CATV PROOF OF PERFORMANCE TESTING

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INTRODUCTION

Testing a cable system to determine compliance with the FCC standards can provide results which are truly meaningful when related to the quality of service the subscriber receives. In some instances though certain test procedures may produce results which bear little relationship to the picture quality as seen on a home television set.

Because video measurements rather than RF transmission measurements have a more direct relationship to what is seen on a television screen that approach has been taken in this paper. The more conventional methods of testing CATV distribution systems often do not include the effects of headend equipment or microwave where it is used. Baseband video measurements also enable the tests to be done on an in service basis with the system in normal operation. Invaribly in service test methods will gain wider acceptance with engineers and subscribers than will sleepless nights and interrupted programs.

These techniques require equipment which is often not a regular part of a cable system's test equipment. They are not the least expensive nor the most expensive methods to perform the FCC tests, but they do provide data which can give a real indication of the quality of service the subscriber receives. In many cases, the tests described can be done faster and with more accuracy than conventional distribution system only tests.

THE TEST POINTS

At the present time the required FCC tests to determine compliance with the standards are, with the exception of radiation tests, very closely tied to the subscriber terminal. The subscriber terminal lies at the interface between cable system owned equipment and subscriber owned equipment. In most cases this means the point to conduct tests or which to relate any other measuring points to is the output of the 75 ohm unbalanced to 300 ohm balanced transformer.

The output of the transformer is where the interface takes place. Some engineering judgement must, of course, be used in selecting the actual test point. In the test methods that follow, the actual measurements are made at the 75 ohm unbalanced impedance side of the transformer. In a converter equipped system, this point is at the output of the converter. The assumption that the transformer does little to degrade the quality of service is usually a very valid one.

FCC rules require that the tests be conducted "at no less than three widely separated points in the system, at least one of which is representative of terminals most distant from the system input in terms of distance." If the tests are viewed as an opportunity to monitor your system's performance, rather than as a burden or hardship, it is then logical to place all three test points at system extremities, preferably on different trunk lines. Each test point should be near the end of a feeder line and after all active equipment. Two drops at each test point should be available near ground level. On a tap having more than two ports, the two test point drops should be hooked up to two ports fed from the same two-way splitter within the tap. In this way, you can simulate worst case customer to customer isolation. Each test point should have twenty-five (25) feet of drop cable between the tap and the actual test point near ground level. The two drops should be installed permanently by placing the ground level test points in a waterproof junction box with the cable running down the pole in conduit. They should be terminated when not in use. Excess cable should be coiled up and fastened on the line near the pole, put in the junction box, or in the case of underground plant, put in a pedestal. Use approved construction practices in all cases.

By establishing the test points permanently, measurements will have more repeatability and comparisons can be made from year to year, or on a more frequent routine maintenance basis.

When the tests are actually conducted another one hundred (100) feet of drop cable can be added to reach the test equipment so that a worst case customer drop should result. As much as possible, try to establish the three test points at locations where a vehicle carrying test equipment can drive up and have easy access to the test point. Power for the test equipment can come from a small gasoline generator. The generator is recommended over inverters or belt driven generators for vehicles. A gasoline generator usually has better regulation, it is easier to use, and the dollar/watt ratio is better! If the generator is kept about seventy-five (75) feet or more away from the test antenna, ignition interference should be no problem during radiation measurements.

THE LOG FORMS

Sample log forms which were, in part, inspired by Tektronix CATV Proof of Performance forms are included at the end of the paper. The log forms, test procedures, and a copy of the FCC Rules and Regulations regarding CATV tests and standards which were in affect at the time of testing should be put in an appropriately labeled binder and retained at the system local office for at least five years, as required by the FCC. A summary of the FCC standards and tests now in effect is included at the end of this paper.

Keep in mind that proof of compliance with FCC standards at the three selected test points in no way relieves the system from the responsibility to maintain such standards at every subscriber terminal. Installation and service records which record signal levels and picture quality should provide evidence to the FCC that every subscriber is being properly served.

Since the installer's or technician's field strength meter or other similar instrument is the key to maintaining system quality, their calibration should be checked regularly and as a part of the FCC performance tests.

LOG FORM INFORMATION

The System Information form, LVOC 21-73, should be completed and on file prior to conducting the tests. The blank spaces in the "Cable CH" column may be used to list FM stations carried on the cable by listing their frequencies. For systems with more than twelve (12) channels, two sheets may be used. The first sheet can list channels 2-13 and the second sheet can list the other channels by striking out 2-13 and putting in the desired channel letter or number in the space below the diagonal.

The second column, "Class", refers to the class of the cable channel as defined by the FCC in Volume III, Part 76, subpart A, 76.5. Class I channels are those cable channels carrying the signals of a television broadcast station. Class II channels are all channels which carry television signals, other than Class I, which can be received by the subscriber without auxiliary decoding equipment. This generally includes local origination, news, and weather channels. Class III channels carry data other than television signals or television signals which require auxiliary decoding equipment. A channel which carried computer data signals, an FM channel or a scrambled television signal would be a Class III channel. Class IV channels are channels which carry signals from a subscriber terminal to any other point in the cable system. For your own information, it is worthwhile to make these performance tests on Class II channels in addition to the required Class I channel testing.

The column labeled "Grade" refers to the Grade A or Grade B field intensity contours of a television broadcast station as defined by the FCC in Part 73, sub-part 73.683. The pickup site location with respect to the Grade A or B contours must be determined and listed. In some cases, the pickup site may be beyond the Grade B contour and should be listed as "none". This information is available from the "TV Digest" or the TV station in question.

The comments column can contain information on programming, i.e., network, independent, news or weather, for example.

Proof of Performance Data form, LVOC 22-73 should be filled out by the person actually making the tests.

System Test Equipment Data form, LVOC 23-73, is not specifically required by the FCC, but is for informational purposes and will serve as a handy record of test equipment calibration data. Because the field strength meter, FSM, is so important to the maintenance of a system, calibration of the system's FSM's as part of the tests should be standard procedure.

List any equipment on a feeder line

(distribution amp, bridger amp, line extender, etc.) under the classification of line extenders on the Test Point Information form LVOC 24-73

A set of System Tests forms, LVOC 26-73 and 27-73 are used at each test point. Cross modulation, intermodulation and co-channel tests are not required by the FCC, but a system operator may want to conduct these tests for his own information, so space has been provided to record the results.

The visual signal level on each channel in dBmV should be listed on the 24 Hour Level Variation Test form, LVOC 28-73. Temperature in degrees Farenheit should be recorded on the bottom row.

THE TESTS

In order to make the tests more manageable, they have been broken up into headend and system tests. At the output of the headend and just before the headend signals enter the distribution system, a directional coupler should be inserted which allows sampling of all outgoing signals. Immediately ahead of this coupler on the headend side of it, another directional coupler should be inserted so that test signals may be inserted into the system. Couplers with eight (8) or twelve (12) dB taps will do the job. Once these are installed, it is a good idea to sweep test them from the sweep input point to the headend output test point. All headend tests are then conducted from the first accessible point in the headend, such as a preamplifier input, to the headend output test point. System tests either test the headend and the distribution system or they are conducted from the system sweep input point to the system extremity test points.

Because accurate results from the carrier to noise and hum or low frequency disturbances tests depend upon knowing the relationship between the video modulating signal and the magnitude of the modulated carrier it is necessary to check the depth of modulation on all channels. On channels where the cable operator has no control over the depth or percentage of modulation, i.e., where channel to channel processors or stripline amplifiers are in use, the broadcast signal will usually be close enough to 87.5% modulation that your measurement error will be insignificant. It is possible to set the modulation on your own modulators by comparison with with a broadcast signal, use of a FSM and a scope, or with a spectrum analyzer. First, check to see that the modulator has the proper composite video input, which in most cases is one (1) volt peak to peak. Using a spectrum analyzer, tune to the channel desired. Then reduce the scan to zero and the bandwidth or resolution to maximum, usually about 3 MHz. Fine tune the analyzer, which is now operating in the time domain, for maximum signal. Then switch from a log to a linear display and adjust the vertical gain until the top of the signal is at the top graticule or reference line. This line now represents the maximum carrier amplitude. The bottom graticule is then zero carrier amplitude.

On a display having eight (8) major vertical divisions, each division represents 12.5% modulation. Set the modulation so that the peak to peak signal displayed on the analyzer occupies seven of the eight major divisions. If a Vertical Interval Test Signal, VITS, is present, it will provide a convenient reference as the maximum peak to peak video signal.

FREQUENCY MEASUREMENTS

If the signal is being carried on channel and you have checked to make sure that the same oscillator is being used for both down and up conversion, then no frequency measurement is needed to determine compliance since the frequency is controlled soley by the originating broadcast station. Similarly, measurement of the 4.5 MHz. intercarrier sound is not necessary unless it is demodulated to baseband audio by the CATV system.

Aside from using a signal processor capable of stripping the modulation from a TV signal and providing a direct counter output, the best way to measure frequency on the system is to set a signal generator to the same frequency as the signal to be measured and then count the signal generator. Most any signal generator or sweep generator in the CW mode is stable enough for the short time needed to make the measurement. The system and the signal generator may be mixed through a splitter and the combination then fed into a set top converter. A spectrum analyzer connected to the output of the converter is then tuned to the output channel of the converter in order to detect the beat between the signal to be measured and the signal generator.

It is important to adjust the signal generator level using an external variable pad to the same amplitude as the carrier to be measured for a good zero beat. Record the counter reading of the generator frequency when a zero beat is obtained on the analyzer. By using a converter ahead of the analyzer, only the signal generator and the converter will have to be adjusted as you move from channel to channel. The analyzer may be left tuned to the converter output. A television set or a FSM could be used to detect the zero beat, but it is more difficult to obtain the correct results using them.

If it is desired or necessary to count the 4.5 MHz. intercarrier frequency, the counter may be connected to the 4.5 MHz. output of a demodulator. By setting the counter for a ten (10) second counting interval, it will average the FM deviation over this interval and provide an accurate count of the 4.5 MHz. aural intercarrier.

In systems using converters, it would be wise to determine that all visual carriers at the input of the converter can meet the ± 25 KHz. standard before making measurements at the output to determine if the ± 250 KHz. standard can be met even though the FCC may only require the latter.

AMPLITUDE MEASUREMENTS

Measurement of the visual and aural carriers is a straight forward process we are all familiar with. A FSM or a spectrum analyzer may be used providing their calibration has been checked. On a spectrum analyzer what is often called "vertical interval roll through" will occur. The picture carrier will increase in level when the vertical interval is displayed at the top of the picture carrier. This occurs because the television station vertical sync rate and the analyzer line sync rate are not equal or phase locked together. It is this maximum amplitude which should be measured and recorded when using the analyzer.

While the analyzer is being used for other tests, a man with a FSM can make the rounds of the test points for the twenty four (24) hour level variation checks. A check of all channels at each test point every three hours should be adequate. Pilot carrier levels and the temperature should also be recorded for your own use in analyzing the data. If you are involved in testing several systems, or wish to do these long term variation checks on a regular basis, an automatic all channel level recorder should be considered. These could be placed at each test point to record the levels over a 24 hour or longer period. One could probably be put together with a detector and chart recorder on the output of a converter which was cycled through all channels every hour and then the entire unit shut off until the next hourly reading was desired. Mounted in a weatherproof box which could be chained to a pole or pedestal, a battery operated unit could be put anywhere in the system as a recording level monitor. Such a unit might not be equipped to give absolute levels, but the FCC requirement over a 24 hour period only involves relative level changes.

Before using such a device to prove compliance with the standards, make sure it is relatively insensitive to humidity, temperature and mechanical changes.

HUM AND LOW FREQUENCY DISTURBANCES

A waveform monitor connected to the video output of a demodulator can be used for single channel tests of hum and low frequency disturbances. Measuring the hum on a pilot carrier may prove the distribution system, but it does not measure the effects of headend equipment. Inadequate low frequency response may be seen as tilting or slope in the synce tips or on the vertical blanking interval. With the video level adjusted for a peak to peak display of 140 IRE units on the waveform monitor and assuming 87.5% modulation, eight (8) IRE units of hum or low frequency disturbances correspond to five (5) percent peak to peak variation in visual signal level. This may be expressed as:

$$\text{\% P-P signal variation} = \frac{\text{P-P video variation IRE}}{\text{140 IRE}} \times 87.5$$

A poor signal from a broadcast station may cause an out of limits condition using this measurement technique, but if that is suspected, it can easily be checked by making the measurement directly off the air and by using more conventional methods to measure the distribution system only hum.

The five (5) percent peak to peak variation is actually 2.5% AM or hum modulation (-32 dB) as most commonly used in the CATV industry.

FREQUENCY RESPONSE

This is one test which must be performed on at out of service basis. Done during the early morning hours, it will cause little interruption to the customer's service.

The results of the headend and system frequency response tests may be added together for a worst case result. The headend poses no small problem with its combination of demodulators, microwave, modulators and processors. If preamplifiers are in use, they too should be tested.

Because headend processing equipment often has frequency response characteristics, similar to a television transmitter, testing from -1 MHz. to +4 MHz. with reference to the visual carrier will not allow the ± 2 dB specification to be met in many instances. In the headend, tests from -.5 MHz. to +4.2 MHz. are more realistic or if you test from -1 to +4, a note indicating that most of the response variation lies below the visual carrier frequency, if that is the case, should be included in the test data.

Preamps or other tower mounted devices can be tested by disconnecting the antenna lead and hooking up a test cable which runs down into the building. Even a long, lossy cable will have very little slope in its response over a 5 MHz. bandwidth. By putting a slow sweep on the input line and a spectrum analyzer with variable persistence on the line which would normally connect to the headend processor, a picture of the frequency response can be "painted" on the analyzer. The analyzer should be set for 1 MHz./division scan width and 30 KHz. resolution. Vertical sensitivity should be set to 1 or 2 dB per division or linear for all frequency response checks. If used in the linear mode, it will be necessary to determine how much vertical deflection on the analyzer a 1dB input change causes. The sweep should be inserted through a 10 dB pad at the normal input level for the preamp. The 10 dB pad will improve the flatness of the sweep.

A demodulator should be put in the manual gain position and set for the same operating level as when it is in AGC. Insert a sweep signal with 1 MHz. markers and use a video detector and a scope to display the frequency response at the output.

When FM microwave is in use, a video multiburst test signal should be used. Clamper amplifiers and other devices which depend upon sync references make sweep testing difficult. Vertical interval test signals will give you a clue as to your system's performance, but these signals have traveled through a lot of processing equipment which can affect frequency response before they reach the CATV system antenna. If you operate your own CARS microwave,testing will be no problem, but if you are served by a common carrier, it may be wise to ask them for annual certification of frequency response in their headend equipment and microwave. Just because you do not have direct control over this will not relieve you of your responsibility to deliver high quality service to your customers.

Modulators may be tested by connecting a slow or manual video sweep to the video input with the spectrum analyzer at the headend output test point. Again, a picture of the frequency response will be displayed on the analyzer.

Processors can be tested by putting them in the manual mode and then adjusting the gain for the same operating level as when in AGC. Slowly sweep the input with the spectrum analyzer connected to the headend output test point. The sweep input level should be the same as the normal signal input. Disable or turn down the sound IF path during this measurement or the frequency response may appear to be excessive as the sweep approaches 4.5 MHz. above the visual carrier frequency. The limiter stages in the sound path will run wide open without an input.

The distribution system frequency response may be tested by inserting a slow or manual sweep at the system sweep input point and using the spectrum analyzer at the system test points to display the frequency response. The sweep level should be set about 4 dB below the visual carriers. This will allow these carriers to be used as frequency markers on the analyzer. It may be necessary to install notch traps at the pilot carrier frequencies on the output of the sweep to avoid AGC amplifier gain or slope changes. If more than one trap is used, a 6 dB pad should be used between traps.

No more than five or six channels should be displayed on the spectrum analyzer screen at one time. In a converter equipped system, only the output channel need be displayed, as the system channel frequency response tests are done one at a time. If a converter is hooked up to the headend output test point and every channel's frequency response is tested through it, then system frequency response checks could be conducted at a point which would normally be the converter input. This can save considerable time and still be representative of overall system performance when the headend and system frequency response measurements are summed.

CARRIER TO NOISE AND COCHANNEL

Use of a video noise test set, such as the Tektronix 1430, on the output of a demodulator is a fast and simple way to make in-service checks of the overall noise performance of the headend and the distribution system. Conventional methods require terminating the system input and then measuring the noise level. Substitution of a termination for the antenna at the input of the first active device is not always easy with tower mounted preamps and must be done at night to avoid interruption of service. Video signal to noise measurements are particularly relevant to systems using microwave where the signal is present as baseband video. Local origination studios and video sources for other cablecasting channels can also be tested by a video noise test set.

On Class I channels, this technique also measures the noise contributed by the broadcaster, but the noise power of the broadcast signal with typical S/N readings of 50-55 dB is negligible when added to the noise power of the cable system where S/N readings of 37-42 dB are typical at the system extremities. If the broadcast signal to noise measured with the demod and noise set is 10 dB or greater than the CATV system signal to noise, the contribution by the broadcaster to the overall measurement made at the system extremities is less than .5 dB. The demodulator with an input of 0 to 10 dBmV will also have a negligible effect on the S/N reading. The FCC requirement and the measurement most often made in the CATV industry is carrier to noise. Assuming 87.5% modulation of the visual carrier and a noise free video modulating signal S/N may be converted to a 4 MHz. bandwidth C/N reading by adding 4 dB to the S/N reading. This 4 dB correction factor should not be confused with the 4 dB factor used for correction of noise measurements made with a FSM. The S/N to C/N conversion factor comes from the amplitude relationships of modulating signal to carrier level and video level to composite video level. The formula relating them is:

$$C/N = S/N + 20 \log ((100\,\text{IRE}/140\,\text{IRE}) \times .875)$$

Where 100/140 represents the ratio of video to composite video (video and sync) and .875 represents the depth of modulation (87.5%). The actual factor which results from the above formula is about 4.08 dB but 4 dB is accurate enough for most purposes. The normal C/N ratio is not weighted, so do not confuse weighted S/N numbers with the unweighted number used above.

Offset cochannel can be measured using a spectrum analyzer set for 5 KHz./division scan width and 3 KHz. or 300 Hz. resolution. The horizontal sync sidebands will appear at 15,750 KHz. above and below the picture carrier and if offset cochannel is present, it will appear at 10 or 20 KHz. above or below the picture carrier. Several interfering cochannel signals may be present simultaneously, but suspect your measurement if any two of them are more than 20 KHz. apart since broadcast stations are normally only assigned ± 10 KHz. offsets.

INTERMODULATION

The spectrum analyzer is one of the best methods available to detect low level beats in a cable system. Set up the analyzer for 200 or 500 KHz./division scan width and 300 or 500 KHz. resolution using variable persistence. Slowly scan the channel of interest, stopping several times to look for beats. Do not confuse the color subcarrier or regularly spaced sync sidebands with real interfering beats. Probably the most distinguishing feature of a beat is that it normally does not change in frequency or amplitude. If the CRT brightness and persistence are kept low enough, a beat "down in the noise" can be measured since it will appear as a hole or bump in the noise. Even a high quality analyzer may not detect beats which are close to the picture carrier and masked by the modulation. If, after viewing a television set, you believe such a beat is present use your RF spectrum analyzer in the time domain as a fix tuned receiver. The vertical output of the RF analyzer may then be used to feed a wave analyzer or a low frequency spectrum analyzer either of which can detect a low frequency intermodulation product. If a low frequency analyzer is not available, try removing the channel from the system and then examine, with the RF spectrum analyzer, the area around the visual carrier frequency for intermodulation products. Removing the visual carrier may also remove some of the beats, but if interference can be seen on a television it is likely that non linearity in the system will have created several intermodulation products. Take care not to drive your analyzer so hard that intermod products are created internally. If adding a three (3) dB pad to the input causes the suspected beat to drop more than three (3) dB then the beat is being created, at least in part, internally in the analyzer. Reduce the input level until this effect is no longer present.

TERMINAL ISOLATION

Display the frequency range to be tested on the analyzer. Single measurements from 54-300 MHz. will produce accurate results. Adjust the sweep generator for an output level of about twenty (20)dB above the visual carrier levels measured at the subscriber terminal under test. Connect the analyzer directly to the slowly sweeping generator and adjust the analyzer for a reference level near the top of the screen, making sure the sweep output is flat. Connect the generator to one test point and the analyzer to the other test point using the shortest drop cables possible in order to simulate a worst case condition. Now measure the sweep level on the analyzer and the difference between the measured and reference values at each channel is the terminal isolation. The visual carriers seen on the analyzer serve as convenient markers.

RADIATION MEASUREMENTS

Making radiation checks is one measurement which has no tie with the subscriber terminal. In fact, worst case radiation is more likely to occur at high level points in the system, such as amplifier locations, rather than at subscriber drops.

Three measurements of radiation would appear to satisfy the FCC annual test requirements, but to insure that the system is really in compliance, on a continual basis, will require more extensive testing.

In making the annual measurements a homemade dipole or a commercial calibrated dipole antenna should be used in conjuction with a preamp and a spectrum analyzer. The antenna should be positioned the required distance from the system components and at least ten feet above the ground and away from any metal objects. A slightly modified studio tripod used with a fiberglass extension pole or "layup stick" can be used as a support for the antenna.

If the analyzer does not have its own preamplifier, a line extender can be used. line extender or other CATV amplifier is convenient since its gain and slope controls may be adjusted to compensate for the loss in cables interconnecting the antenna, preamplifier, and spectrum analyzer.

Since radiation is generally a broadband phenomena in a cable system, testing at one or two frequencies will suffice. Select a channel which is not present as an off the air signal in the area. Connect the analyzer to the system, tune in the cable channel to be measured, reduce the scan width to 5 KHz./division and the resolution to 3 KHz. in order to minimize the internal noise displayed on the analyzer. Then, being careful not to change the center frequency, connect the analyzer to the test dipole and increase the sensitivity to maximum. Rotate the horizontal antenna about its vertical axis for maximum signal.

Measure the absolute amplitude in dBmV and use the antenna correction factor to convert to uV/M. Use of a bandpass filter ahead of the preamp is almost a necessity in urban areas where the multitude of off air signals will overload the preamplifier and the analyzer.

Because of the many possible sources of radiation in a cable system and the complex interaction of their near and far fields, it is not recommended that measurements be made at points other than the ten and hundred foot distances from the cable the FCC radiation limits are specified at. Attempts to simply relate field strength to the inverse of the distance will not always give "real life" results.

The NCTA has recently issued a bulletin on radiation measurements describing a technique devised by Ken Simons of Jerrold Electronics, using a sensitive television receiver and a dipole antenna calibrated and mounted on a vehicle to make system radiation checks at many locations by driving around the system and observing the TV set for any signal leakage from the cable. Not only will this method also meet the annual performance test requirements, but it can be used in a routine maintenance program.

CONCLUSIONS

The methods described in this paper are the results of considerable field experience and although they will yield accurate and repeatable data, so will other methods, some more complex and some less. Which methods to use is a matter which the individual system operator must determine based upon test equipment available to him and his own particular technical experience.

Some of the test techniques used in this paper are described in more detail or from a different viewpoint in the Tektronix "No Loose Ends" proof of performance program by Cliff Schrock.

ACKNOWLEDGEMENTS

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APPENDIX A

SUMMARY OF TECHNICAL STANDARDS

(FCC Volume III, 76.605)

Required completion dates for the first performance tests for various standards are listed below. These incremented test dates apply only to systems in operation before March 31, 1974. Systems which began operation on or after that date are required to complete their first performance tests for all standards by March 31, 1974. Testing to determine compliance with the offset co-channel standard, Section 76.605 (a) (9), and the intermodulation standard, Section 76.605 (a) (10), has been suspended and is not required for either "old" or "new" systems at this time.

Pre March 31, 1972 systems are not required to comply with most FCC standards until March 31, 1977. They are, however, required to meet the radiation standards, Section 76.605 (a) (12), since compliance has been required of all systems since March 31, 1972. Compliance with the standards for systems commencing operation after March 31, 1972 was effective March 31, 1972. Although testing for offset co-channel and intermodulation is not required, compliance with these standards is required of post March 31, 1972 systems. It may also be assumed pending further action by the FCC, that pre March 31, 1972 systems will be required to comply with these standards by March 31, 1977.

TEST	STANDARD	FIRST REQUIRED DATE OF TESTING *
1. Frequency of the visual carrier:	1.25 MHz. ± 25 KHz. above channel boundary	3-31-76
a. At output of converter:	1.25 MHz. ± 250 KHz.	3-31-76
2. Frequency of aural subcarrier:	4.5 MHz. ± 1 KHz.	3-31-76
3. Minimum visual signal level:	1 mV across 75 ohm (0 dBmV)	3-31-74

TEST	STANDARD	FIRST REQUIRED DATE OF TESTING *
4. Permissible signal level variation:	12 dB total/24 hr.period	3-31-74
a. Maximum adjacent channel variation	3 dB	3-31-74
b. Maximum signal level	12 dB	3-31-74
5. Maximum signal level:	Below threshold of degradation (overload point)	3-31-74
6. Maximum hum and low frequency disturbance level:	5%	3-31-75
7. Within channel frequency response:	± 2dB from -1 MHz. to +4 MHz.	3-31-75
8. Aural signal level:	13 to 17 dB below visual	3-31-74
9. Carrier to noise level for all signals picked up or delivered within its Grade B contour:	36 dB S/N ratio 36 dB co-channel	3-31-74 None
10. Signal to intermodulation and non-offset carrier interference:	46 dB	None
11. Subscriber terminal isolation:	18 dB	3-31-75
12. Radiation: Up to 54 MHz:	less than 15 uV/m @ 100'	3-31-74
54 to 216 MHz.:	less than 20 uV/m @ 10'	3-31-74
Above 216 MHz.:	less than 15 uV/m @ 100'	3-31-74

* Incremental testing applies only to systems in operation prior to March 31, 1974

CATV

Proof-of-Performance

LVO CABLE, INC.
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TULSA, OKLAHOMA
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SYSTEM INFORMATION

August 1973 MM
LVOC 19-73

LOCATION__________ DATE__________ SYSTEM__________

MINIMUM VISUAL SIGNAL LEVEL (CLASS I CHANNELS)______ dBmV

CABLE CH	CLASS	LOCAL, OFF-AIR, OR MW	CALL LETTERS	STATION LOCATION	CH	GRADE	COMMENTS
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							

PROOF-OF-PERFORMANCE DATA

LOCATION__________ DATE__________ SYSTEM__________

SENIOR ENGINEER'S STATEMENT

ENGINEER__________ TITLE__________ COMPANY__________

ADDRESS__________ SOCIAL SECURITY NO.__________

FCC LICENSE CLASS__________ LICENSE NO.__________ EXP. DATE__________

EXPERIENCE__________

EDUCATION__________

TEST EQUIPMENT

MODEL	MANUFACTURER	TYPE	SERIAL #	CALIBRATION-DATE	BY

SYSTEM TEST EQUIPMENT DATA

Page___of___ LVOC 22-73

LOCATION__________ DATE__________ SYSTEM__________

TEST EQUIPMENT

MODEL	MANUFACTURER	TYPE	SERIAL #	CALIBRATION-DATE	BY

Page___of___ LVOC 23-73

TEST POINT INFORMATION

LOCATION__________________________ DATE __________________ SYSTEM ______________________________

TP*_____ LOCATION DESCRIPTION____

____ POLE / PEDESTAL NO.__________

TRUNKLINE AMPS CASCADED TO THIS POINT_______TYPE OF TRUNKLINE AMPS__________________________

LINE EXTENDERS CASCADED TO THIS POINT_____TYPE OF LINE EXTENDERS___________________________

TYPE OF TAP______________________________TAP SIZE __________ LENGTH OF DROP CABLE_________

TYPE OF DROP CABLE_____________________________

TP*_____ LOCATION DESCRIPTION____

____ POLE / PEDESTAL NO.__________

TRUNKLINE AMPS CASCADED TO THIS POINT _____TYPE OF TRUNKLINE AMPS__________________________

LINE EXTENDERS CASCADED TO THIS POINT_____TYPE OF LINE EXTENDERS___________________________

TYPE OF TAP______________________________TAP SIZE __________ LENGTH OF DROP CABLE_________

TYPE OF DROP CABLE_____________________________

TP*_____ LOCATION DESCRIPTION____

____ POLE / PEDESTAL NO.__________

TRUNKLINE AMPS CASCADED TO THIS POINT_____TYPE OF TRUNKLINE AMPS___________________________

LINE EXTENDERS CASCADED TO THIS POINT_____TYPE OF LINE EXTENDERS___________________________

TYPE OF TAP______________________________TAP SIZE___________LENGTH OF DROP CABLE_________

TYPE OF DROP CABLE_____________________________

Page___of___ LVOC 24-73

HEADEND TESTS

LOCATION___________________ DATE_______________ ENGINEER________________________ SYSTEM__________________

* AURAL-VISUAL CARRIER SEPARATION UNAFFECTED BY CATV SYSTEM.

CH	STANDARD FREQUENCIES		OFFSET kHz	VISUAL MHz	AURAL MHz	AURAL-VISUAL MHz	RESPONSE ± dB	REMARKS
	VISUAL — MHz	AURAL — MHz						
2	55.25	59.75						
3	61.25	65.75						
4	67.25	71.75						
5	77.25	81.75						
6	83.25	87.75						
7	175.25	179.25						
8	181.25	185.75						
9	187.25	191.75						
10	193.25	197.75						
11	199.25	203.75						
12	205.25	209.75						
13	211.25	215.75						

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SYSTEM TESTS

TEST POINT #____________ DATE____________ ENGINEER__________________ SYSTEM______________

CH	VISUAL dBmV	AURAL dBmV	P-S dB	INTERMOD dB	CROSSMOD dB	CO-CHANNEL dB	CARRIER/NOISE dB	RESPONSE ± dB	HUM %
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									

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SYSTEM TESTS

TEST POINT #____________ DATE____________ ENGINEER__________________ SYSTEM______________

CH	RADIATION		TERMINAL ISOLATION dB	REMARKS
	µV/M	DISTANCE-FT.		
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				

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24 HOUR LEVEL VARIATION TESTS

TEST POINT # ____________ DATE ____________ ENGINEER ____________ SYSTEM ____________

CH	TIME												MAXIMUM VARIATION dB
2													
3													
4													
5													
6													
7													
8													
9													
10													
11													
12													
13													

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