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Methods of Measurement for Digital Terrestrial Set-top Box

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Table of Contents

1	Scope	4
2	Normative References	4
3	Terms, Definitions and Acronyms	5
3.1	Term and Definition	5
3.2	Abbreviation	5
4	Basic Requirements on Measurement	5
4.1	General	5
4.2	Test Signal	6
4.3	Measurement System and Instrument	6
4.4	Standard Measuring Conditions	7
5	Measurement Items and Methods	9
5.1	System Chart	9
5.2	Requirements on RF Demodulation and Channel Decoding	9
5.3	Requirements on Transport Stream Decoding Characteristics	21
5.4	Requirements on Baseband Video Output Performance	23
5.5	Audio Output Characteristic	39
5.6	Requirements on Functions	41
5.7	Requirements on Power Adaptability	41
5.8	Power Consumption	42
5.9	Standby Power Consumption	42
	Appendix A (Normative) Multipath Channel Model	44
	Appendix B (Normative) Acceptable Error-free	46

Foreword

This Standard is drafted in accordance with the rules specified in GB/T 1.1-2009.

This Standard was proposed by the Ministry of Industry and Information Technology of the People's Republic of China.

This Standard shall be under the jurisdiction of the National Technical Committee 242 on Audio, Video, Multimedia System and Equipment of Standardization Administration of China (SAC/TC 242).

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Methods of Measurement for Digital Terrestrial Set-top Box

1 Scope

This Standard specifies the measuring conditions, electric property measurement items and measurement methods of digital terrestrial set-top box (hereinafter referred to as set-top box or SB) that supports digital terrestrial television reception function specified in GB 20600-2006.

This Standard is applicable to standard definition (SD) and high definition (HD) digital terrestrial set-top boxes that support digital terrestrial television reception function specified in GB 20600-2006.

2 Normative References

The following documents are essential for the application of this Standard. For the dated normative references, only the dated editions are applicable to this document. For the undated references, the latest editions of the normative documents (including all the amendments) are applicable to this document.

GB/T 3174 Characteristics of PAL-D Television Broadcasting System

GB 3659-1983 Methods of Measurement of Television Video Channel

GB/T 17975.1 Information Technology - Generic Coding of Moving Picture and Associated Audio Information - Part 1: System (GB/T 17975.1-2010, ISO/IEC 13818-1:2007, MOD)

GB/T 17975.2 Information Technology - Generic Coding of Moving Picture and Associated Audio Information - Part 2: Video (ITU-TH, 262: 1995, IDT)

GB/T 17975.3 Information Technology - Generic Coding of Moving Picture and Associated Audio Information - Part 3: Audio (ISO/IEC 13818-3:1998, IDT)

GB 20600-2006 Framing Structure, Channel-Coding and Modulation for Digital Television Terrestrial Broadcasting System

GB/T 22122-2008 Methods of Measurement of Surround Audio for Digital TV

GB/T 26685-2011 Methods of Measurement for Digital Terrestrial Television Set-top box

GB/T 26270-2010 Standard Test Signals for Digital Television Receiving Equipment

SJ/T 11324-2006 Terminology of Digital Television Receiving Equipment

3 Terms, Definitions and Acronyms

3.1 Term and Definition

For the purpose of this Standard, the following terms and definitions AND the ones defined in SJ/T 11324-2006 apply.

3.1.1

Acceptable error free [Translator: abbreviated as error-free]

Error code events that are not corrected within the specified time are less than a certain threshold during the signal reception process.

3.2 Abbreviation

AEF — Acceptable error-free;

EPG — Electronic program guide;

PSI — Program specific information;

SI — Service information;

UHF — Ultra high frequency;

VHF — Very high frequency.

4 Basic Requirements on Measurement

4.1 General

4.1.1 Operating conditions

Unless otherwise specified, the tested set-top box (TSB) shall be tested according to the measuring conditions specified in 4.4.

4.1.2 Measurement site

The measurement shall be carried out in indoor room not subject to the ambient radio frequency and low frequency electromagnet field interference; if ambient electromagnet field interferes the measuring results, the measurement shall be done

in a shielded room.

4.1.3 Measurement environment conditions

4.1.3.1 Measurement conditions

Ambient temperature: 15°C~35°C;

Relative humidity: 25%~75%;

Atmosphere pressure: 86kPa~106kPa;

Power: 220×(1±5%) V, 50×(1±2%) Hz.

4.1.3.2 Arbitration conditions

Environment temperature: 20°C±2°C;

Relative humidity: 60%~70%;

Atmosphere pressure: 86kPa~106kPa;

Power: 220×(1±2%) V, 50×(1±1%) Hz;

Power harmonic: (0~5)%.

4.1.4 Stability time

The set-top box shall steadily work at least 15 min under the standard measuring conditions, in order to guarantee that the set-top box performance does not obviously change along the time after the measurement begins.

4.2 Test Signal

See GB/T 26270-2010.

4.3 Measurement System and Instrument

For the specific requirements, see Table 1.

Table 1

S/N	Equipment name	Requirement
1	Digital television measurement transmitter (DTMT)	Support 330 operating modes specified in GB 20600-2006
2	Analog television measurement transmitter (ATMT)	Carrier frequency and amplitude are adjustable
3	Frequency spectrum analyzer (FSA)	Frequency range: 0Hz~1GHz
4	Network analyzer	Frequency range: 0Hz~1GHz
5	Video analyzer (VA)	Analyze and measure level, frequency, time delay and phase difference

analyzer; and record it as the amplitude-frequency response curve of the composite video signal.

5.4.4 Brightness signal-to-noise (S/N) ratio of composite video signal

5.4.4.1 Characteristic description

Check the brightness S/N ratio of the composite video output port of the set-top box, expressed in dB.

5.4.4.2 Test chart

The test chart is shown in Figure 19.

5.4.4.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the small slope inclination brightness signal;
- b) Read out the brightness S/N ratio with a video analyzer, load 100kHz high pass filter, 6MHz low-pass filter, chrominance subcarrier XXX, declination compensation and uniform weighting network during the measurement; and record the reading as the brightness S/N ratio of the composite video signal.

5.4.5 Differential gain of composite video signal

5.4.5.1 Characteristic description

Check the amplitude variation of the chrominance subcarrier signal caused by the variance in brightness signal in the video signal of the set-top box composite video output, expressed in percentage (%).

5.4.5.2 Test chart

The test chart is shown in Figure 19.

5.4.5.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the transport stream of color staircase signal;
- b) Read out the differential gain with a video analyzer; and record it as the differential gain of the composite video signal.

5.4.6 Differential phase of composite video signal

5.4.6.1 Characteristic description

Check the phase drift of the chrominance subcarrier signal caused by the variance in

brightness signal in the video signal of the set-top box composite video output, expressed in (°).

5.4.6.2 Test chart

The test chart is shown in Figure 19.

5.4.6.3 Measurement method

- a) Connect the test system as Figure 19; the stream generator outputs the transport stream of color staircase signal;
- b) Read out the differential phase with a video analyzer; and record it as the differential phase of the composite video signal.

5.4.7 Brightness signal non-linear distortion of composite video signal

5.4.7.1 Characteristic description

Check the non-linear between-line distortion of brightness channel in the composite video output of the set-top box, expressed in percentage (%).

5.4.7.2 Test chart

The test chart is shown in Figure 19.

5.4.7.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the transport stream of the 5-staircase brightness signal;
- b) Read out the brightness signal non-linear distortion with a video analyzer; and record it as the brightness signal non-linear distortion of composite video signal.

5.4.8 K factor of composite video signal

5.4.8.1 Characteristic description

Check the linear waveform response of the brightness channel in the composite video output of the set-top box, expressed in percentage (%).

5.4.8.2 Test chart

The test chart is shown in Figure 19.

5.4.8.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the

transport stream of 2T pulse, 20T pulse and bar signal;

- b) Read out K_b , K_{pb} and K_p with a video analyzer, and adopt the largest one as K factor of the composite video signal.

5.4.9 Brightness-color time-delay difference of composite video signal

5.4.9.1 Characteristic description

Check the time difference of the brightness and color superposing of the composite video output signal in the set-top box, expressed in (ns).

5.4.9.2 Test chart

The test chart is shown in Figure 19.

5.4.9.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the transport stream of 2T pulse, 20T pulse and bar signal;
- b) Read out the brightness-color time-delay difference with a video analyzer; and record it as the brightness-color time-delay difference of the composite video signal.

5.4.10 Brightness-color gain inequality of composite video signal

5.4.10.1 Characteristic description

Check the amplitude difference of the brightness and color superposing of the composite video output signal in the set-top box, expressed in percentage (%).

5.4.10.2 Test chart

The test chart is shown in Figure 19.

5.4.10.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the transport stream of 2T pulse, 20T pulse and bar signal;
- b) Read out the brightness-color gain inequality with a video analyzer; and record it as the brightness-color gain inequality of the composite video signal.

5.4.11 Line-synchronization front-edge jittering of composite video signal

5.4.11.1 Characteristic description

Check the variance in horizontal synchronization clocking of the set-top box

- a) Connect the test system as Figure 20; the stream generator outputs the transport stream of the 5-staircase brightness signal;
- b) Read out the non-linear distortion with a video analyzer; and record it as the non-linear distortion of S-terminal channel-Y.

5.4.16 K factor of S-terminal channel-Y

5.4.16.1 Characteristic description

Check the linear waveform response of channel-Y in the S-terminal of the set-top box, expressed in percentage (%).

5.4.16.2 Test chart

The test chart is shown in Figure 20.

5.4.16.3 Measuring method

- a) Connect the test system as Figure 20; the stream generator outputs the transport stream of 2T pulse, 20T pulse and bar signal;
- b) Read out K_b , K_{pb} and K_p with a video analyzer, and adopt the largest one as K factor of the S-terminal channel-Y.

5.4.17 S/N ratio of S-terminal channel-Y

5.4.17.1 Characteristic description

Check the noise characteristic of the S-terminal channel-Y of the set-top box, expressed in (dB).

5.4.17.2 Test chart

The test chart is shown in Figure 20.

5.4.17.3 Measuring method

- a) Connect the test system as Figure 20; the stream generator outputs the small slope inclination brightness signal;
- b) Read out the brightness S/N ratio with a video analyzer, load 100kHz high pass filter, 6MHz low-pass filter, declination compensation and uniform weighting network during the measurement; and record the reading as the brightness S/N ratio of S-terminal channel-Y.

5.4.18 Time-delay difference of S-video Y/C

5.4.18.1 Characteristic description

levels.

5.4.20 Amplitude-frequency response of channel-Y in Y/Pb/Pr output

5.4.20.1 Characteristic description

Check the amplitude-frequency characteristic of the channel-Y in the set-top box Y/Pb/Pr output, expressed in (dB).

5.4.20.2 Test chart

The test chart is shown in Figure 23.

5.4.20.3 Measuring method

- a) Connect the test system as Figure 23; the stream generator outputs the transport stream of sinX/X signal;
- b) Read out the amplitude - frequency change curve in the video band with a video analyzer (or HD video analyzer); and record it as the amplitude-frequency response of the Y/Pb/Pr output channel-Y.

5.4.21 Non-linear distortion of channel-Y in Y/Pb/Pr output

5.4.21.1 Characteristic description

Check the non-linear between-line distortion Y/Pb/Pr output channel-Y in the set-top box, expressed in percentage (%).

5.4.21.2 Test chart

The test chart is shown in Figure 23.

5.4.21.3 Measuring method

- a) Connect the test system as Figure 23; the stream generator outputs the transport stream of the brightness staircase signal;
- b) Read out the non-linear distortion of channel-Y with a video analyzer (or HD video analyzer); and record it as the non-linear distortion of Y/Pb/Pr output channel-Y.

5.4.22 Linear waveform response of channel-Y in Y/Pb/Pr output

5.4.22.1 Characteristic description

Check the linear waveform response of channel-Y in the Y/Pb/Pr output of the set-top box, expressed in percentage (%).

5.4.22.2 Test chart

The test chart is shown in Figure 25.

5.4.22.3 Measuring method

- a) Connect the test system as Figure 23; the stream generator outputs the transport stream of 2T pulse and bar signal;
- b) Read out K_b , K_{pb} and K_p of channel-Y with a video analyzer (or HD video analyzer), adopt the maximum of the absolute values of these three values; and record it as the linear waveform response of channel-Y in Y/Pb/Pr output.

5.4.23 S/N ratio of channel-Y in Y/Pb/Pr output

5.4.23.1 Characteristic description

Check the S/N ratio of channel-Y in the set-top box Y/Pb/Pr output, expressed in (dB).

5.4.23.2 Test chart

The test chart is shown in Figure 23.

5.4.23.3 Measuring method

- a) Connect the test system as Figure 23; the stream generator outputs the small slope inclination brightness signal;
- b) Read out the brightness S/N ratio with a video analyzer (or HD video analyzer), load 100kHz high pass filter, 6MHz low-pass filter (or 30MHz low-pass filter for high definition), declination compensation and uniform weighting network during the measurement; and record the reading as the S/N ratio of Y/Pb/Pr output channel-Y.

5.4.24 Time-delay difference of Y/Pb and Y/Pr in Y/Pb/Pr

5.4.24.1 Characteristic description

Check the time difference of the signal Y and signals Pb/Pr superposing of the Y/Pb/Pr output in the tested set-top box, expressed in (ns).

5.4.24.2 Test chart

The test chart is shown in Figure 23.

5.4.24.3 Measuring method

- a) Connect the test system as Figure 23; the stream generator outputs the transport stream of 100% color bar signal;

output amplitude-frequency responses.

5.4.27 R/G/B output non-linear distortion

5.4.27.1 Characteristic description

Check the non-linear between-line distortion of R/G/B output of the set-top box, expressed in percentage (%).

5.4.27.2 Test chart

The test chart is shown in Figure 24.

5.4.27.3 Measuring method

- a) Connect the test system as Figure 24; the stream generator outputs the transport stream of the 5-staircase signal;
- b) Read out respectively the non-linear distortions of channel-Y, Pb and Pr with a video analyzer (or HD video analyzer); and record them as the non-linear distortions of R/G/B output.

5.4.28 R/G/B output linear waveform response

5.4.28.1 Characteristic description

Check the linear wave form of R/G/B output of the set-top box, expressed in percentage (%).

5.4.28.2 Test chart

The test chart is shown in Figure 24.

5.4.28.3 Measuring method

- a) Connect the test system as Figure 24; the stream generator outputs the transport stream of 2T pulse and bar signal;
- b) Respectively read out K_b , K_{pb} and K_p of channels R, G and B with a video analyzer, adopt the maximum of the absolute values of these three values; and record it as the linear waveform response of R/G/B output.

5.4.29 R/G/B output S/N ratio

5.4.29.1 Characteristic description

Check the output S/N ratios of channels R, G and B of the set-top box R/G/B output, expressed in (dB).

5.4.29.2 Test chart

The test chart is shown in Figure 24.

5.4.29.3 Measuring method

- a) Connect the test system as Figure 24; the stream generator outputs the small slope inclination brightness signal;
- b) Read out the S/N ratios of R, G and B signals with a video analyzer (or HD video analyzer), load 100kHz high pass filter, 6MHz low-pass filter (or 30MHz low-pass filter for high definition), declination compensation and uniform weighting network during the measurement; and record them as the S/N ratios of R/G/B output.

5.4.30 R/G and B/G time-delay differences of R/G/B output

5.4.30.1 Characteristic description

Check the time difference of the channel signal R and signals B/G superposing of the R/G/B output in the tested set-top box, expressed in (ns).

5.4.30.2 Test chart

The test chart is shown in Figure 24.

5.4.30.3 Measuring method

- a) Connect the test system as Figure 24; the stream generator outputs the transport stream of the staircase signal;
- b) Read out R/G and B/G r time-delay differences with a video analyzer (or HD video analyzer); and record them as the R/G and B/G time-delay differences of R/G/B output.

5.4.31 Characteristic of standard definition output synchronizing signal

5.4.31.1 Characteristic description

Check the synchronization characteristic of the SD video output signal of the set-top box.

5.4.31.2 Test chart

The test chart is shown in Figure 19.

5.4.31.3 Measuring method

- a) Connect the test system as Figure 19; the stream generator outputs the

comply with the requirements of Article 9.2.1 in GB/T 22122-2008.

The measurement for multichannel audio amplitude-frequency response shall comply with the requirements of Article 9.1.1 in GB/T 22122-2008.

5.5.3 Audio S/N ratio

The measurement for double-channel audio S/N ratio characteristic shall comply with the requirements of Article 9.2.2 in GB/T 22122-2008.

The measurement for multichannel audio S/N ratio characteristic shall comply with the requirements of Article 9.1.2 in GB/T 22122-2008.

5.5.4 Audio distortion + noise (D+N)

The measurement for double-channel audio distortion + noise shall comply with the requirements of Article 9.2.3 in GB/T 22122-2008.

The measurement for multichannel audio distortion + noise shall comply with the requirements of Article 9.1.3 in GB/T 22122-2008.

5.5.5 Inter-audio-channel gain inequality

The measurement for double-channel audio inter-audio-channel gain inequality shall comply with the requirements of Article 9.2.4 in GB/T 22122-2008.

The measurement for multichannel audio inter-audio-channel gain inequality shall comply with the requirements of Article 9.1.4 in GB/T 22122-2008.

5.5.6 Phase difference of left and right audio channels

The measurement for double-channel audio phase difference shall comply with the requirements of Article 9.2.5 in GB/T 22122-2008.

The measurement for multichannel audio phase difference shall comply with the requirements of Article 9.1.5 in GB/T 22122-2008.

5.5.7 Crosstalk of left and right audio channels

The measurement for crosstalk of left and right audio channels shall comply with the requirements of Article 9.2.6 in GB/T 22122-2008.

5.5.8 Dynamic range of audio channels

The measurement for double-channel audio dynamic range shall comply with the requirements of Article 9.2.6 in GB/T 22122-2008.

The measurement for multichannel audio dynamic range shall comply with the requirements of Article 9.1.5 in GB/T 22122-2008.

5.9.2 Test chart

The test chart is shown in Figure 30.

5.9.3 Measuring method

- a) Connect the test system as Figure 30;
- b) Close down all auxiliary functions of the tested set-top box;
- c) Make the tested set-top box in standby state; and measure the power consumption with a power meter;
- d) Record the standby power consumption of the tested set-top box as the power consumption in procedure c) status.

Appendix A (Normative)

Multipath Channel Model

A.1 Rayleigh Channel Model

Rayleigh channel model (static) is shown in Table A.1.

Table A.1

Path	Amplitude /dB	Time delay / μ s	Phase /(°)
Echo 1	−7.8	0.518650	336.0
Echo 2	−24.8	1.003019	278.2
Echo 3	−15.0	5.422091	195.9
Echo 4	−10.4	2.751772	127.0
Echo 5	−11.7	0.602895	215.3
Echo 6	−24.2	1.016585	311.1
Echo 7	−16.5	0.143556	226.4
Echo 8	−25.8	0.153832	62.7
Echo 9	−14.7	3.324886	330.9
Echo 10	−7.9	1.935570	8.8
Echo 11	−10.6	0.429948	339.7
Echo 12	−9.1	3.228872	174.9
Echo 13	−11.6	0.848831	36.0
Echo 14	−12.9	0.073883	122.0
Echo 15	−15.3	0.203952	63.0
Echo 16	−16.5	0.194207	198.4
Echo 17	−12.4	0.924450	210.0
Echo 18	−18.7	1.381320	162.4
Echo 19	−13.1	0.640512	191.0
Echo 20	−11.7	1.368671	22.6

A.2 Rice Channel Model

Rice channel model (static) is shown in Table A.2.

Table A.2

Path	Amplitude /dB	Time delay / μ s	Phase /(°)
Main path	0	0	0
Echo 1	−19.2	0.518650	336.0
Echo 2	−36.2	1.003019	278.2
Echo 3	−26.1	5.422091	195.9
Echo 4	−21.8	2.751772	127.0

Echo 5	−23.1	0.602895	215.3
Echo 6	−35.6	1.016585	311.1
Echo 7	−27.9	0.143556	226.4
Echo 8	−26.1	3.324886	330.9
Echo 9	−19.3	1.935570	8.8
Echo 10	−22.0	0.429948	339.7
Echo 11	−20.5	3.228872	174.9
Echo 12	−23.0	0.848831	36.0
Echo 13	−24.3	0.073883	122.0
Echo 14	−26.7	0.203952	63.0
Echo 15	−27.9	0.194207	198.4
Echo 16	−23.8	0.924450	210.0
Echo 17	−30.1	1.381320	162.4
Echo 18	−24.5	0.640512	191.0
Echo 19	−23.1	1.368671	22.6

A.3 Dynamic multipath channel model

The dynamic multipath channel model is shown in Table A.3.

Table A.3

Path	Amplitude /dB	Time delay /μs	Doppler category
Echo 1	−3	0	Rice
Echo 2	0	0.2	Rice
Echo 3	−2	0.5	Rice
Echo 4	−6	1.6	Rice
Echo 5	−8	2.3	Rice
Echo 6	−10	5	Rice

Appendix B (Normative)

Acceptable Error-free

Acceptable error-free refers to: Within the specified test time, when observing the video image on display screen that is outputted from the video decoding, there is no observable error on the video.

For the performance test, the subjective measurement period is 60s.

For the function test, the subjective measurement period is 15s.

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