# HYOSUNG MOTORS AMERICA INC.

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# FUEL INDUCTION SYSTEM

MS3 & GV250 Ei / GT250 / R Ei & GV650 Ei / GT650 / S / R Ei

This manual is designed to provide Hyosung dealer technicians with a complete understanding of the construction and operating principles of motorcycle fuel induction systems.

The manual starts with a description of the basic principles of motorcycle fuel injection systems. Subsequent sections describe specific fuel and induction system circuits and operation, adding technical detail as the reader's comprehension grows.

Special care has been exercised in preparing clear, simple illustrations as an aid in visualizing the fuel and induction systems described in this text.

The variety of fuel and induction systems in use and frequent design changes preclude the listing of service and repair specifications. Refer to the Service Manual for service information on specific system models.

For additional information or questions contact Hyosung Motors America.

HYOSUNG MOTORS AMERICA INC.
SERVICE TEAM

## Table of Contents

**A**

| | |
|---|---|
| ABDC | : After Bottom Dead Center |
| AC | : Alternating Current |
| API | : American Petroleum Institute |
| ATDC | : After Top Dead Center |

**B**

| | |
|---|---|
| BBDC | : Before Bottom Dead Center |
| BDC | : Bottom Dead Center |
| BTDC | : Before Top Dead Center |

**D**

| | |
|---|---|
| DC | : Direct Current |
| DOHC | : Double Over Head Camshaft |

**E**

| | |
|---|---|
| ECU | : Engine Control Unit, EI Control Unit |
| EI | : Electric fuel Injection, Electric fuel Injector |
| ET Sensor | : Engine Temperature Sensor (ETS) |

**F**

| | |
|---|---|
| FP | : Fuel Pump |

**G**

| | |
|---|---|
| GP Switch | : Gear Position Switch |

**I**

| | |
|---|---|
| IAP Sensor | : Intake Air Pressure Sensor (IAPS) |
| IAT Sensor | : Intake Air Temperature Sensor (IATS) |
| IG | : Ignition |
| ISC Solenoid | : Idle Speed Control Solenoid |

**L**

| | |
|---|---|
| LCD | : Liquid Crystal Display |
| LED | : Light Emitting Diode |
| LH | : Left Hand |

**M**

| | |
|---|---|
| Max | : Maximum |
| Min | : Minimum |

**O**

| | |
|---|---|
| $O_2$ Sensor | : Oxygen Sensor ($O_2S$) |

**R**

| | |
|---|---|
| RH | : Right Hand |
| RO Switch | : Roll Over Switch |

**S**

| | |
|---|---|
| SAE | : Society of Automotive Engineers |
| SAV Solenoid | : Secondary Air Valve Solenoid |

**T**

| | |
|---|---|
| TDC | : Top Dead Center |
| TP Sensor | : Throttle Position Sensor (TPS) |

For most of the existence of the internal combustion engine, the carburetor has been the device that supplied fuel to the engine. On many other machines, such as lawnmowers and chainsaws, it still is. But as motorcycles have evolved, the carburetor gets more and more complicated trying to handle all of the operating and emission requirements. For instance, to handle some of these tasks, carburetors have five different circuits:

- **Main circuit** - Provides just enough fuel for wide open throttle
- **Mid-Range circuit** - Provides just enough fuel for fuel-efficient cruising
- **Idle circuit** - Provides just enough fuel to keep the engine idling
- **Accelerator pump** - Provides an extra burst of fuel when the throttle is first twisted, reducing hesitation before the engine speeds up
- **Choke** - Provides extra fuel when the engine is cold so that it will start

In order to meet stricter emissions requirements, a fuel induction system that carefully controls the air-to-fuel ratio was introduced. Hyosung's fuel injection system uses oxygen sensors that monitor the amount of oxygen in the exhaust. The ECU uses this information to adjust the air-to-fuel ratio in real-time. This is called closed loop control – it was not feasible to achieve this precision of control with carburetors.

A microprocessor inside the Engine Control Unit (ECU) makes hundreds of changes per second. Each adjustment allows precise fuel and ignition mapping to the engine for the current environmental conditions. This results in maximum fuel economy and performance because each cylinder is given only the fuel it needs.

The Electronic Fuel Injection system uses several sensors to provide feedback about external and internal operating conditions to the electronic "brain" of the system, the ECU.

These operating conditions include:

- Rider Input (throttle position)
- Engine Load
- External Environmental Conditions (outside air temperature and pressure)
- Internal Engine Environmental (cylinder head temperature)

When the rider twists the throttle, the throttle valve opens more, letting in more air. The ECU "sees" the throttle valve open and increases the fuel rate in anticipation of more air entering the engine. It is important to increase the fuel rate as soon as the throttle valve opens; otherwise, when the throttle is twisted, there may be a hesitation as soon as air reaches the cylinders without enough fuel in it.

Each of these conditions must be known in addition to the information already "memorized" by the ECU. This is necessary for the ECU to perform the calculations necessary to deliver the optimum spark advance and fuel amount for each cycle for maximum performance as well as to meet government regulations for emissions.

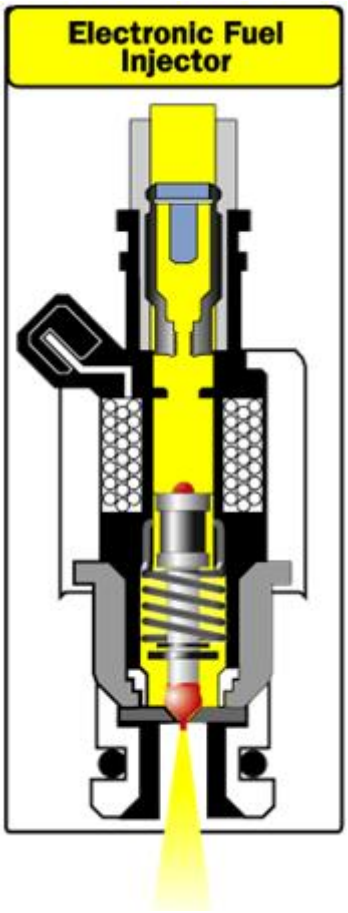
The method of how the required amount of fuel is calculated is based on the EFI system. The ECU calculates and delivers spark and fuel on a set of predetermined spark and fuel "maps."

These "maps" provide the base information necessary to run the engine with only minor adjustments for external / internal environmental conditions, as well as, feedback from the exhaust gas oxygen (O2) sensor to continually adjust the amount of fuel delivered to the engine. This offers the advantage of "learning" the behavior of the engine over time, as well as, responding to a wider variety of conditions encountered while riding. The EFI system then continuously "tunes" the performance of the engine to compensate for changing conditions and provide maximum performance by using the O2 sensors input.

Fuel Injector

When the ECU receives all of its input from the various sensors and calculates this information, it then sends an electronic signal to the fuel injector. A fuel injector is nothing but an electronically controlled valve. It is supplied with pressurized fuel by the fuel pump, and it is capable of opening and closing many times per second.

**Inside the Fuel Injector**

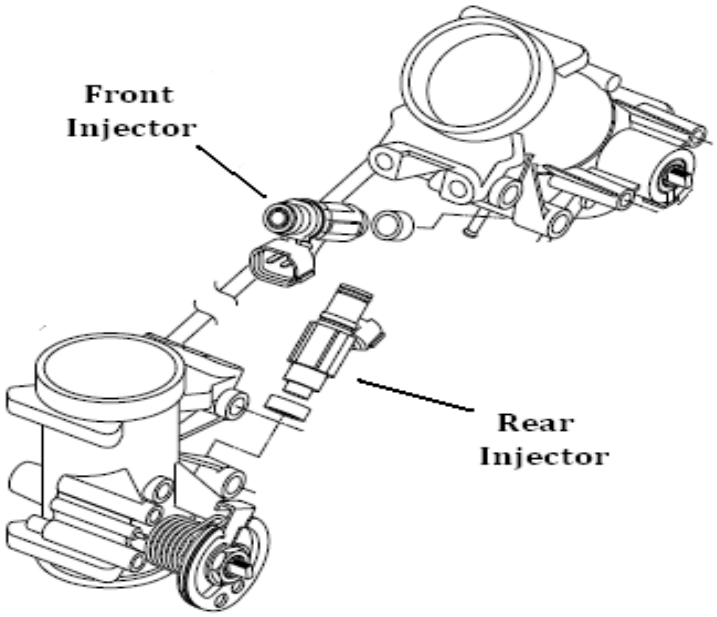


When the injector is energized, an electromagnet moves the plunger that opens the valve, allowing the pressurized fuel to squirt out through a tiny nozzle. The nozzle is designed to atomize the fuel – to make as fine a mist as possible so that it can burn easily.

**A Fuel Injector Firing**

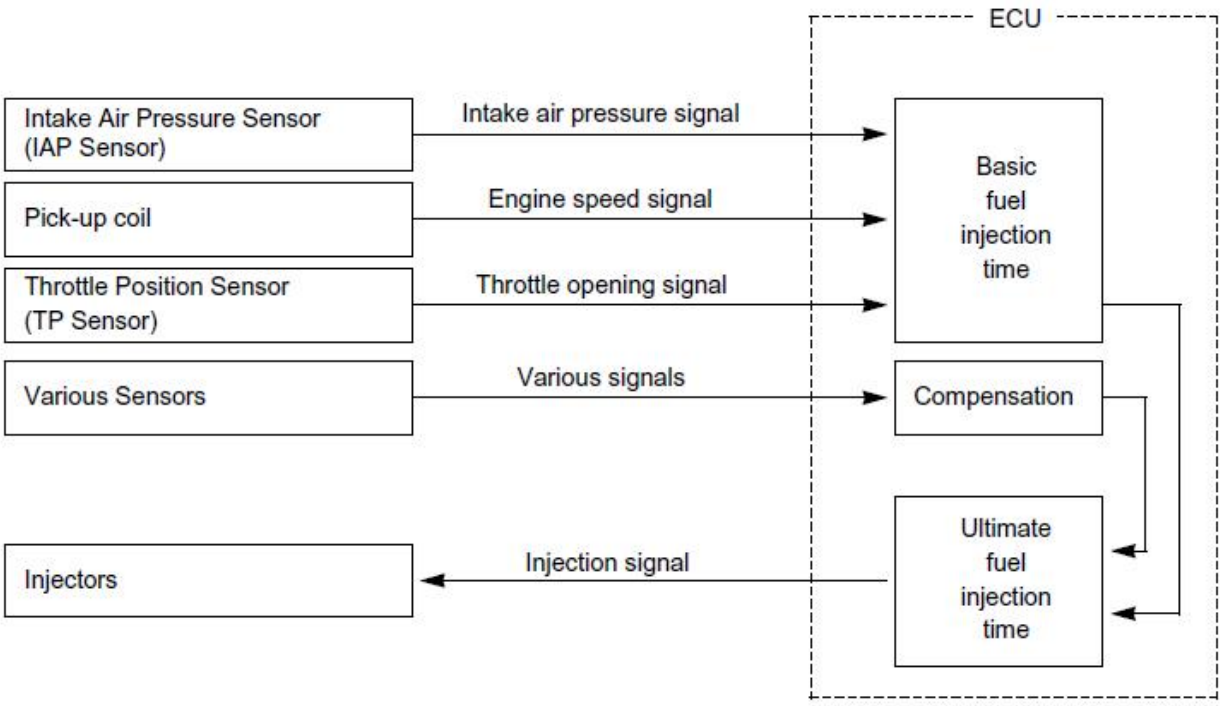
The amount of fuel supplied to the engine is determined by the amount of time the fuel injector stays open. This is called the pulse width, and it is controlled by the ECU.

The injectors are mounted in the intake manifold so that they spray fuel directly at the intake valves. This is called multi-port fuel injection. The fuel pump supplies pressurized fuel to all of the injectors.




**In this picture (650 model), you can see both front and rear injectors mounted in the intake pipe.**

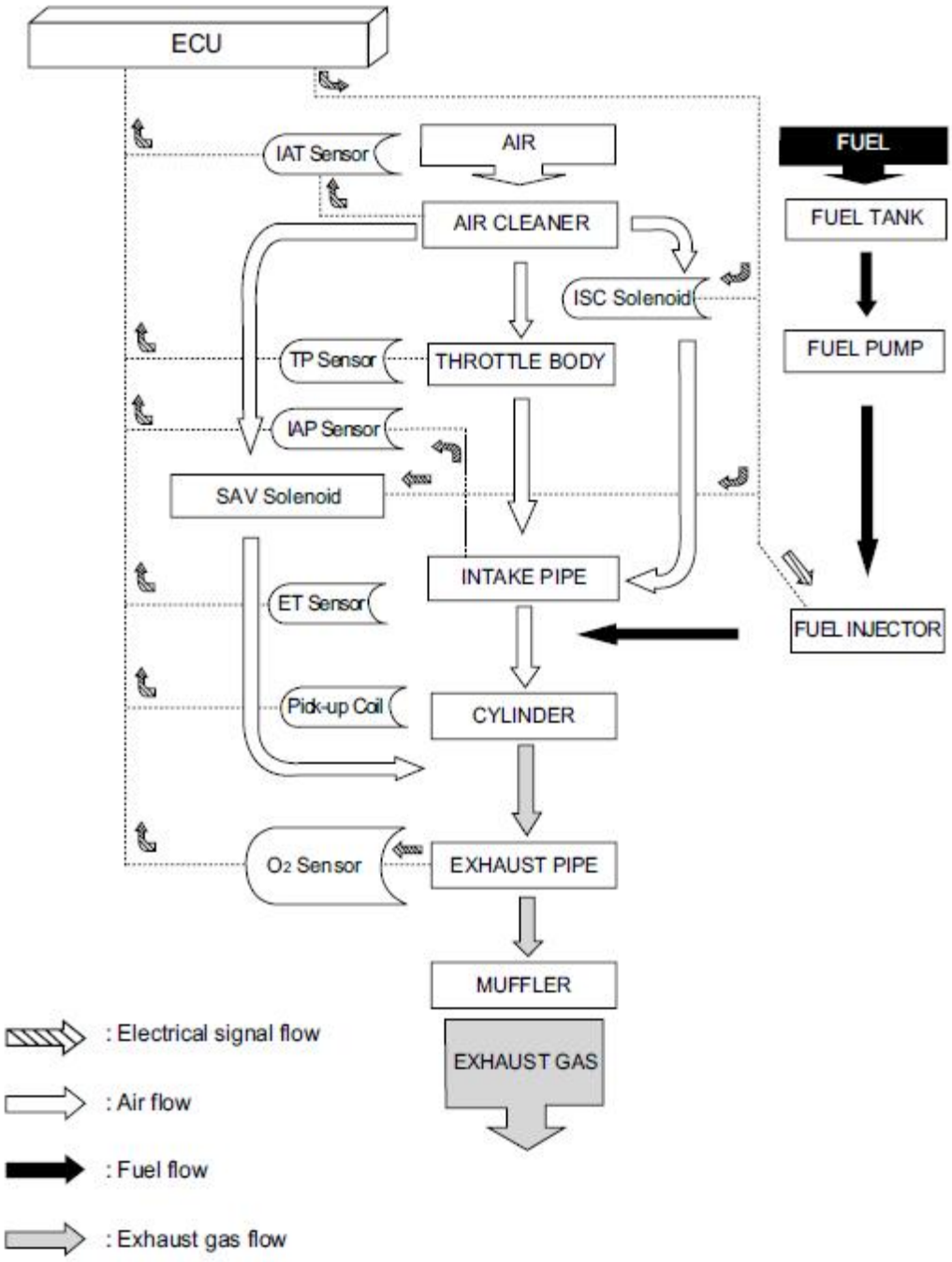
In order to provide the right amount of fuel, the ECU is equipped with a whole lot of sensors.




Engine Sensors

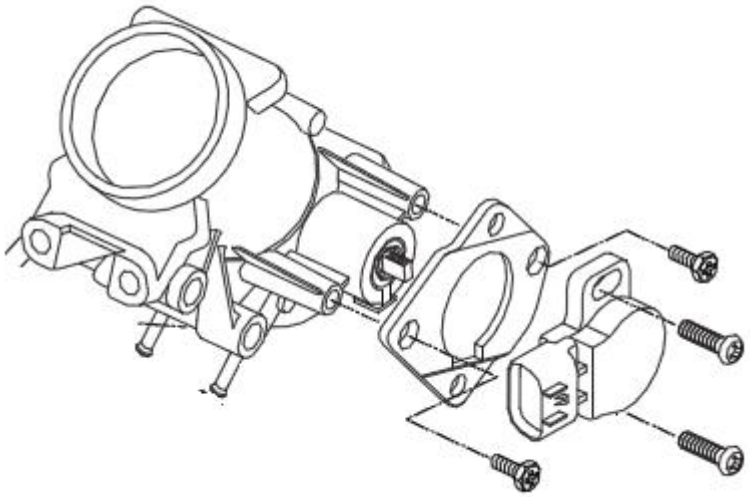
In order to provide the correct amount of fuel for every operating condition, the ECU uses six (6) different sensors to monitor rider demands and changing engine conditions to determine the correct fuel and spark requirements. These sensors are:

1. Throttle Position Sensor (TPS)
2. Pick-Up Coil
3. Intake Air Temperature Sensor (IAT)
4. Intake Air Pressure Sensor (IAP)
5. Engine Temperature Sensor (ET) )(250cc) or Water Temperature Sensor (WTS)(650cc)
6. Oxygen Sensor (O2)

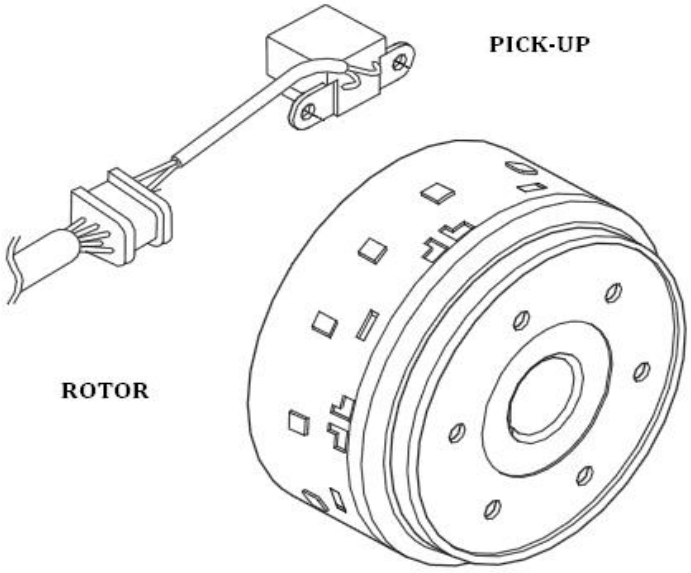

ECU
IAT Sensor
AIR
FUEL
AIR CLEANER
FUEL TANK
ISC Solenoid
TP Sensor
THROTTLE BODY
FUEL PUMP
IAP Sensor
SAV Solenoid
INTAKE PIPE
ET Sensor
FUEL INJECTOR
Pick-up Coil
CYLINDER
O2 Sensor
EXHAUST PIPE
MUFFLER
EXHAUST GAS
: Electrical signal flow
: Air flow
: Fuel flow
: Exhaust gas flow

The TPS monitors the throttle valve position (which determines how much air goes into the engine) by how far the throttle is open, whether it is opening or closing, and how fast it is opening or closing so the ECU can respond quickly to changes, increasing or decreasing the fuel rate as necessary.

**Throttle Position Sensor**

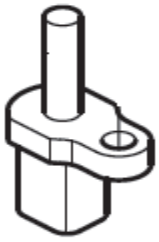


The Pick-Up Coil determines the exact position of both cylinders in the combustion cycle and engine speed by picking-up the signal from the magneto rotor and sending this signal to the ECU to calculate ignition timing and fuel injector pulse width.



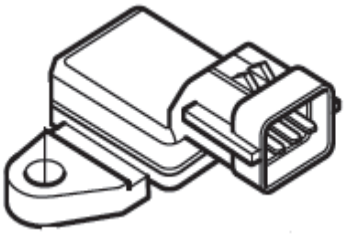
The IAT is located in the air box and measures the temperature of the air entering the engine. The ECU then determines how long the fuel injector pulse width will be and how much to advance or retard ignition timing.

**Intake Air Temperature Sensor**



The IAP is located in the intake pipe and measures the pressure or density of the air entering the engine. The ECU compares absolute pressure (sea-level) with the IAP readings, and then analyzes the air volume indirectly and adjusts accordingly.

**Intake Air Pressure Sensor**

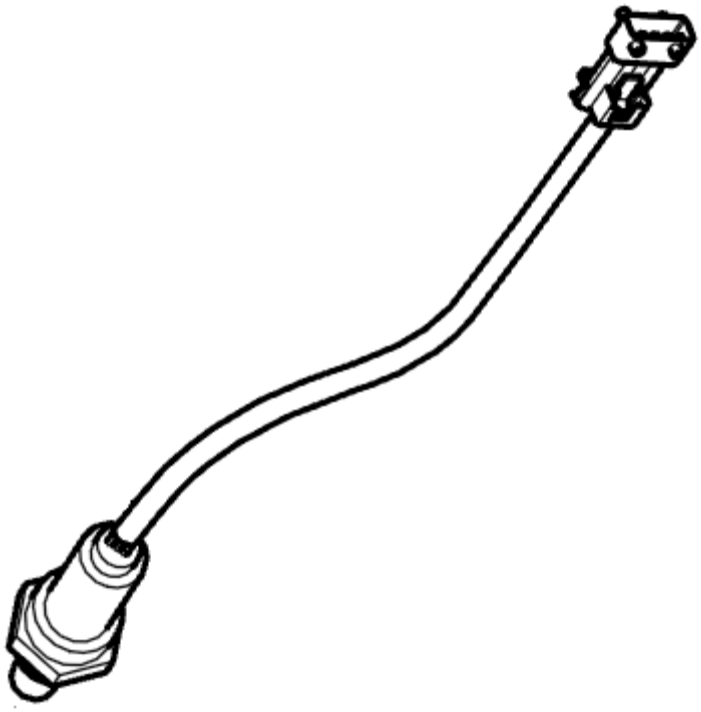


The ET/WTS provides the ECU the current engine temperature. Proper fuel and spark delivery are dependent on the temperature of the engine. When the engine is cold the ECU will provide a richer fuel mixture and a higher degree of spark advanced. As the engine warms up to operating temperature the fuel mixture will lean and spark advance will decrease.

**Engine Temperature Sensor**

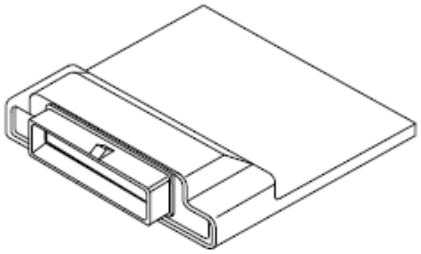
The O2 sensor monitors the amount of oxygen in the exhaust so the ECU can determine how rich or lean the fuel mixture is and make adjustments accordingly.

**Oxygen Sensor**

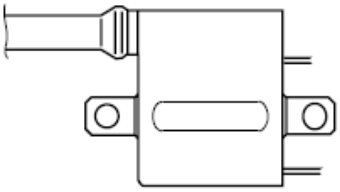


### ECU (Engine Control Unit)

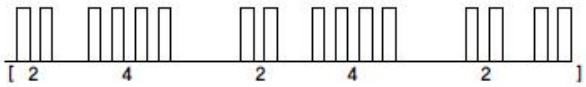
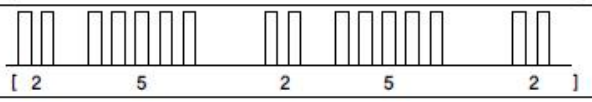
The computer that controls the fuel injection system is referred to as the engine control unit (ECU). The ECU is the central brain which contains the computerized fuel quantity maps. The main function of the ECU is to gather information from the various sensors, analyze their input, and activate the fuel injectors. The ECU is also equipped with some fail-safe functions. In the unlikely event of a component failure, the ECU will utilize input from the other sensors and in most cases override the failed component. The ECU is located under the seat and in front of the battery.



### Ignition Coil



MS3 650 / GV650Ei / GT650/S/REi CODE

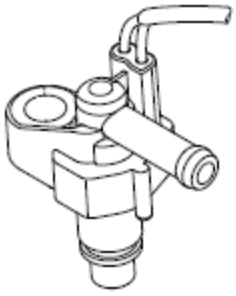
| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C24 |  |
| C25 |  |

## EI (Electric Fuel Injector)

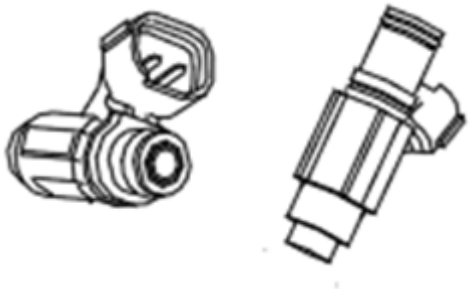
The Fuel Injectors are mounted on the intake pipe. Fuel injectors are electrically opened on/off solenoid valves. They are either fully closed or fully open. The amount of fuel injected is dependent on how long the injector is kept open. Each injector is opened by a signal from the ECU. Fuel is only injected when it is needed – during each cylinder's intake stroke.

Inside the injector there's a spring-loaded plunger that closes against a valve seat. Once seated, the flow of fuel is blocked. When the solenoid coil within the injector assembly lifts the plunger, the pressurized fuel sprays into the cylinder. The battery supplies the power for the solenoid coil. The injector solenoid coils are a switch to ground circuit. The ECU provides an electrical ground when it determines the injector should be opened.

The injector tip's opening is designed to provide a spray pattern that atomizes the fuel to help it mix with incoming air.

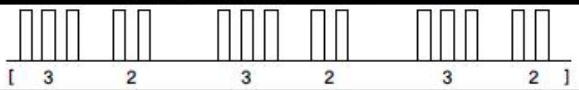
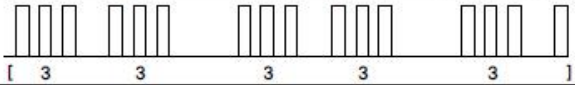


MS3250



GV/GT650-250

MS3 650 / GV650 Ei / GT650/S/R Ei CODE

| GT250/R Ei CODE | GV250 Ei CODE |
|---|---|
| C32 |  |
| C33 |  |



| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Injector signal is interrupted continuous for more than 1 sec. when ECU confirm injector running surge at each combustion chamber. | ● Injector circuit open or short.<br>● Injector malfunction.<br>● ECU malfunction. |

## ET/WT Sensor (Engine Temperature Sensor / Water Temperature Sensor)

The engine temperature sensor senses the temperature of the engine and sends the perceived temperature reading to the ECU. When the engine is cold the ECU will provide a richer fuel mixture and a higher degree of spark advance. As the engine warms up to operating temperature the fuel mixture will lean and spark advance will decrease. The engine temperature sensor, for 250cc models, is mounted on the front cylinder head below the intake pipe. The water temperature sensor, for 650cc models, is mounted on the rear side of the thermostat case.

MS3 250 / GV650Ei / GT650/S/REi CODE

| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C15 |  |



| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Output voltage is out of the specified range for 2 sec. and more.<br>0.08 V ≦ Sensor voltage ≦ 4.65 V | ● ET sensor circuit open or short.<br>● ET sensor malfunction.<br>● ECU malfunction. |

GV250Ei GT250/REi

| ET sensor resistance | |
|---|---|
| **Engine Temp.** | **Resistance (To ECU)** |
| -20 ℃ (-4 ℉) | Approx. 75.5 KΩ |
| 0 ℃ (32 ℉) | Approx. 28.7 KΩ |
| 20 ℃ (68 ℉) | Approx. 12.2 KΩ |
| 40 ℃ (104 ℉) | Approx. 5.6 KΩ |
| 60 ℃ (140 ℉) | Approx. 2.8 KΩ |
| 80 ℃ (176 ℉) | Approx. 1.5 KΩ |
| 120 ℃ (248 ℉) | Approx. 0.5 KΩ |
| 140 ℃ (284 ℉) | Approx. 0.3 KΩ |
| 160 ℃ (320 ℉) | Approx. 0.2 KΩ |
| 180 ℃ (356 ℉) | Approx. 0.13 KΩ |

MS3 650 GV650Ei/GT650/S/REi

| WT sensor resistance | |
|---|---|
| **Engine Coolant Temp.** | **Resistance (To ECU)** |
| -40 ℃ (-40 ℉) | Approx. 48.140 KΩ |
| 0 ℃ (32 ℉) | Approx. 5.790 KΩ |
| 20 ℃ (68 ℉) | Approx. 2.450 KΩ |
| 40 ℃ (104 ℉) | Approx. 1.148 KΩ |
| 60 ℃ (140 ℉) | Approx. 0.586 KΩ |
| 80 ℃ (176 ℉) | Approx. 0.322 KΩ |
| 120 ℃ (248 ℉) | Approx. 0.1163 KΩ |

## GP Switch (Gear Position Switch)

The Gear Position switch is located below the final drive pulley/sprocket and mounted on the engine case. The Gear Position switch provides the input to the ECU of what gear the motorcycle is in. The ECU only utilizes the Gear Position switch at start-up. If the motorcycle is not in neutral the ECU will not allow the bike to start.

### GV650Ei / GT650i / S / REi CODE

| GT250i / REi CODE | GV250Ei CODE |
|---|---|
| C31 | [ 3 1 3 1 3 1 ] |

| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| GP switch voltage is out of the specified range for 2 sec. and more.<br>0.15 V < Switch voltage < 3.93 V | ● GP switch circuit open or short.<br>● GP switch malfunction.<br>● ECU malfunction. |

## IAP Sensor (Intake Air Pressure)

The IAP is mounted to the bottom side of the air box. The IAP measures the pressure or density of the air entering the engine. The ECU compares absolute pressure (sea-level) with the IAP readings, then analyzes the air volume indirectly.

The following example assumes the same engine speed and air temperature.

- Condition 1:

An engine operating at WOT (wide open throttle) on top of a very high mountain has a MAP of about 15" Hg or 50 kPa (essentially equal to the barometer at that high altitude).

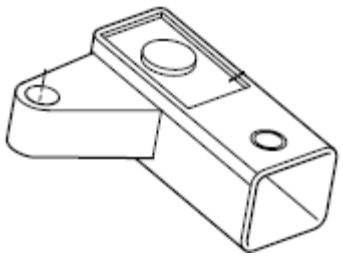
- Condition 2:

The same engine at sea level will achieve 15" Hg of MAP at less than WOT due to the higher barometric pressure.

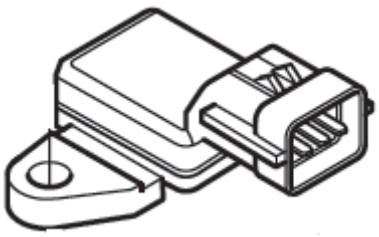
The engine requires the same mass of fuel in both conditions because the mass of air entering the cylinders is the same.

If the throttle is opened all the way in condition 2, the manifold absolute pressure will increase from 15" Hg to nearly 30" Hg (~100 kPa), about equal to the local barometer, which in condition 2 is sea level. The higher absolute pressure in the intake manifold increases the air's density, and in turn more fuel can be burned resulting in higher output.

Anyone who has driven up a high mountain is familiar with the reduction in engine output as altitude increases.

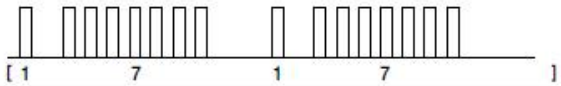
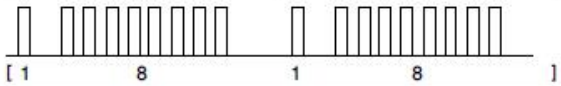


MS3250



GT/GV 650-250

## MS3 650 / GV650Ei / GT650/S/REi CODE

| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C17 |   |
| C18 |   |

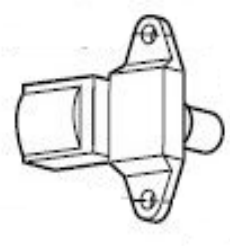
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| IAP sensor voltage is out of the specified range for 6 sec. and more.<br>0.5 V ≦ Sensor voltage ≦ 4.5 V<br>*NOTE :*<br>*Note that atmospheric pressure varies depending on weather conditions as well as altitude.*<br>*Take that into consideration when inspecting voltage.* | ● Clogged vacuum passage between throttle bodies and IAP sensors.<br>● Air being drawn from vacuum passage between throttle bodies and IAP sensors.<br>● IAP sensor circuit open or shorted to ground.<br>● IAP sensor malfunction.<br>● ECU malfunction. |

**Output voltage**
**(Input voltage 5 V, ambient temp. 25 °C, 77 °F)**

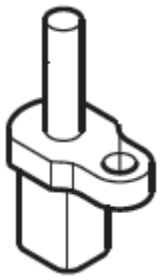
| ALTITUDE (Reference) | | ATMOSPHERIC PRESSURE | | OUTPUT VOLTAGE |
|---|---|---|---|---|
| (ft) | (m) | (mmHg) | kPa | (V) |
| 0 \| 2 000 | 0 \| 610 | 760 \| 707 | 100 \| 94 | Approx. 3.7 ~ 3.9 |
| 2 001 \| 5 000 | 611 \| 1 524 | 707 \| 634 | 94 \| 85 | Approx. 3.3 ~ 3.7 |
| 5 001 \| 8 000 | 1 525 \| 2 438 | 634 \| 567 | 85 \| 76 | Approx. 3.0 ~ 3.3 |
| 8 001 \| 10 000 | 2 439 \| 3 048 | 567 \| 526 | 76 \| 70 | Approx. 2.7 ~ 3.0 |

## IAT Sensor (Intake Air Temperature Sensor / IATS)

The IAT sensor is mounted to the bottom side of the air box. The IAT senses the temperature of the air entering the engine and sends this information electronically to the ECU. The ECU uses the information received from the IAT to adjust the air/fuel mixture.



MS3250



GV/GT 650-250

MS3 250 / GV650 Ei / GT650/S/R Ei CODE

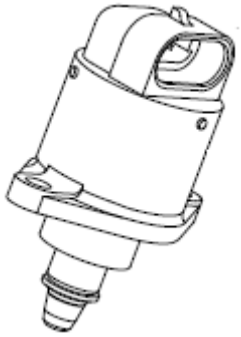
| GT250/R Ei CODE | GV250 Ei CODE |
|---|---|
| C21 | [ 2 1 2 1 2 1 2 1 ] |

| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Output voltage is out of the specified range for 6 sec. and more.<br>0.08 V ≦ Sensor voltage ≦ 4.75 V | ● IAT sensor circuit open or short.<br>● IAT sensor malfunction.<br>● ECU malfunction. |

| IAT sensor resistance | |
|---|---|
| **Intake Air Temp.** | **Resistance** |
| -40 ℃ (-40 ℉) | 44.642 KΩ ± 5% |
| -20 ℃ (-4 ℉) | 14.958 KΩ ± 5% |
| 0 ℃ (32 ℉) | 5.734 KΩ ± 5% |
| 20 ℃ (68 ℉) | 2.438 KΩ ± 5% |
| 40 ℃ (104 ℉) | 1.141 KΩ ± 5% |
| 60 ℃ (140 ℉) | 0.579 KΩ ± 5% |
| 80 ℃ (176 ℉) | 0.315 KΩ ± 5% |
| 100 ℃ (212 ℉) | 0.182 KΩ ± 5% |
| 120 ℃ (248 ℉) | 0.111 KΩ ± 5% |
| 130 ℃ (266 ℉) | 0.088 KΩ ± 5% |

## ISC Solenoid (Idle Speed Control Solenoid)

The ISC is mounted on the right side of the motorcycle beneath the fuel tank. The ISC is controlled by the ECU. When first starting the motorcycle the ISC closes off an air passage that leads to the intake pipe. As the motorcycle begins to warm up the ISC slowly backs out of the air passage, thus allowing more air to enter the engine. ECU controls the ISC to allow more or less air to enter the engine.



**MS3 650 / GV650Ei / GT650/S/REi CODE**

| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C27 |  |



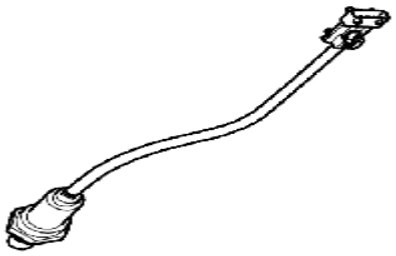
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| ISC solenoid's step is out of the specified range.<br>O step ≦ Solenoid step ≦ 250 step | ● ISC solenoid malfunction.<br>● ISC solenoid's step is out of the specified range.<br>● ECU malfunction. |

## O2 Sensor (Oxygen Sensor)

The oxygen ($O_2$) sensor measures the percent of oxygen in the exhaust gas. The Fuel Injection is continuously adjusted to inject more or less fuel, keeping the amount of oxygen consistently at a level where the lowest amount of toxic gases is produced.

This air/fuel is called the stoichiometric ratio. (Theoretically, this is the A/F ratio for complete combustion.) With the air/fuel ratio controlled around this point by the oxygen sensor, the remaining toxic compounds in the exhaust gas are more efficiently converted to non-toxic compounds.

The oxygen (O2) sensor is mounted on the exhaust pipe just after the cross-over.



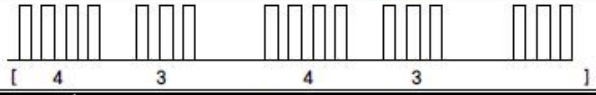
MS3 ESD / GV650Ei / GT650/S/REi CODE

| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C22 |  |



| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Oxygen sensor signal is not inputted in ECU since then 600 sec. after the engine run. | ● Oxygen sensor, Oxygen sensor heater circuit open or short.<br>● Oxygen sensor, Oxygen sensor heater malfunction.<br>● ECU malfunction. |

MS3 ESD / GV650Ei / GT650/S/REi CODE

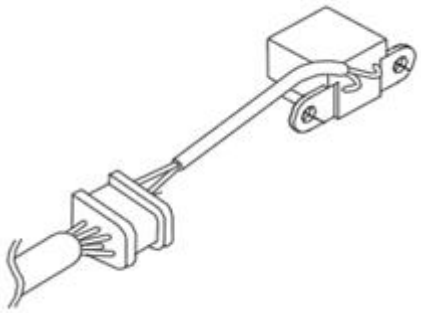
| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C43 |  |



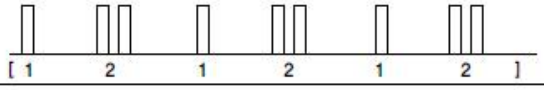
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Oxygen sensor heater signal is not inputted in ECU. | ● Oxygen sensor, Oxygen sensor heater circuit open or short.<br>● Oxygen sensor, Oxygen sensor heater malfunction.<br>● ECU malfunction. |

## Pick-Up Coil

The Pick-Up Coil is mounted to the inside of the magneto cover. The Pick-Up Coil determines the exact position of both cylinders in the combustion cycle and engine speed by picking-up the signal from the magneto rotor and sending this signal to the ECU to calculate ignition timing and fuel injector pulse width.



### GV650Ei / GT650i/S/REi CODE

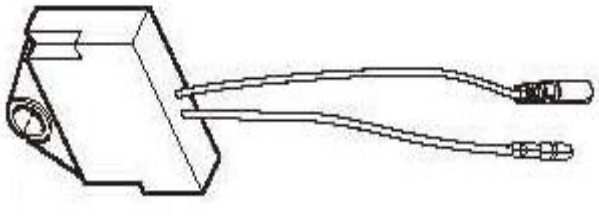
| GT250i/REi CODE | GV250Ei CODE |
|---|---|
| C12 |  |



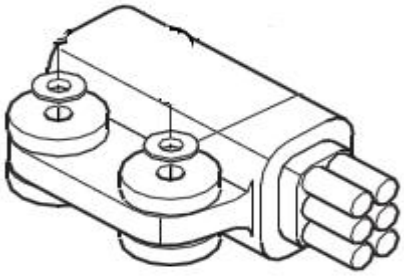
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| The pick-up coil signal does not reach ECU for more than 3 sec. after ECU receiving the ignition switch signal. | ● Metal particles or foreign materiel being attached on the pick-up coil and rotor tip.<br>● Pick-up coil circuit open or short.<br>● Pick-up coil malfunction.<br>● ECU malfunction. |

## RO Switch (Roll Over Switch)

The Roll Over switch provides the input to the ECU that the motorcycle is not leaning greater than a 60 degree lean angle. If the vehicle exceeds a 60 degree lean angle the Roll Over switch will interrupt the operation of the ignition system and the fuel supply. The Roll Over switch is located under the rider's seat beneath the seat lock.



MS3250 / 2010 &UP GT/GV 650-250



2009 GT/GV 650-250

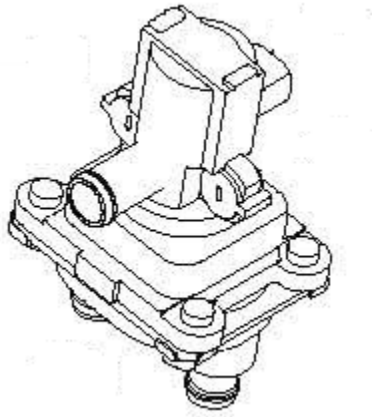
MS3 650 / GV650 Ei / GT650/S/R Ei CODE

| GT250/R Ei CODE | GV250 Ei CODE |
|---|---|
| C23 | [ 2 3 2 3 2 ] |

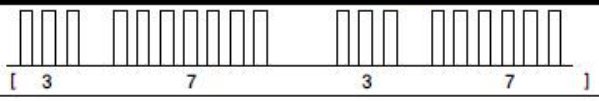
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| The switch resistance should be the following for more than 3 sec. after holding the motorcycle vertically and ignition switch turns "ON" position.<br>Switch resistance ≈ ∞ Ω (Infinity) | ● RO switch circuit short or leaned more than 60°.<br>● RO switch malfunction.<br>● ECU malfunction. |

## SAV Solenoid (Secondary Air Valve Solenoid)

The SAV is located on the left side of the motorcycle next to the thermostat housing on 650cc models and under the fuel tank on the right side of the motorcycle on 250cc models. The SAV is an electronically controlled solenoid that is operated by the ECU. The purpose of the SAV is to supply fresh air to the exhaust system to reduce exhaust gas emissions.



MS3 650 / GV650Ei / GT650/S/REi CODE

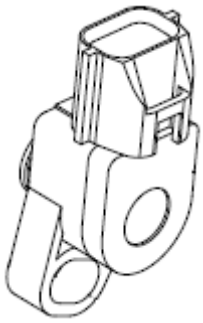
| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C37 |  |



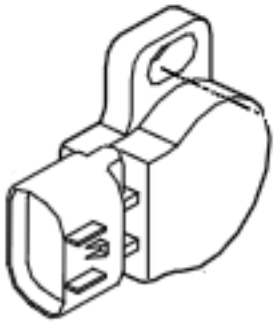
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| No voltage is applied from ECU to SAV solenoid by 400 sec.. | ● SAV solenoid circuit open or short.<br>● SAV solenoid malfunction.<br>● ECU malfunction. |

## TP Sensor (Throttle Position Sensor / TPS)

The TPS is mounted to the rear intake. The TPS monitors the throttle valve position (which determines how much air goes into the engine) by how far the throttle is open, whether it is opening or closing, and how fast it is opening or closing so the ECU can respond quickly to changes, increasing or decreasing the fuel rate as necessary.

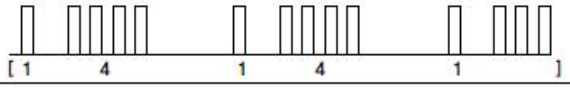


All MS3250 / 2010&UP GT/GV 650-250



2009 GT/GV 650-250

MS3 650 / GV650 Ei / GT650 / S / R Ei CODE

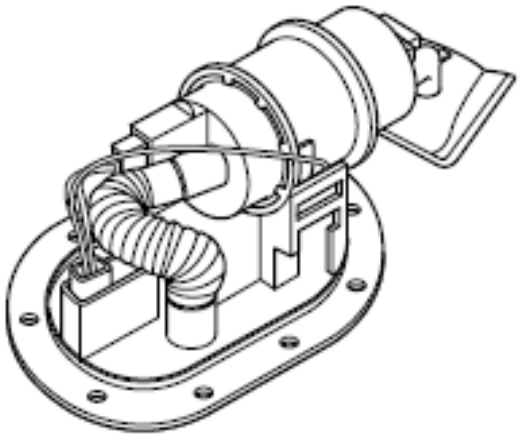
| GT250 / R Ei CODE | GV250 Ei CODE |
|---|---|
| C14 |  |



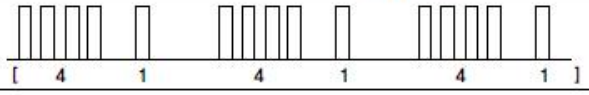
| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Output voltage is out of the specified range for 2 sec. and more.<br>0.1 V ≦ Sensor voltage ≦ 4.8 V | ● TP sensor circuit open or short.<br>● TP sensor malfunction.<br>● ECU malfunction. |

## Fuel Pump

The fuel pump is located in the fuel tank and submerged in the fuel itself. When the engine is running the fuel pump operates continuously, thus exerting a constant 48-53 psi of pressure which supplies the maximum fuel demands of the engine.



### MS3 650 / GV650Ei / GT650/S/REi CODE

| GT250/REi CODE | GV250Ei CODE |
|---|---|
| C41 |  |



| DETECTED CONDITION | POSSIBLE CAUSE |
|---|---|
| Voltage is applied continuous for more than 5 sec., battery voltage ≧ 3.2 V when fuel pump relay is "OFF" position or battery voltage < 1.5 V when fuel pump relay is "ON" position. | ● Fuel pump relay circuit open or short.<br>● Fuel pump relay malfunction.<br>● ECU malfunction. |

MS3 250 & GV250 Ei/ GT250/R Ei & GV650 Ei/ GT650/S/R Ei

| MALFUNCTION CODE | DETECTED ITEM | DETECTED FAILURE CONDITION<br>CHECK FOR |
|---|---|---|
| C | NO FAULT | — |
| C12 | Pick-up coil | The pick-up coil signal does not reach ECU for more than 3 sec. after ECU receiving the ignition switch signal.<br>In this case, the code C12 is indicated. |
| | | Pick-up coil wiring and mechanical parts.<br>(Pick-up coil, lead wire coupler connection) |
| C14 | Throttle position sensor (TPS) | The sensor should produce following voltage.<br>0.1 V ≦ sensor voltage ≦ 4.8 V<br>Without the above range for 2 sec. and more, C14 is indicated. |
| | | Throttle position sensor, lead wire / coupler connection. |
| C15 | Engine temperature sensor (ETS)<br>Water temperature sensor (WTS) | The sensor voltage should be the following.<br>0.08 V ≦ sensor voltage ≦ 4.65 V<br>Without the above range for 2 sec. and more, C15 is indicated. |
| | | temperature sensor, lead wire / coupler connection. |
| C17 / C18 | Intake air pressure sensor (IAPS), NO.1 / NO.2 | The sensor should produce following voltage.<br>0.5 V ≦ sensor voltage ≦ 4.5 V<br>Without the above range for 6 sec. and more, C17 or C18 is indicated. |
| | | Intake air pressure sensor, lead wire / coupler connection. |
| C21 | Intake air temperature sensor (IATS) | The sensor voltage should be the following.<br>0.08 V ≦ sensor voltage ≦ 4.75 V<br>Without the above range for 6 sec. and more, C21 is indicated. |
| | | Intake air temperature sensor, lead wire / coupler connection. |
| C22 | Oxygen sensor ($O_2S$) | The oxygen sensor signal is inputted in ECU since then 600 sec. after the engine run.<br>When this is the case, ECU not receive the signal, C22 is indicated. |
| | | Oxygen sensor, lead wire / coupler connection. |
| C23 | Roll over switch (RO switch) | The switch resistance should be the following for more than 3 sec. after holding the motorcycle vertically and ignition switch turns "ON" position.<br>switch resistance ≃ ∞ Ω (Infinity)<br>Without the above value for 3 sec. and more, C23 is indicated. |
| | | Roll over switch, lead wire / coupler connection. |

| MALFUNCTION CODE | DETECTED ITEM | DETECTED FAILURE CONDITION<br>CHECK FOR |
|---|---|---|
| C24 / C25 | Ignition coil (IG coil), NO.1 / NO.2 | Ignition signal is interrupted continuous by 31 times or more when ECU confirm ignition surge at each combustion chamber. In this case, the code C24 or C25 is indicated. |
| | | Ignition coil, wiring / coupler connection, power supply from the battery. |
| C27 | Idle speed control solenoid (ISC solenoid) | The idle speed control solenoid step should be the following.<br>O step ≦ solenoid step ≦ 250 step<br>Without the above range, C27 is indicated. |
| | | Idle speed control solenoid, lead wire / coupler connection. |
| C31 | Gear position switch (GP switch) | It judges from gear position voltage, engine speed and throttle position by ECU, when 0.15 V < Gear position voltage < 3.93 V for more 2 sec.. If gear position voltage get out of the above voltage, C31 is indicated. |
| | | Gear position switch, wiring / coupler connection, gearshift cam etc. |
| C32 / C33 | Fuel injector, NO.1 / NO.2 | Injector signal is interrupted continuous for more than 1 sec. when ECU confirm injector running surge at each combustion chamber, C32 or C33 is indicated. |
| | | Injector, wiring / coupler connection, power supply to the injector. |
| C37 | Secondary air valve solenoid (SAV solenoid) | No voltage is applied from ECU to secondary air valve solenoid by 400 sec.. In this case, the code 37 is indicated. |
| | | Secondary air valve solenoid, lead wire / coupler connection. |
| C41 | Fuel pump relay | Voltage is applied continuous for more than 5 sec., battery voltage ≧ 3.2 V when fuel pump relay is "OFF" position or battery voltage < 1.5 V when fuel pump relay is "ON" position. In this case, the code 41 is indicated. |
| | | Fuel pump relay, connecting lead wire, power source to fuel pump relay, fuel injector. |
| C43 | Oxygen sensor heater ($O_2S$ heater) | The oxygen sensor heater signal is not inputted in ECU. |
| | | Oxygen sensor heater, lead wire / coupler connection. |

GV250 Ei/ GT250/R Ei

| ITEM | SPECIFICATION | | NOTE |
|---|---|---|---|
| IAP sensor input voltage | 4.5 ~ 5.5 V | | |
| IAP sensor output voltage | Approx. 3.7 ~ 3.9 V when ignition switch "ON" | | |
| TP sensor input voltage | 4.5 ~ 5.5 V | | |
| TP sensor output voltage | Closed | Approx. 0.3 V | |
| | Opened | Approx. 4.5 V | |
| IAT sensor resistance | 0.081 ~ 48.352 KΩ [When Intake air temperature is -40℃ ~ 130℃ (-40℉ ~ 266℉)] | | |
| IAT sensor resistance (each temperature) | Refer to page 48 (4-1-33) | | |
| RO switch resistance | ∞ Ω (Infinity) [at normal condition] | | |
| | 0 Ω [at leaned more than 60° ] | | |
| GP switch resistance | 100 Ω ~ 2.0 KΩ | | |
| Oxygen sensor heater voltage | Battery voltage | | |
| SAV solenoid voltage | Battery voltage | | |
| ET sensor resistance | 0.102 ~ 81.000 KΩ [When Engine temperature is -20℃ ~ 180℃ (-4℉ ~ 356℉)] | | |
| ET sensor resistance [To ECU] (each temperature) | -20℃ (-4℉) | Approx. 75.5 KΩ | |
| | 0℃ (32℉) | Approx. 28.7 KΩ | |
| | 20℃ (68℉) | Approx. 12.2 KΩ | |
| | 40℃ (104℉) | Approx. 5.6 KΩ | |
| | 60℃ (140℉) | Approx. 2.8 KΩ | |
| | 80℃ (176℉) | Approx. 1.5 KΩ | |
| | 120℃ (248℉) | Approx. 0.5 KΩ | |
| | 140℃ (284℉) | Approx. 0.3 KΩ | |
| | 160℃ (320℉) | Approx. 0.2 KΩ | |
| | 180℃ (356℉) | Approx. 0.13 KΩ | |
| Fuel injector resistance | 11.4 ~ 12.6 Ω at 20℃ (68℉) | | |
| Fuel injector voltage | Battery voltage | | |
| Fuel pressure of fuel pump | Approx. 3.4 ~ 3.7 kgf/cm² (333 ~ 363 kPa, 48.4 ~ 52.6 psi) | | |
| Ignition coil primary peak voltage | 150 V and more | | |
| Ignition coil resistance | Primary | 3.5 ~ 5.5 Ω | |
| | Secondary | 20 ~ 31 KΩ | |
| Stator coil resistance | Pick-up coil | Approx. 85 ~ 105 Ω | G-L |
| | Charging coil | Approx. 0.2 ~ 1.0 Ω | Y-Y |
| Magneto no-load performance | More than 60 V / 5,000 rpm | | |
| Charging output (Regulated voltage) | 13.5 ~ 15.0 V / 5,000 rpm | | |

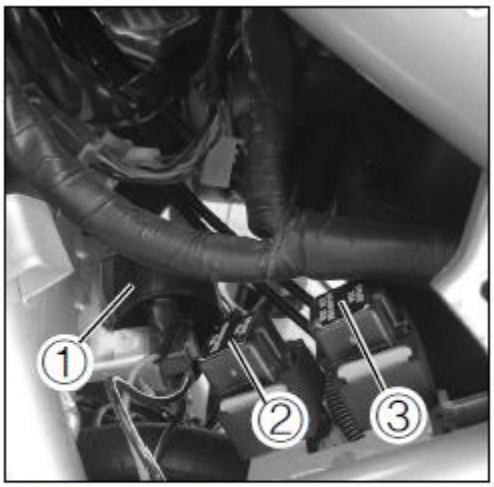
## GV650Ei/GT650i/S/REi

| ITEM | SPECIFICATION | | NOTE |
|---|---|---|---|
| IAP sensor input voltage | 4.5 ~ 5.5 V | | |
| IAP sensor output voltage | Approx. 2.7 V at idle speed | | |
| TP sensor input voltage | 4.9 ~ 5.1 V | | |
| TP sensor output voltage | Closed | Approx. 1.02 ~ 1.22 V | |
| | Opened | Approx. 4.30 ~ 4.70 V | |
| IAT sensor resistance | 0.081 ~ 48.352 KΩ [When Intake air temperature is -40℃ ~ 130℃ (-40℉ ~ 266℉)] | | |
| IAT sensor resistance (each temperature) | Refer to page 45 (4-1-30) | | |
| RO switch resistance | ∞ Ω (Infinity) at normal condition | | |
| | 0 Ω at leaned more than 60° | | |
| GP switch resistance | 100 Ω ~ 2.0 KΩ | | |
| Oxygen sensor heater voltage | Battery voltage | | |
| Fuel injector resistance | 11.4 ~ 12.6 Ω at 20℃ (68℉) | | |
| Fuel injector voltage | Battery voltage | | |
| Fuel pressure of fuel pump | Approx. 2.96 ~ 3.16 kgf/cm² (290 ~ 310 kPa, 42.06 ~ 44.96 psi) | | |
| WT sensor resistance | 0.1163 ~ 48.1400 KΩ [When Water temperature is -40℃ ~ 120℃ (-40℉ ~ 248℉)] | | |
| WT sensor resistance [To ECU] (each temperature) | -40℃ (-40℉) | Approx. 48.140 KΩ | |
| | 0℃ (32℉) | Approx. 5.790 KΩ | |
| | 20℃ (68℉) | Approx. 2.450 KΩ | |
| | 40℃ (104℉) | Approx. 1.148 KΩ | |
| | 60℃ (140℉) | Approx. 0.586 KΩ | |
| | 80℃ (176℉) | Approx. 0.322 KΩ | |
| | 120℃ (248℉) | Approx. 0.1163 KΩ | |
| Ignition coil primary peak voltage | 150 V and more | | |
| Ignition coil resistance | Primary | 3.5 ~ 5.5 Ω | |
| | Secondary | 20 ~ 31 KΩ | |
| Stator coil resistance | Pick-up coil | 110 ~ 140 Ω | G-L |
| | Charging coil | 0.2 ~ 0.4 Ω | Y-Y |
| Magneto no-load voltage | Over 70 V / 5,000 rpm | | |
| Battery standard charging voltage | 13.5 ~ 15.0 V / 5,000 rpm | | |

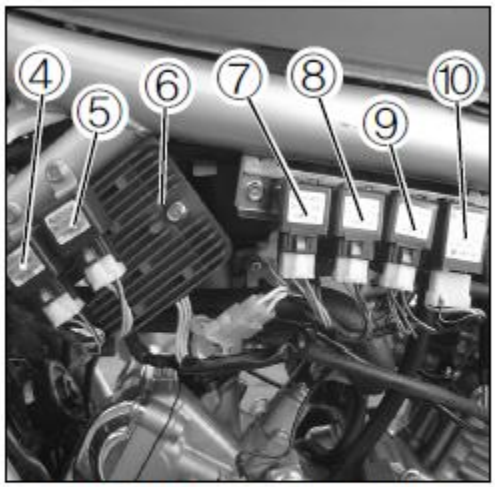
MS3 eso

| ITEM | SPECIFICATION | | NOTE |
|---|---|---|---|
| IAP sensor input voltage | 4.5 ~ 5.5 V | | |
| IAP sensor output voltage | Approx. 4.0 ~ 4.2 V when ignition switch "○" (ON) | | |
| TP sensor input voltage | 4.5 ~ 5.5 V | | |
| TP sensor resistance | Closed | Approx. 1.81 KΩ | |
| | Opened | Approx. 4.75 KΩ | |
| TP sensor output voltage | Closed | Approx. 1.12 V | |
| | Opened | Approx. 4.18 V | |
| IAT sensor voltage | 4.5 ~ 5.5 V | | |
| IAT sensor resistance | Refer to page 4-25 | | |
| TO sensor voltage | 4.5 ~ 5.5 V at normal condition<br>(To sensor switch - "ON" at leaned more than 60°) | | |
| SAV solenoid voltage | Battery voltage | | |
| Oxygen sensor heater voltage | Battery voltage | | |
| Fuel injector resistance | 11.5 ~ 13.5Ω at 20℃ (68℉) | | |
| Fuel injector voltage | Battery voltage | | |
| Fuel pressure | Approx. 3.4 ~ 3.7 kgf/cm$^2$ (333 ~ 363 kPa, 48.4 ~ 52.6 psi) | | |
| WT sensor voltage | 4.5 ~ 5.5 V | | |
| WT sensor resistance (To ECU) | 0℃ (32℉) | Approx. 5.790 KΩ | |
| | 20℃ (68℉) | Approx. 2.450 KΩ | |
| | 40℃ (104℉) | Approx. 1.148 KΩ | |
| | 60℃ (140℉) | Approx. 0.586 KΩ | |
| | 80℃ (176℉) | Approx. 0.322 KΩ | |
| Ignition coil primary peak voltage | 150 V and more | | |
| Ignition coil resistance | Primary | 3.5 ~ 5.5Ω | |
| | Secondary | 20 ~ 31 KΩ | |
| Magneto coil resistance | Pick-up coil | 80 ~ 120Ω | G-L |
| | Charging coil | 0.7 ~ 1.3Ω | Y-Y |

## GV650Ei

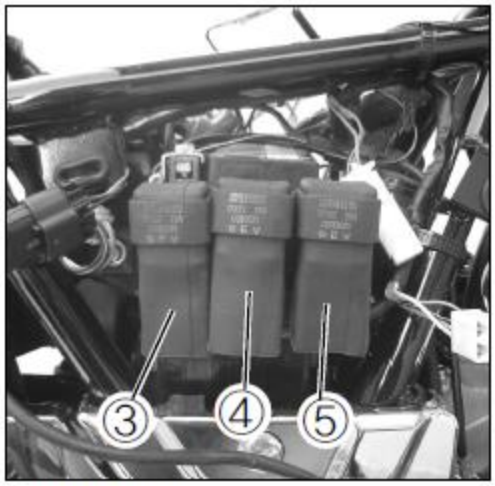



① Ignition coil NO.1
② Main fuse (30A)
③ Head lamp fuse (15A)

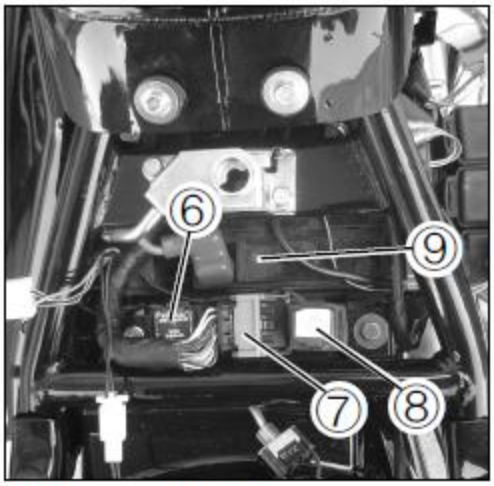



④ Cooling fan motor relay
⑤ Head lamp relay
⑥ Regulator / Rectifier
⑦ Side stand relay
⑧ Main relay
⑨ Fuel pump relay
⑩ Turn signal relay

## GV250Ei

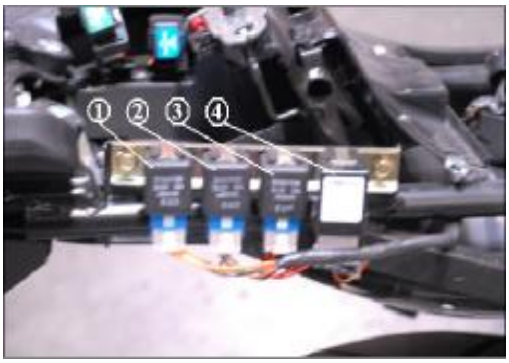



③ Main relay
④ Fuel pump relay
⑤ Head lamp relay

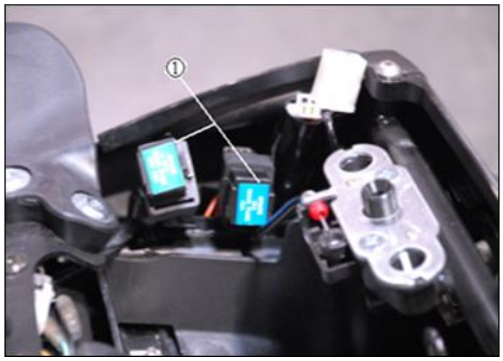



⑥ Main fuse (30A)
⑦ ECU
⑧ Head lamp fuse (15A)
⑨ Battery

## GT250i/R EFi & GV650EFi/GT650i/S/R EFi

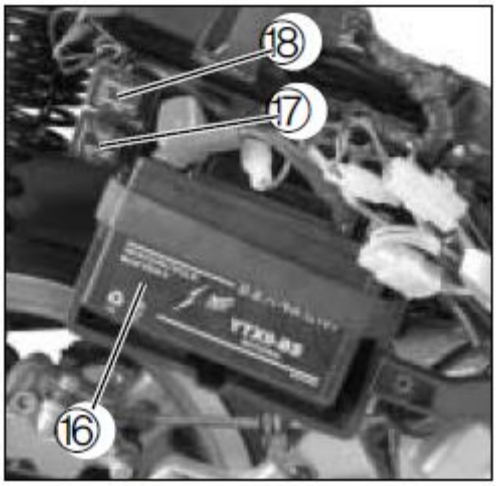



(1) Head Lamp Relay
(2) Fuel Pump Relay
(3) Main Relay
(4) Turn Signal Relay

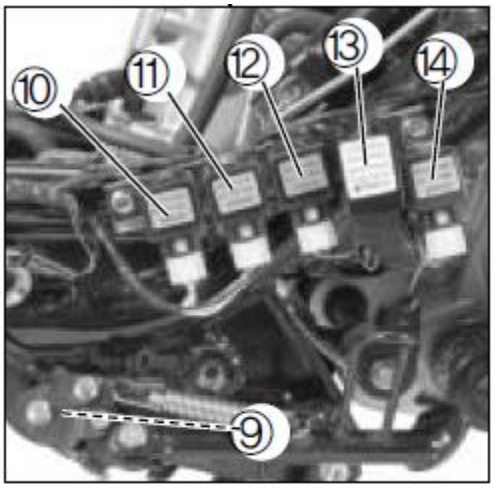



(1) Main Fuse
(2) Head Lamp Fuse

## MS3 250



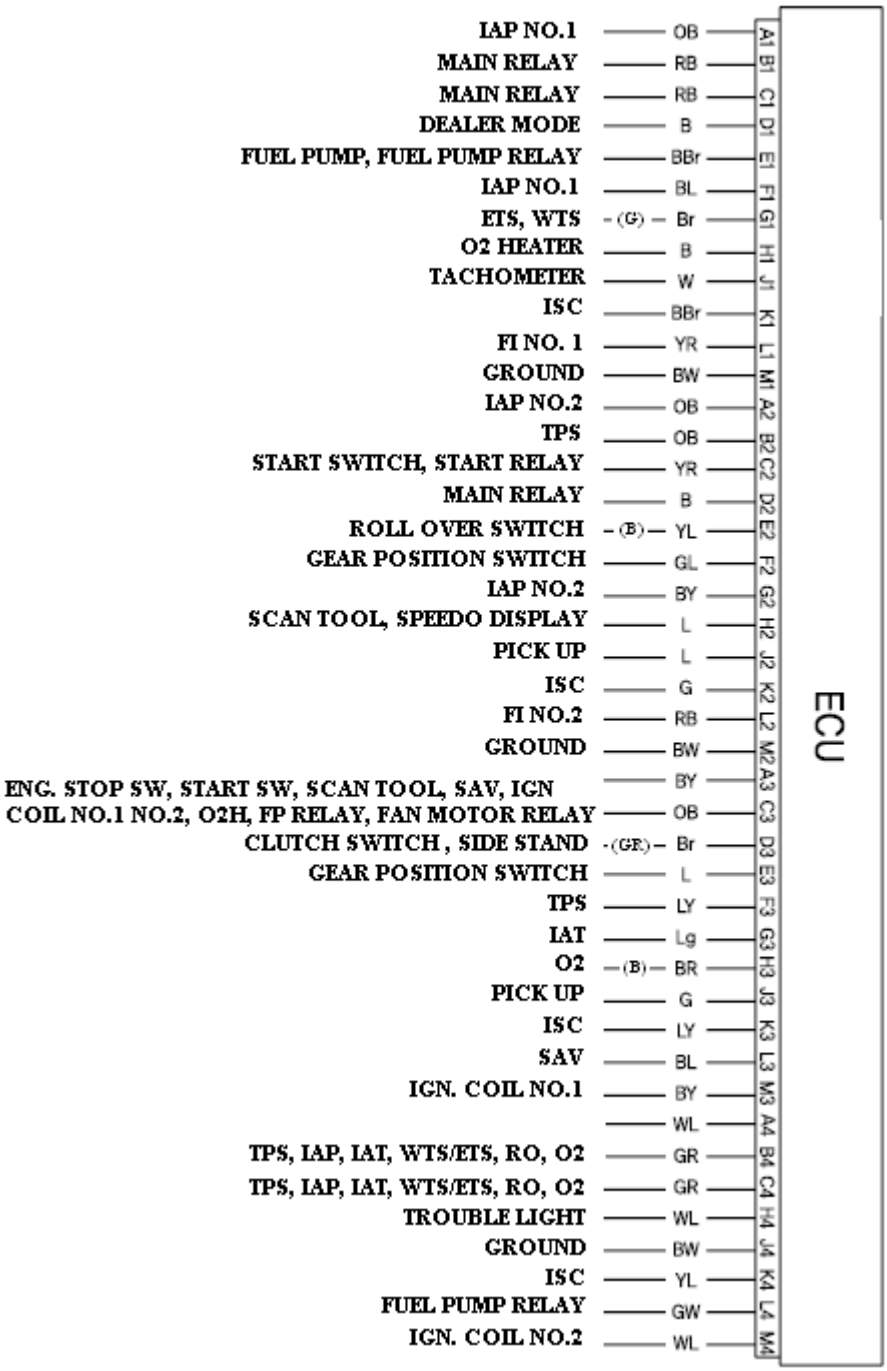

⑯ Battery
⑰ Main fuse (30A)
⑱ Head lamp fuse (15A)

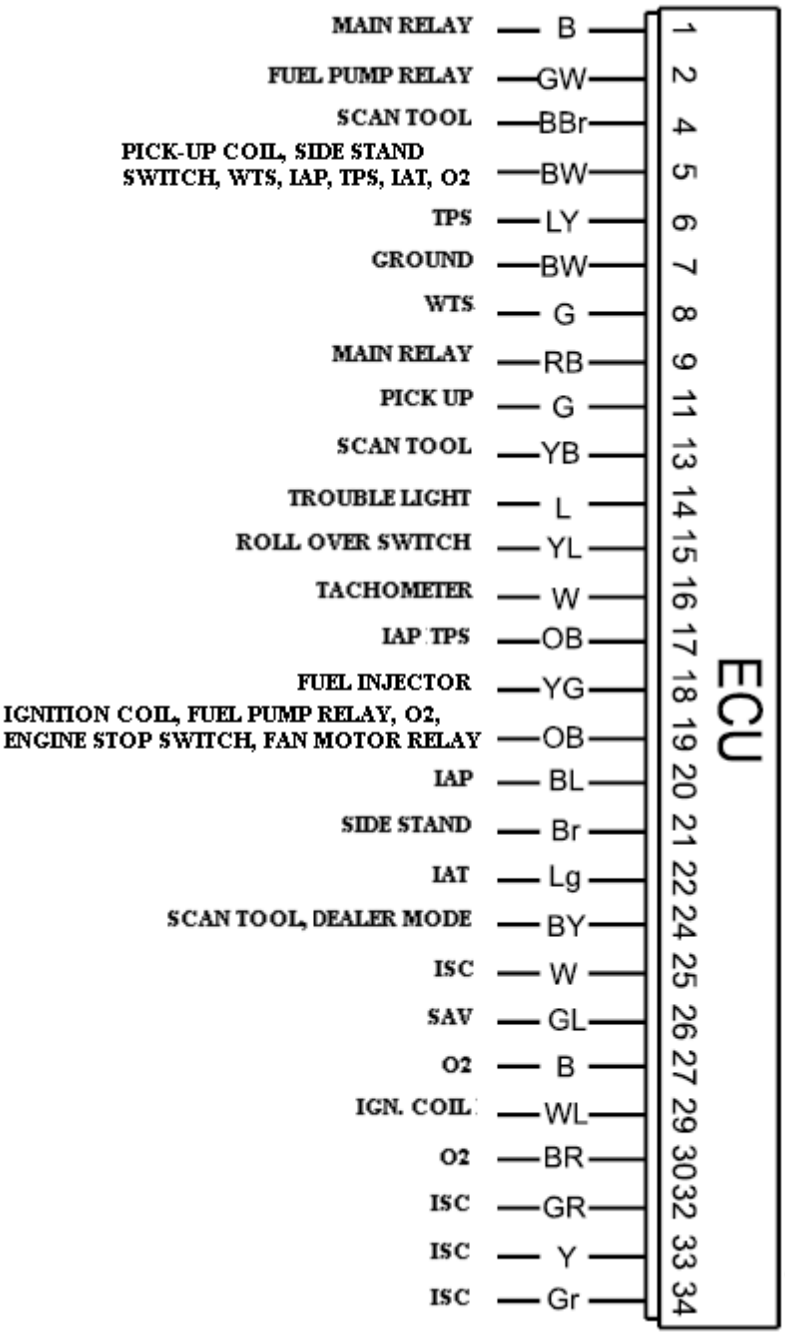



⑨ Side stand switch
⑩ Head lamp relay
⑪ Cooling fan motor relay
⑫ Fuel pump relay
⑬ Turn signal relay
⑭ Main relay

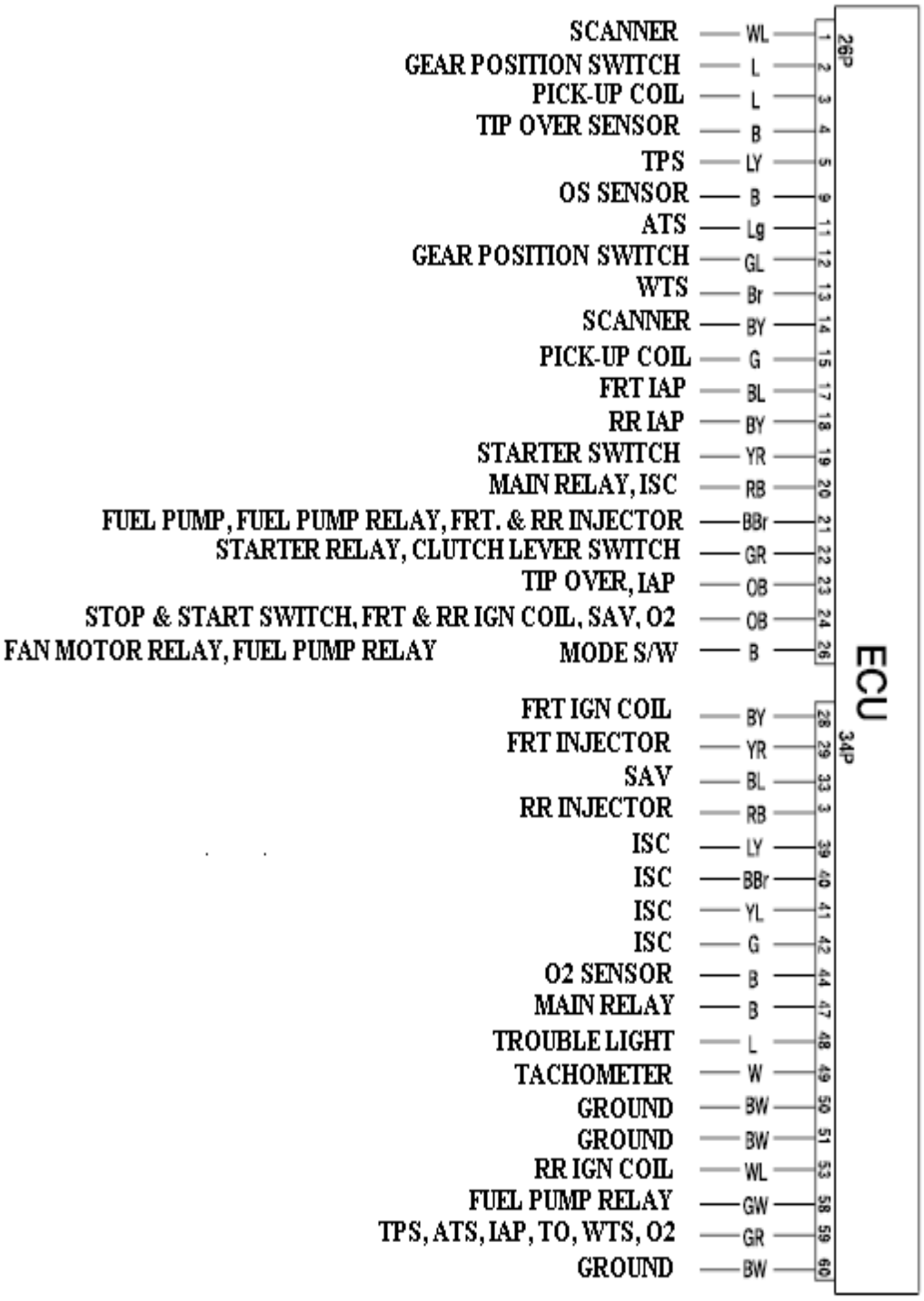
## GV250Ei/GT250/R Ei & GV650Ei/GT650/S/R Ei

(650cc wire color change (G), (B), (GR), (B))




MAIN RELAY — B — 1
FUEL PUMP RELAY — GW — 2
SCAN TOOL — BBr — 4
PICK-UP COIL, SIDE STAND SWITCH, WTS, IAP, TPS, IAT, O2 — BW — 5
TPS — LY — 6
GROUND — BW — 7
WTS — G — 8
MAIN RELAY — RB — 9
PICK UP — G — 11
SCAN TOOL — YB — 13
TROUBLE LIGHT — L — 14
ROLL OVER SWITCH — YL — 15
TACHOMETER — W — 16
IAP TPS — OB — 17
FUEL INJECTOR — YG — 18
IGNITION COIL, FUEL PUMP RELAY, O2, ENGINE STOP SWITCH, FAN MOTOR RELAY — OB — 19
IAP — BL — 20
SIDE STAND — Br — 21
IAT — Lg — 22
SCAN TOOL, DEALER MODE — BY — 24
ISC — W — 25
SAV — GL — 26
O2 — B — 27
IGN. COIL — WL — 29
O2 — BR — 30
ISC — GR — 32
ISC — Y — 33
ISC — Gr — 34
ECU

## 2009 ONLY BV650Ei/GT650i/S/REi



| | | | | | |
|---|---|---|---|---|---|
| B | : Black | Gr | : Gray | Sb | : Light blue |
| L | : Blue | Lg | : Light green | W | : White |
| Br | : Brown | O | : Orange | Y | : Yellow |
| G | : Green | R | : Red | | |

| | | | |
|---|---|---|---|
| BL | : Black with Blue tracer | BBr | : Black with Brown tracer |
| BG | : Black with Green tracer | BO | : Black with Orange tracer |
| BR | : Black with Red tracer | BW | : Black with White tracer |
| BY | : Black with Yellow tracer | LB | : Blue with Black tracer |
| LG | : Blue with Green tracer | LR | : Blue with Red tracer |
| LW | : Blue with White tracer | LY | : Blue with Yellow tracer |
| BrB | : Brown with Black tracer | BrW | : Brown with White tracer |
| GB | : Green with Black tracer | GR | : Green with Red tracer |
| GY | : Green with Yellow tracer | GrB | : Gray with Black tracer |
| GrR | : Gray with Red tracer | GrW | : Gray with White tracer |
| OB | : Orange with Black tracer | OL | : Orange with Blue tracer |
| OG | : Orange with Green tracer | OR | : Orange with Red tracer |
| OW | : Orange with White tracer | OY | : Orange with Yellow tracer |
| RB | : Red with Black tracer | RW | : Red with White tracer |
| WB | : White with Black tracer | WL | : White with Blue tracer |
| WR | : White with Red tracer | YB | : Yellow with Black tracer |
| YL | : Yellow with Blue tracer | YG | : Yellow with Green tracer |
| YR | : Yellow with Red tracer | | |

**Mode Select Switch – Part # 09900-27000**

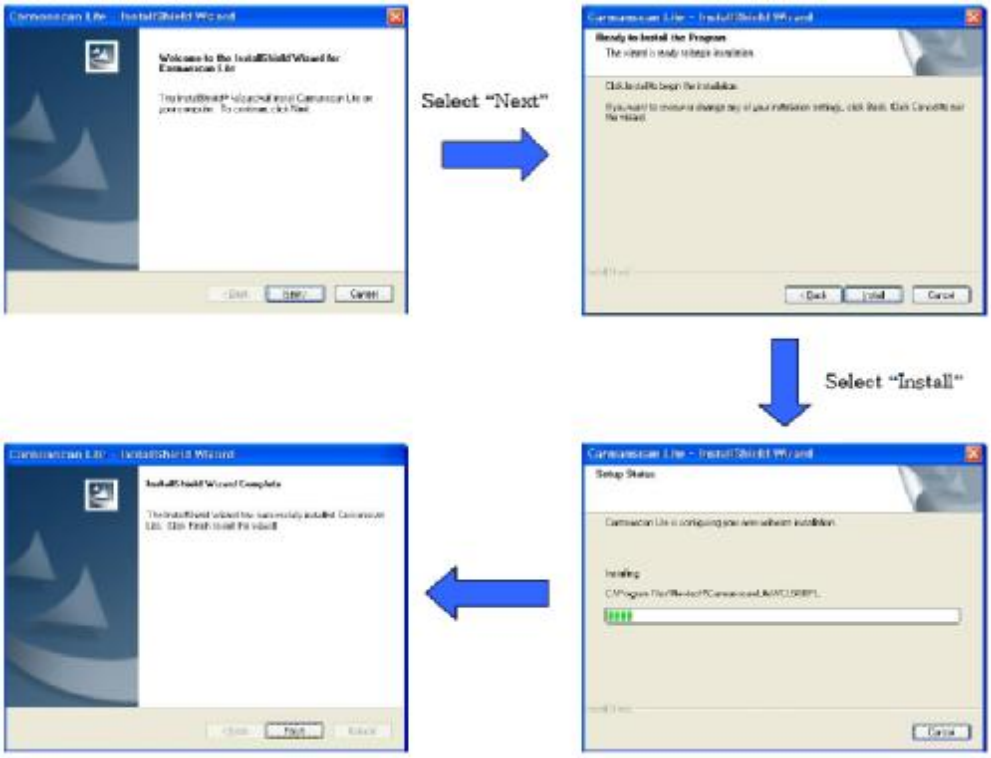
**Fuel Pressure Gauge – Part # 09915-54510**

**Diagnostic Scanner Kit – Part # 09900-27035**

## I. Installing the CARMANSCAN LITE program (Diagnostic Scan Tool Program).

a. Install the download CD in your computer.

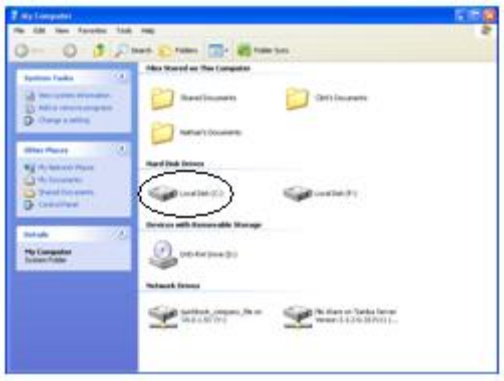
b. Double click the SETUP File and follow the procedures in the box's.

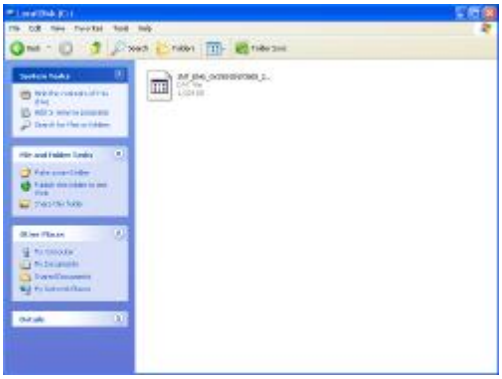



c. When finished installing the program, you can see the CARMANSCAN LITE download program's icon on your desktop.

## II. Installing New Download Updates into the Diagnostic Scan Tool.

1. Move New Download file into you're *(C) Local Disk* file. (*(C) Local Disk* is located in *My Computer* file under *Hard Disk Drives.*)

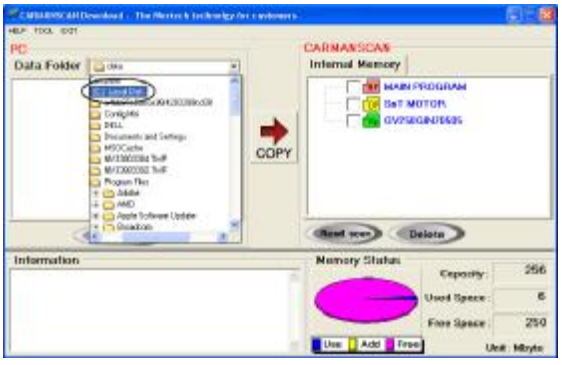


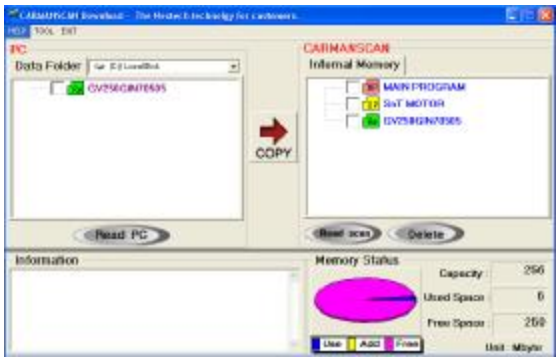


2. Attach power cord to the Diagnostic Scan Tool and press the power up button.
3. From the Initial Screen
    a. Select 05. S/W DOWNLOAD
4. Install the USB cable between Diagnostic Scan Tool and Computer

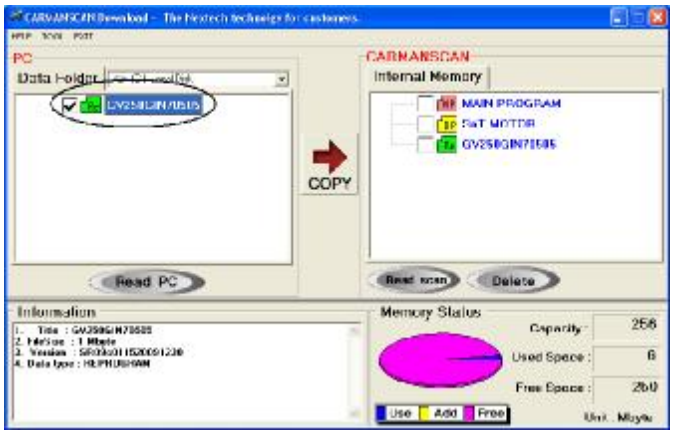
5. Double-Click on the *Carmanscan Lite* Icon, that's installed on your desk.

6. Click on the *Data Folder* dropdown button and select *(C) Local Disk.*

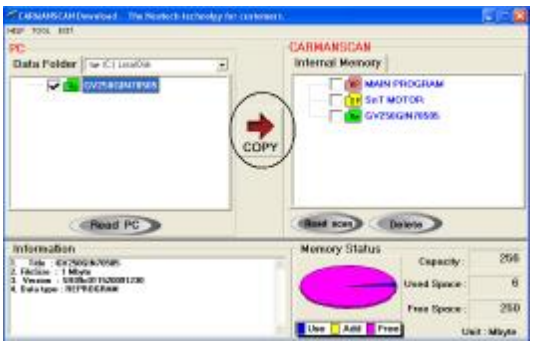


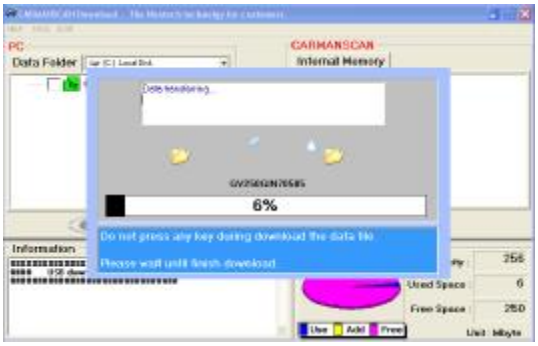



7. Select File to be Downloaded

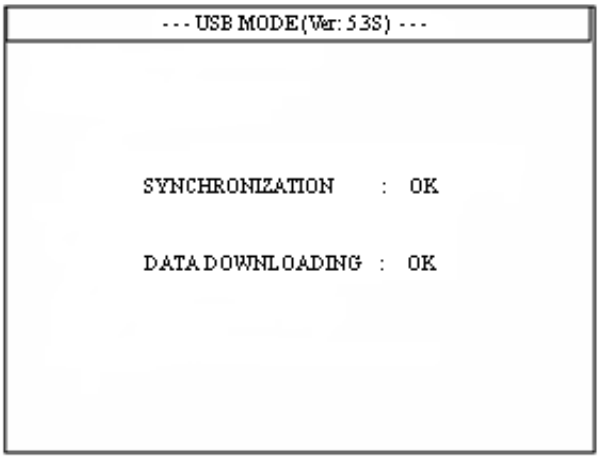



8. Select Copy and file will begin to download.




9. When file finishes downloading the Diagnostic Scan Tool Screen will display as follows:




10. New Download Update is complete.

## III. Installing New Download Update into Motorcycle.

1. Connect Diagnostic Scan Tool to Motorcycle using:

Note: Only install 4-Pin connector to motorcycle at this time.

2. Turn Ignition Switch On and place the Engine Cut-Off switch in the on position.
3. Select 02. REPROGRAMING

| 0. INITIAL SCREEN |
|---|
| 01. VEHICLE DIAGNOSIS<br>02. REPROGRAMING<br>03. SYSTEM SETUP<br>04. SCREEN CAPTURE VIEW<br>05. S/W DOWNLOAD |

4. Select 01. GV250GIN7050

| 2. REPROGRAMING |
|---|
| 01. GV250GIN70505 |

5. Follow instructions on the screen
    a. Turn Ign. Off
    b. Connect Mode Select S/W (2 Pin) 
    c. Turn Ign. On
    d. Press ENTER on the key pad

| BOOTLOADER REPROGRAMING |
|---|
| *REPROGRAM INITAL ERROR*<br><br>ECU NOT GO T OBOOT LOAD MODE TO REPROGRAM. PLEASE CHECK THE BELOW ITEMS AND [ENTER]<br><br>1. IG OFF<br>2. CONNECT MODE SELECT S/W (2PIN)<br>3. IG ON ( ENGIN OFF) |

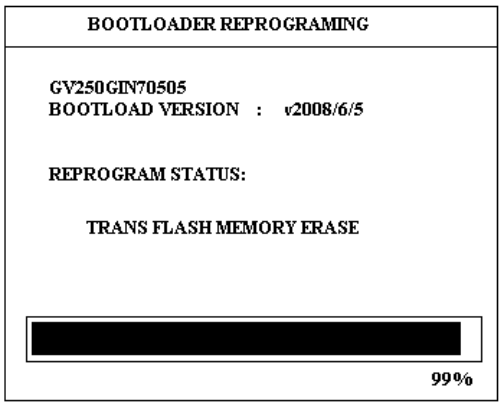
6. CAREFULLY FOLLOW INSTRUCTION ON SCREEN OR DAMAGE WILL OCCUR TO ECU.

| BOOTLOADER REPROGRAMING |
|---|
| *CAUTION*<br><br>PLEASE CHECK THE BELOW ITEMS DEFORE REPROGRAM.<br><br>1. CHECK THE BATTERY CHARGING<br>2. DON'T TURN SCANNER OFF PROGRAMING<br>3. DON'T OPERATE THE KEY PROGRAMING<br>4. DON'T OPERATE THE MODE SW PROGRAMING<br>5. DON'T STARTING THE ENGINE PROGRAMING<br><br>IF YOU NOT FOLLOW THESE CAUSTION, THE ECU WILL BE BROKEN<br><br>AND PRESS [ ENTER ] |

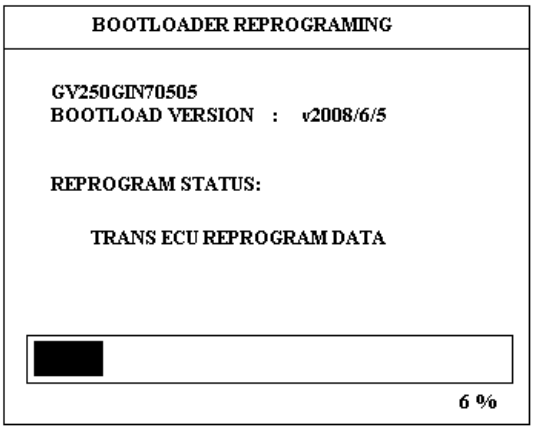
7. Press YES on the key pad.

| BOOTLOADER REPROGRAMING |
|---|
| *CAUTION*<br><br>PLEASE CHECK THE BELOW ITEMS DEFORE REPROGRAM.<br><br>1.<br>2.<br>3.<br>4. DO YOU WANT TO START?<br>( PRESS [ YES ] KEY )<br>NG<br>5. DON'T STARTING THE ENGINE PROGRAMING<br><br>IF YOU NOT FOLLOW THESE CAUSTION, THE ECU WILL BE BROKEN<br><br>AND PRESS [ ENTER ] |

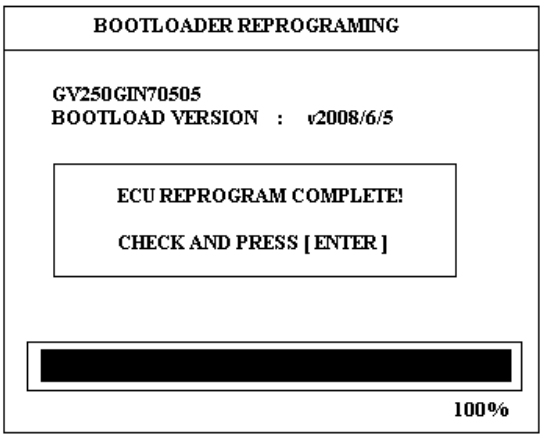
8. Scanner will begin erasing program installed on ECU.




9. Scanner will begin to reprogram ECU.



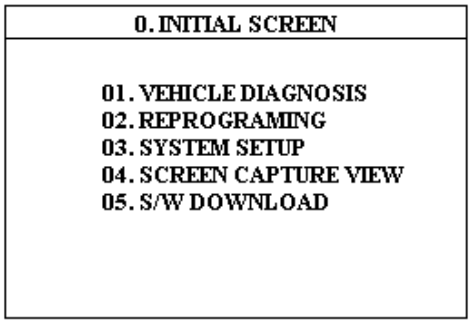

10. When reprogramming is complete press enter.



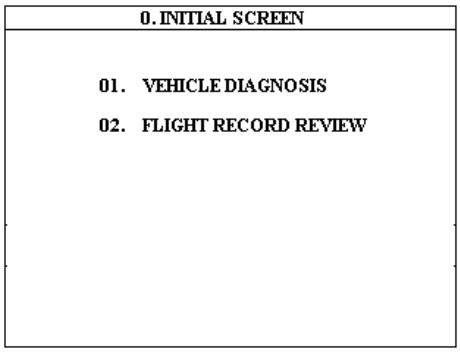
11. CAUTION: FOLLOW PROCEDURES BELOW IN ORDER.

    a. Disconnect Mode Select S/W (2 Pin) 
    b. Turn Ign. Off
    c. Wait 1 Minute
    d. Turn Ignition Switch On and place the Engine Cut-Off switch in the on position.
    e. Verify Motorcycles is running properly.
    f. Finished

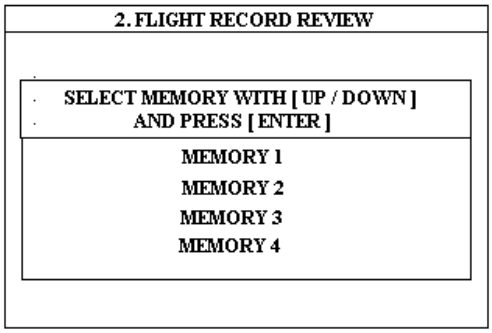
## 0. INITIAL SCREEN



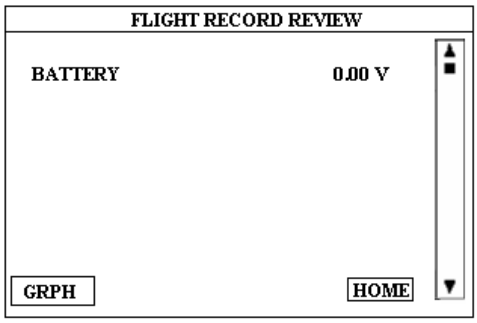

## 01. VEHICLE DIAGNOSIS



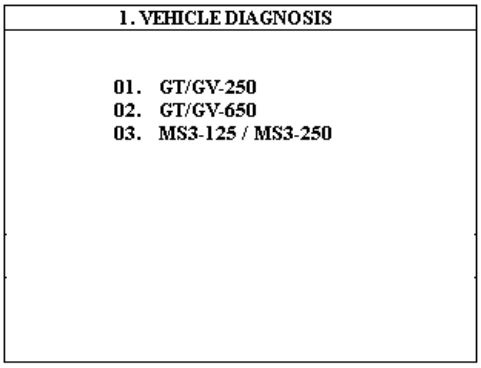

02. Flight Record Review

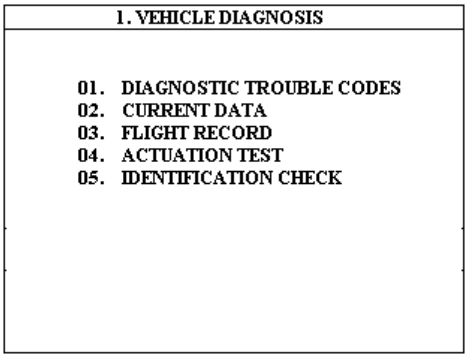



MEMORY 1

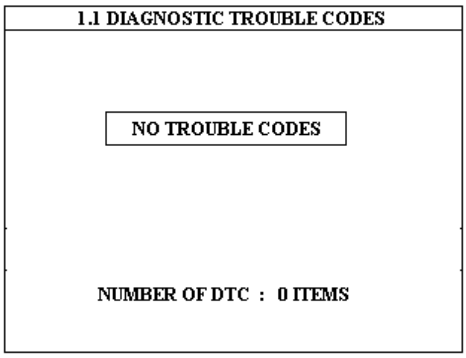


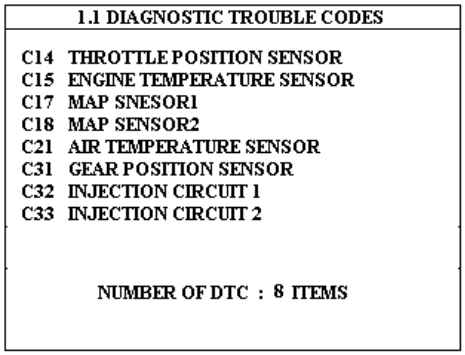
01. Vehicle Diagnosis



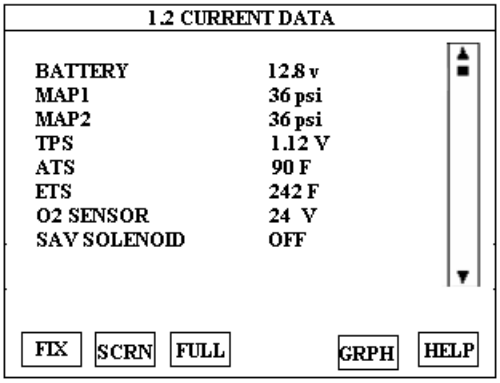




01. Diagnostic Trouble Codes

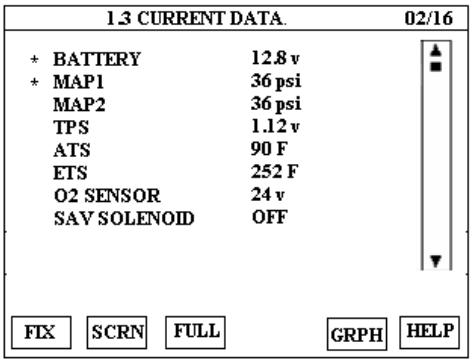


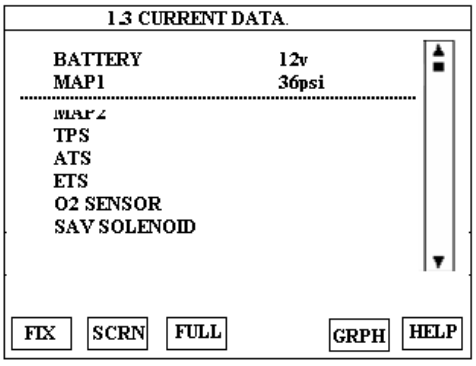
02. Current Data



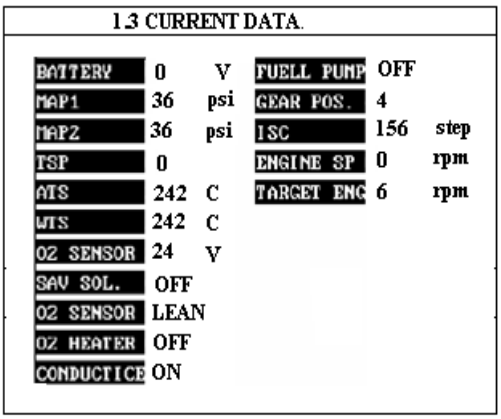

FIX



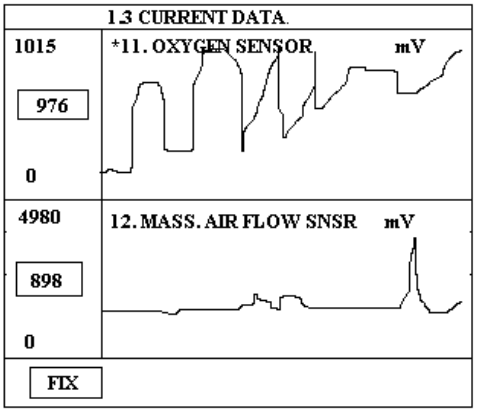

SCRN



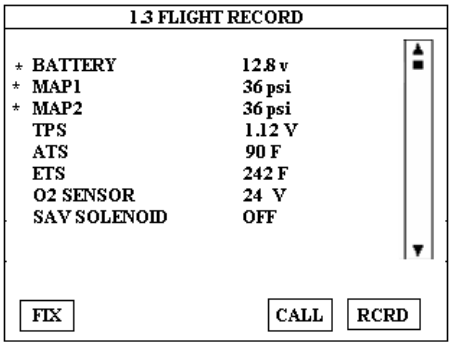

FULL



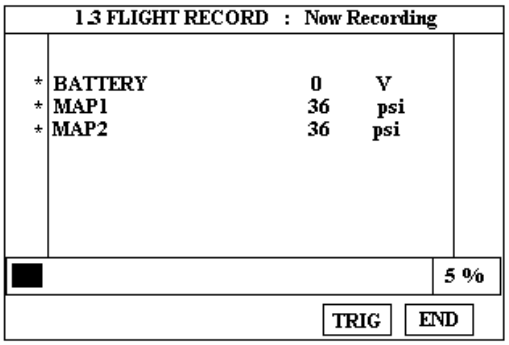

GRPH



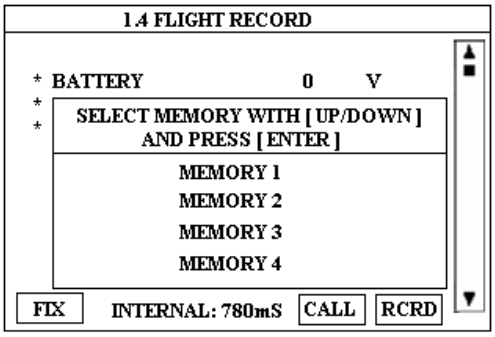
03. Flight Record



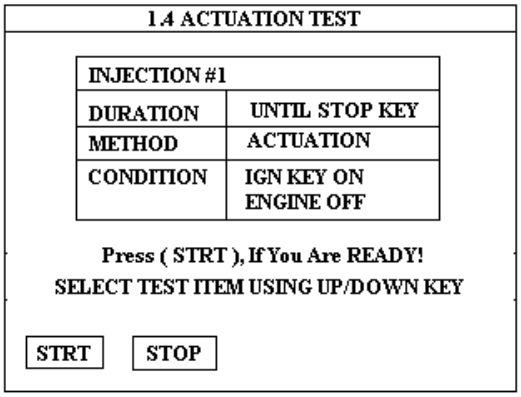

RCRD



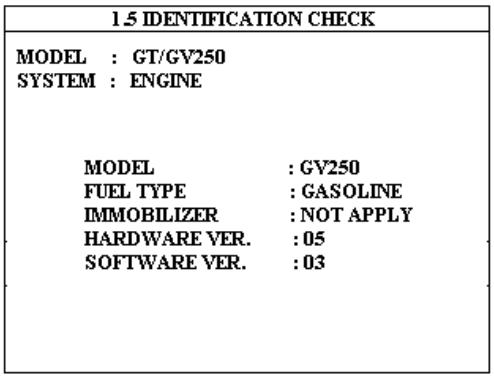

CALL



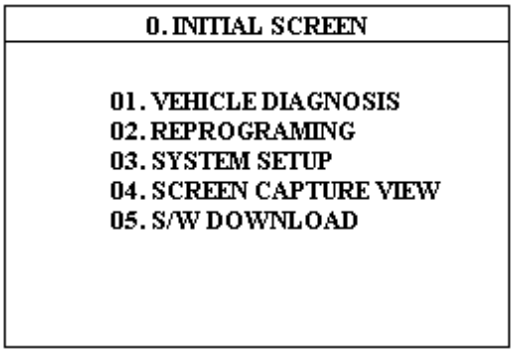

04. Actuation Test



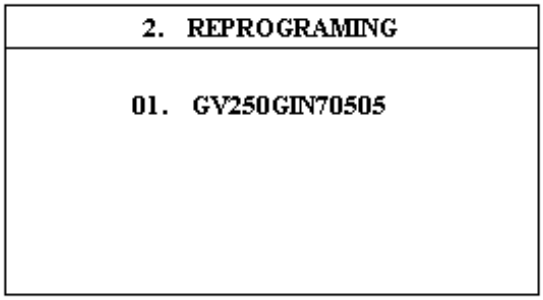

05. Identification Check



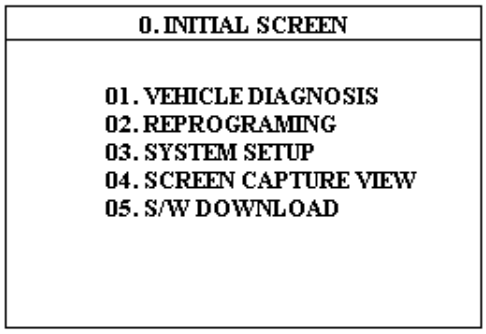
## 0. INITIAL SCREEN



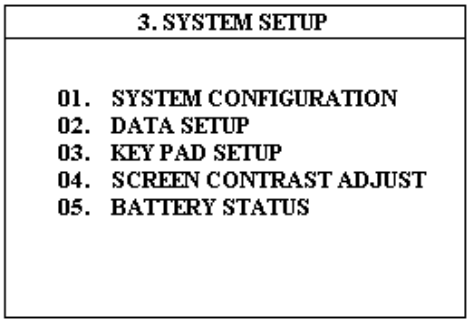

## 02. REPROGRAMING



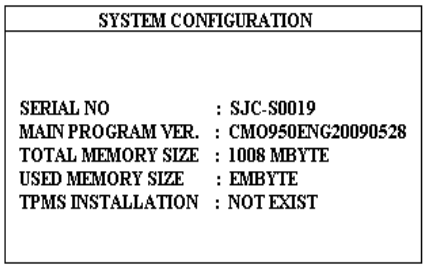
## 0. INITIAL SCREEN



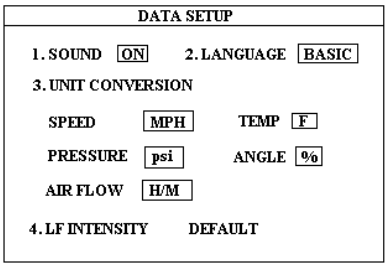

## 03. SYSTEM SETUP



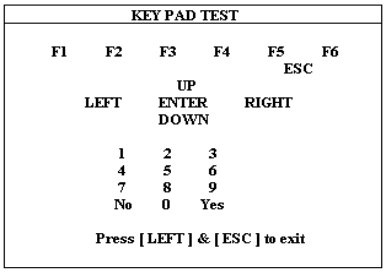

01. SYSTEM CONFIGURATION



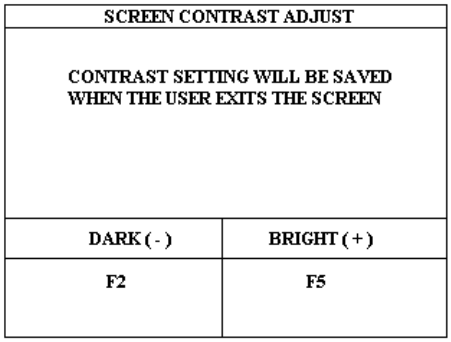

02. DATA SETUP



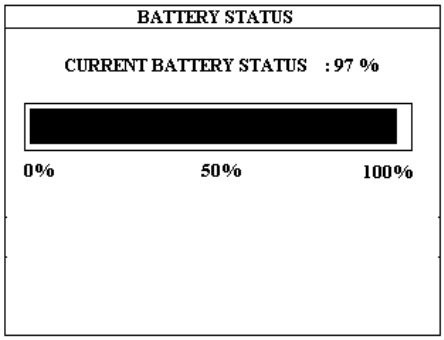

03. KEY PAD SETUP



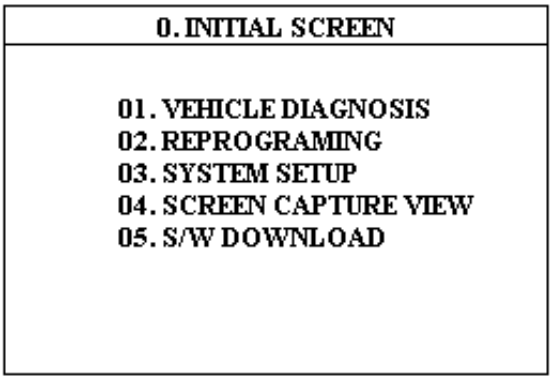

04. SCREEN CONTRAST ADJUST




05. BATTERY STATUS



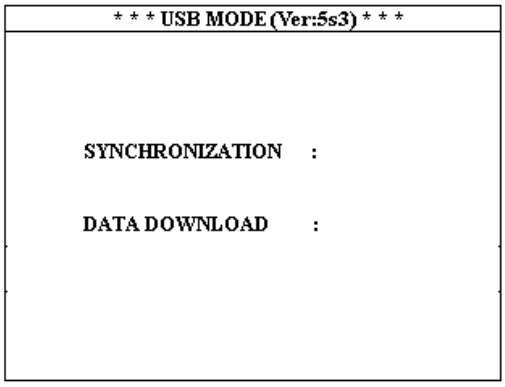
## 0. INITIAL SCREEN




## 04. SCREEN CAPTURE VIEW

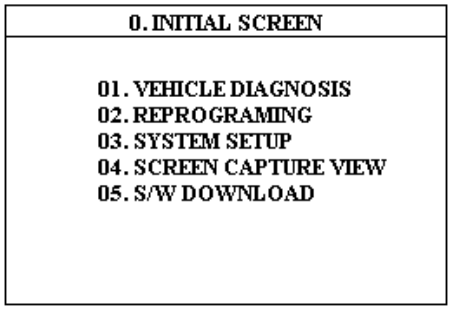
# N/A

## 05. S/W DOWNLOAD

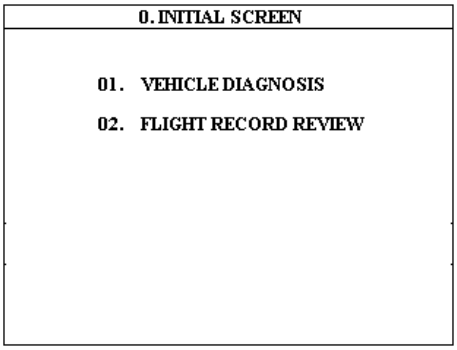


# MS3250 ONLY

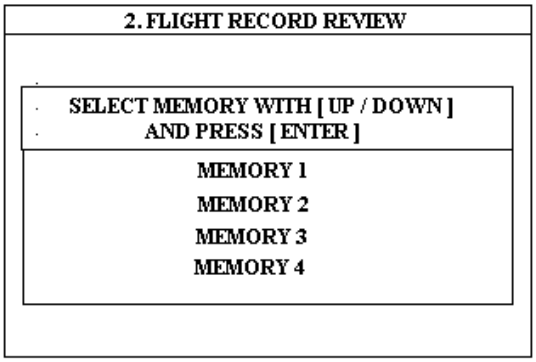
## 0. INITIAL SCREEN



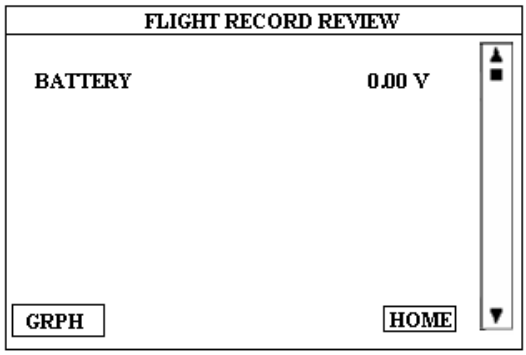

## 01. VEHICLE DIAGNOSIS



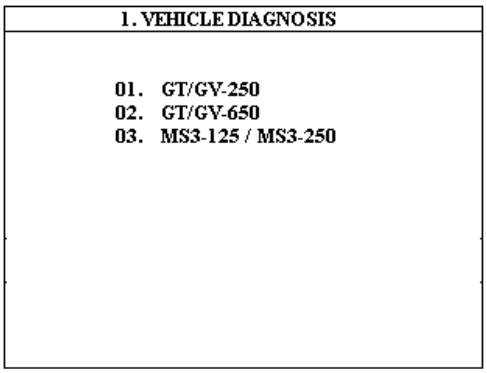

02. Flight Record Review

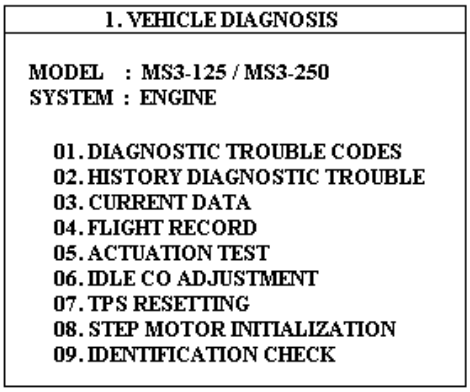



MEMORY 1

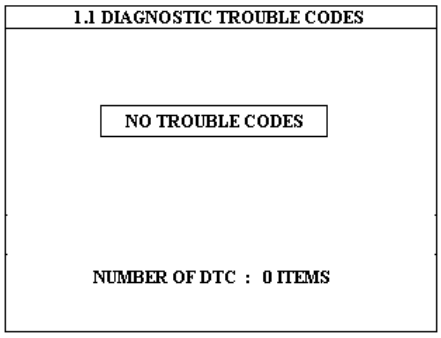


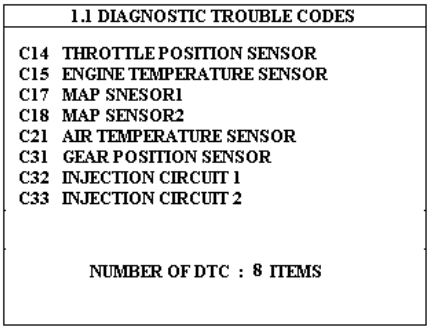
01. Vehicle Diagnosis



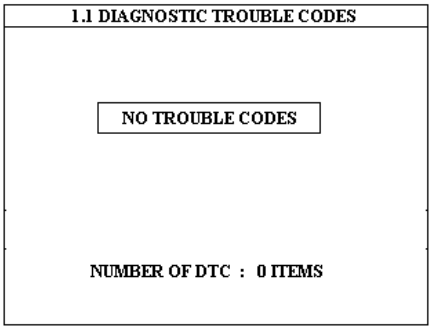



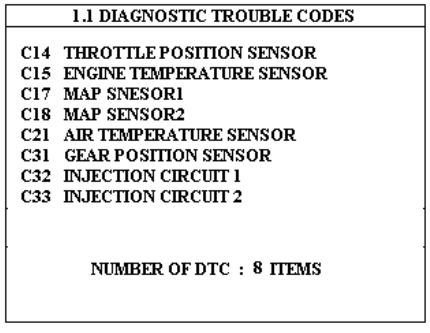

01. Diagnostic Trouble Codes



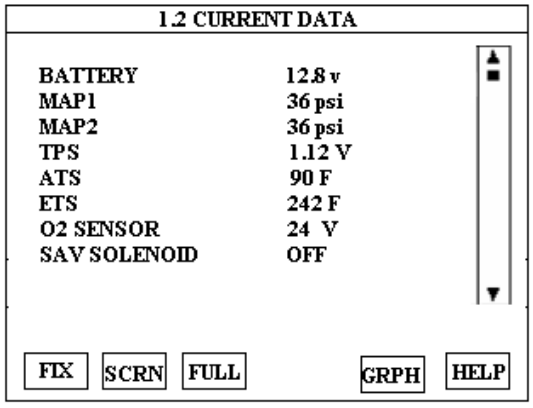




02. History Diagnostic Trouble

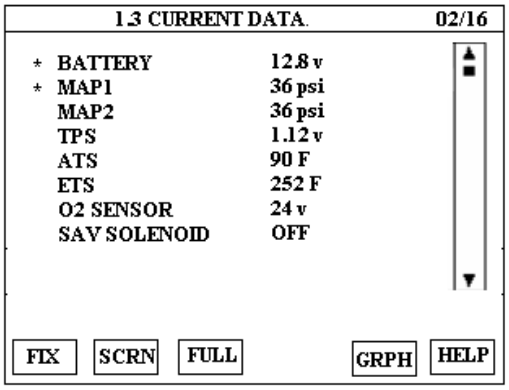


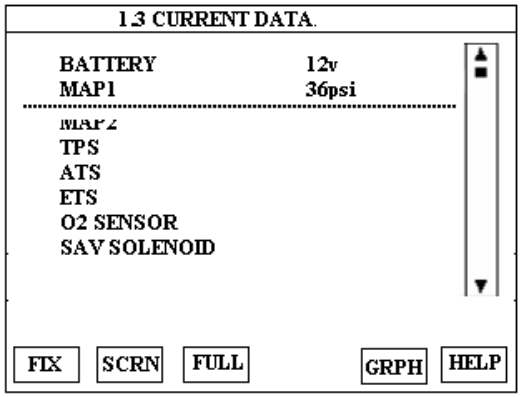
03. Current Data



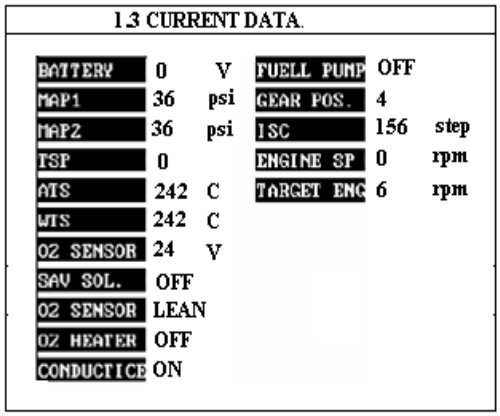

FIX



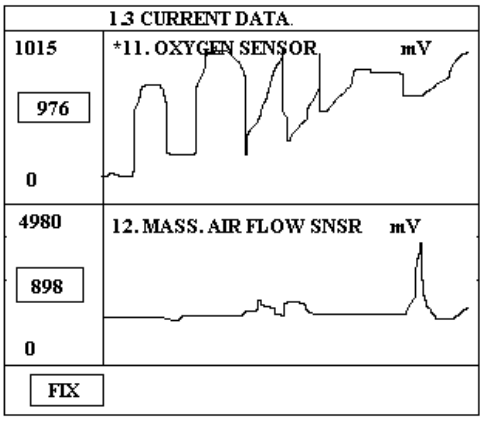

SCRN



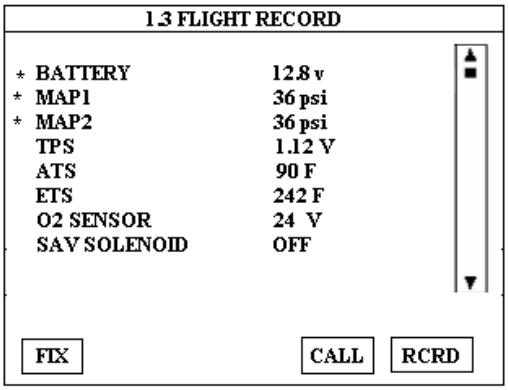

FULL



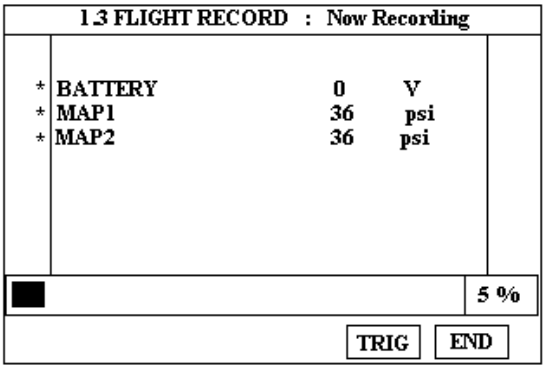

GRPH



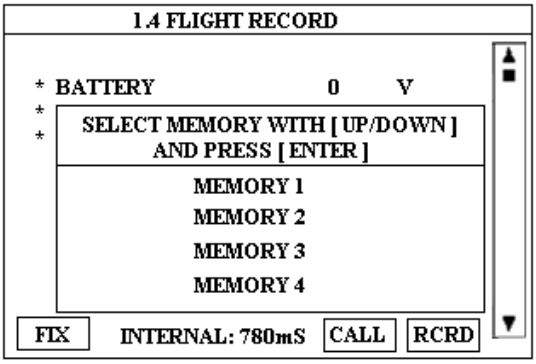
04. Flight Record



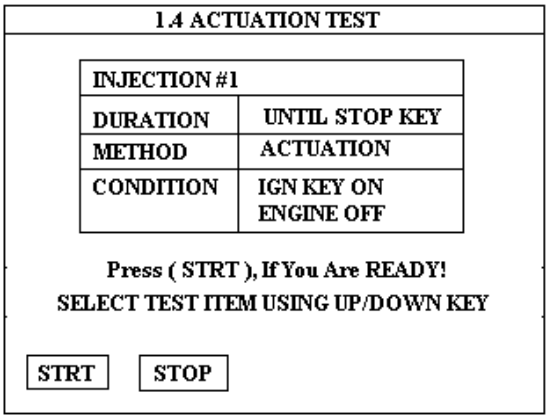

RCRD



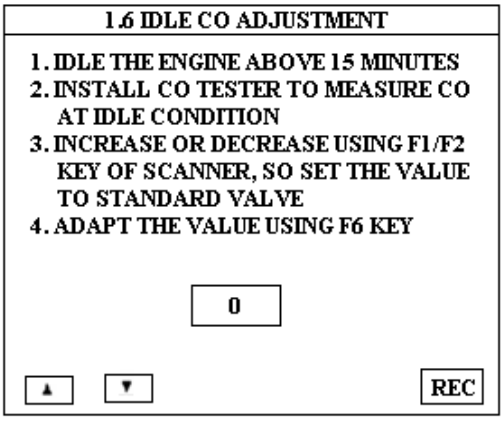

CALL



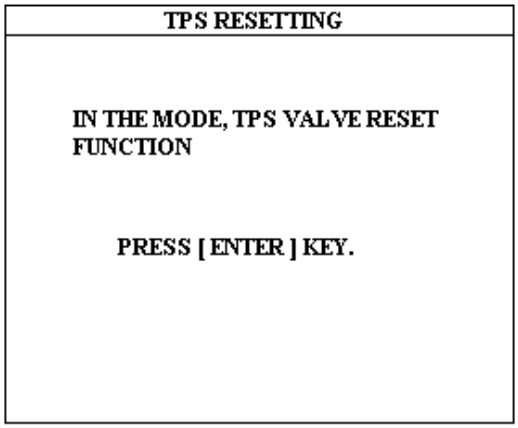

05. Actuation Test

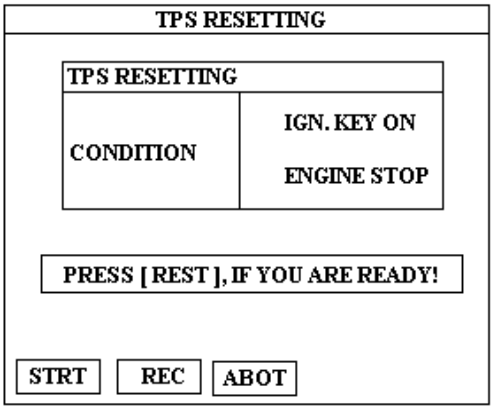


06. Idle CO Adjustment

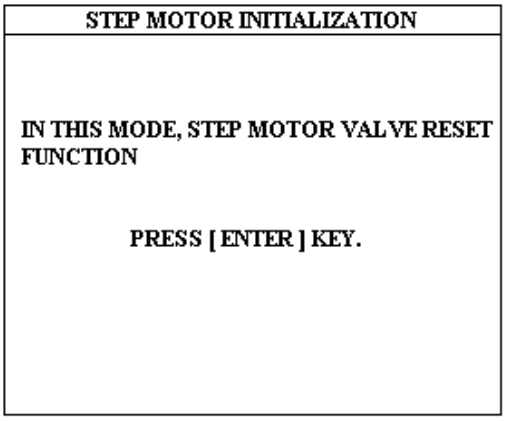


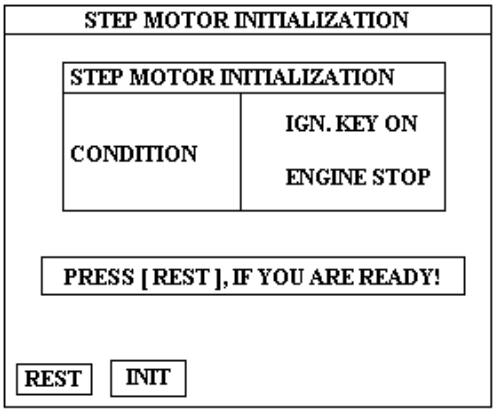

07. TPS Resetting



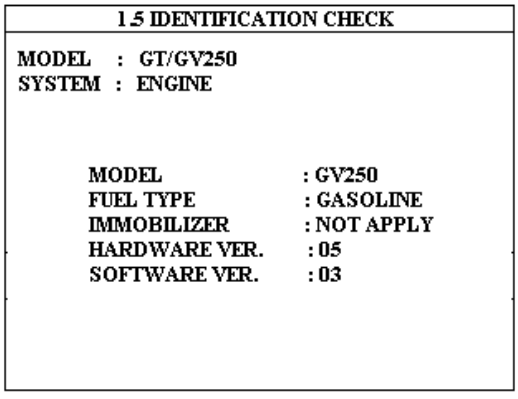



08. STEP Motor Initialization




09. Identification Check



**CAUTION :** Any changes or modifications in construction of this device which is not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

**NOTE :** This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. The limits are designed to provide reasonable protection against harmful interference when the equipment is operated in commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

# TABLE of CONTENTS

## Safety Precautions

This equipment described in this manual is intended for use only by qualified personnel. Safe and effective use of this equipment is dependent upon the operator following normally accepted safety practices and procedures in conjunction with the special requirements detailed in this manual. Specific warning and cautionary statements will be found, where applicable, throughout this manual.

Where necessary, the WARNING statements and ICON will be described in this guide.

WARNING identifies conditions or actions which may damage DIAGNOSTIC TOOL or the vehicle.

IMPORTANT WARNING MESSAGES FOR SAFETY ARE AS FOLLOWS :

DO NOT DROP DIAGNOSTIC TOOL MAIN BODY. AND DIAGNOSTIC TOOL MUST ALWAYS BE COVERED BY THE SHROUD.

STRONG ELECTRO-MAGNETIC INTERFERENCE CAN DAMAGE DIAGNOSTIC TOOL.

A STRONG SURGE OR ELECTRONIC SHOCK IN THE POWER SUPPLY LINE CAN DAMAGE HISCAN ACE POWER SUPPLY. DO NOT USE DIAGNOSTIC TOOL UNDER THESE HARSH ENVIRONMENT.

# DIAGNOSTIC TOOL KIT

The DIAGNOSTIC TOOL kit comprises the following standard along with the option kit where ordered. The kit contents should be checked upon receipt and damage or shortages reported to the supplier immediately.


**[ Figure 0.1 :DIAGNOSTIC TOOL KIT ]**

| | PART NO. | PART NAME |
|---|---|---|
| 1 | 22000-010 | DIAGNOSTIC TOOL MAIN BODY |
| 2 | 22000-020 | DLC CABLE 16 |
| 3 | 22000-030 | 4+2PIN ADAPTOR |
| 4 | 22000-040 | USB CABLE |
| 5 | 22000-050 | COLOR BOX |
| 6 | 22000-100 | OPERATION MANUAL |
| 7 | 22000-110 | PROGRAM CD |
| 8 | 22000-080 | AC/DC ADAPTOR |
| 9 | 22000-090 | RUBBER SHROUD(Installed main body) |

# ICON

OPERATION LEVEL ICON

: LEVEL 1 OPERATION(INIT LEVEL)

: LEVEL 1 OPERATION(MENU LEVEL)

: LEVEL 1 OPERATION(MODE LEVEL)

MESSAGE RELATED ICON

: PROCESS / RESULT MESSAGE

: ERROR MESSAGE

: WARNING MESSAGE

APPLICATION HELP ICON

: SCREEN EXPLANATION

: OPERATION GUIDE

: HELP / TIPS

: NOTE

# I. GENERAL INFORMATION

## 1. General Features

DIAGNOSTIC TOOL offers the following functionality:

- On board diagnostic communication
- Special vehicle test emulation

This combination provides for easy and comprehensive diagnosis of the electronically controlled systems used on all vehicle range.

DIAGNOSTIC TOOL feature include :

Diagnostic communication with S&T Motors
High resolution LCD display
Soft touch key
Shock protecting leather shroud
PC communication facility
PC software download with USB

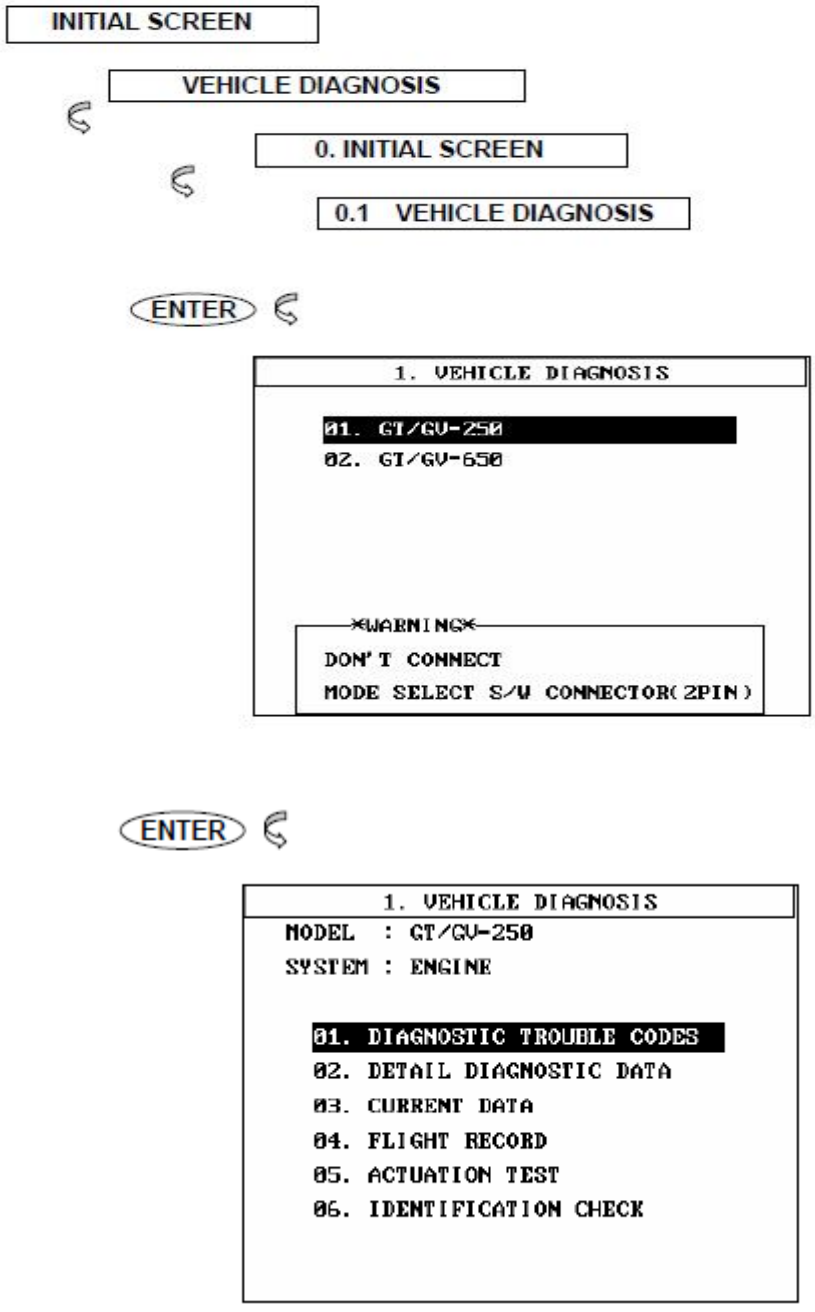
## 2. Specification

| | |
|---|---|
| Case | High strength PC ABS resin |
| LCD | 320 X 240 dpi<br>LED rear lightings<br>Standard character display: 40 spaces X 12 lines |
| Keypad | Power ON/OFF,<br>Variable function key x 6, arrow key x 4<br>Fixed function key x 5<br>Numeric key x 10<br>Type: soft touch key method |
| Memory | Basic memory: 256MB |
| Operating temperature | 0℃ - 50℃ |
| Voltage | 7-36V DC input |
| Self-diagnosis coverage | K-LINE Communication<br>CAN Communication |
| Dimension | Width: 125mm<br>Length: 223mm<br>Height: 68mm |
| Power consumption | 3.6 Watts |

# II. VEHICLE DIAGNOSIS

## 1. VEHICLES AND SYSTEM SELECTION

1-1. OPERATION FLOW




[FLOW II.1 : VEHICLE AND SYSTEM SELECTION SUB-MENU IN/OUT FLOW ]

1-2. BASIC APPLICATION

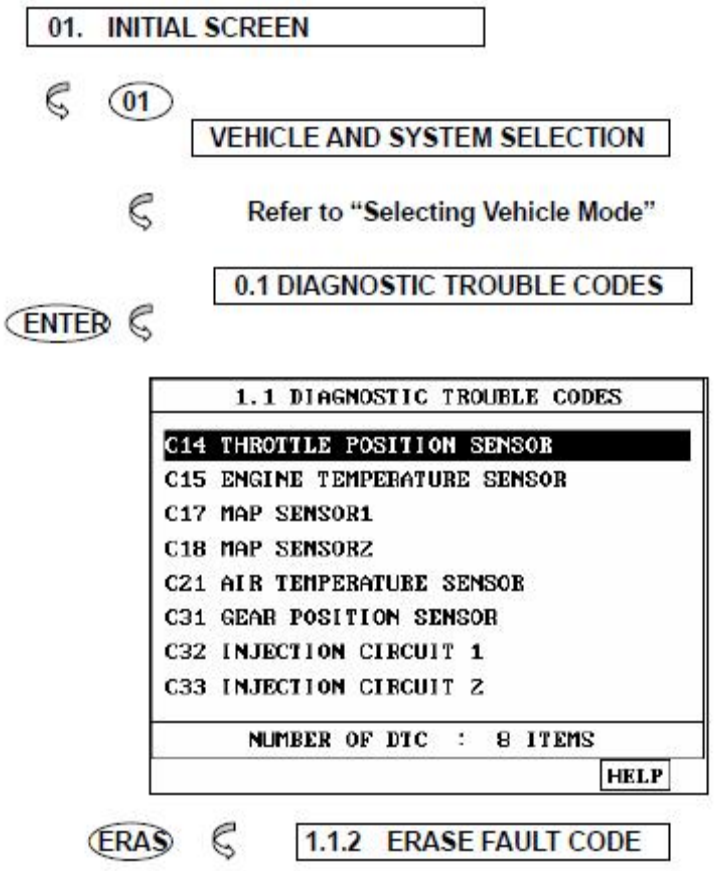
Having connected and turned on DIAGNOSTIC TOOL, the vehicle and systems 1 and 2 selections must be made from the [ 1.0 VEHICLE DIAGNOSIS] screen.

The support functions differ from vehicle to vehicle and therefore the correct selection must be made. Selection can be made by scrolling up or down the screen and pressing ENTER.

Selection is made in the order of VEHICLE, SYSTEM 1, and SYSTEM 2.

## 2. DIAGNOSTIC TROUBLE CODES

2-1. OPERATION FLOW




[FLOW II.2 : DIAGNOSTIC TROUBLE CODES IN/OUT FLOW]

2-2. MODE APPLICATION

At this level, diagnostic trouble codes (DTC) are displayed for the selected ECM

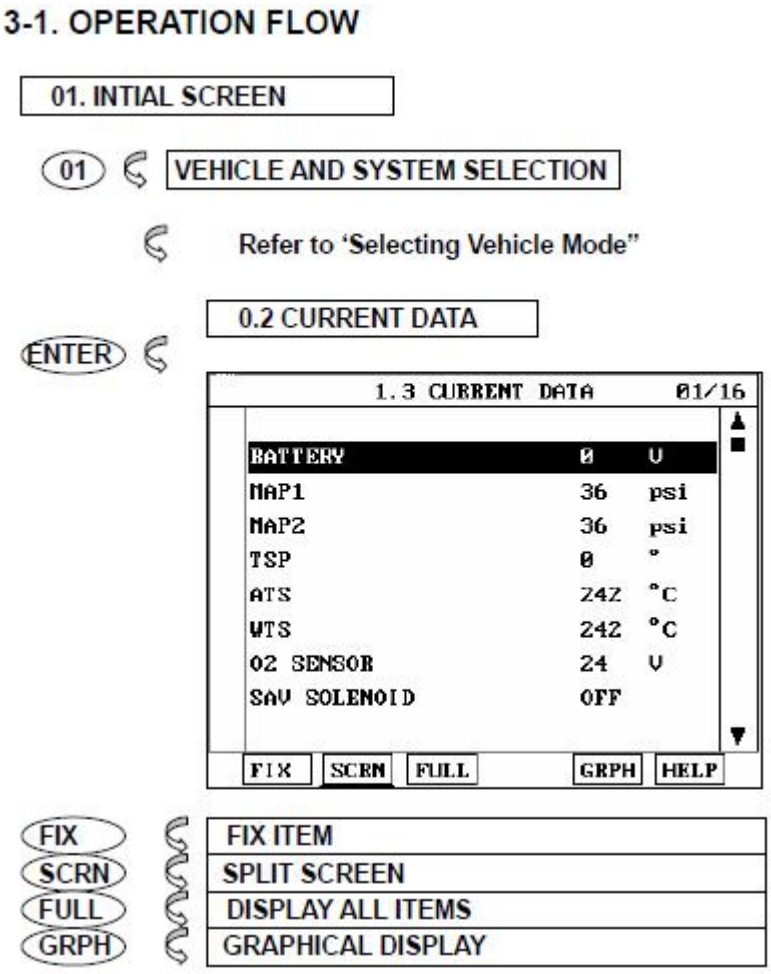
Whenever the screen is opened or refreshed, the cursor moves to the beginning of the display and an audible warning will be given along with the number and description of the component from which the code has been generated.

By using the UP / DOWN key, the display may be scrolled.

**EARS** This soft function key will clear the DTC currently held in the memory of the selected ECM. If this option is selected, a message requesting confirmation of the ERAS request will be displayed. The ENTER or ESC key should be used to confirm or cancel the request to clear the current DTC.

## 3. CURRENT DATA

3-1. OPERATION FLOW




[ FLOW II.3 : CURRENT DATA MODE IN/OUT FLOW ]

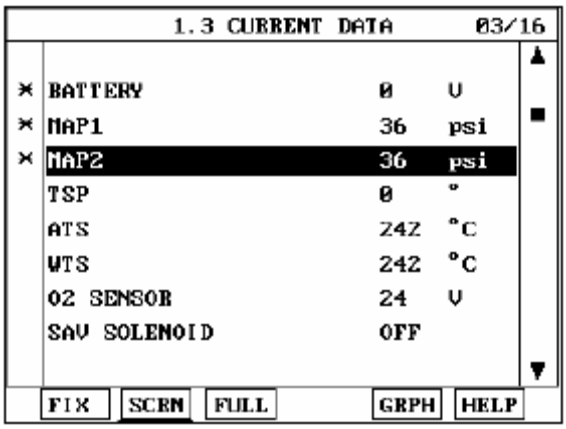
3-2. MODE APPLICATION

The sensor values and the ON/OFF state of the system switches of the selected ECM are displayed.

Scrolling up and down the data is possible by means of the UP / DOWN keys and more detailed data is available by Using the soft function keys as follows :

FIX

Executing the [Figure II.1 FIX ITEM] function that moves the item in inverted text to the top of the display. This item is held and does not move when the cursor keys are used to page through the display and therefore allows specific items to be compared directly to one another.




[ Figure II.1 : FIX ITEM ]

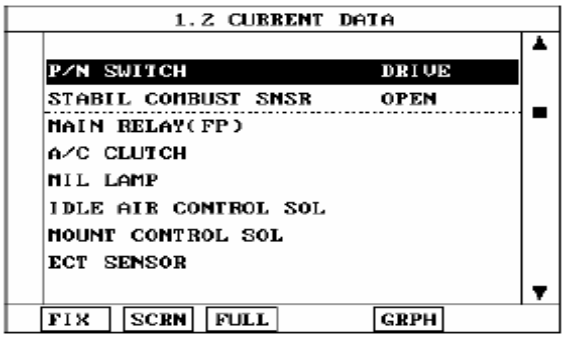
A fixed item may be released by depressing the FIX key again.

In the example, illustrated by figure 1, is fixed as denoted by the asterisk to the left of the item number.

SCRN

Pressing this key will change the number of displayed sensors or switch state which are ‘active’ from 8(MAX), 4, or 2(MIN). Where only 2 items are ‘active’, the rate at which DIAGNOSTIC TOOL update the display data will be faster than where a higher number of ‘active’ items are selected.

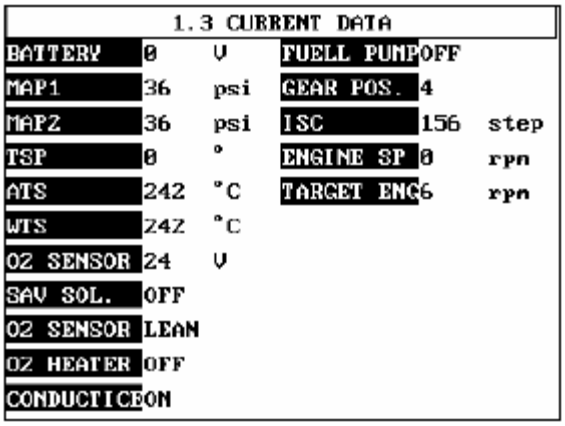
In the example illustrated by [Figure II.2 Split screen], only 2 ‘active’ data items are selected




[Figure II.2 : Split screen]

FULL

Use of this key will cause maximum 22 data value to be displayed on the screen as illustrated in figure 3. The component description displayed will be abbreviated when this mode is used. The date may be scrolled by use of the UP / DOWN key.



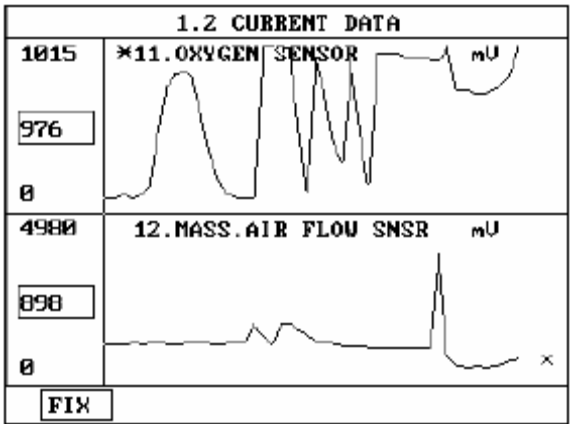

[ Figure II.3 : DISPLAY ALL ITEMS ]

GRPH

Where more 2 ‘active’ data items have been selected using the FIX key, pressing the GRPH key will cause the data for those items to be displayed in the form of a graph as illustrated in [Figure II.4].

FIX

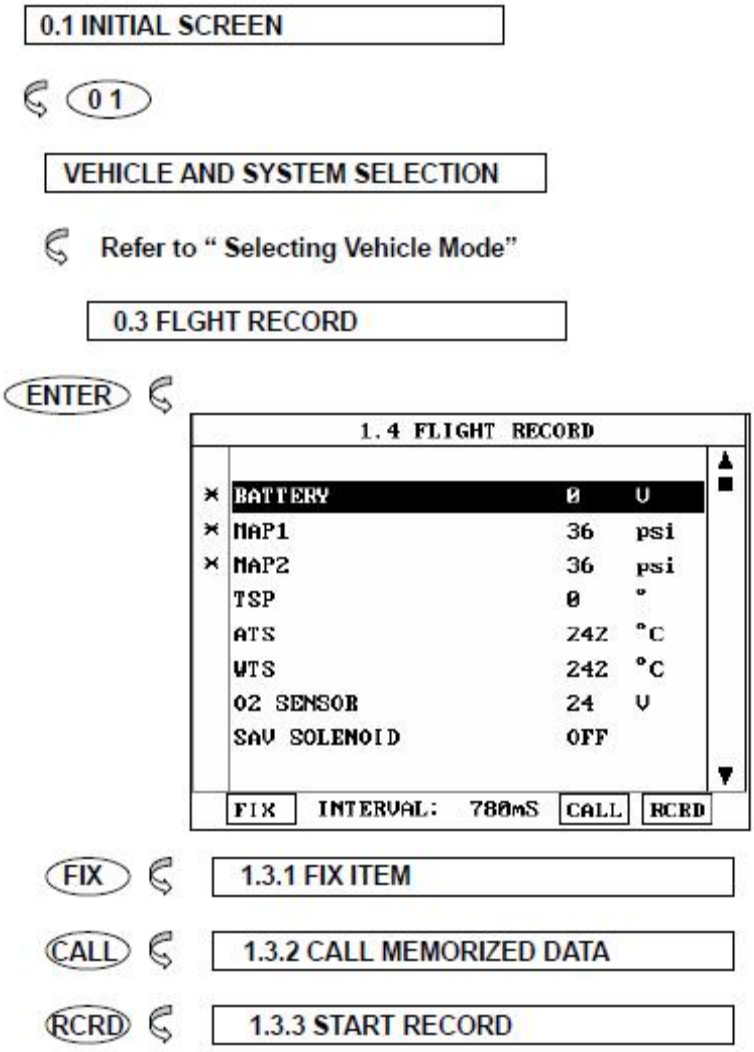
Holding one item of two. When the UP / DOWN keys are used to scroll up and down the display, the item selected by FIX key does not move.




[Figure II.4 : CURRENT DATA (GRPH)]

## 4. FLIGHT RECORD

4- 1 OPERATION FLOW




[ FLOW II.4 : FLIGHT RECORD MODE IN/OUT FLOW]

4-2 . MODE APPLICATION

The FLIGHT RECORD mode allows for the display and recording of data generated by the ECM as determined by the user of DIAGNOSTIC TOOL.

By using the UP / DOWN key, the display may be scrolled.

The function of the FLIGHT RECORD is determined by the following soft function keys :

FIX

This soft function key selects or releases the items for which data is to be recorded. The fixed are identified by means of an asterisk to the left of the item number on the DIAGNOSTIC TOOL screen. The maximum number of items, which may be selected for FLIGHT RECORD functions, is 8.

The data sampling time interval is displayed at the center of the bottom line of the screen.

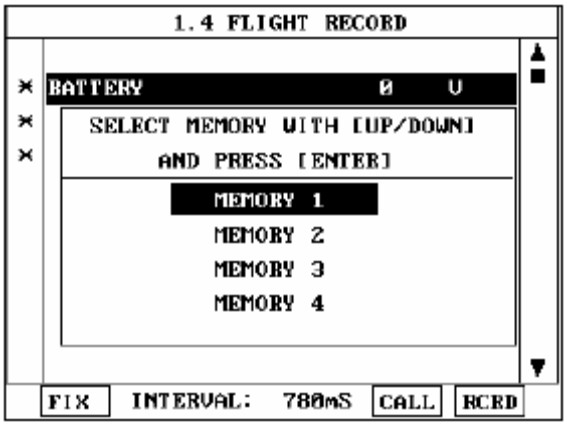
CALL

This function is used to replay the recorded data. Stored data is only overwritten when recording and therefore the same data can be viewed more than once/without being over written provided that no recording takes place.

If the stored file to be viewed relates to vehicle or system, which differs from the current vehicle and system selection, or if no recording data, the following message will be displayed.

NO RECORDED DATA OR
DIFFERENT SYSTEM DATA.

The message is displayed on the screen as shown in Figure 5. The user can select one of the items to read.




[Figure II.5 : FLIGHT RECORD (CALL) ]

MEMORY 1 and MEMORY 4, each memory indicates built-in memory of DIAGNOSTIC TOOL.

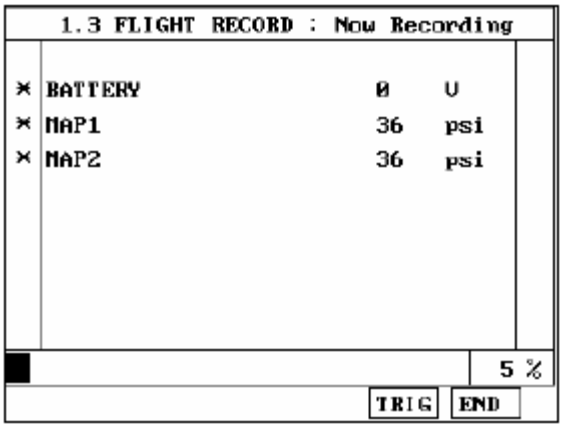
If data is in the selected memory, stored data will be displayed , But the following message will be displayed if the ID of the stored record is different from that of current vehicle and system selection or if no recorded data.

NO RECORDED DATA OR
DIFFERENT SYSTEM DATA

RCRD

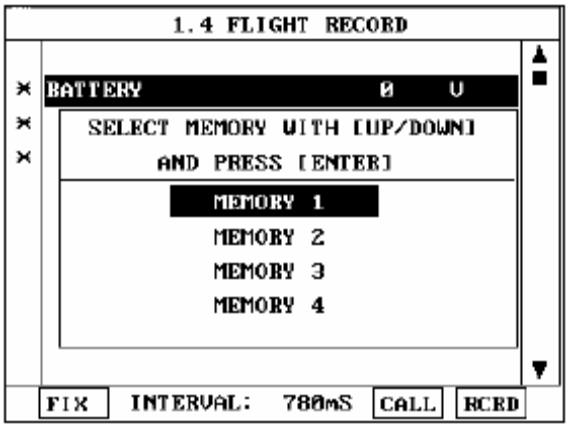
end when either the END or ESC key is depressed. During the recording function, the screen takes the appearance of that illustrated in [ Figure II.6 ]

If the quantity of data being recorded exceeds the capacity of the DIAGNOSTIC TOOL memory, the first recorded data of the current session will be progressively overwritten as recording continues




[ Figure II.6 FLIGHT RECORD (RECORDING) ]

The message is displayed on the screen as in the following figure.




[ Figure II.7 : FLIGHT RECORD (RCRD) ]

MEMORY 1 and MEMORY 4, each memory indicates internal memory of DIAGNOSTIC TOOL.

If user selects memory, [ Figure II.7 ] is display. If this key is pressed without selected items, the following message is displayed.

SELECT ITEM WITH[FIX]

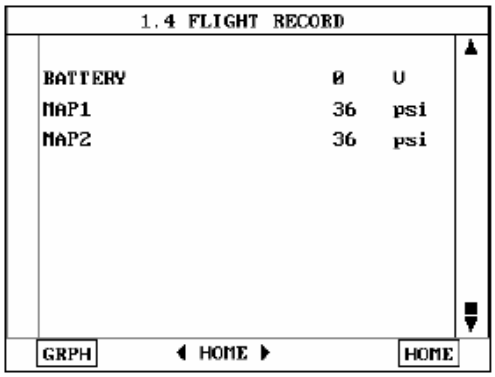
TRIG

This key is used to set trigger point in this recording process.

When TRIG key is depressed more than twice , only the latest TRIG key handled as trigger at trigger point.

If END key or ESC key is depressed before TRIG key , that time becomes the trigger point and recording will be ended.

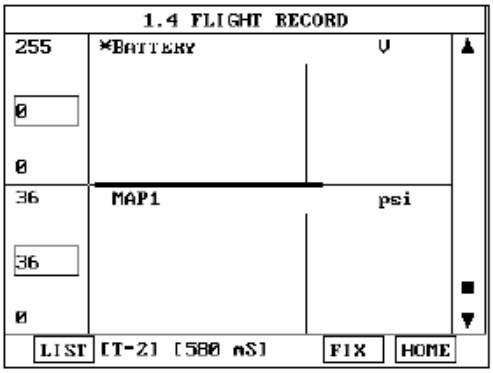
After finishing the recording, screen will display stored data values in a numeric data form. The screen example is as follows:




[ Figure II.8 : FLIGHT RECORD (NUMERIC) ]

In this numerical data display, GRPH key is used to see Graphic views for the items recorded by FIX key operation.

If the two items are selected, a graphical view is as follows.



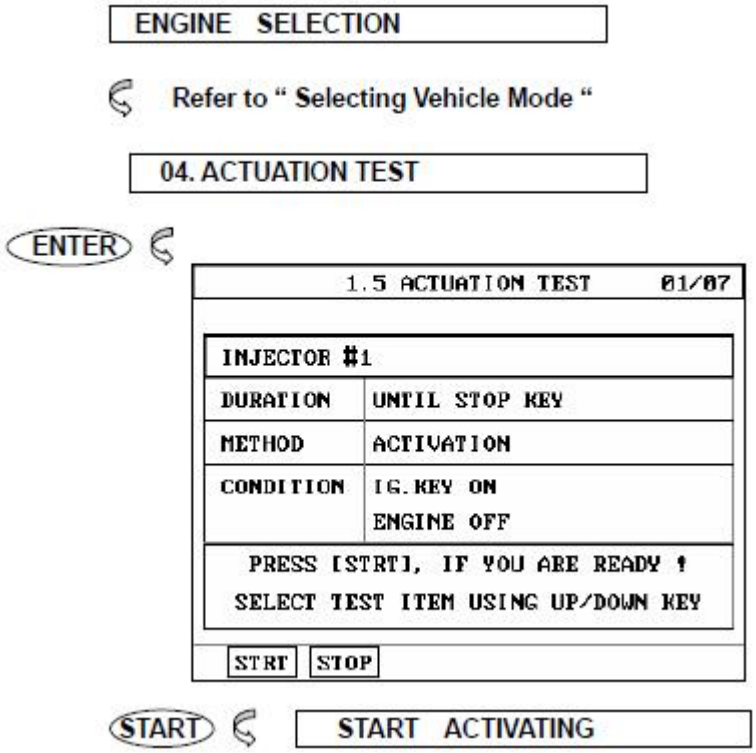

[ Figure II.9 : FLIGHT RECORD (GRAPH) ]

[ T+5 ] MEANS SAMPLED TIME INDEX, AND CURRENT SCREEN DISPLAY THE TIME AFTER 5$^{TH}$ SAMPLING INDEX FROM TRIGGER POINT.

You can change sampled time index by LEFT(◄) or RIGHT(►) key. In graphic display, current sampled time index position is displayed as vertical line cursor. If this cursor is arrived end of screen, screen will be moved as half page.

## 5. ACTUATION TEST

5-1 OPERATION FLOW

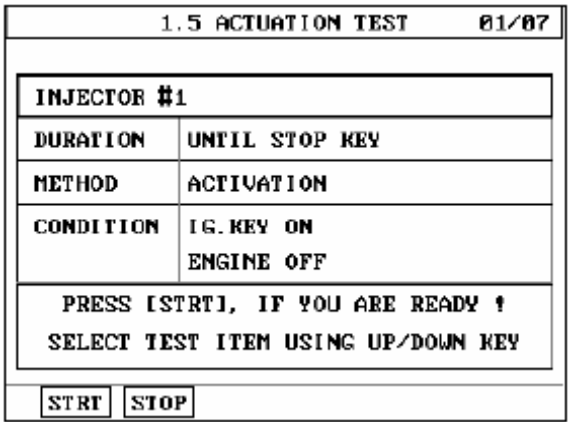



[ FLOW II.5 : ACTUATION TEST MODE IN/OUT FLOW ]

5-2 MODE APPLICATION

The ACTUATION TEST mode allows certain actuators to be forcibly driven by DIAGNOSTIC TOOL but this mode can only be supported according to the selected vehicle. The illustration of a typical screen is shown in [ Figure II.10 ] .

The actuator to be driven can be changed by using the UP / DOWN key to scroll through the list.




[ Figure II.10 : ACTUATOR DRIVING ]

The test must be performed with the vehicle in the state indicated by the CONDITION statement on the screen. In this illustration given, for example, the ignition key must be turned “on”, and the engine must be running.

The duration of the test will either be fixed by DIAGNOSTIC TOOL and indicated on the screen or the duration dialogue will indicate

UNTIL STOP KEY

To begin an actuator test, the STRT key should be pressed. For fixed duration test, the message

COMPLETED!

will be display after an acknowledged code has been received from the vehicle. For tests of no fixed duration, the message

NOW ACTIVATING

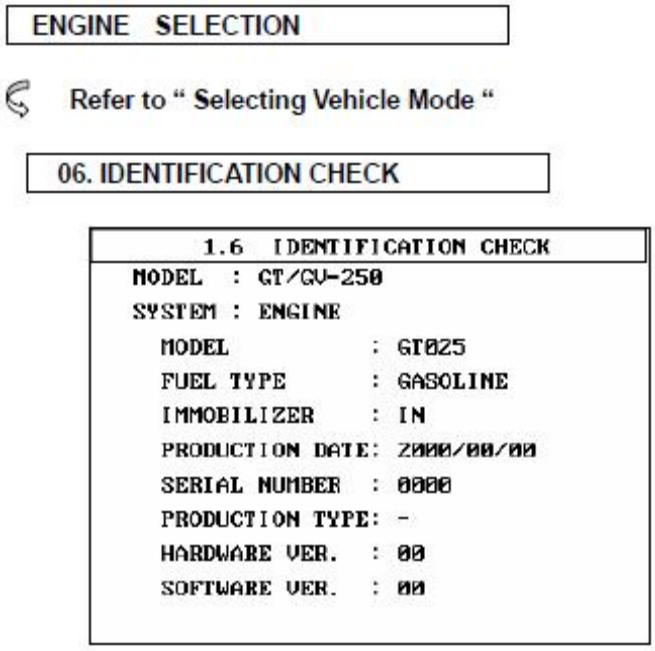
will be displayed once an acknowledged code has been received from the vehicle and until the STOP key is pressed. In both types of test, the message

TEST FAILURE!

will be displayed if no acknowledge code is received from the Vehicle. The messages will be displayed for 0.5 seconds and then disappear.

## 6. IDENTIFICATION CHECK

6-1. OPERATION FLOW



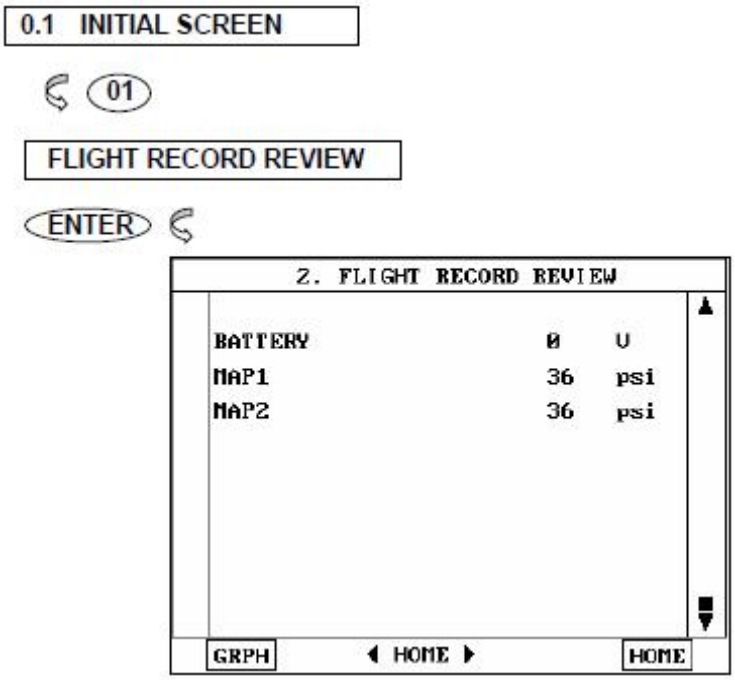

[ FLOW II.6 : IDENTIFICATION CHECK ]

Right after IDENTIFICATION CHECK mode is accessed, Part number and Software Version number will be displayed automatically.

# III. FLIGHT RECORD REVIEW

## 1. OPERATION FLOW

Choose VEHICLE DIAGNOSIS to operate the FLIGHT RECORD REVIEW function.



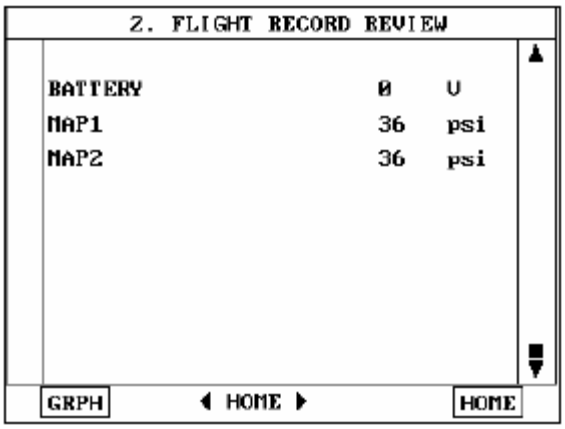

In this mode, you can review recorded Flight Record data. The screen will be displayed by frame unit that is determined by data update.

[ FLOW III.1 : FLIGHT RECORD REVIEW MODE IN/OUT FLOW ]

## 2. MODE APPLICATION

TRIG

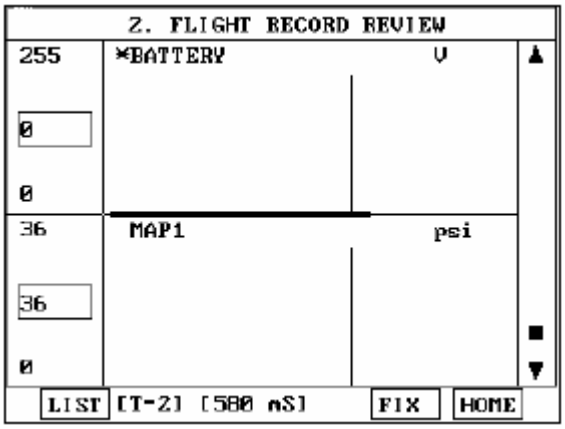
After finishing the recordings, screen will display stored data values in a numeric data form. The example screen is as follows:




[Figure III.1 : FIGHT RECORD (NUMERIC) ]

In this numerical data display, GRPH key is used to see graphic views for the items recorded by FIX key operation.

When two items are selected, a graphical view is as follows.




[ Figure III.2 : FLIGHT RECORD (GRAPH) ]

[ T+5 ] MEANS SAMPLED TIME INDEX, AND CURRENT SCREEN DISPLAY THE DATA AFTER $5^{TH}$ SAMPLING INDEX FROM TRIGGER POINT.

You can change sampled time index by UP or DOWN key. In graphic display, current sampled time index position is displayed as vertical line cursor. When this cursor is reached at the end of screen, the screen will be moved by half-a-page.

# IV. SYSTEM SETUP

## 1. CONNECTION METHOD

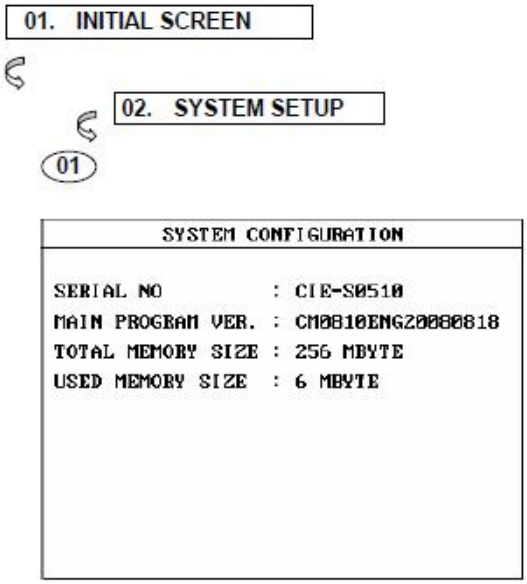
The following four kinds of power supply methods can be used.

(1) DLC cable

(2) AC/DC adapter

## 2. SYSTEM CONFIGURATION

2-1. OPERATION FLOW




[FLOW IV.1 : SYSTEM CONFIGURATION MODE IN/OUT FLOW]

2-2. MODE APPLICATION

This mode displays data for the following items.

1) SERIAL NUMBER

: Display product serial number of your DIAGNOSTCI TOOL

2) MAIN PROGRAM VERSION

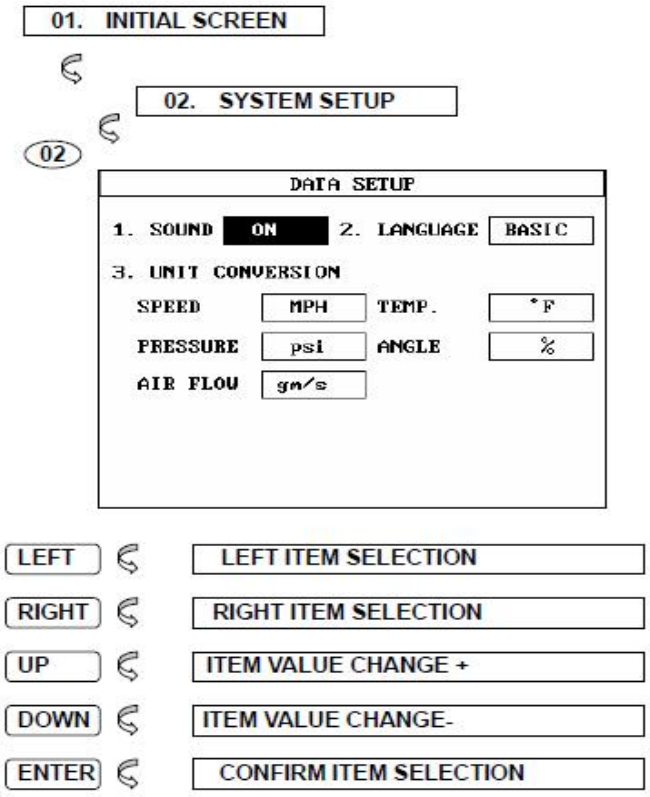
: Display software version of DIAGNOSTIC TOOL

3) USED MEMORY SIZE

: Display Software internal memory size

## 3. DATA SETUP

3-1. OPERATION FLOW




[ FLOW IV.2 : DATA SETUP MODE IN/OUT FOLW ]

3.2 MODE APPLICATION

The operating parameters of DIAGNOSTIC TOOL may be set prior to vehicle testing. The following list details items which are user configurable.

1) SOUND : Determines whether or not the internal beep sounds at each key depression.

2) LANGUAGE : Determines whether or not a local language is used.

3) UNIT CONVERSION : The units of measure used by DIAGNOSTIC TOOL may be selected from either of the following :

Speed : Km/h, MPH

Temperature : Fahrenheit, Centigrade

Pressure : kPa, mmHg, inHg, psi, mbar

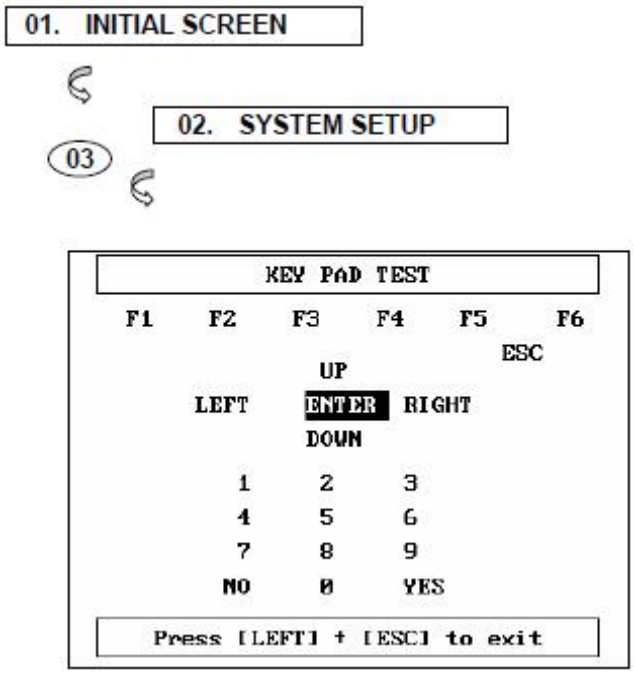
Angle : degree, percent

Airflow Volume : gm/s , Ib/m

Items are selected by using the LEFT / RIGHT key, and values may be changed using the UP / DOWN key.

## 4. KEY PAD TEST

4-1. OPERATION FLOW



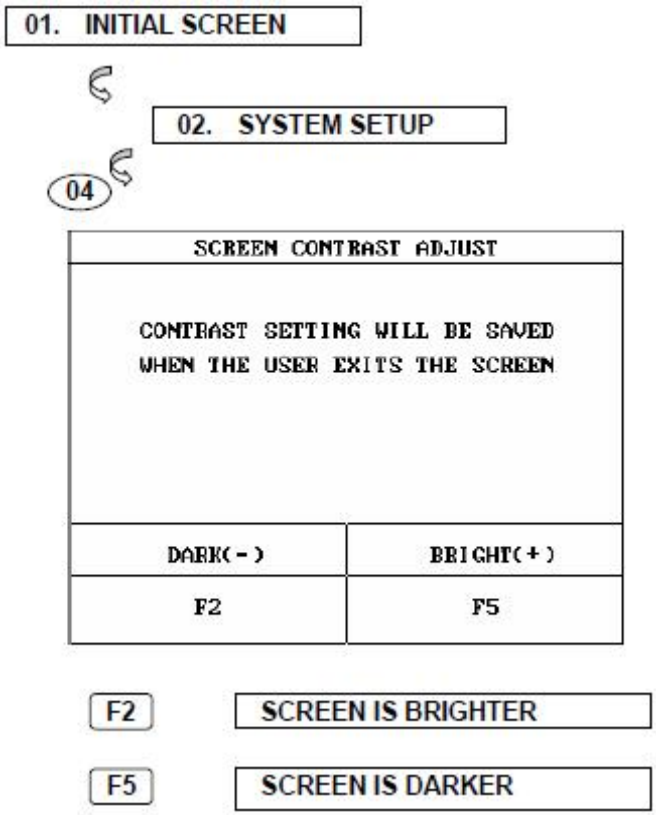

[ FLOW IV.3 : SYSTEM TEST MODE IN/OUT FLOW ]

4-2. MODE APPLICATION

User can perform DIAGNOSTIC TOOL self-test.

## 5. SCREEN CONTRAST ADJUST

5-1. OPERATION FLOW




[ FLOW IV.4 : CONTRAST ADJUST SCREEN ]

5-2. MODE APPLICATION

This mode is for contrast adjust screen because LCD' brightness will change according to the temperature.

Contrast settings will be saved when exiting the screen.

# APPENDIX

## App. A IMPORTANT MESSAGE

### DESCRIPTION

| ABNORMAL VEHICLE POWER<br>CHECK AND PRESS [ENTER] |
|---|

This message occurs when the external power supply is Not connected or is lower than 7.0V. The user must supply sufficient external power.

| CAN'T COMMUNICATION<br>PLEASE CHECK THE SYSTEM |
|---|

The DIAGNOSTIC TOOL cannot perform the Communication.
Because the system status is abnormal. The user must inspect the system.

| COMMUNICATION ERROR<br>CHECK THE SYSTEM, PRESS [ENTER] |
|---|

A communication error occurs when the DIAGNOSTIC TOOL.

Displays data which is received via communication. After checking the system, press the ENTER key.

| DIFFERENT SYSTEM<br>PLEASE CHECK THE SYSTEM |
|---|

This message occurs after opening the communication, when the system is different from the system selected by the user. After checking the system, the user should select the correct system again.

| NO RECORDED DATA OR<br>DIFFERENT SYSTEM DATA |
|---|

This message occurs when there is no recorded data or there is a different system data in the FLIGHT RECORD mode.

| NO TIPS. FOR MORE<br>INFORMATION SEE THE SHOP MANUAL |
|---|

This message occurs when the user selects an item that has no TIPS.

**NO TROUBLE CODE FOR TIPS**

This message occurs when the user presses the TIPS key, but there is no DTC in the DIAGNOSTIC TROUBLE CODES mode.

**SELECT ITEM WITH [FIX]**

This message occurs when the GRPH key is pressed without any item selected in the CURRENT DATA mode, or RCRD key is pressed without any item selected in the FLIGHT RECORD mode. In these cases, you must select an item with the FIX key.

**SYSTEM ROM ERROR!**

This message occurs when an error occurs in the ROM(Read Only Memory) of the DIAGNOSTIC TOOL. If you are having a problem with the DIAGNOSTIC TOOL, please try the procedures in appendix B.

## App.B TROUBLESHOOTING

1. START-UP TROUBLE

(1) Symptom
1) No BEEP sound after power ON key is pressed
2) Blank screen is displayed

(2) Causes Assumption and Recommended Trial
Causes Assume. 1: No power is supplied to the DIAGNOSTIC TOOL
Trial 1-1 : If power is supplied by DLC cable, check that the DLC cable is connected. If there is no problem with the DLC cable, change the power supply method.
Trial 1-2 : If power is supplied by AC/DC adapter, check that the AC/DC adapter voltage is over 12.0 volt. If there is no problem in the AC/DC adapter voltage, change the power supply method.

2. POWER SUPPLY TRIP MODE

To protect the DIAGNOSTIC TOOL and power supply from Harmful electrical shock-such as a surge in the power supply line-, there is a trip function in the DIAGNOSTIC TOOL power supply.

When the power supply has been tripped, the power supply status is still ON but the power supply has been halted. So this status can be mis-understood to be OFF status by the user, but the power supply is still alive. To release the trip mode, you must reset the power supply by pressing the ON/OFF key for more than 2 seconds (power OFF) and pressing the ON/OFF key for about 0.5 second (power ON).

A description of this trip function's symptom and recommended trial is described below.

(1) Symptom
1) LCD suddenly OFF, and no key operation can be performed in the power ON mode.
(2) Causes Assumption and Recommended Trial
Cause Assume. 1: The DIAGNOSTIC TOOL power supply has entered the trip mode for surge protection.
Trial 1-1 :
a. Press the ON/OFF key for more than 2 seconds to turn the power supply OFF.
b. Press the ON/OFF key for more than 0.5 second to turn the power supply ON.
c. In normal mode, the power supply can be restarted by the reset trip.
d. If a severe or continuous surge is sent to the DIAGNOSTIC TOOL power supply, physical recovery may be needed for the power supply of DIAGNOSTIC TOOL. This recovery may take a full day.

3. BLANK SCREEN DISPLAYED

(1) Symptom
1) BEEP sound after power ON key is pressed and a blank screen is displayed.

(2) Causes Assumption and Recommended Trial
Causes Assume. 1: LCD Contrast misadjusted
Trial 1-1 : Press the Left+F5 key or Left+F6 key after power ON if this problem is caused by maladjustment of the screen.

Causes Assume. 2 : Flash memory or ROM misinstalled.
Trial 2-1: Check the main board status.