KRAMER ELECTRONICS LTD

Frequently Asked Questions

In this article we will try to answer some of the frequently asked questions related to video and signal processing.

What affects video signal quality?

There are many factors affecting video signal quality when transmitted from a video source, e.g., camera, VCR, video generator, etc., to a video acceptor - a VCR, video monitor, editing console etc.:

- Source and acceptor signal handling quality.
- Connection cables.
- Sockets and connectors of the sources and acceptors.
- Amplifying circuit quality.
- The distance between source and acceptors.
- Interference from neighboring appliances.

Why do cables have an effect on signal quality?

The video signal is very sensitive, as it has to carry information spread over a wide spectrum of frequencies, from almost 0 Hertz (DC) to many MHz (millions of Hertz - oscillations - per second). When high frequencies are involved, proper cable termination (loading) is needed in order to equally transfer all frequencies and avoid an effect called "standing waves", which is a result of signal reflections in the cable creating signal loss, "ghost" images and instability.
The electrical energy stored in the video signal is perfectly transferred from the source to the acceptor if the cable is fully matched at both ends. Low quality cables are not suitable for good signal handling and usually have excessive built-in capacitance, which degrades the signal.
When an inappropriate cable is used, quality of the signal deteriorates, details of the picture are lost, color fidelity is reduced and noise level, apparent as snow, destroys the picture. In addition, some low quality cables are not properly shielded, and do not isolate the video signal from external interference.

Why is the quality of sockets and connectors so important?

Just as cables, so also sockets and connectors play an important role in line matching. The optimal load of a video transmission line is 75 ohms, which is a low impedance value. A low quality connector, in which metal parts, not made or plated with silver or gold, make the connection, pose an additional load to the line, upset the 75 ohms matching, and create a host of undesirable effects.
A good quality connector creates a tight contact, which is not the case when a low quality connector is used. Therefore, refrain from using low quality cables and connectors, as the savings never pay off.

When is video signal distribution needed?

Signal distribution is needed when one or more signals are to be received at several acceptors. Some examples - in a duplication studio where many copies are made from one master, in shops and at points of sale for advertising and promotion, in railway stations and airports for time and route announcement and in many other applications. In the CCTV and security field several guards may need to control the same scene on several monitors, and in educational applications, pupils in several classrooms may watch one video signal.
The main object is to achieve the highest signal quality and equal outputs at each acceptors' input. In order to achieve high quality distributed video signals a distribution amplifier is needed. The video (and, if necessary, the audio) source is connected to the input(s) of the video distributor, and the outputs of the distributor are connected to the video acceptors. High quality cable and connectors should be used throughout.
This setup is good for short distances between source, amplifier and acceptors of a few meters, up to 15.

What to do when more outputs are needed?

Any distribution amplifier has a finite number of outputs. If more outputs are needed, a second DA may be connected to the first using the loop option, which is built-in in higher quality distributors.
The connection procedure is as follows:

- Connect the video/audio source to the input of the first DA.
- Connect the inputs of the second DA to the LOOP connector of the first DA.
- Connect the inputs of the third DA to the LOOP connector of the second DA, and so on.
- Turn all the termination switches near the input connectors to the Hi-Z position in all machines but the last. On the last DA, toggle the termination switch to the 75 Ohms position.
- Connect all video/audio acceptors to the output sockets of the DAs.
- Do not cascade the machines, using one active output as input to the next DA, as quality may degrade.

Which factors are important in a distribution system?

In setting up a large distribution system, the following factors should be very considered:

- Use only short cables between the loop connectors and the inputs of chained machines.
- Double check that the termination switches are in the correct position.
- Some DAs do not have a termination switch, only Hi-Z inputs. In this case use 75 Ohms dummy loads for termination.

What to do when more than one video source is to be distributed?

In small and medium size studios, it is sometimes necessary to perform two duplication jobs (or more) at the same time, using two different signal sources or even standards.
An elegant setup for such studios is using a multiple-input DA, where each section of the DA can operate independently of the other section. Simultaneous jobs can be done this way, and when a big duplication job is needed, just flip the switch, and all outputs are taken from one input.

How to handle a low quality video source?

Sometimes the video/audio source is of poor quality (high generation tape, old source, misadjusted tape etc.) In this case, signal correction prior to duplication is needed. First, the problem should be defined with as much clarity as possible.
If the image is very unstable, a TBC (time base corrector) should be installed between the source and the DA. If instability is minor, then a Sync or Black Burst restorer may be inserted in the signal path between the source and the DA.
If the sharpness, brightness, contrast or color is wrong, a video processor should be installed in series with the signal path.
This is done in the following way:

- ♦ Connect the output of the video/audio source to the input of the video processor.
- ♦ Connect the output of the video processor to the input of the DA.
- ♦ Connect all video acceptors to the outputs of the DAs.
- ♦ Use the controls of the video processor to correct and adjust the image.

Please keep the following in mind:

- ♦ Always keep the video/audio sources as close as possible to the video processor.
- ♦ Always use a video processor with a screen splitter for fast and accurate enhancement.

How to handle different video formats?

The above mentioned remarks are true also of a Y/C (Super-Video) or Component video setup. There are distributors as well as line amplifiers and processors for Y/C and component video. Such machines are naturally more expensive than Composite video machines as they are more complex, dealing simultaneously with several channels.
When dealing with Y/C or component video signals:

- ♦ Cable lengths of all the components leading to and from the acceptors and sources should be precisely of the same length. If cable lengths are not equal (for example, the "Y" cable is shorter than the "R-Y" or "B-Y" cables) unwanted effects may appear such as color smear, delay problems (bad registration of the black and white content with the color) and so on.
- ♦ Look for a DA that has a conversion option as well, for example, a Y/C DA that provides Y/C and composite outputs. It will save money and increase the flexibility of the studio.

What else is needed in a duplication studio?

Having the basic equipment - VCRs for playback and recording, video distributors and processors - is not sufficient for a foolproof job. The source sent for duplication can be monitored, but that will not reveal a tape that got stuck in one of the recording VCRs or a cable that got loose or disconnected.
In order to monitor what has actually been recorded, a VCR scanner is needed. After duplication, all tapes are rewound and played back. Every output of the recording VCRs is connected to an input of the scanner which sequentially scans each VCR, allowing monitoring of each output on a monitor. A "smart" scanner detects signal loss and either stops the scan on the faulty VCR or registers the mistakes in its internal memory (if the scanner is microprocessor controlled), for later retrieval. Scanners are vital now that 100% error free work has become the standard.

Why is there sometimes picture snow and instability in a normal DA setup?

In several instances, completely unexpected picture snow, interference and instability occur. It may happen in a solid studio setup, even when using high quality equipment and good sources.
The effect shows up on the screen as noise, zigzag lines, picture bending and "flagging" and a host of other unwanted, very visible types of interference. It may happen in all different video formats - Composite, Y/C or Component. There may be several reasons that contribute to the interference, and they have to be checked one by one in order to detect the cause and eliminate it:

- Sometimes, low quality audio cables of excessive length and cable capacitance cause the audio circuitry to oscillate, injecting interference into the whole system. To check this, disconnect the audio cables and watch the picture.
- Breakdown of the shield (screen) of one of the coax cables at one end may cause interference pickup and oscillations. Disconnect each cable in turn to find the faulty one.
- Loose contact of a connector (BNC or other) can invoke instability and image breakdown.
- Connecting to a switcher for example, a video source inputs and outputs to the same set of related connectors may cause instability due to signal looping ("feedback").
- A loose or missing termination switch and/or resistor may cause problems.
- Power brownout is a classic source of video problems. As video needs extremely good power regulation, when mains voltage drops too much, regulation is lost and interference suddenly appears.
- Shorting an output or excessive loading normally induces instability. Check for double loading and shorts.
- Vicinity to interference generators - like electric motors, neon lamps, light dimmers, computers and others - is a sure prescription for noise pickup.
- Wrong ground connection is a very common cause of interference. Check that all the equipment is grounded or disconnected from ground - following manufacturers' recommendation.

Usually, the causes seem minor, but they have a devastating effect.

How to use video amplifiers in fieldwork?

In fieldwork, it is often necessary to add a monitor or a VCR. In order to use a video DA in the field it should have the following features:

- Small physical dimensions.
- High quality, to eliminate signal degradation.
- DC feed and low power consumption.
- Check if the machine can operate on various voltages.
- Check that the trade off between power consumption and video linearity and bandwidth suits your needs.

How to send a video signal over very long distances (hundreds of meters and more)?

In order to transmit a video signal over a very long distance, three options are available:

- The twisted pair solution.
- The fiber optic solution.
- The RF / Microwave solution.

Each solution has advantages and disadvantages, and the user should check and weigh them for his needs:

- The twisted pair solution:
  The advantages of the twisted pair solution are simplicity and very low cost. All that is needed is a twisted pair transmitter, a twisted pair receiver and twisted pair wire of the requisite length. When using a good quality system this solution, can transmit video (and sometimes audio signals as well) over distances ranging from 300 meters up to 1 km.
  Black and white video (for security) can be transmitted up to 3 km using this system. The main disadvantages are fairly quick deterioration of signal quality with distance, and susceptibility to electromagnetic and electrostatic damage (lightning, strong electromagnetic fields etc.)
- The Fiber optic solution:
  Like the twisted pair solution, the fiber optic system consists of a transmitter, receiver and optical fiber of the appropriate length. Fiber optics allows transmitting video signals to distances from 5 km up to 50 km. Signal quality is maintained much better than with the twisted pair solution, and the signal is not susceptible to external interference. The drawbacks of this system are the price, mainly of the optic fiber, and the excessive sensitivity of the plugs and connectors (if a firm attachment of the connector is not assured the signal deteriorates rapidly.)
- The RF / Microwave solution:
  This solution has longest distance of transmission. The equipment involved is complicated and expensive - modulators, converters, transmitters, receivers, headends, downconverters and demodulators. The

received signal quality is excellent, but the price of good equipment is very high. With appropriate relays and satellite use, the range is practically unlimited.

The user should choose the right system for his needs, taking in consideration future expansion and his budget.

What are "ground loop" problems?

In all electronic equipment there is an electrical point connected to "ground". This grounding point may be a real connection to the mains ground or may be "virtual ground", which is a relative internal grounding point, isolated from the external "ground". The ground potential is usually defined as a zero voltage potential, to which all voltages in the device are referenced.

If two machines are connected, and they do not share the precise ground potential, "ground currents" may flow from one machine to the other. In video equipment this creates a disturbance in the picture which is apparent as running bars on the screen, and in audio equipment it can cause a low frequency hum. In Hi-Fi audio equipment, accurate grounding within the machine is critical, as otherwise low frequency oscillations and beating occur and the whole system bursts into instability and distortion.

This problem is called a ground loop, and there are several ways to eliminate it. One of the ways is to assure a firm ground connection between all machines involved and the mains ground. Another solution is exactly the opposite - separate the grounds of the machines, either by big blocking capacitors, transformers or other means of isolation.

How to deal with coupling problems?

When two machines are connected, the signals travelling from one machine to the other may be routed via various coupling devices. One of the most common devices that couples signals from one machine to another is the capacitor.

A capacitor allows a flow of Alternating Current (or Voltage) (AC coupling), but prevents Direct Current from flowing between the machines. A transformer essentially does the same. The "cleanest" and most transparent way to route a signal from one machine to another is DC (Direct Current) coupling, where one machine transfers all the components of the signal - the AC component as well as the DC - to the other machine, thus assuring full bandwidth and highest signal fidelity.

Professional audio and video equipment is usually DC coupled, for best signal transfer. Direct Coupling in video assures best signal quality, stability and color transfer. In many cases though, due to lack of universal standardization, Direct Coupling between machines may be troublesome and problematic, mainly due to different DC levels between inputs and outputs of the machines involved. In this case, inserting a capacitor in the signal path, with the right polarity, cures the problem. In video, a capacitor of about 1000-MicroFarad will suffice, provided the working voltage of the capacitor is higher than the DC level differences between the two machines. Transformer isolation in video is less common, as it is difficult to find a wide bandwidth, high quality transformer.

In professional audio, transformer coupling is more common, as audio transformers are easier and far less expensive to manufacture.

What is the difference between video and audio signal distribution?

Signal distribution techniques are mainly related to the signal bandwidth and level. Audio signals are far less prone to distribution problems if they have a large enough level.

The audio signal has a bandwidth of 20-20000 Hz, and is not as sensitive to loading as is the video signal.

The audio spectrum is defined in a relatively narrow range of frequencies and is, therefore, much easier to handle. When low audio signal levels are involved, using a good, low capacitance, shielded cable and appropriate termination will suffice. In severe cases, when extremely low signals are involved (such as those coming from a high quality microphone), balanced signal technology is used with satisfactory results.

Video signals boast a much wider spectrum of frequencies, ranging from almost zero Hertz (DC), up to 5, 10 or more Megahertz (millions of Hertz). A signal of this vast bandwidth is very problematic to handle.

Distribution and amplification of a video signal require excellent amplification systems, operating linearly over the entire spectrum.
Transferring such a signal from a source to an acceptor must be done via a high quality coaxial cable properly terminated at both edges (usually a 75-Ohm termination). Even when using a very good amplifier and a high quality cable, losses occur for various reasons (see above), and the effective distance of signal transfer is limited.

What are the specific audio related problems?

When dealing with audio, special attention has to be paid to several factors.
One of the least appreciated problems effecting audio performance is the quality of the cables. Normally, not much attention is paid to the cables used in audio, especially when low level signals are used. When working with power amplifiers, heavy wires are recommended for the speakers connection, but where low level audio signals are involved, the use of "shielded cable" is advised. However, shielding is not enough.
The shield around the cable is designed to performs two jobs - one, to shield the cable from external interference, which is why the shield is connected to the common ground. The other job is to act as a transmission line, similar to that used in video. In non-professional audio, the cable impedance is not critical, and cables are not properly terminated. In broadcast applications, however, the common cable load is 600 Ohms.
The failure to properly match the cable to the load gives rise to enhanced sensitivity to cable capacitance.
Audio cables, due to their construction, usually have high capacitance - several hundred Picofarads, in contrast to video cables, which have very low capacitance. This built-in capacitance may degrade the high frequency response of the signal and, even worse, may destabilize the driving amplifier, resulting in oscillations, overheating and noise.
Another important factor that has to be taken in account when dealing with low-level signals is noise. When picking an amplifier or an audio switcher, the Signal to Noise ratio (S/N) of the device has to be checked. The higher the number, the less likely that the device will add unwanted noise to the signal. Figures of 75 dB and higher are suitable when dealing with line level audio signals.
The device may also add distortion to the signal. A device that creates less than 0.1% THD (Total Harmonic Distortion) is acceptable.
Another critical factor is the signal handling capacity. The standard IHF signal levels are normally -10dBm - less than 1-Volt peak to peak. Balanced audio signals, such as used in broadcast applications, have a normal level of +4dBm and at peaks, the signal can rise to 15 Volts peak to peak or even higher. Therefore, before choosing an audio device, the signal levels that are to be used with the machine have to be taken in account.

What should you look for when buying an audio distribution amplifier?

Look for the following features when buying an audio DA:

- How many outputs does it provide?
- Does it operate in stereo?
- Are the signals balanced or unbalanced?
- What is the maximal signal level that the machine can handle?
- What is the S/N ratio?
- What is the distortion level introduced by the DA itself?
- Does the DA have more than one input (for source selection) and does it have looping inputs?

What are the problems when using a wide screen video projector?

Wide screen projectors can be either of the tube type or of the LCD/TFT* type. The tube types have three different tubes, one for each color, produce very bright images, but need frequent alignment, while the LCD/TFT* type are usually less bright and need no alignment.
The projection screen plays a major role in picture brightness and clarity as well, and the best screen should be chosen to suit the chosen projector.

Another important factor is the size of the projector, which is sometimes bulky and heavy, and needs special installation. The projected image contrast is extremely important for achieving a vivid and rich image on the screen. The contrast ratio (the ratio of brightness of the lightest part to the darkest part of the picture) is very important. Tubes and DLP* technology provide a better contrast ratio then LCD/TFT screens.

What kind of wide screen projector should be used?

Besides the points mentioned above, projectors differ in their ability to use different video sources: some are video only projectors, some are DATA (computer) projectors and some have both features, but these are obviously more expensive. DATA only projectors can use video as the source, by employing a device called "line-doubler", which raises the scan frequency and doubles the video lines so the resulting signal resembles a computer DATA signal.
The opposite, using a video only projector for computer DATA presentation, is also possible. This setup requires a scan converter that converts high frequency computer signals to video. This approach is limited in comparison to the one mentioned above because computer data is easily converted to video if the DATA scan rate is 640x480. In PAL, scan rates of 800x600 may also be converted to video, with minimal loss, but higher scan rates and resolutions, such as 1024x768 or 1280x1024, when converted to video, result in a tremendous loss of resolution.
Therefore, before buying, check what is to be displayed with your wide screen projector and the cost of additional devices needed to complement video or DATA only projectors.
Another point to bear in mind is the audio that is needed for presentation. Some projectors do not support audio (amplifier + loudspeaker), and external amplifiers and speakers are needed. Video or DATA presentations, as well as showing a movie need audio to be convincing.
The brightness of the projected image is also a point to consider. For example, a projector with brightness levels of 500 ANSI-Lumen is appropriate for a medium sized, partially illuminated conference room, but is not bright enough for a movie theatre or for an external stage show.
Size, weight and price are additional considerations when choosing a projector, as well as serviceability and physical ruggedness.

How to distribute computer graphic signals over long distances?

There are three ways:

- The simplest way is to convert the computer graphics to video, and then use the video solutions for distant transmissions - by line amplifier, twisted pair or fiber optic. This approach needs a scan converter to convert DATA to video. This solution is simple but is limited by computer resolution. Resolutions of 640x480 can be used with this proposal with a minor loss of details (provided a high quality scan converter is used).
- The second way is to use either three very high quality video DAs for each of the Red, Green and Blue channels or a Component Video DA that amplifies all signals in parallel. In order to obtain the best results, take care to use the best available cables, as high resolution computer graphics signal quality deteriorates very rapidly when using inappropriate cables. Bear in mind that the computer graphics signal may come in various formats - RGB with sync riding on green (three channels), RGBS with separate syncs (four channels), RGBHsVs which uses Red, Green, Blue and two channels for syncs - one for Horizontal and one for Vertical (five channels). The sync signals may be either TTL level (logic level syncs) or analog.
- The third way is to use a three-channel fiber optic system. This is the best solution in terms of quality and transmission distance, but the most expensive one.

What's the difference between a video switcher and a matrix?

The word SWITCHER is also sometimes used to describe a video mixer or SEG. We will use it exactly as the name indicates. A video switcher usually switches from several sources to one acceptor, having many inputs (4, 8, 16 or so) and one output, therefore, only one crosspoint is active at any given moment. Video

switchers may be of the electronic or mechanic type. A Video Matrix, on the other hand, has multiple inputs and outputs, allowing simultaneous connection between several sources and acceptors, and may be used as a DA as well. Matrices are usually of the active electronic type, having many crosspoints.

When is a vertical interval switcher needed?

Vertical Interval Switching assures that the transition from one video source to the other (as in switching between two Genlocked cameras) is smooth and without interference. When recording or transmitting a video program involving several video sources, as in live Broadcast, Vertical Interval Switching is needed to assure "clean", undisturbed picture transitions. The switched sources should be genlocked*.

What is RS-232 control?

RS-232 control is a way of remotely controlling a video device (Switcher, SEG, etc.) by using a personal computer with a serial port, or another device that uses a similar communication protocol. The simplest connection between an RS-232 controller and a controlled device uses two wires (TRANSMIT, RECEIVE) and a common ground wire.

How to extend a video-audio matrix switcher?

Adding inputs, outputs or both may extend a matrix switcher. In order to add OUTPUTS to a matrix setup, a second switcher is added, and the inputs of both matrices are connected in parallel (while assuring proper input termination, to avoid double termination).
In order to add INPUTS to an existing matrix, a second matrix is connected - paralleling the outputs of both machines. When a matrix is to be extended in both directions, both INPUTS and OUTPUTS are paralleled, requiring four or more machines.
A matrix can be extended only if it is designed as an extendable matrix, e.g., inputs must be looping and outputs must be able to be internally disconnected or become "floating".

How to remote control a switcher?

A switcher may be remote controlled with wires or by a wireless remote controller. The wires may be either connected in parallel to the existing control switches (if allowed by the design) or using the RS-232 or RS-422 control option provided by the machine. Wireless remote control usually employs an IR (infrared) transmitting-receiving system, similar to the systems available for home remote control (TV, VCR etc.)

What is needed to switch component video signals?

A dedicated component switcher is needed or a set of several high quality switchers that can be operated in parallel. The switcher, either single or part of a set, has to handle the incoming signals very accurately, as each signal (RGB or YUV) is part of the whole image, and if one part is impaired, the whole image becomes distorted. For example, if a switcher cannot transfer and match the RED signal to the same level as the GREEN signal, the whole image will suffer and have wrong colors and wrong brightness. The inputs and the outputs of the switcher should match the cables perfectly in order to avoid "standing waves" and other unwanted phenomena. The cables leading to and from the switcher should be of best quality and have the same length to avoid cross delay problems.

How to switch different video formats using one switcher?

If a composite video switcher is used to switch component video, the component video signals should first be converted to composite (using a video encoder), then switched, and, if necessary, converted back to component video using a video decoder. The encoding-decoding process usually introduces some noise, distortion and band limiting and should be avoided when working "on line", unless there is no alternative. Normally, encoding and decoding interface between one video format and another and are not done "back-to-back" in the same session.

How to add preview option to an existing switcher?

There are two basic ways:
1. Add a multi-input DA, such as a 4 times 1:2 DA, to where all sources are connected. A typical DA would have two outputs for each input, one connected to the switcher, the other to a monitor. If the DA has a 4x1 built in switcher as well, then only one monitor is needed to preview all inputs.
2. Use a switcher with looping inputs, connecting the loop output of each input to a monitor or an X-to-1 additional switcher.

What will disturb the operation of a vertical interval switcher?

Vertical Interval Switchers rely on incoming sync detection. Usually, the sync signals are stripped from input #1, and are used to operate (after some processing) the switching circuitry. If the switcher is microprocessor or RS-232 controlled, then the Vertical generated signals are also used by the microprocessor. When a low quality video source is connected to input #1, such as a satellite relayed video source or even a VCR in STOP or PAUSE mode, the switcher receives a very noisy signal or only noise. In most cases, this noise disturbs the normal operation of the built-in sync stripper, generating erroneous Vertical signals that might disturb or even completely block the operation of the switcher. In order to avoid this problem, the simplest procedure is to connect a good source to input #1 or, as in many video studios, the master studio Black Burst source.

What are Standby and Alert switchers?

Standby or Alert switchers have one or more inputs connected to the "Alert" or "Standby" source. When the main video signal is interrupted for some reason, or in an emergency, the switcher switches automatically to the "Alert" or "Standby" source, which is either a "filler" or an emergency message. The switcher can be forced into the "Alert" condition manually or via a remote control.

What are "virtual" Non-Linear (PC oriented) video machines / editors?

The classic way to edit video is cut-to-cut or by an AB roll system, where one VCR receives video via a video switcher/editor from several VCRs. VIRTUAL or DISK editing uses a computer and a hard disk. Selected video scenes from several sources are digitally recorded on a hard disk, mixed and edited in digital form, and transferred back to an analog or another digital VCR after editing. The advantages of this editing system are speed of editing, as access to every scene instantaneous due to the random access capability of hard disks, and the fact that there is no submaster stage which might reduce image quality. The drawbacks are the price of the system, which is usually higher than an analog system, the limited recorded time possible on a hard disk and, in some cases, glitches and other unwanted effects from the digitization process.

What is the function of a sequential switcher in a duplication studio?

A duplication studio uses one or more video sources, distribution amplifiers and many recording VCRs. The main problem encountered in duplication studios is the fact that sometimes a videocassette gets jammed, a cable gets loose or broken or one of the outputs of a DA ceases functioning.
A monitoring system is needed to control the recording process in order to produce 100% error free duplicates. This is usually done by rewinding all the VCRs to the beginning of the recording using a master remote control unit, and commanding playback on all VCRs. When all VCRs are playing the recorded tape, a sequential switcher routing the signals one after the other to a screen monitors the output of each VCR. Each recorded tape is viewed for a short period of time (or automatically monitored by a "smart" switcher). A faulty tape can be easily spotted and removed.

How to add audio signals to a video-only switcher?

Audio signals may be added to a video signal in one of two ways:
1. Converting the audio signal to a digitally coded signal, which is inserted into the video signal in the blanking period, where it is not seen on the screen but may be decoded later on.
2. Modulating the audio signal, mixing it with the video signal and, after processing or switching, decoding the audio signal.
The advantage of the first system is accuracy and high fidelity of the recovered audio signal, but the price of encoding and decoding is fairly high. The advantage of the second system is simplicity and lower cost, but the mixed signal, which contains high frequency signals, may be severely degraded by simple switchers and DAs that limit the transmitted video bandwidth. Since DAs and switchers now usually have large bandwidth due to the nature of the signals available in a studio, the second system is most suitable.

What problems are encountered when switching computer generated graphics signals?

Most computers use switching power supplies, eliminating the need for heavy and bulky power transformers. Switching power supplies chop the mains voltage at high frequencies, transferring the electric energy via small, high frequency transformers. If the computer is not firmly grounded, very high voltages may appear on the chassis, outputs and everything using those power supplies. In normal cases this is not a serious problem, as one computer is connected to one monitor, and grounding one of them suffices to eliminate high voltages on the chassis.
When switching several computers outputs to one monitor or vice versa, and all outputs are connected to the same switcher, high voltages, which may appear from several sources, can cause enormous damage, shorts and even fire.
Switchers should target this problem. One of the ways to eliminate the problem is to leave all inputs and outputs of the switcher "floating" and have only the required connection link the signals and the ground between the source and the acceptor.

Which switcher to use in security and CCTV applications?

Security and CCTV applications use sequential automatic switchers that have the appropriate number of inputs and outputs, controllable "dwell" time and some means of alarm detection and control. The sophisticated switchers use RS-232 or RS-422 control, allowing programming of the scanning sequence and duration via a computer.

What to look for when buying a video enhancer/processor?

Before purchasing a video enhancer or processor, you should define the problems you want it to address. Sometimes, only moderate processing is needed, such as brightness and image definition control, which may be achieved inexpensively with a simple image enhancer. In other cases, a stronger tool is needed, such as

for full color correction, black level control, contrast control and more. The format of operation should also been taken in account: Composite video, Y/C or Component video (analog or digital). Before purchasing a video processor, bear in mind your future needs as well, so the processor will not be made obsolete by your next purchase of equipment.

How to convert between different video formats?

There are several video signal formats: Composite, Y/C, YUV (Y, R-Y, B-Y), RGB (S) analog and digital. Component analog video formats (YUV and RGB) are unmodulated signals, where the signal level directly represents the signal intensity, for example, 1 Volt of "Y" signal represents a maximal white level. Converting from YUV to RGB and vice versa is relatively simple, and needs only an accurate matrixing system. Composite video and Y/C (SuperVideo) contains chrominance (color) information, which is a modulated signal using the color subcarrier (3.58 MHz in NTSC, 4.43 MHz in PAL) as the carrier signal. Simply adding or separating the color information from the luminance information does converting between Composite video and Y/C.
To convert between Composite or Y/C and Component video, a color Encoder or Color decoder is needed. The color encoder receives the component signal, and creates a chrominance signal by extracting the Blue and Red information from the Component video signal and modulates this information using the color subcarrier signal. It is often necessary to Genlock the Encoding process to an external Black Burst source.
The color Decoder does the opposite - it removes the color subcarrier and extracts the color difference signals to create the "Components".
Digital conversion does the same, but the signals dealt with are in digital form and different equipment is necessary.

How to convert between different video standards?

Different video standards are used in different countries. Most European countries use PAL, NTSC is used in the US, Japan and some others and SECAM is used mainly in France, and in a few other countries. Each standard uses different color encoding schemes. The most common way to convert between the standards is to use a Standards Converter. It is made of a Multistandard color decoder, which separates video into its components, usually to a digital form, with frame buffers (for converting between PAL and NTSC - as the timing of those standards differ). The final stage uses a digital encoder, for receiving component video, which is "standard-less" at this point, at least color-wise, and converting the components to Composite Video or Y/C in the required standard.

Why is Genlocking needed in video encoding?

Encoding requires color signal modulation of the component video signals. In order that the colors of the encoded signal should match those of the rest of the studio sources, genlocking is needed, so that the timing and color phase of all signals will match.

What are the sync related problems in video?

Sync related problems might be divided into two kinds:
1. Problems with the sync information carried with the video signal.
2. Problems of sync signal compatibility.
As sync information is vital for video image stability, deterioration or loss of the sync signals effects image stability. Both Horizontal and Vertical sync signals are crucial for image stability and proper image centering on the screen. When the sync signals are effected, during transmission or recording, they may be recovered using a sync restoring device or a TBC (Time Base Corrector).
The problem of sync compatibility exists because there are so many standards for transferring sync information with the video signal: sync signals may come in analog form, as a composite sync signal, and they may come in digital form - either composite or separate - Horizontal or Vertical, positive direction or

negative. The sync signals may also be part of the luminance signals (as in Composite Video or Y/C) or ride on a video component signal - such as the "Green" signal.
To solve this compatibility problem, special sync format converters are needed.

What is the difference between a Black Burst Restorer and a TBC?

When sync or color burst information gets lost or distorted, it must be recovered in order to maintain proper signal stability and true color. A Black Burst Restorer strips away all sync and color burst information (the "Black burst" signal) and replaces it with newly generated Black Burst from an internal genlocked generator. In many cases, this solves the instability and the color fidelity problems.
In severe cases, when not only the sync and color burst information are effected, but the lengths of the video signal lines are also distorted (as in high generation video tape copies), a Time Base Corrector (TBC) is needed to restore the video signal. The TBC "re-stretches" the video lines to the proper length and restores the sync and color information.

What are "video grabbers"?

A Video Grabber is usually a computer card, residing in the computer, with one or more video inputs. The video signal applied to the grabber is digitized and converted to a computer signal, and may be recorded digitally on a hard disk or another storage media.
A simple grabber captures a single video frame, "freezing" it in digital form and converting it to a computer graphics file format. The more complicated grabbers capture a short video scene, compress it and store it on a hard disk, so that short scenes may be stored and played back from you disk. Some grabbers allow overlaying the video image on the computer screen, either in a small window or as a full screen.
A critical part of video grabbing is the software that allows editing, special effects and so on.

What is the best computer graphics resolution for video?

The most suitable resolution of VGA for video conversion is 640x480. It is recommended that the maximal color depth is used - 24 bit color, representing 16.7 million colors. Higher VGA resolutions, when converted to video, loose some information because there are no more available video pixels. When higher VGA resolutions are converted to video - such as 800x600 or 1024x768, some compression is needed, and the final apparent video image does not substantially differ from the lower 640x480 resolution.

When to use a Line Doubler?

A line doubler de-interlaces a video image and creates a "cleaner" video picture that does not interlace and jitter. When a video image or movie is played on a wide screen data projector, the output of the line doubler is connected to the Data Input of the projector, normally reserved for computer VGA data. A good line doubler that uses interpolation algorithms creates a high quality, movie-like image on the screen.

What are the problems related to computer graphics conversion to video?

Three basic problems exist when computer graphics is converted to video:

1. The TV monitor and the PC use different types of pixels - square vs. rectangular. Only specific data resolutions can look "normal" when converted to video - not squeezed or stretched.
2. The computer resolution is usually far higher than video resolution, especially when color is involved. The result of this discrepancy is "smeared" colors on the video side with sharp ones on the computer side.
3. The PC generates a non-interlacing image that has to be re-interlaced (converted to different video fields) when converted to video. The problem is apparent when thin horizontal lines are converted to video -

creating a strong flicker effect. To overcome this annoying phenomenon special digital filters are introduced which sometimes lower apparent resolution.

How to interface old video films with new formats?

Old video films are usually in Composite video format. The image has to be enhanced, to start with, then converted at least to Y/C. In order to achieve resolution enhancement - a digital comb filter Y/C separator has to be used. Sometimes, the composite signal has to pass via a TBC if the source is unstable. After conversion to Y/C, further conversion to Component (Y, U, V) or digital format is sometimes needed.

How to interface movie films with video?

If old 8 mm or 16-mm celluloid film is to be converted to video, a Telecine is needed, and it is best to convert it to Y/C.

How to set up a twisted-pair system?

Twisted-pair wire system can be very useful to transmit video and audio signals over long distances. If a new system is designed, low capacitance, high quality, twisted pair wires should be used. However, to use existing twisted-pair wires already installed, it is necessary to verify the following:

1. The existing wires do not carry any voltage - direct or induced.
2. The existing wires go peer-to-peer, that there are no "junctions" and breaks.
3. There is no short between the wires or a link to "ground" along the wires.

What are the problems related to digital video?

Digital video (SDI) is similar to analog video in several ways. Cable and connectors quality is crucial for successful operation and high frequency loss due to poor connectors and cables effect the signal as in analog signals.
Digital signals can become jittery due to various factors similar to analog signals, and total image loss is common when the jitter reaches a certain level (the Cliff Effect*). A lost bit in a digital video signal can have much more adverse effects than a lost pixel in an analog signal.
Signal reconditioning (equalization and reclocking) is often needed when dealing with digital video signals.
The signal language (format) is very important - as digital signals rely on very specific communication protocols for successful signal transfer.
Level compatibility is a problem uncommon in analog signals. Digital signals may come in TTL, ECL or other levels and may not be compatible with each other.
Signal loading (fan-in and fan-out) is another problem encountered with digital signals, and special care should be taken in this regard too.

What is Recklocking?

When a serial digital signal travels in a coax cable over a long distance it may accumulate jitter that, when it reaches a certain level, upsets the stability of the transmitted image. In order to restore stability, a process called reclocking is applied to the signal, which is similar to the function of a TBC in the analog world. The clock signal that travels with the data (video) signal in extracted, and a new stabilized signal is created. Special complex circuitry is needed for this purpose - but if digital video is to be used over long distances - reclocking is a must.