# Race Technology

# VIDEO4

## Instruction manual

**Version 1.5**
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# 1  The VIDEO4



VIDEO4 is a powerful and configurable combined video/data logger.

The VIDEO4 is designed to integrate seamlessly with our other products including our data loggers and displays. In the case that when the VIDEO4 is used with a data logger, then the data logger simply becomes a "data source" which feds data to the VIDEO4 unit, there is no need to have a flash card in the data logger and there is no need to access it. All the data and the video are recorded on the flash card in the VIDEO4 unit. The Video and Data are perfectly synchronized so that the user will be able to analyze them side by side using RT Analysis Software.

The VIDEO4 combines the 4 video streams and overlays the graphics in real time so only a single video stream is stored on the flash card. The video is recorded at a very high quality and stored in standard DVD format, either PAL or NTSC as required.

The complete video/data system has been optimized with simplicity and speed in mind. For the first time it means that video and data can be analyzed quickly and simply, with almost no additional overhead compared with data alone.

Once the logging/recording is complete the flash card can be taken from the unit and then used in our powerful analysis software, to instantly generate a DVD or simply played back using our own video player software.

The unit was initially designed for automotive applications such as circuit racing cars, rally cars, hill climb cars and road cars. However it is also ideally suited to use in other applications such as power boats and on motorbikes. The unit may be used for all types of car testing within the auto-industry and can provide a vital tool for road safety and race training within driving schools.

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# 2  What's in the box (packing list)

## 2.1 VIDEO4 unit when not bought as part of a package:

- 1 x VIDEO4
- 1 x power cable (2m)
- 1 x null modem cable (2m)
- 1 x VIDEO4 user manual
- 1 x Software on CD
- 1 x Pair mounting brackets
- 1 x Video output lead for setting up
- 1 x Carry case

## 2.2 For the VIDEO4 sport system with 2 cameras, in addition to the VIDEO4 package you also get

- 1 x 4GB Compact Flash(CF) card
- 1 x high speed CF reader
- 1 x high resolution bullet camera (6mm, 53° lens)
- 1 x standard resolution bullet camera (3.6mm, 90° lens)
- 2 x small camera suction mounts

## 2.3 VIDEO4 sport system with 4 cameras

- 1 x 4GB CF card
- 1 x high speed CF reader
- 1 x high resolution bullet camera (6mm, 53° lens)
- 3 x standard resolution bullet cameras (3.6mm, 90° lens)
- 4 x small camera suction mounts

## 2.4 For the package that includes a DL1 with the VIDEO4

- 1 x pre-configured DL1
- 1 x DL1 power cable
- 1 x GPS antenna (3m)
- 1 x DL1 mounting kit
- 1 x Quick Start Guide

**"WARNING":** To avoid any possible damage to the car paintwork, please take care when mounting magnetic GPS antennas. In particular make sure that there are no dust or grit under the antenna. In some cases it maybe required to add additional protection to the paintwork prior to mounting the antenna to avoid damage.

# 3  Description of the first use of the VIDEO4

Please complete the following test procedure when using the VIDEO4 for the first time. No configuration is necessary to complete this test as the unit comes configured with a basic sample layout.

1. For a first test make sure nothing is connected to the data port.

2. Connect at least 1 camera to the VIDEO4 unit.

3. If the unit is equipped with GPS, then attached a GPS antenna and put it on the vehicle roof with a clear view of the sky

4. Insert a CF card, formatted as FAT32.

5. Power up the VIDEO4.

6. After about 10 seconds the power light should be on solid and the status light should be blinking, if they are not then refer to the section on LEDs to diagnose the problem.

7. Press the Start/Stop recording button so start a recording, and then after a few minutes, press again to stop recording.

8. Turn the VIDEO4 off by removing the power supply.

9. Remove the flash card from the unit and put it into a USB2 reader connected to your PC.

10. The CF card will have a directory on it labelled "NODATE" and within that directory it will have a number of files. Copy the whole directory to your PCs desktop.

11. Open the directory on your desktop and double click on the **VD4** file.

12. This will start the video file playing in the RT software (assuming that the Race Technology software package has been installed first).

# 4  VIDEO4 Hardware Installation

This section details how to install the VIDEO4 unit and how to connect the cameras, microphones, RT products and 3rd party devices

## 4.1 Connecting cameras

Make sure the unit is not powered. Connect the cameras to the VIDEO4 and power up the unit. The number of cameras that are connected successfully will be indicated from Status LED. See LED indicators (Page 29) for more information.

### 4.1.1 Suitable cameras

The VIDEO4 is designed to work with either PAL or NTSC cameras with a composite output. The connectors for the cameras also include a 12v output feed to simplify cabling. It is therefore strongly recommended that the cameras run off 12v with a maximum current draw of about 150mA per camera. The Cameras can be bought from Race Technology, adapter cables are also available so you can use cameras from other vendors.

Note that the camera quality can vary considerably and it is the quality of the cameras that has the most significant effect on the overall video quality. The process of video digitization, compression and storage of the video causes very little quality derogation.

The performance of cameras is typically described by the number of television lines "TVL" they are able to capture. In reality this method of measuring camera performance has more to do with sales and marketing than engineering; however it can be used to differentiate camera quality from a single vendor. Cameras that use the Sony 1/3 HQ sensor are currently the best choice for quality.

Please note that it is normal to use one high quality camera for the main feed into the VIDEO4 and lower quality cameras for the PIPs. Since the PIPs are reduced in size, there is almost no benefit of using an expensive camera for them.

## 4.2 Audio

**The built in microphone is only fitted to late model VIDEO4, it is not available on earlier VIDEO4s. If fitted the microphone is clearly visible and labelled on the front of the unit in the center of the front panel.**

The audio is setup from the "VIDEO4 Configuration Tool" program, from the Configuration -> Audio menu.



This allows you to select the mix of the audio that is taken from the internal and external microphone, to the left and right channels:
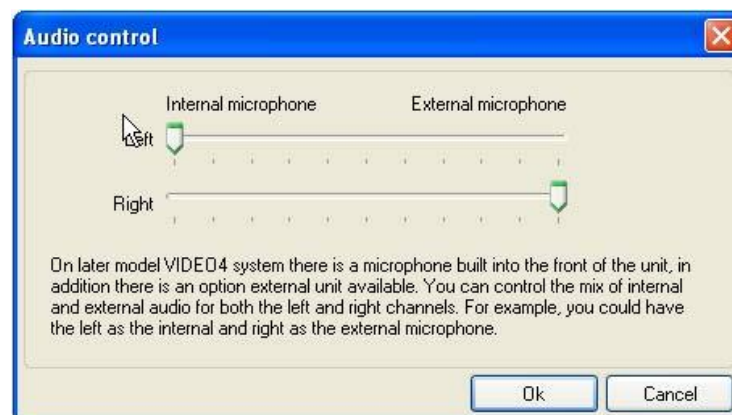


Typical configuration examples might be:

- For a simple installation all the audio for left and right channels is taken from the internal microphone
- Alternatively connect the helmet microphone to the external audio input and have this on the left channel and "ambient" audio from the VIDEO4s build in microphone on the right channel

## 4.3 Using the live video out feed

The VIDEO4 has a live "composite" video output that can be connected to an external monitor or television. This output is ideal for checking camera alignment, and overlay configuration when installing and configuring the unit. You can also playback recorded video from the VIDEO4s video output, using the "VIDEO4 controller software" if required. Note that under some conditions you may see a small "skip" in the live output as a frame is missed. This is completely normal and does not affect the quality of the recorded video.

Note that the layout (VGL) file controls whether the VIDEO4 output is in PAL or NTSC video format.

## 4.4 Configuring the VIDEO4 for use with Other RT Products

### 4.4.1 DL1 Configuration for VIDEO4

**IMPORTANT:** For full compatibility with the VIDEO4, the DL1/2 must be running firmware version 25 or later. If this is not the case the remote start/stop and add lap marker will not work.

When using the DL1/2 and VIDEO4 together, then the DL1/2 simply acts as a source of data for the VIDEO4 - there is no need to access it during normal operation. The DL1/2 doesn't even need a CF card to be inserted, it just needs to be powered and connected to the VIDEO4 with the supplied serial lead. In this configuration the VIDEO4 does all lap timing, can be controlled remotely from a DASH1/2/3 just as the DL1/2 can be and can be configured for automatic start/stop just as the DL1/2.

To ensure correct operation the DL1/2 must be configured correctly so it sends the correct information to the VIDEO4. To do this you need to use the DL1/2 configuration software:
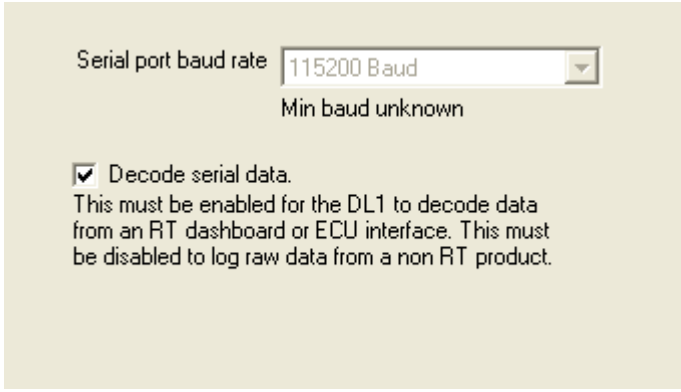
1. Start up the DL1/2 configuration software
2. Make the required settings as described below
3. Save the configuration onto a CF compatible with the DL1. This card must be formatted as FAT16, and the file must be stored in the root directory
4. With the DL1 powered up, insert the CF card into it, the DL1 will read this configuration information and configure itself
5. Note that the DL1 will store the configuration information on the internal flash, there is no need to reconfigure it before each use.

The DL1 MUST BE configured to:

1. Output all analogue and frequency channels at 100Hz to the serial port.



| Channel Name | Memory Card | Serial Port |
| --- | --- | --- |
| Analogue 4 | 100Hz | 100Hz |
| Analogue 5 | 100Hz | 100Hz |
| Analogue 6 | 100Hz | 100Hz |
| Analogue 7 | 100Hz | 100Hz |
| Analogue 8 | 100Hz | 100Hz |
| Accelerometers | 100Hz | 100Hz |
| frequency 1 | 100Hz | 100Hz |
| frequency 2 | 100Hz | 100Hz |
| frequency 3 | 100Hz | 100Hz |
| frequency 4 | 100Hz | 100Hz |
| RPM | 100Hz | 100Hz |
| Incoming serial data | (1) Enabled | (1) Enabled |
| GPS raw data | (1) Enabled | (1) Enabled |
| GPS velocity data | (1) Enabled | (1) Enabled |
| GPS heading data | (1) Enabled | (1) Enabled |
| GPS ms time data | (1) Enabled | (1) Enabled |
| GPS GMT time/date data | (1) Enabled | (1) Enabled |
| GPS positional data | (1) Enabled | (1) Enabled |
| GPS altitude data | (1) Enabled | (1) Enabled |
| GPS time pulse | (1) Enabled | (1) Enabled |

**2.** Enable all GPS data to be output over the serial port (without this the lap timing will NOT work)

**3.** Enable incoming serial data, and all GPS data to the serial port

**4.** Enable lap beacon data to the serial port

**5.** The Autostart/stop control can be left as the default settings as these have no effect when no CF card is used

**6.** The file naming tab can also be left with all the default values as again, these are only used when the DL1 is used to log data to the flash card

**7.** On the serial port configuration tab you must set the serial port baud rate to 115200, and tick the box that says "Decode serial data"
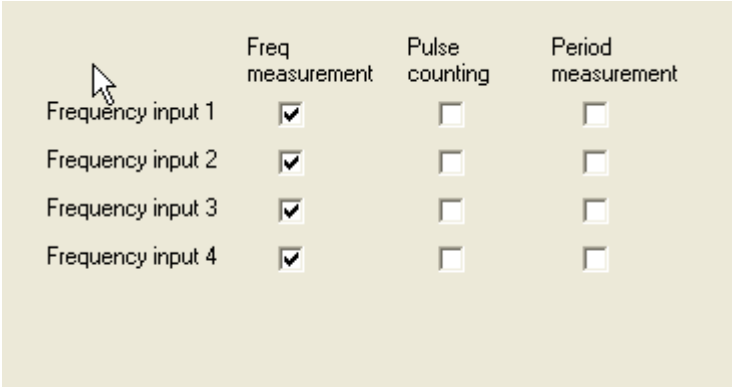


**8.** On the frequency inputs tab, please tick all 4 boxes for "Freq measurement" and leave the boxes for "pulse counting" and "period measurement" un-ticked.
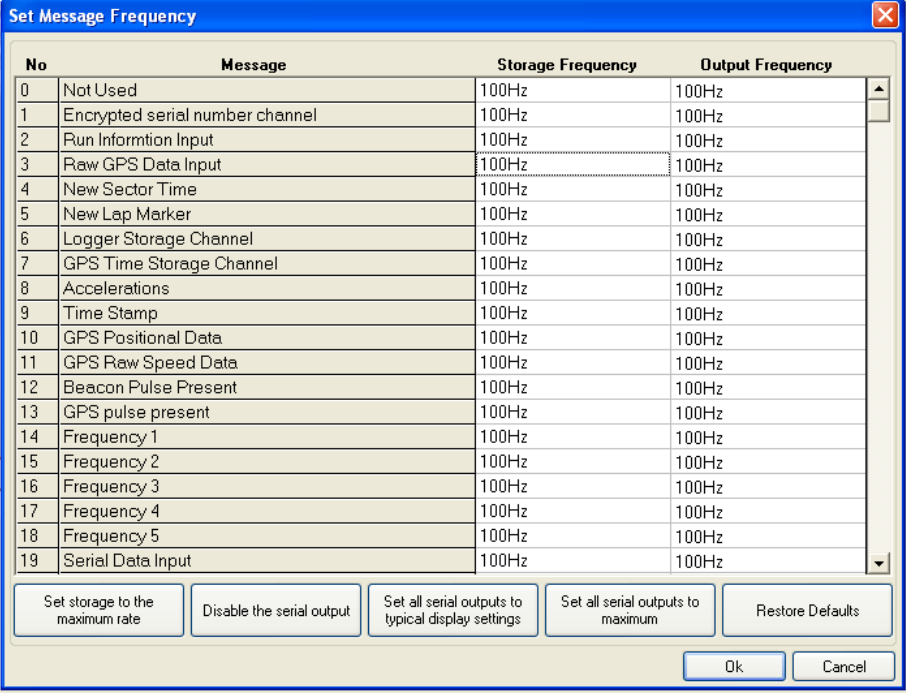
## 4.4.2 Configuring the VIDEO4 for use with a DASH

When using the DASH and VIDEO4 together, all **Output Frequencies** must be set to 5Hz, except acceleration and RPM using the **Set Message Frequency** dialog in the VIDEO4 Configuration Tool.

**1**. Open the VIDEO4 Configuration tool.

**2**. Click on the menu item **Configuration -> Message Frequency** to open the **Set Message Frequency**  Dialog.

| No | Message | Storage Frequency | Output Frequency |
|---|---|---|---|
| 0 | Not Used | 100Hz | 100Hz |
| 1 | Encrypted serial number channel | 100Hz | 100Hz |
| 2 | Run Informtion Input | 100Hz | 100Hz |
| 3 | Raw GPS Data Input | 100Hz | 100Hz |
| 4 | New Sector Time | 100Hz | 100Hz |
| 5 | New Lap Marker | 100Hz | 100Hz |
| 6 | Logger Storage Channel | 100Hz | 100Hz |
| 7 | GPS Time Storage Channel | 100Hz | 100Hz |
| 8 | Accelerations | 100Hz | 100Hz |
| 9 | Time Stamp | 100Hz | 100Hz |
| 10 | GPS Positional Data | 100Hz | 100Hz |
| 11 | GPS Raw Speed Data | 100Hz | 100Hz |
| 12 | Beacon Pulse Present | 100Hz | 100Hz |
| 13 | GPS pulse present | 100Hz | 100Hz |
| 14 | Frequency 1 | 100Hz | 100Hz |
| 15 | Frequency 2 | 100Hz | 100Hz |
| 16 | Frequency 3 | 100Hz | 100Hz |
| 17 | Frequency 4 | 100Hz | 100Hz |
| 18 | Frequency 5 | 100Hz | 100Hz |
| 19 | Serial Data Input | 100Hz | 100Hz |

Set storage to the maximum rate | Disable the serial output | Set all serial outputs to typical display settings | Set all serial outputs to maximum | Restore Defaults

Ok | Cancel

**3**. Click on the button **Set all serial outputs to typical display settings**. This will set all output frequencies to 5Hz, except acceleration and RPM which are 25Hz.



**4.** Press OK to save the settings and exit from the dialog.

### 4.4.3 Configuring the VIDEO4 for use with a DL1

When using VIDEO4 with only a DL1, or a DL1 and ECU interface, but no DASH, all **Serial Outputs** must be disabled. This can be done using the **Set Message Frequency** dialog in the VIDEO4 Configuration Tool.

**1**. Open the VIDEO4 Configuration tool.

**2**. Click on the menu item Configuration -> Message Frequency to open the **Set Message Frequency Dialog**.
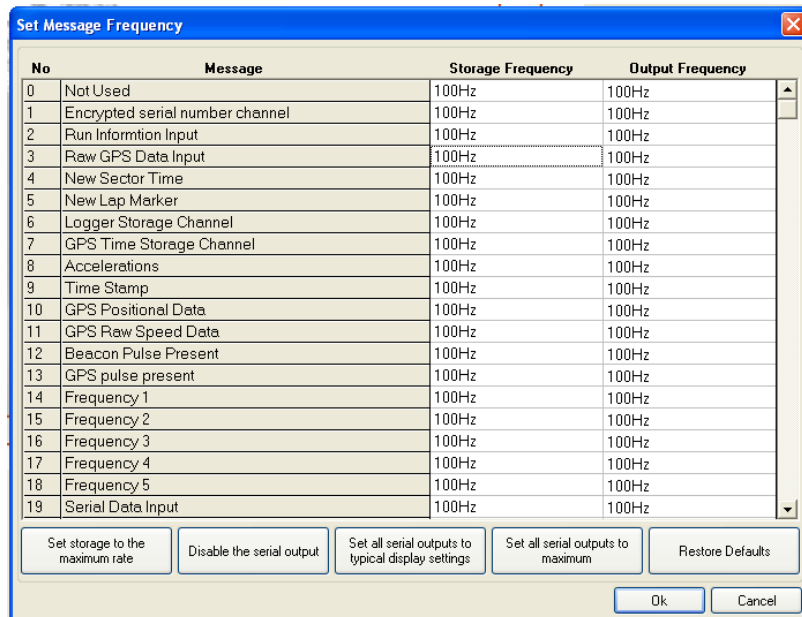


**3**. Click on the button **Disable the serial outputs.**
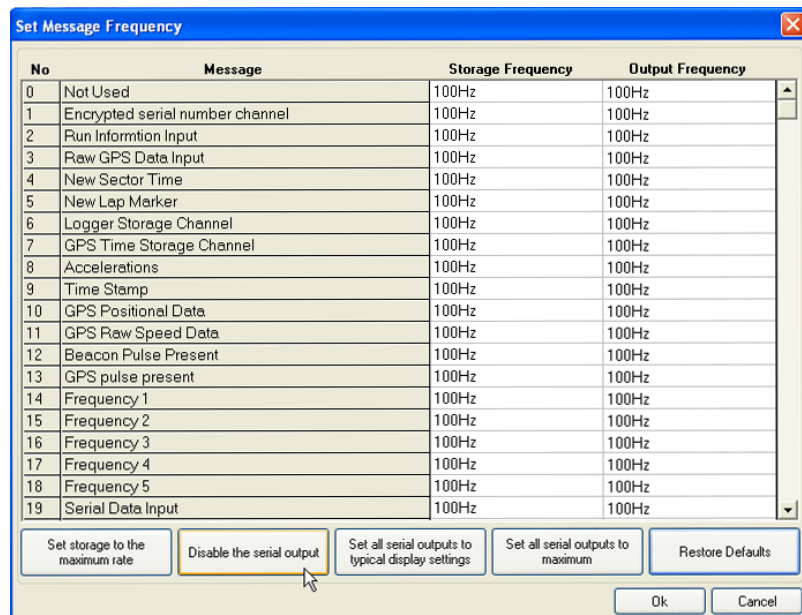
**4.** Press OK to save the settings and exit from the dialog.
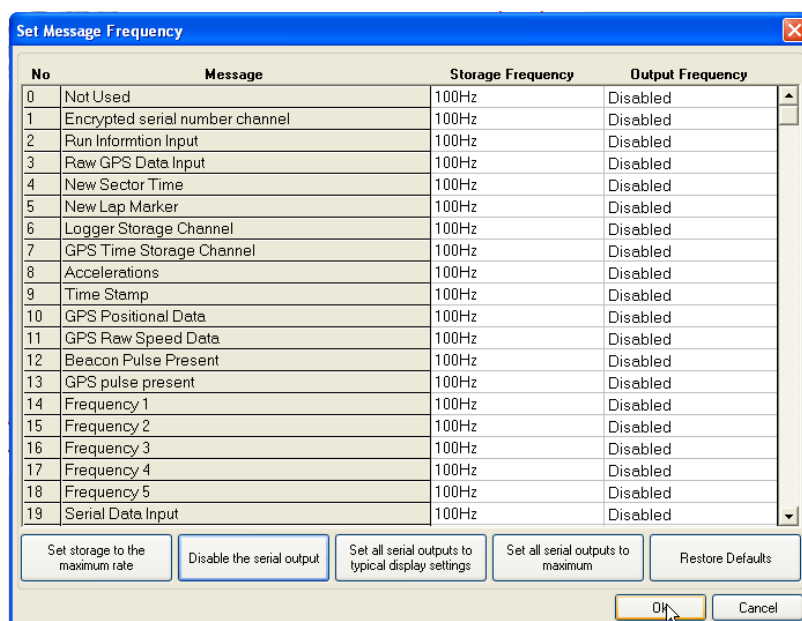


## 4.5 Connection Diagrams for RT Products

All current RT hardware uses a standard data protocol that allows anything to be connected to anything else in almost anything else in almost any combination. Diagrams of how to connect together the most common combinations are illustrated in following pages.

If you have a combination that is not covered then please contact Race Technology and we will supply the information directly.

In the following configurations it is important that both the DL1, DASH display and the VIDEO4 are configured to work together correctly. There is more information about this on the sections 4.4.1, 4.4.2 and 4.4.3

Notes:

- These diagrams are intended to show the data connections between the units and not as a complete wiring diagram. Power connections to the units and the GPS antenna to the DL1 are not shown for clarity.
- Please note that the AX22 is not compatible with the VIDEO4.

**"WARNING": To avoid any possible damage to the car paintwork, please take care when mounting magnetic GPS antennas. In particular make sure that there are no dust or grit under the antenna. In some cases it maybe required to add additional protection to the paintwork prior to mounting the antenna to avoid damage.**

## 4.5.1 VIDEO4 and DL1
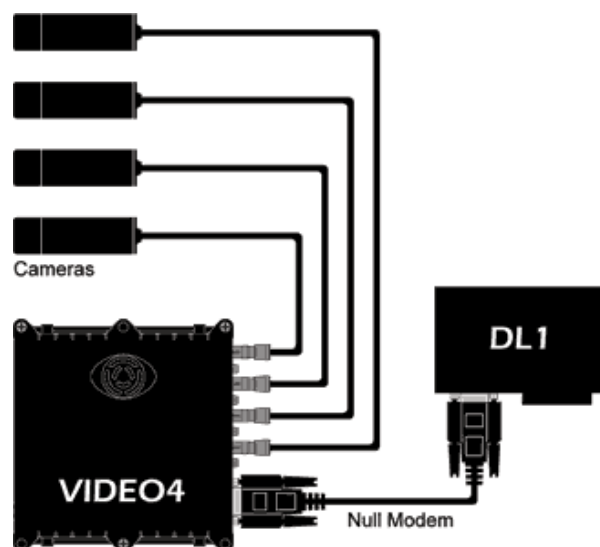


In this configuration it is important that both the DL1 and the VIDEO4 are configured to work together correctly. There is more information about this on the sections 4.4.1 and 4.4.3

## 4.5.2 VIDEO4 and ECU
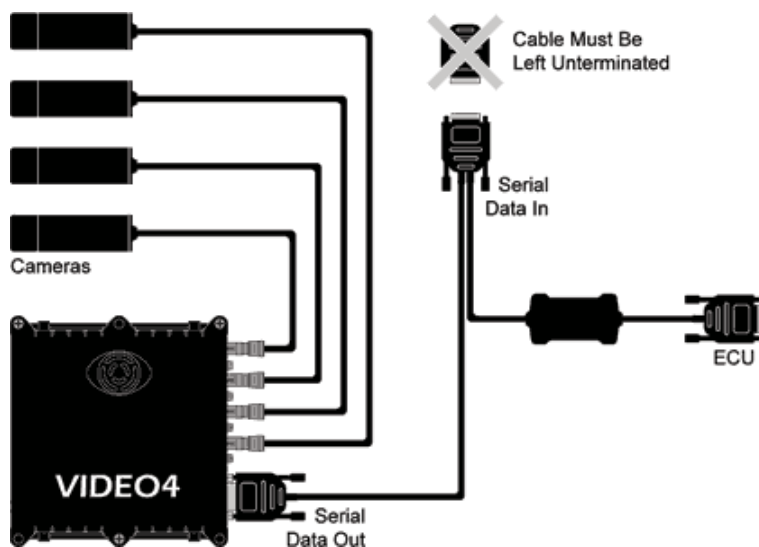
### 4.5.3 VIDEO4, DL1 and ECU
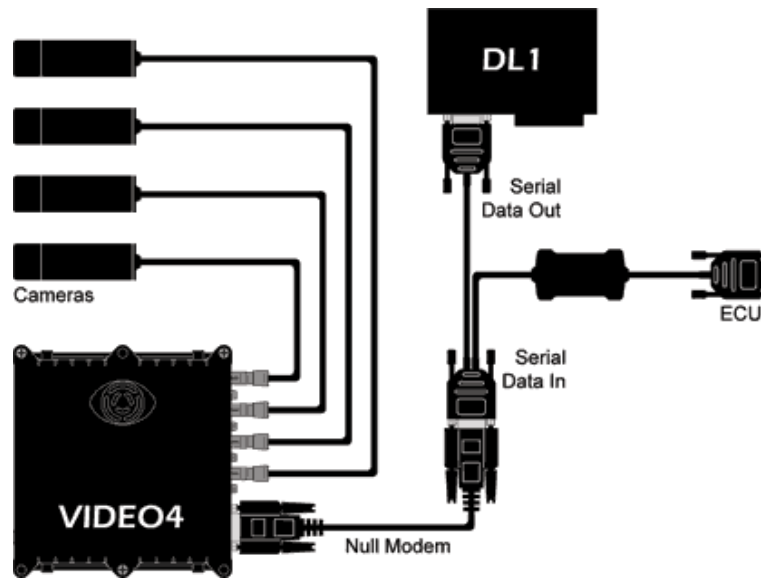


In this configuration it is important that both the DL1 and the VIDEO4 are configured to work together correctly. There is more information about this on the sections 4.4.1 and 4.4.3

### 4.5.4 VIDEO4, DL1 and DASH3
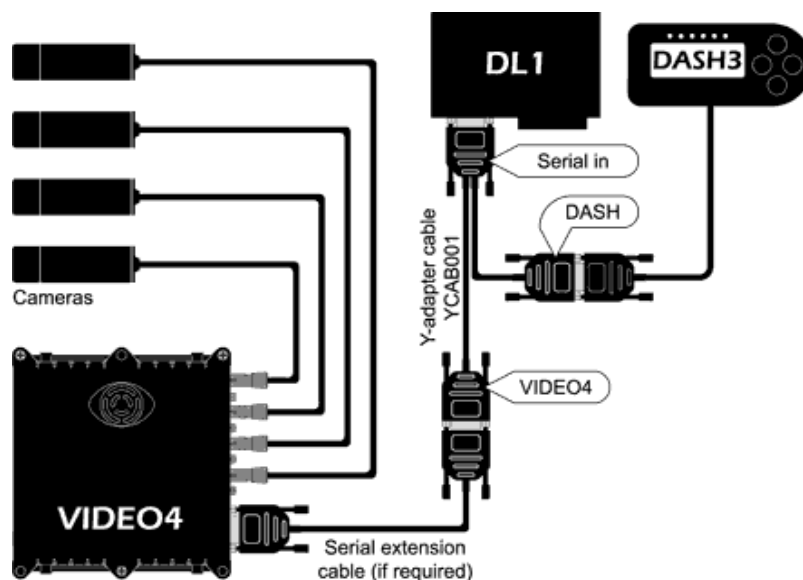


In this configuration it is important that both the DL1, DASH display and the VIDEO4 are configured to work together correctly. There is more information about this on the sections 4.4.1, and 4.4.2

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## 4.5.5 VIDEO4, ECU and DASH2
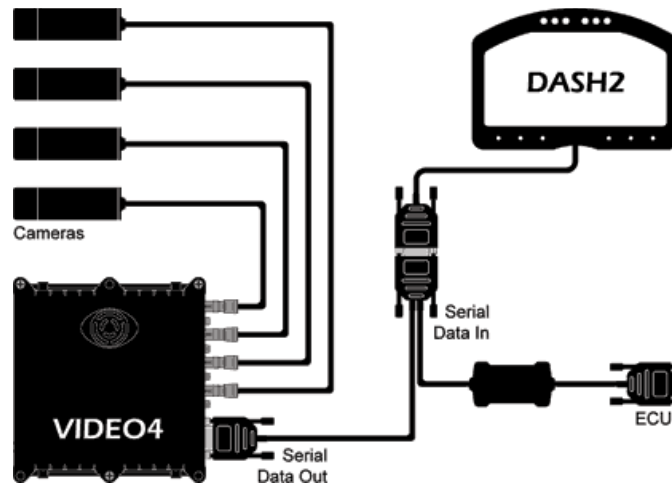


In this configuration it is important that both the DASH display and the VIDEO4 are configured to work together correctly. There is more information about this on the section 4.4.2

**IMPORTANT:**

When connecting a dashboard to a VIDEO4, it must be running firmware that has been published since the release of the VIDEO4 so it correctly decode the new VIDEO4 data. In particular:

- DASH1s must be running firmware version 9.1.5 or later

- DASH2s must be running firmware version 9.1.5 or later

- DASH3s must be running firmware version 1.31.18 or later

### 4.5.6 VIDEO4, DL1, ECU and DASH2
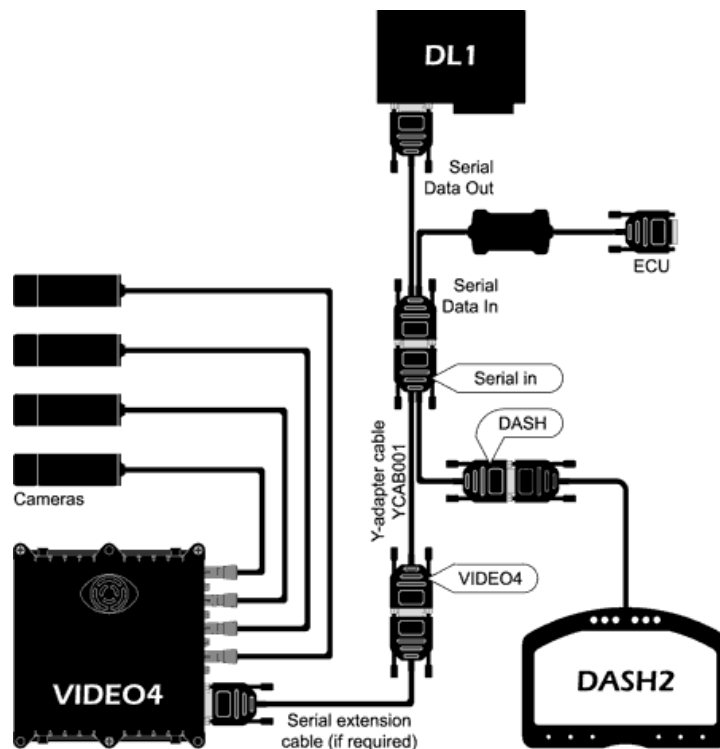


In this configuration it is important that both the DL1, DASH display and the VIDEO4 are configured to work together correctly. There is more information about this on the sections 4.4.1, and 4.4.2

**IMPORTANT:**

- When connecting a dashboard to a VIDEO4, it must be running firmware that has been published since the release of the VIDEO4 so it correctly decode the new VIDEO4 data. In particular:

  o DASH1s must be running firmware version 9.1.5 or later
  o DASH2s must be running firmware version 9.1.5 or later
  o DASH3s must be running firmware version 1.31.18 or later

- For full compatibility with the VIDEO4, the DL1/2 must be running firmware version 25 or later. If this is not the case the remote start/stop and add lap marker will not work.

## 4.6 Interfacing the VIDEO4 to 3rd party products

All Race Technology products use the same data format for our serial data format on the web site (http://www.race-technology.com/wiki/index.php/General/SerialDataFormat ), so products manufactured by Race Technology can be connected directly to the VIDEO4. If you wish to display data from a 3rd party product there are 3 options:

1. If the 3rd party product has a Can output then you can use the Race Technology Can converter to convert the CAN data into a serial format suitable for the VIDEO4. This CAN converter is freely configurable by the user, and only requires that the user knows the format of the CAN data to be converted.

2. The Race Technology Serial data format specification is fully documented and available on our web site, and help file. So you can talk to the manufacturer of the 3rd party product and see if it is possible to add Race Technology format messages.

3. Alternatively Race Technology also makes a range of data converter modules that can convert data from almost any source into Race Technology data. However, depending on the application there might be a charge for this service.

## 4.7 Mounting In the Car

If the VIDEO4 is equipped with built in accelerometers and you wish to use this information, then the VIDEO4 must be mounted flat, square in the car. The front panel (with the start stop button on) must be pointing towards the rear of the car.

When mounting the VIDEO4 in the car, there are a number of options.

### 4.7.1 VIDEO4 sport

For most installations the unit will be mounted using 2 strips of scotch lock tape on the base of the unit. This is simple and secure; however please take care not to cover the ventilation holes with the tape. If a more permanent installation is required then there are two main options available:

1. You can use either the mounting holes on the side of the unit. These are designed to take 2.9mm self tapping screws (No. 4) with a maximum penetration depth of 6.5mm.

2. Or a set of "hook in" brackets are available that fit into the channels on the sides of the case. They are made from brushed stainless steel, and are designed to be used with M4 screws or similar diameter self tapping screws (#7 or #8). The mounting diagram for these is shown below:

**Standard 2 Bracket Mounting:**
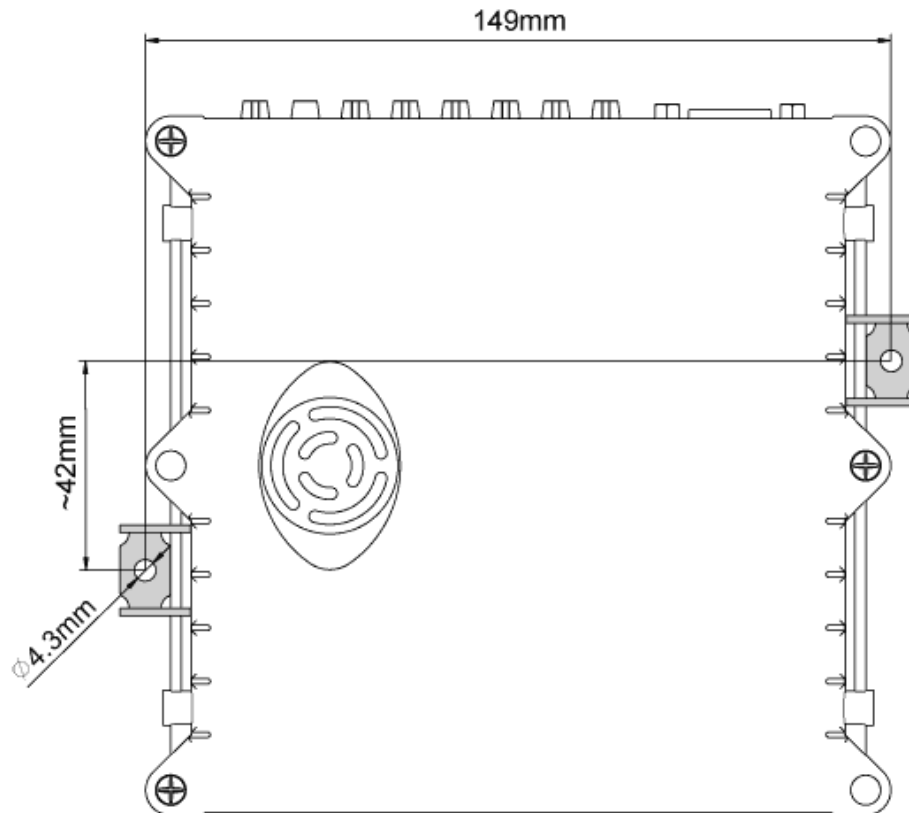
**Extra Secure 4 Bracket Mounting - for demanding applications:**
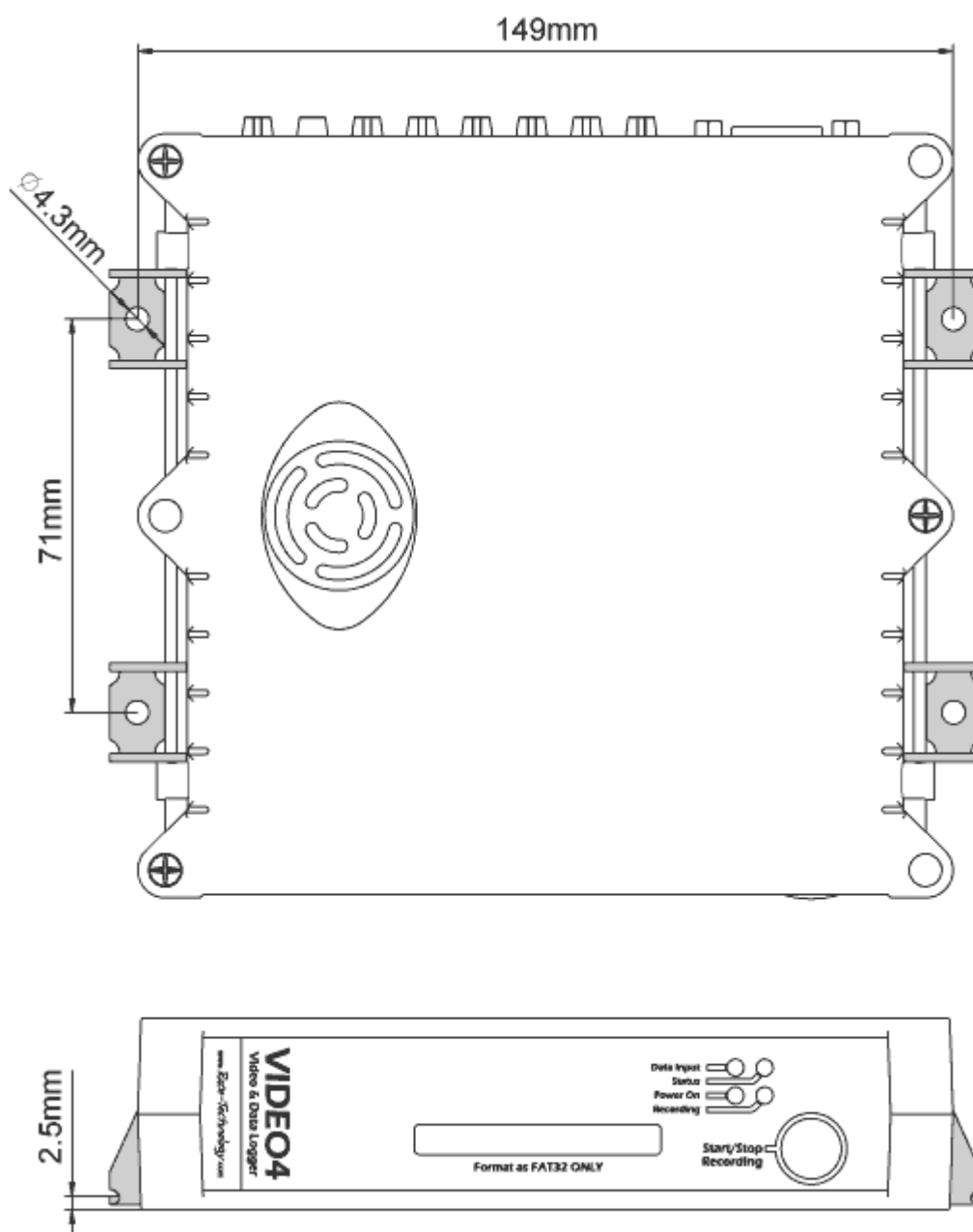


In all cases the unit must be located to allow sufficient cooling, and minimize vibration of the unit.

## 4.7.2 VIDEO4 professional

The VIDEO4 professional unit is designed to be held down using M4 cap head or pan head screws in the base plate. Under some conditions using scotch lock tape might be an option, however due to the weight of the unit this method is not recommended for race conditions.
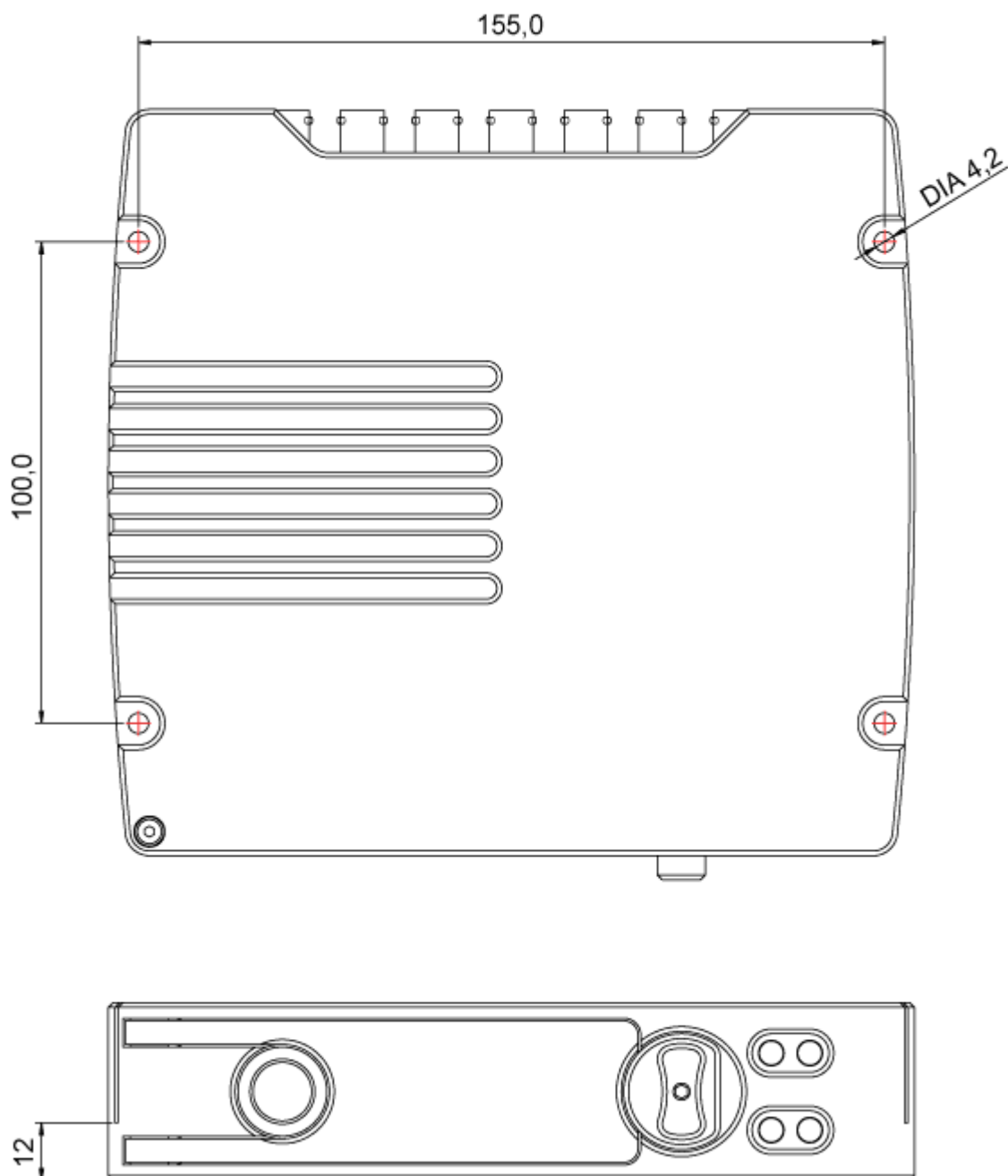
The unit must be located to allow sufficient cooling, and minimize vibration of the unit.

### 4.7.3 Mounting Bullet Cameras In The Car



*Placement of the main camera behind the driver is not recommended.*

When installing the VIDEO4 cameras into a vehicle, it is important to consider the effect camera placement will have on the quality of the produced video. Many installations place the main (high resolution) camera behind the driver (facing forwards), often intentionally capturing the driver in the frame. We do not recommend this setup as it heavily compromises the view out of the front of the car. The view of the track is compromised, partly because of the view obstruction by the dashboard and driver etc (in the example below less than 50% of the main image ends up being of the track), but also because of the difference in brightness. It's important to remember that a camera lens isn't as adaptable as the human eye to varying light conditions; so with bright sunny conditions outside the car, and the contrasting dark interior it is difficult to get a satisfactory or wholly representative view of both. The forward view out of the windscreen is quite simply the most important view, it is the drivers eye view and should be maximised to fill as much of the frame as possible.



*Shows the view of the track that can be expected when mounting the main camera behind the driver.*

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*We recommend placing the main camera as close to the windscreen as possible.*

With the VIDEO4's multiple camera views we strongly recommend that each camera has a singular subject of focus. For example: with the high resolution camera as close to the windscreen as possible (so it only "sees" outside of the car) to concentrate on the front outside view. If a view of the driver is desired we recommend using a secondary standard resolution camera focused solely on the driver. In 4 camera systems it is also useful to have the 3rd and 4th cameras as rear facing and/or at the driver's feet for a complete view of the action. Below is an example which shows the result of placing the main high resolution camera close to the windscreen, maximising the effect of the important forward view. It places the viewer firmly in the driver's seat, not the back seat.



*Shows the view of the track that can be expected when mounting the main camera close to the windscreen.*

The example shown below shows the results you can get with both well placed cameras and the unobstructed widescreen layout, the additional screen resolution providing an area for PIP videos and data overlays. With each camera maximising its focus on a singular subject and the large screen area allowed for each video, the clarity of vision is greatly improved.



*Example of a well placed camera setup used with the widescreen function.*

## 4.8 Powering up the VIDEO4

- Make sure all cameras, audio inputs, external data feeders, etc… are fixed and a Removable CF card is inserted **before** powering up the unit.

- Once everything is ready, just power up the unit and it will indicate the boot progress with **LED indicators**. (Page 29)

The power supplies in the sport and the professional models of the VIDEO4 unit are different in design, both units **must** however have a suitable fuse and be securely connected to the power supply. If the power supply to the VIDEO4 is lost, even for a very short time due to a bad connection for example, then the VIDEO4 will stop recording, automatically close all the files that are open and shut down to standby mode.

## VIDEO4 sport

The VIDEO4 sport is designed to be connected to a standard 12v automotive battery, and typically draws about 500mA plus whatever power is required for the cameras that are connected. In practice this means that the maximum current that the VIDEO4 is likely to require is about 1A for a system with 4 cameras. The unit must be fused to protect it, for most applications a 1.5A fuse is suitable.

The voltage into the VIDEO4 sport is regulated down to 12v and then used to power the external 12v outputs on the rear connector panel for cameras etc. Note that this 12v regulator can only reduce the input voltage and if the cameras that you are using require 12v, then the power supply to the VIDEO4 must be above 12v. In practice most cameras work down to about 10v so operation is unaffected even with a relatively flat automotive battery. The VIDEO4 electronics will operate down to about 9v at which point the VIDEO4 will complete all "open" video files and shut down.

## VIDEO4 professional

The VIDEO4 professional has an improved power supply compared with the VIDEO4 sport and can operate at voltages from 6v to 35v while supplying a regulated 12v to the camera outputs. The VIDEO4 professional requires about 5W of power, plus whatever is required by the cameras, so a typical complete 4 camera system will take about 10W. If the system is run from a 12v source this equated to about 1A, if it is run from a higher voltage then this will decrease and vice versa.

# 5  VIDEO4 General Operation

This sections sets out how to operate the VIDEO4.

## 5.1 Manual start/stop logging

The user can start logging at any moment by pressing the "Start/Stop Recording" button if the unit is ready. Following steps need to be followed to manually start logging.

1. Check all cables are correctly connected including cameras, Microphone, DL1 and power.

2. A Removable CF card is inserted with enough free space.

3. Power on the VIDEO4 unit.

4. Make sure the VIDEO4 is ready to start recording by checking LED indicators (See LED indicators of the VIDEO4 for more details (Page 29))

5. Press "Start/Stop Recording" button on the front panel of the VIDEO4 to begin

6. If logging started correctly, the **Recording LED** will light up. (See LED indicators of the VIDEO4 for more details (Page 29))

To stop logging manually the same button is used. Once the button is pressed to stop, the VIDEO4 unit will finalize the files and the **Recording LED** will switch off to indicate it is ready to proceed with another recording.

**Note 1:** You can add **Auto Start/Stop recording conditions** to your graphics overlay file during the design using the **VIDEO4 Configuration Tool** (page 70). Once the overlay file is loaded into the VIDEO4 system and if Auto start condition is met, VIDEO4 system starts recording and it will continue until the Auto Stop Condition become true.

**Note 2:** When you start recording a file called "RESTART.CMD" is written to the flash card. In the even that the VIDEO4 unexpected stops, for example because power is disconnected, then the VIDEO4 will see this RESTART.CMD and immediately restart recording when it is powered back up. The VIDEO4 only removes this file when recording is stopped in one of the normal ways, i.e. with autostop or a press of the recording button.

## 5.2 Formatting a CF card

VIDEO4 unit supports Removable CF cards that are formatted with the FAT32 file systems.

To format a card on a PC please follow these steps:

1. Insert the card to be formatted into the USB2 reader on the PC
2. In the windows files explorer right click on the drive with the flash card inserted and select format
3. in the format window please ensure that "FAT32" is selected and after checking that the correct drive was selected click "ok"

Please note that it is also possible to format a CF card from the analysis software under **File -> Format Flash Card**

## 5.3 Understanding the LEDs (LED indicators of the VIDEO4)

There are four LED indicators on front panel of VIDEO4 to indicate status of the unit. It is important that users have fare knowledge on these indicators.

### 5.3.1 Stage1 (Just after power up/reset the unit)

**All 4 LEDs** will light up when the unit is powered.

**Power LED** will light up after initialising the devices and before loading the VIDEO4 firmware.

**Error States**
- **Recording LED** will light up if the file system can't be initialised. (Try changing the Removable CF card and restart the unit)
- **Status LED** will blink continuously if VIDEO4 isn't able to find the firmware file. Follow from STEP 2 of VIDEO4 Firmware Update. (Page 36)

### 5.3.2 Stage 2, Normal Operation

**All 4 LEDs** will light up again.
**Power LED** will appear in Stage **I** initialisation.
**Data Input LED** will appear in Stage **II** initialisation.
**Status LED** will appear in Stage **III** initialisation.

Status LED will blink if VIDEO4 is in the process of reflashing firmware to a device like DASH3.

**Recording LED** will appear in Stage **IV** initialisation.
Finally **Power LED** will light again to indicate the VIDEO4 has initialised successfully and ready to accept commands.

After booting, following LED indications are valid while running the VIDEO4.

- If **power LED** starts to blink, it is indicating an error state related to Removable CF card.
    - **Once** if there is no disk in Drive A:
    - **Twice** if the disk in Drive A: is full
      To recover from this state format the card or delete files currently on the card.
    - **3 times** if the disk on Drive A: is too slow,

It is not possible to record if the disk in Drive A: is too slow. To recover from this state reduce the bit rate of the video. If the same error occurs at the lowest possible bit rate the CF card in use is to slow and a faster card is needed. It is also worth trying to reformat the card again and power cycle the VIDEO4.

If you try to manually start the VIDEO4 with the front button, but the auto-stop is already true, then the VIDEO4 will not start logging. To indicate this error condition, **Power LED** will briefly go out.

- **Status LED** will light up for about 1 second and then blink few short blinks in a sequence indicating the number of cameras attached to the system.
- **Data Input LED** will blink for valid data (either from the internal sources, or the external data port) and it will continuously light up when there is a GPS Lock.
- **Recording LED** will light up when the unit begins to record a video and goes off when the unit stops recording.

If Recording LED starts to blink while recording, it is indicating that the Removable Compact Flash card is only having free space to record 10 minutes of video and about to automatically stop soon. Once the CF card has run out of space the VIDEO4 will complete all open files and stop recording.

When logging is terminated (by button press or automatically) then the Recording LED flashes rapidly to indicate that the internal buffer is being cleared and the files closed.

### 5.3.3 Low Power Mode

When the power goes low then all 4 lights flash and recording is suspended, if power returns the recording continues.

## 5.4 Suitable CF Cards

Even though most of the newer cards are compatible with the VIDEO4, we strongly recommend that they are tested for speed by doing a test recording before using them "in the field".

To test the speed of the CF card, insert it into VIDEO4 and record a long segment (5-30 minutes) at 12 Mbps. If the POWER_LED is not flashing to indicate that the disk is too slow to record, the CF card is compatible with the VIDEO4 unit.

If the POWER_LED starts blinking to indicate the disk is too slow to record, reset the VIDEO4, reduce the bit-rate and try again.

If the unit is unable to record even at the lowest bit-rate, then that type of disk is unsupported by the VIDEO4.

If you are buying CF cards for the VIDEO4 then we strongly recommend that you either buy the card directly from Race Technology, or you use a high speed card from SanDisk (at the time of writing these include Ultra II, III and IV).

## 5.5 Recording time for different card sizes

The following gives the approximate recoding time for different bit rates and different card sizes.

| Bit rate | Bytes per minute | notes | 2GB | 4GB | 8GB | 16GB | 32GB | 64GB |
|---|---|---|---|---|---|---|---|---|
| 2Mb/s | 15MB | Low quality, for minimum file size | 2 hours | 4 hours | 8 hours | 16 hours | 1 day | 3 days |
| 4Mb/s | 30MB | Good quality, ideal for track side video/data analysis | 1 hour | 2 hours | 4 hours | 8 hours | 16 hours | 2 days |
| 6Mb/s | 45MB | High quality, ideal for DVD generation with maximum compatibility | 40 minutes | 1 hour 20 minutes | 3 hours | 6 hours | 12 hours | 1 day |
| 8Mb/s | 60MB | Very high quality, most DVD player will still work at this rate | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 16 hours |
| 12Mb/s | 90MB | Maximum quality, but only suitable for playback on PCs | 20 minutes | 40 minutes | 1 hour 20 minutes | 3 hours | 5 hours | 10 hours |

## 5.6 Controlling the VIDEO4 from a DASH display

When the VIDEO4 is used in conjunction with one of our DASH products (at the time of writing DASH1, DASH2 or DASH3), then the following functions are available from the unit:

- start/stop recording
- adding a lap marker for lap and sector timing

Both of these functions work in exactly the same way as they would if the DASH unit was controlling a conventional "data only" logger.

Please refer to the DASH manual for more information.

## 5.7 Re-flashing and Configuring a DASH

### 5.7.1 Re-flash DASH2 from VIDEO4

1. Make sure both DASH2 and VIDEO4 are not powered.

2. Connect DASH2 unit to VIDEO4

3. Put DASH2 firmware file (DASH.HEX) in the root folder of a CF card.

4. Insert the CF card to External Drive of VIDEO4

5. Power the DASH2 unit and wait unit it boots up successfully

6. Power the VIDEO4 unit

7. VIDEO4 will start to re-flashing the DASH2 unit. (Refer DASH2 manual for indicators while re-flashing)

8. After competition both units will continue to their normal operation. (The DASH.HEX file will be moved to folder named DONE after successful update)


### 5.7.2 Reconfigure DASH2 from VIDEO4

1. Make sure both DASH2 and VIDEO4 are not powered.

2. Connect DASH2 unit to VIDEO4

3. Put DASH2 configuration file (DASH.DAT) in the root of a CF card.

4. Insert the CF card into the External Drive of VIDEO4

5. Power up the DASH2 unit and wait until it boots up successfully

6. Power up the VIDEO4 unit

7. VIDEO4 will start to reconfigure the DASH2 unit. (Refer DASH2 manual for indicators while reconfiguring)

8. After competition both units will continue their normal operation. (The DASH.DAT file will be moved to a folder named DONE after successful update)

## 5.7.3 Re-flashing/Reconfiguring DASH3 from VIDEO4

1. Make sure both DASH3 and VIDEO4 are not powered.

2. Connect DASH3 unit to VIDEO4.

3. Put DASH3 firmware/configuration file (DASH.HEX) in the root of a CF card.

4. Insert the CF card into the External Drive of VIDEO4.

5. Power up the DASH3 unit and wait until it boots up successfully.

6. Power up the VIDEO4 unit.

7. VIDEO4 will start to re-flash/reconfigure the DASH3 unit.
   (Refer DASH3 manual for notification messages while re-flashing/reconfiguration)

8. After competition both units will continue to their normal operation. (The DASH.HEX file will be moved to a folder named DONE after successful update)

# 6 Video4 firmware

With the aim of providing a comprehensive product, Race Technology is continuously adding more features to the VIDEO4 Video/Data Logger that will be made available to our users, typically at no additional cost. Upgrades to the firmware maybe be required to keep the hardware compatible with the latest PC software versions or to eliminate any bugs or errors that may be found.

If required it is also possible to "down grade" to old version. Finally, it is also possible to make a copy of existing firmware files and store it on the CF card. (See 6.2)

## 6.1 Method to find current firmware version

Either:

1. Connect to VIDEO4 using VIDEO4 Controller software
2. The current firmware version is displayed on bottom-right corner of the window

Or

1. Log a short data file with the VIDEO4.
2. load the run file into the analysis software.
3. the firmware version number is displayed in the run manager.

## 6.2 Taking a copy of existing firmware files (and all other files on the internal drive)

Sometimes it is desirable to keep a copy of current VIDEO4 firmware and it's configuration on the PC. To do this:

1. Insert a formatted CF card into a USB2 reader connected to a PC and create a blank text file on it using Notepad called "COPYBA.CMD"

2. Insert the flash card into the VIDEO4 unit, and power it up.

3. All the LED indicators on the front panel will light up; At this moment VIDEO4 starts to copy files

4. After a few seconds the Power LED will light up, with the other LEDs off or flashing.

5. Turn the VIDEO4 off and remove the flash card.

6. Review the contents of the flash card by inserting into a USB2 reader connected to a PC

    You will notice the firmware files are backed up inside a folder named INTERNAL (COPYBA.CMD file will be moved to the DONE folder if the copy is successful)

7. Keep a backup of the entire folder in your PC for later use

## 6.3 Update VIDEO4 with new firmware

The following steps need to be carried out to successfully update the VIDEO4 firmware.

**1.** Take a copy of the existing firmware files, and keep these on the PC in case it's required to return to a previous configuration.

**2.** To update the VIDEO4 with new firmware:

    I.   Get a copy of the latest firmware from Race Technology, email **sales@race-technology.com** for details or refer to the downloads and documents section of our website http://www.race-technology.com

    II.   Usually the latest firmware file is released in the name **UPDATE.RT6** If it is not, please rename the file to **UPDATE.RT6**

    III.   Take a blank, formatted flash card and copy the file to root directory

    IV.   Insert the flash card into VIDEO4 unit and power it up

    V.   All the LED indicators on the front panel will light up. At this moment VIDEO4 is updating its firmware

    VI.   After few seconds you will notice that the unit gets restarted automatically. Wait until the Power LED lights up (And the rest turn off or flash)

    VII.   If the firmware file is successfully updated, UPDATE.RT6 will be moved to a folder named DONE

    VIII.   Now VIDEO4 is ready to run with the updated software

## 6.4 Reverting back to old firmware (2 Methods)

### Method 1

**1.** Insert a formatted CF card into a USB2 reader connected to a PC and create a blank text file on it using Notepad called REOLDRT6.CMD

**2.** Insert the CF card into the VIDEO4 unit and power it up.

**3.** All the LED indicators on the front panel will light up -> At this moment VIDEO4 starts reverting back to old firmware version.

**4.** After few seconds you will notice that the unit gets restarted automatically.

Wait until the Power LED lights up (And the rest turn off or flash)
(REOLDRT6.CMD file will be moved to DONE folder if the operation is successful)

**5.** VIDEO4 is now running with old version.
**Note:** Following the same steps again will make the VIDEO4 revert back to new firmware version.

## Method 2

If the old firmware file exists in the PC, we can replace the firmware with that.

1. Find the file DEFAULT.RT6 within backup files.

2. Rename DEFAULT.RT6 to UPDATE.RT6

3. Now follow from STEP 2 of VIDEO4 Firmware Update. (Page 36)

# 7  VIDEO4 Configuration

All aspects of the VIDEO4 are configured using the comprehensive PC configuration software, this includes the video overlay layout, the recording quality, the automatic start and stop recording options and the automated chapter marking. For more information about the software, please see **PC software** and **VIDEO4 Configuration Tool** sections (page 70).

## 7.1 Loading a New Overlay file

1. Rename the Overlay file to DEFAULT.VGL and copy it to a formatted CF card.
2. Insert the CF card to VIDEO4 unit and power it up.
3. All the LED indicators on the front panel will light up; At this moment VIDEO4 starts to copy files.
4. After few seconds the Power LED will light up. (And the rest turn off or flash)
5. If the copy is successful, DEFAULT.VGL will be moved to a folder named DONE.
6. Now VIDEO4 is ready proceed with the new Overlay file.

**Example Layouts:**

Race Technology setup program installs more than fifty example layout files for both PAL and NTSC  with the pc software. They include both standard and widescreen resolution layouts and are in the '"Program Files\RaceTechnologyV7\VIDEO4 Configuration Tool\Example Layouts"' directory.

# 8 Lap and Sector time statistics

Lap timing operation will start automatically when you pass a track marker for the first time, with GPS lock and logging data.

After this, when you complete each sector VIDEO4 updates the following.

- **Best sector time**

  This is the best sector time that has been achieved for the sector that was last completed. This is updated as each sector is completed (as each sector marker is passed).

- **Best lap time**

  This is the best lap time that has been achieved. This is updated each time that lap is completed (as the lap marker is passed).

- **Predictive current lap time 1**

  This is an estimate of the final lap time, and is calculated using the actual times from the sectors that have already been completed and assuming that all the remaining sectors are completed in the same time that it took you during your best lap. This is updated as each sector is completed (as each sector marker is passed).

- **Predictive current lap time 2**

  This is an estimate of the final lap time, and is calculated using the actual times from the sectors that have already been completed and assuming that all the remaining sectors are completed in the best times achieved for each individual sector. This is updated as each sector is completed (as each sector marker is passed).

- **Number of the current lap**

  This is the lap number that you are currently on, this starts at 0 and is incremented by 1 every time the lap marker is passed.

- **Number of the current sector**

  This is reset to 1 when the lap marker is passes and is incremented by 1 every time a track marker is passed.

- **Best sector delta**

  This is the difference between the time that has just been achieved for the sector and the previous best time for that sector. This is updated as each sector is completed (as each sector marker is passed).

- **Best lap delta**

  The best lap delta is the difference between the current lap time, and the lap time from the best lap at the same point. This is updated as each sector is completed (as each sector marker is passed).

- **Last Lap time**

  Last lap time is simply the time for the last lap to be completed . This is updated each time that lap is completed (as the lap marker is passed).

- **Last Sector time**

  Last sector time is the time taken to complete the last sector. This is updated as each sector is completed (as each sector marker is passed).

- **Current lap time**

  This is the time up to the last sector on the lap, also sometimes referred to as a "split time" for the lap. This is updated as each sector is completed (as each sector marker is passed).

# 9 VIDEO4 Professional

## 9.1 Differences between sport (plastic) and pro (waterproof CNC'ed aluminium) versions

**Metal CNC'ed enclosure:**

The enclosure of the VIDEO4 professional is CNC machined from aluminium and is more resistant to impact and to a certain extent vibration than the VIDEO4 sport.

**Waterproof:**

The VIDEO4 professional is fully sealed with 'o' rings, and all connectors are sealed to IP66 standards.

**Deutsch connectors:**

The VIDEO4 professional uses very high quality Deutsch connectors.

**More flexible power supply:**

The power supply on the VIDEO4 professional works over a much larger range and has even more internal protection than the VIDEO4 sport.

**Passively cooled:**

The VIDEO4 professional is passively cooled using it's metal enclosure as a heatsink without the need for a fan.

# 10  VIDEO4 Options

The later models of the VIDEO4 sport have options that include:

- battery backup
- Built in GPS and Accelerometer
- 20Hz GPS
- Analogue and RPM input

These options are specified at the time of purchasing, and are not available on all units. If you are unsure about what options are available on a particular unit then you can check in several places to confirm:

1. there is a label on the bottom of the VIDEO4 which is ticked to indicate the options fitted
2. if you check on a card that has been used in the VIDEO4 unit, there will be a file called "DIAG.TXT" in a directory called "INTERNAL", part way down this file it lists what options are fitted for example, this is an extract from a unit with all options enabled:

   0000001844 4 Camera System

   0000001844 Internal GPS available

   0000001844 Internal Accelerometer 6g FSD

   0000001844 Internal analogue channels available

## 10.1 Battery backup

**Battery backup is a factory fitted optional feature of the VIDEO4 and have been specified at the time of ordering.**

A new optional feature of the VIDEO4 is a built in battery backup. This battery charges up when the unit is connected to an external 12v power source, and then keeps the VIDEO4 running for a short period when external power is lost. Using the battery backup option has 2 advantages:

- In the event that power is lost for a short time, for example during cranking the VIDEO4 continues to record without a break.
- In the even that power is unexpectedly lost at the end of recording, typically when the main power kill switch is used, then the VIDEO4 can power itself to ensure that all recordings are completed.

There are a few important limitations of the battery backup, namely:

- Because the internal battery is charged from the external supply, until the VIDEO4 has been used for a while with an external supply then the internal battery will have no charge and will not be able to power the VIDEO4.
- The internal battery is only used to power the VIDEO4 electronics, the external cameras are not powered. This means that if power is lost (for example during cranking) then although the VIDEO4 will continue to record the recording for this period maybe blank depending on whether the cameras power supply requirements have been met.

There is a configuration option in the "VIDEO4 Configuration Tool" that controls how long the internal battery runs the VIDEO4, this is under the "Configuration menu", see below. This part of the configuration is saved along with all the other configured items when you write the VGL to the memory card and load it onto the VIDEO4 in the normal way.
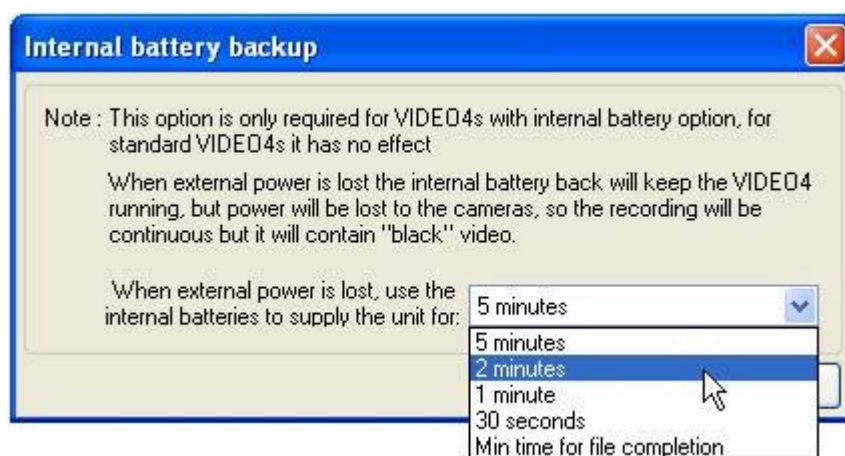
## 10.2 GPS and acceleration (2g or 6g)

**GPS and accelerometer are optional factory fitted features of the VIDEO4 and have been specified at the time of ordering.**

A new optional feature of the VIDEO4 is built in GPS and accelerometer. The GPS system is used for track mapping and speeds, the accelerometer is used to measure grip levels and braking points. With these included it makes it possible to use the system box a "single box" video/data system. An external data logger can still be connected, as well as ECU interfaces, CAN adapters etc to increase the amount of data that is available.

To use the built in GPS receiver, it is required to attach the GPS antenna to the rear of the VIDEO4 unit. Please follow all the normal guidelines when installing the GPS antenna, these are described in the following web page:
http://www.race-technology.com/wiki/index.php/Common/MountingAGPSAntenna

To use the accelerometer, the VIDEO4 must be mounted correctly in the car – that means that is must be mounted square and flat in the vehicle with the memory card and start/stop button pointing towards the rear of the car. If it is not practical to mount the VIDEO4 flat/level/square in the car then you can use the car setup options in the analysis software to correct offsets and different orientations, however the accelerations that are displayed on the live video overlay will be incorrect. Details about using alternative accelerometer setups in the analysis software are included in the following web page:
http://www.race-technology.com/wiki/index.php/VehicleOptions/Mounting

By default the VIDEO4 will take data from its external sensors when it is available, however in some more specialist configurations it might be required to configure where data is taken from. This configuration is set in the "VIDEO4 Configuration Tool", the **Configuration -> Data Configuration** menu.

There are 2 options that are available here. The normal option is to take data from the internal sensors, however as an alternative you can force the VIDEO4 to take the data from the external data port. A typical application of this might be if you want to take RPM from an ECU adapter, instead of the built in RPM input.
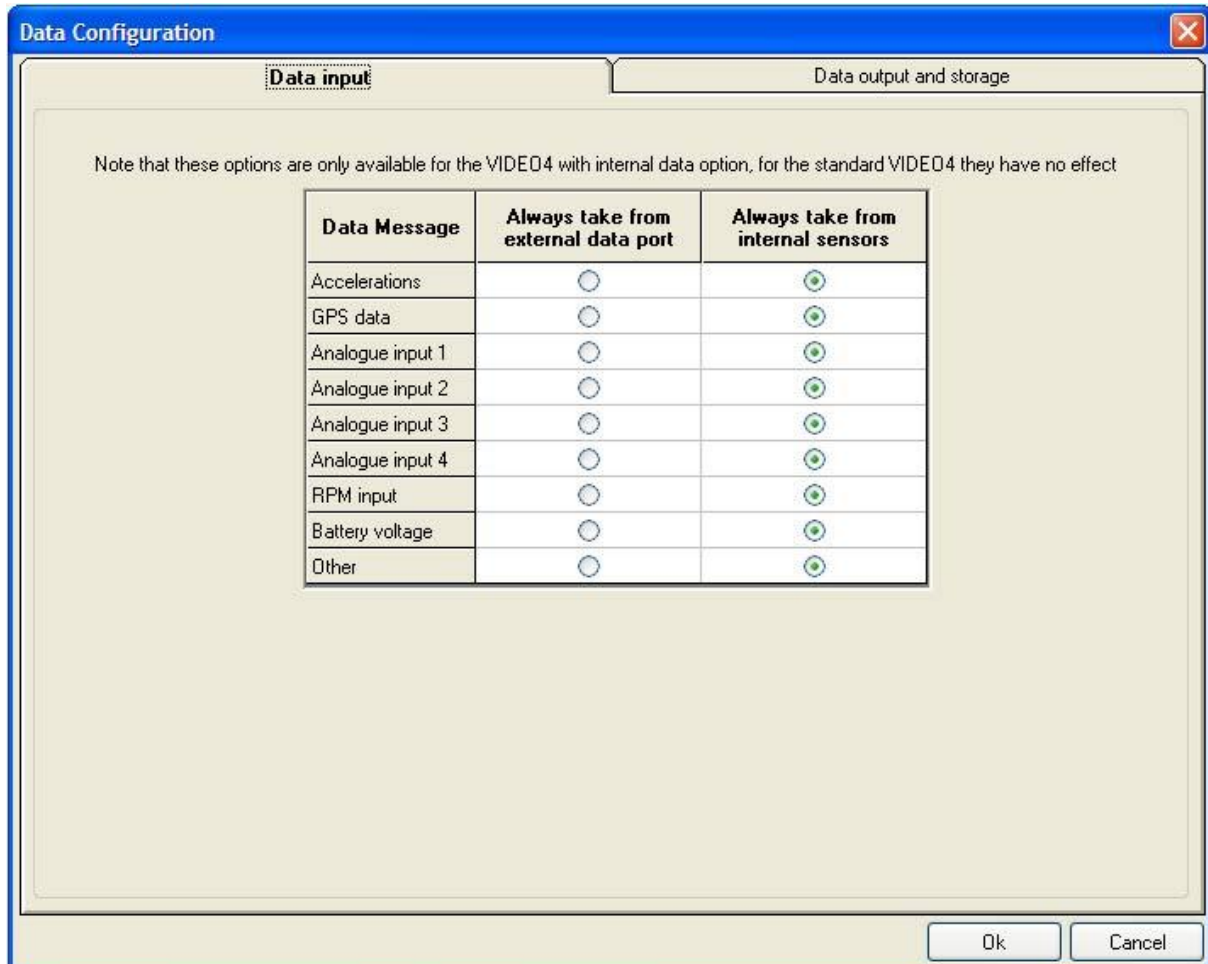


## 10.3 20Hz GPS

If higher GPS accuracy is needed than the standard GPS is capable of, then it is possible to upgrade to the 20Hz GPS system. Under good condition the error on the 20Hz GPS system is about half the error from the base GPS system. The 20Hz upgrade is an extra license that is available, and which has to be installed on the PC.
For more details, please email sales@race-technology.com

## 10.4 Analogue and RPM input

**The analogue and RPM inputs are factory fitted optional features of the VIDEO4 and have been specified at the time of ordering.**

If the analogue and RPM inputs are fitted to the VIDEO4, then the analogue inputs can be used to log data from external sensors, for example you can connect these inputs to temperature and pressure sensors. These inputs accept a voltage in the range of 0 to 5v, making them compatible with all standard Race Technology sensors. The RPM input accepts a "low level signal", that nominally goes between 0 and 12v, this is typical of the type of signal that comes from an ECU. If it's required to connect to a "high level signal", for example from an ignition coil then it is essential to use an RPM conditioner, more details are available about this here:
http://www.race-technology.com/wiki/index.php/OtherSensorTypes/RPMConditioner

for general information about connecting RPM and where to take a signal from, there is more information here:
http://www.race-technology.com/wiki/index.php/Common/ConnectingRPMSensors

for general information about connecting analogue sensors from other manufactures, please read the information here:
http://www.race-technology.com/wiki/index.php/HowDoI/DL1Connect12WireSensor

By default the VIDEO4 will take data from its external sensors when it is available, however in some more specialist configurations it might be required to configure where data is taken from. This configuration is set in the "VIDEO4 Configuration Tool", the **Configuration -> Data Configuration** menu.

There are 2 options that are available here. The normal option is to take data from the internal sensors; however as an alternative you can force the VIDEO4 to take the data from the external data port. A typical application of this might be if you want to take RPM from an ECU adapter, instead of the built in RPM input.

# 11  Two Camera and four Camera Widescreen license

The VIDEO4 is available in 2 versions:

## 11.1 2 camera

This is the "standard version" of the VIDEO4 and allows the unit to take 2 camera inputs, combine them onto a single video stream and then record them. This is done as either NTSC (the video format used in the USA) or PAL (the video format used in the rest of the world). For NTSC the recorded video is 720 x 480 pixels at 30 frames per second. For PAL the output video is 720 x 576 pixels at 25 frames per second. These standard PAL and NTSC formats are commonly referred to as "4:3 formats" as they are designed to be displayed on an "old style non-widescreen TV with an aspect ratio of 4:3". If the image is displayed on a 16:9 widescreen television, then the image either has to be stretched, in which case everything looks "fatter or wider" than it should do, or the top and bottom of the video has to be cropped, in which case some of the picture is lost.

## 11.2 4 camera and widescreen

This is the enhanced version of the VIDEO4 system and requires that the user has the optional "4 camera widescreen licence" installed in the VIDEO4. With this licence it is possible to take up to a maximum of 4 camera inputs and record either as a standard PAL or NTSC format (as described above) OR in widescreen PAL or widescreen NTSC. Widescreen NTSC is recorded at 1024 x 480 and 30 frames per second, widescreen PAL is recorded as 1024 x 576 and 25 frames per second. Note that in the case of widescreen recordings the input cameras are still only standard PAL or NTSC as these are the only types of bullet cameras currently available; so in a typical case it means that you can have 1 main camera pointing out the front at full screen, and then PIPs of the rear and driver down the left and/or right hand sides. Naturally when a 16:9 recording is played back on a widescreen television then no stretching or cropping of the video is required as a result the image is a significantly higher quality.

In both cases the VIDEO4 hardware and firmware are exactly the same, the only difference is the licensing of the unit. The licensing is done with a special file called "license.bin". This file contains a list of all the VIDEO4 serial numbers that are enabled with 4 cameras and widescreen capability, the firmware checks this list and compares it with the unit's serial number. If a match is found then the full 4 camera functionality is enabled. If you purchase a VIDEO4 from Race Technology as a 4 camera widescreen system this licence will be already loaded and no action is required. If you purchase this functionality afterwards then you will be sent to file called "license.bin", simply place this card onto the CF card's root directory and insert into the VIDEO4. If it is accepted then the file will be moved to the "done" directory. Another reboot of the VIDEO4 will be required for the licence to be activated. If required the user can check to see if the VIDEO4 has the licence installed by checking the details in the "DIAG.TXT" file within the "INTERNAL" directory of the flash card.

For those that have already got a 4 camera VIDEO4 system, all you need to do is update your VIDEO4 recorder with the latest firmware available from our website: http://www.race-technology.com/product_firmware_2_30545.html

For those that wish to upgrade their 2 camera systems to a 4 camera system with a widescreen license , please email sales@race-technology.com.

## 11.2.1 Differences between 4:3 (standard video) and 16:9 (widescreen)

Although general operation of the VIDEO4 is the same in either 4:3 or 16:9 mode, there are a number of technical differences:

- 16:9 mode records at a higher resolution compared with the 4:3 mode. The 16:9 mode is not simply a cropped 4:3 image!
- In 4:3 mode the TV output is full screen, In 16:9 mode it's compress to 50% so it fits on a normal (4:3) video output screen. In practice this means that the active area of the screen is quite small, however this live video output it still idea for camera alignment.
- Video playback of files direct from the VIDEO4 in 16:9 mode is disabled, direct playback from the VIDEO4 is only possible for files recorded in 4:3 mode.
- In 16:9 mode video files can only be recorded in I or IP format videos, in 4:3 mode you also get the option of IPB format. In theory the IPB mode gives slightly higher compression quality, in practice the difference is very small and of no practical interest.
- In 16:9 mode you can "filter" the camera inputs to make them software or sharper. In 4:3 mode this feature is disabled.
- In 16:9 mode you can have 100% pips, this is not available in 4:3 mode. (cropped) 100% PIPs are often used in 16:9 mode to have either a large view of the driver to the left or right hand side of the picture or a wide rear view camera.
- In 16:9 mode the de-interlacing is always enabled on the VIDEO4, and is done at a higher quality compared with 4:3 as it uses a more advanced algorithm.

# 12  VIDEO4 Technical

## 12.1 Technical Specification

| | |
|---|---|
| Construction | Custom designed injection molded black ABS |
| Video inputs (electrical) | Standard composite video 1v p-p, Either PAL or NTSC |
| Video encoding standard | MPEG2, constant bit rate with over-ride in the case of slow cards. Frame format, GOP length of 15, IP and B frames |
| Audio inputs (electrical) | Standard line level inputs with a maximum of 1v |
| Audio encoding standard | MP2 layer 2, typically referred to as MP2 |
| Memory | Removable CF card, formatted as FAT32. Most high speed types are compatible, SanDisk cards are recommended. |
| Status indicators | LEDs on the front panel to indicate, power supply OK, system running, incoming serial data available, GPS signal is locked, currently recording video, CF card in use (reading or writing) |
| Processor | 900MHz, 64bit DSP, 64M DDR RAM |
| Data port | data rate is upto 5 Mbit and back compatible with RS232 – compatible with all current Race Technology hardware |
| Power supply requirements | The main unit takes about 5W, at a nominal 12v this equates to about 400mA |

## 12.2 VIDEO4 Connectors

### 12.2.1 Connections – Early VIDEO4 Sport
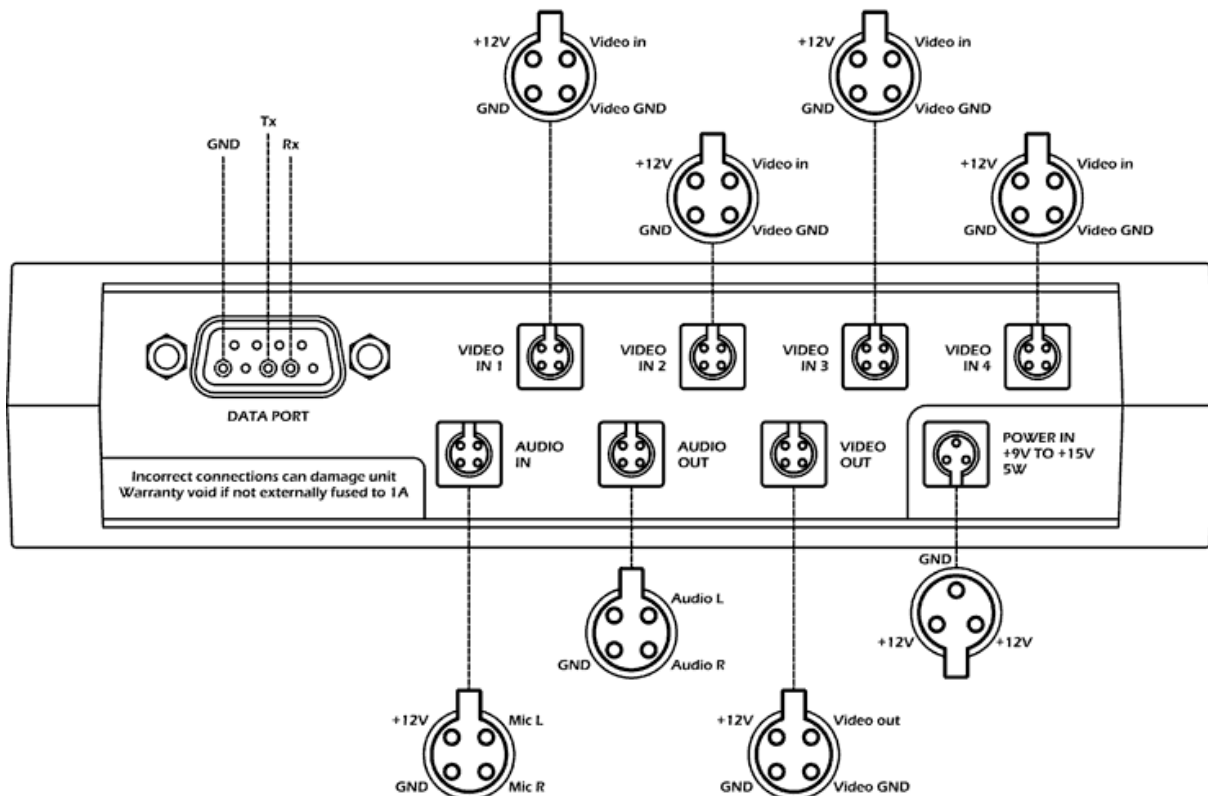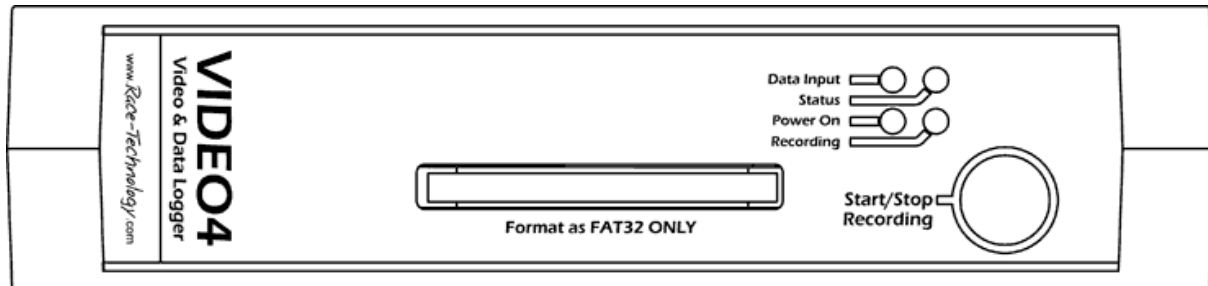
### 12.2.1.1 Part Numbers for mating connectors

**Data port**
9 pin sub-D (Farnell part number 508-2018)

**Video in 1 – 4**
4 pin round connector (binder part number 09 9767 70 04)

**Audio in**
4 pin round connector (binder part number 09-9767-70-04)

Audio out
4 pin round connector (binder part number 09-9767-70-04)

**Video out**
4 pin round connector (binder part number 09 9767 70 04)

**Power**
3 pin round connector (binder part number 09 9747 70 03)

## 12.2.2 Late Model VIDEO4 Sport Connections
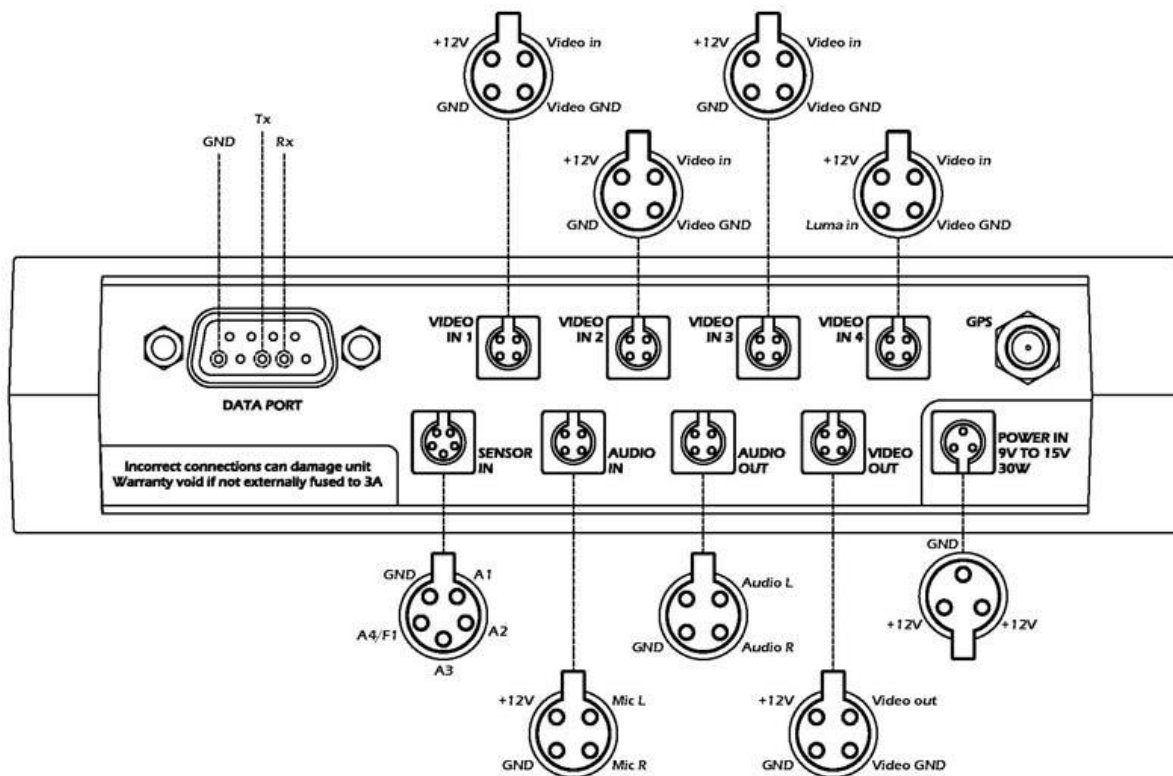
## 12.2.3 Connections - VIDEO4 Professional
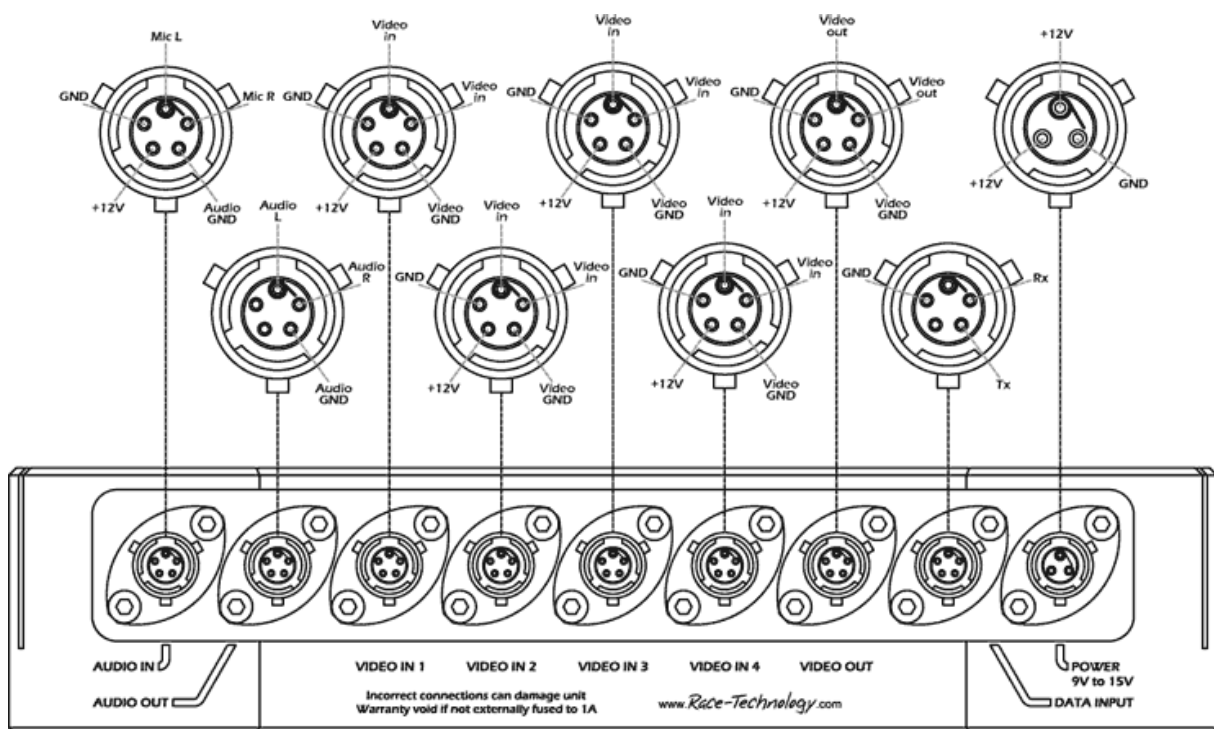
# 12.3 VIDEO4 Cables

## 12.3.1 Cables - VIDEO4 Sport

Note that all the cable lengths are 150mm as standard.

### 12.3.1.1    Video output lead
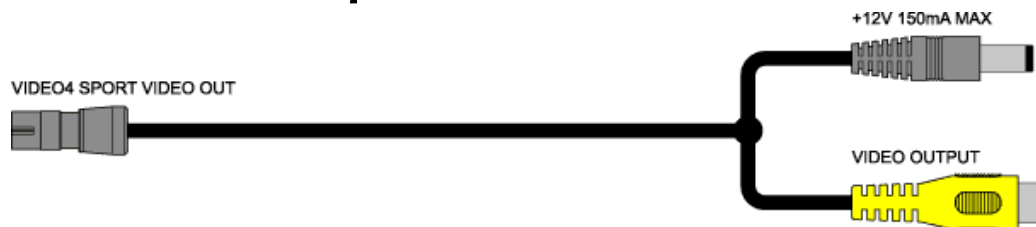


### 12.3.1.2    Video input lead
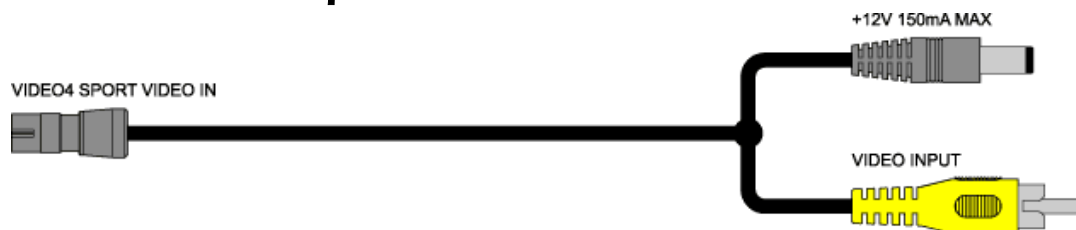


### 12.3.1.3    Audio output lead
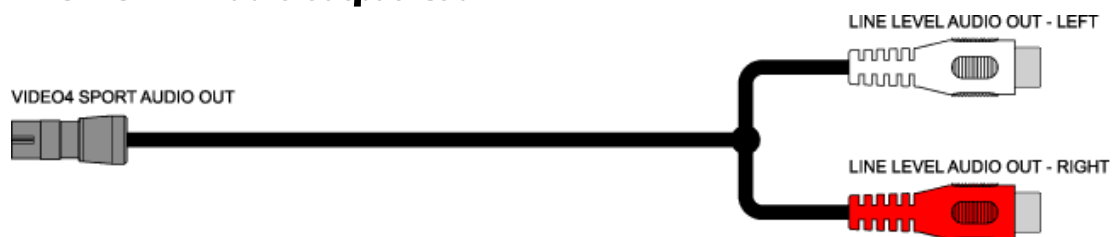


### 12.3.1.4    Audio input lead
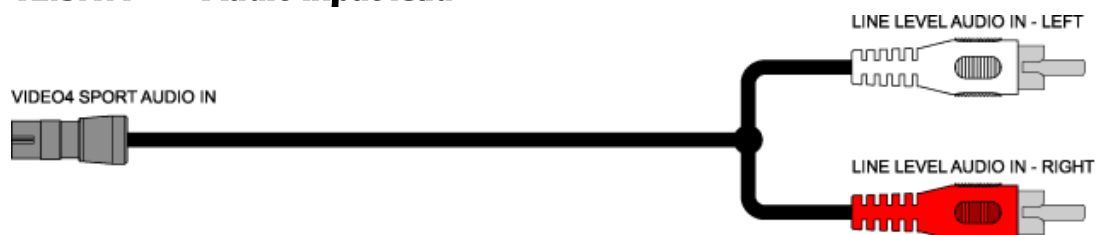
## 12.3.2 Cables - VIDEO4 Professional

### 12.3.2.1    Video output lead



VIDEO4 PRO VIDEO OUT

+12V 150mA MAX

VIDEO OUTPUT

### 12.3.2.2    Video input lead



VIDEO4 PRO VIDEO IN

+12V 150mA MAX

VIDEO INPUT

### 12.3.2.3    Audio output lead



VIDEO4 PRO AUDIO OUT

LINE LEVEL AUDIO OUT - LEFT

LINE LEVEL AUDIO OUT - RIGHT

### 12.3.2.4    Audio input lead



VIDEO4 PRO AUDIO IN

LINE LEVEL AUDIO IN - LEFT

LINE LEVEL AUDIO IN - RIGHT

+12V 150mA MAX
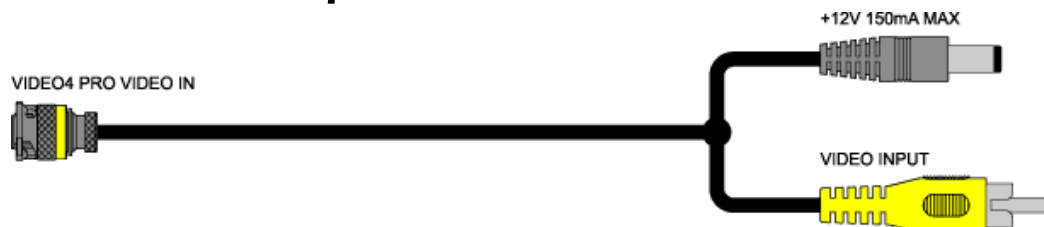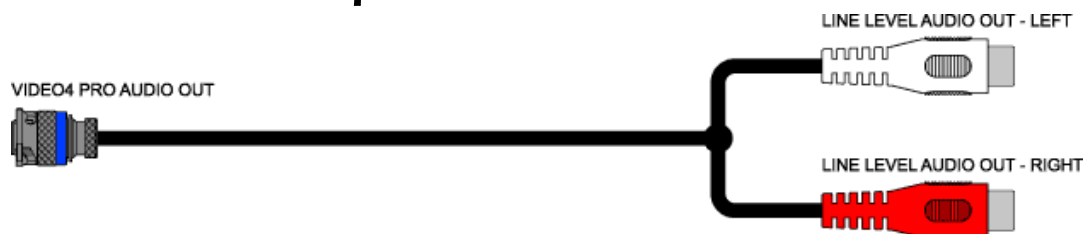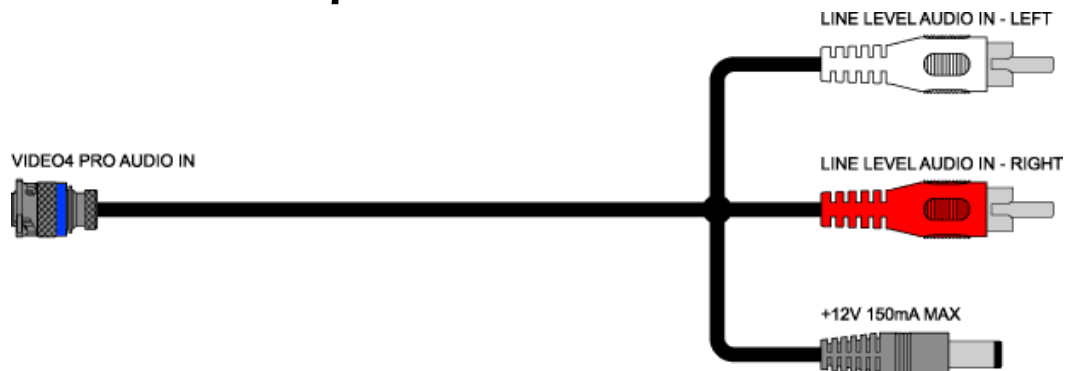
## 12.4 VIDEO4 Dimensions

### 12.4.1 Dimensions - VIDEO4 Sport
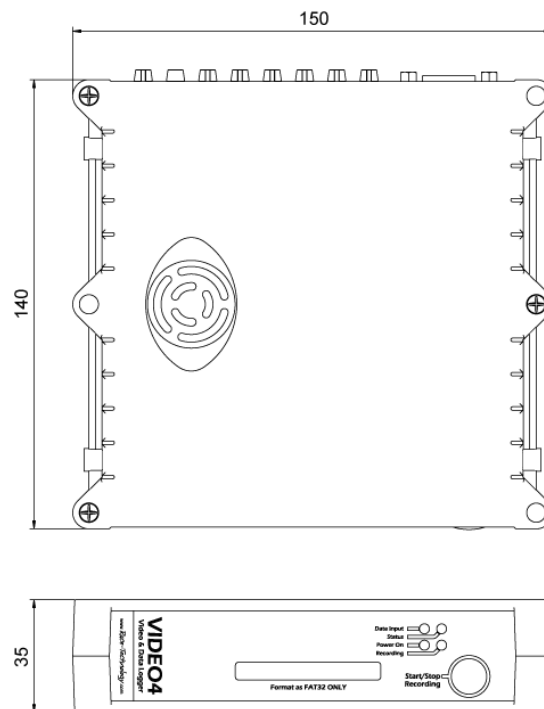


### 12.4.2 Dimensions - VIDEO4 Professional
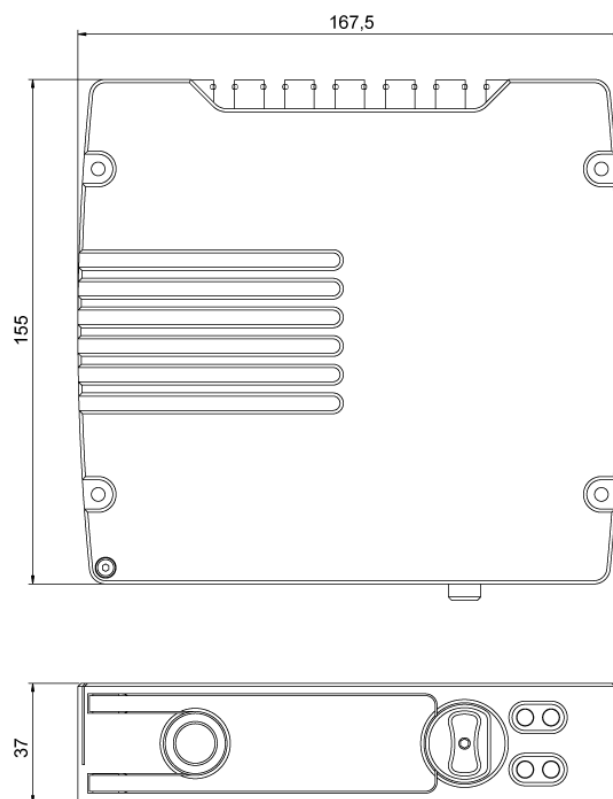
## 12.5 Power Supply Requirements

The power supplies in the sport and the professional models of the VIDEO4 unit are different in design, however both units **must have** a suitable fuse and be securely connected to the power supply.

If the power supply to the VIDEO is lost, even for a very short time due to a bad connection for example, then the VIDEO4 will stop recording, automatically close all the files that are open and shut down to standby mode.

### 12.5.1 Power Supply Requirements - VIDEO4 Sport

The VIDEO4 sport is designed to be connected to a standard 12v automotive battery, and typically draws about 500mA plus whatever power is required for the cameras that are connected. In practice this means that the maximum current that the VIDEO4 is likely to require is about 1A for a system with 4 cameras. The unit **must be fused** to protect it, for most applications a 1.5A fuse is most suitable.

The voltage into the VIDEO4 sport is regulated down to 12v and then used to power the external 12v outputs on the rear connector panel for cameras etc. Note that this 12v regulator can only reduce the input voltage and if the cameras that you are using require 12v, then the power supply to the VIDEO4 must be above 12v. In practice most cameras work down to about 10v so operation is unaffected even with a relatively flat automotive battery. The VIDEO4 electronics will operate down to about 9v at which point the VIDEO4 will complete all "open" video files and shut down.

### 12.5.2 Power Supply Requirements - VIDEO4 Professional

The VIDEO4 professional has an improved power supply compared with the VIDEO4 sport and can operate at voltages from 6v to 35v while supplying a regulated 12v to the camera outputs. The VIDEO4 professional requires about 5W of power, plus whatever is required by the cameras, so a typical complete 4 camera system will take about 10W. If the system is run from a 12v source this equated to about 1A, if it is run from a higher voltage then this will decrease and visa versa.

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## 12.6 Files Generated by the VIDEO4

There are several file types that are either required or saved whilst using VIDEO4 unit. The files that are related to a session will have the same filename with different extensions.

**1.** Video file (.VD4)

This file contains the video and audio as recorded by the VIDEO4, this is by far the largest file that is stored on the flash card.

**2.** Chapter file (.CHP)

This contains the times of the start of chapters in the video files. If this file is lost, the user will not be able to jump to special locations in the video. However the user is still able to continue with other functions.

**3.** Jump index file (.IDX)

This file contains information (pointers) to where each frame starts, for example frame 21556 starts at 8716231 bytes. This "pre-indexing" of frames allows the video file to be loaded almost instantly into the PC. If this file is missing for any reason, then loading takes from a few seconds to a few minutes depending on the length of the video file. This information is then cached in the PC temporary directory, so next time loading is instant.

**4.** RT message file (.RUN)

This file contains normal "data" for example GPS and accelerometer information, as well as any temperatures, pressures etc that were logged. This file is exactly the same format as if it had been logged using one of our other conventional "non video" loggers. This data file can be used without the video file if required.

**5.** Lap marker file (.LAP)

LAP files contain LAP marker information with respect to an origin. Once the VIDEO4 receives a GPS Lock it will match with the origin of all existing LAP files on the Removable CF card. If a matching file is found, the LAPs markers are added according to the file. If there isn't any matching LAP marker file on the CF card, the VIDEO4 unit will save a LAP file based on the origin location with LAP markers added while recording.

**6.** Internet map file (.MAP)

MAP files may contain two types of internet maps (Satellite & Road maps) with three different qualities (High, Medium and Low) related to a specific location. Any combination of map type and quality can co-exists in a single MAP file. User can set the type and quality of the image which is to be overlaid behind the Track Map by using the VIDEO4 Configuration Tool. Once the VIDEO4 receives a GPS Lock and the Track Map is set to overlay Internet Maps, it will match with the origin of all existing MAP files on the Removable CF card until it finds a file. If a matching file is found, it will immediately open it and use it to overlay map images behind the Track Map control.

## 12.7 Vibration of the main unit

The VIDEO4 main unit has been designed to very high engineering standards and is designed to cope with the levels of vibration typically seen in auto sport applications – however as with all electronics there are limits of vibration above which will cause reliability issues. It's recommended that the unit should be mounted as far as possible.

All Race Technology products are built using the latest surface mount components and the latest methods. All electronics are designed, built, checked and calibrated in the UK under our direct control to ensure that the quality is the best available. However, the electronics can only operate within certain limits of temperature and vibration.

Vibration is another important issue which can affect the long term reliability of the electronics. The exact level of acceptable vibration cannot be readily defined by the user, but a good rule of thumb is that if it looks like it is vibrating, then some sort of isolation would be beneficial. Typically, road cars and motorcycles don't normally require any additional isolation. Karts and single seater racing cars often benefit from some vibration isolation. The method of vibration isolation depends on the situation, but, generally, rubber mounts do not offer sufficient isolation, something softer and more compliant is required.

## 12.8 Temperature of the main unit

The VIDEO4 main unit dissipates about 5W of power. The VIDEO4 sport uses a very small fan to aid in temperature regulation, whereas the metal body of the VIDEO4 professional acts as a heatsink and is passively cooled.

In both cases the units must be placed away from any sources of heating (engine, exhaust etc) and surrounded by free air.

Both units have a maximum internal temperate of 70oC and above this temperature will power down into a very low power state. Once the unit has cooled down the unit will power up again as normal.

Note that for sport units fitted with the internal battery operation that it is even more important to not expose the batteries to excessive temperature. If the batteries are exposed to temperatures higher than 60C then there is a risk that the batteries will leak and fail causing internal damage that is not covered by the manufacturers warrantee.

## 12.9 How to check the CPU load, and free buffers (using the analysis software)

With data logged on the VIDEO4 there are a couple of extra channels of data that are available. Typically these do not need to be used, and are mainly used for problem solving and development. The extra channels include:

- the video frame that is associated with that time
- the CPU load expressed as a percentage, typically this will be about 75%-85% depending on the complexity of the layout, the bit rate, the encoding scheme and the content of the video.
- the number of input audio and video buffers, typically the unit will have 6 or 7 free buffers, however if the CPU load is very high then it is possible that this will dip down as low as 2 without any negative impact on video quality
- The amount of free CF buffer space, this is expressed as a percentage. Typically this will be between 80% and 100%, however if the card is generally slow then it will be lower and if there are problems with the card there maybe brief spike down to lower values.
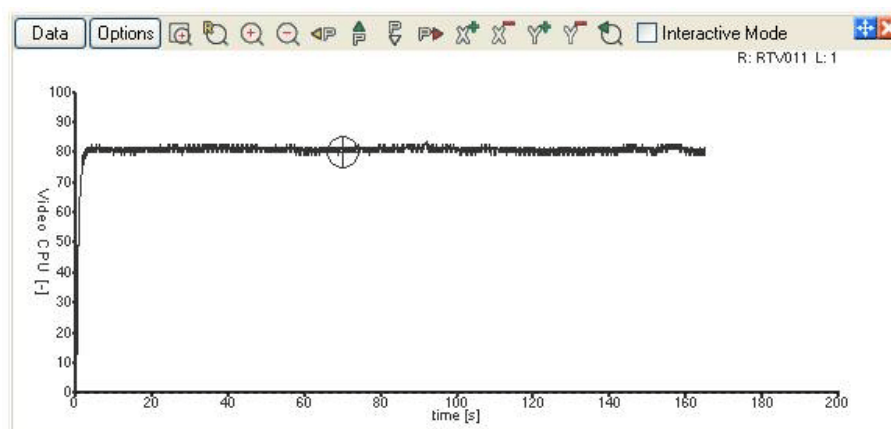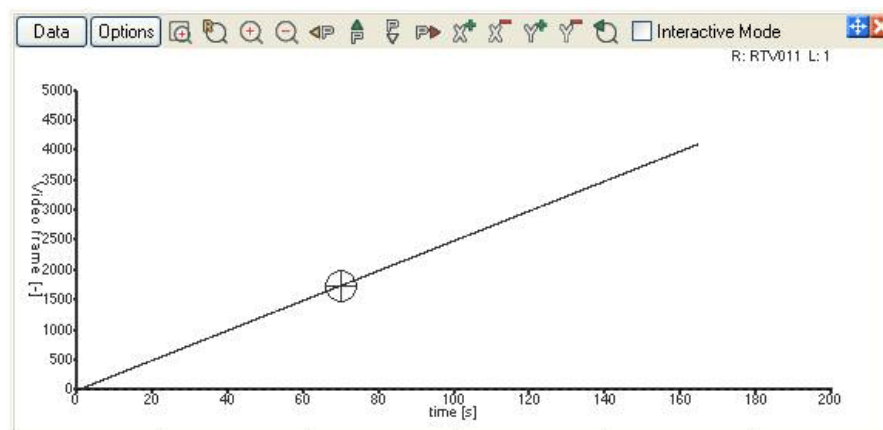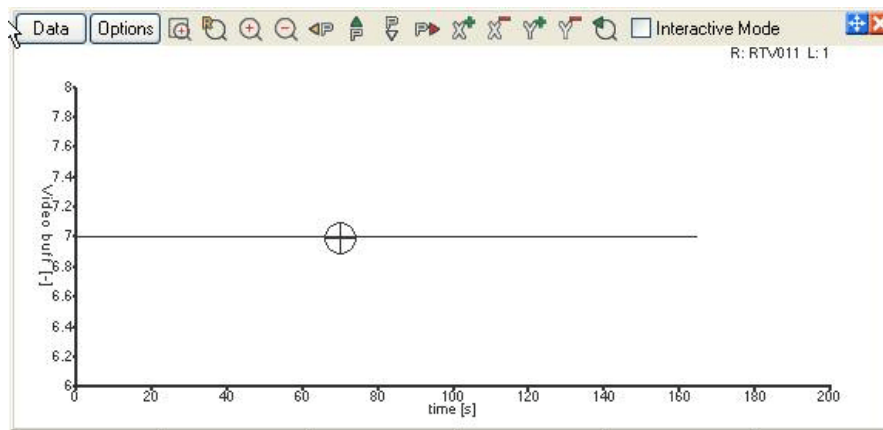
## 12.10 What format is the video file

There are 3 components to the video file that is recorded by the VIDEO4:

1.  The incoming video is encoded as MPEG2 video stream at D1 or wide-screen D1 resolution. This is exactly the same format and resolution as a DVD. The quality that the video is encoded at is set by the "bit rate", this is the amount of information that is stored to the memory card and is measured in bits per second (bps). The bps is configurable on the VIDEO4 between 2Mb/s (2 million bits per second or 250kBytes per second, 250kB/s) for a low quality recording, up to 12Mb/s (1.5MB/s) for very high quality. Note that if you are intending to use the DVD burn tool to write your video directly to a DVD, most DVD players only support video files up to about 6Mb/s although this figure does vary depending on the model.

    The bit rate that you record at depends on a number of factors:

    - **How long you want to record at, and the size of your CF card:**

        Clearly the higher the bit rate, the less time that you can record for on a given card

    - **What the data is to be used for:**

        If the video is for race analysis then typically a low bit rate is used. If the video is for presentation then typically a higher bit rate is used

    - **What cameras are used:**

        If low resolution cameras are used, there is very little benefit from recording at high bit rates

    - **Download consideration:**

        To make use of the video data the video has to be transferred from the memory card to the PC. While the USB2 card readers that Race Technology supply are very fast, long recording at high bit rates result in very large files. This is particularly a consideration when you are using the system at the track where you want to be looking at the video/data as quickly as possible

2.  The audio is recorded as an MP2 audio stream. The audio is sampled at 16bit and 48kHz. The bit rate for the audio is set for xxx. Again this was chosen to be common with DVDs. The performance of the audio in practical applications is really dominated by the microphone and making sure that it is protected from wind and isolated from vibration. Somewhat surprisingly, getting good audio is rather more difficult than getting good video in racing and automotive testing applications.

3.  The video and audio data streams are combined into a single file, this is called "multiplexing". On the VIDEO4 this multiplexing is done to MPEG1 standards. Note that this MPEG1 multiplexing is nothing to do with the standard the video is encoded to that is done using the far more modern MPEG2 standard. The multiplexing only adds header and timing information to ensure that the audio and video are correctly synchronized.

## 12.11 Video playback with 3rd party software

Although the video files generated by the VIDEO4 have the extension **VD4**, they are completely standard **MPG** files, and can be played back using other software if required.

The reason why the system uses the "non standard" VD4 is simply so it can be associated the Race Technology software without changing the configuration of the users machine.

We've tested a number of 3rd party applications:

- VLC does not play our files, we've no idea why but we were aware of this problem. There are no errors in our files, we assume it is either a compatibility problem or a bug in VLC.
- Windows Media Player uses many different codecs to play video files, so whether it can play the files recorded with VIDEO4 is entirely dependent on the configuration of the PC being used. Race Technology has not conducted a full analysis on the use of Windows Media Player with VIDEO4 recorded files and can therefore not provide additional technical support for Windows Media Player.
- The best players for the PC are commercial DVD playing software.

  Nero is "okay", PowerDVD, WinDVD are much better as these are optimized for MPEG2 whilst other players simply "support it".

In fact irrespective of the software that is used to play video on the PC, it is never as good as you get from a "real television", and there are a number of factors that effect performance:

- Smoothness of update rate

  This is always a compromise on a PC as the refresh rate of monitors is variable. All PC players we're aware of only update the screen at **approximately** 25Hz - in comparison a TV is fixed at much higher 50Hz or 100Hz.

- Colour saturation and contrast is also an issue on LCD computer monitors

  They just seem to lack the vibrancy and "life" that you get on proper TVs. The only option here is to increase the colour saturation in the software but they are still not a match for a TV.

However the biggest issue is **de-interlacing:**

All standard cameras capture video in **interlaced format**, but the PC is a progressive display. So a conversion is necessary, otherwise we will get "jaggies" with movement.

Currently the RT player uses quite simple de-interlacing method that simply filters the 2 fields together into a single frame. This eliminates the "jaggies" but in doing so you are losing some vertical resolution. De-interlacing is quite a complicated and "subtle" subject and this is the main reason why some PC based DVD players are better than others. Whilst we don't claim that the Race Technology player is as good as the very best of the commercial DVD players, it is very good and simple to operate - so for 99% of applications this is more than sufficient.

Note that if you wish to experiment with different de-interlacing settings they can be accessed from the **Decoder Settings** ⚒ in the Race Technology player.

## 12.12 Soften, Sharpen Filtering

The new Wide Screen mode of VIDEO4 supports digital image filtering that are used for softening or sharpening of the video image of main camera. (**Configuration -> Recording configuration**)

**Note:** This option is only available for wide-screen overlays.
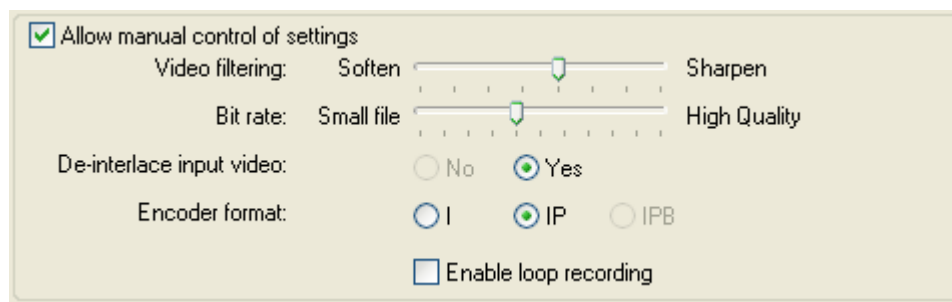


Sharpening works by increasing and exaggerating existing contrast to very small areas and edges. Because the human eye is very sensitive to contrast, the exaggerated edge contrast increases the perceived sharpness of the image. Softening works by making edges or borders in an image less prominent to make the image blur.

VIDEO4 has eight levels of advance video image filtering. The lower levels are for softening and the upper levels are for sharpening.

## 12.13 Video Problems

When playing Recorded videos using the Race technology video player some users may experience jerky video playback. If you are experiencing such a problem try the following steps.

**1.** Make sure Direct3D and DirectDraw acceleration is enabled and working without problems.

Enabling DirectX and Hardware acceleration settings will allow the PC to distribute the workload efficiently between the graphics card and central processor.
DirectX Hardware acceleration settings are enabled by default when Windows operating systems are installed. It is not necessary to change these settings later for most of the users. However some users may change these settings while doing tasks like troubleshooting. Make sure that you haven't disabled any of these acceleration settings.

Using the DirectX diagnostic tool you can find the DirectX settings on your computer. Type the **dxdiag** command on Run window to open the tool. Then open the Display page by clicking on the **Display** tab.

- Make sure that both Direct3D and DirectDraw acceleration is enabled.
- Click on the Test DirectDraw and then Test Direct3D buttons. Each will start series of tests that checks the Direct3D and DirectDraw settings. Test Results are displayed on the Notes section. Make sure that all test results are successful.

**2.** Changing the Draw method in RT Video Player

Open the Decoder settings window by clicking on the Options button  at the bottom right corner of the RT Video player. There are two draw methods available.

- **Direct3D** – this is the default draw method. If you have a newer PC with windows XP installed you will not feel not any difference in play back using either DirectDraw or Direct3D. However in Windows Vista only option we recommend is using direct3D. Vista may switch from Aero theme to Vista Basic theme if you use the DirectDraw.
- **DirectDraw** - If the PC is older, then use DirectDraw. Using Direct3D in some older computers may result a jerky video playback.

**3.** Make sure your PC meets the Recommend Specification.

**I.** Does the PC meet the requirements specified by the Operating System being used?
This is very important as the OS is not guaranteed to be either stable or perform adequately when running with a lower hardware configuration.
**II.** What is the recommended configuration required by the Race Technology software bundle?

- Windows XP or Windows Vista operating system
- Intel Core2Duo 2 GHz with 4 MB Cache (or compatible)
- Intel original motherboard (or compatible)
- 2 GB DDR II/III RAM
- 120 GB hard disk
- Graphics card with 256 MB DRAM

## 12.14  Detecting why a VIDEO4 unexpected stopped recording

There is nothing more frustrating than getting back to the pits to find that you've either got a partial set of data. This page is intended to help you identify why the VIDEO4 stopped logging at a particular time. The reasons are given in the approximate order or likelihood based on our experience supporting the VIDEO4 since it was launched.

### 12.14.1 Power supply problems (or over temperature)

Check the files in the directory and look at the names of the files. The last file that gets updated in the directory is the IDX file – if there was not time for the VIDEO to properly complete the file then it will have the extension "ID~". This normally indicates that either:

- the VIDEO4's power supply was unexpected lost, or the voltage dropped below 9v. Note that the loss of power needs only to be very brief to cause a problem.
- the VIDEO4 got too hot and shutdown to protect the components, this happens when the unit gets to abut 70 degrees C. When the unit goes over temperature, power is removed from the main board and so the symptoms are the same as for a shutdown due to loss of power.

Of these the loss of a good power supply is by far the most common problem, and it can be triggered by either the voltage going to low due to a poor battery/charging system or a momentary loss of power due to a bad connection in the power supply. If problems persist then it's often convenient to try running the VIDEO4 directly from it's own battery with a direct connection.

Note that if the power supply is lost, the VIDEO4 should automatically start up as soon as the power is available again. This is done with the "RESTART.CMD" file:

- When the VIDEO4 starts recording for any reason (manual, autostart, remote start) then the file "RESTART.CMD" is immediately written to the root directory of the compact flash card.
- When the VIDEO4 stops logging in a controlled way then this file is deleted.
- If the VIDEO4 starts up and sees this file on the card then it immediately starts recording

This means that if the VIDEO4 didn't stop recording "properly", for example due to over temperature or loss of power, then as soon as it restarts it will see this file and resume recording. So if you see this RESTART.CMD file on the compact flash card it is another sign that the recording was not correctly terminated.

### 12.14.2 Card full

If the card is full and loop mode is not enabled then the VIDEO4 will simply stop recording. If the recording has terminated due to a full card then the power light will be blinking twice.

### 12.14.3 Autostart/stop enabled

Since the VGL file can be used to set up autostop conditions, then this is a possible source of error. Check that the autostop conditions have been set correctly, or if in any doubt at all remove the autostop condition.

### 12.14.4 Failed card

This is surprisingly common failure mode in motorsport where the cards are getting "a hard life" with large temperature extremes and high levels of vibration etc - compact flash cards have to be considered as a "consumable". It's a very different application to a typical digital camera! Sandisk cards tend to be the most reliable, however be aware that most of these cards available on the internet are counterfeit. For this reason we strongly recommend buying them from a large and reputable retailer. If the VIDEO4 seems to behaving erratically, then trying a brand new, good quality memory card is a good place to start.

### 12.14.5 Incorrect system configuration

It is possible for the VIDEO4 to stop logging if it is incorrectly configured, please check the pages on "connecting systems". The most important thing here is that if there is no DASH in the system then the VIDEO4 should be set to not output any data. If set up incorrectly then the data bus can get overloaded, generating 1000's or errors and eventually sees the correct sequence to cause it to "stop logging"

### 12.14.6 Vibration

Although the VIDEO4 is solid state and therefore largely immune to vibration, there are limit above which it will not work. The limiting factor is the contact between the flash card and the VIDEO4. At high levels of vibration the card will momentarily lose contact with the pins on the VIDEO4, or in extreme cases the memory can can get ejected from the unit.
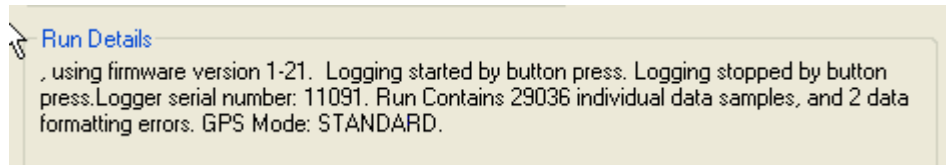
### 12.14.7 Card too slow

If the card is an older type, or the bit rate has been set very high it is possible to get recording to stop as the VIDEO4 cannot get the data onto it quickly enough. In most cases this will not occour as the VIDEO4 will automatically reduce the data rate, so although the video quality will be reduced, the recording will continue. This normally happens when there are internal errors on the memory card, which can completely block writes to it for several seconds. If the card is too slow then it's best to simply replace it for a better card – generally we recommend a genuine Sandisk card, or buy a card from us that we've tested at the maximum data rate. Note that most memory cards do have a speed rating printed on them, eg "10x" "40x" "100x" however this is more to do with marketing than actual performance, so buying a card with a particular speed rating is not an absolute guarantee it is fast enough, although it might be taken as an "indication" of performance. If recording does fail due to a slow memory card then the recordings will be completed correctly, and the power light will be blinking 3 times.

### 12.14.8 The VIDEO4s firmware crashed

Before we release any new VIDEO4 firmware we test it recording with all options enabled, recording at the maximum bit rate in loop mode recording for several days continuously. We then follow this up with road and track testing – but it's always possible that there are "bugs" in the firmware. If the recording fails due to a bug then the "internal" directory will contain a special file "RTCGXXX.TXT", email this file to Race Technology and we can check the source. Note that since the VIDEO4 was launched we've not had a single confirmed report of a failed recording due to firmware – so while it's possible, this is unlikely to be the cause.

### 12.14.9 General diagnosis

If the VIDEO4 is able to correctly complete the files before recording was terminated, then load the run file into the analysis program and check in the run manager. This will normally give the reason why the recording was terminated:

Run Details
, using firmware version 1-21. Logging started by button press. Logging stopped by button press.Logger serial number: 11091. Run Contains 29036 individual data samples, and 2 data formatting errors. GPS Mode: STANDARD.
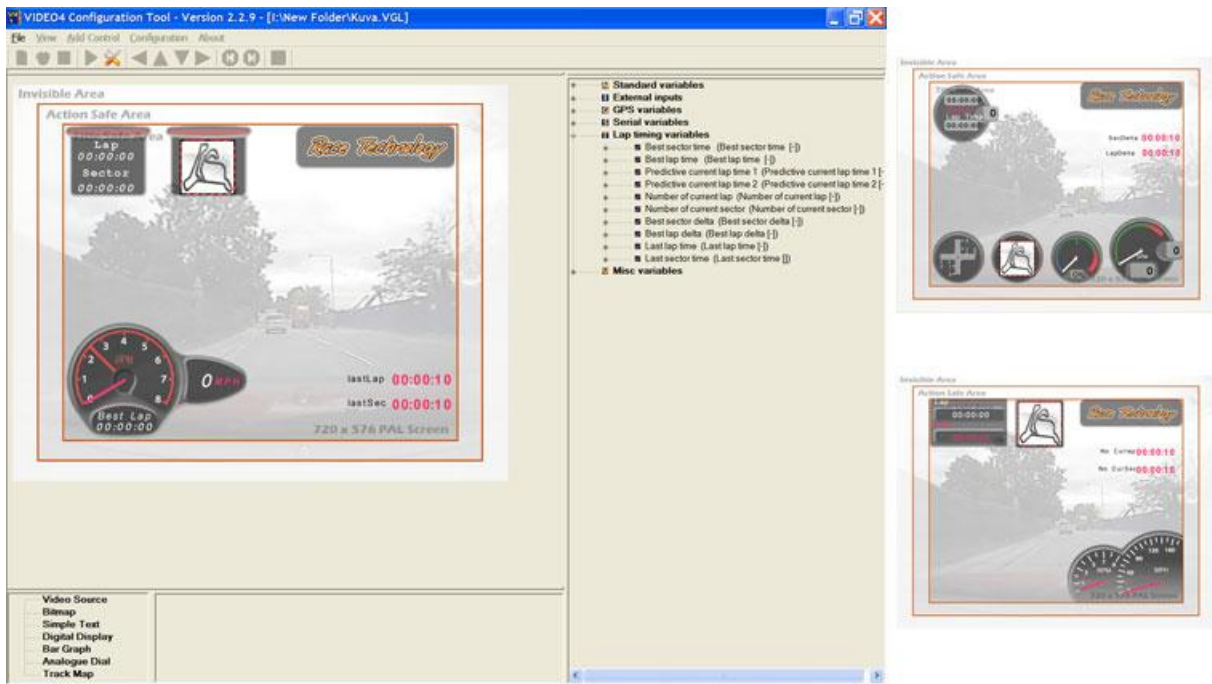
# 13 PC software

This is a quick introduction to what the software does; full instructions are in the software section in the Race Technology website:

(http://www.race-technology.com/wiki/index.php/VideoSoftware)

## 13.1 RT VIDEO4 Configuration Tool



**RT VIDEO4 Configuration Tool** is used to design comprehensive video overlay files that can be loaded to the VIDEO4 unit.
(http://www.race-technology.com/wiki/index.php/VIDEO4ConfigurationTool)

In addition to the four video sources that are placed practically in any combination (as picture-in-picture inputs), it is possible to add several types of high resolution, true colour and fully configurable graphics overlay objects, such as:

- Bitmaps
- Text
- Digital display
- Bar graph
- Analogue dials

Users are able to create their own overlay design using the video sources and overlay objects in any combination using the RT VIDEO4 Configuration Tool. These objects can be assigned to RT Variable IDs which can control those objects dynamically (For example assigning SPEED variable to speedometer). The user can configure many settings using this tool including video format (NTSC or PAL), Video Bit rate, Recording Format (I, IP, IPB), Audio Volume, Chapter mark conditions and Brightness, Contrast, Saturation, Hue for each video input.

## 13.2 RT Analysis

**RT Analysis** software is used to analyse the video in parallel with data. Please read RT Analysis software documentation for more details.

(http://www.race-technology.com/wiki/index.php/Software/MainAnalysisSoftware)
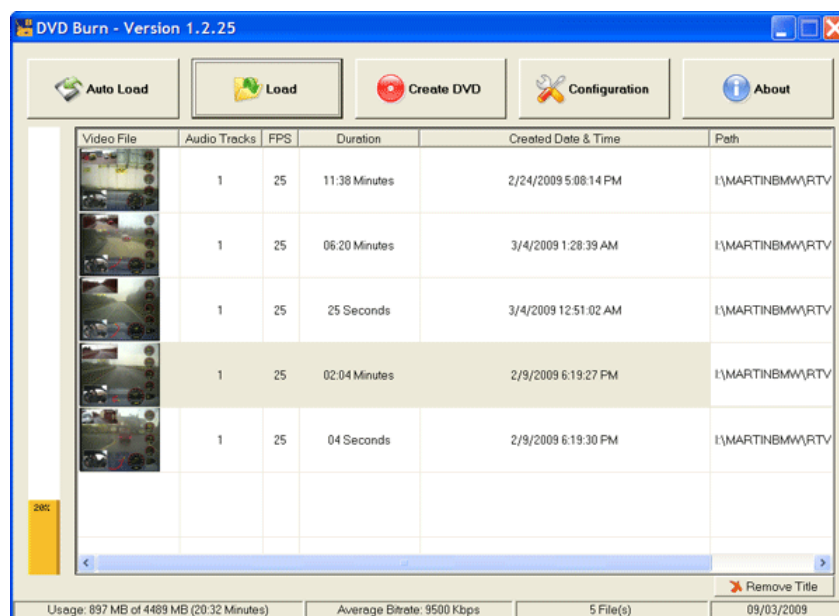
## 13.3 RT Video Playback

**RT Video Playback Tool** is used to playback video files with VD4 extension. Standard playback features like Play, Pause, Fast Forward, Rewind are provided with extensive fast frame jumping capabilities. Please read RT Video Playback Tool documentation for more details.
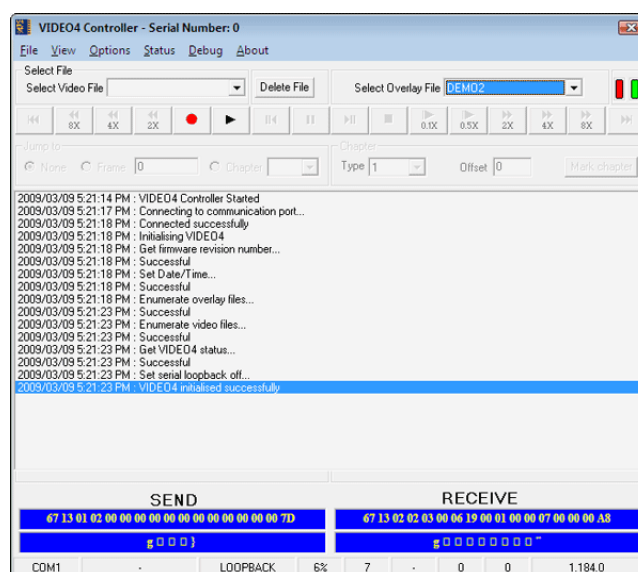
(http://www.race-technology.com/wiki/index.php/VideoSoftware/VideoPlayback)

## 13.4 RT DVD Burn

**RT DVD Burn Tool** can be used to write the video files to a DVD disk which can be played back on any hardware DVD player. Please read RT DVD Burn Tool documentation for more details. (http://www.race-technology.com/wiki/index.php/VideoSoftware/DVDBurn)



## 13.5 RT VIDEO4 Controller

**RT VIDEO4 Controller** software can be used to operate, test and simulate recording and playback capabilities of the VIDEO4 controller. This is very useful for developers who are expecting to develop third party software based on VIDEO4 hardware. See RT VIDEO4 Controller software documentation for more details.
(http://www.race-technology.com/wiki/index.php/VideoSoftware/Video4Controller)



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# 14  FAQs

# 1. Why does the unit reboot when I insert a CF card?

Once a new CF card is inserted, the VIDEO4 needs to load the file system, analyse errors on each file and proceed with firmware/overlay copy process based on the newly inserted card. To complete this task correctly, the VIDEO4 needs to reset itself and boot the system from the beginning.

# 2. How do I reset the unit completely?

1. Take a formatted CF card and place two blank files named to COPYBA.CMD and FORMATB.CMD. These files can be created using an empty notepad document.
2. Insert the disk and power on the VIDEO4 unit.
3. The existing firmware files will copy to a folder named "INTERNAL" and the VIDEO4 will reset completely.
4. Update the firmware again on VIDEO4 (see *Update VIDEO4 with new firmware* - page 23)

# 3. Why does the picture look better on my TV compared with the computer?

Televisions (Both PAL & NTSC types) are capable of displaying YUV422 images directly. Those have built-in functions for filtering and smoothing images that are coming from standard cameras. However the PCs are incapable of displaying YUV graphics directly. To display graphics on a PC monitor, it is required to convert YUV images to RGB format. This conversion can add distortion to the image that may affect the overall quality of the picture when viewed on a PC.

# 4. What does "interlaced mean"?

Interlace is a technique of improving the picture quality of a video signal primarily on CRT devices without consuming extra bandwidth. Interlaced scan refers to one of two common methods for "painting" a video image on an electronic display screen (the second is progressive scan) by scanning or displaying each line or row of pixels. This technique uses two fields to create a frame. One field contains all the odd lines in the image; the other contains all the even lines of the image. A PAL based television display, for example, scans 50 fields every second (25 odd and 25 even). The two sets of 25 fields work together to create a full frame every 1/25th of a second, resulting in a display of 25 frames per second

# 5. What is a PIP?

PIP stands for Picture in Picture. This is a very useful feature which embeds video images (mostly resized to smaller sizes) on to another full screen video. With PIP, user can see recordings from many cameras at once on the same video output. In VIDEO4, all four video inputs supports PIP so that the user can place them in any combination using RT VIDEO4 Configuration Tool. In addition to resizing of PIP images, the user can crop margins, add a nice border in any colour and even mirror the image.

For example, we can design an Overlay file by placing a windscreen camera as the background, camera focusing at pedals as a ¼ PIP on a side and the view from a camera

facing backwards can be made to look like the actual rearview mirror by placing it over the actual rearwiev mirror, mirroring the image, and adding a border.

## 6. How much graphics can I have on the screen at once?

For the convenience of the user, the number of graphical objects that can be added to an Overlay file is not limited in VIDEO4. However the user must aware that there will be frame drops (missing frames) in the file with a complicated Overlay file. User can notice the CPU load while recording with the Overlay file by using RT VIDEO4 Controller Tool. In case the CPU Load of the VIDEO4 unit exceeds 100% with the Overlay file, the graphics need to be reduced to avoid frame drops.

## 7. Why do you use the extension .VD4 for the video files?

VD4 files are created by multiplexing a Standard MPEG2 video stream with a Standard MPEG1 Audio Layer II stream. These files are fully compatible with any PC Media Player available up to date.

However, in addition to the VD4 file, the VIDEO4 unit records data coming from Standard data logging equipments like DL1 in parallel to Video file to make a perfectly synchronized analysis. These files are later used for further analysis by our set of tools including RT Analysis. This combination has made the Video files recorded from a VIDEO4 somewhat different than ordinary MPEG files. So for the ease of identifying the files, we have used a separate extension, VD4, to differentiate it from standard MPEG files.

## 8. What are Chapters and use of them?

Chapters are used to mark specific locations in a VD4 file. These important locations of the video mostly consist of special events such as over speed, breaking, other specified violations, etc… Overlay file is used to define chapters based on Variable changes. Please refer to RT VIDEO4 Configuration Tool for more information.

DVD Burn software captures Video files along with Chapters and records them on DVDs. DVDs that are recorded with chapters allow the user to jump to the locations designated by these chapters instantly on standard DVD players. The chapter file is saved in a .CHP extension along with the VD4 file.

## 9. What are the other files used for and what happens if I lose them?

There are a few types of files that are saved along with video in the VIDEO4 unit. They all share the same filename, but the extensions are different to specify each file type.

**1.** Chapter file (.CHP)

Please refer to "What are Chapters and use of them?" for more information. If this file is lost the user will not be able to jump to special locations in the video. However other functionalities are still available.

**2.** Jump index file (.IDX)

This is used by RT Video Playback Tool & RT Analysis software for fast video frame jumps and scrolling. This is important for large video files. If lost the PC will build this before playing the video, which can take a long time.

**3.** RT message file (.RUN)

This file contains data from standard data loggers like DL1 that are recorded in parallel to the video. This file is very important as if it is lost all the data recorded with the data logger in that session will be lost.

**4.** Lap marker file (.LAP)

If there isn't any matching LAP marker file on the CF card, the VIDEO4 unit will record a LAP file based on the origin location and LAP markers added while recording.

## 10. What specification of PC is required?

There are few aspects to consider in the PC configuration.

**1.** Does the PC meet the requirements specified by the Operating System being used?

This is very important as the OS is not guaranteed to be either stable or perform adequately when running with a lower hardware configuration.

**2.** What is the recommended configuration required by the Race Technology software bundle?

- Windows XP operating system
- Intel Core2Duo 2 GHz with 4 MB Cache (or compatible)
- Intel original motherboard (or compatible)
- 2 GB DDR II/III RAM
- 120 GB hard disk
- Graphics card with 256 MB DRAM

## 11. How to improve Performance of the PC software?

There are two important points to consider in particular.

**1.** Run the software on a PC of at least the recommended configuration

More importantly use a multi-core CPU like Intel Core2Duo which can process few software programs at once rather than a legacy single core CPU like Intel Pentium III. All modern CPUs are multi-core so this point is only relevant for users with old PCs. Use enough Random Access Memory (RAM) to reduce Virtual memory usage.

**2.** Enable DirectX and hardware acceleration from the operating system.

This will allow the PC to distribute the workload efficiently between the graphics card and central processor.

## 12. Can I use my video editing software to change edit the video files and add titles etc…?

This is possible since VD4 files are fully compatible with the MPEG standard. However there can be compatibility issues with RT Analysis and Video Playback Tool. For example, if the number of frames changes, the data file (.RUN) will not be synchronized with the VD4 file any longer. Similarly the Chapter file (.CHP) can be pointing to invalid frames with the same cause.

## 13. Why do I get "jaggies"?

All standard cameras capture video in **interlaced format**, but the PC has a progressive display so a conversion is necessary, otherwise we will get "jaggies" with movement.

It can depend on the video playback software how good the de-interlacing is and therefore whether "jaggies" are seen or not.

Currently the RT player uses quite simple de-interlacing method that simply filters the 2 fields together into a single frame. This eliminates the "jaggies" at a slight cost of vertical resolution.

Note that if you wish to experiment with different de-interlacing settings they can be accessed from the **Decoder Settings** in the Race Technology player

## 14. How to check the CPU load and free buffers (using the analysis software)

With data logged on the VIDEO4 there are a couple of extra channels of data that are available. Typically these do not need to be used, and are mainly used for trouble shooting and development.

The extra channels include:

- **the video frame that is associated with that time**

- **the CPU load expressed as a percentage**
  Typically this will be about 75%-85% depending on the complexity of the layout, the bit rate, the encoding scheme and the content of the video.

- **the number of input audio and video buffers**
  Typically the unit will have 6 or 7 free buffers, however if the CPU load is very high then it is possible that this will dip down to as low as 2 without any negative impact on video quality.

- **The amount of free CF buffer space**
  This is expressed as a percentage. Typically this will be between 80% and 100%, however if the card is generally slow then it will be lower and if there are problems with the card there maybe brief spikes down to even lower values.

## 15. My files take ages to load… what can I do to improve this?

The user is most probably using either a legacy USB reader or a USB 1.1 port on the PC. The reader problem can be sorted out by using a new reader with a USB 2.0 interface. If the port of the PC is USB 1.1, then the user might need to upgrade the PC with a USB 2.0 expansion card.

## 16. How long can I record video for?

| Bit rate | Bytes per minute | notes | 2GB | 4GB | 8GB | 16GB | 32GB | 64GB |
|---|---|---|---|---|---|---|---|---|
| 2Mb/s | 15MB | Low quality, for minimum file size | 2 hours | 4 hours | 8 hours | 16 hours | 1 day | 3 days |
| 4Mb/s | 30MB | Good quality, ideal for track side video/data analysis | 1 hour | 2 hours | 4 hours | 8 hours | 16 hours | 2 days |
| 6Mb/s | 45MB | High quality, ideal for DVD generation with maximum compatibility | 40 minutes | 1 hour 20 minutes | 3 hours | 6 hours | 12 hours | 1 day |
| 8Mb/s | 60MB | Very high quality, most DVD player will still work at this rate | 30 minutes | 1 hour | 2 hours | 4 hours | 8 hours | 16 hours |
| 12Mb/s | 90MB | Maximum quality, but only suitable for playback on PCs | 20 minutes | 40 minutes | 1 hour 20 minutes | 3 hours | 5 hours | 10 hours |

## 17. What happens when my card if full?

Once the card is almost full (within a few MB) all open files are completed and the recording is stopped. A full card is indicted by flashing the power light.

## 18. I've done a long recording and I've got multiple 4GB files, what's going on?

The maximum file size for FAT32 is 4GB, once a file gets to this size, the recording is paused, the file closed, a new file opened and recording resumed.

## 19. Why not use NTFS?

The format of NTFS is kept secret by Microsoft and there is currently no practical or legal way of 3rd parties using this format. FAT32 is also simpler to implement on an embedded system.

## 20. How is the video/audio recorded?

There are 3 components to the video file that is recorded by the VIDEO4:

**1.** The incoming video is encoded as MPEG2 video stream at D1 resolution. This is exactly the same format and resolution as a DVD. The quality that the video is encoded at is set by the "bit rate", this is the amount of information that is stored to the memory card and is measured in bits per second (bps). The bps is configurable on the VIDEO4 between 2Mb/s (2 million bits per second or 250kBytes per second, 250kB/s) for a low quality recording, up to 12Mb/s (1.5MB/s) for very high quality. Note that if you are intending to you the DVD burn tool to write your video directly to a DVD, most DVD players only support video files up to about 6Mb/s although this figure does vary depending on the model.

The bit rate that you record at depends on a number of factors:

- **How long you want to record at**, and the size of your CF card. Clearly the higher the bit rate, the less time that you can record for on a given card

- **What the data is to be used for**. If the video is for race analysis then typically a low bit rate is used. If the video is for a presentation then typically a higher bit rate is used

- **What cameras are used**: If low resolution cameras are used, there is very little benefit from recording at high bit rates

- **Download consideration:** To make use of the video data the video has to be transferred from the memory card to the PC. While the USB2 card readers that Race Technology supply are very fast, long recording at high bitrates result in very large files. This is particularly a consideration when you are using the system at the track where you want to be looking at the video/data as quickly as possible

**2.** The audio is recorded as an MP2 audio stream. The audio is sampled at 16bit and 48kHz. The bit rate for the audio is set for xxx. Again this was chosen to be common with DVDs. The performance of the audio in practical applications is really dominated by the microphone and making sure that it is protected from wind and isolated from vibration. Somewhat surprisingly, getting good audio is rather more difficult than getting good video in racing and automotive testing applications.

**3.** The video and audio data streams are combined into a single file, this is called "multiplexing". On the VIDEO4 this multiplexing is done to MPEG1 standards. Note that this MPEG1 multiplexing has nothing to do with the standard the video is encoded to, that is done using the far more modern MPEG2. The multiplexing only adds header and timing information to ensure that the audio and video are correctly synchronized.

## 21. What is alpha blending?

Alpha blending is an advanced technique that is used to make the displayed graphics partially transparent. For example you can add a dial to the video that is "alpha blended" by 50% which means that when you watch the video you can clearly see the overlaid dial without completely obscuring the picture behind. Alpha blending also improves the look of the overlaid graphics as they can be blended out at the edges. This makes them look smooth and professional. Without this the overlay would look "blocky" rather like "teletext" graphics. The alpha blending on the VIDEO4 supports both a "global" setting for the object which affects the whole object and also "pixel by pixel" blending which allows different pixels in the object to be individually controlled.

## 22. Can the VIDEO4 be used as a standalone data logger?

No. the VIDEO4 is a video recorder - it accepts data from our range of data loggers and stores this data alongside the video. These include the DL1, DL2, AX22 and SPEEDBOX products.

## 23. Can the VIDEO4 be used to play the video back in the car?

Yes. The VIDEO4 has a standard composite video output port available.

## 24. What types of video camera is the VIDEO4 compatible with?

Any standard cameras with a composite output are compatible.

## 25. What resolution does the VIDEO4 record at?

The VIDEO4 records at D1 resolution; which is the same as that used on DVDs and broadcast video. For PAL this is 720x576 and 25 frames per second and for NTSC this is 720x480 and 29.97 frames per second.

## 26. Why doesn't the VIDEO4 use MPEG4 or H.264?

MPEG2 was primarily chosen in order to make the VIDEO4 compatible with the DVD standard. Contrary to some reports, MPEG4 does not offer any significant advantage over MPEG2 and hence is not widely used in professional applications. The newer H264 does certainly offer significant benefits in terms of compression, but it is far slower to encode and decode.

## 27. What type/size of flash memory can the VIDEO4 use?

We use CF cards formatted as FAT32. This makes the files directly readable by Windows. CF format was chosen, as it is available in the largest sizes of all removable media and is also the fastest - this is important for video applications.

## 28. What format is the recorded data in?

The data is stored in the standard RUN file format, as it is will all our products. The details of this format can be found in the knowledge base on our website.

## 29. What format is the video recorded in?

The video and audio are stored as a standard MPG file.

## 30. How many video channels can the VIDEO4 record?

Currently one D1 video channel is recorded, which can contain a main video stream with up to three PIPs overlaid on it. Future firmware may support multiple video streams.

## 31. Is the VIDEO4 waterproof?

The VIDEO4 Sport enclosure is custom made and of the highest quality, but it is not waterproof. The unit should, therefore, be protected from all normal levels of moisture encountered during standard applications.

The VIDEO4 Pro enclosure is a waterproof. The enclosure is made from CNC machined aluminium and sealed with O-rings and all connectors are sealed to IP66 standards

## 32. Is it upgradeable?

Yes. Firmware updates will be available in the future. All firmware updates can be found under downloads and documentation on our website http://www.race-technology.com

## 33. What specification of PC is required?

Video is demanding on the PCs resources. Our standalone player and analysis software are, however, optimized to minimize the requirements. A modern, entry level PC or laptop is more than adequate.

## 34. How do I transfer the video and data onto my PC?

Data and Video are read from the CF card using a reader. A good quality USB2 reader is essential for high transfer speeds.

## 35 Why don't the values on the VIDEO4 and the analysis software match exactly?

There are 2 reasons why there can be slight differences:

1. The time alignment in the overlay is slightly out compared with the GPS data. The GPS data that it outputs maybe up to 0.2 seconds behind the video data.

2. The filtering is different in the real time and post-processed cases. In real time we filter the past x samples, in the post-processed (analysis) case we sample x/2 samples ahead and x/2 samples behind, so the "amount of filtering" is the same, but there "phase response" i.e. the delay in the signal is different:

For information **on filtering and filter lag** see the following page at Race technology knowledge base:  http://www.race-technology.com/wiki/index.php/Technical/FilterLag

## 36. Why isn't my video smooth during playback?

Please refer the section "Video Problems" on page 65 for more information on this.