

Vascar 21R



SPEEDAR LTD

Handbook

Vascar 21R is our new version of the tried and tested Vascar system of speed measurement, introduced to this country in 1975 with our first microprocessor-based Vascar. In subsequent versions, Vascar 2000, 3000 and 4000, the features were improved and the size reduced.

Now in line with the modern demand for video evidence, the new Vascar 21R includes video recording with the Vascar information being superimposed on the output video, all in one self-contained unit.

The system comprises a video camera with windscreen mounting, video recorder (MJPEG) , small hand-held controls for the Vascar and the recorder and the Vascar itself, all except the camera and control contained in a sturdy aluminium housing .



Remote controller for Vascar 21R



High Quality Sony camera as standard



Any camera will work with the Video Vascar system but cameras other than those supplied by Speedar Ltd are not approved and may not be able to use the zoom function on the Vascar remote controller.

There is one channel of audio available if required, the audio track is recorded along with the video on the Solid State Disk (ssd).

Normally it is expected that the Vascar 21R will be used with an existing video screen, this is easily done by connecting the Vascar 21R to a video feed to the existing system. The Vascar 21R then overlays the Vascar information on the video from the camera and it will be shown on the system screen

For single crew operation, the system automatically blanks the video information on the screen when the host vehicle is being driven at faster than walking speeds so that only Vascar information is shown. This function can be overridden for 2 crew operation when the Vascar screen is angled away from the driver's field of view. In either mode, the video is always recorded.

All the recorder operating buttons are arranged on a small hand-held controller with a group of navigation buttons in the centre which are multi function depending on the feature being used. The Menu button is used for initial setup of the recorder and the remaining buttons control the recorder.

The camera is a high quality Sony unit with 10 x optical zoom.

System description

The Vascar 21R system is housed in an aluminium case which has mounting slots with angle brackets enabling the unit to be mounted in any position required.

There is a hand-held controller which sends commands to the Vascar and has an inbuilt squeaker for audio feedback of button presses. This controller has 5 buttons and a rocker switch labelled as shown.

The rocker switch controls the zoom function in the camera allowing the operator to control the field of view of the camera. This function may not work with cameras other than those supplied by Speedar Ltd. and other cameras are not approved for use with the Vascar 21R

< and > These are multifunction buttons whose current function is shown on the Vascar screen, most commonly

- < means Increment (a number) or NO
- > means set or select (a number) or YES

The lower 3 buttons are for starting and stopping the D Distance and T Time functions of the Vascar. The S Button starts and stops both time and distance in synchronism.

There is an additional controller for use with the recorder functions.



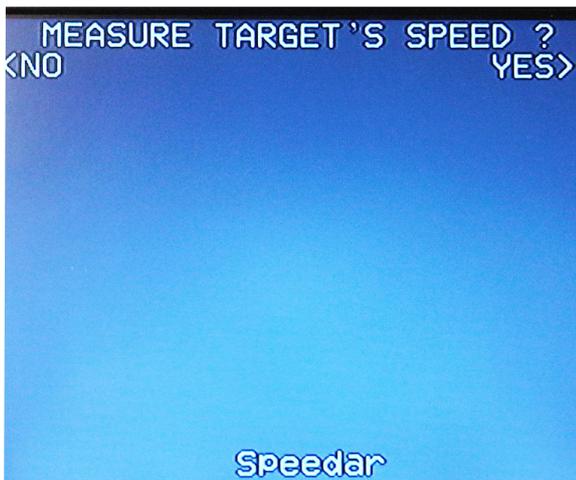
The main housing contains a digital video recorder and the Vascar. The recorder records onto a 64 Gb solid state disk (ssd) inserted into the front of the casing which may be removed by pulling on the attached handle.



Recordings are made in the MJPEG format and the memory may be removed and the recording viewed on a PC using the supplied viewing program which may also be downloaded by authorised users from the speedar.co.uk website.

The recordings on the ssd can of course also be viewed in the recorder.

This picture shows the Vascar information which will be overlaid on the video input from the camera.



If required, the screen can be made to show only the Vascar information by sliding the video switch on the rear of the unit to the auto position. This shows Vascar information only on a grey background when the vehicle is in motion to reduce driver distraction. Video information will always be recorded by the recorder however, whatever the position of the video switch.

The system can be set to record in 3 different modes.

Assuming the recorder is stopped (press the stop button if there is any doubt, the record light should be off)

Mode 1 (recommended mode)

Press the Record button. Recording will begin and continue until either the ssd is full (after approx.16 hours) or the Stop button is pushed. In this mode, whenever a Vascar measurement or calibration is made, the recorder automatically marks this as an Event on the recording. The Event marker will show an E on the left of the screen for the duration of the Event, ie. the whole of the Vascar measurement.

Recording will be one continuous Clip. Playback of events in this mode will automatically include a 30 sec. pre-event recording

Mode 2

The Recorder is left in the Stop state and every time a Vascar measurement or calibration is begun, the recorder automatically starts and then stops when the measurement is complete. During this period, the record LED will light during the recording. Each of these recordings is marked as a Clip in the recorder. Playback of Clips will automatically include a 5 sec. pre-recording.

Mode 3

If required the Recorder can be used on its own by setting the Vascar to OFF in the menu, this removes all Vascar information from the screen except for the letters VV in the top left corner to indicate that the Vascar is available. To reactivate the Vascar, press the D button on the hand controller.

Playback can show either the continuous record with the embedded events marked and selectable as Events or as a series of Clips which can also be selected.

A list of both Clips and Events can be displayed and selected from the on-screen recorder menu. When necessary, the ssd can be erased from the recorder menu options.

Operation of Vascar 21R

The principles of the Vascar speed measuring system are extremely simple making the system easy to use and requiring minimal effort to understand.

They are simply that; Speed equals distance travelled, divided by the time taken to travel that distance

eg. 60 MPH equals 1 Mile travelled in 1/60 Hour (1 minute).

The fundamental basis of all Vascar measurement relies on the following two statements.

- 1 Distance measurement is always carried out by the car in which the Vascar is installed.
- 2 Time measurement is always carried out on the target vehicle.

Full training in its use should always be undertaken before operators use the system for enforcement purposes. Normally this will be as specified by individual police forces with reference to ACPO guidelines.

There is one other important consideration and that is that for distance measurement to be carried out by the Vascar, it is necessary for the Vascar to be connected to the distance pulse output of the car to which it is fitted. Normally this would now be done by taking distance pulses directly from the Canbus wiring in the car but any other method of extracting distance pulses from the vehicle would suffice.

Since no two vehicles will give the same number of distance pulses per unit distance travelled and in fact any one vehicle will over time give different numbers of distance pulses, dependent on tyre fitment and wear, there must be a way of standardising these variations and this is done by calibrating the Vascar. This is achieved by driving over an accurately measured distance and counting the number of distance pulses generated over that distance, this number is used as a calibration factor and applied automatically by the Vascar when calculating distances.

Calibration will normally be carried out at the beginning of each shift or as specified by individual police forces but is additionally required at least every 7 days under CAST design requirements. The Vascar will not operate until this recalibration is carried out if a time of 7 days between calibrations is exceeded.

The calibration number is stored internally in two separate locations, these numbers are checked against each other when the Vascar is switched on. If there is exact agreement between these numbers, the Vascar considers them to be a valid calibration factor, if they disagree, or if there has been any memory failure within the Vascar, the Vascar will refuse to operate until a new calibration has been performed.

Certain other limits are automatically imposed on measurements by the Vascar so that unduly short distances are not used in speed measurements nor in calibration distances and unacceptably low calibration numbers are not allowed. These limits are set by CAST in the Manual Distance/Time Speedometer Handbook and fully complied with in the Vascar 21R.

They are automatically implemented by the Vascar and warnings will appear on screen if they are incorrect, in these circumstances the Vascar 21R will not operate until the error is corrected.

The time of day and the calibration number are stored internally in the Vascar 21R and are retained for several weeks with the equipment switched off. If the equipment is switched off for very long periods, then this information will be lost and the Vascar will require it to be re-entered before any measurements can take place. Any calibration number older than 7 days will in any case be rejected.

It is an absolute requirement that if a Vascar 21R is moved from one vehicle to another, a recalibration must be performed before the Vascar 21R is used for enforcement.

Normally Vascar 21R should only be moved to another vehicle by a qualified vehicle installer.

Initial switch on and calibration

It is assumed that the camera has been positioned on the windscreen and connected to the Vascar 21R, also that the distance sensor has been connected, the hand controller has been connected and the recorder control has been connected. All these items will normally be completed by the installers of the Vascar 21R.

It is assumed that power will be supplied to the Vascar 21R when the associated display screen is powered on. Check that the video switch on the rear of the unit is on Auto for single crew operation, or if the viewing screen is angled away from the driver's line of sight for two crew operation, the switch may be moved to ON. This will allow video to be shown on screen with the Vascar information as an overlay at any speed. Switch on the Vascar 21R with the power switch on the front panel.

The Vascar will carry out internal checks for stuck switches and internal computation functions. The camera will zoom out to a preset zoom factor.

The following messages will appear as overlays on the video on screen as the Vascar 21R carries out its checks.

NO switches stuck ... or if any are stuck, the appropriate one will be indicated.

Then 60.01 .1251
1 (to 7) DAYS SINCE CALIBRATION
INTERNAL TEST OK

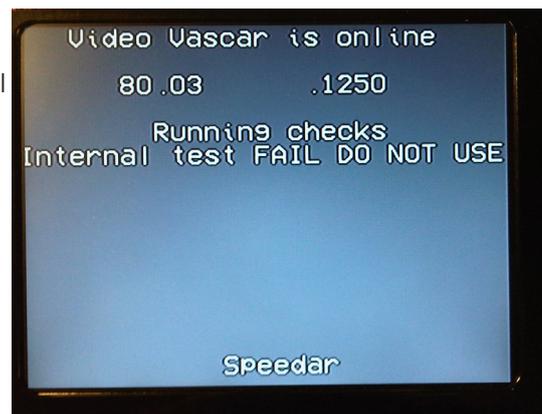
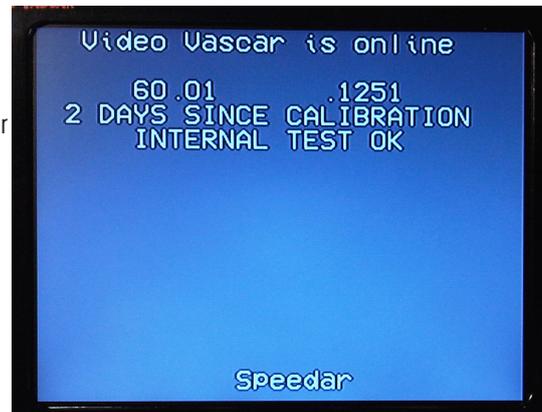
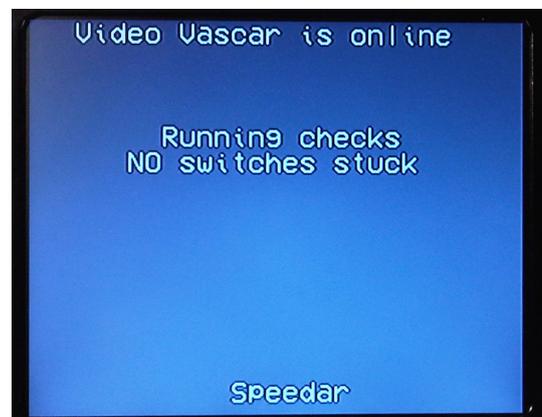
This confirms that the Vascar is calculating correctly and that the internal timers are operating correctly. It is carried out by using one of the 2 independent time sources within the Vascar as a distance input.

Then in accordance with CAST requirements, an operator identifying number must be entered, this can be any number from 0001 to 9999.

If the results of the test calculation are incorrect, the Vascar will refuse to operate further and will display the message

Internal test FAIL DO NOT USE

This will prevent further use of the Vascar 21R except for rebooting.



In this case the Vascar 21R must be tested before further use.

If the equipment is being switched on for the first time, the Vascar 21R may show the message:

CLOCK FAIL CALIBRATION INVALID

or if it has not been calibrated for over 7 days,

CALIBRATION OUT OF DATE RECALIBRATION MANDATORY.

It will then enter the calibration procedure. No other operation is possible until this has been carried out.

The Vascar will now show the message:

CALIBRATION DISTANCE

<INC 0.000 MILES SET>

Use the increment button on the hand controller to either increment the first digit or move on the next digit by pressing set.

Only distances greater than 0.500 Miles will be accepted by the Vascar.

To complete the distance input, step the cursor off to the right by repeated presses of the set button.

Distances less than 0.5 Miles will return the Vascar to the calibration screen.

The Vascar will now show the message:

PRESS D DRIVE OFF WHEN READY

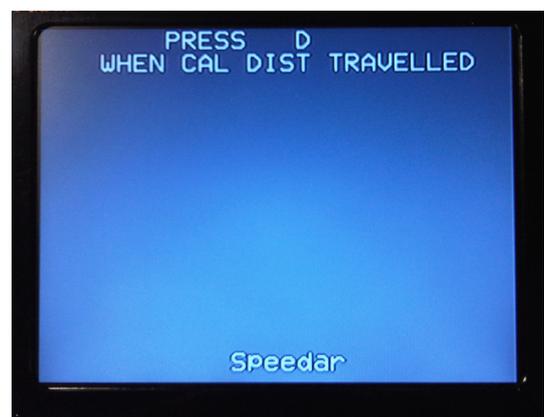
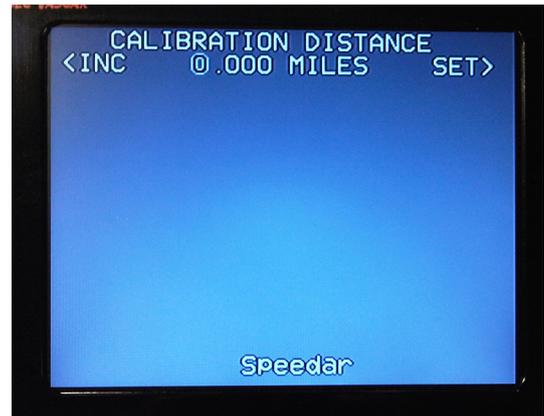
Line the vehicle up with the first measured distance mark by for instance opening the passenger door and lining up the door pillar with the mark.

When this is done press the D Button on the hand controller.

The Vascar will display:

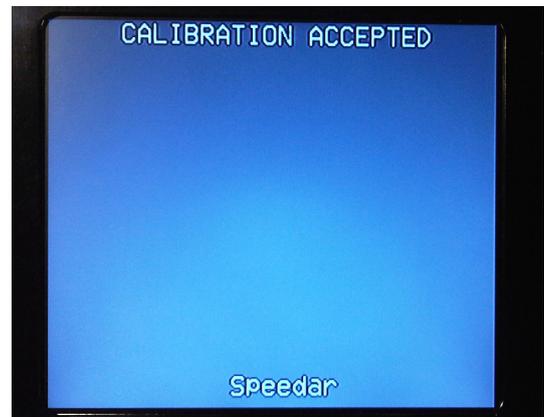
PRESS D WHEN CAL DIST TRAVELLED

Begin to drive at moderate speed and in as straight a line as possible until the second measured distance mark approaches, then line up this mark with the vehicle in exactly the same way as the first mark was aligned. Note this must be done without passing the mark and then reversing as the Vascar will count additional pulses during the reversing.



When the second mark is aligned. press the D button again, the Vascar will calculate the calibration factor and if acceptable will store it internally and show the message:

CALIBRATION ACCEPTED

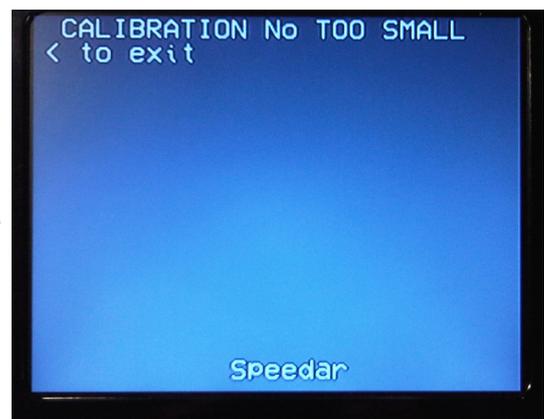


If the calibration factor is below 1760 pulses per mile, the calibration will be rejected and the Vascar will show:

CALIBRATION No TOO SMALL

and then revert to the calibration screen.

In this case, the Vascar cannot be used in this vehicle until a different distance sensor with sufficient pulses per mile is fitted.



The self test function may be carried out at any time if required by simultaneously pressing the D, S and T buttons on the hand controller.

Any time the Vascar 21R is switched off or loses power, it will require the re-entry of an operator number before it can be used.

To Make a Vascar measurement

There are 5 ways of carrying out a Vascar speed measurement, some require more practice than others.

1 **The Following check**

The simplest check is the Following check in which the target vehicle is followed by the Vascar vehicle. There are actually two ways of carrying out this check, one in which the time and distance of the target vehicle are measured directly and the other in which by use of the Synch button, both time and distance are measured on the Vascar vehicle which is assumed to be following the target vehicle at a constant distance. Because this version of the Following check has been incorrectly used in the past, it is now a Home Office requirement that when the Synch button is used to measure a speed, the final speed measurement will indicate that it is actually the speed of the Vascar vehicle which has been measured. This is done by showing the legend MY SPEED instead of SPEED at the completion of the check.

2 **The Being Followed check**

This is similar to the following check but in this case the target vehicle is behind the Vascar vehicle. Obviously this requires a clear view behind the Vascar vehicle.

3 **The Preset Distance check**

This uses a previously measured distance, either a known distance or a distance previously measured by the Vascar and this is entered or recalled into the Vascar. The Vascar vehicle is parked with a clear view of both the start and end of the measured distance and targets are timed over the measured distance by using the T switch on the Vascar.

4 **The Oncoming check**

This requires a clear view ahead and a clear reference point at least 1/8 of a mile ahead. The target vehicle is timed from the distant reference point until it passes the Vascar vehicle, at the instant it passes the Vascar vehicle the time measurement is stopped, distance measurement is started and terminated when the Vascar vehicle reaches the distant reference point. This is the most difficult check to carry out and requires a clear view in front of the Vascar vehicle,

5 **The Crossing check**

This is used with the Vascar vehicle at right angles to the traffic flow, ie. at a road junction or a lay-by. The target vehicle is timed between two reference points and then the Vascar vehicle drives between the same reference points and measures the distance between them.

Reference points

The importance of suitable reference points cannot be stressed too highly, the accuracy of the Vascar measurement depends entirely upon these points. To reduce to a minimum the effects of parallax on measurements, points should only be chosen that are directly on the road surface. Many possibilities are available which fulfil this requirement.

Road markings, changes in road surface, drain covers and shadows across the road are all suitable reference points. However, note that shadows must not be used to define pre-fed distance measurements as they will move with the time of day due to the sun's apparent movement.

Posts beside the road and objects above road level are not suitable reference points unless they cast a shadow directly on the road.

Using the Vascar 21R to make speed measurements

Important ! Remember that Distance is ALWAYS measured by the Vascar vehicle and Time is ALWAYS measured on the target vehicle.

To carry out a speed check

With the Vascar switched on and calibrated, the next choice displayed on the screen is Following check. If this is chosen, the automatic Following check will be carried out. When following a target vehicle, the Synch button is used to start a measurement. The measurement will be automatically terminated after a distance of 0.125 Miles and MY SPEED will be displayed. This indicates that it was the speed of the Vascar vehicle which was measured directly not the target vehicle. The speed of the target vehicle can be assumed to be the same only if the distance between the target vehicle and Vascar vehicle was the same at the beginning and the end of the check. This can be evaluated from the video recording of the check.

To carry out any other form of speed check except the pre-fed distance check, proceed as follows.

Adjust the zoom of the camera using the rocker switch until the screen shows a suitable view of the target vehicle, choose a zoom which also shows the road surface by the target vehicle, then the exact point at which the time measurement is started will be visible on the recording.

This can be carried out at any time without affecting the Vascar measurement.

Select NO when the Following check message is shown. This will take you to the normal speed measuring screen.

1 Following a target vehicle

Follow the target vehicle, not necessarily as the next car. The Vascar vehicle may be separated by several vehicles as long as it has a clear view of the target vehicle. Select in advance a suitable reference point

on the road surface. Assume for instance that there is a painted mark on the road. When a point on the target vehicle, eg. the rear wheel passes the mark, start the Time measurement by pressing the T button on the Vascar hand control.

When the Vascar vehicle passes the same mark on the road, press the D button on the Vascar control. Ensure that you press the D button as a specific part of the Vascar vehicle passes the reference point so that this can be repeated at the end of the measurement. Continue to follow the target vehicle for at least 0.125 Miles. At all times during the measurement, both elapsed time and distance are shown on screen.

While following the target vehicle, it may be appropriate to zoom in on the target to record the index mark of the target, having done this, zoom out again so that the recorder will see the point on the road at which the time measurement is stopped.

Looking ahead of the target vehicle, choose a second reference point on the road. As the same part of the target vehicle as used to start the Time measurement passes the chosen mark, stop the Time measurement by pressing the T button on the Vascar. When the Vascar vehicle passes the second mark, and ensuring the same part of the Vascar vehicle as used to start the measurement is seen crossing the mark, stop the distance measurement by pressing the D button on the Vascar.

SPEED, TIME and DISTANCE will now all be shown on the screen and in addition the time and date on which the measurement was made and the operator number will be shown at the bottom of the screen. In all cases, if the distance travelled during the check is less than the Home Office requirement of 0.125 Miles, the check will give no speed result and the display will show: INSUFFICIENT DISTANCE TRAVELLED.

All this information is recorded as an overlay on the video feed from the camera and may be viewed either immediately to show a driver, or at a later date.

2 Being followed by a target vehicle

Observe the target vehicle following the Vascar vehicle separated by one or more other vehicles, ensure that you have a clear view of the target vehicle. Select a reference point on the road surface and as the Vascar vehicle passes this point, start the Distance measurement by pressing the D button on the Vascar. As always, ensure that you use a specific part of the Vascar vehicle passing the reference point to start the distance measurement. When the target vehicle approaches the reference point, choose a suitable part of the vehicle, eg. the front wheel, and when this chosen part passes the reference point, start the time measurement by pressing the T button on the Vascar. Drive on for at least 0.125 Miles and select a suitable second reference point ahead on the road surface. When the chosen part of the Vascar vehicle passes this point, stop the distance measurement by pressing the D button on the Vascar. When the chosen part of the target vehicle passes the same reference point, stop the time measurement by pressing the T button on the Vascar. The display will show SPEED, TIME and DISTANCE on the display, the time and date at which the measurement was made and the operator number.

If the target vehicle passes the Vascar vehicle during this check, then continue the check stopping the time when the target vehicle passes a second reference point and stopping the distance when the Vascar vehicle passes the same point.

3 Oncoming traffic check

This requires a clear view of a distant reference point, eg. the shadow of a bridge on the road. The target vehicle is observed and when it crosses the distant reference point, the time measurement is started by pressing the T button on the Vascar. When the target vehicle is abreast of the Vascar vehicle, both T and D buttons are pressed simultaneously stopping the time measurement and starting the distance measurement. (Do not use the Synch button to do this as this will then indicate MY SPEED as a result.) When the Vascar vehicle passes the distant reference point, stop the distance measurement by pressing the D button on the Vascar.

SPEED, TIME and DISTANCE will be shown on the display along with the time and date of the measurement and the operator number.

4 Pre-fed Distance check

This method uses a parked Vascar vehicle and requires two reference points, both of which can be seen from the parked position. The distance between these reference points must either be known, ie. specifically marked at for instance 0.125 Miles apart, or previously measured with the Vascar distance function.

The CAST requirements are that for speed limits greater than 40 MPH, 0.125 Miles is the minimum distance allowed, below 40 MPH, 0.07 Miles is the minimum distance allowed. The Vascar automatically enforces these minimums.

From the initial Vascar screen, answer NO to measure speed, then YES to use pre-fed distance. If the Vascar has been used to carry out a distance measurement previously, it will ask OK TO USE LAST DISTANCE MEASURED If YES is chosen, this distance will appear as the distance measured on the screen.

If NO is chosen, enter the speed limit and then the known distance between the reference points in the same way that the calibration distance is entered. When the cursor is stepped off the last digit to the right, the distance will appear as the distance measurement. Distances less than the HOSDB minimums will be rejected.

To measure a speed, observe the target vehicle and as a specific part of the vehicle, eg. the front wheel passes the first reference point, start the time measurement with the T button on the Vascar. When the same point on the target vehicle passes the second reference point, stop the time measurement by pressing the T button on the Vascar again.

Speed distance and time will appear on the display along with the time and date of the measurement and operator number.

Further measurements can be carried out at the same position by choosing reset and then when the OK TO USE LAST DISTANCE message appears, choose YES.

Choose Exit to change to another mode.

5 The Crossing check

Assuming the Vascar vehicle has come to rest at for instance a T-junction.

A target vehicle is observed approaching the T-junction, as the target vehicle passes a reference point on the left side of the junction, the time measurement is started by pressing the T button on the Vascar. When safe to do so, the Vascar vehicle pulls out of the junction and as it passes the same reference point, the distance measurement is started by pressing the D button on the Vascar.

The Vascar vehicle continues to follow the target vehicle along the road until, as in a normal speed check, a suitable reference point is seen ahead and as in a normal check, the T button is used to stop the time measurement when the target passes the reference point and the D button is pressed when the Vascar vehicle passes the reference point.

As normal, SPEED, TIME and DISTANCE etc. are shown on the display.

In all cases, when a speed measurement is completed, the following information is also output to an RS232 port on the main connector.

Date	xx xx xxxx
Time	xx:xx
Speed	xxx.x
Distance	xxxx
Time	xx:xx

RS232 parameters are 9600b NO parity, 1 Stop bit, no handshake.

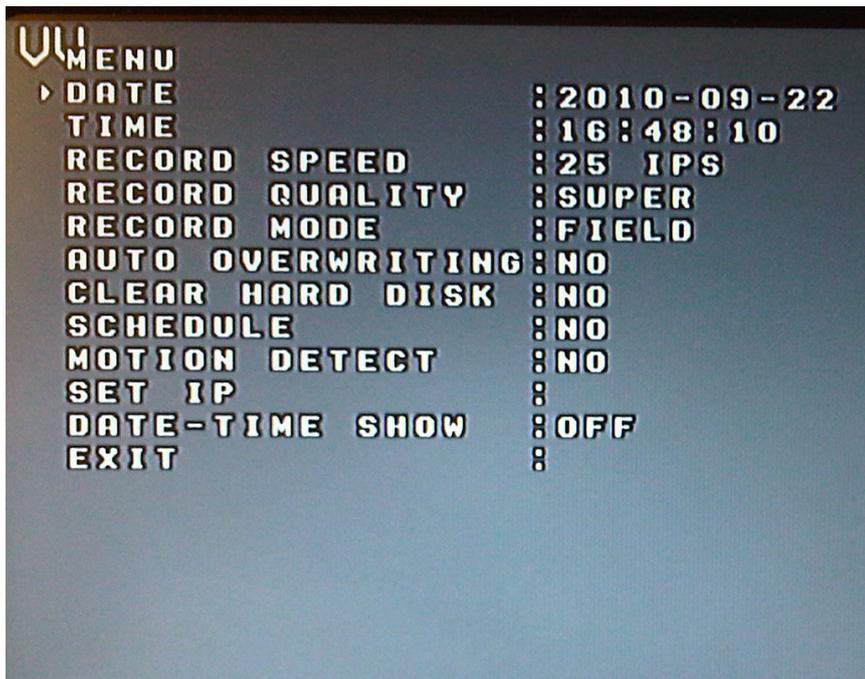
Using the recorder

The recorder automatically starts and stops every time a Vascar measurement is made, it also automatically records the calibration sequence. There are two possible modes of recording, Clip, where the recorder treats each measurement as a separate entity and stores them as a series of separate recordings, or Event, where the recorder is recording continuously and automatically marks the beginning and end of each Vascar measurement as an event. Whenever the recorder is recording, the record LED will be on and during an event, an E will appear on the left of the screen.

This is the recommended mode of operation as it allows the entire day's operation to be recorded, Events being embedded in the total record and retrievable from the recorder menu.

The recorder is controlled by the switches on the hand controller attached to the Vascar unit, they are each marked with a self-explanatory function, eg. Record starts the recorder and lights the record LED, Stop stops the recorder, etc.

The main recorder menu is only used to set up the recorder initially. Set the Vascar 21R to standby so that only the letters VV are shown at the top Left of the screen, and press the Recorder menu button. This will bring up the menu as shown below. Note the menu can be called up at any time but will appear as an overlay on the screen, so it is better not to have any other information on screen at the same time.

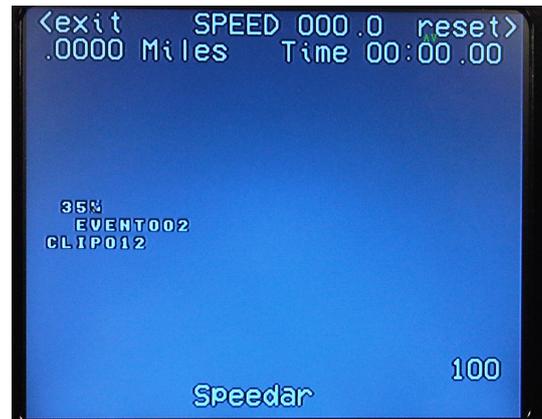


The recorder date and time can be set on this menu by moving the cursor to the appropriate line and pressing the OK button, the value can then be changed with the up/down navigation buttons. To move to the next value to be set, use the Left/Right navigation buttons. When all values have been set press the OK button.

To clear the ssd ready for the day's recording, step down to Clear hard disk, press OK, then up arrow to change the NO to a YES and press OK again. All the other recorder parameters should be left as in the picture above. Move the cursor to the Exit line, press OK and the menu will disappear.

To view a recording in the car

Make sure the Video switch on the rear of the Vascar 21R is set to ON, Press OK, the Event and Clip totals and amount of memory used will appear on the display.



To remove it, you may press OK again.

Press Play then Pause.

While the recorder is showing Pause on the screen, you can change between Event and Clip by pressing the Pause button.

Each press changes from Event to Clip or vice versa.

When in this menu the Clip or Event number can be changed by pressing the Left/Right buttons on the central navigation switches.



Select the Clip or Event you want to watch and press play.

The recording will play from the beginning of the Clip or Event chosen. NOTE an automatic 30 sec. pre-event is included when playing back Events. A 5 sec. pre-clip is included when playing back Clips. While playing, the playback can be speeded up or reversed by pressing the Left/Right buttons on the central navigation switches. To return to normal speed, press Play again. The play speed will be shown on the screen beside the word Play.



While in the Play mode, the playback can be stopped at any point by pressing the Pause button.

When paused, the recording can be stepped on or back one frame at a time by pressing the Up/Down buttons on the central navigation switches.

Recordings can also be viewed on a computer by removing the ssd from the right-hand side of the Vascar 21R and inserting it in a suitable reader attached to an office computer or laptop running the viewing software supplied by Speedar Ltd with the Vascar 21R. When removing or replacing the ssd, the power switch on the Vascar 21R MUST be switched off.

To view a recording on a computer

Switch off the Vascar 21R and remove the ssd from the right-hand side of the casing by pulling on the handle.



Plug the ssd into the adaptor and plug the adaptor into a USB socket on the computer. Additional adaptors can be purchased from Speedar Ltd if required.



Start the Viewer program by double clicking its icon on the desktop in the normal way,

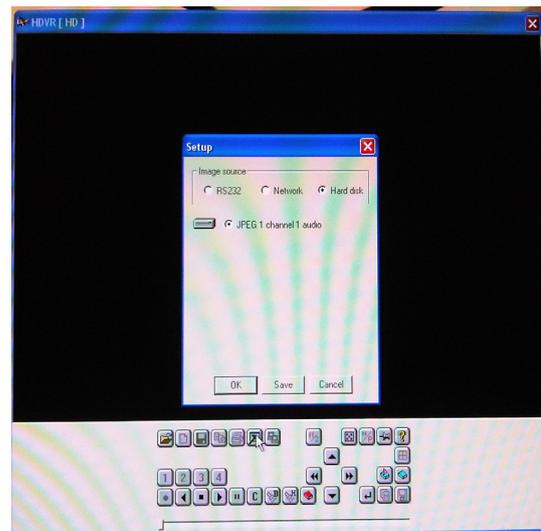
The Viewer controls are shown to the right.



The icons below the viewer to the right have the following meanings.

-  Select a video source, always press this to start viewing
-  Show Clip list (128 clips maximum)
-  Show Event list (128 events maximum)
-  When paused Save video to file .avi or .bmp
-  When paused Print Frame
-  Play
-  Rewind
-  In playback fast forward x2,x4,x8,x16
-  In playback fast rewind x2,x4,x8,x16
-  When paused step forward 1 frame
-  When paused step back 1 frame
-  Switch large/small view
-  Viewer always on top
-  When paused bookmark frame
-  When paused go to bookmark list

Click with the mouse on the Hammer icon below the viewing panel. The program should have identified the ssd and selected Hard disk and JPEG 1 channel 1 audio. Click on OK.



Choose a Clip or Event by double clicking on the chosen item in the list.



Press play to view the Clip or Event. The playback will stop on the last frame of the Clip or Event,

Press  to print the frame as evidence.



Technical description

Vascar 21R comprises three subsystems, they are:

- 1 The Vascar Measuring Unit
- 2 The Digital Recorder
- 3 The Camera

With the exception of the camera and the hand controls for the Vascar and recorder, these subsystems are contained within the same machined aluminium housing. This housing is provided with slotted sides and brackets to enable its fitment in a vehicle.

The subsystems are described in more detail below.

The Vascar Measuring Unit

To comply with current CAST requirements, the Vascar subsystem is divided into two completely isolated parts, the various input switches, video processing circuitry and the Canbus interface are on a part of the circuit board which is grounded to the vehicle power system, the Vascar microprocessor, battery chargers and real time clock are completely isolated from all vehicle power by opto-isolators .

Five opto-isolator ics separate the grounded circuits from the floating circuits. Signals flow in both directions through this isolation interface to allow the microprocessor to output information to the video circuitry and to receive commands from the various switches.

Commencing with the five switch buttons on the hand control, inputs from these buttons are fed through a filtered D connector into the main casing and from there, pass through the opto-isolators to the microprocessor.

To allow the controller to perform a hardware reset, signals from three of these buttons, D, T and S are and-ed together. When all three are pressed simultaneously, a hard reset of all ics will take place on both sides of the isolation barrier.

An additional rocker switch on the hand control is fed to a dedicated microcontroller which converts signals from the rocker switch to serial commands which are sent to the camera. This allows control of the camera zoom to be completely independent of any other function. It does not affect the Vascar operation in any way.

A small buzzer is also incorporated in the hand control to give audio feedback when buttons are pressed and when measurements are completed, this is driven from the Vascar microprocessor via the isolated interface and a transistor buffer.

The Camera.

The Camera supplied with the Vascar 21R is a high quality Sony unit with 10 x optical zoom completely controllable by the Sony VISCA protocol.

It is connected via a cable with Lemo connectors and feeds its video signal to the video processing circuits only. The camera has no connections to the isolated circuitry and plays no part in the actual Vascar measurements. It is solely a means of obtaining a video record of each Vascar operation.

A further connector supplies power to the complete system and takes an input from the vehicle directly related to the movement of the vehicle, this is commonly known as the speed pulse although in fact it is really a measure of the frequency of rotation of a particular part of the vehicle, eg. a gearbox output shaft and can be directly correlated with the distance the vehicle moves between pulses.

Two possible sources of this pulse are catered for, either directly from the vehicle's CanBus or from a proprietary CanBus interface which produces a 12 Volt pulse train or other distance measuring transducer.

These speed pulses are fed across the isolation barrier to the Vascar microprocessor and from the Distance pulse input.

The video circuitry is solely on the grounded side of the isolation barrier and takes an input from the camera and superimposes on this video stream the information sent to it by the Vascar microprocessor. There are two video processors working in parallel, one of which has no video input so that the operator has a choice of either a grey screen with Vascar information only or a screen with Vascar information overlaid on the video. Switching between these two modes is done in a video switch controlled by the slide switch on the rear of the unit and the speed of the vehicle if in auto mode.

Control of the entire Vascar system is via an SPI interface which connects to all the major components on both sides of the isolation barrier, the SPI bus itself is fed through the isolation barrier so that components on both sides of the barrier can be controlled. The Vascar microprocessor acts as the only master on this bus, all other connections are slaves.

Through this SPI bus the video overlay information is sent to the video ics, Canbus filter values are sent to the Canbus interface and time and date information and calibration values are sent and received from the Real Time clock.

The Real Time Clock contains additional memory space which is used to store system variables such as calibration number, time since last calibration, date and time and measurement units in use. This information is retained in the memory through voltage supplied from a separate internal battery allowing retention of data for a period of several weeks.

It is also used to compare its own accurate crystal-controlled clock with the Vascar microprocessor crystal-controlled clock, both during normal operation and when the Vascar is initially switched on. (This is how the Vascar makes a test measurement by using the RTC as a distance input).

Power to the isolated circuitry is supplied by Li-ion battery. Power for the charging is supplied by an isolated 5V converter. Using this arrangement, the power supply for the isolated circuitry is always from a floating battery having no connections with the vehicle supply. In addition, changing of the battery state is inhibited while a Vascar measurement is in progress.

Transistor switches isolate the batteries when vehicle power is removed.

The recorder hand controller incorporates push button switches to control the recorder and navigation switches to move through recorder menus. The video switch used to change between video overlay and Vascar only display modes is situated on the rear panel of the Vascar 21R adjacent to the recorder control socket.

The Recorder

The recorder always takes the output from the video processing circuit having the Vascar information overlaid on the video and records this in MJPEG format onto a solid state memory, a 64GB ssd giving a continuous recording time of about 16 hours. This ssd may be removed and plugged into a PC if required for viewing in the office with the supplied software or may be viewed in situ. Recordings on the ssd may be saved as .avi files or as a .bmp image.

The ssd may be erased from the recorder menu when installed in the Vascar 21R.

Event marker information is passed to the recorder from the Vascar microprocessor over the isolation barrier to allow the recorder to mark parts of the recording as events. Any Vascar measurement including calibration is considered to be an Event.

Events are marked when the recorder is already in record mode when an Event is signalled by the Vascar microprocessor, if the recorder is not in record mode, the Event is recorded as a Clip. Both Events and Clips are listed in playback mode and can be selected for playback as required. There is of course the normal facility for fast forward, reverse and pause. When in pause mode, recordings may be advanced frame by frame for examination of exact points at which Vascar time or distance measurements were started or stopped.

The output to the screen may be either the output from the recorder or the output from the video switch which can be set to either show video all the time or only when the vehicle is travelling at speeds below about 6 MPH. Note when the recorder is stopped, the video in from the camera passes unaltered through the recorder as live video.

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Engineering menu

The engineering menu for use by installers is available by following this sequence of button pushes

Step along the main menu to Turn Vascar off, press the yes button.

Note the Vascar will say press D to restart.

Hold down the < > and S buttons and then press and release the D button on the hand controller.

When the Vascar beeps release all the buttons. Then immediately press the T button, when the engineering menu appears release the T button.

The engineering menu gives options to change the units, distance input mode and language. It is also possible to see the current calibration factor, the manufacturing date and the serial number of the unit. The operation is self explanatory.

Units may be either MPH or km/h.

Currently the distance input mode for internal Canbus is not enabled and Video Vascar will always require an external Canbus interface or other means of providing a distance input.

The only language installed at present is English, other languages will become available to customers requirements.

A hard reset may be performed at any time by holding down the D,T and Sync buttons on the hand controller.

The date may be set by holding down the < and > buttons when the Vascar 21R is switched on.

Pin connections

9 pin D connector Plug

1	+ 12 Volt vehicle supply
2	Distance pulse input
3	CANH
4	Vehicle Gnd Distance pulse ground
5	RS232 out
6	Vehicle ground 0V
7	Vehicle ground 0V
8	CANL
9	RS232 in

9 pin D connector socket

1	< Button
2	D Button
3	S Button
4	T Button
5	> Button
6	Buzzer
7	Lens Wide
8	Lens Tele
9	0V