FMON 2000

DIAGNOSTIC PROGRAM

The following information provides instructions for the use of GFI FIELD MONITOR PROGRAM

This software includes:

- ✓ **Easy to read graphical display**
- ✓ **Digital readout with Accurate, Real Time Information**
- ✓ **"At a glance" summaries of key operating conditions**
- ✓ **Temperatures displayed in Celsius**
- ✓ **Fuel Pressures in PSI**
- ✓ **Tank Pressure, Oxygen Sensor Voltage, Battery Voltage**
- ✓ **Selectable Serial Port**

GFI DIAGNOSTIC SOFTWARE

INTRODUCTION

FMON (Field MONitor) Release 2000 is a dynamic graphical monitoring program for *GFI* System installations. This program is designed for installers and end users that must do routine maintenance and diagnostics on vehicles that contain a *GFI* System.

NOTE: *This program does not replace installation software for dealers and installers. It DOES NOT provide for downloading new calibration files, extracting calibration files or modifying calibrations. Any actions that require these services must be done by an authorized dealer only.*

Specific monitor readout values are charted and furnished in the Service/Maintenance section of the Installation and Service Manuals for Natural Gas and Propane.

SYSTEM REQUIREMENTS

The system requirements for FMON are listed below.

- Minimum 386SX IBM compatible PC or Laptop
- MS DOS 5.0 or higher
- VGA compatible graphics display
- 640K on board RAM minimum, 1M extended memory recommended
- Coprocessor recommended but not required.
- Serial Port with a RS-232 9 pin connector
- RS-232 Cable (P/N NT20232)

PROGRAM INSTALLATION

FMON is designed to be installed on the hard drive of the diagnostic computer. To install the program and support files from floppy disk to the hard drive:

1. Turn on computer.

2. If DOSSHELL comes up on screen, press F3 to exit. The DOS prompt will then appear. If another program menu appears when the computer is turned on, follow the program directions to exit to the DOS prompt. The DOS prompt will appear as a blank screen with only C:\>.

3. Insert the supplied floppy disk then type a:install and hit the return or enter key.

   C:\>A:INSTALL↵

4. The installation program will display several messages as installation occurs. The program will create a directory called "GFI" if one does not already exist, then the install program will copy the following files to that directory:
   - FMON.EXE executable program file
   - 12.SYM symbol table for code 12 kits
   - 13.SYM symbol table for code 13 kits
   - Other NNN.SYM files as required.

NOTE: *All files must be in the GFI directory for the program to operate.*

GFI DIAGNOSTIC SOFTWARE

OPERATING FMON

To run FMON follow the basic steps below:

1. Using the RS-232 cable (P/N NT20232), connect the *GFI* computer (J8) to the RS-232 port on the computer.
2. Turn on computer.
3. At the DOS prompt, change the directory to GFI. At the DOS prompt type CD\GFI and hit the return or enter key.

   C:\>CD\GFI↵

4. At the DOS prompt, type FMON and hit the return or enter key.

   C:\GFI>FMON↵

   NOTE: *The default serial port is Comm 1, to select Comm 2 type FMON -2*

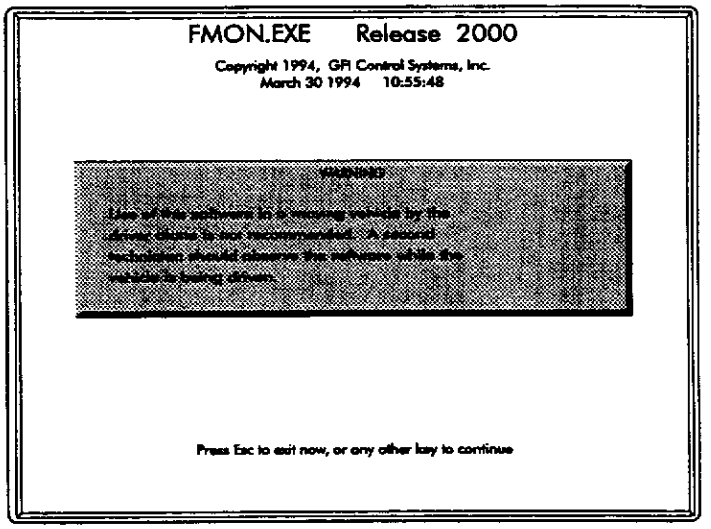
   C:\GFI>FMON -2↵

   This is only required for the first time use, the program will "remember" the port.

5. If not previously done, turn vehicle ignition key to "ON" position.

OPENING SCREENS AND MAIN MENU

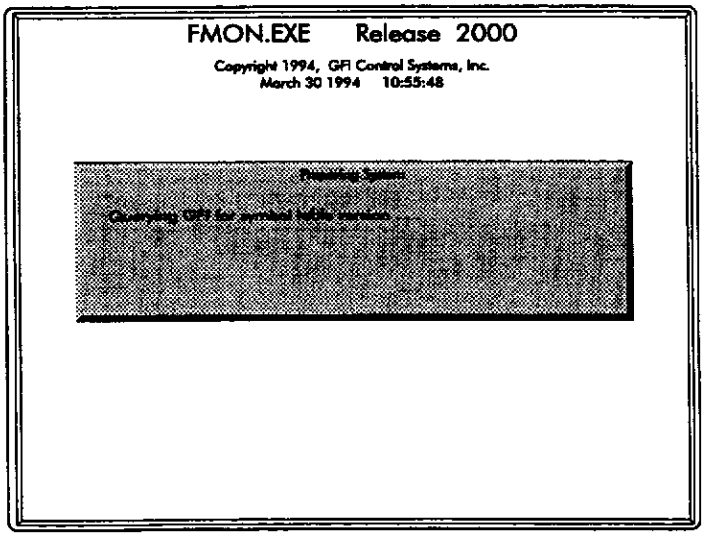
The first screen displayed contains an important warning against driving a vehicle and running the monitor at the same time. Please read and comply with the instructions.



WARNING: *It is important that the operator of any vehicle pay full attention to driving -- the graphical monitor should be viewed only by a passenger while the vehicle is in motion.*

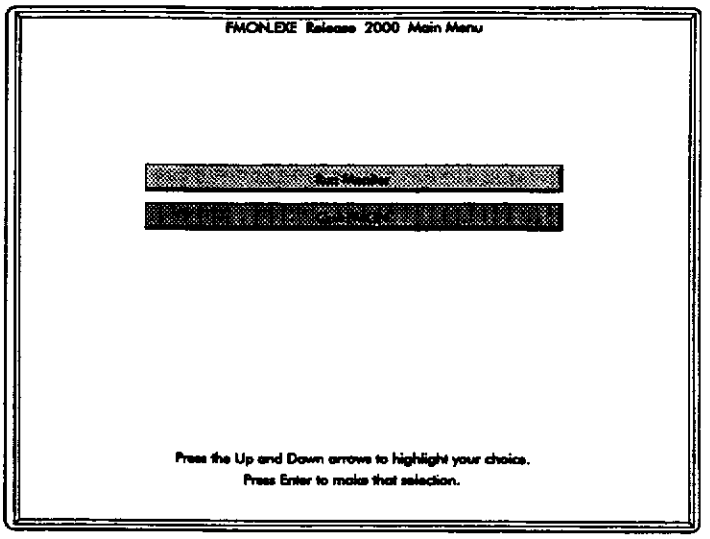
Hit any key to continue.

FMON now attempts to establish a connection with the GFI kit. If the ignition power is off or a fuse is blown or the kit cannot communicate for any reason, a message will appear indicating FMON could not establish a link to the kit. Use the troubleshooting procedure outlined in the Troubleshooting guide if this occurs.

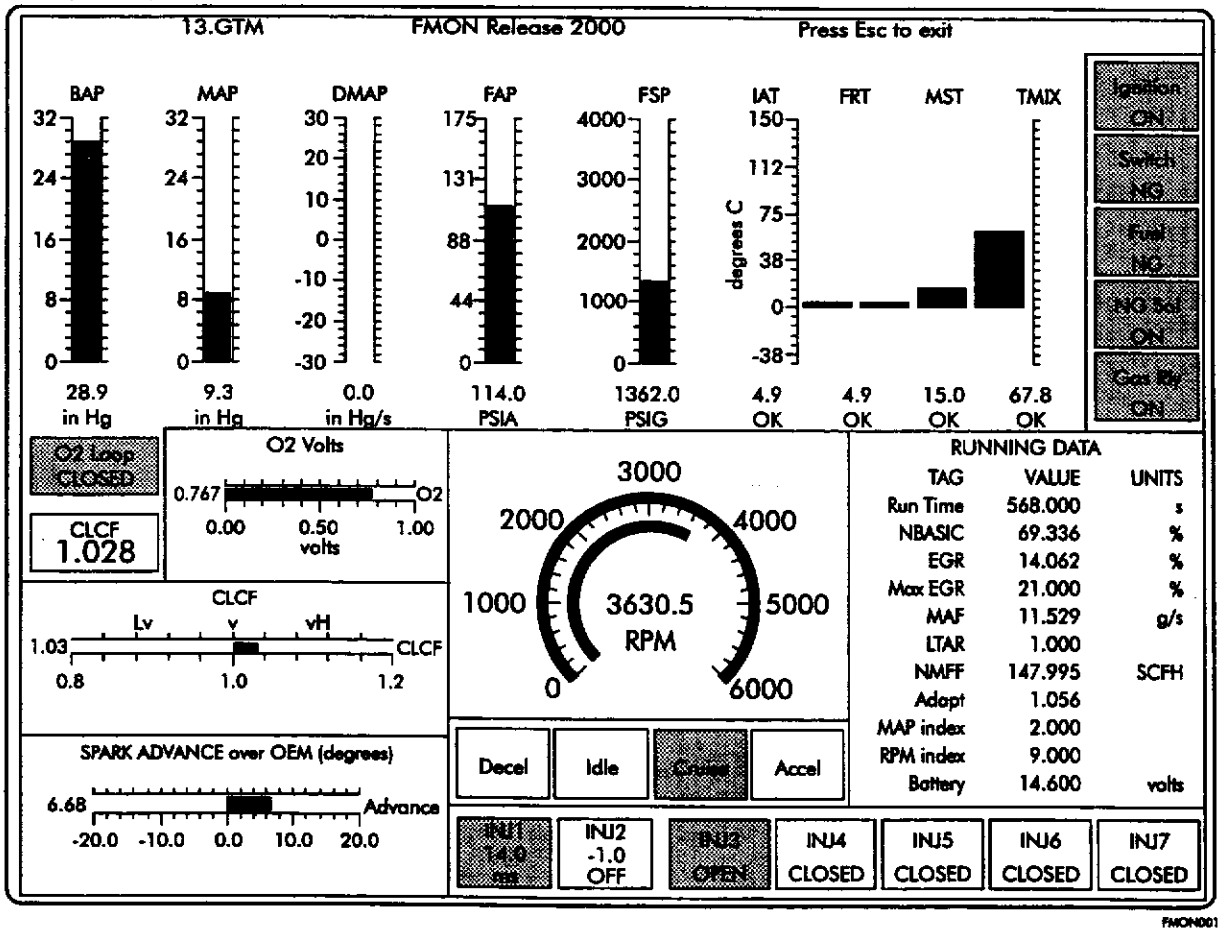


GFI DIAGNOSTIC SOFTWARE

With proper connection established, the main menu appears. The program menu is extremely simple. There are only two options: Run the monitor or Quit. Using the cursor (arrow) keys, highlight the option to use. Hit the return or enter key.



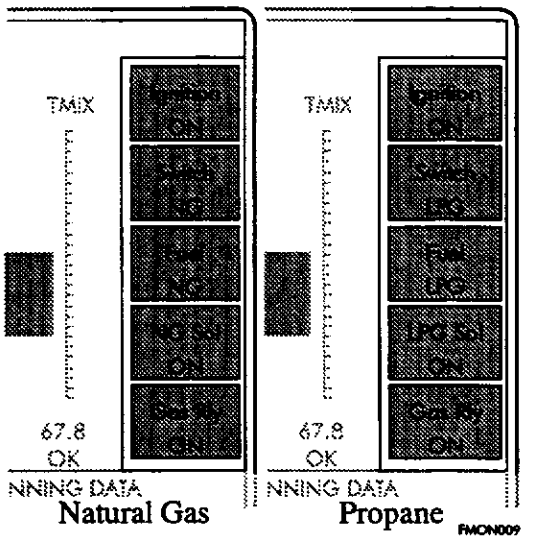
THE MONITOR SCREEN



The information display is divided into 8 functional groups. These are: System Status Indicators; Pressures; Temperatures; Closed Loop Control; Spark Advance (TDC); TACH and Engine Mode; Injector Status and Running Data.

SYSTEM STATUS INDICATORS

This block is located in the upper right of the screen and displays the status for ignition, dash switch, running fuel, high pressure solenoid and gasoline cut-out relay.



IGNITION — ON when the kit is powered up.

SWITCH — NG, LPG or GASO depending on the fuel selector switch setting.

FUEL — NG or LPG if switch = NG or LPG and there is sufficient FAP.

NG SOLENOID — ON if the high pressure solenoid is energized. (Running alternate fuel)

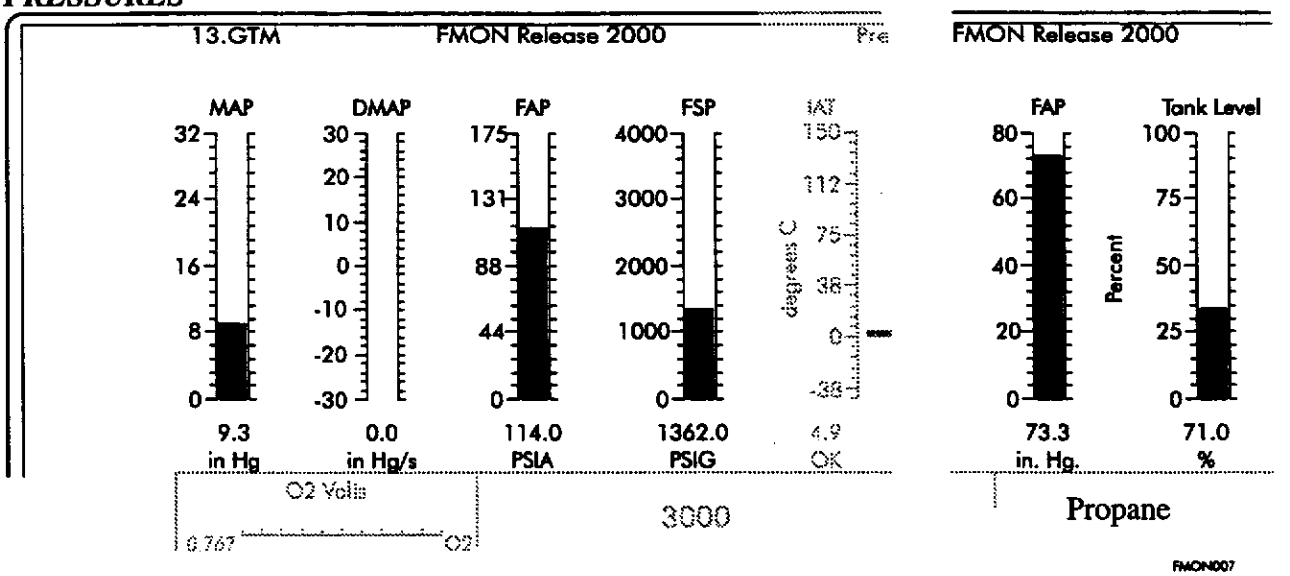
GAS RELAY — ON if the gasoline injector cut-out relay is energized (Running alternate fuel).

NOTE: *The GAS RLY status will still be ON even if no relay is required - such as for monofuel applications.*

These indicators will all be highlighted when GFI is running normally on alternate fuel. If any condition exists to prevent running CNG or LPG, one or more indicators will "turn off."

NOTE: *After 20 seconds of Key On Engine Off, the High Pressure solenoid of the Natural Gas Regulator and the Shutoff Solenoid of the Propane Vaporizer will shut off as a safety feature.*

PRESSURES



The upper left block of information shows the various pressure sensor readings from GFI. The information is displayed by a graph barometer. Directly below the barometer is a text readout of the measurement. The measured pressures are:

BAP — Barometric Absolute Pressure. This display indicates the ambient outside air pressure. Measured in inches of Mercury (Hg). Values will vary with altitude. High altitude (Denver, Colorado) measures approximately 25 inches of Hg. A lower altitude would be closer to 29 inches of Hg.

MAP — Manifold Absolute Pressure. The difference between BAP and Manifold vacuum. During closed throttle coast down - value will be low. Wide open throttle operation would produce a high value. The high value is produced when the pressure inside the manifold is almost the same as the pressure outside the manifold. This value is opposite of what would be indicated on a vacuum gauge.

DMAP — Delta Manifold Absolute Pressure. The rate of change of MAP measured in inches of Hg per second. This value should be fairly steady. This display is similar to installing a vacuum gauge on the engine and watching for a steady needle. Rate of change should be within ± 5 inches Hg during steady throttle (DMAP positive = increasing MAP). Higher rates (± 30 in. Hg) may be observed during transients.

FAP — Fuel Absolute Pressure. Measured between the regulator and the compuvalve (low pressure side). The standard delivery pressure is approximately 115 psia (100 psig) for CNG, 60 to 70 inches Hg for propane.

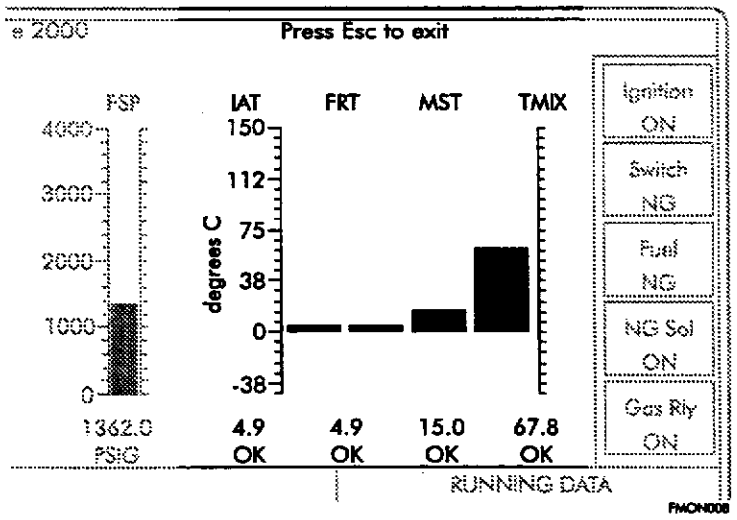
FSP — Fuel Storage Pressure. Tank pressure at the regulator inlet (high pressure side), in PSI Gauge. For propane systems, FSP is replaced by Tank Level, which is based on a tank mounted float sensor and reads 0% to 100%.

These values are based on sensor input. BAP, MAP and FAP sensors are located inside the compuvalve. The FSP sensor is mounted on the regulator. DMAP is calculated as MAP changes. None of these items are serviceable.

TEMPERATURES

This is the graphic display located in the upper center of the screen. GFI uses temperature readings to determine air and fuel density. The key temperatures used by GFI are displayed as follows:

The status display will say "OK" if Temperature is in range (-40° to 150° C), "HIGH" if above range and "LOW" if below range.



IAT — Intake Air Temperature. (An open sensor will read 100C) On Heavy Duty Systems, the IAT reads intake air-fuel temperature.

FRT — Fuel Regulated Temperature.

MST — Manifold Skin Temperature. An open sensor will read -43C.

TMIX — MIXture Temperature. Calculated temperature of the engine heated air-fuel mixture.

All temperatures are displayed in degrees Celsius. Below is a conversion chart for Celsius/ Fahrenheit/Kelvin.

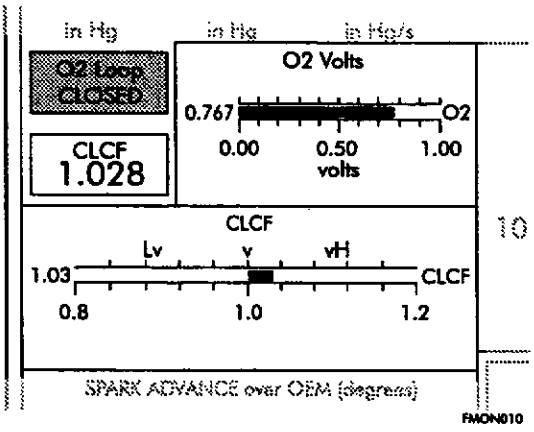
UNITS → / FROM ↓	TO Celsius (°C)	TO Fahrenheit (°F)	TO Kelvin (°K)
Celsius (°C)	_____	(°C x 1.8) + 32	°C + 273
Fahrenheit (°F)	$\frac{°F - 32}{1.8}$	_____	$\frac{°F - 32}{1.8} + 273$
Kelvin (°K)	°K - 273	((°K-273) x 1.8) + 32	_____

Below are some practical examples for reference:

Application	Celsius (°C)	Fahrenheit (°F)
GFI Minimum Operating Temperature	-40°	-40°
Freezing Point of Water	0°	32°
Room Temperature	25°	77°
Boiling Point of Water	100°	212°
GFI Maximum Operating Temperature	125°	257°

CLOSED LOOP CONTROL

This block provides the status of the closed loop fuel control. The upper left indicator shows whether GFI is in OPEN or CLOSED loop. Below this is a digital display of the current value of CLCF, the Closed Loop Correction Factor. The bar graph shows where CLCF is on a scale of .8 to 1.2. CLCF can be thought of as a fueling multiplier. If CLCF < .9 - GFI is correcting for excess fuel (rich). If CLCF > 1.1 - GFI is correcting an underfueling (lean) condition. During steady state idle or cruise, CLCF should remain within the .9 to 1.1 range. Transients may force CLCF outside this range. On a properly running system, CLCF will toggle above and below 1.00. CLCF is based on feedback from the oxygen sensor.

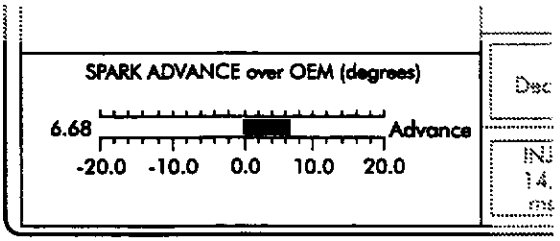


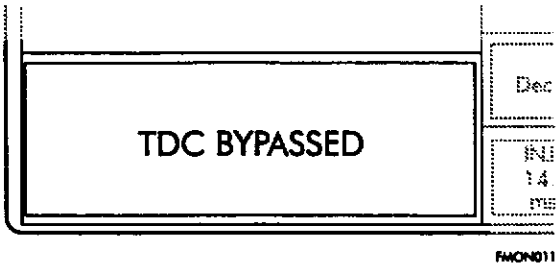
The oxygen sensor voltage is shown by the last bar graph. This is the actual signal output from the sensor. Normal operating range for a O2 sensor is about .2 volts when lean and about .8 volts when rich. If the maximum O2 voltage is less than .7, it may indicate a weak or failing O2 sensor.

NOTE: *Closed Loop Control information is active only for non-heavy duty applications. Heavy duty applications do not currently use O2 sensors for Closed Loop control. This block will be inactive for such systems.*

SPARK ADVANCE (TDC)

Spark advance is shown in the lower left corner of the screen. If GFI is not advancing timing, this block will indicate "TDC BYPASSED". On some systems, an elevated rpm may be required before GFI will start intercepting the timing signal. It is important to note the following points about the spark advance value displayed:





1) For emissions optimization, GFI may apply an emission retard value to spark advance. This retard value is not displayed.

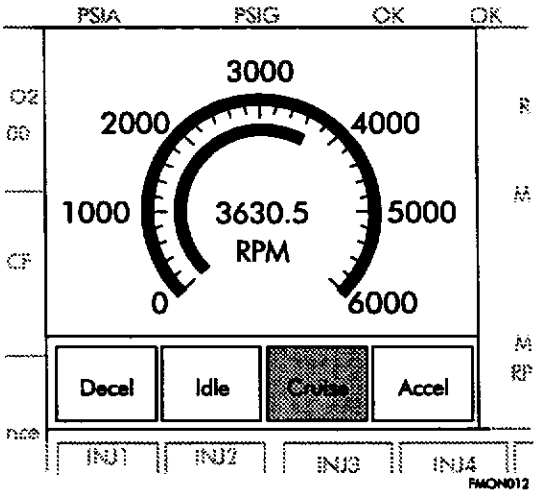
2) The value displayed represents the number of degrees GFI is ADDING to base vehicle timing. Actual spark advance at any time is:
base vehicle base timing + GFI advance value (DISPLAYED) - emissions retard (NOT DISPLAYED)

3) For propane, GFI may retard base vehicle timing.

4) The best way to verify spark advance is to use a timing light. The value displayed on the monitor screen is system strategy. A timing light will measure actual.

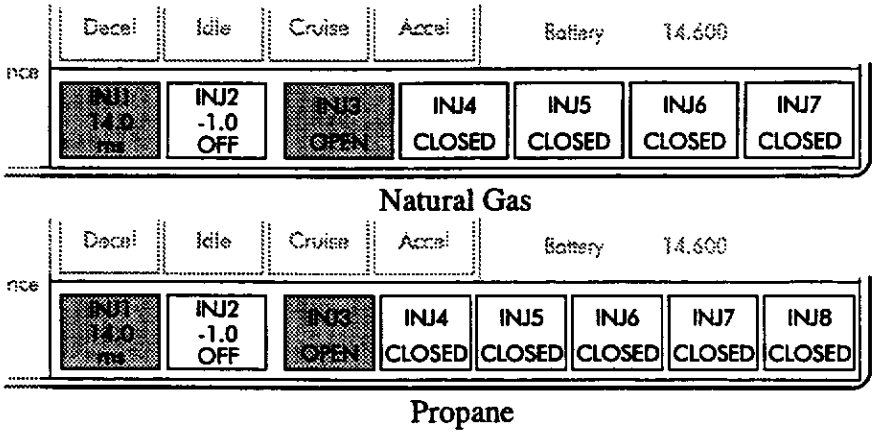
TACH AND ENGINE MODE

The central block of the monitor screen shows a familiar tachometer display of RPM. Below the tachometer is a set of indicators showing the current engine mode as determined by GFI. The possible modes are DECEL, IDLE, CRUISE, and ACCEL. These modes may not always seem appropriate (for example, ACCEL may light while the vehicle is idling), but GFI is constantly monitoring MAP and RPM fluctuations to anticipate mode switches -- so that brief mode changes are normal.



INJECTOR STATUS

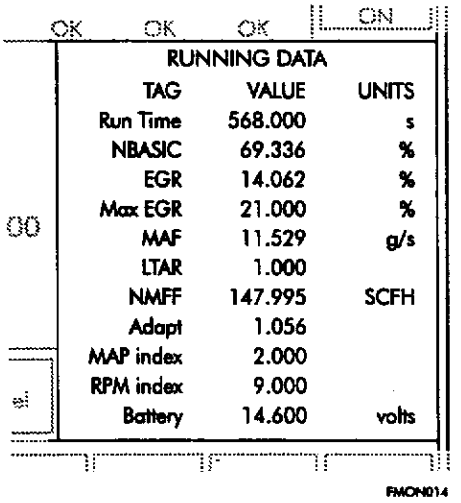
This block displays the status of the GFI fueling injectors. Injectors 1 and 2 are "low flow" injectors, which may be ON, OFF, or PULSED. If pulsed, the pulse width is shown in milliseconds (ms). The "high flow" injector status will be either OPEN (on) or CLOSED (off). In all cases, an injector in use will be highlighted on the monitor. For propane systems, an eighth injector status is displayed.



NOTE: *The status indicator may indicate an injector as OPEN when the system is disconnected or running gasoline - this does not mean that the injector is open and flowing fuel when it is not actually energized. This point is important to remember when troubleshooting.*

RUNNING DATA

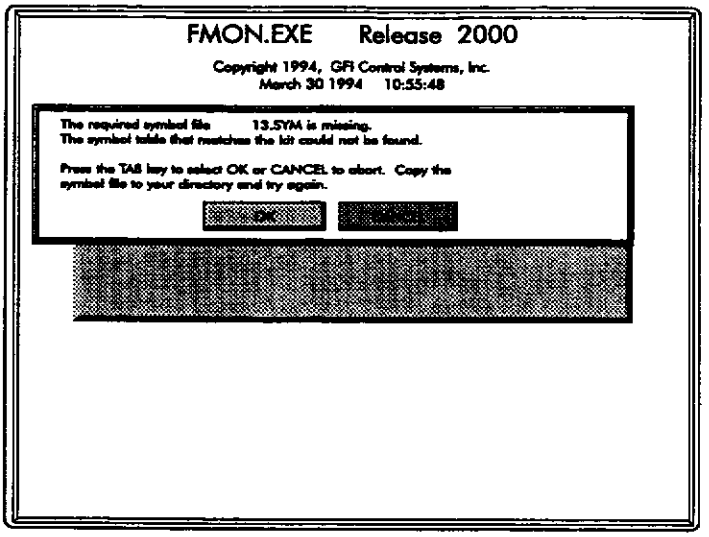
The final block of information collects several useful values used by GFI. These are:



Run Time	Elapsed time since last GFI System reset by power down.
NBASIC	Current estimated volumetric efficiency. A higher number indicates a better breathing engine, and a higher fuel demand.
EGR	Estimated rate of EGR at the current operating point.
Max EGR	The maximum EGR rate for this engine.
MAF	Mass Air Flow - calculated based on speed density.
LTAR	TARget Lambda. 1.00 indicates a stoichiometric target. Lean burn systems will typically display LTAR about 1.2 to 1.6
NMFF	Normalized Mass Fuel Flow. This value indicates how much fuel GFI has calculated to deliver. Units are standard cubic feet per hour; scfh.
Adapt	This indicates the current long term adaptive learn value. A value below .8 or above 1.2 may indicate a past fueling or calibration problem.
MAP Index	The current operating point from 0 (low MAP) to 12 (high MAP)
RPM Index	The current operating point from 0 (low RPM) to 15 (high RPM)
Battery	The actual voltage feed to GFI. This may be useful to diagnose hard starting conditions.

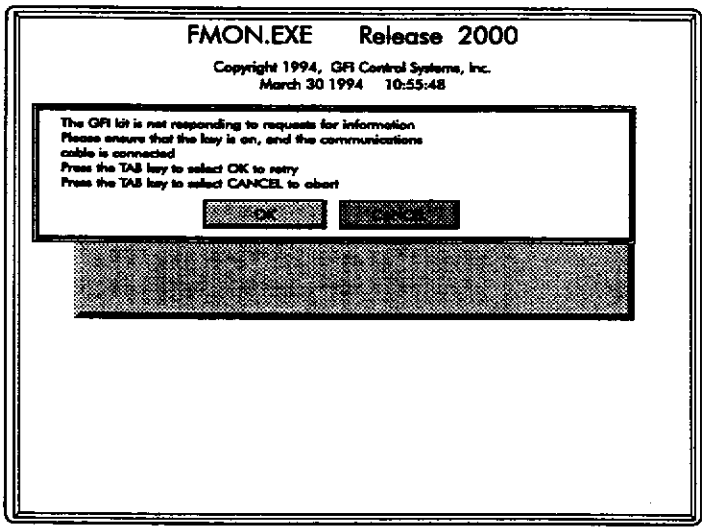
ERROR MESSAGES

There are three warning screens that may appear if there is a communication/operations fault.



SYMBOL TABLE NOT FOUND

During opening screens, after the "Querying GFI for symbol table version", if FMON cannot locate the correct symbol table for the installation, the message at the right will appear. If this occurs, exit the program and ensure that the correct NNN.SYM file is located in the GFI directory. Restart program.

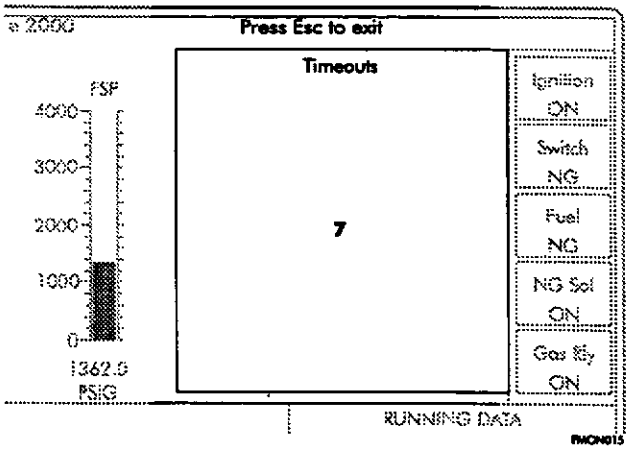


KIT DOES NOT RESPOND

During opening screens, after the "Querying GFI for symbol table version", if FMON cannot communicate with the GFI computer, the message on the right will appear. Check that the ignition key is "ON" and the RS-232 cable is properly attached to the GFI computer and the laptop. If the problem persists, consult the GFI Troubleshooting Manual.

TIMEOUT DURING OPERATION

If FMON loses communication with a GFI compuvalve, a timeout message will appear over the temperature display. The timeout counter will increment as long as FMON is trying to re-establish a link to the kit. This number is reset to 0 when FMON is restarted from the opening menu. Occasional Timeouts are normal during hard accelerations or high RPM operation when GFI ignores communications while prioritizing high speed fueling calculations.



MONITOR READOUT VARIABLES

The monitor readout variables are described below. Under "System INFLUENCE", the system elements that can affect the monitored value are given.

VARIABLE	DESCRIPTION	System INFLUENCE
SYSTEM STATUS INDICATORS	These variables display the status for ignition, dash switch, running fuel, high pressure solenoid, gasoline cut-out relay and current operation mode. These indicators will all be highlighted when GFI is running normally on alternate fuel. If any condition exists to prevent running CNG, one or more indicators will "turn off."	
IGNIT	ON when the kit is powered up.	1. Always On 2. SW B+
SWITCH	NG LPG or GASO depending on the fuel selector switch setting. **NOTE:** *Will read GASO after autoswitching*	1. Switch
FUEL	NG or LPG, if SWITCH = GFI and there is sufficient FAP.	1. Switch 2. FAP Sensor 3. Regulator
NG_SOL	ON if the high pressure solenoid is energized. (Running alternate fuel) **NOTE:** *After 20 seconds of key on engine off, the NG solenoid of the Natural Gas Regulator will shut off as a safety feature.*	1. Switch 2. FAP Sensor 3. TACH Signal
GAS_RLY	ON if the gasoline injector cut-out relay is energized (Running alternate fuel). **NOTE:** *The GAS RLY status will still be ON even if no relay is required - such as for monofuel applications.*	1. Switch 2. FAP Sensor
OP_MODE	SHUTDOWN, STALL, CRANK or RUN describes current operating status of engine.	1. SW B+ 2. TACH Signal
PRESSURES	These values are based on sensor input. BAP, MAP and FAP sensors are located inside the compuvalve. The FSP sensor is mounted on the regulator. DMAP is calculated as MAP changes. None of these items are serviceable.	
BAP	Barometric Absolute Pressure. This display indicates the ambient outside air pressure. Measured in inches of Mercury (Hg). Values will vary with altitude. High altitude (over 5,000 feet) measures approximately 25 inches of Hg. A lower altitude (sea level) would be closer to 29 inches of Hg.	1. Internal BAP Sensor
MAP	Manifold Absolute Pressure. The difference between BAP and Manifold vacuum. During closed throttle coast down - value will be low. Wide open throttle operation would produce a high value. The high value is produced when the pressure inside the manifold is almost the same as the pressure outside the manifold. This value is opposite of what would be indicated on a vacuum gauge.	1. Vacuum Leaks 2. Compuvalve Sensor 3. Overfueling

VARIABLE	DESCRIPTION	System INFLUENCE

3.4.2 PRESSURES (CONT.)

DMAP	Delta Manifold Absolute Pressure. The rate of change of MAP measured in inches of Hg per second. This value should be fairly steady. This display is similar to installing a vacuum gauge on the engine and watching for a steady needle. Rate of change should be within ± 5 inches Hg during steady throttle (DMAP positive = increasing MAP). Higher rates (± 30 in. Hg) may be observed during transients.	1. MAP Takeoff 2. Damper Tube 3. Base Engine Operation
FAP	Fuel Absolute Pressure. Measured between the regulator and the compuvalve (low pressure side). The standard delivery pressure is approximately 115 psia (100 psig).	1. Fuel Flow / Supply 2. Coalescent Filter 3. Regulator 4. Regulator Filter 5. Compuvalve Sensor 6. Ground Plane Volts
FSP	Fuel Storage Pressure. For NG - Tank pressure at the regulator inlet (high pressure side), in PSI Gauge. **NOTE:** *This value will read extremely high (>36000) when running Gasoline..* For LPG - % level of liquid propane in tank	1. Fuel Flow / Supply 2. Coalescent Filter 3. Regulator 4. Regulator Filter 5. Fuel Storage Sensor

TEMPERATURES

The compuvalve uses temperature readings to determine air and fuel density. The key temperatures used are:

IAT	Intake Air Temperature. (An open sensor will read 100°C)	1. External Sensor
FRT	Fuel Rail Temperature.	1. Internal Sensor
MST	Manifold Skin Temperature. An open sensor will read -43C.	1. External Sensor
TMIX	MIXture Temperature. Calculated temperature of the engine heated air-fuel mixture.	1. IAT 2. MST 3. FRT

All temperatures are displayed in degrees Celsius. Below is a conversion chart for Celsius/ Fahrenheit/Kelvin.

UNITS→TO ↓ FROM	Celsius (°C)	Fahrenheit (°F)	Kelvin (°K)
Celsius (°C)	_____	(°C x 1.8) + 32	°C + 273
Fahrenheit (°F)	$\frac{°F - 32}{1.8}$	_____	$\frac{°F - 32}{1.8} + 273$
Kelvin (°K)	°K - 273	((°K-273) x 1.8) + 32	_____

Below are some practical examples for reference:

Application	Celsius (°C)	Fahrenheit (°F)
Minimum System Operating Temperature	-40°	-40°
Freezing Point of Water	0°	32°
Room Temperature	25°	77°
Boiling Point of Water	100°	212°
Maximum System Operating Temperature	125°	257°

VARIABLE	DESCRIPTION	System INFLUENCE
CLOSED LOOP CONTROL		
	This block of information provides the status of the closed loop fuel control.	
O2_LOOP	OPEN/CLOSED. Shows whether the Natural Gas system is operating in OPEN or CLOSED loop.	1. Oxygen Sensor 2. Warm-up Delay Time
CLCF	CLOSED LOOP CORRECTION FACTOR. CLCF can be thought of as a fueling multiplier. If CLCF < .9 - compuvalve is correcting for excess fuel (rich). If CLCF > 1.1 - GFI is correcting an underfueling (lean) condition. During steady state idle or cruise, CLCF should remain within the .9 to 1.1 range. Transients may force CLCF outside this range. On a properly running system, CLCF will toggle above and below 1.00. CLCF is based on feedback from the oxygen sensor.	1. Oxygen Sensor 2. Fueling Components -Regulator -Injectors 3. Fuel Calculation Inputs -MAP, RPM, FRT 4. Engine Condition
O2_VOLTS	OXYGEN VOLTAGE. This is the actual signal output from the sensor. Normal operating range for a O2 sensor is about .2 volts when lean and about .8 volts when rich. If the maximum O2 voltage is less than .7, it may indicate a weak or failing O2 sensor.	1. O2 Sensor 2. Exhaust Content 3. Ground Plane Voltage
SPARK ADVANCE (TDC)		
	It is important to note the following points about the spark advance value displayed:	
ADVANCE	1) For emissions optimization, the system may apply an emission retard value to spark advance. This retard value is not displayed. 2) The value displayed represents the number of degrees the system is ADDING to base vehicle timing. Actual spark advance at any time is: **base timing + advance value - emissions retard (not displayed)** 3) The best way to verify spark advance is to use a timing light. The value displayed on the monitor screen is system strategy. A timing light will measure actual.	1. MAP 2. RPM 3. TMIX
TDC_BY	TDC BYPASSED. If timing is not being advanced, this variable will indicate "TDC BYPASSED". On some systems, an elevated rpm may be required before the compuvalve will start intercepting the timing signal.	1. PIP Signal Input 2. Running Time 3. RPM 4. Fuel = NG
TACH AND ENGINE MODE		
RPM	RPM. Revolutions Per Minute.	1. PIP Signal Input
ENGMODE	ENGINE MODE. Shows the current engine mode as determined by the compuvalve. The possible modes are DECEL, IDLE, CRUISE, and ACCEL (D/I/C/A). These modes may not always seem appropriate (for example, ACCEL may light while the vehicle is idling), but the compuvalve is constantly monitoring MAP and RPM fluctuations to anticipate mode switches – so that brief mode changes are normal.	1. RPM 2. MAP 3. DMAP

VARIABLE	DESCRIPTION	System INFLUENCE
INJECTOR STATUS		
This block displays the status of the GFI fueling injectors.		
INJ1, INJ2	Injectors 1 and 2 are "low flow" injectors, which may be ON, OFF, or PULSED. If pulsed, the pulse width is shown in milliseconds (ms).	1. Fuel Demand
INJ3 thru INJ8	The "high flow" injector status will be either OPEN (on) or CLOSED (off). In all cases, an injector in use will be highlighted on the monitor.	1. Fuel Demand
NOTE: *The status indicator may indicate an injector as OPEN when the system is disconnected or running gasoline - this does not mean that the injector is open and flowing fuel when it is not actually energized. This point is important to remember when troubleshooting.*		
RUNNING DATA		
The final block of information collects several useful values used by the computer. These are:		
ENGRUN	Elapsed time since last system reset by power down.	1. RPM/TACH Signal 2. B+ / SW B+
NBASIC	Current estimated volumetric efficiency. A higher number indicates a better breathing engine, and a higher fuel demand.	1. Calibration *(not serviceable)*
EGR	Estimated rate of EGR at the current operating point.	1. Calibration *(not serviceable)*
Max EGR	The maximum EGR rate for this engine.	1. Calibration *(not serviceable)*
MAF	Mass Air Flow - calculated based on speed density.	1. Calculated
LTAR	TARget Lambda. 1.00 indicates a stoichiometric target. Lean burn systems will typically display LTAR about 1.2 to 1.6.	1. Calibration *(not serviceable)*
NMFF	Normalized Mass Fuel Flow. This value indicates how much fuel the compuvalve has calculated to deliver. Units are standard cubic feet per hour; scfh.	1. Calculated
ADAPT	This indicates the current long term adaptive learn value. A value below .8 or above 1.2 may indicate a past fueling or calibration problem.	1. CLCF 2. Fuel Composition 3. Engine Wear
MAP_INX	MAP INDEX. For fueling calculations, the compuvalve uses lookup tables for volumetric efficiency, EGR rates, etc. MAP_INX is a "pointer" into these tables. It is the current operating point from 0 (low MAP) to 12 (high MAP).	1. MAP
RPM_INX	RPM INDEX. For fueling calculations, the compuvalve uses lookup tables for volumetric efficiency, EGR rates, etc. RPM_INX is a "pointer" into these tables. It is the current operating point from 0 (low RPM) to 15 (high RPM).	1. RPM
BATTERY	The actual voltage feed to the system. This can be useful to diagnose hard starting conditions.	1. B+