



NT-3003 V2.0.0

Technical Standard

concerning

DAB/DAB+ In-House low power Repeaters

Titre en français: **Norme technique** concernant les **réémetteurs DAB bande III de faible puissance** destinés à être exploités à l'intérieur d'immeubles.

Titel auf Deutsch: **Technische Norm** betreffend die **Band III DAB Umsetzer von geringerer Leistung**, welche in Gebäude eingesetzt werden.

Titolo in italiano: **Norma tecnica** relativa a **ripetitori DAB band III bassa potenza** destinati ad essere esercitati nelle case.

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1 General

1.1 Foreword / introduction / Einführung / introduzione

This technical standard specifies, for Band III DAB/DAB+ In-House low power Repeaters, the essential requirement of effective use of the spectrum according article 7 paragraph 2 TIO (Ordinance on Telecommunications Installations [I.2]). Products manufactured in compliance with the requirements of this technical standard benefit from a presumption of conformity with the corresponding essential requirements. This standard is published in the Official Federal Gazette as designated technical standard in accordance with Article 31 paragraph 2 letter a TCA (Telecommunications Act of 30 April 1997 [I.1]) and Article 4 paragraph 2 TIO [I.2].

Note for placing on the market outside Switzerland: As this standard is not a harmonised standard according to the European RED Directive, it does not give presumption of conformity with the essential requirement of effective use of radio spectrum outside Switzerland.

Cette norme technique concrétise pour les réémetteurs de faible puissance DAB/DAB+ bande III destinés à être exploités à l'intérieur d'immeubles, l'exigence essentielle d'utilisation efficace du spectre selon l'art. 7 al. 2 de l'OIT (Ordonnance sur les installations de télécommunication [I.2]). Son respect permet de présumer que cette exigence essentielle est remplie. Elle est publiée dans la Feuille fédérale comme norme désignée selon l'art. 31, al. 2, let. a, LTC (Loi sur les télécommunications du 30 avril 1997 [I.1]) et art. 4, al. 2, OIT ([I.2]).

Remarque concernant la mise sur le marché à l'extérieur de la Suisse: Cette norme n'étant pas une norme harmonisée au sens de la directive européenne RED, elle ne pose pas présomption de conformité à l'exigence essentielle de l'utilisation efficace du spectre en dehors de la Suisse. La suite de ce document est rédigé en langue anglaise.

Diese technische Norm legt für Band III DAB Umsetzer von geringerer Leistung, welche in Gebäude eingesetzt werden, die grundlegenden Anforderungen bezüglich effizienter Nutzung des Spektrums in Übereinstimmung mit Art. 7 Abs. 2 FAV (Verordnung über Fernmeldeanlagen [I.2]) fest. Werden die in dieser technischen Norm aufgeführten Anforderungen eingehalten, so wird vermutet, dass diese grundlegende Anforderung erfüllt ist. Diese Norm ist im Amtsblatt als bezeichnete Norm in Übereinstimmung mit Art. 31 Abs. 2 Bst. a FMG (Fernmeldegesetz vom 30. April 1997 [I.1]) und Art. 4 Abs. 2 FAV [I.2] publiziert.

Bemerkung zum Inverkehrbringen ausserhalb der Schweiz in Hinblick auf die europäische RED-Richtlinie: Da diese Norm keine harmonisierte Norm im Sinne der Richtlinie RED ist, vermittelt sie ausserhalb der Schweiz keine Konformitätsvermutung für die grundlegende Anforderung der effizienten Spektrumsnutzung.

Der weitere Inhalt dieses Dokuments ist in englischer Sprache verfasst.

Questa norma tecnica concretizza, per i ripetitori DAB band III a bassa potenza destinati ad essere esercitati nelle case, l'esigenza fondamentale per l'uso efficace dello spettro ai sensi dell'art. 7 cpv. 2, OIT (Ordinanza sugli impianti di telecomunicazione [I.2]). Il rispetto di questa norma tecnica presume che questa esigenza fondamentale sia adempiuta. Questa norma è pubblicata nel Foglio federale come norme designata ai sensi dell'art. 31, cpv. 2, lett. a, LTC (Legge del 30 aprile 1997 sulle telecomunicazioni [I.1]) e dell'art. 4, cpv. 2, OIT (Ordinanza sugli impianti di telecomunicazione [I.2]).

Osservazione concernente l'immissione in commercio al di fuori dalla Svizzera. Poiché la questa norma non è una norma armonizzata ai sensi della direttiva europea RED, non presuppone la conformità al requisito fondamentale concernente l'utilizzo efficace dello spettro al di fuori dalla Svizzera.

Il resto del documento è scritto in lingua inglese.

1.2 Scope

The present document specifies the technical characteristics, test methods, limits and the requirements for low power In-door DAB/DAB+ Repeaters. The present document is applicable to **full-band, multi-block** and **single-block** DAB/DAB+ repeater systems operating on radio frequencies in the Band III (174-230 MHz).

1.3 References

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

1.4 Normative references

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

- [1] ETSI EN 302 077-1 " Electromagnetic compatibility and Radio spectrum Matters (ERM); Transmitting equipment for the Terrestrial - Digital Audio Broadcasting (T-DAB) service; Part 1: Technical characteristics and test methods"
- [2] ETSI EN 300 401 "Radio Broadcasting Systems; Digital Audio Broadcasting (DAB) to mobile, portable and fixed receivers"
- [3] ETSI TR 100 028 (all parts) (V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics".
- [4] ETSI EG 200 053 "Electromagnetic compatibility and Radio spectrum Matters (ERM); Radio site engineering for radio equipment and systems".

1.5 Legal references

The following referenced documents are legal documents.

- [I.1] SR 784.10; Telecommunications Act of 30 April 1997 (TCA).
- [I.2] SR 784.101.2; Ordinance of 25 November 2015 on Telecommunications Installations (FAV).
- [I.3] SR 784.101.21 / RIR0201-35; Technical interfaces regulations In-door low power DAB/DAB+ Repeater Band III. The technical interface regulations are published in annex 2 of the decree of OFCOM on telecommunication equipment OOIT; SR 784.101.21.

1.6 Informative references

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

- [i.1] Directive 2014/53/EU of the European Parliament and of the Council of 16 April 2014 relating to the making available on the market of radio equipment (RED).

2 Definitions and abbreviations

2.1 Definitions

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

antenna port: port of an apparatus which is designed, in normal operation, to be connected to an antenna using coaxial cable

block: a DAB block is a frequency channel 1.536 MHz wide.

broadcasting service: radiocommunication service in which the transmissions are intended for direct reception by the general public

cabinet radiation: radiation from an enclosure containing, equipment, excluding radiation from connected antennas or cables

class of emission: set of characteristics of an emission, designated by standard symbols, e.g. type of modulation of the main carrier, modulating signal, type of information to be transmitted, and also, if appropriate, any additional signal characteristics

DAB/DAB+ repeater: directional Radio Frequency (RF) amplifier, which is used to amplify and transmit a received DAB/DAB+ signal in the DAB frequency band (e.g signal from a DAB+ base station).

dBc: decibels relative to the unmodulated carrier power of the emission

NOTE: In the cases, which do not have a carrier, for example in some digital modulation schemes where the carrier is not accessible for measurement, the reference level equivalent to dBc is decibels relative to the mean power P.

dBi: decibels relative to the hypothetical isotropic antenna, which uniformly distributes energy in all directions

enclosure port: physical boundary of the apparatus through which electromagnetic fields may radiate or impinge

NOTE: In the case of integral antenna equipment, this port is inseparable from the antenna port.

full-band repeater: repeater, which is designed for retransmitting the whole Band III Frequency (174 – 230 MHz; block 5A to block 12D). Repeater, which is designed for operation on a subset of Band III, is not considered as a full-band repeater; it is a multi-block repeater or a single-block repeater.

harmonic: component of order greater than 1 of the Fourier series of a periodic quantity

intermodulation products: unwanted frequencies resulting from intermodulation between carriers or harmonics of emission, or between any oscillations generated to produce the carrier

mean power: average power supplied to the antenna port by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation envelope taken under normal operating conditions

multi-block repeater: repeater which is designed for operation on more than one DAB/DAB+ frequency block.

necessary bandwidth: for a given class of emission, the width of the frequency band which is sufficient to ensure the transmission of information at the rate and with the quality required under specified conditions

rated output power: power that the transmitter or repeater shall deliver at its output under specified conditions of operation

maximum total radiated power: maximum power that the repeater together with the transmit assembly antenna shall radiate under specified conditions of operation

reference bandwidth: bandwidth in which the emission level is specified

RMS power: the apparent power of an AC power that is calculated by multiplying root-mean-square (rms) current by the root mean square voltage

single-block repeater: repeater which is designed for operation on a single DAB/DAB+ frequency block.

spurious emissions: emissions on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions and intermodulation products.

2.2 Abbreviations

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

BER	Bit Error Ratio
COFDM	Coded Orthogonal Frequency Division Multiplex
CW	Continuous Wave
EMC	ElectroMagnetic Compatibility
EUT	Equipment Under Test
Hz	Hertz (cycles per second)
IEC	International Electrotechnical Commission
IF	Intermediate Frequency
ITU	International Telecommunications Union
PRBS	Pseudo Random Binary Sequence
R&TTE	Radio and Telecommunications Terminal Equipment
RF	Radio Frequency
rms	root mean square
SFN	Single Frequency Network
T-DAB	Terrestrial - Digital Audio Broadcast
Tx	Transmitter
VHF	Very High Frequency
W	Watt

3 Technical requirements specifications and limits

3.1 Introduction

Any low power DAB/DAB+ repeater shall amplify one or more DAB RF frequency blocks, the transmit frequency shall be the same as the receive frequency.

The apparatus shall **include filters** to obtain the necessary protection against the users of adjacent frequency bands and to ensure that the spurious emissions and intermodulation products of the low power DAB/DAB+ repeater remain within the limits. The repeater shall operate within the frequency bands defined in the Technical interfaces regulations for In-door low power DAB/DAB+ Repeaters Band III; RIR0201-35 [1.3].

Receive antenna (located generally outside the building) and transmit antenna (located inside the building) **gain and directivity** shall be specified by the manufacturer of the low power DAB/DAB+ repeater.

The gain characteristics of this antennal shall be :

- receive antenna gain shall be equal or higher than +7 dBi.
- transmit antenna gain shall not exceed + 6 dBi.

The repeater may have a **gain regulation** to enable the correct gain adjustment according the received signal strength, the cable attenuation, and the antenna coupling factor (indoor antenna - outdoor antenna). This may be a manual and/or an automatic adjustment mechanism.

The coaxial cable used between receive antenna (outside the building) and the other parts of the repeater shall have good shielding effectiveness to avoid any feedback loop (TX to RX via the coaxial cable). The **shielding effectiveness** of this coaxial cable shall be better than 50 dB within the operating range of the repeater.

3.2 Basic rules, EG 200 053

The basic rules described in the ETSI guide "Radio site engineering for radio equipment and systems in the mobile service, EG 200 053" [4] apply to equipment that fall within the scope of this document. The rules stated in clause 5.5 "Repeaters", where installation recommendations (clause 5.5.4) are listed are particularly noteworthy. For example, these rules are applicable:

- antenna coupling,
- maximum gain (which will depend on the antennas coupling loss or isolation),
- necessary isolation between several systems,
- the use of filters to obtain the necessary protection against co-located radiocommunication equipment,
- etc.

Annexe H, "Equipment used to avoid radio frequency problems", will provide useful information on the connection between several radiocommunication equipment.

Annexe N, "Radiocommunication in confined spaces", applies particularly to equipment intended to be operated in tunnels and confined spaces.

The design principle, the installation rules, the specification calculation described in the EG 200 053 are to be considered and taken into account.

3.3 Environmental profile

The technical requirements of the present document apply under the environmental profile for operation of the equipment, which shall be declared by the manufacturer of the equipment. The equipment shall comply with all the technical requirements of the present document at all times when operating within the boundary limits of the declared operational environmental profile.

3.4 Nominal DAB RF-test signal

A nominal DAB RF-test signal according EN 300 401 [2] clause 15.3 for transmission mode I and fulfilling the critical mask defined in EN 300 401 [2] clause 15.4 shall be applied to the RX antenna port, the level of this signal shall be set to produce the nominal TX output power (according to manufacturer's declaration).

The frequency of this RF-test signal shall be adjusted according the description of each test procedure below.

3.5 Interpretation of the measurement results

The interpretation of the results recorded in a test report for the measurements described in the present document shall be as follows:

- the measured value compared to the corresponding limit shall be used to decide whether an equipment meets the requirements of the present document;
- the value of the measurement uncertainty for the measurement of each parameter shall be included in the test report;

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028 [3] and shall correspond to an expansion factor (coverage factor) $k = 1,96$ or $k = 2$ (which provide confidence levels of 95 % respectively 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

The particular expansion factor used for the evaluation of the measurement uncertainty shall be stated in the report.

3.6 Requirements, limits and test procedure

3.6.1 Maximal radiated total power

3.6.1.1 Definition

The total power of the signal of a T-DAB repeater is defined as the long-term average of the time-varying short-term signal power.

For full-band repeater, the total power of the signal of a T-DAB Band III repeater is the radiated power resulting the simultaneous application of several signals to the RX port of this repeater.

For multi-block or single-block repeaters, the total power of the signal of a T-DAB Band III repeater is the radiated power resulting the application of a single signal to the RX port of this repeater.

For devices with a permanent 50 Ω or 75 Ω TX antenna connector the maximum declared TX antenna gain "G" in dB has to be taken into account to determine the maximal radiated total power "P" in dBm as follows.

$$P = A + G$$

Whereas "A" is the maximum output power in dBm that the repeater delivers at its TX antenna port.

For devices without a permanent 50 Ω or 75 Ω port, the effective radiated power shall be measured.

3.6.1.2 Limit

3.6.1.2.1 *Limit applicable to full-band repeater*

The maximal radiated total power shall not exceed -5.15 dBm (305 μ W) erp

3.6.1.2.2 *Limit applicable to all repeater except full-band repeater*

The maximal radiated total power shall not exceed -12.15 dBm (61 μ W) erp.

3.6.1.3 Conformance

3.6.1.3.1 *Full-band repeater*

The repeater shall be set to maximum gain. Five nominal DAB RF-test signals according clause 3.4 of this document shall be applied simultaneously via a coupling device to the RX antenna port, the level of this signal shall be increased by 10 dB. The frequency of the 5 DAB RF-test signal should be:

1st test signal: $F_c = 174.928$ MHz (Block 5A)

2nd test signal: $F_c = 188.928$ MHz (Block 7A)

3rd test signal: $F_c = 202.928$ MHz (Block 9A)

4th test signal: $F_c = 216.928$ MHz (Block 11A)

5th test signal: $F_c = 229.072$ MHz (Block 12D)

Alternatively, five RF CW signals may be applied. The level of these RF CW signals shall be adjusted 10 dB higher than the one producing the nominal TX output power, the frequency being the same as described above for the DAB RF-test signals.

For the maximal output power measurements, a thermal power meter shall be used.

For devices having a permanent antenna connector, the maximal output power is measured at the TX antenna port of the repeater.

The maximum radiated power shall be tested under following operational conditions:

- nominal supply voltage

The obtained results shall be compared to the limits in clause 3.6.1.2.1 in order to prove compliance with the requirement.

3.6.1.3.2 *all repeater except Full-band repeater*

The repeater shall be set to maximum gain. A nominal DAB RF-test signal according clause 3.4 of this document shall be applied to the RX antenna port, the level of this signal shall be increased by 10 dB.

The frequency of this RF-test signal shall correspond to the centre frequency of the single-bloc repeater. For multi-block repeater, tests should be carried out on the nominal frequency of the lowest frequency DAB block within the declared repeater frequency band; and repeated on the nominal frequency of the highest frequency DAB block within the declared repeater frequency band.

Alternatively, a RF CW signal may be applied. The level of this RF CW signal shall be adjusted 10 dB higher than the one producing the nominal TX output power, the frequency being the same as described above for the DAB RF-test signal.

For the maximal output power measurements a thermal power meter shall be used.

For devices having a permanent antenna connector, the maximal output power is measured at the TX antenna port of the repeater.

The maximum radiated power shall be tested under following operational conditions:

- nominal supply voltage

The obtained results shall be compared to the limits in clause 3.6.1.2.2 in order to prove compliance with the requirement.

3.6.2 Intermodulation products

3.6.2.1 Definition

This test shall be used to verify that the level of intermodulation products, generated in non-linear elements of the repeater, in the presence of several RF input signals, do not exceed the specified limits.

For the purposes of the present document, intermodulation products are emissions at frequencies within the repeater's operating band.

For devices with a permanent 50 Ω or 75 Ω TX antenna connector the maximum declared TX antenna gain "G" in dBi has to be taken into account to determine the maximal radiated power of the intermodulation products " $P_{\text{Radiated of product \#n}}$ " as follows.

$$P_{\text{Radiated of product \#n}} = A_{\text{Conducted of product \#n}} + G$$

Whereas the maximum output power " $A_{\text{Conducted of product \#n}}$ " in dBm is the power of a intermodulation product that the repeater delivers at its TX antenna port.

3.6.2.2 Limit

The radiated power of any detected intermodulation product shall not exceed -54 dBm erp.

3.6.2.3 Conformance

The measurements shall be performed on TX antenna port of the repeater. For devices without a permanent 50 Ω or 75 Ω port, the effective radiated power of the intermodulation products shall be measured.

The repeater shall be set to maximum gain.

The measurement shall be performed with an RMS detector and a bandwidth of 100 kHz.

3.6.2.4 Step 1, In band stimulus signals

Two continuous sinusoidal RF signals shall be fed to the input antenna port of the repeater using a combining device.

The frequencies of both RF signals shall be within the repeater's operating band. The spacing between both RF signals shall be lower than a DAB block (e.g. 400 kHz). The input signals and resulting third order product shall be within the declared operational frequency band of the repeater.

The level of both RF input signals shall be increased simultaneously, until the maximum rated output power, as declared by the manufacturer, is reached.

The level of the intermodulation products shall be measured by means of a selective measurement device (e.g. spectrum analyser) presenting to the repeater a load with an matched impedance of either 50 Ω or 75 Ω .

The test shall be repeated with both RF input signals increased by 10 dB each.

NOTE: In this case, the automatic gain (level) control may reduce the gain to a value less than maximum gain in order to keep the maximum rated output power per channel, as declared by the manufacturer.

The obtained results shall be compared to the limits in clause 3.6.2.2 in order to prove compliance with the requirement

3.6.2.5 Step 2, Out of band stimulus signals

Two continuous sinusoidal RF signals shall be fed to the input antenna port of the repeater using a combining device.

The frequencies of both RF signals shall be outside the repeater's operating band. The first signal has to be adjusted to 169.500 MHz, the second one being adjusted to $(2 \times 169.500 \text{ MHz}) - F_C$; F_C is the centre frequency of the lowest DAB block contained into the defined repeater band. The resulting third order product shall be within the declared operational frequency band of the repeater.

The level of both RF input signals shall be set to -20 dBm.

The level of the intermodulation products shall be measured by means of a selective measurement device (e.g. spectrum analyser) presenting to the repeater a load with an matched impedance of either 50 Ω or 75 Ω .

The obtained results shall be compared to the limits in clause 3.6.2.2 in order to prove compliance with the requirement.

3.6.3 Spurious emissions

3.6.3.1 Definition

This test shall be used to verify that the level of spurious emissions (measured at TX-antenna port as well as cabinet radiation) in the presence of RF input signal do not exceed the specified limits.

For devices with a permanent 50 Ω or 75 Ω TX the maximum declared TX antenna gain "G" in dBi has to be taken into account to determine the maximal radiated power of the spurious emissions "P_{Radiated spurious emission #n}" as follows.

$$P_{\text{Radiated spurious emission \#n}} = A_{\text{Conducted spurious emission \#n}} + G$$

Whereas:

$A_{\text{Conducted spurious emission \#n}}$ is the maximum output power in dBm of a spurious emission that the repeater delivers at its TX antenna port.

3.6.3.2 Limit

Effective radiated power of spurious emissions and cabinet radiation in the frequency range 30 MHz to 1 GHz (radiated) and 9 kHz to 1 GHz (conducted) shall not exceed -68 dBm erp.

This limit applies to frequencies outside the range $f_C \pm 3 \text{ MHz}$, where f_C is the centre frequency of the RF-test signal or RF CW signal used, irrespective of the number of carriers employed.

3.6.3.3 Conformance

Conducted spurious emission shall be tested between 9 kHz and 1 GHz, and radiated spurious emission shall be tested between 30 MHz and 1 GHz.

The repeater shall be set to maximum gain. A nominal DAB RF-test signal according clause 3.4 of this document shall be applied to the RX antenna port.

The frequency of this RF-test signal shall correspond to :

- Single-block repeater: the nominal frequency of the repeater under test or
- Multi-block repeater: tests should be carried out on the nominal frequency of the lowest frequency DAB block within the declared repeater frequency band; and repeated on the nominal frequency of the highest frequency DAB block within the declared repeater frequency band.

- Full-band repeater: tests should be carried out on the five frequencies listed under 3.6.1.3.1.

Alternatively, a RF CW signal may be applied. The level of this RF CW signal shall be adjusted to produce the nominal TX output power.

The measurement shall be performed with an RMS detector and a bandwidth of 100 kHz.

The obtained results shall be compared to the limits in clause 3.6.3.2 in order to prove compliance with the requirement

3.6.4 Repeater in-band gain

3.6.4.1 Definition

This requirement covers the net gain of the repeater inside the declared transmit frequency band.

The gain of the repeater is defined as total gain of the equipment, including receiving and transmitting antennas, filters, cables and amplifiers.

The maximum in-band gain has been set to a value that limits the risk of self oscillation due to feedback loop over the air between the transmitting and the receiving antenna.

For equipments without embedded RX and TX antennas the maximum in-band gain “ G_{Maximum} ” in dB shall be calculated as follows:

$$G_{\text{Maximum}} = G_{\text{Conducted measurement}} + G_{\text{TX}} + G_{\text{RX}}$$

Whereas:

$G_{\text{Conducted measurement}}$ is the maximum gain measured according clause 3.6.4.3

G_{TX} is the maximum declared TX antenna gain

G_{RX} is the maximum declared RX antenna gain

3.6.4.2 Limits

The in-band gain of the repeater equipment shall not exceed 44 dB.

3.6.4.3 Conformance

For equipments that include filters, cables or similar relevant components these components shall be included in the measurement path.

For equipments without embedded RX and TX antennas the measurement shall be performed without antennas.

- 1) The repeater shall be set to maximum gain.
- 2) A continuous sinusoidal RF signal shall be fed into the RX-antenna input port of the repeater.
- 3) The frequency should be :
 - single-block repeater: the centre frequency of the single-block repeater or
 - multi-block repeater: the centre frequency of the lowest DAB block within the declared repeater frequency band and repeated on the centre frequency of the highest DAB block within the declared repeater frequency band of the multi-block repeater or
 - full-band repeater: the centre frequency of the lowest DAB block (174.928 MHz) and repeated on the centre frequency of Band III (202 MHz) and on the centre frequency of the highest DAB block (229.072 MHz) for full-band repeater.

- 4) The power level of the RF input signal applied should be at least 5 dB below the nominal power level, which would produce, when applied within the pass band, maximum rated output power, as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.
- 3) The average output power in each case shall be measured and the net gain shall be recorded.

The results obtained shall be compared to the limits in clause 3.6.4.2 in order to prove compliance.

3.6.5 Repeater out of band gain

3.6.5.1 Definition

This requirement covers the net gain of the repeater outside the declared transmit frequency band.

The gain of the repeater is defined as total gain of the equipment, including receiving and transmitting antennas, filters, cables and amplifiers.

The out of band gain of DAB repeater has been set to prevent other applications to be disturbed by DAB repeaters. Neighbour applications like Paging base stations, PMR, or others should not produce or suffer of any unnecessary disturbance due to the proximity of a DAB repeater.

For equipments without embedded RX and TX antennas the maximum in-band gain " G_{Maximum} " in dB shall be calculated as follows:

$$G_{\text{Maximum}} = G_{\text{Conducted measurement}} + G_{\text{TX}} + G_{\text{RX}}$$

Whereas:

- $G_{\text{Conducted measurement}}$ is the maximum gain measured according clause 3.6.4.3
- G_{TX} is the maximum declared TX antenna gain
- G_{RX} is the maximum declared RX antenna gain

3.6.5.2 Limits

The out of band gain of the repeater equipment shall not exceed the limits shown in table 1 and table 2.

Table 1: Frequency dependent gain limits

Frequency	Maximum Gain
$< F_L - 8 \text{ MHz}$	0 dB
$F_L - 8 \text{ MHz to } F_L - 2 \text{ MHz}$	10 dB
$F_L - 2 \text{ MHz to } F_L$	the in-band gain limit applies
$F_H \text{ to } F_H + 2 \text{ MHz}$	the in-band gain limit applies
$F_H + 2 \text{ MHz to } F_H + 8 \text{ MHz}$	10 dB
$> F_H + 8 \text{ MHz}$	0 dB

where F_L and F_H are:

- single-block repeater: F_L = the lower frequency of the repeater DAB block and F_H = the upper frequency of the repeater DAB block;
- multi-block repeater: F_L = the lower frequency of the lowest DAB block contained into the defined repeater band and F_H = the upper frequency of the highest DAB block contained into the defined repeater band.
- full-band repeater: F_L = 174.160 MHz and F_H = 229.840 MHz

Table 2: Fixed frequency limits

Frequency	Maximum Gain
242.500 MHz to 243.500 MHz	0 dB

3.6.5.3 Conformance

For equipments that include filters, cables or similar relevant components these components shall be included in the measurement path.

For equipments without embedded RX and TX antennas the measurement shall be performed without antennas.

- 1) The repeater shall be set to maximum gain.
- 2) A continuous sinusoidal RF signal shall be fed successively into the RX-antenna input. Whereas the frequency offsets Y shown below from the edges of the relevant transmit frequency band F_L and F_H defined in table 1 in the clause 0 of the present document shall be used.

The frequency offsets Y shall have the following values:

- 2 MHz;
- 8 MHz;
- 16 MHz;
- 32 MHz

The power level of the RF input signal applied should be at least 5 dB below the nominal power level which would produce, when applied at the centre frequency ($\frac{1}{2}(F_L + F_H)$), the maximum rated output power as declared by the manufacturer. This is to ensure that the equipment is operating in the linear output range.

- 3) The test shall be repeated at
 - 242.500 MHz;
 - 243.000 MHz and
 - 243.500 MHzwith the power level of the RF input signal as defined in point 2) above.
- 4) The average output power in each case shall be measured and the net gain shall be recorded.

The results obtained shall be compared to the limits in clause 3.6.5.2 in order to prove compliance.

4 Repealed documents

NT-3003 V1.0.0

NT-3003 V1.1.0

Biel/Bienne, xx.xx.2020

Federal Office of Communications

Philipp Metzger
Director

Annex A (normative): Requirements and conformance test specifications table

The Requirements and conformance Test specifications Table in table A.1 serves a number of purposes, as follows:

- it provides a statement of all the essential requirements in words and by cross reference to (a) specific clause(s) in the present document or to (a) specific clause(s) in (a) specific referenced document(s);
- it qualifies each requirement to be either:
 - Unconditional: meaning that the requirement applies in all circumstances; or
 - Conditional: meaning that the requirement is dependent on the manufacturer having chosen to support optional functionality defined within the schedule;
- in the case of Conditional requirements, it associates the requirement with the particular optional service or functionality;

Table A.1: Requirements and conformance Test specifications Table

The following requirements and test specifications are relevant to the presumption of conformity under the article 7 paragraph 2 TIO (Ordinance on Telecommunications Installations [I.2])

Requirement			Requirement Conditionality		Test Specification
No	Description	Reference: Clause No	U/C	Condition	Reference: Clause No
1	Maximal radiated total power	3.6.1	U		3.6.1.3
2	Intermodulation products	3.6.2	U		3.6.2.3
3	Spurious emissions	3.6.3	U		3.6.3.3
4	Repeater in-band gain	3.6.4	U		3.6.4.3
5	Repeater out of band gain	3.6.5	U		3.6.5.3

Key to columns:

Requirement:

No A unique identifier for one row of the table which may be used to identify a requirement or its test specification.

Description A textual reference to the requirement.

Clause Number Identification of clause(s) defining the requirement in the present document unless another document is referenced explicitly.

Requirement Conditionality:

U/C Indicates whether the requirement is to be *unconditionally* applicable (U) or is *conditional* upon the manufacturers claimed functionality of the equipment (C).

Condition Explains the conditions when the requirement shall or shall not be applicable for a technical requirement which is classified "conditional".

Test Specification:

Clause Number Identification of clause(s) defining the test specification in the present document unless another document is referenced explicitly. Where no test is specified (that is, where the previous field is "X") this field remains blank.