European Radiocommunications Committee (ERC)
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DSRR/GSM COMPATIBILITY FURTHER STUDY TO AID THEIR CO-EXISTENCE IN ADJACENT BANDS

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1. SUMMARY

1.1 Since the publication of ERC Report No. 7 on DSRR and GSM/EGSM compatibility, concerns have been expressed regarding the potential interference between the two systems due to noise (a combination of GSM **wide-band noise** and **spectrum due to switching transients**, and DSRR **noise**). These were not fully considered in the original study.

1.2 Measurements conducted on a limited number of 900 MHz non-TDMA narrow band synthesised equipments, including some very early laboratory DSRR 'breadboard' devices showed that the level of noise emitted in a 30 kHz bandwidth was well below the -36 dBm (0.25 μW) spurious emission limit.

N.B. Production DSRR equipments would need to have an adjacent channel noise level lower than that of the 'breadboard' device tested in order to meet type approval requirements.

It is therefore concluded that the perceived major compatibility problem, which lead to this further study, was due to the spurious emission limit of DSRR equipments being regarded as the noise level, and that it is extremely unlikely that the noise emitted from 900 MHz non-TDMA narrow band synthesised equipments, including production DSRR equipments, will ever be high enough to become the dominant interference mechanism.

1.3 Measurements conducted on a limited number of GSM equipments showed that the spectrum due to switching transients emitted by one of the GSM MS's tested exceeded the existing limit at 400 kHz offset, and that although the other GSM MS's tested complied with the limits, this was not by an excessive margin.

It is therefore concluded that, after allowing for manufacturing tolerances, there is currently little scope for proposing a tightening of the limits for spectrum due to switching transients from GSM equipments.

1.4 Wide band noise from GSM transmitters meeting the current specifications can affect DSRR receivers. However current thinking indicates that there is no scope for tightening the limits for wide band noise. In practice this will mean that when the GSM and EGSM end of band channels adjacent to DSRR are used a significant proportion of DSRR channels in the vicinity of that location will be rendered unusable (approximately 30% see 5.2).

1.5 In order to reduce the magnitude of the GSM/EGSM wide band noise problem, it is recommended that the use of the GSM/EGSM end of band channels adjacent to DSRR is avoided in urban areas.

1.6 Although the typical level of noise emitted by 900 MHz non-TDMA narrow band synthesised equipments is unlikely to be high enough to become the dominant interference mechanism, there is nothing to prevent equipment that emits excessive noise from entering the market. It is therefore recommended that appropriate limits and measurement methods for noise be included, where necessary, in radiocommunications specifications.

2. INTRODUCTION

2.1 This paper explores further factors which potentially affect the scale of the compatibility problem between DSRR and GSM/EGSM.

2.2 The original DSRR/GSM compatibility study resulted in the publication of ERC Report No 7 which recommended, amongst other things, increased blocking performance and the relocation of the two control channels for DSRR. Both of these recommendations were approved by ETSI.

2.3 Following decisions made at the seventh ERC meeting in Madrid (20-30 October 1992), a further study of GSM and DSRR compatibility was initiated. As with the original study, no mandate was given to investigate changes in DSRR frequency usage.

2.4 The scope for this latest study was to further investigate the factors affecting the compatibility problems between GSM and DSRR, and having studied the performance of typical equipment, recommend measures to aid the co-existence of the two adjacent band systems in their existing bands.

3. THE FURTHER FACTORS AFFECTING COMPATIBILITY

3.1 Since the original report on DSRR and GSM/EGSM compatibility was published, concerns have been expressed regarding the potential interference between the two systems due to noise (a combination of GSM **wide-band noise** and **spectrum due to switching transients**, and DSRR **noise**). These effects were not fully considered in the original study.

3.2 Noise from DSRR to GSM

Papers have been presented that show DSRR equipments could potentially cause interference to GSM receivers at distances of up to 500 metres due to noise being emitted at a level equal to the spurious emission limit of -36 dBm (0.25 μW).

3.3 Wide band Noise from GSM to DSRR

Papers have also been presented that show GSM/EGSM equipments could potentially cause interference to DSRR receivers at distances of up to 4 kilometres due to wide band noise.

4. RESULTS AND CONCLUSIONS - DSRR INTERFERENCE TO GSM/EGSM

4.1 Measurements have been conducted on a limited number of equipments to resolve the uncertainty regarding the typical level of noise emitted by 900 MHz non-TDMA narrow band synthesised equipments, including some very early laboratory DSRR 'breadboard' devices. These measurements have shown that the level of noise emitted by these equipments in a 30 kHz bandwidth is similar, and well below the -36 dBm (0.25 μW) spurious emission limit. These results are presented graphically in figure 1.

4.2 It is therefore concluded that the perceived major compatibility problem was due to the spurious emission limit of DSRR equipments being regarded as the typical noise level, and that it is extremely unlikely that noise from 900 MHz non-TDMA narrow band synthesised equipments, including production DSRR equipments, will ever be high enough to become the dominant interference mechanism.

N.B. Production DSRR equipments would need to have an adjacent channel noise level lower than that of the 'breadboard' device tested in order to meet type approval requirements.

4.3 Measurements have also been conducted to quantify how different types of interferer affect GSM reception. These measurements have shown that the degradation to GSM reception is similar for GSM, CW, noise (assuming a 240 kHz noise power bandwidth at the receiver) and multiple narrow-band interference sources having equal average power during the active part of the wanted GSM signal's burst.

4.4 It is therefore concluded that interference calculations based on the protection requirements of GSM from GSM are a valid means of assessing interference to GSM from DSRR or other unwanted signals such as noise or spurious emissions.

5. RESULTS AND CONCLUSIONS - GSM/EGSM INTERFERENCE TO DSRR

5.1 Measurements have been conducted on a limited range of GSM/EGSM equipments to determine the typical spectrum due to switching transients. These measurements have shown that the spectrum emitted by one of the GSM MS's tested exceeded the existing limit at 400 kHz offset, and that although the other GSM MS's tested complied with the limits, this was not by an excessive margin. These results are presented graphically in figure 2.

It is therefore concluded that, after allowing for manufacturing tolerances, there is **currently** little scope for proposing a tightening of the limits for spectrum due to switching transients for GSM equipments.

5.2 Wide band noise from GSM transmitters meeting the current specifications, affecting DSRR receivers, is a major source of incompatibility. However, current thinking indicates that there is no scope for tightening the limits for wide band noise. In practice this will mean that, when the GSM **and** EGSM end of band channels adjacent to DSRR are used, a significant proportion of DSRR channels in the vicinity of that location will be rendered unusable (approximately 30%).

The figure of 30% is derived assuming that the GSM adjacent channel power is -60 to -70 dBc at 400-600 kHz offset from the carrier (GSM specification for noise due to modulation figure A.1 GSM 05.05 version 4.5.0). Taking 500 kHz as the mean value and subtracting 200 kHz to take account of the frequency separation between the first GSM channel and the band edge, we arrive at 300 kHz of interference spectrum within the DSRR band adjacent to the GSM band.

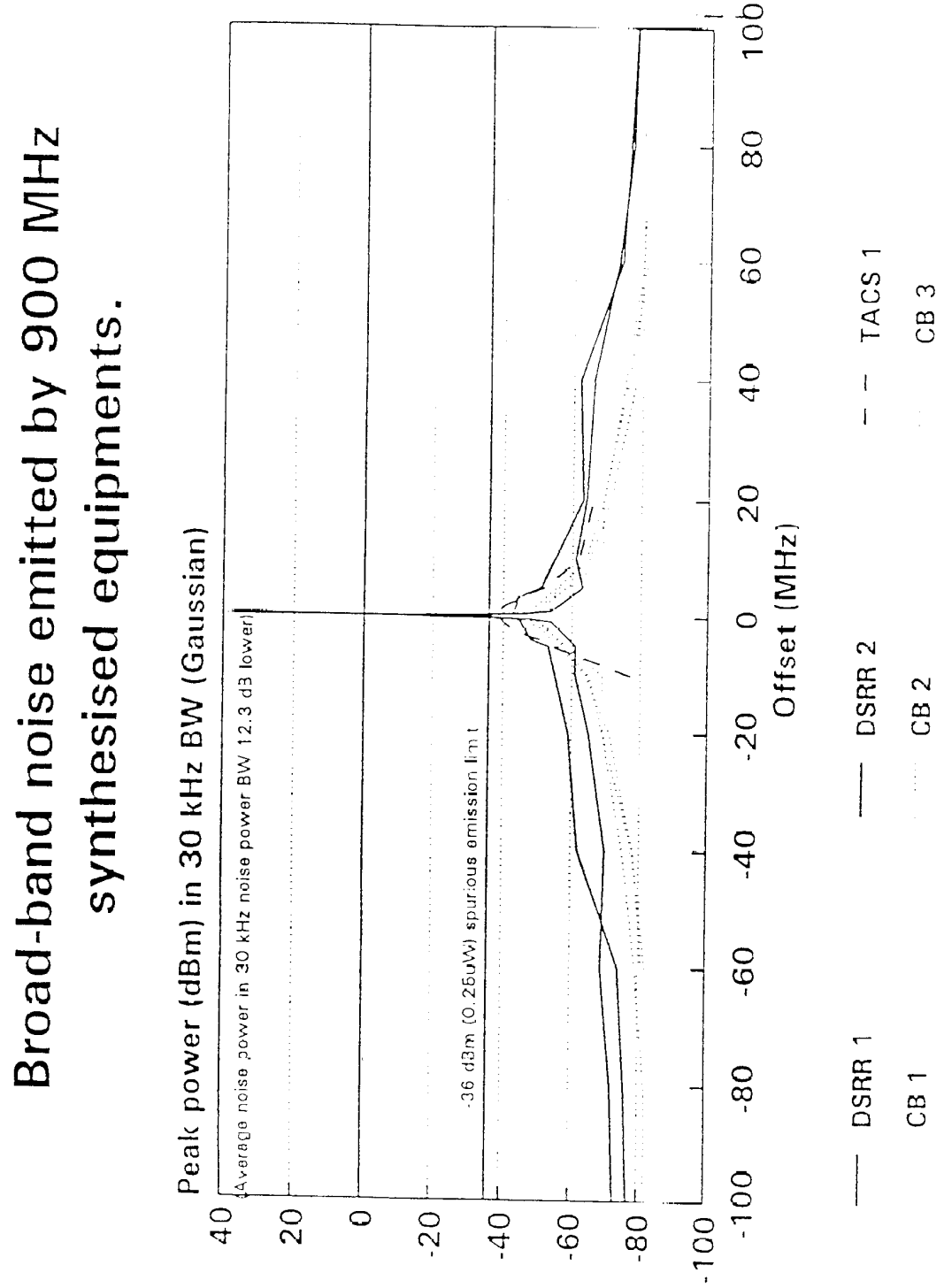
This equates to 12 DSRR traffic channels (300/25 kHz) or approximately 15% (12/76 chs.) of the DSRR band being rendered unusable. This could occur on **both** sides of the DSRR band giving a possible 30% total reduction of available channels.

6. MEASURES TO AID THE CO-EXISTENCE OF THE TWO ADJACENT BAND SYSTEMS IN THEIR EXISTING BANDS

6.1 It is recommended that, in order to reduce the magnitude of the GSM/EGSM wide band noise problem, that the use of the GSM/EGSM end of band channels adjacent to DSRR is avoided in urban areas.

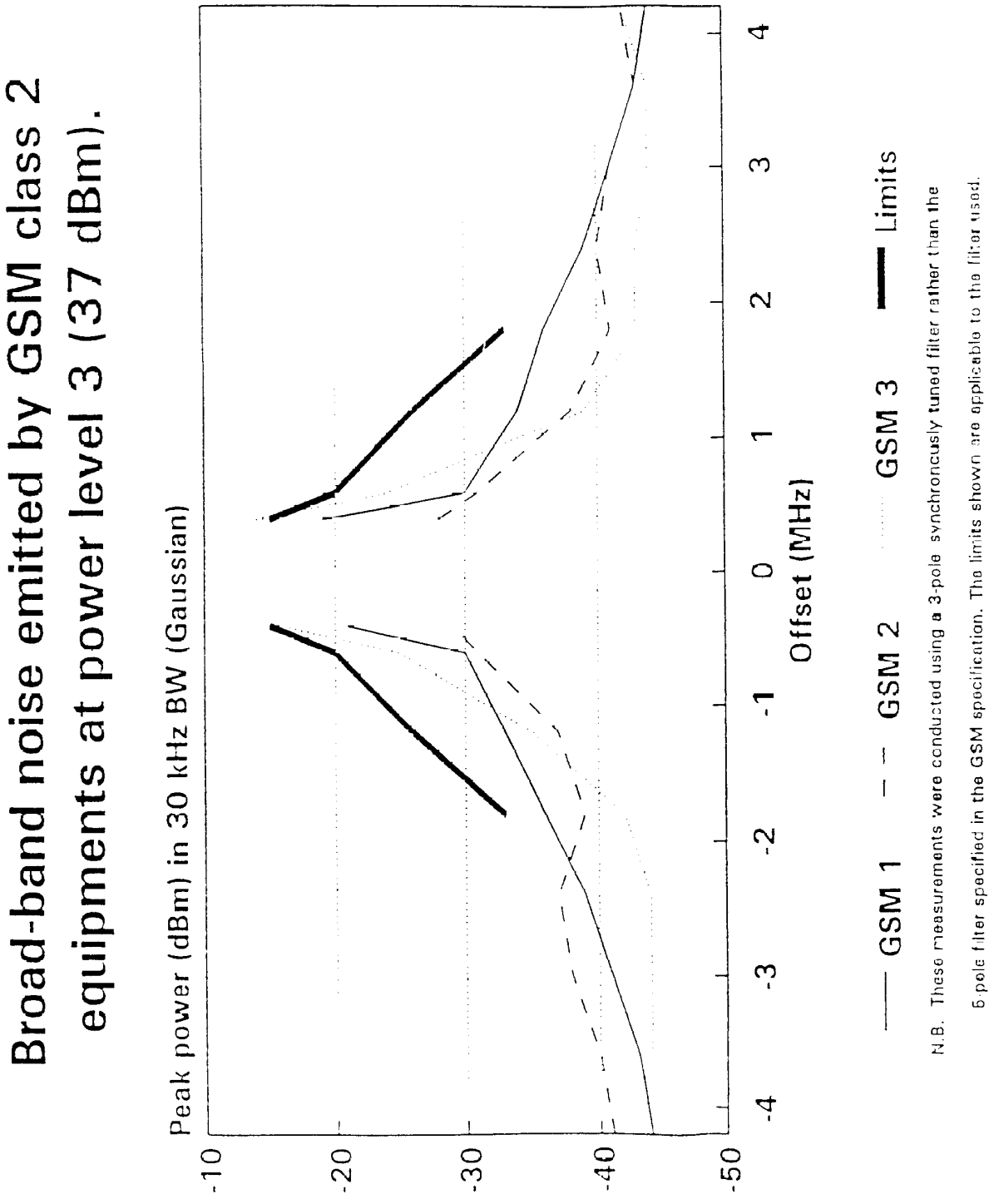
6.2 Although the typical level of noise emitted by 900 MHz non-TDMA narrow band synthesised equipments is unlikely to be high enough to become the dominant interference mechanism, there is nothing to prevent equipment that emits excessive noise from entering the market. It is recommended that appropriate limits and measurement methods for noise be included, where necessary, in radiocommunications specifications.

FIGURE 1



N.B. DSRR 1 and DSRR 2 were very early laboratory 'breadboard' devices, which were built to test and prove the algorithms etc
It is important to note that DSRR 1 and DSRR 2 were not designed to meet any RF performance specification.

FIGURE 2



N.B. These measurements were conducted using a 3-pole synchronously tuned filter rather than the 5 pole filter specified in the GSM specification. The limits shown are applicable to the filter used.