The E1 universal engine monitor combines in one compact 3.5" format instrument all that is needed to monitor most smaller aircraft engines from two-stroke ultralight engines to medium sized four strokes such as from Rotax, Continental and Lycoming. Also most automotive engine conversions can benefit from the use of the E1 engine monitor.

The E1 offers the following abilities:

1) Universal, programmable rev counter (engine RPM) with digital and analog readout.
2) Programmable engine hobbs meter and running timer (flight timer).
3) Up to four thermocouple channels for EGT and CHT probes, fully programmable.
4) A water temperature or oil temperature monitor.
5) Oil pressure monitor.
6) Rotax 912/914 mode with up to four EGT and support for the two built in CHT sensors.

All temperature monitors have user programmable alarm levels, oil temperature and water temperature have both low and high temperature alarms. Oil pressure has both high and low pressure alarms. Many different probe types can be supported.
Operating alarms

The E1 has two different alarm levels, one indicates on the display by means of flashing the affected item, the second level activates the external alarm.

External alarms are usually wired to a suitable alarm lamp.

Once a new alarm condition is found, the external alarm is activated which switches on the alarm light. At the same time the affected item on the screen will flash.

The pilot can acknowledge the alarm by pressing any key, this will deactivate the external alarm and switch the alarm light off.

The item that caused the alarm will however continue to flash on the display until the alarm condition no longer exists.

Should a new alarm condition appear, the external alarm will again become active.

Setting up the E1

Before the E1 can be used with your engine, you need to setup the instrument so it knows what to measure and how to display this.

Basic setup involves the following steps:

a) Select the operating mode – this will select what you want to monitor, for example if you have a Rotax 582 water cooled two stroke engine you may want to monitor two EGT channels as well as the water temperature. The rev counter is always selected so you do not need to choose it.

b) Select the Ranges – here you select what ranges to use for the various bargraphs. Staying with the Rotax 582, you will select a Range of perhaps 700 degrees C for the EGT channels and 90 degrees C for the water temperature. 7000 RPM would be a good choice for the engine rev bargraph.
c) Set up the alarm limits. For the Rotax 582 you would choose 650 degrees C for the EGT and perhaps 85 degrees C for the water temperature. You might also decide to monitor the low limit of the water temperature. For this engine, you could choose 55 degrees C.
d) Enable the alarms. Staying with this example, enable the EGT alarm and both water temperature high and low alarms.
e) Select your probe type. For the rev counter you would select 6.0 pulses per revolution if you are connecting to the grey rev counter wire on the DCDI system. For the water temperature you would most likely use the MGL type if you bought your probe from MGL Avionics.

The following text describes the menu system.

Press the Menu key to enter the menu. You can move forward and backwards in the menu by using the + and – keys. To change or select a menu item, move the highlight to the desired item and then press the Select (Enter) key. To end an edit or function, press the Menu key again.

To exit the menu and continue normal operation, press the Menu key again.
Note: all changes done will only be stored if you exit the Menu and return to the main display.

```
Temp in ... Deg C
Pressure: PSI
Contrast: 30
Backlight: On
Set Hobbs
Setup Op Mode
Alarm Limits
Alarm Enables
Setup Sensors
Setup Ranges
ADC
```

This image shows the available main menu entries. These are described in detail in the next pages.

**Temp in ...**

Choose your temperature units. You can select Degrees Celsius or Degrees Fahrenheit.

**Pressure:**

This setting allows you to select the unit of pressure in BAR or PSI. Ignore this if you are not going to use the oil pressure gauge.
Contrast …

This function allows you to change the display contrast to your liking. You can select values from about 15 to 45. Most common values are around 30.

Backlight …

This function allows you to switch the display backlight on or off. You can reduce the current consumption of the E1 if you switch the backlight off. This may be of interest if you use the instrument on a small battery of limited capacity.

Set Hobbs

This function allows you to set the hobbs meter to your current engine running time.

![Hobbs Reading](image)

Use the plus and minus buttons to change the indicated part of the hobbs reading. Use the Select button to change from hour hundreds to hours to minutes. When you are done, press the Menu button to exit the function.

Setup Op Mode

This function allows you to select the basic mode of operation of your instrument. You can choose from a large number of options. Select the number of CHT and EGT channels to use, if you need to monitor water temperature or oil temperature and pressure.

You will see a display similar to the one shown here that shows one of the modes. Simply use the plus and minus keys to select your desired mode. If you cannot find the exact mode required, choose the nearest possible one. Press the menu key to exit this function.

![Setup Op Mode](image)

Rotax 912/914 mode

One of the supported modes is specifically designed to support the Rotax 912 and Rotax 914 engine models. In this mode the screen is setup as follows:
In this mode the oil/water temperature input becomes CHT channel one and the oil pressure input becomes CHT channel two.

In order to correctly display the CHT temperatures using the standard Rotax CHT probes you will use the setups for the oil temperature. The reason for this is that the sensors that Rotax uses for this are standard NTC temperature probes.

In the sender setup you will select the “Rotax” temperature sender type. You will use the oil temperature alarm enables and limits. You will also use the oil temperature span setup to configure the range of your bargraph.

We suggest the following settings for the Rotax engines:
- CHT (oil) Temperature high limit: 135 degrees C.
- CHT (oil) Temperature low limit: Off.
- CHT (oil) Temperature span: 150 degrees C.
- EGT alarm limit: 850 degrees C.
- EGT span: 900 degrees C.
- RPM Span: 6000 RPM.

**Alarm limits**

This function allows you to select the individual alarm limits for each measured item. For EGT and CHT channels you can select the level above which the alarm will activate. For all other items you can select both upper and lower alarm limits.

You may want to use the lower temperature alarm limits to indicate if your coolant or oil is at a too low temperature.

<table>
<thead>
<tr>
<th>EGT limit</th>
<th>600</th>
<th>OILT high</th>
<th>125</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHT limit</td>
<td>135</td>
<td>OILT low</td>
<td>70</td>
</tr>
<tr>
<td>H2O high</td>
<td>90</td>
<td>OILP high</td>
<td>91</td>
</tr>
<tr>
<td>H2O low</td>
<td>60</td>
<td>OILP low</td>
<td>30</td>
</tr>
</tbody>
</table>

Should the alarm limit fall in the displayable area of the bargraph, it will be shown using a dotted line.

Check your bargraph ranges (spans) in the relevant setup function.

**Alarm Enables**

In this function you enable and disable every individual alarm type. If you disable an alarm, it will never activate.
Setup Sensors

This function allows you to select various sensor types that you can connect to the E1.

### RPM Calib

Enter the number of pulses per revolution that your engine produces. You can enter fractions of a pulse in case of engines that generate a non-integer number of pulses per revolution.

**Typical settings:**
- Rotax 503,582 DCDI – 6.0
- Rotax two stroke Single ignition 1.0 or 2.0.
- Rotax 912,914 – 1.0
- Most other four strokes: 1.0 or 2.0 depending on number of cylinders

### Tprobe:

Choose the probe type that you are using for the water or oil temperature gauge. You can choose from the following:

- **MGL:** This is a TS920 or TS921 type NTC sender, commonly used for water temperature.
- **Rotax:** This is a VDO oil temperature sender. It is often also used for water temperature.
- **LM335:** This is a semiconductor sender type made by MGL Avionics. It can be used for both water and oil temperature and has a large range.
- **Westach:** This is a probe made by the company Westach for both oil and water temperature.

### OP Res:

**OP Res:**

This is a TS920 or TS921 type NTC sender, commonly used for water temperature.

Rotax: This is a VDO oil temperature sender. It is often also used for water temperature.

LM335: This is a semiconductor sender type made by MGL Avionics. It can be used for both water and oil temperature and has a large range.

Westach: This is a probe made by the company Westach for both oil and water temperature.
Here you enter the full span resistance of the oil pressure sender. Oil pressure measurement is based on most VDO senders. These have a resistance of 200 ohms full span. You can select resistance spans from 50 to 1000 ohms.

**OP Max:**

Enter the maximum Pressure reading for your sender. Most senders have a 10 Bar rating, some models go to only 5 Bar.

If your senders resistance increases with pressure, enter the pressure that the sender will be exposed to if a resistance equal to the value you have entered above is reached.

If your senders pressure decreases with pressure, this is the pressure that should be indicated if the sensor reads close to zero ohms resistance. As the sensor reaches the resistance entered above, a pressure of zero is assumed.

**OP DIR**

Select if your oil pressure senders resistance increases or decreases with pressure. Most senders increase resistance as pressure increases but there are some models available that operate inverse to this.

Typical oil pressure sender setup:

The oil pressure sender used in Rotax 912 engines is typical for most senders. This sender requires the following setup:

- OP Res: 200
- OP Max: 10.0
- OP DIR INC
Setup Ranges

This function allows you to setup the bargraph ranges. Bargraphs for temperatures will start at a temperature that is equal to ½ of the selected span while the bargraph for pressure will always start at zero.

Example:

With EGT Span set to 700 degrees, the bargraph will start rising if the temperature exceeds 350 degrees. The bargraph will reach the top of its area when the temperature is 700 degrees or more.

<table>
<thead>
<tr>
<th>RPM</th>
<th>Scale</th>
<th>5500</th>
</tr>
</thead>
<tbody>
<tr>
<td>EGT</td>
<td>Span:</td>
<td>650</td>
</tr>
<tr>
<td>CHT</td>
<td>Span:</td>
<td>150</td>
</tr>
<tr>
<td>H2O</td>
<td>Span:</td>
<td>100</td>
</tr>
<tr>
<td>OILT</td>
<td>Span:</td>
<td>130</td>
</tr>
<tr>
<td>OILP</td>
<td>Span:</td>
<td>100</td>
</tr>
</tbody>
</table>

The oil pressure span is entered in steps of 0.1 bar (or the equivalent PSI).

Typical spans:

Four stroke engines: 900 degrees C, alarm at 850 degrees C.
Two stroke engines: 700 degrees C, alarm at 650 degrees C.
Water temperature: 110 degrees C, alarm at 95 degrees C.
Oil temperature: 150 degrees C, alarm at 135 degrees C.
Oil pressure: 7.0 bar, low alarm at 2 bar.

Consult your engine manual on the required limits for your engine.

ADC

This function is for technical personal. It is not used for ordinary operation of the unit. This function can be accessed if both “+” and “-” are pressed at the same time as the instrument is switched on.
Technical specifications:

Display temperature range (operational): -20 to +80 degrees C
Supply voltage: +8 to +18V. +24/28V with optional pre regulator.
Supply current: 30mA/90mA (backlight off/on)
Thermocouples: K-type
Measurement range: 0 to 1200 degrees C
Technology: Fully cold junction compensated using precision internal temperature reference.
Measurement accuracy: +/- 5 degrees typical over full temperature range, subject to quality of probe used. We recommend Stratomaster EGT and CHT probes.
Measurement interval: 0.5 seconds (all channels). 1000 samples/second, DSP noise filter.
Inputs: Differential, can use grounded and isolated probes.
Common mode voltage range: -2V to +3V
Temperature input: NTC or LM335, types as per setup document
Pressure input: VDO or equivalent pressure sender, resistance rises with pressure.
            Resistance range 50-1000 ohm selectable for 10 bar pressure.
Alarm contact:
Maximum permissible current through alarm output: 500mA.
Typical load for alarm: 12V/1W lamp.
Weight: 190 grams

Warranty:
MGL avionics warrants their products for a period of one year from date of purchase against faulty workmanship. 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 for operation on supplies with inductive loads:

Any operation of electronic instrumentation on power supplies that are subject to high voltages caused by operation of inductive loads (starter motors, solenoids, relays) are required to be fitted with suitable protection.
All Smart Singles are guaranteed to withstand temporary over voltage up to 40V without additional protection. We recommend that measures are taken to prevent voltage transients in excess of this limit.
MGL Avionics recommends the fitment of a fuse in line with a 33V transorb (available from MGL Avionics at low cost) to protect electronic instruments, radios and intercom systems. Only one such arrangement is required for a cluster of instruments.
Please note that product warranty excludes damages caused by unprotected, unsuitable or incorrectly wired electrical supplies.
Installation of the E1

The drawing on the following page shows the connections required to operate the E1.

The Thermocouple channels are labeled TC1 to TC4.
In cases of mixed use of these channels, the lower numbered channels are used for EGT while
the higher numbered are used for CHT probes.
If only two probes of mixed use are used, TC1 is for EGT and TC2 is used for CHT.
In cases where two channels are used only TC1 and TC2 are used.

Connect probes according to the colors of the wires. MGL probes. Supplied probes are marked
with a yellow and a red lead.
If you use other probes and are not certain of their polarity, simply connect one up as TC1 and
switch on the instrument. Warm the probe using your hand. If the indicated temperature
decreases you need to change the polarity around.

Shown is typical wiring used to connect a 12V lamp as external alarm indicator. If you have more
than one instrument you can wire all contacts in parallel so you can use a single lamp if so
desired.

Power supply here assumes a 12V DC source. It is recommended to install suitable protection
against over voltage such as can be generated by solenoids and starter motors

Be sure to install a reference connection between the minus terminal of the instrument and the
engine block. If the engine block is not connected to a good reference, readings may show large
errors. This reference connection must not be used as ground line for other current users. A
straight, good quality connection is required that is not shared with anything else.

Some RPM pickups may require loading with a ballast resistor, if this is the case for your engine,
connect as required.

Extending leads of probes and senders

Thermocouple leads as used with the EGT and CHT probes can be extended either with ordinary
copper cable or with special K-Type extension cable. The choice of either depends on your
desired accuracy.
If it is possible in your installation to ensure that both ends of a copper extension cable will be at
the same temperature (or very close), then it is quite possible to use the copper cable. In most
open-air installations this will be the case.
Should this not be possible or you require best possible accuracy at all times, you can obtain a
special K-type extension cable. This cable is made from the same metals as your probes cable
but uses ordinary plastic sleeving to save costs.
In either case, ensure that the cable is not routed close to sources of electromagnetic interference
of any kind. The voltages present in this cable are very small and are subject to changes applied
by external fields. This can lead to false temperature indications.
You can check your installation by using a hand-held transmitter, such as an airband radio. If you
transmit a signal, no change in temperature reading should occur.
**Alarm lamp**

Suggested rating: 1W

Also usable is a LED if used with suitable dropping resistor

**Red**

**Black**

**Fuse**

**Power switch**

Positive supply (+12V from battery)

Suggested fuse rating: 1.0 A slow blow

To other instruments

**Green**

**Orange**

**Blue**

**Terminal strip (not supplied)**

Ballast resistor (required for some systems)

Negative supply (airframe ground)

Reference ground to engine block

From engine RPM pickup

Oil pressure sender

**Bodies of temperature and pressure senders must have electrical connection to engine block. Engine block must have electrical connection to instrument ground.**

**Note: Brown wire is +5VDC output. Do not connect. This wire is intended as power supply for RPM pickups or signal conditioners.**

Cannon D-9 connector pin mapping and cable colors

1 - ground - Black
2 - temperature probe - Orange
3 - oil pressure - Green
4 - not used
5 - RPM pickup - Blue
6 - power (+12V) - Red
7 - power out - Brown (do not connect)
8 - not used
9 - alarm output - White

Cannon D-9 connector

Water or oil temperature sender

Terminal strip (not supplied)

Power switch

Positive supply (+12V from battery)

Suggested fuse rating: 1.0 A slow blow

Alarm lamp

Suggested rating: 1W

Also usable is a LED if used with suitable dropping resistor

Note: Brown wire is +5VDC output. Do not connect. This wire is intended as power supply for RPM pickups or signal conditioners.

**Pin 6**

**Pin 9**

**Pin 1**

**Pin 5**
In case of MGL K-type probes:

- + = Yellow probe lead
- - = Red probe lead

Join instrument wires to probe wires close to instrument so the junctions are at a very similar temperature compared to the D-15 connector. This will ensure maximum possible accuracy.

Thermocouple input wire codes:

- Blue ----------- - TC1 + pin 1
- Brown ---------- - TC1 - pin 2
- Green --------- - TC2 + pin 3
- Purple -------- - TC2 - pin 4
- Yellow ------- - TC3 + pin 5
- Grey --------- - TC3 - pin 6
- Orange ------- - TC4 + pin 7
- Pink ---------- - TC4 - pin 8
- Black ------- - Ground pin 15

Reference ground (connect to engine block)