MAP-ECU2

Performance Motor Research Limited

Specifications and Instructions

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Information

Please read this manual carefully and only attempt installation if you completely understand all aspects covered in this manual.

Warning!

Installation and use of this product should only be attempted by trained and experienced automotive specialists who are experienced with automotive electrical, mechanical and electronic fuel management technology. Installation by untrained or inexperienced personnel can result in damage to this product or your vehicle.

When installing this unit, observe the operating procedures of any tools, especially soldering irons. Misuse of these tools can cause serious injury.

Never tune the MAP-ECU2 on public roads, this can be dangerous for you and others.

Never attempt to operate the vehicle and tune the MAP-ECU2 at the same time.

When tuning a vehicle always ensure there is adequate ventilation for exhaust fumes as they are harmful.

Avoid open sparks, flames or operation of electrical devices near flammable materials. Ensure there are no leaks from the vehicle fuel system.

Ensure all electrical wiring is well secured and insulated in accordance with the vehicle manufacturers standards. The MAP-ECU2 is designed for negative earth 12V environments only.

Always use a professional Air/Fuel Ratio meter and preferably a knock monitor when tuning the MAP-ECU2.

Improper tuning of the MAP-ECU2 can result in permanent damage to your engine. Performance Motor Research Limited accepts no responsibility for damage due to improper installation and tuning. Tuning any motor vehicle ECU is a combination of art and science. There are many articles on tuning modern EFI vehicles that should be consulted and there is no substitute for experience. Uttermost care must be exercised when tuning a motor vehicle, especially fuel and timing under heavy load conditions.

Performance Motor Research Limited provides no warranty and accepts no responsibility for damage from using any base tables from other vehicles.

Installation of this unit requires modifications to the vehicle's electrical system. Modifications should only be carried out with the ignition key removed and the negative terminal of the battery disconnected.

Never 'short-out' any connections as this could damage the MAP-ECU2 or your vehicle's electrical system.

Ensure all connectors are inserted fully and the locking clip(s) are engaged.

Only use vacuum line specified and ensure it is inserted fully over the barbed fitting. Ensure you do not exert too much force and damage the vacuum sensor.

Ensure the vacuum line is free of kinks or any form of damage. Ensure there is no possibility that the vacuum line can be damaged or blocked by the installation. This may cause erratic operation or damage to your vehicle.

Ensure the MAP-ECU2 is installed securely and the wiring is not strained in any way. The MAP-ECU2 is NOT designed to be installed in harsh or wet environments, e.g. engine bay, outside the vehicle. The MAP-ECU2 should be installed as close as possible to the OEM ECU provided it is installed in accordance with the previous statement.

Disconnect the PC serial cable when tuning is completed. Do not leave the cable connected to the MAP-ECU2 during normal operation.

Specifications

The product, software and manual are subject to change without notice.

Parts List

Ensure your product is complete before proceeding. You should receive the following:

1. MAP-ECU2 module
2. 16-Way wiring harness (1 Metre)
3. 18-Way wiring harness (1 Metre)
4. 3-Way wiring harness (optional)
5. CD-ROM
6. PC serial cable (2 Metre)
7. Inlet Air Temp (IAT) Sensor harness (2 Metre)
8. Inlet Air Temp (IAT) Sensor (1/8"-27 NTPF Thread)
9. Square drive screw adaptor
10. MAP-ECU vinyl sticker
11. "Quickstart" instructions
12. 2200 Ohm Resistor (Red/Red/Red) to replace OEM IAT

Introduction

The Manifold Absolute Pressure Electronic Control Unit (MAP-ECU2) is designed to replace Flap, Hotwire and Karman Vortex Frequency (KVF) based Mass AirFlow (MAF) meters in all ECU based automobiles. The unit does not replace the existing ECU, but simply generates the required airflow signal based on Manifold Absolute Pressure (MAP) and RPM. The MAP-ECU2 is fully programmable with a 494 Zone table controlling either Karman Vortex Frequency (KVF), Hotwire or Flap Air Flow Meter (MAF) voltage output. In addition, the MAP-ECU2 has a 'self-learn' facility whereby it can monitor either the existing frequency or voltage signal and populate the map during normal driving. Programming is carried out using the MAP-CAL2 PC based software supplied with the unit. **Note**: Older generation non-computer based ECU's are not compatible with the MAP-ECU2. All signals, e.g. TPS, MAF, KVF and O2 must be within the 0-5V range. Some older units use 0-12V signals. Refer the 'Specifications' section for more information.

Features

The MAP-ECU2 has the following features:

- 0-10,000 RPM. 200 rpm increments 0-2000, 500 rpm increments 2000-10,000 for Fuel and O2 Adjust tables. 500 rpm increments 0-10,000 for Timing and Auxiliary Injector tables.
- Built-in MAP sensor, +35 PSI. Pressure scale is user configurable using MAP-CAL2.
- Timing adjustment +/-30 degrees per zone - 8 Igniter inputs/outputs.
- Electronic Boost Control
- O2 voltage adjust table.
- Auxiliary Injector table.
- Frequency based Speed Cut Defender (SCD).
- Frequency based Speed Adjust
- Voltage based Fuel Cut Defender (FCD)
- Two (2) general purpose analogue outputs for fuel cut defender, O2 adjust, etc.
- Launch Control - Target RPM and Clutch Switch input.
- Two Complete (2) maps (Primary/Secondary) for Fuel, Timing, Auxiliary Injector, O2 Adjust & EBC - selectable using one of the configurable inputs.
- Support for optional external MAP sensor input.
- Plug compatible with current MAP-ECU harness.
- IAT sensor input to MAP-ECU2 for temp compensation.
- Key-on barometric sensing and compensation
- Self-learn facility for initial set-up.
- Serial port for PC communications.

- Three (3) multi-function high current switched outputs configurable as follows:
  - NOS solenoid drive
  - RPM>0
  - Pressure Switch
  - RPM Switch
  - EBC
  - Auxiliary Injector
- Von Karman Vortex Frequency airflow meter replacement mode, e.g. Mitsubishi™, DSM™
- Mass Air Flow (MAF) meter replacement mode, 'flap' or 'hot-wire' types.
- TPS input for acceleration enrichment.
- O2 Sensor input for monitoring and logging.
- Upgradeable software stored in Flash memory that can be downloaded via the built-in serial port. No additional interface modules are required.

Abbreviations

Throughout this manual, many abbreviations will be used as follows:

AFR	Air/Fuel Ratio
BAR	Barometric Pressure. 1 Bar = 1 Atmosphere
EBC	Electronic Boost Control
ECU	Electronic Control Unit (Computer) that runs the engine.
FCD	Fuel Cut Defeat
Flash	A technology used to implement NVRAM where special programming voltages are not required.
IAT	Inlet Air Temperature
kPa	Kilopascal. 1 Bar = 100kPa
KVF	Karman Vortex Frequency. Air mass is represented as a variable frequency from 16Hz to 3400Hz.
LED	Light Emitting Diode.
MAF	Mass Air Flow meter (Flap or Hot Wire types where air mass is represented as a DC voltage from 0 to 5 Volts).
MAP	Manifold Absolute Pressure
NVRAM	Non-Volatile Random Access Memory. Retains it contents when power is removed.
OEM	Original Equipment Manufacturer
NOS	Nitrous Oxide System
PC	Industry Standard Personal Computer running Microsoft™ Windows2000™ or WindowsXP™ operating system.
PSI	Pounds Per Square Inch
SCD	Speed Cut Defeat
SCA	Speed Cut Adjust
TPS	Throttle Position Sensor.

Wastegate	Turbocharger exhaust gas bypass valve activated by pressure.
WOT	Wide-Open-Throttle, i.e. maximum throttle position.

Description

The MAP-ECU2 generates an output to simulate an air flow meter based on manifold pressure (vacuum and boost) versus RPM. The unit can generate either a square wave frequency (KVF) or Voltage (MAF) depending on the model selected. This allows removal of restrictive air flow meters for performance installations where a larger intake is required. The MAP-ECU2 samples manifold pressure and RPM continuously and calculates new output values based on the 494 Zone table approximately every ten (1) milliseconds, i.e. 1000 times per second.

Von Karman Vortex Frequency output is a continuous square wave from 16Hz to 3400Hz with 1Hz resolution. Air flow meter voltage output is 0 to 5V DC with 1.221mV resolution.

The TPS input is used to provide acceleration enrichment to the output signal as described later in this manual.

A pressure switch function is available for boost pressures from 0-35 PSI in 0.1 PSI increments.

Note: 0 PSI is defined as atmospheric pressure, i.e. 1 Bar.

A NOS activation function is available to drive a solenoid based on RPM and TPS.

A RPM>0 function is available to simulate the Fuel Pump enable signal generated by some air flow meters.

Full timing advance and retard control up to +/-30 degrees in 1 degree increments using a high resolution 380 zone table. Control is via 8 independent igniter inputs/outputs.

Solenoid based Electronic Boost Control - +9.5 PSI to +35 PSI in 0.1 PSI increments. (10 target boost zones and solenoid duty cycle zones for each 1000 RPM). Handles both inline and bleed style solenoids for internal and external wastegates.

O2 voltage adjustment (+/- Adjust in 0.01 volts increments) - Allows voltage adjustment of up to two independent OEM O2 sensors connected to the OEM ECU so you can even change AFR in closed loop mode of OBD-II vehicles.

Auxiliary Injector control using a high resolution 380 zone table. Adjustment is in % duty cycle from 0 to 90% in 1% increments.

Frequency based Speed Cut Defender. Frequency is clamped between 0 and 3400Hz in 100Hz increments.

Frequency based Speed Adjust. Frequency and adjusted by 0 to 200% in 1% increments.

Voltage based Fuel Cut Defender. Input voltage is clamped between 0 to 5.0Volts in 0.1 Volt increments.

Ignition based Launch Control. Launch RPM set between 0 and 10,000 in 100 RPM increments. Launch control activation is via an optional clutch switch.

Two (2) complete sets of tables for configuration, Fuel, Timing, O2 Adjust, Auxiliary Injector and EBC selected using a configurable input and optional switch.

Customised Pressure Scale

The MAP-ECU2 can be configured for different pressure scales to suit different purposes with a maximum of nineteen (19) lines and a constant pressure step between lines. Pressure scale configuration is via MAP-CAL2.

How the Fuel Output is Calculated

Output values are computed based on RPM and Pressure. In these examples the pressure scale is the default –10 PSI to +35 PSI in 2.5 PSI steps where line 1 is –10 PSI. Up to four (4) table values are used for each computed value, as it is virtually impossible for the inputs to line up with table intersections, e.g. 1000 RPM and +2.5 PSI. The MAP-ECU2 takes the input RPM and Pressure and computes the value based on the four (4) values in the table. E.g. The input RPM is 2250 RPM and pressure is +1 PSI. The table has values for 2000 RPM and 2500 RPM for each pressure. The pressure lies between 0 and 2.5 PSI, therefore the MAP-ECU2 will use Zones 518, 520, 618 and 620.

Suppose the area of the table looks like this:

PSI/RPM	2000	2500
0	518 200	520 300
2.5	618 210	620 310

The MAP-ECU2 will look at the RPM and calculate that 2250 is half way (50%) between Zone 518 and Zone 520 and will calculate the half way point between those values. In this case 200 and 300, so the result is 250 (200+((300-200)*50%). It will then do the same for the next line, Zone 618 and Zone 620 and come up with 260 ((210+(310-210)*50%). The MAP-ECU2 will calculate that 1 PSI is between 0 and 2.5 PSI so will do the same with the computed values 250 and 260, i.e. Result=250+((260-250)*40%) or **254**. This is the value used to drive the MAF Voltage output or KVF frequency output depending on the mode. This technique is called interpolation.

How the Timing Output is Calculated

The timing adjustment value is calculated from the 380 zone timing table in the same way as the fuel value is calculated using interpolation. The result is a number in the range –30 (retard) to +30 (advance) degrees. The timing values in the MAP-ECU2 are **not** base timing values, they are **adjustments** on top of the OEM ECU timing. A value of zero (0) means no change to standard base timing, i.e. the MAP-ECU2 is not adjusting timing from the OEM ECU base configuration and the MAP-ECU2 is passing the timing signal "straight-through". If the OEM ECU has a setting of +6 degrees at 0psi and 1500 RPM (zone 510) and the MAP-ECU2 has –2 degrees in zone 510, the overall timing will be adjusted to +4 degrees, i.e. 4 degrees advance which is retarded 2 degrees from stock. The default values in the timing tables is zero (0), no adjustment.

Specifications

Parameter	Specification
Input voltage	10-16 VDC, negative earth. Polarity and over voltage protected.
Input current	Maximum 200mA, not including switched outputs.
Serial Communications	DB9 Female connector, RS232, 38400 baud, 8 bits, Even Parity, 1 stop bit.
Pressure Sensor	35 PSI air pressure sensor, absolute reference (not atmosphere). Barbed fitting accepts ¼" vacuum hose.
Switched Outputs 1-3	1A output switched ground, +12VDC. Programmable using MAP-CAL2.
Pressure Switch Function	Adjustable from 0 to +35 PSI in 0.1 PSI steps.
RPM=0 Function	Simulates nil airflow output of some air flow meters (disengages fuel pump relay).
NOS Activation Function	Minimum RPM, Maximum RPM and Minimum TPS parameters used to activate a NOS solenoid valve.
Igniter Inputs 1-8	Positive or negative going pulse train inputs, typically 5VDC, protected to 16VDC.
RPM	0-10,000 RPM
MAF Input	Connect to OEM Air Flow Meter output, 0-5VDC, input protected to 16VDC for 30 seconds. Resolution of 1.221mV.
MAF Output	0 to 5 VDC at 10mA, short circuit protected for 60

Parameter	Specification
	seconds. Resolution of 1.221mV. Programmable zero point.
Analog Output #1 & #2	0 to 5 VDC at 10mA, short circuit protected for 60 seconds. Resolution of 19.5mV.
KVF Input	'Clean' 0 to 5 VDC square wave, 16Hz-3400Hz, input protected to 16 VDC for 30 seconds. Resolution of 1Hz.
KVF Output	0-5VDC square wave, 16Hz-3400kHz, open collector output with 4K7 pull-up resistor. Maximum sink current of 50mA. Resolution of 1Hz.
TPS Input	Throttle Position Sensor input. 0 to 5 VDC, input protected to 16 VDC for 30 seconds. Ten (10) zones of TPS enrichment in 1000 rpm steps.
O2 Sensor Input	Oxygen Sensor input used for logging and monitoring only. 0 to 5 VDC, input protected to 16 VDC for 30 seconds.
Fuel Table Resolution	494 Zones, RPM versus MAP. 0-2,000 RPM in 200 RPM increments, 2,000-10,000 RPM in 500 RPM increments. Manifold pressure -10 PSI to +35 PSI in 2.5 PSI increments.
Timing Table Resolution	380 Zones, RPM versus MAP. 0-10,000 RPM in 500 RPM increments. Timing adjustment in degrees (+/-30)
O2 Adjust	494 Zones, RPM versus MAP. 0-2,000 RPM in 200 RPM increments, 2,000-10,000 RPM in 500 RPM increments. Manifold pressure -10 PSI to +35 PSI in 2.5 PSI increments.
Auxiliary Injector	380 Zones, RPM versus MAP. 0-10,000 RPM in 500 RPM increments. Injector adjustment in duty cycle (%)
Number of writes to NVRAM	100,000
Retention life of NVRAM	100 years @ 25 degrees centigrade
Size (L x W x H)	78mm x 180mm x 36mm
Weight	400 grams (0.88 lbs)

Configuration

Programming of the MAP-ECU2 is achieved through the PC based MAP-CAL2 application provided with the unit via a serial COM port and the provided cable. All configuration parameters are modified using this interface and saved in Flash NVRAM. Parameters that need to be configured are as follows:

- Igniter/Distributor Configuration
- KVF/MAF selection
- MAF Zero/Baro Adjust
- TPS Idle
- TPS Max (WOT)
- TPS Enrichment Table
- MAP Enrichment Table
- NOS Min/Max RPM & Min TPS
- FCD Clamp Voltage
- Speed Cut Defeat
- Speed Cut Adjust
- RPM Switch
- Launch Control RPM
- Pressure Switch Threshold
- Electronic Boost Control Sensitivity, Gain, Target Boost and Duty Cycle
- Switched Output Configuration
- Input Configuration
- IAT and Barometric compensation enable
- Pressure scale configuration

Igniter/Distributor Configuration

Configures the number of igniter inputs/outputs enabled as well as RPM calculations. An incorrect setting can lead to incorrect RPM reading and timing input/output malfunctions. **Note**: If Switched Output 2 LED begins flashing there may be a mismatch between this configuration and the number of active igniter inputs.

The following table illustrates the igniter configuration options:

Configuration	CH1	CH2	CH3	CH4	CH5	CH6	CH7	CH8
3 Cylinder Distributor	I1							
3 Cylinder Individual Igniter	I1	I2	I3					
4 Cylinder Distributor	I1							
4 Cylinder Group Fire (Inline)	I1, I4	I2, I3						
4 Cylinder Group Fire (Flat)	I1, I2	I3, I4						
4 Cylinder Individual Igniter (Inline)	I1	I3	I4	I2				
4 Cylinder Individual Igniter (Flat)	I1	I3	I2	I4				
5 Cylinder Distributor	I1							
5 Cylinder Individual Igniter	I1	I3	I5	I4	I2			
6 Cylinder Distributor	I1							
6 Cylinder Group Fire (Inline)	I1, I6	I5, I2	I3, I4					
6 Cylinder Individual Igniter (inline)	I1	I5	I3	I6	I2	I4		
V6 Group Fire	I1, I4	I2, I5	I3, I6					
V6 Individual Igniter	I1	I2	I3	I4	I5	I6		
V8 Distributor	I1							
V8 Group Fire (Chev Small Block)	I1, I6	I8, I5	I4, I7	I3, I2				
V8 Individual Igniter (Chev Small Block)	I1	I8	I4	I3	I6	I5	I7	I2
V8 Group Fire (LS1)	I1, I6	I8, I5	I7, I4	I2, I3				
V8 Individual Igniter (LS1)	I1	I8	I7	I2	I6	I5	I4	I3
V10 Distributor	I1							
V10 Group Fire	I1, I6	I10, 5	I9, 8	I4, 7	I3, 2			

NOTE: CHANNELS MUST FOLLOW FIRING ORDER. INCORRECT ORDER CAN CAUSE DAMAGE TO COILS AND/OR ENGINE.

Voltage/Frequency Select

This setting is a binary selection of either Hotwire/Flap MAF (Voltage) or Karman Vortex Frequency (KVF). This option controls both the auto-learn input selection and output control. In MAF mode, values in the table are used to determine the output voltage of the MAP-ECU2 (0-5VDC) on the MAF output where 0=0V and 4095=5V. Each increment is 1.221 mV. In KVF mode, the value in the table controls frequency output on the KVF output. A setting of 0 means no output, i.e. no frequency, and a setting of 2000 means 2kHz. Values in between control the frequency based on 1Hz increments, i.e. 100=100Hz. The minimum frequency is 16Hz.

MAF Zero/Baro Adjust

This value is used for both MAF and KVF MAP-ECU2's and performs different functions.

The MAF Zero Adjust value is only used for MAF mode. This value (0-4095) controls the zero airflow voltage presented to the existing ECU when the engine is at rest, i.e. 0 RPM. If the engine has this type of airflow meter, then the value should be set accordingly. It is unlikely that zero airflow is exactly 0 Volts or 5 Volts and therefore will be set accordingly. If the MAP-ECU2 is installed in parallel with the OEM MAF, it is possible to monitor this signal with the ignition ON but without the engine running to get the exact value. MAP-CAL2 allows the user to sample this input voltage. Refer to the MAP-CAL2 Software Users Guide for more information on editing and configuring this parameter.

When the MAP-ECU2 is a KVF type, this value controls the voltage presented to the OEM ECU Barometric pressure input if there is one present. If a satisfactory signal is not supplied to the OEM ECU an engine check light may appear. This value can be adjusted to make fine air/fuel mixture adjustments across the entire table simulating barometric pressure variations, e.g. high pressure will require more fuel and lower pressure less fuel.

Note: When the unit is in Auto-Learn mode and power is applied, the MAP-ECU2 will check the MAF voltage input with the engine at 0 RPM and store the 'no flow' value as the MAF Zero. This is because the 'no flow' value may be in the range of 0-4095 and allows the MAP-ECU2 to present the most accurate data to the existing ECU at start-up. With a KVF MAP-ECU2, this input can be connected to the Barometric Pressure sensor output of the OEM air flow meter in order to learn the default voltage setting.

TPS Idle

TPS Idle is the voltage presented to the MAP-ECU2 when the throttle is at idle. This is used in conjunction with TPS Max to determine whether the TPS output uses normal or reverse voltage and the rate of change (integral) of TPS for accelerator enrichment. 0=0 Volts, 4095 = 5 Volts.

TPS Max

Like TPS Idle, this is the voltage presented to the MAP-ECU2 when the throttle butterfly is at WOT. It's value determines whether the TPS output uses normal or reverse voltage and the rate of change (integral) of TPS for accelerator enrichment. 0=0 Volts, 4095 = 5 Volts.

TPS Enrichment Table

This table determines the level of enrichment applied by the MAP-ECU2 to the output when fast transitions of the throttle are detected, similar to an accelerator pump. The faster the transition, the more enrichment is applied as a product of transition speed and TPS Percent. Transition speed is computed in the MAP-ECU2 using the integral of TPS input voltage. An integral value of 0-100 percent is generated by the MAP-ECU2 internally which is then multiplied by TPS Percent and the result used to enrich the MAP-ECU2 output. This means slow transitions of the throttle position result in little or no enrichment. Maximum enrichment can only be achieved by a throttle position change from Idle to WOT within approximately 200mS. Note that negative TPS transitions have no effect, i.e. additional leaning of the output signal is not provided. Valid settings for TPS Percent are integers from 0 to 100. It is vital that TPS Idle and TPS Max are set correctly otherwise TPS enrichment will not operate correctly. The TPS Enrichment table is configured as ten (10) Zones in 1000 RPM increments, e.g. 1000, 2000, 3000, etc.

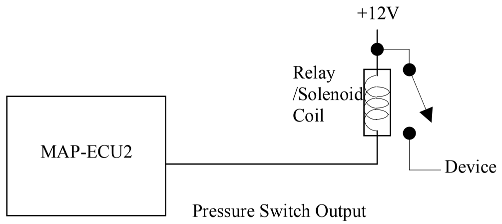
MAP Enrichment Table

This table determines the level of enrichment applied by the MAP-ECU2 to the output when fast transitions of Manifold Pressure are detected, similar to the TPS Enrichment Table. This function is provided for vehicles where a TPS signal is not available. The faster the transition, the more enrichment is applied as a product of transition speed and MAP Percent. Transition speed is computed in the MAP-ECU2 using the integral of Manifold Pressure. An integral value of 0-100 percent is generated by the MAP-ECU2 internally which is then multiplied by MAP Percent and the result used to enrich the MAP-ECU2 output. This means slow transitions of the Manifold Pressure result in little or no enrichment. Maximum enrichment can only be achieved by a large change in Manifold Pressure, e.g. Idle to WOT within approximately 200mS. Note that negative Manifold Pressure transitions have no effect, i.e. additional leaning of the output signal is not provided. Valid settings for MAP Percent are integers from 0 to 100. The MAP Enrichment table is configured as ten (10) Zones in 1000 RPM increments, e.g. 1000, 2000, 3000, etc.

Pressure Switch

The MAP-ECU2 has the ability to control a device based on pressure, e.g. Intercooler water mist pump relay, etc. The pressure output signal is switched to ground, i.e. 0V suitable for relay or solenoid control to 1A @ 12 VDC.

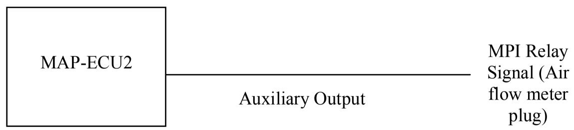
E.g.



RPM>0 (Airflow Signal)

One of the Switched Outputs can be configured to simulate the airflow signal generated by some air flow meters to energise the fuel pump, e.g. Mitsubishi™ MPI control relay.

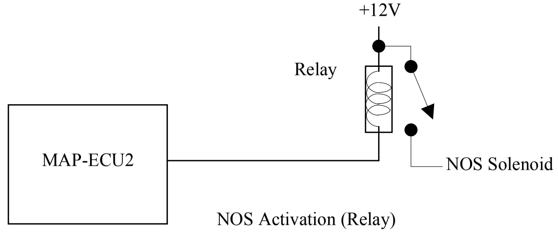
E.g.

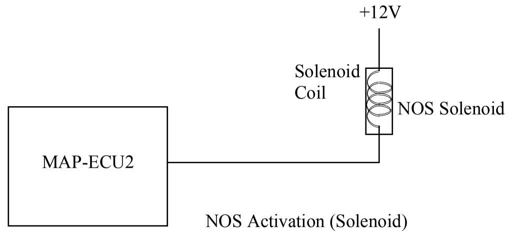


NOS Activation

One of the Switched Outputs can be configured to drive a NOS activation solenoid. Activation is based on Minimum RPM, Maximum RPM and Minimum TPS. The NOS activation output signal is switched to ground, i.e. 0V suitable for relay or direct control of the NOS solenoid to 1A @ 12 VDC.

E.g.

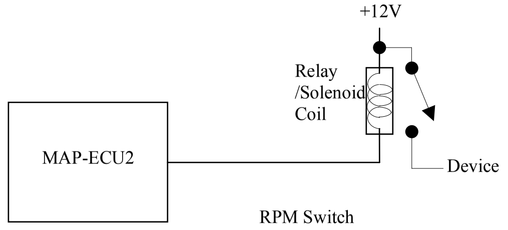




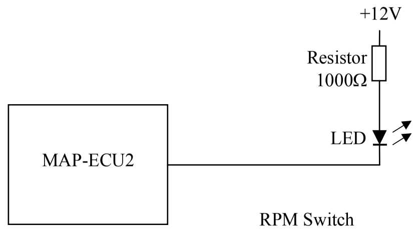
RPM Switch

One of the Switched Outputs can be configured to drive a RPM switch, e.g. Shift light or VTEC™ change over. Activation is based on an RPM value 0-10,000 in 100 RPM increments. The RPM switch output signal is switched to ground, i.e. 0V suitable for relay or solenoid control to 1A @ 12 VDC.

E.g.

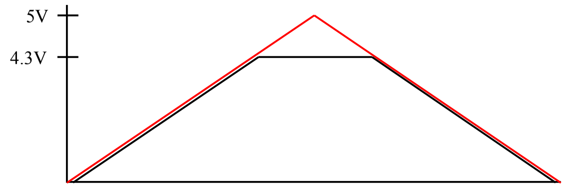


Example of shift light based on a high intensity Light Emitting Diode (LED):



FCD Clamp Voltage

This value clamps a voltage used by the OEM ECU for Fuel Cut Defeat. Fuel Cut voltage is usually derived from a MAP sensor or the MAF. For correct operation, an analogue input and output must be assigned to the FCD function. The FCD value is the clamp voltage from 0 to 5.0 Volts in 0.1 Volt increments. If 4.3 is entered, the output will track the input until 4.3 Volts is reached where it will clamp regardless of how high the input voltage tracks. Once the input voltage drops below 4.3 Volts, the output will once again track the input voltage. The FCD clamp voltage should be set to 0.1 Volts less than the fuel cut threshold. The following diagram illustrates how FCD clamps the output voltage to 4.3V:



Red Line = Input Voltage
Black Line = Output Voltage

Speed Cut Defeat Frequency

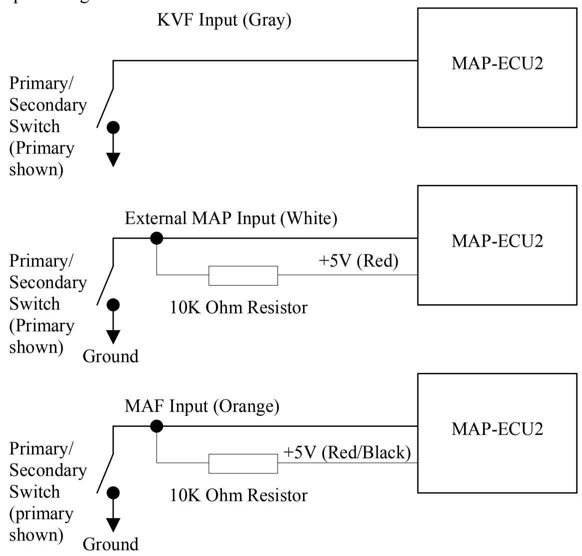
This value clamps the frequency used by the OEM ECU for speed cut. Speed Cut Defeat (SCD) frequency is usually derived from a speed sensor or the speedometer. For correct operation, a digital input and output must be assigned to the SC function. The SC value is the clamp frequency from 0 to 3400Hz in 100Hz increments. If 2100 is entered, the output will track the input until 2100Hz is reached where it will clamp regardless of how high the input frequency tracks. Once the input frequency drops below 2100Hz, the output will once again track the input frequency. The SC clamp frequency should be set to 100Hz less than the speed cut threshold.
Note: Speed Cut utilises the KVF Input and therefore cannot be used if the MAP-ECU2 is in KVF learn mode.

Speed Cut Adjust

This value adjusts the frequency used by the OEM ECU for speed. Speed Cut Adjust (SCA) frequency is usually derived from a speed sensor or the speedometer. For correct operation, a digital input and output must be assigned to the SCA function. The SCA value is the adjust percentage from 0.01 (1%) to 2.00 (200%) in 0.01 (1%) increments. If 0.99 is entered, the output will track 99% of the input, e.g. Input=1000Hz, Output=990Hz. . If 1.10 is entered, the output will track 110% of the input, e.g. Input=1000Hz, Output=1100Hz.
Note: Speed Cut Adjust utilises the KVF Input and therefore cannot be used if the MAP-ECU2 is in KVF learn mode.

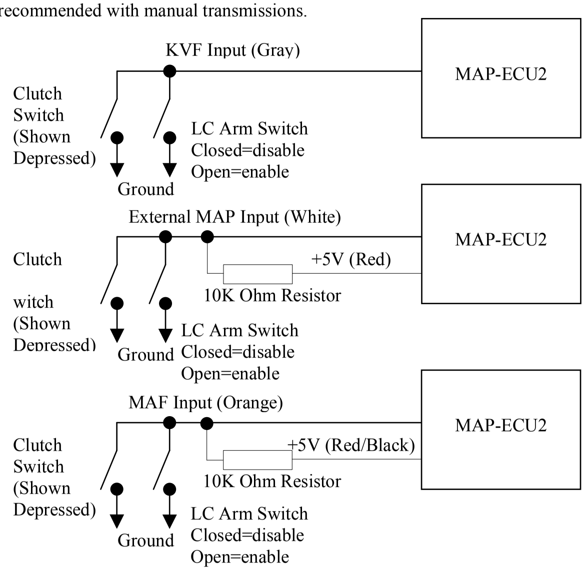
Primary/Secondary Table Selection

The MAP-ECU2 has two (2) totally independent sets of tables and configuration parameters, referred to as the Primary and Secondary tables. Table selection can be allocated to one of the unused inputs, e.g. KVF Input, MAF Input or External MAP Input, using MAP-CAL2. The following diagrams illustrate the various input configurations:



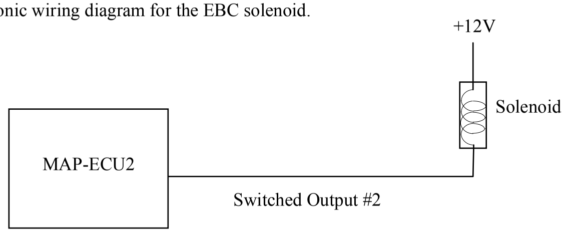
Launch Control

Launch control (sometimes called “2-step”) requires two (2) configuration parameters, RPM and a clutch switch input. Launch Control RPM is the desired RPM for optimum launch or ‘flat-shifting’. Once the clutch switch is activated (open), the MAP-ECU2 will attempt to clamp RPM to the Launch Control RPM value by ‘missing’ igniter pulses. This function only operates when the MAP-ECU2 is configured to control timing. The clutch switch must be configured to ‘open’ when the clutch is depressed and ‘close’ when the clutch disengaged. It is also recommended that a launch control arming switch is wired in parallel with the clutch switch to disable launch control. A magnetic reed switch is recommended for the clutch switch where the magnet is secured to the moving clutch pedal mechanism and the switch to a portion of the pedal box. The Clutch Switch function can be allocated to one of the unused inputs, e.g. KVF Input, MAF Input or External MAP Sensor input. **Note**: Unburnt fuel may enter the exhaust system causing backfires during operation therefore Launch Control Operation should be minimised. Launch Control may not function correctly with some OBD-II vehicles that monitor igniter feedback pulses. Launch Control is only recommended with manual transmissions.



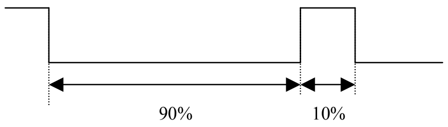
Electronic Boost Control

Electronic Boost Control (EBC) can only be enabled on Switched Output 2. Configuration parameters include Gain, Sensitivity, Internal/External Wastegate Select, Maximum Boost and Target Duty Cycle. The following diagram illustrates the electronic wiring diagram for the EBC solenoid.

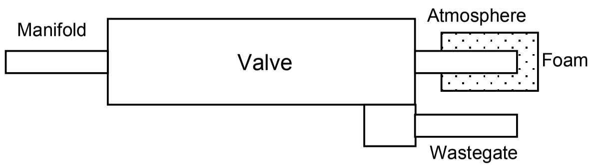


EBC can be configured in *Internal* or *External* modes. *Internal* mode is Normal EBC mode and means the solenoid bleeds boost pressure to atmosphere from the wastegate control actuator using the duty cycle principle. The MAP-ECU2 will pulse the solenoid 20 times per second (20Hz).

The ratio of OFF time versus ON time is called Duty Cycle and is usually expressed as a percentage, e.g. 10% Duty Cycle means the solenoid is OFF 90% of the time and ON 10% of the time as per the following diagram:



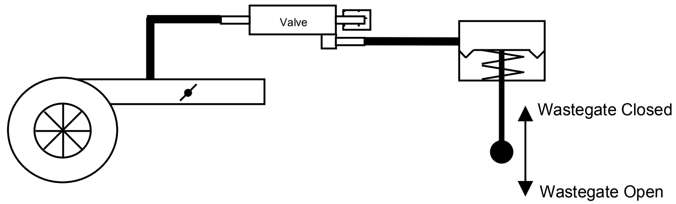
The recommended solenoid is the Delco™ 3-Way Boost Control Solenoid, part number ACD# 214-474 (GM# 1997152) and matching wiring harness part number ACD#PT374 (GM# 12102747). The following diagram illustrates the Delco™ solenoid:



The is system is called a "Closed Loop" system because it continually monitors manifold pressure and alters the duty cycle to prevent excessive boost pressure.

Normal Internal Wastegate

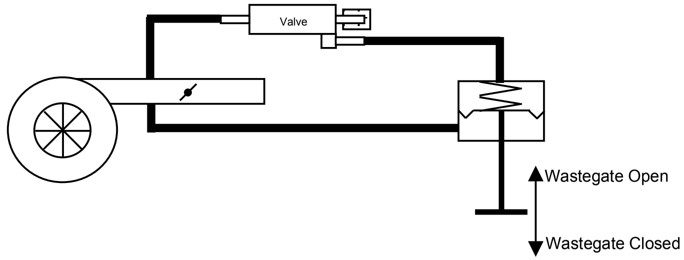
The following diagram illustrates how to configure a normal internal wastegate:



In Normal mode, **more** duty cycle bleeds more boost pressure from the wastegate control actuator line, therefore **increases** boost.

External Wastegate

The following diagram illustrates how to configure an external wastegate:



In External mode, **more** duty cycle bleeds more boost pressure from the wastegate canister, therefore **reduces** boost.

Sensitivity

The EBC Sensitivity value (0-100%) determines the percentage of target boost pressure when the MAP-ECU2 starts operating the solenoid. A EBC Sensitivity value of 100% means the solenoid begins operating at 100% of target boost pressure and will probably result in over boost. A setting of 0% means the solenoid begins operating at 0% of target boost which is the **recommended** setting for **Internal** mode. The **recommended** sensitivity value for **External** mode is 80% where the solenoid will begin operating at 80% of maximum boost ensuring a ‘soft’ boost curve with minimum overshoot.

Gain

The Gain setting (1-255) determines the speed the MAP-ECU2 adjusts solenoid duty cycle based on changes to manifold pressure. A Gain value of 1 means maximum gain (speed) and a setting of 255 means minimum gain (speed). Gain can be adjusted to ensure boost is controlled in the smoothest possible manner. A typical gain setting is ‘20’ during normal operation, with lower values when determining the duty cycle, e.g ‘3’. Should boost pressure becomes erratic, the gain may need to be reduced. Each increment is equal to 128th/sec.

EBC Pressure

EBC pressure is set at 1000 RPM increments and has the range +9.5 PSI to +35 PSI in 0.1 PSI increments. These values are the **maximum boost pressure** for the MAP-ECU2 EBC computations and is used in conjunction with Sensitivity to control solenoid operation.

Note: When adjusting EBC Pressure, EBC Duty needs to be adjusted at the same time. If you enter a target duty cycle of 70% and Maximum boost of 15 PSI, the EBC assumes 70% duty cycle is required for 15 PSI and will ramp duty cycle up according to boost. If 80% duty cycle is required for 15 PSI, the target duty will not be achieved. Similarly, if 60% duty cycle is required for 15 PSI boost and target duty cycle is set to 70%, the EBC will reduce the duty cycle (EBC Cduty %) when overshoot occurs. The speed at which the EBC adjusts EBC Cduty % is determined by Gain. This is why Gain should be set to high speed (low values) while determining the optimum duty cycle. Duty cycle settings will be very dependant on wastegate actuator tension therefore a conservative approach to setting duty cycle is recommended.

EBC Duty %

EBC Duty Cycle is set at 1000 RPM increments and has the range 0 to 100% in 1% increments. These values set the **target duty cycle** for the solenoid to achieve the target boost level. For example, if EBC is configured for *Normal* mode a

Toyota CT-26 turbocharger with 9 PSI wastegate required 80% duty cycle to achieve 14 PSI boost. The values in these zones of the table are copied to “EBC Cduty %” line when the MAP-ECU2 is powered up. If the EBC Duty Cycle entered results in over boost, the EBC Cduty values will be altered to limit boost to that entered in the EBC Pressure zones. Always alter duty cycle values in small increments and very carefully. Lower Gain values are recommended when determining the correct duty cycle values. See below for more information.

EBC CDuty %

EBC CDuty zones are copies of EBC Duty zones and are used by the MAP-ECU2 EBC computations should the duty cycle need alteration to prevent over boost. For example, if EBC is configured for *Internal* mode and EBC Duty is set to 70% and the MAP-ECU2 detects an over boost condition, i.e. manifold pressure greater than EBC Pressure, the MAP-ECU2 will reduce the EBC CDuty % until the desired EBC Pressure is achieved. **Note**: EBC Duty % will not be altered, it is up to the operator to decide what value should be entered as EBC Duty % but it is highly recommended that if the MAP-ECU2 alters EBC CDuty, that value should be entered into EBC Duty %.

EBC and Launch Control

When Launch Control is configured to aid ‘flat-shifting’, EBC Duty cycles will need to be adjusted as boost will be maintained between shifts and therefore maximum boost will be exceeded. Testing has proved that lower duty cycles are required with internal wastegates when using Launch Control to aid flat-shifting compared to normal shifting. The difference between duty cycle between ‘flat-shifting’ and normal driving depends on the wastegate actuator and EBC settings. Some experimentation will be required to find the correct settings as every vehicle combination is different.

IAT Compensation

The MAP-ECU2 can compensate the fuel output signal based on inlet air temperature (IAT) provided the IAT sensor is connected and enabled using MAP-CAL2. Lower air temperatures mean higher density air requiring more fuel to maintain the correct AFR. Higher temperatures air temperatures mean lower density air requiring less fuel to maintain the correct AFR. The MAP-ECU2 is configured for zero IAT compensation at 30 degrees centigrade. IAT less than 30 degrees centigrade means higher density air requiring more fuel to maintain the correct AFR. IAT greater than 30 degrees centigrade means lower air density requiring less fuel to maintain the correct AFR.

Baro Compensation

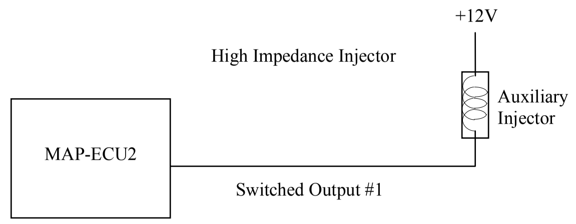
The MAP-ECU2 can compensate the fuel output signal based on barometric air pressure variations. When the internal MAP sensor is in use, barometric air pressure is sampled when the ignition is turned and before the starter is engaged. This value is stored for the journey. When an external MAP sensor is in use, the internal MAP sensor is used for continuous barometric pressure measurement. Normal barometric air pressure is 1013mb or 1 Bar. Higher barometric pressure means higher density air requiring more fuel to maintain the correct AFR. Lower barometric air pressure means lower air density requiring less fuel to maintain the correct AFR.

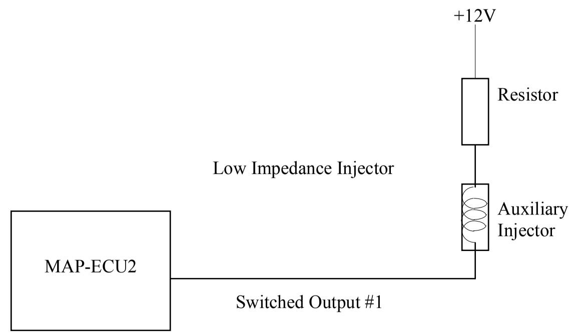
Auto Baro Output Adjust

When the MAP-ECU2 is configured in KVF mode, the baro output voltage can be configured to self adjust based on the barometric pressure sampled as per Baro Compensation. An output voltage of 4 Volts equals a barometric pressure of 1013mb.

Auxiliary Injector

The MAP-ECU2 has a 380 zone table dedicated to controlling an auxiliary injector on Switch Output #1. The purpose of an auxiliary injector is to supplement the OEM fuel injectors under heavy boost, NOS activation, etc. Placement of auxiliary injector(s) in the intake manifold is critical and should only be attempted by experienced installers. The auxiliary injector is controlled using duty cycle, as per the previous discussion on Electronic Boost Control. The auxiliary injector is fired following each igniter pulse detected by the ignition timing control circuitry of the MAP-ECU2. The table is populated with values from 0% to 90% duty cycle. The auxiliary injector is connected to the MAP-ECU2 as per the following diagrams:





Auto Learn

Auto Learn mode monitors RPM and Pressure inputs until there is an intersection point in the table, e.g. 600 RPM and –2.5 PSI, and then samples the current input and copies it into non-volatile memory. The MAP-ECU2 will actually take samples up to 10% outside of the intersection Zone, i.e. –2.5 PSI +/- 0.25 PSI and 600 RPM +/- 60 RPM. This means if the MAP-ECU2 measures 660 RPM and -2.75 PSI, it will store the measured input into the table at Zone 404. Auto-learn is enabled and disabled via the ECU Configuration screen of MAP-CAL2. Once a change to auto-learn mode (off **or** on) is made from MAP-CAL2, the MAP-ECU2 **must** be power cycled for the change to take affect. Auto-learn will only store a sample if the zone is zero (0). If there is any value other than zero (0) stored in the zone already, no sample will be stored.

Before Enabling Auto Learn

Before enabling auto-learn, the MAP-ECU2 must be prepared. This means "zeroing" all the zones you wish to over-write, either individually, or using the bulk edit functions of MAP-CAL2. If you are installing a MAP-ECU2 without a base table, i.e. completely un-programmed, it is recommended that all zones are set to zero (0). Once the zones are zero (0), enable auto-learn as per MAP-CAL2 instructions.

Auto-Learn Set-up Procedure

In order to set-up the MAP-ECU2 for auto-learn, follow this procedure:

1. Install the unit as per the appropriate (MAF or KVF) wiring diagram included in this manual.
2. Install MAP-CAL2 on your computer as per the installation instructions.
3. Connect an available serial port (COM port) to the MAP-ECU2 using the RS232 cable provided. If the cable is not long enough, a cable of up to 10 Metres can be used as per the wiring diagram in this manual. Shielded cable should be used where possible to minimise interference.
4. Execute MAP-CAL2 by selecting 'Start', 'Programs', 'MAP-CAL' program group and the 'MAP-CAL2' icon.
5. If required, configure the serial port to suit your computers configuration. The default is COM 1. This can be accomplished from the 'Serial Configuration' option from the 'Edit' menu.
6. Power up the MAP-ECU2 by either starting the vehicle or turning the ignition to 'ON'.
7. Put the MAP-ECU2 'online' by clicking the 'Online' button. Select the option to read the configuration from the MAP-ECU2. Refer to MAP-CAL2 manual for more details.

8. When the MAP-ECU2 is fully 'online', i.e. data loaded, ensure all zones are set to zero '0' by viewing the data in 'Table Mode'. **Note**: In MAF mode, column 0 reflects the 'MAF Zero' setting.
9. Check that RPM is correct, adjust the 'Cylinders' value until the correct reading is obtained. Note that the MAP-ECU2 RPM may vary to that shown on the vehicles rev counter as it is generally more accurate.
10. Check the pressure reading is correct. At idle most vehicles 'pull' approximately –10 PSI.
11. If you wish to fill the table with zeros, select 'Fill Table' from the 'Edit' menu. Enter '0' into the data entry box and click 'Fill All'. Select 'Yes' to update the MAP-ECU2. It will take some time to update the entire MAP-ECU2. Progress can be monitored via messages in the 'Status" box.
12. Select 'ECU Configuration' from the 'Edit' menu.
13. 'Check' the 'Auto Learn' option box and click the 'OK' button. This should configure the MAP-ECU2 to auto-learn mode.
14. Either take the MAP-ECU2 offline by clicking the 'Offline' button or exit MAP-CAL2 (Ctrl-X).
15. Power cycle the MAP-ECU2 by turning the ignition key all the way 'OFF', wait 5 seconds and turn it 'ON' again. You may wish to start the vehicle to begin the auto-learning process.
16. Bring MAP-CAL2 'online' as instructed and read the MAP-ECU2 data as before.
17. View the MAP-ECU2 data in 'Table Mode'. Some data may have been recorded during the engine start process. If not, take the vehicle for a short, gentle drive. Re-connect the computer and check if some data has been written.
18. If the table is still filled with zeros, check the wiring, pressure sensor line and that 'Auto-learn' is enabled. Especially check the 'MAF In' or 'KVF In' value changes when the vehicle is driven.
19. If data is being recorded, drive the vehicle as per normal and attempt to explore as many load points throughout the entire RPM range. This may require several hours or days depending on the situation. Running the vehicle on a dyno is usually the fastest way to explore the greatest range of load points.

Recommendations

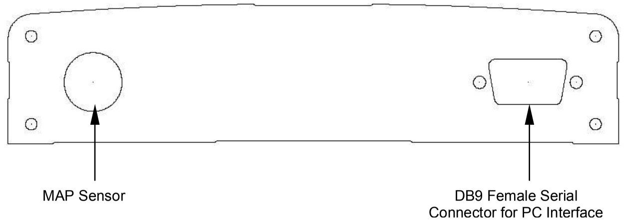
Auto-learn mode is only intended to provide a baseline set up for the table, i.e. should –10 PSI @ 800 RPM be 32Hz or 100Hz, using the existing airflow meter before it's removal, not as a final table set up mechanism. The user is expected to fill out the complete table using standard techniques once auto learn has provided this baseline data and then tune the vehicle as per any MAP based after market ECU. Only professionally trained personnel using a professional Air/Fuel ratio

meter and dyno should attempt the tuning process as terminal damage can be inflicted on an engine with improper configuration.
Do not run your vehicle on the MAP-ECU2 unless there is valid data in **all** Zones, i.e. never leave zeros (0) in any Fuel Zones unless in Auto-Learn mode.

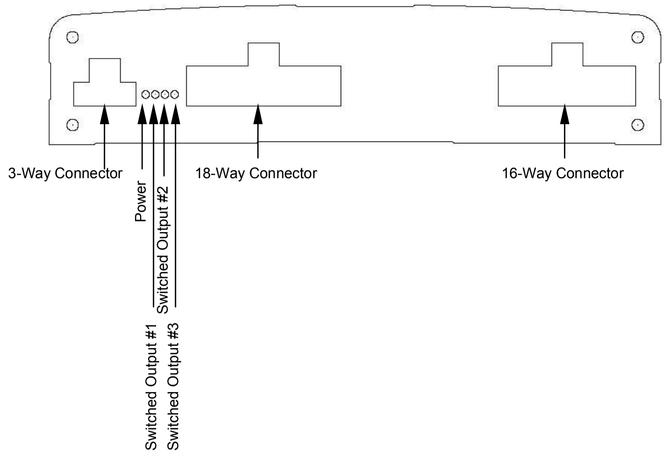
Note: Auto Learn mode is 'remembered' over power cycles to the MAP-ECU2. This means if you enable Auto Learn mode and then turn the engine off (which will remove power to the MAP-ECU2), when you next start the engine, the MAP-ECU2 will automatically enter Auto Learn mode. This feature is present so a unit can be installed in a vehicle over a period of time, including stop and start, without the need to re-enter Auto Learn mode.

Connections

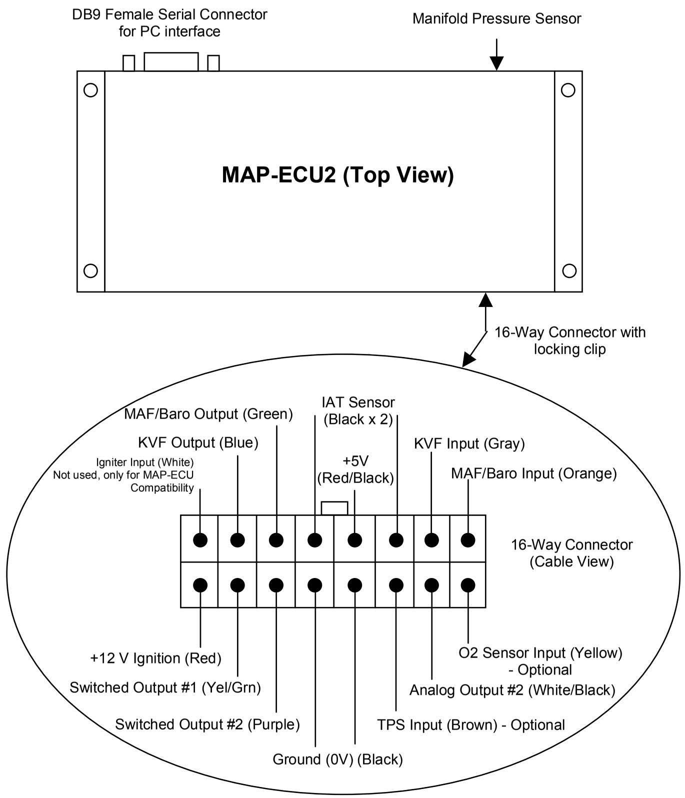
Below is the left hand side of the MAP-ECU2 showing connector and vacuum hose layout:



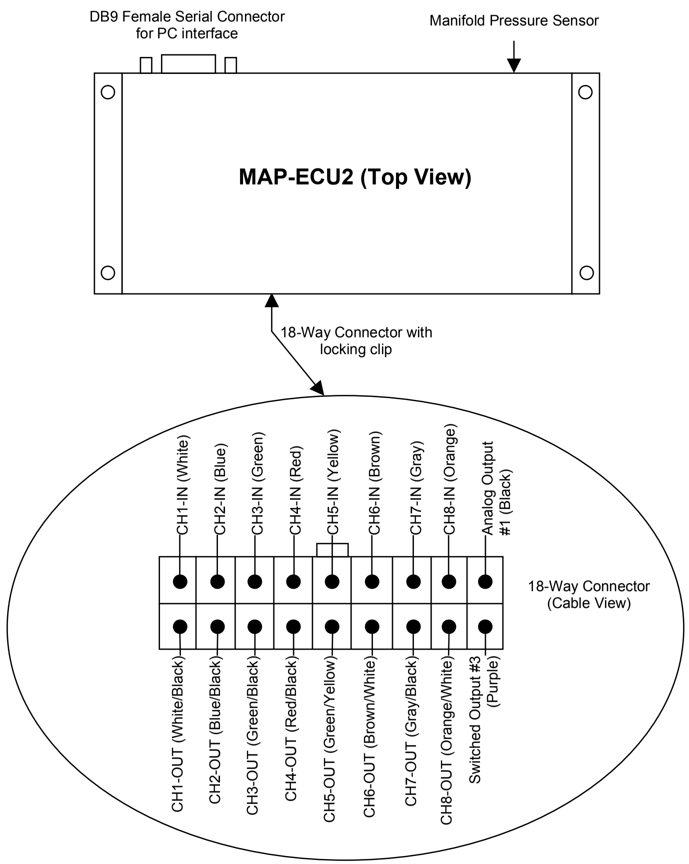
Below is the right hand side of the MAP-ECU2 showing connector and LED indicator layout:



16-Way Connector Diagram

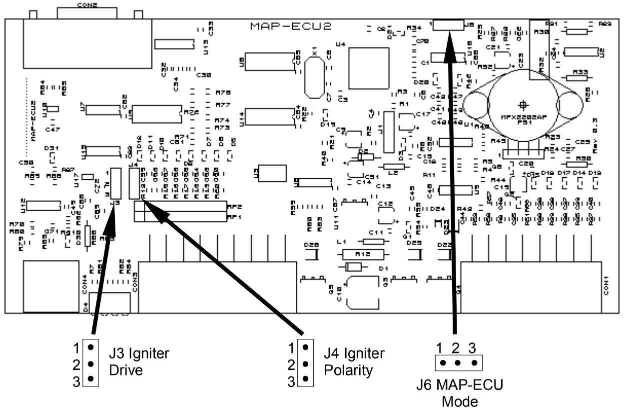


18-Way Connector Diagram



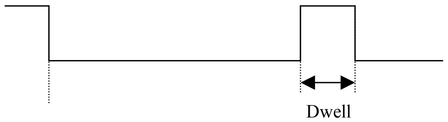
Igniter Configuration Jumpers

The diagram below shows the Igniter Configuration jumpers that must be configured for correct Ignitior operation:

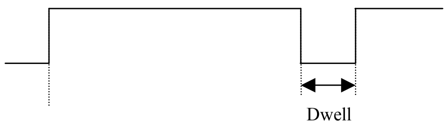


Igniter Polarity (J4)

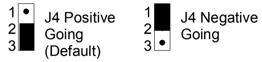
Igniter polarity can be 'positive going' or 'negative going' depending on the type of vehicle. Most igniters are 'positive going' and is the default configuration for the MAP-ECU2. A 'positive going' igniter pulse train displayed on an oscilloscope, is as follows:



A 'negative going' igniter pulse train displayed on an oscilloscope, is as follows:

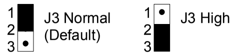


In order the change the igniter polarity, the jumper plug on J4 will need to be configured as follows:



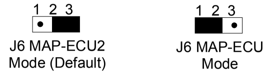
Igniter Drive (J3)

Some igniters require more voltage and current than others. The MAP-ECU2 has two settings, *normal* and *high*. The default setting is *normal* and will fire most igniters. Some igniters, especially late model Toyota's, require *high* output drive. Should the engine not start due to a lack of spark, try the *high* setting, otherwise leave J3 in *normal* drive. In order to change the igniter drive, the jumper plug on J3 will needs to be configured as follows:

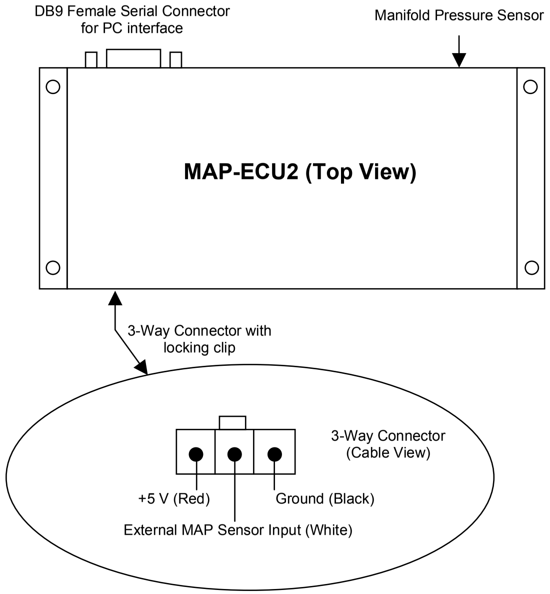


MAP-ECU Mode (J6)

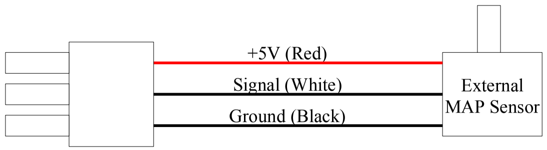
MAP-ECU2 can be configured to emulate the 1st MAP-ECU (no timing control) by changing the position of J6. When MAP-ECU2 is configured in MAP-ECU mode, the white wire of the 16-way connector is used as the RPM input. In order to set MAP-ECU or MAP-ECU2 mode, J6 needs to be configured as follows:



3-Way Connector Diagram



Various External MAP Sensors can be connected to the MAP-ECU2, e.g. GM 2-Bar, GM 3-Bar, AEM 5-Bar. Configuration is completed using MAP-CAL2. An external MAP sensor must be a linear 5 Volt type where minimum voltage equals vacuum and maximum voltage is maximum boost. The wiring is as follows:



Serial Port Cable Wiring

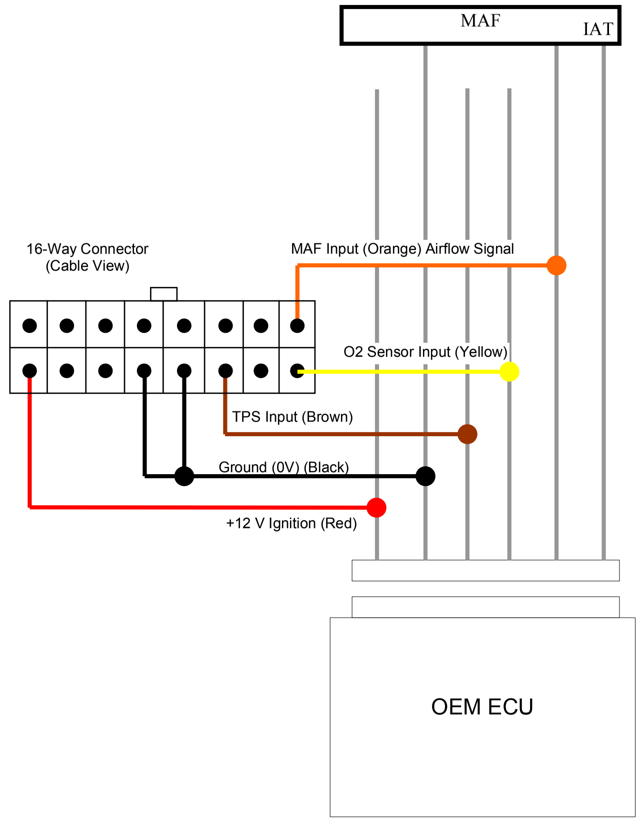
DB9 Female	DB9 Male
5	5
2	2
3	3

Installation Notes and Recommendations

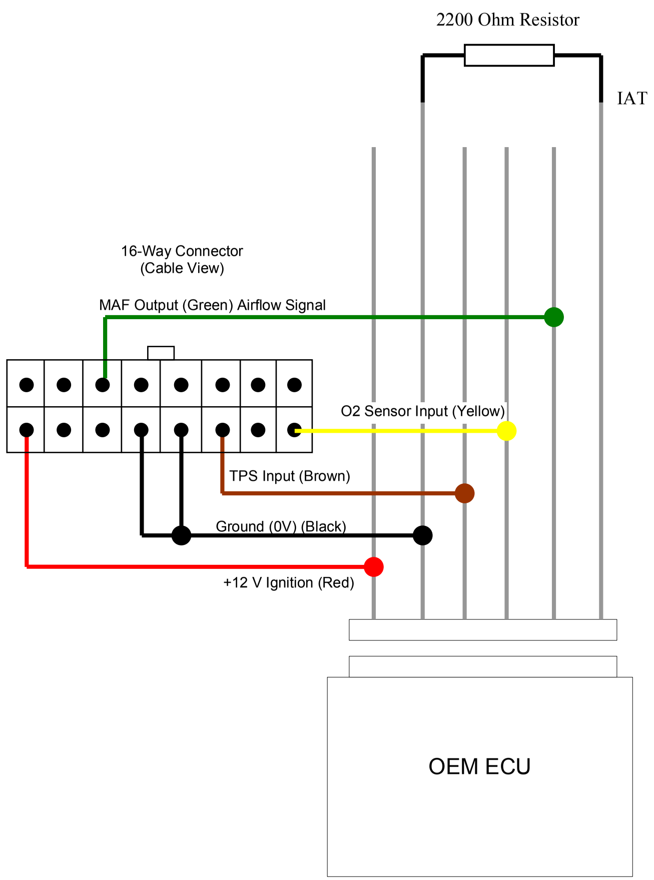
1. It is recommended that all wiring be kept as short as possible to avoid stray signals, especially the O2 Sensor wire (YELLOW).
2. "Crimp-over-wire" type connectors should be avoided. All connections should be soldered and protected with heat-shrink sleeves.
3. The manifold pressure line must be connected after the throttle body, i.e. off the plenum chamber. If no plenum chamber exists, a pressure collector will be required with connections to each throttle body after each throttle butterfly. The pressure line must be automotive standard vacuum line rated to the required pressure with a small internal diameter of no more than 4mm. The recommended vacuum line has an inside diameter of 7/64" (~2.8mm) and outside diameter of ¼" (~6.5mm).
4. The inlet air temperature (IAT) sensor supplied can be installed in the intake, usually the airbox.

Installation Instructions

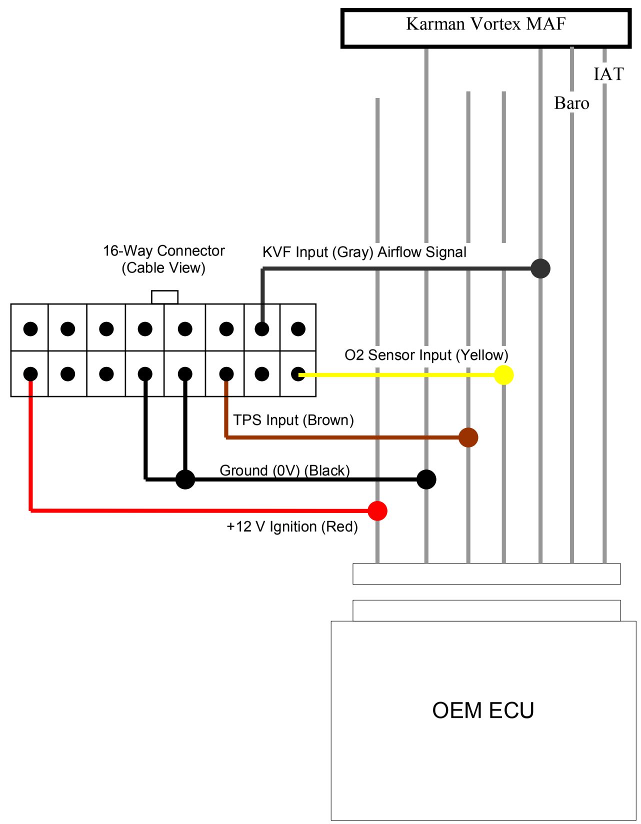
Hotwire/Flap MAF Wiring (Learn Mode)



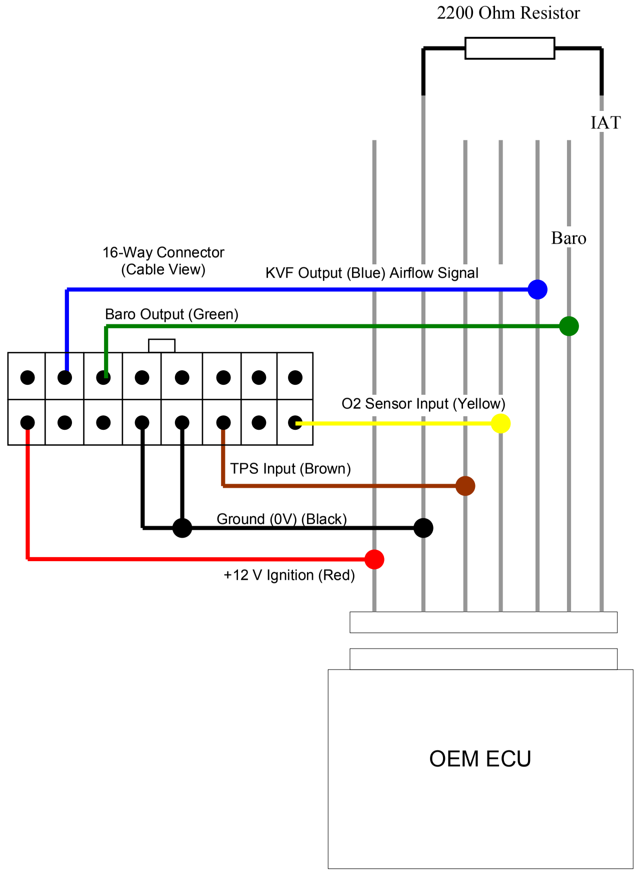
Hotwire/Flap Wiring (Normal Mode)



Karman Vortex Wiring (Learn Mode)

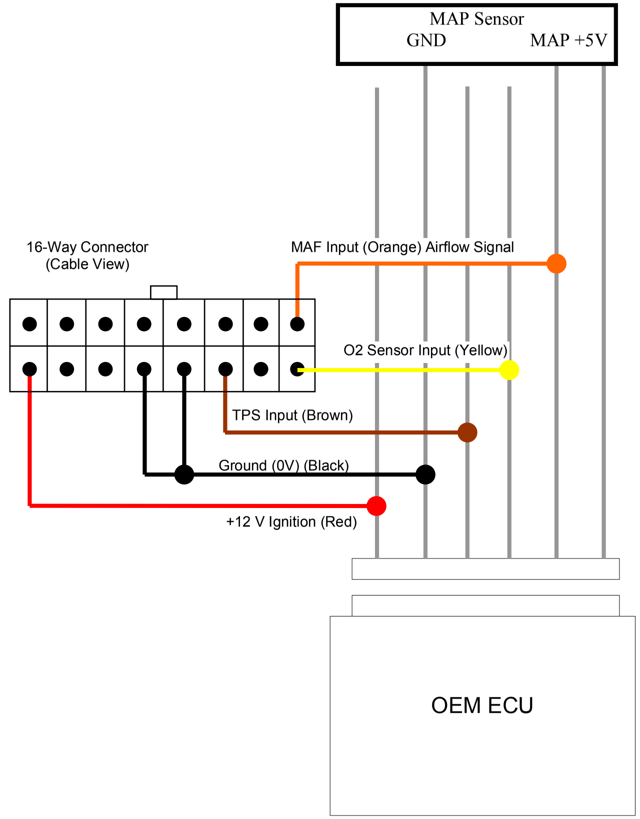


Karman Vortex Wiring (Normal Mode)

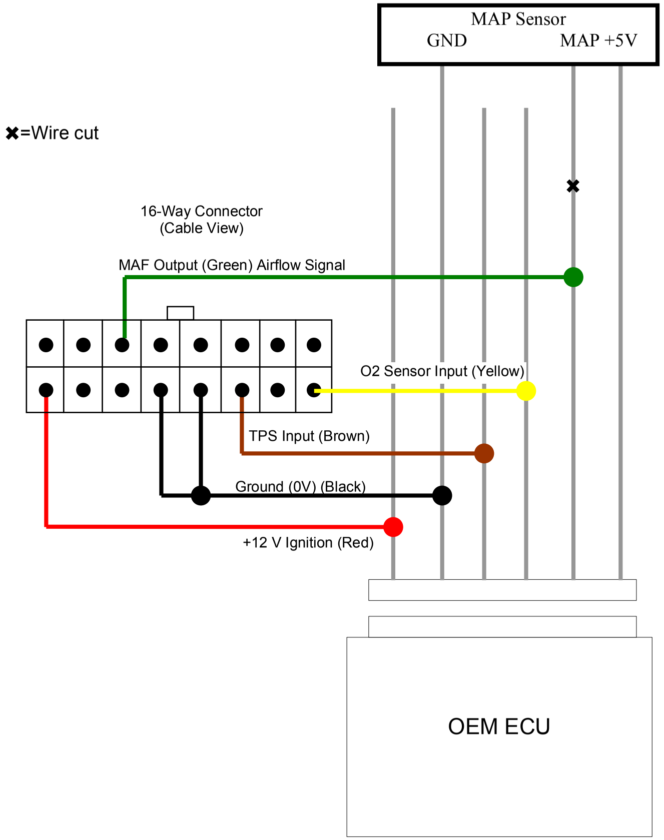


Note: Some Karman Vortex air flow meters do not have a baro signal.

MAP Sensor Wiring (Learn Mode)

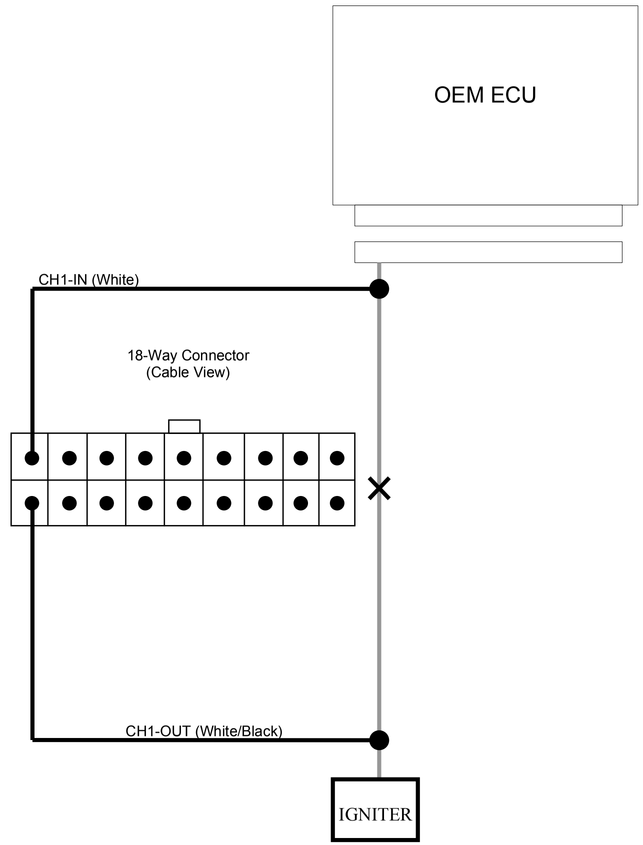


MAP Sensor Wiring (Normal Mode)

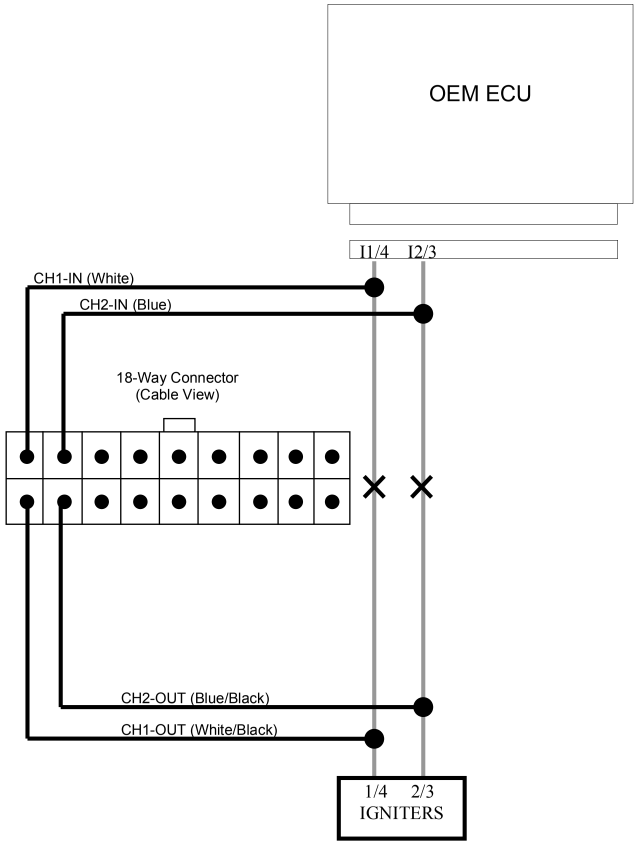


Timing Control Wiring

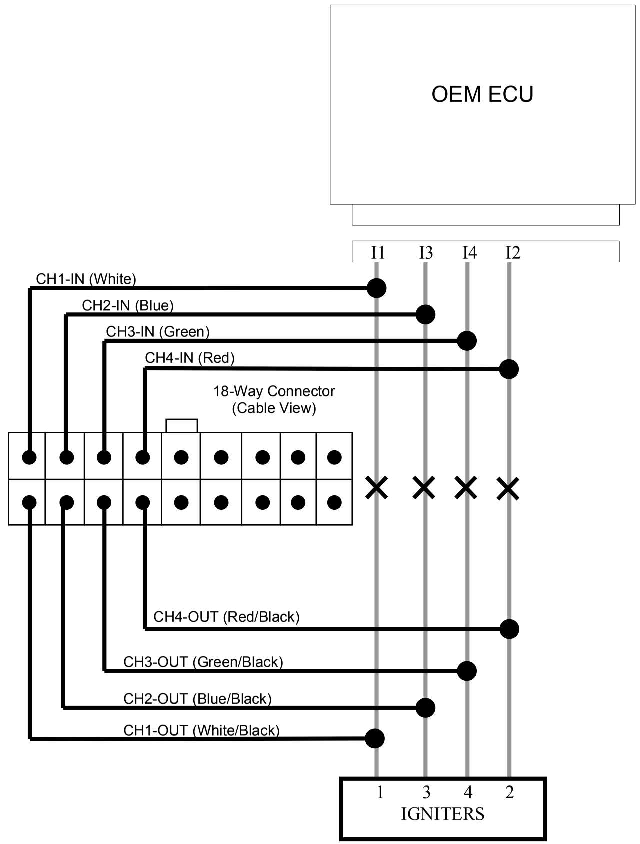
Distributor (3, 4, 5, 6, 8 & 10 Cylinder)



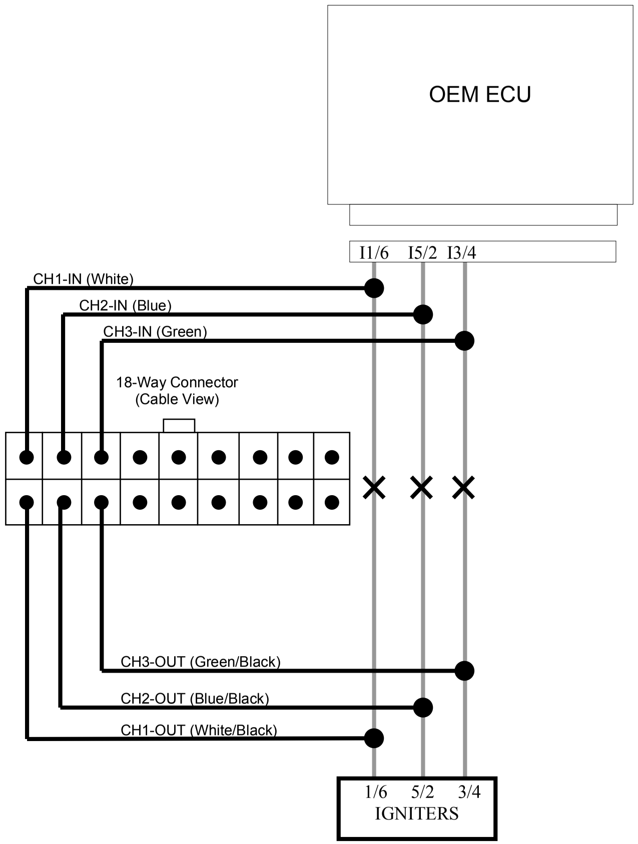
Inline 4 Cylinder Group Fire Igniters



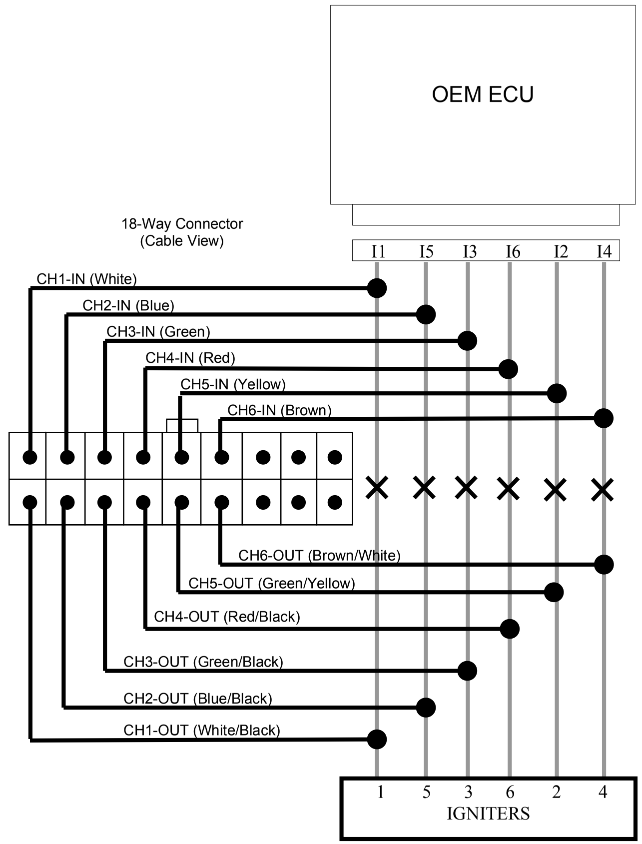
Inline 4 Cylinder Individual Igniters



Inline 6 Cylinder Group Fire Igniters

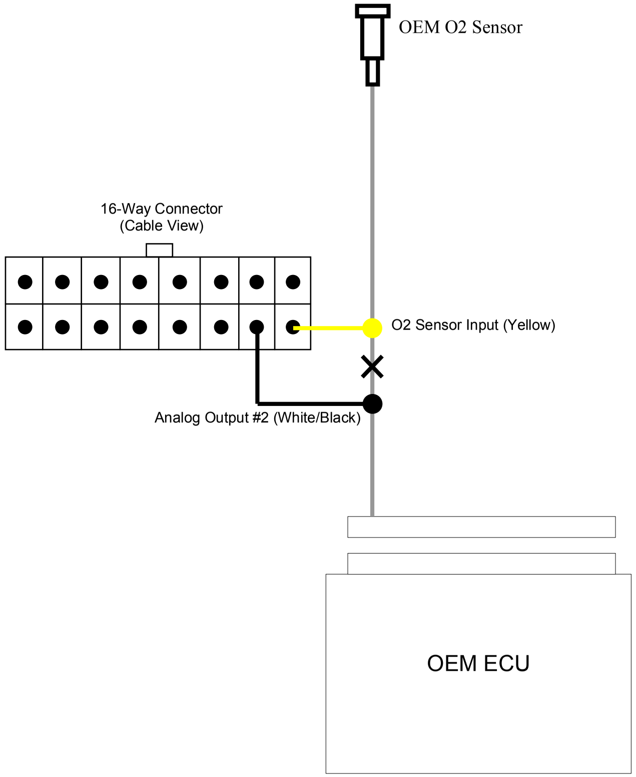


Inline 6 Cylinder Individual Igniters



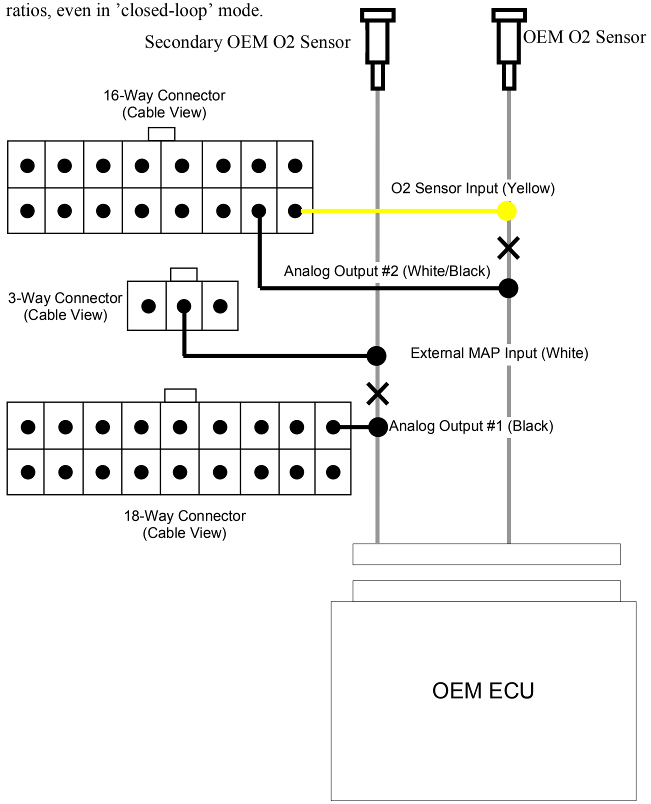
O2 Adjust Wiring

In the example below, the OEM O2 sensor voltage is feed into the MAP-ECU2 O2 Input and the adjusted output is feed into the OEM ECU from Analog Output #2. Either Analog Output #1 or #2 can be used for the adjusted output. Using this mode, adjustments can be made to OEM Air/Fuel ratios, even in 'closed-loop' mode.



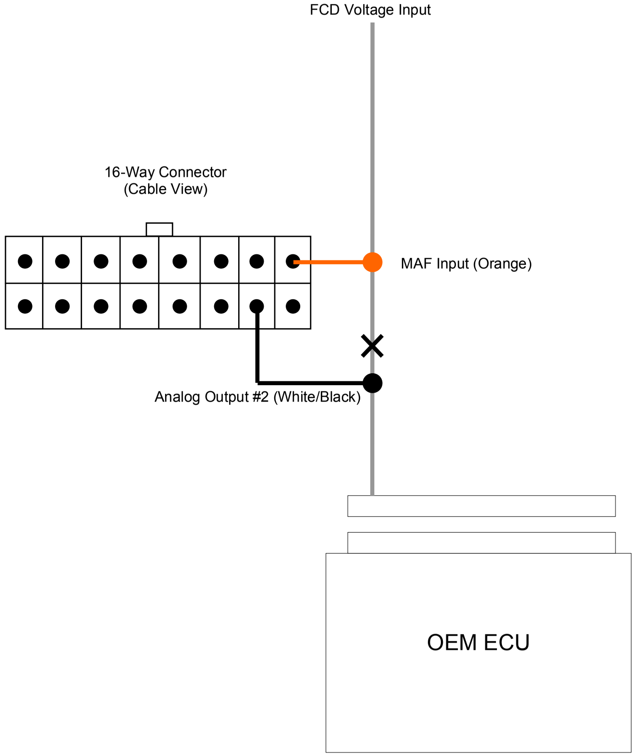
O2B Adjust Wiring

In the example below, the secondary OEM O2 sensor voltage is feed into the MAP-ECU2 External MAP Input and the adjusted output is feed into the OEM ECU from Analog Output #1. Either Analog Output #1 or #2 can be used for the adjusted output. Using this mode, adjustments can be made to OEM Air/Fuel ratios, even in 'closed-loop' mode.



Fuel Cut Defender Wiring

In the example below, the MAF Input is configured as the FCD Input and Analog Output #2 as FCD output. Typically, FCD voltage is derived from a MAP sensor or Air Flow Meter. The MAF Input (shown below) or External MAP Sensor Input can be used as the FCD input. MAF Output (KVF Mode), Analog Output #1 or Analog Output #2 can be used as the FCD Output.

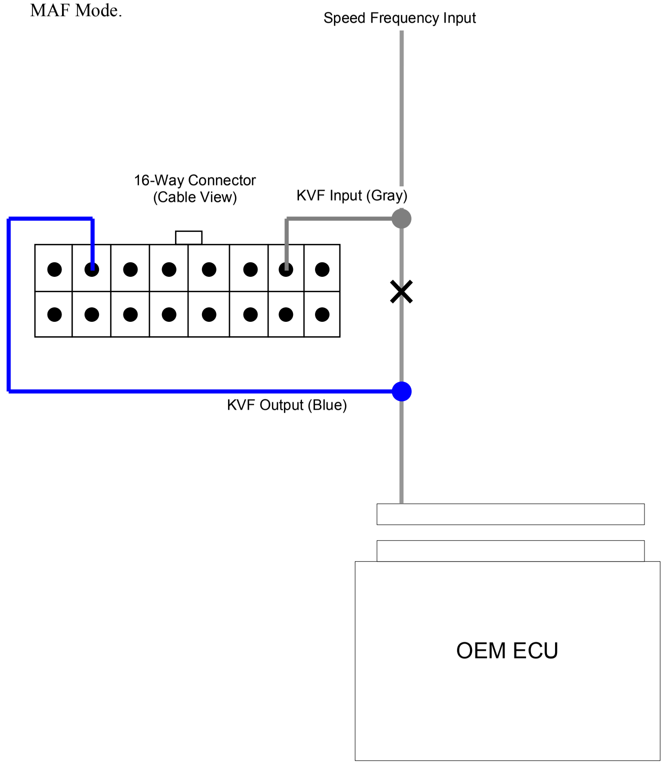


Speed Cut Defender/Adjust

In the example below, the KVF Input is used as the frequency input and the KVF Output is used as the frequency output. The same configuration is used for Speed Cut Defender or Speed Cut Adjust, the only difference is in the MAP-CAL2 configuration.

Note: Speed Cut Adjust can also be used for Vehicle Speed Adjustment.

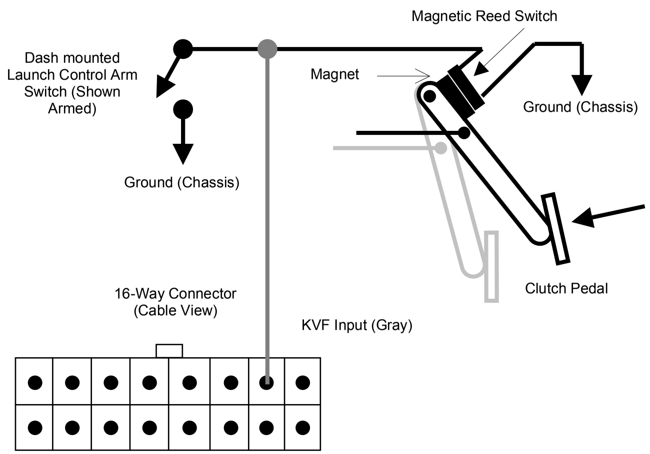
Note: Speed Cut Defender/Adjust is **only** available when the MAP-ECU2 is in MAF Mode.



Launch Control Wiring

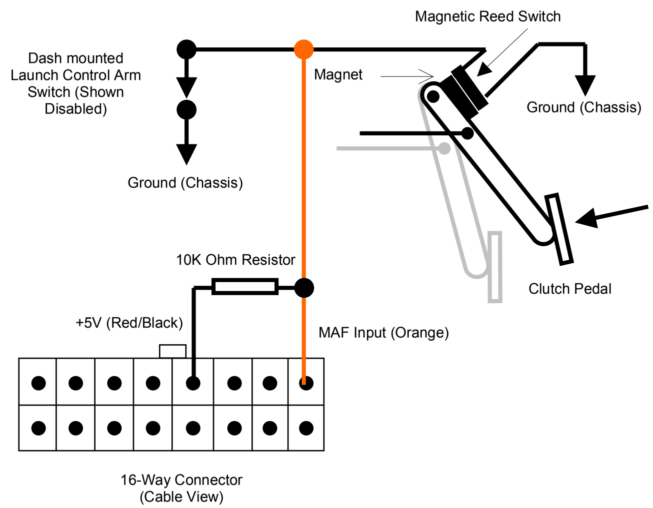
KVF Input

The following diagram illustrates the electrical installation of a magnetic reed switch on the clutch pedal and the launch control arming switch. The arming switch is usually mounted on the dashboard. The example below uses the KVF Input (Gray). The magnetic reed switch is ‘closed’ when the clutch pedal is not depressed, and ‘open’ when the clutch pedal is depressed. The arming switch is shown in the ‘Armed’ position (open). When the arming switch is closed, Launch Control is disabled.



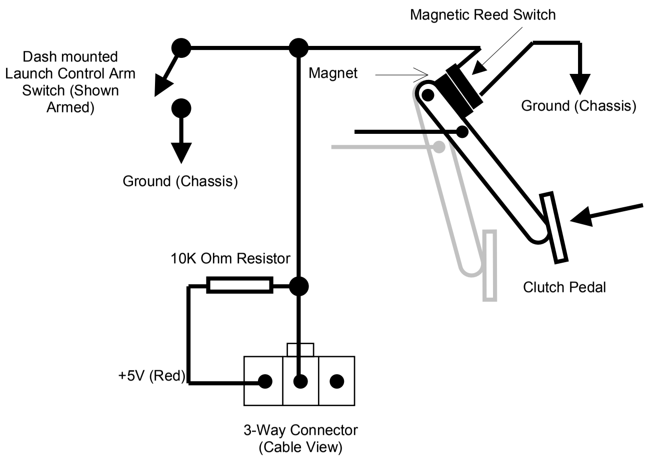
MAF Input

The following diagram illustrates the electrical installation of a magnetic reed switch on the clutch pedal and the launch control arming switch. The arming switch is usually mounted on the dashboard. The example below uses the MAF Input (Orange). The magnetic reed switch is ‘closed’ when the clutch pedal is not depressed, and ‘open’ when the clutch pedal is depressed. The arming switch is shown in the ‘Armed’ position (open). When the arming switch is closed, Launch Control is disabled.



External MAP Input

The following diagram illustrates the electrical installation of a magnetic reed switch on the clutch pedal and the launch control arming switch. The arming switch is usually mounted on the dashboard. The example below uses the External MAP Input (White). The magnetic reed switch is 'closed' when the clutch pedal is not depressed, and 'open' when the clutch pedal is depressed. The arming switch is shown in the 'Armed' position (open). When the arming switch is closed, Launch Control is disabled.

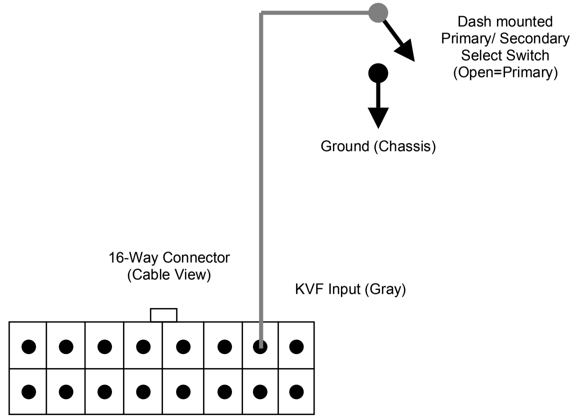


Primary/Secondary Select Wiring

The Primary/Secondary switch function only operates when the MAP-ECU2 is **not** "Connected" to MAP-CAL2. When MAP-ECU2 is "Connected" to MAP-CAL, control of Primary/Secondary selection is transferred to MAP-CAL2. Once MAP-ECU2 is disconnected from MAP-CAL, control is transferred back to the manual switch function.

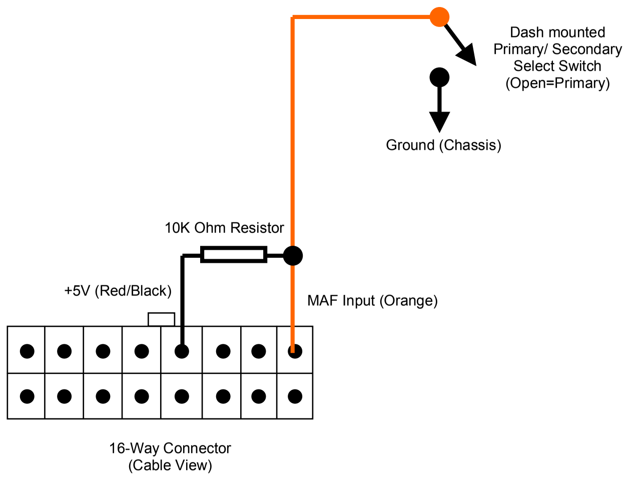
KVF Input

The diagram below illustrates the wiring diagram when the KVF Input is used for Primary/Secondary table selection:



MAF Input

The diagram below illustrates the wiring diagram when the MAF Input is used for Primary/Secondary table selection:



External MAP Input

The diagram below illustrates the wiring diagram when the External MAP Input is used for Primary/Secondary table selection: