STACK
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ST8100 Display System

Users Guide

Preface

Congratulations

Congratulations on choosing the Stack ST8100 Display System. This system will give you a wealth of information to enable you to obtain the maximum safe performance from your vehicle.

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.

Purpose of this manual

This manual will help you install and use the Stack ST8100 Display System. It explains how to set up and configure the system for your vehicle.

Edition Notice

This edition is for all versions of the ST8100 Display System distributed to customers worldwide. The units of measurement used to illustrate the use of the Display System in this edition are for the UK version. Units used in the various versions are shown in the following table.

Parameter Type	UK Version	US Version	EC Version
Speed	MPH	MPH	km/h
Temperature	Degrees C	Degrees F	Degrees C
Wheel Circumference	Millimetres	Inches	Millimetres
Pressure	PSI	PSI	Bar

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- Intelligent Tachometers
- Boost Gauges
- Analogue Sensors
- Digital Sensors
- Data Logging Systems
- Display and Logging Systems
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- Display and Analysis Software
- Video Overlay Systems

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Contents

Chapter 1. Introducing the Display System

The Stack ST8100 Display System monitors and displays a range of values, known as performance parameters, needed for effective car and driver management in most competitive situations.

The system combines an analogue tachometer with a digital display for the following performance parameters:

- Engine speed (RPM)
- Oil pressure
- Oil temperature
- Water temperature
- Fuel pressure
- Battery voltage
- Lateral acceleration (optional). This option is used only in conjunction with the optional logging system. The information from it is not displayed on the Display Module.
- Predictive Lap Timer display (optional)
- Maximum and Minimum Corner Speeds display(optional)

- Wheel speed (optional)
- Lap times up to 45 minutes
- Lap Time Memory (optional)

You can view the peak values (tell-tales) for all the parameters.

The system provides a range of warning messages based on preset alarm values for the following performance parameters:

- Oil pressure
- Oil temperature
- Water temperature

- Fuel pressure
- Battery voltage

You can enable or disable the warning system for each parameter individually.

You can redefine the preset alarm value for each parameter to a value that is more suitable for your vehicle.

The system provides a gearshift warning light that illuminates above a RPM value that you define for your vehicle.

How to use this Manual

Stack recommends that you unpack and connect the components in the system **before** you install it in your vehicle. This will enable you to familiarise yourself with operating the display and configuring it for the vehicle in which you intend to install it.

This manual starts by taking you through the process of setting up the system before installation, operating the digital display, configuring the system and setting the alarm values and installing it in the vehicle. By the end of Chapter 2 you will have set up the system so that you will be assured that it is functioning normally. You can then read Chapter 3 and practice using its functions. Chapter 4 takes you through configuring it for your vehicle, Chapter 5 explains how to install it in the vehicle and Chapter 6 provides a set of trouble-shooting guidelines.

A template for the Display Module dashboard cut-out is provided in Appendix A and a schematic diagram of the wiring harness is in Appendix B.

Please note that this manual does not attempt to explain how to interpret or use the information from the ST8100 Display System as this is very specific to the type of vehicle in which it is installed and the type of competition in which the vehicle is engaged.
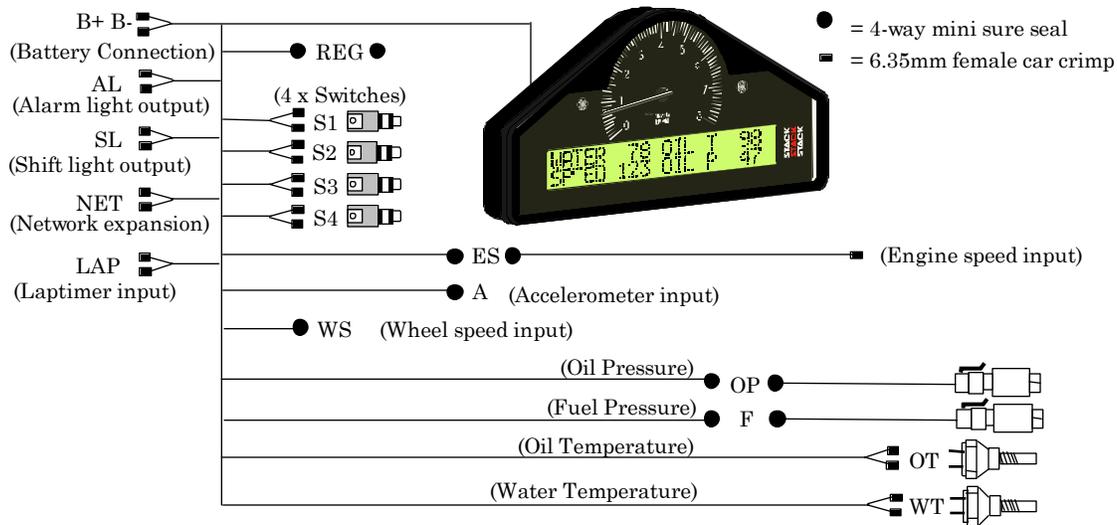
Chapter 2. Getting Started

This chapter guides you through the initial unpacking and setting-up of the equipment for pre-installation checks and familiarisation with its operation.

Standard ST8100 Display System Items

The ST8100 Display System is supplied with the following standard components:

Quantity	Description
1	Display Module (ST867) with 2 mounting brackets
1	Wiring Harness (ST872-**006**)
2	Pressure Sensors (ST747 + thread adapters)
2	Temperature Sensors (ST760, ST761, ST762 or ST764)
4	Switches (ST514)

Optional ST8100 Display System Items

The ST8100 Display System can be used with the following optional components:

Quantity	Description
1	RPM Sensor (ST696 Opto Isolator or ST697 H.T. Pick-up)
1	Wheel Speed Sensor (ST670)
1	Lateral G-force Sensor (ST791)
1	Infra-red Lap Time Receiver (ST543)
1	Infra-red Lap Time Beacon (ST544)
1	External Gear Shift Warning Lamp (ST534, ST537)
1	External Alarm Warning Lamp (ST533, ST536)
1	"Max" Option This includes the Predictive Lap Timer, Corner Speed and Lap Time Memory displays pre-fitted in the Display Module.

The Display Module

The Display Module consists of an analogue tachometer and a digital display panel.
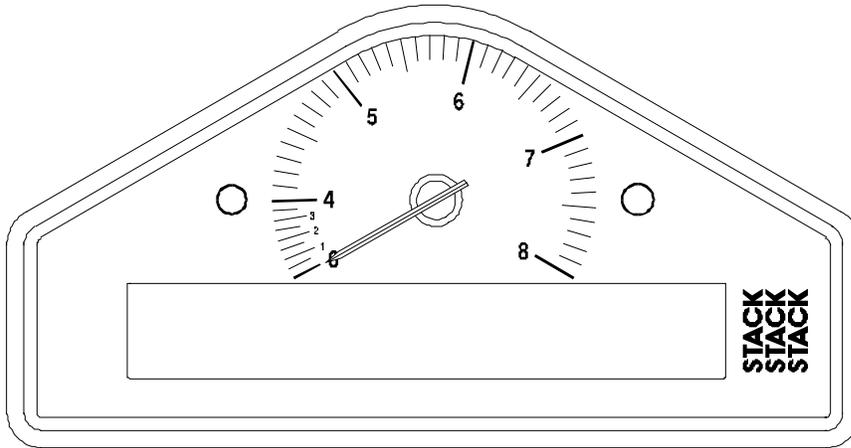
The Display Module is connected to a variety of sensors by a wiring harness. The wiring harness has a 19-way military connector for connection to the Display Module.

Wiring Harness

Each of the wires in the harness is labelled.

Labels on short cables	Connection To
REG	5 volt regulator stub
S1 to S4	Switches 1 to 4
WS	Wheel speed sensor
LAP	Lap timing sensor
SL	Gear shift warning light
AL	Alarm warning light
NET	Data logging expansion pack
ECU (Not normally fitted)	Allows specially configured systems to communicate with engine control units.

Labels on Long Cables:	Connection To
ES	Engine Speed (RPM)
OT	Oil temperature sensor
WT	Water temperature sensor
OP	Oil pressure sensor
F	Fuel pressure sensor
A	Accelerometer sensor
B +	Battery Positive
B -	Battery Negative (Earth)

Connecting the Components

1.   Connect the wiring harness to the Display Module.

2.   Connect the four switches to the cables labelled S1 to S4.

3.   Connect each of the sensors that you have purchased to the appropriate wire in the wiring harness, as shown above.

4.   Connect a 12v DC power supply to the power input cable.

5.   Switch on the 12v DC power supply.

The Display Module should start up with an alarm signal indicating low oil pressure.
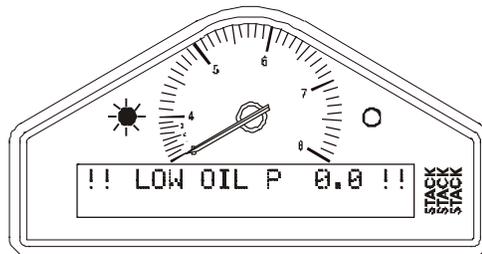
This is normal in this environment.

You can now proceed to familiarise yourself with operating the Display Module

Chapter 3. Operating the Display System

This chapter takes you through the operation of the system so that you can familiarise yourself with its use before you install it in the vehicle.

Switching the Display System on

You will have switched the system on already if you have followed the instructions in the previous chapter and have just set the system up for the first time before installing it.

When installed in the vehicle, the system is switched on when you switch the ignition on.

When the power is first switched on, the digital display will immediately show a "Low Oil P" warning and the alarm light will come on. The tachometer will reset itself by moving the needle until it touches the stop-pin and then moving it back to the zero RPM position. Press Switch 2 or Switch 3 to clear the warning message from the display.

The digital display panel and the analogue dial face are always backlit when the system is switched on.

If none of these actions occurs when you switch on, switch off the power to the system and consult the section on troubleshooting in this manual.

Changing the display layers

The digital display can show separate sets of parameters and their values on the various display layers.

Each of the display layers can be displayed in turn by pressing Switch 3. Press Switch 3 when the last display layer is being displayed in order to return to the first display layer. The Display System will remember which display layer was showing when the unit was switched off and will redisplay that layer at power-up.

The format of the values in these displays will vary for systems supplied outside the UK because the parameters are displayed in different units.

Display Layer 1
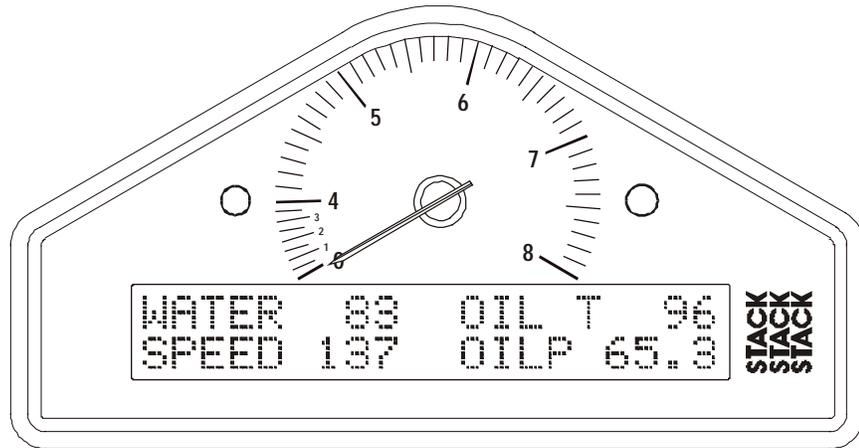
Display layer 1 shows:

- Water Temperature (WATER)

- Oil temperature (OIL T)

- Current speed (SPEED).

- Oil Pressure (OILP)

Press Switch 3 to see display layer 2.

Display Layer 2

Display layer 2 shows:

- Battery voltage (BATT)

- Oil Temperature (OIL T)

- Fuel Pressure (FUELP)

- Oil Pressure (OILP)

Press Switch 3 to change display to layer 3.

Display Layer 3
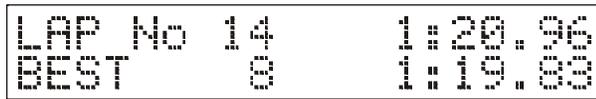
```
LAP No 14      1:20.96
BEST     8     1:19.83
```

Display layer 3 shows:

- Lap number of the last completed lap

- Lap time for the last completed lap

- Lap number of the fastest lap

- Fastest lap time (BEST)

Press Switch 3 to display layer 4.

Display Layer 4

```
 1:19.83 47.8  18.07
--           >■■■■I        +
```

Display layer 4 shows:

- Fastest lap time

- Running time from the start of the current lap

The following two features are only active if the Predictive Lap Timer has been purchased:

- Predicted time for the current lap based on the difference in time taken to reach the same position on the fastest lap.

- A graphical comparison of this lap to the fastest lap. '+' means the vehicle is going faster than the fastest lap and '–' means it is going slower.

Press Switch 3 to change the display either back to layer 1 or on to layer 5 if you have the Corner Speed option.

Display Layer 5 (optional)

This display is available when the optional Corner Speed feature is installed.

```
SPEED 117  MAX    129
HOLD   86  MIN     73
```

Display layer 5 shows:

- Current speed (SPEED)

- Speed at the moment when Switch 1 was last pressed (HOLD)

- Highest speed attained on the previous straight (MAX)

- Lowest speed attained in the previous corner (MIN)

Press Switch 3 to display layer 1 again.

Peak Values (Tell Tales)

The system can display the peak values (sometimes called 'tell-tales') that have been recorded during a run for all the monitored parameters.

Peak values are updated only when the engine speed has exceeded its 'gate value' for RPM *for at least one second*. This allows the values to stabilise. Blipping the engine may not be enough to update the peak values. The gate value is a predefined RPM value that is used to control when the system updates the peak values. This is to prevent abnormal peak values from being recorded when, for example, the engine is either not running, is idling or is being warmed up.

The system stores either a maximum or a minimum value as the peak value, depending on the parameter, as follows:

Parameter	Type of Peak Value	Gated to RPM
Engine Speed (RPM)	Maximum	Yes
Oil Temperature	Maximum	Yes
Water Temperature	Maximum	Yes
Oil Pressure	Minimum	Yes
Fuel Pressure	Minimum	Yes
Battery Voltage	Minimum	Yes
Wheel Speed	Maximum	Yes

Displaying the Peak Values

Press and hold Switch 1 to show the peak values for the parameters currently being displayed. Release the switch to return to the normal display.

```
WATER 115   OIL T 124
SPEED 147   OIL P  45
```

Resetting the Peak Values

You can reset all of the peak values, except the fastest lap time, manually. All peak values are reset at the same time. If the engine is running **at** or **above** its gate value when the peak values are reset, they are set to the current value of each performance parameter.

To reset the peak values:

- Press and hold Switch 1 to display the peak values.

- While holding Switch 1, press and hold Switch 3.

- With Switch 3 held down, you will see the display revert to the current values. The new peak values that are stored are those being displayed when you release Switch 3.

If the engine is running **below** its gate value, the peak values are not reset to the current values but are set to the following values:

Parameter	New Peak Value
Engine RPM	0 RPM
Wheel speed	0 MPH or 0 km/h
Oil Pressure	999.9 PSI or 99.99 bar
Fuel Pressure	99.99 PSI or 99.99 bar
Oil Temperature	0°C or 0°F
Water Temperature	0°C or 0°F
Battery Voltage	26.0V

Peak Value Memory

The peak values are stored in a memory that is powered by an internal back-up battery. They remain stored in this memory when the external power source is disconnected from the system. The system needs to be returned to Stack every 4-5 years for the internal battery to be changed. An alarm is triggered when the power from this battery drops below a safe level and the warning "MEM BATT" is displayed.

Alarms

The Display System has built-in warnings to alert the driver when certain parameters either exceed or fall below their alarm values. For example, a warning is signalled if the fuel pressure falls below its alarm value or if the oil temperature rises above its alarm value. You can adjust the preset alarm levels when you configure the Display System. See Chapter 4, *Configuring the Display System* in this manual.

Some of the warnings (see the following table) are triggered only while the engine speed exceeds its "gate value" for RPM *for at least one second.* Blipping the engine should not be enough to trigger a warning. The gate value is a predefined RPM value that is used to control when the system is to trigger a warning. This is to prevent abnormal warnings from being triggered when, for example, the engine is either not running, is idling or is being warmed up.

(The oil pressure alarm will come on at power-up until the engine is started and the pressure exceeds the threshold set for its alarm.)

The Display System has the following built-in alarms:

Parameter	Alarm is triggered when the:	Gated to RPM
Oil Temperature	current value exceeds the preset value	Yes
Water Temperature	current value exceeds the preset value	Yes
Oil Pressure	current value drops below the preset value	No
Fuel Pressure	current value drops below the preset value	Yes
Battery Voltage	current value drops below the preset value	No

Displaying an Alarm

When an alarm condition occurs, the built-in amber warning light turns on and the digital display gives a warning message to show the type and value of the alarm.

If you purchased the optional External Alarm Warning Lamp, that lamp will illuminate at the same time.
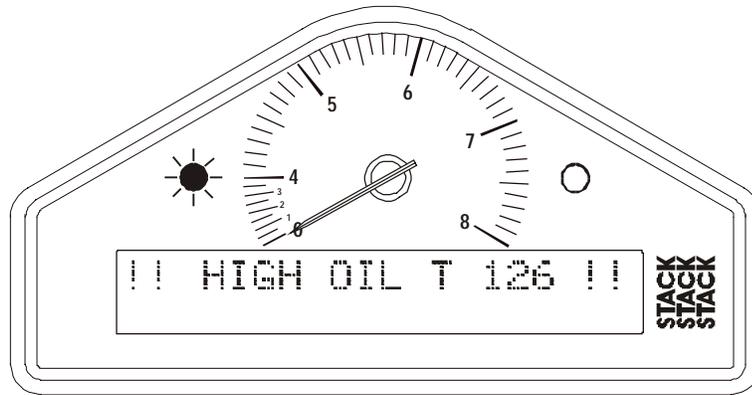
Clearing an Alarm

Press Switch 2 or Switch 3 while the alarm is being displayed.

Showing the Last Alarm

Press and hold Switch 2.

Lap times

The lap time is displayed for a preset time either when triggered by the infra-red lap time sensor passing the lap time beacon or when the driver presses Switch 4.

You can adjust the preset display time when you configure the Display System. See Chapter 4, *Configuring the Display System* in this manual.

```
LAP   1:20.96
```

The most recent lap time is held in display layer 3. Press Switch 3 to see this display layer. This display gives you the lap number and time of the last recorded lap.

```
LAP No 14      1:20.96
BEST     8     1:19.83
```

Resetting the Lap Time to Zero

Press and hold Switch 1 and then press Switch 4 to reset the lap count and lap times to zero.

```
LAP No   0     0:00.00
BEST     0     0:00.00
```

Gear shift light

The gear shift light comes on when the engine RPM exceeds a predefined value. See Chapter 4, *Configuring the Display System* for information about setting this value.

If you purchased the optional External Gear Shift Lamp, that lamp will illuminate at the same time.
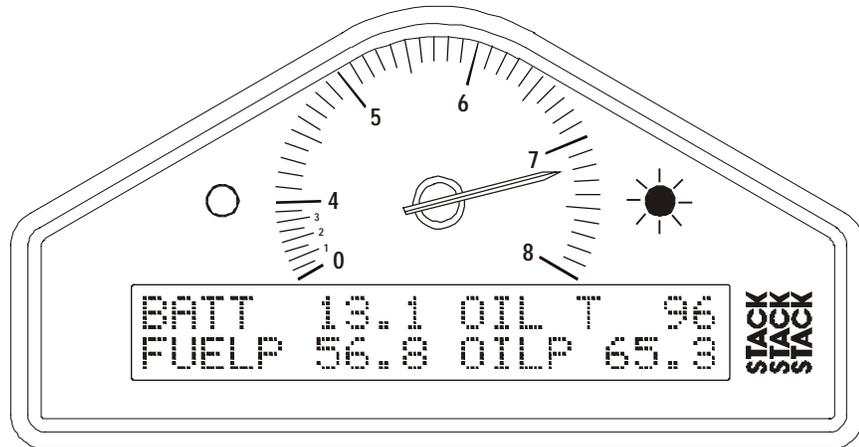
Lap Time Memory (optional)

Press Switch 2 to access the Lap Time Memory.

On entering the Lap Time Memory, the display shows the most recent lap.

The bottom line shows the lap number and the time for that lap.

The top line shows the difference between the displayed lap and the fastest lap time. When displaying the fastest lap, the difference will be displayed as '✳00.00'.

Press Switch 1 to scroll backwards through the laps and Switch 2 to scroll forwards. Press Switch 3 to quit the Lap Time Memory and show the normal display.

Chapter 4. Configuring the Display System

System Configuration Mode

You put the Display System into System Configuration Mode by pressing Switches 1 and 2 together. You then work through the configurable parameters in a preset sequence, pressing Switch 3 to display the next configurable parameter.

Setting or resetting configuration values

Use Switch 1 to decrease the value being configured and Switch 2 to increase it. The rate at which the value increases or decreases accelerates while the switch is being held down. Examples of the displays for each of the configuration items are shown below.

Wheel circumference:

```
EDIT SCALE
Wheel Circ   1000 mm
```

Set the value for the wheel circumference in the units of measurement indicated.

Wheel speed pulses:

```
W.S. Pulses/Rev   10
```

Set the value to the number of ferrous targets that the wheel sensor is to count for each wheel revolution.

Engine speed cylinders:

```
E.S. Cylinders    4
```

Set the number of cylinders for the engine (for RPM).

Gate RPM:

```
EDIT TEST
Gate RPM    3000   on
```

Set the RPM above which peak values are stored and the Fuel Pressure, Oil Temperature and Water Temperature warnings operate.

Logging RPM:

```
EDIT TEST
Log RPM     3000   on
```

Set the RPM at which the logging option is started.

Shift RPM:

```
EDIT TEST
Shift RPM   7000   on
```

Set the RPM at which the gear shift light is to come on.

High water temperature:

```
EDIT TEST
High WaterT 105   on
```

Set the value above which the water temperature alarm will occur.

High oil temperature:

```
EDIT TEST
High Oil T  130   on
```

Set the value above which the oil temperature alarm will occur.

Low fuel pressure:

```
EDIT TEST
Low Fuel P 10.0   on
```

Set the value below which the fuel pressure alarm will occur.

Low oil pressure:

```
EDIT TEST
Low Oil P  35.0   on
```

Set the value below which the oil pressure alarm will occur.

Low battery voltage:

```
EDIT TEST
Low Batt    10.0   on
```

Set the value below which the battery voltage alarm will occur.

Lap time pop-up:

```
EDIT POPUP
Lap Time    8.0   on
```

Set the time in seconds for which the Lap Time pop-up will be displayed when the vehicle passes the lap time beacon.

Optional Parameters

The following parameters are only available if the Predictive Lap Time option is installed:

Predictive lap time bar width:

```
EDIT SCALE
Bar Width    0.45 s
```

Sets the width of the timeline bar either side of the centre. The normal setting is 0.45s which means that time differences of up to 0.45s can be shown. If larger differences need to be displayed, increase this number. If smaller differences are normally used, this setting can be reduced to provide a larger movement of the display.

Predictive lap time acceleration limit:

```
EDIT VALUE
Accel Limit  10.00G
```

Sets the maximum allowable acceleration in units of G. In order to reduce the effects of wheel-spin this setting determines the maximum allowable acceleration of the wheel. If fitted to a non-driven wheel this can be left at the default value of 10G where it will have no affect, otherwise it should be set to a suitable value. In the wet this setting may need to be reduced.

Predictive lap time deceleration limit:

```
EDIT VALUE
Decel Limit  10.00G
```

Sets the maximum allowable deceleration in units of G. In order to reduce the effects of wheel lock-up, this setting determines the maximum allowable braking deceleration of the wheel. This should be set to an appropriate value and reduced in wet conditions to ensure accuracy of the predicted lap time.

Switching Alarms on or off

You can enable (switch on) or disable (switch off) each of the alarm warnings by pressing and holding Switch 1 and then pressing Switch 2.

Note that you might change the preset value of the parameter slightly while pressing both switches. This does not matter if you are switching the alarm warning off and, if necessary, you can correct the preset value after you switch it on again.

Leaving configuration mode

When you wish to return to the normal display, press Switch 4.

Chapter 5. Installing the Display System

Who can install the Display System?

The Display System can be installed by anyone competent in fitting electrical and mechanical accessories to cars.

Tools needed to install the Display System

No special tools other than normal workshop tools are needed.

Preconfigured Display Systems

Use the instructions in the previous chapters to set up, operate and configure the ST8100 before installing it in the vehicle.

Custom Configured Display Systems

If you have purchased a Display System that has been custom configured for you, the system may include components not described in this book. Refer to the additional instructions supplied with the system for such components.

This manual may refer to components not included in the system and you should ignore these.

Fitting the Display Module

The Display Module is fitted into a cut-out in the instrument panel/dashboard and secured using the two U-brackets at the rear. The dimensions for the cut-out are shown below. A full size template can be found in Appendix A.

97mm
(3.82 in.)

42.5mm (1.67 in)
Rad. Typ.

5.5mm (0.22 in)
Rad. Typ.

54.5mm
(2.15 in.)

37.5mm
(1.48 in.)

95mm (3.74 in.)

89.5mm (3.52 in.)

5.5mm
(0.22 in.)

190mm (7.48 in.)
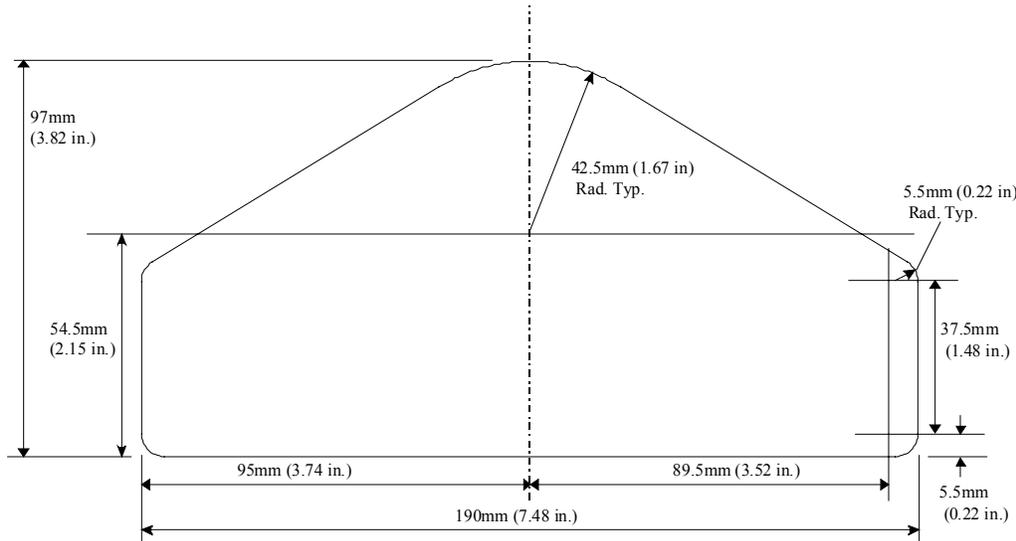
Positioning the Display Module

Ensure that there is sufficient space behind the cut-out to allow the wiring harness to be connected to the 19-way connector without any tight bends to the wiring near the connector.

The Display Module must be positioned on the dashboard so that the driver can see it, either over the steering wheel or through it.

The Display Module should be aligned so that the driver looks at it square or from slightly above or below.

Switches

The four switches are used to control the functions of the Display System.

The normal functions of the four switches are:

Switch	Functions
Switch 1	1. Show Peak Values 2. Freeze speed on "HOLD" display (optional Corner Speed feature only)
Switch 2	1. Show Last Alarm or Enter Lap Time Memory mode (optional) 2. Clear Alarm
Switch 3	1. Change Display Layer 2. Clear Alarm
Switch 4	Manual Lap Marker

You can install the switches in any convenient location. When installing the switches, you should take account of the following considerations:

- The cable for each switch is approximately 400mm in length from the 19-way military connector.

- It is important that the driver is able to reach Switch 3 easily in order to change the display layer and clear warning messages after alarms. This switch is normally fitted on the steering wheel.

- If the driver is also going to enter lap markers manually, Switch 4 should ideally be fitted on the steering wheel.

- When you configure the system, you use Switches 1 to 4 for selecting the parameters and setting their values. These switches should be installed so that you can reach them easily when you are viewing the digital display.

Warning lights

The Display Module has two built-in warning lights. One of these is for
the gear shift light and the other for warning the driver that an alarm
has been triggered.

As an option, you can install additional external warning lights for these
functions. External warning lights should be installed in any position
that is in the driver's direct line of vision as they need to be visible at all
times.

Stack can supply suitable external warning lights for installation in the
dashboard as well as shrouded versions that can be mounted on top of the
dashboard.

*If you are using your own warning lights, ensure that the bulb rating does
not exceed 2 Watts; otherwise the Display Module 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 from the connector labelled
ES connects the Display System to the ignition system or low-tension
side of the coil.

Connecting the Display System to the Ignition System

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

Ignition System	Connection Point
Coil and Points	Coil negative (low tension)
HEI Systems	Coil negative (low tension)
ECU	Tachometer output
Magneto	Use HT pick-up (ST697)

The following connections are shown in greater detail:
- Standard contact breaker system
- Series resistor connection
- ECU Connection (+ Pull-up resistor)

Standard contact breaker system

Connect the ES (Engine Speed) wire to the negative terminal on the coilSeries Resistor Connection
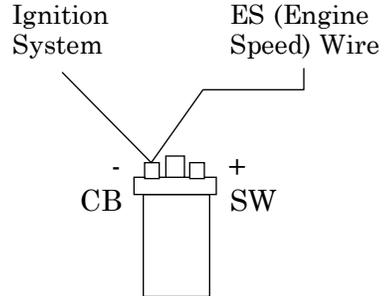
For systems which require series resistor on the ES (Engine Speed Wire) the resistor must be connected directly to the terminal to limit interference from the high tension leads (which must be the screened type).
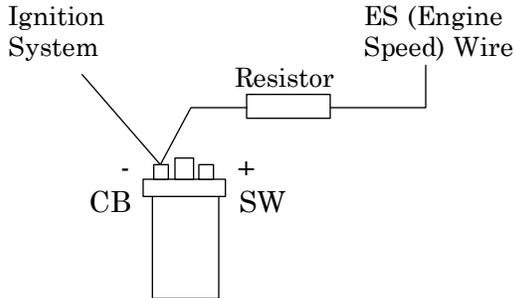
Electronic Ignition or ECU ConnectionPressure sensors

Connect the ES (Engine Speed) wire directly to the "Tacho" output of the electronic ignition or ECU.   If this results in a Zero RPM reading then …Some ECU's (MoTeC M800) require a Pull-up resistor connected between the ES wire & +12v (battery positive). Resistor values between 470 & 4700 Ohms are required.
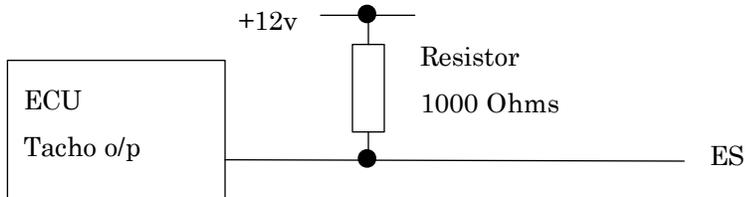
Fitting the pressure sensors

The Display System is supplied with two Stack ST747 10 bar (145 psi) pressure sensors to measure Oil Pressure and Fuel Pressure.

Optional adapters may be supplied to match the pressure ports of different types of engines:

Country Code	Thread Size
EC	M10 x 1
UK / US	1/8th NPTF
Option	1/8th BSPT

If you find that you have a sensor with an incorrect thread, please contact your Stack branch or distributor for advice.

Installing the pressure sensors

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

- Each 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.

- Do not screw the sensor directly into the engine block, as excessive vibration from some racing engines can affect the long-term life of the sensor.

- Do not over-tighten the sensor.

Temperature sensors

The Display System is supplied with two each of one of the following standard types of temperature sensor: Stack ST762 or ST764. There are two other types of optional sensor: Stack ST760 or ST761:
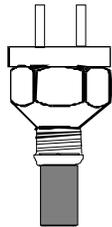
The ST760 temperature sensor has two terminals and a 1/8" BSP taper thread.

The ST761 sensor has a M14 x 1.5 thread.

The ST762 sensor has a M10 x 1 thread (EC versions).

The ST764 sensor has a 1/8" NPTF thread (UK and US version)

Each type of sensor can be used for monitoring oil temperature and water temperature.

If you find that you have a sensor with an incorrect thread, please contact your Stack branch or distributor for advice.

Fitting the temperature sensors

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

- Mount each 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.

Wheel speed sensor (optional)

The Display System may be supplied with one Stack ST670 proximity sensor as an optional feature. This sensor is used to measure wheel speed in order to display the vehicle's speed in MPH or km/h. 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.

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

- Avoid mounting the sensor too close to a 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 1.5±0.5mm (60±20thou). Make sure that no other objects pass within 4mm ($^3/_{16}$") of the end of the sensor while the wheel rotates.

- Once 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.

Lap timing sensor (optional)

The ST543 lap timing sensor is actuated by an infra-red beacon positioned at the side of the track. 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.
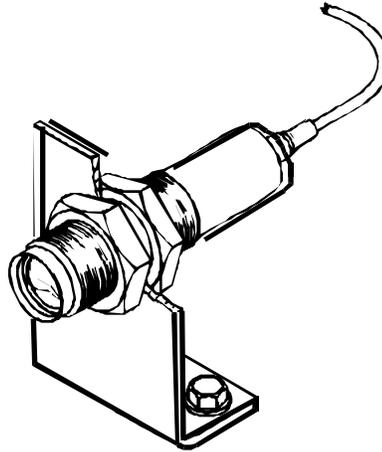
- It is secured by two nuts with M18 x 1mm threads.
- This sensor must be positioned horizontally and square to the axis of the vehicle.
- In order to detect the signals from the beacon, it must be situated outside the vehicle.
- It should, if possible, be positioned so that other vehicles that are being overtaken (or are overtaking) at the moment your vehicle passes the beacon do not block the signal.

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 has a threaded socket on its base for mounting to a standard photographic tripod. It 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 2 and 30 metres (6 to 95ft) from the vehicle when the vehicle passes it.

- Avoid positioning it so that the sun is directly behind it when it is being used.

- 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 peak over the beacon. Do not cover the beacon, for example using a plastic bag.
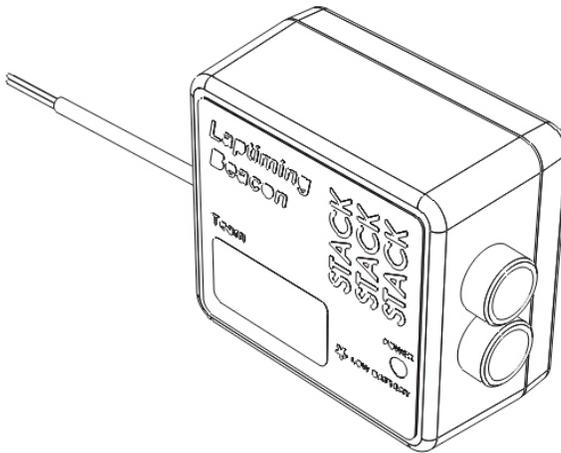
Power supply to Trackside beacon

The beacon operates from a 12-volt DC supply. A sealed lead-acid battery with a minimum rating of 2.5 Amp/hour is recommended. This will provide about 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:

Green   The voltage is, at present, adequate for use

Red   The voltage is too low (replace or charge the battery).

No Colour   Battery is exhausted or disconnected.

Accelerometer (optional)

The ST791 sensor should be mounted on a low vibration surface i.e. a surface with no obvious resonance. It is best to mount the sensor near to supporting ribs at the edge of body panels as opposed to the (unsupported) centre of the panel. For vehicles with extremely high vibration levels, e.g. Karts and Drag Racers, it may be necessary to enclose the sensor in 25mm (1") thick soft foam to obtain a 'Clean' signal.

The Stack label indicates the direction of the G force to be measured so that a left turn will generate positive G and a right turn will generate negative G.

An alignment error of 8 degrees will cause an approximate 10% error in the indicated G reading.

Sensor attachment

The sensor should be fitted to a suitable flat surface. Recommended methods of attachment are double-sided adhesive strip or adhesive foam pads. Note: Fabric Velcro™ is a suitable fixing material but Dual-Lock™, as supplied with Stack expansion systems, is NOT recommended.
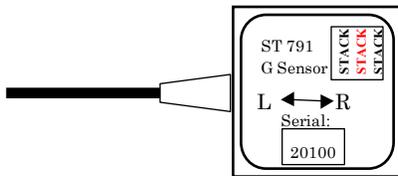
IMPORTANT

Mount the sensor with the Left side facing the Left side of the vehicle (as viewed from the driving seat) to measure lateral G forces.

Wiring harness

The Display Module and the sensors, switches and external lights for your Display System are connected together by means of the wiring harness supplied with the system.

The wiring harness can be fitted after the Display Module and all the sensors and switches have been installed.

This harness has been designed so that the various branches are long enough for most single seater and saloon cars. Occasionally an individual branch may need to be extended or significantly shortened. If the standard harness is totally unsuitable for your vehicle, contact Stack for details of custom harnesses. Provided that you have chosen suitable locations for the switches, sensors and any external warning lights that you are installing, you should not need to extend any of the individual wires in the harness.

Fitting the wiring harness

When fitting the harness on the vehicle, you should observe the following:

- Start by attaching the harness to the Display Module by connecting the 19-way military connector.

- First position the ends of all the wires at the locations of the sensors, lamps and switches to which each is to be connected, but do not connect them yet.

- All wires should be as far as possible and not less than 50mm from sources of electrical noise such as ignition HT leads, distributor caps etc.

- When you pass any wire through a bulkhead or dashboard, fit a cable gland into the hole so that the edge of the hole cannot chafe the wire.

- Particular care is needed when passing wires through holes in carbon fibre as the carbon can cut through cables very easily.

- The heatshrink sleeving around the sensor cables can be cut back, if necessary, to enable the sensor cables to go in separate directions earlier. It is recommended that you always leave at least 150mm

(6 inches) of heatshrink sleeving to provide additional strain relief for the cable where it enters the 19-way connector.

- Connect the wires when all the sensors are in position and you have secured the wiring harness.

Wiring labels

See Chapter 2 if you need to check the labels used to identify the individual cables in the wiring harness

Checks and Alarms

You should check the system to ensure that all the sensors are detecting the correct values. You should also run the engine up to its operational levels to check that the values displayed by the Display System are accurate. You should then check out the alarm systems to ensure that they are functioning correctly before going out on to the circuit.

Chapter 6. Troubleshooting

Symptom	Possible Cause	Remedy	Notes
Display is dead (no backlight, nothing on display, no green dial lights)	Ignition is off	Turn ignition on	The power lead is labelled **B+** & **B-**
	Battery is dead	Recharge or replace battery	The battery positive lead **B+** is 19w conn pin **G**.
	Power connection to **B+** or **B-** is faulty	Check if battery is connected correctly. Check power lead continuity	**B-** is 19w connector pin **H**.
Display is dead (no backlight, nothing on display, green dial lights on but dim) or !! LOW BATT !! warning on display	Battery is almost dead	Recharge or replace battery	
	Power connection to **B-** or **B+** is faulty	Check power lead continuity	
Display flashes and dial pointer resets or vibrates	Battery is almost dead	Recharge or replace battery	
	Power connection to **B-** or **B+** is faulty	Check power lead continuity	

Symptom	Possible Cause	Remedy	Notes
The !! LOW OIL P !! message does NOT appear on power up. The warning light is not turned on.	Pressure sensor has failed	Replace sensor	Swap with the fuel pressure sensor to confirm fault
	Sensor connections are faulty	Check for continuity on sensor lead.	A reading of 999 on the display indicates an open circuit connection (pin D to the red sensor lead and pin H to the black sensor lead)
	Oil pressure alarm disabled	Check that the oil pressure alarm is set on	
Display gives a fixed temperature reading of 999 C or 999 F	Temperature sensor has failed	Replace sensor	Disconnect sensor. If reading changes to 0, replace sensor. Otherwise check harness for short circuit
	Faulty sensor connections	Check continuity of sensor leads	
Display gives a fixed temperature reading of 0° C or 0° F when engine temperature is above 12° C or 55 ° F	A temperature sensor has failed	Replace sensor	Disconnect sensor and short its leads together. If the reading changes, replace the sensor.
	Faulty sensor connections	Check continuity of sensor leads for open circuits.	Check the wiring harness for open circuits (pin E to the red OT sensor wire, pin P to the red WT wire and pin H to both the black OT and WT sensor wires)

Symptom	Possible Cause	Remedy	Notes
Fixed pressure reading of 999.9 PSI or 99.99 Bar	Pressure sensor has failed	Replace sensor	
	Faulty sensor connections	Check continuity of sensor leads for open circuits	Pin D to the red OP wire, pin R to the red F wire and pin H to both the black OP and F sensor wires
Fixed pressure reading of -99.9 PSI or -9.99 Bar	Pressure sensor has failed	Replace sensor	Disconnect sensor. If reading changes to 999, replace sensor
	Faulty sensor connections	Check continuity of sensor leads for short circuits	Check the wiring harness for short circuit
Fixed pressure reading of 0.0 PSI or 0.00 Bar or suspected low/slow reading	Pressure sensor has failed	Replace sensor	Swap with the other pressure sensor to confirm fault
	Faulty sensor connections	Check pressure connections	Check plumbing for a blockage (kinks in flexible hoses)
All sensors show fixed high values	Switch 1 (Peaks) faulty	Replace switch	Disconnect switch. If values return to normal, replace switch.
	Faulty switch wiring	Check switch wiring	Check wiring for short between connector pins K and H (earth)
Displays pressure values too low and temperature values too high	Low Battery voltage	Recharge battery	The system does not give accurate readings when voltage is below 9.0V
Sensor reading incorrect	Another gauge connected to sensor	Disconnect other gauge	It is not permissible to connect a second gauge

Symptom	Possible Cause	Remedy	Notes
Peak values not updated	Gate value set too high	Change Gate RPM in the display configuration menu	Peak values only updated while the engine RPM is greater than the Gate value
	Internal memory battery dead	Return unit to Stack for new battery service	Display shows "!! MEM BATT !!" warning on power up
Switch 1: Show peak values does not work	Switch 1 faulty	Replace switch	Disconnect switch and short its leads. If display changes, replace Switch 1 Otherwise check wiring.
	Faulty switch wiring	Check switch wiring for correct continuity	Pin K to red S1 wire less than 1.0 Ohm and Pin K to Pin H (earth) greater than 1M Ohms)
Switch 2: Show last alarm function does not work	Switch 2 faulty	Replace switch	Disconnect switch and short its leads. If display changes, replace Switch 2 Otherwise check wiring.
	Faulty switch wiring	Check switch wiring for correct continuity.	Pin L to red S2 wire less than 1.0 Ohm and Pin L to Pin H (earth) greater than 1M Ohms)
Switch 3: Change display layer function does not work	Switch 3 faulty	Replace switch	Disconnect switch and short its leads. If display changes, replace Switch 3 Otherwise check wiring.
	Faulty switch wiring	Check switch wiring for correct continuity.	Pin U to orange S3 wire less than 1.0 Ohm and Pin U to Pin H (earth) greater than 1M Ohms)

Symptom	Possible Cause	Remedy	Notes
Switch 4: does not set or display pop-up lap times when no automatic receiver in use	Switch 4 faulty	Replace switch	Disconnect the switch and short the leads together. If the display changes replace Switch 4 Otherwise check wiring.
	Faulty switch wiring	Check switch wiring for correct continuity.	Pin U to yellow S4 wire less than 1.0 Ohm and Pin U to Pin H (earth) greater than 1M Ohms)
Lap time is not displayed automatically (Automatic receiver is fitted)	Lap marker receiver lead faulty	Check lap marker wiring	Disconnect receiver and press lap Switch 4. If display changes replace receiver after checking its wiring.
	Lap marker receiver faulty	Replace lap marker receiver	
External warning light dead when the display warning light is OK	Bulb has burnt out	Replace bulb	Swap with the other light to confirm burnt-out bulb. If not burnt out, check wiring.
	Faulty wiring to light	Check continuity of wiring.	Pin G to red AL wire less than 1.0 Ohm and Pin N to yellow AL wire greater than 1.0 Ohm)
External gear shift light dead	Bulb has burnt out	Replace bulb	Swap with the other light to confirm burnt-out bulb. If not, check wiring
	Faulty wiring to light	Check continuity of wiring:	Pin G to red SL wire less than 1.0 Ohm and Pin M to green SL wire greater than 1.0 Ohm

Symptom	Possible Cause	Remedy	Notes
Display values and messages unclear or unreadable (poor contrast)	Display too hot or too cold	Ensure that the display is operated within the specified temperature range	Operating temperature is −20°C (+5°F) to +70°C (+160°F)
	ECU interface shorted. Not normally fitted	Check the two core screen ECU wires for short circuits	ECU wire is 300mm inside the main sensor leads sleeve. Make sure that none of the wire ends are shorted
No RPM speed reading	Incorrect wiring	Check the connection of the engine speed wire to the ignition system (or sensor, if used)	See instructions supplied in this manual. If connected directly to the coil, check that it is to the switched low tension side (usually the negative side).
Displayed RPM value too high or too low by a constant %-age amount.	System configured with wrong number of engine cylinders.	Reconfigure system to correct number of cylinders.	Ignition systems may either: a) produce "waste" sparks giving double the number of cylinders per revolution b) use multiple coils where each additional coil gives proportionately fewer pulses per revolution.
	Ignition system pulses per revolution not same as number of cylinders	Reconfigure system to correct number of pulses per revolution.	
Tachometer reading erratic, pointer jumps high or low	Incorrect wiring	Reconnect the tachometer as specified in this manual	
	Signal from ignition system or coil is noisy	Condition the ES signal by placing a resistor in line with the ES wire	Resistor values (1/2W 5% 350v) 10K ohms for dedicated tacho output; 47K ohms for coil connection (non-CDI); 100K ohms for CDI connection.

Symptom	Possible Cause	Remedy	Notes
Displayed speed value too high or too low by a constant %-age amount.	System configured with wrong number of targets per wheel revolution	Reconfigure the system with correct values	
	System configured with wrong wheel circumference.		Typical wheel circumference for a car is 1800mm / 70" or 900mm / 35" for a kart
No speed reading Speed reading erratic, value jumps high or low	Faulty sensor and/or wiring	Check sensor indicator for correct operation	Rotate the wheel by hand and check that the sensor indicator lights up as each target passes the sensor
	Incorrect sensor gap (too far apart or too close)	Check that the gap is approximately 1mm	
	Sensor and targets moving apart	Fabricate a more rigid sensor bracket	
Speed reading dies after a short time	Ambient temperature too high	Shield the sensor from radiated heat from brakes and bearings. Insulate sensor from conducted heat with fibre washers. Duct cooling air around the sensor	Maximum temperature for correct operation of the wheel speed sensor is +80°C (175°F)
No alarms for water, oil or fuel (temperatures and pressures) being displayed	All the alarms have been switched off	Switch on the required alarms	Alarms only operate when the engine is running at the RPM gate value or above it.
	The engine RPM gate value is set too high	Reset the RPM gate to a lower value.	

Symptom	Possible Cause	Remedy	Notes
Display and alarm light flash when the engine is running	Intermittent alarm caused by a parameter with its alarm level set too close to the normal operating value	Either change the value for the alarm or turn the alarm off	Press Switch 2 to see which sensor is causing the alarm.
Display works OK until engine starts then Display freezes or resets continuously. Display recovers once engine stopped.	Interference from Ignition system & HT Leads	Fit Suppressed (Silicon) HT Leads. Fit a suppression capacitor (2.2uF) between the coil (battery connection) & chassis	Use 'Helical' suppressed leads in extreme cases
	ST8100 wiring close to HT leads & or injector leads, or HT leads tied to isolated metal work to which ST8100 wiring is also tied.	Run ST8100 wiring away from HT leads & injector leads	Recommended Minimum spacing 75mm (3.0")

Appendix A. Template for the Display Module

Use the template on the following page for cutting out an aperture for the Display System.
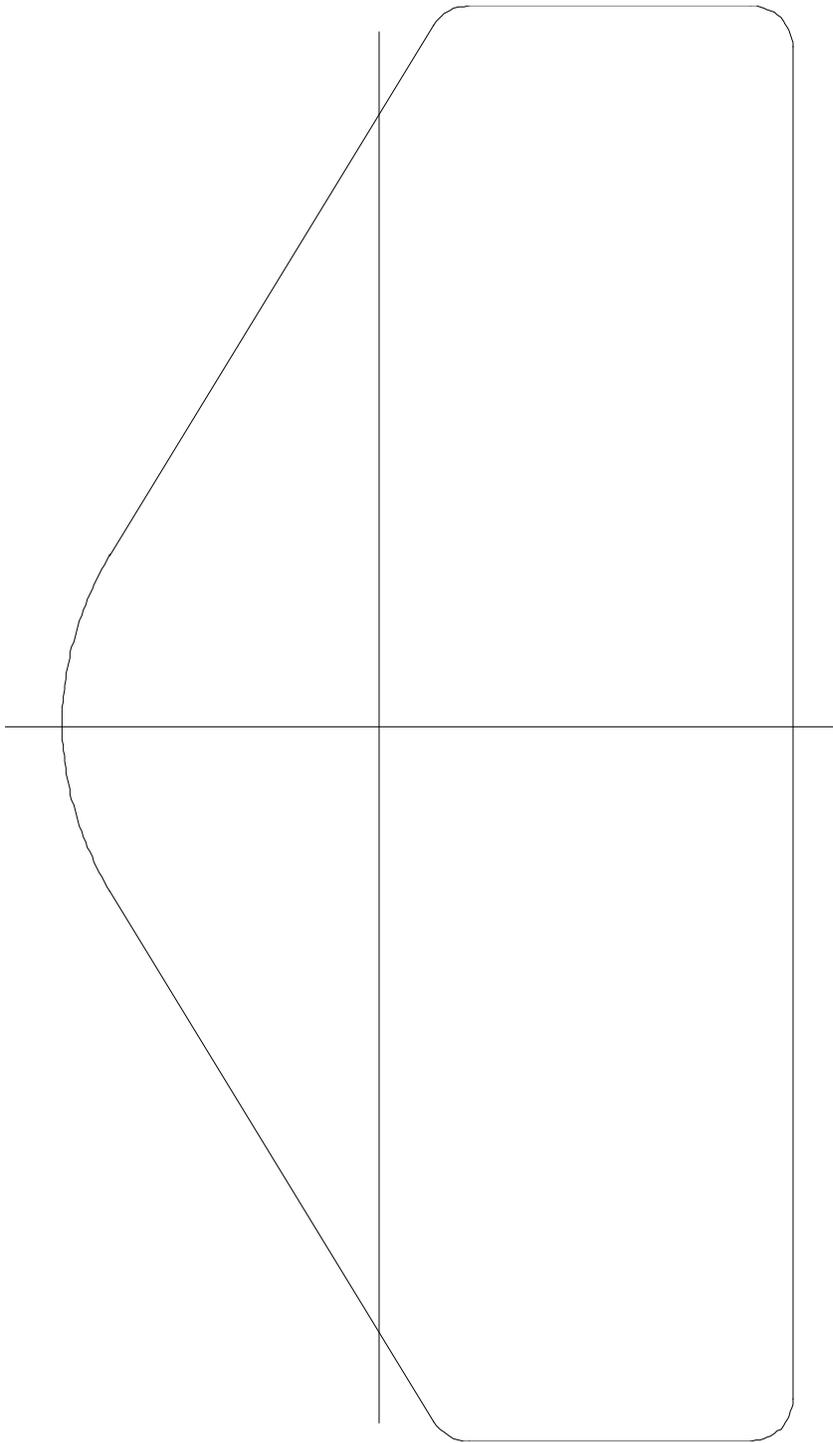
Appendix B. Wiring Harness Schematic Diagram
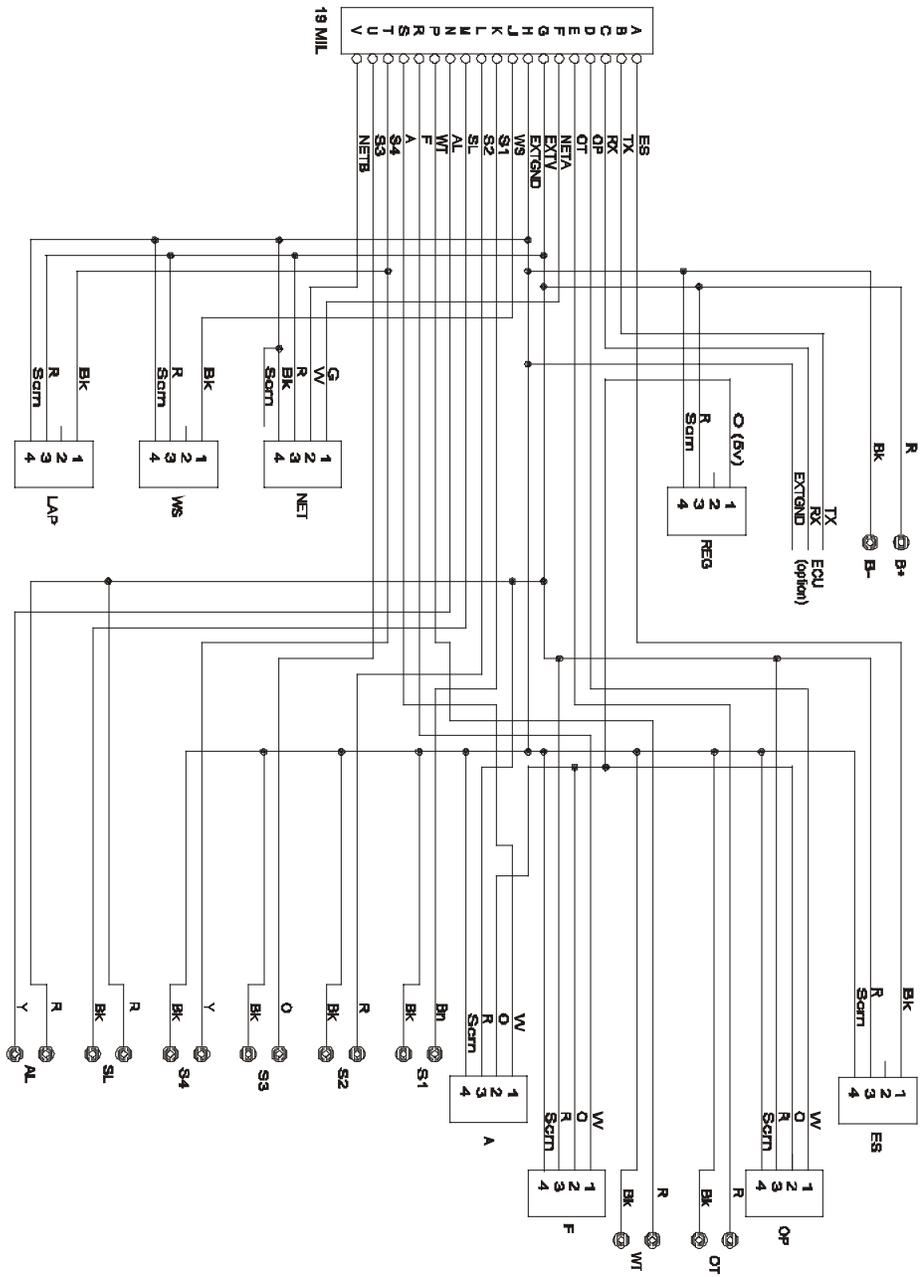
Returned Goods Form

In the unlikely event of a Stack part developing a fault and requiring repairs, you are kindly requested to send the part back to Stack Ltd with a completed Returned Goods Form. Returning a part without this form will lengthen the repair time and possibly increase the cost of the repair.

STACK STACK STACK

Company	_____	Customer	_____
Address	_____	(if different)	
	_____	Contact	_____
	_____		
	_____	Tel No.	_____
Contact	_____	Fax No.	_____
Tel No.	_____		
Fax No.	_____	Return Date	_____

Details of part being returned

Part No.   _____

Serial No.   _____

Description   _____

Other accessories included

(i.e. bracket, switches, etc.)_____

Details of Fault

Please complete as fully as possible. This will speed the repair and return of the parts.

Description of fault_____

_____

_____

Details of vehicle _____

Circumstances leading to fault _____

_____

Stack Ltd use only

Engineer _____Service No. _____ Date _____

Stack Ltd, Wedgwood Road, Bicester, Oxfordshire, OX26 4UL, England, Website: www.stackltd.com

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Email: sales@stackltd.com

Appendix D. Summary of Switch Functions

Normal Operation

Functions	Switch or Switches
Show Peak Values	Switch 1
Change Display Layer	Switch 3
Clear Alarm	Switch 2 or Switch 3
Show Last Alarm or Enter Lap Time Memory (optional)	Switch 2
Manual Lap Marker	Switch 4
Latch Corner Speed Display	Switch 1
Reset Peak Values	Switches 1 & 3 together
Reset lap count and lap time to zero	Switches 1 & 4 together
Enter System Configuration Mode	Switches 1 & 2 together

System Configuration Mode

Functions	Switch or Switches
Decrease the value of the parameter being displayed	Switch 1
Increase the value of the parameter being displayed	Switch 2
Enable or disable an alarm for the parameter being displayed	Switches 1 & 2 together
Display the next configurable parameter	Switch 3
Quit configuration mode and return to normal mode	Switch 4

Lap Time Memory Mode (optional)

Functions	Switch or Switches
Show Previous Lap Time	Switch 1
Show Next Lap Time	Switch 2
Quit Lap Time Memory	Switch 3

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