

Twisted Pair Wire and Skew

As CAT 5 and 6 technologies have been introduced into the A/V industry new problems have been encountered, problems that rarely occur in coax cable systems, and new solutions have been found. One issue that users of twisted pair cable need to be aware of is the issue of skew, a condition where a signal may be time delayed relative to other signals. Fortunately, since the broadcast industry encountered problems with skew years ago, this is one problem that has already been solved, using a tried and proven method.

CAT 5 was originally developed for computer networks, where data is sent in serial form, rather than in parallel form. Therefore, skew was not an issue. However, crosstalk was an issue. Ethernet networks consist of two signals, transmit and receive, running long distances in close proximity. To minimize the crosstalk between individual twisted pairs, the rate of twist is varied among the pairs of wire. This has a side effect of making the twisted pairs vary in length. The pairs with more twist per inch will have a longer length.

As Figure 1 shows, the twisted pairs within a CAT 5e/6 cable vary in length. A signal that has to travel over a longer length of wire will arrive later than the signal that travels over a shorter length of wire. A difference in length of only two feet will produce a noticeable effect on a display. This is what is referred to as skew—the signal has been skewed time wise compared to another signal (or signals). This is a problem, because the late arrival of any part of the video signal will distort the image. For instance, if one of the color signals is delayed, that color will be shifted to the right on the image.

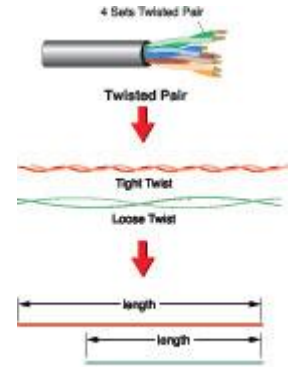


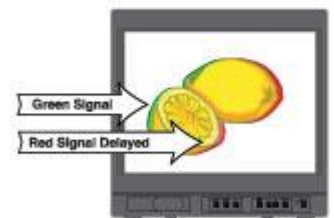
Figure 1

Figure 2 shows a case where the red and green color signals are used in conjunction to create the image of a lemon (the combination of red and green results in yellow). However, if the signal is sent through a CAT 5e/6 cable, and the red is sent on a twisted pair with more twists per inch than the green, the longer cable length will delay the red signal. The red will be applied on screen after the green. Therefore, the red will be shifted off to the right. Figure 3 shows the effect that would be seen on the image of the lemon if the red signal arrives late.



Normal Picture

As Figure 3 shows, the red portion of the lemon is shifted to the right. The red appears on the right, and the absence of red is on the left, as only the green signal is being drawn.



Due to the varying wire lengths, signals will arrive at the display at different times.

Figure 3

Correcting Skew Using Time Delay

One method of correcting skew is to use a skew adjustment that is built in to the receiver unit of a twisted pair transmitter-receiver set. Typically the user will adjust a potentiometer, which is part of a time delay filter, in order to delay signals so they will all arrive at the same time as the others.

A built-in skew adjustment will also likely limit bandwidth as part of the time filter operation. The result is noticeable on a display; images will look softer and not as crisp. It is the same effect seen when using equipment that has a low bandwidth.

Distance Correction: Using a Skew Compensation Cable

Since the cause of the problem is the varying distance between the individual wires, the obvious solution is to add a length of coax cable (a skew equalization cable, or patch cable) to the wire that is shorter, to equalize the distances. Coax is preferred as an equalization cable since it maintains proper impedance. This is the solution the broadcast industry has used for years, to solve this type of problem. It only needs to be done once. Figure 4 shows an example of how the patch cable is used in an actual set up.

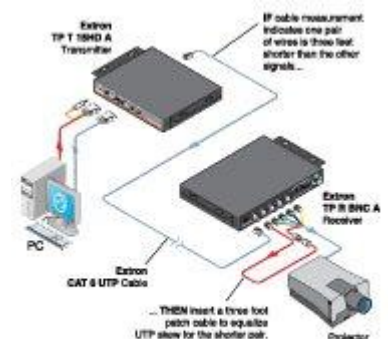


Figure 4

Extron uses this method with its CAT 6 installation kits. Extron's manufacturing department verifies the individual pairs in the CAT 6 cable are equivalent in length. If a pair is significantly shorter a patch cable of the proper length is supplied to equalize the distance between the pairs. The patch cable supplied is a coax cable with BNC connectors for easy connection, so field installation is easy.

When the integrator receives the cable kit from Extron, they simply install the skew adjustment cable. There is no need for measurements or test equipment on the installer's part. And once the patch cable is installed, there should be no need to adjust for skew again.