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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 world wide. 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.

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

## Related Products From Stack Limited

If you need information about other Stack motor sport 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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Tel: 018 312-866 Fax: (3) 794-9959
- 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  
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- 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.  
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**Prodrive Ltd**, Acorn Way, Banbury, Oxon, OX16 7XS.  
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## **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 analog tachometer with a digital display for the following performance parameters:

1. Engine speed (RPM)
2. Oil pressure
3. Oil temperature
4. Water temperature
5. Fuel pressure
6. Battery Voltage
7. Wheel speed (optional)
8. Lap times (optional)
9. 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.
10. Maximum and minimum corner speeds display(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:

1. Oil pressure
2. Oil temperature
3. Fuel pressure
4. Water temperature
5. 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 gear shift warning light that is based on an 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 familiarize 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. 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 familiarization with its operation.

### Standard ST8100 Display System Items

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

Quantity	Description
1	Display Module (ST86x ) with 2 mounting brackets
1	Wiring Harness (ST872 )
2	Pressure Sensors (ST744, ST745, ST746)
2	Temperature Sensors (ST760, ST761, ST762, ST763, ST764)
4	Switches (supplied with and to be connected to the wiring harness)

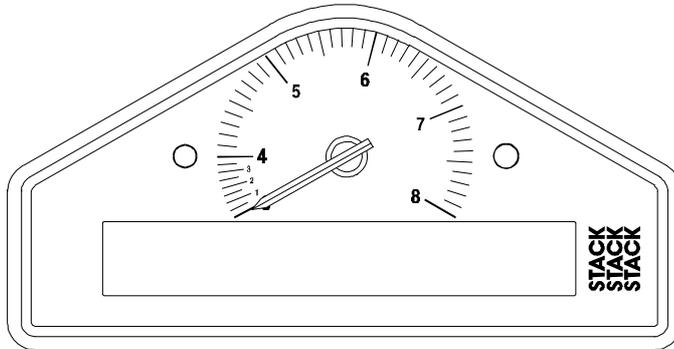
### Optional ST8100 Display System Items

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	Infra-red Lap Time Receiver (ST543)
1	Infra-red Lap Time Beacon (ST544)
1	External Gear Shift Warning Lamp
1	External Alarm Warning Lamp
1	Corner Speed option. <b>Note:</b> The ST8109 Corner Speed option is delivered prefitted in the Display Module.

## The Display Module

The Display Module consists of an analog 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.

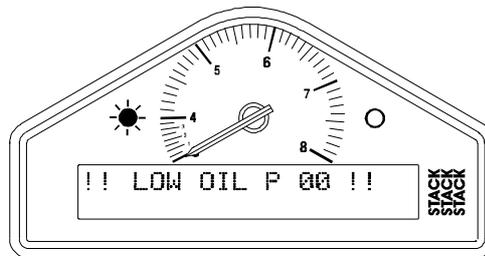
Labels on short cables	Connection To
S1 to S4	Switches 1 to 4
WS	Wheel speed sensor
LAP	Lap timing sensor
SL	Gear shift warning light
AL	Alarm warning light
NET	Data logging expansion pack

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	Lateral Acceleration 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 familiarize 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 familiarize 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 3 to clear the warning message from the display. (Switch 2 can also be used for this.)

The digital display panel and the analog 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

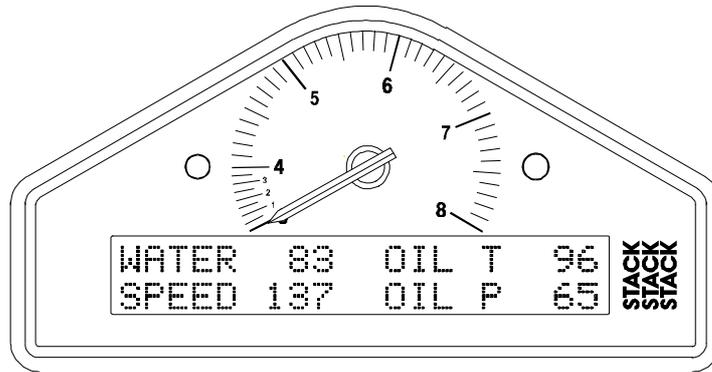
The digital display can show three separate sets of parameters and their values; these are called display layer 1, display layer 2, 3 and 4.

If you have the Corner Speed option, there is an additional layer, layer 5, which displays corner speed data.

Each of the display layers can be displayed in turn by pressing switch 3. Press switch 3 when display layer 4, or layer 5 if you have the Corner Speed option, is being displayed in order to return to display layer 1.

- ⇒ **The format of the values in these displays will vary for systems supplied outside the UK, as 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 (OIL P)

**Note:** OILT is replaced by **BOOST** on the Boost Pressure version of the display system.

Press Switch 3 to see display layer 2.

### Display Layer 2

BATT 13.1	OIL T 96
FUELP 56	OIL P 65

Display layer 2 shows:

- Battery voltage (BATT)
- Oil Temperature (OIL T)
- Fuel Pressure (FUELP)

- Oil Pressure (OIL P)

**Note:** The fuel pressure is displayed as 0.1 PSI (US and UK) and as 0.01 Bar (EU) on the Low Fuel Pressure version of the display system.

Press Switch 3 to change display to layer 3

### Display Layer 3

```
LAP No 14      1:20:96
SPEED 137 BEST:19:83
```

Display layer 3 shows:

- Lap number (LAP No) of last completed lap
- Lap time for last completed lap
- Current Speed (SPEED)
- Fastest lap time (BEST) (only the seconds and milliseconds parts of the lap time are shown)

Press Switch 3 to display layer 4.

### Display Layer 4

```
1:19:83 47.8 + .00
--- >< +
```

Display layer 4 shows:

#### Top Row

- Best lap time
- Running time from start of lap
- Relative time of this lap to a previously selected lap (this feature is active only if the Performance Meter has been purchased).

#### Bottom Row

- A graphical comparison of this lap to a previously selected lap (this feature is active only if the Performance Meter has been purchased).

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

## Display Layer 5

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)
- Maximum speed straight (MAX)
- Actual speed when Switch 1 was last pressed (HOLD)
- 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 kmh
Oil Pressure	999 PSI or 99.9 Bar
Fuel Pressure	999 PSI or 99.9 Bar
Oil Temperature	0C or 0F
Water Temperature	0C or 0F
Battery Voltage	26.0V

## Peak Value Memory

The peak values are stored in a memory which 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 internal battery needs to be changed every 4-5 years. 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 may 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.

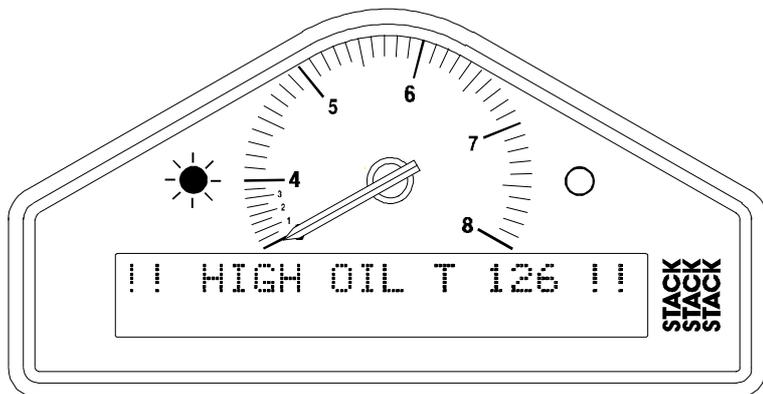
(The oil pressure alarm will come on at power-up until the engine is started and pressure exceeds the threshold set for the alarm.)

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 of alarm:



## Clearing an Alarm

Press Switch 3. ( Switch 2 can also be used.)

## Showing the Last Alarm

Press and hold Switch 2

## Lap times

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

```
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  
SPEED   0 BEST:19:83
```

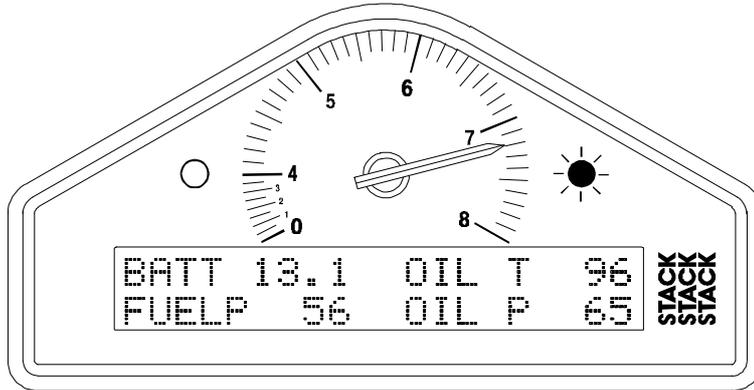
## Resetting the Lap Time to Zero

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

```
LAP No  0      0:00:00  
SPEED   0 BEST:00:00
```

## Gear shift light

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



## Chapter 4. Configuring the Display System

### Configuration mode

You put the Display System into configuration mode by pressing Switches 1 and 2 together. You then work through the configurable parameters in a preset sequence. Press Switch 3 to display the next configurable parameter. The configurable parameters are displayed in the following order:

Configurable Parameter	Setting Required
Wheel Circumference	Set a value in the units of measurement indicated.
Wheel sensor pulses per revolution (W.S. PULSES/REV)	Set the value to the number of ferrous targets that the wheel sensor is to count for each wheel revolution.
Engine Speed (Cylinders)	Number of cylinders in engine (for RPM)
GATE RPM	Minimum RPM for the Fuel Pressure, Oil Temperature and Pressure, and Water Temperature warnings to operate.
Logging RPM	RPM at which the logging option is started.
SHIFT RPM	RPM at which gear shift light is to come on
HIGH WATER	Maximum water temperature alarm
HIGH OIL T	Maximum oil temperature alarm
LOW FUEL P	Minimum fuel pressure alarm
LOW OIL P	Minimum oil pressure alarm
LOW BATT	Minimum battery voltage alarm

## 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 itself increases while the switch is being held down. Example of the displays for each of the configuration items are shown below.

### Wheel circumference:

```
Wheel Cir (mm) 1000
```

### Wheel speed pulses:

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

### Engine speed cylinders:

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

### Gate RPM:

```
EDIT TEST  
GATE RPM 3000 on
```

### Logging RPM:

```
EDIT TEST  
LOG RPM 7000 on
```

### Shift RPM:

```
EDIT TEST  
SHIFT RPM 7000 on
```

**High water temperature:**

```
EDIT TEST  
HIGH WATER 105 on
```

**High oil temperature:**

```
EDIT TEST  
HIGH OIL T 130 on
```

**Low fuel pressure:**

```
EDIT TEST  
LOW FUEL P 10 on
```

**Low oil pressure:**

```
EDIT TEST  
LOW OIL P 35 on
```

**Low battery voltage**

```
EDIT TEST  
LOW BATT 10.0 on
```

## **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.

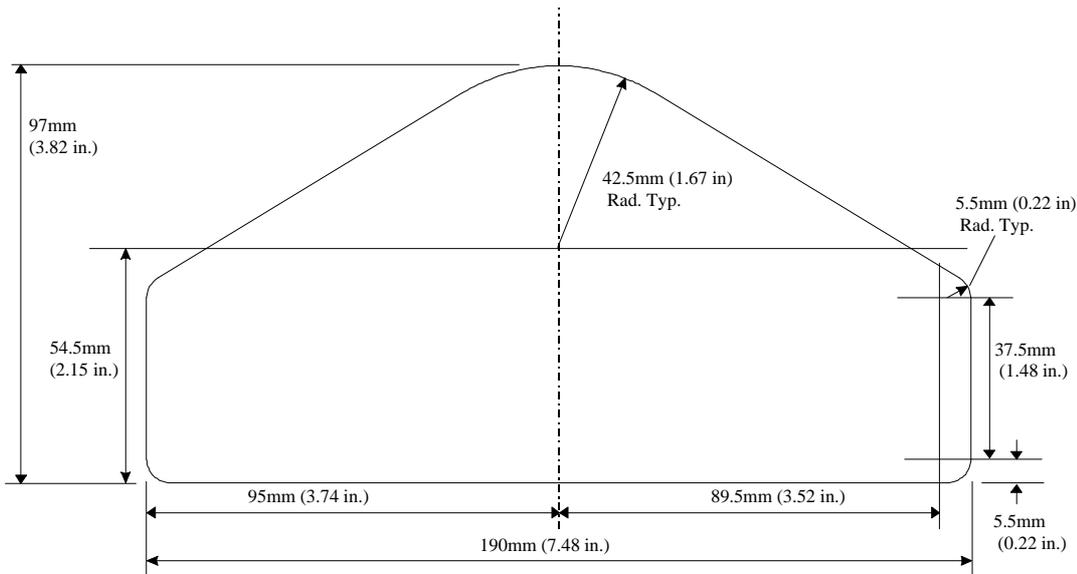
### **Custom Configured Display Systems**

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. 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 is supplied at the end of this manual.



## 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	<ol style="list-style-type: none"><li>1. Show Peak Values</li><li>2. Freeze speed on "HOLD" display (optional Corner Speed feature only)</li></ol>
Switch 2	<ol style="list-style-type: none"><li>1. Clear Alarm</li><li>2. Show Last Alarm</li></ol>
Switch 3	<ol style="list-style-type: none"><li>1. Change Display Layer</li><li>2. Clear Alarm</li></ol>
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 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.

<b>Ignition System</b>	<b>Normally Fitted To</b>	<b>Connection Point</b>
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'
Electromotive (Wasted spark system)	Accessory only	Tacho o/p with 33K series resistor
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)		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
Bosch Blue Coil (With points or Transistor Assisted Ignitions)	Ignition upgrade for Formula Fords 1600 & 2000 Etc.	Coil negative with 47K series resistor (Note fit resistor close to coil with suppressed Ignition leads)

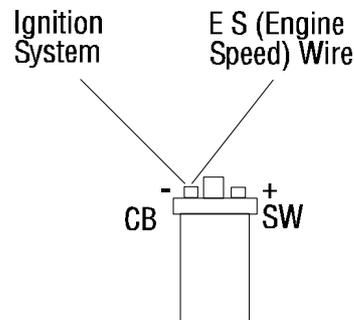
The following connections are shown in greater detail:

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

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

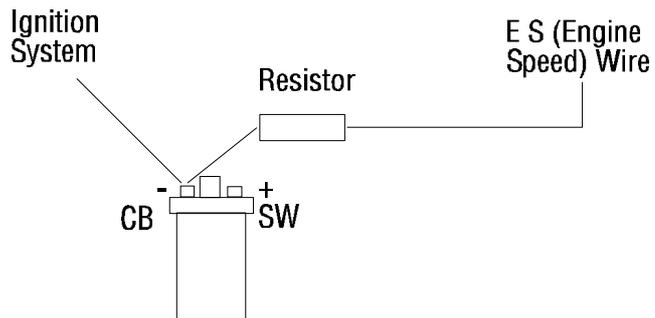
### Standard contact breaker system

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



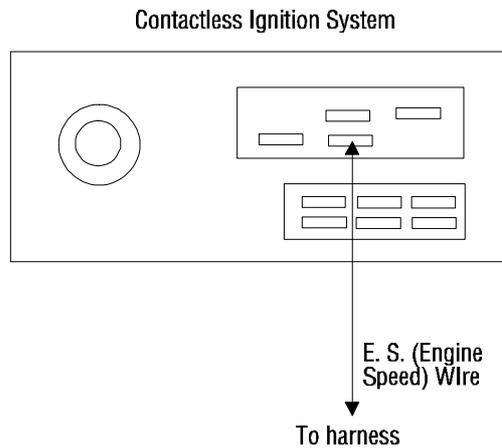
### Series Resistor Connection

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



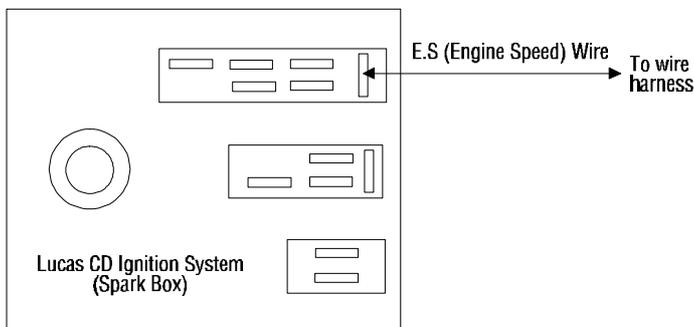
## Contactless system

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



## Lucas CD (Spark box) system

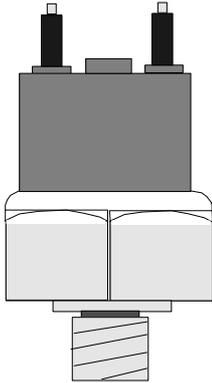
Connect the E.S. (Engine Speed) wire to the Lucas CD Spark Box ignition system as shown in the diagram below.



## Pressure sensors

### Fitting the pressure sensors

The Display System is supplied with two each of the following types of pressure sensors: the Stack ST744, the ST745, or the ST746.



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

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

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

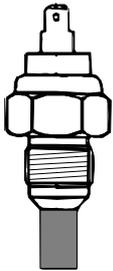
Each of the above types of sensor can be used for monitoring both oil and fuel pressures.

### Installing the pressure sensors

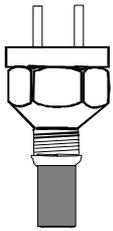
- Position the sensors and their cables as far as possible from all sources of intense heat and from the ignition HT leads.
- Each sensor can be either screwed in directly to the monitoring point or fitted separately by using a suitable pressure hose to connect it to the monitoring point.
- Do not screw 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 types of temperature sensor: Stack ST 760, ST761, ST762, ST763, or ST764:



ST763



ST760  
ST761  
ST762 or  
ST764

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

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

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

The ST763 temperature 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 temperature sensor has two terminals and a 1/8" NPTF thread (U.S. version)

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

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

### Fitting the temperature sensors

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.

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

- The ST763 temperature sensor is connected by the red WT or OT wire. The unused black wire should be tied back to the harness. If this type of temperature 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 (optional)

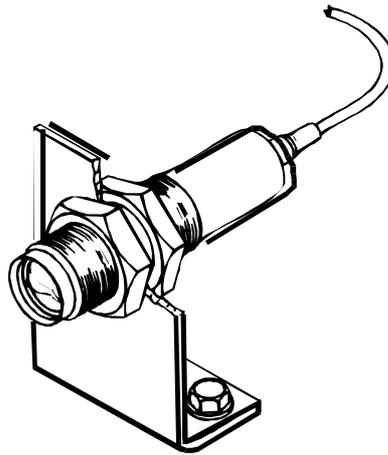
The Display System is supplied with one Stack ST670 proximity sensor as an optional feature. This sensor is used to measure wheel speed in order to display the vehicle's speed in MPH or km/h. The sensor provides an electrical pulse to the system each time a ferrous object, such as a wheel bolt, passes 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.
- 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  $1.5 \pm 0.5\text{mm}$  (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.
- Position the sensors and their cables as far as possible from sources of intense heat and from the ignition HT leads.

## **Lap timing sensor (optional)**

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 sighted 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)

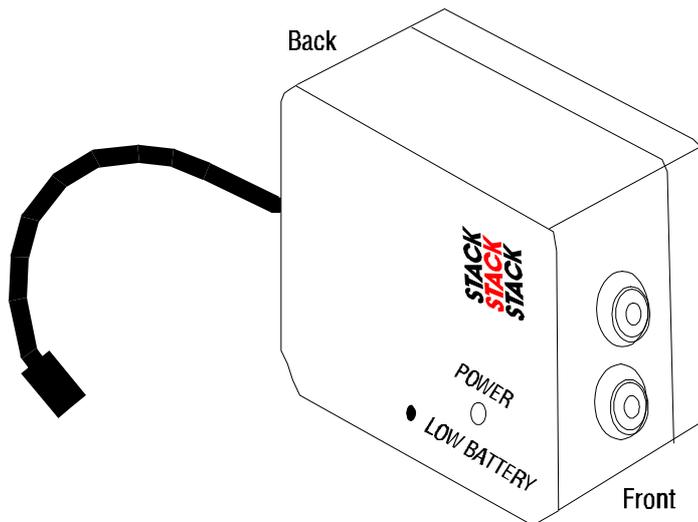
The ST544 trackside infra-red lap beacon should be located as follows:

- 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 2 and 30 meters (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 shroud over the beacon.



## Power supply to Trackside beacon

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

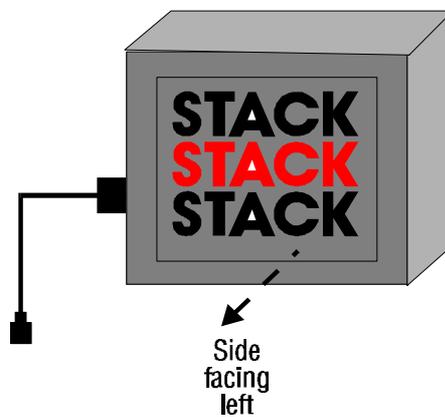
1. Green: The voltage is, at present, adequate for use
2. Red: The voltage is too low (replace the battery).
3. No Colour: Battery exhausted or disconnected.

## Lateral Acceleration sensor (optional)

The lateral Acceleration sensor measures 23 mm x 23 mm x 11.5 mm. It is fitted with a 320 mm cable to connect it to the wiring harness cable labelled 'A'.

The most suitable place to fit the lateral Acceleration sensor is as close as possible to the vehicle's centre of gravity.

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



## 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 ignition HT leads and 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 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 onto the circuit.

## Chapter 6. Troubleshooting

No.	Symptom	Possible Cause	Remedy	Notes
1	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+</b> & <b>B-</b> .  The battery positive lead <b>B+</b> is 19w conn pin <b>G</b> .  <b>B-</b> is 19w connector pin <b>H</b> .
		Battery is dead	Recharge or replace battery	
		Power connection to <b>B+</b> or <b>B-</b> is faulty	Check if battery is connected correctly. Check power lead continuity	
2	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>B-</b> or <b>B+</b> is faulty	Check power lead continuity	
3	Display flashes and  dial pointer resets or vibrates	Battery is almost dead	Recharge or replace battery	
		Power connection to <b>B-</b> or <b>B+</b> is faulty	Check power lead continuity	

No.	Symptom	Possible Cause	Remedy	Notes
4	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	
5	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.
		Faulty sensor connections	Check continuity of sensor leads	Otherwise check harness for short circuit

No.	Symptom	Possible Cause	Remedy	Notes
6	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)
7	Fixed pressure reading of 999 PSI or 99.9 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
8	Fixed pressure reading of -99 PSI or -9.9 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



No.	Symptom	Possible Cause	Remedy	Notes
9	Fixed pressure reading of 0 PSI or 0.0 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)
10	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)
11	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
12	Sensor reading incorrect	Another gauge connected to sensor	Dis-connect other gauge	It is not permissible to connect a second gauge
13	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

No.	Symptom	Possible Cause	Remedy	Notes
14	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)
15	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)

No.	Symptom	Possible Cause	Remedy	Notes
16	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)
17	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)
18	Lap time is not displayed automatically	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.
	(Automatic receiver is fitted)	Lap marker receiver faulty	Replace lap marker receiver	

No.	Symptom	Possible Cause	Remedy	Notes
19	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)
20	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
21	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 $-20^{\circ}\text{C}$ ( $+5^{\circ}\text{F}$ ) to $+70^{\circ}\text{C}$ ( $+158^{\circ}\text{F}$ )
		ECU interface shorted	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

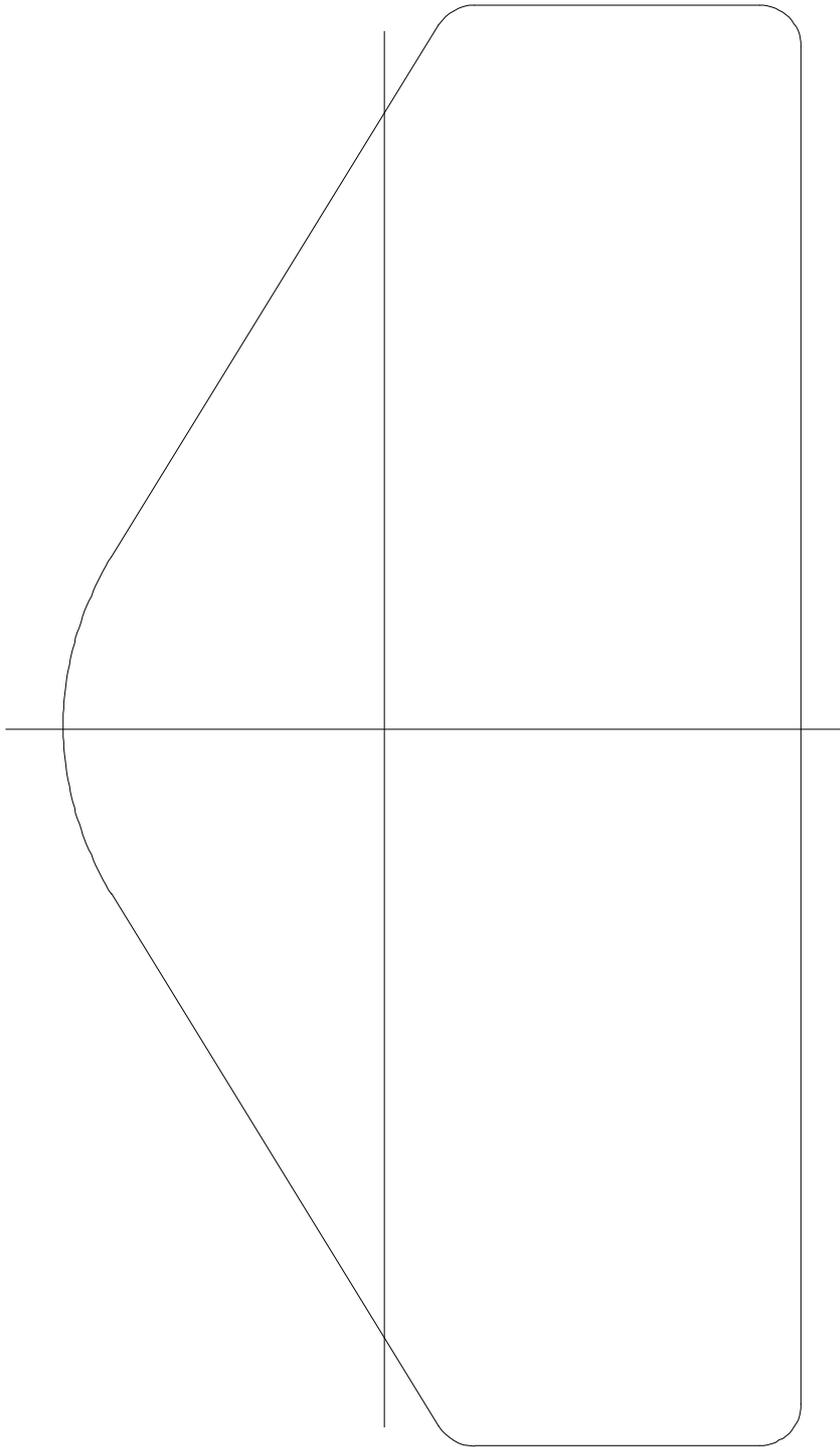
No.	Symptom	Possible Cause	Remedy	Notes
22	No RPM speed reading	Incorrect wiring	Check the connection of the engine speed wire to the ignition system (or sensor, if used)	See instructions supplied in this manual. If connected directly to the coil, check that it is to the switched low tension side (usually the negative side).
23	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: -produce "waste" sparks giving double the number of cylinders per revolution -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.	
24	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: 10K ohms for dedicated tacho output; 47K Ohms for coil connection (Non-CDI); 100K Ohms for coil connection (CDI). Resistors 1/2W 5% 350v

No.	Symptom	Possible Cause	Remedy	Notes
25	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	Typical wheel circumference for a vehicle is 1800mm / 70"  or 900mm / 35" for a kart
		System configured with wrong circumference.		
26	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 or too close)	Check that the gap is approximately 1mm	
		Sensor and targets moving apart	Fabricate a more rigid sensor bracket	
27	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.	Symptom	Possible Cause	Remedy	Notes
28	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.	
29	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.
30	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")

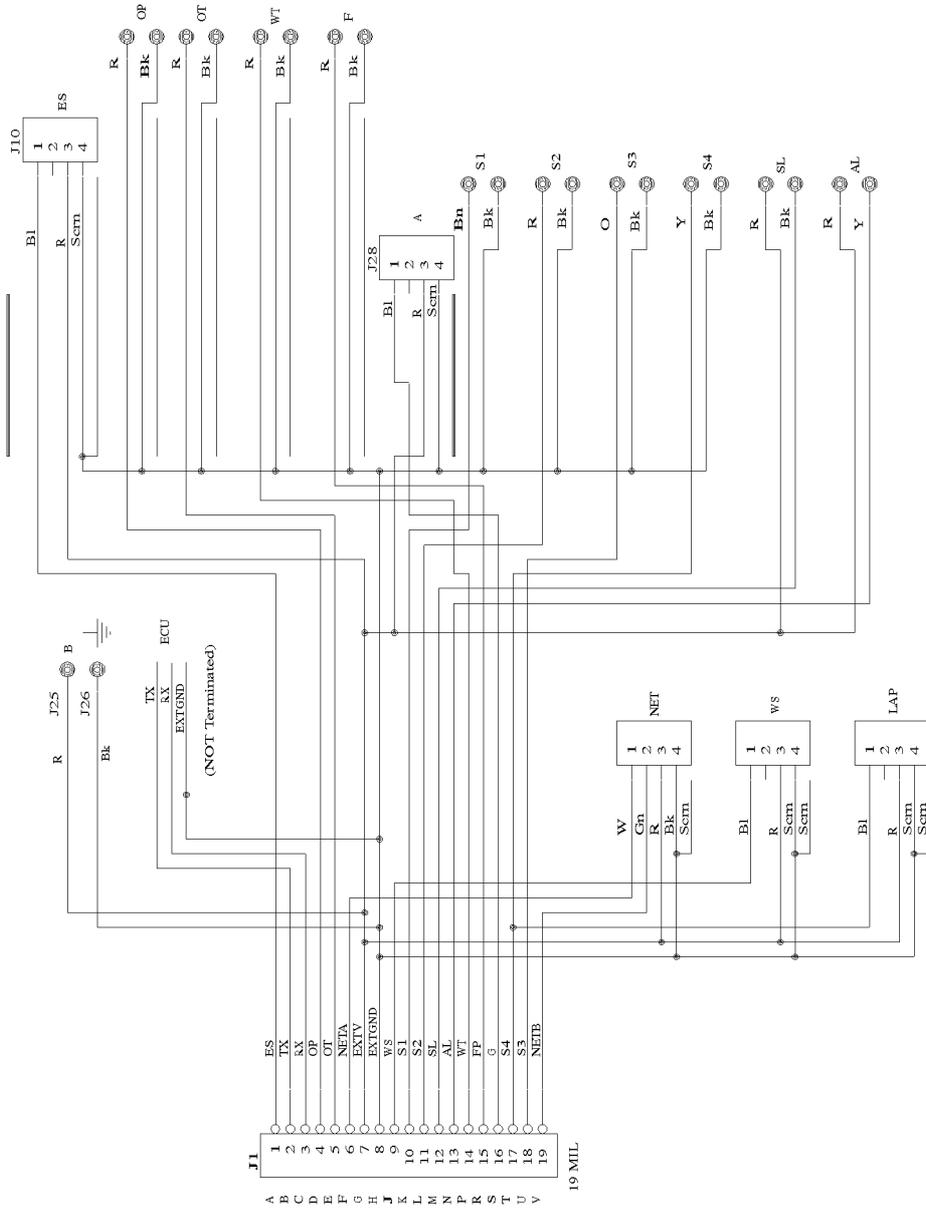
## **Appendix A. Template for the Display Module**

Use the template on the following page for cutting out an aperture for the Display System.





# Appendix B. Wiring Harness Schematic Diagram



ST872 'D'isplay System Harness

# 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.



Company	_____	Customer	_____
Address	_____	(if different)	_____
	_____	Contact	_____
	_____		
Contact	_____	Tel No.	_____
Tel No.	_____	Fax 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, OX6 7UL, England

Tech Support: +44(0)1 869 240420 Tel: +44(0)1 869 240404 Fax: +44(0)1 869 245500

## 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	Switch 2
Manual Lap Marker	Switch 4
Latch Speed Display	Switch 1
Reset Peak Values	Switches 1 & 3 together
Reset lap count and lap time to zero	Switches 1 & 4 together
Put system into configuration mode	Switches 1 & 2 together

### System Configuration Mode

Functions	Switch or Switches
Decrease the alarm value of the parameter being displayed	Switch 1
Increase the alarm 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

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