

EMS-2

Engine Monitoring System

Operating Manual – English 1.12



Introduction

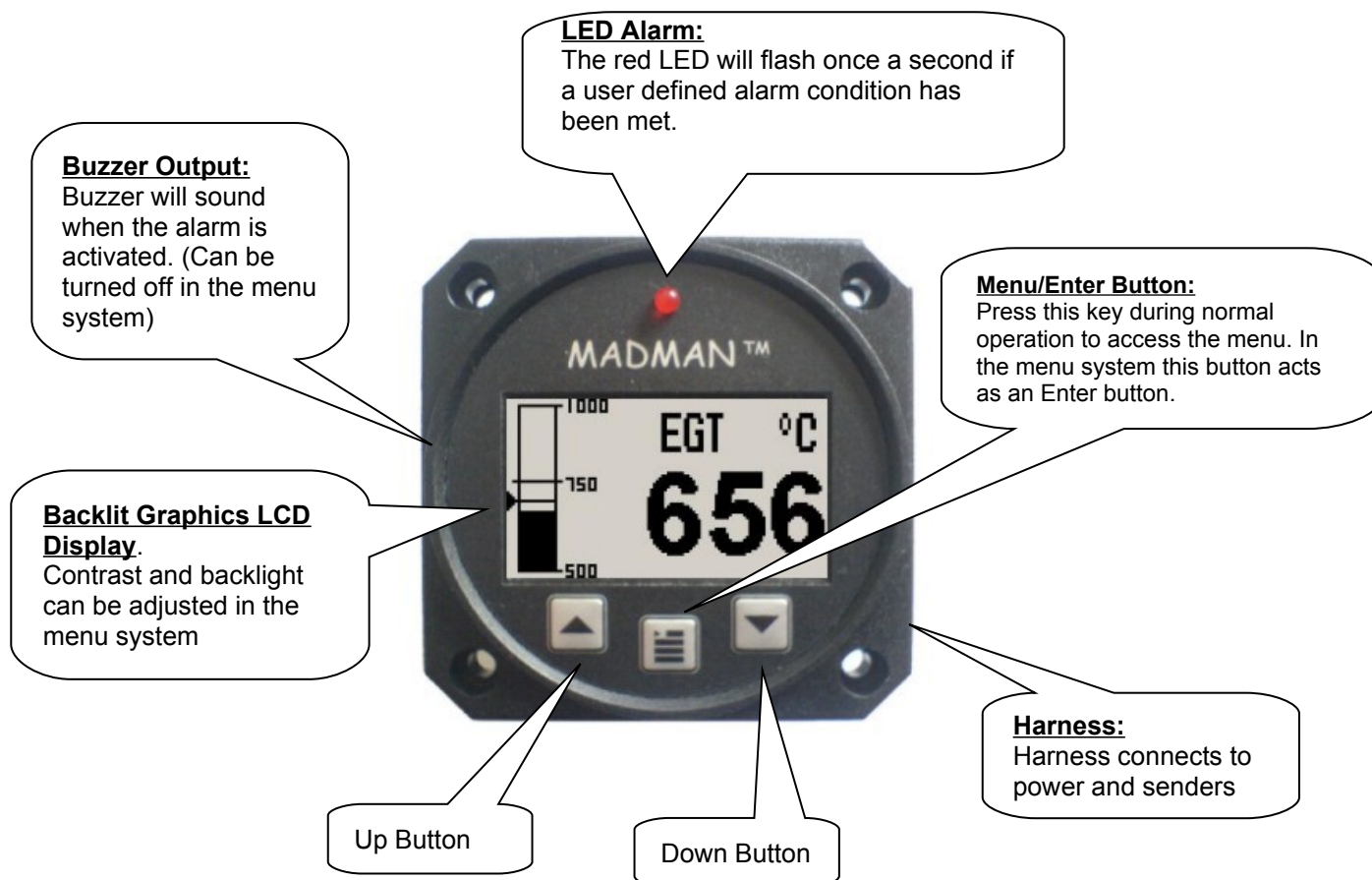
The EMS-2 is a multifunction engine information display and early warning engine monitoring system. It has been specifically designed to monitor crucial vehicle information, and in the event of any engine irregularities, it will alert the driver by the means of a visual and audible alarm.

With its array of advanced features, the EMS-2 is an indispensable unit for the discerning vehicle owner. Costly maintenance bills can easily be avoided by the prevention of major engine problems before they occur.

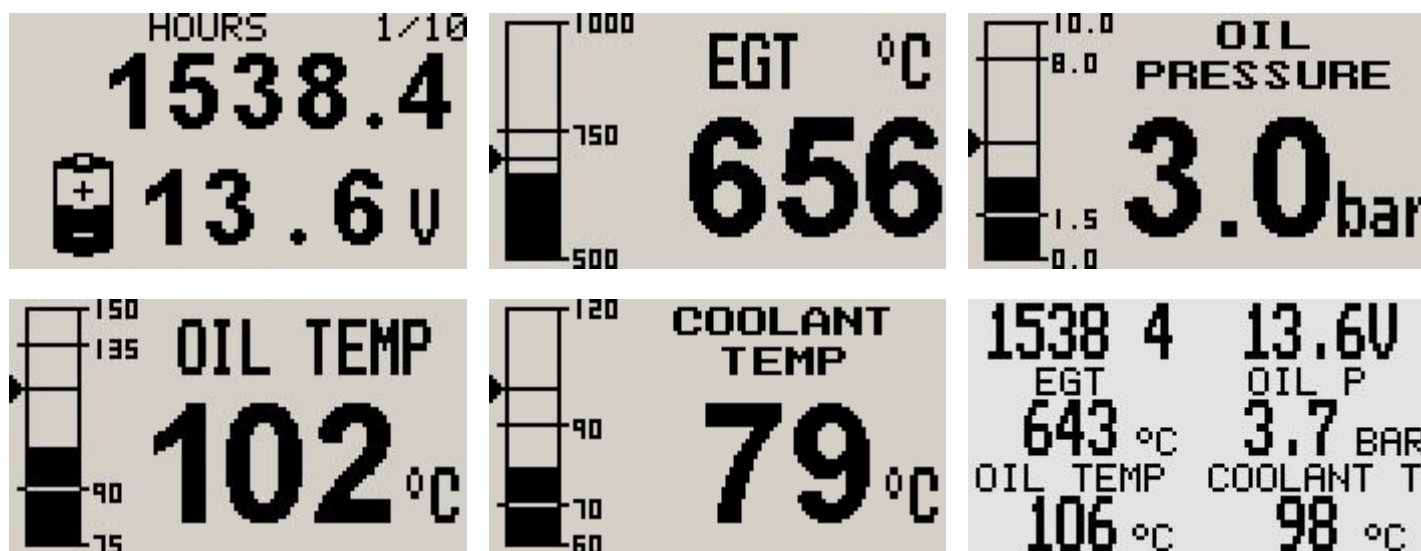
1 Features

- **Battery voltage display**, the EMS-2 can measure voltages up to 30V (Can be used in 12V and 24V vehicles) and contains a programmable low/high voltage alarm to automatically catch alternator failures, drive belt failures and bad batteries
- **Hour meter display** to determine actual vehicle ignition on time with 1/10 hour resolution
- **Built in service interval reminder** based on vehicle ignition on time
- **EGT (Exhaust gas temperature) temperature** can be displayed in degrees Celsius or degrees Fahrenheit from -100°C to 1200°C (-148°F to 2192°F) and contains a user settable high alarm.
- **Includes linearization of EGT K or J Type probes** and is cold junction compensated for greater accuracy
- **Pressure sender measurement** with user settable high and low alarm. Pressure sender input can be from a Fuel, Oil, Manifold, Turbo Boost or an Auxiliary pressure sender.
- **Oil Pressure warning alarm** from oil pressure senders that have a switch output
- **Oil temperature measurement** with user settable high and low alarm
- **Coolant temperature measurement** with user settable high and low alarm
- **Coolant level absence/presence detection** by the means of AC signal probe excitation. The EMS-2 can use inexpensive probes such as stainless steel screws to determine the coolant level. The EMS-2 can also be used with float level type sensors. The Coolant level detection circuit also has a programmable switch time to prevent false alarm messages when driving over rough terrain
- **Selectable Fan control output** for on/off temperature control
- **All senders linearized** for additional accuracy
- **Each sensor display can be individually enabled or disabled**
- **Includes an audible alarm** (The sound can be turned on/off, for example game viewing)
- **Includes a visual alarm** (Built in red LED will turn on when an alarm condition occurs)
- **External alarm output** for remote indicators etc.
- **Back lit graphics LCD** with adjustable contrast
- **On board voltage reversal and over voltage protection** for harsh vehicle environments
- **SMPS (Switch mode power supply)** for use in both 12V and 24V vehicles
- **Maximum values of all readings are recorded**
- **Easy to use menu system** for user parameter setup
- **1 year limited warranty**

2 Layout



3 Information Screens



The information display screens can be viewed by pressing the up and down buttons in the normal run mode. The EMS-2 can also be set up to scroll through the screens automatically (this can be setup under the "UNIT SETUP" menu).

3.1 Battery Volts / Hour Meter Display



The EMS-2 can measure the vehicle's battery voltage in the range of 8V to 30Vdc and has built in over-voltage and reverse voltage protection. The EMS-2 contains a programmable low/high voltage alarm to automatically catch alternator failures, drive belt failures and bad batteries.

The hour meter is a useful instrument to display actual ignition on time for routine maintenance. The hour meter is displayed as hours and fractional minutes in 1/10 of an hour resolution (increments every 6 minutes). The hour meter can be reset to zero in the "SERVICE TIMER" menu.

Note:

If the supply voltage exceeds 30Vdc then an over-range warning message is displayed.

The hour meter updates its internal minute counter every minute. If the unit is turned on and off for a period of less than a minute, then the hour meter will not increment its internal registers.

3.2 EGT (Exhaust Gas Temperature) / Pyrometer

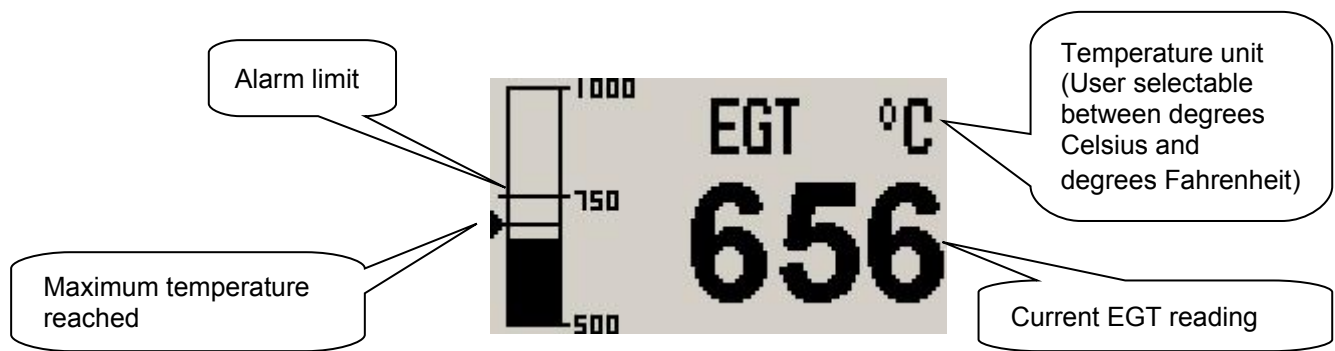
Few things will damage or kill a diesel engine like excessive exhaust gas temperatures, yet the EGT gauges are not standard equipment fitted by the diesel engine manufacturers and are only available as an after market add on unit.

The EMS-2 can alert the driver of any situations where the EGT gets to high which could cause irreparable engine and or turbo charger damage. The EGT can be affected by a too rich air/fuel mixture or an air intake problem. Air intake problems could include a blocked/partially blocked air intake, a dirty air cleaner, high water temperatures etc. The EMS-2 EGT gauge could also save on fuel costs as the EGT is directly related to the air/fuel mixture.

The EGT probe can be installed on the exhaust manifold or immediately after the turbo. It is recommended to install the EGT probe before the turbo as temperature differences of up to 200°C (392°F) between the inlet and outlet of the turbo has been measured under heavy loads.

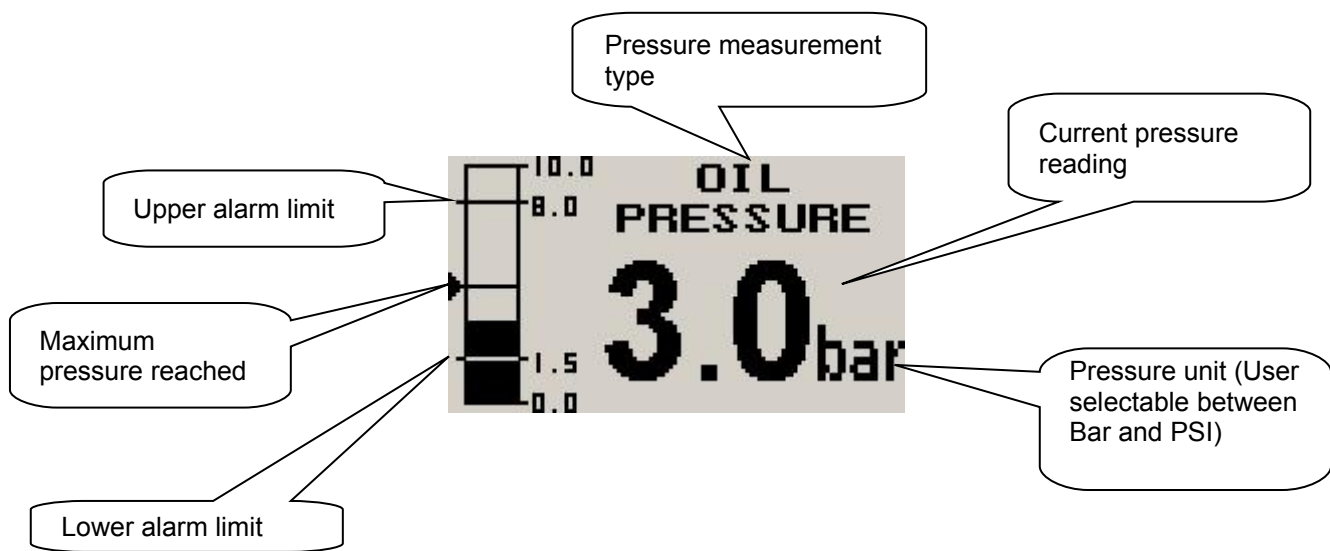
Under normal driving conditions the EGT may vary between 250°C (482°F) and 650°C (1202°F). For most vehicles the alarm limit should be set to 720°C (1328°F). Please be aware that pushing the engine hard or driving up a steep hill, could cause the exhaust gas to exceed this temperature. If you have prolonged high EGT then it is recommended to immediately have it check out by a qualified mechanic.

Madman custom built thermocouple EGT probes are specifically designed for automotive use. The Madman EGT probes can handle temperatures up to 1300°C (2372°F).



The EMS-2 can use K-Type or J-Type thermocouples to display the EGT temperature. The EMS-2 contains precision instrumentation electronic circuitry to amplify and linearize the thermocouple sensor. The EMS-2 also has built in cold junction compensation to make the EGT reading as accurate as possible. All EGT parameters can be changed in the "EGT SETUP" menu.

3.3 Pressure Display



The EMS-2 uses standard automotive pressure senders to display the pressure. The EMS-2 supports 2, 5 and 10 Bar VDO senders or a custom user definable pressure sender curve.

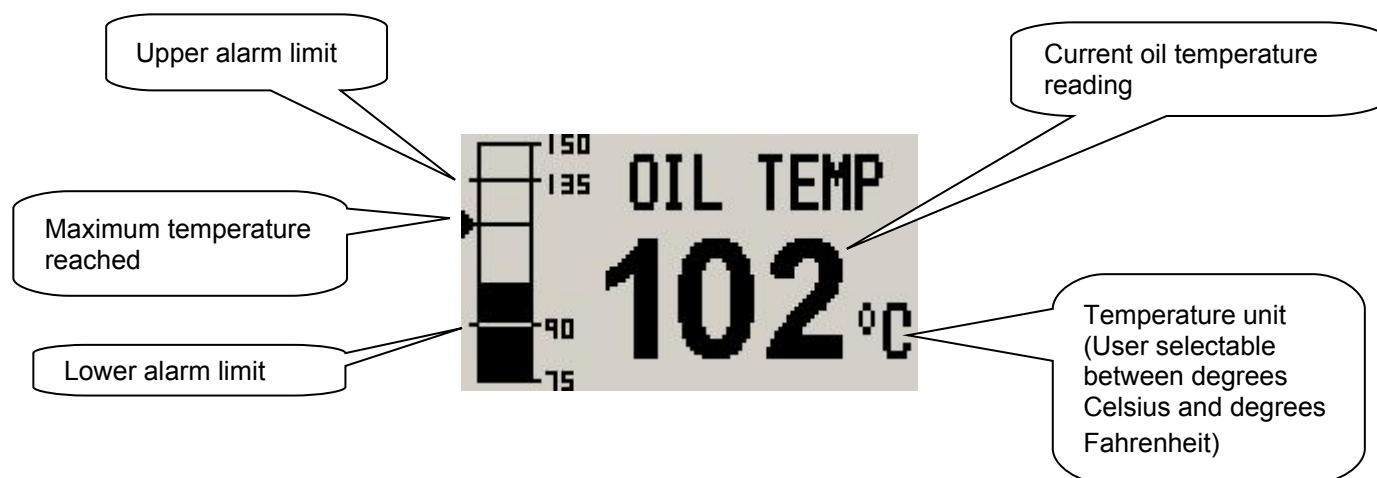
3.4 Oil Pressure Switch Message Display

The EMS-2 can also be used to display a warning message from a switch type oil pressure sender. These senders can be of a NO (Normally Open) or a NC (Normally Closed) type sender. The pressure sender parameters can be changed in the "PRESSURE SETUP" menu.



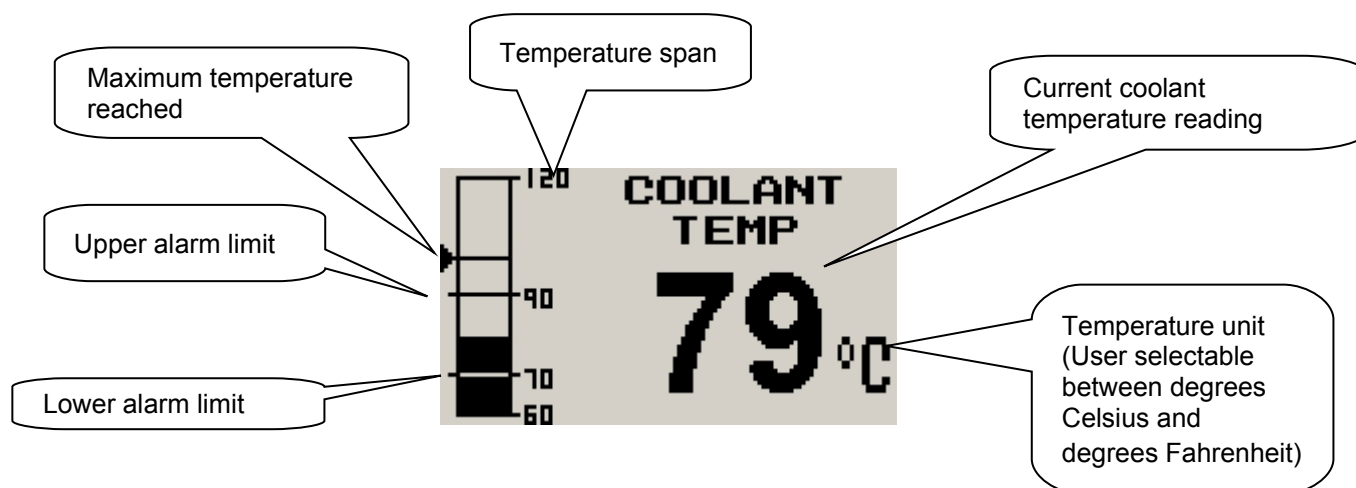
This message is displayed when there is an oil pressure alarm from the switch (NO/NC) on the oil pressure sender.

3.5 Oil Temperature Display



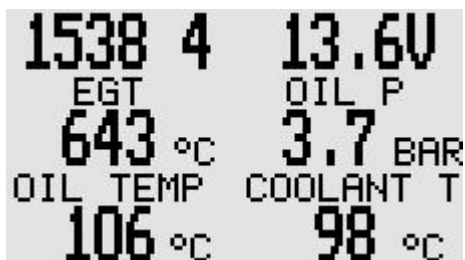
The EMS-2 uses standard automotive oil temperature senders to display the oil temperature. All oil temperature parameters can be changed in the "OIL TEMP SETUP" menu. The EMS-2 also contains fail safe oil temperature inputs to alert the user when the sender has been disconnected or faulty. The EMS-2 oil temperature VDO reading is linearized for a VDO part number VDO323/801/009/001C temperature sender. A custom user sender can also be used.

3.6 Engine Coolant Temperature Display



The EMS-2 uses standard automotive engine coolant temperature senders to display the coolant temperature. All coolant temperature parameters can be changed in the "COOLANT TEMP SETUP" menu. The EMS-2 also contains fail safe coolant temperature and coolant level inputs to alert the user when the sender has been disconnected or faulty. The EMS-2 coolant temperature VDO reading is linearized for a VDO part number VDO323/801/009/001C temperature sender. A custom user sender can also be used.

3.7 Display All Screen



The screenshot shows a monochrome display with the following data:

Parameter	Value	Unit
EGT	1538	°C
OIL P	4	
OIL TEMP	643	°C
COOLANT T	106	°C
OIL P	13.6	V
COOLANT T	3.7	BAR
COOLANT T	98	°C

This screen displays all the measured parameters simultaneously.

3.8 Coolant Level Detector

The coolant level detector is a radiator coolant level early warning system. It uses an AC signal probe excitation to accurately determine the absence/presence of coolant level. The coolant level detector can use inexpensive probes such as stainless steel screws to determine the coolant level. It also features a fail safe input circuit. The coolant level detector can also be used with float level type sensors (These senders must be of a normally open type). The coolant level switch must connect to the vehicles negative supply terminal when the coolant level is at an acceptable level.

The coolant level detector has a programmable switch time. This means that the level alarm from the coolant level switch must be activated for at least the programmed time before an alarm is activated. This prevents false alarm messages when driving over rough terrain etc. The EMS-2 also has a programmable coolant level threshold which allows the user to fine tune the trigger point.

The Coolant level detector parameters can be changed in the "CLD SETUP" menu.



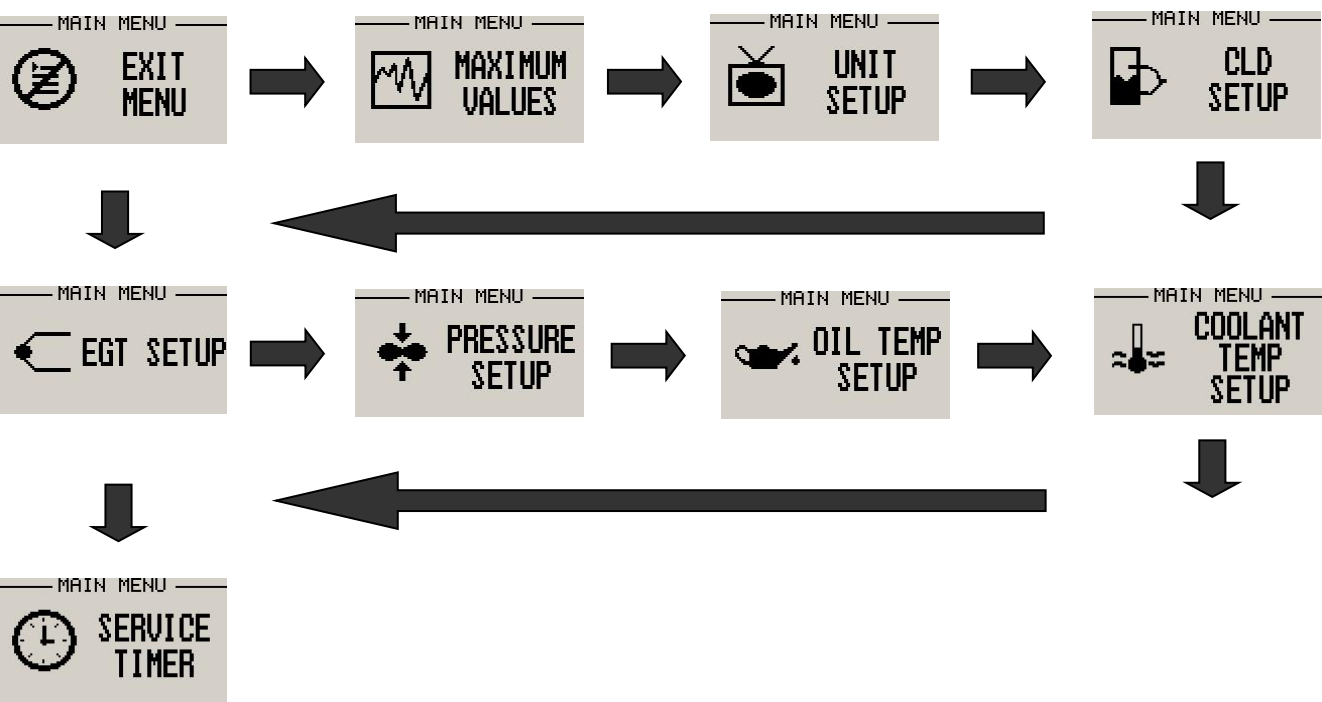
This message is displayed when there is a coolant level problem.

3.9 Service Timer Expired Message



The service timer reminder message will appear for 5 seconds after the unit has switched on if the hour meter is greater or equal to the service hour setting.

4 Menu System

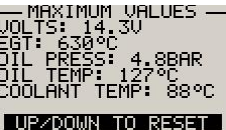


Use the up, down, menu/enter buttons to navigate through the menu system.

4.1 Maximum Values



The “MAXIMUM VALUES” menu displays the maximum values that were reached. Press the up or down button to reset the maximum values to the current readings.

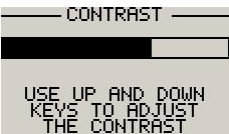
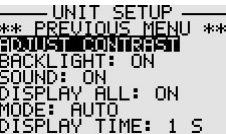


Note: The maximum values are stored in non-volatile memory and are recalled on power-up.

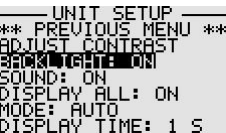
4.2 Unit Setup



The “UNIT SETUP” menu allows the user to adjust the display properties as well as to turn the sound on or off.



This menu option allows the user to adjust the display contrast. Use the up and down keys to adjust the contrast.



This menu option allows the user to turn the back light on or off.

```

UNIT SETUP
** PREVIOUS MENU **
ADJUST CONTRAST
BACKLIGHT: ON
SOUND: ON
DISPLAY ALL: ON
MODE: AUTO
DISPLAY TIME: 1 S

```

The sound of the audible alarm can be turned on or off.

```

UNIT SETUP
** PREVIOUS MENU **
ADJUST CONTRAST
BACKLIGHT: ON
SOUND: ON
DISPLAY ALL: ON
MODE: AUTO
DISPLAY TIME: 1 S

```

Select to enable/disable the display all information screen.

```

UNIT SETUP
** PREVIOUS MENU **
ADJUST CONTRAST
BACKLIGHT: ON
SOUND: ON
DISPLAY ALL: ON
MODE: AUTO
DISPLAY TIME: 1 S

```

This menu option allows the user to either toggle the information screens manually using the up and down keys or automatically (set by the display time).

```

UNIT SETUP
** PREVIOUS MENU **
ADJUST CONTRAST
BACKLIGHT: ON
SOUND: ON
DISPLAY ALL: ON
MODE: AUTO
DISPLAY TIME: 1 S

```

The user can change the time the information screens are automatically displayed. A time of 1, 3, 5, 10, 15, 30, 60 seconds can be selected.

4.3 CLD (Coolant Level Detector) Setup

```

MAIN MENU
CLD SETUP

```

The “CLD SETUP” menu allows the user to adjust the coolant level detector parameters.

```

CLD SETUP
** PREVIOUS MENU **
CLD: ENABLE
CLD SWITCH TIME: 3
CLD SENSITIVITY: 5

```

Select to enable/disable the CLD warning message.

```

CLD SETUP
** PREVIOUS MENU **
CLD: ENABLE
CLD SWITCH TIME: 3
CLD SENSITIVITY: 5

```

The coolant level has a programmable switch time. This means that the level alarm from the coolant level switch must be activated for at least the programmed time before an alarm is activated. This prevents false alarm messages when driving over rough terrain etc.

```

CLD SETUP
** PREVIOUS MENU **
CLD: ENABLE
CLD SWITCH TIME: 3
CLD SENSITIVITY: 5

```

Adjust the sensitivity to fine tune the trigger point.

4.4 EGT (Exhaust Gas Temperature) Setup

```

MAIN MENU
EGT SETUP

```

The “EGT SETUP” menu allows the user to adjust the EGT parameters.

```

EGT SETUP
** PREVIOUS MENU **
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE

```

Select to enable/disable the EGT sensor and display.


```

--- EGT SETUP ---
** PREVIOUS MENU **
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE

```

Set the range of the EGT sender. The range can be set from 400°C (752°F) to 1200°C (2192°F)

```

--- EGT SETUP ---
** PREVIOUS MENU **
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE

```

This allows the user to zoom into the top half of the bar graph resulting in a higher display resolution. This option set to “ON” is recommended.

```

--- EGT SETUP ---
** PREVIOUS MENU **
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE

```

Select whether you want the high alarm to be turned on or off.

```

--- EGT SETUP ---
** PREVIOUS MENU **
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE

```

Enter the high temperature set-point for when the alarm must be activated. Any temperature above this value will activate the alarm.

```

--- EGT SETUP ---
** PREVIOUS MENU **
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE

```

Select whether the sender connected to the EMS-2 is a K-Type or a J-Type probe.

```

--- EGT SETUP ---
EGT: ENABLE
SPAN: 750°C
TOPSCALE: ON
HIGH ALARM: ON
HIGH ALARM: 720°C
PROBE: K-TYPE
TEMPERATURE UNIT: °C

```

Select whether all the temperature readings are displayed in degrees Celsius or degrees Fahrenheit.

4.5 Pressure Setup

```

--- MAIN MENU ---
↓
PRESSURE
↑
SETUP

```

The “PRESSURE SETUP” menu allows the user to adjust the pressure sender parameters.

```

--- OIL PRESS SETUP ---
** PREVIOUS MENU **
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0

```

Select to enable/disable the pressure sender and display.

```

--- OIL PRESS SETUP ---
** PREVIOUS MENU **
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0

```

Select what the pressure sender is measuring, A selection from manifold pressure, oil pressure, fuel pressure, turbo boost pressure or auxiliary pressure can be made.

```

--- OIL PRESS SETUP ---
** PREVIOUS MENU **
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0

```

Set the range of the pressure sender. The range can be set from 1 Bar to 10 Bar.

```

--- OIL PRESS SETUP ---
** PREVIOUS MENU **
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0

```

This allows the user to zoom into the top half of the bar graph resulting in a higher display resolution. This option set to “ON” is recommended.

```

--- OIL PRESS SETUP ---
** PREVIOUS MENU **
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0

```

Select whether you want the low alarm to be turned on or off.

```

— OIL PRESS SETUP —
** PREVIOUS MENU **
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: 0.0

```

Enter the low pressure set-point for when the alarm must be activated. Any pressure below this value will activate the alarm.

```

— OIL PRESS SETUP —
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: ON

```

Select whether you want the high alarm to be turned on or off.

```

— OIL PRESS SETUP —
PRESSURE: ENABLE
PRESSURE TYPE: OIL
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: ON
ALARM HIGH: 8.0

```

Enter the high pressure set-point for when the alarm must be activated. Any pressure above this value will activate the alarm.

```

— OIL PRESS SETUP —
SPAN: 10.0 BAR
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: ON
ALARM HIGH: 8.0
PRESSURE UNIT: BAR

```

Select whether you want to display the pressure in Bar or PSI.

```

— OIL PRESS SETUP —
TOPSCALE: OFF
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: ON
ALARM HIGH: 8.0
PRESSURE UNIT: BAR
PRESS SENDER: VDO10

```

For Oil, Fuel or Aux Pressure use a VDO Pressure Sender 0-10 Bar (0-145 PSI) VDO part number VDO360/081/029/012. For Turbo Boost Pressure VDO Pressure Sender 0-2 Bar (0-29 PSI) VDO part number VDO 360/081/032/025. For a custom sender select "USER".

```

— OIL PRESS SETUP —
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: ON
ALARM HIGH: 8.0
PRESSURE UNIT: BAR
PRESS SENDER: USER
CALIBRATE SENDER

```

If the sender type is set to user, then use this menu option to calibrate your custom pressure sender. See section 4.10 for more details.

```

— OIL PRESS SETUP —
ALARM LOW: ON
ALARM LOW: 1.0
ALARM HIGH: ON
ALARM HIGH: 8.0
PRESSURE UNIT: BAR
PRESS SENDER: VDO10
PRESS SWITCH: ENABLE

```

Select to enable/disable the pressure sender switch warning message.

```

— OIL PRESS SETUP —
ALARM LOW: 1.0
ALARM HIGH: ON
ALARM HIGH: 8.0
PRESSURE UNIT: BAR
PRESS SENDER: VDO10
PRESS SWITCH: ENABLE
SWITCH NO/NC: NO

```

If you are using a pressure sender with a switch then select if the switch is normally open (NC) or normally closed (NO) .

4.6 Oil Temperature Setup

```

— MAIN MENU —
OIL TEMP
SETUP

```

The "OIL TEMP SETUP" menu allows the user to adjust the oil temperature setup parameters.

```

— OIL TEMP SETUP —
** PREVIOUS MENU **
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON

```

Select to enable/disable the oil temperature sender and display.

```

— OIL TEMP SETUP —
** PREVIOUS MENU **
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON

```

Set the range of the oil temperature sender. The range can be set from 20°C (68°F) to 180°C (356°F).

```

— OIL TEMP SETUP —
** PREVIOUS MENU **
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON

```

This allows the user to zoom into the top half of the bar graph resulting in a higher display resolution. This option set to "ON" is recommended.

```

— OIL TEMP SETUP —
** PREVIOUS MENU **
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON

```

Select whether you want the low alarm to be turned on or off.

```

— OIL TEMP SETUP —
** PREVIOUS MENU **
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON

```

Enter the low temperature set-point for when the alarm must be activated. Any temperature below this value will activate the alarm.

```

— OIL TEMP SETUP —
** PREVIOUS MENU **
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON

```

Select whether you want the high alarm to be turned on or off.

```

— OIL TEMP SETUP —
OIL TEMP: ENABLE
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON
ALARM HIGH: 110°C

```

Enter the high temperature set-point for when the alarm must be activated. Any temperature above this value will activate the alarm.

```

— OIL TEMP SETUP —
SPAN: 130°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C

```

Select whether all the temperature readings are displayed in degrees Celsius or degrees Fahrenheit.

```

— OIL TEMP SETUP —
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: VDO

```

Select what sender type you are using. Select VDO for a VDO 50°C (122°F) to 150°C (302°F) resistive temperature sender (VDO part number VDO323/801/009/001C). Select “USER” for a custom sender.

```

— OIL TEMP SETUP —
ALARM LOW: OFF
ALARM LOW: 70°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: USER
CALIBRATE SENDER

```

If the sender type is set to user, then use this menu option to calibrate your custom oil temperature sender. See section 4.10 for more details.

4.7 Coolant Temperature Setup

```

— MAIN MENU —
COOLANT
TEMP
SETUP

```

The “COOLANT TEMP SETUP” menu item allows the user to adjust the coolant temperature sender parameters.

```

COOLANT TEMP SETUP
** PREVIOUS MENU **
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON

```

Select to enable/disable the coolant temperature sender and display.

```

COOLANT TEMP SETUP
** PREVIOUS MENU **
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON

```

Set the range of the coolant temperature sender. The range can be set from 20°C (68°F) to 150°C (302°F).

```

COOLANT TEMP SETUP
** PREVIOUS MENU **
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON

```

This allows the user to zoom into the top half of the bar graph resulting in a higher display resolution.

```

COOLANT TEMP SETUP
** PREVIOUS MENU **
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON

```

Select whether you want the low alarm to be turned on or off.

```

.COOLANT TEMP SETUP
** PREVIOUS MENU **
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON

```

Enter the low temperature set-point for when the alarm must be activated. Any temperature below this value will activate the alarm.

```

.COOLANT TEMP SETUP
** PREVIOUS MENU **
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON

```

Select whether you want the high alarm to be turned on or off.

```

.COOLANT TEMP SETUP
COOLANT: ENABLE
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON
ALARM HIGH: 110°C

```

Enter the high temperature set-point for when the alarm must be activated. Any temperature above this value will activate the alarm.

```

.COOLANT TEMP SETUP
SPAN: 120°C
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C

```

Select whether all the temperature readings are displayed in degrees Celsius or degrees Fahrenheit.

```

.COOLANT TEMP SETUP
TOPSCALE: OFF
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: VDO

```

Select what sender type you are using. Select VDO for a VDO 50°C (122°F) to 150°C (302°F) resistive temperature sender (VDO part number VDO323/801/009/001C). Select "USER" for a custom sender.

```

.COOLANT TEMP SETUP
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: USER
CALIBRATE SENDER

```

If the sender type is set to user, then use this menu option to calibrate your custom coolant temperature sender. See section 4.10 for more details.

```

.COOLANT TEMP SETUP
ALARM LOW: OFF
ALARM LOW: 40°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: VDO
FAN CONTROL: ON

```

Select whether you want the external alarm contact to operate off the alarms or as a fan control output for on/off temperature control

```

.COOLANT TEMP SETUP
ALARM LOW: 40°C
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: VDO
FAN CONTROL: ON
FAN ON TEMP: 90°C

```

Enter the fan control on temperature.

```

.COOLANT TEMP SETUP
ALARM HIGH: ON
ALARM HIGH: 110°C
TEMPERATURE UNIT: °C
SENDER TYPE: VDO
FAN CONTROL: ON
FAN ON TEMP: 90°C
FAN OFF TEMP: 80°C

```

Enter the fan control off temperature.

4.8 Volts Setup

```

----- MAIN MENU -----
+ VOLTS
  SETUP

```

The "VOLTS SETUP" menu allows the user to adjust the voltage parameters.

```

----- VOLTS SETUP -----
** PREVIOUS MENU **
VOLT/HOUR: ENABLE
LOW ALARM: ON
LOW ALARM: 12.0V
HIGH ALARM: ON
HIGH ALARM: 15.0V

```

Select to enable/disable the Volts/hour meter display screen.

```

----- VOLTS SETUP -----
** PREVIOUS MENU **
VOLT/HOUR: ENABLE
LOW ALARM: ON
LOW ALARM: 12.0V
HIGH ALARM: ON
HIGH ALARM: 15.0V

```

Select whether you want the low alarm to be turned on or off.

```

VOLTS SETUP
** PREVIOUS MENU **
VOLT/HOUR: ENABLE
LOW ALARM: ON
LOW ALARM: 12.00
HIGH ALARM: ON
HIGH ALARM: 15.00

```

Enter the low voltage set-point for when the alarm must be activated. Any voltage below this value will activate the alarm.

```

VOLTS SETUP
** PREVIOUS MENU **
VOLT/HOUR: ENABLE
LOW ALARM: ON
LOW ALARM: 12.00
HIGH ALARM: ON
HIGH ALARM: 15.00

```

Select whether you want the high alarm to be turned on or off.

```

VOLTS SETUP
** PREVIOUS MENU **
VOLT/HOUR: ENABLE
LOW ALARM: ON
LOW ALARM: 12.00
HIGH ALARM: ON
HIGH ALARM: 15.00

```

Enter the high voltage set-point for when the alarm must be activated. Any voltage above this value will activate the alarm.

4.9 Service Timer

```

MAIN MENU
SERVICE
TIMER

```

The "SERVICE TIMER" menu allows the user to adjust the hour meter and service timer parameters.

```

SERVICE TIMER
** PREVIOUS MENU **
RESET HOUR METER
SERVICE HOUR: 1000

```

This will reset the hour meter to zero

```

SERVICE TIMER
** PREVIOUS MENU **
RESET HOUR METER
SERVICE HOUR: 1000

```

Enter the next time in hours that the EMS-2 must remind you that a service is due. The service reminder message will appear for 5 seconds after the unit has switched on if the hour meter is greater or equal to the service hour setting.

4.10 Calibrating the user defined pressure and temperature senders

```

CAL PRESS: 595
** PREVIOUS MENU **
NUM OF POINTS: 10
DISP VALUE 1: 010
ADC VALUE 1: 1000
DISP VALUE 2: 020
ADC VALUE 2: 0900
DISP VALUE 3: 030

```

1. Enter the number of points that you want to calibrate.
2. Enter the display reading that you want to show when the sender is at that actual display reading.
3. Enter the ADC (analog to digital converter) reading that corresponds to this display reading. The ADC reading is shown at the top of the calibration menu if you are applying the actual stimulus from the temperature or pressure sender. You can also manually enter this value if the ADC value is known or precalculated.
4. Continue entering display and ADC values until all the points have been entered.
5. Verify the above calibration by checking the temperature/pressure display versus the actual applied sender stimulus.

```

CALIBRATE WT: 220
** PREVIOUS MENU **
NUM OF POINTS: 10
DISP VALUE 1: 010
ADC VALUE 1: 1000
DISP VALUE 2: 020
ADC VALUE 2: 0900
DISP VALUE 3: 030

```

5 Alarms

The alarm sound can be turned on or off in the "UNIT SETUP" menu. This might be favorable for example during game viewing. Please note that the alarm sound only becomes active 30 seconds after power is applied to the EMS-2. The alarm output on the power connector is of a transistor open collector type. When it is turned on it will connect the alarm output to ground. Maximum current through alarm output should not exceed 250mA. The EMS-2 will automatically jump to the information display screen that is causing the alarm.

6 Cleaning

The unit should not be cleaned with any abrasive substances. The screen is very sensitive to certain cleaning materials and should only be cleaned using a clean damp cloth.

Warning: The EMS-2 is not waterproof, serious damage could occur if the unit is exposed to water and or spray jets.

7 Specifications

Operating Temperature Range	-10°C to 50°C (14°F to 122°F)
Storage Temperature Range	-20°C to 80°C (-4°F to 176°F)
Humidity	<85% non-condensing
Power Supply	8 to 30Vdc SMPS (Switch mode power supply) with built in 33V over voltage and reverse voltage protection
Current Consumption	approx. 40mA/10mA @ 13.8V (back light on/off)
Display	114x64 graphics LCD display. Contrast and back light is user configurable
ADC	12bit over sampled successive approximation
Alarm	Red LED/audible buzzer/open collector transistor output
EGT probe	The EMS-2 supports both K-Type or J-Type thermocouple probes
EGT compensation	K-Type and J-Type probe linearization with build in precision internal temperature reference
Pressure sender	Oil, Fuel or Aux Pressure: VDO Pressure Sender 0-10 Bar (0-145 PSI) VDO part number VDO360/081/029/012. Turbo Boost Pressure: VDO Pressure Sender 0-2 Bar (0-29PSI) VDO part number VDO360/081/032/025. EMS-2 has a user sender calibration feature that can be customized for senders not listed above
Oil Pressure switch	NO (Normally Open) or NC (Normally Closed) oil pressure senders supported
Oil Temperature sender / Coolant Temperature sender	Standard VDO 50°C (122°F) to 150°C (302°F) resistive temperature sender (VDO part number VDO323/801/009/001C) The EMS-2 has a user sender calibration feature that can be customized for senders not listed above
Coolant level switch	NO (Normally Open) float sensors. Switch connects to vehicles negative supply terminal when coolant level is at an acceptable level
Coolant level detection	2.5KHz AC signal
Alarm Contact	Transistor open collector, Max current = 250mA
Dimensions	60mmx60mmx61mm (2.36"x2.36"x2.40") (See attached dimensional drawing)
Enclosure	ABS, black in color
Non-volatile memory storage	100000 write cycles

8 Installation

DIY installation can be done but it is recommended that a professional automotive installer installs the EMS-2.

You can use any combination of senders with your EMS – those functions that you do not use can be disabled within the menu structure.

When doing the wiring for the unit it is critical that you fit the black earth wire to the engine block – failure to do so will possibly result in erratic readings as other loads are switched on such as lights, fans, indicators etc.

Wire sizes used can be the same as the wires used on the harness supplied. Ensure that all connections are mechanically and electrically secure. Do not solder connections as these can lead to breakages were the solder stops due to the rigidity of the soldered joint. Crimp terminals or twisted wire joints should rather be used.

Harness wires supplied WILL be too short to reach all the points, extra wire will be needed except for the EGT probe which has a 2.2 meter long lead.

8.1 Fitting sender units

Notes to Remember:

Apply Loctite thread sealer to pressure and temperature fittings – thread tape may cause electrical connectivity problems

All temp senders and pressure senders and EGT probes use the same 1/8"-27 NPT thread. Generally, adapter kits require NO DRILLING or TAPPING, if your engine does not have an adapter listed, check the text to see if it should then be tapped. Your MadMan supplier or local mechanic should be able to offer this service for a small fee. Some engines make use of M10x1 threads or 1/8" BSP female threads on the oil pressure switch port – it is possible to safely fit the 1/8 NPT brass male Tee piece directly to this thread.

8.2 EGT (Exhaust Gas Temperature)

Some vehicles make use of an EGR (Exhaust Gas Recirculation) system or have removable plates on the exhaust manifold for this purpose – if this is the case then the plates can be removed and tapped to accommodate the EGT probe.

Your MadMan supplier should then also have this plate in stock as a listed adapter for that engine. If you have an EGR valve fitted, remove it entirely and disable the diaphragm by removing the wiring loom or vacuum pipe. Use this port of the exhaust for the EGT. If you do not have a port on the exhaust manifold or do not want to disturb it, you will need to drill and tap the manifold. The manifold should be drilled at any suitable point closest to the entrance to the turbo, but still in the manifold, not the turbo housing.

With the engine cold, and idling, drill a pilot hole (4mm) into the manifold – as soon as the drill enters the inside of the manifold, the exhaust gas will escape past the drill bit ejecting the drilling swarf – guard your eyes.

Now drill the hole to 9mm, and immediately thereafter, tap the hole to the required thread (1/8 NPT). The 1/8" NPT thread is a taper thread where the hole gets larger the deeper you tap it, generally the tap should be turned in until 3mm of the thread of the tap remains outside the hole – you can screw the sender in to check for a good fit.

Fit the brass compression fitting to the adapter plate/manifold and tighten the adapter into the manifold/plate with the hex nut section closest to the manifold/plate, leaving the clamping nut (closest to the probe cable) fitted but loose.

Ensure the "olive" is fitted beneath the clamping nut on the compression fitting. Now tighten the clamping nut a bit until the probe is just nipped tight and it cannot move – tighten it another 1/8 turn. Note: it may be necessary to hold the fitting with a second spanner to prevent it from turning deeper into the manifold. It is better to have it too loose and need to tighten it a little more than to overtighten it and break it off.

The braided cable should not be cut as it is very difficult to clean the cable to get to the wires. It is best to roll up the spare cable and tie it up – if both ends are already fitted then roll it in a figure "8" which is easier. The cable can be lengthened using regular copper wire provided the joint is behind the dash and not in the engine bay as the accuracy of the probe will be affected. MadMan can supply special cable to lengthen the probe without loss of accuracy. Any loss will be the difference in temperature between the joint in the cable and the location of the EMS unit.

8.3 Coolant Temperature

Notes to Remember:

The body of the temperature sender must form an electrical return path to the engine block (for single connector temperature senders). The temperature sender should preferably be on the hot side (head side) of the thermostat

The temperature sender should always be in contact with water – no water means no temperature measurement, hence the need for the coolant level detector. A low temperature reading does not mean there is water.

There are several ways to fit the temperature sender:

In a spare coolant plug/probe

In a specially made sandwich adapter

In an inline metal adapter tube

Directly into a drilled and tapped hole in the aluminium/steel coolant piping/housing

Some engines have unused temperature measurement ports or unused blanked off holes. These are ideal to use for the temperature sender – check your vehicle's installation details on the MadMan web site to see if a plug adapter is available – if we do not list one and you have a spare plug port, please contact us so that we can supply the appropriate adapter.

Some engines do not have any spare ports so we have developed the sandwich adapter which bolts between the water inlet/outlet pipe and the block/head. The sandwich has a port in it to take the temperature sender. Check your vehicle's installation details on the MadMan web site to see if a plug adapter is available. If we do not list one, we have either not developed one for your engine yet or it cannot use a sandwich adapter. Either way, please contact us so that we can supply the appropriate adapter.

Some engines have no option of a plug adapter or a sandwich adapter, these engines need an inline metal tube adapter or direct drilling and tapping. The inline metal tube adapter is a short length of tubing with a port welded to it and an electrical tag.

A piece of the top coolant hose is cut out and this adapter is inserted in the space, the hoses are clamped to the tube and the temperature sender screwed in. The tube is then earthed to the engine block. Please contact us if you have a need for this type of adapter. We will need to know what the inside diameter of your coolant hose is. Some older engines had large open spaces where it is easy to drill and tap the cooling jacket to fit the probe. Firstly establish that there is enough free space inside the water cavity to accept the length of the temperature sender (30mm) before drilling.

Drill a pilot hole (4mm) into the metal surface – as soon as the drill enters the inside of the cavity, water will escape past the drill bit ejecting the drilling swarf – guard your eyes.

Now drill the hole to 9mm and immediately thereafter, tap the hole to the required thread (1/8 NPT). The 1/8" NPT thread is a taper thread where the hole gets larger the deeper you tap it, generally the tap should be turned in until 3mm of the thread of the tap remains outside the hole – you can screw the sender in to check for a good fit.

8.4 Oil Temperature

You can choose to monitor either engine oil temperature OR gearbox oil temperature. Should you want to measure both, you must fit a SPDT (Single Pole Double Throw) switch to switch between the two senders as the EMS unit can only accept one oil temperature input at a time.

If you are already reading EGT, oil pressure and coolant temperature you may want to rather monitor transfer box temperature as these run rather hot. If you have an automatic gearbox you MUST monitor auto gearbox oil temperature as these can overheat easily when towing.

We make use of plug adapters for most gearbox temperature measurement.

Please check your vehicle's installation details on the MadMan web site to see if a plug adapter is available for your gearbox or engine sump. If we do not list one and your application can use this type of adapter, please contact us so that we can supply the appropriate adapter. Some ZF automatic gearboxes will accept a 1/8 NPT temperature probe directly into the original drainplug hole.

8.5 Oil Pressure

Most engines use an oil pressure switch, which is coupled to the oil pressure warning light on the dash display. Locate this switch on the engine (often nearby the oil filter) and remove the connector and then the switch.

Some engines make use of M10x1 threads or 1/8" BSP female threads on the oil pressure switch port – it is possible to safely fit the 1/8 NPT brass male Tee piece directly to this thread. If the thread is larger, check your vehicles installation details on the MadMan web site to see if an adapter is available – if we do not list one, and you think you need one, please contact us so that we can supply the appropriate adapter.

You will need to fit the original pressure switch as well as the oil pressure sender to the engine by using a brass Tee piece (available from MadMan) You will need to see which one must be fitted first such that everything can be screwed in tightly. If there is no way that the original pressure switch and new pressure sender cannot co-exist in the space available there are two options:

There may be an adapter pipe available that will effectively move the port away from the engine block to make space for the Tee piece, pressure switch and sender or you can contact us to provide you with a pressure sender that contains both the pressure switch and pressure sender in one unit, which may be easier to fit.

8.6 Coolant Level Detection

The brown wire in the EMS-2 unit connects to a coolant level sensor. EMS units with blue key pads (EMS1 models with a firmware version lower than version 1.10) use an external device to measure coolant level such as the CLD Lite or a mechanical float switch. EMS1 models with firmware version 1.10 and higher (Silver keypad) have a built-in CLD unit.

The CLD uses two probes (self tapping screws) and the presence of water/coolant between them to measure water. The CLD is suitable for plastic coolant tanks, plastic radiator header tanks and can also be installed in the same inline metal adapter tube as for the coolant temperature sender. For steel header tanks or copper radiators the mechanical float switch (MCLD) can be used.

CLD Installation in a Plastic Coolant Tank: See option A and B on the drawing

Select a suitable place on the plastic coolant bottle / plastic tank that is normally flooded with coolant – choose a spot about 10 to 20 mm lower than the normal level Drill two small holes (1.5mm) about 25mm from each other in the same horizontal plane. Fit small lugs to the brown wire from the EMS1 and screw the lug to the tank using a 3.5mm self tapping screw. The hole must be small so that the screw is tight – It makes a good water tight seal. Fit a lug to a loose black wire and screw that into the other hole, take the black wire to the same earth point on the engine block as the EMS earth.

CLD Installation in an in-line steel pipe: See option C on the drawing

Some vehicles have no way of fitting a mechanical float switch and do not have plastic components, these vehicles can use an inline steel pipe in the radiator hose. Select a suitable place in the top coolant hose, close to the engine block that is normally flooded with coolant. Cut the hose here and insert the steel pipe and refit the hose to the other side of the pipe with clamps. Fit the brown wire from the EMS-2 to the pipe. The return path is via the EMS earth wire already installed – no further wiring necessary.

Mechanical Float Switch Installation:

Drill a suitable hole in the metal tank, feed the wires through the hole, ensure that the sealing washer is fitted and tighten the nut, slowly and consistently until it feels tighter than before, then turn it one flat more – if it leaks turn it another flat tighter. The float switch has two black wires, connect any one of these to the engine block and connect the other to the EMS-2 wire directly. If the mechanical float switch is used, the EMS-2 should be set to 5 seconds or any suitable value to prevent false alarms – the shorter the delay the better the safety margin.

8.7 Automotive senders

Oil and Coolant Temperature:

VDO Temperature Sender 50°C-150°C (122-302°F)

VDO Part Number VDO323/801/009/001C

Oil, Fuel or Aux Pressure:

VDO Pressure Sender 0-10 Bar (0-145 PSI)

VDO Part Number VDO360/081/029/012

Tee Piece (For oil pressure sender)

1/8" NPT Running Tee (M-F-F)

Turbo Boost Pressure:

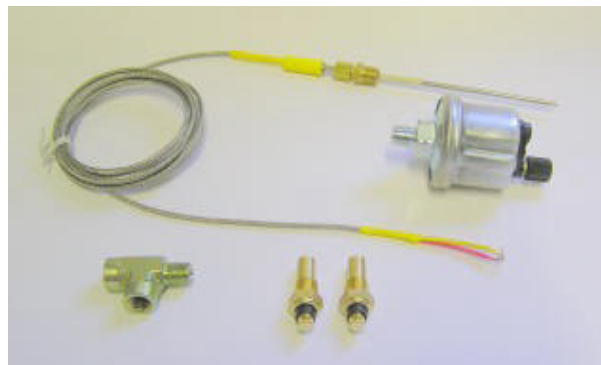
VDO Pressure Sender 0-2 Bar (0-29 PSI)

VDO Part Number VDO360/081/032/025

Thermocouples:

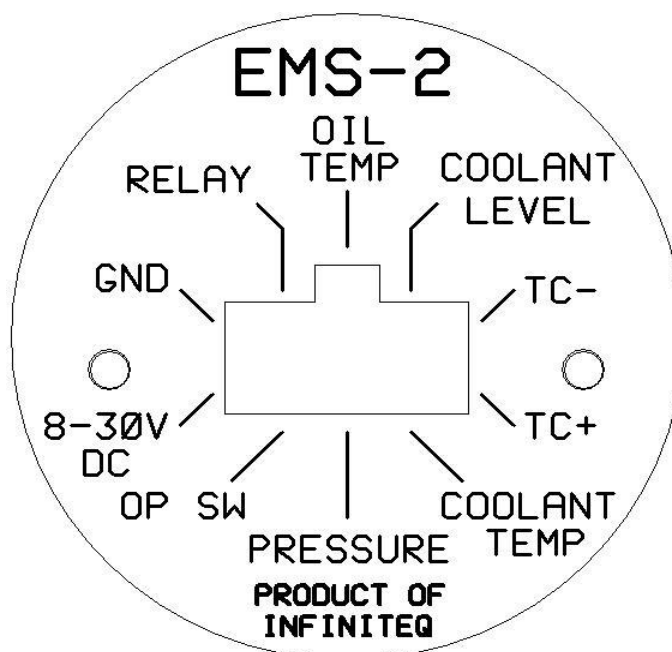
TP 40 – 40mm x 6 K type thermocouple probe with a 2.2 meter (7.2 ft) Stainless steel braided lead and a 1/8 NPT Brass Compression fitting

TP 60 – 60mm x 6 K type thermocouple probe with a 2.2 meter (7.2 ft) Stainless steel braided lead and a 1/8 NPT Brass Compression fitting

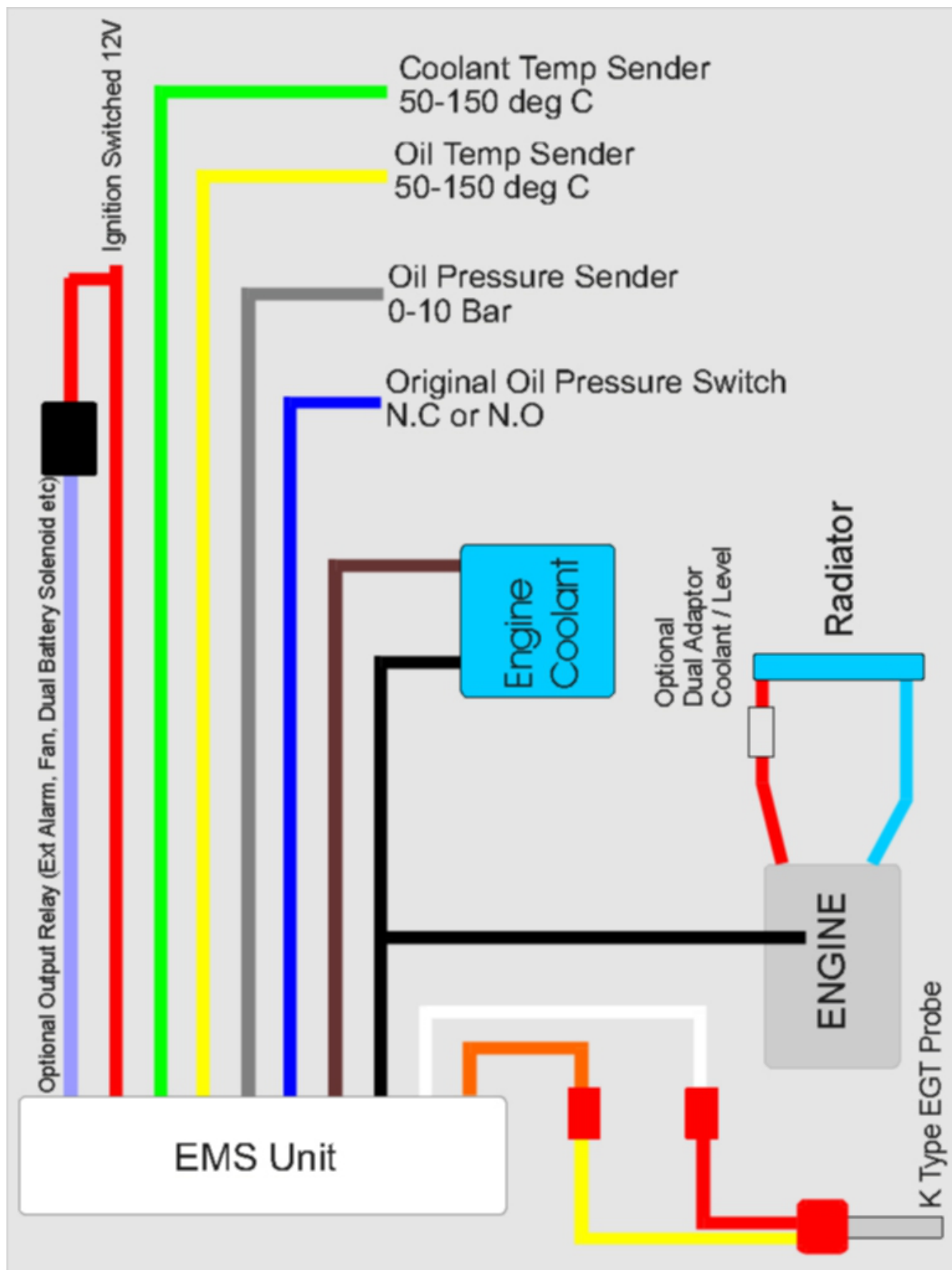


8.8 Connector Layout (Looking at EMS-2)

EMS-2 CONNECTOR COLOR CODING
Red: 8-30VDC
Black: Ground/Engine ground
Purple: Relay contact
White: EGT Probe – (Red probe lead)
Orange: EGT Probe + (Yellow probe lead)
Yellow: Oil Temperature Sender
Grey: Pressure Sender Input
Blue: Oil Pressure switch
Green: Coolant Temperature Sender
Brown: Coolant Level Switch



8.9 Installation Drawing



9 Warranty

This product carries a warranty for a period of one year from date of purchase against faulty workmanship or defective materials, provided there is no evidence of misuse or evidence that the unit has been mishandled. Warranty is limited to the replacement of faulty components and includes the cost of labor. Shipping costs are for the account of the purchaser.

Note: Product warranty excludes damages caused by unprotected, unsuitable or incorrectly wired electrical supplies and or sensors, and damage caused by inductive loads.

10 Disclaimer

Operation of this instrument is the sole responsibility of the purchaser of the unit. The user must make themselves familiar with the operation of this instrument and the effect of any possible failure or malfunction.

The manufacturer reserves the right to alter any specification without notice

WARNING: The EMS-2 must not be operated by the driver when the vehicle is moving. All setups must be done prior to driving the vehicle.

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