

Police Video Recording Systems

Analog

Foreword

This White Paper is designed for an in depth comparison of in car police video systems. Many different types and manufacturers of police video systems are currently on the market today. It is the intention of this document to give the truth about each type of system so police departments can make intelligent decisions based on facts. The information given in the comparison section is believed to be true and accurate. If any person has additional information or disagrees with the conclusions made by this text, please contact the posting person your opinion or fact with the relevant technical documents for evaluation and inclusion in this text.

Introduction

There are several categories of in car police video systems. We will start with the two major categories:

1. **In Cab Systems**
2. **Dash Mount Camcorders**
3. **In Cab Split Systems**
4. **Trunk Mounted Split Systems**

In Cab Systems

Camcorder Systems

The in cab camcorder systems were some of the first to be introduced. This system usually mounts the camcorder on the dash of the vehicle. The major advantage of a camcorder system is easy installation and easy removal for scene recording. This advantage also is a disadvantage since some officers who take the vehicles home remove the camcorder and use it for personal use. This relatively large object mounted on the dash can become a projectile in an accident. For insurance reasons some PDs can not install camcorders on the dash of the vehicle. Camcorders are also designed for non-continuous usage and usually carry a short warranty period. Camcorders can be significantly more expensive to repair than standard VCRs, which presents a problem if regular maintenance is not performed on the camcorder. Since camcorders are mounted on the dash they receive the full extent of summer sun. This heat can actually melt the plastic enclosures and cause irreparable damage.

In the beginning full size VHS camcorders were used that could record a full 8 hrs with a T160 video tape in the EP mode. Currently there are very few full size VHS camcorders on the market that can record in the EP mode, limiting the recording time to 3 hrs with a T-160 tape. When using a VHS-C camcorder the record time is even shorter. The most you can record with VHS-C is 1 hr with the longest tape. 8mm camcorders have a time restriction of 4 hrs. This reduced recording time without changing tapes is the major limitation to dash mount camcorders. The latest hybrid uses DV or Digital Video tape. The video quality is much better since stored in digital format. However internally is still a video tape about 4mm in width using the same helical scan head used in traditional analog video recorders. The time restriction is similar to 4 hrs. However some can record in reduced resolution and obtain higher record times.

The video camera in camcorders is usually of good quality and has at least a 12X zoom with auto focus and auto iris functions. This means you just point the camcorder and a good picture is recorded. Typically the camera portion of a camcorder has specifications equal to the best split system on the market today. A user must compare Lux rating @ the f-stop (e.g. F1.4), zoom range (digital or optical) and resolution. These facts are not easy to find in camcorder specifications but are very popular advertising specifications in split systems. The quality of a video picture is also very subjective to an individual and a particular usage. It is recommended the user not purchase video systems based on specifications but true in-car comparison.

For example, a police department purchased a low light B&W camera system with 0.2 Lux @ f1.4 rating using a f1.8 Vari Focus Auto Iris lens. They did not like the way the camera worked at night when they would go by bright lights or when getting a license plate number using their headlights. The reason was the camera was too sensitive and the zoom lens could not zoom in all the way to the license plate so the auto iris function could work properly. The PD traded the camera for a color one that was rated at 2 Lux @ f1.4 using the same f1.8 lens. The camera performed much better and was acceptable by the PD. The reason was the new camera was 10 times less sensitive at night and this was the application for which this PD was purchasing the video system. Of course there are several other ways to solve this customer's problem, but the point of this example is that specifications can be misleading when the end result is subjective.

Normally camcorders have to be manually initiated to go to the record mode. This can be cumbersome and is sometimes forgotten in critical situations. Some vendors can activate the camcorders to record automatically via take down lights or some easily accessible switch.

Camcorders also can be fitted with remote wireless microphones. Wireless microphones will be discussed later since there are many makes and models with various quality levels. Nonetheless, camcorder systems should be fitted with wireless microphones for a full video and audio record of the events.

Most camcorder systems on the market today have the Time and Date inserted into the video via the camcorder. This is settable on the camcorder via pushbuttons. Since this feature can be turned on it also can be turned off. This leaves a potential problem if the T/D is disabled and an event occurs for legal reasons. Make sure this feature can be permanently set or at least difficult to disable.

Camcorder systems do not contain any type of heating or cooling. In extreme environments the camcorder is removed and stored in normal room temperature and put in a vehicle after the cab is up to normal temperatures. If the camcorder is not removed and is allowed to stay in an extremely hot or cold vehicle, the camcorder must be heated or cooled to operational temperature before any video can be recorded.

Camcorder systems are not covered by any patents. This means the cost does not include the royalty payments to patent owners, which gives this system the lowest cost of any in- car police video system.

In Cab Split Systems

In cab split systems usually include a dash mounted camera connected to a VCR, which is mounted under the seat, behind the seat, on the passenger side floor, or under the dash. There can be a remote control unit to operate the VCR as optional or included equipment. The major advantage of this type of system is that it does not require patent licensing and still has all the advantages of a standard VCR. This type of system operates just like a trunk mount system but without the VCR in the trunk. Since the VCR normally stays in the vehicle, it is supplied with or without heating and cooling. For areas that have extreme cold, it is recommended a heater be included in the unit to bring the VCR to operational temperature. In extreme heat a fan is usually supplied to use the cool air in the cab to blow through the enclosure for bringing the VCR into operational temperature.

Trunk Mounted Video Systems

Trunk mounted systems are very similar to in cab split systems. The major difference is that when mounting a VCR in the trunk it needs to be temperature controlled, either heated or cooled. For most parts of the U.S., heating via resistive heating elements in the winter is used in conjunction with a fan. The fan alone in the summer is usually enough to maintain operating temperatures of the VCR. Some trunk installations use the air from the cab via a duct to eliminate the need for expensive heating and cooling devices. In extreme heat, other systems using heat pumps have been used. This requires a sealed VCR case and thermionic or compressor devices which are extremely inefficient and consume large current draws from the battery and alternator.

Some type of shock mounting is required to reduce sharp vibrations which can dislodge internal components and cause the tape to jump out of the tape path causing tape jams. Some vendors put padding inside the vault and some use shock mounts on the outside.

Up front in the vehicle is usually a control head to give user feedback and controls for the VCR operation. These control heads either mount overhead or on the equipment console. The reason for overhead is to free up space on the equipment consoles in the ever crowded modern police vehicle. There are also handheld controls that lay next to the seat on an embilical type arrangement. These handhelds are usually the most cost effective, with the monitor separate from the control head. Overhead consoles either have internal or external monitors. The newest technology has a recessed LCD monitor for a very low overhead profile. In most systems that use LCD monitors, care has to be taken in mounting so direct sunlight does not shine on the monitor which makes it very difficult to view.

The camera of a trunk mount system is usually mounted on the dash board, from the windshield or from the ceiling. Any kind of camera configuration can be used but most high end systems use an automatic color camera with electric zoom and auto/manual focus.

Many features available on these high end products vary from vendor to vendor. Some of the most useful features are listed below:

- **Record Protection**
This feature insures that videotape can not be rewound and recorded over any portion of the tape. This can be done in software by not allowing the user physical command over the VCR to do this. Other vendors record a unique number on the tape in each video picture or continuously on the audio channel. An interruption in the continuity of this recording will be visible or audible.
- **Take Down Light Activation**
This is where the VCR is automatically triggered to start recording when the lights, siren or pursuit mode lights are turned on by the officer. Usually the VCR records for a short period after the lights are turned off to view the target vehicle leaving the scene.
- **Time Remaining on Tape**
This feature gives the user a running time of how much recording time is left. This allows the officer to replace a tape when nearing the end so no event is lost.
- **Function Inputs**
These are inputs that when connected to lights, siren, etc put on-screen text that is recorded on the video for verification the vehicle had these functions active. This is important for legal proof of correct procedure execution.
- **Auxillary Data Ports**
This is additional data input ports for on-screen radar gun data, computer interface or BAC data from Breathalizers.
- **Wireless Trigger**
With this function, when the wireless microphone is turned on the VCR automatically starts recording. This can be via tone code squelch or RF carrier detect circuitry.
- **Low Tape Warning**
This is an automatic feature that is constantly monitoring the tape left and can initiate an audible alarm when the tape is very close to the end.

Many other features are available and the PD should determine which ones are of importance to their particular operations.

Trunk mounted police car video systems are covered by patents and the selling agent must be licensed or face legal action.

VCRs

In car police video systems have all types of VCRs, usually of standard VHS type. The standard full size VHS is most desirable due to the long recording times of up to 8 hrs with a T-160 tape using the VCR in the EP mode. There are T-180 tapes that can also extend the recording time to 9 hrs.

Some manufacturers use 2 head VCRs and some use 4 head VCRs. All VCRs, whether 2 head or 4 head, use 2 heads to record the tape regardless of the recording speed. A 4 head VCR only uses the 4 heads during playback pause mode or special effects. A 4 head VCR only uses 2 heads to playback a normally recorded tape. This means that a tape recorded on a 2 head VCR will look just as good when played back on a 4 head VCR as a tape recorded on a 4 head VCR. For in car video systems the use of 4 head VCRs are only for playback quality within the car itself. The importance of a 4 head VCR is almost none except

to give the user a false sense of quality difference between a 2 head VCR and 4 head VCR. The important feature of a VCR is the recording quality and not the playback since the tape is removed from the vehicle and reviewed if a problem has been identified anyway.

Most standard VHS VCRs are specified to have a recording resolution of 240 lines. Some industrial models can give up to 350 lines of resolution. SVHS VCRs can give over 400 lines of resolution. Resolution is the measure of the amount of detail or clarity the playback picture contains. All VCR manufacturers specify resolution in SP mode. Almost all video systems are operated in the EP mode which gives the longest recording time. In this recording mode the manufacturer usually does not specify resolution since it is so low. You can see the difference yourself when you record for a short period in each mode and compare. Typically a VCR rated at 240 lines in SP will give about 180 lines in EP.

Another parameter that is misunderstood is S/N (Signal to Noise Ratio). This is the crawling noise in the video or the streaks in the video. Again VCR manufacturers specify this at the SP mode and a good number is 46 Db and above. When you record in the EP mode this number can drop well below 40 Db. You also can not expect the EP S/N Ratio to be better when the SP mode is better. Usually this is the case, but some VCRs are peaked for SP and EP falls way below that of other VCRs even if the SP was lower in the beginning. As stated before, since all of this can be very confusing, believe your eyes, not the specification.

There does exist different quality levels between various VCRs on the market today. There are consumer type VCRs and industrial type VCRs used in various systems. There is a false sense of superior quality of industrial over consumer VCRs. There are many consumer VCRs that are higher quality than industrial VCRs. The only definition of the difference between the two categories (as defined by the US Customs and UL Laboratories) is the following:

Consumer VCRs have two prong AC power cord and RCA video input/output jacks.

Industrial VCRs have a three prong grounded AC power cord and BNC video input/output jacks.

These are the only differences. In fact most VCR manufacturers use the same internal mechanism for their consumer and industrial models. Some manufacturers actually use older models of mechanisms for the industrial models since the sales quantity is so low they do not want to spend the money for model redesign.

The different manufacturers also have different quality in the deck mechanism itself. The deck mechanism is the actual mechanical part of the VCR that loads the tape and plays and records video on the tape. In the past 15 years the mechanisms have gone through tremendous amount of change. Most mechanisms are made of punched and bent metal. Some mechanism are made from die cast chassis. Several years ago the diecast chassis gave better stability of the tape path which yielded a better picture quality. At this early stage the servo control was very basic and drive motors were primitive. In recent years the servo electronic control and advanced motor design have eliminated the need for die cast chassis. Actually the best mechanisms on the market today are made of bent and punched metal with advanced servo control. The perceived durability and superior quality of die cast chassis over other types is simply not true.

The true evaluation of a particular VCR is not the recording and playing back on that VCR. The correct evaluation would be to make a tape on a vendor's system and evaluate the playback on another high quality VCR in the PD. Remember, the major advantage of a 4 head VCR in the vehicle is to review and pause recorded video while in the police car, which yields a noiseless and flickerless picture. If this is a requirement of your video system then a 4 head VCR is required.

VCR Mounting Configurations

- **Horizontal**
Most commercially available VCRs are designed to operate in the horizontal position. The internal tape path is designed for this configuration. If mounted out of this geometry there may be a chance for the tape to jump out of the tape path and cause a jam.
- **Vertical**
Most camcorders are operated in the vertical position. The tape loading of a camcorder is different

from a conventional VCR, allowing for greater head tension which allows operation in the vertical position. Many conventional VCRs, although designed for horizontal, have been operated in the vertical position with no ill effects. This is mainly VCR dependent.

Video Tapes

Care must be taken in using video tapes of good quality. Low cost tapes have higher drag on the hubs which can reduce the service life of the VCR. T-120 tapes are the most common. They give 6 hrs of record time when the VCR is in the EP mode. The T-160 tapes give 8 hrs in the EP mode. T-180 tapes give 9 hrs of recording in the EP mode. The difference between these tapes is the physical length of the tape on the cassette. The more tape the longer the recording time since EP is the slowest recording speed for VHS VCRs. The T-160 tapes usually have the same type of tape as the T-120 but just more of it. The T-180 is actually a thinner tape so the manufacturers can fit more on the same cassette.

Brand new tapes all have a certain amount of ferrite dust on the tape. This is loose particulars of the magnetic material on the tape that the manufacturer could not remove. When you record a tape for the first time all this dust goes into the VCR. This is a major contributor to head clogging and dirty VCRs. New tapes should be recorded once on a test VCR before put into the field. If this procedure is adhered to, the VCR will give a longer service life.

B&W Cameras

B&W cameras normally have a lower (better) light sensitivity. This is great for night use where ambient light is limited. B&W cameras are also lower cost than color. It is this lower cost feature that makes B&W attractive for video systems.

Color Cameras

Color Cameras normally have a higher (worse) Lux rating or are less sensitive than B&W. Color cameras are recommended because of the ease of identification of suspects and objects with the added advantage of color. Color cameras have internal color processing that makes the colors look clear and bright or dull and fuzzy. This color specification is usually left out of the specifications in most color cameras. Again we invoke the subjective rule. Look at the recorded playback to make your decision. Color cameras consume more power than B&W models, which reduces the recording time on batteries.

Lens

All cameras have a lens included. Some cameras have an integrated lens and some have an add on lens. There are C mount lenses and CS mount lenses and some vendors use board cameras in a box that have various types of non standard mounts. There are fixed focus lenses that have no adjustment. VariFocus lens have a type of zoom control but require refocusing after this control is moved. Zoom lens require no refocusing on the full range of zooming. The high end cameras with built in zoom and focus are completely automatic, yielding good pictures with no intervention regardless of the situation.

Lux, F Stop, and IRE

These are the technical specifications that few people understand about cameras and lenses. All cameras have a Lux rating, and an associated lens with an f stop rating. Lux is the rating of the amount of light required to see an image. The lower the Lux the better, which means the camera is more sensitive to light and can be used in darker situations. The f-stop is like an aperture that restricts the amount of light getting in through the lens opening. The lower the f-stop the better or the more light that can get to the imager of the camera. The hidden specification is the IRE associated with the above specifications. IRE represents the level of the video signal; 100 IRE is maximum white and 0 IRE is black. All the levels of video fall in between 0 and 100 IRE. When a camera vendor says 2 Lux @ f 1.4 at 50IRE that means the following; When a camera is pointed at an object illuminated by a light source of 2 Lux and the lens on the camera has a specification of f 1.4 the video level coming out of the camera is half way between white and black or gray. If a vendor rated the same specification but at 25 IRE that camera would have 1/2 the sensitivity of the one rated at 50 IRE. There also is an internal gain of the camera that is sometimes

increased to give the required specification but the picture is very noisy with the picture looking like it is in a snow storm. If the above specification was 2 Lux @ f 1.2 at 50 IRE this camera would be twice as sensitive. Remember that at 2 Lux there is very little color content. Most color cameras at low light conditions show no color at all. The whole exercise here is to show you that a camera vendor can make a camera look as good as they want with specifications. Again the only proof of quality is the subjective test since there is no way to equally compare any two cameras on the market today unless you are a qualified engineer with \$20K worth of test equipment.

Integrated Cameras

The integrated cameras create a specification with the lens' f stop built into the specification. To compare this with a standard camera with an add on lens you have to understand how Lux and f stop work.

Resolution Standard VHS

Resolution is the measure of highest frequency the camera can recognize. This is determined by the number of pixels (eg 768h x 512v) the imager has which directly converts to resolution. Some people consider resolution as the clarity of the picture which is again a subjective opinion. Most color cameras used today have resolution starting at 300 lines and up. The camera resolution as a rule should be greater than the resolution of the VCR. Most standard VHS VCRs on the market today have color resolution at approx. 240 lines. Higher quality VCRs can go up to 300 lines but this is normally the maximum. If a VCR can only record up to 300 lines of resolution the color camera resolution at 330 lines is already greater than the VCR. This means the most you are going to get out of the VCR is 300 lines, so why buy a 400 line color camera? The subjective opinion is again evoked in this comparison. Do not buy a high resolution camera because it looks good on a monitor, make sure the playback looks good on the monitor.

Resolution SVHS

SVHS is a newer format that can give greater than 400 lines of color resolution. This format also requires a SVHS camera and both must connect together using the SVHS connector system. To view the new SVHS resolution you must also use an SVHS monitor. If one or the other is not SVHS the resolution is reduced back to the 240 lines of a standard VHS VCR.

Wireless Microphones

Lapel mounted wireless microphones are almost a requirement in mobile police video systems. The need to record everything an officer says is important in every legal action, and to hear responses from the interviewee is also very important. The only way to guarantee both recordings is to have the microphone mounted on the officer. Various types of wireless microphones are available in various qualities and operating frequencies. The lowest cost units utilize the 47 Mhz band. This frequency is shared with remote telephones, radio controlled cars, garage doors and many other devices. The sheer number of these devices on the market guarantee interference with the audio in any populated area. Other units use 160 Mhz to 190 Mhz. These units operate better since they generally were designed for high quality audio for singers and musicians. Also this frequency range is less polluted with consumer products. Newer units operate on the 900 Mhz spread spectrum frequency. The technology in the frequency band eliminates overlapping by the spread spectrum technology. This band can also be digital which will be the trend for the future to completely eliminate noise and interference.

The biggest disadvantage is that most of this wireless transmitters use a standard alkaline 9V battery. You can expect 6-10hrs of operation and then you need to replace the battery. If a rechargeable system is available this would eliminate many of the current problems in the field of battery replacement.

Some manufacturers supply units with tone code squelch that can be detected by the receiver to trigger the VCR into record when the officer turns on the wireless microphone. Another method is the receiver detects an RF carrier from the transmitter and turns on the VCR. The squelch system is much more reliable since the receiver is looking for a particular code from the transmitter while the RF carrier detect senses only the presence of the transmitting frequency. If another device goes by with the same frequency the RF carrier detect will turn on the VCR. This is very rare but possible.

Trunk mounted antennas must be installed and connected to the receiver in the vault in the trunk or cab. If this antenna is broken or disconnected no audio will be received or recorded.

Wireless Audio and Video

The new trend is to not only have a wireless microphone on the officer but also a wireless camera. This eliminates or adds to the internal camera on the dash. Usually these systems must be FCC licensed so the user can possess a high power transmitter, so clean video is always recorded. The systems that operate at 900 Mhz usually do not have enough power to give quality video. The frequency of choice is 2.4 Ghz with diversity antennas on the receiver to guarantee good video. These units consume a significant amount of power from the battery pack on the belt and must be recharged regularly. A lapel mount of camera and microphone are usually 2"x2"x1" with a wire to the belt pack which houses the transmitter and battery pack.

Radar Gun Interfacing

Many video systems have options for direct input to radar guns. Most new guns have an RS-232 port that can connect easily to most video systems. Care must be taken in expecting older style units to connect. Some models are unable to connect or require additional converter boxes that increase the system cost. Also different manufacturers of radar guns give out different information. Some give only target speed, some only lock speed, some both, some patrol speed and target speed and not lock speed. Check with the video system vendor and evaluate your radar gun stocks to see if compatibility is even possible. Some radar gun manufacturers actually void their warranty when connecting to video interfacing equipment. Assume nothing here, get a working demo.

BAC Interfacing

There exists some vendors who directly support connection of BAC equipment to the video system for verification. AVE manufactures an add-on product called the VSI that overlays most manufacturer's BAC equipment data onto any video system for recording. Interfacing to video gives a proof positive record of test results. This can also be used back at the PD in the testing room.

Installation

Most PDs have their local radio shop do the installation. This is preferable to the shops that install the consoles and light bars. This is only because technicians installing radios are more familiar with electronic product installation and grounding. Improper grounding on installation can cause interference in the video or radio or both. Of course improper cable installation can cause broken connectors or heat damage if near the muffler or catalytic converter. Most problems with mobile police video systems are installation and the subsequent troubleshooting.

RFI and EMI

Sometimes the video system will have interference from the radio when the microphone is keyed. This is usually due to improper grounding on the radio and/or the video system. Some PDs have high powered radios for use in large counties. If this is the case the RF energy may be going directly into the camera, in which case a metal enclosure must be installed around the camera. RFI and EMI must be approached on a case by case basis and each vehicle will be different. Generally quality video systems do not have this problem but eventually you might.

In Conclusion

Congratulations, you made it through. We believe you now have the working knowledge to specify a video system for your PD based on your needs and wants. The most important fact to remember is to evaluate a video system to your specifications, not someone else's.