



**Digital Audio Broadcasting (DAB);
Domestic and in-vehicle digital radio receivers;
Minimum requirements and Test specifications
for technologies and products**

iTeh STANDARD PREVIEW
(see <https://standards.iteh.ai/catalog/standards/sist/1964197-e939-46bc-87d0-83bd814e28a4/etsi-ts-103-461-v1-1-1-2017-08>)

Reference

DTS/JTC-DAB-79

Keywords

DAB, radio, receiver, requirements, testing

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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE 1: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Eureka Project 147 was established in 1987, with funding from the European Commission, to develop a system for the broadcasting of audio and data to fixed, portable or mobile receivers. Their work resulted in the publication of European Standard, ETSI EN 300 401 [1], for DAB (see note 2) which now has worldwide acceptance.

NOTE 2: DAB is a registered trademark owned by one of the Eureka Project 147 partners.

The DAB family of standards is supported by WorldDAB, an organization with members drawn from broadcasting organizations and telecommunication providers together with companies from the professional and consumer electronics industry.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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1 Scope

The present document describes the minimum requirements for digital radios, both domestic and in-vehicle, and the necessary test methods that lead to compliance with the requirements. It may be used as the technical basis for a Digital Radio Certification Mark scheme. A Digital Radio Certification Mark is designed to be used on product packaging and provides an easily recognized mark to correspond to public information campaigns on the necessary requirements for consumers to make a switch to digital radio. Manufacturers are, of course, free to include additional features or increased performance compared to the minimum requirements specified in the present document.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

The following referenced documents are necessary for the application of the present document.

- [1] ETSI EN 300 401 (V2.1.1): "Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers".
- [2] ETSI TS 101 756: "Digital Audio Broadcasting (DAB); Registered Tables".
- [3] ETSI TS 103 176: "Digital Audio Broadcasting (DAB); Rules of implementation; Service information features".
- [4] ETSI ETS 300 799: "Digital Audio Broadcasting (DAB); Distribution interfaces; Ensemble Transport Interface (ETI)".
- [5] ETSI ETS 300 384: "Radio broadcasting systems; Very High Frequency (VHF), frequency modulated, sound broadcasting transmitters".
- [6] IEC 62106:2015: "Specification of the radio data system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 MHz to 108,0 MHz".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

Not applicable.

3 Definitions and abbreviations

3.1 Definitions

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

adapter: product that provides a DAB and DAB+ capability to another device

adequate audio reception: error rate of the output data stream of the Viterbi decoder is equal to or better than 10^{-4} when decoding a 128 kbit/s DAB audio service transmitted with error protection level EEP-3A

band scan: user function to scan the whole of the tuning range to update the stored service list when required

receiver: any device designed to receive digital radio signals

3.2 Abbreviations

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

AAC	Advanced Audio Coding
AUX	AUXiliary
BER	Bit Error Rate
CD	Compact Disc
CU	Capacity Unit
DAB	Digital Audio Broadcasting
DC	Direct Current
DL	Dynamic Label
DUT	Device Under Test
EEP	Equal Error Protection
EId	Ensemble Identifier
EOH	End Of Header
ETI	Ensemble Transport Interface
EU	European Union
FAR	Fully Anechoic Room
FIC	Fast Information Channel
FIG	Fast Information Group
FM	Frequency Modulation
FM-RDS	Frequency Modulation-Radio Data System
MCI	Multiplex Configuration Information
MFN	Multiple Frequency Network
MPEG	Moving Pictures Expert Group
NI	Network Independent
OE	Other Ensemble
OEM	Original Equipment Manufacturer
OOI	Occurrence Of Impairments
PAD	Programme Associated Data
PC	Personal Computer
PI	Programme Identification code (RDS)
PLB	Preferred Line Break
PS	Parametric Stereo
PSU	Power Supply Unit
PWB	Preferred Word Break
RA	Rural Area
RDS	Radio Data System
RF	Radio Frequency
RMS	Root Mean Squared
SAR	Semi Anechoic Room
SBR	Spectral Band Replication
SFN	Single Frequency Network
SId	Service Identifier

SPI	Service and Programme Information
SPL	Sound Pressure Level
TEM	Transverse ElectroMagnetic
TU	Typical Urban
UCS	Universal Character Set
UEP	Unequal Error Protection
UI	User Interface
USB	Universal Serial Bus
UTF	Unicode Transformation Format

4 Digital Radio Certification Mark

The present document comprises the requirements and test specifications by which radio receivers can qualify to carry a Digital Radio Certification Mark ("the Mark"). The purpose of the Mark is to ensure that consumers can readily identify products which are suitable for reception of digital radio services and which provide features at a sufficiently high level of performance to ensure that the product meets the criteria set out for a switchover process and beyond. The requirements are based on the design of DAB transmission networks, which are the result of internationally agreed coverage planning, and essential user features that present digital radio as a desirable yet affordable product.

In order to qualify for use of the Mark, products shall meet the minimum requirements set out for the type of product, either:

- Minimum requirements for domestic digital radio receivers (see clause 5); or
- Minimum requirements for in-vehicle digital radio receivers (see clause 6).

Products are considered to consist of a core technology - that is a chip or module that may be common to many products - and displays, antennas, power supplies, casework, etc. which in combination are specific to a particular product model.

In order to prove compliance against the minimum requirements, products shall pass both of the test specifications, below:

- Test specification for core technology (see clause 7).
- Test specification for products (see clause 8).

The test specification for core technology is designed to explore all aspects of the minimum requirements, whereas the test specification for products is designed to explore how the core technology performs when integrated into the product.

This is shown diagrammatically in figure 1.

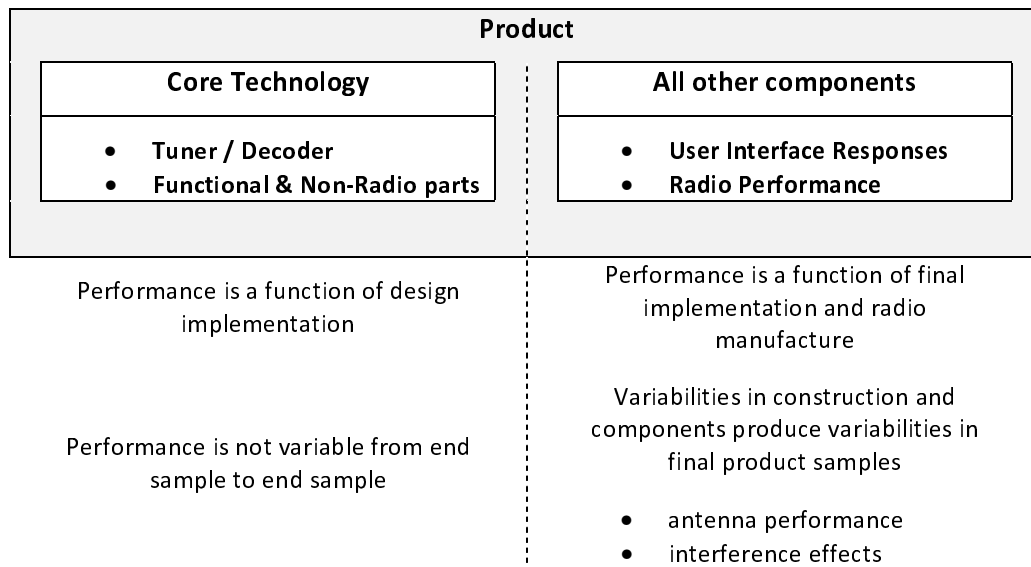


Figure 1: Product testing scheme

For certain product architectures, some aspects of the required functions may be performed by a combination of the core technology and the other components. In this case, some aspects of the core technology testing cannot be performed with the core technology alone: these specific tests shall be recorded in the core technology test report and shall be carried out on the final product in addition to the product testing.

The process for applying for certification to use the Mark is beyond the scope of the present document, but national and international schemes are expected to be in place.

5 Minimum requirements for domestic digital radio receivers

5.1 Introduction

The minimum requirements for domestic digital radio receivers are set out in this clause 5. In-vehicle digital radio receivers are the subject of clause 6.

Domestic products comprise many types of receiver, including portable and larger devices, and receivers incorporated in equipment such as mobile phones and computers. This includes adapters, whose main function is to add a digital radio capability to another device. Domestic products may be mains or battery powered, or both. They may have a telescopic antenna, a flexible wire antenna, an earphone antenna, an antenna integrated into the receiver, or they may be supplied without an antenna.

Products may include additional features beyond the minimum requirement, including reception of digital radio services via other delivery platforms, such as the internet or digital television, or capabilities beyond the minimum requirement.

5.2 Frequency range

Products shall be capable of receiving DAB digital radio broadcasts in the frequency range 174 MHz to 240 MHz. The required centre frequencies of the transmitted signals are specified in annex E.

5.3 Antenna connection

An antenna connection is not required. Products sold with an antenna connection shall have an antenna input impedance of 75 Ohms.

5.4 Gaussian sensitivity

Products sold with a packaged antenna shall provide adequate audio reception of a DAB signal with Gaussian transmission channel characteristics with field strengths at or above the frequency dependent threshold shown in the following formula:

$$FSG_{\min} = [34,4 + 20\log(F/220)] \text{ dB}\mu\text{V/m, where F is the frequency in MHz.}$$

Products sold without an antenna shall provide adequate audio reception with an input power level of -97,7 dBm when fed by a DAB signal with Gaussian transmission channel characteristics.

NOTE: It is assumed that the external antenna has a gain of -8,1 dBi or greater thus producing this power level at the required minimum field strength. The performance of the antenna and the quality of the connectors and cabling will determine the actual sensitivity experienced by the user.

5.5 Rayleigh sensitivity

Products sold with a packaged antenna shall 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:

$$FSR_{\min} = [39,9 + 20\log(F/220)] \text{ dB}\mu\text{V/m, where F is the frequency in MHz}$$

The Rayleigh fading channel characteristics are as specified in annex D.

Products sold without an antenna shall provide adequate audio reception with an input power level of -92,2 dBm when fed by a DAB signal with Rayleigh transmission channel characteristics.

NOTE: It is assumed that the external antenna has a gain of -8,1 dBi or greater thus producing this power level at the required minimum field strength. The performance of the antenna and the quality of the connectors and cabling will determine the actual sensitivity experienced by the user.

5.6 Receiver selectivity (adjacent channel interference)

Products shall provide adequate audio reception in the presence of interfering DAB signals at specified levels on other frequencies.

The wanted signal shall be a DAB signal at a level of -70 dBm. The interfering signal shall be a DAB signal with a frequency offset and amplitude as described in table 1.

Products shall achieve the required selectivity for an interfering signal in all adjacent channels.

Table 1: Receiver selectivity requirements

Frequency of interfering DAB signal	Level of interfering signal, relative to wanted signal
±1,712 MHz relative to wanted signal	+35 dB
±3,428 MHz relative to wanted signal	+40 dB
±5,136 MHz relative to wanted signal	+45 dB
All DAB centre frequencies (see annex E) with more than 6 MHz offset from wanted signal	+45 dB

5.7 DAB and DAB+ channel decoding

Products shall be able to decode one audio sub-channel.

NOTE: Products may decode additional audio sub-channels.

Products shall be able to decode a DAB audio component contained in a sub-channel of a size up to and including 208 Capacity Units.

Products shall be able to decode a DAB+ audio component contained in a sub-channel of a size up to and including 144 Capacity Units.

All protection levels shall be supported.

5.8 Analogue radio requirements

Products, except adapters, shall be able to receive FM analogue radio broadcasts, as described in ETSI ETS 300 384 [5], in the frequency range 87,5 MHz to 107,9 MHz.

5.9 Retuning

Products which store a list of services/service components shall provide a "band scan" user function which scans the whole of the tuning range and updates the stored list when required. This feature shall be initiated by the press of a single button on the device, or, if it is a feature in a menu structure, it shall be in the top level of the menu, or one level down.

The band scan feature shall ensure that all services and service components currently on-air that the receiver is able to decode are added to the service list. Multiple instances of the same service (i.e. same SID) on different ensembles, or on the same ensemble but at different frequencies, shall produce only a single entry in the service list which shall contain at least the source of the service at the best signal quality at the time of scanning. Additional sources may also be stored.

The band scan feature may clear the service list of all entries before performing the scan. Alternatively, the band scan feature shall ensure that previously stored service list entries that are not found during the band scan are suitably marked or removed.

NOTE 1: Since the available services may change after performing a band scan, the effect on preset buttons should be carefully considered.

NOTE 2: DAB ensembles change their configuration from time to time. It is recommended that products update their stored service list by constantly checking the FIC of the ensemble to which they are currently tuned. Background scanning (for example, immediately after switch-off) to maintain an up-to-date service list is recommended.

5.10 Text display

Products shall have a means of displaying text to the user.

The text display shall display the name of the audio components available for selection. Products shall display the **complete** label whenever possible. The label shall only be reduced in length by applying the character selection provided in the flag field of the label. It is not permissible for the product to reduce the length of the label in any other manner.

Products shall display the service label when a primary audio component is selected. Products shall display the service component label when a secondary audio component is selected.

Products shall decode the dynamic label from the X-PAD (short X-PAD, variable length X-PAD, whether the dynamic label is the only PAD application or if it is one of a number of PAD applications) of the currently selected service and display it to the user legibly. Products shall treat the special characters 0x0A, 0x0B, and 0x1F as specified in ETSI EN 300 401 [1] and apply such formatting as is possible on the display. Products 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.

It is accepted that different displays will have different text rendering capabilities. Receivers shall have a display capable of rendering all the characters from the Complete EBU Latin based repertoire character set, as defined in ETSI TS 101 756 [2], annex C, correctly mapped, visually well-formed and clear.

6 Minimum requirements for in-vehicle digital radio receivers

6.1 Introduction

The minimum requirements for in-vehicle digital radio receivers are set out in this clause 6. Domestic digital radio receivers are the subject of clause 5.

In-vehicle products are those products designed specifically for use within a vehicle.

In-vehicle products comprise many types of receiver, including those integrated into the dashboard, and aftermarket products mounted in the dashboard, behind the dashboard, to the vehicle windscreen or elsewhere. Aftermarket products designed to be self-installed by the consumer should ensure that proper consideration is given to ensuring that power adapters, etc., do not cause interference in the FM and DAB broadcast bands.

In-vehicle products may be supplied with or without an antenna.

Products may include additional features beyond the minimum requirement, or capabilities beyond the minimum requirement.

6.2 Frequency range

Products shall be capable of receiving DAB and DAB+ digital radio broadcasts in the frequency range 174 MHz to 240 MHz. The required centre frequencies of the transmitted signals are specified in annex E.

6.3 Antenna connection

An antenna connection with input impedance of 50 Ohms is required.

6.4 Gaussian sensitivity

Products shall provide adequate audio reception with an input power level of -97,7 dBm when fed by a DAB signal with Gaussian transmission channel characteristics.

Products sold with a packaged antenna shall provide adequate audio reception of a DAB signal with Gaussian transmission channel characteristics with field strengths at or above the frequency dependent threshold shown in the following formula:

$$FSG_{\min} = [29,2 + 20\log(F/220)] \text{ dB}\mu\text{V/m, where F is the frequency in MHz.}$$

NOTE: The performance of the antenna and the quality of the connectors and cabling will determine the actual sensitivity experienced by the user. Assuming glass mount antennas are properly fitted in the vehicle, the experienced sensitivity will still depend on several factors, like the type of vehicle, direction of driving, interaction with the body and other components present, etc.

6.5 Rayleigh sensitivity

Receivers shall provide adequate audio reception with an input power level of -92,2 dBm when fed by a DAB signal with Rayleigh transmission channel characteristics.

Products sold with a packaged antenna shall 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:

$$FSR_{\min} = [34,7 + 20\log(F/220)] \text{ dB}\mu\text{V/m, where F is the frequency in MHz}$$

The Rayleigh fading channel characteristics are as specified in annex D.

NOTE: The performance of the antenna and the quality of the connectors and cabling will determine the actual sensitivity experienced by the user. Assuming glass mount antennas are properly fitted in the vehicle, the experienced sensitivity will still depend on several factors, like the type of vehicle, direction of driving, interaction with the body and other components present, etc.

6.6 Receiver selectivity (adjacent channel interference)

Products shall provide adequate audio reception in the presence of interfering DAB signals at specified levels on other frequencies.

The wanted signal shall be a DAB signal at a level of -70 dBm. The interfering signal shall be a DAB signal with a frequency offset and amplitude as described in table 2.

Products shall achieve the required selectivity for an interfering signal in all adjacent channels.

Table 2: Receiver selectivity requirements

Frequency of interfering DAB signal	Level of interfering signal, relative to wanted signal
$\pm 1,712$ MHz relative to wanted signal	+35 dB
$\pm 3,428$ MHz relative to wanted signal	+40 dB
$\pm 5,136$ MHz relative to wanted signal	+45 dB
All DAB centre frequencies (see annex E) with more than 6 MHz offset from wanted signal	+45 dB

6.7 DAB and DAB+ channel decoding

Products shall be able to decode one audio sub-channel.

NOTE: Products may decode additional audio sub-channels.

Products shall be able to decode a DAB audio component contained in a sub-channel of a size up to and including 208 Capacity Units.

Products shall be able to decode a DAB+ audio component contained in a sub-channel of a size up to and including 144 Capacity Units.

All protection levels shall be supported.

6.8 Analogue radio requirements

Products, except adapters, shall be able to receive FM analogue radio broadcasts, as described in ETSI ETS 300 384 [5], in the frequency range 87,5 MHz to 107,9 MHz.

6.9 Retuning

Products which store a list of services/service components shall provide a "band scan" user function which scans the whole of the tuning range and updates the stored list when required. This feature shall be initiated by the press of a single button on the device, or, if it is a feature in a menu structure, it shall be in the top level of the menu, or one level down.

The band scan feature shall ensure that all services and service components currently on-air that the receiver is able to decode are added to the service list. Multiple instances of the same service (i.e. same SId) on different ensembles, or on the same ensemble but at different frequencies, shall produce only a single entry in the service list which shall contain at least the source of the service at the best signal quality at the time of scanning. Additional sources should also be stored to assist with service following.