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Contents

Section 1: Foreword.....	4
1.1 Introduction	4
1.2 Scope.....	4
Section 2: Steering Board Decision	5
Section 3: Domestic Receiver Minimum Specification report	6

Section 1: Foreword

1.1 Introduction

- 1.1.1. The Digital Radio Action Plan (DRAP) sets out the process for allowing Government to make a well-informed decision on whether to proceed with a Radio Switchover, and if so how, it should be implemented.
- 1.1.2. The DRAP is delivered through four central working groups, covering technology, market preparation, coverage planning and government policy.
- 1.1.3 The Technology and Equipment Group (TEG) has been tasked to identify, investigate, report and make recommendations on the technology and equipment issues related to any future Radio Switchover, including both domestic and in-vehicle receivers. The priorities for TEG include the usability of radio devices, the development of a set of common specifications and testing regime to provide quality assurance to consumers. Due to the importance of digital conversion of car radios, there is a specific In-vehicle sub-Group which looks at the barriers to take-up and conversion options.
- 1.1.4. The TEG is chaired by Laurence Harrison, Technology and Market Development Director at Digital Radio UK. Membership of the TEG includes representatives from government, the BBC, Ofcom, trade bodies, manufacturers and consumer groups.

1.2 Scope

- 1.2.1. TEG was asked to define minimum radio receiver technical specifications for equipment for use with digital radio transmissions in the UK, which can be tested for compliance against specified test suites, and which are capable of underpinning any future certification scheme.
- 1.2.2 This report outlines the minimum technical specifications for domestic and personal DAB and DAB+ receivers. Some of these devices may also receive other digital radio services via alternative delivery platforms, such as the internet or digital television. This specification does not cover any element of a receiver designed to receive digital services via these alternative delivery platforms. This specification does, however, cover some aspects of analogue FM radio reception.
- 1.2.3 This report does not cover in-vehicle receivers, which is addressed in a separate report.

Section 2: Steering Board Decision

The Steering Board considered the Domestic Receiver Specification Report in Quarter 4 2012.

The Board agreed the minimum receiver specification report and the recommendations made by TEG. While a decision has yet to be made on a digital radio certification mark, it is the view of the Steering Board that the requirements for any such mark would be as set out in this report. However, the Board noted that it would be prudent to keep this specification under review, to ensure it remains relevant and reflects technological changes, but that no such view should commence for at least 18 months and any changes must reflect the principles of a 'minimum' specification.

The Board noted that the considerable work, including extensive consultation, which had gone into producing this report and the significant contribution broadcasters, manufacturers and DRUK have made to the process.

The minimum receiver specification report should be considered alongside the in-vehicle specification (which was agreed at the same meeting) and the conformance testing regime (which will be published in Q2 2013).

**UNITED KINGDOM
DIGITAL RADIO ACTION PLAN
TECHNOLOGY AND EQUIPMENT GROUP**

**MINIMUM SPECIFICATIONS FOR
DAB AND DAB+ PERSONAL AND
DOMESTIC DIGITAL RADIO RECEIVERS.
DRAP-TEG-002**



1 TABLE OF CONTENTS

1	Table of contents.....	7
2	Purpose of this specification	8
3	Background	8
4	Scope.....	9
5	Definitions.....	10
6	References	10
7	Frequency Range	10
8	RF Performance	11
9	DAB and DAB+ Channel Decoding.....	13
10	Analogue radio services	13
11	Functional Specifications	14
12	APPENDIX ONE Notes on Specifications.	16

2 PURPOSE OF THIS SPECIFICATION

This specification is written for producers, manufacturers, importers and retailers of DAB digital radio receivers who wish to sell products in the United Kingdom.

This specification is not compulsory for all receivers. It will be used to assess the eligibility of a product for use of the Digital Radio Switchover Certification Mark.

All reference to minimum specification is placed outside of boxes i.e. this paragraph does not directly reference the minimum specification.

3 BACKGROUND

The Digital Radio Action Plan (DRAP) has been set up by the UK Government to help in the decision making process leading up to Digital Radio Switchover. The DRAP is intended to enable the Government to decide how and when to deliver a Digital Radio Switchover.

The Technology and Equipment Group (TEG) was set up by the DRAP to focus primarily on consumer equipment. This task included the development of a set of common specifications to provide quality assurance to consumers. These documents include technical specifications for equipment used to receive digital radio transmissions in the UK.

The TEG, chaired by Laurence Harrison of Digital Radio UK (DRUK), comprises representatives from the Government, Ofcom, the Society of Motor Manufacturers and Traders, Intellect, the BBC, RadioCentre, Arqiva and consumer groups.

4 SCOPE

This specification details the requirements for domestic and personal DAB and DAB+ digital radio receivers.

For the purposes of this document such receivers are defined as devices that are not designed specifically for use within a vehicle. This specification covers devices which can receive terrestrially transmitted DAB and DAB+ digital radio services. Some of these devices may also receive other digital radio services via alternative delivery platforms, such as the internet or digital television. This specification does not cover any element of a receiver designed to receive digital services via these alternative delivery platforms. This specification does, however, cover some aspects of analogue FM radio reception.

This specification covers many types of receiver, including personal, pocket, portable and larger devices, and receivers incorporated in equipment such as mobile phones and computers. These devices may be mains powered, or battery powered, or both. They may have a telescopic antenna, a flexible wire antenna, a headphone antenna, an antenna integrated into the receiver or they may be supplied without an antenna. This specification covers devices whose primary function is to receive DAB and DAB+ digital radio services, and also devices which have one or more other functions in addition to receiving DAB and DAB+ digital radio services. This includes adaptors, whose main function is to add a DAB and DAB+ digital radio capability to another device.

5 DEFINITIONS

For the purposes of this document the word Receiver refers to a DAB and DAB+ Digital Radio Receiver unless stated otherwise.

For the purposes of this document the word Adaptor refers to a DAB and DAB+ Digital Radio Adaptor. An Adaptor is defined as a device that provides a DAB and DAB+ capability to another device, for example an analogue radio that does not have that capability.

6 REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

ETSI EN 300 401 Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to Mobile, Portable and Fixed receivers.

ETSI TS 101 756 Digital Audio Broadcasting (DAB); Registered Tables.

ETSI TS 102 563 Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio.

ETSI TR 101 496 Digital Audio Broadcasting (DAB); Guidelines and rules for implementation and operation; (Parts 1 and 2).

ETSI 300 384 Radio broadcasting systems; Very High Frequency (VHF), frequency modulated, sound broadcasting transmitters

BS EN 62104:2007 Characteristics of DAB Receivers.

ETSI TS 103 176 Digital Audio Broadcasting (DAB); Rules of implementation; Service information features

ETSI standards are available, free of charge, from www.etsi.org.

7 FREQUENCY RANGE

Receivers shall be capable of receiving DAB and DAB+ Digital Radio broadcasts in the frequency range 174 to 240 MHz. The centre frequencies of the transmitted signal complies with the preferred Band III frequencies specified in ETSI TR 101 496.

8 RF PERFORMANCE

8.1 BACKGROUND

Broadcast coverage planning is based on the assumption that a receiver has certain RF performance characteristics. These assumptions can be referred to as the "Receiver Model" and have been based on an assessment of receivers already in the market.

In order to be eligible to display a Digital Radio Switchover Certification Mark the receiver must have the same or better performance than the "Receiver Model" used in coverage planning. This required performance is described in the sections below.

All references in this document to "Adequate Audio Reception" are based on the reception of a 128 kbit/s DAB MPEG 2 audio component which has been transmitted with error protection level of UEP3. For test purposes this audio component shall consist of a 1 KHz mono tone, encoded at full scale (0 dBFS).

"Adequate Audio Reception" is taken to be achieved when the receiver is capable of reconstructing a data stream at the output of the Viterbi decoder with an error rate equal to or better than 1×10^{-4} . This threshold is measured in practical terms by observing the audio output of the receiver and observing that audio impairments are occurring with an average gap between audible impairments of approximately 10 seconds. An audible impairment is defined as any disturbance to the signal detectable by a listener. These impairments include mutes or dropouts (when the signal disappears) and audible noise discernible at the output.

The receiver must comply with the Band III provisions of BS EN 62104:2007, with the exceptions that the thresholds for Gaussian Sensitivity, Rayleigh Sensitivity and Adjacent Channel Interference should be taken from this document. The receiver must comply with the requirements for both Gaussian and Rayleigh sensitivity as laid out below.

8.2 GAUSSIAN SENSITIVITY

A domestic receiver that is sold with an antenna must provide Adequate Audio Reception (as defined above) when receiving a DAB signal with a field strength signal greater than FSG_{\min} in a **Gaussian** transmission channel.

The value FSG_{\min} is frequency dependent. It is 34.4 dB μ V/m for a signal with a centre frequency of 220 MHz, and its value at other frequencies can be calculated from the following formula:

$$FSG_{\min} = [34.4 + 20\log(F/220)] \text{ dB}\mu\text{V/m, where } F \text{ is the frequency in MHz.}$$

Receivers supplied without an antenna shall be capable of providing Adequate Audio Reception (as defined above) with an input power level of -97.7 dBm when fed by a DAB signal with Gaussian transmission channel characteristics. This external antenna will require a gain of -8.1 dBi or greater to produce this power at the required minimum field strength. Domestic receivers should have an input impedance of 75 Ohms.

8.3 RAYLEIGH SENSITIVITY

Under normal “real world” reception conditions the DAB or DAB+ signal will be received via a Rayleigh transmission condition containing multiple echoes, Doppler frequency shift and often contributions from multiple SFN transmitters. Under these conditions the receiver will require a greater signal to noise ratio for normal operation.

Broadcast coverage planning in the UK assumes a Rayleigh transmission channel, and for this reason coverage thresholds are set at 5.5 dBs higher than would be required in a Gaussian environment.

The receiver must provide Adequate Audio Reception of a DAB signal with Rayleigh transmission channel characteristics with field strengths at or above the frequency dependent threshold shown in the following formula.

$$FSR_{min} = [39.9 + 20\log(F/220)] \text{ dB}\mu\text{V/m, where } F \text{ is the frequency in MHz}$$

Receivers supplied without an antenna shall be capable of providing Adequate Audio Reception (as defined above) with an input power level of -92.2 dBm when fed by a DAB signal with Rayleigh transmission channel characteristics. This external antenna will require a gain of -8.1 dBi or greater to produce this power at the required minimum field strength. The Rayleigh fading channel characteristics will be as specified in BS EN 62104:2007.

8.4 RECEIVER SELECTIVITY (ADJACENT CHANNEL INTERFERENCE)

The receiver shall be capable of providing Adequate Audio Reception (as defined above) in the presence of interfering DAB signals at specified levels on other frequencies.

A receiver must be able to provide adequate reception of a DAB audio sub-channel with error protection level UEP3 when the wanted signal has a level of -70 dBm, and it is in the presence of any one of the interfering signals with a frequency offset and amplitude as described in the following table.

The figure for adjacent channel interference (N+/- 1) from the table below is applicable for the majority of DAB frequency blocks where the spacing between centre frequencies is 1.712 MHz. This table does not apply in situations where the spacing between DAB frequency block centre frequencies is less than 1.712 MHz.

Interfering DAB Frequency block relative to wanted signal	Level of interfering signal, relative to wanted signal (Gaussian wanted signal at threshold level of -70 dBm at the input to the receiver)
N±1	+35 dB
N±2	+40 dB
N±3 and to extent of band	+45 dB

9 DAB AND DAB+ CHANNEL DECODING

Receivers must be capable of decoding at least one audio sub-channel.

A receiver must be able to decode a DAB audio service contained in a sub-channel of a size up to and including 280 Capacity Units (e.g. 256 kbps@UEP1). DAB audio services are defined in ETSI EN 300 401.

A receiver must be able to decode a DAB+ audio service contained in a sub-channel of a size up to and including 144 Capacity Units (e.g. 96 kbps@EEP1A). DAB+ audio services are defined in ETSI TS 102 563

10 ANALOGUE RADIO SERVICES

10.1 ANALOGUE RADIO REQUIREMENTS FOR DAB DIGITAL RADIO ADAPTORS.

A DAB digital radio receiver with a primary purpose of adapting an analogue receiver to digital is not required to receive any analogue radio services

10.2 ANALOGUE RADIO REQUIREMENTS FOR RECEIVERS NOT PRIMARILY INTENDED TO BE USED AS ADAPTORS.

The receiver must receive FM analogue radio services currently on air in the UK.

The UK FM transmission standard is as described in ETSI 300 384.

11 FUNCTIONAL SPECIFICATIONS

11.1 RETUNING

A receiver which has a stored list of service labels must provide the user with the option of scanning the whole Band III band to update its stored service list when required.

This feature must either be initiated by the press of a single button on the device or, if it is a feature in a menu structure, it must be in the top level of the menu, or one level down.

This rescan / retune feature must be able to cope with the following changes:

1. Service moves to a different multiplex
2. New multiplex launches
3. Multiplex changes its frequency
4. New Service appears
5. Service changes name
6. Service disappears
7. Multiple Instances of the same programme content with the same Service ID on different frequencies and with varying signal levels

DAB Ensembles in the UK change their configuration from time to time. It is preferred by UK broadcasters that the receiver should update its stored database of available programmes by constantly checking the FIC of the ensemble to which it is currently tuned.

11.2 TEXT DISPLAY

The receiver must have a means of displaying text to the user.

The text display shall display the audio service name (the Component Label). The text display must be able to display the following graphic symbols, correctly mapped, visually well-formed and clear:

ABCDEFGHIJKLMNOPQRSTUVWXYZabcdefghijklmnopqrstuvwxyz0123456789

Lower case characters may be mapped to upper case equivalents and therefore show only:

ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789

Note: It is likely that UK Broadcasters will also use the following characters: £ % & ! ."() ,"

For displays wishing to display the full range of Dynamic Label text, including these symbols, this is specified in ETSI EN 300 401

For any of these characters which cannot be shown correctly, the graphical symbol shown should be a "space" or "□" or, in any case, a similar distinctly non alpha / numeric character.

Receivers shall receive labels from ensembles and audio services, and display long form labels in preference to short form labels.

The receiver shall display the Component Label, in preference to the Service Label, as it is possible to have two audio channels sharing the same Service Label. If a Component Label is not broadcast, the Service Label shall be used.

The text display must display the Component label in either its short form (8 characters long) or its long form (16 characters long). It is not permissible for the receiver to truncate the label to any other length.

Receivers shall receive the Dynamic Label Service from up to 48 bytes of the X-PAD of the currently received service and display it to the user legibly. Receivers should treat the special characters 0x0A and 0x0B as specified and apply such formatting as is possible on the display. The Receiver shall act upon the Command to remove the label from the display by **immediately** removing the label, even if it has only been partially displayed.

12 APPENDIX ONE NOTES ON SPECIFICATIONS.

This appendix provides guidance notes for manufacturers.

There are currently six key documents which specify how to create DAB and DAB+ broadcast signals. Detailed knowledge of these five documents is necessary for manufacturers wishing to build DAB and DAB+ receivers. The five documents are listed below. (All of these documents may be downloaded for free from www.etsi.org). This appendix provides some notes as to which sections of these documents are particularly relevant for receivers intended to be sold for use in the United Kingdom.

The six key documents are:

- *ETSI EN 300 401 Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers.*
- *ETSI TS 101 756 Digital Audio Broadcasting (DAB); Registered Tables*
- *ETSI TS 102 563 Digital Audio Broadcasting (DAB); Transport of Advanced Audio Coding (AAC) audio*
- *ETSI TR 101 496 Digital Audio Broadcasting (DAB); Guidelines and rules for implementation and operation; (Parts 1).*
- *ETSI TR 101 496 Digital Audio Broadcasting (DAB); Guidelines and rules for implementation and operation; (Parts 2).*
- *ETSI TS 103 176 Digital Audio Broadcasting (DAB); Rules of implementation; Service information features*

12.1 BROADCAST SIGNAL

The following sections of the specifications describe how the broadcast signal is constructed.

ETSI EN300 401 provides relevant information in the following sections:

- *Section 4 – Basic DAB System Description*
 - *All clauses*
 - *Except clause 4.5 (Conditional Access Systems)*
- *Section 5 – Transport Mechanisms*
 - *Clauses 5.1 (Introduction), 5.2 (FIC), 5.3.1 (MSC)*
 - *Except clauses 5.2.2.2 (FIG Type 2), 5.2.2.3 (FIG Type 5) and 5.2.2.4 (FIG Type 6)*
- *Section 10 – Energy Dispersal*
- *Section 11 – Convolution Coding*
- *Section 12 – Time Interleaving*
- *Section 13 – Common Interleaved Frame*
- *Section 14 – DAB Transmission Signal*
- *Section 15 – Radio Frequency Characteristics*

ETSI TR 101 496 part 1 provides information in the following section:

- *Section 4 – General Outline*
 - *All clauses*
 - *Except clause 4.3.3 (Data services)*

ETSI TR 101 496 part 3 provides information on Implementation and Operation of a DAB Network, and The Transmitted Signal.

12.2 SUB-CHANNEL DECODING

The following sections of the documents provide information to enable receiver technology developers to extract a sub-channel form a received DAB ensemble.

ETSI EN300 401 provides relevant information in the following section

- *Section 6 – Multiplex Configuration Information (MCI)*
 - *All clauses*
 - *Except clause 6.2.2 (FEC Sub-Channel Organisation), 6.3.2 (Service component in packet mode with or without Conditional Access), 6.3.3 (Service component with Conditional Access in stream mode or FIC), 6.3.5 (Service component Global Definition)*

ETSITR 101 496 part 1 provides information in the following section:

- *Section 5 – Description of System Features*
 - *All clauses*
 - *Except clause 5.7 (Fast Information Data Channel), 5.8 (Conditional Access), 5.9 (Future Features)*

ETSITR 101 496 part 2 provides information in the following section:

- *Section 3 – Implementation and Operation of System Features*
 - *Clauses 3.1 (Introduction), 3.2 (Data Transport Mechanisms), 3.2.1 (Fast Information Channel (FIC)), 3.3 (Multiplex Configuration Information)*

1. Audio Service Decoding

- *Stereo, parametric stereo and spectral band replication shall be supported.*

12.3 DECODING OF AUDIO

The following sections of the specifications provide information required to decode DAB and DAB+ audio services.

ETSI EN300 401 provides relevant information for DAB in the following section

- *Section 7 – Audio Coding*
 - *All clauses*
 - *Except clauses 7.4.1.1 (Dynamic Range Control), 7.4.5.1 (MSC Data Groups in X-PAD), 7.4.5.2 (Dynamic Label Segment)*

ETSI TR 102 563 provides relevant information for DAB+ - all sections are relevant.

ETSI TR 101 496 part 2 provides information in the following section:

- *Section 3 – Implementation and Operation of System Features*
 - *Clauses 3.1 (Introduction), 3.2 (Data Transport Mechanisms), 3.2.2 (Stream Mode), 3.4 (Audio Coding).*

12.4 SERVICE LABEL, PROGRAMME TYPE

Services are correctly labelled so that they can be recognised by the listener, replicating behaviour from RDS PS and RDS PTY. Transmission Providers transmit an ensemble label that is helpful to listeners.

Broadcasters transmit a label on each audio service that is unique within each ensemble. This is transmitted as a long label of up to 16 characters in the EBU Latin 1 character set. A short label of up to 8 characters is also defined. Both long and short labels are static, and do not change unless the name of the service changes.

Broadcasters set the Static Programme Type appropriate for the service using the Primary Pty.

ETSI EN300 401 provides relevant information in the following section:

- *Section 6 – Data Features*
 - *Clauses 8.1.1 (Introduction), 8.1.5 (Programme Type), 8.1.13 (Ensemble Label), 8.1.14.1 (Programme Service Label), 8.1.14.3 (Service Component Label).*

ETSI TR 101 496 part 2 provides information in the following section:

- *Section 3 – Implementation and Operation of System Features*
 - *Clauses 3.6.5 (Programme Type), 3.6.13 (Ensemble, Service and Service Component Labels)*

12.5 DYNAMIC LABELS (DLS)

Dynamic Labels are used by broadcasters to convey messages to the listener, in the same way as RadioText is used in RDS. United Kingdom broadcasters transmit meaningful information in Dynamic Labels which is transmitted in up to 48 bytes of X-PAD per audio frame, using the EBU Latin 1 character set. Broadcasters use the additional characters of 0x0A and 0x0B, and the Command to remove the current label.

ETSI EN300 401 provides relevant information in the following section:

- *Section 7 – Audio Coding*
 - *Clause 7.4.5.2 (Dynamic Label Segment)*

ETSI TR102 563 provides relevant information in the following section:

- *Section 5 – Audio*
 - *Clause 5.4 (Programme Associated Data)*

ETSI TR 101 496 part 2 provides information in the following section:

- *Section 3 – Implementation and Operation of System Features*
 - *Clauses 3.2.4 (Programme Associated Data (PAD)), 3.5.6 (Dynamic Label)*