

# Help file for K series ECU

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## **#\$K** Introduction to K400 Series Engine Management Systems

The Lumenition ECU that you have purchased is one of a range of engine management computers designed to control the ignition and fuel requirements for a wide variety of competition engines.

The Lumenition K400 is a plug replacement engine control unit (ECU) for the Rover K series engine as fitted on the Rover MGF and Lotus Elise. The system functions with all the existing sensors since not all the pins on the 36-way connector are used additional features could be included.

Features of these ECU's are; 3D mapping of ignition advance and fuel injection time and angle based upon engine load and rpm. Cold start, warm up and transient fuelling. Automatic adjustment of fuel mixture to compensate for air temperature and pressure. Engine rpm and position sensing from the crank toothed wheel sensor. Engine load measured by throttle angle or manifold absolute pressure. Multipoint semi-sequential fuel injection. Conventional distributor operation using internal ignition driver.

All of the controllable functions are programmed by the installer using the Lumenition Calibration tool, CAL600.

Although designed primarily for use with competition Rover K series engines the ecu includes all of the functions to create a performance road vehicle. If you have a requirement for a different system please contact Lumenition Engineering.

### VARIANTS

#### Z001

This is a four cylinder ECU using the Ford 36 minus 1, or Bosch 60 minus 2 crank tooth pattern. The ignition drive is distributorless with wasted spark. The fuel injection is sequential with the option of upper and lower injectors and a difference table.

## **#\$K** Contents of K400 ECU Kit

Listed below are the usual contents of an ECU kit.

- K400 Lumenition ECU
- Anti Vibration Mounting Kit
- Lumenition Motorsport Sticker

## **#\$K** Installation and Mounting of ECU unit

The ECU is not designed to be waterproof and must be fitted inside the passenger compartment of the vehicle. If this is not possible then the unit must be fully protected against heat, dust and moisture. The ECU should be fixed to a flat surface using the anti vibration buffers supplied. Spacing for the 4.5 mm holes necessary is given on the Physical Specification page. The buffers should be assembled as shown.

When choosing a position for the ECU you should ensure that the loom can be connected without undue stress on the wiring.

---

```
# IDH_K400_INTRO
$ Introduction to the K400 Series ECU
K ECU; ECU, K400 Series
# IDH_K400_CONTENTS
$ K400 Kit Contents
K ECU; ECU, Kit contents
# IDH_K400_INSTALL
$ Installation of K400 ecu
K ECU; ECU, Installation
```

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## #\$K [Connections on the ECU](#)

The ECU has two electrical connectors to allow control of the engine and calibration.

Engine Harness or Loom:

All of the relevant inputs to and outputs from the ECU used to control the engine are made via a 36 way locking connector. This is the standard connector fitted to the vehicles that have the K series engine. The connection pinout is matched to that of the 1.8i Multipoint harness. Although other engines in the range have similar connectors some minor rewiring may need to be carried out to allow the use of our K400 ECU.

See Also: [K400 Series ecu Connector Pinout](#)

When fitting the loom connector to the ECU ensure that it is pushed fully home and that the locking catch is engaged. To remove the loom from the ECU, depress the locking catch and pull the connector free. Do not pull the cable as this can put strain onto the terminals within the body of the connector which may lead to reliability problems.

The connection of the sensors and other parts of the system are described in the instructions that accompany the harness kit.

Calibration Tool Communications Port

Adjacent to the main connector of the ECU there is a small round 3 pin socket that allows connection to and programming by the Lumenition calibration tool.

Manifold Pressure Input

There is also a pipe fitting on the endplate of the K400 ecu to allow the inlet manifold pressure pipe to fitted. This should only be connected if it is intended to use the ecu in a mode that requires engine load to be estimated in relation to manifold pressure. If throttle angle is to be used to measure engine load then the fitting can be left free to air and the original pipe should be blocked to prevent leakage.

See Also:

[Manifold Absolute Pressure](#)

[Barometric Pressure](#)

[Engine Load](#)

## #\$K [ECU Inputs](#)

See Also:

So that the ECU can give the engine accurate fuel and ignition it is essential that the information received from its sensors is accurate and stable. To ensure that measurements are correct the Lumenition ECU is matched to the sensors fitted to the K series engine. Using these sensors it is possible to recreate and improve upon most of the functions of the original ecu and allow full control over the calibration of the engine requirements.

A look at the individual sensor information will indicate the control that each input provides and how each is best suited to your application.

See Also:

[ECU Outputs](#)

[Diagnostic Codes](#)

---

```
# IDH_K400_CONNECT
$ K400 series ecu connections
^K ECU; ECU, Connectors
# IDH_KECU_INPUTS
$ Inputs to the ECU
^K ECU; ECU, Inputs
```

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## #Sensors:

Engine Speed

Throttle Position

Manifold Pressure

Temperature

Exhaust Gas Oxygen (EGO)

Barometric Pressure

## #\$K Engine Speed Sensor

The Engine Speed sensor provides the ECU with information on both the current engine rpm and an indication of the relative position of TDC for cylinder number 1. The K400 ECUs recognise the timing pattern produced by the original 36 tooth, 4 gap flywheel. The standard engine sensor is a variable reluctance type that produces a sinusoidal type waveform related to the flywheel tooth pattern.

The 4 gap pattern enables the ECU to run semi-sequential injection and also the possibility of distributorless ignition (not supported as standard). Earlier K series engines are fitted with a two gap flywheel which must be altered before the K400 will operate. Also there are two different 4 gap patterns for later engines and the correct pattern used on your engine must be determined and calibrated into the ECU before the engine can be run.

See Also:

Tooth Patterns IDH\_KTOOTH\_PATTERNS

Scalars, TOOTH#

Scalars, TOOTH RUN

## #\$K Throttle Position

This is a sensor that measures the angle of the throttle butterfly that is commonly fitted to the throttle body shaft. The original Rover sensor fitted to the single throttle body can be used and also be fitted to the Lumenition direct to head Throttle Body kit. For naturally aspirated engines this can be used instead of manifold pressure to indicate engine load and forms the second axis against engine rpm for mapping fuel and ignition. A secondary function is to trigger acceleration and deceleration functions. The reading from this sensor is also used to determine Idle and starting conditions. For a forced induction engine manifold pressure is generally used to indicate engine load in which case the throttle angle is primarily used for idle and transient fuelling functions.

If an alternative induction system is used with a different throttle position sensor then you must determine its suitability for use with the K400 ECU. The sensor should be a three wire resistive device that never goes fully open or short circuit at the ends of its travel.

The ECU can be programmed to accommodate differing amounts of mechanical sensor movement for indication of minimum and maximum throttle.

See Also:

Variables: Throttle Angle

Variables: Load

---

# IDH\_KSENSORS

# IDH\_ENGINE\_PICKUP

\$ Engine Speed Sensor

K Sensors; Sensors, Engine Pickup; Engine; Engine, Speed Sensor; Input; Input, Engine Speed;

Crank Sensor; Distributor Pickup; TDC Sensor

# IDH\_KTHROTTLE\_POSITION

\$ Throttle Position Sensor

K Sensors; Sensors, Throttle Position; Input; Input, Throttle Position; Load; Load, Throttle Sensor;

Specification; Specification, Throttle Sensor

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[Variables; Raw TPS](#)

[TPS Range and Limit Settings](#)

[Diagnostic Codes](#)

## #\$K **Manifold Pressure Sensor**

In its standard configuration the K series engine uses manifold pressure for load sensing and the K400 ecu contains an internal 1Bar sensor for use if desired. If not used for engine load sensing the internal MAP sensor can be used to provide barometric pressure correction of fuelling.

For turbocharged or supercharged engines a load signal must be derived from a separate manifold pressure sensor and a suitable version of the K series ECU from Lumenition can be supplied. The standard K400 ecu does not support the use of an external MAP sensor

See Also:

[Scalar; MAP SENSE](#)

[Manifold Pressure Range and Limit Setting](#)

## #\$K **Temperature Sensors**

### **ENGINE TEMPERATURE**

A resistive temperature sender which is mounted into the engine cooling system. This sensor is used to control the amount of fuelling for warm-up and cold start enrichment. If the sensor is not connected or short circuit the ECU assumes a default engine temperature of 125°C and gives an error signal. The original sensor is Lucas type 3TT 73198A.

### **AIR TEMPERATURE**

A resistive temperature sender, mounted into the airflow of the inlet system. The original sensor is mounted into the inlet manifold but if you are changing the inlet system you must determine a suitable position for the sensor. It is important that the sensor is mounted so that it is insulated from the heat of the engine otherwise the ECU may be reading the heat of the body of the sensor and not the air surrounding it. For best results the sensor should be positioned directly in the airflow going into the engine. The sensor is used to automatically adjust the mixture to compensate for the change in density of the air charge at differing temperatures. If the sensor is not connected or short-circuit the ECU will assume a default value of 25°C and give an error signal.

The MGF has an additional air temperature sensor that is situated in the engine bay. This sensor provides the measurement that allows the ecu to control the Engine Bay cooling fan.

The original sensor is Lucas Type 3TT 73197A

See Also:

[Variable; Eng Temp](#)

[Variable; Eng Temp Mod](#)

[Variable; Air Temp](#)

[Variable; Air Temp Mod](#)

[Diagnostic Codes](#)

---

# IDH\_KMANIFOLD\_PRESSURE

\$ Manifold Pressure Sensor

K Sensors; Sensors, Manifold Pressure; Input; Input, Manifold Pressure; Load; Load, Manifold Pressure

# IDH\_KTEMP\_SENSORS

\$ Temperature sensors

K Sensors; Sensors, Temperature; Input; Input, Temperature sensors;

Specification; Specification, Temp Sensors;

Temperature; Temperature, Sensors; Air; Air, Temp Sensor; Engine; Engine, Temp Sensor

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## **#\$K** Internal Barometric Pressure Sensor

The K400 ecu is fitted with an internal barometric pressure sensor. This sensor is used to measure the ambient air pressure and automatically adjust the fuel mixture to suit the atmospheric conditions. The range of the sensor is 0mBar to 1050mBar which is suitable for most prevailing conditions. The current reading from the sensor is shown on screen as the variable Air Pressure. The modification to the fuel value given as a result of the barometric pressure reading is shown as the variable Air Pres Mod.

If the air pressure is above 1050mBar or the sensor is faulty the ecu will default to a value of 1000mBar.

See Also:

[Variable: Air Pressure](#)

[Variable: Air Pres Mod](#)

[Diagnostic Codes](#)

## **#\$K** HEGO Sensor

This is an exhaust-mounted sensor that can be used to indicate the air/fuel mixture into the engine. Most vehicle manufacturers now fit such sensors to allow them to run at regulated emissions. A switching type lean or rich sensor may be used to give a feedback signal for correcting the engine fuelling.

The HEGO sensor fitted to the K series exhaust system is used by the ECU to provide a display of air/fuel ratio on the screen and to allow the ecu to run closed loop. It is possible that in the future this input will be used to allow self mapping of the fuelling.

Note that the use of a HEGO sensor should be restricted to Unleaded fuel with no additives.

See Also:

[Variable: Air/Fuel](#)

---

```
# IDH_BARO_SENSOR
$ Internal Barometric Pressure Sensor
^K Sensors; Sensors, Barometric Pressure; Input; Input, Air Pressure
# IDH_HEGO_SENSOR
$ HEGO Sensor
^K Sensors; Sensors, HEGO; HEGO Sensor; Input; Input, HEGO;
Specification; Specification, HEGO Sensor
```

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## FUEL METERING

The basic fuelling is obtained from a table FUEL MAP with the same structure as the ignition maps. The base fuel pulse width is Fuel\_(map) the product of the currently interpolated fuel map value and MicroSec/Bit.

$$\text{Fuel\_}(\text{map}) = \text{MicroSec/bit} ( \text{VE}(\text{MAP})$$

Then various compensations are applied these are derived from Air\_Temp and Coolant temperature, Air\_pressure and the Oxygen sensors, with oxygen feedback derived from the exhaust oxygen sensor. The injection is timed from the specified tooth with an angular delay derived from the injection angle map with the same structure as the ignition and fuel maps.

The amount of fuel injected each cycle is dependent on the time the injector is open. This time period (or Pulse\_width) is calculated by the ECU using factors for volumetric efficiency, air temperature, air pressure, cold start enrichment, injector flow rate and battery voltage.

Volumetric efficiency V.E., the major factor, is determined by the value of Load calculated from the M.A.P. or TPS (throttle position sensor), and Engine\_speed using a three-dimensional look-up table. This 3D table is a simple grid with Load along one axis and engine speed along the other.

The throttle and M.A.P. range from closed to fully open is scaled to 130 points. The throttle axis has 14 sites, one every 10 points from 0 (idle) to 130 (full load). The engine speed axis is divided into 30 sites, one every 200 r.p.m. From 0 to 3000 r.p.m. and 400 r.p.m. from 3000 to 9000 r.p.m..

At each intersection of an engine speed site and a load position site there is a grid value. This is the volumetric efficiency value or V.E. and is directly proportional to the pulse width and therefore the amount of fuel injected.

These values are determined by running the engine on a dynamometer at each obtainable point and adjusting the V.E. values to obtain optimum performance. Values for unobtainable points, such as high-speed low load and low speed high load, are normally selected to blend in with the obtainable values. If the engine is running at an exact engine speed site and an exact load position site then the VE value at the intersection of these two sites will determine the amount of fuel injected.

Load				
Speed	100	110	120	130
5200	135	135	135	135
5600	142	143	144	145
6000	150	152	155	160
6400	165	170	175	180

If the engine speed is 5600 rpm and the load is 110 then the VE value will be 143. If the engine is running at a speed and load position between sites, then the VE value is determined by interpolating the four grid values around the engine running conditions. So using sample fuel map; if the engine speed is 5850 rpm and the load position is 118 then the four grid values are:

143 @ 5600 rpm 110 LOAD

144 @ 5600 rpm 120 LOAD

152 @ 6000 rpm 110 LOAD

155 @ 6000 rpm 120 LOAD

So the interpolated value is 149.

When starting the VE value is obtained from the cranking table that uses throttle position only. There is an additional start fuel amount that is decayed typically over the start decay value in seconds, see tables.

The VE value obtained from the grid is first modified by the operator variable factor Microsec/bit, so that:

$$\text{Fuel\_}(\text{map}) = \text{VE}(\text{MAP}) ( \text{MicroSec/bit}$$

Fuel\_mod is set by the operator using the monitoring and display system and is used to determine the optimum VE values. Under normal conditions Fuel\_mod = 0%.

Fuel\_(map) is then modified with factors for Air\_pressure, Baro\_Fact; Air\_Temp, Air\_Temp\_F air temperature factor; engine coolant temperature factor Cool\_Tmp\_F, an optional exhaust oxygen factor OX\_F.B. and user settable overall factor option called Fuel\_offset that is loaded into Fuel\_mod at power on; LD0M% fuel map compression; and while starting Crank\_Fuel.

$$\text{Fuel\_}(\text{map}) = \text{VE}(\text{MAP}) ( \text{MicroSec/bit}$$

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Fuel\_comp = Fuel\_(map) ( Fuel\_mod, (50%, LDOM% is also applied here.  
Fuel\_Air = Fuel\_comp ( Air\_Temp\_F ,(50% (10% typical.  
Fuel\_Warm\_up = Fuel\_Air ( Cool\_Tmp\_F, +0 to +250%, zero with warm engine.  
Fuel\_OX\_FB = Fuel\_Warm\_up ( OX\_F.B., (50%, see optional limits, (20% typical.  
Fuel\_Baro = Fuel\_OX\_FB ( Baro\_Fact, (50%, (10% typical.  
Fuel\_Start = Fuel\_Baro ( Crank\_Fuel, +0 to +100% start fuel.  
Fuel\_Throt = Fuel\_Start ( Throttle\_mod, (50%, (10% typical non-turbo.  
Fuel\_Pulse = Fuel\_Start ( Fullload\_Fuel, additional full load fuel.

Then two individual pulse-widths are calculated: INJxPW = Fuel\_Pulse ( Inj\_#x\_mod  
Inj\_#x\_mod are the two individual offsets for the two injection pulses they are scaled (50% .If there is no difference then the INJ\_#x\_mod option may be set to zero. The x in the INJx and INJ\_#x\_mod is related to the two injector outputs.

The final fuel pulse width is then calculated by adding a factor determined by battery voltage Bat\_Comp\_F and Accel\_Fuel. Battery voltage compensation ensures the accuracy of the fuel metering at all battery voltages, as it compensates for the variable opening times of different 16-ohm injectors for different battery voltages. Accel\_Fuel helps to compensate for transient and large demands found while accelerating and decelerating.

Fuel\_PW\_#x = Inj\_#x\_PW + Accel\_Fuel + Bat\_Comp\_F

However if D.F.C.O. (deceleration fuel cut off) is active then a minimum amount of fuel is delivered:

Fuel\_PW\_1&2 = Fuel\_1&2 + Bat\_Comp\_F & Fuel\_PW\_3&4 = Fuel\_3&4 + Bat\_Comp\_F

### TRANSIENT FUEL

The fuel map contains the fuel for steady state fuel transients such as acceleration and deceleration of the engine especially at gear changes can require different fuel. To prevent excessively lean or rich stumbles and emission control problems the E.C.U. has four functions: Deceleration fuel cut-off (D.F.C.O.), throttle triggered acceleration fuel enrichment, and throttle triggered deceleration enleanment, manifold absolute pressure triggered acceleration enrichment.

#### D.F.C.O.

When this function is active the engine fuel is dropped to a minimum. The trigger conditions for this function are:

Load < DFCO load option  
and Engine\_Speed > DFCO speed option  
and Coolant > Coolant OK option  
and Throttle < 2 , throttle closed

The closed loop oxygen control is inhibited while D.F.C.O. is active.

#### ACCELERATION FUEL

When there is a large change in throttle position measured every 4 milliseconds, then some additional time is added to the base fuel pulse width.

when +dThrottle > TPS\_Trip option

(+dThrottle(Acell\_M)+Accel\_C)(TPS\_Accel\_mod)(TPS\_Accel\_Amount)(Fuel\_Pulse

when -dThrottle > TPS\_Trip option

(-dThrottle(Acell\_M)+Accel\_C)(TPS\_Accel\_mod)(TPS\_Decel\_Amount)(Fuel\_Pulse

when ( MAP > + MAP\_Trip option

(dMAP)(MAP\_Accel\_mod)(MAP\_Ammount)(Fuel\_Pulse

These three potential sources of transient fuel are summed together with any Accel\_Fuel from the previous calculation. Accel\_Fuel is decayed every injection event or 8 milliseconds back-ground event thus, or if Fast Accel option is on then every 4 milliseconds.

Accel\_Fuel = Accel\_Fuel ( Accel\_Decay, (or Decel\_Decay if Accel\_Fuel is negative)

The decay action is applied every injection event. The filter for TPS allows for detection of smaller throttle changes; the minimum filter value is 0% with 93% giving maximum filter.

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### OXYGEN FEEDBACK

The oxygen sensor signal when functioning is allowed to modulate the fuel pulse width within the limits of options OX\_FB\_+ve and OX\_FB\_-ve. The proportional and integral controller iteration rate and error scaling are set by options OX\_FB\_Gain and OX\_FB\_Rate. The error signal OX\_error is derived from the oxygen switching history OX\_History and the Ox\_Error table. The most significant bit is the most recent condition of the oxygen sensor Oxygen\_raw, compared with the nominal stoichiometric point option called OX\_switch. The four most significant bits are presented to the table and a raw error returned. The raw error is scaled by OX\_FB\_Gain. The error is then processed by the proportional and integral controller, using the proportional and integral coefficients OX\_FB\_pro and OX\_FB\_int respectively. If the coolant temperature exceeds Coolant\_OK then the feedback signal modulates the fuel pulse width. To disable oxygen feedback set rate to zero.

### IGNITION TIMING

Ignition timing is controlled by a three-dimensional look-up table, addressed by engine speed and load. The speed axis has 22 sites 1 every 400-rpm from 800 to 9200. The load axis has 14 sites one every 10 points from 0 to 130. At each site the timing can be set from 0 to 60 degrees BTDC. Interpolation is used to ensure a smooth curve.

There are no compensation factors for ignition timing but there is a user-controlled factor Spark\_Mod that is used for reprogramming the ignition curves.

$$\text{Spark}_{(\text{mod})} = \text{Spark}(\text{map}) + \text{Spark}_{\text{mod}}$$

While cranking the ignition is determined by the Start\_ADV option.

When the idle condition is met, throttle is less than the Idle\_Throttle option the Idle Spark table is active and the Spark\_out parameter shows the effect of the high speed idle stabilisation attempting to control engine speed to Idle\_set.

$$\text{Spark}_{\text{out}} = \text{Spark}_{(\text{mod})} + \text{Spark}_{\text{Idle}}$$

Each trigger tooth has its own offset to allow for fine adjustment the difference should be kept to (2 degrees, although the range may be 0 to 30 degrees to span a tooth gap.

Pickup\_F is used to compensate for the small delays associated with sensors and ignition coils, if there is insufficient range then the Edge option should be changed as a slow edge has been selected. If required ignition retards for air inlet temperature, coolant temperature, and barometric pressure could be added.

### IDLE CONTROL

The idle control is a compensation for engine temperature as measured by the coolant sensor, and Engine\_speed, and the two optional factors A/C\_Idle and >12volt\_Idle. Two types of idle by-pass valves are supported; 5/6-wire stepper motor and 2-wire spring return, a 3-wire push/pull valve could be supported by arrangement. An additional high-speed control using Idle spark is also used to stabilise the idle speed.

### STEPPER MOTOR

When the option Idle\_PW is zero then the standard stepper motor outputs are active. The five or six wire stepper motor, is driven closed at power on this is given the nominal step position of 255 and then the stepper opens the by-pass to the value specified in the Idle\_step table and Idle\_speed table. Idle\_set is a slow proportional control parameter that is activated when Throttle < Idle\_Throttle option, and constrained not to exceed Idle\_set+ and Idle\_set- options, when engine speed is not equal to Idle\_set speed option. Idle\_MOD the user variable may be adjusted to optimise the table. A/C\_Idle is a response to an air conditioning request for an elevated idle. >12volt\_Idle is the response due to a low battery voltage.  
$$\text{IDLE} = \text{Idle from Step Table} + \text{Idle}_{\text{mod}} + \text{Idle}_{\text{speed}} + \text{Idle}_{\text{set}+} \{ \text{A/C\_Idle} \} + \{ >12\text{volt\_idle} \}$$

>12volt\_Idle is added to the current IDLE value when the battery supply voltage is less than 12.5volts.

A/C\_Idle is added if the air conditioning request is pulled low.

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Idle rate is the time between re-calculation of Idle when it has reached target. Note when Idle is greater than 248 the ECU will continuously close the valve. Additionally a dither cycle is added to help prevent sticking of the valve. Beware values of Idle\_rate less than 20mS as this may cause overheating, not necessarily a problem for K400 ECUs.

## PUSH VALVE

When the option Idle\_PW is not zero then a push valve is used for bypass control, where Idle1&2 (Idle 3&4 by arrangement for more drive current) outputs produce a pulse width modulated output. The rate is determined by the Idle\_PW option. This positions the valve to the value specified in the Idle\_step table and Idle\_speed table. Idle\_MOD the user variable may be adjusted to optimise the table. A/C\_Idle is a response to an air conditioning request for an elevated idle. >12volt\_Idle is the response due to a low battery voltage.  $IDLE = \text{Idle from Step Table} + \text{Idle\_mod} + \text{Idle\_speed} + \text{Idle\_set} + \{A/C\_Idle\} + \{>12\text{volt\_idle}\}$

>12volt\_Idle is added to the current IDLE value when the battery supply voltage is less than 12.5volts.

A/C\_Idle is added if the air conditioning request is pulled low.

Idle rate is the time between re-calculation of Idle when it has reached target.

## IDLE SPEED CONTROL

When Throttle is less than Idle\_Throttle option the Hi\_Idle\_Set option is used to derive d\_Idle\_speed until the Hi\_Idle time option has expired the Idle\_set is used. The d\_Idle\_speed is used to access the Idle\_Spark table to find Spark\_Idle to modify the ignition angle. Meanwhile a slower process is moving the idle motor towards a condition suitable for the target Idle\_Set options using the Idle\_set parameter constrained by the Idle\_set+ and Idle\_set- options. There is a Hi\_Idle option that will open the idle by-pass valve for the high idle condition, while Hi\_Idle\_count counts down.

While the engine coolant temperature is less than Hi\_Idle\_Cool the high idle condition will remain active.

## ERROR CODES

When a sensor error is detected by the system the error warning light will give an indication of the failure. When the engine is running the light will be off if there are no errors and on if the speed is at the light limit speed. When the engine is not running the light will be on if there are no errors. If there are errors when the engine is not running then the light will flash a coded message to indicate which error has occurred.

Each error code consists of two numbers counted out in flashes thus for code 2 3 the light will flash twice then be on for 1 second and then flash 3 times.

If there is more than one error then each code will be flashed in sequence with 5 seconds between codes.

CAL600 displays Error bits from left to right Bit 7 to Bit 0.

code failure

Bit 0	1 1	Throttle position sensor incorrectly adjusted or not connected.
Bit 1	1 2	MAP sensor, The manifold pressure sensor is faulty or not connected.
Bit 2	1 3	Air temperature sensor short circuit or sensor low.
Bit 3	1 4	Coolant temperature sensor high or sensor open circuit.
Bit 4	2 1	Air pressure sensor output low or not connected.
Bit 6	2 3	Oxygen sensor has failed to switch when enabled.
Bit 7	2 4	Checksum Error.

Fuelling and ignition data has been reprogrammed without resetting the checksum or data memory has been corrupted and should be uploaded again, or a comparison made.

# Help file for K series ECU

Help screens from K series software

## SCALARS

BAY FAN ON is the coolant temperature at which the bay fan will start, Rover MGF only.

BAY FAN OFF is the coolant temperature at which the bay fan will stop, Rover MGF only.

RAD FAN ON is the coolant temperature at which the radiator fan will start.

RAD FAN OFF is the coolant temperature at which the radiator fan will stop.

PURGE SPEED, Purge minimum engine speed in r.p.m. at this speed the purge valve will start to open.

PURGE MAX, Purge maximum pulse width duty cycle as a percentage, so how open the valve may be.

PURGE INC, Purge rate increase or decrease this controls the rate at which the valve open or closes to allow for absorption by the oxygen feedback.

PURGE PER, Purge period, this is the repetition rate of the valves pulse width period, larger numbers produce a slower frequency, only 0 to 7 are valid values.

REV LIGHT, is the speed in r.p.m. at which the "change up" lamp will illuminate.

FUEL CUT, Fuel cut rev limit in r.p.m. at which a complete fuel cut occurs.

FUEL MOD 1&4, allows for adjustment of a pair or fuel injector drives.

FUEL MOD 2&3, allows for adjustment of a pair or fuel injector drives.

JADV OFFSET this adds an overall offset to the injector opening angle.

ADV OFFSET is an overall ignition offset, should normally be set to zero.

FUEL OFFSET is an overall fuelling offset, should normally be set to zero.

MAP MIN is the minimum value of the map sensor in normal operation this was set in ROM before, to 15.

MAP MAX is the maximum value of the map sensor in normal operation, this was set to 250 in ROM, this value is slightly above normal atmospheric pressure on a DELCO 1 Bar sensor.

TPS MIN should be programmed with the value of TPS raw with the throttle in the idle or fully closed position.

TPS MAX should be programmed with the value of TPS raw at wide-open throttle.

To get the values of TPS RAW use the display F3 function.

LD0MPC this is a fuel map compression factor used to improve the dynamic range of the fuel map. 255 is an uncompressed map. The Optimise function is not currently activated in CAL600 so this scalar should remain at 255.

MICROSECOND/BIT or microseconds per bit the injector flow rate-scaling factor. This value is dependent on the size of the injector and the power of the engine. Ideally it should be adjusted so that the maximum value of VE in the VE table is between 200 and 220. The map manipulation can be used in conjunction with microsecond/bit to optimise the dynamic range of the fuel map, or the automatic LD0MPC in built feature can be used. (Not implemented in CAL600).

IGN CUT is the rev limiter and should be programmed with the rev limit speed, this parameter has a resolution of 100 rpm.

TPS TRIG is the acceleration and deceleration fuel enrichment/enleanment threshold. It is the value that Throttle must change in 8 milliseconds to trigger acceleration fuel enrichment. This value can only be determined by track testing, typical values are 3 to 10. To disable this function set the value to 255.

MAP TRIG is the acceleration fuel enrichment threshold. It is the value that Map, as Load must change in 8 milliseconds to trigger acceleration fuel enrichment. This value can only be determined by track testing, typical values are 3 to 10. To disable this function set the value to 255.

ACCEL DECAY sets how quickly the acceleration fuel decays when Accel\_Fuel is positive. If set to zero the acceleration fuel would be zero after one injection event, if set to 99% then the acceleration fuel will have a long sustain; typical values are 80%.

DECEL DECAY sets how quickly the acceleration fuel decays when Accel\_Fuel is negative. If set to zero the acceleration fuel would be zero after one injection event, if set to 99% then the acceleration fuel will have a long sustain; typical values are 80%.

TOOTH #1, specifies the tooth for the first ignition event in an engine revolution.

DELAY ANGL 1, is the angular distance from the first triggering tooth to a point 60°BTDC.

TOOTH #2, specifies the tooth for the second ignition event in an engine revolution.

DELAY ANGL 2, is the angular distance from the second triggering tooth to a point 60°BTDC.

# Help file for K series ECU

## Help screens from K series software

Delay Angle is the angle between the selected timing tooth and a point 60°BTDC this is in degrees, note this now has the range of 30° so it now more flexible.

```
+++ +++ +++   +++ +++ +++ +++ +++ +++ +++ +++ +++ +++ +++
+ +++ +++ +-----+ +++ +++ +++ +++ +++ +++ +++ +++ +++ +++
tooth No
      33   0   1   2   3   4   5   6   7   8   9  10  11
          _ 90° BTDC
                _ 70°
                  _ _ Delay Angle
                        _ TDC
```

This is in effect an electronic adjustment of timing.

TOOTH RUNS 1 TO 4 describe the disposition of missing teeth on the flywheel.

Current Engines 3,13,2,14 is appropriate, with Tooth 2 and 18.

Early and 1.4 L engines 5,11,4,12, with Tooth 6 and 21.

FUEL\_SYNC swaps the triggering events for the paired injectors so only 0 and 1 are valid.

START ADV is the ignition advance angle BTDC while cranking.

PICKUP FACT is used to compensate the systems timing pickup and ignition coil delays. All sensors have a small electrical delay that can cause a timing error at high speed. This error is particularly noticeable with magnetic detectors, this error is subtracted from the nominal timing point to give a virtual timing point, so the user need not compensate in their map for this sensor error.

The pickup delay is in units of 2 microseconds thus maximum delay is 511µSec just over half a millisecond. Typical value 50µSec.

COIL FACTOR controls the coils charge time for Lucas part DLB 198 a value of 14 should be used, as this will prevent excessive thermal dissipation. However for coils that can not saturate with a normal battery supply then this value may be increased up to 255. Note each unit is approximately 0.25 milliseconds of charge time. Many distributorless coils need about 25.

## SET-UP BITS

### TEST

AUTO EE WRT will force an entire write to the calibration memory, like pressing "c" when any change to the calibration is made.

FAST ACCEL will run the transient fuel calculation of Accel\_Fuel every 4 milliseconds rather than every ( milliseconds).

If MAP is set then LOAD will be calculated by scaling the pressure signal with MAP min and MAP max. If a 1 bar DELCO sensor is used then MAP and BAR can be set together so that when the engine is stopped a barometric correction is applied, and when out of cranking a LOAD derived from the MAP signal is used. Edge if set then the rising rather than falling edge of the input signal is used as the significant edge at 60 degrees BTDC point.

MIN AFUEL is the minimum amount of acceleration fuel to inhibit oxygen feedback.

WOT EXTRA, Fullload Fuel is the extra fuel added when the TPS Fullload value is exceeded.

Min speed is the minimum engine speed at which fuel and ignition pulses will be presented to the engine.

OX FB GAIN is a multiplier applied to the values from the OX Error table to produce the OX error value, this is scaled as a binary mantissa, so 0 gives 1 and 4 give 16.

OX FB RATE is how often the feedback PI loop is run in milliseconds the lower numbers mean faster so the gain may need to be adjusted accordingly. Zero will disable this function giving an OX Feedback of 0%.

OX SWITCH, or Stioch is the value of OX raw the raw value of the exhaust oxygen sensor at which the transition between lean and rich occurs. A typical value is 70, but is best found by halving the maximum (rich) value of display variable OX raw.

OX FB P is the oxygen feedback integrator proportional constant.

## Help file for K series ECU

Help screens from K series software

new OXFBK = (( old OXFBK + ( OXERR x INTCON )) + OXERR ( OXPCON

OX FB +VE and OX FB -VE are the limits for oxygen feedback control, OX\_FB\_+ve must be a positive number, OX\_FB\_-ve must be a negative number..

ENGINE OK, or Coolant Ok is the minimum warmed up engine temperature used to enable the deceleration fuel cut-off feature and Oxygen feedback.

OX LOAD is the maximum load at which the oxygen feedback will still operate.

OX SPEED is the maximum speed at which the oxygen feedback is still active.

OX STEP is a positive value added to OX\_FB when the sensor first switches lean, +5% typical.

DFCO LOAD is the maximum load at which the DFCO will still operate, note if MAP is used then TPS scaled as load must be less than 8. For a MAP based system this may be as high as 50.

DFCO SPEED is the minimum speed at which the deceleration fuel cut-off is still active, to disable DFCO set this to 25,500 rpm.

<12VOLTS IDLE, when the battery voltage drops below 12.5Volts this option is included in the idle position value calculation.

A/C IDLE, when the air conditioning requests more engine power this numbers is added to the current idle value.

IDLE RATE is the time between idle position pulses if no changes in position are required.

IDLE PW, when not zero then a two wire idle by-pass valve may be used in place of a stepper motor.

IDLE TROTTLE the maximum value of throttle for idle stabilisation control loop to be active, replaced with TPS Idle ON and TPS Idle OFF in later versions.

IDLE SET the target idle speed for the idle stabilisation control loop, if table Idle Speed TP not available.

IDLE\_SET+ and IDLE\_SET- the limits for the range of Idle\_set control loop, and must be scaled positive and negative accordingly. Typical values +20 and -20 steps.

ACCEL M and ACCEL C the modifiers of +dTPS and -dTPS for transient fuelling.

ACCEL\_LIMIT the limit to prevent excessive Accel\_Fuel as a percentage of Fuel\_Pulse.

HI IDLE OFFSET is the additional engine speed above target speed for the idle control loop initially until HI\_IDLE TIME expires, if tables: Idle Speed TP and Idle Set TP are not available.

HI IDLE TIME is the time that the Hi\_Idle\_Offset speed is valid after entering the idle condition.

HI IDLE STEP is the offset to open the by-pass valve to obtain a high idle. Typically -20steps.

HI IDLE COOL if the coolant temperature is below this value the high idle condition is maintained.

I OXFB GAIN and I OXFB RATE replace OX FB Gain and OX FB Rate when the engine is in the idle condition to ease emission control tuning when gas flows are low.

MAX IDLE is the maximum engine speed at which the idle control mechanism functions, later versions have RPM Idle ON and RPM Idle OFF to control the entry and exit from idle.

# Help file for K series ECU

Help screens from K series software

## INJECTOR BATTERY COMPENSATION TABLE

The value of the Battery comp option is the scalar for the Battery comp table. If this option is zero then the old table in ROM (not a user variable) is used. If you wish to view the shape of the table use the graph view. The injector battery compensation table is determined by the model and type of injector you are using. If you change injectors or fuel pump pressure you may need to change this table and or microsecond/bit, and re-scale the VE tables, this may also effect the optimum settings for injection open angle.

Battery comp  $F = \text{table value} * \text{Battery comp (option)}$

If we use the Weber IW 058 (43005.010) as an example of a contemporary high impedance injector:

$R = 14.5 \text{ ohms}$   $L = 7.2 \text{ mHenry}$ s

Flow rate 384 millilitre per minute at 300kPa

Battery Volts

Offset	time mSec
6.0	5.387
8.0	2.028
10.0	1.217
12.0	0.806
14.0	0.558
16.0	0.391

If 8 volts is the minimum battery supply for normal operation, then we can scale the system thus:

$2.028 \text{ mSec}/255$  for finest resolution =  $8 \mu\text{Sec}$  per bit

With the overall scaling of  $2 \mu\text{Sec}$  per bit then we may chose 5 ( $10 \mu\text{Sec}/\text{bit}$ ) for convenience.

Battery Volts

Offset time E.C.U. units

0.0 4

for  $8 \mu\text{Sec}$  multiplier

8.0 255

Always interpreted as 255

10.0 153

12.0 101

14.0 70

16.0 49

The missing values for odd voltages are best blended using the graphical editor (F3) in the mod program.

The original internal table would look like this:

0.0 9

for  $18 \mu\text{Sec}$  multiplier option

8.0 255

9.0 139

10.0 79

11.0 52

12.0 30

13.0 20

14.0 11

15.0 9

16.0 7

# Help file for K series ECU

Help screens from K series software

## WARM-UP TABLE

This is a table that controls how much additional fuel to use at any engine temperature from -17°C to 127°C.

## OXYGEN ERROR TABLE

This table converts the Oxygen history of transitions to the oxygen error signal applied to the proportional and integral feedback loop.

## START EXTRA TABLE

This is an additional amount of fuel added, dependent on coolant temperature, while the engine is starting, and is decayed linearly over time depending on the start decay time value.

## START DECAY TABLE

This table determines how quickly the additional start extra fuel is decayed over time. This decay is a linear decay in seconds after cranking commences.

## CRANK PULSE TABLE

This is a single shot of fuel that may be injected into the engine at Key on, or at the start of cranking if the Key on Fuel option is set Off. The value in the table selected dependent on temperature is multiplied by MicroSec/bit (MSPB) to give the parameter Start\_Pulse in microseconds.

## IDLE COOLANT TABLE

This table sets the idle by-pass used to control engine speed. The position is dependent on engine coolant temperatures. 0 represents a fully open valve and 255 a fully closed valve. At power on and after about 3 seconds after stopping the ECU will cycle the stepper motor to re-establish the fully closed condition. Scaled in steps. Note was called Idle step table.

## FULL LOAD TABLE

This Engine\_speed related table establishes the position of the throttle to enable Full\_Load fuel, an extra amount of full and freeze the oxygen feedback control.

## TPS ACCEL TABLE

This Engine\_speed related table determines the amount of throttle triggered acceleration fuel, see also Accel mod table.

## MAP ACCEL TABLE

This Engine\_speed related table determines the amount of MAP triggered acceleration fuel.

## TPS DECEL TABLE

This Engine\_speed related table determines the amount of throttle triggered deceleration fuel.

## OX FB I CONST TABLE

This table varies the oxygen feedback integral constant with engine speed, to improve regulation with the change in transport time between the inlet and exhaust sensor.

# Help file for K series ECU

Help screens from K series software

## IDLE SPEED TABLE

This table adjusts the idle stepper motor with engine speed, its output is the parameter Idle speed. Range (128steps).

## ACCEL MOD TABLE

This table modifies the primary acceleration fuel from the speed related TPS Accel table by producing the parameter Accel\_mod a percentage modifier.

## IDLE SPARK TABLE

The ignition advance is modified by this table when in the idle condition, (30 or (40degrees.

## IDLE SPEED TP TABLE

This is the target idle speed in rpm, and selected with throttle position.

## IDLE SET TP TABLE

This table adds an offset to the idle motor position according to throttle position, in steps usually negative.

## FUEL MAP

Fuel Map is the Load and engine speed map used to produce the base fuel VE(MAP).

## IGNITION MAP

Ignition map is the Load and engine speed map used to produce the base spark advance Spark\_adv.

## INJECTION ANGLE MAP

Inj Angle map is the Load and engine speed map used to offset the injection timing, Inj ADV.

## DISPLAY VARIABLES

Fuel mod this is the parameter that is effected by the up and down arrow keys to vary the current fuelling and has a range of +/-50%.

Spark mod this is the parameter that is effected by the potboxes (virtual and real) to vary the current spark advance and has a range of +/-22.5°.

ERROR is a binary encoded byte where the leftmost bit if a 1 means that the check sum of the non-volatile memory that holds the configuration data, options tables and maps does not tally. Use the compare function in CAL600 to check if no errors then just use the "c" key to correct.

The rightmost or least significant bit indicates a throttle position sensor failure. The next right most bit is a MAP sensor failure. Next is the air sensor followed by coolant. In summary:

Checksum,OX, ,BAR,Coolant,Air,MAP,TPS

TPS raw the unscaled throttle position sensor range 0-255.

Throttle the scaled signal range 0-130.

LOAD this is the engine load used for maps range 0-130.

+dThrottle is the current positive change in the value of Throttle, used to trigger acceleration fuelling.

-dThrottle is the current negative change in the value of Throttle, used to trigger acceleration fuelling.

+dZThrottle is the current positive change in the value of Throttle, when trigged for acceleration fuelling and scaled by Accel\_M and Accel\_C, this peak value is cleared to zero when Accel\_Fuel is zero.

-dZThrottle is the current negative change in the value of Throttle, when trigged for acceleration fuelling and scaled by Accel\_M and Accel\_C, this peak value is cleared to zero when Accel\_Fuel is zero.

Max\_+Afuel and Max\_-Afuel are the working limits for Accel\_Fuel.

Accel\_Fuel is the additional fuel pulse width due to acceleration fuel in microseconds.

## Help file for K series ECU

### Help screens from K series software

Accel mod is the value from the throttle related Accel mod table.  
Accel\_Trig is counter of acceleration triggers cleared to zero if Accel\_Fuel is zero.  
Engine Speed in rpm resolution 4 rpm.  
VE(MAP) the current fuel table value, range 0-255.  
VE\*FMOD the current fuel modified by FMOD, range 0-255.  
Fuel no c is VE(MAP) multiplied by microsecond/bit, scaled in microseconds, range 0-131,070µSec.  
Fuel comp is the fuel pulse after the load factor from LD0MPC compression factor is applied.  
Fuel FMOD is the fuel pulse after the FMOD user modifier, range 0-131,070µS.  
Fuel air after air temperature modifier, range 0-131,070µS.  
Fuel warm-up after warm-up modifier, range 0-131,070µS.  
Fuel OX FB after Oxygen feedback applied, range 0-131,070µS.  
Fuel Baro after barometric modifier if required, range 0-131,070µS.  
Fuel Start after the start modifier if required, range 0-131,070µS.  
Fuel PW is the pulse width the final pulse width including any full load fuel.  
Spark adv the current ignition map value, range 0-60°.  
Spark (mod) after Spark mod.  
Spark idle the effect of the Idle Spark table when in idle condition.  
Pressure Raw the unscaled MAP/BAR input 0-255.  
Air Pressure range 0-127.5 kPa.  
Air Prsr F barometric correction factor +/-15%.  
Battery the current battery voltage 0-16 volts.  
Bat Comp F the additional injector open time in µSec.  
Air Temp in degrees Celsius.  
Air Temp F correction of fuel due to air temp +/-30%.  
Cool Tmp F correction of fuel due to coolant warm-up 0-250%.  
Coolant in degrees Celsius.  
Charge Time the coil on time in microseconds.  
MAP as LOAD is the MAP signal scaled for load, range 0-130.  
Oxygen raw is the unscaled amplified oxygen signal 0-255.  
Ox Error is the error signal from the oxygen error table.  
OX Feedback is the output of the PI loop, range +/-50%.  
OX History is the bit pattern history of OX raw transitions.  
Start Fuel the extra fuel from the Start Extra table 0-250.  
Crank Time the time for which the Start Extra fuel will be applied, valid when engine stopped.  
Start Pulse the one shot fuel pulse to aid starting in µSec.  
TPEER is the accumulation of timing errors, timing errors occur if an invalid number of teeth are detected between missing teeth, or if a tooth gap greater than two teeth is detected.  
Idle mod is the user adjust of idle position, Adjustable by Potbox.  
IDLE is the target position of the idle stepper motor, the base value is taken form the Idle step table.  
Idle speed is the engine speed compensation of the idle stepper position.  
KNKRAW is the normal 0-5volt scaled as 0-255 input on pin 10B.  
HiIdle count is down counter till the Hi\_Idle\_set speed is replaced by Idle\_set.  
d Idle Speed is the difference between actual Engine Speed and the target Idle\_set speeds.

# Help file for K series ECU

Help screens from K series software

## #<sup>\$</sup>K400 Series ECU Pinout

PIN OUT The 36 way AMP connector junior timer type, external view.

Rover numbering:                   25 26 27 28 29 30 31 32 33 34 35 36  
   24 23 22 21 20 19 18 17 16 15 14 13  
   1 2 3 4 5 6 7 8 9 10 11 12

Latch at top

K400 numbering: ROW   A       1 2 3 4 5 6 7 8 9 10 11 12  
                                  B           1 2 3 4 5 6 7 8 9 10 11 12  
                                  C           1 2 3 4 5 6 7 8 9 10 11 12

Latch at top

1A           Ignition output to coil .  
2A           Bay Fan relay drive.  
3A           Idle stepper motor drive #4.  
4A           Main power, now not used.  
5A           Power ground.  
6A           Analogue ground.  
7A           Crank Signal input.  
8A           Crank Signal ground.  
9A           Engine temperature sensor input.  
10A          Engine bay temperature sensor input.  
11A          A/C request input.  
12A          Oxygen sensor relay drive.

1B           Injector pair 1&4 drive.  
2B           Injector pair 2&3 drive.  
3B           Idle stepper motor drive #3.  
4B           Carbon canister purge valve drive.  
5B           Fuel pump relay drive.  
6B           not used.  
7B           Oxygen sensor ground.  
8B           Rev light active low signal.  
9B           Inlet air temperature sensor.  
10B          Fan request?  
11B          not used.  
12B          Immobiliser.

1C           not used.  
2C           Idle stepper motor drive #2.  
3C           Idle stepper motor drive #1.  
4C           Main relay drive.  
5C           A/C relay drive.  
6C           Radiator fan relay drive.  
7C           Exhaust oxygen sensor.  
8C           Throttle position sensor signal.  
9C           5 volt sensor power.  
10C          Standard Diagnostics.  
11C          Permanent 12 volt power, now Main Power .  
12C          Tachometer drive.

---

# IDH\_K400\_PINOUT

\$ K400 series ECU Pinout

<sup>K</sup> ECU; ECU, Pinout;

# Help file for K series ECU

Help screens from K series software

## AIR CONDITIONING CONTROL

The ECU is intended to interact with the air conditioning system. This has not been implemented yet, the Rover documentation is some what ambiguous!

The OE systems works in the following fashion.

An A/C request sense appears at pin A11 [35] active low I think .

The ECU would open the idle by-pass a bit to compensate for the additional load.

The ECU will then activate the A/C compressor clutch and fan pin B6 [19] low.

On the K400 ecu V0.16.

In the absence of ECU control, pin B6 is removed from connector and connected to A11 the compressor circuit should function.

An A/C Fan request appears at pin B10 [15] active low.

The ECU would activate the condenser fan and cooling fan#1 pin C5 [5] and cooling fan#2 pin C6 [6] (also Radiator FAN).

So to maintain this function remove B10 and C5, then link together.

Note to remove crimps from AMP 36 way connector; demate from ECU, remove white latch plate, use small point to lift crimp latch on top of access from mate side, while gently pulling on wire.

## # ECU Outputs

The ecu controls the engine and ancillary devices by supplying output signals to other electronic or electro-mechanical devices. A number of standard outputs are available from the C400 series ECU.

See Also:

[Ignition](#)

[Fuel](#)

[Fuel Pump](#)

[Up-Shift Indicator](#)

## # Ignition

The C400 series ECU provides ignition outputs suitable to drive up to three Lumenition Constant Energy Modules (CEM). The CEM controls the coil charging time and provides the spark voltage protection and suppression required of an ignition driver. This leads to an ECU of reduced complexity and cost with increased flexibility.

When triggered from an LDR signal a single CEM and coil, using the distributor to direct the spark to each plug, provides the ignition.

When triggered from an HDR signal the ECU will drive 2 or 3 CEM's to provide distributorless operation on 4 or 6 cylinder engines.

If desired the distributor can be retained when using an HDR crank signal but a short adaptor loom will be required to connect our standard loom to a single CEM. This adaptor loom is normally supplied in the appropriate IK for this type of application.

---

```
# IDH_ECU_OUTPUTS
$ ECU Outputs
# IDH_IGNITION_OUT
```

# Help file for K series ECU

Help screens from K series software

## #Fuel

The Lumenition C400 series ECU has 3 or 4 injector drive outputs capable of driving 4, 6 or 8 electronic injectors. The injectors should be of the multipoint, 15 ohm type. These injectors are the same as those used in the majority of manufactured injected engines. Many different injectors are available with varying fuel flow and range characteristics. A brief guide to choosing injectors is given in the Lumenition Installation Kit instruction manual ( Document No. 90226 / 3.0 ). Lumenition can supply injectors suitable for engines up to approximately 75bhp/ cylinder.

On 4 cylinder applications it is possible to drive two injectors per cylinder to increase fuel flow at higher rpm. When used in this way all injectors will be operating throughout the rpm range, which will probably lead to overfuelling at low rpm giving poor idle and bad throttle response. There may be other factors that make this method of fuelling inappropriate.

Fuel injection is synchronous when LDR triggering is used and all injectors will fire at the same time once every engine revolution. This means that the fuel requirement for each cylinder is provided in two successive firing from its injector. If HDR triggering is used then half of the injectors will fire during the first 180 degrees of crank rotation and the other half will fire in the next 180 degrees of revolution. This is called banked or semi-sequential injection and gives better matching of injector firing to valve timing at low to mid engine speeds. At higher engine speeds the injectors are generally open for long enough to coincide with intake valve opening anyway.

## #Fuel Pump

An output from the ECU is provided to drive a relay to operate the fuel pump. The loom is supplied with a connector for this relay. The pump is switched on for a short time when the ECU is first powered up to prime the fuel system after which it will switch off. The pump will stay off until an engine speed signal is detected, after which it will remain on until either the ECU is powered off or the engine signal stops (stalled engine). The fuel pump driver is capable of switching a standard automotive relay.

Under no circumstances should a fuel pump be connected directly to the ECU output.

## #Up-shift Indicator Drive

There is an ECU output provided which is rpm controlled. The rpm at which this low power driver switches can be set using the UPSHIFT\_RPM\_scalar.

Primarily intended for a gear change indicator it can be used to operate any rpm dependant function, such as extra injectors or nitrous oxide pumps via a relay.

The driver is low power and has limited output capability. For Up-shift indication it is better suited to drive a large high intensity LED rather than a bulb. A Lumenition Up-shift indicator is available as a separate part.

For driving larger loads a relay must be used. The relay coil must be 12v with a resistance of greater than 200 ohms.

---

# IDH\_FUEL\_OUT  
# IDH\_FUEL\_PUMP  
# IDH\_UPSHIFT\_IND

# Help file for K series ECU

Help screens from K series software

Pin	C400	C410	C451	C460	C660
1	12v Supply	12v Supply	12v Supply	12v Supply	12v Supply
2	ENG Temp	ENG Temp	ENG Temp	ENG Temp	ENG Temp
3	AIR Temp	AIR Temp	AIR Temp	AIR Temp	AIR Temp
4	TPS Input	TPS Input	TPS Input	TPS Input	TPS Input
5	HEGO	HEGO	HEGO	HEGO	HEGO
6	MAP Input	MAP Input	MAP Input	MAP Input	MAP Input
7	LOAD Pwr	LOAD Pwr	LOAD Pwr	LOAD Pwr	LOAD Pwr
8	SensorGnd	SensorGnd	SensorGnd	SensorGnd	SensorGnd
9	LDR Power	HDR VRS-	LDR Power	HDR VRS-	HDR VRS-
10	LDR Signal	HDR VRS+	LDR Signal	HDR VRS+	HDR VRS+
11	N/C	CEM B	N/C	CEM B	CEM B
12	CEM A	CEM A	CEM A	CEM A	CEM A
13	Fpump Rel	Fpump Rel	Fpump Rel	Fpump Rel	Fpump Rel
14	Up-shift	Up-shift	Up-shift	Up-shift	Up-shift
15	N/C	N/C	INJ A	INJ A (1)	INJ A
16	N/C	N/C	INJ B	INJ A (2)	INJ B
17	N/C	N/C	INJ C	INJ B (1)	INJ C
18	N/C	N/C	INJ D	INJ B (2)	CEM C
19	GND 1	GND 1	GND 1	GND 1	GND 1
20	GND 2	GND 2	GND 2	GND 2	GND 2

## Electrical Specification

Supply Voltage	Min 7v	Max 25v Nominal 12 - 13v
Supply Current	200mA	ECU only
Injector Drive Current	Peak 2.4 A	Hold 1 A
Injector Drive Load	Min 2.5 Ohm. Min 15 Ohm	4 Cylinder Others
LDR Pickup Supply voltage	~8v	45mA
Temperature Range	-10°C to +85°C	

## # \$ <sup>K</sup> Scalar List

### Definition of Calibratable Scalars.

The Scalars that are available to the user for controlling the performance of the ECU are presented in screens and grouped together according to their function.

### Map Scalars

Map scalars act upon the values taken from the Fuel and Ignition maps and modify them to produce the actual outputs from the ECU.

Table Multiplier, MAM Offset, Imod, Fmod, Ignition Compensation

### Engine Settings

Engine settings are the scalars that match the ecu to the input signal from the engine and the limits for the engine.

Engine Type, Setup Register, Up-Shift, Rev-Limit

---

# IDH\_SCALAR\_LIST

\$ What Scalars are used?

<sup>K</sup> Scalars; Scalars, Available; Scalars, What are ?

# Help file for K series ECU

Help screens from K series software

## Start & Cold Mods

Start and Cold modifiers affect the action of the ecu during engine starting and warmup.

Crank Injection, Cold Crank Factor, Warmup Factor, Temperature Threshold, Start Ignition Delay

## Acceleration Factors

Control the operation of the extra fuelling required for engine acceleration.

Accel Factor, Accel Trip, Accel Decay

## Load Scalars

Set the limits for the sensors that are used to measure the engine load.

TPS Minimum, TPS Maximum, MAP Minimum, MAP Maximum

## Setup Scalars

Individual On / Off settings for those items represented in the Setup Register and Engine Type.

Cylinders, Wheel Type, Opto Input, Start Delay, B'Grnd Loop, MAP Sense, Ign & Fuel Limit

## # \$ K Fuel Table Multiplier

Name	Range Value	Resolution
TABLE MULT or MSPB	0 - 500 uS	2uS

Fuel Map Table Multiplier (MSPB) operates upon the Base Map Fuel No. from the map and turns that value into a mS pulse width. Fuel No. multiplied by this value will give the actual Injection Pulse Width before corrections.

The most important aspect is to scale the Table Multiplier to ensure that you get the best resolution from the map to give fine adjustment to the fueling of the engine over its full range of operation. It is necessary to check that the injectors will not operate for greater than 80% to 90% to retain control of the fueling. The table below shows the value for Table Multiplier for a range of maximum engine speeds. This assumes that your Fuel No. at maximum rpm is about 220. This value should be set prior to performing any real calibration work on an engine.

Recommended maximum values of Multiplier for expected maximum engine speeds are shown here:

Max. Engine Speed (RPM)	Max. Value for (MSPB) 4,6 & 8 Cyl
6000	38
6200	38
6400	36
6800	34
7000	34
7200	32
7400	32
7600	30
7800	30
8000	28
8200	28
8400	28
8600	26
8800	26
9000	26
9200	26
9400	24
9600	24
9800	24
10000	24

---

# IDH\_TABLE\_MULT

\$ TABLE MULT

K Scalars; Scalars, TABLE MULT; Fuel; Fuel, Table Multiplier

# Help file for K series ECU

Help screens from K series software

## # \$ K **Most Advanced Marker Offset**

Name	Range Value	Resolution
MAM OFFSET	0 - 255	1 bit

The MAM (Most Advanced Marker) OFFSET is the scalar which permits the Lumenition CX00 family of ECU's to be triggered from a variety of differing trigger generators. Its exact method of operating is dependent upon whether the ECU is designed to be triggered from a High Data Rate or a Low Data Rate signal.

### Low Data Rate Triggering

In the case of **Low Data Rate** triggering these usually are Hall Effect and Lumenition Opto trigger profiles. In real terms it is possible to place the MAM trigger signal edge almost anywhere in the crank range. The significance of the MAM is that this is the edge which the ECU uses in calculating where to place the spark. To ensure good Distributor Rotor arm phasing it is necessary typically to have one trigger signal (trailing) edge correspond to the Top Dead Centre (TDC) point in the crankshaft rotation. this will typically result in the leading or MAM edge being somewhere between 50 and 130 degrees Before TDC.

**NB : Only use fully locked up Bob Weight Type distributors as trigger inputs as any additional mechanical advance could risk engine damage.**

The Lumenition CX00 ECU's ability to be triggered from OEM Hall Effect Distributors and also Lumenition Opto converted types means that the MAM value is used to tell the ECU how soon after the MAM edge the full advance of 45 degrees occurs. This value can be defined for most common Lumenition FK type plastic Choppers and additionally for most common Bosch Hall Effect distributor triggers

The value can be calculated by use of the Equation below ;

$$\text{MAM OFFSET} = \frac{((\text{MAM (Deg)} - 45 \text{ Deg}) * 255) - 2}{\text{FINT}}$$

FINT is the firing interval in crank degrees. i.e. 4cyl = 180, 6cyl = 120, 8cyl = 90.

For most common Lumenition Fitting Kits this gives a value of **130** for MAM Offset, whereas FK511 which designed specifically for mapped systems uses a value of **101**. The Ford OHC Bosch Hall effect Distributor uses a value of **44** due to its later occurring MAM edge.

Check with Lumenition Engineering for the latest published list of MAM values against specific Distributor applications.

In setting this value up it is usually only necessary to get it close enough for the engine to run and then bring it in by editing the number whilst the engine is running. In changing its value you should endeavour to bring the Displayed Spark advance in line with that observed by using an adjustable Ignition timing light on the crankshaft.

The value is correctly set when the displayed ignition advance matches that observed for all ignition angles. To achieve this firstly set the range by use of MAM OFFSET and finally match it at all points by slightly adjusting the distributor position. Once the two are matched then the distributor position should be locked and advisably marked. the value of MAM OFFSET should not be edited any further and all ignition calibration performed using the Map structure.

### High Data Rate Triggering

Conversely when used in the case of high Data Rate Triggering the MAM Offset is used to fine tune the Ignition advance to allow for small errors in the positioning of sensors and toothed wheels. In this mode

---

# IDH\_MAM\_OFFSET

\$ MAM\_OFFSET

K Scalars; Scalars, MAM\_OFFSET; Ignition; Ignition, Offset

# Help file for K series ECU

Help screens from K series software

the maximum range of adjustment is equal to the tooth interval. i.e. 10 degrees on a 36 tooth wheel. For a further explanation see under Engine Type

## # \$ K Overall Ignition Modifier

Name	Range Value	Resolution
IMOD.	-22.5 - +22.5 deg	0.5 deg

IMOD allows the user to apply a fixed adjustment of Ignition angle over the whole range of the Ignition map. The scalar is included here for compatibility with the CAL101 which does not have the same powerful map editing functions as the CAL500 or CAL600.

It is recommended if the engine is running with a value of IMOD that is not zero then the user should set IMOD to zero and use the Ignition Map edit function to adjust all of the map values directly by the IMOD value. IMOD should be zero before using the Monitor screen or Potbox on line edit functions.

## # \$ K Overall Fuel Modifier

Name	Range Value	Resolution
FMOD.	-50% to +50%	0.5%

FMOD allows the user to apply a fixed adjustment of percentage over the whole range of the Fuel map. The scalar is included here for compatibility with the CAL101 which does not have the same powerful map editing functions as the CAL500 or CAL600.

It is recommended if the engine is running with a value of FMOD that is not zero then the user should set FMOD to zero and use the Fuel Map edit function to percent change all of the map values directly by the FMOD value. FMOD should be zero before using the Monitor screen or Potbox on line edit functions.

## # \$ K Ignition Compensation

Name	Range Value	Resolution
IGN COMP.	0.00 to 3.00 deg	0.012 deg

Ignition Compensation is a value that can be set into the ECU so that the displayed Ignition Advance (at high rpm) matches that indicated when using a strobe timing light. With this value set to 0.000 deg (default value) then you will find that the Ignition Map values will be slightly higher than indicated by the strobe light operating at high rpm. If all your tuning will be carried out using the ECU then you can accept the map values as correct. If you wish to directly compare strobe values taken at high rpm with the ECU calculated values (i.e.. for back to back tests) then a setting of IGN COMP. may be required.

To calculate a value for IGN COMP. you must measure the ignition advance from the engine at two RPM sites (usually idle and 5000 to 6000 rpm) and note the difference between the CAL500 display and the measured advance. The value is then entered in degrees difference per 1000 rpm.

Assuming display and measured are matched at idle:

$$\text{IGN COMP.} = \frac{\text{difference @ high rpm} \times 1000}{\text{difference in rpm}}$$

---

```
# IDH_IMOD
$ Ignition Modifier
K Scalars; Scalars, IMOD; Ignition; Ignition, Modifier
# IDH_FMOD
$ Fuel Modifier
K Scalars; Scalars, FMOD; Fuel; Fuel, Modifier
# IDH_IGN_COMP
$ IGN COMP
K Scalars; Scalars, IGN COMP; Ignition; Ignition, Compensation
```

# Help file for K series ECU

Help screens from K series software

Example @ 1500 rpm values matched of 18 deg  
@ 5500 rpm display is 32 strobe shows 29

IGN COMP. =  $3 \times 1000 / (5500 - 1500) = 3000 / 4000 = 0.750 \text{ deg}$

**Note:** *This value should be set before any major ignition mapping work is undertaken. The value set is valid only for the particular engine and test equipment used at the time. Using other timing light or engine sensors may require a different IGN COMP. setting. It is always recommended that IGN COMP. is set to zero and ignition advance map is calibrated according to the results of engine power tests.*

## # \$ <sup>K</sup> Engine Type

Name	Range Value	Resolution
ENGINE TYPE	0 - 255	1 (number)

*This Scalar has been retained for backward compatibility to previous Lumenition Calibration tools.*

See Also:

This particular parameter is rather complex but is used by the ECU to configure itself for either Low Data Rate or High Data Rate triggering and additionally tells the ECU the No of cylinders the engine has. The number provides the ECU with the nature of the "missing tooth" pattern applicable. It is generally easier to refer to the table below for guidance as to programming.

For **Low Data Rate** triggered systems the ENGINE TYPE is simply set to the number of cylinders of the engine. Ensure that the correct MAM Offset is used before starting the engine.

For **High Data Rate** systems the ENGINE TYPE is set to a number chosen from the table below. If your particular engine is not shown you will need to count the teeth on the trigger wheel and measure the angle of the crank BTDC when the sensor is aligned with the gap and choose the nearest setting.

Note : It is generally used in conjunction with MAM Offset.

Engine	MAM Offset	Vehicle/Engine Type
20	128	4 Cyl Ford EEC IV, 36-1 @ 90 deg BTDC eg CVH, DOHC, ZETEC,
36	128	4 Cyl Bosch Motronic, 60-2 @ 120 deg BTDC Vauxhall eg 2.0 16v, Late Astra/Nova Peugeot 205 Gti, 309 & 405 1.9I etc.
52	0	4 Cyl Bosch Motronic, 60-2 @ 90 deg BTDC Volvo Turbo, Formula Renault Engines
70	128	6 Cyl Ford EEC IV, 36-1 @ 60 deg BTDC Scorpio 2.4I, 2.9I, V6 24v Probe 24v
84	213	4 Cly VW Digifant, 60-2 @ 80 deg BTDC Golf Gti G28 Engine '92 on
86	213	6 Cyl VW Motronic, 60-2 @ 80 deg BTDC Golf 2.8I VR6
102 *	128	6 Cyl BMW Motronic, 60-2 @ 90 deg BTDC 520I, 525I ETC. M20 Engines
116 *	128	4 Cyl Rover MEMS, 18-1x2 @ 180 deg BTDC Mini 1.3I, K-Series to 96
132 *	128	4 Cyl Renault Renix, 22-1x2 @ deg BTDC Most Models.

---

# IDH\_ENGINE\_TYPE

\$ ENGINE TYPE

<sup>K</sup> Scalars; Scalars, ENGINE TYPE

# Help file for K series ECU

Help screens from K series software

*\*New for ECU's after 01260*

There may be other vehicles and engines that are supported by this list and will be added as we discover them. If your target engine is not listed then please get in touch with us for technical information.

## # Engine Type Split

CYLINDERS

WHEEL TYPE

## # \$ <sup>K</sup>The Setup Register

Name	Range Value	Resolution
SETUP REG.	0 - 255	1 Num

*This Scalar has been retained for backward compatibility to previous Lumenition Calibration tools.*

See Also:

The SETUP REGISTER is a very special control parameter which is capable of configuring the ECU to allow it to select the following list of features :

- Bit 2 : Select either Hall Effect or Lumenition Opto triggering input on LDR.
- Bit 4 :Enable the Cranking Ignition delay feature, In LDR.
- Bit 5 :Select one of 2 methods of decaying out the acceleration fuel enrichment.
- Bit 6 :Select the use of an external Boost pressure sensor input as the Primary Load input.
- Bit 7 :Select Fuel Rev Limiter to operate first.
- Bit 8 :Select Ignition Rev Limiter to operate first.

The actual number which the user inputs is a decimal number in the range 0-255 but whilst changing it the display will show it as a binary 8 bit number which in conjunction with the explanation below shows how each bit can either be a 0 or a 1. A zero typically turns off the feature whilst a 1 will turn it on.

*N.B. As a safety feature the ECU will not respond to a change in the value of SETUP REGISTER until the operator deliberately powers down the ECU. On the next power up the ECU will use the new stored configuration.*

8	7	6	5	4	3	2	1	Bit No
128	64	32	16	8	4	2	1	Bit Value
?	?	?	?	?	0	?	0	

Not Used  
0=Hall Effect, 1= Opto

Not Used

Start Ign Delay On = 1, Off = 0

Accel Decay on Background Loop =1,else =0

Use External Boost Sensor = 1, Not = 0

Fuel Rev limiter to operate 1st = 1, Not = 0

Ignition Rev Limiter to operate 1st =1, Not = 0

If Fuel Rev Limit = 1 & Ignition Rev Limit = 1, both operate at same speed

If Fuel Rev Limit = 0 & Ignition Rev Limit = 0, no rev limit operates

The procedure to use when calibrating this parameter is to initially write out the pattern of 1's and 0's that you require to turn on/off the features.

Then, with the ECU powered but engine not running, and using the Bit Value list, add up the summation of all the individual feature values and arrive at a total.

---

# IDH\_ETYPE

# IDH\_SETUP\_REG

\$ SETUP REG

<sup>K</sup> Scalars; Scalars, SETUP REG

# Help file for K series ECU

Help screens from K series software

Name	Range Value	Resolution
Setup Reg.	0- 11111111	1 Num

This display is the SETUP REG. displayed as a binary number. This value can be compared with the pattern above so that the individual switches can be confirmed.

## #SETUP Switches

OPTO INPUT  
STRT DELAY  
B'GRND LOOP  
MAP SENSE  
FUEL LIMIT  
IGN LIMIT

## #\$<sup>K</sup> Gear Shift Indicator RPM

Name	Range Value	Resolution
UP-SHIFT	100-20,000	100 RPM

UP-SHIFT SPEED is the engine speed at which the Up-Shift lamp driver circuit within the ECU is enabled. Typically this would be set to correspond to a point just after peak Engine Torque has been achieved.

## # \$<sup>K</sup> Engine Rev-Limit RPM

Name	Range Value	Resolution
REV - LIMIT	100-20,000	100 RPM

The REV LIMITER is the parameter used to control the maximum engine speed used under normal running. The user can decide to either limit on the ignition or the fuel first and have the other cut come in at a point +200 Rpm higher.

E.g. if the user has set the Bits in the SETUP REGISTER to cause the Fuel cut to operate first and has set REV LIMITER to 5600 Rpm then the fuel will cut at 5600 and ignition will cut at 5800 Rpm. *If neither bit is set in the SETUP REGISTER then no cut will operate irrespective of the actual value set in REV LIMITER.* If the user selects the Ignition cut to operate first it will produce a very fierce engine braking effect. If the Fuel cut operates prior to the Ignition cut then a smoother Rev Limiter is achieved.

---

# IDH\_SETUP  
# IDH\_UP\_SHIFT  
\$ UP\_SHIFT  
<sup>K</sup> Scalars; Scalars, UP-SHIFT; Rpm; Rpm, Upshift setting; Gear speed indicator  
# IDH\_REV\_LIMIT  
\$ REV-LIMIT  
<sup>K</sup> Scalars; Scalars, REV-LIMIT; Rpm; Rpm, Limit setting; Limit, Rpm

# Help file for K series ECU

Help screens from K series software

## # \$ K Crank Injection Pulse

Name	Range Value	Resolution
CRNK INJ.	0.0 - 25.5 mS	0.1 mS

The CRANK INJECTION PULSE is a cranking single shot of fuel which is triggered by the very first trigger edge coming into the ECU from the crank sensor. It is specifically designed to overcome Manifold wetting problems with very cold engines. This mode operates at all engine temperatures as it has been found to be beneficial to starting even hot engines.

## # \$ K Cold Crank Injection Factor

Name	Range Value	Resolution
COLD CRANK	0 - 100 %	1 %

The COLD CRANKING FACTOR is used to define the level of fueling enrichment required during the cranking phase of cold engines.

The number which the user calibrates is a simple %age which has the effect of going from no enrichment to over 5 times the normal warm idle pulse width. In operation the effect is also proportional to the difference between the Engine coolant Temperature and the threshold set by TEMP THRESHOLD. Hence as the engine is restarted from hot the Cranking Enrichment Factor achieves a minimum of value of +100 %. this level of enrichment is still required to start even a hot engine.

## # \$ K Warm-up Factor

Name	Range Value	Resolution
WARMUP FACT	0 - 100 %	1 %

The WARM UP FACTOR is a calibratable parameter for setting the level of warm up enrichment of fueling to be used between the Cold Cranking Phase and the Engine Coolant Temperature exceeding the value set in TEMP THRESHOLD. The system tends to work like an automatic choke.

In operation if the user tends to find that the cold engine tends to start very easily but dies soon after this is an indication of inadequate warm up fueling being present.

## # \$ K Temperature Threshold

Name	Range Value	Resolution
TEMP THRESH.	-99 - 127 Deg C	1 Deg C

The TEMP THRESHOLD is a value used by the ECU in deriving the levels of both Cold Cranking Enrichment and Warm Up Enrichment.

---

```
# IDH_CRANK_INJ
$ CRNK INJ
K Scalars; Scalars, CRNK INJ; Injection; Injection, Crank; Injection, Starting; Starting; Starting, Injection
Pulse
# IDH_COLD_CRANK
$ COLD CRANK
K Scalars; Scalars, COLD CRANK; Starting; Starting, Cold Crank Injection; Cold Starting
# IDH_WARMUP_FACT
$ WARMUP FACT
K Scalars; Scalars, WARMUP FACT; Starting; Starting, Warmup enrichment; Engine; Engine, Warmup;
Choke
# IDH_TEMP_THRESHOLD
$ Temperature Threshold
K Scalars; Scalars, TEMP THRESH; Starting; Starting, Temperature
```

# Help file for K series ECU

## Help screens from K series software

The user is required to set a desired engine coolant temperature value at which both the cranking enrichment and warm up enrichment are minimised. In the case of the Warm Up Enrichment the value for Coolant Temp Factor tends to zero as the Engine Coolant value tends to TEMP THRESHOLD. A typical value or setting for TEMP THRESHOLD would be in the range 65 to 85 Deg C.

### # \$ K Start Ignition Setting

Name	Range Value	Resolution
STRT IGN DLY	0.0 - 45.0 Deg	0.2 Deg

The START IGNITION DELAY is calibratable parameter for setting the cranking advance to be different from the trailing edge of the trigger profile, typically around TDC. It enables the user to define a crank angle delay between the MAM crank position and when the ignition spark is issued. This feature is only of any use when the MAM edge occurs at a point less than 60 Deg BTDC. This mode require to be switched on by configuring the SETUP REGISTER. When the mode is enabled the delay angle set in the box will be used.

For example : If MAM is set to 55 Deg BTDC and START DLY is set to 35.0 Deg then the cranking advance used will be 55 minus 35 Deg = 20 Deg BTDC. If the mode is disabled in the SETUP REGISTER then the spark will occur on the trailing edge of the trigger profile.

### # \$ K Acceleration Factor

Name	Range Value	Resolution
ACCEL FACT.	0 - 100 %	1%

This scalar sets the magnitude of the Acceleration Enrichment value to be added to the Normal Map derived Injection Pulse Width. Once a Delta TPS value is measured which exceeds the threshold value then the Delta TPS value is multiplied by this scaling parameter to produce the additional fuel pulse width.

Normal usable values are in the range 5% to 25%. A very large value in this scalar can sometimes cause an engine to "stumble" due to over fueling.

### # \$ K Acceleration Enrichment Threshold

Name	Range Value	Resolution
ACCEL TRIP	0 - 255 dTPS	1 dTPS

The ACCELERATION ENRICHMENT TRIP THRESHOLD is set by this scalar. It is calibrated in Delta TPS. This has the effect of setting the rate of change of throttle position required to trip the Acceleration Enrichment Mode.

A large value set here will mean that it is very difficult to trip the Accel Enrichment whereas a lower value means that it will trip very easily. The usable range is normally 4 to 20 Delta TPS counts.

To switch off the acceleration enrichment function set this scalar to 255.

---

```
# IDH_START_IGN
$ Starting Ignition Setting
K Scalars; Scalars, STRT IGN DLY; Starting; Starting, Ignition; Ignition; Ignition, Start
# IDH_ACCEL_FACT
$ Acceleration Factor
K Scalars; Scalars, ACCEL FACT; Acceleration; Acceleration, Factor; Fuel; Fuel, Acceleration;
Factor; Factor, Acceleration; Enrichment; Enrichment, Acceleration
# IDH_ACCEL_TRIP
$ Acceleration Threshold
K Scalars; Scalars, ACCEL TRIP; Acceleration; Acceleration, Trip; Acceleration, Threshold
```

## Help file for K series ECU

Help screens from K series software

### # \$ <sup>K</sup> Acceleration Decay Rate

Name	Range Value	Resolution
ACCEL DECAY	0 - 100 %	1%

This parameter has the effect of controlling the rate of decay of the Acceleration Fuel part of the Final Injection Pulse Width.

In operation a small value will cause a quick decay of Accel Fueling whilst a large value will cause the additional fueling to be removed more slowly.

Normal values lie in the range 50% to 99%.

The Acceleration Enrichment Fueling can be removed by decaying the amount of additional fuel every injection pulse or conversely by having it decayed at exact time intervals (every software background loop, 8mS). The two modes are selected by use of the SETUP REGISTER.

### # \$ <sup>K</sup> TPS Range and Limit Setting

Name	Range Value	Resolution
TPS MIN	3 to 250 Counts	1 Count
TPS MAX	3 to 250 Counts	1 Count

The above 2 scalars are used to set the calibratable part of the throttle range to be used. The values set into each Scalar represent Raw A/D Count values, which correspond to the 0 % and 100 % Throttle position settings.

A normal 0% setting would be in the range 7 -15 Cnts whereas the TPS MAX value can be anywhere in the range. A normal Competition engine would require the 100% setting to be at the actual mechanical, wide-open throttle position. This can be read from the Raw TPS value displayed below with the throttle cable pulling to a wide open throttle position. Likewise the normal warm idle position should be set to correspond to the 0% point (TPS MIN) hence dividing the whole throttle mechanical range up into 100 % steps.

Conversely it is possible for example on a road car to set the TPS MAX value to correspond to a value less than the Wide Open Throttle position. This would result in a finer Load Axis resolution in the part throttle region and for throttle angles greater than the TPS MAX value the same fueling data as the 100 % line is used.

**NB: TPSMIN values less than 7 counts should be avoided to ensure that sensor failsafes are never tripped.**

---

# IDH\_ACCEL\_DECAY

\$ Acceleration Decay Rate

<sup>K</sup> Scalars; Scalars, ACCEL DECAY; Acceleration; Acceleration, Decay rate

# IDH\_TPS\_LIMITS

\$ TPS Range and Limit Setting

<sup>K</sup> Scalars; Scalars, TPS MIN; Scalars, TPS MAX; Limit; Limit, TPS; Range; Range, TPS

# Help file for K series ECU

Help screens from K series software

## # \$<sup>K</sup> Manifold Pressure Range and Limit Setting

Name	Range Value	Resolution
MAP MIN	3 to 250 Counts	1 Count
MAP MAX	3 to 250 Counts	1 Count

The above 2 parameters are very similar to TPS MIN & TPS MAX, in that they are responsible for defining the normal range of sensor input, which corresponds to the 0% and 100% map breakpoints.

In this case the load sensor input range is derived from an external loom mounted MAP sensor the reading from this is available as Raw Boost. Typically this sensor is used on Turbocharged and Supercharged applications.

The exact choice of sensor is not too important as it is possible by virtue of using MAP MIN & MAP MAX to the set the range of input signal corresponding to the least load and maximum load conditions respectively. However the C400 series ecu is configured for a 2.5 Bar MAP sensor to give accurate Boost Pressure indication

Check with Lumenition Engineering for guidance on choice of sensor types for specific applications.

**NB: MAPMIN values less than 7 counts should be avoided to ensure that sensor failsafes are never tripped.**

## # \$<sup>K</sup> Number of Cylinders

Name	Range Value	Resolution
CYLINDERS	1 - 8	1

This parameter was included as part of ENGINE TYPE but it is now possible to set the number of cylinders separately. The stored value for Engine Type will change also to reflect any alterations made to this value. Also any changes to Engine Type will affect the Cylinders setting.

The value in this scalar should obviously match the number of cylinders of the engine that the ecu will be controlling. This value must be correct before attempting to start the engine.

The value is read by the ecu only on first power on so if the value is changed the ecu must be switched off and then back on before the new value will be used.

See Also:

ENGINE TYPE  
WHEEL TYPE

---

# IDH\_MAP\_LIMITS

\$ Manifold Pressure Range and Limit setting

<sup>K</sup> Scalars; Scalars, MAP MIN; Scalars, MAP MAX; Limit; Limit, Manifold pressure; Range; Range, Manifold pressure

# IDH\_CYLINDERS

\$ Number of Cylinders

<sup>K</sup> Scalars; Scalars, CYLINDERS; Engine; Engine, No. of cylinders

# Help file for K series ECU

Help screens from K series software

## #\$K Crank Toothed Wheel Format

Name	Range Value	Resolution
WHEEL TYPE	0 - 16	1

This parameter matches the ecu to a particular crank toothed wheel pattern. If the value is set to zero the ecu will be expecting to receive a LDR signal from the distributor.

The ecu is programmed to interface with a number of OEM toothed wheel patterns. The format describes the number of teeth also the number and the position of the missing teeth on the wheel. Lumenition can program a maximum of 15 different wheel formats into the C400 series ecu. The settings currently available are listed below: This list may be changed or added to as new or different formats are presented to Lumenition. OEM formats are usually matched to particular engine layouts ie 4 or 6 cylinders, the wheels may have the same number of teeth and gaps but the sensed position of the gap will be different.

WHEEL TYPE	Teeth	Gap	Position
1	36	1	90°btdc
2	60	1	120°btdc
3	60	1	90°btdc
4	36	1	60°btdc
5	60	1	80°btdc
6	60	1	85°btdc
7	36	2	90° & 270°
8	44	2	90° & 270°

As with CYLINDERS this parameter is linked with ENGINE TYPE. If a change is made to this value it will be reflected in Engine Type and vice versa. Also the ecu must be switched off and then back on before the changes will be applied to the running of the ecu.

See Also:

ENGINE TYPE  
CYLINDERS

## #\$K Input Trigger Setting

Name	Range Value	Resolution
OPTO INPUT	On or Off	

See Also:

This scalar sets the trigger edge for LDR input from the distributor. Lumenition generally refer to the use of our optical sensor for this. The choice for distributor input is between a hall effect sensor or the Lumenition optical switch. If the optical switch is used then this scalar should be set to ON. If it is set to OFF it will be assumed that the Hall effect trigger is being used.

See Also:

SETUP REGISTER

---

# IDH\_WHEEL\_TYPE

\$ Crank Toothed Wheel Format

K Scalars; Scalars, WHEEL TYPE; Crank Wheel; Toothed Wheel

# IDH\_OPTO\_INPUT

\$ Input Trigger Setting

K Scalars; Scalars, OPTO INPUT; Input; Input, edge; Trigger edge; Opto trigger; Setup; Setup, Opto input

# Help file for K series ECU

Help screens from K series software

## #\$K Start Ignition Delay Switch

Name	Range Value	Resolution
START DELAY	On or Off	

See Also:

This setting will turn on the Start Ignition Delay function. This must be set to ON for the ecu to use the Start Ignition Delay value whilst the engine is at low rpm. If OFF the ecu will use the relevant value from the 800 rpm column in the Ignition Map.

See Also:

SETUP\_REGISTER

Start Ignition Setting

## #\$K Acceleration Fuelling on Background Loop

Name	Range Value	Resolution
B'GRND LOOP	On or Off	

See Also:

This setting changes the calculation of the injection acceleration fuel from each injection event (ie twice per engine revolution) to every 8mS (background loop time). This will affect the rate at which the extra fuel is removed before the Accel Fuel returns to a zero value. With acceleration fuel calculated on background loop the Accel Decay operates over the same length of time regardless of engine rpm. With the Background Loop option OFF the Accel Decay will operate over the same number of engine revolutions.

There is no recommended setting for this as engines may respond differently depending upon the settings of the acceleration factors and this background loop switch. Testing should determine the best settings for your application.

See Also:

SETUP\_REGISTER

ACCEL DECAY

## #\$K External Manifold Pressure Sensor Switch

Name	Range Value	Resolution
MAP SENSE	On or Off	

See Also:

This setting allows the ecu to take the engine load input from an external Manifold Pressure Sensor. When this value is set to OFF the ecu will use the Throttle Position Sensor to derive the Load measurement. If the ecu is configured to use the external MAP sensor then the throttle position is used only to determine starting load value and acceleration fuelling.

See Also:

SETUP\_REGISTER

---

# IDH\_STRT\_DELAY

\$ Start Ignition Delay Switch

K Scalars; Scalars, START DELAY; Setup; Setup, Strt Delay

# IDH\_BGRND\_LOOP

\$ Acceleration Fuelling on Background Loop

K Scalars; Scalars, B'GRND LOOP; Setup; Setup, B'grnd Loop

# IDH\_MAP\_SENSE

\$ Use External Manifold Pressure Sensor

K Scalars; Scalars, MAP SENSE; Setup; Setup, Map Sense

# Help file for K series ECU

Help screens from K series software

Manifold Pressure Range & Limit Setting  
Engine Load

## #\$K Fuel or Ignition Rev-limit Switches

Name	Range Value	Resolution
IGN LIMIT	On or Off	
FUEL LIMIT	On or Off	

See Also:

These settings determine what action is carried out when the engine speed reaches the REV LIMIT rpm.

If both are set to OFF then no rev limit function is provided by the ecu.

If only one limit is set to ON then that ecu function is cut when the engine reaches the rev-limit rpm. The other function will be cut 200rpm later if the engine is still increasing in speed above the rev-limit setting.

If both are set to ON then both ignition and fuel functions are cut when the rev-limit rpm is reached.

See Also:

SETUP\_REGISTER  
REV\_LIMIT

## #\$K Variable List

### Definition of Displayable Real Time Variables

There are a number of Real Time Variables that can be read from the ECU to aid both tuning and diagnostics. These values will tell the user exactly what the ECU is reading from its sensors and the results of calculations it has made for outputs. Output values are calculated based on both values from map calibration, scalars and sensor readings. In general the variables displayed are read only which means the user cannot change them as they represent measured or calculated values. There are some programmable variables, which can be changed and are used in the fine-tuning of maps or tables.

Name	Value	Units	Definition
<u>Engine Speed</u>	1000	Rpm	ECU measured Engine Speed
<u>Load</u>	33.3	%	Scaled % Load Input Signal
<u>Throttle</u>	50.0	%	Scaled Throttle Angle Signal
<u>Ign Advance</u>	36.9	°BTDC	Crankshaft measured Spark Advance
<u>Base Map Adv</u>	30.5	°BTDC	Base Ign Map derived Advance
<u>Pulse Width</u>	5.22	mS	Final Fuel Pulse Width.
<u>Base Fuel No.</u>	98	Abs	Base Fuel Map Value.
<u>Ical Mod</u>	2.8	°	Temporary Ignition adjustment value
<u>Fcal Mod</u>	-5.0	%	Temporary Fuel adjustment value

---

# IDH\_LIMIT\_ON

\$ Fuel or Ignition Rev-limit Switches

K Scalars; Scalars, IGN LIMIT; Scalars, FUEL LIMIT; Setup; Setup, Ign Limit; Setup, Fuel Limit

# IDH\_VARIABLE\_LIST

\$ What Variables are available?

K Variables; Variables, Available; Variables, What are?

## Help file for K series ECU

Help screens from K series software

<u>Air Temp</u>	25	°C	Air Temp Sensor Reading
<u>Eng Temp</u>	99	°C	Engine Coolant Sensor Reading
<u>Air Pressure</u>	990	mBar	Barometric Air Pressure Reading
<u>Battery</u>	14.3	Volts	ECU Power supply voltage
<u>Air/Fuel</u>	1.05	(L)	Lambda value measured from Exhaust Mounted HEGO sensor
<u>Duty Cycle</u>	31.8	%	Injector Duty Cycle, % of available time that injector is turned on
<u>Air Temp Mod</u>	2.0	%	Background Correction factor being applied as a function of Air Temp
<u>Air Pres Mod</u>	-0.8	%	Background Barometric air pressure correction factor being applied
<u>Eng Temp Mod</u>	28.9	%	Warm-up fuelling correction factor being applied, function of Engine coolant temp and user calibratable warm up factor
<u>Revised Fuel</u>	126	Abs	Mathematical result of applying the above correction factors to BaseFuel No
<u>Bat Volt Mod</u>	0.60	mS	Battery Voltage correction factor, function of Battery Voltage.
<u>Accel Fuel</u>	0.00	mS	Acceleration Enrichment Fuelling, function of many user calibratable values.
<u>Cold Start Mod</u>	30	%(+)	Warmup Enrichment modifier, function of Eng coolant Temp and Calibratable factor.
<u>Raw TPS</u>	45	Cnts	Raw Throttle Position Signal value expressed as A/D counts (Range 0 to 255)
<u>Raw Boost</u>	230	Cnts	Raw Boost Press in A/D Cnts
<u>Boost Press</u>	1.50	Bar	External Boost Pressure Sensor signal.
<u>Boost Load</u>	45	%	Scaled external Boost Pressure Sensor
<u>Test Reg.</u>	00000000		Y/N Error Test Register, if any location contains a 1 then an error is detected.

### #<sup>K</sup>Engine Speed

A display of the engine rpm as measured by the ecu from the engine pickup. Usually not valid until the engine is out of cranking / starting mode. The reading will be updated very quickly to allow the ecu to respond to fast changes of engine status. Speed sensor problems or interference on the sensor input will show here as wildly fluctuating values. The ecu will use this value as a reference for the values in the maps and tables.

---

# IDH\_ENGINE\_SPEED

\$ Engine speed

<sup>K</sup> Speed; Speed, Engine; Variables; Variables, Engine Speed; Engine; Engine, Rpm; Rpm; Rpm, Engine

# Help file for K series ECU

Help screens from K series software

## #\$K Load

A percentage indication of the engine load that the ecu will use as a reference for maps and tables. The value is derived either from Throttle Angle or from Manifold Pressure depending upon the settings for the ecu. The range from 0 to 100% is adjusted using the minimum and maximum settings for TPS or MAP.

## #\$K Throttle Angle

A percentage indication of the opening angle of the throttle plate. Zero percent is fully closed and 100 percent is usually fully open. Using a standard throttle potentiometer sensor the scale is linear between these two values. The actual range 0 to 100 relative to the throttle movement can be adjusted using TPS MIN and TPS MAX. Throttle angle readings are used to trigger acceleration enrichment and can be used as a basis for engine load measurement. Throttle angle is commonly used for engine load on naturally aspirated competition engines because of the quick response that can be achieved.

## #\$K Ignition Advance

This is the ecu-calculated value for the timing of the ignition spark before TDC. The value is taken from the Ignition map and any adjustments are applied. To ensure that this value represents the spark timing on the engine the value must be matched to the strobe timing from the engine before any mapping is carried out. The value can be matched using a combination of ENGINE TYPE, MAM OFFSET and physical sensor placement or distributor rotation.

## #\$K Base Map Advance

This is the value that the ecu has calculated for spark advance from the site values in the map. The value includes the interpolation but no other adjustments. Interpolation is the process by which values are calculated between two or more fixed values. This enables the ecu to achieve a smooth transition from one map site to another when engine speed and load are between site reference values.

## #\$K Injection Pulse Width

This value represents the amount of time that the fuel injectors will be opened for on each cycle. The value is given in mS. It is calculated from the fuel map and includes any modification or correction values that may be applied such as acceleration or warmup enrichment.

---

```
# IDH_LOAD
$ Load
K Variables; Variables, Load; Engine; Engine, Load; Load, Percent
# IDH_THROTTLE_ANGLE
$ Throttle angle
K Variables; Variables, Throttle angle; Throttle angle;
# IDH_IGN_ADV
$ Ignition advance
K Variables; Variables, Ign Advance; Ignition; Ignition, Advance; Advance; Timing
# IDH_BASE_ADV
$ Base map advance
K Variables; Variables, Base Map Adv
# IDH_PULSE_WIDTH
$ Injection pulse width
K Variables; Variables, Pulse Width; Injection; Injection, Pulse width
```

# Help file for K series ECU

Help screens from K series software

## #\$K Base Fuel Number

This is the value that the ecu has calculated for fuel number from the site values in the map. The value includes the interpolation but no other adjustments. Interpolation is the process by which values are calculated between two or more fixed values. This enables the ecu to achieve a smooth transition from one map site to another when engine speed and load are between site reference values. This value is used as the basis for the calculation of the injection pulse width.

## #\$K Ignition Calibration Modifier (Ical Mod)

### Programmable Variable

This value is a temporary adjustment angle that is applied to the ecu calculation of ignition advance. It is used during calibration to fine tune the map for spark advance. The value is adjusted using either the physical or virtual potbox to swing the value plus or minus 22.5 degrees or can be directly edited when shown in a variables window. The value can be transferred into the current ignition map site that is being used by the engine. If the engine speed and load or off site then the adjustment is applied to the nearest site. The value of Ical Mod is returned to zero following this transfer or if the ecu is switched off.

## #\$K Fuel Calibration Modifier (Fcal Mod)

### Programmable Variable

This value is a temporary adjustment percentage that is applied to the ecu calculation of fuel pulse width. It is used during calibration to fine tune the map for fuel numbers. The value is adjusted using either the physical or virtual potbox to swing the value plus or minus 50% or can be directly edited when shown in a variables window. The value can be transferred into the fuel map site that is being used by the engine. If the engine speed and load or off site then the adjustment is applied to the nearest site. The value of Fcal Mod is returned to zero following this transfer or if the ecu is switched off.

## #\$K Intake Air Temperature

This displays the reading taken from the air temperature sensor mounted in the inlet. Air temperature is used to correct the fuelling. The default value if the sensor is not connected or a fault is detected is 25°C that gives no correction to the fuel values.

---

```
# IDH_BASE_FUEL
$ Base fuel number
K Variables; Variables, Base Fuel No.; Injection; Injection, Base Fuel
# IDH_ICALMOD
$ Ignition Calibration Modifier (Ical Mod)
K Variables; Variables, Ical Mod; Ignition; Ignition, Calibration Modifier
# IDH_FCALMOD
$ Fuel calibration modifier
K Variables; Variables, Fcal Mod; Fuel; Fuel, Calibration Modifier
# IDH_AIR_TEMP
$ Intake air temperature
K Variables; Variables, Air Temp; Temperature; Temperature, Air; Air; Air, Temperature
```

# Help file for K series ECU

Help screens from K series software

## #\$K Engine Coolant Temperature

This displays the reading taken from the temperature sensor mounted in the engine coolant. Engine temperature is used to correct the fuelling during starting and warmup. The default value if the sensor is not connected or a fault is detected is 125°C that gives no correction to the fuel values.

## #\$K Air Pressure

This is a reading taken from the ecu internal barometric pressure sensor. Barometric air pressure is used as a correction to the fuelling for the engine. The correction is displayed as Air Press Mod. This correction is disabled if manifold absolute pressure is used as the load input for the map. The default value if a fault is detected is 1000mBar at which no correction is applied.

## #\$K Battery Voltage

An indication of the battery voltage supplied to the ecu. This is measured internally. The battery voltage is used to apply a correction to the injection pulse width based upon the expected opening time of the injectors when different voltages are applied to them. The correction value can be seen as Batt Volt Mod.

## #\$K Air/Fuel Ratio (Lambda)

This is an indication of the air / fuel ratio measured from the Exhaust Gas Oxygen (EGO) sensor mounted in the exhaust manifold. A value of 1 is the stoichiometric optimum and represents a ratio of 14.7:1 by mass. Values higher than 1 indicate a lean mixture and lower values indicate a rich mixture compared to this optimum figure. Peak power from an engine is normally achieved using a rich mixture at the expense of fuel consumption and emissions. The standard C400 series ecu will use the EGO sensor purely to display this value and cannot operate in the closed loop mode.

## #\$K Injector Duty Cycle

This reading represents the amount of time that the injector is open compared to the available open time. A value of 100% would indicate that the injectors are open all of the time (referred to as 'going static'). This is not a desirable situation. A reasonable maximum value would be 85 to 90% that commonly will occur at peak torque for the engine.

---

```
# IDH_ENGINE_TEMP
$ Engine coolant temperature
K Variables; Variables, Eng Temp; Engine; Engine, Temperature; Temperature; Temperature, Engine
coolant
# IDH_AIR_PRESSURE
$ Air pressure
K Variables; Variables, Air Pressure; Air; Air, Pressure; Pressure; Pressure, Barometric
# IDH_BATTERY
$ Battery voltage
K Variables; Variables, Battery
# IDH_AIR_FUEL
$ Air/Fuel ratio (Lambda)
K Variables; Variables, Air/Fuel; Lambda; Air/Fuel Ratio
# IDH_DUTY_CYCLE
$ Injector duty cycle
K Variables; Variables, Duty Cycle; Injection; Injection, Duty cycle; Fuel; Fuel, Injector duty cycle
```

# Help file for K series ECU

## Help screens from K series software

If you find during calibration that duty cycle values are approaching maximum then you may have to find a method to reduce the opening time of the injectors. This may involve increasing fuel pressure or sourcing larger injectors with a higher flow rate.

Alternatively, if the maximum for duty cycle is much lower than 70 to 80% then it may be beneficial to increase the opening times for the injectors to get finer control of the fuelling. This may involve using smaller injectors or reducing the fuel pressure.

### #\$K Air Temperature Modifier

Gives the amount of fuelling correction applied resulting from the measured inlet air temperature. The amount is a percentage of the Base Fuel no., taken from the fuel map. This correction is automatic and based upon calculations of air density verses temperature. For this correction to be properly applied it is important that the inlet air temperature sensor is mounted correctly in the air flow and so accurately measures air temperature.

### #\$K Air Pressure Modifier

Gives the amount of fuelling correction applied resulting from the measured barometric air pressure. The amount is a percentage of the Base Fuel no., taken from the fuel map. This correction is automatic and based upon calculations of air density verses pressure. The barometric pressure is measured using a sensor mounted inside the ecu. This value is not used if the manifold absolute pressure is used to measure engine load.

### #\$K Engine Temperature Modifier

Gives the amount of fuelling correction applied resulting from the measured engine coolant temperature. The amount is a percentage of the Base Fuel no., taken from the fuel map. The value is based upon the measured engine temperature and the scalars TEMP THRESH and WARMUP FACT.

### #\$K Revised Fuel Number

This is the new value for the fuel number after the temperature and pressure corrections have been made to the base fuel number from the map. It is this figure when multiplied by the scalar TABLE MULT that forms the basis for injection pulse width.

---

# IDH\_AIR\_TEMP\_MOD  
\$ Air Temperature Modifier  
K Variables; Variables, Air Temp Mod; Air; Air, Temp Modifier; Correction; Correction, Air temperature  
# IDH\_AIR\_PRESS\_MOD  
\$ Air Pressure Modifier  
K Variables; Variables, Air Pres Mod; Air; Air, Pressure modifier; Correction; Correction, Air pressure  
# IDH\_ENG\_TEMP\_MOD  
\$ Engine temperature modifier  
K Variables; Variables, Eng Temp Mod; Correction; Correction, Engine temperature; Warmup enrichment  
# IDH\_REVISIED\_FUEL  
\$ Revised fuel number  
K Variables; Variables, Revised Fuel

# Help file for K series ECU

Help screens from K series software

## #\$K Battery Voltage Modifier

This shows the time included in the injection pulse width to compensate for the battery supply voltage level. This value is constant for any particular voltage reading and is added to the adjustable element of the injection time calculated from the revised fuel number. The relationship between battery voltage and the modifier is pre-set for most commonly used injectors and is not user adjustable in the C400 series ecus.

## #\$K Acceleration Enrichment Fuel

This value shows the time added to the calculated injection pulse width resulting from acceleration enrichment. The acceleration enrichment function of the C400 series ecu is controlled by three scalars ACCEL TRIP, ACCEL FACT and ACCEL DECAAY.

## #\$K Cold Start Modifier

Gives the percentage of additional fuel that will be used during starting based upon the engine temperature. This value is controlled by the scalar COLD CRANK but has a minimum setting of 100% to increase fuelling during starting even when the engine is warm.

## #\$K Raw TPS

This gives the actual value following A/D conversion that the ecu is reading from the throttle position sensor. The range of values is between 0 and 255 and is used to set the scalars TPS MIN and TPS MAX. Problems with the throttle sensor will show here as inconsistent or wildly varying values.

## #\$K Raw Boost Pressure

This gives the actual value following A/D conversion that the ecu is reading from the external MAP sensor. The range of values is between 0 and 255 and is used to set the scalars MAP MIN and MAP MAX. Problems with the MAP sensor will show here as inconsistent or wildly varying values.

---

```
# IDH_BATT_MOD
$ Battery Voltage Modifier
K Variables; Variables, Bat Volt Mod; Correction; Correction, Battery voltage
# IDH_ACCEL_FUEL
$ Acceleration Enrichment Fuel
K Variables; Variables, Accel Fuel; Fuel; Fuel, Acceleration Enrichment
# IDH_COLD_START_MOD
$ Cold Start Modifier
K Variables; Variables, Cold Strt Mod; Correction; Correction, Cold Start
# IDH_RAW_TPS
$ Raw Throttle Position Sensor
K Variables; Variables, Raw TPS; Raw; Raw, TPS
# IDH_RAW_BOOST
$ Raw Boost Pressure
K Variables; Variables, Raw Boost; Raw; Raw, Boost; Boost; Boost, Raw
```

# Help file for K series ECU

Help screens from K series software

## #\$K Boost Pressure (MAP)

This is the measurement of manifold absolute pressure taken from the external MAP sensor. The C400 series ecus are configured to use a 2.5 Bar, 0 to 5 volt pressure sensor and this figure will only be correct if this sensor is used. The manifold absolute pressure reading can be used as a measure of the engine load. Most commonly manifold pressure will be used in turbocharged or supercharged engines.

## #\$K Boost as Load

A percentage indication of the engine load using the manifold absolute pressure reading. Zero percent is full vacuum depression and 100 percent is usually maximum boost pressure. Using a MAP sensor the scale is linear between these two values. The actual range 0 to 100 relative to the MAP sensor measurement can be adjusted using MAP MIN and MAP MAX. MAP is commonly used for engine load on turbo or supercharged engines so we refer to the measurement as Boost.

## #\$K Test Register

This represents a set of switches that show the error status of the attached sensors. If a figure 1 is shown in any of the 8 positions it may indicate a problem with a sensor. The faults that may be detected are shown below:

00000001	TPS less than TPSPMIN
00000010	TPS sensor open circuit or not connected
00000011	TPS sensor short circuit
00000100	Air Temp sensor short circuit
00001000	Air Temp sensor open circuit or not connected
00010000	Int.Bar Pressure sensor faulty or out of range
00100000	Ext.Bar Pressure sensor faulty or out of range
01000000	Engine Coolant sensor faulty or not connected
10000000	ECU checksum error, possible fault in ECU, can also be caused by disorderly exit from calibrate session

## #Lumenition Motorsport Engineering

Autocar Electrical Equipment Co. Ltd  
49/51 Tiverton Street  
LONDON  
SE1 6NZ  
Tel. 0(044) 20 7403 4334  
Fax. 0(044) 20 7378 1270

---

```
# IDH_BOOST_PRESS
$ Boost Pressure (MAP)
K Variables; Variables, Boost Press; Boost; Boost, Pressure; Pressure; Pressure, Boost; Pressure, Manifold
# IDH_BOOST_LOAD
$ Boost as Load
K Variables; Variables, Boost Load; Boost; Boost, As load; Pressure; Pressure, As load
# IDH_TEST_REGISTER
$ Test Register
K Variables; Variables, Test Reg.; Diagnostic; Diagnostic, Test register; Fault; Fault, Test register
# IDH_LUMEN_ENG
```

## Help file for K series ECU

Help screens from K series software

### #<sup>\$K</sup>Fuel Number

The fuel number is the value that is shown in each cell of the fuel map. This number is adjustable between 0 (zero) and 255. The fuel number is directly proportional to the fuel injection pulse width that is used to supply fuel to the engine. The fuel injection pulse width ignoring correction factors would be:-

Fuel Number (from the fuel map) x FUEL TABLE MULTIPLIER

Working in this fashion gives greater flexibility to the fuel map for engine tuning. The shape of the fuel map using fuel numbers is generally determined by the Volumetric Efficiency (VE) of the engine. Many engines have similar VE characteristics but differ in the amount of fuel delivered. This means that the same or similar maps may be used for a range of different engines and the overall level of fuelling adjusted by using the scalar TABLE MULT, fuel pressure or injector flow rates.

The aim to reach the ideal situation is that a balance is determined between the ranges of fuel numbers used in the map, injector duty cycle and fuel injector flow. It is preferable that fuel numbers and duty cycle do not exceed 80-90% of their maximum values. But also that a figure between 60-80% is achieved for best operating range.

---

# IDH\_FUEL\_NUMBER

\$ What is the Fuel Number?

<sup>K</sup> Fuel; Fuel, Number; VE

# Help file for K series ECU

## Help screens from K series software

### Footnotes

#This represents the signal that the ecu receives from the engine to start the calculation of ignition angle. The signal must occur before the maximum spark advance that the ecu will calculate, hence the term Most Advanced Marker. Common engine angles for this signal are 60, 90 and 120 degrees BTDC, in the form of crank teeth or distributor vane. To allow correct correlation between ecu spark advance and engine position an adjustable offset is used.

#The crankshaft position at which the piston has reached the top of its stroke. The TDC position for number one cylinder is commonly marked for strobe timing.

#The ecu receives a signal from a distributor, rotating at half engine rpm, representing each cylinder. Usually a vane passing through an optical or hall effect sensor.

#The ecu receives a signal from the crankshaft indicating speed and position for each rotation. Usually a set of teeth with one or more removed in a set position.

# A change in the value indicated for TPS or the difference between successive readings from Throttle position by the ecu.

# A feature that allows the fuel injection values to be controlled by measuring the level of unburned fuel in the exhaust gases.

# A measure of the air pressure within the inlet manifold. Naturally aspirated vehicles generally operate at pressures lower than 1 bar (i.e. vacuum) and boosted vehicles will operate both below and above 1 bar. E.g. a 2.5bar sensor will measure 1 bar vacuum and 1.5 bar boost pressure.

---

# IDH\_MAM  
# IDH\_TDC  
# IDH\_LO\_DATA  
# IDH\_HI\_DATA  
# IDH\_DELTA\_TPS  
# IDH\_CLOSED\_LOOP  
# IDH\_MAP

## Help file for K series ECU

### Help screens from K series software

# A switching device which has an Infra Red beam that is interrupted by a chopper blade. The device produces a high or low voltage output depending upon whether the opto beam is interrupted or not.

# A switching device that has a magnetic field that may be interrupted using a metal vane passing between the magnetic poles. The result is a signal output that is high or low voltage depending upon whether the field is interrupted or not.

# A magnetic sensor that generates a signal based upon the proximity of metal to the tip of the sensor. The output voltage will be positive or negative and the transition point from positive to negative voltage is used to trigger the ecu.

---

# IDH\_OPTO\_TRIG  
# IDH\_HALL\_EFFECT  
# IDH\_VR\_SENSE