TA2 Malfunction Indicator Lamp (MIL) and Engine Protection			
Document Number:	FD-0007	**Author:**	J. Goodloe
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Version History

Version	Date	Modified Sections	Description
01	2016-03-18	n/a	Initial Release
02	2017-01-16	All	Formatting update
03	2017-02-24	All	Updated functionality descriptions

Scope
This document outlines the use of Malfunction Indicator Lamp (MIL) and Engine Protection functions as implemented on AEM Infinity Series 508 TA2 ECUs, with software version v96.2. MIL and Engine Protect features may be revised periodically as necessary.

Introduction
The AEM Infinity ECU has the built-in capability to trigger a Malfunction Indicator Lamp (MIL) as well as Engine Protection strategies. These can be used together or separately depending on user preference. The MIL status is sent out over CAN and can be configured in a race dash display, such as the new AEM CD-7L digital dash.

Selecting a suitable light
There is a 5 amp maximum for the MIL output on the AUX connector. It is best to use an automotive resistive type LED for this output. The lowside MIL output from pin 7 on the TA2 chassis AUX connector can also be used as an input to a third party dash display, such as Aim or Motec.

Wiring the MIL
When the Infinity ECU switches the MIL on, it is grounding Pin 7 in the chassis harness AUX Connector. The easiest way to wire this would be to connect an LED to Pin 7 and Pin 12 of the AUX Connector wires. Pin 12 is a 12 volt feed when the ECU is on.

Recommended Use of the MIL Function
On TA2 ECU's the following sensors will activate a MIL output when out of range (i.e. open circuit or short circuit). Calibrations for these sensors have been revised for 2017 to facilitate error detection while still allowing the engine to operate safely on track in the event of a sensor failure.

ErrorAirTemp
ErrorCoolantTemp
ErrorFuelPressure
ErrorMAP
ErrorOilPressure
ErrorThrottle
UEGO_0_Diag_error (=ErrorLambda1)

A MIL light can be used as a simple way to help identify problems with sensors and/or wiring before your car goes out on track. When properly wired, turn on the master power and then switch on the ignition. The MIL light will illuminate briefly while the UEGO (lambda) sensor warms up. After this, the light will turn off indicating that the outputs from all of these sensors are in a normal operating range. Note that it may initially take up to 10-15 seconds for the lambda sensor to warm up from cold. The MIL light will also illuminate with the engine running if any of these sensors go out of range while on track, or if the engine protection MIL is enabled and becomes active.

A MIL tab has been added to the latest default TA2_508 Infinity Tuner layout display. In the event a MIL light stays on beyond the lambda warmup period, simply connect your laptop to the AEM Infinity ECU, open the Infinity Tuner program using the TA2_508 default layout, and select the MIL display tab. The background of the MILOutput channel display will be yellow and any out of range sensors will be red. The EngineProtectOut channel and any active engine protections will also be displayed similarly. (See example below).

Confirm that any sensors showing an error condition are properly plugged in and the sensor wires are not broken or shorted out. The sensor error channel value will be either 1 or 2 depending on the type of fault. If you need additional assistance with troubleshooting, please contact your AEM technical support representative.

(Infinity Tuner TA2_508 MIL tab display)

How to Activate the MIL and Engine Protection Indicators
The MIL output must first be enabled in the Wizards -Setup Wizard - Engine Protection menu. With only the "Enable MIL Output" function selected, your MIL will only illuminate during the listed sensor failures (out of calibrated range), and when the wideband UEGO (lambda) sensor is warming up.

The MIL can also be configured to illuminate when an engine protection feature is activated (i.e due to low oil pressure, low fuel pressure, UEGO too lean, and low and/or high coolant and oil temperatures). Select the "Activate MIL when EngineProtectOut is active" option as shown above.

Optionally, either the MIL and/or the EngineProtect outputs can be latched, for example to catch an intermittent condition, by selecting the appropriate options in the above wizard.

Optional Sensors – Disabling MIL Error Detection and Engine Protection
Oil Pressure and Oil Temperature sensors are optional ECU inputs that may be setup to activate MIL and/or engine protection functions. (Note: ErrorOilTemp currently does <u>not</u> activate the MILOutput.)

If not using an oil pressure sensor input to the ECU, calibrate the oil pressure sensor voltage range to 0V and 5V, as shown below, to disable the MIL output for this sensor. Also, uncheck the Oil Pressure Protection Enable option in the Engine Protection wizard to disable the oil pressure protection function. Otherwise, select the appropriate oil pressure sensor calibration in the setup wizard.

If not using an oil temp sensor input to the ECU, the ErrorOilTemp fault indication will remain on in the Infinity Tuner MIL tab, but the MILOutput will <u>not</u> be on, and the OilTempProtect will <u>not</u> function. Otherwise, select the appropriate oil temperature sensor calibration in the setup wizard.

Enabling Engine Protections
If the "Activate MIL when EngineProtectOut is active" option is selected, then the MILOutput function will be on any time an engine protection rev limiter is active.
Engine Protect functions will <u>NOT</u> activate when the associated sensor input is in error.

Oil Pressure Protection Setup
First check the box in the Wizards – Setup Wizard – Engine Protection – Oil Pressure Protection Enable.
Choose an Activation Delay (the units are milliseconds).
Choose a rev limit for safety. This can be anything from 0 RPM if you want the engine to shut off, or >6800 RPM if you don't want anything to happen other than EngineProtectOut activating.

Finally, fill out the table called OilPressProtectTable under the Protection tab in the layout.

In the example above, the EngineProtectOut (and MILOutput if activated) will come on after the Oil Pressure falls below 20 psi for 1.5 seconds any time engine speed is above 1000 RPM, and the engine will rev limit to 3000 RPM.

Lean Protection Setup
Check the "Lambda 1 Protection Enable" box in the Engine Protection wizard.
Enter a minimum engine speed and minimum throttle position for this protection to activate.
Enter an activation delay time (in milliseconds).
Enter the Lean Protect rev limit. This can be anything from 0 RPM if you want the engine to shut off, or >6800 RPM if you don't want anything to happen other than EngineProtectOut activating.

Lean Protection Basic Setup		
Lambda 1 Protection Enable	☑	
Lean Protect on Sensor Error	☑	
Lean Fuel Cut Enable	☑	
Lean Spark Cut Enable	☑	
Lean Protection Minimum Engine Speed	2000	rpm
Lean Protection Minimum Throttle	20	%
Lean Protection Activation Delay	500	ms
Lean Protect Rev Limit	3000	rpm

Finally, fill out the table under the Protection tab in the layout called LeanProtectTable (see below).

LeanProtectTable [Lambda]									
1.10	1.10	1.00	0.95	0.90	0.90	0.90	0.90	0.90	0.90
50	80	100	125	150	175	200	225	250	300

MAP [kPa]

In this example, the EngineProtectOut (and MILOutput if activated) will come on after the Lambda1 sensor exceeds 0.90 lambda for at least 0.5 sec. any time MAP is above 150 kPa (while throttle position > 20% and engine speed > 2000 rpm), and the engine will rev limit to 3000 RPM by cutting both fuel and spark. Cuts can be disabled and/or the rev limit moved out of the way if no intervention is desired.

In the above example, lean protection would also be activated any time the lambda sensor is in an error condition (i.e. unplugged or failed), based on the "Lean Protect on Sensor Error" option selected above.

Fuel Pressure Protection Setup
The FuelPressProtect feature functions similarly to the oil pressure protection. Again, the rev limit can be set to anything from 0 RPM (if you want the engine to shut off), or >6800 RPM (if you don't want anything to happen other than EngineProtectOut activating). In the example below, the EngineProtectOut (and MILOutput if activated) will come on after the Fuel Pressure falls below 30 psi for 1.5 seconds any time engine speed is above 3000 RPM, but the protection rev limit setting of 10000 RPM cannot actually be achieved.

Fuel Pressure Protection

The minimum allowable fuel pressure must be defined using the 1D table 'FuelPressProtectTable [psig]'. If the measured 'InjPressure [psig]' channel remains lower than the value in the table for longer than the 'Fuel Pressure Protection Activation Delay' time, the ECU will activate the 'Fuel Pressure Protection Rev Limit'.

Fuel Pressure Protection Enable	☑	
Fuel Pressure Protection Activation Delay	1500	ms
Fuel Pressure Protection Rev Limit	10000	rpm

FuelPressProtectTable [psig] [No Data]

-5	10	20	30	30	30	30	30	30	30
0	1000	2000	3000	4000	5000	6000	7000	8000	9000

EngineSpeed [RPM]
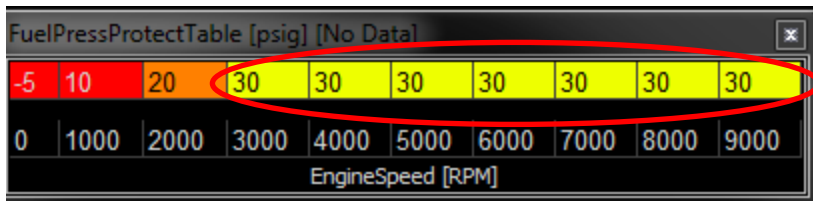
Coolant Temperature Protection Setup

In the example shown below, a coolant temperature <= 20°C or >= 120°C will activate a 5000 rpm engine protection rev limiter. The rev limit will be interpolated between breakpoints, but otherwise the limiter has been calibrated out of the way (i.e. 10000 rpm) for all other temperature ranges.

If the "Activate MIL when EngineProtectOut is active" option is selected, then the MILOutput function will be on any time the coolant protection rev limiter is active.

CoolantProtectRPMLimit [RPM]

5000	5000	10000	10000	10000	10000	10000	10000	10000	5000
0	20	40	60	80	90	100	110	115	120

CoolantTemp [C]

Oil Temperature Protection Setup

The OilTempProtect feature functions similarly to the coolant temp protection. In the example below the OilTempProtect rev limiter function will effectively never be activated, since the 15000 rpm calibration threshold cannot be achieved.

OilTempProtect [RPM]

15000	15000	15000	15000	15000	15000	15000	15000	15000	15000
0	20	40	60	80	100	120	130	140	150

OilTemp [C]

If the "Activate MIL when EngineProtectOut is active" option is selected, then the MILOutput function will be on any time the oil temp protection rev limiter is active.