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BETS-7
Issue 2
June 2008

Spectrum Management and Telecommunications

Broadcasting Equipment Technical Standard

Technical Standards and Requirements for Radio Apparatus Capable of Receiving Television Broadcasting

Purpose

This document establishes the technical requirements and standards for radio apparatus capable of receiving television broadcasting, such as TV receivers, VCRs and DVD recorders equipped with ATSC and/or NTSC type tuners, intended and used for the purpose of home entertainment.

Equipment manufactured or imported solely for re-export, prototyping, demonstration, exhibition or testing purposes does not have to comply with the technical standards and requirements in this document.

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1. General

This document applies to all radio apparatus capable of receiving television broadcasting, such as television sets, set-top-boxes for digital-to-analog conversion and other interface devices such as VCRs, DVD recorders equipped with ATSC and/or NTSC tuners, intended and used for the purpose of home entertainment. Such apparatus must conform to the requirements and technical standards established in this document.

2. Definitions

The following definitions become effective with the publication of this new issue of BETS-7.

- 2.1 *National Television Systems Committee (NTSC)*, the committee that created the standards for the production and distribution (over-the-air) of broadcasting analog colour television signals in Canada and the United States.
- 2.2 *Advanced Television Systems Committee (ATSC)*, the committee that was formed to establish the technical standards for advanced television systems. It has defined the DTV broadcast standards for digital television in Canada and the United States.
- 2.3 *Aspect Ratio*: the ratio of image width to image height. It may apply to the display apparatus configuration or to the shape of the content being displayed. HDTV uses an aspect ratio of 16 units wide by 9 units high (16:9). Conventional format (NTSC) uses an aspect ratio of 4 units wide by 3 units high (4:3). The Digital SDTV format uses aspect ratios ranging from 4:3 through 16:9, the choice depending on the content and the source.
- 2.4 *Analog Television Receiving Apparatus*: a television receiver that incorporates an NTSC tuner for over-the-air reception of analog television broadcasting signals. **Analog television receivers** display the NTSC-type television signal using the 4:3 aspect ratio and are capable of up to 480 pixels by 640 lines interlace resolution. These receivers require a set-top-box (STB) to receive and display over-the-air ATSC digital TV signals.
- 2.5 *HD-Ready (or HD-Compatible) Television Receiving Apparatus*: a television receiver that incorporates only an analog NTSC tuner for over-the-air reception of television broadcasting signals but not an ATSC-type (digital) tuner. HD-Ready or HD-Compatible television receivers are capable of displaying wide-screen HDTV-type signals using the 16:9 aspect ratio and either of the following high resolution format: 1280 pixels by 720 lines progressive resolution or 1920 pixels by 1080 lines, interlaced or progressive resolution. These receivers require a set-top-box (STB) to receive and display over-the-air ATSC digital TV signals.
- 2.6 *Digital Television (DTV) Receiving Apparatus*: a television receiver that incorporates an ATSC-type digital tuner. This type of receiving apparatus is capable of displaying wide-screen HDTV-type signals using the 16:9 aspect ratio and either of the following high resolution format: 1280 pixels by 720 lines progressive resolution or 1920 pixels by 1080 lines, interlaced or progressive resolution. This apparatus does not need a set-top-box to receive over-the-air digital TV signals.

- 2.7 *Set-Top Box As Television Receiving Apparatus*: an external apparatus to the television receiver that is used to process or convert a broadcast television signal that is not compatible with the television receiving apparatus. As applied to over-the-air digital television signals, two types of set-top-boxes are available:
- (a) Converter boxes: A box that receives and converts over-the-air digital television signals (ATSC-type) to analog (NTSC-type) signals for display by the analog television receiving apparatus.
 - (b) DTV Tuner Boxes: A box that receives over-the-air digital television signals (ATSC-type) for display on an HD-Ready or HD-Compatible television receiving apparatus.
- Set-top boxes* may have a coaxial cable input terminal to connect to a cable distribution undertaking.
- 2.8 *Standard Television Receiving Apparatus*: a television receiver designed to receive the VHF and UHF channels and that is either an analog television receiver, an HD-Ready (or HD-Compatible) receiver or a DTV receiver as defined in sections 2.4, 2.5 and 2.6 above. The standard television receiver may be connected to a cable distribution undertaking through a coaxial cable input terminal.
- 2.9 *Standard Cable Compatible Television Receiving Apparatus*: a Standard Television Receiver Apparatus which is designed and intended to be connected to a cable distribution undertaking through a coaxial cable input terminal.
- 2.10 *Supplementary Television Receiving Apparatus*: a television receiver that incorporates an ATSC (digital) and/or NTSC tuner for over-the-air reception of television broadcasting signals such as in Section 2.7(a) and which may be connected to a cable distribution undertaking through a coaxial cable input terminal. The apparatus does not include a display apparatus.
- 2.11 *Type* (for the purpose of this document): a unit that, as one of many similar units, has been manufactured in accordance with a particular electronic design and physical pattern, subject to improvements or minor changes while not degrading performance.
- 2.12 *Cable distribution undertaking*: an undertaking for the reception of broadcasting and the retransmission thereof by radio waves or other means of telecommunication to more than one permanent or temporary residence or dwelling unit or to another such undertaking.
- 2.13 *Cable input conducted emissions*: interference produced by the receiving apparatus itself (i.e. local oscillator, any undesired or spurious signal generated internally) and which arrives at the cable input terminals of the receiving apparatus.
- 2.14 *cw*: a continuous wave signal without modulation.
- 2.15 *Noise figure*: the ratio, expressed in decibels (dB), of the total noise power delivered to the output terminal of a radio apparatus when the noise temperature of its terminal is 290 degrees

- Kelvin, to the portion thereof engendered by the input terminal.
- 2.16 *Spurious emissions*: an undesired emission on a frequency or frequencies which are outside the necessary bandwidth of the desired channel.
- 2.17 *Mid-band channels*: the nine channels, commonly identified by the alphabetical designators, A, B, C, D, E, F, G, H and I, that are used in the frequency band 120 MHz to 174 MHz.
- 2.18 *Super-band channels*: the 14 channels, commonly identified by the alphabetical designators J, K, L, M, N, O, P, Q, R, S, T, U, V and W, that are used in the frequency band 216 MHz to 300 MHz.
- 2.19 *Ultra high frequency channels (UHF)*: the 56 channels identified by the numerical designators 14 to 69 that are used in the frequency band 470 MHz to 806 MHz.
- 2.20 *Very high frequency channels (VHF)*: the 12 channels, commonly identified by the numerical designators 2 to 13, that are used in the frequency bands 54 MHz to 72 MHz, 76 MHz to 88 MHz and 174 MHz to 216 MHz.

3. Testing and Labelling

- 3.1 Before importing or offering for sale and/or use in Canada any radio apparatus of the class described in Section 1 above, the manufacturer or importer shall ensure that the apparatus or a production sample or other representative unit of that type of apparatus is tested to determine whether it conforms to the applicable technical requirements and standards established in this document.
- 3.2 Every manufacturer or importer referred to in Section 3.1 shall:
- (a) forward electronically to the Director General, Spectrum Engineering Branch of Industry Canada (e-mail: bets_ntmr_notifs@ic.gc.ca), a notification in PDF file format, attesting that the apparatus meets the requirements set in this document and giving the make and model/type number for each type of apparatus tested as required by Section 3.1; this notification shall also indicate if the television receiver is equipped with the ATSC-type tuner to receive off-air digital TV signals;
 - (b) keep and make available to the Minister of Industry on demand, for a period of five years, a copy of all test data obtained as a result of the tests carried out as required by Section 3.1;

(c) alternatively, if desired, forward the above documents in paper format to the

Director General
Spectrum Engineering Branch
Industry Canada
300 Slater Street
Ottawa, Ontario
K1A 0C8
Canada

3.3 Every manufacturer or importer referred to in Section 3.1 shall ensure at the time of import or before offering for sale, as appropriate, that each unit of the type that they offer for sale bears, in a location convenient for inspection, a permanent label or marking containing (in French and English), the following statement:

(a) for the **Standard Television Receiving Apparatus** defined in Section 2.8:

“Standard Television Receiving Apparatus - Appareil de réception télévision ordinaire, Canada
BETS-7 / NTMR-7”;

(b) for the **Standard Cable Compatible Television Receiving Apparatus** defined in Section 2.9:

“Standard Cable Compatible Television Receiving Apparatus - Appareil de réception de télévision câblo-compatible ordinaire, Canada
BETS-7 / NTMR-7”;

(c) for the **Supplementary Television Receiving Apparatus** defined in Section 2.10:

“Supplementary Television Receiving Apparatus - Appareil supplémentaire de réception de télévision, Canada
BETS-7 / NTMR-7”.

3.4 Equipment for which a label is not properly affixed is not considered to meet the technical requirements of this standard.

4. Technical Standards and Requirements

4.1 Technical Requirements for the Standard Television Receiving Apparatus

4.1.1 Channel Selection Requirements

Every standard television receiving apparatus, which incorporates an ATSC and/or an NTSC tuner, is required to receive television broadcasting from a broadcasting transmitting

undertaking and from a cable distribution undertaking, on all VHF and UHF channels.

4.1.2 Noise Figure

The noise figure shall not exceed 14 dB for any television channel between 14 to 69 inclusive.

4.1.3 Additional Technical Requirements

The receiving apparatus described in Section 4.1.1 is also required to comply with the Radiation Emission Limits of Section 4.5.

4.2 Technical Requirements for the Standard Cable Compatible Television Receiving Apparatus

4.2.1 Channel Selection Requirements

Every television receiving apparatus intended for display that is capable of receiving television broadcasting from a broadcasting transmitting undertaking and from a cable distribution undertaking, must be capable of receiving on all VHF, mid-band, super-band and UHF channels.

4.2.2 Additional Technical Requirements

The receiving apparatus described in Section 4.2.1 shall also comply with the following technical requirements:

Cable Input Conducted Emissions:	see Section 4.4
Radiation Emission Limits:	see Section 4.5
Analogue NTSC Reception:	see Section 4.6

4.3 Technical Requirements for the Supplementary Television Receiving Apparatus

The digital-to-analog converter boxes, as described in Section 2.7(a) above, should comply with the technical requirements of Annex A.

4.3.1 Channel Selection Requirements

Every supplementary television interface-type receiving apparatus, such as a set-top converter box or a recorder with a TV tuner that is capable of receiving television broadcasting from a broadcasting transmitting undertaking and from a cable distribution undertaking, must be capable of receiving on all VHF and UHF channels.

4.3.2 Additional Technical Requirements

The television receiving apparatus described in Section 4.3.1 shall comply with the Radiation Emission Limits of Section 4.5.

4.4 Cable Input Conducted Emissions Applicable to Cable Compatible Television Receiving Apparatus

When the receiver is connected to a cable distribution undertaking, the level of any local oscillator signal and any signal of an undesired or spurious nature generated within the apparatus and arriving at the cable input terminals of the apparatus shall not exceed:

- (a) -26 dBmV in the frequency range above 5 MHz and below 54 MHz;
- (b) -26 dBmV in the frequency range 54 MHz to 300 MHz;
- (c) -20 dBmV in the frequency range above 300 MHz and below 1000 MHz.

Refer to the latest version of CEA Standard #CEA-23-A, Section 4.1 on “Cable Input Conducted Emissions” for further details on the test procedure, test conditions, calibration and measurement procedure.

4.5 Radiated Emission Limits Applying to all Television Receiving Apparatus

The field strength of any emission produced by the apparatus at a distance of 3 metres shall not exceed:

- (a) 100 μ V/m, in the frequency range from 30 MHz to below 88 MHz;
- (b) 150 μ V/m, in the frequency range from 88 MHz to below 216 MHz;
- (c) 200 μ V/m, in the frequency range from 216 MHz to below 960 MHz;
- (d) 500 μ V/m, in the frequency range above 960 MHz.

As an alternative to the emission limits shown in this section, the apparatus shall comply with the standards contained in the Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, *Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement*.

The television test signal is the standard television colour bar signal according to ITU-R Recommendation BT 471-1. For the method of measurement, refer to the latest version of IEEE Standard 187 on “Measurement Methods of Emissions from FM and Television Broadcast Receivers in the Frequency Range of 9 kHz to 40 GHz”, in Section 7 (where it applies to Television Broadcast Receivers). The number of test frequencies shall be adequate to ensure measurement of maximum emission levels within the frequency range of 30 MHz through 1 GHz. Measurements on 6 channels evenly spaced across the required radio frequency (RF) input range will meet this requirement.

4.6 Additional Technical Requirements Applying to Analog NTSC Reception in Standard Cable Compatible Television Receiving Apparatus

Every standard cable compatible television receiving apparatus intended to receive NTSC type broadcast signals from a broadcasting transmitting undertaking or from a cable distribution undertaking, shall in addition to the requirements specified in Section 4.2, conform to the technical requirements outlined below:

4.6.1 Noise figure

The noise figure shall not exceed 14 dB for any television channel between 14 to 69 inclusive. If a tuner has a built-in splitter, a relaxation of 4dB shall be applied to the above limits.

4.6.2 Adjacent channel interference

Spurious signals within the IF passband shall be attenuated at least 55 dB below the visual carrier of the desired signal when in the presence of a lower adjacent channel CW signal set at 1.5 MHz below the visual carrier frequency of the desired signal.

Refer to the latest version of CEA standard 23-A on “Lower Adjacent Channel Performance” (Section 5.4) for the test procedure, test conditions, calibration and measurement procedure.

4.6.3 Direct pickup interference

The immunity requirements of cable compatible television receiving apparatus is given by the ratio of the desired to the undesired co-channel interfering ambient field at the IF passband which shall not exceed 45 dB.

Refer to the latest version of CEA standard 23-A on the “Immunity of Subscriber Equipment to Co-channel Direct Pick-up” (Section 5.1) for the test procedure, test conditions, calibration and measurement procedure.

4.6.4 Impedance

The signal input shall be through a 75 ohm impedance coaxial connection.

4.6.5 Receiver overload

The spurious signals present within the IF passband shall be attenuated by at least:

- (a) 55 dB below the visual carrier of the desired channel from 54 to 550 MHz; and
- (b) 51 dB below the visual carrier of the desired channel from 550 to 804 MHz.

Refer to the latest version of CEA standard 23-A on “Tuner Overload Performance” (Section 5.3) for the test procedure, test conditions, calibration and measurement procedure.

4.6.6 Image Channel Interference

Any image frequency shall be attenuated by at least 60 dB on TV channels from 54 MHz to 714 MHz (inclusive) and at least by 50 dB for TV channels from 714 MHz to 804 MHz.

Refer to the latest version of CEA standard 23-A on the “Image Rejection” (Section 5.2) for the test procedure, test conditions, calibration and measurement procedure

4.6.7 Definitions Applicable to Cable Compatible Television Receiving Apparatus with an NTSC-type Tuner

adjacent channel interference: an in-band interference in the desired channel when an NTSC-type TV broadcasting signal is present in the lower adjacent channel.

direct pickup interference: a co-channel interference experienced by the receiving apparatus when tuned to a specific channel.

image channel interference: an interference experienced by the receiving apparatus when tuned to a specific channel in the presence of another TV signal 90 MHz above the visual carrier of the tuned channel.

receiver overload: how the receiving apparatus should perform in the presence of strong over-the-air signals.

signal level: the RMS voltage over an RF cycle during the transmission of the synchronizing pulse of a television signal expressed:

- (a) in microvolts (μV), with respect to an impedance of 75 ohms, or
- (b) in dBmV, with 0 dBmV corresponding to one millivolt (mV) across 75 ohms.

Annex A - Technical Requirements for the Digital-to-Analog Converter

Forward

This type of converter, a particular type of set-top converter box described in Section 2.7(a), is to receive and convert over-the-air ATSC digital TV signal to an analog NTSC signal for display on a standard analog television receiving apparatus.

The minimum performance requirements for this type of apparatus follow¹.

A.1 Decoder

Shall be capable of receiving and presenting for display program material that has been encoded in any and all of the video formats contained in Table 3 of the ATSC A/53 document.

A.2 Output Formats

Shall support a 4:3 center cut-out of the 16:9 transmitted image, the 16:9 letterbox output of the letterbox transmitted image, and a full or partially zoomed output of unknown transmitted image.

A.3 PSIP Processing

Shall process and display the ATSC A/65C Program and System Information Protocol (PSIP) data to provide the user with tuned channel and program information. See ATSC A/69 for further guidance.

A.4 Tuning Range

Shall be capable of receiving RF channels 2 to 69 inclusive.

A.5 RF Input

Shall include a female 75 ohm F Type connector for VHF/UHF antenna input.

A.6 RF Output

Shall include a female 75 ohm F Type connector with user-selectable channel 3 or 4 NTSC RF output.

¹ The source reference for these requirements can be found at the National Telecommunications and Information Administration (NTIA) of the United States' website at <http://www.ntia.doc.gov/dtvcoupon/DTVmanufacturers.pdf>.

A.7 Composite Output

Shall include female RCA connectors for left and right stereo audio (white and red) and a female RCA connector for composite video (yellow). Output shall produce video with ITU-R BT.500-11 quality scale of Grade 4 or higher.

A.8 RF Dynamic Range (Sensitivity)

Shall achieve a bit error rate (BER) in the transport stream of no worse than 3×10^{-6} for input RF signal levels directly to the tuner from -83 dBm to -5 dBm over the tuning range. Subjective video/audio assessment methodologies could be used to comply with the bit error rate requirement.² Test conditions are for a single RF channel input with no noise or channel impairment. Refer to ATSC A/74 Section 4.1 for further guidance. (**Note:** the upper limit specified here is different than that in A/74 4.1).

A.9 Phase Noise

Shall achieve a bit error rate in the transport stream of no worse than 3×10^{-6} for a single channel RF input signal with phase noise of -80 dBc/Hz at 20 kHz offset. The input signal level shall be -28 dBm. Subjective video/audio assessment methodologies described above could be used to comply with the bit error rate requirement. Refer to ATSC A/74 Section 4.3 for further guidance.

A.10 Co-Channel Rejection

The TV receiving apparatus shall not exceed the thresholds indicated in Table 1 for rejection of co-channel interference at the given desired signal levels. Refer to ATSC A/74 Section 4.4.1 for further guidance.

Table 1: Co-Channel Rejection Thresholds

Type of Interference	Co-Channel D/U Ratio (dB)	
	Weak Desired (-68 dBm)	Moderate Desired (-53 dBm)
DTV interference into DTV	+15.5	+15.5
NTSC interference into DTV	+2.5	+2.5
Notes: NTSC split 75% colour bars with pluge bars and picture to sound ratio of 7 dB should be used for video source. ATSC high definition moving video should be used for video source. All NTSC values are peak power; all DTV values are average power.		

² Subjective evaluation methodologies use the human visual and auditory systems as the primary measuring “instrument.” These methods may incorporate viewing active video and audio segments to evaluate the performance as perceived by a human observer. For subjective measurement, the use of an expert viewer is recommended. The viewer shall observe the video and listen to the audio for at least 20 seconds in order to determine Threshold of Visibility (TOV) and Threshold of Audibility (TOA). Subjective evaluation of TOV should correspond with achievement of transport stream error rate not greater than a BER of 3×10^{-6} . If there is disagreement over TOV performance evaluation, it will be resolved with a measurement of actual BER.

A.11 First Adjacent Channel Rejection

The TV receiving apparatus shall not exceed the thresholds indicated in Table 2 for rejection of adjacent channel interference at the given desired signal levels. Refer to ATSC A/74 Section 4.4.2 for further guidance.

Table 2: Adjacent Channel Rejection Thresholds

Type of Interference	Adjacent Channel D/U Ratio (dB)		
	Weak Desired (-68 dBm)	Moderate Desired (-53 dBm)	Strong Desired (-28 dBm)
Lower DTV interference into DTV	≥-33	-33	-20
Upper DTV interference into DTV	≥-33	-33	-20
Lower NTSC interference into DTV	≥-40	-35	-26
Upper NTSC interference into DTV	≥-40	-35	-26
Notes: NTSC split 75% colour bars with pluge bars and picture to sound ratio of 7 dB should be used for video source. ATSC high definition moving video should be used for video source. All NTSC values are peak power; all DTV values are average power.			

A.12 Taboo Channel Rejection

The TV receiving apparatus shall not exceed the thresholds indicated in Table 3 for rejection of taboo channel interference at the given DTV desired and undesired signal levels. Refer to ATSC A/74 Section 4.4.3 for further guidance.

Table 3: Taboo Channel Rejection Thresholds for DTV Interference into DTV

Channel	Taboo Channel D/U Ratio (dB)		
	Weak Desired (-68 dBm)	Moderate Desired (-53 dBm)	Strong Desired (-28 dBm)
N+/- 2	≥-44	-40	-20
N+/- 3	≥-48	-40	-20
N+/-4	≥-52	-40	-20
N+/- 5	≥-56	-42	-20
N+/- 6 to N+/- 13	≥-57	-45	-20
N +/- 14 and N+/- 15	≥-46	-45	-20
Notes: ATSC high definition moving video should be used for video source. All DTV values are average power.			

A.13 Burst Noise

Shall tolerate a noise burst of at least 165 μ s duration at a 10 Hz repetition rate without visible errors. The noise burst shall be generated by gating a white noise source with average power -5 dB, measured in the 6 MHz channel under test, referenced to the average power of the DTV signal. The input DTV signal level shall be -28 dBm. Refer to ATSC A/74 Section 4.4.4 for further guidance.

A.14 Field Ensembles

Shall demonstrate that it can successfully demodulate, with two or fewer errors, 30 of the 50 field ensembles available from ATSC in conjunction with the ATSC A/74 document. Error counts are not expected to include inherent errors associated with the start and end or looping of field ensembles for playback. Refer to ATSC A/74 Section 4.5.2 for further guidance.

A.15 Single Static Echo

Shall comply with either Criteria A or Criteria B, hereafter:

Criteria A:

Shall tolerate a single static echo with the magnitude, relative to a desired DTV signal power of -28 dBm, and delay defined in Table 4.

Criteria B:

May demonstrate compliance by tolerating a single static echo with the magnitude, relative to a desired DTV signal power of -28 dBm, and delay defined in Table 5 if the apparatus also demonstrates that it can receive 37 of the 50 field ensembles. See Field Ensembles requirement.

Criteria A

Criteria B

Table 4: Maximum Single Static Echo Delay

Table 5: Minimum Single Static Echo Delay

Echo Delay	Desired to Echo Ratio
-50 μ s	16 dB
-40 μ s	12 dB
-20 μ s	6 dB
-10 μ s	5 dB
-5 μ s	2 dB
0 μ s	1 dB
10 μ s	2 dB
20 μ s	3 dB
40 μ s	10 dB
50 μ s	16 dB

Echo Delay	Desired to Echo Ratio
-50 μ s	16 dB
-40 μ s	16 dB
-20 μ s	7.5 dB
-10 μ s	5 dB
-5 μ s	2 dB
0 μ s	1 dB
10 μ s	2 dB
20 μ s	3 dB
40 μ s	16 dB
50 μ s	16 dB

A.16 Channel Display

Must display all channels, including multicast channels, broadcast by a digital television station that can be displayed on an analog TV receiver.

A.17 Remote Control

A remote control to operate the apparatus shall be provided with batteries. Standard codes will be used and provided so that the consumer can program an existing remote control to, at a minimum, change channels and turn on and off the converter box and the consumer's existing analog television receiving apparatus.

A.18 Audio Outputs

The RF output must be modulated with associated audio program information; the RCA audio connectors must provide stereo left/right, when broadcast.

A.19 Energy Standards

Shall use no more than two watts of electricity in the "Sleep" state. Sleep state power shall be measured in accordance with industry standard CEA-2013-A. Eligible equipment shall provide the capability to automatically switch from the "On" state to the Sleep state after a period of time without user input. This capability shall be enabled at the factory as the default setting for the device. The default period of inactivity before the equipment automatically switches to the Sleep state shall be four hours. Eligible

equipment may allow the current program to complete before switching to the Sleep state. The default energy related settings shall not be altered during the initial user set-up process and shall persist unless the user chooses at a later date to manually: (a) disable the “automatic switching to Sleep state” capability, or (b) adjust the default time period from four hours to some other value.

A.20 Owner’s Manual

An owner’s manual shall include information regarding the remote control codes used to permit the consumer to program a universal remote control. The owner’s manual will include information regarding the availability of the main audio channel and other associated audio channels on the RF and left/right audio outputs.

A.21 LED Indicator

Shall contain an LED to indicate when the unit is turned on.

A.22 RF Cable

Will include at least one RF cable to connect the unit with its associated analog television receiver.

A.23 Signal Quality Indicator

Will display on the television receiver signal quality indications such as signal strength per ATSC A/74, Section 4.7.

Reference Documents

ATSC A/74, Receiver Performance Guidelines, June 2004

ATSC A/53E, ATSC Digital Television Standard, Revision E with Amendments No. 1 and No. 2, September 2006

ATSC A/65C, Program and System Information Protocol for Terrestrial Broadcast and Cable (Revision C) With Amendment No. 1, May 2006

Recommendation ITU-R BT.500-11, Methodology for the subjective assessment of the quality of television pictures

ATSC A/69, PSIP Implementation Guidelines for Broadcasters, June 2002