Society of Cable Telecommunications Engineers

ENGINEERING COMMITTEE
Network Operations Subcommittee

SCTE 204 2014

FCC Proof-of-Performance Checklist for Analog and Digital Signals

Recommended Practice

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1.0 SCOPE

The purpose of this document is to provide a guide to the Federal Communications Commission (FCC) required technical standards for analog and digital signals. This document acts as a complement to *SCTE Measurement Recommended Practices for Cable Systems, Fourth Edition* (SCTE RP 4th Ed.) and ANSI/SCTE 40 2003, *Digital Cable Network Interface Standard.*

It is important to note that during the development of this guide, FCC rules referenced the 2003 version of SCTE 40. There is currently a 2011 version of SCTE 40 that has superseded the 2003 version, but has yet to be adopted into the FCC rules.

The intent of this document is to highlight FCC performance requirements, how often to test for performance, where the testing should take place, and in some instances, references to SCTE RP 4th Ed. on how to conduct testing.

2.0 INFORMATIVE REFERENCES

The following documents may provide valuable information to the reader but are not required when complying with this recommended practice.

2.1 SCTE References

SCTE Measurement Recommended Practices for Cable Systems, Fourth Edition (SCTE RP 4th Ed.), 2011

ANSI/SCTE 40 2003 – Digital Cable Network Interface Standard

ANSI/SCTE 40 2011 – Digital Cable Network Interface Standard

2.2 Standards from other Organizations

CEA-542-B – Cable Television Channel Identification Plan

CEA-542-D – Cable Television Channel Identification Plan

3.0 COMPLIANCE NOTATION

"SHOULD"	This word or the adjective "RECOMMENDED" means that there may be valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighted before choosing a different course.
"SHOULD NOT"	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
"MAY"	This word or the adjective "OPTIONAL" means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

4.0 ANALOG NTSC TV SIGNALS PERFORMANCE CHECKLIST

Table 1 summarizes the technical standards in §76.605 of the Federal Communications Commission's Rules, in effect as of January 2014, and is intended to serve as a checklist for analog TV channel proof-of-performance tests. Additional information is available in §76.601, §76.602, the aforementioned §76.605, and §76.609.

Note that 76.605(a)(1)(ii) references CEA-542-B for the channel allocation plan to be used in U.S. cable networks. As of January 2014, the current version of the referenced standard is CEA-542-D. Changes made to the standard in subsequent revisions have largely been editorial in nature; the frequency tables remain unchanged.

The column labeled "SCTE RP 4th Ed." guides the reader to applicable sections in *SCTE Measurement Recommended Practices for Cable Systems, Fourth Edition*, which includes measurement procedures for the listed FCC technical standards.

Table 1 – Analog Signal Performance Checklist

Parameter	FCC Rule	Required Performance	Channels	When	Where	SCTE RP 4th Ed.
Viewability	§76.605(a)(1)(i)	Capable of being received and displayed by TV broadcast receivers	All	Semi-annual	Subscriber terminal	N/A
Channelization	§76.605(a)(1)(ii)	Frequency usage comply with CEA-542-B	All	Semi-annual	Subscriber terminal	Section 7.1
Aural Carrier Frequency	§76.605(a)(2)	4.5 MHz ±5 kHz above visual carrier frequency	All	Semi-annual	Headend, subscriber terminal	Section 7.2
Visual Carrier Level	§76.605(a)(3)	Not less than 0 dBmV	All	Semi-annual	Subscriber terminal	Section 2.1
		Not less than +3 dBmV			End of 30 meter drop cable connected subscriber to tap	
24 Hour Test	§76.605(a)(4)	≤8 dB variation over 6 months	All	Semi-annual (January or February, again in July or August)	End of 30 meter drop cable connected to subscriber tap	Section 2.1
		Each channel within 3 dB of adjacent channels				
		Within 10 dB of any other channel to 300 MHz, increased 1 dB per additional 100 MHz of cable network upper frequency limit (e.g., 11 dB for 301-400 MHz, 12 dB for 401-500 MHz, etc.)				
		Maximum level must not overload subscriber's receiver or terminal				
Aural Carrier Level	§76.605(a)(5)	-10 to -17 dBc	All	Semi-annual	Headend, subscriber terminal	Section 2.1
		-6.5 to -17 dBc if baseband converter is being used			Subscriber terminal	
In-channel response	§76.605(a)(6)	±2 dB from 0.75 MHz to 5.0 MHz above lower channel boundary	Test channels	Semi-annual	Subscriber terminal	Section 6.1
Visual carrier C/N	§76.605(a)(7)	Not less than 43 dB	Test channels	Semi-annual	Subscriber terminal	Section 3.2
Visual signal level-to-coherent disturbance ratio	§76.605(a)(8)	Not less than 51 dBc for noncoherent systems (i.e., STD channelization)	Test channels	Semi-annual	Subscriber terminal	Section 4.1
		Not less than 47 dBc for coherent systems (i.e., IRC or HRC channelization)				
Terminal Isolation	§76.605(a)(9)	At least 18 dB	Test channels	Semi-annual	Subscriber terminal	Section 12.1
Hum and repetitive transients	§76.605(a)(10)	Peak-to-peak variation must be less than 3% of visual carrier level	One channel or CW carrier	Semi-annual	Subscriber terminal	Section 4.4

Parameter	FCC Rule	Required Performance	Channels	When	Where	SCTE RP 4th Ed.
Chrominance-to-luminance delay inequality	§76.605(a)(11)(i)	Within 170 ns	Test channels	Triennial	Headend	Section 10.2
Differential Gain	§76.605(a)(11)(ii)	Shall not exceed ±20%	Test channels	Triennial	Headend	Section 10.3
Differential Phase	§76.605(a)(11)(iii)	Shall not exceed ±10 degrees	Test channels	Triennial	Headend	Section 10.3
Signal leakage	§76.605(a)(12)	≤15 μV/m at 30 meters	≤54 MHz and >216 MHz	Continuous	Entire network	Section 12.2
		≤20 μV/m at 3 meters	>54 MHz to 216 MHz			

5.0 DIGITAL SIGNAL PERFORMANCE CHECKLIST

§76.640 of the FCC Rules mandates that digital signals in cable networks with an activated channel capacity of 750 MHz or greater must comply with the technical parameters in SCTE 40 2003. Note that §76.640 references an earlier version of SCTE 40 (the current version is SCTE 40 2011). The FCC issued a Notice of Proposed Rulemaking in 2012 regarding digital proof-of-performance tests and leakage of digital signals, which references SCTE 40 2011.

The following is excerpted from Section §76.640 of the FCC Rules, in effect as of January 2014:

> *§ 76.640 Support for unidirectional digital cable products on digital cable systems.*
>
> *(a) The requirements of this section shall apply to digital cable systems. For purposes of this section, digital cable systems shall be defined as a cable system with one or more channels utilizing QAM modulation for transporting programs and services from its headend to receiving devices. Cable systems that only pass through 8 VSB broadcast signals shall not be considered digital cable systems.*
>
> *(1) Digital cable systems with an activated channel capacity of 750 MHz or greater shall comply with the following technical standards and requirements:*
>
> *(i) SCTE 40 2003 (formerly DVS 313): "Digital Cable Network Interface Standard" (incorporated by reference, see § 76.602), provided however that with respect to Table B.11, the Phase Noise requirement shall be −86 dB/Hz, and also provided that the "transit delay for most distant customer" requirement in Table B.3 is not mandatory.*

Table 2 includes the technical parameters that downstream QAM signals in networks with an activated channel capacity of 750 MHz or greater must meet as per SCTE 40 2003. That table is provided here for reference, and can be used as a checklist for characterizing the performance of downstream QAM signals. The phase noise requirement according to the FCC is -86 dB/Hz rather than the -88 dB/Hz shown in the table; also, the transit delay parameter is not mandatory.

A column labeled "SCTE RP 4th Ed." has been added to the table. The information in the column is intended to guide the reader to applicable sections in *SCTE Measurement Recommended Practices for Cable Systems, Fourth Edition*, which includes measurement procedures for the listed SCTE 40 parameters applicable to digital signals. The comment "see analog table" in the last column refers to Table 1, the FCC Proof-of-Performance Checklist table earlier in this document.

Table 2 – Analog and FAT Channel: RF Transmission Characteristics

RF Transmission Characteristics		SCTE RP 4th Ed.
RF Channel Spacing	6 MHz	N/A
RF Frequency Range	54 MHz to 864 MHz IRC/HRC/Standard Channel Plans.	N/A
Transit delay from headend to most distant Customer	< 0.800 ms (typically much less)	N/A
Carrier-to-noise ratio, C/(N+I), in a 6-MHz band where C/(N+I) includes the simultaneous presence of all additive impairments in the 6-MHz channel bandwidth including CTB, CSO, other discrete interference.	Not less than 27 dB for 64 QAM; 33 dB for 256 QAM;	Section 3.5
C/N (analog channels)	43 dB for AM-VSB analog	See analog table
CTB	Not worse than -53 dBc referenced to inband carrier levels for analog channels. *(Note 1)*	Sections 3.5 and 4.1
CSO	Not worse than -53 dBc referenced to inband carrier levels for analog channels. *(Note 1)*	Sections 3.5 and 4.1
Carrier-to-any other discrete interference (ingress)	Not worse than -53 dBc *(Note 1)*	Sections 3.5 and 4.1
AM Hum Modulation	Not greater than 3% p-p	Section 4.5
Group Delay Variation	< 0.25 μsec/MHz across the 6-MHz channel	Section 11.4
Chroma / Luma Delay	≤ 170 ns (AM-VSB analog)	See analog table
Phase Noise	< -88 dBc/Hz @ 10 kHz offset (relative to the center of QAM signal spectrum)	Section 3.7
Maximum amplitude variation across the 6-MHz channel (digital channels)	≤ 5 dB p-p	Section 6.4
Maximum amplitude variation across the 6-MHz channel (analog channels)	≤ 4 dB p-p	See analog table

RF Transmission Characteristics		SCTE RP 4th Ed.
Micro-reflections bound for dominant echo	-10 dB at < 0.5 µs -15 dB at < 1.0 µs -20 dB at < 1.5 µs -30 dB at < 4.5 µs	Section 9.4
	Micro-reflections longer than 4.5 microseconds rarely occur in conventional cable television systems. Moreover very low-level micro-reflections (e.g., -40 dB) longer than 4.5 microseconds may not be measured reliably. Therefore, micro-reflections longer than 4.5 microseconds shall be considered under item 4 (of this table) as a contributor to C/(N+I)	
Burst Noise *(Note 2)*	Not longer than 25 µs at 10-Hz repetition rate	Section 3.6
Carrier level at the terminal input *(Note 3)*	64 QAM: -15 dBmV to + 15 dBmV	Section 2.2
	256 QAM: -12 dBmV to +15 dBmV	
	Analog Visual Carrier (c): 0 dBmV to +15 dBmV	See analog table
	Analog Aural Carrier: -10 dBc to -17 dBc	

Notes:

1. For digital channels, CTB, CSO and other discrete interference are included in the overall C/(N+I) parameter.

2. Burst noise is statistical in nature and a reference level should be defined. Studies on this are continuing.

3. See SCTE RP 4th Ed., section 6.4.1 for the allowable variation in level between adjacent channels.