FCC TEST REPORT No. 13/236	**2013**
for 47 CFR Part 90	June, 14

Model name:	4G Interpreter
Product description	The Water Meter
FCC ID	NTA2W4GB1
Applicant	Telematics Wireless Ltd., Israel
Manufacturer	Telematics Wireless Ltd., Israel

The results in this report apply only to the samples tested.
Reproduction or copying of this report or its any part may only be made with the prior written approval of PE TC "Omega"

PUBLIC ENTERPRISE
TESTING CENTER
"OMEGA"

29 Vakulenchuk str., Sevastopol,
99053, Crimea, Ukraine, P.O.B.-37
phone: +380 692 53 70 72
fax: +380 692 46 96 79
e-mail: stcomega@stc-omega.biz

Approved by
Sergey Bogach,
Chief TC of PE TC "OMEGA"

Table of contents

1 EQUIPMENT UNDER TEST

1.1 Basic description

Equipment Category	
Model name	**4G Interpreter**
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
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
Harmonics	< -62dBc

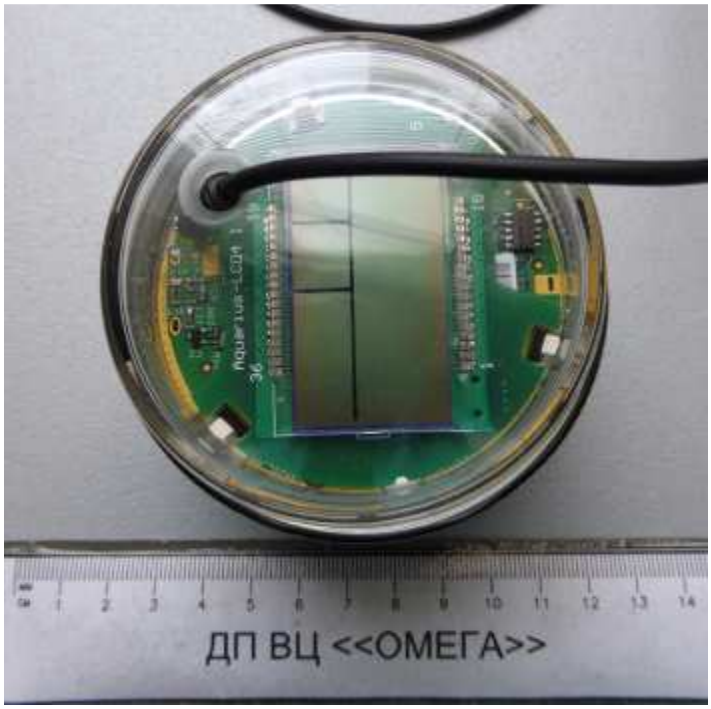
Receiver

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

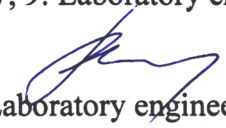


2 GENERAL INFORMATION ABOUT TESTS

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. 1,2,4-7, 9: Laboratory engineer


Boris Trifonov

tests No. 3, 8: Laboratory engineer


Vladimir Osaulko

Checked by:
Leading engineer


Fjodor Shubin

2.2 Test manner

2.3 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 = +3.6 V

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

Extreme power source:
- minimum voltage Umin = 2.7 V
- maximum voltage Umax = 3.6 V

The frequencies for the testing

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

2.4 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	TDS1002	C041673
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.	RF Trigger	-	111008
14.	Antenna (30 – 1000) MHz	Schwarzbeck UBAA 9114	9111-214
15.	Antenna (1000 - 6000) MHz	HP11966 model 3115	9903-5701
16.	Antenna (1000 - 6000) MHz	ETS-Lindgren 3117	100200
17.	Antenna (1000 - 6000) MHz	ETS-Lindgren 3117	100201
18.	Digital multimeter	FLUKE 189	89750179
19.	Preamplifier (0.1-18) GHz	Agilent 87405c	MY47010400
20.	Psychrometer	ВИТ-2	В931
21.	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.	Test load	Telematics Wireless RTU_S
2.	Notebook	IBM ThinkPad

2.5 Measurement uncertainty

Parameter	Maximum uncertainty
Radiated emission	± 5.2 dB
Conducted emission	± 2.7 dB
Frequency	$\pm 1.5 \times 10^{-7}$
Temperature	± 1 °C
Humidity	± 2 %
Voltage supply DC	± 2 %

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

Measurement uncertainty complies with the requirements of the normative documents and is guaranteed by the test procedures and test equipment.

2.6 Photo of test site

Figure 2.6.1

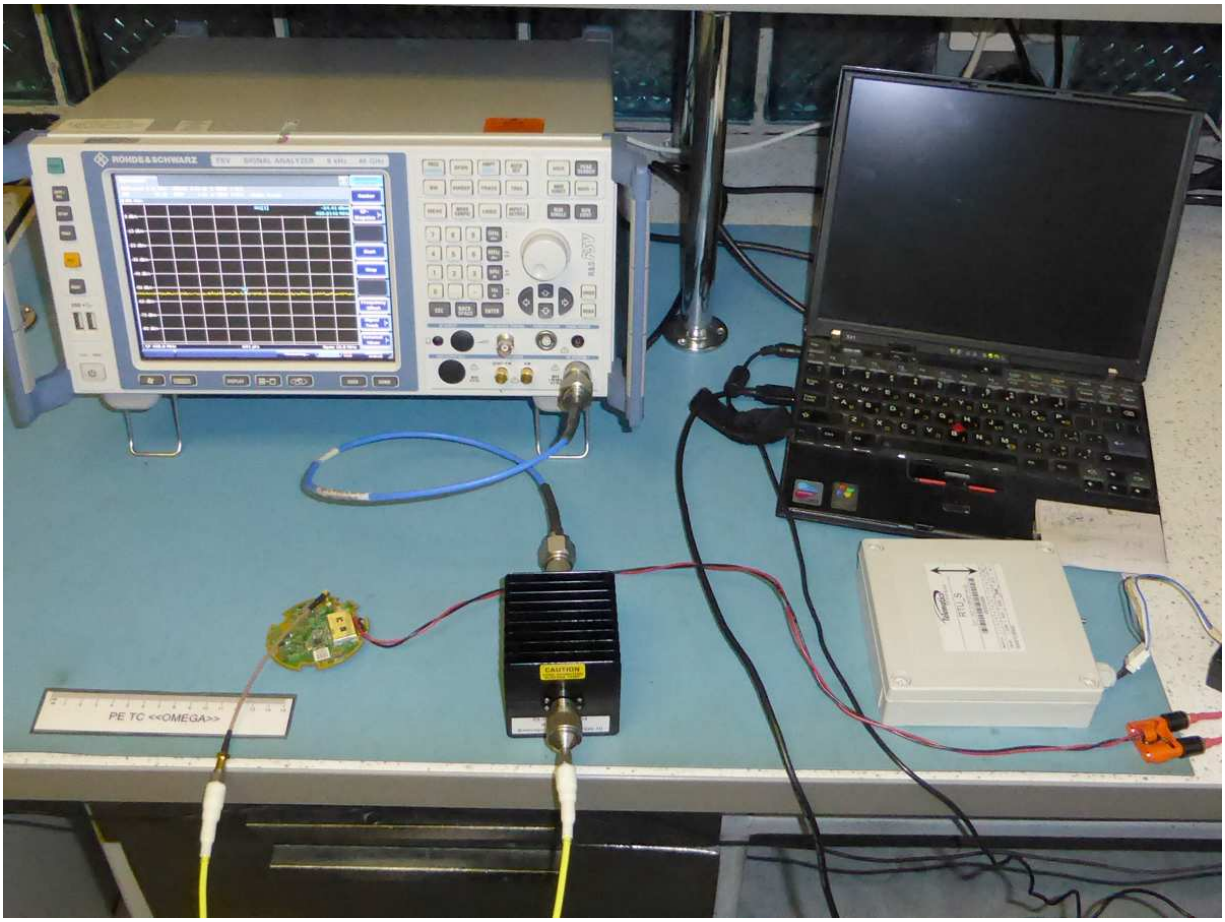


Figure 2.6.2

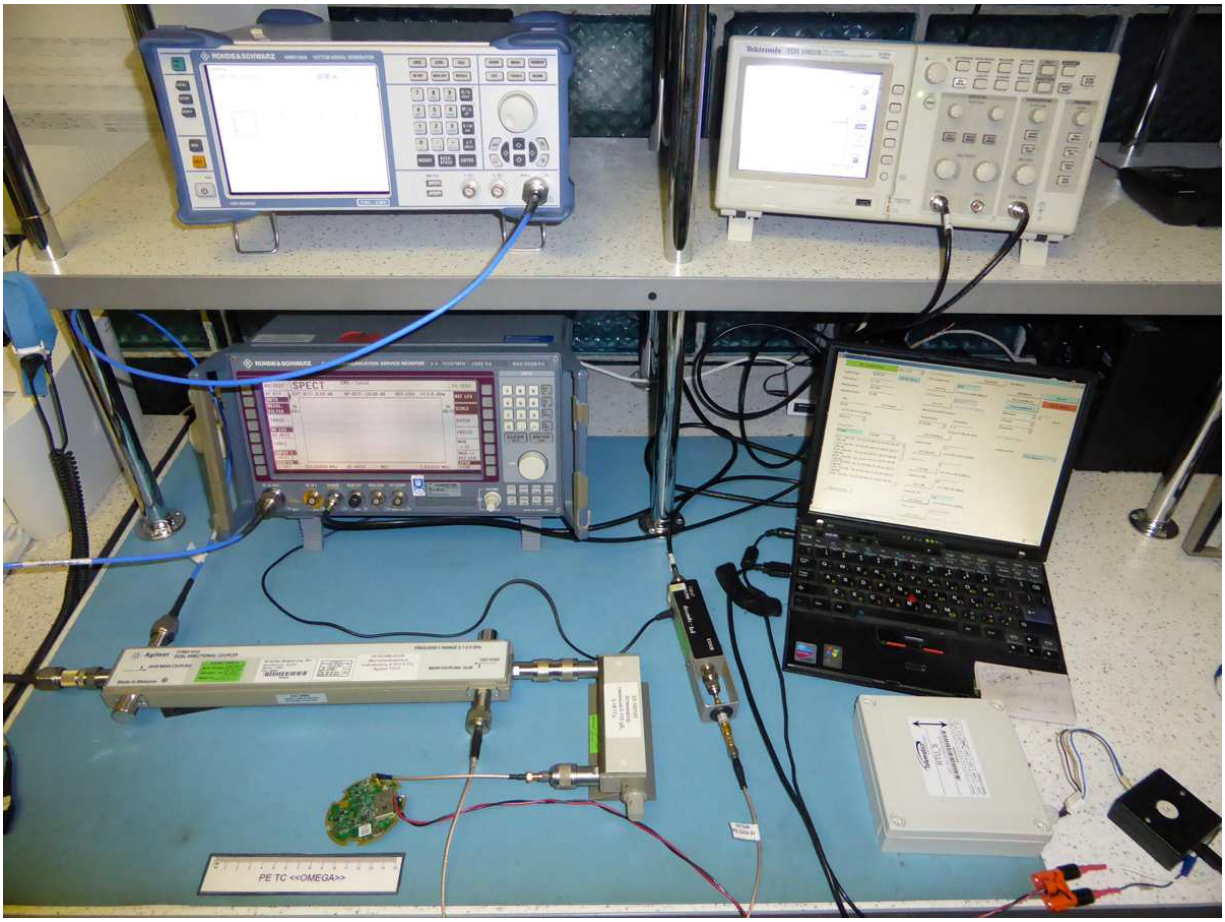
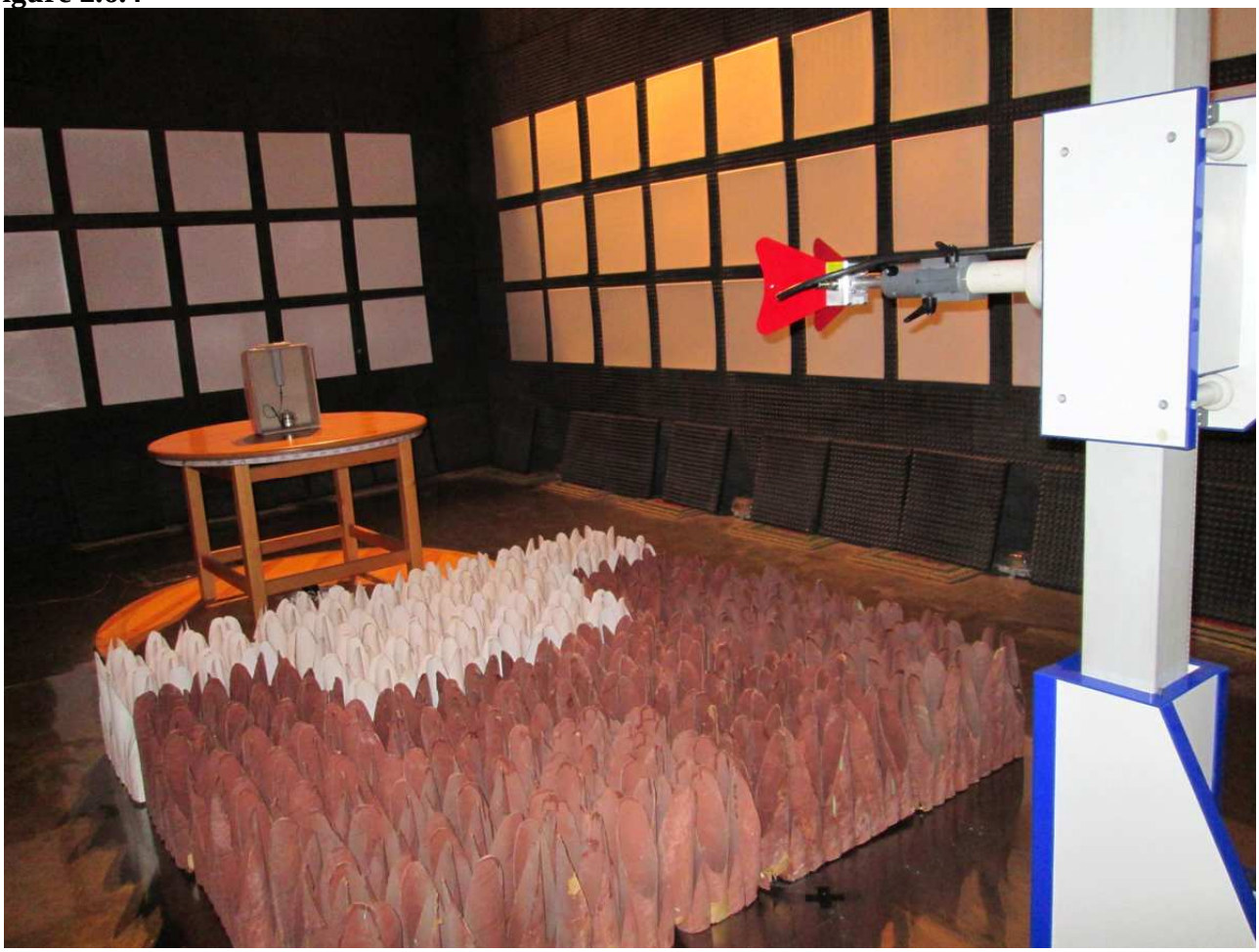


Figure 2.6.3

Figure 2.6.4



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

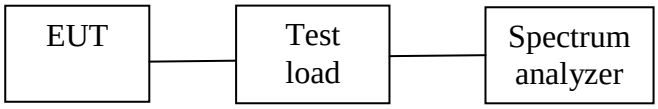
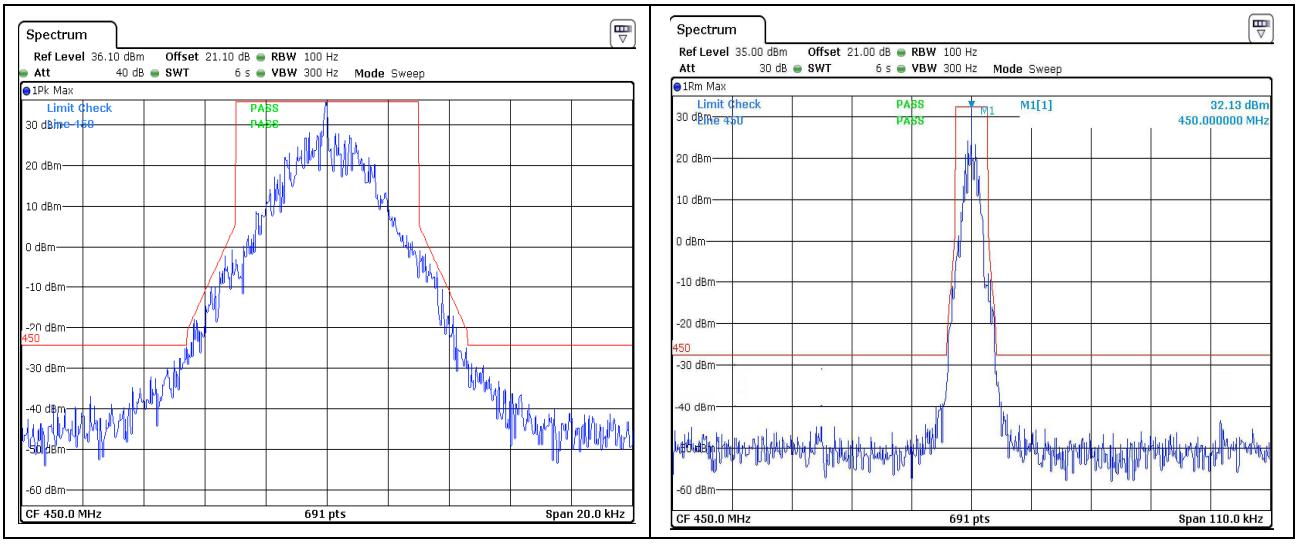


Figure 3.1.1

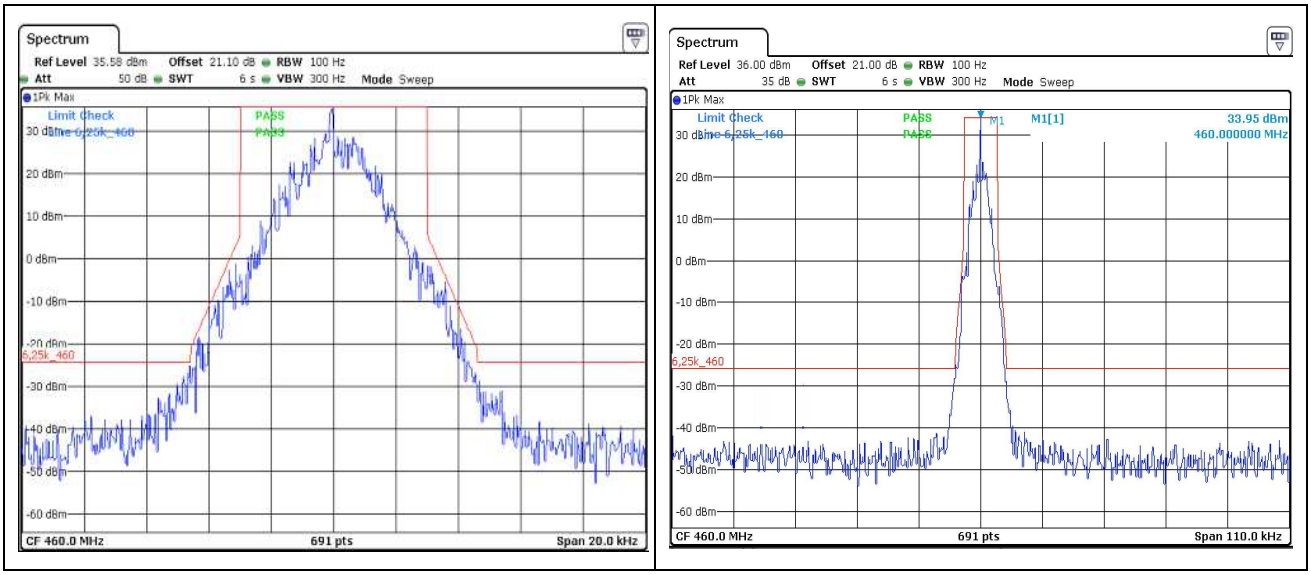
3.1.4 Test result

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

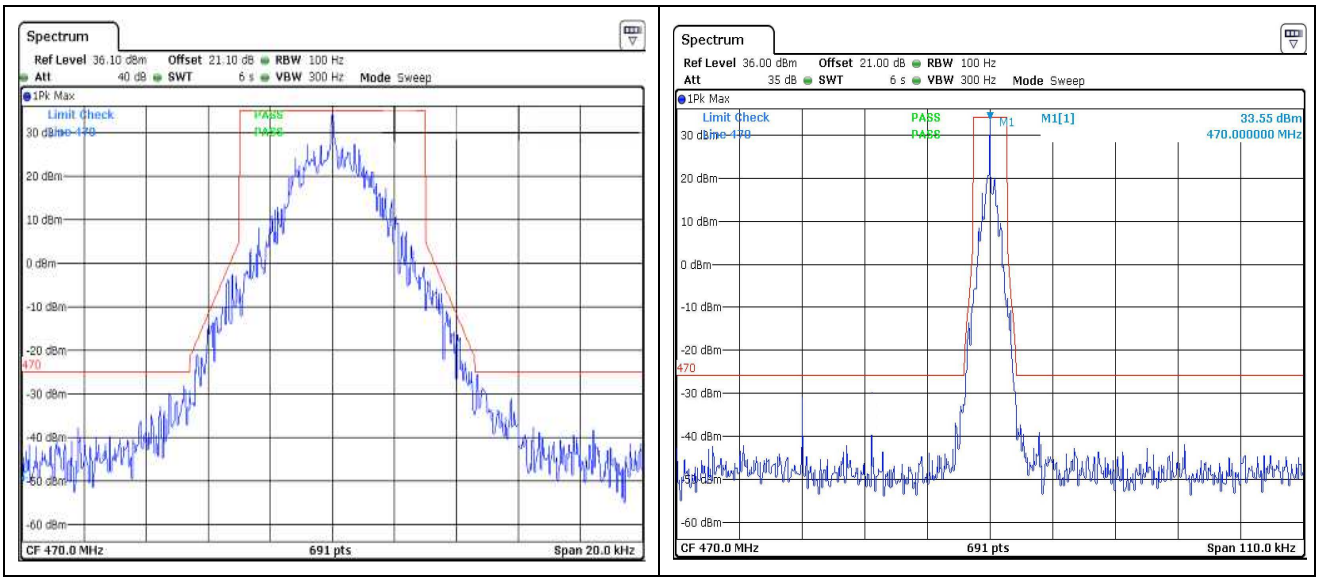
3.1.1 Plots Emissions Mask test result at low frequency



3.1.2 Plots Emissions Mask test result at mid frequency



3.1.3 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.

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 +50 kHz from the edge of the authorized bandwidth to frequency equal 10 times the carrier frequency.

The spectrum analyzer was adjusted for the following settings:

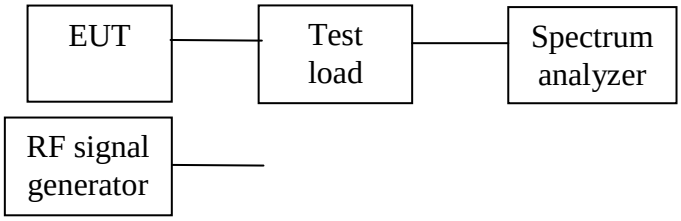
Resolution Bandwidth = 10 kHz for spurious emission below 1 GHz, and 1 MHz for spurious emission above 1 GHz.

Video Bandwidth ≥ 3 times the resolution bandwidth.

Sweep Speed ≤ 2000 Hz per second.

Detector Mode = average power.

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	34.19	-	-	-	-
450.053	- 31.17	- 30.60	- 64.79	- 60	Pass
450.197	- 33.12	- 32.56	- 66.75	- 60	Pass
450.244	- 34.65	- 33.92	- 68.11	- 60	Pass
460	34.14	-	-	-	-
460.056	- 30.34	- 29.65	- 63.79	- 60	Pass
460.158	- 31.69	- 30.75	- 64.89	- 60	Pass
460.192	- 32.01	- 31.35	- 65.49	- 60	Pass
470	33.95	-	-	-	-
470.054	- 31.61	- 30.80	- 64.75	- 60	Pass
470.078	- 31.27	- 30.50	- 64.45	- 60	Pass
470.194	- 33.50	- 32.80	- 66.75	- 60	Pass

Table 3.2.1 Conducted Spurious Emissions (Frequency 450 MHz)

Frequency, MHz	Output Power, dBm	Gen. Output, dBm	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
450	34.19	-	-	-	-
900	- 31.51	- 30.95	- 65.14	- 60	Pass
1350	- 75.34	- 74.63	- 108.82	- 60	Pass
1800	- 74.73	- 73.96	- 108.15	- 60	Pass
2250	- 66.61	- 65.84	- 100.03	- 60	Pass
2700	- 74.00	- 73.36	- 107.55	- 60	Pass
3150	- 74.61	- 73.87	- 108.06	- 60	Pass
3600	-	-	-	- 60	Pass
4050	-	-	-	- 60	Pass
4500	-	-	-	- 60	Pass

Table 3.2.2 Conducted Spurious Emissions (Frequency 460 MHz)

Frequency, MHz	Output Power, dBm	Gen. Output, dBm	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
460	34.14	-	-	-	-
920	- 32.56	- 31.92	- 66.06	- 60	Pass
1380	- 73.83	- 73.08	- 107.22	- 60	Pass
1840	- 69.58	- 68.96	- 103.10	- 60	Pass
2300	- 67.67	- 66.84	- 100.98	- 60	Pass
2760	- 74.92	- 74.10	- 108.24	- 60	Pass
3220	-	-	-	- 60	Pass
3680	- 74.82	- 74.06	- 108.20	- 60	Pass
4140	- 72.26	- 71.61	- 105.75	- 60	Pass
4600	- 73.41	- 72.74	- 106.88	- 60	Pass

Table 3.2.3 Conducted Spurious Emissions (Frequency 470 MHz)

Frequency, MHz	Output Power, dBm	Gen. Output, dBm	Difference, dBc	Limit, dBc	Result (Pass, Fail, N/A)
470	33.95	-	-	-	-
940	-33.74	- 33.05	- 67.00	- 60	Pass
1410	-73.00	- 72.31	- 106.26	- 60	Pass
1880	-68.20	- 67.48	- 101.43	- 60	Pass
2350	-69.73	- 69.12	- 103.07	- 60	Pass
2820	-	-	-	- 60	Pass
3290	-74.94	- 74.24	- 108.19	- 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.

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

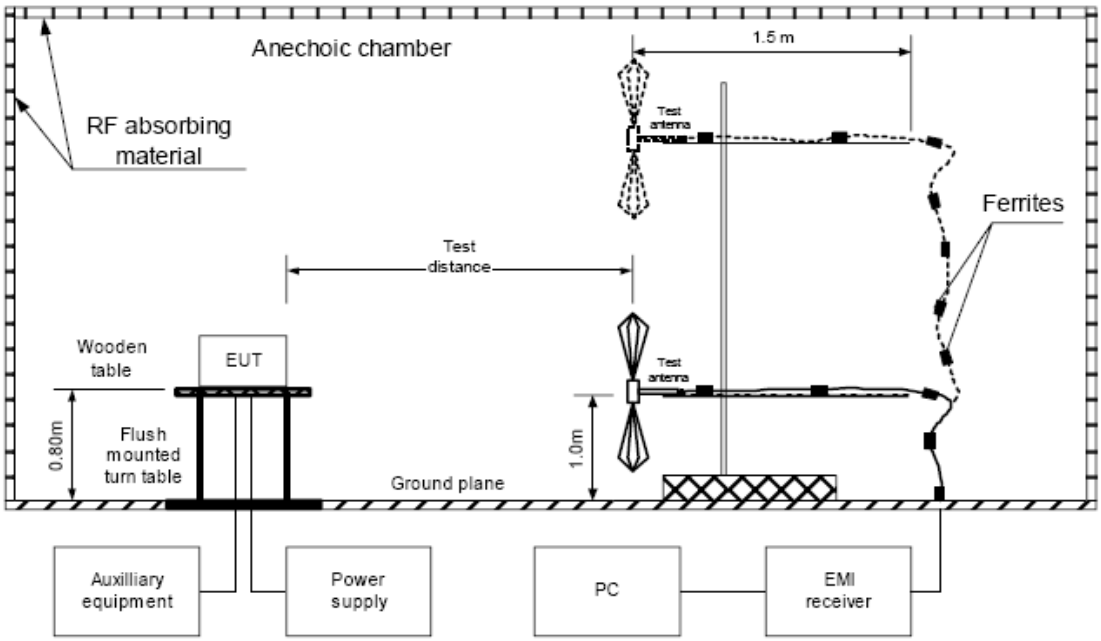
The procedure used was ANSI/TIA-603-D:2010. Substitution antenna with RF signal generator was used.
The transmitter was set up to the normal operational mode with maximum output power and connected to standard transmitter load.

1) The spurious emissions were observed in the band of +50 kHz from the edge of the authorized bandwidth to frequency equal 10 times the carrier frequency.
2) The transmitter to be tested was placed on the turntable in the test site compliant with ANSI C63.4-2001 clause 5.4.
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 +50 kHz from the edge of the authorized bandwidth to the tenth harmonic of the carrier.
The spectrum analyzer was adjusted for the following settings:
Resolution Bandwidth = 10 kHz for spurious emission below 1 GHz, and 1 MHz for spurious emission above 1 GHz.
Video Bandwidth = 300 kHz for spurious emission below 1 GHz, and 3 MHz for spurious emission above 1 GHz.
Sweep Speed slow enough to maintain measurement caliblation.
Detector Mode = Positive Peak.
5) The height of measurement antenna was changed from 1m to 4m in 10 cm steps to obtain maximum result on the spectrum analyzer.
6) The turntable was rotated around its axis to obtain maximum result on the spectrum analyzer.
7) Highest possible readings of the spectrum analyzer were recorded.
8) Measurements were repeated for horizontal polarization of measurement antenna.
9) The transmitter was replaced with a substitution antenna connected to RF signal generator.
10) The power into a reference ideal half-wave dipole antenna is calculated by reducing the reading from RF signal generator by the power loss in the cable between the generator and the substitution antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna:

$$P_d \text{ (dBm)} = P_g \text{ (dBm)} - \text{cable loss (dB)} + \text{antenna gain (dB)},$$

where:
P_d is the dipole equivalent power,
P_g is the generator output power into the substitution antenna.
11) Radiated spurious emissions (dB) = TX power (dBm) - P_d (dBm).

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					**33,95**			
940	-31,32	2,3	-7,29	-9,44	-43,06	-77,01	- 60,0	**Pass**
1410	-45,37	3,3	4,80	2,65	-46,02	-79,97	- 60,0	**Pass**
1880	-51,12	4,4	5,00	2,85	-52,67	-86,62	- 60,0	**Pass**
2350	-52,25	4,6	5,50	3,35	-53,50	-87,45	- 60,0	**Pass**
2820	-49,34	5,8	6,50	4,35	-50,79	-84,74	- 60,0	**Pass**
3290	-49,13	6,5	7,20	5,05	-50,58	-84,53	- 60,0	**Pass**
3760	-53,15	6,2	7,66	5,51	-53,84	-87,79	- 60,0	**Pass**
4230	-57,35	6,6	7,62	5,47	-58,48	-92,43	- 60,0	**Pass**
4700	-56,51	7,1	7,70	5,55	-58,06	-92,01	- 60,0	**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					**34,14**			
920	-29,71	2,4	-7,12	-9,27	-41,38	-75,52	- 60,0	**Pass**
1380	-49,84	3,3	4,60	2,45	-50,69	-84,83	- 60,0	**Pass**
1840	-54,33	4,1	5,00	2,85	-55,58	-89,72	- 60,0	**Pass**
2300	-53,19	5,0	5,40	3,25	-54,94	-89,08	- 60,0	**Pass**
2760	-55,54	5,7	6,40	4,25	-56,99	-91,13	- 60,0	**Pass**
3220	-52,11	6,4	7,12	4,97	-53,54	-87,68	- 60,0	**Pass**
3680	-54,22	6,3	7,60	5,45	-55,07	-89,21	- 60,0	**Pass**
4140	-57,18	6,5	7,70	5,55	-58,13	-92,27	- 60,0	**Pass**
4600	-55,78	7,1	7,50	5,35	-57,53	-91,67	- 60,0	**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					**34,19**			
900	-30,42	2,5	-6,90	-9,05	-41,97	-76,16	- 60,0	**Pass**
1350	-56,20	3,6	4,50	2,35	-57,45	-91,64	- 60,0	**Pass**
1800	-52,28	4,1	5,50	3,35	-53,03	-87,22	- 60,0	**Pass**
2250	-51,32	5,2	5,40	3,25	-53,27	-87,46	- 60,0	**Pass**
2700	-48,42	5,3	6,24	4,09	-49,63	-83,82	- 60,0	**Pass**
3150	-43,65	6,6	7,10	4,95	-45,30	-79,49	- 60,0	**Pass**
3600	-49,31	6,2	7,50	5,35	-50,16	-84,35	- 60,0	**Pass**
4050	-54,18	6,4	7,90	5,75	-54,83	-89,02	- 60,0	**Pass**
4500	-55,24	7,1	7,30	5,15	-57,19	-91,38	- 60,0	**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					**33,95**			
940	-36,23	2,3	-7,29	-9,44	-47,97	-81,92	- 60,0	**Pass**
1410	-57,62	3,3	4,80	2,65	-58,27	-92,22	- 60,0	**Pass**
1880	-57,67	4,4	5,00	2,85	-59,22	-93,17	- 60,0	**Pass**
2350	-54,21	4,6	5,50	3,35	-55,46	-89,41	- 60,0	**Pass**
2820	-54,42	5,8	6,50	4,35	-55,87	-89,82	- 60,0	**Pass**
3290	-53,70	6,5	7,20	5,05	-55,15	-89,10	- 60,0	**Pass**
3760	-57,13	6,2	7,66	5,51	-57,82	-91,77	- 60,0	**Pass**
4230	-53,32	6,6	7,62	5,47	-54,45	-88,40	- 60,0	**Pass**
4700	-54,81	7,1	7,70	5,55	-56,36	-90,31	- 60,0	**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					**34,14**			
920	-37,14	2,4	-7,12	-9,27	-48,81	-82,95	- 60,0	**Pass**
1380	-59,32	3,3	4,60	2,45	-60,17	-94,31	- 60,0	**Pass**
1840	-55,17	4,1	5,00	2,85	-56,42	-90,56	- 60,0	**Pass**
2300	-52,58	5,0	5,40	3,25	-54,33	-88,47	- 60,0	**Pass**
2760	-54,31	5,7	6,40	4,25	-55,76	-89,90	- 60,0	**Pass**
3220	-53,42	6,4	7,12	4,97	-54,85	-88,99	- 60,0	**Pass**
3680	-54,32	6,3	7,60	5,45	-55,17	-89,31	- 60,0	**Pass**
4140	-53,54	6,5	7,70	5,55	-54,49	-88,63	- 60,0	**Pass**
4600	-54,38	7,1	7,50	5,35	-56,13	-90,27	- 60,0	**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					**34,19**			
900	-37,52	2,5	-6,90	-9,05	-49,07	-83,26	- 60,0	**Pass**
1350	-62,43	3,6	4,50	2,35	-63,68	-97,87	- 60,0	**Pass**
1800	-57,1	4,1	5,50	3,35	-57,85	-92,04	- 60,0	**Pass**
2250	-54,21	5,2	5,40	3,25	-56,16	-90,35	- 60,0	**Pass**
2700	-54,52	5,3	6,24	4,09	-55,73	-89,92	- 60,0	**Pass**
3150	-53,46	6,6	7,10	4,95	-55,11	-89,30	- 60,0	**Pass**
3600	-53,37	6,2	7,50	5,35	-54,22	-88,41	- 60,0	**Pass**
4050	-52,11	6,4	7,90	5,75	-52,76	-86,95	- 60,0	**Pass**
4500	-52,15	7,1	7,30	5,15	-54,10	-88,29	- 60,0	**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

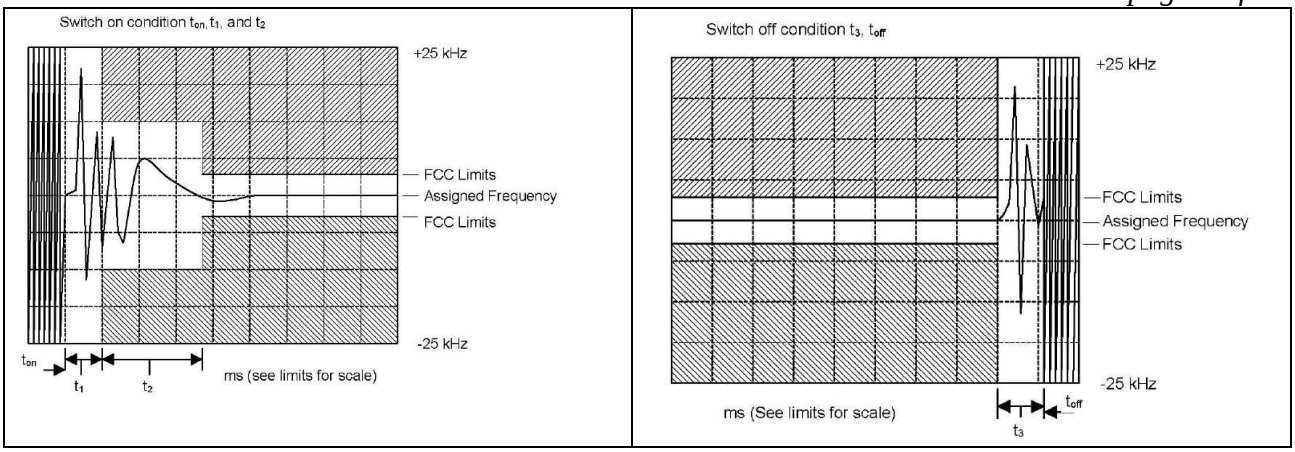
[1] t_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.

- 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.

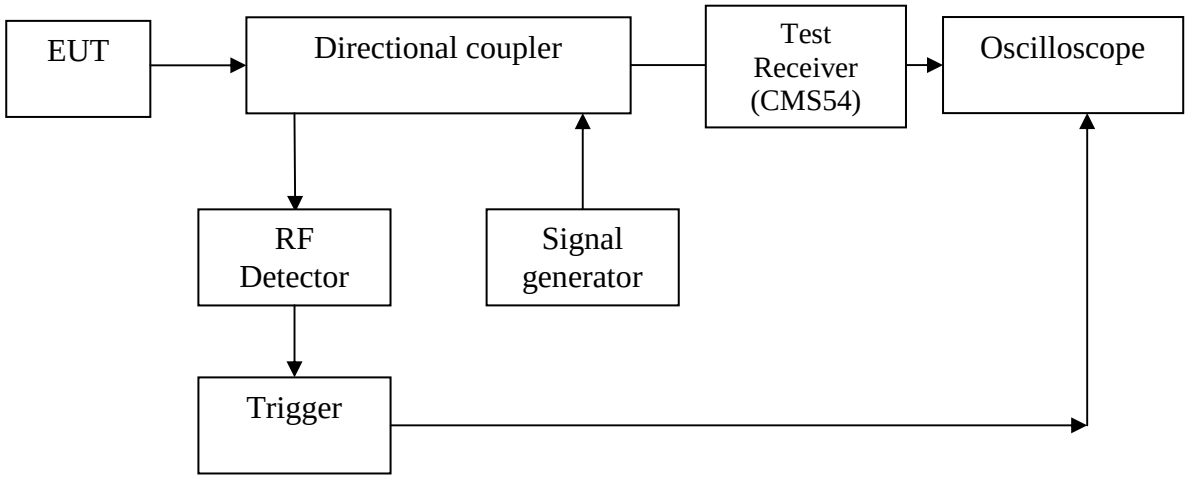
[2] During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or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



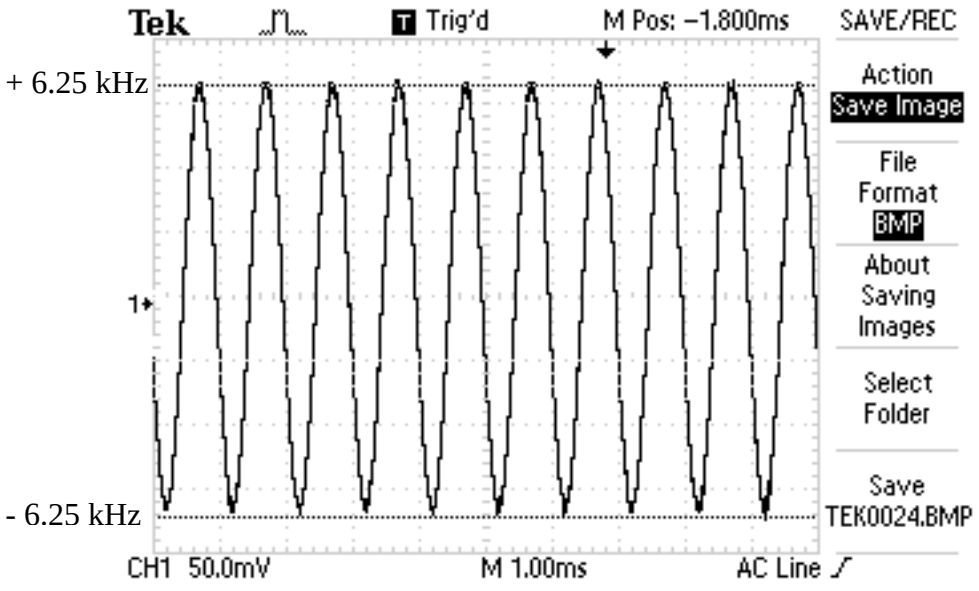
3.4.3 Test setup layout



3.4.4 Test result

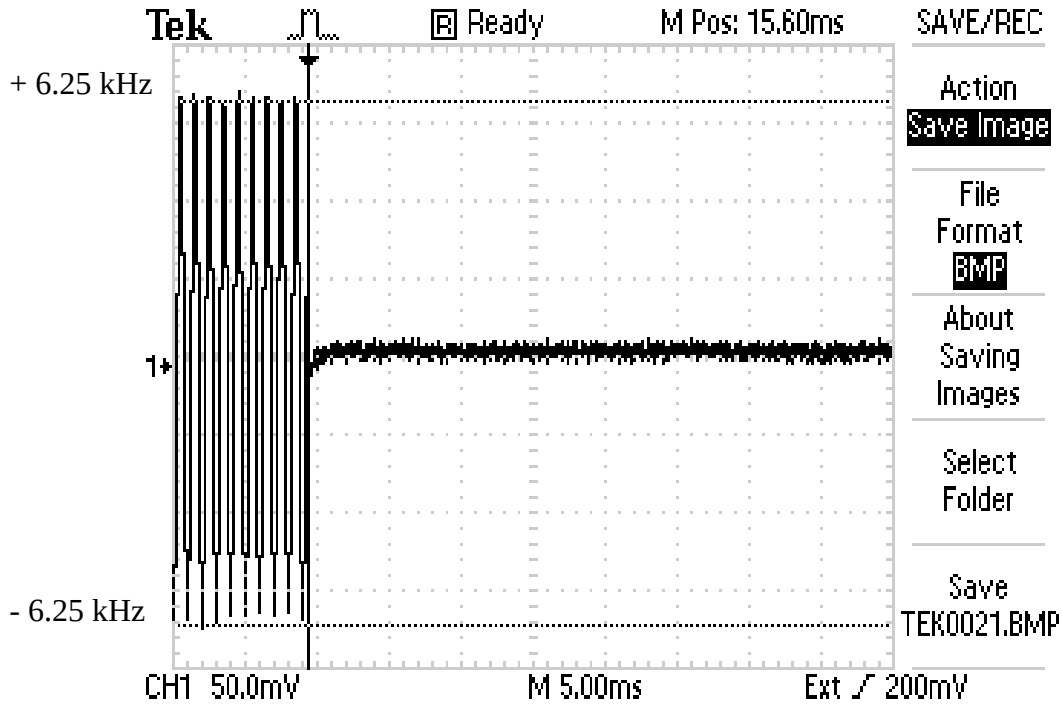
Temperature: +18 ^{o}C Relative humidity: 50 %

3.4.1 Plot

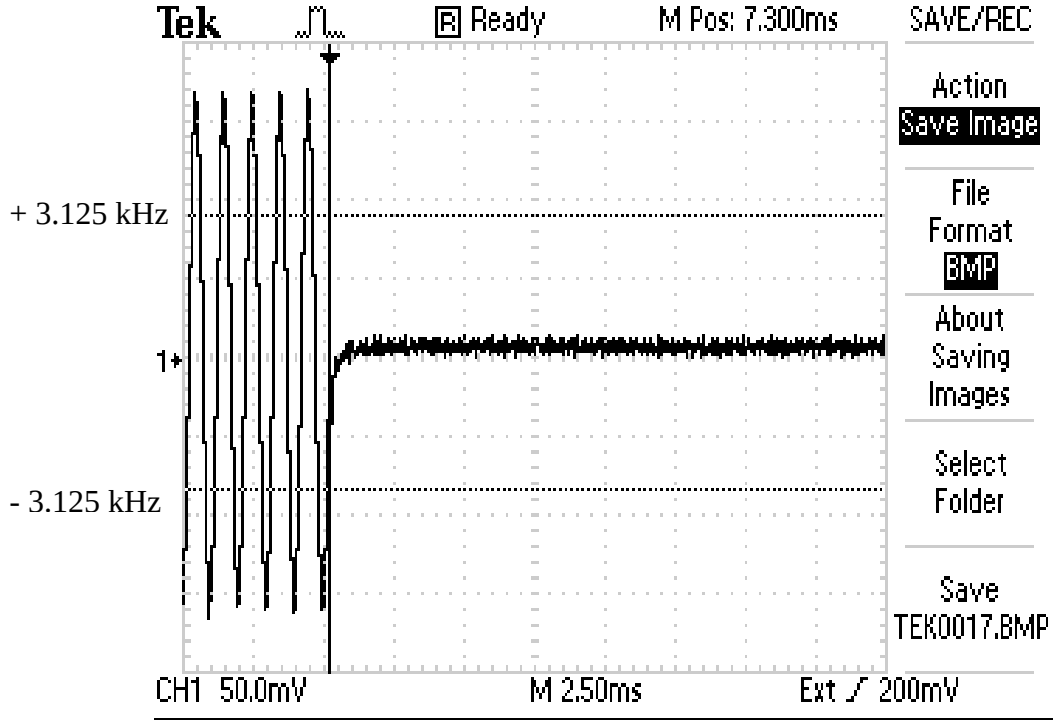


± 6.25 kHz = 336 mV
± 3.125 kHz = 168 mV
± 225 Hz (±0.5 ppm) = 12 mV

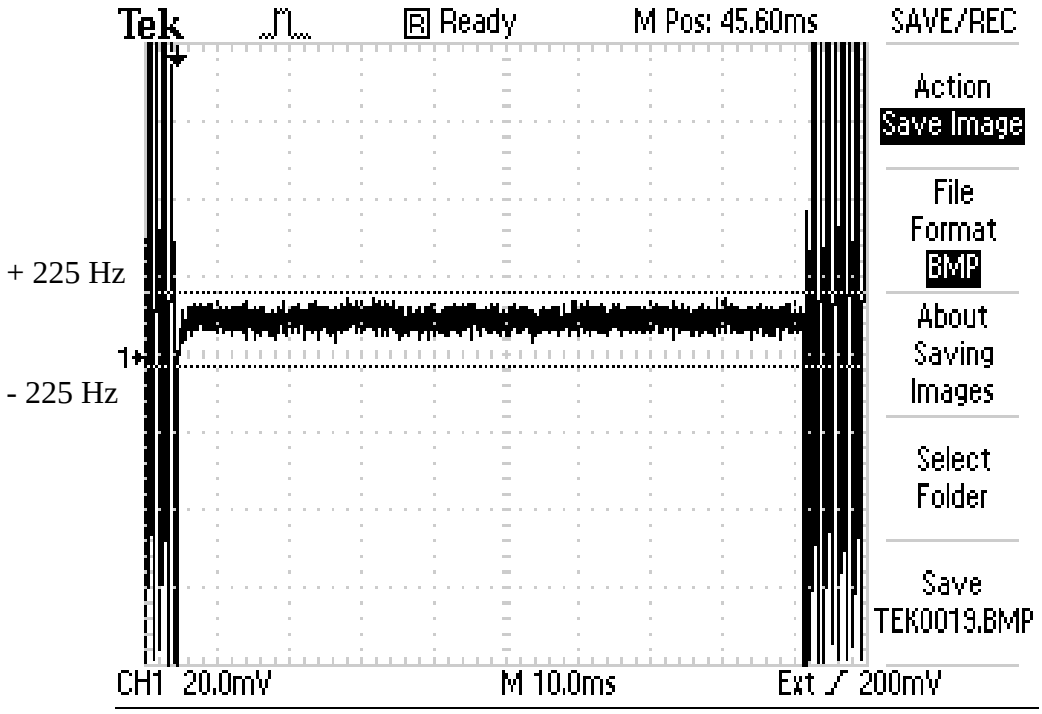
3.4.2 Plot: t_1 time period



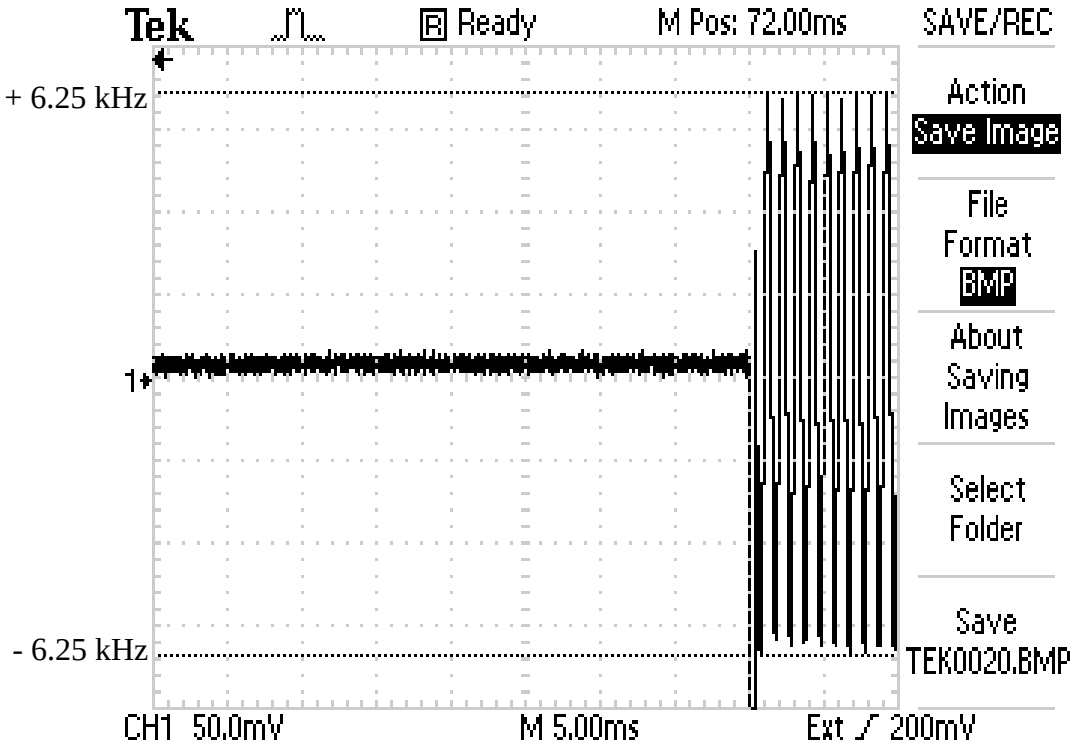
3.4.3 Plot: t_2 time period



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 Limit frequency stability vs power supply

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.

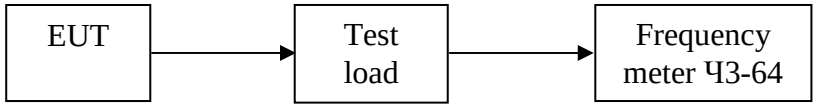
[8] In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

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)
3.6	452.650029	+29	+0.064	0.5	Pass
3.5	452.650029	+29	+0.064	0.5	Pass
3.4	452.650014	+14	+0.031	0.5	Pass
3.3	452.650014	+14	+0.031	0.5	Pass
3.2	452.650014	+14	+0.031	0.5	Pass
3.1	452.650000	0	0	0.5	Pass
3.0	452.650000	0	0	0.5	Pass
2.9	452.649993	-7	-0.016	0.5	Pass
2.8	452.649986	-14	-0.031	0.5	Pass
2.7	452.649986	-14	-0.031	0.5	Pass

Reference frequency = 452.650000 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.

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.

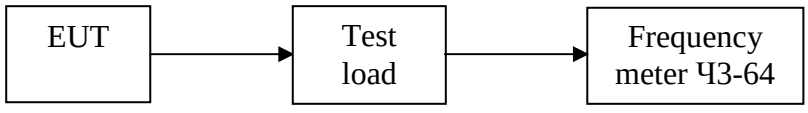
[8] In the 421-512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm. Mobile stations designed to operate with a 6.25 kHz channel bandwidth must have a frequency stability of 1.0 ppm.

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 °C Relative humidity: 50 %

Temperature (°C)	Frequency (MHz)	Deviation (Hz)	Deviation (ppm)	Limit, ppm	Result (Pass, Fail, N/A)
+85	452.649857	-147	-0.325	0.5	Pass
+80	452.649857	-147	-0.325	0.5	Pass
+70	452.649842	-158	-0.349	0.5	Pass
+60	452.649784	-216	-0.477	0.5	Pass
+50	452.649799	-201	-0.444	0.5	Pass
+40	452.649842	-158	-0.349	0.5	Pass
+30	452.649857	-147	-0.325	0.5	Pass
+20	452.649928	-72	-0.159	0.5	Pass
+10	452.649813	-187	-0.413	0.5	Pass
0	452.649813	-187	-0.413	0.5	Pass
-10	452.649914	-86	-0.190	0.5	Pass
-20	452.649914	-86	-0.190	0.5	Pass
-30	452.649842	-158	-0.349	0.5	Pass
-40	No Transmission	-	-	-	-
+20	452.650029	+29	+0.064	0.5	Pass

Reference frequency = 452.650000 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.

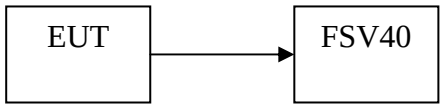
(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(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

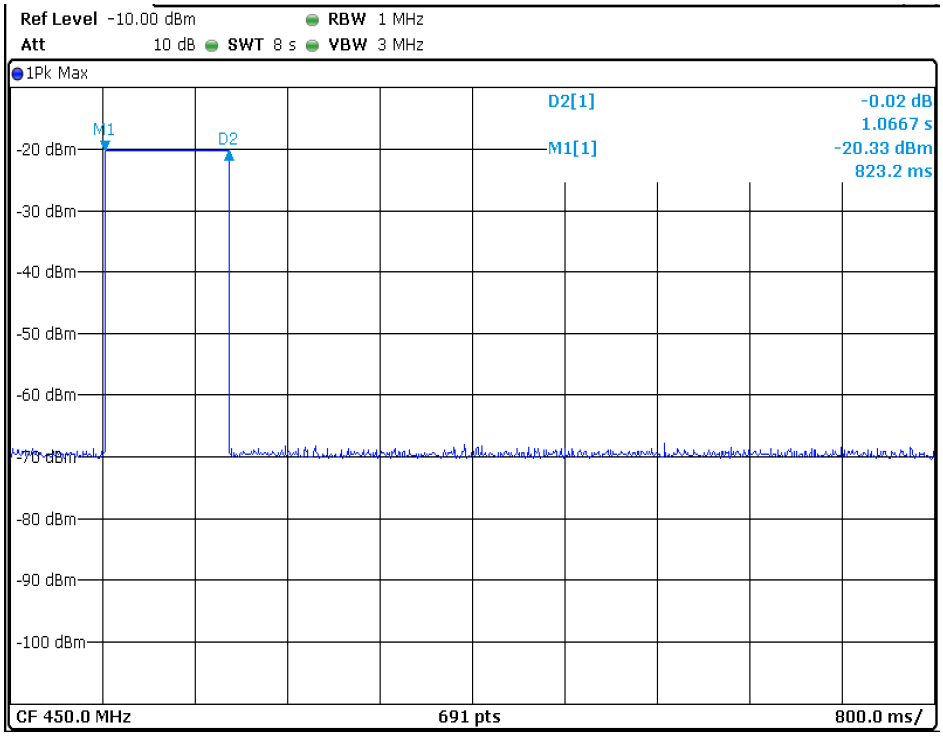


3.7.4 Test result

Temperature: +18 °C Relative humidity: 50 %

3.7.1 Plot Transmit duration

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



Verdict Pass

3.8 Field strength of emissions

3.8.1 Test requirements § 15.231 (b)

Fundamental frequency (MHz)	Field strength of fundamental (μV/m)	(dBμV/m)	Field strength of spurious emissions (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

3.8.2 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.

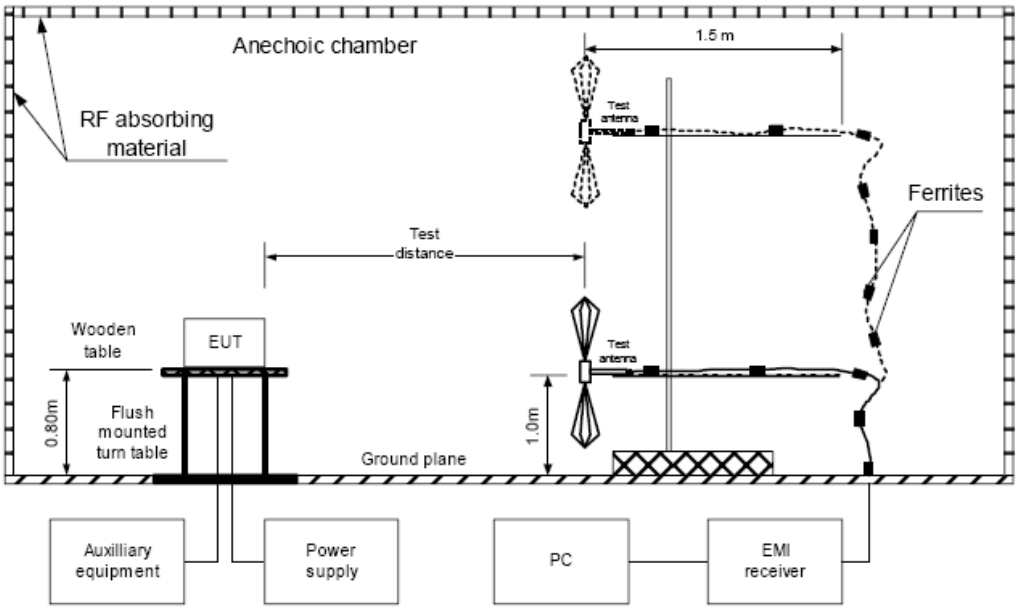
1) The equipment under test was set to transmission mode Pout = -17 dBm.

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)



3.8.3 Test result

Temperature: +18 °C Relative humidity: 67 %

EUT OPERATING MODE: transmission mode
Pout = -17 dBm

Table 3.8.1 Radiated emission test result (450 MHz)

Frequency, MHz	Turntable position, degrees	Antenna height, m	Antenna polarization	Peak detector emission, dBμV/m	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
39.840000	0	4.0	V	28.3	22.5	15.4	61.1	Pass
45.720000	0	4.0	V	29.3	22.4	15.3	61.1	Pass
61.360000	0	1.0	V	27.5	21.5	14.4	61.1	Pass
87.840000	0	1.0	V	26.0	20.5	13.5	61.1	Pass
122.920000	20	1.0	V	25.7	19.6	12.5	61.1	Pass
210.640000	40	2.0	H	27.1	21.5	14.5	61.1	Pass
347.880000	90	3.0	V	31.9	25.5	18.5	61.1	Pass
406.280000	90	4.0	V	49.0	26.7	19.6	61.1	Pass
406.600000	90	1.0	V	60.2	27.8	19.6	61.1	Pass
407.080000	0	2.0	H	49.9	26.8	19.6	61.1	Pass
407.480000	0	4.0	H	46.7	26.8	19.6	61.1	Pass
413.200000	30	1.0	H	50.1	27.1	19.8	61.1	Pass
422.160000	0	1.0	V	44.7	28.1	19.9	61.1	Pass
430.800000	180	2.0	V	44.6	27.6	20.0	61.1	Pass
446.360000	0	2.0	V	45.1	29.0	20.3	61.1	Pass
450.000000	0	2.0	V	78,6	31.8	22.4	81.1	Pass
550.000000	90	3.0	V	53.3	28.3	20.2	61.1	Pass
453.240000	180	1.0	V	44.7	29.5	20.5	61.1	Pass
620.920000	10	4.0	V	39.3	32.8	25.8	61.1	Pass
951.720000	0	4.0	V	43.7	37.0	30.0	61.1	Pass
1164.071823	0	1.0	H	37.3	21.9	24.2	61.1	Pass
1410.336198	350	3.0	V	37.6	22.3	24.6	61.1	Pass

Frequency, MHz	Turntable position, degrees	Antenna height, m	Antenna polarization	Peak detector emission, dBμV/m	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
1663.203679	20	2.0	V	39.1	23.7	25.9	61.1	Pass
1973.207175	90	4.0	H	41.4	25.8	28.1	61.1	Pass
2265.037403	90	1.5	H	42.3	26.6	28.9	61.1	Pass
2876.205389	0	3.0	V	43.9	28.6	30.8	61.1	Pass
3249.206760	40	3.0	H	45.3	29.8	32.0	61.1	Pass
3996.054349	30	2.5	V	48.5	32.3	34.7	61.1	Pass
4993.794472	0	2.0	H	49.4	34.0	36.3	61.1	Pass
5906.846441	0	1.5	V	50.3	33.9	36.2	61.1	Pass

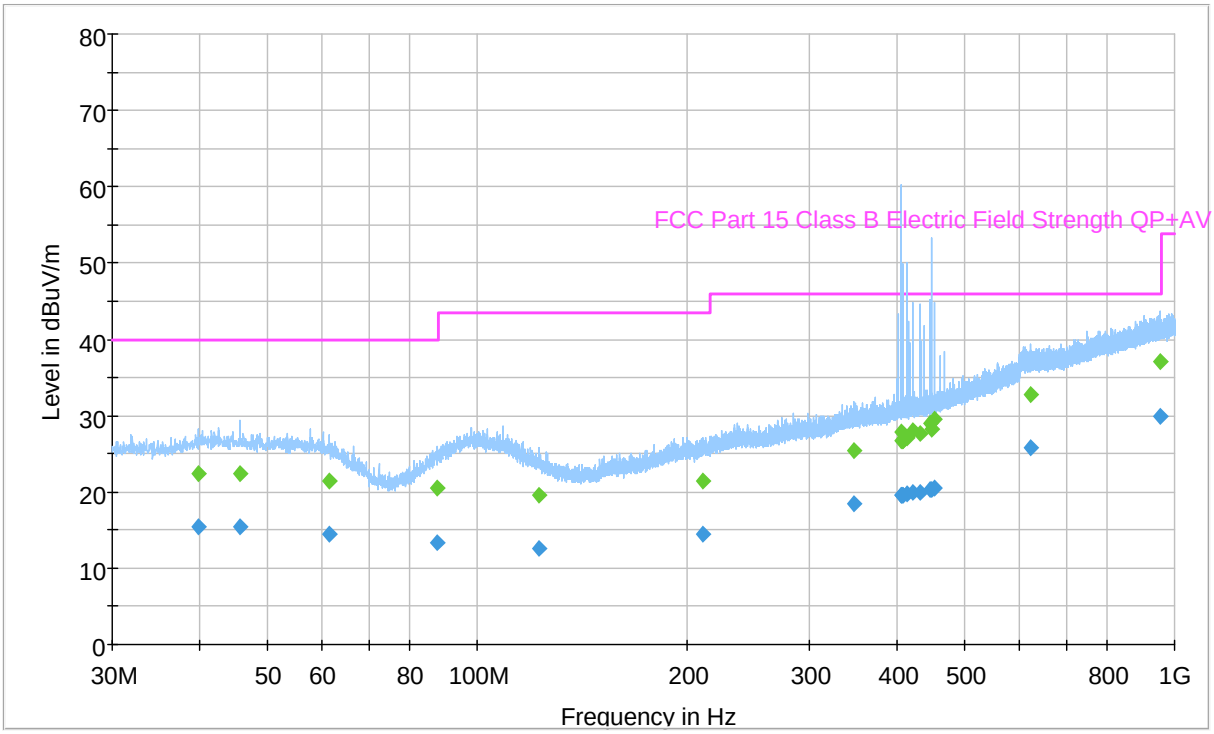
Table 3.8.2 Radiated emission test result (460 MHz)

Frequency, MHz	Turntable position, degrees	Antenna height, m	Antenna polarization	Peak detector emission, dBμV/m	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
41.440000	0	1.0	H	28.6	22.5	15.4	61.5	Pass
56.960000	0	4.0	V	28.5	22.1	15.0	61.5	Pass
61.920000	10	4.0	H	26.3	21.2	14.2	61.5	Pass
87.480000	0	3.0	V	25.8	20.4	13.3	61.5	Pass
171.360000	90	2.0	V	25.5	19.5	12.4	61.5	Pass
211.080000	90	1.0	V	28.0	21.5	14.5	61.5	Pass
333.440000	270	3.0	V	31.4	25.3	18.3	61.5	Pass
403.680000	0	1.0	H	44.4	26.8	19.6	61.5	Pass
404.960000	180	1.0	V	52.2	26.9	19.6	61.5	Pass
406.280000	180	3.0	H	47.8	26.7	19.6	61.5	Pass
420.520000	90	1.0	V	48.2	28.4	19.9	61.5	Pass
429.680000	10	2.0	V	42.8	27.4	20.0	61.5	Pass
436.040000	20	1.0	V	43.9	28.0	20.1	61.5	Pass
451.600000	30	1.0	V	40.7	28.5	20.4	61.5	Pass
459.360000	240	4.0	V	62.0	29.6	20.5	61.5	Pass
460.000000	200	2.0	V	79.8	34.0	30.5	81.5	Pass
641.440000	0	3.0	H	39.4	33.0	25.9	61.5	Pass
930.400000	90	4.0	V	43.2	36.7	29.7	61.5	Pass
1176.940829	90	2.5	V	38.1	22.0	24.3	61.5	Pass
1224.948213	180	2.5	H	42.8	22.0	24.1	61.5	Pass
1710.407556	0	1.0	H	39.0	24.1	26.3	61.5	Pass
2005.016383	240	2.0	V	41.5	26.5	28.7	61.5	Pass
2362.145430	210	3.5	V	43.3	27.6	29.8	61.5	Pass
2887.727479	350	2.0	H	44.1	28.1	30.2	61.5	Pass
3252.455967	30	3.5	H	45.4	30.1	32.3	61.5	Pass
3996.054349	10	1.5	V	47.7	32.6	34.8	61.5	Pass
5013.799632	220	2.5	V	50.1	34.2	36.4	61.5	Pass
5270.730954	0	3.0	V	50.3	33.7	35.8	61.5	Pass

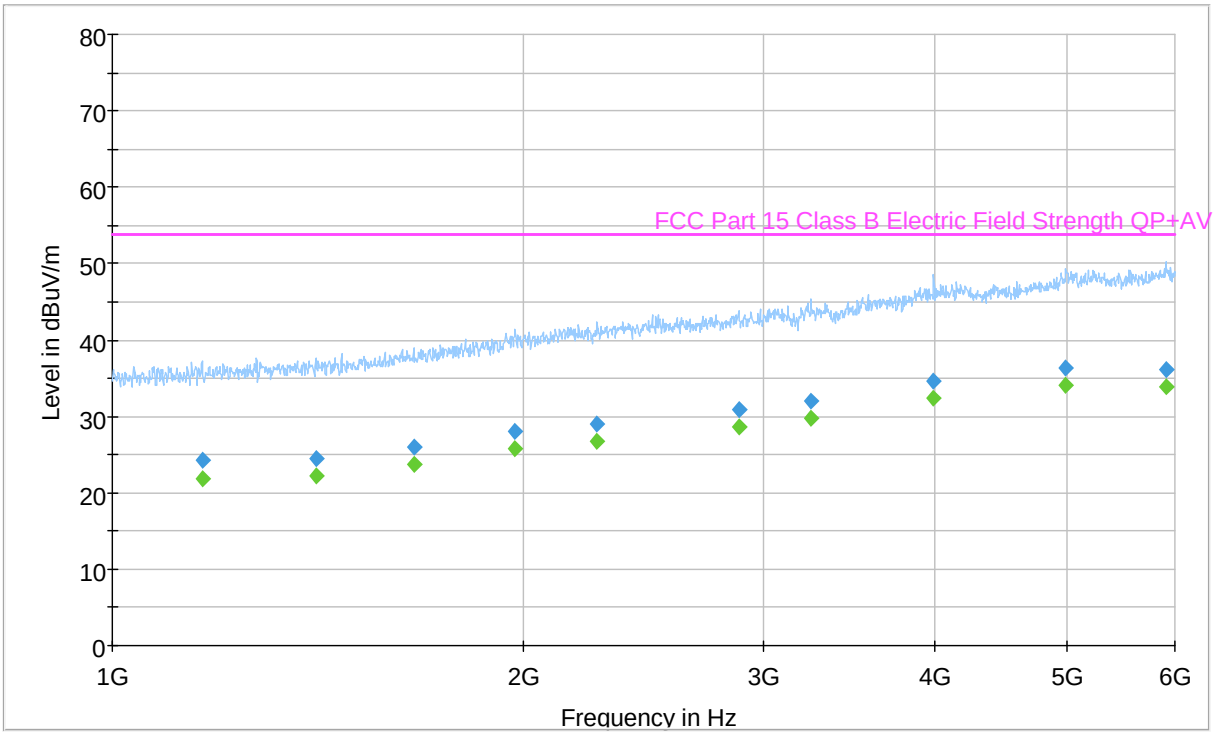
Table 3.8.3 Radiated emission test result (470 MHz)

Frequency, MHz	Turntable position, degrees	Antenna height, m	Antenna polarization	Peak detector emission, dBμV/m	Quasi-Peak Detector Emission, dBμV/m	Average detector emission, dBμV/m	Limit, dBμV/m	Result (Pass, Fail, N/A)
38.960000	0	4.0	H	27.7	22.2	15.2	61.9	Pass
45.200000	60	3.0	V	28.3	22.4	15.4	61.9	Pass
60.640000	40	1.0	V	27.2	21.8	14.7	61.9	Pass
86.440000	10	3.0	H	26.7	20.0	13.0	61.9	Pass
166.120000	250	3.0	H	24.9	19.3	12.2	61.9	Pass
215.280000	90	3.0	V	27.4	21.8	14.7	61.9	Pass
334.120000	180	4.0	V	31.5	25.2	18.1	61.9	Pass
405.200000	20	3.0	V	49.6	26.7	19.6	61.9	Pass
406.800000	310	1.0	V	61.1	28.2	19.6	61.9	Pass
420.800000	190	3.0	V	42.7	27.1	19.9	61.9	Pass
422.360000	0	1.0	V	44.3	27.7	19.9	61.9	Pass
430.480000	90	2.0	V	45.2	27.5	20.0	61.9	Pass
453.440000	10	1.0	V	41.3	28.3	20.4	61.9	Pass
468.960000	10	1.0	V	61.4	31.2	20.8	61.9	Pass
469.360000	0	1.0	H	44.0	27.9	20.8	61.9	Pass
470.000000	180	3.0	H	64.5	31.3	20.8	81.9	Pass
645.360000	90	1.0	H	40.1	33.0	25.9	61.9	Pass
920.760000	0	2.0	V	43.0	36.7	29.7	61.9	Pass
1116.216718	180	2.0	H	37.1	21.3	23.7	61.9	Pass
1326.917515	0	3.5	H	39.2	22.2	24.3	61.9	Pass
1643.374362	90	1.5	V	38.5	23.0	25.2	61.9	Pass
1943.844516	240	3.5	V	41.0	25.5	27.8	61.9	Pass
2424.335085	320	2.5	H	42.6	27.4	29.6	61.9	Pass
2847.600896	180	3.0	V	44.2	28.8	31.1	61.9	Pass
3456.926548	180	1.5	V	44.9	29.9	32.1	61.9	Pass
4154.898396	0	3.0	H	47.8	32.5	34.7	61.9	Pass
4899.854592	0	3.0	V	48.9	33.1	35.4	61.9	Pass
5990.081970	20	2.0	V	49.9	34.5	36.8	61.9	Pass

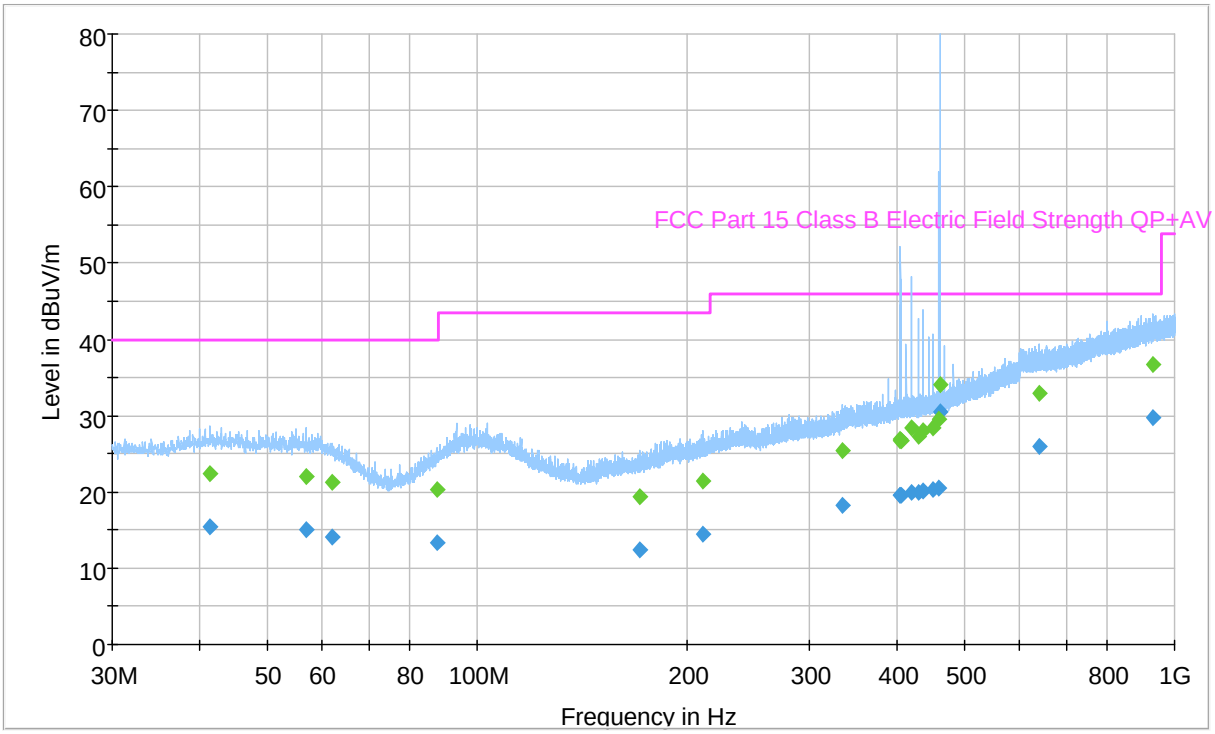
Plot 3.8.1 Radiated emission measurements in (30 – 1000) MHz range, vertical and horizontal polarization (450 MHz)



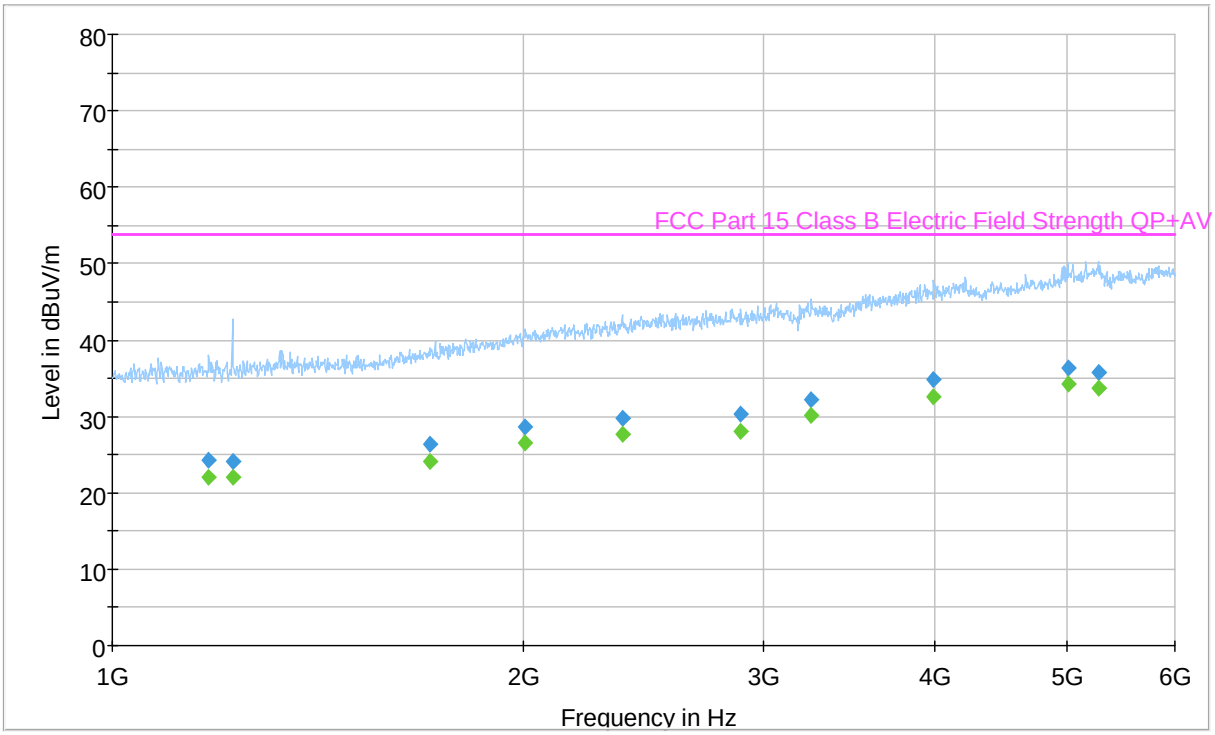
Plot 3.8.2 Radiated emission measurements in (1000 – 6000) MHz range, vertical and horizontal polarization (450 MHz)



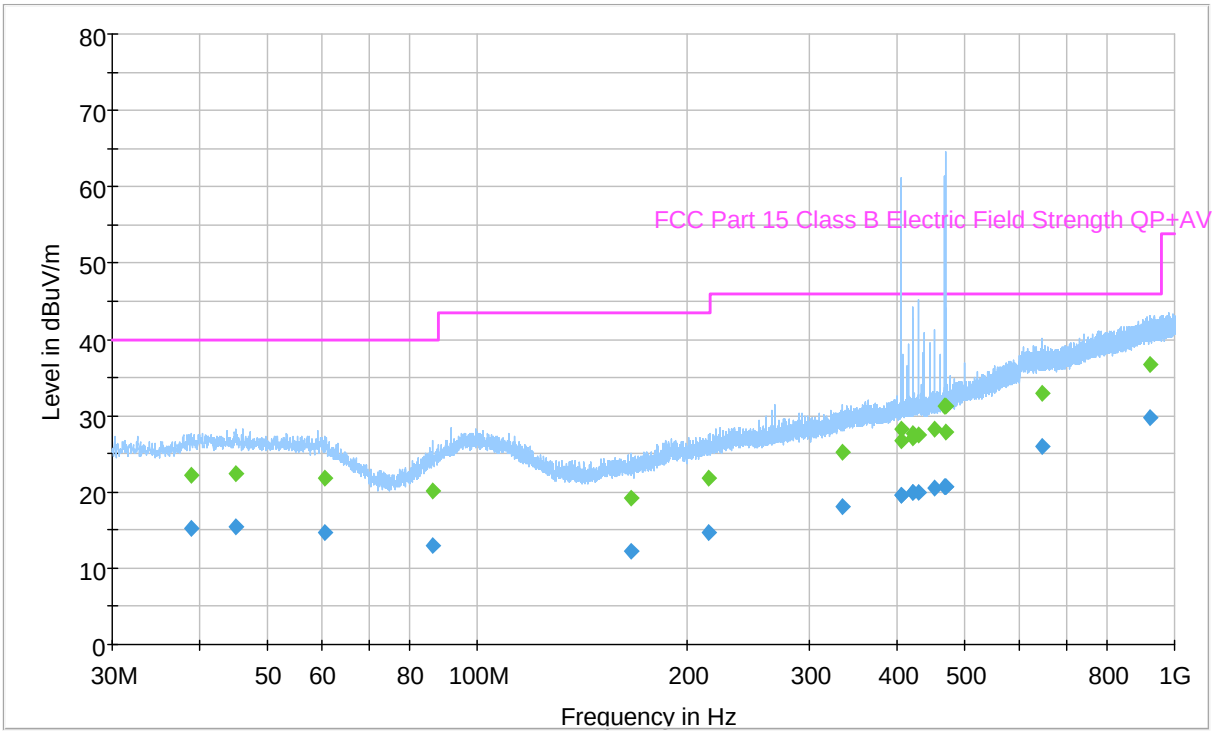
Plot 3.8.3 Radiated emission measurements in (30 – 1000) MHz range, vertical and horizontal polarization (460 MHz)



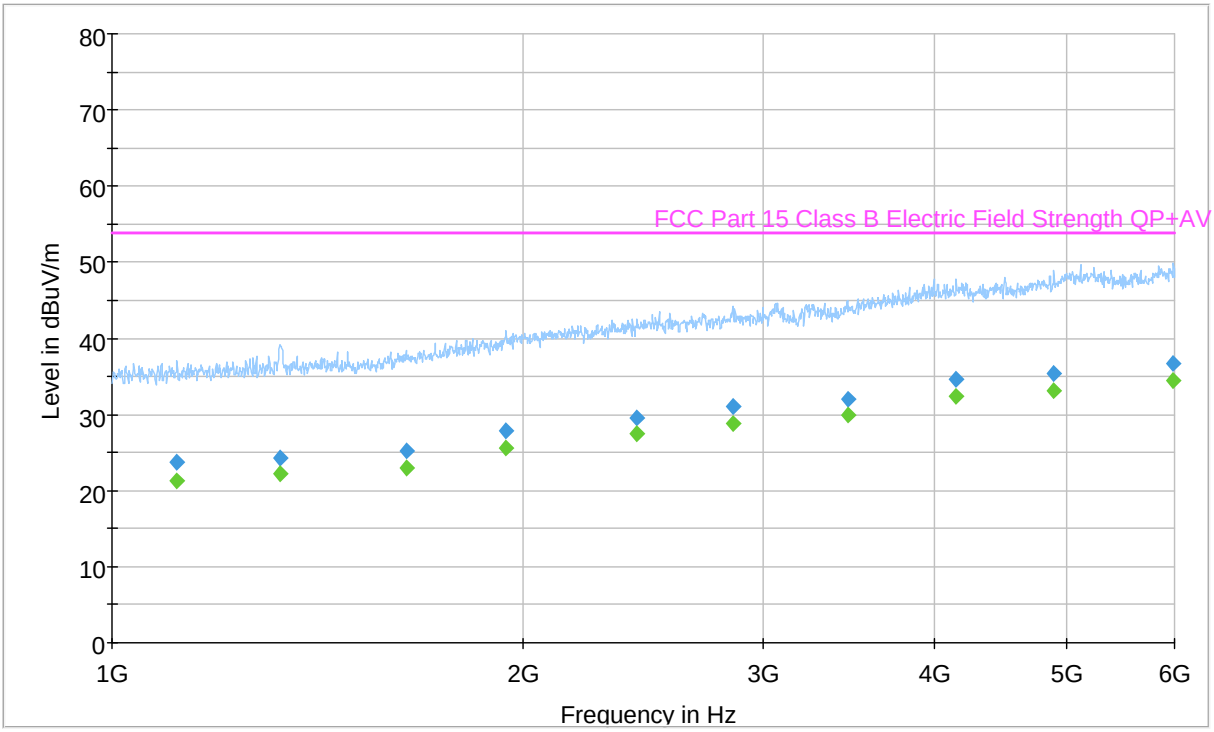
Plot 3.8.4 Radiated emission measurements in (1000 – 6000) MHz range, vertical and horizontal polarization (460 MHz)



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)



3.9. The bandwidth of the emission

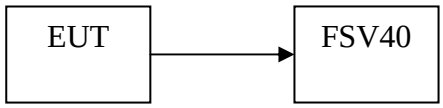
3.9.1 Test requirements Section 15.231c

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 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) 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



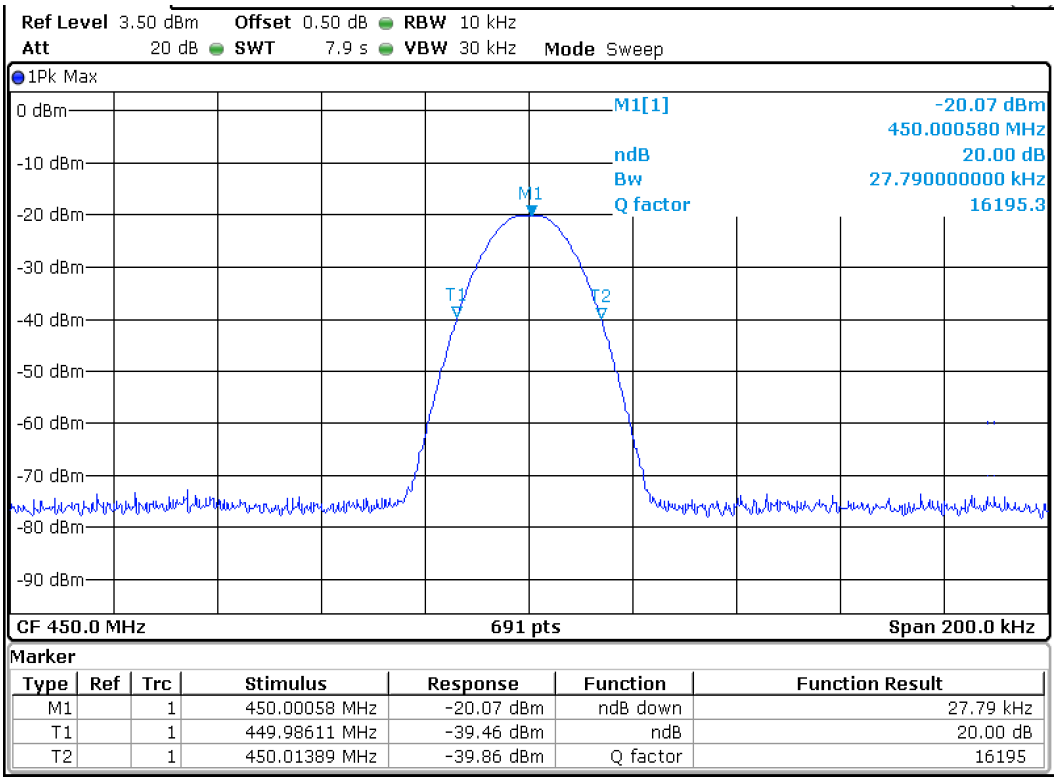
3.9.4 Test result

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

Table 3.9 The bandwidth of the emission

Frequency, MHz	Measurement result, kHz	Limit, kHz	Result (Pass, Fail, N/A)
450	27.79	1125	Pass
460	28.08	1150	Pass
470	28.08	1175	Pass

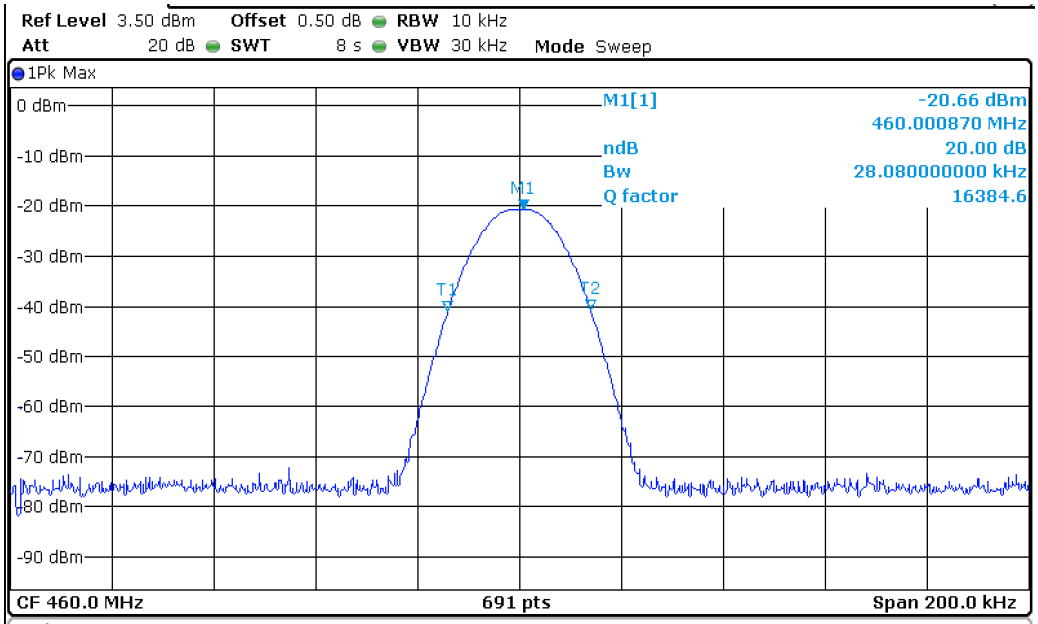
3.9.1 Plot



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	450.00058 MHz	-20.07 dBm	ndB down	27.79 kHz
T1		1	449.98611 MHz	-39.46 dBm	ndB	20.00 dB
T2		1	450.01389 MHz	-39.86 dBm	Q factor	16195

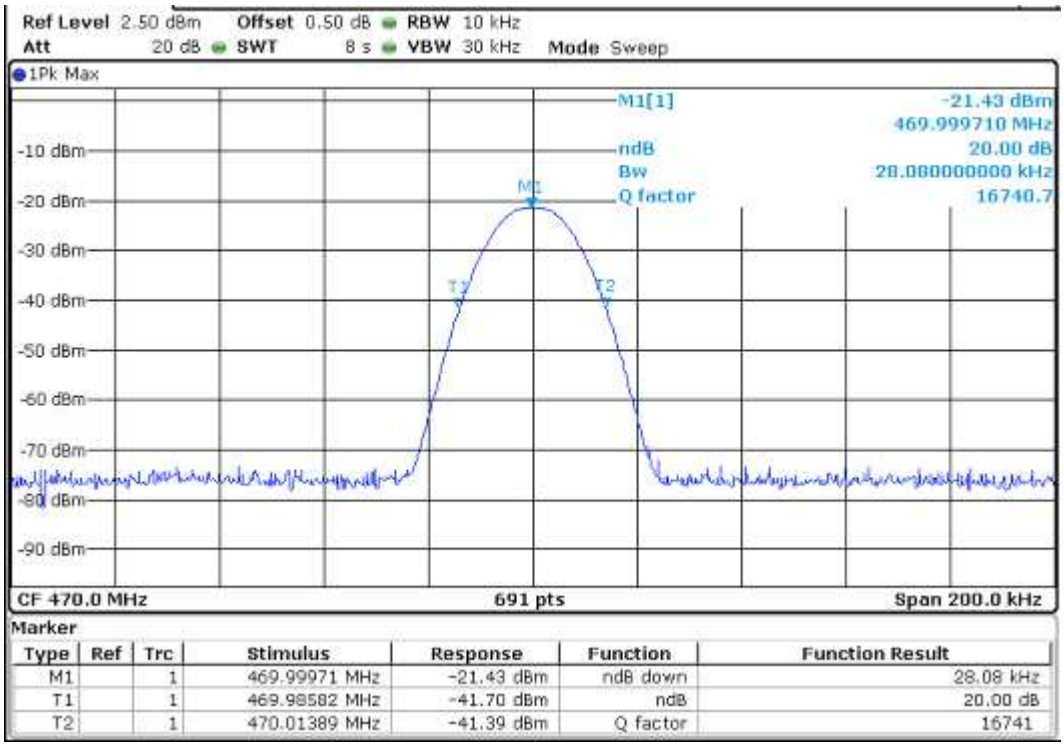
3.9.2 Plot



Marker

Type	Ref	Trc	Stimulus	Response	Function	Function Result
M1		1	460.00087 MHz	-20.66 dBm	ndB down	28.08 kHz
T1		1	459.98582 MHz	-40.78 dBm	ndB	20.00 dB
T2		1	460.01389 MHz	-40.62 dBm	Q factor	16385

3.9.3 Plot

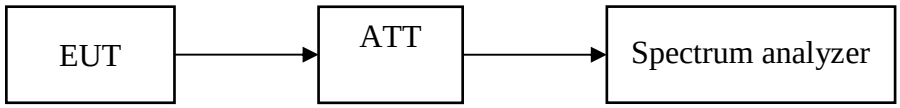


3.10 Operating Frequencies

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 shall be used for measuring 99% power bandwidth.

Settings for the spectrum analyzer:

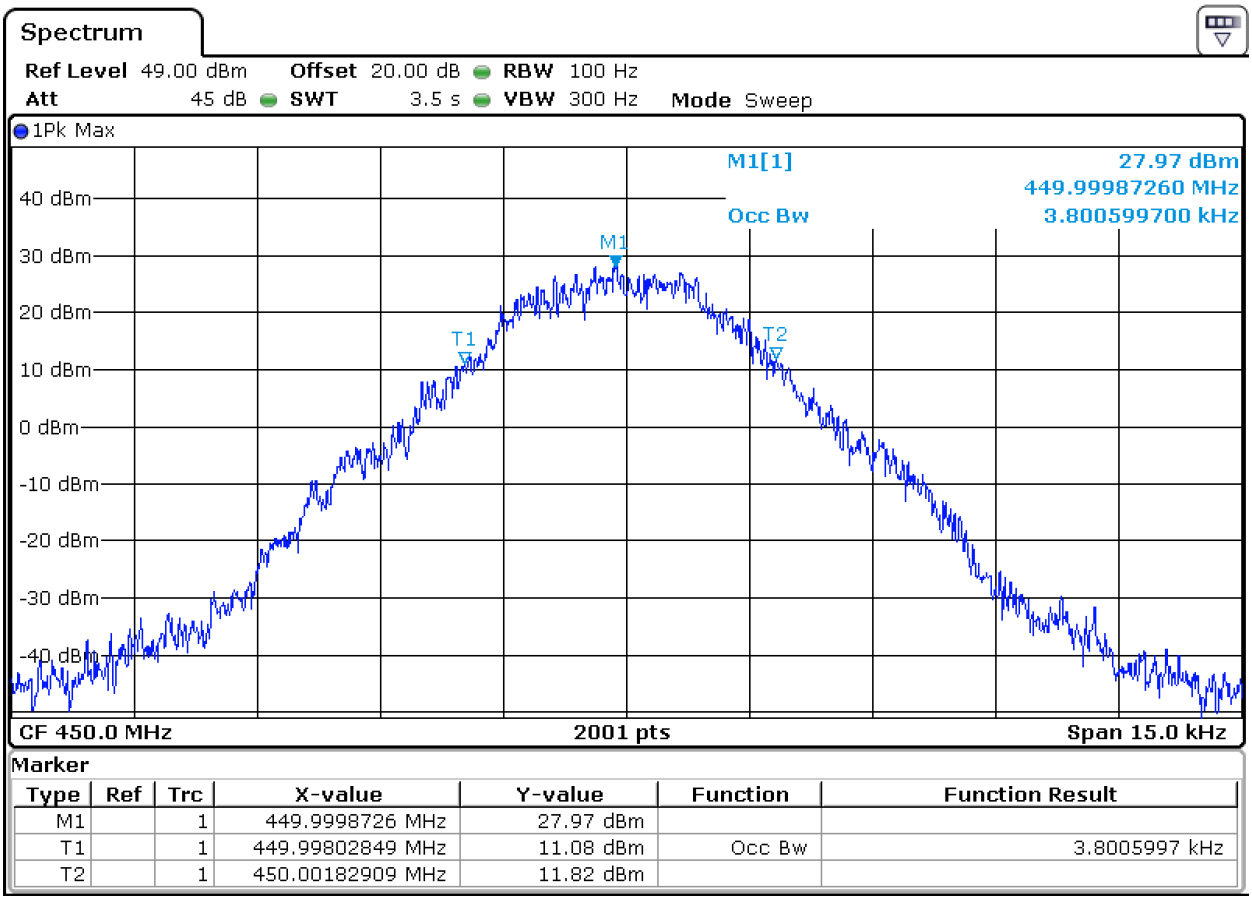
- center frequency is set to the nominal EUT channel center frequency;
- frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the occupied bandwidth (OBW);
- RBW shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW;
- Set the reference 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	3.80	6.00	Pass
460	3.85	6.00	Pass
470	3.82	6.00	Pass

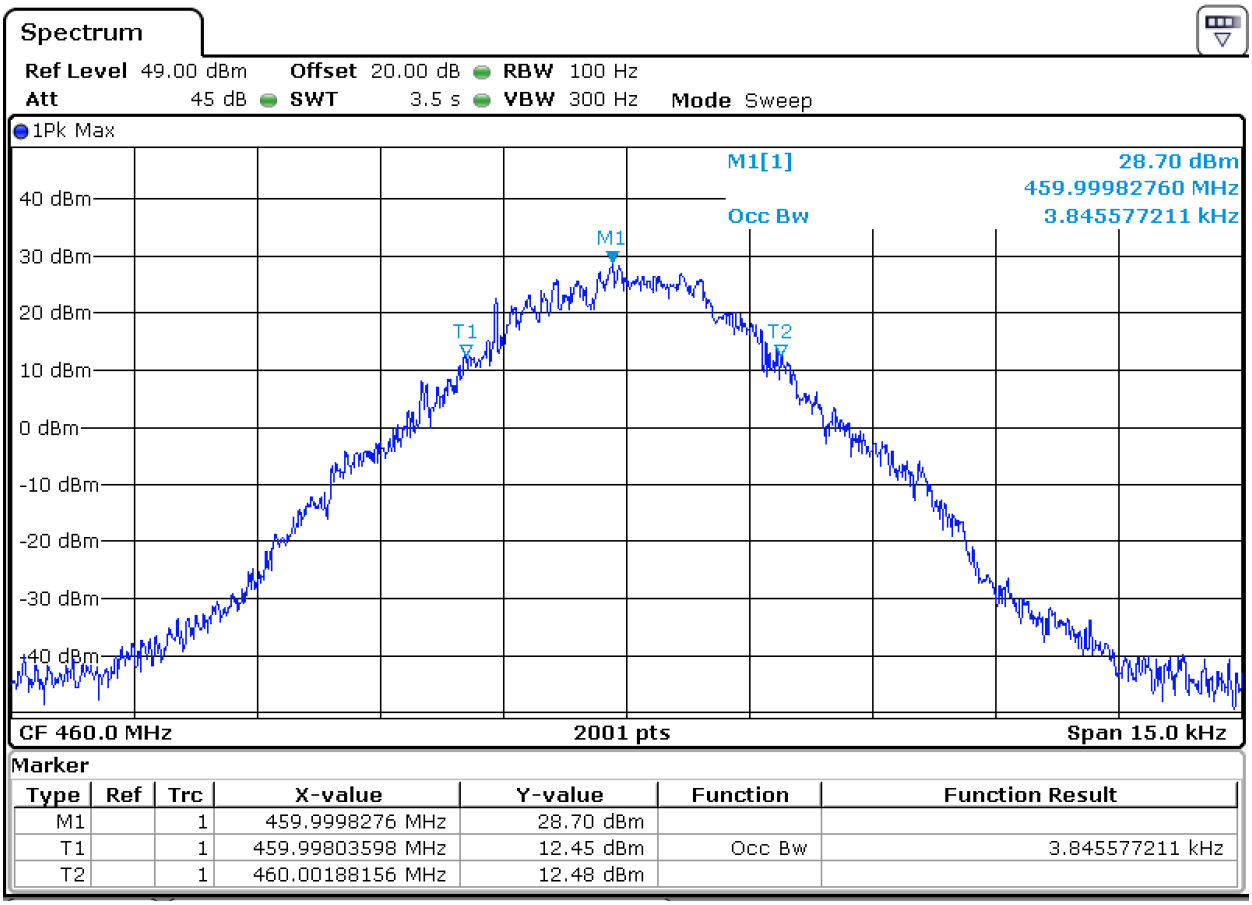
Low Channel Plot



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	449.9998726 MHz	27.97 dBm		
T1		1	449.99802849 MHz	11.08 dBm	Occ Bw	3.8005997 kHz
T2		1	450.00182909 MHz	11.82 dBm		

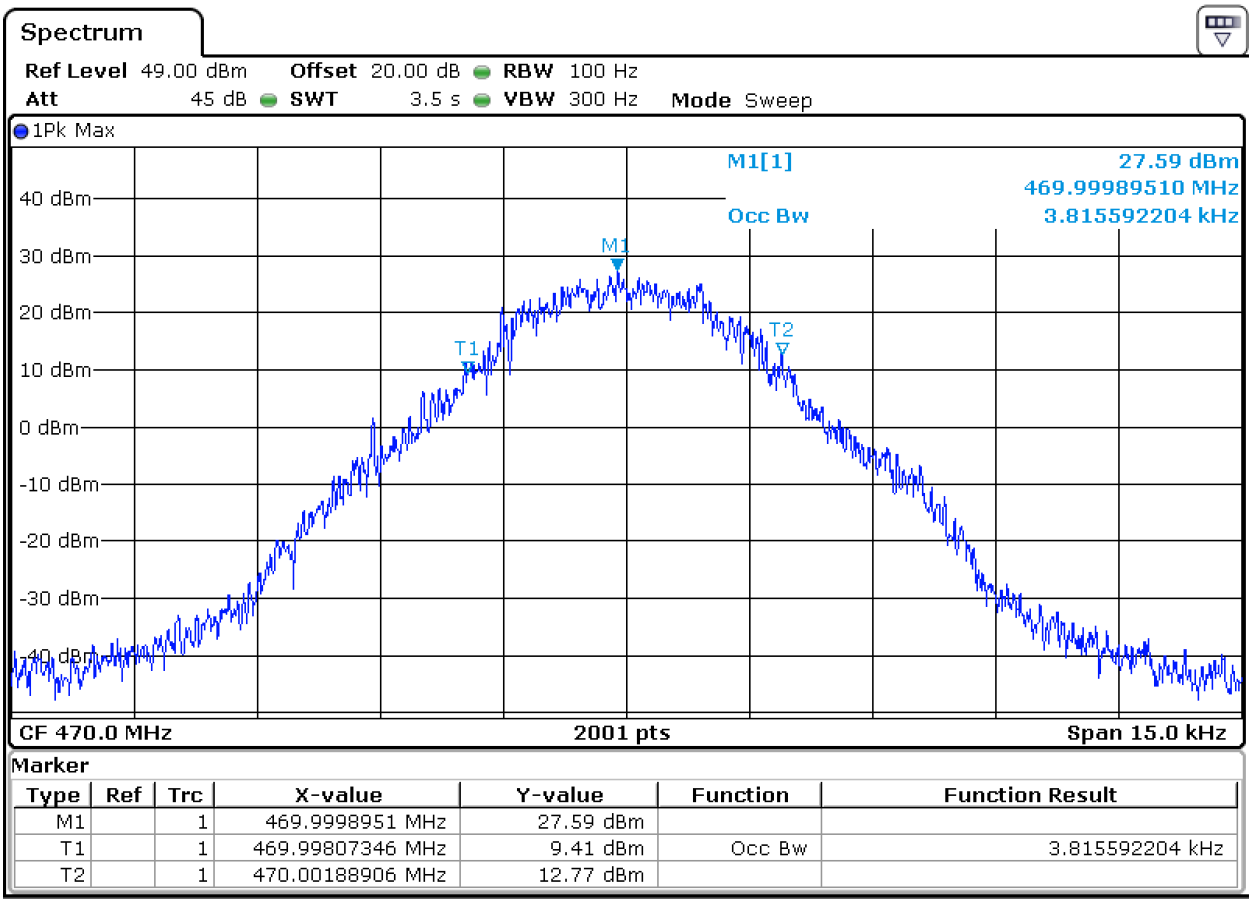
Middle Channel Plot



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	459.9998276 MHz	28.70 dBm		
T1		1	459.99803598 MHz	12.45 dBm	Occ Bw	3.845577211 kHz
T2		1	460.00188156 MHz	12.48 dBm		

High Channel Plot



Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	469.9998951 MHz	27.59 dBm		
T1		1	469.99807346 MHz	9.41 dBm	Occ Bw	3.815592204 kHz
T2		1	470.00188906 MHz	12.77 dBm		