# Lynx Broadband

# Amplifier Selection Guide

# and

# System Design Manual


## Lynx Video Network

## Lynx Video and Data Network

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## Summary of Key Concepts and Amplifer Costs

**Headend amplifiers:** Most applications with under 200 drops need one power doubling amplifier in the headend. Use a 43 dB amp if the incoming signal strength is less than 10 db and a 30 dB amp if the incoming signal strength is more than 10 dB. When in doubt select the 43 dB amp, since you can always add an attenuator to bring the signal strength down to 9 dB or less.

These amps are purchased from others. Contractor pricing ranges from $360 to $530. See page 2 for more specific information.

**Amplifiers in the wiring closets:** Push-pull amplifiers can be used in the wiring closets, with one amp driving up to three 8 port hubs in a given closet. Use a 30 dB amp if the incoming signal is between 10 and 20 dB, a 42 dB amp if the signal is between 5 and 9 dB, and a 50 dB amp when the incoming signal is less than 5 dB. These amps are purchased from others. Contractor pricing ranges from $120 to $300. See page 3 for more specific information.

**Important installation tip:** If there are multiple hubs in a wiring closet, be sure to group the runs according to run length. The short runs should go to one 8 port hub, the medium runs to another 8 port hub, and long runs to a third 8 port hub (if available). (One 16 port hub is two 8 port hubs mounted on a common rackmount plate.)

**Amplifier settings:** The Lynx design model should be used to select the optimal gain and slope for the distances and channel numbers in a given application. The design model spreadsheet lets the installer balance the system on a computer rather than the time consuming and marginally effective "trial and error" process of balancing the system in the field.

The objective of the system design is to have the signal strength at every TV between -10 dB and +15 dB, and to have the signal strength differential between the highest and lowest channel (slope) less than or equal to 11 dB.

When sending channel numbers higher than CATV channel 50 over distances greater than 220 feet, it is usually best to set the gain so the amplifier output is 49 dB (the maximum useful output for most commercial amplifiers). This means turning up the gain until the output reaches 49 dB as measured on a signal strength meter. (It does not mean turning up the gain control as high as it will go.)

Setting the amp output at 49 dB and maximum slope may optimize the picture for the longest runs, but in order to optimize the picture for the short runs it may be necessary to install an attenuator in front of the hub serving short runs.

In most cases the optimal slope setting will be the maximum amount of slope available.

See page 4 for more specific information.

**Configuring the amplifiers and hubs in the wiring closet:** Diagrams on pages 6 & 7 show the best way to connect amplifiers to multiple hubs in a wiring closet.

**Headend Amplifier**

A "power doubling" amplifier should be used in the headend. The following power doubling amps are good options:

| | Highest CATV Channel Capability | Max Gain | Max Input Signal | Max Slope | Bi-Directional |
|---|---|---|---|---|---|
| Drake DA7533 | 116 | 33 dB | 20 dB | 10 dB | Yes - passive & active |
| Drake DA7543 | 116 | 43 dB | 9 dB | 10 dB | Yes – passive & active |
| Blonder Tongue 55A-30P | 78 | 32 dB | 20 dB | 8 dB | Yes - passive & active |
| Blonder Tongue 55A-43P | 78 | 43 dB | 9 dB | 8 dB | Yes – passive & active |

Blonder Tongue amps with higher channel capacities are also available. The BIDA 75A-30P and 75A-43P can handle CATV channels up to #116 (750 MHz), and the BIDA 86A / 30 and 86A/30P can handle channels up to #134 (860 MHz).

These amplifiers can be purchased from RF distributors like Multicom (www.multicominc.) or DF Countryman (www.drcco.com). Contractor pricing ranges from $360 to $520 for the Drake amps and the 550 MHz Blonder Tongue models.

The size of the amp should be determined based on the strength of the signal coming into the amp. If the incoming signal strength is not known, select the 43 dB amp because you can always "pad down" the input signal to 9 dB if necessary.

| | Range of Signal Strengths into Amp | Maximum Signal Signal Strength into Amp |
|---|---|---|
| 32 or 33 dB amp | 10 dB to 20 dB | 20 dB |
| 43 dB amp | 5 dB to 9 dB | 9 dB |

It is very important not to exceed the maximum input signal strengths listed above. Doing so will overdrive the amps and result in a distorted picture with white horizontal lines. If necessary an attenuator should be installed on the input to the amp to bring the signal strength down to the ranges listed above.

One amplifier is usually adequate in the headend. But in large installations (with more than 200 drops) an additional amplifier may be needed.

The headend amplifier should be set up with a forward slope in order to counteract the reverse slope inherent in the cable. (The maximum slope setting is the best choice for most applications).

All cables introduce reverse slope because high channels have greater cable losses than low channels. Forward slope helps to offset this effect by reducing the strength of the low channels.

Ideally, the gain and slope of the headend amplifier will result in a signal at the wiring closet that is flat or forward sloped with a signal strength between 0 dB and 20 dB (with a stronger signal being preferable). A flat signal means that all channels have a signal strength within 2 dB of each other. A forward sloped signal means the low channels have less signal strength than the high channels.

## Cabling between the headend and wiring closets

In most applications RG-11 coax should be installed between the headend and the wiring closets. 1/2" coax is often specified for large facilities, and is also a good choice.

Cable losses for various types of coax are:

| | Channel 2 | Channel 78 |
|---|---|---|
| RG-6 | 1.5 dB / 100 ft. | 4.8 dB / 100 ft. |
| RG-11 | 1 dB / 100 ft. | 3 dB / 100 ft. |
| ½ ″ hard line | .5 dB / 100 ft. | 1.8 dB / 100 ft. |

Fiber optic cable can also be used and is typically selected when delivering signals between buildings. For applications with more than five channels single mode fiber is needed. Prices for fiber transmitters start at $2,000. Prices for fiber receivers start at $650.

## Secondary Amplifiers in wiring closets

Ideally the signal entering the amp in the wiring closet will be flat or forward sloped, with high channels having a signal strength of 10 to 20 dB. In these circumstances a 30 dB push–pull amp is usually appropriate. If the incoming signal is less than 10 dB an amp with a higher gain is recommended.

The size of the amp should be determined based on the strength of the signal coming into the amp. If the incoming signal strength is not known, select the 42 dB amp because you can always "pad down" the input signal to 9 dB if necessary.

| | Range of Input Signal Strength | Maximum Input Signal Strength |
|---|---|---|
| 30 dB amp | 10 to 20 dB | 20 dB |
| 42 dB amp | 5 to 9 dB | 9 dB |
| 50 dB amp | 0 to 5 dB | 5 dB |

It is very important not to exceed the maximum input signal listed above. Doing so will "overdrive" the amp and result in a distorted picture with white horizontal lines. If necessary an attenuator should be installed on the input to the amp to bring the signal strength down to an appropriate level.

The following push – pull amplifiers can be purchased from Multicom at 1-800-423-2594.

| | Highest CATV Channel Capability | Max Gain | Max Input Signal | Max Slope | Bi-Directional |
|---|---|---|---|---|---|
| Blonder Tongue BIDA 550-30 | 78 | 33 dB | 20 dB | 10 dB | If diplexer is added |
| Blonder Tongue BIDA 750-30 | 116 | 31 dB | 20 dB | 10 dB | If diplexer is added |
| Drake DDA5542R | 78 | 42 dB | 9 dB | 15 dB | Yes - passive |

These amplifiers can be purchased from RF distributors like Multicom (www.multicominc.) or DF Countryman (www.dfcco.com). Contractor pricing ranges from $120 to $300.

One amplifier can usually drive up to 24 drops in a given wiring closet. For closets serving 25 to 48 drops a second amplifier is needed. See page 4 for suggestions on how to configure amps, splitters, and hubs for optimal results.

The maximum output for these amps is usually 49 dB (assuming 77 channels are being delivered.) Exceeding a 49 dB output level can compromise picture quality and shorten amplifier life.

**Important installation tip:** Be sure to group the runs according to run length, so that the short runs go to one 8 port hub, medium runs to another 8 port hub, and long runs to a third 8 port hub (if available).

## Selecting the Optimal Gain and Slope Settings

The optimal gain and slope settings can be determined using the interactive Lynx design model available on a CD and shipped with every Lynx order. It is also available by e-mailing info@lynxbroadband.com or calling 952-894-9590. The model predicts the signal strength at the TV based on the signal strength entering the hub, run length, and high and low channel numbers. The strength and slope of the incoming signal can then be adjusted to optimize the results for all TVs served by a given hub.

For all TVs manufactured after 1995, the signal strength at the TV should be between -10 dB and +15 dB. In addition the slope at the TV should not exceed 11 dB. (Slope is the difference in signal strength between the highest and lowest channels.)

It is highly recommended that the installer use the Lynx design model to optimize the system design prior to installation. Then when the equipment is installed a signal strength meter should be used to set the amps and verify that the installation conforms to the design. This is much more efficient than adjusting the amps by "trial and error" (a difficult process when one amp affects up to 24 TVs in various remote locations). An example of the output of the Lynx design model is shown in Exhibit A on the page 10.

Another point of reference for system design is the system loss table shown in Exhibit B on page 11.

For quick reference purposes, however, an example of optimal amplifier settings is shown below. (A figure like 23 dB/ 31 dB means 23 dB for the low channel and 31 dB for the high channel.)

**For channels 2 – 50:**

| | Distance range | Recommended amp output* | Signal strength at TV | |
|---|---|---|---|---|
| | | | Shortest run | Longest run |
| 8 port hub serving short runs | 25 feet – 100 feet | 26 dB / 32 dB | 11 dB / 13 dB | 8 dB / 3 dB |
| | channel 2 | | channel 50 | |
| 8 port hub serving medium runs | 100 feet – 200 feet | 33 dB / 43 dB | 15 dB / 14 dB | 10 dB / 0 dB |
| 8 port hub serving long runs | 200 feet – 300 feet | 39 dB / 49 dB | 16 db / 6 dB | 12 dB / -7 dB |

* same as hub input if the signal goes directly from the amp to the hub

In the preceding example, a 10 dB line equalizer should be inserted in front of the hub for the runs over 200 feet. This will bring the slope at the TV within the design objective to have slope ≤ 11 dB. Adding the equalizer results in the following signal strengths:

| | Distance range | Signal strength entering hub | Signal strength at TV | |
|---|---|---|---|---|
| | | | 200 foot run | 300 foot run |
| 8 port hub serving long runs | 200 feet -300 feet | 29 dB / 48 dB | 6 dB / 5 dB | 2 dB / -8 dB |

General advice for setting the gain: The best way to determine optimal gain is to use the Lynx design model. If this is not practical, it is usually a good idea to set the gain such that the output of the amp is 49 dB – which is the maximum output for most amplifiers handling a full load of analog programming (78 channels). Then check the picture quality on the highest channel of the longest run. If the signal is too strong (indicated by a corduroy pattern) turn the gain down. If the signal is too weak (indicated by a snowy picture) you need to redesign the system to add more amplifiers or reduce system losses. If the picture has horizontal white lines you need to pad down the signal coming into the amp.

(Note that setting the output to 49 dB does not mean turning the gain up to the highest setting. Rather it means using a signal strength meter and turning up the gain until the output is 49 dB. It may be possible to get more than 49 dB out of the amplifier but this is not recommended because it usually results in a degradation of picture quality.)

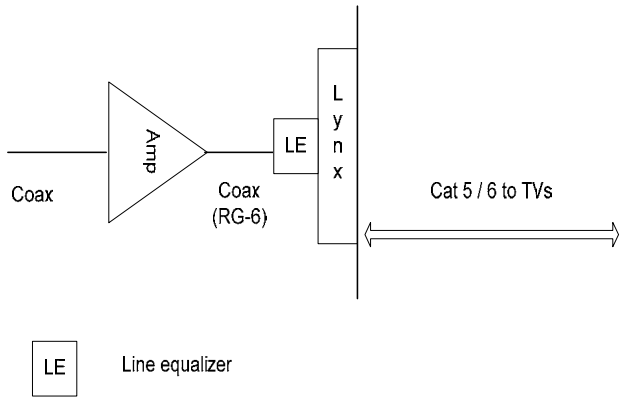
General advice for setting the slope: In most cases maximum slope should be used.

**IMPORTANT DESIGN PRINCIPLE:** Always "group" the runs in the IDF closet according to their length. If there are three 8 port hubs in each closet, the longest runs should go to one hub, the medium runs to another hub, and the short runs to a third hub. (A 16 port Lynx hub actually consists of two 8 port hubs with two separate F connector inputs.)

**INSTALLATION EQUIPMENT:** When the equipment is installed, an RF signal strength meter will be needed to set the amplifier's slope and gain to match the levels called for in the system design.

**Designing the Coax Network between the Amplifiers and the Hubs**

System design for 8 drops per wiring closet

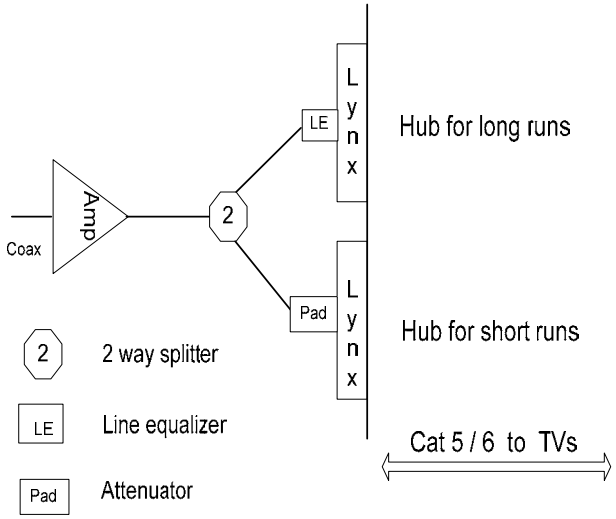



Optimal settings for gain and slope can be determined using the Lynx design model.

In applications with a wide range of channel numbers and run lengths it is usually helpful to insert a line equalizer after the amp so that the slope at the TV does not exceed 11 dB.

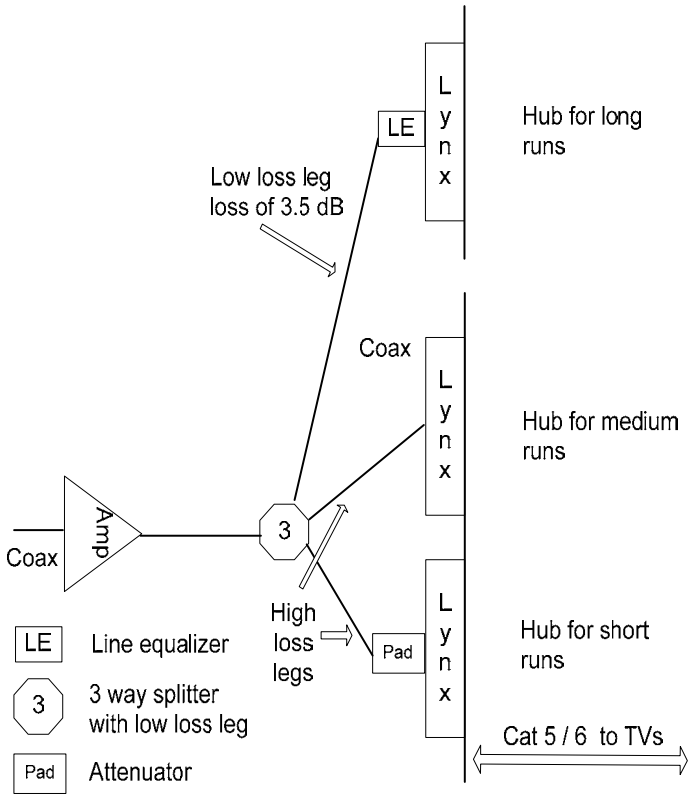
Slope is the difference in signal strength between the high channel and low channel. A 6 dB line equalizer reduces the signal strength of the low frequency (usually channel 2) by 6 dB, but only reduces the signal strength of the high frequency by 1 dB.

System design for 16 drops per wiring closet




The splitter after the amplifier reduces the signal strength by 3.5 dB. Installing a pad (attenuator) in front of the hub handling short runs is usually a good idea, in order to keep the signal strength for these runs under 15 dB at the TV. The Lynx design model should be used to determine the amount of attenuation needed, as well as the optimal gain and slope settings. It may also be necessary to install a line equalizer in front of the long hub in order to keep the slope at the TV under 11 dB. The size of the line equalizer can be determined from the design model.

System Design for 24 drops per wiring closet




A three way splitter with a low loss leg (also called an "unbalanced" three way splitter) will reduce the signal strength on the low loss leg by 3.5 dB, while the signal strength on the high loss legs are reduced by 7 dB. The low loss leg should be used to feed the hub serving the long runs in order to give this hub the hottest signal. A line equalizer may be needed to keep the slope at the TV under 11 dB.

The high loss legs should service the hubs with medium and short runs. Installing an attenuator (pad) in front of the medium hub may or may not be necessary. The Lynx design model can be used to determine if the signal strength for the lowest channel will be greater than 15 dB without attenuation. If so, an attenuator should be selected to bring the signal strength down to at least 15 dB.

The same process should be used to determine the value for the attenuator installed in front of the short hub.

System Design for more than 24 drops per wiring closet

If more than 24 drops are being serviced by a given wiring closet, it is usually necessary to install an additional amplifier (or amplifiers). The design is based on putting together various combinations of the configurations shown above.

The key design concept is that one amplifier can serve up to three eight port hubs in a given location.

**NOTE: The preceding recommendations are intended as guidelines. The installing contractor is responsible for the system design work related to each job, and should prepare a system design based on the specific circumstances related to that job.**

## System Design Assistance

System design assistance is available from GB Tech Service at a cost of $75 per hour. The installer provides information on the signal sources at the headend, the channels being delivered, the distances to the wiring closets, and the distances from the wiring closets to the televisions. A fire escape type drawing is also requested.

GB Tech will then provide a drawing of the coax backbone to the wiring closets, a drawing of the coax layout in each closet, an equipment list for each closet, and recommended signal strength levels at each stage of the network.

An example of the drawing for a wiring closet is shown in Exhibit C on page 15 of this document.

GB Tech can be reached at 952-994-4325.

## Bi-directional Amplifiers

Bi-directional capabilities are needed in applications that broadcast from a remote location to the rest of the building (a common application in school applications, but not common elsewhere).

In applications where bi-directional operation is needed, an amplifier with a passive return is usually appropriate if there is only one amplifier between the sub-band separator and the TV. In cases with two amplifiers between the sub-band separator and the TV an active return is usually needed.

Passive return paths are activated by installing jumpers that let sub-band channels traveling back to the headend bypass the amplifier.

Active return paths are activated by installing a reverse amplification module and related filters.

## Digital Channels

Lynx is fully capable of handling standard digital channels (bandwidth of 2 MHz per channel) and high definition HDTV channels (bandwidth of 6 MHz per channel). Digital channels typically start at 550 MHz and can go as high as 860 MHz. Unlike analog channels, the numbers for digital channels are usually assigned by the cable company in a manner that does not correlate with frequency. So digital channel XYZ could be any frequency between 550 MHz and 860 MHz. In order to design for digital channels the safest approach is to assume frequencies up to 860 MHz (equivalent to analog channels up to 134).

The incoming signal strength of digital channels is typically 10 dB lower than analog channels. However, the TV's threshold for receiving a digital channel is 15 dB lower (-25 dB versus -10 dB). Consequently, the characteristics for digital channels can be calculated using the Lynx design model and assuming that for frequencies above 550 MHz the threshold for a good picture is -15 dB.

(The analog threshold for an acceptable picture is -10 dB. The design model can be adapted for use with high frequency digital channels by reducing the minimum threshold from -10 dB to -15 dB. As noted earlier, the incoming signal is 10 dB weaker but the threshold is 15 dB lower, so the net effect can be estimated using the model by lowering the minimum threshold from -10 dB to -15 db.)

Assuming an incoming signal strength of 49 dB, the distance capabilities for various frequencies are shown below. (49 dB is the maximum output of most commercial amps.)

| Frequency | CATV channel | Maximum distance with 49 dB to hub |
|---|---|---|
| 550 MHz | 78 | 310 ft. |
| 600 MHz | 87 | 302 ft. |
| 650 MHz | 100 | 295 ft. |
| 700 MHz | 109 | 275 ft. |
| 750 MHz | 117 | 265 ft. |
| 800 MHz | 125 | 260 ft. |
| 860 MHz | 134 | 245 ft. |

Note that if digital channels up to 860 MHz are desired, an 860 MHz amplifier is needed.

## Example of the Lynx Design Model

**1. Enter lowest and highest channel number to be distributed**

| | |
|---|---|
| Lowest channel # | 2 |
| Highest channel # | 55 |

**2. Enter the strength of signals entering the Lynx distribution hub**

| | | |
|---|---|---|
| For lowest channel | 35 | **dB** |
| For highest channel | 45 | **dB** |

It is usually a good idea to start with 39 dB for the low channel and 49 for the high channel, which assumes that the amp is inserting 10 dB of slope. If the results shown in step 3 below show the the signal at the TV is too hot, you can go back to step 2 and insert lower numbers. (49 dB is the maximum output of most commercial amplifiers.)

**3. In the table below enter the length of each run in column A. Then read the resulting signal strength in columns B & C.** (It is usually best to enter run lengths in ascending or descending order.)

| A<br>Run length in feet | B<br>Signal strength at TV for channel # 2 | C<br>Signal Strength at TV for channel # 55 |
|---|---|---|
| 210 | 12 | 1 |
| 200 | 12 | 2 |
| 190 | 13 | 4 |
| 180 | 13 | 5 |
| 170 | 14 | 6 |
| 160 | 14 | 8 |
| 150 | 14 | 9 |
| 140 | 15 | 10 |

An acceptable range for signal strength at the TV is -10 dB to +15 dB. If the signal strength numbers above are too high, you may need to reduce the amplifier settings or insert an attenuator (pad) in front of the TV.

If the numbers are too low, you may need to increase the amplifier gain settings.
more amplification. It is also recommended that the difference between the signal strength for the high channel And low channel should not exceed 11 dB. If it does it may be necessary to increase the slope setting for the amplifier or to insert a line equalizer after the amplifier.

**Lynx Video Network**
**Cable and insertion losses (in dB)**

**Note: Operating in conditions where losses exceed 60 dB is not recommended. Most amplifiers cannot provide an output greater than 50 dB. With an amplifier output of 50 dB and losses of 60 dB the signal strength reaching the TV is -10 dB. Many TVs start to show a "snowy" picture when the signal strength is less than -10 dB.**

**Conditions where losses exceed 60 dB are shaded in the graph below.**

**All figures assume the use of Cat 5e cable.**

| Channel | Cable Length in Feet | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Number | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 330 |
| T7 | 14 | 14 | 15 | 15 | 15 | 16 | 16 | 17 | 17 | 17 | 18 | 18 | 18 | 19 | 19 |
| T8 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 21 | 21 |
| T9 | 15 | 15 | 16 | 16 | 17 | 17 | 18 | 18 | 19 | 19 | 20 | 20 | 21 | 21 | 22 |
| T10 | 15 | 16 | 16 | 17 | 17 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 23 | 23 | 23 |
| T11 | 15 | 16 | 16 | 17 | 18 | 19 | 19 | 20 | 21 | 21 | 22 | 23 | 23 | 24 | 25 |
| T12 | 15 | 16 | 17 | 17 | 18 | 19 | 20 | 20 | 21 | 22 | 23 | 23 | 24 | 25 | 25 |
| T13 | 15 | 16 | 17 | 18 | 18 | 19 | 20 | 21 | 21 | 22 | 23 | 24 | 25 | 25 | 26 |
| T14 | 15 | 16 | 17 | 18 | 19 | 20 | 20 | 21 | 22 | 23 | 24 | 25 | 25 | 26 | 27 |
| 2 | 17 | 18 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 25 | 26 | 27 | 28 | 28 |
| 3 | 17 | 18 | 19 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 29 |
| 4 | 17 | 18 | 19 | 20 | 21 | 22 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 5 | 17 | 18 | 19 | 20 | 21 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| 6 | 17 | 18 | 19 | 20 | 21 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 |
| 95 | 17 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 28 | 29 | 30 | 31 | 32 | 33 |
| 96 | 18 | 19 | 20 | 21 | 22 | 23 | 25 | 26 | 27 | 28 | 29 | 30 | 32 | 33 | 33 |
| 97 | 18 | 19 | 20 | 21 | 23 | 24 | 25 | 26 | 28 | 29 | 30 | 31 | 33 | 34 | 35 |
| 98 | 18 | 19 | 20 | 22 | 23 | 24 | 26 | 27 | 28 | 29 | 31 | 32 | 33 | 35 | 35 |
| 99 | 18 | 19 | 21 | 22 | 23 | 24 | 26 | 27 | 28 | 30 | 31 | 32 | 34 | 35 | 36 |
| 14 | 18 | 20 | 21 | 22 | 24 | 25 | 26 | 28 | 29 | 31 | 32 | 33 | 35 | 36 | 37 |
| 15 | 18 | 20 | 21 | 22 | 24 | 25 | 27 | 28 | 29 | 31 | 32 | 34 | 35 | 36 | 37 |
| 16 | 18 | 20 | 21 | 23 | 24 | 25 | 27 | 28 | 30 | 31 | 32 | 34 | 35 | 37 | 37 |
| 17 | 18 | 20 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 32 | 33 | 35 | 36 | 38 | 38 |
| 18 | 18 | 20 | 21 | 23 | 24 | 25 | 27 | 28 | 30 | 31 | 33 | 34 | 36 | 37 | 38 |
| 19 | 18 | 20 | 21 | 23 | 24 | 26 | 27 | 29 | 30 | 32 | 33 | 35 | 36 | 38 | 39 |
| 20 | 19 | 20 | 22 | 23 | 25 | 26 | 28 | 30 | 31 | 33 | 34 | 36 | 37 | 39 | 40 |
| 21 | 19 | 20 | 22 | 23 | 25 | 27 | 28 | 30 | 31 | 33 | 35 | 36 | 38 | 39 | 40 |
| 22 | 19 | 20 | 22 | 24 | 25 | 27 | 28 | 30 | 32 | 33 | 35 | 36 | 38 | 39 | 40 |
| 7 | 19 | 20 | 22 | 24 | 25 | 27 | 29 | 30 | 32 | 33 | 35 | 37 | 38 | 40 | 41 |
| 8 | 19 | 20 | 22 | 24 | 25 | 27 | 29 | 30 | 32 | 33 | 35 | 37 | 38 | 40 | 41 |

| Channel Number | Cable Length in Feet | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 330 |
| **9** | 19 | 21 | 23 | 24 | 26 | 28 | 29 | 31 | 33 | 34 | 36 | 38 | 40 | 41 | 42 |
| **10** | 19 | 21 | 23 | 25 | 27 | 28 | 30 | 32 | 34 | 36 | 37 | 39 | 41 | 43 | 44 |
| **11** | 20 | 21 | 23 | 25 | 27 | 29 | 31 | 32 | 34 | 36 | 38 | 40 | 42 | 43 | 44 |
| **12** | 20 | 21 | 23 | 25 | 27 | 29 | 31 | 32 | 34 | 36 | 38 | 40 | 42 | 43 | 44 |
| **13** | 20 | 22 | 24 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 46 |
| **23** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 39 | 41 | 43 | 45 | 46 |
| **24** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 |
| **25** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 41 | 43 | 45 | 47 | 48 |
| **26** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 41 | 43 | 45 | 47 | 48 |
| **27** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 41 | 43 | 45 | 47 | 48 |
| **28** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 41 | 43 | 45 | 47 | 48 |
| **29** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 41 | 43 | 45 | 47 | 48 |
| **30** | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 | 38 | 41 | 43 | 45 | 47 | 48 |
| **31** | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 48 |
| **32** | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 48 |
| **33** | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 35 | 37 | 39 | 41 | 43 | 45 | 47 | 48 |
| **34** | 21 | 23 | 25 | 27 | 29 | 31 | 33 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 49 |
| **35** | 21 | 23 | 25 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 48 | 50 |
| **36** | 21 | 23 | 25 | 28 | 30 | 32 | 34 | 36 | 38 | 40 | 42 | 44 | 46 | 49 | 50 |
| **37** | 22 | 24 | 26 | 28 | 30 | 33 | 35 | 37 | 39 | 42 | 44 | 46 | 48 | 50 | 51 |
| **38** | 22 | 24 | 26 | 29 | 31 | 33 | 36 | 38 | 40 | 42 | 45 | 47 | 49 | 52 | 53 |
| **39** | 22 | 24 | 27 | 29 | 31 | 34 | 36 | 39 | 41 | 43 | 46 | 48 | 50 | 53 | 54 |
| **40** | 22 | 24 | 27 | 29 | 31 | 34 | 36 | 39 | 41 | 43 | 46 | 48 | 50 | 53 | 54 |
| **41** | 22 | 24 | 27 | 29 | 32 | 34 | 36 | 39 | 41 | 43 | 46 | 48 | 50 | 53 | 54 |
| **42** | 22 | 25 | 27 | 29 | 32 | 34 | 37 | 39 | 41 | 44 | 46 | 49 | 51 | 53 | 55 |
| **43** | 22 | 25 | 27 | 29 | 32 | 34 | 36 | 39 | 41 | 44 | 46 | 48 | 51 | 53 | 54 |
| **44** | 23 | 25 | 28 | 30 | 33 | 35 | 38 | 40 | 43 | 45 | 48 | 50 | 53 | 55 | 57 |
| **45** | 23 | 25 | 28 | 31 | 33 | 36 | 39 | 41 | 44 | 46 | 49 | 52 | 54 | 57 | 58 |
| **46** | 23 | 25 | 28 | 31 | 33 | 36 | 39 | 41 | 44 | 46 | 49 | 52 | 54 | 57 | 58 |
| **47** | 23 | 26 | 28 | 31 | 34 | 36 | 39 | 42 | 44 | 47 | 49 | 52 | 55 | 57 | 59 |
| **48** | 23 | 26 | 28 | 31 | 34 | 36 | 39 | 42 | 44 | 47 | 49 | 52 | 55 | 57 | 59 |
| **49** | 23 | 26 | 28 | 31 | 34 | 36 | 39 | 42 | 44 | 47 | 49 | 52 | 55 | 57 | 59 |
| **50** | 24 | 27 | 29 | 32 | 35 | 37 | 40 | 43 | 45 | 48 | 50 | 53 | 56 | 58 | 60 |
| **51** | 24 | 27 | 29 | 32 | 35 | 37 | 40 | 43 | 45 | 48 | 50 | 53 | 56 | 58 | 60 |
| **52** | 24 | 27 | 29 | 32 | 35 | 37 | 40 | 43 | 45 | 48 | 50 | 53 | 56 | 58 | 60 |
| **53** | 24 | 27 | 29 | 32 | 35 | 37 | 40 | 43 | 45 | 48 | 50 | 53 | 56 | 58 | 60 |
| **54** | 24 | 27 | 29 | 32 | 35 | 37 | 40 | 43 | 45 | 48 | 50 | 53 | 56 | 58 | 60 |
| **55** | 24 | 27 | 29 | 32 | 35 | 37 | 40 | 43 | 45 | 48 | 50 | 53 | 56 | 58 | 60 |
| **56** | 24 | 27 | 29 | 32 | 35 | 38 | 40 | 43 | 46 | 48 | 51 | 54 | 56 | 59 | 60 |
| **57** | 24 | 27 | 29 | 32 | 35 | 38 | 40 | 43 | 46 | 48 | 51 | 54 | 56 | 59 | 60 |
| **58** | 24 | 27 | 30 | 33 | 35 | 38 | 41 | 44 | 46 | 49 | 52 | 55 | 57 | 60 | 62 |
| **59** | 24 | 27 | 30 | 33 | 35 | 38 | 41 | 44 | 46 | 49 | 52 | 55 | 57 | 60 | 62 |
| **60** | 24 | 27 | 30 | 33 | 36 | 38 | 41 | 44 | 47 | 50 | 52 | 55 | 58 | 61 | 62 |

| Channel Number | Cable Length in Feet | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 330 |
| **61** | 25 | 28 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 62 | 64 |
| **62** | 25 | 28 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 62 | 64 |
| **63** | 25 | 28 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 62 | 64 |
| **64** | 25 | 28 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 62 | 64 |
| **65** | 25 | 28 | 30 | 33 | 36 | 39 | 42 | 45 | 48 | 51 | 54 | 57 | 59 | 62 | 64 |
| **66** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 49 | 51 | 54 | 57 | 60 | 63 | 65 |
| **67** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 49 | 52 | 55 | 58 | 61 | 64 | 66 |
| **68** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 49 | 52 | 55 | 58 | 61 | 64 | 66 |
| **69** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **70** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **71** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **72** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **73** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **74** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **75** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **76** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **77** | 25 | 28 | 31 | 34 | 37 | 40 | 43 | 46 | 50 | 53 | 56 | 59 | 62 | 65 | 66 |
| **78** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **79** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **80** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **81** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **82** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **83** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **84** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **85** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **86** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 56 | 60 | 63 | 66 | 67 |
| **87** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 57 | 60 | 63 | 66 | 68 |
| **88** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 57 | 60 | 63 | 66 | 68 |
| **89** | 25 | 28 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 53 | 57 | 60 | 63 | 66 | 68 |
| **90** | 25 | 29 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 54 | 57 | 60 | 63 | 66 | 68 |
| **91** | 25 | 29 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 54 | 57 | 60 | 63 | 66 | 68 |
| **92** | 25 | 29 | 32 | 35 | 38 | 41 | 44 | 47 | 50 | 54 | 57 | 60 | 63 | 66 | 68 |
| **93** | 26 | 29 | 32 | 35 | 38 | 41 | 45 | 48 | 51 | 54 | 57 | 61 | 64 | 67 | 69 |
| **94** | 26 | 29 | 32 | 35 | 38 | 42 | 45 | 48 | 51 | 54 | 58 | 61 | 64 | 67 | 69 |
| **100** | 26 | 29 | 32 | 36 | 39 | 42 | 45 | 49 | 52 | 55 | 58 | 62 | 65 | 68 | 70 |
| **101** | 26 | 29 | 32 | 36 | 39 | 42 | 46 | 49 | 52 | 55 | 59 | 62 | 65 | 68 | 70 |
| **102** | 26 | 29 | 33 | 36 | 39 | 43 | 46 | 49 | 52 | 56 | 59 | 62 | 66 | 69 | 71 |
| **103** | 26 | 29 | 33 | 36 | 39 | 43 | 46 | 49 | 53 | 56 | 59 | 63 | 66 | 69 | 71 |
| **104** | 26 | 30 | 33 | 36 | 40 | 43 | 46 | 50 | 53 | 57 | 60 | 63 | 67 | 70 | 72 |
| **105** | 26 | 30 | 33 | 36 | 40 | 43 | 47 | 50 | 53 | 57 | 60 | 64 | 67 | 70 | 72 |
| **106** | 26 | 30 | 33 | 36 | 40 | 43 | 47 | 50 | 54 | 57 | 60 | 64 | 67 | 71 | 72 |
| **107** | 26 | 30 | 33 | 37 | 40 | 44 | 47 | 51 | 54 | 58 | 61 | 64 | 68 | 71 | 73 |
| **108** | 26 | 30 | 33 | 37 | 40 | 44 | 47 | 51 | 54 | 58 | 61 | 65 | 68 | 72 | 73 |

| Channel Number | Cable Length in Feet | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | 260 | 280 | 300 | 320 | 330 |
| **109** | 27 | 30 | 34 | 37 | 41 | 44 | 48 | 51 | 55 | 58 | 62 | 65 | 69 | 72 | 74 |
| **110** | 27 | 30 | 34 | 37 | 41 | 44 | 48 | 51 | 55 | 58 | 62 | 65 | 69 | 72 | 74 |
| **111** | 27 | 30 | 34 | 37 | 41 | 44 | 48 | 51 | 55 | 58 | 62 | 65 | 69 | 72 | 74 |
| **112** | 27 | 30 | 34 | 37 | 41 | 44 | 48 | 51 | 55 | 58 | 62 | 65 | 69 | 72 | 74 |
| **113** | 27 | 30 | 34 | 37 | 41 | 44 | 48 | 51 | 55 | 58 | 62 | 65 | 69 | 72 | 74 |
| **114** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **115** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **116** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **117** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **118** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **119** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **120** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **121** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **122** | 28 | 31 | 35 | 38 | 42 | 45 | 49 | 52 | 56 | 59 | 63 | 66 | 70 | 73 | 75 |
| **123** | 28 | 32 | 35 | 39 | 43 | 46 | 50 | 53 | 57 | 61 | 64 | 68 | 72 | 75 | 77 |
| **124** | 28 | 32 | 35 | 39 | 43 | 46 | 50 | 53 | 57 | 61 | 64 | 68 | 72 | 75 | 77 |
| **125** | 28 | 32 | 35 | 39 | 43 | 46 | 50 | 53 | 57 | 61 | 64 | 68 | 72 | 75 | 77 |
| **126** | 28 | 32 | 35 | 39 | 43 | 46 | 50 | 53 | 57 | 61 | 64 | 68 | 72 | 75 | 77 |
| **127** | 28 | 32 | 35 | 39 | 43 | 46 | 50 | 53 | 57 | 61 | 64 | 68 | 72 | 75 | 77 |
| **128** | 28 | 32 | 35 | 39 | 43 | 46 | 50 | 53 | 57 | 61 | 64 | 68 | 72 | 75 | 77 |
| **129** | 28 | 32 | 36 | 39 | 43 | 47 | 50 | 54 | 58 | 61 | 65 | 69 | 73 | 76 | 78 |
| **130** | 28 | 32 | 36 | 39 | 43 | 47 | 50 | 54 | 58 | 61 | 65 | 69 | 73 | 76 | 78 |
| **131** | 28 | 32 | 36 | 39 | 43 | 47 | 50 | 54 | 58 | 61 | 65 | 69 | 73 | 76 | 78 |
| **132** | 28 | 32 | 36 | 39 | 43 | 47 | 50 | 54 | 58 | 61 | 65 | 69 | 73 | 76 | 78 |
| **133** | 28 | 32 | 36 | 40 | 44 | 47 | 51 | 55 | 59 | 63 | 66 | 70 | 74 | 78 | 80 |
| **134** | 29 | 32 | 36 | 40 | 44 | 48 | 52 | 55 | 59 | 63 | 67 | 71 | 75 | 78 | 80 |

# Humboldt University Science Complex - 3D

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## Equipment List - 22 Drop Design

| QTY | DESCRIPTION | PART NO |
|---|---|---|
| 130' | CommScope RG11 Quad Shield Riser Cable | F11SSVR |
| 2 | RG11 Snap-n-Seal Connectors | SNS11 |
| 75' | CommScope RG6 Quad Shield Riser Cable | F6SSVR |
| 20 | RG6 Snap-n-Seal Connectors | SNS6 |
| 3 | Viewsonics 2 way Splitters | VSP2WSP |
| 0 | Viewsonics 3 way Splitters | VSP3WSP |
| 1 | Blonder Tongue Directional Coupler | BTSRT9 |
| 1 | Blonder Tongue Directional Coupler | BTSRT12 |
| 2 | 16 Port Lynx Hub with faceplate | 040-0119 |
| 2 | BT Bi-Directional Rack Mount Amplifier | RMDA 860-30 |
| 2 | Pico Macom Attenuator | FAM-10 |
| 6 | Pico Macom 75 ohm Terminator | F59T |