Video Fundamentals 12

Cables, Connectors & Termination

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This time I would like to talk about connecting analogue video items up. Simple really just connect A to B right? Well in practice it can be just so, but like a lot of systems there is more to it than that.

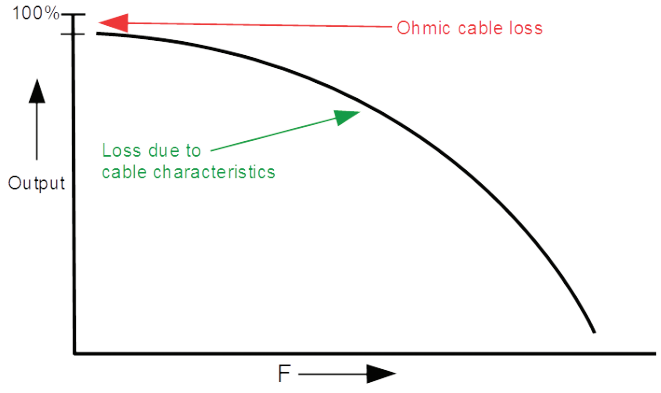
Type of cable and losses.

Ideally you use good quality 75Ω co-axial cable with BNC connectors, but even in this ideal scenario there are losses, not to much at the low frequency end of the video spectrum, but increasing with frequency. The colour burst and chroma waveforms will be reduced in amplitude leading to the picture being de-saturated, additionally the high frequency edges will be attenuated with apparent loss of resolution. Length for length, poor quality or small diameter cable will show these effects sooner.

Equalisation

There are a number of issues here, first modern TVs with video inputs often "auto correct" for chroma loss and low video, this is fine, but can lead to a false sense that all is well. If the burst to chroma ratio is wrong at source, the TV can add to the problem by auto correcting incorrectly[i]!

The correct way to proceed is to use an equalising DA[ii] the simple ones have gain, to correct LF losses and HF gain to correct chroma loss. Better ones have a proper network to give gain to match the losses in the type of cable in use.



▶ *Fig. 1: Typical cable loss against frequency*

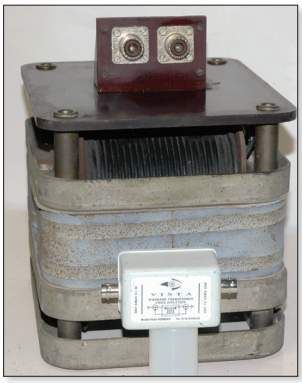
Hum

This can be a problem, often caused by the sending unit and the receiving unit having different earth (ground) potentials. Perhaps by being different parts of the building. As the video signal is only 700mV. it does not take much difference in earth potential to create a problem. In mild cases this shows up in a dark hum bar drifting up or down the screen[iii], in bad cases loss of picture lock can happen. Safety note if the earth potentials are wildly different, perhaps due to some fault condition, a shock is possible along with a bang as you connect up! Some intelligent awareness of possible hazards is necessary.

Dealing with HUM

In the past this was difficult and a special DA with a differential input was used or a device called a "stop coil" could be inserted in the input to the receiving unit. A stop coil[iv] was a large transformer with a coil of co-ax just wound on to it, it's inductance providing a series impedance to limit the flow of current due to the different earth potentials.

Later "stop coils" were real transformers using modern ferrites to give a wide, but not perfect frequency response, they were small an light, ideal for external monitors but, professionally, you would not want to put one in the transmission path. See Fig 2.



▶ *Fig. 2: Vintage "Stop Coil" with the modern transformer version*

Differential inputs

This useful technique is worth a better explanation as it is widely used on all sorts of equipment. Simplistically it can be considered to have the same effect as the balanced input transformers found on professional audio equipment. In video use the inner pin of the BNC would go to one input of a differential input amplifier and the BNC outer, insulated from earth, would go to the other differential inverting input. With this method of input connection, as the Hum voltage was applied to both inputs in phase it cancelled out at the output of the input stage. The wanted video signal being amplified as normal.

Connectors

The common BNC is a good choice, for analogue video it does not make much difference if they are 50 or 75Ω. The so called UHF connector (PL-259) is OK but tedious to do up and if loose can lead to LF distortion, not recommended. If I have a unit with the SO-239 connectors I normally leave an adaptor to BNC permanently fitted, and well tightened. The only good



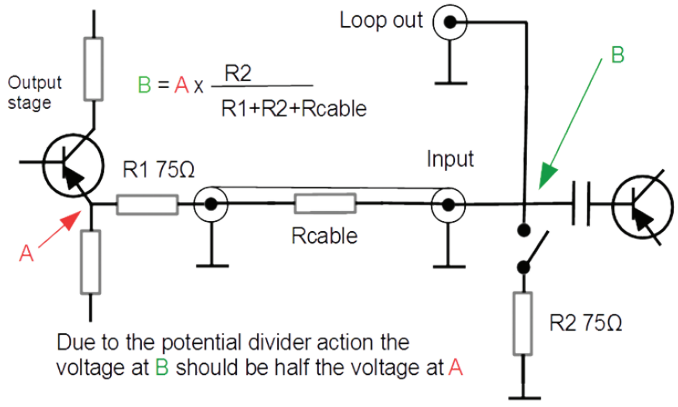
point about a phono connector is it's cheapness. Another connector often encountered in professional use is the Musa, handy for jackfield use.

Tee Adaptors & Loop Through

Video equipment, monitors and the like normally, have an input and output connector, used in conjunction with a switched termination. If the monitor is the last or only item connected it should be terminated with a 75Ω resistor. If you are looping through all but the last unit should be in the un-terminated state; i.e. high input impedance.

Terminations & Reflections.

You may be wondering why this termination business is so important? There are two practical aspects that need consideration:-



▶ *Fig. 3: Simplified termination circuit*

a. For video a coaxial cable is a 75Ω transmission line. That is the signal is sent from a 75Ω source and terminated with a 75Ω load resistor. If either is wrong the video signal level will be wrong! Easy to tweak if you are looking at a monitor but what about you transmitter? is the level low or high? dim or clipped?
In Fig.3, by Ohms Law, you can see the potential for errors. The obvious ones are
No termination = 200% volts
Double termination = 66% volts
The resistance of the cable (Rcable) has a smaller, but measurable effect.

b. Simplistically any length of co-ax cable can be seen as a transmission line with a characteristic impedance, 75 Ω for video work. A signal propagating along the line will see the terminating resistor (75Ω impedance) as a continuation of the cable and no reflection will occur. However if the terminating impedance (R2) is wrong, a most extreme case is if the termination is open circuit. The signal energy "having nowhere to go" will be reflected back up the cable and be absorbed by the sending resistor (R1 75Ω impedance). If the load is > 75Ω the reflection is non-inverted. If the load is < 75 Ω the reflection is inverted. Both the source and load impedance must be wrong if reflections are to be seen at the receiving end.

Any impedance discontinuity along the cable can cause reflections depending on the impedance change and the length of this impedance discontinuity. These small/short discontinuities are more troublesome for digital signals acting to reduce the eyehight[v].

Any Questions?

This is the twelfth in this series of simple explanations and now is your chance to have that troublesome question answered? Drop me an email and I will have a go at it. The answer may appear here in number thirteen or on the BATC Wiki

i An interesting effect can be seen if you just parallel up two of these domestic TV monitors, as you add the second connection the upstream TV goes dim for a moment while it thinks about it and then springs back to the "normal" display.

ii DA = Distribution Amplifier

iii The drift is caused by the difference in mains (50/60Hz.) and the picture field rate frequency.

iv The stop coil was aptly named, as well as reducing hum, it was sufficiently heavy to stop you picking it up!

v See Video Fundamentals part 8 for "Eye Hight"