

## Introduction

The SM022 is a dual / single sensor engine temperature monitor which has available various sensors for exhaust temperature and/or engine block temperature monitoring. Independent overheat alarms may be set for each sensor. It is specifically designed for marine water cooled exhaust systems.

Fig.1



Fig.2



Marine water cooled exhaust systems are designed to withstand temperatures of up to about 120°C. However the exhaust gases from the engine may reach in excess of 450°C. In order to protect the exhaust system it needs a continuous flow of cooling water from the engine, should this flow be interrupted by debris being sucked into the intake or by a problem with the water pump or simply forgetting to open the seacock then the exhaust temperature will start to rise immediately. Depending on the extent of the blockage the increased temperature can cause seriously damage the exhaust system and water lock. The pre installed engine water temperature and/or oil temperature alarms will eventually alert you, however there can be a considerable time lag especially if the engine has been started from cold which means that damage may already have be done.

In order to protect the exhaust components and provide the earliest possible warning you need measure the temperature INSIDE the exhaust. Systems which measure the outside temperature will inevitably be delayed as the heat has to make its way through the exhaust components.

This product uses a quality stainless steel in-exhaust probe containing a platinum wire sensor. The control unit allows the exhaust temperature to be monitored and the alarm point set to a temperature appropriate for your engine.

The SM022 comes with either one or two sensors, the sensor configuration allows the exhaust to be monitored on two engines or the exhaust and engine block on a single engine.

### Kit Components:

The SM022 comes as a complete kit which includes the following:-

1 x Display unit	Connector box	NMEA cable
1m Power lead	Display Lead	Drill template
Mounting screws	Double-sided tape	Piezo buzzer
1 or 2 Sensors with 5m cable, Type 'A', 'B' or 'C'		1 x Test Resistor

## Sensor Installation

### Type 'A' In-Hose Sensor

The sensor has been designed so that it can be fitted without the need to dismantle any of the exhaust system components. Cut the steel band to size making sure you leave enough overlap. Make sure the cut end has no burrs else it will be difficult to feed through the worm drive.

Assemble the sensor as shown, the shake proof washer should go above the steel band, tighten the nuts firmly. No thread should protrude below bottom nut (see picture).

Select a point on the hose about 150mm downstream from the water injection point. Drill a 4mm hole avoiding the steel reinforcement rings (If you have a horizontal hose it is preferable to mount the sensor on the top). Push the sensor through the hole into the exhaust pipe and secure firmly.

The sealing O ring should make a good waterproof seal; if in doubt add a little silicon sealant.

Use the supplied cable tie to secure the cable to the hose clamp as shown.



### Type 'B' External

The sensor has been designed for strapping to a metal exhaust hose section. Cut the steel band to size making sure you leave enough overlap, make sure the cut end has no burrs else it will be difficult to feed through the worm drive.

Assemble the sensor as shown in the picture, tighten the nut firmly.

Select a point on the riser about 150mm downstream from the water injection point and tighten the band to secure firmly.

Use the supplied cable tie to secure the cable to the hose clamp for strain relief. Note: This is not suitable for attaching to the outside of rubber exhausts.



### Type 'C' Engine Block

This sensor is intended for engine block temperature monitoring. When choosing a position for the sensor you should find a location associated with the water circulation, i.e. thermostat, heat-exchanger, pipes, water-pump (not the sea water pump), these contain coolant water and therefore when the engine is running normally should remain well under the 200c display limit else the water would have already turned to steam and the alarm should be sounding.



The sensor is an M8 ring that is designed to be held in place by an existing engine bolt. Use the supplied cable tie to secure the cable for strain relief.

### Notes:

The sensor leads may be cut or extended as required, the cable resistance has little effect on the temperature reading this is due to the use of high resistance sensors. However make sure any joints are sound.

The maximum temperature that the displays can read is 200c although this is not the maximum that the sensors can withstand. There are parts of the engine which during normal operation can exceed these temperatures; for instance the exhaust manifold, the sensor must not be attached to any of these areas.

## Mounting the display

When mounting the display there are a number of options, either use the double-sided sticky pad that has been provided which will hold the display firm, or mount the display from the rear using the supplied screws and washers or because the display is very light it can simply be held in place with marine sealant. Which ever option is chosen if the display is likely to get wet then apply sealant to the rear particularly around the cable entry point..

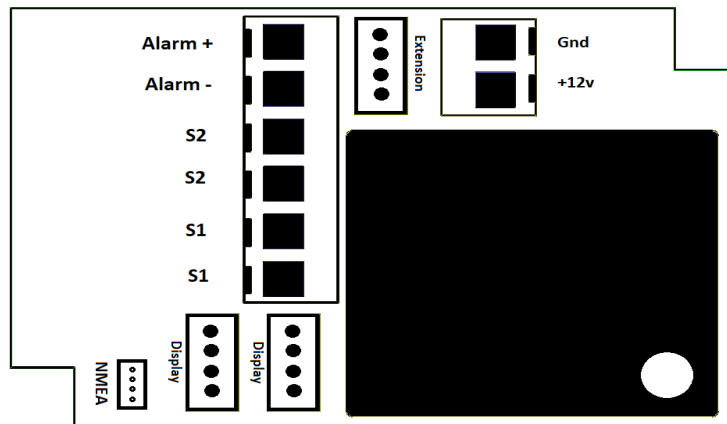
When mounting the display flush against a panel the screws on the back may be removed, the back panel is held in place with glue and the screws are not required.

The display may be mounted on a panel without having to get behind with a screw driver, assemble the wing nut and washers onto the long M3 screw, then from the rear push the screw through the panel and make it finger-tight in the threaded insert on the back of the display (do not over-tighten). Now the wing nut can be tightened to hold the display in place.

Make sure you connect the cable before mounting the display as it will be almost impossible after, also test the display is working before fixing in place.

A drill template has been provided to accurately cut the screw and cable holes.

There is an optional swivel mount accessory (SM5024)



## Connector Box Wiring

Power is supplied to the connector marked Gnd / +12v. Although it shows '+12v' the supply may be 24v without any issues. The connector box contains self-resetting fuses, however should you wish to include your own fuse in the supply then this should be 500mA.

It is suggested that if possible the supply comes from the engine ignition so that the alarm will always be active when the engine is running and you don't forget to turn it on. Alternatively your Nav instruments.

The sensors connect to S1/S1 and S2/S2 these are not polarity sensitive so it does not matter which color sensor wire is connected to which terminal. If you only have only one sensor then this should be connected to S1 and sensor two disabled in the display menu.

The display contains an internal buzzer and the kit also comes with an additional external buzzer which connects to Alarm+ / Alarm -. The red wire goes to the Alarm+ terminal. The external buzzer may be extended if required but is commonly attached to the top of the connector box using the sticky pad on the bottom of the buzzer. If you connect your own buzzer please ensure this is of the low power piezo type as the alarm output is limited to 160mA by an internal self-resetting fuse.

The display cable plugs into either one of the display connectors, the reason why there are two connectors is because you can run an additional 'slave' display from this box.

The connector marked 'Extension' provides independent alarm outputs for each sensor and should only be used in conjunction with the dual extension alarm kit which is available separately.

NMEA data is provided via a two pin connector, a plug and cable has been provided for this in the kit.

Fig.3



Fig.4



The main display shows the current temperature readings, the left-hand is from sensor '1' and the right-hand from sensor '2'. The sensors are initially named Port and Stbd however this can be changed in the setup menu. Fig.4 shows the screen for a single sensor configuration and shows additional information; Max is the highest temperature recorded (even if the unit has been switched off). Alm shows the current alarm temperature. The color band corresponds to the current temperature in relation to the alarm temperature. If the current temperature is less than 20c below the alarm temperature it will be green, turning to yellow at 10c below and red as it approaches the alarm temperature.

The bell symbol is displayed if the audible alarm is enabled, (this should normally be the case)  
In the event of an alarm the border around the display will flash and the bell symbol will be highlighted.

When the display is fitted with two sensors, pressing the down-arrow key will cycle through the sensors displaying the Max and Alarm values.

\* The maximum temperature recorded can be reset in the System menu.

Fig.2 shows the histogram screen which can be accessed by pressing the up-arrow key. This shows the temperature over the last 30 minutes, it updates every 24 seconds and like the main screen the chart colour represents the temperature in relation to the alarm. The scaling on the graph is such that the bottom line is 20c and the visible horizontal line is the alarm temperature. A vertical violet line indicates that the display had been turned off.

The display shows the Max temperature, but unlike the main screen (Fig.4) this is the maximum over the graph period not the maximum temperature recorded.

### Disabling the second sensor

If you have purchased a single sensor unit then the second sensor would normally have been disabled before shipping.

These are the steps to follow to disable the unused sensor.

Press and hold the Rtn key until the System Menu is displayed, scroll-down to where it says 'Sensor 2' then press and hold the Rtn key until the Sensor Menu is displayed. The top option in the Sensor Menu is 'Sensor Enabled', press and hold the Rtn key to select this option, now short press the Rtn key to change this to 'N' to indicate it is not enabled. Long press on the Rtn key to save this setting and you should now be back to the Sensor 2 menu where most options relating to sensor 2 will now be greyed out.

Complete the process by a long press on Esc twice to return to the main screen screen.

## Basic key functions

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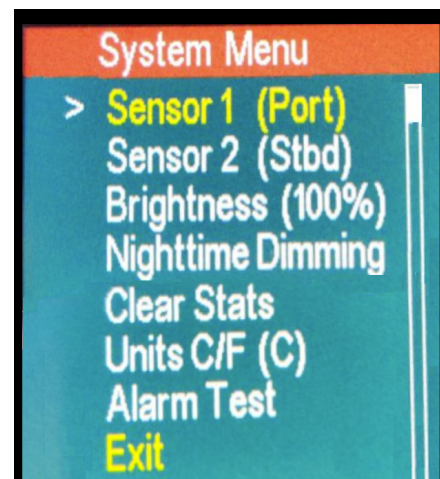
The display has two keys, the left is 'up' and Esc, the right is 'down' and Rtn (Return).

A short press on the 'down' key will scroll down a menu or change a value, a long press on this button acts like the 'return' key on a conventional keyboard and is used to select an item from a menu or save a value you have changed in the setup.

A short press on the 'up' key will scroll up a menu or change a value in the setup, a long press on this key acts like the 'Esc' key on a conventional keyboard and is used to exit a menu or exit without saving.

The Rtn key has an additional function when the displaying the main screen, a short press on the key will cycle through the two sensors displaying additional information whilst a long press will enter the setup menu.

The Esc key also has an additional function when displaying the main screen, a short press on the key will change the display to histogram mode and cycle through the two sensors displaying additional information.



## Initial testing / operation

Inside the connector box is a translucent cover through which you will see a coloured indicator light which gives a basic indication of the system status. When power is applied you should always see something if not check the power connections.

When power is first applied you will see an amber light which indicates it is starting up, it will then try to communicate with the display. It will first show red but after a few seconds should turn green which indicates that it is communicating. If it stays red check the cable to the display. The display does not have an on/off function and it should always be on when power is applied.

The display should now be showing the temperature readings from the sensors. If you have purchased a dual sensor alarm then you should see both sensor temperatures displayed, if any of them shows 'Error' then check the sensor connections.

If you have purchased a single sensor alarm and you have connected the sensor to S1 in the connector box and the second sensor has not yet been disabled then the left (port) sensor should show the temperature and the right will show 'Error', this is correct as no sensor is connected to S2. Page 4 describes disabling the unused sensor.

### Testing the alarm

The alarm test function is available from the main menu, to access this press and hold the right key until the menu appears.

Now use short presses on the keys to navigate the menu up / down. When Alarm Test is selected a long press on the Rtn key will access it. The internal alarm and any external alarm should now sound. Press any key to cancel the alarm.

*All the basic initial testing has now been completed.*

Should at any time you suspect that a sensor is malfunctioning then there are a few basic checks you can do, if you have a dual alarm then switch the sensors connections over and see if the error moves to the other reading on the display.

You can also check the system using the supplied test resistor, if you put this in place of a sensor then you should see a reading of approximately 25c (77 Fahrenheit).

You can also check a sensor with an ohm meter when disconnected from the connector box. The reading will be dependant on the sensor temperature, 1100 ohms is 25c and 1155 ohms is 40c and there should be no continuity between the sensor wires and the sensor housing.

## Setting the alarm temperature

### Setting the alarm temperature

It is important that you adjust the alarm temperature following the first trial with the engine running. If the alarm temperature is set too high then the response to a cooling water loss will be slower than it needs to be and if set too low will possibly give false alarms.

The display keeps track of the maximum recorded temperature for each sensor, this is displayed on the main screen, (Fig.4). First clear down the reading using the 'Clear Stats' function then after running the engine for sufficient time to bring it up to its normal working temperature, add 20°C (68f) to the displayed maximum recorded temperature and use this as the initial setting for the alarm. (Each sensor has its own alarm setting).

When the alarm sounds it can be momentarily silenced by pressing any key. If the temperature is still high after two minutes then the alarm will sound again. The temperature must fall 5°C below the alarm temperature for the alarm to turn off.

Please note: Use the maximum recorded temperature as shown in Fig.4 not the max temperature shown on the histogram screen which only shows the maximum over the graph period and therefore possibly not be the highest recorded.

## System configuration / menus

### System Menu.

Fig.5

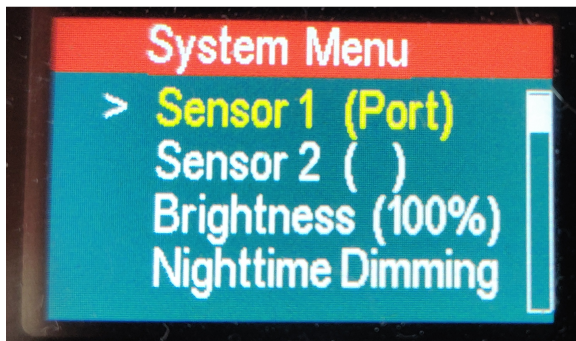
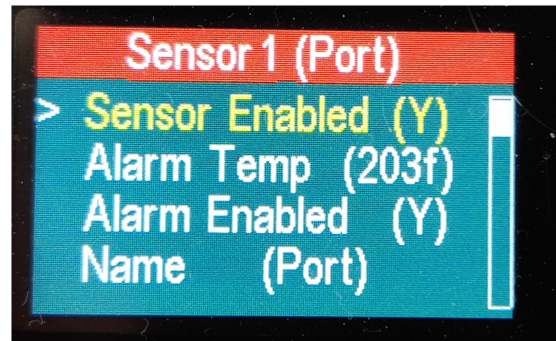


Fig.6



The system menu can be accessed from main screen by pressing and holding the Rtn key, you will then see a screen similar to Fig.5. Use short presses on the up/down keys to navigate the menu, when you get to the bottom of the screen the menu will scroll showing further options. To select an item from the menu press and hold the Rtn key, to exit the menu or any other function press and hold the Esc key.

### Sensor 1 / Sensor 2

Selecting either of these options will take you to the Sensor Menu which has four options. (Fig.6)

### Sensor Enabled Y /N

If a sensor is not connected or you wish to disable it because it is faulty then set this option to 'N'. The sensor temperature will not be displayed on the main screen and the alarm for this sensor will be disabled.

### Alarm Temp

This option allows you to set the alarm temperature, use the up/down keys to adjust the value then a long press on Rtn to exit and save or Esc to exit without saving. The range is 5c to 195c ( 42 - 383 Fahrenheit) in 5c steps.

*Sensor menu continued..*

### **Alarm Enabled**

Use this function to disable the audible alarm for this sensor, the sensor temperature will be displayed normally on the main screen but no audible alarm will sound. Note that when the display is initially turned on if any of the sensor alarms are disabled a warning message will briefly be displayed.

### **Name**

The sensors are initially named Port and Stbd however these can be changed to whatever is appropriate using this function. When selected you will be presented with a keyboard layout, use the up/down keys to navigate the keyboard and press Rtn to select a character. The CLR icon deletes the whole name not just the last character. When finished select the Rtn icon in the bottom right corner or long press on Esc to exit without saving changes.

### **Brightness**

Use this function to adjust the screen daytime brightness.

### **Night-time Dimming**

When enabled the screen will automatically dim in low light conditions. Between the two keys is a light sensor which measures the ambient light conditions and when it falls below a preset level it will dim the display.

To set the point at which the screen dims first wait until the ambient light conditions are at a level when you would like the display to dim. Select this function and move your hand away from the display so it can get an accurate reading. When it gets a stable reading you will see the message 'Level has been set'.

To disable dimming altogether press the Esc key when told to do so, then the display will then always be set to the day time brightness level.

Note: The screen will temporarily return to normal daytime brightness whenever the menu screens are being displayed.

### **Clear Stats**

This option clears down the highest recorded temperature for both sensors and resets the histogram graph.

### **Units C/F**

Switches between Centigrade and Fahrenheit.

### **Alarm test**

The screen will display the wording 'Alarm Test' and the alarm in the display will sound, also if you have an additional alarm connected to the connector box this will also sound. To cancel the alarm press any key.

Note: If you have two displays the alarm test works independently, therefore an alarm test on display '1' will not sound the alarm on display 2, this needs to be checked separately.

### **General Notes:-**

If you have two displays then changing a setting on one display will automatically update the other with the following exceptions.. Brightness / Alarm Test / Nighttime Dimming.

An over temperature alarm will not sound when displaying a menu.

The display will automatically exit any menu and return to the main screen if no key is pressed for two minutes.

## NMEA 0183

The display will output the sensor temperatures as a NMEA sentences at 4800 baud, No parity, 1 stop.

The sentence is in the transducer format \$IIXDR.

\$IIXDR,C,25.0,C,SM022A,\*xx <CR> <LF> for sensor 1 (where xx is the checksum)

\$IIXDR,C,25.0,C,SM022B,\*xx <CR> <LF> for sensor 2 (where 25.0 is the temperature in Celsius)

The output will be suppressed for any sensor that is faulty or disabled.

The data is available on a dedicated 2 pin connector in the connector box, a suitable cable has been supplied with the kit.

Specifications:-

Dimensions: Display 69.6 x 50.5 x 12 mm

Supply Voltage: 8 – 30v DC, 35mA (single display) 59mA (dual display)

Sensor Temperature range: -20 - + 250°C (display will only show 0- 200°C)

Temperature probe: Marine grade stainless steel with platinum wire sensor with 5.0m cable

Calibration: +/- 1°C self-calibrating.

Alarm range: 0 - 195°C user adjustable in 5°C steps.

Alarm Output: Connected to ground when alarm sounds, 160mA max.

Fuse: Internally fused with self-resetting fuses

Designed and Manufactured in the United Kingdom



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