

CTA Standard

Measurement Procedures for Determining Compliance with FCC Rules for “Cable-Ready Consumer Electronics Equipment”

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(Formulated under the cognizance of the CTA **R4 Video Systems Committee.**)

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FOREWORD

This standard was developed under the auspices of the CEA R4 Video Systems Committee.

CEA-23-B supersedes CEA-23-A.

CONTENTS

1 Scope.....	5
1.1 Applicability	5
1.2 Federal Regulations	5
2 References	5
2.1 Regulatory Reference List	5
2.2 Normative Reference List	5
2.3 Reference Acquisition.....	6
3 Mechanical and Electrical Interface	6
3.1 Impedance	6
3.2 Connectors	6
3.3 Signals Intended for Reception by Cable-Ready	6
3.3.1 Levels	6
3.3.2 Differential Levels	6
3.3.3 Frequency Accuracy of Channels on Cable	6
3.3.4 Video C/N	7
3.4 Amplitude of Other Carriers Delivered to Input of Cable-Ready Receivers	7
3.4.1 Maximum Individual Carrier Amplitude	7
3.4.2 Maximum Average Power Density	7
4 Applying to the Cable Ready Television Receiving Device—Characteristics Required to Avoid Interference to Others.....	7
4.1 Cable Input Conducted Emissions	7
4.1.1 Test Procedure.....	7
4.1.2 Test Conditions.....	7
4.1.3 Initial Calibration.....	8
4.1.4 Measurement Procedure.....	9
4.2 Re-radiation of Cable Signals.....	10
4.3 A/B Switch Isolation—Between Input Ports	10
4.4 Signal Loss in Cascaded Equipment.....	10
5 Applying to the Cable Ready Television Receiving Device—Characteristics Required for Acceptable Cable Service	11
5.1 Immunity of Subscriber Equipment to Co-channel Direct Pick-up	11
5.1.1 Direct Pickup (DPU) Interference Test Procedure	11
5.1.2 Test Facility	11
5.1.3 Test Conditions.....	12
5.1.4 Initial Calibration.....	12
5.1.5 Test Procedure.....	13
5.2 Image Rejection	15
5.2.1 Image Channel Interference Test Procedure	15
5.2.2 Test Conditions.....	15
5.2.3 Initial Calibration.....	16
5.2.4 Measurement Procedure	16
5.3 Tuner Overload Performance	17
5.3.1 Test Procedure.....	17
5.3.2 Test Conditions.....	18
5.3.3 Initial Calibration.....	18
5.3.4 Measurement Procedure	19
5.4 Lower Adjacent Channel Performance.....	20
5.4.1 Test Procedure.....	20

5.4.2 Test Conditions	20
5.4.3 Initial Calibration	21
5.4.4 Measurement Procedure	21
6 Test Methodology Background	22
Annex A Calibration Procedure for DPU Test Facility (Normative)	24
A.1 General	24
A.2 Recommended Field Strength Calibration Procedure	25
A.3 Recommended Field Uniformity Calibration Procedures	26
Annex B Calculating Average Reference Values (Normative)	27
Annex C Test Methodology Background (Informative)	28
C.1 Introduction	28
C.2 Discussion of Basic Test Methods Employed	28
Demodulation of the Video Signal	28
Signal Substitution Method	29

TABLES

Table 1 Cable Input Conducted Emission Limits	10
Table 2 RF Switch Isolation Limits	10
Table 3 Cascaded Equipment Signal Loss Limits	11
Table 4 Test Signal Amplitudes at the EUT RF Input Port	15
Table 5 Test Signal Amplitudes (at the EUT RF Input Port)	21

FIGURES

Figure 1 DPU Conducted Emissions Equipment Configuration	9
Figure 2 Direct Pickup Interference Test Equipment Configuration	13
Figure 3 Direct Pickup Signal Substitution Test Configuration for IF Measurement Method	14
Figure 4 Direct Pickup Signal Substitution Test Configuration for Baseband Video Measurement Method	14
Figure 5 Image Channel Interference Equipment Configuration	16
Figure 6 Tuner Overload Equipment Configuration	19
Figure 7 Adjacent Channel Interference Equipment Configuration	21
Figure 8 Direct Pickup and Cable Input Conducted Emissions Test Equipment Calibration Configuration	24
Figure 9 Field uniformity Calibration Test Point Locations	25
Figure 10 Interference Signal Masking	29
Figure 11 Spectral Display of Substitution Signal at RF, IF and Baseband	30

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Measurement Procedures for Determining Compliance with FCC Rules for "Cable-Ready Consumer Electronics Equipment"

1 Scope

CEA-23-B defines the measurement procedures for determining compliance with FCC Rules for "Cable Ready Consumer Electronics Equipment", under 47 C.F.R. §15.118(c). These procedures define the specific tests needed to determine compliance with the following requirements:

- §15.118(c)(1) - Adjacent Channel Interference
- §15.118(c)(2) - Image Channel Interference
- §15.118(c)(3) - Direct Pickup Interference
- §15.118(c)(4) - Tuner Overload
- §15.118(c)(5) - Cable Input Conducted Emissions

For convenience and clarification, CEA-23-B also references additional related requirements applicable to television receiving devices and cable television systems. Those additional requirements have test procedures defined in other documents.

1.1 Applicability

CEA-23-B is intended to apply to all cable systems and to all receiving devices which may be directly connected to a cable system residential outlet, including, but not limited to, television sets, video cassette recorders, and converters (whether furnished by cable operators or independently acquired by subscribers).

1.2 Federal Regulations

CEA-23-B assumes that cable operators comply with all federal regulations, including the performance criteria given in 47 C.F.R. §76.605. To the extent that specific performance levels are given in CEA-23-B, they are intended to supplement, not replace federal regulations. If conflicts exist between CEA-23-B and the federal regulations, the stricter of the two will be applicable.

CEA-23-B assumes that television receiving devices comply with all federal regulations, including the performance criteria given in 47 C.F.R. Part 15. To the extent that specific performance levels are given in CEA-23-B, they are intended to supplement, not replace federal regulations. If conflicts exist between CEA-23-B and the federal regulations, the stricter of the two will be applicable.

2 References

2.1 Regulatory Reference List

Federal Communications Commission

- 47 C.F.R. Part 15, Radio Frequency Devices
- 47 C.F.R. Part 76, Multichannel Video and Cable Television Service
- FCC MP-9, "FCC Procedure for Measuring Cable Television Switch Isolation"

2.2 Normative Reference List

The following standards contain provisions that, through reference in this text, constitute normative provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

Consumer Electronics Association

- CEA-542-B, (formerly ANSI/EIA-542 and formerly EIA-132), Cable Television Channel Identification Plan, July 2003

NOTE—FCC regulations reference EIA IS-132; however, CEA-542-B supersedes both ANSI/EIA-542 and EIA IS-132.

- CEA-544-B, Low Frequency Immunity of Tuners in a Cable System, November 2004

Society of Cable Television Engineers

- ANSI/SCTE SCTE 02 1997 (formerly IPS SP 406), "F" Port (Female Indoor) Physical Dimensions
- ANSI/SCTE 40 2004, Digital Network Interface Standard

2.3 Reference Acquisition

CEA Standards:

- Global Engineering Documents, World Headquarters, 15 Inverness Way East, Englewood, CO USA 80112-5776; Phone 800-854-7179; Fax 303-397-2740; Internet <http://global.ihs.com>; Email global@ihs.com

ANSI/SCTE Standards:

- Society of Cable Telecommunications Engineers Inc. (SCTE), 140 Philips Road, Exton, PA 19341-1318; Phone 800-542-5040; Fax 610-363-5898; Internet <http://www.scte.org>; Email info@scte.org

Federal Communications Commission (FCC) Regulations:

- U.S. Code of Federal Regulations (C.F.R.), U.S. Government Printing Office, Washington, D.C. 20401; <http://www.access.gpo.gov/nara/cfr/cfr-table-search.html>

3 Mechanical and Electrical Interface

3.1 Impedance

As required by 47 C.F.R. §76.605(a)(3), signal interconnection of the cable drop to subscriber receiving devices utilizes shielded coaxial cable at a nominal impedance of 75 ohms.

3.2 Connectors

The cable to the subscriber's device employs a Type F male connector that mates properly to a Type F female connector conforming to ANSI/SCTE 02 1997. Cable system signals comply with the technical requirements in 47 C.F.R. Part 76.

3.3 Signals Intended for Reception by Cable-Ready

3.3.1 Levels

Under normal operating conditions, a cable television system provides the following signal level range at the first subscriber device at each outlet:

- Maximum Individual Visual Carrier Input Level: + 20 dBmV (10.0 mV across a 75 ohm terminating impedance) as defined in ANSI/SCTE 40 2004 Section 6.1.1
- Minimum Individual NTSC Visual Carrier Input Level: 0 dBmV (1.00 mV across a 75 ohm terminating impedance) as specified in 47 C.F.R. §76.605(a)(3)

3.3.2 Differential Levels

To reduce visible co-channel interference on a dual cable system, the terminated level differential between equivalent channels should be within 5 dB.

3.3.3 Frequency Accuracy of Channels on Cable

All NTSC channels, measured at the ground block of the dwelling, are required to be within ± 25 kHz of nominal Standard, HRC or IRC frequency assignments in CEA-542-B, formerly EIA IS-132¹. When measured after any on-premise signal processing devices furnished and maintained by the cable operator, the frequency is required to be within ± 250 kHz of nominal. This requirement in no way overrules any FCC or other federal regulation requiring tighter tolerance or other nominal frequency than

¹ FCC regulations reference EIA IS-132; however CEA-542-B supersedes EIA IS-132.

listed in CEA-542-B.

3.3.4 Video C/N

The video carrier-to-noise ratio, as defined in 47 C.F.R. Part 76 and measured at the subscriber terminal, is required to be at least 43 dB.

3.4 Amplitude of Other Carriers Delivered to Input of Cable-Ready Receivers

3.4.1 Maximum Individual Carrier Amplitude

Under normal operating conditions, the maximum RMS value of any individual signal whose frequency is between 5 and 30 MHz does not exceed -7 dBm (+42 dBmV across 75 ohms). The maximum RMS value of any individual signal whose frequency is between 30 and 41 MHz does not exceed -25 dBm (+24 dBmV across 75 ohms). The maximum RMS value of any individual signal whose frequency is between 41 and 48 MHz does not exceed -49 dBm (0 dBmV across 75 ohms). The maximum RMS value of any individual signal whose frequency is between 48 and 54 MHz does not exceed -59 dBm (-10 dBmV across 75 ohms). See CEA-544-B.

The maximum RMS value of any individual signal whose frequency exceeds 54 MHz (including those signals greater than 1,000 MHz) is less than 10.0 mV across a 75 ohm terminating impedance (+20 dBmV).

3.4.2 Maximum Average Power Density

Under normal operating conditions, the average level of multiple 6-MHz bandwidth signals whose frequencies exceed 54 MHz is less than +15 dBmV RMS for digital, and is less than + 15 dBmV peak for analog.

4 Applying to the Cable Ready Television Receiving Device—Characteristics Required to Avoid Interference to Others

Receiver measurements are required to comply with the specifications of Section 4.

4.1 Cable Input Conducted Emissions

See 47 C.F.R. §15.118(c)(5). Spurious signals from 5 MHz up to but not including 54 MHz are limited to -26 dBmV.

4.1.1 Test Procedure

The cable input conducted emissions test procedure is significantly different than the procedures for the other four cable ready receiver performance categories. In this test, an absolute measurement of the emissions emanating from the receiver and appearing at the RF input connector is performed. Emissions emanating from the receiver can be from internal sources, such as the receiver local oscillator, and/or external sources such as direct pick up (DPU) ingress of ambient fields.

The cable input conducted emissions test is performed with the EUT configured in the same manner as described for the DPU performance test, i.e., inside of a shielded enclosure on a rotatable non-metallic table. For the external source test, the EUT is irradiated with a horizontally polarized field at a frequency 2.55 MHz above the desired visual carrier frequency. The ambient field is adjusted for a level of 100 mV/m at the EUT (See **Annex A** (normative) for details on the calibration of the test enclosure). A total of 12 tests is performed.

As is the case with the DPU test procedure, if a coaxial cable is supplied by the manufacturer, this cable is required to be used for the cable input conducted emissions test; otherwise, it is recommended that a high quality double shielded coaxial cable be used for both the RF input cable and the IF output cable. Placement of the input RF coaxial cable and the AC line cable is important. It is essential that these cables be exposed to the same ambient field as the receiver under test. For this reason no ferrite loading or additional shielding may be used on the RF input cable or AC line cable. However, in order to limit the size of the test volume, it is recommended that these cables exit the receiver chassis and be routed vertically (cross polarized to the impinging ambient field) to the floor of the enclosure. In this manner only a short section of cable is exposed to the horizontally polarized field. Although this procedure does not present worst case exposure of the cables, it is a reasonable compromise in limiting the test volume and, therefore, the enclosure size.

4.1.2 Test Conditions

Desired (Test) Channels:

Twelve CEA-542-B channels will be tested. Four evenly spaced channels in each of the following bands:

- a) 54 up to and including 300 MHz,
- b) 300 up to and including 450 MHz, and
- c) 450 up to and including 804 MHz.

Test Channel Signal Amplitudes (at the EUT RF input port):

Desired Visual Carrier: 0 dBmV
Desired Aural Carrier: -10 dBmV

Modulation:

- a) Desired Visual Carrier: 10 IRE Flat Field with color burst
- b) Desired Aural Carrier: Unmodulated
- c) Co-Channel Radiated RF Signal: Unmodulated

Co-Channel Radiated Field:

- a) Horizontally Polarized
- b) Uniform field strength of 100 mV/m

Co-Channel Radiated Carrier Frequency:

The co-channel radiated carrier frequency is 2.55 MHz above the desired test channel visual carrier. [As an example, if TV Channel 2 is to be tested, the radiated carrier frequency is 57.8 MHz, 55.25 (visual carrier) plus 2.55 MHz.]

4.1.3 Initial Calibration

1) Calibrate the test enclosure in accordance with the procedures contained in Annex A (normative) for each of the twelve test frequencies. Record the output level of the co-channel interference generator necessary to produce a 100 mV/m ambient field at the EUT for each test channel.

2) Configure the test equipment and EUT as shown in Figure 1. For the first test channel, adjust the desired channel signal generator for a visual carrier level of 0 dBmV and an aural carrier level of -10 dBmV at the input to the EUT (measured after the customer supplied coax) using a calibrated level signal meter. Set the video modulation to 10 IRE flat field. Tune the EUT to the desired test channel. Record the input signal level and generator/attenuator settings required to produce the proper signal levels at the RF input to the EUT. Correct the measurement result for tap loss and amplifier gain. See Figure 1.

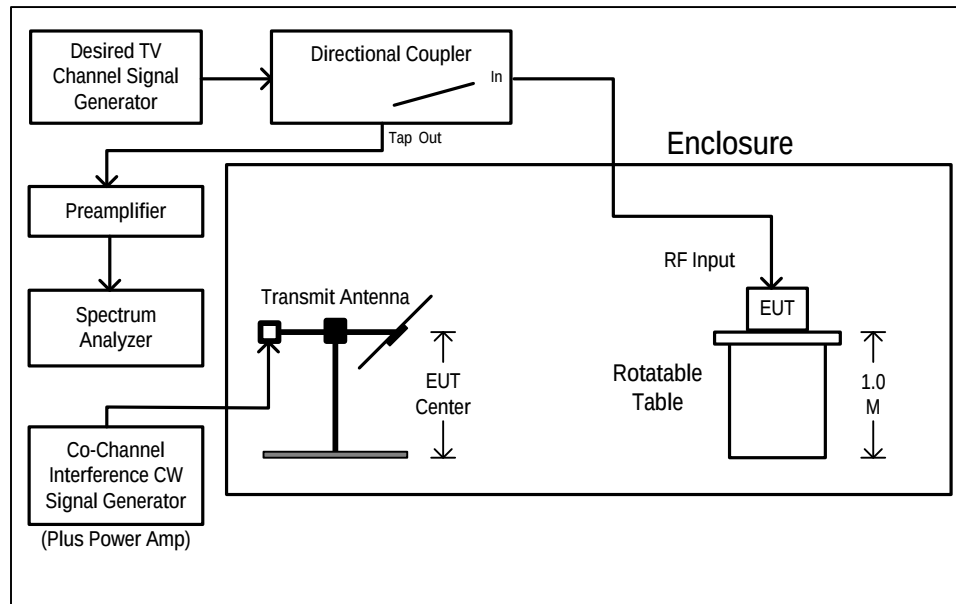


Figure 1 DPU Conducted Emissions Equipment Configuration

4.1.4 Measurement Procedure

Emissions from Internal Sources

- 1) Verify that the test system is configured and adjusted as described in Section 4.1.3 1) and that the co-channel interference generator is deactivated.
- 2) Scan the spectrum between 54 MHz and 804 MHz for emissions (excluding the desired test channel).

NOTE—It is recommended that the frequency scan be performed in segments in order to achieve the required resolution on the spectrum analyzer display. The spectrum analyzer scan width and resolution bandwidth should be adjusted so that the system noise floor is at least 10 dB below the performance limits specified in 47 C.F.R. §15.118(c)(5). A pre-amplifier with low noise figure is essential for this test.

- 3) Record the amplitude and frequency of each emission in units of decibels above one millivolt (dBmV) (75 ohm measurement system impedance).

NOTE—In order to improve the accuracy of the measurement, it is recommended that a calibrated signal source be used, in conjunction with the spectrum analyzer, as a signal substitute. In this manner reliance is placed on the accuracy of the calibrated signal source and not on the spectrum analyzer for this absolute measurement. The calibrated signal source should have an accuracy of ± 1 dB.

Emissions from External Sources

- 4) Activate the co-channel interference generator. Set the generator frequency to a value 2.55 MHz above the desired channel visual carrier frequency. Adjust the output level of the generator to the setting required to produce a 100 mV/m ambient field as determined in section 4.1.3 1).
- 5) Center the spectrum analyzer display at the frequency 2.55 MHz above the desired channel visual carrier frequency. Adjust the scan width and resolution bandwidth of the analyzer so that