CATV Balun II (500302)

Application Guide

Version 1.05

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Introduction

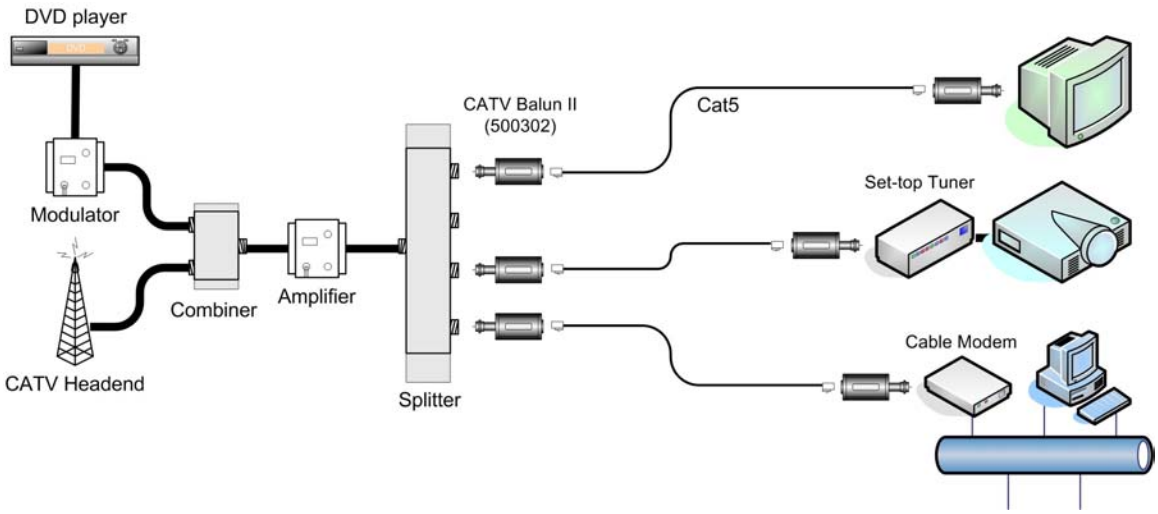
Broadband CATV has experienced a steady growth in recent years due to the introduction of digital cable and broadband Internet services. Coupled with this growth has been the need to streamline the cabling infrastructure to support the proliferation of newly installed equipment. MuxLab's CATV Balun II (500302), with its improved bandwidth performance is helping to widen the range of broadband services that are supported by copper twisted pair and RF video technology.

Purpose

This document is a sequel to the CATV Balun II Application Guide and its purpose is to explain the enhanced performance and capabilities of the CATV Balun II. The document is meant to supplement the CATV Balun II Installation Guide and not to replace it.

Extended Channel Frequency Range

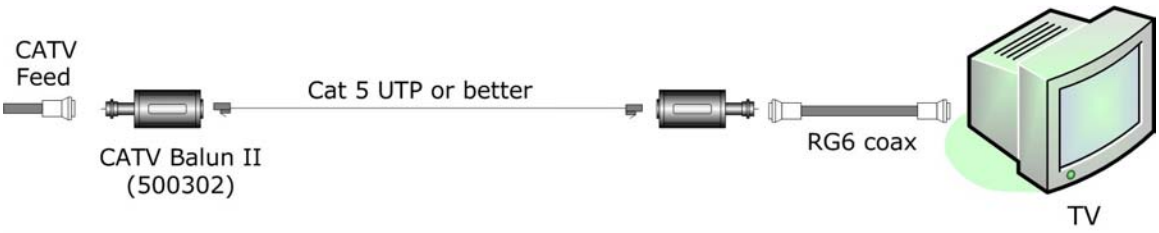
The CATV Balun II (500302) is the upgrade replacement to the CATV Balun (500006).with the key improvement being that it has a bandwidth of 900 MHz versus 550 MHz for the 500006. This enhancement further enables the product to support higher frequency services such as broadband Internet and digital cable via Cat5 as shown in the following diagram.



Notes:
1. Cable modem upstream and downstream bandwidth must be within bandwidth of the CATV Balun II.
2. All RF equipment in the link must be able to support bi-directional transmission.

Maximum Distance via Cat 5 Twisted Pair

Proper cable planning requires that one know how far the TV set can be located from the CATV feed in order to achieve acceptable audio/video picture quality.



The maximum distance achievable between the CATV feed and the TV set via UTP is based on several factors:

a) Input Signal Level (dBmV at the Given Channel Frequency)
b) CATV Balun II Loss (dBmV per balun pair at the Given Channel Frequency)
c) Cable Loss Per Meter (dBmV/m at the Given Channel Frequency) for UTP. The grade of cable used is important. The minimum grade recommended is Cat 5
d) Required Signal Level at the TV Set (dBmV at the Given Channel Frequency).

The basic formula to estimate the maximum achievable distance for a given signal level at a given channel frequency is:

[Maximum Distance**] = [[**Input Signal Level**] – [**CATV Balun II Loss**] – [**Required Signal Level at TV set**]] ÷ [**Cable Loss Per Meter**]**.

Examples:

Maximum Distance at Higher Frequency Channels (i.e.; Channel 61)

Input Signal level =	30 dBmV
CATV Balun II Loss Per Pair at Channel 61 =	3.0 dBmV
Required signal at TV =	10 dBmV
Cable Loss at Channel 61 (445.25 MHz) =	.45 dB/meter
Max. UTP Cable Length =	38 meters

Maximum Distance at Lower Frequency Channels (i.e.; Channel 2)

Input Signal level =	30 dBmV
CATV Balun II Loss Per Pair at Channel 2 =	3.0 dBmV
Required Video Signal at TV =	10 dBmV
Cable Loss at Channel 2 (55.25 MHz) =	.15 dB/meter
Max. UTP Cable Length =	113 meters

Maximum Distance Tables

The following distance tables are designed to help estimate the maximum drive distances that are possible based on the above formulae. Each table is based on a set of a assumptions about the RF transmission interfaces. In regard to the losses of Cat5e cable above 600 MHz, estimates for signal attenuation have been made until published data is added.

Table 1: This table is based on RF tuner equipment with moderate signal sensitivity. The minimum signal level would be 0 dBmV.

RF Input Level:	20 dBmV
Minimum required RF level at RF tuner:	0 dBmV
CATV Balun II Insertion Loss:	3 dB/pair
Cable Type:	Cat 5e twisted pair

Typical. Cat 5e Cable Attenuation dB/m	RF Band	EIA Channel	Frequency MHz	Max. Distance Feet / Meters	
.15	VHF-Low	2-6	54-88	370ft	113m
.20	FM	95-97	90-108	278ft	85m
.25	VHF-Mid	98-99 14-22	108-174	223ft	68m
.30	VHF-High	7-13	174-216	187ft	57m
.35	VHF-Super	23-36	216-300	187ft	57m
.43	VHF-Hyper	37-61	300-450	131ft	40m
.49		62-77	450-550	115ft	35m
.52		77-87	550-600	108ft	33m
.60 est.		87-125	600-800	90ft	28m
.80 est.		125-150	800-950	70ft	21m

Table 2: This table shows the effect of increasing the RF input signal level to 25 dBmV and is also based on RF tuner equipment with moderate signal sensitivity at 0 dBmV.

RF Input Level:	25 dBmV
Minimum required RF level at RF tuner:	0 dBmV
CATV Balun II Insertion Loss:	3 dB/pair
Cable Type:	Cat 5e twisted pair

Typical. Cat 5e Cable Attenuation dB/m	RF Band	EIA Channel	Frequency MHz	Max. Distance Feet / Meters	
.15	VHF-Low	2-6	54-88	479ft	146m
.20	FM	95-97	90-108	360ft	110m
.25	VHF-Mid	98-99 14-22	108-174	288ft	88m
.30	VHF-High	7-13	174-216	240ft	73m
.35	VHF-Super	23-36	216-300	207ft	63m
.43	VHF-Hyper	37-61	300-450	167ft	51m
.49		62-77	450-550	148ft	45m
.52		77-87	550-600	138ft	42m
.60 est.		87-125	600-800	121ft	37m
.80 est.		125-150	800-950	90ft	28m

Table 3: This table is based on RF tuner equipment with superior signal sensitivity. The minimum signal level required to provide good image quality would be -15 dBmV.

RF Input Level:	20 dBmV
Minimum required RF level at RF tuner:	-15 dBmV
CATV Balun II Insertion Loss:	3 dB/pair
Cable Type:	Cat 5e twisted pair

Typical. Cat 5e Cable Attenuation dB/m	RF Band	EIA Channel	Frequency MHz	Max. Distance Feet / Meters	
.15	VHF-Low	2-6	54-88	699ft	213m
.20	FM	95-97	90-108	525ft	160m
.25	VHF-Mid	98-99 14-22	108-174	419ft	128m
.30	VHF-High	7-13	174-216	351ft	107m
.35	VHF-Super	23-36	216-300	299ft	91m
.43	VHF-Hyper	37-61	300-450	242ft	74m
.49		62-77	450-550	214ft	65m
.52		77-87	550-600	200ft	61m
.60 est.		87-125	600-800	174ft	53m
.80 est.		125-150	800-950	131ft	40m

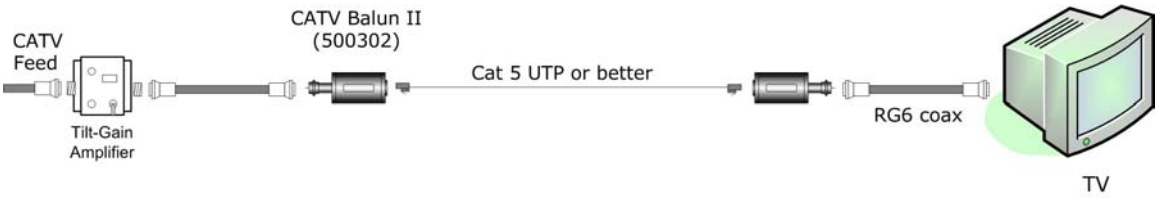
Table 4: This table is based on RF tuner equipment with superior signal sensitivity and RF input level of 25 dBmV. The minimum signal level required to provide good image quality in this assumption is -15 dBmV.

RF Input Level:	25 dBmV
Minimum required RF level at RF tuner:	-15 dBmV
CATV Balun II Insertion Loss:	3 dB/pair
Cable Type:	Cat 5e twisted pair

Typical. Cat 5e Cable Attenuation dB/m	RF Band	EIA Channel	Frequency MHz	Max. Distance Feet / Meters	
.15	VHF-Low	2-6	54-88	807ft	246m
.20	FM	95-97	90-108	607ft	185m
.25	VHF-Mid	98-99 14-22	108-174	485ft	148m
.30	VHF-High	7-13	174-216	403ft	123m
.35	VHF-Super	23-36	216-300	344ft	105m
.43	VHF-Hyper	37-61	300-450	282ft	86m
.49		62-77	450-550	246ft	75m
.52		77-87	550-600	233ft	71m
.60 est.		87-125	600-800	200ft	61m
.80 est.		125-150	800-950	152ft	46m

Extending Distance via Cat 5 Twisted Pair

Amplification may be needed to compensate for losses due to the UTP cable and other components. More amplification is needed at the higher frequency channels than at the lower ones.



In order to determine how much amplification is needed at the higher and lower frequencies respectively, it is necessary to calculate the total signal loss between the CATV feed and the TV set. The values needed in order to make the calculation are as follows:

a) Input Signal Level (dBmV at the Given Channel Frequency)
b) CATV Balun II Loss (dBmV per balun pair at the Given Channel Frequency)
c) Cable Loss per Meter (dBmV/m at the Given Channel Frequency)
d) Required Length of UTP (meters)
e) Required Signal Level at the TV Set (dBmV at the Given Channel Frequency).

The basic formula to estimate how much amplification is needed at a given channel frequency for a required length of cable is as follows:

[Amplification Needed at Given Channel Frequency**] = [**Required Signal Level at TV Set**] + [**CATV Balun II Loss**] + {[**Cable Loss Per Meter**] x [**Required Length of UTP**]} – [**Input Signal Level**]**.

Amplification at Higher Frequency Channels (i.e.; Channel 61)

For example to determine how much amplification is needed at Channel 61 (445 MHz):

Input Signal Level	= 10 dBmV
Required Signal Level at TV Set	= 10 dBmV
Channel Frequency at the TV set	= 445 MHz (Channel 61)
Required Length of UTP	= 50 meters
CATV Balun II Loss per Pair	= 3 dBmV
Cable Loss per Meter	= .45 dBmV/meter
Amplification at 445MHz = 10 + 3 + (.45 * 50) – 10	= 25.5 dBmV

Amplification at Lower Frequency Channels (i.e.; Channel 2)

For example to determine how much amplification is needed at Channel 2 (55.25MHz):

Input Signal Level	= 10 dBmV
Required Signal Level at TV Set	= 10 dBmV
Channel Frequency at the TV set	= 55.25 MHz (Channel 2)
Required Length of UTP	= 50 meters
CATV Balun II Loss per Pair	= 3 dBmV
Cable Loss Per meter	= .15 dBmV/meter
Amplification at 55.25 MHz = 10 + 3 + (.15 x 50) – 10	= 10.5 dBmV

Once the required amplification at the high and low frequencies are determined, the amount of amplifier "tilt" can be determined. Based on the two calculations above, the amount of "tilt" needed is:

Tilt = Amplification at High Frequency – Amplification at Low Frequency
= 28.5 dBmV – 10.5 dBmV
= 18 dBmV

Therefore the amplifier in this case should provide 25.5 dBmV amplification at 445MHz with a tilt of 18 dBmV over the frequency range. Some amplifiers have fixed tilt-gain. Others have adjustable tilt-gain. In the example above, one could use an amplifier operating in the 40MHz -1GHz range that provides a gain of up to 35 dBmV with a tilt control of up to 20 dBmV.

RF Splitters

Additional signal losses are introduced when RF splitters are used to distribute CATV to different parts of a building. These losses must be accounted for when planning a CATV cabling system. The following table provides typical signal loss values for RF splitters.

RF splitter	Loss (dBmV)
1-to-2 CATV Coax Splitter	3.5 dBmV
1-to-3 CATV Coax Splitter	5.5 dBmV
1-to-4 CATV Coax Splitter	7 dBmV
1-to-8 CATV Coax Splitter	11dBmV

Cable Modems

Cable modems allow Internet, telephony and CATV services to be offered via the existing CATV cabling infrastructure. The ability to support cable modem service via UTP depends on the performance of the CATV balun that converts the CATV coax cable to UTP. MuxLab's CATV Balun II has an operating frequency of 5MHz to 950 MHz. Cable modem applications are supported via UTP providing the following conditions are met:

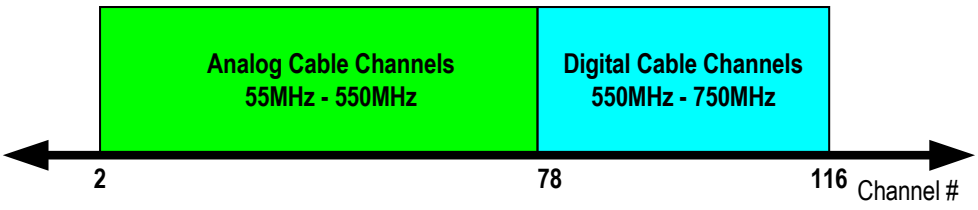
1. The downstream data channel lies within the operating frequency range of the CATV balun.

2. The upstream data channel lies within the operating frequency range of the CATV balun.

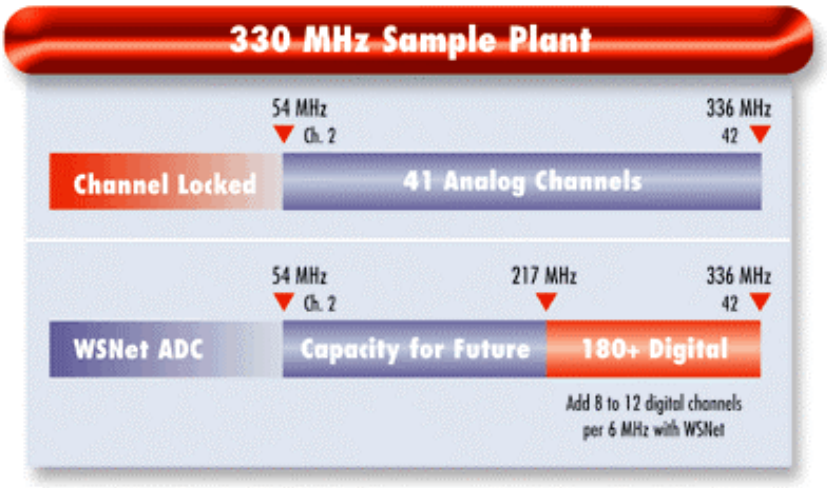
3. All data channels are able to tolerate the added signal loss introduced by the baluns and UTP.

Digital Cable

One of the questions that come up is whether the CATV Balun II supports digital cable. Digital cable is part analog and part digital. The analog channels are typically broadcast in the 55MHz to 550 MHz range. The digital channels typically use the frequency range that would normally carry analog channels (550 MHz to 750 MHz) to broadcast compressed digital signals that contain hundreds of TV channels.



When these digital signals are decoded at the digital set-top box, they are assigned arbitrary channel numbers on the box. Some cable companies, such as WSNET (http://www.wsnet.tv/) transmit their digital cable channels in the 300 to 550 MHz range as shown in the following diagram from WSNET.



In regard to using the CATV Balun II with digital cable, if the cable company is transmitting the digital cable channels in a frequency range below 900 MHz, then the CATV Balun II will support transmission of the signals via Cat5 unshielded twisted pair. If the digital cable signals are located above 900 MHz, then the signal strength will be more attenuated due to the 3dB roll-off of the balun. In this case, increasing the signal input power may help to push some of the higher channels through over Cat5 cable.

FCC Compliance

MuxLab's CATV Balun II meets with FCC Class A requirements provided certain maximum input levels are respected as shown in the following table. MuxLab can provide a table of maximum signal levels that allow the CATV Balun II to conform to FCC maximum emissions when used in a point-to-point configuration. For more information, please contact MuxLab Technical Support at 877-689-5228.

Category 5e Channel Spec versus Category 7 Cable

Signal attenuation plays a critical role in determining the maximum distance that is achievable via twisted pair for RF transmission. For example if Category 7 rated cable is used instead of Category 5e rated cable, there is an expected improvement based on the superior bandwidth performance at the higher channel frequencies. In order to determine the expected performance improvement by using Cat 7 versus Cat 5e cable, the following comparison table is provided. The table is based on assumptions related to; input signal power, receiver sensitivity and balun insertion loss and has been verified by MuxLab's R&D lab. Cat 5e data is based on the TIA Cat5e Channel Specification and not on actual Cat5e cable.

Assumptions	**Value**
RF Input Level	25 dBmV
Receiver Sensitivity	-10 dBmV
Balun Insertion Loss:	3 to 4 dB/pair

		Cat 5e Channel Spec*		Cat 7 Cable**		
Channel Frequency (MHz)	Balun Insertion Loss (dB/pair)	Insertion Loss (dB/m)	Max. Distance (m)	Insertion Loss (dB/m)	Max. Distance (m)	Δ%
31.25	3	.13	246m			
62.5	3	.19	168m			
100	3	.24	133m	.20	160m	+20%
155	3					
200	3	.35 est.	91m			
250	3	.40 est	80m	.33	97m	%21 %
300	3	.45 est.	71m			
350	3					
400	3	.53 est.	60m			
450	3					
500	3	.60 est.	53m	.49	65m	+23%
550	3					
600	4	.67***	48m	.55	56m	+17%
800	4	.80***	40m	.64***	48m	+20%
900	3	.86***	37m	.69***	46m	+24%

* The Cat 5e Channel Specification goes up to 100 MHz. Higher frequencies are estimated based on graphs published by www.ieee802.org and may be viewed at the following link: (http://www.ieee802.org/3/tutorial/nov02/tutorial_2_1102.pdf)

** Based on the Performance Warranty for an actual vendor's Category 7 rated cable.

*** Based on figures provided by an actual cable manufacturer.

Doubling Up Twisted Pairs

In regard to the CATV Balun II and based on testing by MuxLab's R&D dept, there is performance degradation if the twisted pairs are doubled up. In the lab, it was found that there was 55% more signal loss versus no doubling. The lower performance is mainly due to impedance mismatch since the doubled twisted pairs present a 50-ohm impedance to the balun instead of 100 ohms. The test was performed using a 200 ft length of Category 5e UTP cable and a second Cat5e cable with pins 7&8 "doubled up". The result was approximately 6.8 dB (55%) more signal loss than if there was no doubling-up. Consequently it is not recommended to double-up twisted pairs when using the CATV Balun II in the RF environment.

CATV Channels Supported

The following table summarizes the domestic and international CATV channels supported by the CATV Balun II.

Region	Band	Channel	Freq Range (MHz)
USA	VHF Low	2-6	54-88
	FM	95-97	90-108
	VHF MID	98-99, 14-22	108-174
	VHF HIGH	7-13	174-216
	VHF SUPER	23-36	216-300
	VHF HYPER	37-64	300-470
	UHF TV/DTV	65-150	470-950
UK, France, Italy	B	1-12	45-209.75
	F	2-12	52-212
	I	A-B	52.5-68
	II	C	81-88
	III	D-H, H1-H2	174-230
	IV & V	21-68	471-850
Western Europe	I	2-4	47-68
	II	S3-S10	118-174
	III	5-12	174-230
	SUPERBAND	S11-S17	230-279
		21-69	470-862
	INTERNET		280-860 (Access) 30-65 (Return)
Japan		J1-J62	91-765
South Africa		4-68	174-854
Eastern Europe	OIRT	1-12	49-223

Cabling Guidelines – What to Plan For

1. When planning and installing a CATV system using UTP, the following guidelines are suggested -

2. Use Cat 5 UTP cable or better and make sure there are no splices or kinks in the cables.

3. Keep cabling away from sources of electromagnetic interference such as fluorescent lights, transformers, radio transmitters, and power cables.

4. In order to minimize the effects of crosstalk, install home-run cables from the CATV distribution panel to each TV set.

5. Keep UTP cable distances within the CATV balun vendor's specifications.

6. In order to minimize electromagnetic interference (EMI), when terminating the twisted pairs, ensure that the twisted pairs remain twisted right up to the point of termination. Do not use UTP splits or taps.

7. Before installing equipment, test the video image quality of the longest cable run.

8. On cable runs where the signal may overdrive TV set use attenuators. Based on industry specifications, no more than 10 dBmV should be at the TV set.

9. If the system needs to be amplified install amplifiers as far "upstream" as possible. For example, place one amplifier at the head-end and one tilt-gain amplifier in each wiring closet where the baluns are located.

10. Try for 10dBmV of signal strength at each television. When in doubt, run the signal a little high to the television and use an attenuator to lower the signal strength going into the TV. Attenuators may be combined (i.e. two -3dBmV attenuators will equal -6dBmV). According to industry experts, many TV sets operate below 0dBmV (1mV).

11. For downstream only applications, ensure that all splitters, taps, and amplifiers are rated for operation from 50MHz to 860MHz or more. If upstream communications are also needed, ensure all splitters and taps are rated for operation from 5MHz to 860MHz or more. In addition, all amplifiers must be either rated for downstream operation from 50MHz to 860MHz or more and upstream/reversal operation from 5MHz to 42MHz, or have external upstream filtering added as necessary.

12. Check and make sure that all televisions are ready to receive the desired channel frequencies.

13. Always compensate for insertion loss with a good amplifier. There will always be a drop in signal strength when combining a modulator to an existing system due to insertion loss from the combiner.

14. When combining an existing signal with a modulated signal, make sure to have equal signal strength at the point of the combiner so one signal does not degrade the other.

15. For channels outside the supported frequencies, use a channel converter to place the channel on a carrier that is within a frequency band supported by the cabling. When possible, use the lowest frequencies available for the modulated channels in order to achieve maximum distance. If channels are available, allow 1 to 2 channel spacing between “modulated” and "active" channels.

16. If using modulators, install them as close to the head-end as possible.

17. The maximum input signal that can be transmitted through the CATV Balun II is 60dBmV.

Compatibility with the 500006

The CATV Balun II (500302) and CATV Hub (500300, 500301, 500303, 500304) are fully compatible with the CATV Balun (500006) and may be mixed and matched in the same installation. However, when the 500006 is installed on one end and the 500302 or 500300 is installed on the opposite end, the performance specifications are in accordance with the 500006.

RF Amplifiers

In order to compensate for signal losses, it may be necessary to use an RF amplifier. Due to the fact that the higher channel frequencies exhbit higher losses than the lower channels, it is advisable to use an RF amplifier that has a "tilt" or "slope" adjustment, such as from Channel Vision (CVT-40BID), Triax (TLA 240E) and Toner Cable (TDA35-1000).

CVT-40BID (USA)
http://www.ambientweather.com/dbcvt40bid.html

TDA35-1000 (UK)
http://www.tonercable.com/index.php?id=3&ProdID=413

TLA 240E (UK)
http://www.triax.com/AntennaSystems/Distr/Amplifiers/Distribution%20amplifiers/RF%20+%20SAT%20amplifiers.aspx?productId={BE026723-D39D-4A11-8FE6-FA92D9482E28}&Tab=0

Ground Loop Isolators

Ground loop problems can result when the signal ground of the CATV cable is at a different voltage level than the CATV receiver in the building. The image may display horizontal bands moving up the screen and an audible "hum" may be present. In order to isolate the ground, it is recommended to use a CATV RF ground loop isolator such the ones shown in the photo below.

Feed-Thru "F" Panels

In regard to mounting several CATV Balun in a rack, one approach would be to connect the baluns to a feed-thru "F" connector panel such as the one shown below.

http://www.l-com.com/item.aspx?id=853

IR over RG6

In regard to IR, there are devices that combine infra-red control (IR) over the same RG6 cable. IR is below the operating frequency range of the CATV Balun II (500302) and therefore there may be too much signal loss to achieve significant distance.

Measurement Devices

In order to measure RF signal power at different points in the system, the following test equipment has been recommended by the MuxLab R&D department.

http://www.sencore.com/markets/a-v-installation-calibration/43

Off Air Interference

In some cases, off air channels may interfere with the CATV channels coming in from the CATV provider. This may be caused by nearby broadcasting stations. The interference is often manifest by multiple lines running through the screen as shown in the images below. In order to correct the problem, it is recommended to add an RF amplifier upstream from the source balun. This has been validated in MuxLab's facilities.

Z-Band and 500302

According to feedback from a customer, they tested the 500302 with the Z-Band CATV Hub in a single ended configuration and found it worked satisfactorily. However, MuxLab has not tested the configuration and therefore cannot guarantee performance.

Conclusion

Structured cabling techniques, when applied to CATV can be an effective way to offer broadband video and Internet services more easily to greater number of viewers in a school, office or home environment. However, structured CATV cabling via copper twisted pair requires more planning and pre-testing than other cabling systems. For more information, contact an expert in the design and installation of broadband video systems.

Glossary

Adjacent Channels - Any of two TV channels are considered adjacent when their frequencies are next to each other in frequency or channel number.

Amplifier - A device that boosts the strength of a television signal.

Analog - A method of signal transmission in which information is relayed by continuously altering the wave form of the electromagnetic current. Now used in AM radio or most voice telephone circuits. In telephone transmission, the signal being transmitted voice, video or image is "analogous" to the original signal.

Antenna - A wireless system component that converts wired electrical energy to wireless radio waves, and directs them through the air in some pattern.

Attenuation - In general terms, a reduction in signal strength.

Automatic Gain Control - A circuit for automatically controlling amplifier gain in order to maintain a constant output voltage with a varying input voltage within a predetermined range of input-to-output variation. A process by which gain is automatically adjusted as a function of input or other specified parameter.

Band - A clearly defined range of radio frequencies dedicated to a particular purpose.

Bandwidth - The number of cycles per second (Hertz) expressing the difference between the lower and upper limiting frequencies of a frequency band; also, the width of a band of frequencies. The range of frequencies within which the performance of the antenna, with respect to some characteristic, conforms to a specified standard. Greater bandwidth generally provides for a more robust system because changes in the installation environment will not degrade antenna performance.

Bandwidth - A range of frequencies on the electromagnetic spectrum.

Bi-directional - Communications between two points where each point both transmits and receives.

Broadband - A descriptive term for evolving digital technologies that provide consumers a signal switched facility offering integrated access to voice, high-speed data service, video-on-demand services and interactive delivery services.

Broadband - In television system use, a device having a bandpass greater than the band of a single VHF television channel.

CATV Cable TV - A service through which subscribers pay to have local television stations and other programs brought into their homes from the antenna via coaxial cable

Cable Modem - A modem that connects to a cable TV network, providing Internet access, typically for homes with speeds comparable to DSL. The download speed is generally higher than the upload speed, but since cable connections are shared, the actual speed varies, depending on the number of users attached to the network.

Coax - Short for coaxial cable.

Coaxial Cable - A type of cable capable of transmitting a range of frequencies with low signal loss. Commonly used for transmitting video and audio in security systems.

Coaxial Cable - A type of cable commonly used in cable (CATV) and direct broadcast satellite (DBS) television systems. Composed of two concentric conductors (an inner wire and a braided shield) separated by a dielectric material. The whole thing is usually wrapped in another insulating layer and an outer protective layer. Most coaxial cable used in CATV and DBS applications has an impedance of 75 ohms. A coaxial cable has great capacity to carry great quantities of information. It is typically used to carry high-speed data and in CATV (multiplexed TV stations.)

Crosstalk - An undesired signal from a different channel interfering with the desired signal.

dB - Decibels A technique for expressing voltage, power, gain, loss, or frequency in logarithmic form against a reference. Typical references include volts, Watts or Ohms. An analog unit of measure of signal strength, volume or signal loss due to resistance as expressed in logarithmic form. A measure of the power ratio of two signals. In system use, a measure of the voltage ratio of two signals, provided they are measured across a common impedance.

Hz. - Decibels are calculated using the expression: dB = 10*log(x/y)

dBmV - A signal measurement whereby 0 dBmV equals 1000 microvolts across 75 ohms. A recommended signal level for a TV to receive is 10 dBmV.

Decibel - A unit to measure the relative levels of current, voltage or power. This is the scale used to measure the strength of a TV signal. An increase of 3 dB indicates a doubling of power.

Demodulation - The process for retrieving an information signal that has been modulated onto a carrier.

Descrambler - Set-top box. A device which corrects a signal (often video) that has been intentionally distorted to prevent unauthorized viewing. Used with satellite TV systems.

Digital - A method of storing, converting and sending data in the form of binary digits (0 or 1). In displays, the use of digits for direct readout. In telecommunications, in the recording or in computing, digital is the use of a binary code to represent information. Analog signals (like voice or music) are encoded digitally by sampling the voice or music analog signals many times a second and assigning a number to each sample. Recording or transmitting information digitally has two major benefits. The signal can be reproduced more precisely so digital transmission is much "cleaner" than analog transmission. The second major benefit of digital is that the electronic circuitry to handle digital is getting cheaper and more powerful.

Digital Cable - Digital cable is a term for a type of cable digital television that delivers more channels than possible with analog cable by using digital video compression. Digital cable also enables two-way communication, enabling services such the ability to purchase pay-per-view programming without the use of a phone line. Recently, some companies have also added video on demand services.

Distortion - The deviation of the received signal waveform from that of the original transmitted waveform.

Distribution Amplifier - A device that provides several isolated outputs from one looping or bridging input, and has a sufficiently high input impedance and input-to-output isolation to prevent loading of the input source.

Dynamic Range - The difference between the maximum acceptable signal level and the minimum acceptable signal level.

F-connector - The final piece of hardware on a cable designed for CATV or DBS or other signal distribution applications. It is cylindrical with a center pin sticking out, that plugs into the set-top box, cable ready TV, satellite receiver, or VCR.

Filter - A circuit that selects the frequency of desired channels through the use of band pass, low pass, and high pass filters remove certain unwanted signals to make room for the insertion of a new modulated TV channel

Frequency Response - The range of band of frequencies to which a unit of electronic equipment will offer essentially the same characteristics.

Frequency - The number of times an electromagnetic wave goes through a complete cycle in one second, measured in Hertz.

Gain - An increase in voltage or power, usually expressed in dB. In a given direction, 4 pi times the ratio of the radiation intensity in that direction to the net power accepted by the antenna from the connected transmitter. A measure of amplification expressed in dB. Gain of an amplifier is usually specified at the highest frequency of operation.

Ghost - A spurious image resulting from an echo.

GHz - Gigahertz; one trillion cycles per second (a measure of frequency).

Headend - A cable TV systems control center where incoming signals from satellites and other sources are put into the system. (Head End) The originating point of a signal in cable TV systems. At the head end, you'll often find large satellite receiving antennae. A central control device required within some LAN systems to provide such centralized functions as demodulation, re-timing, message accountability, connection control, diagnostic control, and access.

Headend Homerun Wire - The Homerun Wire is most often a single wire (usually an RG6 or RG59 coaxial cable) that runs from each apartment building's meter room to each apartment and is designed to deliver television or telephone services. Some of the modern day Homerun Wires are being used to deliver all services, cable and satellite television, telephone and fax and high-speed Internet connections.

High Definition Television - Technology that significantly increases the resolution of digital video signals offering vastly improved picture quality over the current NTSC standard.

Hum - Electrical disturbance at the power supply frequency or harmonics thereof.

Hz - Hertz Cycle per second; a measure of electromagnetic frequency that represents the number of complete electrical waves in a second. One kilohertz (kHz) is one thousand cycles per second; one megahertz (MHz) is one million; one gigahertz (GHz) is one billion.
Impedance (input or output) The input or output characteristic of a system component that determines the type of transmission cable to be used. The cable used must have the same characteristic impedance as the component. Expressed in ohms. Video distribution has standardized on 75-ohm coaxial and 124-ohm balanced cable.

Inside Wiring - That wiring located inside your premises or building. Inside wiring starts at the telephone or cable company's Demarcation Point and extends to the individual extensions. Traditionally, Inside Wiring was installed and owned by the installing company.

Interference - Extraneous energy which tends to interfere with the reception of the desired signals.

Jitter - Small, rapid variations in a waveform due to mechanical disturbances or to changes in the characteristic of components. Supply voltages, imperfect synchronizing signals, circuits, etc.

Line Amplifier - An amplifier for audio or video signals that feeds a transmission line; also called program amplifier.

Loop Through - Also called looping. The method of feeding a series of high impedance circuits (such as multiple monitor/displays in parallel) from a pulse or video source with a coax transmission line in such a manner that the line is bridged (with minimum length stubs) and that the last unit properly terminates the line in its characteristic impedance. This minimizes discontinuities or reflections on the transmission line.

Loss - A reduction in signal level or strength, usually expressed in dB. Power dissipation serving no useful purpose.

Low-Frequency Distortion - Distortion effects which occur at low frequencies. In television, generally considered as any frequency below the 15.75 kHz line frequency.

Matrix Switcher - A device that routes any of its inputs to any of its outputs. Inputs are normally cameras or alarms, and outputs are normally recorders or monitors. A matrix switcher allows a user to control what information is sent where within a large security network.

MHz - Megahertz, a measure of frequency in millions (mega) of cycles per second.

MMDS - Multipoint Multi-channel Distribution Service. MMDS is a way of distributing cable television signals, through microwave, from a single transmission point to multiple receiving points. Often used as an alternative to cable-bases cable TV. An MMDS service, "in digital form, will provide more than 100 channels to a radius of approximately 40 miles from the transmitter. The MMDS transmitter delivers video to homes that are in its 'line of sight.' MMDS transmissions are limited by the terrain and foliage of a given market. The microwave signal is received by an antenna on the subscriber's home, then sent down coaxial cable to a box atop the customer's TV set. The box decodes and decompresses the digital signal." MMDS is increasingly being called "Wireless Cable."

Modems - Acronym for Modulator/Demodulator. Conventional modems comprise equipment which converts digital signals to analog signals and vice versa. Conventional PC modems outputs data in the form of "1's" and "0's" which are represented by varying levels of voltage. The modem converts the digital data signal into variations of the analog sine wave so the data can be transmitted over the device with a digital bit stream. The modulation techniques include some combination of Amplitude Modulation (AM), Frequency Modulation (FM) and Phase Modulation (PM), also known as Phase Shift Keying (PSK). Used in combination, these techniques allow multiple bits to be represented with a single (or single set) OF SINE WAVES). In this fashion, compression is accomplished, which allows more data to be transmitted in the same period of time and which therefore reduces the connect time and the associated cost of the data transfer.

Modulation - The process of superimposing an information signal onto a carrier for transmission. The process where some characteristic of one signal is varied in accordance with another signal. The carrier may be modulated in three fundamental ways: by varying the amplitude, called amplitude modulation; by varying the frequency, called frequency modulation; by varying the phase, called phase modulation. The creation of a TV channel from a video and audio source for transmission over a distribution coaxial cable network.

Modulator - The electronic equipment required to combine video and audio signals and convert them to TV radio frequencies (RF) for distribution to other equipment (including televisions) on a cable network.

MPEG - Motion Pictures Experts Group.

Multiplexer - A device that can accept a number of camera inputs and almost simultaneously display them on a single monitor. Can be used to transmit multiple cameras over the same transmission medium. A device that accepts video signals from more than one camera and encodes them onto one signal that is sent to a digital recorder or VCR. The multiplexer also decodes the recording so it can play back video from one camera or several cameras at once on a monitor.

Noise - The word "noise" originated in audio practice and refers to random spurts of electrical energy or interference. In some cases, it will produce a "salt-and-pepper" pattern over the televised picture. Heavy noise is sometimes referred to as "snow".

NTSC - Abbreviation for National Television Systems Committee. A committee that worked with the FCC in formulating standards for the present day United States color television system. A television industry group that develops standards for standard television broadcasting and receiving equipment in the US.

Off-Air - Reception of a TV signal that has been broadcast through the air by a TV station.

Output - The signal level at the output of an amplifier or other device.

Patch Cords - Cables used to interconnect electronic equipment often terminated with modular or RCA-type plugs.

Patch Panel - A panel where circuits are terminated and facilities provided for interconnecting between circuits by means of jacks and plugs.

PCS - Personal Communications System.

Peak-to-Peak - The amplitude (voltage) difference between the most positive and the most negative excursions (peaks) of an electrical signal. A full video signal measures one volt peak to peak.

Resolution (horizontal) - The amount of resolvable detail in the horizontal direction in a picture. It is usually expressed as the number of distinct vertical lines, alternately black and white, which can be seen in a distance equal to picture height.

RF Radio Frequency - The area (or band) of the electromagnetic spectrum where most radio communication takes place, typically from 100 KHz to 100 GHz. A frequency at which coherent electromagnetic radiation of energy is useful for communication purposes. Analog electrical signals sent on cable or over the air. Conventional (broadcast) television and radio, as well as cable TV, deliver RF signals to your television/radio.

Ripple - Amplitude variations in the output voltage of a power supply caused by insufficient filtering.

Signal Leakage - (Leakage) is a cable TV term. Leakage occurs when certain radio frequencies ooze out of the CATV's coaxial cable in such strength that they are evident outside the home. They might be sufficiently strong to interfere with aircraft navigation. Leakage is really a shielding problem.

Splitter - A passive device (one with no active electronic components) which distributes a television signal carried on a cable in two or more paths and sends it to a number of receivers simultaneously.

Transceiver - A combination transmitter and receiver.

UHF Ultra High Frequency - The part of the radio spectrum from 470 MHz to 806 MHz, including TV channels 14 through 83.

Vertical Resolution - The number of horizontal lines that can be seen in the reproduced image of a television pattern.

VHF Very High Frequency - The part of the radio spectrum from 54 to 88 MHz and 174 to 216 MHz, which includes TV channels 2 through 13.

Video Amplifier - A wideband amplifier used for passing picture signals.

Video Band - The frequency band width utilized to transmit a composite video signal.

Video Signal - (Non-Composite) The picture signal. A signal containing visual information and horizontal and vertical blanking (see also Composite Video Signal) but not sync.

MuxLab Inc.
Telephone : (+1) 514-905-0588
Toll-free (North America) : 877-689-5228
Fax : (+1) 514-905-0589
E-mail: videoease@muxlab.com
URL: www.muxlab.com