

WorldDAB Aftermarket Devices Guidelines

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WorldDAB Aftermarket Devices Guidelines – Background

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The WorldDAB Aftermarket Devices Group was created in 2018 to develop Guidelines for manufacturers developing products for this sector

This is an ongoing project to help improve the user experience of Aftermarket Devices (AMDs), which include DAB digital radio in-car. The guidelines cover the three types of aftermarket devices on the market; car specific devices, adaptors and black box solutions (slide 3).

Please also note:

- This document is live and may change over time as feedback is received from stakeholders and partners. Please ensure you have the latest version number from WorldDAB
- The current focus of the WorldDAB Aftermarket Devices Group is to bring together stakeholders to develop further these guidelines, provide information of marketing of AMD in DAB markets including marketing campaigns, communication and information on installer schemes, AMD regulation and testing
- The guidelines in this document were created based on, but not wholly, the research into UX design carried out by the WorldDAB UX Group. Allowances and changes have been made in line with the nature of AMDs

WorldDAB Aftermarket Devices Guidelines – Scope

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world **dab**

Aftermarket Device User Interface

Guidelines

Guideline – User Interface

Device display: Basic & Advanced

These guidelines are not mandatory but do provide the best User Interface

- **Basic**
 - Station name
 - A-Z station list
 - DLS
 - Station update reminder – ‘Station Update’ – NOTE: Suggestions needed for this phrase
 - Service Following
 - Further information on Service Following can be found [here](#) and on Slide 11 of these guidelines
 - The device should tell you or show you - Blinking or Service Following
 - For 1 Tuner – The device should say ‘Searching for Signal’
 - Default: Service Following should always be ON if ON/OFF is available
- **Advanced** - Screen (as above +) - See WDAB UX Guidelines for further information
 - Slideshow
 - Logos

Recommendation: Traffic Announcements is important for switchover countries which don’t have any FM RDS Traffic information. Alarm announcements are now mandatory for all receivers - ETSI TS 103 176 v2.1.1 (2017-08) clause 7.6.1. If Traffic and Alarm announcements are implemented in a device, it is easy to implement all other announcement types as well. These should therefore be implemented so devices are future compatible.

Aftermarket Devices Connections

Guidelines

Guidelines - Connections

Priority of connections

The ideal is to have as many of these solutions as possible to protect against product returns

Connections are prioritised by best usability

- AUX
- Bluetooth
- FM
- USB (Possible to use for hidden solutions)

Aftermarket Device Functionality, Power, Service lists, Car display

Guidelines

Guidelines – Functionality, Power, Service lists, Car display

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Device Display: Basic & Advanced

The ideal is to have as many of these solutions as possible to protect against product returns

- **Functionality**
 - Pre-sets
 - Basic: Physical buttons - press & hold
 - Setting Menu – Service Following ON/FM, Set Frequency, AUX OUT/FM OUT, Bluetooth, Factory re-set, Traffic Announcements ON/OFF, Alarm Announcement, Auto Tune
- **Power**
 - USB - preferred
 - Cigarette adapter 12V*
- **Service lists**
 - A-Z Stations
 - Only show each service once but show service with strongest signal (Service Following)
- **Car Display** - *Device where DAB information is broadcast in FM RDS connected into cars tuner*
 - Station name

*EU EMC compatibility directive should apply – Directive 2014/30/EU

Aftermarket Devices Service Following

Guidelines

Guidelines – Service Following

It is Important for all Aftermarket Devices to create the best listening experience for the driver

Ensuring service following and alarm announcements work correctly is part of this listening experience

Service Following

- Must be implemented - ETSI TS103176v2.1.1
 - 2 tuners is optimal (price point problem)
 - Hard, soft and Implicit linking (available in Norway)

Technical Information

- Alarm announcements is now mandatory for all receivers. In ETSI TS 103 176 v2.1.1 (2017-08) it says in clause 7.6.1: Receiver support for tunes ensemble alarm announcements is mandatory and receivers shall meet all requirements of clause 7.6
- Service Following - ETSI TS103176v2.1.1

Aftermarket Device Antennas

Guidelines

Choice of Antenna is a primary concern as part of the Aftermarket Device

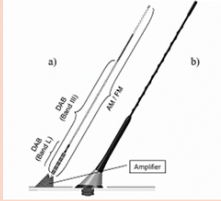
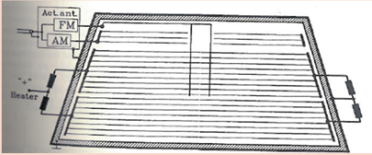
Select premium products and ensure accessory parts (e.g. power inserters) and are designed according to radio frequency principles e.g. decoupling dc power from radio frequency signal

Antenna recommendations in order of best to least (see slide 14 overview):

- Re-use existing FM roof
- Shark-antenna
- Install a roof antenna
- Two glass-mounted antennas (check following conditions and combine signals correctly as this will influence the resulting antenna diagram).
- Combine the antennas spatially with a 0° combiner, with a combining loss of lower than 4dB and an isolation of higher than 20dB between the inputs (combining loss is measured from input A to output with input B terminated with a 50 Ohm load). The combiner shall provide a feed-through of the power supply
- The adapter device shall provide at least 100mA power supply over coaxial cable to feed two antennas for spatial combination
- Antennas shall be provided with a low noise preamplifier with a noise figure below 2dB
- Prior to solution sales, a proof of concept shall be performed and the resulting antenna diagram measured

Pro's and Con's of different antenna systems

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Antenna configuration	Pro's	Con's
Rod Antenna 	Best reception performance Low cost Size reduction possible Suitable for AM, FM, DAB, WLAN, Cellular	Requiring large ground plane Esthetically not preferred LNA required for reduced size
Glass Antenna 	Hardly visible: esthetically preferred Multiple antennas systems possible Suitable for AM, FM, DAB, WLAN, Cellular	Requiring LNA Lower reception performance, higher EMI sensitivity & directional behavior Adaptation per car type required
Sharkfin antenna 	Esthetically preferred over Rod Antenna	Still visible ('no flat roof') High quality LNA required Limited flexibility wrt positioning
Foil Antenna 	Esthetically superior: invisible antenna Flexible and easy integration	Low reception performance, high quality LNA required Directional behavior Highly sensitive to EMI

Minimum Requirements (antennas)

- Antenna **polarisation (vertical)**
- **Antenna gain or FoM** “figure of merit” for active antennas **(-10.2dBd / - 8dBi acc.** ETSI TS 103 461 V1.1.1 (2017-08); for channels 5 to 13)
- **Definition of “Figure of Merit” FoM** = $-105 - p_n + g_{ant}$, **> - 8dBi** according ETSI EN 303 354 V1.1.1 (2017-03)
- **Requirement for the antenna element:** even with a preamplifier, the antenna element contributes the most to the performance. Cropping the length of the antenna can easily result in a bad performance (figure of merit), even with a preamplifier. Therefore special care has to be taken to optimise antenna performance.
- The antenna should be equipped with a capacitive ground connection (foil or magnet)
- **Requirements for preamplifier** (pre-amplification gain, filtering, noise figure, third order intercept point)
- Noise figure of preamplifier: < 2dB for all channels 5 to 13
- Minimum input TOI (third order intercept point): > 6 dBm, minimum output TOI (third order intercept point): > 6 dBm + gain of preamplifier [dB]
- The amplification gain shall be limited to a reasonable value around 12 – 18 dB, just to compensate the cropped antenna length and cable loss. Too much gain will overload the preamplifier and the receiver in large signal situations
- Selectivity: apply filtering of VHF band III to avoid overloading the preamplifier or DAB receiver by strong FM, DTT, PPDR or mobile radio signals

Minimum Requirements (antennas)

- **Antenna return loss (> 10dB) @ 50 Ohms**
- An antenna connection with an input impedance of 50 Ohms is required acc. ETSI TS 103 461 V1.1.1 (2017-08)
- **Antenna diagram** (avoid strong directionality, horizontal ripple shall be lower than 9dB for all channels) – otherwise the SFN concept of the network and so the performance will be degraded (please refer to slide 30 for definition how the antenna performance is measured)
- Total **man-made noise** power coupled from in-car systems (**max. -106dBm for 3dB degradation to -115dBm for no degradation**) – very hard to reach
- Please refer also to the EBU Tech 3391 DAB planning guideline for further reading
- The antenna shall provide these performance parameters for power supplies between 5V to 30V
- The **user manual** shall describe the correct mounting of the antenna

Minimum Requirements (receiver with antenna)

- Frequency range: 174 MHz to 240 MHz
- Receiver sensitivity in the Gaussian channel: $FSG_{min} = [29,2 + 20\log(\text{frequency in MHz} / 220)] \text{ dB}\mu\text{V/m}$,
- Receiver sensitivity in the Rayleigh channel: $FSR_{min} = [34,7 + 20\log(\text{frequency in MHz} / 220)] \text{ dB}\mu\text{V/m}$,
- Maximum fieldstrength FS_{max} : 120dBuV/m per channel
- Above mentioned values are applicable for protection level EEP- 3A

Further Information

- FSG_{min} : minimum fieldstrength in the Gaussian channel (line of sight to the transmitter)
- FSR_{min} : minimum fieldstrength in the Rayleigh channel (no line of sight to the transmitter)
- Please refer to ETSI TS 103 461 V1.1.1 2017-08, chapter 6
- Please refer also to the EBU Tech 3391 Guidelines for DAB network planning for further reading

For reference, EBU Factsheet on planning parameters for outdoor coverage:

https://tech.ebu.ch/docs/factsheets/ebu_tech_fs_planning_parameters_for_dab_in_vhf_band_III.pdf Including country specific information: Norway 42dBuV/m, Italy 43dBuV/m minimum, Switzerland 48dBuV/m minimum at 1.5m above ground.

Minimum Requirements (receiver device)

- Receiver noise figure (lower than 6dB @ antenna input) for all channels
- Receiver carrier-to-noise ratio (for different protection levels and radio-channels), e.g. for EEP-3A: 6dB for the Gaussian channel, 11.5dB for the Rayleigh channel acc. ETSI TS 103 461 V1.1.1 (2017-08))
- Gaussian receiver sensitivity ($< -97.7\text{dBm}$) for all channels acc. ETSI TS 103 461 V1.1.1 (2017-08)
- An antenna connection with input impedance of 50 Ohms is required, return loss $> 10\text{dB}$ for all channels acc. ETSI TS 103 461 V1.1.1 (2017-08))
- Receiver selectivity (adjacent channel interference) acc. ETSI TS 103 461 V1.1.1 (2017-08)) (desirable 40dB for N+1)
- Above mentioned values are applicable for protection level EEP- 3A

Further Recommendations

- Total man-made noise power coupled from the phantom power supply of the device into the antenna system shall be carefully limited (-106dBm leads to a 3dB degradation of the receiver performance, -115dBm for no degradation), the cables shall be shielded
- Any electromagnetic interference of the power supply of the receiver device (e.g. a 12V to USB converter) has to be avoided in order to reach the limits as depicted above
- Level for muting/linking (post Viterbi BER higher than $5 \cdot 10^{-3}$); time delay for muting/linking; hysteresis
- Power supply for the antenna between 5V to 30V with up to 100mA

Guideline – Aftermarket Devices: Antenna Installation Guidelines for Users and Installers

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Clear Guidelines must be included with the device for the best possible user experience

- All manufacturers should provide clear information for the installation of antennas for self-installation and installers:
 - Clear written instructions, clear graphics and if possible an instruction video
 - Examples for consumers: <https://youtu.be/iiel2oYwHzk>
 - Examples of information for professional installers:
 - Mount the antenna vertically.
 - Find the best place for the antenna use a receiver with a built-in signal strength indicator.
 - Check if window is thermally treated and is attenuating the signal. Check the attenuation of the glass. Avoid mounting the antenna over heating wires or other metallic parts
 - Confirm a minimum distance to the roof and frames of the car or heating wires. Mounting the antenna too close to metallic parts may result in a over emphasized directivity of the antenna diagram or loss of performance, both is not preferable.
 - The place for the antenna shall be evaluated carefully due to Electromagnetic interference. Do not place the antenna too close to electrical parts of the car. Be aware that the rear of the car often has less interference.
 - Avoid electromagnetic interference from power supply. Start first tests with a trusted source of power without interference. Check any difference in signal quality when changing to the power supply delivered with the device.
 - Avoid ground loops when mounting the 'ground' for the antenna. Connections provided are usually foil or magnet in the most cases. Read the user manual for the correct mounting of antenna and ground.
 - Two examples for recommendations and trainings by Swiss installation partner

<https://www.carcom.ch/de/carcom-news-detail/dab-empfang-in-ihrem-fahrzeug-nachruesten.html>

<http://www.exklusivcarhifi.ch/index.php/de-ch/2-uncategorised/6-car-upgrade-dab-haendlerschulungen>

Aftermarket Device Annex

Guidelines

- ETSI TS 103 461 V1.1.1, Digital Audio Broadcasting (DAB); Domestic and in-vehicle digital radio receivers; Minimum requirements and Test specifications for technologies and products; 2017-08
- ETSI EN 303 354 V1.1.1, Amplifiers and active antennas for TV broadcast reception in domestic premises; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU; 2016-06
- EBU tech 3391 Guidelines for DAB network planning, Geneva 2018
- EBU Fact Sheet, Planning Parameters for DAB in VHF Band III, Geneva 2019
- ETSI EN 300 401 V2.1.1 – Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers, January 2017