Digital Radio Certification Mark

Minimum requirements for domestic and in-vehicle digital radio receivers

Test specifications for technologies and products

Version 1.0r2

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Changes to this document

A process is in place to consider requests to change the content of this document. The process is managed by DRUK.
Changes to this document since the last published version are provided in Annex E.

DIGITAL RADIO CERTIFICATION MARK

This 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 must meet the minimum requirements set out for the type of product, either:

- Minimum Requirements for domestic digital radio receivers, or
- Minimum Requirements for in-vehicle digital radio receivers.

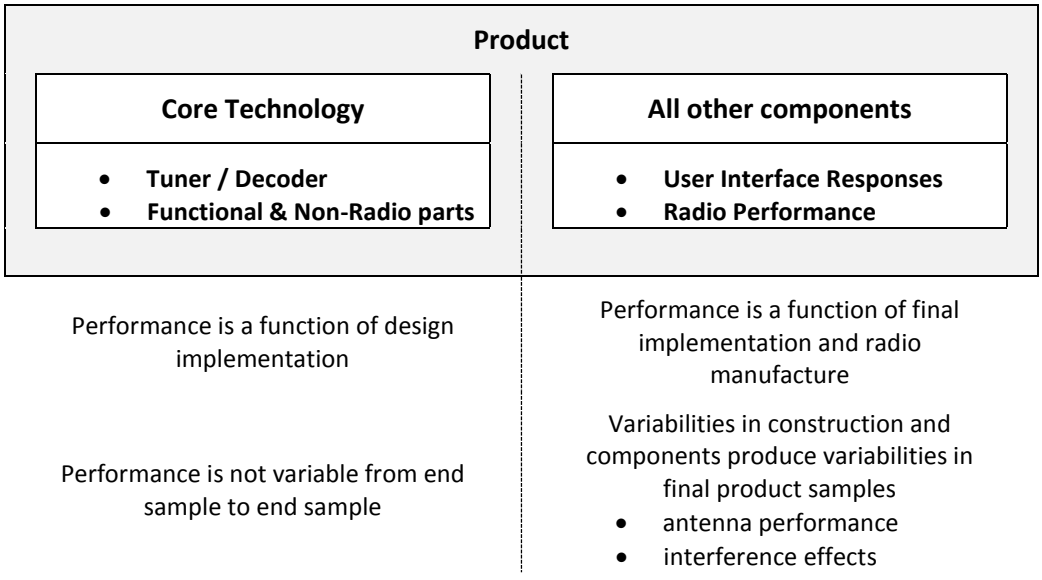
Products are considered to consist of a core DAB technology - that is a chip or module that may be common to many products - and displays, antennas, power supplies, casework, etc., which in combination are specific to a particular product model.

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

- Test Specification for Core Technology
- Test Specification for Products

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. The Core Technology may be tested when included in an evaluation board.

This is shown diagrammatically below:



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 requirements of the Core Technology testing cannot be met: 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.

This document is based on work undertaken as part of the UK Government's Digital Radio Action Plan (DRAP), which ran between 2010 and 2013, by the DRAP Technology and Equipment Group.

The process for applying for certification to use the Mark is beyond the scope of this document, but national and international schemes are expected to be in place. When used on digital radio equipment, the Mark certifies that "The radio is 'Future-ready' and receives the available DAB, DAB+ and FM radio stations in your area".

A typical process for being granted use of the Mark is as follows:

- Complete the Technology Provider Test at an independent test house
- Apply for use of the Mark on core technology – submit the test report above, a sample module, and other necessary documentation to the Mark licensor
- Successful applications receive a reference number, a certificate and list the technology publicly, for example on the licensor's website
- Complete the Per Product Test at a an approved test house
- Apply for use of the Mark on the final product – submit the test report above, and other necessary documentation to the Mark licensor
- Successful applications receive a reference number, a certificate and list the technology publicly, for example on the licensor's website

CONTENTS

1 SCOPE

This document describes the minimum requirements for digital radios, both domestic and in-vehicle, and the necessary test methods to achieve a Digital Radio Certification Mark. A Digital Radio Certification Mark is designed to be used on product packaging and provides an easily recognised 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 this document.

2 REFERENCES

- *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 TS 103 176 Digital Audio Broadcasting (DAB); Rules of implementation; Service information features*
- *ETSI EN 300 384 Radio broadcasting systems; Very High Frequency (VHF), frequency modulated, sound broadcasting transmitters*
- *IEC 62104:2015 Characteristics of DAB Receivers*
- *IEC 61000-4-3 "Test and Measurement Techniques – Radiated , radio frequency, electromagnetic field immunity test"*
- *CISPR 16-2-3 "Methods of Measurement…"*
- *ANSI C63.4-2003, p18-46 Methods of Measurement of Radio Noise Emissions from L.V. Electrical And Electronic Equipment in the range 9kHz to 40GHz.*
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- *ETSI standards are available, free of charge, from www.etsi.org.*

3 DEFINITIONS

For the purposes of this document the following definitions are valid:

Receiver	*any device designed to receive digital radio signals*
Adapter	*a product that provides a DAB and DAB+ capability to another device*
DAB service	*a service where the primary component is an MSC audio stream containing MPEG II audio*
DAB+ service	*a service where the primary component is an MSC audio stream containing HE-AAC audio*
Adequate audio reception	the reception of a 128 kbit/s DAB service which has been transmitted with error protection level EEP-3A when the receiver has reconstructed a data stream at the output of the Viterbi decoder with an error rate equal to or better than 10^{-4}

4 MINIMUM REQUIREMENTS FOR DOMESTIC DIGITAL RADIO RECEIVERS

4.1 INTRODUCTION

The minimum requirements for domestic digital radio receivers are set out in this clause 4. In-vehicle digital radio receivers are the subject of clause 5.

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, a headphone 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.

4.2 FREQUENCY RANGE

Products shall be capable of receiving DAB and DAB+ digital radio broadcasts in the frequency range 174 to 240 MHz. The required centre frequencies of the transmitted signals are specified in IEC 62104:2015.

4.3 ANTENNA CONNECTION

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

4.4 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:

$$FSG_{min} = [\ 34.4 + 20\log(F/220)\ ]\ dB\mu V/m$$, *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.

4.5 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:

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

Products sold without an antenna shall provide adequate audio reception with an input power level of -92.2 dBm when fed by a DAB signal with Rayleigh transmission channel characteristics.

The Rayleigh fading channel characteristics are as specified in IEC 62104:2015.

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.

4.6 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 containing a DAB audio sub-channel with error protection level UEP-3. The interfering signal shall be a DAB signal with a frequency offset and amplitude as described in the following table.

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

Interfering DAB Frequency block, relative to wanted signal	**Level of interfering signal, relative to wanted signal**
N±1	+35 dB
N±2	+40 dB
N±3 and to extent of band	+45 dB

The figure for first adjacent channel interference (N±1) is only applicable where the spacing between centre frequencies is 1.712 MHz or greater (the majority of DAB frequency blocks); it does not apply where the spacing between centre frequencies is less than 1.712 MHz.

4.7 DAB AND DAB+ CHANNEL DECODING

Products shall be able to decode one audio sub-channel (or more).

Products shall 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@UEP-1).

Products shall 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@EEP-1A).

4.8 ANALOGUE RADIO REQUIREMENTS

Products with a primary purpose of permitting an analogue radio receiver to decode and play out digital radio services are not required to receive any analogue radio services.

All other products shall be able to receive FM analogue radio broadcasts, as described in ETSI EN 300 384, in the frequency range 87.5 to 107.9 MHz.

4.9 RETUNING

Products which store a list of services/service components shall provide a user function to scan the whole of the tuning range to update 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 scan feature shall be able to cope with the following changes:

1. Service moves to a different ensemble;
2. New ensemble appears;
3. Ensemble changes frequency;
4. New service or service component appears;
5. Service or service component changes label;
6. Service or service component disappears;
7. Multiple instances of the same service (i.e. same SId) on different ensembles, or on the same ensemble but at different frequencies, and with varying signal levels.

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.

4.10 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 EN 300 401 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 Annex C, correctly mapped, visually well-formed and clear.

5 MINIMUM REQUIREMENTS FOR IN-VEHICLE DIGITAL RADIO RECEIVERS

5.1 INTRODUCTION

The minimum requirements for in-vehicle digital radio receivers are set out in this clause 5. Domestic digital radio receivers are the subject of clause 4.

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 supplied with or without an antenna.

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

5.2 FREQUENCY RANGE

Products shall be capable of receiving DAB and DAB+ digital radio broadcasts in the frequency range 174 to 240 MHz. The required centre frequencies of the transmitted signals are specified in IEC 62104:2015.

5.3 ANTENNA CONNECTION

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

5.4 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:

$$FSG_{min} = [\ 29.2 + 20\log(F/220)\ ]\ dB\mu V/m$$, *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.

5.5 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:

$$FSR_{min} = [\ 34.7 + 20\log(F/220)\ ]\ dB\mu V/m$$, *where F is the frequency in MHz*

The Rayleigh fading channel characteristics are as specified in IEC 62104:2015.

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.

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 containing a DAB audio sub-channel with error protection level UEP-3. The interfering signal shall be a DAB signal with a frequency offset and amplitude as described in the following table.

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

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Products shall be able to decode one audio sub-channel (or more).

Products shall 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@UEP-1).

Products shall 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@EEP-1A).

5.8 ANALOGUE RADIO REQUIREMENTS

Products with a primary purpose of permitting an analogue radio receiver to decode and play out digital radio services are not required to receive any analogue radio services.

All other products shall be able to receive FM analogue radio broadcasts, as described in ETSI EN 300 384, in the frequency range 87.5 to 107.9 MHz.

5.9 RETUNING

Products which store a list of services/service components shall provide a user function to scan the whole of the tuning range to update 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 scan feature shall be able to cope with the following changes:

1. Service moves to a different ensemble;
2. New ensemble appears;
3. Ensemble changes frequency;
4. New service or service component appears;
5. Service or service component changes label;
6. Service or service component disappears;
7. Multiple instances of the same service (i.e. same SId) on different ensembles, or on the same ensemble but at different frequencies, and with varying signal levels.

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.

NOTE: A WorldDMB task force is currently defining rules for the proper management of service lists. Additional requirements are likely to appear when this work is complete.

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.

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 Annex C, correctly mapped, visually well-formed and clear.

NOTE: In-vehicle receivers are not required to implement dynamic label.

5.11 ANNOUNCEMENT SIGNALLING AND SWITCHING

Products shall support announcement switching as defined in ETSI 300 401 clause 8.1.6 (i.e. same ensemble only). This feature instructs the receiver to select an alternative audio source only for the duration of an audio announcement, before returning to the original source.

Manufacturers may provide the user with an option to disable this feature.

Products shall switch from the selected service component (even if the user is listening to the CD, AUX, etc.) to a traffic announcement if all the following conditions are met:

- The announcement feature is enabled;
- The selected service is signalled as supporting announcements by means of FIG 0/18 with ASu flag bit 1 set to indicate “Road Traffic Flash” and is provided with a Cluster Id;
- In the same ensemble, an announcement is signalled by means of FIG 0/19 with ASw flag bit 1 set to indicate “Road Traffic Flash” and with the same Cluster Id as the selected service;

Manufacturers may provide Other Ensembles and/or FM announcement switching, but this is not required. If provided, it shall conform to all the requirements for announcement support: i.e. no interruption shall be made to any service that does not provide announcement support.

If the selected service has correct ASu signalling and the product provides support for FM-RDS traffic announcements, then it shall not switch from DAB/DAB+ to FM for a traffic announcement of a hard-linked service (explicit or implicit) since these services carry the same audio which may not be co-timed.

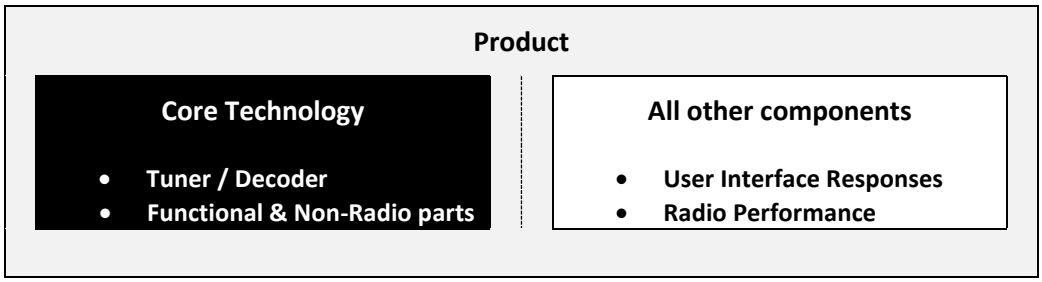
5.12 SERVICE FOLLOWING

Products shall support all aspects of service following, including soft linking and hard linking, as specified in ETSI TS 103 176v1.2.1 Digital Audio Broadcasting (DAB); Rules of implementation; Service information features. Products required to support service following shall also decode the relevant parts of the RDS data (as defined by IEC EN 62106:2015) transmitted as part of an FM broadcast signal to achieve DAB to FM linking. Service following algorithms shall be designed so as to provide the best possible user experience. If no alternative signal is available, undisturbed reception shall be maintained at the minimum sensitivity level.

6 TEST SPECIFICATION FOR CORE TECHNOLOGY

6.1 INTRODUCTION

This clause 6 provides high level descriptions for the testing that provides evidence that the core technology meets the Minimum Requirements set out in clauses 4 and 5.



Manufacturers will need to determine the necessary test equipment and detailed procedures needed to conduct the tests, including sourcing of input streams (ETI files, IQ files, test signals), etc.

The term "receiver" is used to describe the device under test, although this may be an evaluation board, or similar.

For certain receiver architectures, some aspects of the Core Technology testing can only be carried out on the final product because the functional element is carried out by a combination of Core Technology and other components. In this case, the Core Technology test report shall detail which Core Technology tests have not been passed and these Core Technology tests shall be carried out on the final product in addition to the Product tests in order to achieve certification.

6.2 DAB STREAM MSC

Sub area	Test number	Test description							Valid result
		DAB mode	Protection level	Encoding rate	Audio mode	Data rate	SBR	PS	
DAB (MPEG Audio Layer II) DAB modes, protection levels, encoding rate, audio mode and data rate permutations	1.1.1	1	UEP-3	24kHz	mono	32	n/a		Audio plays for 5 minutes without any interruptions or audio artefacts
	1.1.2			24kHz	mono	48			
	1.1.3			24kHz	mono	64			
	1.1.4			48kHz	mono	80			
	1.1.5			48kHz	mono	96			
	1.1.6			48kHz	joint stereo	96			
	1.1.7			48kHz	joint stereo	112			
	1.1.8			48kHz	joint stereo	128			
	1.1.9			48kHz	joint stereo	160			
	1.1.10			48kHz	stereo	160			
	1.1.11			48kHz	stereo	192			
	1.1.12			48kHz	stereo	256			
	1.1.13		UEP-1	24kHz	mono	48			
	1.1.14			48kHz	joint stereo	128			
	1.1.15			48kHz	stereo	192			
	1.1.16			48kHz	stereo	256			
	1.1.17		UEP-2	24kHz	mono	48			
	1.1.18			48kHz	joint stereo	128			
	1.1.19			48kHz	stereo	192			
	1.1.20			48kHz	stereo	256			

Sub area	Test number	Test description							Valid result
		DAB mode	Protection level	Encoding rate	Audio mode	Data rate	SBR	PS	
	1.1.21		UEP-4	24kHz	mono	48			
	1.1.22			48kHz	joint stereo	128			
	1.1.23			48kHz	stereo	192			
	1.1.24		UEP-5	24kHz	mono	48			
	1.1.25			48kHz	joint stereo	128			
	1.1.26			48kHz	stereo	192			
DAB+ (HE-AACv2) DAB modes, protection levels, encoding rate, audio modes, data rate and additional AAC encoding permutations	1.2.1	1	EEP- 3A	32kHz	Mono	16	SBR		Audio plays for 5 minutes without any interruptions or audio artefacts
	1.2.2			32kHz	Mono	32	SBR		
	1.2.3			32kHz	Mono	40	SBR		
	1.2.4			32kHz	Mono	48	SBR		
	1.2.5			32kHz	Stereo	32	SBR	PS	
	1.2.6			32kHz	Stereo	40	SBR		
	1.2.7			32kHz	Stereo	48	SBR		
	1.2.8			48kHz	Mono	32	SBR		
	1.2.9			48kHz	Mono	40	SBR		
	1.2.10			48kHz	Mono	48	SBR		
	1.2.11			48kHz	Mono	56	SBR		
	1.2.12			48kHz	Stereo	32	SBR		
	1.2.13			48kHz	Stereo	40	SBR		
	1.2.14			48kHz	Stereo	48	SBR		
	1.2.15			48kHz	Stereo	32	SBR	PS	
	1.2.16			48kHz	Stereo	40	SBR	PS	
	1.2.17			48kHz	Stereo	48	SBR	PS	

Sub area	Test number	Test description							Valid result
		DAB mode	Protection level	Encoding rate	Audio mode	Data rate	SBR	PS	
	1.2.18			48kHz	Stereo	56	SBR		
	1.2.19			48kHz	Stereo	64	SBR		
	1.2.20			48kHz	Stereo	72	SBR		
	1.2.21			48kHz	Stereo	80	SBR		
	1.2.22			48kHz	Stereo	88	SBR		
	1.2.23			48kHz	Stereo	96	SBR		
	1.2.24			48kHz	Stereo	128			
	1.2.25			48kHz	Stereo	136			
	1.2.26			48kHz	Stereo	56			
	1.2.27			48kHz	Stereo	64			
	1.2.28			48kHz	Stereo	72			
	1.2.29			48kHz	Stereo	80			
	1.2.30			48kHz	Stereo	88			
	1.2.31			48kHz	Stereo	96			
	1.2.32			48kHz	Stereo	192			
	1.2.33		EEP- 1A	48kHz	Stereo	32	SBR	PS	
	1.2.34			48kHz	Stereo	64	SBR		
	1.2.35			48kHz	Stereo	96			
	1.2.36		EEP- 2A	48kHz	Stereo	32	SBR	PS	
	1.2.37			48kHz	Stereo	96			
	1.2.38			48kHz	Stereo	144			
	1.2.39		EEP- 4A	48kHz	Stereo	32	SBR	PS	
	1.2.40			48kHz	Stereo	96			
	1.2.41			48kHz	Stereo	192			

Sub area	Test number	Test description							Valid result
		DAB mode	Protection level	Encoding rate	Audio mode	Data rate	SBR	PS	
	1.2.42		EEP- 1B	48kHz	Stereo	32	SBR	PS	
	1.2.43			48kHz	Stereo	96			
	1.2.44			48kHz	Stereo	160			
	1.2.45		EEP- 2B	48kHz	Stereo	32	SBR	PS	
	1.2.46			48kHz	Stereo	96			
	1.2.47			48kHz	Stereo	192			
	1.2.48		EEP- 3B	48kHz	Stereo	32	SBR	PS	
	1.2.49			48kHz	Stereo	96			
	1.2.50			48kHz	Stereo	192			
	1.2.51		EEP- 4B	48kHz	Stereo	32	SBR	PS	
	1.2.52			48kHz	Stereo	96			
	1.2.53			48kHz	Stereo	192			

6.3 DAB CHANNELS AND SERVICES

Sub area	Test number	Test description	Valid result
Multiple sub-channels	2.1.1	Ensure that the receiver can tune to an ensemble with 32 primary audio components (all pointing to different sub-channels), list all components and that all components play out audio	All 32 components are available to the user and all components play out audio
Multiple components	2.2.1	Ensure that the receiver can tune to an ensemble with 50 mixed audio DAB and DAB+ and data components, list all components that the receiver handles and that all handled components are handled correctly	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported

Sub area	Test number	Test description	Valid result
Secondary audio components	2.3.1	Ensure that the receiver can tune to an ensemble with DAB primary component with a DAB secondary component	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported
	2.3.2	Ensure that the receiver can tune to an ensemble with DAB primary component with a DAB+ secondary component	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported
	2.3.3	Ensure that the receiver can tune to an ensemble with DAB+ primary component with a DAB+ secondary component	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported
Secondary data components	2.4.1	Ensure that the receiver can tune to an ensemble with DAB primary audio component with 10 data secondary component	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported
	2.4.2	Ensure that the receiver can tune to an ensemble with DAB primary component with a data secondary component	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported

Sub area	Test number	Test description	Valid result
	2.4.3	Ensure that the receiver can tune to an ensemble with DAB+ primary component with a data secondary component	The receiver should display and handle all supported components. Any unsupported components should be hidden from the user - e.g. if data is not supported
Reselection	2.5.1	When tuned to a primary component ensure that the receiver can recover and play out the same audio automatically after losing the signal temporarily (10 or more seconds) NOTE: no alternate service is available; i.e. no active links are signalled	As the radio loses and regains the service some amount of noise might be heard depending upon the algorithm and PREFERENCE of the manufacturer. The radio will output audio within 3 seconds of the RF being available again.
MFN support	2.6.1	In a location where multiple instances of the same ensemble can be seen on difference channels ensure that when a service is initially selected the strongest (in RF terms) of the available channels is selected	The strongest channel will be selected regardless of where the channel sits in terms of sequence of channels within the DAB band(s)
	2.6.2	In a region where multiple instances of the same ensemble can be seen on different channels, and the broadcasters are supporting this with FIG 0/21 information, ensure that if the receiver is moved from a location where only 1 channel can be seen to another region where only a different channel can be seen then the radio will reselect the same service on the different channel without the user needing to select it	The service will be tuneable in either location without user intervention (provided the radio has a 'last listened' function as standard on turning on)
Duplicate handling	2.7.1	In a location where multiple instances of the same service, (SId matching), can be seen on different channels ensure that one of the services is selected This could be implemented using FIG0/24 information from the broadcast or by having seen all linked services following a scan	One of the versions of the services will be selected

Sub area	Test number	Test description	Valid result
	2.7.2	When a receiver is moved from one location to another and another instance(s) of a duplicate service can subsequently be received then the radio must be capable of selecting the alternative duplicated service either automatically or via a new scan.	The services can be accessed in either location post discovery
Service information checking	2.8.1	The receiver will display a 16 character component label when one is present	Component label displayed correctly in supported forms i.e. long and short form. Long form is the preferred version to display
	2.8.2	The receiver will display a 16 character service label when no component label is present	Service label displayed correctly in supported forms i.e. long and short form Long form is the preferred version to display
	2.8.3	The receiver will display static program type when present	Program type displayed correctly

6.4 RECONFIGURATIONS

Sub area	Test number	Test description	Valid result
Adding a secondary component	3.1.1	Add a DAB secondary audio component when a DAB primary audio component is selected	No interruption to service, new component can now be found within service list
	3.1.2	Add a DAB secondary audio component when an existing DAB secondary audio component is selected	No interruption to service, new component can now be found within service list
	3.1.4	Add a secondary data component when a primary DAB audio component is selected	No interruption to service, new component can now be found within service list if data services are supported
	3.1.5	Add a secondary DAB+ audio component when a primary DAB+ audio component is selected	No interruption to service, new component can now be found within service list
	3.1.5	Add a secondary data component when a primary DAB+ audio component is selected	No interruption to service, new component can now be found within service list if data services are supported
Removing a secondary component	3.2.1	Remove a secondary audio component when a primary audio component is selected	No interruption to service Confirm that the radio has handled the removal of the secondary component
	3.2.2	Remove a secondary audio component when an alternative existing secondary audio component is selected	No interruption to service Confirm that the radio has handled the removal of the secondary component
	3.2.4	Remove a secondary audio component when the component to be removed is selected	If the related Primary component of the same service is an audio component then the receiver falls back to this component: if the primary component is a component then mute the receiver Confirm that the radio has handled the removal of the secondary component

Sub area	Test number	Test description	Valid result
	3.2.6	Remove a secondary data component when a primary audio component is selected	No interruption to service. Confirm that the radio has handled the removal of the secondary component
	3.2.7	Remove a secondary audio component when an alternative existing secondary DAB+ audio component is selected	No interruption to service Confirm that the radio has handled the removal of the secondary component
	3.2.8	Remove a secondary DAB+ audio component whilst the component to be removed currently selected	If the related Primary component of the same service is an audio component then the receiver falls back to this component: if the primary component is a data component then mute the receiver.. Confirm that the radio has handled the removal of the secondary component
Removing a service	3.3.1	Remove an audio service that is currently selected and also has no secondary components NOTE: no alternate service is available; i.e. no active links are signalled	Service is lost.
	3.3.2	Remove an audio service with its primary component currently selected that does have secondary components NOTE: no alternate service is available; i.e. no active links are signalled	Service with all components is lost. Confirm that the radio has handled the removal of the service and components

Sub area	Test number	Test description	Valid result
	3.3.3	Remove an audio service with one of its secondary components currently selected NOTE: no alternate service is available; i.e. no active links are signalled	Service with all components are lost. Confirm that the radio has handled the removal of the service and components
Moving CU locations	3.4.1	Moving the start CU of the service selected to a position that is ahead of where it started but still overlaps the previous CU's used	No interruption to service
	3.4.2	Moving the start CU of the service selected to a position that is ahead of where it started and none of the new location overlaps the previous CUs used	No interruption to service
	3.4.3	Moving the start CU of the service selected from using CU 0 to using the last CU	No interruption to service
	3.4.4	Moving the start CU of the service selected from using the last CU to using CU 0	No interruption to service
Bit rate and audio encoding rate changes	3.5.1	Full Rate DAB Component increases bit rate from 128kbps@UEP-3 to 192kbps@UEP-3	No interruption to service
	3.5.2	Full Rate DAB Component decreases bit rate from 192kbps@UEP-3 to 128kbps@UEP-3	No interruption to service
	3.5.3	Half Rate DAB Component increases bit rate from 128kbps@UEP-3 to 160kbps@UEP-3	No interruption to service
	3.5.4	Half Rate DAB Component decreases bit rate from 160kbps@UEP-3 to 128kbps@UEP-3	No interruption to service
	3.5.5	48kHz DAB+ Component increases bit rate from 128kbps@EEP-3A to 192kbps@EEP-3A	Only a minor break (<1 second) of breakup

Sub area	Test number	Test description	Valid result
	3.5.6	48kHz DAB+ Component decreases bit rate from 192kbps@EEP-3A to 128kbps@EEP-3A	Only a minor break (<1 second) of breakup
Protection level	3.6.1	Full Rate DAB Component increases protection level from 128kbps@UEP-4 to 128kbps@UEP-3	No interruption to service
	3.6.2	Half Rate DAB Component decreases protection level from 128kbps@UEP-3to 128kbps@UEP-4	No interruption to service
	3.6.3	48kHz DAB+ Component increases protection level from 96kbps@EEP-4A to 96kbps@EEP-1A	No interruption to service
Service/Component label changes	3.7.1	Change the service label when connected to the primary component	If only the component label is visible then no change should be noticed. If the service label is also shown then this will be seen to change. In either case there will be no interruption to the audio service
	3.7.2	Change the service label when connected to the secondary component	If only the component label is visible then no change should be noticed. If the service label is also shown then this will be seen to change. In either case there will be no interruption to the audio service
	3.7.3	Change the primary component label when connected to the primary component	If the component label is visible then the change should be noticed. If the service label is also shown then this will not have changed. In either case there will be no interruption to the audio service
	3.7.4	Change the secondary component label when connected to the secondary component	If the component label is visible then the change should be noticed. If the service label is also shown then this will not have changed. In either case there will be no interruption to the audio service

Sub area	Test number	Test description	Valid result
Combined changes	3.8.1	DAB Primary Component increases bit rate from 128kbps@UEP-3 to 160kbps@UEP-3 & loses 32kbps@UEP-3 DAB Secondary - DAB Primary selected	No interruption to service. Confirm that the radio has handled the removal of the secondary component
	3.8.2	DAB Primary Component increases bit rate from 128kbps@UEP-3 to 160kbps@UEP-3 & loses 32kbps@UEP-3 DAB Secondary - DAB Secondary selected	The receiver falls back to the primary component of the service that the secondary component was associated with or mutes the receiver. Confirm that the radio has handled the removal of the secondary component
	3.8.3	DAB Primary Component decreases bit rate from 160kbps@UEP-3 to 128kbps@UEP-3 & adds in a 32kbps@UEP-3 DAB Secondary - DAB Primary selected	No interruption to service. Record whether new secondary component has been added to the service list
	3.8.4	DAB+ Primary Component increases bit rate from 128kbps@EEP-3A to 160kbps@EEP-3A & loses 32kbps@EEP-3A secondary - Primary selected	Only a minor break (<1 second) of breakup. Confirm that the radio has handled the removal of the secondary component
Audio parameter changes	3.9.1	DAB+ Primary Component changes sample rate from 32khz to 48khz	Only a minor break (<1 second) of breakup
	3.9.2	DAB+ Primary Component changes audio mode from Mono to Mono with SBR	Only a minor break (<1 second) of breakup
	3.9.3	DAB+ Primary Component changes audio mode from Mono with SBR to Stereo with SBR	Only a minor break (<1 second) of breakup
	3.9.4	DAB Primary Component changes sample rate from 24kHz to 48kHz	Only a minor break (<1 second) of breakup

Sub area	Test number	Test description	Valid result
	3.9.5	DAB Primary Component changes audio mode from mono to Stereo	No interruption to service.
	3.9.6	DAB Primary Component changes audio mode from Stereo to joint Stereo	No interruption to service.

6.5 DYNAMIC LABEL

Sub area	Test number	Test description	Valid result
Transport methods	4.1.1	Receiver will be able to receive and display dynamic label text carried within a service with **full rate** audio encoding using **short** xpad	The dynamic label is displayed correctly, and the scroll rate if applicable enables the text to easily be read
	4.1.2	Receiver will be able to receive and display dynamic label text carried within a service with **half rate** audio encoding using **short** xpad	
	4.1.3	Receiver will be able to receive and display dynamic label text carried within a service with **full rate** audio encoding using **variable** xpad	
	4.1.4	Receiver will be able to receive and display dynamic label text carried within a service with **half rate** audio encoding using **variable** xpad	
Maximum length dynamic label	4.2.1	Receiver will be able to receive and display a 128 single byte character long string of text carried within pad (Charset = EBU)	The dynamic label is displayed correctly, and the scroll rate if applicable enables the text to easily be read
Minimum length dynamic label	4.3.1	Receiver will be able to receive and display which is only 1 character long carried within pad	The single character is displayed correctly
Special characters	4.4.1	Receiver will be able to receive and handle an end of headline special character (0x0B)	If supported by the display on the receiver the end of headline character will be handled correctly The special character will never be displayed

Sub area	Test number	Test description	Valid result
	4.4.2	Receiver will be able to receive and handle a preferred word break special character (0x1F) The word break character needs to be placed in the dynamic label text string such that the character can be utilised by the display on the receiver where possible	If supported by the display on the receiver the preferred word break character will be handled correctly and the word will be broken in the correct location The special character will never be displayed regardless of whether the receiver needs to support it or not
	4.4.3	Receiver will be able to receive and handle a preferred line break special character (0x0A) The line break character needs to be placed in the dynamic label text string such that the character can be utilised by the display on the receiver where possible	If supported by the display on the receiver the preferred word break character will be handled correctly and the line will be broken in the correct point in the text string The special character will never be displayed regardless of whether the receiver needs to support it or not
The dynamic label clear command	4.5.1	The receiver will correctly handle a dynamic label clear command	When a dynamic label clear command is received then the receiver will stop displaying the current dynamic label irrespective of the point at which it is scrolling

6.6 CHARACTER SETS

Sub area	Test number	Test description	Valid result
Complete EBU Latin based repertoire (TS 101 756 annex C)	5.1.1	The receiver will support the display of all characters from the character set. The characters being transmitted may be within dynamic labels or ensemble/service/component labels	All characters will be displayed correctly
UCS-2 encoding of the Complete EBU Latin based repertoire (TS 101 756 annex C)	5.2.1	The receiver will support the display of all characters from the character set encoded as UCS-2. The characters being transmitted may be within dynamic labels or ensemble/service/component labels	All characters will be displayed correctly
UTF-8 encoding of the Complete EBU Latin based repertoire (TS 101 756 annex C)	5.3.1	The receiver will support the display of all characters from the character set encoded as utf-8. The characters being transmitted may be within dynamic labels or ensemble/service/component labels	All characters will be displayed correctly

6.7 SCANNING AND TUNING

Sub area	Test number	Test description	Valid result
Scanning	6.1.1	Run a full band 3 scan (excluding the N channels) and ensure that all supported services available from all ensembles seen within the band are stored	All supported services are available to the user and work correctly (i.e. play audio if an audio service)
A new multiplex launches	6.2.1	After running a scan in 6.1.1 locally transmit another DAB signal on a channel not currently in use and then re-run test 6.1.1 and ensure that the new ensemble has been added to the list	All supported services are available to the user and work correctly (i.e. play audio if an audio service) including those of the new ensemble
Multiplex changes frequency	6.3.1	Alter the channel used by the ensemble that was added within tests 6.2.1 to yet another currently unused channel and then re-run test 6.1.1 This test assumes that the ensemble is switched and not simulcast for a transition period	All supported services are still available and only one iteration of the ensemble is listed.
Manual tuning	6.4.1	Ensure that all 38 band 3 channels are available to choose from. Select one channel known to have an ensemble contained on it and select to manually.	All supported services on the ensemble are available to the user and work correctly (i.e. play audio if an audio service).
Service move to a new multiplex	6.5.1	Scan and find 2 ensembles (on 2 different channels) Select a service on 'a' channel, reconfigure the ensemble on this channel to lose this service. Simultaneously reconfigure the 'other' ensemble on the 'other' channel to add the service (same service details apart from the containing ensemble)	Manual tune to the 'other' channel, scan the whole band or select another service on the 'other' ensemble then the moved service is now available on the 'other' channel/ensemble

6.8 PERFORMANCE RELATED

Sub area	Test number	Channel	Test description	Valid result
Conducted sensitivity	7.1.1	5a	Test method in accordance with IEC 62104:2015 clause 7.3 and 7.4	Meets the requirement in IEC 62104:2015 clause 7.4.4
	7.1.2	5b		
	7.1.3	5c		
	7.1.4	5d		
	7.1.5	6a		
	7.1.6	6b		
	7.1.7	6c		
	7.1.8	6d		
	7.1.9	7a		
	7.1.10	7b		
	7.1.11	7c		
	7.1.12	7d		
	7.1.13	8a		
	7.1.14	8b		
	7.1.15	8c		
	7.1.16	8d		
	7.1.17	9a		
	7.1.18	9b		
	7.1.19	9c		
	7.1.20	9d		
	7.1.21	10a		
	7.1.22	10b		
	7.1.23	10c		
	7.1.24	10d		
	7.1.25	11a		

Sub area	Test number	Channel	Test description	Valid result
	7.1.26	11b		
	7.1.27	11c		
	7.1.28	11d		
	7.1.29	12a		
	7.1.30	12b		
	7.1.31	12c		
	7.1.32	12d		
	7.1.33	13a		
	7.1.34	13b		
	7.1.35	13c		
	7.1.36	13d		
	7.1.37	13e		
	7.1.38	13f		
Sensitivity using UEP-3 protection	7.1.39	11C	Set up a stream with the following parameters: UEP-3 / music (royalty free) / stereo / 128kbit/s stream / -97.7dBm to be conducted on channel 11C,	“Using a listening test (or equivalent method) in a period of least 10 seconds the sound image should be substantially intact and recognisable”.
Fading testing	7.2.1	12b	Test method in accordance with IEC 62104:2015 clause 7.8	Meets the requirement in IEC 62104:2015 clause 7.8.5 for an Urban channel
	7.2.2			Meets the requirement in IEC 62104:2015 clause 7.8.5 for a Rural channel

Sub area	Test number	Channel	Test description	Valid result
	7.2.3			Meets the requirement in IEC 62104:2015 clause 7.8.5 for an SFN channel
ACR	7.3.1	5a	Test method in accordance with IEC 62104:2015 clause 7.7	Meets the requirement in IEC 62104:2015 clause 7.7.2.4
	7.3.2	5b		
	7.3.3	5c		
	7.3.4	5d		
	7.3.5	6a		
	7.3.6	6b		
	7.3.7	6c		
	7.3.8	6d		
	7.3.9	7a		
	7.3.10	7b		
	7.3.11	7c		
	7.3.12	7d		
	7.3.13	8a		
	7.3.14	8b		
	7.3.15	8c		
	7.3.16	8d		
	7.3.17	9a		
	7.3.18	9b		
	7.3.19	9c		
	7.3.20	9d		
	7.3.21	10a		
	7.3.22	10b		
	7.3.23	10c		

Sub area	Test number	Channel	Test description	Valid result
	7.3.24	10d		
	7.3.25	11a		
	7.3.26	11b		
	7.3.27	11c		
	7.3.28	11d		
	7.3.29	12a		
	7.3.30	12b		
	7.3.31	12c		
	7.3.32	12d		
	7.3.33	13a		
	7.3.34	13b		
	7.3.35	13c		
	7.3.36	13d		
	7.3.37	13e		
	7.3.38	13f		
	7.3.39	ALL 38 channels affected	Test set up in accordance with IEC 62104:2015 clause 7.7, except that the interfering channel power level shall be set to the target for the 3rd adjacent channel. For each wanted channel, from 5A to 13F, the test shall be repeated with the interfering channel being each channel from 5A to 13F except the wanted channel and the 1st, 2nd and 3rd adjacent channels above and below the wanted channel.	The BER ≤ 10^{-4} for all wanted channels with all interferers
	7.3.40	12b wanted	Ensure that in situations where there is a strong 1st adjacent channel present (upper and lower) that all ensembles can be seen during a scan Low power test -	All ensembles are seen.

Sub area	Test number	Channel	Test description	Valid result
			wanted set at -90dBm adjacents both set at 30dB greater RF levels	
	7.3.41	12b wanted	Ensure that in situations where there is a strong 1st adjacent channel present (upper and lower) that all ensembles can be seen during a scan High power test - wanted set at -50dBm adjacents both set at 30dB greater RF levels	All ensembles are seen.

6.9 IN-VEHICLE SPECIFIC

Sub area	Test number	Test description	Valid result
SFN following	8.1.1	With an SFN set up correctly within the lab ensure that a radio can be switched between transmitters on the SFN without any interference to the radio	No breakup in audio is ever heard
	8.1.2	Within the coverage area of an on-air SFN, drive the radio along a route that is known to provide large variations in signal strength from different transmitters and ensure that there is no breakup in audio as the radio follows the SFN	No breakup in audio is ever heard
Service following DAB	8.2.1	An ensemble is set up on two different frequencies (MFN). The signal quality of each transmitter is varied in order to simulate a receiver travelling between coverage areas	The radio will follow between the two transmitters according to the best signal quality without intervention from the user
	8.2.2	Two ensembles are set up on different frequencies (co-timed); each contains a DAB service with identical audio content but different SId. A hard link (FIG 0/6) connecting the two services is signalled on each ensemble. The Linkage Actuator flag is set to 1 (activated). Frequency information for each ensemble is signalled (FIG 0/21). OE Service information is signalled (FIG 0/24). The signal quality of each ensemble is varied in order to simulate a receiver travelling between coverage areas	The radio will follow the hard link between the two ensembles according to the best signal quality without intervention from the user
	8.2.3	Set up as for 8.2.2 except that the Linkage Actuator flag is set to 0 (de-activated)	The radio will NOT alter the station that it is tuned to
	8.2.4	Set up as for 8.2.3. In addition third service is available on both ensembles and a soft link (FIG 0/6) connecting all three services is signalled on each ensemble. The Linkage Actuator flag for the soft link is set to 1 (active)	The radio will offer the soft link alternative when the signal quality of the tuned service becomes poor. The radio will not follow without user selection at the point of loss unless an overriding menu choice allows automatic selection of soft linked services

Sub area	Test number	Test description	Valid result
	8.2.5	Linkage Set toggle – check that brief deactivations do not lose the linkage database Set up as for 8.2.3. Tune to one service then reactivate the hard link. Within 5 seconds depower the tuned ensemble	The radio will follow the hard link without intervention from the user.
Service following FM (NOT required for adapters)	8.2.6	An ensemble is set up containing a DAB service with identical audio content to an FM-RDS service. The SId and PI codes are identical. The signal quality of the DAB ensemble and FM service are varied in order to simulate a receiver travelling between coverage areas	The radio will follow between DAB and FM according to the signal quality without intervention from the user; preference will be given to the DAB service when both signals are of adequate quality.
	8.2.7	An ensemble is set up containing a DAB service with identical audio content to an FM-RDS service. The SId and PI codes are different. A hard link (FIG 0/6) connecting the two services is signalled on the DAB ensemble. The Linkage Actuator flag is set to 1 (activated). Frequency information for the FM-RDS service is signalled (FIG 0/21). The signal quality of the DAB ensemble and FM service are varied in order to simulate a receiver travelling between coverage areas	The radio will follow the hard link according to the signal quality without intervention from the user; preference will be given to the DAB service when both signals are of adequate quality.
	8.2.8		
	8.2.9	An ensemble is set up containing a DAB service with different audio content to an FM-RDS service. The SId and PI codes are identical. A dead link (FIG 0/6) is signalled on the DAB ensemble. The signal quality of the DAB ensemble and FM service are varied in order to simulate a receiver travelling between coverage areas	Radio will not link to the FM station even though the SId and the PI are identical
Announcements	8.3.1	Ensure that the radio can respond to and play out an announcement indicated as traffic and using a supported cluster id where the radio is tuned to the correct service before the announcement is signalled	The announcement is played out fully and the radio returns to the previously tuned service when the announcement stops

Sub area	Test number	Test description	Valid result
	8.3.2	Ensure that the radio can decline an announcement where the announcement type and cluster id are not supported/selected/set	The radio plays out from the previously tuned service and remains uninterrupted by the announcement
	8.3.3	When not currently in DAB mode and the previously tuned DAB service had announcement support indicated with FIG 0/18 then the current audio mode (CD,USB etc.) shall respond to announcements as if tuned to the previously tuned service and the current audio will be interrupted	The announcement is played out and the radio returns to the previous audio mode (CD, USB etc.) when the announcement stops
	8.3.4	Ensure that if announcement support is available on the DAB service (as indicated with FIG 0/18) then the Radio shall not respond to any FM announcements that are available.	Announcements on FM services shall be ignored
	8.3.5	If announcement support is NOT available on the DAB service then the Radio shall not respond to any announcement that is made on an implicitly linked FM service (i.e. PI code = SId)	Announcements on the implicitly linked FM service shall be ignored
	8.3.6	Ensure that if the RF signal is lost for a short enough period of time for the announcement to still be present, the radio can recover and continue to play the announcement	The radio re-starts playing the announcement when the RF source is regained
	8.3.7	Ensure that if the RF signal is lost for a period of time longer than the announcement has left to run the radio can recover and continue to play the previously tuned service.	The radio plays out from the previously tuned service when the RF source is regained

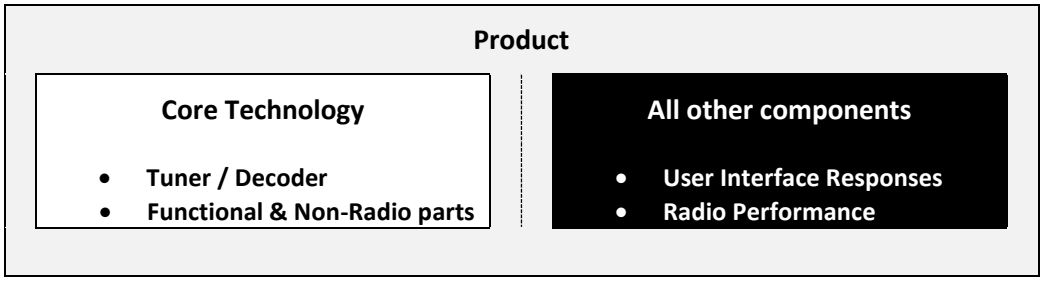
6.10 FM (ANALOGUE) RADIO

Sub area	Test number	Test description	Valid result
FM (NOT required for adapters)	9.1.1	Select 3 FM radio stations in the location where testing is taking place and tune to each and listen.	Audio plays for 5 minutes on each service without any interruptions or audio artefacts

7 TEST SPECIFICATION FOR PRODUCTS

7.1 INTRODUCTION

This clause 7 provides high level descriptions for the testing that provides evidence that the product meets the Minimum Requirements set out in clauses 4 and 5.



Manufacturers will need to determine the necessary test equipment and detailed procedures needed to conduct the tests, including sourcing of input streams (ETI files, IQ files, test signals), etc.

7.2 PRODUCT TYPES

The following types of DAB receiver are identified as forming the main groupings of products. Other types which come about in the future – or otherwise not listed here – will also be addressable by application of the test methods where appropriate.

Product Type	Capabilities and features
Transportable systems, Hi-fi and micro systems which may or may not include audio sources such as portable music players or CD players etc.	Rigid whip antennas or free wire antennas Built-in user interface with input finger control and visual display Antenna input or fixed antenna Mains powered, mains/adapter powered through a DC input socket or battery powered, or any of these Loudspeaker(s) for audio output Optional headphone and line outputs
Portable receivers, “lounge” or “kitchen” receivers	Rigid whip antennas or free wire antennas Built-in user interface with input finger control and visual display Antenna input or fixed antenna Mains powered, mains/adapter powered through a DC input socket or battery powered, or any of these Loudspeaker(s) for audio output Optional headphone and line outputs
Hand portable or pocket receivers	Mains / adapter powered through a DC input socket or battery powered or both Integral antenna or via headphone input With headphones and with or without a loudspeaker output
Self-contained aftermarket vehicle receivers (i.e. in-vehicle accessories)	Vehicle powered in the range 8 – 32 VDC User interface integrated or part of the product package Antenna input or fixed antenna Loudspeaker, line-out or external loudspeaker connectors
Self-contained in-vehicle receivers for OEM and aftermarket fitments	User interface integrated or part of the product package Antenna input Line-out and / or external loudspeaker connectors

7.3 PRODUCT DESIGN TARGETS VERSUS TEST CRITERIA

Receiver products shall be designed to meet the minimum requirements described in clauses 4 and 5. Products shall be tested against limits provided in this clause 7, using calculated measurement margins. This philosophy ensures that products at the design limits achieve the correct performance criteria to be granted use of the Mark.

7.4 APPLICABILITY OF THE TESTS

All types of receivers are required to pass the user interface responses tests described in annex B. The testing consists of four tests, the aims of which are:

- To ensure that the receiver can tune to, and identify an ensemble in Band-3, and play an audio service
- To ensure that the receiver can correctly add another ensemble in Band-3 to the service list
- To ensure that the user interface for scanning meets the Minimum Requirements
- To ensure that service labels are displayed correctly
- To ensure that dynamic labels are displayed correctly on domestic products (not required for in-vehicle products).

Domestic receivers supplied without an antenna and in-vehicle receivers with an antenna connector are required to pass the conducted sensitivity tests, as described in annex C clause C.5.

Domestic receivers supplied with an antenna – either fixed or detachable – and in-vehicle receivers with an antenna connector are required to pass the radiated sensitivity test with a signal induced at the antenna, as described in annex C clause C.8.

A fully representative sample of the receiver – such as the consumer would obtain from retail outlets – shall be tested.

The ETI files necessary to perform the tests are described in annex A. The tests require specialised test equipment and knowledge specific to radio product testing and shall be performed in an accredited test facility. The technical standards for the test facility are described in annex D.

A TEST STREAMS (NORMATIVE)

A.1 PRODUCT-TESTSTREAM-001_V1.0R2.ETI

This file contains a 120 minute long ETI (NI) test stream and contains the following services:

LABEL: PRODUCTMUX1 **EID**: CCCC

Service label **SId**	**Bit rate/codec** **Protection**	**Audio Content**	**Dynamic label (see note)**
Sine+ C000	128k AAC EEP-3A	1kHz tone -3dB FS mono image	AAC 128kbps 1kHz tone for sensitivity testing
OOI Music C001	128k MP2 UEP-3	Royalty free music* 0dB FS stereo image	Product Test<EOH> This message includes ABCDEFGHIJKLM<PWB>NOPQRSTUVWXYZ and many<PLB>short words to show all is well
AABBCCDDEEFFGGHH C002	128k MP2 UEP-3	1.5kHz tone	MP2 128kbps 1.5kHz tone
##&&@@[[]](( )) C003	96k AAC EEP-3A	2kHz tone	AAC 96kbps 2kHz tone
0011223344556677 C004	96k AAC EEP-3A	3kHz tone	AAC 96kbps 3kHz tone
8899++--**//==°° C005	96k AAC EEP-3A	4kHz tone	AAC 96kbps 4kHz tone
hhggffeeddccbbaa C006	64k AAC EEP-3A	5kHz tone	AAC 64kbps 5kHz tone
€€££$$__©©%%<<>> C007	64k AAC EEP-3A	6kHz tone	AAC 64kbps 6kHz tone
¡"¡"«¿«¿»?»?'!'! C008	64k AAC EEP-3A	7kHz tone	AAC 64kbps 7kHz tone
¡¡¿¿..,,::;;??!! C009	64k AAC EEP-3A	8kHz tone	AAC 64kbps 8kHz tone

*The music file is AKMusic AK033-“Good Time Grooves - Jazz n Funk”, track 11 “newyorkskyline”

NOTE: <PLB> indicates the "preferred line break" control code 0x0A; <EOH> indicates the "end of headline" control code 0x0B; <PWB> indicates the "preferred word break" control code 0x1F.

A.2 PRODUCT-TESTSTREAM-002_V1.0.ETI

This file contains a two minute long ETI (NI) test stream and contains the following services:

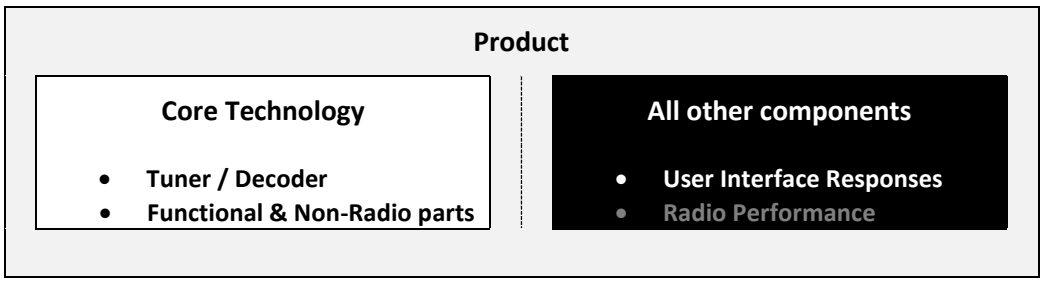
LABEL: PRODUCTMUX2 **EID**: DDDD

Service label SId	Bit rate/codec Protection	Audio Content	Dynamic label
ĂĞIJKLMNĂĞIJKLMN D001	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
ĄĘIŲĄĘIŲOPQROPQR D002	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
ĀĒĪŪSTVLĀĒĪŪSTVL D003	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
ÁÉÍÓÚÁÉÍÓÚĆĹŃĆĹŃ D004	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
ÀÈÌÒÙWXYÀÈÌÒÙWXY D005	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
ÂÊÎÔÛZÆŒÂÊÎÔÛZÆŒ D006	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
ÄËÏÖÜŸDØÄËÏÖÜŸDØ D007	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
ÃÕŇŘŚÝźUÃÕŇŘŚÝźU D008	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
ÅŮÇĢĶĻŅŞÅŮÇĢĶĻŅŞ D009	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
ĚČĎŇŘŠŤŽĚČĎŇŘŠŤŽ D010	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
ĖİĊĠŻĖİĊĠŻĐĦŁĐĦŁ D011	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
LŞŢLŞŢŐŰßŵÞŐŰßŵÞ D012	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
nmlkjiğănmlkjiğă D013	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
rqpouıęarqpouıęą D014	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
łvtsūīēãłvtsūīēã D015	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
ńÍćńÍćúóíéáúóíéá D016	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
yxwùòìèàyxwùòìèà D017	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
œæzûôîêâœæzûôîêâ D018	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
øŋÿüöïëäøŋÿüöïëä D019	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
uźýśŕñõãuźýśŕñõã D020	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
şņļķģçůåşņļķģçůå D021	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
žťšřňďčěžťšřňďčě D022	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone
łħđłħđżġċıėżġċıė D023	48k AAC EEP-3A	2kHz tone	AAC 48kbps 2kHz tone
þÿðűőþÿðűőţşlţşl D024	48k AAC EEP-3A	1kHz tone	AAC 48kbps 1kHz tone

B PRODUCT TEST FOR THE USER INTERFACE RESPONSES (NORMATIVE)

B.1 INTRODUCTION

This method description forms part of the Product test for the user interface responses.



B.2 USER INTERFACE TESTS

The testing consists of four tests, the aims of which are:

- To ensure that the receiver can tune to, and identify an ensemble in Band-3, and play an audio service
- To ensure that the receiver can correctly add another ensemble in Band-3 to the service list
- To ensure that the user interface for scanning meets the Minimum Requirements
- To ensure that service labels are displayed correctly
- To ensure that dynamic labels are displayed correctly on domestic products (not required for in-vehicle products).

The tests shall be performed in sequence, starting with Test 1 and continuing to Test 4. This procedure is required since the state of the product at the beginning of each test is dependent on the previous tests.

The text display shall render all characters from the Complete EBU Latin based repertoire. Products with a graphical display may use a font at the manufacturer's choice; it is recommended to apply accessibility considerations. Products with a starburst display with 14 or more segments shall render according to ETSI TS 101 756 Annex C, table C.3. Products with starburst displays with fewer than 14 segments are permitted to apply "best efforts rendering" to a small sub-set of 12 characters, as detailed in table B.1b. "Best efforts rendering" means that the character may be formed with a different set of segments to those indicated, but the character shall be recognisable.

The product will be exposed to the test streams and the behaviour of the product will be verified.

B.3 TEST STREAMS

The test streams described in annex A are used for these tests.

B.4 TEST EQUIPMENT NEEDED

The following equipment is needed:

- Signal generator suitable for playing an ETI file and for generating a range of RF output from ~-20dBm to -50dBm
- Suitable telescopic antenna attached to the signal generator or
- Other means to couple the signal to the receiver antenna input ensuring that the signal at the receiver is strong enough.

B.5 TEST 1 –SCAN ADD NEW SERVICES

- Objective
  - To prove that the receiver can recover and show all services within an ensemble and that the method for initiating the scan meets the Minimum Requirements.
- Method
  - Identify 2 DAB channels that are currently unused within the test vicinity. For the purposes here these will be labelled:
    - DAB_channel_1
    - DAB_channel_2
  - Setup the signal generator and start playing stream PRODUCT-TESTSTREAM-001_V1.0r2.eti
  - Set the RF level to be suitable for the receiver to tune (i.e. a strong signal e.g. -50dBm)
  - The aim is to set the level so that the receiver will tune without any errors occurring
  - Set the signal generator to DAB_channel_1
  - Turn on the receiver
  - Either reset the receiver to clear the service list or confirm that none of the services in the test streams already currently reside in the service list on the receiver
  - Leave the receiver in an ‘on’ state
  - On the receiver, initiate a scan
  - After the scan completes, navigate to the services and confirm that the service list on the receiver contains all services defined for PRODUCT-TESTSTREAM-001_V1.0r2.eti, see table B.1.
  - Leave the receiver in the ‘on’ state

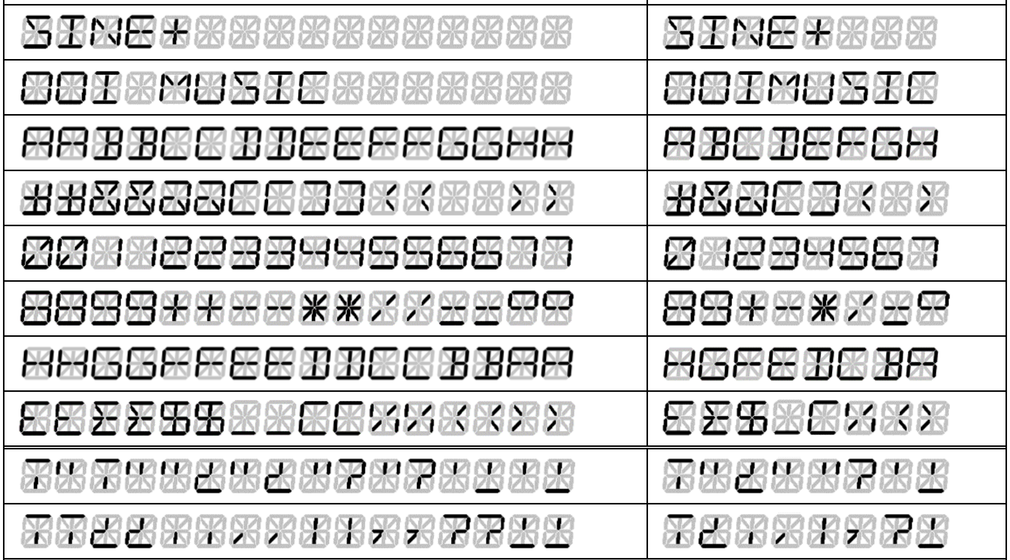
- Required results
  - The scan was initiated by the press of a single button on the device or, if it is a feature in a menu structure, it was in the top level of the menu, or one level down.
  - The product's service list contains all services; listed by either long (16 character) or short (8 character) label with every character rendered correctly according to table B.1. The order of presentation is at the manufacturer's choice.

Table B.1a – Display of service labels for Test 1: graphic display

16 character	8 character
Sine+	Sine+
OOI Music	OOIMusic
AABBCCDDEEFFGGHH	ABCDEFGH
##&&@@[[]](( ))	#&@[]( )
0011223344556677	01234567
8899++--**//==°°	89+-*/=°
hhggffeeddccbbaa	hgfedcba
€€££$$__©©%%<<>>	€£$_©%<>
¡"¡"«¿«¿»?»?'!'!	¡"¿«»?'!
¡¡¿¿..,,::;;??!!	¡¿.,:;?!

Table B.1b – Display of service labels for Test 1: starburst display

16 character	8 character



NOTE: For the bottom two service labels **only**, "best efforts rendering" is acceptable for displays with fewer than 14 active segments; "best efforts rendering" means that the character may be formed with a different set of segments to those indicated, but the character shall be recognisable.

B.6 TEST 2 –PLAY AUDIO AND VIEW LABEL FOR AUDIO SERVICE

- Objective
  - To ensure that the receiver can select a service, play out the audio and that the label for the audio playing is correct
- Method
  - Navigate through the receiver's service list and select "OOI Music".

  - Listen for Audio
  - Leave the receiver in the 'on' state
- Required results
  - "OOI Music" is labelled according to table B.1.
  - Audio is played out as expected (music is heard)

B.7 TEST 3 –DYNAMIC LABEL IS DISPLAYED AND DISPLAYED CORRECTLY

In-vehicle receivers are not required to pass this test.

- Objective
  - To ensure that the receiver can display a dynamic label and in doing so prove that the control codes are correctly handled by the receiver.
- Method
  - Via the product's information system, navigate to display the dynamic label
  - Compare the dynamic label displayed to the examples shown below:

Example A. On a single line, scrolling display, without headline capability:

```
Product Test This message includes ABCDEFGHIJKLMNOPQRSTUVWXYZ and many short
words to show all is well
```

NOTES: The <EOH> and <PWB> are not displayed at all; the <PLB> is displayed as a space.

Example B. On a single line, scrolling display, with headline capability (in this case showing the headline in bold):

Product Test This message includes ABCDEFGHIJKLMNOPQRSTUVWXYZ and many short words to show all is well

NOTES: recognising the <EOH> causes the text to appear in bold until the <EOH> is reached. The <EOH> and <PWB> are not displayed at all; the <PLB> is displayed as a space.

Example C. On a four-line display with 16 characters per line, with headline capability:

Product Test	**Product Test**	**Product Test**	**Product Test**	**Product Test**
This message	includes	ABCDEFGHIJKLM	NOPQRSTUVWXYZ	and many
includes	ABCDEFGHIJKLM	NOPQRSTUVWXYZ	and many	short words to
ABCDEFGHIJKLM	NOPQRSTUVWXYZ	and many	short words to	show all is well

NOTES: The headline is emphasised and remains in the top line of the display whilst the lower three lines scroll the message line by line. The <PWB> divides the long word. The <PLB> forces a new line.

Example D. On an eight-line display with 32 characters per line:

```
Product Test
This message includes
ABCDEFGHIJKLMNOPQRSTUVWXYZ and
many
short words to show all is well
```

NOTES: The headline is emphasised on the top line of the display which is large enough to display the rest of the label without scrolling. The <PWB> divides the long word. The <PLB> forces a new line in this case, but other presentations are also acceptable.

- Required results
  - All characters and formatting in the dynamic label are as expected. If a starburst display is used, the character correspondence shall be checked against TS 101 756 annex C.3.

B.8 TEST 4 –SCAN AND ADD ANOTHER ENSEMBLE

- Objective
  - To ensure that the receiver can discover another ensemble and show these new services within the service list
- Method
  - Turn the receiver off
  - Turn off the signal generator RF output
  - Setup the signal generator and start playing stream PRODUCT-TESTSTREAM-002_V1.0.eti
  - Set the signal generator to DAB_channel_2
  - Set the RF level to be suitable for the receiver to tune (i.e. a strong signal e.g. -50dBm)
    - The aim is to set the level so that the receiver will tune without any errors occurring
  - Turn on the receiver
  - On the receiver initiate a scan
  - After the scan completes, navigate to the services and confirm that the service list on the receiver contains all services defined for PRODUCT-TESTSTREAM-002_V1.0.eti
  - Turn the receiver off
- Required results
  - The product's service list contains all expected services; listed by either long (16 character) or short (8 character) label with every character rendered correctly according to table B.2. The order of presentation is at the manufacturer's choice. Note that the services from table B.1 may also be present.

Table B.2a – Display of additional service labels for Test 4: graphic display

16 character	8 character
ĂĞIJKLMNĂĞIJKLMN	ĂĞIJKLMN
ĄĘĮŲĄĘĮŲOPQROPQR	ĄĘĮŲOPQR
ĀĒĪŪSTVŁĀĒĪŪSTVŁ	ĀĒĪŪSTVŁ
ÁÉÍÓÚÁÉÍÓÚĆĹŃĆĹŃ	ÁÉÍÓÚĆĹŃ
ÀÈÌÒÙWXYÀÈÌÒÙWXY	ÀÈÌÒÙWXY
ÂÊÎÔÛZÆŒÂÊÎÔÛZÆŒ	ÂÊÎÔÛZÆŒ
ÄËÏÖÜŸŊØÄËÏÖÜŸŊØ	ÄËÏÖÜŸŊØ
ÃÕÑŔŚÝŹUÃÕÑŔŚÝŹU	ÃÕÑŔŚÝŹU
ÅŮÇĢĶĻŅŞÅŮÇĢĶĻŅŞ	ÅŮÇĢĶĻŅŞ
ĚČĎŇŘŠŤŽĚČĎŇŘŠŤŽ	ĚČĎŇŘŠŤŽ
ĖİĊĠŻĖİĊĠŻĐĦŁĐĦŁ	ĖİĊĠŻĐĦŁ
ĽŞŢĽŞŢŐŰßŵÞŐŰßŵÞ	ĽŞŢŐŰßŵÞ
nmlkjiğănmlkjiğă	nmlkjiğă
rqpouįęarqpouįęą	rqpouįęą
łvtsūīēāłvtsūīēā	łvtsūīēā
ńĺćńĺćúóíéáúóíéá	ńĺćúóíéá
yxwùòìèàyxwùòìèà	yxwùòìèà
œæzûôîêâœæzûôîêâ	œæzûôîêâ
øŋÿüöïëäøŋÿüöïëä	øŋÿüöïëä
uźýśŕñõãuźýśŕñõã	uźýśŕñõã
şņļķģçůåşņļķģçůå	şņļķģçůå
žťšřňďčěžťšřňďčě	žťšřňďčě
łħđłħđżġċıėżġċıė	łħđżġċıė
þŷðűőþŷðűőţşľţşľ	þŷðűőţşľ

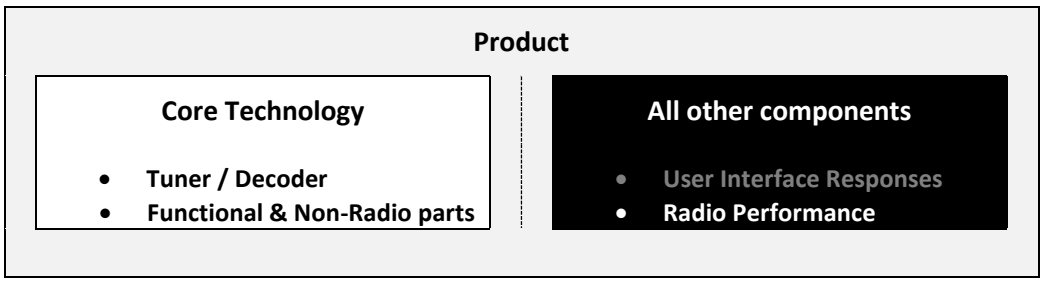
Table B.2b – Display of additional service labels for Test 4: starburst display

16 character	8 character
AGIJKLMNAGIJKLMN	AGIJKLMN
AEIUAEIUOPQROPQR	AEIUOPQR
AEIUSTVLAEIUSTVL	AEIUSTVL
AEIOUAEIOUCLNCLN	AEIOUCLN
AEIOUWXYAEIOUWXY	AEIOUWXY
AEIOUZÆŒAEIOUZÆŒ	AEIOUZÆŒ
AEIOUYNØAEIOUYNØ	AEIOUYNØ
AONRSYZUAONRSYZU	AONRSYZU
AUCGKLNSAUCGKLNS	AUCGKLNS
ECDNRSTZECDNRSTZ	ECDNRSTZ
EICGZEICGZDHLDHL	EICGZDHL
LSTLSTOURWPOURWP	LSTOURWP
NMLKJIGANMLKJIGA	NMLKJIGA
RQPOUIEARQPOUIEA	RQPOUIEA
LVTSUIEALVTSUIEA	LVTSUIEA
NLCNLCUOIEAUOIEA	NLCUOIEA
YXWUOIEAYXWUOIEA	YXWUOIEA
ŒÆZUOIEAŒÆZUOIEA	ŒÆZUOIEA
ØNYUOIEAØNYUOIEA	ØNYUOIEA
UZYSRNOAUZYSRNOA	UZYSRNOA
SNLKGCUASNLKGCUA	SNLKGCUA
ZTSRNDCEZTSRNDCE	ZTSRNDCE
LHDLHDZGCIEZGCIE	LHDZGCIE
PYDUOPYDUOTSLTSL	PYDUOTSL

C PRODUCT TEST FOR RADIO PERFORMANCE (NORMATIVE)

C.1 INTRODUCTION

This method description forms part of the Product test for radio performance.



C.2 RADIO PERFORMANCE TESTS

This method description forms part of the final receiver product test for radio performance, to show that the conducted or radiated sensitivity of a product meet the Minimum Requirements.

A “go / no go” RF power level pass / fail test method is used which is straightforward and time efficient.

The testing shall be carried out in carefully qualified and accredited test facilities, or by an alternate methodology which is approved by the operator of the certification scheme.

The four basic receiver types are tested as follows:

- Domestic products supplied with an antenna shall be tested using the radiated test method
- Domestic products supplied without an antenna shall be tested using the conducted test method
- In-vehicle products with an antenna connector shall be tested using the conducted test method
- In-vehicle products with a fixed antenna (i.e. no antenna connector is available) shall be tested as domestic products using the radiated test method

C.3 STANDARD TEST CONDITIONS

C.3.1 ENVIRONMENTAL

- Ambient Temperature 15 to 35 Deg C
- Relative Humidity 25 % to 75%
- Atmospheric pressure 86 kPa to 106 kPa
- Mains Voltage (EU) 230 V RMS ±10% 50Hz ±6%
- Mains Voltage (Non-EU) According to laboratory norms

C.3.2 EQUIPMENT AND TEST CONDITIONS REQUIRED AT ALL TEST FACILITIES

The Test Facility shall be familiar with the technical requirements to establish an environment which has the radio wave stability / planarity and absolute calibration in dBµV/m and with sufficient understanding of DAB receiver products to ensure measurement repeatability and accuracy.

The technical requirements for the test facility are given in annex D.

All equipment to be fully warmed up and operating within calibrated limits.

Exact equipment list and chamber details shall be provided by the test facility with test reports.

C.3.3 THE OOI "ONSET OF IMPAIRMENT" TEST

Products will typically not provide a means to determine the BER and therefore a test method is specified which allows the audio output of the product to be used to determine the radio performance.

The success / failure criterion is the quality of an audio tone delivered by the product, when supplied with a specifically encoded test stream. The audio output of the product is monitored over a 10 second period for the detection of audio impairments. An impairment is defined as any recognisable deviation from a constant amplitude audio tone; for example audio drops or gaps, or bursts of non-programme sound image – sometimes called "burbles", "tweets", "chirps" or "birdies".

The required test stream is provided in the ETI file detailed in annex A.1. The service named "Sine+" consists of a 1 kHz, sine wave -3dB FS, mono image, encoded as a 128 kbit/s AAC DAB+ service at protection level EEP-3A.

The audio level at the listeners ears shall be set to >75 dBA weighted SPL at 30 cm and the listening environment shall be a quiet room, or alternately using isolating headphones. Automated monitoring is also permitted.

C.4 RF TEST FREQUENCIES, PASS / FAIL LIMITS

The pass / fail limits are derived from:

1. The Minimum Requirements set out in clauses 4 and 5;
2. A correction factor of -1.1 dBm to take account of the difference between the BER of 10^{-4} and the point at which the test signal ceases to provide clean tone;
3. Measurement uncertainties. The Test Facility will identify the measurement uncertainties for radiated and conducted measurements and declare these in the results report for each receiver test.

C.4.1 ESTABLISHMENT OF THE CONDUCTED TEST THRESHOLD VALUE

The conducted test pass / fail signal threshold, Sc, at the connector of the receiver is the required target of −97.7 dBm plus the correction factor of −1.1 dBm plus a measurement uncertainty allowance Ytf.

Ytf is defined as the conducted uncertainty value (U.V.) calculated by the Test Facility in dB, and

Sc = −97.7 − 1.1 + |Ytf| (positive magnitude of Ytf) dBm

In any case, the maximum permitted value of |Ytf| is 0.4 dB.

C.4.2 ESTABLISHMENT OF THE RADIATED TEST THRESHOLD VALUE

The radiated test pass / fail signal threshold, Sr, is the required target of 34.4 + 20log10(F/220) dBµV/m plus the correction factor of −1.1 dBµV/m plus a measurement uncertainty allowance Xtf.

The Test Facility will seek to minimise the uncertainties for setting of field strength intensity in the test zone and for the OOI measurement process, by choice of equipment and methods and will calculate and report the uncertainty value (U.V.) which prevails at the time of test.

Xtf is defined as the radiated uncertainty value (U.V.) for the Test Facility in dB, and

Sr = 34.4 + 20log10(F/220) − 1.1 + |Xtf| (positive magnitude of Xtf)

In any case, the maximum permitted value of |Xtf| is +4 dB.

C.5 METHOD FOR CONDUCTED SENSITIVITY GO/ NO GO TEST

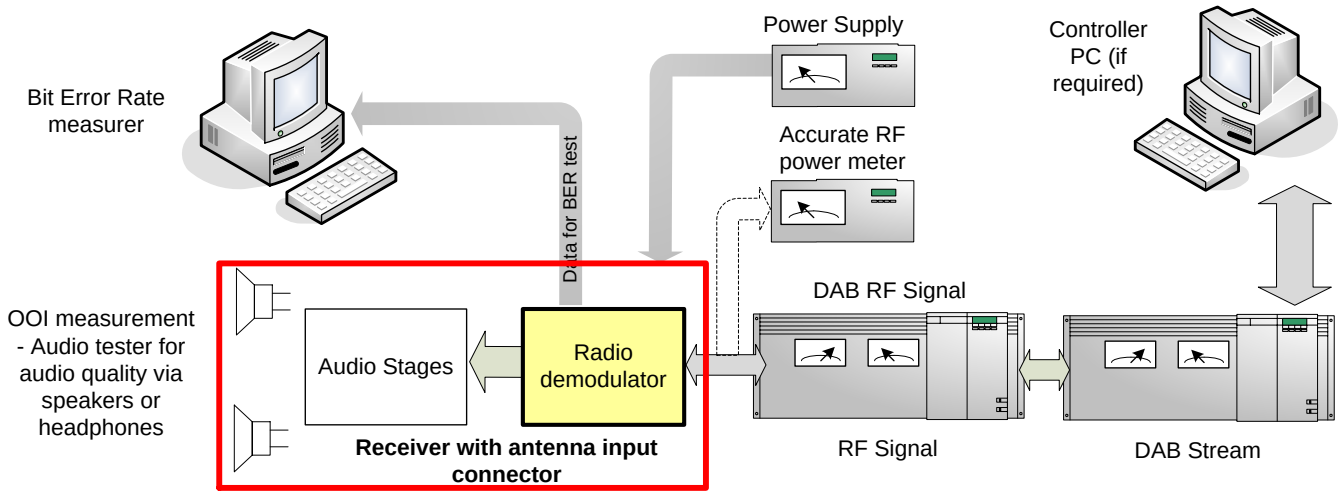


Figure C.1: Conducted Test set up for domestic and in-vehicle receivers

C.5.1 METHOD OF CONDUCTED SIGNAL MEASUREMENT USING ACOUSTIC OOI

NB The OOI test performed at a go / no-go test signal level is a straightforward test to apply.

C.5.1.1 INITIAL CONDITIONS- MEASUREMENT UNCERTAINTY CALCULATION

In order to maximise measurement accuracy and repeatability certain test conditions are stipulated and must be adhered to. The measurement uncertainty for the measurement of onset of impairment is ± 0.3 dB with a high confidence level.

The Uncertainty Value – U.V. (for the whole process, including power level and OOI test) will be established by the test facility and if <0.4dB, used to calculate the dBm in column C of the table in clause C.6; if equal or greater than 0.4dB, then column E will be used. The U.V. will be recorded in box Y of the table in clause C.6.

C.5.1.2 EMPIRICAL METHOD – 1 KHZ TONE, DAB+, EEP-3A

1. The measurement set-up is given in figure C.1 above for the purpose of explanation of method.
2. The signal generator shall be connected to the RF input of the receiver under test.
3. The acoustic output shall be monitored through speakers or headphones connected to the receiver.
4. Check that the set-up is working with these steps:
    a. Set the RF input power level to -80 dBm. Set the frequency to channel 10A.
    b. Play the specified stream PRODUCT-TESTSTREAM-001_V1.0r2.eti.
    c. Tune the receiver to channel 10A or initiate a scan. Select the service "Sine+"
    d. Expected result - the 1 kHz tone can be heard with no impairments.
    e. Set the RF input power level to -110 dBm.
    f. Expected result - 1 kHz cannot be heard (the receiver may also display that the service is not available).

   If the results are as expected, continue with the measurement:

5. Using the table in clause C.6, set the generator frequency to channel 5A, given in column B. Repeat the following steps for test numbers 1 to 38:
6. Set the RF input power level to the value in column C or column E.
7. Tune the receiver to the set frequency or initiate a scan.
8. Select the service "Sine+" - if it is not in the service list then mark "Fail" against this frequency and go to step 11 else continue.
9. A 1 kHz tone should be heard - if it is not then mark "Fail" against this frequency and go to step 11 else continue.
10. Listen for audio impairments in the 1 kHz tone over a period of 10s - if no impairments are heard then mark "Pass" against this frequency else mark "Fail".
11. Set the generator to the next frequency given in column B. Continue at step 7.

Results must be submitted in a standardised way using the test report format in clause C.6.

C.5.1.3 EMPIRICAL METHOD – MUSIC STREAM, MP2, UEP-3.

1. The measurement set-up is given in Figure C1 above for the purpose of explanation of method.
2. The signal generator shall be connected to the RF input of the receiver under test.
3. Using the table in clause C.9, set the generator frequency to channel 11C, given column B.
4. Set the RF input power level to the value corresponding to test number 39, column C or column E (**important**: this value is **not** the same as for the Sine+ test).
5. Play the specified stream PRODUCT-TESTSTREAM-001_V1.0r2.eti.
6. Tune the receiver to the set frequency or initiate a scan.
7. Select the service "OOI Music"
8. During a listening period of least 10 seconds, verify that the sound is substantially intact and recognisable. In this case mark the test as a "Pass"; otherwise mark as a "Fail".

C.6 CONDUCTED TEST RESULT TEMPLATE

Receiver Make Model and type and serial number ……..		Mains voltage / Frequency ……..
Date and time of test ……..	Test personnel names: …….. ……..	Box Y. Measurement uncertainty value, (U.V.) Ytf in dB for 95% confidence: ……..
List attached files / diagrams / Photos / video clips: ……..		Other Calibration data / test equipment ……..

Use Column C and D **OR** Column E and F

	A	B	C	D	E	F
Test No.	**Channel**	**Frequency (MHz)**	**Input power (dBm) using U.V. in Box X**	**PASS / FAIL**	**Input power (dBm) using maximum allowed limit**	**PASS / FAIL**
"Sine+", AAC, EEP-3A						
1	**5A**	174.928	(–98.8+Ytf)		-98.4	
2	**5B**	176.640	(–98.8+Ytf)		-98.4	
3	**5C**	178.352	(–98.8+Ytf)		-98.4	
4	**5D**	180.064	(–98.8+Ytf)		-98.4	
5	**6A**	181.936	(–98.8+Ytf)		-98.4	
6	**6B**	183.648	(–98.8+Ytf)		-98.4	
7	**6C**	185.360	(–98.8+Ytf)		-98.4	
8	**6D**	187.072	(–98.8+Ytf)		-98.4	
9	**7A**	188.928	(–98.8+Ytf)		-98.4	
10	**7B**	190.640	(–98.8+Ytf)		-98.4	
11	**7C**	192.352	(–98.8+Ytf)		-98.4	
12	**7D**	194.064	(–98.8+Ytf)		-98.4	
13	**8A**	195.936	(–98.8+Ytf)		-98.4	
14	**8B**	197.648	(–98.8+Ytf)		-98.4	
15	**8C**	199.360	(–98.8+Ytf)		-98.4	
16	**8D**	201.072	(–98.8+Ytf)		-98.4	
17	**9A**	202.928	(–98.8+Ytf)		-98.4	
18	**9B**	204.640	(–98.8+Ytf)		-98.4	
19	**9C**	206.352	(–98.8+Ytf)		-98.4	
20	**9D**	208.064	(–98.8+Ytf)		-98.4	
21	**10A**	209.936	(–98.8+Ytf)		-98.4	
22	**10B**	211.648	(–98.8+Ytf)		-98.4	
23	**10C**	213.360	(–98.8+Ytf)		-98.4	

24	**10D**	215.072	(–98.8+Ytf)		-98.4	
25	**11A**	216.928	(–98.8+Ytf)		-98.4	
26	**11B**	218.640	(–98.8+Ytf)		-98.4	
27	**11C**	220.352	(–98.8+Ytf)		-98.4	
28	**11D**	222.064	(–98.8+Ytf)		-98.4	
29	**12A**	223.936	(–98.8+Ytf)		-98.4	
30	**12B**	225.648	(–98.8+Ytf)		-98.4	
31	**12C**	227.360	(–98.8+Ytf)		-98.4	
32	**12D**	229.072	(–98.8+Ytf)		-98.4	
33	**13A**	230.784	(–98.8+Ytf)		-98.4	
34	**13B**	232.496	(–98.8+Ytf)		-98.4	
35	**13C**	234.208	(–98.8+Ytf)		-98.4	
36	**13D**	235.776	(–98.8+Ytf)		-98.4	
37	**13E**	237.488	(–98.8+Ytf)		-98.4	
38	**13F**	239.200	(–98.8+Ytf)		-98.4	
"OOI Music", MP2, UEP-3						
39	**11C**	220.352	(–97.7+Ytf)		-97.3	

C.7 CONDUCTED MEASUREMENT UNCERTAINTY CALCULATION (EXAMPLE)

Item			**dB**	dB squared
1	Uncertainty in baseband signal and RF level from Signal gen	Assume a Power meter is used to set level	0.25	0.0625
2	Uncertainty loss (variability) in conducted RF match.	Use matching pad.	0	0
3	Variation in sens due to the variability in noise / self interference of the receiver		0.2	0.04
4	Variability in the Acoustic OOI measurement		0.25	0.0625
		Sum of squares		0.165
		Root sum squares ± dB		0.4

C.8 METHOD FOR RADIATED SENSITIVITY GO / NO GO TEST

This clause describes the free field test method in a large screened room (FAR/SAR) with a transmit antenna radiator propagation or a GTEM cell with guided wave propagation.

C.8.1 FAR/SAR TEST SETUP

In order to obtain the required test accuracy and repeatability, this method is to be used in Accredited Test Facilities and in-house test departments meeting the standards required for receiver testing and free field, radiated electromagnetic wave conditions. See Appendix D for these technical requirements.

The radiated test employs the threshold levels in dBµV/m, see the table in clause C.9.

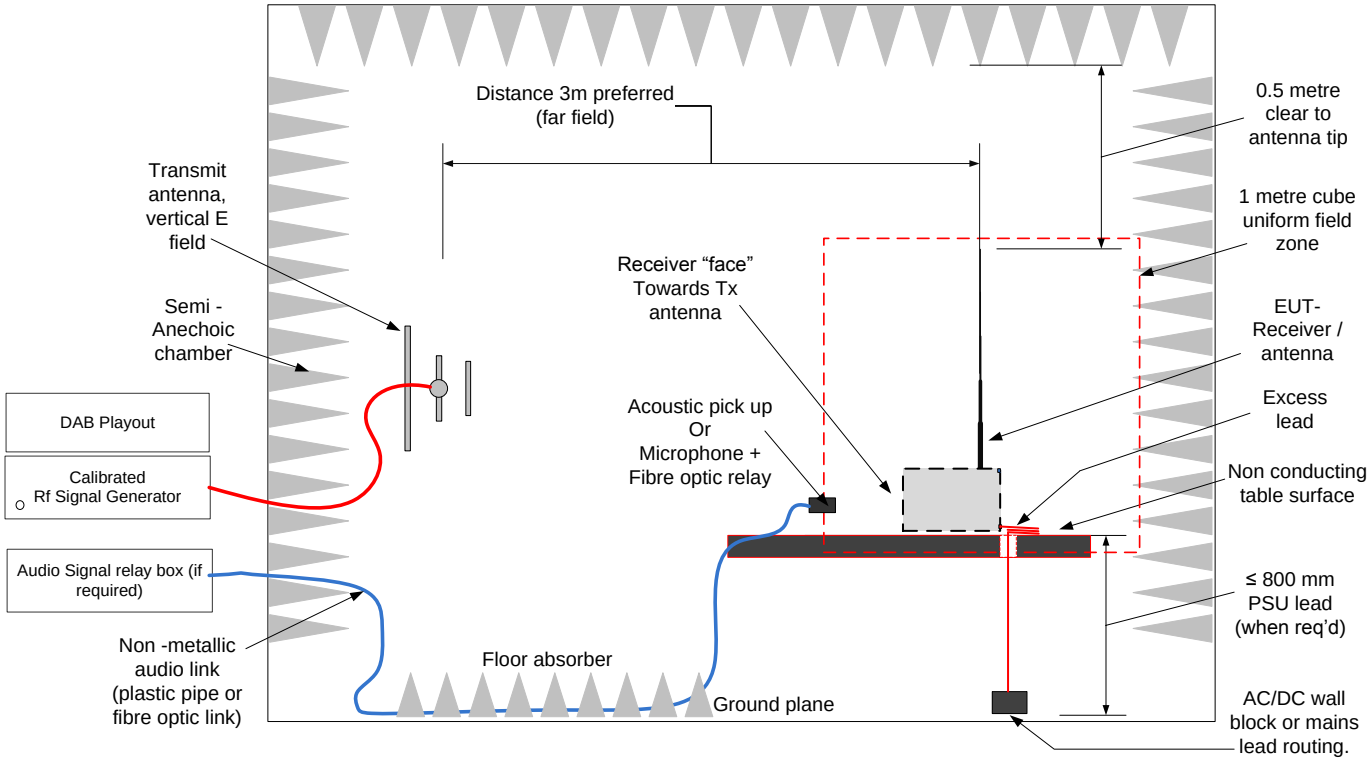


Figure C.2 – Generalised receiver configuration in large anechoic test chamber.

N.B. It is beneficial to have a uniform field volume proportionate to the size of the EUT - 1m x1m x1m is a minimum.

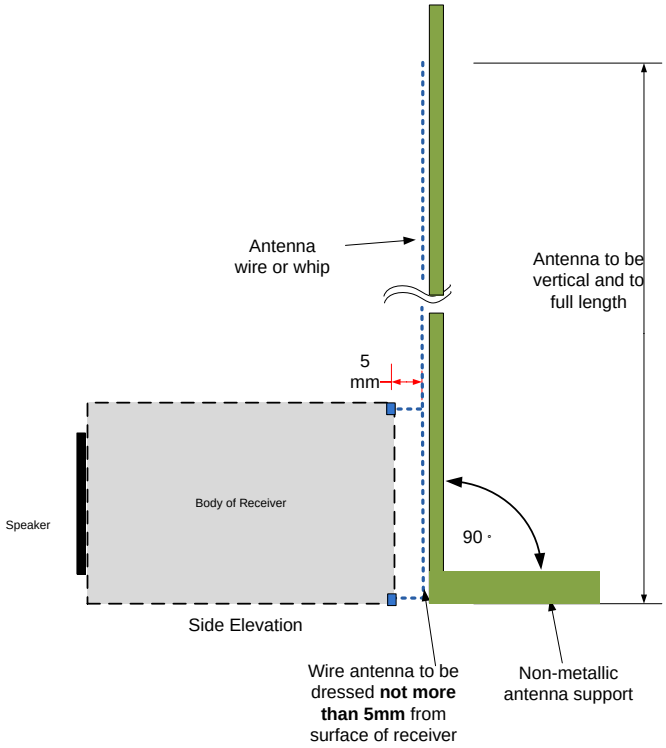


Figure C.3 – Antenna and radio body positioning standard (e.g. for non rigid whip antennas)

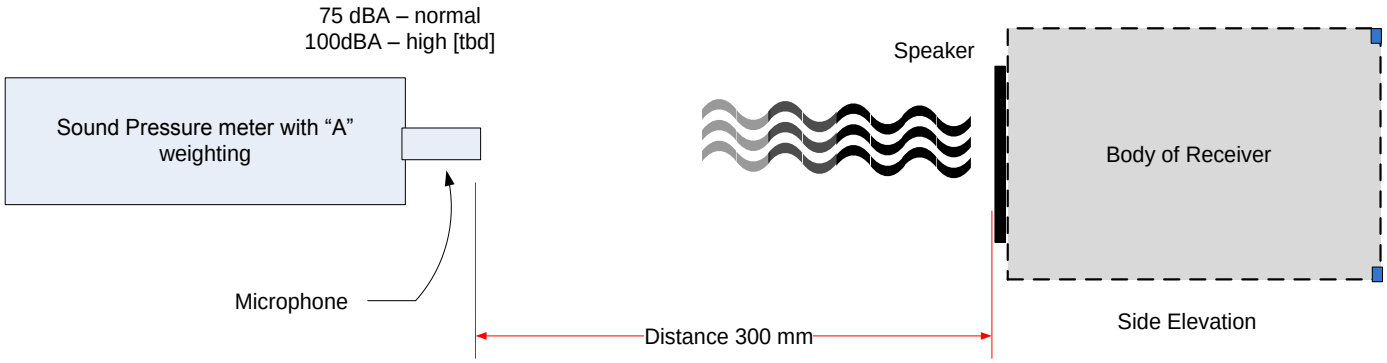


Figure C.4 –Measuring Speaker sound level. To set a known acoustic level and hence audio PA drive.

This may be important as the acoustic PA stage - if class D, may create RF noise and the load on the PSU may similarly cause RF noise which can affect sensitivity.

Note, it can be important to control Mains and PSU leads as they may act both as an antenna counterpoise, and as a radiative element for interference which can influence the overall sensitivity result.

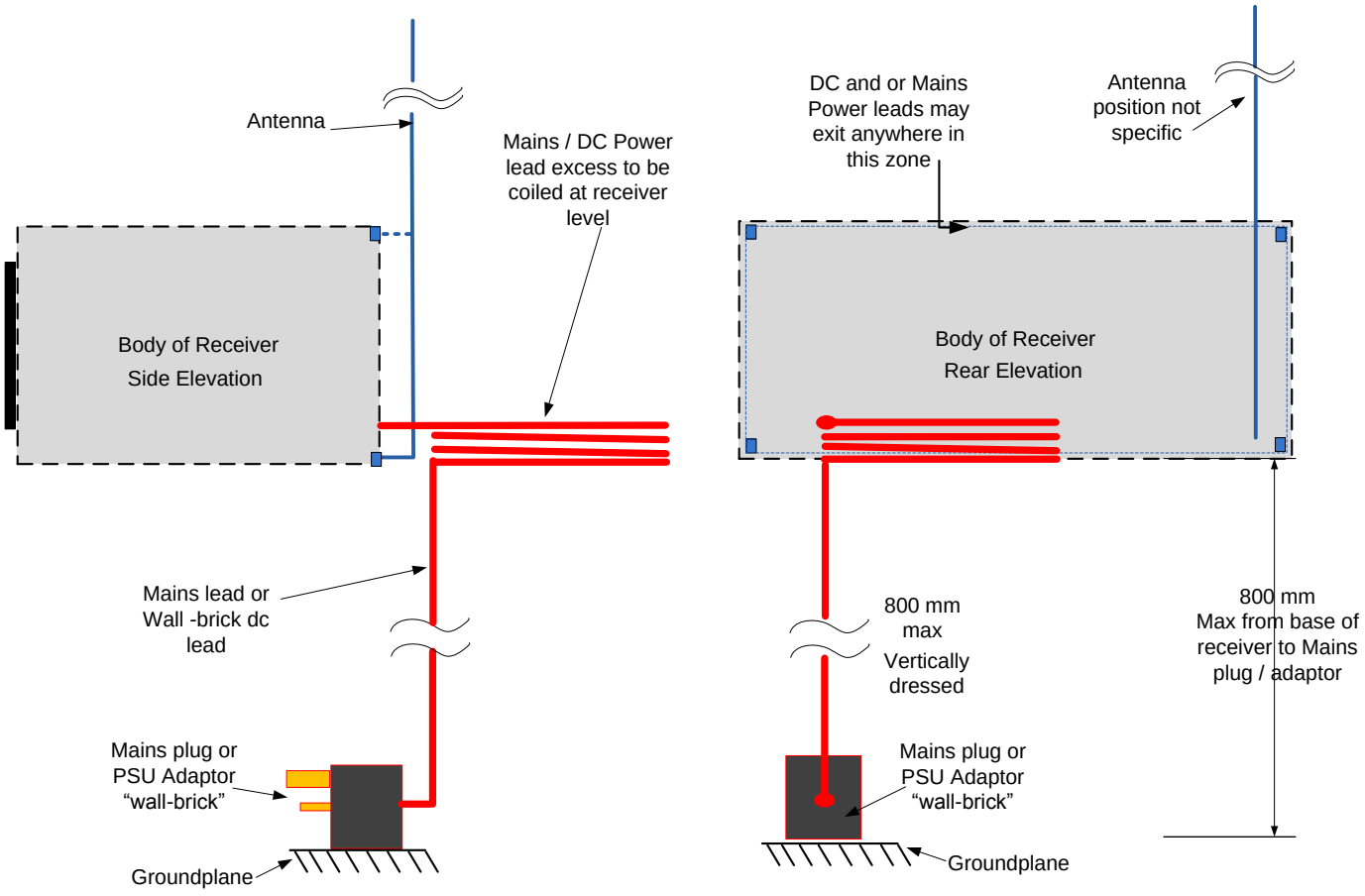


Figure C.5 – power supply lead positioning 1

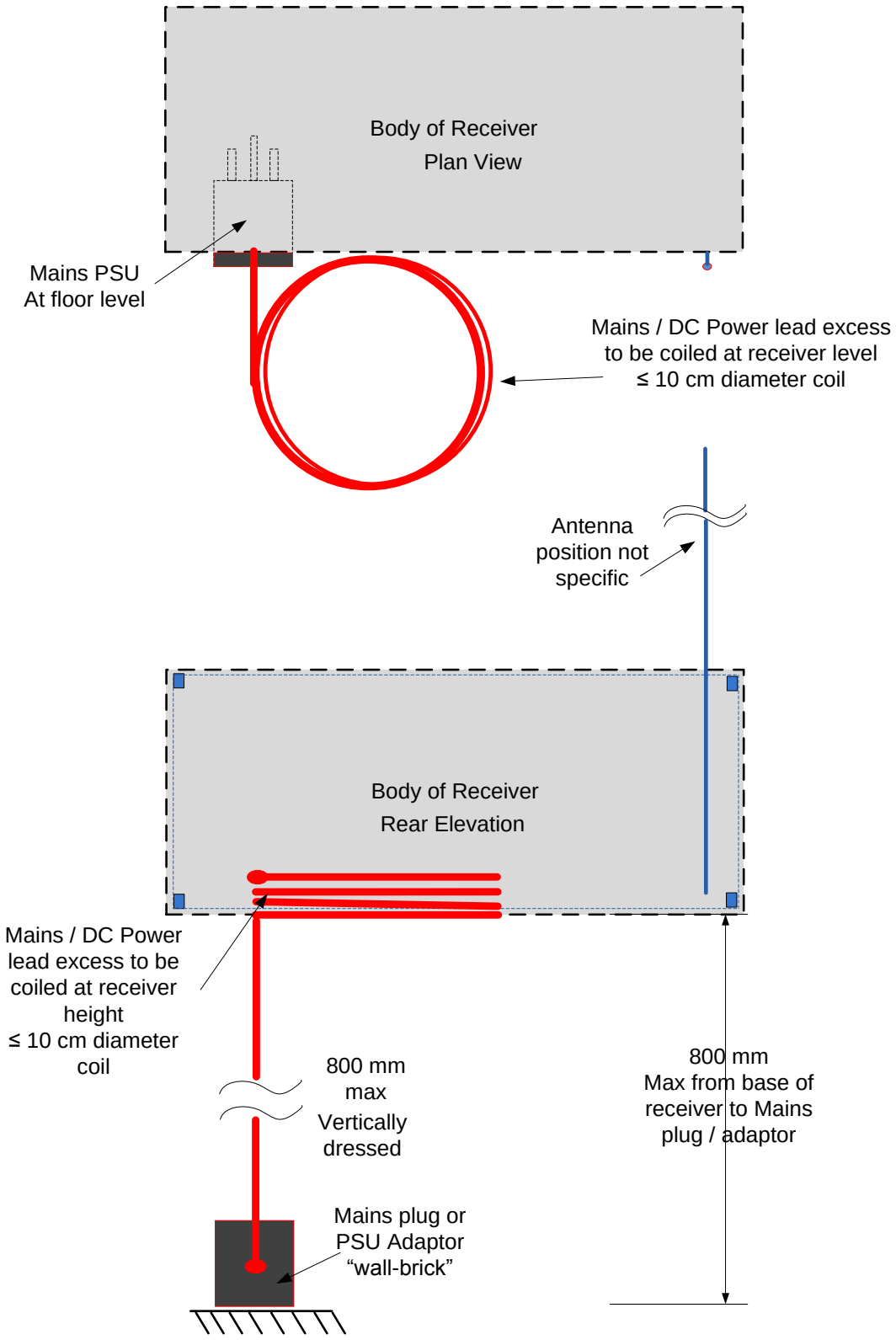


Figure C.6 – Excess Power Supply (and other) Lead Positioning 2 – coiled at the receiver, not at mains end.

Figure C.5 and C.6 show how excess length in PSU and other (audio, data, USB) leads should be arranged.

Any excess cable should be bundled as per CISPR 16-2-3 section 7.2.5.2. This requires the cable to be placed in a figure of 8 of approximately 30-40cm length tied in the middle. The cable is then connected to the exit point of the TEM cell as per the test procedure.

C.8.2 GTEM TEST SETUP

In order to obtain the required test accuracy and repeatability, this method is to be used in Accredited Test Facilities and in-house test departments meeting the standards required for receiver testing and free field, radiated electromagnetic wave conditions. See Appendix D for these technical requirements.

A GTEM cell with sufficiently large internal dimensions may be considered for the receiver equipment radiated test. The dimensions must allow accommodation of the equipment with a stable zone of field distribution. The GTEM should allow deployment of the receiver, antenna and any power supply and leads to be arranged in a configuration equivalent to that of the FAR / SAR arrangement.

The radiated test employs the threshold levels in dBµV/m, see the table in clause C.9.

Test arrangement in GTEM cell

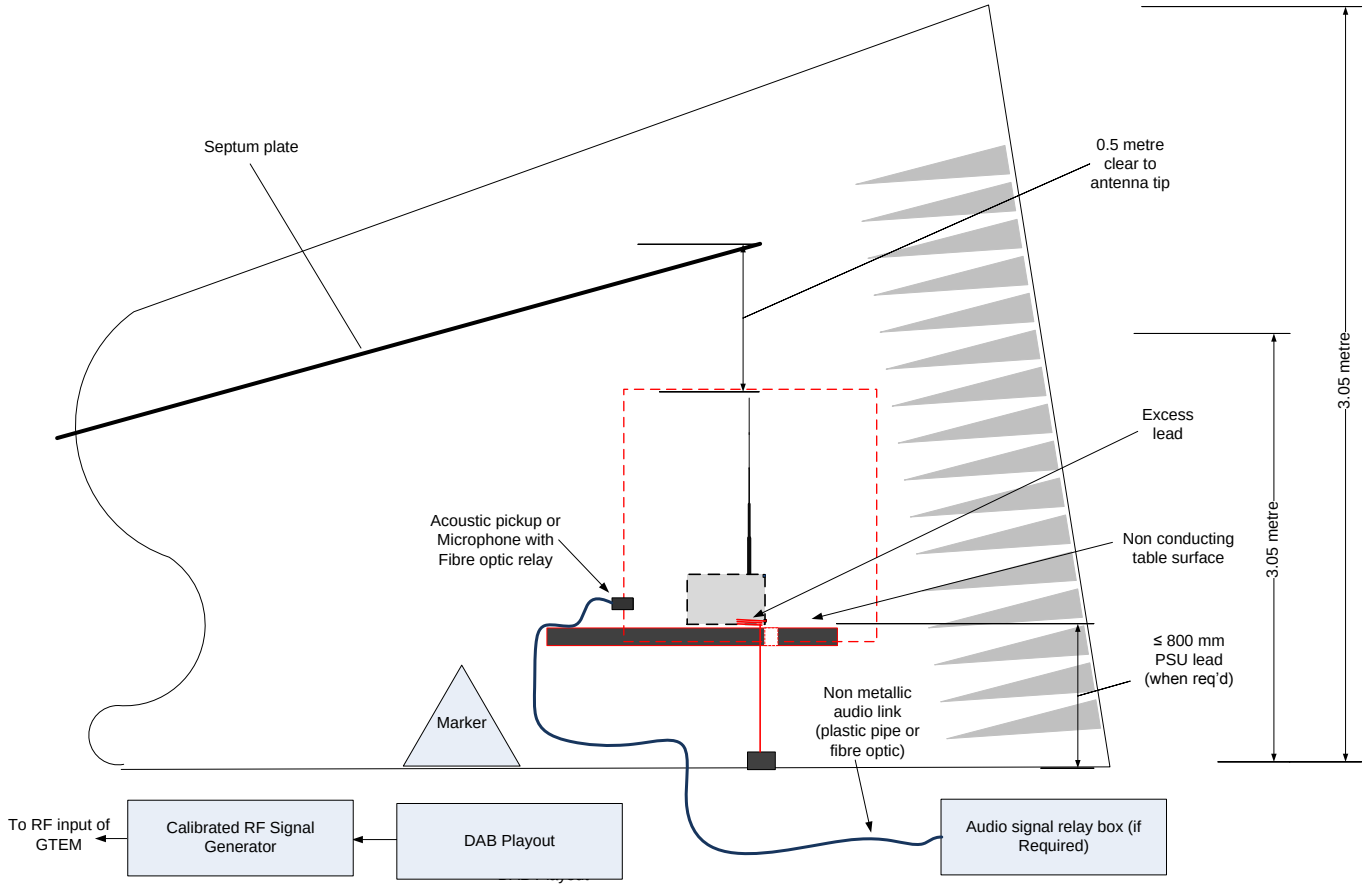


Figure C.7 – Generalised receiver configuration in GTEM cell.

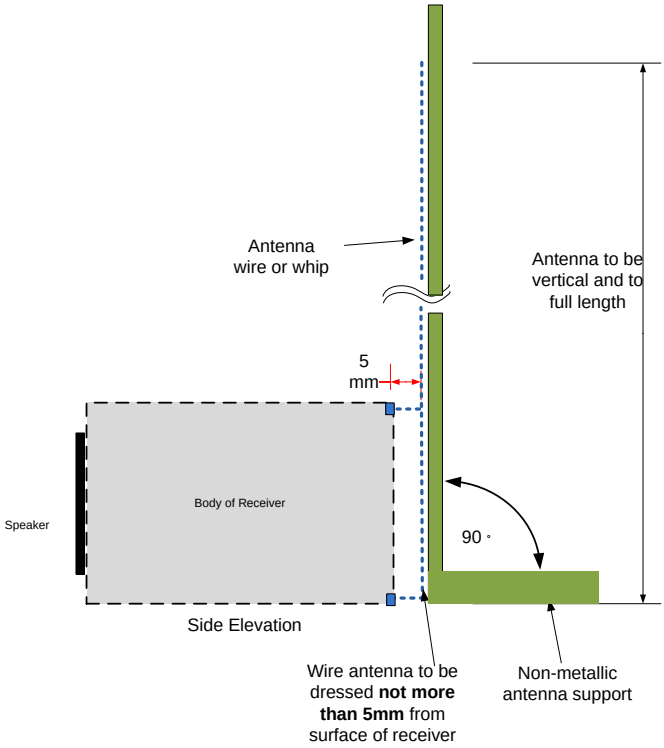


Figure C.8 – Antenna and radio body positioning standard (e.g. for non rigid whip antennas)

The device under test must be placed so that its antenna is on the centreline (long axis) of the GTEM cell, and in the "operating plane" of the cell. The operating plane is perpendicular to the longitudinal axis of the cell and its position is dependent on the size of the particular GTEM cell in use.

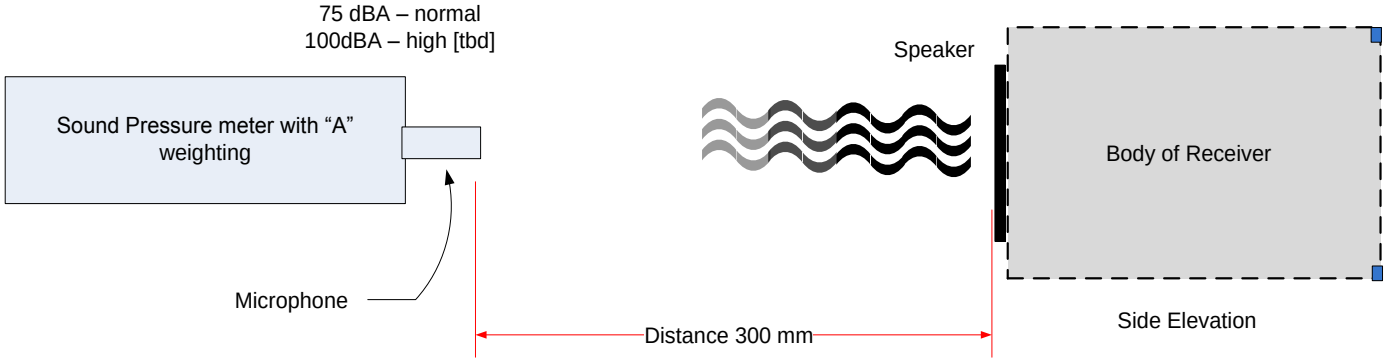


Figure C.9 – Measuring Speaker sound level. To set a known acoustic level and hence audio PA drive.

This may be important as the acoustic PA stage- if class D, may create RF noise and the load on the PSU may similarly cause RF noise which can affect sensitivity.

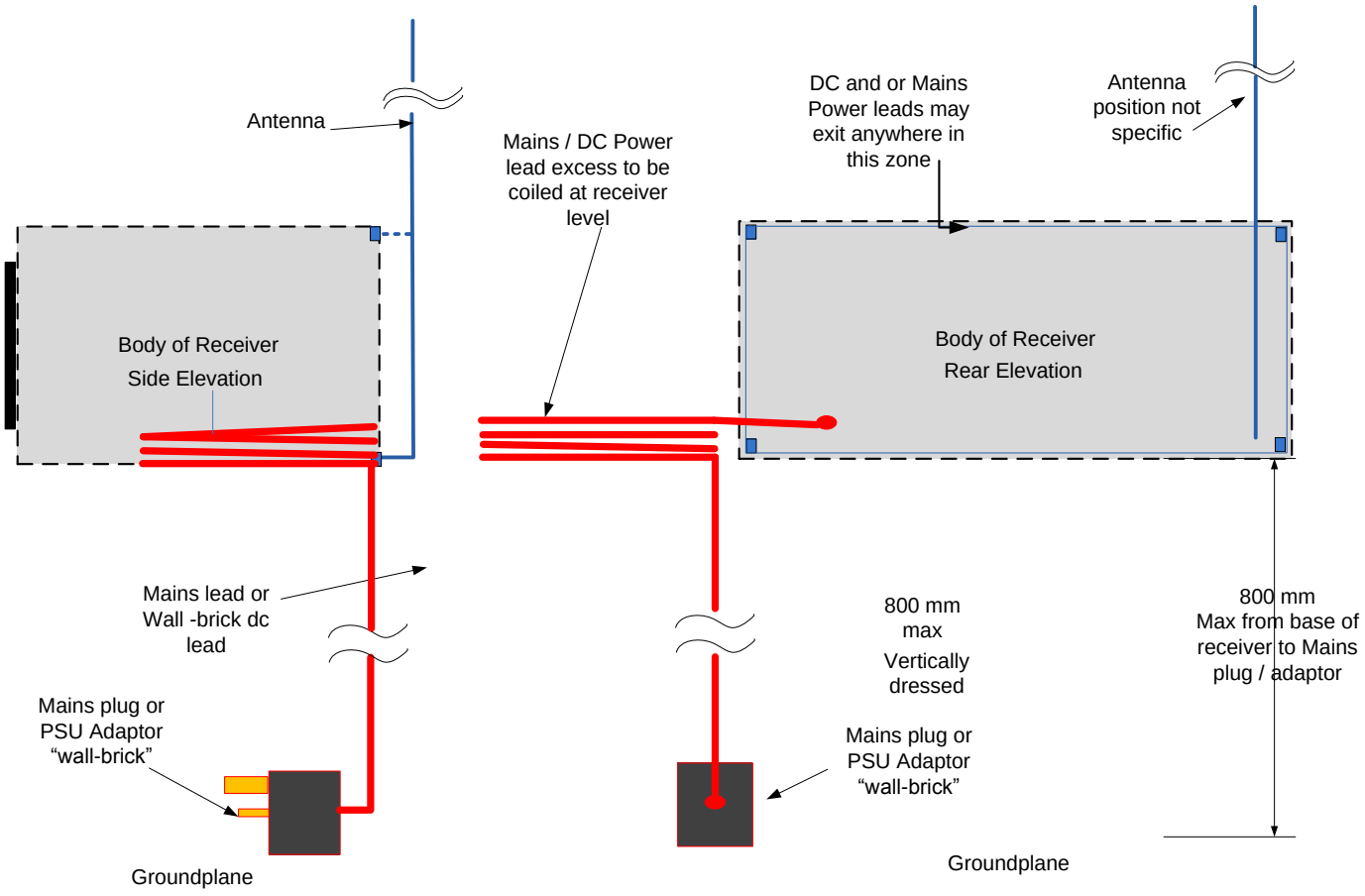


Figure C.10 – GTEM Power Supply Lead Positioning

Due to the longitudinal field component generated in a GTEM cell, any cables connected to the EUT should not be routed along this axis. The longitudinal axis is defined as the direction of the wave propagation from the input to the cell along its length.

To avoid this, most of the cable should be dressed along the y axis (the vertical axis in line with the electric field) or diagonally down to the mains or wall plate as much as possible with the rest along the x axis (the horizontal axis in line with the magnetic field).

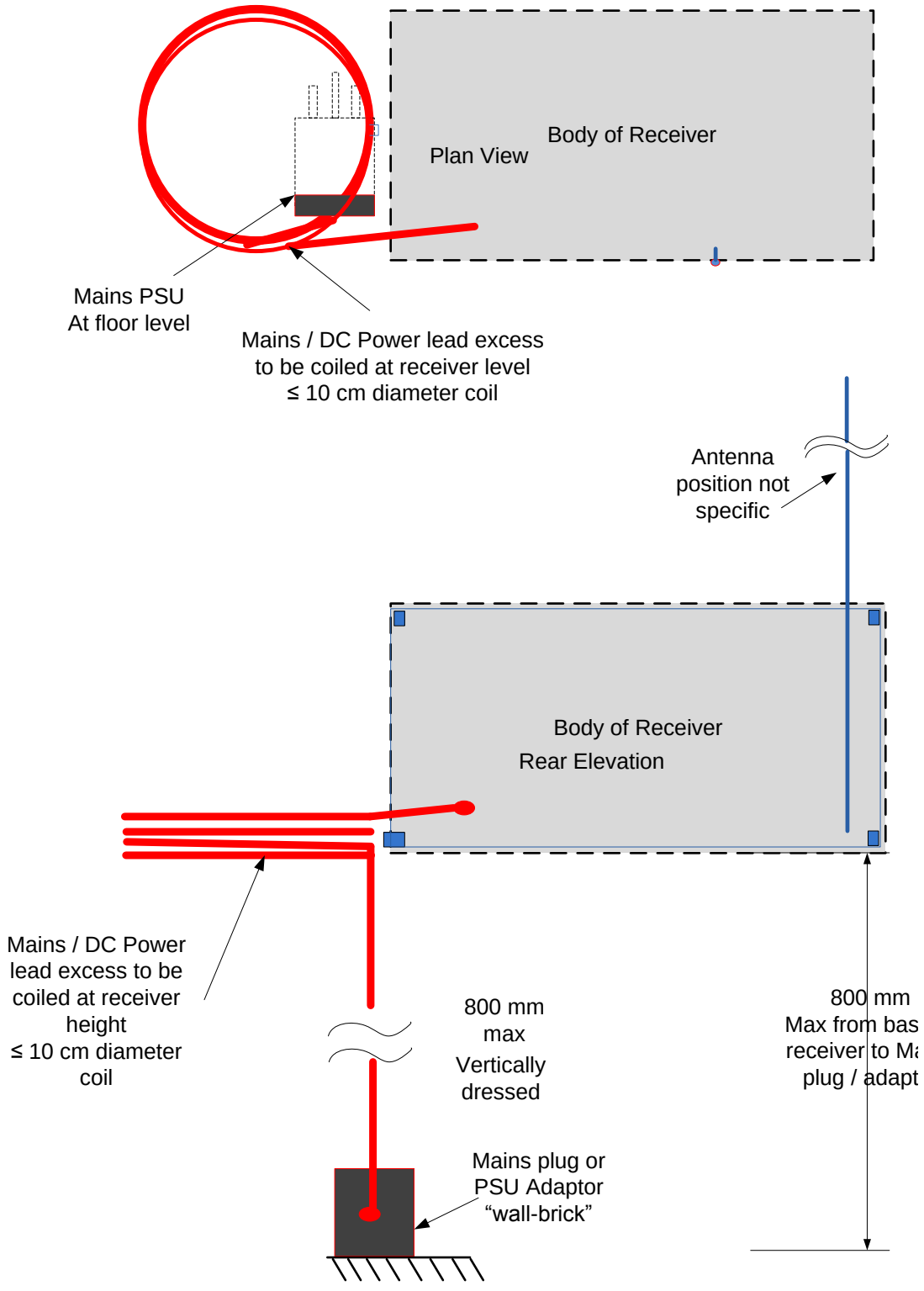


Figure C.11 – Excess Power Supply (and other) Lead – coiled at the receiver, not at mains end

C.8.3 METHOD OF RADIATED SIGNAL MEASUREMENT USING ACOUSTIC OOI

C.8.3.1 INITIAL CONDITIONS - MEASUREMENT UNCERTAINTY CALCULATION

In order to maximise measurement accuracy and repeatability certain test conditions are stipulated and must be adhered to. The measurement uncertainty for the measurement of onset of impairment is ± 0.3 dB with a high confidence level.

The Uncertainty Value – U.V. (for the whole process, including field strength and OOI test) will be established by the test facility and if <4 dB, used to calculate the dBµV/m in column C of the table in clause C.9. If equal or greater than 4dB, then column E will be used. The U.V. will be recorded in box X of the table in clause C. 9.

C.8.3.2 EMPIRICAL METHOD – 1 KHZ TONE, DAB+, EEP-3A

1. The measurement set-up is given in figures C.2 to C.6 for FAR/SAR and figures C.7 to C.11 for GTEM.
2. The signal generator shall be connected to the RF input of the chamber.
3. The audio level from the speaker should be controlled to achieve a 75dBA SPL at 300mm distance. The acoustic output shall be monitored through the sound link relay to speakers or headphones outside the chamber.
4. Check that the set-up is working with these steps:
    a. Set the field strength to 55 dBµV/m. Set the frequency to channel 10A.
    b. Play the specified stream PRODUCT-TESTSTREAM-001_V1.0r2.eti.
    c. Tune the receiver to channel 10A or initiate a scan. Select the service "Sine+"
    d. Expected result - the 1 kHz tone can be heard with no impairments.
    e. Set the field strength to 15 dBµV/m.
    f. Expected result - 1 kHz cannot be heard (the receiver may also display that the service is not available).

   If the results are as expected, continue with the measurement:

5. Using the table in clause C.9, set the generator frequency to channel 5A, given in column B. Repeat the following steps for test numbers 1 to 38:
6. Set the field strength to the value in column C or column E.
7. Tune the receiver to the set frequency or initiate a scan.
8. Select the service "Sine+" - if it is not in the service list then mark "Fail" against this frequency and go to step 11 else continue.
9. A 1 kHz tone should be heard - if it is not then mark "Fail" against this frequency and go to step 11 else continue.
10. Listen for audio impairments in the 1 kHz tone over a period of 10s - if no impairments are heard then mark "Pass" against this frequency else mark "Fail".
11. Set the generator to the next frequency given in column B. Continue at step 6.

Results shall be submitted in a standardised way using the test report format in clause C.9.

C.8.3.3 EMPIRICAL METHOD – MUSIC STREAM, MP2, UEP-3.

1. The measurement set-up is given in figures C.2 to C.6 for FAR/SAR and figures C.7 to C.11 for GTEM.
2. The signal generator shall be connected to the RF input of the chamber.
3. The audio level from the speaker should be controlled to achieve a 75dBA SPL at 300mm distance. The acoustic output shall be monitored through the sound link relay to speakers or headphones outside the chamber.
4. Using the table in clause C.9, set the generator frequency to channel 11C, given column B.
5. Set the field strength to the value corresponding to test number 39, column C or column E (**important**: this value is **not** the same as for the Sine+ test).
6. Play the specified stream PRODUCT-TESTSTREAM-001_V1.0r2.eti.
7. Tune the receiver to the set frequency or initiate a scan.
8. Select the service "OOI Music"
9. During a listening period of least 10 seconds, verify that the sound is substantially intact and recognisable. In this case mark the test as a "Pass"; otherwise mark as a "Fail".

C.9 RADIATED TEST RESULT TEMPLATE

Receiver Make Model and type and serial number ……..		Mains voltage / Frequency ……..
Date and time of test ……..	Test personnel names: …….. ……..	Box X. Measurement uncertainty value, (U.V.) Xtf in dB for 95% confidence: ……..
List attached files / diagrams / Photos / video clips: ……..		Other Calibration data / test equipment ……..

Use Column C and D **OR** Column E and F

	A	B	C	D	E	F
Test No.	**Channel**	**Frequency (MHz)**	**Field strength (dBµV/m) using U.V. in Box X**	**PASS / FAIL**	**Field strength (dBµV/m) using maximum allowed limit**	**PASS / FAIL**
"Sine+", AAC, EEP-3A						
1	**5A**	174.928	(31.3 + Xtf)		35.3	
2	**5B**	176.640	(31.4 + Xtf)		35.4	
3	**5C**	178.352	(31.5 + Xtf)		35.5	
4	**5D**	180.064	(31.6 + Xtf)		35.6	
5	**6A**	181.936	(31.6 + Xtf)		35.6	
6	**6B**	183.648	(31.7 + Xtf)		35.7	
7	**6C**	185.360	(31.8 + Xtf)		35.8	
8	**6D**	187.072	(31.9 + Xtf)		35.9	
9	**7A**	188.928	(32.0 + Xtf)		36.0	
10	**7B**	190.640	(32.1 + Xtf)		36.1	
11	**7C**	192.352	(32.1 + Xtf)		36.1	
12	**7D**	194.064	(32.2 + Xtf)		36.2	
13	**8A**	195.936	(32.3 + Xtf)		36.3	
14	**8B**	197.648	(32.4 + Xtf)		36.4	
15	**8C**	199.360	(32.4 + Xtf)		36.4	
16	**8D**	201.072	(32.5 + Xtf)		36.5	
17	**9A**	202.928	(32.6 + Xtf)		36.6	
18	**9B**	204.640	(32.7 + Xtf)		36.7	
19	**9C**	206.352	(32.7 + Xtf)		36.7	
20	**9D**	208.064	(32.8 + Xtf)		36.8	
21	**10A**	209.936	(32.9 + Xtf)		36.9	
22	**10B**	211.648	(33.0 + Xtf)		37.0	
23	**10C**	213.360	(33.0 + Xtf)		37.0	

24	**10D**	215.072	(33.1 + Xtf)		37.1	
25	**11A**	216.928	(33.2 + Xtf)		37.2	
26	**11B**	218.640	(33.2 + Xtf)		37.2	
27	**11C**	220.352	(33.3 + Xtf)		37.3	
28	**11D**	222.064	(33.4 + Xtf)		37.4	
29	**12A**	223.936	(33.5 + Xtf)		37.5	
30	**12B**	225.648	(33.5 + Xtf)		37.5	
31	**12C**	227.360	(33.6 + Xtf)		37.6	
32	**12D**	229.072	(33.7 + Xtf)		37.7	
33	**13A**	230.784	(33.7 + Xtf)		37.7	
34	**13B**	232.496	(33.8 + Xtf)		37.8	
35	**13C**	234.208	(33.8 + Xtf)		37.8	
36	**13D**	235.776	(33.9 + Xtf)		37.9	
37	**13E**	237.488	(34.0 + Xtf)		38.0	
38	**13F**	239.200	(34.0 + Xtf)		38.0	
"OOI Music", MP2, UEP-3						
39	**11C**	220.352	(34.4 + Xtf)		38.4	

C.10 RADIATED MEASUREMENT UNCERTAINTY CALCULATION (EXAMPLE)

Item			**dB**	dB squared
1	Uncertainty in free field signal strength at Receiver Test zone	items include	2.98	8.8804
		Uncertainty in signal level from Signal generator		
		RF Cable loss variability		
		SG - Antenna Mismatch variability		
		Antenna calibration variability		
		Spurious signal coupling variability		
		Polarization variability		
2	Uncertainty (variability) in conducted sensitivity of Receiver (due to changes of environment / PSU etc lead coupling effects)		0.2	0.04
3	Variability in the gain of the receiver antenna "system" due to placement differences		2	4
4	Variability in the noise / self interference of the antenna system due to placement differences		2	4
5	Variability in the Acoustic OOI measurement		0.25	0.0625
		Sum of squares		16.9829
		Root sum squares ± dB		**4.1**

The value is rounded down to 4.0 dB.

D TECHNICAL REQUIREMENT FOR THE RADIO TEST FACILITY (NORMATIVE)

D.1 INTRODUCTION

This annex gives the standards for accreditation of the radio frequency test facility to meet the measurement and test requirements.

The capability of the test facility will determine the accuracy and repeatability of the radio performance measurements. It is thus critically linked to the confidence in the test pass / fail levels quoted in clause C.

D.2 STANDARD

The test house will be shown to meet standards for:

Item	Standard
Quality management systems, record keeping and calibration	ISO 9001
Laboratory RF Measurement capability – general. Use of transfer standards.	ISO17025
DAB receiver test familiarity	
Absolute calibration accuracy and repeatability of Free Field signals: Test zone arrangements normalised site attenuation (NSA) Positioning of antennas and Device under test. RF cabling practice. Electromagnetic wave polarization stability and level flatness absolute level calibration accuracy.. Solving RF problems.	ANSI C.63.4 – 2003 pp 18 - 30 CISPR equivalent CISPR16-1-4 CISPR 22
Uncertainty measurement calculations.	NAMAS NIS 81, May 1994 UKAS Document LAB 34

In absolute measurement terms, the uncertainty of the field level will be in the order of ±4dB or more when using these generic standards above (CISPR16 -1-4).

This alone is unlikely to be sufficiently accurate for the sensitivity measurements.

Therefore additional standards below will be applied to reduce measurement uncertainties, to the assumed ±4dB. This table defines the equipment and configurations necessary.

Semi Anechoic or Fully Anechoic screened chamber. • Screened room to exclude sources of airborne interference; • Mains outlet under the mounting table in floor of chamber.
Non-metallic mounting table for EUT 0.8 m to 1.5 m height.
RF signal generator for VHF. • Level to be controlled in 0.1 dB steps. Baseband DAB stream generator. • ETI files as specified in Annex A.

A sound level meter to check weighted acoustic tone level
Non-metallic acoustic link to get the acoustic output from speaker to outside the chamber. E.g. a. Plastic acoustic pipe or b. Miniature microphone and fibre optic link.
Test zone 1 x 1 x 1 metre cube with uniform vertically polarized RF field over the mounting table. Distance of screened wall / ceiling to any part of the product antenna 50 cm minimum (to avoid detuning antenna).
The method given in ANSI C63.4, especially sect 5.4 pages 18 – 30 will be employed.
Additionally, a calibrated transfer standard dipole rather than directional antenna will be used to establish the NSA of the range at each frequency of interest. (This provides a signal collection more representative of the EUT).
Additionally a floor absorber of at least 3 metre x 3 metre must be placed immediately in front of the EUT test zone to prevent reflections from the floor to the EUT.
Additionally the test zone around the EUT position will be checked for signal variability – the substitution dipole should be moved ± 35cm back and forth, up and down to verify that the signal level is uniform and no sharp nulls are present.

To meet these criteria

Antenna test position	**Expected result if e-m wave is propagated correctly**
35cm backwards (away from tx antenna) and forwards	Signal changes according to path loss change of +35cm – i.e. fraction of dB.
35cm side to side	Substantially same signal level.
35cm up and down	Substantially same signal level.
If the test zone does not meet these criteria, then adjustments must be made until the conditions are fulfilled.	

Note: It would be beneficial to reduce the uncertainty with a target of ± 2dB.

E CHANGES SINCE LAST PUBLISHED VERSION (INFORMATIVE)

Clause number	Summary of change	Reason
C.6	Headings for columns C and E corrected to "Input power (dBm)".	Editorial correction - drafting error; was "Field strength (dBµV/m)"
4.10, 5.10	Reference to starburst display removed.	Requirement should be independent of display type.
A.1	Service labels redesigned.	Permit wider range of displays.
B.2	Text added to clarify text requirements.	Permit wider range of displays.
B.5	Table B.1 split for graphic and starburst displays, service labels revised and "best effort rendering" note added.	Permit wider range of displays.