

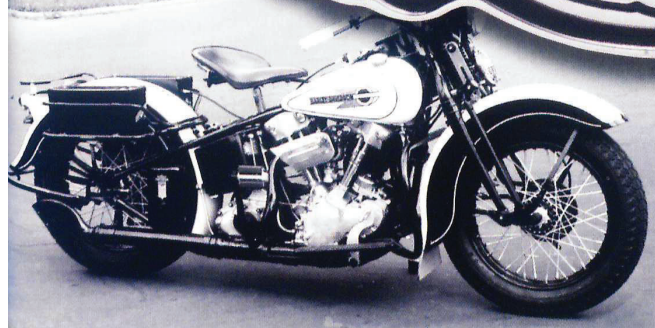
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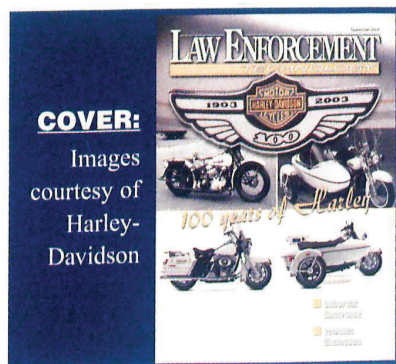
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IMAGING TECHNOLOGY

Story and photos by Craig Peterson

Digital Mobile Witness recording system

A 4.25-inch color monitor can be linked to as many as four miniature Sony industrial cameras. The auto-zoom feature captures the plate then reverts to wide angle to record the action. Automatic pre- and post-event image capture is one of the advantages of digital recording systems.



Although videotape remains the industry-standard medium for mobile recording systems, the Digital Age is at hand. The T.A.W. Digital Mobile Witness, from T.A.W. Security Concepts, located in Wheat Ridge, Colorado, is a dedicated processor with an application-specific, Unix-based real-time operating system and removable 120-gigabyte hard drive. The combination is able to record up to 45 hours of full-motion, 30 frame-per-second audio and video.

The absence of videotape means there are almost no moving parts to break and no tapes to archive. Data security is ensured by T.A.W.'s proprietary "hybrid wavelet" file format. Unlike the JPEG or AVI files common to PCs that can be manipulated at will, T.A.W.'s algorithm embeds a reference number on each frame recorded. When the data are downloaded, the same algorithm again reads the frame number and compares it to the original. If the two differ by

even a single pixel, the system refuses to display an image, leaving the operator staring at a blank monitor.

Catching the pre- and post-event action

Use of digital imaging affords some tantalizing capabilities. Key

The unit records in a continuous loop, capturing 4.25 minutes of action before and after an event.

among them are pre- and post-event recording. In essence, the unit records in a continuous loop, capturing 4.25 minutes of action before and after an

event. Once the system has been triggered, either manually by activation of the emergency lights or by the officer switching on the belt-worn wireless microphone, the previous 4-plus minutes are captured. The same amount of images will be captured after the system is switched off.

The implications are obvious. Say an officer is en route to a call and gets in a traffic accident. With a conventional system, if he isn't running Code 3, the tape probably won't be rolling. It'll be up to the lawyers and court to sort out who's at fault. But a system such as the T.A.W. will have recorded the previous 4.25 minutes, capturing the events leading up to the accident. If equipped with the optional Radar Interface/Vehicle Status Overlay, the T.A.W. will also have recorded the status of up to eight vehicle parameters including patrol speed, brake-light and turn-signal activation, emergency lights and siren, even GPS coordinates and airbag deployment.

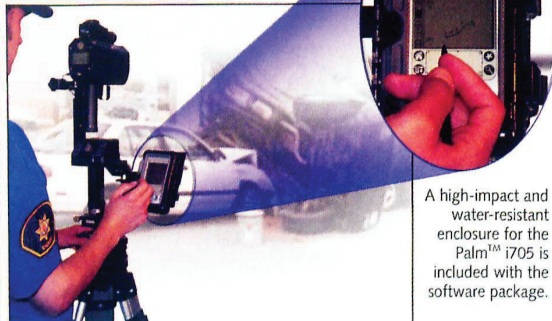
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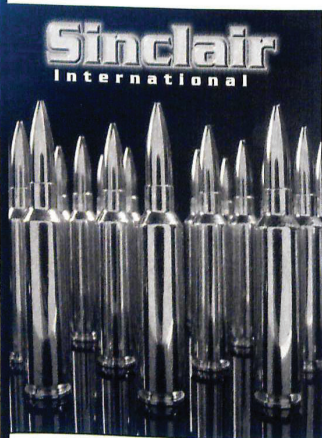
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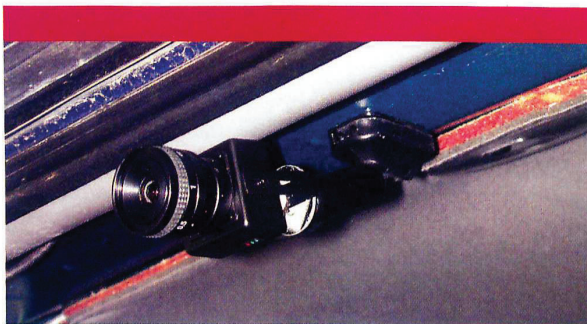
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(Above) The Sony industrial-grade, high-resolution camera has digital zoom and is light enough to be mounted from an existing headliner screw in the police Ford Expedition test vehicle. It proved to be unaffected by windshield tint, although that also made it invisible from outside the vehicle.

(Right) A rearward-facing camera was mounted on the vehicle headliner looking through the tailgate glass. Like the front camera, tinted glass obscured it from inquisitive eyes.



The computer can be programmed to simultaneously record images from up to four cameras and four audio sources, the latter including a wireless microphone on the officer. And due to its digital format, images are superior. While VHS images have approximately 240 horizontal TV lines of resolution, the T.A.W. system delivers 400.

More importantly, the images can easily be enhanced. At T.A.W.'s plant in suburban Denver, I viewed on a PC monitor the image of a license plate, which, taken at night, was washed-out and unreadable because of headlight glare. Then I watched as Vice President Charles Kirmuss used image-enhancement software called Paragon Enhance-Pro to peel away layers of glare and reveal the plate number with a few clicks of the mouse. The process took less than a minute.

Digitized images offer other advantages. Once downloaded and converted to a conventional file format such as AVI or MPEG, they can be sent as e-mail attachments or burned onto a CD. Such versatility will likely endear digital technology to those accustomed to enduring the practical limitations of videotape. For example, say an officer has made a DUI arrest and returns with the prisoner to the station. After taking out the hard drive from the vault in the vehicle, he can load the image to T.A.W.'s desktop workstation for viewing. Marking the desired in and out points with the mouse, he'll download the needed files. Back with the suspect, video camera switched on, he can administer a sobriety test and capture these images and audio on the same CD or storage device as that taken from the car. Breath test results can be overlaid and recorded as well.

Locating the images, archiving the files

With an incident number automatically embedded on the

file, any authorized person in the system — from supervisor to prosecutor — can quickly retrieve the images. Instead of having to laboriously search through multiple videotape cassettes generated by the stop, sobriety test and booking, the viewer is instantly taken to the key files, consolidated on one CD, by entering the incident number. And because the files are tamper-proof, chain-of-custody concerns are unlikely to be an issue.

A point to remember is that like other digital systems, the T.A.W. mobile recorder requires using the company's proprietary PC-based workstation, an additional expense. And officers familiar with operating a VCR may be in for a shock when faced with using a computer-based data retrieval system.

One key advantage of the digital format lies in its archiving images efficiency: a comparative handful of hard drives can replace a mountain of videotapes. Instead of removing videotapes after each shift, there's enough capacity that the hard drive may require downloading perhaps only weekly or monthly, depending upon the number of hours the system is used. This could free an administrator to perform other tasks instead of spending the day shuffling tapes and filling out logs.

The data can also be downloaded to other storage media, including a RAID 5 mass-storage device. Eric Shuey, Traffic Section administrative officer and point man in San Antonio (Texas) Police Department's evaluation of the system, found an alternative storage solution he likes even better. "We've been downloading to our mainframe since it's got almost unlimited capacity," he says.

Shuey admits to being a convert to digital recording. "I like the lack of mechanical moving parts in the system," he notes. "We've been using heavy-duty, commercial-grade VHS-format VCRs and, while they've been fairly reliable, we still manage to break quite a few of them."

For Shuey, an attraction of the T.A.W. system is its prevent recording feature. "We had a motor officer hit and killed in February," he recalls. "If we'd had this unit, we'd have had a much better idea of what happened, rather than having to depend on what some witnesses think they saw."

Downsized packaging, alternate applications

The T.A.W. unit will fit onto a motorcycle as well. A smaller hard drive is used, and its downsized vault is small enough to fit inside a waterproof case mounted on the rear of the motorcycle. Depending upon the motorcycle's configuration, there may also be room available inside a hard-sided storage area.

This type of application comes with a smaller, 2.5-inch-diameter color monitor. It is housed in an unexpectedly heavy enclosure. When I was handed a demo unit, it promptly escaped my grasp and ricocheted off the concrete floor. "It's heavy because we make it from solid billet aluminum," explains Kirmuss. "You'd have to hit it a lot harder than that to do any damage."

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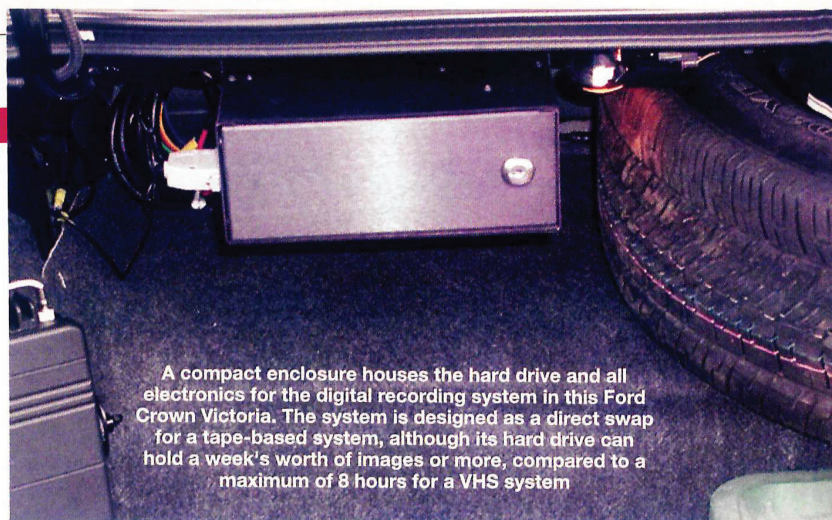
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For motor duty the camera is affixed to a special vibration-damping mount, which, assisted by a very fast shutter speed, allows it to produce unusually steady images even while being flogged over trackless off-road terrain. I reviewed footage recorded from a street-driven Colorado State Patrol Harley-Davidson and found it to be of equally high quality.

Installed in a vehicle, there are few visual tip-offs that the system is anything special. There's a 4-inch TFT color monitor linked to a remotely mounted steel case, almost indistinguishable from a typical VCR vault, that contains the hard drive and electronics. It's both heated and cooled electrically to stabilize operating temperatures.

Optional is a tamper-proof version of this mini-camera encased in a robust metal housing. It's significantly



A compact enclosure houses the hard drive and all electronics for the digital recording system in this Ford Crown Victoria. The system is designed as a direct swap for a tape-based system, although its hard drive can hold a week's worth of images or more, compared to a maximum of 8 hours for a VHS system.

heavier than the other camera, necessitating a more substantial mounting arrangement, but it's a set-and-forget, full-auto unit that can't be adjusted, deliberately or otherwise. Also optional is a wireless camera allowing images to be transmitted via RF link to the vehicle-mounted recording unit.

The base system doesn't permit an in-car review of recorded images; it

requires an optional keypad with conventional playback and rewind buttons. A vehicle's Windows-compatible MDT or laptop can also handle these functions, reducing cockpit clutter and simplifying the installation process as well.

Installing the system

I was intrigued enough by this hardware to request a demo unit for an extended evaluation. Although the vendor offered to install the system, I elected to go it alone, to better to judge the system's ease of installation compared to a conventional videotape system, several of which I've installed over the past decade in a variety of police vehicles.

I'd call the installation relatively straightforward but with a few caveats. For example, the monitor and keyboard on my early production unit were linked to the hard drive by a 50-conductor shielded cable, ending with an enormous DB-50 computer connector. The fat cable resisted efforts to conform it to the contours of the vehicle interior just as the bulky connector proved difficult to route through bulkheads or under carpeting. In the months since my installation T.A.W. has initiated a redesign of the wiring system to simplify the task.

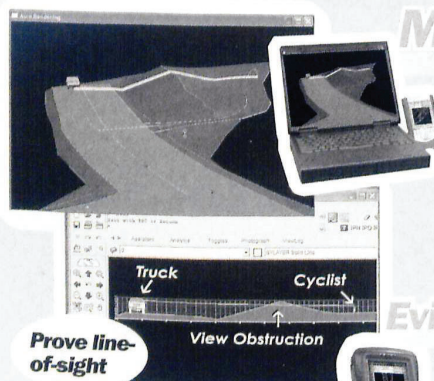
The vault can be mounted anywhere and isn't fussy about orientation. I placed mine under the Ford Expedition's rear seat, although had the vehicle been equipped with a cage, I'd have chosen to mount it vertically on the front of the cage, between the front seats. Mindful of



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A tiny T.A.W. digital camera is mounted on a crash bar above the radar antenna on this Colorado State Patrol Harley-Davidson. Extensive vibration tests led to the development of shock-resistant mountings, enabling the camera to absorb high-G impacts without damage while delivering clear, steady images.

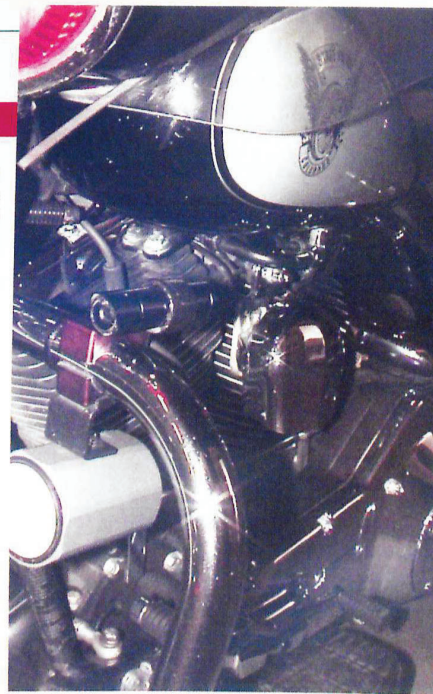
chain-of-custody issues, the vault features redundant locks and is secured with tamper-proof bolts. I can attest that once installed, a thief would probably conclude that stealing the vehicle would be the quickest method of getting hold of the recording system.

Mounting the cameras was a snap. Since I had chosen the lightweight version, installation was effected by simply removing one screw from the center of the windshield header trim, running it through the mounting bail and reinstalling it. Total elapsed time: about 2 minutes. Installation of the rear camera was equally simple. Routing coaxial cables required the same amount of time as would any tape-based system.

Life on the road: VHS vs. digital

On the road, the T.A.W. system acts much like a traditional VCR-based unit. Mine was equipped with a momentary-on button to control the camera's 3x digital zoom. Pressed down, it goes to full zoom; once released, it returns to wide angle. The zoom function can also be controlled by using a relay that's triggered when the vehicle is shifted into park during a traffic stop, capturing the plate on zoom-in, then returning to wide angle to record the action.

In my months of living with the system, I noticed only one possible negative: the image resolution available when viewed in real-time. I'm



not referring here to playback; once recorded, the images have stunning resolution, far beyond that of VHS, especially in ultra-low light

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conditions. When using the basic mini-camera, even fully zoomed-in on a plate, perhaps one car-length ahead, I couldn't make out the numbers. My assumption is that the software is biased in favor of playback resolution, giving up some clarity in preview mode to conserve system resources. This is a small point and of no consequence if the system is fitted with the playback controls or when interfaced with a laptop or MDT.

It's even more of a non-issue if an optional camera supplants the mini-cam. At T.A.W.'s offices I watched in amazement as a 220x-zoom camera easily read a product barcode from a box sitting on the other side of a dimly lit warehouse, a remarkable performance. (A 120x-zoom camera is also being evaluated.) Either of the high-powered cameras would be ideal for surveillance applications.

Also useful for surveillance is the system's capacity to record from up to four cameras at once, their images displayed simultaneously in split-screen format on the monitor. Equally attractive is a new Video Transponder Box, which transmits the images over CDMA and CDPD cellular telephone systems. Now a supervisor at the station will be able to, for example, view a pursuit in real time. Forget about having the dispatcher ask the officer running primary if things perhaps are getting a little hairy. Now the supervisor can judge if it's time to break off a pursuit before events get out of hand.

It's too soon to know whether a digital system's hard drive will prove to be cop-proof and how well officers will make the transition to computer-based imaging. Priced comparably to a conventional videotape system, with the added versatility and advantages

of digital recording technology, I'll not be shocked to see a slow, steady migration from recording analog images on tape to capturing and storing them on computer hard drives, all in a format of ones and zeros. ■

Craig Peterson is a Phoenix-based freelance writer specializing in law enforcement technology, EVOC driver training and vehicles. He has been a regular contributor to U.S. law enforcement magazines since 1990.

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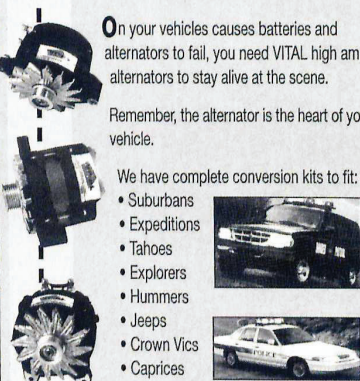
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