

Appendix 10 to Radio Access Equipment Regulations. Part I. Rules of radio access equipment usage for wireless transfer within the range between 30 MHz and 60 GHz.

Radio access equipment ratings for open system technology and wireless data transfer under IEEE standard 802.11n

1. Radio access equipment ratings for open system technology and wireless data transfer under IEEE standard 802.11n are given in Table 1.

Table 1. Radio access equipment ratings for open system technology and wireless data transfer under IEEE standard 802.11n

Parameter	Value
Frequency range	2 400 – 2 483.5 MHz and/or 5 150 – 5 350 MHz, 5 650 – 6 425 MHz
Environment access method	Carrier sense multiple access with collision prevention
Minimum number of MIMO flows	base station – 2 abonent station – 1
Maximum number of MIMO flows	4
Spectrum broadening method	OFDM
Frequency channel separation	20 MHz and/or 40 MHz
Number of subcarriers in a channel	56 (at channel width 20 MHz) 114 (at channel width 40 MHz)

1.1. Possible radio channel bitrates (Mbit/s), modulation types, and encoding rates are given in Tables 2-16.

Table 2. Parameters for a single three-dimensional flow NSS = 1, number of convolutional coders NES = 1 and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5
0	BPSK	1/2	6.50	7.20

1	2	3	4	5
1	QPSK	1/2	13.00	14.40
2	QPSK	3/4	19.50	21.70
3	16-QAM	1/2	26.00	28.90
4	16-QAM	3/4	39.00	43.30
5	64-QAM	2/3	52.00	57.80
6	64-QAM	3/4	58.50	65.00
7	64-QAM	5/6	65.00	72.20

Table 3. Parameters for two three-dimensional flows NSS = 2, number of convolutional coders NES = 1, the same multiplexing scheme in each flow (EQM) and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
8	BPSK	1/2	13.00	14.40
9	QPSK	1/2	26.00	28.90
10	QPSK	3/4	39.00	43.30
11	16-QAM	1/2	52.00	57.80
12	16-QAM	3/4	78.00	86.70
13	64-QAM	2/3	104.00	115.60
14	64-QAM	3/4	117.00	130.00
15	64-QAM	5/6	130.00	144.40

Table 4. Parameters for three three-dimensional flows NSS = 3, number of convolutional coders NES = 1, the same multiplexing scheme in each flow (EQM) and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5
16	BPSK	1/2	19.50	21.70
17	QPSK	1/2	39.00	43.30
18	QPSK	3/4	58.50	65.00

19	16-QAM	1/2	78.00	86.70
1	2	3	4	5
20	16-QAM	3/4	117.00	130.00
21	64-QAM	2/3	156.00	173.30
22	64-QAM	3/4	175.50	195.00
23	64-QAM	5/6	195.00	216.70

Table 5. Parameters for four three-dimensional flows NSS = 4, number of convolutional coders NES = 1, the same multiplexing scheme in each flow (EQM) and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
24	BPSK	1/2	26.00	28.90
25	QPSK	1/2	52.00	57.80
26	QPSK	3/4	78.00	86.70
27	16-QAM	1/2	104.00	115.60
28	16-QAM	3/4	156.00	173.30
29	64-QAM	2/3	208.00	231.10
30	64-QAM	3/4	234.00	260.00
31	64-QAM	5/6	260.00	288.90

Table 6. Parameters for a single three-dimensional flow NSS = 1, number of convolutional coders NES = 1 and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5
0	BPSK	1/2	13.50	15.00
1	QPSK	1/2	27.00	30.00
2	QPSK	3/4	40.50	45.00
3	16-QAM	1/2	54.00	60.00
4	16-QAM	3/4	81.00	90.00
5	64-QAM	2/3	108.00	120.00

6	64-QAM	3/4	121.50	135.00
1	2	3	4	5
7	64-QAM	5/6	135.00	150.00

Table 7. Parameters for two three-dimensional flows $N_{SS}=2$, number of convolutional coders $N_{ES}=1$, the same multiplexing scheme in each flow (EQM) and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
8	BPSK	1/2	27.00	30.00
9	QPSK	1/2	54.00	60.00
10	QPSK	3/4	81.00	90.00
11	16-QAM	1/2	108.00	120.00
12	16-QAM	3/4	162.00	180.00
13	64-QAM	2/3	216.00	240.00
14	64-QAM	3/4	243.00	270.00
15	64-QAM	5/6	270.00	300.00

Table 8. Parameters for three three-dimensional flows $N_{SS}=3$, the same multiplexing scheme in each flow (EQM) and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5
16	BPSK	1/2	40.50	45.00
17	QPSK	1/2	81.00	90.00
18	QPSK	3/4	121.50	135.00
19	16-QAM	1/2	162.00	180.00
20	16-QAM	3/4	243.00	270.00
21	64-QAM	2/3	324.00	360.00
22	64-QAM	3/4	364.50	405.00
23	64-QAM	5/6	405.00	450.00

Table 9. Parameters for four three-dimensional flows $NSS = 4$, the same multiplexing scheme in each flow (EQM) and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
24	BPSK	1/2	54.00	60.00
25	QPSK	1/2	108.00	120.00
26	QPSK	3/4	162.00	180.00
27	16-QAM	1/2	216.00	240.00
28	16-QAM	3/4	324.00	360.00
29	64-QAM	2/3	432.00	480.00
30	64-QAM	3/4	486.00	540.00
31	64-QAM	5/6	540.00	600.00

Table 10. Parameters for a single three-dimensional flow $NSS = 1$, number of convolutional coders $NES = 1$ and frequency channel separation equal to 40 MHz with 52 subcarriers ($NSD = 48$)

MCS scheme number	Modulation	Encoding rate	Bitrate, Mbit/s	
			Safeguard 800 ns	Safeguard 400 ns (optional)
32	BPSK	1/2	6.00	6.70

Table 11. Parameters for two three-dimensional flows NSS = 2, number of convolutional coders NES = 1, different multiplexing scheme in each flow (UEQM) and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation		Encoding rate	Bitrate, Mbit/s	
	Flow 1	Flow 2		Safeguard 800 ns	Safeguard 400 ns (optional)
33	16-QAM	QPSK	1/2	39.00	43.30
34	64-QAM	QPSK	1/2	52.00	57.80
35	64-QAM	16-QAM	1/2	65.00	72.20
36	16-QAM	QPSK	3/4	58.50	65.00
37	64-QAM	QPSK	3/4	78.00	86.70
38	64-QAM	16-QAM	3/4	97.50	108.30

Table 12. Parameters for three three-dimensional flows NSS = 3, number of convolutional coders NES = 1, different multiplexing scheme in each flow (UEQM) and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation			Encoding rate	Bitrate, Mbit/s	
	Flow 1	Flow 2	Flow 3		Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5	6	7
39	16-QAM	QPSK	QPSK	1/2	52.00	57.80
40	16-QAM	16-QAM	QPSK	1/2	65.00	72.20
41	64-QAM	QPSK	QPSK	1/2	65.00	72.20
42	64-QAM	16-QAM	QPSK	1/2	78.00	86.70
43	64-QAM	16-QAM	16-QAM	1/2	91.00	101.10
44	64-QAM	64-QAM	QPSK	1/2	91.00	101.10
45	64-QAM	64-QAM	16-QAM	1/2	104.00	115.60
46	16-QAM	QPSK	QPSK	3/4	78.00	86.70
47	16-QAM	16-QAM	QPSK	3/4	97.50	108.30
48	64-QAM	QPSK	QPSK	3/4	97.50	108.30
49	64-QAM	16-QAM	QPSK	3/4	117.00	130.00
50	64-QAM	16-QAM	16-QAM	3/4	136.50	151.70
51	64-QAM	64-QAM	QPSK	3/4	136.50	151.70

1	2	3	4	5	6	7
52	64-QAM	64-QAM	16-QAM	3/4	156.00	173.30

Table 13. Parameters for four three-dimensional flows NSS = 4, number of convolutional coders NES = 1, different multiplexing scheme in each flow (UEQM) and frequency channel separation equal to 20 MHz

MCS scheme number	Modulation				Encoding rate	Bitrate, Mbit/s	
	Flow 1	Flow 2	Flow 3	Flow 4		Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5	6	7	8
53	16-QAM	QPSK	QPSK	QPSK	1/2	65.00	72.20
54	16-QAM	16-QAM	QPSK	QPSK	1/2	78.00	86.70
55	16-QAM	16-QAM	16-QAM	QPSK	1/2	91.00	101.10
56	64-QAM	QPSK	QPSK	QPSK	1/2	78.00	86.70
57	64-QAM	16-QAM	QPSK	QPSK	1/2	91.00	101.10
58	64-QAM	16-QAM	16-QAM	QPSK	1/2	104.00	115.60
59	64-QAM	16-QAM	16-QAM	16-QAM	1/2	117.00	130.00
60	64-QAM	64-QAM	QPSK	QPSK	1/2	104.00	115.60
61	64-QAM	64-QAM	16-QAM	QPSK	1/2	117.00	130.00
62	64-QAM	64-QAM	16-QAM	16-QAM	1/2	130.00	144.40
63	64-QAM	64-QAM	64-QAM	QPSK	1/2	130.00	144.40
64	64-QAM	64-QAM	64-QAM	16-QAM	1/2	143.00	158.90
65	16-QAM	QPSK	QPSK	QPSK	3/4	97.50	108.30
66	16-QAM	16-QAM	QPSK	QPSK	3/4	117.00	130.00
67	16-QAM	16-QAM	16-QAM	QPSK	3/4	136.50	151.70
68	64-QAM	QPSK	QPSK	QPSK	3/4	117.00	130.00
69	64-QAM	16-QAM	QPSK	QPSK	3/4	136.50	151.70
70	64-QAM	16-QAM	16-QAM	QPSK	3/4	156.00	173.30
71	64-QAM	16-QAM	16-QAM	16-QAM	3/4	175.50	195.00
72	64-QAM	64-QAM	QPSK	QPSK	3/4	156.00	173.30
73	64-QAM	64-QAM	16-QAM	QPSK	3/4	175.50	195.00
74	64-QAM	64-QAM	16-QAM	16-QAM	3/4	195.00	216.70
75	64-QAM	64-QAM	64-QAM	QPSK	3/4	195.00	216.70

1	2	3	4	5	6	7	8
76	64-QAM	64-QAM	64-QAM	16-QAM	3/4	214.50	238.30

Table 14. Parameters for two three-dimensional flows NSS = 2, number of convolutional coders NES = 1, different multiplexing scheme in each flow (UEQM) and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation		Encoding rate	Bitrate, Mbit/s	
	Flow 1	Flow 2		Safeguard 800 ns	Safeguard 400 ns (optional)
33	16-QAM	QPSK	1/2	81.00	90.00
34	64-QAM	QPSK	1/2	108.00	120.00
35	64-QAM	16-QAM	1/2	135.00	150.00
36	16-QAM	QPSK	3/4	121.50	135.00
37	64-QAM	QPSK	3/4	162.00	180.00
38	64-QAM	16-QAM	3/4	202.50	225.00

Table 15. Parameters for three three-dimensional flows NSS = 3, different multiplexing scheme in each flow (UEQM) and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation			Encoding rate	Bitrate, Mbit/s	
	Flow 1	Flow 2	Flow 3		Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5	6	7
39	16-QAM	QPSK	QPSK	1/2	108.00	120.00
40	16-QAM	16-QAM	QPSK	1/2	135.00	150.00
41	64-QAM	QPSK	QPSK	1/2	135.00	150.00
42	64-QAM	16-QAM	QPSK	1/2	162.00	180.00
43	64-QAM	16-QAM	16-QAM	1/2	189.00	210.00
44	64-QAM	64-QAM	QPSK	1/2	189.00	210.00
45	64-QAM	64-QAM	16-QAM	1/2	216.00	240.00
46	16-QAM	QPSK	QPSK	3/4	162.00	180.00
47	16-QAM	16-QAM	QPSK	3/4	202.50	225.00
48	64-QAM	QPSK	QPSK	3/4	202.50	225.00

1	2	3	4	5	6	7
49	64-QAM	16-QAM	QPSK	3/4	243.00	270.00
50	64-QAM	16-QAM	16-QAM	3/4	283.50	315.00
51	64-QAM	64-QAM	QPSK	3/4	283.50	315.00
52	64-QAM	64-QAM	16-QAM	3/4	324.00	360.00

Table 16. Parameters for four three-dimensional flows NSS = 4, different multiplexing scheme in each flow (UEQM) and frequency channel separation equal to 40 MHz

MCS scheme number	Modulation				Encoding rate	Bitrate, Mbit/s	
	Flow 1	Flow 2	Flow 3	Flow 4		Safeguard 800 ns	Safeguard 400 ns (optional)
1	2	3	4	5	6	7	8
53	16-QAM	QPSK	QPSK	QPSK	1/2	135.00	150.00
54	16-QAM	16-QAM	QPSK	QPSK	1/2	162.00	180.00
55	16-QAM	16-QAM	16-QAM	QPSK	1/2	189.00	210.00
56	64-QAM	QPSK	QPSK	QPSK	1/2	162.00	180.00
57	64-QAM	16-QAM	QPSK	QPSK	1/2	189.00	210.00
58	64-QAM	16-QAM	16-QAM	QPSK	1/2	216.00	240.00
59	64-QAM	16-QAM	16-QAM	16-QAM	1/2	243.00	270.00
60	64-QAM	64-QAM	QPSK	QPSK	1/2	216.00	240.00
61	64-QAM	64-QAM	16-QAM	QPSK	1/2	243.00	270.00
62	64-QAM	64-QAM	16-QAM	16-QAM	1/2	270.00	300.00
63	64-QAM	64-QAM	64-QAM	QPSK	1/2	270.00	300.00
64	64-QAM	64-QAM	64-QAM	16-QAM	1/2	297.00	330.00
65	16-QAM	QPSK	QPSK	QPSK	3/4	202.50	225.00
66	16-QAM	16-QAM	QPSK	QPSK	3/4	243.00	270.00
67	16-QAM	16-QAM	16-QAM	QPSK	3/4	283.50	315.00
68	64-QAM	QPSK	QPSK	QPSK	3/4	243.00	270.00
69	64-QAM	16-QAM	QPSK	QPSK	3/4	283.50	315.00
70	64-QAM	16-QAM	16-QAM	QPSK	3/4	324.00	360.00
71	64-QAM	16-QAM	16-QAM	16-QAM	3/4	364.50	405.00
72	64-QAM	64-QAM	QPSK	QPSK	3/4	324.00	360.00

1	2	3	4	5	6	7	8
73	64-QAM	64-QAM	16-QAM	QPSK	3/4	364.50	405.00
74	64-QAM	64-QAM	16-QAM	16-QAM	3/4	405.00	450.00
75	64-QAM	64-QAM	64-QAM	QPSK	3/4	405.00	450.00
76	64-QAM	64-QAM	64-QAM	16-QAM	3/4	445.50	495.00

1.2. Transmitter assembly errors are given in Table 17. Transmitter assembly errors.

Table 17. Transmitter assembly errors

Modulation method and relative encoding rate	Mean-square value of modulation error dB, max
BPSK 1/2	-5
QPSK 1/2	-10
QPSK 3/4	-13
16-QAM 1/2	-16
16-QAM 3/4	-19
64-QAM 2/3	-22
64-QAM 3/4	-25
64-QAM 5/6	-28

2. Ratings of a radio access transmitter for open system technology and wireless data transfer under IEEE standard 802.11n

2.1. Ratings of a transmitter operating in the range between 5 150 and 5 350 MHz and 5 650 and 6 425 MHz are given in Table 18. Ratings of a radio access transmitter for open system technology and wireless data transfer under IEEE standard 802.11n

Table 18. Ratings for a transmitter operating in the range 5 150 – 5 350 MHz, 5 650 – 6 425 MHz

Parameter	Value
Maximum transmitter power in frequency band	
5 150 – 5 250 MHz	20 dBm (100 mWt) max
5 250 – 5 350 MHz	20 dBm (100 mWt) max
5 650 – 5 725 MHz	30 dBm (1000 mWt) max
5 725 – 5 825 MHz	30 dBm (1000 mWt) max
5 825 – 6 425 MHz	30 dBm (1000 mWt) max
Relative transmitter frequency instability	20×10^{-6}

2.2. Side emission levels of transmitter are given in Table 19

Table 19. Side emission levels of a transmitter

Frequency span, GHz	Maximum ERP power, dBm	Pass band width, kHz
0.03 – 0.047	–36	100
0.047 – 0.074	–54	100
0.074 – 0.0875	–36	100
0.0875 – 0.118	–54	100
0.118 – 0.174	–36	100
0.174 – 0.23	–54	100
0.23 – 0.47	–36	100
0.47 – 0.862	–54	100
0.862 – 1.0	–36	100
1.0 – 5.15	–30	1 000
5.35 – 5.47	–30	1 000
5.725 – 26.0	–30	1 000

Table 20. Adjacent channels' noise suppression at packet error $\leq 10\%$, packet length equal to 4096 byte and the signal level 3 dB above the sensitivity level

Modulation method and relative encoding rate	Relative signal level in the first adjacent channel, min (dB)
BPSK 1/2	16
QPSK 1/2	13
QPSK 3/4	11
16-QAM 1/2	8
16-QAM 3/4	4
64-QAM 2/3	0
64-QAM 3/4	–1
64-QAM 5/6	–2

2.3. Ratings for a transmitter operating in the range between 2400 and 2483.5 MHz are given in Table 21 .

Table 21. Ratings for transmitter operating in the range between 2400 and 2483.5 MHz.

Parameter	Value
Transmitter's maximum power	24 dBm (250 mWt) max
Maximum spectral concentration of power (in the	

1 MHz band) shall not exceed:	10 dBm/MHz (10 mWt/MHz)
Relative transmitter frequency instability	25×10^{-6}
Adjacent channels' noise suppression at packet error $\leq 10\%$, packet length equal to 4096 byte and the signal level 3 dB above the sensitivity level	Table 20

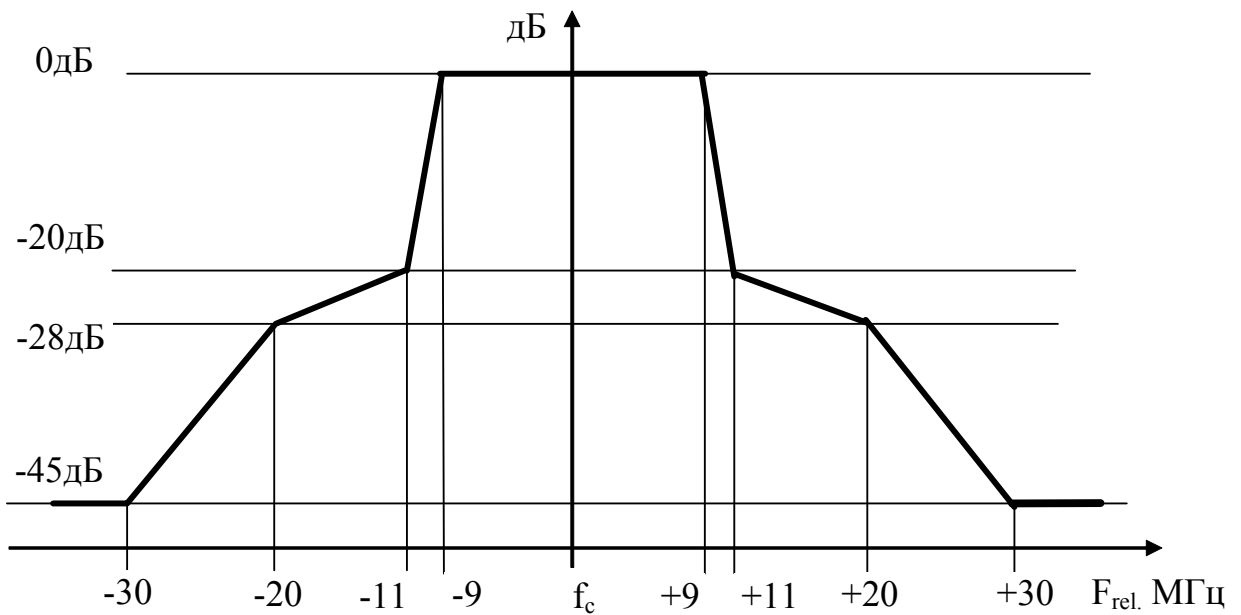
2.4. Ratings for side emission level of a transmitter operating in the range between 2400 and 2483.5 MHz are given in Table 22

Table 22. Ratings for side emission level of a transmitter operating in the range between 2400 and 2483.5 MHz.

Frequency range GHz	Parameter value shall not exceed, dBm	
	in operative mode	in stand-by mode
0.03 – 1.00	-36	-57
1.00 – 12.75	-30	-47
1.80 – 1.90	-47	-47
5.15 – 5.30	-47	-47

2.5. Ratings for an emitted signal-spectrum mask

2.5.1. An emitted signal-spectrum mask with frequency separation equal to 20 MHz is given in Figure 1.



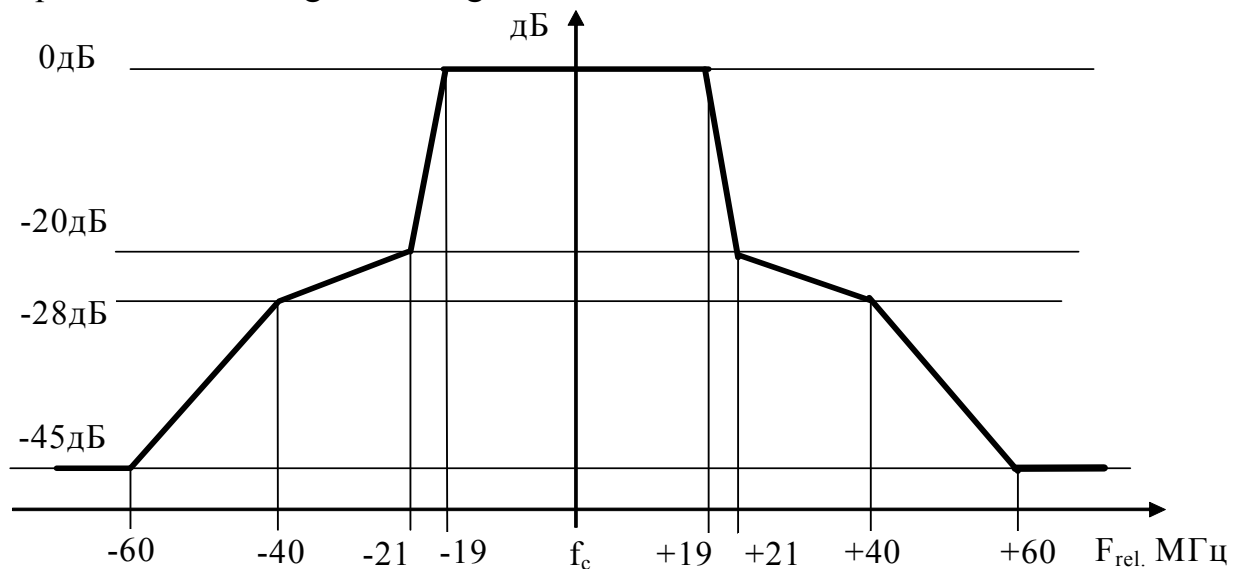
Notice. Measurement mode:

1. Passband width at intermediate frequency is 100 kHz.
2. Swath – 100 MHz.
3. Video filter bandwidth – 30 kHz.

Figure 1. Signals spectrum mask (20 MHz)

When the MIMO configuration is used in the equipment, the emitted signal spectrum mask of each transmitter corresponds to the aforementioned values.

2.5.2. An emitted signal-spectrum mask with the frequency separation equal to 40 MHz is given in Figure 2 .



Notice. Measurement mode:

1. Passband width at intermediate frequency is 100 kHz.
2. Swath – 120 MHz
3. Video filter bandwidth – 30 kHz.

Figure 2. Signals spectrum mask (40 MHz)

When the MIMO configuration is used in the equipment, the emitted signal spectrum mask of each transmitter corresponds to the aforementioned values.

3. Ratings of a radio access receiver for open system technology and wireless data transfer under IEEE standard 802.11n

3.1. Ratings of a receiver operating in the range between 5 150 and 5 350 MHz and between 5 650 and 6 425 MHz are given in Table 23 Ratings of a radio access receiver for open system technology and wireless data transfer under IEEE standard 802.11n

Table 23. Ratings for a receiver operating in the range between 5 150 and 5 350 MHz and between 5 650 and 6 425 MHz.

Parameter	Value, dBm	
1	2	
The minimum receiver level for microwave frequency shall not exceed at packet error $\leq 10\%$ and packet length equal to 4096 byte, depending on channel width and modulation:	20 MHz:	40 MHz:
BPSK 1/2	-82	-79
QPSK 1/2	-79	-76
QPSK 3/4	-77	-74
16-QAM 1/2	-74	-71
16-QAM 3/4	-70	-67
64-QAM 2/3	-66	-63
64-QAM 3/4	-65	-62
64-QAM 5/6	-64	-61
1	2	
The maximum level of input signal at packet error $\leq 10\%$ and packet length equal to 4096 byte shall not be beneath	-30	
The level of spurious emission shall not exceed in frequency range:		
0.03 GHz – 1 GHz	-57	
1 GHz – 26.5 GHz	-50	

When the MIMO configuration is used in the equipment, these values are applicable to each receiver.

3.2. Ratings for a receiver operating in the range between 2400 and 2483.5 MHz, are given in Table 24 .

Table 24. Ratings for a receiver operating in the range 2400 – 2483.5 MHz.

Parameter	Value, dBm	
The minimum receiver level for microwave frequency shall not exceed at packet error $\leq 10\%$ and packet length equal to 4096 byte, depending on channel width and modulation:	20 MHz:	40 MHz:
BPSK 1/2	-82	-79

QPSK 1/2	-79	-76
QPSK 3/4	-77	-74
16-QAM 1/2	-74	-71
16-QAM 3/4	-70	-67
64-QAM 2/3	-66	-63
64-QAM 3/4	-65	-62
64-QAM 5/6	-64	-61
The maximum level of input signal at packet error $\leq 10\%$ and packet length equal to 4096 byte shall not be beneath	-20	
The level of spurious emission shall not exceed in frequency range:		
0.03 GHz – 1 GHz	-57	
1 GHz – 12.75 GHz	-47	

When the MIMO configuration is used in the equipment, these values are applicable to each receiver.