6a.2 Modulation Characteristics and Necessary Bandwidth -- Pursuant 47 CFR 2.1033(c) 13, 2.1047(d) & 2.202

6a.2.1 Digitally encoded digital data is transmitted in groups of four sub-channels at a 4 kHz rate using M-ary symbols mapped to predetermined fixed magnitude and phase components within 1 of 3 constellations associated with a particular modulation scheme. One to four groups of four sub-channel streams are combined using frequency division multiplexing to form the modulated waveform. Figure 6-3 illustrates symbol mapping to one of the four QPSK sub-channels constellations. Figure 6-4 illustrates symbol mapping to one of the four 16QAM sub-channels constellation. Figure 6-5 illustrates symbol mapping to one of the four 64QAM sub-channels constellation. For Quad-QPSK modulation, this mapping adjusts the amplitude and phase variations of the baseband signal to one of 4 points on the constellation. For Quad-16QAM modulation, this mapping adjusts the amplitude and phase variations of the baseband signal to one of 16 points on the constellation. For Quad-64 modulation, this mapping adjusts the amplitude and phase variations of the baseband signal to one of 64 points on the constellation.

The bandwidth of the modulating signals is limited by the pair of modulation limiting low pass filters within the modem block function of U801 (see Figure 4-2 in Exhibit 4.3). These filters serve to limit out-of-band and spurious emissions due to modulation. The necessary bandwidth of the sub-channels is limited to 4.8 kHz by the pair of modulation limiting low pass filters. The transfer response of these filters is depicted in Figure 6-1 where the filter excess bandwidth coefficient of 0.2 is shown. This excess bandwidth leads to the necessary bandwidth calculation of (1 + 0.2) x (4 kHz) = 4.8 kHz. Since the sub-channels are spaced 4.5 kHz apart, and the groups that each contain 4 sub-channels are spaced apart in integer multiples of 25 kHz, the necessary bandwidth of the composite 4 sub-channel symbol streams (single group) is 4.8 + (3 x 4.5) = 18.3 kHz and the necessary bandwidth of the entire waveform depends on the number and combination of groups transmitted.

Table 6-2 illustrates all group combinations and corresponding bandwidths.

Case	Description (Figure)	Number of Groups	Number Of Sub-channels	Emission Designator
1	When Transmitting Voice, data or fax on one 25kHz channel (6.2.1)	1	4	18K3D7W
2	When Transmitting data on 2 adjacent 25kHz channels (6-2 (Adjacent))	2	8	43K3D7D
3	When Transmitting data on 3 adjacent 25kHz channels (6-3)	3	12	68K3D7D
4	When Transmitting data on the 2 outer 25kHz channels of 4 25kHz channels (6-2(outer))	2	8	93K3D7D
	When Transmitting data on 4 adjacent 25kHz channels (6-4)	4	16	93K3D7D

Table 6-2: Waveform Description of all transmitted cases.

The designator for emissions in case 2 and 3 is determined by adding N x 25 to the first 2 digits, when N = the number of channels. The designator for case 4 is determined by adding 3 x 25 to the fist 2 digits because the outer channels are 3 channels apart. D is used for the last character when only data is transmitted, not telephony.

The limits for the masks are based on either 47 CFR 90.210(g) Emission Mask G or the EA SMR emission mask 90.691(a). Each Figure is identified as to the mask used.

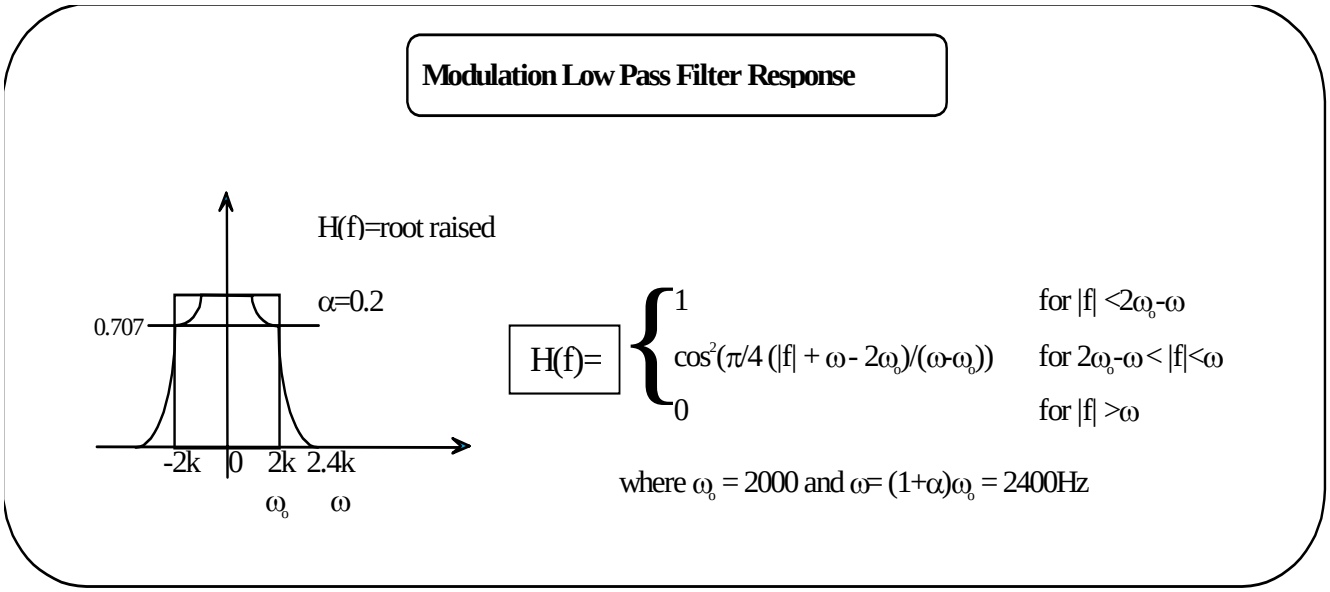


Figure 6a-1: Modulation Low Pass Filter Response

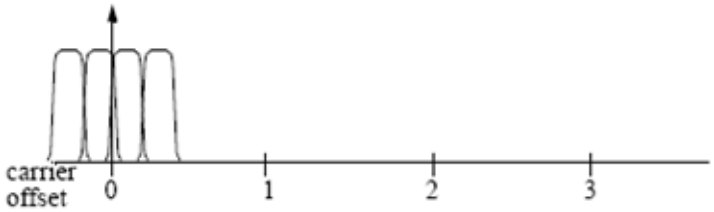
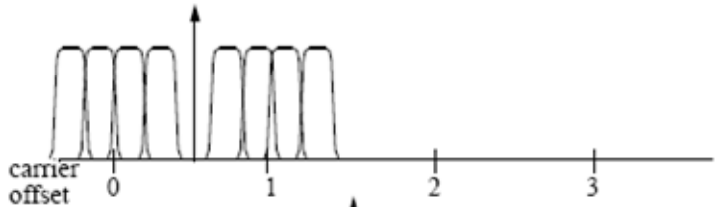
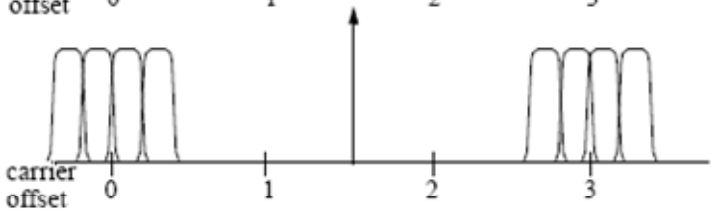
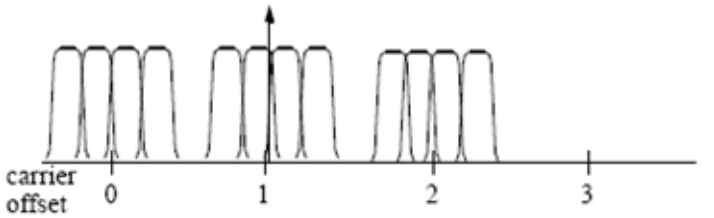
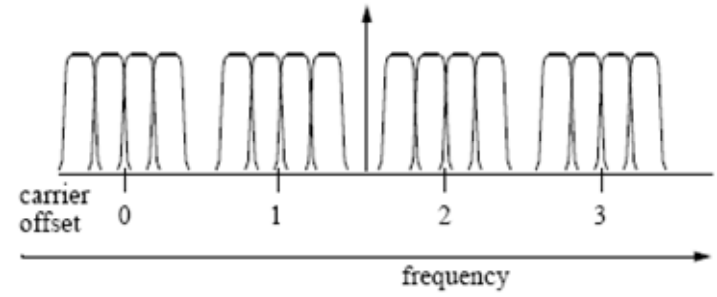
Number of Sub-Channel Groups	Bandwidth (kHz)	Sub-Channel Group Combination
1	18.3	
2 (adjacent)	43.3	
2 (outer)	93.3	
3	68.3	
4	93.3	

Figure 6a-2: Sub-Channel Group Combination Bandwidths

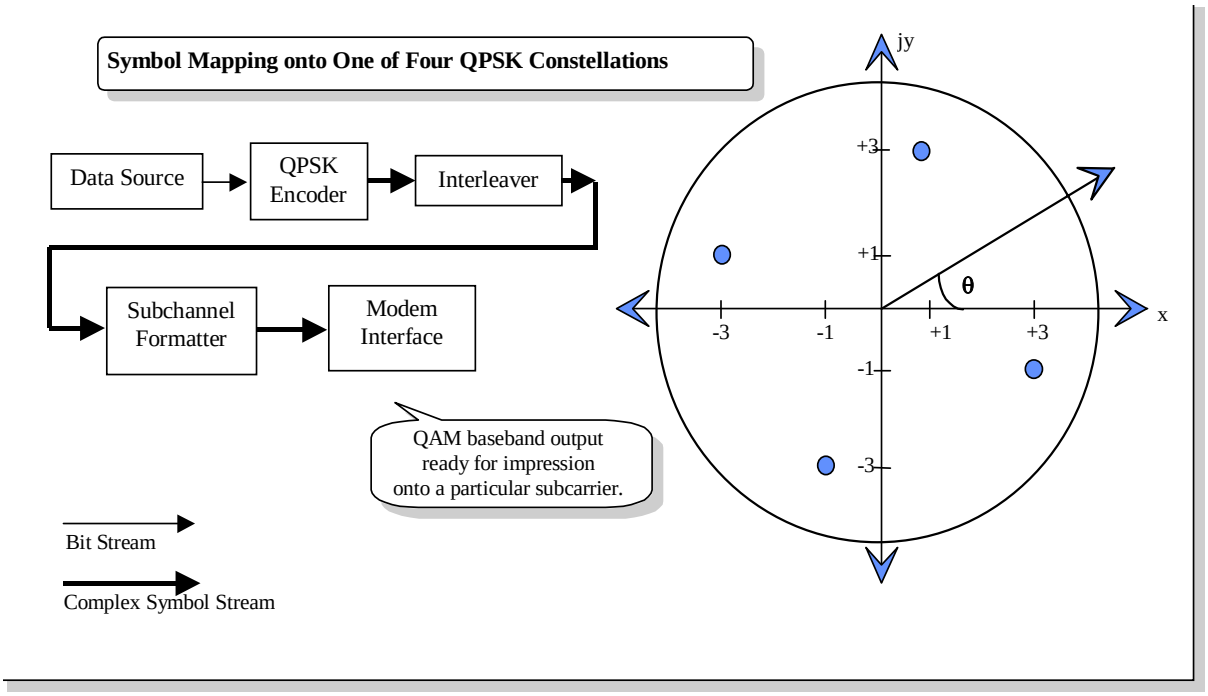


Figure 6a-3. Symbol Mapping onto One of Four QPSK Constellations

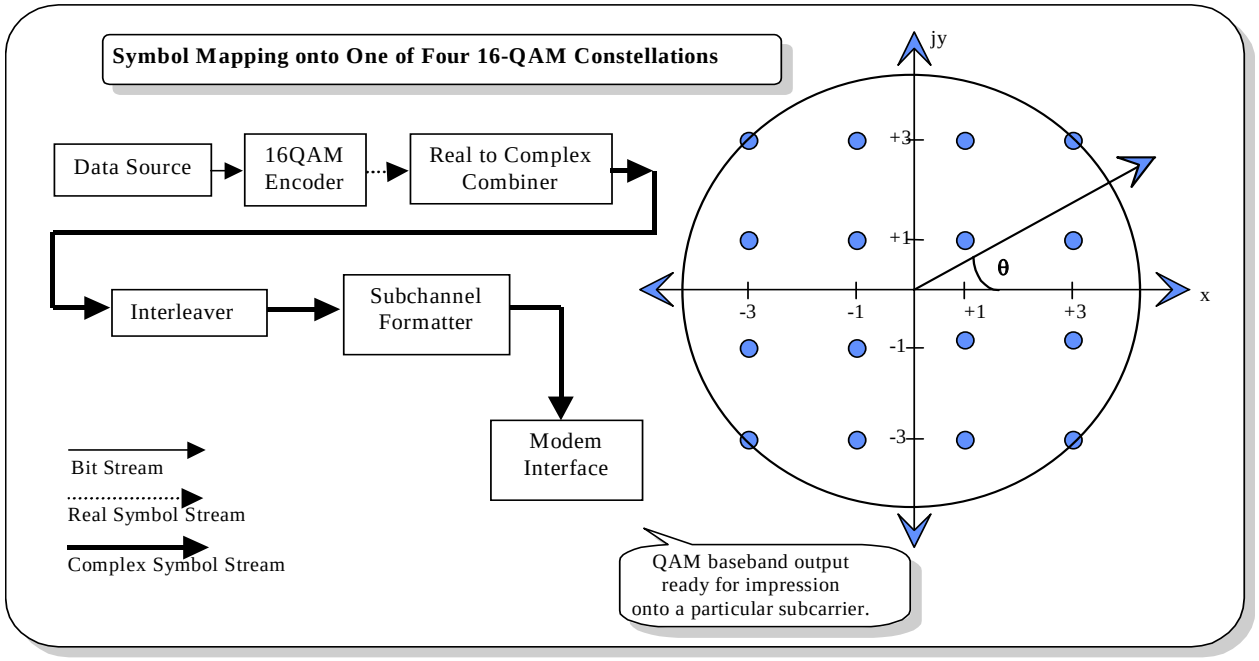


Figure 6a-4. Symbol Mapping onto One of Four 16-QAM Constellations

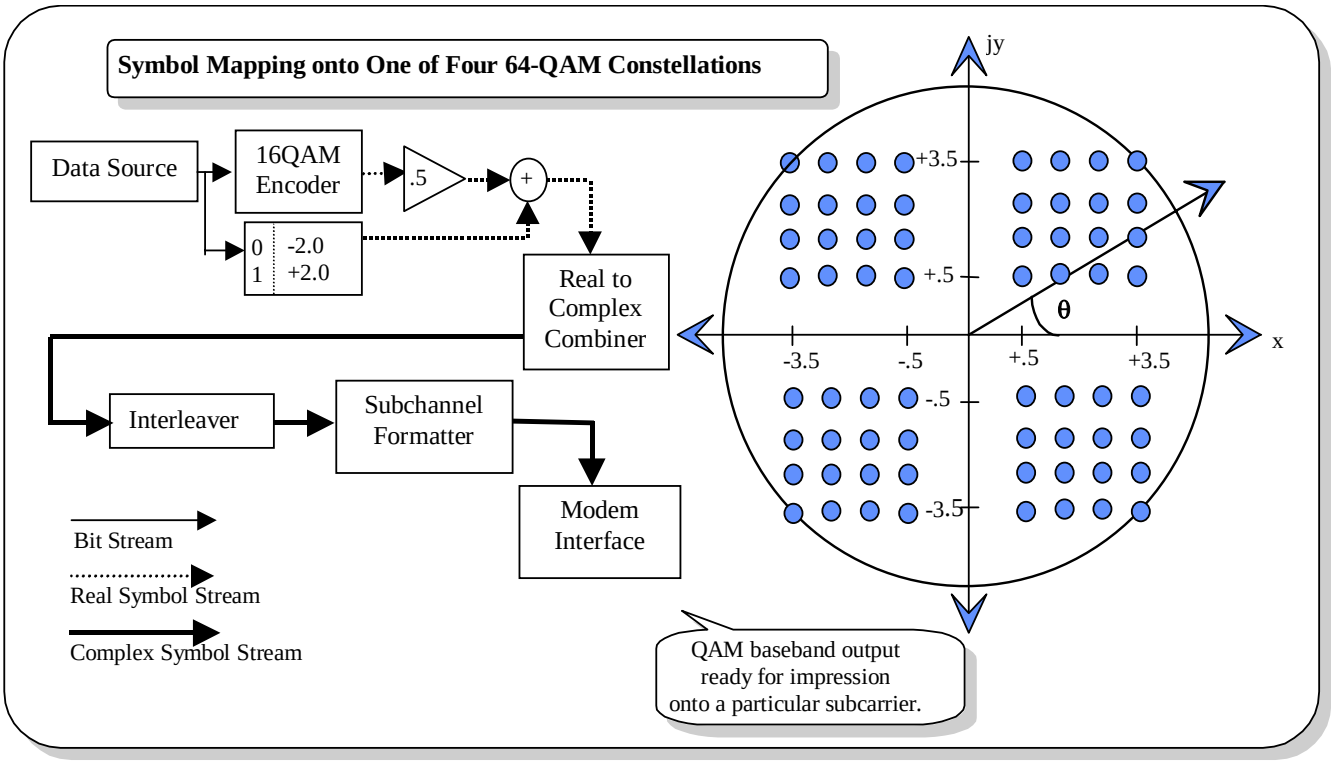


Figure 6a-5. Symbol Mapping onto One of Four 64-QAM Constellations

6a.2.2 Emission Designator 18K3D7W - iDEN 800 MHz Band Measured data

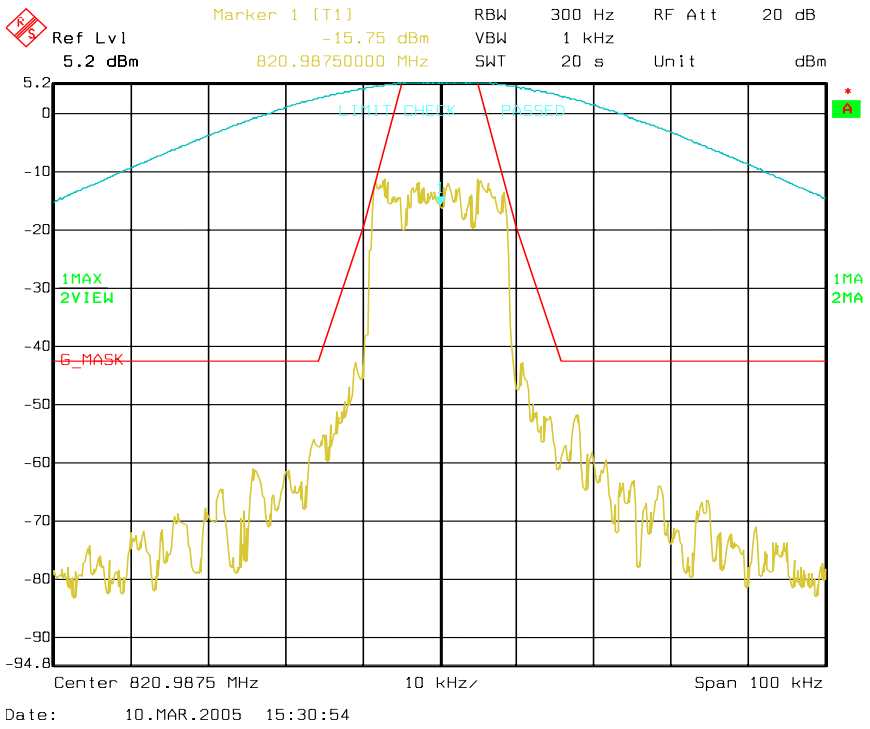


Figure 6a-6: iDEN 800 MHz Band, QPSK, Maximum Power, Emission Mask G

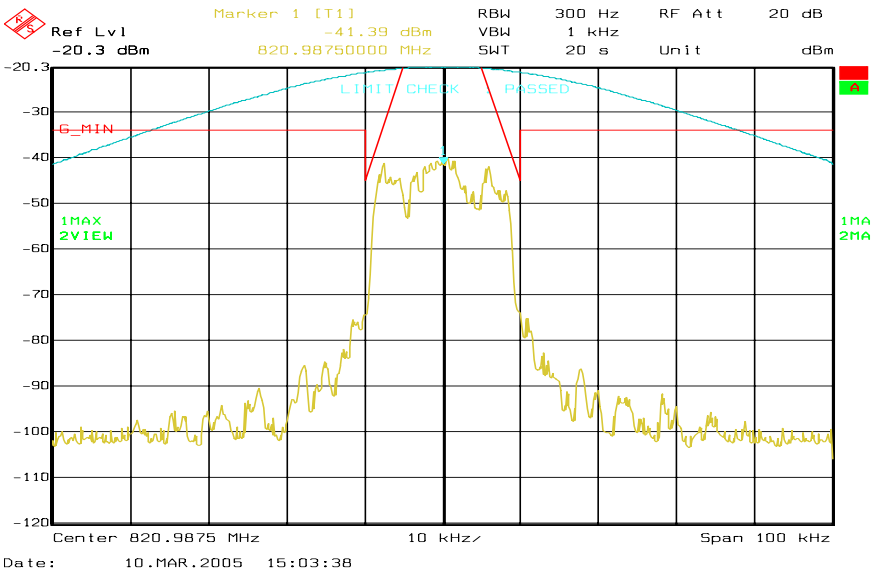


Figure 6a-7. iDEN 800 MHz Band, QPSK, Minimum Power, Emission Mask G

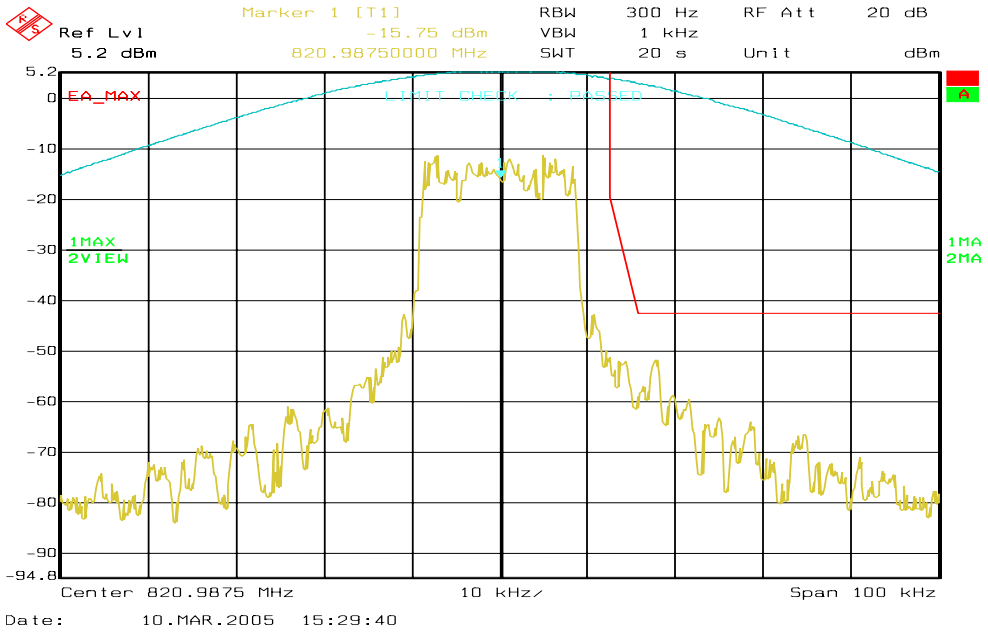


Figure 6a-8: iDEN 800 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

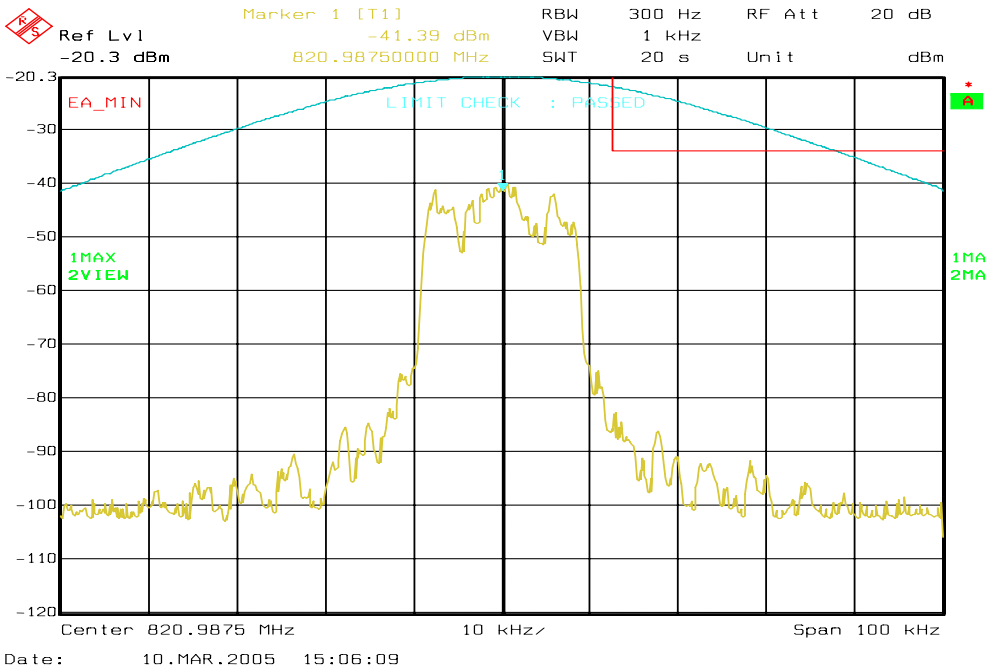


Figure 6a- 9: iDEN 800 MHz Band, QPSK, Minimum Power, EA Emission Mask

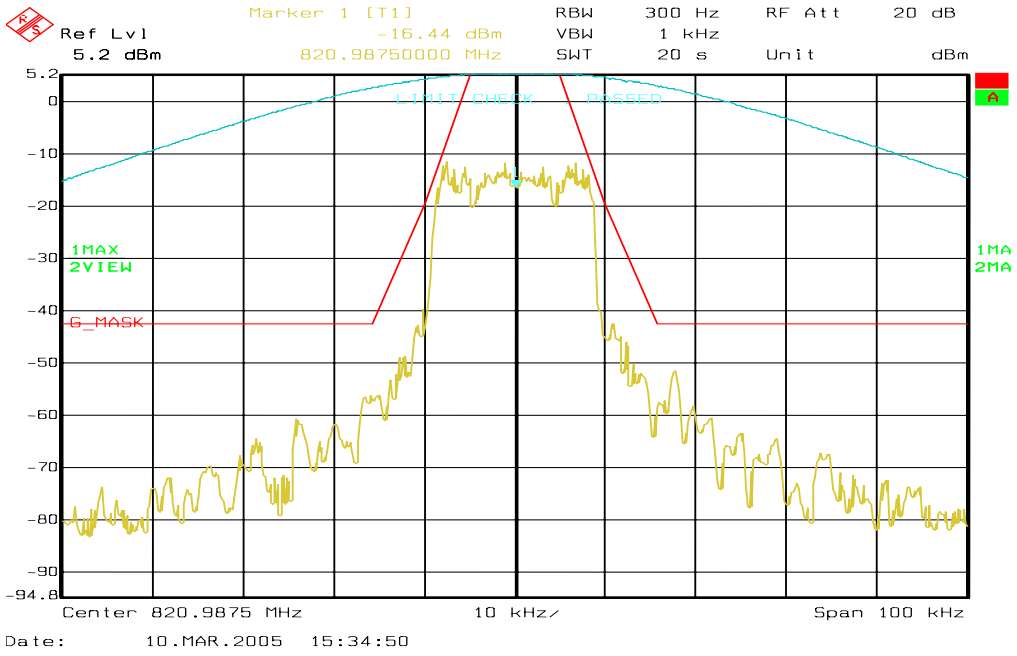


Figure 6a-10: iDEN 800 MHz Band, QAM16, Maximum Power, Emission Mask G

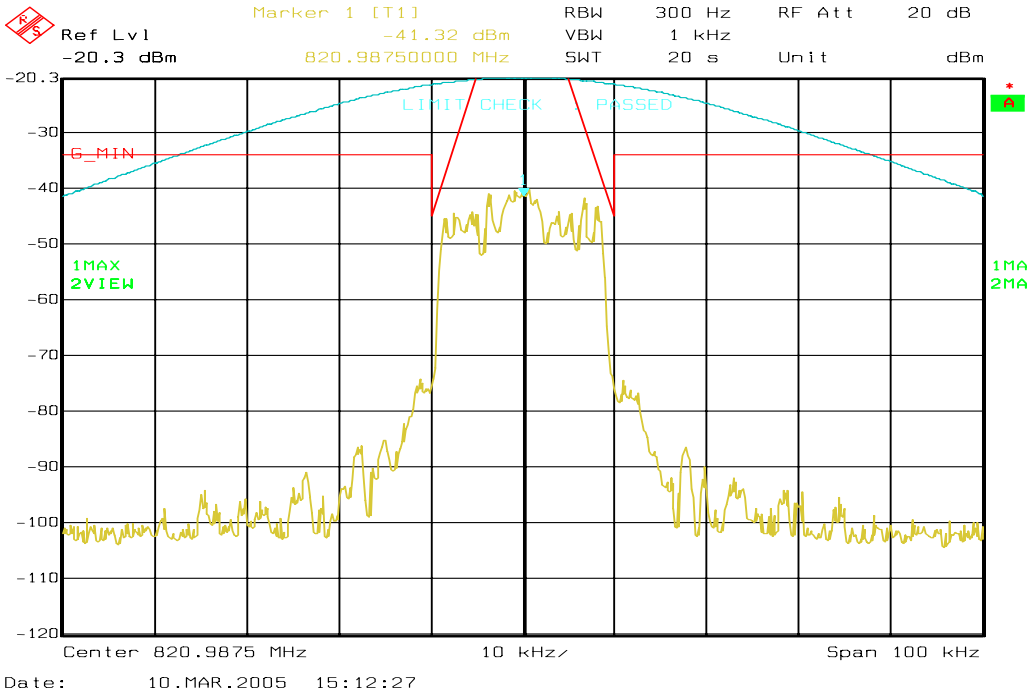


Figure 6a-11: iDEN 800 MHz Band, QAM16, Minimum Power, Emission Mask G

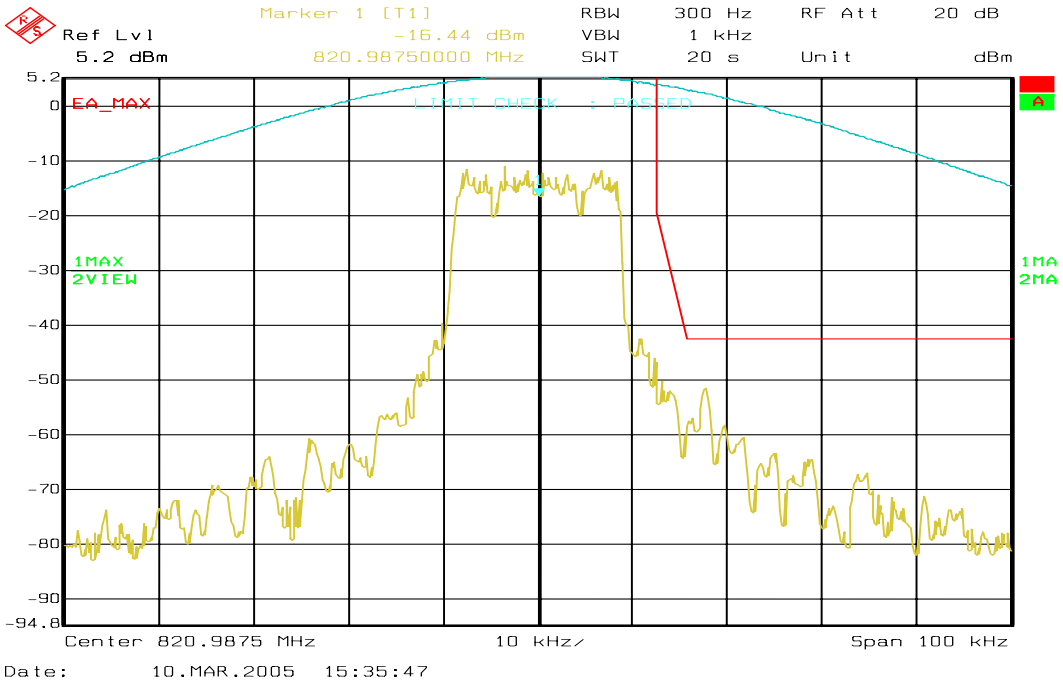


Figure 6a-12: iDEN 800 MHz Band, QAM16, Maximum Power, EA Emission Mask

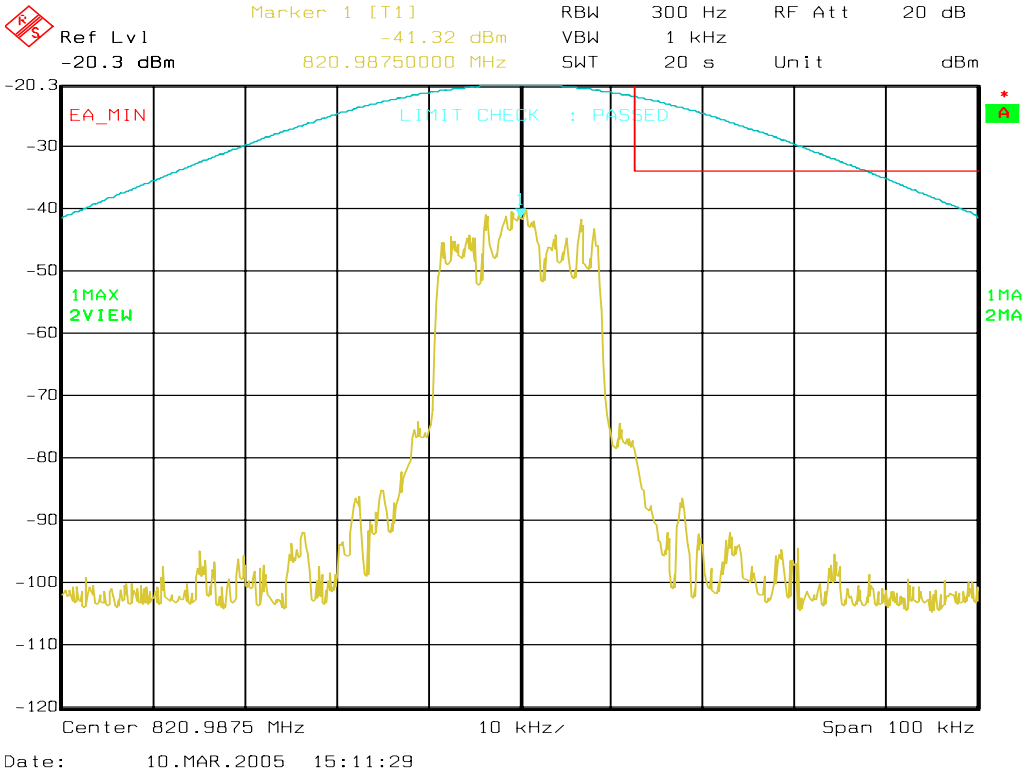


Figure 6a-13: iDEN 800 MHz Band, QAM16, Minimum Power, EA Emission Mask

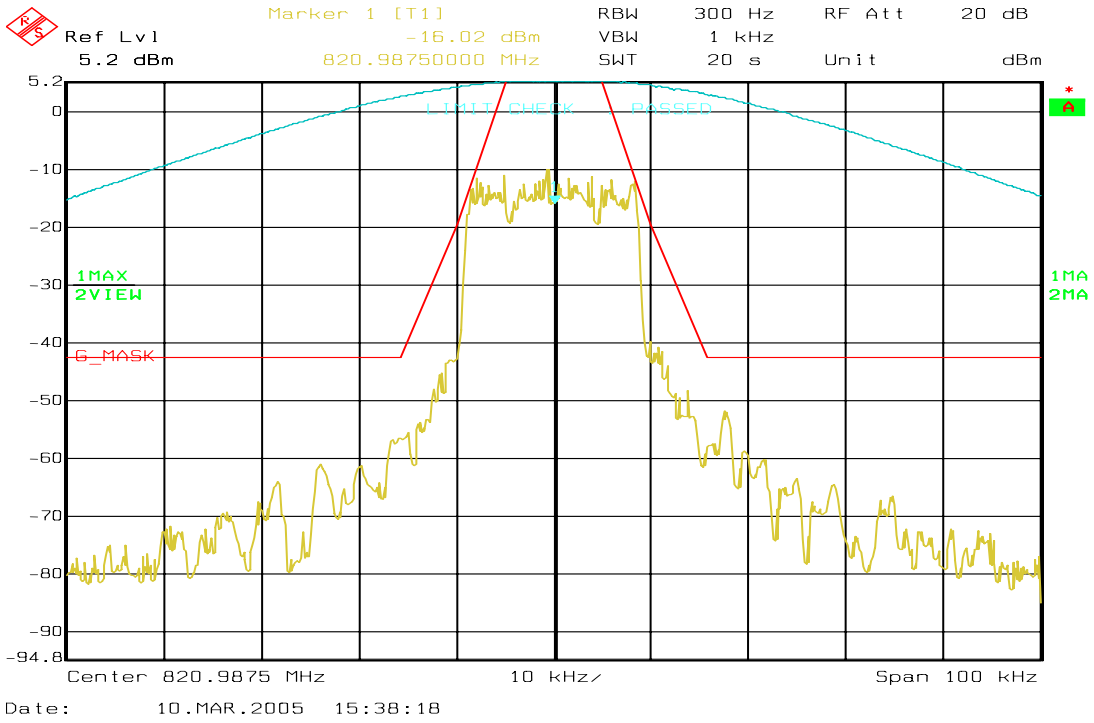


Figure 6a-14: iDEN 800 MHz Band, QAM64, Maximum Power, Emission Mask G

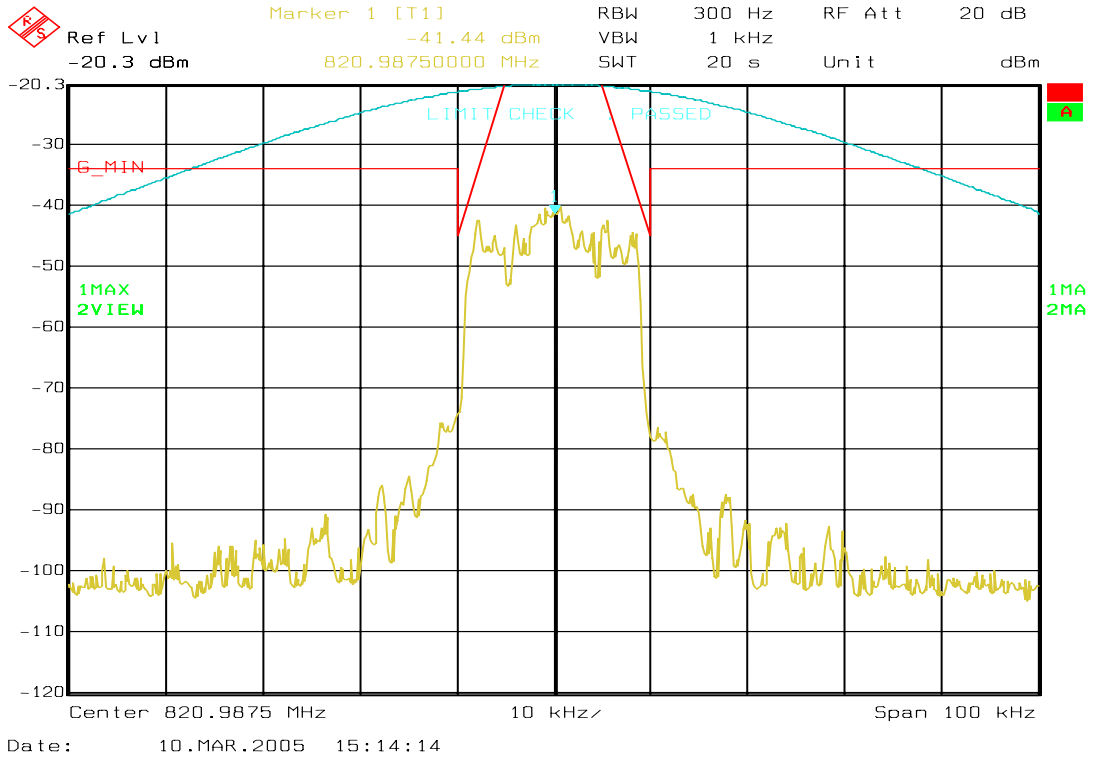


Figure 6a-15: iDEN 800 MHz Band, QAM64, Minimum Power, Emission Mask G

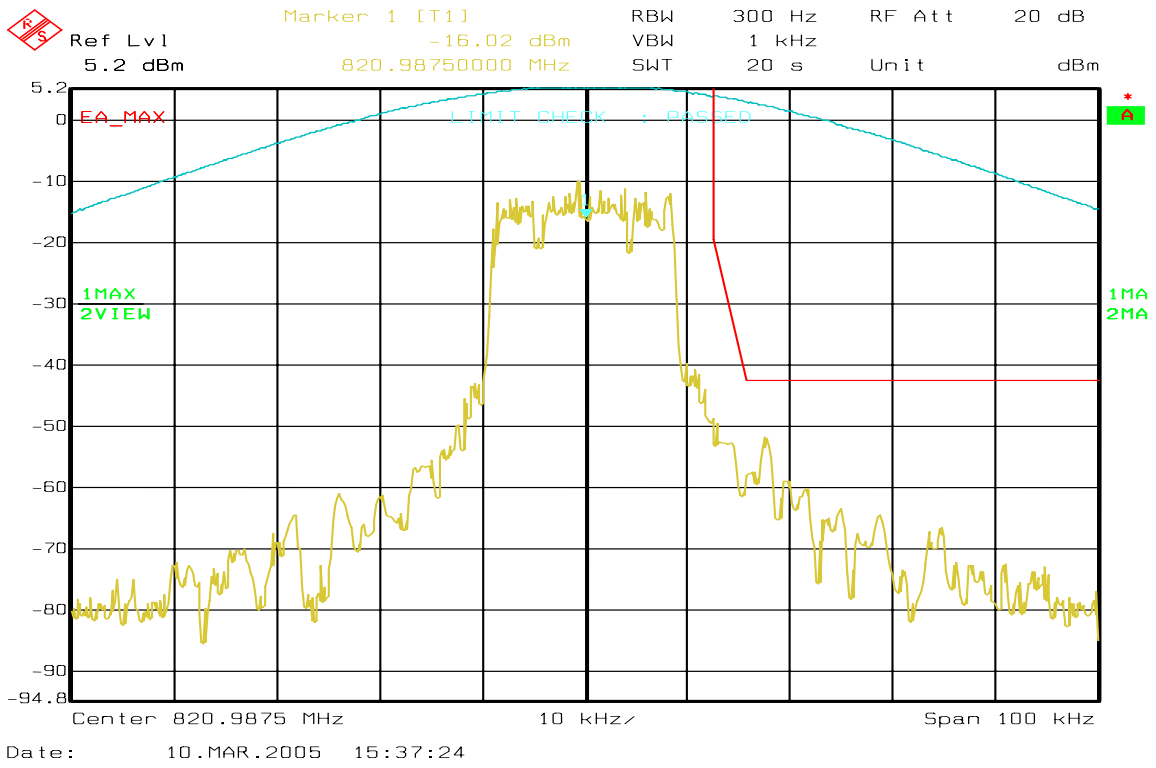


Figure 6a-16: iDEN 800 MHz Band, QAM64, Maximum Power, EA Emission Mask

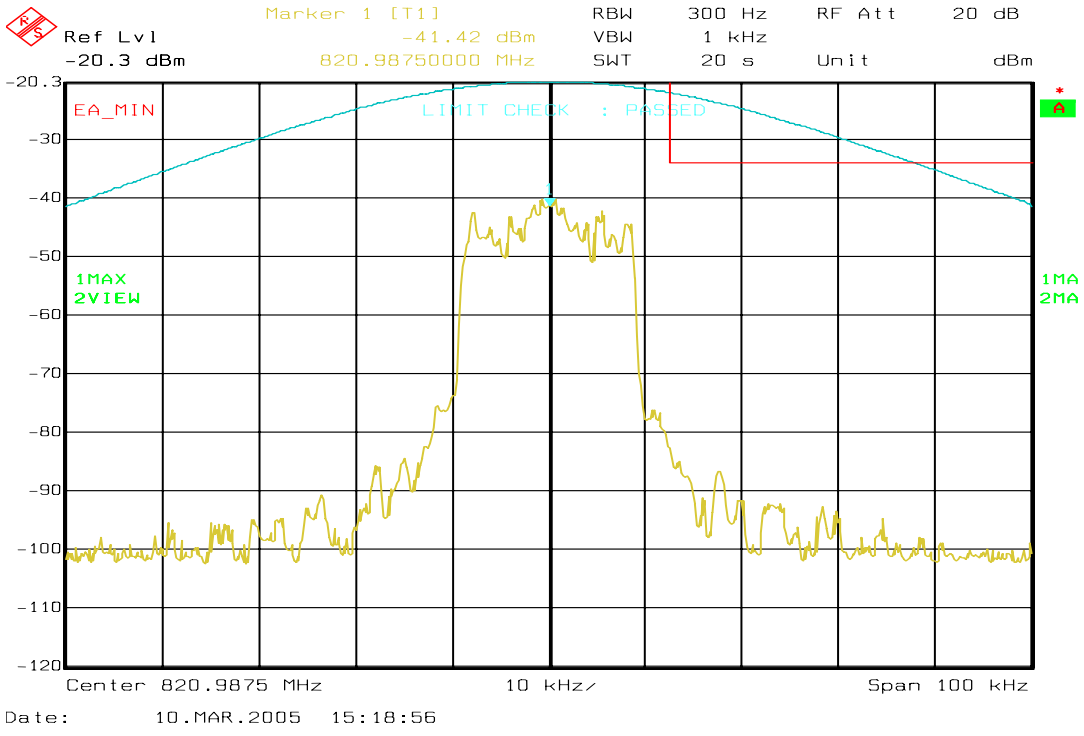


Figure 6a-17: iDEN 800 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.3 Emission Designator 18K3D7W - iDEN 900 MHz Band Measured Data

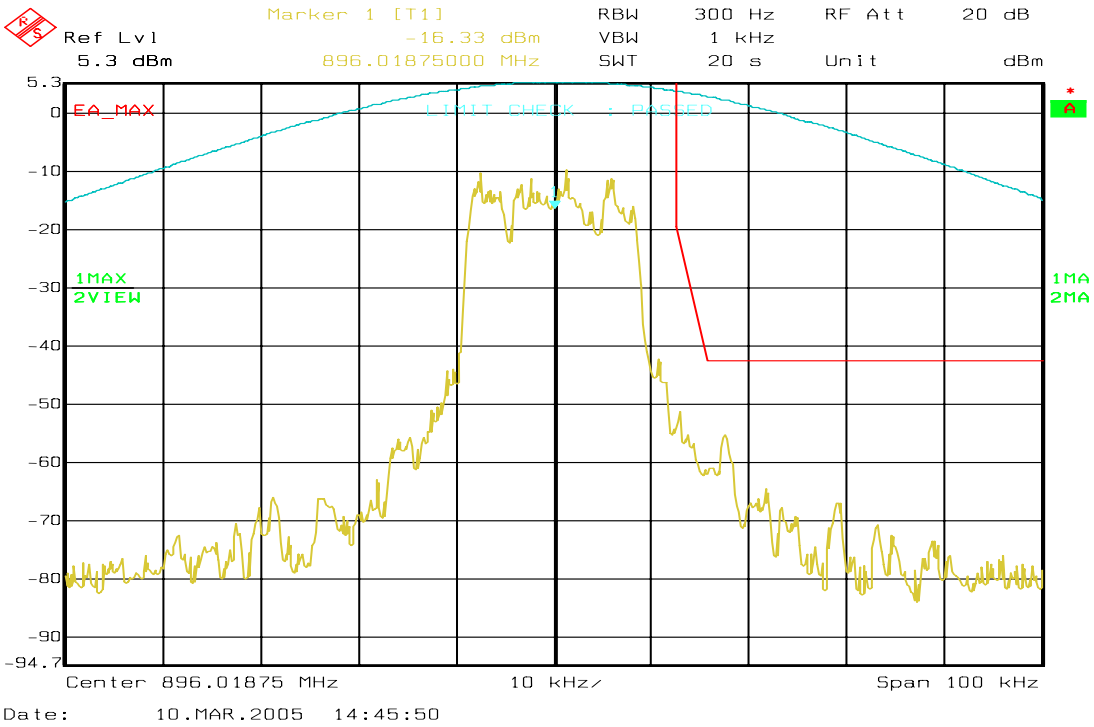


Figure 6a-18: iDEN 900 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

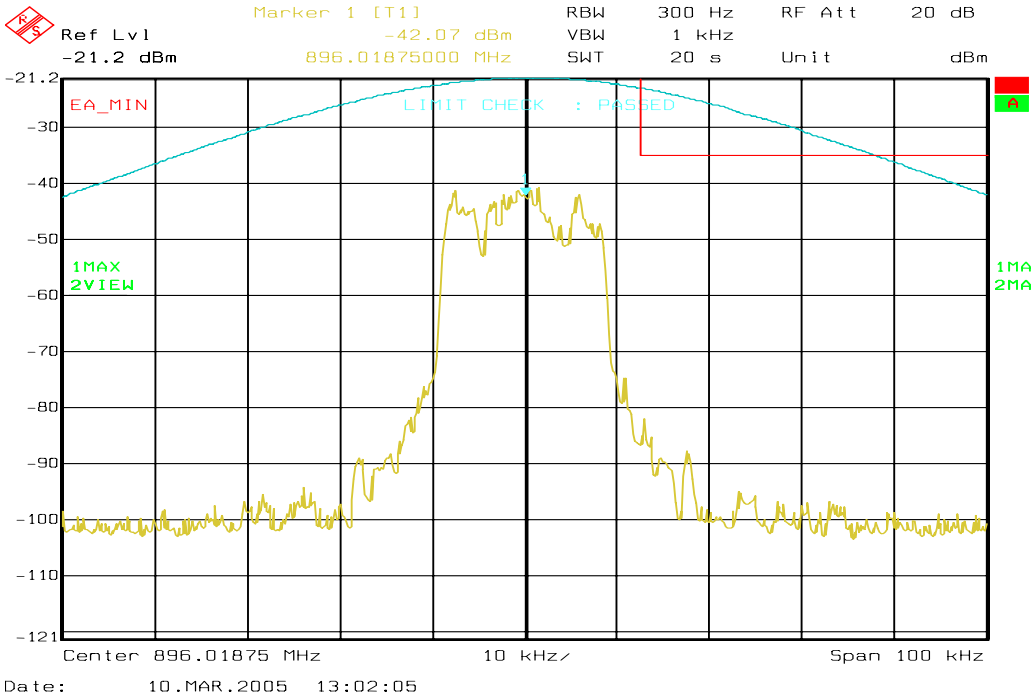


Figure 6a-19: iDEN 900 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

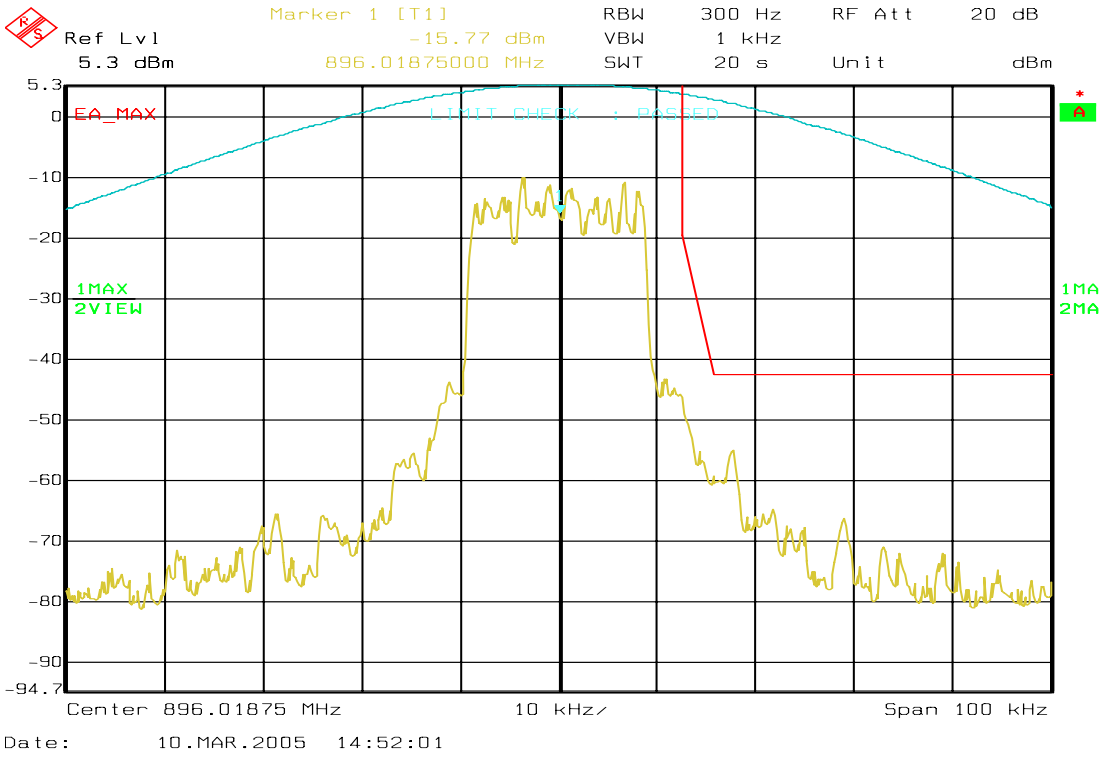


Figure 6a-20: iDEN 900 MHz Band, QAM16, Maximum Power, EA Emission Mask

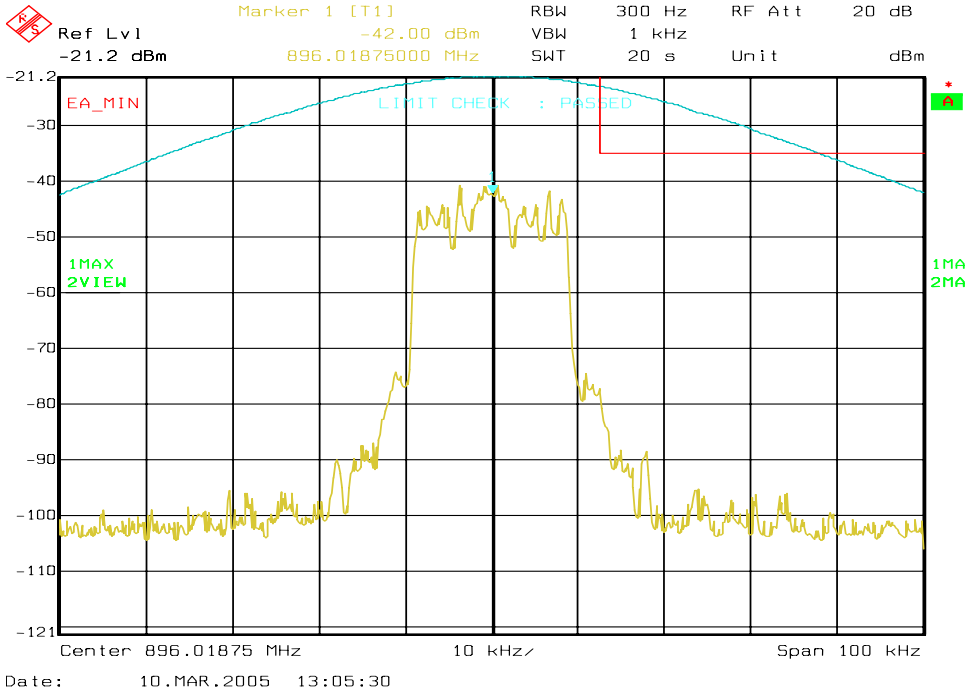


Figure 6a-21: iDEN 900 MHz Band, QAM16, Minimum Power, EA Emission Mask

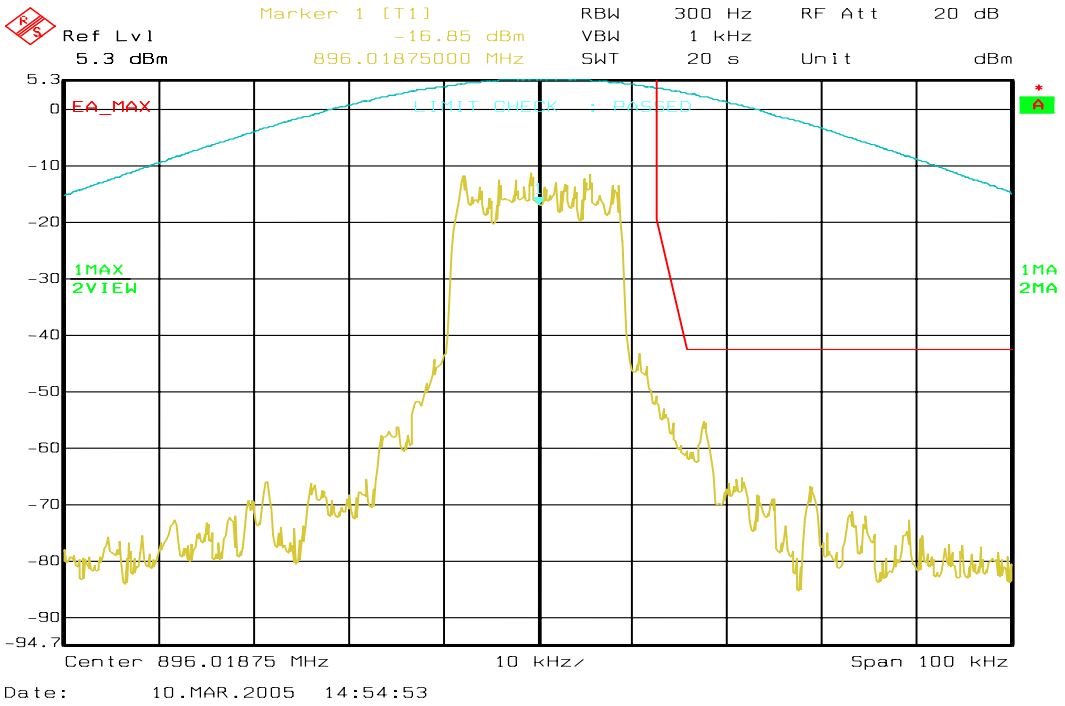


Figure 6a-22: iDEN 900 MHz Band, QAM64, Maximum Power, EA Emission Mask

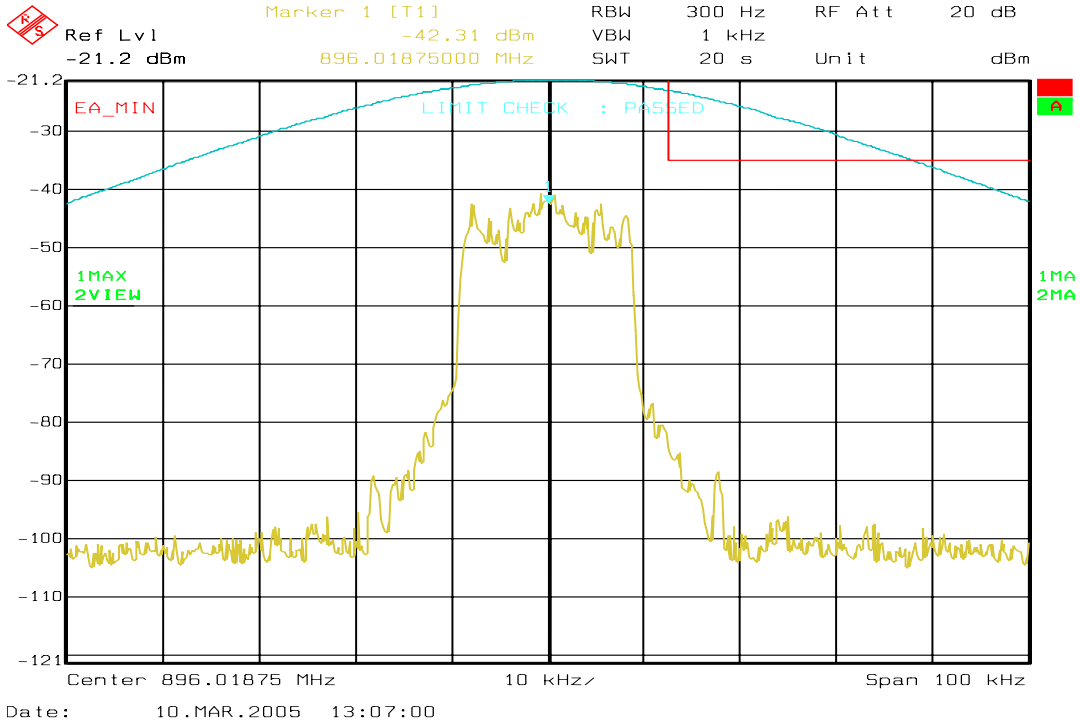


Figure 6a-23: iDEN 900 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.4 Emission Designator 18K3D7W - WiDEN25 800 MHz Band

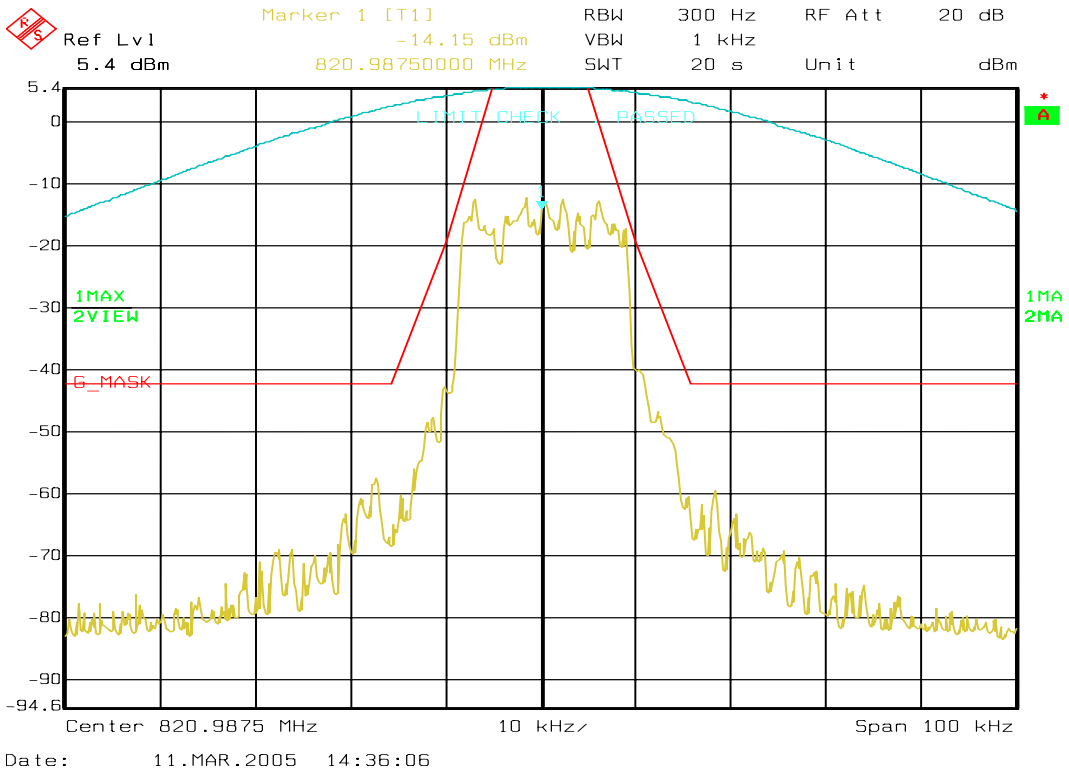


Figure 6a-24: WiDEN25 800 MHz Band, Quad-QPSK, Maximum Power, Emission Mask G

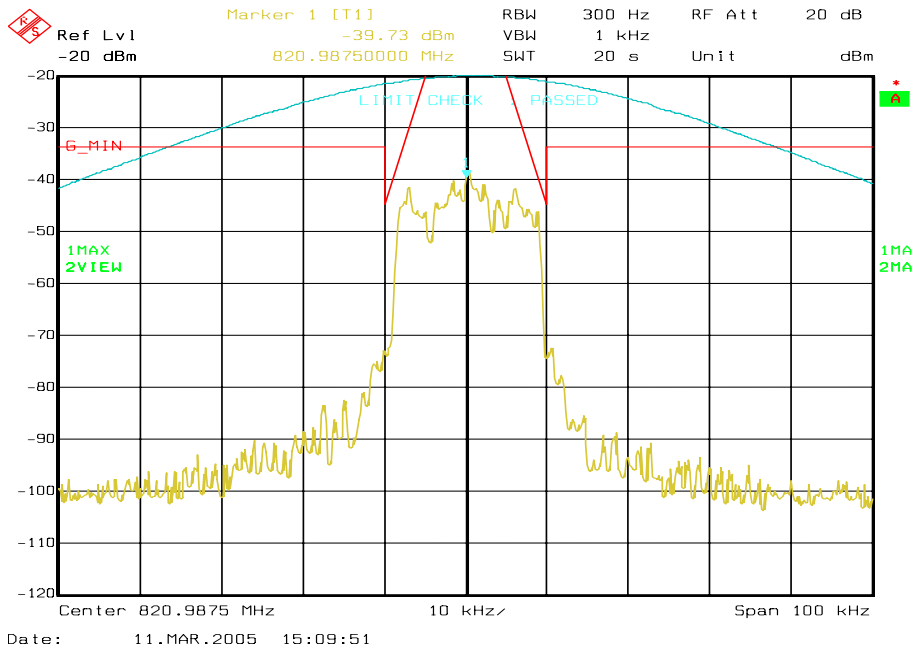


Figure 6a-25: WiDEN25 800 MHz Band, Quad-QPSK, Minimum Power, Emission Mask G

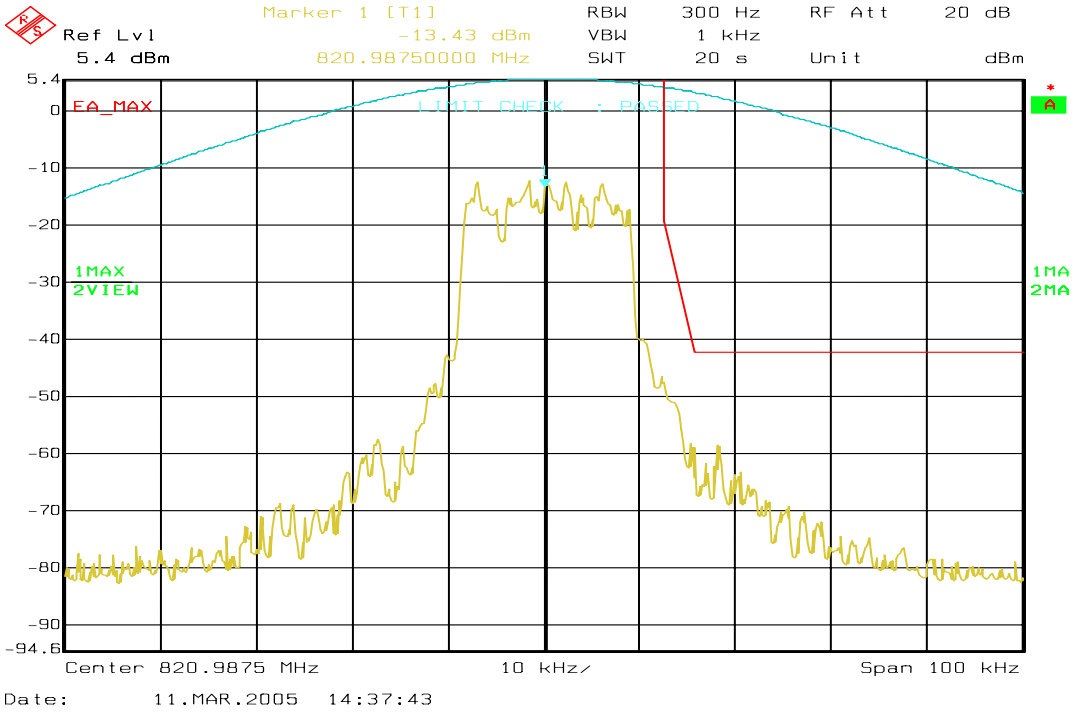


Figure 6a-26: WiDEN25 800 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

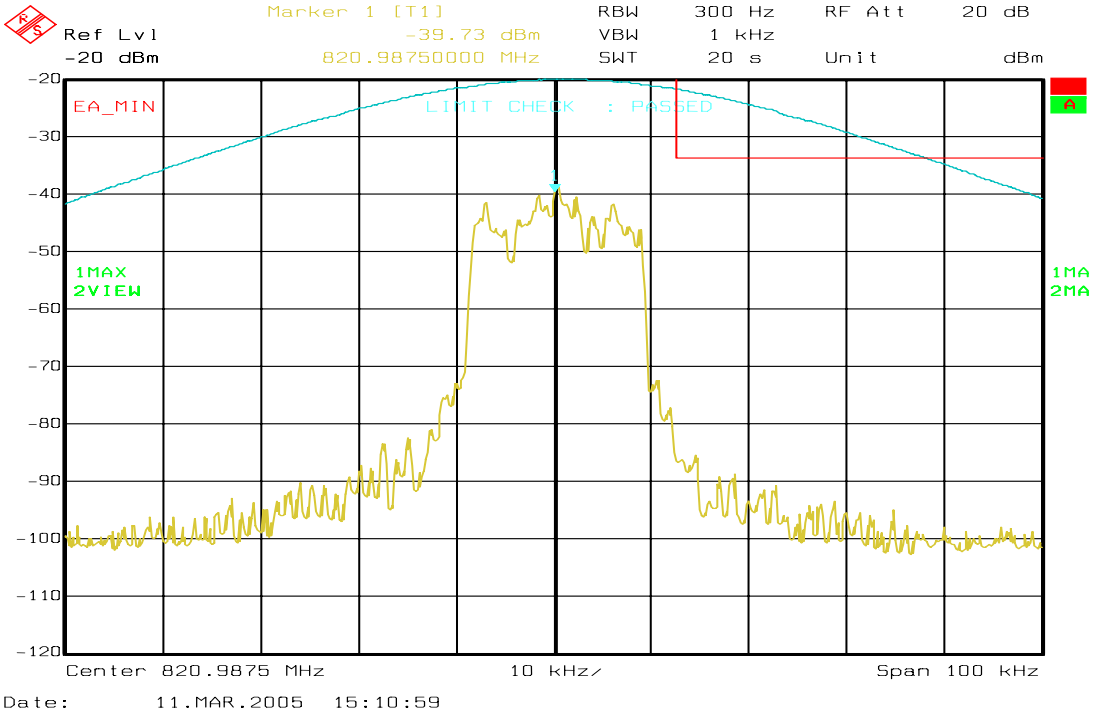


Figure 6a- 27: WiDEN25 800 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

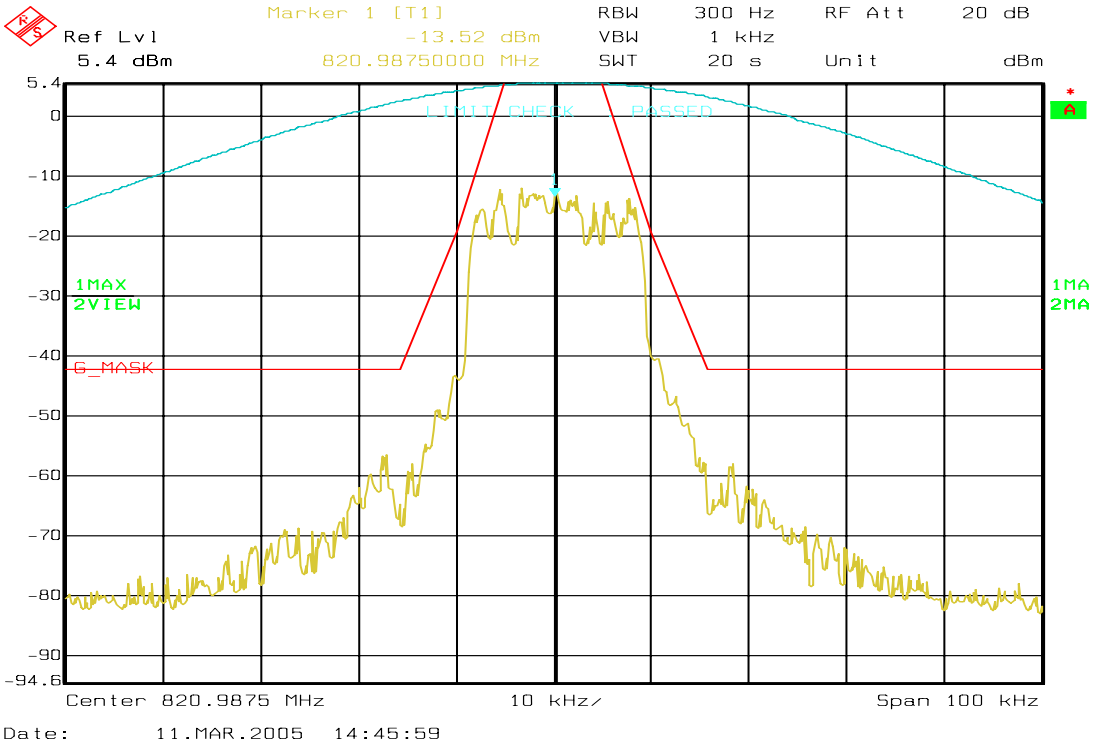


Figure 6a-28: WiDEN25 800 MHz Band, QAM16, Maximum Power, Emission Mask G

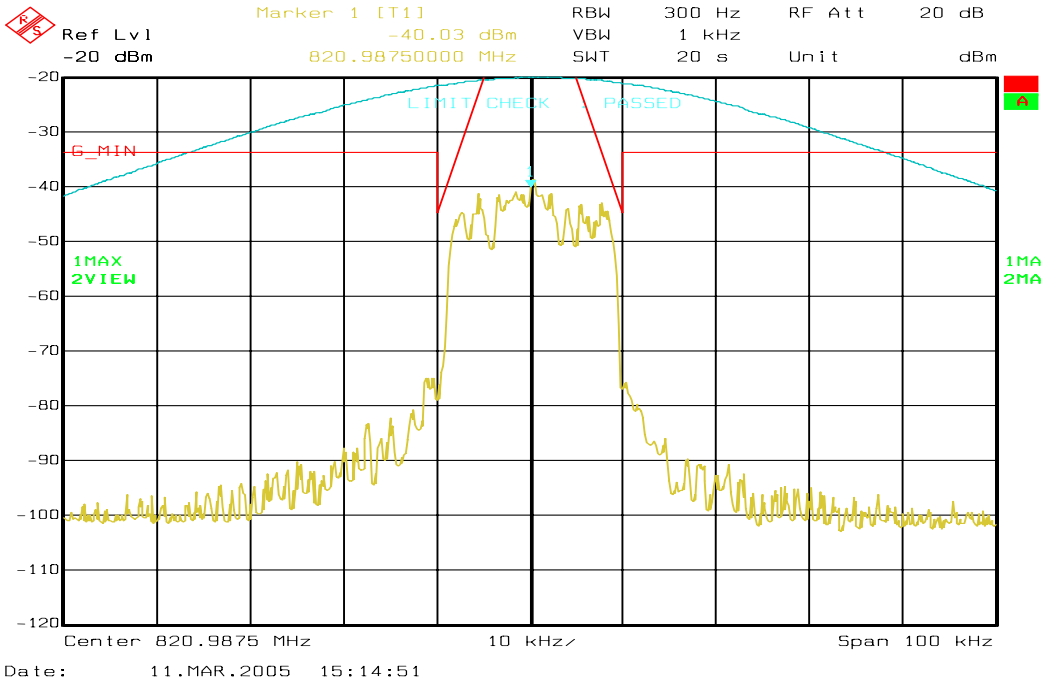


Figure 6a-29: WiDEN25 800 MHz Band, QAM16, Minimum Power, Emission Mask G

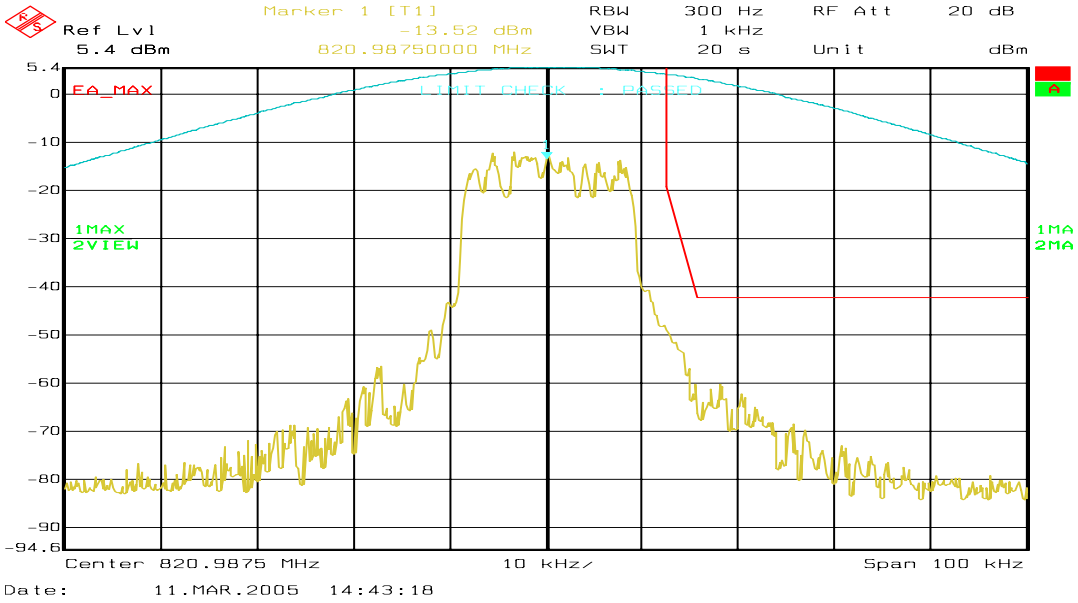


Figure 6a-30: WiDEN25 800 MHz Band, QAM16, Maximum Power, EA Emission Mask

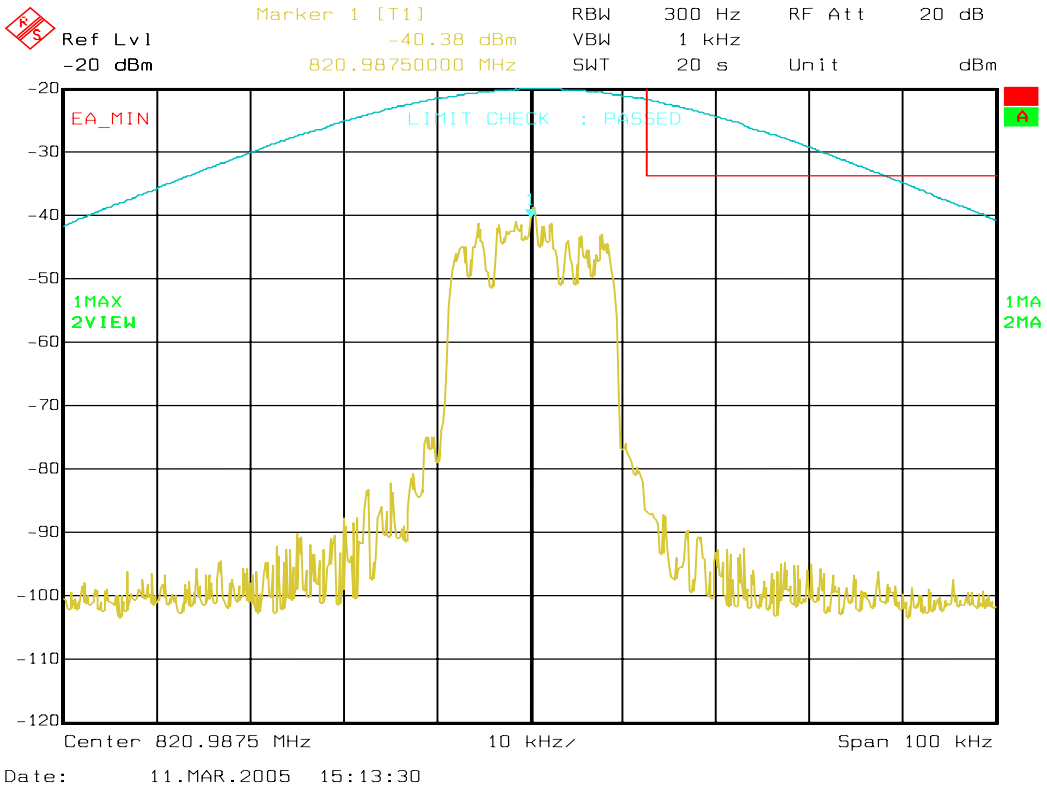


Figure 6a-31: WiDEN25 800 MHz Band, QAM16, Minimum Power, EA Emission Mask

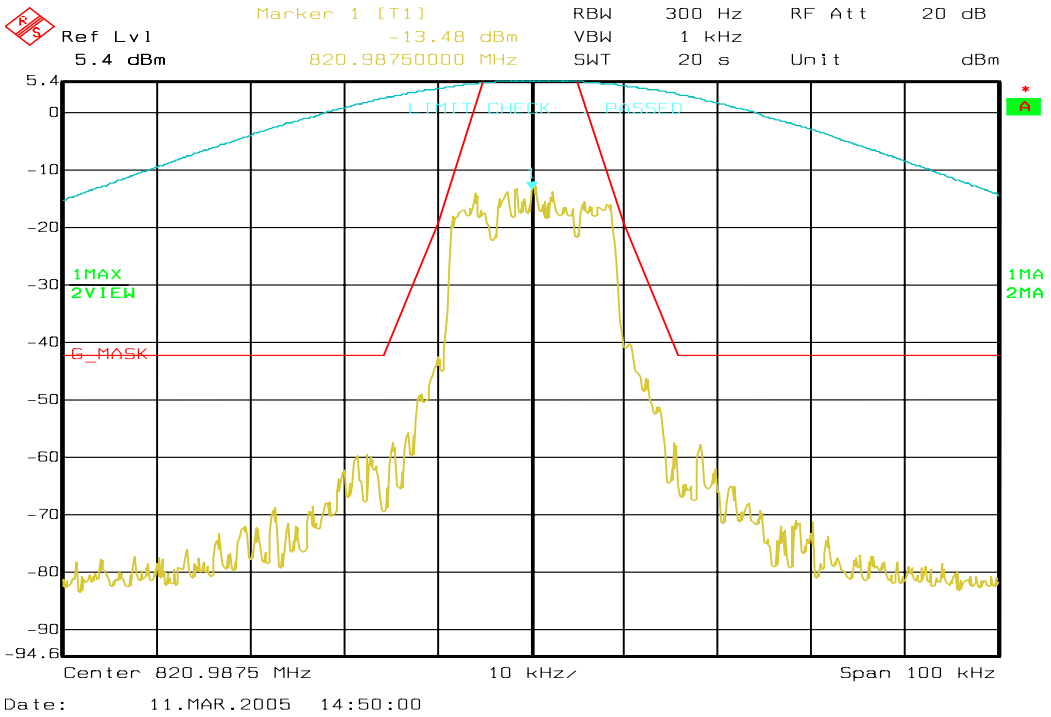


Figure 6a-32: WiDEN25 800 MHz Band, QAM64, Maximum Power, Emission Mask G

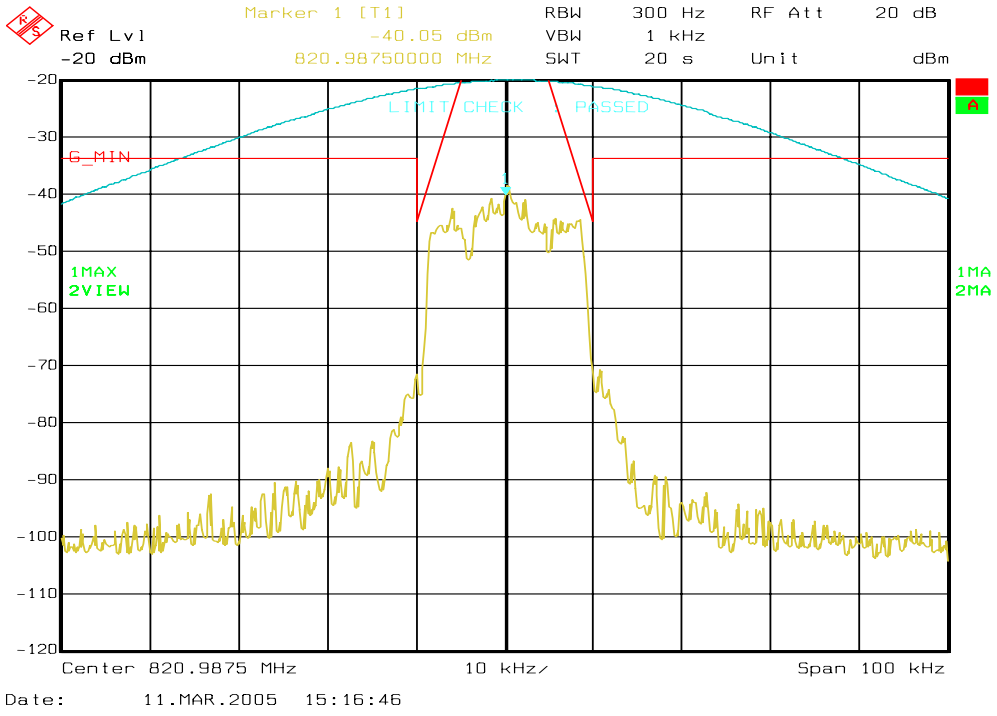


Figure 6a-33: WiDEN25 800 MHz Band, QAM64, Minimum Power, Emission Mask G

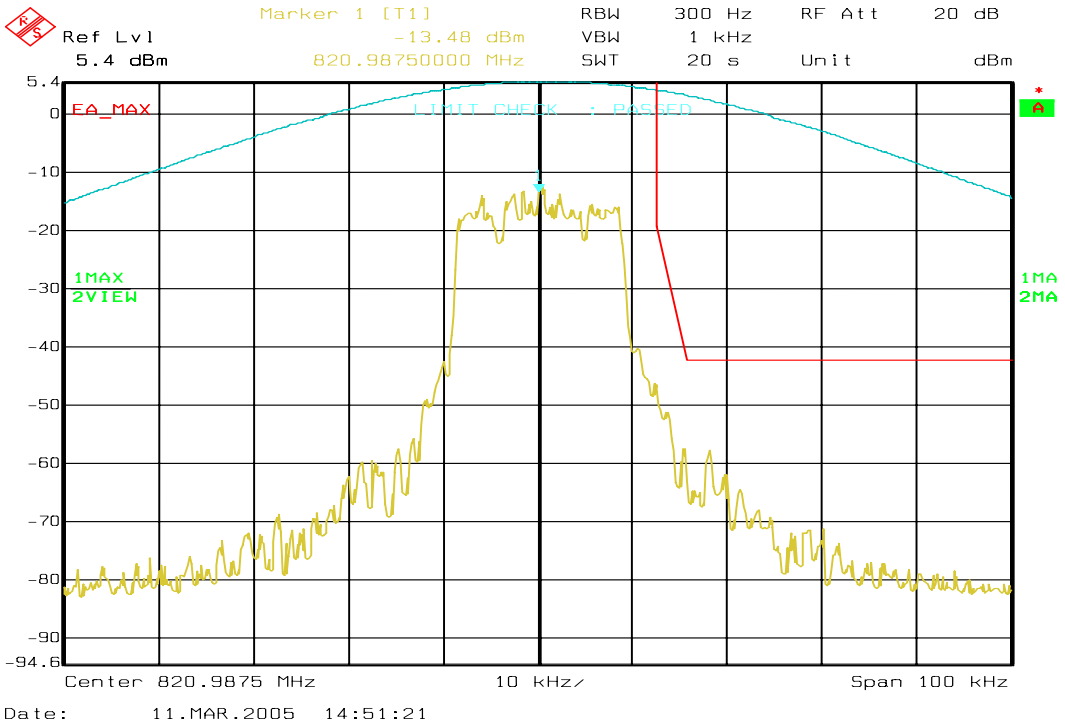


Figure 6a-34: WiDEN25 800 MHz Band, QAM64, Maximum Power, EA Emission Mask

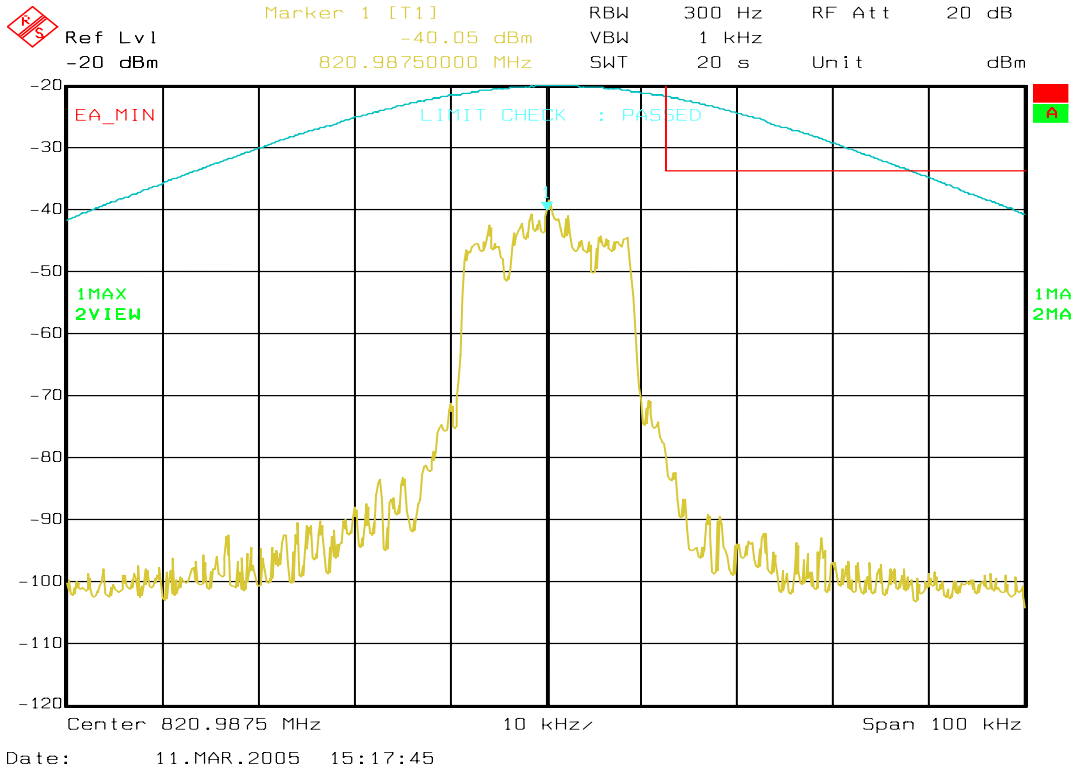


Figure 6a-35: WiDEN25 800 MHz Band, QAM64, Minimum Power, EA Emission Mask

6.a.2.5: Emission Designator 43K3D7D - WiDEN50 800 MHz Band

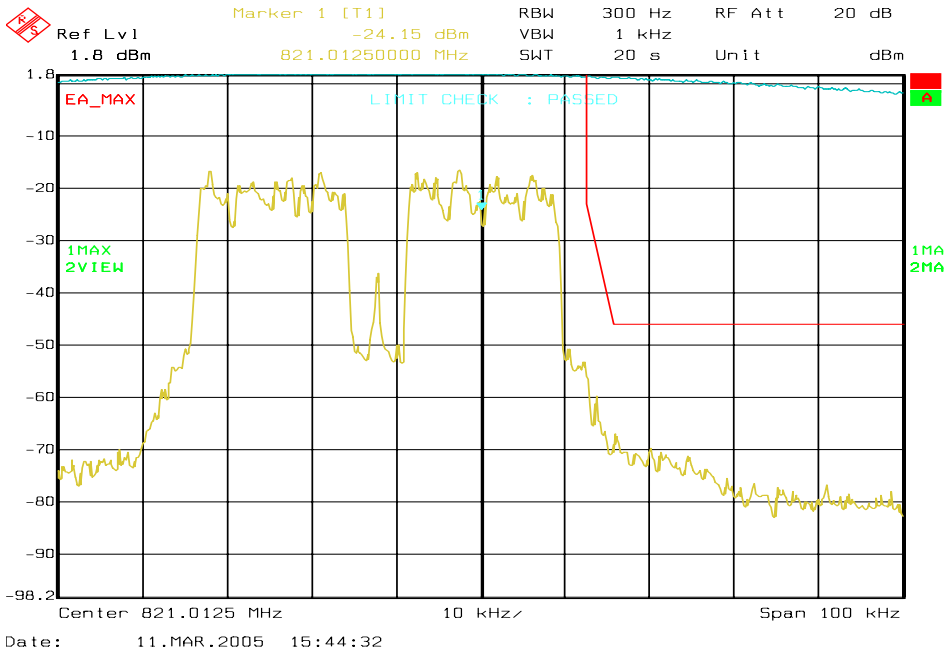


Figure 6a-36: WiDEN50 800 MHz Band, Continuous Quad-QPSK, Maximum Power, EA Emission Mask

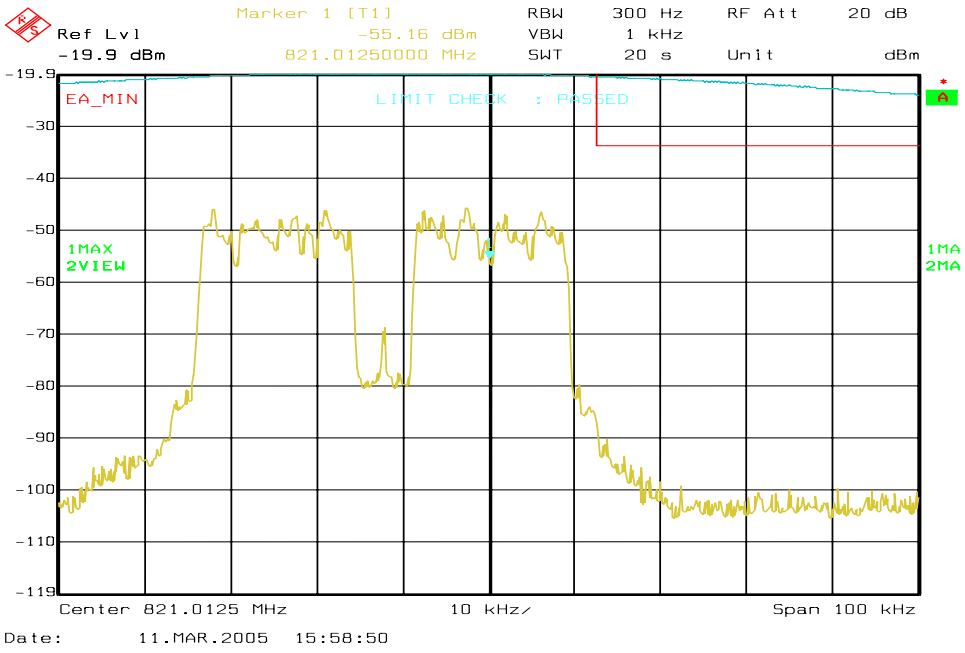


Figure 6a-37: WiDEN50 800 MHz Band, Continuous Quad-QPSK, Minimum Power, EA Emission Mask

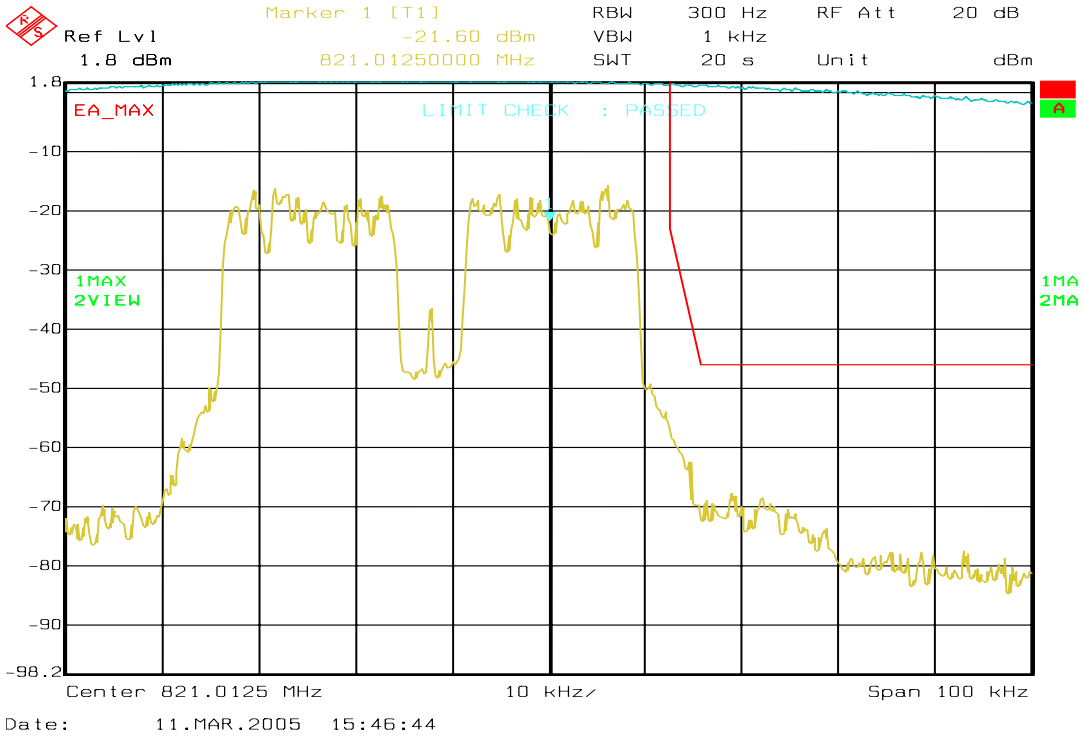


Figure 6a- 38. WiDEN50 800 MHz Band, Continuous QAM16, Maximum Power, EA Emission Mask

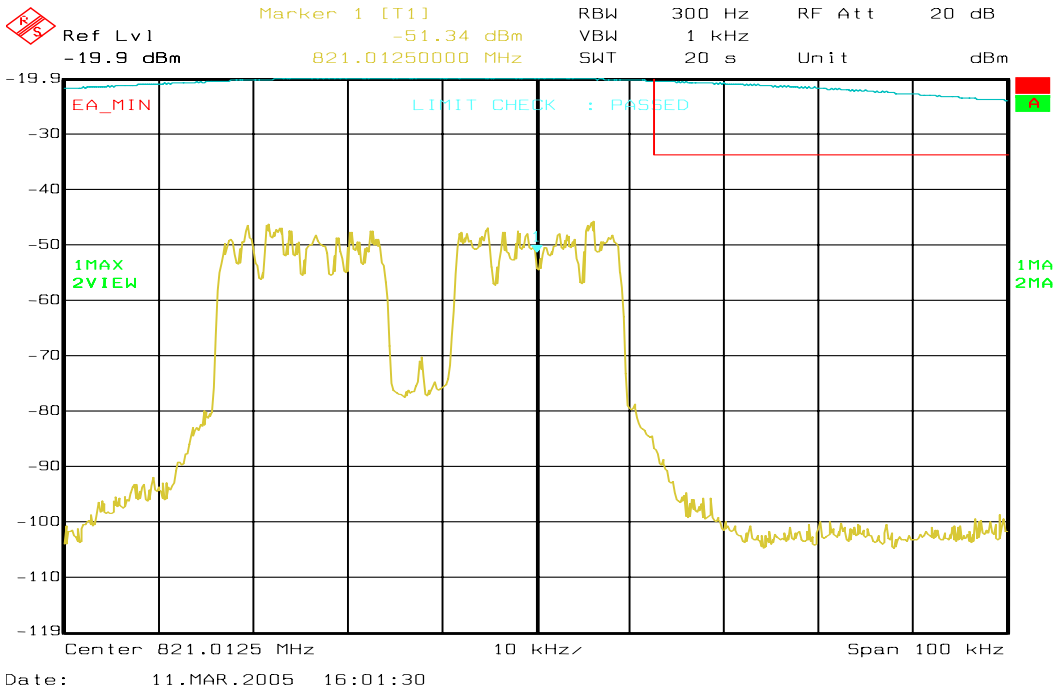


Figure 6a-39 . WiDEN50 800 MHz Band, Continuous QAM16, Minimum Power, EA Emission Mask

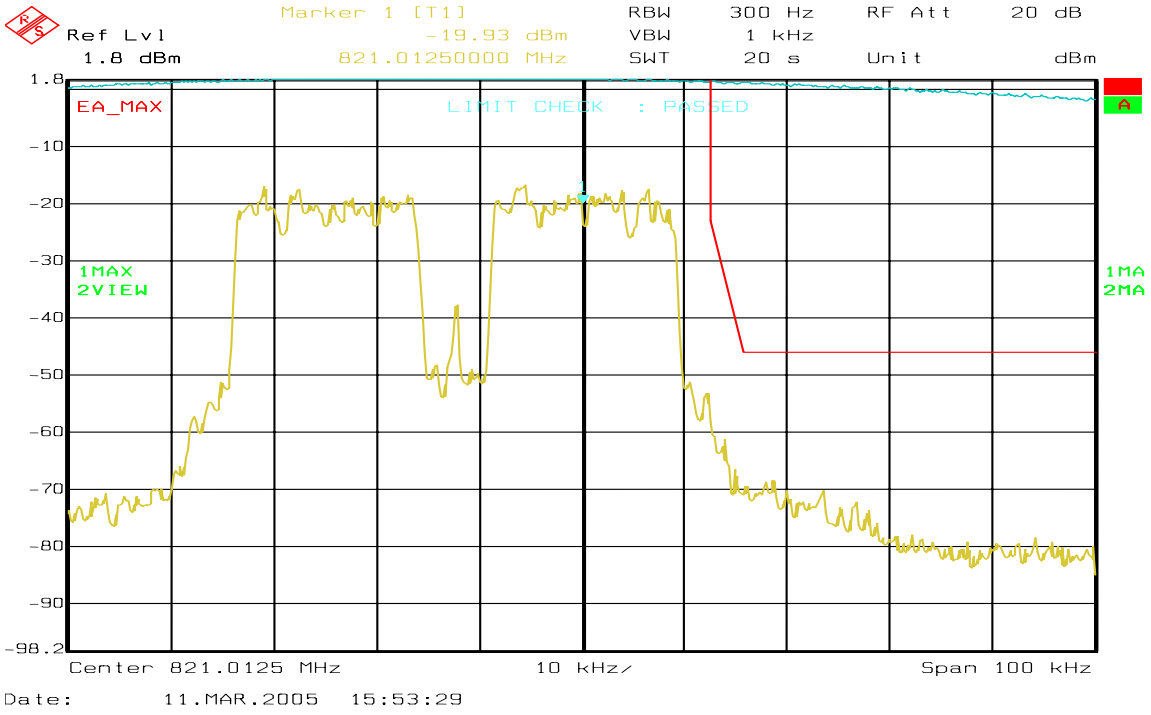


Figure 6a-40 . WiDEN50 800 MHz Band, Continuous QAM64, Maximum Power, EA Emission Mask

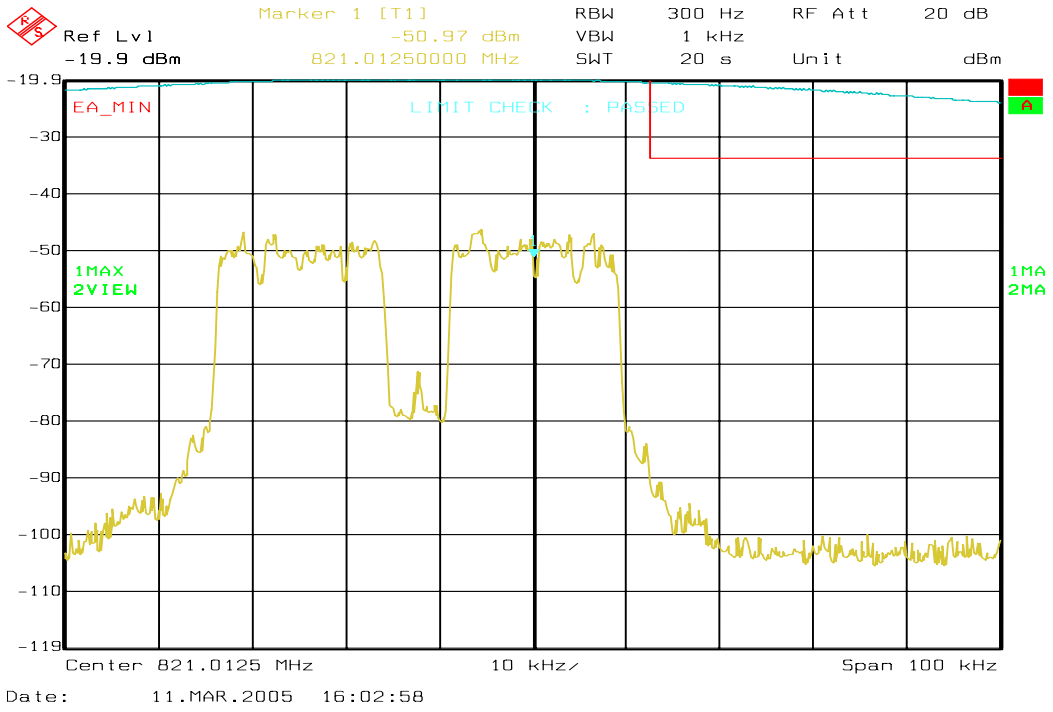


Figure 6a-41 . WiDEN50 800 MHz Band, Continuous QAM64, Minimum Power, EA Emission Mask

6a.2.6 Emission Designator 68K3D7D - WiDEN75 800 MHz Band

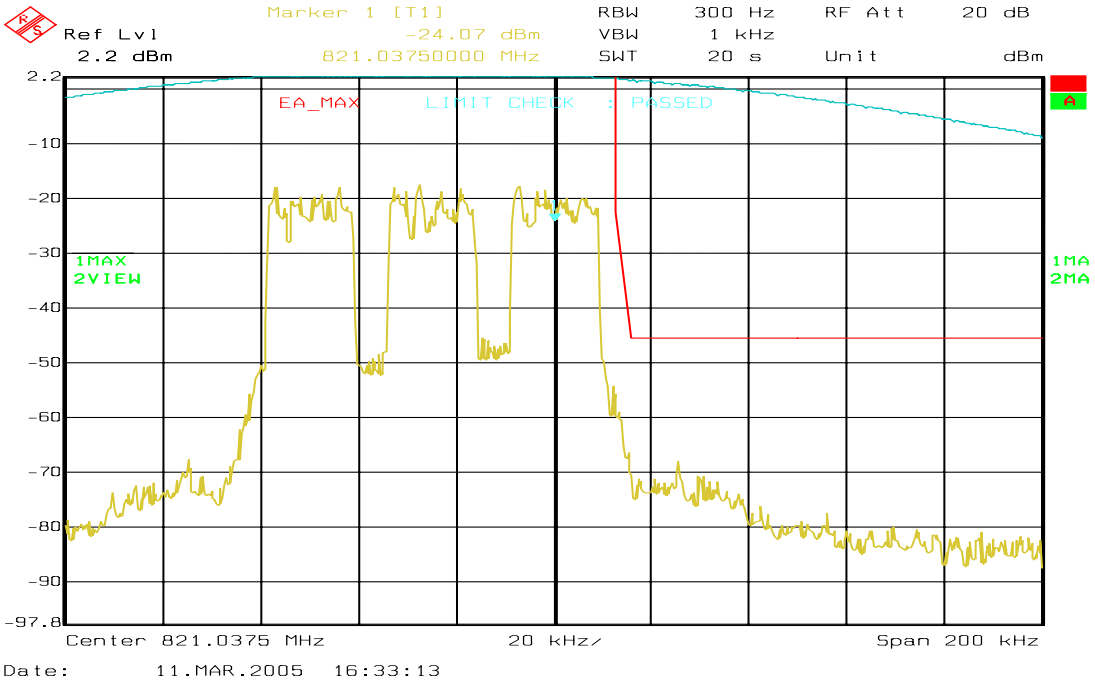


Figure 6a-42 . WiDEN75 800 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

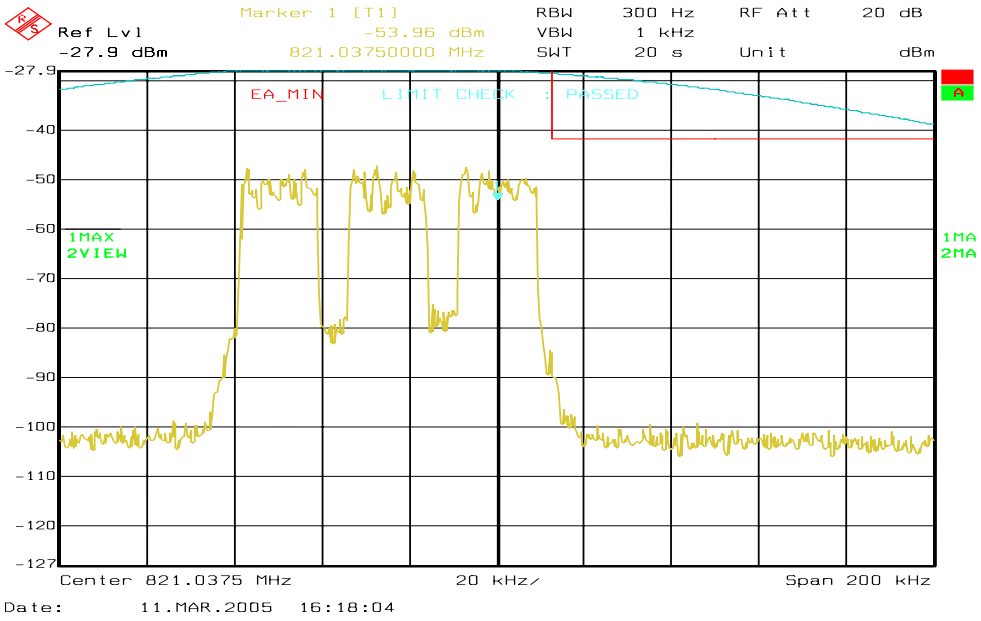


Figure 6a-43 . WiDEN75 800 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

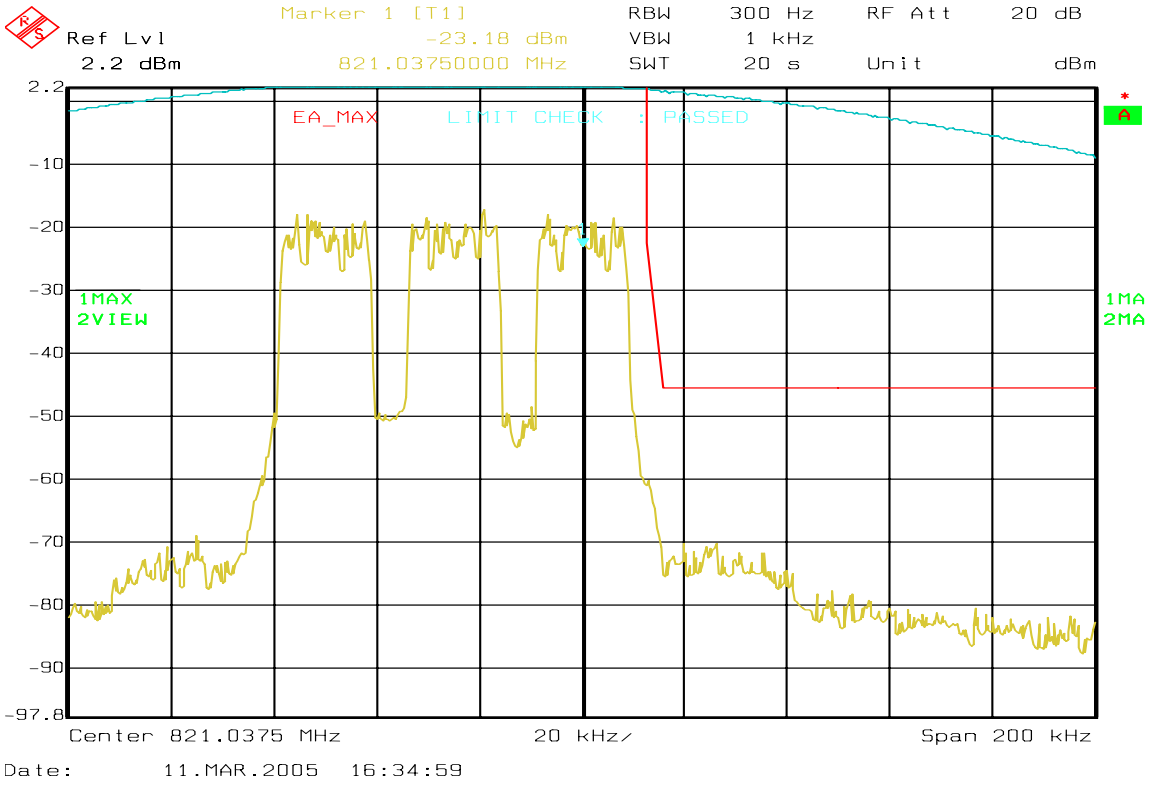


Figure 6a-44 . WiDEN75 800 MHz Band, QAM16, Maximum Power, EA Emission Mask

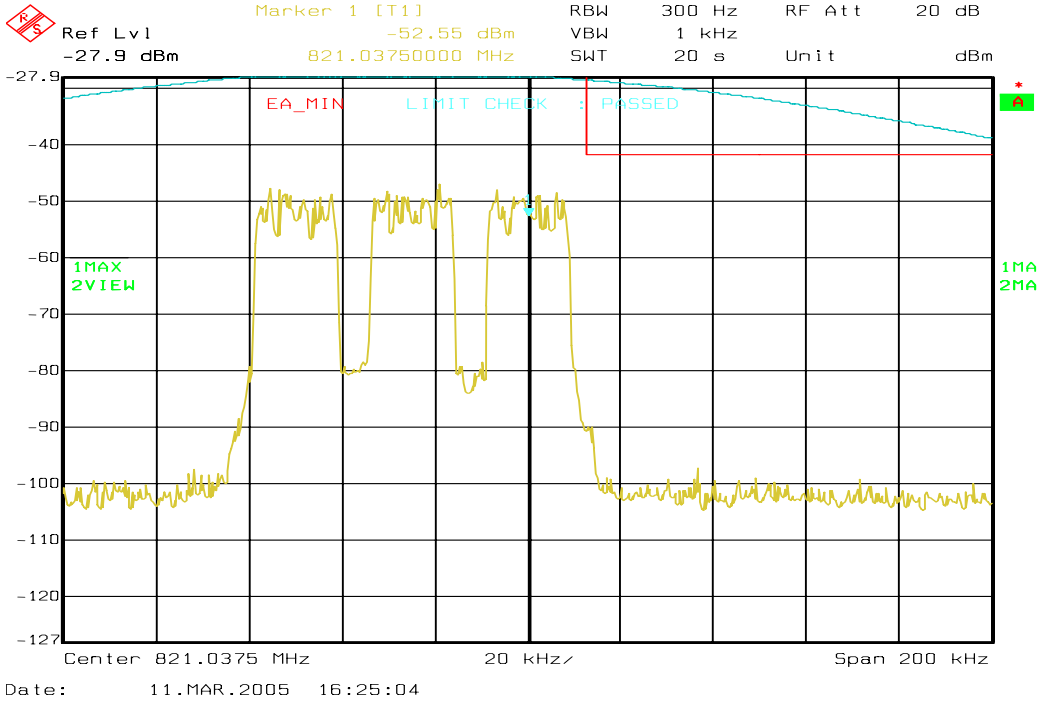


Figure 6a-45 . WiDEN75 800 MHz Band, QAM16, Minimum Power, EA Emission Mask

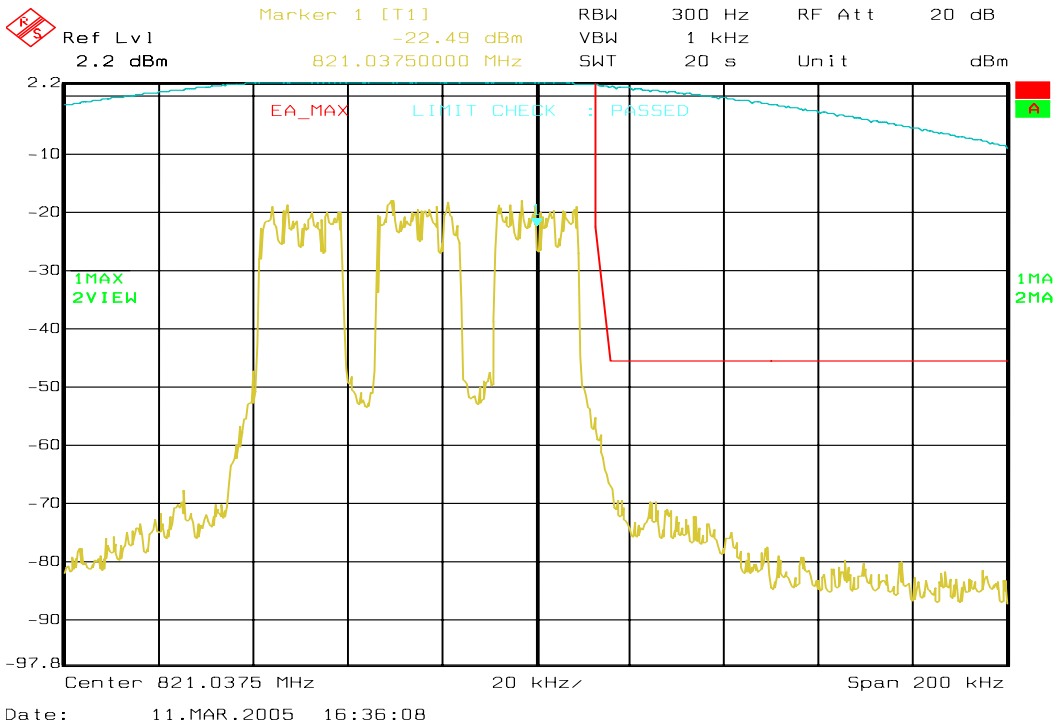


Figure 6a-46 . WiDEN75 800 MHz Band, QAM64, Maximum Power, EA Emission Mask

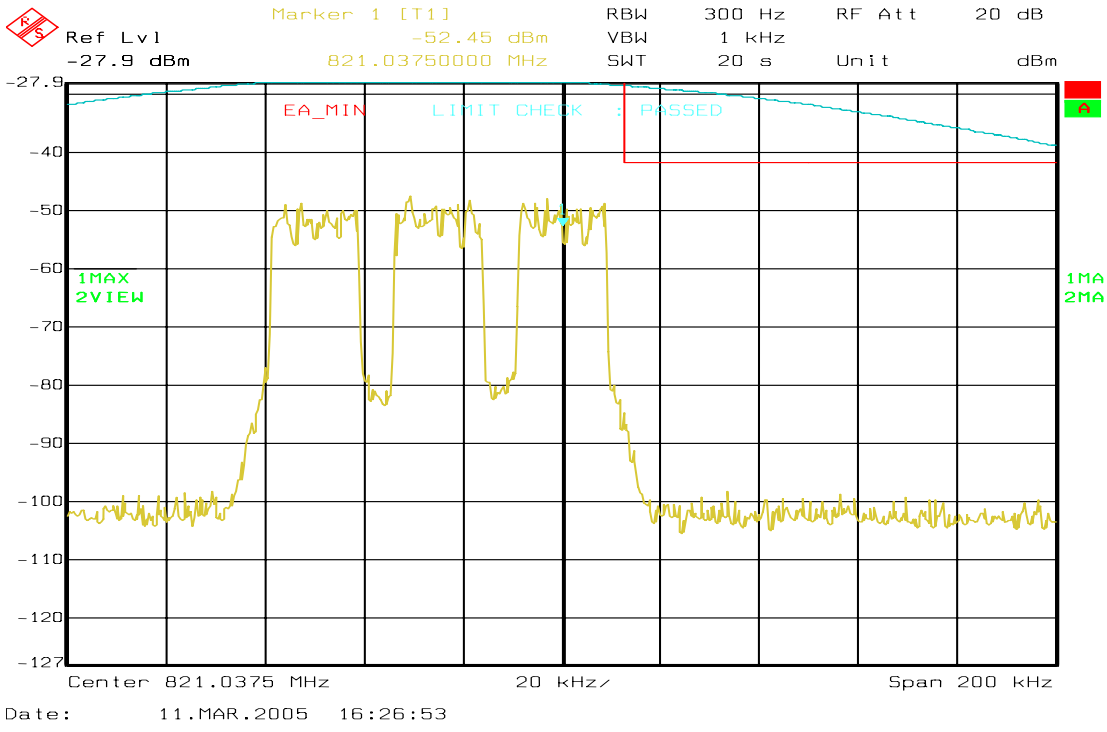


Figure 6a-47 . WiDEN75 800 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.7 Emission Designator 93K3D7D - WiDEN100 800 MHz Band

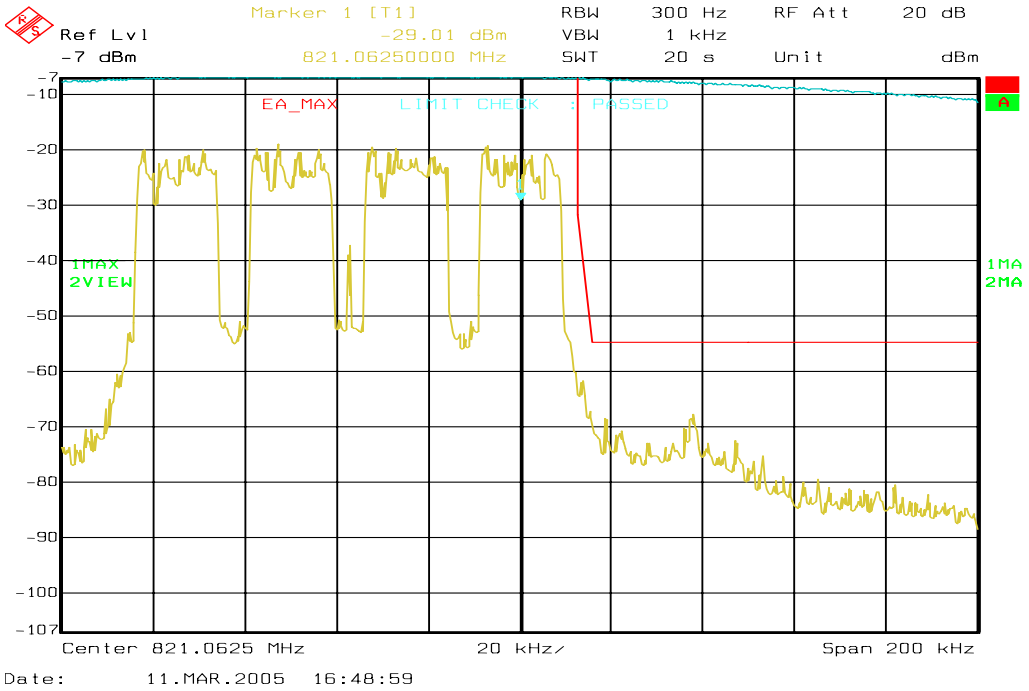


Figure 6a-48 . WiDEN100 800 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

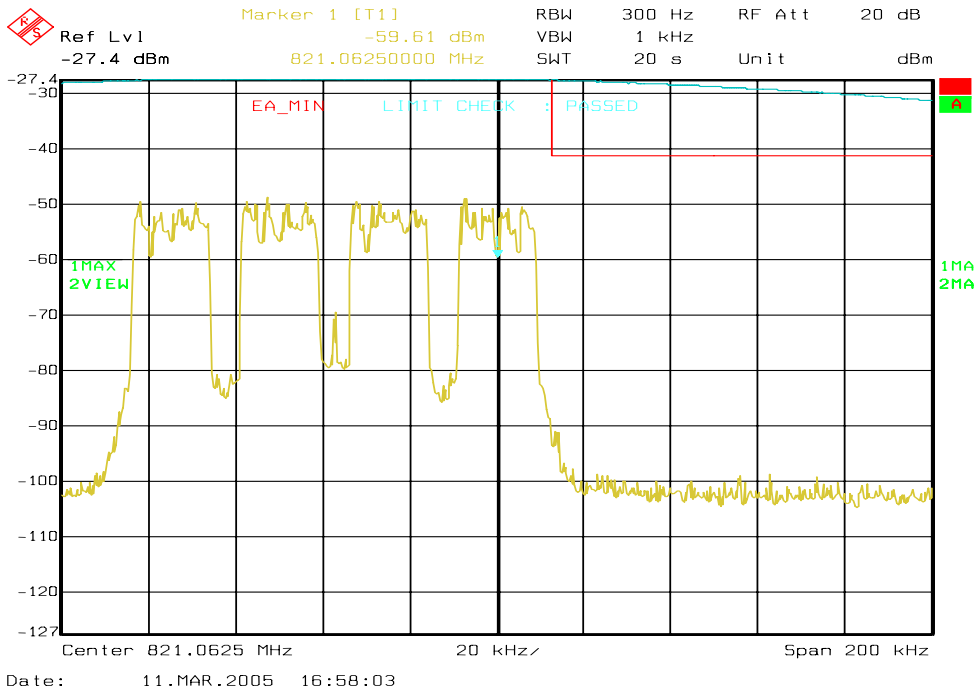


Figure 6a-49 . WiDEN100 800 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

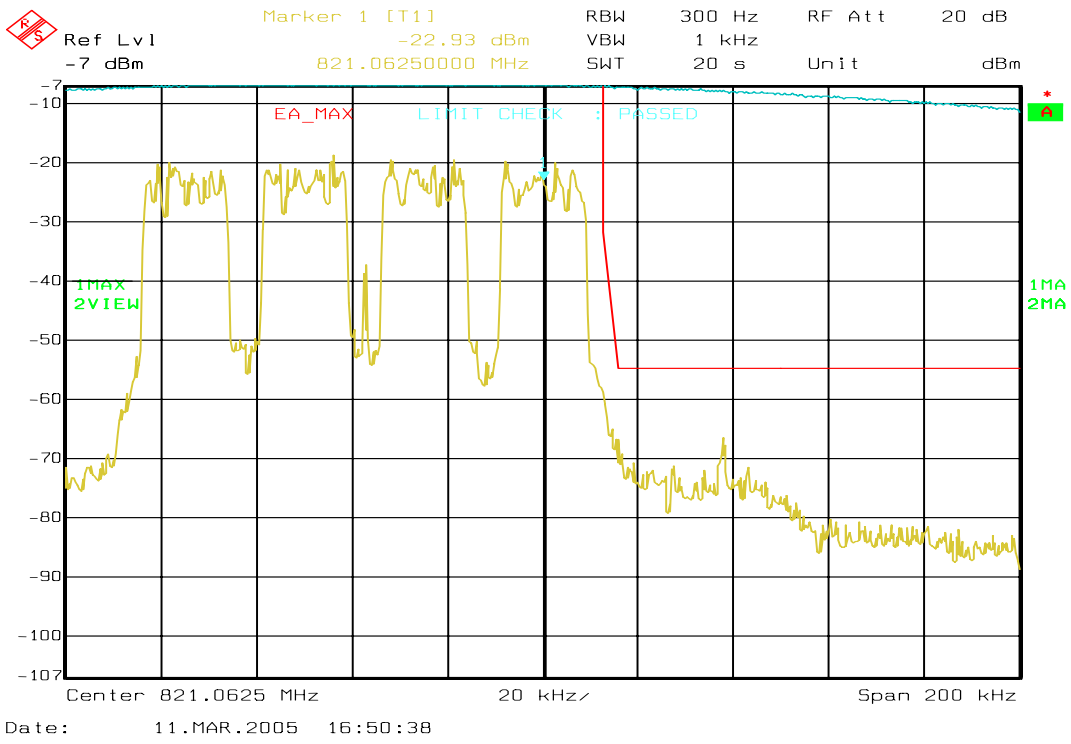


Figure 6a-50 . WiDEN100 800 MHz Band, QAM16, Maximum Power, EA Emission Mask

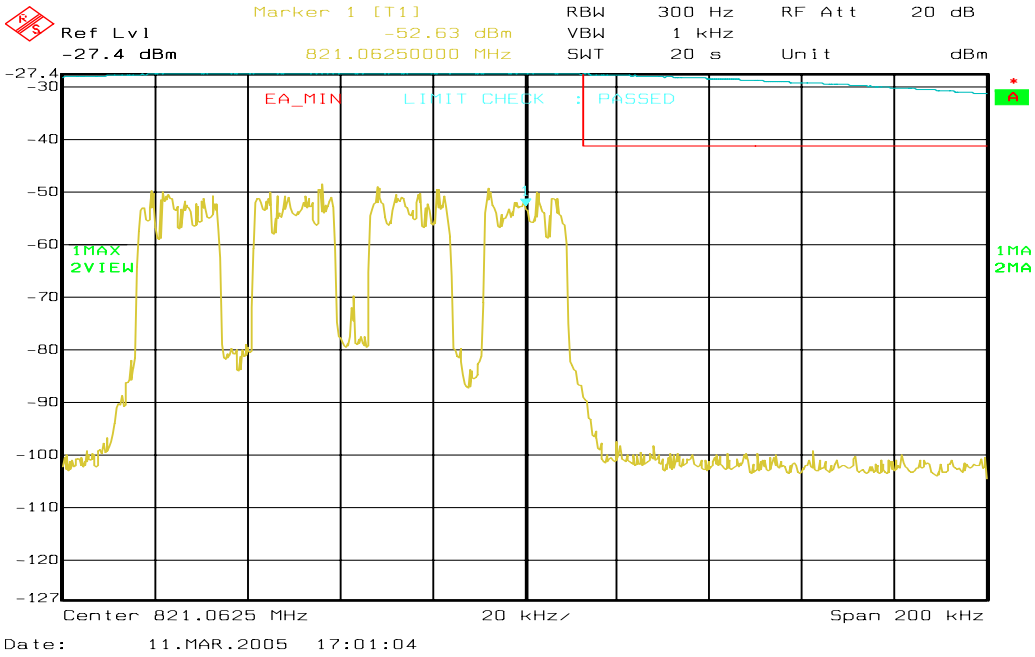


Figure 6a-51 . WiDEN100 800 MHz Band, QAM16, Minimum Power, EA Emission Mask

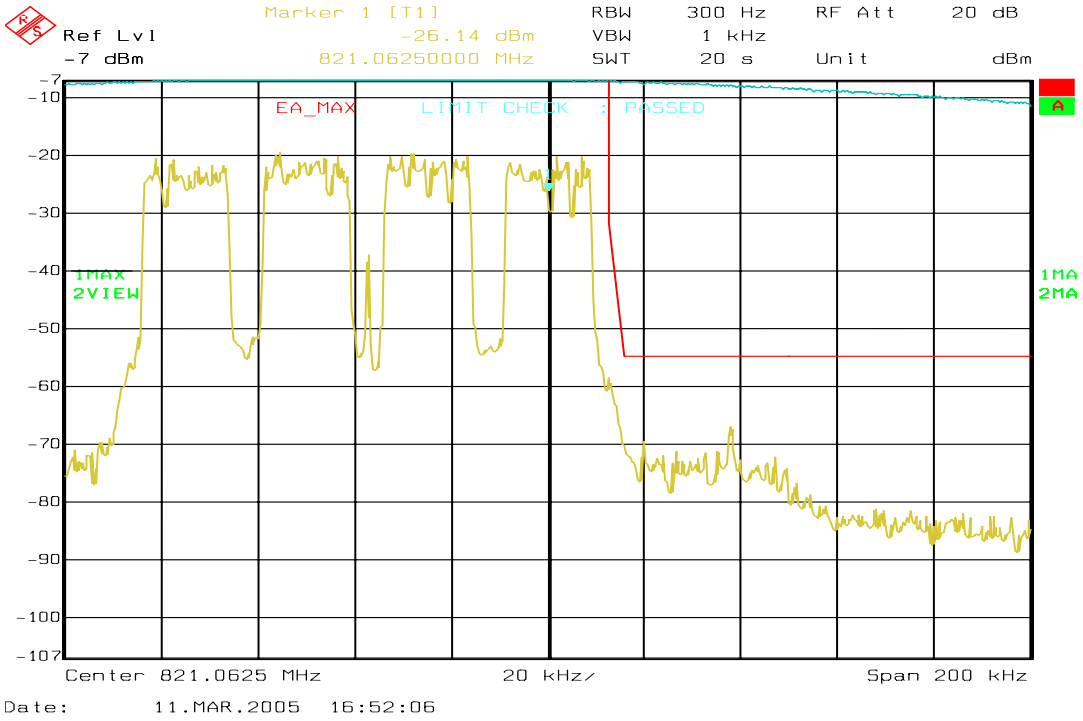


Figure 6a-52 . WiDEN100 800 MHz Band, QAM64, Maximum Power, EA Emission Mask

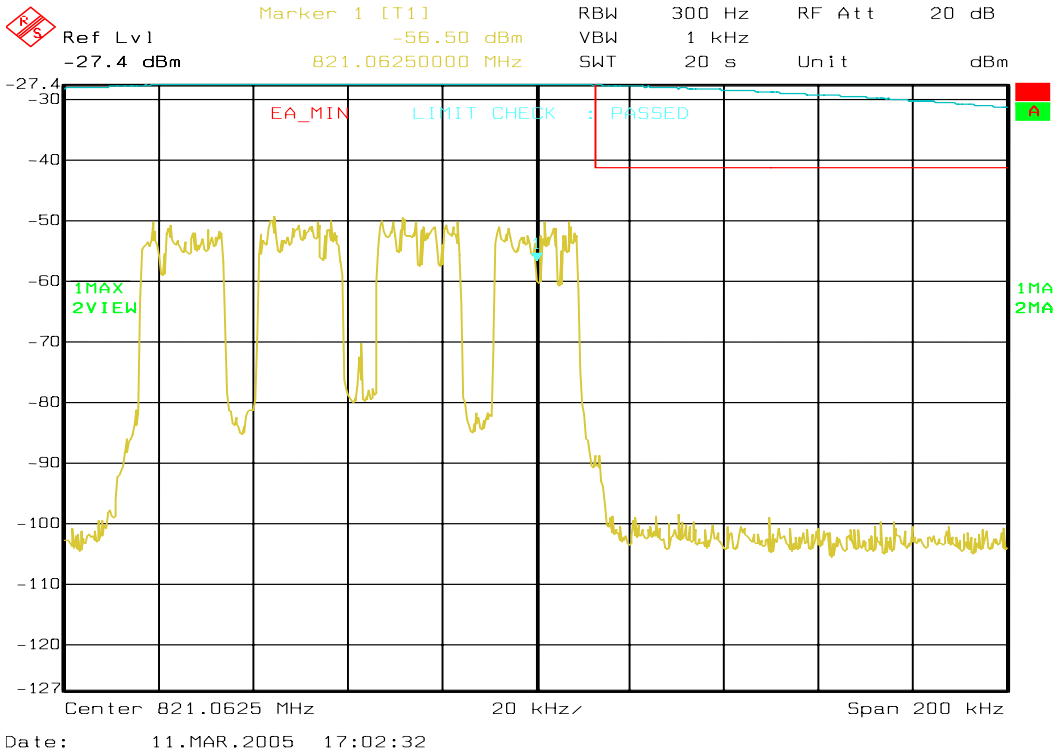


Figure 6a-53 . WiDEN100 800 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.8 Emission Designator 93K3D7D - WiDEN50_Split 800 MHz Band

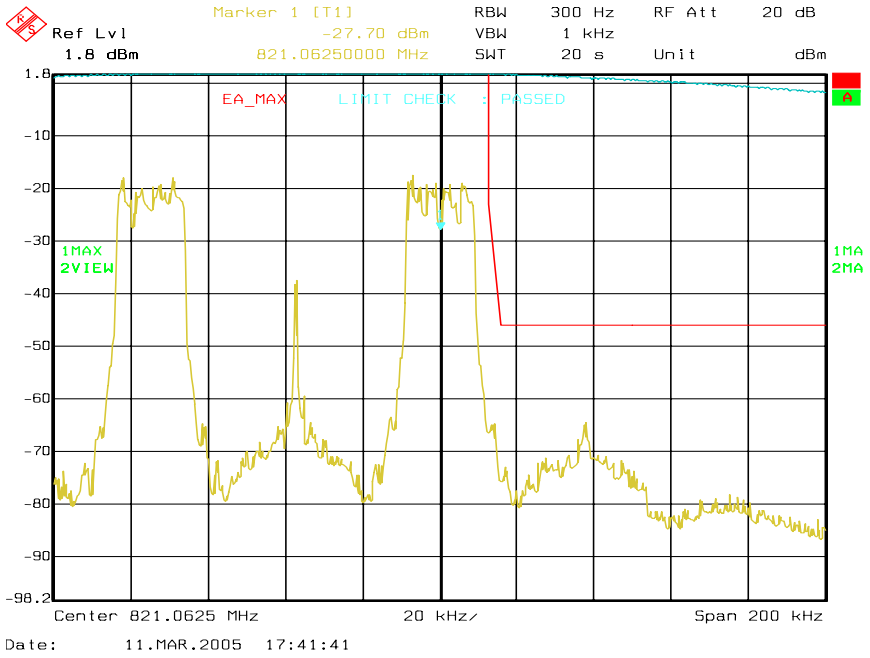


Figure 6a-54 . WiDEN_50_Split 800 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

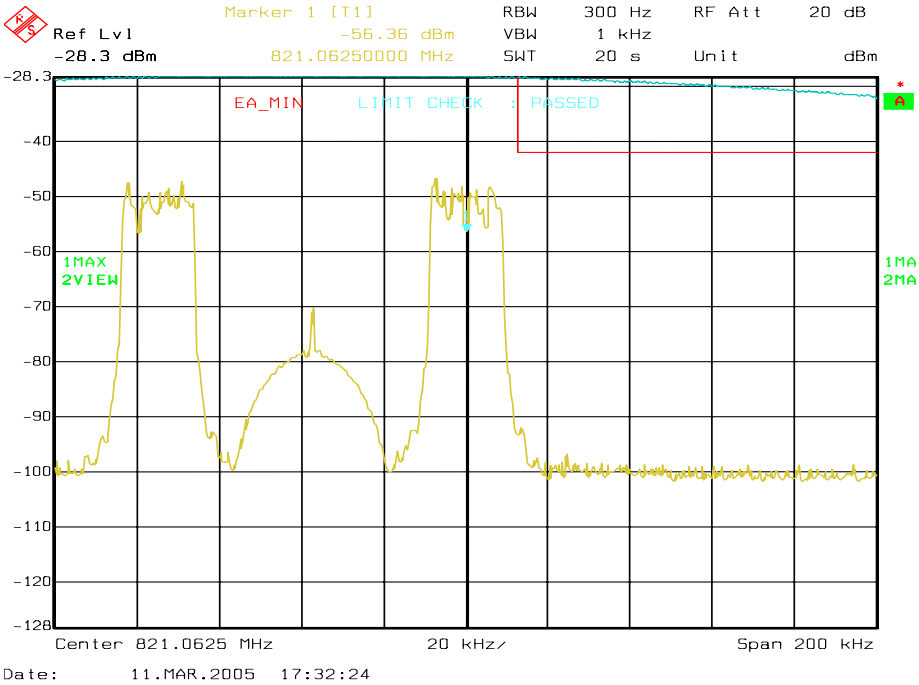


Figure 6a-55 . WiDEN_50_Split 800 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

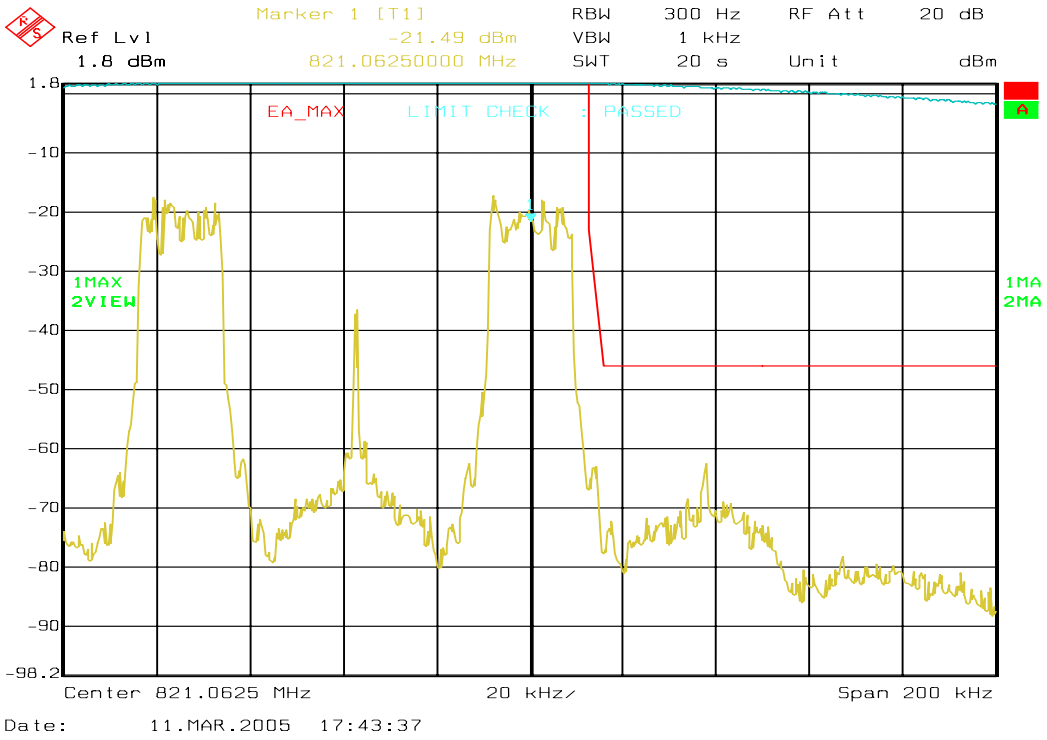


Figure 6a-56 . WiDEN_50_Split 800 MHz Band, QAM16, Maximum Power, EA Emission Mask

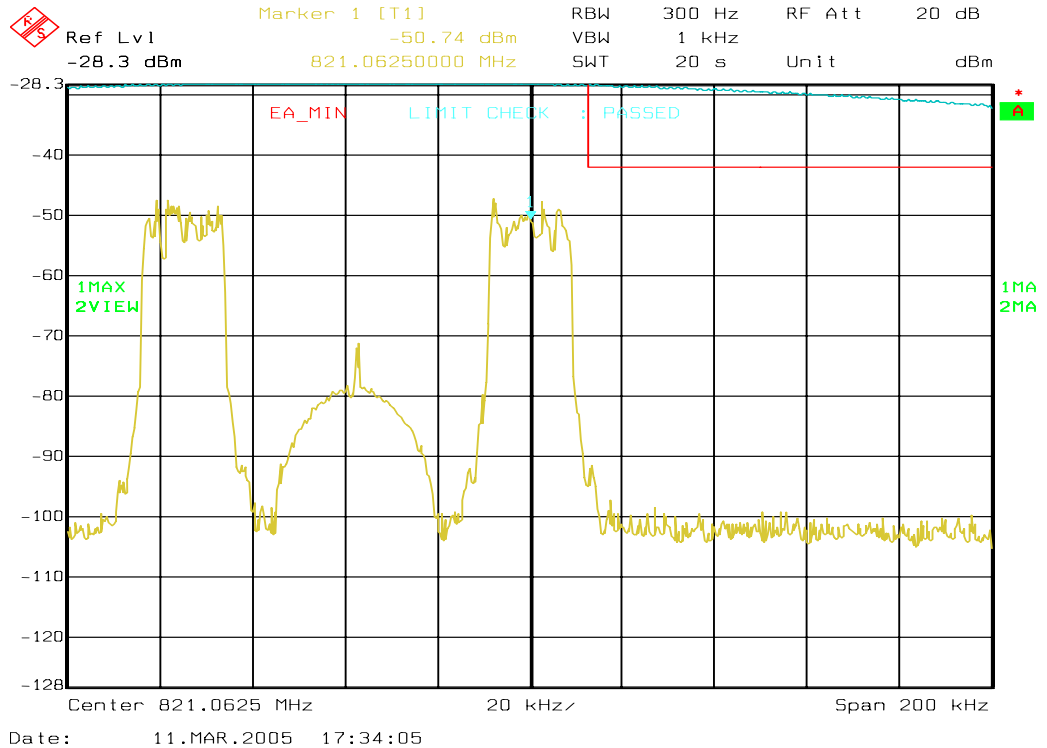


Figure 6a-57 . WiDEN_50_Split 800 MHz Band, QAM16, Minimum Power, EA Emission

Mask

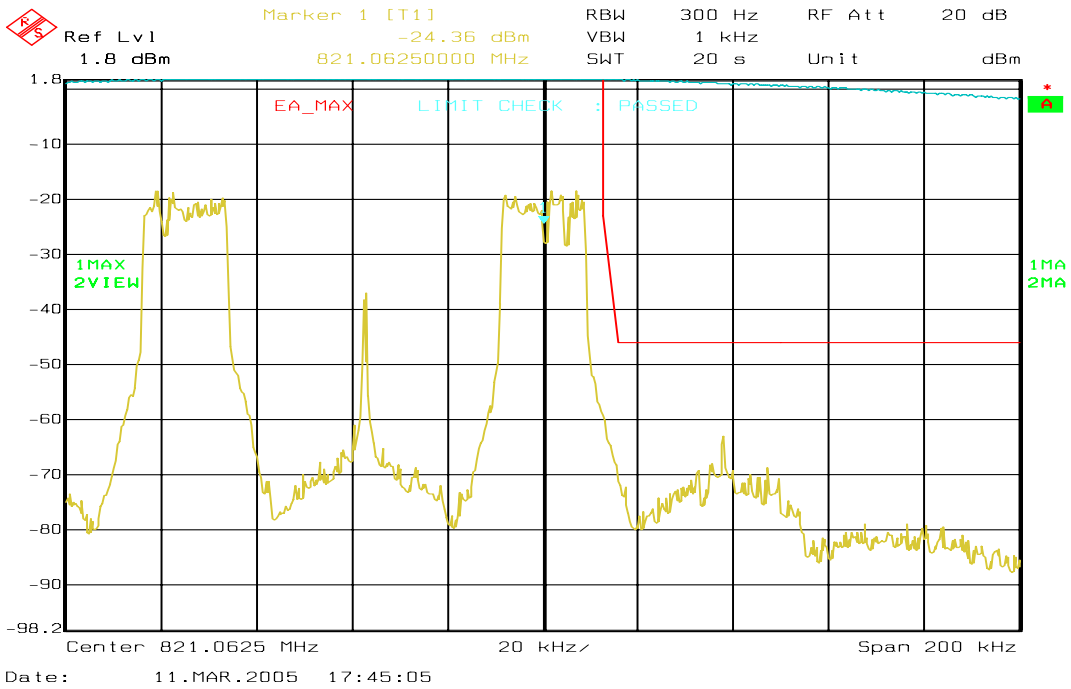


Figure 6a-58 . WiDEN_50_Split 800 MHz Band, QAM64, Maximum Power, EA Emission Mask

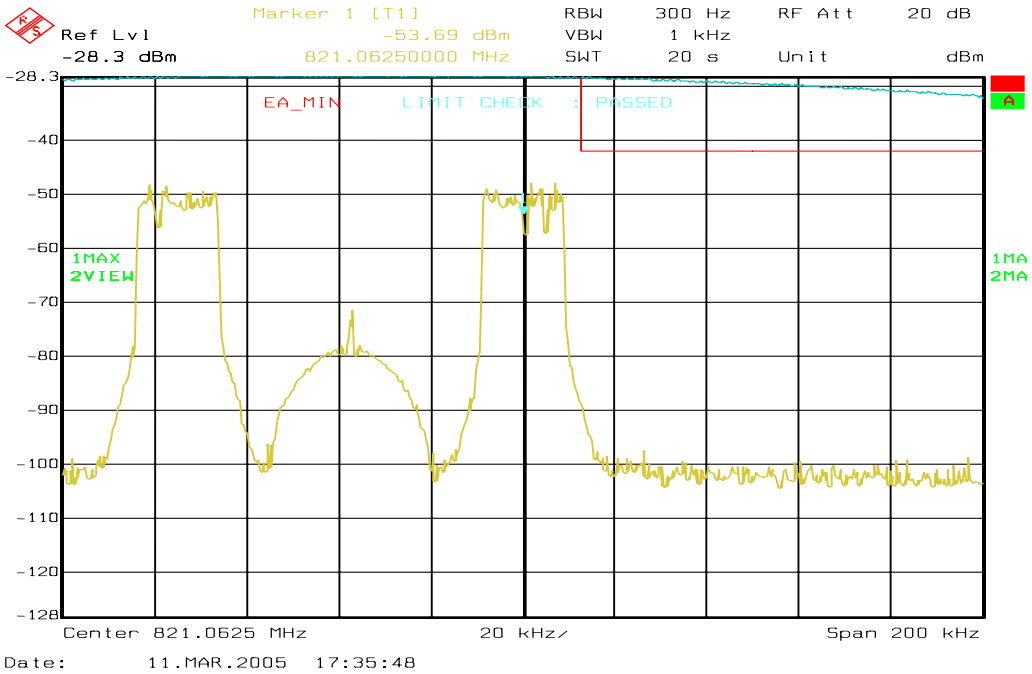


Figure 6a-59 . WiDEN_50_Split 800 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.9 Emission Designator 18K3D7W - WiDEN25 900 MHz Band

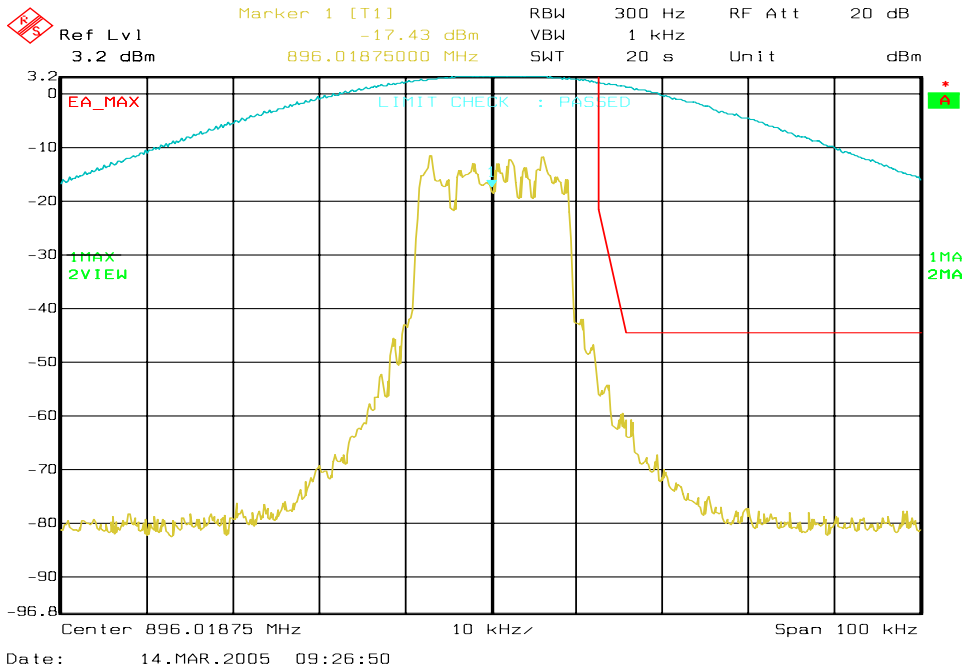


Figure 6a-60 . WiDEN25 900 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

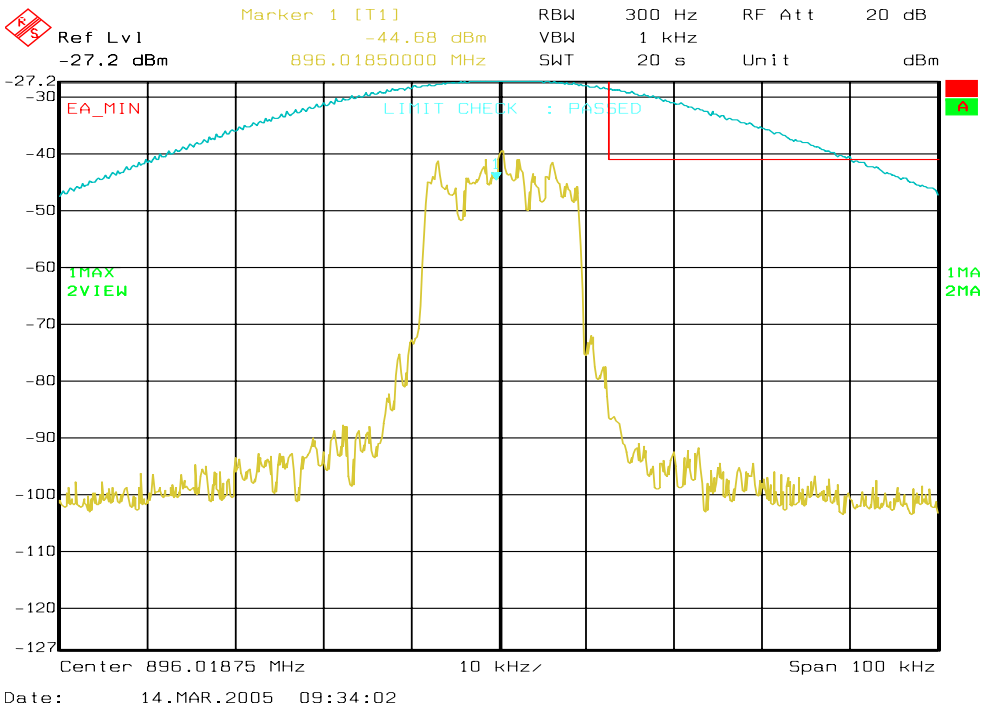


Figure 6a-61 . WiDEN25 900 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

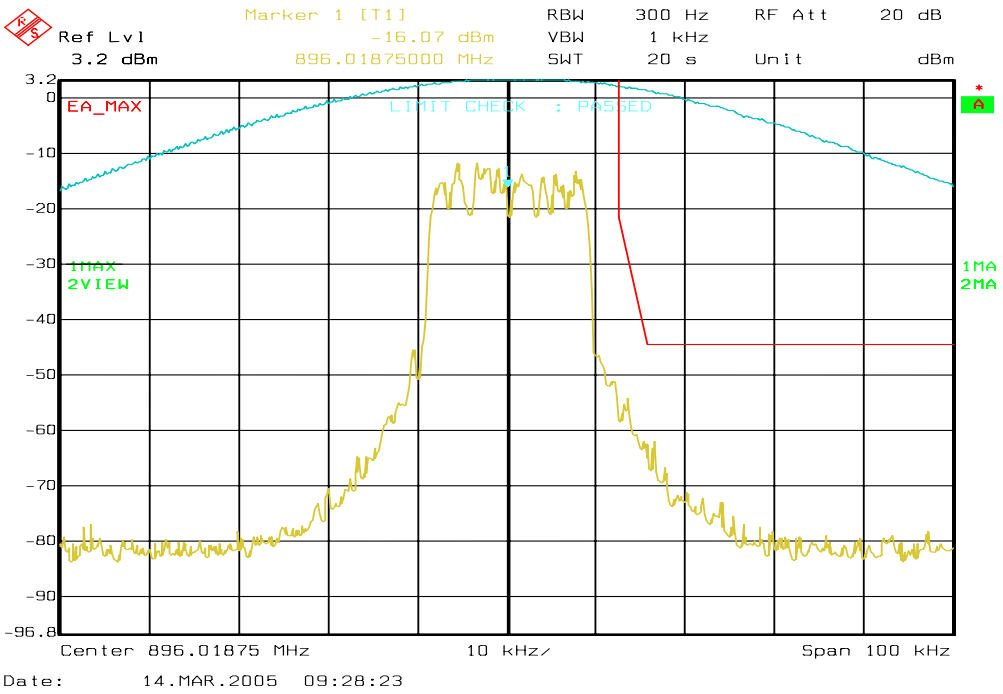


Figure 6a-62 . WiDEN25 900 MHz Band, QAM16, Maximum Power, EA Emission Mask

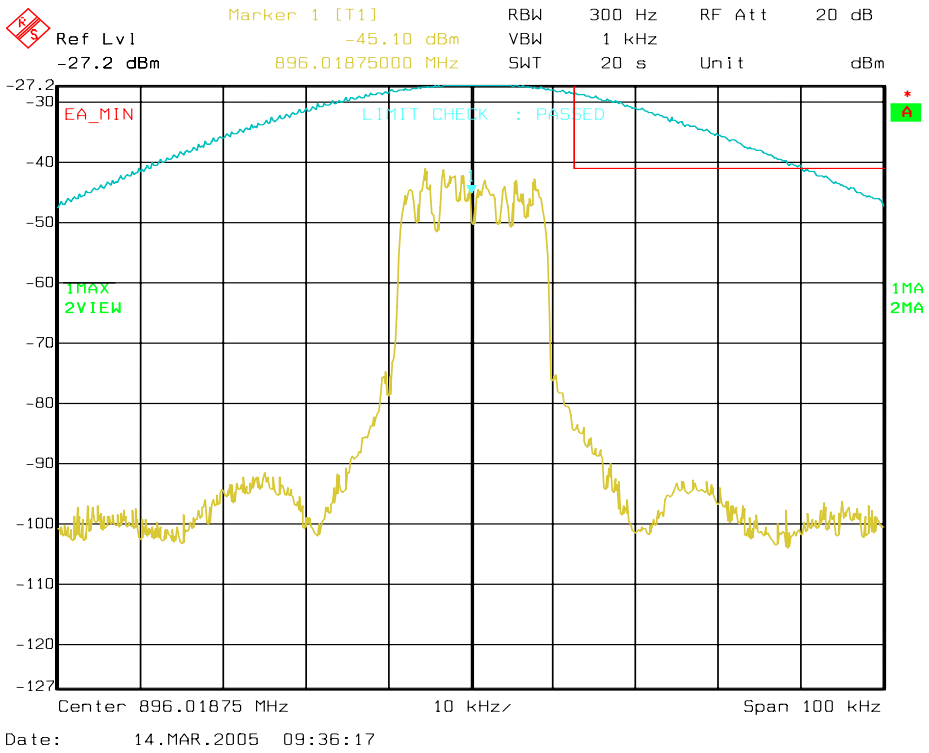


Figure 6a-63 . WiDEN25 900 MHz Band, QAM16, Minimum Power, EA Emission Mask

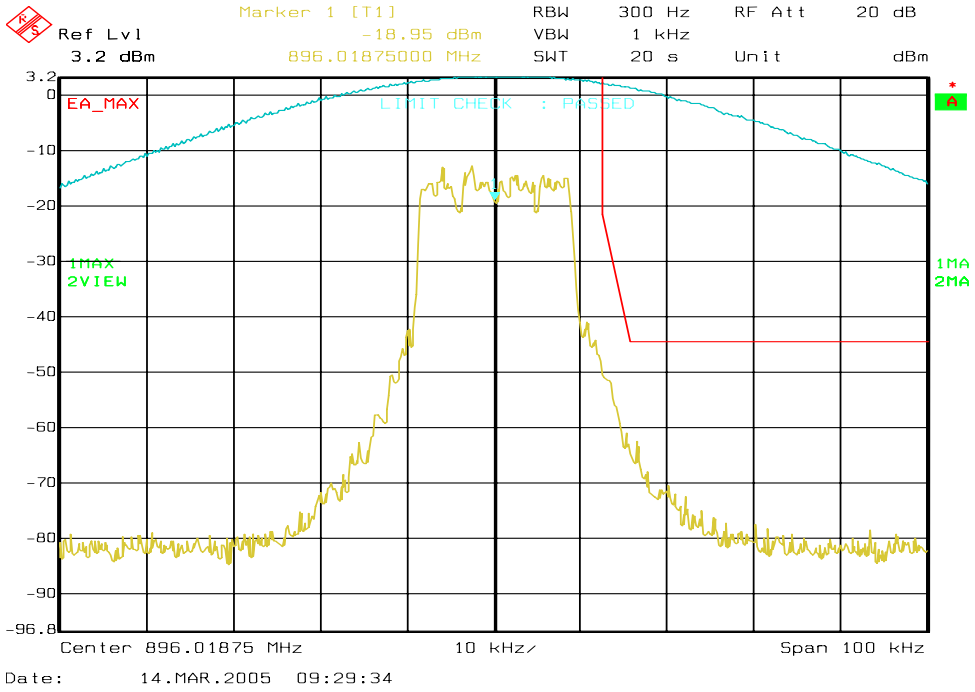


Figure 6a-64 . WiDEN25 900 MHz Band, QAM64, Maximum Power, EA Emission Mask

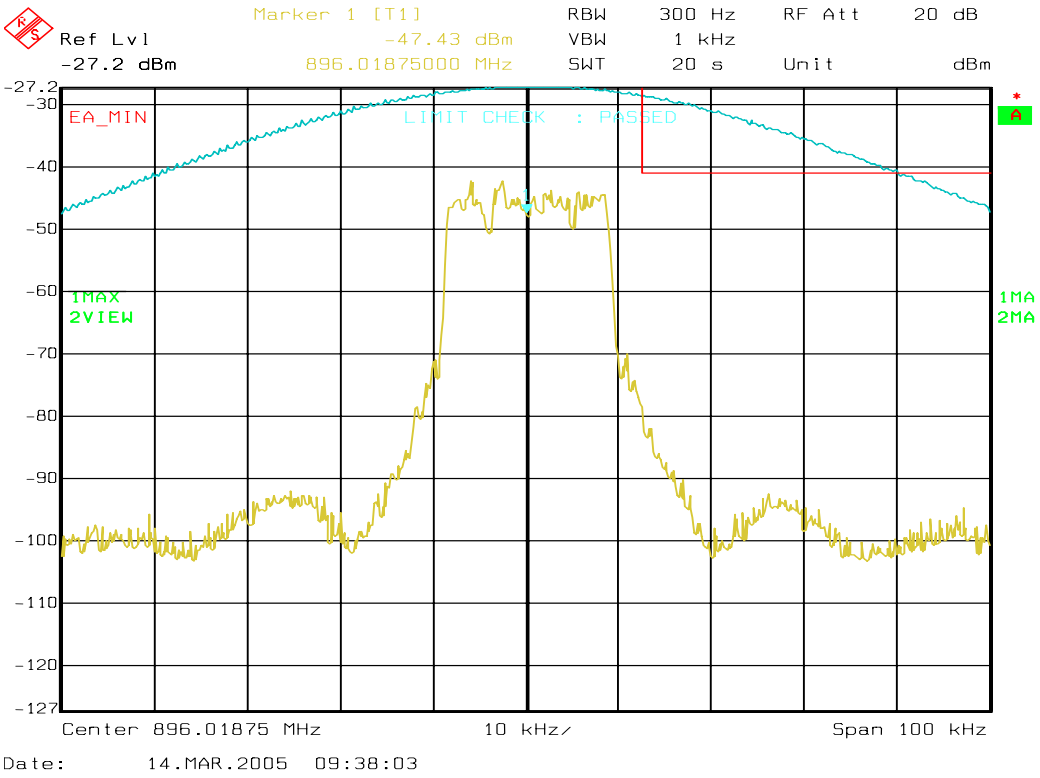


Figure 6a-65 . WiDEN25 900 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.10 Emission Designator 43K3D7D - WiDEN50 900 MHz Band

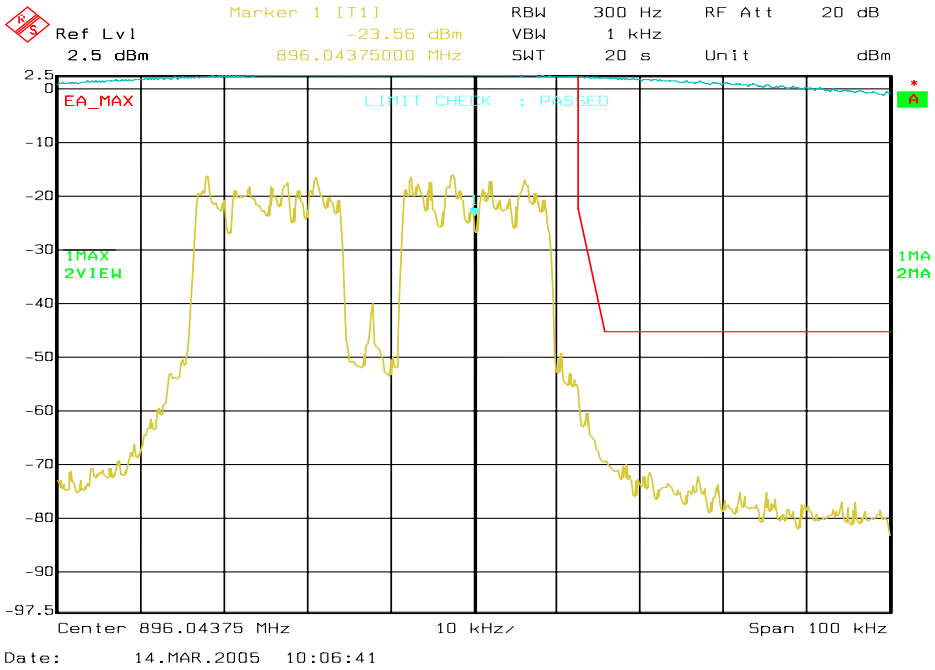


Figure 6a-66 . WiDEN50 900 MHz Band, Continuous Quad-QPSK, Maximum Power, EA Emission Mask

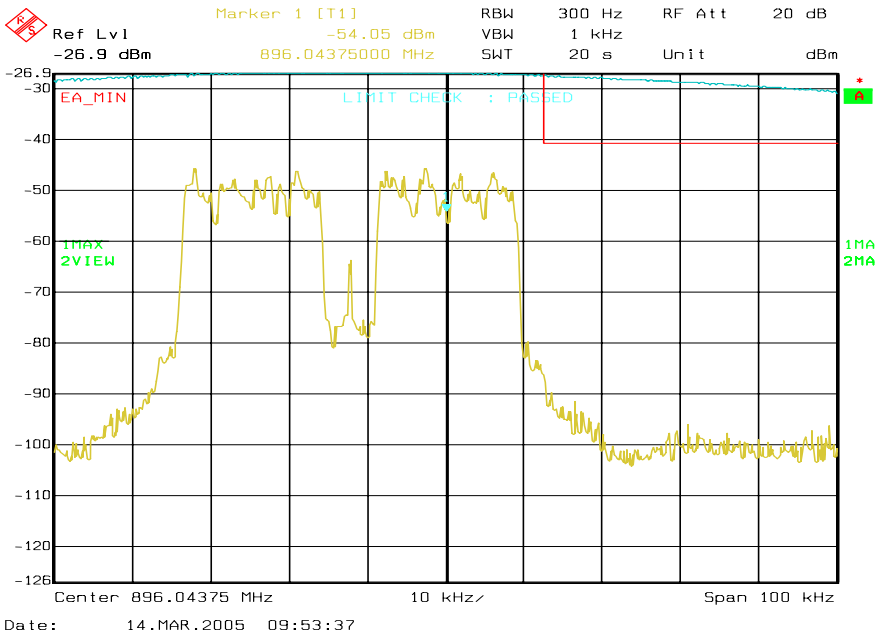


Figure 6a-67 . WiDEN50 900 MHz Band, Continuous Quad-QPSK, Minimum Power, EA Emission Mask

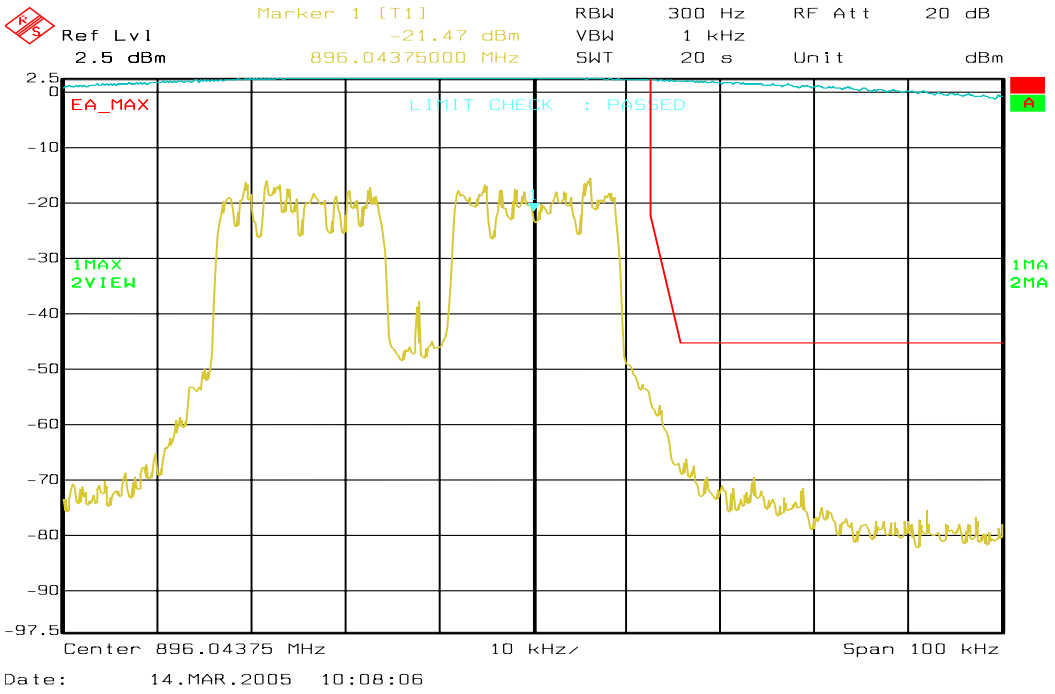


Figure 6a-68 . WiDEN50 900 MHz Band, Continuous QAM16, Maximum Power, EA Emission Mask

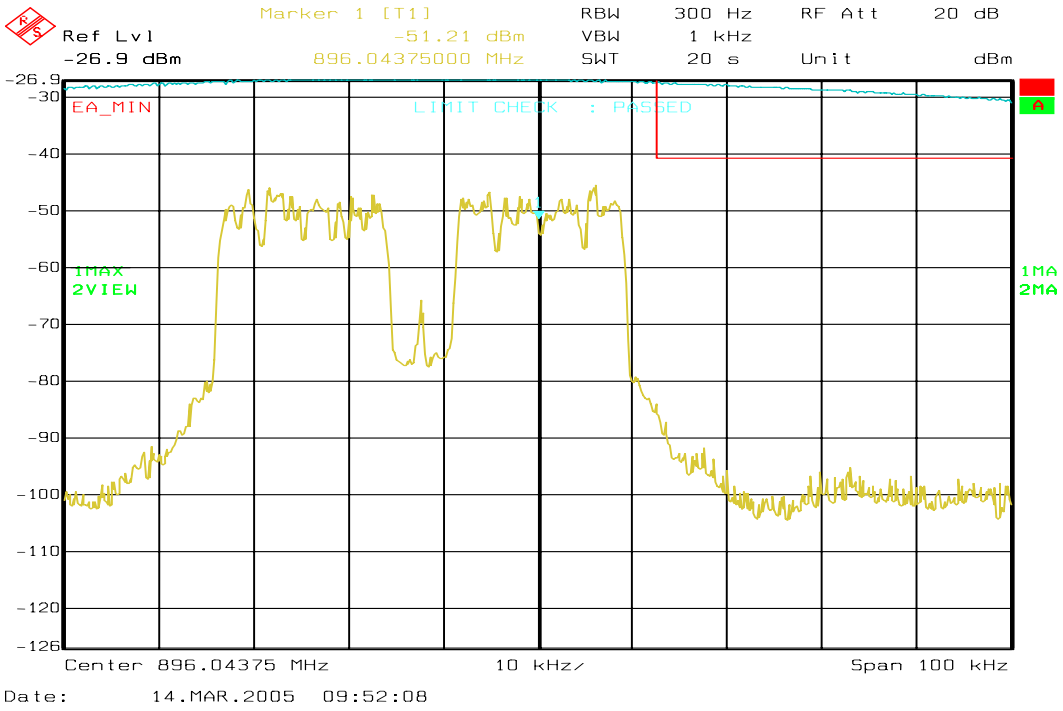


Figure 6a-69 . WiDEN50 900 MHz Band, Continuous QAM16, Minimum Power, EA Emission Mask

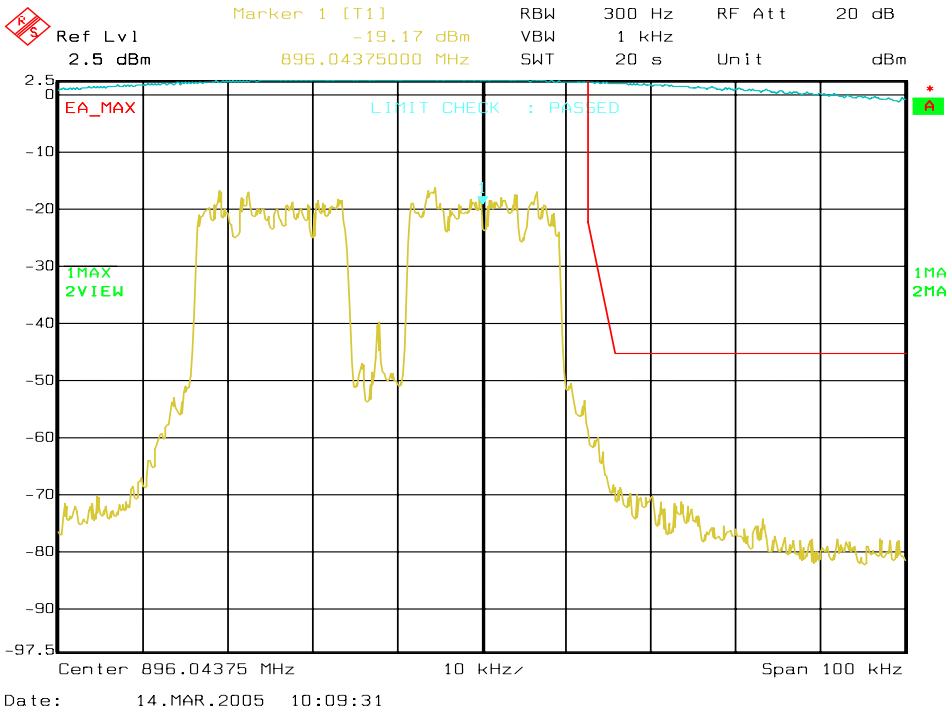


Figure 6a- 70. WiDEN50 900 MHz Band, Continuous QAM64, Maximum Power, EA Emission Mask

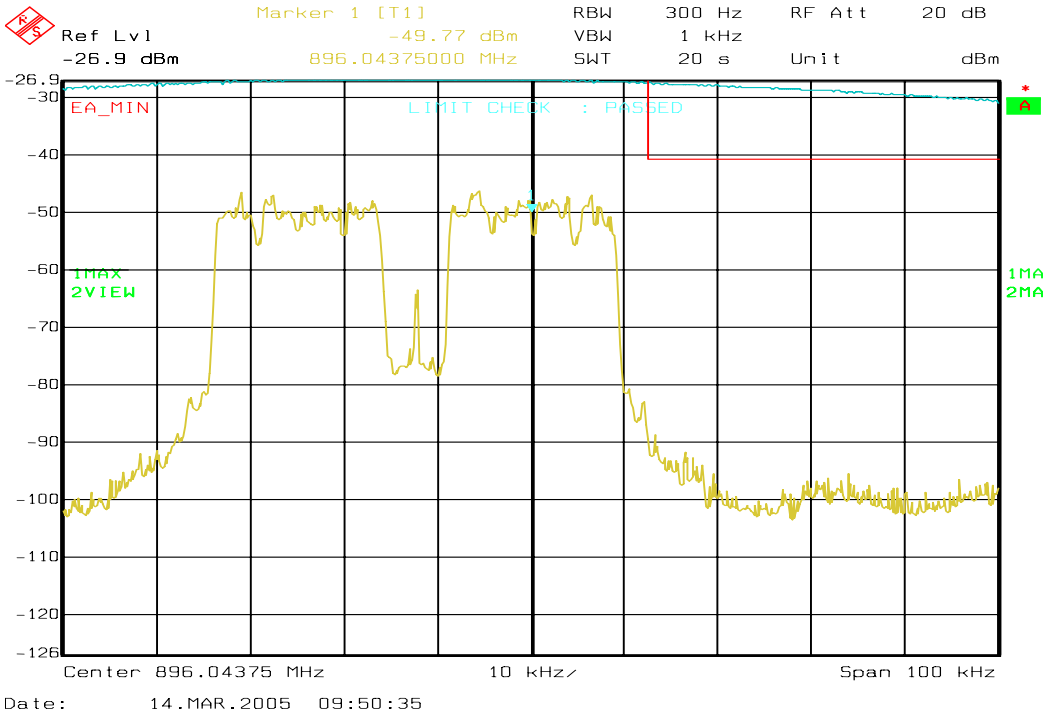


Figure 6a-71 . WiDEN50 900 MHz Band, Continuous QAM64, Minimum Power, EA Emission Mask

6a.2.11 Emission Designator 68K3D7D - WiDEN75 900 MHz Band

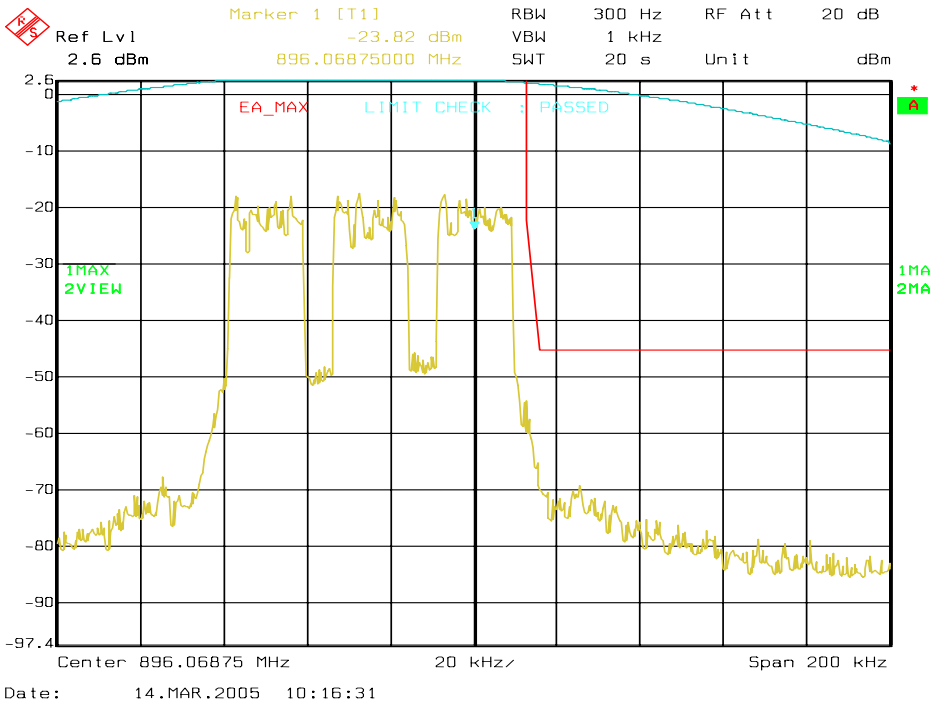


Figure 6a-72 . WiDEN75 900 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

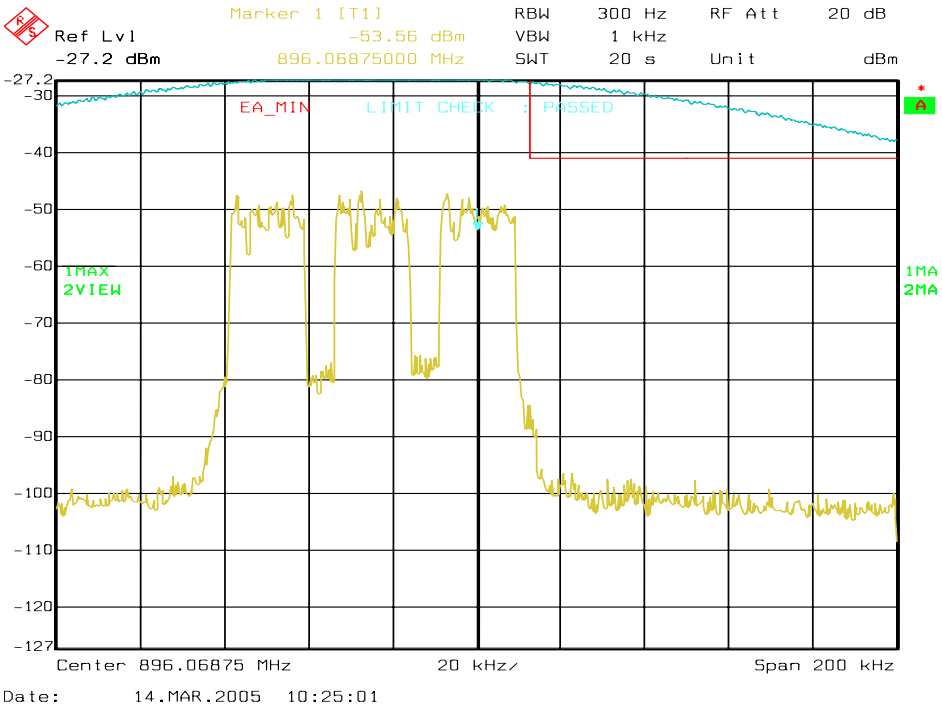


Figure 6a-73 . WiDEN75 900 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

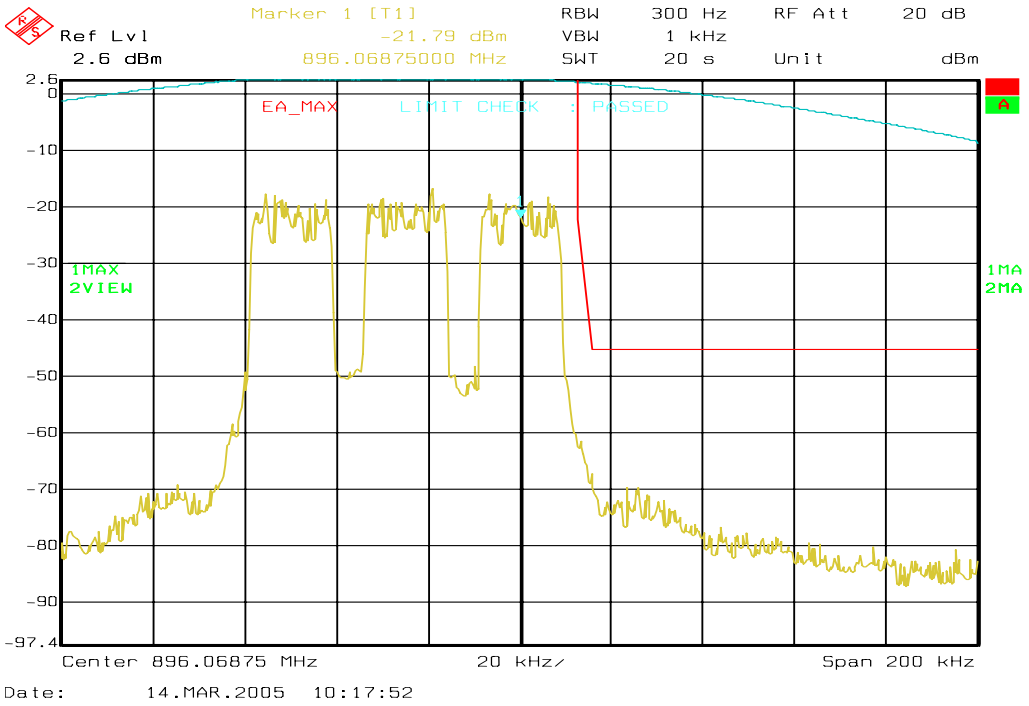


Figure 6a-74 . WiDEN75 900 MHz Band, QAM16, Maximum Power, EA Emission Mask

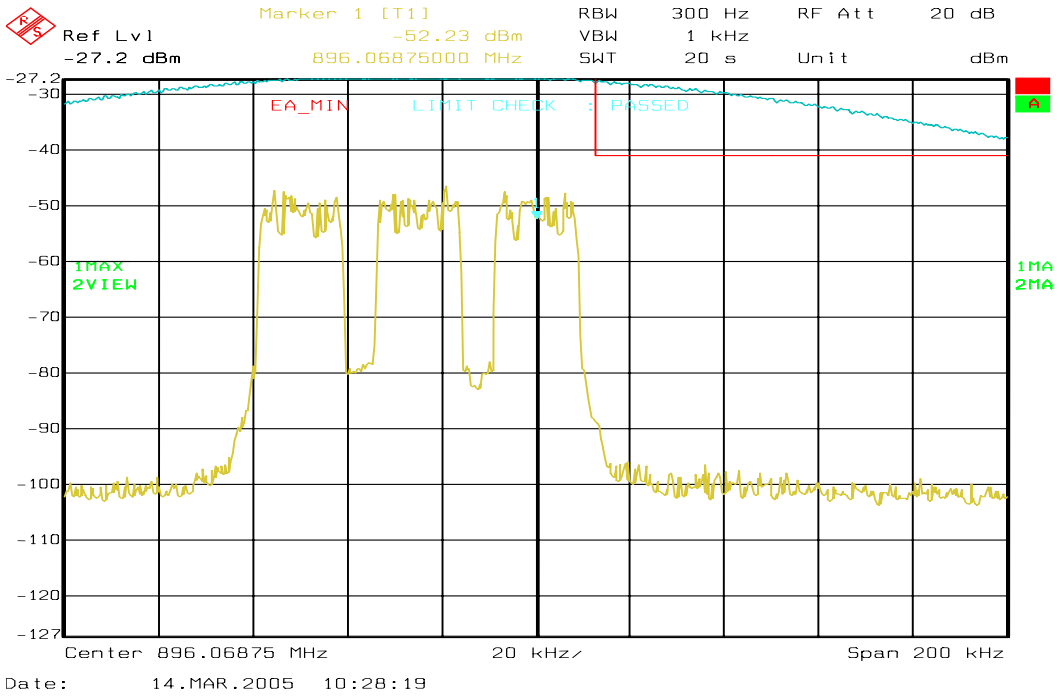


Figure 6a-75 . WiDEN75 900 MHz Band, QAM16, Minimum Power, EA Emission Mask

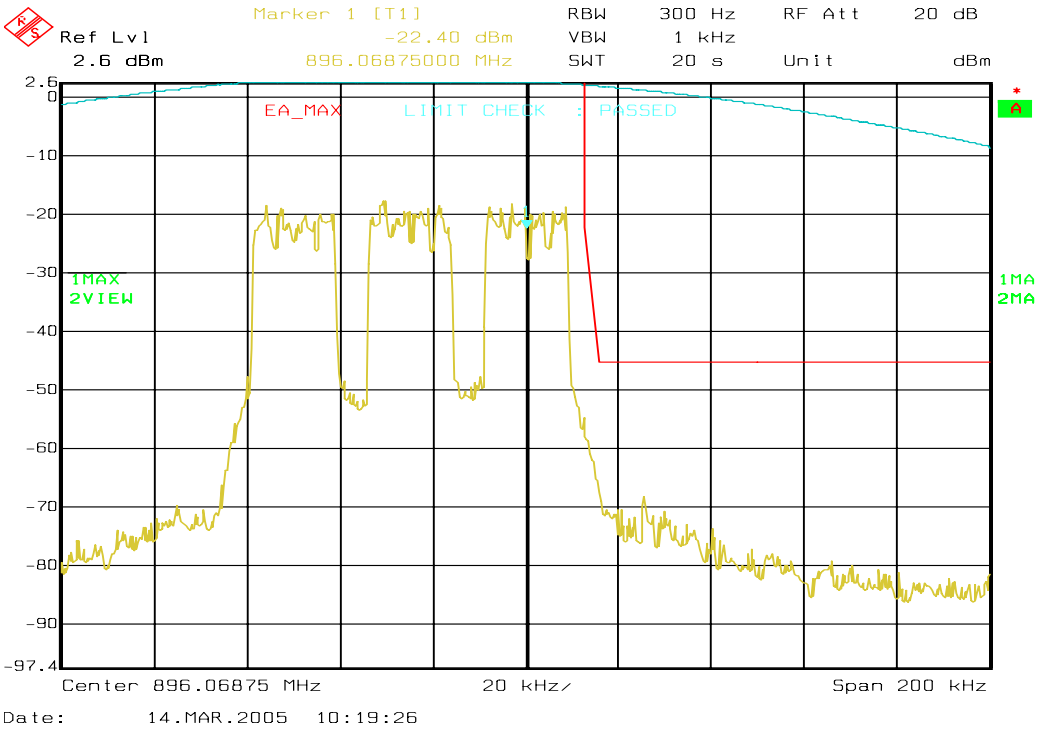


Figure 6a-76 . WiDEN75 900 MHz Band, QAM64, Maximum Power, EA Emission Mask

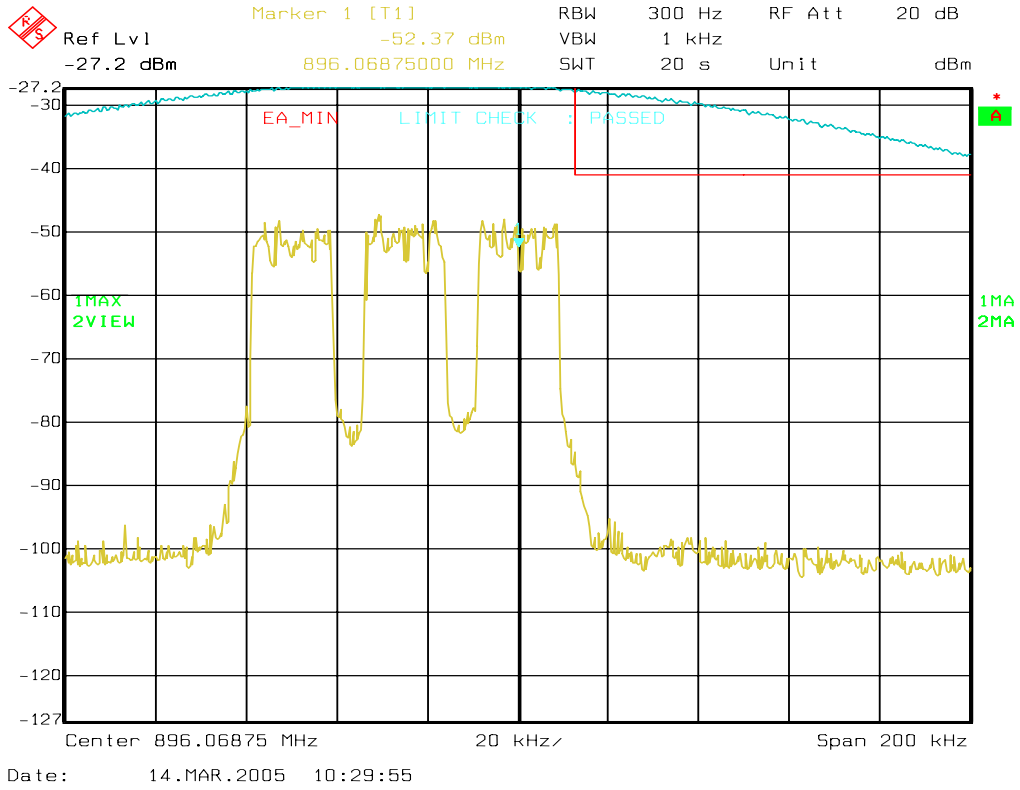


Figure 6a-77 . WiDEN75 900 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.12 Emission Designator 93K3D7D - WiDEN100 900 MHz Band

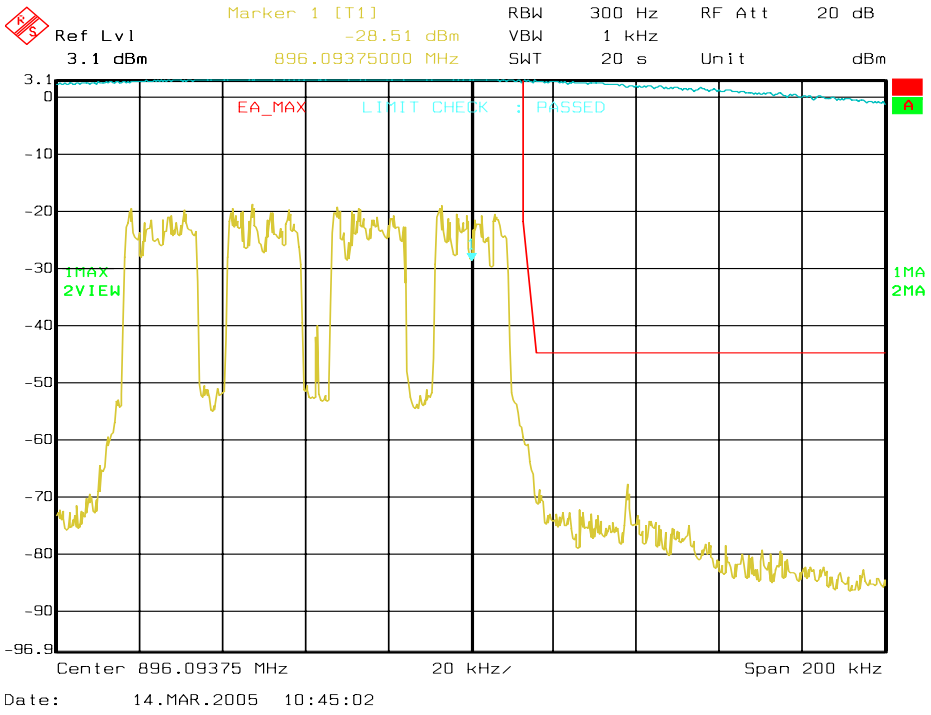


Figure 6a-78 . WiDEN100 900 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

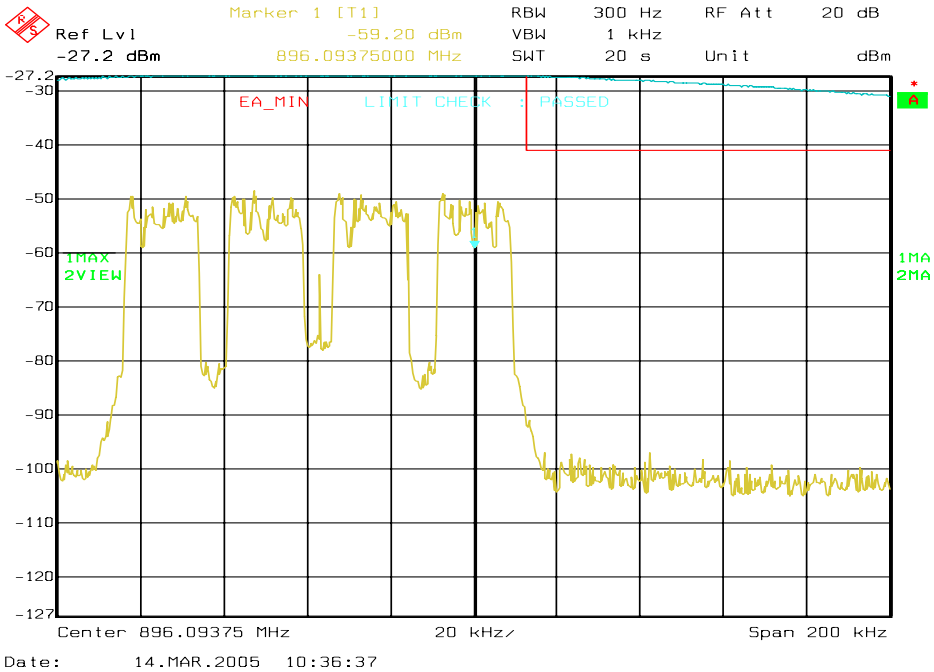


Figure 6a-79 . WiDEN100 900 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

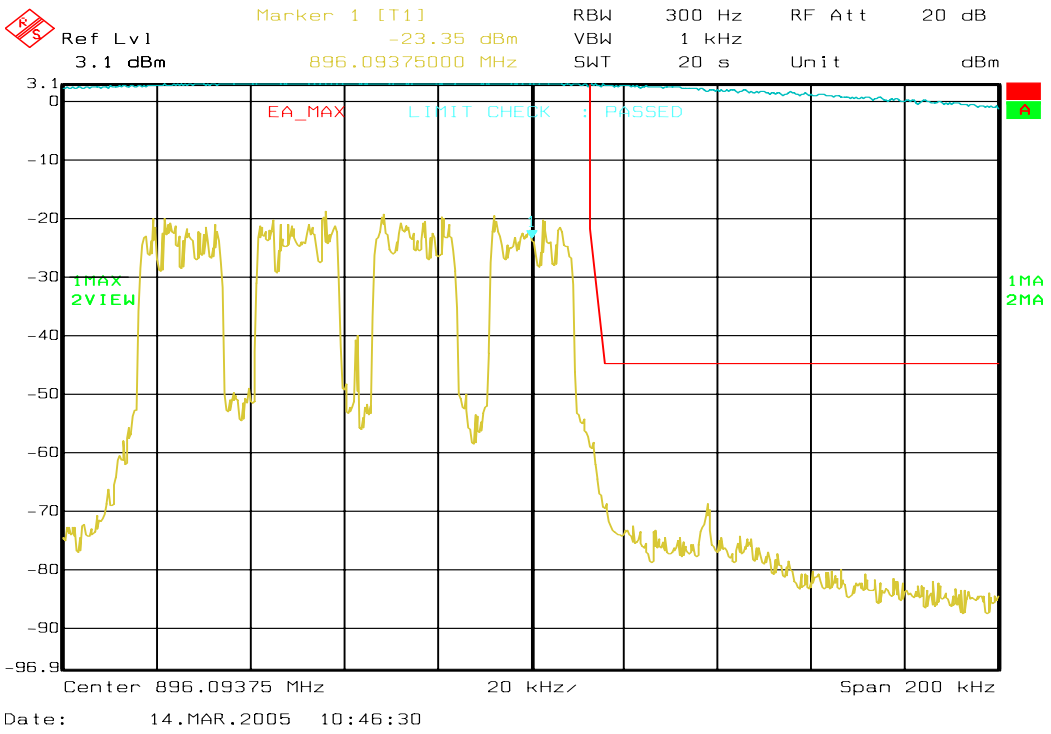


Figure 6a-80 . WiDEN100 900 MHz Band, QAM16, Maximum Power, EA Emission Mask

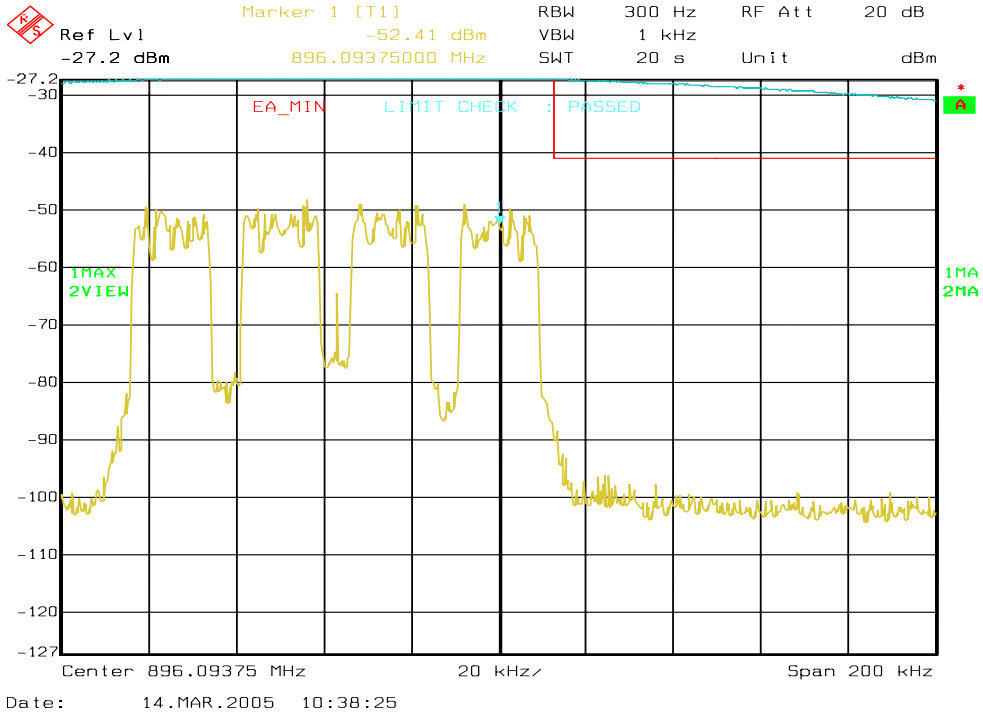


Figure 6a-81 . WiDEN100 900 MHz Band, QAM16, Minimum Power, EA Emission Mask

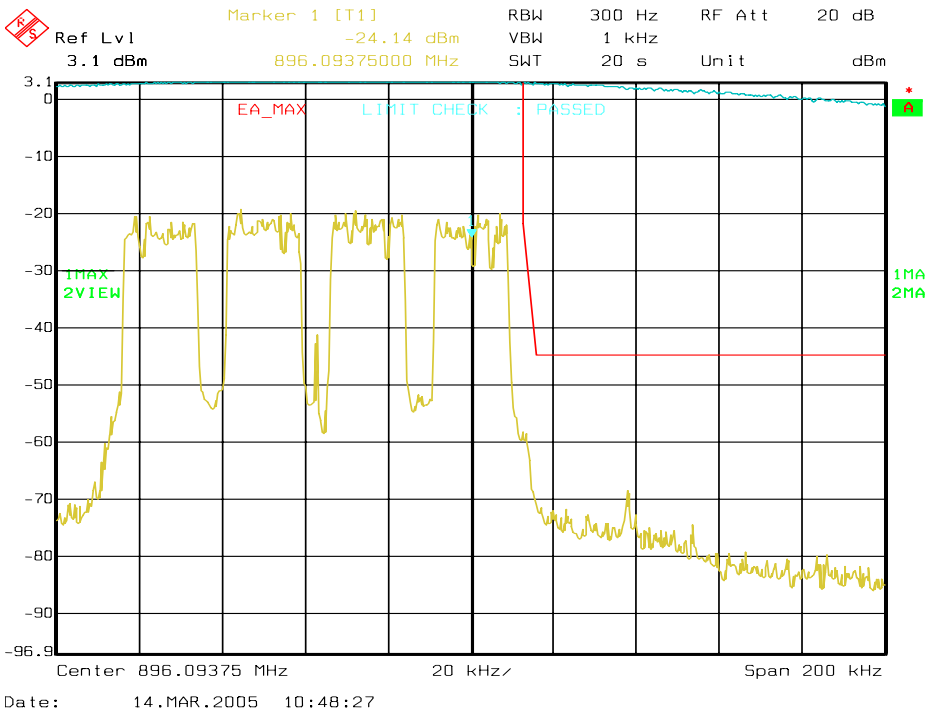


Figure 6a-82 . WiDEN100 900 MHz Band, QAM64, Maximum Power, EA Emission Mask

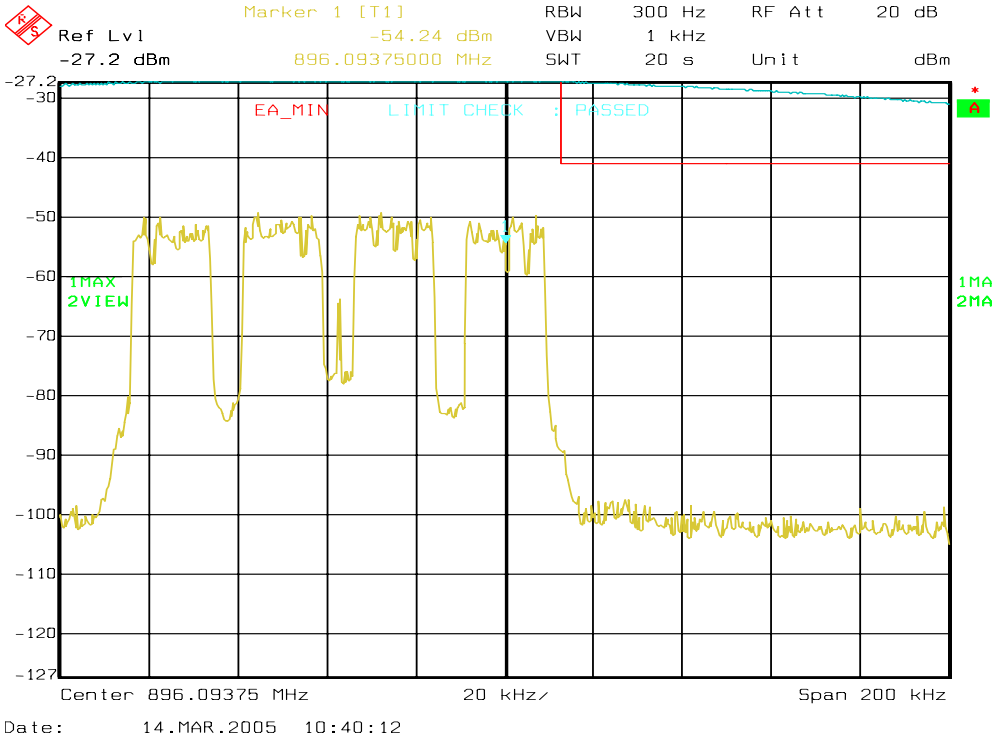


Figure 6a-83 . WiDEN100 900 MHz Band, QAM64, Minimum Power, EA Emission Mask

6a.2.13 Emission Designator 93K3D7D - WiDEN50_Split 900 MHz Band

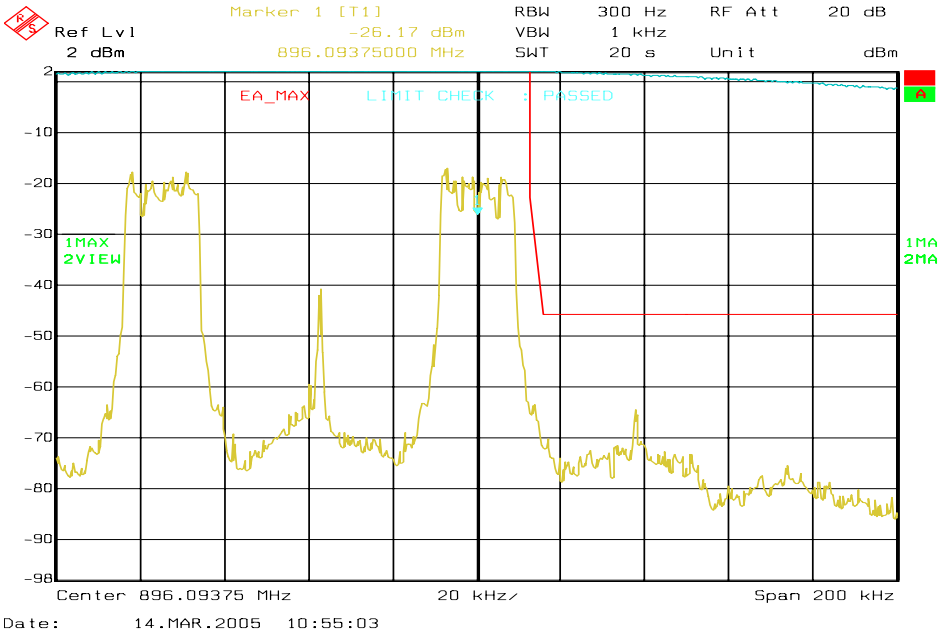


Figure 6a-84 . WiDEN_50_Split 900 MHz Band, Quad-QPSK, Maximum Power, EA Emission Mask

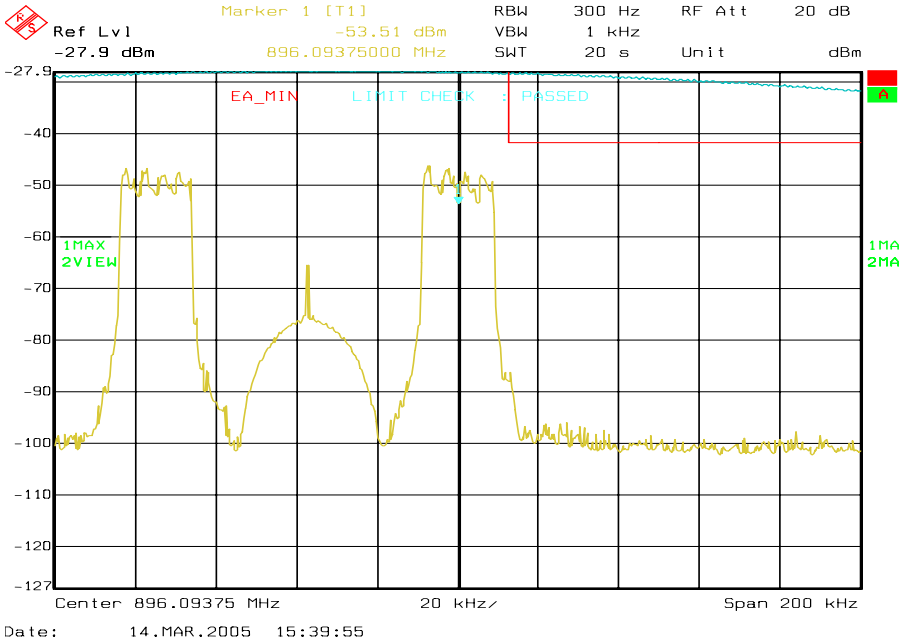


Figure 6a-85 . WiDEN_50_Split 900 MHz Band, Quad-QPSK, Minimum Power, EA Emission Mask

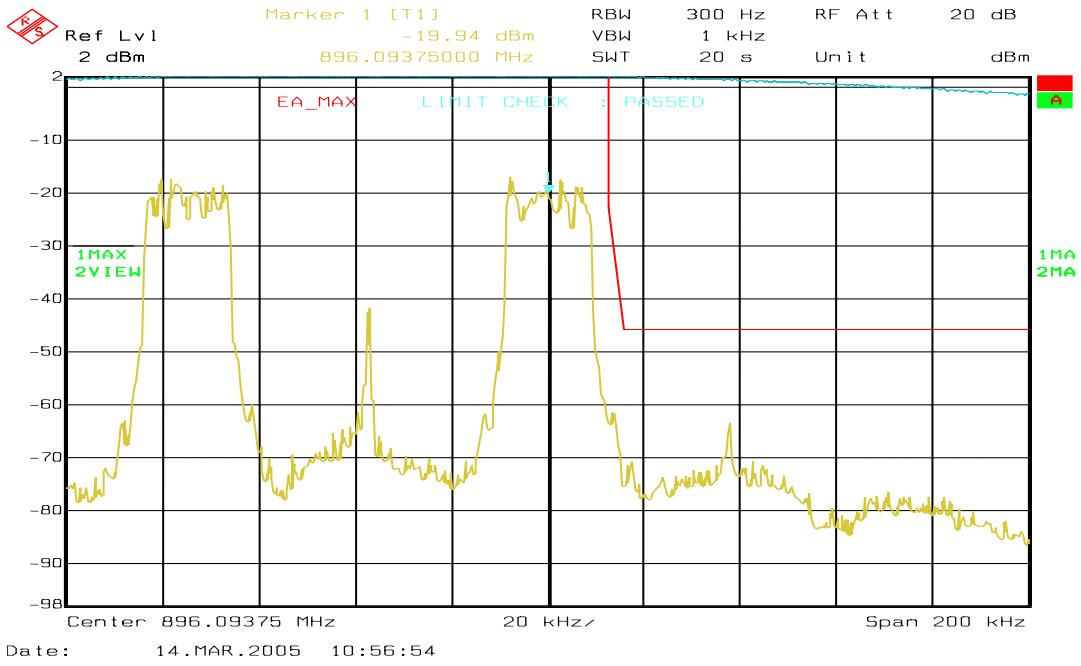


Figure 6a-86 . WiDEN_50_Split 900 MHz Band, QAM16, Maximum Power, EA Emission Mask

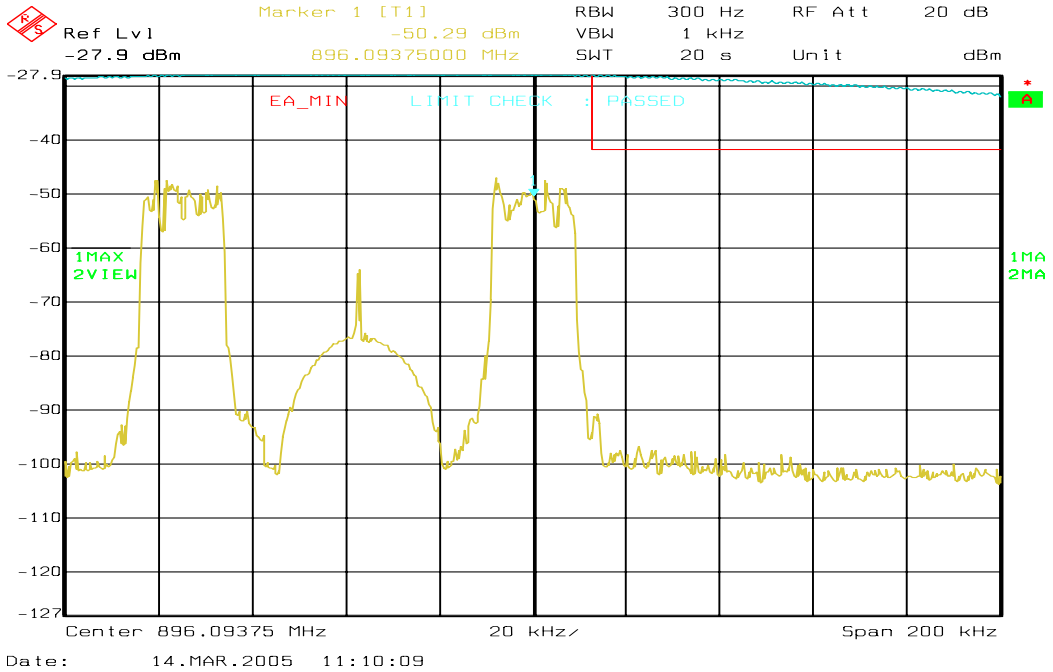


Figure 6a-87 . WiDEN_50_Split 900 MHz Band, QAM16, Minimum Power, EA Emission Mask

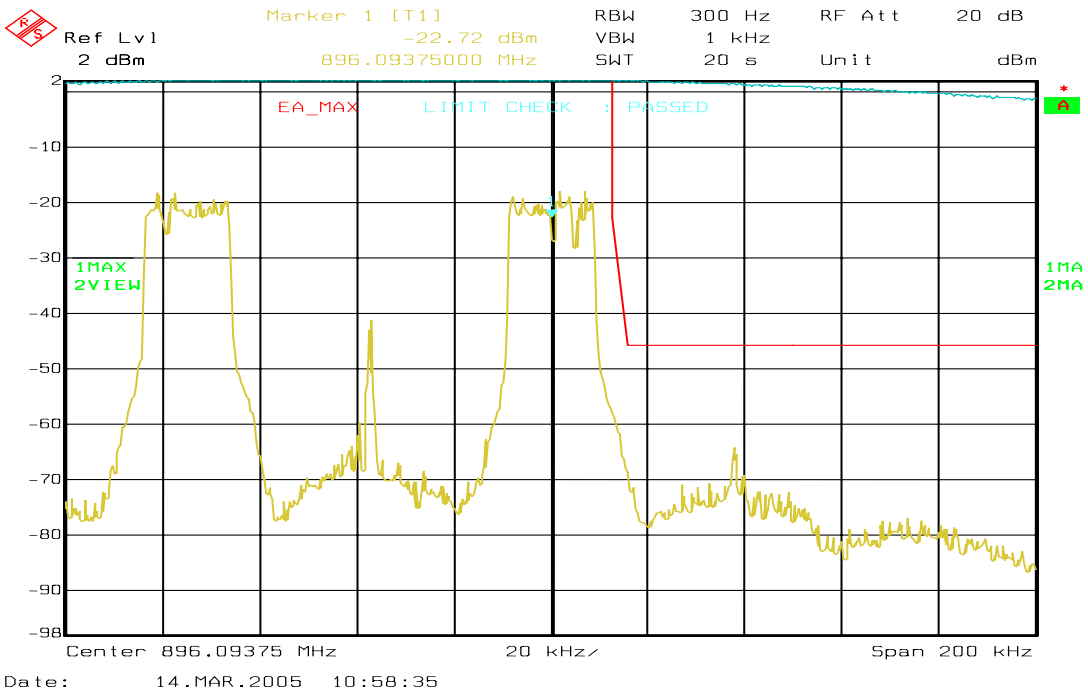


Figure 6a-88 . WiDEN_50_Split 900 MHz Band, QAM64, Maximum Power, EA Emission Mask

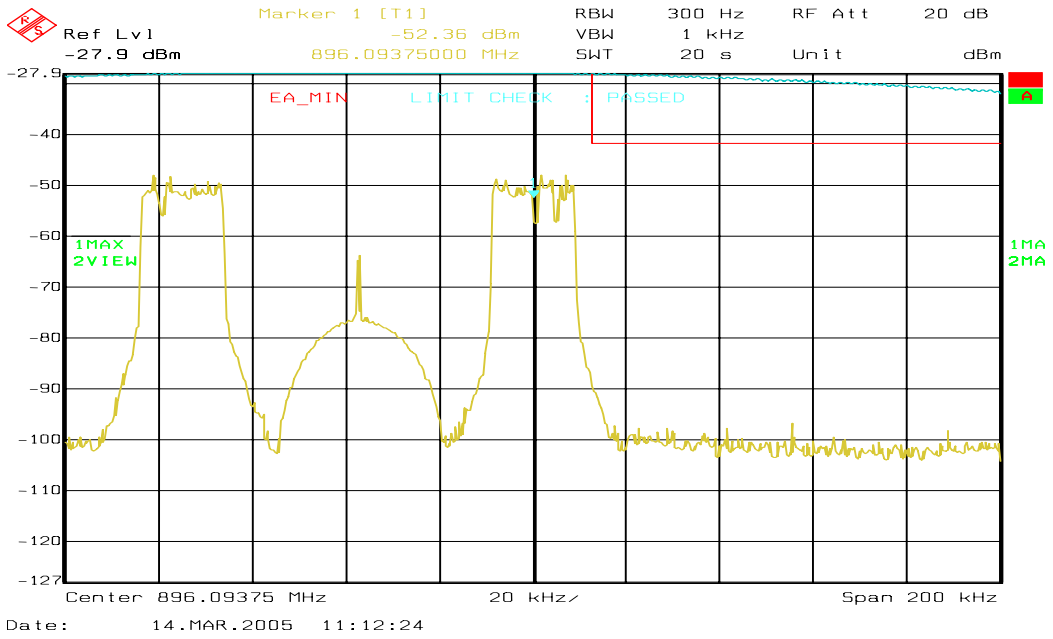


Figure 6a-89 . WiDEN_50_Split 900 MHz Band, QAM64, Minimum Power, EA Emission Mask