Lumenition®

COMPETITION ENGINE
MANAGEMENT SYSTEM

C400 Series
User Handbook

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Document No. 90247 Rev Level 2.0 11/04/00

INTRODUCTION.

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

All of the controllable functions are programmed by the installer using one of the Lumenition CAL Series of Calibration Software tools.

Although designed primarily for use with competition 4,6 and 8 cylinder, 4 stroke engines, many other applications are not excluded. If you have a requirement for a different system please contact Lumenition Engineering.

CONTENTS.

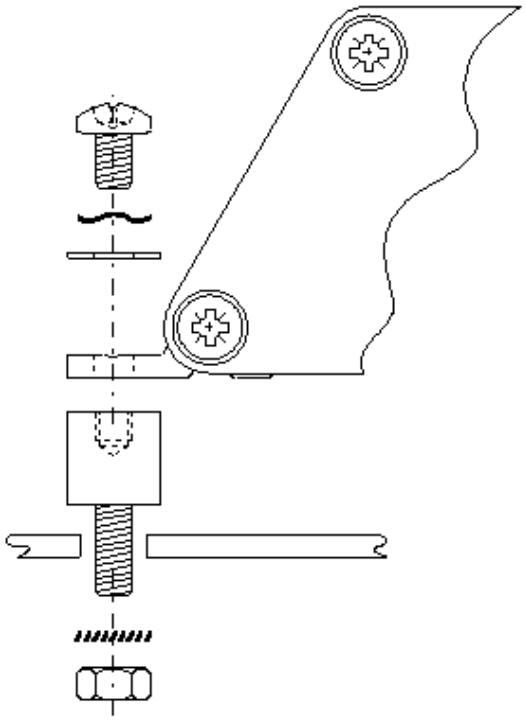
Cxxx Lumenition ECU
Anti Vibration Mounting Kit
Lumenition Motorsport Sticker
This Manual

Listed are the general contents of an ECU kit. The designation for the Lumenition ECU is based upon the target application and the internal features available. Currently there are 5 ECU types.

C400 Ignition only all engines LDR triggering.
C410 Ignition only all engines HDR triggering.
C451 Complete Management all engines LDR triggering
C460 Complete Management 4/8 cyl engines HDR triggering.
C660 Complete Management 6 cyl engines HDR triggering.

INSTALLATION.

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. The other end of the ECU has the connector for the Handheld Controller used to do the mapping so requires clearance also. It is also useful to be able to view L1 and L2 as an aid to setting up.

CONNECTION.

The ECU has two connectors to allow control of the engine and communication with the CAL101.

All of the relevant inputs to and outputs from the ECU used to control the engine are made via a 20 way locking connector. Lumenition standard looms (WH???) provide all of the required wiring for most applications. All other parts such as sensors, ignition and injection components needed for conversion are available separately from Lumenition. 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.

At the other end of the ECU there is a 9 pin 'D' type plug which allows connection to and programming by the CAL101 or PC. The two screw lock devices can be used to prevent the cable from becoming disconnected whilst in use. A rubber cover is provided to protect this connector when not in use.

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

INITIAL TEST AND SETUP.

Once the ECU is connected to the loom and all the sensors are in place then it can be powered up. When the ECU is powered the two indicators L1 and L2 are used to indicate the status of the inputs to the ECU.

- **L1.** This red LED provides an indication of the distributor pickup state when fitted as a Low Data Rate system. This means that the distributor can be statically timed before attempting to start the engine. The distributor should be set so that the L1 just comes on when the engine is at TDC.

  NOTE. *The ECU must be programmed for the type of distributor sensor used (hall effect or opto) before this setting can be relied upon. The full setup procedures to be carried out before attempting to start the engine are described in the Lumenition Mapping Guidelines booklet.*

- **L2.** The green LED has two functions which both indicate the correct connection of the engine parameter sensors. Before the ECU has received a valid rpm signal L2 will come on when all the vital sensors; air temp, coolant temp, throttle position, air pressure and manifold pressure (if used) are present and within range. Providing that alll the other sensors are connected it is possible to use L2 to set the throttle position sensor at closed throttle. The sensor should be set so that L2 remains on when the throttle is closed. Once the engine has turned then L2 will flash for approximately two minutes before flashing diagnostic codes.

DIAGNOSTIC CODES

If there is a problem with any of the primary sensors associated with the engine management the ECU will flash a diagnostic code using L2. Each code is a pair of numbers represented by counting the flashes of L2. The meaning of the codes are given in the table below. If there is more than one fault detected then each code will be given in order.

Code	Fault Condition
1-1	TPS input shorted to earth. Or below TPS minimum.
1-2	TPS input open circuit, not connected. Or above TPS maximum.
1-3	Air Temp out of range low. short to earth.
1-4	Air Temp out of range high. not connected.
2-1	Internal Pressure sensor signal out of range.
2-2	External Pressure sensor signal out of range.
2-3	Coolant Temp out of range low or high.
2-4	ECU Checksum mismatch. (Always shown during calibration.)

INPUTS.

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 a set of sensors giving particular values. These sensors are available from Lumenition.

It is possible to use alternative sensors to provide the necessary signals to the ECU. To enable installers to determine the suitability of other sensors this section of the manual gives the expected sensor types and values and their function in the system.

CRANK SENSOR.

There are two different methods for the ECU to determine engine speed and position.

- **Low Data Rate.**(LDR). A signal usually provided by an Optical or Hall Effect switch and segmented disc mounted within the distributor. The switch will give a positive or negative going trigger signal at a point before the maximum advance position (45°) for each cylinder. This is called the Most Advance Marker (MAM). The other switching edge of the segmented disc is often at TDC.

The ECU can be programmed to suit both positive or negative triggers and for any MAM angle from 45° to 130° BTDC.

The ECU has three connections for earth 0v, trigger signal and supply. The supply voltage is 8v which is suitable for most of the switches used.

Some engines have a usable hall effect distributor fitted or Lumenition can provide an optical switch and fitting kit for many contact breaker distributors.

In both cases the original centrifugal / vacuum advance mechanism must be "locked up" to prevent inaccurate advance triggering.

NOTE. *OEM variable reluctance type distributors are not suitable as LDR speed and position sensors for our ECUs.*

- **High Data Rate.** (HDR). This is a signal derived from a multi-toothed wheel fixed to the crankshaft or flywheel of the engine. The passing teeth are picked up by a variable reluctance sensor and a corresponding signal is fed to the ECU. Many engine manufacturers

use this method to trigger their ECUs however the Lumenition ECU requires the signal and toothed wheel in a specific format.

The teeth must be regularly spaced, commonly at 10° or 6° intervals i.e. 36 or 60 teeth. There must be a single gap created by a missing tooth or teeth at a position before TDC on No. 1 cylinder, usually 60°, 90° or 120° BTDC.

Using this triggering method gives increased spark accuracy, semi-sequential injection and the opportunity of distributorless ignition on 4 and 6 cylinder engines.

To interface to our standard loom Lumenition can provide small adaptor leads for OEM hall effect distributors (**DFK**...) and variable reluctance sensors (**CFK**...).

THROTTLE POSITION.

This is a sensor that measures the angle of the throttle butterfly which is commonly fitted to the throttle body shaft, as in the Lumenition TBPs. For naturally aspirated engines this is used to indicate engine load and forms the second axis with engine rpm for mapping fuel and ignition.

The Lumenition sensor is a three wire resistive device measuring ≈5000 ohms between ends, the third wire is low resistance to one end at closed throttle. This end will be the sensor ground when connected to the ECU. The sensor 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.

MAP SENSOR.

For turbocharged or supercharged engines a load signal must be derived from the manifold pressure. The MAP sensor is an electronic device that does this. The MAP sensor used gives a steady voltage signal between 0v and 5v depending upon the measured pressure. The Lumenition sensor is a 2.5 bar absolute pressure sensor. The ECU can be programmed to use other similar sensors to measure engine load from 0 to 100%. However the value for Manifold Absolute Pressure given on the Calibration display will not represent the correct pressure unless the Lumenition type of sensor is used.

ENGINE TEMPERATURE.

A resistive temperature sender which must be mounted into the engine cooling system, usually on the head or upper block. This sensor is used to control the amount of fueling for warmup and cold start enrichment. A sensor with a differing characteristic will affect these conditions and give incorrect temperature values on the CAL101. 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 coolant temperature characteristic is shown on the next page.

The Lumenition sensor characteristic is:-

Temp °C	Resistance Ohms
0	5500
25	2000
50	820
75	370
100	180

AIR TEMPERATURE

A resistive temperature sender which is mounted in the airflow of the inlet system. It is important that the sensor is mounted so that it is insulated from the heat of the engine otherwise the ECU will 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. A sensor with a differing characteristic will give incorrect compensation and inaccurate displayed values on the CAL101. 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 Lumenition sensor characteristic is:-

Temp °C	Resistance Ohms
-10	9100
0	5500
10	3800
20	2400
25	2000
40	1200

HEGO SENSOR (optional).

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. Many of these sensors are of the same characteristic as the specified Lumenition sensor. The HEGO (Heated Exhaust Gas Oxygen) sensor connector has wiring for a 12v supply for heated sensor types.

The HEGO sensor is currently used by the ECU only to provide a display of air/fuel ratio on the screen of the calibration display so that the user can adjust their mapping to give the correct value. It is possible that in the future this input will be used to give closed loop control of the fueling.

As an optional sensor it is available separately as HEG001. Note that the use of a HEGO sensor should be restricted to Unleaded fuel with no additives.

OUTPUTS.

IGNITION.

The Lumenition 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 the ignition is provided by a single CEM and coil using the distributor to direct the spark to each plug.

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 (WH???) is supplied separately for this type of application.

FUEL.

The Lumenition 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 breif guide to choosing injectors is given in the Lumenition Installation guide provided with the wiring harness kit (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. Under normal circumstances all injectors will be operating throughout the rpm range which will probably lead to overfueling at low rpm giving poor idle and bad throttle response. There may be other factors that make this method of fueling 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 received, 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.

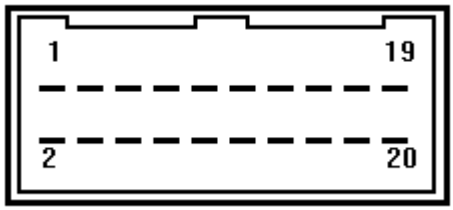
UPSHIFT.

There is an ECU output provided that is rpm controlled. The rpm at which this low power driver switches is set by the calibrator. 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 Upshift indication it is better suited to drive a large high intensity LED rather than a bulb. The wiring for an LED is given below. For driving larger loads a relay must be used. The relay coil must be 12v with a resistance of greater than 200 ohms. Upshift indicators and suitable relays are available from Lumenition (Part no. UPS001, UPS002 and UPS003)

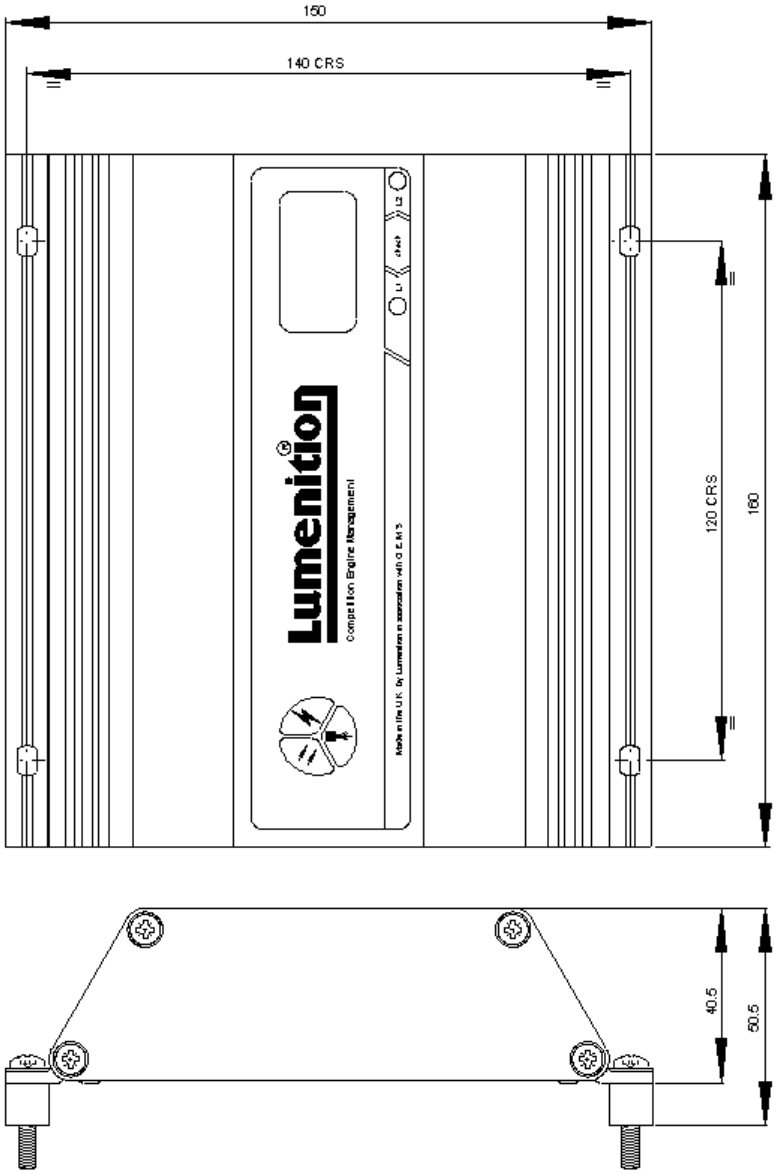
ECU PINOUT.



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	Upshift	Upshift	Upshift	Upshift	Upshift
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

For Installers wishing to make their own specific loom for their application Lumenition can provide connectors.


150
140 CRS
120 CRS
160
40.5
50.5
Lumenition
Competition Engine Management

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	