# Recommendation on minimum receiver technical requirements for the reception of DVB-T and DVB-T2 signal in the Republic of Croatia[1]

**Disclaimer**
Only the Croatian version of this document is to be considered official and used as a reference.

[1] This document is a recommendation issued by the Croatian Post and Electronic Communications Agency and it is therefore not binding.

Contents

# 1. INTRODUCTION

The Croatian Post and Electronic Communications Agency (HAKOM) has issued this document as a recommendation regarding the minimum technical requirements to be met by DVB-T and DVB-T2 receivers in order to facilitate high-quality reception of basic digital terrestrial television services in the Republic of Croatia.

*"The Recommendation on minimum receiver technical requirements for the reception of DVB-T and DVB-T2 signal in the Republic of Croatia" (hereinafter: Recommendation) is based on relevant international norms, i.e. standards and regulations.*

The Recommendation deals with four categories of DVB-T and DVB-T2 receivers:

1. DVB-T or DVB-T2 receiver for decoding MPEG2 signal of standard definition (SDTV) produced as an independent device (MPEG2 SD STB) which is connected to the TV set;
2. TV set with integrated DVB-T or DVB-T2 receiver for decoding MPEG2 signal of standard definition (MPEG2 SD iDTV);
3. DVB-T or DVB-T2 receiver for decoding MPEG4 signal of high definition (HDTV) produced as an independent device (MPEG4 HD STB) which is connected to the TV set;
4. TV set with integrated DVB-T or DVB-T2 receiver for decoding MPEG4 signal of high definition (MPEG4 HD iDTV).

Rationale:

In order to enable high-quality reception of basic digital terrestrial television services, each technical requirement in an individual category is marked either by the word ***SHALL*** or ***MAY.***

Technical requirements which **must** be met are indicated by the word ***SHALL***, and are mandatory for the category to which they are assigned.

Technical requirements which **may** be met are indicated by the word **MAY**, and are not mandatory for the category to which they are assigned, but if they are met, they must be in accordance with the standards and recommendations stated in the technical requirement.

# 2. DOCUMENT HISTORY

| Date | Version | Comment |
|---|---|---|
| 29.9.2010. | v.1.0 | The first release of the recommendation |
| 13.9.2011. | v.1.1 | Inclusion of DVB-T2 standard |
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# 3. RECEPTION OF THE DVB-T AND DVB-T2 SIGNAL

The input RF interface of the DVB-T and DVB-T2 receiver shall comply with the standard IEC 60169-2, part 2. The input connector shall be IEC 60169-2 male, input impedance of 75 Ohm.

All categories of DVB-T and DVB-T2 receivers shall be required to receive DVB-T signal in conformity with the ETSI EN 300 744 standard. DVB-T2 receivers shall be required to receive DVB-T2 signal in conformity with the ETSI EN 302 755 standard. DVB-T2 receivers that receive DVB-T2 signal in conformity with the ETSI EN 302 755 standard shall also be required to receive DVB-T signal in conformity with the ETSI EN 300 744 standard.

Receivers that receive DVB-T signal shall support each of the following parameters:

- Channel bandwidth 8MHz in UHF frequency range and 7MHz in VHF frequency range
- Transmission modes: 2k and 8k
- Modulation procedures: QPSK, 16-QAM and 64-QAM
- Code rate (FEC – Forward Error Correction): 1/2, 2/3, 3/4, 5/6 and 7/8
- Guard Intervals: 1/4, 1/8, 1/16 and 1/32

The reception of hierarchical modulation is not mandatory; however, the use of hierarchical modulation shall not be the cause of non-functioning of the DVB-T receiver.

DVB-T2 receivers shall support all transmission modes specified in the ETSI EN 302 755 standard.

There is no requirement for DVB-T2 receivers to support Time Frequency Slicing (TFS), but the usage of TFS shall not cause malfunction of the DVB-T2 receiver.

The receivers in all categories shall support reception in MFN and SFN modes.

The receivers manufactured as independent devices (categories 1 and 3) shall have the output RF interface active or passive. The level and quality of the signal shall be identical to that of input RF interface signal. If the output RF interface is active, it shall be switched on while the DVB-T receiver is switched on and while it is working in the “stand-by” mode. The connector shall be type IEC 60169-2 female, output impedance of 75 Ohm.

# 4. FIRST TIME OPERATION INITIALISATION OF DVB-T AND DVB-T2 RECIEVERS (FIRST INSTALLATION)

All menus in DVB-T and DVB-T2 receivers, available to a user, shall also be available in the Croatian language. All parts of the menu, including teletext, DVB and teletext subtitles, and electronic program guide (EPG) shall support ISO/IEC 8859-2 graphic character set. The receivers may support other languages and graphic character sets. Other available languages depend on the manufacturer's free choice, and the name of a language shall be in the language it represents.

When switching on the DVB-T or DVB-T2 receiver for the first time, the receiver shall first offer the choice of languages which relate to all menus in the DVB-T or DVB-T2 receiver. After that it shall offer the automatic search of available programs. If the automatic search is selected, the receiver starts searching on all TV channels in VHF-III, UHF-IV and UHF-V frequency ranges.

On completing the search, it creates three starting program lists, one for television programmes, one for radio programmes, and one for other types of services which do not fall into the category of television or radio services. The DVB-T and DVB-T2 receivers shall recognize as duplicates programmes that have equal combination of Service ID (SID) and Network ID (NID) parameters, and enter into the programme list the one found on a channel with higher quality reception.

The order of programmes on the starting list shall be in accordance with the following criteria:

1. The top of the list contains programmes from the DVB-T or DVB-T2 multiplex with parameter ONID=0x20BF;
2. The programmes of the DVB-T or DVB-T2 multiplex of the same ONID parameter continue to be listed in the ascending order in accordance to the SID.

The DVB-T and DVB-T2 receivers shall automatically classify programmes into television, radio, and other according to corresponding DVB service_type category in the SDT component in accordance with Table 1.

| SERVICE CATEGORY | DVB_service type | STARTING LIST |
|---|---|---|
| MPEG2 SD television programme | 0x01 | TV |
| MPEG4 AVC SD television programme | 0x16 | TV |
| MPEG4 AVC HD television programme | 0x19 | TV |
| MPEG L2 radio programme | 0x02 | Radio |
| MPEG4 HE.AAC radio programme | 0x0A | Radio |
| Teletext as an independent service | 0x03 | Other |
| SW upgrade of DVB-SSU receiver | 0x0C | Not on the programme list |
| DVB-MHP | 0x10 | Not on the programme list |
| Other | Other | Other |

*Table 1 – Instruction for the classification of services in DVB-T and DVB-T2 multiplexes*

The functions that shall be available to users on starting lists shall be the change of the order of programmes, and deletion of programmes.

Subsequent addition of programmes is completed by manual search or by automatic search of available programmes. The parameters that a user shall be able to enter/select are the number of the TV channel or restart the automatic search of available programmes. The DVB-T and DVB-T2 receivers shall automatically determine other parameters necessary for demodulation and decoding.

The DVB-T and DVB-T2 receiver menu shall contain the option to create the additional list of programmes. The user may fill this list with programmes of his/her own choice from the starting programme list and/or choose the order of programmes on the existing list.

The programme lists and all their characteristics shall be saved in the permanent memory of a DVB-T receiver until the user has selected the option “restore to factory settings”.

# 5. DVB-T AND DVB-T2 MULTIPLEX RECEPTION CHARACTERISTICS

## 5.1. PSI/SI components

DVB-T and DVB-T2 receivers shall be able to interpret all PSI/SI components in accordance with ETSI EN 300 468, ISO/IEC 13818-1 and ETSI TR 101 211.

The receiver shall retain in its memory all PSI/SI components PAT, PMT, NIT, CAT, EIT, SDT until the DVB-T or DVB-T2 receiver has been switched off or put into "stand by" mode. This shall apply to all multiplexes whose programmes are stored in the channel list. If one of the mentioned components changes, the receiver shall register the change on the channel and multiplex it currently receives and update the changes in its own memory.

If any of the SI components is missing, the DVB-T and DVB-T2 receivers shall behave in accordance with the Table included in chapter 9.4.5.2 of IEC 62216-1, and if a faulty SI components are received (wrong CRC at the end of the component), the DVB-T receiver shall ignore them and behave as if the component is missing.

The time on the DVB-T and DVB-T2 receivers shall be set automatically through the TDT and TOT components in the multiplex.

The DVB-T and DVB-T2 receivers shall read the programme guide from the EIT component in accordance with recommendation ETSI EN 300 468. All categories of DVB-T and DVB-T2 receivers shall support EIT p/f, EIT sch, EIT p/f other i EIT sch other.

The DVB-T and DVB-T2 receivers shall show the contents of the EPG:

1. When the TV channel is switched – in that case, it shall show the contents of EIT p/f, i.e. start time, end time and the names of the current and following shows broadcasted on the selected channel.
2. When pressing the EPG (electronic programme guide) button – in that case the TV schedule for several TV programmes is shown at the same time. The type of design and navigation through the programme guide depends on the digital receiver manufacturer's free choice.

Receivers shall read and show the following data on the show:

- Name of the show
- Date and start time
- Duration of the show – using this information the DVB-T and DVB-T2 receivers calculate and show the end time
- Rating based on the appropriate age for viewing the event (if the DVB-T or DVB-T2 receiver has parental control).

Receivers shall read and show at least one of the following data on the show:

- Short description of the show
- Detailed description of the show.

It is desirable that receivers are able to show the contents of the EPG for at least seven days in advance, and that they are able to read and search by the type of the show (e.g. news, movies, sport, etc.).

## 5.2. Programme components

The programme components of a DVB-T or DVB-T2 multiplex shall include video, audio, teletext and DVB subtitles.

The decoder shall support the decoding of a signal encoded in accordance with the technical specification ETSI TS 101 154 v1.9.1.

All categories of DVB-T2 receivers shall be able to decode MPEG-4 AVC video signal in conformity with the ISO/IEC 14496-10 standard.

Depending on the category of a DVB-T or DVB-T2 receiver, the decoding of programme components shall or may be supported in accordance with the Table 2:

| | **VIDEO** | **MPEG2 SD STB** | **MPEG2 SD iDTV** | **MPEG4 HD STB** | **MPEG4 HD iDTV** |
|---|---|---|---|---|---|
| 1.1. | MPEG-2 MP@ML | shall | shall | shall | shall |
| 1.2. | MPEG-2 MP@HL | | | may | may |
| 1.3. | MPEG-4 AVC MP@L3 | may | may | shall | shall |
| 1.4. | MPEG-4 AVC HP@L4 | | | shall | shall |
| | **AUDIO** | | | | |
| 2.1. | MPEG Layer2 | shall | shall | shall | shall |
| 2.2. | MPEG-4 HE.AAC | may | may | shall | shall |
| 3. | **TELETEXT** | shall | shall | shall | shall |
| 4. | **DVB subtitles** | shall | shall | shall | shall |

*Table 2 – The list of supported programme components*

If the decoding of an individual component is supported, the corresponding standards and recommendations shall be applied:

For points 1.1. and 1.2. the corresponding standard is ISO/IEC 13818-2. For decoding of point 1.1. it is mandatory that image resolutions 720x576, 544x576 and 480x576 are supported. It is desirable that the following image resolutions are also supported: 704x576 and 640x576. For decoding of point 1.2. it is mandatory that resolutions 1920x1080i, 1440x1080i and 1280x720p are supported.

For points 1.3. and 1.4. the corresponding standard is ISO/IEC 14496-10. For decoding of point 1.3. it is mandatory that image resolution 720x576 is supported. For decoding of point 1.4. it is mandatory that resolutions: 1920x1080i, 1440x1080i and 1280x720p are supported.

For all points related to the video format the receiver shall support fixed and variable transmission speed in compliance with the corresponding standards.

For point 2.1. the corresponding standard is ISO/IEC 13818-3; the receiver shall support all transmission speeds defined for mono, dual mono and stereo transmission.

For point 2.2. the corresponding standard is ISO/IEC 13818-7; the receiver shall support all transmission speeds defined for mono and stereo transmission. The support for multichannel versions is dealt with in the chapter on video and audio interfaces.

The receiver may also support other standards for audio encoding, such as e.g. AC3 and EAC3 (corresponding standard ETSI TS 102 366). If the receiver supports them, it shall support all

transmission speeds defined for mono and stereo. The support for multichannel versions is dealt with in the chapter on video and audio interfaces.

If a television or radio programme contains several audio components, and each component is designated by its own ISO-639.2 language code, the DVB-T and DVB-T2 receivers shall automatically select the audio component designated by *hrv* language code. The option to change the audio component shall be available in the following manner: by pressing the proper button on the remote control, a menu listing available audio component languages is opened, and it is possible to change the component which is to be decoded. In the case of a multichannel AAC audio, iDTV-type DVB-T and DVB-T2 receivers shall adapt that audio to two-channel reproduction on integrated loudspeakers.

For point 3 the corresponding standard is ETSI EN 300 472. When there are more languages when the teletext is switched on, the DVB-T and DVB-T2 receivers shall offer the option to select a language in accordance with ISO-639 language code as well as the list of available teletext subtitles which shall be marked so that they may be distinguished from the teletext. Notwithstanding the code order, the teletext and subtitles marked by *hrv* language code shall be placed on the top of the list. The STB-types of the DVB-T and DVB-T2 receivers normally show the teletext through the STB. The manufacturer may install into the STB the option to insert the teletext into the vertical blanking interval (VBI) of the analogue video on available outputs.

For point 4 the corresponding standard is ETSI EN 300 743.

# 6. VIDEO AND AUDIO INTERFACES

Depending on their type, DVB-T and DVB-T2 receivers shall have input/output interfaces defined in Table 3.

| | **VIDEO** | **MPEG2 SD STB** | **MPEG2 SD iDTV** | **MPEG4 HD STB** | **MPEG4 HD iDTV** |
|---|---|---|---|---|---|
| 1.1. | SCART | output | input | output | input |
| 1.2. | HDMI | | | output | input |
| | **AUDIO** | | | | |
| 2.1. | SCART | output | input | output | input |
| 2.2. | RCA | output | output | output | output |
| 2.3. | HDMI | | | output | input |
| 2.4. | SPDIF | | output | output | output |

*Table 3 – the list of available interfaces on DVB-T*

The SCART interface shall be designed in compliance with the recommendation EN 50157-2-1. The additional SCART interface on the STB-type device, if there is one, shall be designed both as output and input.

The stereo analogue audio output shall be included in all STB-type devices via the RCA interface. If STB supports the decoding of multichannel audio, it shall convert it to stereo audio. The video via the RCA interface may be composite CVBS format for SD and/or component YPbPr format for SD and HD.

The digital audio SPDIF output, if there is one, may be included in the RCA or optical interfaces and shall be able to let through all audio formats defined in chapter 5.2. If the DVB-T or DVB-T2 receiver supports the decoding of a multichannel audio, it shall convert the supported formats in DTS or Dolby formats.

The HDMI interface shall be in compliance with the corresponding standard *HDMI Licensing, LLC: HDMI, „High-Definition Multimedia Interface", rev. 1.4a*

# 7. SOFTWARE UPDATE OF DVB-T AND DVB-T2 RECEIVERS

All DVB-T and DVB-T2 receivers shall support the software update through the incoming DVB-T or DVB-T2 signal (DVB-SSU) in conformity with the recommendation ETSI TS 102 006. Alternative methods of software update are a free choice of the DVB-T and DVB-T2 receiver manufacturer.

For the purpose of reliable operating of DVB-T and DVB-T2 receivers, the factory or the last properly operating version of the system software shall be permanently stored in the memory and always available if the start-up with a new software is not functioning properly whether due to the error in the reception of the new software or due to faulty operation of the new software.

# 8. SUPPORT FOR CA SYSTEMS

DVB-T and DVB-T2 receivers of iDTV type shall have at least one DVB CI (Common Interface) for the instalment of the CA (Conditional Access) module. The CA module shall comply with the recommendation EN50221.

The support for individual CA systems is a free choice of the DVB-T and DVB-T2 receiver manufacturer, and its performance shall comply with the specifications of the CA system manufacturer.

# 9. ABBREVIATIONS

| | |
|---|---|
| AAC-HE | Advanced Audio Coding High Efficiency |
| AVC | Advanced Video Coding |
| CA | Conditional Access |
| CAT | Conditional Access Table |
| CI | Common interface |
| CRC | Cyclic Redundancy Check |
| CVBS | Colour, Video, Blank And Sync |
| DTS | Digital Theatre Sound |
| DVB | Digital Video Broadcasting |
| DVB SSU | DVB System Software Update. |
| DVB-T | Digital Video Broadcasting - Terrestrial |
| DVB-T2 | Digital Video Broadcasting – Second Generation Terrestrial |
| EICTA | European Information & Communications Technology Industry Association |
| EIT | Event Information Table |
| EITp/f | Event Information Table, present/following |
| EITsch | Event Information Table, schedule |
| EPG | Electronic Program Guide |
| ETSI | European Telecommunications Standards Institute |
| HD | High Definition |
| iDTV | Integrated Digital TV set |
| LCN | Logical Channel Number |
| MFN | Multi-Frequency Network |
| MPEG | Motion Picture Experts Group |
| NID | Network ID |
| NIT | Network Information Table |
| ONID | Original Network ID |
| PAT | Programme Association Table |
| PIN | Personal Identification Number |
| PMT | Program Map Table |
| PSI | Program Specific Information |
| RCA | Radio Corporation of America |
| RF | Radio Frequency |
| SCART | Syndicat des Constructeurs d'Appareils Radiorécepteurs et Téléviseurs / Radio and Television Receiver Manufacturers' |
| SD | Standard Definition |
| SDT | Service Description Table |
| SFN | Single Frequency Network |
| SI | Service Information |
| SID | Service ID |

| | |
|---|---|
| STB | Set-Top box |
| TDT | Time and Date Table |
| TOT | Time Offset Table |
| TSID | Transport Stream ID |
| UHF | Ultra High Frequency |
| VHF | Very High Frequency |

# 10. REFERENCES


| | |
|---|---|
| IEC 60169-2, part 2 | Radio-frequency connectors. Part 2: Coaxial unmatched connector |
| ETSI EN 300 744 v1.5.1 | DVB Framing structure, channel coding and modulation for digital terrestrial television. (ETSI) |
| ETSI EN 302 755 v1.2.1 | Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2) |
| ETSI TS 101 154 v1.9.1 | Digital Video Broadcasting (DVB);Specification for the use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream |
| ISO/IEC 8859-2 | Information technology -- 8-bit single-byte coded graphic character sets -- Part 2: Latin alphabet No. 2 |
| EN 300 468 v1.11.1 | Digital Broadcasting Systems for television, sound and data services; Specification for service information (SI) in Digital Video Broadcasting (DVB) Systems |
| ETSI TR 101 211 v1.7.1 | Guidelines on Implementation and Usage of Service Information (SI) |
| HDMI Specification 1.4a | HDMI Licensing, LLC: HDMI, High-Definition Multimedia Interface Specification Version 1.4a |
| ISO/IEC 14496-10 | Information technology — Coding of audio-visual objects — Part 10: Advanced Video Coding |
| ISO/IEC 13818-1 | Information technology - Generic coding of moving pictures and associated audio information: Systems. |
| ISO/IEC 13818-2 | Information technology - Generic coding of moving pictures and associated audio information: Video |
| ISO/IEC 13818-3 | Information technology - Generic coding of moving pictures and associated audio information - Part 3: Audio |
| ISO/IEC 13818-7 | Information technology - Generic coding of moving pictures and associated audio information - Part 7: Advanced Audio Coding (AAC). |
| ETSI TS 102 366 | Digital Audio Compression (AC-3, Enhanced AC-3) Standard |
| ETSI EN 300 472 v1.3.1 | Conveying ITU-R System B Teletext in DVB bitstreams |
| ISO 639.2 | Code for the representation of names of languages |
| ETSI TS 102 006 v1.3.1 | Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems |
| EN 300 743 V1.2.1 | Subtitling systems |
| EN 50221 | Common Interface Specification for Conditional Access and other Digital Video Broadcasting Decoder Applications |