ST8500 Series Data Logging and Analysis Systems

User's Guide

Part Number - Issue: 542033-001

Preface

Congratulations

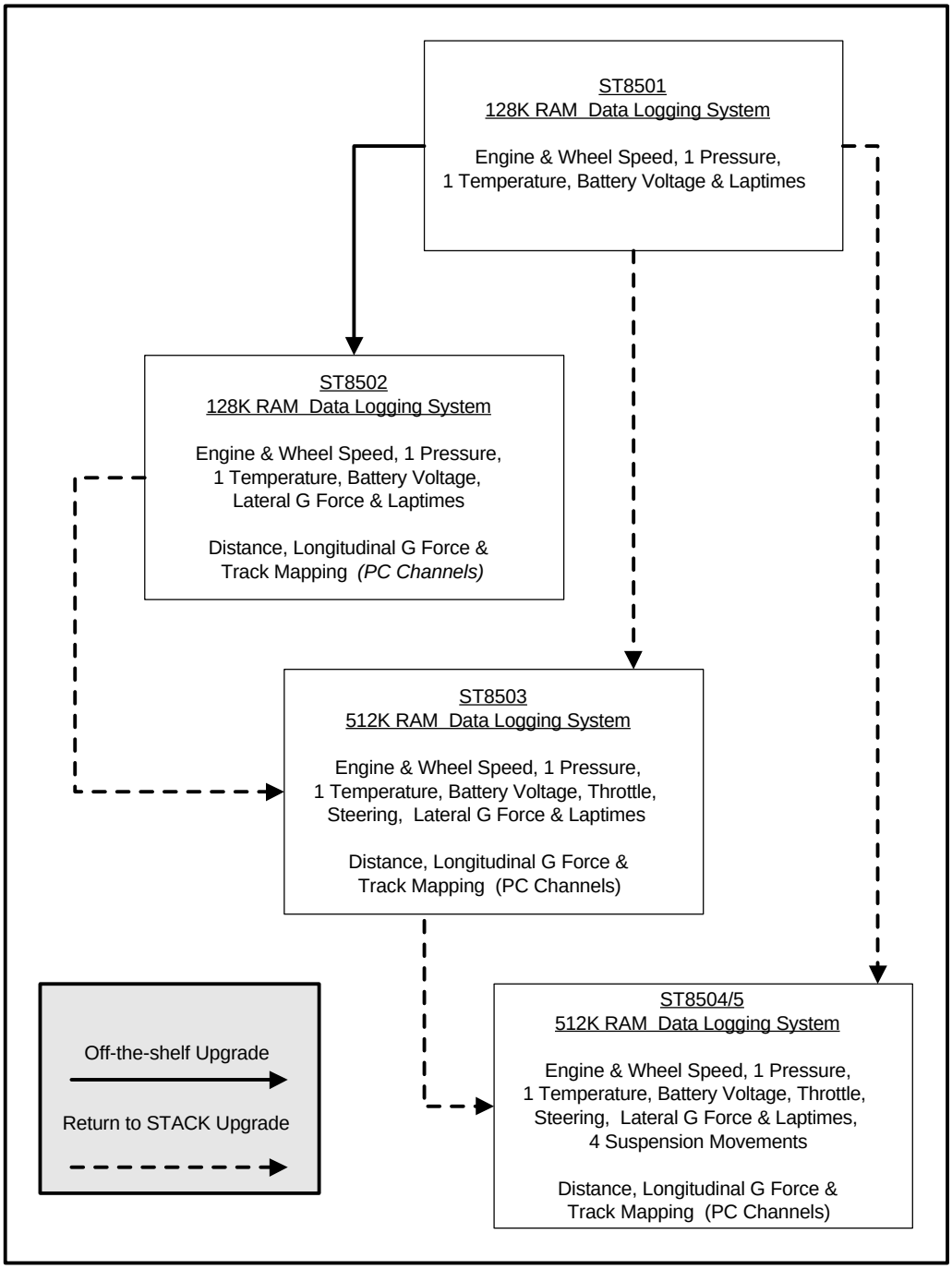
Congratulations on choosing one of the ST8500 Series Data Logging and Analysis Systems.

The ST8500 product range

The ST8500 Series Data Logging and Analysis Systems are a progressive set of data logging and analysis systems available from Stack. The systems currently available are:

- The ST8501 System provides six-channel data logging equipment and software producing time-based analyses of Engine and Wheel speed, Battery voltage, lap times, 1 Pressure (either fuel or oil), and 1 Temperature (either oil or water) logged in practice sessions/races.
- The ST8502 System extends the ST8501 features to include distance-based data analysis/comparison, and track mapping features based on data logged from the Lateral G-force and Lap Marker sensors.
- The ST8503 System extends the features of the ST8502 system to include hardware and software for time and distance-based analysis of data logged from steering and throttle sensors.
- The ST8504 & 5 Systems extend the features of the ST8503 system to include hardware and software for time and distance-based analysis of data logged from 4" (100mm) or 8" (200mm) suspension sensors respectively. For 1996 the system incorporates the ST8506 software, which provides additional vehicle information in the form of Pitch & Roll and Ride Height channels, generated from recorded suspension movement data.
- The ST8509 System option adds Turbo Boost Prsssure measurement, logging and Data analysis to any of the ST8500 products.

The following chart shows which of the above systems is supplied off-the-shelf and which of them are supplied as upgrades to existing systems. You return the data logging module from the original kit to Stack to when you purchase the upgrade kit. The data logging module in the new kit replaces the returned module.


ST8501
128K RAM Data Logging System
Engine & Wheel Speed, 1 Pressure,
1 Temperature, Battery Voltage & Laptimes
ST8502
128K RAM Data Logging System
Engine & Wheel Speed, 1 Pressure,
1 Temperature, Battery Voltage,
Lateral G Force & Laptimes
Distance, Longitudinal G Force &
Track Mapping (PC Channels)
ST8503
512K RAM Data Logging System
Engine & Wheel Speed, 1 Pressure,
1 Temperature, Battery Voltage, Throttle,
Steering, Lateral G Force & Laptimes
Distance, Longitudinal G Force &
Track Mapping (PC Channels)
ST8504/5
512K RAM Data Logging System
Engine & Wheel Speed, 1 Pressure,
1 Temperature, Battery Voltage, Throttle,
Steering, Lateral G Force & Laptimes,
4 Suspension Movements
Distance, Longitudinal G Force &
Track Mapping (PC Channels)
Off-the-shelf Upgrade
Return to STACK Upgrade

Registration Form

Please complete and return the registration form contained in the package. This will allow us to keep you up to date on the latest developments from Stack.

Organisation of this manual

This manual helps you install and use each of the Stack ST8500 Series Data Logging and Analysis Systems. It contains sections covering setting up and installing the software and hardware, a reference section describing the features and functions of the software, a guide to everyday operation of the system, a maintenance section, and a problem solving section.

Stack Ltd supplies this manual with each of the ST8500 Series Systems. Refer to the section of the manual that corresponds to the ST8500 system that you have purchased.

Edition Notice

This edition covers all versions of the ST8500 Series Data Logging and Analysis Systems distributed to customers world wide. The units of measurement used in this in this edition of the manual to illustrate the use of the this system are for the UK version. Units used in the various versions of the ST8500 are shown in the following table.

Parameter Type	UK Version	US Version	EU Version
Speed	MPH	MPH	km/h
Temperature	Degrees C	Degrees F	Degrees C
Wheel Circumference and Suspension Movement	Millimetres	Inches	Millimetres
Pressure	PSI	PSI	Bar
Distance	Metres	Feet	Metres

Related Products From Stack Limited

If you need information about other Stack Motorsport products, these can be obtained from Stack or from your local Stack dealer. Products available from Stack include:

- Intelligent Tachometers
- Action Replay Tachometers
- Performance Analysers
- Speedometers
- Boost Gauges
- Analog Sensors
- Digital Sensors
- Data Logging Systems
- Display and Logging Systems
- Radio Telemetry Systems
- Display and Analysis Software

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Who to Contact at Stack in Case of Difficulty

Stack and its approved distributors provide a comprehensive Technical Help service to assist with your enquiries. Contact your local Stack branch or distributor.

Approved Stack Distributors

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Belgium	**Van Den Bossche, B.V.B.A**, Boomsesteenweg 62, 2630 Aartselaar. Tel: 03 877 30 40 Fax: 03 887 24 52 GSM: 003275 42 96 37
Canada	**Orion Racing**, 2270, Industrial(Laval) Montreal, H7S 1P9 Tel: (514) 667 9769 Fax: (514) 667 6320
France	**Danielson Equipment**, 5 Rue de Champ Magny BP2 ZI 58470, Magny Cours. Tel: 86 21 22 55 Fax 86 21 22 65 **Oreca Co**., Parc D'Activite de Signes, 83870, Signes. Tel: 94 32 80 00 Fax 94 32 80 01
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Section 1. Setting Up and Starting Up

This section contains:

- Introductions to the ST8500 Series Data Analysis Systems
- Unpacking instructions
- Instructions for installing the software
- A Quick Start guide to get you up and running with the system.

Introducing the ST8500 Series Data Logging and Analysis Systems

The ST8501, ST8502 128K RAM Systems are used to record, analyse, and compare the general vehicle performance and engine parameters.

The ST8503 512K RAM System provides all the features of the ST8501, ST8502 and allows recording and analysis of additional selected driver activity parameters.

The ST8504 & ST8505 512K RAM Systems provides all the features of the ST8501, ST8502, ST8503 and in addition, allows suspension movement parameters to be analysed.

The following table summarises the performance parameters which are charted by each of the ST8500 Series Data Analysis Systems:

Performance Parameters	**Product number**	**8501**	**8502**	**8503**	**8504**	**8505**
Engine speed (RPM)	ST876	Yes	Yes	Yes	Yes	Yes
Wheel speed	ST670	Yes	Yes	Yes	Yes	Yes
Battery voltage	N/A	Yes	Yes	Yes	Yes	Yes
Laptimes	ST546	Yes	Yes	Yes	Yes	Yes
Oil or Fuel pressure	ST744	Yes	Yes	Yes	Yes	Yes
Oil or Water temperature	ST762	Yes	Yes	Yes	Yes	Yes
Lateral G-force	ST791	No	Yes	Yes	Yes	Yes
Distance	PC Channel	No	Yes	Yes	Yes	Yes
Longitudinal G-force	PC Channel	No	Yes	Yes	Yes	Yes
Performance	PC Channel	No	Yes	Yes	Yes	Yes
Throttle	ST770	No	No	Yes	Yes	Yes
Steering	ST771	No	No	Yes	Yes	Yes
Suspension Movement	ST673	No	No	No	Yes	Yes
Pitch & Roll	ST8506	No	No	No	Yes	Yes
Ride Heights	ST8506	No	No	No	Yes	Yes
Damper Velocities	ST8506	No	No	No	Yes	Yes
Turbo Boost Pressure	**ST8509**	**Option**	**Option**	**Option**	**Option**	**Option**

The ST8500 System software allows you to download the data recorded by the ST8500 data logging system as numbered runs in separate sessions, such as practice sessions and the race itself, which can be stored and retrieved for subsequent analysis and comparison.

The data from the runs is analysed lap by lap. In addition, you can compare the data from different runs or sessions on the same track.

Introducing the ST8501

Standard ST8501 Data Logging and Analysis System Items

Quantity	Part No.	Description
1	ST837	Data recording unit
1	ST874	Wiring Harness & Extenders
1	ST890	PC Network Cable
1	ST876	Network Harness
1	ST517	Switch (supplied with and connected to the wiring harness)
1	ST670	Wheel Speed Sensor
1	ST536	External “in operation” Lamp
1	ST546	Laptiming System
1	ST762	Temperature Sensor (0-150deg. C / 32-302deg. F)
1	ST744	Pressure Sensor (0-10 Bar/0-150PSI)
1	S/W	PC Software Disk Set (ST8501 Base Set)

The **ST8501** Data Logging and Analysis system records and analyses Time based parameters from Engine speed, Wheel speed, 1 Fluid Pressure, 1 Fluid Temperature, Battery voltage and Laptime data and also allows comparison of data from two runs.

The following performance parameters are charted by the PC:

1. Engine speeds (RPM)
2. Oil or Fuel Pressure
3. Engine Oil or Transmission Oil or Water Temperature
4. Wheel speed
5. Battery voltage
6. Laptimes

Introducing the ST8502

Standard ST8502 Data Logging and Analysis System Items

Quantity	Part No.	Description
1	ST8501	Full ST8501 System
1	**ST8502**	**Additional Items (listed below)**
1	ST791	Lateral G Force Accelerometer
1	S/W 2	ST8502 Replacement Software Disk

The **ST8502** Data Logging and Analysis software is used to record, analyse, and compare the performance parameters logged by the system.

The distance-based analysis includes facilities to create a circuit map showing the position of the vehicle at the moment that each of the parameter values is recorded.

The following performance parameters are recorded for analysis:

1. Engine speed (RPM)
2. Oil or Fuel Pressure
3. Engine Oil, Transmission Oil or Water Temperature
4. Battery voltages
5. Wheel speed
6. Lap times
7. Lateral G force

The ST8502 is available either as a complete package or as an upgrade to the ST8501 Data Logging and Analysis software.

This system includes all the components supplied in the ST8501 package together with a lateral G-Force sensor. It includes additional software to provide Track Mapping capability, Distance and Longitudinal G Force channel generation and Distance-based data analysis features for all of the data channels.

When supplied as an upgrade to the ST8501, it includes a lateral G-Force sensor and additional software package.

The ST8502 software can be used to:

- Compare two runs using Distance-based data
- Analyse performance through individual corners by providing a continuous comparison of time gained and lost between any two laps
- Identify quickly where on the track you can gain performance by using the track mapping facilities
- Identify optimal lines through corners by display and comparing the cornering forces through the run
- Evaluate Early or Late Braking performance.

Introducing the ST8503

Standard ST8503 Data Logging and Analysis System Items

Quantity	Part No.	Description
1	ST8502	Full ST8502 System
1	**ST8503**	**Additional Items (listed below)**
1	ST770	Throttle Position Sensor
1	ST771	Steering Position Sensor
1	S/W 3	ST8503 Software Disk (Replaces ST8502 disk)

The ST8503 records and analyses the following performance parameters:

1. Engine speed (RPM)
2. Oil or Fuel Pressure
3. Engine Oil, Transmission Oil or Water Temperature
4. Battery voltages
5. Wheel speed
6. Lap times
7. Lateral G force
8. Throttle position
9. Rotary steering position

This system extends the capability of the ST8502 by providing larger memory and two additional channels for recording throttle position and steering wheel position data and is supplied as either a complete system or an upgrade to any lower specification ST8500 system.

When supplied as a complete system, the ST8503 system contains equivalent hardware and software components supplied in the complete ST8502 system with the addition of throttle position and rotary steering sensors, expanded logger memory and enhanced data analysis software.

When supplied as an upgrade, the hardware includes an eight-channel data logger with expanded memory, as a replacement for your original ST8501 or ST8502 logger, additional throttle position and rotary steering sensors and new PC software.

The ST8503 software produces extra displays for the additional throttle position and rotary steering channels. Steering position is displayed as the number of degrees of steering wheel movement + or - from the central point. Throttle is displayed as a number between 0 and 100% of full throttle opening.

ST8503 Charts

The ST8503 provides the following combinations of channel displays on the PC:

• All channels	All channels separately
• All channels Full	All channels, overlaid
• Battery	Battery, engine speed, and wheel speed
• Driver Activity	Wheel speed, throttle position, and steering angle and lateral G-force overlaid
• Engine+Wheel Speed	Engine and wheel speed
•	
• Lat-G, Long-G + Speed forces	Wheel speed, lateral & longitudinal G
• Lat-G, Throttle+Speed	Wheel speed, throttle position, and lateral G-force
• Performance Comparison	Compares the wheel speeds from two laps and plots a graph of differences between the speeds. It also plots a graph of the time difference between the two laps at any given point on the circuit.
• Steering	Wheel speed, lateral G-force, and steering angle
• Temp + Pressure	Wheel speed, a temperature and a pressure

- Wheel Speed Comparison — Compares the wheel speeds from two laps and plots a graph of differences between the speeds

Lateral-G, Longitudinal-G and Speed

This choice displays a graphical data chart containing the wheel speed for a run and the corresponding lateral-G and longitudinal-G forces recorded at the same time

Lateral-G, Throttle and Speed

This choice displays a graphical data chart containing the wheel speed for a run and the corresponding throttle movements and lateral-G forces recorded at the same time.

Steering

This choice displays a graphical data chart showing the wheel speed, lateral G-force and steering position.

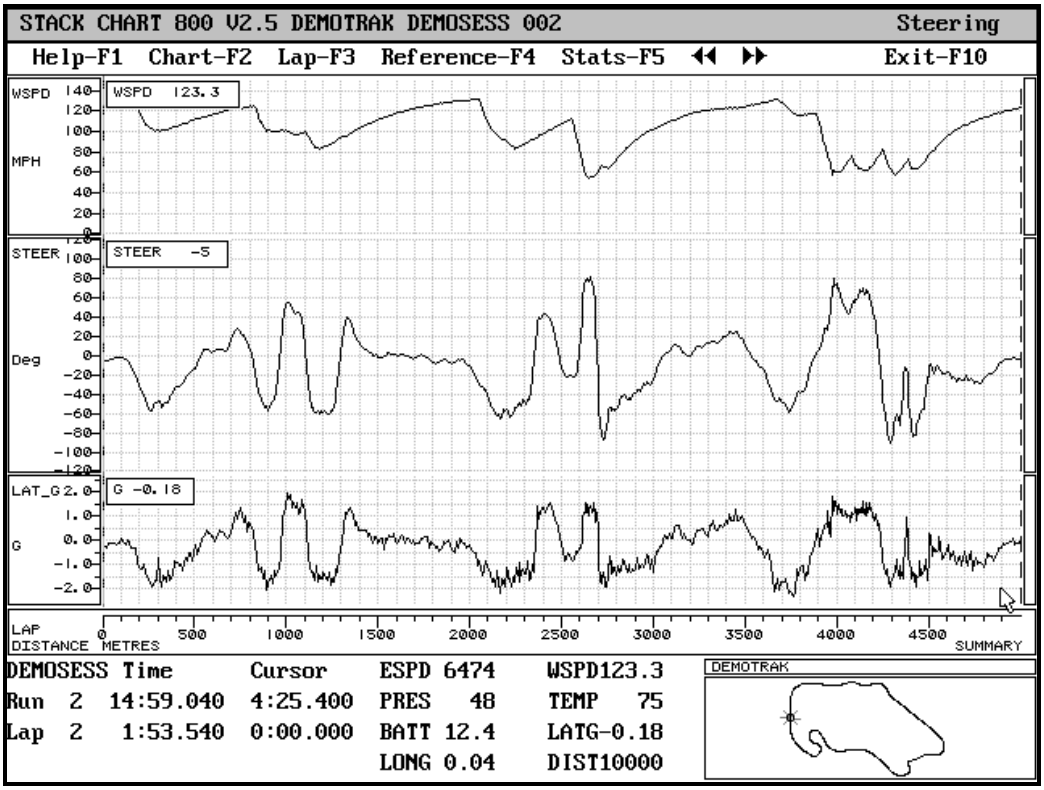
Driver Activity

This choice displays a graphical data chart showing the wheel speed and throttle position and steering wheel movement overlaid with lateral-G force data, to assist in the determination of Understeer and Oversteer conditions.

Understeer: Is indicated by excessive steering movement with no corresponding increase in lateral-G force.

Oversteer: Is indicated by rapid steering movements in the opposite direction to the direction of the turn indicated by the lateral G force.

The following example is a graphical data chart display produced by the **Steering** choice:



Introducing the ST8504 & ST8505

Standard ST8504/5 Data Logging and Analysis System Items

Quantity	Part No.	Description
1	ST8503	Full ST8503 System
1	**ST8504**	**Additional Items (listed below)**
1	ST847-1	Extra Sensor unit
1	ST896	Network Harness (Replaces ST876 on the vehicle)
1	ST875	Sensor harness & extender pack
4	ST673 or ST674	4”(100mm) Linear Potentiometers or 8”(200mm) Linear Potentiometers
1	S/W 4	ST8504/5 Software Pack (Replaces existing discs)

The ST8504 & 5 each record and analyse the following performance parameters:

1. Engine speed(RPM)
2. Oil or Fuel Pressure
3. Engine Oil, Transmission Oil or Water Temperature
4. Battery voltages
5. Wheel speeds
6. Lap times
7. Lateral G force
8. Throttle position
9. Rotary steering position
10. Suspension movement.

The ST8504/5 software includes all the features of the ST8503 software with the addition of the suspension performance analysis features. It produces displays with four additional channels for suspension damper data. The movement of each damper is plotted as units of ***0.1 millimetres*** for EU/UK systems and ***0.01 inches*** for the US system. The ST8504/5 is supplied either as a complete system or as an upgrade to any of the other ST8501 - ST8503 Data Logging and Analysis systems.

When supplied as a complete system, the ST8504/5 systems contain equivalent hardware and software components supplied in the complete ST8503 system with the addition of four suspension movement sensors, expanded logger memory, an additional sensor module with harness and enhanced data analysis software.

When supplied as an upgrade, the hardware includes a twelve-channel data logger with expanded memory, as a replacement for your original ST8501,2 or 3 logger, together with an additional sensor module, sensor harness, four suspension movement sensors and enhanced PC software.

ST8504/5 Charts

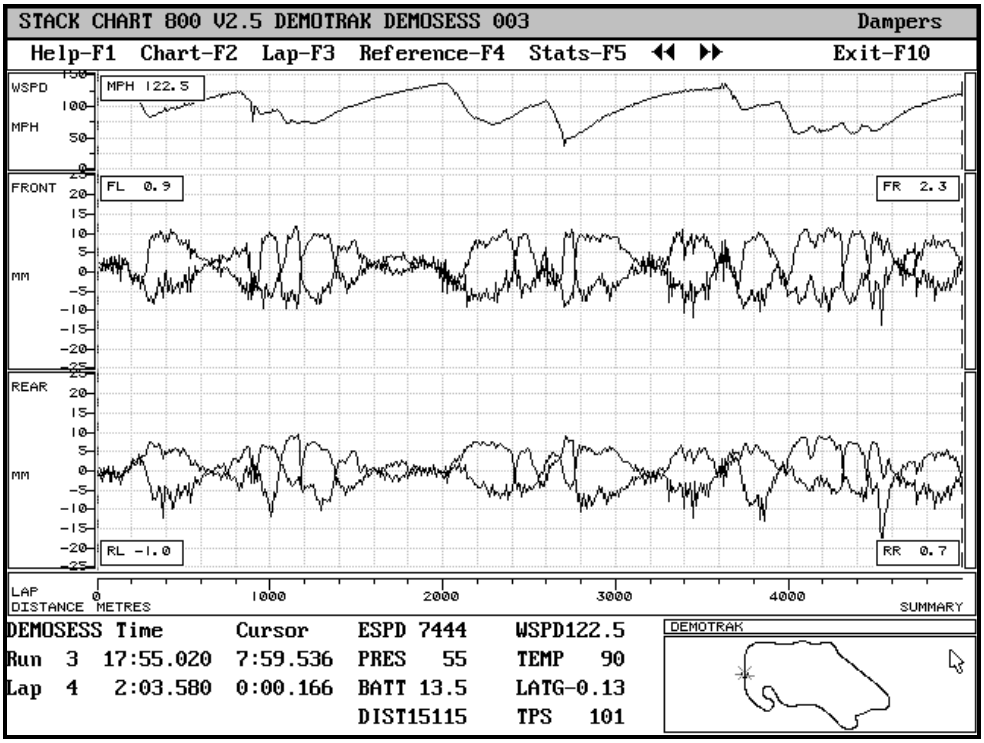
The ST8504/5 provide the following combinations of channel displays:

• All channels	All channels separately
• All channels Full	All channels, overlaid
• Battery	Battery, engine speed, and wheel speed
• Dampers	Wheel speed and front and rear damper movement
• Driver Activity	Wheel speed, throttle position, and steering angle and lateral G-force overlaid
• Engine+Wheel Speed	Engine and wheel speed
• Lat-G, Long-G + Speed forces	Wheel speed, lateral & longitudinal G
• Lat-G, Throttle+Speed	Wheel speed, throttle position, and lateral G-force
• Performance Comparison	Compares the wheel speeds from two laps and plots a graph of differences between the speeds. It also plots a graph of the time difference between the two laps at any given point on the circuit.
• Smoothed Dampers	Wheel speed and front and rear smoothed damper movement
• Steering	Wheel speed, lateral G-force, and steering angle
• Temp + Pressure	Wheel speed, a temperature and a pressure
• Wheel Speed Comparison	Compares the wheel speeds from two laps and plots a graph of differences between the speeds

The following are the additional charts available with ST8504 software.

Dampers Chart

The Dampers choice in the Chart-F2 menu produces a graphical data chart showing wheel speed and the movements of the suspension dampers. For example:



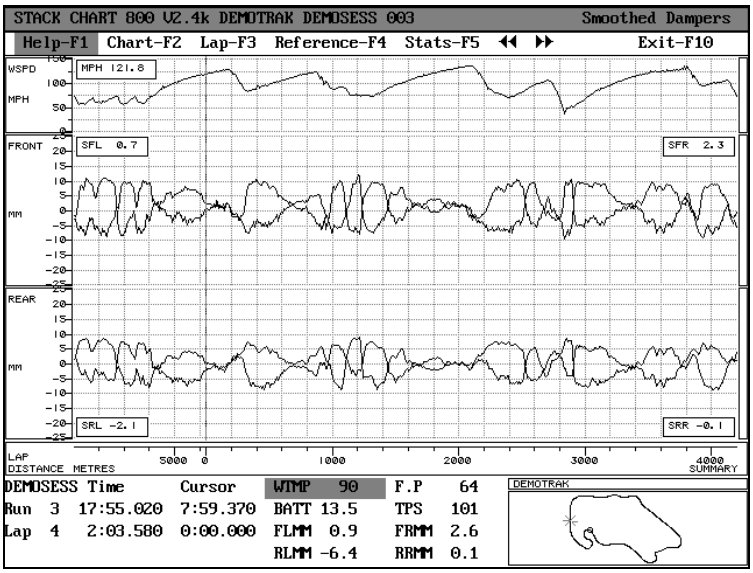
In the this and the following example, the damper movements are shown in 0.1mm (0.01in). This assumes that the damper pot readings are the actual wheel movements and do not require further scaling to compensate for ratios or non-linearities. For all Damper channels, higher values mean that either the vehicle has moved upwards or the wheel has moved downwards: in either case, the ST673 has increased in length.

Normally higher values correspond to the rebound from a bump while lower values correspond to the bump itself.

Smoothed Dampers Chart

The Smoothed Dampers choice from the Chart-F2 menu produces a graphical data chart showing wheel speed and a smoothed representation of the suspension damper movements.

For example:



This chart allows you to see the movements of the suspension dampers corresponding to the position of the chassis. All high frequency transitions due to the track surface have been removed by the smoothing calculation.

Damper Setup

You can reset the range of values and units (inches/mm) displayed for the front and rear dampers in these charts by means of the:

Edit-Menu > Chart Ranges choice.

Damper Values

The values for each of the dampers are displayed in the lower centre part of the chart, as illustrated above:

- FLMM/FLIN Front left-hand damper (mm or inches)
- FRMM/FRIN Front right-hand damper (mm or inches)
- RLMM/RLIN Rear left-hand damper (mm or inches)
- RRMM/RRIN Rear right-hand damper (mm or inches)
- SFL Smoothed front left-hand damper
- SFR Smoothed right-hand damper
- SRL Smoothed rear left-hand damper
- SRR Smoothed rear right-hand damper

The enhanced ST8506 software providing the user with Shock Velocities, Pitch & Roll and Ride Height parameters is described in detail in section 3 of this manual.

Unpacking the ST8500 System

Unpack the entire system or upgrade from the containers in which it was delivered.

Check through all loose packing material prior to disposal, to ensure that none of the smaller system components are being thrown away.

Note

It is recommended that you retain the original packaging in preparation and readiness for any future system updates or expansions you may undertake in the future, that may require the return of system components to STACK.

Use the **Introducing the ST8500** section lists included in this manual, to check off all of the components for the system type you have purchased. Advise STACK Ltd immediately of any potential errors or omissions from your system.

ST8500 Software Installation

This section describes how to install the ST8500 software. If you have purchased the ST8502, ST8503, ST8504, or ST8505 systems, and you have not used the ST8500 Series software before, you are advised to install only the ST8501 software and Demonstration Data to begin with, so that you can familiarise yourself with its operation, before proceeding to the more advanced ST8500 Series software products.

System requirements

Operating System

The ST8500 Series software runs on IBM PC or PS/2 compatible personal computers running MS-DOS Version 5.0 or later. The system has NOT been evaluated for use with **DR DOS** and is not recommended for use with **Microsoft's WINDOWS 3.1 or WINDOWS 95** products.

NOTE

During ST8500 software installation process your PCÆs CONFIG.SYS file will be automatically adjusted to meet the requirements ST8500 system.

Storage

At least 4.5 MB of disk space is needed to install and start running the ST8500 Series software. The storage required will thereafter depend on the extent of the track, session, and run data that is created by using the system:

The ST8501 and 2 systems provide up to 30 minutes of recording time for each run and use up to 128KB of storage. The ST8503, 4 & 5 provide up to 60 minutes of recording and use up to 512K of storage for each run.

Memory

At least 640K RAM is needed to run the software on MS-DOS systems. The ST8500 software requires 512KB of free conventional memory.

The ST8504 & 5 software also requires 128K of EMS memory. See Optimising and Customising Your System in Section 3 for information on how to configure you personal computer with EMS.

Display system

The software can be used on systems with EGA, VGA, and SVGA, and other compatible display systems.

Keyboard

The software is used with a standard keyboard.

Mouse

Although a mouse is not required, the use of a mouse is recommended as this greatly enhances the ease of use of the ST8500 Series software. Ensure that your PC loads the Mouse Driver software on power up.

Communication Interface for On-vehicle Data Logging System

The network interface between the personal computer and the on-vehicle logging system uses the PC parallel port. The network interface to the ST8500 Series Data Logging Device is built into the PC interface connector.

Installing the ST8501 Software

See Section 3 for more details on system requirements and how to configure your personal computer for running the ST8500 series software.

System Type	Disk 1 Base Disk	Disc 2	Disc 3	Disc 4
ST8501	ST8501 **(Base Disk)**	Demo1	**None**	**None**
ST8502	ST8501**(Base Disk)**	ST8502	Demo 1	**None**
ST8503	ST8501**(Base Disk)**	ST8503	Demo 1	**None**
ST8504	ST8501**(Base Disk)**	ST8504	Demo 2	ST8506
ST8505	ST8501**(Base Disk)**	ST8505	Demo 2	ST8506
ST8509	Turbo Boost (Option)			

System Disk Table

Note

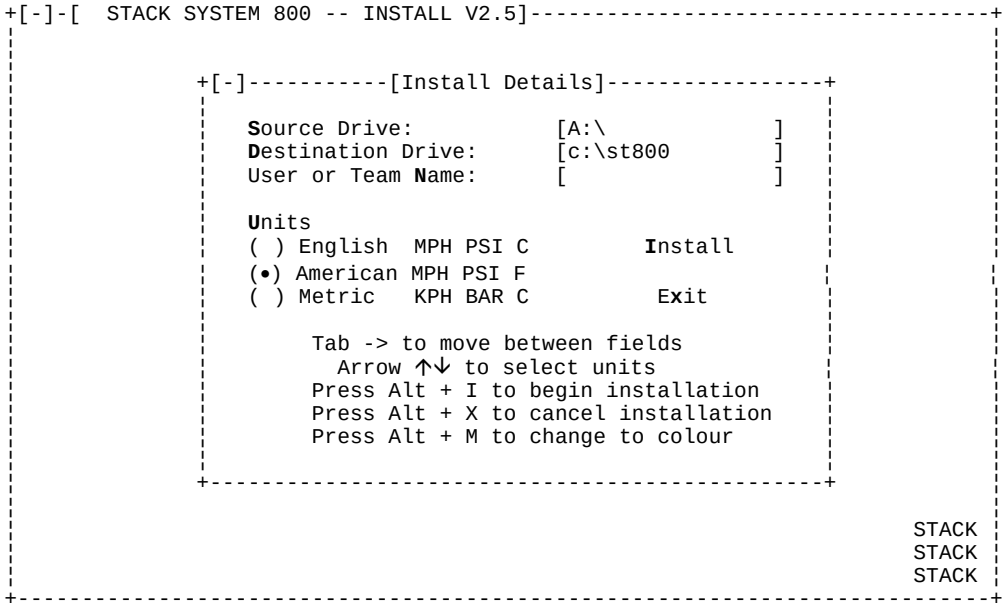
Do not make any of the supplied disks "Write Protected"

In the case of all new system installations, the first operation is to insert the ST8501 software Disk (labelled ST8501) into the personal computer and enter the following at the C:\ prompt:

```
A:\INSTALL <return>
```

This commences the installation of the ST8501 software.

During the installation process, you are asked to choose configuration values from the following window that you require to be used in the data displays screens.



1. Use the tab key move between the fields in this dialogue page.
2. Use the up-arrow and down-arrow keys to move between the three sets of unit measurements.
3. When finished, tab to ôInstallö and press the Enter, or press Alt and the I key together to proceed with installing the software.

Source Drive :

is set to the A: drive by default. If you are installing from a different drive or using a different file name, enter the details on this line.

Destination Drive :

and directory are set to C:\ST800. You can change the destination drive to any drive and to a directory of your choice on a hard disk.

User or Team Name:

Any text you enter here will appear as the title volume on the disk.

Use the up-arrow and down-arrow keys to move between the three sets of unit measurements. The selected line is shown with (•). The unit measurements are:

- **English :-**

  for systems configured with temperature and pressure parameter values for the UK version of the ST8500 system.

- **American : -**

  for systems configured with temperature and pressure parameter values for the US version of the ST8500 system.

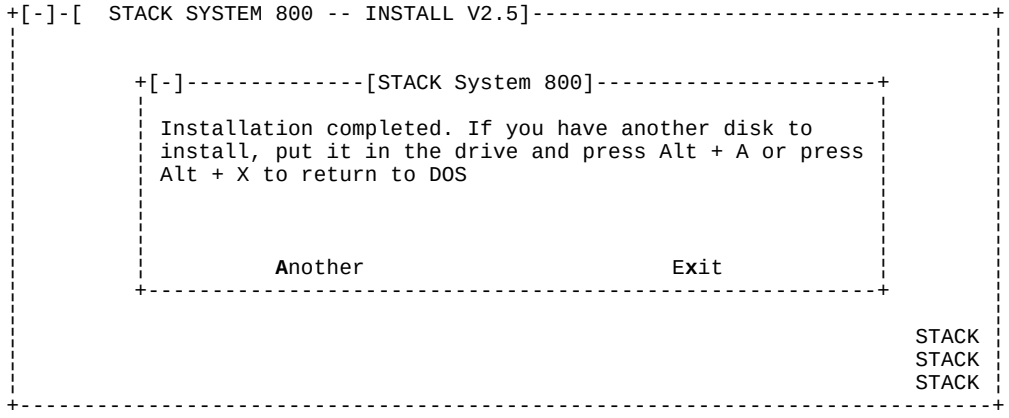
- **Metric :-**

  for systems configured with temperature and pressure parameter values for the EU version of ST8500 system.

The units of measurement for your ST8500 system will be determined automatically by the PC during the Software configuration process.

Installation Messages

As installation proceeds, various messages will be displayed, this is normal. When the first disk (the ST8501 software disk) has been installed, the following message is displayed:



Remove the ST8501 installation disk from the drive

The next step is determined by the type of ST8500 system you have purchased.

Study the previous System Disk Table and determine the next disk in the set of disks supplied for your system.

Example:-

System Type	Disk 1	Disk 2	Disk 3
ST8503	ST8501**(Base Disk)**	**ST8503**	Demo 1

Insert the next disk in the sequence into your floppy disk drive. In the case of the example this is the ST8503 (shaded) disk.

Select **Another** and press <**Enter**>.

When this disk has been fully installed, the message above reappears. Replace the disk with the next disk in the sequence and then :-

Select **Another** and press <**Enter**>.

When all of the disks supplied with your system have been installed by this process, you will be in a position to proceed by selecting the **Exit** option, which will return you to the DOS prompt.

Quick Starting the ST8500 Software

If you have just installed the ST8500 software and are using it for the first time, you can start to familiarise yourself with it by starting it up and displaying the data analysis charts created from the demonstration data, supplied on the Demo Data disk.

Here we introduce most of the techniques and features you will use while analysing the data, without going into every detail about each function of the software. A full reference of the software features is given in Section 3 of this manual.

To start the ST8500 software, start an MS-DOS or PC-DOS session. Select the drive prompt for the hard disk on which you have installed the software. For example, if you have installed the software on the C: drive, select the C:\ prompt and enter:

8500<RETURN>

Note: Do not select the ST800 directory before entering the **8500** command as this can cause the software to start up without setting the correct graphics mode for the graphics hardware on your PC.

NOTE

If you did not use the default ST800 directory when you installed the ST8500 software, you will need to edit the **8500.BAT** DOS Batch file to call the software correctly.

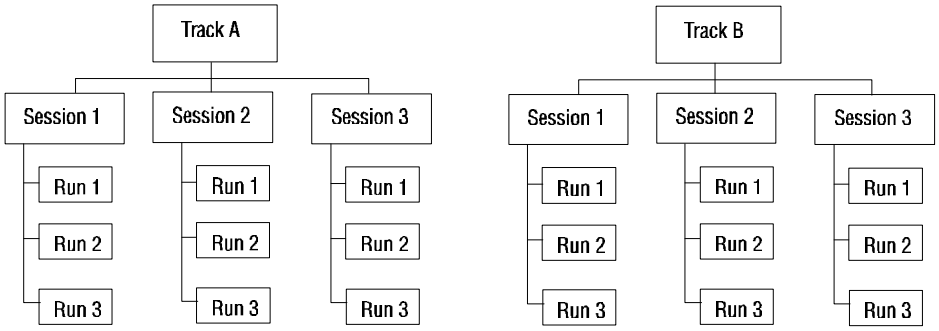
See Section 3 for instructions on how to complete this task.

How the ST8500 Recorded Data is Organised

The display software uses data organised by Track, Session, and Run. Each Session is a convenient set of data, usually from a single day. You can use the software to record and analyse the data for multiple ST8500-equipped vehicles by creating separate Sessions for each vehicle.

When you use the data analysis software, you select the particular Track from a menu of the Tracks for which you have previously recorded data. You can then create a new Session for this Track and record as many separate Runs for this Session. Subsequently, you can retrieve, analyse, and compare the data for any particular Run and for the Track.

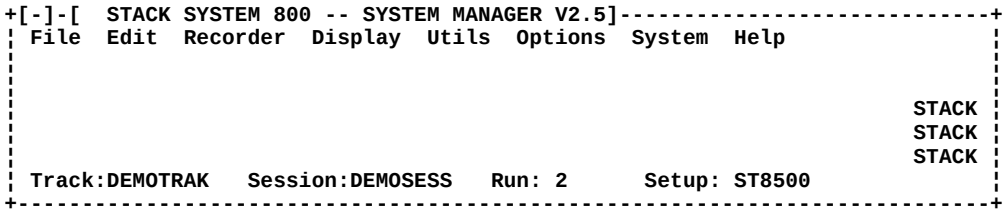
This concept is illustrated as a block diagram that shows a database with two tracks, Track A and Track B:



You can compare any of the Runs for a Track with any other Runs on the same Track that you have recorded either during the same Session or during any other Session.

Main Menu Display Window

This window is displayed when you first start the ST8500 Series software and it contains the following information:



You use this window for preparing each session prior to downloading the data and analysing it. You can also use it retrieve data downloaded from previous sessions from files stored on the personal computer's disk storage. You can select each of the main functions of the ST8500 data analysis software:

- Download data
- Display an analysis of the downloaded data for a session
- Compare the data from different laps and different runs
- Monitor the Stack ST8500 Data Recording System on the vehicle.
- Organise and manage downloaded data
- Calibrate sensors

Data Charting Window

The following example of the data charting window shows values logged for parameters plotted over an entire run using time-based analysis.

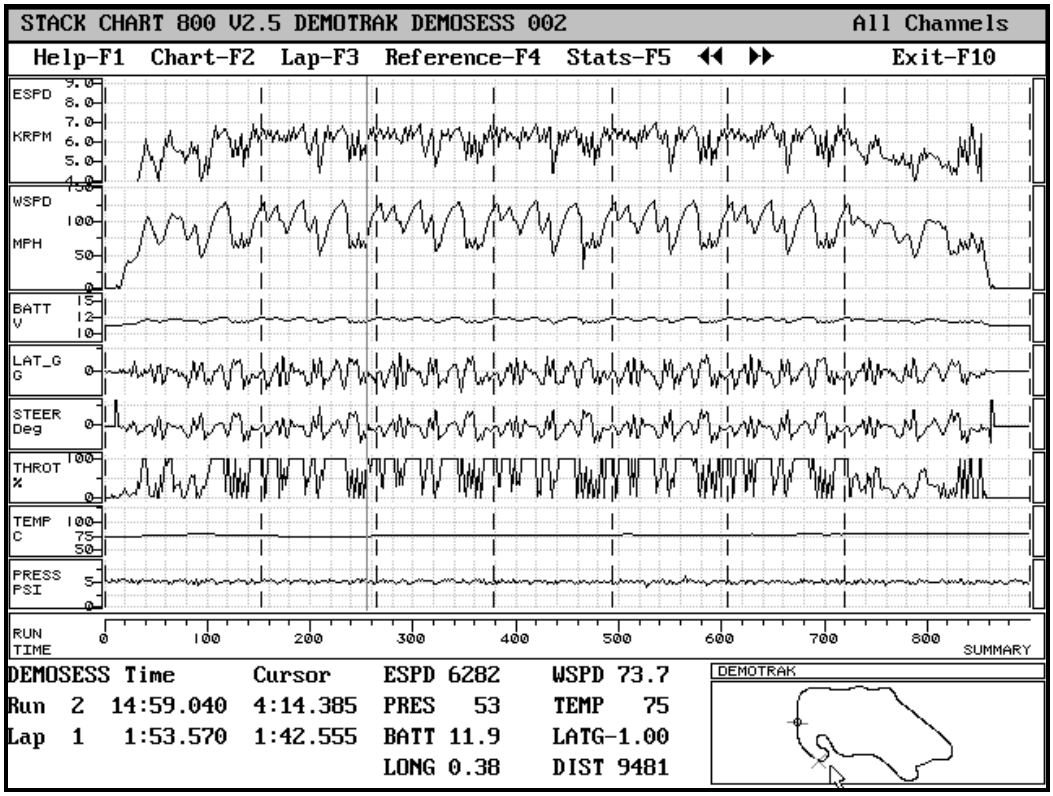
The display shows a map of the circuit with the position of the vehicle at the moment that the parameter value or compared values are recorded.

Note: Map display is not available in the ST8501 software. Map displays can be produced by the distance-based software in the ST8502 and higher versions of the ST8500 Series software products.

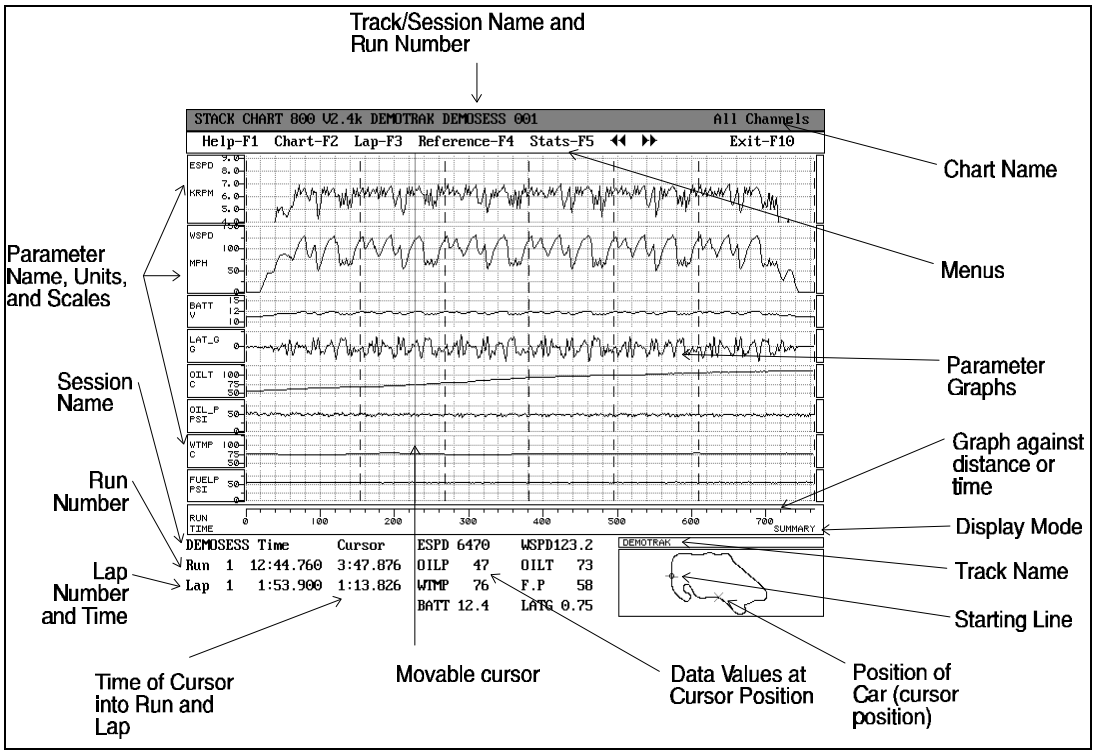
Each of the logged parameter values from the run are displayed as lines plotted on a graph, that shows for time-based analyses the value of the parameter at the moment of recording. For distance-based analysis, the values are displayed relative to the distance travelled from the start of each lap.

You can move the cursor line representing the vehicle, to any position on the track during the run. A separate tabular data display shows the numeric values of the parameters as logged when the vehicle was at the point on the track indicated by the cursor.

You can zoom into any particular section of any screen display to see graphical information in greater detail.



The following illustration shows the main components of the data charting window.



```
+[-]-[  STACK SYSTEM 800 -- SYSTEM MANAGER V2.5]-----------------------------+
¦ File  Edit  Recorder  Display  Utils  Options  System  Help                ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                            ¦
¦                                                                     STACK ¦
¦                                                                     STACK ¦
¦                                                                     STACK ¦
¦ Track:DEMOTRAK   Session:DEMOSESS   Run:  2   Setup:ST8500                 ¦
+----------------------------------------------------------------------------+
```

The information at the bottom of the screen indicates that the software is installed pre-set to use demonstration track DEMOTRAK, the demonstration session DEMOSESS, the demonstration run information is from Run 2, and the demonstration Setup is ST8500.

You can use these settings to acquire a feel for using the software before going out to a circuit and using the software to record and analyse your own information.

The entries across the top of the screen are the function menus which you use for all the facilities in this software. The **File** menu is normally highlighted.

Move the highlight from **File** menu to the **Display** menu by pressing the right arrow key three times.

Press the Enter key and the following panel is displayed:

```
+--------------------+
¦  Chart             ¦
¦  Compare Chart     ¦
¦  Quick Chart    F3 ¦
¦  Quick Compare  F4 ¦
+--------------------+
```

This panel offers the following display choices:

1. **Chart**: Displays a chart showing the data logged for a single run.
2. **Compare Chart**: Displays a chart showing a comparison between two runs that you select. .
3. **Quick Chart F3:** Provides a shortcut key for selecting the Chart function to display the last selected run.
4. **Quick Compare F4:** Provides a shortcut key for selecting the Compare Chart function for the last selected run.

The runs are those that have already been recorded for the track and session.

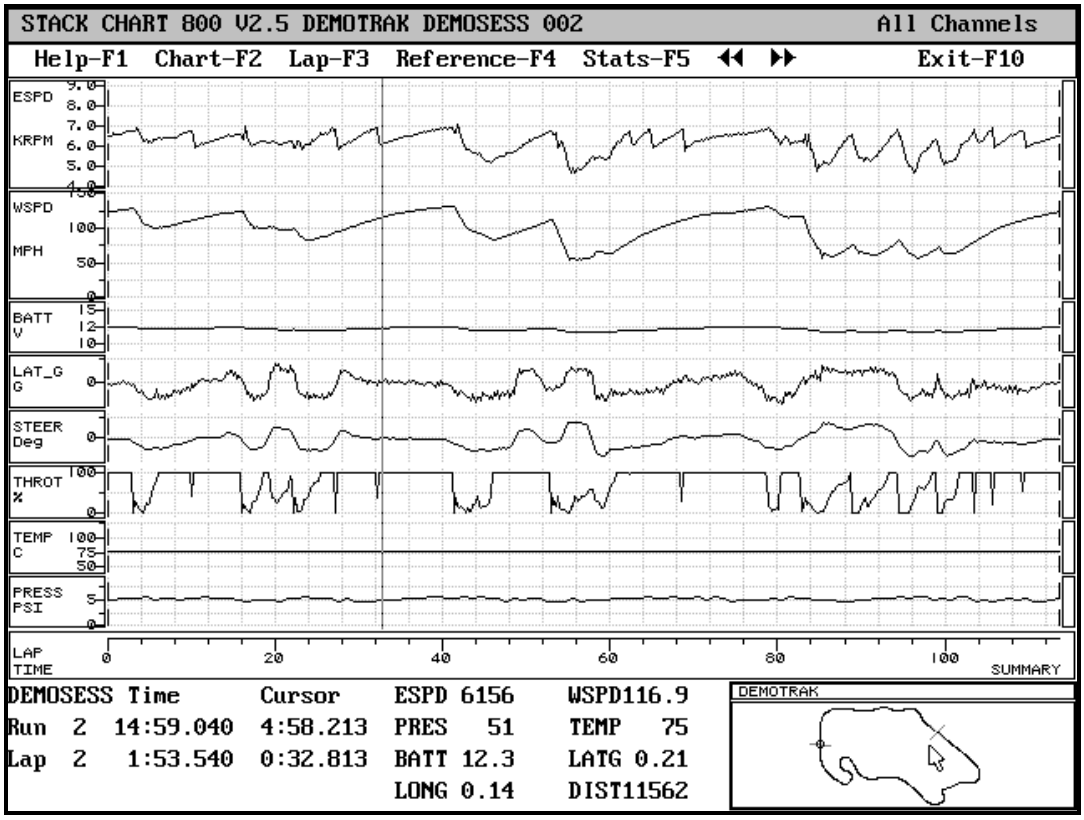
The entry for **Chart** is highlighted.

Press the Enter key to select the Chart function and the Select Run Number panel is displayed:

```
+[-]-[Select Run Number:]-------------------------------------+
|  1   Sat Jan  1  13:00:00    12:44   5    1:53.580  12      |
|  2   Sat Jan  1  13:21:50    14:59   6    1:53.540  12      |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|                                                             |
|Run   Date        Time     Duration  Laps   Fastest  Chan    |
+-------------------------------------------------------------+
```

This panel contains a list of the runs that have been recorded for the track and session. In this example the session is DEMOSESS and the track is DEMOTRAK. The second line (Run Number 2) is highlighted. Use the up-arrow and down-arrow keys to select a different run. Press the Enter key to select this run.

The following chart is displayed:



When the chart is first displayed, it shows the values logged for the fastest lap in the run. In this case, the chart uses time-based recording.

Altering the background grid

The background grid can be displayed in two different styles or not displayed. The two styles are:

1. As dotted lines. The chart uses this method when you first display it after installing the software.
2. As single dots.

To alter background grid, press either the Alt + H keys together or the **#** key until you reach the style you prefer.

Altering the graph plotting mode

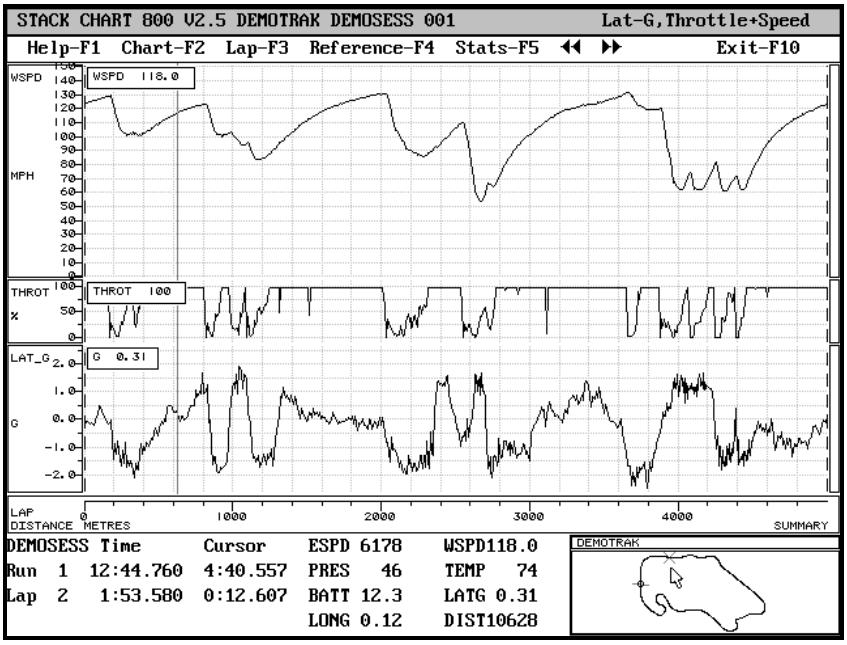
Three types of graph plotting modes are available by pressing either the Alt + G keys together or the ~ key. The modes are:

1. Summary
2. Real
3. Points

You can tell which mode is in use as this is displayed below the bottom right-hand corner of the chart, above the map of the circuit.

Summary mode. This mode is used when you first display the chart after installing the software. It shows one data value per screen pixel.

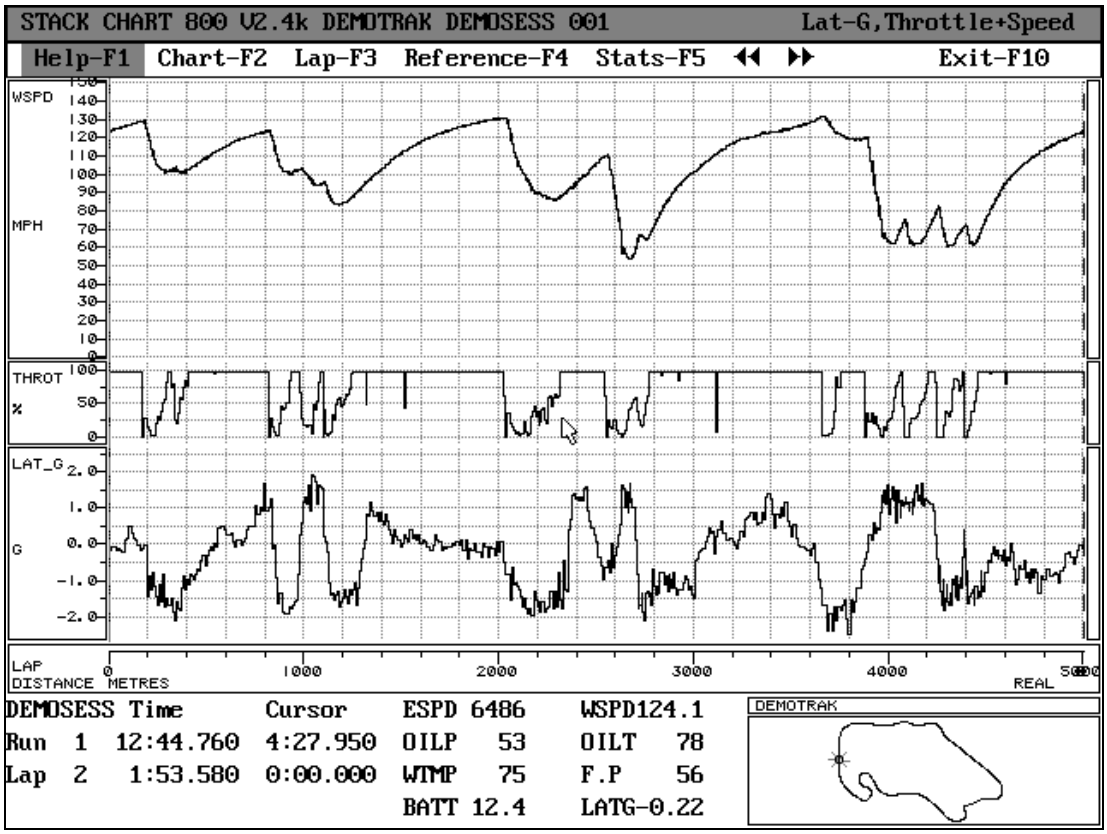
1. When there are more data values than pixels, the intervening data points are not displayed.
2. When there are more screen pixels than data points, the data values are joined by a sloping line.



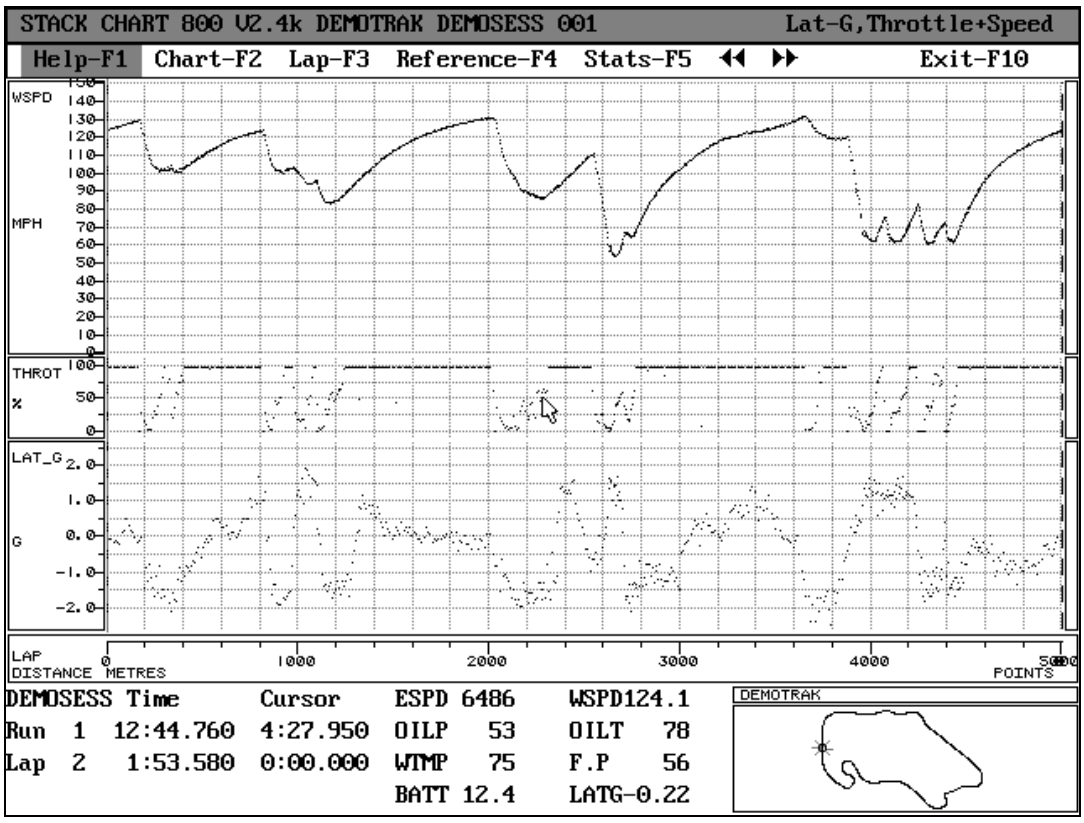
This is an example of a chart displayed in summary mode.

Real mode. This mode shows the maximum and minimum value of data for each screen pixel. Example shown below.

1. When there are more data values than pixels, each pixel shows a bar from the minimum to the maximum value.
2. When there are more screen pixels than data points, the previous value is continued until the next data value.



Points mode. This mode shows all the data values as individual points not joined by lines:



Viewing details of the run

The chart cursor is a solid vertical line that you move by pressing the left or right arrow keys. You can move the cursor across the chart in larger steps by holding down the Ctrl key and pressing the left-arrow or right-arrow key.

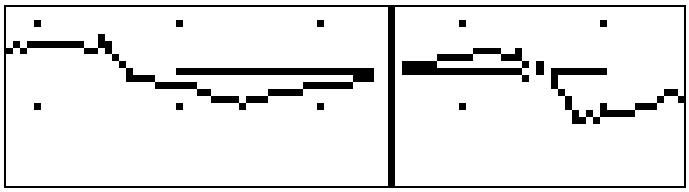
You can use the mouse to position the cursor at any position in the chart by pointing and clicking at the required position.

When you first display data in a chart, the software shows the runs fastest lap in a full screen width display.

As you move the cursor the recorded parameter values at the cursor position are displayed in tabular form at the bottom of the chart.

ESPD 6062	WSPD115.8
OILP 47	OILT 90
WTMP 75	F.P 55
BATT 12.3	LATG-1.18

You can select each of these parameters in turn by pressing the Tab key. This also displays a horizontal line (cross-hair) corresponding to the current value of the highlighted parameter on the chart:



The position of this line changes as you move the cursor. This can be helpful in identifying a parameter if more than one parameter is being graphed on the same area of the chart

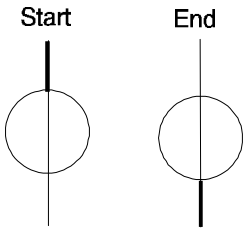
Press the tab key to highlight and select the first item in the list.

- Use the TAB key, PgDn, or + key to move down the list.
- Use the SHIFT and TAB keys together, PgUp, or the - key to move back up the list.

The ST8502/3/4/5 software provides track mapping facilities. The chart display can include a map of the circuit in the bottom right-hand corner. The map shows the position of the lap marker on the circuit, as a circle with three protruding lines.

It shows the position of the cursor on the circuit as two crossed diagonal lines.

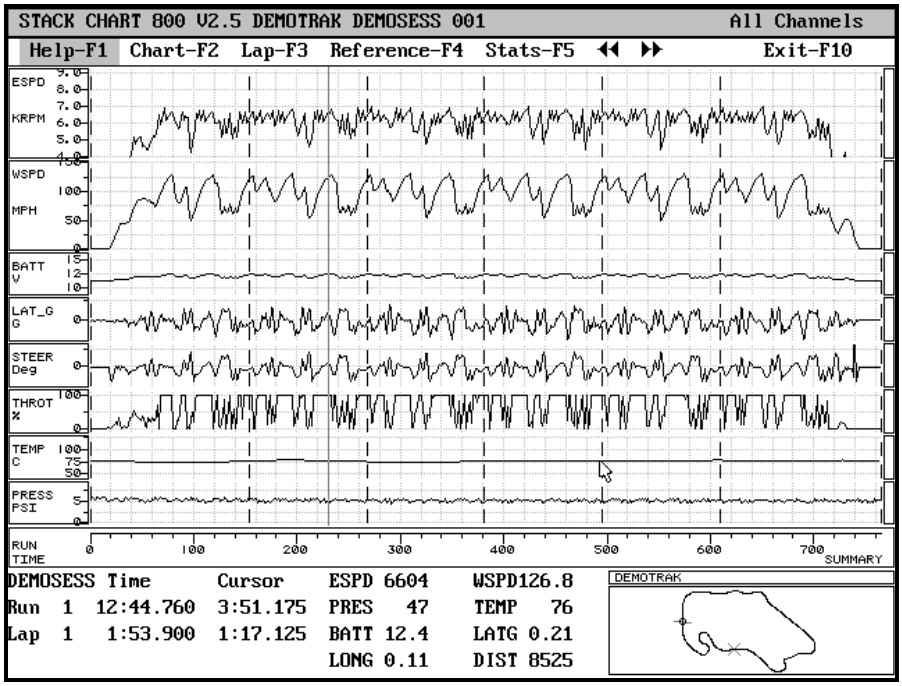
When you select a section of the track on the chart, the start and end of the portion selected are shown as:



Selecting an individual lap

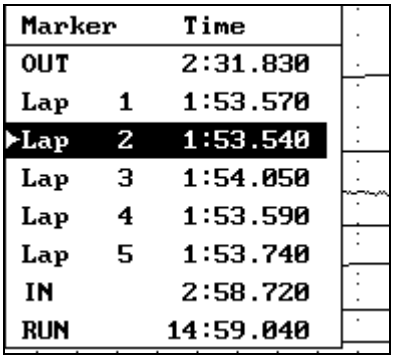
There are two methods for you to select a full lap of data.

You can change the view from an individual lap to the full run by pressing the down-arrow key. The start or end of each lap in the run is then shown as a broken vertical line. You can move the cursor to the lap that interests you and then press the up-arrow key to display the chart for the individual lap. An example of a chart showing the full run is given below.



The Run number and the lap number (which is dependent on the cursor position) are shown in the first column. The **Time** for the run and lap are shown in the second column and the time into the current run and lap represented by the position of the **cursor** on the chart are shown in the third column. The fourth and fifth columns show the values of the recorded parameters at the cursor position.

If your ST8500 software includes the optional lap marker; instead of scrolling across the entire chart for a run to find a particular lap, you can save time in selecting a lap by using the Lap-F3 menu. Press the F3 key. The lap selection panel is displayed:



If you are using a three-button mouse it is also possible to display this panel, by pressing the centre mouse button.

Move the highlight onto the lap you want to see with the down-arrow or up-arrow key and press Enter. You can also use the mouse to select the **Lap-F3** menu and then the lap you want to see.

When you are viewing a lap, you can view the preceding lap (if there is one) either by pressing ALT + J, the "," key or by clicking the mouse on the left-hand pair of arrow heads on the menu bar.

Similarly, to view the following lap, press Alt + K, the "." key or click on the right-hand pair of arrow heads in the menu bar.

Viewing the fine detail (Zoom facility)

You can see the details of the data recorded down to a level of a few seconds (or a few metres if you have a distance-based display) or less:

- Select the start of the section of the run that interests you by pressing the cursor key and moving the cursor to the start position.
- Select the section to be enlarged by holding down the Shift key and pressing the cursor key. The section of the chart will be highlighted.
- To highlight larger sections more quickly, hold down both Shift and Ctrl keys and then press the required cursor key. Remember to release the Shift key last when you use this method of highlighting.
- When you have highlighted the section, press the up-arrow key.

You can also use the mouse to highlight the section of interest:

- Click and hold the left mouse button on the start of the section and drag it to the left or right.
- Release the button when the area is highlighted.
- Press the right mouse button to zoom in.
- Press the right mouse button again when you wish to zoom out again.

Viewing channels selectively

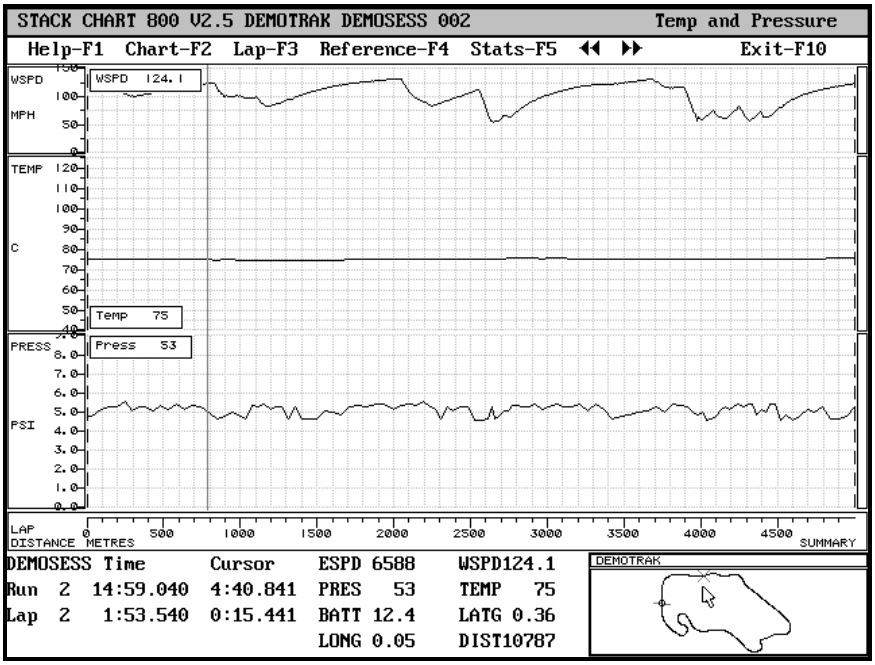
You can see more graphs for individual channels in more detail by using the **Chart** menu at any time. Press the F2 key to open this menu. It contains choices such as :-

- All Channels
- All Channels Full
- Battery
- Engine + Wheel Speed
- Temp & Pressure
- Wheel Speed Comparison

The initial All Channels choice shows each of the available channels separately. Select the **Temp & Pressure** choice (use the down-arrow key to highlight it, then and press Enter or click on it with the mouse). This displays a chart containing just three channels:

The following example shows lap 2 of Run 2 from the DEMOSESS session using the Temp & Pressure Chart.

(This chart shows distance-based data rather than time-based data):



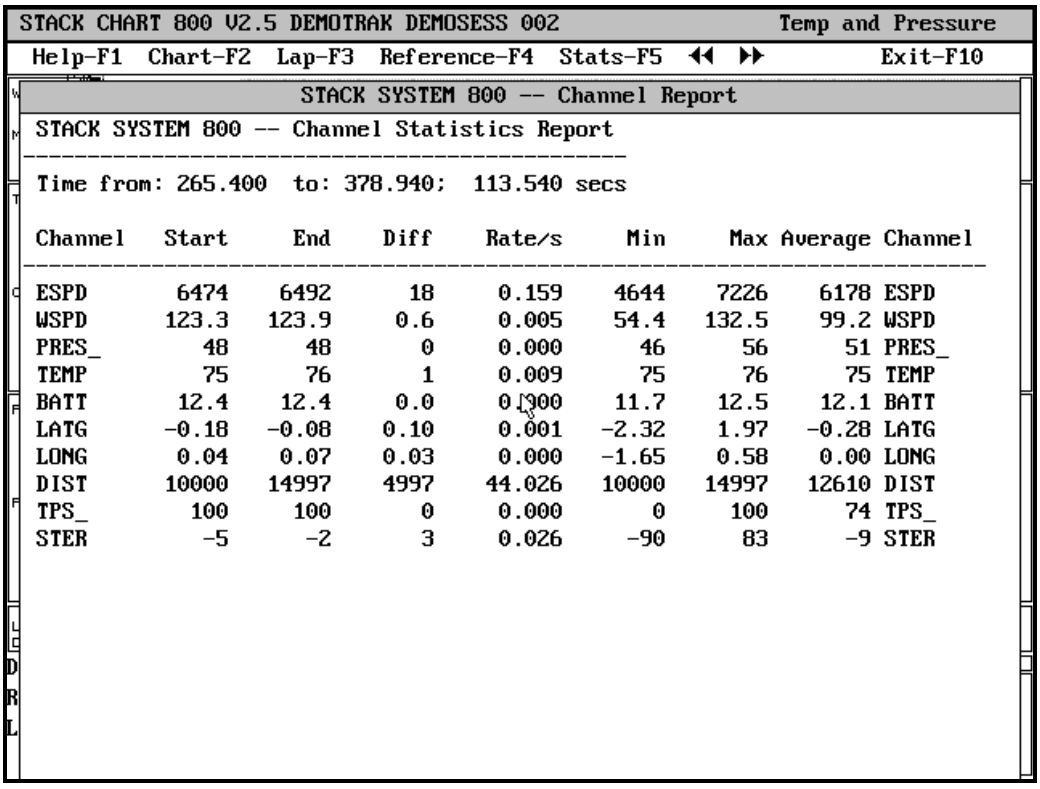
The other choices in this menu include charts for:

- **All Channels Full**: All channels together. This choice plots for graphs for all of the available channels which are displayed overlaying each other.
- **Battery.** This chart displays the battery voltages recorded during the run along with the engine and wheel speed data.
- **Engine and Wheel Speed**: This chart shows two channels: engine RPM and wheel speeds.
- **Temp & Pressure**. This chart is used to display temperature and pressure data along with the wheel speed data for the run.
- **Wheel Speed Comparison** This chart is used to display the graphs for the wheel speeds from two different runs. It shows the two wheel speeds plotted over each other and a second graph showing the difference between the two runs. (The comparison of two runs is described in more detail later in this section.)

Viewing the Statistics for a Lap

To see the statistics for the lap on which the cursor is currently positioned, press the Stats-F5 choice.

Lap 2 of demonstration Run 2 produces the following output:

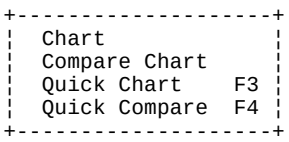


This shows the start and end values, and the differences between them, of each performance parameter being logged. It also shows the minimum, maximum, and average values recorded during the lap. Press the Esc key to return to the chart.

Viewing the Wheel Speed Comparison Chart

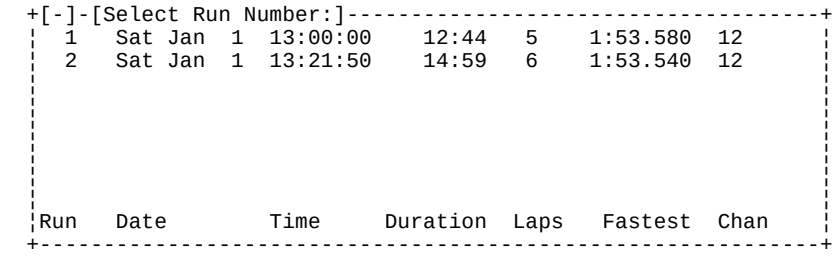
To display a chart comparing two runs.

- Press F10 to return to the menu window. The **Display** menu should be highlighted.
- Press Enter to display the following panel:

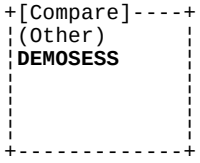


- Press the down-arrow key to move the highlight Compare Chart line.

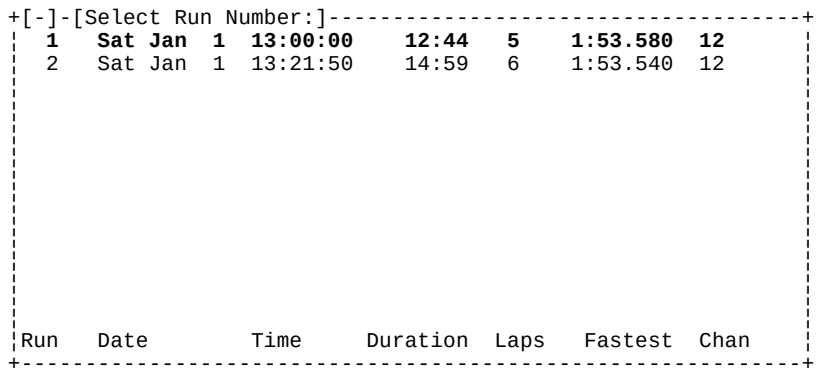
Press Enter to display this baseline run selection panel:



Move the highlight to Run 2 and press the Enter key to select it. This displays the following panel:



DEMOSESS is already highlighted. Press the Enter key to select it. This displays the comparison run selector panel:



Run 1 is already highlighted. Press Enter to select it.

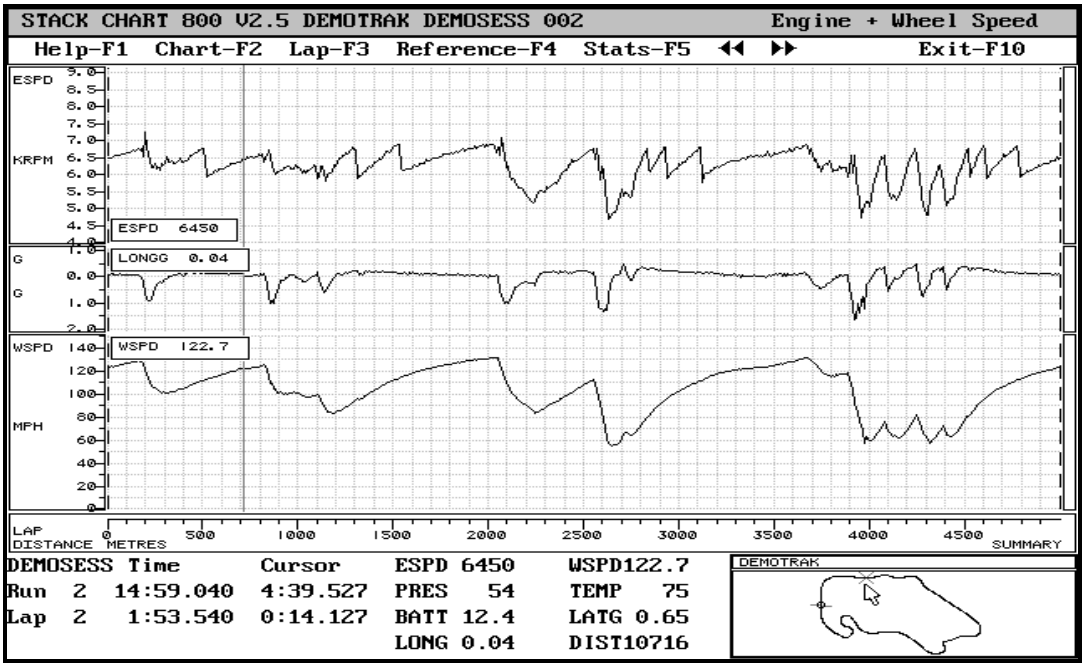
This displays a chart comparing the two runs. Now press F2 and select the Engine + Wheel Speed) choice. Next press F3 and select Lap 2.

Note: You can compare the laps from the same run. To do this, select the same run twice in the preceding sequence. Initially you will select the same lap: select another lap to see the difference.

A chart showing a comparison of the two runs is displayed, showing the fastest lap from the first run you select (the current run) compared with the corresponding lap from the second run (the reference run).

You can select a section of the chart and zoom in on it to see the comparison in more detail.

An example of equivalent sections of two runs being compared is shown in the following chart:



This shows a time-based comparison between two runs of wheel and engine speeds.

You can compare each of the laps in the current run with the same lap in the reference run by simply selecting a new lap with the **Lap-F3** option. The laps from the reference run and compare run both change when you scroll across lap boundaries within runs, as laps are locked together.

You can compare any of the laps in the reference run with a lap from the current run by selecting the **Reference-F4** menu and selecting the lap from the list displayed.

The graph for each data channel indicates any obvious differences between the two laps. The lower control section shows the overall run time for the first run (the current run) that you select when you set up the comparison and the time for the current lap.

The values for each of the channels reflect the current cursor position. The first column is the value of the parameter from the current lap . The second column contains the value for the reference lap. The third column contains the differences between the for the two laps.

Now press the ô/ö key. Notice that this changes the information in the lower left hand section about the run and lap times and also the cursor times for the runs and laps being compared. When the data is for the current run, the **Time** heading is present. When the data for the reference run is being shown, the **Reference** is present.

- To change the lap from the current run, press F3 (Lap menu) and select a new lap from the list.
- To change the lap from the reference run, press F4 (Reference menu) and select a new lap from the list.

Not all the data channel values are visible at the same time. To see any others that may be hidden, select one and use the TAB, + or PgDn keys to scroll down the list. Use the SHIFT + TAB, - or PgUp keys to scroll up this list.

The TAB Key is marked :- |← →| on your keyboard.

Section 2. Vehicle Installation and Setup

This section contains information on:

- Installing the data logging equipment in the vehicle
- Checking the installed equipment and its configuration
- Calibrating the equipment

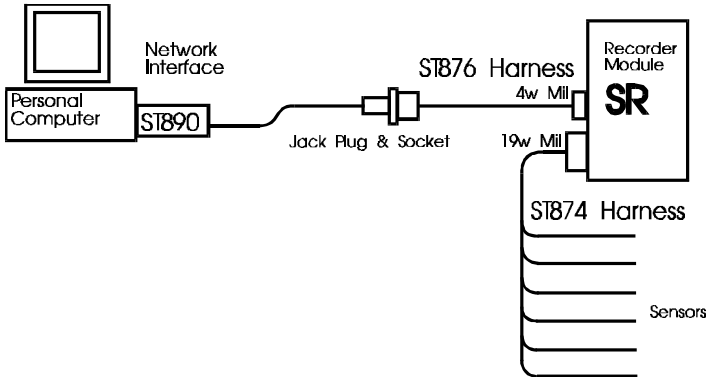
Installing the ST8500 Data Logging Equipment

This section describes how to install the data logging components supplied with the ST8500 package on the vehicle, set them up, and check that they are operating correctly.

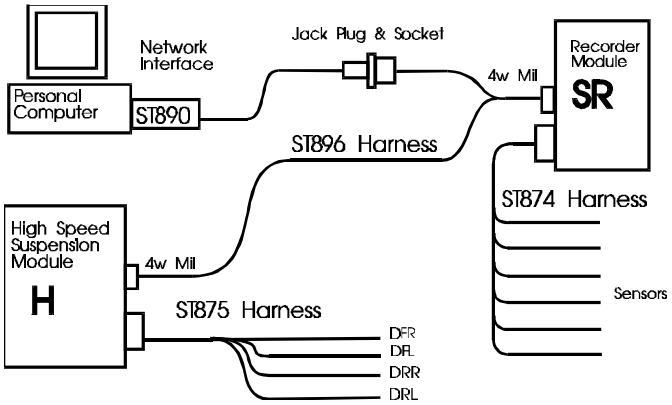
All ST8500 systems include the following standard items:

- A data logger box unit labelled SR to be fitted into the vehicle
- For ST8501 - ST8503 systems an ST876 connecting cable with jack plug socket for connection to the external computer and a terminal for connection to the SR data logger unit.
- For ST8504/5 systems an ST896 connecting cable with jack plug socket for connection to the external computer and terminals for connection to the SR data logger and H sensor units.
- A connecting cable consisting of a network transceiver with a built-in parallel plug, a cable, and a jack plug.
- Dual-Lock™ fixing material for attaching the data logger/sensor units to the vehicle.

The following diagrams show the overall wiring layout for the data logging systems:-



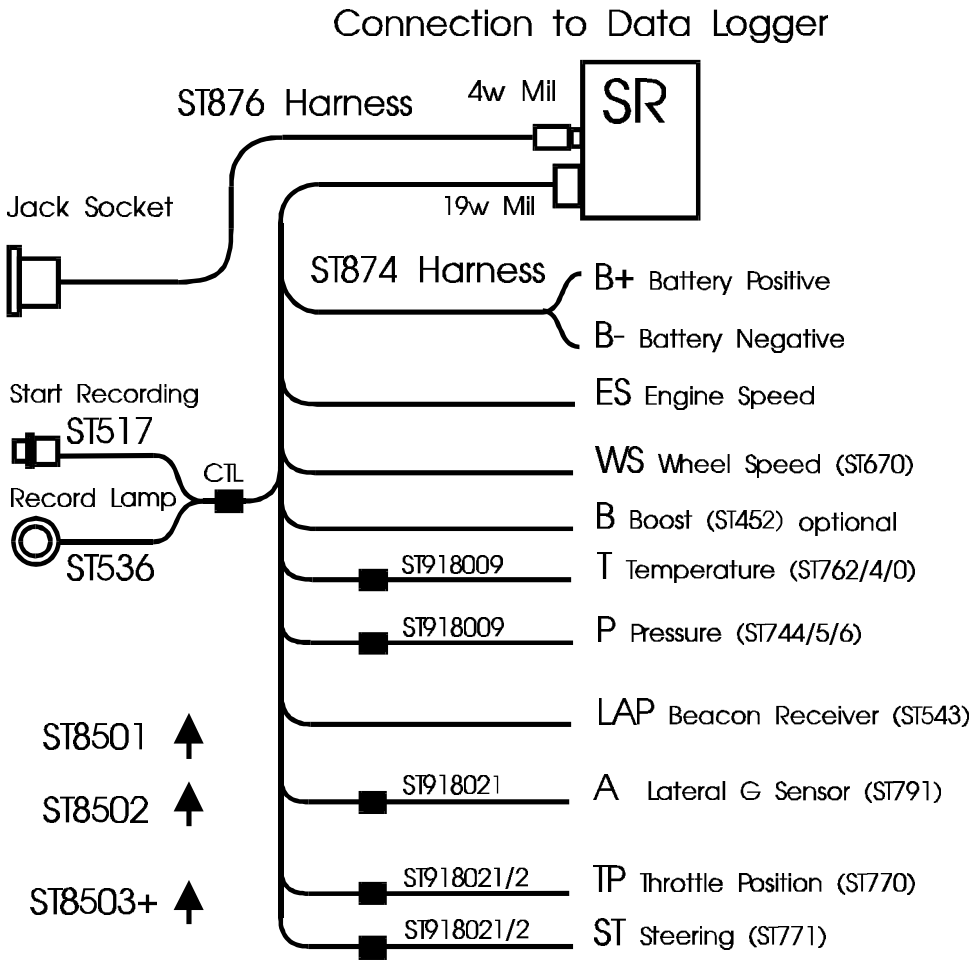
ST8501 - ST8503 System



ST8504 - ST8505 Systems

- Locate a convenient bulkhead on which you can fix the module(s).
- Fix the modules to the bulkhead (using the Dual Lock™ material supplied).
- Install the jack plug socket end of the connecting cable at a convenient point within reach by the cable of the data logger unit in its installed position. This socket should be easily accessed and should be fixed either into an external body panel or into the instrument panel.
- Connect the other connector(s) on the cable to the module(s) you have installed.

Wiring Harness



Each of the wires in the harness is labelled.

Labels on short cables	Connection To
WS	Wheel speed sensor
LAP	Lap timing sensor
CTL *	Recording indicator light & Switch
TP	Throttle position sensor
ST	Steering angle sensor
B	Optional Boost Sensor ST8509
Labels on Long Cables:	**Connection To**
ES *	Engine Speed (RPM)
T *	Temperature sensor
P *	Pressure sensor
A	Lateral G-force sensor
B+	Battery Positive
B-	Earth (Battery Negative)
*	(signifies connection via extender)

Connecting the Components

1. Connect the wiring harness to the Data Logging unit.
2. Connect the switch to the cable labelled **S**.
3. Connect the recording indicator light to the cable labelled **L**.
4. Connect each sensor supplied in the ST8500 product you have purchased to the appropriate wire in the wiring harness, as above.
5. Connect a 12v DC power supply to the power input cable.
6. Switch on the 12v DC power supply.

Recording Indicator Light

The ST8500 is supplied with a recording operation light to inform the driver when data logging is taking place.

You can install your own additional external light for this purpose. Any light needs to be visible at all times to verify when logger is operating.

Stack can also supply lights that can be mounted on top of the dashboard.

⇨ **If you are using your own light, ensure that the bulb rating does not exceed 2 Watts; otherwise the Data Logging unit will be damaged.**

Engine Speed (RPM) Measurement

The engine speed (RPM) is measured by connecting the engine speed wire directly to the ignition system. A single wire, with the label ES, connects the ST8500 to the ignition system or low-tension side of the coil.

Ignition System Connection

The ST8500 System can be connected to engines with a variety of ignition systems. These are shown in the following table.

Ignition System	Normally Fitted To	Connection Point
Bosch Blue Coil	F2000 and S2000 Ford Engines	Coil negative with 47K series resistor
Bosch	Citroen AX 'Sport' and 'GT'	Tacho output (coil negative) with 100K series resistor
Bosch 3-pin CD	Porsche 911 Carrera '76	Pin 'C' (points connection)
Bosch 8-pin CD	Porsche 930 Turbo '76	Pin 7 on ignition unit
'Contactless'	Accessory only	Dedicated Tacho output
Cosworth ECU	DFR89	ECU connector pin 'N'
General Motors GME-071	Formula Vauxhall Lotus	Tacho output (coil negative) with 10K series resistor
Lucas CD racing (Sparkbox)	F3000	Connector 'C' pin (7 pin)
Lumenition Performance (Black)	Accessory only	Blue wire from distributor pick-up
Lumenition Optronic MK17 (Silver)	Accessory only	Brown wire on coil negative
Motoplat flywheel system		Use the optional ST696 Engine Speed sensor with this type of ignition system
Motorcraft	Formula Ford	Coil negative with 47K series resistor
Sodamo engine management	Formula Renault	White wire on coil negative
Zytek ECU	Accessory only	Dedicated Tacho output

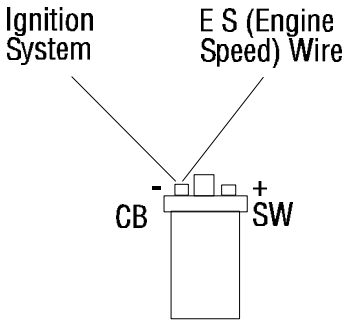
The following connections are shown in greater detail:

- Standard contact breaker system
- Series Resistor Connection
- Contactless system
- Lucas CD (Spark box) system

The connection of the ST8500 System to these types of ignition system is described below:

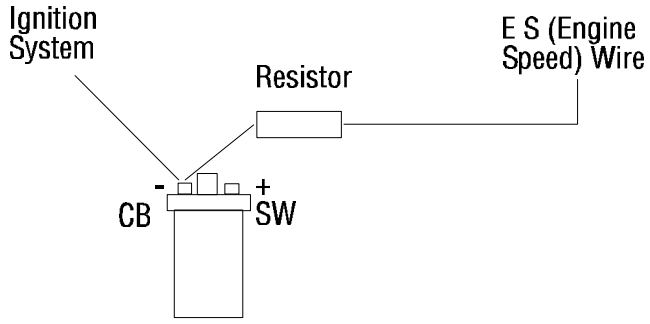
Standard contact breaker system

Connect the ES (Engine Speed) wire to the negative terminal on the coil.



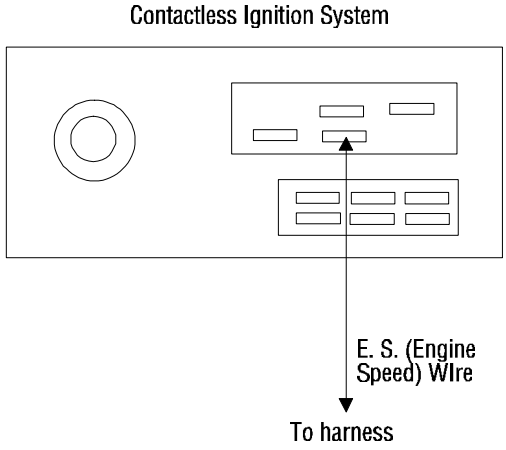
Series Resistor Connection

The Series Resistor Connection requires a resistor on the ES (Engine Speed Wire).



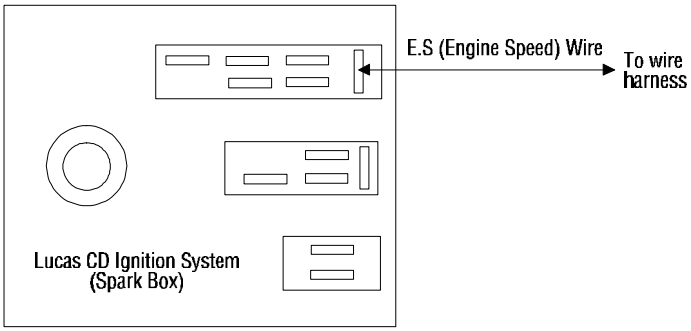
Contactless system

Connect the E.S. (Engine Speed) wire to the Contactless ignition system as shown in the diagram below.



Lucas CD (Spark box) system

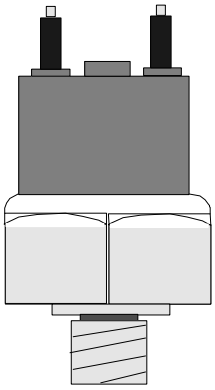
Connect the E.S. (Engine Speed) wire to the Lucas CD Spark Box ignition system as shown in the diagram below.



Pressure sensor

Fitting the pressure sensor

The ST8500 system is supplied with one of the following types of pressure sensors: the ST744, the ST745, or the ST746. Each type of sensor can be used for recording either oil or fuel pressures.



The ST744 pressure sensor has an M10 x 1 thread (UK, EU).

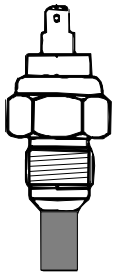
The ST745 pressure sensor has a 1/8" NPTF thread (USA).

The ST746 pressure sensor has a 1/8" BSP taper thread

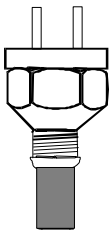
Installing the pressure sensor

- Position the sensor and its cable as far as possible from all sources of intense heat and from the ignition HT leads.
- The sensor can be either screwed in directly to the monitoring point or fitted separately by using a suitable pressure hose to connect it to the monitoring point. Separate fitting will reduce the amount of vibration to which the sensor is subjected and prolong its operational life.
- Do not over-tighten the sensor.

Temperature sensor



ST763



ST760 , ST761 , ST762 , or ST764

The ST8500 system is supplied with one of the following types of temperature sensor: Stack ST760, ST761, ST762, ST763, or ST764. Each type of sensor can be used for recording either Engine oil or water temperatures, or Transmission Oil Temperature.

The ST760 sensor has two terminals and a 1/8" BSP taper thread.

The ST761 sensor (not normally used) has an M14 x 1.5 thread.

The ST762 sensor has an M10 x 1 thread (UK, EC versions).

The ST763 sensor has one terminal and a 1/8" NPTF thread (U.S. version, not normally used). It makes its earth contact through its screw thread.

The ST764 sensor has two terminals and a 1/8" NPTF thread (U.S. version)

If you find that you have a sensor with an incorrect thread, please return it to Stack for replacement.

Fitting the temperature sensor

Mount the temperature sensor directly in the appropriate fluid line. Screw the sensor into a suitable mounting boss, so that its end lies in the middle of the flow of fluid.

- Position the sensor and their cables as far as possible from sources of intense heat and from the ignition HT leads.

- The ST763 sensor is connected by the red wire. The unused black wire should be tied back to the harness. If this type of sensor is to be fitted at a point between two plastic sections of fluid line or hose where it is unlikely to have an earth contact with a metal part of the engine, add an earth connection between the place where the sensor is to be fitted and an earthing point.

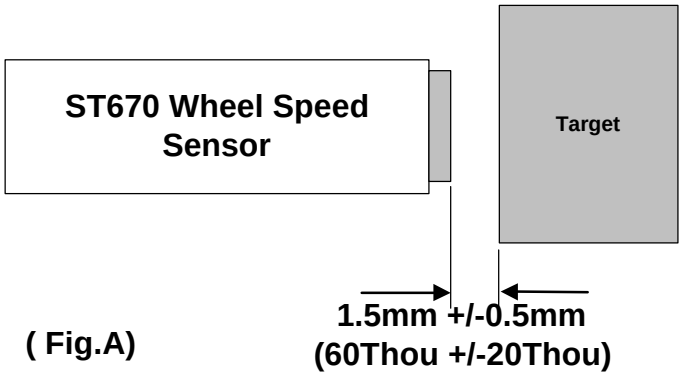
Wheel speed sensor

The ST8500 System is supplied with one ST670 proximity sensor. This sensor is used to measure wheel speed in order to record the vehicle's speed in MPH or KPH. The sensor provides an electrical pulse to the system each time a ferrous object, such as a wheel bolt, passes near to the end of the sensor. When you configure the system, you will need to supply the circumference of the wheel and the number of ferrous objects that will be counted for each revolution of the wheel.

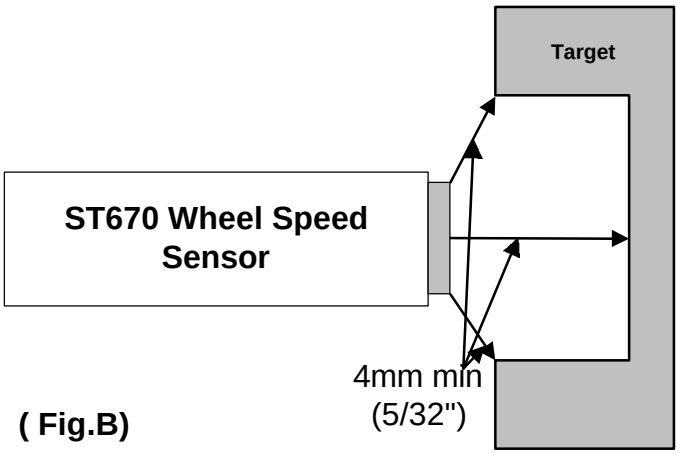
Fitting the wheel speed sensor

- Locate a suitable position for the wheel speed sensor so that one or more ferrous objects (such as bolt heads) will pass the end of the sensor as the wheel turns.
- If possible, choose the wheel that incurs the least amount of wheel spin, wheel lift, or lock-up, as these will affect the speed reading.
- Avoid mounting the sensor too close to the brake disc to avoid excessive heating.
- Make a suitably rigid bracket for the sensor and fit it onto the vehicle. Fit the sensor to the bracket.
- Do not over-tighten the sensor.
- Adjust the distance between the end of the sensor and the target ferrous object(s), so that the gap is nominally 1.5mm ± 0.5mm (60thou ± 20thou) (see fig A following). Make sure that no other objects pass within 4mm (5/32")of the end of the sensor while the wheel rotates (see fig B following)

- When the system is powered up, a small LED built into the back of the sensor will light up each time a ferrous object passes within the defined distance from the end of the sensor.
- Position sensors and their cables as far as possible from sources of intense heat and from the ignition HT leads.



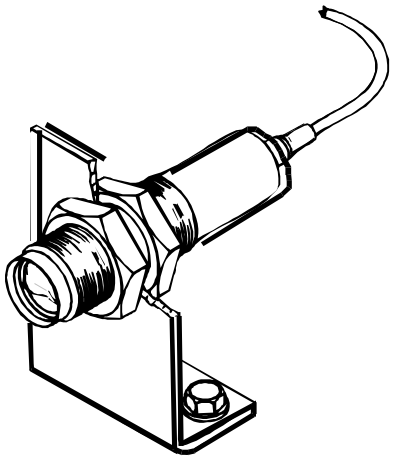
(Fig.A)



(Fig.B)

Lap timing sensor

The lap timing sensor is actuated by an infra-red beacon positioned at the side of the circuit. The sensor is fixed to a rigid bracket mounted at a convenient position on the outside of the vehicle where it is able to detect the signals from the beacon.



It is secured by two nuts with an M18 x 1 mm thread.

This sensor must be positioned horizontally and square to the axis of the vehicle. In order to detect the signals from the beacon, it must be sited outside the vehicle. It should, if possible, be positioned so that other vehicles that are being overtaken (or are overtaking) at the moment your vehicle passes the beacon do not block the signal.

Note that after detecting a signal, the system does not recognise any further signals from beacons for a period of ten seconds.

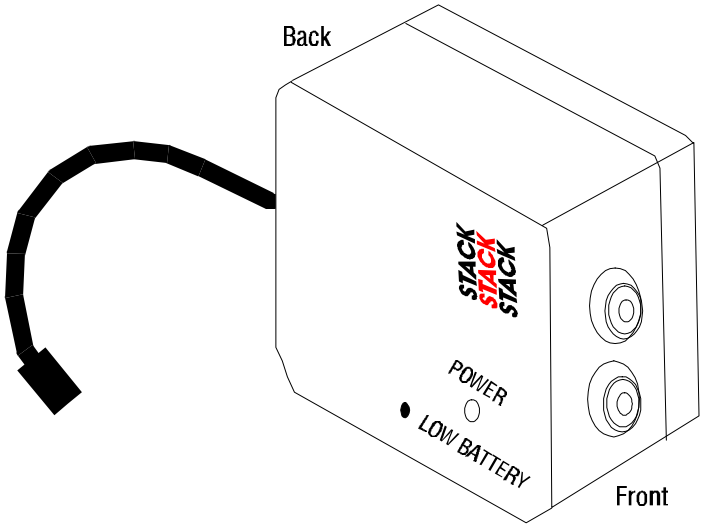
Trackside Infra-Red Lap Beacon (optional)

The ST544 trackside infra-red lap beacon should be located as follows:

- As near to the start-finish line as possible
- At the same height as the on-vehicle detector
- Level, so that it emits a horizontal beam
- It must be between 6 and 100 feet (2 and 30 meters) from the vehicle when the vehicle passes it.

Note:-

- Do not position unit so that the sun is directly behind it when in use.
- Where the unit is to be used for lengthy periods in very hot, sunny conditions, it should be protected by shading it from direct sunlight.
- Do not allow water to be sprayed onto the transmitter lenses. During wet conditions, fit a protective cover/shroud over the beacon.



Power supply to Trackside beacon

Beacon operates from a 12v DC supply. A sealed lead-acid battery min. rating 2.5 Amp/hour is recommended. This gives ≅ 15 hours of operation.

The condition of the battery is indicated by the colour of the LED indicator on the front panel of the unit:

1. Green: The voltage is, at present, adequate for use
2. Red: The voltage is too low (replace the battery).
3. No Colour: Battery exhausted or disconnected.

When testing the Beacon system the system light will blink on each lap.

Lateral G-Force Sensor

Complete ST8502 - ST8505 systems and upgrades from ST8501 are supplied with a 5G Accelerometer sensor for measuring lateral G forces.

Caution: The Lateral-G sensor is a sensitive instrument able to measure forces up to 5G. Dropping it only six inches onto a hard surface creates a deceleration force greater than 200G, which will damage it permanently.

The sensor measures 23 mm x 23 mm x 11.5 mm (15/16" x 15/16"x 7/16"). Supplied with 300mm/1ft of cable to connect it to the harness cable labelled G.

Before fitting the sensor, you can use the real time display facilities (select either **Utils>Real Time Display** or F6) of the software to check that it is operating correctly. Firstly, connect it to the data logging system and record its data while it is lying with the Stack label uppermost. The sensor should give a reading of 1.00G (+/- 0.1G). Next, turn the sensor over onto its label side. In this position, the sensor should give a reading of -1.00G (+/- 0.1G).

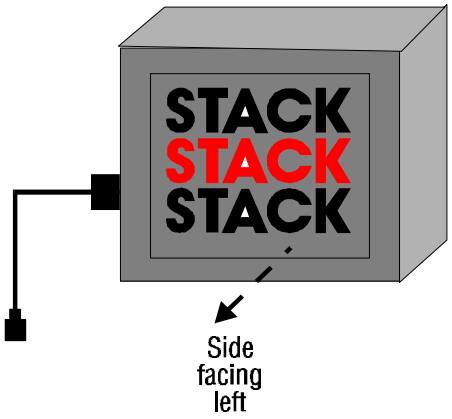
Recommended methods of fixing the sensor are:

- Double-sided Adhesive strip or Adhesive foam strip
- An appropriate fastening through the two 0.116 inch (2.9mm) fixing holes at 0.72 inch x 0.73 inch (18.3mm x 18.5mm) spacing.

Note: Velcro™, Dual-Lock™, or mushroom strip are not recommended for this purpose.

The most suitable place to fit the lateral G-force sensor is as close as possible to the vehicle's centre of gravity. Any other position will cause the instrument to measure the relative motion of each end of the vehicle rather than the vehicle as a whole.

The sensor **must** be positioned vertically with the side carrying the **Stack** label facing the **left** side of the vehicle. The side from which its cable emerges can be positioned at any angle.



Rotary Steering Sensor

The rotary steering sensor consists of a unit activated by a pulley attached to the steering column.

1. Mount the rotary steering sensor so that the movement of the steering shaft activates the pulley. (See supplied sensor instructions).
2. After installation connect it to the ST8500 module by means of the ST873 wiring harness supplied and extenders where necessary. Use the connector labelled ô**ST**ö.
3. **You must calibrate the steering sensor before attempting to record any data with it.**

Throttle Position Sensor

1. Mount the throttle position sensor onto the butterfly valve so that opening or closing the throttle activates the sensor.
2. After installation connect it to the ST8500 module by means of the ST873 wiring harness supplied and extenders where necessary. Use the connector labelled ô**TP**ö.
3. Remember that the sensor must be calibrated prior to use. See the sensor calibrating process detailed later in this manual.

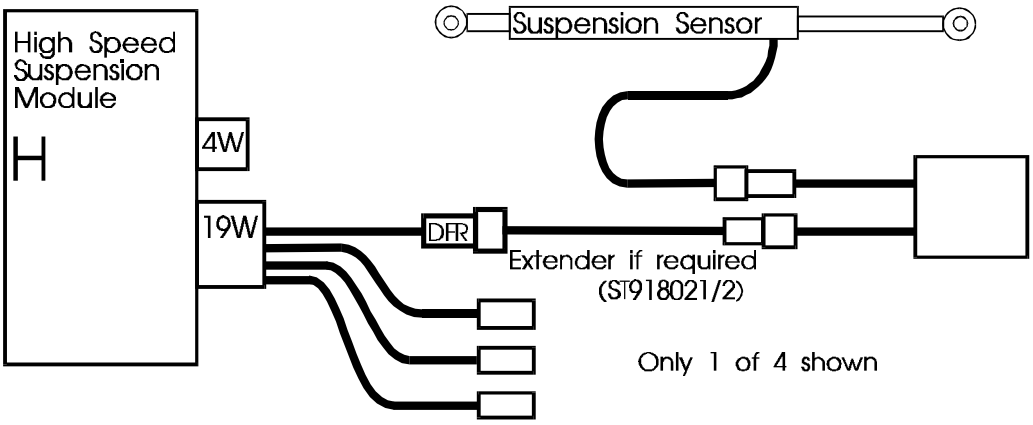
Suspension Damper Pot Sensors

The ST8504/5 Data Logging and Analysis systems are supplied with the following components that are used for recording the suspension damper movements:

1. Four 4" (100mm) - 8" (200mm) (**pot**) sensors for ST8504 and ST8505 systems respectively
2. Four ST673 differential voltage interfaces
3. One wiring loom
4. One four-channel data logger.

The information from the pot sensors is received by the interface module and transferred to the additional 4-channel sensor module, that is in turn connected to the recording module by the main network cable.

A schematic of the layout of the pot sensors, the ST673s, and the recorder module follows:



Installing the Pot Sensors

Bolt a pot sensor to each of the suspension units.

- The sensor must be positioned parallel to the suspension unit so that any movement of the suspension unit results in exactly the same movement to the sensor. If the sensor is positioned at an angle to any suspension unit, inaccurate data will be recorded.
- The range of movement between the maximum compression and extension **must not be exceeded** otherwise the sensor will be damaged.
- Avoid bolting the pot sensor to any part which is subject to excessive vibration, such as the engine block.

Installing the ST683 Differential Voltage Interfaces

Each ST683 Differential Voltage Interface must be mounted within 200mm of the pot sensor to which it is to be connected.

Make sure that the ST683 is not close to any HT lead or powerful source of heat.

Dual-Lock™ fixing material is supplied to facilitate fixing each ST683 to a suitable surface. Take one of the supplied strips, remove the adhesive backing, and attach it to a suitable clean and flat surface on the vehicle, pushing it firmly to ensure maximum adhesion. Attach the second strip to the first strip making sure that it is aligned correctly. Remove the backing from the second strip. Attach the sensor to the second strip by pushing it firmly onto the strip to ensure maximum adhesion.

Avoid separating the two strips if possible. Do not attempt to separate them until at least 24 hours after joining them.

Additional Sensor Module

Installation of the additional sensor module supplied with ST8504 & ST8505 systems should be made in a suitable position on the vehicle, so that the terminal connectors on the wiring loom can reach the cables for each of the ST673 units. Also ensure that when you install or Exchange the on-car Network cable that both modules can be connected together.

Wiring the Pot Sensors to the Data Logger

Connect each pot sensor to its ST673 using the cables attached to these units then connect each ST673 to the appropriate terminal connectors on the wiring loom.

The connectors to be used are labelled as follows:

- DFL Front left-hand ST673/pot sensor pair
- DFR Front right-hand ST673/pot sensor pair
- DRL Rear left-hand ST673/pot sensor pair
- DRR Rear right-hand ST673/pot sensor pair

Appendix A gives details of the wiring pinouts should need this information in order to repair or extend a connecting cable.

Checking the Operation of the Data Logging System

You should check that you have installed the data logging equipment and cables correctly and that the software is functioning correctly before you attempt to calibrate the throttle, steering, and suspension sensors or try to use the system for recording any performance data.

Carry out the following steps:

1. Start PC and install the ST8500 software (if not already installed).
2. Start the ST8500 software (Type **8500** at the C:> DOS prompt).
3. Connect the network interface module to the parallel port on the personal computer.
4. Plug the lead from the network interface module into the jack plug socket on the vehicle.
5. Turn on the power to the on-vehicle ST8500 Data Logging System.
6. If this is the first time that you have connected the PC to the vehicle, select the :- **Utils->Config Net** menu choice.

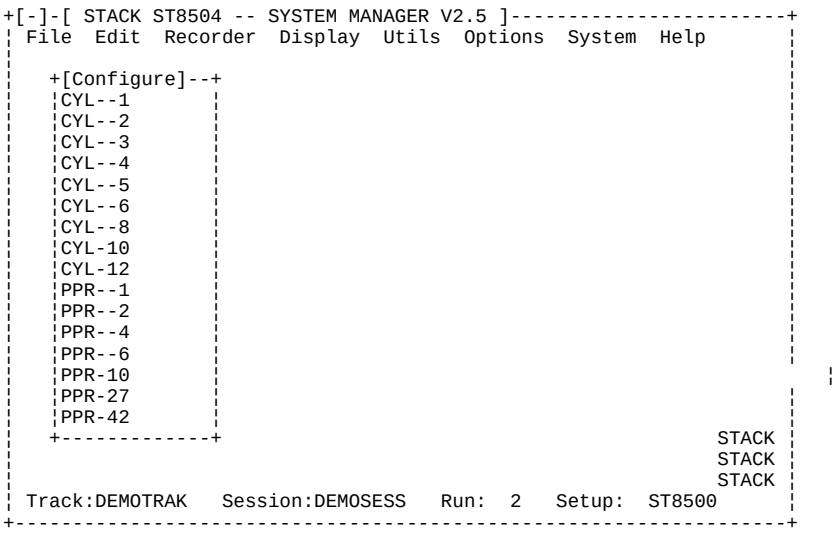
   The PC will automatically test communications between the PC and the ST8500 system and establish the fastest and most reliable speed for data transfer.

   Select the :- **Recorder > Configure Recorder** option.

There are two pieces of information you must upload into the ST8500 system before it can operate correctly.

- The number of cylinders in the engine you are using. **CYL**
- The number of target pulses detected for each rotation of the wheel from which you are measuring Wheel Speed. **PPR**

An Example of the screen display is shown on next page.



Example 1

8 Cylinder engined car with 42 Tooth ABS ring.

- Select **CYL--8** from the options displayed and press enter.
- Reselect **Recorder > Configure Recorder** option.
- Select **PPR-42** from the options displayed and press enter.

Example 2

3 Cylinder engine and 6 wheel speed targets.

- Select **CYL--3** from the options displayed and press enter.
- Reselect **Recorder > Configure Recorder** option.
- Select **PPR-6** from the options displayed and press enter.

The ST8500 system is now configured for use on this car.

Test the recording operation of the system as follows:-

1. Select the :- **Utils** -> **Real Time Display** menu choice whilst running the vehicle's engine. If the values displayed are normal, press F10 to leave this display.
2. Select the :- **Recorder** -> **Start Logging** menu choice.
3. While waiting one minute, blip the throttle a number of times to give a changing rpm signal.
4. Select the :- **Recorder -> Download Display Run** menu choice.

Check that the data recorded during the one-minute run is correct.

If the number of pulses required by your vehicle is not available from the list, choose the closest value available and Upload that value to the recorder and then modify the tyre circumference as follows:-

$$\text{New Circumference} = \textbf{Original Circumference} \times \frac{\textbf{PPR set}}{\textbf{Actual PPR}}$$

Example

1500mm Tyre Circumference

32 Pulses per Revolution (Actual)

27 Pulses per Revolution (Available from PPR list)

$$\text{New Circumference} = 1500 \times \frac{27}{32} = 1266\text{mm}$$

Calibrating the Installed Equipment

You need to calibrate ST8503, ST8504 and ST8505 systems so that the correct data is recorded from the sensors for steering, throttle, and suspension movements.

Before starting:

1. Connect PC (with the ST8503, 4/5 software installed) to the vehicle.
2. Activate the ST8503, 4, or 5 Data Logging System. (You do not need to start the engine.)
3. Start the ST8503, 4 or 5 software.

Calibrating the Steering Sensor

1. Select the **Edit** menu
2. Position the steering wheel at its central point.
3. Select **Setup Calibration**.
4. Enter ô2ö **(Calibrate STEERING Angle)** An error is indicated if the system is not connected to the data logger correctly
5. Follow the screen prompts for various steering wheel positions and press any key on the keyboard when each reading becomes steady.
6. The Steering Sensor calibration is now stored in the vehicle Setup
7. To quickly re-centre the Steering pot any time after initial calibration. Set steering wheel straight ahead, use F6 Real Time Display and adjust pulley belt position until the reading is correct.

Calibrating the Throttle Sensor

1. Select the **Edit** menu, **Setup Calibration** option
2. Enter ô1ö (**Calibrate THROTTLE Position)**. An error is indicated if the system is not connected to the data logger correctly.
3. Follow the screen prompts for various throttle positions and press any key on the keyboard when each reading becomes steady.

Calibrating the Pot Sensors

1. Place the vehicle with the suspension in a nominal zero reference position. This can be, for example, with the vehicle loaded with its driver and any fuel and on level ground.
2. Select the **Edit** menu
3. Select **Setup Calibration**
4. Enter ô3ö (**Zero Suspension)**. An error is indicated if the system is not connected to the data logger correctly.
5. When prompted, check for a constant reading and press any key.
6. Repeat step 5 for all four suspension sensors.

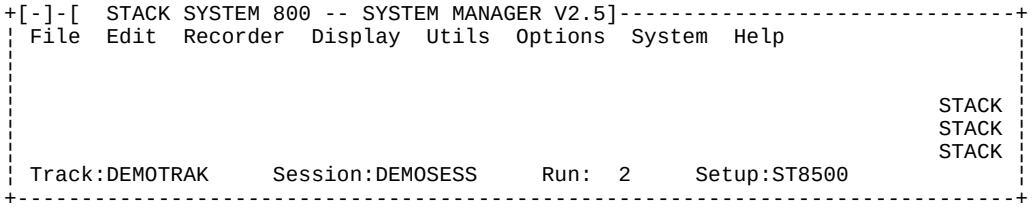
Exit the Calibration procedures when all sensors have been calibrated.

Section 3. Reference Guide

This section contains information on the functions available in the ST8500 Series Software menus and charts, the calculations carried out, and the configuration requirements for personal computer used to run the software.

Menu Functions

The top row of the menu screen identifies the version of the Stack ST8501 software that you are running. The second row contains a set of function menus. Each function menu offers you a range of actions for setting up and running the software. The bottom row shows the track, session, run, and set up that you have chosen.



Using the Keyboard

To see the choices in a menu with the keyboard, use the left (←) and right arrow (→) keys to move to each function menu.

When you start the software, the **File** menu is highlighted, meaning that you can select it..

1. To see the choices in a function menu, press the down-arrow key (↓) or Enter key.
2. Use the up-arrow (↑) or down-arrow key (↓)to move the highlight to the choice you want in the menu.
3. Press the Enter key to select and activate the highlighted choice.
4. To cancel a menu, press the Esc key. The list of menu choices is removed from the screen and the focus returns to the function menu.

Mouse

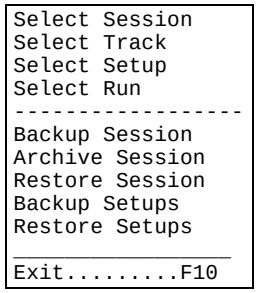
If you have a mouse and the Mouse driver software is enabled prior to running the STACK software, you can move the mouse to the menu and click on it to see its choices.

Selecting a Function from a Menu

You select a choice in a function menu either by moving the highlight onto it and pressing the Enter key or by clicking on it.

File Menu

The File menu contains the following choices:



Use the up-arrow and down-arrow keys to select a choice in this list.

The use of the actions in this menu are described below. The normal sequence of actions is:

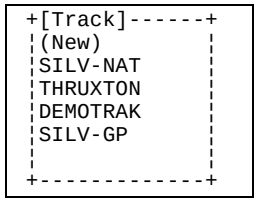
1. You select the track. This can be a track that you have used previously or a new track.
2. You select the session. This can be either a new one for which you use data that you are about to download from the vehicle or a previous session that you wish to analyse.
3. You select the Setup for the vehicle used in the session. The correct vehicle Setup must be defined prior to Recorder Download.

For the ST8501 software, the only Setup calibration requirement is to set the wheel circumference to the correct value for your vehicle.

Select Track

This displays the item (New) followed by a list of existing tracks.

For example:



Use the up-arrow and down-arrow keys to highlight the required track and press Enter to select it.

If the track does not appear in this list, select New. You are prompted to enter details for the new track.

New Tracks

Select (New) if this is the first visit to a track. You are prompted with the message:

`Enter a New Track Name`

Type in the name of the track. The track name must be **eight characters or less in length**. Press the Enter key. You are prompted with another message:

`Enter New Session for Track: track-name`

Enter a session name. See **Select Session** for further details about session names.

You can now proceed to the Setup action to set the wheel circumference and down load the data for the session from the vehicle. This is described later in this section.

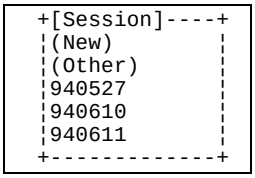
Existing Tracks

When you want to analyse the data from a previous session at a particular track, move the focus to the track name in the list and press the Enter key, or click on it.

Select Session

Select this action after you have selected the Select Track action.

The Select Session action opens a list containing entries similar to the following:



where **(New)** asks you to name a new session for the track named in the dialogue box. If you select (New), a dialogue starts in which you define the name of a new session:

A suggestion for a session name is given or you can type in a session name of your choice. A convenient naming convention is to use the current date in the form yymmdd (for example, ô940812ö for August 12th, 1994) as this makes subsequent sorting of the sessions into date order straightforward. Then press the Enter key.

The message blanks and the track & session names appear at the bottom of the screen

Selecting **(Other***)* displays a list of other tracks that are available for analysis

In the example **940527**, **940610**, and **940611** are the names of previous sessions recorded at the track you have chosen. The session names in this list are for the only for the track you selected.

Select Setup

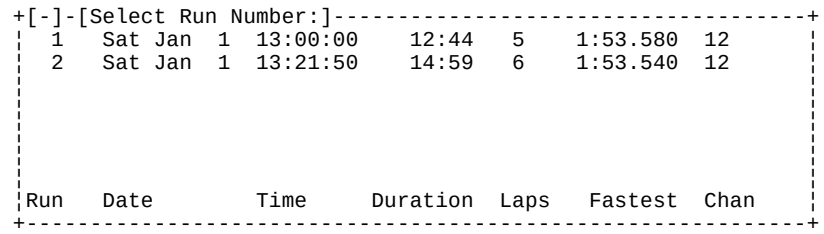
Use this choice to select the setup for a specific vehicle from the displayed Setup menu.

The system is supplied with a Generic Setup called 8500 which can be modified with the software Setup Calibration facility for use with a particular vehicle. By using the Copy Setup facility (described later) uniquely named Set-ups can be created.

Prior to each Data Download, ensure that the correct Setup has been selected for the vehicle being downloaded.

Select Run

Use this choice to select the run you wish to analyse.



Either move the focus to the line containing the run to be analysed and press the Enter key or click on it. The list of runs is cleared and the run number appears at the bottom of the screen.

Backup Session

Enables you to make compressed copies of session data on floppy disk.

The existing data on the hard disk is left unchanged. This allows you to protect the data or pass the data onto someone else while still continuing to work on it yourself.

- Put a blank, formatted floppy disk in the appropriate drive.
- Select **File > Backup Session** and press Enter.
- Choose the session to backup, from the Track and Session selection boxes shown.

The program will check that the destination disk is available and will report an error at this stage if **No Disk** is found or the disk is **Write Protected.**

- The software will now compress the session data using the shareware utility PKZIP.
- Do not interrupt this process.
- As each file is added to the archive it will be listed on the screen.
- The compression method used means that several small sessions can be backed up onto a single disk.

Archive Session

Enables you to move and compress session data files.

This is similar in operation to the Backup Session facility, except that once the session data has been compressed and stored on the floppy disk most of the session files on the hard drive are removed, leaving only a few reference files that allow the runs to be identified.

- It is recommended that you archive data regularly
- Do not allow your hard disk to become completely full
- From time to time you should check that the procedure and disks you are using are valid by restoring and viewing some archived data.

1. Put a blank, formatted floppy disk in the appropriate drive.
2. Select **File >Archive Session** and then press Enter.
3. Choose the session to backup, from the Track and Session selection boxes shown.

The software will check that the destination disk is available and will report an error at this stage if No Disk is found or the disk is Write Protected.

- The software will now compress the session data using the shareware utility PKZIP.
- Do not interrupt this process.
- As each file is added to the archive it will be listed on the screen.
- If all the files are transferred successfully and the archive appears correct then the program will remove the session files from the local disk.
- As long as their is space on the destination disk you can put multiple archived sessions on the same disk.

Remember to label any disk with the track and session names and the disk number.

Restore Session

The restore feature has the ability to cope with archive disks containing:-

1. Compressed sessions (.ZIP files)
2. Decompresses copies of sessions made using the DOS COPY or XCOPY commands.

Note: The archived sessions need not have been present on the machine previously.

Always remember to label disks with the archived track and session names

The software will scan the current archive disk (usually a:\ST800) and present a list of tracks found on the disk. This may take a few seconds if the drive is slow or there are many tracks.

- Select a track using the mouse or cursor keys and click or press Enter.
- The program will now scan the disk for session in the selected track.
- Choose the required session to restore and press Enter.
- The restore program will now copy and de-compress the session files from the archive disk to the current system.
- It will create new track and session directories as required.
- Once the restore is complete the restored track and session are made current and the status line at the bottom of the screen is updated.
- The data is now ready for viewing or calculations.

Note that it is possible to:-

- Archive some session data.
- Restore it.
- Download some more runs and archive the data again.

In this case the new data will be added to the existing archive.

Backup Set-ups

Enables all the Setup, Calc and Chart files to be saved to a floppy disk.

The mechanism used is the same as for Backup Session except that the target path is normally **a:\st800\views**.

You may either:-

1. Archive the set-ups to a floppy regularly for backup purposes.
2. Add the set-ups to a Session archive to ensure that the data can be viewed properly after being transferred to another PC.

The setup archive typically takes up very little space and will make session archives more independent of the original machine.

- Insert the selected Floppy disk in the disk drive
- Select File, Backup Set-ups.
- Check that the compression stage completes successfully and gives no error messages (most likely errors are either No Disk or Write protected disk).
- Remove the Floppy Disk, label it and keep in a safe place.

Note That in this case the original files are **NOT** removed from your PC. They are retained for further use. This disk is simply a backup. Also note that this process will **OVERWRITE** any existing files of the same names on the disk so take care in selecting disks.

Restore Set-ups

Enables recovery of Setup, Calc and Chart files from an archive disk.

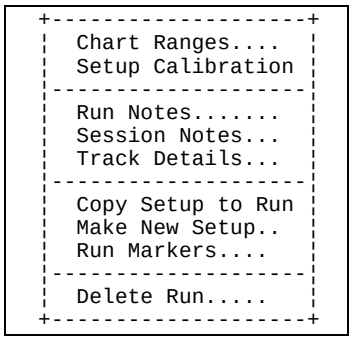
Normally performed under the following circumstances:

1. When moving the data to a new PC
2. To revert to a previous setup after making changes to the system or when recovering from disk problems.
    - Place the archive floppy disk containing the files in the disk drive.
    - Select **File > Restore Set-ups** and press Enter
    - The software will scan the disk for files in the A:\st800\views and A:\st800\def subdirectories and will restore them to the hard disk.

Note If the ST800.INI file has been modified to handle archives and archive recovery from disks other than the A:\ drive, then these files can only be recovered from that nominated disk drive

Edit Menu

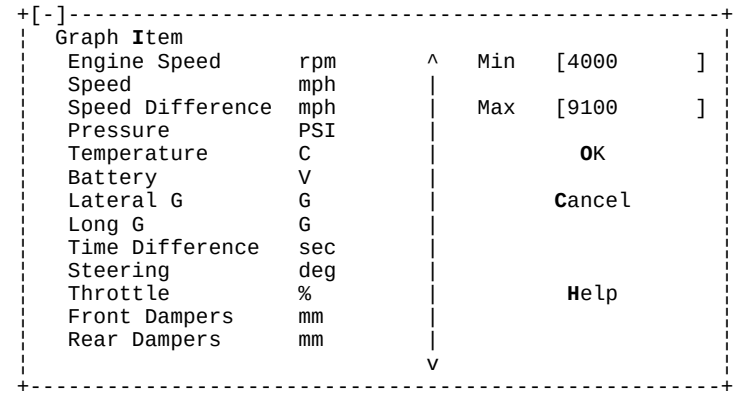
When you select the Edit menu, the following list of choices appears:



The Track Notes, Session Notes, and Run Markers options display information which you can modify. An on-screen editor is provided for this purpose. When you select any of these choices, a notes window is displayed for you to enter and read the information you record. See the Run Notes section later in this section for a description of the on-screen editor.

Chart Ranges

When you select the Chart Ranges choice, a panel containing some or all of the following performance characteristics, depending on which level of software you have installed, is displayed:



The values shown are used to determine the ranges of values that you wish to see in the graphs. You can change minimum and maximum values for each of the items in the list. By narrowing the range to the typical minimum and maximum values you would expect for each sensor, you obtain a more meaningful graph plot of that aspect of the vehicleÆs performance.

You can also set inverted minimum and maximum values (where Min > Max) to plot the graph upside down. This may be useful for plotting Lateral G forces and suspension movements

To do this:

- Use the up-arrow and down-arrow keys to select each item.
- Use the tab key to move to the Min, Max, OK, Cancel and Help fields.

  You cannot use the up-arrow and down-arrow keys to select a different item while any of these fields are selected. You must press the tab key until none of these fields is selected. Then you can use the up-arrow and down-arrow keys to select the next item

The Min and Max fields can be reset for each item. You can either select the OK or Cancel field for each line or once only when you have changed

all the values you want to change. If you select OK or cancel for each line separately, you must select the Edit menu and then the Chart Ranges choice for each line you wish to change.

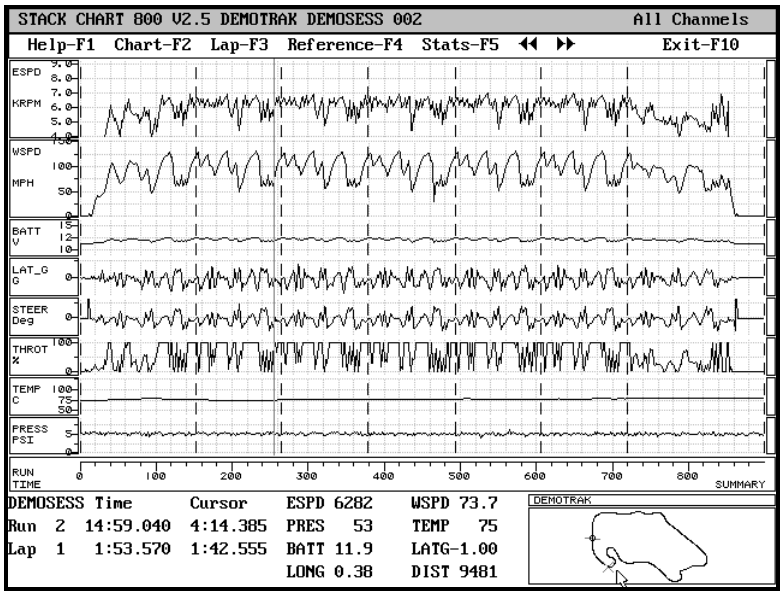
OK confirms any new values just entered and **Cancel** cancels them.

Note: You cannot change the units of measurement in this dialogue.

The following chart has minimum and maximum values set as follows:

• Engine Speed:	4000	9100	RPM
• Speed:	50.0	150.0	MPH
• Speed Difference:	15.0	15.0	MPH
• Pressure:	0	90	PSI
• Temp	60.0	125.0	°C
• Battery	9.0	16.0	V
• Lateral G Force	-2.60	2.60	G
• Throttle	0	100	%
• Steering	-120	120	deg

Note: The speed difference values are not used in the following illustration.



Setup Calibration

Use this choice to calibrate the software to match the values used by the ST8500 on your vehicle.

The following dialogue is displayed:

```
STACK SYSTEM 800 -- SENSOR CALIBRATION TOOL

                MENU
1       Calibrate THROTTLE Position
2       Calibrate STEERING Angle
3       Zero Suspension
4       Set Wheel Circumference
0       Exit
        Choose a number:
```

The list includes items not available on the ST8501 software. The only setting that you need to check for the ST8501 is the wheel circumference. Enter the digit 4. This displays the current setting, for example:

```
 Set Wheel Circumference
 Current Value=1600
 Enter New Wheel Circumference,
mm:
```

Enter a new value if necessary and press Enter. If you do not need to change the value, you still need to enter a value in order to escape from this dialogue. Do not press the Esc key... You return to the Calibration menu. When you are satisfied with the settings, enter 0 in the number field. This causes the following messages to appear:

```
Save Changes to Setup ?
Press Enter to Continue, Any other key to Quit:
```

Press the Enter key to save the new wheel circumference value. Press any other key to cancel the new value and revert to the original value.

In both cases you return to the Edit menu.

Run Notes

This choice allows you to create and store your own notes and comments about a run. You can refer to your notes at any time subsequently. The displays a panel containing a list of the names of the runs that exist for the currently selected track and session. Select the run you wish to add notes to from this panel.

Note that the text you enter does not ôwrapö itself automatically onto the next line. You need to press the Enter key at the end of each line if you want to see all the information without scrolling horizontally.

An example of the top portion of a notes window is given below:

```
+[-]-[STACK SYSTEM 800 --   RUN002.TXT]-------------------------
|
|Use this for notes which relate to this run only.
|Information which is the same for all runs within one session
|should be kept in the session notes file.
|
|This run is a demonstration run.
|
```

The **Editor** has the following standard function keys:

F2 Save — Saves the text you enter. You use this function to save your text without closing this window.

F5 Mark — You can mark any text that you want to cut or copy into another part of the notes text.

Position the cursor at the start of the text to be cut/copied. Press F5. Move cursor to the end of the text to be cut /copied. The marked text is highlighted. You can now use the F6 or F7 keys to cut /copy the marked text. You can also delete the marked text with the DEL key. Press the F5 key to remove the highlight from marked text that you do not want to cut or copy.

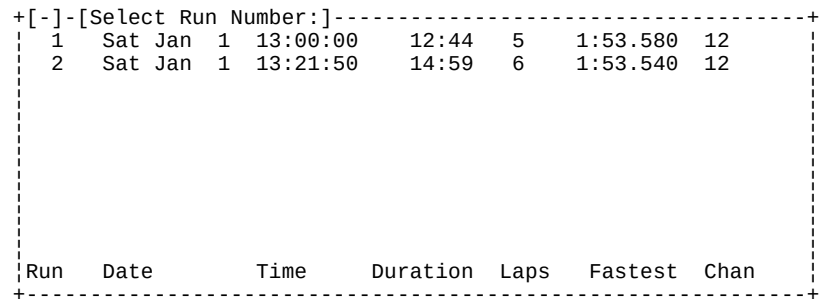
F6 Cut — Use this key to cut marked text. The text is removed and retained in a buffer until you next use the F6 or F7 keys.

F7 Copy — Use this key to copy marked text. The text is copied and retained in a buffer until you next use the F6 or F7 keys.

F8 Paste — Use this key to insert text previously cut or copied from a different part of the notes text.

	You can paste the same text as many times as you require. You can also paste from one file to another.
F9 Abort	Use this key to end your notes editing session without saving any changes to the text since you started the notes session or since you last used F2 to save the changes.
F10 Exit	Use this key to end your notes session. Any changes to the text since you started the notes session or since you last used F2 to save the changes are saved automatically
Esc Abort	Same as **F9 Abort**

For example:



Select the run and press Enter. Any existing notes for the run are displayed. You can add further notes and change or delete existing ones. The use of the editor for entering and changing the information in a notes window is given earlier in this chapter.

Session Notes

Use this choice to open the notes for the currently selected session.

Refer to the preceding section on Run Notes for details about the Editor function keys available when working with the session notes.

Track Details

Use this choice to define the nominal track length and track tolerance that the software will use with recorded data to calculate the length of each lap.

Note that the ST8501 software does not make use of track lengths, so this information can be used for reference only.

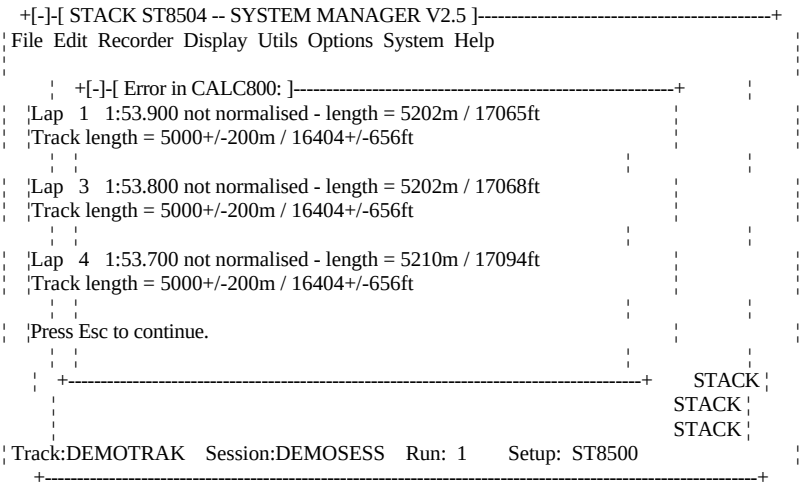
The ST8502 and higher specification systems require details of track lengths in order to produce the distance-based graphical and statistical output.

- Start by entering the official track length data supplied by the circuit operator and apply an initial tolerance of 150ft or 50metres.
- If the track length has changed since your last visit to the circuit, you need to redefine the nominal length in this panel. You are advised to determine the nominal track length from data recorded during practice, that is based on a lap or laps that provide clean data. In particular, you should choose laps where the line of the vehicle is ôgoodö and which does not contain excessive wheel lock-up, understeer, or oversteer.
- When using data from runs already downloaded from the vehicle prior to changing the track length, you must remember to recalculate the normalised lap lengths for the run(s). Use the **Calculate** choice (for **Distance**) in the **Options** menu to do this, after you have reset the nominal track length.

During calculation if all laps fall within the track length and tolerance values you have set, the PC screen will not display an error warning box.

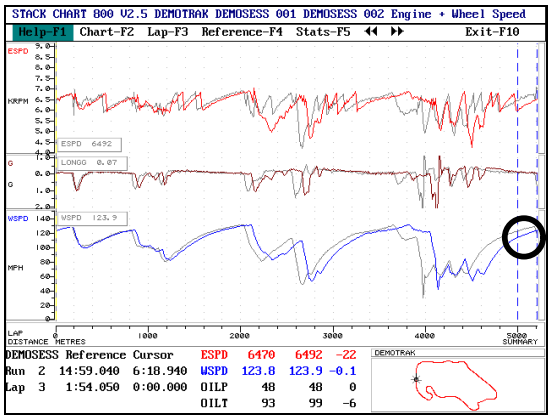
If any or all laps fall outside the track length and tolerance ranges or track length and tolerance are not set, an error message box will appear containing details of the laps concerned.

Any error message will be similar to the example below:-



Study the lap lengths and determine the revised track length and tolerance you need to insert in the Track Details section. Remember to re-run the **Calculate (Distance)** choice from the **Options** menu for all affected recorded data runs, after revising track length and tolerance.

In the event that you do not perform this operation the data will not compare correctly. An Example of this is given below showing the end of lap mis-alignment circled.



Copy Setup to Run

The currently defined calibration Setup for the sensors is transferred immediately after the data is downloaded. It defines how the ST8500 software should scale and present the channel data.

The Update Setup choice allows you to change this information at a later date. This might be necessary if the sensors have to be recalibrated, the wrong Setup file was used during download, or because the data is old and contains no scaling information.

You can use this choice to copy the correct calibration Setup information to the run you select.

Any calibration information already present for the run that you select is overwritten.

When you select this choice, a warning message is displayed:

```
Calibrations in Current Run will be replaced from the current Setup,
Continue?

Select the OK button or press ENTER to continue,
Select the CANCEL button or press ESCAPE to
abort the update and return to the main program.
```

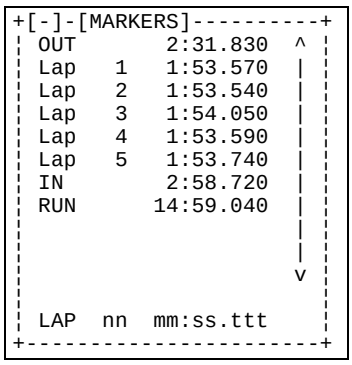
Make New Setup

Use the Make New Setup choice to define a new Setup for a vehicle or create additional Set-ups for other vehicles in a multi vehicle team.

You are prompted for the name of the new Setup. Type in the new name and press the Enter key. The current Setup file is copied into the new Setup which now becomes the current Setup. Its name is shown on the bottom line of the ST8500 screen. You can now modify the values that you have copied to the values you require by running the Setup Calibration procedure.

Run Markers

Use this choice to check your lap time data after you have downloaded a run. You are prompted to select a run. An example of a set of lap times that is displayed when you select this choice follows:



The data shown above is from the supplied demonstration run, Run 2.

Each line shows a time recorded during the run. The first column shows the lap marker type. The lap marker types are:

OUT First lap recorded in the run.

IN Last lap recorded in the run.

RUN Total of the IN, OUT, normal lap, and segment times

Lap Any lap except the IN and OUT laps

Seg Separately timed part of a lap (segment)

The second column shows the shows the lap or segment number. The third column shows the time recorded for the lap in the form minutes:seconds:milliseconds. The final RUN line shows the time for the whole run.

You can modify the information in this list if it has not been recorded correctly. You can add new lap markers if any are missing, and correct or remove any incorrect lap markers that have been recorded incorrectly.

You can use the Editor function keys as detailed previously in the Run Notes section to cut, copy, and paste the information in this list.

Care must be taken to enter the times in the correct format. Except for the IN and OUT laps, each lap must be numbered and the time must be entered with both the colon, the decimal point, and the three-digit fractional second. For example, 1:54.200 not 1:54.2

The software will automatically change the lap numbers of all laps affected by inserting new laps or removing existing ones. This means that when you insert or delete laps, you do need to adjust the numbers of the subsequent laps.

Take care when editing lap markers as an incorrect marker file can produce incorrect results. It should **not** be necessary to change the total run time as this is recorded separately rather than based on adding the individual lap and segment times.

After changing the lap marker list for a run, press the F10 key to save the new values and return to the Edit menu.

At this point the software creates a new lap marker file from the information in the lap marker list. It adjusts the IN lap time so that the sum of the lap times matches the run time. In some cases this results in a negative in lap time.

After saving the lap marker information, you should review it again to check that the software has interpreted the data as you intended.

Here are examples of the types of change you might need to make to the list of lap markers:

Replace a missing lap marker

The following list shows two laps counted as one:

```
LAP  nn  mm:ss.ttt
OUT       2:34.050
Lap   1   1:53.900
Lap   2   3:47.380
Lap   3   1:53.700
IN        2:35.730
RUN      12:44.760
```

Here the real lap 3 marker is missing, making lap 2 double length. Assume that the actual lap time of lap 2 was 1:53.58 and make the following changes:

1. Calculate the time for lap 3 by subtracting 1:53:58 from 3:47.38. This easier if you convert these times to milliseconds (ms).

   227380 - 113580 = 113800 = 1:53.800

2. Add a new line below lap 2 for the new lap 3:

   Lap 3 1:53.800

3. Change the time for Lap 2 to 1:53:58
4. There is no need to add 1 to the remaining lap numbers, as lap 3 is changed automatically to lap 4, and so on.

Delete a spurious marker

The following lap marker list contains a spurious lap marker:

```
LAP  nn  mm:ss.ttt
OUT       2:34.050
Lap   1   1:53.900
Lap   2   0:01.000
Lap   3   1:52.580
Lap   4   1:53.800
Lap   5   1:53.700
IN        2:35.730
RUN      12:44.760
```

Here the real lap 2 is made up of laps 2 and 3.

1. Add times for laps 2 and 3 and enter this value as the time for lap 2.
2. Delete lap 3.
3.

Move all the laps 100ms back up the track

Here all that is required is to subtract 100ms from the OUT lap. As all the lap times are given as relative times they will maintain their values. The amount removed from the OUT lap will be added automatically to the IN lap in order to maintain the RUN time.

Adding course provided timing for Hillclimb and Sprint Competition.

1. Ensure you have official run time available.
2. Select **Edit>Run Markers**
3. Select appropriate Run to be updated.
4. The Display will show an **OUT** time, an **IN** time and a **RUN** time.
5. Place cursor on the **I** character in the word **IN** and press **Enter**↵ to create a new line.
6. Move to the new line and type in:-

   LAP L 0:ss.ttt

   where L = 1 (L will always =1), ss = the number of seconds in the run and ttt= the tenths, hundredths and thousandths of a second for the run. i.e for a single run of :

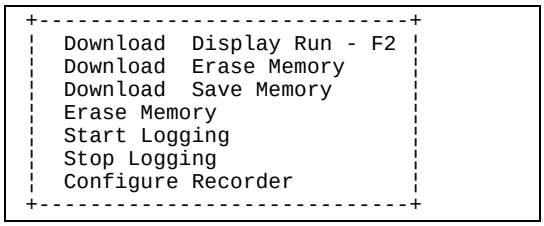
   58.091 seconds, you must enter **LAP 1 0:58.091**
7. The screen should now have 4 lines:-
   - OUT
   - LAP
   - IN
   - RUN
8. The times should be aligned in their columns. If the display is not as described, press **F9** to exit and repeat the process from step 2.
9. If all of the 4 lines are OK press **F10** to store the timing details.
10. The software will now re-run the distance calculation to ensure that comparison runs can be overlaid correctly.
11. The standard Display procedures can now be run to analyse data from a single run or comparison runs.

Recorder Menu

Note: Before you use any of the choices in this menu for the first time, be sure to connect your PC to the ST8500 System with the STACK Network cable supplied with the system software **before** you select this choice.

- This enables automatic configuration of the software for the external interface on your personal computer to the on-vehicle recorder. See Section 2. Vehicle Installation and Setup.

The Recorder menu contains the following choices:



Download and Display Run

This option downloads all runs stored in the recorder. If downloading is successful, data is erased from the recorder, leaving it ready for the next run, and the last downloaded run is displayed in the currently selected chart format. If downloading is unsuccessful, recorder data is not erased.

You can select this with the F2 key, before you connect the PC to the recorder.

You may disconnect the PC from the recorder as soon as downloading is complete.

When the calculations are complete, the latest run is displayed.

Download Erase Memory

Use this choice to download the data from the ST8500 on your vehicle after a run has been completed. The data is removed from the on-vehicle system. The data is not displayed on the PC; it is stored as a run for later analysis.

This choice waits until you connect the PC to the recorder if you select it before connecting them. It downloads all runs stored in the recorder and, upon successful completion if downloading, erases the data from the recorder, leaving it ready for another outing. If the download operation is not completed successfully, the data is not erased from the recorder.

Disconnect the PC from the recorder as soon as downloading is complete.

Download and Save Memory

Use this choice to download the data from the data logger on your vehicle after a run has been completed. The data is **not** removed from the data logger on the vehicle. The data is not displayed on the personal computer; it is stored as a run for later analysis.

This option will wait until the personal computer is connected to the recorder. It downloads data for all runs present in the recorder but does not erase it from the recorder. Use this choice when you need to download the data in the recorder into more than one personal computer.

Disconnect the personal computer from the recorder as soon as downloading is complete.

Erase Memory

Use this choice to remove any unwanted data present in the on-vehicle recording system and reset it, leaving it ready for the next outing.

Start Logging

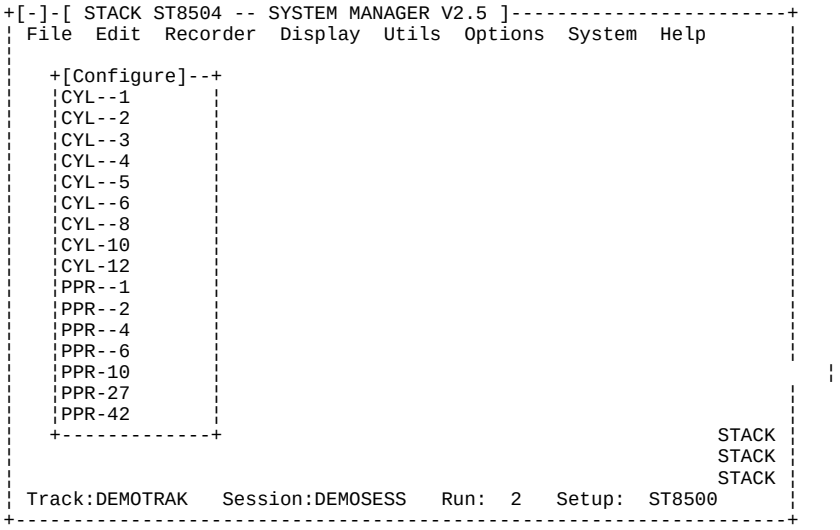
Use this action to start logging data directly from vehicle.

Stop Logging

Use this action to stop logging data directly from the vehicle.

Configure Recorder

This menu option allows you to setup your hardware with the cylinder configuration for your own engine type and the correct number of targets for the Wheel from which you are measuring Wheel Speed.



Select the CYL configuration that matches that of your vehicles engine.

Note The CYL entries are for conventional 4 stroke engines.

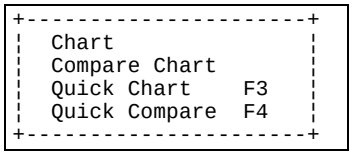
Cylinders in your engine	4 Stroke Single Coil	2 Stroke Single Coil	4 Stroke 1 Coil per Pair of Cylinders (Wasted Spark)	4 Stroke Single Coil per cylinder
1	1	2	2	1
2	2	4	2	1
3	3	6	2	1
4	4	8	2	1
6	6		2	1
8	8		2	1
10	10		2	1
12	12		2	1
16	16		2	1

Note: Multiple coils settings are only applicable if the signal is taken from a single coil.

If the signal is taken from the engine management system/ignition tacho output then use the single coil configuration. For engine management systems it is essential to verify the pulses/rev from the unit. If in doubt use alternative means to verify the engine revs (e.g. known speed and gear).

Display Menu

The Display menu contains four choices:



1. **Chart**-This choice causes the software to display data logged during the run you select for the current track and session, in the most recently selected chart layout style.

   Note. You are prompted for the track and session if one is not already selected.

2. **Compare Chart**: -This choice causes the software to display data logged during the runs for the track and sessions that you selected earlier, in the most recently selected compare chart style.

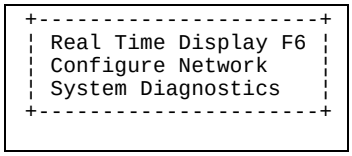
   Note. You are prompted for the two runs to be compared and the sessions in which they occur, if these have not already selected.

3. **Quick Chart**: - Displays a chart for the currently selected run in the most recently selected chart layout style. Press F3 as a shortcut key for this option.

4. **Quick Compare Chart**: - Displays a chart showing the comparison between the most recently selected compare runs in the most recently selected chart layout style. Press F4 as a shortcut key for this option.

Utils Menu

The Utils menu contains the following three choices:



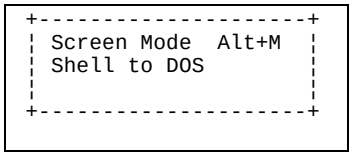
1. **Real Time Display**: (F6) Use this choice when the system is connected to the static vehicle to monitor the data from the system sensors.
2. **Configure Network**: Use this choice the first time that you connect the system to the ST8500 system on your vehicle or if you copy the software onto another PC. Its purpose is to enable the software to configure itself for system communications on the PC hardware on which it is running. You must do this before attempting to download any data from the ST8500 system.
3. **System Diagnostics**: This choice displays a summary of any errors encountered during the downloading session just completed and reports any problems with the data downloaded.
   This information is for use by Stack engineers to assist with diagnosing problems.
   If you select this option, press F10 to return to the menu.

Options Menu

This menu contains no choices for ST8501 systems. Use it for setting up maps if you are using ST8502 - ST8505 systems.

(See **Section 4** Everyday Operation, Creating a Track Map and Select a Track Map options for details on these features)

System menu



This menu contains two choices:

Screen Mode. Allows users of colour Notebook PC's to toggle screen mode from colour to monochrome using key combination Alt + M to increase legibility of the Menu screen.

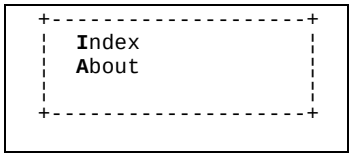
Shell to DOS. Select this choice when you wish to suspend the software and run another program.

This function gives you access to the operating system prompt without ending the session. You can be use the operating system prompt if you need to run any utility programs or issue any MS-DOS commands to delete, copy, or move files and generally maintain your system.

You return to the session by entering the **Exit** command at the MS-DOS prompt.

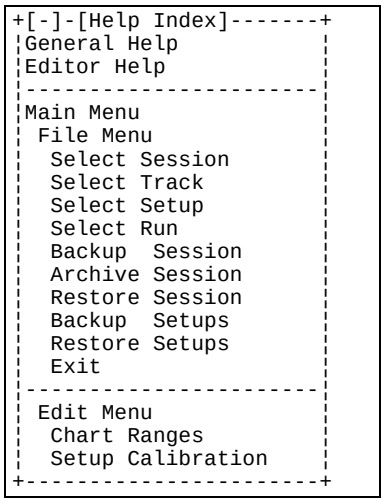
Help Menu

This menu offers two choices:



Index

The Index choice displays the following list of entries for which additional detailed on-line help information is provided:



Highlight the topic of your choice and press Enter to see the help information.

About

This choice displays information about the Stack System 8500 software and the operating environment in which you are currently using it.

Press the Enter key to return to the menu screen.

Chart Menus

The following menus appear at the top of each chart in Display mode:

- Help-F1
- Chart-F2
- Lap-F3
- Reference-F4
- Stats-F5
- Exit-F10

You can select each of these menus by pressing the function key or by clicking on it with the mouse. Press the Esc key to cancel a menu and return to the chart if you decide not to use any of its choices.

Help-F1

Press the F1 key to see the help text for using the Chart 800 facilities.

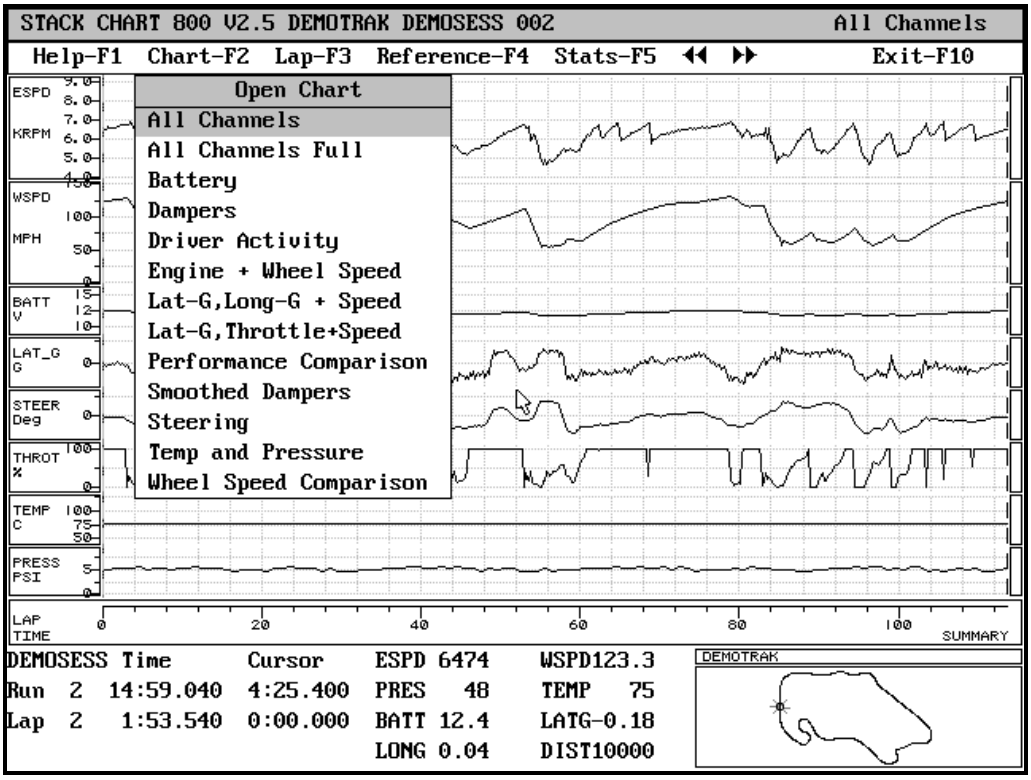
Chart-F2

This menu allows you to choose from a variety of different display formats. The choices available depend on the ST8500 Series software systems you have installed.

The full list of choices for the ST8501-ST8505 range of systems includes:

Choice	**ST8501**	**ST8502**	**ST8503**	**ST8504**	**ST8505**
All Channels	Yes	Yes	Yes	Yes	Yes
All Channels Full	Yes	Yes	Yes	Yes	Yes
Battery	Yes	Yes	Yes	Yes	Yes
Dampers	No	No	No	Yes	Yes
Driver Activity	No	No	Yes	Yes	Yes
Engine + Wheel Speed	Yes	Yes	Yes	Yes	Yes
Lat-G, Long-G + Speed	No	Yes	Yes	Yes	Yes
Lat-G, Throttle + Speed	No	No	Yes	Yes	Yes
Performance Comparison	No	Yes	Yes	Yes	Yes
Smoothed Dampers	No	No	No	Yes	Yes
Steering	No	No	Yes	Yes	Yes
Temp and Pressure	Yes	Yes	Yes	Yes	Yes
Wheel Speed Comparison	Yes	Yes	Yes	Yes	Yes
Damper Velocities	No	No	No	Yes	Yes
Pitch & Roll	No	No	No	Yes	Yes
Ride Height	No	No	No	Yes	Yes

The type of menu that appears for the ST8504 is shown in the following example:



All Channels

This choice produces a display showing data for all the logged channels. You can check the data to see how the temperature increases and pressure decreases during a run. You can also check for unexpectedly low pressures.

All Channels Full

This choice produces a chart showing the graphs for all the recorded parameters overlaid on each other.

Battery

This choice produces a chart showing the battery voltages recorded during the run. It also incorporates engine and wheel speeds.

Dampers

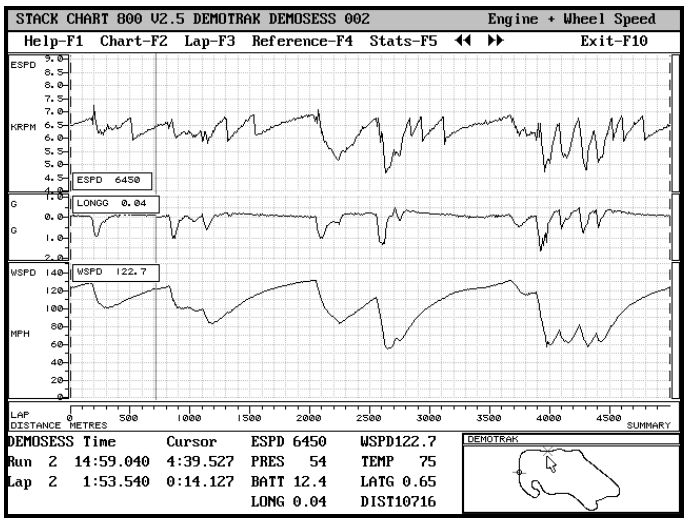
This choice produces a chart showing the range of movement of the suspension dampers in ST8504 & ST8505 systems. It also incorporates wheel speed.

Driver Activity

This choice produces a chart showing throttle and steering wheel position for ST8503 - ST8505 systems. It also incorporates wheel speed.

Engine + Wheel Speed

This choice produces a chart showing the engine and wheel speeds only. Use this chart to check the run for abnormal results. An example follows:



Lateral-G, Long-G and Speed

This choice produces a chart of the wheel speed for a run and the corresponding Lateral-G and Longitudinal-G forces recorded at the same time.

Lateral-G, Throttle, and Speed

This choice produces a chart of the wheel speeds for a run and the corresponding throttle movements and lateral-G forces recorded at the same time.

Performance Comparison

This choice produces a chart showing a performance comparison displaying the wheel speeds for two runs being compared, and the time and speed differences between these runs.

Smoothed Dampers

This choice plots the velocities of the dampers smoothed to a value that you define.

Steering

This choice produces a chart of the movements of the steering wheel during the run.

Temp and Pressure

This choice produces a chart displaying the wheel speed for the run together with a pressure and a temperature recorded at the same time.

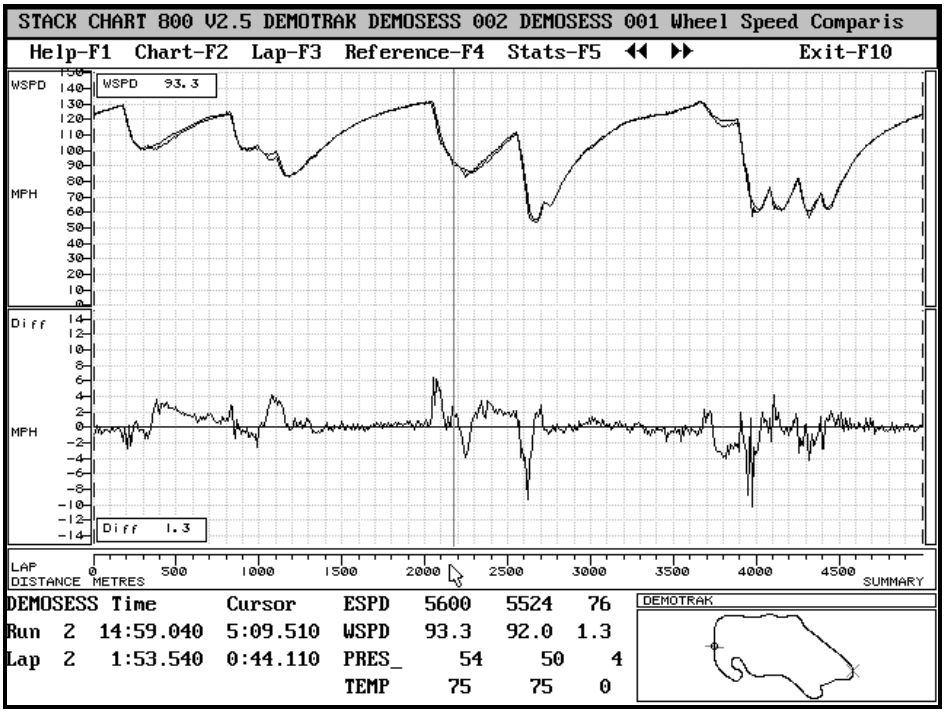
Note that the Temperature and pressure channels can measured from a variety of fluid locations on the car and should be scaled in the Chart Ranges section so as to display correctly for that particular application.

i.e. Engine Oil, Water or Transmission Oil Temperature

Engine Oil, Fuel or Transmission Oil Pressure.

Wheel Speed Comparison

This choice produces a chart showing a performance comparison displaying the wheel speeds for two runs and the speed differences between them.



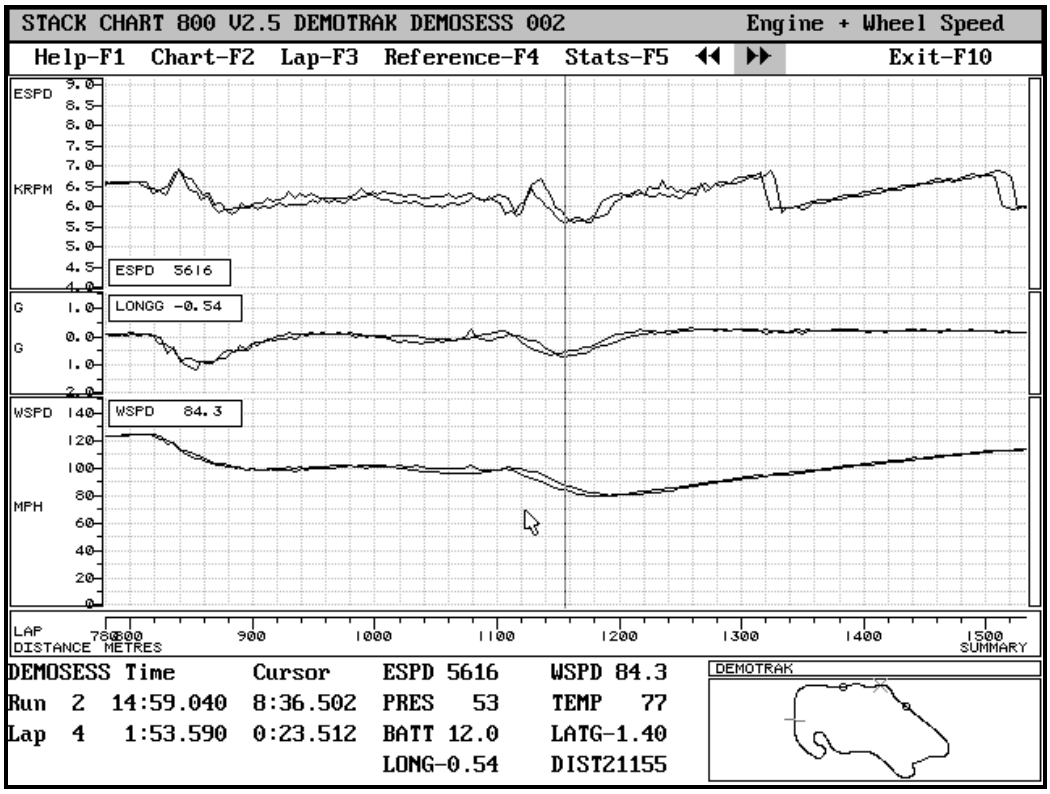
Overlaying Sections of the Same Run

You can use the software to draw the graphs for complete laps of the same run on the same chart. You can also do this for sections of the track, such as a corner, for as many preceding or succeeding laps as you choose. This makes it easier for you to compare performances during the same run over critical sections of the track.

To overlay two or more laps, display the first lap of interest.

1. Press the Shift and ô,ö keys together to overlay the preceding lap.
2. Repeat this to overlay each preceding lap.
3. Press the Shift and ô.ö keys together to overlay the succeeding lap.
4. Repeat this to overlay each succeeding lap

You can do this for a section of the track by selecting and zooming into the section and carrying out the above procedure. The resultant display will be similar to the example below.

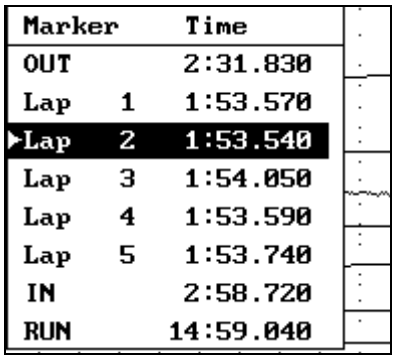


The preceding example shows the engine and wheel speed graphs for a section of laps 3 and 4 of run 2 of the demonstration session.

Lap-F3

Allows the selection of a particular Lap from the list of individaul laps contained within a Run.

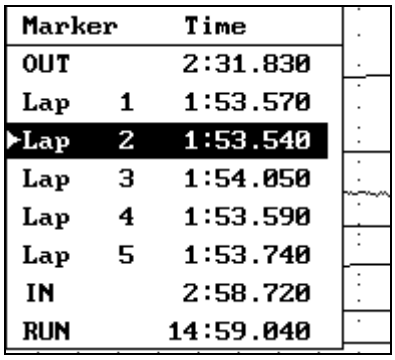
Move the highlight onto the lap you want to see with the down-arrow or up-arrow key and press Enter. You can also use the mouse to select the **Lap-F3** menu and then click on the lap you want to see.



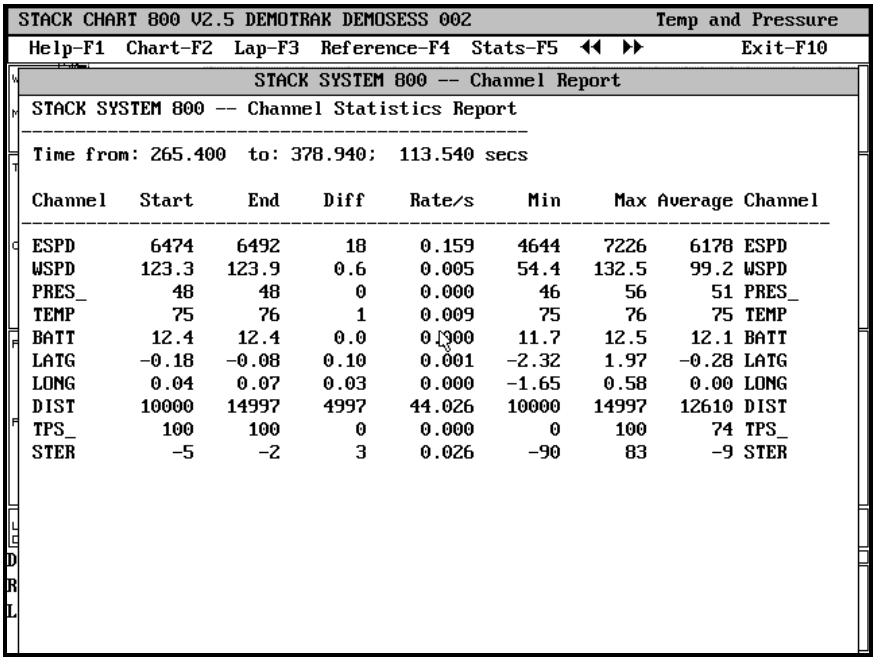
Reference -F4

(In Compare mode) This option allows for the selection of a particular Lap from the list of individaul laps contained within the selected comparison Run. It will act as the reference Lap with which other laps will be compared.

Move the highlight onto the lap you want to see with the down-arrow or up-arrow key and press Enter. You can also use the mouse to select the **Reference-F4** menu and then click on the lap you want to see.



Stats-F5



Selecting Stats-F5 generates a tabular output for the data you have on screen which may be, a full Run, several Laps, a single Lap or any highlighted portion of any of these displays.

Exit-F10

Selecting this option allows you to exit from the Chart Display screen back to the Main Menu screen.

PC Chart Functions

View modes

When the chart is first displayed, it uses a range of colours for the various performance parameters, a variety of backgrounds, and three different graph plotting modes. You You may need to change the colours used to improve legibility, especially if you are using a monochrome display.

Altering the display mode

You may need to change the colours used to improve legibility, especially if you are using a monochrome display. You can alter the display mode colours by pressing the Alt + M keys together. There are seven display modes:

1. Seven light colours on a grey background. The chart is displayed in this mode when you first view it after installing the software.
2. Seven dark colours on a white background with a grey grid.
3. Black on a white background with a grey grid.
4. Black on a white background with a black grid.
5. Seven colours on a black background with a grey grid.
6. White on a black background with a grey grid
7. White on a black background with a white grid.

Aligning Time-Based Data

You will notice that the comparison of data using the ST8501 time-based method of analysis for two separate laps or runs results in the differences between the two sets of data reflecting the values recorded at a given **time** from the start of the run. The displayed time differences at any point in the run indicate the relative positions of the vehicle on the track.

This is useful but does not help in comparing the relative performances of the vehicle over the same section of the track. It also means that the differential between the two performances increases as the analysis progresses further along the lap.

The distance-based analysis provided by the ST8502 - 5 solves this problem by comparing the two performances at the same point in the track throughout the analysis. However, the time-based ST8501 software provides an alignment feature that allows you to realign the two runs over a short section of the track temporarily to approximate a distance-based analysis. This results in more meaningful comparisons over the selected section. For example, by realigning the time-based data of different laps through the same corner, you can compare the performance through the corner on the laps more meaningfully.

The alignment procedure follows:

1. Highlight a section of the chart that represents a corner or other part of the track that you are examining. You can zoom onto the selected section.
2. Put the mouse pointer on the relevant point on the graph for the reference lap. If you are not sure which is the reference lap, check the numeric values at the foot of the chart for each of the plotted lines.
3. Select from this point up to the relevant point on the graph for the current lap. The relevant point would be where you want to align the two plotted lines, such as a peak or minimum value.
4. Press the **Alt + A** keys together. This should result in the two point you selected for the reference lap being moved to the point you selected for the current lap.

Try selecting other charts and zooming into the various sections of the data and realigning it.

Note: If the plotted graphs for the two laps move apart rather than converge as a result of this operation, this is probably because you have selected the graph for the current lap and attempted to move it to that of the reference lap.

Also, the realignment is maintained until you exit back to the Main Menu.

Vehicle Setup

The Setup for a vehicle contains information that is specific to the characteristics of the vehicle. Such characteristics include:

1. Wheel circumference
2. Throttle calibration (for the ST8503,4 and 5 systems)
3. Steering calibration (for the ST8503,4 and 5 systems)
4. Damper positions (for the ST8504 and 5 systems)

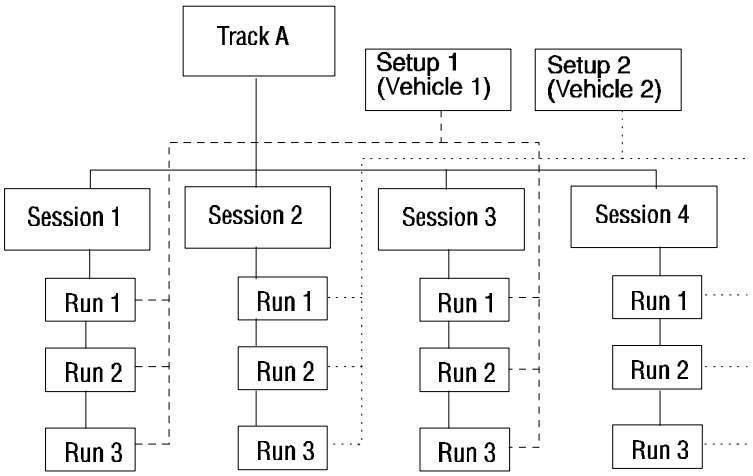
It is possible for the same vehicle to have multiple setups, for example, when using two different sizes of wheel. It is also possible to create multiple setups for multiple vehicles. For example, different vehicles will each have unique throttle and steering calibrations.

You must select the correct vehicle Setup for the vehicle **before** downloading data from it otherwise the results from the data analysis will be incorrect. This is because the ST8500 software performs calculations during the downloading process that use the vehicleÆs Setup data that was in use at the time of the download. Later changes to this Setup will not affect the interpretation of the downloaded data.

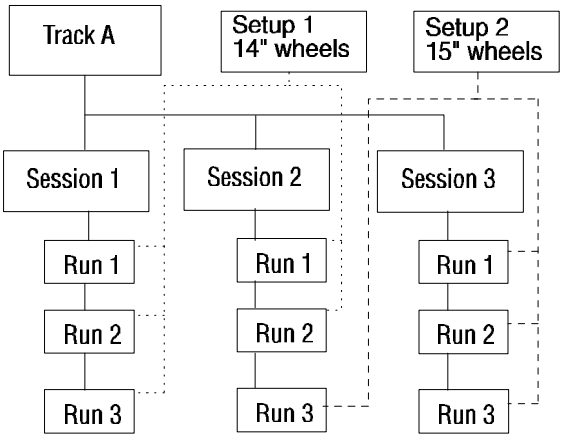
See Copy Setup to Run for further information

Some permutations of track, session, run and vehicle setups for multiple vehicles and multiple setups are shown in the following diagrams.

1. Setups for Multiple Vehicles



2. Multiple Setups for One Vehicle



The sessions in the preceding diagram are organised as follows:

1. Session 1: All runs are with 14ö wheels
2. Session 2: Runs 1 and 2 use 14ö wheels, run 3 uses 15ö wheels
3. Session 3: All runs are with 15ö wheels.

PC Configuration Information

Optimising and Customising Your System

CONFIG.SYS file

The Installation process automatically updates your PC's CONFIG.SYS file is in the root directory to have the following settings for the ST8500 Series software to operate correctly:

FILES = 80

This is the minimum number of files required to run the ST8506 software correctly and may be increased if desired.

8500.BAT file

This file is placed in the root directory of your PC and configures the software for the correct display mode printing and for other miscellaneous functions.

Note If you use a front end menu program it will need to run the **8500.BAT** program NOT the MENU800.EXE in the ST800 directory.

Printing charts

The ST8500 Series software uses a DOS utility called GRAPHICS to print a copy of the image displayed on the screen. Once the 8500.BAT file is set for the correct printer, you can connect the printer to the PC. and print the information on the screen by pressing the shift and Print Screen keys together.

Selecting Printers

To print the information displayed on your screen you must edit the **8500.BAT** file with the type of printer you are using. (Note that the default setting with no printer specified is EPSON graphics).

The format of the GRAPHICS command in this file is

GRAPHICS [**type**] [/R] [/B] [/LCD]

-where **type** specifies the type of printer. Type can be one of the following:

COLOR1	An IBM Personal Computer Colour Printer with a black ribbon
COLOR4	An IBM Personal Computer Colour Printer with RGB (red, green, blue, and black) ribbon
COLOR8	An IBM Personal Computer Colour Printer with CMY (cyan, magenta, yellow, and black) ribbon
HPDEFAULT	Any Hewlett-Packard PCL printer
DESKJET	A Hewlett-Packard DeskJet printer
GRAPHICS	An IBM Personal Graphics Printer, IBM Proprinter, or IBM Quietwriter printer
GRAPHICSWIDE	An IBM Personal Graphics Printer with an 11-inch-wide carriage
LASERJET	A Hewlett-Packard LaserJet printer
LASERJETII	A Hewlett-Packard LaserJet II printer
PAINTJET	A Hewlett-Packard PaintJet printer
QUIETJET	A Hewlett-Packard QuietJet printer
QUIETJETPLUS	A Hewlett-Packard QuietJet Plus printer
RUGGEDWRITER	A Hewlett-Packard RuggedWriter printer
RUGGEDWRITERWIDE	A Hewlett-Packard RuggedWriterwide printer
THERMAL	An IBM PC-convertible Thermal Printer
THINKJET	A Hewlett-Packard ThinkJet printer

Example: GRAPHICS LASERJETII

and the switches /R. /B, /LCD are

/R Prints the image as it appears on the screen (white characters on a black background) rather than reversed (black characters on a white background). The latter occurs by default.

/B Prints the background in colour. This switch is valid for COLOR4 and COLOR8 printers.

/LCD Prints an image by using the liquid crystal display (LCD) aspect ratio instead of the CGA aspect ratio.

Display Monitors:

The ST8500 software can use a variety of displays with different levels of high resolution. The default display type is IBM VGA with 640x480x16 colour resolution. This is set by a line in the **ST800.INI** file, as follows:

Display=

The complete list of display options follows:

Option	**Type**
vga12	IBM VGA 640x480x16 colour
egacolor	IBM EGA 640x200x16 colour
egaecd	IBM EGA 640x350x16 colour
egalowres	IBM EGA 320x200x16 colour
evgahires	Everex EVGA 800x600x16 colour
orchidprohires	Orchid Prodesigner VGA 800x600x16 colour
paradisehires	Paradise VGA 800x600x16 colour
tridenthires	Trident VGA 800x600x16 colour
vegavgahires	Video 7 Vega VGA 800x600x16 colour
vesa6a	Vesa 06A VGA 800x600x16 colour
vesa2	Vesa 2 VGA 800x600x16 colour

NOTE: If this line is omitted then the software reverts to the standard EGA resolution (640x200x16) display.

Installing the Software in Directories other than ST800

The ST8500 software installation program installs the software on any drive and directory that you specify. The default drive is the root drive and the default directory name is ST800.

If you install the software in a directory that is not called ST800 or is not on the root drive, you must change the following line in the **8500.BAT** file:

cd \ST800

For example, to:

D:

cd DATALOG\STACK

-where **D:** is an additional disk drive on your personal computer and **DATALOG\STACK** identifies the directory on this drive in which you installed the software.

Setting Data Archive Path

By default the archive is set to A:\ST800\track\session\session.zip where track and session are the currently selected track and session names.

It is possible to change this target path by editing a line in the ST800.INI file:

archive_dir=A:\ST800

You may wish to do this in the following circumstances:

NOTE: If you have installed the main PC software into a directory other than the st800 directory, change **st800** in all of the following examples to the alternate directory name you have chosen.

1. Your floppy drive is **b:** -- change the line to :

   archive_dir=B:\st800

2. You don't want to use floppies but wish to compress the data to gain space on your system -- change the line to :

   archive_dir=C:\st800\archive

3. You wish to archive files to a network drive change the line to :

   archive_dir=N:\myfiles\st800\archive

Menu800 will only load information data files from floppy disks or archive directories.

Parallel Port Assignment

If you are planning to use the ST890 Network Interface Adapter on a port that is **not** LPT1 i.e LPT2, you must change the entry in the [PCNIU] section of the ST800.INI file main system software directory.

Example change:-

[PCNIU] [PCNIU]

to

PORT=1 PORT=2

EMS Memory:

The ST8504/5 software can process a large number of data channels simultaneously provided that it has enough memory. With a large number of channels, for example, 16, the memory required by the ST8504/5 software becomes significant. This requirement doubles when comparing two runs. The software checks whether EMS memory is available and, if there is and it is large enough, allocates its data buffers in it. This effectively allows you to analyse a greater number of channels than would be possible otherwise.

Do I need this feature?

If your system can display all the charts with all the data channels you require while running the ST8505 software in a normal MS-DOS or PC DOS environment, you do not need to reconfigure the system memory with EMS. If, however, you see the error message "VNOM Insufficient memory to continue" and the chart closes, the EMS feature may help.

What is EMS?

The standard DOS operating systems can only access memory in the first megabyte of addressable memory space even though the hardware (80286 processors and above) can address much more. Most modern personal computers have at least 2MB. This means some additional software is required to take advantage of the available memory beyond the 1MB limit.

EMS means ôexpanded memory specificationö and refers to a mechanism for making the memory above 1MB available to DOS by allocating an area below the 1MB boundary as a ôpage frameö. Into this area are swapped page frames from the higher memory whenever required by the application that is running. The page frame is usually fitted into the region between 640K and 1MB.

The DOS command MEM will show you how much memory is available to DOS and whether any EMS memory has been allocated.

How do I set up EMS?

On older personal computers you will usually find a specific driver for EMS that you can add to your CONFIG.SYS file. It will probably be called EMM.SYS. You should consult the documentation for the version of DOS that you are using.

Third party programs such as QEMM from Quarterdeck also provide EMS (as well as other services to assist in using memory beyond 1MB).

Personal computers with 80386 processors, and above, with DOS Version 5 or 6 installed, can use a program called EMM386 to makes EMS memory available.

MS-DOS Version 6 also includes a program called MEMMAKER.EXE which will automatically configure your personal computer to make optimal use of the memory, to load DOS and other device drivers into memory above 640K and also making EMS available.

PC DOS Version 6.3 includes a similar program called RAMSETUP.EXE.

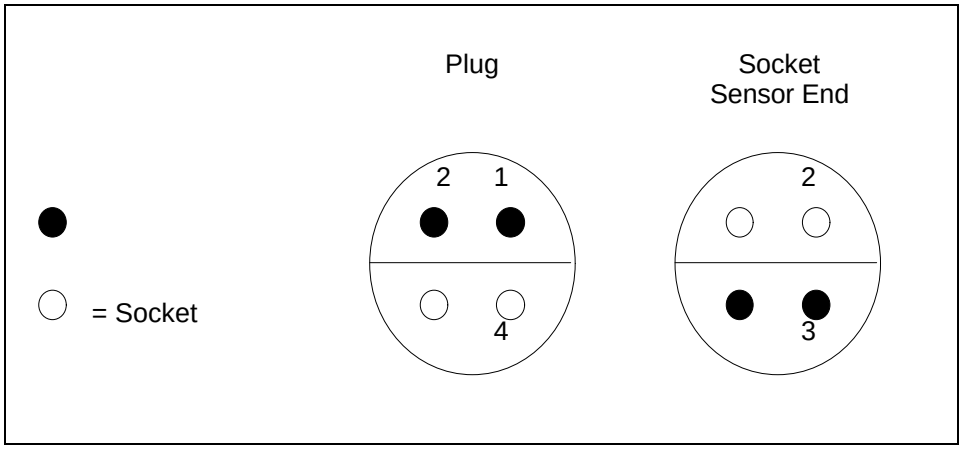
We recommend the MEMMAKER or RAMSETUP method as by far the simplest.

Vehicle Harness Connections

Sensor Connections

This information is supplied to help you if you need to repair or extend the wiring between a Stack sensor and the wiring loom.

All of the sensors supplied by Stack connect into the ST8500 system by means of a 4-way, ITT Cannon Mini Sure Seal (MSS) connector. The following polarity is observed in all cases :



These terminals must be connected to the corresponding terminals of the selected input channel.

Pin Number	Signal Description
1	Signal from sensor
2	Screen
3	+12v
4	0v

Section 4. Everyday Operation

This section takes you step by step through the various processes carried out during day to day use of the ST8500 Series Data Logging and Analysis software products.

The steps are grouped into the following types of tasks:

1. Start of day tasks
2. System checkout tasks
3. Normal data gathering tasks.
4. End of day tasks
5. Changing Vehicle Setups
6. System Specific Options
7. Sensor Calibration
8. Multiple-Vehicle Setup

Start of Day Tasks

At a new track:

Use the **File -> Select Track -> (new)** choice and define the new track.

The system will automatically ask for a new **Session** to define the first session for the new track.

At a track you have been to previously:

Use the **File -> Select Track ->** choice and select the correct track name.

The system will automatically go to **File -> Select Session ->** Use the **(new)** choice to define a new session for that track.

A new day at the same track:

Use the **File -> Select Session -> (new)** choice to define a new session for that track.

If the vehicle Setup you used last is not the same as the Setup for the vehicle that you are about to use for the new session, use the **File -> Select Setup** choice.

If there is no Setup that can be used for the vehicle, you must create a new one for it. Use the **Edit -> Make new Setup** choice to do this.

Use the **Edit -> Session Notes** choice to enter notes about the new session. Include, for example, the name of the Setup for the vehicle and its details, name of the driver, the date, the competition (if any), and the weather conditions.

System checkout tasks

The following checks are highly recommended before taking the vehicle onto the track for a new session:

1. Connect the personal computer to the vehicle and power up the ST8500 system.
2. Select the **Recorder -> Erase** choice.

3. Start the engine.
4. Select the **Utils -> Real Time Display F6** choice on the computer. Check the values displayed on the computer: they should correspond to the values you would expect in this situation.
5. If wheel speed option is fitted; Spin the wheel and check for a speed reading on the real-time display.
6. If the Lap timing option if fitted; point the transmitter at the receiver and power the transmitter on and off for 1 second.
7. Stop the engine.
8. Select the **Recorder -> Download Display Run** choice.
9. Check the displayed data you have just downloaded. For example, check that a lap time has been recorded correctly. If all channels show valid data, press **F10** to return to main menu.
10. Remove the test data by entering **Edit -> Delete Run** choice.

Normal Data Gathering Tasks

Note: If you use the ST8500 with the lap timing option, do not forget to place the lap transmitter on the circuit before the car goes out. Position the transmitter as previously advised and ensure that the battery powering the transmitter is fully charged.

The recorder starts recording data as soon as the recording switch is pressed. The recorder continues recording until the ignition is switched off.

After the vehicle completes each run, you can stop the engine. The ST8500 system power must be ON (but the engine does not need to be running) in order to download the data.

The following tasks must be carried out run when you are recording the data for each run:

1. If you are using more than one vehicle Setup then select the correct Setup, use the **File -> Select Setup** choice.
2. Connect the jack plug to the socket on the vehicle.
3. Make sure the ST8500 system power is on.
4. When ready, download the data from the recorder by selecting the **Recorder -> Download Display Run** choice or by pressing the F2 key. If the recorder is still running when you do this, it stops recording automatically.
5. When the downloading is complete, disconnect the PC from the vehicle and turn off the ignition.
6. Review the data that has been down loaded.
7. Update your run notes with any particular information that will help you interpret the data in the future.

Repeat the above tasks for each run during the day.

Different tyre sizes

The following is required where the change in circumference is significant i.e. 14ö and 15ö diameter wheels. It is not necessary for changes due to normal tyre wear.

1. Download any data recorded when the vehicle was using the original tyre size.
2. When the tyres are changed use the **Edit -> Setup Calibration** choice to enter the correct tyre circumference.
3. Download subsequent data as normal

For operation with more than one vehicle see **Multiple Setup Operation**

End of Day Tasks

The following tasks are recommended when you have completed all the runs for the session and downloaded the data from the last.

The main task at this stage is to tidy up the list of runs for the session by removing any runs that you do not wish to use:

1. Select the **Edit -> Delete Run** choice.
2. Highlight the run you want to delete and press Enter. The highlighted run is deleted.
3. Repeat this action for each run to be deleted.
4. Finally update your session notes with any relevant information about the session that will need later.

Note: If you have the Laptiming option; Do not forget to recover the Lap transmitter from the circuit.

Changing Vehicle Setups

If you are using the ST8500 system on vehicles with different tyre circumferences, it will be necessary to create multiple SETUP files. This is only required where the change in circumference is significant i.e. 14ö and 15ö diameter wheels. It is not necessary to set different tyre circumferences due to normal tyre wear.

Any number of Setups can be created using the **Edit -> Make new Setup** choice and copy the default ST8501 Setup file to a file with a recognisable name e.g. **14inch, 15inch,** etc.

Having created a new Setup then use the **Edit -> Setup Calibration** choice to enter the correct tyre circumference for that Setup.

IMPORTANT: When using multiple setups, always make sure the correct Setup is selected before downloading a run from the datalogger. Use the **File -> Select Setup** choice to select the correct Setup.

System Specific Options

Options Menu

This menu contains the following choices:

```
Calculate...   F5
Select Track Map
```

Creating a Track Map

The ST8502 - ST8505 software contains the track mapping feature. The use of this feature to create new maps is described below.

Calculate Choice

The Calculate choice (F5) provides a facility for creating a map of the circuit based on the data you have logged for a lap. You can create maps using the following choices:

- CCW-MAP: Counter clockwise direction
- CW-MAP: Clockwise direction
- DISTANCE: Distance only
- FIG8-MAP: Figure of 8 circuit (Suzuka-Japan style)

Calculate Track Map

To create a map:

- Highlight the type of map to be drawn from the above list and press Enter
- Select the Run containing the data from which you wish to create a Track Map and press Enter

You are presented with a list of the laps in the run you selected.

- Enter the number of the required lap and press Enter or enter zero ô0ö to calculate a map for all laps.

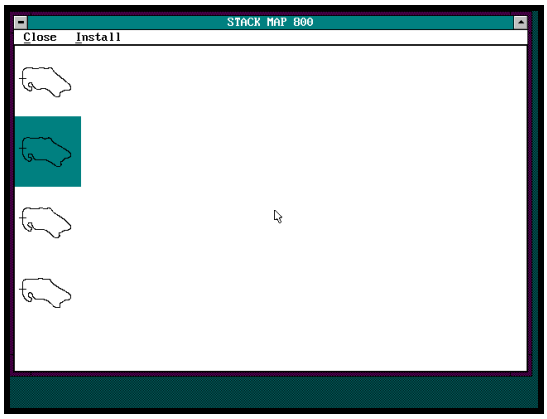
Note The best maps are usually produced by laps which are fractional slower than the fastest lap.

You will see some messages during the map(s) creation process. When it is finished, you can display the calculated map(s) by returning to the **Options** menu and selecting the **Select Track Map** choice (described later in this section).

Select Track Map choice

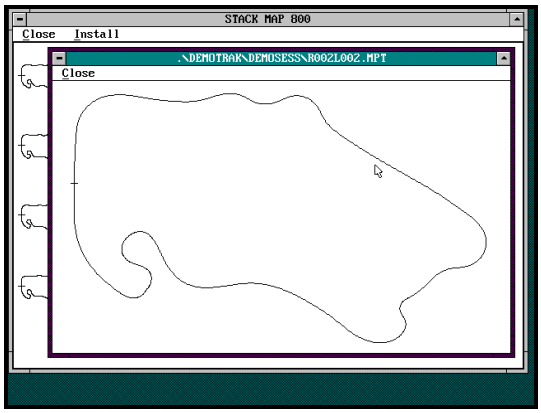
From the Options Menu, choose Select Track Map and press enter.

The screen will clear and a library of the Map(s) previously calculated will displayed. If you selected the 0 option a map for each of the laps in the run will be displayed. If you only selected a lap or a few laps from which to make maps then the library will only contain that many maps.



To highlight a map, use the cursor arrow keys to reach it.

You can view a large view of each map by highlighting it and pressing Enter.



To return to the main map display, click on the large map with the mouse. Click on the **Close** button or press **Alt + C.**

To select the map you wish to use with the analysis charts.

1. Highlight the required map from those available and click on the **Install** button or press **Alt + I**.
2. To exit the Map Selection process, click on the **Close** button or press **Alt + C** to return to the Main menu.

Distance Calculation

The distance covered by the vehicle for each lap in a run is automatically calculated when the data is downloaded from the vehicle.

However, it is possible that the nominal length of a track can vary from one session to another as a result of modifications to its layout. If this has occurred you should change the nominal and tolerance values for the track set previously in the **Edit->Track Details** panel.

You should then use the **Options->Calculate->Distance** choice to recalculate the length of each lap in a run. if you have changed the nominal length of the track that was been.

The calculation uses the value of the tolerance defined in the track details to normalise the lap lengths that it computes from the recorded data.

A track length that is calculated to be outside the tolerance is not normalised and an error box detailing the laps and lap lengths concerned is displayed. To correct errors. adjust the Track Length in the Track Details section and re-run the Distance Calculation.

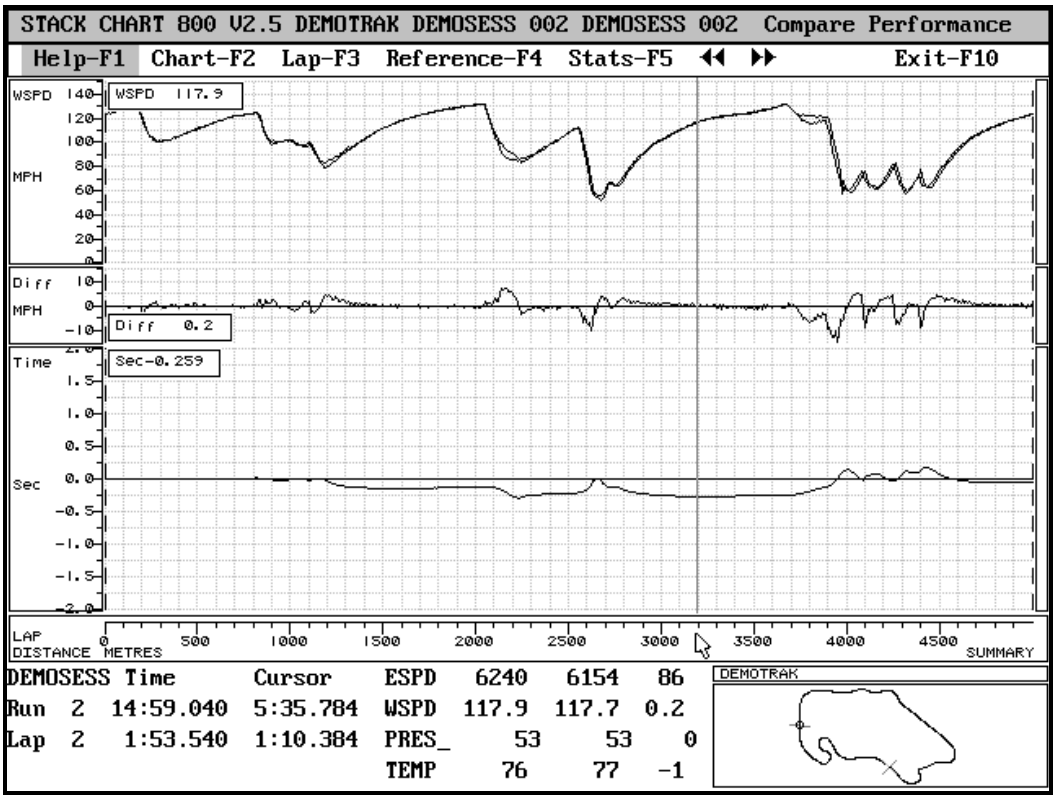
Using Distance-Based Charts

The charts produced by the ST8502 software and above include the following enhancements over the charts from the ST8501 software that result from the use of distance-based analysis:

1. Charts are displayed using distance-based analysis. The main visible difference is that the gradations are now shown as distances in metres.
2. The map of the circuit is displayed in the bottom right-hand corner. The map shows the cursor position as a cross-hair. The start-end of lap position is indicated by an inverted ϕ symbol. You can use your mouse to select a section of the circuit, such as a corner, which you wish to see in greater detail:
    - Click on a point on the circuit at the start of section and hold the mouse button down.
    - Drag the mouse pointer to the end of the section.
    - The section of the chart is automatically highlighted.
    - Press the down-arrow key to view the section
3. The data in comparisons between runs stay one on top of the other, showing true differences for a given point on the circuit. Even when, as is the case in lap 3 of the demonstration data, there is a wheel lockup while the engine is running at approximately 4000rpm, the data graphs remains stable showing true distance-based comparisons through the following corners.

4. The Performance Comparison choice of the Chart menu produces a chart (see below) showing a performance comparison displaying the wheel speeds for two runs being compared, and the time and speed differences between these runs.

5. This chart shows at the top the two wheel speeds aligned for the distances they have travelled and below a speed difference trace. Below this it shows a time difference trace giving the difference in time in reaching the same point on the circuit. For example, compare lap 2 of the current run (run 2) with lap 4 of the reference run (also run 2) from the demonstration. The time for lap 2 is 1:53:54 and the time for lap 4 is 1:53:59, a difference of 0.05 seconds. In this particular example, notice the following points:



- There is no significant difference in lap speeds up to about 1100 m.
- On lap 2, the vehicle is about 4.5 mph faster through the apex of the corner at about 1200 m (3950ft).
- On lap 2 the vehicle enters the straight faster at the 1200 meter point and so has gained 0.131 seconds by the 1400 m (4600ft) point.
- On lap 2, the vehicle takes the following corner, at about 2200 m, about 7.5mph faster and gain a further 0.1 seconds to give a total gain of 0.224 seconds at 2400 m (7875ft).
- On the corner at about 2600 m, on lap 2 the vehicle is slower in and faster out than on lap 4, although there is no overall time difference for this corner. You can check this by highlighting the corner. The time difference is shown in the time difference (Sec) box for the highlighted section
- On lap 2 at about 3000 m (9850ft) from the start, the vehicle is about 0.245 seconds faster than on lap 4.
- On lap 2 at about 3200 m (10500ft) from the start, the vehicle is about 0.266 seconds faster than on lap 4. (See illustration)
- On lap 4 the vehicle recovers all lost time and gains a 0.152-second advantage over the lap 2 time at the same distance while braking into the corner between 3800 and 4000 m.
- On lap 2 the vehicle recovers its advantage by accelerating out of the last corner faster than on lap 4 to complete the lap 0.05 seconds faster.

Sensor Calibration

Normally the sensors will only need recalibrating if the Steering or Throttle linkage has physically been altered or disassembled since the last time the vehicle was run.

Suspension Calibration will be required if:-

- Fuel load is significantly increased or a class weight penalty has been added to the vehicle.
- Coil-over shock springs have been changed.
- Suspension pre-load changes significantly.

If in doubt, select the correct Setup file and recalibrate the sensors as described previously.

The need to re-calibrate sensors may arise after overhaul or service work on the vehicle.

For the Steering sensor, re-establish the straight ahead position by selecting **F6/Real Time Display** and move the sensor/pulley assembly until the Steering channel shows 0 when the steering wheel is set straight ahead.

Multiple-Vehicle Setup

If you are using the ST8500 on more than one vehicle, it will be necessary to create multiple SETUP files.

Each vehicle should have its own unique Setup file. Any number of setups can be created using the **Edit -> Make new Setup** choice and copy the default ST8500 Setup file to a file with a recognisable name e.g. Car1, Car2, etc.

Having created a new Setup then use the **Edit -> Setup Calibration** choice to enter the correct tyre circumference, and calibrate the sensors for that vehicle.

IMPORTANT: When using multiple setups, always make sure the correct Setup is selected before downloading a run from the datalogger. Use the **File -> Select Setup** choice to select the correct Setup.

Different Tyre Sizes

The following is only required where the change in circumference is significant, for example, from 14ö to 15ö diameter wheels. It is not necessary to set different tyre circumferences due to normal tyre wear.

1. Download any data recorded when the vehicle was using the original tyre size.
2. When the tyres are changed use the **Edit -> Setup Calibration** choice to enter the correct tyre circumference.
3. Download subsequent data as normal

Suspension Data

Logging Rates (Dampers)

The ST8504/5 has three logging modes, recording times as follows

- 15 minutes. Dampers Recorded at 50Hz (**15MINREC**)
- 25 minutes. Dampers Recorded at 20Hz (**25MINREC**)
- 60 minutes. Dampers NOT recorded (**60MINREC**)

Configure the logging rates as follows

1. Connect the personal computer with the ST8504/5 software installed to the on-vehicle system.
2. Switch the ST8504/5 system on (you do not need to start the engine).
3. Start the ST8504/5 software.
4. Use the **Recorder -> Configure Recorder** choice to select the required logging time.

The choice of logging times is dependant on the following factors:

- 15 Min 50Hz recording:
    1. Use this for detailed analysis of suspension movements, in particular for damper rates and max-min travel.
    2. Open a display chart and zoom into a transition of interest. Highlight a transition using the shift cursor keys from the max to min peak of the transition.
    3. Press F5 (Stats) to see the total travel and the damper velocity (Rate) in mm (inches for USA) per second.
- 25 Min 20Hz recording. Use this for analysis of chassis performance and travel. It helps identify vehicle roll, pitch, and cornering transition behaviour.
- 60 Min recording. Use this for the maximum recording time where the suspension information is not required, such as when recording a complete race.

Smoothing Suspension Data

The suspension data can be smoothed to simplify the task of interpreting vehicle chassis movements. The original suspension data will contain a large amount of high-frequency transitions caused by the wheel traversing holes and bumps on the surface of the track. This data is difficult to use for analysing vehicle chassis movements.

To smooth the data for a run, use the **Options -> Calculate** choice to open the list of smoothing options. Choose the appropriate option. Your choice depends on the type of vehicle analysis you require:

1. **SM100** (100mS). Use this option use to clean the data for wheel movements.
2. **SM250** (250mS) use this option to clean the data for fast types of chassis movement, such as squat and dive
3. **SM500** (500mS) use this option to clean the data for slower types of chassis movement, such as pitch and roll
4. **SM1000** (1000mS) use this option to clean the data when you want to see ride height and aerodynamic chassis effects.

Use the Smoothed Damper chart to graph this data

Update your run notes with any particular information that will help you interpret the data in the future. Repeating the above tasks for each run during the day.

Smoothing the Example Data

Before you can display any supplied example data for suspension performance, you must first perform the following calculations **in the order given here**:

1. Select the **SM500** option form the **Options->Calculate** list.
2. Select Run 3 from the demonstration data. This starts Stack System 800 Channel Calculator performing the calculation which takes several minutes on a system with an 80486 processor running at 50MhZ. The calculation is carried out on each of the channels for the dampers.

Operation of ST8506 Software Package

ST8506 Software Package Installation & Operation

Install the supplied ST8506 software disk in the same way that you have already installed the normal ST8500 software disks.

After installation you can access the additional features of the **ST8506** software through the **Option Menu > Calculate** function.

Once you have either loaded data from the Demo disk for Run 3 or have your own data recorded from suspension movement sensors, you can calculate, Shock velocities, and Pitch/Roll data.

ST8506 Charts

The ST8506 provides two additional charts:

1. Pitch and Roll Chart
2. Damper Velocities Chart

Setup For Pitch and Roll Data Recording

If the system is for a vehicle equipped with a Front Monoshock, connect a damper pot for it to the **front left** (DFL) connector cable. Leave the damper front right cable (DFR) disconnected.

Calculation Files Created by the ST8506

The pot sensor data downloaded from a run must be pre-processed to create a set of files that are then used in generating the display charts for pitch and roll, heights, and damper velocities.

The **Options->Calculate** choice will contain three items that must be used to create these files, DAMPERV, PITCHROL, and PITCHROM.

Note. The damper data must be smoothed by running one of the smoothing calculations (SM100, SM250, SM500, or SM1000) before you proceed to create the additional files using these calculations, as described previously under **Smoothing Suspension Data** .

All calculations assume that the scaled readings from the pot sensors reflect wheel movements exactly and that further scaling to compensate for any differences between the measured movements and actual wheel movements are not required. (Further scalings are necessary if the pot sensors measure movements differently due to being mounted where an exact one-to-one movement ratio and exact linearity cannot be obtained.)

Note that for the front, rear, and height channels, higher values mean that either the vehicle has moved upwards or that the wheel has moved downwards; in either case, the pot sensor has lengthened.

Note that the pitch attitude is indicated as follows:

- Positive values: dive (front down, rear up)
- Negative values: squat (front up, rear down)

and that the roll is indicated as:

- Positive values: Right (vehicle in left-hand turn)
- Negative values: Left (vehicle in right-hand turn)

DAMPERV Calculation

The DAMPERV calculation uses the smoothed suspension data from the four suspension damper pots to create four new data channels, each containing the derived velocity for the associated damper. The velocities are shown either as mm/sec (UK/EU) or 0.1"/sec (US).

PITCHROL Calculation

The PITCHROL calculation uses the smoothed suspension data from the four suspension damper pots to create seven new data channels, as follows:

- Roll Front and Rear
- Pitch Left and Right
- Ride Heights Front and Rear
- Ride Heights Centre of vehicle

The formula for the pitch calculation is:

(rearHeight-frontHeight)/wheelbase (degrees)

The pitch and roll angles are calculated for a vehicle with a wheelbase and a track width of either one metre or one foot, according to the unit of measurement you specified for the logged data (US, UK, or EU).

Divide the pitch angle in the chart by the wheelbase (in feet for the US, in metres for the UK and EU) for your vehicle to obtain the correct angle of pitch.

Divide the roll angle in the chart by the track width of your vehicle to obtain the correct roll angle.

Heights

The front and rear ride heights are the average (total) of the measurements from the front and rear dampers on each of the two sides, and the height is the average of all four.

PITCHROM Calculation

The PITCHROM calculation uses the smoothed suspension data from a vehicle equipped with the Monoshock front suspension unit. It takes the data from the three suspension damper pots to create six new data channels, as follows:

- Roll Rear
- Pitch Left and Right
- Ride Heights Front and Rear
- Ride Height Centre of vehicle

You use the wheelbase and track dimensions of your vehicle to calculate the true values as described above for the PITCHROL data.

Heights

The front ride height is determined by the single front-left-hand pot sensor reading. The rear ride height is the average (total) of the heights of the two rear sides.

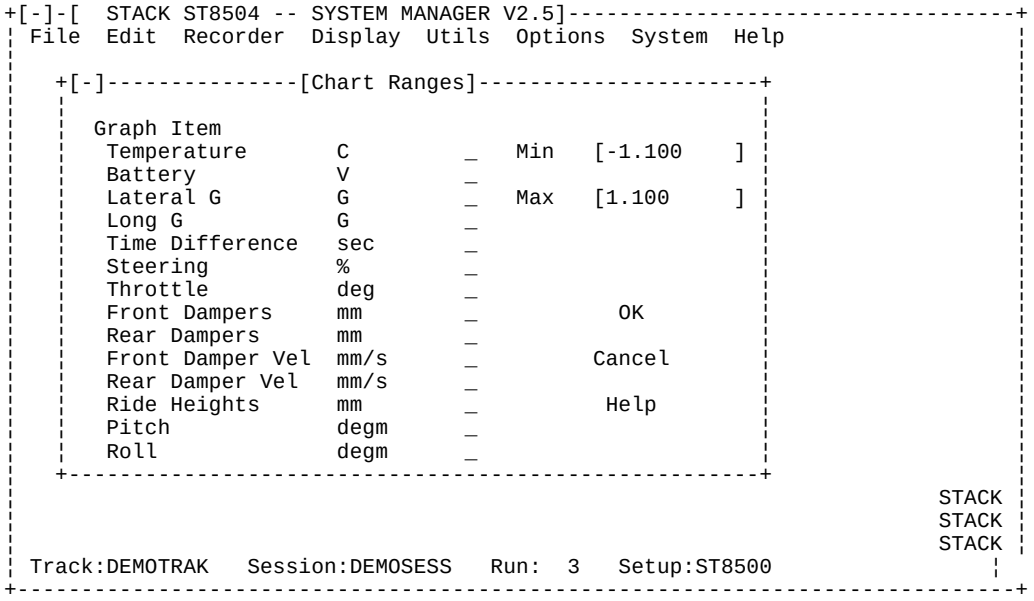
The height is the average of the front height times two plus the rear left height plus the rear right height.

Chart Value Ranges

You can reset the range of values displayed in the charts for the following items:

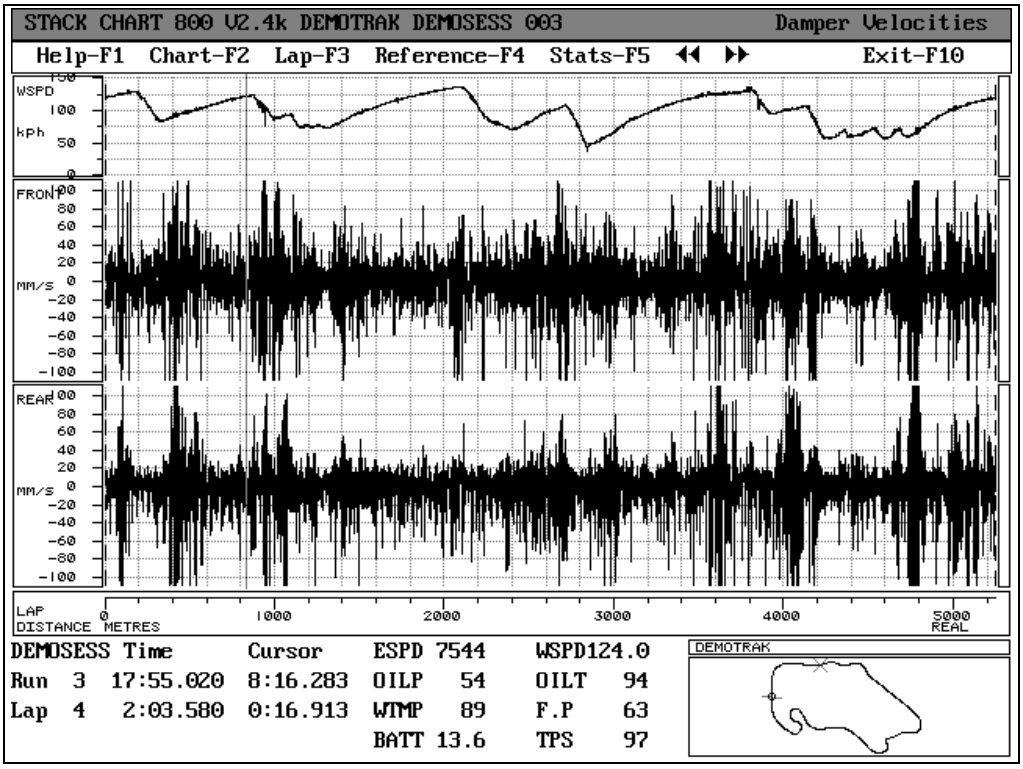
- Front Damper Vel
- Rear Damper Vel
- Ride Heights
- Pitch
- Roll

To do this, select the **Edit->Chart Range** choice and scroll down to the end of the list. You should see the following items:



Damper Velocities Chart

The damper Velocities chart shows separate graphs for front and rear suspension velocities. The left and right damper data is overlaid. To help you identify areas of the track where the damper velocities are greatest, use the Alt + G (Graph Type) display mode function to select real mode line display. This displays an envelope of maximum and minimum values for damper velocity. For example,



Pitch and Roll Chart

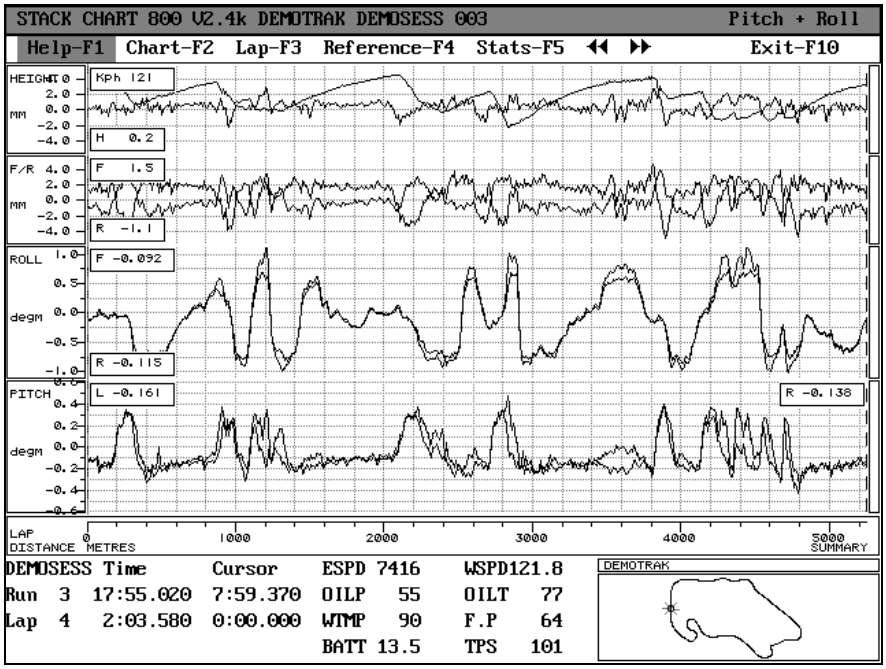
The pitch and roll (Ride height) chart (example below) shows graphs for six types of data .

The top graph contains the wheel speed overlaid by the overall ride height of the vehicle.

The second graph shows the front and rear ride height as separate lines. The third graph shows the front and rear roll. Note that on the example data (Run 3) the front and rear roll traces separate from each other when the rear inside wheel lifts up while going through corners.

The third graph shows the left and right pitch of the vehicle.

An example of the Pitch and Roll chart follows.



Data Values Shown in the ST8506 Charts

You can inspect the following data values in the lower centre section of the chart. Select the values list by means of the tab key and scroll down it to reveal the values that are hidden when you open the chart.

The values are as follows:

DVFL	Damper Velocity Front Left	PL	Pitch Left
DVFR	Damper Velocity Front Right	PR	Pitch Right
DVRL	Damper Velocity Rear Left	RF	Roll Front
DVRR	Damper Velocity Rear Right	RR	Roll Rear
FRT	Front ride height		
REAR	Rear ride height		
HT	Ride Height		

Operation of ST8509 Turbo Boost Pressure Option

The ST8509 system comprises of one ST452 0-5 Bar Turbo Pressure Sensor and a Software disk.

ST8509 Hardware Installation & Operation

Install the ST452 Pressure sensor in a convenient position in the engine bay. Mount the sensor with the pressure pipe nipple facing downwards and ensure that you fit a snubber with a 1mm hole in the pressure line leading from the engine to the sensor to minimise potential damage from pressure spikes.

Connect the cable from the ST452 to the Harness connection labelled B (Make sure to not confuse this harness connection with those labelled B- and B+ for the power supply to the system).

ST8509 Software Package Installation & Operation

Install the supplied ST8509 software disk in the same way that you have already installed the normal ST8500 software disks.

After installation power up the ST8500 system, start the 8500 software on the PC. Connect the PC Interface lead tp the ST8500 system and then select:-

Recorder -> Configure Recorder menu choice.

Select BOOST-ON fron the list of available configurations to enable the system for Boost Pressure logging.

When Boost pressure logging is not required, repeat the above steps but select the BOOSTOFF option.

After installation you can access the additional features of the ST8509 software through the F2 CHART Menu during recorded data display.

Appendix A. Solving Problems

No	Fault Description	Possible Cause	Remedy	Notes
1	"No Logging RAM" on START LOG or DOWNLOAD	Internal RAM Failure in Recorder	No user maintenance possible	Return recorder for service
2	Recorder will not download data or fails with 'Download incomplete' Error	No power to ST8500	Check power feed to ST8500	Check fuse in wiring if you have fitted one
		Incorrect network configuration on the PC	Reconfigure. Select [Utils] [Configure Network]	Check for 'Network access errors' on the PC when downloading starts
		PC has gone into Power Save mode. (Non Turbo, Slow Speed)	Set PC SETUP options for High Speed & No Powerdown	Consult your PC user manual for instructions on hoe to do this
		Network cable harness not connected to recorder unit	Reconnect the harness	Check correct operation using [Recorder] [Start Logging]
		Faulty network cable connection or harness or loose 4w MIL connector	Check cable for damage. Check MIL connector for correct mating	Also check that ST890 PC Interface module is correctly attached to Parallel port of PC.
		Wrong parallel port connection on PC	Check the **Port=** parameter in ST800.INI file	
			Check the lead is plugged into the correct port	
3	No recorded data	Switch not pressed to start recording or Switch failed	Check Switch operation. Remember to press switch.	Check record light indicator comes on when recorder is running

No	Symptom	Possible Cause	Remedy	Notes
4	Channel values from suspension module freeze for intermittent periods. Horizontal lines in the data.	Faulty network cable, harness or loose 4w MIL connector to suspension module	Check cable for damage. Check MIL connector for correct mating	
5	Recorded data JUMPS to an invalid value. Vertical lines in data on all channels	Incorrect network configuration on the PC or as 4 above	Reconfigure network. Select [Utils] [Configure Network]	Check for 'Network access errors' on the PC when downloading starts
6	Recorded wheel and/or engine speed(s) are incorrect by a fixed %	Tyre size incorrect in ST8500 Setup. The pulses per wheel revolution is set up incorrectly in the ST8500 unit.	Select correct Setup [Files] [Select Setup] or change tyre size in Setup. [Edit] [Setup Calibration]	Use [Edit] [Copy Setup to Run...] to transfer new value to recorded data. Repeat for all runs affected by this error. Upload correct configurations to module
8	Recorded data JUMPS to an invalid value. Vertical lines in data on one or more channels	Cable harness too close to the HT lead or a radio transmitter antenna lead	Re-route the harness. Must be 100mm (4") from HT and antenna leads	
9	All Configurable parameters have returned to their default values	Arc-welding on car causes the Recorder system to perform a MAJOR reset.	IMPORTANT Remove all Recorder & Sensor systems from the car before arc-welding.	Only remove modules, sensors can stay in place during welding
10	Extra Laps recorded. Lap times too short.	More than one transmitter around the circuit	Remove all but one transmitter from the circuit.	

No	Symptom	Possible Cause	Remedy	Notes
11	All or some Lap Times not Recorded in data	Red protective cover not removed from receiver	Remove Red protective cover.	
		All or some Lap Times Not recorded in data	Connect or charge transmitter battery.	Check for Green light on side of Transmitter
		Incorrect alignment of Transmitter and/or Receiver	Re-align Transmitter and/or Receiver	Follow user guide instructions for setup
		Transmitter positioned with the Sun at a low angle behind it.	Move transmitter to face into the sun +/- 90 degrees.	
		Transmitter positioned to close to another Lap timing Transmitter	Move transmitters to be at least 4m, 12ft apart.	
		Water on Transmitter Lenses	Remove water from lenses. Fit cover	Shield lenses with cover in all wet conditions

No.	Symptom	Possible Cause	Remedy	Notes
	MENU (General)			
12	'Insufficient Memory' error	Not enough conventional RAM to run the program (512k required)	Use DOS MEMMAKER to optimise memory. See DOS manual for details	You must exit the program and return to the DOS prompt C:> to do this
13	'Invalid Directory Bad Command or File name, error	Software installed to a different directory	Edit 8500.BAT file and enter the correct directory path	
14	'Demonstration Version' errors or... Inconsistent menu options/operation	ST800.INI file corrupted or erased	Replace by Copying ST800.ORG file to ST800.INI	
	Backup, Archive and Restore			
15	'Nothing to Do' error when backing up, archiving or restoring data	Selected data does not exist and hence can not be backed up, archived or restored	Use Dos UNDELETE to recover data. See DOS user guide	You must exit the program and return to the DOS prompt C:> to do this
		Duplicate action, data has already been backed up, archived or restored	No action required	

No.	Symptom	Possible Cause	Remedy	Notes
16	'Could not create destination directory' error	Floppy disk Write protected	Remove disk and check that the hole is blanked off	
	when backing up, archiving or restoring data	Disk contains a file of the same name as the track	Use DOS to RENname the file See DOS user guide for details	You must exit the program and return to the DOS prompt C:> to do this
17	'Target disk not accessible' error when backing up, archiving or restoring data	Disk not placed in appropriate drive	Insert disk into the drive.	Check that the correct drive is specified by archive_dir=A:\ in ST800.INI file
18	Menu options scroll over the top of screen	Unexpected DOS/Disk error has occurred	Press the 'F' key to recover	Press the 'A' key to return to DOS
19	'Error creating compressed file' when backing up, or archiving data	Floppy disk is full	Insert blank disk into the drive	Do not forget to label the disk with the track and session
		Too many runs in one session to fit onto one disk	Use 1.44mbyte HDdisk in place of a DD 720kbyte disk	
			Reduce the amount of data by deleting unwanted session runs	

No.	Symptom	Possible Cause	Remedy	Notes
	Display (Chart800)			
20	No data visible in chart. Numbers on Left Axis incorrect	Incorrect chart range	Use **Edit** ⇒ **Chart Range** to enter the correct Min and Max. values of the chart	
21	Chart displays 'Warning Data channel not recorded' error	Data has been Archived onto floppy and not restored	Use **File** ⇒ **Restore** Data to recover data	
		Download of Data did not complete successfully	Use **Recorder** ⇒ **Download**, to Download data	
22	Invisible peak or valley in data graphs. Values at bottom of chart are correct	Incorrect chart range is truncating data outside the Min Max. range	Use **Edit** ⇒ **Chart Range** to enter the correct Min and Max. values of the chart	
23	Laps within two runs do not align, or overlay correctly (All laps affected)	Lap Beacon was moved or placed differently for each run	Use **Alt+A** to realign data	Always setup the Lap beacon in the same place
		The value for the track length has been changed	Use **Edit** ⇒ **Track Details** to reset the Track length and tolerance	Use **Options** ⇒ **Calculate** to correct the affected runs

No.	Symptom	Possible Cause	Remedy	Notes
	Display (Chart800)			
24	One or more Laps within two runs do not align, overlay correctly (Not all laps affected)	Lap Beacon was missed on one or more laps for one or both of the runs	If the lap times are known use **Edit ⇒ Run markers** to insert the missing lap times	Check alignment of both the transmitter and the receiver
		Track tolerance set too tight	Use **Edit ⇒ Track Details** to increase the Track tolerance	
25	Chart displays blank graphs, may have correct speeds at bottom of chart	Insufficient number of Files specified in CONFIG.SYS	Check the **Files=** parameter in the CONFIG.SYS file (See appendix A)	To do this Exit the program and return to the DOS prompt **C:\>**. Reboot the PC after any changes
	Printing graphs			
26	Unable to print graphs, no response from the printer **(Shift+Print Scrn)**	DOS **Graphics** program not loaded MENU800.EXE run direct from the 8500 directory	Run the program by typing **8500** at the C:\> prompt	You must exit the program and return to the DOS prompt **C:\>** to do this
		Wrong printer port connection	Check the lead is plugged into the correct port	Usually **LPT1:**
			Check the DOS **PRN:** device is set to the correct port	See DOS user guide for details
		Printer not ON LINE	Switch the printer to be ON LINE	

No.	Symptom	Possible Cause	Remedy	Notes
27	Printing graphs gives Illegible characters from the printer	DOS **Graphics** program configured for the wrong type of printer	Edit **8500.BAT** file and enter the correct printer type	

Appendix B. Menu Key Functions

F **F**ile
- **S** **S**elect Session...
- **T** Select **T**rack...
- **P** Select Setu**p**...
- Select Run...
- ---
- **B** **B**ackup Session...
- **A** **A**rchive Session...
- **R** **R**estore Session
- **C** Ba**c**kup setups
- **O** Rest**o**re Setups
- ---
- **X** E**x**it **F10**

R **R**ecorder
- **D** Download **D**isplay Run **F2**
- **E** Download **E**rase Memory
- **S** Download **S**ave Memory
- Erase Memory

U **U**tils
- (No Choices)

S **S**ystem
- **M** Screen **M**ode **Alt+M**
- **S** **S**hell To DOS

E **E**dit
- **C** **C**hart Ranges...
- **B** Setup Cali**b**ration
- ---
- **R** **R**un Details...
- **S** **S**ession Notes...
- **T** **T**rack Details...
- ---
- **O** C**o**py Setup to Run...
- **N** Make **N**ew Setup...
- **M** Run **M**arkers...
- ---
- Delete Run

D **D**isplay
- **C** **C**hart...
- **O** C**o**mpare Chart...
- **Q** **Q**uick Chart **F3**
- **U** Q**u**ick Compare **F4**

O **O**ptions
- **C** **C**alculate... **F5**

H **H**elp
- **I** **I**ndex
- **A** **A**bout

Hot key functions summary

F1	Context sensitive Help	**Alt+F1**	General Help
F2	Download - Erase & Display	**F3**	Quick Chart
F4	Quick Compare	**F5**	Calculate Data
F10	Exit Menu	**Esc**	Cancel Selection
		Alt+M	Change Colour scheme

CHART800 Key Summary

F1 Help		**Alt+A**	Align runs
F2 Alt+C Select Chart		**Alt+G ~**	Change graph line type
F3 Alt+L Select Current Lap		**Alt+H #**	Change grid type
Ctrl-F3 Select Current Run		**Alt+M**	Change colour scheme
F4 Alt+O Select Reference Lap		**Alt+R /**	Toggle current/ref. display
Ctrl-F4 Select Reference Run		**Tab**	Select Channel
F5 Alt+S Display Statistics		**F10**	Exit

Cursor movement keys

←/→	Cursor Left/Right
Ctrl+**←/→**	Cursor Jump Left/Right
(Shift)+**←/→**	Highlight Left/Right
(Shift)+**Ctrl**+**←/→**	Highlight Jump Left/Right
(Up Arrow)	Zoom in
(Down Arrow)	Zoom out
Home/End	Scroll Half Screen Left/Right
Ctrl+Home/End	Scroll Full Screen Left/Right
, Alt+J / . Alt+K	Scroll Lap Left / Right
< Alt+U / > Alt+I	Superimpose Lap Left / Right
[Alt+D /] Alt+F	Cursor Start / End of Lap

Mouse Buttons:

Left Mouse Button	Move/Select
Centre Mouse Button	Select Lap (Three button mouse Only)
Right Mouse Button	Zoom In/Out

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