An Coimisiún um
Rialáil Cumarsáide
Commission for
Communications Regulation

ANNEX 2:
Technical Conditions for ASB, DSB and DTT Licences

ANNEX

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Commission for
Communications Regulation

Appendix 1 - Technical Conditions

Technical Conditions for Analogue Radio

General conditions attached to a licenced analogue VHF - FM, LF and MF - AM Broadcasting Station

Document No:	**12/04a**
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Contents

1. TECHNICAL CONDITIONS FOR ANALOGUE RADIO

1.1. PURPOSE

1.2. This document specifies the general conditions attached to a licence issued by ComReg to: -

(a) The Broadcasting Authority of Ireland ("BAI") under Part 6 of the Broadcasting Act 2009, for the establishment, maintenance and operation of an LF-MF independent radio station in the frequency band 150 – 285 kHz or 525 – 1605 kHz and/or a VHF-FM station for an independent radio service in the frequency bands 87.5 to 108MHz. These conditions are set out in accordance with section 59(3) of the Broadcasting Act 2009. The BAI, in accordance with section 50 of the Broadcasting Act 2009, shall ensure that these technical conditions are complied with by the sound broadcasting contractor concerned.

(b) RTÉ for the establishment maintenance and operation of analogue radio broadcasting stations. These conditions are set out in accordance with section 121(1) of the Broadcasting Act 2009.

1.3. This document consolidates the technical conditions for VHF-FM and LF/MF – AM stations into one document. These conditions shall apply to all such stations in the frequency bands 150 – 285 kHz, 525 – 1605 kHz and 87.5 – 108.0 MHz. This document replaces the document published by the Department of Transport, Energy and Communications in September 1995 (T&RT 95/10) and the analogue radio technical conditions contained in the RTÉ licence of 2005, (ComReg document 05/13a).

1.4. GENERAL

1.5. These conditions detail the characteristics of the equipment required for the purposes of frequency spectrum management and safety and do not include detailed equipment specifications.

1.6. Evidence of type approval of equipment is not required by the Commission[1]. Instead a procedure of station certification by a suitably qualified person, will apply.

1.7. Procedures for the modification of or addition of a station assignment are also specified in this document.

1.8. The technical parameters specified in this document are in accordance with values specified in the Radio Regulations (2008), in the Final Acts of the Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3), Geneva 1975, and in the Final Acts of the Regional Administrative Conference for the planning of VHF Sound Broadcasting, Geneva 1984.

[1] It is recommended that broadcasting transmitters comply with any appropriate European Telecommunications Standard.

1.9. The conditions specified in this document may be varied or added to from time to time by the Commission as required.

1.10. In cases of doubt regarding the interpretation of these conditions, the decision of the Commission will be final.

1.11. **DEFINITIONS AND GLOSSARY OF TERMS**

1.12. Radio Regulations
Radio Regulations, Edition of 2008, as published by the International Telecommunication Union (ITU) as replaced or amended from time to time.

1.13. Assignments
A radio frequency or radio frequency channel for which authorisation by the Commission for Communications Regulation has been granted for its use at a specified station with specified characteristics.

1.14. Station
One or more transmitters or receivers, or a combination of transmitters and receivers, including the associated equipment necessary, at one location for the purpose of carrying on a broadcasting service.

1.15. Geneva 1975 Agreement
The Final Acts of the Regional Administrative LF/MF Broadcasting Conference (Regions 1 and 3), Geneva 1975. An updated plan of assignments constitutes part of this Agreement.

1.16. Geneva 1984 Agreement
The Final Acts of the Regional Administrative Conference for the planning of VHF Sound Broadcasting, Geneva 1984. An updated plan of assignments constitutes part of this Agreement.

1.17. Effective Radiated Power (ERP) in a given direction.
The product of the power supplied to the antenna and its gain relative to a halfwave dipole in a given direction. This is usually expressed in decibels relative to one watt (dBW).

1.18. Effective Monopole Radiated Power (EMRP) in a given direction.
The product of the power supplied to the antenna and its gain in the horizontal plane relative to a short vertical antenna.

1.19. Maximum Effective Radiated Power.
The maximum value of the effective radiated power in any direction.

1.20. Effective Antenna Height (Eff. Ht.)
The height in metres, above the average level of the ground between distances of 3 and 15km from the transmitter. This is calculated for each of 36 evenly spaced radials (10 degree separation) starting from true North[2].

[2] This can be calculated by the Commission using the latitude and longitude in degrees minutes and seconds, for the transmitting station, provided the antenna height above ground level is supplied

1.21. Maximum Effective Antenna Height
The maximum value in metres for the effective antenna height in any one of the 36 directions referred to in 1.21 above.

1.22. Omnidirectional Antenna
An antenna having a horizontal radiation pattern with variations of 2 dB or less over 360 degrees.

1.23. Service Area
Locations where the field strength available (in the case of VHF at the reference receiver height of 10 metres above ground) exceeds both the minimum wanted field strength and the protected field strength (PFS) values as derived from the assignments in the appropriate plans.

1.24. Vertical Aperture
In relation to a VHF antenna system, the distance in wavelengths between the centres of the outermost radiating elements, plus one half wavelength, in the vertical plane.

1.25. Commission
Commission for Communications Regulation.

1.26. Contractor
The holder of a sound broadcasting contract entered into under Section 63 of the Broadcasting Act 2009.

1.27. **TRANSMITTER CONSTRUCTION**

1.28. General
The mechanical and electrical construction shall meet such requirements as can be reasonably set, taking the state of the art into account (see also 1.35 ‘Safety and Weather Protection’).

1.29. All controls, meters, indicators and terminals shall be clearly labelled. Details of the power supply from which the equipment is intended to operate shall be clearly indicated. The equipment should normally consist of one complete unit.

1.30. Controls
Controls which, when wrongly adjusted, increase the risk of causing interference or of improper functioning of the transmitter shall be immediately accessible to qualified personnel only.

1.31. Manufacturer’s Identification
The transmitter shall be provided with an indication showing the manufacturer’s trademark, type designation and serial number. The indication shall be fitted on the outside of the transmitter, shall be clearly readable, non-removable and indelible.

1.32. **FACILITIES FOR TESTING TRANSMISSION INSTALLATION**

1.33. Adequate and accurately calibrated test equipment shall be made available for non-radiative measurement of transmitter power, modulation characteristics and spurious emissions while the station is undergoing initial alignment and regular maintenance.

1.34. SAFETY AND WEATHER PROTECTION

1.35. General Safety

The station and its premises must comply with all relevant statutory safety regulations.

1.36. Safety Controls

There shall be a single control to isolate power for the entire installation. If a form of auxiliary power (such as diesel generators or an uninterruptable power supply) is provided, then the same control should isolate these. The "on" position of such a device must be clearly indicated.

1.37. Safety Standards

The system must comply with

- the Safety Requirements for Radio Transmitting Equipment as per I.S./EN 60215 : 1989 [3]
- any radiation emission standards adopted and published by the International Commission for Non-Ionising Radiation Protection (ICNIRP) or its successors from time to time; any radiation emission standards of the European Committee for Electrotechnical Standards and any other radiation emission standards specified by national and EC law. The Licensee shall ensure that non- ionising radiation emissions from apparatus operated by the Licensee or by its contractors are within the limits specified by the guidelines published by ICNIRP. The Licensee shall ensure that apparatus operated by the Licensee or by its contractors is not installed or operated at a location in such a manner as to cause the aggregate of non-ionising radiation emissions to exceed the limits specified by the guidelines published by ICNIRP.

1.38. Weather Protection

All apparatus and cables exposed to weather, corrosive atmosphere or other adverse conditions shall be so constructed or protected as may be necessary to prevent danger or interference to other services arising from such exposure.

1.39. SITE ENGINEERING

1.40. General

The practice of good site engineering is a necessary requirement to ensure good coverage, safety of personnel and minimum interference to other services. This is particularly relevant when considering other services, especially aeronautical systems and private mobile radio networks used by the emergency services, operating in frequency bands adjacent to the VHF-FM radio broadcasting bands. In addition, careful consideration is required for other services when operating from the same site or in close proximity to them.

1.41. Spurious Emissions

Careful consideration should be given to the levels of spurious emissions set out in 1.54.

[3] This standard is available from the National Standards Authority of Ireland

1.42. Standard
The European Telecommunications Report ETR132 outlines site engineering practises for VHF-FM systems and is freely available from the European Telecommunications Standards Institute (ETSI) website. The Licensee shall ensure that all necessary precautions are undertaken to ensure good site engineering practise.

1.43. **TRANSMISSION CHARACTERISTICS FOR LF AND MF AM BROADCASTING STATIONS**

1.44. Frequency Aspects
The equipment shall be designed to operate on the assigned frequency in the frequency Band 150 – 285 kHz or 525 – 1605 kHz only.

1.45. The frequency tolerance of the main carrier shall be ±10 Hz.

1.46. The transmit-frequency shall be derived from a crystal-oscillator. If use is made of a synthesiser and/or a phase locked loop system, the transmitter shall be inhibited when synchronisation is absent. The transmitter frequency adjustment control shall be accessible to qualified personnel only.

1.47. Maximum Permitted Levels of Spurious Emissions
The maximum permitted level of spurious emission shall be at least 40dB below the mean power level of the transmitter and at no time may exceed an absolute power level of 50mW.

1.48. Class of Emission, Bandwidth and Modulation Standards
In accordance with the Geneva 1975 Agreement, the transmission system used shall be double sideband amplitude modulation with full carrier. This is normally specified as 9K00A3EGN.

1.49. AF input and RF output Impedance
The nominal A.F. input impedance shall be 600 Ohm balanced to earth within the modulation frequency range 40Hz – 4.5 kHz. The R.F. output impedance of the equipment shall be in the range of 50 - 160 Ohm.

1.50. Transmit Power and Radiated Power
The transmitter power, stated in the licence, is the carrier power in the absence of modulation.

1.51. The radiated power is the sum of the nominal power of the transmitter (in dBW) and the gain of the antenna in dB (relative to a short vertical antenna) without taking any losses into account. It is expressed as the effective monopole radiated power (emrp in kW or in dB relative to 1 kW).

1.52. As the radiated power is the sum of the transmitter output power (in dBW) and the gain of the antenna (in dB) the output carrier power of transmitter shall be adjustable so that the value of the radiated power permitted for each station is not exceeded. If the equipment is designed to operate with different levels of carrier power, the rated output for each power level must be declared by the manufacturer.

1.53. SITE TRANSMISSION CHARACTERISTICS FOR VHF – FM BROADCASTING STATIONS[4]

1.54. Frequency Aspects
The equipment shall be adjusted to operate on the assigned frequency in the frequency band 87.5 to 108 MHz only.

1.55. The frequency tolerance of the main carrier shall be:

- ±2 kHz, for transmitters of mean power greater than 17 dBW.

- ±3 kHz, for transmitters of mean power less than or equal to 17 dBW.

1.56. The transmit-frequency shall be derived from a crystal-oscillator. If use is made of a synthesiser and/or a phase locked loop system, the transmitter shall be inhibited when synchronisation is absent. The transmitter frequency adjustment control shall be accessible to qualified personnel only.

1.57. Maximum Permitted Levels of Spurious Emissions
The maximum permitted level of spurious emission for a transmitting station shall be:

- 40 dB below the licensed E.R.P. for a transmitting station E.R.P. equal to or less than 4 dBW;
- 250 µW E.R.P. for a transmitting station E.R.P. greater than 4 dBW and less than 49 dBW;
- 85 dB below the licensed E.R.P. for a transmitting station E.R.P. equal to or greater than 49 dBW.

1.58. These limits must be adhered to for the frequency range 87.5 to 137 MHz.

1.59. A band pass filter, which provides a minimum attenuation of 60 dB at frequencies outside the VHF-FM broadcasting band, shall be fitted. At frequencies close to the band edges where 60dB attenuation is more difficult, the Licensee may request that an alternative attenuation be permitted, subject to agreement with the Commission.

[4] ETS 300 384 (1995) is the applicable VHF-FM transmitter standard from the European Telecommunications Standard Institute.

1.60. Designation of Emission and Maximum Permitted Bandwidth

1.61. The bandwidth of the radiated signal shall not exceed 270 kHz. The emission shall comply with the following designation :-

- 270KF9EHW for Stereophonic;
- 270KF9EGW for Monophonic, where:

270K	=	Necessary bandwidth	=	270 kHz
F	=	Type of modulation	=	Frequency modulation
9	=	Modulating signal	=	Composite analogue/digital signal
E	=	Information type	=	Sound broadcasting
H	=	Broadcast quality sound (stereophonic)		
G	=	Broadcast quality sound (monophonic)		
W	=	Combination of frequency and time division multiplex		

1.62. Modulation Standards

In accordance with the Geneva 1984 Agreement, the transmission system used shall be either Monophonic or Stereophonic pilot tone system.

(a) Monophonic Transmission

The radio-frequency signal consists of a carrier, frequency modulated by the sound signal, after pre-emphasis, with a maximum frequency deviation of ±75 kHz.

(b) Stereophonic Transmission

The radio-frequency signal consists of a carrier, frequency modulated by a baseband signal according to the specifications of the pilot-tone system. The maximum frequency deviation is ±75kHz.

(c) Pre emphasis and low pass filter

The transmitter must be provided with a pre-emphasis filter with a time-constant of 50 microseconds, combined with a low-pass filter with an attenuation of at least 30 dB at an input modulation frequency of 20 kHz, relative to the level at 1 kHz.

1.63. It is possible, even while operating within the specified maximum deviation limit of ±75kHz, to infringe on the internationally agreed protection ratios used in planning. This is caused by a degree of audio processing resulting in an increase, beyond a reference level[5], of the average power contained within the multiplexed signal envelope integrated over 60 seconds. Where this occurs, the audio signal level must be adjusted, at the responsible station, so as to eliminate any such infringement. Alternatively, an e.r.p. restriction may be imposed by the Commission.

1.64. Permitted subcarriers for the transmission of supplementary information

The addition of a sub-carrier on 57 kHz for the transmission of supplementary information using the Radio Data System (RDS), as specified in I.S. EN 62106 : 2009, is considered as being included in the above Designation of Emission and Permitted Bandwidth. The standard is available from the National Standards Authority of Ireland. Only certain features of this system are licensed[6]. The Licensee

[5] As per ITU-R BS.412-9 or as subsequently amended

[6] An updated list of approved features shall be provided to the Licensee by the Commission on request.

shall provide a completed Certificate of Compliance[7] to the Commission within one month of the commencement of transmission of RDS features.

1.65. RF Output Impedance

The RF output ports of the transmitter and associated equipment shall be capable of interfacing with equipment whose input impedance is 50 ohms.

1.66. Vertically Radiated Power

Due to the proximity of the VHF-FM radio broadcasting band to frequency bands used by aeronautical services, it is important, in the interests of safety, that the power radiated in the vertical direction is restricted. This applies to the entire country due to the nature of the aeronautical services involved. Therefore, the minimum limits, contained in table 1.0, for the vertical aperture of the transmitting antenna shall be complied with. For an effective radiated power of less than 30 dBW, a correction factor may apply, which allows the use of a single dipole. This will be applied by the Commission, and specified on the licence, when appropriate.

Maximum Total E.R.P.	Vertical aperture in Wavelengths
44 dBW <= E.R.P.	8
37 dBW <= E.R.P. < 44 dBW	4
30 dBW <= E.R.P. < 37 dBW	2
E.R.P. < 30 dBW	1

Table 1.0: Minimum limits for Vertically Radiated Power

1.67. **MINIMUM FIELD STRENGTH**

1.68. The minimum field strengths used in planning are:

1) +73dB(µV/m) for LF (150 kHz to 285 kHz)

2) +60dB(µV/m) for MF (525 kHz to 1605 kHz)

3) +54dB(µV/m) for band II Stereo (87.5 MHz to 108 MHz)

4) +48dB(µV/m) for band II Mono (87.5 MHz to 108 MHz)

1.69. The VHF values are for 10 metres above ground level.

1.70. Protection cannot be sought for locations with a field strength below the above mentioned values.

[7]The Certificate of Compliance form is contained at Annex 3. In some cases only the sections of a certificate relevant to RDS operation may be necessary.

1.71. STATION CERTIFICATION AND MAINTENANCE

1.72. Access and Personnel

Only authorised personnel shall have access to the Transmission Equipment for the purpose of adjustment or maintenance of that equipment. The Licensee shall ensure that all authorised personnel are adequately trained for the functions they are to undertake.

1.73. Examination and Testing

When the installation of equipment is complete the Licensee shall inform the Commission and seek permission for on-air testing. Permission for on air testing prior to the examination and commencement of regular service can be obtained. On-air testing shall not be carried out with real programme material but with loop-around of sample programming not lasting more than fifteen minutes. The Licensee shall then examine the station and complete a Certificate of Compliance, contained in Annex 3. This will be maintained by the Licensee. The Licensee, when ready to commence operations, shall inform the Commission of the date of commencement of operations, indicating that the station is operating in accordance with the specified conditions and characteristics of the licence.

1.74. Maintenance

The transmission installation shall be so maintained as to always comply with these conditions. The Licensee and/or the sound broadcasting contractor where appropriate shall ensure that a suitably qualified person has the necessary technical training, knowledge and practical experience so as to be able to certify that the installation and maintenance of the station complies with these conditions. The Licensee and/or the sound broadcasting contractor where appropriate shall examine each station annually to ensure compliance and shall keep a log indicating dates and results of these examinations. In the case of sound broadcasting contracts, the BAI will audit such stations on a regular basis and will agree its approach for such audits with the Commission.

1.75. Time Limit

A maximum period of one year will be allowed from the date of amendment of a licence for an amended station to come on air and the procedures outlined in this section to be completed. If a certificate of compliance has not been forwarded to the Commission within this period the approval for the station in question may be revoked by the Commission.

1.76. ADDITIONAL AND MODIFIED ASSIGNMENTS

1.77. Requisite Information

The Licensee shall provide the Commission with all the necessary details in support of an application for an additional assignment or a modification of an existing assignment. The standard information required is contained in Annex 1.

1.78. Examination

The Licensee shall have regard, in preparation of an application for an additional or modified assignment, to other Licensees having assignments in the same frequency segment and make an examination of the compatibility of the assignments. A report of this examination shall be provided to the Commission at the time of making an application.

1.79. Field Strength Measurements

It may be necessary to supply field strength measurements in support of an application or an interference complaint. In relation to VHF, these measurements shall be supplied in accordance with the procedures outlined in Annex 2.

1.80. International Agreements

The Commission is bound by the provisions of the Radio Regulations and various Regional Radiocommunications Agreements, including but not limited to the the Geneva 1975 Agreement, the Geneva 1984 Agreement and the LEGBAC Memorandum of Understanding[8]. These agreements require the Commission to undertake certain co-ordination and registration procedures when considering additions or modifications of the assignment plan.

1.81. A minimum of three months is allowed for co-ordination. However, co-ordination of additional or modified assignments cannot be guaranteed. The Licensee shall allow adequate time in planning and provide the Commission with the relevant information to ensure compliance with these agreements.

[8] Limited Exploratory Group on Broadcasting to Aeronautical Compatibility. Memorandum of Understanding signed at the World Administrative Radio Conference, 1992.

ANNEXES

Annex1

Information for the Addition / Modification of a sound broadcasting assignment

1 Frequency (MHz/kHz):

2 Name of Transmitting Station:

3 Geographic Co-ordinates:

4 National Grid Reference:

5 Altitude of Site above Sea Level (m):

6 Height of Antenna above Ground Level (m):

7 Polarization:

8 Total Effective Radiated Power (dBW):

9 Maximum Horizontal ERP (dBW):

10 Maximum Vertical ERP (dBW):

11 Directivity of Antenna (D or ND):

12 Map, Ordnance Survey Maps such as the “Discovery Series" or equivalent are acceptable, outlining the intended service area. The map shall outline the complete area to be served by the programme service requiring the additional or modified assignment, where appropriate.

Annex2

Standardised Procedure for Making Field Measurements of Signals Radiated from VHF and UHF Broadcasting Transmitters

Location of Tests

1. The precise location of the selected test point should be noted on a map. The scale of the map should be large enough to allow a national grid reference, accurate to 100m, to be easily read.

2. A general description of the test point vicinity should be noted (i.e. urban, suburban, rural, mountains, flat etc).

3. Particular note should be made of obstructions, if any, in the vicinity that may obscure the line of sight from the selected test point to a particular transmitter.

4. The test point should be selected as far as possible, so as to minimize electrical interference from ESB power lines, heavy traffic or high-power industrial electrical apparatus.

Taking Measurements

1. **Height of Antenna above ground level (agl)**
   The internationally accepted reference height, used in VHF and UHF broadcast planning, for field strength values is 10 metres agl.

2. **Horizontal separation distance of the antenna from the mast**
   The antenna should be separated a suitable distance from the mast. This minimises any distortive effects on the specified antenna gain pattern which may be caused by the proximity of the mast. A separation distance of at least one quarter wavelength between the antenna and the mast is recommended.

3. **Cable Loss**
   Cable loss should be taken into account

4. **Voltage Standing Wave Ratio (VSWR)**
   The VSWR of the antenna should be measured, for the frequency range in question, using a VSWR meter. This is done to verify the antenna impedance is matched to that of the cable. The VSWR should be between 1.0 and 1.5.

   A form to plan and record measurements has been drawn up and is contained below.

5. **Conversion Formulae**

Equations for the conversion of voltage values to electric field strength values are contained in below.

Equations for conversion of voltage values to electric field strength values :

$$E = 4 * (\Pi / \lambda) * \sqrt{((30 * V^2) / (R * G))}$$

where

E = Electric Field Strength (volts/metre)
Π = 3.14159
λ = Wavelength of transmitted signal (metres)
V = Measured Voltage Reading (volts)
R = Input Impedance (50 ohms)
G = Receiving Antenna Gain (Linear Ratio)

$$E_{dB\mu V/m} = 20 * Log_{10} E_{\mu V/m}$$

Alternatively,

$$E_{dB\mu V/m} = V_{dB\mu V} + 20 * Log_{10}(F_{MHz}) - G_{rx} + L_{dB} - 29.78$$

where

F = Frequency
L = Feeder losses

Date: **Sheet No.**

MEASUREMENTS

Downlead (Uncorrected) Values

Antenna Details:		
Type:	Height (m):	Gain (dB):
	Polarization:	VSWR:
Cable Loss at 100 MHz (dB):	Cable Loss at 200 MHz (dB):	
Cable Loss at 600 MHz (dB):	Cable Loss at 800 MHz (dB):	
Measuring Instrument Used:		

Test Point

NGR: Description:	NGR: Description:	NGR: Description:

Transmitter Site	Description of Terrain in Transmitter Direction			
Station	Freq (MHz)	Signal Level (dBµV)		

Transmitter Site	Description of Terrain in Transmitter Direction			
Station	Freq (MHz)	Signal Level (dBµV)		

Date: **Sheet No.**

Test Point

NGR: Description:	NGR: Description:	NGR: Description:

Transmitter Site	Description of Terrain in Transmitter Direction			
Station	Freq (MHz)	Signal Level (dBµV)		

Transmitter Site	Description of Terrain in Transmitter Direction			
Station	Freq (MHz)	Signal Level (dBµV)		

Transmitter Site	Description of Terrain in Transmitter Direction			
Station	Freq (MHz)	Signal Level (dBµV)		

Annex 3

Certificate of Compliance

Programme Service Name _____

Name of Transmitter site _____

Transmitter Site National Grid Reference _____

Frequency (MHz/kHz) _____

On-Air date _____

Transmitter:

Operating Output RF Power of transmitter
FM sound carrier unmodulated carrier _____
AM sound carrier unmodulated carrier _____
Vision Carrier peak envelope power _____

Measured Frequency of transmitter
AM or FM Sound Carrier _____
Vision Carrier _____

Measured Frequency Deviation at 100 % Modulation _____
(FM sound carrier only)

Measured Maximum Bandwidth of Transmission _____

Measured Maximum Spurious Emission Level _____

Height of Antenna (above ground level) _____

Polarization _____

Aperture of Antenna in Wavelengths _____

Maximum Gain of Antenna _____

Azimuth of preferred Orientation (if N.D.) _____

Azimuth of Maximum Gain (if D) _____

Feeder, Transformer / Harness Loss (dB) _____

Describe any filtering or isolation equipment fitted between the Transmitter output and the Antenna system

_____
_____
_____
_____

I hereby certify that this station complies with the licence characteristics and conditions as issued by the Commission for Communications Regulation.

Signed _____ Date _____
on behalf of _____

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Commission for
Communications Regulation

Technical Conditions

Digital Video Broadcasting Terrestrial (DVB-T) Network Technical Conditions attached to a Digital Terrestrial Television (DTT Licence)

Document No:	**07/90b**
Date:	**09 Novemer 2007**

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Contents

1 General

1.1 Purpose

This document specifies characteristics for the operation of a Digital Video Broadcasting Terrestrial (DVB-T) transmission network under a Digital Terrestrial Television (DTT) Licence.

1.2 Summary Information

These conditions detail the characteristics of the equipment that must be considered in order to ensure that services are provided to subscribers, in a safe manner. They do not include detailed equipment specifications.

These conditions also detail those characteristics relevant for ensuring compatibility with other authorised users of the radio frequency spectrum.

The parameters specified in this document are based on harmonised European Standards as revised: including those given in ETSI and CENELEC documents: ISO/IEC 13818-1, 2, 3, ISO/IEC 14496 for coding standards, EN 300 744 and TR 101 190 for the transmission standards.

For conditions not referred to by this document, the licensee shall comply with standards set out in any relevant ETSI (European Telecommunications Standards Institute), IEC (International Electrotechnical Committee) or CENELEC (Comité Européen de Normalisation ELECtrotechnique) standard relating to DVB-T.

The conditions specified in this document may be revised and/or added to from time to time.

1.3 Definitions

ComReg

Commission for Communications Regulation.

Conditional Access Service Provider

A provider of conditional access services or operator of conditional access systems.

Conditional Access System/Service

A system or service or any part thereof controlling access to digital television services, so that only authorised subscribers receive such services. This includes *Encryption Services*, that is to say, any encryption of signals for digital television services; and the conveyance by such a system of encryption information.

Digital Multiplex

A signal (which in its baseband form is a DVB transport stream, but is a signal with a bandwidth of 8 MHz in UHF and 7 MHz in VHF Band III, when modulated) containing one or more than one programme service, with associated and other data.

Digital Terrestrial Television System (DTT)

A Digital Terrestrial Television System (DTT) is a system used for the transmission of a modulated data stream containing Digital Multiplexes in the broadcasting bands III, IV and V intended for direct reception by the general public.

Effective Radiated Power (e.r.p.) (in a given direction)

The product of the power supplied to the antenna and its gain in a given direction relative to a half-wave dipole. This is usually expressed in decibels relative to one watt (dBW).

Electronic Programme Guide (EPG)

Electronic Programme Guide is the means by which a user can navigate around the supplied services.

Encryption

A method of encoding a Programme Service, such that it is only available to subscribers who are authorised to avail of such a service.

European Standards Body

A body such as ETSI, the IEC or CENELEC, which sets standards for equipment or services.

Licensee

Means the holder of a DTT licence or any party to whom the benefits and obligations of the Licence have been assigned to.

Multiplex Contractor

Provider of the programme service multiplex, under a Broadcasting Commission of Ireland Multiplex Contract.

Omni directional Antenna.

An antenna having a horizontal radiation pattern with variations of 2 dB, or less, over 360 degrees.

Programme Redistribution Operator

The operator of a system for the retransmission or relay of programme service multiplexes on a point-to-multipoint basis over-the-air or by cable.

Programme Service Multiplex (Multiplex)

A signal containing one or more than one Programme Service, with associated and other data.

Programme Service Provider

A compiler of programme content into a programme service.

Set Top Box

A device, which can receive and demodulate fully a scrambled Programme Service, which when a normal television is connected to it enables a subscriber to view such a service.

Station

One or more transmitters or receivers, or a combination of transmitters and receivers, including the associated equipment necessary, at one location for implementing a digital terrestrial television system.

Subscriber Authorisation Services

The means to actuate or control remotely or otherwise decoders or any other such device or the initial transmission of messages connected with the aforesaid.

Subscriber Management Services

The preparation and/or supply to subscribers of essential components, or the preparation from subscribers' orders of instructions for authorisation signals, for transmission to decoders, or both.

Technical Services

Those detailed in the definitions for Subscriber Management Services or Subscriber Authorisation Services or any part thereof which is of a technical nature, which prevents the digitally transmitted services of the Programme Service provider, or the Programme Service Multiplex provider, being accessed by subscribers.

Trans-control

The means whereby, upon payment of any relevant charges, a Programme Redistribution Operator may access Programme Services and retransmit them, using their own Technical Services.

Transport Stream

A data stream corresponding to the relevant ETSI (DVB) standards carrying MPEG encoded video and associated or other data.

1.4 System Engineering:-

1.4.1 General

The mechanical and electrical construction of the installation shall be in accordance with best practice.

The practice of good system engineering is a necessary requirement to ensure the provision of a high quality service and the minimising of the potential for interference to, or from, radiocommunication services operating in accordance with the Irish Table of Frequency Allocations.

1.4.2 Controls

Controls which, when wrongly adjusted, change the system parameters, increase the risk of interference or cause improper functioning of the transmitter and other appropriate equipment, shall be immediately accessible to qualified personnel only.

1.4.3 Manufacturer's Identification.

The equipment shall be labelled with the manufacturer's trademark, type designation and serial number.

1.4.4 Weather Protection.

All apparatus and cables exposed to weather, corrosive atmosphere, or other adverse conditions shall be so constructed, or protected, as may be necessary to prevent danger, or interference, arising from such exposure.

1.5 Installation Certification and Maintenance:-

1.5.1 Access and Personnel

The licensee shall, on a request made by an authorised officer of ComReg, facilitate that officer in the inspection[1] of any part of the multiplex or digital terrestrial television system installation.

Only authorised personnel shall have access to the multiplex or digital terrestrial television system for the purpose of adjustment and/or maintenance of that equipment.

The licensee shall ensure that all authorised personnel are adequately trained for the functions they are to undertake.

1.5.2 Examination and Testing

When the installation of equipment is complete, the licensee shall examine the station and indicate to ComReg whether the installation is ready to commence operation in accordance with these conditions. Permission for on-air testing prior to the examination and commencement of regular service can be obtained.

On commencement of operation, the licensee shall inform ComReg of the date of commencement and provide certification indicating that the station is operating in accordance with the specified conditions and characteristics.

[1] Inspection shall include the undertaking of measurements.

1.5.3 Maintenance

The digital multiplex and digital terrestrial television system installation shall be so maintained as to always comply with these conditions. The licensee shall ensure that a suitably qualified person has the necessary technical training, knowledge and practical experience so as to be able to certify that the installation and maintenance of the installation complies with these conditions. The licensee shall ensure that the installation is examined annually to ensure compliance and a log shall be kept indicating the dates and results of these examinations.

2 System Standards:-

2.1 Software Updates and Encryption:-

Changes to software and/or services, should be implemented 'over the air' with the data in the form dictated by EN 301 192 conforming to TS 102 006.

Encryption data may be included in the Transport Stream to enable only authorised subscribers to view certain programmes.

2.2 Additional Broadcasting Services:-

2.2.1 Permitted Additional Broadcasting Services

The transmission of; subtitling, EPG, Sound Broadcasting Services or teletext services are permitted[2].

Any data carried which is an integral part of the programme shall conform to the methods described in EN 301 192[3] and observe the guidelines referenced in TR101 202 and TR 101 211. The subtitling system used must conform to EN 300 743 or any future European standard describing the implementation of such services. 'Over the air' software updates to set top boxes conforming to TS 102 006 are also permitted.

2.2.2 Non-Programme Related Data

The provision of data services and internet on a Transport Stream should be secondary to the provision of programme services (both television and Sound Broadcasting). However, where there is residual capacity in a Transport Stream it may be used for non-broadcast related purposes subject to the following limit; Non Programme Related Data may comprise no more than 20 percent of the capacity of each Transport Stream at any one time, subject to a cumulative maximum of 15 percent in any 24 hour period.

[2] These services include and are not limited to, sound broadcasting services, closed caption signing, audio description, multi-channel or alternative language audio, interactive programme features and in general enhanced content related to the programme service.

[3] For Reasons of spectrum efficiency Time Slicing is not permitted.

2.3 DTT Transmission characteristics

2.3.1 Transmission Standard

The Transmission Standard used shall be the DVB-T standard as specified in EN 300 744.

2.3.2 Summary List of Parameters:-

MPEG 2 Encoding Standards

System	ISO/IEC 13818-1
Video *	MPEG 2 Main Profile, Main Level, ISO/IEC 13818-2
Audio	MPEG 2 layer I and II, ISO/IEC 13818-3
Audio (Sound Broadcasting Services)	ISO/IEC 13818-3[5] (MPEG-1 Layer 2)
Data (Additional services for general reception)	EN 301 192
Data (Additional services for closed user groups)	EN 301 192
Technical Services (CA Message sections)	TR 101 289

**Note: Higher levels and profiles may be used for the provision of HDTV.*

MPEG 4 Encoding Standards

System	ISO/IEC 13818-1
Video *	ISO/IEC 14496-10, MPEG4 High Profile, Level 4.0 or Main Profile, Level 3.0
Audio	ISO/IEC 14496-3, HEAAC
Audio (Sound Broadcasting Services)	ISO/IEC 13818-3[5] (MPEG-1 Layer 2)
Data (Additional services for general reception)	EN 301 192
Data (Additional services for closed user groups)	EN 301 192
Technical Services (CA Message sections)	TR 101 289

Other Video and Audio Parameters

SD Video Frame rate	25 or 50Hz
SD Aspect Ratio	4:3 or 16:9
SD Resolution	720 x 576
Audio Sampling Frequency	48kHz
Emphasis	None
HD Video Frame rate	25 or 50Hz
HD Aspect Ratio	4:3, 14.9or 16:9
HD Resolution	1920 x 1080
Audio Sampling Frequency	48kHz
Emphasis	None

2.3.3 Frequency Spacing and Bands of Operation

Nominal radio-frequency channel bandwidth occupied by a modulated Digital Multiplex for UHF:- Band IV and V	8MHz
Nominal radio-frequency channel bandwidth occupied by a modulated Digital Multiplex for VHF:- Band III[4]	7MHz

2.3.4 Modulation

Modulation (COFDM)	X7F
Number of carriers[5]	6817
Carrier Modulation	16QAM or 64QAM
Guard Interval (Single Frequency Network)* (Multi Frequency Network or SFN where the inter-station distance is less than 8.5km)	1/8 to 1/32
Forward Error Correction (FEC) [6]	All

**Note: Where a station that is a member of an SFN loses synchronisation, then the output of that station should be reduced by 6dB, or the station should cease transmission, to avoid interference with the remaining synchronised stations.*

[4] Band III may be considered post analogue switch off.
[5] For reasons of spectrum efficiency the use of the 2k and 4k DVB-T modes is not permitted.
[6] For Reasons of spectrum efficiency the use of Multi-Protocol Encapsulation Forward Error Correction (MPE-FEC) as specified in EN 301 192 is not permitted.

2.3.5 Emission Designation

UHF Band IV and V (470 to 862MHz)	8M00X7FXF
VHF Band III (174 – 230MHz)	7M00X7FXF

3 System Performance:-

3.1 Planning Criteria

The performance limits set out in this section apply in the presence of all signals for which the Digital Terrestrial Television System was designed.

There are three main forms of visible interference in a digital television signal. These are exhibited by artefacts; such as an absence of picture, freezing of frames and blocking (where the picture turns into course blocks).

The signal should be free from all such interference for 95% of the time at 50% of locations served for an ITU-R 601 Grade 4[7] service.

3.2 Frequency Stability

The equipment shall be designed to operate on the assigned frequency in the frequency Bands III, IV and V only.

The frequency tolerance shall be

Fs = Bw/100N

Fs	Frequency Stability
Bw	Bandwidth (8 MHz or 7 MHz)
N	No of carriers

Or

- ± 250 Hz, for transmitters for which the licence characteristics do not require the use of offset and are part of a Multi Frequency Network.

- ± 1 Hz, for transmitters for which the licence characteristics require the use of offset or are part of a single frequency network

The transmitter frequency adjustment control shall be accessible to qualified personnel only.

3.2.1 Power

As the total effective radiated power is the sum of the transmitter output power (in dBW) and the gain of the antenna (in dB), the output power of transmitter shall be adjustable so that the value of the effective radiated power permitted for each station is not exceeded.

If the equipment is designed to operate with different levels of power, the rated output power for each power level must be declared by the manufacturer.

[7] Impairments are perceptible but not annoying

3.3 Maximum Permitted Levels of Spurious Emissions

The maximum permitted level of spurious emission for a transmitting station shall be:-

- at least 40 dB below the transmitter e.r.p. and shall not in any case:-
  exceed -46 dBW for a transmitter e.r.p. less than, or equal to, 14dBW.

- at least 60dB below the transmitter e.r.p. and shall not in any case:-
  exceed -17 dBW for transmitter e.r.p. above 14 dBW.

3.4 Overview of National Band Plan:-

3.4.1 Frequency Channels and Standard Groups

The frequency bands for broadcasting are bands III, IV and V.

Due to the phased development of the Digital Terrestrial Television System, a station may initially have coverage in excess of the planned service area. With the introduction of additional stations, it is to be expected that this extended service area will be reduced.

3.4.2 Assignment List

A list of the Assignments, which constitute the national plan, will be maintained by ComReg.

3.4.3 Planning Parameters

The planning parameters used by ComReg correspond to those set out in the Final Acts of the Regional Radiocommunication Conference for planning of the digital terrestrial broadcasting service in parts of Region 1 and 3, in the frequency bands 174 – 230 MHz and 470 – 862 MHz, Geneva 2006 (GE06). This was a conference convened by the ITU. A summary of these parameters is given in Appendix A

3.4.4 Additional and Modified Assignments:-

3.4.4.1 Requisite information

The licensee shall provide ComReg with all the necessary details in support of an application for an additional assignment, or a modification of an existing assignment.

3.4.4.2 Examination

The licensee shall examine any proposal for an additional, or modified, assignment with regard to other persons having assignments in the same frequency segment.

3.4.4.3 Field Strength Measurements

It may be necessary to supply field strength measurements in support of an application or an interference complaint.

3.4.4.4 International Agreements

ComReg is bound by the provisions of the Radio Regulations and the Final Acts of the Regional Radiocommunication Conference for planning of the digital terrestrial broadcasting service in parts of Region 1 and 3, in the frequency bands 174 – 230 MHz and 470 – 862 MHz, Geneva 2006 (GE-06) in relation to aspects of UHF and VHF Band III broadcast television services. These agreements require ComReg to undertake certain co-ordination and registration procedures when considering additions / modifications of the assignment plan.

A minimum of three months is allowed for co-ordination. However, co-ordination of additional or modified assignments cannot be guaranteed. The licensee shall allow adequate time in planning, and provide ComReg with the relevant information, to ensure compliance with these agreements.

3.4.5 Information to be submitted to ComReg:-

3.4.5.1 Update of System Information

The licensee shall, upon request from ComReg, submit in a format specified by ComReg:

- an up to date frequency plan indicating the Digital Multiplex on any given frequency channel.
- An updated network diagram/map of their system, clearly indicating the most up to date geographical area of operation of their DVB-T transmission network and
- Any additional information required by ComReg within 21 days of the receipt of the request.

4 Conditions for the Operation of Conditional Access Systems:-

4.1 Condition 1; Conditional Access Standards:-

Licensees in the State, intending to use the above Conditional Access Systems as defined or part thereof, must use either of the systems referred to in subparagraph a) or b) below.

a) Multicrypt technology, as specified in CENELEC standards EN50221 and R 206001.
b) Simulcrypt technology, as specified in ETSI standards TS 101 197-1, 101 197-2.

Licensees must ensure that any Set Top Box offered for sale, lease or rent by them or their agents is fully labelled to indicate the equipment functionality and that all user manuals clearly document any limitations of the equipment.

4.2 Condition 2; Service Obligations for Conditional Access Service Providers:-

4.2.1 Non Discrimination

Any Technical Services, in respect of the licensee's Conditional Access System, offered by the licensee to a programme service provider or a Multiplex Contractor shall be offered on a fair, reasonable and non-discriminatory basis.

4.2.2 Co-operation

If any Technical Service is provided under subparagraph 4.3.1 the licensee shall co-operate with the programme service provider or Multiplex Contractor and do whatever is required, within reason, to ensure the interconnection and or interoperability of the relevant system and all associated apparatus for provision and maintenance of Technical Services.

4.2.3 Proportionality of Incremental Expenditure

The licensee shall not cause the programme service provider or Multiplex Contractor to incur costs or incremental expenditure in interfacing with the licensee's apparatus or systems greater than the initial charge for the Technical Service or disproportionate to the benefit to be gained from the use of the Technical Services.

4.3 Condition 3, Cost Effective Trans-control:-

4.3.1 Effecting Trans-control

Where the licensee provides to a programme service provider or Multiplex Contractor any Technical Service in relation to the provision of digital video services; and the programme service providers or Multiplex Contractor's digital video services are provided to a programme redistribution operator for the purpose of redistribution;

The licensee shall co-operate with and assist the programme redistribution operator, providing all information and assistance necessary to facilitate cost effective trans-control, whereby the programme redistribution operator can trans-control and redistribute the digital video service using its own Technical Services.

4.3.2 Licensees Responsibility for Third Party Services

The licensee shall be responsible for third party services where the licensee does not provide any Technical Services but contracts a Conditional Access Service Provider to provide Technical Services in relation to the provision of programme services, which programme services are then provided to a programme redistribution operator for the purpose of redistribution.

Furthermore the licensee shall make all reasonable efforts to ensure that the Conditional Access Service Provider co-operates with and assists the programme redistribution operator, providing all information and assistance necessary to facilitate cost-effective trans-control, such that , whereby :-the programme redistribution operator can trans-control and redistribute the digital video service using its own Technical Services.

4.4 Prohibition on Linked Sales:-

4.4.1 Attachment of Conditions

The licensee or Conditional Access Service Provider shall not attach any condition on the provision of Technical Services where such condition requires the purchase of:-

a) another service from the licensee, except where the service is essential for the operation of the Technical Service requested; or

b) any apparatus or system, unless the requested Technical Service cannot be provide without such apparatus or system.

Appendix A – Planning Parameters

Table 1.0

Parameter	Description	Value used
Propagation using terrain data	Wanted Signal: Unwanted Signal, Domestic: Unwanted Signal, DVB-T and RBL[8]:	50% location, 50% time 50% location, 5% time 50% location, 1% time
Quality of service	Continuous Interference: Tropospheric Interference:	Grade 4 [9] Grade 3 [10]
Polarisation Discrimination	Domestic: RBL:	15 dB 20 dB

Table 2.0

Parameter	Description	Value used
Maximum Receive antenna directivity	Domestic: RBL:	16 dB 20 dB

Analogue television (for information)

Table 3.0

Parameter	Description	Value used
Analogue Protection Ratios	Co-channel, continuous	52 dB, no offset
		40 dB, 3/12 line offset
	Co-channel, tropospheric	45 dB, no offset
		30 dB, 3/12 line offset
	Lower Adjacent Channel	-9 dB, tropospheric
	Upper Adjacent Channel	-12 dB, tropospheric
	Image channel	-10 dB, tropospheric
	Local oscillator channel	-10 dB, tropospheric
Analogue Protection Ratios, with precision offset	Continuous, no offset	36 dB
	Tropospheric, no offset	32 dB
	Continuous, 3/12 line offset	27 dB
	Tropospheric, 3/12 line offset	22 dB

Table 4.0

Parameter	Description	Value used
Analogue, PAL I interfered with by DVB-T 8 MHz.	Co-channel, continuous	40 dB
	Co-channel, tropospheric	34 dB
Analogue vision signal interfered with by a DVB-T 8 MHz channel.	Lower adjacent, continuous	-5 dB
	Lower adjacent, Tropospheric	-9 dB
	Upper adjacent, continuous	-5 dB
	Upper adjacent, tropospheric	-8 dB

[8] Radio Broadcasting Link
[9] Grade 4: Perceptible, but not annoying
[10] Grade 3: Slightly annoying

Table 5.0

Parameter	Description	Value used
Analogue, PAL I interfered with by DVB-T 7 MHz.	Co-channel, continuous	41 dB
	Co-channel, tropospheric	35 dB
Analogue vision signal interfered with by a DVB-T 7 MHz channel.	Lower adjacent, continuous	-5 dB
	Lower adjacent, tropospheric	-9 dB
	Upper adjacent, continuous	-5 dB
	Upper adjacent, tropospheric	-8 dB

Digital Video Broadcasting – Terrestrial (DVB-T)

Table 6.0

Parameter	Description	Value used
Protection rations for co-channel DVB-T interfered with by DVB-T, for fixed reception.	16-QAM 1/2	11.00 dB
	16-QAM 2/3	14.00 dB
	16-QAM 3/4	15.00 dB
	16-QAM 5/6	16.90 dB
	16-QAM 7/8	17.50 dB
	64-QAM 1/2	17.00 dB
	64-QAM 2/3	20.00 dB
	64-QAM 3/4	21.00 dB
	64-QAM 5/6	23.30 dB
	64-QAM 7/8	24.30 dB

Table 7.0

Parameter	Description	Value used
Protection rations for co-channel DVB-T interfered with by DVB-T, for portable indoor reception.	16-QAM 1/2	13.00 dB
	16-QAM 2/3	16.00 dB
	16-QAM 3/4	18.00 dB
	16-QAM 5/6	19.40 dB
	16-QAM 7/8	20.10 dB
	64-QAM 1/2	19.00 dB
	64-QAM 2/3	23.00 dB
	64-QAM 3/4	25.00 dB
	64-QAM 5/6	25.80 dB
	64-QAM 7/8	26.90 dB

Table 8.0

Parameter	Description	Value used
Protection ratios for DVB-T interfered with by DVB-T.	Lower adjacent	-30 dB
	Upper adjacent	-30 dB

Table 9.0

Parameter	Description	Gauss	Value used
Protection ratios for DVB-T, fixed reception, interfered with by co-channel analogue television.	16-QAM 1/2	-8.0 dB	-8.0 dB
	16-QAM 2/3	-3.0 dB	0.0 dB
	16-QAM 3/4	0.0 dB	2.5 dB
	16-QAM 5/6	9.0 dB	10.3 dB
	16-QAM 7/8	16.0 dB	17.40 dB
	64-QAM 1/2	-3.0 dB	0.0 dB
	64-QAM 2/3	3.0 dB	4.5 dB
	64-QAM 3/4	9.00 dB	12.0 dB
	64-QAM 5/6	15.0 dB	16.30 dB
	64-QAM 7/8	20.0 dB	21.4 dB

Table 10.0

Parameter	Description	Gauss	Value used
Protection ratios for DVB-T, portable indoor reception, interfered with by co-channel analogue television.	16-QAM 1/2	- 8.0 dB	-8.0 dB
	16-QAM 2/3	- 3.0 dB	3.0 dB
	16-QAM 3/4	0.0 dB	5.0 dB
	16-QAM 5/6	9.0 dB	12.8 dB
	16-QAM 7/8	16.0 dB	20.0 dB
	64-QAM 1/2	- 3.0 dB	3.0 dB
	64-QAM 2/3	3.0 dB	6.0 dB
	64-QAM 3/4	9.00 dB	15.0 dB
	64-QAM 5/6	15.0 dB	18.8 dB
	64-QAM 7/8	20.0 dB	24.0 dB

Table 11.0

Parameter	Description	Gauss	Value used
Protection ratios for DVB-T, fixed reception and portable indoor reception, interfered with by lower adjacent (N – 1) analogue television.	16-QAM 1/2	- 43.0 dB	- 43.0 dB
	16-QAM 2/3	- 42.0 dB	- 42.0 dB
	16-QAM 3/4	- 38.0 dB	- 38.0 dB
	16-QAM 5/6	- 39.4 dB	- 39.4 dB
	16-QAM 7/8	- 38.9 dB	- 38.9 dB
	64-QAM 1/2	- 40.0 dB	- 40.0 dB
	64-QAM 2/3	- 35.0 dB	- 35.0 dB
	64-QAM 3/4	- 32.0 dB	- 32.0 dB
	64-QAM 5/6	- 32.0 dB	- 32.0 dB
	64-QAM 7/8	- 31.1 dB	- 31.1 dB

Table 12.0

Parameter	Description	Gauss	Value used
Protection ratios for DVB-T, fixed reception and portable indoor reception, interfered with by upper adjacent (N + 1) analogue television.	16-QAM 1/2	- 45.4 dB	- 45.4 dB
	16-QAM 2/3	- 43.0 dB	- 43.0 dB
	16-QAM 3/4	- 41.5 dB	- 41.5 dB
	16-QAM 5/6	- 40.4 dB	- 40.4 dB
	16-QAM 7/8	- 39.9 dB	- 39.9 dB
	64-QAM 1/2	- 40.2 dB	- 40.2 dB
	64-QAM 2/3	- 38.0 dB	- 38.0 dB
	64-QAM 3/4	- 36.4 dB	- 36.4 dB
	64-QAM 5/6	- 35.0 dB	- 35.0 dB
	64-QAM 7/8	- 34.1 dB	- 34.1 dB

Table 13.0

Parameter	Description	Gauss	Value used
Protection ratios for DVB-T (7 MHz), fixed reception, interfered with by overlapping 8 MHz analogue television.	16-QAM 1/2	- 5.8 dB	- 4.8 dB
	16-QAM 2/3	- 3.4 dB	- 2.3 dB
	16-QAM 3/4	- 1.9 dB	- 0.7 dB
	16-QAM 5/6	- 0.8 dB	0.5 dB
	16-QAM 7/8	- 0.3 dB	1.1 dB
	64-QAM 1/2	- 0.2 dB	0.8 dB
	64-QAM 2/3	2 dB	3.1 dB
	64-QAM 3/4	3.6 dB	4.8 dB
	64-QAM 5/6	5.0 dB	6.3 dB
	64-QAM 7/8	5.9 dB	7.3 dB

Table 14.0

Parameter	Description	Gauss	Value used
Protection ratios for DVB-T (7 MHz), portable indoor reception, interfered with by overlapping 8 MHz analogue television.	16-QAM 1/2	- 5.8 dB	- 2.6 dB
	16-QAM 2/3	- 3.4 dB	0.0 dB
	16-QAM 3/4	- 1.9 dB	1.7 dB
	16-QAM 5/6	- 0.8 dB	3.0 dB
	16-QAM 7/8	- 0.3 dB	3.7 dB
	64-QAM 1/2	- 0.2 dB	3.0 dB
	64-QAM 2/3	2 dB	5.4 dB
	64-QAM 3/4	3.6 dB	7.2 dB
	64-QAM 5/6	5.0 dB	8.8 dB
	64-QAM 7/8	5.9 dB	9.9 dB

Table 15.0

Parameter	Description	Value used
Protection ratios for DVB-T, fixed reception, interfered with by co-channel T-DAB.	16-QAM 1/2	16.00 dB
	16-QAM 2/3	19.10 dB
	16-QAM 3/4	21.20 dB
	16-QAM 5/6	21.90 dB
	16-QAM 7/8	22.50 dB
	64-QAM 1/2	21.00 dB
	64-QAM 2/3	25.10 dB
	64-QAM 3/4	27.20 dB
	64-QAM 5/6	28.30 dB
	64-QAM 7/8	32.40 dB

Table 16.0

Parameter	Description	Value used
Protection ratios for DVB-T, portable reception, interfered with by co-channel T-DAB.	16-QAM 1/2	18.20 dB
	16-QAM 2/3	21.40 dB
	16-QAM 3/4	23.60 dB
	16-QAM 5/6	24.40 dB
	16-QAM 7/8	25.10 dB
	64-QAM 1/2	23.20 dB
	64-QAM 2/3	27.40 dB
	64-QAM 3/4	29.60 dB
	64-QAM 5/6	30.80 dB
	64-QAM 7/8	35.00 dB

Minimum Field Strength

The minimum field strengths used in planning are:-

DVB-T, Band III (174 – 230 MHz)

Table 17.0

Parameter	Description	Value used
Minimum median field-strength values (dB(μV/m)) for fixed reception at reference frequency 200 MHz.	16-QAM 1/2	40.60
	16-QAM 2/3	43.10
	16-QAM 3/4	44.70
	16-QAM 5/6	45.90
	16-QAM 7/8	46.50
	64-QAM 1/2	46.20
	64-QAM 2/3	48.50
	64-QAM 3/4	50.20
	64-QAM 5/6	51.70
	64-QAM 7/8	52.70

Table 18.0

Parameter	Description	Value used
Minimum median field-strength values (dB(μV/m)) for portable indoor reception at reference frequency 200 MHz.	16-QAM 1/2	71.80
	16-QAM 2/3	74.40
	16-QAM 3/4	76.10
	16-QAM 5/6	77.40
	16-QAM 7/8	78.10
	64-QAM 1/2	77.40
	64-QAM 2/3	79.80
	64-QAM 3/4	81.60
	64-QAM 5/6	83.20
	64-QAM 7/8	84.30

DVB-T, Band IV/V (470 - 862 MHz)

Table 19.0

Parameter	Description	Value used
Minimum median field-strength values (dB(μV/m)) for fixed reception at reference frequency 500 MHz.	16-QAM 1/2	44.60
	16-QAM 2/3	47.10
	16-QAM 3/4	48.70
	16-QAM 5/6	49.90
	16-QAM 7/8	50.50
	64-QAM 1/2	50.20
	64-QAM 2/3	52.50
	64-QAM 3/4	54.20
	64-QAM 5/6	55.70
	64-QAM 7/8	56.70

Table 20.0

Parameter	Description	Value used
Minimum median field-strength values (dB(μV/m)) for portable indoor reception at reference frequency 500 MHz.	16-QAM 1/2	81.80
	16-QAM 2/3	84.40
	16-QAM 3/4	86.10
	16-QAM 5/6	87.40
	16-QAM 7/8	88.10
	64-QAM 1/2	87.40
	64-QAM 2/3	89.80
	64-QAM 3/4	91.60
	64-QAM 5/6	93.20
	64-QAM 7/8	94.30

The minimum median field-strengths given in the above tables 17 – 20 (above) are for reference frequencies, *fr*, 200 MHz (Band III) and 500 MHz (Band IV/V). For other frequencies, the following interpolation rule shall be used:-

$$E_{med\ (f)} = E_{med\ (fr)} + Corr$$

where:

$E_{med\ (fr)}$ The minimum median field strength at the reference frequency in dBµV/m,
$E_{med\ (f)}$ The minimum median field strength at the actual frequency in dBµV/m,

Fixed reception:-

Corr $Corr = 20 \log_{10} (f/fr)$, *f* is the actual frequency, *fr* is the reference frequency.

Portable reception:-
Corr $Corr = 30 \log_{10} (f/fr)$, *f* is the actual frequency, *fr* is the reference frequency.

The above values are for 10 metres above ground level for fixed reception.
Protection cannot be sought for locations with a field-strength below the values mentioned above.

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Commission for
Communications Regulation

Appendix B - Technical Conditions

Digital Sound Broadcasting Multiplex Licence - Technical Conditions

Document No:	**08/100a**
Date:	**12 December 2008**

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Contents

1 Purpose

This document specifies the general conditions attached to a licence for Digital Sound Broadcasting Systems in LF, MF, VHF band III and L band; including Digital Audio Broadcasting (DAB), DAB+ and Digital Radio Mondial (DRM).

2 Summary Information

These conditions detail the characteristics of the equipment that need to be considered for the purposes of frequency spectrum management, safety and the provision of a satisfactory service to the subscriber. They do not include detailed equipment specifications.

These conditions also detail those characteristics relevant for ensuring compatibility with other authorised users of the radio frequency spectrum.

The parameters specified in this document are mainly based on those given in European Telecommunications Standards Institute (ETSI) documents: EN 300-401, 300-797, 300-798, ETS 300-799, TS 102-563, 102-428 and ES 201-980.

For issues not referred to by this document, the licensee shall comply with standards set out in any relevant ETSI, International Electrotechnical Commission (IEC) or European Committee for Electrotechnical Standardization (CENELEC) standard relating to DAB, DAB+ or DRM.

The Commission for Communications Regulation does not require evidence of type approval of equipment. Instead a procedure of system audits will apply.

The conditions specified in this document may be revised and/or added to from time to time.

Nothing contained in these conditions shall absolve the licensee from any requirement in law to obtain whatever additional consents, permissions, authorisations, or licences that may be necessary for the exercise of entitlements under the licence.

3 Definitions

"Carrier to Noise ratio" means the difference in decibels between the carrier level at a given point in the system and the noise level at that point (measured within a bandwidth appropriate to the system in use).

"Commission" means the Commission for Communications Regulation.

"Digital Audio Broadcasting (DAB)" means a Digital Sound Broadcasting System in the broadcasting band III and L band in accordance with the relevant ETSI (DAB) standards and intended for direct reception by the general public.

"Digital Sound Broadcasting System" means a system used for the transmission of a modulated data stream containing Programme Services intended for direct reception by the general public.

"Digital Multimedia Broadcasting (DMB)" means a Digital Sound Broadcasting System in the broadcasting band III, in accordance with the relevant ETSI standards and intended for direct reception by the general public.

"Digital Radio Mondial (DRM)" means a Digital Sound Broadcasting System in the broadcasting bands LF, MF and HF, in accordance with the relevant ETSI standards and intended for direct reception by the general public.

"Effective Antenna Height (Eff. Ht.)" means the height in metres above the average level of the ground between distances of 3 and 15 km from the transmitter. This is calculated for each of 36 evenly spaced radials (10 degree separation) starting from true North[1].

"Effective Radiated Power (ERP)" means the product of the power supplied to the antenna and its gain in a given direction relative to a half-wave dipole. This is usually expressed in decibels relative to one watt (dBW).

"HE AAC" means High Efficiency Advanced Audio Coding, as specified in ISO/IEC 14496-3

"Ensemble" means a signal (which in its baseband form is a DAB Transport Stream, but is a signal with a bandwidth of 1.536 MHz when modulated) containing more than one programme service, with associated and other data.

[1] Note: This takes into account both the height of the site (a.s.l) and the height of the mast (a.g.l). This can be calculated by the Commission using the national grid reference for the transmitting station, consisting of one letter and six digits, provided the site height above sea level and the antenna height above ground level are supplied.

"European Standards Body" means a body such as the European Telecommunications Standards Institute ETSI, International Electrotechnical Commission (IEC) or European Committee for Electrotechnical Standardization (CENELEC), which specifies standards for equipment or services.

"Interference" means interference with the working of, or interference which otherwise injuriously affects, any apparatus for wireless telegraphy in respect of which a licence has been granted under the Wireless Telegraphy Acts 1926 to 1988 and is in force, or any apparatus for wireless telegraphy lawfully maintained or worked without any such licence or any broadcasting station maintained under Part II of the Act of 1926 or under the Broadcasting Authority Act, 1960;

"Licence" means a licence in respect of the establishment, maintenance and operation of a sound broadcasting multiplex issued by the Commission under the Broadcasting (Amendment) Act 2007, Wireless Telegraphy Acts 1926 to 1988 and, where relevant, under the Broadcasting Authority Act 1960 to which these Technical Conditions apply.

"Licensee" Means the holder of a Digital Sound Broadcasting Multiplex licence or any party to whom the benefits and obligations of the Licence have been assigned to.

"Multiplex" means an electronic system which combines programme material and related and other data in a digital form and the transmission of that material and data so combined by means of wireless telegraphy directly or indirectly for reception by the general public.

"Omnidirectional Antenna" means an antenna having a horizontal radiation pattern with variations of 2 dB, or less, over 360 degrees.

"Programme Service Provider" means a provider of sound broadcasting programmes.

"Programme Service" means a sound broadcasting programme.

"Sound broadcasting multiplex" means a multiplex in which the programme material is predominantly sound.

"Station" means one or more transmitters or receivers, or a combination of transmitters and receivers, including necessary associated equipment, at one location implementing a Digital Sound Broadcasting System.

"Transport Stream" means a data stream corresponding to the relevant ETSI standards carrying digitally encoded audio, associated and other data.

4 System Engineering

4.1 System Transparency

Unless specifically excluded by the Licence, the Digital Sound Broadcasting System shall be designed in such a manner that it is capable of relaying all components within a Programme Service[2] intended for general reception[3].

4.2 General

The mechanical and electrical construction of the Digital Sound Broadcasting System shall be in accordance with best practice.

Digital Sound Broadcasting System engineering and maintenance is necessary to ensure the provision of System Performance (see section 6) and to minimise the potential for interference to, or from, radio communication services operating in accordance with the Irish Table of Frequency Allocations

4.2.1 Transmitter Construction

All controls, meters, indicators and terminals shall be clearly labelled. Details of the main and any auxiliary power supply from which the equipment is intended to operate shall be clearly indicated. The equipment should be housed in one complete unit.

Controls which, when wrongly adjusted, increase the risk of causing interference, or of improper functioning of the transmitter, shall be immediately accessible to qualified personnel only.

The transmitter and associated equipment shall be labelled with the manufacturer's trademark, type designation and serial number. The label shall be fitted on the outside of the transmitter and associated equipment, and shall be clearly readable, non-removable and indelible.

4.2.2 Access and Personnel

The licensee shall, on a request made by an authorised officer of the Commission, facilitate that officer in the inspection[4] of any part of the Digital Sound Broadcasting System.

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[2] While not intended for reception by the general public, broadcast organisations include test signals in the Transport Stream. The Digital Sound Broadcasting System must be transparent to these signals so as to facilitate performance measurements.

[3] While the Digital Sound Broadcasting System shall be designed to relay all the components within an audio signal, the actual components relayed shall take account of the copyright arrangements between the licensee and the service provider.

[4] Inspection shall include the undertaking of measurements

Only authorised personnel shall have access to the Digital Sound Broadcasting Multiplex for the purpose of adjustment and maintenance. The licensee shall ensure that all authorised personnel are adequately trained for the functions they are to undertake.

4.2.3 Examination, Testing and Maintenance

Adequate and accurately calibrated test equipment shall be made available to the Commission, for non-radiative measurements of transmitter power, modulation characteristics and spurious emissions whilst the station is undergoing initial alignment and regular maintenance.

Permission for installation and commissioning transmissions prior to the examination and commencement of regular service can be obtained from the Commission. On commencement of operation, the licensee shall inform the Commission of the date of commencement and provide certification indicating that the station is operating in accordance with the specified conditions and characteristics.

The transmission installation shall be so maintained as to always comply with these conditions. The licensee shall ensure that a suitably qualified person has the necessary technical training, knowledge and practical experience so as to be able to certify that the installation and maintenance of the station complies with these conditions. The licensee shall examine a station annually to ensure compliance and shall keep a log indicating the dates, and results, of these examinations.

A copy of any maintenance programme and the log shall be made available to an authorised officer of the Commission upon request.

4.2.4 Weather Protection

All apparatus and cables exposed to weather, corrosive atmosphere, or other adverse conditions shall be so constructed, or protected, as may be necessary to prevent danger, or interference, arising from such exposure.

5 System Standards

5.1 DAB Transmission Standard

The Transmission Standard used shall be the DAB (Eureka 147) standard as specified in EN 300-401.

5.1.1 Frequency Spacing and Bands of Operation

Nominal radio-frequency channel bandwidth of an Ensemble	1.536MHz
Frequency Bands	III, and L

5.1.2 Modulation (band III)

Modulation (COFDM)	X7E
Number of carriers	1536
Carrier Modulation	QPSK,
Guard Interval*	246μS

5.1.3 Modulation (L band)

Modulation (COFDM)	X7E
Number of carriers	384
Carrier Modulation	QPSK,
Guard Interval*	62μS

**Note: Where a station is a member of a Single Frequency Network (SFN) and loses synchronisation, then the output of that station should be reduced by 6dB, or the station should cease transmission to avoid interference with the remaining synchronised stations.*

5.1.4 DAB Emission Designation

VHF Band III 1M54X7EXF
L Band 1M54X7EXF

5.2 DRM Transmission Standard

The Transmission Standard used shall be the DRM standard as specified in ES 201 980.

5.2.1 Frequency Spacing and Bands of Operation

Nominal radio-frequency channel bandwidth	9kHz
Frequency Bands	LF and MF

5.2.2 Modulation (LF)

Modulation (COFDM)	X7E
Number of carriers	204
Carrier Modulation	64QAM
Guard Interval	2.66mS

5.2.3 Modulation (MF)

Modulation (COFDM)	X7E
Number of carriers	204
Carrier Modulation	64QAM
Guard Interval	2.66mS

**Note: Where a station is a member of a Single Frequency Network (SFN) and loses synchronisation, then the output of that station should be reduced by 6dB, or the station should cease transmission to avoid interference with the remaining synchronised stations.*

5.2.4 DRM Emission Designations

LF 9KX7EXF
MF 9KX7EXF

5.3 Additional Broadcast Services

5.3.1 Format of Additional Broadcast Services

Additional broadcast services may be provided by the licensee in accordance with ETSI TS 102 427.

5.3.2 Additional Broadcast Services Requiring Authorisation

Licensees must seek the express prior approval of the Commission to use the services detailed in ETSI TS 102 428.

6 System Performance

6.1 Impairment Quality

The performance limits set out in this section applies in the presence of all signals for which an Ensemble or Multiplex serves.

There are three main forms of audible interference to a Digital Sound Broadcasting service. These are exhibited by audible artefacts, such as an absence of service, distortion and stereo image shift.

The signal should be free from these or other audible degradation for 99% of the time at 99% of locations served

6.2 Frequency Offset and Stability

In all cases the transmitter frequency adjustment control shall be accessible to qualified personnel only.

6.2.1 VHF Band III

A frequency offset of
$\mathbf{f_c \pm 1/T_u}$
may be used, where;
$\mathbf{f_c}$ is the centre frequency of the channel and
$\mathbf{T_u}$ is the usable part of the OFDM symbol.

The equipment shall be designed to operate on the assigned frequency in the appropriate frequency band only.

The frequency tolerance shall be

Fs = Bw/100N

Fs	Frequency Stability
Bw	Bandwidth
N	No of carriers

6.2.2 LF/MF

Fs<= 10Hz

6.3 Power

As the total effective radiated power is the sum of the transmitter output power (in dBW) and the gain of the antenna (in dB), the output power of transmitter shall be adjustable so that the value of the effective radiated power permitted for each station is not exceeded.

If the equipment is designed to operate with different levels of power, the rated output power, for each power level must be declared by the manufacturer.

6.4 Maximum Permitted Levels of Spurious Emissions

The maximum permitted level of spurious emission for a transmitting station shall be:

- LF/MF: 50dBc or not greater than 50mW;
- VHF Band III: 46+10log(P[5]), 60dBc or not greater than 1mW.

[5] P = mean power of the device.

7 Safety

7.1 General Safety and Safety Controls.

The Station and its premises must comply with all relevant statutory safety regulations.

There shall be a single control to isolate power for the entire installation. If a form of auxiliary power (such as diesel generators or an un-interruptible power supply) is provided, then the same control should isolate these. The 'on' position of such a device must be clearly indicated. Guards or key switches may be fitted to the device to prevent accidental operation.

7.2 Safety Standards

The system must comply with I.S./EN 60215: 1990 *Safety Requirements for Radio Transmitting Equipment*.

This standard is available from the National Standards Authority of Ireland.[6]

[6]Please note that the standard ENV 50166-2 is a European Pre standard and shall be replaced by the respective European Standard when it becomes available.

8 Information to be Submitted to the Commission

8.1 General

Upon receipt of a request from the Commission, the licensee shall provide the following:

- a complete and up-to-date frequency plan indicating, for each programme service in the Ensemble or Multiplex, the programme name, position and ID; and/or
- an updated network diagram or map of the Digital Sound Broadcasting System system, clearly indicating the most up to date geographical area of operation of it.

The licensee shall notify the Commission immediately following any change to the above.

8.2 Additional and Modified Assignments

8.2.1 Requisite information

The licensee shall provide the Commission with all the necessary details in support of an application for an additional assignment, or a modification of an existing assignment.

8.2.2 Examination

The licensee shall examine an application for an additional, or modified, assignment with due regard to other spectrum users, nationally and internationally, having assignments in the same frequency segment.

8.2.3 Field Strength Measurements

It may be necessary to supply field strength measurements in support of an application or an interference complaint received by the Commission.

9 Annex 1: Planning Parameters

9.1 LF / MF

DRM is designed to operate in accordance with the Regional Agreement, Geneva 1975 (GE75); DRM is required to operate with 7dB less power than the analogue station under GE75 which it replaces.

9.2 VHF Band III

In accordance with GE06

9.2.1 Protection ratio for DAB/DAB+ interfered with by DAB/DAB+

For DAB/DAB+ vis-à-vis DAB/DAB+, the protection ratio of 15dB shall be used.

9.2.2 Protection Ratios for DAB/DAB+ interfered with by DVB-T 8 MHz system

Table A1: Protection Ratios for DAB/DAB+ interfered with by DVB-T 8 MHz system

^f (MHz)	**-5**	**-4.2**	**-4**	**-3**	**0**	**3**	**4**	**4.2**	**5**
PR (dB) Mobile and Portable reception	-43	6	7	8	8	8	7	6	-43
PR (dB) Gaussian Channel	-50	-1	0	1	1	1	0	-1	-50

Note: Frequency separation (^f): centre frequency of the DVB-T signal minus centre frequency of the T-DAB signal.

9.2.3 Protection Ratios for DAB/DAB+ interfered with by DVB-T 7 MHz system

Table A2: Protection Ratios for DAB/DAB+ interfered with by DVB-T 7 MHz system

^f (MHz)	**-4.5**	**-3.7**	**-3.5**	**-2.5**	**0**	**2.5**	**3.5**	**3.7**	**4.5**
PR (dB) Mobile and Portable reception	-42	7	8	9	9	9	8	7	-42
PR (dB) Gaussian Channel	-49	0	1	2	2	2	1	0	-49

Note: Frequency separation (^f): Centre frequency of the DVB-T signal minus centre frequency of the DAB signal.

9.2.4 Protection ratios for DAB/DAB+ interfered with by analogue television system I/PAL (Band III)

Table A3: Protection ratios for DAB/DAB+ interfered with by analogue television system I/PAL (Band III)

^f(MHz)	**-8**	**-7.5**	**-7**	**-6.5**	**-6**	**-5.5**	**-5**	**-4.5**	**-4**
PR(dB)	-42	-23.5	-10	-3	-2	-3	-24	-21	-23
^f(MHz)	**-3.5**	**-3**	**-2.5**	**-2**	**-1.5**	**-1**	**-0.9**	**-0.8**	**-0.7**
PR(dB)	-31	-31.5	-30	-28.5	-25	-19.5	-17.5	-11	-7
^f(MHz)	**-0.6**	**0**	**0.6**	**0.7**	**0.8**	**0.9**	**1**	**2**	**3**
PR(dB)	-1.5	-1.5	-4	-5.5	-13.5	-17	-20	-33	-47.5

Note: Frequency separation (^f): Analogue system vision carrier frequency minus DAB centre frequency.

9.2.5 Protection ratios for analogue television (vision signals) interfered with by DAB/DAB+

Figure 1 and Table A4 give protection ratios for negative modulated vision signals interfered with by a 1.5 MHz wide COFDM signal according to the DAB/DAB+ system (see Recommendation ITU-R BS.1114). A reduction of 2 dB should be applied for positive modulated vision signal in the range from –1 MHz to 5 MHz.

Figure 1: Protection ratios for analogue television (vision signals) interfered with by DAB/DAB+

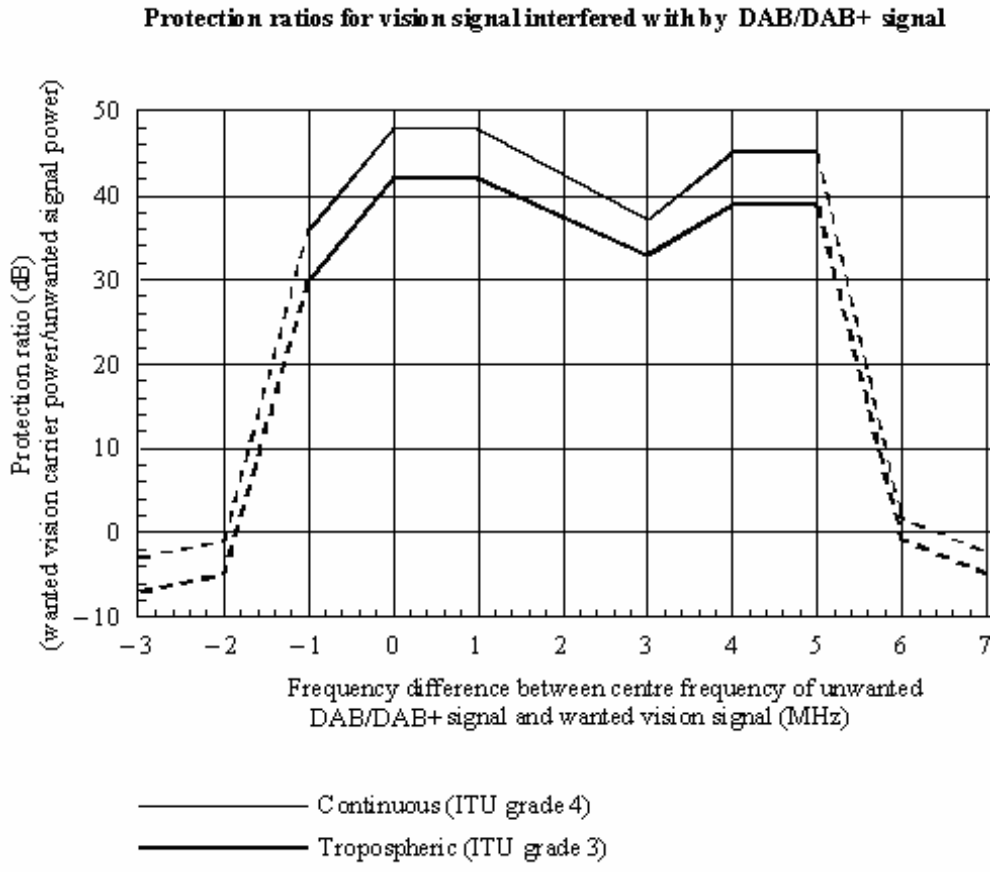

Table A4: Protection ratios for analogue television system I/PAL (Band III) interfered with by DAB/DAB+

Protection Ratio (dB)	Frequency difference between unwanted and wanted carriers (MHz)													
	Luminance Range							Chrominance range						
	-3.0	**-2.5**	**-2.0(1)**	**-1.0**	**0.0**	**1.0**	**3.0**	**4.0**	**5.0**	**6.0(2)**	**6.5(3)**	**7.0(4)**	**7.5(5)**	**8.0**
Tropospheric interference (T)	-7	-6	-5	30	42	42	33	39	39	-1	-3	-5	-7	-9
Continuous interference	-3	-2	-1	36	48	48	37	45	45	2	0	-2	-4	-6

(1) Only B/PAL, D1/PAL.

(2) Only B/PAL, D1/PAL.

(3) Only B/PAL, I/PAL.

(4) Only B/PAL, I/PAL, D/PAL, D1/PAL.

(5) B/PAL, I/PAL, D/PAL, D1/PAL.

9.3 L Band

In accordance with MA02revCO07

9.3.1 Intra-service (DAB interfered with by DAB)

Table A5: Intra-service (DAB interfered with by DAB)

	Protection Ratio (dB)	**Propagation Correction Factor to protect wanted T-DAB signals for 99% locations (dB)**	**Minimum median equivalent field strength (dBμV/m)**	**Maximum permissible field strength at contour of an allotment (dBμV/m)**
DAB interfered with by co-block DAB	10	18	69	41* based on (69 -10 - 18)
DAB interfered with by adjacent DAB block	-30	18	69	81* based on (69 -(-30) - 18)

***** In the case of Reference Network 2 and Reference Network 3 this value should be increased by 2 and 4 dB respectively.

RDS Features

Programme Identification (PI) Code (Hexadecimal)

Programme Service Name

Basic Features ☐ Group Types OA/OB, 15B, 14A/14B, 1A/1B and 4A including

Traffic Programme	Traffic Announcement,	Clock Time
Program Type	Music/Speech,	Decoder Information
Alternative Frequencies	Programme Item Number	Enhanced Other Networks

Alternative Frequencies	
Transmitter Site	Frequency

Enhanced Other Networks
by Pl Hexadecimal Code

Additional Features

Radio Text	*	Group Type 2A/2B
Transparent Data Channel	*	Group Type 5A//5B
In-House	*	Group Type 6A/6B
Radio Paging	*	Group Type 7A
Traffic Message Channel	*	Group Type 8A

* = authorised / not authorised

I hereby certify that this station complies with the licence characteristics and conditions as issued by the Commission for Communications Regulation.

Signed _____ Date _____

on behalf of _____