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# Cable networks for television signals, sound signals and interactive service - Part 2-4: LTE (4G) Interference Mitigation Filters operating in the 700 MHz and 800 MHz bands

Réseaux de distribution par câbles pour signaux de télévision, signaux de radiodiffusion sonore et services interactifs - Partie 2-4: Filtres d'atténuation de brouillage LTE (4G) fonctionnant dans les bandes 700 MHz et 800 MHz

To be completed

This draft European Standard is submitted to CENELEC members for enquiry.
Deadline for CENELEC: 2019-01-25.

It has been drawn up by CLC/TC 209.

If this draft becomes a European Standard, CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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# European Foreword

This document (prEN 50083-2-4:2018) has been prepared by CLC/TC 209 “Cable networks for television signals, sound signals and interactive services”.

This document is currently submitted to the CENELEC Enquiry.

The following dates are proposed:

| | | |
|---|---|---|
| • latest date by which the existence of this document has to be announced at national level | (doa) | dor + 6 months |
| • latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement | (dop) | dor + 12 months |
| • latest date by which the national standards conflicting with this document have to be withdrawn | (dow) | dor + 36 months (to be confirmed or modified when voting) |

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

# Introduction

Standards and deliverables of EN 60728 series and EN 50083 series deal with cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques.

This includes, for instance:

a) regional and local broadband cable networks;

b) extended satellite and terrestrial television distribution systems;

c) individual satellite and terrestrial television receiving systems;

and all kinds of equipment, systems and installations used in such cable networks, distribution and receiving systems.

The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input of the customer premises equipment.

The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems.

The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.

This document introduces the requirements for the LTE filters that cover the 700 MHz and 800 MHz bands. These filters are to be used in individual and MATV antenna installations for reception of DTT signals when the 700 MHz band will be used by telecommunication services (LTE) in addition to the 800 MHz band.

These requirements extend those of CLC/TS 50083-2-3 for mitigation filters for LTE services operating in the 800 MHz band only and ETSI EN 303 354 V.1.1.1 (2017-03), that deals with “Amplifiers and active antennas for TV broadcast reception in domestic premises; Harmonized standard covering the essential requirements of article 3.2 of Directive 2014/53/EU”. The ETSI document is mainly applicable to new equipment available on the market, while this document has the purpose to allow the existing individual and MATV antenna installations as well as amplifiers designed for the full spectrum of band 4 and 5 for reception of DTT signals to avoid or mitigate the interference due to the new telecommunication services (LTE) when the 700 MHz band is added to the 800 MHz band already used.

# 1 Scope

This document provides requirements to passive filters intended to reduce RF interference from LTE Base Stations (LTE-BS) and LTE User Equipment (LTE-UE) to receiving equipment and cable distribution systems of broadcast DVB-T and DVB-T2 signals in the VHF and UHF bands. While primarily intended to be used with VHF/UHF DVB-T and DVB-T2 receivers and signal distribution systems, filters can also be useful for mitigation of interference to VHF FM or DAB radio.

# 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50083-2:2012, *Cable networks for television signals, sound signals and interactive services - Part 2: Electromagnetic compatibility for equipment*

EN 60529:1991, *Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60728-11, *Cable networks for television signals, sound signals and interactive services – Part 11: Safety (IEC 60728-11)*

EN 61169-2, *Radio-frequency connectors - Part 2: Sectional specification - Radio frequency coaxial connectors of type 9,52 (IEC 61169-2)*

EN 61169-24, *Radio-frequency connectors - Part 24: Sectional specification - Radio frequency coaxial connectors with screw coupling, typically for use in 75 ohm cable networks (type F) (IEC 61169-24)*

# 3 Terms, definitions and abbreviations

## 3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

**3.1.1**
**bandwidth**
width of a frequency band over which a given characteristic of an equipment or transmission channel does not differ from its reference value by more than a specified amount or ratio

**3.1.2**
**pass-band**
frequency band throughout which the attenuation is less than a specified value

**3.1.3**
**stop-band**
frequency band throughout which the attenuation is greater than a specified value

## 3.2 Abbreviations

For the purposes of this document, the following abbreviations apply.

| | |
|---|---|
| BS | base station |
| DC | direct current |
| EMC | electromagnetic compatibility |
| LTE | long term evolution |
| MATV | master antenna television |
| RF | radio frequency |
| TV | television |
| UE | user equipment |
| UHF | ultra-high frequency |
| VHF | very high frequency |

# 4 LTE filter characteristics

## 4.1 General

To comply with this specification a filter shall pass a range of frequencies (the pass-band) which includes a number of VHF and UHF TV channels and shall attenuate a range of LTE frequencies (the stop-band). In all cases the stop-band lies above the pass-band.

## 4.2 Pass-band and stop-band of a LTE filter (700 MHz and 800 MHz bands)

**Pass-band** (terrestrial broadcasting service):

a) the lower boundary of the pass-band shall lie between 0 Hz (DC) and 174 MHz;

b) the upper boundary of the pass-band shall lie on the upper edge of a TV channel, UHF channel *N,* such that the pass-band upper bound frequency is (8**N*+310) MHz. The value of *N* shall be in the range 47 to 48.

It should be noted that a filter of the band-stop (or band-reject) type can be used to meet this specification. Where this type of filter is used, the range of frequencies lying above the defined stop-band is not considered to be part of the pass-band for the purpose of this specification.

**Stop-band**: shall be from 703 MHz to1 006 MHz, divided in four parts:

1) **Stop-band 1**: 703 MHz to 733 MHz (LTE User Equipment (LTE-UE))

2) **Stop-band 2**: 738 MHz to 821 MHz (LTE Base Station (LTE-BS))

3) **Stop-band 3**: 832 MHz to 862 MHz (LTE User Equipment (LTE-UE));

4) **Stop-band 4**: 862 MHz to 1006 MHz (other services)

## 4.3 Types of standard for a LTE filter

Three types of standard for a LTE filter are defined, considering the stop-band attenuation performance, as defined below.

a) Standard 1 LTE filter

"Professional" filter for use in large cable systems incorporating distribution amplifiers and/or where greater attenuation of LTE interference is required in the case that channel 60 is not distributed.

b) Standard 2 LTE filter

"Consumer" filter intended for use with a single receiver or a number of receivers fed via a passive distribution network.

c) Standard 3 LTE filter

"Typical" filter for use in MATV systems incorporating distribution amplifiers and/or where a typical attenuation for LTE interference mitigation is required.

## 4.4 LTE filter specifications

The nominal characteristic impedance for the LTE filters is 75 Ω, to be used also in measurements. The main LTE filter characteristics are specified in Table 1.

**Table 1 — LTE filter specifications**

| Parameter | Requirement | | | Note |
|---|---|---|---|---|
| | Standard 1 filter | Standard 2 filter | Standard 3 filter | |
| **Pass-band (excluding any band edge relaxation)** | | | | **1** |
| **UHF channel *N*** | **47** | **48** | **48** | |
| **Insertion loss from 174 MHz to** | **≤ 1,5 dB** | **≤ 2,0 dB** | **≤ 1,5 dB** | **2** |
| **Input/output return loss from 174 MHz to channel N UHF** | **≥ 16 dB** | **≥ 14 dB** | **≥ 16 dB** | **3** |
| **Maximum amplitude response variation** | **4 dB** | **6 dB** | **4 dB** | **4** |
| **Maximum group delay variation within channel *N* UHF** | **250 ns** | **250 ns** | **250 ns** | **4** |
| **Pass-band (upper band edge [a] or other parameters optional relaxation)** | | | | |
| UHF channel *N* | **48** | **48** | **48** | |
| Insertion loss in channel N UHF | **≤ 3,0 dB** | **≤ 4,0 dB** | **≤ 3,0 dB** | **2** |
| **Input/output return loss** from 174 MHz to channel N UHF | **≥ 12 dB** | **≥ 10 dB** | **≥ 12 dB** | **3** |
| Maximum amplitude response variation | **6 dB** | **8 dB** | **6 dB** | **4** |
| **Stop-band1 (703 MHz to 733 MHz)(LTE-UE)** | | | | |
| Insertion loss | **≥ 30 dB** | **≥ 15 dB** | **≥ 15 dB** | **2** |
| **Stop-band 2 (738 MHz to 821 MHz)(LTE-BS)** | | | | |
| Insertion loss | **≥ 55 dB** | **≥ 25 dB** | **≥ 30 dB** | **2** |
| **Stop-band 3 (832 MHz to 862 MHz)(LTE-UE)** | | | | |
| Insertion loss | **≥ 30 dB** | **≥ 15 dB** | **≥ 15 dB** | **2** |

| Parameter | Requirement | | | Note |
|---|---|---|---|---|
| | Standard 1 filter | Standard 2 filter | Standard 3 filter | |
| **Stop-band 4 (862 MHz to 1006 MHz)(other services)** | | | | |
| **Insertion loss above 862 MHz** | **≥ 30 dB** | **≥ 15 dB** | **≥ 15 dB** | **2** |
| [a] The extent of the relaxed band, if used, shall not exceed 8 MHz. | | | | |
| NOTE 1: The pass-band is defined less the amount of any upper band edge relaxation used (see footnote [a]).<br>NOTE 2: Insertion loss is measured between a matched source and load (impedance 75 Ω), equivalent to $-\lvert S_{21}\rvert$ in S-parameter terms.<br>NOTE 3: Return loss (equivalent to $-\lvert S_{11}\rvert$ or $-\lvert S_{22}\rvert$ is measured at the input and output ports; the output port is intended to be connected to the receiver.<br>NOTE 4: The maximum variation is intended in the 8 MHz band around the centre frequency of the relevant UHF channels. | | | | |

## 4.5 Connections, EMC, environmental and other factors

### 4.5.1 Connections

A Standard 1 filter and a Standard 3 filter shall be fitted with two female 'IEC type' connectors complying with EN 61169-2 or two female Type-F connectors complying with EN 61169-24. A screw terminal capable of accepting a 4 mm² stranded conductor shall also be provided to facilitate protective equipotential bonding in accordance with EN 60728-11.

A Standard 2 filter shall have an input port marked with the letter 'A' and an output port marked with the letter 'B' intended for direct connection to a receiver or similar equipment. The 'A' port may be either a female Type-F connector complying with EN 61169-24, or a female 'IEC type' 9,52-connector complying with EN 61169-2. The 'B' port shall consist of a male 'IEC type' 9,52-connector complying with EN 61169-2 and mounted on a flexible coaxial cable tail of length (150 ± 10) mm, measured between the body of the filter and the extremity of the connector outer conductor. This tail shall be permanently attached to the body of the filter.

### 4.5.2 EMC – Screening effectiveness

The screening effectiveness of a Standard 1 filter and a Standard 3 filter shall comply with EN 50083-2:2012, Class A.

The screening effectiveness of a Standard 2 filter, including the output tail shall comply with EN 50083-2:2012, Class B.

### 4.5.3 DC and 50 Hz line power considerations

The LTE filter should precede any active equipment in a system, so a line power-pass facility is not usually required. However this feature can be provided, if desired. If a pure low-pass filter structure is used it will occur naturally unless one or more blocking capacitor(s) are included.

To avoid the risk of inadvertent damage to other equipment neither port of a filter shall present a DC short-circuit between the inner and outer conductors.

Each port of a filter shall have an internal high-value resistor connected between the inner and outer conductors, to prevent any build-up of atmospheric 'static' charge in thundery weather conditions. The value of this resistor shall be in the range from 100 kΩ to 1 MΩ. Only one resistor is required where the filter provides a DC through-path.

### 4.5.4 Climate and operating temperature range

Filters intended for outdoor use shall meet the specifications in Table 1 over the temperature range −10 °C to +50 °C and shall be protected against the ingress of dust and water to EN 60529:1991, IP54.

Filters intended for indoor use only, which is deemed to include use in roof spaces, shall meet the specifications in Table 1 over the temperature range −5 °C to +45 °C.

#### 4.5.5 Drop test

A Standard 2 filter shall meet the specifications in Table 1 after being dropped three times from a height of 1,2 m onto a hardwood floor.

No drop test is specified for Standard 1 and Standard 3 filters. These shall have adequate robustness for their intended use.

#### 4.5.6 Fixings

A Standard 1 filter and a Standard 3 filter shall be provided with an appropriate number of fixing holes, permitting permanent screw fixing.

A Standard 2 filter shall be supplied with a means of retaining it in place, for example behind a TV receiver. The fixing method shall be non-penetrative, for example self-adhesive pads.

### 4.6 Information to be supplied by the manufacturer or responsible vendor

The following information about each model of filter shall be provided:

a) the pass-band and stop-band frequencies. The TV channel numbers may be used for the pass-band where appropriate;

b) the filter Standard: 1, 2 or 3;

c) environmental suitability i.e. for use indoors and outdoors, or indoors only (indoors includes use in roof spaces);

d) where a DC through-path is provided, the maximum operating voltage and current should be stated;

e) when data sheets or electronic data are provided separately from the filter, the connector types and sexes used should be detailed in addition to clauses a) to d) above;

f) when data sheets are provided with the filter, the connector data may be omitted.

Provision of this data may be made by any of the following means:

1) published data sheet and/or website;

2) instruction card or leaflet supplied with each product;

3) printed on the product packaging.

# Annex A
(informative)

# Signal protection from LTE signals

## A.1 Frequency allocation of LTE signals in the 700 MHz and 800 MHz bands

The frequency allocation of the LTE signals in the 700 MHz and 800 MHz bands is presented in Figure A.1. The downlink is from the LTE-BS (Base Station) to the LTE-UE (User Equipment), while the uplink is from LTE-UE to LTE-BS.

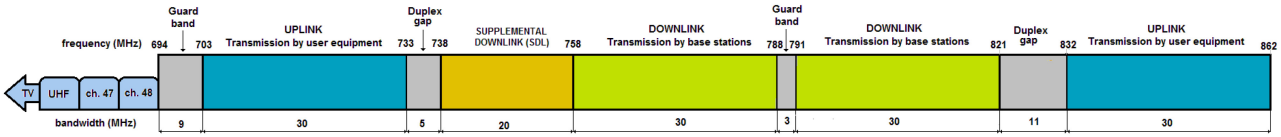


**Figure A.1 — Allocation of LTE signals in the 700 MHz band and 800 MHz bands**

## A.2 LTE-UE field strength in the 700 MHz and 800 MHz bands

The maximum radiated power *P* by a LTE User Equipment (LTE-UE) in the 703 MHz to 733 MHz band and in the 832 MHz to 862 MHz band can reach 25 dB(mW) and can produce a field strength *E* at the distance *D*, calculated according to Formula (A.1):

$$E = \frac{\sqrt{30P}}{D} \qquad \text{(A.1)}$$

In Table A.1 the calculated values of field strength *E* at different distances *D* (in free space) are presented.

**Table A.1 — Field strength *E* produced at a distance *D* (free space) by a radiated power *P* of 25 dB(mW) of a LTE-UE**

| ***D*** m | ***E*** V/m | ***E*** dB(µV/m) |
|---|---|---|
| **3** | **1,0** | **120** |
| **5** | **0,6** | **116** |
| **10** | **0,3** | **110** |

With reference to Table A.1, the LTE-UE can produce at a distance of 3 m a field strength of **120 dB(µV/m) (1 V/m)** in the 703 MHz to 733 MHz band and in the 832 MHz to 862 MHz band, to be considered as a disturbing signal mainly inside a room of a building.

## A.3 LTE-BS field strength in the 700 MHz and 800 MHz bands

The radiated power *P* by a LTE Base Station (LTE-BS) in the 738 MHz to 788 MHz band and in the 791 MHz to 821 MHz band, due to the LTE transmitter power $P_T$ and the LTE antenna gain $G_a$, can produce a field strength *E* at the distance *D*, calculated by using the CEPT Report 30 propagation model.

In Table A.2 the calculated values of field strength *E* at different distances *D* (in free space) are indicated. The radiated power *P* (EIRP) depends on the site location (rural or urban) of the LTE Base Station. The distances *D* considered in Table A.2 are related to field strengths in the range from 120 dB(µV/m) to 106 dB(µV/m).

**Table A.2 — Field strength *E* produced at a distance *D* by a radiated power *P* of a LTE-BS placed in rural or urban sites**

| Site | Transmitter power $P_T$ dB(mW) | Antenna gain $G_a$ dB | Transmitted power *P* dB(mW) | Transmitted power (EIRP) *P* W | Distance *D* m | Field strength *E* V/m | Field strength *E* dB(µV/m) |
|---|---|---|---|---|---|---|---|
| **Rural** | **50,0** | **17** | **67,0** | **5 011,9** | **100** | **1,0** | **120** |
| **Rural** | **50,0** | **17** | **67,0** | **5 011,9** | **180** | **0,5** | **114** |
| **Rural** | **50,0** | **17** | **67,0** | **5 011,9** | **300** | **0,2** | **106** |
| **Urban** | **42,0** | **17** | **59,0** | **794,3** | **40** | **1,0** | **120** |
| **Urban** | **42,0** | **17** | **59,0** | **794,3** | **100** | **0,5** | **114** |
| **Urban** | **42,0** | **17** | **59,0** | **794,3** | **180** | **0,2** | **106** |

According to Table A.2, the LTE Base Station can produce a field strength *E* of **120 dB(µV/m) (1 V/m)** at a television antenna installation placed at a distance of about 100 m from the LTE-BS in rural areas, or at about 40 m in urban areas.

The signal level produced by these disturbing fields at the output of the receiving television antenna is injected (conducted interference) at the input port of the first wide-band amplifier (located near the antenna or in the headend) and can generate overload and intermodulation products.

This requires suitable provisions to be introduced and, in particular, a filter should be inserted between the antenna and the input of the first wide-band amplifier in order to appropriately reduce the overload effects.