Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C., 20554

In the Matter of	)	
	)	
Service Rules for Advanced Wireless	)	
Services in the 2155-2175 MHz Band	)	WT Docket No. 07-195
	)	
Service Rules for Advanced Wireless	)	WT Docket No. 04-356
Services in the 1915-1920 MHz,	)	
1995-2000 MHz, 2020-2025 MHz	)	
and 2175-2180 MHz Bands	)	

COMMENTS OF MOTOROLA, INC.

Motorola, Inc. ("Motorola") hereby replies to the Commission's Further Notice of Proposed Rulemaking in the above-captioned proceedings concerning the establishment of service rules for Advanced Wireless Services ("AWS") in the 1915-1920 MHz, 1995-2000 MHz, 2155-2175 MHz and 2175-2180 MHz bands.[1] The 1915-1920 MHz band is paired with the 1995-2000 MHz band and is commonly referred to as the H-Block while the 2155-2175 MHz band is commonly referred to as the AWS-3 block.

The *Further Notice* provides interested parties the opportunity to respond to the Commission's tentative conclusions on appropriate technical, operational and licensing rules applicable to these three bands. The Commission's tentative conclusions are presented primarily as proposed revisions to the Commission's Rules as codified in the Code of Federal Regulations. The *Further Notice* provides little analysis or discussion on the rationale behind these proposals.

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[1] *See* Service Rules for Advanced Wireless Services in the 2155-2175 MHz Band; Service Rules for Advanced Wireless Services in the 1915-1920 MHz, 1995-2000 MHz, 2020-2025 MHz and 2175-2180 MHz Bands, WT Docket No. 07-195, WT Docket No. 04-356, FCC 08-158 (2008) ("*Further Notice*").

Motorola has been an active participant in the Commission's previous proceedings concerning the use of these bands and has consistently expressed the overarching view that utilization of this spectrum presents significant challenges for ensuring compatibility with existing services and networks.[2] Motorola therefore supports the proposals in the *Further Notice* to adopt more stringent limits on power and out of band emissions ("OOBE") than are routinely applied by the Commission and which were proposed by some parties in these proceedings.[3] However, in some cases the Commission's proposals are not sufficiently restrictive and would create significant interference risks to adjacent band operations. To this end, the Commission should not rely on the probability analyses that have been submitted into the record that are intended to demonstrate that there is little likelihood of interference to incumbent services regardless of the technical parameters adopted. As further discussed below, there are ample reasons to question and discount the results of the analyses.

Comments on H-Block Proposal

The H-Block is located immediately adjacent to the Broadband PCS allocation. The primary concern over the use of the 1915-1920 MHz band is the potential for interference to PCS mobile receivers operating above 1930 MHz. Two interference mechanisms must be considered: 1) receiver overload and intermodulation interference where the main carrier from the 1915-1920 MHz device will interfere with PCS mobile receivers operating above 1930 MHz, and 2) out-of-band emissions caused by 1915-1920 MHz transmitting devices and that fall into the 1930-1990

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[2] *See e.g.*, Comments of Motorola, Inc., WT Docket No. 07-195, (Dec. 14, 2007) at 3; Comments of Motorola, Inc., WT Docket No. 04-356, (Dec. 8, 2004) at 4.

[3] *See e.g.*, Letter from Uzoma Onyeije, M2Z Networks to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 07-195, (July 2, 2008) (supporting the adoption of an out-of-band emission specification of 43 + 10 log P for the AWS-3 band).

MHz band.[4] To address these concerns, the Commission is proposing the following technical specifications for operations within the H-Block:

Transmit Power:

- Mobile and portable devices: 23 dBm/MHz EIRP
- Fixed devices: 33 dBm/MHz EIRP
- Base Stations: 1640 watts EIRP for emission bandwidths of 1 MHz or less; 1640 watts/MHz EIRP for emission bandwidths greater than 1 MHz (3240 watts EIRP and 3240 watts/MHz in defined rural areas).
- Measurements are based on average power measurements with the peak to average ratio limited to 13 dB.

Out-of-Band Emissions:

- 43 + 10 log P (-13 dBm/MHz) for fixed and base stations
- 90 + 10 log P (-60 dBm/MHz) for mobile and portable emissions that fall above 1930 MHz
- Mobile and portable devices not permitted in the 1995-2000 MHz band.

Motorola notes that the proposal to limit the maximum permitted output power of H-block handsets to 23 dBm/MHz EIRP is not presented in a manner consistent with either past Commission practice or industry standards. Typically, mobile and portable transmitter output power is limited by the total power on the channel and not as a per megahertz value. The *Further Notice* does not explain its rationale for this deviation from past practice. If it is indeed presented as intended, Motorola opposes this proposal and recommends the Commission follow its current practice of specifying transmit power level for both fixed and mobile devices on a per channel basis. A 23 dBm/MHz standard would allow handsets operating over 5 megahertz to transmit up to 1 watt – a level that Motorola has previously demonstrated to be harmful to PCS

[4] *See* Comments of Motorola, Inc., WT Docket No. 04-356 (Dec. 8, 2004) at 4.

handsets.[5] Motorola believes that the Commission should limit handset power on the H-Block to no more than a total of 23 dBm, which equates to a transmitter power limit of approximately 200 milliwatts. It should be noted, however, that a 200 milliwatt H-Block handset operating in close proximity to a Broadband PCS handset will cause harmful interference under certain circumstances and that even lower operating powers would improve compatibility with Broadband PCS operations.

The Commission proposes to limit interference from OOBE by specifying the H-Block emissions that fall into PCS receive band above 1930 MHz to be -60 dBm/MHz. Motorola had previously proposed -61 dBm/MHz.[6] Motorola supports the Commission's proposed level as it is comparable to industry standards for the GSM technology operating in the PCS bands.[7]

Comments on AWS-3 Proposal

Until now, the AWS-3 band has been confined to the 2155-2175 MHz band. Immediately below (2110-2155 MHz) is the mobile receive band for the AWS-1 spectrum. Immediately above (2175-2180 MHz) is a 5 MHz spectrum block that is paired with the 2020-2025 MHz band. In the *Further Notice*, the Commission proposes to combine the 2175-2180 MHz band with the AWS-3 block to create a combined 25 megahertz block of spectrum. Within this combined 25 megahertz block, the FCC proposes to allow both uplink and downlink transmissions across the entire block in accordance with the following technical parameters:

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[5] *See* Letter from Steve B. Sharkey, Director, Spectrum and Standards Strategy, Motorola, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 04-356, (Aug. 24, 2005) at Appendix, page 4.

[6] *See* Motorola Reply Comments, WT Docket No. 04-356, (Feb. 8, 2005) at 6.

[7] The GSM standard requires emissions levels into the PCS receive band of -71 dBm/100 kHz. *See* 3GPP TS 45.005 v8.1.0 at §4.3.3.2.

Transmit Power:

- Mobile and portable devices: 23 dBm/MHz EIRP
- Fixed devices: 33 dBm/MHz EIRP
- Base Stations: 1640 watts EIRP for emission bandwidths of 1 MHz or less; 1640 watts/MHz EIRP for emission bandwidths greater than 1 MHz (3240 watts EIRP and 3240 watts/MHz in defined rural areas).
- Measurements are based on average power measurements with the peak to average ratio limited to 13 dB.

Out-of-Band Emissions:

- 43+10 log P (-13 dBm/MHz) for base and fixed stations
- 60+10 log P (-30 dBm/MHz) for mobile/portable OOBE that fall below 2155 MHz and above 2180 MHz

Motorola does not object to combining the 2155-2175 MHz band with the 2175-2180 MHz band. However, this approach breaks up a potentially useful 10 MHz paired block of spectrum and strands the 2020-2025 MHz band. Motorola has previously supported allowing the 2155-2175 MHz band to be paired with other bands for asymmetrical use.[8] If the Commission is going to add the 2175-2180 MHz band to AWS-3, it should also consider whether it should include the 2020-2025 MHz band to facilitate asymmetrical use. Otherwise, Motorola sees little value with an orphaned 2020-2025 MHz block.

The tentative conclusion to allow uplink transmissions from mobile and portable devices on all of the combined AWS-3 frequencies, including those immediately adjacent to 2155 MHz, will result in harmful interference to AWS-1 handsets. As Motorola has previously explained, it is not technically possible today or in the foreseeable future to protect receivers in the 2110-2155 MHz band from an unacceptably high level of interference from immediately adjacent Time

[8] Reply Comments of Motorola, Inc., ET Docket No. 00-258, (April 28, 2003) at 5.

Division Duplex ("TDD") operations in the 2155-2175 MHz band.[9] As previously described by Motorola, there has been extensive work done with regard to state-of-the-art filtering for commercial handsets, and it is apparent from Motorola's investigation of this issue and the record that a guard band in excess of 10 MHz is required to provide sufficient receiver blocking performance to AWS-1 receivers. Motorola is not aware of any evidence demonstrating or suggesting that better blocking performance is achievable.

Like many others, Motorola continues to believe that the best use of the 2155-2175 MHz band is for downlink only applications as that mode of operation presents the least interference risk to AWS-1.[10] If the FCC rejects this fundamental recommendation, then it must impose technical standards on AWS-3 operations that enhance compatibility with AWS-1 to the maximum extent possible. To this end, if the Commission allows AWS-3 mobile devices, it should require that full power mobile devices (200 milliwatts or 23 dBm EIRP) be restricted to frequencies above 2168 MHz.[11] The attached Appendix shows that with a 13 MHz guard band, handsets from a variety of technology platforms can operate with 23 dBm and meet an OOBE limit of -60 dBm/MHz into the AWS-1 mobile receive band. Allowing mobile units in the 2155-2168 MHz would require a much lower transmitter power limit in order for the device to achieve

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[9] *See* Letter from Steve B. Sharkey, Director, Spectrum and Standards Strategy, Motorola, Inc. to Marlene H. Dortch, Secretary, Federal Communications Commission, WT Docket No. 07-195, (June 5, 2008) at 2.

[10] Comments of Motorola, Inc., WT Docket No. 07-195 at 3, Comments of Verizon Wireless, WT Docket No. 07-195 at 5; Comments of T-Mobile USA, Inc., WT Docket No. 07-195 at 3; Reply Comments of AT&T Wireless, WT Docket No. 07-195, at 1.

[11] Similar to its comments with respect to the proposal for H-block mobile and fixed device power limits, Motorola opposes the *Further Notice's* proposal to limit AWS-3 mobile and fixed power on a per megahertz basis. The limit should be an absolute power limit and not expressed as a power spectral density.

the requisite attenuation into the AWS-1 band for out-of-band emission and to avoid receiver blocking of AWS-1 Mobiles.[12]

Motorola strongly recommends that the Commission base its technical standards on providing AWS-1 receivers with adequate protection from OOBE. The FCC proposes to allow OOBE emissions from AWS-3 devices as high as -30 dBm/MHz (60+10 log P) into the AWS-1 receive band. Conversely, the same *Further Notice* proposes to limit OOBE emissions from H-Block devices to the PCS mobile receive band to -60 dBm/MHz (90+10 log P). There is no reason to believe that AWS-1 receivers can accommodate an additional 30 dB of noise into the band than can PCS receivers without harmful interference occurring. Motorola's previous submissions indicate that emission restrictions of at least -60 dBm/MHz are needed to protect AWS-1 handsets.[13] The lack of a guard band between AWS-3 and AWS-1 should not dissuade the Commission from applying at least the same level of attenuation that it adopted for the H-Block. A variety or options exit for beneficial and efficient use of this spectrum pursuant to limits consistent with providing adequate protection to AWS-1. These include using the AWS-3 band for downlink operations, using the lower part of the band for downlink operations or operating low power devices in the frequencies near 2155 MHz. The proposed increase of spectrum to the AWS-3 allocation may provide additional flexibility to AWS-3 licensees to use this spectrum, but the impact of the change must be considered in the overall spectrum scheme, including the potential to strand the 2020-2025 MHz band.

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12 Comments of Motorola, Inc., WT Docket No. 07-195 at 5.

13 *Id.* at 7.

Comments on the Monte Carlo Analysis Submitted by M2Z

On June 5, 2008, M2Z filed an *ex parte* presentation regarding the use of statistical models to evaluate the potential for interference between AWS-3 operations and AWS-1 operation. Based on our experience with such system simulations we believe that the models used will underestimate the likelihood of interference. Motorola recommends that the FCC not rely on M2Z's analysis to justify or rationalize the adoption of power and OOBE levels.

Motorola has a long history and unique understanding of statistical Monte Carlo simulations as applied to inter-system interference analysis. In fact, Motorola was among the first ones to support the use of statistical Monte Carlo technique for complex radio compatibility analysis when the commonly used technique was worst case deterministic.[14] As the idea gained supporters, Motorola became actively involved in the industry wide efforts that led to the initial versions of the publicly available Spectrum Engineering Advanced Monte Carlo Analysis Tool (SEAMCAT) by helping to define the underlying models and algorithms, select the software company that developed the SEAMCAT software, debug the tool, develop the training materials and provide training.[15] Since then, Motorola has continued its own internal efforts to refine the initial Monte Carlo methodology in order to be able to design new systems (*e.g.*, W-CDMA,

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[14] *See* Johnson, C.; Benamar, A.; Boscovic, D., Motorola, *Statistical Approach to the Spectrum Engineering Practices*, IEEE Vehicular Technology (1998). *See also*, Moorut, P.; Peries, F.; Benamar, A.; Boscovic, D., Motorola, *Advanced Methodology for Spectrum Engineering*, IEEE Vehicular Technology (1999).

[15] *See* Motorola, CEPT Spectrum Engineering Project Team 21/SEAMCAT, MC(98)22 rev1, *Introduction to the Spectrum Engineering Monte Carlo Advanced Simulation Tool (SEAMCAT)*, August 1998. *See also*, Motorola, CEPT Spectrum Engineering Project Team 21/SEAMCAT, PMC(97)/XXX, *Evaluation of Software Bids for the Development of the Monte Carlo Tool*, November 1997.

OFDMA), define specifications in 3GPP and other standards bodies, help define spectrum usage and regulatory rules and deploy new radio systems.[16]

While Motorola cannot fully review the Alion Science results due to incomplete information provide regarding the details of the modeling[17], it offers the following observations:

- System level simulations, such as SEAMCAT, for evaluating mobile-to-mobile interference typically assume uniform or other standard statistical user distribution within a cell.[18] The assumption of a standard statistical distribution of the users about the cell leads to optimistic results by making the chance of AWS-1 and AWS-3 mobiles coming close to each other unreasonably low. Mobile users tend to aggregate at high-user density areas such as a coffee shop, sports stadium, metro station or other transportation hubs. Modeling of these hotspots of cellular usage will portray a more accurate representation of the interference environment. These concerns were also raised by 3GPP and WiMAX Forum.[19]
- The study implies that the AWS-3 mobiles considered are WiMAX (OFDMA based) mobiles. However, on the SEAMCAT website, it is stated that the OFDMA version of SEAMCAT (version 3.2) is a Beta version that is currently being debugged, tested and calibrated.[20] It is not clear how WiMAX was modeled

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[16] See Motorola, ITU-R Working Party 8F, Compatibility Analysis of IMT-2000 (UMTS 1800) Downlink and GSM 1900 Uplink in Adjacent Frequency Bands, June 2001; Motorola, 3GPP RAN WG4 R4-070743, Coexistence Simulation Results for 20 MHz E-UTRA - UTRA FDD Uplink, May 2007; Motorola, UK Broadband, Clearwire Denmark, WiMAX Telecom Europe, CEPT ECC PT SE19, Doc. SE19(06)70**,** Inter-System MWA MS to MWA MS Coexistence Analysis in 3.5 GHz Band for Unsynchronized TDD Systems or TDD Adjacent to FDD Systems, 17 November 2006, Peilu Ding, Peijuan Liu, Xiaowei Jin and Prakash Moorut, IEEE Vehicular Technology Conference 2008, A Framework for Evaluating Mobile-to-Mobile Inter-System Interference with Hotspot Considerations for WiMAX TDD Coexistence, May 2008.

[17] Simulation parameters that were not included in the presentation submitted by M2Z include: Adjacent channel selectivity of the AWS-1 mobile receivers, the mobile user density and distribution of AWS-1 and AWS-3 mobile devices, the version of SEAMCAT was utilized.

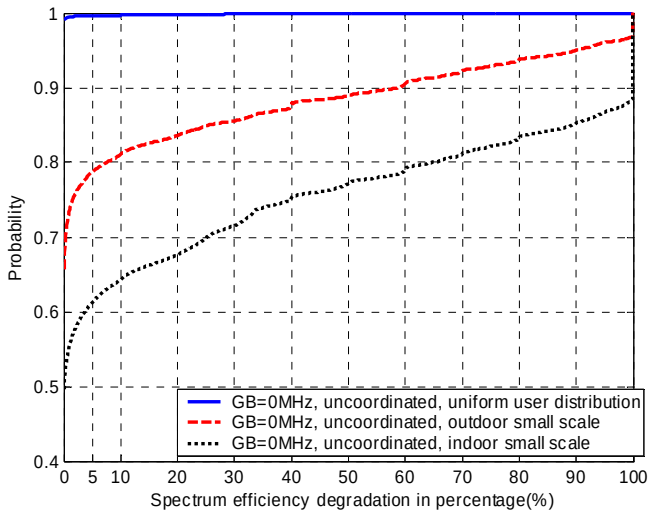
[18] See 3GPP TR 25.889, Feasibility Study Considering the Viable Deployment of UTRA in Additional and Diverse Spectrum Arrangements, version 6.0.0, 2003-07-01. See also, SEAMCAT User Manual, Software Version 2.1, February 2004.

[19] See WiMAX Forum contribution to ITU-R WP 5D, Document 5D/24-E , Working Document Towards a Preliminary Draft New Report on Sharing Studies in the 2500-2 690 MHz Band Between IMT-2000 and Mobile Broadband Wireless Access (MBWA) Systems in the Same Geographical Area, January 2008.

[20] *See* http://www.ero.dk/seamcat.

using SEAMCAT, which version of SEAMCAT was used to model AWS-3 WiMAX mobiles and, if the Beta version was used, how reliable the results are.

- Motorola has performed initial simulations using more appropriate methods consistent with its reports referenced above. Those results show that the consideration of high-user density factors can significantly impact the results obtained and therefore, require close consideration. As shown below, if evaluated using the Monte Carlo simulation with uniform user distribution, no interference would be predicted because the hotspot areas that would occur in practice are not modeled, while consideration of hotspots can increase the probability to approximately 38 percent that the AWS-3 mobile service would degrade AWS-1 spectrum efficiency by 5 percent.



Spectral Efficiency Assuming Uniform User Distribution And Non Uniform User Distribution (Hotspots)

- Some of the market developments expected with the introduction of next generation technologies include the use of embedded devices and machine-to-machine broadband communications. Both of these developments will increase the chances that devices will operate in near vicinity to each other. In addition, it will become less obvious to users when devices come within close proximity such that options for reducing proximity may be more limited. Existing standard models do not account for this development yet such conditions are expected to increase.

- Results may be read to indicate that much of the interference could be mitigated by the AWS-1 operator increasing the power of the base stations. Generally base station power is a limited resource and is managed to maximize the throughput and capacity, increasing power for one user means taking it from another which can result in not having enough to set up a call at a given signal level and Quality of Service or degrading an existing call.

In summary, Motorola believes that the probability study presented by M2Z is of little value in assessing the appropriate power and OOBE limits for AWS-3 devices.

Conclusion

Enabling services within the H-Block and AWS-3 allocations has the potential to enable additional services to the American public. However, technical rules for such use must be compatible with adjacent, pre-existing spectrum uses to avoid degrading service to millions of Americans and negatively impacting the overall efficient use of spectrum. Motorola urges the FCC to adopt technical standards that adequately protect Broadband PCS and AWS-3 handsets consistent with the recommendations contained herein.

Respectfully Submitted,

/S/ Steve B. Sharkey
Steve B. Sharkey
Senior Director
Regulatory and Spectrum Policy

/S/ Robert D. Kubik
Robert D. Kubik
Director
Telecom Relations Global

Motorola, Inc.
1455 Pennsylvania Avenue, NW
Washington, DC 20004
202.371.6900

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APPENDIX

ABILITY OF POTENTIAL AWS-3 DEVICES TO MEET EMISSION LEVELS IN 2110-2155 MHZ

1 Introduction

In reviewing the emissions masks of various technologies, Motorola believes that a AWS-3 device operating at 23 dBm power level operating in 2168-2180 MHz will be able to meet the emissions levels well below the FCC proposed value of 60 + 10log P (-30 dBm/MHz) into the AWS-1 receive band. Devices will also be able to operate in 2155-2168 MHz but must reduce the transmit power level to meet blocking requirements and emissions levels for AWS-1 protection.

Technology	Measured data		Estimated emission level in AWS-1 band, 23 dBm device in 2168-2180 MHz[1]
	Tx power	Emission level at offset[2]	
GSM	30 dBm	-47 dBm/MHz @ 0.5 MHz	< -61 dBm/MHz
EDGE	28 dBm	-51 dBm/MHz @ 0.5 MHz	< -61 dBm/MHz
WCDMA	24 dBm	-40 dBm/MHz @ 2.5 MHz -53 dBm/MHz @ 5 MHz	< -66 dBm/MHz
CDMA	25 dBm	-53 dBm/MHz @ 3 MHz	< -76 dBm/MHz

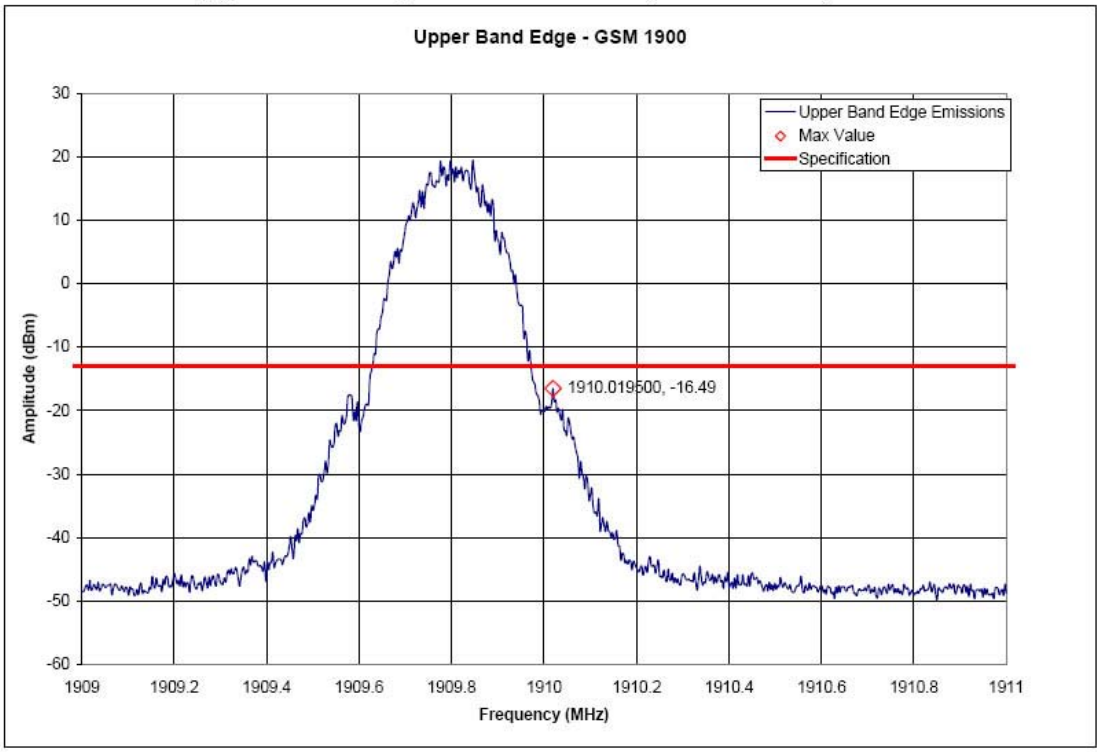
[1] Based on applicable standards requirements for the Technology standards, 3GPP TS 25.101 v7.6.0, 3GPP2 C.S0011-C.

[2] Offset is from channel edge and not channel center.

2 GSM

Motorola device in PCS band[3], Transmit power of 30 dBm.

GSM 1900 – Upper Band Edge – Channel 810 (1909.8 MHz)

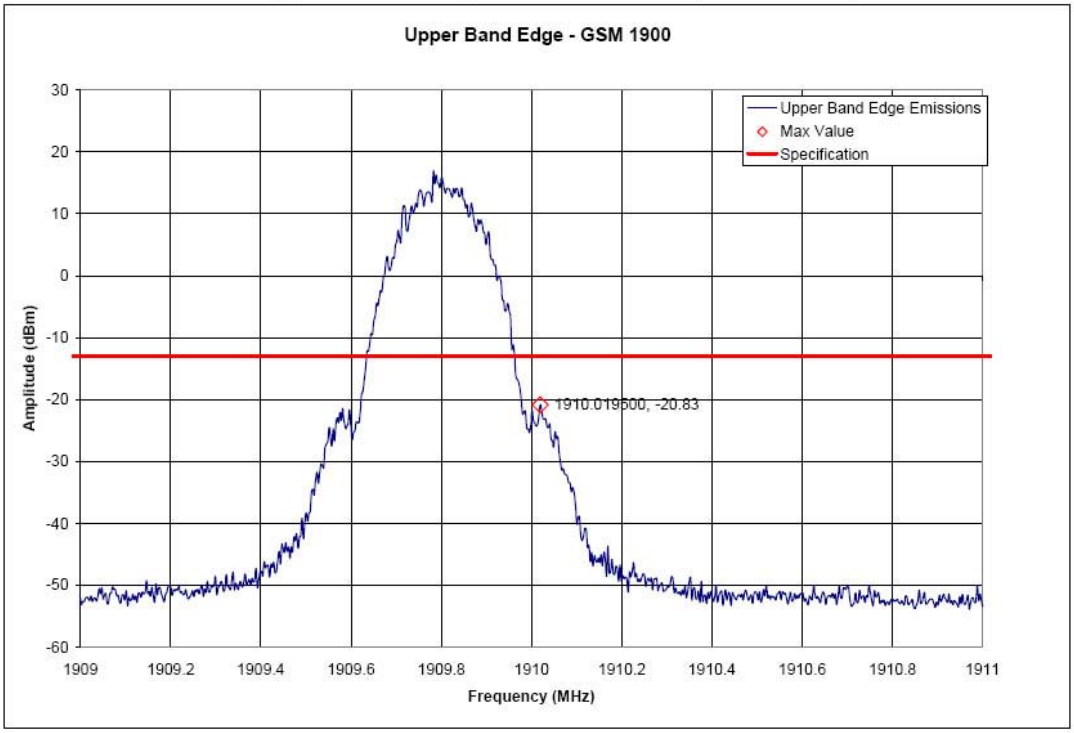


3 FCC ID IHDP56JG1

3 EDGE

Motorola device in PCS band[4], Transmit power of 28 dBm.

GSM 1900 EDGE – Upper Band Edge – Channel 810 (1909.8MHz)

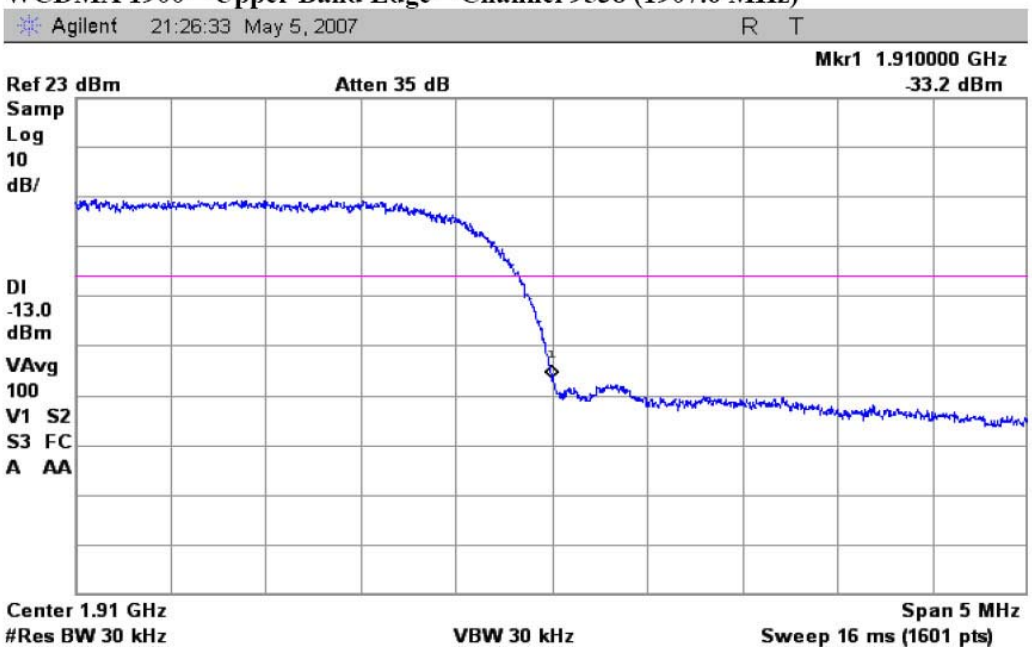


4 FCC ID IHDT56JT1

4 WCMDA

Motorola device in PCS band[5], Transmit power of 24 dBm.

WCDMA 1900 – Upper Band Edge – Channel 9538 (1907.6 MHz)

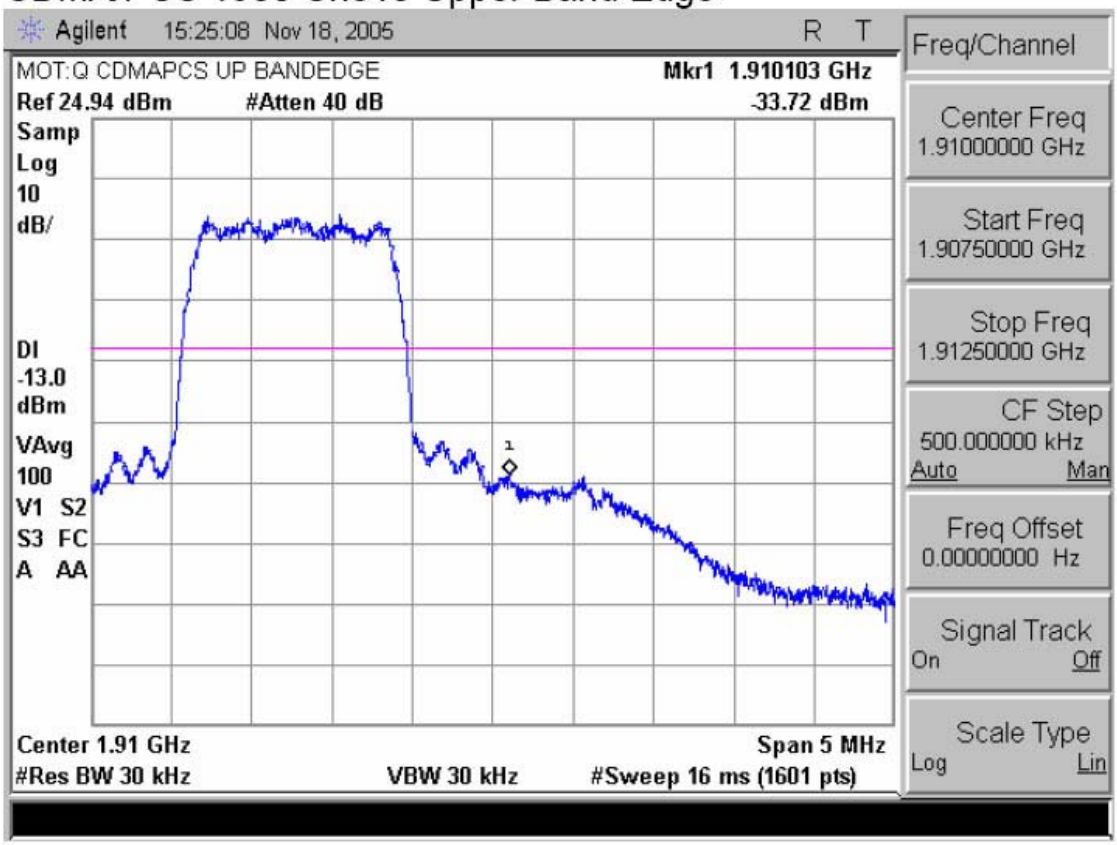


5 FCC ID IHDT56HW1

5 CDMA

Motorola device in PCS band[6], Transmit power of 25 dBm.

CDMA/PCS 1900 Ch810 Upper Band Edge



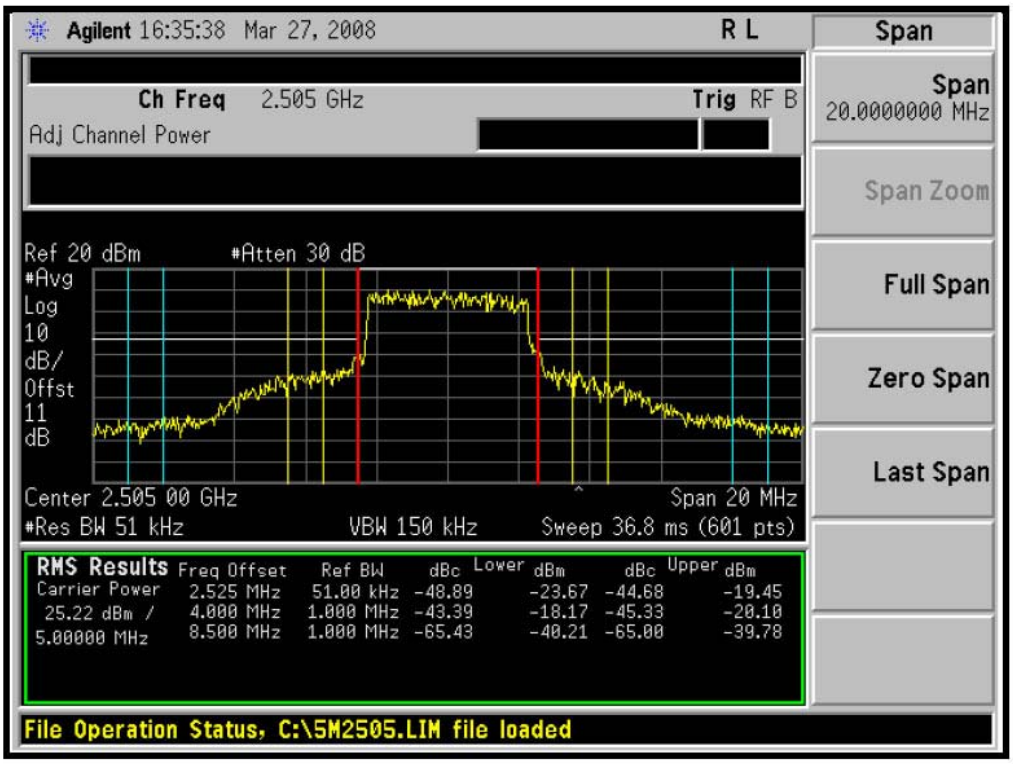
6 FCC ID IHDT56HW1

6 WiMAX

Motorola device in BRS/EBS band[7], Transmit power of 25 dBm in 5 MHz channel. Form factor is desktop CPE.

CHANNEL BANDWIDTH: 5MHZ

LOW CHANNEL



[7] FCC ID VYO-CPE25750