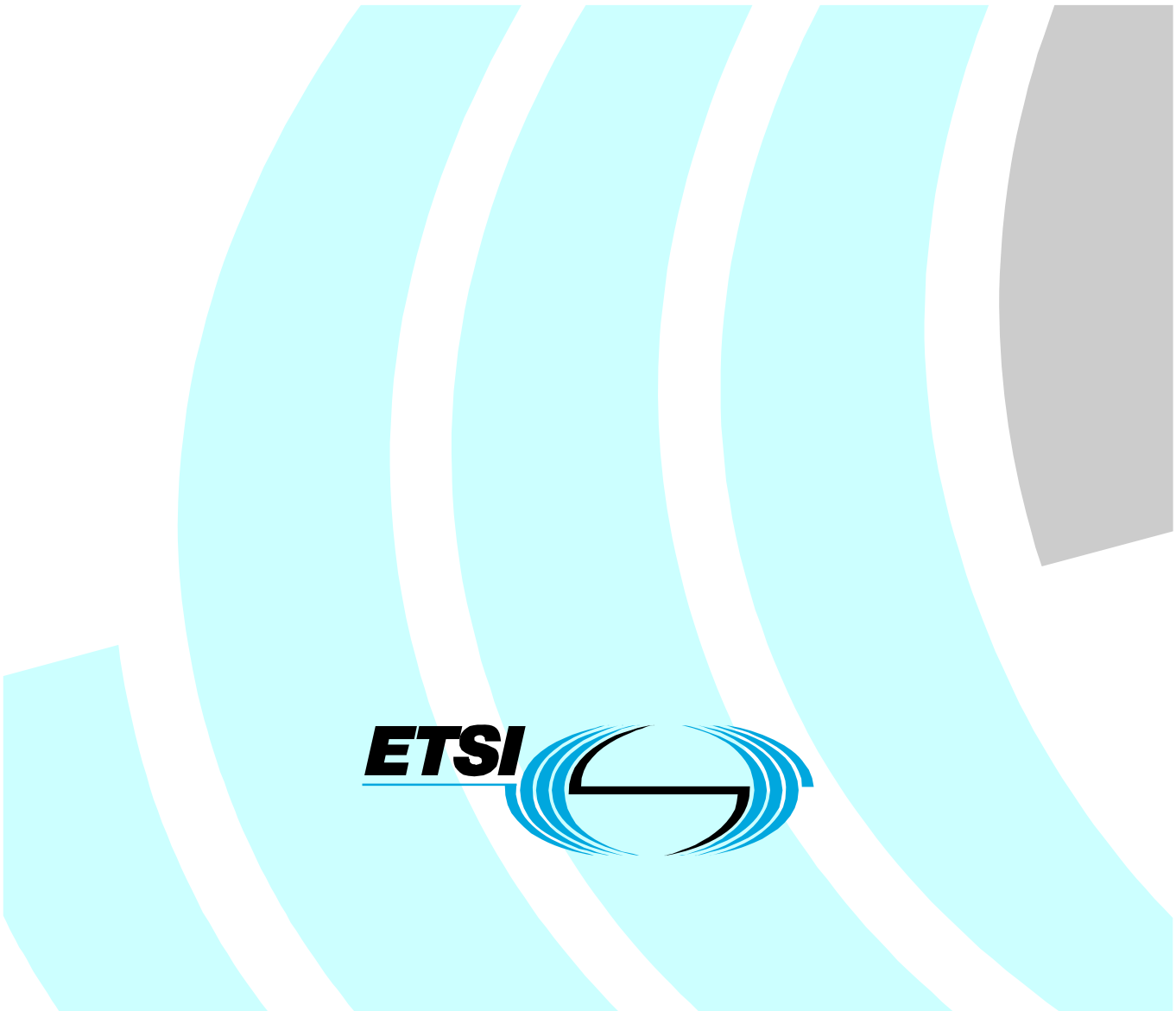
ETSI TR 102 626 V1.1.1 (2009-08)

Technical Report

Electromagnetic compatibility and Radio spectrum Matters (ERM); System Reference Document; Citizens' Band Radio



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Contents

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

Introduction

The present document has been developed to support the co-operation between ETSI and the Electronic Communications Committee (ECC) of the European Conference of Post and Telecommunications Administrations (CEPT).

Technical parameters for terrestrial television have changed dramatically since the original investigation of compatibility between Citizens' Band Radio (CB) and domestic receivers resulting in ERC Recommendation T/R 20-09 [i.1] (Chester 1990) and the ERC/DEC(98)11 [i.2].

The present document seeks to explore those changes along with the change in use patterns of CB users.

Following the Chester 1997 Multilateral Coordination Agreement television is now well on the way to becoming fully digital throughout Europe in the UHF frequency range 470 MHz to 862 MHz, whilst the use patterns of CB is now increasingly mobile, thus the original interference problem of domestic use of CB at 27 MHz and terrestrial television at 45 MHz to 70 MHz are a subject of the past.

Increasingly stringent EMC requirement (within EN 60601 [i.9]) for pacemakers and other medical implants referred to in document WGRR/PT11 (98)28 annex 11 [i.10] are no longer likely to receive sufficient EMF from CB radio devices to interfere in any way with their function.

At present National regulations within Europe are not fully harmonized which is confusing for users especially those such as long distance truck drivers crossing a number of National borders in a day and needing to change settings on their transmitters. CB may be considered as one of the first implementations of the e-safety and Intelligent Transport System agendas.

The present document seeks to examine via laboratory tests, practical tests and calculation the compatibility issues which are likely to occur with modern equipment and considers the present regulation with a view to achieving full harmonization of both technical parameters and regulation.

1 Scope

The present document defines the requirements for radio frequency usage by Citizens' Band (CB) Radio which may require a change in the present regulatory framework regarding output power and modulation.

The present document includes necessary information to support the co-operation between ETSI and the Electronic Communications Committee (ECC) of the European Conference of Post and Telecommunications Administrations (CEPT), including:

- market information;
- technical information;
- expected sharing and compatibility issues;
- results of compatibility tests.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area. For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] CEPT T/R 20-09 E: "PR 27 radio equipment intended to provide short range voice radiocommunication in the 27 MHz band".

[i.2] CEPT/ERC/DEC(98)11: "Decision of 23 November 1998 on the harmonized frequency band to be designated for CEPT PR 27 radio equipment and on the implementation of the technical standard for this equipment".

[i.3] ETSI EN 300 135 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Citizens' Band (CB) radio equipment; Angle-modulated Citizens' Band radio equipment (PR 27 Radio Equipment)".

[i.4] ETSI EN 300 433 (all parts): "ElectroMagnetic compatibility and Radio spectrum Matters (ERM); Land Mobile Service; Citizens' Band (CB) radio equipment".

[i.5] ETSI EN 301 489-1: "Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements".

[i.6] ETSI EN 301 489-13:"Electromagnetic compatibility and Radio spectrum Matters (ERM); ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 13: Specific conditions for Citizens' Band (CB) radio and ancillary equipment (speech and non-speech)".

[i.7] CEPT/ERC Recommendation 70-03: "Relating to the use of Short Range Devices (SRD)".

[i.8] CEPT/ERC Recommendation 74-01:"Unwanted emissions in the spurious domain (2005)".

[i.9] CENELEC EN 60601-1-2: "Medical Electrical Equipment - Part 1: General Requirements for Safety; 2. Collateral Standard: Electromagnetic Compatibility - Requirements and Tests (IEC 601-1-2)".

[i.10] CEPT/ERC/WGRR/PT11 (98)28 annex 11: "Reasons for a Member State to prevent marketing of certain types of radio equipment in the 27 MHz band".

[i.11] ETSI TR 101 837: "Electromagnetic compatibility and Radio spectrum Matters (ERM); Study on 27 MHz CB radio compatibility with analogue television broadcast receiver installations".

[i.12] ETSI EG 201 788 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Guidance for drafting an ETSI System Reference Document".

[i.13] ITU Radio Regulations (2004).

[i.14] CENELEC EN 55020: "Sound and television broadcast receivers and associated equipment - Immunity characteristics - Limits and methods of measurement".

[i.15] ITU-R Recommendation BT.500-7: "Methodology for the subjective assessment of the quality of television pictures".

[i.16] ANSI C63.5 (2006): "American National Standard for Electromagnetic Compatibility - Radiated Emission Measurements in Electromagnetic Interference (EMI) Control - Calibration of Antennas (9 kHz to 40 GHz)".

[i.17] Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity (R&TTE Directive).

[i.18] IEEE 802.11b: "Working Group for Wireless Local Area Networks (WLANs)".

[i.19] IEEE 802.11g: "Standard for Higher Rate (20+ Mbps) Extensions in the 2.4GHz Band".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

angle modulation: modulation with an audio pre-emphasis characteristic for the transmitter and an audio de-emphasis characteristic for the receiver

Base Station (BS): equipment fitted with an antenna socket, for use with an external antenna, and intended for use in a fixed location

handportable station: equipment either fitted with an antenna connector or an integral antenna, or both, normally used on a stand-alone basis, to be carried on a person or held in the hand

integral antenna: antenna designed as a fixed part of the equipment, without the use of an external connector and as such which cannot be disconnected from the equipment by the user

NOTE: An integral antenna may be fitted internally or externally.

Mobile Station (MS): mobile equipment fitted with an antenna connector, for use with an external antenna, normally used in a vehicle or as a transportable station

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AC	Alternating Current
AF	Audio Frequency
AM	Amplitude Modulation
CB	Citizens' Band
CEPT	European Conference of Postal and Telecommunications administrations
DAB	Digital Audio Broadcast
dB	deciBel
dBµV	deciBel relative to one microvolt
dBm	deciBel relative to one milliwatt
DC	Direct Current
DVB	Digital Video Broadcast
e.r.p.	effective radiated power relative to a dipole
ECC	Electronic Communications Committee
EMF	ElectroMagnetic Field
ERM	Electromagnetic compatibility and Radio spectrum Matters
EU	European Union
FM	Frequency Modulation
GHz	GigaHertz
ITU-R	International Telecommunication Union - Radiocommunications sector
KHz	KiloHertz
LW	Long Wave
MHz	MegaHertz
MP3	MPEG Layer 3
MW	Medium Wave
OS	Ordnance Survey
PEP	Peak Envelope Power
RF	Radio Frequency
SSB	Single SideBand
TV	TeleVision
Tx	Transmitter
UHF	Ultra High Frequency
UK	United Kingdom
USB	Universal Serial Bus
UWB	Ultra-WideBand
VHF	Very High Frequency
W	Watt

4 Comments and status of the System Reference Document

4.1 Comments on the System Reference Document

Information has been sent to a number of ETSI e-mail lists as to this work item, advertising the meetings, including those groups most likely to be affected i.e. Broadcast, ERM TG 17, and the main ERM list no adverse comments have been received. Advice has been sought on the medical implant issue from members of ERM TG30.

Comments (change requests) from AER, ECBF, CTE International and EBU were received during ETSI internal enquiry and were all be accepted.

4.2 Status of the System Reference Document

The present document has been created by TC ERM TG DMR. Former version 0.0.4 was submitted to ECC WGFM and WGSE as well as the ETSI internal consultation.

The present version is now submitted for approval for publication at ERM#38 and for submission to ECCworking groups, PT FM38 and EC.

Table 4.1: Status of pre-approval draft

Target version	Pre-approval date version (see note)				
V1.1.1	a	s	m	Date	Description
	0.0.1			October 2008	For discussion at DMR#29.
	0.0.2			22nd January 2009	Output of ERM TG DMR extra-ordinary meeting.
	0.0.3			February 09	Addition of reports.
	0.0.4			26 February	Inclusion of comments.
	0.0.5			16th June 09	inclusion of all comments (all resolved).
NOTE: See clause A.2 of EG 201 788 [i.12].					

5 Executive summary

Extensive testing has been carried out to ascertain if the proposed changes in modulation and RF power would cause interference to domestic and vehicle based equipment. None of the testing has shown any interference potential, given the bad reputation of SSB and AM in generating both audio breakthrough and frequency related interference it is reasonable to seek an answer to the lack of interference.

CB equipment conforms to the strict spurious requirements of the broadcast bands and CEPT/ERC Recommendation 74-01 [i.8], couple this with the greater immunity of modern domestic and vehicle equipment brought about by the R&TTE Directive [i.17] and realization by equipment manufacturers of both radio and non radio devices that their equipment would be used in close proximity to radio devices and the lack of interference may be put into context.

The adoption of the proposed changes would have a range of positive outcomes:

- Simpler front panels for the CB units, resulting in greater ease of use.
- Conformance of these much travelled units to all national interface requirements.
- A boost to the sales of CB equipment.

5.1 Market information

The sales figures for CB radio equipment in the year 2007 were as shown in table 5.1.

Table 5.1: Sales in 2007

	FM	AM	AM/FM	AM/SSB	AM/FM/SSB	Totals by type
Mobile	12 000	51 500	580 000	0	3 000	646 500
Hand portable	4 000	4 200	21 100	0	0	29 300
Totals	**16 000**	**55 700**	**601 100**	**0**	**3 000**	
Grand Total						**675 800**
Fixed Stations are approximately 5 % of mobile total						

The market in Europe is stable without showing significant growth rates.

The high percentage of mobile usage is mainly caused by long distance lorry drivers using CB radio.

The application of *"CB radio has matured into a communication medium mainly used by long distance lorry drivers as their only means of communicating with fellow drivers and as such plays a vital part in communicating road safety and weather information".*

An annual increase of 15 % to 20 % on the 2007 figures based on the removal of present restrictions to the majority users (long distance Lorries) is assumed.

No information has been provided on traffic and usage density as the existing spectrum allocation at 27 MHz is considered adequate for the projected increase in equipment numbers based on its use for *"short range radio communications".*

5.2 Technical description

Spectrum allocation already exists. Transmission and reception takes place on the same channel (single frequency simplex mode) as shown in table 5.2.

Table 5.2: Carrier frequencies

Carrier frequencies	Channel Number	Carrier frequencies	Channel Number
26,965 MHz	1	27,215 MHz	21
26,975 MHz	2	27,225 MHz	22
26,985 MHz	3	27,235 MHz	24
27,005 MHz	4	27,245 MHz	25
27,015 MHz	5	27,255 MHz	23
27,025 MHz	6	27,265 MHz	26
27,035 MHz	7	27,275 MHz	27
27,055 MHz	8	27,285 MHz	28
27,065 MHz	9	27,295 MHz	29
27,075 MHz	10	27,305 MHz	30
27,085 MHz	11	27,315 MHz	31
27,105 MHz	12	27,325 MHz	32
27,115 MHz	13	27,335 MHz	33
27,125 MHz	14	27,345 MHz	34
27,135 MHz	15	27,355 MHz	35
27,155 MHz	16	27,365 MHz	36
27,165 MHz	17	27,375 MHz	37
27,175 MHz	18	27,385 MHz	38
27,185 MHz	19	27,395 MHz	39
27,205 MHz	20	27,405 MHz	40

Table 5.2 is in line with the existing frequency plan of ERC/DEC(98)11 [i.2].

The bandwidth of each channel is 10 kHz as defined in existing Harmonized European Standards EN 300 135 [i.3] and EN 300 433 [i.4].

EN 300 135 [i.3] covers FM- (or also called angle modulated) CB radio equipment having output power levels up to 4 Watts. EN 300 433 [i.4] covers AM- modulated equipment with output power up to 1 Watt and SSB- modulated equipment with output power up to 4 Watts PEP.

The *ITU Radio Regulations [i.13] definitions are* 8K00F3E (FM), 8K00A3E (AM) and 3K00J3E (SSB).

Existing standards already comply with *the spurious emissions and the out-of-band emissions (as defined by the Article 1.146 of the ITU Radio Regulations [i.13] and using the limits defined in CEPT/ERC Recommendation 74-01 [i.8]*.

5.3 Compatibility Issues

Compatibility tests were performed as shown in clause A.2.1.

A number of the testing team were *extremely* sceptical, having been involved in interference issues when CB first came into Europe as to the possibility of using SSB modulation without interference to domestic television therefore a rigorous test plan was agreed as shown in clause A.2.1. Testing results proved them wrong and the present TV immunity would allow a far higher RF power than that requested without interference. The conclusions from the tests are:

- No blocking or other kind of picture or sound degradation was visible below a CB radio interference level of 25 dBm at the TV receiver input (valid for both, SSB and AM modulation). Taking into account the minimum isolation provided by free space propagation loss, 4 Watt AM/FM CB radiated signals as well as SSB CB radiated signals with 12 Watt PEP appear unlikely to create visible interference to DVB-T reception.

- It was demonstrated that AM and SSB modulated interfering signals show a higher interference potential than FM modulated interferers, however, at the RF powers requested, there was no indication of interference. However, interference was only experienced in the presence of RF power levels far exceeding those being considered in the present document.

- During differential mode testing, 2 UHF TV tuners broke down when applying extreme high input power to them (estimated power load value between 35 dBm to 40 dBm at receiver antenna input connector). Surprisingly, these two devices could be used again during the following day due to "self-healing" over one night.

Other compatibility issues identified so far:

- The Increasingly stringent EMC requirement (within EN 60601 [i.9]) for pacemakers and other medical implants referred to in WGRR/PT11 (98)28 annex 11 [i.10] mean that these devices are no longer likely to receive sufficient EMF from CB radio devices to interfere in any way with their function.

- *The change in use patterns from fixed (now < 5 %)to mobile (> 95 %) keep the CB equipment physically away from domestic premises where audio breakthrough used to be an issue also as with medical implants the EMC requirements have improved the immunity of audio equipment.*

- *Addition practical testing took place as defined in clause A.3.2 to encompass Domestic and Vehicle mounted equipment for broadcast reception and a range of audio and communication devices. No interference was recorded either to broadcast functions or audio and communication equipment.*

6 Current regulations

There is ERC/DEC(98)11 [i.2] in place for angle modulated CB radio equipment.

The following information is the list of CB radio country regulation as in November 2008:

- Implementation of ERC/DEC(98)11 [i.2] is in all EU countries, in addition in 4 other EFTA countries (IS, N, CH, FL) - single mode, FM only with up to 4 Watts output power. However, the situation is far from being harmonized:
  - Austria allows only single mode FM- modulated CB radios without switch to other modes that can be operated by a user.
  - Some countries allow additional channels(e.g. D, CZ, SK and UK).
  - Some countries allow AM- modulation:
    - AM with 1 Watt: B, BG, CH, D, E, EST, F, FIN, FL, GR, I, IRL, LV, NL, P, PL, RO, RSM.
    - AM with 4 Watts: E and PL, whereas Poland has a 5 kHz channel centre frequency offset.
    - AM with 5 Watts: I, however just for 34 channels.
  - Some countries allow SSB- modulation:
    - SSB with 40 channels with 4 Watts PEP: B, CH, D, FL, F, FIN, GR, I, LV, NL, P, RSM.
    - SSB with 40 channels with 12 Watts PEP: E and PL.

The investigation also triggered unclear responses with regard to the use of AM- and SSB- modulation in some other countries. Another investigation performed by ECC/WGFM/SRDMG on T/R 20-09 [i.1] also showed "no information" for 17 countries.

The number of SSB countries is less than the number of AM countries, because not all countries answered the request. Where no answer was received, they have not been placed on the SSB list.

7 Proposed regulations

A harmonized usage of CB radio in Europe with the following parameters is proposed to be investigated:

- Harmonized use of FM/AM modulation and SSB throughout Europe based on EN 300 135 [i.3] and EN 300 433 [i.4] with output power levels of up to 4 Watts AM/FM - modulation and 12 Watts PEP for SSB using the spectrum identified by ERC/DEC(98)11 [i.2].

8 Main conclusions and justification

At present the plethora of different National regulation both confuses users and hinders sales. Given that long distance lorry drivers may transit a large number of European borders in the course of a few days consideration should be given to harmonizing both the technical regulation and the licensing position of this much travelled equipment.

Harmonization of the technical parameters will provide a new impetus to sales and driver safety.

Citizens' Band equipment has been on the European market since the early 1970,s whilst it has always had to conform to the stringent spurious levels required for broadcast bands, its early use was predominately in domestic premises where it caused interference to broadcast band 1 television receivers. Since that date:

- *Europe agreed:* The Chester 1997 Multilateral Coordination Agreement relating to Technical Criteria, Coordination Principles and Procedures for the introduction of Terrestrial Digital Video Broadcasting (DVB-T).

- *The requirements of first the EMC directive and then the R&TTE Directive have improved the immunity of electronic equipment.*
- *Increasing miniaturization of circuitry has reduced the potential interference entry point on electronic equipment.*
- Television is now well on the way to becoming fully digital throughout Europe in the UHF frequency range 470 MHz to 862 MHz whilst the use patterns of CB is increasingly mobile, thus the original interference problem of domestic use of CB at 27 MHz and terrestrial television at 45 MHz to 70 MHz are a subject of the past.
- A plethora of non licensed or licence exempt communications devices at affordable prices ranging from mobile phones to PMR446 have taken the place of CB as the preferred (and in the early 1990's the only) communication medium for the general population.

The CB market has evolved to being both a means of communication and probably the first implementation of both the e-safety and ITS agenda for truck drivers, it is this market the changes requested for an increase in RF power and the harmonization of modulation types across Europe seeks to address.

Harmonization of the technical and regulatory requirements as suggested in the present document would also contribute to the ease and safer use of CB equipment by mobile users, will allow manufacturers to reinvigorate the sales market.

9 Expected ECC, EC and ETSI actions

9.1 Expected ECC and EC actions

ETSI requests ECC to consider the present document, which includes necessary information under the MoU between ETSI and the ECC issuing regulations for the proposed harmonized CB radio usage.

ETSI asks CEPT-ECC to consider the compatibility work carried out as given in annex A and perform any additional relevant compatibility studies required to determine whether the emissions of CB radio equipment as proposed by the present document are appropriate to protect other radio services.

Changes should be considered to ERC/DEC(98)11 [i.2], *DECIDES 1*:

- *that for the purpose of this decision, CEPT PR 27 radio equipment shall mean angle-modulated radio equipment complying with EN 300 135 [i.3];*
- to include Amplitude as well as Frequency modulation plus single sideband transmissions (as described in EN 300 433 [*i.4*]).

Whilst these devices are not at present considered as Short Range Devices (SRDs) by CEPT, ERC/DEC(98)11 [i.2] states that "*The CEPT PR 27 application is intended for short range radio communications with transmission and reception taking place on the same channel (single frequency, simplex traffic). The radio equipment is designed to be used without the need to have any technical qualifications.*"

Therefore, CB radio usage has many characteristics of SRDs contained in CEPT/ERC Recommendation 70-03 [i.7] in that it is meant for non technical users and is mobile throughout Europe.

It is proposed that ECC and EC may consider harmonizing the frequencies used by CB radio as far as possible, taking into account the results from spectrum engineering studies as proposed by the present document.

ECC is requested to conclude their investigations before end of 2009.

9.2 Expected ETSI actions

EN 300 135 [i.3] and EN 300 433 [i.4] are already published as Harmonized European Standards along with EN 301 489-1 [i.5] and EN 301 489-13 [i.6].

It is planned to revise EN 300 433 [i.4] to include new power limits and consider the methods of measurement associated with the proposed power increase.

A revision of TR 101 837 [i.11] to include the results of measurements as covered by annex A may also be envisaged.

Annex A:
Expected sharing and compatibility issues

A.1 Coexistence issues

*Interference from CB radio has traditionally been to Television Broadcast receivers and a possible interference with the working of heart pace makers (*WGRR/PT11 (98)28 [i.10] annex 11).

These issues have been addressed by:

- Compatibility testing carried out by the Test Laboratory of the German Federal Network Agency, results are provided in clause A.3. The conclusion states: *No blocking or other kind of picture or sound degradation was visible below a CB radio interference level of 25 dBm at the TV receiver input (valid for both, SSB and AM modulation). Taking into account the minimum isolation provided by free space propagation loss, 4 Watt AM/FM CB radiated signals as well as SSB CB radiated signals with 12 Watt PEP appear unlikely to create visible interference to DVB-T reception.*

- Practical compatibility tests to vehicle mounted and domestic equipment detailed in clause A.3.2, where no interference was observed in normal use of the vehicle and domestic equipment

- The Increasingly stringent EMC requirement (within EN 60601 [i.9]) for pacemakers and other medical implants referred to in WGRR/PT11 (98)28 annex 11 [i.10] mean that these devices are no longer likely to receive sufficient EMF from CB radio devices to interfere in any way with their function.

- *The change in use patterns from fixed (now < 5%)to mobile (> 95%) keeps the CB equipment physically away from domestic premises where audio breakthrough used to be an issue also as with medical implants the EMC requirements have improved the immunity of audio equipment*

- *The CB allocation is using a designated ISM band and cannot claim any protection from other services or users*

A.2 Current ITU and European Common Allocations

An excerpt of the European Common Allocation Table is reproduced here.

Table A.1: Allocation of radio services and applications

Frequency range	Radio Service Allocation	Applications
26,175 MHz to 27,500 MHz	FIXED MOBILE EXCEPT AERONAUTICAL MOBILE FIXED MOBILE EXCEPT AERONAUTICAL MOBILE	CB radio Inductive applications ISM Model control Non-specific SRDs Point-to-Multipoint Point-to-Point Railway applications Defence systems Eurobalise

A.3 Sharing and compatibility studies

A.3.1 Test Plan Testing of Digital TVs for interference levels from CB radios

A.3.1.a TV sets immunity test with a 27 MHz CB signal

A.3.1.b Laboratory test

A.3.1.c Measurement method and test conditions

Three different Digital television sets were be used.

A Digital Video Broadcast (DVB) generator was be used to provide a TV signal of 60 dBµV (-49 dBm)in Bands IV-V.

The 27 MHz generator was AM modulated to a depth of 80 % by a 1 kHz AF signal as prescribed in EN 55020 [i.14].

The test was repeated using FM modulation using ±5 kHz deviation.

Care was taken to minimize generation of 27 MHz harmonics.

The evaluation of the observed picture degradation were be set up in accordance with ITU-R Recommendation BT.500-7 [i.15]. The 27 MHz RF levels causing perceptible picture degradation were be recorded.

The following tests were be carried out:

- Internal immunity in differential mode (normal conduction).
- Internal immunity in common mode.

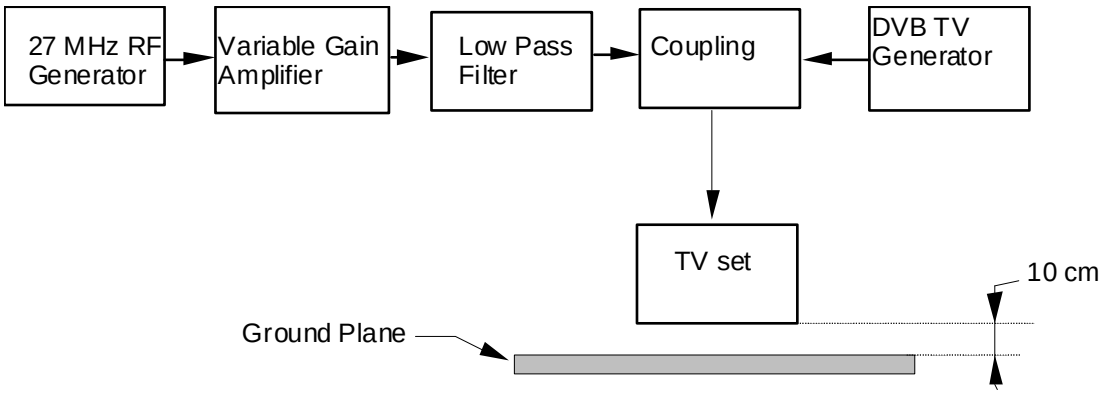

Figure A.1: Immunity test layout in laboratory

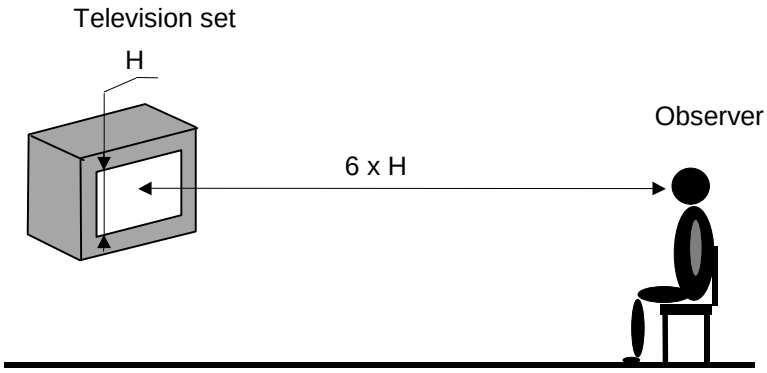

Figure A.2: Picture degradation observation plan

- Results

Table A.2: Digital TV sets immunity levels to 27 MHz signals in laboratory (Test frequencies given as examples)

TV sets	Test frequency (MHz)	27 MHz RF level to causing perceptible picture degradation				
		Differential mode dBµV/75 Ω			Common mode dBµV emf.	
				Ch 55 B V		Ch 55 B V
TV set 1	26,515	Test results are shown in clause A.3.1.1				
	27,205					
	27,855					
TV set 2	26,515					
	27,205					
	27,855					
TV set 3	26,515					
	27,205					
	27,855					

A.3.1.1 Testing of Digital TVs for interference levels from CB radios

At Kolberg, Germany (test lab of the Federal Network Agency), 22-23 December 2008.

A.3.1.1.1 Participants

Copsey, Brian	Copsey Communications
Espallargas- Oscar	President Electronics Iberica
Groß, Sven	Bundesnetzagentur
Rohrsen, Udo	Stabo Elektronik
Schnorrenberg, Wolfgang	CTE/ALAN Electronics
Weber, Thomas	Bundesnetzagentur
Winnefeld, Rüdiger	CTE/ALAN Electronics

A.3.1.1.2 Test Purpose

Evaluation of interference potential and resulting observed picture degradation caused by CB radio signals (27 MHz) to the different modes (Differential Mode and Common Mode) of DVB-T receivers.

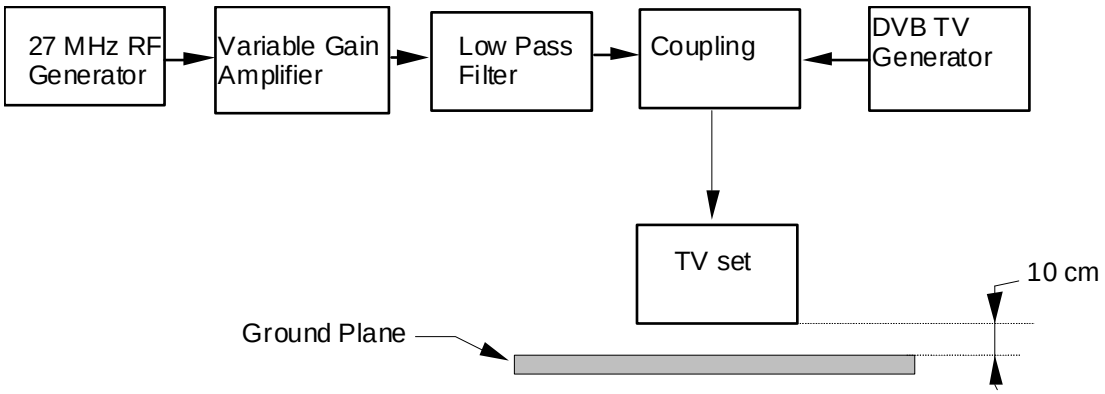

Figure A.3

A.3.1.1.3 Setup

Three different digital television sets were used. Some test were also performed using the analogue TV receiver.

A Digital Video Broadcast (DVB) generator was used to provide a TV signal of 60 dBµV (-49 dBm) in Bands IV-V.

This is a typical level for "co-channel" type tests because a DVB-T receiver should have achieved backstop performance (DTG & EICTA use -50 dBm for CCI tests). Alternatively, a protection ratio test or loss of sensitivity type test for out-of-band interferers could also be conducted using a wanted signal input level that is close to the sensitivity limit. However, as far as we can be seen from the measurements that have been performed there would not seem to be a significant problem. The 27 MHz generator was:

- AM modulated to a depth of 80% by a 1 kHz AF signal as prescribed in EN 55020 [i.14].
- FM modulated using ±5 kHz deviation (whereas EN 300 135 [i.3] includes ±2 kHz maximum permissible frequency deviation, in clause 5.2.3).
- SSB amplitude modulation with PEP up to 12 Watts, SSB modulation was such as described in EN 300 433 [i.4], clause 7.5.2 a), two-tone modulation.

Test were carried out with AM as well as SSB modulation power levels up to 4 Watts (16 Watts PEP), and 4 Watts FM modulated.

Stabo, CTE and President also provided CB radio equipment and the tests could be repeated with CB radio equipment generating the interferer instead of the signal generator.

The evaluation of the observed picture degradation was set up in accordance with ITU-R Recommendation BT.500-7 [i.15]. The 27 MHz RF levels causing perceptible picture degradation was recorded.

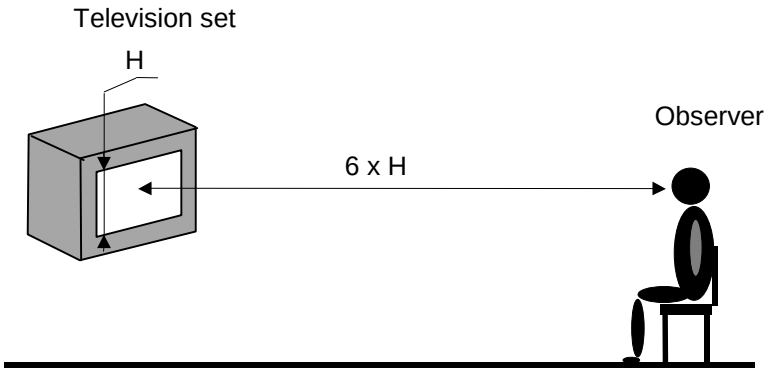

Figure A.4

The following tests were carried out:

- Internal immunity in differential mode (normal conduction).
- Internal immunity in common mode.

A.3.1.1.4 List of used equipment

Broadcast Test System	R&S	SFU	RegTP 1100 5634
Impedance Matching	R&S	RAM	01/0228
Attenuator		10 dB	01/0177
Power Divider 4-Way	Vortex Microwave	PDK-507	01/0129
Signal Generator	R&S	SMH	BAPT 604 2827
Amplifier	ifi	SMXE50-S3	RegTP 1100 5464
Millivoltmeter	R&S	URV55	RegTP 1100 2121
Detector	R&S	URV5-Z2	BAPT 604 3114
Signal Generator	R&S	SMHU	BAPT 604 2789
Amplifier	Amplifier Research	40WD1000	BAPT 064 2509
Attenuator		6 dB	RegTP 1100 2108
Millivoltmeter	R&S	URV5	BAPT 604 2667
Detectorf	R&S	URV5-Z4	BAPT 604 3030
Electromagnetic Injection Clamp	Lüthi GmbH	EM 101	BAPT 604 2510
Audio Analyzer	R&S	UPV	RegTP 1100 5633
Software	R&S	EMC32	
DVB-T TV Sets	LG	19LS4D-2B	RegTP 1100 8589
LCD Color TV-Gerät	Sony - Bravia	KDL-26S3020	RegTP 1100 8591
LCD-TV	Panasonic	TX-26LE7FA	RegTP 1100 8590
(all TVs procured in 2008, with Analogue TV, DVB-T, VHF as well as UHF)			
TFT-TV	Sharp - Aquos	LC-26GD7E	RegTP 1100 5496

(5 years old, with Analogue TV, DVB-T, VHF as well as UHF)

Power supply for CB radios	ALAN	K 715	RegTP 1600 8564
CB- Radio	1	Albrecht	AE 5800 (AM, FM, SSB)
CB- Radio	2	President	Jackson II (AM, FM, SSB)
CB- Radio	3	Stabo	XM 3003 (AM, FM)

A.3.1.1.5 Differential Mode Measurements

Used TV Channels (wanted signal)

DVB-T K 5: 177,5 MHz

DVB-T K 9: 205,5 MHz

ATV K 9: 203,25 MHz

DVB-T K 25: 506,0 MHz

ATV K 25: 503,25 MHz

DVB-T K 55: 746,0 MHz

ATV K 55: 743,25 MHz

80 dBµV Generator

-10 dB Attenuator

-6 dBPower Divider 4-Way

-4 dBRAM

60 dBµV EUT

CB- Channel 27,125 MHz.

Depiction of test results

NOTE: OK means: no experienced degradation or loss of picture or sound.

Key to columns

- Column 1: TV-Set.
- Column 2: Wanted TV Signal.
- Column 3: Interfering signal generator SMH (Differential Mode) / SMHU (Common Mode) or CB radio device as well as channel of CB radio device.
- Column 4: Modulation.
- Column 5: Power at input of EM 101 and equivalent voltage on line to EUT.
- Column 6: Either:

  i) o.k. → maximum power/voltage was created; no degradation; or

  ii) empty (no stronger signal could be produced because of intrinsic noise amplification of the amplifier or maximum output of CB radio device); no degradation; or

  iii) occurring degradation until threshold was reached by reducing power/voltage. Threshold was tested from above and below of the values without any observable hysteresis.

Table A.3

1	2	3	4	5	6
Sony	DVB-T K 55	Gen	AM	11 dBm	o.k.
Sony	DVB-T K 55	Gen	FM	11 dBm	o.k.
Sony	DVB-T K 9	Gen	AM	0 dBm (see note)	o.k.
Sony	DVB-T K 9	AE 5800	SSB	29 dBm	Blocking
			FM	> 35 dBm	o.k.
			AM	25 dBm	Blocking
LG			SSB	17 dBm	o.k.
			FM	17 dBm	o.k.
			AM	17 dBm	o.k.
Sharp			SSB	17 dBm	o.k.
			FM	17 dBm	o.k.
			AM	17 dBm	o.k.
Sony	DVB-T K 9	Jackson II	SSB	27 dBm	o.k.
			FM	25 dBm	o.k.
			AM	25 dBm	Blocking (CB overmodulation assumed)
LG			SSB	27 dBm	o.k.
			FM	25 dBm	o.k.
			AM	25 dBm	o.k.
Sharp			SSB	26 dBm	o.k.
			FM	25 dBm	o.k.
			AM	25 dBm	o.k.
Sony		XM 3003	FM	25,5 dBm	o.k.
			AM	26,5 dBm	Blocking
LG			FM	25,5 dBm	o.k.
			AM	26 dBm	o.k.
Sharp			FM	25,5 dBm	o.k.
			AM	26 dBm	frozen picture, at start of modulation until approx, 1 s)
NOTE: Reduction of the interfering level to 0 dBm (= 109 dBµV).					

It should be noted that the blocking situation was confirmed by repeating the tests on different frequencies showing that the effect was of broadband nature.

A.3.1.1.6 Common Mode Measurements

Used TV Channels (wanted signal)

DVB-T K 9: 205,5 MHz

ATV K 9: 203,25 MHz

DVB-T K 25: 506,0 MHz

ATV K 25: 503,25 MHz

DVB-T K 55: 746,0 MHz

ATV K 55: 743,25 MHz

60 dBµV at EUT

Interferer

Calibration:10-V →

-14,5 dBm Gen out (maximum: 0 dBm).

-14,5 dBm + 50 dB (amplifier.) → 35,5 dBm (maximum: 50 dBm possible).

35,5 dBm - 6 dB (Attenuator) → 30 dBm at "EM 101".

(30 dBm → 1 W →

50 dBm (max) - 6 dB (Attenuator) → 44 dBm at "EM 101".

(44 dBm → 20 W →

48 dBm (reading value) → 16 W → 25 V as Common-Mode-Signal:

Reading: amplifier output.

Power at input EM 101: 16 W.

Voltage as Common-Mode-Signal: 25 V.

Sony	DVB-T K 9	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	***FM, AM***	***42 dBm / 25 V***	***o.k.***
		27,405 MHz	FM, AM	42 dBm / 25 V	o.k.
	DVB-T K 55	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	***FM, AM***	***42 dBm / 25 V***	***o.k.***
		27,405 MHz	FM, AM	42 dBm / 25 V	o.k.
	ATV K 9	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	***FM***	***42 dBm / 25 V***	***o.k.***
		27,215 MHz	***AM***	***40 dBm / 20 V***	***degradation***

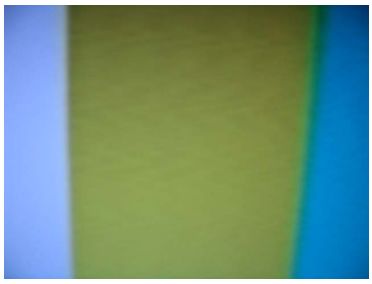

Figure A.5

		27,405 MHz	FM	42 dBm / 25 V	o.k.
		27,405 MHz	***AM***	***35 dBm / 11 V***	***degradation***

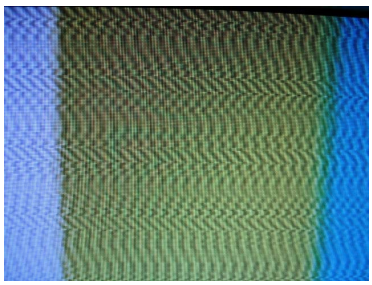

Figure A.6

		27,8 MHz	FM	38 dBm / 16 V	
		27,8 MHz	AM	35 dBm / 11 V	degradation

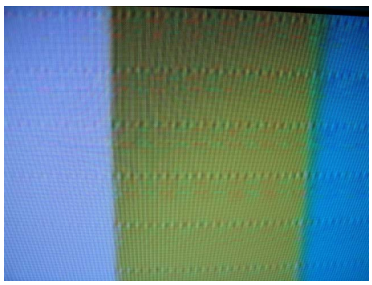

Figure A.7

	ATV K 55	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	***FM, AM***	***42 dBm / 25 V***	***o.k.***
		27,405 MHz	FM, AM	42 dBm / 25 V	o.k.
Sharp	ATV K 9	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,405 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,800 MHz	FM, AM	42 dBm / 25 V	o.k.
	DVB-T K 9	Gen			
		26,965 MHz	FM	42 dBm / 25 V	o.k.
		27,215 MHz	FM	42 dBm / 25 V	o.k.
		27,405 MHz	FM	42 dBm / 25 V	o.k.
		27,800 MHz	FM	42 dBm / 25 V	o.k.
	DVB-T K 9	Gen			
		26,965 MHz	AM	29 dBm / 5,6 V	Freezing, Audio off
		27,215 MHz	AM	29 dBm / 5,6 V	Freezing, Audio off
		27,405 MHz	AM	29 dBm / 5,6 V	Freezing, Audio off
		27,800 MHz	AM	29 dBm / 5,6 V	Freezing, Audio off
	DVB-T K 5	Gen			
		27,8 MHz	AM	32 dBm / 8 V	Freezing, Audio off
		27,215 MHz	AM	29 dBm / 5,6 V	Freezing, Audio off
LG	DVB-T K 9	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,405 MHz	FM, AM	42 dBm / 25 V	o.k.

		27,800 MHz	FM, AM	42 dBm / 25 V	o.k.
	ATV K 9	Gen			
		26,965 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,215 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,405 MHz	FM, AM	42 dBm / 25 V	o.k.
		27,800 MHz	FM, AM	42 dBm / 25 V	o.k.
		AE 5800			
		Ch 01	SSB	39,5 dBm / 19 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	39,5 dBm / 19 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
	DVB-T K 9	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	35,5 dBm / 12 V	o.k.
			AM	39,5 dBm / 19 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35,5 dBm / 12 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
Sony		AE 5800			
	DVB-T K 9	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.

DVB-T K 25	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
DVB-T K 55	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
ATV K 9	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
ATV K 25	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.

			AM	39 dBm / 18 V	o.k.
	ATV K 55	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
Sharp		AE 5800			
	ATV K 55	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
	ATV K 25	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
	ATV K 9	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.

	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
DVB-T K 25	Ch 01	SSB	37 dBm / 14 V	
		FM	35 dBm / 11 V	o.k.
		AM	36 dBm / 12,5 V	
	Ch 21	SSB	37 dBm / 14 V	
		FM	35 dBm / 11 V	o.k.
		AM	36 dBm / 12,5 V	
	Ch 40	SSB	37 dBm / 14 V	
		FM	35 dBm / 11 V	o.k.
		AM	36 dBm / 12,5 V	
DVB-T K 9	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	37,5 dBm / 15 V	
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	37 dBm / 14 V	
	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	36 dBm / 12,5 V	
DVB-T K 5	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	37 dBm / 14 V	
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	37 dBm / 14 V	
	Ch 40	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	37 dBm / 14 V	
DVB-T K 55	Ch 01	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.
		AM	39 dBm / 18 V	o.k.
	Ch 21	SSB	40 dBm / 20 V	o.k.
		FM	35 dBm / 11 V	o.k.

			AM	39 dBm / 18 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	35 dBm / 11 V	o.k.
			AM	39 dBm / 18 V	o.k.
Sharp		Jackson II			
	DVB-T K 05	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	DVB-T K 09	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	DVB-T K 25	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	
	DVB-T K 55	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.

		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	ATV K 09	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	ATV K 25	Ch 01	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
LG		Jackson II			
	DVB-T K 09	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	DVB-T K 55	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	ATV K 09	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	ATV K 55	Ch 21	SSB	40 dBm / 20 V	o.k.

			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
Sony		Jackson II			
	ATV K 09	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		Ch 40	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	ATV K 55	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	DVB-T K 09	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
	DVB-T K 55	Ch 21	SSB	40 dBm / 20 V	o.k.
			FM	37 dBm / 14 V	o.k.
			AM	41 dBm / 22 V	o.k.
		XM 3003			
	ATV K 09	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	ATV K 55	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	DVB-T K 09	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	DVB-T K 55	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
Sharp		XM 3003			
	ATV K 09	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	ATV K 55	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	DVB-T K 05	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	33 dBm / 9 V	
	DVB-T K 09	Ch 21	FM	37 dBm / 14 V	o.k.

			AM	33 dBm / 9 V	
	DVB-T K 25	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	34 dBm / 10 V	
	DVB-T K 55	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	34 dBm / 10 V	
LG		XM 3003			
	ATV K 09	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	ATV K 55	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	DVB-T K 09	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.
	DVB-T K 55	Ch 21	FM	37 dBm / 14 V	o.k.
			AM	40 dBm / 20 V	o.k.

Key to columns

- Column 1: TV-Set.
- Column 2: Wanted TV Signal.
- Column 3: Interfering signal generator SMH (Differential Mode) / SMHU (Common Mode) or CB radio device as well as channel of CB radio device.
- Column 4: Modulation.
- Column 5: Power at input of EM 101 and equivalent voltage on line to EUT.
- Column 6: Either:

  26 o.k. → maximum power / voltage was created; no degradation; or

  ii) empty (no stronger signal could be produced because of intrinsic noise amplification of the amplifier or maximum output of CB radio device); no degradation; or

  iii) occurring degradation until threshold was reached by reducing power/voltage. Threshold was tested from above and below of the values without any observable hysteresis

A.3.1.1.7 Pictures

Measurement setup

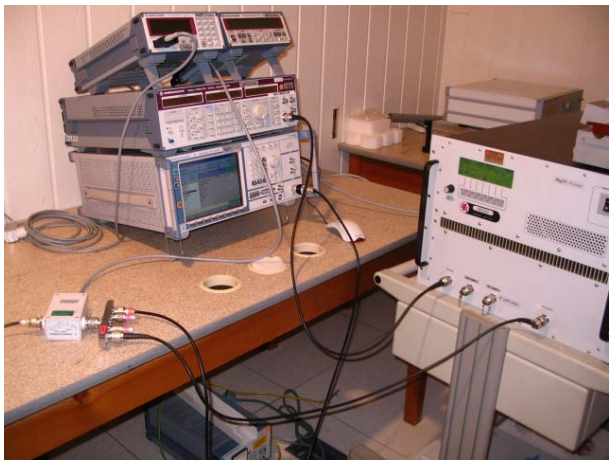

Figure A.8: Differential Mode (with Generator SMH)

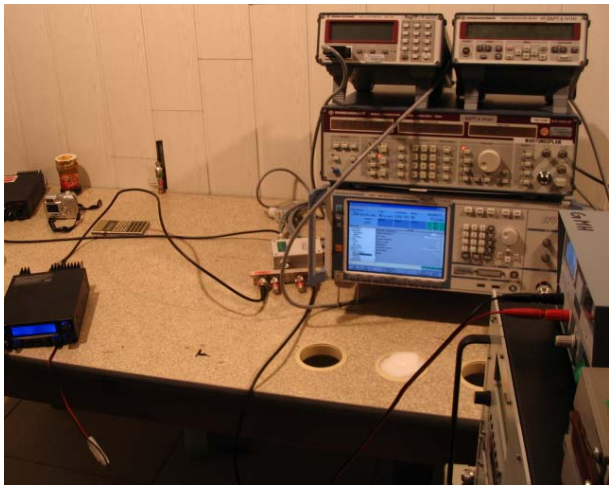

Figure A.9: Differential Mode (with CB Radio Albrecht "AE 5800")

Figure A.10: Differential Mode (with CB Radio President "Jackson II")

Figure A.11: Differential Mode (testmonitor Sony)

Figure A.12: CB Radio President "Jackson II"

Figure A.13: CB Radio STABO "XM 3003"

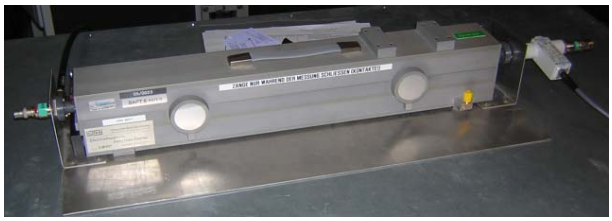

Figure A.14: Common Mode (10 V Calibration)

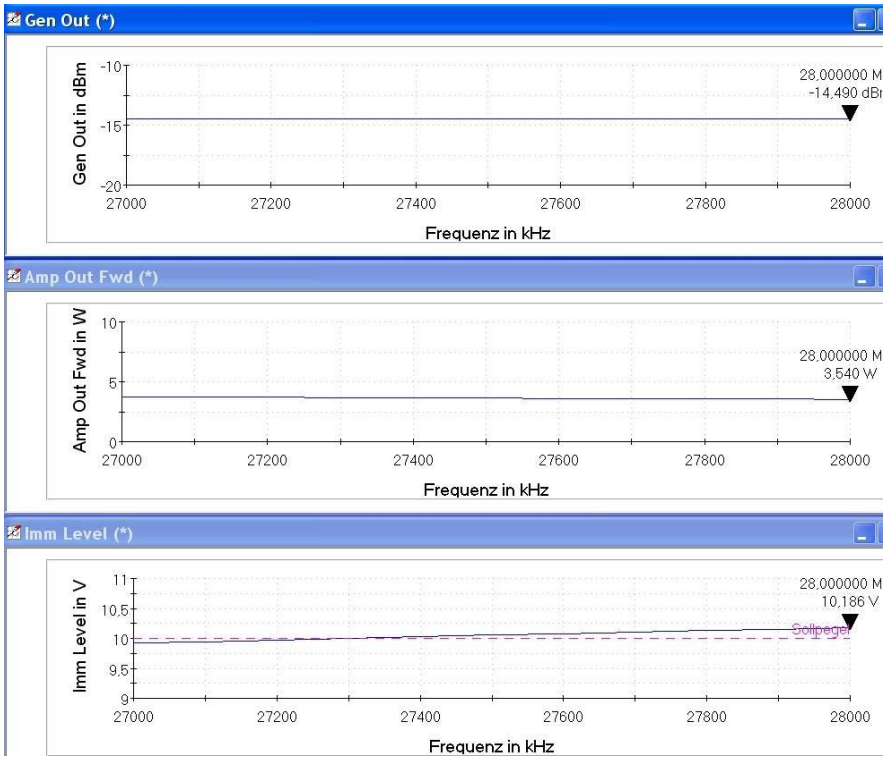

Figure A.15: Common Mode (Calibration routine10 V)

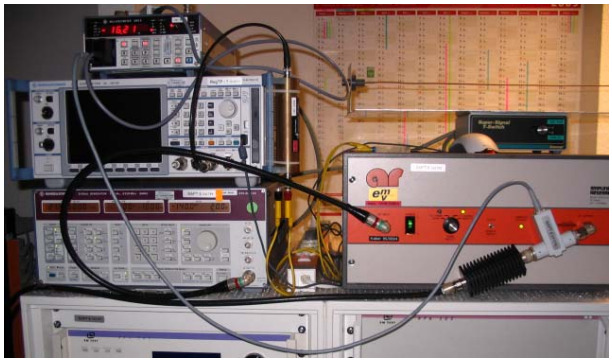

Figure A.16: Common Mode (Generator, Amplifier, Voltmeter)

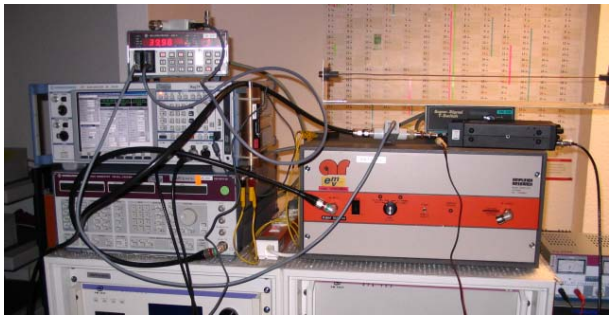

Figure A.17: Common Mode (CB Radio, Voltmeter)

A.3.1.1.8 Observations and conclusions

- No blocking or other kind of picture or sound degradation was visible below a CB radio interference level of 25 dBm at the TV receiver input (valid for both, SSB and AM modulation). Taking into account the minimum isolation provided by free space propagation loss, 4 Watt AM/FM CB radiated signals as well as SSB CB radiated signals with 12 Watt PEP appear unlikely to create visible interference to DVB-T reception.

- As expected, it is confirmed that the AM and SSB modulations have the greatest interference potential, however, at the RF powers requested, there was no indication of interference. Interference was only experienced in the presence of RF power levels far exceeding those being considered in the present document.
- During differential mode testing, 2 UHF TV tuners broke down when applying extreme high input load to it (estimated load value between 35 dBm to 40 dBm at receiver antenna input connector). Surprisingly, these two devices could be used again during the following day due to "self-healing" over one night.

A.3.2 Test Plan Testing of Domestic and Vehicle Equipment for interference levels from CB radios

Practical tests to:

- Long-Wave (LW) and Medium-Wave (MW) AM Broadcast receivers (domestic and vehicle-based);
- band II FM receivers (domestic and vehicle-based);
- Digital Audio Broadcast (DAB) receivers (domestic and vehicle-based); and
- a variety of domestic communications and audio devices.

Using CB radios utilizing 12 W PEP SSB and 4 W AM/FM modulation to:

- ascertain whether any interference was generated; and
- if so, what kind and under what circumstances, such that further studies may be made.

A.3.2.1 Testing of Domestic and Vehicle Equipment for interference levels from CB radios

A.3.2.1.1 Introduction

The present clause displays the results of a brief practical study conducted to ascertain the interference potential of CB radios utilizing 12 W PEP SSB and 4 W AM/FM modulation to:

- Long-Wave (LW) and Medium-Wave (MW) AM Broadcast receivers (domestic and vehicle-based);
- band II FM receivers (domestic and vehicle-based);
- Digital Audio Broadcast (DAB) receivers (domestic and vehicle-based); and
- a variety of domestic communications and audio devices.

The objective was to ascertain whether any interference was generated and, if so, what kind and under what circumstances, such that further studies may be made.

A.3.2.1.2 Test Plan

A.3.2.1.2.1 Environmental Considerations

The tests were carried out at Edgcott in Buckinghamshire in the United Kingdom (UK), which is located at Ordnance Survey (OS) grid reference SP677225.

A.3.2.1.2.1.1 Local Transmitting Stations

The Band II (FM) and DAB signals were primarily received from Oxford Transmitting Station, located at Beckley, OS grid reference SP567105, some 19 miles from Edgcott. This location also broadcasts MW (AM) on 1197 KHz.

MW (AM) signals were also received from a number of stations in the area, including:

- Kings Heath at SP740633, on 1557 KHz;
- Kempston, Bedford at TL035464, on 1161 KHz; and
- Aylesbury at SP829117, on 1575 KHz.

Additionally a number of transmissions were used from MW (AM) and LW (AM) stations located approximately 70 miles away from Edgcott.

A.3.2.1.2.1.2 Environmental Conditions

The weather was clear and dry, and between 5 °C and 10 °C throughout the duration of the testing, which was performed on 17th February 2009.

A.3.2.1.2.2 Equipment used during tests

A.3.2.1.2.2.1 Transmit Equipment

A Midland "3001" FM CB radio with an MPT 1320 Specification mark (CB 27/81, see figure A.18) was used as a reference.

Figure A.18: CB 27/81 mark on Midland "3001" FM CB radio

Two CB radios capable of transmitting with AM, FM and SSB modulation were used for comparison. These included a President "Jackson II" and an Albrecht "AE 5800", both of which are capable of transmitting 12 W PEP on SSB and 4 W on AM and FM modulations.

A Midland centre-loaded "18-2442" whip antenna was used for all the CB transmissions, and each CB radio was used with its own specific microphone.

The equipment is shown in figures A.19, A.20, A.21 and A.22.

Figure A.19: Midland "3001"

Figure A.20: President "Jackson II"

Figure A.21: Albrecht "AE 5800"

Figure A.22: The three radios, and Midland antenna

The Transmit equipment was installed in a Vauxhall Corsa, and powered by the vehicle's 12V DC battery. The vehicle's engine was kept running to ensure a steady power supply for the radio, and the antenna was mounted on the roof of the vehicle (figure A.23).

Figure A.23: Antenna installed on Vauxhall Corsa roof

A.3.2.1.2.2.2 Receive Equipment

A variety of domestic and vehicle-based devices were used to check for interference from the SSB CB radio. These included:

- a Standard-fit MW and LW (AM) and Band II (FM) receiver in a Toyota Amazon;
- a Pure Highway DAB Receiver in a Toyota Amazon;
- D-Link DWL-7100AP wireless access point communicating with a Sony Vaio VGN-SZ1VP laptop, operating on 2,4 GHz 802.11 b/g ([i.18] and [i.19]);
- an IMOVES "IP300" iPod speaker unit;
- a Creative "Travelsound" MPEG Layer 3 (MP3) player speaker unit;

- two Tomy "Light 'n' Listen" Baby Alarms;
- an Hitachi "AX-M66" LW/MW (AM)/Band II (FM) Receiver, and Matsui "DA-1" DAB Receiver;
- a Sennheiser 863 MHz (FM) cordless audio system; and
- a Belkin Wireless Universal Serial Bus (WUSB) Hub.

A.3.2.1.2.2.2.1 Standard-fit MW and LW (AM) and Band II (FM) receiver in a Toyota Amazon

The standard-fit, 12 Volt (V) Direct Current (DC) powered MW and LW and Band II FM radio utilizes the vehicle's antenna in a Toyota Amazon (see figure A.24). The receiver has a manual tuning knob allowing tuning across the broadcast bands as well as a search function.

Figure A.24: Standard-fit MW/LW (AM) and Band II (FM) receiver in a Toyota Amazon The Pure Highway DAB receiver is also visible to the top right of the image

A.3.2.1.2.2.2.2 Pure Highway DAB Receiver

A 12V DC powered Pure Highway DAB receiver, in a Toyota Amazon (see figure A.25). The DAB receiver has a dedicated antenna on which it receives 174-240 MHz. It then transmits audio to the car stereo on Band II FM, (see figure A.26). The Pure Highway is capable of tuning and searching across the band.

Figure A.25: Pure Highway DAB receiver

Figure A.26: the Pure Highway's dedicated antenna

A.3.2.1.2.2.2.3 D-Link DWL-7100AP wireless access point communicating with a Sony Vaio VGN-SZ1VP laptop, operating on 2,4 GHz 802.11 b/g

An AC mains powered D-Link "DWL-7100AP" wireless access point and an AC mains powered Sony "Vaio VGN-SZ1VP" laptop were used to create and maintain an 802.11 b/g ([i.18] and [i.19]) communications link, operating on 2,4 GHz (see figures A.27 and A.28). The D-Link uses standard antennas, while the Sony uses its standard internal 802.11 b/g ([i.18] and [i.19]) card and antenna.

Figures A.27 and A.28: D-Link access point and Sony laptop with vehicle visible behind both windows

A.3.2.1.2.2.2.4 IMOVES "IP300" iPod Speaker Unit

The IMOVES "IP300" is a battery powered unit with a "dock" built to fit an Apple iPod. The unit allows the iPod to play audio content through a built-in amplifier and speakers.

Figure A.29: The battery powered IMOVES iPod speaker unit

A.3.2.1.2.2.2.5 Creative "Travelsound" MP3 player Speaker Unit

The Creative "Travelsound" is a battery powered unit with a cable terminated in a 3,5 mm jack. This jack can be used to connect to any audio source with a 3,5 mm socket, but is intended mainly for use with portable MP3 players such as an iPod. An internal amplifier and speakers allow audio material from the source device to be played.

Figure A.30: The battery powered Creative MP3 player speaker unit

A.3.2.1.2.2.2.6 Tomy "Light 'n' Listen" Baby Alarm

An AC mains-powered Tomy "Light 'n' Listen" baby alarm (see figures A.31 and A.32), when used in conjunction with a second unit, enables a person near the first unit to receive audio from the second unit in another part of the same building, and the second to receive audio from the first unit. The baby alarm consists of two units and maintains two-way communications on 49,82 MHz to 49,98 MHz.

Figures A.31 and A.32: Tomy Light 'n' Listen baby alarm

A.3.2.1.2.2.2.7 Hitachi "AX-M66" MW/LW (AM) and Band II (FM) Receiver, and Matsui "DA-1" DAB Receiver

An AC mains powered Hitachi "AX-M66" MW/LW (AM) and Band II (FM) receiver and amplifier (see figure A.33). Additional to this equipment is an AC mains powered Matsui "DA-1" DAB receiver which provides audio output connected to the Hitachi amplifier. Both devices make use of the same type of antenna, a simple length of wire, as can be seen in figure A.34.

NOTE: In figure A.34, note the antenna

Figures A.33 and A.34: The Hitachi AX-M66 MW/LW (AM) and Band II (FM) receiver and amplifier, with separate Matsui DA-1 DAB receiver on top

A.3.2.1.2.2.2.8 Sennheiser 863 MHz (FM) Cordless Audio Device

An AC mains-powered transmitter (see figure A.35) is connected to a domestic audio system, which is its source for audio content. The transmitter sends audio content on 863 MHz (FM) to a receiver located approximately 12 m away alongside the Hitachi system (see figure A.36).

Figure A.35: The Sennheiser transmitter

Figure A.36: The Sennheiser receiver

A.3.2.1.2.2.2.9 Belkin WUSB Hub

The AC mains powered Belkin WUSB hub (see figure A.37) utilizes Ultra-WideBand (UWB) with a centre frequency of 3,5 GHz to communicate with a "dongle" which may be placed up to 10 m away. These devices permit remote operation of certain Universal Serial Bus (USB) devices such as scanners (see figure A.38) or printers from a computer. The Hub is AC mains powered and the Dongle will only work when the laptop machine is powered by AC mains: this system will not work while running off a laptop battery.

Figures A.37 and A.38: The mains powered WUSB Hub and Dongle and mains powered HP 5590P scanner

A.3.2.1.2.3 Tested Features

The CB radios were tested for the ability to generate interference to MW and LW (AM), Band II (FM), and DAB 12V DC powered receivers in a vehicle, an AC mains powered MW and LW (AM) and Band II (FM) broadcast receiver with DAB converter, and a variety of other domestic devices either using wireless communications or which may be vulnerable to direct breakthrough, and which may be used in proximity of a CB transmitter.

A.3.2.1.2.4 Approach

The interference scenarios utilized a variety of victim equipment in realistic conditions with the CB transmissions on a broad spread of channels. A number of scenarios were tried such as varying the distance and height of the battery powered units to ensure "worst case" conditions.

A.3.2.1.2.5 Method

The tests have been conducted on one or more channels from the list at table A.4. These channels were selected to ensure a good spread of frequencies across the band.

Table A.4: Channel numbers and associated Frequencies in the United Kingdom (UK) and throughout the European Union (EU)

Channel number	UK Frequency (MHz, applies to Midland radio)	CEPT/EU Frequency (MHz, applies to President and Albrecht radios)
1	27,60125	26,965
10	27,69125	27,075
20	27,79125	27,205
30	27,89125	27,305
40	27,99125	27,405

The CB units were operated in one vehicle in order to generate possible interference to:

- another vehicle's in-car MW and LW (AM) receiver;
- another vehicle's in-car Band II (FM) receiver;
- another vehicle's in-car DAB receiver;
- 802.11b/g ([i.18] and [i.19]) communications;
- battery-powered audio devices which may be located close to the transmitter;
- other wireless devices (Tomy "Light 'n' Listen" baby alarm);
- domestic MW and LW (AM), Band II (FM) and DAB receivers;
- a Sennheiser 863 MHz (FM) cordless audio device;

- a Belkin WUSB Hub's UWB communications link.

In each instance, the CB radios were set to transmit on channels 1, 10, 20, 30 and 40 and were set to transmit on each available modulation scheme, unless otherwise specified. Varying speech was used to enable easy detection of interference.

Where the victim equipment provides the user with a variety of receivers, such as domestic broadcast receivers, the tests were carried out with the receiver set to MW/LW (AM), Band II (FM) and DAB in turn and tuned across the relevant band, which allowed assessment of both on-station and off-station interference.

A.3.2.1.2.5.1 Standard-fit MW and LW (AM) and Band II (FM) receiver, and Pure Highway DAB receiver, in a Toyota Amazon

The transmit antenna was set to approximately 3 m separation and then reduced to approximately 1,5 m distance from the victim antenna in order to simulate likely traffic scenarios (see figure A.39).

Figure A.39: Vehicle setup

A.3.2.1.2.5.2 D-Link DWL-7100AP wireless access point communicating with a Sony Vaio VGN-SZ1VP laptop, operating on 2,4 GHz 802.11 b/g

The wireless access point and laptop were set up with the vehicle in the transmission path, considered the worst case that could be achieved. A 250 Mb directory of photographs was sent from a network drive accessible via the access point to the local drive on the laptop, with the intention of checking the integrity of the photographs once the transfer was complete. During the transfer, the President CB radio was transmitting across the band using SSB in the vehicle parked approximately five meters away (see figure A.40).

Figure A.40: Vehicle parked with D-Link Wireless Access Point in the window to the far left of the image, and the Sony laptop behind the window to the right

A.3.2.1.2.5.3 IMOVES "IP300" iPod speaker unit and Creative "Travelsound" MP3 player speaker unit

The battery powered units sourced their audio content from a single attached iPod during the testing. The iPod was docked in the IMOVES unit and the Creative unit was simultaneously connected to the iPod's audio output socket using an unshielded cable, and were used in proximity to the vehicle hosting the CB radio (see figure A.41). The units were activated some 12 m away and brought to the vehicle at a walking pace, and set upon the roof of the vehicle. The President CB radio was set to transmit and operated on all channels using AM, FM and SSB while the units were active to determine if any distortion or blocking was present.

Figure A.41: Creative "Travelsound" (left) and IMOVES "IP300" (right) next to the Transmit antenna

A.3.2.1.2.5.4 Tomy "Light 'n' Listen" baby alarm

This 49,82 MHz to 49,98 MHz system includes two units to maintain two-way communications between parent and child, and were placed in two different rooms of the house nearest to the parked vehicle, neither of which is more than six meters away (see figure A.42). The baby alarm set was activated and, while the President CB radio transmitted and was operated on all channels using AM, FM and SSB, is monitored for any distortion or blocking.

Figure A.42: The circle indicates the baby alarm location

A.3.2.1.2.5.5 Hitachi "AX-M66" AM/FM Receiver and Matsui "DA-1" DAB Receiver

The CB transmit antenna was approximately 10 m away from the domestic receiver which was placed inside the house in order to simulate a likely vehicle/building scenario (see figure A.43).

The President CB radio was set to transmit throughout the band and used AM, FM and SSB modulation.

The test was carried out with the receiver set to MW/LW (AM), Band II (FM) and DAB in turn and scanned through the entire frequency band to determine if any interference was audible.

Figure A.43: The red circle indicates the approximate location of the Hitachi receiver

A.3.2.1.2.5.6 Sennheiser 863 MHz (FM) Cordless Audio Device

The test setup was in the same position as seen in figure A.43, with the CB transmit antenna approximately 10 m away from the Sennheiser receiver which is marked by the red circle. The CB transmit antenna was approximately 15 m from the transmitter which is located on the other side of the house. The base station was set to transmit audio content to the receiver and this 863 MHz (FM) link was monitored for interference while the President CB radio was transmitting across the band.

A.3.2.1.2.5.7 Belkin WUSB Hub

A Belkin WUSB link is active in the office. It links a computer and an HP Scanjet 5590P consumer scanner which is on a desk approximately four meters away (see figure A.44). The vehicle with the CB radio was parked behind the window where the scanner and WUSB hub were located (see figure A.45). The President CB radio was activated and set to transmit across the band on AM, FM and SSB modulations. The HP scanner was set to scan an image at a large resolution such that the UWB link was used continuously. Any interruption or slowing of the communications link would have been instantly noticeable as the UWB devices blink when a link is active and stable, and their behaviour alters if this is not the case.

Figure A.44: The Scanner and WUSB Hub are in front of the window, the Host WUSB device on the desk to the right

Figure A.45: The car parked behind the window The WUSB Hub location is marked by the circle

A.3.2.1.3 Results

A.3.2.1.3.1 Standard-fit MW and LW (AM) and Band II (FM) receiver, and Pure Highway DAB receiver, in a Toyota Amazon

The reference Midland "3001" FM CB radio generated no symptoms of interference in the victim receivers at a distance of 3 m (see table A.5) or 1,5 m (see table A.6).

Table A.5: Midland "3001" FM CB radio at a distance of 3 m

Receive Modulation	CB (FM) Channel 1	CB (FM) Channel 10	CB (FM) Channel 20	CB (FM) Channel 30	CB (FM) Channel 40
MW/LW (AM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
Band II (FM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
DAB	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms

Table A.6: Midland "3001" FM CB radio at a distance of 1,5 m

Receive Modulation	CB (FM) Channel 1	CB (FM) Channel 10	CB (FM) Channel 20	CB (FM) Channel 30	CB (FM) Channel 40
MW/LW (AM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
Band II (FM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
DAB	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms

The President "Jackson II" CB radio generated no symptoms of interference at a distance of 3 m in the first two channels tested (see table A.7). After completing Channel 10 with the President unit, the vehicles were moved closer, to a distance of 1,5 m, and testing restarted (see table A.8). Albrecht "AE 5800" was also tested at this range and, as table 5 demonstrates, both provided the same result.

Table A.7: President "Jackson II" CB radio, at a distance of 3 m

Receive Modulation	CB (SSB) Channel 1	CB (SSB) Channel 10	CB (FM) Channel 1	CB (FM) Channel 10	CB (AM) Channel 1	CB (AM) Channel 10
MW/LW (AM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
Band II (FM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
DAB	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms

Table A.8: President "Jackson II" CB radio and Albrecht "AE 5800", at a distance of 1,5 m

Receive Modulation	CB (SSB) Channel 1	CB (SSB) Channel 10	CB (SSB) Channel 20	CB (SSB) Channel 30	CB (SSB) Channel 40
MW/LW (AM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
Band II (FM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
DAB	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
	CB (AM) Channel 1	**CB (AM) Channel 10**	**CB (AM) Channel 20**	**CB (AM) Channel 30**	**CB (AM) Channel 40**
MW/LW (AM)	No symptoms	Some audible interference (see note)	No symptoms	No symptoms	No symptoms
Band II (FM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
DAB	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
	CB (FM) Channel 1	**CB (FM) Channel 10**	**CB (FM) Channel 20**	**CB (FM) Channel 30**	**CB (FM) Channel 40**
MW/LW (AM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
Band II (FM)	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
DAB	No symptoms	No symptoms	No symptoms	No symptoms	No symptoms
NOTE: Around 900 kHz when the car radio receiver was deliberately tuned off-station (i.e. between broadcast stations at full audio volume), some modulation peaks from AM CB could be discerned. It was not possible to hear distinct words and was not discernable when on-station. This was present with both the President and Albrecht radios.					

These tests show conclusively that usage of 12 W PEP SSB and 4 W AM/FM CB equipment does not generate undue interference to in-vehicle MW/LW (AM), Band II (FM) or DAB receivers.

A.3.2.1.3.2 D-Link DWL-7100AP wireless access point communicating with a Sony Vaio VGN-SZ1VP laptop, operating on 2,4 GHz 802.11 b/g

The directory copied from the cabled network storage location to the local drive on the laptop via 802.11 b/g ([i.18] and [i.19]) contained 331 jpeg images between 600 Kb and 1,1 Mb in size, with one file slightly under 7 Mb in size. The directory was 250 Mb total in size.

After transfer, which took approximately four minutes, the transmitted files were checked both visually and electronically for any sign of corruption. No corruption was found, indicating that the link maintained cohesion throughout testing.

A.3.2.1.3.3 IMOVES "IP300" iPod speaker unit and Creative "Travelsound" iPod speaker unit

The two units were moved from an approximate distance of 12 m to adjacent to the antenna on the roof of the car, and displayed no signs of distortion or interference despite the final close proximity to the CB radio antenna. The Creative unit was also connected to the audio output of the iPod whilst it was docked in the IMOVES unit, using an unshielded lead, to provide a worst-case interference case.

A.3.2.1.3.4 Tomy "Light 'n' Listen" baby alarm

The baby alarm communications link was maintained throughout the testing without interference.

A.3.2.1.3.5 Hitachi "AX-M66" AM/FM Receiver and Matsui "DA-1" DAB Receiver

The Hitachi system displayed no symptoms of interference.

A.3.2.1.3.6 Sennheiser Cordless Audio Device

The cordless audio link displayed no symptoms of interference.

A.3.2.1.3.7 Belkin WUSB Hub

The UWB communication devices displayed no corruption of the communication link.

A.3.2.1.4 Conclusion

Whilst conventional wisdom suggests that SSB and higher-power AM and FM equipment will cause interference to domestic equipment, both testing in the Kolberg laboratory and that described in the present document suggests that the power levels suggested (12 W PEP for SSB and 4 W for AM and FM) will not cause undue interference to a range of domestic and in-vehicle systems.

A.3.3 Sharing and compatibility issues

Please see previous clauses where Television reception in Band 3, 4 and 5, and domestic and vehicle mounted equipment where considered.

Annex B:
Interference Potential Consideration

Free space propagation loss at 27 MHz for distances between 1 m and 10 m between transmitter and interferer:

$$f := 27 \quad \text{MHz}$$

$$L(d) := 32.4 + 20 \cdot \log(f) + 20 \cdot \log\left(d \cdot 10^{-3}\right)$$

Frequency (f) in MHz.

Distance between Transmitter and receiver (d) in metres.

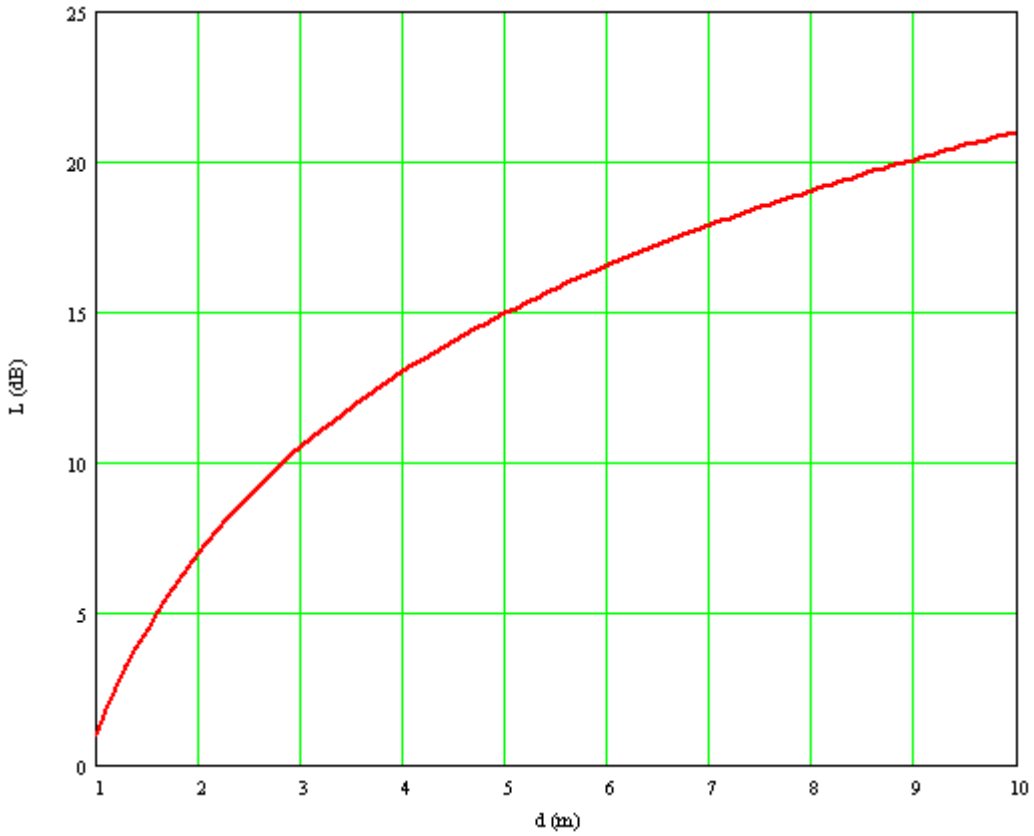

Figure B.1: Linear scale

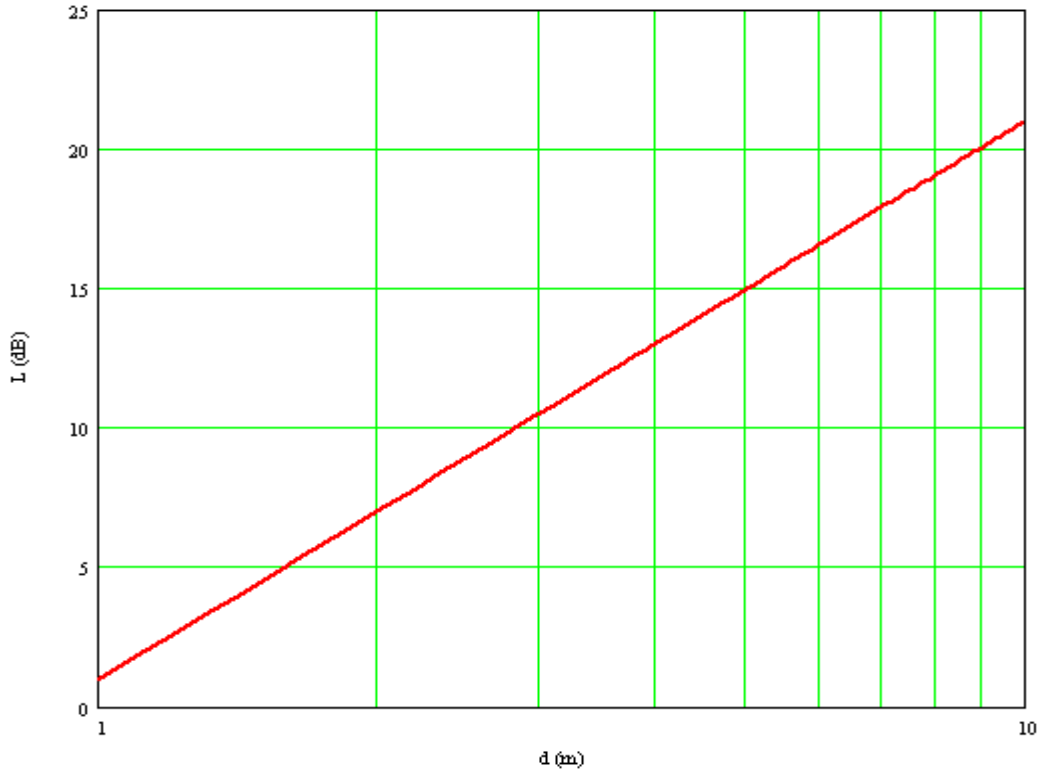

Figure B.2: Logarithmic scale

No blocking or other kind of picture or sound degradation was visible below a CB radio interference level of 25 dBm at the TV receiver input (valid for both, SSB and AM modulation). Taking into account the minimum isolation provided by free space propagation loss, 4 Watt AM/FM CB radiated signals as well as SSB CB radiated signals with 12 Watt PEP appear unlikely to create visible interference to DVB-T reception.

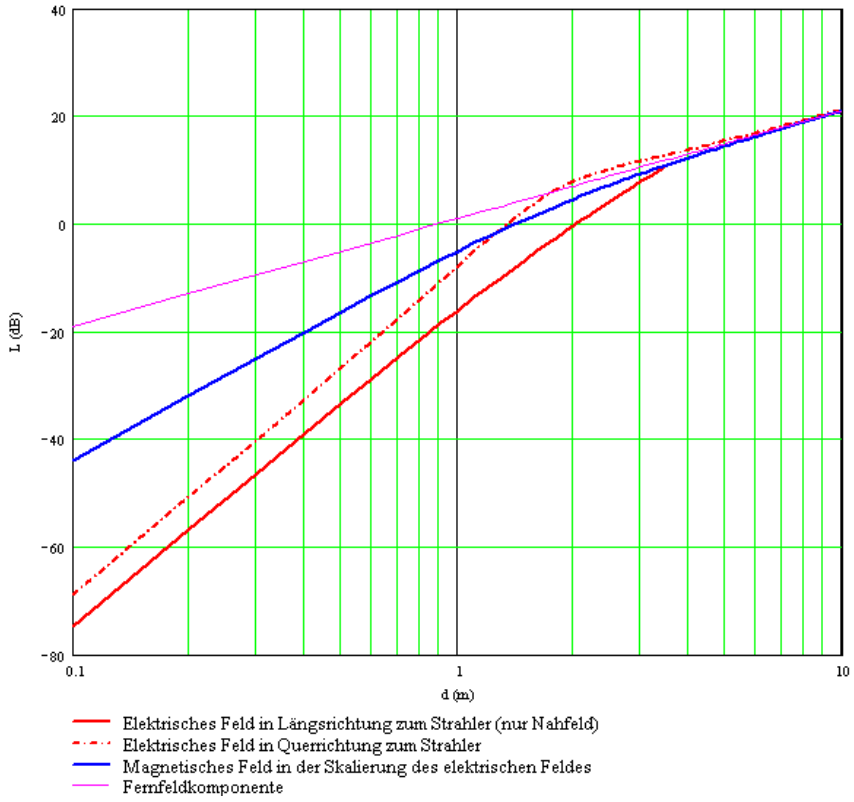

Figure B.3: Near Field Consideration

As can be seen from figure B.3, at 27 MHz (λ = 11 m) is the near field dominating up to about 2 m. As of 4 m distance, the far field is dominating (purple line represents the far field, all other lines are near field components). Near field considerations are assumed to have an negligible effect on interference considerations.

Since λ = 11 m, one CB radio antenna with these dimensions is impossible to install in a lorry or car. Therefore, all CB antennas, with a 99 % confidence, are a 1/4λ dipoles, reduced in their length by a using a coil, that very often is also used to match the impedance.

One popular and widely used antenna is a model with a 1,5 m of length, made by several manufacturers (Midland, President, Sigma, Sirtel and more). This antenna can be considered like the most sale antenna in Europe and was used in the TR 101 837 [i.11]. The calibration method used in that report was in accordance with ANSI C63.5 [i.16] and the three-antenna method has been used. The conclusion was to have a negative gain of about -10 dB fort his model.

To take into account extreme high gain CB radio antennas such as Santiago 1 200 family or Colorado, the present document assumes a maximum gain of -7 dBi with extremely high confidence that this covers almost all cases.

Taking into account a negative antenna gain of - 7 dBi, the calculation would accordingly be as follows:

- CB Radio Tx power - Propagation Loss = input at DVB-T receiver, whereby the maximum allowable input level is assumed to be 25 dBm.
- CB Radio Tx power is 4 Watt AM/FM and 12 Watt PEP for SSB modulation.

Table B.1: Resulting minimum separation distance

	CB Radio emission, e.r.p.	Maximum allowable input at victim receiver	Losses/Gains of antennas and cables involved	Necessary isolation in dB	Minimum separation distance
AM	36 dBm (4 Watts)	25 dBm	-7 dBi	4 dB	1 m to 2 m
FM	36 dBm (4 Watts)	25 dBm	-7 dBi	4 dB	1 m to 2 m
SSB	41 dBm (PEP) (12 Watts PEP)	25 dBm	-7 dBi	12 dB	3 m to 4 m

Annex C:
Worldwide Spectrum Use

Table C.1: Spectrum use

		26 000 MHz				27 000 MHz			27 500 MHz		
	26 330		**26 565**	**26 770**	**26 955**	**26 965**		**27 405**	**27 601,25**	**27 855**	**27 991,25**
EN 300 135 [i.3] and EN 300 433 [i.4]											
Germany, Czech Republic and Slovak Republic											
United Kingdom											
Poland same of EC but shifted 5 kHz											
Brazil											
Uruguay											
New Zealand											
Australia, Canada, USA											
Argentina, Chile, Colombia, Peru, and Venezuela											
Japan only 8 channels in this band but not the same frequency											
Indonesia, South Korea											

Table C.2: Power levels and modes

					Non essential radiations	
	W	**FM**	**AM**	**SSB (pep)**	**2nd harm**	**Unwanted radiations**
Europe		4	1	4	-54 dBm	-54 dBm
Italy, Poland and Spain		4	4	12	-54 dBm	-54 dBm
USA, Canada,		N.A.	4	12	-60 dBC	-60 dBC
Argentina		N.A.	5	12		-40 dBC
Colombia,		N.A.	5	15		
Uruguay		7	7	20	-60 dBC	-60 dBC
Brazil		10	10	25	-60 dBC	-40 dBC
Chile		N.A.	4	12		
Venezuela, Peru		N.A.	5			
Australia		N.A.	4	12		
New Zealand		N.A.	4	12		
Japan			0,5			
Indonesia				12		-50 dBC
South Korea		4	4	N.A.	-60 dBC	-60 dBC

History

Document history		
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