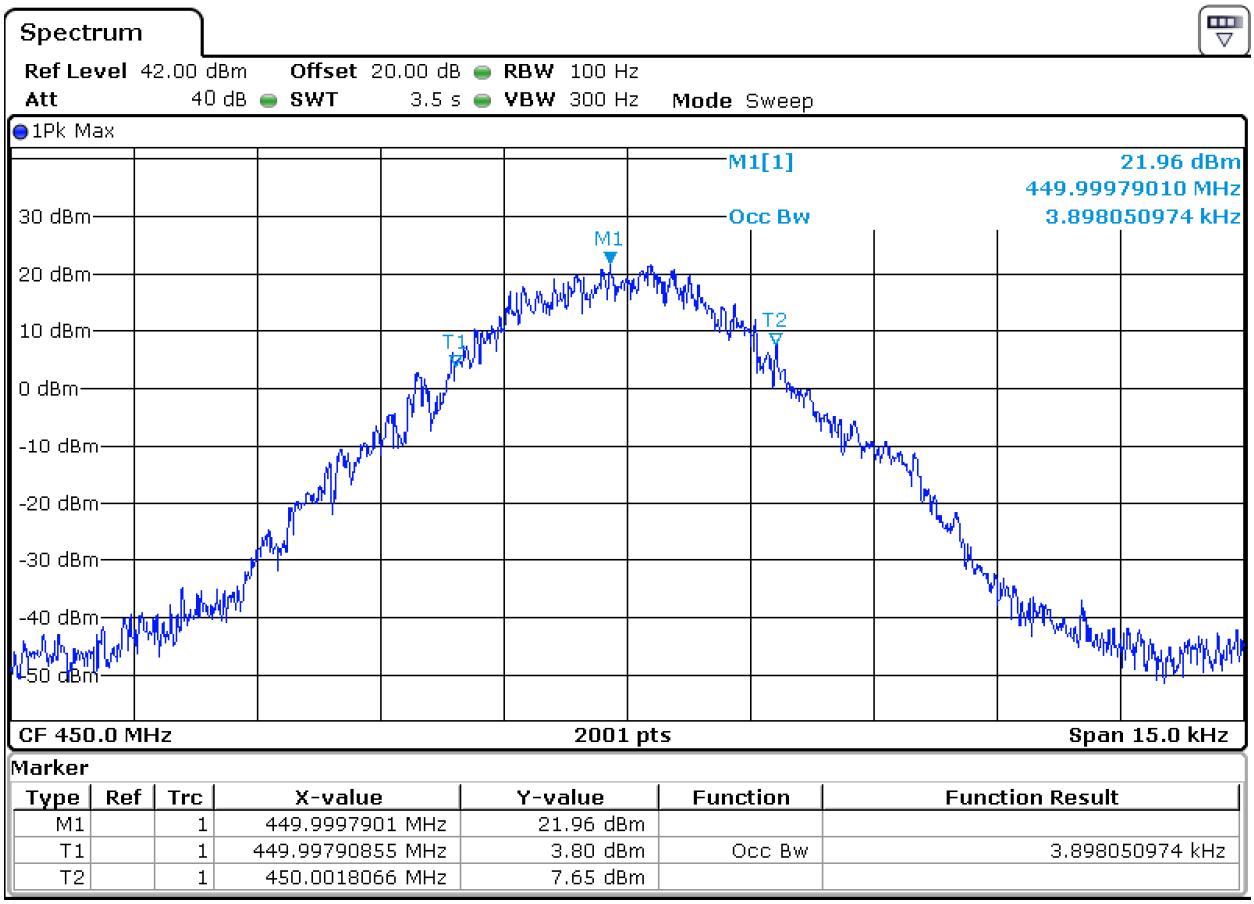
- center frequency is set to the nominal EUT channel center frequency;
- frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the occupied bandwidth (OBW);
- RBW shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW;
- Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. The peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.
- Peak detection and max hold mode (until the trace stabilizes) shall be used.
- The 99% power bandwidth function of the spectrum analyzer shall be used.

3.11.4 Test Results

Temperature: +25 ^{o}C Relative humidity: 60 %

Channel Frequency, MHz	99% Occupied Bandwidth, kHz	Limit, kHz	Test Result (Pass, Fail, N/A)
450	3.90	6.00	Pass
460	3.85	6.00	Pass
470	3.83	6.00	Pass

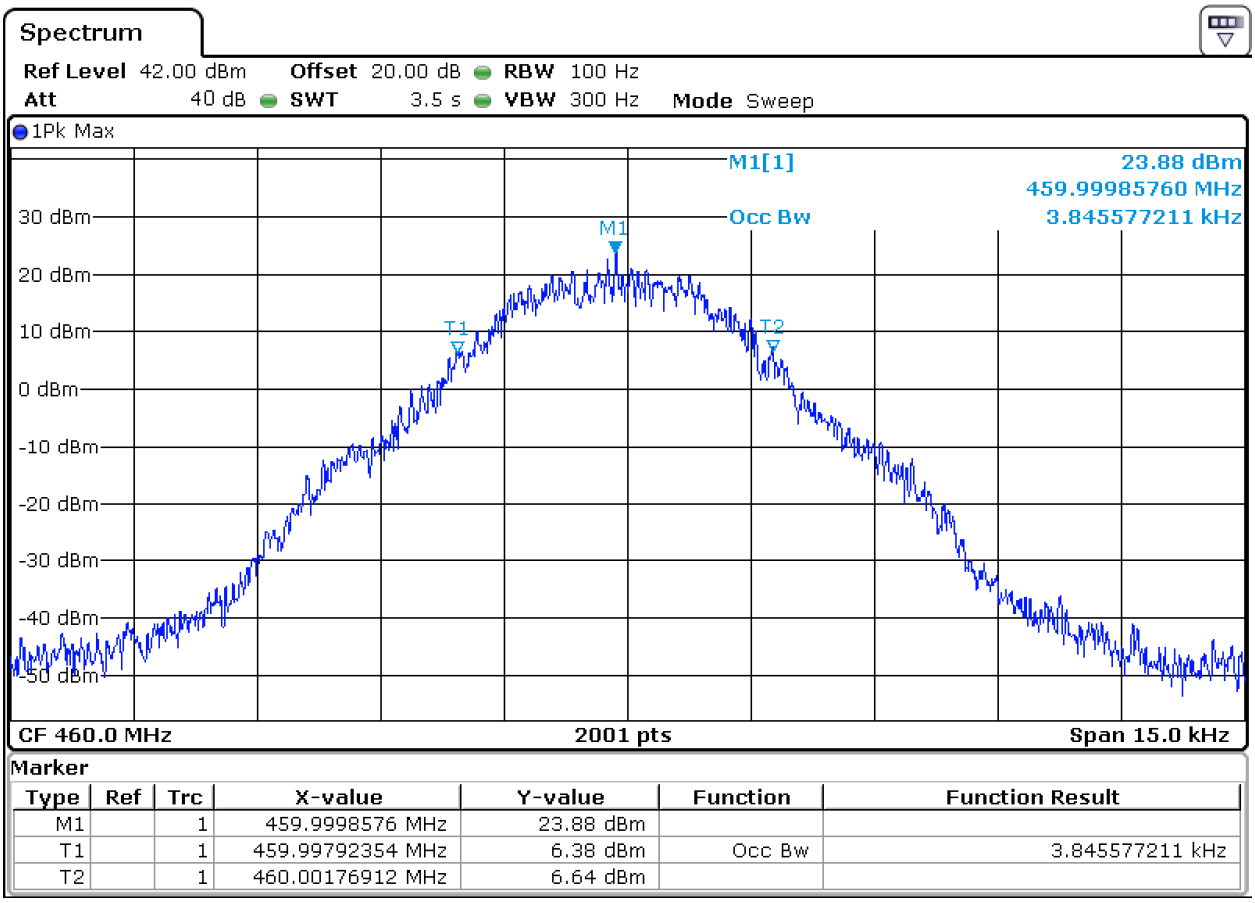
Low Channel Plot



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	449.9997901 MHz	21.96 dBm		
T1		1	449.99790855 MHz	3.80 dBm	Occ Bw	3.898050974 kHz
T2		1	450.0018066 MHz	7.65 dBm		

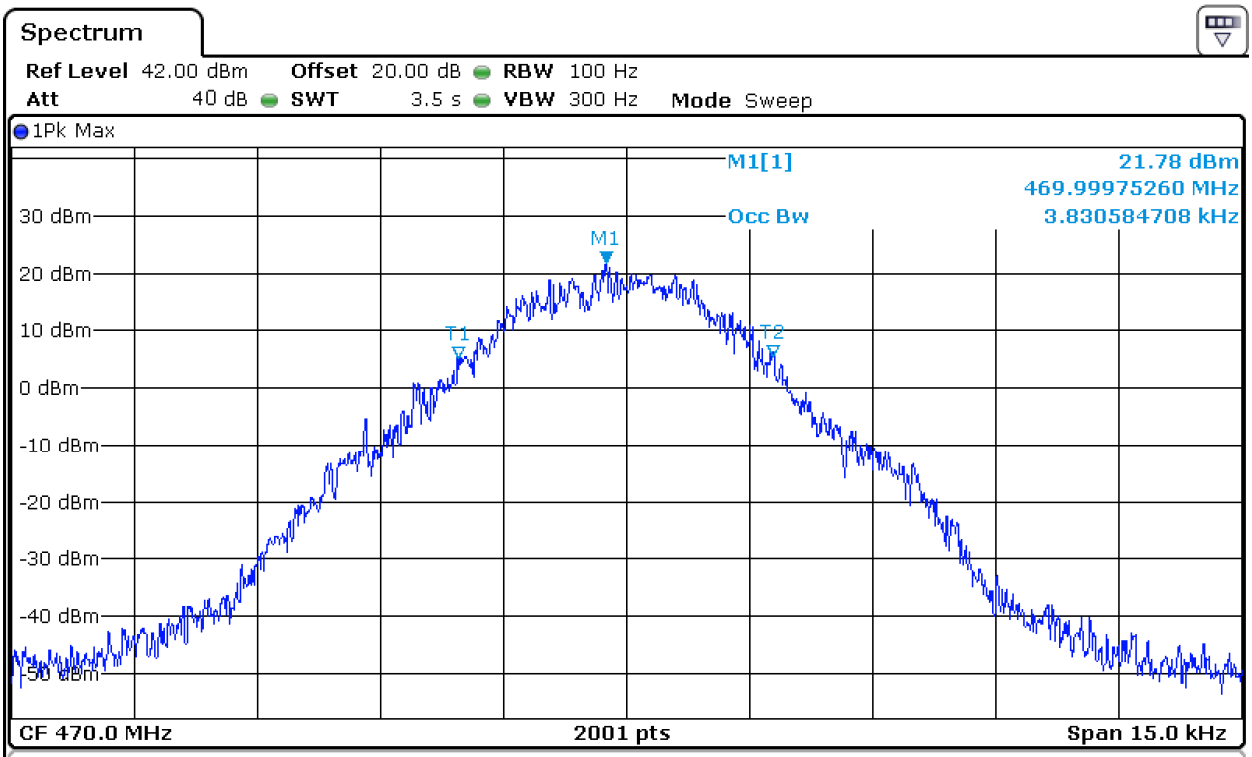
Middle Channel Plot



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	459.9998576 MHz	23.88 dBm		
T1		1	459.99792354 MHz	6.38 dBm	Occ Bw	3.845577211 kHz
T2		1	460.00176912 MHz	6.64 dBm		

High Channel Plot



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	469.9997526 MHz	21.78 dBm		
T1		1	469.99794603 MHz	5.15 dBm	Occ Bw	3.830584708 kHz
T2		1	470.00177661 MHz	5.55 dBm		