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ZENITH
FUEL SYSTEMS LLC



ZEEMS

Zenith Electronic Engine Management System

**Propane and Gasoline
Electronic Fuel Injection**





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The ZEEMS Advantages

Precise fuel control

throughout all operating temperatures and conditions

Virtually **eliminates “flat spots” and engine run-on (dieseling)**

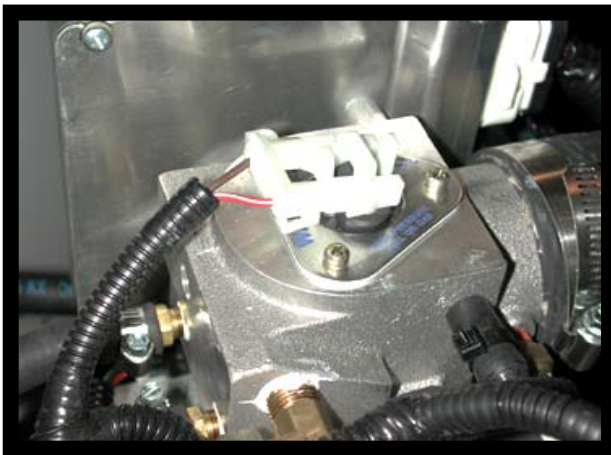
Achieves **maximum power with lowest emissions**



The ZEEMS Control system electrically controls the following:

Fuel Delivery via fuel injector (gas, propane or both)

Engine RPM via throttle shaft actuator control





The ZEEMS System

The ZEEMS system is a
“**Speed-Density**” design.

This system measures the engine RPM
(speed of the engine)

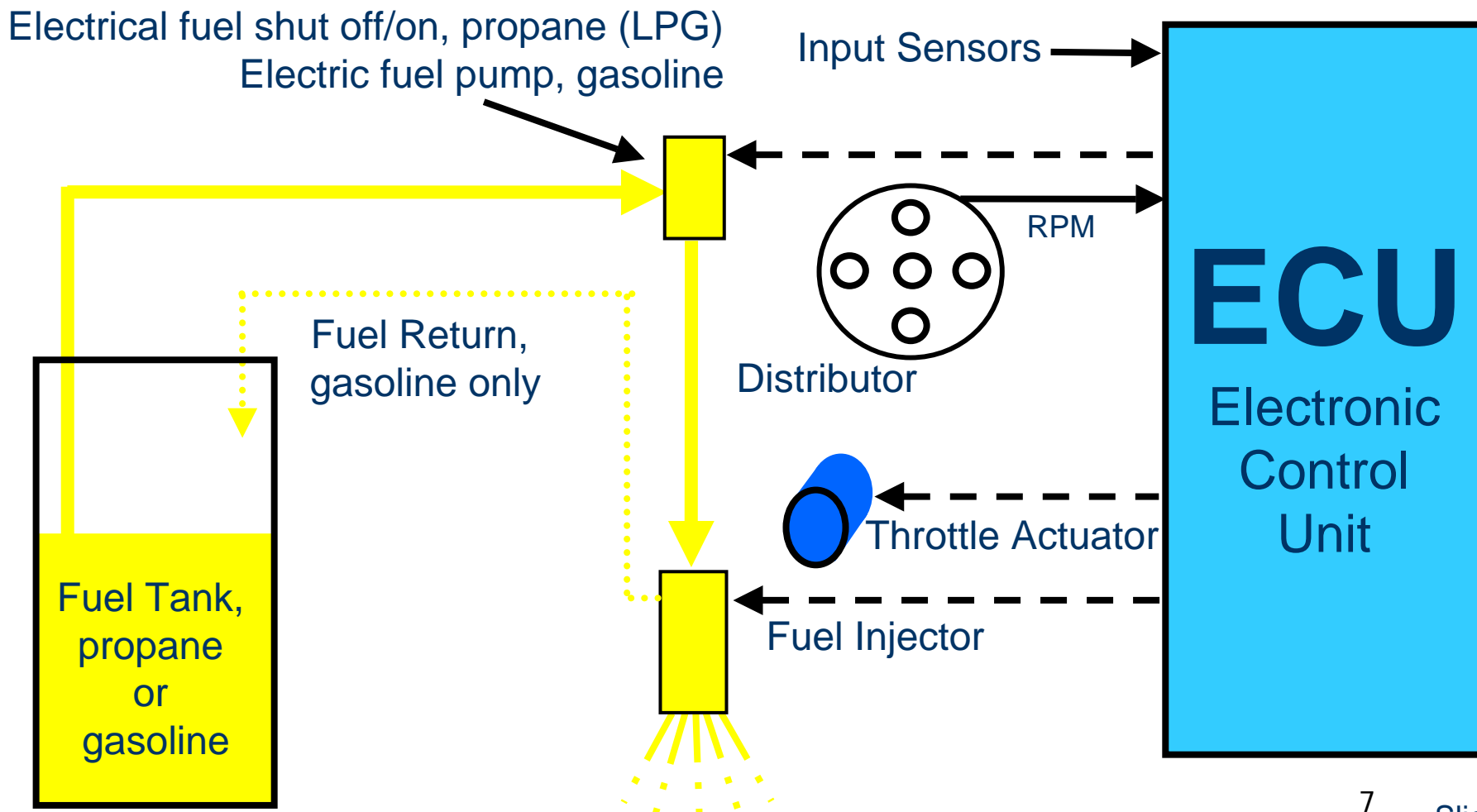
and calculates the
Density of the Air

(from atmospheric pressure and temperature of the air)

to determine the optimum fuel and air settings for
the altitude and climatic conditions.



ZEEMS Block Diagram





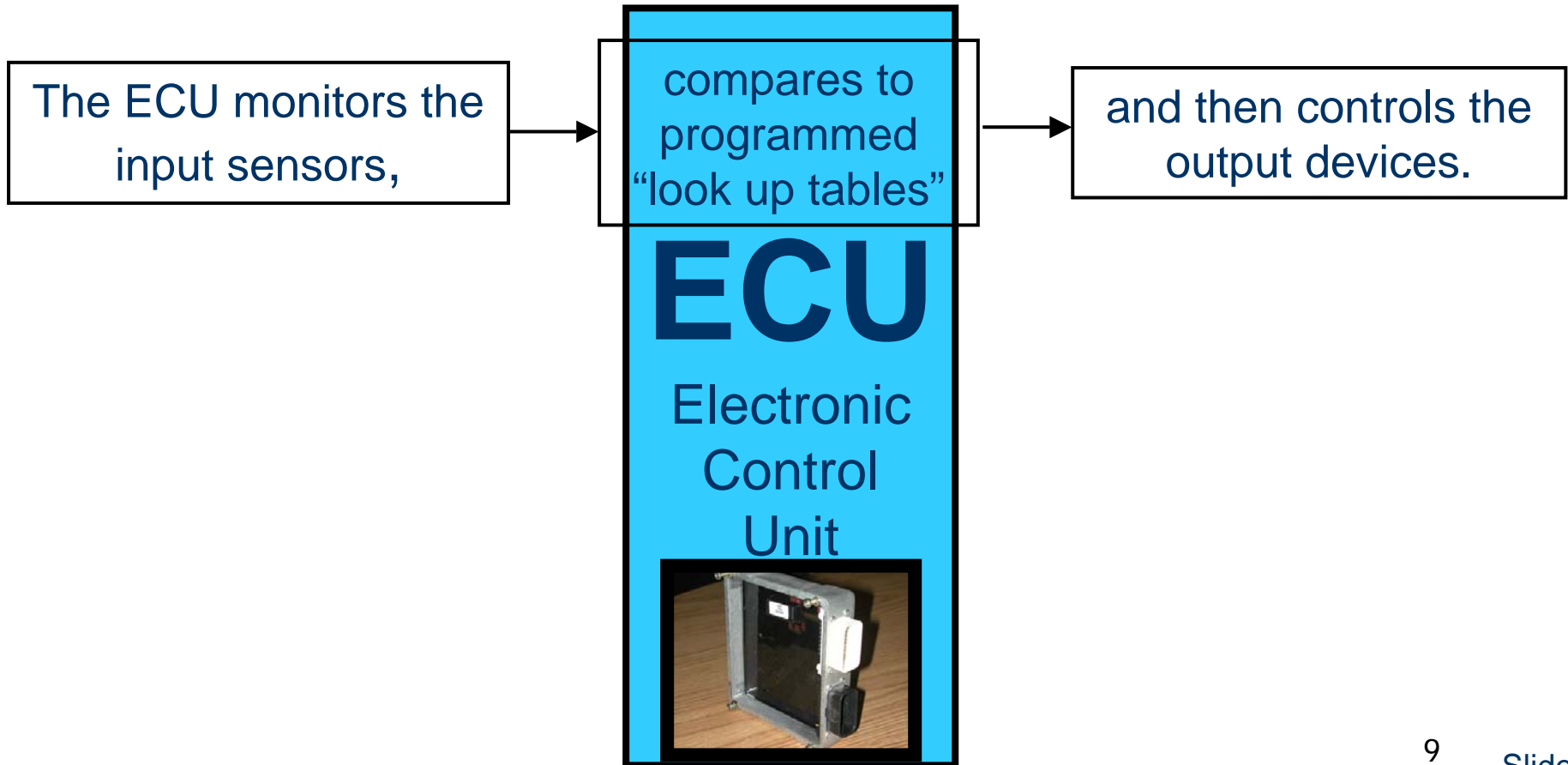
ZEEMS COMPONENT LOCATIONS

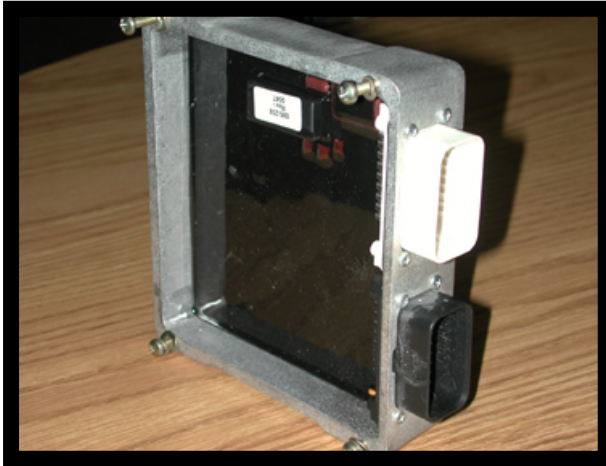
Plant Tour

1. THROTTLE BODY
2. ECU
3. INJECTOR
4. O2 SENSOR
5. IAT
6. ECT
7. MAP
8. TB COOLANT FITTINGS
9. SPARK PORT VACUUM ADVANCE
10. FUEL PUMP
11. FUEL FILTER
12. PRIMARY VAPORIZER
13. SECONDARY REGULATOR
14. MANIFOLD ADAPTER
15. HEAT SHIELD
16. LP FILTER
17. FUEL INLET
18. GASOLINE PRESSURE REGULATOR



The ECU is the ‘control center’ of the ZEEMS, sometimes called the processor or “brain box” (logic device)





The **Black Connector** is used for low level current devices, such as input signals, transmit and receive signals, and other low voltage signals.

ECU

Electronic Control Unit

The **White Connector** is used for high current loads, such as battery power and ground and controlling the out put devices.

Battery Ground Feed
Pins 20 & 21 on
White Connector

Battery Power Feed
Pins 22 & 23 on
White Connector



The ECU monitors most input sensors once every distributor pulse or engine “event”, depending on engine RPM and operating conditions.

One engine “event” is an ignition pulse (spark plug firing).

ECU

Electronic
Control
Unit

There are two distributor pulses (events) per engine revolution on a 4 cylinder, 4 cycle engine

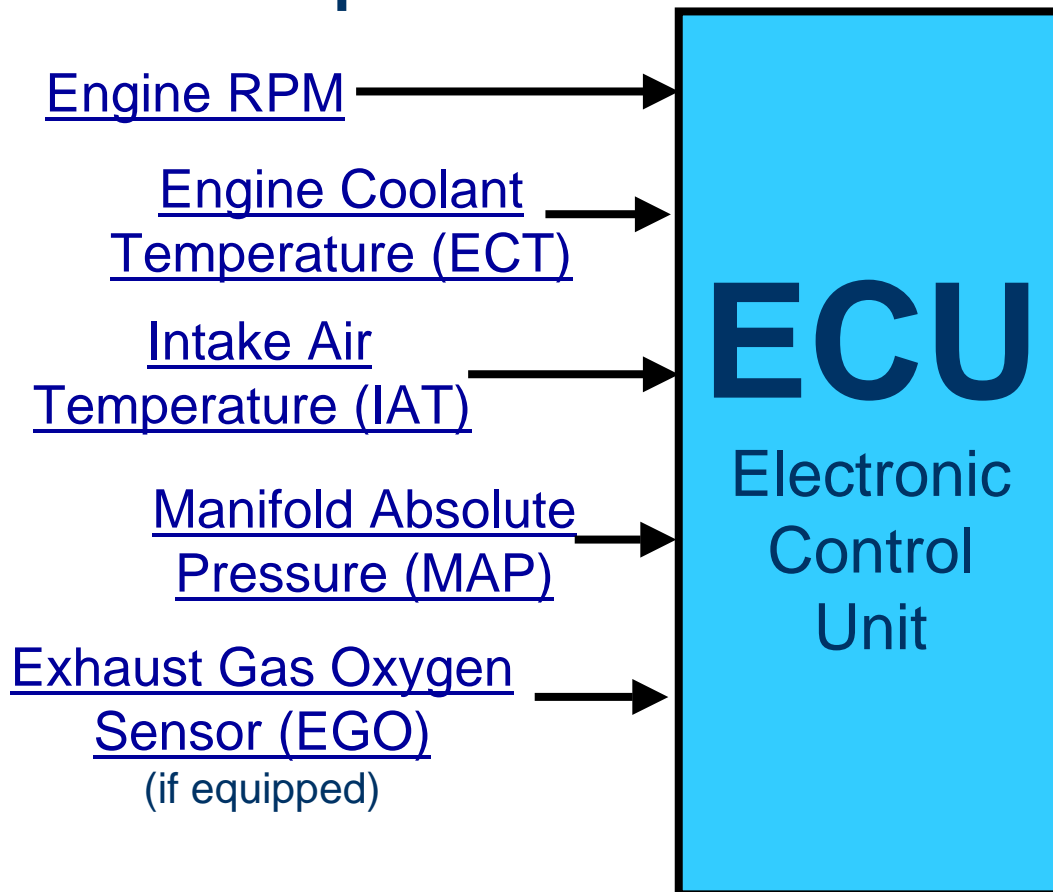
Therefore:

500 RPM = 1000 events
1000 RPM = 2000 events
2000 RPM = 4000 events



The ZEEMS systems uses several input devices to monitor the engine and atmospheric conditions.

ECU Inputs



Lets examine each input sensor in depth



RPM

ECU Inputs

Engine RPM



ECU
Electronic
Control
Unit

Engine RPM

Engine RPM is determined from the distributor pulses generated by the magnetic pick up and converted to a digital pattern.



RPM

ECU Inputs

Engine RPM →

ECU

Electronic
Control
Unit

Questions?

Engine RPM

For every ignition pulse, a signal is received at the ECU.

The ECU then signals fuel injector to “turn on” and spray fuel.

One fuel injector pulse per “event”.



ECT & IAT

Engine Coolant Temp Sensor (ECT) , Intake Air Temp Sensor (IAT)

ECU Inputs



ECT →



ECU

Electronic
Control
Unit



IAT →

The ECT is located in Manifold Adapter under the Throttle Body or in engine head (coolant stream).

The IAT is located in the Throttle Body assembly.

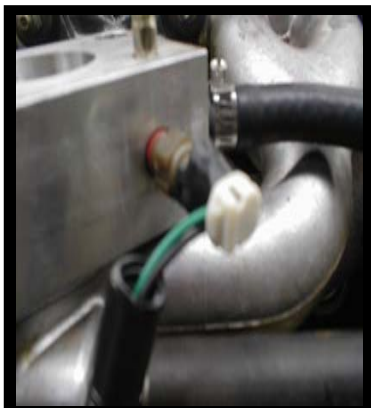
Both sensors are two (2) wire sensors.



ECT & IAT

Engine Coolant Temp Sensor (ECT) , Intake Air Temp Sensor (IAT)

ECU Inputs



ECT →



IAT →



The ZEEMS system uses a Negative Temperature Coefficient (NTC) thermistors for the ECT and IAT sensors.

A thermistor changes its internal resistance as the temperature changes.

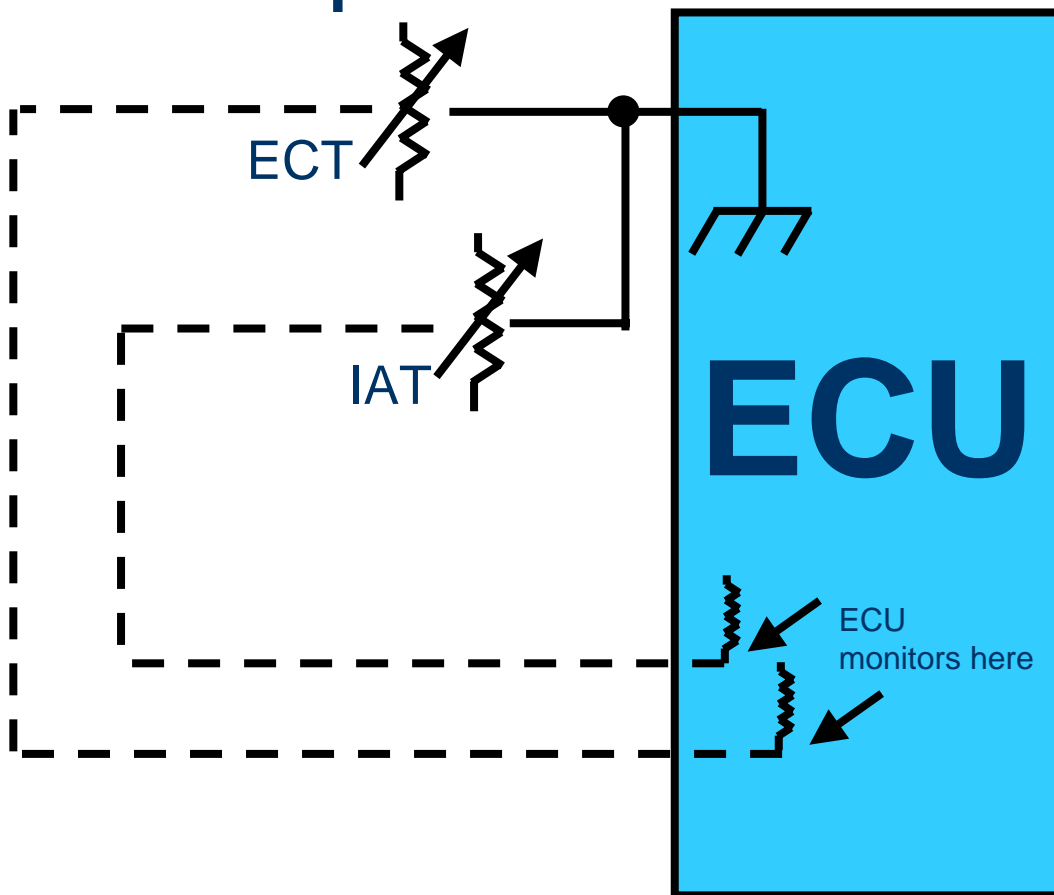
A “NTC” thermistor resistance increases as the temperature decreases, and the resistance decreases as the temperature increases.



ECT & IAT

Engine Coolant Temp Sensor (ECT) , Intake Air Temp Sensor (IAT)

ECU Inputs



The ECU “monitors” the ECT and IAT wires to determine the temperature changes.

Sensors are electrically identical but are cosmetically different.

Questions?



MAP

Manifold Absolute Pressure Sensor

ECU Inputs

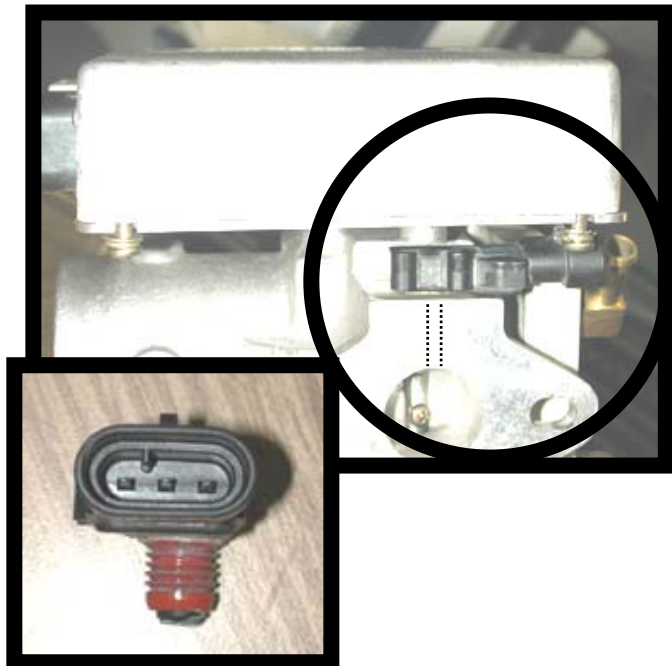
Manifold Absolute Pressure Sensor



The MAP is located between the throttle body assembly and the ECU .

This MAP sensor is a three (3) wire sensor similar in operation to a potentiometer.

Routing to the intake manifold source is accomplished by a passage way drilled from the throttle bore directly into the MAP.





MAP

ECU Inputs

Manifold Absolute
Pressure Sensor



ECU
Electronic
Control
Unit



The MAP changes its internal resistance as the atmospheric or intake manifold pressure changes.

The MAP sensor with the ECU calculates the barometric pressure when the key is turned on. (KOEO=Key On Engine Off).

As the engine starts/runs, the MAP's internal resistance changes causing the signal wire voltage to change. (KOER = Key On Engine Run).



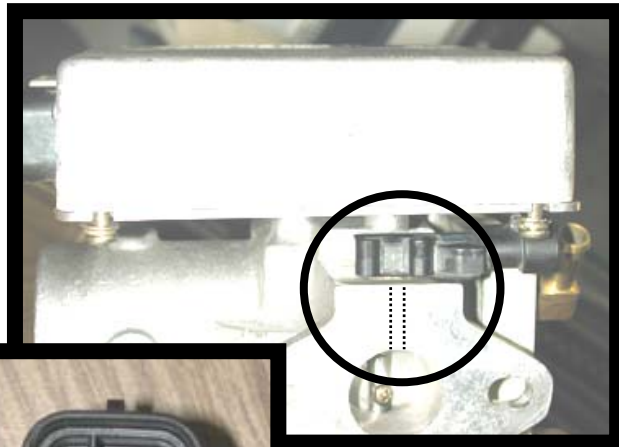
MAP

ECU Inputs

Manifold Absolute
Pressure Sensor



ECU
Electronic
Control
Unit

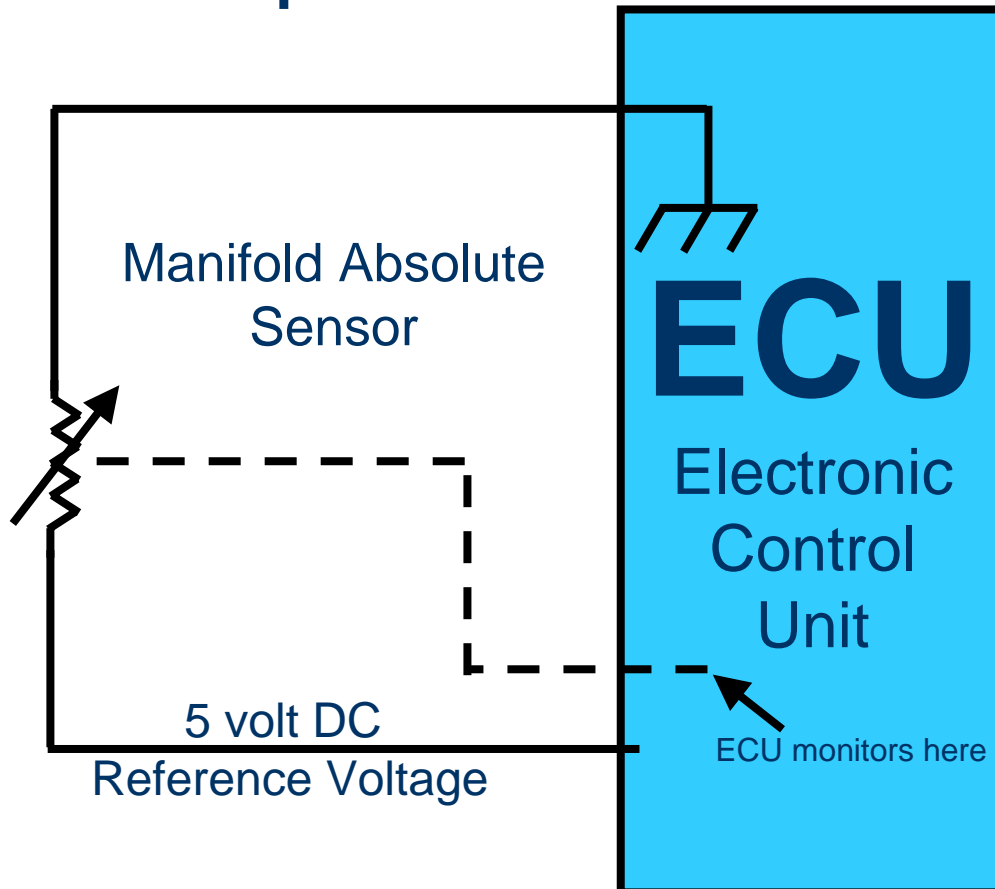


This sensor has two chambers internally. These chambers are isolated by a silicone diaphragm.



MAP

ECU Inputs



The ECU sends a fixed 5 vDC +/- 10% voltage to the MAP.

The ECU “monitors” the signal wire to determine the barometric pressure and/or engine load changes. (intake manifold pressure).

Questions?



EGO

(if equipped)

ECU Inputs

Exhaust Gas Oxygen
Sensor →



ECU
Electronic
Control
Unit

The EGO is located on the exhaust pipe within six (6) inches of the exhaust manifold. (15 cm)

This sensor is a four (4) wire sensor.

The ZEEMS system uses a heated EGO sensor.

h
e
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r
a
d
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t
a
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e

l
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k



ECU Inputs

Exhaust Gas Oxygen
Sensor



EGO

(if equipped)

ECU

Electronic
Control
Unit

The EGO sensor generates a DC voltage (0-1vDC) that is proportional to the Oxygen content of the exhaust stream and ambient oxygen.

When the Oxygen (O2) content in the exhaust stream goes up the voltage goes down.

Question

If the engine is running with too much fuel and no misfires, will the EGO voltage be high or low?



Exhaust Gas
Oxygen Sensor

EGO

(if equipped)

ECU Inputs

Exhaust Gas Oxygen
Sensor



ECU

Electronic
Control
Unit

When the EGO sensor approaches 600 degrees "F"/ 300 degrees "C" it starts to operate properly.

An internal heater brings the EGO to its operating temp and maintains this temp if the exhaust gases temp decreases.

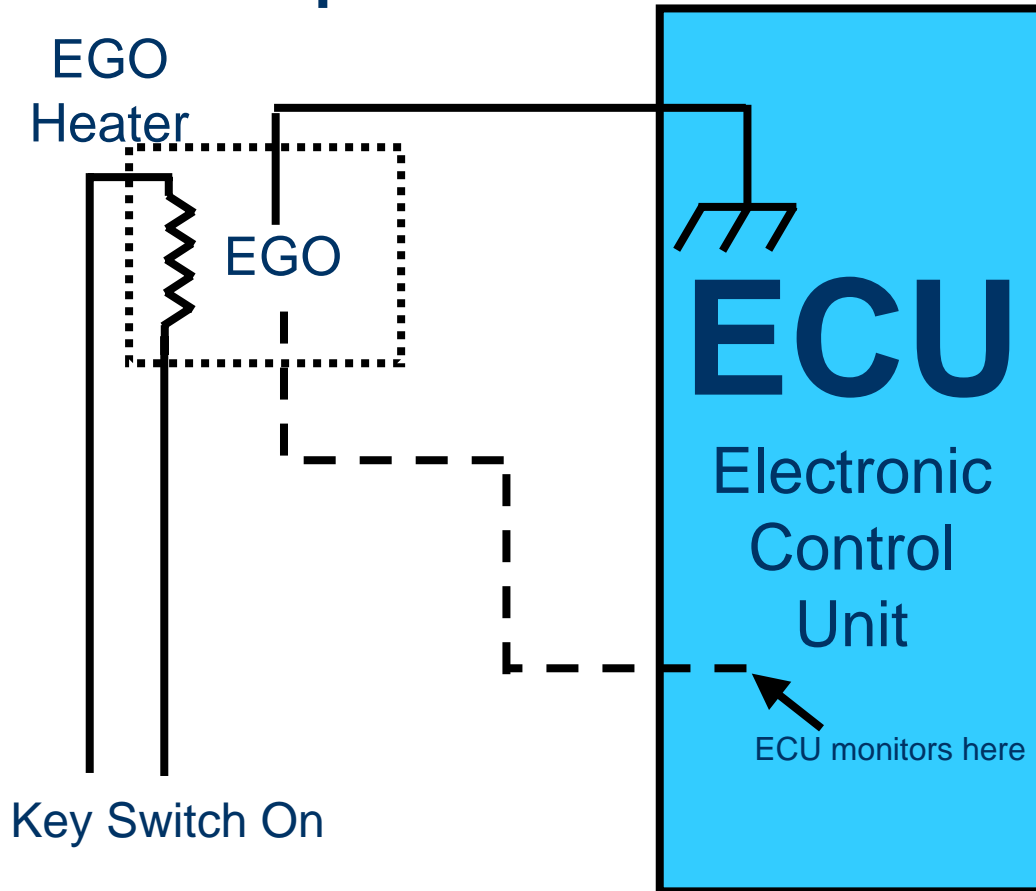
The EGO heater is a 12v heater controlled by the ignition switch. This is not controlled by the ECU. These are the white wires going to sensor harness.



EGO

(if equipped)

ECU Inputs



The EGO generates voltages between 0-1vDC.

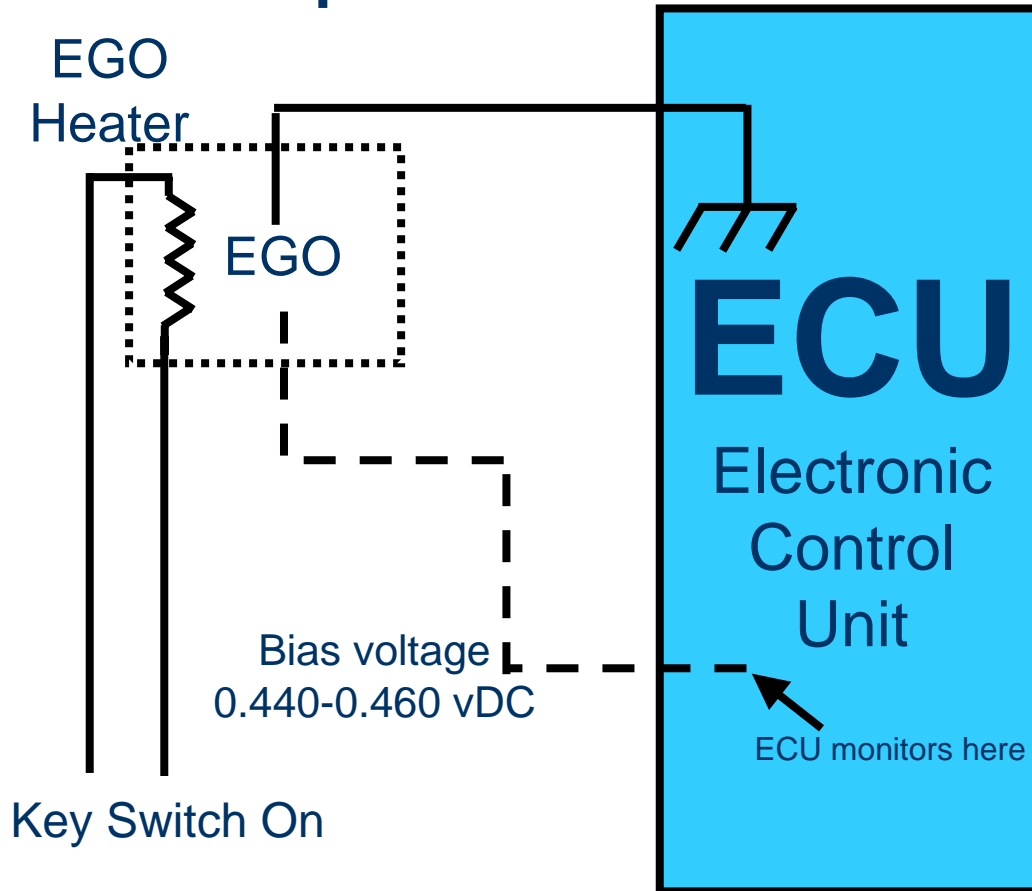
The ECU “monitors” the signal wire to determine the O₂ content of the exhaust stream.



EGO

(if equipped)

ECU Inputs



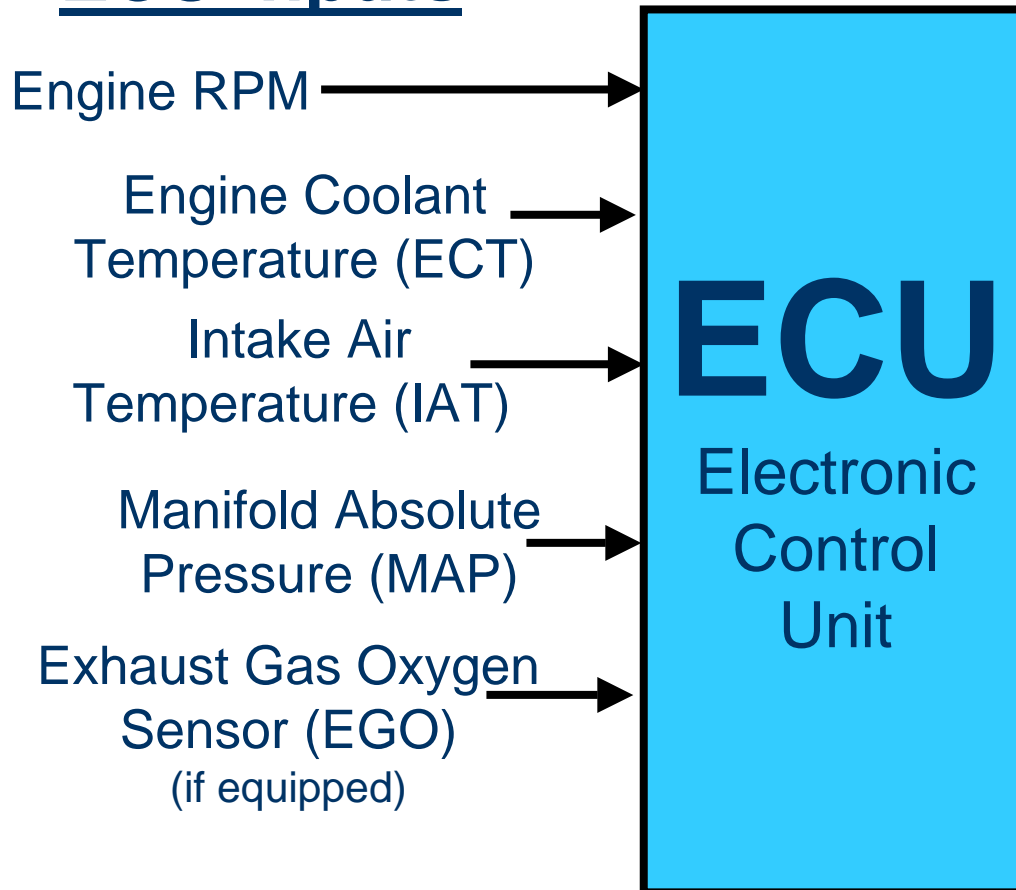
The ECU internally sends a 'bias' voltage to the EGO signal wire. This 'bias' voltage is in the 0.4 - 0.5 vDC range.

If the EGO generates a voltage higher than the bias voltage the ECU determines less fuel is required, if under the bias voltage, more fuel is required.



The ZEEMS systems uses several input devices to monitor the engine and atmospheric conditions.

ECU Inputs



Input Sensor
Review

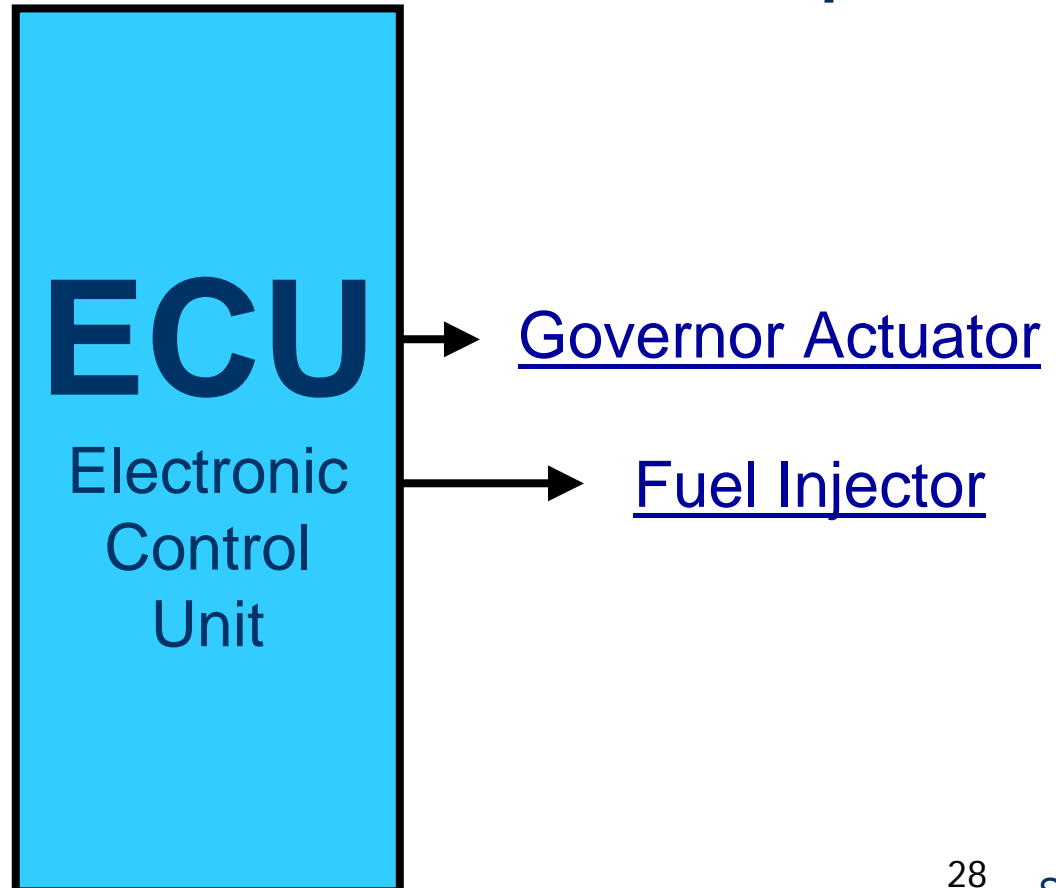


The ZEEMS systems uses two output devices.
Commands to the outputs are determined from input conditions.

ECU Outputs

Output Controls

Lets examine
each output
device in depth





Governor

ECU Outputs

The Governor is an electric actuator which controls (turns) the throttle plate.

The governor actuator motor is the only connection to the throttle plate.

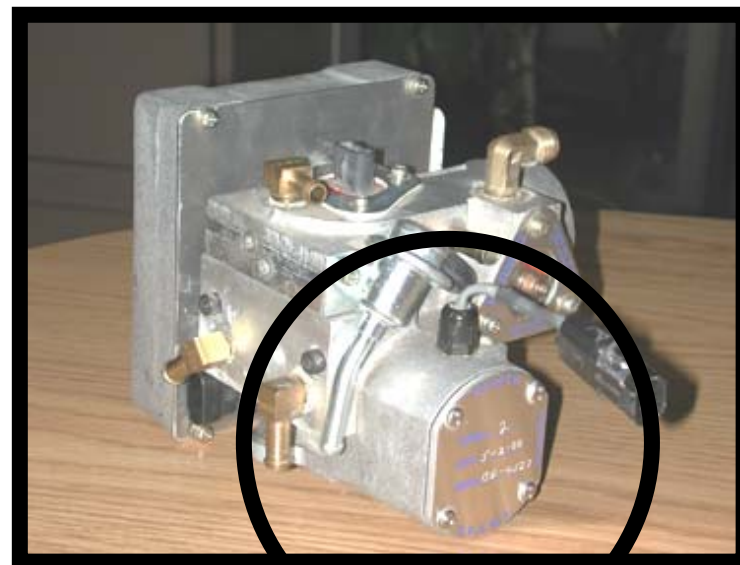
The governor uses two wires to control the actuator.

A ground wire and the control circuit from the ECU.

ECU
Electronic
Control
Unit



Governor Actuator





Governor

ECU Outputs

The governor is located on the throttle body assembly and is the only part that is not field replaceable.

The throttle plate has a mechanical stop.

The proper RPM for the mechanical stop is Dependant on the application (see spec sheet).

ECU
Electronic
Control
Unit



Governor Actuator





Governor

To control the governor, the ECU uses two inputs:

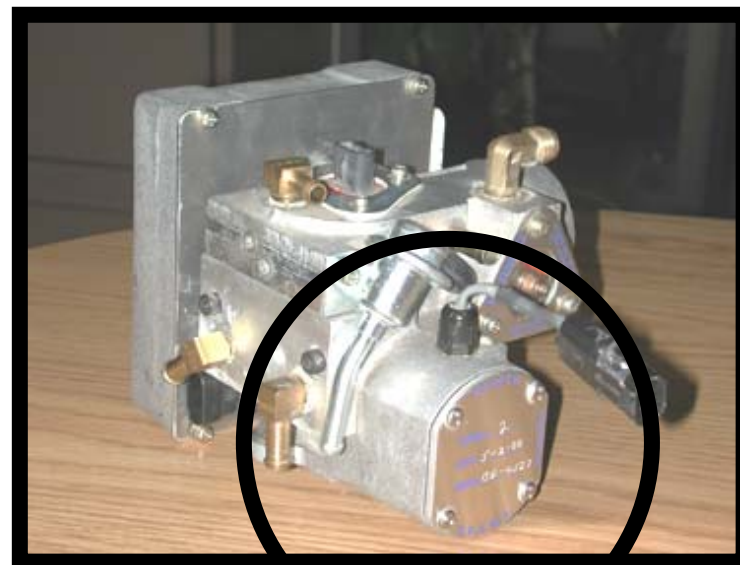
- **Throttle pedal or speed switch**
- **engine RPM**

From the RPM input (condition), the ECU commands the governor to increase or decrease the RPM depending on the engine load and other operating conditions to match the throttle pedal (speed switch) desired RPM.

ECU
Electronic Control Unit



ECU Outputs
Governor Actuator

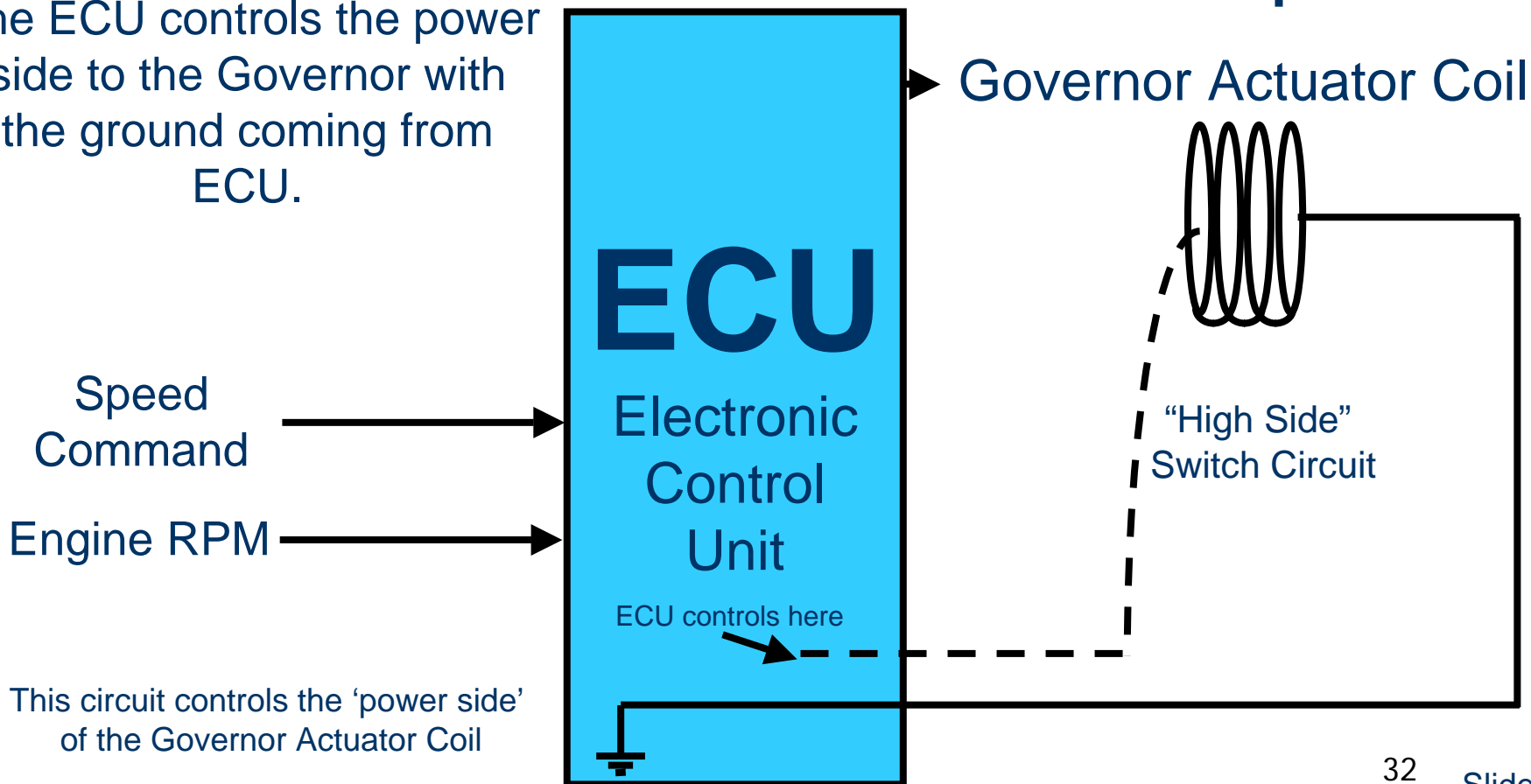




Governor

The ECU controls the power side to the Governor with the ground coming from ECU.

ECU Outputs



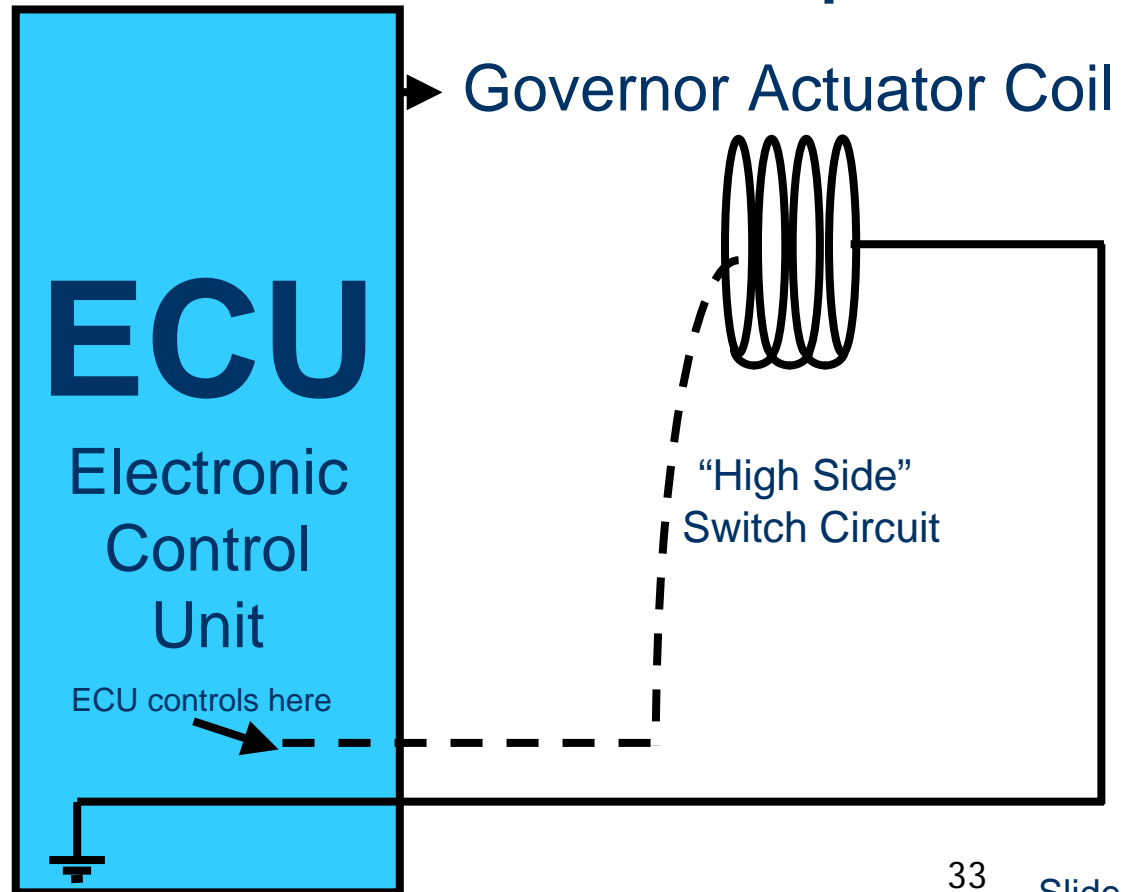


Governor

ECU Outputs

The duty cycle will vary according to the engine load, based on the throttle plate setting, ignition timing, quality of fuel and many other factors.

The duty cycle must change as the demand for engine RPM is commanded.





Governor

If the ECU or throttle body/governor assembly is replaced or the base idle setting is altered, the ECU must relearn the base throttle setting. This procedure takes 2-6 minutes during normal operation.

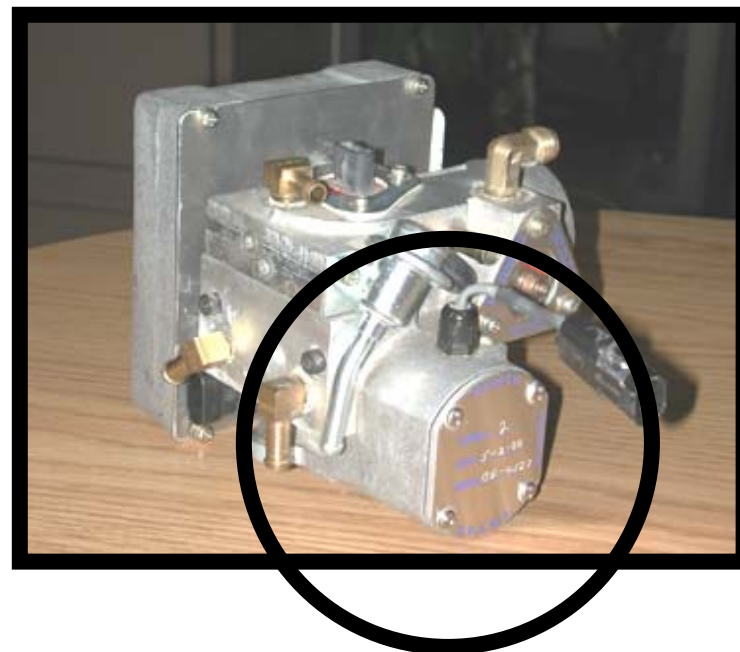
This 'idle setting relearn' procedure is a 'self-programming' operation of the ECU

ECU

Electronic
Control
Unit

ECU Outputs

Governor





Governor

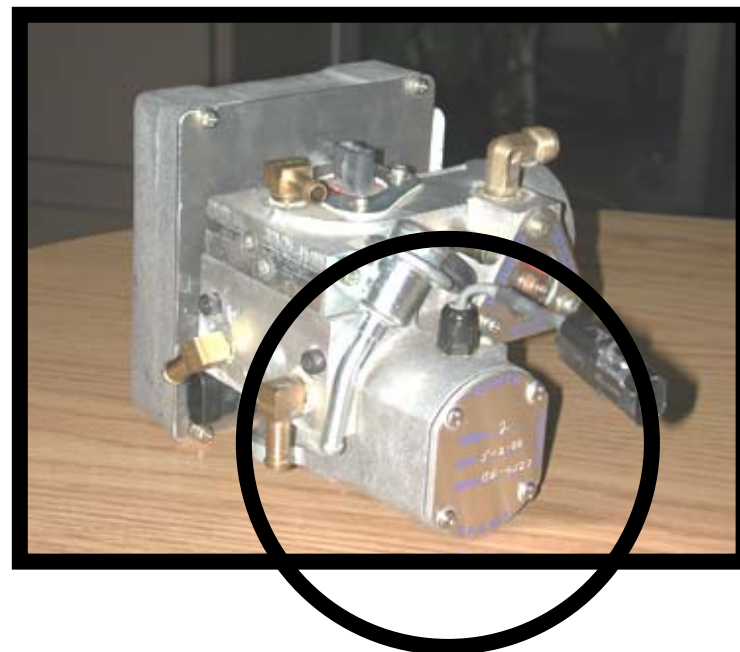
ECU Outputs

Governor

The proper RPM for the mechanical stop is dependant on engine. This screw is air flow set at Zenith and tamperproof.

The mechanical stop is required only to eliminate the Throttle Plate from sticking inside Bore.

ECU
Electronic
Control
Unit





Self-Learn Procedures

Governor Idle Self-Learn
Engine Temperature must be at 161 degrees °F or above.
Engine at Idle speed.

Procedures:

- A. For harness with Self-Learn wire and Throttle pedal.
1. Using a Jumper wire, ground the Self-Learn wire to frame (ground). Note: keep this wire grounded during the entire Self-Learn procedure.
 2. Start engine and Fully Depress the throttle pedal Once Only.
 3. Allow the engine to idle for a minimum of two (2) full minutes.
 4. Turn off engine and disconnect the jumper wire from the Self-Learn wire.
 5. The Self-Learn process is now complete.

Notes, Precautions.

1. Do not touch any function during this procedure.
2. When the Self-Learn procedure is in process, the Throttle pedal is disabled.
3. For Dual fuel applications, the Self-Learn procedure must be performed for each fuel selection.



Self-Learn Procedures

Governor Idle Self-Learn

Engine Temperature must be at 161 degrees °F or above.

Engine at Idle speed.

Procedures:

- B. For units that are not required to Self-Learn with wire**
 - 1. Start engine and allow to run at Idle for a minimum of two (2) full minutes.**

Notes, Precautions.

- 1. Do not touch any function during this procedure.**
- 2. For Dual fuel applications, the Self-Learn procedure must be performed for each fuel selection.**



Fuel Injector

The Fuel Injector is an electric actuator which controls the fuel flow to the engine.

The gasoline fuel injector is calibrated at 10-12 psi (open Loop)

15 psi (closed Loop)

and the propane fuel injector is calibrated at 12 or 24 psi (open Loop)

12 or 15 psi (closed Loop)

Normal servicing is required.
Dependant on Fuel Quality.

ECU
Electronic Control Unit

ECU Output

Fuel Injector





Fuel Injector

ECU Output

Fuel Injector

To control the fuel injector, the ECU provides the power and controls the “ground side” of the circuit.

The injector fires once per engine event and varies the pulse width (on-time) according to the engine conditions.

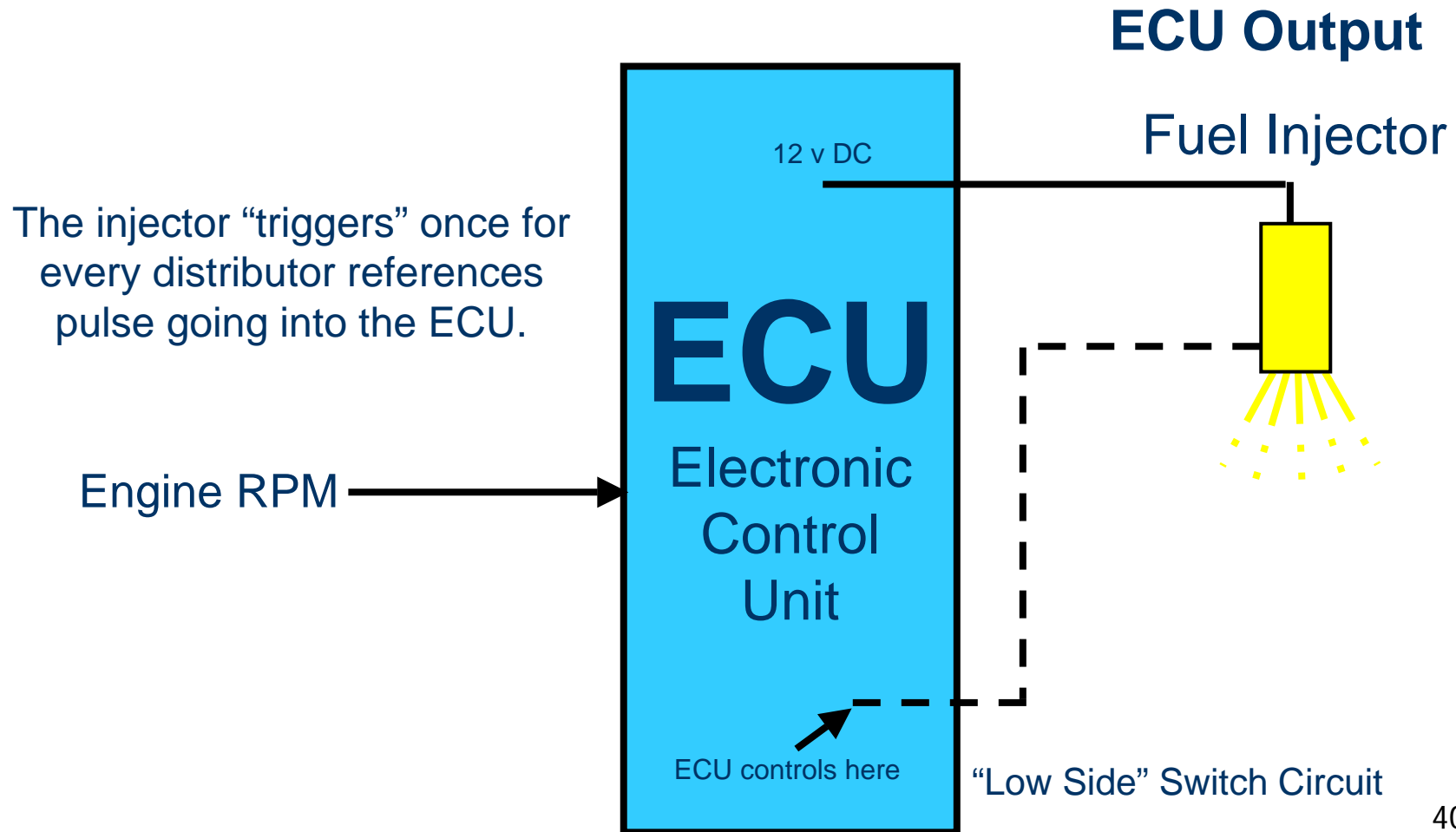
The engine conditions are monitored by the input sensors and the the ECU commands the fuel injector with a longer or shorter pulse width (on time).

ECU
Electronic
Control
Unit



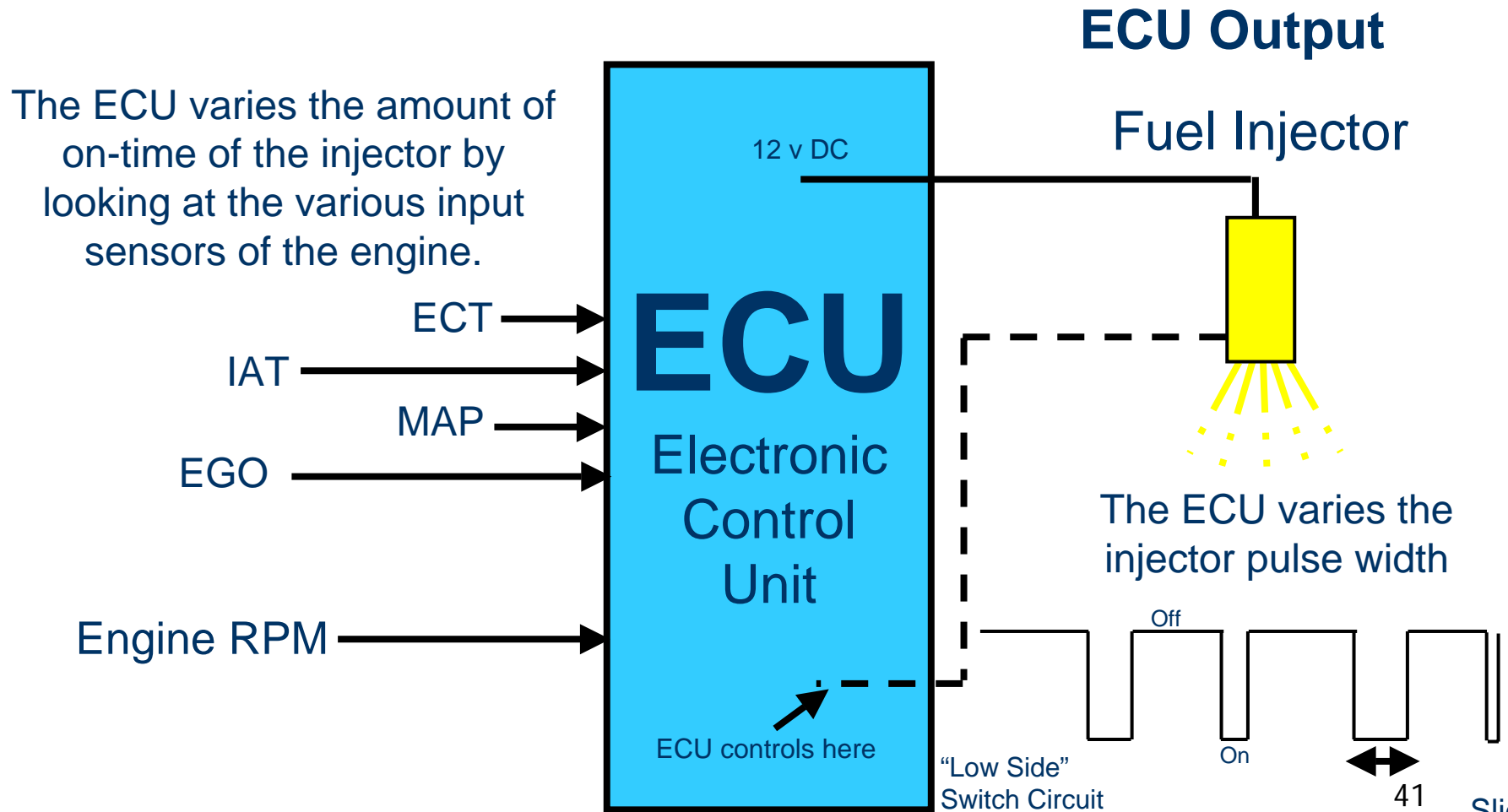


Fuel Injector





Fuel Injector





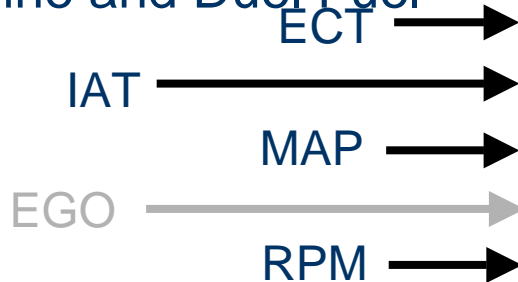
Ignition Timing

The ECU controls the ignition timing based on the MAP, ECT, IAT and RPM inputs.

Base Ignition Timing checked with vacuum advance disconnected at Idle speed.

12 degrees BTDC for Lp.

5 degrees BTDC for Gasoline and Dual Fuel



ECU Output

Ignition Timing





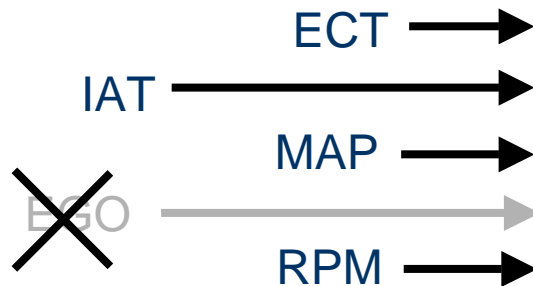
Open & Closed Loop

Open Loop

During warm-up the ECU controls in “open loop”.

The ECU controls the outputs based on the MAP, ECT, IAT and RPM inputs.

Open Loop is defined as “no EGO control”.

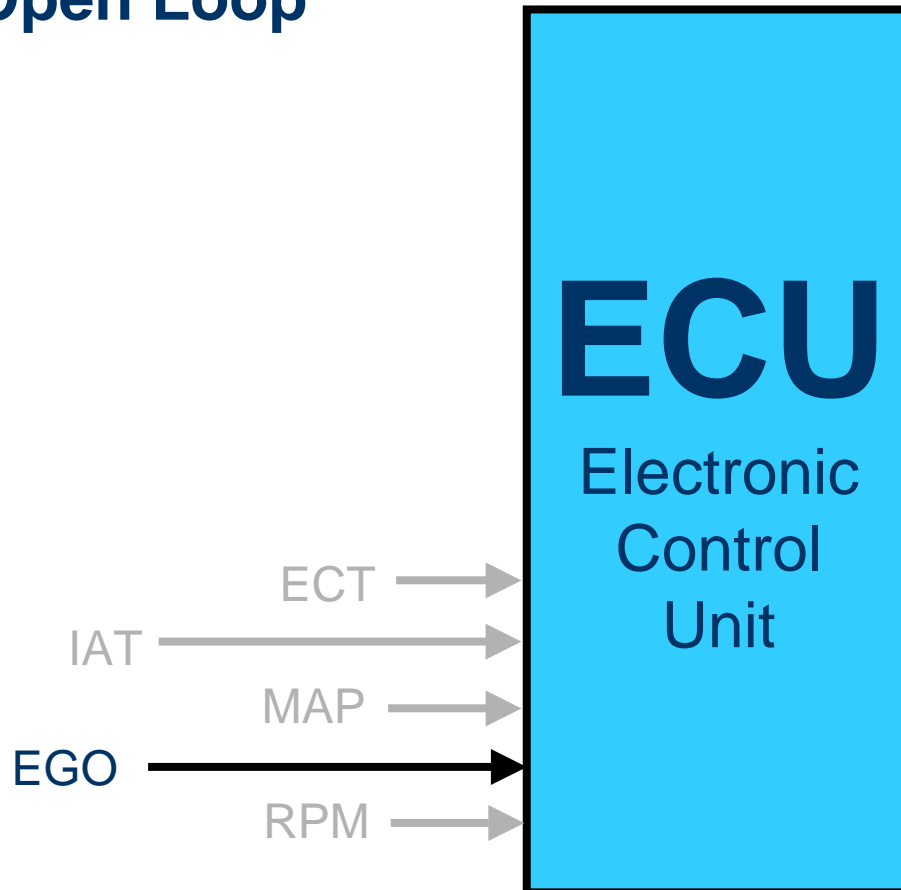


Closed Loop



Open & Closed Loop

Open Loop



Closed Loop

- To achieve 'closed loop' these conditions must be met:
- engine fully warm
 - EGO hot and operating
 - engine running for 30 seconds

Closed Loop is defined as the EGO is monitoring the the O2 content of the exhaust stream and the ECU is adjusting the fuel injector pulse width based on the EGO values.

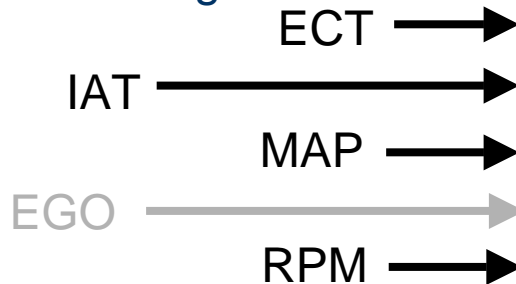


Closed Loop to Open Loop

Open Loop

The ECU will move from Closed Loop to Open Loop if sudden changes in MAP, ECT, or RPM values occur.

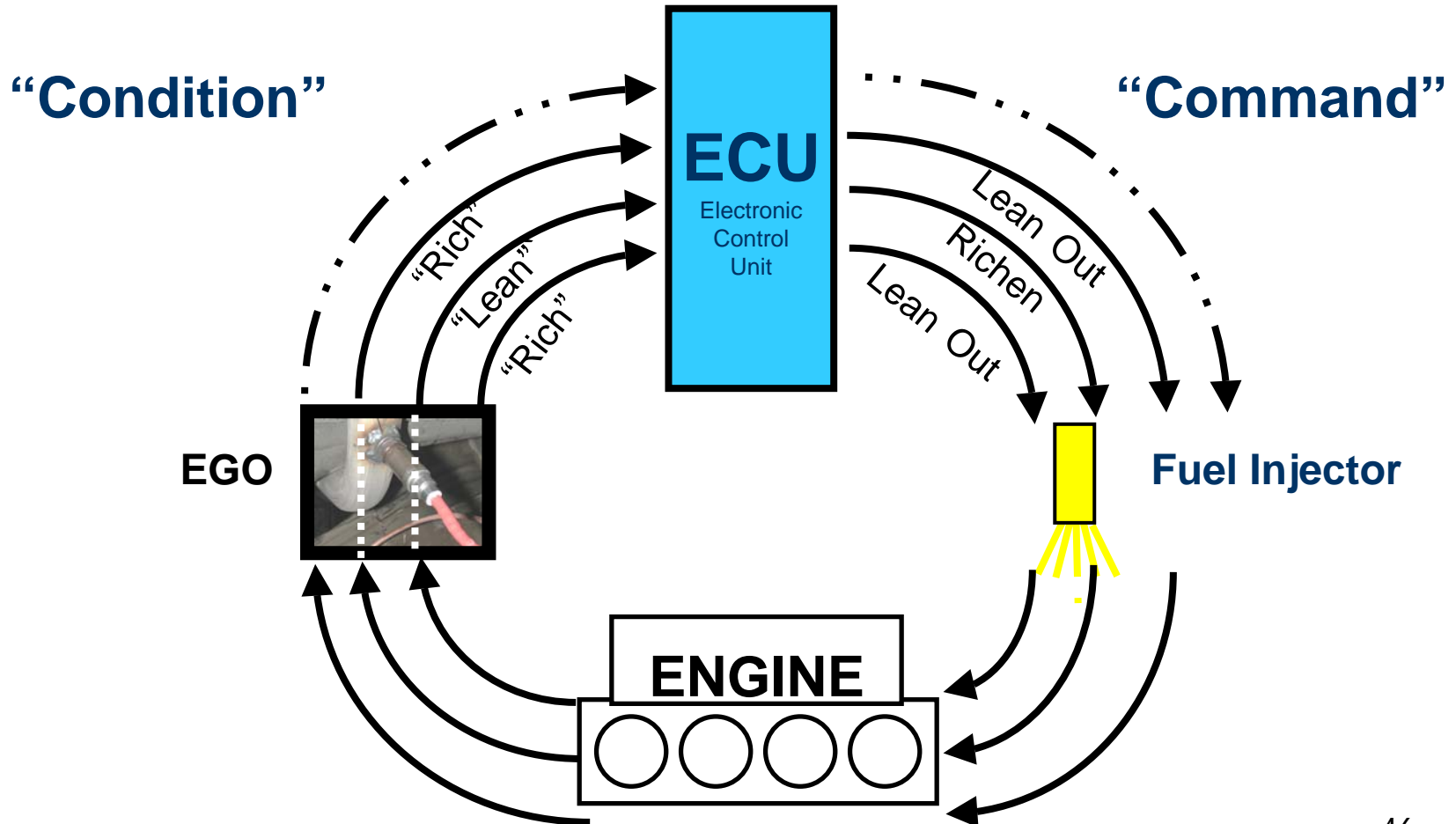
MAP sensor changes are load dependent. ECT changes are coolant related. RPM changes are engine running conditions.



Closed Loop



Closed Loop Operation





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Review Questions and Answers

Operation Review



Key On

Calculates or measures:

- Altitude, barometric pressure
- Coolant temperature
- Ambient temperature

MAP



ECT



IAT



ECU Turns on Fuel Pump (gasoline)

or

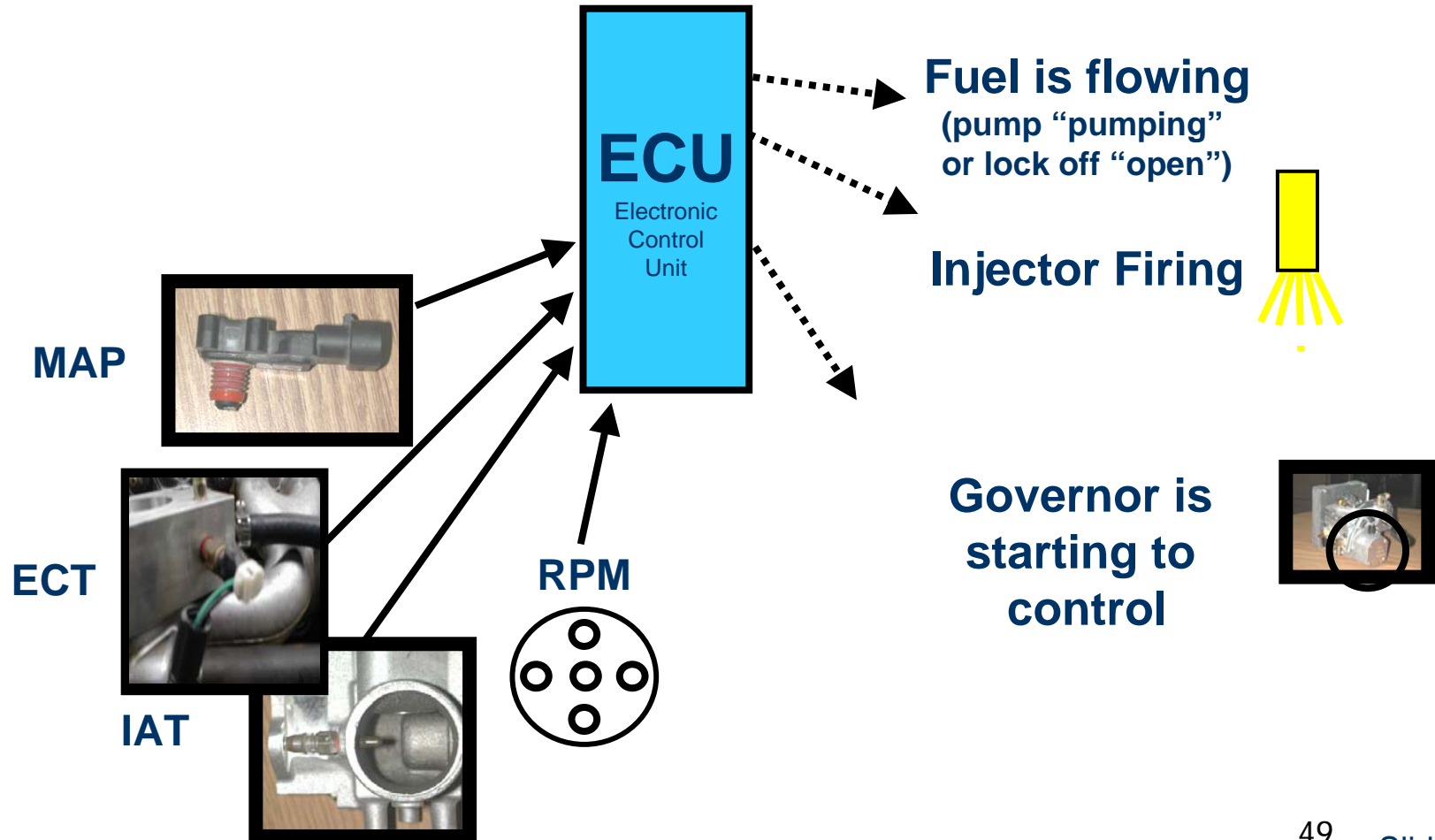
Opens Fuel Lock Off (propane)

This will be “on” for 2 seconds if a RPM signal is not received.

Listen and “feel” the pump run or the lock off to “turn on”.



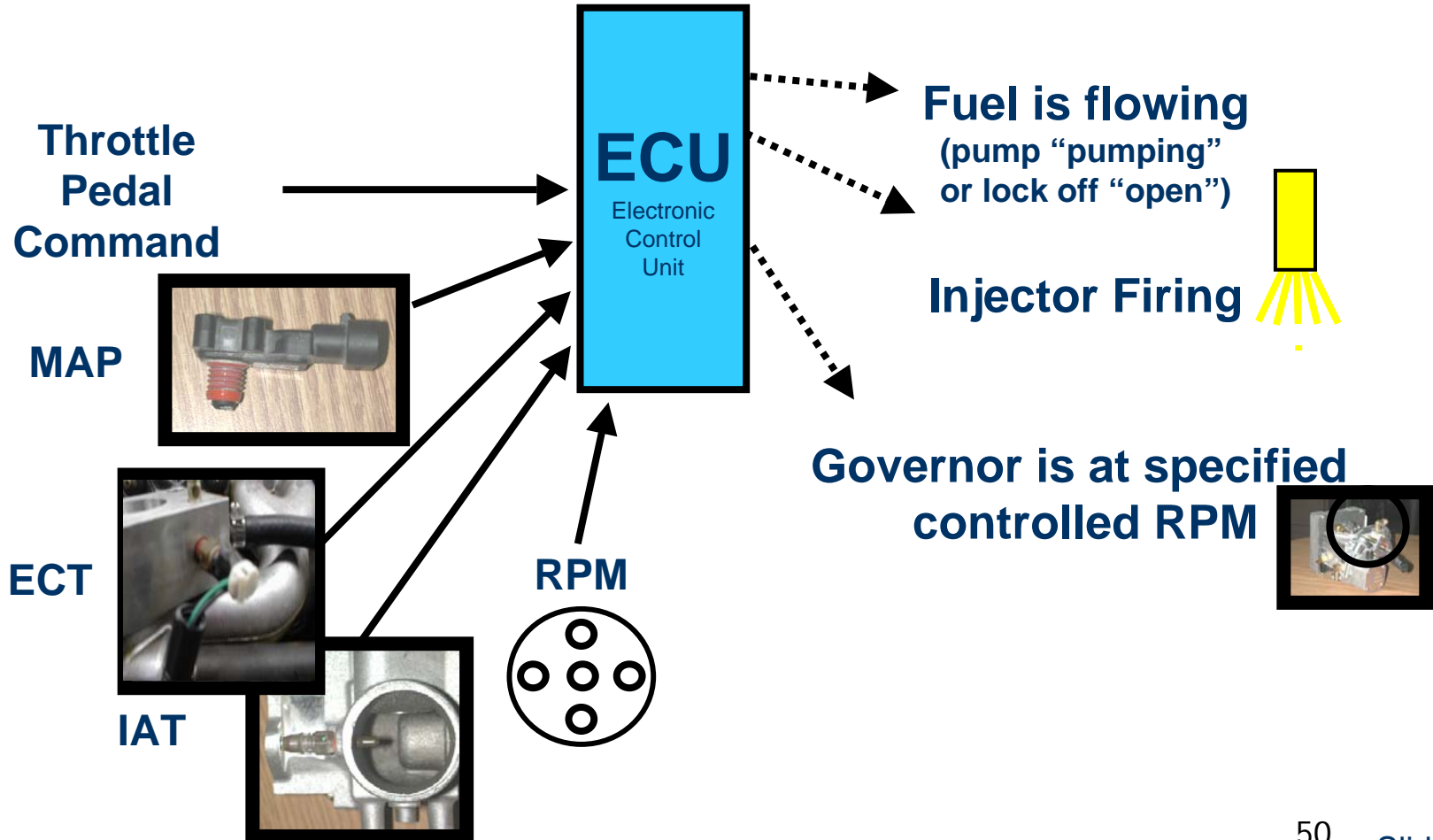
Cranking





Running

without EGO Sensor



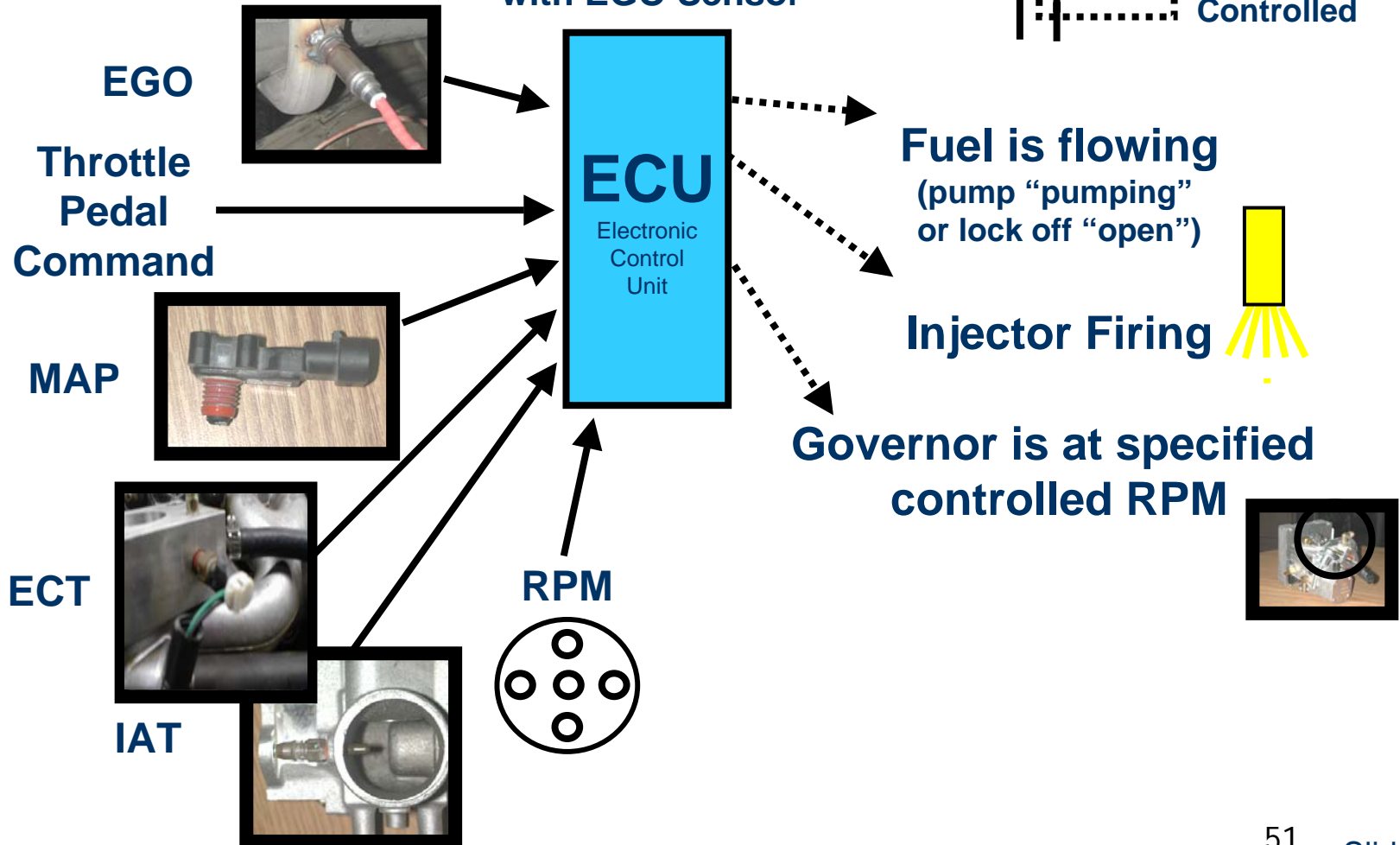


Running

with EGO Sensor



Key On
Not ECU
Controlled





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Operation Review



System Operation

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Application Guide review

(Jack Belcher)



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Diagnositics



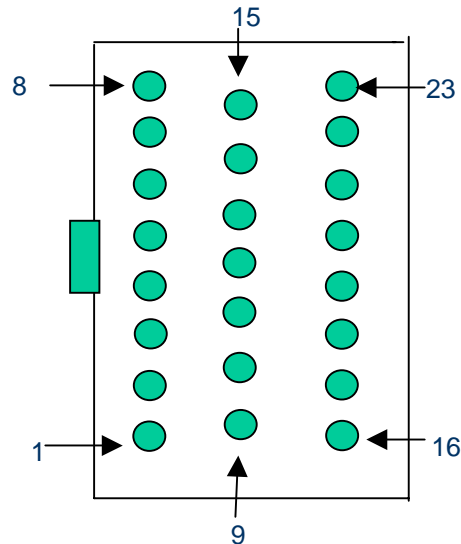
- A Service kit is available to diagnose all system components.
- Zenith part number is C282-311



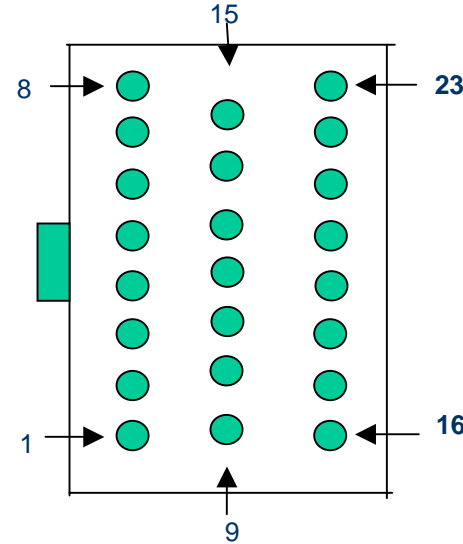
Diagnostics

ECU testing:

Black



White





Diagnostics

White Connector

Pin #	Wire Color	Description	Pin#
1	Yellow	12v LP Request	1
2	Brown/white	LP Injector (Ground) (also pin #3)	2
3	Brown	Gas Injector (Ground)	3
4	Purple	12v output for fuel	4
5	Tan	signal to Governor	5
6	Empty		6
7	Empty		7
8	Gray	12v thru 10K resistor to pin 11	8
9	12v input	(optional)	9
10	Empty		10
11	Gray	5v from resistor pin 8	11
12	Red/White	Ground to diagnostic light	12
13	Empty		13
14	Red/White	12V Neutral Switch	14
15	Red/Black	12V Injector	15
16	Empty		16
17	12V input	(optional)	17
18	Empty		18
19	Blue	Distributor input (digital reading)	19
20	Black	Ground	20
21	Black	Ground	21
22	Red	Power	22
23	Red	Power	23

Black Connector

Wire Color	Description
Green	Coolant Sensor
White	Pot input 0-5 V
Green/black	5V output (pot)
Orange	5V output (MAP)
Yellow/Black	(speed ground)
Empty	(programming port)
Pink	12V to oil switch (typ.)
Orange/Black	Self-Learn/fault lamp reset
Blue	Air Temp Sensor
White/Black	O2 sense input
Black	All Sensor Ground
Black/White	Signal ground for O2/pedal
Red/Black	(speed ground)
Empty	
White/Black	(speed ground)
Gray	Idle validation 5VI
Green	MAP Sensor 5V input
Empty	
Empty	
Empty	
Empty	
Empty	
Empty	



Diagnostics

- **Processor Quick Tests**

refer to previous chart

- **Conclusion**

- If all of these tests fail, suspect a faulty power or ground circuit/s to the ECU.
- If one or two of these tests fail, suspect a faulty ECU.



- **Input Sensor Quick Tests**
 - IAT Testing
 - ECT Testing
 - MAP Testing
 - EGO Testing
 - Distributor Reference



● IAT and ECT Testing

- Remove wiring harness from sensor/s
- Install “test harness” to IAT or ECT sensor
- Measure the resistance values in Ohms and compare to chart below

Temp F	Temp C	Nominal Resistance	Minimum Resistance	Maximum Resistance
266	130	84	80	88
230	110	144	139	151
212	100	189	182	199
176	80	349	334	369
140	60	693	657	734
104	40	1484	1398	1579
68	20	3481	3254	3719
32	0	9099	8442	9767
-4	-20	27050	24910	2910
-40	-40	93630	85570	101400



- IAT and ECT Testing
 - Remove wiring harness from sensor/s
 - Turn Key On (KOEO)
 - Measure voltage between terminals “A” & “B” of the wiring harness going to the IAT or ECT
 - Black Voltmeter lead to “B”, red lead to “A”
 - Voltage should be 5 Vdc +/- 10% (KOEO)



● MAP Testing

- Complete ECU reference voltage test at MAP
- With the MAP connected “in-circuit”
- Connect a voltmeter as follows, key on (KOEO)
 - Red lead to terminal “B”, black lead to ground
 - Measure the Voltage values and compare to chart
 - These voltages will vary according the current weather conditions at your location

Altitude above Sea Level	Nominal Voltage DC
0-1000	5.00-4.60
1000-2000	4.60-4.10
2000-3000	4.10-3.60
3000-4000	3.60-3.20



- **EGO Testing** (if equipped)
 - Complete EGO Bias voltage test
 - With the EGO connected “in-circuit”
 - Connect a voltmeter as follows, key on (KOEO)
 - Red lead to Cavity “B”, black lead to Cavity “A”.
 - Complete EGO test in machine per EGO testing sequence
 - ‘Richen Mixture’ EGO voltage 0.8 vDC or higher
 - ‘Lean Mixture’ EGO voltage 0.3 vDC or lower
 - A= ground B= Sense C= system ground D= 12V IGN (heat)



- **EGO Bias Voltage Test** (KOEO, Black Connector Pin 10)

- (if equipped)
- Measure “Bias” voltage to EGO Sensor
 - Turn Key Off
 - Leave harness installed to EGO
 - Start Engine
 - Voltmeter red lead to Cavity “B” on EGO Sensor Connector, black lead to Cavity “A”
 - Results should be 0.1 - 0.9 vDC when sensor is activated and engine running.



● Fuel Injector Testing

- Disconnect wire/s to fuel injector
- Measure the resistance of the fuel injector
 - 1.2 - 1.6 Ohms is specification
- Turn Key on and measure voltage on the harness
 - Volt meter red lead to terminal “A”, black lead to terminal “B”, turn key on (KOEO)
 - Voltage is pulsing but can be seen. Noid light is best for this test.
- Complete fuel injector “tap test”



● Governor Actuator Testing

- Disconnect wire/s to Governor Actuator
- Measure the resistance of the actuator
 - 3.0-4.5 Ohms is specification
- Turn Key on and measure voltage on the harness
 - Volt meter red lead to terminal “A”, black lead to terminal “B”, turn key on (KOEO)
 - Voltage is Pulse Width Modulated and could vary between 2.3V and 6.2V

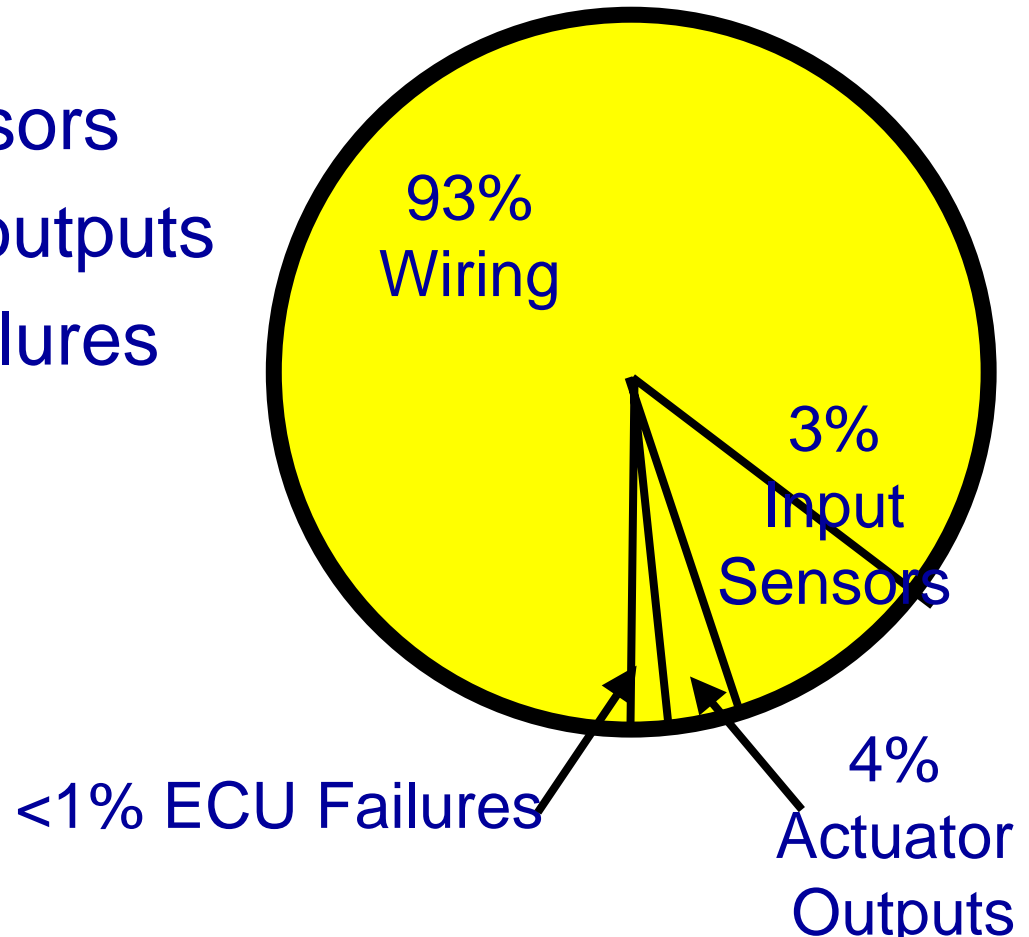


- Ignition Timing Testing
 - Start engine and monitor ignition timing
 - From idle up to 1000 RPM, the ignition timing should be close to base timing setting
 - Vacuum Advance of engine timing occurs through a vacuum port located on Throttle Body.
 - If the ignition timing does not advance, suspect in this order; Vacuum hose disconnected, Vacuum port clogged, Distributor malfunction



● Diagnostic Review

- 93% Wiring
- 3% Input sensors
- 4% Actuator outputs
- <1% ECU Failures





IAT and ECT

Temp F	Temp C	Nominal Resistance	Minimum Resistance	Maximum Resistance
266	130	84	80	88
230	110	144	139	151
212	100	189	182	199
176	80	349	334	369
140	60	693	657	734
104	40	1484	1398	1579
68	20	3481	3254	3719
32	0	9099	8442	9767
-4	-20	27050	24910	2910
-40	-40	93630	85570	101400

Fuel Injector

1.2 - 1.4 Ohms

Fuel Pressure

- **Gasoline**

10-12 psi
(open Loop)

15 psi
(closed Loop)

MAP

Altitude above Sea Level	Nominal Voltage DC
0-1000	5.00-4.60
1000-2000	4.60-4.10
2000-3000	4.10-3.60
3000-4000	3.60-3.20

Governor Actuator

3.0-4.5 Ohms

1 amp max current draw

- **Propane**

12 or 24 psi.
(open Loop)
12 or 15 psi
(closed Loop)



Diagnostics, No Start

- No Start Quick Tests
 - Determine the following when ‘cranking’ the engine
 - No Fuel, with spark plugs ‘firing’
 - No Spark, with fuel injection spray from injector
 - Both No Fuel Spray and No Ignition Spark



● No Start: No Fuel, w/spark Quick Tests

- Check fuel level in tank and fuel filter for blockage
- Check for the fuel pump running or LPG lock-off 'click' during cranking.
- If no lock-off 'click' or fuel pump run, suspect faulty wiring to pump/lock off, if o.k suspect faulty pump/lockoff.



- No Start: No Fuel, w/spark Quick Tests
(Tap Test)

- If the fuel pump runs or the lock-off ‘clicks’, operate the fuel injector manually as follows:
 - Cycle “key” several times (off-on-off-on-off)
 - Disconnect wiring harness to the fuel injector
 - Connect one terminal of the injector to the battery plus (B+) with a **fused** jumper lead.
 - Connect a test light to ground
 - Tap the other terminal of the injector with the test light probe.
 - When “tapped”, the test light should light and the injector should spray fuel



- **No Start: No Fuel, w/spark (Tap Test)**
 - If the fuel injector does not spray fuel and test light ‘lights’ (a small ‘click’ from the fuel injector will be heard when test light is tapped, no ‘click’ is a faulty fuel injector):
 - Suspect fuel is not ‘getting to the injector’ or the fuel injector fuel passage is plugged
 - If the fuel injector does not spray fuel and test light ‘does not light’ when tapped:
 - Suspect a faulty (open) fuel injector
 - If the fuel injector sprays fuel when tapped:
 - Suspect the fuel injector is not receiving “signal/s” from the ECU (wiring), a defective RPM signal to the ECU or a faulty ECU.



Diagnostic Trouble Codes

Result – What the ECU will do when it detects a fault condition.

Trouble Code – The code that will be displayed by the Engine Check Light.

Trouble Flag – Code that will be displayed on a laptop using the Zenith monitoring software while the engine is running.

Code/Flag retained in memory with key off? – Which flags and codes that will be retained for retrieval when the key is turned off.

Check Engine Light – The engine check light condition that the operator will see when a fault condition occurs.

Trouble Code Operation:

When the Engine Check Light is on continuous there will be trouble codes stored to retrieve.

To retrieve codes:

1. With the engine off, turn the key to the on position.
2. The engine check light will flash once pause and flash twice to indicate a code 12. Code 12 indicates that the fault system is functioning. Code 12 will be flashed 3 times with a double pause between each.
3. The next trouble code will be displayed in the order of occurrence. It will also be flashed three times with a double pause between each.
4. After all trouble codes have been flashed three times, the codes will repeat starting with code 12.

To clear the codes:

1. After all of the codes have been retrieved and conditions repaired, start the engine. With the engine running, momentarily ground the self learn wire. You will hear the engine hesitate as the ground is made and the engine check I



	CONDITION	SEQUENCE	RESULT	TROUBLE CODE	TROUBLE FLAG	CODE/FLAG RETAINED IN MEMORY WITH KEY OFF?
1	ENGINE OIL PRESSURE SWITCH INDICATES LOW OIL PRESSURE		OIL PRESSURE SWITCH INDICATES OIL PRESSURE IS LOW FOR 1 COMPLETE SECOND - ENGINE SHUTDOWN OCCURS		2	NO
2	ENGINE OVERHEATING DETECTED (COOLANT >= 239 F)	1	RPM LIMITED TO 950 MAXIMUM FOR 60 SECONDS		3	NO
		2	ONCE 60 SECOND TIME LIMIT IS EXCEEDED - ENGINE SHUTDOWN OCCURS		3	NO
3	TRANSMISSION OIL TEMPERATURE SWITCH INDICATES OVERTEMP	1	RPM LIMITED TO 950 MAXIMUM FOR 60 SECONDS		4	NO
		2	ONCE 60 SECOND TIME LIMIT IS EXCEEDED - ENGINE SHUTDOWN OCCURS		4	NO
4	BEGINNING OF DIAGNOSTIC ROUTINE		NO FAULT CONDITION EXITS - SIGNIFIES BEGINNING OF FLASH CODES	12		YES-ALWAYS PRESENT
5	ENGINE COOLANT SENSOR INDICATES SHORT CIRCUIT OR EXTREME OVERHEATING OF ENGINE (COOLANT TEMP >= 266 F)	1	TROUBLE CODE IS STORED IN MEMORY	14	3	CODE RETAINED IN MEMORY
		2	RPM LIMITED TO 950 MAXIMUM FOR 60 SECONDS	14	3	FLAG CLEARS WHEN IGNITION IS OFF
		3	ONCE 60 SECOND TIME LIMIT IS EXCEEDED - ENGINE SHUTDOWN OCCURS	14	3	FLAG CLEARS WHEN IGNITION IS OFF
6	ENGINE COOLANT SENSOR INDICATES OPEN CIRCUIT		TROUBLE CODE IS STORED IN MEMORY	15		CODE RETAINED IN MEMORY
7	PEDAL POSITION SENSOR OVER VOLTAGE (OVER 4.5 VOLTS)		TROUBLE CODE IS STORED IN MEMORY	21		CODE RETAINED IN MEMORY
8	PEDAL POSITION SENSOR UNDER VOLTAGE (0 VOLTS)		TROUBLE CODE IS STORED IN MEMORY	22		CODE RETAINED IN MEMORY
9	AIR TEMPERATURE SENSOR INDICATES OPEN CIRCUIT		TROUBLE CODE IS STORED IN MEMORY	23		CODE RETAINED IN MEMORY
10	AIR TEMPERATURE SENSOR INDICATES SHORT CIRCUIT		TROUBLE CODE IS STORED IN MEMORY	24		CODE RETAINED IN MEMORY
11	MAP SENSOR CIRCUIT INDICATES HIGH VOLTAGE (4.98 V OR ABOVE)		TROUBLE CODE IS STORED IN MEMORY	33		CODE RETAINED IN MEMORY
12	MAP SENSOR CIRCUIT INDICATES SHORT TO GROUND		TROUBLE CODE IS STORED IN MEMORY	34		CODE RETAINED IN MEMORY
13	OXYGEN SENSOR - LEAN CONDITION DETECTED		TROUBLE CODE IS STORED IN MEMORY	44		CODE RETAINED IN MEMORY
14	OXYGEN SENSOR - RICH CONDITION DETECTED		TROUBLE CODE IS STORED IN MEMORY	45		CODE RETAINED IN MEMORY



- Both No Fuel Spray and No Ignition Spark Quick Tests
 - Visually inspect system wiring and correct defects (no spark = no fuel)
 - Verify power to the coil
 - Inspect Ignition system completely



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- Laptop Diagnostics



Communication Interface Instruction Sheet

Monitoring Engine Data

1. Copy all files from provided disk onto computer hard drive. (This step necessary for first time use only.)
2. Recessed buttons located to the right of serial cable connection of the communication box are not to be depressed. (located thru drilled holes)
 3. Disconnect the **BLACK** connector on wiring harness from mating connector on Z.E.E.M.S. ECU.
 4. Connect the **BLACK** connector on communication interface to mating connector on Z.E.E.M.S. ECU.
 5. Connect the **BLACK** connector on wiring harness to mating connector on communication interface.
 6. Connect 9-pin serial cable between computer serial port and communication interface.
 7. Open Nissan.exe on computer.
 8. Select appropriate *.cfg file for the application (i.e. Nfcna.cfg).
9. "ECU Online" is displayed in the lower right corner of the screen and the current operating data is displayed at the top of the screen when key power is applied or the engine is running.

Special Functions

UPLOAD

Use the **UPLOAD** command in the **FILE** menu to receive the latest **EDU** data (key power must be on).

SAVE

Use the **SAVE** command in the **FILE** menu to store **ECU** data in file.

OPEN

Use the **OPEN** command in the **FILE** menu to retrieve previously stored data.

PLOT

Use the **PLOT** function to display operating parameters graphically. In the **PLOT** menu select a variable to graph from the list and center a valid graphing scale.



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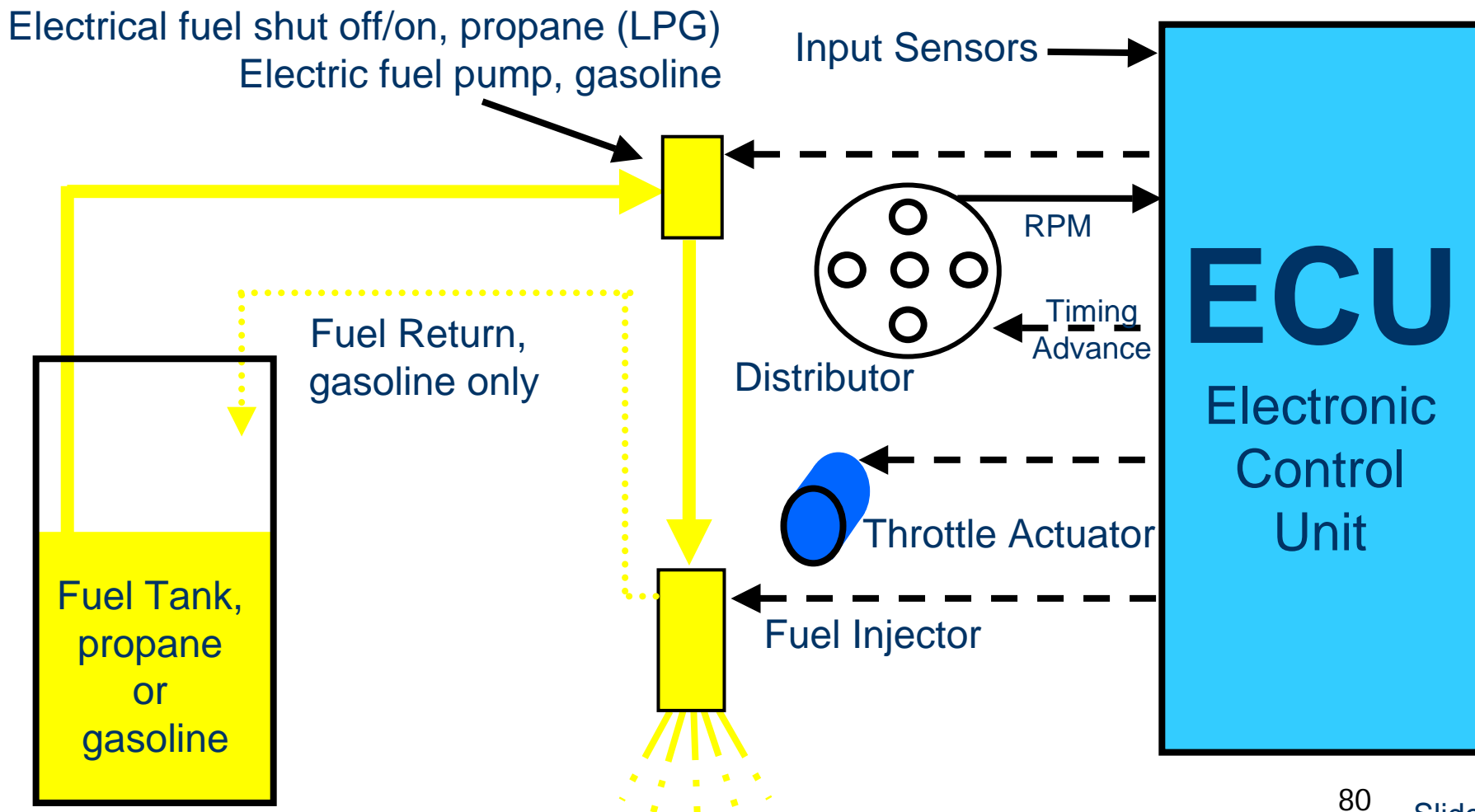


Warranty Discussion



Block Diagram Review

ZEEMS Block Diagram



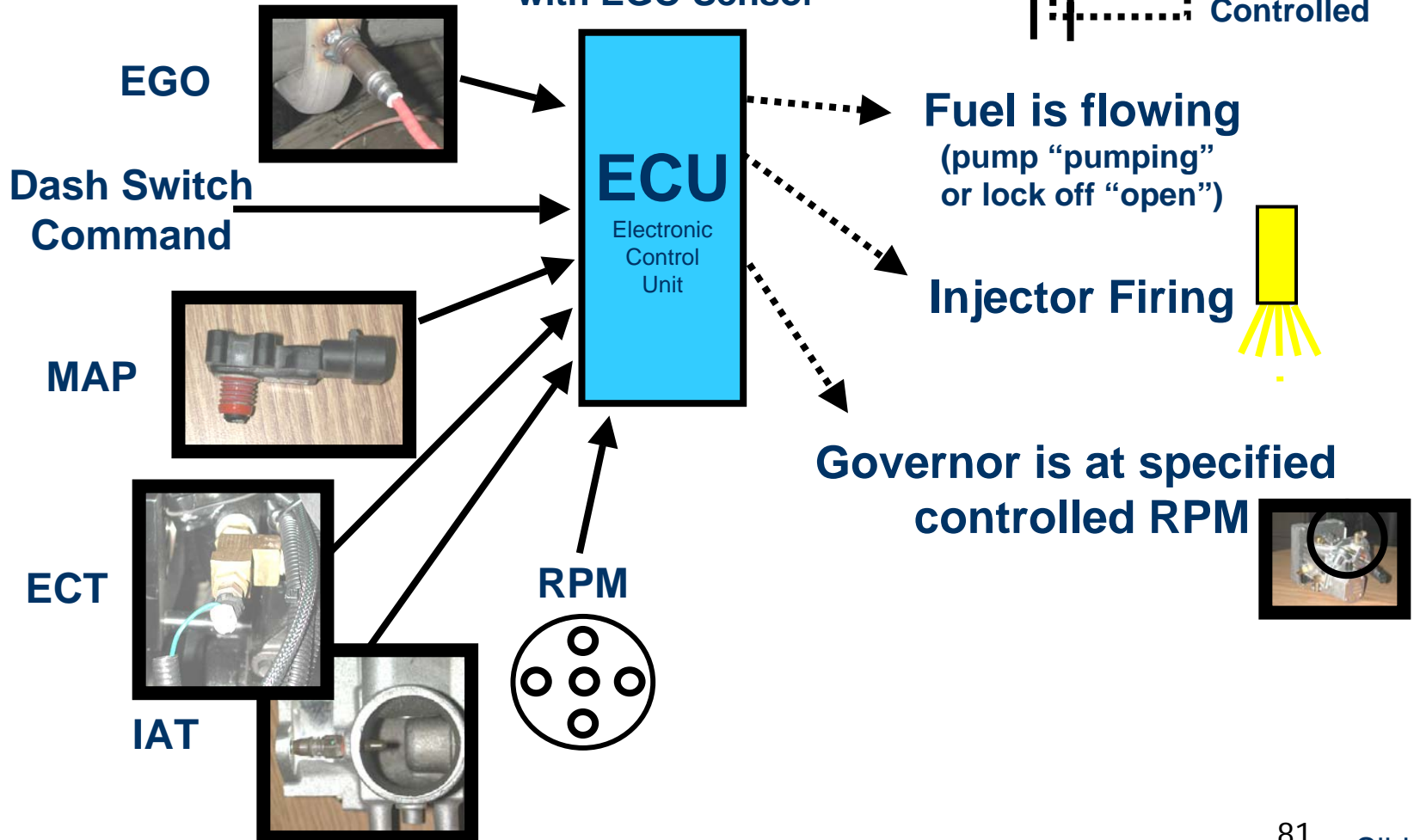


Running

with EGO Sensor



Key On
Not ECU
Controlled





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Zenith Electronic Engine Management System

**Propane and Gasoline
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