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# Ignition Patterns

## Introduction

The electronic ignition patterns described here are divided into two groups:

1. Standard Electronic Ignition, which generally uses a ballast resistor such as in Chrysler Electronic Ignition and Ford Dura-Spark Ignition.
2. Current Regulating Ignition, which generally does not use a ballast resistor such as in General Motors H.E.I., Ford Thick Film Ignition and most late model Japanese imports.

When reading descriptions refer to the numbered points on the pattern to determine the location of pattern events.



**Normal Primary Points System**  
(See Figure 160)

The pattern begins at:

**Point (1)** - where the CONDENSER is absorbing current while the points are open. The condenser action continues until

**Point (2)** - where the COIL action begins and should consist of four or more oscillations. After the remaining energy is dissipated at

**Point (3)** - where the POINTS CLOSE and primary current flows through the coil windings for a length of time called DWELL.

**At Point (4)**, the POINTS OPEN and two things happen immediately: the coil fires and the condenser action begins. Occasionally a spike may appear. This is actually the beginning of the condenser action and is normal.

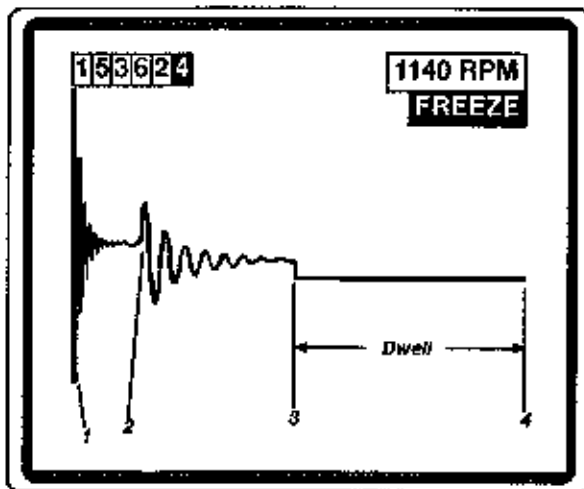


Figure 160

**Chrysler Standard Electronic Primary**  
(See Figure 161)

The primary pattern begins at:

**Point (1)** - where energy is being dissipated through the COIL windings creating four or more oscillations.

**At Point (2)**, the CONTROL MODULE TURNS ON allowing primary current to flow through the coil windings for a fixed period of time (dwell).

**At Point (3)**, the CONTROL MODULE turns the primary current OFF causing the coil to fire.

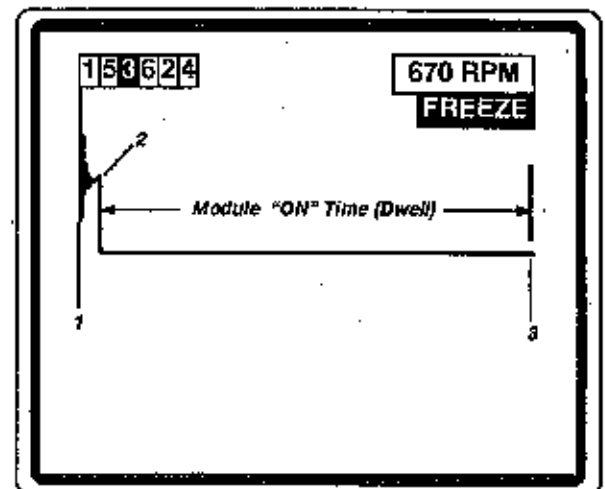


Figure 161

**Ford Standard Electronic Primary**  
(See Figure 162)

The primary pattern begins at:

**Point (1)** - an oscillation created by the module during coil firing. The oscillation offers no diagnostic information.

**At Point (2)**, energy is dissipating through the COIL for four or more oscillations.

**At Point (3)**, the MODULE TURNS "ON" the primary current through the coil windings for a fixed period of time (dwell).

**At Point (4)**, the CONTROL MODULE turns the primary current "OFF" causing the coil to fire.

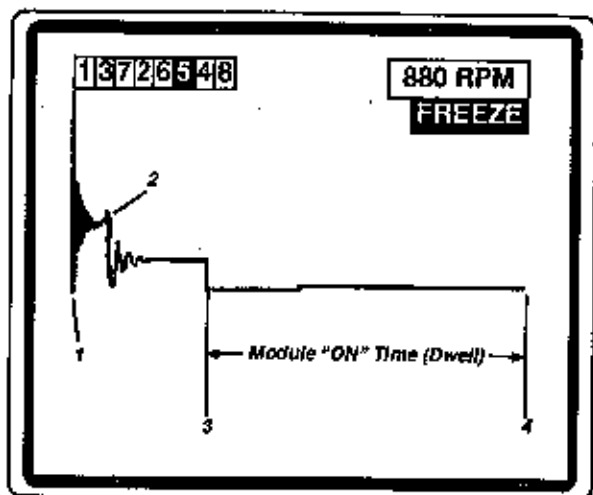


Figure 162

**Current Regulating Electronic Primary, Idle Speed** (See Figure 163)

The primary pattern begins at:

**Point (1)** - where a FIRING TIME LINE extends to (2). Because firing time is examined in greater detail elsewhere, it will be ignored in the primary. A spike may also appear at (1), but is not important at this time.

**At Point (2)**, energy is dissipating through the COIL for at least four oscillations.

**At Point (3)**, the control MODULE TURNS "ON" for a variable rate of time (dwell), based on engine speed.

**At Point (4)**, the CURRENT CONTROL FUNCTION of the module is seen. On certain GM modules, a small ripple may appear following the rise in the trace. This is normal. Not all current regulating ignitions display the rise at (4). Also, odd firing V-6 engines by GM may not display (4) due to their firing characteristics.

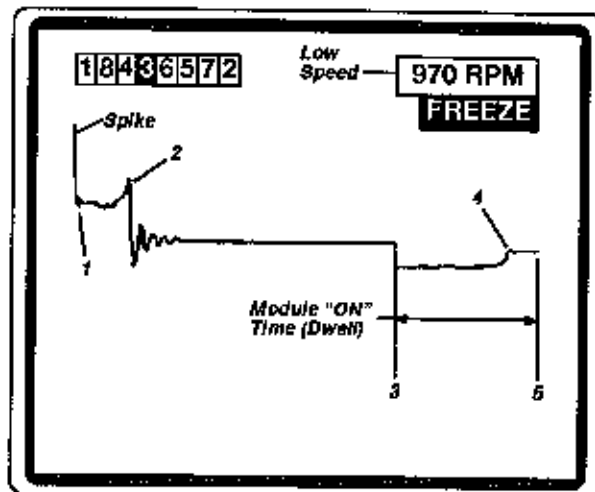


Figure 163

### Current-Regulating Electronic Primary, High Speed (See Figure 164)

This pattern is the same as the previous one, but at high speed. Notice dwell time is much longer. The current regulator may flatten out at high speed. This is normal. If the dwell time does not vary with RPM, the module is defective. This test may best be done while observing a dwell meter. The numbers are not important, just the fact that dwell increases and decreases with RPM.

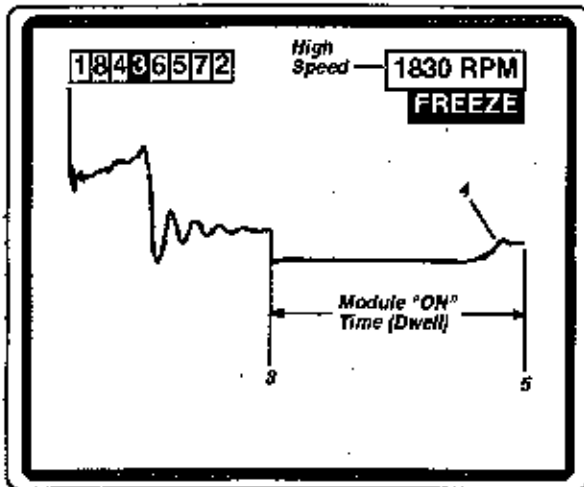


Figure 164

### Normal Cylinder Dwell (See Figure 165)

These two patterns show the difference between Normal Individual Cylinder Dwell and excessive individual Cylinder Dwell. Individual Cylinder Dwell is checked by comparing each cylinder's point close signal. To accurately measure Individual Cylinder Dwell, perform the Service Test "Secondary KV and Dwell." The reading should not be more than six degrees from lowest dwell reading to highest.

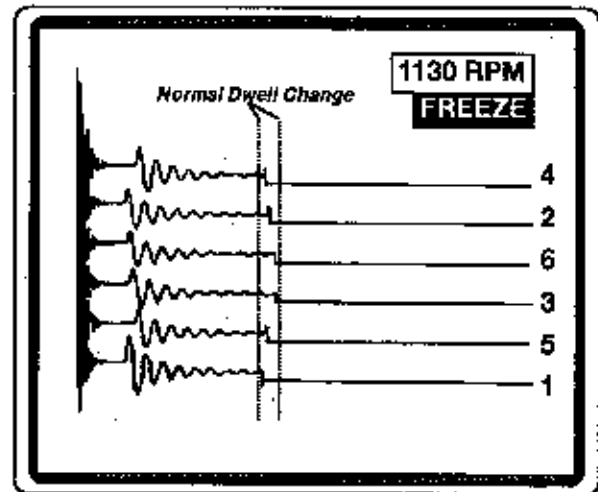


Figure 165

### Excessive Dwell Change (See Figure 166)

Excessive dwell change may be caused by factors such as a faulty distributor cam, distributor shaft and bearings, breaker plate assembly or timing chain.

Odd-firing V-6 engines by GM will not display even dwell due to their firing characteristics.

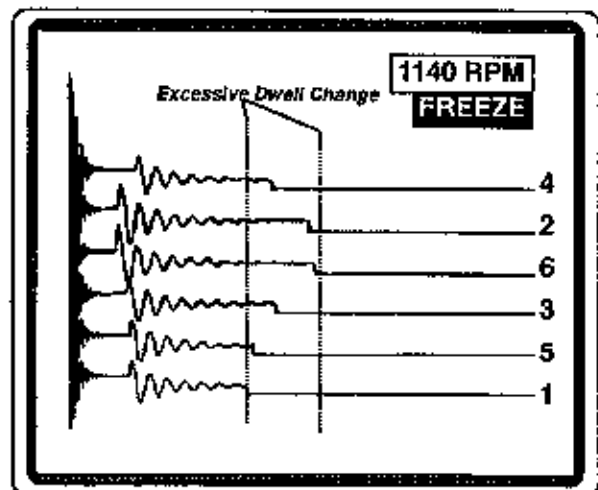


Figure 166

## Point System Arcing (See Figure 167)

In the following, arcing occurs at the beginning of the pattern. This happens when the points open and the condenser DOES NOT absorb current properly. If this condition exists, check the coil input voltage. If normal (4.5V to 8V with key "ON", engine "OFF"), replace condenser and points.

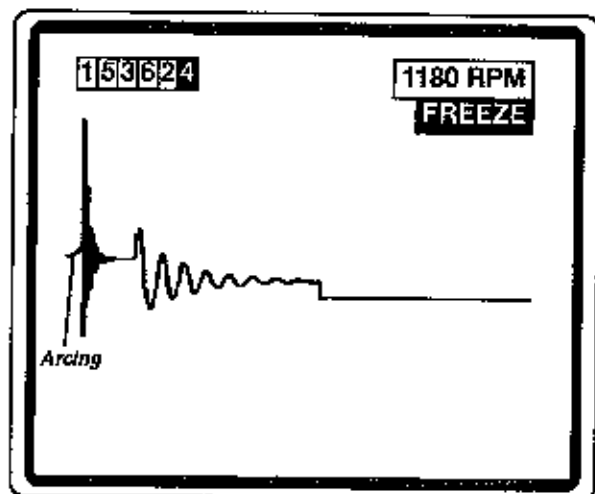


Figure 167

## Point System Arcing Affects Coil Pattern (See Figure 168)

Because the action of the condenser and coil are related, a defective condenser can also affect the coil appearance. If this pattern is encountered, replace the condenser and recheck the pattern.

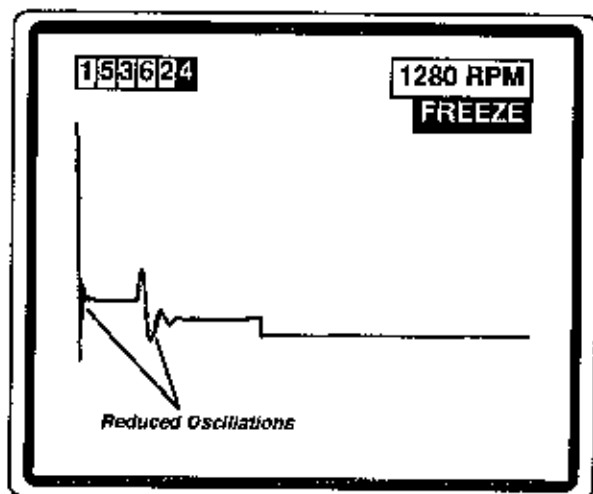


Figure 168

## Normal Secondary Points System (See Figure 169)

The Secondary Pattern begins at:

**Point (1)** - where a SPARKLINE extends to (2). A sparkline is actually a picture of energy crossing the plug gap and its action on the screen is affected by the condition of the ignition parts and the condition of the cylinder (compression, mixture, etc.).

A spike may appear at (1); this is a firing spike that we look at in greater detail in Parade Patterns.

**At Point (2)**, the plug has stopped firing but there are still several hundred volts remaining in the coil. This energy is not strong enough to jump the gap between the rotor and cap, so it is dissipated through the COIL WINDINGS, creating four or more oscillations. If there are less than four oscillations, the coil should be checked.

**At Point (3)**, the primary current turns "ON." This oscillation is COIL POLARITY, and it should point down.

**At Point (4)**, the primary current shuts "OFF" and the coil fires.

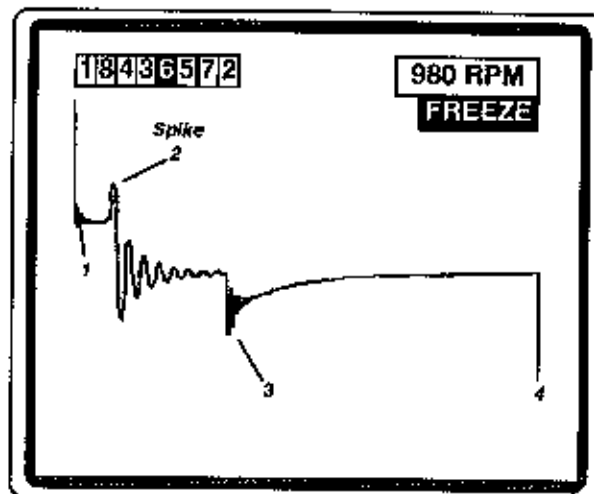


Figure 169

**Ford Standard Electronic Secondary**  
(See Figure 170)

The pattern description for the Ford Electronic Ignition (non-current regulated) is the same as Breaker Point.

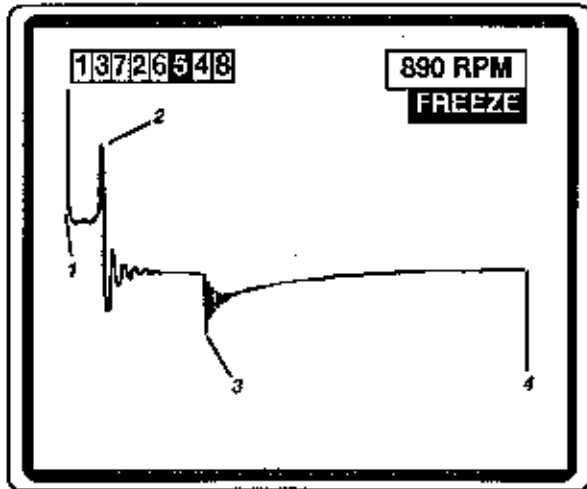


Figure 170

**Current Regulating System Secondary**  
(See Figure 172)

The secondary pattern for a current regulating ignition is virtually the same, except for the normal rise in the baseline, between (3) and (4). Not all current regulating ignitions display this rise.

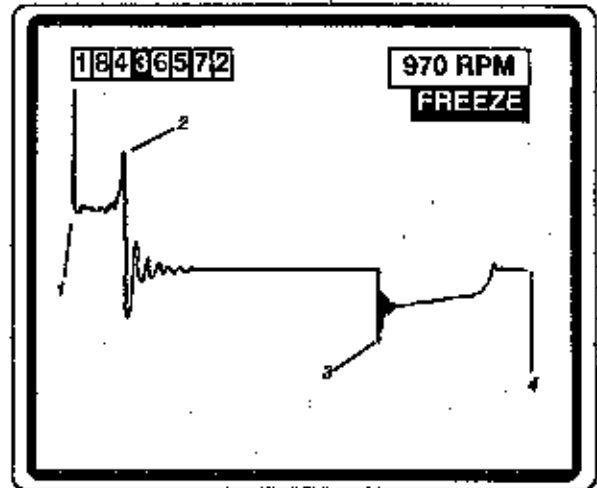


Figure 172

**Chrysler Standard Electronic Secondary**  
(See Figure 171)

The pattern description for Chrysler Electronic Ignition (non-current regulated) is the same except that the coil polarity oscillation does not appear, due to long dwell. Use the coil oscillation to indicate current polarity.

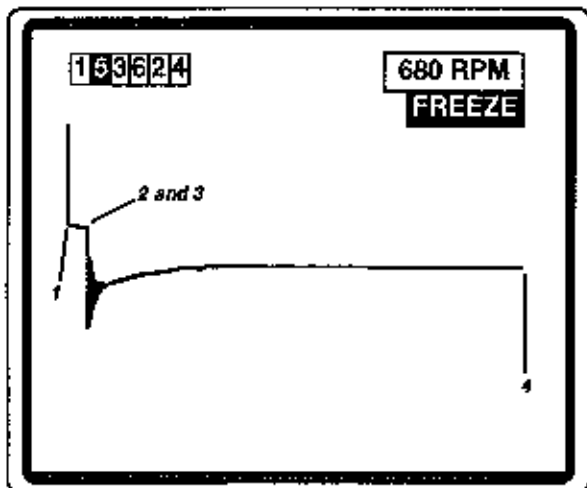


Figure 171

### D.I.S. (Distributorless Ignition System) Secondary (See Figure 173)

DIS secondary ignition patterns look different than other patterns. The positive-polarity cylinder patterns have a downward slope (left to right).

If the pattern shows an upward slope, it is displaying the waste firing, not the compression firing. Go back to "Set-Up," press [REPEAT] and make sure all the leads read "OK" and setup information is correct.

For better viewing, use the expanded display.

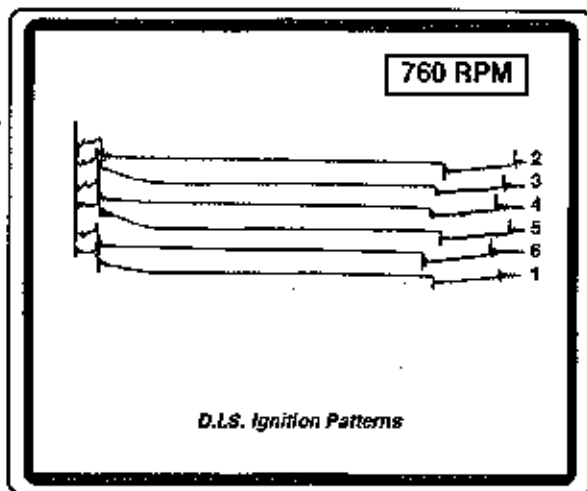


Figure 173

### Sparkline Analysis (See Figure 174)

When the ignition circuit is normal, a normal sparkline should last between 1.25 and 1.75 milliseconds (1.25 to 1.75 thousandths of a second). To measure firing time, press [EXPAND] and the Right Arrow key once. Dotted lines on the screen will appear. Starting from the left, each row is equal to 1/1000 of a second.

When analyzing sparklines, it is best to compare sparkline action for all cylinders at one time (see Figure 175). If the ignition parts are good, all the sparklines will look similar. Combustion turbulence will cause slight variations in sparklines when the screen refreshes. This is normal. If there is a definite ignition fault, it will be very obvious when compared to good cylinders

Use "Cylinder Miss Recall" test procedures (under "Master Menu" ) for detailed digital displays of burn time (ms) and Burn KV.

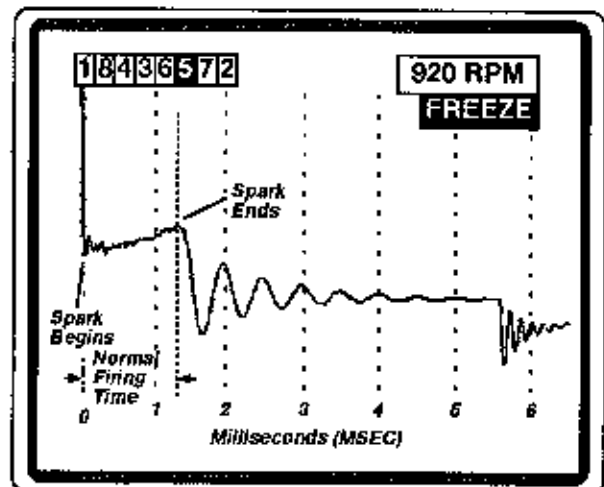


Figure 174

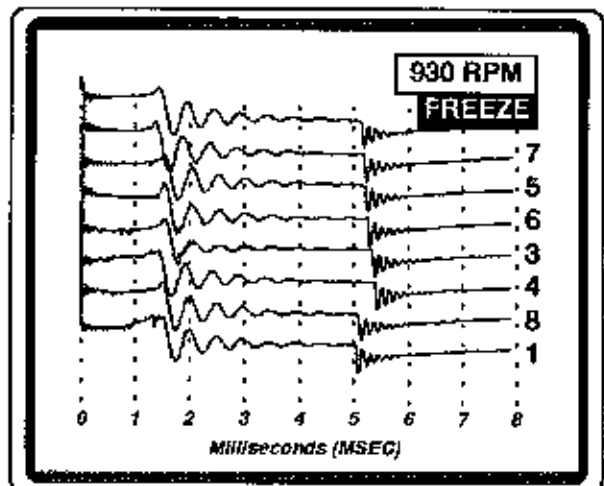


Figure 175



### Open Circuit Secondary (See Figure 176)

An Open Circuit Pattern is caused by a plug wire that is disconnected and/or has a very large internal break in the conductor and is not grounded internally. This prevents the spark from reaching the plug.

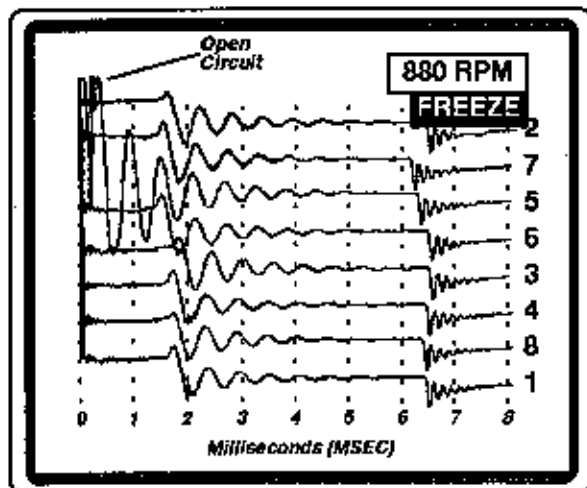


Figure 176

### Series Gap Secondary (See Figure 177)

Series Gap is caused by a spark plug wire that has a small break in its internal conductor or a wire not completely connected. This extra gap is small enough to carry the spark but uses up some of the available energy so the plug doesn't fire as long.

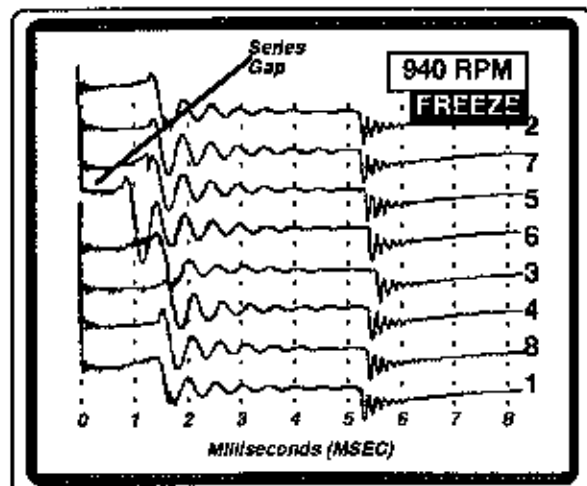


Figure 177

### Grounded Secondary (See Figure 178)

A grounded circuit pattern appears when the coil voltage for that cylinder takes a short to ground instead of across the plug gap. Because the voltage to ground is lowered, the sparkline is longer. Check for a carbon-fouled plug, grounded wire or cracked distributor cap.

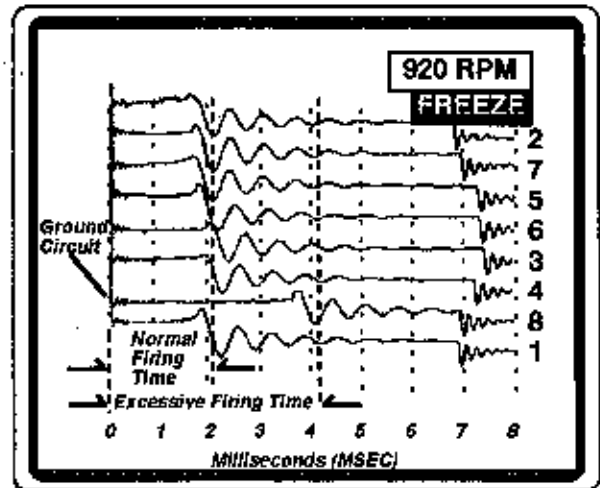


Figure 178

### Sloping Sparkline (See Figure 179)

A sloping sparkline appears when there is too much resistance in the ignition wire for that cylinder. A plug that is gas-fouled on a current regulating ignition can appear like this also.

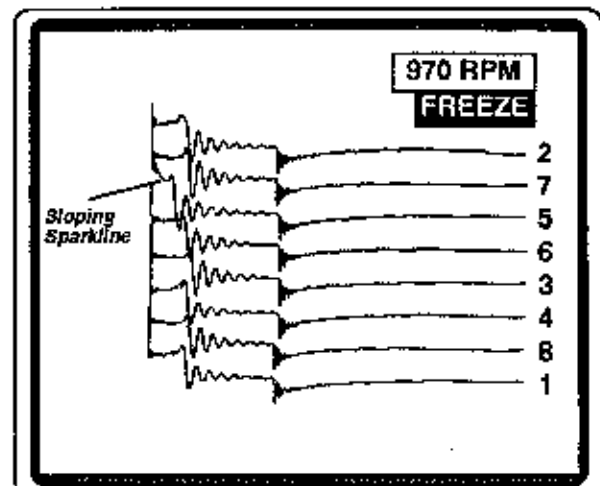


Figure 179

**Several Sloping Sparklines  
(See Figure 180)**

When two sparklines in the firing order are sloping, the problem might be high resistance on both cylinders, but more than likely is caused by a crack in the cap between the two cylinders. Don't forget that the cylinders at the bottom and top of the screen are in firing order.

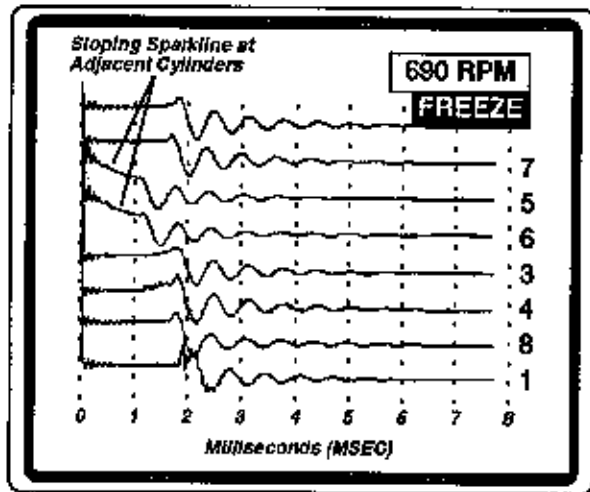


Figure 180

**Short Firing Times (See Figure 181)**

When the firing time for all cylinders is short, it indicates a problem with an ignition part that is common to all cylinders, such as coil, coil wire, carbon button, air/fuel mixture, etc.

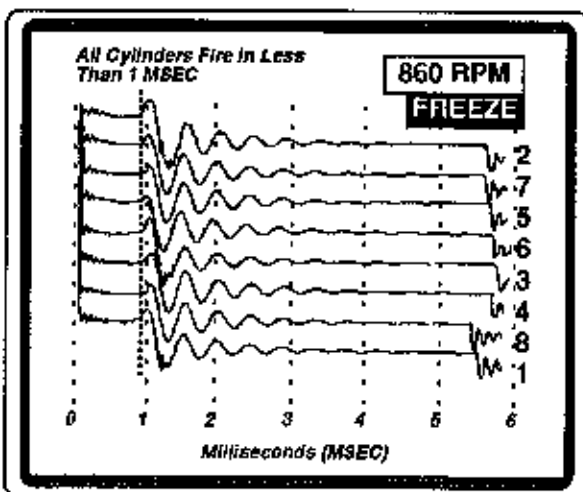


Figure 181

**Rising Sparklines (See Figure 182)**

Engine operating characteristics, such as air/fuel mixture, valve train condition, combustion chamber design, etc., all combine to cause cylinder turbulence. Cylinder turbulence is displayed by a sharp rise in the sparkline near the end of its firing. Occasional turbulence is normal. Some engines produce very turbulent sparklines. Others produce less. Use your experience to determine what is excessive and what isn't.

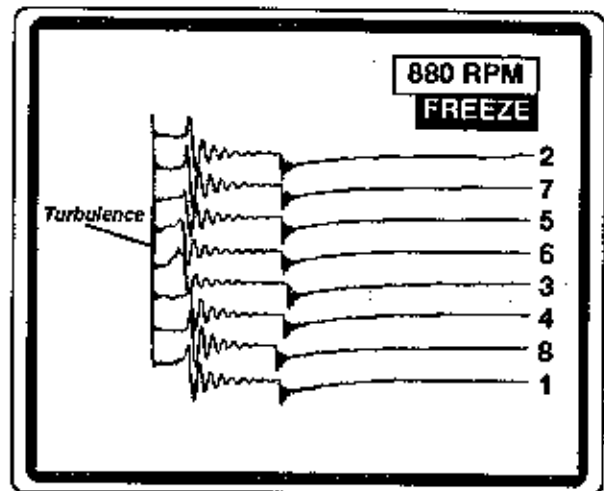


Figure 182

**Upside Down Patterns (See Figure 183)**

An upside down secondary pattern is displayed when the vehicle's primary wires are reversed on the coil.

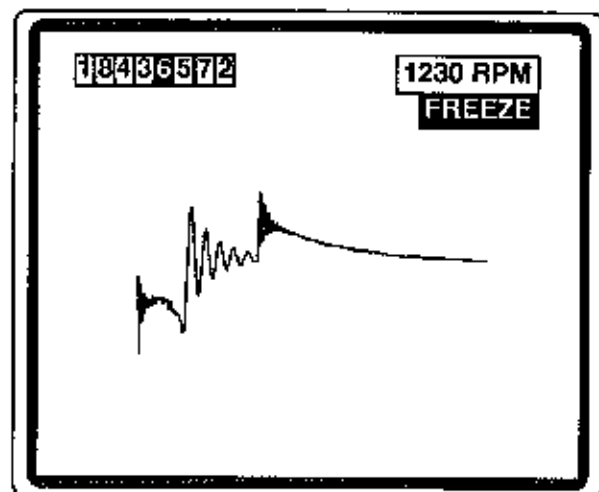


Figure 183

### Conventional Parade Patterns (See Figure 184)

A Parade Pattern is actually a measurement of average KV — that is, the voltage required to pass through the circuit of each cylinder, averaged over a number firings. Normal firing voltage is between 8 and 12 thousand volts (KV) on most systems. More important is that, on non-DIS systems, the voltages for all cylinders are within 4 KV of each other.

A low voltage reading (see Figure 185) can be caused by a close-gapped plug, fouled plug, rich fuel mixture or grounded plug wire.

A high voltage reading can be caused by a worn or wide-gapped plug, a broken wire, or a lean mixture into one cylinder.

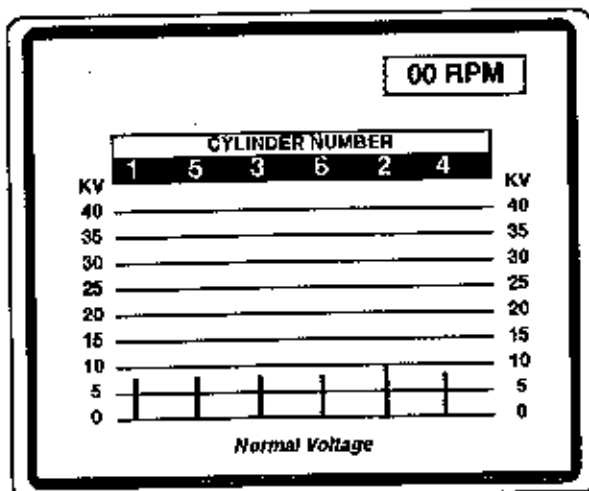


Figure 184

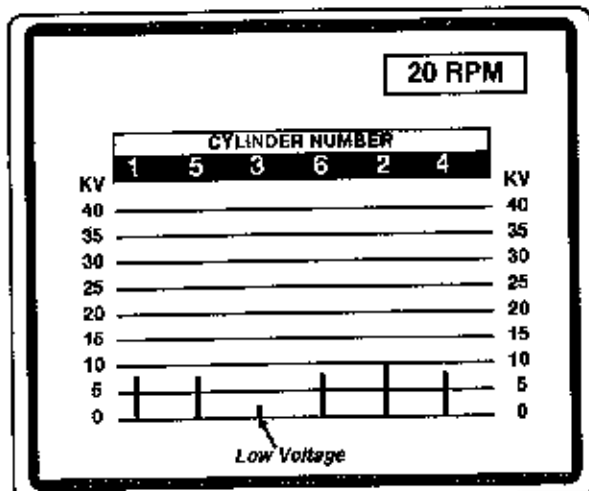


Figure 185

### D.I.S. Parade Patterns (See Figure 186)

D.I.S. parade patterns show average kv for compression and exhaust firings of the same set of cylinders.

The relationship between compression and exhaust firings can be complex. Consider the relationships between companion cylinders, also. Here are some rules of thumb:

- Compression kv should be somewhere between 6 - 16.
- Exhaust kv should be between 0 - 3.
- Most importantly, exhaust kv should never be more than half of compression kv. This would indicate a definite problem in the combustion chamber.

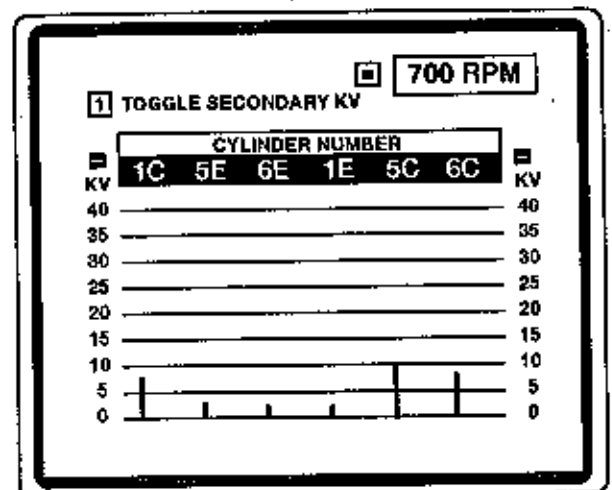


Figure 186

### Alternator Patterns

(See Figures 187 thru 189)

Figure 187 shows a normal alternator pattern. Slight variations in the normal pattern are acceptable. Figure 188 shows an unacceptable pattern caused by open diodes or stator. Figure 189 shows an unacceptable pattern caused by shorted diodes or stator.

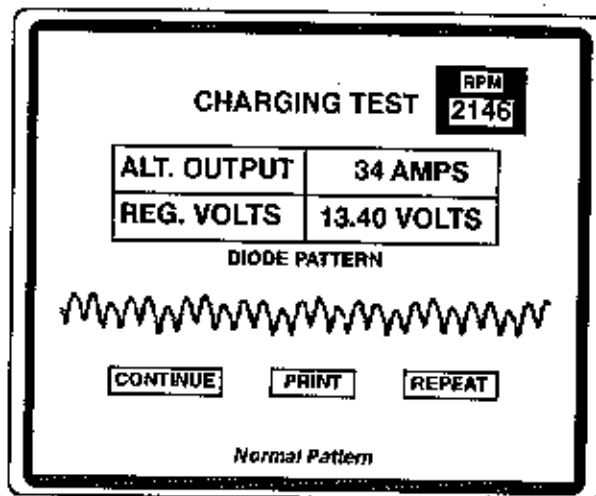


Figure 187

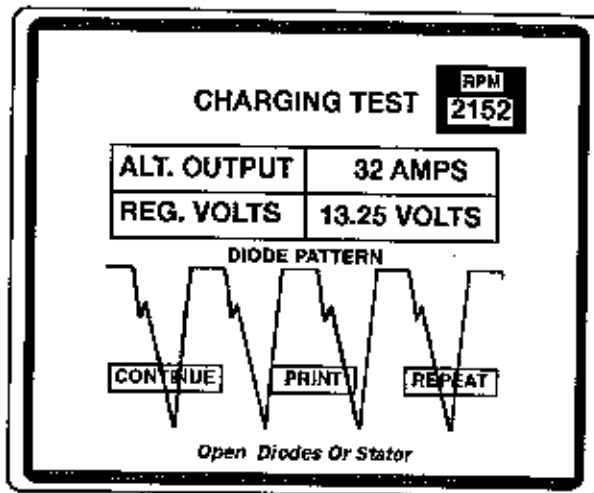


Figure 188

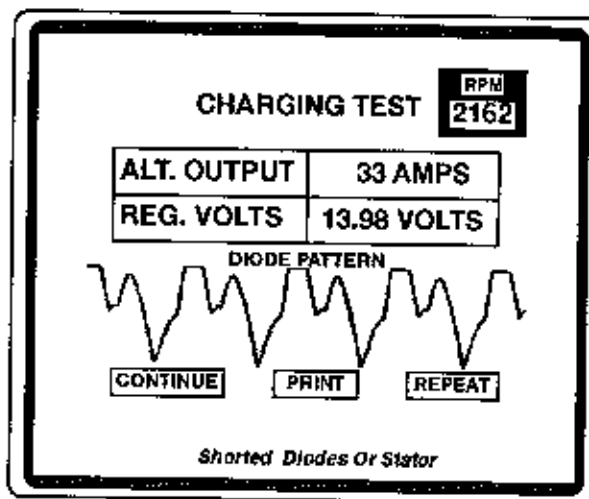


Figure 189

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## ***Utilities/Modem***



## Set Clock

Time is kept by a quartz clock powered by the batteries in the power supply. Use the keyboard to set the time, day, month and year. The clock is independent of the analyzer programming.

The current clock setting appears at the top of the "Set Clock" screen (see Figure 190). If the date and time display is accurate, press [ABORT]. The menu screen will return. To change the date and time display:

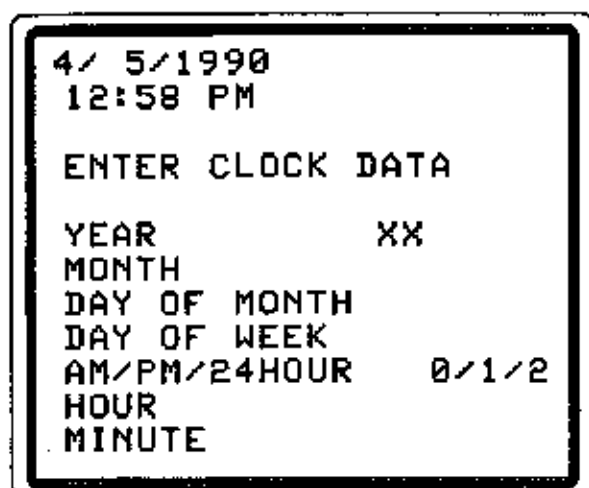


Figure 190

1. Press [CLEAR] to clear the information on the top line.
2. Enter the last two numbers for the year.
3. Press [ENTER].
4. Press [CLEAR].
5. Enter the month (one or two digits, as needed) and then press [ENTER].
6. Press [CLEAR] and enter day of the month (one or two digits). Then press [ENTER].
7. Press [CLEAR] and enter one digit for the day of the week (Sunday is 1, Monday 2, etc.). Then press [ENTER].
8. Press [CLEAR] again. Then press [0] for AM, [1] for PM, or [2] for 24-hour. Then press [ENTER] again.
9. Press [CLEAR] and enter one or two digits as needed for the hour of the day. Then press [ENTER].
10. Press [CLEAR] and enter one or two digits as needed for the minutes of the hour. Then press [ENTER].

### NOTES:

- If [ENTER] is pressed without entering new numbers, the numbers shown at the top of the screen are not changed.
- To stop changing date or time at any point, press [ABORT].
- If an entry error is made before pressing [ENTER], press [CLEAR], then re-enter the change.
- If an error is made on a line above the cursor, press [BACKUP] until the cursor rests on the line that needs to be changed. Any numbers already correctly entered will remain the same and do not need to be re-entered.

# Calibration and Self Test

Calibration and self-test ensure accuracy and test lead continuity over long term use.

## Battery and Boom Clip Leads

The "Connect" screen shows boom and battery lead connections to a usable automobile battery. Make the connections (see Figure 191), then press [CONTINUE].

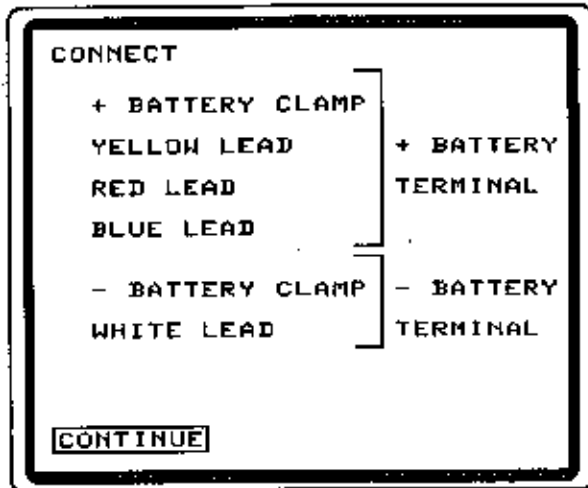


Figure 191

If connections and leads are good, calibration is done and the screen advances to the Vacuum Calibration screen.

If a lead or connection problem exists, a symbol appears in front of the lead name and a "CHECK CONNECTIONS" flag appears on the screen. Recheck the connections or troubleshoot the lead. Press [REPEAT].

If a lead continues to be flagged, press [CONTINUE]. All leads with good connections will be calibrated. Information from the flagged lead should NOT be considered dependable. Call your authorized service center.

## Vacuum Calibration

For vacuum calibration (see Figure 192), disconnect the rubber vacuum hose, if connected, from the engine connection. Press [CONTINUE]. DO NOT DISCONNECT LEAD FROM BOOM.

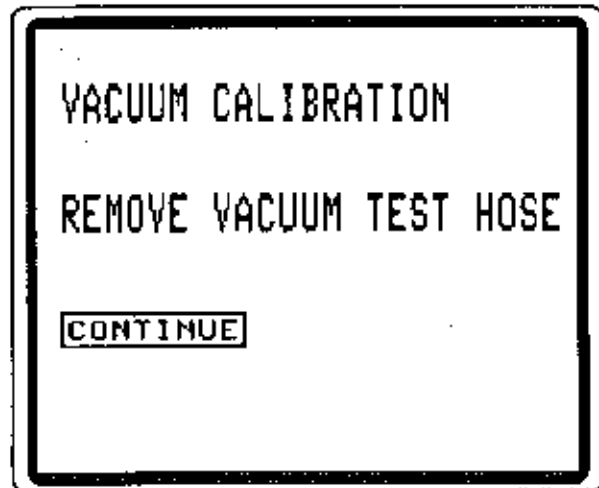


Figure 192

## Ohmmeter and Search Voltage Leads

Connect the ohmmeter lead clip to the ohmmeter probe. Connect the voltage search leads together. Press [CONTINUE]. If leads are not connected properly, calibration will be inaccurate (see Figure 193).

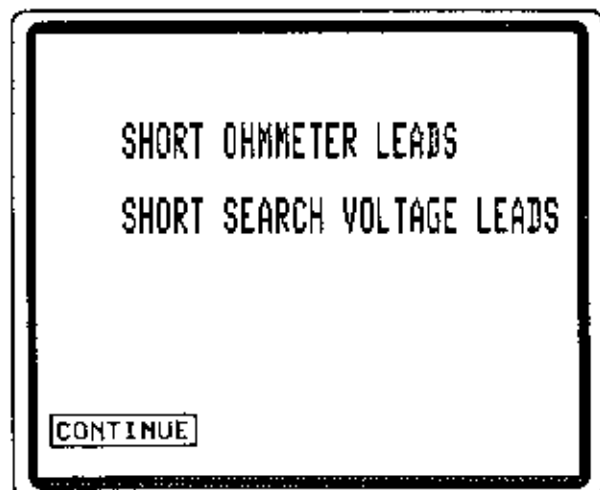


Figure 193



## Typewriter

Use the Typewriter feature to enter, edit, display and (with the optional printer) print as many paper copies of a typed screen as desired.

To date copies, press [.] on the numeric keypad before selecting "TYPEWRITER" from the Master Menu (see Figure 194).

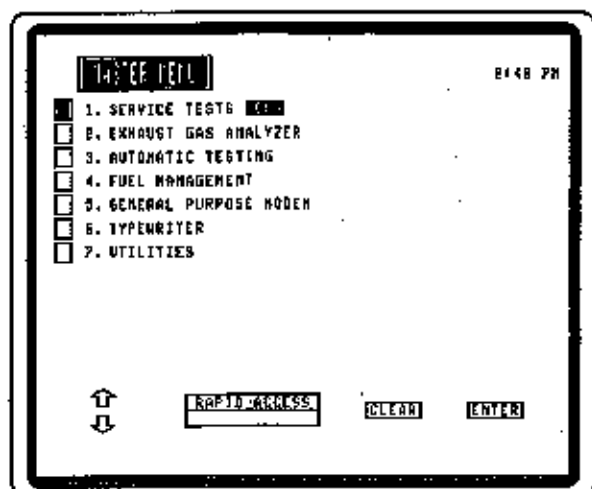


Figure 194

### To Type:

Press keys on the typewriter keyboard. The letter, number or symbol will appear at the flashing cursor (see Figure 195). Move the cursor around the screen by using the Arrow keys on the Program and Waveform keypads. To display the symbols (above numbers on the typewriter keyboard), press one of the shift keys and hold while pressing the key for the symbol.

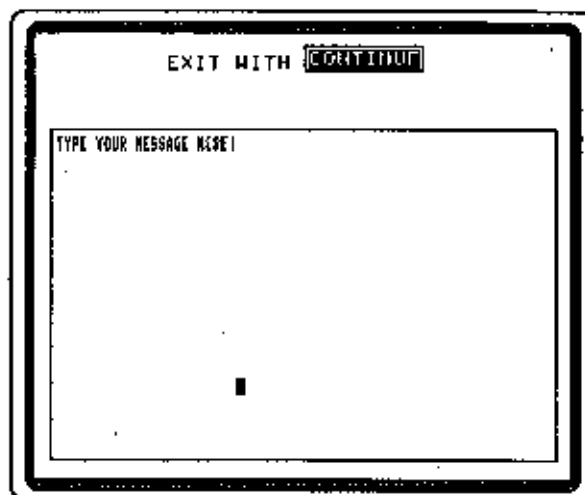


Figure 195

Correct errors by moving the cursor with the Arrow keys, then retyping as needed. To erase, place the cursor ahead of the words to be erased, then press the spacebar.

Each line on the screen is 62 places long. A change in the audio tone signals when five places are left on that line. Advance to the next line by pressing the spacebar.

- Press Arrow keys to move the cursor around screen without disturbing the text.
- Press [BACKUP] to delete text while moving the cursor back.
- Press [CONTINUE] to erase the entire screen.
- Press [PRINT] to print the screen.
- Press [CONTINUE] to exit the Typewriter screen.

# Modem

## General Description

The communications package is installed inside the analyzer. It consists of the hardware, (a plug-in circuit board), and a communications program stored in memory. The analyzer is equipped with a modem (telephone communications device) and can be used with tone or rotary (pulse) dialing systems.

## Definitions

1. When the communications package is working, the analyzer acts like a device called a "terminal."
2. The computer on the other end of the phone line is called the "host," which can display information on the terminal display.
3. The communications package in the analyzer is referred to as a "modem."

## Modem Menu

Connect the telephone cord from the analyzer to the telephone jack. Turn analyzer on; then select General Modem from the main menu.

The modem menu has the following selections (see Figure 196):

- 1) AUTO DIAL - The three auto dial selections can be set up to automatically dial commonly used phone numbers. (Select setup from this menu to assign the numbers.)
- 2) AUTO DIAL -
- 3) AUTO DIAL -
- 4) MANUAL DIAL - Allows you to dial a number manually.

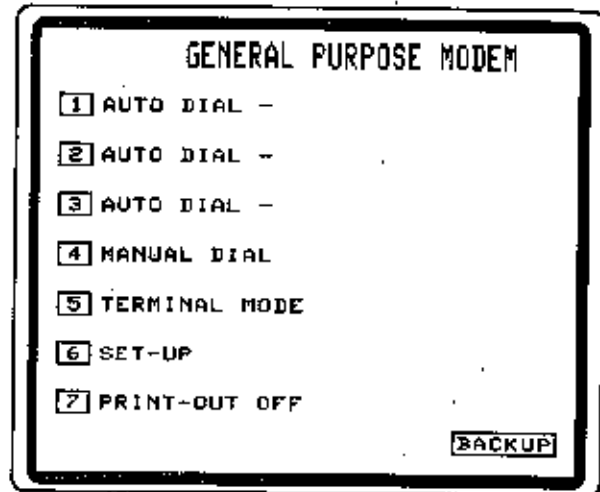


Figure 196

- 5) TERMINAL MODE - Turns the analyzer into a "dumb" terminal. This allows the operator to use Hayes-compatible commands to control the modem.
- 6) SET-UP - Used to set up dialing parameters for the auto dial selections.
- 7) PRINT-OUT - Press this to toggle the printer "ON" or "OFF." When "ON", the printer will then print all information received from the modem.

## Auto Dial

The three Auto Dial selections can be set up to automatically dial commonly used phone numbers (see "Setup" instructions to assign the numbers).

To make a call, press the number of the correct auto-dial selection. The computer automatically dials the number and makes contact with the host. Then enter a log-in prompt and password, as required by the host computer.

Follow host service instructions for exiting on-line communications.

### **Manual Dial**

Enter the necessary Set-Up information listed below each time you make a manual call to a host computer. This is the same kind of information needed for setting up Auto Dial. For best results, get a copy of the necessary host information before beginning.

Summary instructions are below. See the Set-up instructions in this section for detailed explanations of baud and parity/#bits.

Follow host service instructions for exiting on-line communications.

"ENTER PHONE #" - Enter the phone number as shown in Set-up instructions.

"1) 2400 BAUD" - Press [1] to toggle between 300, 1200, or 2400 baud.

"2) TONE/ROTARY" - Press [2] to toggle between tone and rotary.

"3) PARITY/#BITS" - Press [3]. A new screen appears. Set # stop bits, data word length, and parity. (See explanation in Setup.)

"4) DIAL PHONE# - Press [4] to start dialing. ENTERED"

### **Terminal Mode**

This mode allows the operator to use the display screen as a dumb terminal. This requires knowledge of the standard, Hayes-compatible communications commands. For detailed information on such commands and procedures, see the book included with the Hayes modem.

Press [5] to select Terminal Mode. The screen goes blank. Type in the commands needed to perform desired operations.

When completed, press [ESC], [CONTINUE], or [ABORT] to return to the menu.

### **Print-Out**

Press [7] to toggle the printout feature either "ON" or "OFF." When "ON," the printer will then print all information received from the modem.

### **Set-up**

Set-Up information is stored in long-term battery backed memory.

### **"0" Touch Tone / Rotary**

Press [0] to toggle the top line between touch tone and rotary. Set it once to fit your phone and leave it (unless you change phones).

### **Auto-Dial Parameters**

The rest of the screen shows the three parameters for each auto-dial selection. Select the appropriate number to enter or change a parameter. The three parameters appear on the next page.

*Continued...*

### *Autodial Parameters (continued)*

#### **"1. PHONE # / AUTO-IDENTIFIER" —**

Screen prompts you to enter the phone number of the host computer. Enter:

- A local phone number, with or without using a dash. For example, the modem will accept "666-6666" or "6666666."
- An area code before the local number, as "666-666-6666" or "6666666666."
- If you must dial 9 from your phone to get an outside line, press [9] and then [w] before entering the number. For example: 9w6666666.

Type in the digits and press [ENTER].

Follow the screen prompts and enter the identifier, (the name) to appear on the menu at the auto dial selection for that number. Type in a name and press [ENTER]. The program then returns to the Set-Up screen.

#### **"2. PARITY / #BITS" —**

The correct settings for most popular hosts are already installed for each "Auto Dial" selection. However, some hosts may be different. Compare parity/#bits information from the host vendor to the information listed below:

- # Stop Bits - 1.
- Data Word Length - 8.
- No parity.

If the host vendor information is different, set the information by entering the "Set-Up" screen for the correct Auto Dial number and entering the correct information.

To exit the "Set-Up" screen, press [REPEAT] or [ENTER].

#### **Upload Data to Auto-Line**

1. Call Auto-Line manually and establish voice contact with the technician.
2. Auto-Line will initialize the system when you are ready to send data.
3. Any information that can be printed can be uploaded. After you hear the system initialize, press the print command (either "PRINT" key, "DOT" key, or a test report menu selection, depending on the screen). Then immediately press the "UP" arrow. The data will be uploaded.

If no on-line connection has been made, data will be printed on the analyzer printer instead.

#### **Troubleshooting**

If no telephone number has been entered for the "Auto Dial" number selected, the message "NO PHONE # ENTERED" flashes before the menu screen returns. Refer to the "Set-Up" procedure.

If the phone connection is not working, the message "NO DIAL TONE DETECTED" flashes before the menu screen returns. Refer to the modem manual for troubleshooting procedure.

If the line is busy, or if the host computer does not answer the call after about thirty seconds of ringing, the message "NO ANSWER" flashes briefly before the menu screen returns. Often, selecting "AUTO DIAL" again will make the connection.

If contact with the host computer is not made, the message "NO ANSWER" flashes briefly before the menu screen returns. The most common reason for this is that the host computer is not available at the moment.

Follow host service instructions for exiting on-line communications.

---

# ***Maintenance***



## General Cleaning

### Video Display

Clean with a common window cleaning solution and a soft cloth.

### Analyzer Surfaces

Clean at least once a month; more often under dusty conditions. Use a cloth dampened with a mixture of mild dishwashing detergent and water. DO NOT use kerosene, gasoline or solvents containing petroleum distillates. Reduce static build-up on plastic surfaces by using an anti-static sprays available at electronics supply stores.

### Spec-Dek (if equipped)

The best maintenance for keeping the Spec-Dek clean is to keep the pages covered when not in use. If the bars become hard to read because of dirt, moisten cloth with a mild dishwashing detergent and wipe using light pressure. Replace any pages which become hard to read due to wear.

### Cooling Fan Filter Service

The foam cooling fan filters should be cleaned once a week; more often in dusty environments.

The main fan filter is on the back of the head next to the fuses. There is also a filter on back of the (optional) gas analyzer bench.

#### **To clean main fan filter:**

1. Remove the black plastic fan cover.
2. Blow out the filter with compressed air. If necessary, clean with mild soap and water. Air dry and return to place.
3. Replace fan cover.

## Lamps

**WARNING!** To prevent the possibility of personal injury through electrical shock, disconnect the unit power cord from building electrical power outlet before replacing lamps.

Sign lamps should be replaced by authorized service center personnel.

### Console Lamps (Refer to Figure 197)

Use 5-watt lamps for lighting the console area (12-volt cartridge type lamps, Westinghouse type 212 or equivalent; Part Number 672-42890). If a lamp fails to light, check to be sure main Display Lights switch is "ON." To replace console lamp, pull lamp from spring clamp holder and press replacement lamp into holder.

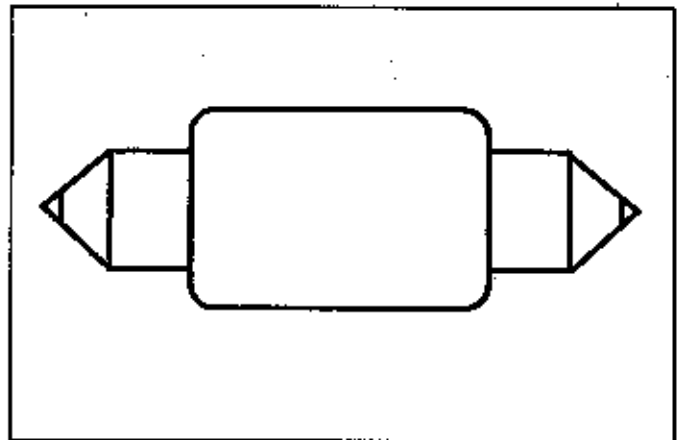


Figure 197

# Battery Replacement

## Long Term Memory

The analyzer has battery-backed memory that retains information entered by the operator, such as Dealer I.D., User Tests and Gas Calibration values. When main power to the unit is shut "OFF," this information is retained through a tiny amount of battery power. The batteries do not have any other effect on unit operation.

## When to Replace Batteries

Nominal life of the batteries in this unit is about one year. In order to maintain long term memory storage, batteries should be replaced before they fail. Replace batteries annually. If information such as Dealer I.D. and user Tests is not being stored after the unit is shut "OFF," batteries must be replaced.

## Changing Batteries (Refer to Figure 198)

1. If information is stored in memory, turn main power "ON" before replacing batteries. (This prevents loss of battery-backed memory information during replacement procedure.)
2. Remove battery compartment cover at rear of analyzer. Remove old batteries.
3. Install three new alkaline long life batteries, size AA, following the (+) and (-) signs on the battery holder decal. Then re-install the compartment cover.
4. If memory was lost, re-enter the following information:
  - Dealer I.D.,
  - Clock Settings,
  - Gas Analyzer Calibration Values,
  - User Tests.

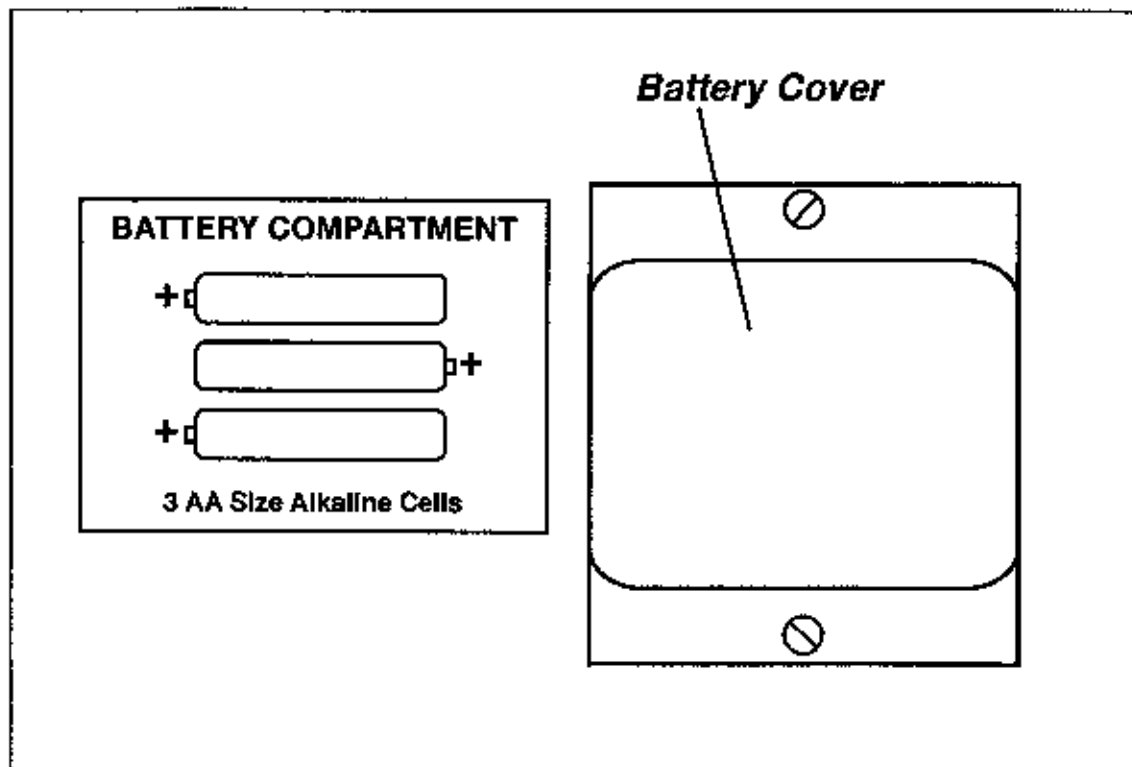


Figure 198



## Fuses

**⚠ WARNING!** To prevent the possibility of personal injury through electrical shock, disconnect the unit power cord from building electrical power outlet before replacing fuses.

Replace any defective fuse with the same type and size fuse. DO NOT install fuses of a higher ampere rating than specified in the list below:

- Vacuum pump and lighting fuse: 5A-125V "Slo-Blo."
- Unit power fuse: 2.5A-125V "Slo-Blo."

These fuses are secured by bayonet type fuse holders.

- Optional paper printer fuse: 1.75A-250V

This fuse is located in the back of the printer, in a screw type fuse holder (see Figure 199).

The fuses for the optional gas analyzer are discussed in the Gas Analyzer manual, Maintenance Section.

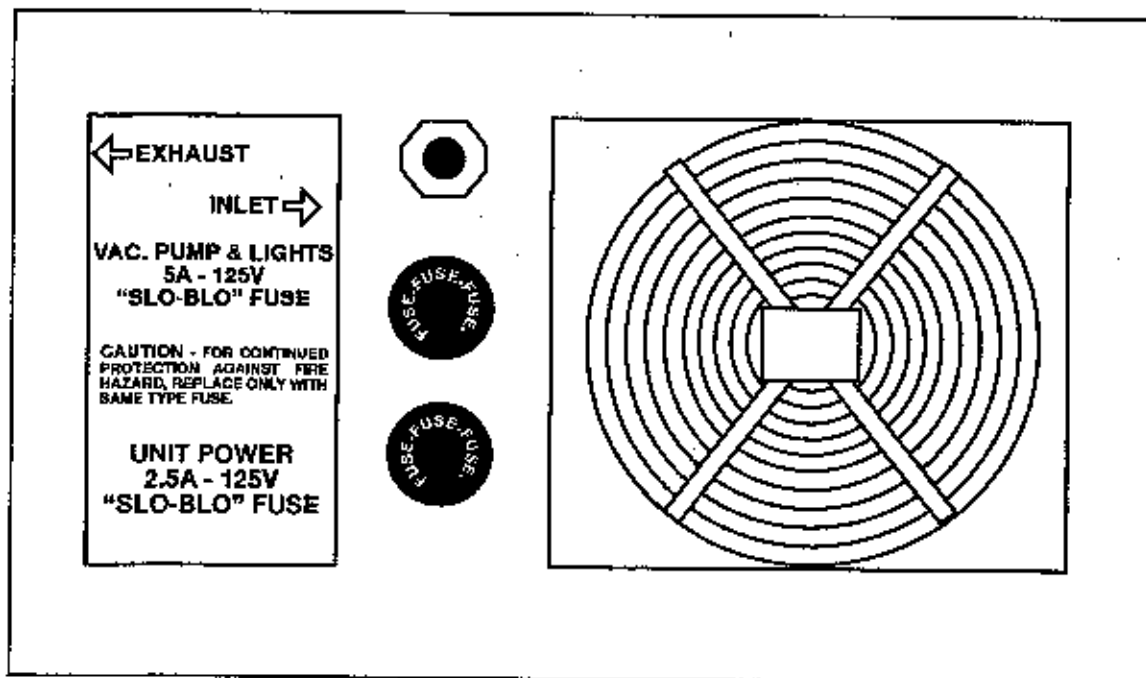


Figure 199

## ***Preventive Maintenance Schedule***

### **Weekly Maintenance**

1. Check calibration gas bottle pressure. Replace bottle if gauge pressure is 20 PSI or less. Enter new gas bottle values.
2. Inspect all cooling fan foam filters. Wash with soapy water and air dry.
3. Inspect water trap/filter bowl. Replace if dirty. Wash bowl in soapy water.
4. Inspect water trap filter. If dirty, wash bowl with warm soapy water.
5. Inspect in-line supplemental gas analyzer filter. Replace filter with AC GF81, FRAM G2 or equivalent.
6. Blow gas analyzer line and probe with clean shop air. Remove and blow out line towards probe.
7. Calibrate analyzer using "UTILITIES." Select "Calibration and Self Test."
8. Check printer paper supply. Replace as necessary.
9. Leak check and gas calibrate gas analyzer. Perform "Leak Check" and "Gas Calibration."

### **Monthly Maintenance**

10. Inspect printout quality. Replace ribbon if quality is poor.
11. Inspect casters for damage. Replace any broken casters immediately to prevent serious analyzer damage.
12. Clean and inspect all test leads, probes, hoses, etc. Contact local Bear Service Center for replacement leads if required.
13. Clean outside surface of cabinet and keyboards. Use a multi-purpose cleaner such as Fantastik or Formula 409.

### **Annual Maintenance**

14. Replace memory backup batteries. Use 1.5 AA heavy duty batteries.
15. Contact service for available updates. Cost is determined at time available.

***NOTE: Gas analyzer warranty is one (1) year. Test Lead Warranty is 30 days.***

## Test Lead Check

If you suspect a bad lead, first try the "tug test": Hold the boot of the lead in one hand and the wire in the other and tug with moderate pressure. If the wiring is bad, it often "gives" when pulled.

Most of the leads can also be checked with an ohmmeter, as follows:

### Primary Test Set (See Figure 200) (Part Number: 617-88450)

Zero resistance between:

- Pin 1 and red boot clip.
- Pin 2 and white clamp.
- Pin 3 and yellow boot clip.
- Pin 4 and blue boot clip.
- Open circuit between any other combination.

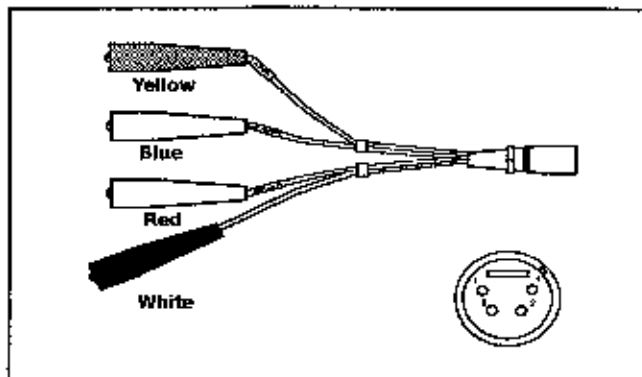


Figure 200

### Green #1 Trigger Probe (See Figure 201) (Part Number: 900-00005)

- Zero to one-half ohm between pins 1 and 2.
- Open circuit pins 4 to 1 and 4 to 2.

### Yellow High Tension Probe (See Figure 202) (Part Number: 900-00007)

Remove the probe clamp (or H.E.I. adapter) by uncoupling the center connector. There are two slots: one for the wide spade, one for the narrower spade.

- Zero between pin 1 and wide spade slot.
- Open circuit between pins 1 and 5.
- Zero between pin 5 and narrow spade slot.

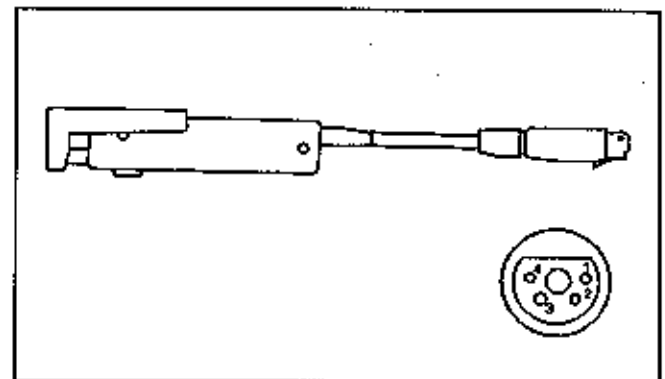


Figure 201

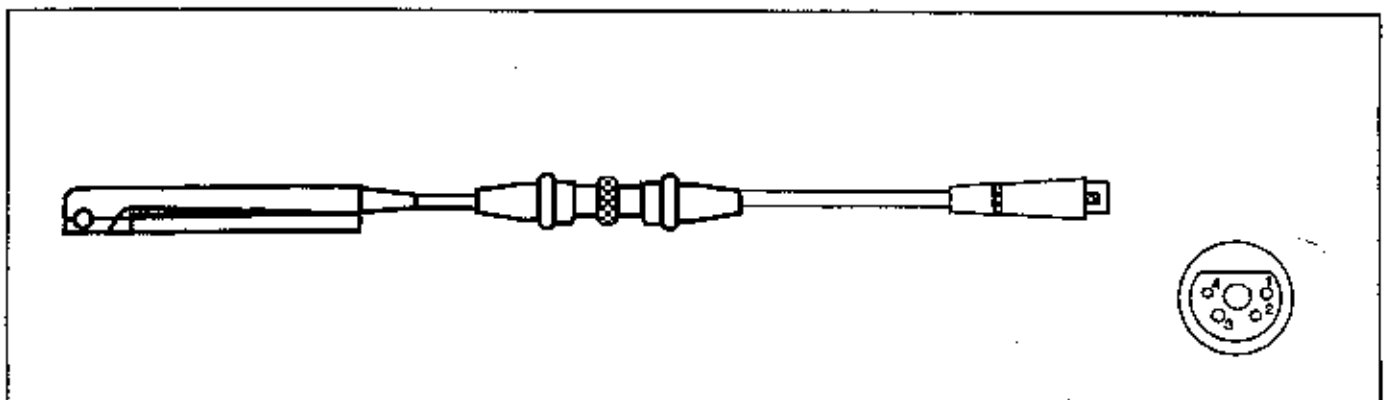


Figure 202

*continued...*

Test Lead Check (continued)

**Engine Temp. Probe (See Figure 203)**  
(Part Number: 617-88421)

High resistance showing continuity between pins 1 and 3.

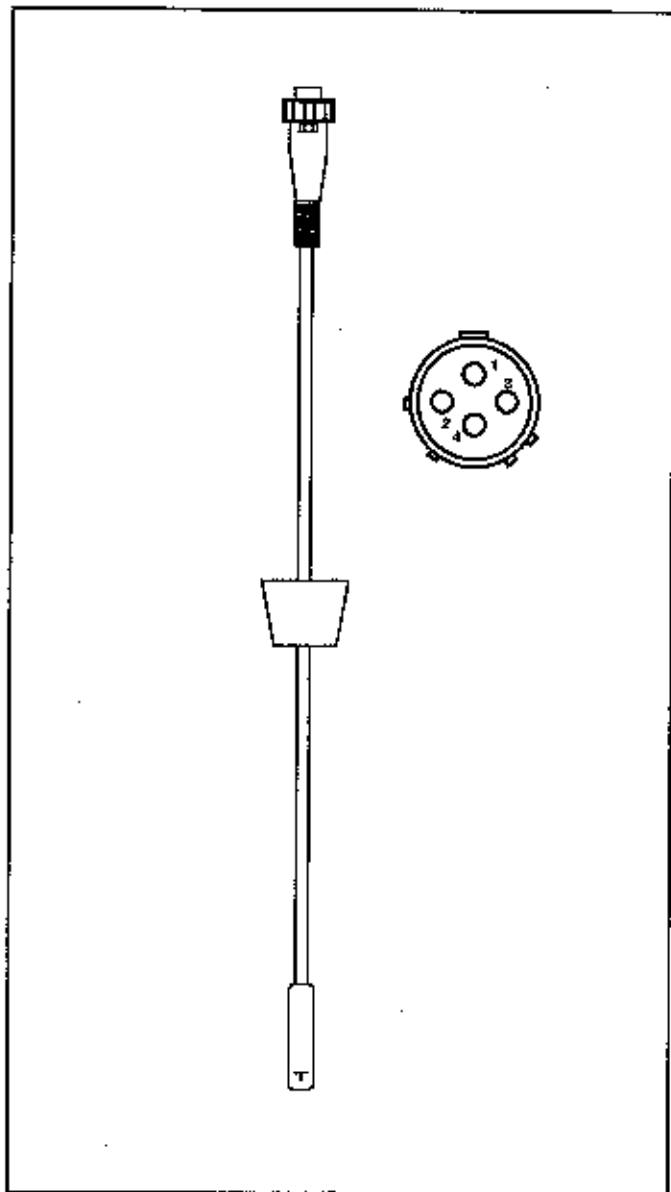


Figure 203

**Volts Search (See Figure 204)**  
(Part Number: 634-88417)

- Zero ohms between red probe and pin 1.
- Zero ohms between black clip and pin 4.
- Zero ohms between pins 1 and 4.

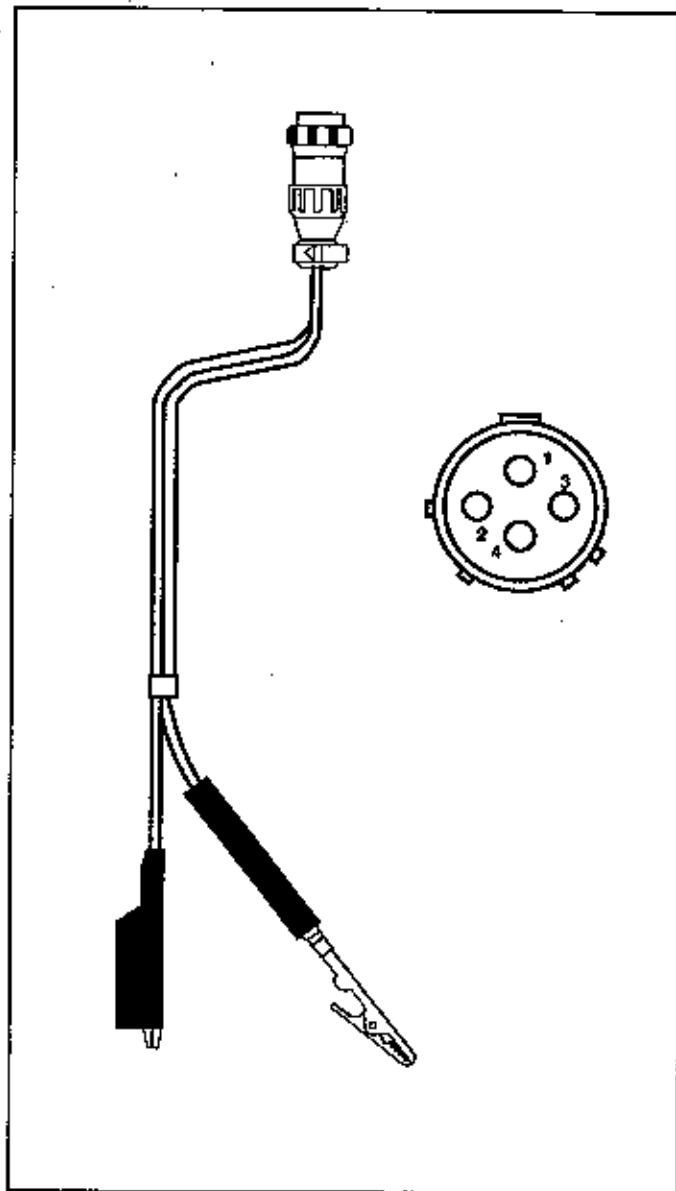


Figure 204

**Mag. Timing Probe (See Figure 205)**  
(Part Number: 617-87329)

Select the Diesel Charging Test and tap lightly and rapidly with a metal screw driver on the end of the probe. Tap straight on to the end. If rpm values register on screen, the probe is good. If not, the probe is probably bad.

If you're still not sure, substitute a new probe.

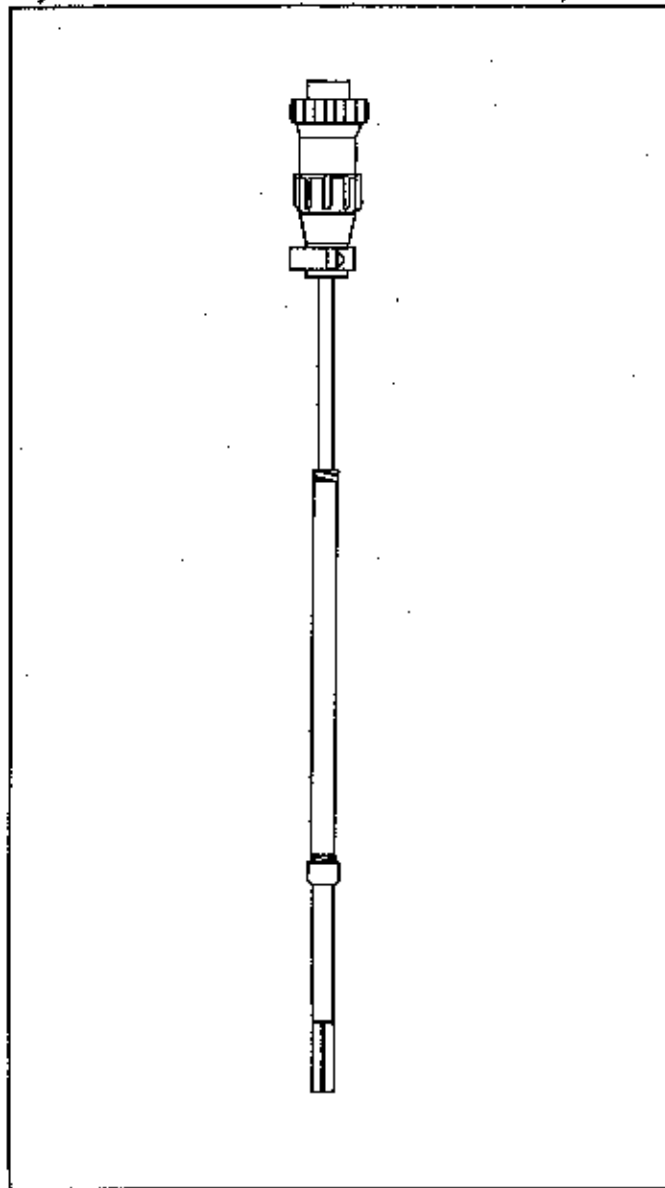


Figure 205

**Grey Ampere Clamp (See Figure 206)**  
(Part Number: 617-88423)

Approximately four ohms between pin 1 and pins 2, 3 and 7.

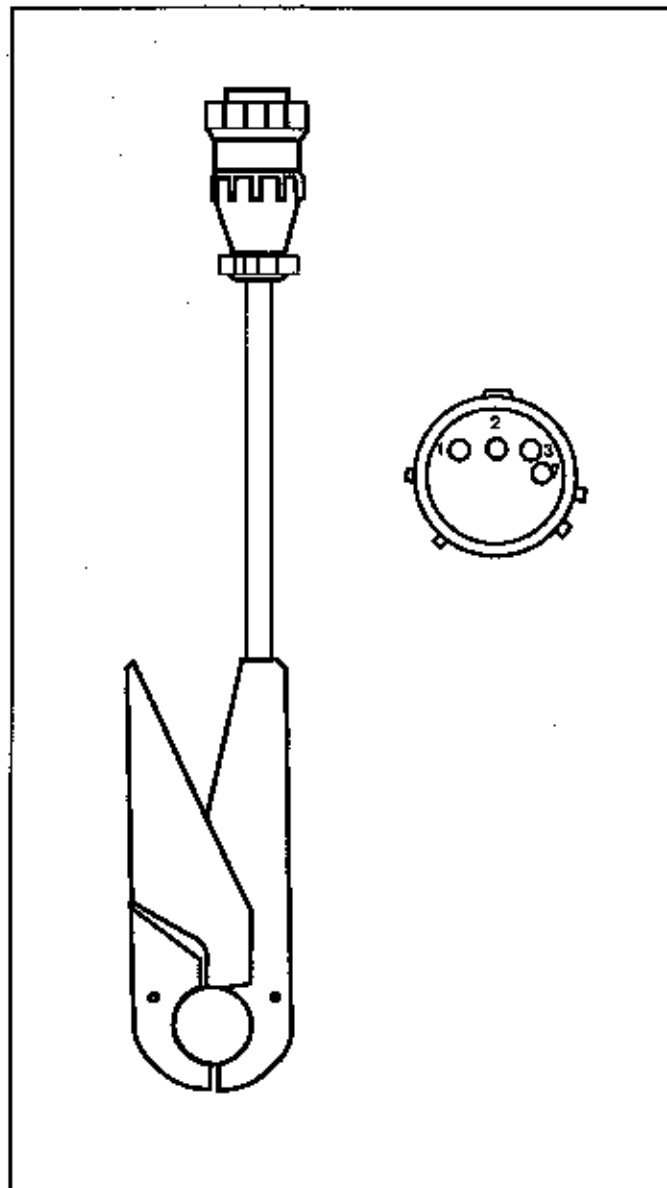


Figure 206

Continued...

## Maintenance

### Test Lead Check (continued)

#### Ohmmeter Leads (See Figure 207) (Part Number: 634-88520)

- Zero ohms between red lead and pin 2.
- Zero ohms between black lead and pin 3.
- Open circuit between pins 2 and 3.

#### Accessory Leads (See Figure 208) (Part Number: 634-88411)

- Zero ohms between yellow lead and pin 4.
- Small resistance (caused by fuse) between yellow lead and pin 3.
- Open circuit between pins 3 and 4.

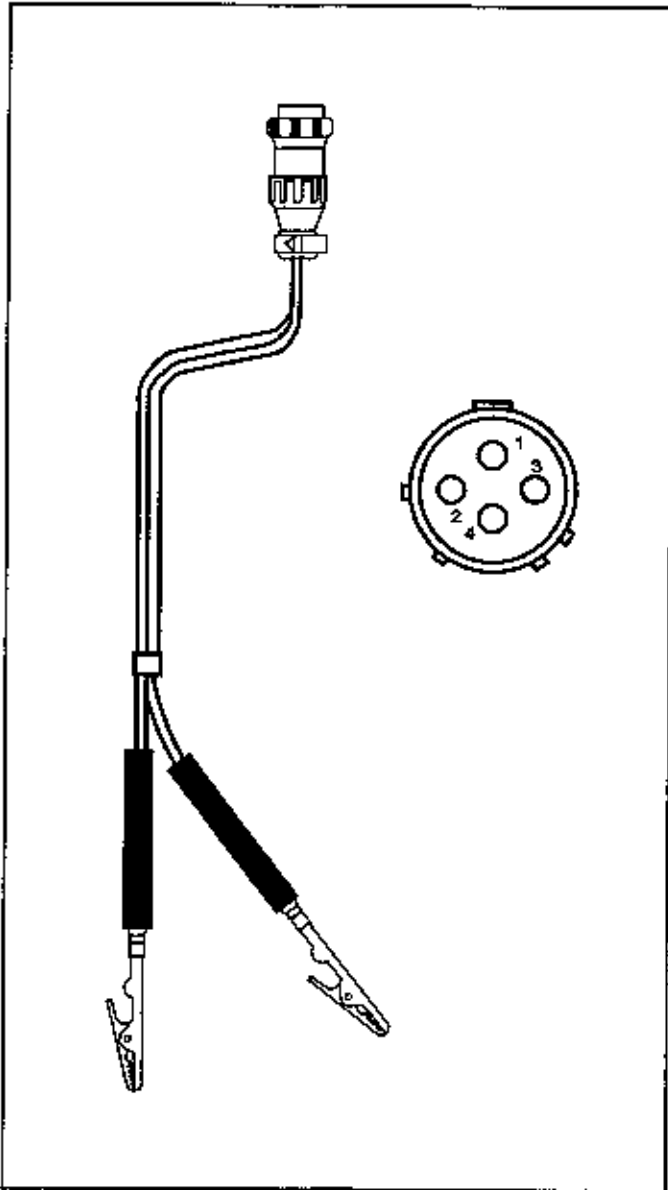


Figure 207

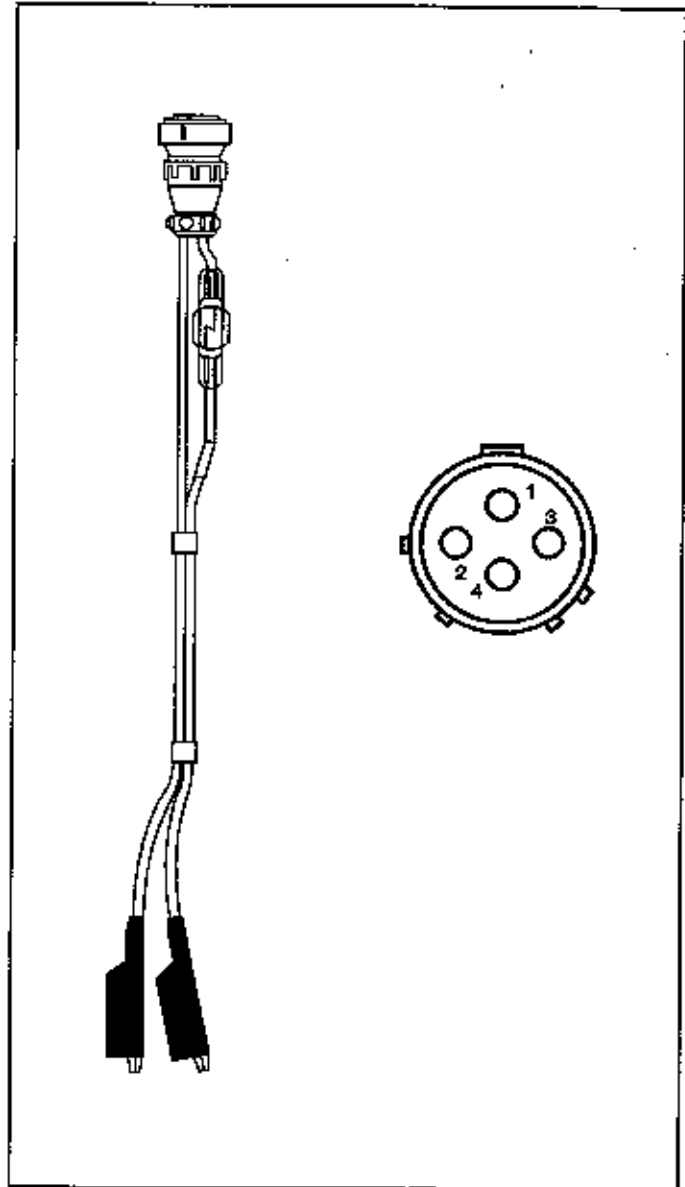


Figure 208

## Fault Messages

If the analyzer has an internal fault, fault message(s) will appear on screen when power is turned "ON." Call your local authorized service center and give the serviceman an exact description of the message.

Listed below are fault messages and their meanings.

### "CPU FAULT" (See Figure 209)

This fault does not always mean that the unit is not usable; it does mean that something is probably wrong with the Central Processing Unit (CPU). The operator may continue to run by pressing [CONTINUE]. The problem may show at any time during certain operations and may not show at all in others. When it does show, it will probably blank the screen or print random letters and numbers anywhere, forcing the operator to press [RESET]. The problem is likely to occur at the same point in the same operations.

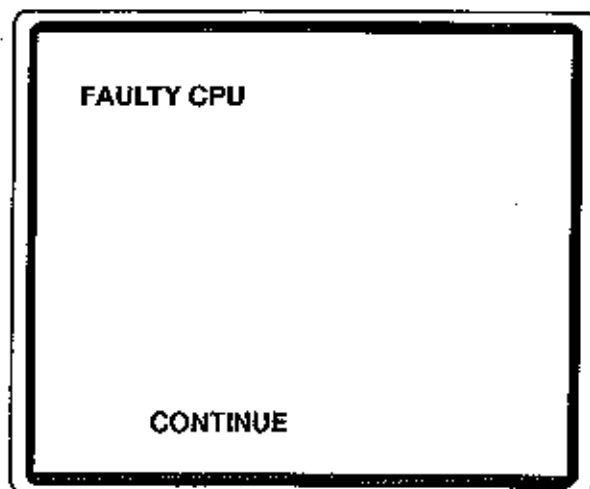


Figure 209

### "SLOT #X FAULTY MODULE" (See Figure 210)

This message shows a fault in an operating module. The slot number tells a serviceman the location of the faulty module. Press [RESET]. If the same message appears again, it is still possible to run the analyzer. Press [CONTINUE] - the faulty module is locked out of operation by the computer and the feature controlled by the module will not appear on the Master Menu. Other operations of the unit are generally not affected.

If the message reads "SLOT #X FAULTY MODULE 4", the problem is with the gas analyzer module. Take a look at the LED's under the gas analyzer cover. Note which ones are lit and report that to service as well.

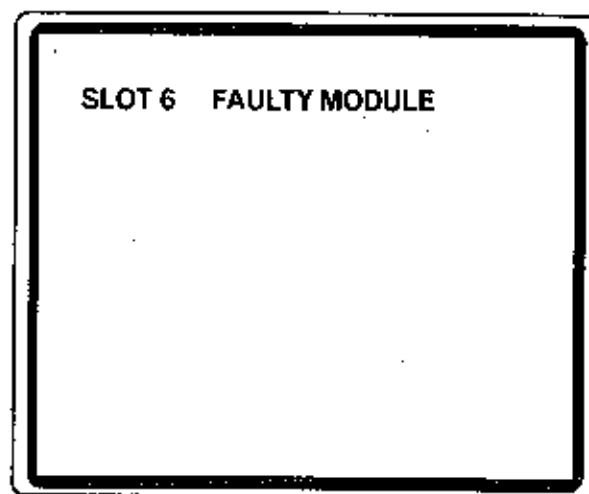


Figure 210

## Optional Printer Paper & Ribbon Replacement

### To Load Paper (Refer to Figure 211)

1. Remove the paper compartment cover (attached with fabric adhesive tabs).
  2. Remove the black plastic spool and place through the center of the new roll of paper.
  3. Install the paper into the compartment, pushing it back until the spool clicks into place. Paper should unroll from underneath the spool. (Paper tension drop plate will rest on top of paper roll.)
  4. Pull out about 12" of paper, enough to feed through the printer. Replace the paper compartment cover.
  5. Remove the plastic printer cover and the printer access cover.
  6. Open the paper release lever by pulling it towards you. Raise the column indicator bar.
  7. Insert paper between paper guides, sliding it in until it appears in front of the platen.
- NOTE:** Use roll paper 8.5" wide, 4.5" in diameter.
8. Make sure the paper is straight, then close the paper release lever. (If paper does not feed straight from compartment, shift printer slightly to align it.) Advance paper using the platen knob. Lower column indicator bar.
  9. Replace the access cover and the plastic printer cover.

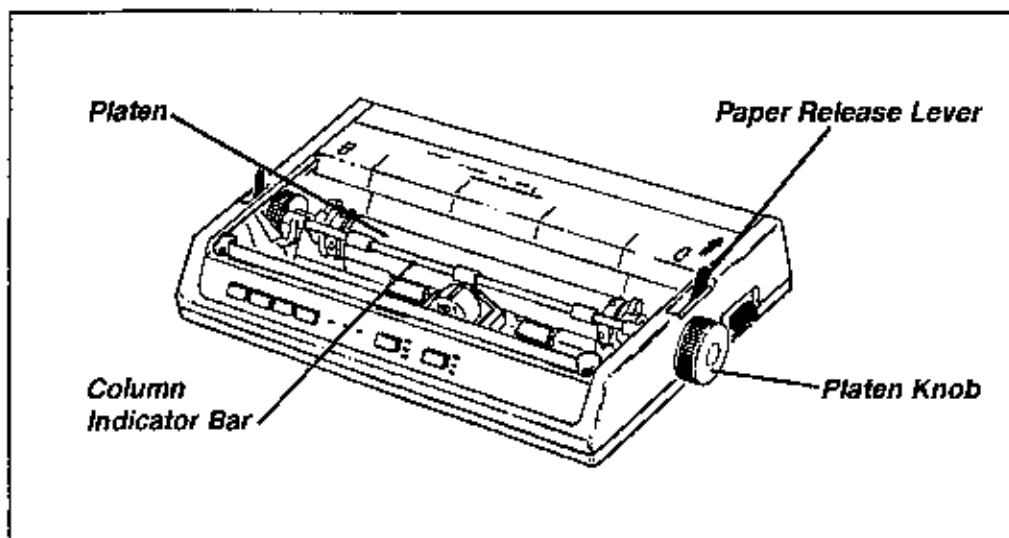


Figure 211



## To Change Ribbon (Refer to Figure 212)

1. With the knob side up, tilt the ribbon cartridge onto the printhead plate so that it slides into the area of the plate that is closest to the front of the printer (see Figure 212).

**(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 lines up 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.

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

3. Press on the cartridge until you feel it snap into place.

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

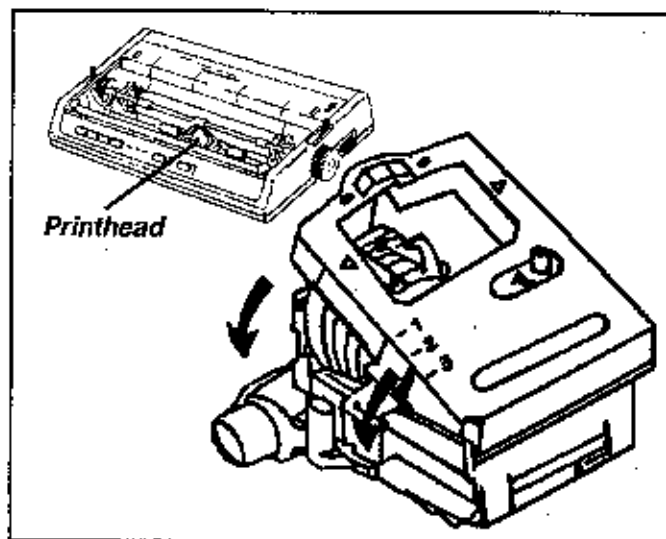


Figure 212

**Original equipment ribbons (Part Number 697-91076) may be ordered locally using supplier Number 52102001.**

**NOTE:** For more information on printer maintenance, refer to the printer manufacturer's operation manual (packed with printer).

## How To Obtain Service

If service is required, refer to the nearest authorized service center noted on the decal attached to rear of analyzer.

Warranty repairs will be considered only if proof of sale is presented to an authorized service center.



**BEAR**

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