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Evaluation of Commercially Available Exterior Digital VMDs

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Evaluation of Commercially Available Exterior Digital VMDs

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ABSTRACT

This report discusses the testing and evaluation of thirteen commercially available exterior digital video motion detection (VMD) systems. The systems were evaluated for use in a specific outdoor application. The report focuses primarily on the testing parameters, each system's advertised features, and the nuisance alarm and detection test results.

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Introduction

Sandia National Laboratories, Intrusion Detection Technology Department, recently conducted a field evaluation of commercially available outdoor digital video motion detectors (VMDs). There has been considerable interest in the past few years concerning the use of VMD systems as exterior intrusion sensors. New-generation VMD systems advertise advanced video signal processing techniques and algorithms that are aimed at rejecting nuisance alarm sources inherent to the uncontrollable exterior environment. In the past, VMD systems had high nuisance alarm rates, which made them generally unacceptable for use as exterior sensors.

An increasing number of VMD systems are appearing on the commercial market that advertise to be outdoor or exterior VMD systems. All the evaluated VMD systems employ digital processing techniques for detection and nuisance alarm reduction. This evaluation focused on these new-generation VMDs with the primary goal to analyze their detection and nuisance alarm rejection characteristics. The systems included in the evaluation tests were:

3-Dimensional Intelligent Space (3DIS)
3-DIS Security System 4
(719) 481-4277

American Dynamics
DigiTect II - 4500
(914) 365-5802

Burle
TC8214
(717) 295-6123

Detec Vision Systems
Auto Sentry SA3
(603) 643-6048

EDS-Scicon Defence Ltd.
Sentinel
(703) 742-2045

Geutebruck
TeleTect VS-30
(215) 664-8600

GYYR
DVMD32
(800) 854-6853

Quark Digital Systems Inc.
Q18VM4
(416) 940-2920

Magal Security Systems, Ltd.
DTS-1000
(201) 488-1022

Senstar
David 300
(613) 839-5572

Senstar
David 200
(613) 839-5572

Shorrock/Hymatom
Movicom 4
(805) 688-2608

Tech. Services International (TSI)
TSI-2020
(905) 569-2072

Vision Systems Limited
Adpro VMD-1
(800) 274-3711

Senstar's David 200 was previously evaluated, but was re-evaluated to establish a baseline from previously evaluated VMDs to the VMDs in the current evaluation. Below is a list of previously evaluated VMD systems that were not included in this evaluation because they had not changed the algorithms since the last Sandia evaluation.

Digi-Spec Corporation
DS-1
(DS-4 not available at time of evaluation)
(818) 989-9033

Sony
YS-D100
(303) 447-1115

Sas-Tec USA Inc.
VSM 210
(310) 645-4700

Vicon
V223MD
(516) 293-2200

Section 1 — Testing Parameters

Test Setup

This section describes the evaluation test criteria, including the area where the tests were conducted, the types of detection tests performed, and the equipment used to collect the test data.

Test Area

Tests were conducted at Sandia's Video Technology Test Laboratory, which has a number of perimeter-type zones with double fencing spaced 50 feet apart. All vegetation was removed from all zones at the video test laboratory to create clear dirt zones. All evaluation testing was conducted in the same perimeter test zone. Figure 1 shows the test laboratory layout, including the zone where testing was conducted, the trailer where the VMD systems and data collection equipment were located, and the location of the camera used in the test.

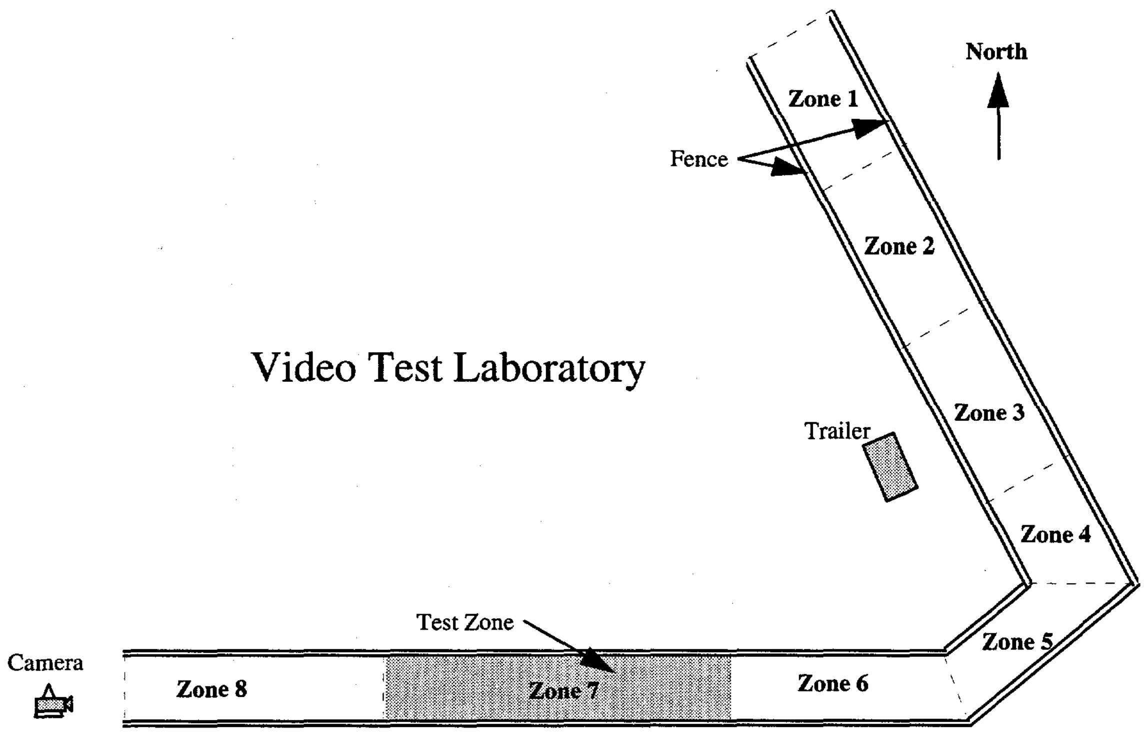


Figure 1. Layout of Video Test Laboratory

Test Zone

Figure 2 shows the dimensions of the perimeter test zone (zone 7) in which the evaluation was conducted. As illustrated, the test zone begins at a distance of 284 feet from the camera. This is the camera's 50-foot horizontal field of view (FOV). The end of the test zone is at the camera's 100-foot horizontal FOV, which is 568 feet from the camera. Markers were placed in the test zone at the camera's 50-, 60-, 70-, 80-, 90-, and 100-foot horizontal FOVs. The intrusion detection tests were conducted at these locations.

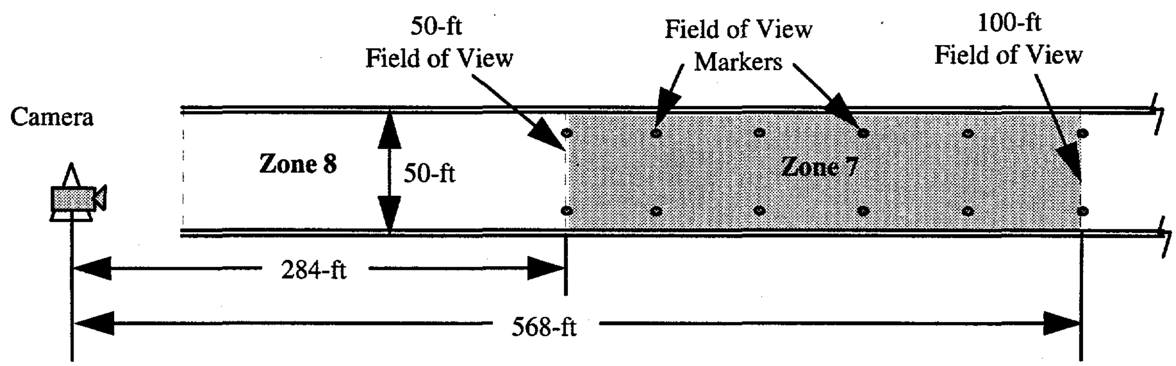


Figure 2. Test Zone Details

Camera/Video Signal

The camera used in this evaluation was a Cohu model 4815, 2/3-inch format, with a 50mm lens. The video signal (NTSC, 1Vp-p, 75-ohm) was transmitted over fiber-optic cable to the trailer where the data collection equipment was located. The video signal from the fiber-optic system was connected to the distribution amplifiers, with the outputs from each amplifier adjusted to an equal level. The outputs from the distribution amplifier were connected to the video inputs of each VMD system. The VMD units that had more than one channel available in the evaluation had a second input tied to a separate channel for monitoring. The video outputs for each VMD system were routed to a video switcher to allow manual switching of each system's output screen to a monitor.

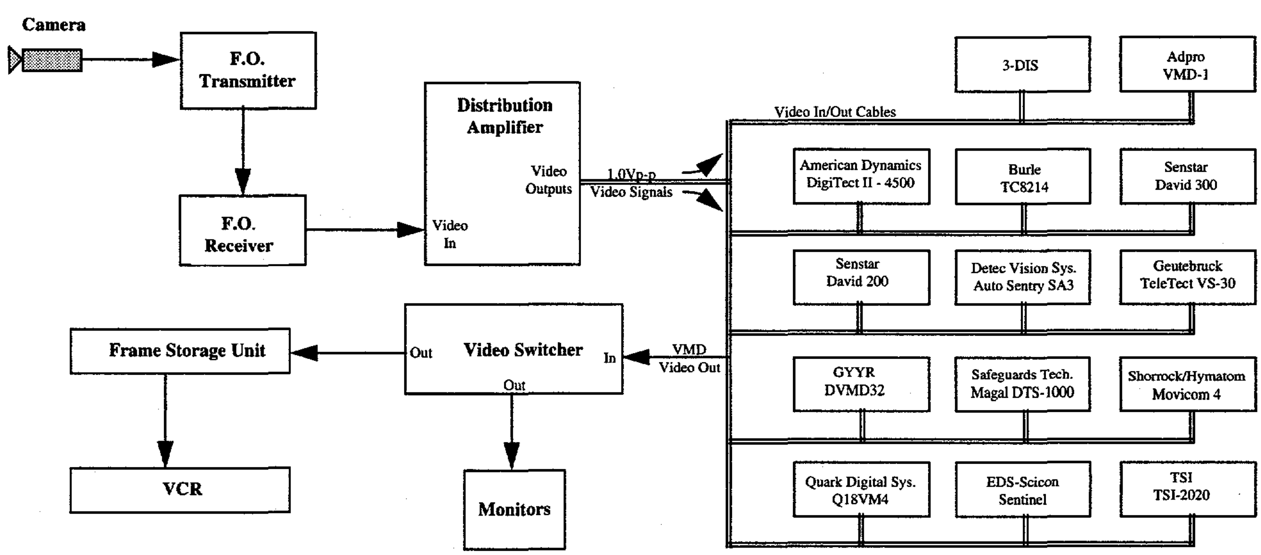


Figure 3. Video Signal Block Diagram

Data Collection System

The data collection system used for this evaluation was a prototype Display and Control System, designed at Sandia, with modifications to enhance its data collection capabilities. The system records data from multiple sensor inputs and allows relay-controlled outputs. For the evaluation, sensor alarm information was available via hard-copy printouts and was logged to a data file. For every sensor alarm, the video image from two seconds prior to the alarm to two seconds after the alarm was recorded and transferred to a VCR tape for assessment. The pre-alarm recording feature proved to be essential in determining the cause of some otherwise unknown nuisance alarms.

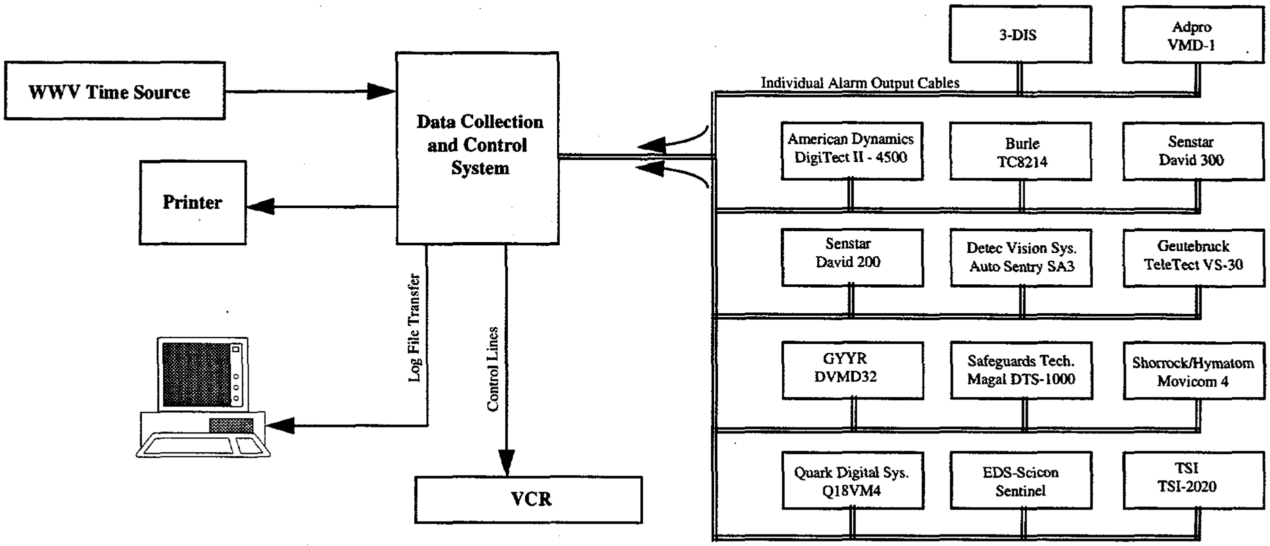


Figure 4. Block Diagram of Data Collection System

VMD Test Guidelines

The basic test guidelines used for the VMD evaluation called for a setup of each VMD system to detect an intruder crossing the test zone from either direction. In general, the detection area or area of interest (AOI) for each VMD was set up to cover the area inside the FOV markers. These markers were placed approximately 10 feet in from each fence, which allowed the AOI to be 30 feet wide. Figure 5 shows the camera's view, with details showing the 50-foot and 100-foot FOVs and the other FOV marker locations.

Detection Criteria

Based on customer requirements, the detection criteria were based on the following parameters:

- A running *intruder* (maximum speed of 5 meters/second).
- A crawling intruder or dummy to simulate a crawler (slowest speed .15 meters/second).
- Minimum cross-sectional size of intruder or dummy (one square foot).
- Intruder could cross through the test zone in any manner (run, walk, crawl), as long as the total elapsed time of each intrusion attempt fell between the above specified speeds.
- Intruder could dress in any manner required to blend into the background as closely as possible.
- Detection tests would be performed at all times of day, including dusk, dawn, night, and daytime, with the majority of detection testing done at times when the intruder blended best into the background.

The ***goal of the detection tests*** was to set up each VMD system to achieve 90% probability of detection (Pd) at 95% confidence. If possible, each system had its parameters adjusted to achieve this level of detection.

Nuisance Alarm Criteria

Once the systems were set up to meet (if possible) the detection alarm criteria, each system was monitored to establish the rate of nuisance alarms at the current parameter settings. If the false or nuisance alarm rate of a VMD system was very high (more than 10 in a 24-hour period on a clear day), the system(s) parameter settings were adjusted to limit the number of alarms generated to an acceptable level, which in this case, was an average of fewer than 10 false/nuisance alarms in a 24-hour period on a clear day.

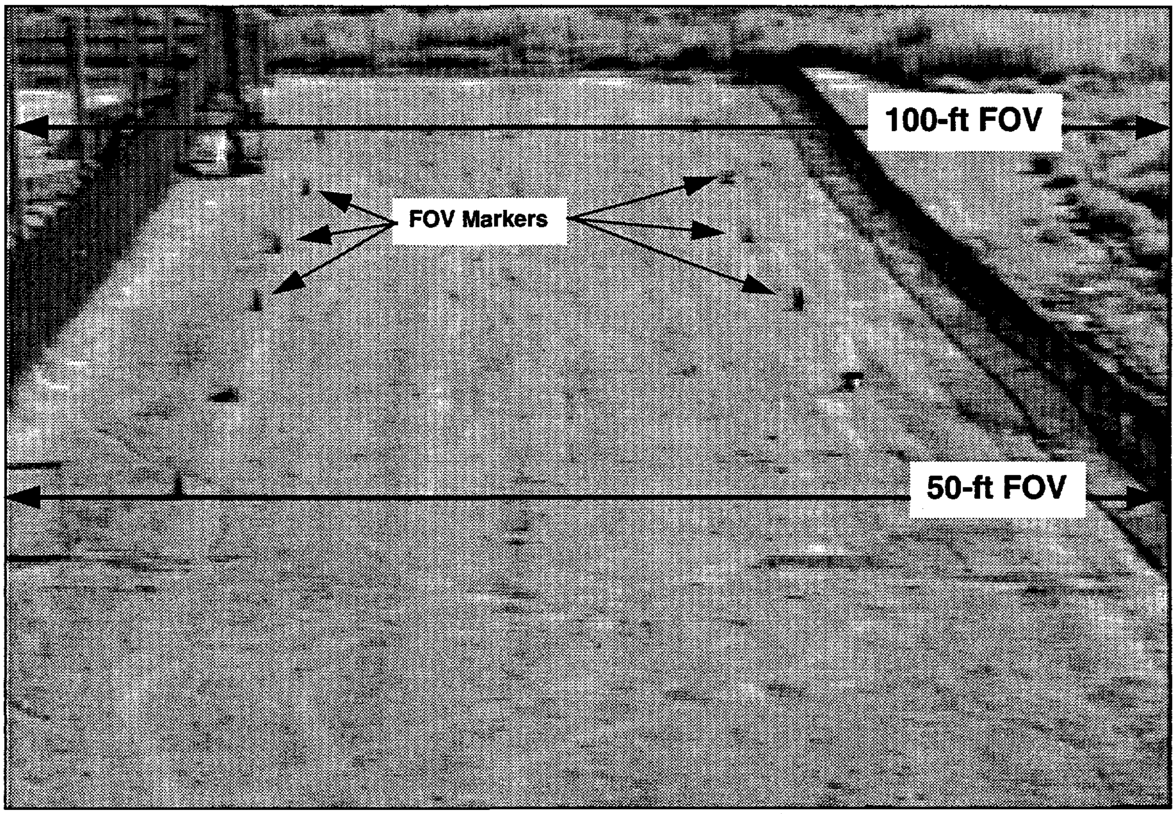


Figure 5. View of Test Zone on Monitor

VMD Test Procedures

Bench Testing

Testing procedures for each VMD consisted of first becoming familiar with the parameters and operation of the VMD system. Bench testing consisted of playing a series of pre-recorded SVHS tapes through each VMD system. These tapes had recorded scenes of an intruder running, walking, and crawling through the zone in which testing would be done. Other recorded scenes of cloud shadows and falling snow were also used to get a basic understanding of how each system would handle nuisance alarms. Bench testing each unit gave a good understanding of what effect changing VMD system parameters had on detection and nuisance alarm rejection capabilities.

Using scenes recorded on SVHS tape allowed replaying the same scene over and over, which was necessary to tune the system(s) to the best level possible for detection and nuisance alarm rejection. The quality of the signal from a tape machine is not as good as a live video scene but was close enough to determine the effects that changing VMD parameters had on detection and nuisance alarms. Figure 6 shows a block diagram of how the bench test hardware was configured. The output of the SVHS recorder was fed through a switcher and then assigned to each of the camera input channels available on the VMD being tested. This facilitated testing by trying different settings on each channel, playing the tape, recording the results, and repeating the tests until an understanding of the system was gained. Throughout the testing and evaluation process, ongoing consultations took place with the individual VMD manufacturers to ensure that each system was set up in the best way possible for the application in which the evaluation would be conducted.

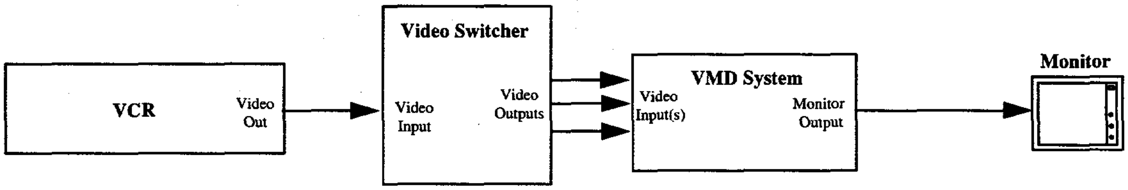


Figure 6. Block Diagram of Bench Test Hardware

Field Testing

Once bench testing was completed, each of the systems was set up for field testing using the parameters established during bench testing. To determine the range of parameter settings from good detection levels to good nuisance alarm rejection levels, the parameters of each system were adjusted first to reject most nuisance alarms and then set back to the required levels of detection.

Nuisance Alarm Adjustments

Several weeks of data were gathered and analyzed, continuously adjusting each VMD system to reject most of the nuisance alarms from clouds, shadows, etc. Walk tests at the far FOV were also conducted during this time to make sure the system was still detecting to some extent. This process gave an idea of where levels would have to be before the systems could reject the majority of nuisance alarms.

Detection Tests Adjustments

The next step in the field testing concentrated on adjusting the VMD system parameters to catch an intruder in a variety of detection tests. The detection tests consisted of a person running, walking, and crawling, and a test object (simulated crawler) being pulled across the test zone. Detection tests were conducted between each of the FOV markers. Once again, the FOV markers are located at the 50-, 60-, 70-, 80-, 90-, and 100-foot camera horizontal FOVs. Intruder paths included horizontal as well as diagonal crossings of the test zone. A FOV marker was always a start-and-stop point in the detection tests. Figure 7 illustrates the locations and directions of detection tests that were conducted in the test zone.

Figure 7 shows diagonal tests from the 50-foot to the 100-foot FOV markers. All diagonal testing consisted of a walking intruder. All detection testing was recorded to SVHS tape to be used in further testing and adjustments. Adjustments to the VMD parameters were made continuously throughout the live detection tests and by playing back the SVHS recordings of the tests to achieve a 90% Pd at 95% confidence.

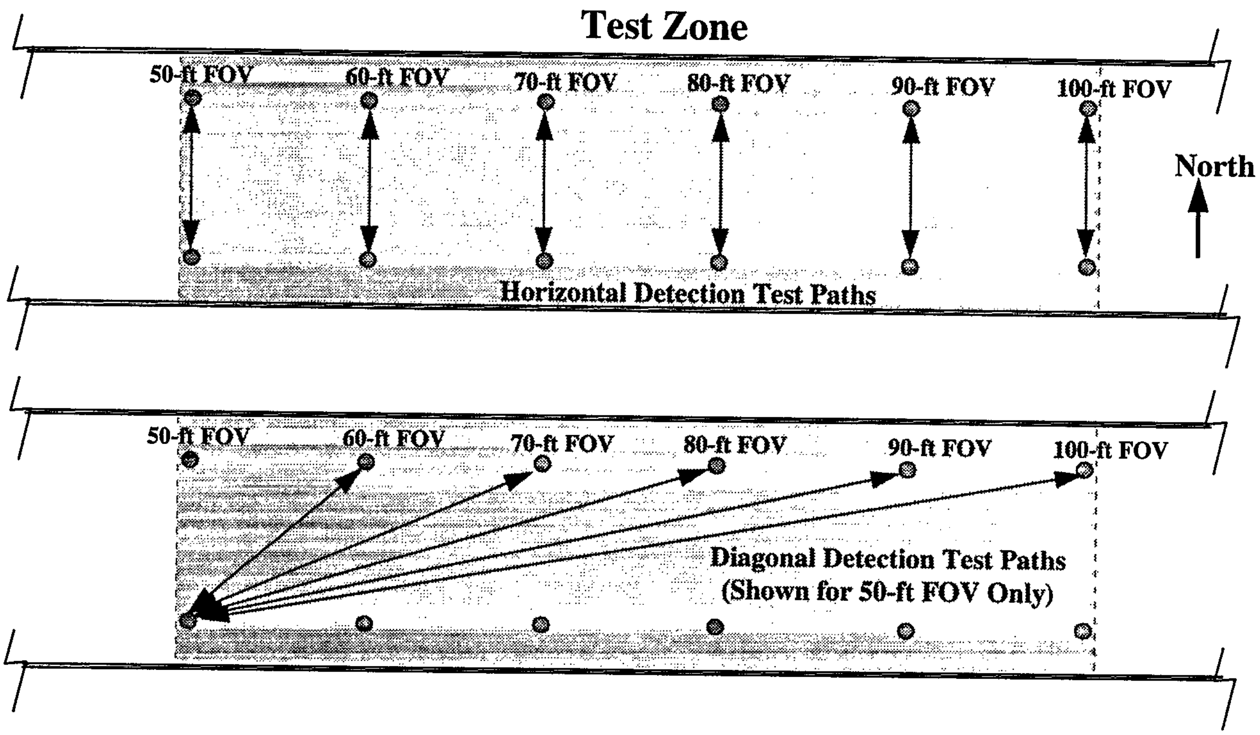


Figure 7. Intrusion Detection Test Paths

SVHS Tape Testing

All intruder detection tests were recorded on SVHS tape to use in adjusting each of the VMD systems. Several hours of nuisance alarm sources were recorded on SVHS tape to allow further adjustment of each system's parameters. The reactions of the VMD systems to the live scenes were compared to their reactions to the same recorded scenes when played back through each system (system parameters were not changed from the live to recorded tests). Although a recording does not have the same resolution as a live scene, the results of comparing live tests to recorded tests showed little difference in how each system reacted to the detection and nuisance alarm tests. If the test scenes were recorded on SVHS, the live camera signal of the test zone was replaced with the output signal from the SVHS tape recorder.

Final Parameter Settings

The final parameter settings level that would be used to collect data was achieved when the system reached a 90% Pd at 95% confidence level with the nuisance alarm rate maintaining an average of fewer than 10 in a 24-hour period. Evaluation test results were received from detection and nuisance alarm testing that was conducted from live scenes as well as tape-recorded scenes. Figure 8 is a block diagram showing the video inputs to the VMDs as being either from a recorded scene played back on a VCR or from the live camera scene.

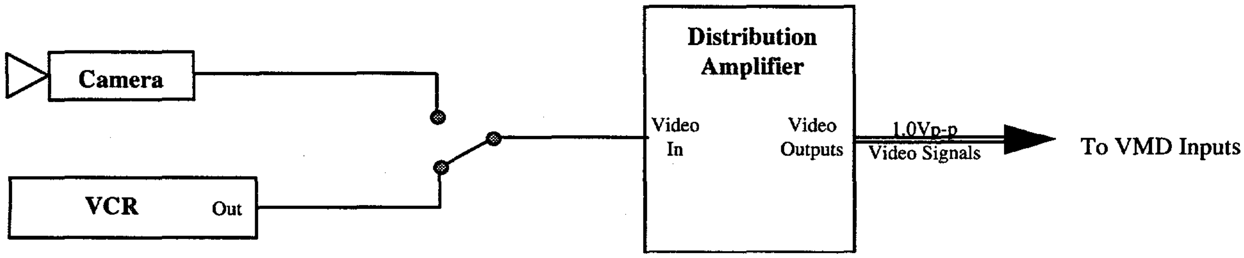


Figure 8. Block Diagram of SVHS Tape Play-Back System

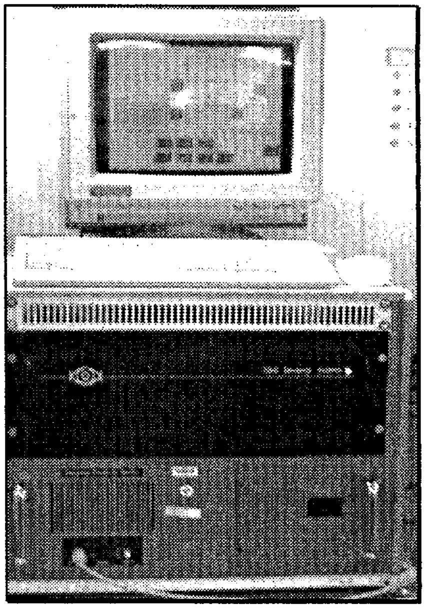
Section 2 — VMD System Descriptions

This section gives a brief overview of each VMD system evaluated. Each VMD system is discussed with emphasis placed on the categories listed below. The actual results of the evaluation tests are discussed in the Test Results section. The description categories are:

- **Overview of Advertised Features and Specifications**
- **Description of System Settings Used in Evaluation**
  - **AOI Description**
  - **System Parameter Settings**
- **System Features Strong Points**
- **System Features Weak Points**
- **System Cost**
- **Summary of System Features**

The information in this section concerning the systems' features and capabilities is from the manufacturers' advertisements or specifications unless otherwise noted. Not all features of each system may have been utilized because of time constraints, so information on the effectiveness of these features is not known unless specifically stated.

3-Dimensional Intelligent Space —*3-DIS Security System 4*



Advertised Features and Specifications

The 3-DIS (3-Dimensional Intelligent Space) Security System 4 is a video motion detection and alarm control system designed to provide automatic video surveillance. The 3-DIS VMD system uses hardware and software to create user-definable, three-dimensional (3-D) detection zones from the overlapping FOVs of standard CCTV cameras. Figure 9 shows a block diagram of the 3-DIS system, followed by the manufacturer's advertised specifications.

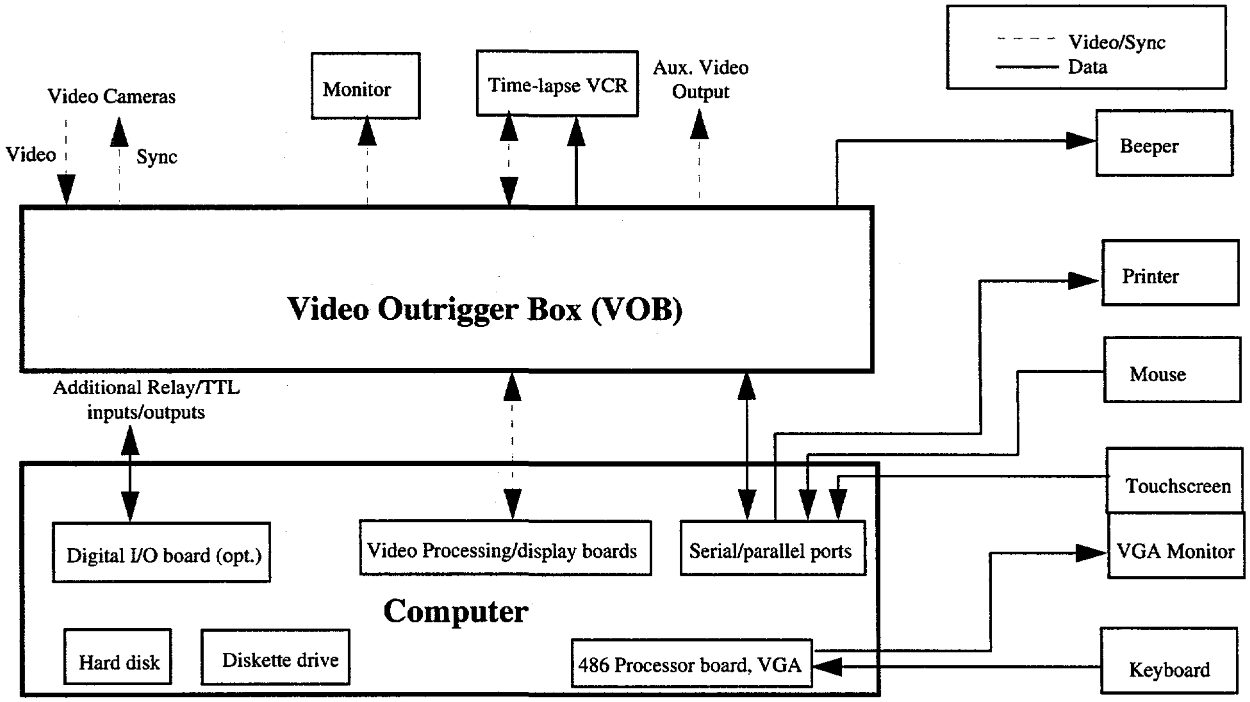


Figure 9. 3-DIS System Block Diagram

System Specifications

Video Inputs: Up to 28 CCIR or RS-170 (625/50) monochrome camera inputs, each 75-ohm, 1Vp-p, genlockable.

Video Outputs: 3 x monochrome outputs — display monitor, time-lapse VCR, and auxiliary, each 75-ohm, 1Vp-p.

Sync Outputs:	One per camera provided, each 75-ohm, 2Vp-p, negative going composite.
Image Resolution:	Gray Scales: 256 levels Detection Zone Definition: 768x512 (CCIR), 640x480 (RS-170) pixels Freeze-frames: 256x256 (CCIR), 320x240 (RS-170) pixels
Image Storage:	Automatic capture of still pictures on alarm, from up to 14 cameras.
Detection Zones:	Up to 300 independent zones (gangs) definable, with individually adjustable size, position, and detection parameters.
External Trigger Inputs:	TTL signal (5V maximum), or contact closure. Eight inputs provided, expandable to any number.
Alarm Control Outputs:	i) Two 1A, 24VDC relay contacts, one for control of time-lapse VCR, one general alarm output. ii) Three general TTL level outputs provided, expandable. iii) Audible alarm device with adjustable volume control.
User Interface:	Site map display on color VGA monitor, input via touchscreen, keyboard, or mouse.
Security:	Three levels (User, Supervisor, Configurer) via user-definable, four-digit PINs.
Image and Log Storage:	Pictures from all cameras are saved to 480-hour VHS time-lapse VCR, with automatic time/date stamp overlay. Comprehensive textual log file saved to hard disk, able to be printed or archived to diskette.
Computer:	80386 or above industrial computer, with 4MB of RAM, hard disk, diskette drive, VGA monitor, two serial and two parallel ports.
Power Supply:	Internal 240V/50Hz or 110/60Hz at 300W (approx.).
Environmental:	Temperature Range: 0°-40° Celsius; Humidity <90%, non-condensing.
Mechanical:	Self-contained steel cabinet, exterior finish light gray, or 19" rack-mount. For 1–16 cameras — 8 rack units high (excludes monitors). For 17–28 cameras — 12 rack units high (excludes monitors). (1 standard rack unit = 44.5mm).

Final VMD System Settings

The manufacturer recommended the system be used in a 3-D configuration, which requires using two or more cameras to look at the same area. Utilizing two or more cameras per zone would greatly enhance the performance of the system, especially in nuisance alarm rejection, but for the purpose of the evaluation only one camera was used per zone. The results of testing one camera per zone would better test how the system algorithms handle detection and nuisance alarms. It is acknowledged that using more than one camera per zone could dramatically improve the ability of the system to reject nuisance alarms.

Description of Area of Interest (AOI)

Several different ways of configuring the AOI were investigated to determine the best configuration for evaluation testing. It was found that the larger the individual cells in a window, the less sensitive each cell became, although it performed better in rejecting nuisance alarms such as small birds and rabbits. In detection testing, the sensitivity of the system had to be to compensate for the size of the cell versus the expected target.

After several different AOI configurations were tested and the manufacturer was consulted, the AOI configuration used for testing, shown in figure 10, was chosen. Notice that the cell size increases from the camera's far field of view (FOV) to the camera's near FOV. This established perspective compensation for the target size at the near and far FOVs. Also note the overlapping of each cell, which increased the likelihood of detection by requiring a target to pass through more than one cell to cross the test zone. This concept was further enhanced by two rows of overlapping detection cells that ran the length of the test zone. Cells numbered 8, 9, and 10 are not detection cells but are cells used to reduce nuisance alarms called *inhibitory sub-gangs.*

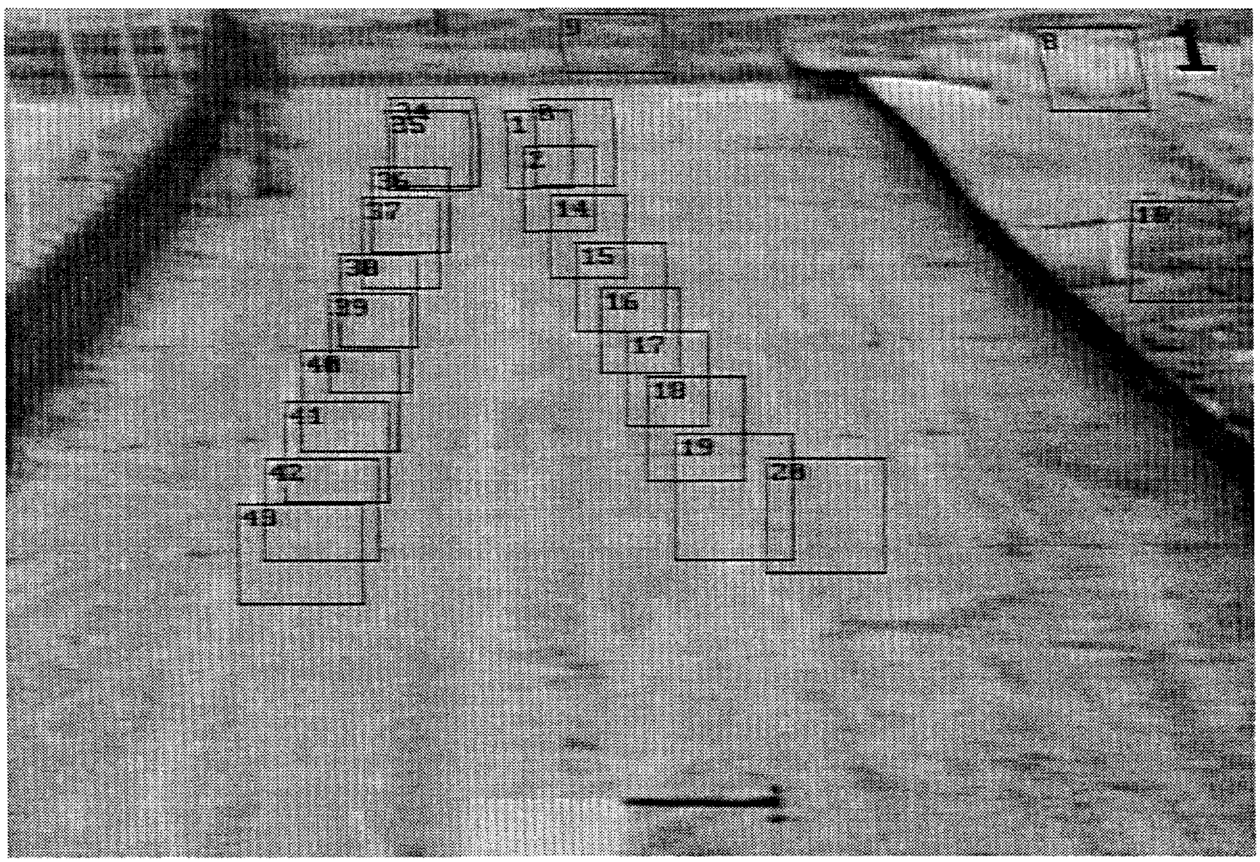


Figure 10. Area of Interest — 3-DIS

System Parameter Settings

The 3-DIS security system has numerous settings that, when changed, affect the system's overall performance. This section does not explain the function of each parameter but shows the final settings used for the evaluation test results. All settings are accessed from the configuration menu and cannot be changed except by authorized personnel. Following is an example of some of the configuration menu screens available to the person configuring the system.

Parameter settings for the 3-DIS VMD Security System 4 are described in Table 1 and Table 2, with the sub-gang numbers in Table 2 corresponding to the numbered cells shown in figure 10. Any parameters not shown remain at the factory default settings.

PARAMETER SETTINGS	Sub-GANG 0	Sub-GANG 1	Sub-GANG 2	Sub-GANG 14	Sub-GANG 15	Sub-GANG 16	Sub-GANG 17	Sub-GANG 18	Sub-GANG 19	Sub-GANG 20
BIAS FREQUENCY	6	6	6	6	6	6	6	6	6	6
RESET FREQUENCY	500	100	100	500	500	500	500	500	500	500
MARGIN FREQUENCY	50	50	50	50	50	50	50	50	50	50
MINIMUM MARGIN	7	7	7	10	10	10	10	10	10	10
MAXIMUM MARGIN	35	35	35	35	35	35	35	40	40	47
OBJECT ENHANCE	4	4	4	4	4	4	4	4	4	4

PARAMETER SETTINGS-*Cont'd*	Sub-GANG 34	Sub-GANG 35	Sub-GANG 36	Sub-GANG 37	Sub-GANG 38	Sub-GANG 39	Sub-GANG 40	Sub-GANG 41	Sub-GANG 42	Sub-GANG 43
BIAS FREQUENCY	6	6	6	6	6	6	6	6	6	6
RESET FREQUENCY	10	500	500	500	500	500	500	500	500	500
MARGIN FREQUENCY	50	50	50	50	50	50	50	50	50	50
MINIMUM MARGIN	6	6	10	10	10	10	10	10	10	10
MAXIMUM MARGIN	31	32	35	35	35	35	35	35	35	35
OBJECT ENHANCE	3	3	4	4	4	4	4	2	4	4

Inhibition Gang Settings (Inhibition Gang #0 with Sub-gangs #'s 8, 9, 10)

Inhibition Gang Settings	
minimum duration	50 f
extend until stable	no
extend while inhibit active	yes
type of rebias at start	none
type of rebias at end	none
threshold/margin increase	full
reduce activity level by	100%
ignore trigger last cycle	yes

Inhibit:

Camera	1
gangs	All

All sub-gangs:

Max bias time	30 c
Rebias 1 time	20 c
Rebias 2 times	4 c
Bias checktime	100 f

Gang Information:

method	And
use gang thresh	no
instant reset	no
active threshold	80%
return threshold	60%
require active	0
gang type	Inhibit

Sub-gang #	Type	Algorithm	Low Thresh	High Thresh	Active Thresh	Return Thresh	Stability Thresh	Stability Time	Max. Stable Time
GANG 8	Inhibit	A1	6	11	9	8	4	30	1000
GANG 9	Inhibit	A1	6	11	9	8	4	30	1000
GANG 10	Inhibit	A1	6	11	9	8	4	30	1000

Table 1. 3-DIS Parameter Settings

Sub-Gang	Gang	Algorithm	Low	High	Active	Return	Stability	Stability	Max. Stable

#	Type		Thresh	Thresh	Thresh	Thresh	Thresh	Time	Time
GANG 0	Norm	C2	6	17	11	6	4	20	1000
GANG 1	Norm	C2	6	12	11	6	4	20	1000
GANG 2	Norm	C2	6	12	11	6	4	20	1000
GANG 14	Norm	C2	6	17	11	6	4	20	1000
GANG 15	Norm	C2	6	12	11	6	4	20	1000
GANG 16	Norm	C2	6	12	11	6	4	20	1000
GANG 17	Norm	C2	6	17	11	6	4	20	1000
GANG 18	Norm	C2	6	12	11	6	4	20	1000
GANG 19	Norm	C2	6	12	11	6	4	20	1000
GANG 20	Norm	C2	6	17	11	6	4	20	1000
GANG 34	Norm	C2	6	12	11	6	4	20	1000
GANG 35	Norm	C2	6	12	11	6	4	20	1000
GANG 36	Norm	C2	6	17	11	6	4	20	1000
GANG 37	Norm	C2	6	12	11	6	4	20	1000
GANG 38	Norm	C2	6	12	11	6	4	20	1000
GANG 39	Norm	C2	6	17	11	6	4	20	1000
GANG 40	Norm	C2	6	12	11	6	4	20	1000
GANG 41	Norm	C2	6	12	11	6	4	20	1000
GANG 42	Norm	C2	6	12	11	6	4	20	1000
GANG 43	Norm	C2	6	12	11	6	4	20	1000

Table 2. 3-DIS Sub-Gang Threshold Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing. Although not all of these features may be utilized in the evaluation because of time constraints, incorporating these features could have beneficial results in reducing nuisance alarms while maintaining a 90% Pd at 95% confidence.

- Inhibitory gangs — special gangs individually set up to temporarily inhibit or lower the sensitivity of a normal gang. Especially useful in reducing false alarms from camera motion, lightning, and changes in ambient lighting (clouds, reflections, etc.). Care must be taken when using this feature because it will temporarily reduce the probability of detection.
- External inputs change threshold settings or deactivate some or all detection zones.
- System automatically adjusts to gradual changes in scene.
- Multiple algorithms are available for different applications.
- Separate alarm outputs for each detection zone are available.
- Threshold settings can be changed by time of day, external input, or automatically by activation of a specific detection zone. (The output of an individual detection zone can be connected to an external input to change threshold parameters to new settings.)

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer.

- The amount of time required to set up and adjust the system is significant because of the number of parameters that can be changed.

- Each camera requires synchronization. Also, the system is sync sensitive (glitches in signal could cause false alarms unless proper inhibitory techniques are used).
- Better explanations are needed of the interacting effects that changing individual system parameters has on the system. Examples of how to handle several different nuisance alarm situations would be useful in configuring the system.
- Erratic signals can cause the system to crash in a way that it does not recover on its own (operator has to manually reboot).
- There are no target speed adjustment parameters to allow the system to ignore targets that move too fast through the scene (airplane shadow, birds, etc.).

System Cost

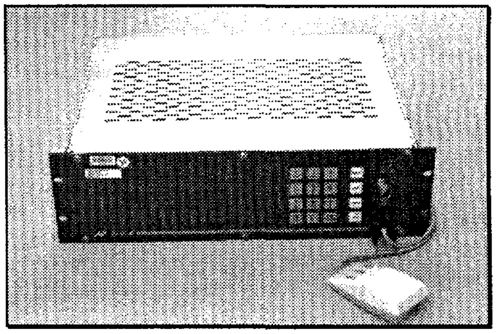
This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 3 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices.

Quantity	Description	Price
1 ea.	3-DIS Security System 4 (four-camera system), to include all manuals, hardware. and software for a 3-D intelligent space monitoring system. Hardware to include System 4 software licenses, video outrigger box, cables, frame grabber and display buffer cards mounted in a rack-mount computer chassis, VGA graphic screen with touch-screen panel, Sony time-lapse VCR. and B/W monitor.	$30,390

Table 3. 3-DIS System Cost

Summary of System Features

The 3-DIS system gives the end user access to detailed parameter settings. On one hand, this is good because it allows fine-tuning of the system for specific areas or environments. On the other hand, the end user must understand the effects that changing each parameter has on the system, which requires detailed knowledge of how the system works. This could make the initial set-up time much longer than necessary or require special training to set up and maintain the system. The system has good detection capabilities and features that allow the rejection of most nuisance alarms. A negative aspect of the system is its requirement to have sync to each of its cameras.



American Dynamics — *DigiTect II - 4500*

Advertised Features and Specifications

The 4500 DigiTect II consists of individually programmable camera modules housed in a rack-mountable bay. Each DigiTect II bay has slots for eight camera modules. Multiple DigiTect II bays can be integrated to provide up to 24 video channels, all controlled by a single front-panel keyboard. The DigiTect II bays also have a built-in sequential switcher, independent of motion detection, with a separate video output that provides a sequential display-and-call function for all eight video inputs.

Below is a list of the manufacturer's advertised features:

- Detection zone mapping using a mouse.
- Over 2900 detection zones per channel.
- Selectable setting for perspective compensation.
- Inputs for external alarm closures.
- Three system and eight individual channel alarm relay outputs.
- Display with or without on-screen motion indicators.
- Sequencing of video inputs with individual dwell times.
- RS-232 output for interfacing to matrix switcher or printer.
- Video loss detection.
- On-screen camera ID and status information.
- No camera synchronization required.
- System protection via a key-switch and pass code.
- On-screen programming and setup with mouse and front-panel or remote keypad.
- Modular design, DigiTect II bay, camera modules from one to eight per bay, cascade bays to provide 24-channel system capacity.
- Microprocessor on camera module analyzes the detected motion for size, position, and rate of movement.
- Alarm action includes relay closures (three global and eight individual per bay), audible and visual alarm; video from alarmed camera is placed on two video outputs for external viewing or recording.
- Detection sensitivity: Two settings work together to determine the sensitivity for each channel. A pixel setting defines the amount of contrast variation between the target and background, which initiates the system's motion analysis. A response setting defines the size and dynamic characteristics of the target.
- Video inputs: Eight looping inputs. Two BNCs with a 75-ohm/HiZ switch per input.
- Video outputs: Three BNC 75-ohm, 1Vp-p nominal. Outputs include switcher output, alarm output without motion pattern indicators, status, and set-up information.
- Power failure protection: System set-up parameters are protected for a minimum of 3 months.

Final VMD System Settings

The DigiTect II has several levels of menus that permit setting the operational parameters both for individual channels and for the complete system. Only the areas that were changed in the evaluation are discussed.

Description of Area of Interest (AOI)

The AOI used in evaluating the DigiTect II is shown in figure 11. Note that perspective compensation is accomplished through the spacing of the individual detection cells. As shown in figure 11, the AOI is set up to cover the volume of area between the cones. Several different perspective settings were tried, with the one shown being used for evaluation testing.

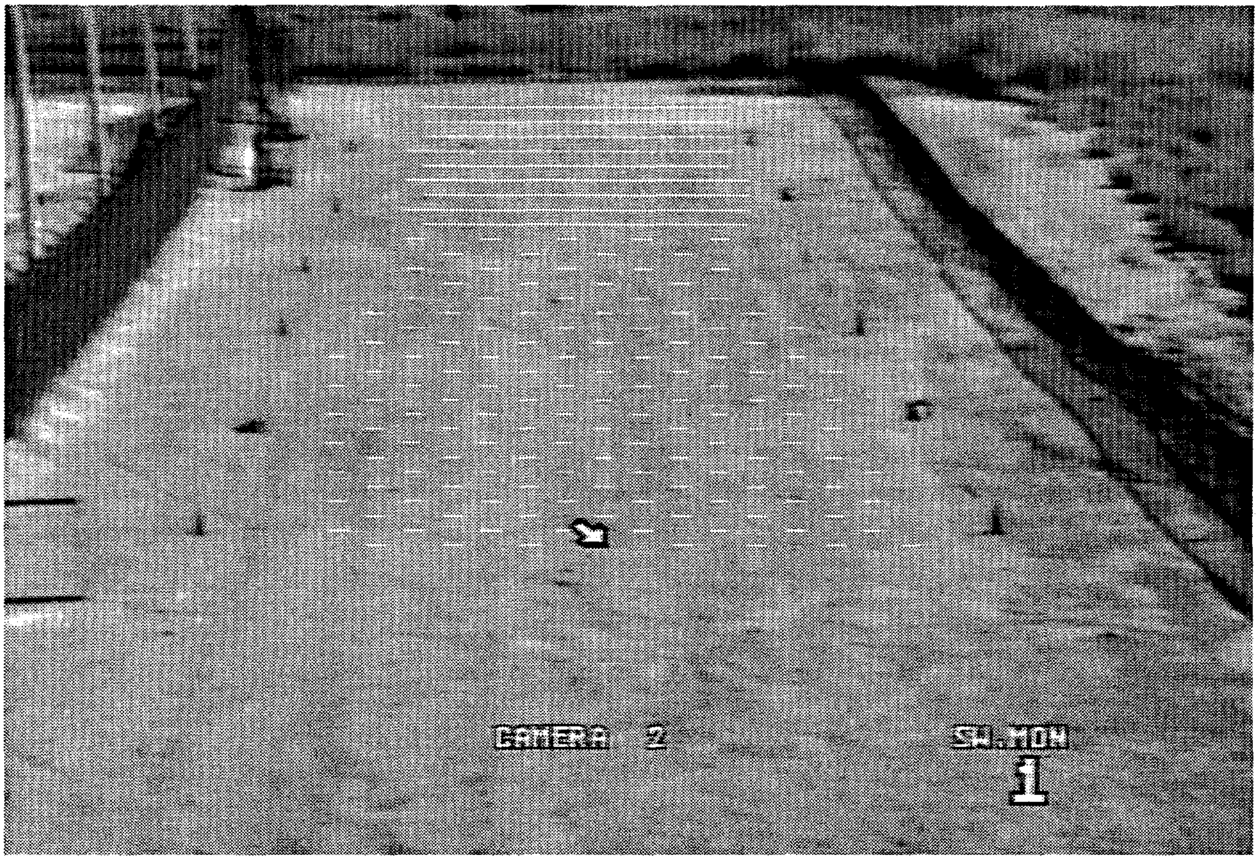


Figure 11. Area of Interest — DigiTect II

System Parameter Settings

The DigiTect II VMD system has three parameters that affect the system's ability to detect motion. These parameters are found in the Channel Parameters menu. There is also a System Parameters menu that sets up other features for the system that do not affect the system's ability to detect motion. Table 4 shows the final parameter settings that were used in the evaluation. These settings were selected for evaluation testing after considerable testing of the system's ability to detect intruders versus its ability to reject nuisance alarms. The parameter menus cannot be changed except by authorized personnel (password and key-switch protected).

Response Setting	5
Pixel Setting	2
Perspective	3
Dwell Time	1 Sec
Caption	Camera 1
External Input	Switcher
Internal Alarm	Enabled
External Alarm	Disabled

Table 4. DigiTect II Parameter Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing.

- The system can be set up quickly because of a minimum number of parameter options.
- The system is modular, allowing one or several cameras to be added at a time.
- The system provides visual indication of where the intrusion alarm occurred.
- The system incorporates a parameter to help in perspective adjustments.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated.

- The system parameters for size and speed have been combined into one value so that when an operator changes this value, it affects several values in the actual detection algorithms. This made setup easier but, because the settings are combined, fine-tuning of the system to reject nuisance alarms is limited.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 5 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

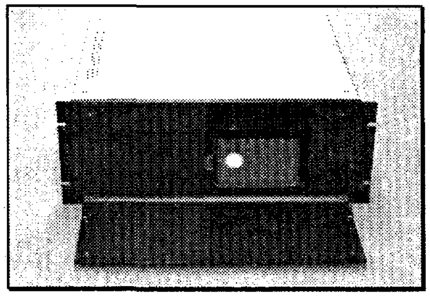
Quantity	Description	Price
1 ea.	AD4501 — Master bay; includes front-panel keyboard and mouse. Camera modules not included.	$5,600
1 ea.	AD4500CM — Camera module; up to eight per bay (two modules used in evaluation).	$525

Table 5. DigiTect II System Cost

Summary of System Features

The American Dynamics DigiTect II 4500 series VMD system can be easily and quickly set up to monitor exterior scenes. The number of parameter settings available to the end user is limited, making adjustments easy and quick, but it also limits the ability of the system to be fine-tuned, to possibly eliminate site-specific nuisance alarms.

Burle Industries — *TC8214*



Advertised Features and Specifications

The TC8214 series digital video motion detector is designed for use outdoors. The system is packaged for rack-mount use and can be configured for either four (*TC8214*) or eight (*TC8218*) camera inputs with two monitor outputs. Individual and common relay outputs on alarm allow for easy external interfaces. Below is a list of advertised features and specifications as advertised by the manufacturer:

- Designed for outdoor detection.
- 64 selectable zones per camera.
- 32 levels of sensitivity adjustments per zone.
- Direction-sensing capabilities.
- On-screen menu-driven set-up programming with built-in trackball (mouse).
- Color-compatible.
- Video inputs: Four or eight camera inputs dependent on model, user-selectable; 75-ohm terminated or high-impedance looping.
- Video outputs: Two monitor outputs, 75-ohm; Main — Setup, Callup, or Alarm Callup; SEQ — Sequence, Callup.
- Detection zones: 64 sets per camera, each set consisting of one standard sensor and two directional sensors. Size: User-selectable for each zone and may be overlapping (960 detection points per camera), 32 levels of sensitivity per detection zone.
- Loss of video: Audible and on-screen indication of affected camera.
- On-screen information: Time, date, monitor, and camera information and indication of violated area during alarm.
- Alarm indicators: Individual camera alarm relay outputs, common alarm relay output, common VCR relay output. Audible: Built-in multitone generator, external or menu disabled. Visual on-screen indication of violated area.
- Timed sequences: Four separate time-activated setups of system detection parameters stored and recalled at user-defined times.
- Built-in diagnostic tests to aid in the setup and use of the system.
- Two levels of menus for normal or advanced system setups.
- Two levels of user-defined password controls to limit access to menus.

Final VMD System Settings

The Burle TC8214 series VMD has two menu levels that permit setting the operational and detection parameters both for individual channels and for the complete system. Both levels of menus were used to determine the best settings for evaluating under the test application.

Description of Area of Interest (AOI)

Several different concepts were evaluated to determine the configuration to detect targets and reject nuisance alarms in the test zone. Direction required a high number of detection zones (64 maximum) to protect against a target moving in any direction crossing the detection zone. Direction sensing helped to reduce nuisance alarms, although the probability of detection for small targets was reduced because a target had to be seen three times instead of one. Because of the reduced level of detection, direction sensing was not used in determining the evaluation test results.

After extensive testing, it was determined that detection zones should cover as much of the area between the cones as possible to increase the probability of one of the cells detecting the target. Each of the rectangular boxes is a separate detection zone. Each detection zone has its own sensitivity setting. When any one of the detection cells alarm, the alarm relay is activated for that camera. Figure 12 shows the detection zone layouts used in determining the evaluation test results.

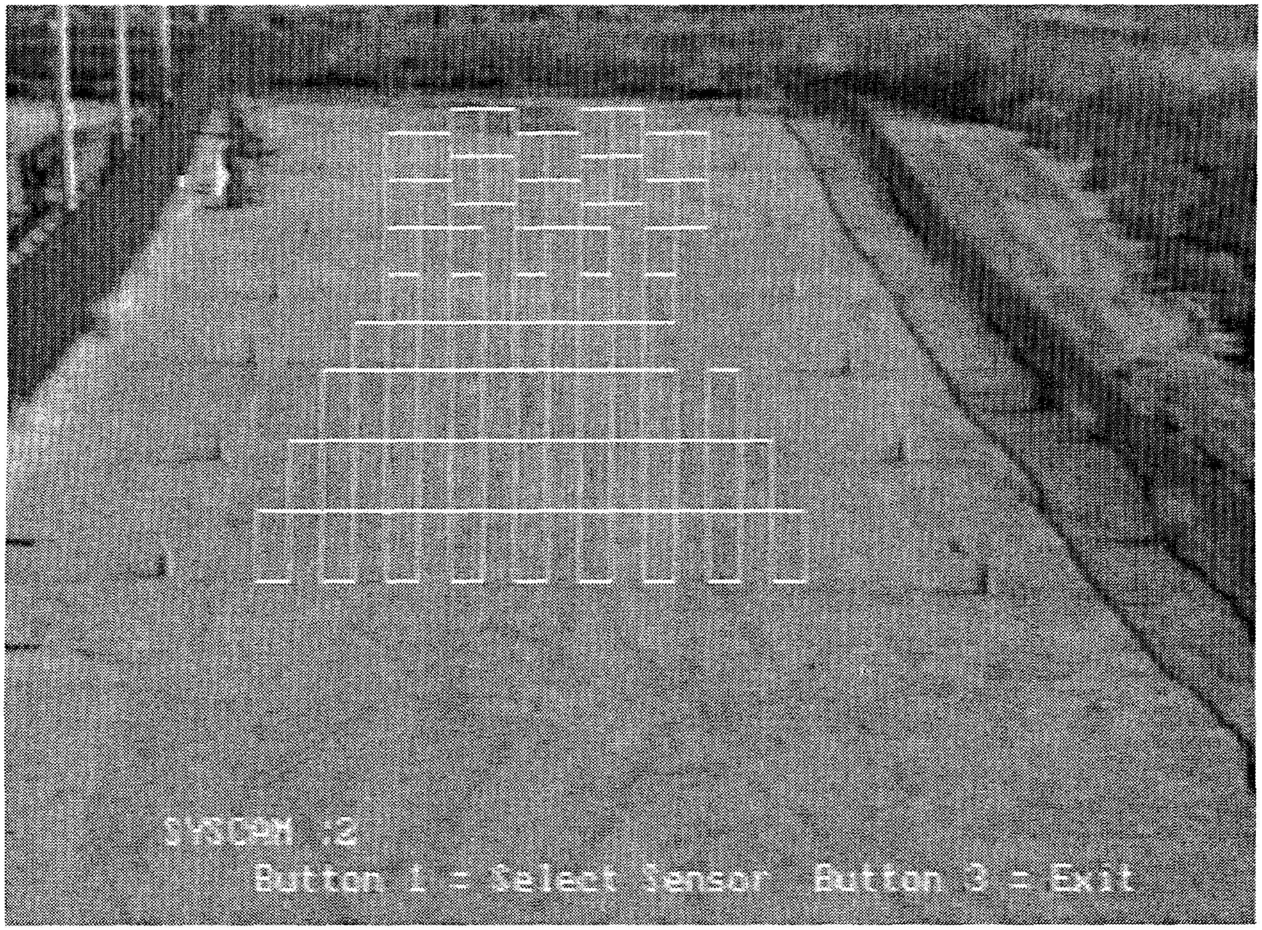


Figure 12. Area of Interest — Burle TC8214

System Parameter Setting Menus

The sensitivity levels and size for each detection zone varied from the far FOV to the near FOV. Perspective compensation was accomplished by increasing the size of the detection zone and/or increasing the sensitivity level of the individual detection cells.

The sensitivity settings used for testing were adjusted to get the highest probability of detection possible without exceeding the established nuisance alarm rate of fewer than 10 in a 24-hour period. As can be seen in figure 12, there are eight horizontal rows of cells. All of the cells on each row have the sensitivity levels set the same. For explanation purposes, the rows will be numbered 1 through 8 with row number 1 being the top-most row in the scene. The sensitivity levels for the cells in each row had available range settings from 1 to 32, with 1 being most sensitive. Timed switching of the sensitivity levels was possible but was not used for this evaluation. Table 6 shows the final settings used for the evaluation testing:

Number Rows	8	Number Cells	59
Row Number	Number of Cells	Sensitivity Level	
1	10	8	
2	10	10	
3	5	12	
4	5	12	
5	5	12	
6	7	9	
7	8	8	
8	9	7	

Configure Menu	
Printer	Off
Periodic Refresh	On
Cloud Compensation	On
Vibration Compensation	On
Display Statistics	Off
Full Screen Activity	Off
Audible Alarm	On
Seq. System Monitor	Off
Dot Filled Sensor	On
Built in Tests:	--
Test-picture	Off
Scope	Off

Parameters Menu	
Refresh Period	4
Vibration Compensation	.95
Cloud Compensation	6.0
Grid Sensitivity	12
False Trigger Threshold	10

Table 6. Burle TC8214 Parameter Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing. Not all of the features of the system, such as changing the setups based on time of day, may have been utilized in the evaluation, and they may or may not be beneficial in the system's performance.

- Built-in diagnostic tests help determine levels at which to set sensitivities.
- Individual cell adjustments allow fine-tuning of AOIs.
- Operators can load and store up to four different setups for each camera that is time loaded.
- Visual indication of which detection zone(s) alarmed is provided.
- Capability of direction sensing associated with timing parameters is provided.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated.

- The system has no settings to reject targets that move too fast through the scene.
- Using direction sensors requires extensive set-up time, and it is questionable whether this scheme could protect against an intruder walking diagonally across the test zone.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices listed in Table 7 show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

Quantity	Description	Price
1 ea.	TC8214 Series Digital Video Motion Detector (four-camera rack-mount system).	$8,795
NA	TC8218 Series Digital Video Motion Detector (eight-camera rack-mount system). NOT EVALUATED.	$12,660

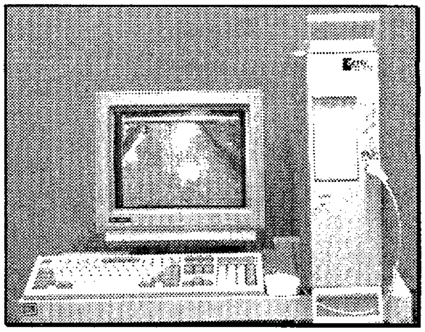
Table 7. Burle TC8214 System Cost

Summary of System Features

The Burle TC8214 Series VMD has many features that are beneficial to the user during installation to allow fine-tuning of the system. Its ability to allow individual cell sensitivity, size adjustments, and direction sensing would be beneficial in multiple applications.

The TC8214 does not have parameters that allow adjustments to reject fast-moving objects such as a flying bird, airplane shadow, or flying bugs. This fact will increase the nuisance alarm rates accordingly, depending on the rates in which these types of nuisance alarm sources are present.

Detec Vision Systems — *Auto Sentry SA3*



Advertised Features and Specifications

Auto Sentry SA3 provides real-time activity detection and event capture on one to four channels of video input. Up to three rectangular detection regions may be active per camera. Detection response time is generally under 3 seconds for four channels of operation — single-channel response in a fraction of a second, depending on system parameters. Event detections are annunciated by a tone on the host computer and a highlighted update of the operator's display. In addition, the corresponding reed relay outputs are closed. Optionally, a succession of frames can be stored on the hard drive for later review.

Auto Sentry SA3 is a PC-based, Windows 3.1-compatible program that operates in conjunction with machine vision hardware to perform real-time activity detection and event capture on one to four channels of video input. A software key is required to run this program. A typical sequence for program operation is as follows:

1. Upon program initiation, all four inputs are scanned automatically for the presence of an active video source.
2. The operator defines the rectangular area for each detection region desired.
3. The program is started, and each region is simultaneously initialized automatically by the program's algorithm studying the ambient activity level of each active detection region.
4. Once the automatic initialization is completed, the program begins to continuously monitor each active detection region for levels of activity above the thresholds established during the initialization period.
5. The operator can stop the activity at any time and save the current initialized settings for retrieval at a later invocation of the Auto Sentry program.
6. The operator can stop the activity detection and review image frames stored during previous event detections.

The Auto Sentry SA3 Activity Detection System includes the following:

- 386DX-25 processor
- Windows 3.1, configured for 256 colors
- Super VGA display board and driver, capable of 640x480x256 colors
- 4K RAM memory
- 85MB hard drive
- Windows-compatible serial mouse
- Machine vision and multiplexer boards
- Industrial computer chassis with built-in battery back-up

Final VMD System Settings

The system was manually initialized from tape-recorded scenes that included clouds, bugs, dusk, dawn, and day and night scenes. About 1.5 hours were spent initializing one camera containing three regions to the tape-recorded scenes. The system parameter settings were then adjusted to achieve the best possible levels.

Description of Area of Interest (AOI)

As illustrated in figure 13, three regions were used to cover the area of interest. Three regions were used because there is a maximum of 12 regions per card (four cameras per card), which allows up to three regions per camera. The regions were sized perspectively from the far FOV to the near FOV to cover the complete test zone.

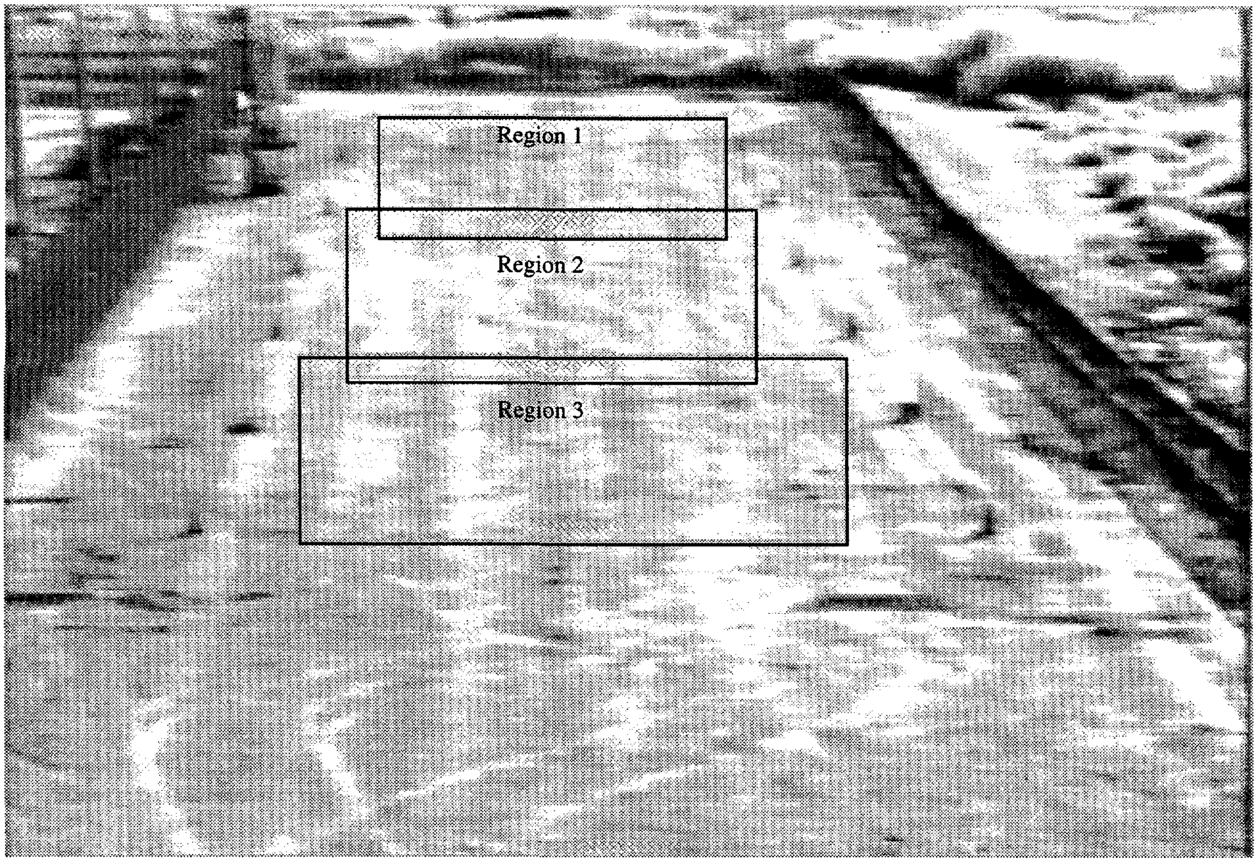


Figure 13. Area of Interest — Detec Auto Sentry SA3

System Parameter Settings

This section contains the parameter settings used for evaluation testing. About 30 minutes per region was spent in initializing the system to different environmental conditions that were pre-recorded on SVHS tapes. The data collection system monitored the alert level alarms. Warn level alarms were used for set-up and adjustment purposes only, and were usually set one value below the alert level alarm settings. Table 8 shows the final parameter settings used for each region.

	Process Rate	Motion Sensing	Alert Level	Sensitivity	Initialization Type	Confidence Level
Region 1	Fast	Both	3	9	Manual	10
Region 2	Fast	Both	5	2	Manual	10

Region 3	Fast	Both	1	10	Manual	10

Table 8. Detec Auto Sentry SA3 Parameter Settings

The manufacturer recommended that the program initialization file be modified by adding two lines allowing adjustable settings ranging from 1 to 10. Changing of either or both of these settings affects the system's reactions during the initialization time. The following lines were added to the initialization file and were the values used in evaluation testing.

XR = 10
SR = 0

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing.

- The system can learn the ambient activity in a scene during automatic or manual initialization and not alarm on the actions that happened during initialization.
- The system has individual relays available for each region, and each region has two relays (one for early warning and one for alarm).
- The system allows storing of multiple setups, including the learned scenes, during the initialization process.
- The system has alarm picture capture, storage, and retrieval features.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated.

- To get the system to ignore most nuisance alarms, these alarm sources have to occur during the program initialization time. Once initialization time is over and the settings are saved, the program can not be initialized on any new sources of nuisance alarms without forgetting its previous settings. The initialization period could be very long if every source of nuisance alarm has to be recorded and then played back into the system so it can initialize on that particular scene. If any new object is placed into the scene, the recorded scenes with nuisance alarm data must be redone to include the new object. As can be seen, an extensive amount of time could be required unless no changes to the scene are anticipated.
- The system tested had some software bugs that, according to the manufacturer, have been corrected. The main problem was that the sensitivity setting in a region at times may automatically change to the default settings whenever the operator was in the menu mode. This may not be obvious to the operator, so care had to be taken to ensure that the correct sensitivity levels were loaded.
- The evaluated system could have potential problems if all four camera inputs were used at one time. The response of the system with four cameras could be up to 3 seconds. A running intruder could probably be through the detection zone in this amount of time. The

manufacturer said that using a faster PC would help this problem, or using fewer cameras would increase the response time.

- The system lacks an automatic load-and-run feature that could allow the system to automatically restart without operator action whenever power to the system is removed. The system evaluated did have a battery backup feature that provided some degree of power loss protection and recovery.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 9 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

Quantity	Description	Price
1 ea.	#SA3; Auto Sentry (PC-AT internal card handles up to four cameras).	$3400
1 ea.	Industrial 386 computer and chassis with relay card, keyboard, and mouse.	$4600
1 ea.	Software for #SA3.	$400

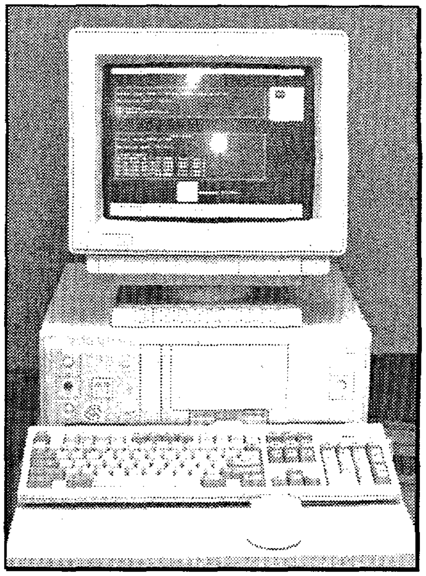
Table 9. Detec Auto Sentry SA3 System Cost

Summary of System Features

The Auto Sentry SA3 system by Detec has several promising features, assuming the software bugs are fixed (manufacturer says this has been done). The system's ability to initially learn ambient background and environmental conditions as normal could be beneficial in reducing known nuisance alarms. The system's ability to capture and store alarm pictures and to assign relays to individual regions is also a benefit of the Auto Sentry SA3.

The amount of time required to train the system to all potential types of normal scene activity could become very time-consuming in an outdoor environment. Re-initialization must take place when any significant changes in the scene occur. This retraining process is not additive and must be started from scratch for each region of interest.

EDS-Scicon Defence Ltd. — *Sentinel*



Advertised Features and Specifications

The Sentinel VMD system was designed to work in cluttered or busy environments in which it would learn the normal background movements (trees, bushes, shadows, etc.) and alarm only on actual intrusions. The Sentinel system is PC-based with one board per camera. One board could also handle four cameras if a quad multiplexer is used. There is a single relay output for any alarm from the board. The list below is from the manufacturer's advertisements.

- Automatic detection of user-defined events of interest
- Outdoor applications
- Minimum false responses
- Designed to operate in complex, cluttered environments
- Copes with camera motion
- Highly adaptive
- Easy to learn/use
- Rapid deployment
- Specific event sequences define alarm conditions
- High detection, low false alarm rates
- Improve efficiency, effectiveness

Some additional features of the Sentinel VMD system include:

- Multiple setups can be saved in various files.
- System event log files are stored on hard disk.
- Direction detection is available.
- Multiple setups with different names can be run at the same time and logged to file.

Final VMD System Settings

The Sentinel system was evaluated using a quad multiplexer. Only one camera was evaluated because of the limited number of system tiles (detection zones) available per board. The system was set up using the smallest possible object sizes to get the detection levels as sensitive as the system allowed.

Description of Area of Interest (AOI)

As much of the area between the cones was covered as the system would allow (limited number of tiles). Figure 14 shows the AOI used for evaluation testing. Both the entrance and destination locations covered the complete AOI. After multiple tests were run, it was determined that the following AOI would be used for evaluation testing.

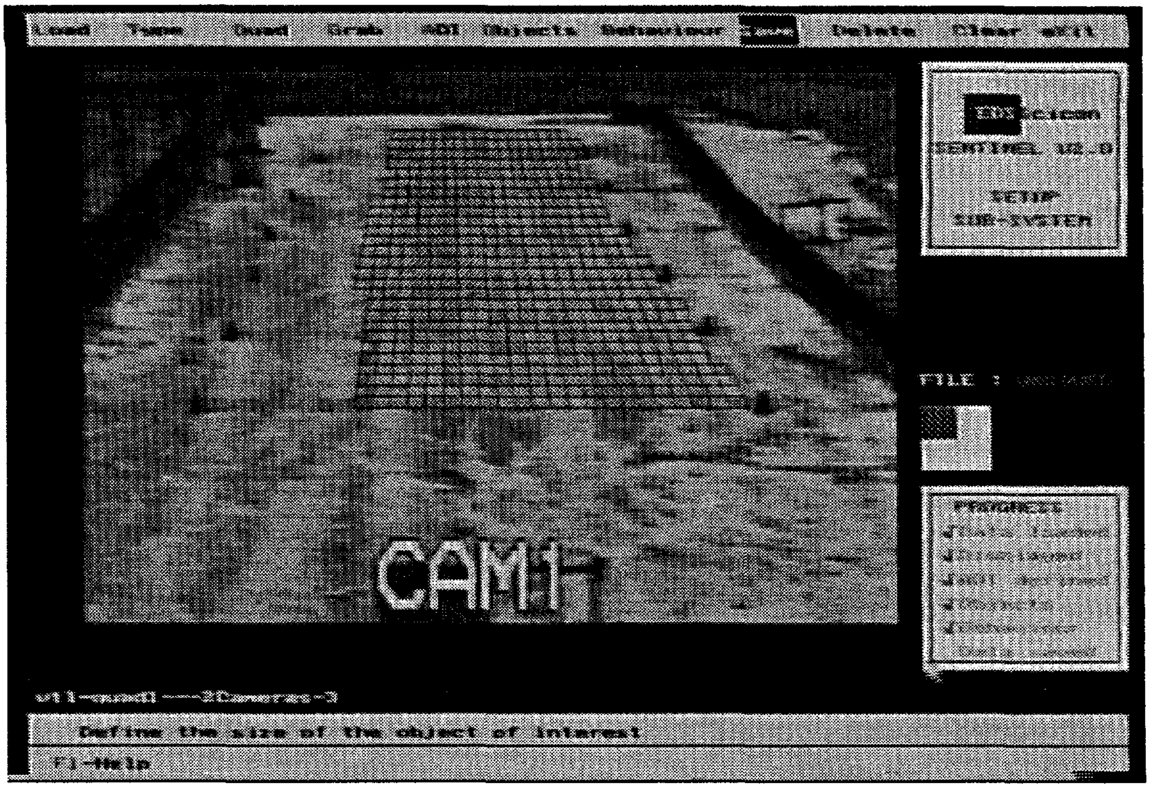


Figure 14. Area of Interest — Sentinel

System Parameter Settings

Table 10 shows the final parameter settings that were used for evaluation testing. Any settings not shown were left at default values.

Destination Persistence	.2
AOI Persistence	.3
Sensitivity	1

Table 10. Sentinel Parameter Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing.

- The system has the capability to store multiple parameter settings to hard disk.
- The system logs alarm and event files to the hard disk and makes them available for later review.
- The system has advanced user features to assist in setting up the system.
- The system seems to handle ambient noise or motion in the camera scene well.
- The system has timing and direction features that allow fine-tuning of the system for specific targets.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated.

- Although the system has the capability to monitor up to four cameras using a quad multiplexer, in the test application only one camera could be used because of the limited number of tiles available per board.
- The system currently has only one relay output. If four cameras were used, any and all would trip the same relay upon alarm.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 11 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

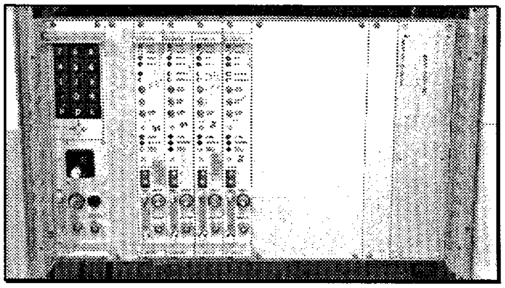
Quantity	Description	Price
1 ea.	Sentinel — Intelligent scene-monitoring system, to include all software and hardware licenses with standard options, relay output for VCR, 1.5 days on-site training, multi-camera quad to allow input of four cameras at once, and installation and operation manuals.	$20,500

Table 11. Sentinel System Cost

Summary of System Features

The Sentinel VMD system is a PC-based system that has many analysis features available to the expert user and, with its short-term scene analysis learn mode, it seems to handle environmental changes well. For the application in which the Sentinel system was evaluated, only one camera could be used because of the limited number of tiles (detection cells) available. Another feature that would prohibit using more than one camera is its single global relay output that trips when any camera alarms. This would make interfacing to other systems difficult.

Geutebruck — TeleTect VS-30



Advertised Features and Specifications

The TeleTect VS-30 is a modular system in a 19" rack-mount chassis. It is assembled from individual plug-in components according to the specific requirements. There are several ordering options, including different size rack-mount chassis (largest will hold modules for up to 12 camera or video memory modules). There is an option for video memory modules that will supply freeze-frame on alarm pictures for each of the VMD modules. The modular chassis can be chained together to provide up to 99 VMD sensors in one system. The following are general features associated with the TeleTect VS-30:

- Front-panel keyboard used for setup and programming (or special remote programming module).
- Distinction between movements and varying illumination by ignoring global changes.
- Perspective adjustments.
- Recognition of direction and speed.
- Four different stored modes of operation recalled manually or remotely; can be transferred from one module to the next.
- Integrated video memory option with up to 34 fields per module to record an alarm event (assigned per camera or as common memory for several different cameras).
- Up to 20 individually programmed zones (sensitivity, size, location).
- Zones can be assigned several functions (group, pre-alarm, main alarm, suppression).
- RS-232 data output for connection to printer or computer.
- Individual dry contact relay contacts on alarm and global contacts.
- Self-test program tests 90% to 95% of VMD system components.
- Video presence/loss detection.

Final VMD System Settings

Several tests were performed to determine the final parameter settings for the TeleTect VS-30. A combination of changing the AOI (size and location of zones), the sensitivity of the individual zones, and the mode in which each zone operated (group, pre-alarm, suppression, or main alarm) was evaluated to determine settings that would meet the 90% detection, 95% confidence levels required. Once these levels were met, adjustments were made to reduce the nuisance alarm level while still maintaining the required level of detection. The actual settings used for evaluation are shown in the System Parameter Settings section.

The system evaluated consisted of the following components:

1. VS-30/BGT-12 — Modular chassis allowing up to 12 VMD modules or video memories
2. VS-30/PM-E — Programming module with power supply
3. VS-30/VMD — Video motion detector module (four each in system evaluated)

Description of Area of Interest (AOI)

The AOI utilized for the evaluation used all 20 of its available zones. Figure 15 below shows the layout of the zones. The two rows of zones running the length of the detection area were the zones used for detection purposes. The detection zones were sized perspectively from the far FOV to the near FOV. The other four larger zones were set up as suppression cells to reduce nuisance alarms.

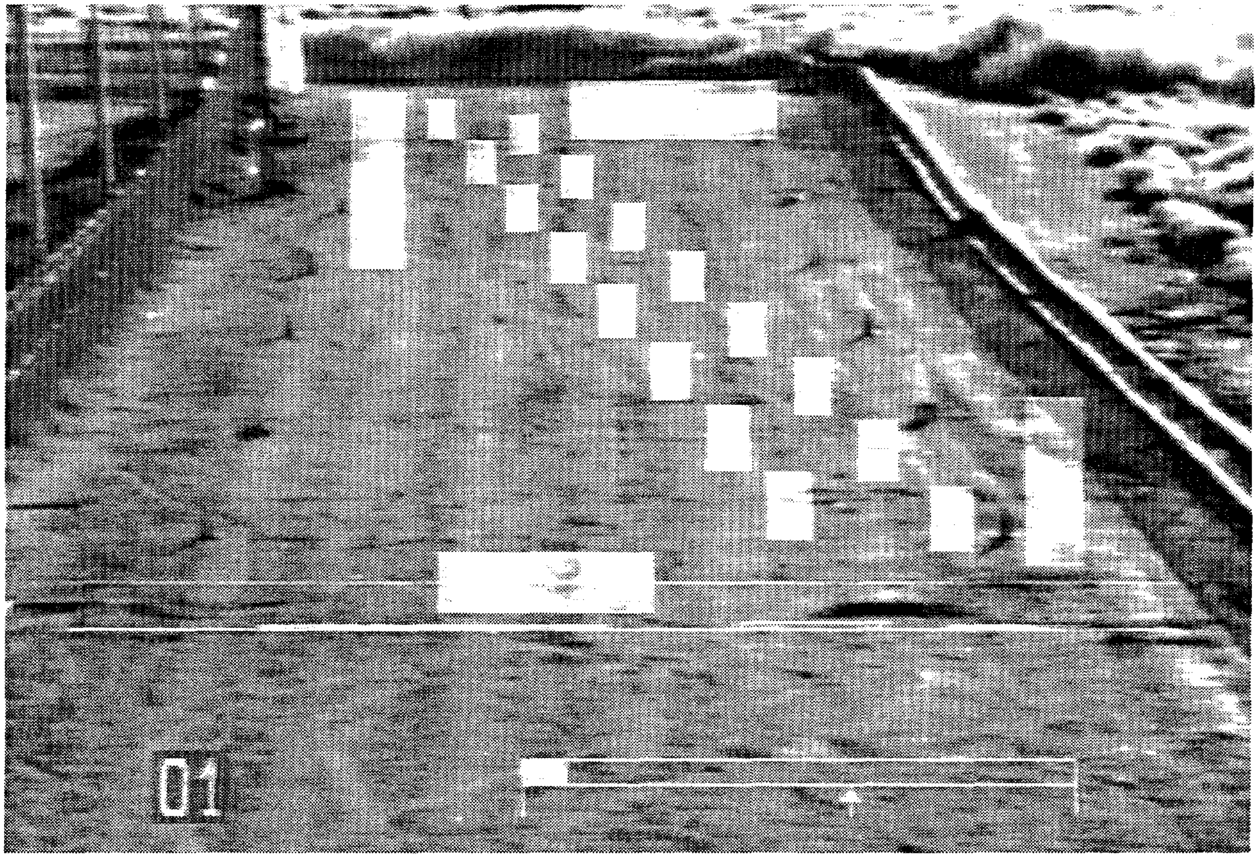


Figure 15. Area of Interest — TeleTect VS-30

System Parameter Settings

This section shows some of the different parameter settings available and those used for the evaluation testing. Only the parameters that were changed from default are shown in Table 12 and Table 13.

Suppression	15
Motion Threshold	13
Signal Failure Threshold	10
Measuring Cycle 40 msec	off
Measuring Cycle 160 msec	off
Measuring Cycle 640 msec	on
Measuring Cycle 2.5 sec	off
Measuring Cycle 10 sec	off
Pre-Alarm Time	5.0
Block-Alarm Time	2
No. of Pre-Alarms	1
Motion Auto Threshold Factor	off

Table 12. TeleTect VS-30 Parameter Settings

Figure 15 shows the individual zone locations. The two center rows, the detection cells, consist of 16 cells numbered 5 through 20 with eight cells (zones) in each row. The detection cells and the larger four remaining cells numbered 1 through 4 are the suppression cells. Table 13 shows the final zone threshold settings used for the evaluation.

Zones Menu

No.	Sens.	Fct.	Grp.	No.	Sens.	Fct.	Grp.
1	120	SUPP	-	11	100	PRE	1
2	120	SUPP	-	12	100	PRE	1
3	120	SUPP	-	13	90	PRE	1
4	120	SUPP	-	14	100	PRE	1
5	90	PRE	1	15	100	PRE	1
6	100	PRE	1	16	100	PRE	1
7	100	PRE	1	17	100	PRE	1
8	100	PRE	1	18	100	PRE	1
9	100	PRE	1	19	100	PRE	1
10	100	PRE	1	20	100	PRE	1

Table 13. TeleTect VS-30 Zone Threshold Settings

System Features Strong Points

This section describes some features of the TeleTect VS-30 system that proved to be beneficial during testing. Not all available system features may have been utilized, such as switching in multiple parameters, in evaluation testing because of time constraints. Utilizing these features may or may not affect the overall system performance.

- On-screen scope and other functions assist in the set-up process.
- Graphic overlay shows where intrusion occurred.
- Individual cell size, position, and sensitivity adjustments are possible.
- Zones can be set up to function as pre-alarm, alarm, or as a group of cells.
- Modular design allows expansion for one camera at a time.

- Option is provided to add on-board frame-capture capabilities.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable in other situations.

- The number of maximum cells available is limited to 20 per camera. If the application requires small target detection and the camera FOV covers a large area, the number of available cells may not be adequate when trying to use the advanced available features.
- The operator interface (front keyboard and joy stick), while adequate to accomplish the set-up functions, are not user friendly.
- The manuals could give more details and examples on how to set up and use the system and on how the parameters interact with one another.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 14 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

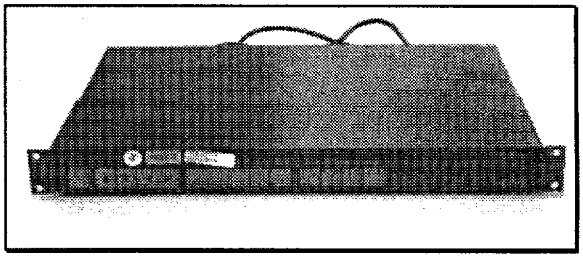
Quantity	Description	Price
1 ea.	#VS-30 PME — Program module.	$2,019
1 ea.	#VS-30/VMD — Video motion detection board (4 ea. used in system evaluated).	$2,214
1 ea.	VS-30 BGT-12 — 19" rack-mount chassis.	$997
1 ea.	VS-30/NG — Power supply.	$301

Table 14 Geutebruck TeleTect VS-30 System Cost

Summary of System Features

The Geutebruck TeleTect VS-30 VMD system has many features and options that make the system adaptable to different applications and interfaces. The system has features to suppress the ambient background noise and environmental effects associated with outdoor environments. The detection capabilities are good, but care should be taken in setting up the system when using suppression to not allow an intruder to cross the zone during cloud conditions as the probability of detection goes down during the times when suppression cells are used.

GYYR — *DVMD32*



Advertised Features and Specifications

The DVMD32 is a self-contained motion detection system in a desk-top or rack-mount chassis. It includes a built-in quad that simultaneously displays four camera views. The unit will accept up to eight camera inputs with up to 32 alarm detection windows spread across the eight cameras. It is possible to define five different configurations of alarm windows and to save these configurations for later use. The system automatically adjusts to ambient alarm conditions using a special light detection window that monitors light levels and ensures that sudden light changes do not trigger false alarms. The unit features user-friendly on-screen menus programmed with a mouse or the unit's front panel. The unit's RS-232 port allows interface with a computer. Below are additional features of the DVMD32:

- Eight single or four looping video inputs, full-screen or quad display
- 10 alarm outputs
- Monitors scenes in museum or motion detection modes
- 32 user-defined independent alarm detection windows
- Individually programmable detection windows
- Window sizing/position by front-panel buttons or mouse
- On-screen menu-driven programming
- Museum Mode ignores surrounding movement
- Set individual camera dwell times .5 to 30 seconds for alarm sequencing or during non-alarm switching
- 256 gray-scale resolution
- Alarm detection windows unseen except during alarm
- Low false alarm rate
- Automatically adjusts for ambient light changes
- Programmable freeze-frame on alarm with 2X digital image enlargement possible
- Programmable camera titles
- Three programmable video outputs
- Alarm outputs (TTL +/- 24 ma.), one for each camera alarm, one general alarm, one video loss alarm

Final VMD System Settings

The DVMD32 allowed changing each detection window size, location, mode of operation, and sensitivity. Each of these factors has an influence on how the system operates. The manufacturer was consulted to determine the best settings for testing under the evaluation parameters. Several different configurations of the detection windows were tried in an effort to achieve the best possible detection while maintaining a low nuisance alarm rate. The actual settings used for the evaluation testing are shown in the System Parameter Settings section.

Description of Area of Interest (AOI)

The AOI used in the evaluation of the DVMD32 is shown in figure 16. Several different sizes of cells were used in trying to determine settings for detection and nuisance alarm rejection for the application used in evaluation testing. Note that eight detection windows are used in this setup. There are only 32 total detection windows available for the system, so if eight cameras are used, each could not have eight detection windows because of the limited number available (32 total for eight cameras).

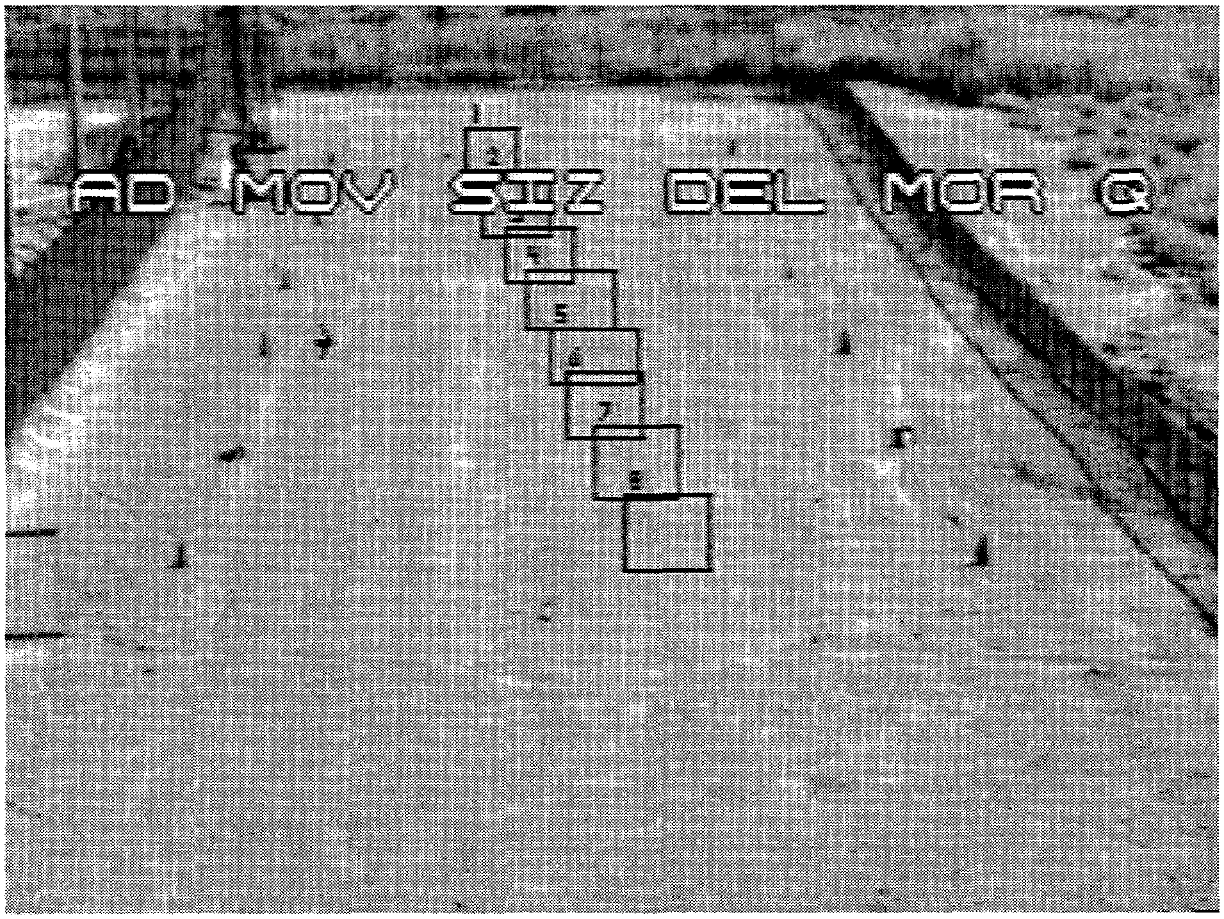


Figure 16. Area of Interest — GYYR DVMD32

System Parameter Setting Screens

The available parameters for adjusting the DVMD32 are the type of detection window, detection window sensitivity, light window sensitivity, and reference period update rate. The reference update parameter was a global setting for all cameras. The detection window sensitivity and type were for each cell or window (could be several on a camera), and the light window sensitivity was for all cells on the same camera. Table 15 shows the final parameter settings used for the evaluation testing.

Window Number	Window Type	Window Sensitivity
1	Motion	75
2	Motion	75
3	Motion	75
4	Motion	75
5	Motion	75
6	Motion	75
7	Motion	75
8	Motion	75

Light Window Sensitivity	Reference Update
60	5

Table 15. GYYR DVMD32 Parameter Settings

System Features Strong Points

This section describes some features of the DVMD32 system that proved to be beneficial during testing.

- The system has multiple monitor configurations, including programmable freeze-frame on alarm, quad modes, and zoom features.
- The system is programmable by front-panel keypad or external mouse with password-protected menus.
- The system is quickly set up without having to change or set up many parameters.
- The system has overlaid graphic boxes showing were the alarm occurred.
- The system has the ability to store up to five different configurations or setups (manually recalled).

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable to other situations.

- There is a maximum of 32 detection cells available for the whole system. This can be divided between each of the eight cameras, which would limit the number of detection cells per camera to four.
- The system can account for clouds with its sensitivity levels set high enough, but has problems detecting a crawling intruder at these levels.
- More application examples in the installation manual would help in determining the correct size of detection cell to use in setting up the AOI.
- The system has TTL output for alarm interfaces. For the tested application, dry relay contacts were preferred and had to be added to interface with the data collection system.
- At times the system would hang up in the alarm condition when multiple alarms were generated at once. When this happened, a manual reset was required to return to normal operation.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 16 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

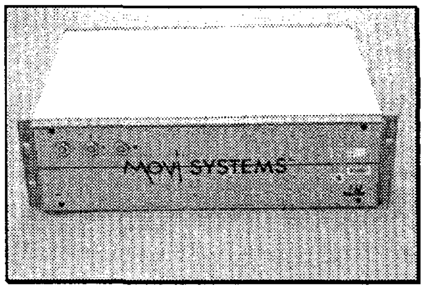
Quantity	Description	Price
1 ea.	DVMD32 Digital Video Motion Detector (eight camera inputs).	$3,330

Table 16. GYYR DVMD32 System Cost

Summary of System Features

The GYYR DVMD32 VMD system is easy to set up, with only three parameter settings plus sizing of the cells to determine how the system detects motion or rejects nuisance alarms. The system can be used as a stand-alone detection system with programmable (switch-on alarm) monitor outputs, freeze-frame on alarm VCR control, and playback. The system allows the placement of 32 independent alarm windows across eight cameras and has the capability to store and manually recall multiple configurations.

Shorrock/Hymatom — *Movicom MV-4VMD*



Advertised Features and Specifications

Movicom, a video surveillance sensor that can be used in manual or automatic mode, can manage from 1 to 240 cameras. The Movicom surveillance module is an autonomous control system that provides video motion detection and digital image storage as well as camera and alarm management. The basic Movicom module consists of a system unit, mouse, and system access keys. You may add a display monitor, cameras, communications options, additional memory, and other options to expand the system to meet your particular needs.

Movicom can be configured in two basic modes:

1. *Stand-Alone Emitter Station*: Configured as an emitter, the Movicom 4 base unit can control a stand-alone security system that can manage from one to four cameras. With the addition of the Movicom 7 extension, the unit can control a stand-alone system of up to seven cameras. In this configuration, the remote controls cannot be used. With a communications option, it can report to a remote reception station as part of a centralized video network.
2. *Receiver Configuration*: Configured as a receiver, the Movicom unit forms the control center for a centralized video network that can manage input from up to 40 Movicom emitters (up to 240 cameras). The networking communications are via phone lines with external modems.

The configuration used in the evaluation testing was #1 (Movicom 4), which could accept up to four camera inputs. The features to remotely monitor and access the alarm data were not part of this evaluation. Below are some of the advertised features of the Movicom 4 used as a stand-alone security system.

- 19" rack-mountable unit
- Four video looping camera inputs and two monitor outputs
- Front-panel controls with programming via external mouse
- Hard-disk storage of alarm pictures (three pictures per alarm)
- Day and Night modes of operation (different setups)
- Mode of operation changed via key-switch or external device
- Manual or automatic alarm reset
- Key-lock switch prevents unauthorized system parameter changes
- Ignores background noise
- Two monitor outputs (one for parameter access and alarm review from hard disk, one for cyclic image scan with automatic switching of the alarm camera)

Final VMD System Settings

The Movicom 4 surveillance system allowed changing the size of the AOI and the changing of several parameters associated with how the detection cells in the AOI process movement. Each of these parameters had an influence on how the Movicom MV-4VMD operated. The manufacturer was consulted to determine the best settings for testing under the test application. Several different combinations of changing the parameter settings (global changes per camera) were tried in order to reach the required detection levels while maintaining a low nuisance alarm rate. The actual settings used for the evaluation testing are shown in the System Parameter Settings section.

Description of Area of Interest (AOI)

The AOI used for evaluation of the Movicom 4 VMD was determined after several tests, including changing the AOI. One of the changes to the AOI included perspective compensation from far to near FOV. To incorporate perspective compensation, manually setting up each detection cell in the AOI was required. The results or benefit of using perspective compensation proved to be inconclusive; therefore, perspective compensation by adjusting the number of cells in the AOI was not used. Figure 17 shows the final AOI layout used for evaluation testing.

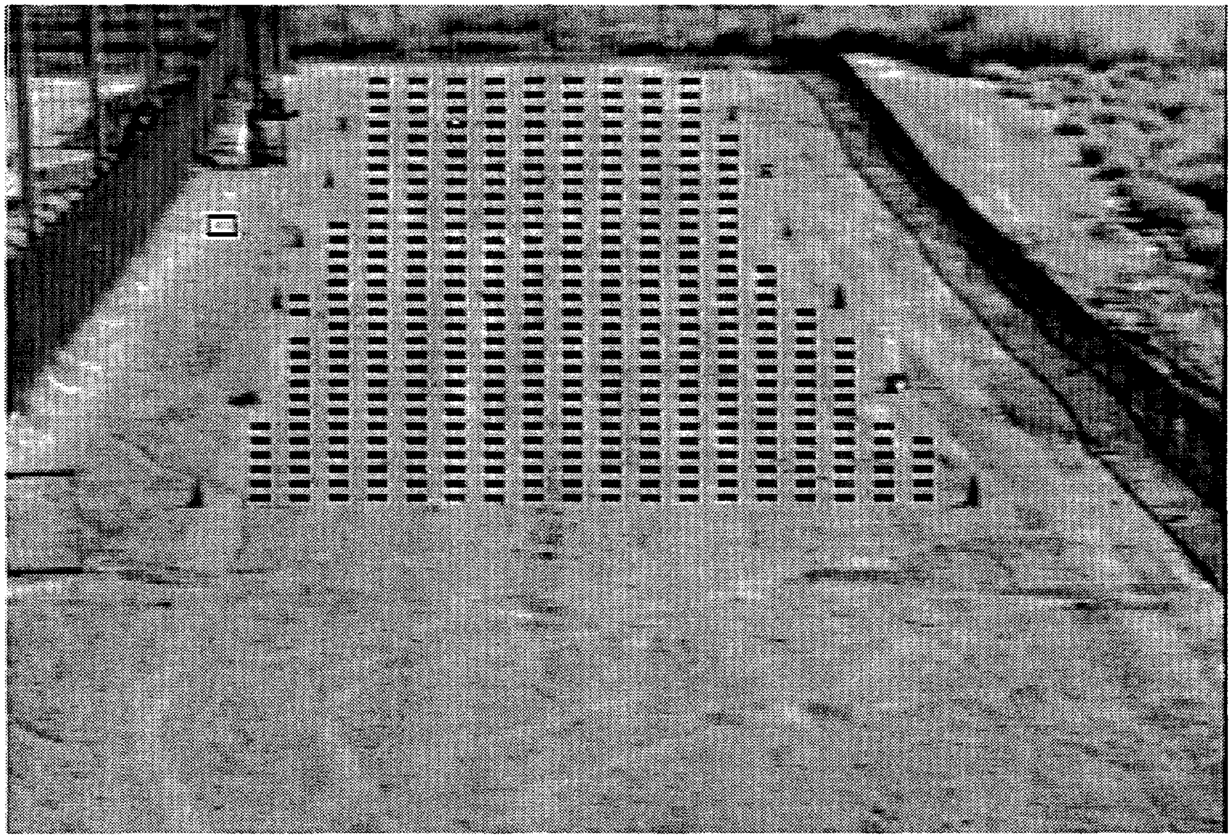


Figure 17. Area of Interest — Movicom MV-4VMD

System Parameter Settings

Table 17 shows the final system parameter settings used in determining the evaluation test results. Any parameters not shown were left at their default values.

Number of Markers	1
Gray Level Sensitivity	2
Movement Value	1
Direction of Movement	Horizontal Only
Analysis Time	3
Noise Compensation	6

Table 17. Movicom MV-4VMD System Parameters

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing. Although not all of the available features (such as remotely changing configurations) may have been utilized in the evaluation, incorporating these features could have beneficial results in reducing nuisance alarms.

- Alarm pictures (three per alarm) are stored to hard disk for later review.
- System allows remote assessing of alarm pictures from hard disk via phone lines.
- System menus are protected via key-switch.
- System allows remote switching of two sets of parameters.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable in other situations.

- The system has no easy way to adjust for target size between the near and far camera FOVs (no automatic perspective adjustments, although it can be done manually).
- The system has voltage level outputs (not relay outputs) that make interfacing to other systems more time-consuming.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 18 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

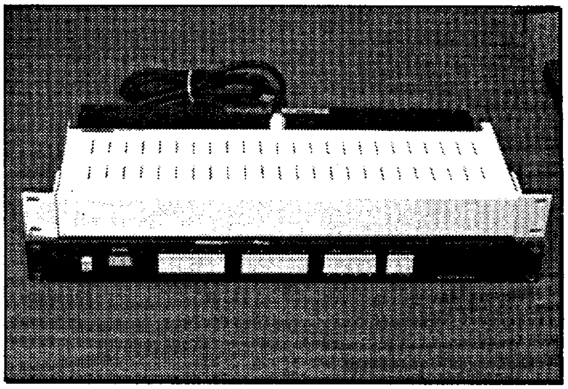
Quantity	Description	Price
1 ea.	Movicom 4 #MV-4VMD Video Motion Detector.	$9,600
NA	Two days on-site training (optional).	$1,000

Table 18. Movicom MV-4VMD System Cost

Summary of System Features

The Movicom 4 VMD system can be set up with remote access capabilities via phone lines if there is a receiver on the other end. The evaluated system handles up to four cameras and stores three pictures for each alarm to the hard disk for later review. The system has manual or remotely switched day/night modes that allow changing the parameter settings from day settings to night settings.

Quark Digital Systems — *Q18VM4*



Advertised Features and Specifications

The Q18VM4 video motion detector/switcher has extensive alarming and switching capabilities based on motion detected from a composite video signal normally provided by CCTV cameras. The Q18VM4 uses a fast internal computer to analyze video from up to 18 cameras to decide on specific action based on programming and settings provided by the user. The Q18VM4 is a complete head-end switching device capable of routing video to monitors and VCRs on motion detection or sequentially at up to two cameras/second. Extensive control provided by the RS-232 option allows complete system operation and monitoring from other head-end equipment. Below is a list of features of the Q18VM4 video motion detector/switcher:

- Up to 18 camera motion detection in a single rack-mount unit (B/W, color, infrared)
- Four monitor outputs (one hold/alarm, one motion switch, two programmable sequences)
- 24-character camera identification
- Time and Date display
- Menu-driven on screen with password-protection option
- Video loss detection and alarm
- No external synchronization required
- Four alarm time presets per camera with programmable alarm responses including external triggers
- All settings held in solid-state memory
- Up to 16 external alarm inputs
- Automatic alarm resetting and tone disable for unattended modes
- Programmable auto sequence during no motion
- Individual camera motion sensitivity and size adjustment with zone masking grids
- Automatic compensation for slowly changing light levels
- Optional relay board for adding up to 19 individual relay outputs
- Optional RS-232 communication with extensive control and monitoring protocol for remote operation or control by a host or card access system
- Major video standards supported

Final VMD System Settings

Several settings were tried with the Q18VM4 system. The manufacturer was consulted when determining the settings to use for the application in which evaluation testing would be performed. The settings used for the evaluation are described in the System Parameter Settings section. The system used in the evaluation testing was the Q18VM4 with the optional relay board and RS-232 options installed.

Description of Area of Interest (AOI)

Figure 18 shows the AOI used in the evaluation testing. The AOI is changed by activating or deactivating one square detection area (see figure 18) at a time. If the outermost detection zones were active, it would cover the area from the arrows to the edge of the screen. As can be seen, this allows some level of determining where the AOI will be. The scene below shows the detection cells at the 100-foot FOV to be off. This reduced the number of nuisance alarms. During the test, the system could not detect an intruder at the 100-foot FOV at any settings without continually alarming for unknown reasons.

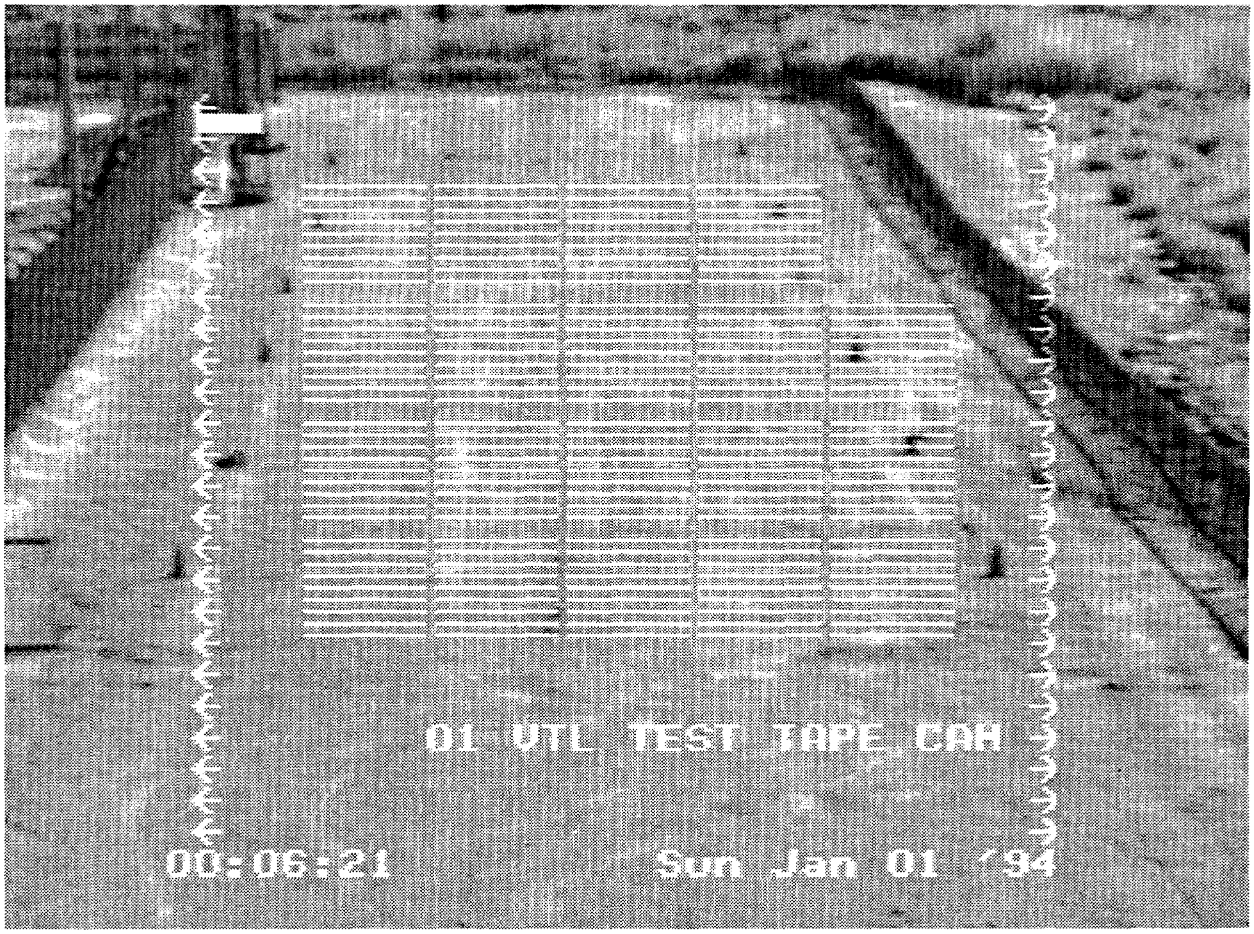


Figure 18. Area of Interest — Quark Q18VM4

System Parameter Settings

Each camera used for the evaluation testing was set up with the settings shown in Table 19, which were the lowest the manufacturer recommended for our application. These settings are global for each camera scene. Each camera can have different settings. Any setting not shown was not utilized for the evaluation (i.e., changing settings at different times).

Sequence #	2
Sensitivity Level	10
Trigger Level	03

Table 19. Quark Q18VM4 Parameter Settings

System Features Strong Points

This section describes some features of the system that proved to be beneficial during testing.

- System cost per camera is very low.
- Hardware interface capabilities are good (RS-232, relay board).
- System features a switcher and provides motion detection.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable in other situations.

- System does not adapt well to outdoor changing environments.
- System provides no on-screen indication of where alarm occurred.
- System has limited detection capabilities for design criteria.
- There are no speed adjustment parameters.
- System reacts differently from one channel to the next when both are at the same settings and are provided with the same video signal.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 20 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

Quantity	Description	Price
1 ea.	Q18VM4 — Video Motion Detector/Switcher with RS-232 option and optional relay board (18 camera inputs).	$2,195

Table 20. Quark Q18VM4 System Cost

Summary of System Features

The Quark system has many useful features that allow it to function as a switcher as well as a motion detector. The number of user-adjustable parameters are limited, so setup is straightforward. The ability of the system to interface easily with other equipment is an asset. The system's ability to monitor up to 18 cameras makes per-channel cost of the system its most attractive feature.

Magal — *DTS-1000 Outdoor VMD System*

Advertised Features and Specifications

The DTS-1000 video motion detection system is designed and optimized for outdoor as well as indoor detection. The basic system requires an IBM-compatible PC computer platform — 80386 or better, for display, operation, and control. The algorithms implemented by the software enable the system to differentiate between objects, to selectively track targets in predetermined areas, directions, speed, and size, and to sound and alarm only when the above criteria are met. The DTS-1000 system requires the following components for operation:

- IBM AT PC or compatible
- Color graphic monitor
- B/W CCTV monitor
- Optional VCR
- One to eight interface cards (four cameras per card, 32 cameras maximum)
- Graphic overlay card

The following is a list of the advertised features and specifications of the DTS-1000 VMD system:

- Programmable multiple areas of interest (AOIs) per camera associated with time or external sensors.
- Has a quasi-three-dimensional perception so that the target size, movement, and speed are calculated in length area dimensions as opposed to angular measurement in non-3-D systems.
- Target size, direction, and distance parameters for each camera.
- No false alarms from light changes caused by time and weather.
- Video signal failure recognition.
- Camera blocking alarm.
- More than 7000 detection cells.
- Simple procedure for camera replacement.
- Priority procedure in reporting alarms.
- Automatic picture perspective.
- Recording of first alarm indication by freezing frame on hard disk.
- On-screen camera identification.
- Continuous self-testing.
- Learning mode to optimize surrounding conditions and AOIs.
- Tracing of intruder is visually displayed by tracking window.
- Extremely small target size detection.
- Extremely low-contrast resolution.

- CCIR or RS-170 video input.
- Four cameras per interface card expandable to 32 total cameras per system.
- External synchronization of cameras not required.

Final VMD System Settings

Several different parameter and AOI settings were tried with the DTS-1000 system. The manufacturer was consulted when determining the settings to use for the application in which evaluation testing would be performed. The parameter settings used for the evaluation are described in the System Parameter Settings section.

Description of Area of Interest (AOI)

The final AOI used for evaluation testing is shown in figure 19. Note that the area covered extends past the area within the cones. This increased the width of the AOI to cover the greatest area between the fences as possible, which gave the system the maximum amount of time in which to respond to a runner. If the width of the AOI was narrow, the likelihood of missing running intruders increased. Note that the cones in the scene were masked out. This reduced any potential nuisance alarms caused by the cones being in the scene. The level of nuisance alarms rose dramatically when the AOI was moved any closer to the fence than shown.

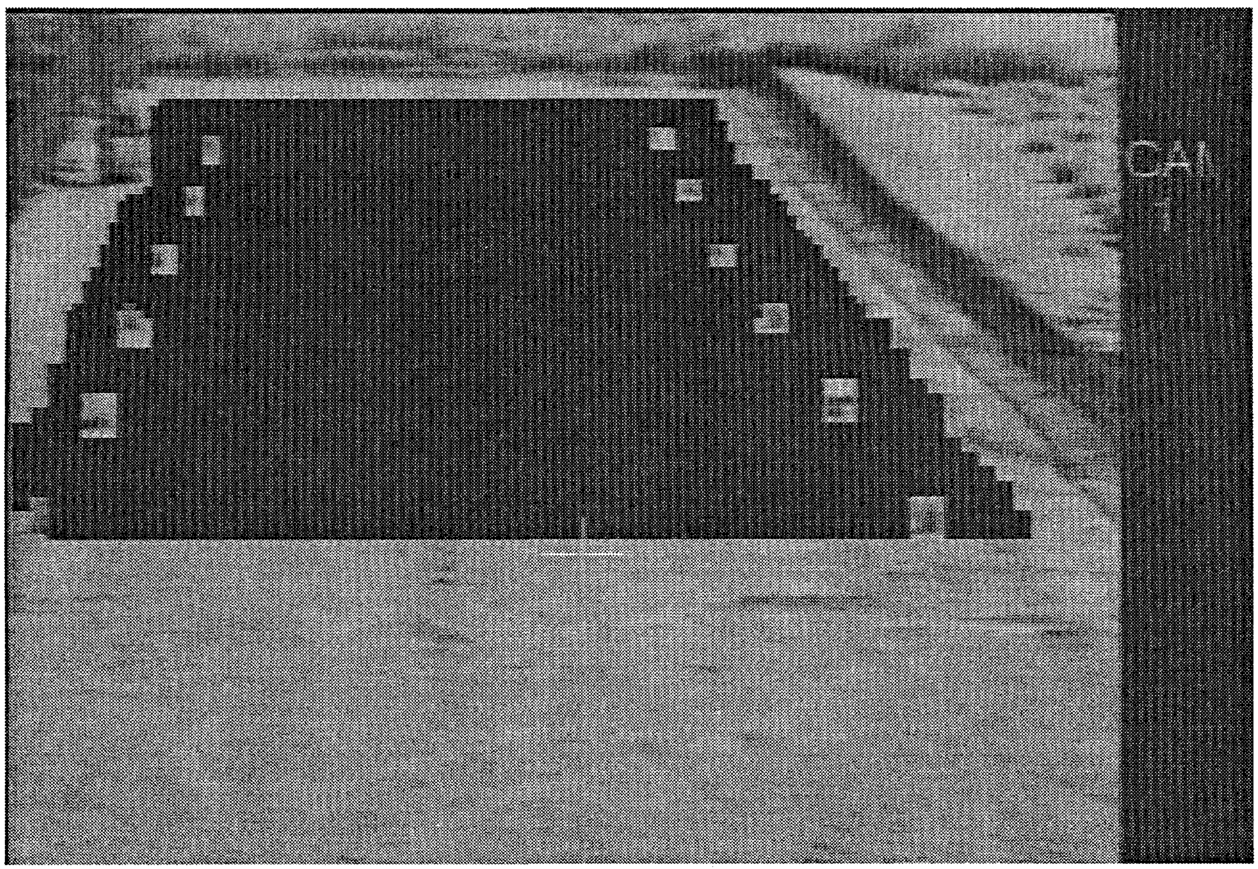


Figure 19. Area of Interest — Magal DTS-1000

System Parameter Settings

The parameter settings used for the evaluation testing are listed in Table 21. Multiple combinations of changing the parameters were tried prior to coming up with the best values for the test application. The manufacturer was contacted to verify that the values used were appropriate for the application under which the system was being tested.

Pic. Name	VTL ZONE 7
Height	9.2 m
Inclination	5.25 deg
Focal Length	49.62 mm
Camera Format	2/3"

SET NAME	VTL-12-9	**DIRECTIONS RANGE**	0 > 0
ACTIVE CAMERA	YES	**PRIORITY**	0
THRESHOLD	NORM	**IDENTIFICATION**	NO
MIN. SIZE (m2)	.2	**MAX VELOCITY (m/sec)**	12
MIN. DIST (m)	3	**TIME LIMIT (sec)**	20

Table 21. Magal DTS-1000 Parameter Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing. Although some of these features, such as changing parameters at different times, may not have been utilized in the evaluation, incorporating these features could have beneficial results.

- System uses target size, distance traveled, and speed to determine alarm criteria.
- System saves alarmed image to hard disk for later review.
- System logs alarm and event files to hard disk.
- Multiple parameter sets can be stored and loaded manually or remotely.
- System presents alarm to operator with graphic box and tracer showing where the alarm occurred and its current location.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer.

- System has problems consistently detecting a runner when the AOI is less than 40 feet wide because the system acquires the image once every .5 second and needs three images to determine whether or not there is an alarm. With a short zone, the runner may not be in the FOV long enough.
- System has only one relay output per camera for all alarm types (blocking, detection, interference, video loss).
- The graphic overlay of the system does not allow monitoring for the complete FOV of the camera. The area close to the edge of the screen cannot be part of the system's detection zone or AOI.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 22 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

Quantity	Description	Price
1 ea.	DTS-1000 System, which includes one overlay board, one four-camera processing board, 386 computer, software, and manuals.	$18,000

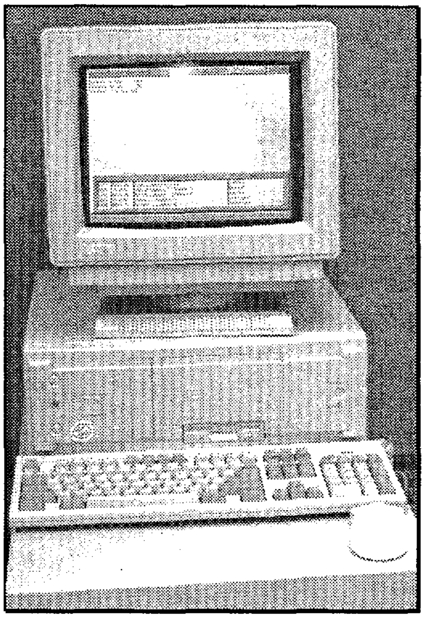
Table 22. Magal DTS-1000 System Cost

Summary of System Features

The Magal DTS-1000 uses detection as well as tracking algorithms to determine if there is a valid intrusion. The DTS-1000 is a pseudo-3-D system, enabling data processing of real size, velocity, and direction range of movement. The first image on alarm is recorded to hard disk. Multiple parameter sets are stored and can be recalled by time or external input.

Senstar — *David 300*

Advertised Features and Specifications



The David 300 is a third-generation video intrusion detection sensor for outdoor applications. David 300's intelligence recognizes human intruder characteristics while ignoring factors such as cloud shadows, wind-induced camera shake, rain, snow, birds, and small animals. An intruder is initially detected and tracked through a number of user-defined detection cells. These cells provide perspective compensation to detect intruders over an entire FOV with uniform sensitivity. If size, speed, and direction of the target correspond to human intruder characteristics, an alarm is activated and the intruder is graphically highlighted on a video monitor.

The David 300 system consists of a PC chassis, keyboard, monitor, mouse, and plug-in intrusion detection cards. Each detection card processes data from two video channels with no inter-camera sync requirements. Some additional advertised features and specifications are:

- Patented target tracking and spatial filtering algorithms accurately detect human intruders and disregard environmental effects and small animals.
- Can have detection zone lengths up to 200 meters, reducing the number of cameras needed.
- Setup is simple and quick, using pull-down menus.
- System automatically adapts to different environmental conditions without changing setups.
- Integral control and data logging provide stand-alone alarm system.
- Continuous monitoring of video quality with fail-safe operation on loss of video.
- System inputs include:
  - RS-170 or CCIR monochrome or color video signal (one per channel).
  - Contact closure input for Verify function (one per channel).
  - Contact closure input for Reset function (one per channel).
  - Keyboard/mouse for system control and set-up functions.
- System outputs include:
  - Input video signal from each channel with added text and graphic annotation.
  - Independent alarm and fault relay outputs for each channel (fault relay will activate on power failure).
  - Parallel or serial printer output.
  - Data logging file on hard disk for over 1 million system events; separate files produced for each day's events.

Final VMD System Settings

The manufacturer's recommendations were followed to establish the AOI and to define sensitivity adjustments. Fine-tuning of the parameters was performed to meet the evaluation detection criteria. Several more adjustments were made to try to eliminate false alarms. The actual settings used for testing are found in the Parameter Settings section.

Description of Area of Interest (AOI)

The AOI for the David 300 system was set up according to the manufacturer's instructions. Figure 20 shows the AOI layout used in evaluation testing.

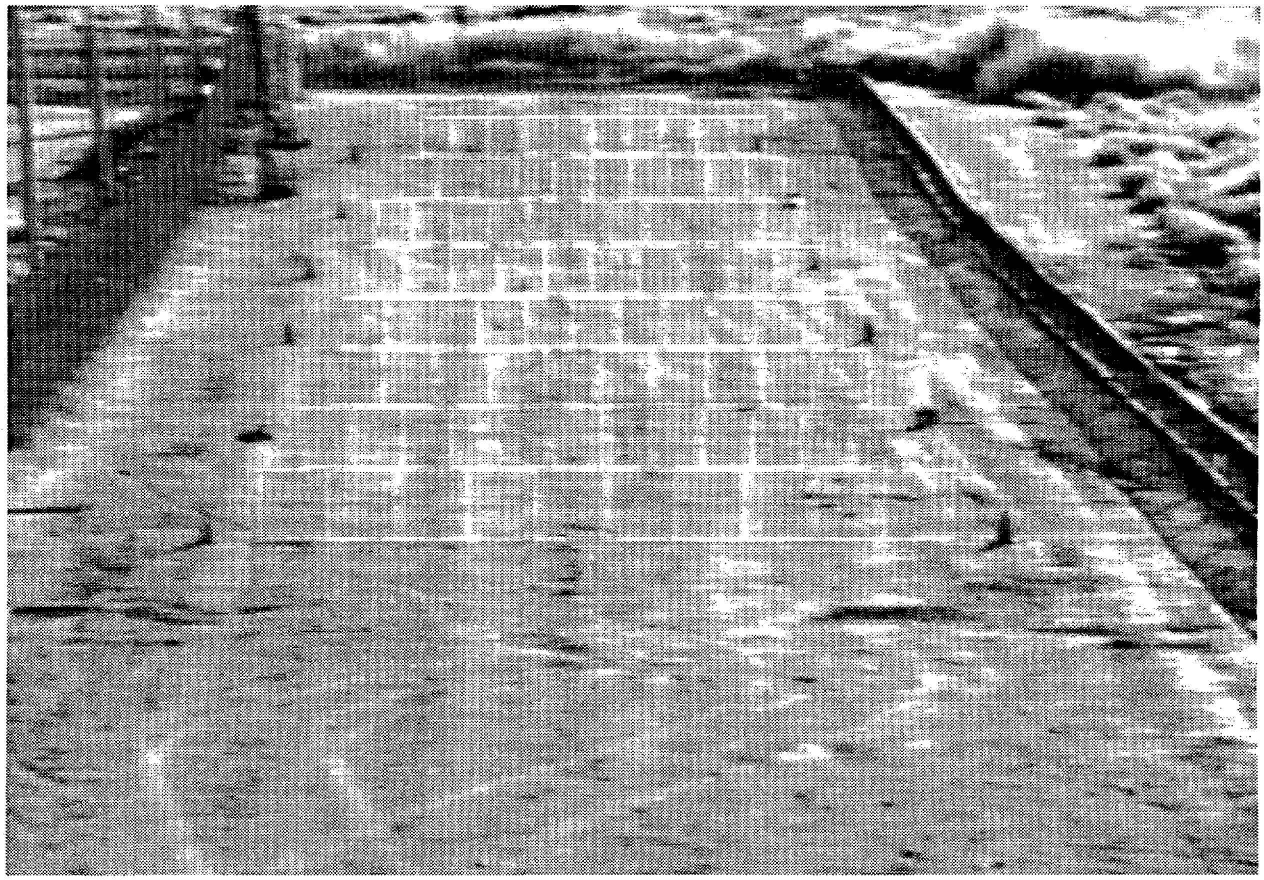


Figure 20. Area of Interest — David 300

System Parameter Settings

Table 23 shows the parameter settings used for evaluation testing for the David 300 system. Any parameters not shown either did not affect the detection algorithm's performance or were not changed from their default values.

DISTANCE TO DETECTION ZONE START	284 ft. or 85.29 meters
TYPE OF ZONE	NONE
REFERENCE HEIGHT	1 meter
HORIZONTAL TRACK	BOTH DIRECTIONS
VERTICAL TRACK	DISABLED
% WIDTH TO HEIGHT	88%
TOTAL # CELLS	84
VIDEO TEST WINDOW	2 sec
VIDEO LOW LEVEL	5%
VIDEO JAM LEVEL	95%
VIDEO SIGNAL INPUT	1Vp-p
AUTO RESET TIME	2 sec
CAMERA THRESHOLDS (NORMAL)	
RATIOMETRIC THRESHOLD	8
DETECTION THRESHOLD I	17
DETECTION THRESHOLD II	30
HORIZONTAL TRACKING	4
VERTICAL TRACKING	4
DAWN/DUSK FACTOR	12
CAMERA THRESHOLDS (EXTENDED)	
MAX TARGET SIZE	3.0 meters
CELLS FOR GLOBAL CHANGE	35 %
NOISE REACTION TIME	20 sec
NOISE LIMIT	300
NOISE FACTOR	6
CLOUD DETERMINATION RATIO	.7
CLOUD REACTION TIME	10 sec
CLOUD RECOVERY TIME	600 sec
CELLS FOR SMALL CLOUD	20 %
CELLS FOR LARGE CLOUD	45 %

Table 23. David 300 Parameter Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing.

- Multiple settings can be stored and recalled from hard disk.
- Log files are stored to hard disk.
- System is password-protected.
- Video signal monitoring is provided for video loss detection.
- Direction and distance traveled adjustments are possible.
- Hardware interfaces allow multiple relays for different alarm conditions.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable in other situations.

- Adjustments to allow rejection of fast-moving objects are not available.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 24 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

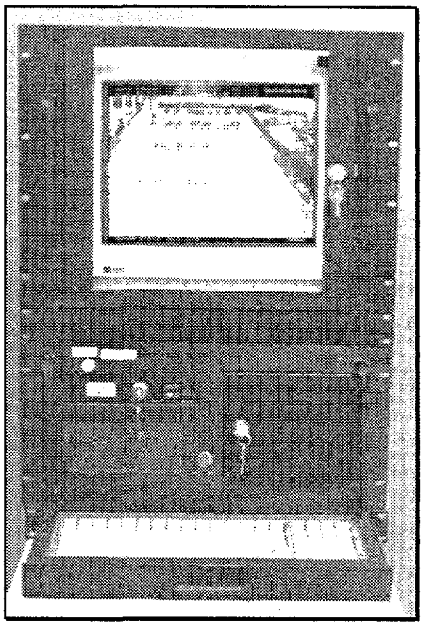
Quantity	Description	Price
1 ea.	#DM-1 David 300 universal module for two cameras.	$7,578
1 ea.	#DC-2 David 300 commercial chassis; accepts up to four David 300 modules (up to eight cameras); desktop includes PC chassis, color monitor for setup and control, keyboard, mouse, VGA card, interface card, and system control software.	$4,931
1 ea.	#AP-8 screw terminal panel for 1-8 cameras; connects to alarm interconnect to allow screw terminal interface to customer alarm panel.	$423

Table 24. David 300 System Cost

Summary of System Features

The David 300 VMD system is a PC-based system that can support up to 15 two-camera processing cards (30 cameras). The system logs events to files and to an optional printer. System features allow adjustment of target direction and distance traveled. The algorithms of the David 300 system were tailored to detect a human target with respect to size and speed. The system also has features that allow specific adjustments for nuisance alarms caused by clouds.

Tech. Services International — *TSI-2020*



Advertised Features and Specifications

The TSI-2020 is an intelligent video motion detection system that not only detects motion but also makes decisions concerning the motion. The system uses a motion detection algorithm that is impervious to day/night conditions yet is extremely sensitive to true motion. Below is a list of features that are advertised by the manufacturer:

- Up to 64 independent detection regions or zones per camera, with individual sizing, placement, and sensitivity parameters.
- External communications and control through two serial RS-232 ports (an RF modem and video tape recorder).
- Up to 32 SPDT relay switch contacts user-assigned to individual regions or multiple regions.
- System allows sequencing (up to 64 per system) of individual regions where, when a region is in a sequence, it will not trigger an alarm unless it is the last region in the sequence. Multiple regions can be set up in a sequence where each has to trip in a defined order within a defined time-frame for the system to trigger an alarm.
- System security features include password control and software key.
- System has on-screen indication level of motion detected (motion values) to assist in setup and alarm analysis.
- The system keeps track of the alarm history for later review.
- On-board help menus.
- On-screen menu programming.
- Line type or rectangular type detection regions.
- Can be used as a node in a proprietary network.

Final VMD System Settings

Several different parameter and AOI settings were tested to determine the best possible settings for the application in which the system was evaluated. The manufacturer was contacted and consulted when determining the settings to use for the application in which evaluation testing would be performed. Parameter, AOI, and threshold settings used for the evaluation are described in the following sections.

Description of Area of Interest (AOI)

Several different AOI setups were tested to find the one with the best overall probability of detection and lowest nuisance alarm rate. Figure 21 shows the final AOI setup for the TSI-2020 that was used for the evaluation testing. The AOI consists of a series of vertical detection lines that are combined to cover the complete detection zone defined by the cones. Each line is a detection point (cell) and can be individually adjusted in size and sensitivity. The shorter a line the more sensitive the cell becomes. Notice that shorter lines were used at the far FOV because targets appear smaller at this distance.

The other feature used in setup of the AOI for the test application was sequencing of the individual cells. The system allows setups that require a defined number of cells to trip in a pre-defined order and within an established time period before an alarm is reported. Utilization of this feature was beneficial in reducing nuisance alarms. The System Parameter Settings section shows how the sequenced cells were set up for the test application. Many sequences and regions were used because sequenced regions were optimized to catch a crawler, a runner, and a walker in both directions. The sequenced regions were also set up in three groups covering the far, middle, and near FOVs.

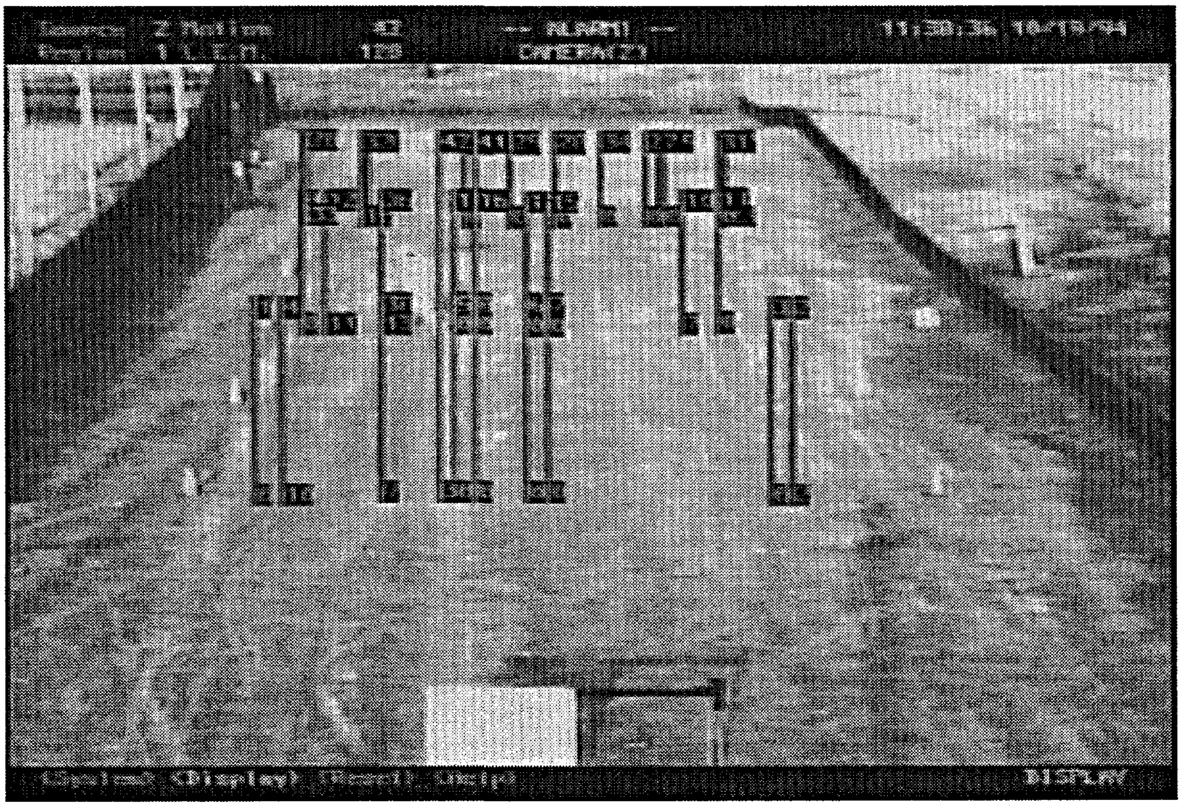


Figure 21. Area of Interest — TSI-2020

System Parameter Settings

This section gives the parameters used in the application for which evaluation testing was performed. Only the parameter settings that may have been changed from their default settings are shown. Each region was part of a sequence. Each region in the sequence had to trip within the sequence time before an alarm was initiated. Table 25 shows all the region's parameter settings, and sequences used for evaluation testing on the TSI-2020.

TOTAL # OF REGIONS	42

TOTAL # OF SEQUENCES	16

Region #	Region Type	Maximum Threshold	Motion Factor
REGION 1	Vert. Line	10,000	.1
REGION 2	Vert. Line	10,000	.1
REGION 3	Vert. Line	10,000	.1
REGION 4	Vert. Line	10,000	.1
REGION 5	Vert. Line	4,000	.1
REGION 6	Vert. Line	4,000	.1
REGION 7	Vert. Line	4,000	.1
REGION 8	Vert. Line	4,000	.1
REGION 9	Vert. Line	7,000	.1
REGION 10	Vert. Line	7,000	.1
REGION 11	Vert. Line	7,000	.1
REGION 12	Vert. Line	3,000	.1
REGION 13	Vert: Line	3,000	.1
REGION 14	Vert. Line	3,000	.1
REGION 15	Vert. Line	3,000	.1
REGION 16	Vert. Line	3,000	.1
REGION 17	Vert. Line	500	.1
REGION 18	Vert. Line	500	.1
REGION 19	Vert. Line	1,500	.1
REGION 20	Vert. Line	1,500	.1
REGION 21	Vert. Line	1,500	.1
REGION 22	Vert. Line	1,500	.1
REGION 23	Vert: Line	300	.1
REGION 24	Vert. Line	300	.1
REGION 25	Vert. Line	300	.1
REGION 26	Vert. Line	300	.1
REGION 27	Vert. Line	300	.1
REGION 28	Vert. Line	300	.1
REGION 29	Vert. Line	300	.1
REGION 30	Vert. Line	300	.1
REGION 31	Vert. Line	500	.1
REGION 32	Vert. Line	500	.1
REGION 33	Vert: Line	300	.1
REGION 34	Vert. Line	300	.1
REGION 35	Vert. Line	3,000	.1
REGION 36	Vert. Line	3,000	.1
REGION 37	Vert. Line	4,000	.1
REGION 38	Vert. Line	4,000	.1
REGION 39	Vert. Line	14,000	.1
REGION 40	Vert. Line	14,000	.1
REGION 41	Vert. Line	14,000	.1
REGION 42	Vert. Line	14,000	.1

Sequence #	Regions #'s in Sequence (In Order)	Sequence Time (min-max)	Assigned to Relay-Switch #
1	7-8-38	1 to 13	24
2	9-10	1 to 15	24
3	11-12	1 to 15	24
4	35-13-14	1 to 13	24
5	15-16-36	1 to 13	24
6	23-24-25-33-26	1 to 7	24
7	27-34-28-29-30	1 to 7	24
8	17-18	1 to 15	24
9	19-20	1 to 15	24
10	21-22	1 to 15	24
11	31-32	1 to 15	24
12	1-2	1 to 15	24
13	3-4	1 to 15	24
14	37-5-6	1 to 13	24
15	39-40	1 to 8	24
16	41-42	1 to 8	24

Table 25. TSI-2020 System Parameters

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing. Although not all of these features may have been utilized in the evaluation because of time constraints, incorporating these features could have beneficial results in reducing nuisance alarms.

- 32 independently selected relays (assigned to regions).
- Motion value displayed on screen (assists in setup and alarm classification).
- Ability to establish sequences between regions.
- Multiple parameters allow fine-tuning of system.
- Password-protected.
- Can be a node on a network.
- On-screen help menus available at any time.
- Log files for reviewing alarm history.
- VCR control port.
- Capability to store multiple parameters sets.
- Detection selectable by motion, light levels, or between minimum and maximum threshold range levels individually or by combining the detection criteria .
- Detection can be set up to alarm at, above, or below user-defined minimum and maximum threshold levels.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable in other situations.

- The minimum time cutoff for sequenced regions is at 1 sec, which disallows rejection of extremely fast-moving objects (birds, bugs, airplane shadows, video signal sync glitch).
- Documentation on changing system parameters and the overall system effect is not clear.
- The system does not allow the full camera FOV to be used as the AOI. The top, sides, and bottom of the scene are used to display information and are not available as detection areas.
- The system does not allow the operator the option to turn off the overlaid graphics showing the region locations which, if used as the assessment screen, could prohibit the operator from seeing what caused an alarm.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 26 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

Quantity	Description	Price
1 ea.	TSI-2020 video motion intrusion detection system, includes rack-mount CPU and display, three camera channel inputs, 32 relay outputs, 64 detection regions per input channel, outputs to include video, S-video, RGB and VGA, communications protocol documentation, and installation and user manuals.	$49,900

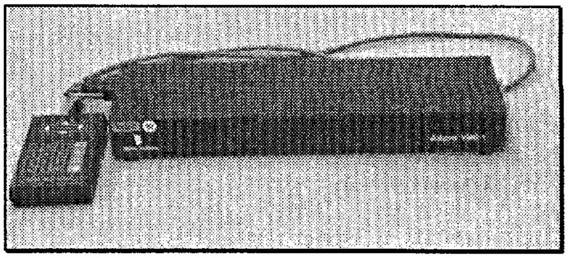
Table 26. TSI-2020 System Cost

Summary of System Features

The TSI-2020 motion detection system is a very versatile system that could adapt to many different applications and environments. The system has a lot of flexibility in setting up alarm conditions using sequencing and individual region sizing and threshold adjustments. The system is able to store multiple setups in different files and is password-protected. The system's ability to assign separate or the same relay outputs to regions on the same camera is seen as an asset.

Vision Systems Limited — *Adpro VMD-1*

Advertised Features and Specifications



The VMD-1 is a high-performance single-channel video movement detection system optimized for maximum protection and reliability in the outdoor environment. A new generation of detection algorithms provides multiple target tracking capability to determine target direction speed and distance traveled. Advertised features and specifications of the VMD-1 are listed below:

- Programmable perspective, target size, direction, and speed to ensure that only valid targets are detected.
- Outdoor algorithms compensate for lighting changes caused by cloud fronts and auto-iris changes.
- 1440 (CCIR/PAL) or 1152 (RS-170/NTSC) programmable detection zones.
- Low- or high-contrast detection and alarming.
- Camera or cable failure detection and alarming.
- On-screen menu programming via remote removable keyboard.
- External alarm input for integration of other alarm sensors.
- External mode switching of detection settings (day/night).
- External access control input.
- External detection inhibit input resets all alarms.
- Selectable display of on-screen time, date, and camera identification.
- Automatic or manual reset of alarms.
- Automatic timed switching between access and secure states.
- Differential video input to minimize ground loop problems.
- Video bypass on power failure.
- Operates with monochrome or color cameras.
- Requires no external synchronization.
- Continuous self-testing with automatic recovery or fault indication.
- Visible indication on alarm of the track of the target; on-screen text displays alarm type.
- Two relay and one optoisolated transistor outputs on alarm.

Final VMD System Settings

The evaluation test application was discussed with the manufacturer. The manufacturer's suggestions were followed, and settings were adjusted to first meet the detection criteria and then to reduce the nuisance alarm rate. The final settings used in the evaluation are shown in the System Parameter Settings section.

Description of Area of Interest (AOI)

The AOI for the VMD-1 was set up to cover the complete area between the cones as shown in figure 22. This provided the maximum amount of available coverage to take advantage of the

VMD-1 distance moved before alarm feature. This limited the false alarms due to camera vibration from wind.

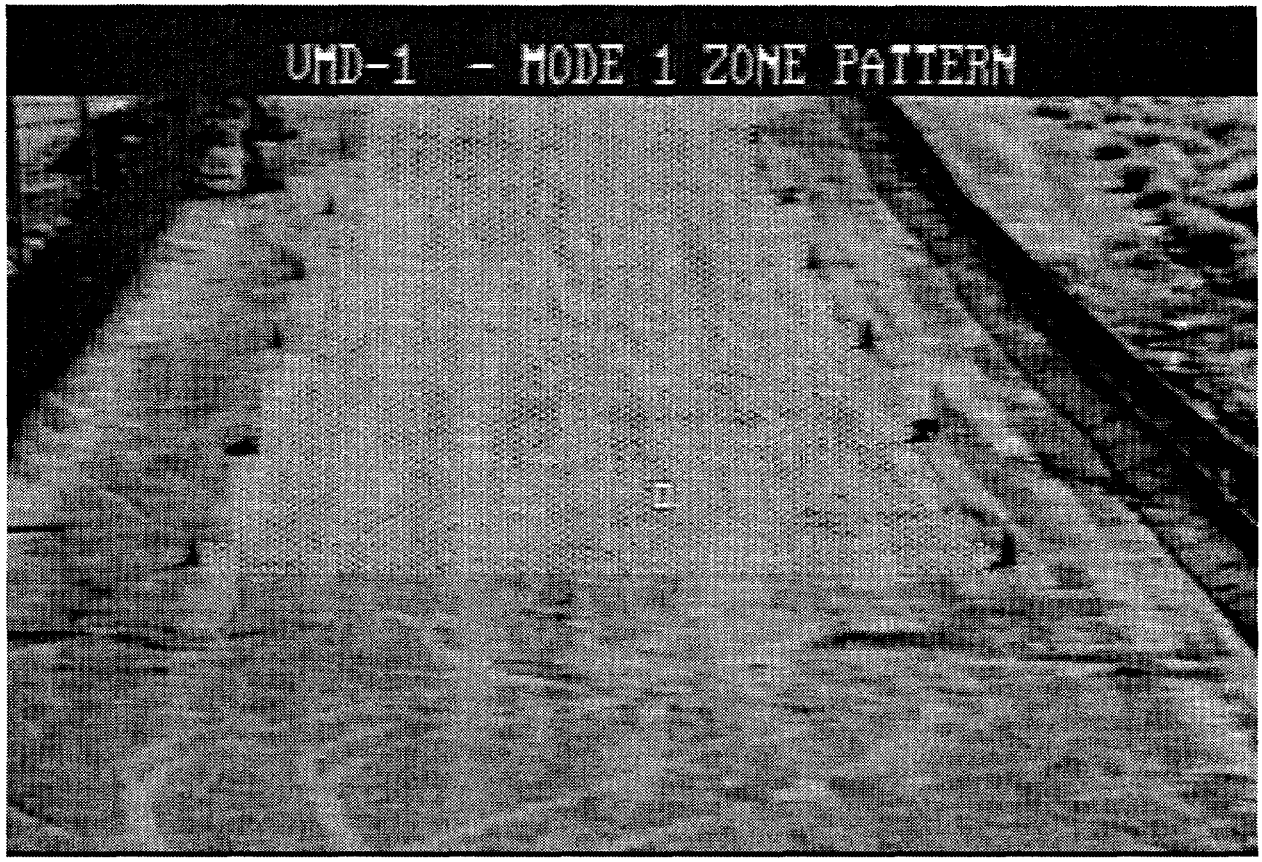


Figure 22. Area of Interest — Adpro VMD-1

System Parameter Settings

The parameters shown in Table 27 were used to determine final test results in the evaluation. Any system parameters not shown were left at the default or manufacturer's recommended settings.

ALARM PARAMETERS	
CONTRAST ALARM	HIGH-100 LOW-14
ALARM RESET MODE	AUTOMATIC
ACCESS MODE	EXTERNAL
ALARM COMBINATION	VMD ONLY
EXTERNAL LOGIC	HIGH TO LOW
IDENTIFICATION	VMD TEST TAPE
DISPLAY MODE	IDENT.- ON TIME/DATE-ON
MODE 1 PARAMETERS CAMERA 1 (VMD)	
FOREGROUND	4
BACKGROUND	1
TARGET DIRECTION	Horizontal Only
MIN TARGET DISTANCE	04
MAX TARGET SPEED	25
REFERENCE PERIOD	15
CAMERA THRESHOLD	3

Table 27. Adpro VMD-1 Parameter Settings

System Features Strong Points

This section describes the features of the system that proved to be beneficial during testing.

- The system is straightforward and easy to set up.
- Capability is provided to adjust for speed, size, and distance traveled before declaring an alarm condition.
- The system performs video signal monitoring to detect tampering with the video signal.
- The system supplies information on the average video signal level, which proved useful in troubleshooting and setup.
- Settings are available to allow perspective compensation from far FOV to near FOV.

System Features Weak Points

The items listed in this section are areas where the system has problems, extra time was required, or changes were recommended to the manufacturer. These points apply only to the application under which the system was evaluated and may or may not be applicable in other situations.

- The system does not allow the full camera FOV to be used as the AOI. The top and bottom of the scene are used to display information and are not available as detection areas.

System Cost

This section contains the list price for the VMD system used for the evaluation. Pricing may vary depending on options and quantities purchased. The prices quoted in Table 28 are listed to show approximate VMD system costs. The manufacturer should be contacted to obtain current prices. Where possible, the prices show individual component breakdowns.

Quantity	Description	Price
1 ea.	Adpro, VMD-1, single-channel unit with programming keyboard (used for evaluation).	$2,276
--	VMD-10, 10-channel chassis with one module.	$4,180
--	VMD-10, 10-channel chassis with ten modules.	$16,261

Table 28. Adpro VMD-1 System Cost

Summary of System Features

The Adpro VMD-1 is easy to set up and install. It has features that analyze the video signal level, protect against tampering with the video signal, and two different set-up modes that can be changed by an external input. The system has adjustments for target speed, distance traveled, size, and perspective compensation, all of which aid in setting up parameters tailored for specific applications.

Section 3 — Evaluation Results

This section discusses and summarizes the evaluation test results. Note that these results were based on evaluation testing for a specific application. The test results may vary if factors such as the test zone's background, lighting, or camera-to-target distances changed. The following items are discussed in this section:

- **Detection Test Results**
- **Nuisance Alarm Testing**
- **Individual VMD System Conclusions**
- **Future Development and Testing**

Detection Test Data

The detection criterion for this evaluation was 90% probability of detection (Pd) at 95% confidence with different methods of intrusion. Testing was done at the 50-, 60-, 70-, 80-, 90-, and 100-foot fields of view (FOVs). Tests were performed using crawlers, walkers, runners, and simulated crawls using a dummy. Testing was done at several different times, including scenes during day, night, dusk, and dawn.

The goal was to set up each system so that the design criterion of 90% Pd at 95% confidence was achieved. In some cases, the system tested did not meet this goal. Although some of the systems could detect at these levels, the nuisance/false alarm rates were too high to even consider leaving them at the sensitivity levels required to meet the detection criteria. When this was the case, the sensitivity levels were adjusted to a point where the nuisance/false alarm rates were kept at an acceptable level for the evaluation. This level was determined by trying to adjust the system to keep the false/nuisance alarm levels down to an average of 10 or fewer in a 24-hour period when there were normal environmental conditions (few clouds, bright, sunny, calm days).

Overall Probability of Detection Test Results

Table 29 shows the overall Pd test results for each of the VMD systems evaluated. The systems with more than one channel shown had all parameters for each channel set up identically or as close as possible. The results are based on the parameters shown in the system description section of this report.

Combined Test Results	3-DIS-CH. 1	3-DIS-CH. 2	David300-CH. 1	David300-CH. 2	Magal-CH. 1	Magal-CH. 2	Magal - CH. 3	Magal - CH. 4	Geutebruck-CH. 1	Geutebruck-CH. 2	TSI-CH. 1	TSI-CH. 2	GYYR-CH. 1	GYYR-CH. 2	Burle-CH. 1	Burle-CH. 2	DigiTect II-CH. 1	Movicom-CH. 1	Movicom-CH. 2	Quark-CH. 1	Quark-CH. 2	David200-CH. 1	Detec-CH. 1	Sentinel-CH. 1	Adpro-CH. 1
Total Number Tests	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396	396
Total Number Detections	395	395	383	385	389	388	391	394	375	375	391	390	295	329	336	332	292	220	141	101	28	381	198	378	345
Probability of Detection	99	99	95	95	97	96	97	98	93	93	97	97	71	80	82	80	70	51	32	22	5	94	46	93	84

Table 29. Overall Probability of Detection Test Results

Categorized Probability of Detection Test Results

This section shows that the results of the intrusion detection tests, when categorized as to location (i.e., 100-, 90-, 80-, 70-, 60-, and 50-foot FOVs) and intrusion type (i.e., crawler, walker, runner), can present different conclusions as to a system's detection characteristics. This information should be considered when designing a security system that utilizes a VMD system because there could be areas of the detection zone that have vulnerabilities. These areas of vulnerability would have to be accounted for in a security system design (other sensors protecting same zone) in order for the overall security system to maintain a high probability of detection.

Further analysis of the test results may reveal other vulnerabilities of VMD systems, such as specific times of day (dusk or dawn) or adverse weather conditions (overcast, rain, etc.), in which an intruder would have a higher than normal chance of crossing the detection zone undetected.

Table 30 shows the number of intrusions that were missed for a crawling intruder facing the camera at the 50-foot through 100-foot FOVs. As the test results show, a crawling intruder at the far FOV of the camera is one of the hardest targets for a VMD sensor to consistently detect. Note that the shorter FOVs had the best detection characteristics because the target appears larger the closer it is to the camera.

Number of Missed Crawler Tests	3-DIS-CH. 1	3-DIS-CH. 2	David300-CH. 1	David300-CH. 2	Magal-CH. 1	Magal-CH. 2	Magal - CH. 3	Magal - CH. 4	Geutebruck-CH. 1	Geutebruck-CH. 2	TSI-CH. 1	TSI-CH. 2	GYYR-CH. 1	GYYR-CH. 2	Burle-CH. 1	Burle-CH. 2	DigiTect II-CH. 1	Movicom-CH. 1	Movicom-CH. 2	Quark-CH. 1	Quark-CH. 2	David200-CH. 1	Detec-CH. 1	Sentinel-CH. 1	Adpro-CH. 1
Overall	0	0	8	8	0	0	2	2	13	13	3	4	30	16	58	60	75	64	75	99	131	5	110	17	39
50-ft FOV	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	11	14	27	3	24	0	0
60-ft FOV	0	0	0	0	0	0	0	0	0	0	1	1	2	1	5	4	0	4	7	10	15	0	11	0	0
70-ft FOV	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	8	8	10	9	15	18	0	18	0	1
80-ft FOV	0	0	0	0	0	0	0	0	1	1	1	1	3	3	15	14	13	5	5	13	16	0	15	0	5
90-ft FOV	0	0	2	2	0	0	0	0	4	3	0	0	4	3	12	14	19	14	17	16	20	0	15	4	8
100-ft FOV	0	0	5	6	0	0	2	2	8	9	1	2	21	7	21	20	33	23	26	31	35	2	27	13	25

Table 30. Crawling Intruder Detection Test Results

Table 31 shows the total number of misses for a walking intruder and the number of misses for a walking intruder at the 50-foot through 100-foot FOVs. Diagonal walk tests were also performed but were not included in the walk test results, although each system had little trouble detecting a person walking diagonally through the test zone. As the walk test results show, most systems had no problem catching a walking intruder; each system was set up to catch a crawler, which posed a much smaller target. The VMDs that were not designed for the long distance of the test sector showed more misses as the maximum FOV distance was reached. The walking intruder portion of the detection tests tended to raise the overall probability of detection for each system.

Number of Missed Walker Tests	3-DIS-CH. 1	3-DIS-CH. 2	David300-CH. 1	David300-CH. 2	Magal-CH. 1	Magal-CH. 2	Magal - CH. 3	Magal - CH. 4	Geutebruck-CH. 1	Geutebruck-CH. 2	TSI-CH. 1	TSI-CH. 2	GYYR-CH. 1	GYYR-CH. 2	Burle-CH. 1	Burle-CH. 2	DigiTect II-CH. 1	Movicom-CH. 1	Movicom-CH. 2	Quark-CH. 1	Quark-CH. 2	David200-CH. 1	Detec-CH. 1	Sentinel-CH. 1	Adpro-CH. 1
Overall	0	0	2	3	0	0	0	0	0	0	0	0	5	1	5	5	8	29	49	67	74	0	19	4	4
50-ft FOV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	8	10	12	0	5	0	0
60-ft FOV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	6	7	0	0	0	0
70-ft FOV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4	10	12	0	1	0	0
80-ft FOV	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	3	8	12	12	0	0	0	0
90-ft FOV	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	11	12	13	0	1	0	0
100-ft FOV	0	0	2	3	0	0	0	0	0	0	0	0	4	0	5	5	8	9	15	17	18	0	12	4	4

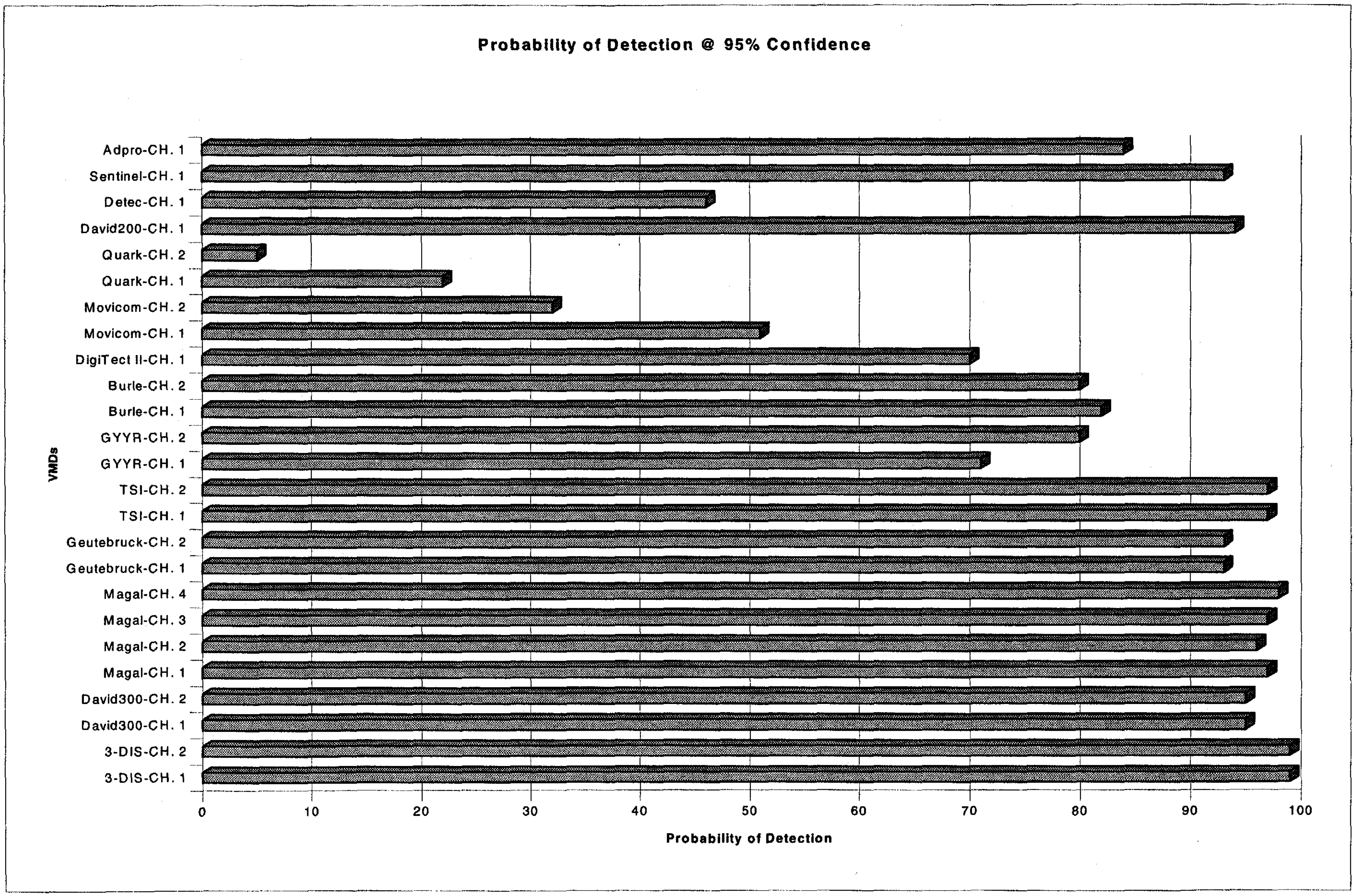
Table 31. Walking Intruder Detection Test Results

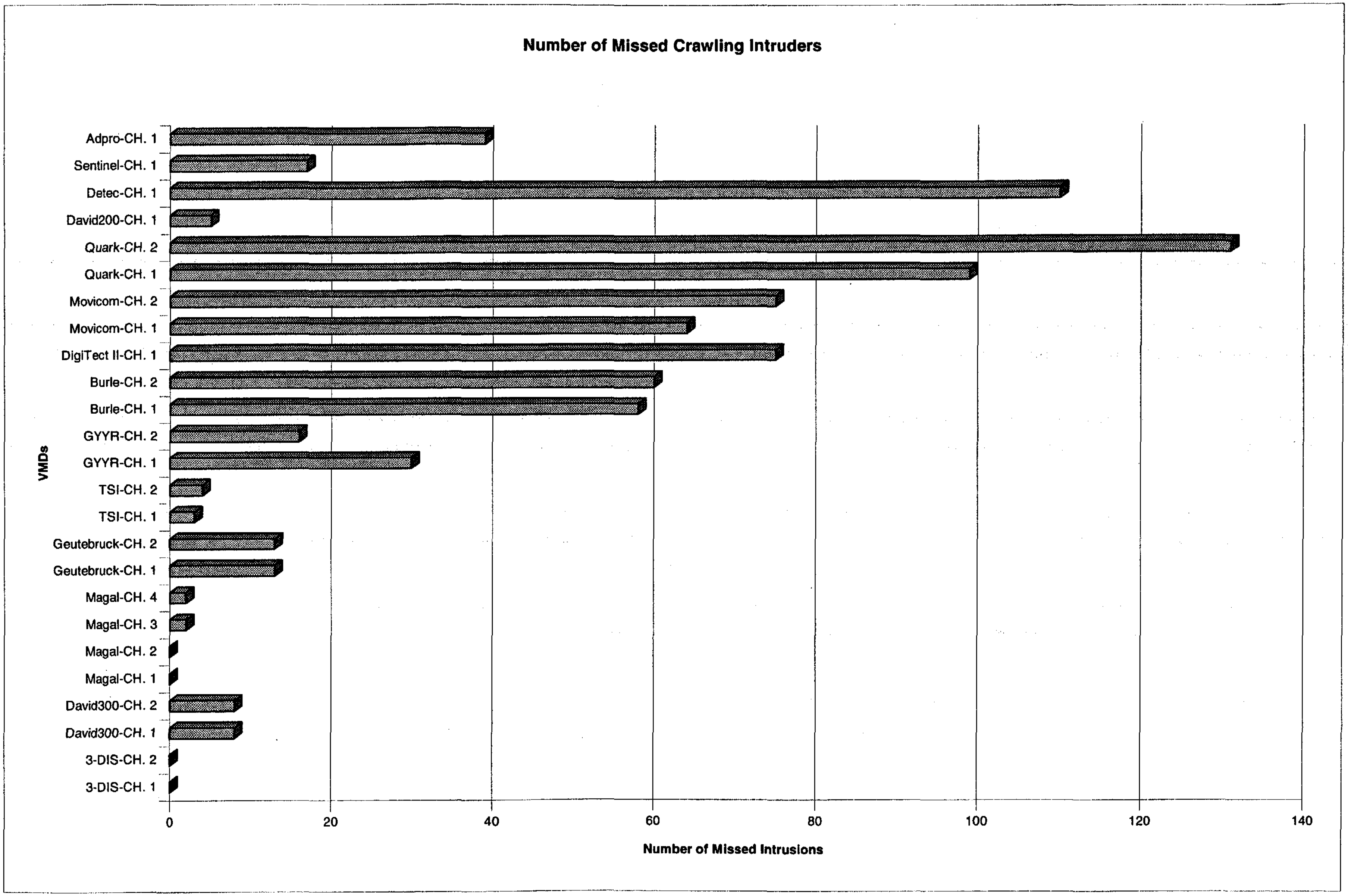
Table 32 shows the total number of misses for a running intruder and the number of misses for a running intruder at the 50-foot through 100-foot FOVs. As the run test results show, most systems are somewhat susceptible to running intruders because of the way their detection algorithms work. The width of the test zone and speed of a runner determine how well some of the systems detect a runner. This is because the algorithm tracks a target a certain distance before alarming. A wider AOI is required for the system to be able to consistently catch a fast runner and not false alarm on things such as birds flying through the scene.

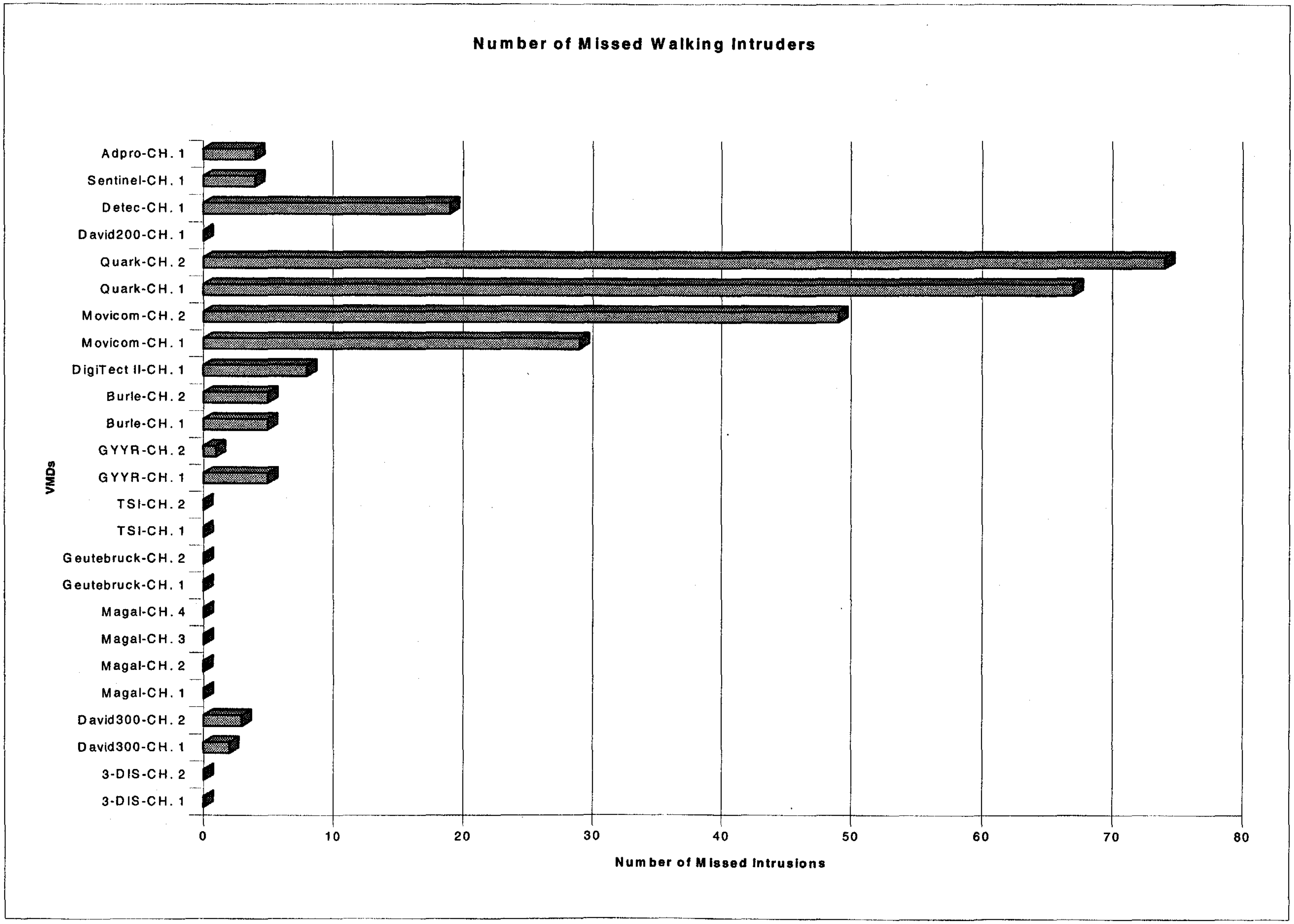
Number of Missed Runner Tests	3-DIS-CH. 1	3-DIS-CH. 2	David300-CH. 1	David300-CH. 2	Magal-CH. 1	Magal-CH. 2	Magal-CH. 3	Magal-CH. 4	Geutebruck-CH. 1	Geutebruck-CH. 2	TSI-CH. 1	TSI-CH. 2	GYYR-CH. 1	GYYR-CH. 2	Burle-CH. 1	Burle-CH. 2	DigiTect II-CH. 1	Movicom-CH. 1	Movicom-CH. 2	Quark-CH. 1	Quark-CH. 2	David200-CH. 1	Detech-CH. 1	Sentinel-CH. 1	Adpro-CH. 1
Overall	1	1	5	3	9	10	6	3	10	10	6	5	69	50	1	3	25	78	104	107	129	0	71	1	0
50-ft FOV	1	1	0	0	3	2	4	1	1	1	3	2	17	10	0	0	5	19	23	13	22	0	21	1	0
60-ft FOV	0	0	0	0	1	1	0	0	0	0	0	0	7	6	0	0	1	11	11	13	15	0	0	0	0
70-ft FOV	0	0	0	0	1	3	0	0	0	0	1	1	12	3	0	0	1	8	12	14	18	0	1	0	0
80-ft FOV	0	0	0	0	0	1	0	0	0	0	0	0	6	9	1	1	1	10	11	16	18	0	1	0	0
90-ft FOV	0	0	0	0	1	0	0	0	2	1	0	0	4	13	0	0	3	16	19	20	21	0	21	0	0
100-ft FOV	0	0	5	3	3	3	2	2	7	8	2	2	23	9	0	2	14	14	28	31	35	0	27	0	0

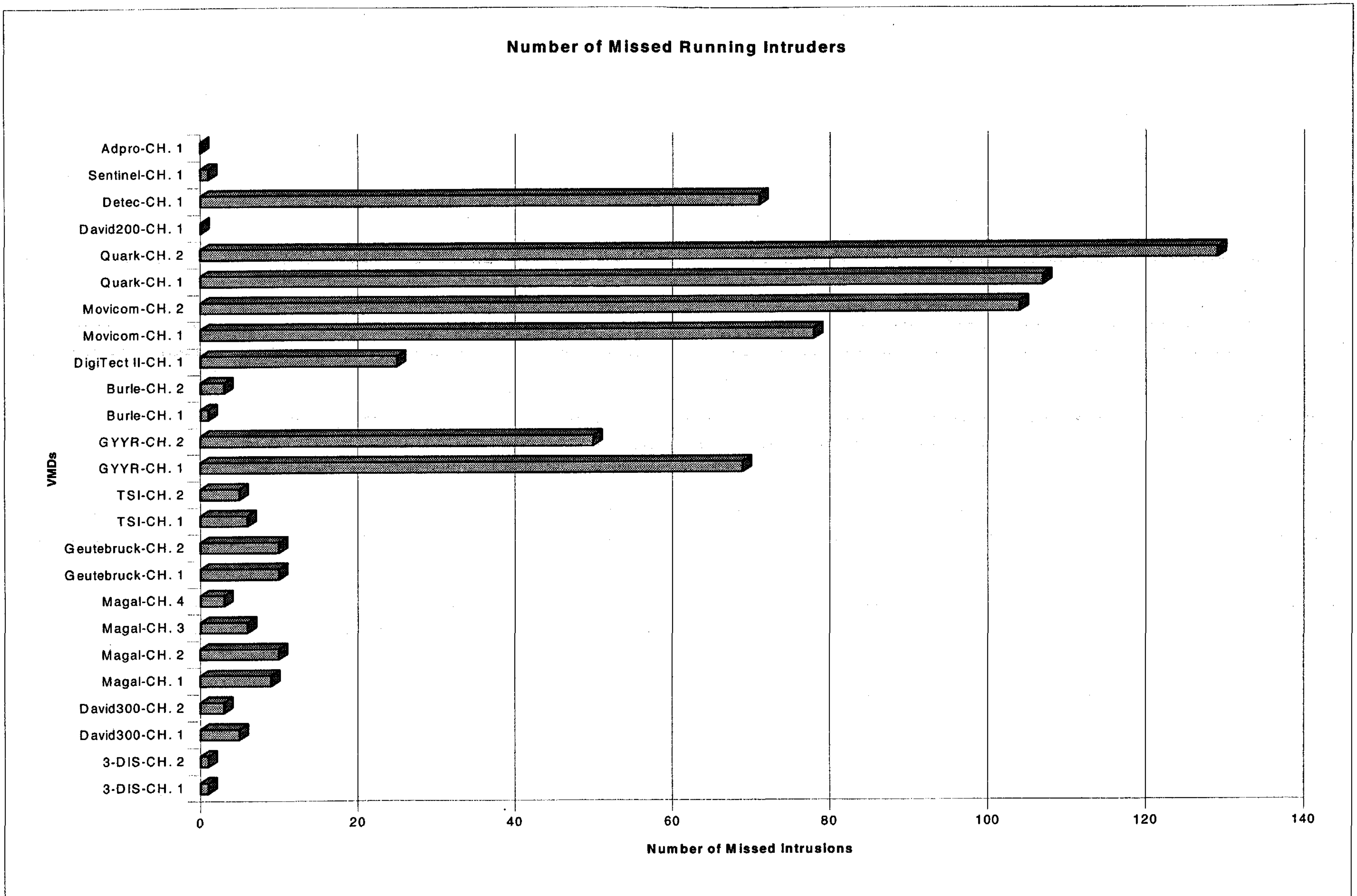
Table 32. Running Intruder Detection Test Results

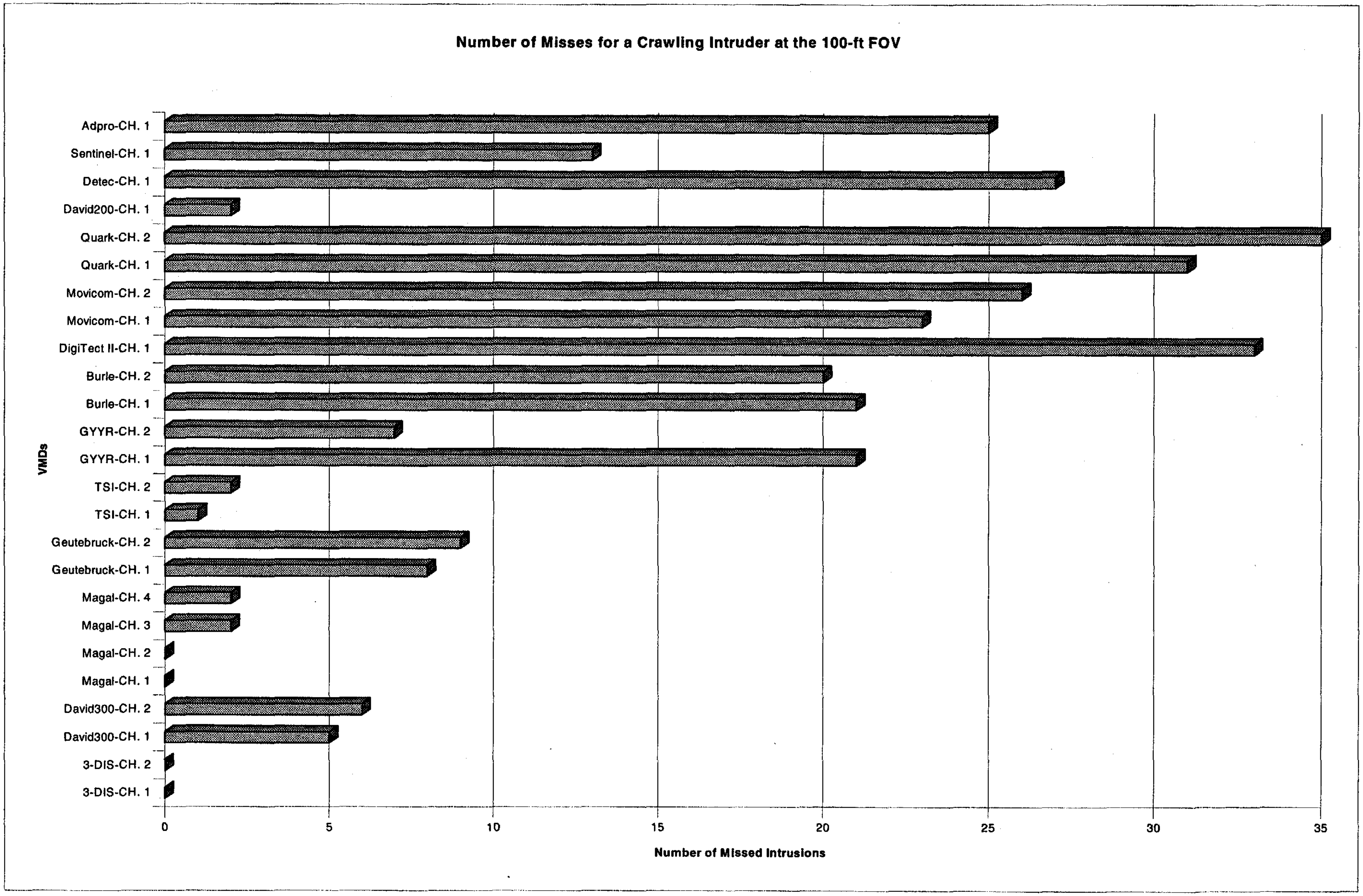
The following five charts show the overall results of the detection testing and the results when categorized by intrusion type (crawler, runner, or walker). The last detection chart shows the results of a crawler at the 100-foot FOV, which is the most difficult target for the VMD systems to consistently detect. As the charts show, some of the evaluated systems would not be suitable for the design criteria of this evaluation. These systems may work adequately in applications with shorter detection zones.


Probability of Detection @ 95% Confidence
Adpro-CH. 1
Sentinel-CH. 1
Detec-CH. 1
David200-CH. 1
Quark-CH. 2
Quark-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David300-CH. 2
David300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
0
10
20
30
40
50
60
70
80
90
100
Probability of Detection


Number of Missed Crawling Intruders
VMDs
Adpro-CH. 1
Sentinel-CH. 1
Detec-CH. 1
David200-CH. 1
Quark-CH. 2
Quark-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David300-CH. 2
David300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
0
20
40
60
80
100
120
140
Number of Missed Intrusions


Number of Missed Walking Intruders
VMDs
Adpro-CH. 1
Sentinel-CH. 1
Detec-CH. 1
David200-CH. 1
Quark-CH. 2
Quark-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David300-CH. 2
David300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
0
10
20
30
40
50
60
70
80
Number of Missed Intrusions


Number of Missed Running Intruders
Adpro-CH. 1
Sentinel-CH. 1
Detec-CH. 1
David200-CH. 1
Quark-CH. 2
Quark-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David300-CH. 2
David300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
0
20
40
60
80
100
120
140
Number of Missed Intrusions


Number of Misses for a Crawling Intruder at the 100-ft FOV
VMDs
Adpro-CH. 1
Sentinel-CH. 1
Detec-CH. 1
David200-CH. 1
Quark-CH. 2
Quark-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David300-CH. 2
David300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
0
5
10
15
20
25
30
35
Number of Missed Intrusions

Nuisance Alarm Testing

A high number of nuisance alarms have been the primary problem in the past with using VMDs in an outdoor environment. Improved algorithms and technology advances have helped in lowering the nuisance alarm rate while maintaining a high probability of detection (Pd).

The nuisance alarm data for the evaluation were based on the number of alarms that could be tracked to an identifiable source. Any alarms that could not be tracked to an identifiable source were classified as *unknown* or *false*. For the test application, the assessment equipment was set up to record 2 seconds of information before an alarm and 2 seconds of information after the alarm. It was found that many alarms previously classified as unknown or false could now be tracked to an actual cause. In many cases, the use of pre-alarm recording will lower the number of unknown or false alarms generated by a VMD system because of the speed at which some nuisance alarm sources occur.

The following paragraphs give a brief description of each of the nuisance alarm sources that occurred during the evaluation test period.

Clouds Any alarm caused by the movement of clouds through the detection zone is classified as a cloud alarm. Clouds are usually the cause of a large number of nuisance alarms from VMDs in an outdoor environment.

Camera Motion Camera motion is usually caused by wind moving the camera. A camera motion alarm occurs when the whole picture is moving at once.

Dawn Shadows Any alarm that occurs as a direct result of the sun rising over the horizon in the mornings is classified as a nuisance alarm from dawn shadows. This could be from shadows of fences or buildings that appear suddenly when the sun tops the horizon or from reflections off rocks or shiny objects in the detection zone.

Dusk Shadows Any alarm that occurs when the sun sets, which may cause shadows from fences or buildings to appear in the test zone, is classified as a nuisance alarm caused by dusk shadows.

Plane Shadow Any alarm that occurs from an airplane or helicopter flying between the sun and the test zone, causing a moving shadow to briefly appear in the test zone, is classified as a nuisance alarm caused by a plane shadow.

Flying Birds Any alarm from birds flying through the detection zone is classified as an alarm caused by flying birds. An alarm caused by birds that walk through the zone (such as a roadrunner) are classified as a nuisance alarm caused by a small animal.

Bugs Flying bugs near the camera lens appear as large objects and can cause a VMD to alarm. Alarms caused from any flying insect are classified as nuisance alarms from bugs.

Lightning Any alarm caused by flashes or video signal noise from lightning is classified as a nuisance alarm caused by lightning. This includes glitches in the video sync signal that occur during lightning storms.

Rain Any alarm caused by rain falling, including water running through or causing puddles in the test zone, is classified as a nuisance alarm caused by rain.

Snow Any alarm caused by snow falling or blowing across the test zone is classified as a nuisance alarm caused by snow.

Fog Any alarm that occurs during foggy conditions in which no movement occurs other than that from the fog is classified as a nuisance alarm caused by fog.

Small Animals Any alarm caused by a small animal on the ground moving through the detection zone is classified as a small animal alarm. This can be from rabbits, walking birds, squirrels, etc.

Blowing Debris Any alarm caused by dust or small debris carried by the wind through the zone is classified as a nuisance alarm caused by blowing debris.

Tumbleweeds Any alarm caused by a tumbleweed blowing through the test zone is classified as a nuisance alarm caused by tumbleweeds. In many applications, this type of nuisance alarm would not be a problem because of double-fenced zones.

Headlights Any alarm caused by a vehicle's headlights passing through the detection zone is classified as a nuisance alarm caused by headlights.

Camera Signal Any alarm caused by the camera signal getting noisy or from glitches in the signal is classified as a nuisance alarm caused by the camera signal.

Interference This type of alarm is unique to the Magal DTS-1000. It occurs whenever the video picture becomes too flat (not enough gray scale present to detect). This typically occurs when there is little contrast in the picture, usually at dusk, after a snowfall, during fog, or after a heavy cloud moves over.

Unknown Any alarm that occurs without any known cause is listed as an unknown alarm. In a security system, these would be classified as false alarms. If a VMD system has too many false alarms, its sensitivity levels must be adjusted or operator confidence in the system will fall rapidly.

All evaluated VMDs were susceptible to certain types of nuisance alarm sources, which will vary depending on the application and location in which a VMD system is used. The type of nuisance alarm sources that occur in an area should be considered when selecting the VMD system that will maintain the highest probability of detection while maintaining a low nuisance alarm rate.

The results discussed in the following sections show the reaction of each VMD system to the different nuisance alarm sources that each was subjected to in the evaluation testing period.

Nuisance Alarm Test Results

This section gives the results of nuisance alarm testing, which were collected for the same parameters used for the detection testing. Nuisance alarm tests were run from scenes recorded on tape as well as from live testing. The results of the tape tests show nuisance alarm results for all the evaluated VMD systems, whereas the nuisance alarm results from live testing show only the VMD systems that were left on continuously. The VMD systems not included in live testing generated too many nuisance alarms when operated continuously. The results of the tape tests show how each evaluated system responded when subjected to known nuisance alarm sources.

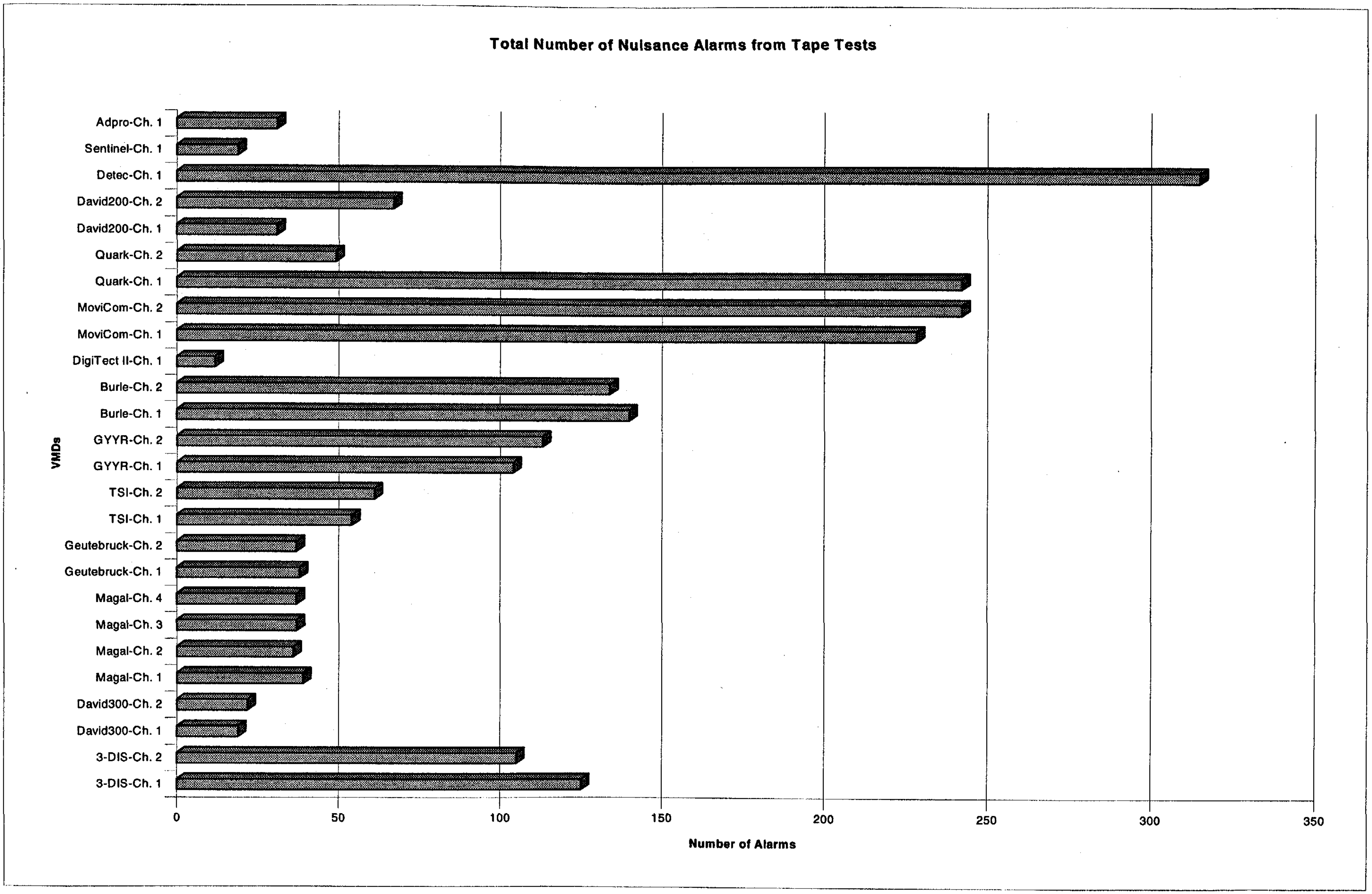
SVHS Tape Test Results

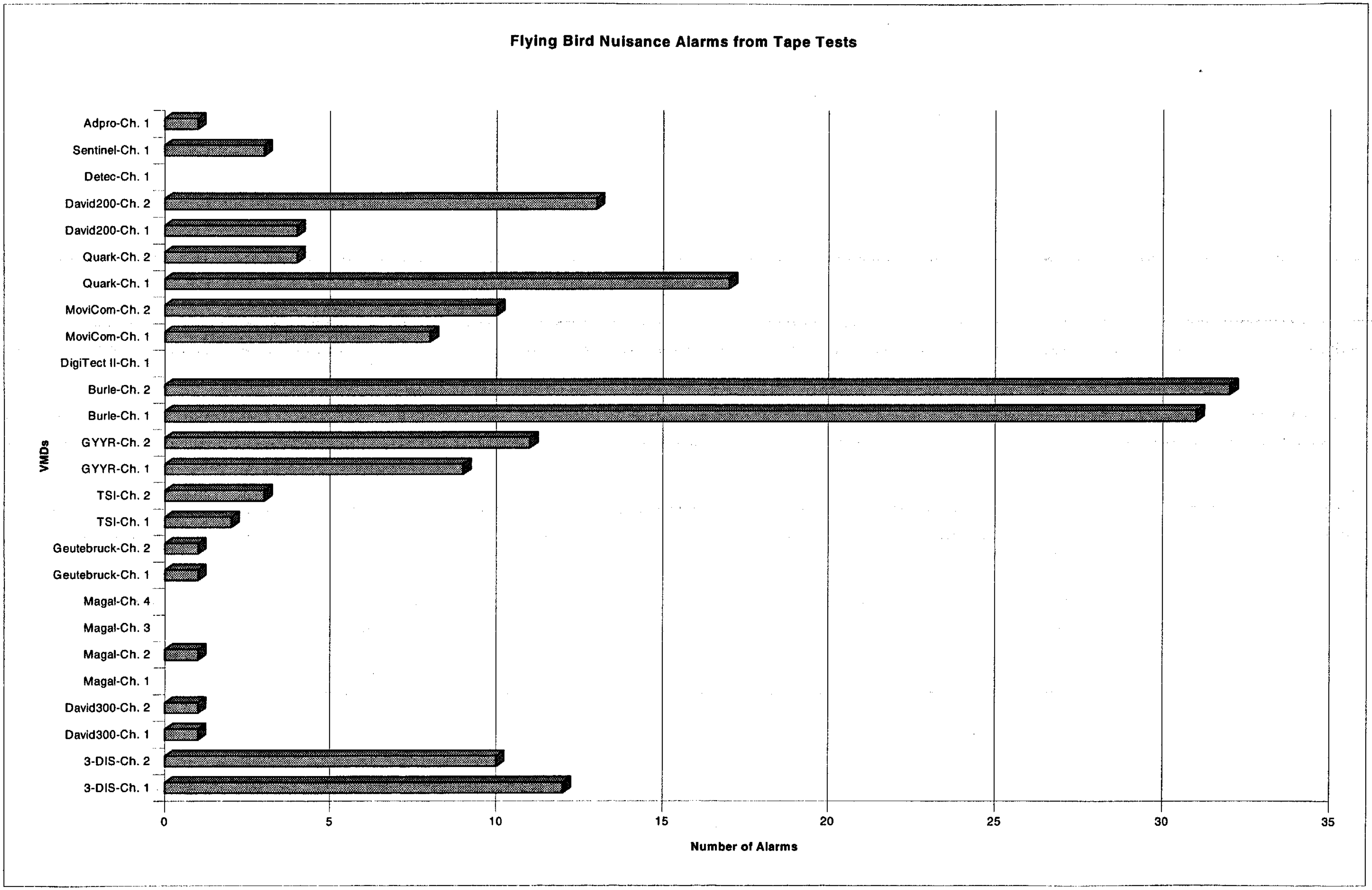
This section shows the number and types of nuisance alarms for each VMD system during testing from SVHS tapes. The results were achieved from videotaped occurrences of several different nuisance alarm sources. Each VMD system listed was subjected to the same potential number of nuisance alarms. The amount of time in days associated with the number of alarms generated is not shown because the scenes were taped at different times of day, some during known nuisance alarm periods. A total of 24 hours of taped scenes was used in this test. Table 33 shows the total number and types of nuisance alarms recorded during the tape testing portion of the evaluation. All the evaluated systems were active during tape testing.

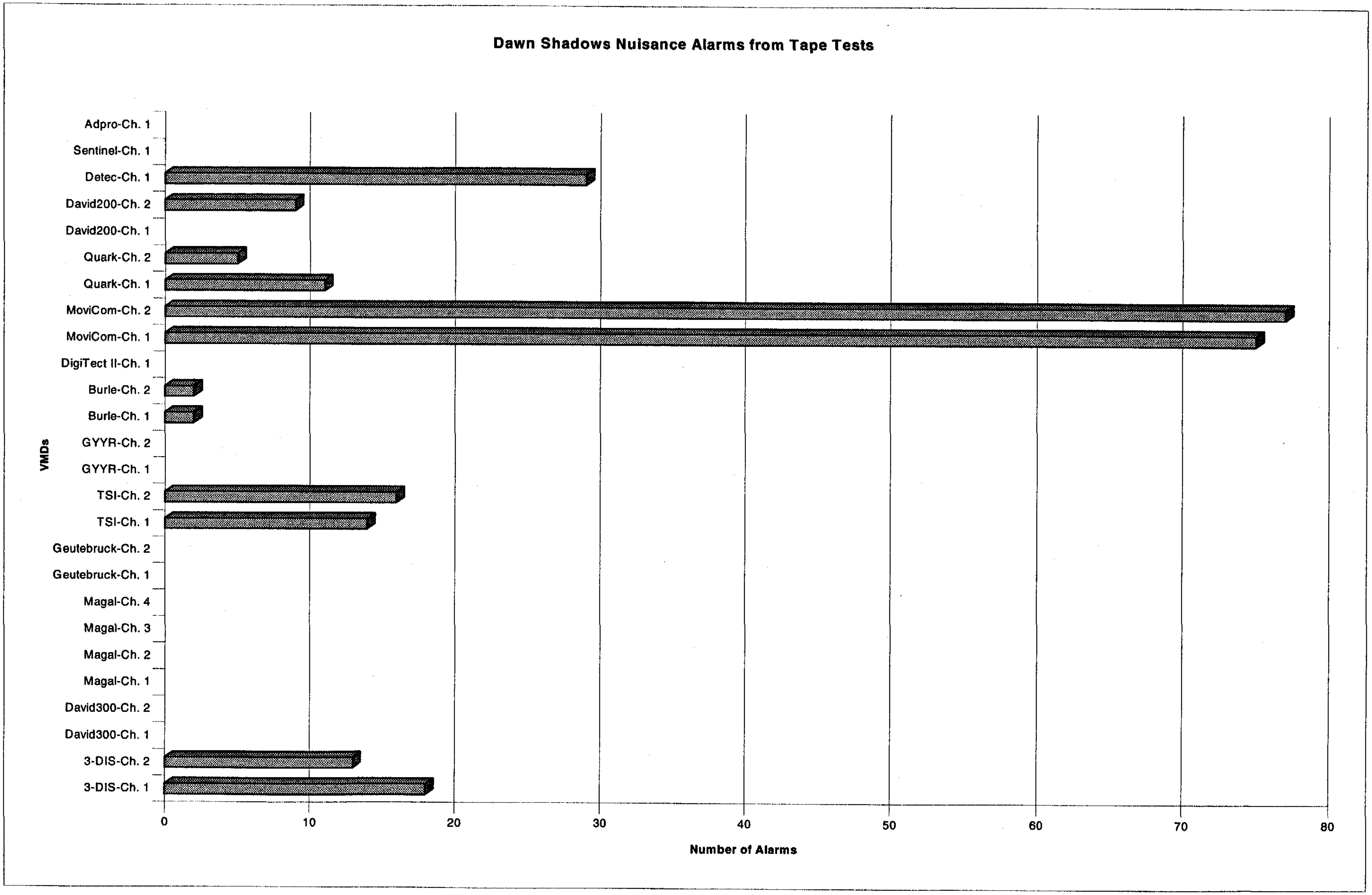
Nuisance Alarm Source	3-DIS-Ch. 1	3-DIS-Ch. 2	David300-Ch. 1	David300-Ch. 2	Magal-Ch. 1	Magal-Ch. 2	Magal-Ch.3	Magal-Ch. 4	Geutebruck-Ch. 1	Geutebruck-Ch. 2	TSI-Ch. 1	TSI-Ch. 2	GYYR-Ch. 1	GYYR-Ch. 2	Burle-Ch. 1	Burle-Ch. 2	DigiTect II-Ch. 1	Movicom-Ch. 1	Movicom-Ch. 2	Quark-Ch. 1	Quark-Ch. 2	David200-Ch. 1	Detec-Ch. 1	Sentinel-Ch. 1	Adpro-Ch. 1
Plane Shadow	1	1							1	1			1		1	1				1				1	
Flying Bird	12	10	1	1		1			1	1	2	3	9	11	31	32		8	10	17	4	4		3	1
Bugs	9	9	5	5					5	5	12	16	27	34	76	71	1	15	18	42	7	8		4	10
Clouds	25	26	8	8	8	7	8	7	17	18	7	5	45	47	11	12	6	25	29	44	20	10	54	4	8
Blowing Debris	4	4	1	3					5	4			2	2			1	5	4	2		3	2		4
Headlights	10	11	3	3	5	4	4	2	7	6	4	4	10	10	10	8	2	8	7	7	5	3	2	7	5
Lightning			1	1					1	1			2	3		1		1	1	2	2	1	2		2
Unknown	24	11											3	2				1	1	74	2		52		
Interference					26	24	25	28																	
Cam. Signal	10	7									10	11			3	2		45	53	32	1		65		
Rain				1					1	1		1	4	4				2	1	7	3	2	16		1
Dawn Shadow	18	13									14	16			2	2		75	77	11	5		29		
Dusk Shadow	12	13									5	5	1		6	5	2	43	41	3			93		
Tape Totals	125	105	19	22	39	36	37	37	38	37	54	61	104	113	140	134	12	228	242	242	49	31	315	19	31

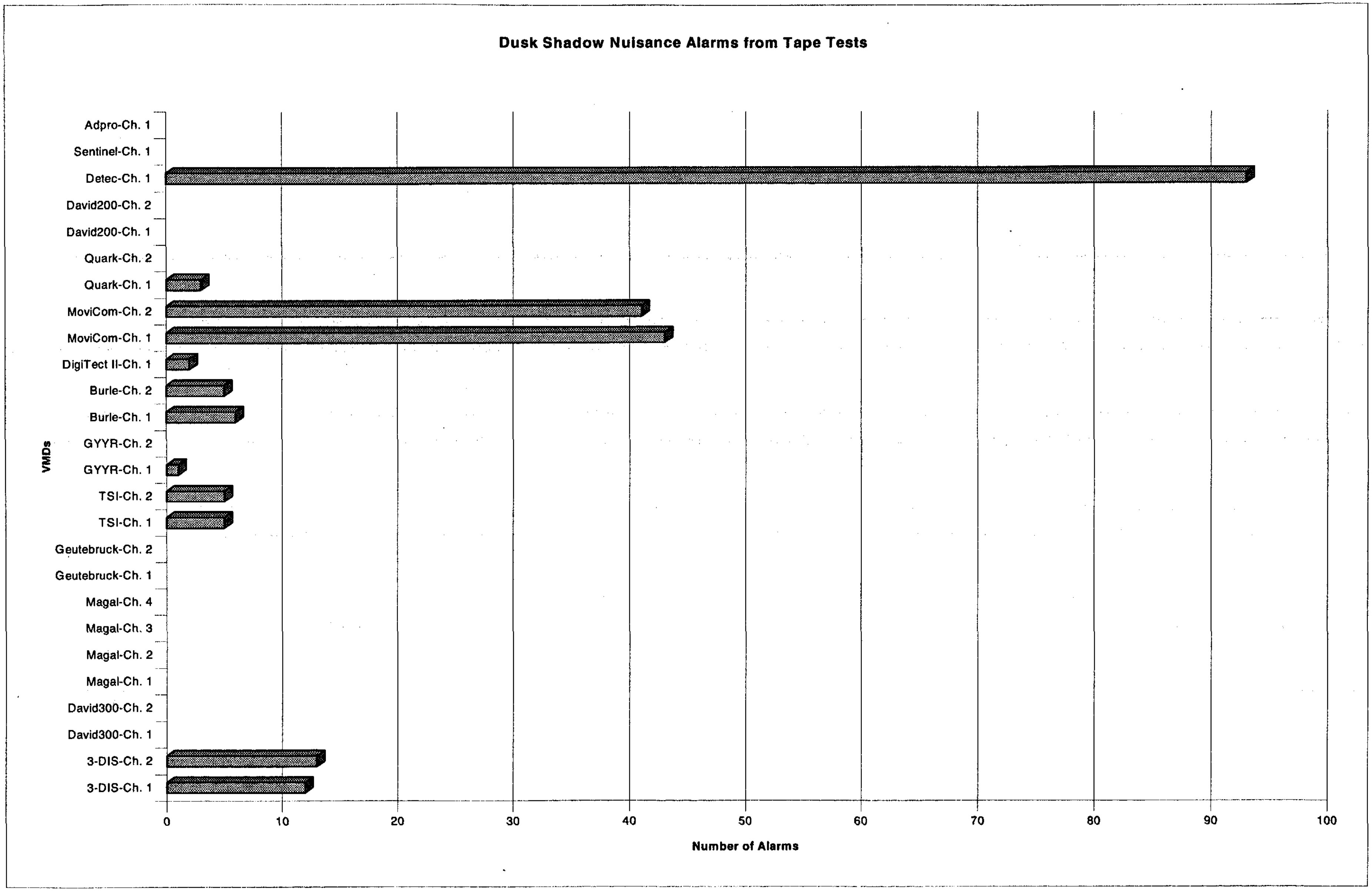
Table 33. Nuisance Alarm Results from Tape Testing

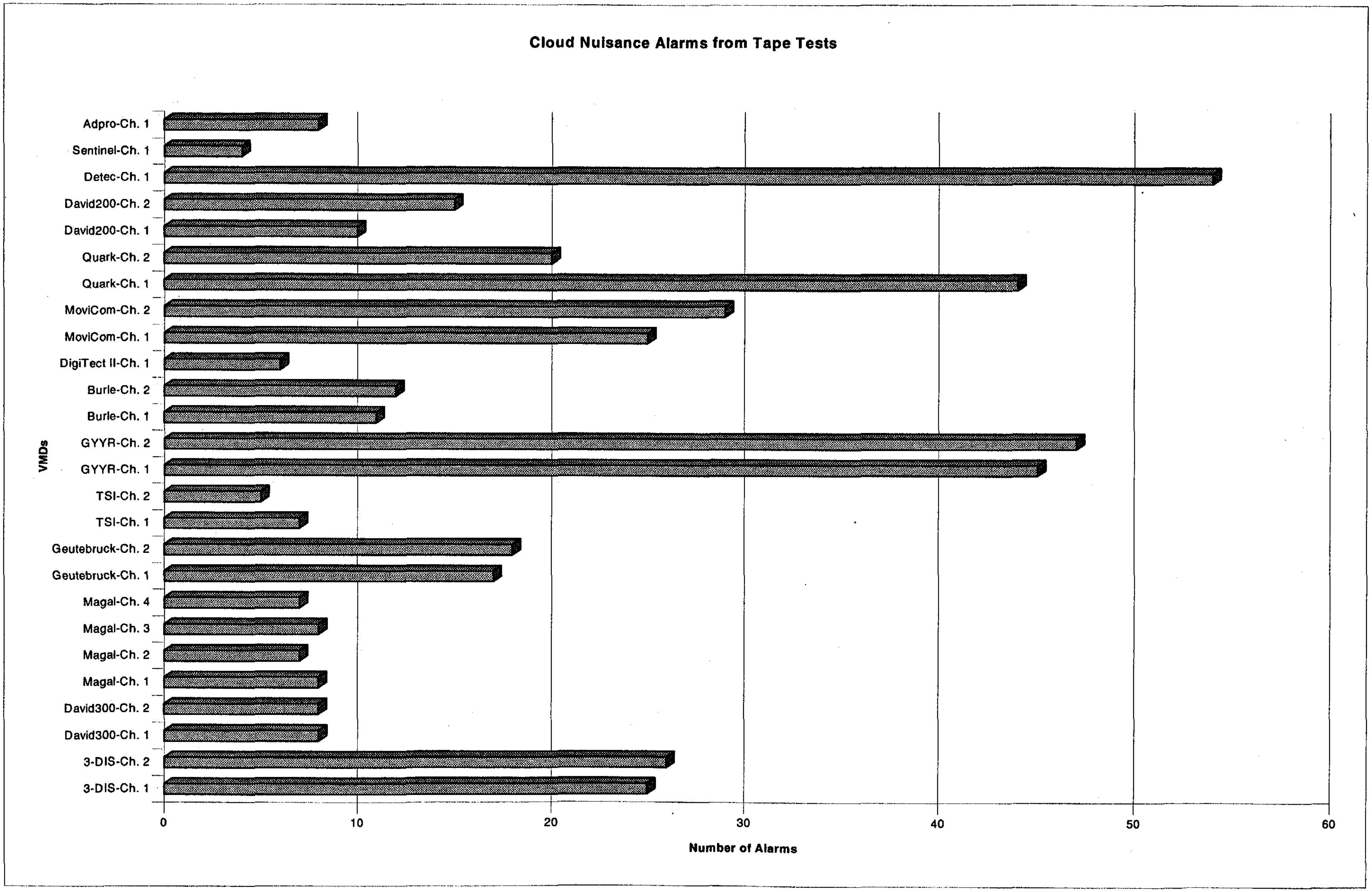
The following six charts graphically illustrate how the VMD systems did in comparison with one another for several of the most common nuisance alarm sources. All the following charts were based on the numbers from Table 33.

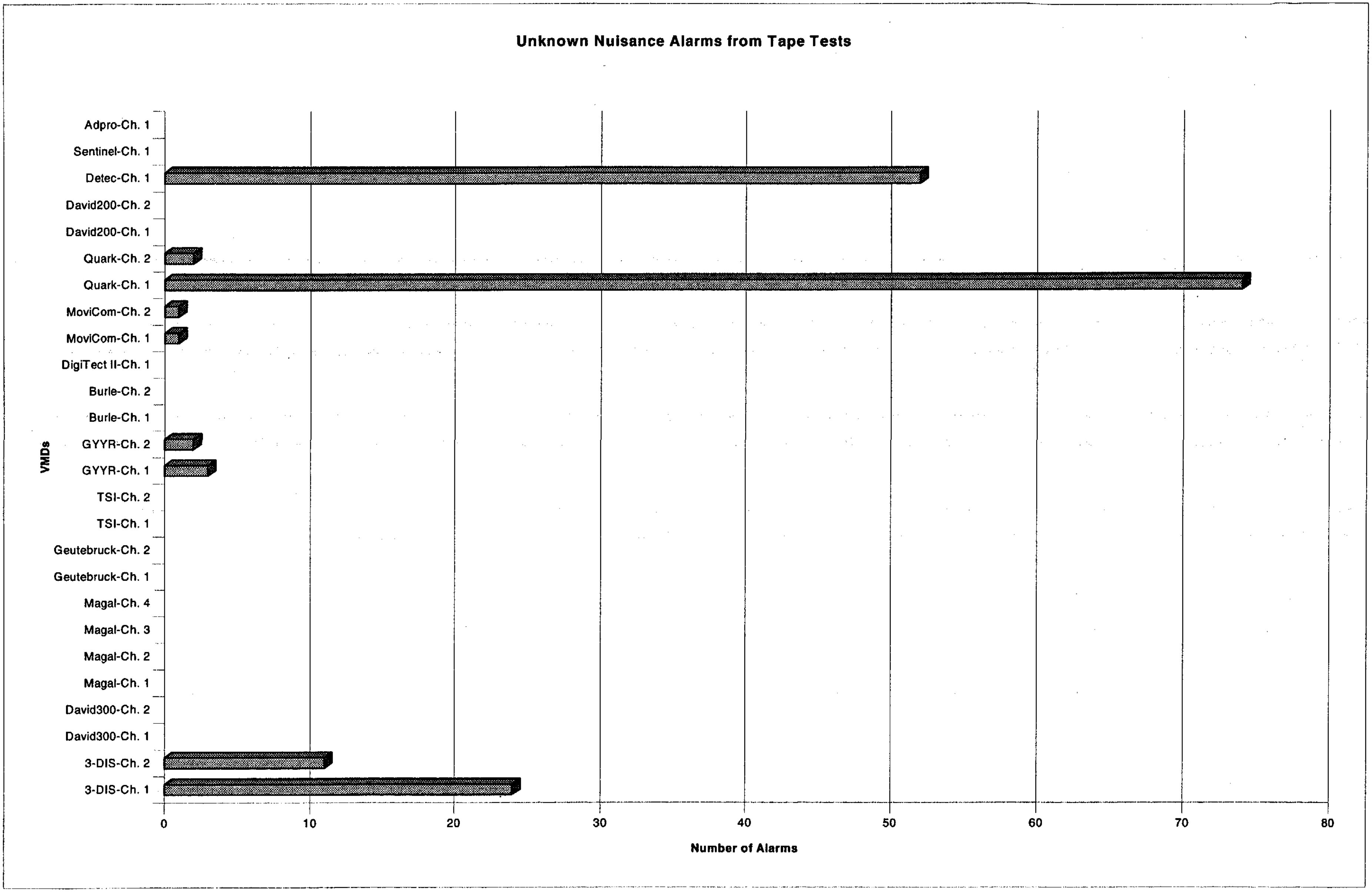

Total Number of Nuisance Alarms from Tape Tests
Adpro-Ch. 1
Sentinel-Ch. 1
Detec-Ch. 1
David200-Ch. 2
David200-Ch. 1
Quark-Ch. 2
Quark-Ch. 1
MoviCom-Ch. 2
MoviCom-Ch. 1
DigiTect II-Ch. 1
Burle-Ch. 2
Burle-Ch. 1
GYYR-Ch. 2
GYYR-Ch. 1
TSI-Ch. 2
TSI-Ch. 1
Geutebruck-Ch. 2
Geutebruck-Ch. 1
Magal-Ch. 4
Magal-Ch. 3
Magal-Ch. 2
Magal-Ch. 1
David300-Ch. 2
David300-Ch. 1
3-DIS-Ch. 2
3-DIS-Ch. 1
VMDs
0
50
100
150
200
250
300
350
Number of Alarms


Flying Bird Nuisance Alarms from Tape Tests
VMDs
Adpro-Ch. 1
Sentinel-Ch. 1
Detec-Ch. 1
David200-Ch. 2
David200-Ch. 1
Quark-Ch. 2
Quark-Ch. 1
MoviCom-Ch. 2
MoviCom-Ch. 1
DigiTect II-Ch. 1
Burle-Ch. 2
Burle-Ch. 1
GYYR-Ch. 2
GYYR-Ch. 1
TSI-Ch. 2
TSI-Ch. 1
Geutebruck-Ch. 2
Geutebruck-Ch. 1
Magal-Ch. 4
Magal-Ch. 3
Magal-Ch. 2
Magal-Ch. 1
David300-Ch. 2
David300-Ch. 1
3-DIS-Ch. 2
3-DIS-Ch. 1
0
5
10
15
20
25
30
35
Number of Alarms


Dawn Shadows Nuisance Alarms from Tape Tests
VMDs
Adpro-Ch. 1
Sentinel-Ch. 1
Detec-Ch. 1
David200-Ch. 2
David200-Ch. 1
Quark-Ch. 2
Quark-Ch. 1
MoviCom-Ch. 2
MoviCom-Ch. 1
DigiTect II-Ch. 1
Burle-Ch. 2
Burle-Ch. 1
GYYR-Ch. 2
GYYR-Ch. 1
TSI-Ch. 2
TSI-Ch. 1
Geutebruck-Ch. 2
Geutebruck-Ch. 1
Magal-Ch. 4
Magal-Ch. 3
Magal-Ch. 2
Magal-Ch. 1
David300-Ch. 2
David300-Ch. 1
3-DIS-Ch. 2
3-DIS-Ch. 1
0
10
20
30
40
50
60
70
80
Number of Alarms


Dusk Shadow Nuisance Alarms from Tape Tests
Adpro-Ch. 1
Sentinel-Ch. 1
Detec-Ch. 1
David200-Ch. 2
David200-Ch. 1
Quark-Ch. 2
Quark-Ch. 1
MoviCom-Ch. 2
MoviCom-Ch. 1
DigiTect II-Ch. 1
Burle-Ch. 2
Burle-Ch. 1
GYYR-Ch. 2
GYYR-Ch. 1
TSI-Ch. 2
TSI-Ch. 1
Geutebruck-Ch. 2
Geutebruck-Ch. 1
Magal-Ch. 4
Magal-Ch. 3
Magal-Ch. 2
Magal-Ch. 1
David300-Ch. 2
David300-Ch. 1
3-DIS-Ch. 2
3-DIS-Ch. 1
VMDs
0
10
20
30
40
50
60
70
80
90
100
Number of Alarms


Cloud Nuisance Alarms from Tape Tests
VMDs
Adpro-Ch. 1
Sentinel-Ch. 1
Detec-Ch. 1
David200-Ch. 2
David200-Ch. 1
Quark-Ch. 2
Quark-Ch. 1
MoviCom-Ch. 2
MoviCom-Ch. 1
DigiTect II-Ch. 1
Burle-Ch. 2
Burle-Ch. 1
GYYR-Ch. 2
GYYR-Ch. 1
TSI-Ch. 2
TSI-Ch. 1
Geutebruck-Ch. 2
Geutebruck-Ch. 1
Magal-Ch. 4
Magal-Ch. 3
Magal-Ch. 2
Magal-Ch. 1
David300-Ch. 2
David300-Ch. 1
3-DIS-Ch. 2
3-DIS-Ch. 1
0
10
20
30
40
50
60
Number of Alarms


Unknown Nuisance Alarms from Tape Tests
VMDs
Adpro-Ch. 1
Sentinel-Ch. 1
Detec-Ch. 1
David200-Ch. 2
David200-Ch. 1
Quark-Ch. 2
Quark-Ch. 1
MoviCom-Ch. 2
MoviCom-Ch. 1
DigiTect II-Ch. 1
Burle-Ch. 2
Burle-Ch. 1
GYYR-Ch. 2
GYYR-Ch. 1
TSI-Ch. 2
TSI-Ch. 1
Geutebruck-Ch. 2
Geutebruck-Ch. 1
Magal-Ch. 4
Magal-Ch. 3
Magal-Ch. 2
Magal-Ch. 1
David300-Ch. 2
David300-Ch. 1
3-DIS-Ch. 2
3-DIS-Ch. 1
0
10
20
30
40
50
60
70
80
Number of Alarms

Live Test Results

This section shows the number and types of nuisance alarms generated by the VMD systems when left on continuously. The Quark Q18VM4 and the Detec Auto Sentry SA3 systems were not operated continuously and consequently do not have results shown in this section.

At the programmed settings, the Quark Q18VM4 system usually operated properly on a clear, cloudless day. The main problem was at night when the system generated many false alarms. Once the detection levels were already very low at the current parameters, it was determined that increasing the values even more to eliminate the false alarms at night served no useful purpose for the application under which the evaluation was conducted. For this reason, the Q18VM4 was not included in the live testing.

The Detec Auto Sentry SA3 system was not included in the live testing because, once the system was initialized for the current backgrounds and nuisance alarm sources, it ran well for a few weeks until the angle of the sun caused the shadow line locations to shift, which in turn required re-initializing the system to prevent excessive false alarms. Also, each time the weather conditions changed (rain, snow, etc.), a new recording had to be made, and the system then had to be re-initialized to stop false alarms caused by weather changes. Because of the amount of time required to keep the system on line continuously, it was not included in the live testing.

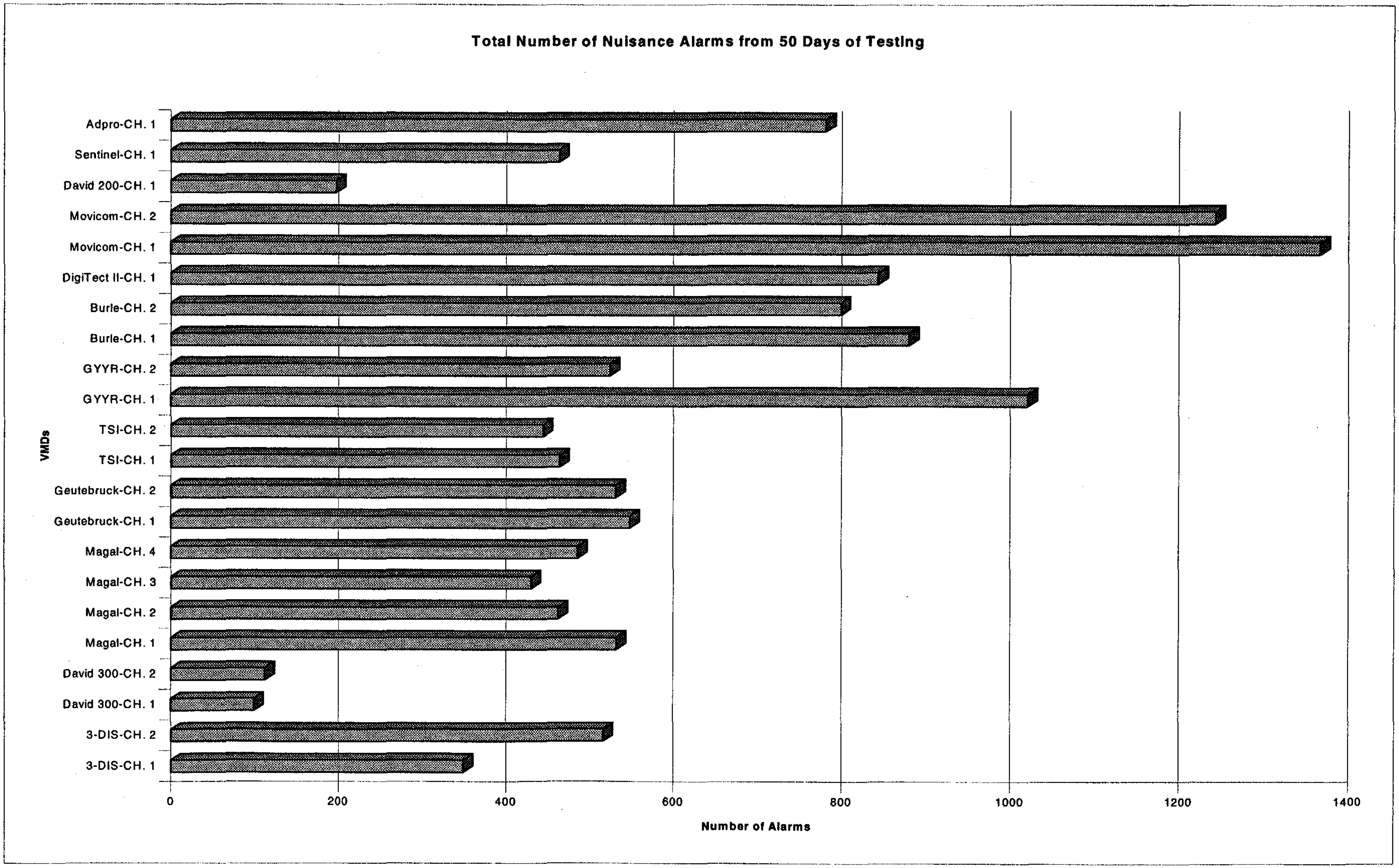
An important factor to note that is not reflected in the test results is that during lots of cloud activity, the Adpro and GYYR systems go into constant alarm until all traces of cloud movement are gone. The other systems may alarm several times during the time period that these two units are in constant alarm. For this reason, the number of cloud nuisance alarms for the Adpro and GYYR units are artificially low in the test results.

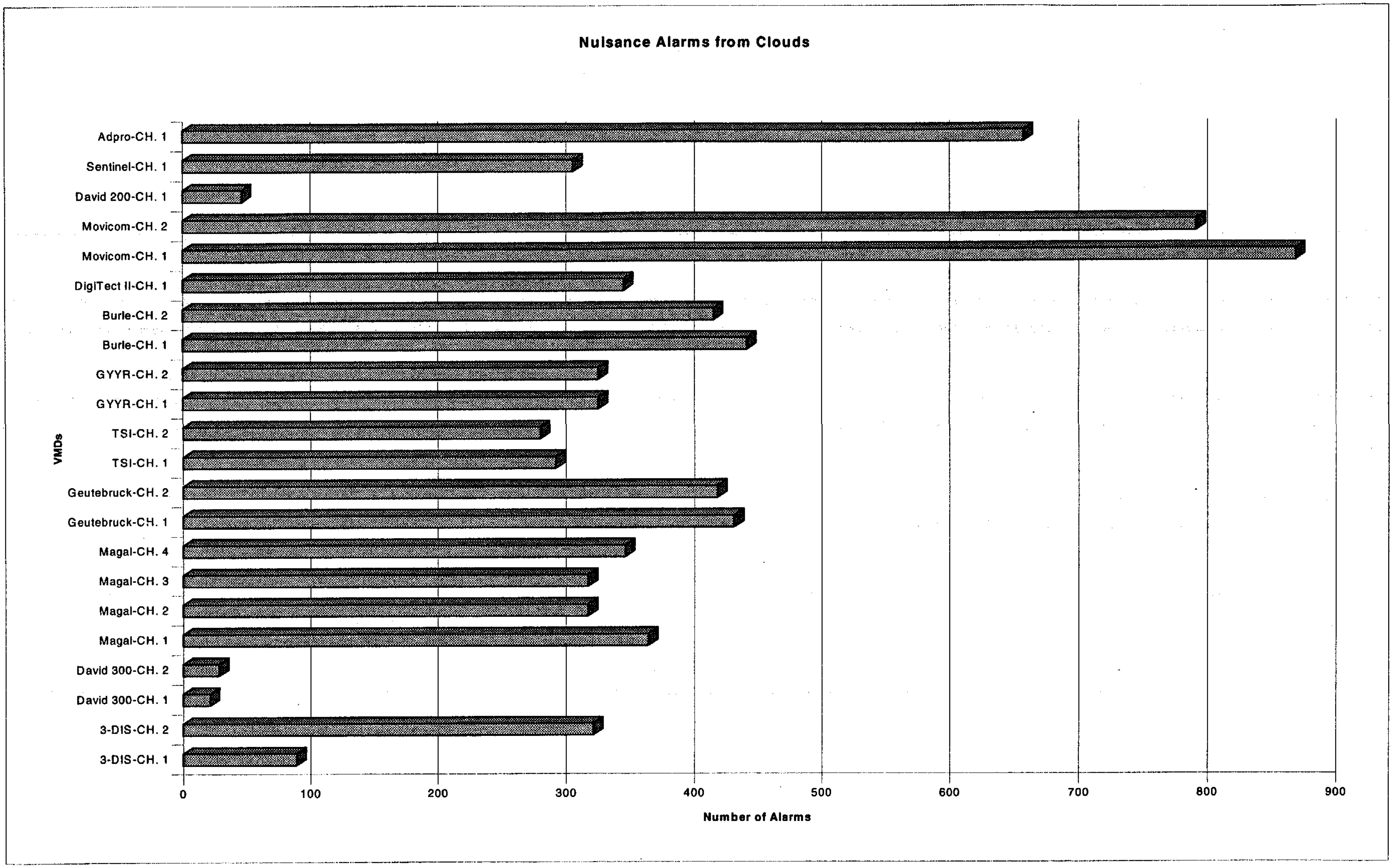
The live test results, shown in Table 34, were accumulated from approximately 50 days of data collection. All of the VMD systems were operated at the parameter levels used in detection testing and during the same time periods.

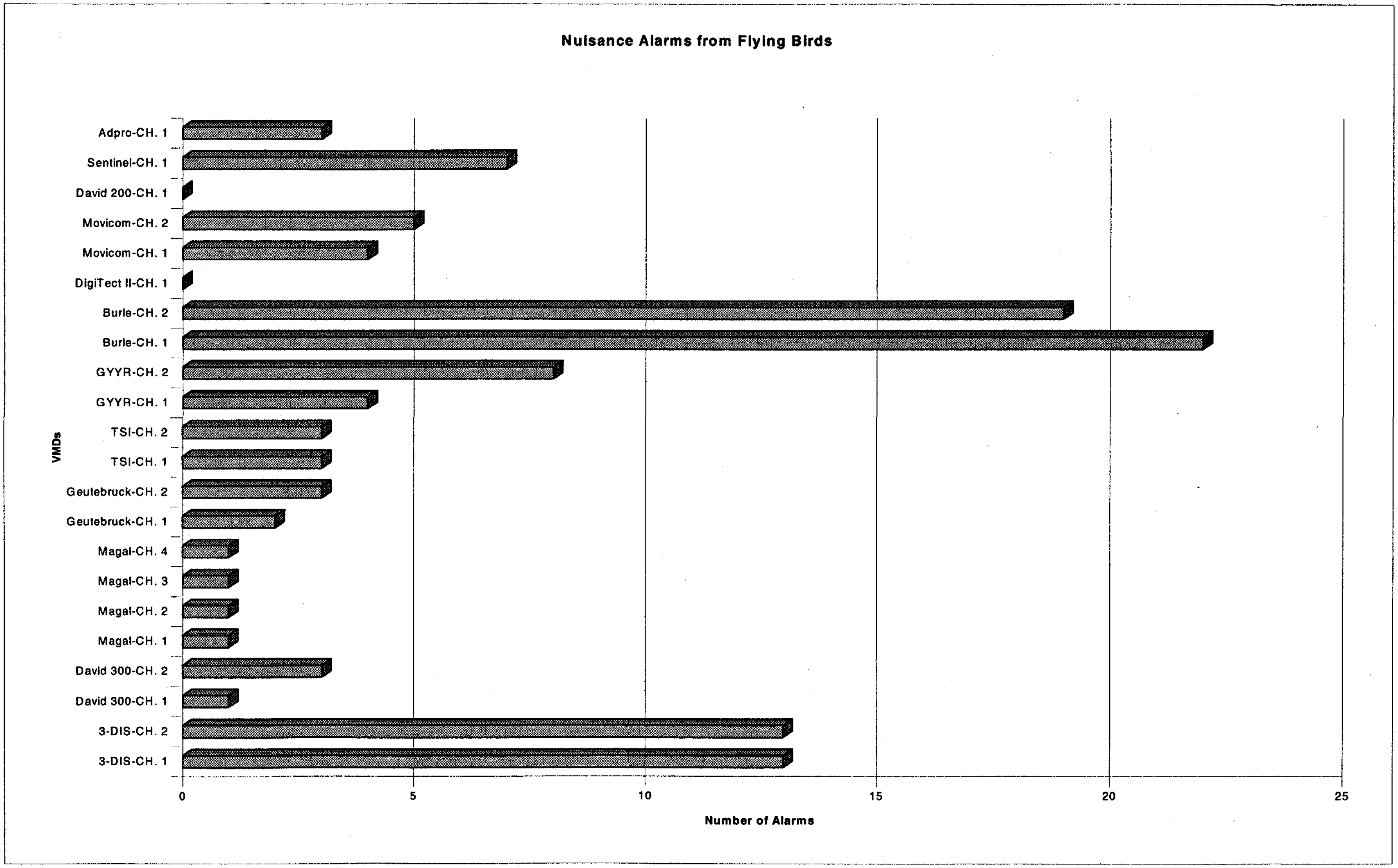
Summary of Nuisance Alarm Data from 50 Days of Live Tests	Airplane Shadow	Walking Bird	Flying Bird	Clouds	Blowing Dust	Headlights	Rabbits	Snow	Tumbleweeds	Unknown	Interference	Camera Signal	Rain	Dawn Shadows	Dusk Shadows	Melting Snow	Ground Wet to Dry	Camera Motion	Fog	Total Alarms
3-DIS-CH. 1	2	2	13	89	1	3	0	55	77	5	0	8	0	4	2	78	0	10	0	349
3-DIS-CH. 2	1	2	13	321	0	2	0	30	74	5	0	6	1	0	2	47	0	12	0	516
David 300-CH. 1	0	2	1	21	2	2	0	7	46	7	0	0	2	8	1	0	0	0	0	99
David 300-CH. 2	0	2	3	28	2	3	0	16	55	0	0	0	0	1	1	0	0	0	1	112
Magal-CH. 1	0	2	1	364	0	2	0	2	72	0	79	1	0	2	4	3	0	0	0	532
Magal-CH. 2	0	2	1	317	0	1	0	3	66	4	59	1	0	3	3	2	0	0	0	462
Magal-CH. 3	0	2	1	317	0	1	0	2	62	3	34	1	0	2	3	2	0	0	0	430
Magal-CH. 4	0	1	1	346	0	2	0	3	67	1	57	1	0	3	2	2	0	0	0	486
Geutebruck-CH. 1	5	2	2	431	5	10	0	9	63	8	0	0	0	2	1	8	0	2	0	548
Geutebruck-CH. 2	5	2	3	418	5	11	0	7	62	5	0	0	0	1	1	9	0	2	0	531
TSI-CH. 1	0	1	3	292	0	2	1	78	47	7	0	0	0	0	0	31	0	2	0	464
TSI-CH. 2	0	1	3	280	0	1	1	76	45	4	0	0	0	0	2	29	0	2	0	444
GYYR-CH. 1	1	1	4	325	1	2	0	60	28	547	0	0	0	0	24	23	0	4	1	1021
GYYR-CH. 2	4	1	8	325	0	4	0	56	27	55	0	0	1	0	8	8	9	10	8	524
Burle-CH. 1	8	0	22	441	0	3	0	289	51	10	0	0	4	32	12	6	0	2	0	880
Burle-CH. 2	8	0	19	415	0	5	0	270	46	2	0	0	6	10	14	3	0	1	0	799
DigiTect II-CH. 1	0	0	0	345	0	3	0	12	24	360	0	1	3	78	8	5	2	2	0	843
Movicom-CH. 1	0	0	4	868	3	1	0	336	38	57	0	1	9	17	12	7	0	14	0	1367
Movicom-CH. 2	1	0	5	791	2	3	1	301	39	46	0	0	6	16	13	8	0	11	0	1243
David 200-CH. 1	0	3	0	46	4	3	2	34	59	2	0	0	0	8	34	0	0	1	1	197
Sentinel-CH. 1	5	2	7	305	0	3	1	21	58	3	0	0	0	31	25	2	0	0	0	463
Adpro-CH. 1	1	2	3	657	2	4	1	40	58	1	0	0	0	0	0	8	0	4	0	781

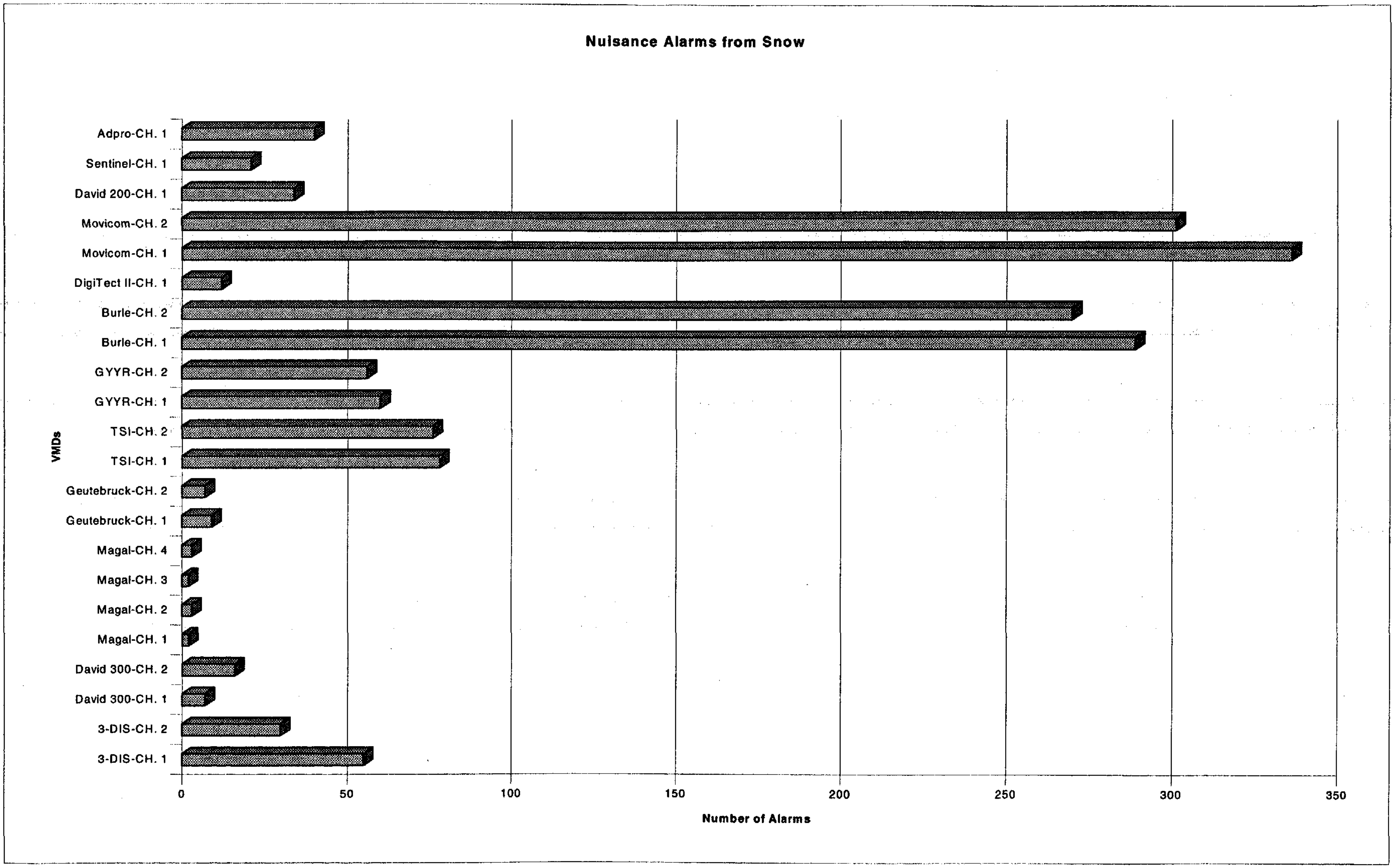
Table 34. Nuisance Alarm Results from 50 Days of Live Testing

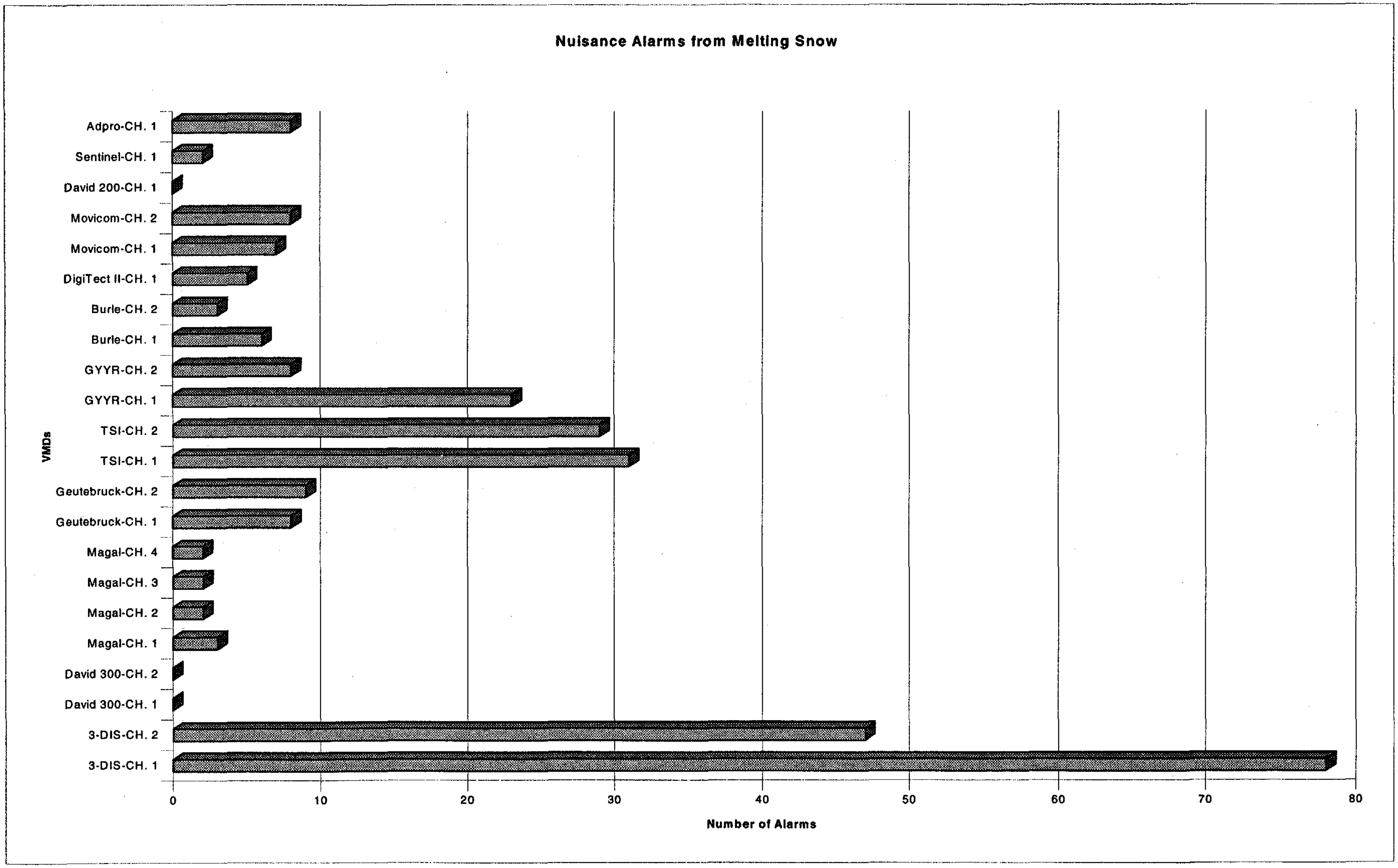
The next nine pages show charts of the total number of nuisance alarms recorded during the live testing portion of the evaluation. Also shown are charts of the most common nuisance alarm sources and how each VMD system reacted to them. All the following charts are based on the data presented in Table 34.

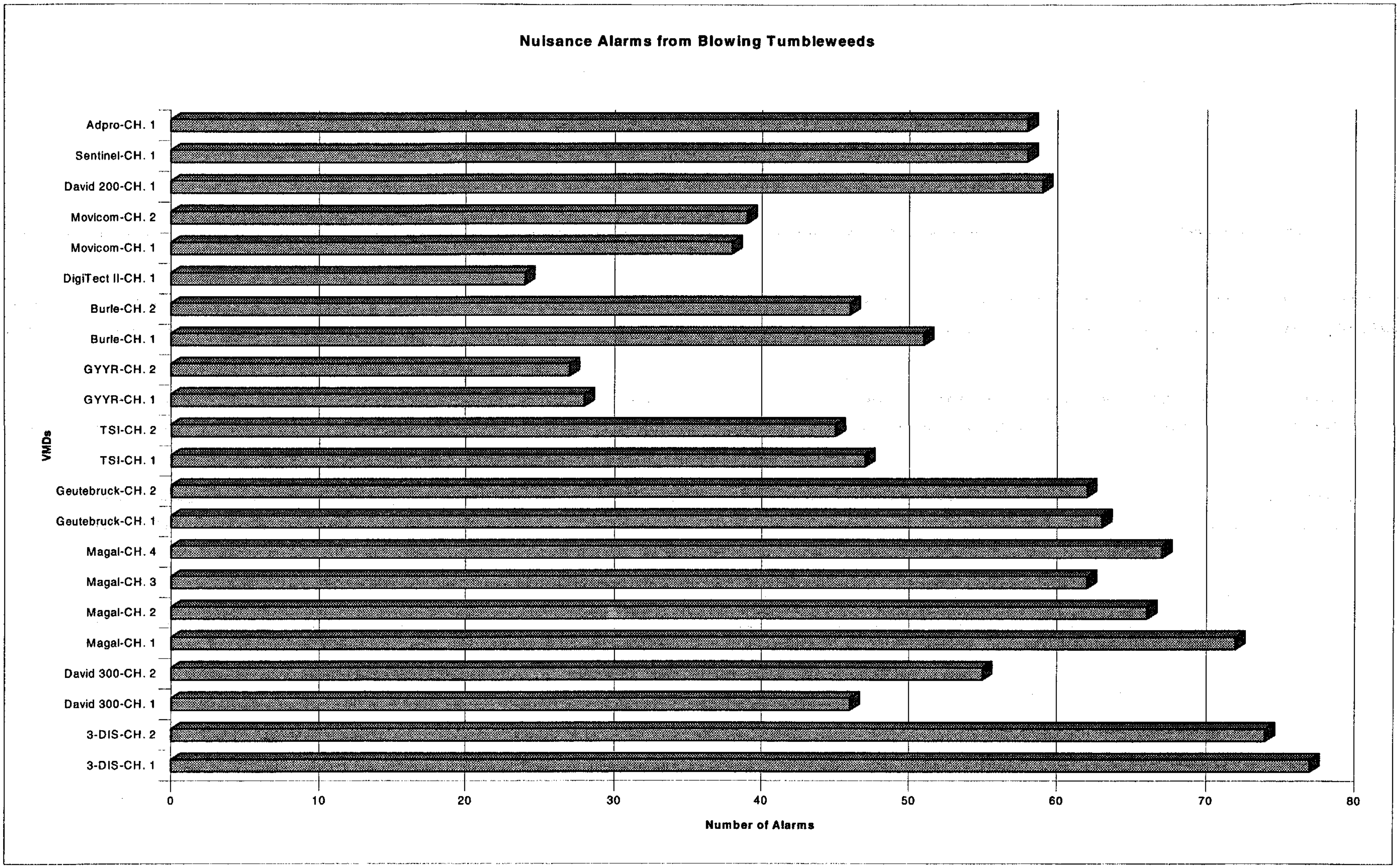

Total Number of Nuisance Alarms from 50 Days of Testing
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
0
200
400
600
800
1000
1200
1400
Number of Alarms

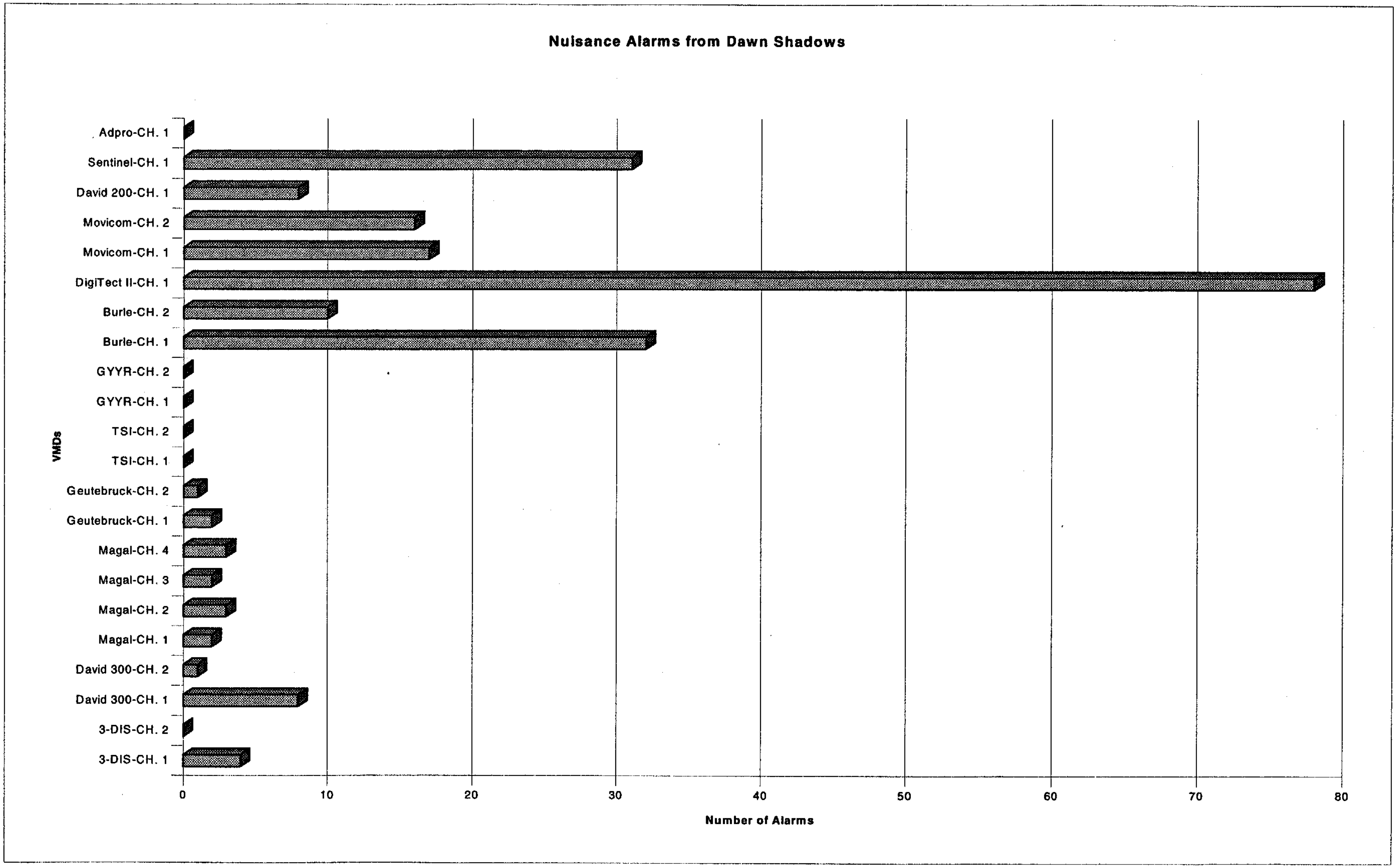

Nulsance Alarms from Clouds
VMDs
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
0
100
200
300
400
500
600
700
800
900
Number of Alarms

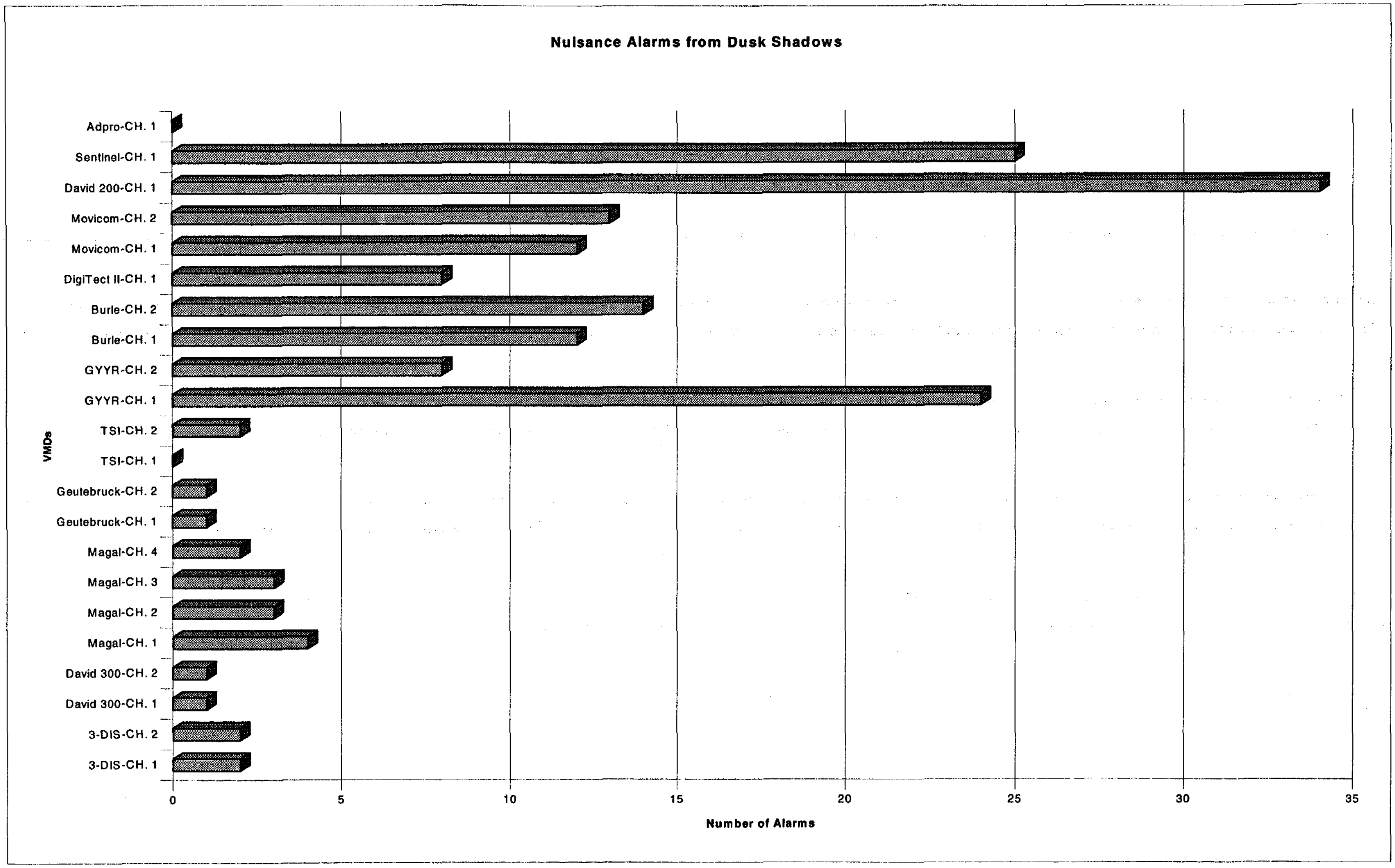

Nuisance Alarms from Flying Birds
VMDs
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
0
5
10
15
20
25
Number of Alarms


Nuisance Alarms from Snow
VMDs
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
0
50
100
150
200
250
300
350
Number of Alarms


Nuisance Alarms from Melting Snow
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
0
10
20
30
40
50
60
70
80
Number of Alarms


Nuisance Alarms from Blowing Tumbleweeds
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
0
10
20
30
40
50
60
70
80
Number of Alarms


Nuisance Alarms from Dawn Shadows
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
0
10
20
30
40
50
60
70
80
Number of Alarms


Nuisance Alarms from Dusk Shadows
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
Movicom-CH. 2
Movicom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
VMDs
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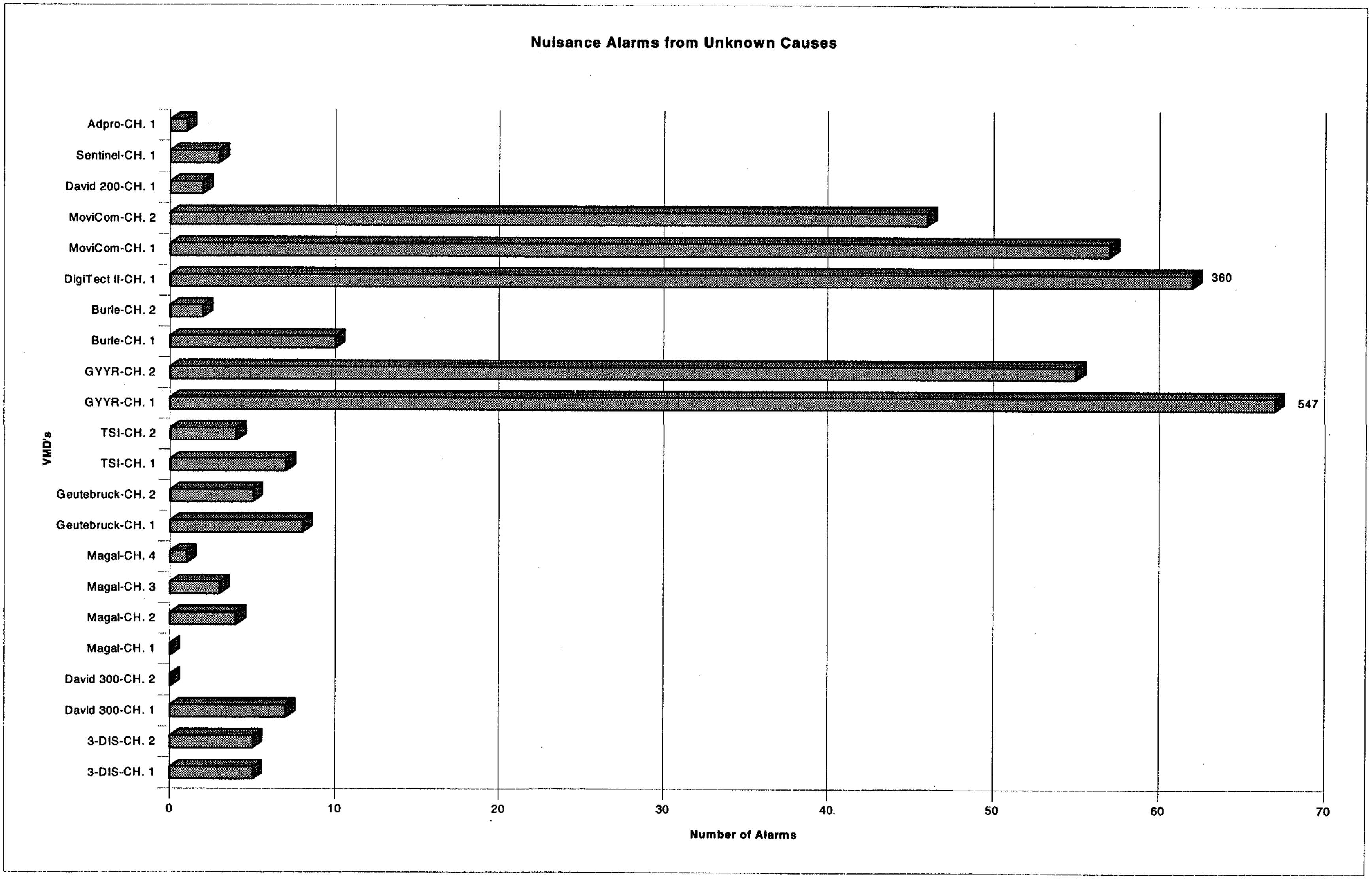
10
15
20
25
30
35
Number of Alarms


Nuisance Alarms from Unknown Causes
VMD's
Adpro-CH. 1
Sentinel-CH. 1
David 200-CH. 1
MoviCom-CH. 2
MoviCom-CH. 1
DigiTect II-CH. 1
Burle-CH. 2
Burle-CH. 1
GYYR-CH. 2
GYYR-CH. 1
TSI-CH. 2
TSI-CH. 1
Geutebruck-CH. 2
Geutebruck-CH. 1
Magal-CH. 4
Magal-CH. 3
Magal-CH. 2
Magal-CH. 1
David 300-CH. 2
David 300-CH. 1
3-DIS-CH. 2
3-DIS-CH. 1
360
547
0
10
20
30
40
50
60
70
Number of Alarms

Individual VMD System Conclusions

This section gives a brief summary of the evaluation test results for each VMD system tested. Note that the results are based on a short-term evaluation of each system's performance in a specific application and may or may not reflect how each system would perform under different applications.

3-DIS *3-DIS Security System 4*

The main aspect of 3-DIS Security System 4 is its ability to three-dimensionally analyze a scene with the use of two or more cameras looking at the same zone. This evaluation tested the 3-DIS system by using only a single camera. It is acknowledged that using more than one camera would increase the system's ability to reject nuisance alarms. The evaluation test looked at the 3-DIS system's capability to reject normal environmental changes in an outdoor environment using a single camera while maintaining a high probability of detection.

As the test results show, the 3-DIS Security System 4 exceeded the application requirement of 90% Pd at 95% confidence. At the test parameters used, the 3-DIS system was susceptible to any glitches in the camera signal, camera motion, and melting snow conditions. The system could reject many nuisance alarms caused by clouds and lighting when the inhibitory gangs were used. Note that the use of inhibitory gangs can create a vulnerability if not set up properly. If every time a cloud passes through the scene the inhibitory process completely squashes the detection signal, a knowledgeable intruder could possibly pass through at this time. Further testing of intrusions during cloud activity is required to verify this possibility. (*Note: The manufacturer recommends that more than one camera be used when looking at the same zone under cloudy conditions.*)

The 3-DIS Security System 4 is versatile enough to be adapted to many different applications. The number of parameters available to the user allows fine-tuning of the system's detection and nuisance alarm rejection capabilities, but dramatically increases the amount of time required to set up the system. A limiting factor of the 3-DIS system is the requirement for each camera to have a sync signal supplied from the system. Existing sites may or may not have cameras that can be synchronized. A number of available options of the 3-DIS system were not used in the evaluation, such as using the external inputs to change parameter settings based on time or other specified conditions. Utilizing some of these other options could increase the system's ability to reject more nuisance alarms.

American Dynamics *DigiTect II - 4500*

The DigiTect II 4500 series VMD system's primary asset in the application for which the system was evaluated was in the ease of setup of the system's parameters. For the application in which the system was tested, the test results show that the DigiTect II's detection capability would not pass the application test guidelines of 90% Pd at 95% confidence. As the test results show, the system's capability to detect crawlers at the camera's far FOV was limited and was primarily the reason the system failed to meet the detection criteria. The sensitivity levels of the system, when set lower, dramatically increased the number of nuisance/false alarms, particularly at dusk and dawn. The levels had to be raised to the levels used in the evaluation tests to reduce the number of nuisance alarms to an acceptable level.

As can be seen from the nuisance alarm test results, the system still had several nuisance alarms at the threshold settings used for evaluation testing. Clouds and reflections at dusk or dawn seemed to be the primary cause of most of the system's nuisance alarms. There were also a significant number of unknown alarms during the evaluation period. Most of these unknown alarms occurred over a period of two days under night conditions and should not be considered normal daily occurrences.

The system has only three parameter settings that affect detection and nuisance alarm rejection capabilities. If more of the system's parameters were available to the user, fine-tuning of the system to reduce nuisance alarms might be possible, although the more parameters available, the more complicated the system is to set up.

When set at the manufacturer's recommended threshold settings, the system has the capability to reject more nuisance alarms. However, with the settings required in the test application, to improve detection the system's parameters were set more sensitive; thus, the system's nuisance alarm rate increased dramatically. In applications with shorter zones, the threshold levels recommended by the manufacturer may provide adequate levels of detection.

Burle *TC8214*

The TC8214 VMD system allows the user to individually add and adjust thresholds and sizes for up to 64 individual detection cells per camera. Parameters were also available for adjusting global system settings to account for clouds and camera motion. Direction sensing was evaluated in an effort to decrease the number of nuisance alarms. Direction sensing helped eliminate nuisance alarms but also hurt the detection results because more cells (three) had to trip before an alarm would occur.

As the detection test results show, the system had trouble detecting a crawler at the far FOV. When the sensitivity of the cells was lowered to catch most crawlers, the nuisance alarm rate during dawn, dusk, and clouds increased significantly. The detection cell sensitivities were finally set to a level that reduced the nuisance alarm data to acceptable levels. As the results show, the system did not meet the level of detection required for the application under which it was tested. In general, the Burle TC8214 system detects fast-moving targets well while having more trouble detecting the slower-moving targets.

The nuisance alarm results show that the system had problems ignoring clouds, shadows, and fast-moving objects such as birds, bugs, or falling snow. These fast-moving objects could be rejected if a parameter was available for ignoring objects that pass too quickly through the scene, but at the time of the evaluation this parameter was not available.

The TC8214 VMD system could reject more nuisance alarms if the FOV of the camera was shorter. For the application tested, the system would not meet the detection requirements without introducing many nuisance alarms. The option of changing parameters at different times of day was not utilized in this evaluation but could potentially help reduce nuisance alarms by changing the level of sensitivity of the cells at dusk and dawn, which could hurt detection also.

Detec *Auto Sentry SA3*

The Auto Sentry SA3 VMD has the unique ability to allow the operator to control what the system learns as normal background activity. Once the operator initializes the system on all potential sources of background noise, the system can usually then ignore the learned actions, which reduces the number of nuisance alarms generated by known causes. The main problem with this type of setup was that it took a significant amount of time to collect and initialize the system for as many types of nuisance alarm sources as possible. The complete initialization process had to be restarted any time a new nuisance alarm source was identified. This meant keeping tapes of all known nuisance alarm sources and having the capability to record new nuisance alarm sources. Another feature of the system was its ability to capture and store alarm pictures to hard disk. This feature was used as a backup to the data collection video capture equipment.

The Auto Sentry had problems detecting the crawler. The system's parameters were adjusted to the maximum sensitivity and the system still missed several crawlers, yet the nuisance alarm count increased significantly. The system parameters were then adjusted to catch as many crawlers as possible while rejecting as many nuisance alarms as possible. The Auto Sentry SA3 could not meet the detection criteria required for the application under which the system was evaluated.

A point of concern for the Auto Sentry SA3 tested was that the system seemed to have bugs in the software that would change the sensitivity levels of the regions without the user's knowledge. The manufacturer is aware of this bug and believes the problem has been fixed in the newer upgraded models.

EDS *Sentinel*

The Sentinel VMD security system was designed to operate in cluttered environments with lots of ambient background noise. Although the system can be used for the application in which it was evaluated, it would probably do better in a different application. The Sentinel uses target size, tracking, and direction-sensing techniques in its algorithms. It has a short-term learning feature that adjusts to environmental changes in its AOI.

The problem encountered with the Sentinel system in the application tested was that the system had trouble detecting the crawler at the far FOV with the sensitivity levels set at their lowest values. The object size was also set as small as possible to increase the likelihood of detection. The maximum number of cells or tiles the system allowed was used on one camera to increase the Pd level of the system by covering as much area in the detection zone as possible. As the test results show, the Sentinel system met the detection criteria but was vulnerable to a crawling intruder at the 100-foot FOV tests.

When the maximum number of cells or tiles were used on one camera, the system could not have any detection cells on the other available three cameras (when using a quad setup). Another factor for consideration is that only one global relay output is available for all cameras on the system. Individual relay outputs per camera on the same board were not available on the model tested. For the application tested, only one camera per system could be used and still meet overall detection criteria.

The nuisance alarm test results show that the Sentinel system rejected a large number of nuisance alarms even with sensitivity levels set low. The system did have problems with some clouds and under some dusk/dawn conditions. If the application was for a shorter test zone, the sensitivity levels could be raised, which would allow the use of the four-camera capability per board using an external quad multiplexer. Raising the sensitivity levels would also reduce the nuisance alarm rate.

In general, the Sentinel system tends to work well in outdoor environments when sensitivity levels are not set too low. This system would not be a cost-effective choice in applications like the one under which it was evaluated since only one camera could be used per board.

Geutebruck *TeleTect VS-30*

The TeleTect VS-30 VMD system has many features, making it adaptable to many different applications. The detection parameters allow adjustments for speed, target size, direction, and automatic threshold adjustments based on background levels. The system allows grouping and definition of cells as a main alarm, pre-alarm, or suppression cell. The system also has the option to have frame-capture capabilities and the capability to add or replace camera modules one at a time. Four different set-up modes can be programmed for each camera and switched remotely from external inputs. These features allow the user a great deal of flexibility in adjusting the system for the best response in different applications.

The detection results show that the TeleTect VS-30 detection capabilities met the detection criteria for the application under which it was tested. Of concern is the system's ability to maintain a high Pd under cloudy conditions. The TeleTect VS-30 will detect intruders in light and medium clouds if set up for that activity, but when set up in that manner the system will double the nuisance alarm count for birds, insects, and other fast-moving objects passing in front of the camera. The tests were run without this setup to lower the number of nuisance alarms. The evaluation did not include enough detection tests during cloud activity to generate a Pd level for those periods.

The nuisance alarm rejection capability of the TeleTect VS-30 was good for rejecting cloud movement when suppression cells were used and set to higher levels of suppression than during the evaluation testing. A concern in using suppression to reduce nuisance alarms is that the detection capability, while not completely disabled during suppression, is lower than during normal conditions. This factor has to be carefully weighed against the application in which the system is used and if additional sensors back up the system during these vulnerable times. The suppression levels chosen for the evaluation were set to reject some of the nuisance alarms while still meeting the overall detection criteria under which the system was evaluated.

GYYR *DVMD32*

The DVMD32 VMD system is a small, compact, eight-channel VMD system that can be quickly set up and installed. The system provides an internal quad for displaying multiple camera alarms on the same monitor. The system has short-term frame storage on alarm, 2X zoom functions, and VCR control. Individual TTL outputs are supplied for each camera alarm.

In the application tested, the detection capability of the GYYR DVMD32 could meet the detection requirements, but at these parameter levels the nuisance alarm rate was very high. The detection zones were set up according to suggestions from the manufacturer for best detection and nuisance alarm rejections. The problem was that at the levels required to have reliable detection, the system had a high number of nuisance alarms, especially when clouds passed across the scene. As the test results show, the GYYR system did not meet the detection criteria at the parameter levels used during the evaluation test period. Even at the levels used in the evaluation, the nuisance alarm results show that the system still has a high nuisance alarm rate.

One problem noted with the DVMD32 is that it may not always reset on its own, although this happens rarely, and it requires a manual reset to start the system again. This could be a problem in unattended situations. Another factor is that the parameters used for evaluation testing utilized eight detection cells per camera, which limits the number of available cameras to four instead of eight because of the 32 detection cell limit of the system.

Note that the GYYR system remains in alarm until all traces of clouds or snowfall have passed. This affected the number of nuisance alarms shown in the test results, making them artificially lower in comparison with the other systems evaluated.

The DVMD32 has many desirable features, but for the application tested it would have a high number of nuisance alarms when set up to meet the detection criteria. If the application allowed a shorter test zone, the detection levels could be set near the recommended values, and the system may reject more nuisance alarms. The DVMD32 would probably do better in indoor controlled environments.

Quark *Q18VM4*

The Q18VM4 18-channel VMD switcher combination's most appealing feature is the system cost per channel. The system's ability to act as a switcher on alarm or on external input could be useful in several different applications.

In the application in which the Q18VM4 was tested, the system did not have the detection capability required by the design criteria. The system seems to have been designed for applications with larger targets or much shorter camera FOVs. The system has no visual indication of where on the screen an alarm occurs, so when the sensitivity levels were lowered to try to detect a person at the far FOV, it was unclear whether the system was false alarming all the time or sometimes actually detecting the intruder. For the test results of this evaluation, the thresholds of the system were adjusted to the point where the system would not false alarm during the day with no clouds present. As the test results show, the capability of the system to detect intrusions consistently was very poor.

The nuisance alarm test results show the system was very susceptible to cloud, dusk, and dawn conditions at the parameter levels in which the system was evaluated.

A problem was noted in testing the Q18VM4 when using more than one channel. When two channels were evaluated at the same time with both using the same input source and threshold settings, the test results varied greatly from one channel to the next. It is unknown why this seemed to happen, but a second unit was evaluated under the same conditions and the results were similar.

The Q18VM4 motion detection system did not meet the design criteria. It might do better with a shorter FOV but probably would still be somewhat susceptible to environmental changes. Interior instead of exterior applications might possibly be better for this system because of its low cost and switching and hardware interface capabilities.

Magal *DTS-1000*

The DTS-1000 VMD system utilizes a pseudo-3-D algorithm to determine target size, speed, and direction. Each of these parameters is used to determine whether movement will be classified as a true alarm or rejected as normal environmental conditions. The user determines the size, speed, and distance traveled before alarm of a target. When detected, the target is outlined by a box and leaves a tracer line showing the path in which the target was tracked. These features make setting up the DTS-1000 system relatively easy and quick. Another useful feature of the system is that a picture is snapped on alarm and written to hard disk for later review.

The DTS-1000 met the detection requirements for the design criteria. As the results show, the system did well detecting slow-moving targets (crawlers and walkers). A potential weakness of the system is its requirement for its AOI to cover a wide enough area so that a running intruder cannot pass through the zone in 1.5 seconds or less. This is because the system needs three scenes to analyze the area for movement, and the system acquires a scene only every .5 second per camera. As the test results show, the system misses some of the runners because of the time required for the system to analyze the AOI used in the evaluation. The setup used in the test application borders on not being wide enough to meet the detection criteria for running intruders. Although the fenced zone is wider than the AOI used in the test, and increasing the AOI width did improve the detection statistics for a runner, the AOI was kept away from the fences in the test zone to lower the nuisance alarm rate caused by fence shadows, especially during cloud movements.

Another area to note for the DTS-1000 is that the system requires at least 10 levels of gray scale for reliable detection and will give an interference alarm (caused by inadequate contrast in the scene) when the level drops below this. The system can not detect motion in an interference alarm state. In the test application, interference alarms were seen after heavy clouds, at dusk, during fog, or after snow has completely covered the detection zone. Several things could cause this alarm, including the quality of the camera being used and whether the test zone background has adequate contrast. The test zone background used in the evaluation was dirt and had little contrast, which could have contributed to the number of interference alarms received. Detection and interference alarms report on the same output, so if this output reports to a central alarm system, the operator would not know the difference between a detection alarm or an interference alarm. The system allows only one external output per camera although there are three alarm types (detection, interference or blocking, and video loss).

The DTS-1000 rejects most nuisance alarm sources if set up properly by using the learn mode to determine where alarms potentially would occur and masking that area if possible. If the system is set up with the AOI too close to the fences or with low sensitivity levels, alarms will occur during cloud movements. For the test application, low target size and sensitivity levels were used to improve the detection results for a running intruder. Changing these parameters significantly increased the nuisance alarm rates to the levels shown in the test results.

Senstar *David 300*

Senstar's David 300 model VMD system is a PC-based system that allows addition of camera modules or cards to the PC. Being PC-based had allowed the David 300 more flexibility than the David 200. Multiple set-up files can be stored and recalled by the user. The David 300 has additional parameters to help in nuisance alarm rejections from clouds. The David 300 was designed to detect human intruders, and the algorithms are based on the shape, rate of movement, and size of a human target. The David 300 logs files to hard disk and/or a printer. The system also monitors the incoming video signal for signs of tampering, signal loss, or degradation. The test results show little difference between the detection and nuisance alarm rejection capabilities for the David 200 and the David 300, with a slight edge going to the David 300.

As the test results show, the David 300 met the detection criteria required for the test application. The only locations it had trouble detecting were at the far FOV for crawlers that blended into the scene. To reduce nuisance alarms, the evaluation testing was run with the system set up for horizontal tracking only. The system could still detect a diagonal walking intruder because of the width of the AOI. This concept may not be possible in all applications, and care should be taken when disabling the vertical tracking features of the David 300. The nuisance alarm rates increased when vertical tracking was enabled.

The nuisance alarm test results show that heavy clouds and blowing dust were the major causes of nuisance alarms. The threshold levels used in the evaluation were lower than recommended in order to increase the probability of detection. If the threshold levels were set higher, the detection levels would decrease along with the rate of nuisance alarms. In the test application, the system alarmed on blowing dust, even at the higher threshold settings.

Shorrock/Hymatom *Movicom 4*

The Movicom 4 VMD system was evaluated for its detection and nuisance alarm rejection capabilities only. There are several other application-driven features that may or may not determine how the overall the system would work. These include the system's ability to capture alarms to disk and have remote alarm assessment capabilities via phone lines.

For the application tested, the test results indicate that the Movicom 4 had trouble detecting a crawling intruder. The system was set up at the most sensitive levels and still could not reliably detect crawlers at the FOV, so the nuisance alarm rate was very high. The test results were gathered at sensitivity levels that kept the nuisance alarm rate at an acceptable level for data collection. As can be seen from the test results, the detection levels were better when the targets were at the camera's near FOV or were not crawling.

The Movicom 4 had a high nuisance alarm rate because of the levels of sensitivity that were set to give the system the highest Pd possible. As the test results show, clouds, shadows, and night scenes were problem areas for the Movicom 4.

The Movicom 4 did not meet the detection criteria required for the application in which it was tested and, as the test results show, it has a high nuisance/false alarm rate at the sensitivity levels tested. The system may have better results if the test zone is shorter, allowing the sensitivity levels to be raised.

TSI *TSI-2020*

The TSI-2020 video motion detection system's major asset is its easy adaptability to multiple applications. The ability to select whether the system will alarm on motion or light-level changes, or when motion levels fall within a specified range, allows the system to be adapted to many applications for which VMDs have not previously been considered. The system's ability to allow the user to assign relays to specific regions in the same scene and to sequence regions is also an important factor when a user requirement calls for the system to adapt to multiple-type scenes.

The detection test results show that for the application tested, the TSI-2020 met the design criteria for detection. Overall, the system had good detection capabilities, even when the regions were set up for sequencing. When the test results were analyzed for detection levels at the far FOV for a crawler, the Pd for the TSI-2020 decreased significantly. This number could be increased at the cost of a higher nuisance alarm rate.

One of the major causes of nuisance alarms for the TSI-2020 was swarming bugs near the camera. When the bugs were present long enough, eventually the sequence criteria were met and an alarm was generated. For this reason the system could ignore single bugs and birds but had trouble with multiple bugs. For the same reason, the TSI-2020 also had problems ignoring global changes to the scene, such as camera motion or melting snow, even though sequencing was used. TSI-2020's algorithm handles cloud movement very well. At the parameter levels used for evaluation testing, some heavy clouds caused false alarms, but in general the system ignored most cloud movements.

Overall, for the application in which it was tested, the system had good detection and nuisance alarm rejection capabilities. The system handled varying light changes from clouds or shadows very well. Extra time was necessary in setup to determine timing parameters, sequencing, and threshold levels required to achieve the best results for the system.

Vision Systems *Adpro VMD-1*

The Adpro VMD-1 video motion detection system has many desirable features, including parameters that allow adjustments for target direction, speed, size, and distance traveled. The system is easy to set up and analyze and has features that protect the video signal from tampering.

For the application in which the Adpro VMD-1 system was tested, the detection levels had to be set lower than the manufacturer's recommended values in order to try to meet the detection requirements. As the test results show, the Adpro VMD-1 was susceptible to crawlers at the far

FOVs under dusk and dawn conditions when the target nearly blended into the background. When the levels of detection were brought down to try to detect these targets consistently, the nuisance alarm rate increased dramatically while minimal improvements in detection were achieved. The system could not be set sensitive enough to detect all the targets, no matter the levels to which the system parameters were adjusted. The final parameter settings used for the evaluation test results were determined, based on maintaining the best possible detection and keeping the nuisance alarm level at an acceptable level.

The nuisance alarm test results show the Adpro VMD-1 system, at the parameter settings used for testing, to be susceptible to heavy clouds and rain. The nuisance alarm rates rose dramatically as the parameter levels were dropped below the levels used for the evaluation. A factor to note concerning the number of cloud alarms shown in the test results is that the system does not reset until all traces of cloud activity disappear, which lowers the overall number of alarms caused by clouds in comparison with the other systems evaluated.

The Adpro VMD-1 system may work well with shorter zones or larger targets, but for the application in which it was evaluated, the system could not meet the detection levels required and, at the parameter levels used, had a high nuisance alarm rate from clouds.

Overall Evaluation Test Conclusions

Commercially available video motion detectors were tested and evaluated for a specific application. It is acknowledged that the systems may act differently when used in applications other than the one in which they were evaluated. The evaluation was meant to push the detection and nuisance alarm rejection capabilities of each system to their limits. Testing was done in a dirt zone, which may have posed more difficult test conditions than would be normal in a gravel-covered zone.

Tape testing may have had some influence on the test results because of tape noise and lower resolution than with the live camera. The idea was that if the systems could handle the taped conditions, they were more likely to handle live conditions.

Final conclusions are that VMDs in general, when used in an outdoor environment, are susceptible to nuisance alarms from environmental effects, especially cloud movements. Some of the systems handled these conditions better than others, but all had some problems rejecting nuisance alarms. The main reason for this is that to keep detection levels high for small targets at the camera's far FOV, the systems' sensitivities had to be set below recommended values. Each of the systems performed better when used on shorter zones where the minimum target size was larger and the sensitivity levels could be raised.

Table 35, on the following page, is a summary of the VMDs included in the evaluation. This table shows the overall results of the evaluation based on the design criteria. It also shows which systems passed the 90% Pd at 95% confidence requirement and the systems' overall detection probability. Table 35 shows whether the systems passed the basic nuisance alarm requirement of fewer than 10 in a 24-hour period on a clear day and the total number of nuisance alarms recorded over 50 days of live testing. This table is a summary of the detailed data presented earlier in this section.

VMD System	Design Criteria				Major Cause of Nuisance Alarms	Major Points
	Probability of Detection		Nuisance Alarm Rate			
	Pass	%	Pass	#		
David 300	yes	95%	yes	106	Clouds, dust, dawn, dusk	Susceptible to blowing dust and some dusk and dawn conditions.
3-DIS	yes	99%	yes	433	Clouds, snow, camera signal	Cameras require sync, 3-D if two cameras used, long set-up time.
TSI	yes	97%	yes	454	Clouds, snow	Long set-up time, individual regions can be sequenced.
Sentinel	yes	93%	yes	463	Clouds, dawn, dusk, snow	Limited number of detection cells limits number of cameras.
Magal	yes	97%	yes	478	Clouds, dusk conditions	Flat scenes cause interference alarms when no detection is available.
Geutebruck	yes	93%	yes	545	Clouds, headlights	Vulnerable during clouds, detection zones limited to 20, long set-up time.
Adpro	no	84%	yes	781	Clouds, snow	Stays in alarm during all cloud activity.
Burle	no	81%	yes	840	Clouds, birds, bugs, snow	Alarms on fast-moving objects, 64 individual zones per camera.
DigiTect II	no	70%	yes	843	Clouds, dawn, unknown	Low detection at far FOVs, several unknown alarms, limited adjustments.
GYYR	no	76%	yes	773	Clouds, snow, unknown	Sticks in alarm requiring manual reset, system has max. of 32 detection zones.
Movicom	no	42%	yes	1305	Clouds, dawn, snow	Cannot detect small objects, remote assessment capabilities.
Detec	no	46%	no	NA	Any untrained action	Re-initialization required for each environmental change, long set-up time.
Quark	no	14%	no	NA	Clouds	Low-cost system with low detection and high nuisance alarm rate.

Table 7. Summary of VMD Evaluation Testing

Using VMDs as stand-alone perimeter security sensors would not be recommended for DOE-type applications. There are periods in which the VMD systems are vulnerable. For instance, any condition in which the operator cannot see something in the zone, such as fog, rain, shadows, etc., will also pose detection problems for a VMD system. Using a VMD in conjunction with other perimeter sensors would be a better solution than using a VMD as a stand-alone sensor in a perimeter security system application.

Future Development and Testing

Long-term evaluation of each system as the seasons change will continue. Suggested improvements will be made to the manufacturers. Testing of new systems and/or algorithms will be pursued as funding allows. Testing of VMDs in different applications/locations will be done as time and funding allow. Some of the VMD systems evaluated may work well in applications with shorter or closer zones. Plans are to take a look at the distances these systems can effectively monitor while maintaining an acceptable nuisance alarm rate. Long-term data collection at these levels will be gathered as funding allows.

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