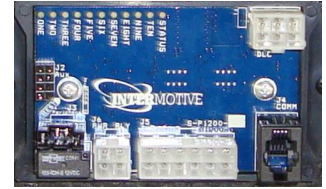# Eco-Star Application Note

Introduction

The Eco-Star product line is a family of automatic engine stop/start systems that provide lower vehicle emissions and improved fuel economy by forcing an idling engine to shut off. The system monitors user inputs, as well as vehicle conditions, to determine when to turn off an idling engine. An anti-idle timer is also implemented as an additional method to guarantee that idle time is reduced. Vehicle restarts may be automatically triggered by low battery voltages or a user restart request.

Operating Conditions

The following safety conditions must be met in order for all Eco-Star products to operate:

Vehicle Hood = Closed	Vehicle Speed < 2 MPH
Trans Range = Park	

Table 1: Safety Conditions

When all of the above safety conditions are met, Eco-Star is ready to begin operation. However, there are still multiple pre-conditions that may prevent Eco-Star operation (engine shut down). What these pre-conditions are depends on what the application of the Eco-Star system is, as well as modifications the installer may have made to the system configuration. The default configurations are as follows:

-AW (Work Truck Applications)	-AT (Transit Applications)
Battery Voltage > 11.8 V [1]	Battery Voltage > 11.8 V [1]
Ambient Temp > -200 F and < 200 F [1, 2, 3]	Ambient Temp > 32 F and < 100 F [1, 3]
Engine Temp > -200 F [1, 2]	Eng Temp > 120°F (Diesel) / 170°F (Gas)[1]
Engine On Request = Not Active	Shutdown Inhibit = Not Active
Engine Speed < 1100 RPM [2]	Engine Speed < 1100 RPM
Brake Pedal = Not Pressed	Brake Pedal = Not Pressed

Table 2: Default Pre-Conditions

1. Pre-conditions that may be modified from their default values
2. Pre-conditions ignored by the Engine Shutoff Request input (still apply to the Anti-Idle Timer)
3. Ambient Air temp is not available on 6.0L and 6.4 L Diesel engines and is defaulted to 24C.

Operating Conditions Continued

Once Eco-Star has successfully shutoff the engine, it may auto restart it if the safety conditions are still met (see Table 1) and the key has not been switched off. The module monitors when the key is no longer in Run to determine when to go into its low current sleep mode. Once it determines the key is Off, it enters sleep mode. At this point the ignition key will have to restart the vehicle.

The main difference between the safety and pre-conditions is that the latter may be ignored, where as the safety conditions can not be violated. In fact, most of the pre-conditions are ignored when Eco-Star is put into its Test mode. The exceptions are the Engine On Request / Shutdown Inhibit input and the brake pedal applied. These two conditions are always over rides to engine shutoff. You should use this mode if you believe one of the pre-conditions is preventing shutdown. Test mode can be entered by applying a ground to the "TEST" pad on the printed circuit board. If successful, the Status Led will start flashing on and off.

System Operation: Work Truck vs. Transit

Eco-Star can be ordered to operate in one of two modes that differ based on the intended application. The first mode, Work Truck, is designed to give the user more control over the start/stop process and maximize engine off time. The other mode, Transit, is designed to make the start/stop process more automated.

Engine Off Request

Both modes behave in similar manners, the largest difference is in the way in which the Engine Off Request works.

Work Truck:
In this mode, the Engine Off request may originate from a manual switch being controlled by an operator, say in an aerial bucket. As such, it ignores all of the temperature related pre-conditions and well as the engine speed condition. The operator may be working for hours, and want the engine to be off. It also has the ability to hold the ignition in the key Off position to minimize battery drain by keeping the vehicle electronics Off, allowing for the most time between low battery restarts. Eco-Star will auto restart the engine in this state if the battery voltage drops below the pre-set restart value.

Transit:
The idea here is to auto shut down the engine, for example, when the driver is loading passengers. In this mode, the Engine Off request can be connected to the passenger door switch. In this case, you probably don't want to auto shut down the engine if it's extremely cold or very hot, thus the temperature pre-conditions. The Engine Off request will not trigger the engine to shutdown until all the pre-conditions are met. It also lacks the ability to hold the ignition in the key off position, as it is not expected the engine will be off for an extended period of time like the Work Truck version.

System Operation Continued

When it turns the engine Off, only the hot in Run/Start circuit is powered down for several seconds while the engine is stopped. This keeps all the loads powered from the Hot in Run/Acc circuits running--even during engine shutoff. It also allows the loads on the Hot in Run/Start to power back up after shutoff. This obviously will cause a low battery restart to initiate sooner than in the Work Truck version, but it prevents losing OEM loads. Note that there is also a Hot in Run module output, which may be connected to a relay which can drive upfitter loads. This output will remain active even when Eco-Star shuts the engine down.

Engine On Request

The second major difference between the two modes is the way in which they restart the vehicle. Both versions will restart based on a low battery voltage. They can even be configured to restart on a secondary battery voltage (up to 40 Volts), but the primary method for requesting restart is fairly different between the 2 versions.

Work Truck:

The Engine Restart Request is a discrete input (pin #5) that the user activates to restart the engine in lieu of turning the ignition key to Start. This pin doubles as a Shutdown Inhibit input; as long as it remains active the engine will not auto shutoff due to the idle timer or the Engine Off Request. These inputs are designed to give an operator the most control over the engine from a remote location such as up in the boom bucket.

Transit:

The Service Brake pedal is the only restart request input for Transit mode. When applied after an auto shutoff, the engine will restart. This makes the stop/start process as automatic as possible, taking all burden off the driver to minimize idling. No discrete wire connection to the Service Brake is required—the pedal is sensed over the vehicle network. Pin #5 is not a Request Engine On input like it is on the Work Truck version. This pin is solely a Shutdown Inhibit input that prevents Eco-Star from auto-shutting off the engine. This could be connected to an A/C and/or heater switch to prevent engine shutdown during ambient temperature extremes.

Hood Switch

Eco-Star requires the installation of a hood open switch. This is essential to prevent auto restarts when someone is working under the hood. Several hood switches are available from Intermotive for specific vehicle applications. The switch must ground Eco-Stars hood input when the hood is closed. If this wire is left disconnected or becomes broken, Eco Star will not auto restart the engine from low battery voltage or from the remote restart request.

Thermostat/Thermistor

The thermistor option may be used to auto restart the engine as a result of either cold or hot temperatures. For example, it may be used to prevent the engine from getting too cold in severe environments. It may also be used in police K9 vehicles to prevent cabin temperature extremes.
Mount the thermistor in a location where it cannot be damaged by sharp objects and mechanical moving parts such as the Park Brake or tilt steering wheel mechanisms. Attach the Green wire to Pin #5 on the 12 pin connector and the Black wire to a ground source.

Modifying the Configuration

It can be seen in Table 2 (first page) that the default configurations for the two Eco-Star modes are not the same. This reflects the different intended applications of Eco-Star. Not all applications will have the same requirements and it may become desirable to modify some of the default Eco-Star parameters. This can be done by following the Laptop Connection tutorial that explains how to establish communication with Eco-Star.

Establishing Laptop Communication

- This requires the use of InterMotive's Download Cable, part# s-h37a1 (not part of ECO501 kit). You will be required to download and install the proper USB driver the first time you use this cable. All driver files are located online at: http://www.ftdichip.com/Drivers/VCP.htm

- Find the correct drivers for your PC and follow the steps to download the latest version (located under the "Driver Version" heading). If unsure about the installation process, contact InterMotive for further assistance.

- Plug one end of the cable into your PC's USB port, and with the vehicle's key in the off position, plug the other end into the Eco-Star module's COM port.

- Open the Microsoft communication application HyperTerminal. This program can be found under: Start > All Programs > Accessories > Communications > HyperTerminal.

- You will be prompted to give this connection setup a name. We suggest something meaningful such as "EcoStar Config", which you may reuse in the future.

- The next window will prompt you to select the "COM port" to use for communicating with the module. Even though this download cable plugs into a USB port, it is treated like a serial COM port by Hyper-Terminal. Typically, the highest numbered COM port will be the InterMotive Communication cable.

- **Note**: The COM port number can be confirmed in Windows XP by right-clicking on 'My Computer' and selecting 'Properties.' From this window select the 'Hardware' tab and click on 'Device Manager.' In the Device Manager window, expand the 'Ports' menu and the download cable connection will be displayed as 'USB Serial Port.'

- In the next window, you will need to change several of the default parameter for the Port Settings as follows:

    - Bits per second to: **57600**

    - Data bits: **8**

    - Parity: **None**

    - Stop bits: **1**

    - Flow control: **None**.

- HyperTerminal setup is now complete.

- Turn the vehicle key to the ON position. The Eco-Star module should wakeup and text should display on the open HyperTerminal window.

- If nothing appears, unplug the 6 pin Data Link connector going into the Eco-Star module, wait several seconds and plug the connector back in.

- If still nothing appears, go to File > New Connection and try re-configuring the HyperTerminal as described above. If unsuccessful, contact InterMotive for further assistance.

- Once communication is established, type in "config" (followed by the enter key).

- All options in the configuration menu come with descriptions that explain what parameters are currently set and how to update them.

The following is a list of parameter's that can be modified once that connection is made:

	Parameter	Description
1	Main Battery Low Voltage Restart	Set the restart voltage, filter time, recovery voltage, and the recharge time
2	Second Battery Low Voltage Restart	Set the restart voltage, filter time, recovery voltage, and the recharge time
3	Anti-Idle Timer Length	Set the shutdown timer in seconds (0 to 1800)
4	Enable / Disable Anti-Idle Timer	Allows the Anti-Idle Timer to be completely disabled
5	Ambient Operating Temperatures	Set the temperature range to operate within (-200 F to 200 F)
6	Minimum Engine Operating Temp	Set the minimum warm-up temperature (-200 F to 200 F)
7	Operation of Brake Pedal	Set the effect the Brake Pedal will have in inhibiting and/or auto-restarting the engine.
8	Thermostat Settings	Enable / Disable Thermostat to trigger an auto restart at a user configured temperature and to shut the engine off at a user configured temperature.
9	Enable / Disable Driver's Door Ajar via CAN as a shutdown trigger	Some 2011 F Series trucks have Drivers Door Ajar available on the CAN network. (ECO501 only)
10	Enable / Disable Hood Ajar via CAN	Some not all 2011 F Series trucks come with a Hood Ajar switch that can be read on the CAN network. (ECO501 only)

Table 3: Configurable Parameter Definitions

By typing "config", Eco-Star will display the following information on the laptop. The default settings can be changed by typing the selected parameters number, followed by "enter".
Additional prompts will lead you through changing settings.

```
File   Edit   Setup   Control   Window   Help
Modify Eco-Star parameters by entering one of following numbers:
1 = Primary Battery Restart, Recharge, and Delay Values
2 = Secondary Battery Restart, Recharge, and Delay Values
3 = Idle Shutoff Timer Duration
4 = Enable / Disable Idle Shutoff Timer
5 = Min and Max Operating Temperatures
6 = Min Engine Temperature for Auto-Shutoff to Occur
7 = Operation of the Brake Pedal
8 = Thermostat Settings

To Enter Temperature in Celcius Add a 'C' Suffix to the Entry ( e.g. 100C )
Press Escape to Exit

Change Parameter:
```

Example of changing Thermostat Settings

3. Under "Change Parameter:" type '8' (followed by the Enter key).
4. Enter '1' to enable the thermostat and '2' to disable the thermostat. If '2' was selected, the thermostat function has been disabled. If '1' was selected continue to the next step.
5. If engine restart is desired when a low temperature is reached, enter '1'. If engine restart is desired when a high temperature is reached enter '2'.
6. Enter the temperature that the customer would like the engine to restart at. The default selection will be in Fahrenheit. If Celsius is desired, add a 'C' suffix to the entry (e.g. 100C).
7. Enter the temperature that the customer would like the engine to shut off at.
8. Press Enter to continue. Verify that the vehicle auto-restarts and shuts off at the desired temperatures.

```
File  Edit  Setup  Control  Window  Help
Modify Eco-Star parameters by entering one of following numbers:
 1 = Primary Battery Restart, Recharge, and Delay Values
 2 = Secondary Battery Restart, Recharge, and Delay Values
 3 = Idle Shutoff Timer Duration
 4 = Enable / Disable Idle Shutoff Timer
 5 = Min and Max Operating Temperatures
 6 = Min Engine Temperature for Auto-Shutoff to Occur
 7 = Operation of the Brake Pedal
 8 = Thermostat Settings

To Enter Temperature in Celcius Add a 'C' Suffix to the Entry ( e.g. 100C )
Press Escape to Exit

Change Parameter:
```