

Technical Specification for Digital Terrestrial Television Receivers

Adopted on September 12, 2005.

1. Scope and Objectives

This specification is applicable to integrated digital television (receivers with screen) and other digital television receivers (e.g. Set-Top-Box, STB, etc.).

Objectives of the methods and requirements specified in this specification are to verify the essential functions and features of digital television receivers.

This specification does not exclude the requirements of other laws, regulations or specifications with which the above-mentioned products are requested to comply.

This specification does not apply to car-based and PC-based digital television receivers.

2. References

References listed below are important to this specification. Please refer to their up-to-date versions.

- 2.1 ETSI EN 300 468 V1.5.1 2004-06 – Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB Systems
- 2.2 ETSI EN 300 744 V1.5.1 2004-06 – Digital Video Broadcasting (DVB); Framing Structure, Channel Coding and Modulation for Digital Terrestrial Television
- 2.3 ETSI TS 101 154 V1.5.1 2004-05 – Digital Video Broadcasting (DVB); Implementation Guidelines for the Use of Video and Audio Coding in Broadcasting Applications based on the MPEG-2 Transport Stream
- 2.4 Draft ETSI TR 101 162 V1.2.1 2001-01 – Digital Video Broadcasting (DVB); Allocation of Service Information (SI) and Data Broadcasting Codes for Digital Video Broadcasting (DVB) Systems
- 2.5 ETSI TR 101 211 V1.6.1 2004-05 – Digital Video Broadcasting (DVB); Guidelines on Implementation and Usage of Service Information (SI)
- 2.6 ISO/IEC 14496-1, 2, 3, 10 – MPEG-4 Systems, Visual, Audio, Advanced Video Coding
- 2.7 IEC 62216-1 Digital terrestrial television receivers for the DVB-T system – Part 1: Baseline receiver Specification
- 2.8 ISO/IEC 13818-1 – Information Technology – Generic Coding of Moving Pictures and Associated Audio – Part 1: Systems
- 2.9 CNS 13439 Sound and television broadcast receivers and associated equipment - Radio disturbance characteristics Limits and methods of measurement
- 2.10 CNS 14408 Audio, video and similar electronic apparatus – safety requirements
- 2.11 CNS 14409 Limits and methods of measurement of immunity characteristics of sound and television broadcast receivers and associated equipment
- 2.12 CNS 13438 Limits and methods of measurement of radio interference characteristics of information technology equipment
- 2.13 CNS 14336 Information technology equipment - Safety - General requirements

- 2.14 CNS 14676-4 Electromagnetic compatibility (EMC) - Testing and measurement techniques- Part 4:Electrical fast transient/burst immunity test
- 2.15 CNS 14676-5 Electromagnetic compatibility (EMC) - Testing and measurement techniques- Part 5: Surge immunity test

3. Terminologies, Definitions, and Abbreviations

3.1 Terminologies and Definitions

Terminologies and definitions listed below are applied in this specification.

3.1.1 MPEG-2

Reference is made to CNS 14357 series standards. Systems coding is defined in Part 1. Video and audio coding are defined in Part 2 and Part 3, respectively.

3.1.2 Multiplex

Stream of all the digital data carrying one or more services within a single physical channel.

3.1.3 Service Information, SI

Digital data describing the delivery system, content and scheduling/timing of broadcast data streams etc. It includes MPEG-2 Program Specific Information together with independently defined extensions.

3.1.4 Transport Stream, TS

TS is a data structure defined in CNS 14357-1

[Information Technology – Generic Coding of Moving Pictures and Associated Audio – Part 1: Systems].

3.2 Abbreviations

AVC (Advanced Video Coding)
CA (Conditional Access)
CATV (Community Antenna TeleVision)
COFDM (Coded Orthogonal Frequency Division Multiplexing)
DVB (Digital Video Broadcasting)
DVB-CI (DVB-Common Interface)
DVB-SI (DVB-Service Information)
DVB-T (DVB-Terrestrial)
ETSI (European Telecommunication Standard Institute)
HDTV (High Definition TeleVision)
HE-AAC (High-Efficiency Advanced Audio Coding)
IF (Intermediate Frequency)
MP@ML (Main Profile at Main Level)
MPEG (Moving Picture Experts Group)
PES (Packetized Elementary Stream)
PID (Packet Identifier)
PSI (Program Specific Information)
QAM (Quadrature Amplitude Modulation)
QPSK (Quaternary Phase Shift Keying)
RF (Radio Frequency)
SDTV (Standard Definition TeleVision)
SI (Service Information)
STB (Set-Top Box)

TS (Transport Stream)

TV (TeleVision)

Note: HDTV defined in this specification shall be capable of (i) receiving and decoding video signal coded at least in 1080i and (ii) displaying the decoded video at least in 720p.

4. Technical Requirements

Digital television receivers within the scope of this specification are required to satisfy the following technical requirements. They shall

- Be able to receive the digital terrestrial television broadcast signals.
- Be able to accurately decode and display video and audio signals that satisfy the DVB-T specification (EN 300 744 V1.5.1).
- Be able to decode and display the video signals specified in MPEG-2 MP@ML, and the MPEG-1 Layer I/II and MPEG-2 Layer I/II audio signals specified in TS 101 154 V1.5.1 when SDTV is applied.
- Be able to decode and display the video signals specified in MPEG-4 AVC HP@L4, and the audio signals coded in HE-AAC in addition to satisfying the requirements for SDTV when HDTV is applied.
- Provide an embedded Chinese Electronic Program Guide application services.
- Be able to accurately process information of program, service, and others defined in DVB-SI (EN 300 468 V1.5.1) and MPEG-PSI (ISO/IEC 13818-1).
- Be able to accurately decode and process MPEG-2 Transport Stream defined in ISO/IEC 13818-1. The maximum data rate is 23.751 Mbit/s (64QAM, Code Rate 7/8, GI 1/32 in 6 MHz Channel Bandwidth).
- Be able to accurately decode MPEG video defined in DVB specification TS 101 154 V1.5.1.
- Be able to accurately decode audio signals defined in HE-AAC when HDTV is applied.
- Be able to accurately decode audio signals defined in MPEG-1 Layer I/II.
- Be able to accurately decode audio signals defined in MPEG-2 Layer I/II.
- Be able to support video signals formats defined in MPEG-2 MP@ML.
- Be able to support video signals formats defined in MPEG-4 AVC HP@L4 when HDTV is applied.
- Be able to support stereo audio signals output.

Sections 4.1 to 6.3 in this specification describe the methods that can be applied to verify products that satisfy all technical requirements described above.

4.1 General conditions during testing

Unless otherwise specified in this technical specification, the following testing conditions shall be applied to each test item during testing.

4.1.1 Feed point of testing signal

Unless otherwise specified in this technical specification, digital television RF input signals shall be directly fed into the antenna input terminal of digital television receiver via cables with matching impedance.

4.1.2 Patterns for digital TV input signal during the test

This input signal shall at least include video, audio and SI components. Video and audio format for SDTV or HDTV shall be selected depending on the function of the digital television under test.

The following functions shall be included in the input patterns:

- Field flags: Four successive white areas appearing in every field indicate a continuous decoding of the transport stream.
- Moving spot: White spot that moves back and forth in the black field. A complete movement is performed in 30 frames. Thus, the errors in the time domain can be detected during decoding and also delay measurements between the different transmission paths.
- Monitor test pattern:
 - Grid and circle: For adjustment of geometry of picture tubes/monitors.
 - Color bar: For observing color purity / interchange of components etc.
 - Multiburst: For judging frequency response, horizontal resolution.

4.1.3 Conformity assessment

Picture quality shall be used to evaluate the conformity of each test item. Either subjective or objective evaluation of picture quality shall be used.

Objective evaluation method: See CISPR 20 2005 Annex K.

Subjective evaluation method: using qualified personnel to evaluate the picture quality.

In case of discrepancy, subjective evaluation method takes precedence.

Note: When making subjective evaluation, an additional reference display (or test-TV-set) can be used to compare with EUT's (equipment under test) picture quality, e.g. resolution characteristic of HDTV.

4.2 RF sensitivity and minimum input level

4.2.1 A digital television receiver specified in this specification shall be able to receive digital terrestrial television broadcast signals in Taiwan (Frequency range 470 MHz ~ 806 MHz, Channel 14 ~ 69, Channel Bandwidth 6 MHz).

4.2.2 All channels of a digital television receiver defined in this specification shall be able to accurately receive digital terrestrial television broadcast signals while the input signal level is -76dBm.

4.2.3 All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals without degradation while the input signal level is increased to 0 dBm.

4.3 Receive and demodulation of digital television receiver

4.3.1 There shall be at least one tuner in the digital television receiver specified in this specification that can be used to receive digital terrestrial television broadcast signals specified in EN 300 744 V1.5.1.

4.3.2 The tuner specified in this specification shall receive digital terrestrial television broadcast signals in Taiwan (Frequency range 470 MHz ~ 806 MHz, Channel 14 ~ 69, Channel Bandwidth 6 MHz).

- 4.3.3 The tuner specified in this specification shall be able to receive the existing digital terrestrial television broadcast signals broadcasted in Taiwan.
- 4.3.4 There shall be at least one demodulator in the digital television receiver specified in this specification that can be used to demodulate digital terrestrial television broadcast signals specified in EN 300 744 V1.5.1.
- 4.3.5 The demodulator specified in this specification shall be able to accurately demodulate all modes from any combination of constellation (QPSK, 16QAM, 64QAM), code rate (1/2, 2/3, 3/4, 5/6, 7/8), guard interval (1/4, 1/8, 1/16, 1/32), and transmission mode (2K, 8K).
- 4.3.6 The demodulator specified in this specification shall accurately demodulate the existing terrestrial television broadcast signals broadcasted in Taiwan.

A digital terrestrial television receiver defined in this specification shall be able to accurately decode and process MPEG-2 Transport Stream defined in ISO/IEC 13818-1. The maximum data rate is 23.751 Mbit/s (64QAM, Code Rate 7/8, GI 1/32 in 6 MHz Channel Bandwidth). Table 1 describes all combinations of constellation (QPSK, 16QAM, 64QAM), code rate (1/2, 2/3, 3/4, 5/6, 7/8), guard interval (1/4, 1/8, 1/16, 1/32), and transmission mode (2K, 8K).

Table 1 – All combinations of constellation (QPSK, 16QAM, 64QAM), code rate (1/2, 2/3, 3/4, 5/6, 7/8), guard interval (1/4, 1/8, 1/16, 1/32), and transmission mode (2K, 8K)

| Mode | Constellation | FEC | GI | | | |
|------|---------------|-----|-----|-----|------|------|
| 8K | QPSK | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | QPSK | 2/3 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | QPSK | 3/4 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | QPSK | 5/6 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | QPSK | 7/8 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 16QAM | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 16QAM | 2/3 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 16QAM | 3/4 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 16QAM | 5/6 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 16QAM | 7/8 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 64QAM | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 64QAM | 2/3 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 64QAM | 3/4 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 64QAM | 5/6 | 1/4 | 1/8 | 1/16 | 1/32 |
| 8K | 64QAM | 7/8 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | QPSK | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | QPSK | 2/3 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | QPSK | 3/4 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | QPSK | 5/6 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | QPSK | 7/8 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 16QAM | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 16QAM | 2/3 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 16QAM | 3/4 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 16QAM | 5/6 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 16QAM | 7/8 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 64QAM | 1/2 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 64QAM | 2/3 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 64QAM | 3/4 | 1/4 | 1/8 | 1/16 | 1/32 |
| 2K | 64QAM | 5/6 | 1/4 | 1/8 | 1/16 | 1/32 |

| | | | | | | |
|----|-------|-----|-----|-----|------|------|
| 2K | 64QAM | 7/8 | 1/4 | 1/8 | 1/16 | 1/32 |
|----|-------|-----|-----|-----|------|------|

4.4 Performance with Additive White Gaussian Noise (AWGN)

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with additive white Gaussian noise. The power level of DVB-T wanted signal access to the digital television receiver is adjusted to -50 dBm. The digital television receiver should be able to receive the broadcast signal with the C/N value at 13.8dB or less on 16QAM mode and 17.9dB or less on 64QAM mode after added with additive white Gaussian noise.

4.5 Performance with adjacent channel DVB-T interference

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with adjacent channel DVB-T interference signal. The protection ratio of wanted signal with interference signal should be at least -52dB on 16QAM mode and at least -48dB on 64QAM mode.

4.6 Performance with multipath

A digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with multipath. The model of multipath is described in sections 4.6.1 to 4.6.4.

4.6.1 Performance with short delay echoes

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with short delay echoes. The power level of DVB-T wanted signal access to the digital television receiver is adjusted to -50 dBm. The digital television receiver should be able to receive the broadcast signal with the C/N value at 19.5dB or less on 16QAM mode and 22.2dB or less on 64QAM mode after mixes with the short delay echoes as table 2.

Table 2 - Performance with short delay echoes

| Delay (μ s) | Relative Attenuation (dB) | Phase (deg.) |
|------------------|---------------------------|--------------|
| 0 | 2.8 | 0 |
| 0.05 | 0 | 0 |
| 0.4 | 3.8 | 0 |
| 1.45 | 0.1 | 0 |
| 2.3 | 2.6 | 0 |
| 2.8 | 1.3 | 0 |

4.6.2 Performance with long delay echoes

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with long delay echoes. The power level of DVB-T wanted signal access to the digital television receiver is adjusted to -50 dBm. The digital television receiver should be able to receive the broadcast signal with the C/N value at 18dB or less on 16QAM mode and 22.2dB or less on 64QAM mode after mixes with the long delay echoes as table 3.

Table 3 - Performance with long delay echoes

| Delay (μ s) | Relative Attenuation (dB) | Phase (deg.) |
|------------------|---------------------------|--------------|
| 0 | 0 | 0 |
| 5 | 9 | 0 |
| 14 | 22 | 0 |

| | | |
|----|----|---|
| 35 | 25 | 0 |
| 54 | 27 | 0 |
| 75 | 28 | 0 |

4.6.3 Performance with a single 0 dB echo within the guard interval

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with a single 0 dB echo within the guard interval. The power level of DVB-T wanted signal access to the digital television receiver is adjusted to -50 dBm. The digital television receiver should be able to receive the broadcast signal with the C/N value at 22dB or less on 16QAM mode and 23dB or less on 64QAM mode after mixed with a signal which is phase shift 90 degree, delay 3.5µsec and relative attenuation 0 dB echo within the guard interval.

4.6.4 Characteristic with a single echo outside the guard interval

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals with a single 0 dB echo outside the guard interval. The power level of DVB-T wanted signal access to the digital television receiver is adjusted to -50 dBm. The digital television receiver should be able to receive the broadcast signal while wanted signal mixes with a signal which is phase shift 90 degree echo outside the guard interval. The delay and relative attenuation of mixed echo refer to table 4.

Table 4 - Characteristic with a single echo outside the guard interval

| Delay (µs) | -347 | -307 | -270 | -200 | -16 | 16 | 200 | 270 | 307 | 347 |
|-----------------------------------|------|------|------|------|-----|----|-----|-----|-----|-----|
| 8K, 64QAM, R=2/3, GI=1/8 | 15 | - | 13 | 10 | 5 | 5 | 10 | 13 | - | 15 |
| 8K, 64QAM, R=2/3, GI=1/4 | 10 | 5 | | | | | | | 5 | 10 |
| 8K, 64QAM, R=3/4, GI=1/4 | 12 | 6 | | | | | | | 6 | 12 |

4.7 Impulsive interference tests

All channels of a digital television receiver defined in this specification shall be able to receive digital terrestrial television broadcast signals while mixed with the impulsive interference as list in table 5.

Table 5 – parameters for Impulse noise tests

| Test | Pulses per burst | Effective Burst Duration (µsec) | Min. Pulse Spacing (µsec) | Max. Pulse Spacing (µsec) | Range of actual burst durations (µsec) |
|------|------------------|---------------------------------|---------------------------|---------------------------|--|
| 1 | 1 | 0.25 | N/A | N/A | 0.25 |
| 2 | 2 | 0.50 | 1.5 | 45 | 1.75-45.25 |
| 3 | 4 | 1.00 | 15 | 35 | 45.25-105.25 |
| 4 | 12 | 3.00 | 10 | 15 | 110.25-165.25 |
| 5 | 20 | 5.00 | 1 | 2 | 19.25-38.25 |

| | | | | | |
|---|----|-------|-----|---|-------------|
| 6 | 40 | 10.00 | 0.5 | 1 | 19.75-39.25 |
|---|----|-------|-----|---|-------------|

4.8 Service Information/Program Specific Information

- 4.8.1 A digital television receiver defined in this specification shall be able to process information of program, service, and others defined in DVB-SI (EN 300 468 V1.5.1) and MPEG-PSI (ISO/IEC 13818-1).
- 4.8.2 A digital television receiver defined in this specification shall be able to process Chinese information of program, service, and others defined in DVB-SI (EN 300 468 V1.5.1) and MPEG-PSI (ISO/IEC 13818-1).
- 4.8.3 There shall be an embedded Chinese Electronic Program Guide (EPG) application in the digital television receiver defined in this specification. This Chinese EPG shall at least display information of Now and Next programs or services.

4.9 Video Display Format

A digital television receiver defined in this specification shall support display formats defined in MPEG-MP@ML. When HDTV is applied, this digital television receiver shall be able to receive and decode video signals defined in MPEG-4 AVC HP@L4 (at least in 1080i) and shall be able to display the decoded video signals at least in 720p.

4.10 Audio Output

A digital television receiver defined in this specification shall support stereo audio output. This digital television receiver shall at least output audio signals in L and R channels, respectively but not necessarily concurrently.

5. Satisfaction of technical requirements

5.1 Satisfaction of Requirements in Video

- 5.1.1 Accurately receiving, decoding, working, and processing
There is no mosaic and no delay during video displaying.

- 5.1.2 Distortion in video
There is mosaic or delay during video displaying.

5.2 Resolution of video

Resolution of video is determined subjectively by comparing with a standard HDTV video.

5.3 Satisfaction of Requirements in Audio

A digital television receiver defined in this specification shall be able to decode the audio signal carried in the transport stream and be able to play the decoded audio synchronously with video via an audio playback device.

During the test audio shall be output through L and R channels, respectively but concurrently. Stereo audio output is not necessary to be verified. There is no burst and no distortion during audio output.

6. Immunity requirements

- 6.1 A digital television shall comply with CNS 14409.
- 6.2 A digital television shall comply with CNS 14676-4 Electromagnetic compatibility (EMC) - Testing and measurement techniques- Part 4:Electrical fast transient/burst immunity test

(1kV test level is required for power supply lines; 500 V test level is required for other signal cables).

- 6.3 A digital television shall comply with CNS 14676-5 Electromagnetic compatibility (EMC) - Testing and measurement techniques- Part 5: Surge immunity test (2 kV test level is required for N-G and L-G; 1 kV test level is required for L-L)

7. Essential instructional items for HDTV

For an HDTV receiver, in addition to the correct labeling, manufacturers are further required to describe the detailed product display information including horizontal and vertical resolution, e.g. 1280 x 720 or 1920 x 1080, in user manual.