



DL1 Data Logger

What is the DL1?

The DL1 is a state of the art, highly robust, compact "black box" data logging system. Put in the simplest terms, it stores a wide range of vehicle data for later analysis on a computer - the system does not include an in-vehicle display, although there are products from Race Technology which provide this function.

speeds, temperatures, pressures, lap times, sector times etc. The data is sampled 100 times per second and then stored onto the compact flash card in a format that the computer can read. Our software can then load and process the data and allow analysis of all aspects of the data, from lap times to speeds, temperatures, suspension movement, etc. To view data in real time the DL1 can be connected to the DASH1, DASH2, DASH3, VIDEO4 or VOB.



Figure 1:DL1 general arrangement

Who is the DL1 designed for?

The DL1 was initially designed for autosport applications including drag racers, single seater racing cars, rally cars or road cars - however it is also ideal for use on power boats, go karts and motorbikes. It is also an ideal platform for use in the auto industry for car testing of all types, from long term monitoring to competitor benchmarking.

What does the DL1 do?

The DL1 can store data from a number of sources including its built in high accuracy GPS and accelerometers, wheel speeds, shaft speeds, engine

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What does the DL1 do?

The DL1 can store data from many sources including it's built in high accuracy GPS and accelerometers, wheel speeds, shaft speeds, engine speeds, temperatures, pressures, lap times, sector times etc. The DL1 comes packaged with the highly acclaimed Race Technology data analysis software. This allows highly accurate track mapping, user configurable data channels, powerful graphing and data summary tables and allows direct comparison of up to 10 data sets (for example different sessions or different drivers) simultaneously with almost unlimited laps. With the optional video software licence it is also possible to import and synchronise video and data, make virtual dashboard overlays, and export video files with data overlay.

Why use GPS?

One of the key features of the DL1 is its built in high accuracy GPS system - this gives the DL1 advantages over other data loggers in 2 key areas – greatly improved track maps and far more accurate speed measurement.

Track Mapping. Conventional data loggers require a "closed circuit" to enable them to calculate the track map; the shape of the track is estimated from a combination of the lateral acceleration and speed. This works adequately in some situations but it becomes increasingly inaccurate for long tracks and impossible for open circuits, motorbikes or boats. In contrast, the GPS will produce high accuracy track maps in almost any situation.

Speed Measurement. While speed is probably the most important parameter that anyone wants to measure using the data logging system, it is also the most inaccurate in a "conventional" system. The normal way to measure speed is to simply attach a pickup to a wheel to detect how fast it is rotating - but the rolling circumference of a tyre changes by 4% just with wear and temperature. Even worse, the error increases significantly under race conditions where the tyre is under load - typically the tyre slips by up to 20% under hard braking at corner entry. Measuring speed using GPS is now common practice in high-end systems - under typical conditions speed error is well under 1%.

Features of the DL1 data logger

The DL1 is an all-new, 2nd generation, data logger system from Race Technology. Whilst the DL1

builds on the strengths of our highly successful DL90 system, it is a brand new design in almost every respect. Some of the most noteworthy features include:

- Built in GPS. The new GPS unit is based on our own high accuracy GPS3 technology and calculates position and speed 5 times or 20 times every second (depending on model). This is easily the fastest, most accurate GPS system available in its price range. The measurements from the GPS and accelerometers are combined to calculate very high accuracy positions and speeds at 100 times a second.
- Built in accelerometers. Built in 3-axis accelerometer with 2g full scale (optional 6g full scale available).
- Logging to Compact Flash memory card. This format is robust, economical and ideal for use in data logging products. The advantages of using Compact Flash memory include incredibly fast download times and huge storage capacities.
- 8 analogue inputs. The DL1 has 8 very high accuracy analogue inputs. All the inputs are 12-bit accuracy (4096 different levels) and rated at 0-12V
- 2 RPM inputs. The DL1 has 2 alternative RPM inputs. One input is designed to be connected to "high level" sources, such as an HT lead pickup or the ignition coil. The other input is designed for low level signals such as a tacho feed from the ECU.
- 4 wheel/shaft speed inputs. The DL1 features 4 totally independent wheel/shaft speed inputs. These can be used to measure the speed of all four wheels, or slip ratios across a torque converter for example.
- Serial data (RS232) input. The serial port can be configured to accept data from an external source - possible examples are data from the engine management system, OBDII or CAN data (with a suitable adapter).
- Serial data (RS232) output. As well as logging the data to compact flash it is also available from the serial port for display on a Race Technology dash or video unit
- Lap beacon input. For some applications it is desirable to use a lap beacon, so we have included a dedicated input for this purpose. This channel can also be used as a general-purpose digital input if required.

- Small and tough. It's the most compact logger in its class, at just 110mm x 75mm x 30mm (4.3" x 3" x 1.2") it can be fitted into the smallest single seater, motorbike or kart. The DL1 is housed in a robust enclosure for durability and impact resistance
- Simple operation. A single button to start or stop logging, it is as simple as that. If the button is inaccessible from the driving seat a remote button and status indicator can be added if required, or the D11 can be configured to autostart.
- Power supply requirements. The power supply to the DL1 data logger can be taken directly from the vehicle 12v supply, or it can be powered from its own battery pack if required. The power supply is smoothed and regulated within the DL1 ensuring its performance is highly robust and stable.
- Testing. Very high reliability is ensured by calibrating, temperature testing and vibration testing each unit on an individual basis. Autosport applications make tremendous demands on electronic systems and we take great care to make sure our products are up to the task. Connections to the units are vibration proof, high strength, spring tag terminals to ensure that connections do not fail at the critical time.
- Powerful. The 2 processors in the DL1 are the very latest generation RISC units that feature high speed operation and flash upgradeability - so as we add new features to the DL1 you can upgrade yours to the latest specification for free.

Frequently Asked Questions

What is the maximum g-force/speed that can be measured? The standard DL1 is configured for a maximum of 2g acceleration, 6g is a factory option. The maximum measurable speed is approximately 1000mph.

How often do you get GPS speed updates? The GPS system calculates speed every 200ms (5 Hz) or 50ms (20Hz) however this data is combined with the data from the accelerometers to calculate speed 100 times every second with very high accuracy.

How often do you get GPS position updates? The GPS system calculates position every 200ms (5 Hz) or 50ms (20Hz), however this data is combined

with the data from the accelerometers to calculate position 100 times every second with very high accuracy.

How accurately is speed measured? With typical GPS reception quality, speed accuracy is approximately 0.1mph (or 0.1% if greater) at steady state, and approximately 0.2mph (or 0.1% if greater) during fast accelerations or hard braking. The only exception is at very low speeds (under 10mph) where the error increases to approximately **1mph. Do not be fooled by exaggerated claims from other manufacturers... this is as good as it gets with this type of GPS-based system. In contrast, a standard wheel speed pickup is only accurate to about 4% at constant speeds, and during hard acceleration or braking, the error increases up to around 20%.**

How accurately is position measured? With good GPS reception, positional accuracy is approximately 2m (95% CEP).

What happens to the data if you drive under a bridge/tunnel/trees etc? Because speed and position are calculated from both the GPS data and accelerometers, even if the GPS data "disappears" for a number of seconds, you won't be able to tell from the data in the software. Only if GPS data disappears for an extended time (20+ seconds) will the data start to degrade noticeably.

Where can I buy it? Go to www.Race-Technology.com to purchase from our secure online shop, or contact Race Technology by telephone or email to place an order or find your nearest stockist.

Is it upgradeable? The DL1 is upgradeable in a number of ways; please check www.race-technology.com for an up-to-date list of options. Software and firmware updates, including new features, are freely available as we introduce them.

How much data can you log to a Compact flash card? The DL1 logs about 20MB of data per hour, so with a 1GB card you could record up to 50 hours of data.

Will it work with any Compact Flash card? Whilst we cannot guarantee that the DL1 works with all compact flash cards, we have successfully tested many makes and sizes of card. If in doubt please contact Race Technology for advice.

Is it easy to use? The DL1 has one button to start and stop logging, how much simpler could it be? We have kept the software as simple as possible whilst making it as flexible as we can to ensure that you can do what you need to with it. As with all computer programs, the first time you use it there is a lot to take in - after you've become familiar with it, you will be able to analyse data quickly and efficiently.

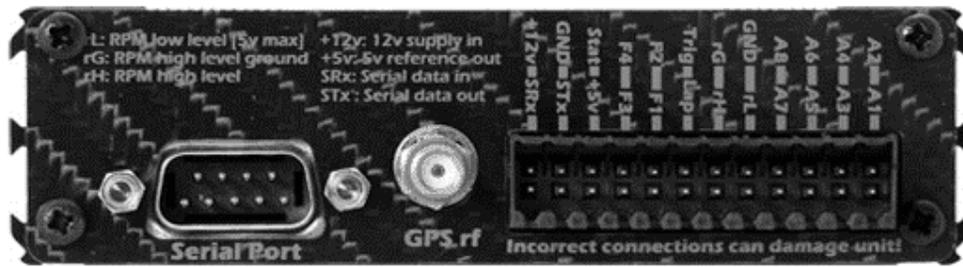
What specification of computer is required? As with most programs, the analysis software will run on just about any PC with Windows 95 or later – however, the faster the PC, the faster the program will run. The main restriction is the memory required for long runs; typically we recommend

that your PC has an absolute minimum of about 30MB of memory installed for each hour of data loaded. The PC also requires some means of downloading the data from the compact flash cards, there are many options available – normally a USB type reader is most convenient.

Is the DL1 reliable and well made? The DL1 is absolutely class leading in terms of component quality, build quality and reliability – this is a very high quality professional instrument, entirely designed in-house and manufactured in England. The unit carries a 12 month guarantee against component and manufacturing defects and lifetime email support.

Technical Specification

Memory	Compact flash type I. Data in FAT16 PC format. Minimum card size 32MB, maximum card size 2GB (limited by FAT16), or larger if formatted in DOS
GPS	Outputs position, speed, position accuracy and speed accuracy every 100ms with no interpolation. GPS tracking loops optimised for applications up to approximately 4g. Tracking of all satellites in view.
GPS antenna	Magnetic base, 3.3v active antenna with SMA connector
Analogue Inputs	8 external inputs, all 12 bit resolution. All 0-12V scale. All inputs are protected to twice maximum input voltage.
Frequency Inputs	4 external frequency inputs with a maximum input frequency >2kHz. Hardware dividers of 4 or 16 to average readings if required. Triggering voltage requires a low input of <1v and a high input of >4v and 15v maximum.
Lap Beacon Input	Triggering voltage requires a low input of <1v and a high input of >4v and 15v maximum.
Start Sample Input/Output	Input requires grounding to start sampling and again to stop sampling. Open collector output with a maximum current of 50mA
Power Supply Requirements	12v nominal input, minimum of 10v, maximum of 15v. Current consumption of about 180mA including GPS, dependant on compact flash card size
+5v Reference Out	Maximum current draw 100mA, tolerance 1%.
Ignition In Signal (High Level)	Triggered by fast voltage transients. Can be connected directly to the low tension side of the ignition coil, or capacitively coupled to the high-tension side.
Ignition In Signal (Low Level)	Triggering voltage requires a low input of <1v and a high input of >4v up to 15v maximum. Suitable for connection directly to most ECU tach outputs. Maximum input frequency >300Hz.
Case Construction	Extruded aluminium anodised black, nominal case thickness 2mm. End panels CNC cut carbon fibre. Overall dimensions (excluding connectors) 107mm x 68mm x 29mm
Connector Type	Weidmuller spring retention type, 24 way. 2 part unpluggable connector
Main Processor	24MHz RISC with embedded flash program memory
GPS Serial Port	User configurable for baud rate and messages. Factory set at 4800 baud and outputting NMEA messages of \$GPRMC and \$GPGGA,
DL1 Serial Port	2 separate ports. Port 1 fixed at a baud rate of 115200 baud. Whilst logging outputs all data from all channels at 100Hz. Also used for re flashing, diagnostics and configuration. Port 2 used for inputting RS232 data for storage during a run, from an ECU, OBDII adapter or any other compatible device.
Accelerometers	3-axis, precision digital output. Guaranteed 2g minimum full scale on both axes. Resolution of 0.005g. Upgrade 6g available.
Vibration	Factory tested at 25g, 50Hz sinusoid for 5 minutes (without compact flash card inserted).
Temperature	Factory tested from -20°C to +70°C



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