

**MCS 2000 SL
MODULAR COMPUTER SYSTEM**

OPERATOR'S MANUAL

SUN ELECTRIC EUROPE

OPERATOR'S MANUAL

THE MODULAR COMPUTER SYSTEM

MCS-2000SL

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software version : V5.1x

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INTRODUCTION

OPERATOR'S MANUAL

This manual will assist you to become familiar with the MCS-2000SL. You can also use it for reference, when you want to use features of the MCS which you do not use regularly. The manual is divided into sections as outlined in the table of contents. This enables you to go directly to a particular section, when you are already familiar with the MCS. When information is only applicable to an option, the word OPTION is in front of that information. In lists, the word (OPTION) is placed after the applicable item. Check if the information is applicable to the configuration of your tester. If you have no options installed, you can skip the sections identified with OPTION.

GENERAL DESCRIPTION

The Modular Computer System, MCS-2000SL, shown in figure 1 is an engine analyser which can show you the operating conditions, and give you a diagnosis of a tested engine. This is accomplished by a software program which is on a 3.5" floppy disk. The use of this disk makes it possible to :

- easily upgrade the MCS to future demands.
- make a separate diagnostic program for each vehicle make.

The video display unit is a 20" monochrome monitor.

The MCS has a remote control which enables you to control the tester from the driving seat or near the engine compartment.

An OPTION for the MCS is a digital scope which can show the ignition primary and secondary patterns, but also the pattern of, for example an electronic injection system. With the digital scope you can store and recall the patterns, so you can easily observe them without having an engine running all the time.

The scope patterns and the test data are displayed on the 20" monitor. Some test data are displayed with a bargraph, other test data are given as numerical data. Diagnosis and instructions are given as text.

Another OPTION is an eighty column, high speed printer. With this printer you can print :

- customer diagnostic reports
- technician diagnostic reports
- patterns displayed by the digital scope.

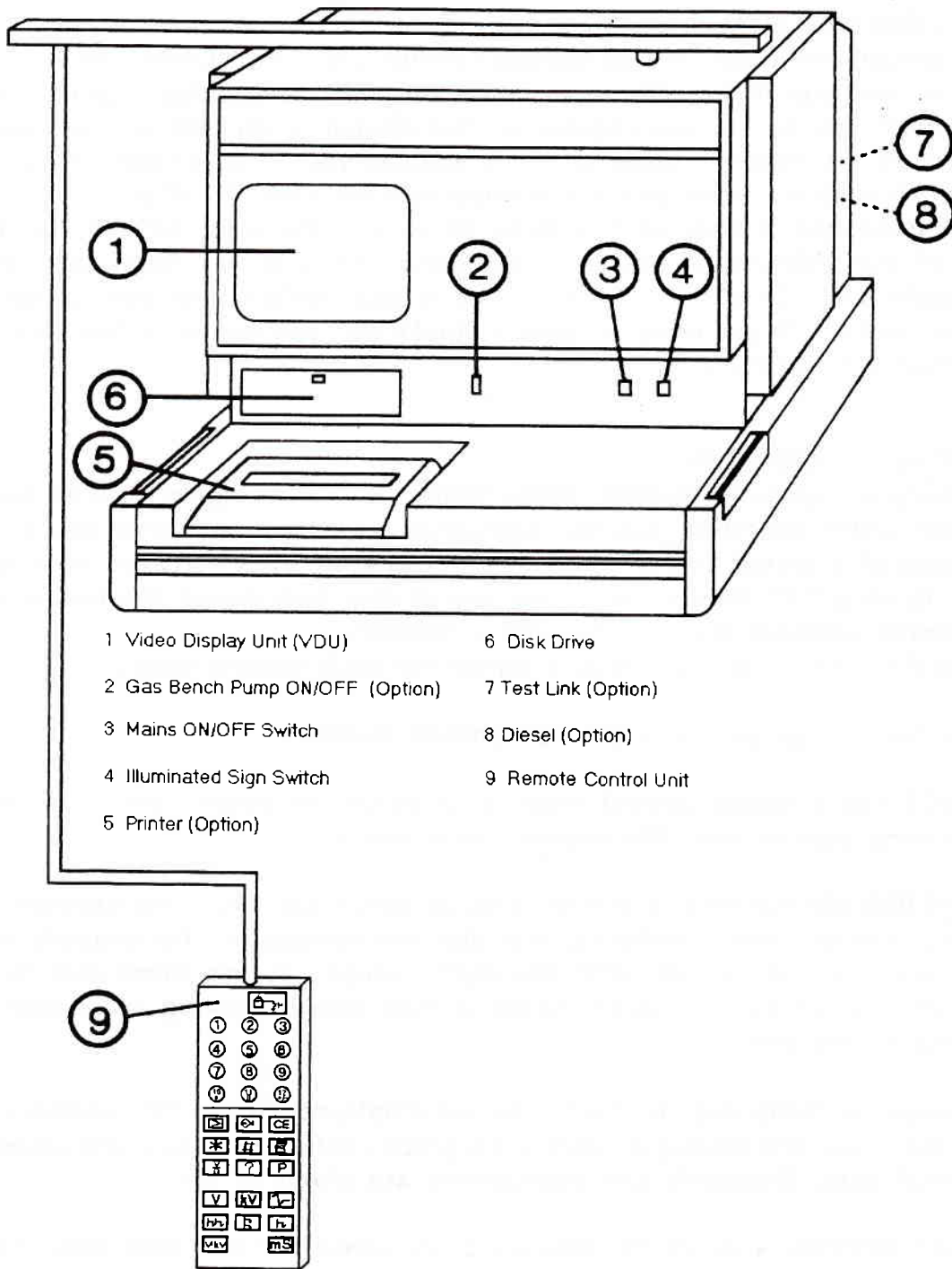


Figure 1, MCS-2000SL

SPECIFICATIONS

The MCS-2000SL is capable of testing 2, 3, 4, 5, 6, 8 and 12 cylinder engines with 4 stroke and 2 stroke operation.

STANDARD

Parameter	Range	Resolution
RPM	50..9999	1 RPM
Dwell	0...180 0...100	0.1 Deg. 0.1 %
Strobe timing	0...90	0.1 Deg.
Magnetic timing	-20...+180	0.1 Deg.
Coil + (k115)	-20...+20	0.01 V
Coil - (k1 1)	-20...+20	0.01 V
Battery Volt	-40...+40	0.01 V
Altern.ripple	0...10	0.1 %
Current	-100...+100 -500...+500	0.1 A 1 A
Firing voltage	0...50	0.1 kV
Spark voltage	-10...+10	0.1 kV
Spark duration	0...10	0.1 mS
Vacuum	0..1000	1 mBar
Oil temperature	-10...+150	1 Deg.
Pin-point volts	-40...+40	0.01 V
Pin-point resistance	0...10 0...100 0...500 0...10 0...100	0.01 Ohm 0.1 Ohm 1 Ohm 0.01 k Ohm 0.1 k Ohm
Pin-point frequency	15..1000	1 Hz

OPTIONAL

GAS ANALYSER MODULE

Parameter	Range(s)	Resolution
CO	0.....10	0.01 % vol
HC	0...2800	1 PPM vol
Delta HC	0..7000	1 PPM vol
CO2	0....20	0.01 % vol
O2	0....20.8	0.1 % vol
Lambda	0.50..1.6	0.001
AFR	7.3..23.5	0.1

DIGITAL OSCILLOSCOPE

Vertical scales:

Primary	25, 50, 250, 500V
Secondary	5, 10, 25, 50kV
Lab Scope	1, 2, 5, 10, 20, 40V

Horizontal scales:

Primary	single cylinder (100%, 5mS) Parade (all cylinders)
Secondary	single cylinders (100%, 5mS) Parade (all cylinders)
Labscope	100% and 5, 25, 100, 500 mS
Frequency	15...1000 Hz
Trigg. levels	0.5, 3, 10, 20V
Trigg. slope	Positive and Negative
Two cursors for exact time, duty cycle and voltage measurements.	

UNIVERSAL DIESEL KIT:

RPM and diesel injection timing. If you have a digital oscilloscope, you can display fuel pressure waveforms.

STL/SDL TEST LINK

To diagnose on-board electronic systems with serial communications capability.

SAFETY PRECAUTIONS

GENERAL

This tester is supplied in a safe condition. To keep it in a safe condition and to ensure safe operation of the tester, you must follow the instructions and pay attention to the Warnings and Cautions.

ABOUT WARNINGS

A warning gives instructions to prevent injury to people. Warnings will be given in the following list and just before the subject in this book to which the warning is applicable.

WARNINGS

1. Before you switch on the tester, make sure that the power cord is plugged in a proper mains outlet. (See serial number plate on the rear of the tester for power requirements). A too high voltage can damage the tester and make it unsafe.
2. Only use fuses with the fuse rating which is indicated near the fuse holder. The use of wrong fuses can damage the tester or the power cord and make these items unsafe.
- 3A. Do not make connections to a vehicle before the mains lead of the tester is connected to a proper mains outlet.
 - B. Plug the mains lead in a mains outlet with a protective earth contact.
 - C. Do not disconnect the mains lead before you disconnect the connections to the vehicle.

If the tester is not connected to earth, dangerous voltages can be present on the casing of the tester.
4. Do not open the tester. There are high voltages on several points inside the tester.
5. Do not use the tester when:
 - it is warmer than 40 °C
 - it is colder than 5 °C
 - the relative humidity is higher than 80 %

When the tester is used outside of these operating limits its functionality may decrease.

At temperatures lower than -10°C the tester may become unsafe.

6. Do not operate the tester before you contact your Sun service centre, when the tester:

- shows visible damage
- fails to perform the intended measurements
- has been subjected to prolonged storage under unfavourable conditions
- has been subjected to severe transportation stresses.

It is possible that these conditions can make the tester unsafe.

7. Place wheel chocks in front and at the rear of the drive wheels before you test a vehicle. This is to prevent the vehicle from moving.

8. Do not inhale exhaust gases. Work in a properly ventilated area. Exhaust gases contain carbon monoxide which is a colourless and odourless lethal gas.

9. Use insulated pliers when you handle components on the secondary side of the ignition system. You can get shocks of up to 30000 Volts if you touch any of these components with bare hands or conductive tools.

10. Wipe up fuel spills immediately and dispose of soaked rags in proper airtight containers. The soaked rags produce gasoline fumes which are explosive.

11. Do not smoke near gasoline. Gasoline fumes are explosive.

12. Do not open closed coolant systems while the fluid is hot. Steam will escape which can burn your skin.

13. Do not look directly into the carburettor throat when cranking or running the engine. Backfiring may cause burns.

14. Avoid contact with hot surfaces such as:

- exhaust manifolds and pipe
- mufflers
- catalytic converters
- radiators and hoses.

This can cause serious burns to your skin.

15. Do not use a naked flame near the battery. Batteries produce a hydrogen gas which is explosive.

16. Keep a fire extinguisher in the work area. The extinguisher should be suitable for a range of uses including gasoline, chemical and electrical fires.

17. Do not lay tools or equipment on the battery. Accidental shorting of the battery terminals may cause shocks and burns, and may damage wiring or the battery itself.

18. Do not get battery acid in your eyes or on your skin or clothes. Battery acid can damage eyes, skin, and clothes. If you accidentally come in contact with battery acid, wash with as much water as possible and use weak soda (such as baking soda) to neutralize the acid. If acid gets in your eyes, visit a doctor as soon as possible.
19. Use safety goggles when you work on a vehicle. This protects your eyes against acid, dust, gasoline, or objects which may fly from moving parts.
20. Do not wear a necktie, scarf, or loose clothing near an operating engine. Keep hands and hair away from moving engine parts such as fan blades, belts, or pulleys. This can cause a serious injury.
21. Do not wear wrist watches, rings, or other jewellery when you work on an engine. Such items may catch on moving parts or cause a burn to the wearer when an item makes a short circuit.
22. Do not operate the timing light too near fans or belts. The timing light has the effect of making the fan seem to "stand still". This is a dangerous optical illusion which might cause the operator to contact the fan.
23. Keep your hands away from the electric cooling fan. The fan can start at any time.

ABOUT CAUTIONS

Cautions give instructions to prevent damage to equipment. Cautions will be given in the following list and just before the subject to which the caution is applicable.

CAUTIONS

1. Check the engine oil level and add oil if necessary before you do a test. An engine should not be tested if the oil level is too low. The test results will be influenced and the engine can be damaged if you do a test with a low oil level.
2. Check the coolant level and add coolant if necessary before you do a test. An engine should not be tested if the coolant level is too low. The test results will be influenced and the engine can be damaged when you test an engine with a low coolant level.

3. Follow the car manufacturer's instructions when you work on cars with a catalytic converter. Converters may be damaged by after burning or by too much unburned fuel getting into the exhaust system.
4. Keep the tester's connection leads away from moving or hot engine parts. The test leads can not withstand high temperatures or severe mechanical stress.

MARKINGS

If a gasbench is installed, there is a symbol (shown below) on the rear of the tester. This symbol indicates that lethal gases escape from the rear of the tester. Therefore it is necessary to work in a well ventilated area.



CALIBRATION AND SERVICE

To maintain proper functionality, the following must be done.

1. A Sun Electric Representative must do a complete gasbench calibration every 3 months.
2. Maintenance must be done as described in "Maintenance".

STORAGE

The minimum and maximum storage temperature range of the tester is as follows : -4 to +55 degrees Celsius.

OPERATION

The operation of the MCS depends on the kind of software used. This software is available on floppy disks.

DISKS

The following three types of disks are available :

- A system disk.
- A standard limits disk.
- A make specific limits disk.

When you use a system disk, the tester will show you the test results but no diagnostics.

When you use a standard limits disk the tester will show you the test results and some diagnostics.

When you use a make specific limits disk you will get the test results and full diagnostics.

PROGRAM

You must always start MCS2000SL with the system disk. When you switch on the tester with the system disk inserted, the tester will test some of its components. If a component fails, the display shows a message. If no component fails, the tester will look at its memory, as to which options are installed. (tester configuration). Then the warm-up page shows, if a gas bench is installed it shows for 15 minutes, if no gas bench is installed it shows for 2 minutes.

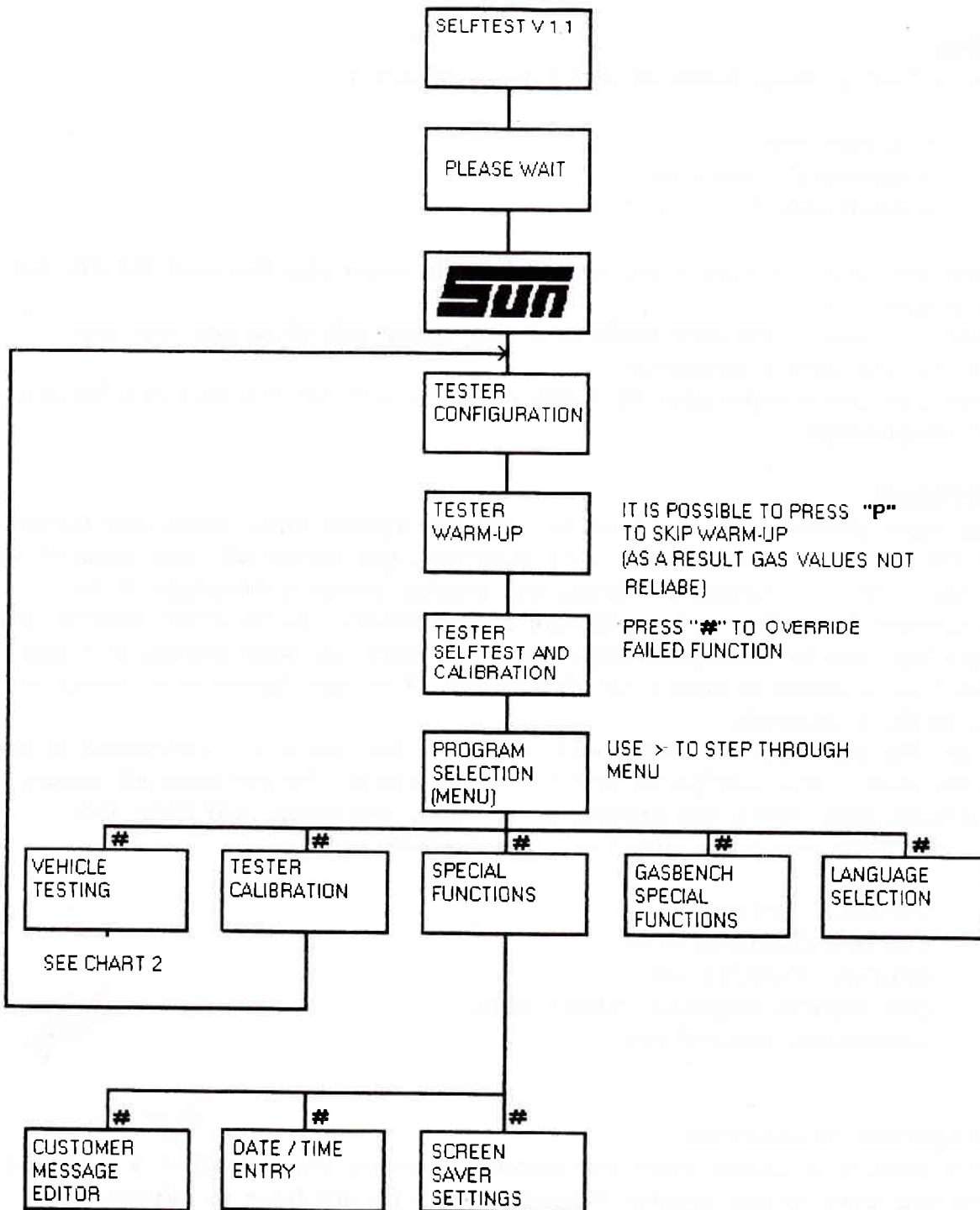
After the warm-up the tester will look if all test-leads are connected to the tester and if the configured options are available. Furthermore all values are calibrated. When the calibration is done, the tester will show the program selection menu with the following items :

- VEHICLE TESTING
- TESTER CALIBRATION
- SPECIAL FUNCTIONS
- GAS BENCH SPECIAL FUNCTIONS
- LANGUAGE SELECTION

LANGUAGE SELECTION

This feature is useful when the tester is already started-up in a language and you want to use another language. You do not have to restart the tester and wait for the warm-up period again. You can just insert a floppy with another language and select "language selection". The screen will give a list of the available languages. Select the desired language and press the enter # key.

CHART 1



GAS BENCH SPECIAL FUNCTIONS

If the standard gas approval type is used, the gas bench special functions menu has only one option. This is module display.

MODULE DISPLAY

If you select module display, the screen will show which type of gas bench is installed and it will show a checksum number.

SPECIAL FUNCTIONS

The special functions is a menu. From this menu you can choose :

- CUSTOMER MESSAGE EDITOR
- DATE / TIME ENTRY
- SCREEN SAVER SETTINGS

If you select "customer message editor", you can make or edit a customer message. This message will be printed on top of a printout together with the vehicle particulars. The following keys are used for the customer message editor.

> To step up through the character set.

+/- To step down through the character set.

* To enter a character and go to the next space on the line.
(32 spaces maximum).

To enter a character and go to the next line. (8 lines maximum).
If this key is pressed with the cursor in the last line, the message will be written in the memory.

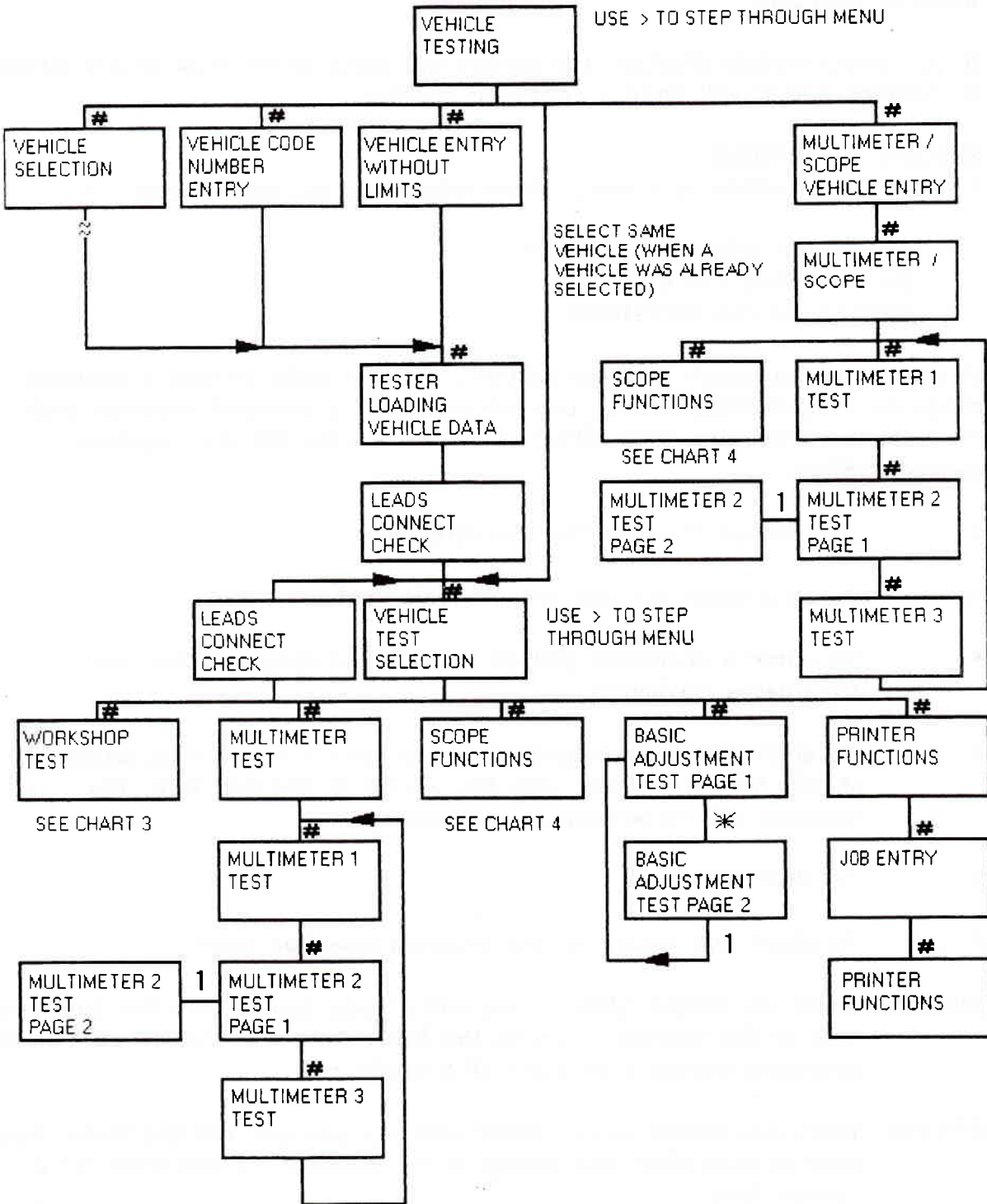
0 To clear line.

P To abort and return to the program selection page.

OPTION When you select "date / time entry" you can update the date and time of the internal clock in the MCS. Date and time is used in all printouts except a printout of a single test.

OPTION When you select screen saver settings you can tell the tester how soon it must clear the screen if the buttons are not used for a certain time.

CHART 2



TESTER CALIBRATION

When you select this item, the tester will do the calibration and some initial tests again. (see chart 1) The tester will go through a warm-up period of only two minutes.

VEHICLE TESTING

When you select vehicle testing, you get the following menu :

- VEHICLE SELECTION
- VEHICLE CODE NUMBER ENTRY
- VEHICLE ENTRY WITHOUT LIMITS
- SELECT SAME VEHICLE (only when a vehicle was selected before)
- MULTIMETER / SCOPE

VEHICLE SELECTION

Before you select vehicle selection you have to insert a "standard limits disk" or a "make specific limits disk". When a "make specific limits disk" is used, the tester will show several screens with lists of specifications. You must choose the specifications which are applicable to the vehicle you want to test. When a standard limits disk is used, the tester will show a screen with the limit data, it is possible to change these data for your own requirements. (the changed data will not be saved on disk.) When all information is entered the tester starts to load the applicable vehicle data. (see chart 2).

VEHICLE CODE NUMBER ENTRY

Instead of determining the vehicle type by giving the tester all the specifications, you can use the vehicle code number. For a "standard limits disk", you can find the vehicle code number in the Sun code book. When you use a "make specific limits disk", you have to go through the selection procedure once to get the vehicle code number. If you have to test a vehicle regularly, you can write the vehicle code number somewhere in the engine compartment. Before you select "vehicle code number entry", you have to insert a "standard limits disk" or a "make specific limit disk" in the drive. When you have entered the vehicle code number the tester starts to load the applicable vehicle data. (see chart 2).

VEHICLE ENTRY WITHOUT LIMITS

When you choose vehicle entry without limits, you can leave the system disk in the drive. Press enter # and the tester will show a page with engine data, you can enter this data or first change it to make it applicable for the engine you want to test. When you have entered the engine data the tester starts to load the applicable vehicle data (see chart 2). The tester will give no diagnostics when you use "Vehicle entry without limits".

MULTIMETER / SCOPE

If you select multimeter / scope from the vehicle testing menu, you also come in a page with engine data. When you have entered the engine data the tester will show a menu from which you can choose :

- MULTIMETER TEST
- SCOPE FUNCTIONS

Multimeter and scope can also be chosen from the "vehicle test selection" menu, the description will be given there.

TESTER LOADING VEHICLE DATA

The tester starts to load the specific vehicle data as soon as a vehicle is defined.

LEADS CONNECT CHECK

When the specific vehicle data is loaded, the tester does a leads connect check. The tester will look if the test leads are connected to an engine. If not, it will give a message on the screen which tells you which lead you have to check. When all leads are correctly connected, you have to press enter # and the tester will go to the "vehicle test selection" menu.

VEHICLE TEST SELECTION

The vehicle test selection page is a menu with the following items:

- WORKSHOP TEST SELECTION
- MULTIMETER TEST
- SCOPE FUNCTIONS
- BASIC ADJUSTMENTS TEST
- LEADS CONNECT CHECK
- PRINTER FUNCTIONS

WORKSHOP TEST SELECTION

The workshop test selection is again a menu with the following items:

- IGNITION ON TEST
- STARTING SYSTEM TEST
- CHARGING SYSTEM TEST
- IGNITION DWELL TEST
- TIMING ADVANCE TEST
- IDLE EMISSIONS TEST
- SECONDARY KV TEST 1
- SECONDARY KV TEST 2
- SNAP ACCELERATION TEST
- CYLINDER COMPARISON TEST

If you start with the ignition on test, and save the test data by pressing the * key, and then enter by pressing the enter # key, the tester will automatically proceed with the next test. If you do all tests in this given order, you can detect engine problems as quickly as possible. It is also possible to start with any other test by selecting it from the menu with > and start it with enter #. Some tests have a secondary page, you can access this page by pressing the 1 key.

IGNITION ON TEST

The ignition on test measures parameters to ensure that the ignition system and the battery are in good condition.

STARTING SYSTEM TEST

The starting system test measures the starter current, the battery voltage and looks if the ignition is still working correctly under cranking conditions. It also checks the compression electronically and checks if a fuel mixture is available.

CHARGING SYSTEM TEST

The charging system test measures the output of the generator and the voltage of the regulator under load. It also checks the condition of the diodes.

IGNITION DWELL TEST

The ignition dwell test, measures dwell angles between idle and cruise speeds to test settings and to indicate if the dwell regulation is correct. (if a dwell regulation system is installed).

TIMING ADVANCE TEST

The timing advance test measures basic timing and the advance systems, including vacuum retard system. (if installed).

IDLE EMISSIONS TEST

The idle emissions test measures the exhaust gas values, at idle speed.

LOW SPEED SECONDARY KV TEST

The low speed secondary kV test captures the secondary kV readings at idle speed and together with the exhaust gas values diagnoses the ignition system.

HIGH SPEED SECONDARY KV TEST

The high speed secondary kV test captures the secondary kV readings at cruise speed and together with the exhaust gas values diagnoses the secondary ignition system.

SNAP ACCELERATION TEST

The snap acceleration test checks the fuel enrichment and the condition of the spark plug and the secondary ignition system under load.

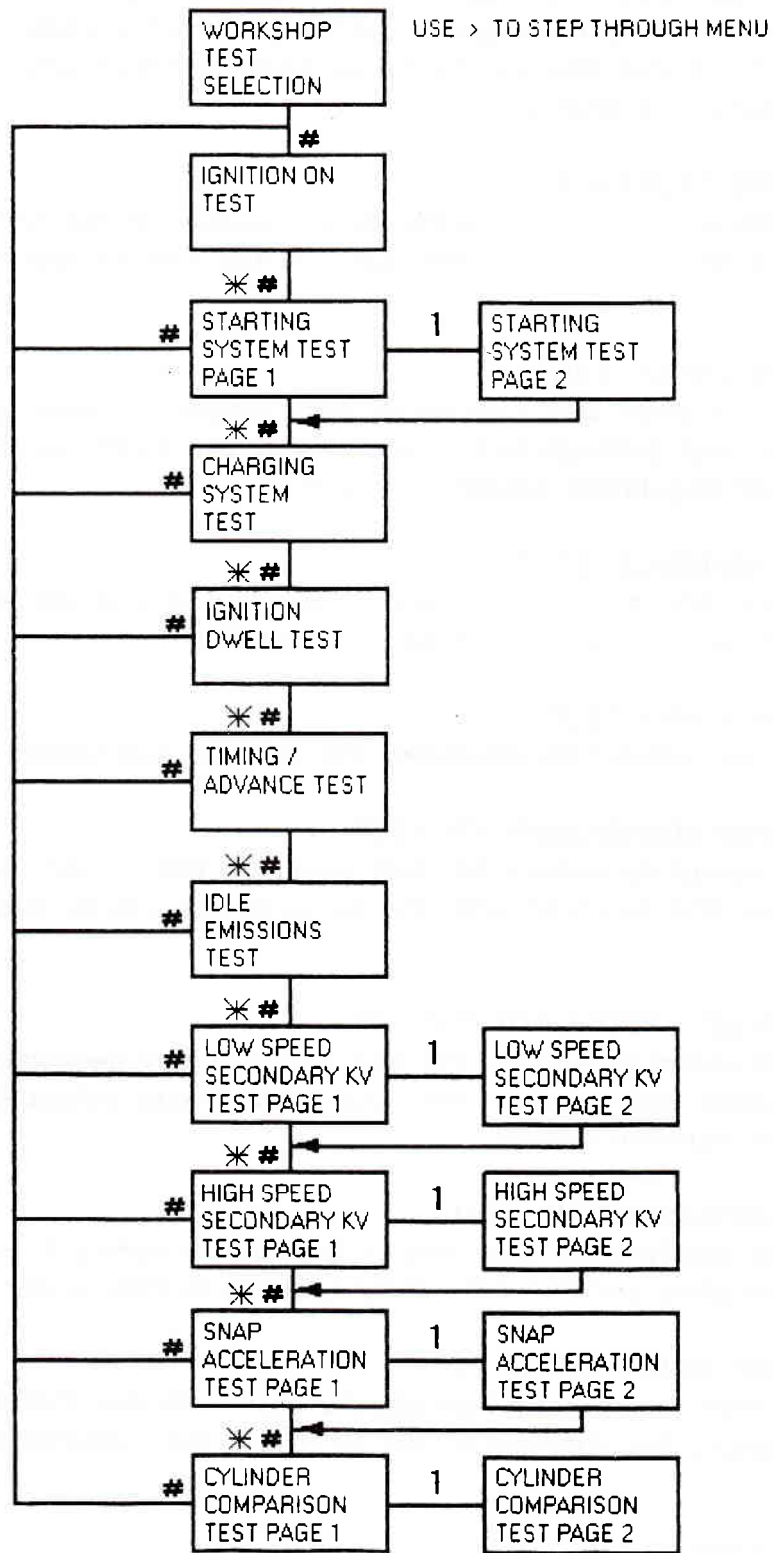
CYLINDER COMPARISON TEST

The cylinder comparison test checks each cylinder individually for power performance, the changes of the RPM and the unburnt fuel readings.

MULTIMETER TEST

The multimeter test consists of three tests when you select multimeter it starts with multimeter 1 test.

CHART 3



MULTIMETER 1 TEST

This test will show continually updated information from the :

- Engine speed
- Alternator ripple
- Coil + / KL 15 voltage
- Dwell
- HC value
- Battery voltage
- Current
- Coil - / KL 1 voltage
- Peak firing voltage
- Oil temperature

Where applicable, all results shown are averaged for all cylinders. Individual cylinder results are available in full workshop test facilities. To go to the multimeter 2 test, you have to press the enter # key.

MULTIMETER 2 TEST

This test is divided into two pages. The first page shows the :

- Engine speed
- Dwell
- Vacuum
- Timing
- Peak firing voltage
- Oil temperature

The second page shows the :

- Engine speed
- CO value
- CO2 value
- Lambda
- Oil temperature
- HC value
- O2 value
- Air Fuel Ratio

Where applicable all results shown are averaged for all cylinders. Individual cylinder results are available in the full workshop test facilities. To advance to multimeter 3 test, you have to press the enter # key. This is possible in multimeter 2 test page 1 as well as page 2.

MULTIMETER 3 TEST

In multimeter 3 test you can show the voltage (volts) or the resistance (ohms) which exist between the two measuring probes. The measuring probes are on a separate twin lead from the overhead boom. When you come in the multimeter 3 test it shows the voltage range. If resistance is required press the cursor > to change. The ohm meter has two ranges, one variable and one fixed. To toggle between these choices press * for the fixed range or the +/- key to reset to variable. You can leave the multimeter tests by pressing P.

BASIC ADJUSTMENT TEST

The basic adjustment test is divided into two pages. The first page shows the:

- Engine speed
- Dwell
- Initial timing
- Oil temperature

The second page shows the:

- Engine speed
- HC value
- O2 value
- Air fuel ratio
- CO value
- CO2 value
- Calculated lambda
- Oil temperature

This test is arranged so that all adjustments are done in a chronological order to minimize on duplicated work. The test will give some instructions, when you completed an instruction, you have to press the enter # key.

SCOPE FUNCTIONS

The MCS2000SL has (as an OPTION) a digital scope, with this scope it is possible to freeze, save and print various scope patterns. When you use the scope, it is very useful to press the "0" key, this will bring a key definitions page on the screen which shows the dedicated keys used in the current mode.

```
SCOPE FUNCTIONS
KEY DEFINITIONS
RUNNING MODE
1/2 TIME-SCALE
4/5 VOLT-SCALE
7/8 CYL. EXCHANGE RATE
+/- PREV CYLINDER
) NEXT CYLINDER
3 PRIM/SEC SELECT
6 STORAGE
9 GASSES IN/OUT
* FREEZE
PRESS P TO RETURN

Ignition scope
Key Definitions
```

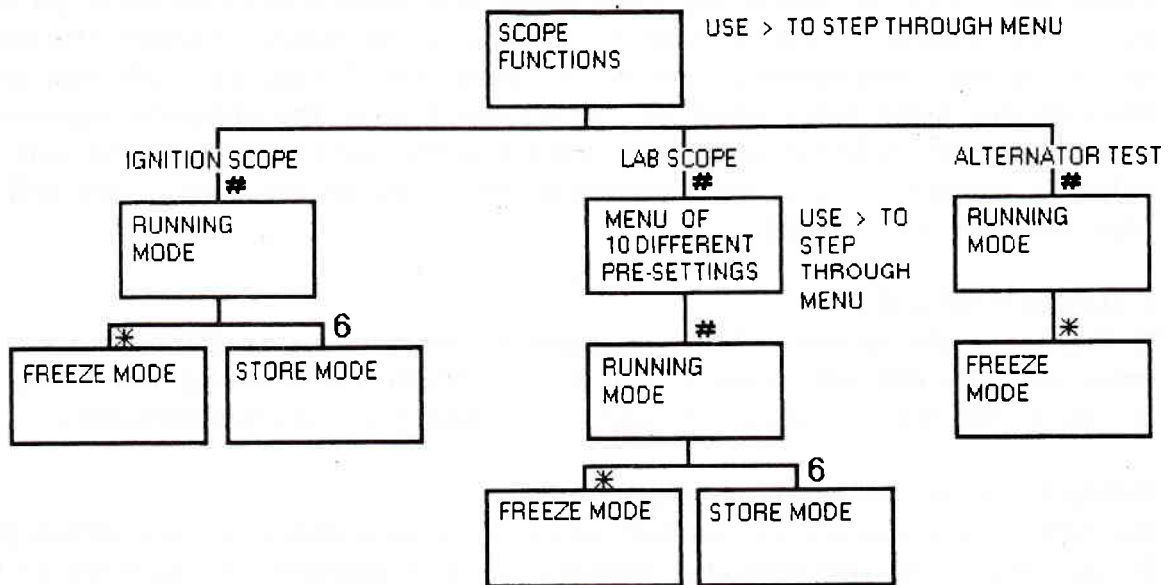
```
SCOPE FUNCTIONS
KEY DEFINITIONS
FREEZE MODE
1 CURSOR 1
2 CURSOR 2
3 GRID
4/5 CURSORS MOVEMENT
7 CURSORS OUT
8 CURSOR VALUES IN/OUT
9 GASSES IN/OUT
# RUNNING MODE
PRESS P TO RETURN

Ignition scope
Key Definitions
```

The scope functions page is a menu it has three options :

1. IGNITION SCOPE
2. LABSCOPE
3. ALTERNATOR TEST

CHART 4



1. IGNITION SCOPE

When you select ignition scope, the tester will go to the running mode of the ignition scope. Several settings of the running mode can be changed by the keys on the remote control.

SCALE

With the 1 key you can step down through the horizontal scales, with the 2 key you can step up. You can also use the ms key to step through the horizontal scales. There are three different horizontal scale settings :

Parade : This shows the cylinder patterns of all cylinders on one screen.

5 ms : This shows 5 milli seconds of one cylinder pattern, it is also possible to let the scope swap to the next cylinder every few seconds (cylinder swap rate).

100 % : This shows 100% of one cylinder pattern, it is also possible to let the scope swap to the next cylinder every few seconds (see cylinder swap rate).

With the 4 key you can step down through the vertical scales, with the 5 key you can step up. You can also use the V/kV key to step through the vertical scales. On the vertical scale the voltage level is shown, there are four voltage scales for the primary ignition scope and four scales for the secondary ignition scope.

CYLINDER SWAP RATE

The 5 ms scale and the 100% scale show the pattern of one cylinder. If you press the 7 key, or the 8 key, the scope will show a next cylinder pattern every few seconds. The cylinder swap rate is the speed in which the scope will go to the next cylinder. When you press the 7 key, you will slow down the cylinder swap rate, when you press the 8 key, the opposite happens. There are four cylinder exchange rates and the continuous view of one cylinder pattern. If you keep pressing the 7 key or the 8 key, you will step through all 5 modes.

CYLINDER SELECT

If the scope shows one cylinder pattern continuously (see cylinder swap rate) you can manually step to the next cylinder by pressing the > key. If you press the +/- key, the scope will show the previous cylinder.

PRIMARY / SECONDARY SELECT

Normally the scope shows the secondary ignition pattern. If you press the 3 key, the scope will show the primary ignition pattern. To go back to the secondary ignition pattern, you have to press the 3 key again. You can also use the V button to select the primary ignition pattern and the kV button to select the secondary ignition pattern.

PATTERN STORE

If you press the 6 key, the scope will put the last 32 waveforms into the memory. To look at (recall) the saved patterns, you have to press the * key. With the > key, you can step forward through the saved patterns and with the +/- key, you can step backwards through the saved patterns. When you are in this recall mode, it is possible to use the cursor measurement facility. The cursor measurement facility will be described later.

EXHAUST GAS DISPLAY

When you press the 9 key, the four exhaust gas data readings will show in upper right section of the scope. To cancel the exhaust gas data display, you have to press the 9 key again.

FREEZE

To freeze any waveform, you have to press the * key. To release freeze you have to press the enter key. In the freeze mode the keys have different functions. (see freeze mode key definitions).

CURSOR MEASUREMENT

In the freeze mode, you can make use of two cursors, these cursors are vertical lines on the scope. If you press the 1 key, the first cursor will be placed and activated if you press the 2 key, the second cursor will be placed and activated. With the 4 key, you can move a cursor to the left and with the 5 key, you can move a cursor to the right. If you press the 8 key, the scope will show :

- the voltage levels at the place of the cursors
- the difference in the voltage level, of cursor 1 and 2
- the time span between the cursors in ms or % (depending on the used scale).

To remove this data from the screen, you have to press the 8 key again.
To remove the cursors from the screen, you have to press the 7 key.

OSCILLOSCOPE GRID

If you press the 3 key, you will place a grid on the screen which can be helpful to quickly check duty cycles etc. To remove the grid you have to press the 3 key again.

EXHAUST GAS DISPLAY

In the freeze mode it is also possible to display the exhaust gas values. (9 key).

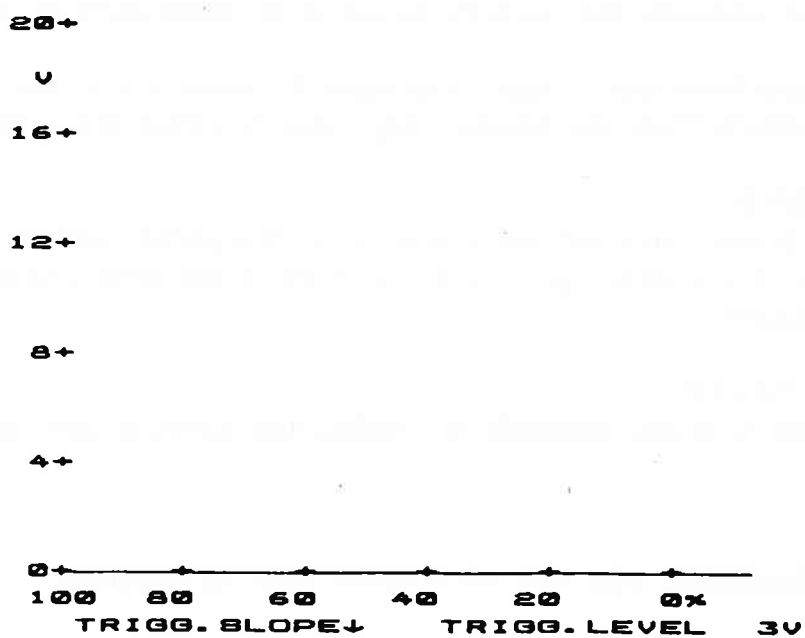
2. LABSCOPE

When you select labscope, you will get a menu with 10 different pre-settings.

- STANDARD SETTING
- DUTY CYCLE
- INJECTOR
- IDLE MIXTURE CONTROL
- INTEGRATOR VOLTAGE
- LAMBDA SENSOR
- AIR FLOW SENSOR
- INDUCTIVE SENSOR
- HALL EFFECT SENSOR
- CRANKSH. POSITION SENSOR

The following figures give an example of each signal, but please keep in mind that the signals can vary in voltage, frequency and cycle time, this depends on the type and operating conditions of the component under test. If you select an option other than standard, the scope settings are already adjusted to the signal which must be measured. However, it is still possible to change the settings. You can change the settings, just as you did for the ignition scope. For the lab scope, you can also select a trigger mode and change the trigger level.

LAB SCOPE RPM : 847



FREQ. HZ : 0.0
 RPM : 0
 VOL. %CO : *
 PPM HC : *
 VOL. %CO2 : *
 VOL. %O2 : *
 LAMBDA : *
 AFR : *

Figure 2, Labscope Standard Setting

LAB SCOPE FREQ. HZ : 99.5
RPM : 854

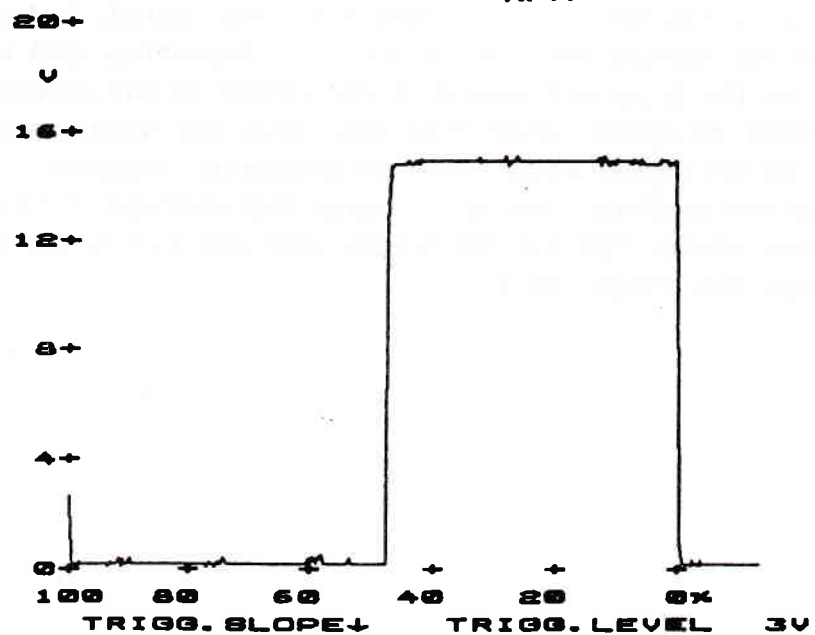


Figure 3, Labscope Duty Cycle

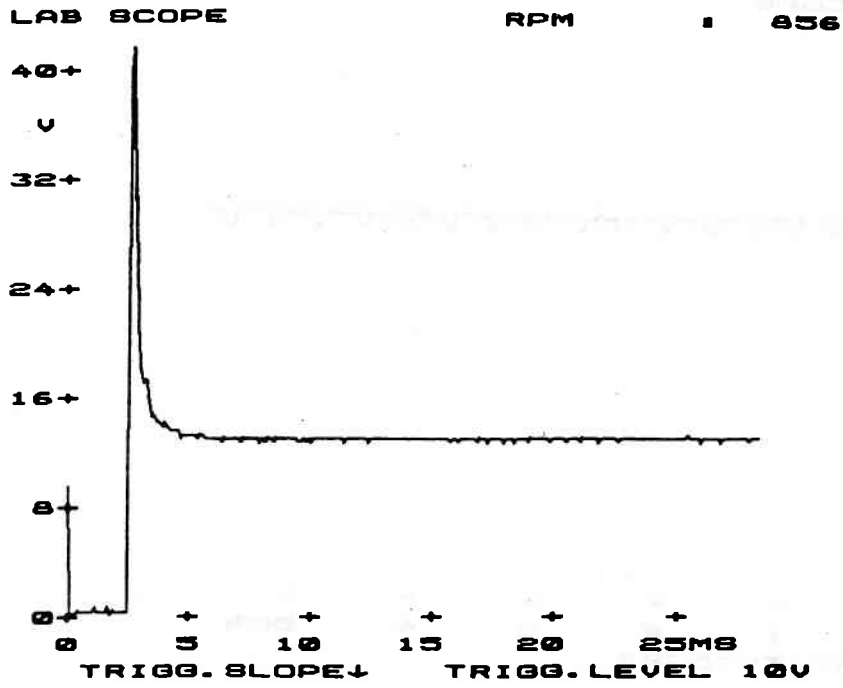


Figure 4, Labscope Injector

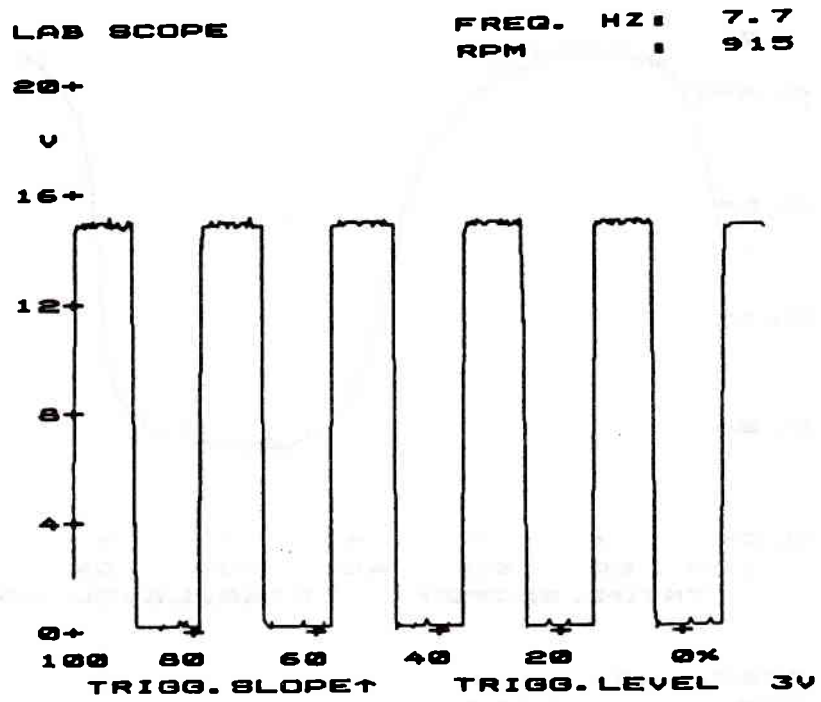


Figure 5, Labscope Idle Speed Control

LAB SCOPE

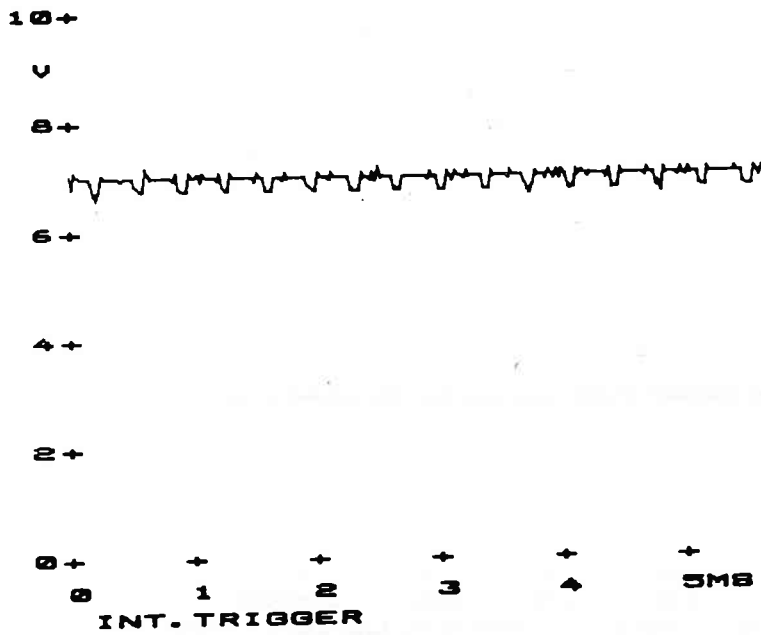
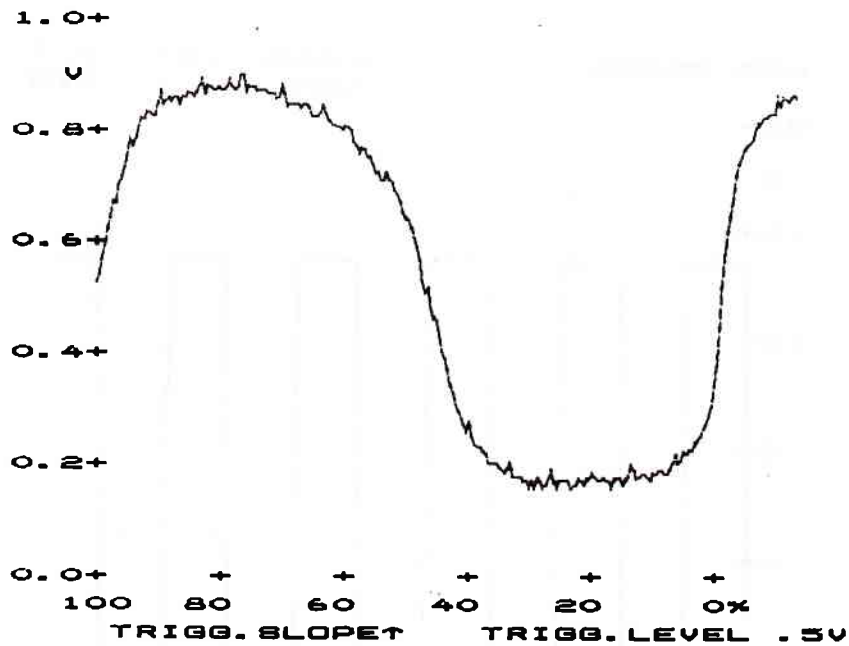


Figure 6, Labscope Integrator Voltage

LAB SCOPE



FREQ. HZ: 1.1
RPM: 1983

Figure 7, Lambda Sensor

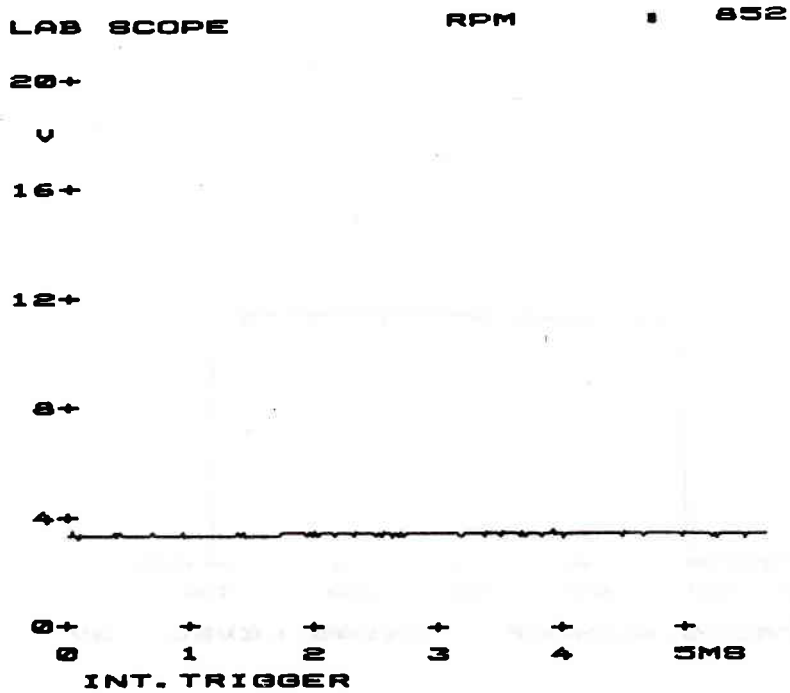


Figure 8, Labscope Air Flow Sensor

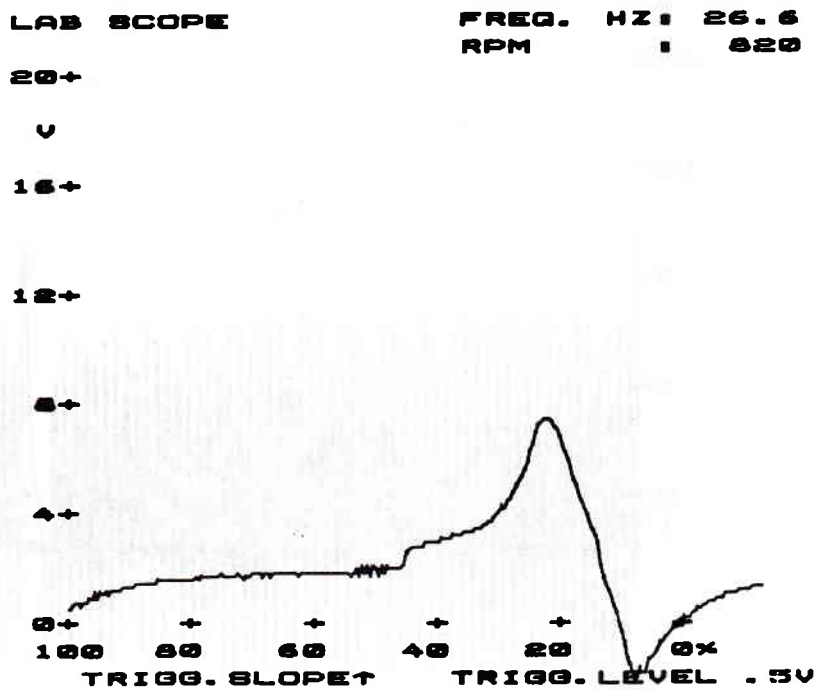


Figure 9, Labscope Inductive Sensor

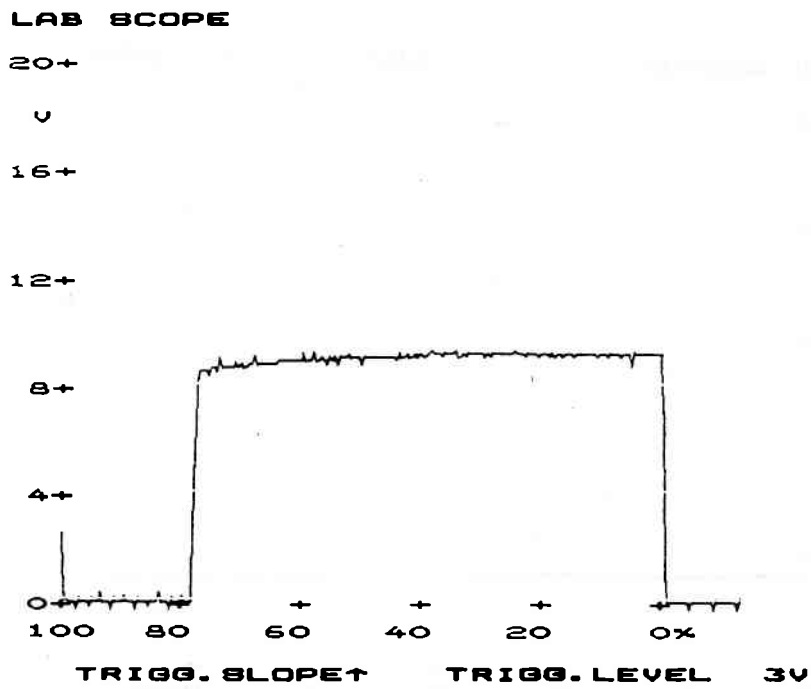


Figure 10, Labscope Hall Effect Sensor

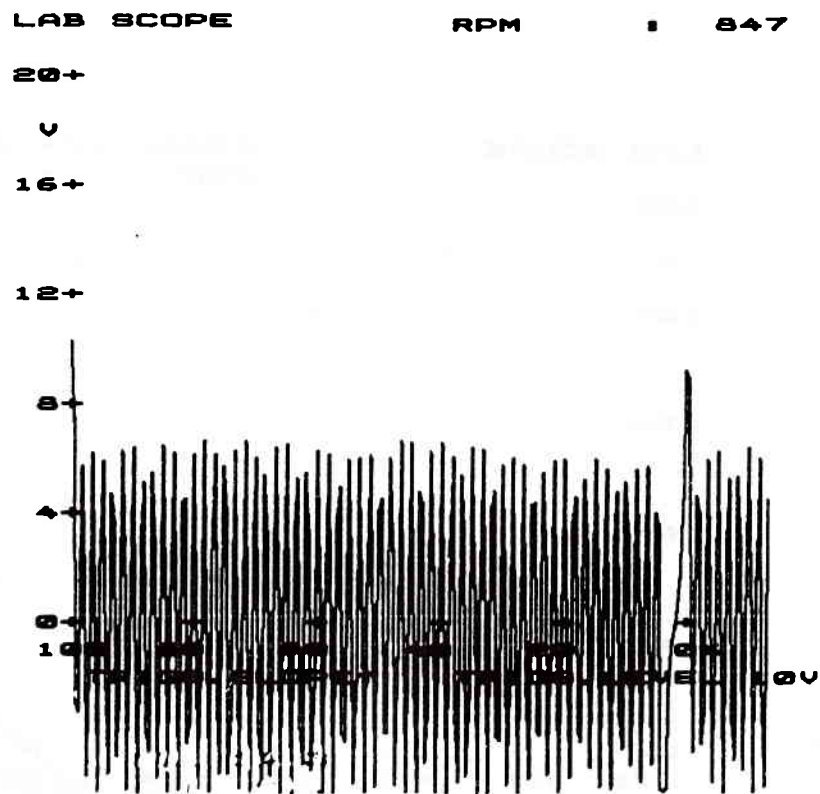


Figure 11, Labscope Crankshaft Position Sensor

TRIGGER MODES

There are four trigger modes:

- rising slope
- falling slope
- engine
- internal

When rising slope is selected, the scope will start writing the waveform when the voltage of the signal increases. When falling slope is selected, the scope will start writing the waveform when the voltage of the signal decreases. With the engine trigger selected, the scope will start to write the waveform when the tester receives a signal from the first cylinder (red clamp).

The internal trigger will write a signal continuously on the screen. You can step up through the trigger modes with the 7 key and step down with the 8 key.

TRIGGER LEVEL

For the rising slope and the falling slope you can set a trigger level, this determines at which voltage the waveform will start. There are 4 trigger levels :

- 0,5V
- 3V
- 10V
- 20V

You can step up through the trigger level with the > key and step down with the +/- key.

LABSCOPE SCALES

The horizontal scales for the labscope are :

- 100 % to 0 %
- 500 ms to 0 ms
- 100 ms to 0 ms
- 25 ms to 0 ms
- 5 ms to 0 ms

The vertical scales for the labscope are :

- 0 V to 40 V
- 0 V to 20 V
- 0 V to 10 V
- 0 V to 5 V
- 0 V to 2 V
- 0 V to 1 V

3. ALTERNATOR

If you select alternator test, all scales are fixed. Figure 12 will show some typical alternator waveforms.

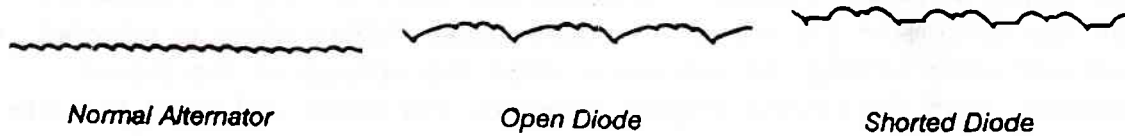


Figure 12, Alternator waveforms

PRINTER FUNCTIONS

If you select printer functions, the screen shows the customer message and below this the date, time, job number and odometer miles are displayed. You can edit these last 4 items with the > key, the +/- key or the numbers 0 to 9.

If you do not need to edit these items, you can just keep pressing the enter # key to go through this page. After this page the following menu shows.

```
TITLE PAGE
TECH. REPORT:      SINGLE TEST
                   FULL TEST
                   BASIC ADJUSTMENT
CUSTOMER REPORT:  SINGLE TEST
                   FULL TEST
                   BASIC ADJUSTMENT
LIMIT DATA
```

You can move the cursor with the > key, and select an item with the enter # key.

TITLE PAGE

If you only print the title page, the customer message, the date, time, job number, and odometer miles, furthermore some data of the vehicle under test will be printed. (see figure 13).

```

=====
WELL EQUIPPED GARAGE PLC
2000 SUN WAY
UPYOUR STREET
NEAR PERFECT
MCS 2000

ALL CARS CATERED FOR

DATE:           01/01/90
JOB NUMBER:     MISC 1234
ODOMETER MILES: 10234
=====

```

VEHICLE UNDER TEST

```

=====
SUN CODE NUMBER: 18500122
MANUFACTURER:   FORD
MODEL NAME:     SIERRA/SAPPHIRE
NUMBER OF CYLINDERS: 4
LIMITS VALID FROM: 02.87->>
IGNITION TYPE:  TRANSISTORISED
FUEL SYSTEM TYPE: CARBURETTOR
=====

```

Figure 13, Title Page

TECHN. REPORT SINGLE TEST

If you choose single test, the tester will show a menu of all tests. (see figure 14). If you select one of the tests, the data of this test together with the limit data and the diagnosis will be printed. (see figure 15).

```

          WORKSHOP TEST

IGNITION ON TEST
STARTING SYSTEM TEST
>CHARGING SYSTEM TEST
IGNITION DWELL TEST
TIMING / ADVANCE TEST
IDLE EMISSIONS TEST
LOW SPEED SECONDARY KV TEST
HIGH SPEED SECONDARY KV TEST
SNAP ACCELERATION TEST
CYLINDER COMPARISON TEST

MOVE CURSOR WITH > OR +/- KEYS
TO ENTER PRESS #           MENU:P

```

Figure 14, Workshop Test Menu

CHARGING SYSTEM TEST

TEST DATA		DIAGNOSIS
		Test result: No problems found.
ENGINE	RPM 3095=	
BATTERY	VOLTS 13.5=	
CURRENT	AMPS 6.7=	
ALT. RIPPLE	% 0.2=	
OIL TEMPERATURE	°C 80=	
LIMIT DATA		MIN./ MAX.
ENGINE SPEED	RPM 2800/ 3200	
CHARGING VOLTAGE	V 12.4/ 14.5	
CHARGING CURRENT	A 1.0/ 15.0	
ALTERNATOR RIPPLE	% 0.0/ 3.0	
OIL TEMPERATURE	°C 20/ 115	

Figure 15, Typical Diagnostic Report

TECHN. REPORT: FULL TEST

If you select full test, the title page, and from all the tests, the test data, limit data and the diagnosis will be printed. (see figure 15).

TECHN. REPORT: BASIC ADJUSTMENT

If you select basic adjustment, the title page, and from the basic adjustment test the test data, the limit data, and the diagnosis will be printed (see figure 16).

CUSTOMER REPORT

The customer report selections are the same as the technical reports but it does not print the limit data. The test data only tells what has been tested. In the diagnosis there are no instructions to correct a possible defect. (see figure 17).

LEADS CONNECT CHECK

If you select leads connect test, the tester does this test as described previously (page 14) and then returns to the "vehicle test selection" menu.

TEST DATA		DIAGNOSIS	
ENGINE TIMING SPEED	RPM 810=	CO reading:	high!
DWELL	° 19.8=	HC reading:	high!
INITIAL TIMING	° 12.0=	Probable cause:	
		-incorrect idle mixture setting	
		Set emissions to specifications	
		and adjust idle speed; repeat	
		test.	
ENGINE IDLE SPEED	RPM 815=	End of Diagnostic Messages.	
CO	% 2.34=		
HC	PPM 594=		
CO2	% 14.4=		
O2	% 1.4=		
LAMBDA CALCULATED	0.97=		
AIR FUEL RATIO	:1 14.2=		
OIL TEMPERATURE	°C 89=		
LIMIT DATA		MIN./ MAX.	
OIL TEMPERATURE	°C 80/ 115		
TIMING WINDOW			
ENGINE SPEED	RPM 700/ 900		
IGNITION DWELL	° 10.0/ 45.0		
TIMING ADVANCE	° 11.0/ 13.0		
EMISSIONS WINDOW			
ENGINE SPEED	RPM 850/ 950		
HYDROCARBONS	PPM 100/ 300		
CARBON MONOXIDE	% 1.5/ 2.0		
CARBON DIOXIDE	% 10.0/ 15.0		
OXYGEN	% 0.0/ 2.0		
LAMBDA CALC.	0.95/ 1.15		

Figure 16, Basic Adjustment Report (Technician)

TEST DATA	DIAGNOSIS
THIS TEST CHECKS:	CO reading: high!
- BASIC DWELL SETTING	HC reading: high!
- BASIC TIMING SETTING	
- IDLE SPEED SETTING	Probable cause:
- IDLE MIXTURE (CO) SETTING	-incorrect idle mixture setting

Figure 17, Basic Adjustment Report (Customer)

3.3 DATA PRESENTATION

When a standard limits disk or a make specific limits disk is used, the tester will show whether the measured data is within limits, it uses three signs for this purpose.

An arrow pointing up means that the measured value is higher than the specified value. This sign is placed after the test data.

An arrow pointing down means that the measured value is lower than the specified value.

An equal sign = means that the measured value is within the specification.

Some data is shown as a bargraph the specified value for this data is between the arrows > < . Bargraphs are placed on top of a test page and is labelled with, for instance RPM or VOLTS see figure 18.

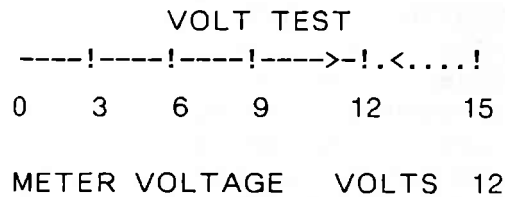


Figure 18, Bargraph

REMOTE CONTROL, KEY DEFINITIONS

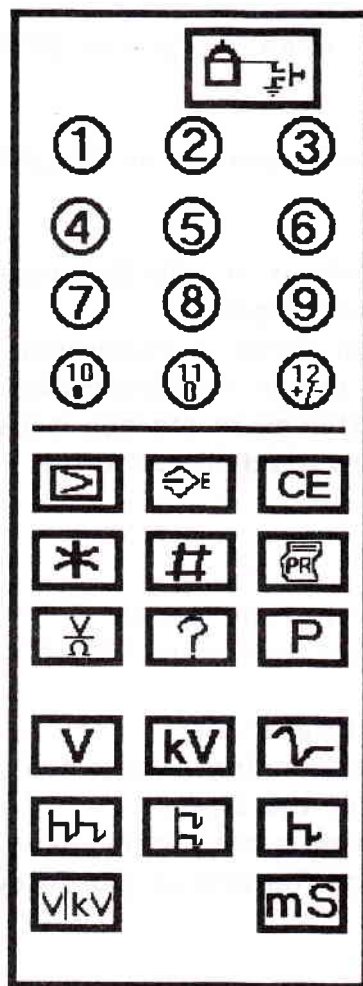


Figure 19, Remote control



- Go to next item in menu pages.
- Go to next cylinder in the running mode of the ignition scope.
- Display next saved pattern in the storage modes of the scope.
- Toggle trigger level up in the running mode of the lab scope.
- Step (up) through character table in data entry pages.
- Toggle between volt and ohm in multimeter 3.



- Go to SDL/STL when you are in MCS mode.



- Back to MCS when you are in SDL/STL mode.



- Go to second column in selection pages.
- Save data in test pages.
- Select fixed ohm range in multimeter 3.
- Freeze pattern in the running modes of the scope.
- Save last 32 patterns in storage mode.
- Go to next entry field in job entry page and customer message page.



- Enter selection in menu pages.
- Proceed with test, when the tester has given you an instruction.
- Go to next multimeter test.
- Go to the scope running mode when you are in the freeze or memory modes of the scope.
- Go to next line of a data entry page.
- Exit and save at the end of job entry page and customer message page.



- Print screen. (press only a short time).
- To give a form feed, hold this key until paper moves and then release it.



- Go to multimeter 1 in menu and test pages.
- Toggle between ohm and volt in multimeter 3.



- Gives help pages. (press again for more help pages).



- Abort or go to menu.
- Skip warm-up in tester warm-up page. (15 minutes with a gas bench 2 minutes without a gas bench).



- Select primary pattern in ignition scope.



- Select secondary pattern in ignition scope.



- Go to ignition scope from any test page.
- Go to lab scope from ignition scope.
- Go to alternator scope from lab scope.



- Select parade display in ignition scope.



- In ignition scope, select a 100% pattern, swapping each cylinder.



- In ignition scope, select a 100% pattern of one cylinder at the time.



- Step through Y scales in the running mode of the ignition and labscope.



- Step through X scales in the running mode of the ignition and labscope.



- Go to vehicle testing menu.



- Go to key definition page.
- Clear line in customer message entry.

12
+/-

- Go to previous item in menu pages.
- Repeat test.
- Select auto ohm range in multimeter 3.
- Select previous cylinder in ignition scope.
- Display previous pattern in scope memory modes.
- Step (down) through trigger levels in labscope.
- Step (down) through character table in data entry pages.

1

- Go to next menu in menu pages.
- Exit key definition, help, vehicle summary and limits page.
- Go to next test page (if available) in test pages and multimeter pages.
- Go to next page of an instruction.
- Activate cursor 1 in ignition and labscope freeze and memory modes.
- Enter number in data entry pages.
- Step through X scales in the running mode of ignition and labscope.

2

- Gives help pages. (press again for more help pages).
- Activate cursor 2 in ignition and labscope freeze and memory modes.
- Enter number in data entry pages.
- Step through X scales in the running mode of ignition and labscope.

3

- Go to vehicle description. (press again for more pages).
- Toggle grid in/out in ignition and labscope freeze and memory modes.
- Toggle grid in/out in labscope running mode.
- Enter number in data entry pages.
- Toggle primary / secondary in the running mode of the ignition scope.

4

- Go to limits page from tests (press again for more limits pages).
- Move selected cursor to the left in the freeze and memory modes of the ignition scope and the labscope.
- Enter number in data entry pages.
- Step up through Y scales in the running mode of ignition and labscope.


- ⑤
 - Go to diagnostics page from test and multimeter pages.
 - Press again for more diagnostics pages.
 - Move selected cursor to the right in the freeze and memory modes of the ignition scope and the labscope.
 - Enter number in data entry pages.
 - Step down through Y scales in the running mode of ignition and labscope.

- ⑥
 - Go to storage mode in scope running modes.
 - Enter number in data entry pages.

- ⑦
 - Step (up) through cylinder swap rates in the running mode of the ignition scope.
 - Step through trigger modes in the running mode of the lab scope.
 - Enter number in data entry pages.

- ⑧
 - Step (down) through cylinder swap rates in the running mode of the ignition scope.
 - Toggle cursor values in/out in the freeze and memory modes of the ignition scope and the labscope.
 - Enter number in data entry pages.

- ⑨
 - Toggle gases in/out in all scope modes except the store modes.
 - Enter number in data entry pages.

-  - Engine kill key.

Faint, illegible text at the top of the page, possibly bleed-through from the reverse side.

Second section of faint, illegible text.

Third section of faint, illegible text.

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Fourth section of faint, illegible text.

PRINTER OPERATION

GENERAL DESCRIPTION

An option is available to connect a printer (182-E) to the MCS2000SL. Sun personnel will install and set-up the printer. The printer uses $9\frac{1}{2}$ " x 11" fan folded print paper (p/n 0528-0994). It is also possible to use $9\frac{1}{2}$ " x 12" fan folded print paper. To use this paper you must select another paper length on the printer. (refer to page 44). The paper is in a storage compartment under the printer and it is fed into the printer from underneath. The ribbon cartridge (p/n 0528-0995) is easy to replace. (refer to page 45).

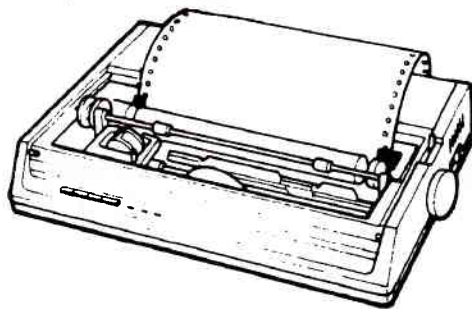



Figure 20, Printer

PRINTER CONTROLS

The  PRINT button on the MCS2000SL remote control, controls the printer. Do not use the push buttons on the printer, this can cause improper operation of the printer.

The power ON/OFF switch

Normally the power supply is controlled by the MCS2000SL. If you are loading paper you can switch off the power for the printer separately with the power ON/OFF switch. (see figure 21).

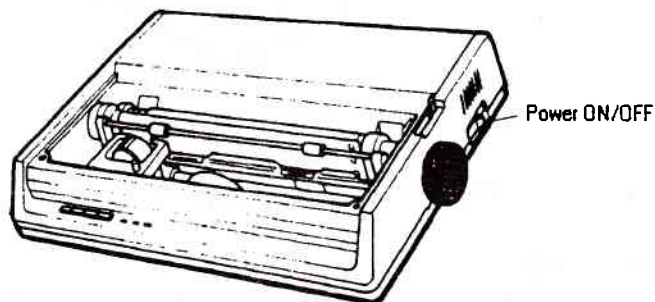


Figure 21, Power ON/OFF switch

PAPER RELEASE LEVER

When you use perforated fan folded paper, the paper release lever must be in the forward position. (see figure 22).

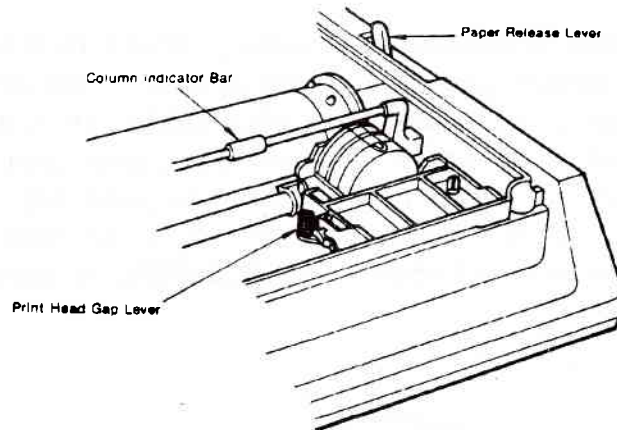


Figure 22, Paper release lever

ADJUSTMENT LEVER

The adjustment levers are located at the edges of the platen. (see figure 23). You can slide the adjustment levers to the unlocked position to adjust the pin feed width. The pin feed width must always be set to $9\frac{1}{2}$ ".

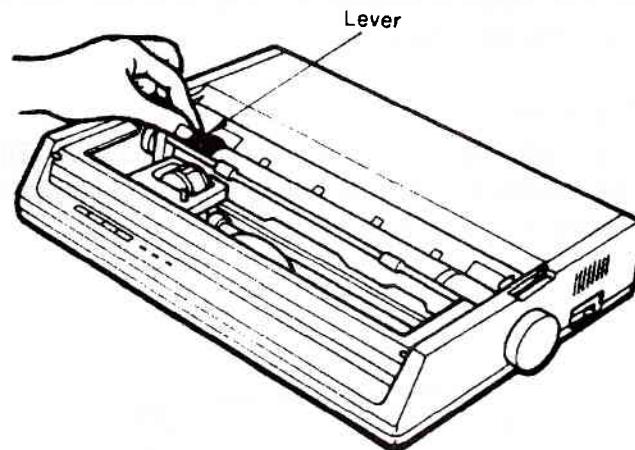


Figure 23, adjustment lever

PRINTHEAD GAP LEVER

With the printhead gap lever, you can adjust the gap to the thickness of the paper. (see figure 22). For normal paper the lever must be in position nr 1.

BAIL LEVER

The bail lever is connected to the column indicator. When you load the paper the column indicator must be lifted.

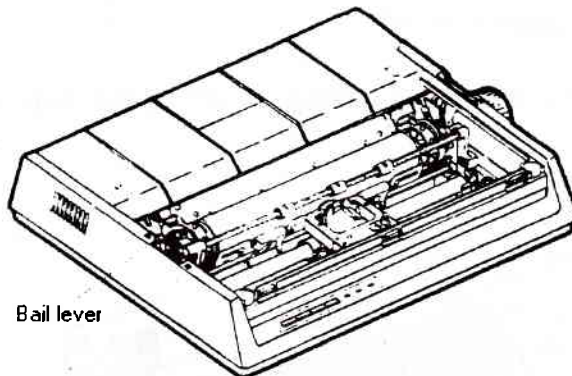


Figure 24, Bail lever

PRINTER INDICATOR LIGHTS

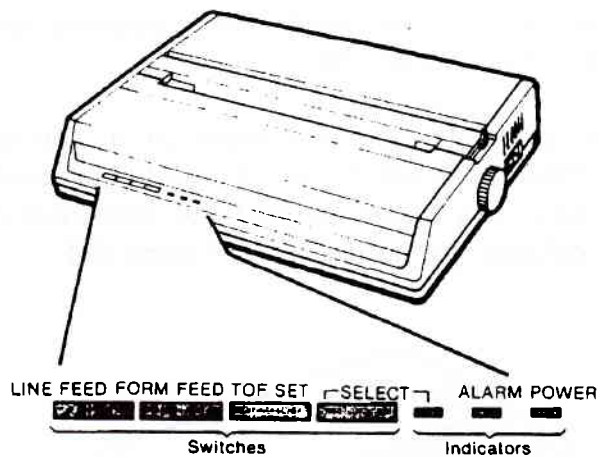


Figure 25, Indicators

POWER INDICATOR LIGHT

The power indicator light is on when the printer receives power.

ALARM INDICATOR LIGHT

The alarm indicator light is on when the printer is out of paper or when the paper is jammed. The printer stops until the paper is reinstalled.

SEL INDICATOR LIGHT

The Sel indicator light is on when the printer communicates with the MCS2000SL. This indicator light should always be on.

PAPER LOADING

1. Place a stack of paper in the paper compartment under the printer.
2. Set the POWER switch to OFF. (see figure 21) (the platen turns smooth when the power is off).
3. Remove the access cover by lifting it off. (see figure 26).

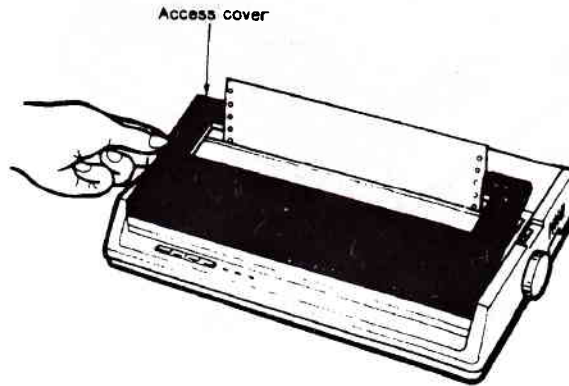


Figure 26, Access cover

4. Make sure the paper lever is in the forward position and lift the column indicator bar. (see figure 22).
5. Take the first sheet of the paper and insert it in the bottom of the printer. Place the first sprocket holes in the paper over two aligned sprocket pins and turn the platen knob until one inch of paper appears above the column indicator. (see figure 27).

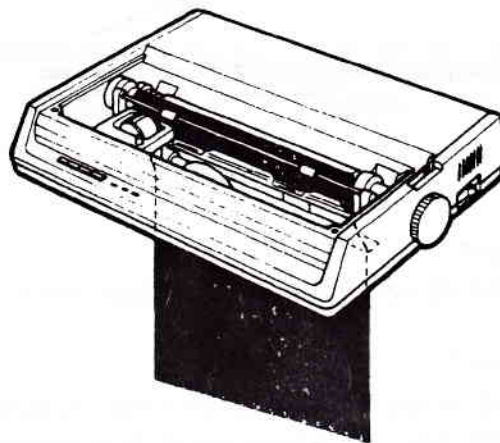


Figure 27, Insert paper

6. Move the column indicator back onto the platen, so that the rollers rest on the paper you just inserted.
7. Install the access cover
 - a. Insert the three tabs under the front edge of the access cover into the holes on the top front of the printer. (see figure 28).
 - b. Lower the access cover onto the printer. (see figure 26).

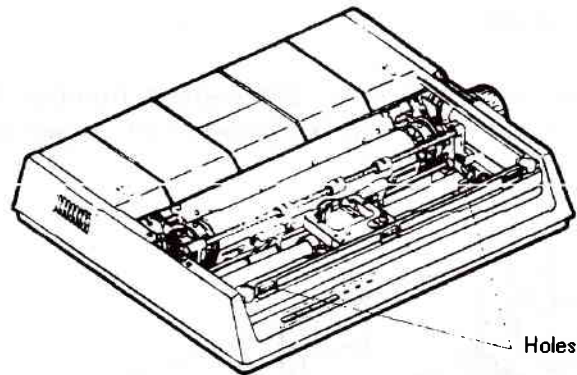


Figure 28, Holes

8. Use the PLATEN knob (see figure 29) until the first perforation between two pages is at the tear off edge of the access cover.

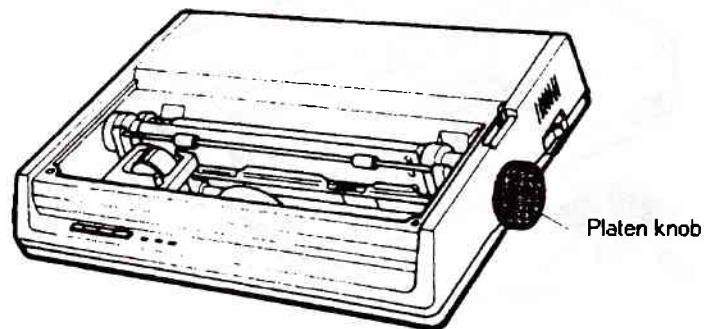


Figure 29, Platen knob

9. Set the POWER switch to ON.

SELECT OTHER PAGE LENGTH

1. Set switch 3 (see figure 1 on page 2) of the MCS2000SL to 0.
2. Remove the paper from the printer (turn the PLATEN knob counterclockwise).
3. Remove the switch cover from the printer. (see figure 20).
 - a. Remove the screw.
 - b. Lift of the cover.
4. With a ballpoint pen or toothpick, set switch number 5 to OFF to select 11" paper length or set it to ON to select 12" paper length.

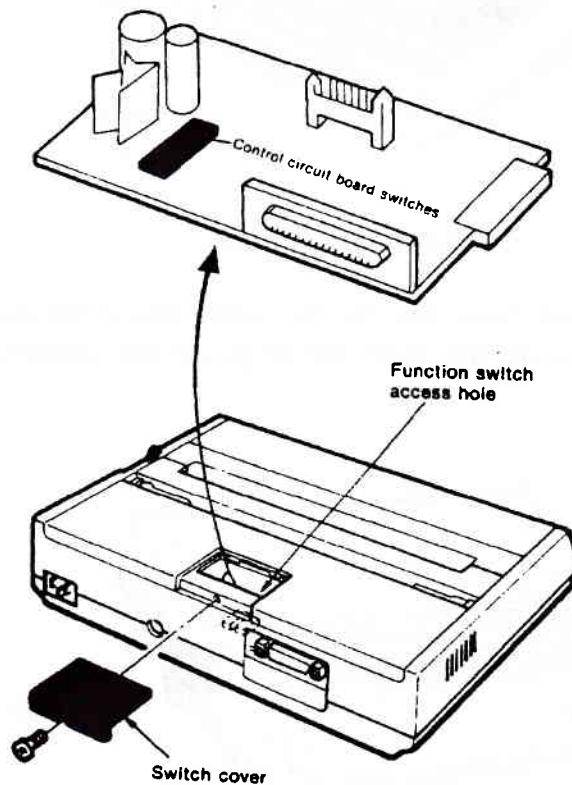


Figure 20, Switch cover

5. Install the switch cover on the printer. (see figure 20).
 - a. Place the cover on the printer.
 - b. Install the screw.
6. Reinstall the paper. (see paper loading on page 42).

PRINTER MAINTENANCE

RIBBON CARTRIDGE REPLACEMENT

Note : Only use genuine oki replacement printer ribbons. (P/n: 0528-0995). Inferior quality ribbons are prone to shredding which can cause severe damage to the print-head. Also, using an inferior quality ribbon invalidates the warranty of the printer.

1. Set the printer's POWER switch to OFF (power indicator light off).
2. Remove the printer access cover. (see figure 26).
3. Gently slide the printhead to the middle of the printer. (see figure 31).

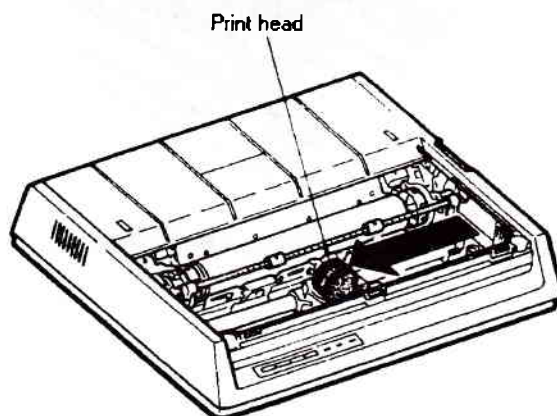


Figure 31, Printhead position

4. Grasp the old ribbon cartridge at both sides off the printhead and lift it up. (see figure 31).
5. Install a new ribbon cartridge
 - a. Tilt the ribbon cartridge as shown on figure 32.
 - b. Place the ribbon cartridge in the cartridge holder.
 - c. Push the front of the ribbon cartridge holder down until it snaps into place.
6. Set the printhead gap lever on the printhead to the number 1 position. (see figure 22).
7. Install the access cover
 - a. Insert the three tabs under the front edge of the access cover into the holes on the top front of the printer.
 - b. Lower the access cover onto the printer.

8. Set the POWER switch on the printer to ON.

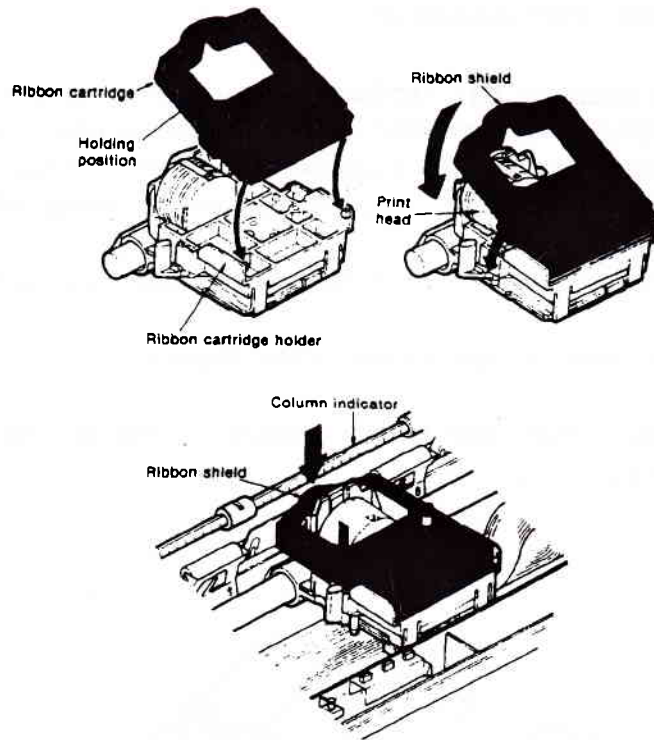


Figure 32, Ribbon cartridge

ROUTINE MAINTENANCE

Caution

1. Do not use a compressed air supply to clean the printer. The force of compressed air will damage the mechanical construction of the printer.
2. Do not apply any lubricants to the printer. It will accumulate dust.

At least once a month or after 300 hours of operation the printer should be cleaned. To ensure a trouble-free operation clean the printer as follows.

1. Set the printer's POWER switch to OFF.
2. Remove the paper from the printer (turn the PLATEN knob counterclockwise).
3. Remove the printer access cover.
4. Remove any loose paper-particles or other debris. Dust the area around the carriage shaft, platen and paper sensor with a clean and dry soft cloth.
5. Carefully vacuum the carriage shaft and paper feeding areas with a nozzle attachment of a vacuum cleaner.
6. Reload the paper. (see paper loading).
7. Set the printer's POWER switch to ON.

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TEST PREPARATION

WARNINGS

1. Before you switch on the tester, make sure that the power cord is plugged in a proper power outlet. (See serial number plate on the rear of the tester for power requirements). A too high voltage can damage the tester and make it unsafe.
2. Plug the mains lead in a socket outlet with a protective earth contact. If the tester is not connected to earth, dangerous voltages can be present on the casing of the tester.
3. Do not use the tester when:
 - it is warmer than 40 °C
 - it is colder than 5 °C
 - the relative humidity is higher than 80 %

When the tester is used outside of these operating limits its functionality may decrease. At temperatures lower than -10°C the tester may become unsafe.

4. Do not operate the tester before you contact your Sun service centre, when the tester:
 - shows visible damage
 - fails to perform the intended measurements
 - has been subjected to prolonged storage under unfavourable conditions
 - has been subjected to severe transportation stresses.

It is possible that these conditions can make the tester unsafe.

5. Do not make connections to a vehicle before the mains lead of the tester is connected to the proper socket outlet. Do not disconnect the mains lead before you disconnect the connections to the vehicle. If the tester is not connected to earth, dangerous voltages can be present on the casing of the tester.

TESTER SET-UP

1. Plug the tester's power cord into the proper mains outlet. See the serial number plate on the back of the tester for power requirements.
2. Insert the MCS system disk V5.1x in the left disk drive. (see figure 1 item 6 on page 2). (right disk drive is for SDL/STL OPTION). The arrow on the disk must point towards the drive.

3. Connect Volt/Ohm lead clips together and ensure that the test leads and the vacuum hose are not connected to the engine.
4. Switch on the tester with the switches 3 and 4. (see page 2). The tester will show several VDU pages (see chart 1 on page 10) and will eventually show the "program selection page". If an error occurs, it will be displayed on the VDU.
5. With switch 2 you can switch off the pump, the pump will switch it self on whenever it is required for measurements (in this case you have to wait until the flow stabilizes).

CAUTION

Keep the test leads away from moving or hot engine parts. The test leads can not withstand high temperatures or severe mechanical stress.

6. Make sure the engine to be tested is off and connect the testleads according to the table on page 51. (see also the illustration on the front of the tester.

Note: If the vehicle does not have a mag probe, or the magnetic timing option is not installed, check the timing with the timing light. Clean the crankshaft pulley and timing mark. Use a piece of chalk or white touch-up paint to identify the pointer on the pulley and the zero line. Turn the timing advance knob on the timing light fully counter-clockwise (off) until it clicks. Place the on/off button in the off position. (white dot out).

CONNECTIONS	FUNCTION
OIL TEMPERATURE PROBE : Set end stop to length of dipstick and insert into crankcase through dipstick hole.	To measure oil temperature in crankcase.
RED TRIGGER PICK-UP : Clamp on No. 1 cylinder spark plug lead as near to the distributor as possible.	To provide signal for cylinder identification, timing light and DIGI-scope.
VACUUM HOSE : Connect to a source of engine vacuum.	To measure Engine Vacuum.
EXHAUST SAMPLE PROBE : Insert at least 30 cm into vehicle tailpipe (option).	To provide sample of Exhaust Gas to Gas Analyser. (Option).
VOLT/OHM TEST LEADS	Used for Pinpoint testing, LAB-scope and ALTERNATOR scope functions.
CHROME SECONDARY PICK-UP : Clamp on coil high-tension lead.	To measure Secondary Voltages and Durations.
RED CLIP : Connect to the positive (+) terminal of the battery.	To measure Battery Voltage and Alternator Ripple.
BLACK CLIP : Connect to the negative (-) terminal of the battery.	To measure Battery Voltage.
GREEN CLIP : Connect to the negative or Circuit Breaker terminal of ignition coil (KL1).	To measure Dwell, provide a trigger for RPM, input signal for DIGI-scope and to enable Cylinder Shorting for Power Balance Testing.
YELLOW CLIP : Positive or SW terminal of the ignition coil (KL15).	To measure Coil Voltage and to enable Cylinder Shorting for Power Balance Testing.
MAGNETIC TIMING PICK-UP	To measure timing on vehicles with Magnetic Timing Facility. (Option)
GREEN AMMETER PICK-UP : Clamp around all negative battery cables with arrow pointing away from battery.	To measure Starter Current, Amps per Cylinder and Current Flow.
DIESEL TEST LEAD : (Option) - Black : engine ground. - White : Piezo transducer clipped to No. 1 injector pipe.	To measure RPM and Start of Fuel Delivery.

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TESTING

Key functions during testing.

During testing, the following keys have some useful functions.

- 0 Go to key definitions page.
- 1 Go to next test page. (if available).
- 2 Go to help page.
- 3 Go to vehicle description page.
- 4 Go to limit data page. (if available).
- 5 Go to diagnostic results page.
- p To exit.
- * To save test data.
- +/_ To repeat current test.
- # To proceed. (at end go to next test).

The following procedures give the same instructions as the MCS2000SL program does. But it will also give some useful tips and extra information. Therefore it can be useful to use these procedures the first time you work with the MCS2000SL.

IGNITION ON TEST

1. Enter the "IGNITION ON TEST" from the "WORKSHOP TEST SELECTION" menu. (see chart 2 on page 12).
2. Switch off all current consumers, such as heated screens, radios and carphones etc (as instructed on the screen). When ready, switch on the ignition and press the enter # key.
3. When the readings are stabilised press the * key.

STARTING SYSTEM TEST

1. Enter the "STARTING SYSTEM TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Switch off all current consumers, such as heated screens, radios and carphones etc and press the enter # key. (as instructed on the screen).
3. Crank the engine without interruption until the engine starts, normally about 10 seconds. If the engine will not start, crank the engine until the screen shows "Test data Saved" on the top screen line.

CHARGING SYSTEM TEST

1. Enter the "CHARGING SYSTEM TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Switch on current consumers, it is usually sufficient to switch on the heated rear screen and the headlights.
3. Bring the engine RPM within the specified RPM (this is between the arrows > < which are shown in the graph on top of the screen) and press the * key.
4. Return to idle speed.
5. Switch off the current consumers which were switched on in step 1.

note : If the * key is continuously pressed and the engine throttle opened and released to pass through the specified RPM range, the results will be saved on screen.

IGNITION DWELL TEST

1. Enter the "IGNITION DWELL TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Bring the engine RPM within the specified RPM (this is between the arrows > < which are shown in the graph on top of the screen) and press the * key.
3. Bring the engine RPM within the new specified RPM and press the * key.

IGNITION TIMING TEST

This procedure is generalised and the steps may vary slightly according to specification and depending on the vehicle presented for test. The screen will always prompt you to conduct this test in the correct sequence. The analyzer normally instructs you to press the timing light button to save data. If the alternative method of checking ignition timing via a diagnostic harness plugged in to the vehicle system, the message will be displayed accordingly.

Using the timing light

- a. Set the switch on top of the timing light to ON.
- b. Turn the timing advance control on the timing light clockwise until it clicks.
- c. Point the timing light at the timing mark.
- d. Turn the advance control until the pointer on the pulley lines up with the zero degree mark.

If the engine has no zero degree mark, but a mark at the correct ignition time angle.

- a. Set the switch on top of the timing light to ON.
 - b. Turn the advance control counter clockwise until the reading on the centre display is zero (until it clicks).
 - c. Check if the mark on the pulley lines up with the mark of the ignition timing angle.
1. Enter the "IGNITION TIMING TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
 2. Disconnect and plug, vacuum pipes and press the button on the timing light or the * key.
 3. Bring the engine RPM within the specified RPM (this is between the arrows > < which are shown in the graph on top of the screen) and press the timing light button or the * key.
 4. Bring the engine RPM within the new specified RPM and press the timing light button or the * key.
 5. Reconnect vacuum hose and press the timing light button or the * key.
 6. Bring the engine RPM within the specified RPM and press the timing light button or the * key.
 7. Return to idle speed, the analyzer will prompt "TEST DATA SAVED".

IDLE AND EMISSIONS TEST

This procedure is generalised and the steps may vary slightly according to specification and depending on the vehicle presented for test. The screen will always prompt you to conduct this test in the correct sequence.

1. Enter the "IDLE AND EMISSIONS TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Disconnect or turn off any Air Conditioning, Pulse Air, Air Pumps and Exhaust Gas Recirculation devices where applicable and press the enter # key when ready.

3. Ensure that the readings are stable and press the * key.
4. Connect or turn on the equipment mentioned in step 2.

LOW SPEED SECONDARY KV TEST

1. Enter the "LOW SPEED SECONDARY KV TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Bring the engine RPM within the specified RPM (this is between the arrows > < which are shown in the graph on top of the screen) and press the * key.

HIGH SPEED SECONDARY KV TEST

1. Enter the "HIGH SPEED SECONDARY KV TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Bring the engine RPM within the specified RPM (this is between the arrows > < which are shown in the graph on top of the screen) and press the * key.

SNAP ACCELERATION TEST

1. Enter the "SNAP ACCELERATION TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
2. Bring the engine RPM within the specified RPM (this is between the arrows > < which are shown in the graph on top of the screen) and press the * key.
3. Snap accelerate by depressing and immediately releasing the throttle pedal.

Note: You should use the throttle pedal rather than the under bonnet linkage. This ensures that any engine management system fitted will react to the throttle movement. The action should consist of a firm and positive movement using one foot, in the exact same way as one would accelerate when overtaking.

CYLINDER COMPARISON TEST

1. Enter the "CYLINDER COMPARISON TEST" from the "WORKSHOP TEST SELECTION" menu or enter it from the previous test.
 2. Bring the vehicle in power balance conditions. This generally means :
 - setting the engine speed to approximately 1500 RPM
 - Bridge the electric cooling fan switch (if fitted) to ensure that the fan operates throughout the test.
- note : If the 2 key is pressed at this stage, the display will offer help pages to assist with correct function of this test according to the vehicle presented for test.
3. If step two is completed press the enter # key and ensure that the readings are stable and press the * key to start the test.
 4. Reset the vehicle systems to normal (see step 2)
 5. If you press the enter # key at this stage the display will show the "WORKSHOP TEST SELECTION" menu.

It is now possible to make a printout of the single test or a full test, simply step through the menu see chart 1 to 4.

1. The purpose of this document is to provide a comprehensive overview of the current state of the project and to identify the key areas that require attention.

2. The project has made significant progress since the last meeting, with several key milestones being achieved. However, there are still a number of challenges that need to be addressed in order to ensure the project is completed on time and within budget.

3. The main areas of concern are the lack of resources, the need for better communication, and the need for more frequent updates. It is recommended that the project manager should focus on these areas and take the necessary steps to address them.

4. The project team should be encouraged to work together and share their ideas and concerns. Regular meetings should be held to discuss the progress of the project and to identify any potential problems.

5. The project manager should also ensure that the project is well-documented and that all team members are kept up-to-date on the latest developments. This will help to ensure that everyone is working towards the same goals and that the project is completed successfully.

6. The project manager should also ensure that the project is well-communicated to the relevant stakeholders. This will help to ensure that everyone is aware of the project's progress and that any potential issues are identified early on.

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UNDERSTANDING FOUR GAS ANALYSIS

GENERAL

This chapter is intended to be technical information rather than an operation procedure for the MCS2000SL.

The full value and benefits of understanding four-gas analysis will become apparent as you use your "MCS2000SL" to obtain data to diagnose engine problems and make necessary repairs.

IDEAL ENGINE

If we could imagine the "Ideal" internal Combustion Engine, it would burn its fuel completely. The combustion by-products (the exhaust gas) of this theoretical ideal engine would be Carbon Dioxide (CO_2) and water vapour (H_2O).

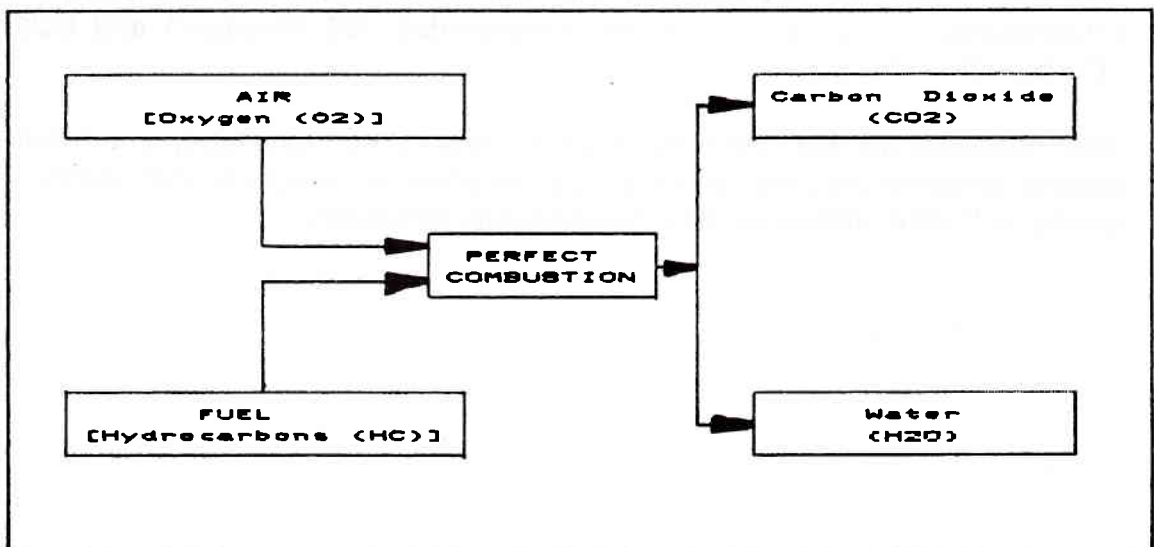


Figure 33, Ideal Engine

REAL- WORLD ENGINE

Unfortunately, nothing is perfect. In the real world engine, the flame front is set off by the spark and hits the relatively cool cylinder walls. At this cool cylinder wall, not all fuel will be burnt. Also, if the carburettor or injection system is improperly adjusted, the "Air Fuel" ratios are incorrect for complete combustion.

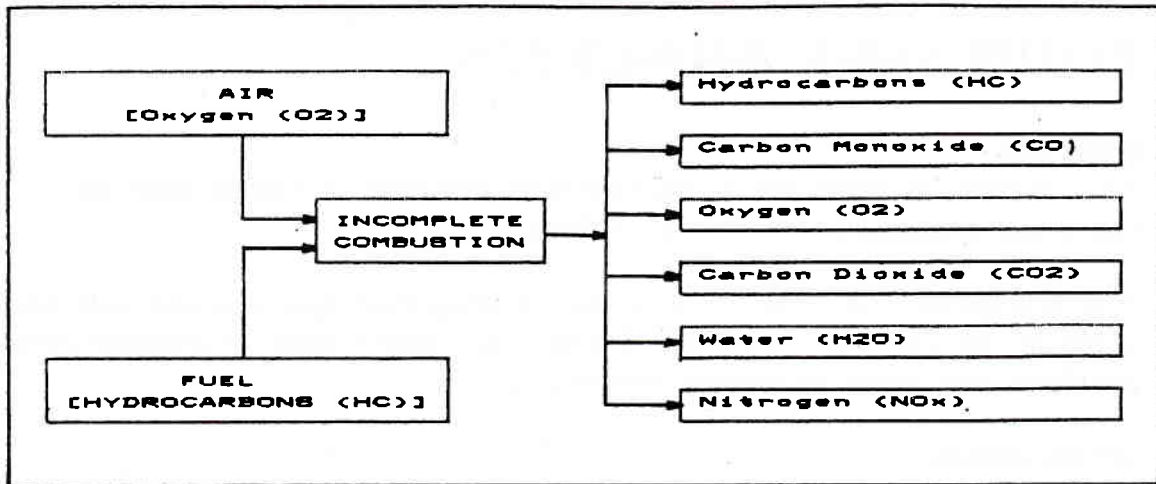


Figure 34, Real-World Engine

The basic relationships between the four components of combustion are HC (Hydrocarbon = Fuel), CO (Carbon Monoxide), O₂ (Oxygen) and CO₂ (Carbon Dioxide).

The relationships can vary by engine, depending upon age, condition and engine temperature. Mal-adjusted carburetion or injection and ignition timing will also influence this relationship drastically.

EXHAUST GASES

Hydrocarbons

Hydrocarbons are unburnt or partly burnt fuel. High levels of hydrocarbons (Measured in Parts Per Million - PPM) in the exhaust gas are often related to problems in the ignition system, fouled plugs, poor ignition wires, improper timing or dwell, vacuum leaks or incorrect "Air/Fuel" ratios; all cause improper combustion and high HC readings.

Carbon Monoxide

CO is formed when there is not enough oxygen present during combustion. High levels of carbon monoxide (Measured as a percentage % volume of the exhaust gas) can be caused by a too rich mixture, low idle speed, incorrect float level, blocked air filter, malfunction of the PCV valve or incorrectly adjusted carburettor or injection system. Low oxygen available. This could be called oxygen starvation. The solution is to reduce the amount of fuel.

Carbon Dioxide

CO₂ (Measured as a percentage % volume of the exhaust gas) is an important diagnostic clue to the efficiency of the combustion process. Carbon Monoxide (One part Carbon to one part Oxygen) is the result of too little oxygen in the combustion process. Carbon Dioxide (One part Carbon to two parts oxygen) is the result of a more efficient combustion. The greater the percentage of CO₂ in the exhaust gas, the more efficient the engine is running. A reading of 13% to 15% is considered ideal, with CO and HC at or near to zero and oxygen within 1% to 3%.

Oxygen

O₂ (Measured as a percentage % volume) indicates the accuracy of the carburettor setting. If the oxygen content is measured as the Air/Fuel ratio is adjusted from rich to lean, or lean to rich, a step jump in the reading of at least 0,5 % shows the crossover point from rich to lean. O₂ measurement is also useful in detecting vacuum leaks and ignition problems causing a misfire and of course an incorrect sample because the exhaust probe is not correctly inserted and/or the exhaust system is leaking. Oxygen readings of 1,5 % or less is considered ideal with HC and CO at or near zero and CO₂ within the range of 13 % to 15 %.

Oxides of Nitrogen

Nitrogen (N) makes up approximately 80 % of the air we breath, the balance of approximately 20 % is oxygen. An internal combustion engine uses the oxygen O₂ to operate and exhaust the nitrogen. However, Oxides of Nitrogen NO_x are formed when the combustion temperature exceeds 1370 degrees Celsius.

Although NO_x compounds do not directly effect how the engine works, when NO_x combine with unburnt fuel HC, in certain atmospheric conditions, they are the basis of SMOG. For this reason, NO_x (Measured in grams per mile) are measured for the type approval test.

To reduce a part of the NO_x, a device called EGR (Exhaust Gas Regulation) valve is used. This valve provides lower combustion temperatures by recirculating exhaust gases back to the combustion chamber. There is not much what the Mechanic/Technician can do to control emissions except to make sure that the engine and the EGR valve (if installed) are functioning correctly.

It is not practical to measure NO_x in the service workshop without the use of a dynamometer and special equipment.

THE KEY - AIR/FUEL RATIO

The Air/Fuel ratio at which the fuel burns most efficiently, is called "Stoichiometric" point. This is also the point at which HC and CO emissions are lowest and CO₂ is highest.

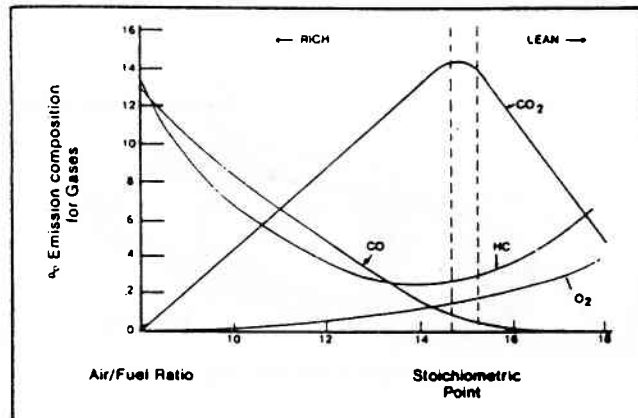


Figure 35, Air Fuel Ratio

As shown above, the point at which most efficient combustion (low HC and CO, high CO₂) occurs is approximately 14,7 : 1 air/fuel ratio

Note: This point may vary slightly because of the difference in fuel composition.

Testing of vehicles today, and tomorrow, on vehicles fitted with catalytic converters and engine management systems, has made fuel system adjustments more difficult than before. The new computer engine management will maintain correct air/fuel ratios with very little error, but only if the system inputs are operating correctly.

Carbon Dioxide CO₂ and Oxygen O₂ are the keys to proper adjustment of today's electronic carburetors and fuel injection systems.

There is no compromise on modern engines for the correct settings. We are now in the era when all carburettion, injection system settings are critical. It is only by using the four gas method of analysis that problems can be accurately diagnosed.

CATALYTIC CONVERTER

A catalytic convertor is a device which resembles a silencer, and is fitted into the exhaust system between the manifold and the silencer. It consists of a chamber in which a chemical reaction takes place to change toxic and harmful gases into less harmful ones. The most common use for emission control is a three-way catalytic converter which will change approximately 90 % of the CO, HC and NO_x from the engine into CO₂, N (Nitrogen) and H₂O (Water) at the tail pipe.

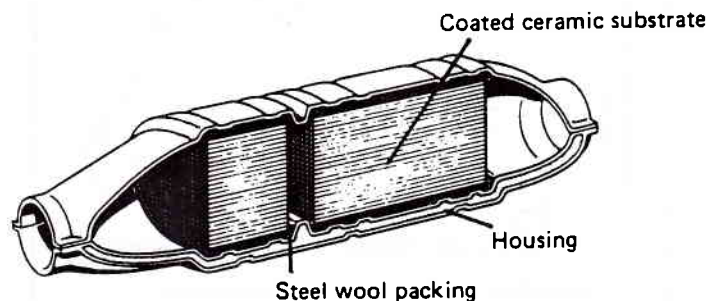


Figure 36, Typical Catalytic Converter

A typical three-way catalytic converter consists of a stainless steel outer layer with an inner honeycomb structure of ceramic material. This material is initially covered with a wash coat of aluminium oxide which has the effect of increasing the surface area of the material to approximately the size of three football pitches. The surface area is then covered with a small amount (2/3 grams) of noble metals, Platinum and Rhodium. Platinum accelerates the oxydisation of CO and HC whilst Rhodium reduces NO_x.

A catalytic converter will only operate at maximum efficiency if the air/fuel ratio of the mixture being burnt is at stoichiometric (14,7 : 1) and the operating temperature of the catalytic converter is between 400 and 800 degrees centigrade.

At temperatures below 300 degrees centigrade, the catalytic converter will not function. At temperatures of 800 degrees and higher, breakdown of the noble metals will occur. Over 1000 degrees centigrade, severe and rapid deterioration of the catalytic converter will take place.

Any severe engine malfunction, such as a misfire, could cause a temperature rise of up to 1400 degrees centigrade which would cause melting of the substrate material. The use of leaded petrol and excessive oil residue can also poison the catalytic converter.

In order to maintain the correct mixture strength (AFR), the majority of vehicles fitted with a catalytic convertor will be equipped with Electronic Fuel Injection or Electronic Carburettor Control. These systems may be "Open Loop" with reliance being placed on a correctly tuned and maintained engine or, "Closed Loop" which uses the "Lambda" sensor to provide information to the Electronic Fuel Injection with a Closed Loop System.

LAMBDA

Lambda is a number which indicates in a simple way how much air is present in the fuel mixture being burnt. When "Lambda" equals one (1,00) this means that there is just enough air for complete combustion of the fuel and no excess oxygen. Any reading over 1.00 indicates excess air (lean mixture) and a reading less the 1,00 indicates not enough air (rich mixture). Lambda is directly related to air/fuel ratio with the ideal AFR (14,7 : 1) being Lambda 1,00

$$\text{Lambda} = \frac{\text{ACTUAL AFR}}{\text{IDEAL AFR}}$$

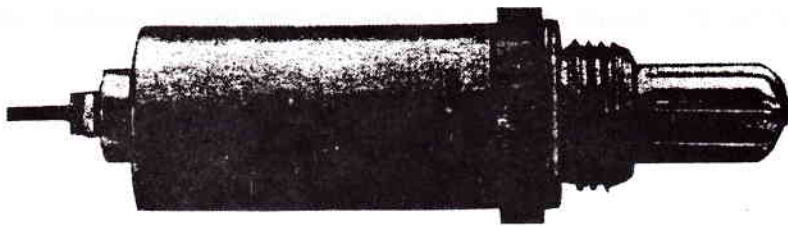


Figure 37, Lambda Sensor

A Lambda sensor is a ceramic device placed in the exhaust system on the engine side of the catalytic converter. It consists of a body of ceramic material, the surface of which has porous platinum electrodes.

One electrode is open to atmosphere and the other is in the exhaust stream. When the oxygen content on both sides of the electrodes is different, a voltage is created. Therefore, the function of the Lambda sensor is to detect the amount of oxygen in the exhaust gas and to feed the resultant voltage generated to the Electronic Control Unit.

The ECU will evaluate the signal received from the Lambda sensor and will increase or decrease the quantity of fuel supplied in order to maintain the correct air/fuel ratio or Lambda 1,00. A signal from a lambda sensor is shown in figure 7 on page 24.

The Lambda sensor will not operate below 250 degrees centigrade, before that temperature, the system will operate under "Open Loop" (No Control). In order to speed up the operation of the Lambda sensor, some are pre-heated. These are identified by three or four wires coming from the Lambda sensor instead of one.

USE OF LAMBDA MEASUREMENT

Sun now provides Lambda and AFR measurements on all gas analysers which can measure four gases. The method adopted for Lambda measurement is derived from the Spindt formula, which takes account of CO, HC, CO₂ and O₂. This formula has been adopted as it is the most comprehensive, and allows for Lambda (AFR) measurement both, before and after the catalytic converter, with the same result. It is expected that the majority of "Open Loop" systems will have an exhaust tapping before the catalytic converter in order that fuel mixtures may be adjusted accurately to Stoichiometric. On "Closed Loop" systems, some manufactures are fitting a tapping before the catalytic converter.

To test an engine fitted with a catalytic converter and/or a Lambda sensor, the engine should be running at 3000 rpm for approximately three minutes to ensure that it is at operating temperature. If monitoring exhaust gas you will see the change in values as the catalytic converter comes into operation.

DIESEL OPTION:

THEORY OF A DIESEL ENGINE

For the proper function of the diesel engine, the start of delivery has almost the same importance as the timing of a petrol engine. In a petrol engine the timing of the ignition, controls the combustion of the fuel-air mixture. In a diesel engine the timing of the injection, controls the combustion. The diesel engine is more sensitive to changes of injection timing than a petrol engine because the air-diesel mixture needs a certain pressure to combust.

The combustion, respectively the beginning of injection, can be investigated by adequate methods in a laboratory. These methods are applied for the development of engines. For the workshops, however, such extensive methods are not applicable because :

- At a given pump adjustment (angle adjustment of the pump versus the crankshaft) the start of injection changes within certain tolerances depending on :
 - the tolerances of the injection system
 - the tolerances of the nozzle pressure
 - the coking condition of the nozzle.
- At a given start of injection the combustion can change within certain limits, depending on :
 - the cetane number of the fuel
 - the air pressure of the engine
 - the coking condition of the engine.

Therefore, it is suggestive for the workshop to use the start of delivery as an adjustment value, as it can be measured and influenced directly.

Before beginning of delivery, there is a certain pressure level in the injection line which is known as residential pressure. At beginning of delivery the pressure at the pump output rises. The pressure wave passes through the injection line with sonic speed. The pressure wave needs a certain period, depending on the length of the lines, to reach the nozzle. Therefore, all injection lines on a multi-cylinder diesel engine have the same length. So the start of injection is delayed with respect to the beginning of delivery, due to the delay in the lines. Expressed in degrees, this delay rises linearly with the engine speed. At a speed of 1000 RPM the delay is 2 degrees, at 2000 RPM it is 4 degrees.

Because the air-diesel mixture needs a certain time to combust, the injection of diesel needs to be advanced. If the speed of the engine increases the advancement of the injection must also increase. To obtain this increasing advancement of injection, the diesel pump is equipped with a centrifugal advance control. This centrifugal advance control also compensates the delay in the pressure lines.

It has been mentioned that the diesel engine sensitively responds to changes of the start of injection. The beginning of delivery strongly influences the efficiency of the diesel engine. For example, if you have a passenger-vehicle diesel-engine of 60 kW and the beginning of delivery is changed by only 3 degrees crank angle, the power drops 6 kW, the torque 9 Nm and the smoke blackening rises.

TESTER HOOK-UP

Refer to page 49 to set-up the tester.

WARNING

- A. Do not make connections to a vehicle before the main lead of the tester is connected to the proper socket outlet.
- B. Do not disconnect the mains lead before you disconnect the connections to the vehicle.

If the tester is not connected to earth, dangerous voltages can be present on the casing of the tester.

CAUTION

Keep the test leads away from moving or hot engine parts. The test leads can not withstand high temperatures or severe mechanical stress.

1. Select a straight part of the injection line of cylinder number 1, as close as possible to the injection pump, or a location specified by the vehicle manufacturer.
2. Clean the clamping spot with emery cloth, remove any paint or oil. The clamping spot must be undamaged and perfectly clean.

Note: The clamp-on transducer, type KG 6, supplied as a standard with the diesel kit option is suitable for the 6 mm lines. Clamp-on transducers with other sizes ranging from 4.5 mm to 12.7 mm are available through your local Sun representative.

3. Carefully fit the clamp-on transducer to the straight and cleaned portion of the line, without turning or sliding the transducer, as the measuring areas of the transducer can be easily damaged.
4. Clamp the ground clip firmly onto a paint-free part of the injection pump.
5. Attach the push-on terminal of the transducer lead to the clamp-on transducer. (see figure 38).
6. OPTION Install the mag probe in the receptacle, if required use the adapter. Connect the mag probe to the universal harness.

7. If the vehicle does not have a mag probe or the magnetic timing option is not installed, check the timing with the timing light. Clean the crankshaft pulley and timing pointer. Use a piece of chalk or white touch-up paint to mark the pointer on the pulley and the zero line. Turn the timing advance knob on the timing light fully counter-clockwise (off) until it clicks. Then place the on/off button in the off position (white dot out).
8. Connect the red crocodile-clip of the black twin lead to the positive battery terminal.
9. Connect the black crocodile-clip of the black twin lead to the negative battery terminal.
10. OPTION Clamp the green ammeter pick-up around the negative battery cable (around all wires if there is more than one) with the arrow on the pick-up pointing away from the battery.

DIESEL TEST PROCEDURE

To show the pressure waveform, you have to select diesel test in the scope functions menu (see chart 2 on page 12).

The picture which is shown on the scope should be similar to the picture of figure 39. The figure shows the pressure in the injector line. The curve rises at the beginning because the pressure is increasing, until the injector starts to inject the diesel fuel into the cylinder. Then the injector stays open for a certain time, so the pressure decreases. The injector stops injecting at point 1. When the pressure has dropped to a certain level the spring in the injector returns the injector needle to its seating. After that, the pressure drops to the normal system pressure.

The signals of the other cylinders should be similar to one another. To display the other signals, the clamp-on has to be clamped onto each injector line in turn. Be sure each clamping place is clean, to avoid damaging the delicate measuring surfaces of the clamp-on.

To measure RPM, timing and Current you must use the multimeter test. (See chart 2 on page 12).

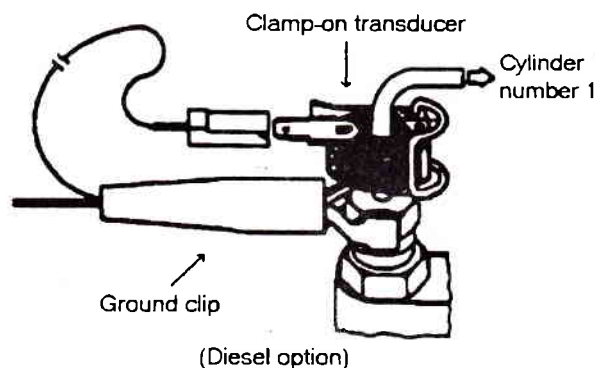


Figure 38, Clamp On Transducer

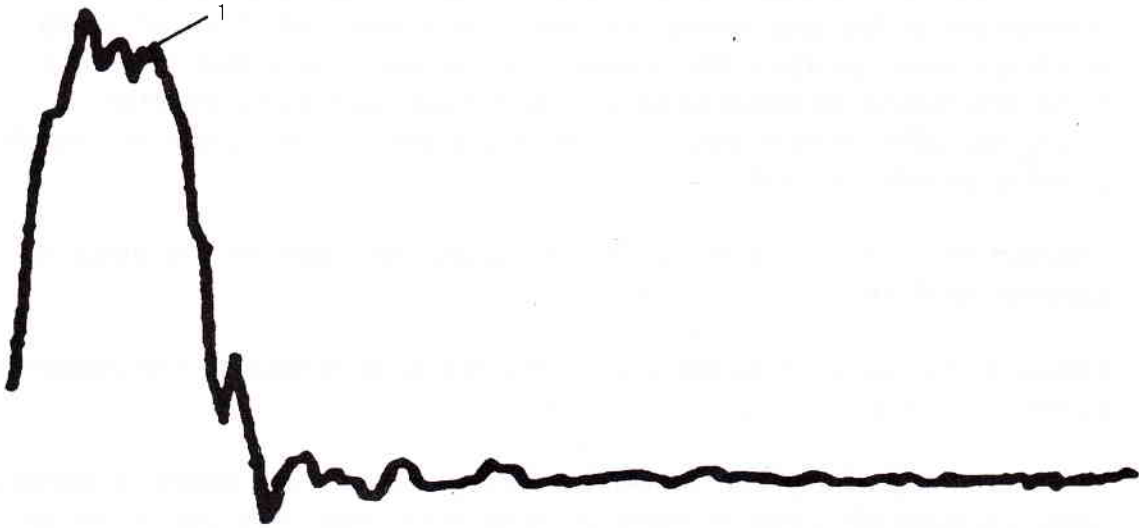


Figure 39, Diesel pattern

MAINTENANCE

GENERAL

The maintenance and service procedures for the MCS 2000SL presented in this section can be done by the operator. All other service must be done by an authorized Sun representative.

SAMPLE HOSE MAINTENANCE

Periodically inspect the sample hose for any sign of damage such as leaks, cuts, and kinks. Also, check sample hose connections for tightness. Replace the hose if you find or suspect leaks.

SAMPLE PROBE MAINTENANCE

Frequently inspect the sample probe for damage. Check for clogged holes in the probe tip. If the holes are found to be clogged, use a piece of stiff wire or an other suitable object to dislodge and remove any foreign matter.

WHEN TO SERVICE THE FILTERS

Check the sample probe and sample hose when the "LOW FLOW" message appears. If the "LOW FLOW" message still appears, replace or clean the primary and secondary filters.

PRIMARY FILTER MAINTENANCE

You can either clean or replace the primary filter element. Service the primary filter as follows.

1. Disconnect the water outlet and air inlet hose from the fitting on the filter bowl. See figure 40.

Note : Do not damage the "O" ring at the top of the bowl when you do step 2.

2. Turn the filter bowl counter clockwise and remove it from the filter housing.
3. Turn the element retainer nut counterclockwise and remove the filter element.
4. Wash out the bowl and filter element in a mild soap and water solution. Allow the bowl and element to dry before assembling.

Note : Before you reassemble the primary filter, make sure the "o" ring is properly positioned in the groove of the filter bowl.

5. Assemble the primary filter in reverse order of disassembly.
6. Connect the water outlet and air inlet hoses.

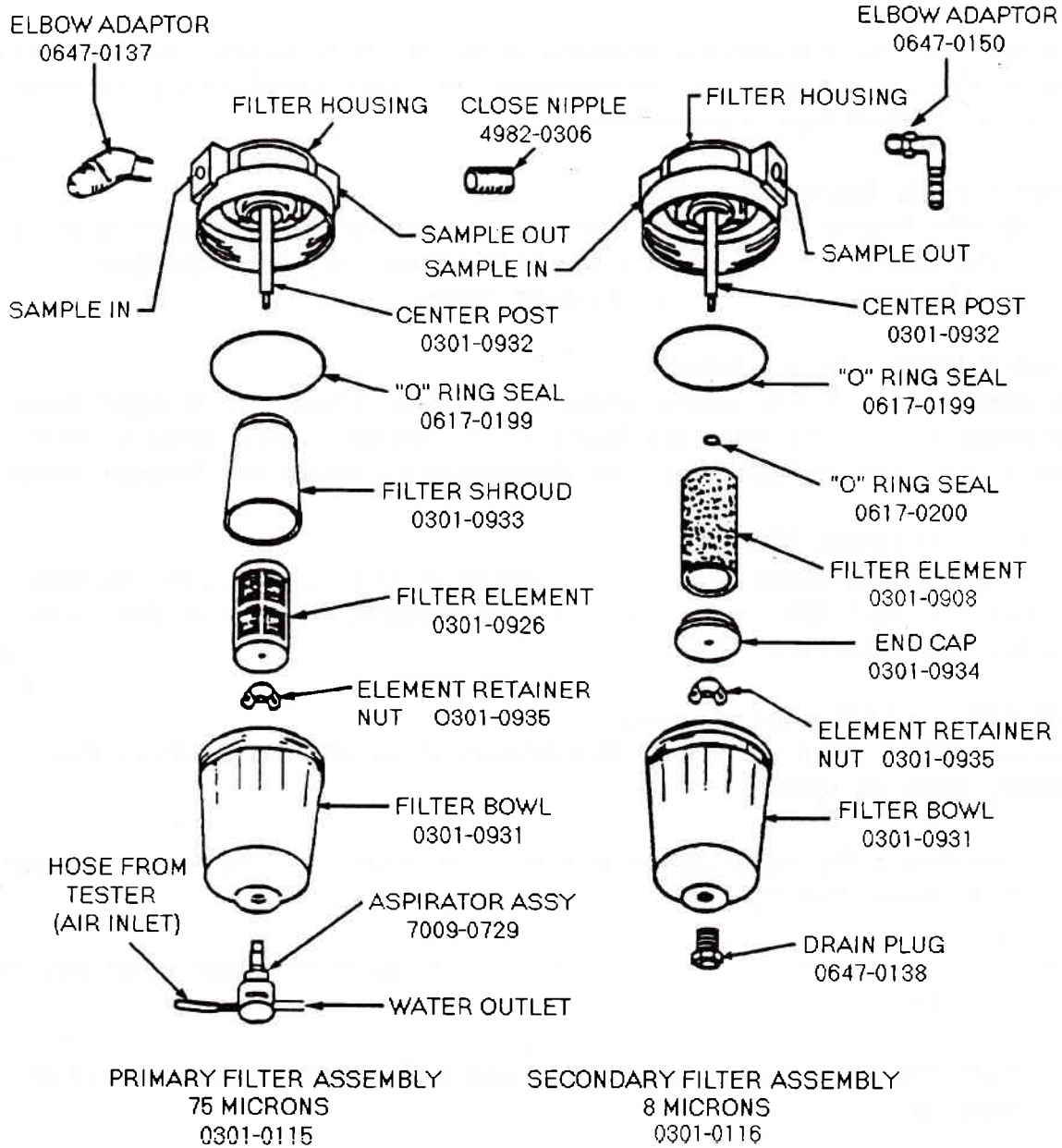


Figure 40, Filters

SECONDARY FILTER MAINTENANCE

Replace the secondary filter element when it becomes dirty or clogged. Service the secondary filter as follows.

Note : Do not damage the "o" ring at the top of the bowl when you do step 1.

1. Turn the filter bowl counterclockwise and remove it from the filter housing.
2. Turn the element retainer nut counterclockwise and remove the end cap.
3. Remove and discard the old filter element.
4. Wash out the filter bowl in a mild soap and water solution. Allow the bowl to dry before assembling.
5. Install a new filter element.

Note : Before you assemble the primary filter, make sure the "o" ring is properly positioned in the groove of the filter bowl.

6. Assemble the secondary filter in reverse order of disassembly.

TESTER'S FINISH MAINTENANCE

The tester is finished with a stain resistant baked enamel and brushed aluminium. It is recommended that the painted and plated surfaces are polished with an automobile wax. Once this has been done, a periodic wipe down with a dry cloth will be sufficient.

Care should be taken not to damage the tester front screen panel when cleaning and therefore, only a clean soft cloth should be used with a proper brand glass-cleaner.

TEST LEAD MAINTENANCE

Inspect all test leads weekly for cuts and abrasions and care should be taken when routing the leads across an engine that they do not touch rotating engine components or rest on hot exhaust manifold systems.

Test leads and mains power cable will retain a favourable appearance if they are cleaned regularly using waterless hand cleaner and wiped dry.

Induction clamps fitted to the test leads should be kept free of oil, grease and contaminants and should be cleaned when necessary to minimise mistriggering situations.

LUBRICATION

Apply a light machine oil to the wheels of the cabinet, every 2 to 3 months. This prevents the wheels from squeaking and make them roll smoothly. No other lubrication is required.

MISCELLANEOUS MAINTENANCE

is recommended that the MCS2000SL is left switch on during the working day, but to prolong the life of certain items, it is advisable to switch off the exhaust analyse pump and timing light when not required.

FLOPPY DISK MAINTENANCE

Floppy disks should be kept clean and dry, and should be stored in the disk compartment located on the right of the main disk drive.

CAUTION: Magnetic materials, such as magnetised screwdrivers, electric motors, coils, HEI distributors, etc, should be kept away from all disks to prevent damage.

OPTIONS

OKI-182E Printer	7096E4056-95
Printer Mounting Kit	7009E9314-70
Printer Connection Kit	7009E9316-21
Printer Cover	7009E9313-44
Interface Kit for SGA	SGK-2009
SGA Support Tray Kit	7009E9313-95
Sun Gas Module	SGM-2004
Barometric Pressure Sensing Kit	7009E9316-26
Digital Scope kit	7009E9314-93
Universal Diesel Kit	UDK-1
Sun Test Link	STL-2
Sun Data Link	SDL-20
Real Time clock	7009E9316-57
Keyboard Kit	7009E9317-00

CONSUMABLES

Standard MCS2000SL

Test Probe Red	0003-2000-609
Test Probe Black	0003-2000-608
Croc Clip Red	0003-2000-614
Croc Clip Black	0003-2000-613
Spark Plug Connector Set	3676-A
Bosch Adapter Kit	7096E4026
Autolite Adapter Kit 6mm	4107-0000-000
Autolite Adapter Kit 5mm	4108-0000-000
Resistance Test Contactor	4344-000
Jumper Lead	0002-0133-015
Air Filter	7096E9056-23
HT Pliers	0002-1028-000
Tee Assy Hose	0647-0170
Shorting Out Fan Lead	6004E9006-000
Remote Control Assy	7009E9316-54
Timing Light Assy	7009E9015
Test Harness Universal	6004E9310-32
Test Lead Assy (Current)	6005-0133
Test Lead (Pattern)	4720-0000-000
Test Lead (Trigger)	4721-0000-000
Pick-up (Pattern)	1747-0101-000
Pick-up (Trigger)	0507-0006-000
Test Lead Assy (Volt / Ohm)	6004E9005-000
Test Lead Assy (Low Temp)	6004E9004-000
Hose Assy (Vacuum)	6006-0003

Printer

Printer Paper 2000 sheets
Ribbon Cartridge

0528-0994
0528-0995

Sun Gas Module

Oxygen (O2) Sensor
Filter Assy, Primary
Filter Assy, Secondary
Bowl, Filter
Aspirator Assy
"O" Ring, Seal
Filter Element, 75 Micron
Filter Element, 8 Micron
Air Filter
Probe Assy, Exhaust
Hose Assy, Exhaust

7049-0004
0301-0115
0301-0116
0301-0931
7009-0728
0617-0199
0301-0926
0301-0908
7096E9056-23
7009-0511
3988-0202

Universal Diesel kit

Diesel lead
Diesel Pick-up 6mm

003-2000-578
0008-0472

Sun Test Link

Remote Control Assy
Extension Cable

7009E9314-09
6004E9310-41

Sun Data Link

Extension Cable

6004E9310-41

ERROR CODES

PROBLEM	DESCRIPTION	ACTION
INTERRUPT XX	SYSTEM FROZEN	SWITCH OFF TESTER AND RE-START
ERROR CODE 84	CRC ERROR IN ID FIELD	INSERT NEW DISK
ERROR CODE 85	CRC ERROR IN DATA FIELD	INSERT NEW DISK
ERROR CODE 87	BUSY BIT ALWAYS SET	INSTALL / REPLACE DISK
ERROR CODE 88	BUSY BIT ALWAYS RESET	INSTALL / REPLACE DISK
ERROR CODE 134	READING PAST END OF FILE	INSERT NEW DISK
ERROR CODE XX		CONTACT SUN SERVICE DEPARTMENT

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