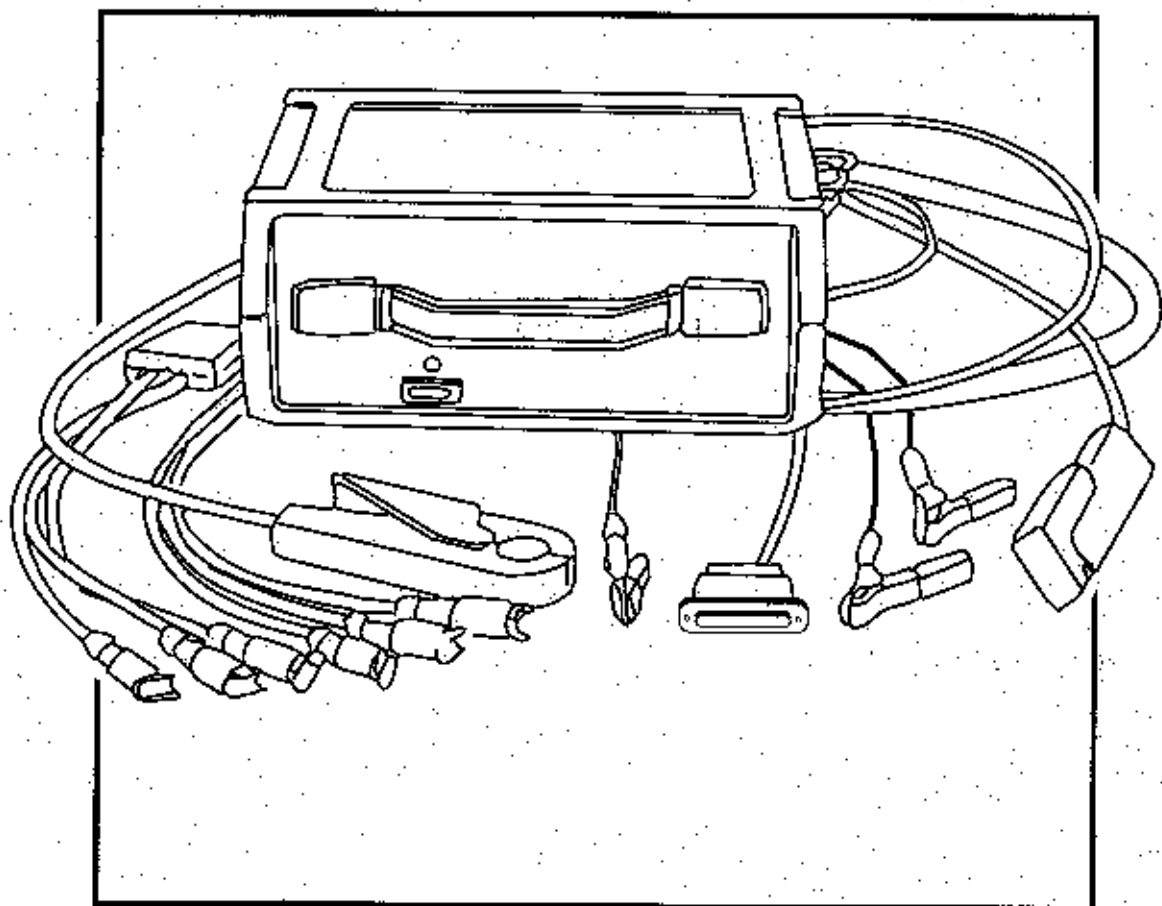


Operation & Maintenance Instructions



Engine Analyzer Module

Engine Analyzer Module

Operation & Maintenance Instructions

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Written and edited by D. Siwula, B. Ward, and H. Phillips

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Introduction

The Engine Analyzer Module is designed to add full-function engine analysis capability to any compatible host system.

A complete assortment of test leads permits fast and easy hookup to both conventional and DIS vehicles. The portable module is connected to the host system by an RS-232 cable which plugs into any open COM Port on the host system computer.

About The Manual...

Figure 1 details the features on each page which will allow the reader to find and understand information quickly and easily.

1 Chapter Heading - Allows the reader to locate main section headings while "thumbing through" the manual.

2 Topic Headings - Identifies major topics within the chapter.

3 Topic Sub-Headings - Calls attention to important concepts.

4 Illustrations - Explain important ideas or procedures.

5 Important Reader Messages:



When this symbol appears, the potential exists for serious injury and/or damage to the analyzer. READ AND FOLLOW THE INSTRUCTIONS IN THIS TYPE OF NOTE CAREFULLY!



Information in this type of note is extremely important and may affect analyzer operation and test result quality. **READ THESE NOTES CAREFULLY!**



Notes contain helpful hints and tips to make operating the analyzer easier.

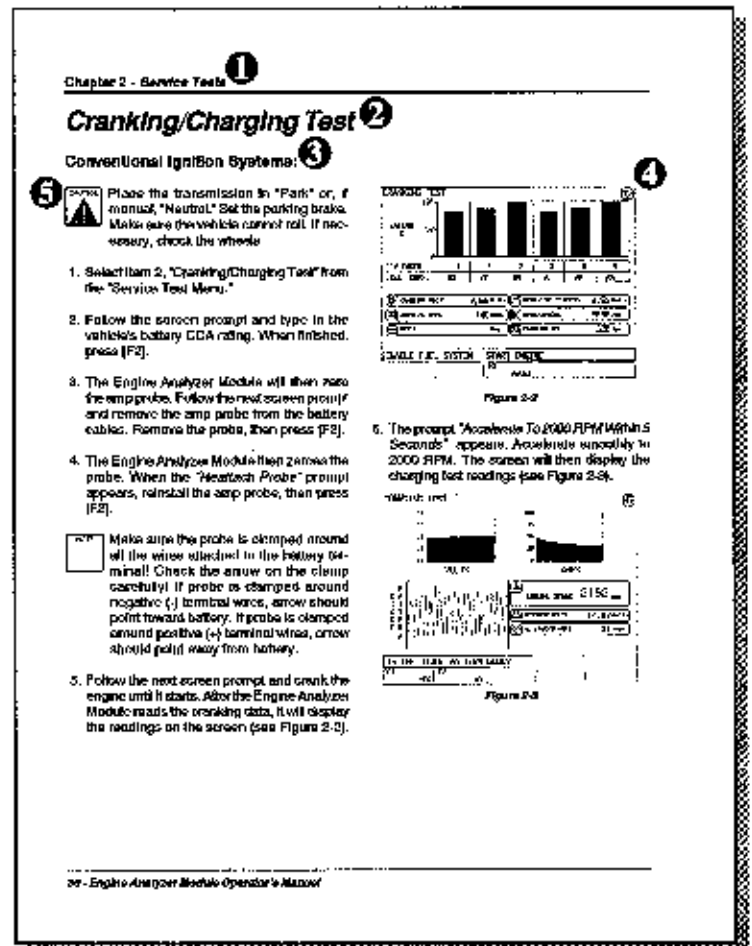


Figure 1-1

Safety Precautions

General

- To prevent electrical shock, avoid wet floors when making electrical connections.
- Read the operating instructions before attempting to operate the equipment. Keep this manual with your analyzer at all times.

Personal Safety

Read all service procedures and precautions, installation instructions and equipment operating manuals thoroughly. Failure to observe these precautions, or the improper use of equipment, could result in property damage, serious injury or death. Never allow improperly trained personnel to perform these procedures or operate equipment.

Ventilation

- Provide ventilation through an exhaust gas removal system, ventilation fans or large doors. Inhalation of carbon monoxide gas emission, which is odorless, will cause a person to suffer slowed reaction and may lead to serious injury when working around an engine.

Batteries

Automotive batteries contain sulfuric acid and produce explosive gases. To avoid battery explosion and serious injury or death, follow these important safety precautions whenever servicing batteries or performing tune-up procedures:

- Wear Safety Goggles!
- Keep lighted cigarettes, sparks, flames or other ignition sources away from battery at all times.
- DO NOT lay tools or equipment on battery. Accidentally grounding the "hot" battery terminal can cause shock, burns, and damage to wiring, battery, tools or tester.
- DO NOT wear jewelry, rings, watches or metal belt buckles when working on or around batteries.
- Cover battery vents with damp cloth to suppress explosive gases before load testing or charging.
- NEVER lean over battery during testing or charging.
- When connecting battery test leads, avoid sparks which could cause the battery to explode.
- Avoid spilling or splashing electrolyte on skin, eyes or clothing. Electrolyte contains sulfuric acid, is poisonous and causes severe burns.
- Be sure work area is well ventilated and has access to water should flushing be required.

*Safety Precautions (continued)***Make Sure the Vehicle Cannot Move During Testing and Tune-Up**

- Before testing vehicles, place the automatic transmission shift lever in the "Park" position, or manual transmission in "Neutral."
- Securely set the parking or emergency brake on test vehicles. If there is any possibility the vehicle will roll, block the wheels.
- Some vehicles have an automatic release on the parking brake when the vehicle is put in gear. Disconnect and plug automatic release vacuum hose before performing any tests while vehicle is in "Drive." If there is any doubt whether the vehicle will remain immobile, block the wheels.
- Make sure motor mounts are in good condition. Broken motor mounts can cause an engine to jump into gear, or the throttle to stick when the engine is accelerated.
- Take the vehicle out of gear after setting the carburetor. DO NOT rev the engine when the transmission is in "Drive."

Personal Injury

Protect Face, Hands and Feet From Burns and Other Injury:

- NEVER smoke or light a match when working on a vehicle, since gasoline vapor and battery gases are highly flammable and explosive.
- Make sure all electrical connections are tight. An improperly grounded condenser can cause engine backfire. NEVER look directly into the carburetor throat while the engine is cranking or running, since backfire can cause severe burns and injury.
- NEVER remove radiator pressure cap when system is under pressure or before the engine has cooled. Steam or hot coolant can cause burns if cap is removed before pressure is allowed to escape or while engine is hot.
- Avoid contact with hot surfaces such as spark plugs, exhaust manifolds and pipes, mufflers, catalytic converter, resonator, radiator and hoses, etc.
- NEVER pour gasoline down the carburetor to start the engine.
- When engine is running, DO NOT touch spark plug ignition cable wires, ignition coil or distributor cap.

- Turn off ignition key before installing, working on or adjusting contact sets, condensers, or other ignition parts.
- Handle extension lights carefully, using only bulb-protector types. Route the cord safely outside or above engine compartment.
- Use proper tools and extensions carefully to avoid cuts and bruises on sharp engine parts when installing spark plugs in hard to reach cylinders.
- Wear safety goggles to protect eyes from loose material flying off moving engine parts.
- When working under the hood, make sure fan blades, belts, pulleys, etc. are in good condition. Any fan blade can break, especially when it has been bent.
- Keep out of a direct line with fan blades, especially when testing timing advance with a timing light.
- Keep hands, hair and clothes clear from any moving parts, including throttle and transmission linkages.
- NEVER wear neckties, loose clothing, wrist watches, rings or other jewelry when working on a vehicle. They could catch on moving parts or cause an electrical short circuit resulting in severe electrical shock and burns.
- Remove tools from vehicle before starting engine. Tools can fall into moving components and be propelled into the air, which could result in property damage or injury.
- Avoid bringing hook-up leads over engine fan, pump and belt areas. Whenever possible, route leads outside of the engine compartment.
- Electric fans are activated by a coolant temperature sensing switch. Disconnect a fan lead whenever working on a hot engine with an electric fan because the fan can start when the engine is "OFF."

Specifications

Engine Analyzer Module

- **Module Power Requirements:**
7.0 to 20.0 volts D.C.
750 mA. @ 12 volts
- **Size:**
Height - 4.25 in.
Width - 9.50 in.
Depth - 10.75 in.
- **Weight:** 10 lbs.
- **Tachometer:** Inductive primary
and/or secondary type.

Ranges & Accuracies

- **Battery Voltage:** 0 - 20 Volts
.1 Volt Resolution
- **Amperage:** -1000 - +1000 DC Amps
.1 Amp Resolution
- **Dual Trace Scope:**
0 to +/- 25.00 Volts
3 MS/Division to 64 MS/Division
Chart: .01 Volt Resolution 0.5 to 10.8 seconds.
- **Uniscope:**
0 to +/- 25.00 Volts
1.5 MS/Division to 32 MS/Division
Chart: .01 Volt Resolution 0.3 to 5.4 seconds
- **Secondary Voltage:** 0 - +/- 40kV
1KV Resolution
- **Dwell:** 0 - 360°
.1° Resolution
- **RPM:** 0 - 10,000 RPM
1 RPM Resolution
- **Cylinder Display:** 1 - 12

Optional Gas Analyzer Ranges

Channel	Range	Resolution
HC	0-2000 ppm	1 ppm
CO	0-10%	.01%
CO ₂	0- 20%	.1%
O ₂	0-25%	.1%

Engine Analyzer Module Installation

Connect the module to any open host computer serial port. Specific connections for standard host systems follow.

100 Series Analyzers

1. Route the Engine Analyzer cable (A), (see Figure 1-2), up through the opening (B) underneath the power switch (C).
2. Attach the 25-pin data cable to COM 1 (D).

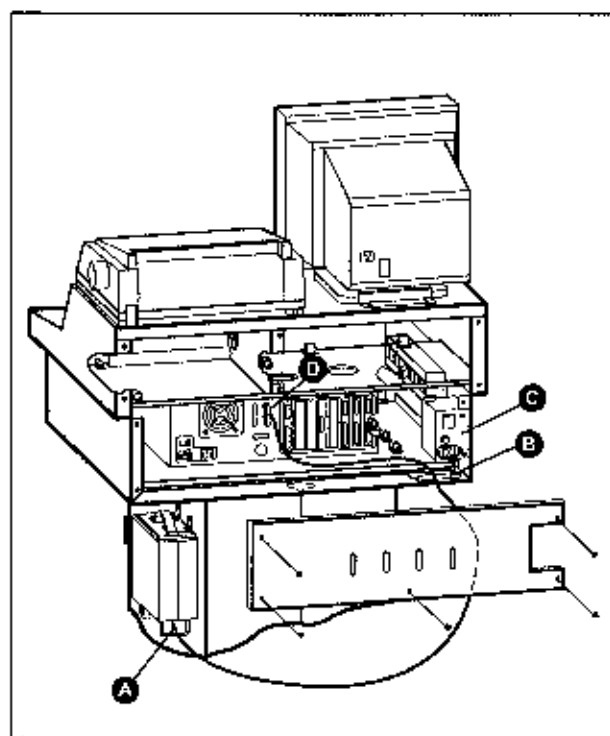


Figure 1-2

Allen BAR-90 Analyzers

Plug the serial cable into the RS-232 serial port on the back of the analyzer head.

Bear BAR-90 Analyzers

Plug the serial cable into the OBD Interface Port on the back of the Gas Analyzer (see Figure 1-3).

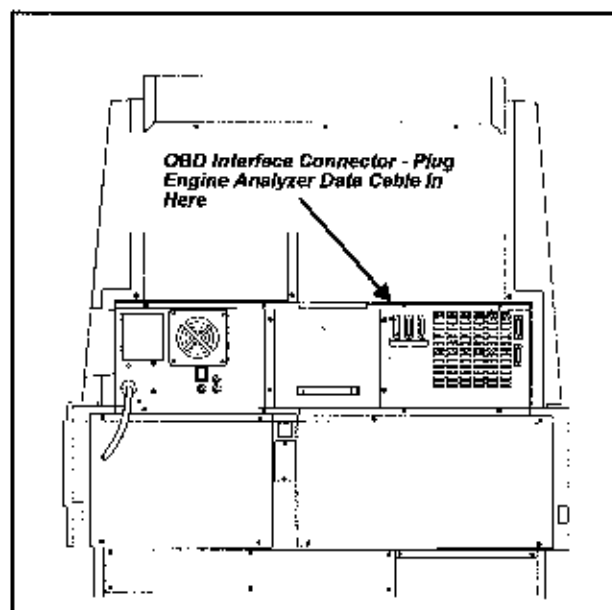


Figure 1-3

200 Series Analyzers

Connect Module data cable to Analyzer COM1 as shown in Figure 1-4.

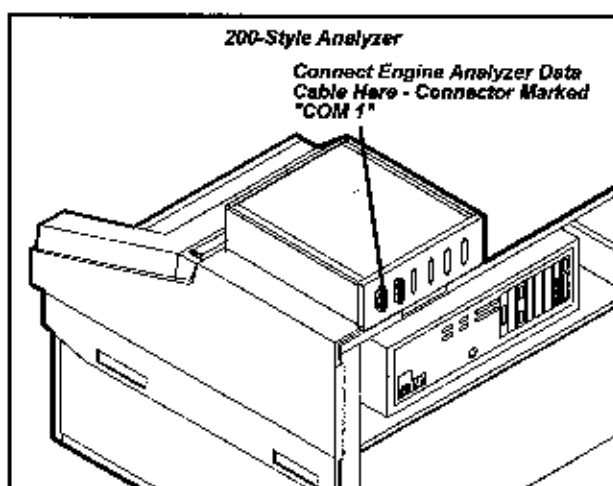


Figure 1-4

Engine Analyzer Components

This section describes the main hardware and software components of the Engine Analyzer Module. Use this section to become familiar with each part of the Engine Analyzer and how it is used.

NOTES:

- Install the leads on the Engine Analyzer Module, if necessary. Refer to Figure 1-5 for the proper connections.
- Connect the Engine Analyzer Module battery clamps to the battery - black to the negative (-) terminal and red to the positive (+) terminal.
- Connect the data cable from the Engine Analyzer Module to the serial port on the back of the Analyzer, if necessary.
- Press the "ON"/"OFF" switch on the Engine Analyzer Module. If the battery clamps are connected correctly, the red indicator next to the carrying handle should light.
- While all leads are not required for every test, most leads must be in place to obtain proper readings. Therefore, it's best to connect all the leads right away, to make sequential testing easier and faster.

DIS Secondary Probe Assemblies

There are two secondary probe assemblies. One assembly is positive (red); one is negative (black). Each assembly has four small clips. These must be clipped securely around each spark plug wire on the test vehicle. On 4- and 6-cylinder systems, some clips will be dangling free. Make sure they are not touching the engine block or any other components or wires. Make sure any extra wires cannot come into contact with a moving fan blade.

NOTE Pull the vehicle plug wires apart so that they are at least 1" apart from each other. Connect the DIS leads to the plug wires. Make sure the DIS leads are at least 1" apart from each other and from ground. This prevents "cross-talk" between leads.

Test Leads & Accessories

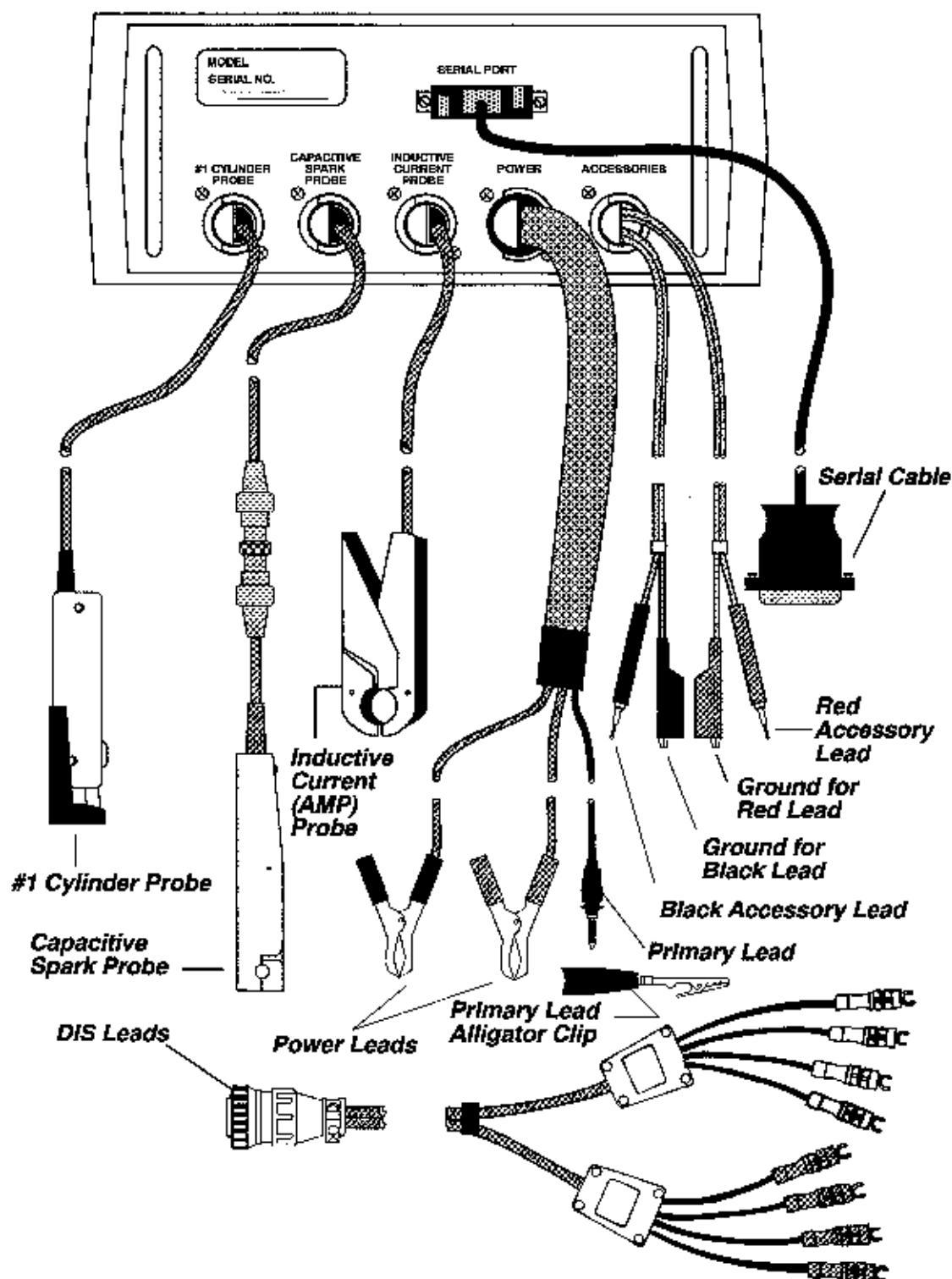


Figure 1-5

Gas Bench Components

Optional Gas Analyzer Module

The Fuel System Test requires the Gas Analyzer Bench Kit. The kit includes gas analyzer bench, exhaust probe (draws gas sample from the tailpipe into the analyzer), and dual-exhaust equipment.

The Engine Analyzer requires the Gas Analyzer Bench kit for emission system testing. The gas analyzer checks the quantity of four gases in vehicle emissions: Carbon Monoxide (CO); Hydrocarbons (HC); Carbon Dioxide (CO₂); and Oxygen (O₂). This information is used to generate diagnostics.

Letter	Component
A	Exhaust Gas Outlet Hose
B	Water Drain Hose
C	Filter Housing
D	Sample Gas Inlet
E	Water Filter (Screen Type)
F	Fine Filter
G	Gas Screen Filter
H	Zero Air Inlet
J	Low Calibration Gas Port
K	High Cal Gas Port (Not Used)

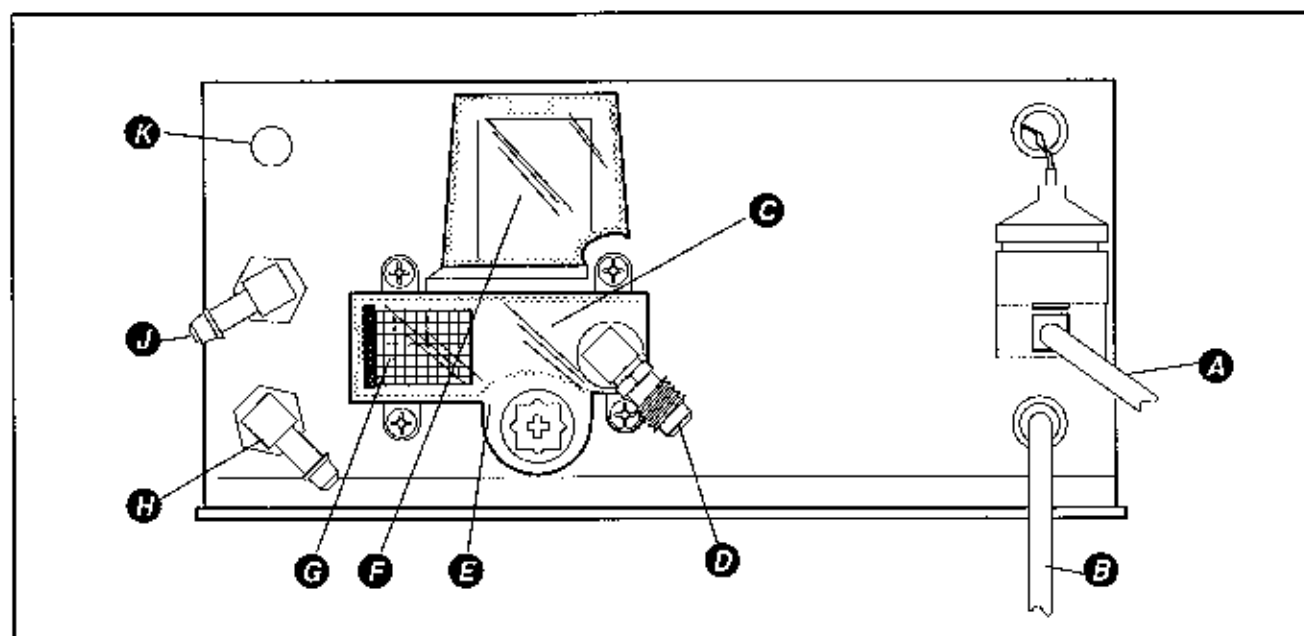


Figure 1-6

Screen Components

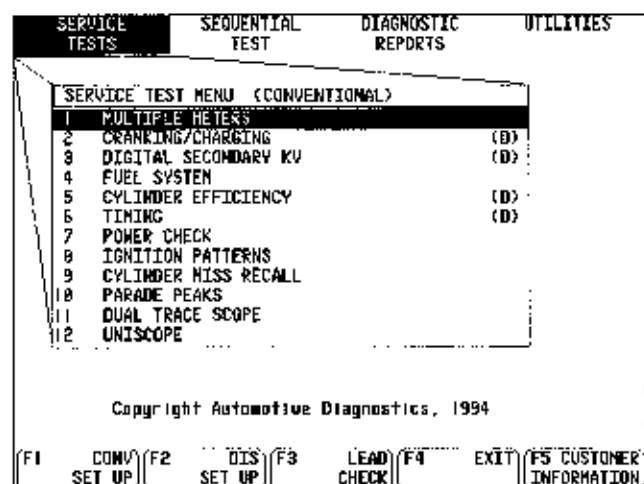


Figure 1-7

Menu Screen Components

The main menu bar (see Figure 1-7) across the top of the screen offers four choices:

- **SERVICE TESTS** - all of the individual tests which can be performed on a vehicle.
- **SEQUENTIAL TEST** - a pre-programmed routine to run a complete diagnostic test series on an engine.
- **DIAGNOSTIC REPORTS** - Prints all or selected reports on the optional printer. Also provides "display only" choice which allows reports to be displayed on the screen without being printed.
- **UTILITIES** - allows the operator to set up customer or dealer report headers, to calibrate the test leads, change time and date settings, and more.

The "Service Test Menu" changes slightly for DIS tests. Item 5, "Cylinder Efficiency" changes to "Cylinder Performance." Item 7, "Power Check," does not apply to DIS engines, and will appear "ghosted" on the screen.

NOTE On some DIS applications, the Cylinder Performance Test will appear "ghosted" on the screen because there is not sufficient vehicle-specific information available to accurately calculate cylinder performance.

All the entries on the "Service Test Menu" with a "(D)" at the end of the line on the screen will display and print Diagnostic Messages. These messages suggest probable causes and possible repairs to help the operator correct problems. For complete details, see the "Diagnostic Reports" chapter.

NOTE If optional Gas Analyzer Bench Kit is not installed, the "Fuel System" menu choice will appear "ghosted" on the screen.

Meter & Data Screen Components

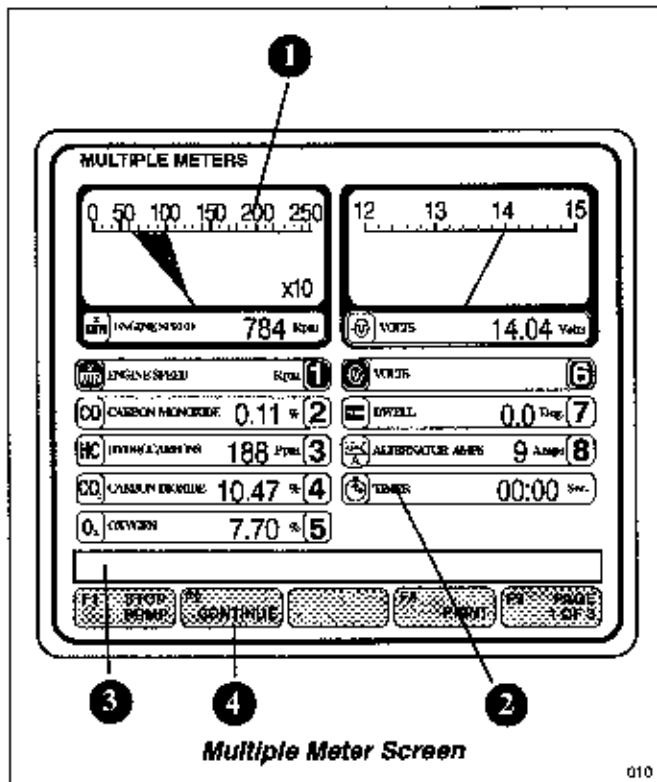


Figure 1-8

Figure 1-8 shows a typical meter and data screen. Most screens will have these common components:

- 1 Meters** - The meters in most cases feature a shadow to show the specified range that a system should be reading within. Meters also have auto ranging (sliding scales), for maximum flexibility. Meters also feature a trace function to show trends.
- 2 Data/Option Blocks** - These areas of the screen display all of the meters or optional functions that are available, and/or display the current data readings. "Ghosted" options are not available, either because the meter or function is already in use, or the meter does not apply to the system being tested.

- 3 Message Bar** - This bar displays test instructions, prompts and informational messages to explain what the analyzer is doing while it is calculating test results, etc.
- 4 Command Keys** - These boxes list the "F" key that will activate a particular function. Usually, pressing [F2] will move the program along to the next step in a test or will exit the test and return to the "Engine Analyzer" main menu.
- 5 Arrows** (see Figure 1-9) - When arrow icons appear on the screen, press the appropriate arrow to expand or shrink the display scales. This function is available in ignition pattern screens.

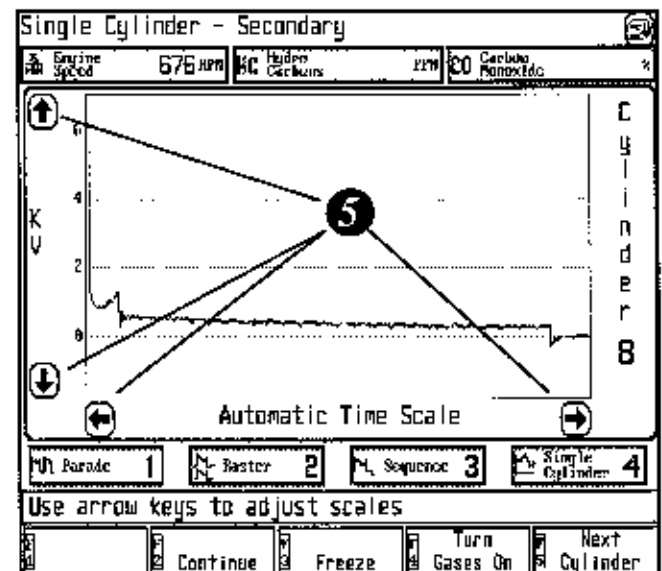


Figure 1-9

General Information

Definitions

In this manual, to "enter" a number, press or type that number and then press [ENTER]. Example: "Enter 1 from the Main Menu" means "press the number 1 key, then press the key marked "ENTER" on the keyboard."

NOTE Press the key enclosed in square brackets. In the example above, the command is "...press [ENTER]," meaning press the key marked "ENTER" on the typewriter keys.

Cursor - refers to the lighted dot on the screen, or a reverse video bar, that can be moved around using the arrow keys.

Engine Analyzer Module

The Engine Analyzer Module requires power from the vehicle battery in order to operate. Make sure that the battery clamps make good contact with the vehicle battery terminals. Clean the terminals, if necessary.

Press the "ON"/"OFF" switch near the handle on the box - the red indicator should light up.

Use And Care

Engine Analyzer Module Use and Care

1. DO NOT drop the Engine Analyzer Module. The Engine Analyzer Module will stand up to most everyday bumps and jolts, but may not survive impact on a concrete floor.
2. Make sure that the battery power clamp connections are good. Check the clamps to make sure that they are clean and clean the battery terminals if necessary.
3. The Engine Analyzer Module is designed to work at between 7-20 volts. DO NOT apply AC current to the leads. DO NOT apply any voltage greater than 20 volts across the power clamps. The Engine Analyzer Module will not work with 6-volt systems.
4. DO NOT drop the test leads.
5. DO NOT expose the Engine Analyzer Module to rain or other moisture.
6. DO NOT open the Engine Analyzer Module case - there are no user-serviceable parts inside.

General Test Procedure

Optional Gas Analyzer Use and Care

1. Check the water trap and filter daily for excessive build-up of dirt or water.
2. Replace the sample system filter at least every other week.
3. Store the gas analyzer exhaust probe off the floor to prevent damage and contamination.
4. Remove exhaust probe from the tailpipe while carburetor or combustion chamber cleaners are being used in the engine. This is particularly important because of the highly corrosive nature of carburetor and combustion chamber cleaners.
5. DO NOT drop the exhaust probe; this will break the probe and cause leaks.
6. DO NOT disconnect the exhaust probe from the gas analyzer.
7. DO NOT test diesel exhaust; this will contaminate the sample system.
8. DO NOT use the gas analyzer while the vehicle is running on a dynamometer.

1. Prepare for Testing.

- A. Turn the Analyzer "ON." The "Module Selection" menu screen will appear (see Figure 1-10). Highlight the "Engine Analyzer" and press [ENTER] to start the program.

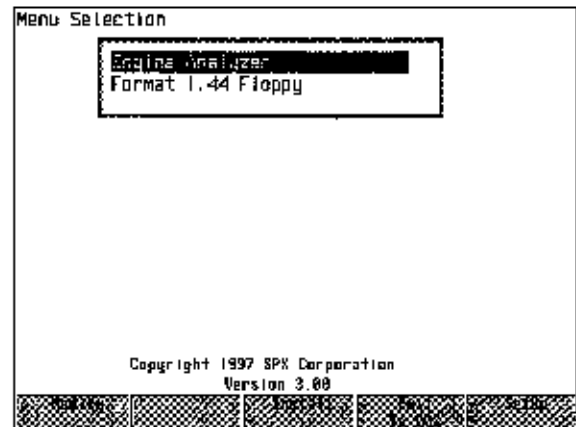


Figure 1-10

- NOTE** If your engine analyzer module is interfaced with a Micro 4-Gas Module, be sure the module is connected to the host computer and that power is applied to the module bench **before** entering the Engine Analyzer module selection.

The "Module Selection" menu screen will reappear after each time the operator leaves a software module.

- B. The main menu screen will appear. Press:
 - [F1] to set the analyzer up for testing conventional ignition;
 - [F2] to set up for testing DIS ignition systems;
 - [F3] to perform an engine-running lead check;
 - [F4] to return to the "Module Selection" screen;
 - [F5] to enter Customer Information.

Continued . . .

2. Install the test leads on the engine.

While all leads are not required for every test, most leads must be in place to obtain proper readings. Therefore, it's best to connect all the leads right away, to make sequential testing easier and faster.

NOTE Accessory leads used in the Dual Trace and Uniscope test modes should only be connected to voltage sources while performing tests within these test modes. Disconnect the accessory leads from all voltage sources when performing all other tests.

Conventional Ignition Systems:

- Yellow Capacitive Spark Probe (see Figure 1-11) around high tension lead from coil to distributor. Must be completely closed; not touching plug wires, metal parts, vacuum hoses or water. Supplies high voltage information. (Not used in DIS testing.)

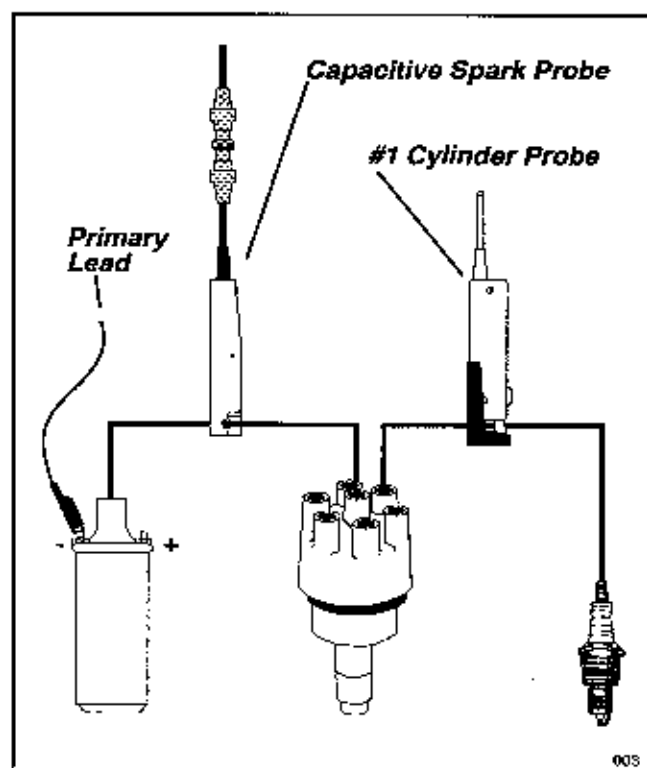


Figure 1-11

- Green #1 Cylinder Probe (see Figure 1-11) around #1 spark plug wire. Supplies cylinder #1 firing information.
- Power Clamps (see Figure 1-12), positive and negative, directly onto the battery posts. Primary Lead to negative terminal on ignition coil (see Figure 1-11). Use the alligator clip provided. The clamps provide Engine Analyzer Module power and system voltage readings.
- Gray Inductive Amp Probe (see Figure 1-12) around the positive or negative battery cable. Supplies current information. Clamp must be around all wires to terminal.

NOTE Check the arrow on the clamp carefully! If the probe is clamped around the negative (-) terminal wires, the arrow should point toward the battery. If the probe is clamped around the positive (+) terminal wires, the arrow should point away from the battery.

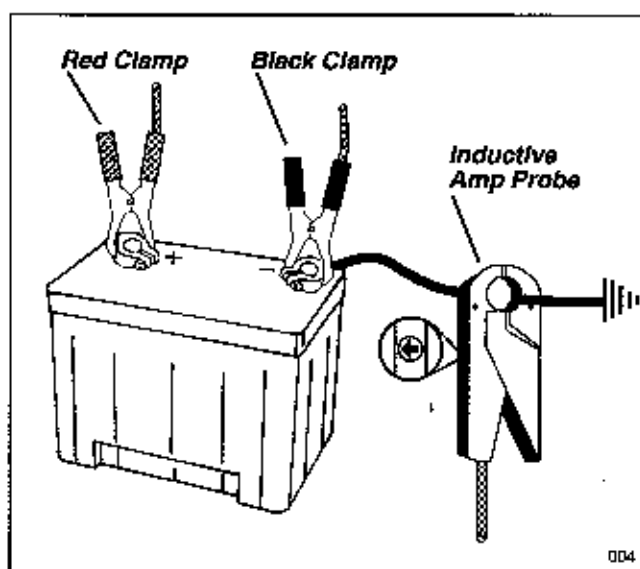


Figure 1-12

- Accessory Leads (refer to Figure 1-5) used for waveform/dual trace display.

Secondary Ignition Adapters

Your Engine Analyzer Module is supplied with the 617-99802 Accessory Kit. The kit contains the following special adapters:

The **H-Clip Adapter** (see Figure 1-13) provides a hookup site for the primary lead clip on late model Ford and GM vehicles.

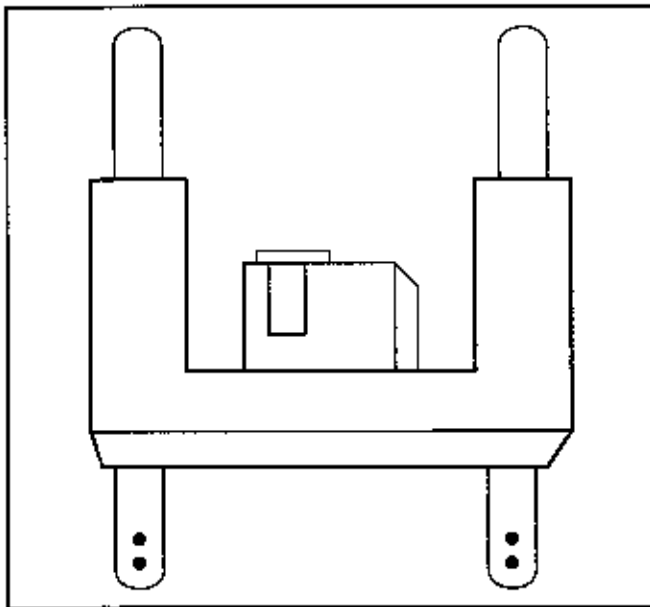


Figure 1-13

Fords: Slip the two dimpled prongs into the distributor coil adapter. Connect the primary lead clip to the negative (DEC) terminal side of the coil.

GMs: Disconnect the coil wires at the coil. Slip the center connectors of the adapter into the socket where the coil wires were connected. Attach the disconnected coil wires to the dimpled prongs. Then connect the primary lead clip to the smooth prong on the negative side of the coil.

GM H.E.I. Adapter (see Figure 1-14).

This adapter is used in place of the yellow pickup on all GM H.E.I. vehicles where the coil and distributor are one integral unit. Disconnect the yellow pickup from the module lead. Plug the H.E.I. adapter into the module lead and tighten the connector ring securely. Attach H.E.I. adapter to the vehicle at the coil.

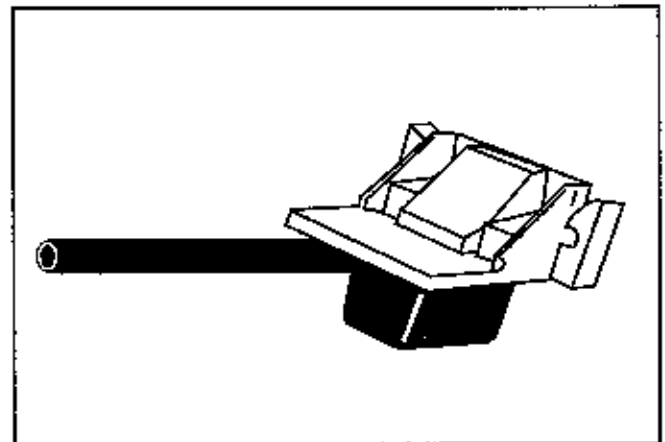


Figure 1-14

Continued...

Toyota HEI Adapter

Use this adapter probe in place of the standard yellow, high-tension secondary probe.

To attach the adapter probe:

1. See Figure 1-15. Align adapter probe clip (A) with slots and pin on adapter probe (B), then turn counterclockwise to secure in place.

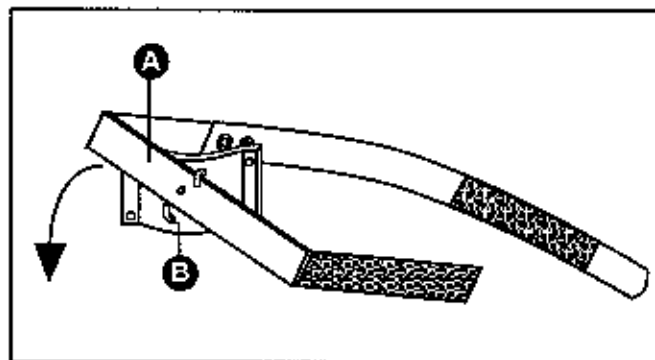


Figure 1-15

2. Place adapter probe on front-center of distributor cap.
3. Wrap adapter probe clip strap tightly around distributor cap, then press velcro ends together to secure (see Figure 1-16).

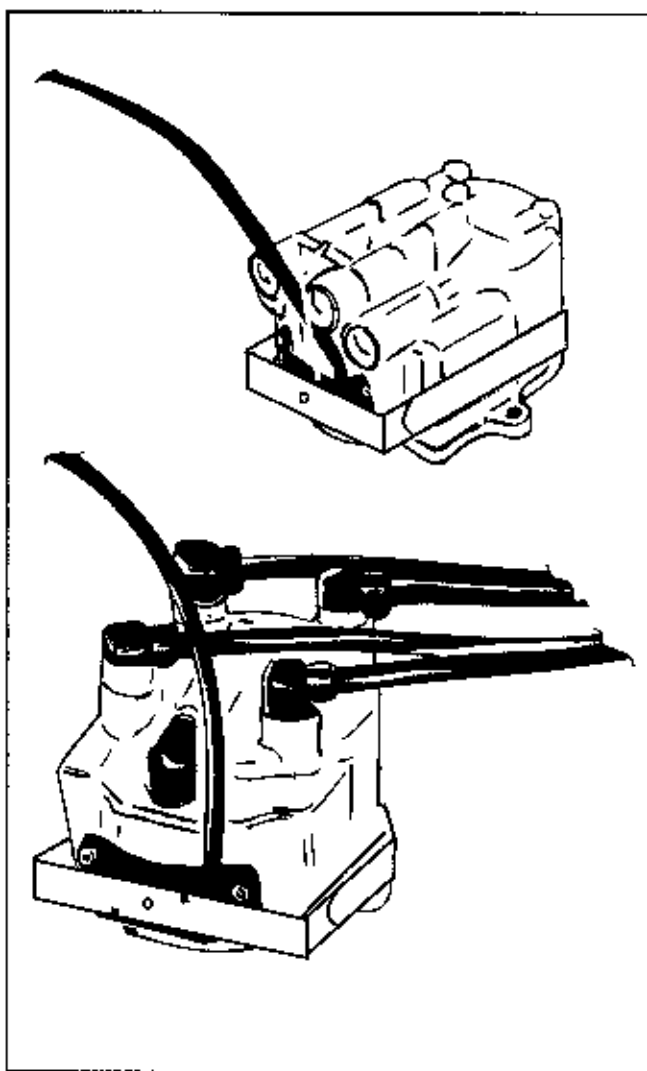


Figure 1-16

To remove the adapter probe:

1. Pull velcro material apart.
2. Remove adapter probe assembly.

DIS Leads

DIS Secondary Probe Assemblies

There are two secondary probe assemblies. One assembly is positive (red); one is negative (black). Each assembly has four small clips. These must be clipped securely around each spark plug wire on the test vehicle. On 4- and 6-cylinder systems, some clips will be dangling free. Make sure they are not touching the engine block or any other wires. Make sure any extra wires cannot come into contact with a moving fan blade.

NOTE

Pull the vehicle plug wires apart so that they are at least 1" apart from each other. Connect the DIS leads to the plug wires. Make sure the DIS leads are at least 1" apart from each other and from ground. This prevents "cross-talk" between leads.

Special DIS Secondary Clip Connections

NOTE

For the GM 2.3L (QUAD-4) with IDI System, and the Nissan Pulsar 1.6L, connect secondary clips as follows:

- a) On the GM, remove and invert the coil assembly. Then reinstall the coil so the coil terminals are accessible.

On Nissan, remove the cover, unbolt the coils and remove them from the plugs.

- b) Install plug wires between the coil terminals and the spark plugs. GM makes a kit for this purpose. The kit is available from your local dealer.
- c) Clip the secondary clips onto the spark plug leads just installed, according to the polarity setup of the vehicle.

See manufacturer's information for more details on this procedure.

Ford 2.3L - This is a double spark system with a full-time pack that does most of the work, and a part time pack that only operates under certain conditions, for emissions controls. Test these ignition systems in two steps:

- a) Connect DIS leads to the full-time pack and run all tests in the usual way.
- b) After testing the full-time pack, connect the DIS leads to the part-time pack. Press [F2] and perform a DIS setup routine again, with engine running at idle (the part-time pack is always active at idle). After verifying setup on the part-time pack, run any necessary ignition system tests to check the part-time pack.

Optional Ignition Adapters

The Model 43-243 Ignition Adapter Kit includes the following standard Primary Ignition Adapters for many domestic and import vehicles:

- Ford and GM electronic ignitions (including HEI)
- GM External Coil
- Ford E-Core, Thick Film Ignition (TFI) systems
- GM Micropak Coil
- Acura and Honda with Hitachi ignition system
- Toyota, Suzuki, Subaru, Isuzu, Mitsubishi and GM imports with Nippondenso ignition system
- Nissan with Hitachi ignition system
- AMC, Renault, Peugeot, and Jeep with Renix/Ducellier ignition system

Continued ...

3. Set Up the Analyzer Module for the Ignition System You Are Testing.

Conventional Ignition Systems

- a) At the main menu screen, press [F1]. The "CONVENTIONAL VEHICLE SELECTION" screen will appear (see Figure 1-17).

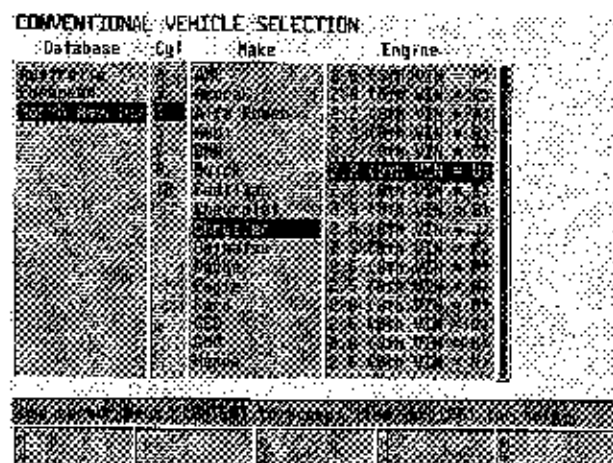


Figure 1-17

- b) Highlight the appropriate "Database" (region of the world where the vehicle is marketed) and press [ENTER].

NOTE The Database you select will be stored as the default selection on subsequent vehicle setup operations. To abort the vehicle selection process at any time, press [F10] or [ESCAPE]. You will be asked if you wish to quit without making a selection. Use the right- or left-arrow keys to highlight the appropriate response (or press the "Y" or "N" keys) and press [ENTER].

- c) Highlight the correct number of cylinders and press [ENTER].

- d) Highlight the appropriate vehicle "Make" (the car division of the parent corporation) and press [ENTER].

SHORTCUT: To quickly scroll through the list of makes, simply press the first letter of the make name. The cursor will move to the first make that starts with that letter. You may also use the Page-Up and Page-Down keys on the keyboard to move through the list.

- e) Highlight the appropriate engine (engine size in liters and other characteristics) and press [ENTER].

- f) You may be required to answer an additional "qualifier" question. These questions are occasionally necessary to further identify the vehicle under test. Select the appropriate response and press [ENTER].

NOTE Press [F6] at any Vehicle Selection screen for help. Use the F-keys listed at the bottom of the screen to navigate through the help screens. Press [F10] to exit help and return to the Vehicle Selection screens.

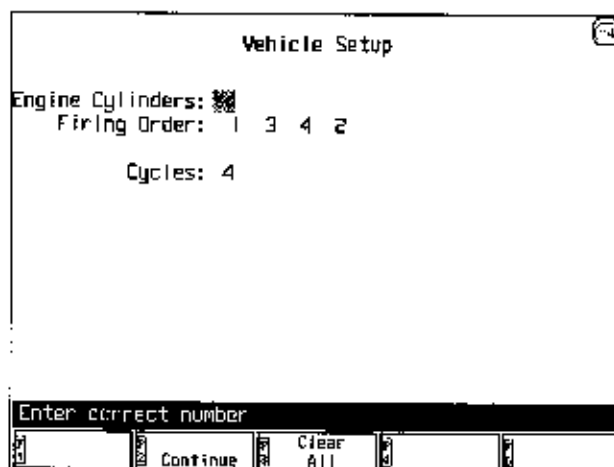


Figure 1-18

- g) After the vehicle has been selected, the "Vehicle Setup" screen is displayed (see Figure 1-18). After verifying the information is correct, press [F2] to proceed to the Lead Check screen (see Figure 1-19).

LEAD CHECK (F1)

ENGINE ANALYZER STATUS ~

#1 SIGNAL	OK
PRIMARY SIGNAL	OK
SECONDARY SIGNAL	OK
SECONDARY TRIGGER LEVEL	STANDARD

GAS BENCH STATUS -

SYSTEM READY.

(F2) CONTINUE (F5) CHANGE TRIGGER

Figure 1-19

Start the engine. The analyzer will display a series of messages relating to the condition of the lead signal status.

Possible Messages:

- "ENGINE ANALYZER NOT RESPONDING"
- "ENGINE ANALYZER COMMUNICATION PROBLEM"
- WAITING FOR ENGINE ANALYZER RESPONSE"
- Signal Status: "OK" or "MISSING"
If the signal is missing, check the following:
 - Lead Connections
 - Test Lead Connections on back of Engine Analyzer Module
 - Serial Cable between Engine Analyzer Module and analyzer
- Trigger Selection:
 - *Normal*: this is the default trigger.
 - *High*: Use this trigger if you see erratic RPM readings.

Direct Ignition Setup

- a) At the Main menu Screen, press [F2]. The "DIS VEHICLE SELECTION" screen will appear (see Figure 1-20).

DIS VEHICLE SELECTION

Database	Cyl	Make	Engine
Australia	2	Acura	3.2 (8th VIN = R)
European	3	Alfa Romeo	3.2 (8th VIN = J)
North America	4	Audi	3.3 (8th VIN = G)
	5	BMW	3.3 (8th VIN = R)
	6	Buick	3.3 (8th VIN = T)
	8	Cadillac	3.3 (8th VIN = U)
	10	Chevrolet	3.5 (8th VIN = F)
	12	Chrysler	3.8 (8th VIN = L)
		Dodge	
		Eagle	
		Ford	
		Honda	
		Infiniti	
		Isuzu	
		Jaguar	
		Lexus	

Use cursor keys, [ENTER] to accept item, or [F6] for help.

(F1) (F2) (F3) (F4) (F5) (F6)

Figure 1-20

- b) Highlight the appropriate "Database" (region of the world where the vehicle is marketed) and press [ENTER].

NOTE The database you select will be stored as the default selection on subsequent vehicle setup operations. To abort the vehicle selection process at any time, press [F10] or [ESCAPE]. You will be asked if you wish to quit without making a selection. Use the right- or left-arrow keys to highlight the appropriate response (or press the "Y" or "N" keys) and press [ENTER].

- c) Highlight the correct number of cylinders and press [ENTER].
- d) Highlight the appropriate vehicle "Make" (the car division of the parent corporation) and press [ENTER].

Continued ...

General Test Procedure (continued)

SHORTCUT: To quickly scroll through the list of makes, simply press the first letter of the make name. The cursor will move to the first make that starts with that letter. You may also use the Page-Up and Page-Down keys on the keyboard to move through the list.

- e) Highlight the appropriate engine (engine size in liters and other characteristics) and press [ENTER].
- f) You may be required to answer an additional "qualifier" question. These questions are occasionally necessary to further identify the vehicle under test. Select the appropriate response and press [ENTER].

Vehicle Setup

Engine Cylinders: 6
Firing Order: 1 2 3 4 5 6
Firing Polarity: - - - + + +
Cycles: 4
Multistriking: Yes

Press F2 if setup is correct

F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21 F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 F36 F37 F38 F39 F40 F41 F42 F43 F44 F45 F46 F47 F48 F49 F50 F51 F52 F53 F54 F55 F56 F57 F58 F59 F60 F61 F62 F63 F64 F65 F66 F67 F68 F69 F70 F71 F72 F73 F74 F75 F76 F77 F78 F79 F80 F81 F82 F83 F84 F85 F86 F87 F88 F89 F90 F91 F92 F93 F94 F95 F96 F97 F98 F99 F100

Figure 1-21

NOTE Press [F6] at any Vehicle Selection screen for help. Use the F-keys listed at the bottom of the screen to navigate through the help screens. Press [F10] to exit help and return to the Vehicle Selection screens.

- g) All of the messages that appear on the "Lead Check" screen apply to DIS systems. If the analyzer displays any problem messages, check the following items:

- ✓ Make sure the secondary leads are properly connected according to the polarity setup.
 - ✓ Make sure each secondary clip is securely connected to its spark plug wire.
 - ✓ Make sure the green #1 lead is installed on the #1 cylinder wire, as far away from the DIS module as possible. The lead should be connected between the secondary clip and the plug.
- h) After the vehicle has been selected, the "Vehicle Setup" screen is displayed (see Figure 1-21). After verifying the information is correct, press [F2] to proceed to the Lead Check screen (see Figure 1-22).

Lead Check

Engine Analyzer Status -
#1 Signal Missing
Secondary Signal Missing
Secondary Trigger Level Normal

Gas Bench Status -
System ready.

F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12 F13 F14 F15 F16 F17 F18 F19 F20 F21 F22 F23 F24 F25 F26 F27 F28 F29 F30 F31 F32 F33 F34 F35 F36 F37 F38 F39 F40 F41 F42 F43 F44 F45 F46 F47 F48 F49 F50 F51 F52 F53 F54 F55 F56 F57 F58 F59 F60 F61 F62 F63 F64 F65 F66 F67 F68 F69 F70 F71 F72 F73 F74 F75 F76 F77 F78 F79 F80 F81 F82 F83 F84 F85 F86 F87 F88 F89 F90 F91 F92 F93 F94 F95 F96 F97 F98 F99 F100

Figure 1-22

NOTE Vehicle manufacturers have added many different DIS vehicles to their product lines. Although every effort is made to confirm our database information on all vehicles, you may encounter a vehicle that has different cylinder firing polarities from those found in our database. For instructions on determining correct DIS polarity, see Appendix A, "Lead Connections for Various Cylinder Firing Polarities."

4. Enter Customer Information

From the main menu screen, press [F5]. The "Customer Information" screen will appear (see Figure 1-23).

CUSTOMER INFORMATION

NAME: John Redmond
 ADDRESS: 123 Elm Street
 CITY: Kalamazoo
 STATE: Michigan
 ZIP CODE: 12345
 PHONE: 329-0000
 WORK ORDER: 0000000015
 VEHICLE MODEL: PONTIAC CPE
 VEHICLE YEAR: 80
 ODOMETER READING: 123000
 LICENSE NUMBER: ABC-123
 ENGINE SIZE: 2.5L

[F2] CONTINUE [F3] CLEAR ALL [F4] SAVE RECORD [F5] DELETE RECORD

Figure 1-23

Press:

- [F1] to access the customer file access screen;
- [F2] to continue on to the main menu screen;
- [F3] to clear all of the data fields, to allow you to enter new information;
- [F4] to save the customer record displayed on the screen;
- [F5] to delete the current record displayed on the screen.

Enter the information in each field and press [F4] to save the record in analyzer memory. Then press [F2] to continue with testing.

Customer File Access

The analyzer can save customer records on the analyzer hard drive. The information is saved by the analyzer to allow you to work on multiple jobs at the same time and recall the correct customer and vehicle specification information on each one.

NOTE

The "Customer Record" contains the customer's personal information (name, address, etc.) and also the results of the last completed tests. These results are available under the "Diagnostic Reports" section after you have selected and entered a customer record. The appropriate menu items will be highlighted on the "Diagnostic Reports" menu.

From the "Customer Information" screen, press [F1]. The "Customer File Access" screen appears (see Figure 1-24).

CUSTOMER FILE ACCESS

ORDER #	VR	VEHICLE MODEL	CUSTOMER NAME	LICENSE
000000007	92	FORD T150 VAN	BOAR AUTOMOTIVE FIELD VAN	NONE
000000001	91	BUICK PARK AVENUE	CLAYTON HITTENSPON	OR 1234
000000002	90	Ford Taurus SED	Merry Macdonald	OR 2234
000000001	93	FORD PROBE GT	Rth Thomas	JVR 2899
000000011	88	Pontiac Grand AM	Howard Graves	APA-156
000000000	87	BUICK PARK AVENUE	Bill Joplin	BAC-314
000000001	93	FORD PROBE GT	Rth Thomas	JVR 2899

CURRENTLY HOLDING CUSTOMER FILE ON DRIVE ... C

USE ARROW KEYS TO SELECT RECORD AND PRESS ENTER

[F1] CHANGE DISK DRIVE [F2] CONTINUE [F3] NEXT PAGE [F4] PREVIOUS PAGE

Figure 1-24

The message above the Message Center (see A in Figure 1-25 on the next page) indicates which drive the analyzer is storing the information on.

To select a Customer File from the list, move the highlight bar to the desired customer entry and press [ENTER] to enter the information into analyzer memory.

Continued ...

Press:

- [F1] to change the disk drive where the customer information will be stored.
- [F2] to return to the menu screen without making any changes. If customer information is held in analyzer memory, that information will be deleted, and the customer last name will no longer appear at the bottom of the menu screen.
- [F3] to display the next page of the Customer File List, if there is one;
- [F4] to display the previous page of the Customer File List, if there is one.

After you select a customer from the list the next "Customer File Access" screen appears (see Figure 1-25). This screen allows you to check all of the customer information to make sure that the information that you will load into memory is correct.

NOTE

If you confirm this record as the correct record, the information shown on this screen and the test results recorded at the time that this record was last entered into memory will replace any customer and test data currently in analyzer memory.

Press:

- [F1] to change the drive that the records should be retrieved from;
- [F2] to continue without loading the record;
- [F4] to load the record into analyzer memory;
- [F5] to permanently delete the record from the customer record list stored in the analyzer.

CUSTOMER FILE ACCESS				
ORDER #	YR	VEHICLE MODEL	CUSTOMER NAME	LICENSE
000000003	91	BUICK PARK AVENUE	BILL SMITH	ENC 914
000000004	91	BUICK PARK AVENUE	BILL SMITH	ENC 914
000000005	91	BUICK PARK AVENUE	CLYDE TURNER	DEAR 914
000000006	88	CHEVY BLAZER 4X4 S19	JANE JARVILL	THIR 914
000000007	88	CHEVY BLAZER 4X4 S19	JANE JARVILL	THIR 914
000000008	91	OLDS CUTLASS SCIMITAR	JIM SAWYER	620-779
000000009	92	FORD F150 VAN	DEAR ALTERNATIVE FIELD VAN	NONE
000000010	92	Ford Crown Victoria	Tom McDonald	HTR 293
000000011	90	Chrysler New Yorker	Dennis Bailey	JHR 292
000000012	90	Chevy Camaro	Dennis Finn	JLY-060
000000013	91	Ford Taurus 380i	Mark Haslam	720-499
000000014	92	Dodge Caravan	Mike King	JHR 00
000000015	92	Ford Crown Victoria	Bill KORTWEG	JHR-585
000000016	92	Ford Crown Victoria	Tom McDonald	HTR 293
000000017	92	HERCULEY SABLE LS	JANE WILSON	JHR-256
000000018	90	PONTIAC GTE	GREG NUNN	TRH-356
000000019	90	PONTIAC GTE	GREG NUNN	TRH-356

CURRENTLY ACCESSING CUSTOMER FILE ON DRIVE

WARNING—NUMBER OF CUSTOMER RECORDS EXCESSIVE

F1 CHANGE DISK DRIVE F2 CONTINUE F3 NEXT PAGE F4 PREVIOUS PAGE

Figure 1-25

The message above the Message Center ('A' in Figure 1-25) indicates where the information is being retrieved from.

5. Select A Test

Use the arrow keys to move back and forth along the main menu bar at the top of the screen. To select a test from a "pop-down" menu, use the Up or Down Arrow keys to highlight the test you choose. Press [ENTER] to start the test.

You can also select a test by typing in the test number and then pressing [ENTER].

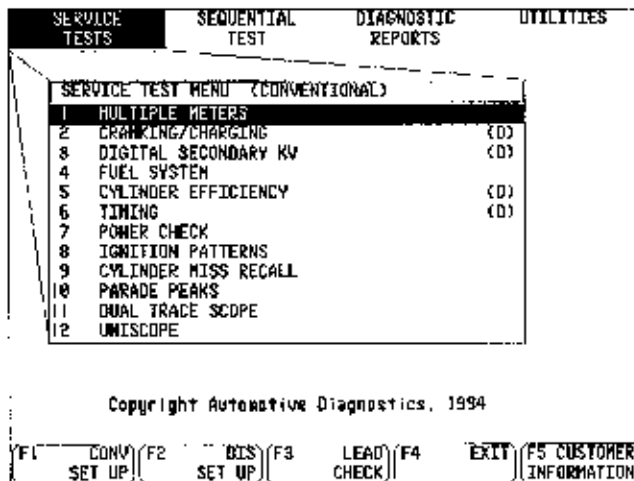


Figure 1-26

The main menu bar (see Figure 1-26) across the top of the screen offers four choices:

- **Service Tests** - all of the individual tests which can be performed on a vehicle.
- **Sequential Tests** - a pre-programmed routine to run a complete diagnostic test series on an engine.
- **Diagnostic Reports** - Prints all or selected reports on the printer. Also provides "display only" choice which allows reports to be displayed on the screen without being printed.
- **Utilities** - allows the operator to set up customer or dealer report headers, to calibrate the test leads, change time and date settings, and more.

The "Service Test Menu" changes slightly for DIS tests. Item 5, "Cylinder Efficiency" changes to "Cylinder Performance." Item 7, "Power Check," does not apply to DIS engines, and will appear "ghosted" on the screen.

NOTE On some DIS applications, the Cylinder Performance Test will appear "ghosted" on the screen because there is not sufficient vehicle specific information available to accurately calculate cylinder performance.

All the entries on the "Service Test Menu" with a "(D)" at the end of the line on the screen will display and print Diagnostic Messages. These messages suggest probable causes and possible repairs to help the operator correct problems. For complete details, see the "Diagnostic Reports" chapter.

NOTE If optional Gas Analyzer Bench Kit is not installed, "Fuel System" menu choice will appear "ghosted" on the screen.

6. Run the Test and Access Diagnostic Messages

Follow the screen prompts to run the test that you selected. Each test usually provides a "live" screen which allows you to see the current system status. The "live" screen will show you the results of any adjustments that you make.

Most tests will allow you to repeat the procedure if you make a mistake or if the vehicle will not behave properly.

7. Print Test Reports

After you complete any test, you can return to the main menu and select "Diagnostic Reports." All available reports will be highlighted on the "Diagnostic Reports" menu (see Figure 1-27).

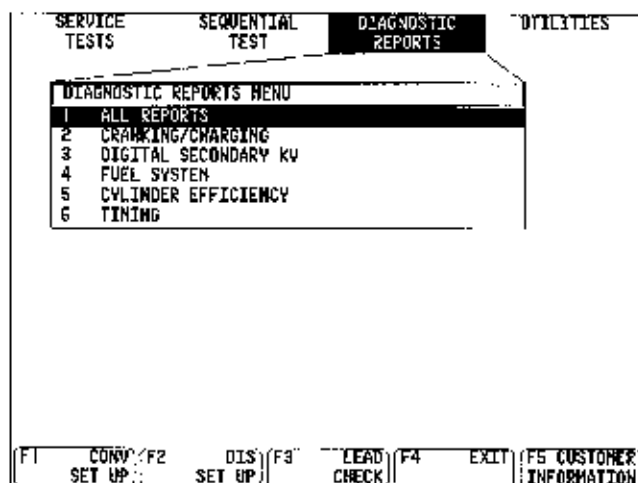


Figure 1-27

Highlight the report that you need and press [ENTER] to print that report. Select "ALL REPORTS" to print all of the available reports.

Service Tests

Multiple Meters

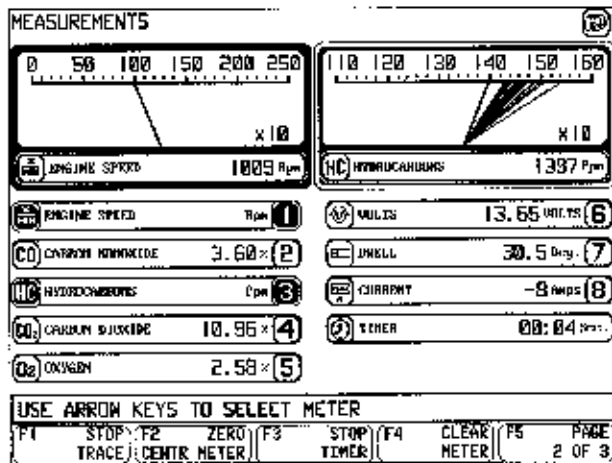


Figure 2-1

The "Multiple Meters" screen allows the operator to see the "live" results of any adjustments made on the test vehicle.

The default meters (RPM and Volts) will always appear when "Multiple Meters" is selected. Use the RIGHT and LEFT Arrow keys to select an active meter in order to change it to another meter. Active meters display a yellow border. In Figure 2-1, the "Engine Speed" meter is active. All of the data/option blocks except for the timer can be displayed as meters. Press the number matching the data/option block to display that meter. "Ghosted" data blocks are not available for meter display, either because they do not apply, or because they are already in use. The available meters:

- Engine Speed
- Carbon Monoxide (CO)
- Hydrocarbons (HC)
- Carbon Dioxide (CO₂)
- Oxygen (O₂)
- Volts
- Dwell (not available for DIS)
- Current

From the "Multiple Meter" screen, press:

- [F1] to toggle the gas analyzer sample pump "ON" and "OFF."
- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F4] to print the "Multiple Meter" report.
- [F5] to display the next set of command options (new "F" key command selections).

Press [F5] once to see the second set of commands. Then press:

- [F1] to toggle the "trace" function "ON" and "OFF" on the highlighted meter.
- [F2] to "zero center" the highlighted meter.
- [F3] to toggle the test timer "ON" and "OFF."
- [F4] to clear the meter (this function redraws the meter and turns the "trace" and "zero center" functions "OFF."
- [F5] to display the last available set of command options ("F" key command selections).

Press [F5] twice to see the third set of commands. Then press:

- [F3] to toggle the test timer "ON" and "OFF."
- [F4] to "zero" the grey amp probe lead.
- [F5] to display the first page of "F" key command options again.

NOTE

Non-US customers may see a slightly different Multiple Meters screen which includes Lambda in place of the Timer, and a Corrected CO display. Start/Stop Timer F-keys will be blank on these applications.

Cranking/Charging Test

Conventional Ignition Systems:



Place the transmission in "Park" or, if manual, "Neutral." Set the parking brake. Make sure the vehicle cannot roll. If necessary, chock the wheels.

1. Select Item 2, "Cranking/Charging Test" from the "Service Test Menu."
2. Follow the screen prompt and type in the vehicle's battery CCA rating. When finished, press [F2].
3. The Engine Analyzer Module will then zero the amp probe. Follow the next screen prompt and remove the amp probe from the battery cables. Remove the probe, then press [F2].
4. The Engine Analyzer Module then zeroes the probe. When the "Reattach Probe" prompt appears, reinstall the amp probe, then press [F2].



Make sure the probe is clamped around all the wires attached to the battery terminal! Check the arrow on the clamp carefully! If probe is clamped around negative (-) terminal wires, arrow should point toward battery. If probe is clamped around positive (+) terminal wires, arrow should point away from battery.

5. Follow the next screen prompt and crank the engine until it starts. After the Engine Analyzer Module reads the cranking data, it will display the readings on the screen (see Figure 2-2).

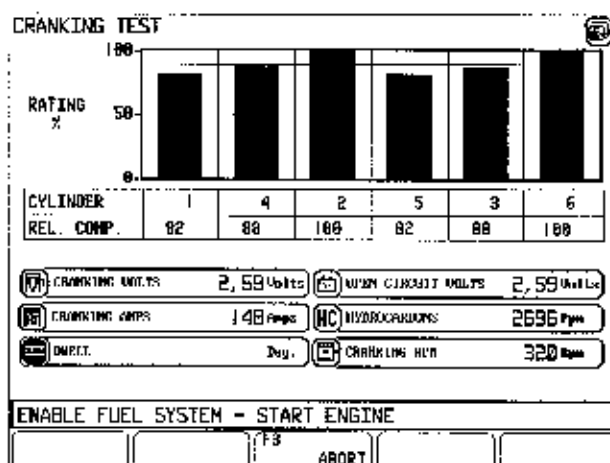


Figure 2-2

6. The prompt "Accelerate To 2000 RPM Within 5 Seconds" appears. Accelerate smoothly to 2000 RPM. The screen will then display the charging test readings (see Figure 2-3).

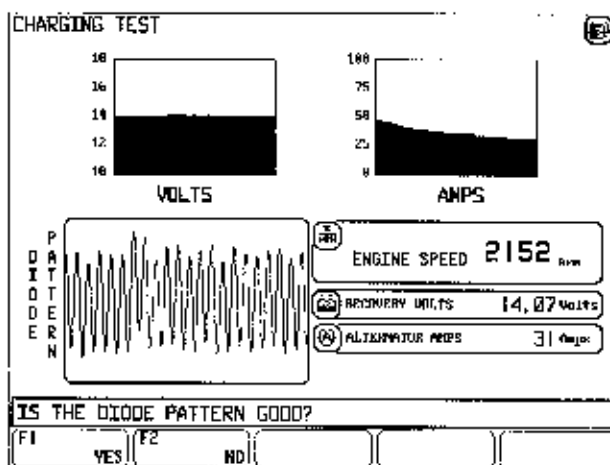


Figure 2-3

7. Follow the screen prompt and run the engine at 2000 RPM for 30 seconds. When the timer times out, release the throttle and look at the display screen.

8. The diode pattern will appear in the lower left-hand corner of the screen (see Figure 2-3). Follow the screen prompt and determine whether the diode pattern is good or bad. Compare the pattern on the screen to the patterns shown on this page. A good pattern will have regular, even waves, with some variation acceptable. A bad pattern has uneven or irregularly-shaped waves (see Figure 2-4). Press:

- [F1] for yes, the pattern shown on the screen is good;
- [F2] for no, the pattern shown on the screen is not good.

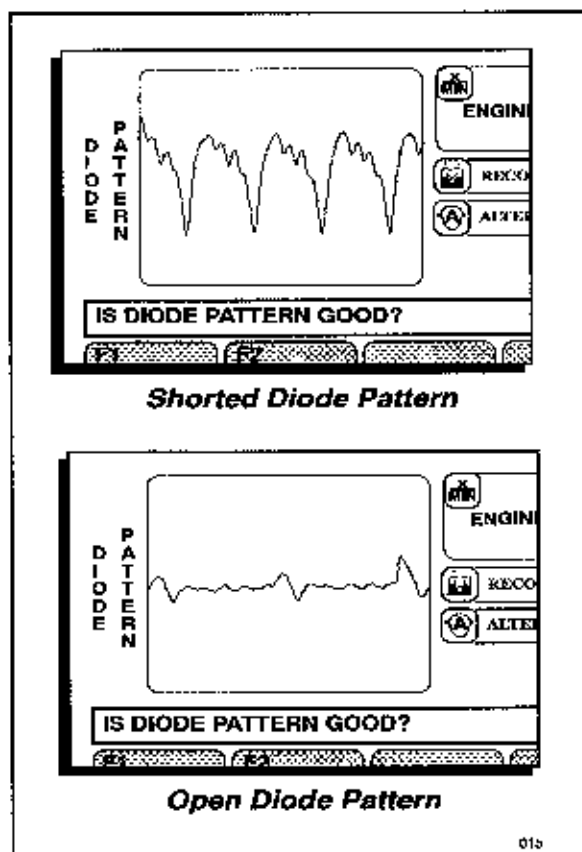


Figure 2-4

Cranking Test: DIS



Place the transmission in "PARK" or, if manual, "NEUTRAL." Set the parking brake. Make sure the vehicle cannot roll. If necessary, chock the wheels.

DIS Test Procedure

1. Select Item 2, "Cranking/Charging Test" from the "Service Test Menu."
2. Follow the screen prompt and type in the vehicle's battery CCA rating. When finished, press [F2].
3. The Engine Analyzer Module will then zero the amp probe. Follow the next screen prompt and remove the amp probe from the battery cables. Remove the probe, then press [F2].
4. The Engine Analyzer Module then zeroes the probe. When the "Reattach Probe" prompt appears, reinstall the amp probe and then press [F2].



Make sure the probe is clamped around all the wires attached to the battery terminal! Check the arrow on the clamp carefully! If probe is clamped around negative (-) terminal wires, arrow should point toward battery. If probe is clamped around positive (+) terminal wires, arrow should point away from battery.

5. Follow the screen prompt and disable the fuel system. The procedure is different depending on the vehicle being tested.

Disabling Fuel Systems

Fuel Injected Systems

Ported Fuel Injection (PFI) *With Clear Flood Mode* and Sequential Fuel Injection (SEFI) *With Clear Flood Mode*

1. Turn the ignition key to the "RUN" position.
2. Depress the accelerator all the way to wide open throttle.
3. Begin cranking the engine until prompted to enable fuel system.



If the engine starts, immediately release the accelerator pedal and rerun the test.

4. Release the accelerator and continue cranking until the engine starts.

Ported Fuel Injection (PFI) *Without Clear Flood Mode* and Sequential Fuel Injection (SEFI) *Without Clear Flood Mode*

1. Disconnect fuel pump relay or inertia switch.
2. Run the engine until all fuel is exhausted from the fuel system.
3. Follow the screen prompts to complete the test.

Throttle Body Injection (TBI) and Central Fuel Injection (CFI)

1. Disconnect the fuel injector connector(s) at the fuel injector.
2. Run the engine until all fuel is exhausted from the fuel system.
3. Follow the screen prompts to complete the test.

Carbureted Systems

Carburetor W/ Electric Fuel Pump

1. Disconnect fuel pump relay or wiring connector to fuel pump.
2. Run the engine until all fuel is exhausted from the carburetor bowl.
3. Follow the screen prompts to complete the test.

Carburetor W/ Mechanical Fuel Pump

1. Crimp rubber fuel inlet hose with hose pliers.
2. Run the engine until all fuel is exhausted from the carburetor bowl.
3. Follow the screen prompts to complete the test.

Carburetor W/ Decel Valve

1. Disconnect decel valve per manufacturer's recommendations.
2. Run the engine until all fuel is exhausted from the carburetor bowl.
3. Follow the screen prompts to complete the test.

Complete The Test

1. The prompt *"Accelerate To 2000 RPM Within 5 Seconds"* appears. Accelerate smoothly to 2000 RPM. The screen will then display the charging test readings (see Figure 2-3).
2. Follow the screen prompt and run the engine at 2000 RPM for 30 seconds. When the timer times out, release the throttle and look at the display screen.
3. The diode pattern will appear in the lower left-hand corner of the screen (see Figure 2-3). Follow the screen prompt and determine whether the diode pattern is good or bad. A good pattern will have regular, even waves, with some variation acceptable. A bad pattern has uneven or irregularly-shaped waves (see Figure 2-4). Press:

- [F1] - for yes, the pattern shown on the screen is good;
 [F2] - for no, the pattern shown on the screen is not good.

DIS Cranking Test results are displayed in the same format as Conventional Cranking Tests.

Cranking Test Error Messages

The following messages may appear during cranking test, under certain conditions:

"Engine Deseled" - appears if a cylinder fires during cranking. This message may also appear when the trigger is bad (due to erratic RPM readings). Repeat the test. If this message appears again, and the engine did not diesel, go to the main menu screen and perform a "Lead Set-Up" and check the trigger.

"Engine Started; Repeat Test" - appears if the engine started before cranking information could be gathered. Shut the engine "OFF." Press [F3] and run the test again.

"Reverse Direction of Amp Probe" - appears if the amp probe is installed incorrectly. If the probe is clamped around negative terminal wires, arrow should point toward battery. If probe is clamped around positive terminal wires, arrow should point away from battery.

"Cranking Speed Too Low - Retest" - cranking revolutions are too low; recharge the battery or make any repairs needed to improve cranking speed.

For Conventional Cranking Tests Only:

"Check Test Leads For Proper Connections" - the Engine Analyzer Module recognizes a current draw, but no ignition clocks. Check all test leads.

For DIS Cranking Tests Only:

"Check DIS Leads and/or Ignition Module" - the Engine Analyzer Module recognizes a current draw, but no cylinder firings. Check all test leads.

Digital Secondary kV

Conventional Ignition

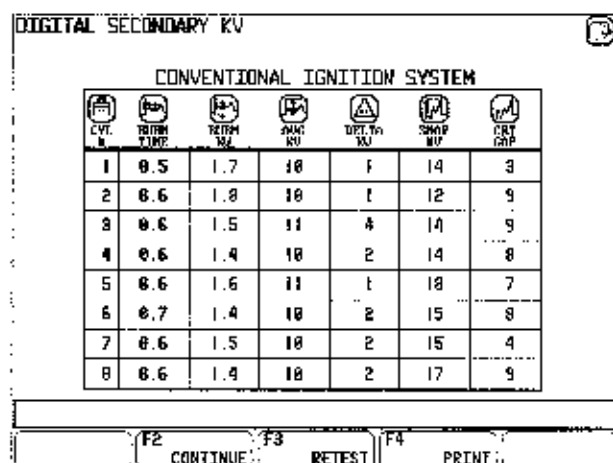


Figure 2-5

The kV test samples a series of firings for each cylinder, then reports on individual spark plug burn times (milliseconds) and the following kV readings:

"BURN TIME" - The length of time in milliseconds that the spark plug is arcing.

"BURN kV" - The average kV required to maintain the spark. The amount for each cylinder's secondary circuit is stored and shown on the screen in the proper cylinder column.

"AVERAGE kV" - The average firing kV required to initiate a spark. The amount for each cylinder's secondary circuit is stored and shown on the screen in the proper cylinder column.

"DELTA kV" - The difference between the minimum and maximum kV.

After Delta kV is displayed, the operator will be prompted to snap the throttle wide open and release it. This action is needed to obtain Snap kV and Circuit Gap values.

"SNAP kV" - Secondary kV for each cylinder is sampled under load caused by engine acceleration. The maximum firing kV value is stored and shown on the screen.

"CIRCUIT GAP kV" - The voltage required to jump the largest air gap (except spark plug gap) in each cylinder secondary circuit is stored and shown on the screen. The value shown represents the minimum required firing kV during deceleration.

Repeating this test may yield slightly different values due to variations in mixture richness, turbulence, temperature, etc.

1. Start the engine. Select Item 3, "Digital Secondary kV" from the "Service Test Menu." The "Digital Secondary kV" screen appears (see Figure 2-5).
2. Follow the screen prompt and "snap" the throttle. The Engine Analyzer Module measures the burn time, various kV readings and circuit gap, and then displays the results for each cylinder on the chart on the screen. Press:
 - [F2] to continue. The program will return to the "Service Test Menu."
 - [F3] to run the test again.
 - [F4] to print the "Secondary Ignition Report."

Digital Secondary kV - DIS

DIGITAL SECONDARY KV						
COMPRESSION				D.I.S. EXHAUST		
CYL #	AVG KV	DELTA KV	BURN TIME	AVG KV	DELTA KV	BURN TIME
1	10	4	1.3	2	1	1.2
4	11	5	1.3	2	1	1.2
2	14	7	1.2	3	0	1.2
5	10	4	1.2	3	1	1.2
3	10	5	1.2	1	1	1.3
6	9	6	1.2	2	1	1.2

(F2) CONTINUE (F3) RETEST (F4) PRINT

Figure 2-6

The screen displays tachometer and digital RPM readout. Follow screen prompt and allow engine RPM to stabilize at idle (800 - 1000 RPM). When RPM is stable, press [F2].

Secondary data is collected from the DIS system. After a few seconds, the display screen reports the following kV readings for the Compression Firings and Exhaust Firings of each cylinder (see Figure 2-6):

"AVERAGE KV" - The average firing kV required to initiate spark, averaged over a number of firings.

"DELTA KV" - The difference between the minimum and maximum firing kV.

"BURN TIME" - The length of time in milliseconds that the spark plug is arcing.

Again, repeating this test may yield slightly different values, due to variations in mixture richness, turbulence, temperature, etc.

Fuel System

This test provides an "Automatic" mode which allows the operator to remain in the car to control the accelerator during the test.

NOTE This menu item will appear "ghosted" on the screen until the Optional Gas Bench Kit has been installed. See your local service representative for details.

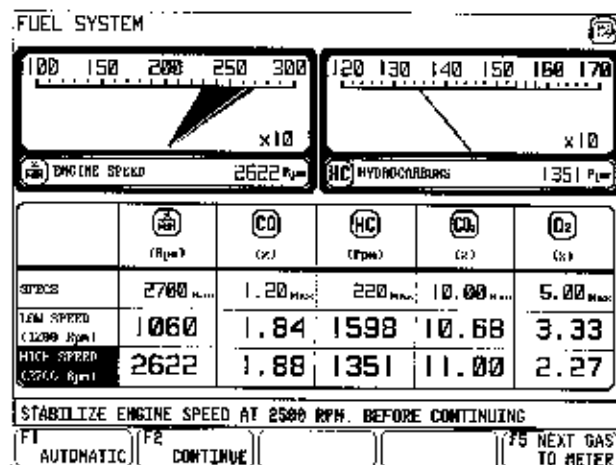


Figure 2-7

Test Setup

1. Start the engine, if necessary. Select Item 4, "FUEL SYSTEM," from "Service Test Menu."
2. A special "Fuel System" screen appears. Press:
 - [F1] to select carbureted fuel system;
 - [F2] to select fuel injection system.
3. The "Emissions Specifications" screen appears. Follow the screen prompts and type in the requested vehicle data:
 - a) the last two digits of the vehicle model year
 - b) then press [F2].
4. On some (non-US) applications, the analyzer prompts for entry of emission specifications for CO and HC. Default specifications are automatically entered, based on the vehicle model year and its corresponding entry in the Diagnostic Limit table in the Utilities Menu. Make any necessary modifications and press [F2] to proceed.
5. The "Fuel System" meter screen appears (see Figure 2-7). The Engine Speed Meter on the left side will always be displayed. Press [F5] to toggle right meter through each exhaust gas.
6. Choose either the "Manual" or "Automatic" test mode as described below to complete the test.

Manual Mode

1. Follow the screen prompt and adjust the vehicle's engine to run at the manufacturer's idle RPM. When the engine is running at the correct RPM, press [F2] to start the test. The Engine Analyzer Module will read the RPM and dilution values, and will display the results on the screen, with a shadow function to show the acceptable range.

NOTE This test meter screen features a "shadow function" which shows the acceptable range for meter readings. When making adjustments, make sure the "reading" line is within the shadow.

2. After the idle portion of the test is complete, follow the screen prompt and adjust the engine RPM for cruise speed. When the engine is at "cruising" RPM, press [F2]. The high-speed portion of the test will run.
3. The meters will change to display the high-speed data. When the screen prompt *"Test Complete - Results Stored"* appears, press:

[F2] to return to the "Service Test" menu;
[F3] to repeat the test;
[F4] to print a report listing the results and any diagnostic messages available.

Automatic Mode

1. Press [F1] to begin testing under "Automatic" mode.

Follow the screen prompt and adjust the vehicle's engine to run at the manufacturer's idle RPM. The Engine Analyzer Module will read the RPM values over a set number of revolutions and will begin sampling automatically when a stable RPM is reached. The Engine Analyzer Module will automatically display both the "Low Speed" and "High Speed" results on the screen, with a shadow function to show the acceptable range.

NOTE This test meter screen features a "shadow function" which shows the acceptable range for meter readings. When making adjustments, make sure the "reading" line is within the shadow.

2. The meters will change to display the high-speed data. When the screen prompt *"Test Completed - Results Stored"* appears, press:

[F2] to return to the "Service Test" menu;
[F3] to repeat the test;
[F4] to print a report listing the results and any diagnostic messages available.

Cylinder Efficiency/Performance

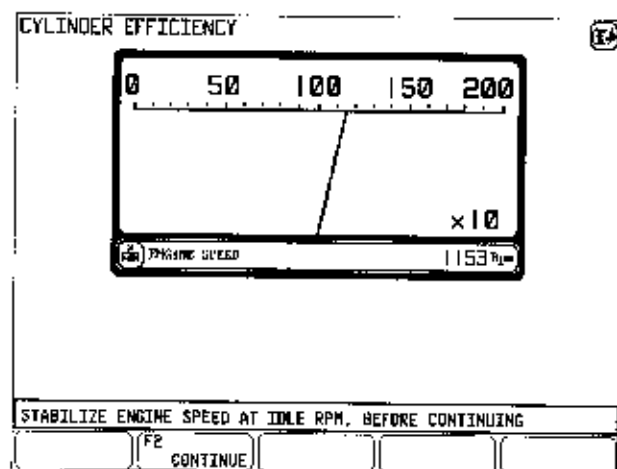


Figure 2-8

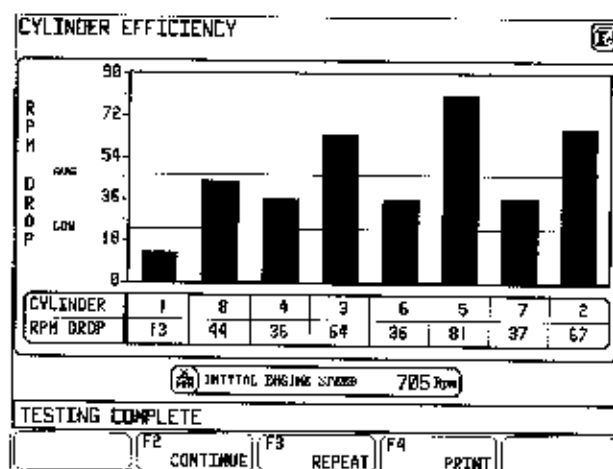


Figure 2-9

The Cylinder Efficiency test compares the relative power contribution of each cylinder to overall engine performance. The test measures power lost when each cylinder is inhibited. Then the computer calculates the relative contribution of each cylinder and displays that information on the screen in the form of a bar graph.

1. Select Item 5, "CYLINDER EFFICIENCY" from the "Service Test Menu."
2. The "Cylinder Efficiency" meter screen appears. Adjust the vehicle's engine to provide a stable RPM reading, and then press [F2].
3. The "Cylinder Efficiency" data screen appears. The prompt "Please Wait - Collecting Data" appears. Each cylinder block will be highlighted as the data is collected from it.

After the data has been collected, the computer calculates the results and displays the RPM Drop Values in the boxes under the graph, and then displays a diagnostic message in the message box (see Figure 2-9). Press:

- [F2] to continue to the main menu;
- [F3] to repeat the test;
- [F4] to print the "Cylinder Efficiency" report.

- The vertical bars represent the power LOST when a cylinder is "killed." The taller the bar, the greater the power loss. There is a bar for each cylinder and they are arranged in firing order.
- The "AVG" line shows the average power loss experienced during the cylinder test.
- The "LOW" line is a caution line. A vertical bar which ends below or near this line represents a weak cylinder.

Cylinder Performance (DIS Vehicles)

When the Engine Analyzer Module is set up for DIS testing, Item 5 on the "Service Test" menu changes to read "Cylinder Performance."

NOTE On some DIS applications, the Cylinder Performance Test will appear "ghosted" on the screen because there is not sufficient vehicle-specific information available to accurately calculate cylinder performance.

The Cylinder Performance test compares the relative power contribution of each cylinder to overall engine performance. The computer calculates the relative contribution of each cylinder and displays that information on the screen in the form of a bar graph.

1. Select Item 5, "Cylinder Performance" from the "Service Test Menu."
2. The "Cylinder Performance" meter screen appears. Adjust the vehicle's engine to provide a stable RPM reading, and then press [F2].
3. The "Cylinder Performance" data screen appears. The prompt *"Please Wait - Collecting Data"* appears.

After the data has been collected, the computer calculates the results and displays the Rating Values in the boxes under the graph, and then displays the message *"Testing Complete"* in the message box (see Figure 2-10). Press:

- [F2] to continue to the main menu;
- [F3] to repeat the test;
- [F4] to print the "Cylinder Performance" report.

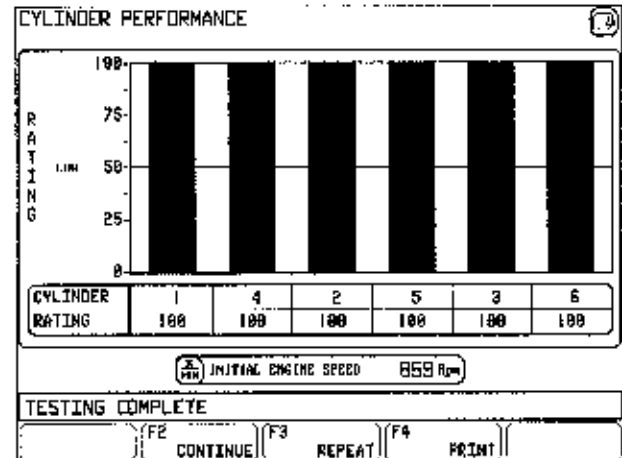


Figure 2-10

- The vertical bars represent cylinder power output. The taller the bar, the greater the power output. There is a bar for each cylinder and they are arranged in firing order.
- The "AVG" line shows the average power loss experienced during the cylinder test.
- The "LOW" line is a caution line. A vertical bar which ends below or near this line represents a weak cylinder.

NOTE **Important Notes:**

- During testing, the engine fan may start, causing a dramatic RPM change which could affect test results. You may then need to repeat the test to achieve accurate results. If possible, either make sure that the fan runs all the time during the test or disconnect it entirely. If you disconnect the fan to run the test, be sure to reconnect it when you are finished.
- If test results are inconsistent over two or three tests, check for:
 - Mixture/vacuum leak
 - Engine or cylinder problem.

Timing Results Entry

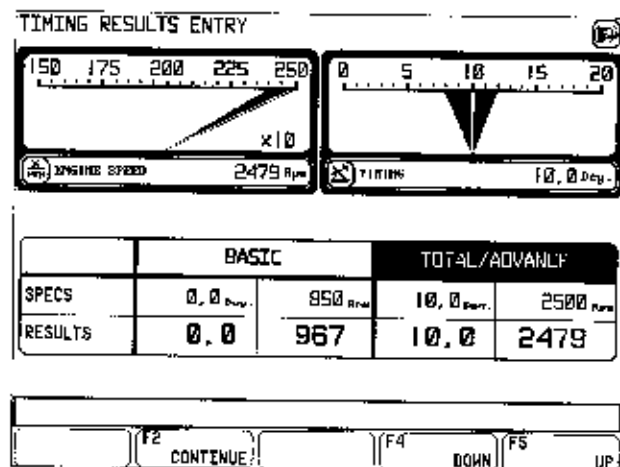


Figure 2-11

This function allows the operator to enter the timing values to allow the Engine Analyzer Module to generate diagnostic messages.

NOTE This test meter screen features a "shadow function" which shows the acceptable range for meter readings. When making adjustments, make sure the "reading" line is within the shadow.

1. Select Item 6, "TIMING," from the "Service Test Menu."
2. The "Timing Specifications" screen appears. Type in the required timing and RPM specifications. Press [ENTER] after each entry. To correct a mistake, press the up- or down-arrow keys to scroll up or down the list. When finished, press [F2].

3. The "Timing Results Entry" screen appears (see Figure 2-11). The "Basic" data box will be highlighted.

Use a timing light to measure timing. Then press the up- or down-arrow keys to change the values shown on the screen so that they match the actual readings.

4. Press [F2] to highlight the "TOTAL/ADVANCE" data box. Press the up- or down-arrow keys to change the values shown on the screen so they match actual readings.
5. The Engine Analyzer Module then completes the test and stores the results. When the "Timing Test Completed" prompt appears, press:
 - [F2] to continue on to the next test. The program returns to the "Service Test Menu."
 - [F3] to repeat the test.
 - [F4] to print the "Timing Test Report."

Power Check

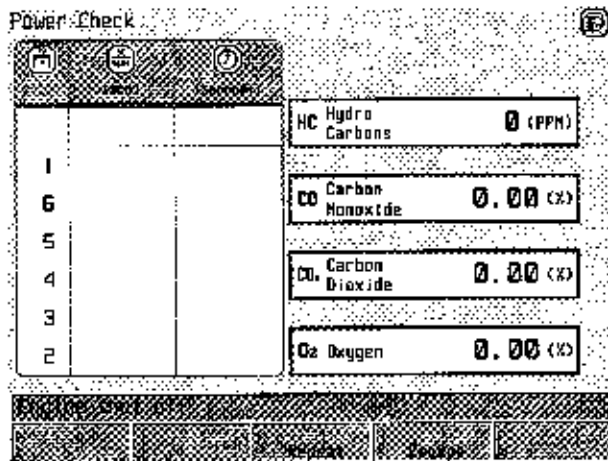


Figure 2-12

Power Check allows the operator to "kill" cylinders and watch the resulting changes in engine RPM, HC, CO, CO₂ and O₂. This information allows the operator to evaluate the performance of individual cylinders. This test will provide better results on older engines or on engines which are running roughly.

NOTE **IMPORTANT:** Power Check does NOT apply to DIS systems.

NOTE Most computer-controlled fuel management systems compensate for RPM loss during Power Check. This compensating feature can often be disabled (by disabling the idle speed controls to force an open loop condition) according to the vehicle manufacturer's instructions. However, it may be easier to run a Cylinder Efficiency test, which will not trigger the computer compensation.

When finished, remember to reconnect any components disconnected from the vehicle.

1. Start the engine, if necessary.
2. Select Item 7, "POWER CHECK" from the "Service Test Menu."
3. The "Power Check" screen appears (see Figure 2-12). Follow the screen prompt or press:
 - [F1] to run an automatic sequence. The Engine Analyzer Module will kill each cylinder, one at a time, take readings and display the test results.
 - [F2] to continue on to the next test. The program returns to the "Service Test Menu."
 - [F3] to release an inhibited cylinder. Type in the number of the cylinder to be released.
 - [F4] to print the "Power Check Report."
 - [F5] to clear the screen. If the "Automatic" sequence is selected, the Engine Analyzer Module will begin displaying new readings as each cylinder is retested.
4. Make sure the engine is running at a stable RPM. For manual testing, type in the cylinder number(s) to inhibit. The Engine Analyzer Module then inhibits the cylinder and charts the various readings. Type the number of an inhibited cylinder to release that cylinder.
5. When finished, press [F2] to return to the "Service Test Menu."

Ignition Patterns

For correct results, the engine must be running. From the main menu, press [F3] to make sure the Engine Analyzer Module is receiving good signals from all sources, and number of cylinders are correct. For testing DiS vehicles, the Engine Analyzer Module must get a good secondary trigger.

1. If necessary, start the engine.
2. Select Item 8, "IGNITION PATTERNS" from the "Service Test Menu."
3. The sequential pattern appears. To change the pattern display, type in the pattern number as shown across the bottom of the display.

The parade pattern (see Figure 2-13) shows kV peaks of all active cylinders. The format of this pattern cannot be changed. Press:

- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to toggle between display "Freeze" and "Unfreeze."
- [F4] to toggle optional gas analyzer readings on and off.

Press Up and Down Arrow keys to change the vertical scales available:

- 0 to 40kV
- 0 to 20kV
- 0 to 12kV

Parade Pattern

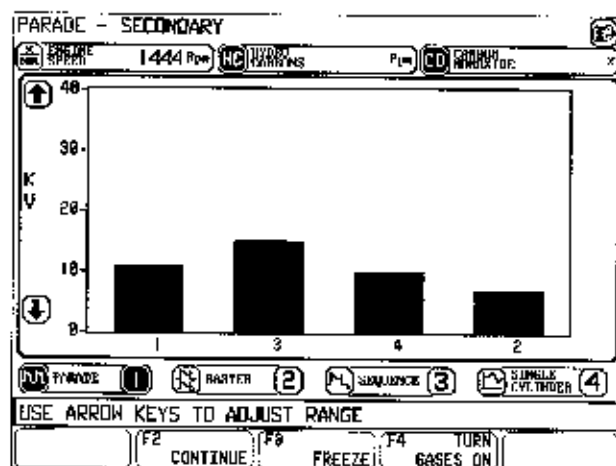


Figure 2-13

For DIS vehicles ONLY (see Figure 2-14), press:

- [F4] to toggle the gas readings on and off.
- [F5] to toggle between DIS exhaust and compression patterns.

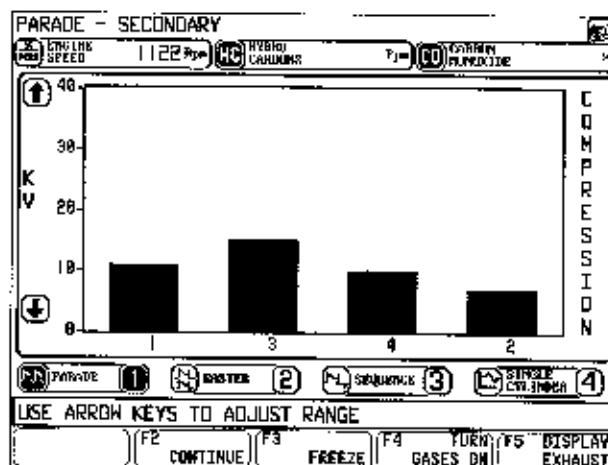


Figure 2-14

Raster Patterns

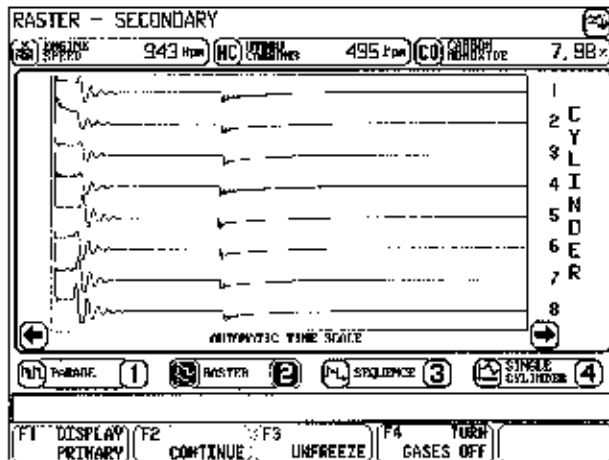


Figure 2-15

Raster patterns display the waveforms for all cylinders at one time (see Figure 2-15). The patterns are arranged in firing order from top to bottom. Press:

- [F1] to toggle back and forth between primary and secondary patterns;
- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to toggle between display "Freeze" and "Unfreeze."
- [F4] to toggle the gas readings on and off.

Press the right- or left-arrow keys to change the horizontal time scale. The default mode is "Automatic Time Scale." The Time Scale range is from 1-4 milliseconds. The scale can be changed in 1-millisecond increments.

Sequential Pattern

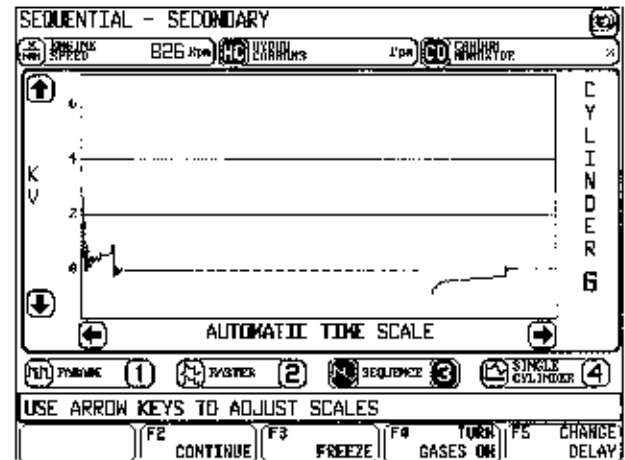


Figure 2-16

Sequential patterns (see Figure 2-16) display a waveform for each cylinder, in firing order as entered through the "Setup" function at the main menu. Press:

- [F1] to toggle back and forth between primary and secondary patterns;
- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to "freeze" the pattern on the screen.
- [F4] to toggle the gas readings on and off.
- [F5] to change the screen delay, slowing the refresh rate.

Press the right- or left-arrow keys to change the horizontal time scale. The default mode is "Automatic Time Scale." The Time Scale range is from 1-4 milliseconds. The scale can be changed in 1-millisecond increments.

continued...

Single Cylinder Patterns

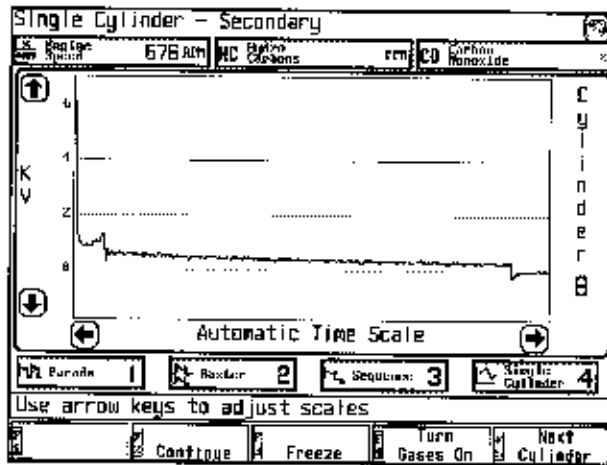


Figure 2-17

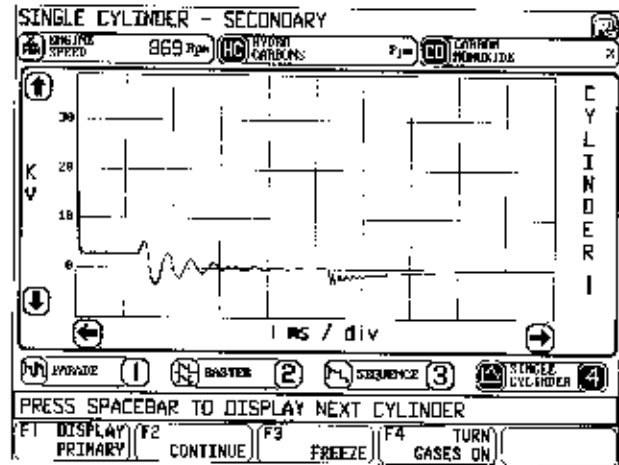


Figure 2-18

This pattern will display the waveform for a single cylinder (see Figure 2-17). Press:

- [F1] to toggle back and forth between primary and secondary patterns.
- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to "freeze" the pattern on the screen.
- [F4] to toggle the gas readings on and off.
- [F5] to display the next cylinder in firing order.

Press the up- and down-arrow keys to change the vertical scales available:

- 10 to +40
- 2 to +7

Press the right- or left-arrow keys to change the horizontal time scale. The default mode is "Automatic Time Scale." The time scale range is from 1-10 milliseconds. This scale can be changed in 1-millisecond increments.

NOTE For DIS systems, the [F1] function key will not appear, since the primary waveform will appear as a meaningless flat line.

NOTE Figure 2-18 shows a pattern in "expanded" mode at 1-millisecond/division.

Cylinder Miss Recall

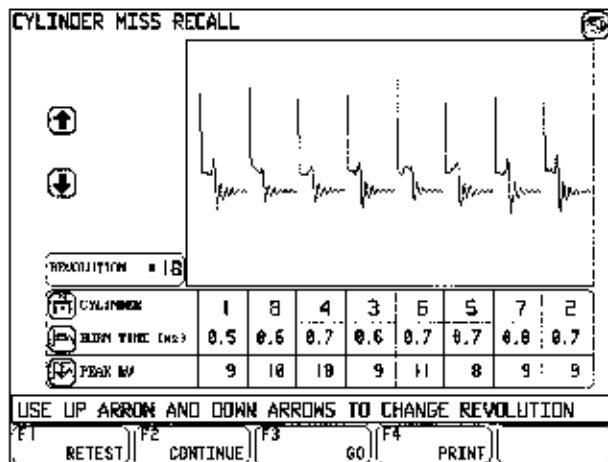


Figure 2-19

Cylinder Miss Recall pinpoints misfiring cylinders by recording the waveforms from each cylinder firing and playing them back for the operator to examine. Before running this test, press either [F1] or [F2] from the main menu and make sure that:

- the number of cylinders is entered correctly;
- the firing order is entered correctly;
- the Engine Analyzer Module is getting signals from the test leads.

1. Start the engine, if necessary.
2. Select Item 9, "Cylinder Miss Recall" from the "Service Test Menu."

3. The "Cylinder Miss Recall" screen appears (see Figure 2-19). As the computer gathers the required information the prompt "Collecting Ignition Patterns" appears. Follow the screen prompts and press:

- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to begin displaying the recorded information on the screen.

The "Cylinder Miss Recall" screen displays the following information for each revolution when playback is stopped by pressing [F3]:

- Revolution number;
- Burn time per cylinder, measured in milliseconds;
- Peak kilovolts, per cylinder.

The Engine Analyzer Module will play back each revolution recorded until the operator stops the playback.

Press:

- [F1] to repeat the test.
- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to stop the playback on a particular revolution.
- [F4] to print the "Cylinder Miss Recall Report."

Watch the screen for the miss. When it appears, press [F3] to stop the playback. If the "frame" that shows the misfire is missed, press the up-arrow key to see the next revolution or press the down-arrow key to see the previous revolution. Press [F3] to resume the playback again.

Parade Peaks

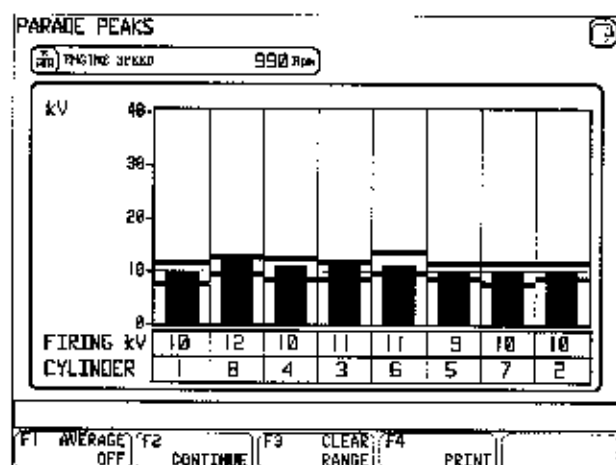


Figure 2-20

This test provides a visual reference of the high, low and average firing kilovolts for each cylinder.

1. Start the engine, if necessary.
2. Select Item 10, "PARADE PEAKS" from the "Service Test Menu."
3. The "Parade Peaks" screen appears (see Figure 2-20). The vertical bars show the "live" readings, while the horizontal lines across each column represent the high and low kilovolt peaks. The average line is the straight line across all the columns shown.
4. The "Parade Peaks" screen also shows the "Firing kV" value for each cylinder. To adjust the screen, press:

- [F1] to toggle the average function "ON" and "OFF." The horizontal line across the columns will appear or disappear.
- [F2] to continue on to the next test. The program will return to the "Service Test Menu."
- [F3] to redraw the high and low RPM indicators on the screen.
- [F4] to print the "Parade Peaks" report.

Parade Peaks (DIS Vehicles)

The "Parade Peaks" test operates in the same manner as for conventional systems. The screen appears slightly different, however. The label "Compression kV" will appear in the upper right-hand corner of the screen. To adjust the screen, press:

- [F1] to toggle the average function "ON" and "OFF." The horizontal line across the columns will appear or disappear.
- [F2] to continue on to the next test. The program will return to the "Service Test Menu."
- [F3] to clear the range, or remove the high and low peak indicator lines so the Engine Analyzer Module can redraw them. This acts as a "retest" function.
- [F4] to print the "Parade Peaks" report.
- [F5] to display the kV readings for "Exhaust kV."

Dual Trace Scope

During this test, the Engine Analyzer Module will convert voltage readings from any electrical device into a waveform on the display screen. Display any electrical pattern ranging from ± 2.5 up to ± 25 volts, freeze it, and analyze it for voltage changes over millisecond time periods.

Use the Dual Trace Scope to compare the waveforms from two different components. For example, call up the waveforms for the MAP sensor and an injector. If you know what their respective waveforms should look like, you can compare the two to see whether or not the injector is firing at the wrong time because it is receiving a bad signal from the MAP sensor.

To Synchronize the Pattern

When a pattern is not synchronized, it will often be hard to read because its position on the screen is not controlled.

To stabilize the pattern on the screen, synchronize the pattern so that it is triggered by some event, such as a cylinder firing. When synchronized, the pattern begins at the left edge of the screen, where the triggering event occurs.

1. Select Item 11, "DUAL TRACE SCOPE" from the "Service Test Menu." The "Dual Trace Scope" screen appears (see Figure 2-21).
2. Choose the settings that you will use. Press the up and down arrow keys to move the highlight bar up and down the settings list. Press [ENTER] to display a pop-up menu of the selections available for that setting.
For the "A" and "B" channels, you may choose a vertical meter scale which ranges from ± 2.5 volts up to ± 25 volts. For the trigger selection, choose one of the following:

- None;
- Primary;
- Cylinder Clock;
- #1 Lead.

You may also change the time scale. The smallest scale that can be read and displayed is 3 milliseconds per division; the largest scale available is 64 milliseconds per division. Make a selection from the pop-up menus by using the up- and down-arrow keys to move the highlight to the desired setting. Press [ENTER] to use the highlighted selection. If you change your mind about a selection, press [F4] to cancel the selection and return to the "live" screen.

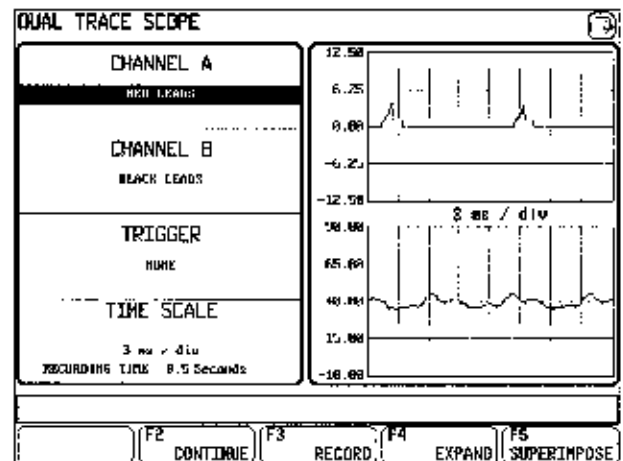


Figure 2-21

3. Connect the red and black leads to the appropriate signal test points.

NOTE Make sure the ground clip from each test lead is securely clamped to a good ground to eliminate excess noise from the pattern.

4. Start the engine, if necessary. The waveforms will appear in the display halves of the boxes.

continued...

Dual Trace Scope (Continued)

Press:

- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to start the waveform recorder.
- [F4] to expand the pattern display to take up the entire screen.
- [F5] to superimpose the waveforms.

Figure 2-23 shows a superimposed display that has been fully expanded.

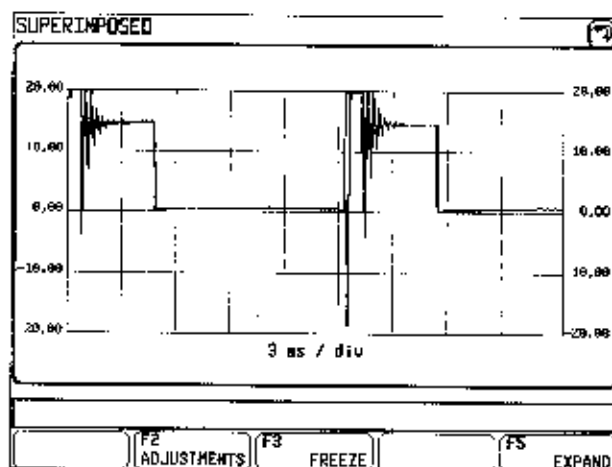


Figure 2-23

Expanding the Waveform Display

From the adjustments screen, press [F4]. The waveform display boxes will expand to take up the entire screen (see Figure 2-22).

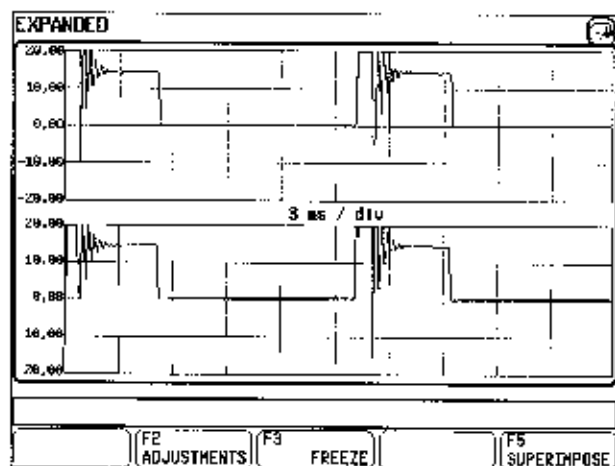


Figure 2-22

Press:

- [F2] to return to the "Dual Trace Scope" screen. This allows you to make any necessary adjustments to triggers, voltage or time scales.
- [F3] to toggle between "freeze" and "un-freeze."
- [F5] to superimpose the waveforms (see Figure 2-23).

Waveform Recorder Functions

From the "Dual Trace Scope" screen, press [F3]. The message "Please Wait - Recording Waveforms" will appear. After the analyzer has recorded twenty (20) frames, an "expanded" screen will appear (see Figure 2-24). The analyzer will repeatedly display the recorded sequence one frame at a time.

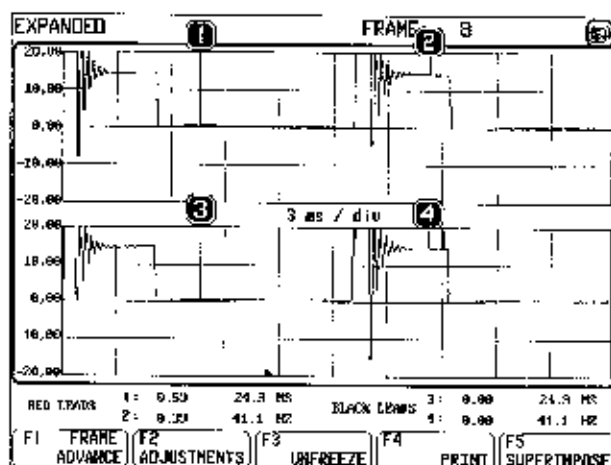


Figure 2-24

Press:

- [F1] to display each captured frame in order. This function key only appears if you press [F3] to freeze the display. Use this function to closely examine each data frame.
- [F2] to return to the "Dual Trace Scope" screen. This allows you to make any necessary adjustments to triggers, voltage or time scales.
- [F3] to "freeze" the pattern on the screen. The Engine Analyzer Module then stops (freezes) the waveforms on the screen and displays time flags and voltage readings at particular times. The flags are spaced apart according to the time scale selected from the "Dual Trace Scope" screen. To return to "live" readings, press [F3] again.
- [F4] to print the "Dual Trace Scope Report." The report provides a hard copy of the voltages and time scale for reference.

NOTE

This option appears only after pressing [F3] to freeze the waveforms.

- [F5] to superimpose the waveforms (see Figure 2-25). This allows close comparison of both waveforms over time.

"Freeze" Screen Options

From either an "expanded" or "superimposed" screen, press [F3]. The Engine Analyzer Module then stops (freezes) the waveforms on the screen and displays time flags and voltage readings at particular times. The flags are spaced apart according to the time scale selected from the "Dual Trace Scope" screen. To return to "live" readings, press [F3] again.

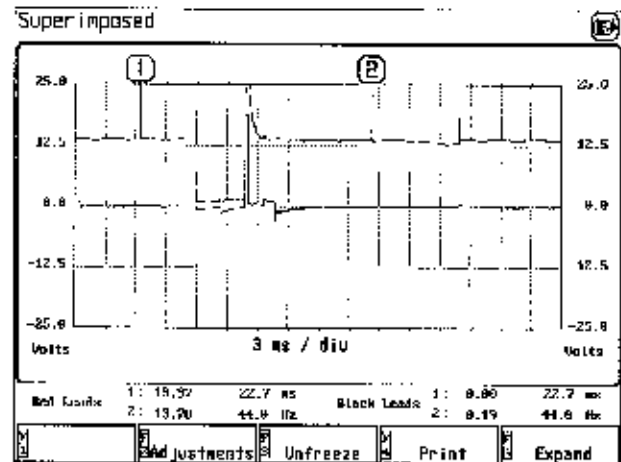


Figure 2-25

Press:

- [F2] to return to the "Dual Trace Scope" screen. This allows the operator to make any necessary adjustments to triggers, voltage or time scales.
- [F3] to toggle between "freeze" and "un-freeze."
- [F4] to print the "Dual Trace Scope Report." The report provides a hard copy of the voltages and time scale for reference.

NOTE

This option appears only after pressing [F3] to freeze the waveforms.

- [F5] to return to "expanded waveforms" mode.

Only one flag can be moved at a time. To select a flag, press the corresponding number. Press the right and left arrow keys to move the flags. This allows the operator to check and compare voltages at any particular time.

Uniscope

The Uniscope allows the operator to record a single waveform over an extended period of time, to allow discovery of intermittent faults. Use this test to isolate voltage problems.

When the test is selected, the "Uniscope" screen appears (see Figure 2-26).

To Synchronize the Pattern

When a pattern is not synchronized, it will often be hard to read because its position on the screen is not controlled.

To stabilize the pattern on the screen, synchronize the pattern so that it is triggered by some event, such as a cylinder firing. When synchronized, the pattern begins at the left edge of the screen, where the triggering event occurs.

1. Choose the settings that you will use. Press the up and down arrow keys to move the highlight bar up and down the settings list. Press [ENTER] to display a pop-up menu of the selections available for that setting.

You may choose a vertical meter scale which ranges from ± 2.5 volts up to ± 25 volts. For the trigger selection, choose one of the following:

- None;
- Primary;
- Cylinder Clock;
- #1 Lead.

You may also change the time scale. The smallest scale that can be read and displayed is 1.5 milliseconds per division; the largest scale available is 32 milliseconds per division. Make a selection from the pop-up menus by using the up and down arrow keys to move the highlight to the desired setting. Press [ENTER] to use the highlighted selection. If you change your mind about a selection, press [F4] to cancel the selection and return to the "live" screen.

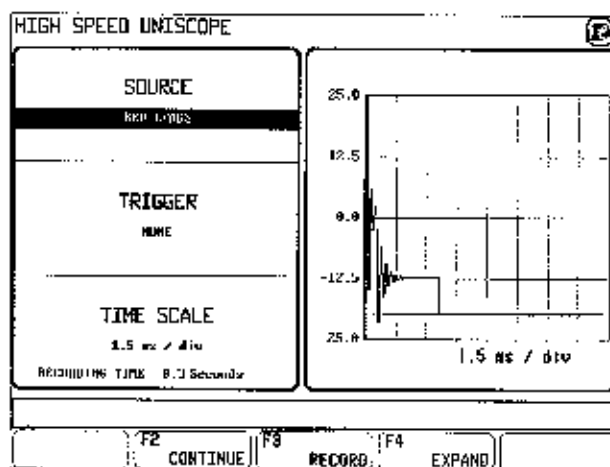


Figure 2-26

2. Connect the red and black leads to the appropriate signal test points.

NOTE Make sure the ground clip from each test lead is securely clamped to a good ground to eliminate excess noise from the pattern.

3. Start the engine, if necessary. The waveform will appear in the meter display.

Press:

- [F2] to continue on to the next test. The program returns to the "Service Test Menu."
- [F3] to start the waveform recorder.
- [F4] to expand the pattern display to take up the entire screen.

Expanding the Waveform Display

From the adjustments screen, press [F4]. The waveform display boxes will expand to take up the entire screen (see Figure 2-27).

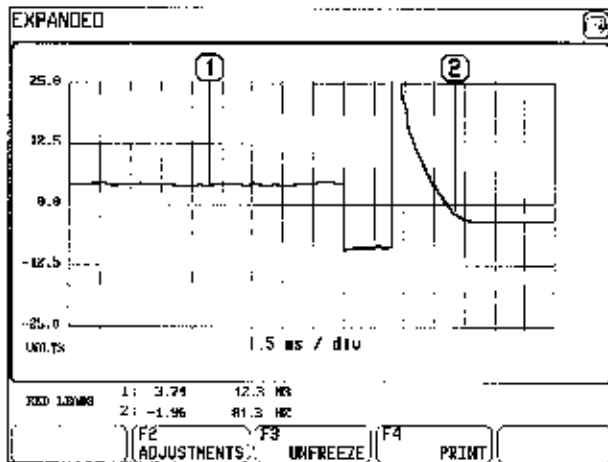


Figure 2-27

Press:

- [F2] to return to the "Uniscope" screen. This allows you to make any necessary adjustments to triggers, voltage or time scales.
- [F3] to toggle between "freeze" and "un-freeze."
- [F4] to print the "Uniscope." The report provides a hard copy of the voltages and time scale for reference.

NOTE This option appears only after pressing [F3] to freeze the waveforms.

Waveform Recorder Functions

From the "Uniscope" screen, press [F3]. The message "Please Wait - Recording Waveforms" will appear. After the analyzer has recorded twenty (20) frames, an "expanded" screen will appear (see Figure 2-28). The analyzer will repeatedly display the recorded sequence one frame at a time.

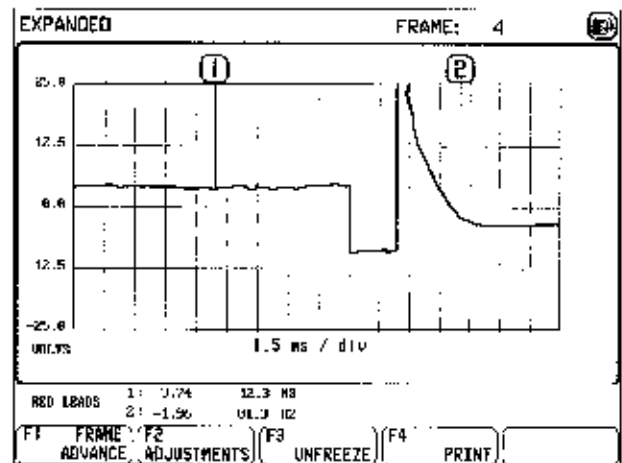


Figure 2-28

Press:

- [F1] to display each captured frame in order. This function key only appears if you press [F3] to freeze the display. Use this function to closely examine each data frame.
- [F2] to return to the "Uniscope" screen. This allows you to make any necessary adjustments to triggers, voltage or time scales.
- [F3] to "freeze" the pattern on the screen. The Engine Analyzer Module then stops (freezes) the waveforms on the screen and displays time flags and voltage readings at particular times. The flags are spaced apart according to the time scale selected from the "Uniscope" screen.
- [F4] to print the "Uniscope." The report provides a hard copy of the voltages and time scale for reference.

NOTE This option appears only after pressing [F3] to freeze the waveforms.

To return to "live" readings, press [F3] again.

"Freeze" Screen Options

From either an "expanded" or "superimposed" screen, press [F3]. The Engine Analyzer Module then stops (freezes) the waveforms on the screen and displays time flags and voltage readings at particular times (see Figure 2-29). The flags are spaced apart according to the time scale selected from the "Uniscope" screen.

To return to "live" readings, press [F3] again.

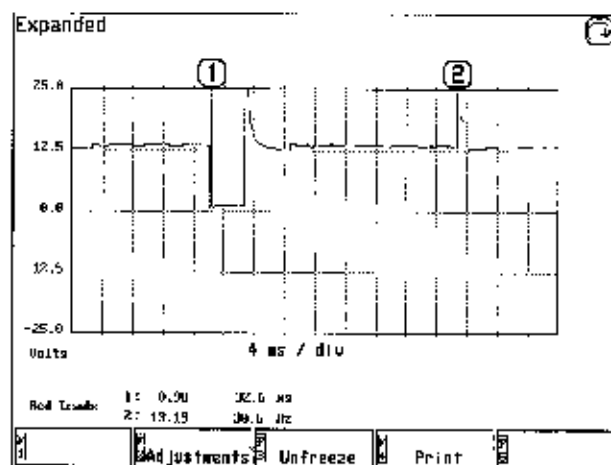


Figure 2-29

Press:

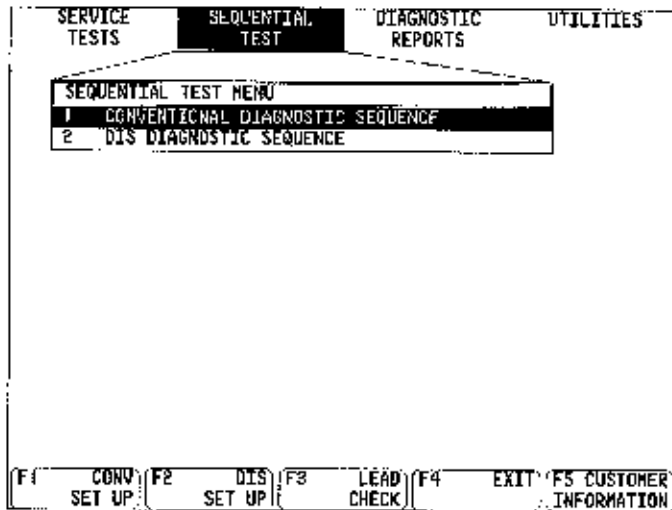
- [F2] to return to the "Uniscope" screen. This allows the operator to make any necessary adjustments to triggers, voltage or time scales.
- [F3] to toggle between "freeze" and "unfreeze".
- [F4] to print the "Uniscope." The report provides a hard copy of the voltages and time scale for reference.

NOTE

This option appears only after pressing [F3] to freeze the waveforms.

Only one flag can be moved at a time. To select a flag, press the corresponding number. Press the right and left arrow keys to move the flags. This allows the operator to check and compare voltages at any particular time.

Sequential Tests



This automatic sequence of system tests is designed to provide an overall look at vehicle performance. During testing, the computer collects and stores diagnostic information. When the tests are complete, the results can either be displayed on the screen or can be printed out in either customer or technical report formats. The reports show vehicle performance data compared to specifications, and include diagnostic messages, which point out problem areas and suggest possible causes and solutions.

The Sequential Test sequence is arranged so that:

- The analyzer provides a clear overall look at performance while vehicle systems are operating;
- Very little manipulation of the vehicle is required;
- Testing of all performance-related systems on the vehicle takes a minimum of time;
- The analyzer provides a Comprehensive report of test results, including diagnostic messages, on the screen display or from the printer.

To check specific systems further after Comprehensive testing is completed, select the appropriate test from the "Service Test Menu" (see "Service Tests" chapter).

The Sequential Test Menu provides tests for both conventional and direct ignition systems. The procedures are nearly the same, except for the test setup procedure.

Pre-Test Inspection

It is important to perform a thorough inspection of the test vehicle before running Sequential tests. This way, the technician can repair any minor problems that would make it difficult to perform the tests (obviously bad wires, vacuum lines, fan belts, etc.). Use the checklist below as a guide to a more thorough visual inspection.

Battery

- Check for loose hold-downs.
- Check electrolyte level; fill if necessary.
- Check cable connections for good contact, cleanliness, excessive corrosion. Clean and tighten as needed.
- Check cables for fraying, breaks, poor insulation.
- Check battery case for cracks.

Belts

- Check fan belt for cracks, impending breaks, proper tension; tighten or fix as needed.
- Check all other drive belts in the same way and make necessary corrections.

Fluid Levels

- Check engine oil level and add if necessary.
- Check transmission fluid; add if needed.
- Also check other fluid levels in power steering, brake system, windshield washer, etc.

Filters, Emission Control Devices

- Check air filters (carburetor, air pump, crank-case breathers), PCV, air injection, other emission devices, vacuum control valves, etc.

Electrical Connections

- Check all wiring (both low and high tension) for cleanliness, tightness, seating, general condition.

Exhaust System

- Quickly check resonator, muffler, exhaust pipes, clamps, tail pipes and catalytic converter for breaks, leaks.

Hoses

- Check all hoses (PCV, heater, radiator, power steering, vacuum, fuel, evaporative control, etc.) for general condition, leaks, cracks, tightness, proper connection, etc.

Radiator and Cap

- Check coolant level; fill as needed.
- Check cap for condition.

Conventional Diagnostic Sequence

1. If necessary, connect all test leads as described in the "General Test Procedure" section in the "Introduction" chapter.
2. Use the right- or left-arrow keys to select the "Sequential Test" menu.
3. Select Item 1, "Conventional Diagnostic Sequence" and complete the conventional vehicle selection as described in Chapter 1.

If vehicle system information was entered earlier, a special screen will appear. Follow the screen prompt and press [F1] to clear the customer and vehicle information from memory. Press [F2] to check the test lead signals.

4. The "Engine Running Lead Check" screen appears. Make sure the analyzer is ready and receiving signals from the #1, primary and secondary probes. If all of the parameters read "OK," press [F2].
5. The "Customer Information" screen appears.

Press:

- [F2] to continue on to the next screen;
- [F3] to clear all of the information fields so new information can be entered;
- [F4] to save customer information to disk.

Change the customer information and/or press [F2].

6. Follow the screen prompt and type in the battery CCA rating. Then press [F2].
7. Follow the next screen prompt and remove the amp probe. Make sure the probe jaws are completely closed and then press [F2].

8. After the analyzer finishes zeroing the probe, follow the screen prompt and reinstall the probe.



IMPORTANT: If the probe is installed around the negative (-) battery leads, make sure the arrow on the probe points back toward the battery. If the probe is installed around the positive (+) leads, make sure the arrow points away from the battery.

9. The "Cranking Test" begins. Follow the screen prompts and run the test. For complete details, see the "Cranking Test" section in the "Service Tests" chapter. Press:

- [F2] to continue on to the next step;
- [F3] to repeat the cranking test;
- [F4] to print the "Cranking Test Report."

10. The "Multiple Meter" screen appears for troubleshooting purposes. Refer to the "Service Tests" chapter for complete information. Use the meters to make adjustments, if necessary. When finished, press [F2].
11. The "Digital Secondary kV" test then runs. Run through the normal test sequence (refer to the "Service Tests" chapter for complete details). Print the "Digital Secondary kV Report," if necessary.
12. The "Emissions Specifications" screen appears. Enter the vehicle model year and then press [F2].
13. The "Fuel System" test then runs. Again, refer to the "Service Tests" chapter for complete details. Press [F2] when the test is completed.

14. The "Cylinder Efficiency" test then runs. When the test is completed, press [F2] to continue.
15. The "Timing Results Entry" routine then runs. Again, refer to the "Service Tests" chapter for complete details. When the timing data is entered, press [F4] to print the report or press [F2] to return to the main menu.
16. The "Comprehensive Report" screen appears (see Figure 3-1).

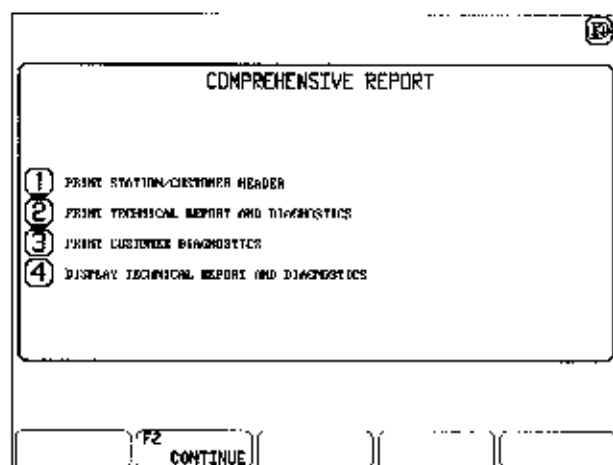


Figure 3-1

Press:

- [1] to print the Station Header (entered in "Utilities") and the Customer Information. This provides a "title page" for all the reports which follow.
- [2] to print the technical report and diagnostics for the technician.
- [3] to print an easy-to-understand report which may be given to the customer.
- [4] to display the technical report and diagnostics results on the screen. The report for each test performed will appear on the screen.

If the operator chooses to print the report, the program prints the report and then returns to the "Comprehensive Report" screen.

If the operator chooses an on-screen report, it will look similar to Figure 3-2.

FUEL SYSTEM REPORT						
EMISSION	HIGH SPEED	RESULT	LOW SPEED	RESULT	LIMITS	
CO	8.58	OK	8.58	OK	1.20 %	
HC	35	OK	239	HIGH	228 PPM	
CO2	14.57	OK	14.69	OK	16.68 MIN	
O2	0.30	OK	0.45	OK	5.68 MAX	
RPM	2618	OK	793	OK	2796/1698	MAX

Figure 3-2

Press:

- [F1] to toggle between test result and diagnostic data displays for that particular test.
- [F2] to display the on-screen report for the previous test that was performed, if any are available.
- [F3] to display the on-screen report for the next test that was performed, if any are available.
- [F4] to exit to the main menu.

DIS Diagnostic Sequence

1. If necessary, connect all of the test leads as described in the "General Test Procedure" section in the "Introduction" chapter.

2. Use the right- or left-arrow keys to select the "Sequential Test" menu.

3. Select Item 2, "DIS Diagnostic Sequence" and complete the DIS vehicle selection as described in Chapter 1.

If vehicle system information was entered earlier, a special screen will appear. Follow the screen prompt and press [F1] to clear the customer and vehicle information from memory. Press [F2] to check the test lead signals.

4. The "Lead Check" screen appears. Make sure the analyzer is ready and receiving signals from the #1 and secondary probes. If all of the parameters read "OK," press [F2].

5. The "Customer Information" screen appears.

Press:

- [F2] to continue on to the next screen;
- [F3] to clear all of the information fields so that new information can be entered;
- [F4] to save customer information to disk.

Change the customer information and/or press [F2].

6. Follow the screen prompt and type in the battery CCA rating. Then press [F2].
7. Follow the next screen prompt and remove the amp probe. Make sure the probe jaws are completely closed and then press [F2].

8. After the analyzer finishes zeroing the probe, follow the screen prompt and reinstall the probe.

NOTE

IMPORTANT: If the probe is installed around the negative (-) battery leads, make sure the arrow on the probe points back toward the battery. If the probe is installed around the positive (+) leads, make sure the arrow points away from the battery.

9. The "Cranking Test" begins. Follow the screen prompts and run the test. For complete details, see the "Cranking Test" section in the "Service Tests" chapter. When the test is complete, press:

- [F2] to continue on to the next step;
- [F3] to repeat the cranking test;
- [F4] to print the "Cranking Test Report."

10. The "Multiple Meter" screen appears for troubleshooting purposes. Refer to the "Service Tests" chapter for complete information. Use the meters to make adjustments, if necessary. When finished, press [F2].

11. The "Digital Secondary kV" test then runs. Run through the normal test sequence (refer to the "Service Tests" chapter for complete details).

12. The "Emissions Specifications" screen appears. Enter the vehicle model year and then press [F2].

13. The "Fuel System" test then runs. Again, refer to the "Service Tests" chapter for complete details. When the test is completed, press [F2].

14. The "Cylinder Performance" test then runs. When the test is completed, press [F2] to continue.

NOTE On some DIS applications, the Cylinder Performance Test will not be performed as part of the Sequential Test because there is insufficient vehicle-specific information available to accurately calculate cylinder performance.

15. The "Timing Results Entry" routine then runs. Again, refer to the "Service Tests" chapter for complete details. When the timing data is entered, press [F2] to continue.

NOTE If the vehicle being tested does not require a timing test, press [ESC] when the specification screen appears.

16. The "Comprehensive Report" screen appears (see Figure 3-3).

Figure 3-3

Press:

- [1] to print the Station Header (entered in "Utilities") and the Customer Information. This provides a "title page" for all the reports which follow.
- [2] to print the technical report and diagnostics for the technician.
- [3] to print a less technical report which may be given to the customer.
- [4] to display the technical report and diagnostics results on the screen. The report for each test performed will appear on the screen.

If the operator chooses to print the report, the program prints the report and then returns to the "Comprehensive Report" screen.

If the operator chooses an on-screen report, it will look similar to Figure 3-4.

MISSION	HIGH SPEED	RESULT	LOW SPEED	RESULT	LERETS
MI	0.51	OK	0.50	OK	1.28 %
MC	95	OK	230	OK	228 UTM
MDZ	11.57	OK	14.63	OK	19.00 TLM
MUM	0.50	OK	0.45	OK	5.00 MAX
	20.18	OK	749	OK	2769/1600 MAX

Figure 3-4

continued...

DIS Diagnostic Sequence (Continued)

Press:

- [F1] to toggle between test result and diagnostic data displays for that particular test.
- [F2] to display the on-screen report for the previous test that was performed, if any are available.
- [F3] to display the on-screen report for the next test that was performed, if any are available.
- [F4] to exit to the main menu.

Diagnostic Reports

SERVICE TESTS	SEQUENTIAL TEST	DIAGNOSTIC REPORTS	UTILITIES
DIAGNOSTIC REPORTS MENU			
1 ALL REPORTS			
2 CRANKING/CHARGING			
3 DIGITAL SECONDARY KV			
4 FUEL SYSTEM			
5 CYLINDER EFFICIENCY			
6 TIMING			

F1	CONV SET UP	F2	DIS SET UP	F3	LEAD CHECK	F4	EXIT	F5	CUSTOMER INFORMATION
----	-------------	----	------------	----	------------	----	------	----	----------------------

The "Diagnostic Reports" menu offers six different choices for printing out the results of a test sequence. The operator may choose to print out a report for one particular test, or all of the available reports in one large report.

Use the arrow keys to move across the main menu until the "Diagnostic Reports" menu appears.

Type in the number of the report to be printed.

The "Comprehensive Report" screen appears.

Press:

- [1] to print the Station Header (entered in "Utilities") and the Customer Information. This provides a "title page" for all the reports which follow.
- [2] to print the technical report and diagnostics for the technician.
- [3] to print an easy-to-understand report which may be given to the customer.
- [4] to display the technical report and diagnostics results on the screen. The report for each test performed will appear on the screen. Figure 4-2 shows an example of a screen report.

Figure 4-1 shows a partial sample of each type of report. After printing the report, the program will return to the "Diagnostic Report" menu.

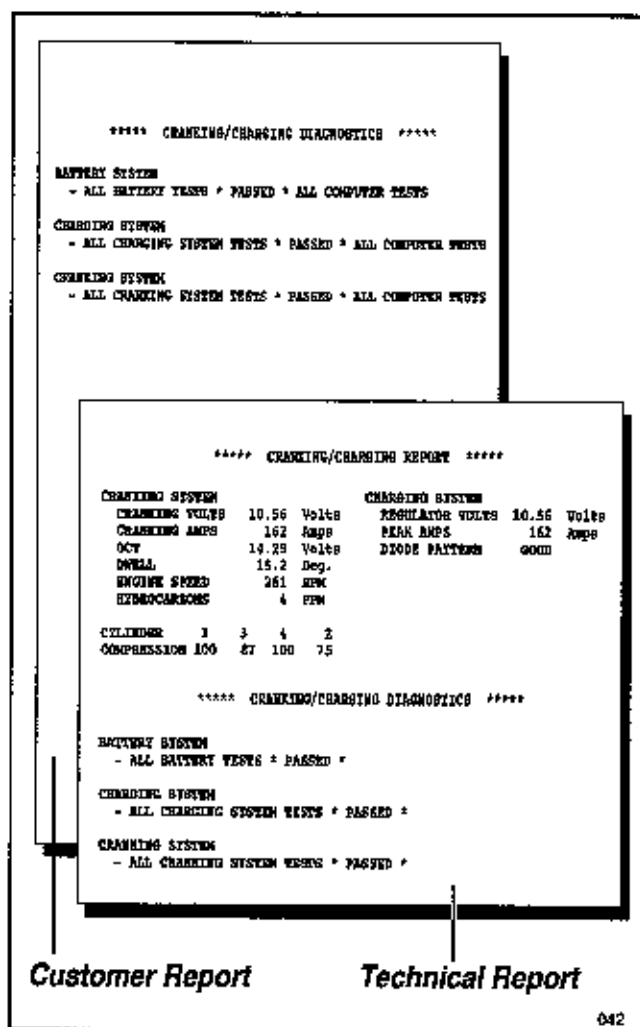


Figure 4-1

The on-screen report will look similar to Figure 4-2.

FUEL SYSTEM REPORT					
MISSION	HIGH SPEED	RESULT	LOW SPEED	RESULT	LIMITS
CO	9.59	OK	9.59	OK	1.20 %
HC	35	OK	239	WARN	220 PPM
CO2	14.57	OK	14.69	OK	18.00 PPM
O2	0.59	OK	0.45	OK	5.00 PPM
RPM	2608	OK	719	OK	2700-1600 RPM

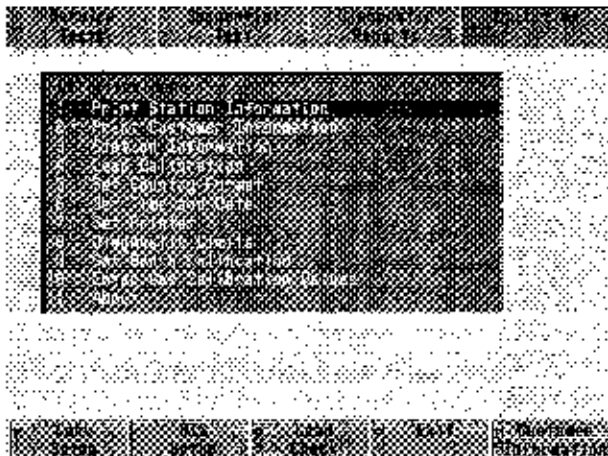
[F1] DISPLAY	[F2] PREVIOUS	[F3] NEXT	[F4]
DIAGNOSTICS	TEST	TEST	EXIT

Figure 4-2

Press:

- [F1] to toggle between test result and diagnostic data displays for that particular test.
- [F2] to display the on-screen report for the previous test that was performed, if any are available.
- [F3] to display the on-screen report for the next test that was performed, if any are available.
- [F4] to exit to the main menu.

Utilities



The "Utilities Menu" provides various administrative and calibration functions. Non-supported functions will appear "ghosted" on the display screen. For example, if the analyzer is not equipped with a Gas Analyzer Module, the "Gas Bench Calibration" menu item will be "ghosted" on the screen.

Print Station/Customer Information

The Utilities menu provides two choices for printing information on the printer. For example, if a technician were about to print a series of diagnostic reports using the choices under the "Diagnostic Reports" menu, he might print out the Customer Information file first to act as a "title" page for the reports and then print out the Station information file to act as a "back cover" page. This way, any particular customer's report can be kept separate from any other customer's report, or the "Customer" report can be kept separate from the "Technical" report that is available from the analyzer

Use the arrow keys to move across the main menu until the "Utilities" menu appears.

Press [F5] to display the "Customer Information" screen. Modify the information if necessary, and then press [F2] to return to the "Utilities" menu. For complete details on modifying customer information, refer to the "Introduction" section.

Use the up- or down-arrow keys to toggle between the two choices and then press [ENTER] to start the printer. The printer will print out the selected data.

Station Information

1. Select "Station Description" from the "Utilities Menu." The "Station Description" screen will appear (see Figure 5-1).

The screenshot shows a terminal window titled "STATION INFORMATION" with a small icon in the top right corner. The window contains the following text:

```

NAME: Automotive Diagnostics
ADDRESS: 8001 Angling Road
CITY: Kalamazoo
STATE: MI
ZIP CODE: 49002
PHONE: 616-329-7600
MESSAGE 1: Test msg 1
MESSAGE 2: Test msg 2
MESSAGE 3: Test msg 3
  
```

At the bottom of the window, there are four buttons: [F2] CONTINUE, [F3] CLEAR ALL, and two empty rectangular buttons.

Figure 5-1

Press:

[ENTER] or arrow keys - to scroll through the list.

[F2] to return to the "Utilities" menu.

[F3] to clear all information fields.

Type the information into the field and then press [ENTER] to move to the next field. There are three separate lines available for custom sale messages. Each line is forty (40) characters long.

Lead Calibration

Select "Lead Calibration" from the "Utilities" menu to calibrate the accessory leads (see Figure 5-2). The only time the accessory leads will need to be calibrated is when a new lead set is installed on the leads module.

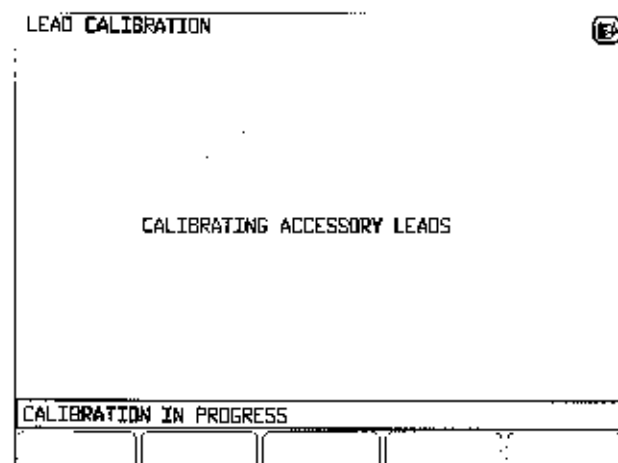


Figure 5-2

Follow the screen prompts, short the leads and press [F2]. After the calibration process is complete, press [F2] again to return to the "Utilities" menu.

Set Country Format

This function allows the operator to change the display character format according to a particular country's requirements.

1. Select "Set Country Format" from the "Utilities" menu.
2. The "Set Country Format" screen appears (see Figure 5-3). The current settings are displayed on the screen.

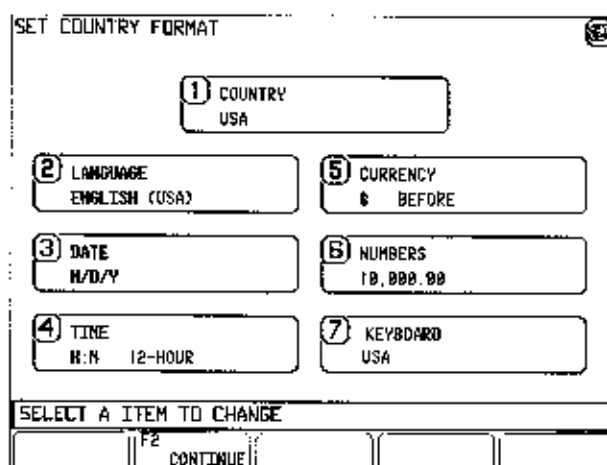


Figure 5-3

Set Time And Date

- Press the number of the category to be changed. A dialog box will appear listing the available choices for that particular category (see Figure 5-4).

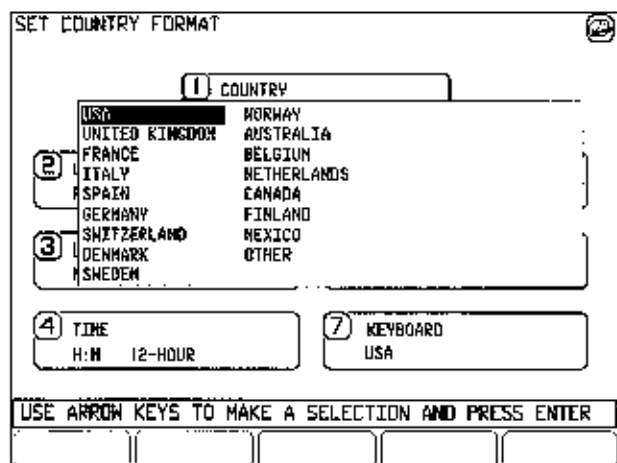


Figure 5-4

Use the arrow keys to move the highlight up and down the list until the correct choice is highlighted. Press [ENTER] to confirm the change. To make the choice faster, type in the number or letter corresponding to the correct choice and then press [ENTER] to confirm the change. The dialog box will disappear and the new selection will be displayed on the "Set Country Format" screen.

This selection allows the operator to enter the correct time and date. The time and date are automatically printed on all customer and technical reports generated by the analyzer.

- Select "Set Time and Date" from the "Utilities" menu.
- The "Set Time and Date" screen appears (see Figure 5-5) with the current settings displayed.

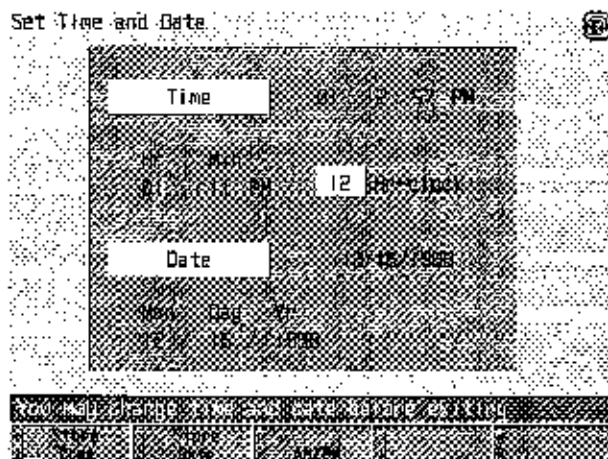


Figure 5-5

- Press the up- or down-arrow key to move the cursor to the setting that must be changed. The cursor will appear in one of the data fields. Type in the correct setting and press [ENTER]. Press [ENTER] to move the cursor from one field to the next.
Press:
[F1] to store the entered time,
[F2] to store the entered date,
[F2] to toggle between AM and PM.
- When finished, press [F10] to return to the "Utilities" menu.

Continued ...

NOTE To change the clock style from a 24 hour (1:00 p.m.) style to military style (13:00), use the "Time" format change function in the "Set Country" menu option.

NOTE The program does NOT automatically compensate for Daylight Savings Time.

Set Printer

The Set Printer function allows you to customize your printer setup to suit your individual needs.

Select "Set Printer" from the "Utilities" menu. Press:

- [1] to select 11-inch fanfold paper type,
- [2] to select 12-inch fanfold paper type,
- [F1] to restore default settings (11-inch fanfold paper, printer port 1),
- [F3] to toggle between printer port 1 or 2 (LPT1/LPT2),
- [F2] to save settings and return to the Utilities Menu.

Diagnostic Limits

The gas analyzer will compare test results received with the information entered by the operator, and can generate lists of possible problems and suggested solutions based on the emission readings.

To Enter Diagnostic Limits:

1. Select "Diagnostic Limits" from the "Utilities" menu.
2. The "Set Diagnostic Limits" data screen appears (see Figure 5-6).

NOTE Limits shown are default values.

Set Diagnostic Limits

Year Range	HC Maximum	CO Maximum
1990-1994	1200	09.00
1965-1969	0700	07.00
1970-1974	0400	04.00
1975-1979	0300	02.00
1980-2001	0220	01.20

Back Exit
Cancel Save

Figure 5-6

To add a new entry to the list, press [F1]. A dialog box appears (see Figure 5-7).

Set Diagnostic Limits

Year Range	HC Maximum	CO Maximum
1930-1964	1000	06.00
1965-1969	0700	07.00
1970-1974	0500	04.00
1975-1979	0300	02.00
1980-2001	0220	01.20

Figure 5-7

- Type in the starting model year, followed by the ending model year, then press [ENTER].
- Type in the maximum allowable limit for hydrocarbons. This limit can be any number chosen by the operator, or can be based on State guidelines. Press [ENTER] when finished.

NOTE

All character fields must be filled with numbers. To avoid entering an out-of-limit value, use zeros as placeholders. For example, to enter the value 220, press [0],[2],[2],[0], then press [ENTER].

- Type in the maximum allowable carbon monoxide limit. Again, this number can be chosen by the operator or can be based on State guidelines.

NOTE

All character fields must be filled with numbers. To avoid entering an out-of-limit value, use zeros as placeholders. For example, to enter the value .9%, press [0],[0],[9], then press [ENTER].

Press [F2] when finished to save the entry. The analyzer will maintain these values in memory until they are changed by the operator.

To scroll through an entry to make changes, press [ENTER]. The cursor will move to the next line on the list.

To delete an entry from the list, use the arrow keys to move up and down the list until the desired entry is highlighted. Then press [F3].

- A dialog box appears.
- Press [F1] to delete, or [F2] to return to the list.

To edit an entry from the list, press [F4]. A dialog box appears. Press [ENTER] to scroll through the list to the desired line. Type in the correct information and then press [ENTER] to move down to the next item, or press [F2] to save the changes.

Press [F10] to abort at any time before saving an entry.

Gas Bench Calibration

The "Gas Bench Calibration" routine is an automatic calibration routine. The gas analyzer requires a warm-up period before completing a calibration.

The gas analyzer calibrates itself using specially formulated gases which are certified for concentration. These gases are stored in the bottle inside the cabinet behind the lower left-hand door.

To run the calibration procedures, open the valve on the gas bottle and look at the pressure gauge. If the gauge reads less than 20 PSI, replace the bottle. Replacement bottles are available from any authorized service center.

If the display shows a "Gas Calibration Failure" message, (see Figure 5-8), follow the instructions on the display screen and check the gas analyzer. **Make sure the gas bottle valve is open — turn the valve counterclockwise.** If the message persists, press [ESC] to return to the main menu.

Always close the gas bottle valve after each calibration. Turn the valve clockwise to close.

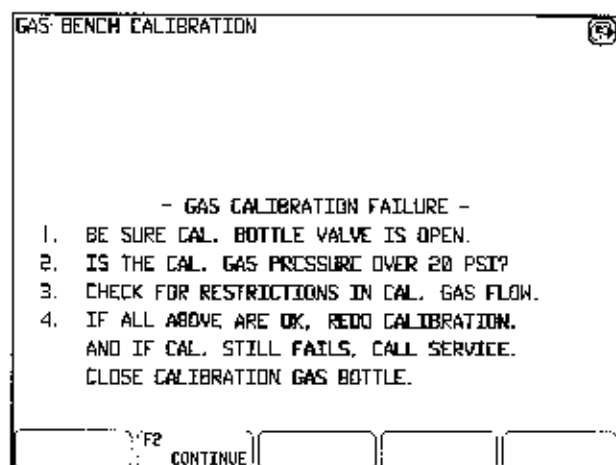


Figure 5-8

Calibration Procedure:

1. Select "Gas Bench Calibration" from the "Utilities" menu.
2. The prompt "Open Cal. Gas Bottle Valve" appears. Open each gas valve and check the pressure gauge. If the gauge reads less than 20 PSI, replace the bottle.
3. Press [F2] to continue the calibration.
4. The screen will display a series of messages explaining what is happening during the automatic calibration process (see Figure 5-9). The gas analyzer then completes the gas calibration portion of this procedure.

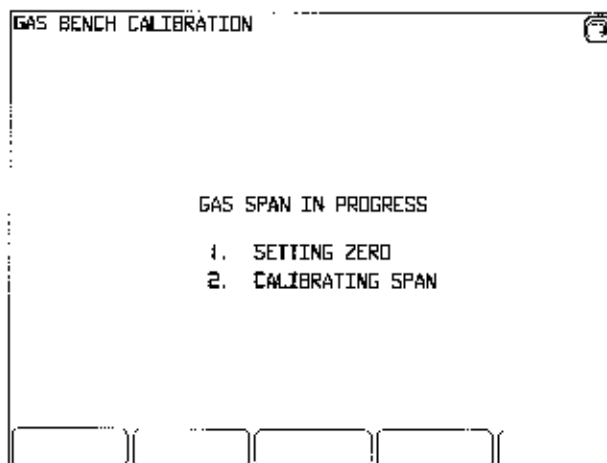


Figure 5-9

5. The "System Leak Check" screen will appear. Follow the prompt and place the cap on the end of the sample probe. Press [F2] to continue.
6. If the message "System Leak Test Passed" appears, press [F2] to complete the calibration. The program will return to the "Utilities" menu, and the analyzer will now be ready to continue testing.

NOTE

Perform a gas bench calibration whenever the water trap is serviced.

If the sample hose is set up for dual exhaust testing, remove the dual exhaust assembly and install a probe on the end of the standard hose.

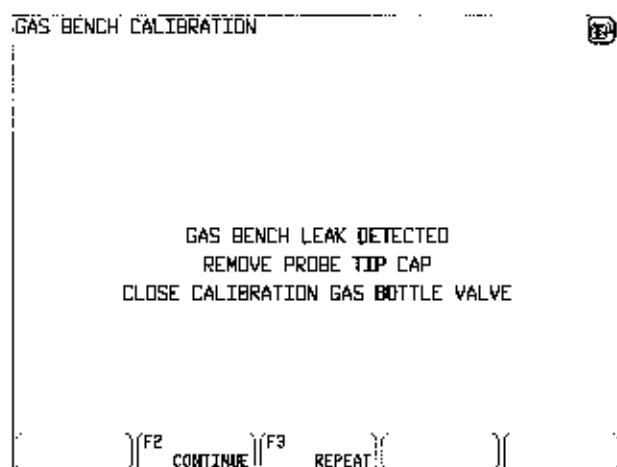


Figure 5-10

If the message "Gas Bench Leak Detected" appears (see Figure 5-10), press [F10] to return to the main menu.

Run the gas bench calibration again. If "Gas Bench Leak Detected" message appears again, remove the sample hose from the gas analyzer bench. Seal the sample hose inlet fitting and press [ESC] again to return to the "Utilities" menu.

Run another gas bench calibration. If the "System Leak Test Passed" message appears, carefully check the sample hose and probe for leaks. If the gas analyzer still fails, check the following:

Check	For
Filter Housing	Cracks or chipped surfaces which might cause leaks.
Filter Housing O-Ring	Cracks, tears or brittleness which might cause leaks
Clear Tubing Ends	Cracks
Probe Tip Cap	Cracks or tears

If no leaks can be found and the gas analyzer will not pass a leak test, call an authorized service center for repairs.

NOTE

IMPORTANT: Remember to remove the plastic cap from the probe end before continuing to test!

Enter Gas Calibration Values

About

If new calibration values must be entered for any reason, follow the procedure below.

1. Select "Enter Gas Calibration Values," item 10 on the "Utilities" menu. Preset calibration values will appear (see Figure 5-11).

BENCH CALIBRATION VALUE ENTRY			
CO2	(CARBON DIOXIDE)	11.20	%
CO	(CARBON MONOXIDE)	01.60	%
HC	(PROPANE)	0600	PPM
O2	(OXYGEN)	20.90	%

ENTER CALIBRATION VALUES FROM BOTTLE	
F1	F2
SAVE	CONTINUE

Figure 5-11

The "About" option displays the Engine Analyzer Module's version numbers for such items as the host software and the gas bench (if equipped). This screen allows you to view the information only. You cannot change any of the items.

2. Check the values on the calibration gas bottle being used. If the values on the screen match those on the bottle, press [F2] to return to the Main Menu. If the values differ from those on the screen, new values must be entered. Press [ENTER] to move from field to field.
3. When values are entered correctly, press [F1] to download the new values to the gas analyzer bench.

NOTE

Pressing [F2] will NOT download new values to the gas analyzer bench. To download values properly, you MUST press [F1].

Maintenance

Preventive Maintenance Gas Bottle Service

Weekly Maintenance

1. Check the printer paper supply. Replace as necessary.
2. Perform "Lead Calibration" procedures.
3. If the unit is equipped with the optional Gas Analyzer Bench Kit:
 - a) Check calibration gas bottle pressure. Replace the bottle if gauge reads 20 PSI or less.
 - b) Inspect water trap/filter bowl. Wipe bowl with damp, soapy cloth.
 - c) Replace the secondary gas filter if it looks dirty. For best performance, replace both filters as a set. If desired, wash the mesh pre-filter in warm soapy water.

Monthly Maintenance

1. Inspect printout quality. Replace the printer ribbon if quality is poor.
2. Inspect casters for damage. Replace any broken casters immediately to prevent serious damage.
3. Clean and inspect all test leads, probes, hoses, etc. Contact your local service representative for replacement leads if required.
4. Clean the outside surfaces of the cabinet with a nonabrasive household cleaner.

Annual Maintenance

1. Contact Service for updates which may be available.

NOTE

The gas values listed on any replacement bottle must match those on the old bottle. If they do not, call Service for bottle replacement.

1. Turn the knob on the gas bottle valve clockwise to close the valve (see Figure 6-1).

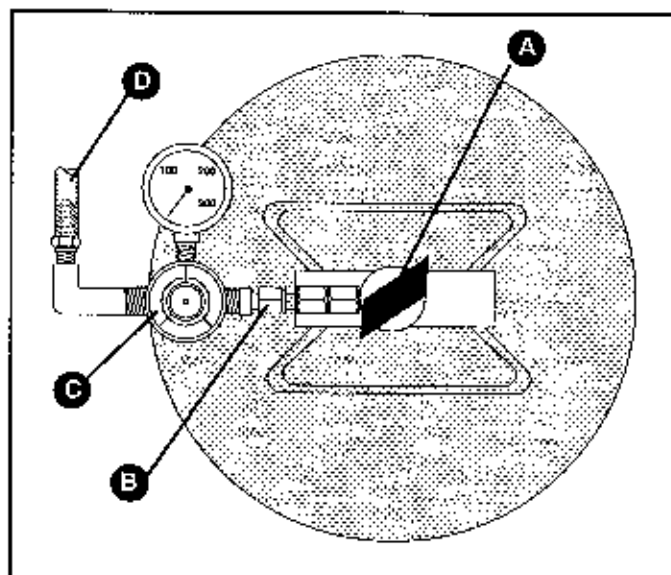


Figure 6-1

2. Loosen regulator nut (B) and remove regulator assembly (C) from bottle.
3. Place new bottle inside cabinet and install regulator assembly on new bottle. Tighten regulator nut with a wrench. Do not over-tighten the nut.

NOTE

REMEMBER: Conserve calibration gas by turning the gas off after every gas calibration procedure!

Filters

Exhaust Sample Filter - In-Line Style Bench

Replace the exhaust sample filter whenever the filter looks dirty or whenever the screen displays the "Low Flow" message during calibration procedures. Filters are low-cost insurance to protect the gas analyzer bench. **Do NOT wait for "Low Flow" message to appear** - Change the filters whenever they look dirty (see next page for replacement procedure).

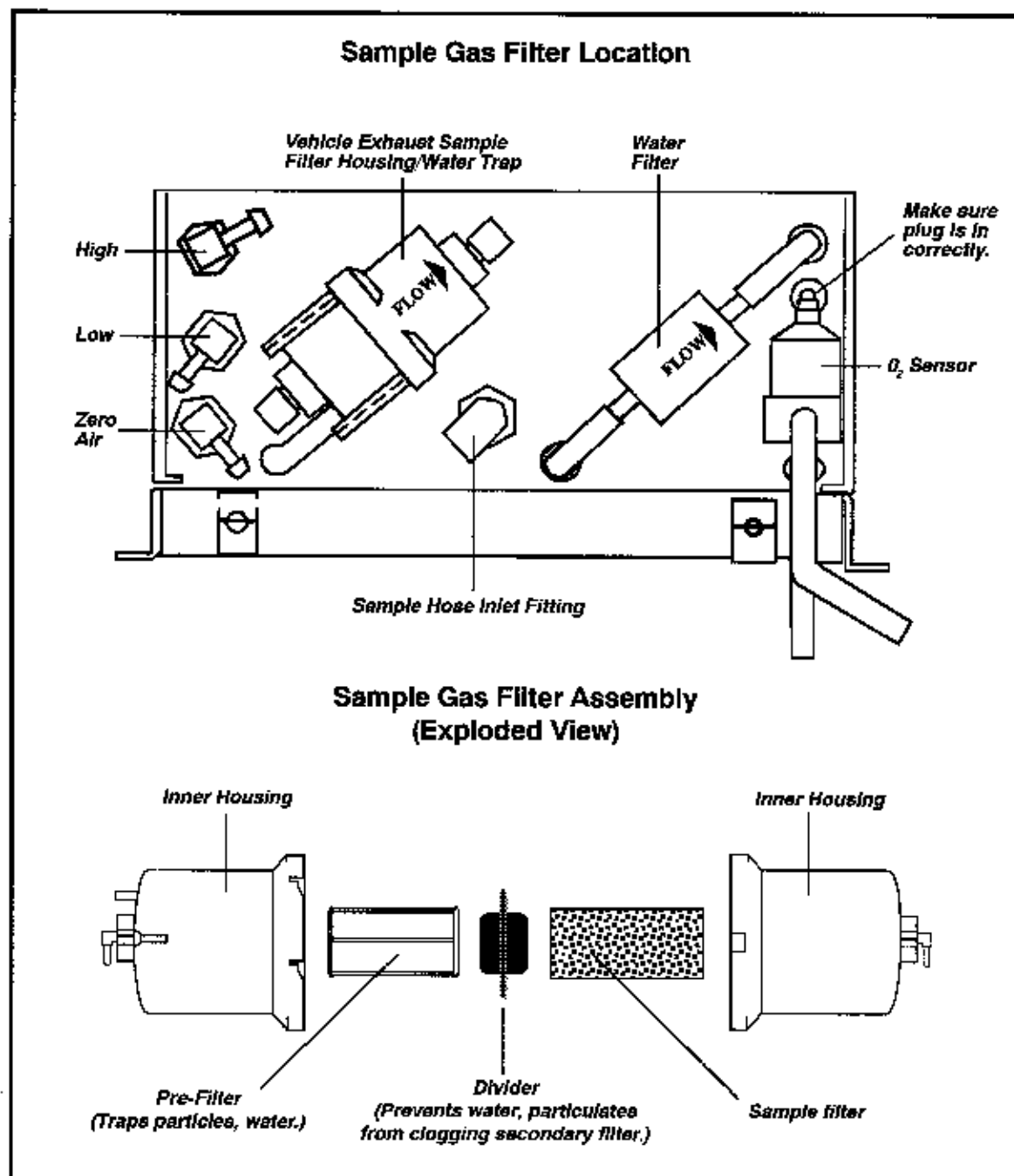


Figure 6-2

Exhaust Sample Filter Replacement

1. Carefully pull the filter housing out of the clips on the front of the gas analyzer bench (see Figure 6-2).
2. Pull the filter housing forward to provide room to work.
3. Grasp the filter housing and twist the two halves apart. Remove the pre-filter screen, the rubber divider and the secondary filter. Discard the secondary filter.
4. Wipe out the filter bowl with a damp soapy rag.
- c) Fit both ends of the filter assembly over the locator tubes on the filter housing and press the halves together. Twist the halves until they lock together securely.
- d) Gently feed the tubes back through the holes in the end wall of the gas analyzer bench and then snap the filter housing into its retaining clip.

Water Filter

The in-line water filter shown in Figure 6-2 removes dirt from the condensed water. This filter should be replaced every three (3) to six (6) months, depending on amount of use.



CAUTION Using a solvent to clean out the filter bowl will cause excessive HC hang-up to occur.

5. Clean the mesh pre-filter with warm soapy water, if possible. For best results, replace the filter.
6. Reassemble the filter housing.
 - a) Check the rubber divider between the housing halves to make sure it is not cut or torn.
 - b) Slip the pre-filter onto one end of the rubber divider and then slip a new secondary filter onto the other end of the ring. Replace the filter assembly inside the housing, with the pre-filter pointing down and to the left.

Tri-Filter Assembly-Style Bench

Replace the exhaust sample filter(s) every two weeks or whenever the screen displays the "LOW FLOW" message during calibration procedures. Sample filters are low-cost insurance to protect the analyzer. **DO NOT WAIT FOR "LOW FLOW" MESSAGE TO APPEAR - Change the filters whenever they look dirty.** (See next page for replacement procedure.)

Gas Bench Components

- A - Filter Housing Mounting Screws
- B - High Gas Port
- C - Low Gas Port
- D - Zero Air Inlet
- E - Sample Hose Connector Fitting
- F - Water Drain Hose
- G - Exhaust Gas Hose
- H - Oxygen Sensor
- I - O₂ Sensor Wiring Connector

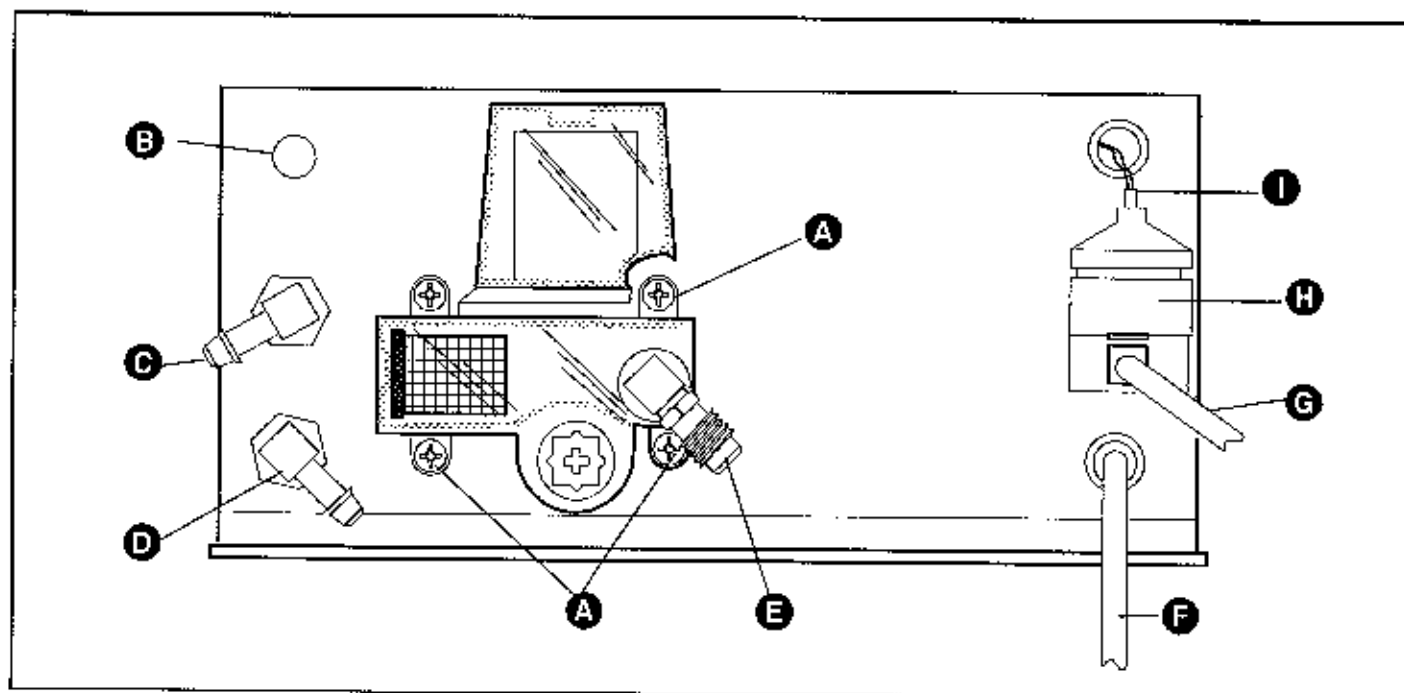


Figure 6-3

Filter Assembly Components

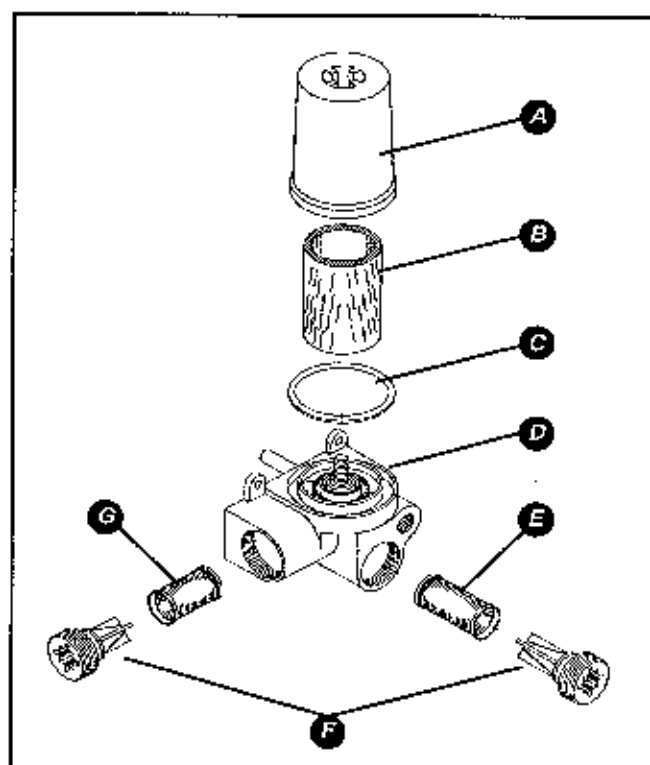


Figure 6-4

- A - Filter Bowl
- B - Filter Element
- C - Gasket, Filter Bowl
- D - Housing, Filter
- E - Water Screen Filter
- F - Filter Plug With O-ring
- G - Gas Screen Filter

Exhaust Sample Filter Replacement

1. If necessary, insert a 3/8" ratchet drive into the opening provided to remove the filter plugs or the filter bowl from the filter housing (see Figure 6-4).
2. Pull the filters out of the housing.
3. Discard the secondary filter (Item B, Figure 6-4). The secondary filter is not washable.
4. Wipe out the filter bowl with a damp soapy rag.



Using a solvent to clean out the filter bowl will cause excessive HC hang-up to occur.

5. Clean the mesh filters with warm soapy water, if possible. For best results, replace the filter(s).
6. Reassemble the filter housing. Hand-tighten the upper Bowl (Item A, Figure 6-4). For best results, *do not* use a ratchet.

Optional Printer Maintenance

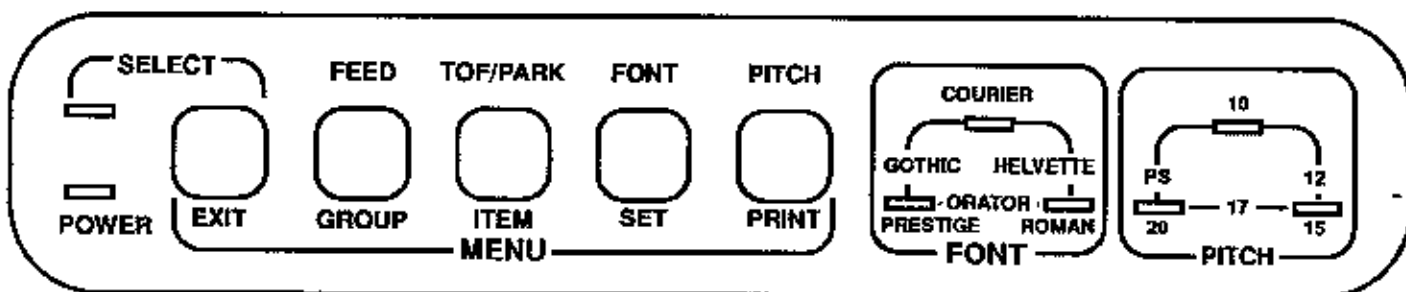


Figure 6-5

Set Printer Defaults (Refer to Figure 6-5)

- A. Turn printer "OFF."
- B. Hold down the EXIT and GROUP keys while turning power "ON."
- C. If the SELECT light is not lit press the SELECT button.
- D. Press the FONT and PITCH buttons simultaneously to place the printer in the Menu mode. Printer prints:
Menu Mode
- E. Press the GROUP button. The following line prints:
Font Print Mode LQ Courier
- F. Press SET (printer will step through the fonts) until the following prints:
Font Print Mode Utility
- G. Press GROUP. The following line prints:
General Control Cut Sheet Feeder Not Installed
- H. Press ITEM. The following line prints:
General Control Graphics Unidirectional
- I. Press SET. The following line prints:
General Control Graphics Bidirectional
- J. Press ITEM. The following line prints:
Max Receive Buffer 1 Line
- K. Press SET. The following line prints:
Max Receive Buffer 8K
- L. Press GROUP. The following line prints:
Vertical Control Line Spacing 6 LPI
- M. Press ITEM. The following line prints:
Vertical Control Form Tear-Off Off
- N. Press SET. The following line prints:
Vertical Control Form Tear-Off 300ms
- O. Press EXIT.
- P. Set paper position.
 - 1) Press the TOF/PARK button. Paper will retract.
 - 2) Pull the bail lever forward. Paper will advance.
 - 3) Push bail lever back and the paper will move to Top of Form position.

The printer is ready for use.

Loading Paper

The printer can feed sprocket (computer) paper or single sheets and accepts up to four-part forms.

Before loading paper, set the blue print head gap lever (at the left of the print head) to position 1 for 1- or 2-part paper, position 2 for 3- or 4-part paper or position 3 for extra thick paper.

1. Pull the printer drawer out. Load the paper drawer.
2. Slide the paper separator guides to their widest position.
3. Lift off the access cover.
4. Open the paper lever and the bail lever.
5. Insert the paper in the slot in the paper separator.
6. Continue sliding the paper until it reaches the platen.
7. Using the platen knob, engage the sprocket holes with the pins. If the pins need adjusting, pull the tabs forward and slide the pins left or right to accommodate the width of the paper. Lock the tabs when the pins are at the proper distance.

NOTE Do not stretch the paper. If the sprocket holes stretch or tear during printing, re-adjust the pins.

8. Close the bail, but leave the paper lever open for sprocket paper feeding.
9. Replace the access cover, making sure the paper exits through the opening.

Ribbon Removal

1. Open the printer cover.
2. Lift off the access cover.
3. Push the print head to the center of the carriage so it is away from the bail rollers. Make sure the bail is closed (lever back - see Figure 6-6).

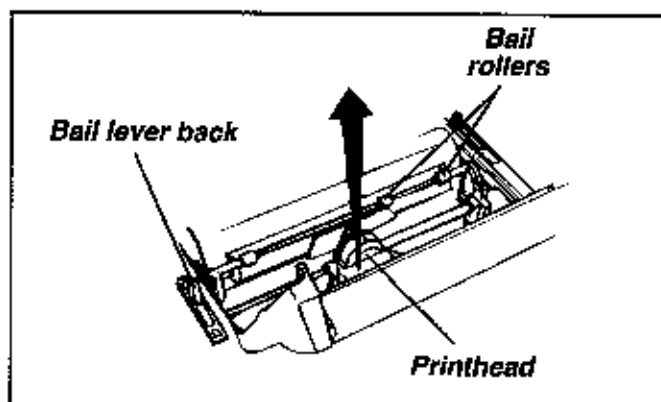


Figure 6-6

4. To remove the cartridge, slide the print head away from the rollers, grasp the cartridge on both sides and lift the cartridge off.

Ribbon Replacement

1. With the knob facing up, tilt the ribbon cartridge onto the printhead plate so it slides into the area of the plate is closest to the front of the printer (see Figure 6-7).

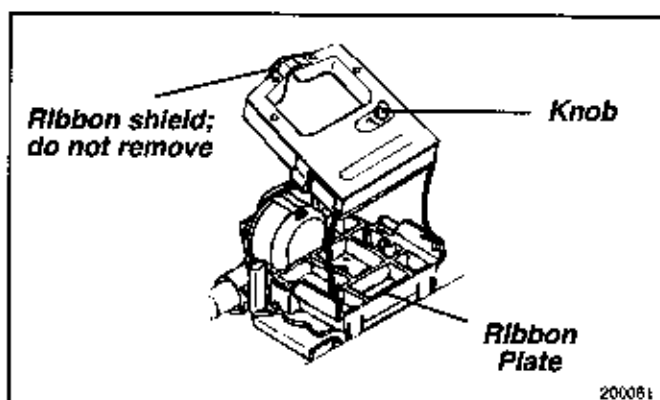


Figure 6-7

- NOTE** If the ribbon won't load easily, turn the blue knob slightly until the x-shaped notch on the bottom of the ribbon cartridge aligns with the x-shaped insert on the ribbon plate.

2. Lower the ribbon shield over the printhead, aligning the tabs with the inserts on the printhead plate (see Figure 6-8).

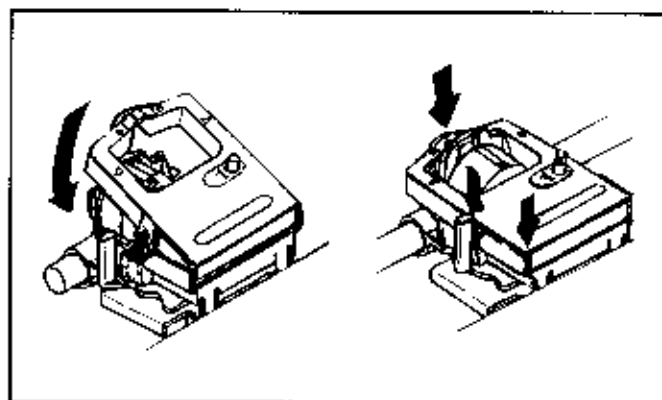


Figure 6-8

- NOTE** Do not remove the clear plastic ribbon shield from the ribbon cartridge.

3. Press on the cartridge until it snaps into place.
4. Turn the knob in the direction of the arrow to take up slack in the ribbon (see Figure 6-9).

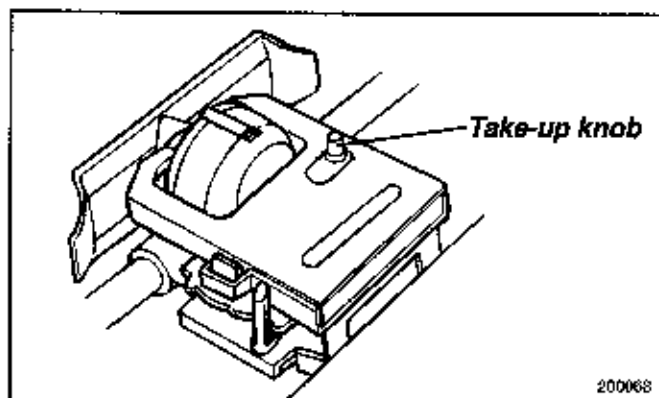


Figure 6-9

- CAUTION** Do NOT touch the printhead directly after printing. Allow five minutes for it to cool.

Replacement Parts

How To Obtain Service

Engine Analyzer:

Description	Part Number
Yellow HEI Adapter	617-66433
Amp Probe Lead	617-96363
#1 Pick-Up Lead	617-96364
Battery Power Lead	617-96366
Conventional High Tension Probe...	634-98128
Dual Trace Lab Scope Lead	634-98272
RS-232 Communication Cable	634-98274
Conventional Secondary Lead	634-98277
DIS Secondary Lead	634-98278
Alligator Clip	651-88482

Refer to the nearest authorized service center listed on the decal attached to the rear of the analyzer or call:

1-800-833-3377

Optional Gas Analyzer:

Description	Part Number
Exhaust Probe	617-97041
Pre-Filters	697-97141
Tube Filters	697-97142
Probe Tip Caps	697-85986
Calibration Gas Bottle	697-88997

Appendix A

Lead Connections for Various Cylinder Firing Polarities

Technical Information — DIS Polarity Testing

Vehicle manufacturers have added many different DIS vehicles to their product lines. Although every effort is made to confirm our database information on all vehicles, you may encounter a vehicle that has different cylinder firing polarities from those found in our database. Please use the procedures below to determine the correct polarities.

NOTE

For the following procedures, it is assumed that your analyzer is working properly and the display problems are caused by the test vehicle, or incorrect polarity programming, not lead failures. Handle and route leads carefully to avoid damage, and inspect and clean your lead sets daily to ensure long life and accurate signal inputs.

Procedure

Follow these steps if you are experiencing problems with Sync, Ignition signals or Cylinder Performance functions.

Lead Status Check

Press [F3] to display the Lead Status screen and determine which input is FAULTY.

- **If the Green #1 signal is FAULTY**, perform the following while checking the lead status:
 - 1) Check for proper installation of the sync probe on the cylinder #1 ignition wire. If no problem is detected, proceed to Step 2.
 - 2) Install the Green #1 probe on a different spark plug wire to determine if cylinder #1 has a faulty ignition signal.
- If the Green #1 probe displays "OK" there is a problem with cylinder #1 ignition components, for example, plug, wire, coil secondary, ignition module.

- If the Green #1 probe still displays "FAULTY" try connecting to another ignition wire. If possible, connect to another known-good vehicle to verify unit is functioning properly.
- **If the Secondary signal is FAULTY**, proceed with the following steps.

1. Turn the engine off.
2. Remove all secondary clips and the #1 Signal probe.
3. Verify the engine firing order and write it down.
4. From the Main Menu, select #12, *Uniscope*.
5. Choose the **Red Leads** and select +/- 15 volt scale.
6. Set the Trigger to **None**.
7. Set the Time Scale to **16ms/dv**.
8. Press [F4], *Expand*.
9. Connect the Red Lead ground to a suitable engine ground.
10. Start the engine.

Continued...

Appendix A - Lead Connections for Various Cylinder Firing Polarities

DIS Polarity Testing (continued)

11. To determine the polarity of a cylinder, touch the Red Lead tip to a plug wire, and observe the pattern on the screen.

NOTE Please see Figures A-1 and A-2 on page A-5 for spike polarity illustrations.

NOTE Be sure to separate the plug wires to prevent "cross talk." Do not pierce the plug wire insulation.

12. Record the polarity of that cylinder under the appropriate cylinder number recorded in Step 3.
13. Repeat steps 11 and 12 for the remaining cylinders.
14. Turn the engine off.

15. Press **[F10]** to return to the *Main Menu*.
16. Press **[F2]**, *DIS Setup*, and re-enter the vehicle.
17. When the *Vehicle Setup* screen is displayed, use the down arrow key to highlight the *Firing Polarity* field.
18. Edit the polarities to match the polarities as determined by this test procedure.
19. Reconnect the secondary clips to match the new polarity, and connect the #1 Signal probe.

You have now completed the testing process.

Red Accessory Lead on Positive Polarity Cylinder

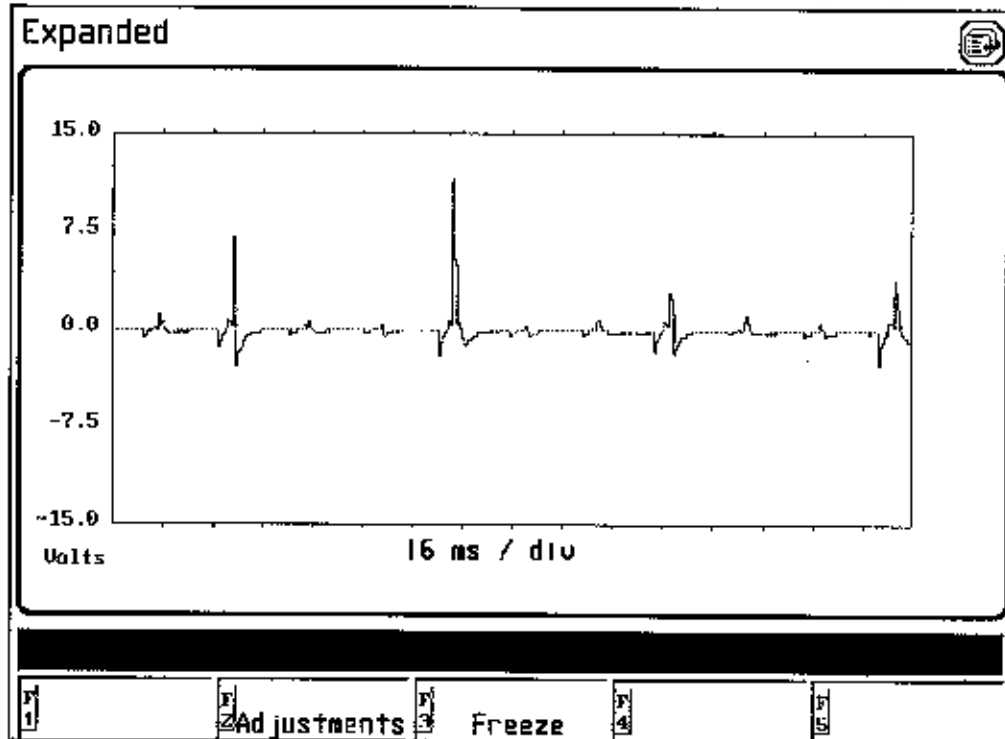


Figure A-1

Red Accessory Lead on Negative Polarity Cylinder

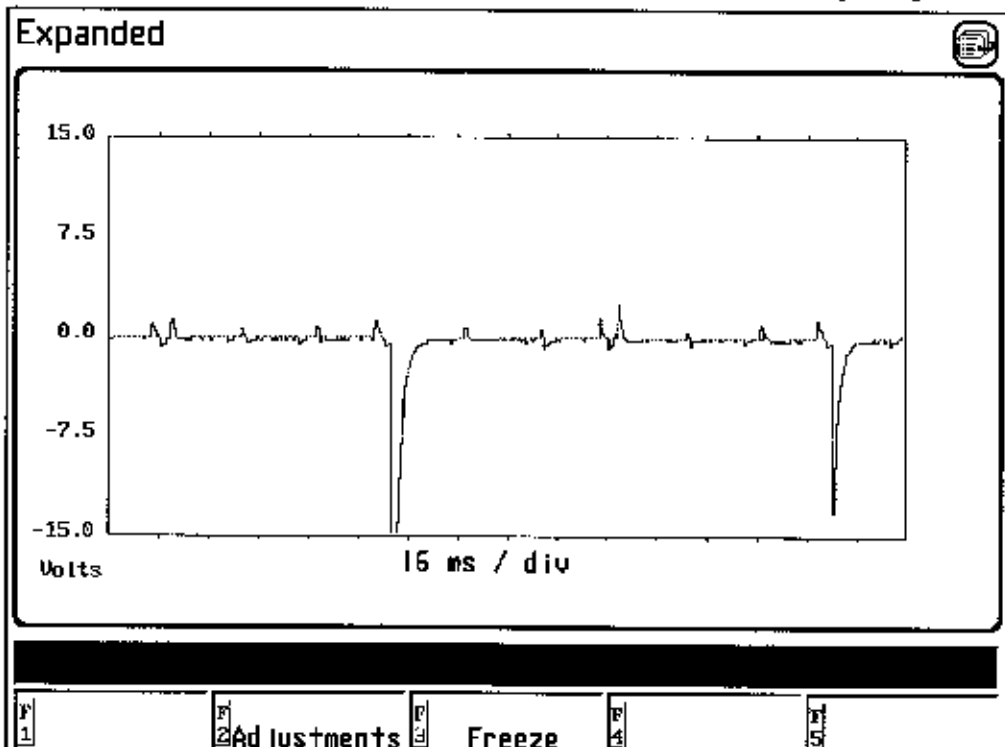


Figure A-2

