**Before the**
**Federal Communications Commission**
**Washington, D.C. 20554**



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| In the Matter of | ) | |
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| Amendment of Parts 2, 15, and 97 of the | ) | |
| Commission's Rules to Permit Use of Radio | ) | ET Docket No. 94-124 |
| Frequencies Above 40 GHz for New Radio | ) | RM-8308 |
| Applications | ) | |

# MEMORANDUM OPINION AND ORDER AND FOURTH NOTICE OF PROPOSED RULE MAKING

**Adopted: July 28, 1997** **Released: August 14, 1997**

**Comment Date: [30 days from date of publication in the Federal Register]**
**Reply Comment Date: [45 days from date of publication in the Federal Register]**

By the Commission:

## INTRODUCTION

1. By this action, the Commission grants the Petition for Reconsideration, as supplemented, filed by Cutler-Hammer, Inc. ("Cutler-Hammer") and denies the Petition for Reconsideration filed by Vorad Safety Systems, Inc., ("Vorad") both of which request reconsideration of the *First Report and Order and Second Notice of Proposed Rule Making* ("*Order*") in this proceeding.[1] This action makes available the 59-64 GHz band for fixed field disturbance sensors and reaffirms the previous Commission decision on the limit for spurious emissions from vehicle radar systems operating in the 46.7-46.9 GHz band. In addition, the Commission is requesting comments regarding a proposed spectrum etiquette ("Spectrum Etiquette") filed by the Millimeter Wave Communications Working Group ("MWCWG") for operation of systems in the 59-64 GHz band. Moreover, this action permits the interim operation in the 59-64 GHz band pending consideration of the proposed Spectrum Etiquette. Further, on its own motion, the Commission is correcting two errors that were contained in the *Order*.

## BACKGROUND

2. In the *Order*, the first of several that are expected to be forthcoming in this proceeding, the Commission adopted regulations to permit the commercial development and use

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[1] *See, First Report and Order and Second Notice of Proposed Rule Making* in ET Docket No. 94-124, 11 FCC Rcd. 4481 (1995), adopted on December 15, 1995. Unless otherwise stated, all references to Part 15 of the regulations are to the rules adopted therein.

of a portion of the "millimeter wave" frequency bands above 40 GHz.

3. The 59-64 GHz band ("60 GHz band") was made available for use by general unlicensed communications devices. Possible uses of this band include the development of short-range, high capacity wireless radio systems that could be used for educational and medical applications and for wireless access to libraries or other information databases. The *Order* also prohibited the use of field disturbance sensors in the 60 GHz band due to the likelihood that they would interfere with data communications systems. In response to several comments in this proceeding, the Commission delayed the implementation of the 60 GHz band for up to one year in order to permit industry to develop a spectrum etiquette.[2]

4. The 46.7-46.9 GHz band ("46 GHz band") and the 76-77 GHz band ("76 GHz band") were made available for use by vehicle radar systems. The use of these bands would permit the development of collision avoidance systems that could be used in conjunction with Intelligent Transportation Systems. In order to provide interference protection to present and future Government operations near 94 GHz and 140 GHz, the Commission proposed and adopted strict limits on spurious emissions from transmitters operating in the 46 GHz band.[3] The second and third harmonics of a fundamental emission operating in the 46 GHz band fall within the 94 GHz and 140 GHz bands.[4] The Commission understood in the *Order* that its decision might have an adverse economic impact on the manufacture of vehicle radar systems in the 46 GHz band, and it indicated that it would be willing to reconsider this spurious emission limit if the manufacturers of vehicle radar systems could demonstrate, in collaboration with the manufacturers of equipment operating on harmonically-related frequencies, that there is a low probability of interference. Transmitters operating in the 76 GHz band were not subject to the same strict limits for spurious emissions because their second and third harmonics do not fall in the 94 GHz and 140 GHz bands.

5. Two Petitions for Reconsideration were filed in response to the *Order*. The Petition for Reconsideration filed by Cutler-Hammer seeks to permit the operation of fixed field disturbance sensors in the 60 GHz band. The Petition for Reconsideration filed by Vorad requests that the spurious emission limits for field disturbance sensors operating in the 46 GHz band be relaxed and made the same as the spurious emission requirements of field disturbance sensors operating in the 76 GHz band.

## CUTLER-HAMMER PETITION

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[2] *Id.* at para. 64.

[3] *Id.* at para. 45-47. Spurious emissions from transmitters operating in the 46 GHz band shall not exceed 2 pW/cm$^2$ at a distance of 3 meters. If the transmitter is operating at its maximum permitted output level, 60 μW/cm$^2$ at a distance of 3 meters, spurious emissions must be attenuated by about 75 dB.

[4] The bands 94 GHz and 140 GHz are two spectrum windows above 40 GHz that have minimal attenuation due to the atmosphere.

6. Petition. Cutler-Hammer, a manufacturer of sensors used in industrial applications, requests that the Commission amend its rules to permit the operation of lower power, fixed field disturbance sensors in the 60 GHz band. Cutler-Hammer states that lower frequency sensors of the type currently being manufactured are limited in their ability to perform speed control, fluid level, and motion detection functions because humidity, fog, or dust can cause measurement errors. It adds that millimeter wave sensors can overcome these limitations because they are not susceptible to these environmental factors. Furthermore, Cutler-Hammer argues that millimeter wave sensors can be designed to fit into smaller enclosures and can provide greater sensor accuracy and distance than lower frequency sensors.[5] Cutler-Hammer also asserts that its sensor applications typically require an operating range of less than two feet, with a need to perform accurate measurements with the sensor within six inches of the target and indicates that a 5 GHz bandwidth is necessary to eliminate problems from measurements at this near distance.[6]

7. Cutler-Hammer recognizes that a number of parties participating in this proceeding expressed concern about suggestions that vehicle radar systems be permitted to operate in the 60-61 GHz band. It agrees that the potential for interference from mobile field disturbance sensors to fixed operations is hard to predict and to avoid.[7] Fixed field disturbance sensors operating characteristics are much more predictable and the potential for causing and receiving interference is more easily determined, while the operating characteristics of mobile field disturbance sensors are very difficult to predict due to the inherently variable nature of the system, which results in unpredictable radiation patterns and potentials for causing and receiving interference. In addition, Cutler-Hammer indicates that, in contrast, the fixed sensors it desires to employ would operate with very little power and would create a predictable radiation pattern, permitting them to be designed and installed in such a way that they would neither be susceptible to, nor likely to cause, interference. Accordingly, Cutler-Hammer believes that the prohibition against the use of fixed field disturbance sensors is unnecessarily broad and is not supported by the record.

8. Cutler-Hammer's Petition for Reconsideration originally requested that fixed field disturbance sensors operate with an output level of 200 nW/cm$^2$ measured at a distance of 3 meters for the 60 GHz band. However, Cutler-Hammer's supplemental filing indicates that the sensors typically would operate at an output level of 9 nW/cm$^2$ at a distance of 3 meters, an output that is about 30 dB lower than the level permitted for other communications systems in the 60 GHz band.[8] Cutler-Hammer argues that the fixed, low power operation makes it unlikely that emissions from the sensors would be strong enough to interfere with communications systems operating in this band.

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[5] *See* Petition for Reconsideration of Cutler-Hammer, Inc. at 6.

[6] *Id.* at 2.

[7] *Id.* at 8-9.

[8] *See Ex Parte Presentation*, filing from Cutler-Hammer, Inc., dated December 19, 1996.

9. Cutler-Hammer also notes that the Commission, as indicated above, delayed the implementation of the 60 GHz band to permit industry to develop a spectrum etiquette.[9] Cutler-Hammer is concerned that delays in the industry negotiations regarding a spectrum etiquette could delay the introduction of field disturbance sensors in this band. Cutler-Hammer adds that because its sensors will not present a risk of interference to data communications systems, implementation of a spectrum etiquette is not needed to ensure that the sensors can co-exist with other broadband applications. Moreover, Cutler-Hammer indicates that its sensors will comply with the spectrum etiquette submitted by industry and argues that it should be permitted to commence operation immediately with its sensors conditioned upon the final outcome of any spectrum etiquette for the 60 GHz band.

10. Comments. MWCWG filed comments in support of Cutler-Hammer's supplemented Petition for Reconsideration, stating that 9 $nW/cm^2$ is acceptable for fixed field disturbance sensors operating throughout the 60 GHz band.[10] MWCWG also indicates that fixed field disturbance sensors occupying less than 500 MHz of bandwidth can operate in the 61-61.5 GHz band with an output level of 9 $\mu W/cm^2$ at a distance of 3 meters. Cutler-Hammer indicates in its supplemental filing that it agrees with these specifications. No other comments were received concerning Cutler-Hammer's Petition for Reconsideration.

11. Discussion. The Commission agrees with Cutler-Hammer that fixed field disturbance sensors at the proposed output level of 9 $nW/cm^2$ at 3 meters would not be likely to be a source of interference to other communications systems in the 60 GHz band. This is the only unlicensed frequency band under the Commission's regulations that provides a bandwidth this wide and at a power level that makes operation practical. Accordingly, the Commission is granting the request from Cutler-Hammer to remove the prohibition against fixed field disturbance sensors. The Commission also recognizes that, in many cases, the manufacturing process may require that the sensor be capable of movement, even though the equipment in which the sensor is installed is fixed. Thus, the Commission will clarify in its rules that the permission to operate fixed field disturbance sensors applies to sensors installed in fixed equipment, even if the sensor itself moves within the equipment. However, this action does not affect the Commission's existing prohibition on mobile field disturbance sensors. The Commission agrees with Cutler-Hammer's request that it be permitted to operate its sensors immediately, conditioned upon the final outcome of any spectrum etiquette adopted for the 60 GHz band, as described below.

## INTERIM OPERATION PENDING ADOPTION OF THE PROPOSED SPECTRUM ETIQUETTE

12. Although the Commission stated in the *Order* that operation in the 60 GHz band would be permitted only after adoption of a spectrum etiquette, we now believe that this

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[9] *See* Petition for Reconsideration of Cutler-Hammer at 4, 10-12.

[10] *See* MWCWG *Ex Parte Presentation* dated December 13, 1996.

prohibition no longer is necessary and would be detrimental to the introduction of new products and services. Therefore, the Commission will permit operation in the 60 GHz band, of any authorized, unlicensed communications devices, including fixed field disturbance sensors, on an interim basis pending consideration of the Spectrum Etiquette proposed in the Fourth Notice of Proposed Rule Making. The Commission believes that permitting interim operation will serve the public interest by permitting early rollout of new and innovative technologies and services. The Commission will require, however, that equipment approved for such interim operation comply with the proposed Spectrum Etiquette. The Commission stresses that any spectrum etiquette finally adopted in this proceeding may differ significantly from the proposed Spectrum Etiquette contained in the Fourth Notice and that manufacture and operation of equipment under this interim provision is at the risk of the manufacturer and operator exclusively. The Commission also stresses that initial operation which complies with the proposed Spectrum Etiquette does not guarantee continued operation if any changes in that etiquette are adopted.

## VORAD PETITION

13. Petition. Vorad Safety Systems, Inc. ("Vorad"), a manufacturer of field disturbance sensors used for vehicle collision avoidance systems, requests reconsideration of the spurious emission limit for sensors operating in the 46 GHz band. Vorad requests that the limits on spurious emissions applicable to field disturbance sensors operating in the 76 GHz band also be applied to sensors operating in the 46 GHz band.[11]

14. Vorad states that it originally requested 200 MHz of spectrum for a vehicle radar system to operate in the 46-50 GHz band to permit it to adapt its existing 24 GHz system through the use of a frequency doubler. This would permit a rapid introduction of the new equipment at a lower cost.[12] Vorad notes that, while the Commission originally proposed a spurious emission limit of 2 pW/cm$^2$ at 3 meters for all unlicensed millimeter wave devices, this limit was strongly opposed by proponents of vehicle radar systems and other unlicensed operations. These parties argued that the limit would be extremely difficult to meet and was unnecessary to protect other communications users. Further, the emissions meeting this limit would be difficult to measure. Vorad adds that the Commission, in response to these concerns, relaxed the standard for vehicle radar systems in the 76 GHz band but adhered to its strict proposal for radar operating in the 46 GHz band.[13] Vorad states that the adopted limit conflicts with the Commission's stated goal of encouraging expeditious development of an important safety

[11] *See* Petition for Reconsideration of Vorad Safety Systems, Inc. at i, 12. The limits on spurious emissions from transmitters in the 76 GHz band are 300 pW/cm$^2$ at 3 meters for side or rear looking sensors and 600 pW/cm$^2$ at 3 meters for forward looking sensors. The limit for spurious emissions from transmitters operating in the 46 GHz band is 2 pW/cm$^2$ at 3 meters. *See* 47 CFR § 15.253(c).

[12] *See* Vorad petition at 2, 6.

[13] *Id.* at 2-3.

product.[14] Vorad adds that meeting the stricter limit using current technology would be possible only by reducing operating power, which would significantly degrade the performance of the system.[15] Further, Vorad states that even if technology permitting compliance with the adopted limits could be developed, at a minimum this would delay the introduction of vehicle radar systems in the 46 GHz band at least one to two years and would result in a large cost increase.[16] This cost increase, according to Vorad, would make the system less affordable and might make it uneconomical to produce and market. It would also place the 46 GHz equipment at a competitive disadvantage once systems in the 76 GHz band become available.

15. Vorad argues that the limit on spurious emissions adopted by the Commission for the 46 GHz band is not technically justified.[17] It states that the Commission based its decision on the need to protect existing and future U.S. Government uses of the 94 GHz and 140 GHz bands. However, Vorad indicates that the evidence in the record does not demonstrate that there is a real threat of interference to such uses by vehicle radar systems, since vehicle radar systems use highly directionalized antennas and will primarily be used on the nation's highways. It adds that it has operated vehicle radar systems in the 24 GHz band for several years and has been experimenting with operations in the 47 GHz band for over a year. Vorad indicates that the spurious emissions from its 24 GHz and 47 GHz transmissions were suppressed by only 50 dB, and that no complaints of interference were received. Thus, Vorad states that its experience with these systems demonstrates that an attenuation standard of 50 dB is sufficient to protect other spectrum users. Vorad adds that there is no evidence that operations in the 46 GHz band will present more of an interference risk than do operations in the 76 GHz band, for which a much more reasonable standard was adopted.[18] Vorad believes that it is likely in the initial states of development that 76 GHz radar devices will employ 38 GHz or 26 GHz fundamental oscillators and use frequency doublers or triplers or second or third harmonic pumped oscillators to achieve the fundamental, resulting in harmonics near the 94 or 140 GHz bands.

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[14] *Id.* at i-ii, 3, 5, 7-8.

[15] According to Vorad, the reduced power would mean that the radar system would not detect weaker targets and may miss some critical targets altogether. The effect on performance would be particularly severe in snowy or rainy conditions. *Id.* at 7.

[16] Vorad states that adhering to the present emission limit would require inserting special filtering in the transmission line, which in turn would produce additional transmitter and receiver losses to the system. In addition, radio frequency (RF) shielding would need to be incorporated into the equipment packaging and cabling and that generally more demanding specifications for system components would be necessary. Vorad estimates that the total impact of these requirements would be to increase system costs by 25-50 %. *Id.* at 8-9.

[17] *Id.* at 4, 10-11.

[18] The limits on spurious emissions from transmitters in the 76 GHz band are 300 pW/cm$^2$ at 3 meters for side or rear looking sensors and 600 pW/cm$^2$ at 3 meters for forward looking sensors. If the transmitter is operated at its maximum permitted output levels, spurious emissions must be attenuated by at least 50 dB. *See* 47 CFR § 15.253(c).

16. Finally, Vorad argues that vehicle radar systems in the 76 GHz band will create spurious emissions over a much larger range of spectrum than will operations in the 46 GHz band.[19] It states that the narrow 200 MHz bandwidth employed by transmitters in the 46 GHz band will limit the bandwidth of harmonic emissions. In contrast, the permissible bandwidth of the 76 GHz radar is 1000 MHz, resulting in spurious emissions over much more of the spectrum due to intermodulation frequency products.

17. Comments. The National Telecommunications and Information Administration (NTIA) was the only party to file comments in response to the Vorad petition. NTIA strongly opposes VORAD's request to relax the spurious emission limit. It states that the majority of U.S. Government operations occur in the propagation windows centered at 94 GHz, 140 GHz and 220 GHz.[20] It adds that new radio receiver technologies using wide bandwidth (typically 4-10 GHz) and improved sensitivities have resulted in greater resolution and precision for detection and guidance systems and remote sensing of the environment. NTIA points out that a joint Federal Aviation Administration/Department of Defense/Industry program is currently underway to develop and test "synthetic vision" systems intended for use in airport environments during poor visibility. Further, it states that recent analysis indicates that the noise threshold of these receivers can be more than 30 dB below the threshold assumed by the Commission in its *Order* for this type of equipment, so further relaxation of the limit on spurious emissions could have serious consequences on the effectiveness of systems in these bands.[21] Finally, NTIA states that it invited Vorad to present its views to the Interdepartment Radio Advisory Committee (IRAC), but that Vorad did not respond to this offer. NTIA adds that it remains willing to assist Vorad should it decide to pursue an effort to demonstrate compatibility of its equipment, but in the interim urges the Commission not to relax the limit on spurious emissions.

18. Discussion. The Commission is denying Vorad's petition to relax the limits on spurious emissions from field disturbance sensors operating in the 46 GHz band. The Commission recognized in the *Order* that its decision might have an adverse economic impact on manufacturers but concluded that the limit was appropriate to protect present and future U.S. Government operations in the 94 and 140 GHz bands.[22] It stated that the 94 GHz and 140 GHz

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[19] *See* Vorad petition at 11-12.

[20] The band centered at 220 GHz is centered at a null for water absorption, while still having relatively low attenuation properties due to absorption from dry air. Since the bands being addressed in this proceeding did not exceed 155 GHz and spurious emissions were addressed only below 200 GHz, the 220 GHz band was not addressed in the Commission's earlier considerations.

[21] *See Technical Characteristics and Interference Criteria for Radiolocation Systems Operating in the 92-100 GHz Band, and Compatibility with Active Spaceborne Sensors*, U.S. paper to the ITU-R JWP 7-8R, Document 7-8R/27-E, March 12, 1996. In this paper, the radiometer threshold for a 4 GHz passive imager operating at 94 GHz was stated to be -136 dBW, as opposed to the value of -103 dBW used by the Commission in its *Order*. *See Order* at footnote 57.

[22] *See Order* at para. 46.

bands share many potential uses, since these bands are in the only two atmospheric transmission windows between 60 GHz and 300 GHz. The 94 GHz band is employed for radio astronomy, U.S. Government passive imaging systems, and Department of Defense classified applications. The 140 GHz band is used for radio astronomy and Government military passive imaging systems. In particular, the Commission noted that the Advanced Research Projects Agency's MIMIC program to develop lower-cost millimeter wave components has involved technology in the 94 GHz area and is likely to increase the use of this and other millimeter wave bands. The Commission, in the *Order*, added that, while it appreciated the arguments in the comments from General Motors Corporation and GM Hughes Electronics for relaxing the spurious emission limits, it did not agree that directional antennas and the use of vehicle radar systems on highways would be sufficient to eliminate interference to airborne passive sensors.[23] Further, as noted by NTIA in its comments on Vorad's petition, current development of a passive imaging system used as an aircraft landing aid in adverse weather conditions involves resolution capabilities which are directly related to the amount of RF signal noise in the band. Thus, we continue to believe that the presence of excessive spurious emissions from other signal sources, *e.g.*, harmonic emissions from vehicle radar systems in the 46 GHz band, would degrade the usefulness of these bands for passive imaging and other possible functions.[24]

19. While Vorad indicates that its previous experience with field disturbance sensors operating at 24 GHz and at 47 GHz and employing a spurious emission suppression of 50 dB has not resulted in complaints of interference, the Commission does not find this sufficiently conclusive to relax the spurious emission requirements. First, operations in the 94 GHz and 140 GHz bands are only now being developed. As U.S. Government and other operations increase in these bands, along with the proliferation of field disturbance sensors in the 46 GHz band, the potential for interference would also increase. Second, Vorad's argument does not address the cumulative effects of multiple transmitters operating simultaneously within a service area. Finally, 50 dB attenuation of the spurious emissions from transmitters operating in the 24 GHz band results in an emission level that is relatively close to the emission limit adopted in the *Order* for spurious emissions from the 46 GHz band.[25]

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[23] *See Order* at para. 46.

[24] At the sensitivity level stated by NTIA in its comments, -136 dBW, using a parabolic receiving antenna with an efficiency factor of 55 % and an area of 1 square meter, the second harmonic would have to be reduced to less than 0.2 pW/cm$^2$ at a distance of 3 meters in order not to be detected by 94 GHz passive imaging receivers at a distance of 600 meters, the distance originally considered in the *Order*. If the 1 MHz resolution bandwidth of the measuring instrument is taken into account, the 400 MHz bandwidth of the second harmonic of the 46 GHz transmission indicates that the attenuation factor would need to be reduced by a factor of 1/400, *i.e.*, to 0.0005 pW/cm$^2$ at 3 meters, in order not to be detected at 600 meters.

[25] The fundamental output level of the 24 GHz systems is limited to 2.5 V/m at a distance of 3 meters. Based on free space propagation, this is roughly equivalent to a spectral power density of 1.7 μW/cm$^2$ at 3 meters. With 50 dB of attenuation, the level of the spurious emissions would be approximately 17 pW/cm$^2$ at 3 meters. This level is only about 9 dB higher than the fundamental emission limit adopted for spurious emissions from the 46 GHz band systems. However, for a transmitter operating at 24 GHz it is the fourth and sixth harmonics that produce emissions

20. The Commission does not agree with Vorad's claims that harmonic emissions from the 76 GHz system present the same, or greater, interference potential to 94 GHz and 140 GHz systems as sensors operating in the 46 GHz band, even if the 76 GHz devices use frequency doublers or triplers to achieve the fundamental emission. If, as suggested by Vorad, the 76 GHz systems generate their fundamental emissions through the use of a 25.5 GHz oscillator, the third harmonic is at 76.5 GHz, the fourth harmonic is at 102 GHz, the fifth harmonic is at 127.5 GHz, and the sixth harmonic is at 153 GHz. If the 76 GHz systems generate their fundamental emissions through the use of a 38.25 GHz oscillator, the second harmonic is at 76.5 GHz, the third harmonic is at 114.75 GHz, and the fourth harmonic is at 153 GHz. In every case, the harmonic emissions from the 76 GHz system are well removed from the 94 GHz and 140 GHz bands. While Vorad also argues that the wider bandwidth of the 76 GHz system will result in spurious emissions covering a larger bandwidth, as compared to systems in the 46 GHz band, this wider bandwidth is not sufficient to cause the harmonic emissions to fall within the 94 GHz or 140 GHz bands.

21. Finally, in the *Order*, the Commission added that it would be willing to reconsider the spurious emission limit for the 46 GHz band if manufacturers of vehicle radar equipment can demonstrate, in collaboration with the manufacturers of equipment operating on harmonically-related frequencies, a low probability of interference, *e.g.*, based on angular distribution and susceptibility of the sensor to off-axis signals.[26] While NTIA invited Vorad to present its views to the IRAC, Vorad did not respond to this offer.

22. For the reasons explained above, we decline to permit a higher spurious emission level for field disturbance sensors operating in the 46 GHz band. Accordingly, the Petition for Reconsideration of Vorad Safety Services, Inc. is denied. We will consider revisiting this issue later if Vorad and NTIA demonstrate that a different emission limit would be unlikely to cause harmful interference.

## FOURTH NOTICE OF PROPOSED RULE MAKING

23. Spectrum Etiquette. In the *Second Notice of Proposed Rule Making* the Commission requested comment regarding a spectrum etiquette for operation in the 59-64 GHz band. The Commission provided one year for a spectrum etiquette to be submitted and encouraged industry to form a working group to develop a spectrum etiquette to permit efficient use of the 59-64 GHz

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near the 94 GHz and 140 GHz bands. Typically, the fourth and sixth order harmonics are lower than the second, third, and fifth order harmonics. Therefore, it is likely that the fourth and sixth order harmonics from a 24 GHz transmitter are attenuated considerably more than 50 dB. A similar calculation for the attenuation of spurious emissions on Vorad's transmission at 46 GHz was not performed because Vorad did not disclose the output level of its 46 GHz transmission system in its petition. However, as stated above, operations in the 94 GHz and 140 GHz bands are only now being developed, making it unlikely that harmful interference would have been caused regardless of the levels of the harmonics produced in Vorad's earlier experimental operation.

[26] *See Order* at para. 47.

band.[27]

24. In response, the MWCWG developed and proposed a Spectrum Etiquette for equipment operating in the 59-64 GHz band.[28] MWCWG's proposal includes five recommendations. First, the proposed Spectrum Etiquette seeks to establish a coordination channel located at 59.0-59.05 GHz to be used exclusively to establish techniques that various transmitters could use to help mitigate or eliminate interference. Second, it seeks to establish a format for transmitter identification by requiring a 60 GHz transmitter with an output power of 0.1 mW or more to transmit information that contains the FCC ID number, the serial number of the transmitter, and a user definable field of up to 24 bytes of information. Third, the Spectrum Etiquette seeks to adopt a limit for peak equivalent isotropically radiated power of 20 W for 60 GHz transmitters. Fourth, the Spectrum Etiquette seeks to limit the peak transmitter output power to 500 mW. Fifth, the Spectrum Etiquette seeks to limit the peak transmitter output power for transmitters employing a 6 dB bandwidth of less than 100 MHz, as measured with a 100 kHz resolution bandwidth spectrum analyzer, according to the following formula: $P \leq 500$ [bandwidth in MHz/100] mW.

25. The Spectrum Etiquette submitted by MWCWG differs from the standards adopted in the *Order*. The standards in the *Order* did not consider a coordination channel, transmitter identification requirements, limits on the peak equivalent isotropically radiated power or peak transmitter output power. Instead, the *Order* adopted a power spectral density for transmitters operating in the 60 GHz band of 9 $\mu W/cm^2$ measured at three meters from the transmit antenna. MWCWG seeks adoption of its proposal to permit efficient use of the spectrum by enabling greater frequency reuse and lowering the probability of interference.

26. The Commission seeks comments on whether it should adopt the standards contained in the MWCWG proposal. The Commission is particularly interested in comments regarding the proposed transmitter identification requirements and the designation of a coordination channel. It wishes to clarify, however, that the reference in the MWCWG filing for "radiated power" actually refers to transmitter output power.[29] Further, the Commission notes that the limits on total peak output power are based on the use of "an RF detector that encompasses the 59-64 GHz band and that has a video bandwidth of at least 10 MHz."[30] However, Section 13.1.4.2 and Appendix I4, note 2, of the Commission's measurement procedure, as specified in ANSI C63.4-

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[27] *See Order* at para. 64.

[28] *See* MWCWG *Ex Parte Presentation* dated December 13, 1996. *See* Public Notice, *Commission Receives Industry Spectrum Etiquette Proposal for Unlicensed Operation Above 40 GHz*, DA 97-288, released February 10, 1997. The MWCWG proposed Spectrum Etiquette can be accessed at [http://www.fcc.gov/oet/dockets/et94-124/].

[29] *See* MWCWG *Ex Parte Presentation* dated December 13, 1996 at pages 3, 5 and 6.

[30] *Id.*

1992,[31] both indicate that a pulse desensitization correction factor must be applied if the bandwidth of the measuring instrument is less than the pulse repetition frequency.[32] Parties commenting on the proposed peak limits and measurements should be aware of the possible application of a pulse desensitization correction factor. Comments should be directed towards the specific substance contained in the proposed Spectrum Etiquette and we remind parties that the actual regulations adopted may differ from those contained in the proposed Spectrum Etiquette.[33]

## OTHER ISSUES

27. The Commission is taking this opportunity to correct two typographical errors contained in the *Order* in this proceeding. Section 15.215(a) is being amended to reflect the two new rule Sections 15.253 and 15.255 covering operations above 40 GHz.[34] Section 15.215 notes the exceptions to the general emission limits contained in Section 15.209 and should have been amended in the *Order*.[35] Section 15.31(f)(1) is also being corrected to reflect that the inverse linear-distance-squared extrapolation factor (40 dB per decade) for measurements above 40 GHz applies only to measurements performed in the near field.[36] In response to the *Notice of Proposed Rule Making* in this proceeding, Epsilon Lambda, General Motors and Vorad expressed concern that measurements at the specified distance of 3 meters could result in measurements in the near field, requiring the use of an inverse linear-distance-squared extrapolation factor (40 dB per decade) instead of inverse linear-distance (20 dB per decade), as previously specified in the rules.[37] The Commission agreed with these comments but inadvertently stated that all measurements above 40 GHz could be made at a distance greater than 3 meters using an inverse linear-distance-squared extrapolation factor, even if the measurements were not being performed in the near field. However, the inverse linear-distance-squared factor correctly extrapolates the change in signal level versus distance when measurements are made in the near field, whereas

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[31] *See* American National Standards Institute (ANSI) C63.4-1992, "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range 9 kHz to 40 GHz," Institute of Electrical and Electronics Engineers, Inc., July 17, 1992, document number SH5180. *See* also 47 CFR 15.31(a).

[32] The pulse desensitization correction factor is contained in the Hewlett-Packard Spectrum Analyzer Application Note number 150-2, Spectrum Analysis . . . Pulse RF.

[33] For example, the rule amendment proposed for § 15.35(b) does not incorporate the Commission's existing requirement to use a minimum 1 MHz bandwidth resolution for emissions greater than 1 GHz. The Commission is not proposing to delete this existing standard for other measurements above 1 GHz.

[34] *See* 47 CFR § 15.215(a).

[35] *See* 47 CFR § 15.209.

[36] *See* 47 CFR § 15.31(f)(1).

[37] *See Order* at para. 52 and 55.

the inverse linear-distance factor correctly extrapolates the change in signal level versus distance when measurements are made in the far field. The use of the inverse linear-distance-squared extrapolation factor under all measurement conditions could permit a manufacturer to increase measurement distance until the results demonstrated compliance, even though the emissions exceed the limit when the product is measured at a shorter distance. Accordingly, the rules are being amended to indicate that the use of an inverse linear-distance-squared extrapolation factor applies only to near-field measurements. Measurements in the far field will continue to be extrapolated employing an inverse linear-distance extrapolation factor. Since these changes to the rules involve typographical amendments, public notice and comment on these changes is unnecessary pursuant to Section 553(b)(3)(B) of the Administrative Procedure Act.[38]

## PROCEDURAL MATTERS

28. This is a permit-but-disclose proceeding. Ex Parte presentations are permitted, except during the Sunshine Agenda period, provided they are disclosed as provided in the Commission's rules. See generally 47 C.F.R. § 1.1202, 1.1203, and 1.1206(a).

29. As required by Section 603 of the Regulatory Flexibility Act, the Commission has prepared an Initial Regulatory Flexibility Analysis ("IRFA") of the expected impact on small entities of the proposals suggested in the Fourth Notice of Proposed Rule Making. The IRFA is set forth in Appendix B. Written public comments are requested on the IRFA. These comments must be filed in accordance with the same filing deadlines as comments on the rest of the Notice, but they must have a separate and distinct heading designating them as responses to the IRFA. The Secretary shall send a copy of this Fourth Notice of Proposed Rule Making, including the IRFA, to the Chief Counsel for Advocacy of the Small Business Administration in accordance with paragraph 603(a) of the Regulatory Flexibility Act. Pub. L. No. 96-354, 94 Stat 1164, 5 U.S.C. Section 601 et seq (1981).

30. Initial Paperwork Reduction Act of 1995 Analysis. The Memorandum Opinion and Order and Fourth Notice of Proposed Rule Making contains either a proposed or modified information collection. As part of its continuing effort to reduce paperwork burdens, we invite the general public and the Office of Management and Budget ("OMB") to take this opportunity to comment on the information collections contained in the NPRM, as required by the Paperwork Reduction Act of 1995, Pub. L. No. 104-13. Public and agency comments are due at the same time as other comments on this NPRM; OMB comments are due 60 days from date of publication in the Federal Register. Comments should address: (a) whether the proposed collection of information is necessary for the proper performance of the functions of the Commission, including whether the information shall have practical utility; (b) the accuracy of the Commission's burden estimates; (c) ways to enhance the quality,utility, and clarity of the information collected; and, (d) ways to minimize the burden of the collection of information on the respondents, including the use of automated collection techniques or other forms of

[38] *See* 5 U.S.C. 553(b).

information technology.

31. Comment Dates. Pursuant to applicable procedures set forth in Sections 1.415 and 1.419 of the Commission's Rules, 47 C.F.R. § 1.415 and § 1.419, interested parties may file comment on the Fourth Notice of Proposed Rule Making on or before **[insert date 30 days from date of publication in the Federal Register]** and reply comments on or before **[insert date 45 days from date of publication in the Federal Register]**. To file formally in this proceeding, you must file an original and five copies of all comments, reply comments, and supporting comments. If you want each Commissioner to receive a personal copy of your comments, you must file an original plus nine copies. You should send comments and reply comments to the Office of the Secretary, Federal Communications Commission, Room 239, 1919 M Street, N.W., Washington DC 20554. You may also file comments electronically via the Internet at mmwaves@fcc.gov. Comments and reply comments will be available for public inspection during regular business hours in the FCC Reference Center of the Federal Communications Commission, Room 239, 1919 M Street, N.W., Washington DC 20554. Written comments on the proposed and/or modified information collections are due **[insert date 30 days from date of publication in the Federal Register]**. Written comments must be submitted by the Office of Management and Budget ("OMB") on the proposed and/or modified information collection on or before **[insert date 30 days from date of publication in the Federal Register]**. In addition to filing comments with the Secretary, a copy of any comments on the information collections contained herein should be submitted to Judy Boley, Federal Communications Commission, Room 234, 1919 M Street, N.W., Washington, DC 20554, or via the Internet to jboley@fcc.gov and to Timothy Fain, OMB Desk Officer, 10236 NEOB, 725 - 17th Street, N.W., Washington, DC 20503 or via the Internet to fain_t@al.eop.gov.

## ORDERING CLAUSES

32. In accordance with the above discussion and pursuant to the authority contained in Sections 4(i), 302, 303(e), 303(f), 303(g), 303(r), and 405 of the Communications Act of 1934, as amended, IT IS ORDERED that the Petition for Reconsideration filed by Cutler-Hammer, Inc., as supplemented, to permit operation of low power, fixed field disturbance sensors in the 60 GHz band IS GRANTED as described below by the amendments to the rules shown in appendix A. IT IS FURTHER ORDER that the Petition for Reconsideration filed by Vorad Safety Systems, Inc., IS DENIED.

33. For further information regarding this Memorandum, Opinion and Order and Fourth Notice of Proposed Rule Making, contact John A. Reed (202) 418-2455 or Rodney P. Conway (202) 418-2904, Office of Engineering and Technology.

FEDERAL COMMUNICATIONS COMMISSION

William F. Caton
William F. Caton
Acting Secretary

## APPENDIX A

Title 47 of the Code of Federal Regulations, Part 15, is amended as follows:

1. The authority citation for Part 15 continues to read as follows:

**AUTHORITY: Sec. 4, 302, 303, 304, 307 and 624A of the Communications Act of 1934, as amended, 47 U.S.C 154, 302, 303, 304, 307 and 544A.**

2. Section 15.31 is amended by revising paragraph (f)(1), to read as follows:

Section 15.31 Measurement standards.

* * * * *

(f) * * *

(1) At frequencies at or above 30 MHz, measurements may be performed at a distance other than that specified provided: measurements are not made in the near field, and it can be demonstrated that the signal levels to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using one of the following formulas: for measurements above 30 MHz that are not performed in the near field, an inverse linear-distance extrapolation factor (20 dB/decade); for measurements performed in the near field, an inverse linear-distance-squared extrapolation factor (40 dB/decade).

* * * * *

3. Section 15.215 is amended by revising paragraph (a), to read as follows:

Section 15.215 Additional provisions to the general radiated emission limitations.

(a) The regulations in sections 15.217-15.255 provide alternatives to the general radiated emission limits for intentional radiators operating in specified frequency bands. Unless otherwise stated, there are no restrictions as to the types of operation permitted under these sections.

* * * * *

4. Section 15.255 is amended by revising paragraphs (a) and (b), to read as follows:

Section 15.255 Operation within the band 59.0-64.0 GHz.

NOTE: Equipment may be authorized and operated on an interim basis under the provisions of this section provided it complies with the proposed Spectrum Etiquette parameters contained in the Fourth Notice of Proposed Rule Making in ET Docket 94-124.

(a) Operation under the provisions of this section is not permitted for the following products:

(1) Equipment used on aircraft or satellites.

(2) Field disturbance sensors, including vehicle radar systems, unless the field disturbance sensors are employed for fixed operation. For the purposes of this section, the reference to fixed operation includes field disturbance sensors installed in fixed equipment, even if the sensor itself moves within the equipment.

(b) Within the 59-64 GHz band, emission levels shall not exceed the following:

(1) For products other than fixed field disturbance sensors, the power density of any emission shall not exceed 9 $\mu W/cm^2$ at a distance of 3 meters.

(2) For fixed field disturbance sensors that occupy 500 MHz or less of bandwidth and that are contained wholly within the frequency band 61.0-61.5 GHz, the power density of any emission within the band 61.0-61.5 GHz shall not exceed 9 $\mu W/cm^2$ at a distance of 3 meters and the power density of any emission outside of the 61.0-61.5 GHz band, but still within the 59-64 GHz band, shall not exceed 9 $nW/cm^2$ at a distance of 3 meters.

(3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (b)(2) of this section, the peak transmitter output power shall not exceed 0.1 mW and the peak power density shall not exceed 9 $nW/cm^2$ at a distance of 3 meters.

* * * * *

## APPENDIX B

## FINAL REGULATORY FLEXIBILITY ANALYSIS

As required by Section 603 of the Regulatory Flexibility Act, 5 U.S.C. § 603 ("RFA"), an Initial Regulatory Flexibility Analysis ("IRFA") was incorporated into the *Notice of Proposed Rule Making* ("*Notice*") in ET Docket No. 94-124.[39] The Commission sought written public comments on the proposals in the *Notice*, including the IRFA. The Commission's Final Regulatory Flexibility Analysis ("FRFA") in this Memorandum Opinion and Order conforms to the RFA, as amended by the Contract with America Advancement Act of 1996 (CWAAA), Pub. L. No. 104-121, 110 Stat. 847 (1996).[40]

*Need for and Objective of the Rules.* Our objectives are to permit the operation within the 59-64 GHz band of fixed field disturbance sensors in an industrial environment. These products were prohibited under the *Report and Order* in ET Docket No. 94-124.[41]

*Summary of Significant Issues Raised by Public Comments in Response to the IRFA.* No comments were submitted in direct response to the IRFA. However, Cutler-Hammer, Inc. filed a Petition for Reconsideration requesting that the Commission amend its rules to permit the operation within the 59-64 GHz band of fixed field disturbance sensors in an industrial environment. No comments were filed in response to this petition.

*Description and Estimate of the Number of Small Entities to Which the Rules Will Apply.* For the purposes of this Memorandum Opinion and Order, the RFA defines a "small business" to be the same as a "small business concern" under the Small Business Act, 15 U.S.C. § 632, unless the Commission has developed one or more definitions that are appropriate to its activities.[42] Under the Small Business Act, a "small business concern" is one that: 1) is independently owned and operated; 2) is not dominant in its field of operation; and 3) meets any additional criteria established by the Small Business Administration (SBA).[43] Since the Regulatory Flexibility Act amendments were not in effect until the record in this proceeding was closed, the Commission did not request information regarding the number of small businesses that might use this service and is unable at this time to determine the number of small businesses that would be affected by this action in addition to Cutler-Hammer, Inc.

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[39] *See* 9 FCC Rcd 7078 (1994).

[40] Subtitle II of the CWAAA is "The Small Business Regulatory Enforcement Fairness Act of 1996" (SBREFA), codified at 5 U.S.C. § 601 *et seq.*

[41] *See* 11 FCC Rcd 4481 (1995).

[42] *See* 5 U.S.C. § 601(3) (incorporating by reference the definition of "small business concern" in 5 U.S.C. § 632).

[43] *See* 15 U.S.C. § 632.

The Commission has not developed a definition of small entities applicable to unlicensed communications devices. Therefore, we will utilize the SBA definition applicable to manufacturers of Radio and Television Broadcasting and Communications Equipment. According to the SBA regulations, unlicensed transmitter manufacturers must have 750 or fewer employees in order to qualify as a small business concern.[44] Census Bureau data indicates that there are 858 U.S. companies that manufacture radio and television broadcasting and communications equipment, and that 778 of these firms have fewer than 750 employees and would be classified as small entities.[45] The Census Bureau category is very broad, and specific figures are not available as to how many of these firms will manufacture unlicensed communications devices. However, we believe that many of them may qualify as small entities.

*Description of Projected Reporting, Recordkeeping and Other Compliance Requirements.* Our new rules permit the introduction of a new type of equipment which will operate in the 59-64 GHz band. As with other communications equipment already permitted to operate within this frequency band, the transmitter must be authorized under the Commission's certification procedure. No changes were made to the standards that must be met by the equipment or the reporting or recordkeeping requirements.

*Significant Alternatives and Steps Taken to Minimize Significant Economic Impact on a Substantial Number of Small Entities Consistent with Stated Objectives.* No alternatives or other steps were addressed in this proceeding.

*Report to Congress.* The Commission shall send a copy of this Final Regulatory Flexibility Analysis, along with this Memorandum Opinion and Order, in a report to Congress pursuant to the Small Business Regulatory Enforcement Fairness Act of 1996, 5 U.S.C. § 801(a)(1)(A). A copy of this FRFA will also be published in the Federal Register.

## INITIAL REGULATORY FLEXIBILITY ANALYSIS FOR FOURTH NPRM

*Need for and Objective of the Rules.* This rule making proceeding is initiated to obtain comments regarding the proposed Spectrum Etiquette for general unlicensed operation in the 59-64 GHz band. The Commission seeks comment on a spectrum etiquette proposed by the Millimeter Wave Communications Working Group for the purpose of minimizing interference among general unlicensed systems operating in the 59-64 GHz band.

*Legal Basis.* The proposed action is authorized under Sections 4(j), 301, 302, 303(e), 303(f), 303(g), 303(r), 304 and 307 of the Communications Act of 1934, as amended, 47 U.S.C. Sections 154(i), 301, 302, 303(e), 303(f), 303(g), 303(r), 304 and 307.

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[44] *See* 13 C.F.R. § 121.201, (SIC) Code 3663.

[45] *See* U.S. Dept. of Commerce, *1992 Census of Transportation, Communications and Utilities* (issued May 1995), SIC category 3663.

*Reporting, Recordkeeping and Other Compliance Requirements.* We propose to establish a spectrum etiquette that would apply to and minimize interference between general unlicensed systems operating in the 59-64 GHz band. The spectrum etiquette will require measurements to be reported to the Commission as part of the normal equipment authorization process under our certification procedure.

*Federal Rules Which Overlap, Duplicate or Conflict With These Rules.* None.

*Description, Potential Impact and Number of Small Entities Involved.* We expect that multiple manufacturers will manufacture transmitters to operate in the 59-64 GHz band for fixed field disturbance sensors and high speed computer to computer transmission systems.

*Any Significant Alternatives Minimizing the Impact on Small Entities Consistent with Stated Objectives.* None.