Video Surveillance Trailer

User's Manual

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Prepared for the

State of California Department of Transportation Division of Research and Innovation

In cooperation with the

U.S. Department of Transportation Research and Special Programs Administration

March 2008

ACKNOWLEDGMENTS

Thanks go to the Project Evaluation Team, including Alyssa Begley and Dave Clark from Caltrans New Technology and Research, Kristi Burney and Kim Hanagan from Caltrans District 2, Ken Kochevar from the California Division of the Federal Highway Administration, and Lt. Jerry Godnick from the California Highway Patrol. This group provided consistent help and guidance in resolving technical issues related to this evaluation.

Thanks also go to Caltrans maintenance staff at the Susanville dispatch office, for their considerable assistance in supporting with time and facilities various data collection activities in this project.

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1 INTRODUCTION

The purpose of this guide is to provide an overview of the usage and capabilities of WTI's video surveillance trailers. This manual summarizes the relevant functions of the system as a whole, and of each of the components individually. This manual does not serve to replace or supersede vendor documentation for any of the trailer components. Hopefully, this document will provide an overview adequate to set up, use, and disassemble the trailers for whatever research data collection activities may be required.

2 DESCRIPTION OF OVERALL CHARACTERISTICS

As a part of the California/Oregon Advanced Transportation Systems (COATS) and COATS Showcase projects, WTI purchased three video surveillance trailers. The overall purpose of these trailers was to provide long-term video surveillance of traffic to support a variety of research and evaluation activities. WTI worked with Capital Enterprise, a vendor based in Salem, Oregon, to design these trailers based on anticipated need.

The following are some of the principal design characteristics of these trailers.

- <u>Time-lapse video recording equipment</u>. For the three trailers, WTI has a total of four video recording units, three of which use standard VHS tape while the other is a digital video recorder.
- <u>Mast-mounted closed-circuit television (CCTV) camera</u>. This camera can transmit real-time black-and-white images from up to 25 feet above ground.
- <u>Detachable mast</u>. The mast consists of several interlocking pieces of black powdercoated aluminum, which may be stored on the trailer when not in use.
- <u>Microwave sensor input</u>. Video recording is initiated only when vehicles are approaching the camera location.
- <u>Autonomous power</u>. Each trailer is designed, through an integrated solar panel and battery system, to allow for up to 30 days of continuous operation.
- <u>Two-tired trailer mount</u>. The two-tired trailer can be towed by a vehicle using the trailer hitch, which attaches to the vehicle by a standard 2" ball. Once detached from the vehicle, the trailer can be supported by four self-adjusting jack-legs. (See Figures 1 and 2)

Figure 1: Trailer (Initial Position).



Figure 2: Trailer (Installed Position).



3 DESCRIPTION OF TRAILER

3.1 Description of Chassis

The video surveillance trailer consists of a black powder-coated steel frame supporting a large aluminum box, which contains the trailer power system (see chapter 7) and is the connection point for all devices used on the trailer. One picture is shown in Figure 3. The frame is mounted on two independently rotating rubber tires which permit it to be towed by hand or a vehicle. For towing and moving purposes, the trailer has a tongue which includes a hitch for attachment to a vehicle (see section 3.3). The weight of the assembly is significant - an estimated 1.500 pounds – but it can be moved easily by one person on level, firm ground. The chassis may be secured in place through the use of jack legs (see section 3.5).

3.2 Description of Trailer Box

The aluminum trailer box, mounted on the trailer chassis, contains the power system used by the trailer, and includes all connections necessary for trailer operation. The inside of the box is shown in Figure 4. There is a metal rod on the right side of the trailer that may be used to prop the lid open. On the left underside of the trailer lid is a switch box used for turning on power to various trailer components. On the right underside of the lid is a sheet metal compartment in which the recorder may be slid. The box's volume is occupied primarily by a bank of batteries at the bottom, which are described in chapter 7. An AC outlet is







supplied toward the front of the box when open on the left side.

3.3 Description of Hitch

The trailer hitch is shown in Figures 5 and 6. It attaches to the trailer body with two hexagonal bolts, and a screw lock. The hitch will be removed from the trailer when the mast is in use. The hitch attaches to a vehicle on a standard 2-inch ball.

To attach the hitch to the ball on the vehicle, the tongue will need to be raised slightly, and the aluminum lever will need to be raised away from the trailer box. (The lock will need to be undone for this.) The socket for the ball should be placed just ahead of the vehicle ball, and eased down onto the ball. It should close pretty securely. After the ball is attached, the lock should be re-secured.

3.4 Description of Detachable Mast

Each trailer is equipped with a modular, steel tubed mast. The base of the mast is the same piece as the tongue that will connect the hitch to the trailer chassis. After removing the hitch piece, each successive mast piece is connected by inserting the hook on the end of the added piece into the slot of the last piece of the mast, and securing it with the two hexagonal bolts provided for each piece. An example connection is shown in Figure 7.

At the base of the mast is a lock that secures the mast in either a horizontal or vertical position, as shown in Figure 8. The mast will need to be in the horizontal position for towing or moving the trailer or for assembling the mast. It needs to be locked to the chassis except during mast assembly, when the weight of the mast will be adequate to secure it. (It is critical that the trailer be parked using the jack legs before assembling the mast; this is described in the following section.) The mast will need to be secured in the vertical position for surveillance activities. Figure 5: Hitch (Top View).



Figure 6: Hitch (Side View).



Figure 7: Interlock Between Mast Pieces.



Figure 8: Mast Base with Lock.



The mast pieces are largely interchangeable, with a couple of exceptions. First, it should be noted that the bottom removable piece – the one closest to the tongue of the trailer – has a pin on which the winch is attached. Second, the top mast piece has a single hexagonal bolt at the end for mounting the camera. Third, it should be noted that there are some machining irregularities between the components, and the order on which they are stored on the trailers is also the order they should be added to the mast. Otherwise, connections will be very tight and difficult to complete. In general, it is better to use the full length of the mast, and to preserve the installation order of the individual pieces.

Once the mast is assembled, the camera and microwave components should be mounted (see chapters 4 and 5 for descriptions on these components). The cables from the trailer box would then be run up the length of the mast and connected to the appropriate devices. The cables should be secured to the plastic appendages on the sides of the mast pieces using zipties, providing a little slack near the devices and at the bottom of the mast.

It is critical that the trailer be properly positioned and rotated before assembling the mast. Because the mast is assembled in a horizontal position, caution needs to be exercised to ensure that when the mast is assembled that technicians are safely removed from traffic when the mast would be at its tallest position. Once the mast is assembled, the winch hook should be attached to the winch pin on the mast, as shown in Figure 9. The mast may then be raised by rotating the winch arm. The mast should be locked in place once it is vertical.



3.5 Description of Jack Legs



Each trailer includes four sidewinder jack legs to help level the trailer (see Figure 10). The jacks attach to the trailer via pins. One will almost always want the pins fully locked to secure the jack legs. There are two basic positions for the jack legs – parked (with the foot on the ground, as shown in Figure 10) and free (with the foot in the air, as shown in Figure 11). While setting up the trailer it is important to see that the trailer is leveled properly on the ground. There are two spirit levels (bubbles) mounted on the chassis of the trailer (see Figure 12) to help level the trailer on the ground. The trailer can be leveled by adjusting the height of the jack legs and using these two spirit levels. To adjust the jack legs, make sure that the legs are in the parked position. Rotate the sidewinder arm to extend or compress the length of the jack leg. Once the trailer is leveled, make sure all the jack legs are firmly on the ground and supporting the weight of the trailer. This can be checked by seeing that the tires rotate freely while the trailer is fixed. At the same time, it is important to keep the trailer as low to the ground as possible to enhance its stability.





3.6 Description of Trailer Lights

For trips at night or in excess of one mile, the trailer brake and turning lights should be connected to the vehicle's system. From the trailer, this is done using the fourpin connection shown in Figure 13. This is a fairly standard connection for vehicles as well, although some vehicles may need some adaptors to make the connection work.

The trailer lights – each turn signal and the brakes – should be checked before the trailer is moved.

Figure 13: Four-Pin Connection to the Trailer Lights.



4 DESCRIPTION OF CAMERA EQUIPMENT

4.1 Description of CCTV

The video surveillance trailer uses an Iteris VantageTM camera. The camera is affixed to the top of the mast by a hexagonal bolt. The camera is stored with the black powder-coat bracket and bolt.

The weatherproof housing incorporates a mounting bracket that allows proper positioning of the camera. The mounting bracket is pre-drilled to allow attachment to standard brackets for mounting on mast arms or on poles. There are separate connectors at the back of the housing for both video and power cables. The camera produces a monochrome image of the roadway scene for detection of vehicle traffic. The camera is permanently mounted tilted down 20° below horizontal to avoid direct view of sun or horizon.

The back of the camera unit contains two jacks of concern: video out, and focal length and focus adjustment connector (see Figure 14). The video out

output provides video feed output into the trailer unit, where it may be fed into the video recorder or into a video monitor. The focal length and focus adjustment connector provides an interface for control by the lens adjustment module (see section 4.2).

4.1.1 <u>Mounting and Installation</u>

Figures 15 and 16 illustrate the installation of camera on to the top piece of the mast. The





Figure 15: Top Mast Piece with a Bolt to Install the Camera.



camera is installed on the top piece of the mast through the camera bracket and a bolt (1/2-13 X 0.75"). The two bolts (3/8-16 X 0.75") that attach the bracket to the camera body can be used to adjust the head angle of the camera.

4.1.2 Connections

There are two connections at the rear of the camera housing:

- a BNC connector for video at the rear of housing, and
- a power connector for line power, DC input, neutral, and safety ground at rear of housing.

4.2 Description of Lens Adjustment Module

The Lens Adjustment Module is an easy-to-use hand held device that allows field adjustment of the camera settings. It is a small handheld unit that plugs into the switch box (see Figures 17 and 18). The purpose of the lens adjustment module is to remotely control the zoom and focus on the camera. The module does not control pan or tilt on the camera; these must be done manually when the mast is lowered. Having a fully motorized pan-tilt-zoom system was deemed to be too power-intensive for these trailers. Use of the module is self-explanatory. One note is that the module plug must be very snug for the module to work properly.

4.3 Description of Video Monitoring Equipment

A Panasonic video monitor (Model WV-BM990) was provided with each of the trailers (see Figure 19 and 20). The video monitor is AC-powered, and will therefore be plugged into the AC outlet or into a power strip. The purpose of the video monitor is primarily to assist in set-up of the camera and microwave. The monitor can be used to identify any pan or tilt adjustments that need to be made, as well as to zoom and focus the camera. The monitor can also indicate at what moment the detectors are picking up vehicles.

Figure 17: Lens Adjustment Module (Front View).



Figure 18: Lens Adjustment Module (Top View) and Its Connection to the Switch Box.





The power switch for the video monitor is on the front panel; other controls are selfexplanatory. The only jack that will be used for video surveillance will be video in, using coaxial cable feeding directly from the camera or from the video recorder.

Note that after 7 years of use, these monitors stopped operating. It is suspected that years of rugged use in sever environments (ex. sitting in trailers exposed to below zero temperatures) led to the failures. As a result, it is recommended that any monitors used in the future are not stored in the trailers when they are in field operation or storage.

4.3.1 Connections

The AC power connection of the monitor plugs into the AC inverter outlet inside the trailer body. Video in to the monitor is fed through the video out of the recording equipment or video out of the camera through the coaxial cable.

5 DESCRIPTION OF MICROWAVE EQUIPMENT

The microwave vehicle motion detector (TC26-B) is a microprocessor controlled vehicle detector, which is designed to detect the motion of a vehicle and then trigger the operation of the time-lapse video recorder. It will only respond to motion in one direction (approach-only or depart-only selectable). A microprocessor analyzes the reflected microwave energy and responds to motion in the proper direction. The TC-26B generates an extremely low power microwave beam, some of which is reflected by a moving target, such as an automobile or truck. Larger vehicles such as semi trucks, reflect more energy than automobiles and can be detected at further distances.

5.1 Direction and Range Adjustments

Before mounting the sensors, make sure that direction and range switches are adjusted according to the user requirement. These switches are located inside the sensor body, so the user needs to remove the cover for adjustments.

To take off the cover, remove the four (4) hex head machine screws holding the cover. These screws are located on the front (2) and rear (2) of the sensor (see Figure 21). After these screws have been removed, the cover can be lifted off to expose the terminal strip. (See Figure 22 and 23)





The range switch allows the detection pattern to be set in high or low position. In the high position, the unit will sense vehicles at a maximum of 200' for cars, and 350' for semi-trucks or other large vehicles. In the low position, the unit will sense vehicles at a maximum of 150' for cars, and 200' for semi-trucks or other large vehicles. The direction switch allows the sensor to detect traffic traveling either toward or away from the sensor.

5.2 Installation

The TC-26B is mounted with 2 lag bolts through 2-1/2" prepunched mounting holes. It is installed on the top piece of the mast below the camera (See Figures 24 and 25). To remove the fastening bracket from the sensor, take out the 1/4-20 bolt holding the bracket to the hinge. Using the bracket as a template for locating screw holes, fix the bracket to the mast and refasten the sensor to the bracket with the 1/4-20 bolt removed earlier.

- To adjust sensor's pointing angle in the vertical direction (head angle), loosen the ¹/₄-20 X 1.25" hinge bolt (bolt "A" as shown in Figure 25). This allows movement of the TC-26B in vertical plane.
- To adjust sensor's pointing angle in the horizontal direction (pan angle), loosen the ¼-20 X 0.5" bolt (bolt "B" as shown in Figure 25) that holds the sensor-mounting bracket to the sensor body. This allows movement of the TC-26B in horizontal plane.
- When alignment is complete make sure that all bolts and screws are tightened.

Figure 23: Range and Direction Adjustment for the Sensor.



Figure 24: Installation of Sensor Mounting Brackets onto Mast.



Figure 25: Installation of Sensor onto the Bracket.



6 DESCRIPTION OF RECORDING EQUIPMENT

The surveillance trailer uses time-lapse video recording that allows the compression of many hours of recording time. The time-lapse recorder activates video recording only when it gets indication of vehicle presence through an alarm fed through microwave sensor input. There are three types of video recorders, which are used on the trailers, two of which are VHS based video recorders (GYYR and Sanyo) while one is a digital data recorder (Iteris). These video recorders can record at variable speeds up to real time (30 frames per second).

6.1 Description of GYYR Time-Lapse

There are two (2) GYYR TLC2100-232 Time-Lapse Recorders to go with the three trailers. The front view of the recorder is shown in Figures 26 and 27 with the control compartment closed and open, respectively. The back of the recorder is shown in Figure 28.

6.1.1 Connections

Spacing is tight for the video recorder; therefore, it is important to try to make all the connections in the proper order.

- Connect the camera to the VCR's Video In connector (coaxial cable with BNC connector)
- Connect the monitor to the VCR's Video Out connector (coaxial cable with BNC connector)
- Alarm signal and Power to the GYYR is fed through a special connector (see Figures 29 and 30). One end of this connector connects to the alarm input connector that comes from inside of trailer body through inside circuitry (see Figure 31), while the other end

has a 15-pin connector bus that plugs into the 15-pin external interface at the back of the GYYR VCR. The other end of this connector has two power connections that will plug into DC power inlet of GYYR VCR.

• Connect alarm input bus of the connector to the 15-Pin external interface at the back of the VCR (See Figure 32).











- Power to GYYR Time-Lapse recorder is fed through the DC power inlet at the back of the VCR. Connect the red wire (with butt connector end) of the connector to the positive 12 Volts inlet of the VCR and the black wire of the connector to the ground connection at the back of the VCR. (See Figure 33).
- Slide recorder into slot on underside of lid.

Figure 29: GYYR Alarm and Power Input Connector.





Figure 31: Alarm Bus Connection to the Bus Coming from Inside of the Trailer Body.



Figure 32: Alarm Connection into the 15pin External Interface at the Back of GYYR.









6.1.2 <u>Programming</u>

Table 1 shows the front panel control compartment controls that are frequently used for setting up the recorder.

ress to display main menu. Iso used for various menu functions. ress to go to the next function or value. ress to go to previous function or value displayed. ress to change to a lower value or to move to the next line in a enu. ress to change to a higher value or to move to the previous line in menu.
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splay.
ess repeatedly to control the horizontal position of the Time / ate display.
ress to set the digital counter to "0000"
ress Down to change the Play or Record speed to a lower value.
ress Up to change the Play or Record speed to a higher value.
a ····

 Table 1: GYYR VMS Programming Controls.

Press PROG to display the Main Menu. Use DOWN or UP to move the cursor from one menu line to another.

<u>Main Menu</u>. Press PROG to display the Main Menu. The Main Menu appears as shown in Figure 35. The Main Menu allows access to the submenus listed above. Selected submenus are highlighted in the following sections. Full details of each submenu are provided in the recorder documentation.

<u>Time/Date Submenu</u>. When the unit is first turned on, the message "Set Clock" will be displayed flashing on the monitor screen. The clock is set in the Time/Date submenu, as shown in Figure 36.

<u>Display Options Submenu</u>. The Display Options Submenu is shown in Figure 37. Time Format lets you choose a time format of either a 12-hour clock or a 24-hour.

Date Format lets you choose date formats with a slash or a dash between the month, day and year settings as well as different combinations of date, month and year.

Time Screen lets you choose the size of Time/Date stamp: Full, Half and Off. For video surveillance applications with the trailer, this should be set at Half.

Char Color lets you choose black or white characters for the on screen Time/Date stamp. If black is selected, the characters will be displayed with a white border. If white is selected, the characters will be displayed with a black border.

System Code lets you enter up to 24 characters that will be displayed with the on-screen Time-Date stamp. This is an easy way to title tape images. You may enter the digits 0-9, upper and lower case alphabet letters, a space and a variety of punctuation and graphic characters. Note that the first "character" displayed in a character position is always a blank space; push NEXT or PREV immediately after moving to the desired character position.

The text position function is a submenu that allows you to choose the position of the Time, Date and System Code on the Main Menu.

Time/Date Exit Time: 12:00:00A Date: 1/01/96 Day: Sun

Figure 36: GYYR VHS Time/Date Submenu.

Display Time Format: Date Format: Time Screen: Char Color: System Code:	Options 12 Hour mm/dd/yy Half White
Text Position	>
Figure 37: GY Display Option Submenu.	YR VHS

monitor. You may place them in any order on lines 1 through 12. Please note that the Time, Date and System Code must be positioned on different lines. These will be recorded directly onto the tape; therefore, make sure that they do not obstruct the surveillance images in which you are interested.

Main Menu Exit > Time/Date > Display Options > System Options > Timer Program > Alarms > Camera Switcher Pulse > STD/Remote Port > System Data > Figure 35: GYYR VHS

<u>Alarms Submenu</u>. The Alarms Submenu, shown in Figure 38, gives you access to two alarm submenus. Only the Alarm Record Options submenu will typically be relevant for surveillance applications using the trailers.

The alarm record options submenu is shown in Figure 39. Duration sets the length of the alarm recording. Various durations are selectable: 15 seconds, 30 seconds, 1 minute, 3 minutes, 5 minutes, and manual. The manual setting causes the alarm recording to take place as long as the alarm input is active, which will likely be too short for most data collection purposes.

Speed sets the recording speed during an alarm. All recording speeds are available except 00. Table 2 shows the relationship between Record/Playback speeds and tape rate (fields/second) for applications where the record rate is required. (Note: Two fields are equivalent to one frame).

Recycle Options sets what the recorder will do when the end of tape has been reached. The normal mode used for longterm remote data collection activities is Rewind, Stop. This option rewinds the tape and then enters STOP mode. Other

options include Re-Rec Even if Alarm, which rewinds the tape and enters RECORD mode at the beginning of tape even if there has been an alarm; and Recycle, Stop If Alarm which rewinds the tape and enters STOP mode if there is an alarm; otherwise it enters RECORD mode at the beginning of the tape.

REC Time (Hours)	2	18	24	48	72	120	180	240	360	480	600	720	960
Fields/Sec	60	6.66	5	2.5	1.66	1	0.667	0.5	0.33	0.25	0.2	0.166	0.125
Sec/Fields	0.016	0.15	0.2	0.4	0.6	1	1.5	2	3	4	5	6	8

Table 2: Relationship Between Record/Playback Speeds and Time-Base Rate (fields per second).

Exit Alarm Memory > Alarm Record Options >

Figure 38: GYYR VHS Alarms Submenu.

Alarm Record	Options			
Duration:	Manual			
Speed:	02			
Alarm Ready:	Yes			
Alarm Out:	Duration			
Recycle Options	:			
Rewind, Stop				

Figure 39: GYYR VHS Alarm Record Options Submenu.

6.2 Description of Sanyo Time-Lapse

There is one (1) Sanyo SRT-7072 Time-Lapse Recorders to go with the three trailers. The front and back views of the recorder are shown in Figures 40 and 41, respectively.

6.2.1 Connections

Spacing is tight for the video recorder; therefore, it is important to try to make all the connections in the proper order.

- Connect the camera to the VCR's Video In connector (coaxial cable with BNC connector).
- Connect the monitor to the VCR's Video Out connector (coaxial cable with BNC connector).



- Insert the power cord into the AC power input at the back of the Sanyo recorder and then insert the plug of this power cord into the AC inverter outlet.
- Alarm signal and common (ground) to the Sanyo are fed through a special connector. One end of this connector connects to alarm input connector that comes from inside of trailer body through inside circuitry (see Figure 31), while the other end has two connections - alarm in and common - that will plug into the alarm in and the common connection at the back of the recorder respectively (see Figure 41).
- Slide recorder into slot on underside of lid.



6.2.2 Programming

Before setting up the Sanyo VCR, the "ON SCREEN" switch must be in the "ON" position. Press the MENU button to proceed with setting up the VCR. This will display the SET UP 1 menu. Pressing the MENU button consecutively will display SET UP 2 menu, SET UP 3 menu, SET UP 4 menu and so on successively. The following features from the different SET UP menus are frequently used while setting up the trailers:

- SET UP 1 menu: Clock setting.
- SET UP 2 menu: Selecting the On-Screen Display (Date/Time Display Position).
- SET UP 3 menu: Alarm Recording Setting, and Setting the Action to Take When a Cassette is Loaded.
- SET UP 4 menu: Correct tape thread check function.

<u>SET UP 1 Menu</u>. This menu is shown in Figure 43. To set the clock, press MENU button to display the (SET UP 1) menu. Turn the SHUTTLE ring to set the auto daylight saving time/standard time adjustment. NO USE means that no daylight saving time/standard adjustment is made, while USE means that the auto daylight saving time/standard adjustment is made. Since most of the trailer applications will not take place over a daylight saving time transition, this should read "NO USE".

Turn the JOG dial clockwise, until the "CLOCK SET" setting is flashing. Turn the SHUTTLE ring to set the month, then turn the JOG dial clockwise. Note that the day of the week is set automatically. Turn the SHUTTLE ring to set the day, then turn the JOG dial clockwise. Turn the SHUTTLE ring to set the year, then turn the JOG dial clockwise. Note that only the last

<set 1="" up=""></set>								
*DAYLIGHT SET NO USE								
	WEEK MONTH TIME							
ON	1ST-SUN	04 02:00						
OFF	LST-SUN	10 02:00						
*OUTP	UT	SERIES						
*CLOC	K SET							
01-0	1-00 SAT	00:00:00						
*REMO	TE	EJECT						
*LANGUAGE-LANGUE-IDIOMA								
ENGLISH								
Figure 43: Sanyo VCR								
Set-up Menu 1.								

two digits of the year are displayed. Turn the SHUTTLE ring to set the hours, then turn the JOG dial clockwise. Note that the clock display is only 24 hours (e.g. there is no AM or PM indication). Turn the SHUTTLE ring to set the minutes, then turn the JOG dial clockwise. For accurate clock setting, turn the SHUTTLE ring counterclockwise timed with a time broadcast, or other accurate time signal. This will start the seconds counting from 00.

Press SEARCH button. The setting procedure is now complete.

SET UP 2 Menu. The SET UP 2 menu is shown in Figure 44. Through this menu, you can select whether or not to display the date, time, the number of alarm recordings and recording/playback tape speed. Turn the power on to all devices being used. From the SET UP 2 menu, turn the JOG dial clockwise, until the desired item for which the display function will be set is flashing. Turn the SHUTTLE ring to set "Y" for the appropriate function(s). Press the SEARCH button to save the settings. The setting procedure is now complete.

Note: If the ON SCREEN switch is set to the "ON" position, the items for which "Y" is set are recorded. The items for which "N" was set above are not recorded.

To change the Date/Time Display Position, make sure that

the power is on to all input devices to the VCR. Set the ON SCREEN switch to the "ON" position, which will display the date and time. Press the SHIFT \rightarrow or SHIFT \downarrow button to move the display toward the right or the bottom, respectively. If the SHIFT \rightarrow or SHIFT \downarrow button is

<set 2="" up=""></set>						
*DISPLAY						
DATE	Y					
TIME Y						
ALARM COUNT Y						
SPEED Y						
*BUZZER						
ALARM IN Y						
TAPE END Y						
KEY IN	N					
WARNING	Y					
Figure 44: Sanyo VCR Set-up Menu 2.						

kept pressed for one second or more the display will move at a faster speed. Note: The display position cannot be changed while recording.

<u>SET UP 3 Menu</u>. Figure 45 shows the SET UP 3 menu for the Sanyo VCR. From this menu, you can set the mode the VCR will go into when a cassette is loaded. Turn the JOG dial, until the "TAPE IN MODE" setting is flashing. Turn the SHUTTLE ring, to set the desired mode:

- STOP Stays in stop mode
- REC Goes into recording mode.

Note: The "STOP" mode is normally used on the trailer to help the user start recording at his convenience.

Press the SEARCH button to save the setting.

In order to record events when the sensor detects a vehicle,

alarm recording must be used. Alarm recording is performed when there is an input trigger at the ALARM IN terminal. When this occurs, "AL" is displayed on the digital display. The alarm recording settings are completed as follows.

- Make all necessary connections.
- Load a cassette tape. (Note: If TAPE IN MODE is set to REC, recording will start after the tape thread has been checked.)
- Set the "ON SCREEN" switch to the "ON" position.
- Set the TAPE SELECT switch to the "T-120" or "T-160" position (according to the duration of the tape used).
- Set the ALARM SPEED switch to the desired recording speed. 8H provides 8-hour mode recording and 24H provides 24-hour mode recording. NC leaves the recording speed at the speed already set. Table 3 shows the relationship between various recording speeds and the number of recorded fields per second.
- Set ALARM DURATION switch to the desired recording duration. Options include 20S for a 20-second recording, PROG to record at the setting specified in Set-up

fable 3: Relationship Between	Record/Playback Speeds and	Tape Rate (Fields/Second).
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				_	
When	TAPE	SELECT	switch	is set to	T-160:

ALARM SPEED (Hours)	8	24	40	64	96
Fields/Sec	60	20	12	7.5	5
Seconds/Field	0.017	0.050	0.083	0.133	0.200

When TAPE SELECT switch is set to T-120:

ALARM SPEED (Hours)	6	18	30	48	72
Fields/Sec	60	20	12	7.5	5
Seconds/Field	0.017	0.050	0.083	0.133	0.200

*ALARM MODE	Yl			
*ALARM DURATION	20S			
*VERTICAL SYNC	Y			
*EXT TIME ADJ.	01:00			
*TAPE IN MODE	STOP			
*TAPE END MODE	REW			
*TAPE END OUT	-3M			
*CLOG DETECT.	Y			
*SERIES REC IN	Ν			
*RS-232C	19200			
Figure 45: Sanyo VCR				
Set-up Menu 3.				

<SET UP 3>

Menu 3, and CC to record as long as an alarm signal is being received. PROG provides maximum flexibility, although 20S would be adequate for most surveillance applications.

- Available settings include 20S, 40S, 1M, 2M, 3M, 4M, 5M or CC. For most vehicle surveillance applications, 20S (20 seconds) is adequate. CC maybe used to record only as long as the alarm signal is active (for a minimum of five seconds).
- Press MENU button until the (SET UP 3) menu is displayed.
- Turn the SHUTTLE ring to set the desired alarm mode: Y1, where alarm recording is done when there is an alarm trigger; Y2, where alarm recording is done only when there is an alarm trigger during programmed timer recording; Y3, where alarm recording is done only if there is an alarm trigger and the VCR is not in programmed timer mode; Y4, where alarm recording is done only when there is an alarm trigger during programmed timer necessary is a alarm trigger during programmed timer mode; Y4, where alarm recording is done only when there is an alarm trigger during programmed timer recording duration; and N, where alarm recording is not performed even if there is an alarm trigger. The normal mode for using the trailers is Y1.

If the ALARM DURATION switch is set to the "PROG" position, turn the JOG dial, until the "ALARM DURATION" setting is flashing. Turn the SHUTTLE ring, to select the desired alarm recording duration (20S, 40S, 1M, 2M, 3M, 4M, 5M, or CC). Settings between 20S and 5M will record only for the displayed duration (where S = seconds and M = minutes). CC will record as long as alarm signal is being input (minimum 5 seconds).

Press the SEARCH button to save the settings. The setting procedure is now complete. A few comments:

- During alarm recording all buttons are disabled. If "OFF" is displayed on the digital display, alarm recording is not possible in order to protect the recorded tape from being recorded over.
- To cancel the "OFF" display, press the STOP, EJECT or PLAY button or turn the SHUTTLE ring. (Note: "OFF" will be displayed on the digital display if a pre-recorded tape is inserted into the recorder for alarm recording).
- If an alarm trigger is received while alarm recording is in progress, recording duration for the second alarm will be calculated from that point. The alarm counter will register the alarm, but it will not be found during an alarm scan and alarm search.
- If there is a power failure during alarm recording, and power is restored within the recording set duration, alarm recording will continue.

<u>SET UP 4 Menu</u>. The SET UP 4 menu is shown in Figure 46. The Thread Check function checks to make sure that the cassette has been correctly loaded. It is recommended to use this function to make sure the recordings are conducted reliably. If this function is on, after the cassette tape is loaded, a mechanism will operate for about 5 seconds to check that the tape has been threaded (loaded) correctly. If the cassette is not loaded properly, the cassette will be ejected. If during the tape thread check operation, the REC, PLAY or STOP button is pressed or if the SHUTTLE ring is turned, the command will only be executed after the tape thread has been checked. Only the EJECT button will operate while tape thread is being checked. If in the TAPE IN MODE (see SET-UP 3 Menu) is set to "REC", the recording indicator "o" will light while the tape thread is checked.

<set 4="" up=""></set>					
*SW OUT					
FIELD	01				
TIMING	FIELD				
8H	Y				
*THREAD CHECK	Y				
*VIDEO LOSS	N				
*REC SPEED	N				
*EJECT SET					
EJECT MODE	EJECT1				
OPERATION	SLAVE				
Figure 46: Sanyo VCR					
Set-up Menu 4.					

However, recording will only start after the tape thread check is completed. To cancel recording, press the STOP button.

To activate the thread check function, press the MENU button until the (SET UP 4) menu is displayed. Turn the JOG dial, until the "THREAD CHECK" setting is flashing. Turn the SHUTTLE ring, to set desired mode ("Y" to activate the correct tape thread check function; "N" to turn this function off.) Press the SEARCH button to save the setting.

Other functions. There are numerous other set-up features not described in this manual. The reader is encouraged to review the product documentation for information about other features.

6.3 Description of GYYR Digital Recorder

There is one GYYR Digital Video Monitoring System (DVMS) to go with the three trailers. The digital recorder differs from the time-lapse recorders in that it utilizes an internal hard drive to store video images, as opposed to VHS tapes. This is advantageous in certain situations where the surveillance location makes it difficult to exchange tapes.

The front and back of the DVMS are shown in Figures 47 and 48.

6.3.1 Connections

Spacing is tight for the video recorder; therefore, it is important to try to make all the connections in the proper order.





- Connect the camera to the DVMS's Video In connector (coaxial cable with BNC connector)
- Connect the monitor to the DVMS's Video Out connector (coaxial cable with BNC connector)
- Insert the power cord into the AC power input at the back of the GYYR DVMS recorder and then insert the plug of this power cord into the AC inverter outlet.
- Alarm signal and common to the GYYR DVMS are fed through a special connector. One end of this connector connects to alarm input connector that comes from inside of trailer body through inside circuitry (see Figure 31), while the other end has two connections - alarm in and common - that will plug into the alarm in and the common connection at the back of the recorder respectively (see Figure 48).
- Slide recorder into slot on underside of lid.

6.3.2 **Operational Controls**

Access to DVMS 100 Graphical User Interface (GUI) and controls is password-protected. A user number and password must be set to control access to the setup and operation of a DVMS 100 system. The default password that DVMS 100 is shipped with is 1234. User numbers and passwords are set with the cursor control and the buttons on the front of the DVMS 100 unit. Because the unit is kept in a locked trailer box, users should not need to alter passwords.

The cursor control buttons (see Figure 47) are the main controls that select, retrieve and enter information in the DVMS 100 operating system. Cursor controls are used to perform most operating and setup actions. The outer four buttons are used to move the cursor right, left, up and down while the middle cursor button is used as "Enter" key or to return to previous menu.

The text entry keypad is used to insert text into a text screen item. To access the text entry keypad highlight the screen text item and press enter; this will activate the text item. Press the 3 button on the front of the DVMS 100 unit. The text entry keypad appears on the screen in front of the active screen. Use the cursor controls to move around the keypad. When desired character is selected press the enter button. The selected character appears in the text window at the top of the Text Entry screen. When the appropriate name is displayed in the text window at the top of the text window select the Accept button on the text entry keypad and press Enter. The keypad disappears and the appropriate text appears in the text screen item.

6.3.3 <u>Programming</u>

The DVMS 100 system offers two setup methods, quick and normal. The Normal Setup method is used for the trailer application. To access the Normal Setup screens, the Quick Setup screen must be disabled. The main setup screen allows access to all of the Normal settings and features in the DVMS 100 system. Each screen item provides access to additional screens and settings for a particular setup function.

The main set-up screen, using the normal setup method, is depicted in Figure 49. (Note that for most of the trailer applications, only the following submenus will be used: Clock Set, Disk, and Install).



The main set-up menu is accessed by pressing the setup button, selecting a user name and keying in the password.

<u>User Access Control</u>. To change user names and passwords, use the cursor controls to select the Change Password function and press enter. A user name selection box appears. To select a user name, press one of the numbered buttons on the front of the DVMS 100 unit. The user name associated with the button appears in the text space on the screen and the password text item is activated. Create a password up to 10 digits long using the numbered buttons 1 to 4 on the front of the DVMS 100 unit and press enter. A screen prompt appears to confirm the password. Enter the same password exactly as before and press enter. The User Permissions screen appears.

To create a user name, select the user name text item with the cursor control buttons and press enter. The first character space in the user name text item is activated. Select the desired characters with either the cursor control buttons or the jog shuttle knob. When the desired character appears, advance to the next character with the right or left cursor buttons. When the new user name is complete press enter. The text item is no longer activated.

The DVMS allows up to four users to be identified in the user permissions setup. When a user name has been set, access to the DVMS 100 system is controlled by enabling or disabling permissions on the User Permissions screen. There are three levels of permissions:

- Enable User ID Allows the user to have access to the DVMS 100 system controls.
- Administrative Access Gives the user full access to the setup functions of the DVMS 100 system through the Setup button on the front of the unit.
- Allow Remote Access Gives the user full access to the DVMS 100 unit through the Remote Access Software.

<u>Clock Set</u>. From the main menu, select the Clock Set screen item and press enter. There are several preference settings in addition to the time and date settings available in this screen. To choose a format for the DVMS 100 clock, select the Clock Format item using the cursor controls and press enter. Scroll through the clock formats using either the cursor controls or the jog shuttle knob and press enter. After the clock format has been set, the date and time can be entered in the date and time text item.

The Daylight Savings Time setting enables DVMS 100 to change dates for daylight savings time automatically. This typically will not be necessary unless the surveillance period spans the time when the transition is made between standard time and daylight savings time.

Text Insertion Synchronization enables DVMS 100 to synchronize time and date formats with a device connected to the text insertion port on the rear panel of the DVMS 100 system. For the trailer application, this will typically be disabled.

<u>Disk</u>. The DVMS may be set up to utilize external hard drives to extend the recording time of the unit, and to provide automatic back-up capabilities. The Disk option from the main set-up menu assists in managing disk drives. For disk drive settings, select the Disk submenu from the main menu and press enter. The Disk submenu, shown in Figure 50, allows access to the following submenus: Disk Setup, and Disks 0-6. Disk 0 (WDC WD40) is the default disk drive of the DVMS 100, with a capacity of 40 GB. If no external disk is connected to the DVMS 100, the Disk 1 to Disk 6 submenus will be disabled.





To set the disk drive settings, select Disk Setup submenu from the Disk Screen and press enter. When one or more external drives are connected to the DVMS 100, the user may specify which drive is to be used as an archive drive through the Select Archive Drive setting. When no drive is selected, all the drives will be used to record event video clips. When no external drive is connected to the DVMS 100, specify None in this setting. This will use the entire Disk 0 (DVMS 100 Hard Disk) to record event video clips.

To allow easy archiving of large amounts of data a drive can be specified as a hot-swap drive; this can be done using the Select Hot-Swap Drive setting. The hot-swap drive can be replaced while the unit is powered on. When no external drive is connected to the DVMS 100, specify None in the Select Hot-Swap Drive setting.

The drive space usage section of the Disk Setup screen allows the user to set the percentage of disk drive space to be allocated for Event mode recording (video recording triggered by events). The remaining space will be automatically used for time lapse recording. For most of the trailer applications the video clips will be recorded by Event mode recording –

i.e. video recording triggered by events. Therefore all the DVMS 100 disk drive (100 percent) can be allocated to record data by event mode recording.

The Disk Setup screen also allows to clear all video clips using the Format All button without affecting any of the settings. The Clear Events button clears only event video clips. The Clear Lapse button clears only time-lapse video clips.

<u>Install</u>. The Install Screens are used to set up and configure the core monitoring features of the DVMS 100 unit. The Install submenu from the Main menu allows access to the following submenus: Service, Text In, Alarm Inputs, MUX Setup, Event Recording, Video In, Time-Lapse Recording, and Pre-Event Recording. For surveillance applications with the trailer, the following submenus need to be set before the trailer usage: Alarm Inputs, Event Recording, Video In, and Time-Lapse Recording.

Video In. From the Install menu select the Video In button and press enter. The





monitor changes to Camera 1 screen. Use the Camera 1 screen to enable a camera on the DVMS 100 system. To enable the camera, select the check box beside the Camera Present item at the top of the Camera 1 screen and press enter. All of the Camera 1 screen items become available. Date Enable allows the DVMS 100 to show the date on-screen during video monitoring and recording. Title Enable allows the DVMS 100 to display a customized title for the video from the DVMS 100 camera. This title can be entered using the Title Text option. Position Setting provides four screen positions for displaying the on-screen title and date.

Event Recording. The Event Recording screen contains settings and preferences that control the way DVMS 100 records event video. The combination of settings entered at this screen determine the quality and amount of data DVMS 100 can save to the disk drive. DVMS 100 is capable of recording in two video modes: field and frame. There are two fields per frame. Time-lapse recording capacity and video quality is affected by the video recording mode, the number of frames or fields recorded per second, and the compression.

The DVMS 100 system records three kinds of events: Transaction Text, Alarm and Motion. For most of the trailer applications, Alarm events will be used. To set up event recording, select the Event Recording function from the install screen and press enter. The monitor shows the Event Recording functions menu. For most of the trailer applications, only the General Setup and Alarm Events submenus need to be set before trailer usage.

The General Setup function sets up the common conditions for all three types of event recording. The following options may be entered from this submenu.

- Compression Ratio sets the recording compression for all three event recording types. (See explanation about compression ratio at the end of this chapter.) To set the compression ratio, select the compression ratio screen item and press enter. Use cursor controls or the jog shuttle knob to scroll through the list of compression ratio numbers. The status box will adjust to show the maximum possible recording time for the hard drive for each compression ratio number in the list. When the desired frames or fields per second (fps) number is shown, press enter. The selected number is saved.
- Event Recording allows selection of field or frame mode for all event recording. There are two fields per frame.
- The End of Disk option specifies what the DVMS 100 should do once disk capacity is exhausted. This item has two options: Recycle and Stop. The Recycle selection has the DVMS 100 cycle continuously through the disk drive after it is filled with video information, overwriting existing clips. The stop selection will have the DVMS 100 stop recording when the disk is full. Stop mode will typically be used for trailer surveillance applications.
- The Disk Full option tells DVMS 100 to beep or to send a signal to the alarm output to activate an external alarm device (such as a light) when the disk drive is full. Since staff are typically remotely located from this equipment, this option will typically not be used for trailer surveillance applications.
- The System Error option tells DVMS 100 to beep or to send a signal to the alarm output to activate an external alarm device when a system error occurs. This option is typically not used for trailer surveillance applications.
- The Video Loss option tells DVMS 100 to beep or to send a signal to the alarm output to activate an external alarm device or to send a text message to the monitor when video signal is interrupted or lost. This option is typically not used for trailer surveillance applications.

To record a hardwired alarm event, settings must be made in two different screens. Event name, reset type and fps rate are assigned to an alarm event in the Alarm Event 1 screen. Settings for the Alarm inputs are made in the Alarm Inputs screen accessed from the Install functions menu (described earlier). Settings made here indicate to the DVMS 100 unit if alarm contacts are normally open or normally closed. For the trailer, the alarm input status is normally open (NO).

In the Events setup screen select the Alarm Events screen item and press enter. The monitor shows the Alarm Event 1 setup screen. Highlight the Enable button at the top of the Alarm Event 1 setup screen. The Alarm Event controls become available. The following are the different options for the Alarm Event 1 setup screen.

• Camera Rate specifies the number of frames, or fields, per second to be recorded by the camera when an alarm event is triggered. The Camera Rate item must contain an fps number to allow alarm event recording; a rate of 0 fps will not record an event.

- Event Text is used to create a title for reviewing events and creating reports.
- Reset Type provides three choices for resetting the event recording: manual, which resets event recording through a manually operated external switch connected to the Reset Alarm input; timed, which resets after the time specified in the Reset Time boxes (a time interval from 1 second to 9 minutes and 59 seconds may be specified with the Reset Time item located below Reset Type); and auto, which resets event recording automatically after an event is triggered, which means recording will be done as long as alarm signal is being input. For most of the trailer surveillance applications timed or auto setting will be used.
- Audio allows the user to select or deselect for audio recording with alarm event recording. This will be deselect for most of the trailer applications.
- Beep is selected to have DVMS 100 beep when an alarm event occurs; this is normally deselected.
- Alarm is selected to have DVMS 100 activate an external alarm such as light or bell when an alarm event occurs; this is normally deselected.

Alarm Inputs. To set the status of the hardwired alarm input, select the exit button in the Alarm Event setup screen and press enter. The monitor shows the Install functions screen. Select the Alarm Inputs screen. Settings made here tell the DVMS 100 if the alarm contacts are normally open or normally closed. Alarm Inputs screen allows access to following settings: Input State, Reset Enable/Disable, and Arm Enable/Disable. For most of the trailer applications these settings will be set with the input state as Normally Open (NO), and both Reset and Arm as Disable.

Time-Lapse Recording. Note that for most of the trailer applications data will be recorded in Event Recording mode rather than Time-Lapse recording mode. Therefore, the recording rate in this setup needs to set to zero fps before using the DVMS for event recording.

The Time-Lapse Recording screen allows access to several options. Recording allows selection of frame or field mode. Audio Recording allows enabling or disabling audio recording. This is disabled for trailer surveillance applications. End of Disk tells the DVMS 100 to stop or recycle Time-Lapse recording when disk is full. Record Rate sets the video record rate in frames or fields per second (fps); select the Record Rate screen item and press enter. Note that since Event Recording data is used for most of the trailer applications rather than Time-Lapse recording, Record Rate for the Time-Lapse recording should be set to zero fps. Compression Ratio sets the recording compression. Disk Full tells the DVMS 100 to beep or to send a signal to the alarm output when disk is full.

6.3.4 Recording Video

When you press Rec button on the front panel the DVMS 100 will prompt you to enter your user name and password. Once you have entered a valid user name and password it will start recording according to the values entered in the setup program, and the green light beside the Rec button will be lit. During the time-lapse recording, the green light will remain on.

When an event is triggered the event recording or event action specified in the setup program will be started. There are three event-reset types which determine how events are cleared. In manual mode, the event is active until the external Alarm Reset contact is activated. In automatic mode the event is reset as soon as the input signal returns to inactive. In timed mode, the alarm is active for the interval set in the setup program. After the event timer expires the event will be considered reset. The triggering signal must be deactivated before another timed mode alarm event can be recognized.

Alarm event will cause an event video clip to be recorded. An event video clip records the starting time and date of the event, the type of the event, and the video images that were recorded during the event.

6.3.5 Compression Ratio

Compression is a mathematical process that reduces the amount of data in a given file. There are many different types of compression processes or algorithms tailored for the type of data they are designed to compress.

Compression algorithms can be divided into reversible and non-reversible algorithms. When data is compressed and then de-compressed using a reversible algorithm the result is exactly same as the original data. This type of compression is effective for data with a lot of redundancy, such as text, but it provides very little reduction in data size for non-redundant data such as digital video data.

To reduce the data size of video images, non-reversible algorithms have been developed which provide higher compression ratios than reversible algorithms. Non-reversible algorithms don't give you back exactly the same data when they are de-compressed. Non-reversible algorithms specially designed for video images create very small changes in the image that do not significantly alter the overall look of the picture.

The DVMS 100 uses compression rates that vary from 10:1 to 35:1 in increments of 5. A balance between the picture quality desired against the hard drive storage space available must be maintained when selecting a compression ratio. Table 4 shows the relationship between compression ratio, fps, and hard drive capacity, based on the 40 GB hard drive resident in the DVMS. Additional hard drives could increase this capacity.

Compression	Data Capture Rate	Approx. time that could be captured on a 40 GB drive			
Ratio	(MB/s)	60 fields/sec	10 fields/sec	1 field/sec	
10:1	2.0	5.7	34.1	340.9	
20:1	1.0	11.4	68.2	681.8	
30:1	0.67	17.0	102.3	1,022.7	

Table 4: Relationship Between Compression Radio and Recording Rate for NTSC.

6.4 Description of Hunt Digital Video Recorder (DVR)

There are three Hunt Electronics Digital Video Recorders (DVR) to go with the three trailers. These have now replaced the original VCR and DVMS equipment. The DVR differs from the time-lapse recorders in that it utilizes an internal hard drive to store video images, as opposed to VHS tapes. It also



differs from the DVMS unit in that it has a far larger hard drive – approximately 250 gb – which enables the units to collect over three weeks of continuous video. This is advantageous in certain situations where the surveillance location makes it difficult to exchange tapes, or where round-the-clock data collection is desired.

The front and back of the DVR are shown in Figure 52 and Figure 53.

6.4.1 <u>Connections</u>

The DVR is compact; as a result, there is some flexibility in making the wiring



connections on the back of the unit while it is sitting in the recorder compartment. The recommended order of connections is as follows:

- Connect the camera to one of the DVR's Video Input connections (coaxial cable with BNC connector). The connection can be made to any of the available channels (1-4).
- Connect the monitor to the DVR's Video Output Monitor connection (coaxial cable with BNC connector).
- Insert the power cord into the DC power input on the back of the DVR (below the power switch) and then insert the plug of this power cord into the AC inverter outlet or power strip.
- While the DVR's are equipped with alarm signal capabilities, these have not been utilized to date. Given the storage capacity of the units, the use of the microwave alarm system has diminished.
- Once connections are completed, slide the recorder back into slot on underside of lid.

6.4.2 **Operational Controls**

Access to DVR Graphical User Interface (GUI) and controls is straightforward. Switch the DVR power on by flipping the power switch on the back of the unit. Following this, if the user is looking at a monitor, they will see a set of numbers representing each channel (1-4) and the date and time on the screen. To reach the setup menus, press the Menu button on the front of the DVR.

The circular array of buttons on the right side of the unit (see Figure 52) are the main controls that select, retrieve and enter information in the DVR menu system. Cursor controls are used to perform most operating and setup actions. The outer four buttons are used to move the

cursor right, left, up and down. The Enter key is used to select a specific sub-menu. To exit a menu selection, press the Exit/Lock button.

Based on previous set up of the DVRs for field collection, the majority of menu settings have already been made. In this respect, the DVR is basically "plug and play" in terms of its setup. The user would make the appropriate wiring connections, turn the DVR on, verify that it is recording (by reviewing footage recorded shortly after the unit was turned on), and close up the trailer. However, there may be a need on the part of the user to change one or more menu settings. The following text describes the process for making such changes. For more detailed instructions, consult the Hunt Electronics DVR-04 User's Manual.

6.4.3 <u>Menu Options</u>

When examining the menu options of the DVR, the user is presented with eight options. These include Quick Setup, Camera, Normal Rec., Alarm Rec., Relay, Monitor, System, and Utility.

<u>Quick Setup</u> This menu option is used to set the date and time of the DVR, as well as configuring the recording quality. Date and Time settings should be correct, although some changes might be required with respect to time zone. The Recording sub-menu allows the user to specify the number of images being recorded per second (anywhere from 15 to 30 - the maximum – is recommended) and the quality of the video footage (Q5 – highest- is recommended). As with all menus, the circular array of keys is used to navigate through options, with the Enter and Exit/Lock buttons used to select and leave menus/choices.

<u>Camera</u> The Camera menu allows the user to adjust elements of the video being input to the DVR (brightness, contrast, etc.). The default settings for these items are optimized, so it is recommended that they are not changed by the user.

<u>Normal Rec.</u> Normal Recording is the menu where recording speed, image quality and other elements can be changed to match a recording schedule. The default settings for these items are optimized, so it is recommended that they are not changed by the user.

<u>Alarm Rec.</u> This menu option allows the user to change items such as recording speed and image quality, among other elements, when an alarm recording setup (microwave sensor) is employed. Since alarm recording is no longer utilized, the user should not change anything in this menu.

<u>Relay</u> This menu option relates to the motion sensor related to alarm recording. Since alarm recording is no longer utilized, the user should not change anything in this menu.

<u>Monitor</u> This menu option relates to the motion sensor related to alarm recording. Since alarm recording is no longer utilized, the user should not change anything in this menu.

<u>System</u> The default settings in this menu should not be changed by the user except for those related to Audio (record sound or not) and Network. Network allows for the DVR to be set up to download data via an eathernet connection. These changes and the download process will subsequently be discussed in later sections of this chapter.

<u>Utility</u> This menu mainly provides information on the internal hard drive which data are recorded on, as well as allows for the downloading of a limited amount of data (seconds) via a USB flash drive. For more detailed instructions on this method of download, consult the Hunt Electronics DVR-04 User's Manual.

6.4.4 <u>Recording Video</u>

The recording of video is straightforward. Once the user turns the power on to the DVR, the unit begins recording. If no video input is being sent to the DVR, it will simply record a blank screen. If video is being received, then this is recorded as soon as the unit is turned on.

6.4.5 <u>Viewing Video</u>

Once the DVR has been turned on, the user should see the video footage being recorded via a monitor. This will appear as one of four screens in a quadrant (depending on which video Input receptacle the user plugged the bnc cable into, the image may appear in one of the four quadrants). To view the channel which video is playing on as a full screen, press the corresponding numbered button on the bottom of the DVR.

To view past video, the user can either select the play button (the center button in the circular array of buttons) and then select the rewind button (to the right of the play button). Rewind speeds range from 2x to 16x. However, unless a the footage the user wishes to view has been recorded recently (e.g. in the last few hours) the alternative strategy of scrolling is recommended.

To scroll through video, have the specific channel which the video was recorded to selected and press play. Next, select the Relay/Search button. This will bring up a menu of dates, listing the earliest date for which video has been recorded, as well as the latest. Use the up, down, left and right buttons to scroll to the date or time selection. Once the user has reached the date or time, hit the Enter button. The user should now be able to change the date or time by using the array of arrows. the date or time desired has bee set, hit Enter. This will begin playing the video pertaining to that date or time. To exit, press the Exit/Lock button twice.

6.4.6 <u>Downloading Video</u>

Before the user attempts to download the data from the DVR, they must install Hunt's DVR Manager software on the machine which the data will be sent to. Once the software is present, plug an Ethernet cable (Cat 6 type) into both the DVR and the computer the data will be downloaded to/through. Next, turn the DVR on and, on the DVR select the Menu button and scroll to > System (Enter) > Network (enter) > DHCP ON.

On the computer which data is to be downloaded to/through, go to the Start menu and select Start > Run > cmd (type this into the Run box). From the command line, type "ipconfig/all" to find IP address. Next, on the DVR, scroll to System > Network > IP. This will allow the user to change the IP address to a network address with similar numbers as host computer and match the Subnet Masks. Note that the IP address of the DVR needs to be slightly changed so that the computer and DVR are not trying to claim to be the same device. For example, if the computer has an IP address of 169.254.65.116, the DVR address should be

entered as 169.254.65.117. Notice that the last number has been changed so that a slightly different IP address results.

To change the IP and Subnet Mask on the DVR, select System -> Network (hit the enter button) -> IP Address (hit the enter button). This will open an array of numbers and symbols in a quasi-menu format. To enter the IP address, using the example above, the user would enter the number 1 by pressing the 1 button on the DVR twice. To enter the next number, 6, press 6 and then 1. To enter 9, press 9 and then 1. To enter the period, press 1, and then 2. The basic premise is that the user first selects a column, and then the row corresponding to what number or element is to be selected. Once the IP or Subnet address has been changed, select enter. When all addresses have been changed, exit the menu entirely.

Next, open the DVR Manager Monitor from the desktop. The user will find the DVR in Local Area DVR side menu area. Drag the DVR to My DVR and name it. The user/pass default is admin/admin. Once this has been completed, open the DVR Manager Playback software and press the disk icon. This will begin the download process. Follow prompts to backup files. Note that it will be helpful to know the approximate dates and times data collection began and ended in order to minimize download times and file size. While downloading, the video footage from the DVR may or not play. The cause of this is unknown, but repeated video downloads have confirmed that the procedure discussed above allows DVR footage to be saved on a hard drive despite not appearing on the monitor. Once these have been saved, there has been no problem selecting playing them in the DVR Playback Manager program.

At this point, all steps have been completed. If the connection still fails, restart computer and turn off/on DVR, with Ethernet cable still connected.

6.4.7 <u>Miscellaneous Notes</u>

The process which the DVR uses to record video is first-in, first-out (FIFO). In other words, the first video recorded to the hard drive of the DVR will be the first footage overwritten when the drive becomes full. However, for most projects, this will not be of concern, as the capability of the DVR to record multiple weeks of data between downloads reduces the possibility of such an overwrite occurring. Still, the user should be aware of this and, on longer term monitoring projects, plan intermittent downloads to prevent any overwrites from occurring.

The video download can be made to either the hard drive of the machine the DVR software is installed on or to an external hard drive. Given the amount of video footage which may be recorded during data collection efforts, it is advisable that a user acquire an external hard drive of 500 gb or greater. The proprietary format of Hunt DVR video files is compressed, so it will not utilize the available space on an entire external hard drive. For example, roughly 40 days worth of data collected continuously between three DVRs (13.3 days each) used only 75 gb of available hard drive space.

Note that the file type of the video files from the DVRs is .re3. This format is not compatible with common video players, such as Windows MediaPlayer or Real Player. DVR files will only play in the DVR Manager Playback program. However, it is possible to convert

.re3 files via specialized software packages. These can be identified and obtained via an internet search.

7 DESCRIPTION OF POWER EQUIPMENT

The video surveillance trailers are autonomously powered, to enhance their versatility. This section describes the trailers' power system.

7.1 SunWize Power Ready (PR) System

This is a fully integrated system that provides a stand-alone electric power source for the trailer. It is a self-contained power supply that uses sunlight to generate electricity at 12 volts DC 75 Watts. The PR system consists of two major assemblies: a roof mounted photovoltaic (PV) module array (e.g. solar panel), and a battery enclosure.

The PR system includes the following different elements:

- The PV array (Model SP-75), consisting of PV modules and associated wiring, converts sunlight into electricity that charges sealed batteries mounted in the enclosure.
- Sunwize/Steca charge controller, which regulates battery charging and protects the system from high/low voltage and over current.
- Four Concorde sealed batteries (PVX-2580L) operating at 12 VDC with a total capacity of 258 amp-hours (AH) each (24 hour rating).
- Circuit breakers (CB1, CB2 and CB3) and fuses for protection of PV and battery circuits.

7.2 Solar Panel Installation

The solar panel has two basic positions: flat, which is used when the trailer is in transport, and installed, which is used when the trailer is actively collecting data. These two positions are shown in Figures 54 and 55, respectively.

- The solar panel should be secured using the mounting holes in the feet attached to the solar panel mounting rails.
- For optimum performance in the Northern Hemisphere, the solar panel



should face true south (true north in Southern Hemisphere).

7.3 "Non-Solar" Battery Charging

Since solar exposure may not always be available (clouds, tree cover, etc.), the batteries may require charging from the power grid (or with a generator). The following paragraphs explain these aspects.

7.3.1 State of charge

Battery state of charge, or conversely, depth of discharge (DOD) is best determined with a hydrometer by checking the specific gravity of the acid. This will **not** tell the condition (capacity in AH) of the battery – only a load test will do that. With sealed batteries such as the PVX-2580L, specific gravity can not be measured, but voltage can. A fully charged 12 volt lead acid battery will read ~12.7 volts (about 2.14 volts per cell). The table below shows the state of charge for a measured voltage. It is important to note that the voltage measurements shown are only approximate.

Tuble 5. No Loud State of Charge					
State of Charge	12 Volt battery	Volts per Cell			
100%	12.7	2.12			
90%	12.5	2.08			
80%	12.42	2.07			
70%	12.32	2.05			
60%	12.20	2.03			
50%	12.06	2.01			
40%	11.9	1.98			
30%	11.75	1.96			
20%	11.58	1.93			
10%	11.31	1.89			
0	10.5	1.75			

Table 5: No-Load State of Charge

Higher rates of DOD reduce battery life considerably. Sun Xtender testing showed 20% DOD cycles gave battery life of 2800 cycles and 50% DOD cycles gave a battery life of 1050 cycles. For 80% DOD cycles, battery life was only 550 cycles. They also state 50% DOD cycles is fairly common for photovoltaic systems. The charge controller shuts the load off at about 60% DOD or 11.9 volts. For more information see: (http://www.solar-

electric.com/deep_cycle_batteries/deep_cycle_batery_faq.htm)

7.3.2 Capacity

The capacity of a battery is measured in amp-hours. The capacity can only be measured with a sustained load test which requires a specialized piece of equipment. In lieu of load test equipment, battery voltage can be measured but can give a false capacity reading. If battery plates are sulfated, damaged or partially gone from extensive use, a voltage reading may indicate full charge but the battery will act like one of much smaller size and go dead quickly under load. Again, the only way to know for sure is to perform a sustained load test which many battery or automotive stores can perform.

7.3.3 Charging

Batteries that are stored for long periods eventually lose all their charge due to "leakage" or selfdischarge. This discharge rate varies from 1% to 15% per month depending on battery type, age and temperature. The batteries used in the video collection trailers are absorbed glass mat (AGM) type, which have a 1% to 3% per month self discharge rate. Note high temperatures may cause batteries to self-discharge at a higher rate.

One of the main killers of batteries is storing them in a partly discharged state for an extended period of time. A "float" charge (1 to 2 Amps/battery) should be maintained on the batteries when stored, but if this is impossible or impractical, the batteries should be "fully charged" before storing.

Overcharging (charging at a voltage higher than recommended) will significantly reduce the life of the battery. Optimum charging voltage for an AGM type battery is 14.4 volts. A Sun Xtender study showed overcharging at only 15.2 volts reduced the cycle life 23%. (<u>http://www.sunxtender.com/agmvsgel.php</u>) (For other types of batteries this reduction is much greater.) What this means is since most automotive type chargers only have high and low charge settings, the voltage must be closely monitored to avoid overcharging and reducing the battery life. Chargers designed for deep cycle batteries have microprocessors that monitor the charging voltage and adjust it according to the charging stage. The charging stages are bulk, absorption and float.

7.3.3.1 <u>Bulk</u>

Bulk charge is the first stage in charging where current is sent to the batteries at the maximum safe rate they can accept. This occurs until the voltage rises to near 80% to 90% of full charge. Voltages at this stage may range from 10.5 to 15 volts; there is no "correct" voltage for bulk charging. Most batteries have a maximum charging current rate but AGM battery charging current rate is only limited by the charger's capability.

7.3.3.2 Absorption

Absorption charge is the second stage in charging where the voltage remains constant and the current gradually tapers off. This is the stage where charger voltage is at maximum and may damage the batteries if set on high. Smart chargers or deep cycle chargers limit the voltage at this stage to avoid over charging the batteries.

7.3.3.3 Float

The final stage of charging is the float charge where the battery has reached full charge and maintenance or float charge is used to keep the battery from discharging. The charger's voltage is reduced to about 13 volts which typically provides from one to two amps of current. Note that with 4 batteries this would be 4 to 8 amps total.

7.3.4 Charger types

There are several types of chargers, ranging from automotive to smart chargers. Most automotive chargers are bulk chargers with little or no voltage regulation (The one available for the trailers was measured at 16.1 volts.). These chargers can very easily over charge a battery. The other type of charger is a regulated charger that has voltage regulation. The voltage may be a fixed regulated voltage or a smart regulated voltage. The fixed regulated charger, as its name implies, sets a fixed voltage dependent on the battery voltage (6volts, 12volts, etc.). This prevents the battery from being over charged, but increases the charging time required. As the battery is charged, the battery voltage increases, which reduces the charging current (This is sometimes called a "taper charge".). To reduce the charging time, several manufactures offer "smart" or multi-stage chargers that sense the battery voltage to provide the three stages of charging, thereby minimizing battery charging time and avoiding battery over charge.

7.3.5 Trailer Power System Load Calculations

The trailer power system must provide power for the microwave (if used), recording, and camera equipment. The microwave equipment, recording equipment, and camera require:

- 8.5 watts,
- 24 watts and
- 15 watts respectively.

This equates to 47.5 watts or 4 amps (47.5/12) or 1A per battery. The batteries are rated at 305 AH apiece (120H rating). Therefore the equipment should theoretically run for 1220AH/4A (305/1) or 305H (12.7 days) if discharged to 100% DOD and no solar charging. For 50% DOD it would be 6.4 days (12.7x0.5). Note the 305AH rating is for a 2.5A per hour discharge rate (305/120) which is higher rate than the 1A per hour rate being drawn; consequently these calculations are conservative.

Each solar panel is rated at 75 watts for full sun exposure. This may occur for 8 - 10 hours on a good day, providing 600 - 750 WH of charging power or about 50 - 62.5 AH for the 12 volt system. This will supply trailer power requirements for a little over half a day (50AH / 4A = 12.5H). With new batteries, new solar panels and bright sunny days, a trailer with one solar panel charging could expect to operate about 11 to 13 days before recharging i.e. the charge controller disconnects the load. Operating time before recharging, using the microwave detection system, could be significantly extended depending on the duty cycle of the recorder (which is 50% of the load). For example, if the recorder duty cycle was reduced to 50%, the load current would be reduced to 3A ((8.5+12+15)/12) increasing solar charged operating time from 11 to 27.7 days [(1220*0.5)/((24H*3A-50AH)/day)].

7.4 Power System Operation

(Please refer to Figures 56 and 57.)

There are several switches that are used to control power generation and drawing. On the interior left wall of the trailer are three switches (CB1, CB2 and CB3). The back two switches are used to accept power input from the solar panel (CB1), and to allow the solar panel to charge the batteries (CB2). Switch CB3 is the load switch that directs power from the batteries to the different components of the trailer. CB3 is the main load switch that controls power from batteries to all the equipment on the trailer, while the other switches (camera, sensor, recorder and alarm) on the switch box of trailer are the auxiliary switches that control power to the respective ex-

Figure 55: Solar Panel (Installed Position).



switches that control power to the respective equipment.

The following steps should be followed while turning ON these switches.

- Turn ON the switch CB2 (Battery switch), and then turn ON CB1 (Solar Panel switch).
- Turn ON CB3 (Load Switch).
- Once the Solar Panel is exposed to the sun it will begin to charge the batteries. The Sunwize/Steca Photovoltaic Controller located inside the enclosure automatically regulates charging.
- Turn ON the auxiliary switches (camera, sensor, recorder and alarm) on the switch box of the trailer.

There are two LED's on the charge controller, described as follows.



• The left LED (marked with an "i") should flash green. When this left LED is flashing red, take action immediately to charge the battery and /or disconnect or reduce the loads. The controller incorporates a Low Voltage Disconnect (LVD) feature to automatically disconnect loads when battery state of charge is too low. The load will automatically reconnect when battery is recharged (i.e. all equipment using outlets should turn back on).

• The right LED (marked with a rectangular figure) indicates the state of charge of the battery as follows: red = discharged, yellow = 50% charged, green = fully charged.

When first powered up by turning on CB2 (Battery switch), both controller LED's will remain blank for approximately 2 seconds and then flash red before turning green. This is normal and is not indicative of a problem with controller or the system.



8 PRIMARY OPERATIONAL TASKS

This chapter outlines some of the typical tasks that would be performed using the video surveillance equipment.

8.1 Set up trailer

- Detach trailer from the vehicle
- Carry the trailer to a position appropriate for the application required
- Rotate the jack legs from the free position to the parked `(foot on the ground) position
- Level the trailer adjusting the height of the jack legs and using the spirit levels (bubbles)

8.2 Assemble mast

- Remove hitch piece
- Remove bolts from base piece
- Add next piece, and secure with two bolts
- Continue adding pieces, securing the two bolts of each piece as you go
- Unwind the winch to provide slack
- Attach the winch hook to the mast
- Wind the winch to provide tension
- Attach the camera and the sensor cables to the mast putting zip ties through the tags on the mast. Leave some slack at the bottom of the mast.

8.3 Set up camera

- Bolt the camera to the top piece of the mast
- Aim and adjust the head angle of the camera using the bracket bolts. (Usually the camera is mounted tilted down 20° below horizontal to avoid direct view of sun or horizon)
- When alignment is complete make sure that all bolts are tightened.
- Connect the video cable with BNC connector to "video out" on back of camera
- Connect the focal length and focus adjustment connector to the respective connection on back of camera
- Adjust the camera using monitor and lens adjustment module (See section 8.7)

8.4 Set up microwave sensor

- Initially detach sensors from the sensor mounting brackets. Detaching the hinge bolt that holds sensor body to the sensor-mounting bracket can do this.
- Install the sensor mounting brackets on the top piece of mast below the camera using the two lag bolts.
- Install the sensors onto the sensor mounting brackets using the hinge bolt removed earlier.
- Connect alarm connection to back of sensor
- Aim and adjust the head angle of the sensor.

- Head angle of the sensor can be adjusted using the hinge bolt that attaches sensor body to the sensor-mounting bracket.
- Pan angle of the sensor can be adjusted using the bolt that holds the sensor body to the hinge.
- A small hollow tube or a laser pointer can be attached to the top of the sensor to properly aim and adjust its head angle.
- When alignment is complete make sure that all bolts are tightened.
- Adjust the sensor to detect vehicles at the right position by using monitor (See section 8.7)

8.5 Hook up recording equipment

- Connect alarm input to back of recorder
- Connect power cord to AC outlet¹
- Connect video cable from camera to "video in" on back of VCR
- Connect video cable from "video out" on back of VCR to video monitor²
- Slide recorder into slot on underside of lid

8.6 Programming recording equipment

(Consult chapter 6 for specific details on programming each recorder)

- Set the date and time
- Set display options
- Set alarm recording options, including duration and recording speed

8.7 Use of monitor and lens adjustment module

- Connect monitor to the video out of the recording equipment.
- Connect lens adjustment module into the switch box.
- Adjust zoom and focus of the camera using the lens adjusting module
- Set the correct zoom and focus as per user requirements by visually inspecting the camera view in the monitor (Note: the camera pan and/or tilt angle may need to be changed for correct view. See section 4.1.1 for details).
- Turn on the sensor switch
- Wait for live traffic to see when sensor is activated (Time scans).
- Once the alarm input signal is fed by any of the sensors to the recording equipment, the recording equipment starts recording and at the same moment the dots that separate hour, minutes and seconds of the time display on the monitor turn into stars.
- Use this test to ascertain the moment and the direction in which the sensors are picking up the vehicle signal in order to record the vehicles at the right place (Note: the sensor pan and/or tilt angle may need to be changed to record the vehicles at the right place. See section 8.4 for details).

¹ Only for the Sanyo Time-Lapse VCR or the digital data recorder.

² This will be necessary only until the camera is adjusted properly.

8.8 Re-charge batteries

- Unlock and open the trailer lid
- Ensure that all power switches are off
- Turn off all other power draw switches as a precaution
- Identify battery terminals that have two connections (See Figure 58)
- Measure the battery voltage across the identified battery terminals
- Connect red cable first to the positive post, then connect the black cable to the ground post
- Plug in charger to generator or other AC outlet
- Switch on charger to 12V HI setting (40A)
- If the measured battery voltage was at or below 11.8 volts, allow up to 12 hours for charging
- Switch charger to 12V LO setting (20A)
- Allow to charge another 2 to 3 hours



8.9 Prepare trailer for move

- Unlock and lower mast
- Disconnect and re-package camera
- Disconnect and re-package microwave sensor
- Cut zip-ties on mast and discard
- Disassemble and stack mast
- Coil and attach mast cable to remaining mast, as shown in Figure _____.
- Attach and lock hitch
- Take down and secure solar panel
- Disconnect and package video recorder
- Check tire pressure and inflate as necessary
- Raise jack legs (secure trailer wheels)
- Rotate trailer to best position toward vehicle
- Attach trailer to vehicle hitch
- Attach brake light cable

9 APPENDIX

9.1 Recommended Tools List

- Adjustable Wrench
- Side Cutter
- Combination Wrenches:
 - 1. ¼"
 - 2. 5/16"
 - 3. 7/16"
 - 4. 9/16"
 - 5. 3/8"
- Socket Wrenches: -
 - 1. ¼"
 - 2. 5/16"
 - 3. 7/16"
 - 4. 9/16"
 - 5. 3/8"
- Adjustable pliers
- Needle nose pliers
- Screw drivers straight and Phillips
- 5/32 Hex Wrench (Allen Wrench)
- Head Lamp
- AA Flash Light
- Electric tape
- 100' Tape measure
- Tire pressure gauge
- Marker
- Ammeter
- Solder gun
- VCR Head Cleaner tape
- Duct Tape
- Equipment Pointer: A small hollow tube OR laser pointer (For aiming and adjusting camera and sensor)

9.2 Spare Parts List

- Hex Head Bolts (Galvanized): -
 - \circ ¹/₄-20 X 4" 4 Nos. (For mast mounting)
 - \circ ¹/₄-20 X 0.5" 2 Nos. (Hinge bolt for sensor mounting)
 - \circ 3/8-16 X 0.75" 2 Nos. (Camera bracket bolt)
 - o ¹/₂-13 X 0.75" 2 Nos. (Camera mounting bolt)
 - o 3/8-16 X 4" 4 Nos. (Lag bolt for installation of sensor mounting bracket)
- Carriage Bolt: ¹/₄-20 X 3.5" 2 Nos.
- Terminal (Thumb) Screws: ¹/₄ 20 X 0.75" 4 Nos. (For solar panel installation)

- Socket Button Head tamperproof stainless steel bolt: ¹/₄-20 X 1" 2 Nos. (For solar panel installation)
- Cable (zip) ties
- ¹/₄" Screw mount cable tie holder (see Figure 59) Zack Electronics Prt. No. AL-SM2-0-C
- Light bulbs for headlamp 2 Nos.
- Butt Connectors: For DC power connections (see Figure 60)
- Cup hooks -7/8" (see Figure 61)
- 60/40 Rosin core solder metal (Dia. 1 mm)
- Multi purpose self-adhesive labels.



Figure 59: Screw mount cable tie holders

Figure 60: Butt Connectors (for DC Power Connections).



Figure 61: Cup Hooks – 7/8".

