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AM Receiver Performance for 10 kHz and 9 kHz Signal Spacings

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AM RECEIVER PERFORMANCE FOR 10 kHz and 9 kHz SIGNAL SPACINGS

NOTE: This Technical Memorandum reports on analysis of technical considerations and is not meant to reflect final FCC policy.

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1.0. EXECUTIVE SUMMARY

Tests of ten AM receivers were conducted at the FCC Laboratory in order to observe effects of a proposed AM channel spacing reduction to 9 kHz from the present 10 kHz adjacent channel spacing. These tests, intended to be more inclusive than previous work with respect to operating practices of AM licensees, yielded results in general agreement with other observations, notably those of the National Telecommunications and Information Administration (NTIA). (The NTIA had recommended the proposed 9 kHz spacing, Docket 79-164.)

The measurements indicate that a degradation of about 3 dB in RF protection or conversely in audio desired to undesired signals (D/U) would be expected on the average with 9 kHz spacing being less favorable than 10 kHz.

2.0. INTRODUCTION

In July, 1979, a Notice of Inquiry was issued by the FCC regarding a change in the minimum frequency separation of adjacent channel AM station frequencies from 10 kHz to 9 kHz. This was proposed by the National Telecommunications and Information Administration in a petition for rulemaking. Since information germane to FCC perspectives was necessary, a memorandum was addressed to the Chief, Office of Science and Technology, from the Chief AM Channel Spacing Task Force, entitled "Request for Laboratory Test of AM Broadcast Receivers", dated October 10, 1979. Data from these tests were available to the Task Force in December, 1979. This report is to complete the documentation of the tests. Two aspects of AM receiver performance were explored:

- o Adjacent channel rejection performance data for 10 kHz and 9 kHz channel spacing and,
- o Receiver sensitivity data, since FCC Rules regarding adjacent carrier frequency assignments assume definite values for usable field strengths.

3.0. TEST PROCEDURES

AM station channel spacing has been under investigation in Europe as well as in the United States, and various tests and test signals have been used. For the purposes of the AM Channel Spacing Task Force, the following constraints were applied:

- o It was advantageous to perform a larger number of tests on a relatively small number of receivers rather than a smaller number of tests on a relatively large number of receivers.

- o The operating practices of U.S. AM stations were simulated in the receiver tests with additional conditions to permit comparisons with previous investigations.

Broadcast frequency signals were radiated from a loop, except for tests of an automobile radio for which a network was used as described in IEC Publication 315-1 (1970), Figure 5, page 43. The loop was about one meter in diameter and about two and one-half meters from the radio under test. Calibration of the fields was accomplished with a portable field strength meter. This meter, used in the broadcast industry, conveniently incorporates a loop antenna in its lid which in turn is hinged at the top of the instrument. Except for the automobile radio, the ferrite rod antennas permanently affixed to the receivers for AM were used. One of the radios which had a signal strength meter was employed to give some confidence that these antennas would react the same to the test signals as to off-the-air signals.

This was done by first using the field strength meter to measure an off-the-air signal. The field strength meter was then replaced with the radio, oriented so that its antenna was at the same location used for the field strength meter's loop antenna. After noting the deflection of the radio's signal strength meter, the radio was removed, and a test signal field strength was established with the field strength meter, equal to that of the off-the-air signal. Again replacing the field strength meter with the radio, the deflection of the radio's signal strength meter was seen to be the same as that found with the off-the-air signal. This observation was taken to show that the field strength meter and the radios with ferrite rod antennas had the same response to equal level signals whether off-the-air or test.

Outputs from the radios were measured with an rms voltmeter during setup and with a loudness meter(1) during tests. The meter provides a shaped quasi-peak response that is weighted to match human hearing. The usual reference level for setup was one volt rms across the loudspeaker or earphone impedance, unless the radio would be operating at or near distortion. Where one volt could not be obtained, the output was such that:

- o Excessive audible distortion did not occur,
- o A reasonable loudness resulted, and
- o The maximum output signal to noise ratio capability for the receiver was achievable with the relatively strong reference field of 10 mV/m.

3.1. Tests of 10 kHz versus 9 kHz Carrier Frequency Separations

Two approaches were taken for observations of the effects of carrier frequency separations:

I. Given an adjacent carrier equal in level to the desired carrier, measure the change in the audio interference with a change in the carrier frequency separation from 10 kHz to 9 kHz. (In the FCC Rules, 73.182(w), interference free service for a 10 kHz frequency separation is assumed where the desired groundwave is equal in field strength to the undesired groundwave.)

II. Given a specified ratio of desired to undesired audio, determine the ratio of the desired to undesired radio frequency signals for 10 kHz and then 9 kHz spacing.

3.1.1. Modulation

3.1.1.1. Noise Modulation

It was believed to be desirable to determine effects due to different types of modulation including program modulation and shaped noise. The latter was employed according to CCIR Recommendation 559 (Reference 2). This noise is intended to have the frequency and amplitude distributions which are characteristic of "modern dance music programmes." The modulation percentage with noise was established according to the recommendation except that for convenience the output of the generator, providing the modulating signal, was measured with an rms voltmeter. The AM signal generator was first modulated at 50% with a 1 kHz tone, the level of which was measured with the rms voltmeter. An output from the shaped noise generator, 6 dB less, also measured on the rms voltmeter, was used for noise modulation. To quote the Recommendation:

> "....This corresponds to a depth of modulation of 50% measured with a programme meter with quasi-peak indication. Deeper modulation is not appropriate, because, on account of its very small dynamic range, the noise would have a more disturbing effect than any real programme."

(Development of the instrumentation specified in Recommendation 468-2 was not undertaken in view of our making comparative, rather than absolute measurements, and determining that the quoted objective was satisfactorily achieved.)

3.1.1.2. Program Modulation

For the tests with program modulation, 50% modulation of the AM signal was established with a 1 kHz tone. A VU meter was calibrated with the tone so that for 50% modulation, the VU meter read 0 VU. With program modulation at 0 VU for peaks of frequent recurrence, the spectrum analyzer display of the modulated signal was compared with and found representative of local AM broadcast station modulation. Segments of program modulation, about one minute in duration, were taped off-the-air with a spectrum analyzer used as a receiver with a 30 kHz bandwidth.

Four types of program modulation were used in the comparison: non-strident voice, music for "easy listening", "rock and roll" music, and "classical" music. Combinations of modulation were employed for the desired and adjacent signals in attempts to find those that might be of particular interest from the standpoint of adjacent channel interference.

3.1.2. Desired Signal Levels

The FCC Rules, 73.182, indicate that, for certain stations, a desired signal strength of 100 uV/m is expected to be usable under some conditions (protected contour). Since none of the radios tested had "satisfactory" sensitivity (a 20 dB SINAD *) for this signal level, the weakest desired signal used was 0.5 mV/m, a contour protected in general from adjacent channel interference for all stations in daytime, and Class I-A, I-B, and II-A nighttime.

Another signal level tested was 2.5 mV/m, representing primary service, for example, in city residential areas. The third desired signal level used for the tests was 10 mV/m. The Rules give a range of 10 mV/m to 50 mV/m as sufficient for primary service in city business or factory areas.

Note that compared to 0.5 mV/m, the desired signal levels may be expressed as

Level	Ratio in dB relative to 0.5 mV/m
0.5 mV/m	0 dB
2.5 mV/m	14 dB
10 mV/m	26 dB

These signal levels were anticipated to be within the capabilities of the tested receivers.

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* SINAD is an acronym for the ratio of signal plus noise and distortion to noise plus distortion and is expressed in decibels.

Naturally, signal requirements were different for the tested automobile radio since it did not have a built-in antenna. An input network was built, based on Figure 5(c) of IEC Publication 315-1, (1970), p. 43. The desired voltages at the antenna input of the radio were

Level	Ratio in dB relative to 50 uV
50 uV	0 dB
250 uV	14 dB
1000 uV	26 dB

The ratios of desired antenna input voltages were the same for the automobile radio as for the other radios, with the 50 uV signal chosen because of its providing an output SINAD near 20 dB.

3.1.3. Measurement of Audio D/U ratio for RF D/U ratio = 0 dB (D/U: Desired signal level to undesired signal level ratio, expressed in decibels.)

As mentioned, one study was to measure the change in audio interference from an adjacent signal, equal in level to the desired signal, when changed from a 10 kHz to a 9 kHz frequency separation. With 1 kHz, 50% modulation of the desired signal at 1160 kHz, 1 mV/m, no adjacent signal, the radio under test was tuned. These tuning signal levels were chosen for better accuracy than could be obtained with stronger signals. (Sufficient tuning accuracy was obtained with the relatively strong signal of 1 mV, used with the automobile radio for convenience.) With the loudness meter(1) connected appropriately to the radio under test, a reference reading was obtained with the particular modulation type to be used. (The volume control of the radio was adjusted with the 1 kHz modulation, 50%, usually for 1 volt rms as noted previously.) "Typical" loud sections of music modulation were used for judgments of the reference loudness meter indication. Such sections can be expected to be representative of program material of the same type. An oscilloscope at the output of the radio under test was used to monitor against clipping distortion.

According to practice for measurements of adjacent channel performance, the modulation was removed from the desired signal generator after the reference loudness meter indication was determined. The interference signal generator was set equal in level to the desired signal generator but was at either 1,150 kHz (10 kHz separation) or 1,151 kHz (9 kHz separation). With the interference signal generator modulated with audio of the type desired for the test, note was made of the resulting loudness meter indication for "typical" loud sections. The ratio of the desired audio, previously measured, to the interference signal audio constituted the audio D/U for the adjacent signal's RF level equal to the desired signal's RF level.

3.1.4. Measurement of RF D/U Ratios for Specified Audio D/U Ratios

Another approach to observe changes due to station spacing would be to measure a change in RF D/U ratios for a given audio D/U ratio. Using the reference audio level previously established for the desired signal in the preceding tests, the particular undesired audio level was calculated for audio D/U's of 20 dB, 26 dB, 30 dB, and 40 dB. With the desired signal unmodulated, the undesired signal with the appropriate modulation was set for the 10 kHz or 9 kHz condition and adjusted in level to produce a calculated audio level. The ratio of desired RF signal to adjacent RF signal was the RF D/U ratio reported for a selected audio desired to undesired signal ratio. Selected audio ratios represented a range of audible interference conditions from marginal to acceptable within a range delimited by "unusable" and "excellent".

3.2. Receiver Sensitivity Measurements

For comparison purposes, tests were made by methods intended to be analagous to those described in Reference 4. An audio noise and distortion meter was used to establish a "signal plus noise and distortion to noise and distortion" (SINAD) ratio of 20 dB. The carrier to which a receiver was tuned was amplitude modulated 30% with a 1 kHz tone. Receiver tuning was done with a 1 mV/m field (car radio, 1 mV) as used previously. The receiver's volume control was adjusted, if necessary, as the signal strength was decreased, to provide a condition representative of weak signal operation (reasonably loud, undistorted). The signal level to produce the 20 dB audio SINAD ratio is reported as receiver sensitivity. Note that this measurement follows practice for measurements of "usable sensitivity", 20 dB SINAD representing a criterion for signal usefulness.

4.0. DISCUSSION

4.1. Effects of 10 kHz Versus 9 kHz Carrier Frequency Separations

In the report, "Nine and Ten Kilocycle Selectivity of Standard Broadcast Receivers", Project No. 22221, FCC Laboratory, November 8, 1948, it was stated that:

> "In considering the advisability of 9 kc separation between broadcast stations, a number of factors are found to be interlocking and hence require considerable care in evaluating. However, one broad conclusion becomes apparent from the data available: The utilization of 9 kc separation would provide no increase in the total number of stations allowable with 10 kc

separation, provided that the service is not to be degraded."

It appears that the technical bases for the above conclusion have been altered with respect to the impact of the degradation of service and the present "interlocking" factors. For example, CCIR Recommendation 560 (Reference 3), shows a "degradation" due to a decrease in signal spacing from 10 kHz to 9 kHz, which has apparently not prevented adoption of a 9 kHz separation by other radio administrations. (The CCIR data, in the context of the test conditions, are not considered to be in conflict with the data obtained for this report.)

Similarly the National Telecommunications and Information Administration stated in support of its petition to the FCC for 9 kHz signal separations(4), CONCLUSIONS:

> "3. Most importantly, the range of protection ratios required by the sample of receivers tested is so large (40 dB for 5 kHz modulation or 28 dB for 15 kHz modulation bandwidth) that the median 3 dB increase in going to a 9 kHz channel spacing is essentially insignificant. This can be illustrated by noting that under circumstances where 90% of the receivers gave satisfactory reception for 10 kHz channel spacing then 83% of the same receivers would give satisfactory reception under circumstances requiring an additional 3 dB of protection."

Technically, the data accumulated for the present report can be interpreted as in substantial agreement with the referenced efforts, in relation to the average magnitude of the change in performance for a 9 kHz versus a 10 kHz spacing. That is, taking the data obtained as representing 255 various reception conditions, the average magnitude of the degradation in performance due to signal spacing reduction was about 3 dB (RF or audio) with a standard deviation of about 1 dB, excluding data where the audio signal to noise ratio was 20 dB or less with no undesired signal. The range of degradation was from 0 dB to 6 dB.

The test sample used here did not display as large a range of desired to undesired RF signal ratios as reported by the NTIA, quoted above. This is attributed to the smaller size of the sample (10 receivers versus the NTIA's 46). At an audio ratio of 26 dB, 10 kHz signal separation, 10 mV/m desired signal strength, a range of 15 dB difference between receiver performances was noted. Although this is also large compared to a 3 dB change due to 9 kHz spacing, the importance of the range of receiver performance is arguable without better information regarding which receivers in use are actually subject to adjacent channel interference.

Descriptions of the tested AM receivers are given in Table 1. The D/U ratio data obtained are tabulated in the Appendices.

TABLE 1

Rcvr. No.	Description
1	AM pocket radio
2	AM/FM table model
3	AM/FM/TV/cassette
4	"European" AM/FM pocket radio
5	AM car radio
6	AM portable (Tuned RF)
7	AM/FM/cassette/phonograph with outboard loudspeakers
8	AM/FM "high fidelity" tuner
9	AM/FM/SW portable
10	AM pocket radio (T-104 used by the National AM Stereophonic Radio Committee)

The data given in the Appendices indicate that the use of various combinations of program modulation offers no particular insights concerning the difference in receiver performance for a 9 kHz versus a 10 kHz adjacent channel. Future tests of this type could probably be made with the CCIR (2) signal for procedural convenience. However, absolute values of the reported ratios do exhibit some dependence on modulation.

Desired signal levels apparently affect measured differences between 10 kHz and 9 kHz signal ratios primarily by the introduction of receiver noise. That is, the noise at weaker desired signals obscures adjacent signal interference whether the adjacent signal is at a 10 kHz or 9 kHz spacing.

4.2. 10 kHz Versus 9 kHz, Considerations of "Significant" Degradation

Although the FCC Rules dealing with AM broadcast stations are complex, there is some guidance as to conditions constituting acceptable reception from which conditions of "significant" degradation may be inferred. (See, for example, 73.182(q), FCC Rules.) From 73.182(v), an RF D/U ratio of 26 dB demarks objectionable interference for co-channel signals. If the co-channel radio frequency protection ratio is taken to be equal to the audio frequency protection (Reference 3, p. 45), the FCC Rules imply that desired audio at a level of 26 dB with respect to undesired audio demarks objectionable audio interference to a listener, poorer conditions being objectionable and better conditions being "free from objectionable interference" (73.21(a)(1), FCC Rules). Audio quality is apparently acceptable, not high quality, for the 26 dB audio ratio, inferred from the Rules. For example, "A 30 dB signal-to-noise ratio is excellent for communications where intelligibility is all that is demanded: (however,) it is barely adequate (if that) for high fidelity music reproduction.", Peter E. Sutheim, High Fidelity Magazine, January

1973, p.43. Also, "... a 50 dB signal-to-noise ratio constitutes reasonably good listening quality...", Leonard Feldman, Audio Magazine, January 1974, p.20. So with a cochannel RF D/U ratio of 26 dB, the service is probably "acceptable," not high quality. It is reasonable to assume that the FCC expected the same performance to pertain to service limited by adjacent channel conditions.

Evidently a substantial number of AM receivers are not capable of providing 26 dB or better audio D/U ratio under the RF adjacent channel criterion of D/U = 0 dB (FCC Rules 73.182(w)). The Appendices show that only one receiver, No. 8, yielded such performance, and this at a desired field strength of 10 mV/m, not at the protected contour field strength of 0.5 mV/m. Although interpolating the NTIA data (Reference 4, Table 1) indicates that 28 of the 46 tested receivers (about 60%) could provide such performance or better, it is noted that those results were also obtained at a high desired signal field strength, not representative of protected contour conditions. Thus the described adjacent channel contour criteria may be infrequently realized and so render the subject of "significant" degradation moot. That is, near the fringes of protected contours, the limiting factor in the quality of received signal may be noise generated in typical receivers, not interference from adjacent channel stations.

Aside from receiver inadequacies, the 3 dB degradation of the specified 26 dB audio ratio (for a change to 9 kHz) deserves examination. If a 3 dB audio degradation resulted from a change to 9 kHz spacing, the audible interference would be increased by an amount perceptible as a change in the loudness of the undesired audio, if a back and forth comparison to the initial condition could be made. As a rule of thumb, a 1 dB change in loudness is perceivable by an astute observer, and a 3 dB change is generally perceivable. For human perception of loudness, not being an absolute quantity, a 3 dB degradation would be expected to have no dramatic impact on a listener now experiencing a 26 dB audio D/U due to adjacent channel interference.

In limited listening tests of audio D/U ratios with different programs on the desired and undesired stations, a 10 kHz separation was not noticeably different from 9 kHz, insofar as program to program interference, partly because of human insensitivity to the " 3dB" effect described above and partly because of the psychoacoustic effect of masking of the undesired random audio by the desired audio. Perhaps a more significant change would occur for a listener who would be more annoyed by a 9 kHz intercarrier beat than by the 10 kHz intercarrier beat, an effect which did not appear significant with the loudness meter used.

Although the 1948 report mentioned in the beginning of this discussion spoke of "significant" degradation in the context of a change from 10 kHz to 9 kHz spacing, "significant" degradation is not now indicated. The difference can be attributed to changes in the nature of the broadcast service. These changes and "interlocking factors" are described in the Conclusion.

4.3. Receiver Sensitivities

The concept of a protected contour for adjacent channel signals, FCC Rules, 73.182(w), can be inferred to assume an audio signal to noise ratio greater than 26 dB for reception of a 0.5 mV/m desired signal alone. The Appendices show that none of the tested receivers yielded such performance with the antennas supplied (0.5 mV/m desired, columns for audio ratio marked 26 dB)*. Table 2 presents receiver sensitivity data for a desired audio signal plus noise and distortion to noise and distortion ratio (SINAD) of 20 dB as typically used for such measurements. These data are similar to those given by the NTIA (4), and tend to support the 0.5 mV/m performance observed in the Appendices. The obvious differences between the SINAD approach and that used for the Appendices account for the incomplete correlation. (Compare 3.2 with 3.1.4.)

TABLE 2

Receiver Sensitivities

Rcvr. No.	Sensitivity (20 dB SINAD)
1	1.3 mV/m
2	0.79 mV/m
3	0.4 mV/m
4	0.4 mV/m
5	55 uV (car radio)
6	0.14 mV/m
7	0.28 mV/m
8	0.71 mV/m
9	0.25 mV/m

5.0. CONCLUSION

"Significant degradation", compared to existing AM broadcast system performance, is judged unlikely for a change in AM station adjacent channel spacing to 9 kHz. This results largely from the apparent underutilization of the capabilities of AM broadcast stations by contemporary AM receivers. That is, AM receivers exhibit:

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*The AM car radio, Receiver No. 5, was not tested in terms of received field strength.

1. Poor sensitivity, relative to 0.5 mV/m.
   Protection of a 0.5 mV/m contour, adjacent channel, is difficult to justify on the basis of contemporary data, if a 26 dB audio D/U criterion is assumed.

2. Poor frequency response, compared to transmitters.
   The 3 kHz frequency response evidenced in contemporary receivers tends to obscure differences between 10 kHz and 9 kHz station separations; however, speculation would offer the possibility that high quality receivers may be more prone to adjacent channel interference because their wider passband may pass more unwanted modulation products from the 9 kHz adjacent station and a pronounced 9 kHz beat may appear.

3. Limited dynamic range.
   An undesired audio signal at a level 26 dB below a desired signal may be masked by noise inherent to the receiver at the weaker field strengths associated with service contours. (Such masking may also result from highly compressed transmissions, electrical noise in AM reception environments (automobiles, kitchens), and ambient audio noise in such environments.)

However, "interlocking factors" should be weighed in a conversion from the 10 kHz to 9 kHz spacing, namely:

1. Receiver technology.
   Although from a technical perspective AM receivers reflect market considerations rather than high performance, there may be developments which will encourage performance tending to reveal adjacent channel problems. This may occur, for example, following an introduction of AM stereo and receivers with improved frequency response. Then the difference frequency tone from adjacent channel stations might be more audible and more objectionable at 9 kHz than at 10 kHz. Also during a changeover to 9 kHz, there may be market penetration of receivers with frequency synthesized tuning at 10 kHz intervals. Such receivers might be rendered unsatisfactory by 9 kHz station spacings. Additionally, such synthesized receivers will likely be owned by those who will be very vocal in opposition to AM service degradation, as evidenced by the fact that they were more willing to purchase more costly equipment.

2. Transmitter pre-emphasis.
   Apparently recognizing the frequency response characteristics of receivers in their audiences, AM broadcasters are exploring pre-emphasis of higher frequencies in program material. Increased energy at higher audio frequencies may affect adjacent channel interference adversely. Most

stations on the air today already have some control over frequency response through switches on audio mixing boards or audio equalizers.

3. Weak signal areas.
   The AM broadcast service is an important, if not sole, source of broadcast entertainment and information over large regions of the country, especially west of the Mississippi River. Listeners in such regions where AM signals are weak may have taken special care with their AM installations and be receiving relatively good service, which might be degraded more than predicted with a change from 10 kHz to 9 kHz spacing.

4. Second and third adjacent channels.
   The 10 kHz spacing multiples would have to be changed for 9 kHz spacing. No changes in the relative signal strengths given in the Rules (73.37) are suggested for 18 kHz and 27 kHz, compared to 20 kHz and 30 kHz, except for avoiding intercarrier beat problems as 9 kHz spacings were introduced.

Finally, if an AM broadcast service as reflected by the data obtained for this report is assumed, then a technical argument against 9 kHz spacing is weak. If, however, the reference becomes an improved AM broadcast service in anticipation of technically feasible improvements in receiver and transmitter signal characteristics, then the conclusion might well question 9 kHz spacing. In that case, additional degradation due to adjacent channel interference might be judged "significant," at least where the desired signal is weak. So the trade-off becomes whether an upgraded AM service is more or less desirable than an increased number of AM stations in the present band. This decision may be further tempered by the 1979 World Administrative Radio Conference which voted to expand the upper and lower frequency limits of the AM broadcast band. This would allow an increased number of AM stations without changing the present 10 kHz spacing.

APPENDICES

Explanatory Notes

Heading: Audio D/U's for RF D/U = 0 dB

(See 3.1., Roman numeral I.) Audio desired to undesired ratios are shown for three field strengths for which the desired and adjacent RF signals are equal. Note that "D" means desired, "U" means undesired.

Heading: RF D/U ratios.....required to achieve specified audio ratios...

(See 3.1, Roman numeral II.) Four audio desired to undesired signal ratios, "A", were used to determine the tabulated RF desired to undesired signal ratios for three desired signal strengths.

Appendix 1-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Receiver No. 1

Desired Modulation: Noise
Undesired Modulation: Noise

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
19	16	1	5	10	14	(30)	-	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
16	13	(19)	-	-	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
(8)	7	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 1-2

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Rock
Undesired Modulation: Rock

Receiver No. 1

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
22	18	-2	1	5	9	10	13	(34)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
20	18	1	3	(25)	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
10	10	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 1-3

Effects of 9 kHz and 10 kHz Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Voice

Receiver No. 1

Audio D/U's for RF D/U = 0 dB || RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.

Spacing: 10 kHz	9 kHz	A= 20 dB* 10 kHz	9 kHz	A= 26 dB 10 kHz	9 kHz	A= 30 dB 10 kHz	9 kHz	A= 40 dB 10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
24	22	-6	-1	1	7	9	13	(32)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
20	18	0	4	(24)	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
12	11	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 1-4

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Easy Listening
Undesired Modulation: Easy Listening

Receiver No. 1

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
16	13	4	6	11	13	18	20	(32)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
12	10	10	15	(22)	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
8	8	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 1-5

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Rock

Receiver No. 1

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
22	20	-2	0	4	7	10	12	(32)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
20	18	0	3	-	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
12	11	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 1-6

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Easy Listening

Receiver No. 1

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
20	16	0	3	7	10	12	15	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
19	16	2	5	-	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
12	11	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 1-7

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Classical — Receiver No. 1
Undesired Modulation: Classical

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
22	22	-4	-2	1	6	9	13	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
21	18	-1	3	-	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
-	-	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 2-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 2

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
22	18	-2	2	5	9	10	15	(36)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
21	19	-2	2	(26)	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
13	13	(13)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 2-2

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Rock
Undesired Modulation: Rock

Receiver No. 2

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
21	17	0	3	5	9	12	12	(40)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
21	20	0	1	6	8	(30)	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
(16)	15	(16)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 2-3

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Voice

Receiver No. 2

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
21	16	-1	4	5	9	10	14	(39)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
20	17	0	3	9	12	(29)	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
15	14	(15)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 2-4

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Easy Listening — Receiver No. 2
Undesired Modulation: Easy Listening

Audio D/U's for RF D/U = 0 dB — Spacing: 10 kHz	9 kHz	RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths. A= 20 dB* 10 kHz	A= 20 dB* 9 kHz	A= 26 dB 10 kHz	A= 26 dB 9 kHz	A= 30 dB 10 kHz	A= 30 dB 9 kHz	A= 40 dB 10 kHz	A= 40 dB 9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
16	13	4	7	11	13	15	18	(37)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
16	13	5	8	14	17	(28)	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
12	11	(13)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 2-5

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Rock

Receiver No. 2

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
20	18	1	3	8	10	12	14	(38)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
20	18	1	3	9	11	(29)	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
14	14	(16)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 3-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 3

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
23	20	-3	1	3	7	8	11	25	29
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
22	19	-2	2	5	9	15	19	(32)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
15	13	(16)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 3-2

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Rock
Undesired Modulation: Rock

Receiver No. 3

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
21	19	-1	0	4	7	9	10	19	21
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
21	21	-1	1	5	8	9	11	(38)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
19	17	2	4	(24)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 3-3

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Voice

Receiver No. 3

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
24	20	-4	0	2	6	6	10	17	21
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
23	20	-2	1	4	8	9	12	(37)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
17	16	3	7	(22)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 3-4

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Easy Listening
Undesired Modulation: Easy Listening

Receiver No. 3

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
16	13	4	7	10	13	14	18	26	29
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
17	14	3	6	9	12	15	18	(35)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
15	12	10	14	(21)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 3-5

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Rock

Receiver No. 3

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
22	20	-2	0	3	6	7	10	18	20
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
21	20	-1	0	5	6	10	11	(37)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
19	18	1	4	(23)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 4-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 4

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
23	19	-2	1	3	6	7	11	21	25
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
24	21	-4	-1	1	6	12	16	(31)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
17	17	(18)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 4-2

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Rock
Undesired Modulation: Rock

Receiver No. 4

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
23	21	-3	-1	3	5	8	9	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
23	22	-4	-2	2	4	6	9	(37)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
21	21	-4	-1	(23)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 4-3

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Voice

Receiver No. 4

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
24	20	-4	0	3	6	6	10	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
24	21	-4	-1	2	5	6	10	(36)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
20	19	0	2	(21)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 4-4

Effects of 9 kHz and 10 kHz Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Easy Listening
Undesired Modulation: Easy Listening

Receiver No. 4

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
17	14	3	5	8	11	13	14	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
19	16	1	5	8	11	14	17	(33)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
17	15	(19)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 5-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 5

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 1000 uV		Desired 1000 uV							
19	15	1	5	8	12	15	19	(33)	-
D=U= 250 uV		Desired 250 uV							
19	15	1	5	12	16	(28)	-	-	-
D=U= 50 uV		Desired 50 uV							
17	13	(17)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 5-2

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Rock
Undesired Modulation: Rock

Receiver No. 5

Audio D/U's for RF D/U = 0 dB, Spacing: 10 kHz	9 kHz	RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths. A= 20 dB* 10 kHz	A= 20 dB* 9 kHz	A= 26 dB 10 kHz	A= 26 dB 9 kHz	A= 30 dB 10 kHz	A= 30 dB 9 kHz	A= 40 dB 10 kHz	A= 40 dB 9 kHz
D=U= 1000 uV		Desired 1000 uV							
19	16	2	4	8	10	12	15	(38)	-
D=U= 250 uV		Desired 250 uV							
19	16	2	4	9	11	14	17	(33)	-
D=U= 50 uV		Desired 50 uV							
16	16	6	9	(22)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 5-3

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Voice

Receiver No. 5

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 1000 uV		Desired 1000 uV							
18	15	2	6	9	12	13	17	(36)	-
D=U= 250 uV		Desired 250 uV							
18	15	2	5	10	13	(30)	-	-	-
D=U= 50 uV		Desired 50 uV							
17	16	(18)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 5-4

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Easy Listening
Undesired Modulation: Easy Listening

Receiver No. 5

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 1000 uV		Desired 1000 uV							
16	14	3	7	10	13	14	17	(37)	-
D=U= 250 uV		Desired 250 uV							
16	12	4	8	12	15	21	25	(31)	-
D=U= 50 uV		Desired 50 uV							
15	12	(20)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 5-5

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Voice
Undesired Modulation: Rock

Receiver No. 5

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 1000 uV		Desired 1000 uV							
17	15	3	6	9	12	14	17	(36)	-
D=U= 250 uV		Desired 250 uV							
16	15	3	6	10	13	17	21	(32)	-
D=U= 50 uV		Desired 50 uV							
16	14	14	17	(21)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 6-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 6

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
25	22	-5	-2	1	4	5	8	17	20
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
24	21	-4	-1	2	5	7	10	(36)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
20	19	0	3	(23)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 7-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 7

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
21	16	-1	4	5	10	10	15	(40)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
19	15	1	5	8	13	16	21	(34)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
16	13	(19)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 8-1

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 8

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
28	26	-8	-6	-2	0	3	5	(34)	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
22	21	-5	-2	(23)	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
9	8	(9)	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 9-1

Effects of 9 kHz and 10 kHz Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise
Undesired Modulation: Noise

Receiver No. 9

Audio D/U's for RF D/U = 0 dB			RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
	Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m			Desired: 10 mV/m							
	12	9	7	11	13	17	17	21	31	34
D=U= 2.5 mV/m			Desired: 2.5 mV/m							
	13	9	7	11	14	17	21	25	(34)	-
D=U= 0.5 mV/m			Desired: 0.5 mV/m							
	14	11	15	19	(21)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 9-2

Effects of 9 kHz and 10 kHz
Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Rock
Undesired Modulation: Rock

Receiver No. 9

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
14	10	7	10	13	16	17	19	28	31
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
14	11	6	9	13	15	17	19	(37)	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
16	14	4	8	(25)	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

Appendix 10-1

Effects of 9 kHz and 10 kHz Carrier Frequency Separations

Desired: 1160 kHz
Undesired: 1150 kHz or 1151 kHz

Desired Modulation: Noise — Receiver No. 10
Undesired Modulation: Noise

Audio D/U's for RF D/U = 0 dB		RF D/U ratios (desired to undesired, in dB) required to achieve specified audio ratios for given channel separations at selected desired RF field strengths.							
Spacing:		A= 20 dB*		A= 26 dB		A= 30 dB		A= 40 dB	
10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz	10 kHz	9 kHz
D=U= 10 mV/m		Desired: 10 mV/m							
20	17	0	3	9	13	(28)	-	-	-
D=U= 2.5 mV/m		Desired: 2.5 mV/m							
-	-	-	-	-	-	-	-	-	-
D=U= 0.5 mV/m		Desired: 0.5 mV/m							
-	-	-	-	-	-	-	-	-	-

Notes:

All results are in dB.

Dashes, "-", indicate that data were not obtained due to receiver audio noise.

* A = Audio desired to undesired ratio in dB.

() = Audio ratio with no undesired signal, that is, reference audio/receiver noise as observed with loudness meter.

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