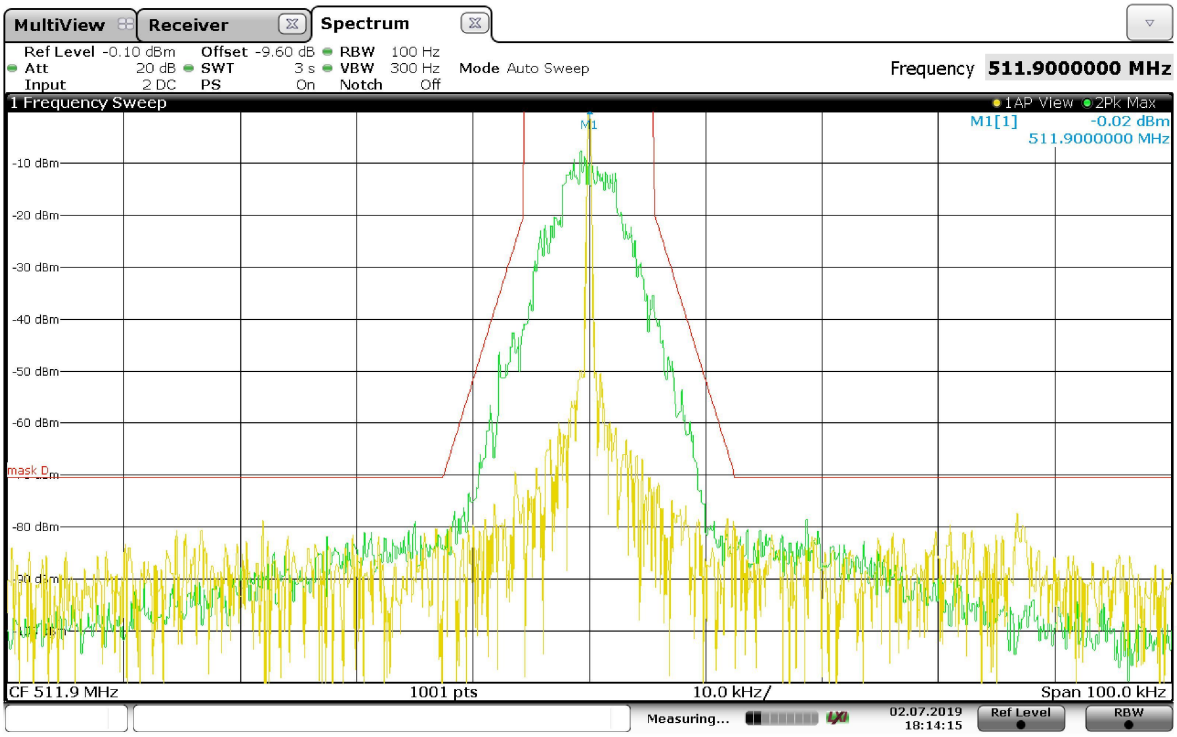
Test data



18:14:16 02.07.2019

Channel HIGH – C4FM modulation with 12.5 kHz channel bandwidth

Clause 90.210 and 22.359 Spurious emissions at antenna terminals

§90.210 Emission masks.

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 (o) 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 under this part.

APPLICABLE EMISSION MASKS

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 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854[6]	B	H
809-824/854-869[35]	B, D	D, 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

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

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

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

(5) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(6) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd–2.88 kHz) dB.

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

(8) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission 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 (o) 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, an alternate procedure may be used provided prior Commission approval is obtained.

§22.359 Emission limitations.

The rules in this section govern the spectral characteristics of emissions in the Public Mobile Services, except for the Air-Ground Radiotelephone Service (see §22.861, instead) and the Cellular Radiotelephone Service (see §22.917, instead).

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

(c) Alternative out of band emission limit. Licensees in the Public Mobile Services may establish an alternative out of band emission limit to be used at specified frequencies (band edges) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

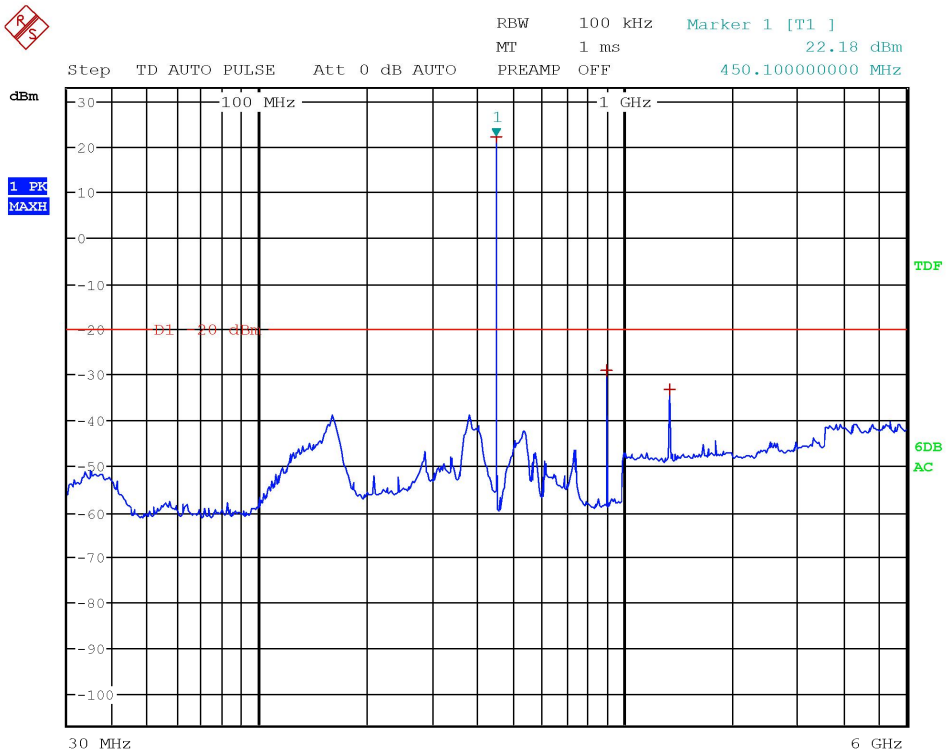
(d) Interference caused by out of band emissions. If any emission from a transmitter operating in any of the Public Mobile Services results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§2.1051 Measurements required: Spurious emissions at antenna terminals.

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

Test date: 2019-07-03
Test results: Pass

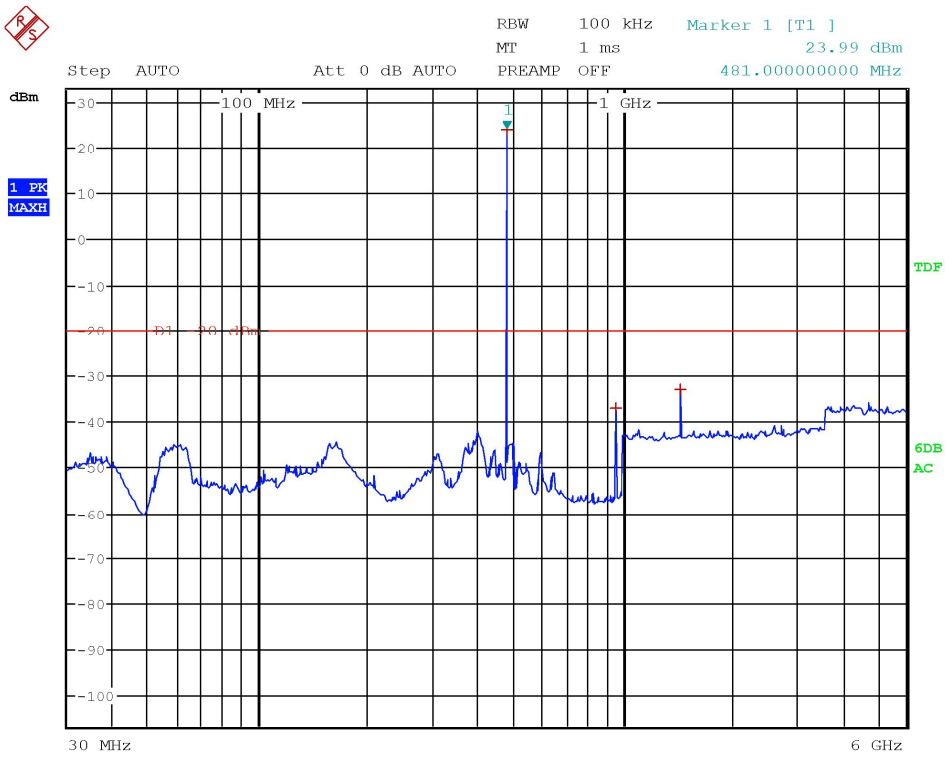
Test data



Channel LOW – 25 kHz channel bandwidth FM modulation

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
450.1000	22.2	--	--
900.2000	-29.3	-20.0	-9.3
1350.2500	-33.3	-20.0	-13.3

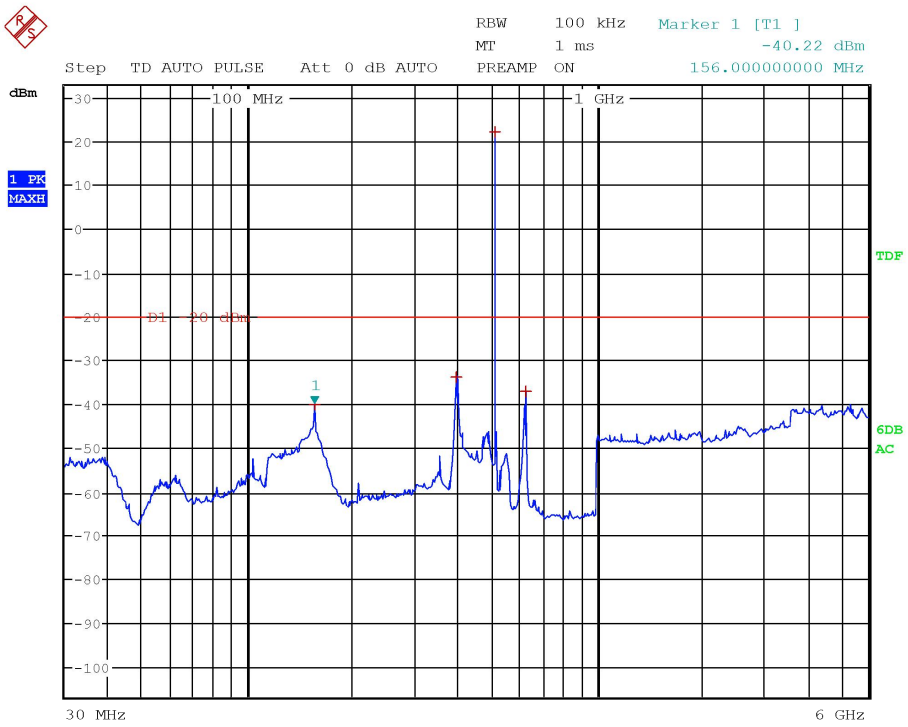
Test data



Channel MID – 25 kHz channel bandwidth FM modulation

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
481.0000	24.0	--	--
962.0000	-37.2	-20.0	-17.2
1443.0000	-33.2	-20.0	-13.2

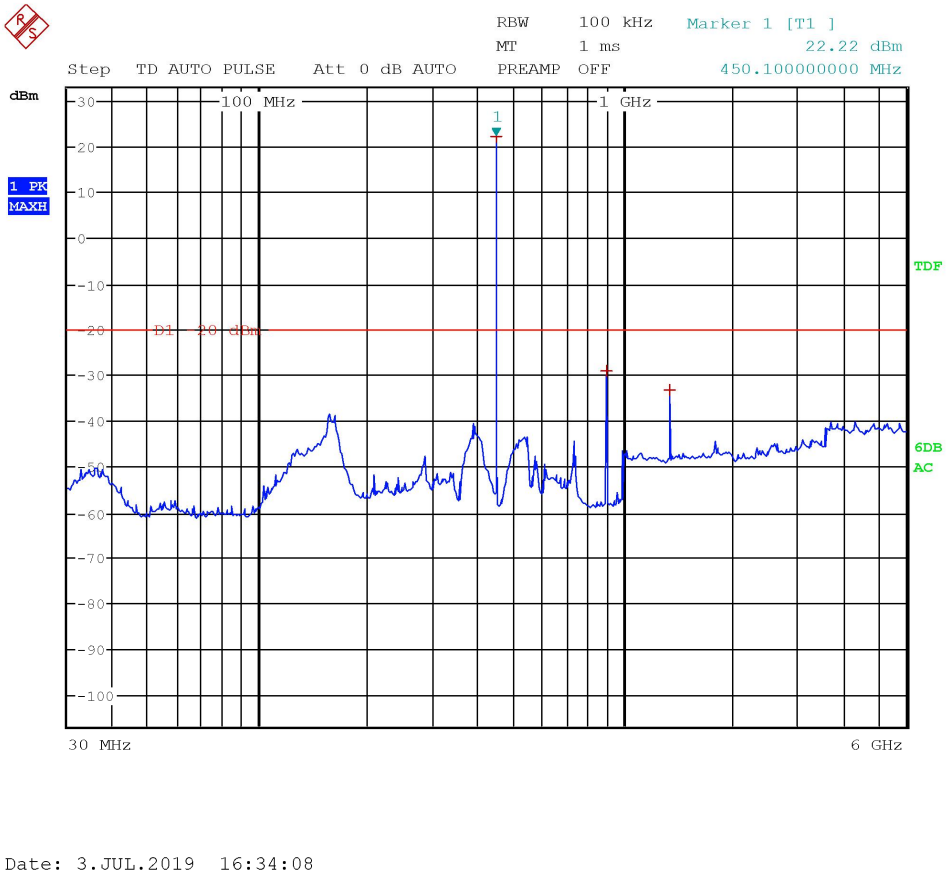
Test data



Channel HIGH – 25 kHz channel bandwidth FM modulation

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
156.0000	-40.3	-20.0	-20.3
397.7750	-33.9	-20.0	-13.9
511.9000	22.4	--	--
625.875	-37.1	-20.0	-17.1

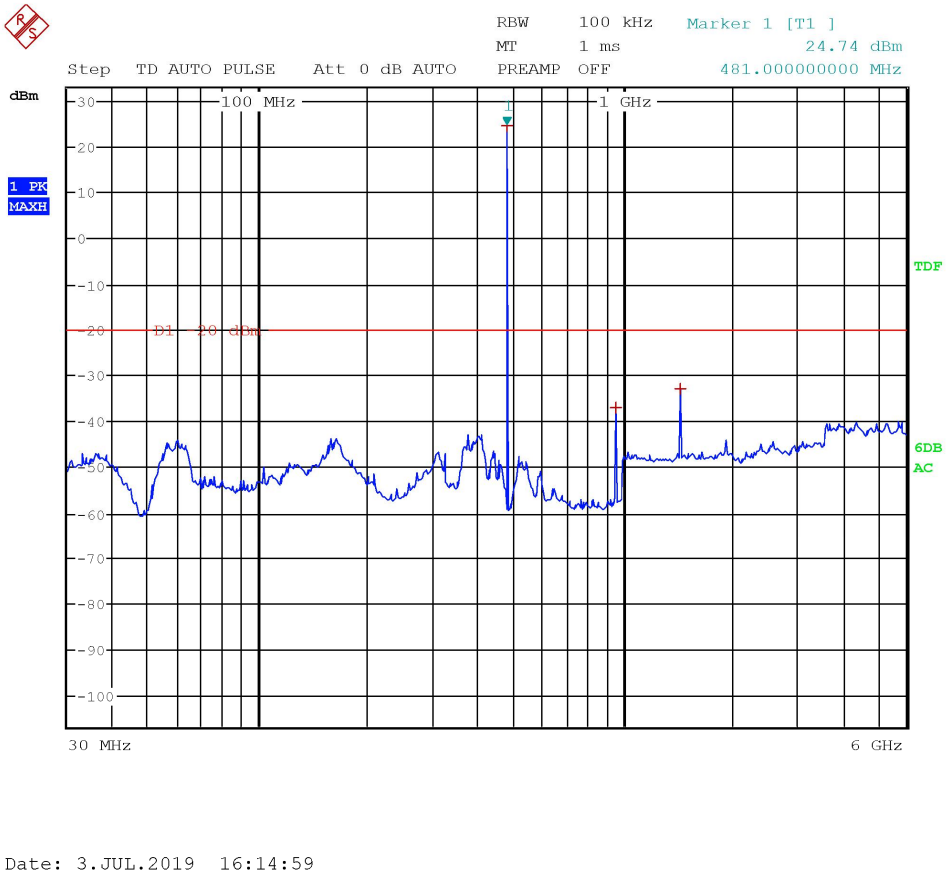
Test data



Channel LOW – 12.5 kHz channel bandwidth modulation

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
450.1000	22.3	--	--
900.2000	-29.3	-20.0	-9.3
1350.2500	-33.3	-20.0	-13.3

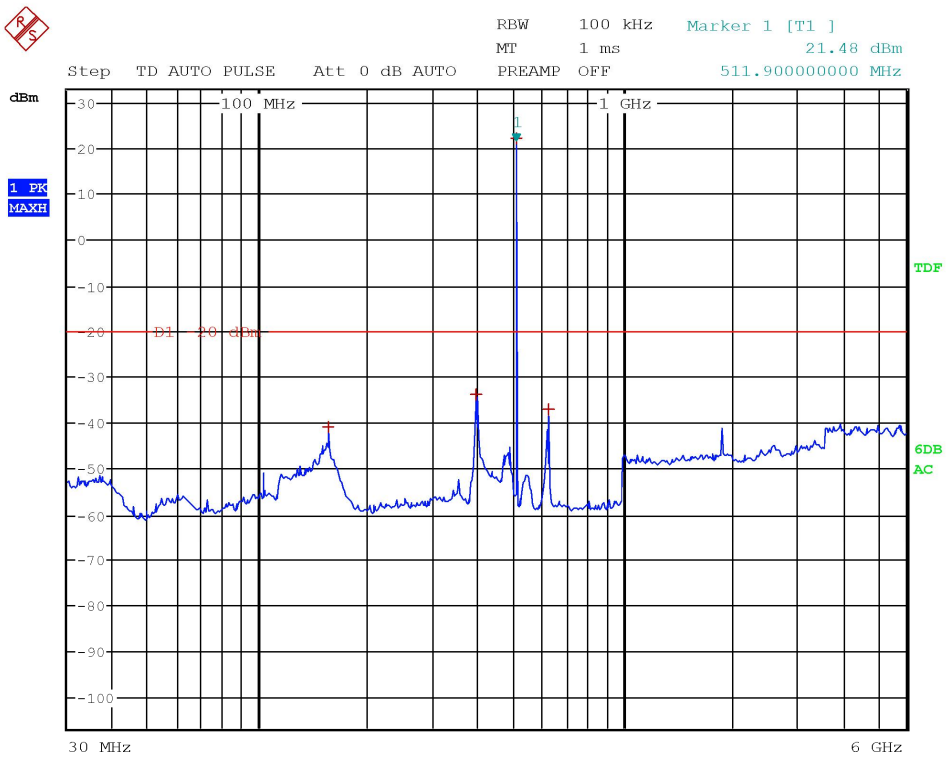
Test data



Channel MID – 12.5 kHz channel bandwidth modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
481.0000	24.8	--	--
962.0000	-37.2	-20.0	-17.2
1443.0000	-33.2	-20.0	-13.2

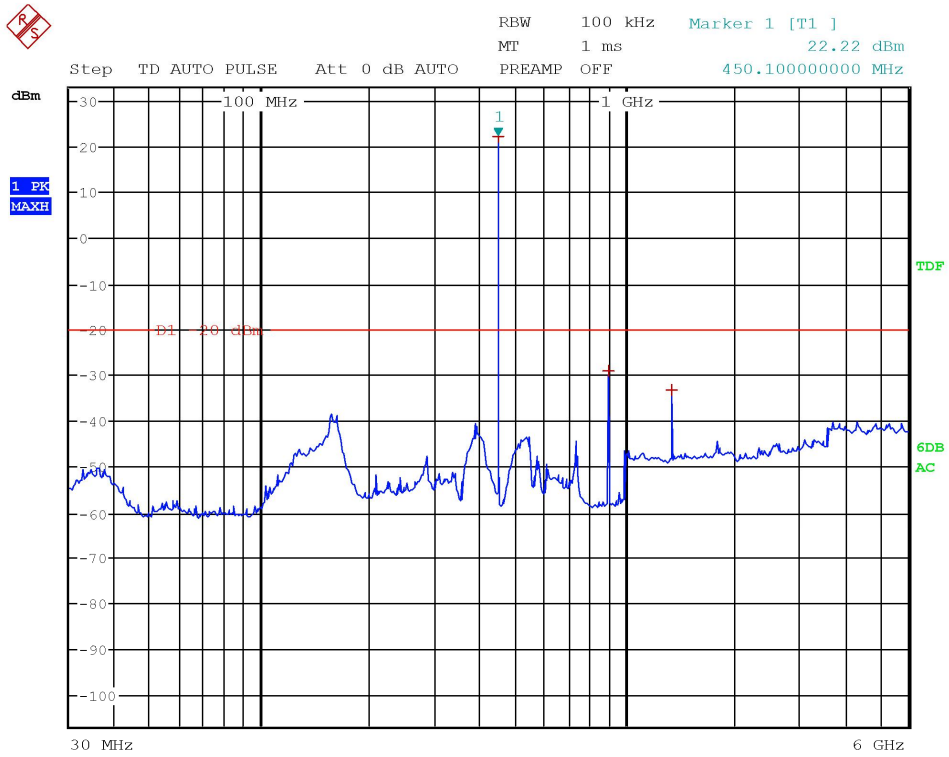
Test data



Channel HIGH – 12.5 kHz channel bandwidth modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
156.0000	-40.9	-20.0	-20.9
397.7750	-33.9	-20.0	-13.9
511.9000	22.4	--	--
625.875	-37.1	-20.0	-17.1

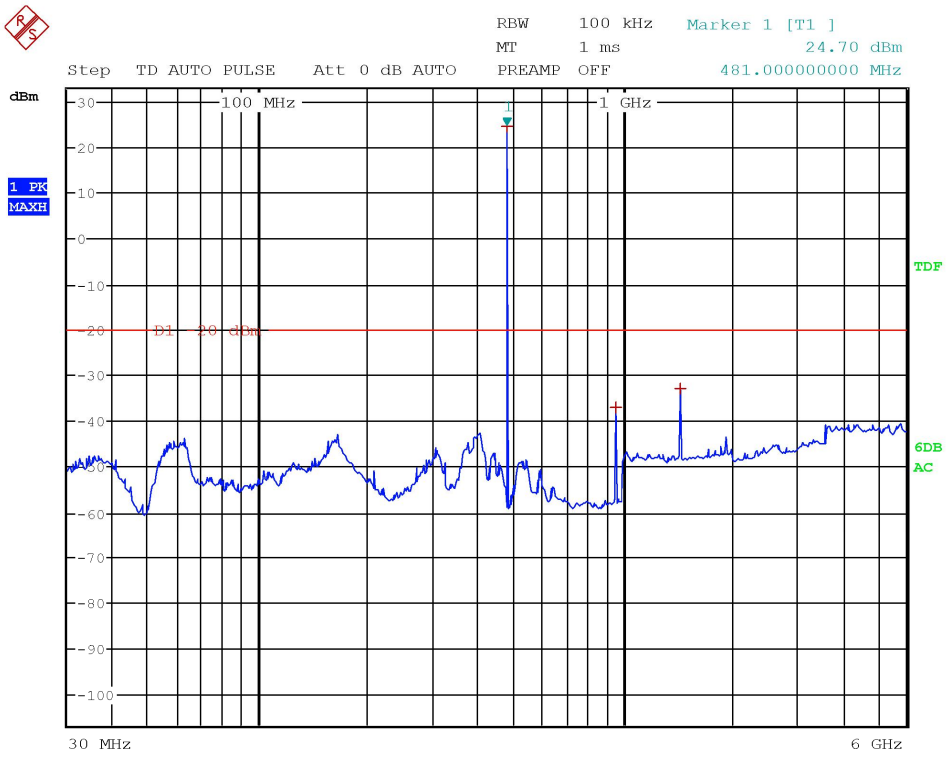
Test data



Channel LOW – C4FM modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
450.1000	22.3	--	--
900.2000	-29.3	-20.0	-9.3
1350.2500	-33.3	-20.0	-13.3

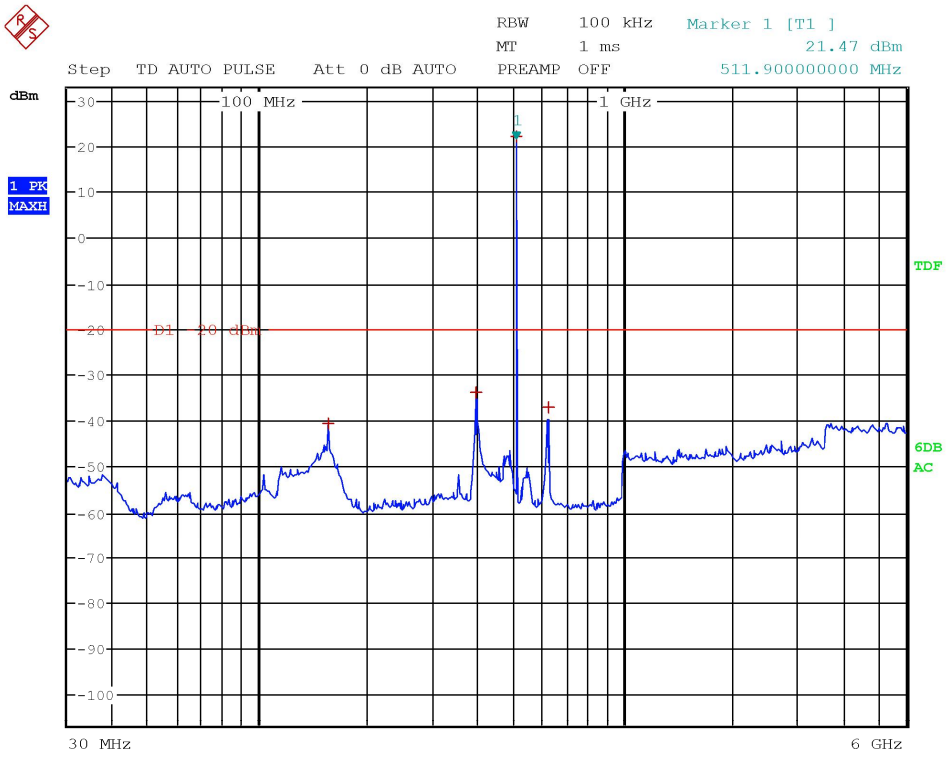
Test data



Channel MID – C4FM modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
481.0000	24.8	---	--
962.0000	-37.2	-20.0	-17.2
1443.0000	-33.2	-20.0	-13.2

Test data

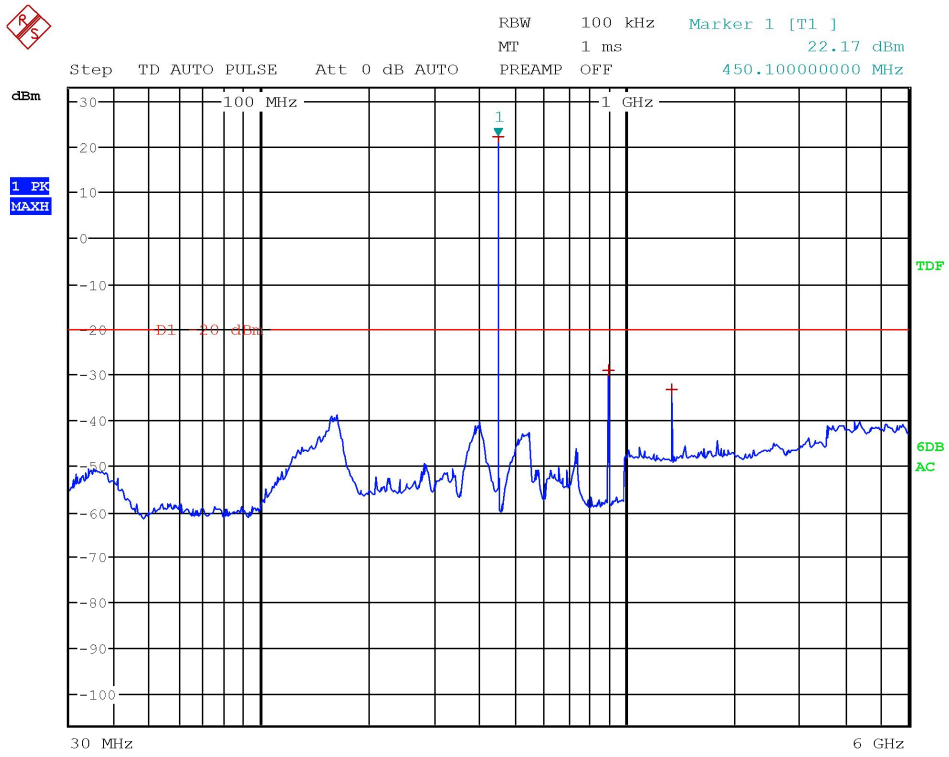


Date: 3.JUL.2019 15:51:31

Channel HIGH – C4FM modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
156.0000	-40.6	-20.0	-20.6
397.7750	-33.9	-20.0	-13.9
511.9000	22.4	--	--
625.875	-37.1	-20.0	-17.1

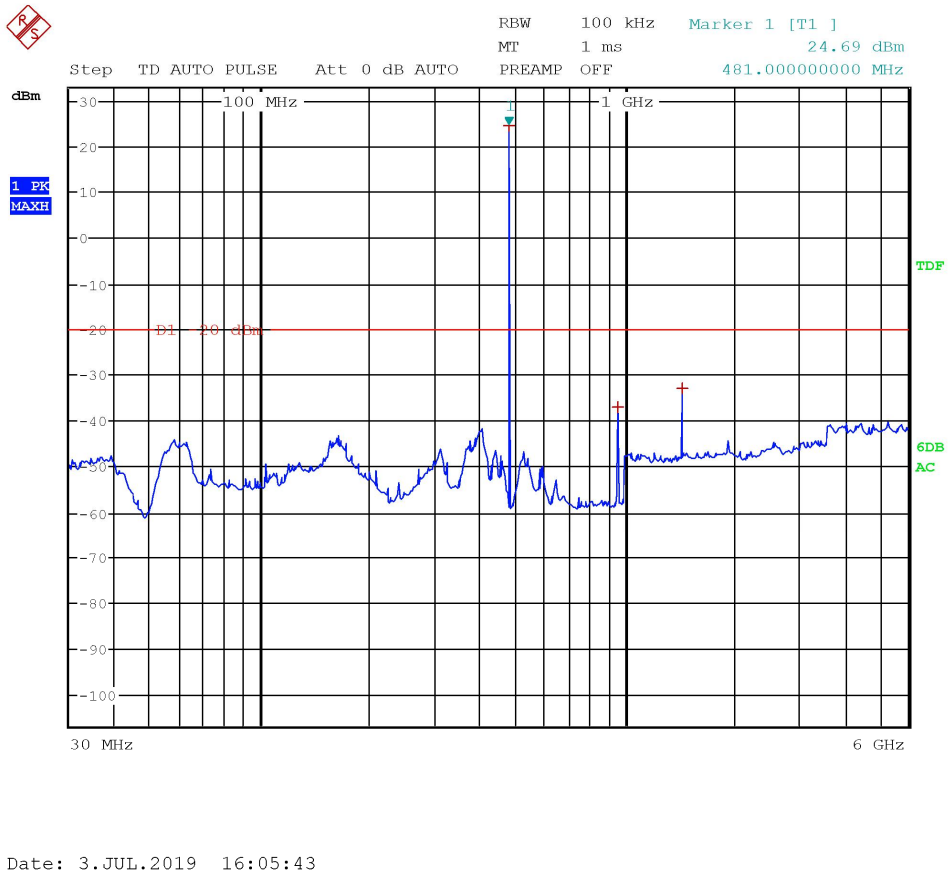
Test data



Channel LOW – 4FSK modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
450.1000	22.2	--	--
900.2000	-29.3	-20.0	-9.3
1350.2500	-33.3	-20.0	-13.3

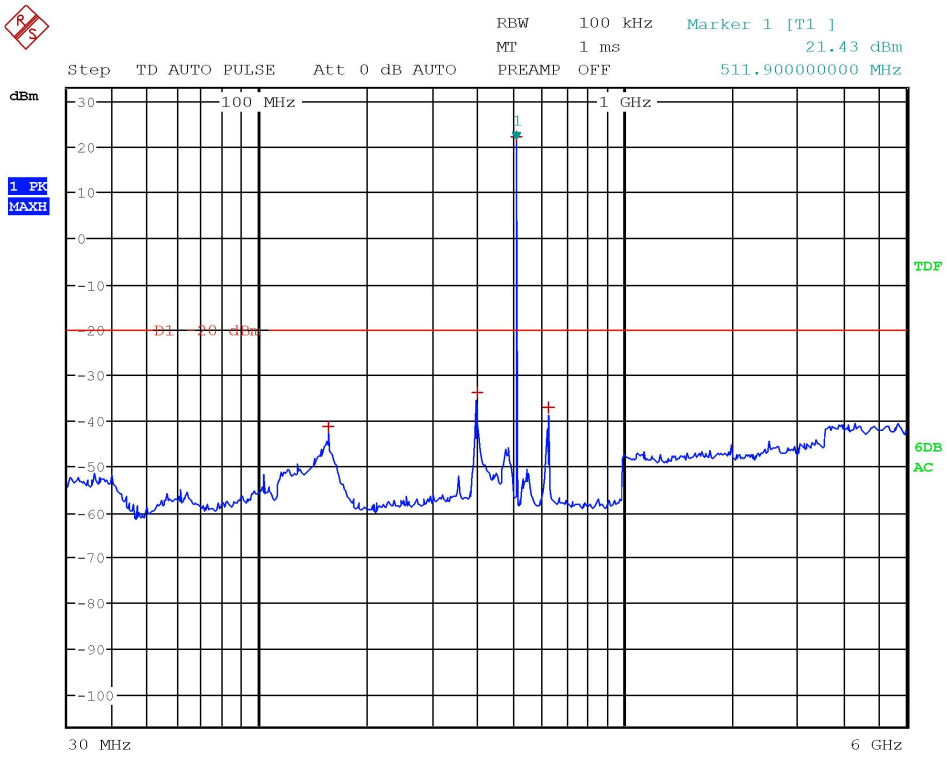
Test data



Channel MID – 4FSK modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
481.0000	24.7	--	--
962.0000	-37.2	-20.0	-17.2
1443.0000	-33.2	-20.0	-13.2

Test data



Date: 3.JUL.2019 15:42:31

Channel HIGH – 4FSK modulation (same result for all modulations)

Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)
156.0000	-41.2	-20.0	-21.2
397.7750	-33.9	-20.0	-13.9
511.9000	22.4	--	--
625.875	-37.1	-20.0	-17.1

Clause 90.210 and 22.359 Field strength of spurious radiation

§90.210 Emission masks.

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 (o) 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 under this part.

APPLICABLE EMISSION MASKS

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 5]	B, D, or E	C, D, or E
450 paging only	B	G
806-809/851-854[6]	B	H
809-824/854-869[35]	B, D	D, 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

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

(4) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.
(5) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.
(6) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

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

(9) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(10) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(fd–2.88 kHz) dB.

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

(12) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission 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 (o) 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, an alternate procedure may be used provided prior Commission approval is obtained.

§22.359 Emission limitations.

The rules in this section govern the spectral characteristics of emissions in the Public Mobile Services, except for the Air-Ground Radiotelephone Service (see §22.861, instead) and the Cellular Radiotelephone Service (see §22.917, instead).

(a) Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB.

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

(c) Alternative out of band emission limit. Licensees in the Public Mobile Services may establish an alternative out of band emission limit to be used at specified frequencies (band edges) in specified geographical areas, in lieu of that set forth in this section, pursuant to a private contractual arrangement of all affected licensees and applicants. In this event, each party to such contract shall maintain a copy of the contract in their station files and disclose it to prospective assignees or transferees and, upon request, to the FCC.

(d) Interference caused by out of band emissions. If any emission from a transmitter operating in any of the Public Mobile Services results in interference to users of another radio service, the FCC may require a greater attenuation of that emission than specified in this section.

§2.1053 Measurements required: Field strength of spurious radiation.

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:

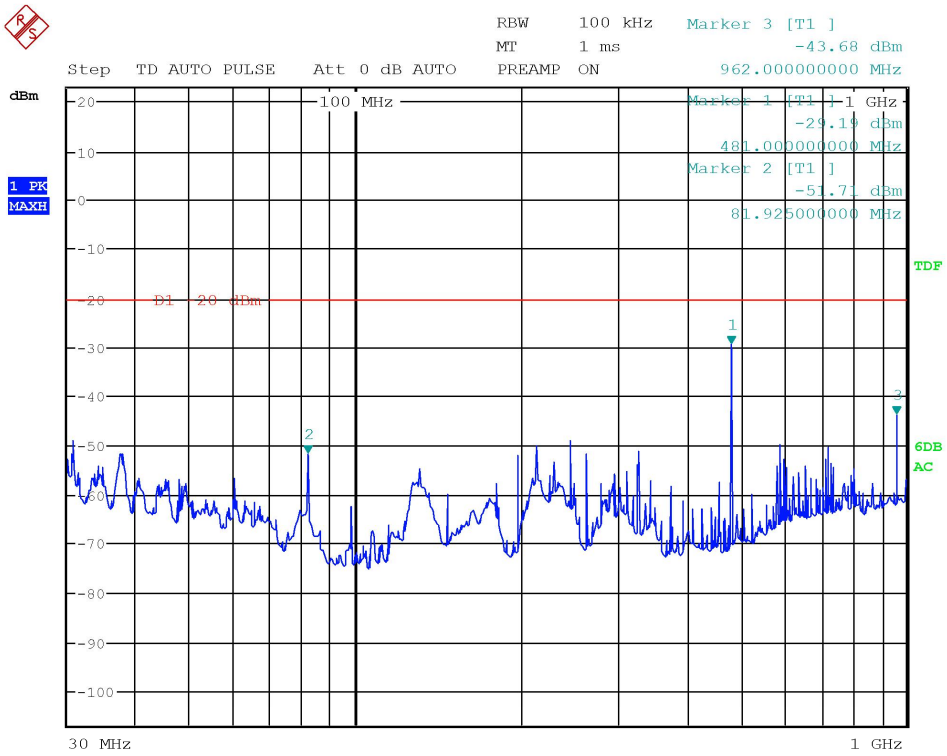
(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

Other types of equipment as required, when deemed necessary by the Commission.

Test date: 2019-06-27/ 2019-07-04

Test results: Pass

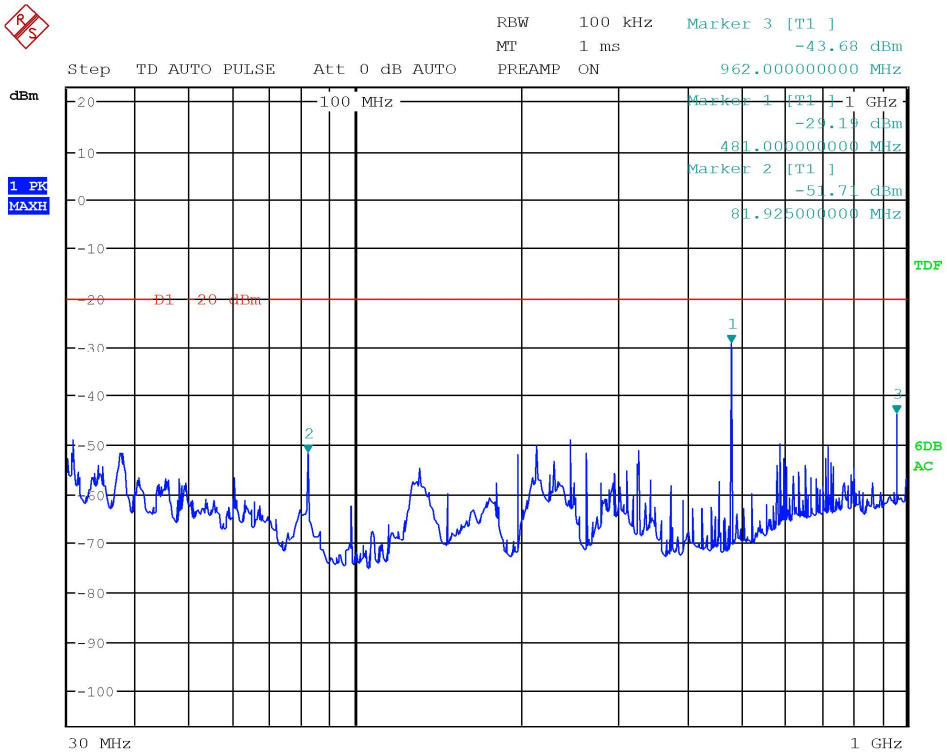
Test data



Date: 27.JUN.2019 17:32:51

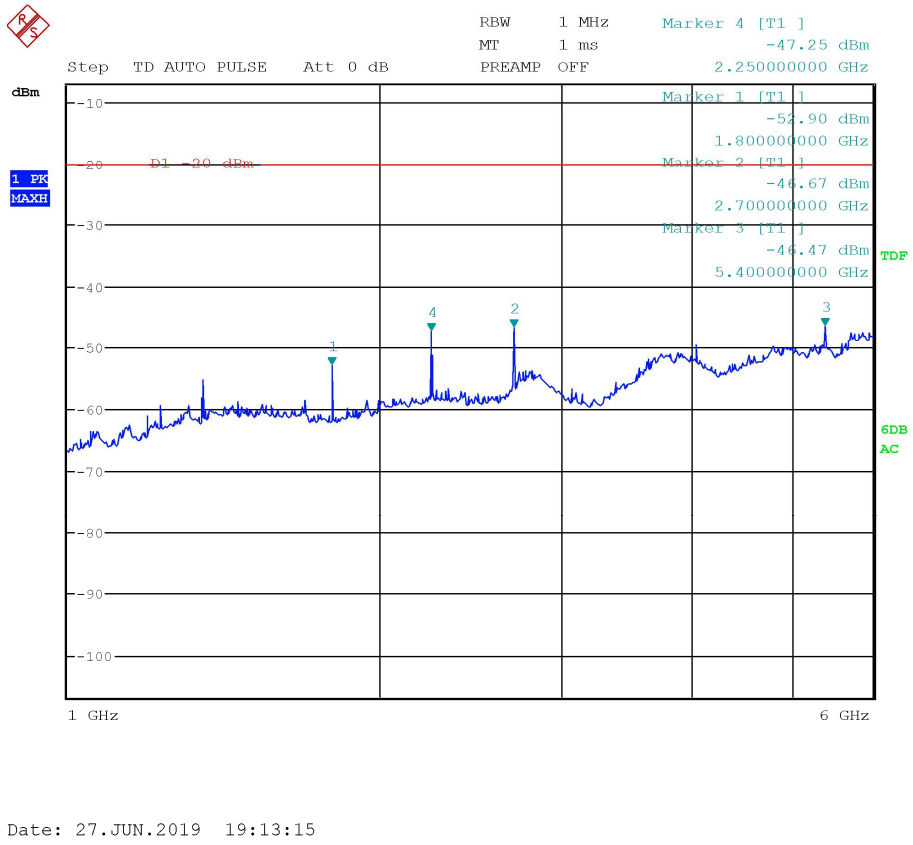
Channel LOW – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

Test data



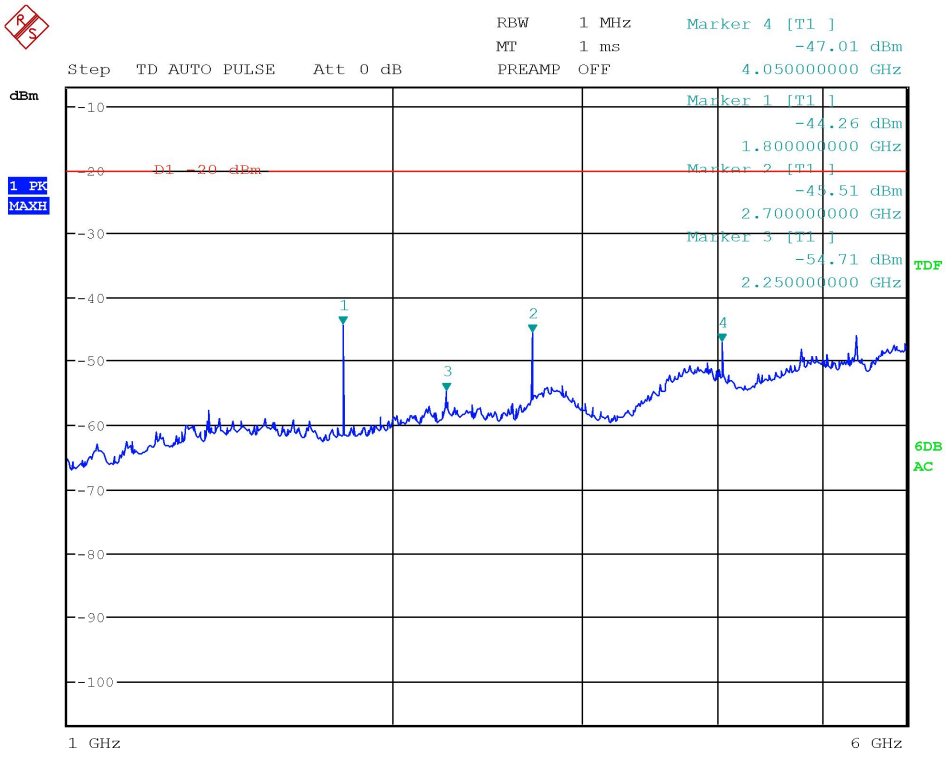
Channel LOW – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

Test data



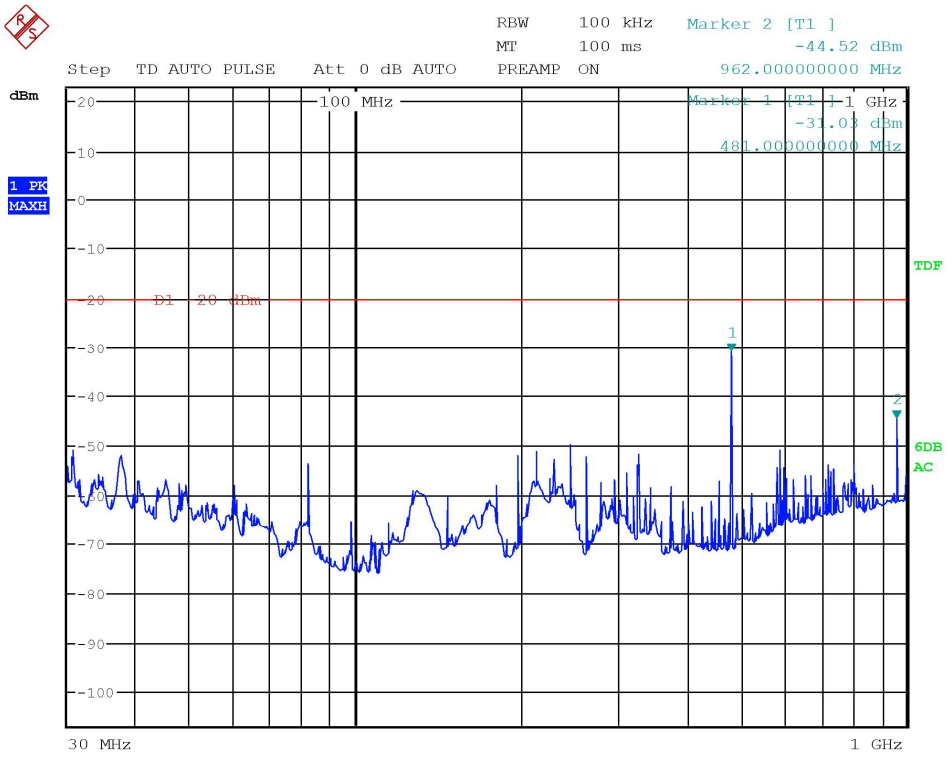
Channel LOW – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 1000 MHz to 6000 MHz with antenna in horizontal polarization

Test data



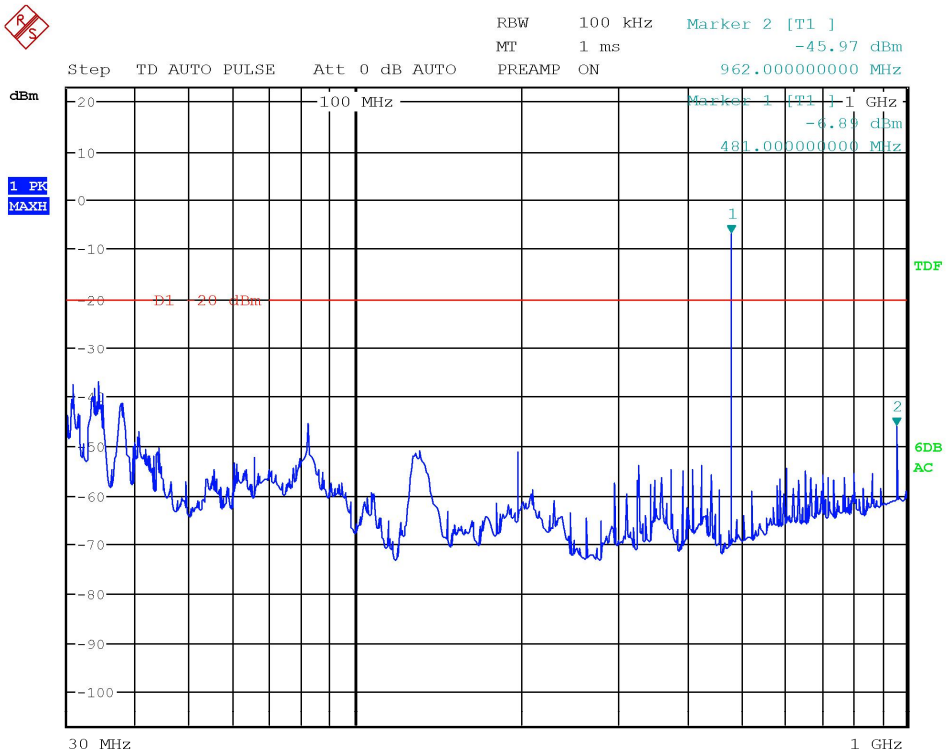
Channel LOW – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 1000 MHz to 6000 MHz with antenna in vertical polarization

Test data



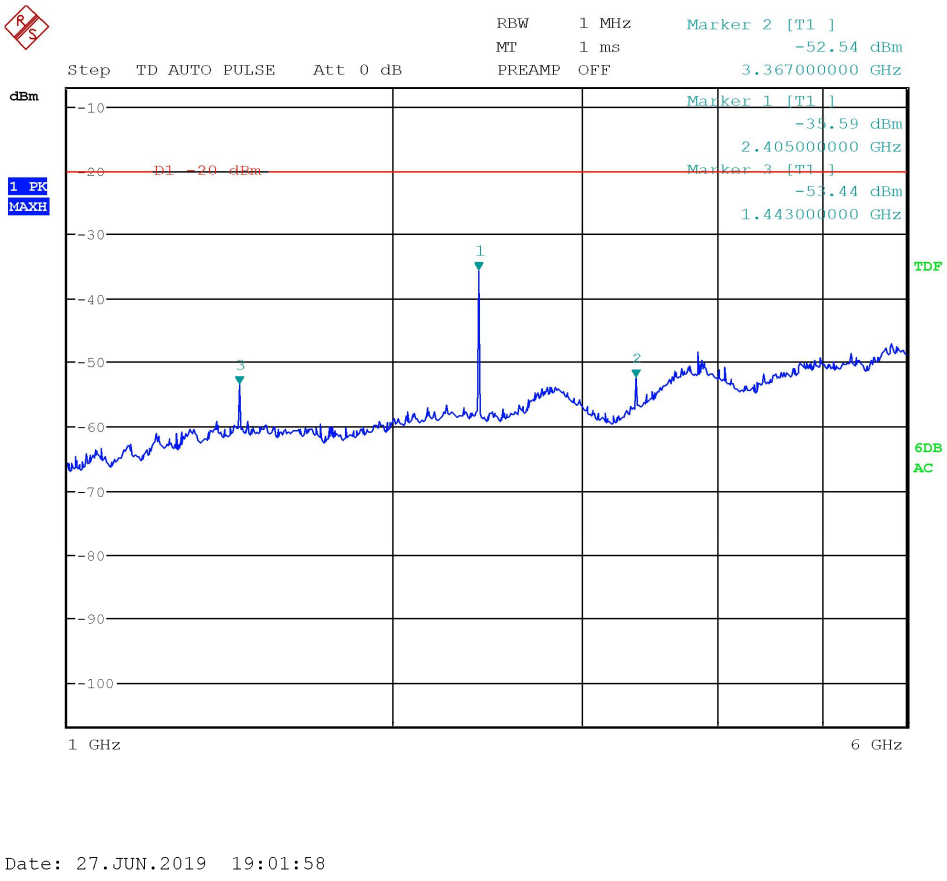
Channel MID – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization

Test data



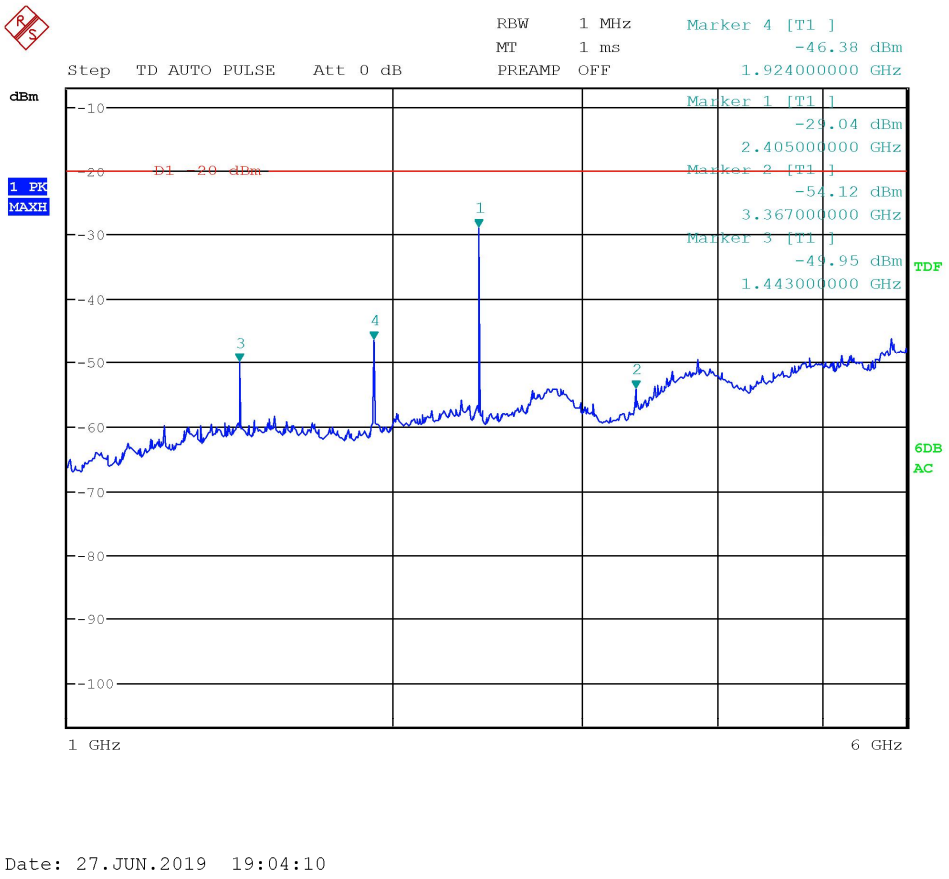
Channel MID – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 30 MHz to 1000 MHz with antenna in vertical polarization

Test data



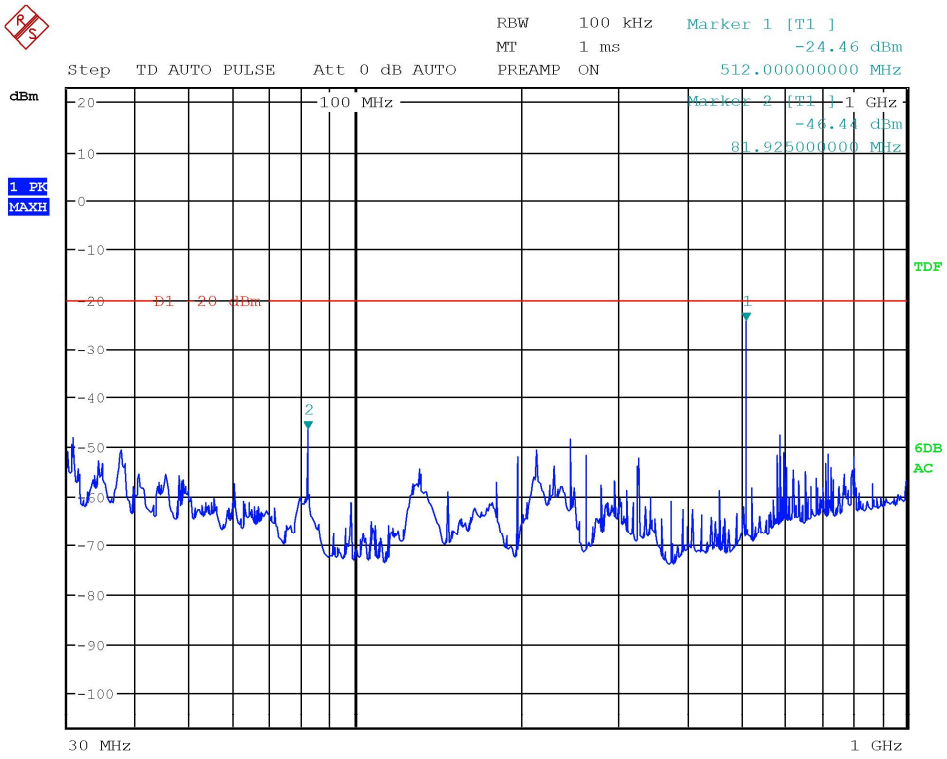
Channel MID – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 1000 MHz to 6000 MHz with antenna in horizontal polarization

Test data



Channel MID – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 1000 MHz to 6000 MHz with antenna in vertical polarization

Test data



Date: 27.JUN.2019 17:07:51

Channel HIGH – 12.5 kHz channel bandwidth modulation (same result for all modulations)
Frequency range 30 MHz to 1000 MHz with antenna in horizontal polarization