

Carroll County, MD
Technical Audit
February 2008

**TECHNICAL AUDIT
OF THE
COMCAST CABLE SYSTEM
FOR
CARROLL COUNTY, MARYLAND**

February 2008

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I. EXECUTIVE SUMMARY

Columbia Telecommunications Corporation (“CTC”) has been contracted by Carroll County, Maryland Cable Commission (“Commission”) to conduct a technical audit of the County PEG video feeds and a technical inspection of the cable system operated by Comcast. This report documents the findings of our testing of the County PEG video feeds, inspection of the headend facility, electrical testing of the cable network, and inspection of selected portions of the physical plant.

The purpose of our inspection was to determine if the cable system as operated by Comcast meets the technical requirements of the franchise agreement and to determine if the network is performing consistent with the performance levels established by the Federal Communications Commission (FCC).

1.1 PEG Video Feed Testing

Our testing and examination of the PEG video feeds to Comcast and the Community Media Center (CMC) found that the majority of PEG video transport equipment was operating within specifications. We noted that Comcast recently upgraded the PEG video transport equipment at the CMC, Carroll County Community College (CCCC), and Carroll County Public Schools (CCPS). These upgraded locations generally provided the best video testing results. The video transport equipment between the municipalities and the CMC indicated that the older video transport equipment showed some video irregularities. Although these irregularities would not likely be noticeable to subscribers, CTC recommends upgrading this equipment to prevent future issues and to provide enhanced functionality.

CTC observed issues with varying audio levels between programs and inputs on the County’s PEG channels. These issues are often seen on PEG channels nationwide due to the variety of programming sources used to generate PEG content and the environment in which PEG content is produced. CTC recommends that the PEG operators test each audio input in their production system to ensure that levels are properly set. CTC also recommends using modern digital audio processing equipment to control audio level inputs and minimize distortion, especially on microphone inputs. These issues are discussed in more detail in Section III.

1.2 Overall Picture Quality

Our examination of the picture quality of the individual cable channels at the headend and various tests points selected in the County found picture quality to be similar to other cable systems in the region.

All of the video channels examined by CTC during our onsite inspection as well as the measurement data included in Comcast’s FCC proof test measurement tabulations confirm that the system meets the FCC minimum performance criteria for cable systems. These issues are discussed in more detail in Section IV.

1.3 Headend Concerns

Comcast has made improvements in the Carroll County headend since CTC's last technical inspection of the system in 2004, when the cable system was owned by Adelphia Communications. When owned by Adelphia, the headend site was self-contained and not linked to other facilities. All off-air broadcast television and satellite reception was provided using antennae located at the headend site. Comcast has extended their fiber optic backbone to the Carroll County location and has migrated many of the headend functions, such as off-air reception, satellite reception and video on demand, to other headends within the region. At present, most programming to Carroll County subscribers is provided from the Comcast White Marsh facility and the Comcast Prince George's facility. Although the Comcast facility is small compared to current modern cable systems, equipment has been upgraded or is in the process of being upgraded, which will produce more available space within the headend. New analog video modulators and PEG fiber transport equipment have been installed and lasers are currently being replaced. Comcast maintains redundant equipment at the Carroll County hub so that in the event of an outage to its fiber optic backbone network, the equipment at the Carroll County headend will provide service to subscribers.

The Comcast Carroll County hub is currently not manned. We noted that audio levels were not consistent throughout the channels. At the time of our inspection, audio deviation (volume) was low on nine analog television channels. These included channels 18, 19, 32, 45, 59, 62, 65, and 71. The audio issue was reported to local Comcast technical staff, who informed us they would report the issue to Comcast regional staff for repair or adjustment. CTC recommends that video quality and audio quality be monitored daily and adjustments, when necessary, should be made by local Comcast technical staff.

1.4 Cable Network Physical Plant

In addition to the system performance testing, CTC inspected the physical cable plant located in public and private rights-of-way. The inspection included an examination of aerial cable plant on the utility poles, underground cable plant, and subscriber drop cables which connect subscriber residences to the cable network. We found the cable plant to be in adequate condition in relationship to the local power and telephone utilities and adequate when compared with other cable systems that we inspected.

CTC examined the construction and installation of the system at 100 locations, including underground areas and aerial construction along sections of roadway. In addition, CTC inspected subscriber drop installations, power supplies and node locations.

In general, we noted that most of the underground coaxial cable plant is placed using a direct-bury method. In most cases, observed fiber optic cable was either placed aerially or located in conduit in underground areas. During the inspection, we found eight violations out of the 100 sites inspected. Of the total locations inspected, approximately 92% were in acceptable condition. These issues are discussed in more detail in Section V.

1.5 Technical Recommendations

Overall, we find the Comcast system to be in generally good working order. We recommend that as a part of the upcoming negotiations with Comcast, the following technical issues be brought into the discussions for resolution:

- Replace the existing video transport equipment between the Municipalities and the CMC with equipment that is at a minimum capable of supporting analog video, stereo audio, and second audio programming (SAP).
- Although the existing video transport equipment is working properly in general, CTC recommends developing a plan for migrating to digital video and audio transport of PEG programming feeds. The existing equipment supplied by Comcast only provides for one analog video and one mono audio feed. Modern video transport equipment can transport digital video signals, such as SD and HD SDI video, as well as multiple stereo digital audio signals.
- At the time of inspection, CTC found that audio deviation (volume) was low on nine analog television channels. CTC recommends that video quality and audio quality be monitored daily and adjustments, when necessary, should be made by local Comcast technical staff.
- Comcast should allow the PEG community to use a portion of the video on demand (VOD) servers to provide additional PEG services, such as general information programming (bilingual) as well as archived meetings or events, as a public service.
- While the system meets FCC requirements, CTC recommends that Comcast should expedite the replacement of older headend lasers to provide better carrier-to-noise performance. This replacement will provide less “grainy” or “snowy” analog video reception to subscribers.
- Comcast should correct grounding deficiencies in the physical plant and drops. They should conduct an inspection of all plant grounding infractions that may present immediate safety hazards. The specific details of these violations are discussed in Section IV of this report.

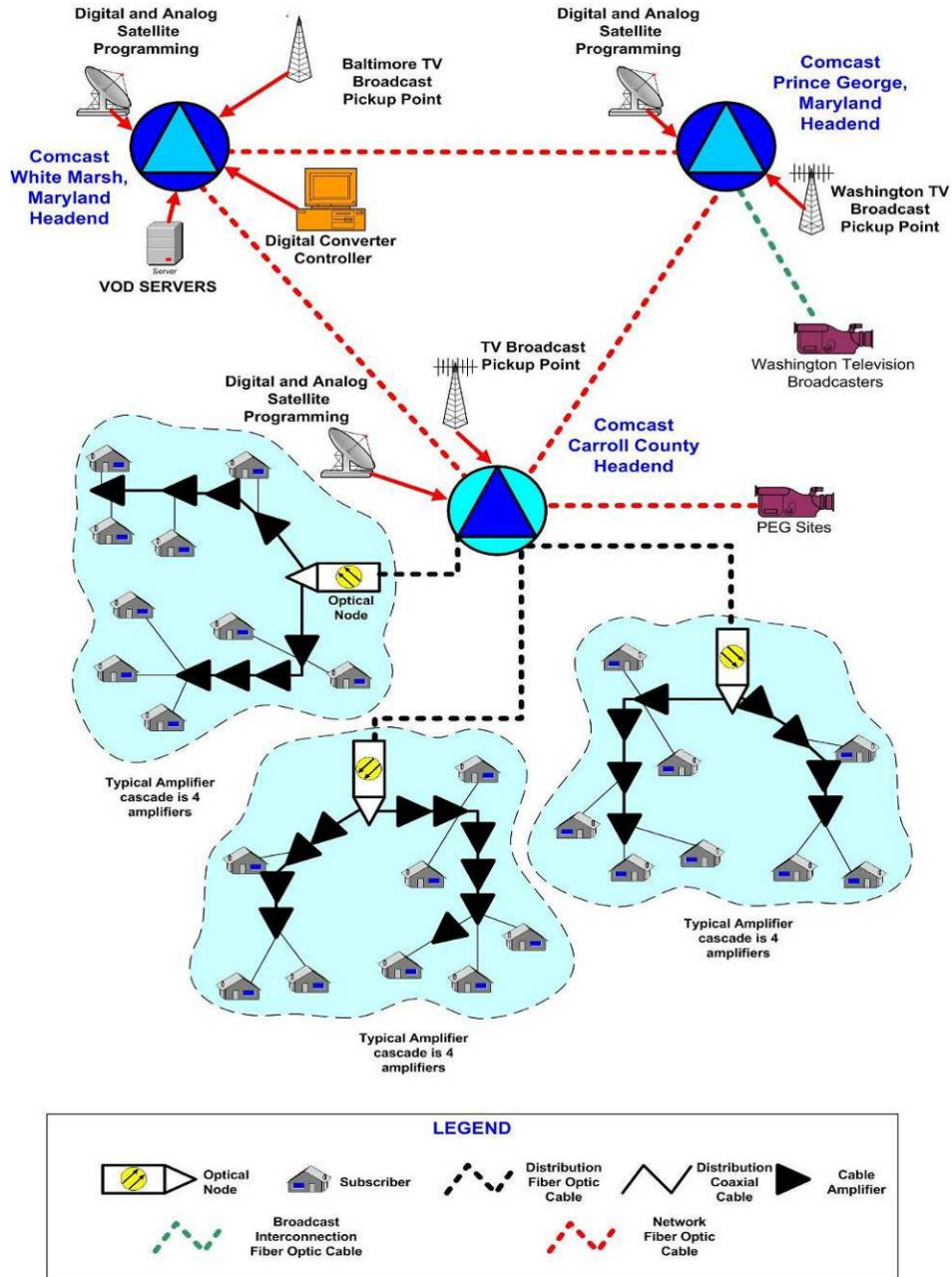
II. SYSTEM DESCRIPTION

The Carroll County system employs 750 MHz technology, offering analog and digital television channels as well as digital audio, video on demand, pay-per-view channels, high-definition television, high-speed data services, and telephony. Unlike other systems in the region, the Carroll County system is a harmonically related carrier (HRC) system, which provides analog channels on slightly offset frequencies compared to a standard EIA channel plan.

The Carroll County headend facility is located at 1327 Washington Road in Westminster. The facility is connected to other Comcast headends using redundant fiber optic paths. The White Marsh, Maryland headend currently provides most digital services, provides control of the set-top digital converters, houses the video on demand (VOD) servers, and provides the Baltimore, Maryland off-air broadcast television feeds. Additionally, the headend site in Prince George's County, Maryland provides the Washington, DC off-air broadcast television feeds. The Carroll County headend provides redundant off-air reception for Baltimore, MD and Washington, DC television stations and satellite programs for provision of service during a fiber failure. Commercial ad insertion equipment to provide local advertising is also located at the White Marsh facility.

Local PEG access channels are transported to the Carroll County headend using dedicated fiber optic video transport equipment and are inserted into the channel line-up at the headend. The Carroll County system has five PEG channels assigned on the network. The programming carried on the PEG channels originates at three locations in the County and is transported to the headend through a fiber optic link. At the CMC, Community TV, Town and Community Programming, and the Carroll County Government Channel are produced. The Carroll County Public Schools and the Carroll County Community College produce their own channels. Figure 1 illustrates the Carroll County system architecture.

Figure 1: Carroll County Cable System



2.1 Westminster Headend

On September 12, 2007, and February 7, 2008, CTC inspected the Comcast headend facilities located at 1327 Washington Road in Westminster. The function of the headend is to receive and process all programming information for distribution on the cable network and to serve as the local facility for monitoring all video programming. We found the headend to be a small facility for all the required electronic equipment. All equipment was mounted in commercial grade telecommunications equipment racks. As additional services are moved to regional headends and as Comcast finishes upgrades to its existing equipment, more space may become available in the headend.

The majority of modulators have been replaced with the Stratum series made by Standard Communications. These devices are used to generate the individual channels carried on the cable system. The fiber optic lasers and optical receivers are the older Scientific Atlanta Prisma series, but Comcast is in the process of changing over to the Motorola GX series. Fiber patch panels and combining networks are made by ADC.

Baltimore, MD off-air channels are received from Comcast's White Marsh headend facility. Washington, DC off-air channels are received from the Comcast Prince George's facility. The existing off-air antennas are used to provide redundant program sources. Most of the digital television services are provided from the White Marsh headend. The digital television controller that activates service levels on the digital set-top converters is also located at the White Marsh facility. Comcast offers digital services including high definition television (HDTV), VOD, and digital television recorders (made by Scientific Atlanta). Commercial insertion of advertisements is provided by Comcast using equipment located at the White Marsh facility.

Headend equipment is powered by a Liebert battery operated uninterruptible power supply (UPS). A stand-alone Onan back-up generator is in place that automatically goes into operation in the event of failure of the commercial power. The UPS provides power during the transition phase while the generator starts after a commercial power interruption.

Overall, the majority of the headend equipment examined appeared to be in working condition and consistent in age and quality to what we have observed in other modern cable systems. Figure 2 illustrates the headend facility, tower, and satellite antennae.

Figure 2: Westminster Headend

Headend Modulators



Self Supporting Tower



Headend Satellite Antennae



PEG Optical Receivers



Standby Generator



Lasers and Fiber



2.2 Distribution System

The Comcast system in Carroll County consists of hybrid fiber-coaxial cable plant. There are approximately 294 miles of aerial plant and 882 miles of underground plant.

The node is the location where the cable plant transitions from the fiber optic cable to the coaxial cable links to neighborhoods and customers. A greater amount of fiber optic cable (and therefore a greater number of nodes, or fewer customers served per node) is desired since it provides more reliability, more Internet capacity, and more capacity for video-on-demand in the future.

Less coaxial cable provides more reliability, since the system has fewer active components (coaxial amplifiers) that may fail. It is common in the cable industry to measure the amount of coaxial cable by describing the “amplifier cascade,” the greatest number of amplifiers that exist between the cable headend and any customer. In a modern, recently upgraded system, this number should be below four.

There are approximately 140 fiber optic nodes serving the County. This is an increase of approximately 40 nodes since our last inspection of the system in 2004. The maximum cascade of coaxial amplifiers from a fiber node is seven. As noted, this cascade length is high compared with systems recently upgraded. We estimate that, on average, a node serves an area of approximately 500 dwelling units. This number is average by industry standards. As discussed, a lower number is desirable since it results in greater capacity per customer for advanced services.

The bandwidth of the cable system is 750 MHz. In areas of newer construction or where equipment has been recently replaced, the fiber optic nodes and amplifiers have greater capacity and are rated at 860 MHz. The 750 MHz systems are prevalent in systems that have been upgraded over the last decade, while most new cable system construction uses 860 MHz technology.

The cable plant has battery-powered stand-by power supplies that provide a minimum of two hours of operation in the event of local utility outages. Power supplies include a combination of both 60 and 90 Volt units.

2.3 Analog and Digital Program Channels

The Carroll County system provides 71 analog channels, 45 digital audio channels, 30 premium digital channels, approximately 150 standard definition digital video channels (SDTV), and 23 high definition channels (HDTV). The cable channel line-up is provided in Appendix C.

Digital video subscribers use Scientific Atlanta converters for standard (NTSC) format digital service and HDTV service. The digital modulation is part of what determines how many digital channels can be provided on a cable system.

Digital channels are received from the satellites and groomed at the White Marsh facility. Grooming of digital channels allows cable operators to “cherry-pick” specific digital channels provided via satellite and place them on the subscriber system, or to delete individual channels before they are inserted into the cable system. Additionally, with grooming, the cable operator has the ability to transmit all digital signals at 256 QAM and as discussed, potentially be able to provide more programs on the system.

2.4 Video On Demand

Comcast offers Video on Demand (VOD) services to its digital television subscribers. The VOD servers are located at the White Marsh facility. VOD programming allows selection and narrowcast to individual subscribers as they order a program. This allows the subscriber to independently control program navigation (start, pause, fast-forward, rewind, and stop).

2.5 High Definition Television (HDTV)

At the time of our inspection, HDTV services were available to subscribers on 23 channels.

2.6 Emergency Alert System

The national Emergency Alert System (EAS) enables authorized government authorities to override the programming on a cable system to provide emergency information to subscribers. The specific requirements for EAS system operations are defined in the FCC Rules and Regulations. These regulations detail a testing procedure and the documentation required to be maintained by the cable operator.

The Comcast system uses the Trilithic EASy Plus EAS system. Using this system, a full-screen message is displayed on all analog channels, and a message crawl is displayed on all digital channels. The EAS equipment is located at the Carroll County headend.

The cable operator is required to maintain records documenting the results of the FCC required EAS testing. As part of our inspection, we reviewed the EAS logs and found them to be in good order with regard to the technical materials. The EAS equipment has the capability to provide local interruption of channels for local emergency alert messages.

2.7 Public, Educational, and Government Channels

The headend receives public, educational, and government access (PEG) channels for the Carroll County franchise area, and broadcasts them to area subscribers. The signal paths for Carroll County PEG channels and I-Net usage are illustrated in Figure 4. The Carroll County system has the following five PEG channels available and currently programmed:

- Channel 18: Educational Access (Carroll County Community College)
- Channel 19: Public Access (Community TV)
- Channel 21: Educational Access (Carroll County Public Schools)
- Channel 23: Government Access (Carroll County Municipalities)
- Channel 24: Government Access (Carroll County Government)

Channels 19, 23 and 24 originate from the Community Media Center (CMC) and use the PEG video transport system to receive video feeds from the municipalities and the County. Channels 18 and 21 originate at the Community College and Public Schools Administration Building respectively.

2.8 Cable Modem Service

Comcast provides cable modem service throughout the system. Comcast uses industry-standard Data Cable Service Interface Specification (DOCSIS) headend equipment and cable modems. All modems must meet standards developed for the cable industry by CableLabs. CableLabs conducts tests and has certified cable modems from numerous manufacturers that can be used by subscribers on DOCSIS-compliant systems like the Comcast Carroll County system. The DOCSIS certification process makes it technically possible for subscribers to purchase equipment from retail stores rather than leasing equipment from their cable company. The Cable Modem Termination System (CMTS) is provided via a Motorola BSR 64000 system.

2.9 Telephony

Comcast currently offers voices services to customers in Carroll County.

2.10 Digital Video Recording

Comcast offers digital video recording (DVR) service on the cable system. Additionally, Comcast subscribers have the option of purchasing their own digital recording devices from other vendors and using them with the Comcast cable service.

III. PEG Video Testing

The PEG channel program sources are linked to the Comcast headend via fiber optics, using dedicated fiber optic video transport equipment. The fiber optic transport equipment for the PEG program feeds and for the municipalities is Radiant Communications VA700 transmitters and receivers, except for the County and Mt Airy feeds to the CMC, which use the Optelecom CWDM video solution.

Between November and December of 2007, CTC performed baseband video measurements between the PEG channel producers and Comcast, and between the municipalities and the CMC. The purpose of baseband video testing was to ensure that equipment used to transport the PEG video signals was operating correctly. PEG operators informed CTC that the equipment between the PEG operators and Comcast had recently been upgraded.

Of the 17 links tested, CTC noticed only minor issues with the video transport equipment. The majority of the issues were noted in the links between the Municipalities and the CMC, which consists of older Radiant equipment that had not been upgraded.

CTC recommends the County approach Comcast about replacing the remaining legacy Radiant Communications equipment with newer fiber optic transport equipment. The County should also consider developing a plan for migrating from analog video and audio transport to a system that is capable of supporting digital video and audio. At a minimum, CTC recommends replacing the existing aging equipment with hardware that is capable of supporting stereo audio and second audio programming (SAP).

In addition to video testing, CTC observed the audio levels of the PEG channels. CTC noticed varying audio levels between programming. CTC recommends that the PEG operators adjust the audio levels on each input source and use digital audio processing equipment on each audio input to minimize distortion and improve quality of the audio signals.

3.1 Baseband Video Testing

The objective of the baseband video testing is to comprehensively evaluate the quality of the video transmission between each PEG origination facility and Comcast. The test procedure was designed to measure signal variations caused by the PEG link that relate to visible signal properties.

The video measurements were made using a Tektronix TSG 95 NTSC Signal Generator and a Tektronix VM100 measurement test set. Baseband video measurements were made by connecting the test signal generator at the PEG origination facility to the fiber optic transmitter without any additional equipment in the path. The Tektronix VM100 was connected to the video output of the fiber optic receiver and measurements were taken. Tables 1, 2 and 3 show the results of our testing in comparison to three common standards used in video transport: the RS-250C, NTC 7, and FCC standards. RS-250C is the most rigorous standard, followed by NTC 7, and the FCC standards. Appendix E provides an explanation of baseband measurements.

Table 1: Baseband Video Testing Results for County PEG Channels

SITE NAME SITE CHANNEL MEASUREMENT	CMC 24	CMC 19	CMC 23	CCCC 18	CCPS 21	RS-250C OBJECTIVE	NTC7 OBJECTIVE	FCC CABLE REQUIREMENTS
DIFFERENTIAL PHASE	0.3	0.3	0.5	0.6	0.7	<1.3 degrees	< 5 degrees	< 10 degrees
DIFFERENTIAL GAIN	3.9%	2.8%	4.0%	2.6%	3.4%	< 2%	<15%	<20%
CHROMANANCE LUMINANCE DELAY	8.5	9.1	2.8	3.0	7.9	± 20 ns	±75 ns	±170 ns
CHROMANANCE LUMINANCE GAIN	99.2%	99.6%	100.3%	98.8%	98.9%	98 to 102%	97 to 103%	N.A.
SIGNAL TO NOISE RATIO WTD.	60.4	71.3	71.3	55.9	59.0	≥ 60 dB	≤ 53 dB	C.N. ≥ 43 dB
MULTIBURST TESTS								
OVERALL	0.0	± 0.0	± 0.1	± 0.1	± 0.1	≤ .2 dB	± .5 dB	± 2 dB
FLAG	72.1	69.1	69.1	69.9	70.3	64.1 to 75.9 IRE	67 – 73 IRE	N.A
FREQUENCY 1	-0.1	-0.1	-0.2	-0.1	0.0	± .1 dB	± .5 dB	± 2 dB
FREQUENCY 2	-0.0	0.0	-0.1	0.0	0.0	± .15 dB	± .5 dB	± 2 dB
FREQUENCY 3	0.0	0.0	0.0	0.0	0.0	± .18 dB	± .5 dB	± 2 dB
FREQUENCY 4	0.0	0.0	0.0	0.0	0.0	± .2 dB	± .5 dB	± 2 dB
FREQUENCY 5	0.0	0.0	0.0	0.0	0.0	± .1 dB	± .5 dB	± 2 dB
FREQUENCY 6	0.0	0.0	-0.1	-0.2	-0.1	± .2 dB	± .5 dB	± 2 dB
SYNC AMPLITUDE	40.4	39.7	39.5	40.2	40.6	38.8 to 41.2 IRE	36 -44 IRE	N.A.
BURST AMPLITUDE	40.9	39.6	40.1	39.7	40.2	38.8 to 41.2 IRE	36 -44 IRE	N.A.
WHITE FLAG	103.4	99.6	98.9.	100.5	101.1	98 to 102 IRE	97 – 103 IRE	N.A.
2T K-FACTOR	0.2%	0.2%	0.2%	0.1%	0.4%	N.A.	6%	N.A.
LUMINANCE NON-LINEARITY	2.7%	2.1%	3.9%	3.3%	3.5%	2%	10%	N.A.
60 HZ. HUM	1.3%	1.7%	1.8%	0.5%	0.5%	N.A.	3%	3%
120 HZ. HUM	0.4%	0.4%	0.6%	1.2%	0.9%	N.A.	3%	3%

CTC observed no major issues with the upgraded Radiant Communication equipment installed for the County’s five PEG channels. These results are what would be expected from modern fiber optic transport equipment. Tables 2 and 3 outline the results of the PEG video testing from the municipalities to the CMC.

Table 2: Baseband Video Testing Results - Municipalities to the CMC

SITE NAME SITE CHANNEL MEASUREMENT	County 1	County 2	County 3	County 4	Manch ester	Taney town	Union Bridge	RS-250C OBJECTIVE	NTC7 OBJECTIVE	FCC CABLE REQUIREMENTS
DIFFERENTIAL PHASE	0.9	0.8	0.6	0.5	1.4	0.3	1.3	<1.3 degrees	< 5 degrees	< 10 degrees
DIFFERENTIAL GAIN	0.6%	0.5%	1.2%	2.4%	5.1%	5.1%	10.4%	< 2%	<15%	<20%
CHROMANANCE LUMINANCE DELAY	26.3	25.3	21.6	20.0	2.9	10.2	62.9	± 20 ns	±75 ns	±170 ns
CHROMANANCE LUMINANCE GAIN	101.0%	101.3%	96.2%	104.1%	80.0%	87.9%	90.6%	98 to 102%	97 to 103%	N.A.
SIGNAL TO NOISE RATIO WTD.	66.9	66.2	55.7	64.1	66.2	66.5	65.3	≥ 60 dB	≤ 53 dB	C.N. ≥ 43 dB
MULTIBURST TESTS										
OVERALL	± 0.1	± 0.1	± 0.2	± 0.2	± 1.0	± 0.4	± 0.8	≤ .2 dB	± .5 dB	± 2 dB
FLAG	73.8	72.6	73.0	71.2	50.3	70.2	69.7	64.1 to 75.9 IRE	67 – 73 IRE	N.A
FREQUENCY 1	-0.2	-0.2	-0.1	-0.1	0.0	0.3	0.2	± .1 dB	± .5 dB	± 2 dB
FREQUENCY 2	0.0	-0.1	0.0	-0.1	0.0	0.2	0.0	± .15 dB	± .5 dB	± 2 dB
FREQUENCY 3	-0.1	0.0	0.0	0.0	-0.5	-0.1	-0.7	± .18 dB	± .5 dB	± 2 dB
FREQUENCY 4	-0.1	0.1	0.1	0.2	-1.0	-0.2	-1.0	± .2 dB	± .5 dB	± 2 dB
FREQUENCY 5	0.0	0.0	0.1	0.2	-1.4	0.4	-1.2	± .1 dB	± .5 dB	± 2 dB
FREQUENCY 6	0.0	0.0	0.0	0.2	-1.9	-0.5	-1.4	± .2 dB	± .5 dB	± 2 dB
SYNC AMPLITUDE	41.7	40.9	41.5	41.5	28.2	39.9	40.9	38.8 to 41.2 IRE	36 -44 IRE	N.A.
BURST AMPLITUDE	42.2	41.9	42.2	42.2	23.7	37.5	36.3	38.8 to 41.2 IRE	36 -44 IRE	N.A.
WHITE FLAG	105.2	104.0	105.1	104.4	72.6	104.8	101.2	98 to 102 IRE	97 – 103 IRE	N.A.
2T K-FACTOR	0.5%	0.5%	0.6%	0.0%	1.1%	0.7%	2.6%	N.A.	6%	N.A.
LUMINANCE NON-LINEARITY	0.7%	0.6%	0.8%	1.5%	4.5%	5.0%	12.0%	2%	10%	N.A.
60 HZ. HUM	0.2%	0.2%	0.0%	0.4%	0.0%	0.0%	0.0%	N.A.	3%	3%
120 HZ. HUM	0.2%	0.1%	0.1%	0.0%	0.0%	0.1%	0.0%	N.A.	3%	3%

Table 3: Baseband Video Testing Results - Municipalities to the CMC

SITE NAME SITE CHANNEL MEASUREMENT	Mt Airy 1	Mt Airy 2	Mt Airy 3	Mt Airy 4	Sykes ville	RS-250C OBJECTIVE	NTC7 OBJECTIVE	FCC CABLE REQUIREMENTS
DIFFERENTIAL PHASE	0.6	0.7	0.7	0.7	0.4	<1.3 degrees	< 5 degrees	< 10 degrees
DIFFERENTIAL GAIN	1.0%	0.8%	0.8%	1.0%	1.8%	< 2%	<15%	<20%
CHROMANANCE LUMINANCE DELAY	29.3	26.4	26.9	27.1	5.3	± 20 ns	±75 ns	±170 ns
CHROMANANCE LUMINANCE GAIN	101.3%	101.2%	101.4%	101.8%	90.7%	98 to 102%	97 to 103%	N.A.
SIGNAL TO NOISE RATIO WTD.	64.3	63.7	66.9	65.0	66.5	≥ 60 dB	≤ 53 dB	C.N. ≥ 43 dB
MULTIBURST TESTS								
OVERALL	± 0.1	± 0.1	± 0.1	± 0.1	± 0.4	≤ .2 dB	± .5 dB	± 2 dB
FLAG	71.8	72.0	71.6	72.4	70.1	64.1 to 75.9 IRE	67 – 73 IRE	N.A.
FREQUENCY 1	-0.2	-0.2	-0.2	-0.2	0.0	± .1 dB	± .5 dB	± 2 dB
FREQUENCY 2	-0.1	-0.1	-0.1	-0.1	0.0	± .15 dB	± .5 dB	± 2 dB
FREQUENCY 3	-0.1	-0.1	-0.1	-0.1	-0.3	± .18 dB	± .5 dB	± 2 dB
FREQUENCY 4	0.0	0.0	0.0	0.0	-0.4	± .2 dB	± .5 dB	± 2 dB
FREQUENCY 5	0.0	0.0	0.1	0.0	-0.5	± .1 dB	± .5 dB	± 2 dB
FREQUENCY 6	0.0	0.0	0.0	0.0	-0.7	± .2 dB	± .5 dB	± 2 dB
SYNC AMPLITUDE	40.8	40.9	40.7	41.2	38.4	38.8 to 41.2 IRE	36 -44 IRE	N.A.
BURST AMPLITUDE	41.4	41.4	41.4	41.9	37.3	38.8 to 41.2 IRE	36 -44 IRE	N.A.
WHITE FLAG	102.7	103.0	102.5	103.5	99.5	98 to 102 IRE	97 – 103 IRE	N.A.
2T K-FACTOR	0.4%	0.4%	0.5%	0.5%	1.1%	N.A.	6%	N.A.
LUMINANCE NON-LINEARITY	0.7%	0.6%	0.3%	0.6%	5.6%	2%	10%	N.A.
60 HZ. HUM	0.1%	0.1%	0.1%	0.2%	0.1%	N.A.	3%	3%
120 HZ. HUM	0.1%	0.1%	0.1%	0.1%	0.1%	N.A.	3%	3%

CTC observed that for all four municipalities using the original Radiant Communications fiber optic video transport equipment had chrominance-to-luminance gains that were below the NTC 7 objective. Chrominance-to-luminance gain distortion causes reduction or peaking of color saturation.

The Manchester link did not meet NTC 7 objectives for sync amplitude, burst amplitude, and white flag levels. These results tend to indicate that the overall video gain for the Manchester link is low. CTC recommends replacing the equipment for the Manchester link as the video gain is not externally adjustable on the Radiant Communications equipment.

The low chrominance-to-luminance gains for the Sykesville, Taneytown, and Union Bridge links may be an indication that the equipment is no longer maintaining a uniform gain across all aspects of the video signal as the sync and bar amplitudes, and multiburst and white flags are within specifications. CTC recommends replacing the equipment for these links.

CTC noted that baseband video testing results for the Optelecom equipment used for the County and Mt Airy feeds generally met or exceeded the NTC 7 video objectives. CTC did not note any major problems with the Optelecom equipment.

3.2 Subjective Audio Testing

CTC observed the audio levels of the PEG channels during the course of our inspection of the Comcast headend and the baseband video testing. CTC noted varying audio levels between programming sources and varying audio levels within programs, especially government meetings and public access programming. These varying audio levels are often seen in PEG programming

nationwide as the production environment for PEG programming is not as consistent and controlled as other professional broadcast environments. Oftentimes, getting speakers to talk properly into microphones can dramatically improve the audio quality of productions.

CTC developed the following recommendations after reviewing the audio quality of the existing PEG channels:

- Perform audio gain control on each PEG programming feed prior to transmission to Comcast.
- Perform digital audio processing on all audio inputs during production. Processing should include automatic gain control, noise gating, feedback cancellation, and audio limiting.
- Measure and adjust all audio sources in the playback system to ensure equal audio levels between sources. This adjustment by PEG operators will help minimize audio variations when the PEG channel switches between sources (i.e. bulletin board to media server).
- Monitor audio quality of PEG content. If consistent audio problems occur, steps should be taken to minimize distortions such as:
 - Installation of additional microphones or repositioning of existing microphones
 - Adjustment of audio level input and digital processing
 - Education of speakers and producers on proper use of microphones

IV. PERFORMANCE TESTING

On February 7, 2008, in cooperation with Comcast technical staff, CTC and Comcast staff jointly performed a set of tests replicating a subset of the FCC Proof-of-Performance (proof) tests. For the proof tests, CTC supervised Comcast tests of six selected channels throughout the spectrum using an HP/Agilent 8591C spectrum analyzer provided by Comcast. CTC also used a Stealth signal level meter to conduct concurrent tests on all channels on the system to measure signal level, carrier-to-noise, and hum. The results of these tests are provided in Appendix B.

The FCC requires semi-annual proof tests and annual Cumulative Leakage Index tests to verify the system meets the FCC's minimum technical standards. The tests must be performed once in the winter and once in the summer. The FCC procedures define a sample of measurements taken for selected channels at a number of locations across the system that will be representative of the system as a whole. However, the operator is required to have all channels meet the FCC minimum technical requirements. The number of channels and locations to be tested is determined using an FCC formula based on the number of subscribers and the cable system design.

Proof tests require testing of signal levels for all channels of the system as well as signal-to-noise ratio, second and third order distortions or other coherent disturbances on a number of channels determined by the bandwidth of the system, and hum on a single channel. Frequency measurements of both carrier and separation are also required. The 24-hour tests measure the stability of the system over time and compare the results of tests taken over a 24-hour period in the winter to those taken in the summer.

The FCC also requires tests of the color quality (chrominance-luminance delay inequality, differential gain, and differential phase) once every three years.

CTC tested all channels at five locations throughout Carroll County. Table 4 lists the location of the test points. The test points include one FCC proof test point in order to verify previous proof data with hands-on measurements.

Table 4: Test Point Locations

Test Point #	Address
	Comcast Headend
1	1327 Washington Road
2	2325 Pin Oak Drive (FCC TP)
3	1001 Terrace Court
4	1627 Exeter Road
5	213 Lincoln Lane

4.1 Performance Measurements

All test point measurements met the FCC minimum technical requirements. The measurements for carrier-to-noise (C/N) at the headend averaged 49.4 dB. In the field the test points at 1001 Terrace Court (TP3) and 1627 Exeter Road (TP4) were typically below levels we would expect to see on a modern cable system. The C/N at these locations averaged 45.5 dB and 45.6 dB. C/N corresponds to the sharpness and clarity of the picture. A high C/N is sharp and clear, comparable to video from a digital video disk (DVD). Low C/N signals correspond to snowy, fuzzy video.

The carrier-to-noise ratio in a modern cable system is a function of received optical power at the node. Comcast technical staff advised us they were in the process of replacing the older headend lasers which generate the optical power. CTC recommends that Comcast expedite the replacement of lasers and make sure all optical connectors are clean. This should improve C/N ratios to averages of 48 dB as measured at the other test points.

4.2 Cumulative Leak Index (CLI)

The FCC requires that each cable operator measure and record signal leakage radiating into the air from a cable plant to demonstrate cumulative leakage index (“CLI”) compliance. Signal leakage is generally caused by defects in the distribution hardware, which can cause interference with other communications signals such as aeronautical and navigation signals. To protect against these harmful signals, the FCC requires that the cable operator check the CLI of the cable plant at least once a year.

The required measurements may be accomplished by either extensive ground-based observations or by measurements made while flying over the system. Signal leakage measurements are also useful for locating damaged cable plant or components that interfere with picture quality.

Mar-Tech Engineering conducted a fly-over measurement of the Comcast cable system in Carroll County on November 8, 2007. The CLI measurement provided a score of 99.97% which confirms that the system meets minimum FCC requirements.

V. PHYSICAL PLANT INSPECTION

CTC selected a sample portion of the Comcast cable plant to inspect which included both underground and aerial construction. On February 7, 2008 CTC inspected areas of the system throughout the County to determine the quality of the plant construction and compliance with national standards. The national inspection standards and authorities, along with descriptions of the violations, are included in this section of the report. Accompanied by Comcast representatives, CTC inspected aerial and underground cable construction in the public rights-of-way and at individual subscriber residence connections (“drops”) in different residential areas. These residential areas were typically within the vicinity of the test points, and covered selected areas of the County.

CTC examined the construction and installation of the system at 100 locations, including underground areas and aerial construction along sections of roadway. In addition, CTC inspected subscriber drop installations, power supplies and node locations.

In general, we noted that most of the underground coaxial cable plant is placed using a direct-bury method. In most cases, observed fiber optic cable was either placed aerially or located in conduit in underground areas. During the inspection, we found eight violations out of the 100 sites inspected. Of the total locations inspected, approximately 92% were in acceptable condition.

Physical plant and drop infractions resulted from missing grounding and bonding. A total of six plant end-of-line locations were not grounded. Two of the six locations were in underground areas, and the remaining four locations were in aerial plant. The two drop locations with infractions were due to disconnected drops that were not grounded.

Appendix A contains a list of the locations where we found violations, categorized by type of construction, (plant or drop), and nature of the violation. The following section contains a description of the types of construction violations we report.

5.1 Physical Plant

There are two primary national construction standards cited with which the cable system must comply.

The first standard, the National Electrical Safety Code (“NESC”) published by the Institute of Electrical and Electronics Engineers, Inc., 2007, is the primary guide to construction of the cable system in the public rights-of-way. The NESC is a national code designed to provide standards and work rules to protect persons against hazards from the installation, maintenance, and operation of electrical systems and communications lines.

The second standard is the National Electrical Code (“NEC”) published by the National Fire Protection Association, Inc., 2008. This national code establishes rules for the safe installation of electrical conductors and equipment.

Other industry standards and authorities for construction and installation practices will also be mentioned as they relate to problems we found that warrant correction.

The categories for violations of physical plant constructed primarily in the public rights-of way are as follows:

5.1.1 Bonding and Grounding

We inspect bonding and grounding according to NEC and NESC and industry standards for the safety of workers on the aerial and underground cables and at subscriber homes and equipment. Grounding protects against injury from lightning and surges of excessive electrical current on the system.

Grounding is required for electrified system components at specified locations along the plant itself. This is accomplished by bonding the cable plant and equipment to the common neutral ground of the other utilities on the poles. Alternatively, when there is no other ground, the cable system is directly grounded with a ground rod at the site where grounding is required. Bonding creates “the permanent joining of metallic parts to form an electrically conductive path that ensures electrical continuity and the capacity to conduct safely any current likely to be imposed”.

During our inspection we found six end-of-line locations where the system was not properly grounded as required by the NEC or the NESC.

**Figure 3: Disconnected Drop Not Grounded
(1001 Terrace Court)**



**Figure 4: Underground Plant EOL Not Grounded
(213 Lincoln Lane)**



**Figure 5: Complaint Aerial Standby Power Supply
(Blanker Road and SR 32)**



5.1.2 Lashing

In aerial portions of the cable system, the cables are attached to steel cables or “strand” that is bolted to the poles. A strong thin lashing wire is wrapped around both the cable and strand to secure the cable to its supporting strand. This practice places the weight of the cable on the strand rather than on the cable itself.

Improper lashing can result in undue stress on the cable and connectors, potentially causing signal quality problems. If the lashing wire breaks and unravels, it usually causes the cable to fall from its supporting strand toward the ground, thereby reducing clearances over streets, driveways, or sidewalks and presenting hazards to vehicular and pedestrian traffic.

CTC’s inspector noted no violations for broken lashing wires.

5.1.3 Construction

The construction category addresses the manner in which the cable system is built. Poor construction practices are evident in such violations as bolts of improper length, which if too long create hazards for personnel climbing the poles, or if too short fail to secure the cables to the poles. Other violations in this category include missing bolts, strand that is not attached to poles, strand that does not have the proper tension, cable supports and spacers that are missing or improperly installed, and equipment that is improper for the system.

No construction violations were found.

5.1.4 Clearances

Clearances of the cables from the ground, streets and sidewalks, and other utilities are specified in national codes such as the NESC §23 and Tables 232 and 234. All cables on the utility poles and underground should be placed in a manner to avoid contact with one another. The codes establish acceptable distances between power, telephone, and other communications lines placed on the same poles and in the same area in the public rights-of-way or public utility easements.

Proper distance between cable television lines and other utility cables provides a level of safety for all workers on the poles. The clearance distances from power lines and streets and sidewalks are established to permit safe and unhindered access to cables on the poles and to avoid obstructions to vehicular traffic and pedestrians traveling under the cables.

No clearance violations were found during inspection.

5.1.5 Guying and anchoring

In aerial construction, guy wires are necessary to provide additional support to the utility pole where the weight of cables on the poles is greater than can be safely supported by the poles alone. Guy wires are required not only for poles that support a large number of cables, but also

for poles supporting very long spans of cable, and on corners or at the end-of-lines where there is also additional weight on the poles.

Missing or improperly installed guy wires can create a public safety hazard because of a greater potential for pole failure under stress from high winds, accidents, or pole degradation over time.

The steel cables used to guy the poles must be properly bolted to the poles and anchored in the ground at prescribed tensions. At ground level, the guy wire itself is required to be covered with a plastic “guard” to alert passersby to the presence of the wire and protect pedestrians from accidental injury.

CTC found no guying and anchoring violations.

5.2 Subscriber Drop-Related Violations

“Drops” are the wires that connect the subscriber homes to the cable system on the street. Under the NEC, drops are required to meet specific construction standards for attachment to the homes. These standards have requirements for attachment to the residence, clearance from the ground or depth of buried cable, and grounding to protect against shock, equipment damage, and fire hazards. Drop violations include drops from aerial plant down a utility pole to an underground service connection not being secured to the pole and which may become inadvertently snagged and disconnected.

Safety is a significant concern in installation and maintenance of drops. For example, a common operator practice is to place a temporary unburied drop to a home serviced by underground plant. This can also occur when the ground is frozen or snow covered and cable cannot be buried at the time of installation. This may be acceptable for a few days, if properly guarded or marked, but when left exposed for weeks it is not only an annoyance to subscribers but presents a safety hazard in the public rights-of-way. These situations are also reported as violations. Standards for drop installation and maintenance are governed by generally accepted industry practices and by the NEC.

5.2.1 Drop grounding

We found two disconnected drops that were not grounded.

5.2.2 Exposed, Broken, or Missing Underground Plant or Equipment

In areas of new construction, we often find exposed, broken, or missing plant or equipment. Where public utilities are placed underground, cable and related equipment must also be placed underground. Cables are to be buried at specified depths and at specified distances from public utilities. When repairs or replacement of the cables is necessary, temporary exposed “jumper” cables are often installed to maintain service while work to properly install and bury the new cables is scheduled. When temporary jumper cables are installed, the cables should be marked

with tape or cones to alert the public to the hazard and to protect the public from injury. Temporary cables must be replaced with properly installed cables as soon as possible.

In other cases, drops may be installed without properly burying the cable in order to facilitate a subscriber service connection, with the cable operator scheduling burial of the cable for a later date. These unburied cables also present safety hazards to residents passing by the cables. When we find this type of installation that has been in place for some time or is unprotected, we report it as a violation.

We found no locations with infractions in this category.

5.2.3 Drop Clearance

We found no locations where the cable drop had insufficient clearance.

APPENDIX A INSPECTION DETAILS

PHYSICAL PLANT AND DROP INSPECTION									
Inspector: David Randolph									
Cable Company: Comcast									
Franchise: Carroll County, Maryland									
REF.	ADDRESS	Total Locations	Drop Power Ground	Missing Plant Ground	Plant OK	Other	Date	INSPECTOR COMMENTS	NEC COMPLIANCE
1	1001 Terrace Court	1				1	2/7/08	Disconnected drop not grounded	No
2	1026 Terrace Court	1				1	2/7/08	Disconnected drop not grounded	No
3	1024 Terrace Court	1	1				2/7/08	Bonded to power OK	Yes
4	1025 Terrace Court	1	1				2/7/08	Bonded to power OK	Yes
5	850 Regent Street	1		1			2/7/08	Aerial end-of-line not grounded (riser)	No
6	1600 Exeter Road	1		1			2/7/08	Aerial end-of-line not grounded	No
7	1609 Exeter Road	1		1			2/7/08	Aerial end-of-line not grounded	No
8	1659 Exeter Road	1			1		2/7/08	Grounded end-of-line OK	Yes
9	1635 Exeter Road	1	1				2/7/08	Bonded to power OK	Yes
10	1659 Exeter Road	1	1				2/7/08	Bonded to power OK	Yes
11	217 Lincoln Lane	1		1			2/7/08	Underground end-of-line not grounded	No
12	213 Lincoln Lane	1		1			2/7/08	Underground end-of-line not grounded	No
13	616 Blanker Road	1			1		2/7/08	Grounded end-of-line OK	Yes

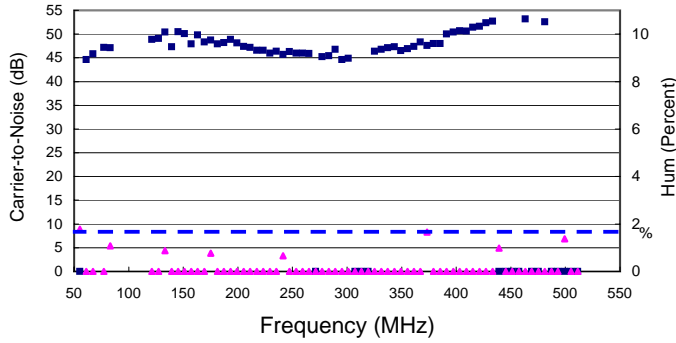
REF.	ADDRESS	Total Locations	Drop Power Ground	Missing Plant Ground	Plant OK	Other	Date	INSPECTOR COMMENTS	NEC COMPLIANCE
14	Blanker Road & 32	1			1		2/7/08	Power supply OK	Yes
15	1001 Terrace Court	1		1			2/7/08	Aerial end-of-line not grounded	No
16	482 & Gablemammer	20			20		2/7/08	Aerial plant OK	Yes
17	1627 Exeter Road	3			3		2/7/08	Aerial plant OK	Yes
18	Washington & 97	17			17		2/7/08	Aerial plant OK	Yes
19	Lincoln Lane	20			20		2/7/08	Underground plant OK	Yes
20	Dear Park Road	25			25		2/7/08	Aerial plant OK	Yes
	TOTALS	100	4	6	88	2		NEC COMPLIANT	92
								NOT NEC COMPLIANT	8
								TOTAL	100

APPENDIX B

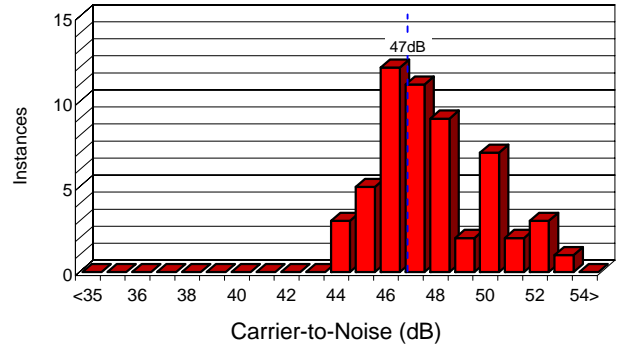
MONITOR TEST DATA RESULTS

Comcast Headend 11/09/07

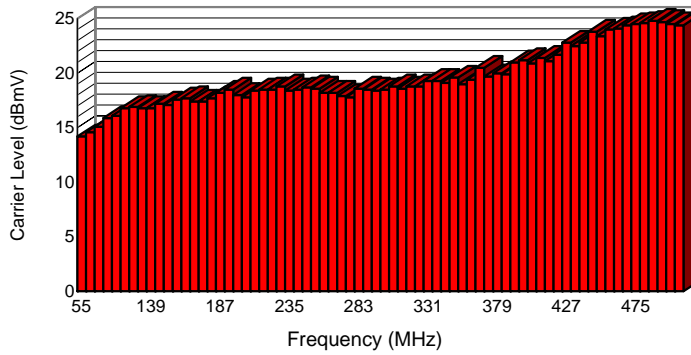
CARRIER-TO-NOISE AND HUM PERFORMANCE



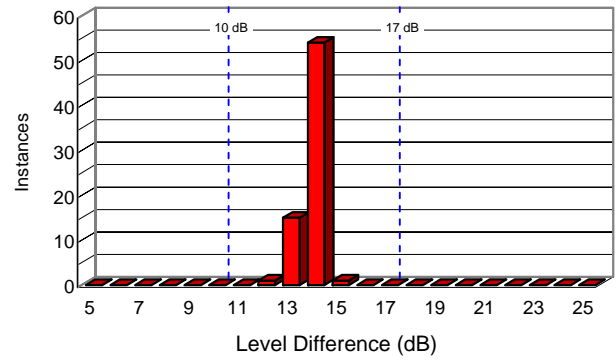
C/N PERFORMANCE DISTRIBUTION



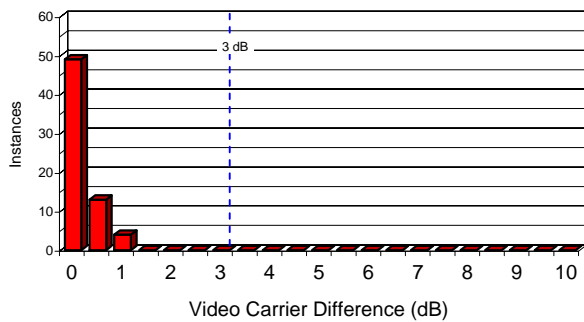
VIDEO CARRIER LEVELS



VIDEO-TO-AUDIO RATIO



ADJACENT CHANNEL DIFFERENCE



Carrier-to-Noise

Average 48.0 dB Min. allowable 43 dB

Carrier Level Variation

Overall 10.6 dB Max. allowable 13 dB
 Adjacent 1.1 dB Max. allowable 3 dB

Hum

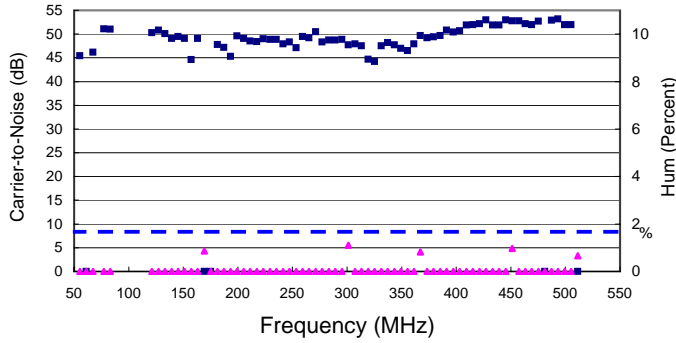
Average 1.15% Max. allowable 2 %

A/V Ratio

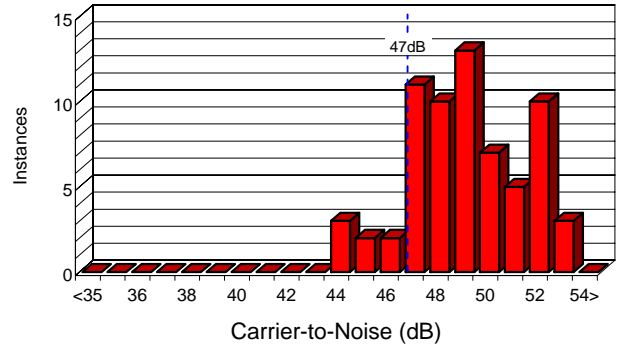
Maximum 15.0 dB Max. allowable 17 dB
 Minimum 12.9 dB Min. allowable 10 dB

TP1 1327 Washington Road (Headend) 02/07/08

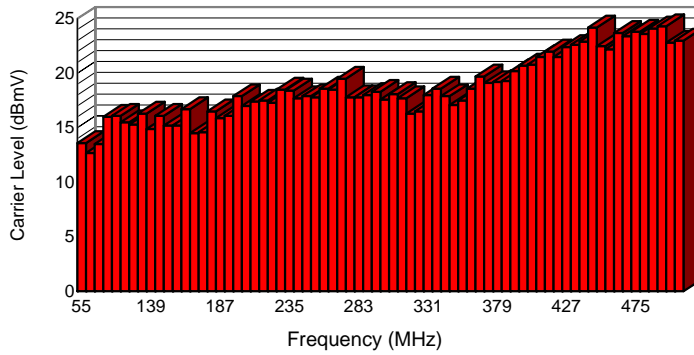
CARRIER-TO-NOISE AND HUM PERFORMANCE



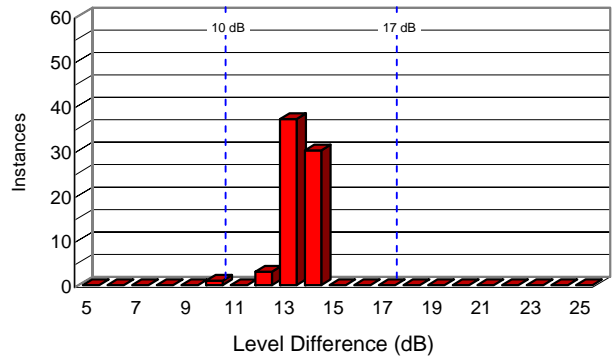
C/N PERFORMANCE DISTRIBUTION



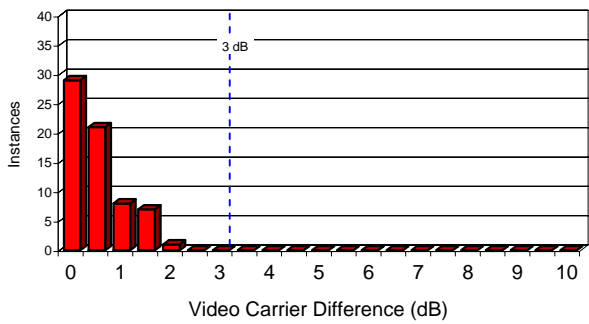
VIDEO CARRIER LEVELS



VIDEO-TO-AUDIO RATIO



ADJACENT CHANNEL DIFFERENCE



Carrier-to-Noise

Average	49.4 dB	Min. allowable	43 dB
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Carrier Level Variation

Overall	11.6 dB	Max. allowable	13 dB
Adjacent	2.2 dB	Max. allowable	3 dB

Hum

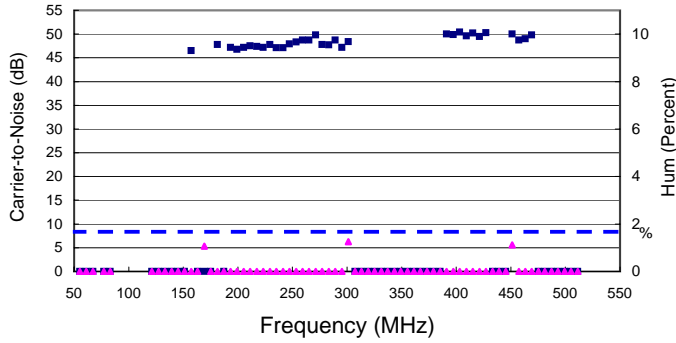
Average	0.89%	Max. allowable	2 %
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A/V Ratio

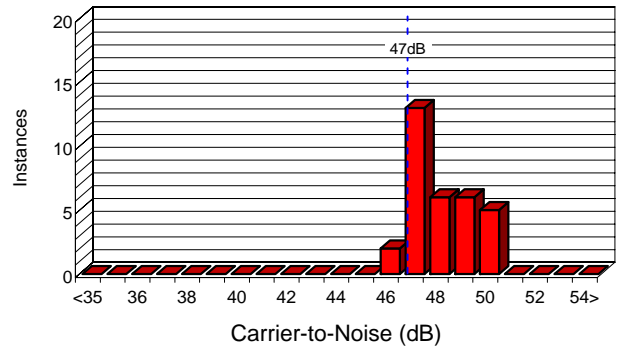
Maximum	14.8 dB	Max. allowable	17 dB
Minimum	10.4 dB	Min. allowable	10 dB

TP2 2325 Pin Oak Drive 02/07/08

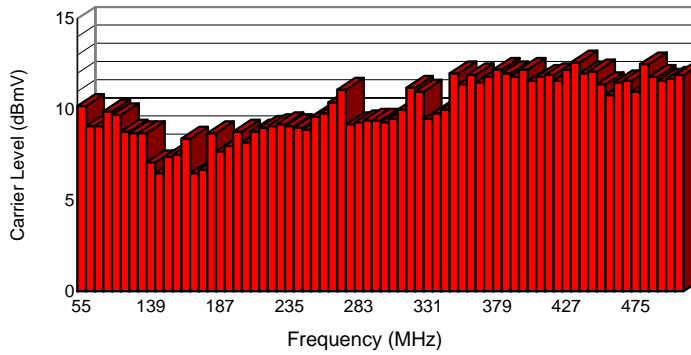
CARRIER-TO-NOISE AND HUM PERFORMANCE



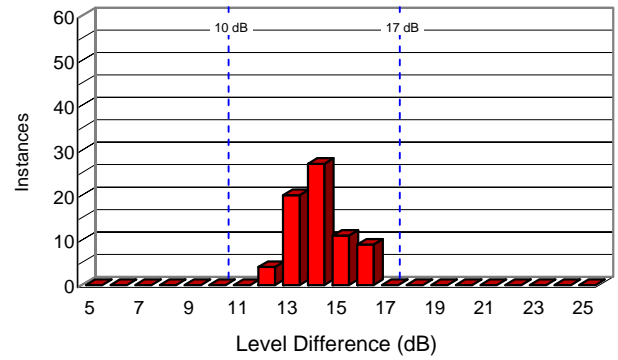
C/N PERFORMANCE DISTRIBUTION



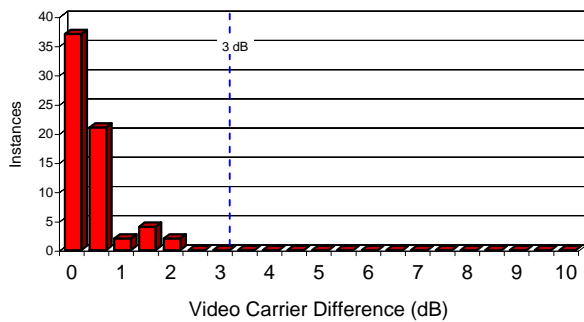
VIDEO CARRIER LEVELS



VIDEO-TO-AUDIO RATIO



ADJACENT CHANNEL DIFFERENCE



Carrier-to-Noise

Average	48.4 dB	Min. allowable	43 dB
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Carrier Level Variation

Overall	6.1 dB	Max. allowable	13 dB
Adjacent	2.0 dB	Max. allowable	3 dB

Hum

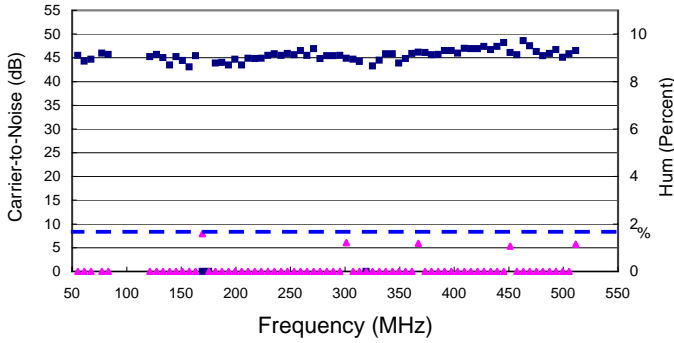
Average	1.15%	Max. allowable	2 %
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A/V Ratio

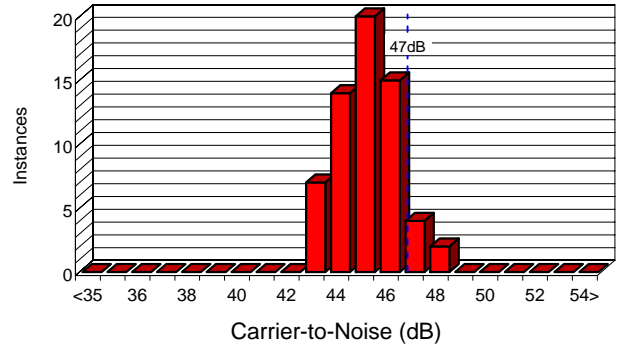
Maximum	16.8 dB	Max. allowable	17 dB
Minimum	12.2 dB	Min. allowable	10 dB

TP3 1001 Terrace Court 02/07/08

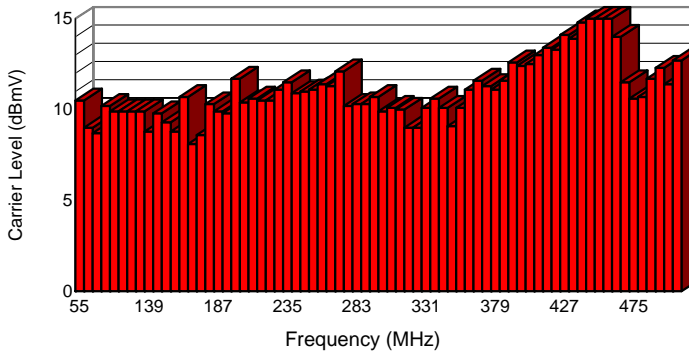
CARRIER-TO-NOISE AND HUM PERFORMANCE



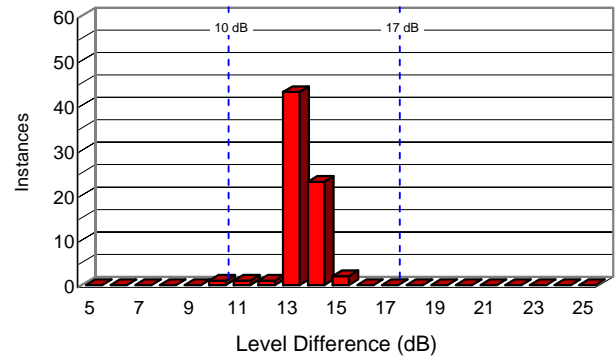
C/N PERFORMANCE DISTRIBUTION



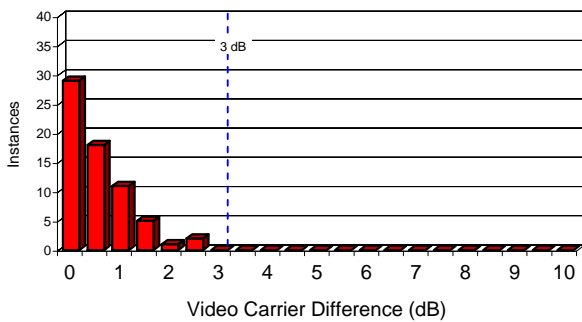
VIDEO CARRIER LEVELS



VIDEO-TO-AUDIO RATIO



ADJACENT CHANNEL DIFFERENCE



Carrier-to-Noise

Average	45.5 dB	Min. allowable	43 dB
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Carrier Level Variation

Overall	8.0 dB	Max. allowable	13 dB
Adjacent	2.6 dB	Max. allowable	3 dB

Hum

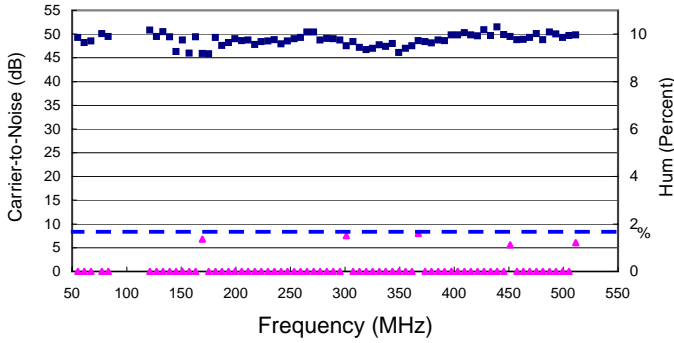
Average	1.24%	Max. allowable	2 %
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A/V Ratio

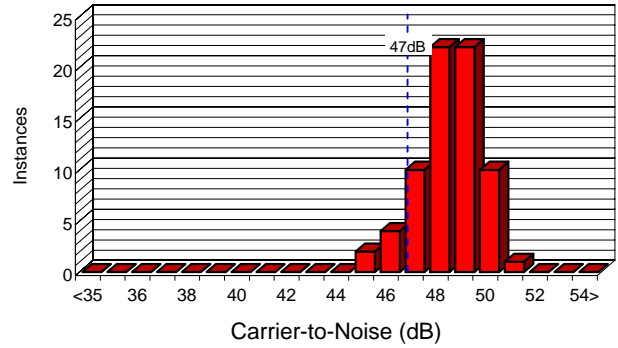
Maximum	15.6 dB	Max. allowable	17 dB
Minimum	10.2 dB	Min. allowable	10 dB

TP4 1627 Exeter Road 02/07/08

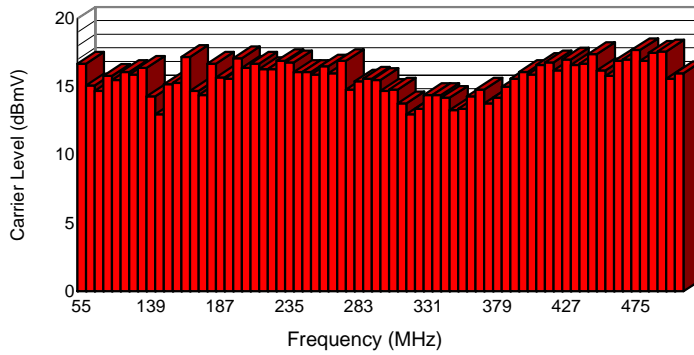
CARRIER-TO-NOISE AND HUM PERFORMANCE



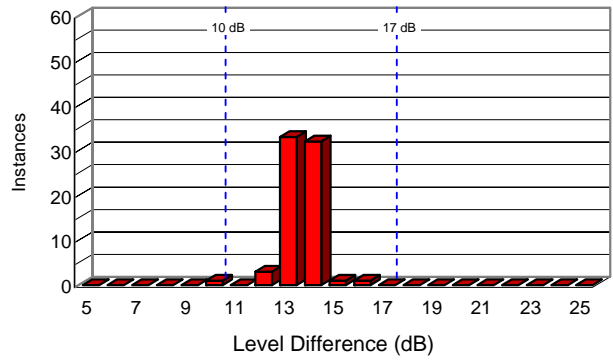
C/N PERFORMANCE DISTRIBUTION



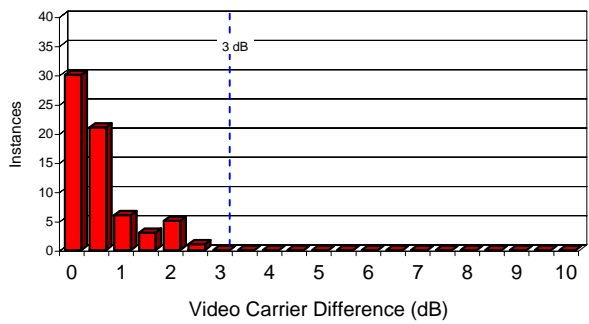
VIDEO CARRIER LEVELS



VIDEO-TO-AUDIO RATIO



ADJACENT CHANNEL DIFFERENCE



Carrier-to-Noise

Average	48.8 dB	Min. allowable	43 dB
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Carrier Level Variation

Overall	4.7 dB	Max. allowable	13 dB
Adjacent	2.5 dB	Max. allowable	3 dB

Hum

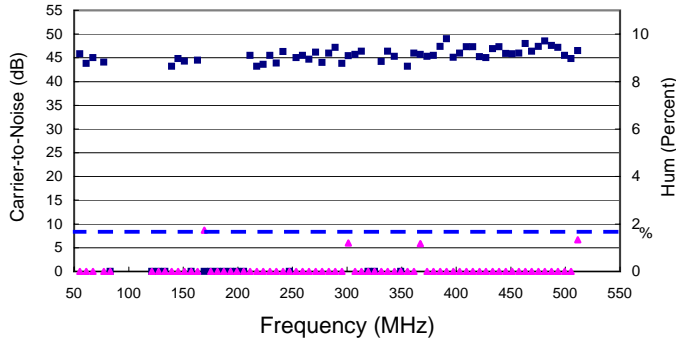
Average	1.36%	Max. allowable	2 %
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A/V Ratio

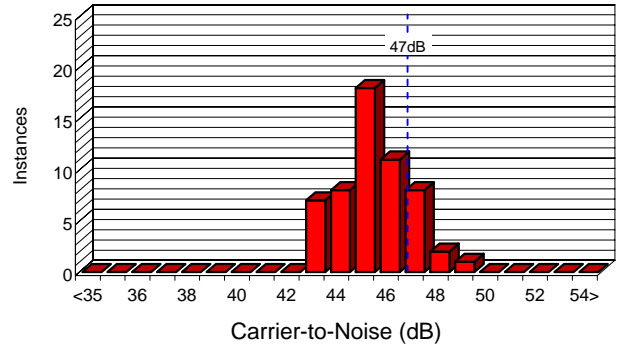
Maximum	16.1 dB	Max. allowable	17 dB
Minimum	10.2 dB	Min. allowable	10 dB

TP5 213 Lincoln Lane 02/07/08

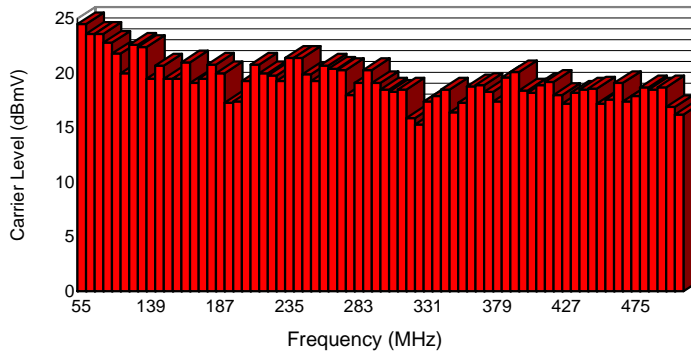
CARRIER-TO-NOISE AND HUM PERFORMANCE



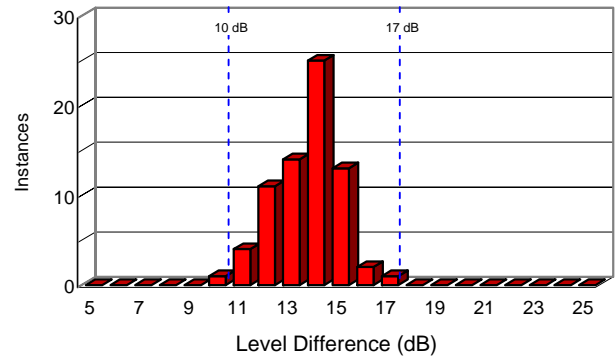
C/N PERFORMANCE DISTRIBUTION



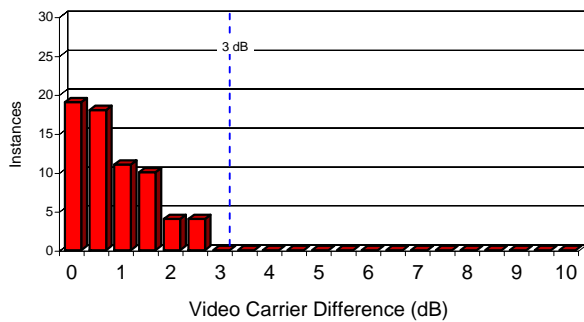
VIDEO CARRIER LEVELS



VIDEO-TO-AUDIO RATIO



ADJACENT CHANNEL DIFFERENCE



Carrier-to-Noise

Average	45.6 dB	Min. allowable	43 dB
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Carrier Level Variation

Overall	9.2 dB	Max. allowable	13 dB
Adjacent	2.9 dB	Max. allowable	3 dB

Hum

Average	1.36%	Max. allowable	2 %
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A/V Ratio

Maximum	17.0 dB	Max. allowable	17 dB
Minimum	10.6 dB	Min. allowable	10 dB

APPENDIX C

COMCAST ANALOG CHANNEL LINEUP



Channel Lineup

Location: CARROLL COUNTY

Last updated: July 10, 2007

Package: Full Standard Service

Full Standard Service

2	C-SPAN
3	CSN+/ C-SPAN 2
4	WRC-4 (NBC Washington)
5	TV Guide
6	WUTB-24 (My Network TV)
7	WJLA-7 (ABC Washington)
8	CN 8
9	WUSA-9 (CBS Washington)
10	QVC
11	WBAL - 11 (NBC Baltimore)
12	WBFF-45 (FOX Baltimore)
13	WJZ - 13 (CBS Baltimore)
14	WMAR - 2 (ABC Baltimore)
15	WNUV-54 (CW Baltimore)
16	WGN-9 (IND Chicago)
17	HSN
18	Carroll Co. Community College
19	Community TV
20	Inspirational Network
21	Public Schools
22	WMPB-67 (PBS Balt)
23	Town & Community Prog.
24	Carroll Co. Government
25	EWTN
26	WETA-26 (PBS-Wash)
27	Shop NBC
28	Lifetime
29	ION
30	Cartoon Network
31	Travel
32	Court TV

33	Comedy Central
34	TBS Superstation
35	ESPN
36	ESPN 2
37	Comcast SportsNet
38	Versus
39	MASN
40	Sci-Fi
41	Food Network
42	MTV
43	VH1
44	CMT
45	Spike TV
46	USA Network
47	ABC Family
48	CNN
49	Headline News
50	Discovery Channel
51	Nickelodeon
52	E!
53	AMC
54	A&E
55	History Channel
56	The Weather Channel
57	Hallmark
58	CNBC
59	TLC
60	TNT
61	Fox News
62	HGTV
63	TV Land
64	TCM
65	FX
66	Speed Channel
67	Animal Planet
68	The Golf Channel
69	MSNBC
70	Disney Channel
71	BET
72	Bravo

APPENDIX D

Explanation of Performance Test Graphs

Each group of tests in this report is presented in several pages of data. Each page presents the graphic display of six results from the tests.

GRAPH PAGE NOTATIONS

A header on each page indicates test point location where tests were conducted, and the date tests were conducted. For example, to indicate that Poolesville test point number 04 was tested on December 11, 2001, the header would read:

PV TP-04 12/11/01

A footer on each page shows the average of the individual channel measurements for carrier-to-noise and the signal level variation. A typical footer would appear as:

Carrier-to-Noise (dB)		Carrier Level Variation (dB)			
Average	48.1	Overall	6.2	Adjacent	1.8

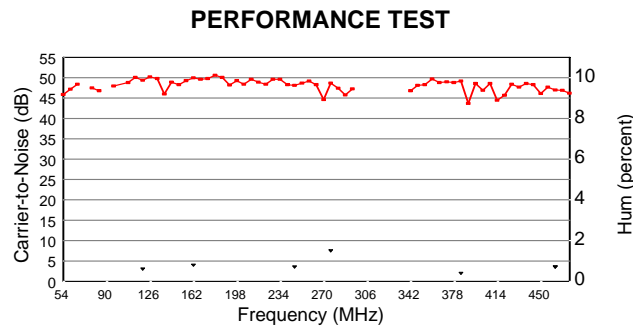
The **Carrier-to-Noise** ratio (C/N) for an individual channel is the average video carrier power level relative to the noise power level when measured across 4.2 MHz of bandwidth. The higher the number, the better the picture quality. The minimum C/N allowable by the FCC is 43 dB. Measurements less than 43 dB can result in deteriorated picture quality, which is often viewed as a grainy picture or a picture with snow in it.

C/N is measured on all channels except the scrambled channels. Comparing scrambled channels to unscrambled channels may provide false numbers since scrambled channels cannot be accurately measured for signal level by the Stealth analyzer. Therefore, the video carrier levels of scrambled channels are not included in the calculation of C/N or carrier level variation.

The **Carrier Level Variation** expresses the overall difference in signal level between the highest and lowest video carrier signal level for all of the channels tested, and the difference between the signal levels for each channel and its adjacent channel. The overall measurement is required to be less than or equal to 12 dB. The adjacent channel variation must be less than or equal to 3 dB. If these measurements are exceeded there can be an annoying difference in the picture quality from channel to channel.

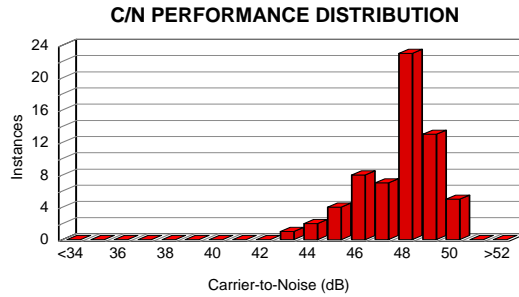
PERFORMANCE TEST GRAPHS

Performance test graphs display carrier-to-noise and hum data collected at each test point as measured by the Wavetek Stealth SDA 4040 signal analyzer (Stealth). The carrier-to-noise readings are plotted on the upper portion of the graph and are required by the FCC to be at least 43 dB. Hum readings on selected channels are plotted near the bottom and referenced to the right-hand scale. Hum is undesired modulation of the television visual carrier by power line frequencies or their harmonics (i.e. 60 or 120 Hz), or other low frequency disturbances. Hum causes decreased picture quality, typically described as horizontal lines that scroll up the screen. Hum measurements are required by the FCC to be less than 3 percent.



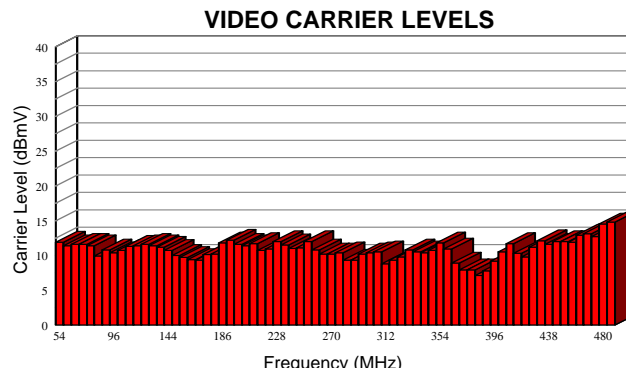
C/N PERFORMANCE DISTRIBUTION GRAPHS

Carrier-to-noise performance distribution graphs show the number of measurements taken (instances) which register each dB level. The carrier-to-noise ratio is required by the FCC to be at least 43 dB.



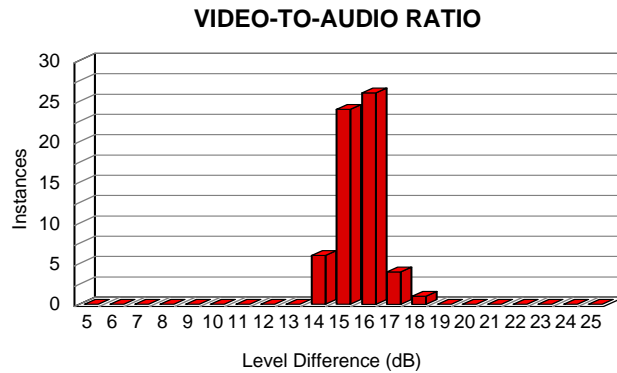
VIDEO CARRIER LEVELS

Each channel's video carrier signal is measured at the test point using a standard 30-meter drop cable. The results of these measurements are plotted on the Video Carrier Level graphs. The carrier level for each channel is indexed by frequency assignment. The FCC requires that each channel must have a video carrier level of at least 0 dBmV.



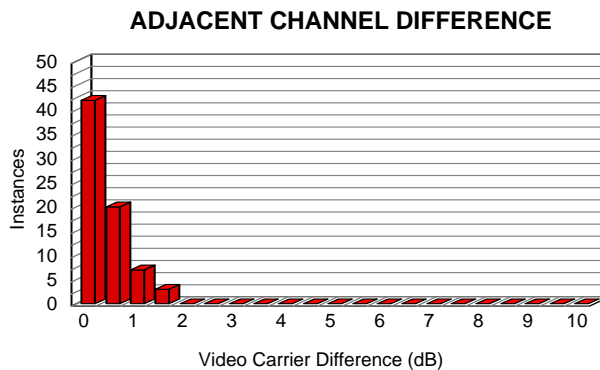
VIDEO-TO-AUDIO CARRIER RATIO

The video-to-audio carrier ratio graphs illustrate the difference, measured in dB, between the video carrier and the audio carrier on the channels. The audio carrier level is required by the FCC to be between 10 and 17 dB below the video carrier level. In the sample below, 26 channels had a difference of 16 dB.



ADJACENT CHANNEL DIFFERENCES

The difference in video carrier measurements from one channel to its adjacent channel is called the adjacent channel difference. The FCC requires there be no greater than a 3 dB difference between the two channels. In the example below, 20 channels had a difference of 0.5 dB.



APPENDIX E

BASEBAND VIDEO PERFORMANCE STANDARDS

Technical performance tests were conducted to establish the transportation system performance of the access cable channels. Video measurements, tests, and performance objectives were conducted according to NTC Report Number 7, Video Facility Testing And Technical Performance Objectives (NTSC-7) prepared by the Network Transmission Committee of the Video Transmission Engineering Advisory Committee. Major elements of these standards are described in the following paragraphs.

DIFFERENTIAL PHASE distortion is a result of the transportation system's inability to uniformly process the high frequency color information at all brightness levels. The hues or colors may not be properly reproduced, particularly in high brightness parts of the picture. The test is conducted by inserting a 5 step modulated staircase signal at the access facility. The color phase of each modulated step is measured and the differential phase between steps is recorded. The NTSC-7 performance objective is 5 degrees.

DIFFERENTIAL GAIN distortion is also a result of the transportation system's inability to uniformly process the high frequency color information at all brightness levels. The saturation of the colors may not be properly reproduced, particularly in high brightness parts of the picture. The test is conducted by inserting a 5 step modulated staircase signal at the access facility. The color amplitude of each modulated step is measured and the differential amplitude between steps is recorded. The NTSC-7 performance objective is 15 percent or 15 IRE units.

CHROMINANCE – LUMINANCE DELAY inequality is a result of the transportation system's inability to uniformly pass the high frequency color information and the brightness information with the same delay. Delay distortion causes color smearing or bleeding. This distortion is seen particularly at the edges of objects in the picture and causes poor reproduction during sharp brightness transitions. The test is conducted by inserting a 12.5T sine-squared pulse with 3.58 MHz modulation. The color and brightness delay is measured and recorded. The NTSC-7 performance objective is ± 75 nanoseconds.

CHROMINANCE – LUMINANCE GAIN inequality is a result of the transportation system's inability to uniformly pass the high frequency color information and the brightness information with the same level. Gain distortion causes reduction or peaking of color saturation. The test is conducted by inserting a 12.5T sine-squared pulse with 3.58 MHz modulation. The color and brightness delay is measured and recorded. The NTSC-7 performance objective is ± 3 percent or ± 3 IRE units.

SIGNAL-TO-NOISE RATIO degradations are results of the transportation system's inability to transport the signal without excessive noise. Noise refers to the fluctuations which are present in any electrical system. Noise can either be either random or coherent and comes from a variety of natural and man-made sources. Excessive noise causes pictures to often appear grainy or snowy, and sparkles of color may be noticeable. Extremely noisy signals may suffer from blurriness, lack of resolution, and inability to lock the picture. The test is conducted by using a quiet line in

the vertical interval without video modulation. The noise is measured and expressed as a ratio of the noise compared to 100 IRE unit video. The NTSC-7 performance objective is a minimum of 53 dB.

GAIN FREQUENCY DISTORTION degradations are results of the transportation system's inability to transport uniformly the signal without affecting the amplitudes of different frequencies. Frequency response problems can cause a wide variety of aberrations in the picture. The most noticeable include fuzzy vertical edges, ringing, loss of color saturation, and loss of resolution. The test is conducted by inserting a multiburst signal in the vertical interval with a white flag, and frequency bursts at .5, 1.25, 2.0, 3.0, 3.58, and 4.1 MHz. The amplitude of each frequency burst is measured and compared to each frequency burst. The NTSC-7 performance objective is + .03 Db to .05 dB.

2T K-FACTOR measurements are primarily used to measure linear distortions caused by frequency response problems and group delay aberrations in the transportation system. The most noticeable picture distortions include fuzzy vertical edges and ringing. The test is conducted by inserting a 2T pulse signal in the vertical interval. The shape and amplitude of the 2T pulse is measured and compared with the original test signal. The NTSC-7 performance objective is 94 to 106 IRE units.

WHITE FLAG measurements are primarily used to measure the insertion gain or loss in the transportation system. If the system does not have unity gain, the picture will appear too light or too dark. Because of the effects of ambient light, apparent color saturation is also affected. The test is conducted by inserting a white 100 IRE signal in the vertical interval. The received amplitude of signal is measured and compared with the original test signal. The NTSC-7 performance objective is 97 to 103 IRE units.

LUMINANCE NON-LINEARITY distortions are caused when there is a non-linear relationship in the transportation system between the input and output luminance signals. Luminance non-linearity is often most noticeable in color pictures. The eye is more sensitive to variations in color saturation rather than brightness. When large luminance non-linearity distortion is present, loss of detail or color may occur in areas of the picture with shadows or highlights. The test is conducted by inserting a 5-step staircase signal in the vertical interval. The received amplitude of each step is measured and compared with the original test signal. The NTSC-7 performance objective is 10 percent.

HUM MEASUREMENT distortions are caused when there is an undesired low frequency disturbance (hum or repetitive transient) in the transportation system. Excessive hum is usually seen in the picture as line or bands rolling from the top to the bottom of the picture. The test is conducted by using a quiet line in the vertical interval. The received amplitude of the hum is measured. The Federal regulation on telecommunications, 47 CFR 76.605 (Section 11) establishes a maximum distortion of 3 percent.

BURST LEVEL problems occur as a result of frequency response deficiencies or misadjusted video processing equipment in the transportation system. The burst signal establishes the color phase and indicates that a color signal is present. If the level is very low, a television receiver

may lose color lock and display the picture in black and white. The test is conducted by measuring the color burst level in the vertical interval. The received amplitude of the burst is measured and displayed. The NTSC-7 performance objective is 36 to 44 IRE.