

Saab 9000

SERVICE MANUAL

SAAB



I:4 ISAT

M1988-1990

AE.IG 9-6 WP

Saab 9000

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1:4 ISAT M 1988–1990

Foreword

ISAT (Intelligent SAab Tester) has been designed specifically to enable efficient service work to be carried out on the increasingly sophisticated electronic systems being developed in the field of automotive technology. The development by Saab of ISAT represents an important step forward in testing and fault-diagnosis technology where many of the functions that need to be checked require the use of computers and suitable software.

For many of the functions described in this manual, continual upgrading of the support software will take place. This applies, for instance, to the functions described in the section, 'Linking ISAT to other computer equipment'.

Scope for future expansion of the tester functions has been designed into ISAT and the relevant information will be sent to ISAT users as and when the new facilities become available.

Saab Automobile AB

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Glossary of computer terms used in the manual

Microprocessor	This corresponds to a central processing unit and is ISAT's 'brain'. It controls instruction processing and other housekeeping operations.	EEPROM	EEPROM (Usually pronounced double-E PROM) is an acronym for Electrically Erasable Programmable Read Only Memory. This is a semi-permanent memory which, in common with EPROM, retains the data stored even when the tester has been switched off. Existing data are destroyed when new data are written to the memory. The memory is thus electrically erasable and, unlike EPROM, erasure does not require UV light.
RAM	RAM (Random Access Memory) comprises an array of cells for temporary storage of data. This type of store allows fast and direct access to the data. When the power supply is switched off, the contents of the memory are cleared and all data deleted. ISAT's RAM is used for the short-term storage of fault data (error codes) or measured values.	Sampling	Sampling is the technique by which a given unit (e.g. current, voltage, temperature, etc.) is measured at regular intervals to produce a set of discrete values. ISAT displays the results in the form of minimum, mean and maximum values.
EPROM	EPROM (Erasable Programmable Read Only Memory) is an integrated circuit memory chip that retains the data even when the power supply is switched off. The contents must be deleted by UV light before new data can be written into the memory. ISAT's control program is stored in an EPROM chip.		

Technical data

Casing

The casing is made of black polyamide plastic and is resistant to impact, oil, petrol (gasoline), acid, etc.

Display

The display is of the liquid-crystal type (LCD) and comprises four lines of twenty characters per line. Each character on the dot matrix is made up of 5 x 7 dots. The background colour is green and the angle of the display can be adjusted by means of a screw.

Keypad

The keys are made of translucent rubber and provision is included for back lighting. The keys function like pushbuttons.

Processor

Motorola 68HC11 processor.

Computer memory

ISAT has two totally independent memories for storing data from the fault-diagnosis and measuring functions: a working memory for temporary storage and a permanent memory for data that need to be kept for a longer period. The two memories, known respectively as RAM and EEPROM, each have a capacity sufficient to store the fault-diagnosis results for ten systems or approximately 1,000 measured values.

Control program

ISAT's control program is contained on an EPROM chip on a plug-in printed circuit board. The board is readily accessible behind a cover in the bottom edge of the instrument casing and upgrading of ISAT by fitting a new board is therefore very simple. The program is available in different language versions.

Power supply

During testing, the instrument receives power from the car battery through the appropriate test lead set (diagnostic or TSI leads). The instrument has its own 9-V battery for when no test leads are connected. The battery is behind the cover in the bottom edge of the instrument.

A rechargeable battery may be used instead of the standard battery, in which case the battery will be recharged when the instrument is connected to the car's power supply via either the diagnostics or the TSI test leads.

TSI module

A special TSI module, which amplifies and filters the signals measured, is used for testing the ignition system.

The module is provided with ports for connecting TSI leads, an inductive clip-on sensor and TDC sensor, and a stroboscope.

Environmental requirements

The instrument must be stored at an ambient temperature of between -20°C and +70°C (-4°F and +158°F).

For operation of the tester, the ambient temperature must be between -15°C and +70°C (5°F and 158°F).

Multimeter functions (DMM)

When in the multimeter mode, the tester has an autoranging function which selects the correct measuring range automatically.

Measuring

range: Voltage: -126 to +126 V d.c.
Resistance: 0 - 256 kohm
Current: -10 to +10 A d.c.
(10 - 600 A with current tongs)

Accuracy: Voltage: **Better than 1%**
Resistance: **Better than 0.5%**
Current: **Better than 1%**

Frequency-meter function

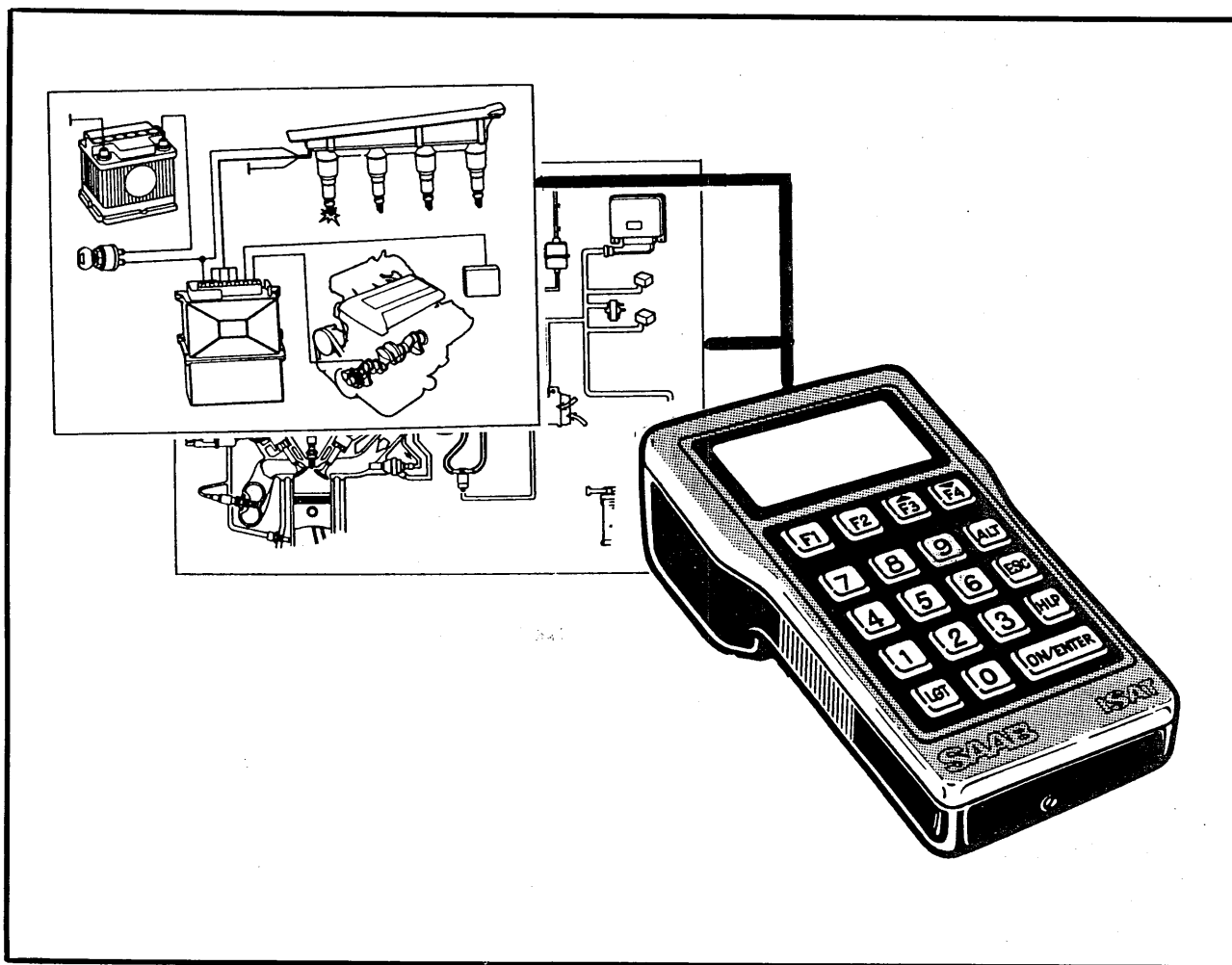
Frequency range: 1 Hz - 10 kHz (approx.)
Time: 13 microseconds minimum

Measuring of pressure

Measuring range: 0 - 200 bar (0 - 2900 psi), depending on pressure sensor used

Measuring of temperature

Measuring range: -40°C to +400°C (-40°F to +755°F)



Description

General

ISAT (Intelligent Saab Tester) is a testing and measuring instrument for use in an extremely wide range of applications on both existing and future electrical and electronic systems. The tester also has tremendous potential for future development.

ISAT has primarily been designed for fault-finding in electronic systems incorporating self-diagnostics, e.g. Saab DI, LH, TCS, EDU, ACC2, etc. The self-diagnostics function in these systems identifies faults (even intermittent ones) and stores data on them in the ECU for the respective system. ISAT is used to tap into the ECUs for subsequent display of the fault data in the form of 5-figure codes.

These fault (error) codes can then be referred to on the fault-diagnosis chart in the relevant section of the Workshop Service Manual for the system, which details the procedure to be followed to rectify the faults.

The diagnostic ability of ISAT is wholly dependent on the self-diagnostics capability incorporated in the respective ECUs.

Using the ISAT keypad, the technician can issue commands to the ECU for the system being tested to control certain predetermined functions, such as triggering sparks, generating a speed signal, controlling the lambda function, etc. ISAT can also interrogate the systems for information on different functions, e.g. the status of different switches, etc.

By connecting external sensors, e.g. for pressure and temperature, ISAT can also be used as a central link in other fault-diagnosis work on the car's electrical and electronic systems.

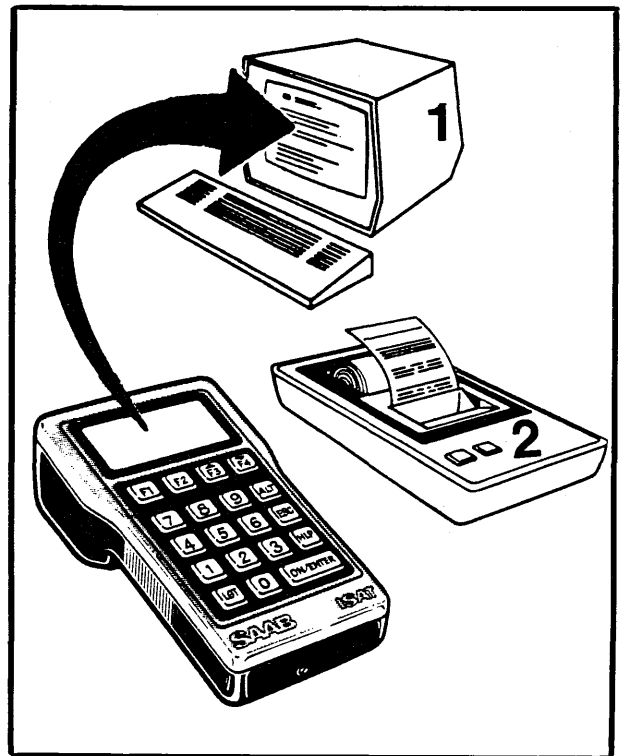
ISAT also functions as a digital multimeter (DMM); as well as measuring voltage, current and resistance, it can measure other signal parameters, such as pulse length and frequency, and the pulse ratio for the AIC valve and lambda sensor.

With the TSI module connected, ISAT can monitor dwell angle, ignition timing (TDC) and engine RPM.

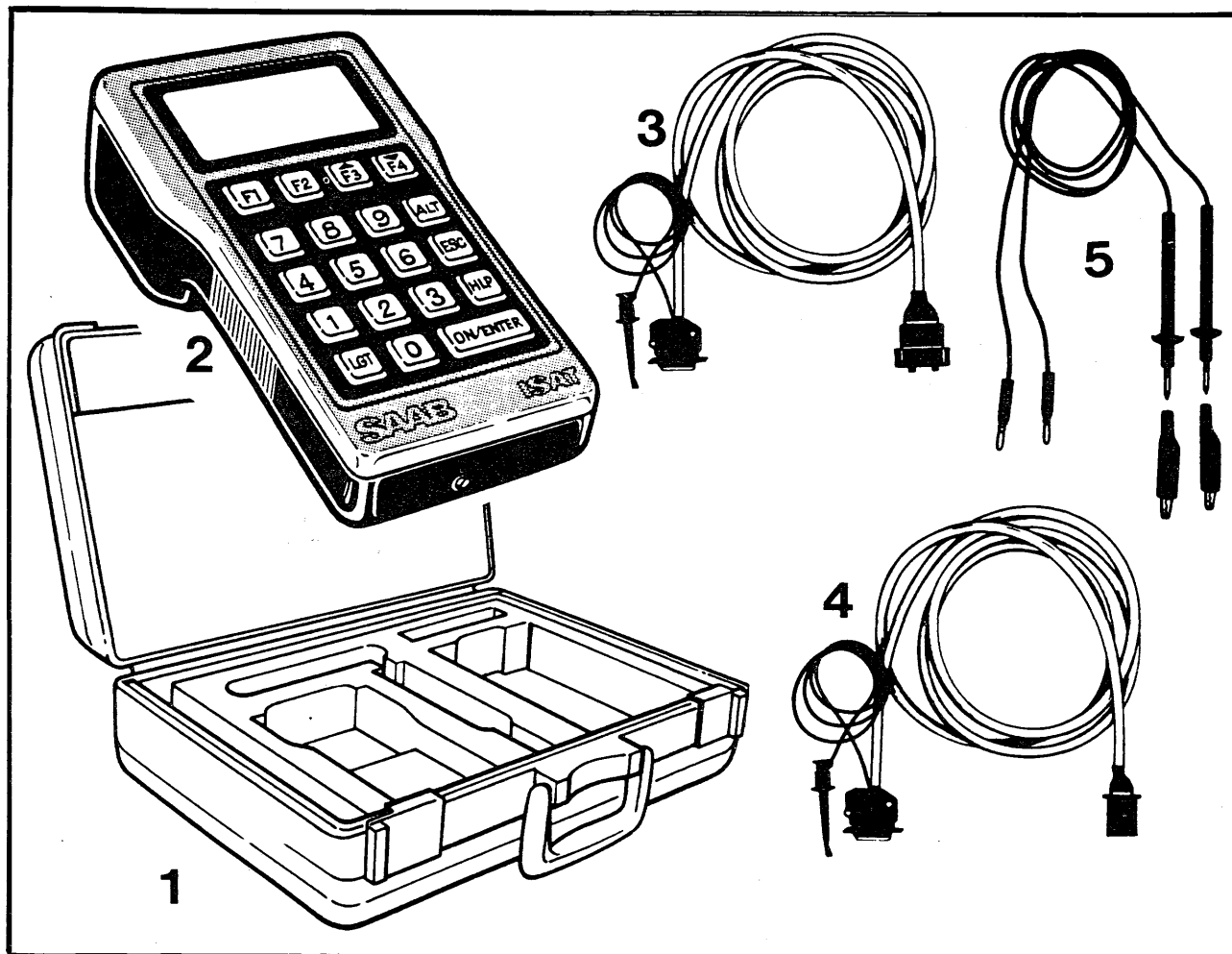
Features available on later versions

When linked to a personal computer (PC) and printer, ISAT can compare the measured values with corresponding reference values and also print out the results in the form of diagrams and charts. The data collected by ISAT can be transferred to a PC for interpretation of error codes, storage or statistical analysis. It is also possible to control ISAT direct from a PC. In this case, the data will be displayed on the PC monitor instead of on the ISAT display. The necessary interface ports for linking ISAT to other computers are incorporated in the instrument.

ISAT can readily be upgraded to meet future requirements by changing the control program. Immediately after the instrument has been switched on, a message appears on the display to tell the technician which version of the control program is being used.



1 PC
2 Printer

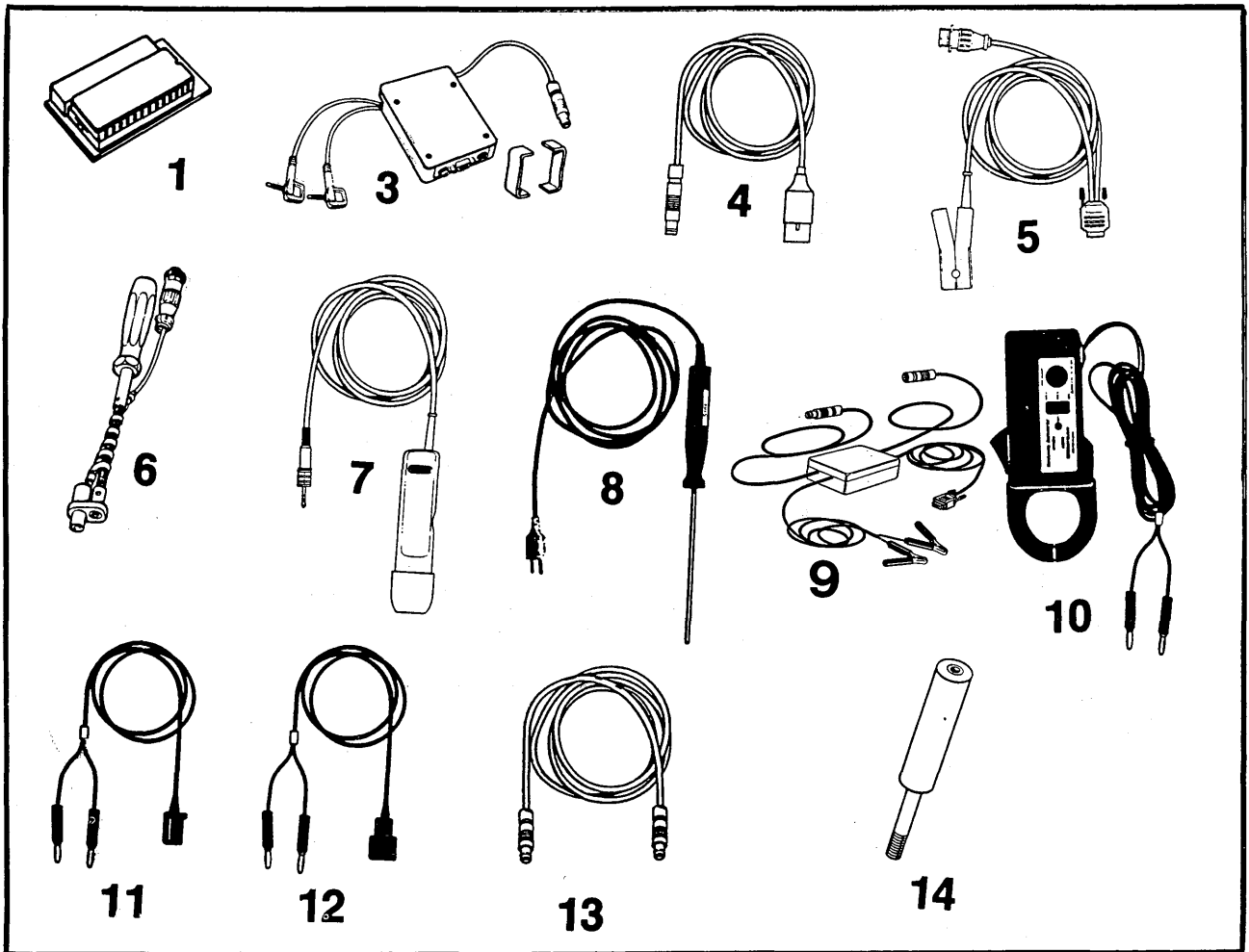


Basic ISAT kit, part no. 86 10 834

Basic ISAT kit

The basic ISAT kit contains the following items of equipment:

- 1 Storage/carrying case, part no. 86 10 826
- 2 ISAT instrument, part no. 86 10 651
- 3 Diagnostics lead set (10-pin), part no. 86 10 701
- 4 Diagnostics lead set (4-pin) for Saab DI system (M88 onwards), part no. 86 10 693.
- 5 Multimeter (DMM) test lead set, part no. 86 10 719



Accessories

The following accessories are available:

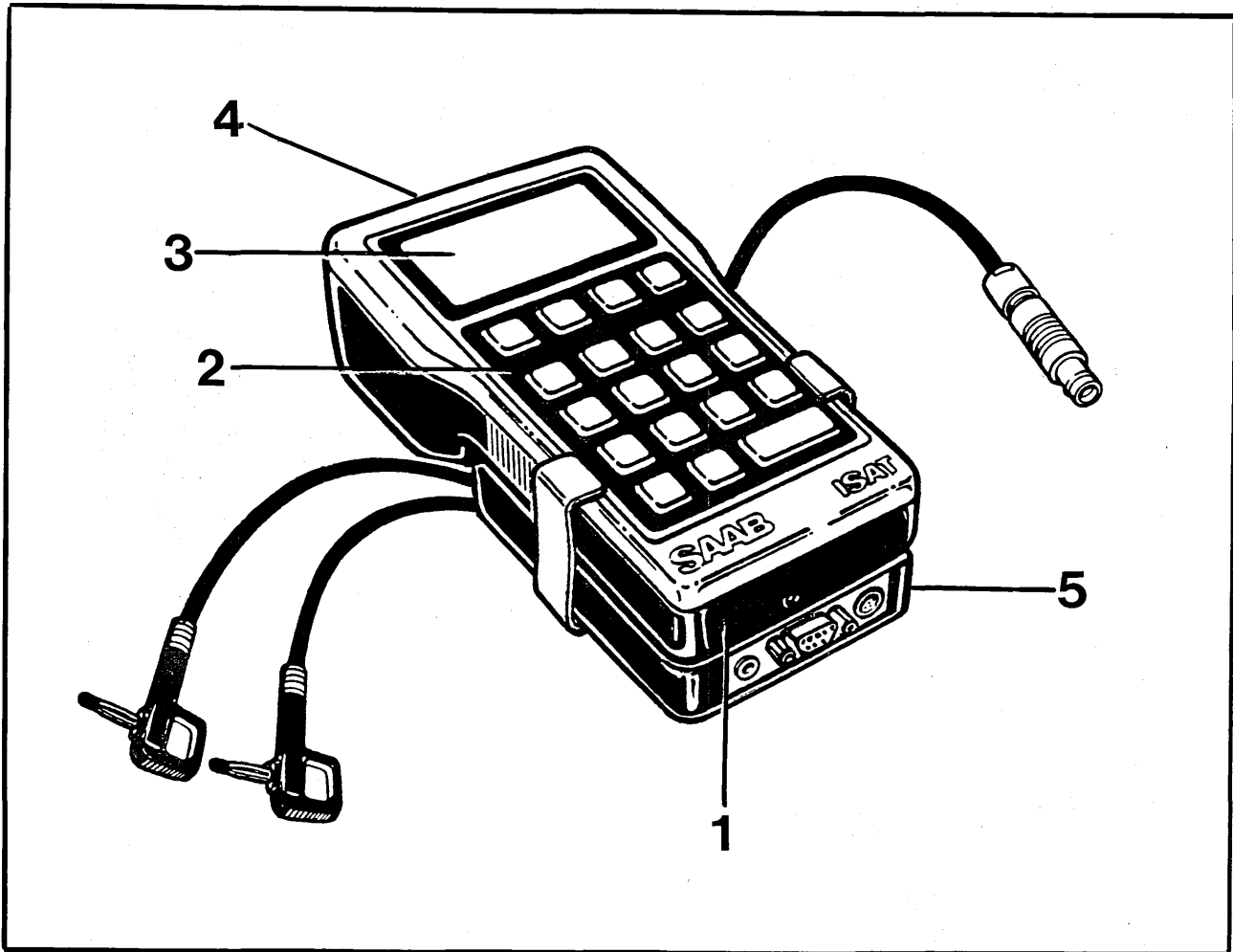
- 1 Control-program boards in different language versions, part nos. 86 10 833, 86 10 891, 86 10 909 and 86 10 917 (see page 40 for details).
- 2 TSI module complete (items 3 - 7 inclusive), part no. 86 10 925.
- 3 TSI module with clips and ISAT interface leads, part no. 86 10 941. Module clips are also available separately under part no. 86 10 933.
- 4 Test lead set for connection to TSI socket on car, part no. 86 10 727.
- 5 Clip-on inductive proximity detector complete with lead and connectors (including leads for TDC sensor), part no. 86 10 735.
- 6 TDC sensor, part no. 88 19 005.
- 7 Stroboscope complete with lead and plug, part no. 86 10 958.
- 8 Temperature-sensor lead complete with sensor for measuring range -40°C to $+400^{\circ}\text{C}$ (-40°F to $+755^{\circ}\text{F}$), part no. 86 10 750.

- 9 Pressure-sensor module, part no. 86 10 990.
- 10 Clip-on inductive proximity current detector (current tongs) for current up to 600 A, part no. 86 10 743.
- 11 Test lead for Lambda CI, part no. 86 10 776.
- 12 Test lead set for Lambda LH, part no. 86 10 784.
- 13 Adaptor lead for compression testing, part no. 86 10 982.
- 14 Compression tester (pressure sensor), part no. 86 10 974.

Information on additional accessories will be given in Service Information bulletins when the items become available.

The following items of equipment can also be connected to ISAT using pressure-sensor module 86 10 990:

- Pressure sensor for ABS tester, part no. 89 96 522.
- Pressure sensor for LH tester, part no. 83 94 355.



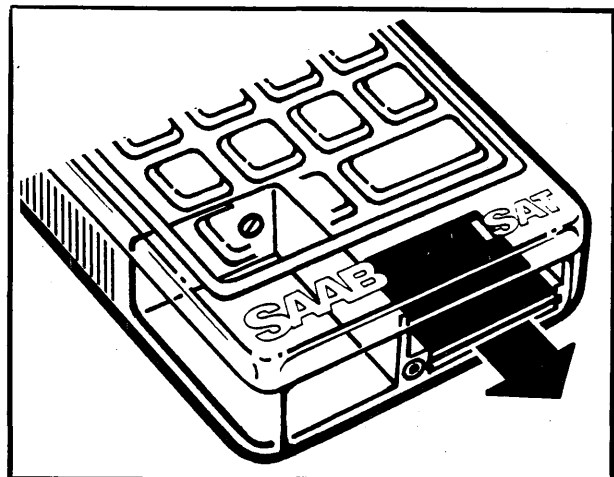
ISAT tester

- 1 Cover for access to battery, control-program board and adjusting screw for display view-angle.
- 2 Keypad
- 3 Display
- 4 Interface ports
- 5 TSI module

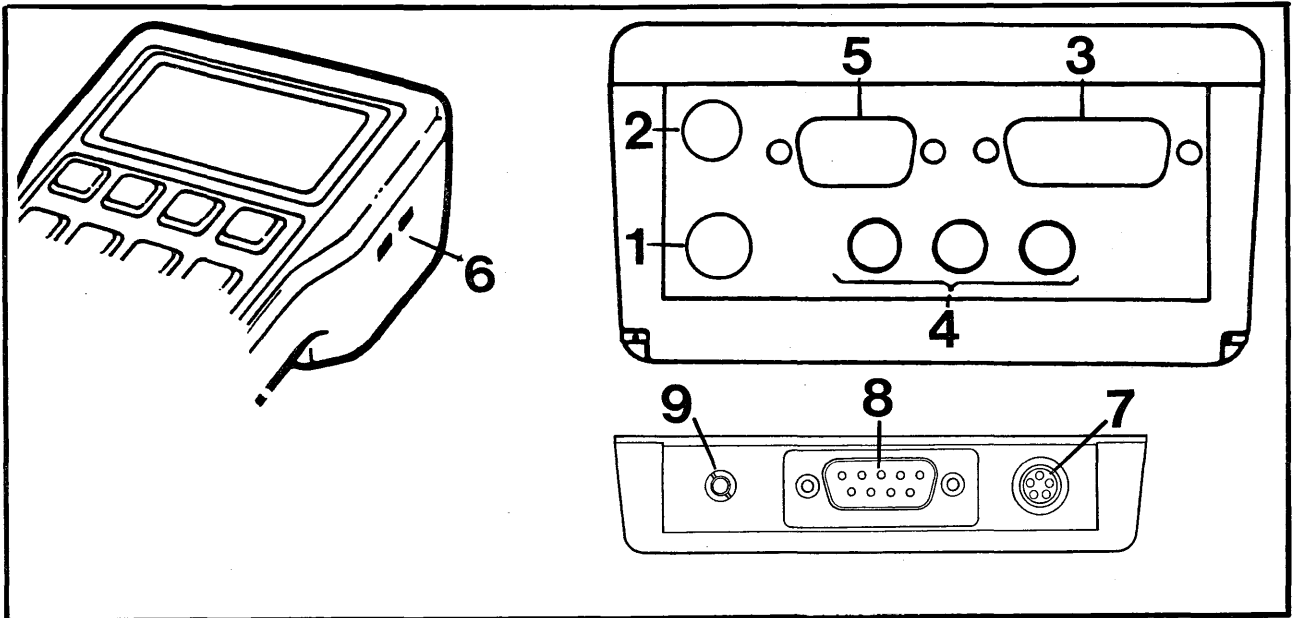
Control program

ISATs control program is stored on a plug-in EPROM board, accessible behind the cover in the bottom edge of the instrument. It is therefore easy to upgrade the control program to the latest version by removing the old board and inserting the new one.

Instructions on how to change the control program are given on page 41.

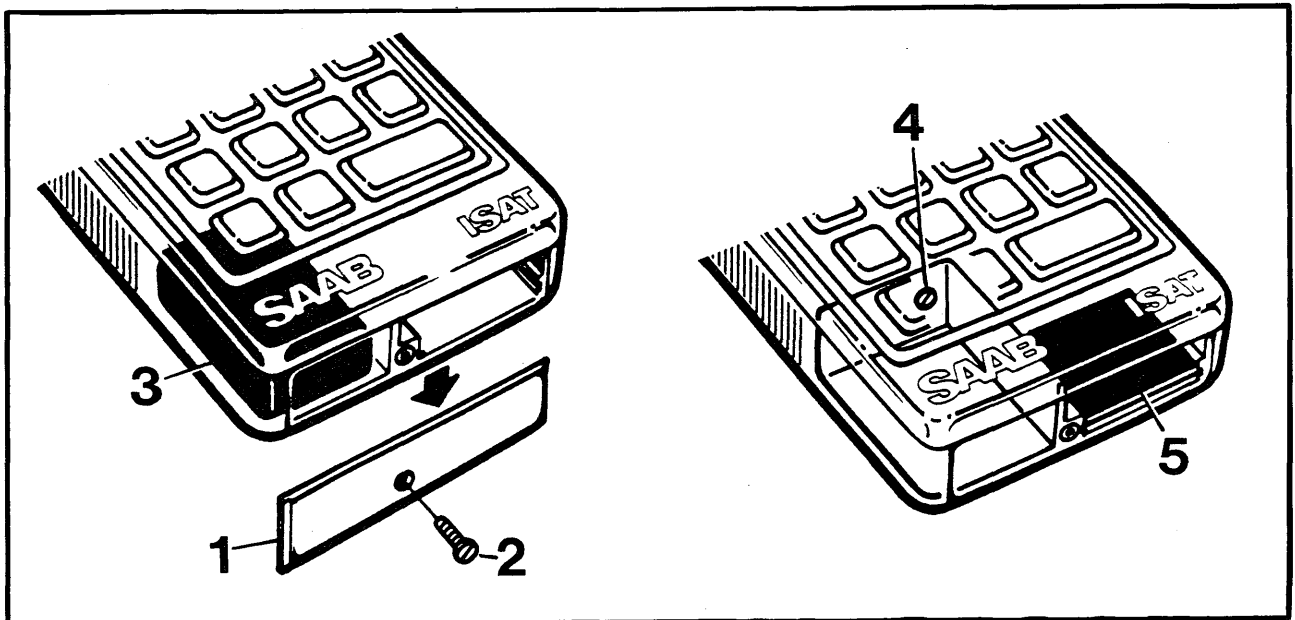


Plug-in control program board



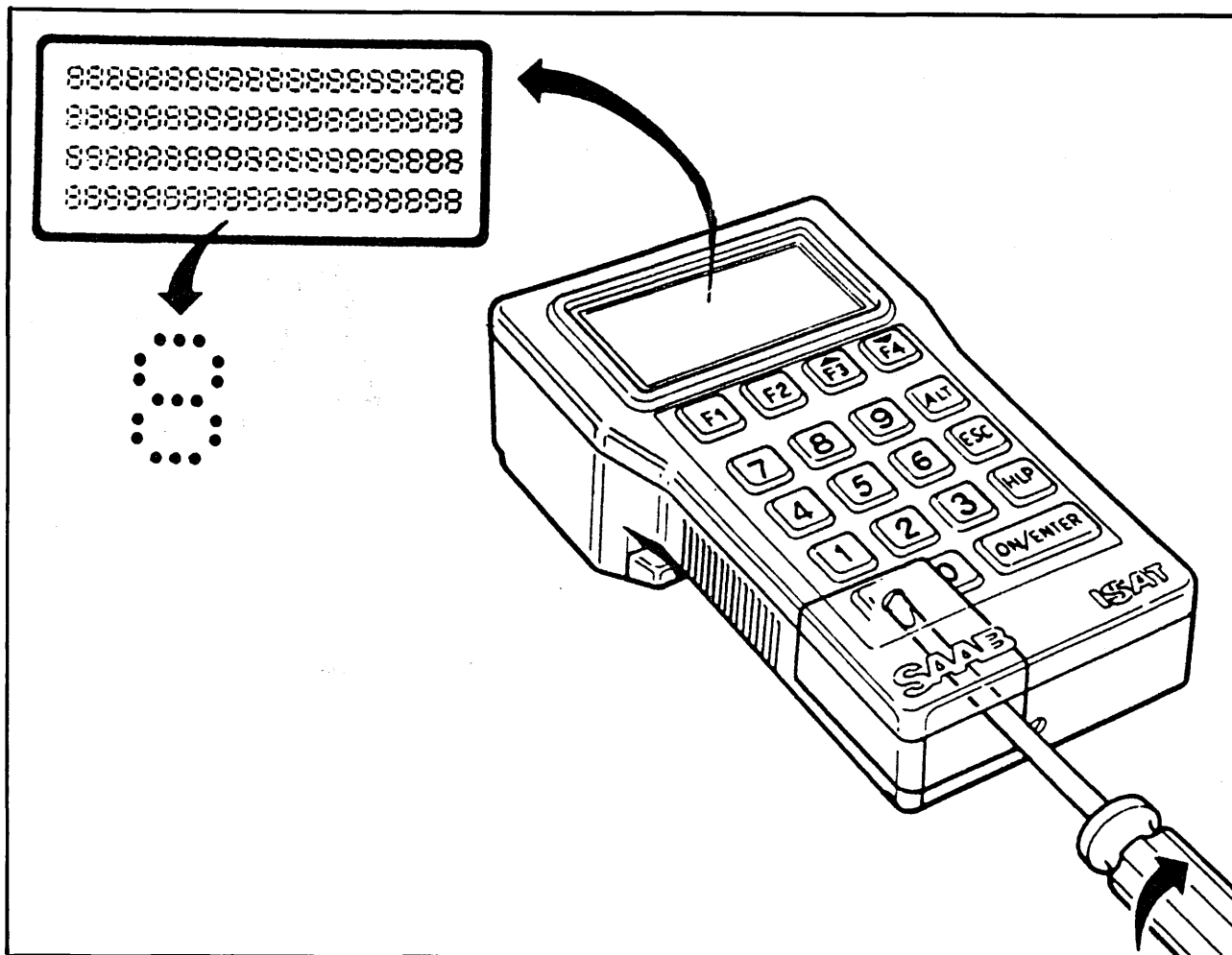
Interface ports

- | | |
|---|-------------------------------------|
| 1 Port for connection of TSI module (5-pin connector) | 6 Temperature |
| 2 Pressure (4-pin socket) | 7 Port for TSI lead |
| 3 System diagnosis (standard D-15 connector) | 8 Port for current tongs/TDC sensor |
| 4 DMM port, port for pulse width and frequency, and port for connection of TSI module | 9 Port for stroboscope |
| 5 Computer interface (standard D-9 connector) | |



Bottom edge of instrument

- 1 Cover
- 2 Cover retaining screw
- 3 9-V battery (type IEC 6F 22 or rechargeable)
- 4 Adjusting screw for display view-angle
- 5 Control program (plug-in EPROM board)



Each character is formed from a matrix of 5 x 7 dots.

Use a small screwdriver to turn the screw behind the battery cover to adjust the view-angle of the display.

Display

The display consists of a dot matrix of LCDs comprising four lines of 20 characters per line. Each character is formed from a fixed matrix of 5 x 7 dots.

To ensure that the display is clearly visible during use, the view-angle of the display can be adjusted to suit the position in which ISAT is held or placed. To adjust the view-angle, remove the battery cover and battery, and use a small, thin screwdriver to turn the adjusting screw.

With ISAT in the desired position, turn the screw slowly until the text on the display is as clear as possible. (Obviously adjustment can only be made with the tester switched on and text on the display.)

Keypad

The keypad consists of 19 translucent rubber keys for which automatic back-lighting is provided.

The ON/ENTER key (1) is used to switch the tester on and to execute commands that have been given.

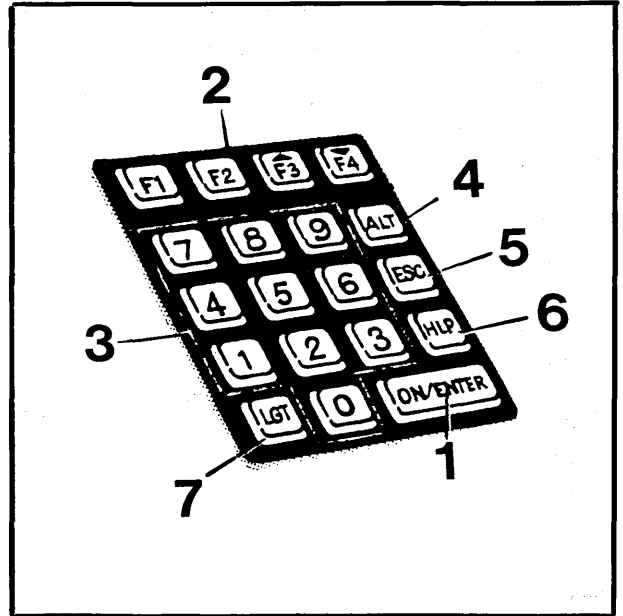
The four function keys, F1 - F4 (2), are used to select the appropriate menu functions. F3 and F4 are also used to scroll the display up or down when there are more than two error codes.

The numerical keys, 0 - 9 (3), are used to input data in response to prompts on the display.

To the right of the keypad is a group of three keys: ALT (4) to access additional functions by moving sideways through the menu; ESC (5) which is an escape key for aborting the current function; and HLP (6) which provides help in the form of additional information.

The LGT key (7) is not used.

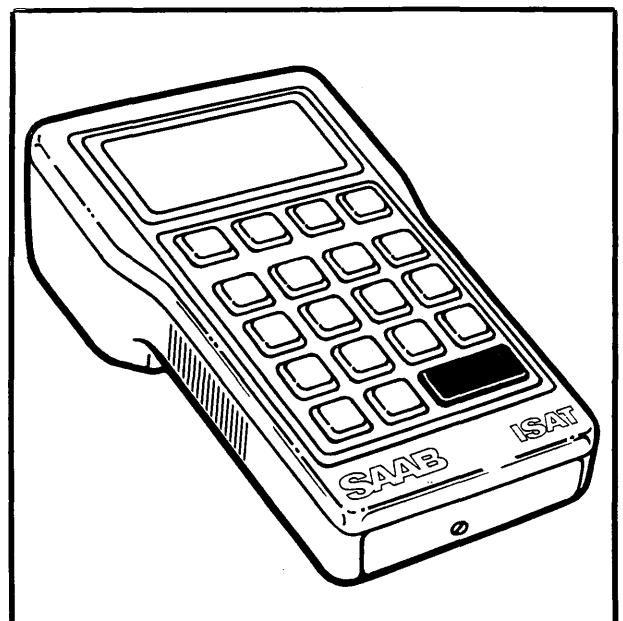
A more detailed explanation of the functions of the different keys follows.



ON/ENTER key

The key has two functions:

- To switch the tester on
- To instruct the tester to execute the command given. This function is similar to that performed by the RETURN or ENTER key on a computer keyboard.



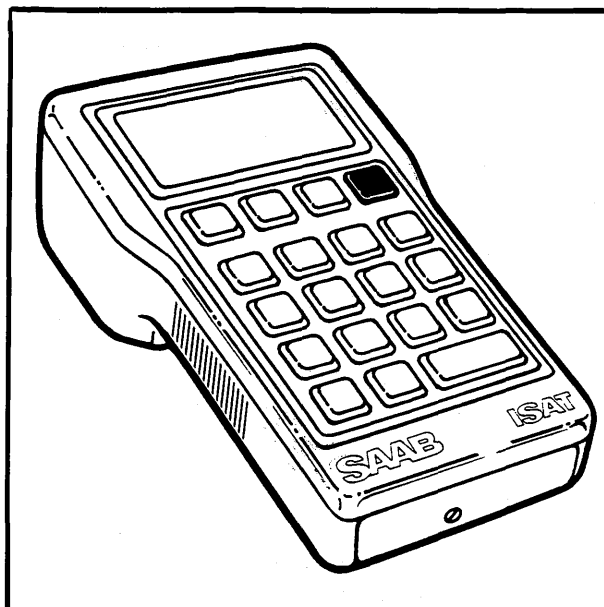
Switching the tester off

Regardless of which mode the tester is in (which menu function is on the display), the tester can be switched off as follows:

- 1 Call up the main menu (DIAG COMMS MEAS OFF).
- 2 Press F4 (OFF).

The tester is now off.

The tester will switch itself off automatically if it has not been used (no key pressed) for about eight minutes. To switch it on again, press the ON/ENTER key, whereupon ISAT will revert to the mode it was in immediately before it was switched off.

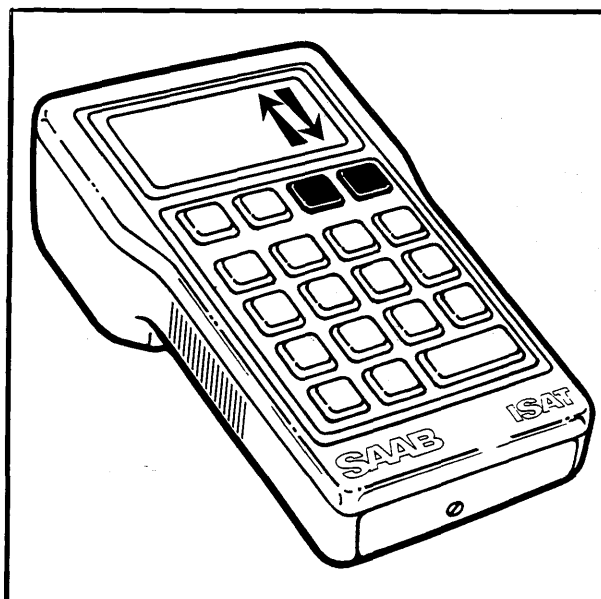


Function keys

The function keys (F1 - F4) are used to select/execute the menu function shown immediately above the respective key on the bottom line of the display.

The menu can be displayed in a variety of languages, details of which are given on page 40.

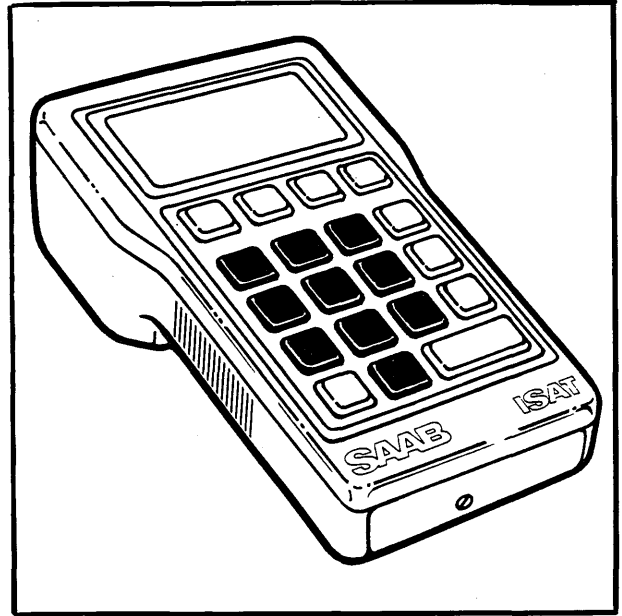
Keys F3 and F4 are used to scroll the display up or down to run through the error codes.



Press F3 to advance through the error codes (scroll display upwards). Press F4 to scroll back (down) through the error codes.

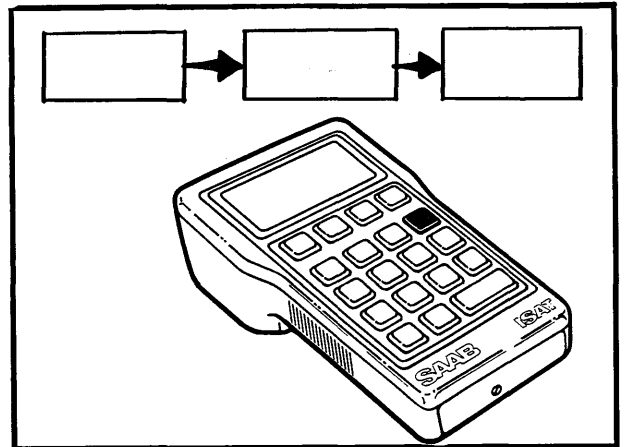
Numerical keys

The numerical keys are mainly used to respond to prompts appearing on the display. The different options and commands available are dealt with later on in the manual.



The ALT key

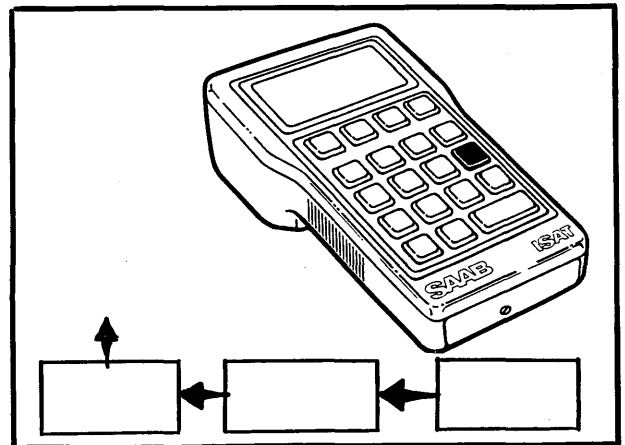
The ALT key is pressed one or more times to move sideways through the menu to access a new set of functions.



The ALT key is used to move sideways through the menu to access additional functions.

The ESC key

The ESC (escape) key is used to go back to the preceding menu page or next highest level in the menu. If for some reason you do not wish to continue the selected function, press this key and the function will abort immediately (this applies to the majority of functions).

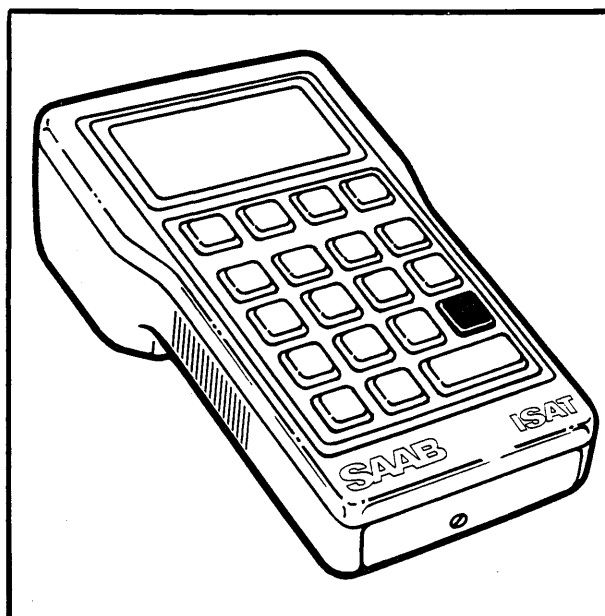


Use the ESC key to return to the preceding or next highest menu page.

The HLP key

The HLP (help) key is used to obtain additional information on the menu functions. For instance, if you are unsure about the meaning of DIAG, when the main menu is on the display, press this key and the tester will display: DIAGNOSIS of systems.

Help is available for all the menu functions shown on the display.



If uncertain of the meaning of the menu, use the HLP key.

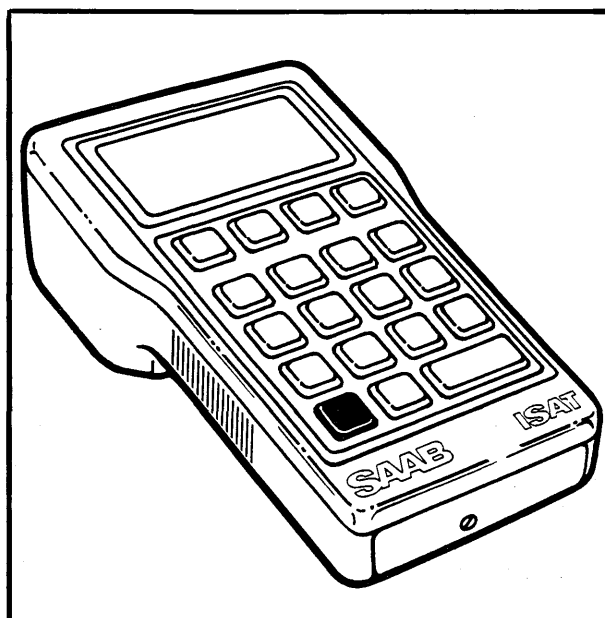
The LGT key

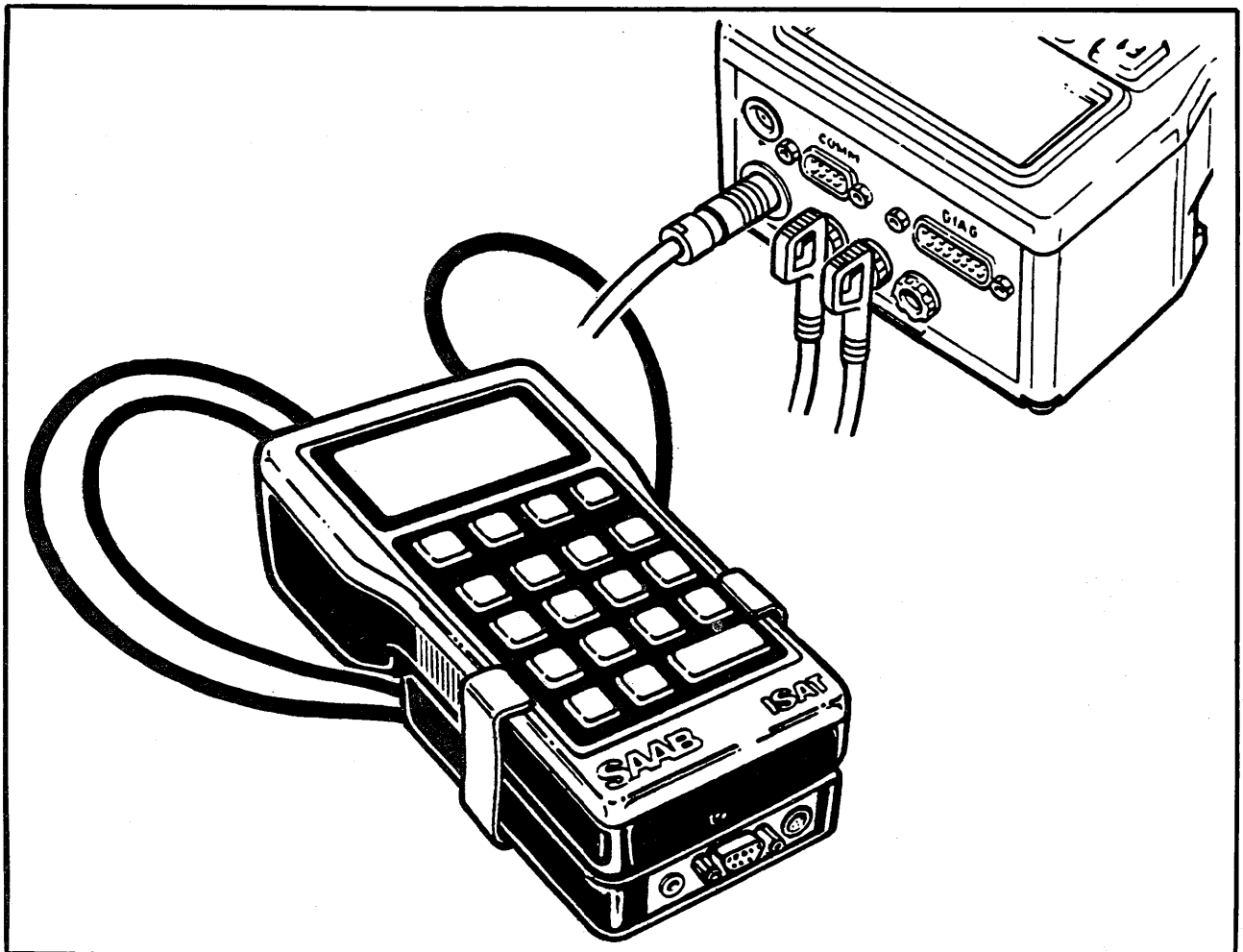
This switch was provided for switching on/off the back-lighting for the display and keys.

However, since power consumption is high with the back-lighting on, the tester's battery would quickly be run down if the tester were not connected to the car battery. ISAT has therefore been modified so that back-lighting can only come on when the tester is connected to the car's power supply.

The modification means that back-lighting is now switched on automatically when the tester is connected to the car's diagnostics or TSI socket.

The LGT key is thus no longer used.

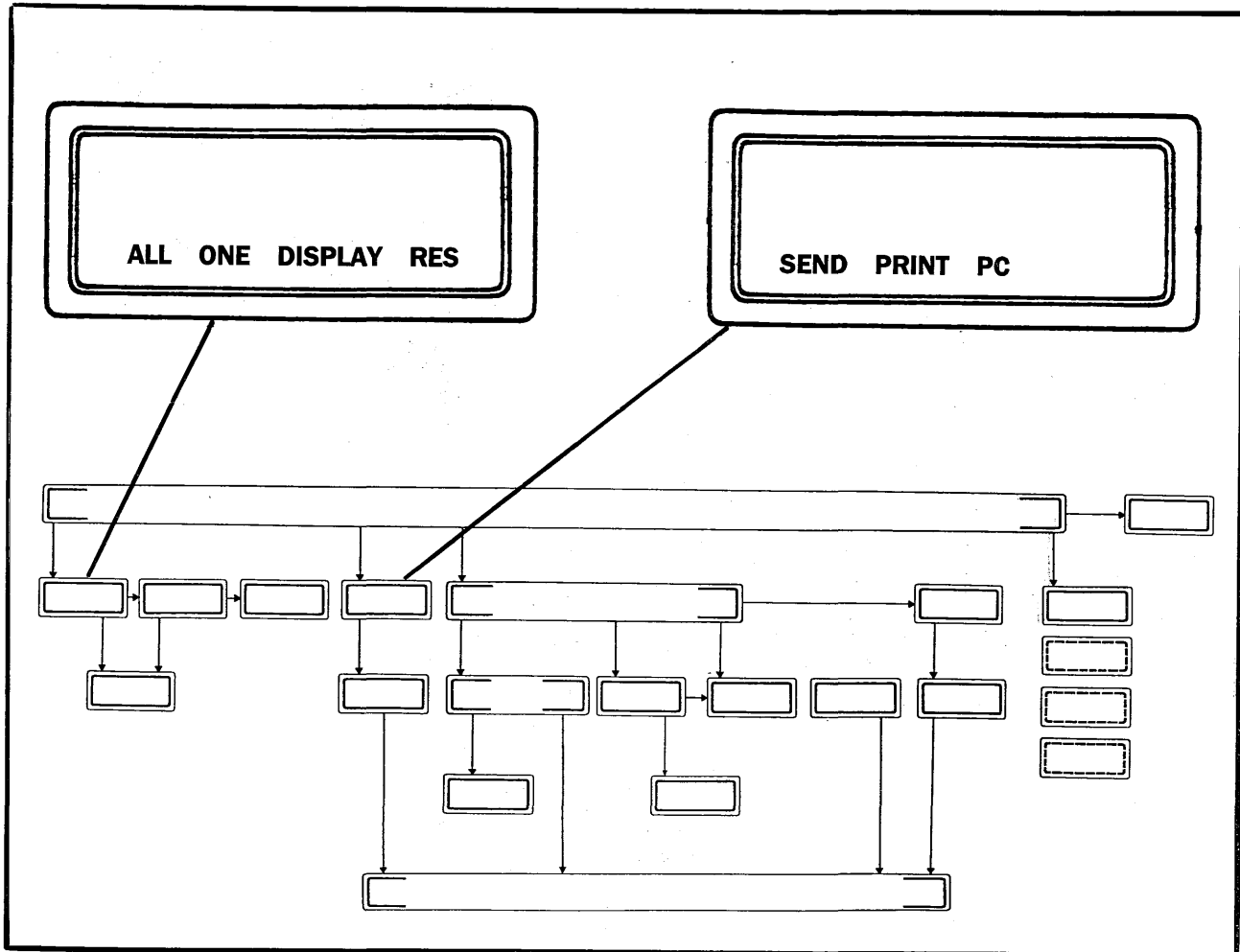




Fitting the TSI module (Part no. 8610941)

For testing the ignition system, the TSI module must first be connected to ISAT as follows.

- 1 Slide the module in position underneath ISAT and fit the clips to secure it, as shown.
- 2 Plug the respective module leads into the TSI port and red and black ports on ISAT.
- 3 Connect the TSI test lead between the car's TSI socket and the TSI port on the module. Plug the combined lead for the inductive proximity detector and TDC sensor into the D-9 port on the TSI module. If the stroboscope is to be used, plug this into the TSI module as well.



A flowchart for the menu is given on the fold-out on page 43. Open the page out so that you can refer to it when reading the description of how to use the menu pages.

Menu functions

The majority of instructions and commands to ISAT are entered via the function keys (F1 - F4), the functions of which are always shown on the bottom lines of the display.

Put simply, the system of menu pages can be likened to the root system of a tree, with new roots branching off from each level.

Before using ISAT, you must acquaint yourself with the way in which the menu system is built up, so that you know what functions are available and roughly where in the menu they are to be found.

A comprehensive flowchart for the menu will be found on the fold-out on page 43.

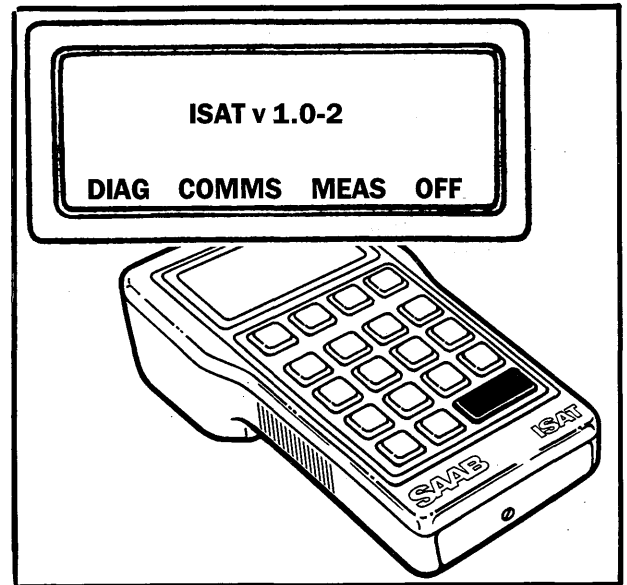
Moving through the menu

Immediately after the ON/ENTER key has been pressed to switch on the tester, the current version of the ISAT software and hardware will be displayed: e.g. 'ISAT v 1.0-2'. When ISAT is upgraded, by fitting a new control program board, the version number on the display will be upgraded automatically.

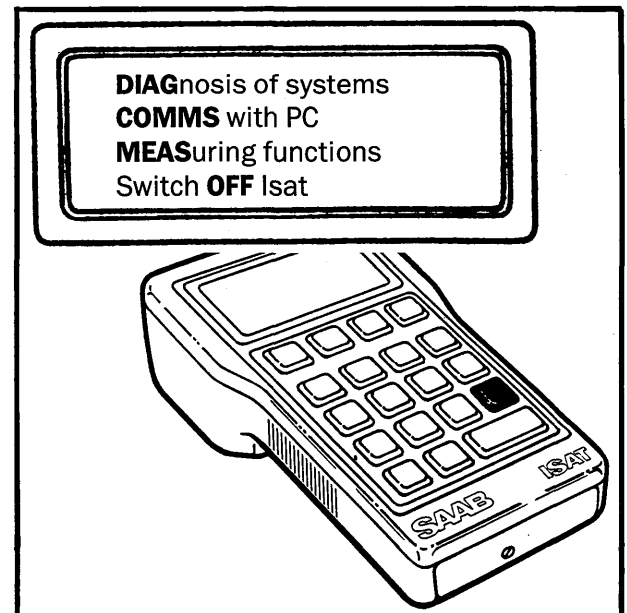
Also shown on the display is the main menu page:

DIAG COMMS MEAS OFF

This is the page at the top of the menu tree.



For an explanation of these functions, press the HLP key.



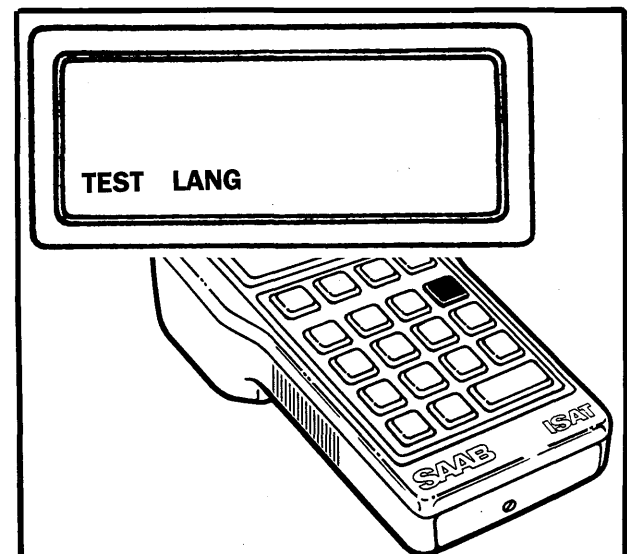
To access other functions at this level in the menu, call up the next menu page by pressing the ALT key. A new set of functions will now appear on the display (see the menu flowchart).

If more functions are available at this level (another menu page), press the ALT key again to bring these onto the display. If there are no more functions, ISAT will return to the preceding menu page at the same level.

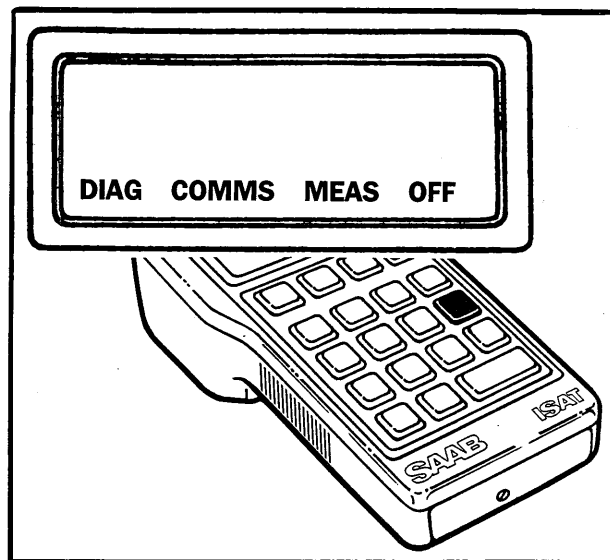
Note

Always use the ESC key to return to the preceding menu page, or to move back further through the menu.

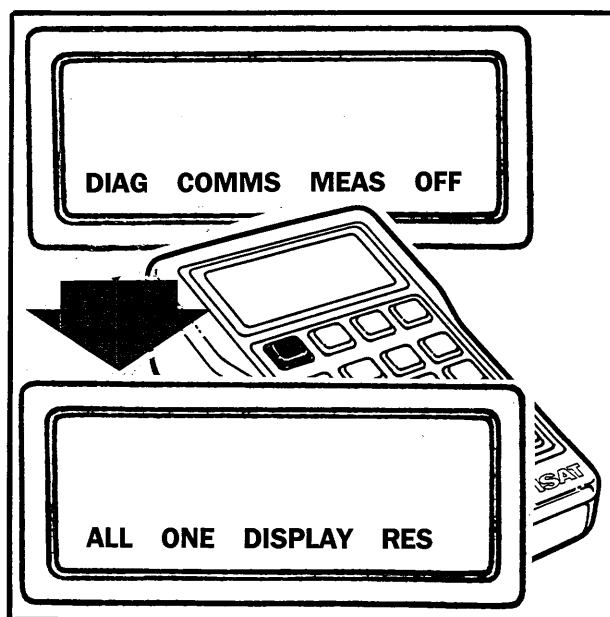
Although pressing the ALT key will have the same effect if no other functions are available on the same level of the menu, if other functions are added at a later date, pressing the ALT key would then call in the next menu page



Thus, to return to the preceding menu page, always use the ESC key, which is basically a cancel key for the current function.



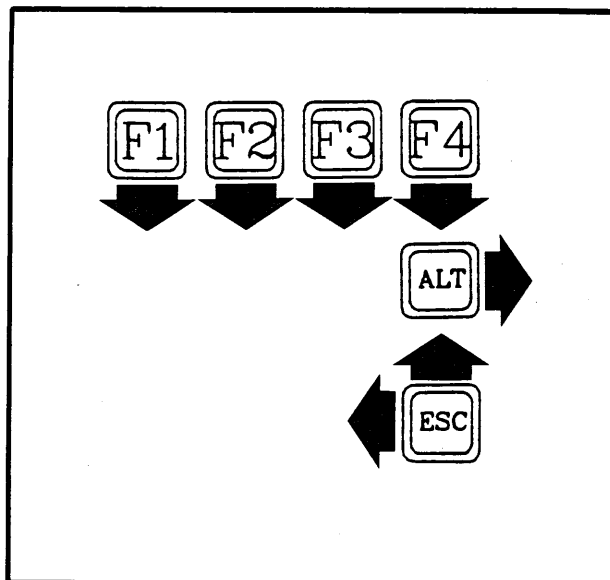
To move down to the next level in the menu, press the appropriate function key, i.e. F1 for DIAG, F2 for COMMS, etc.

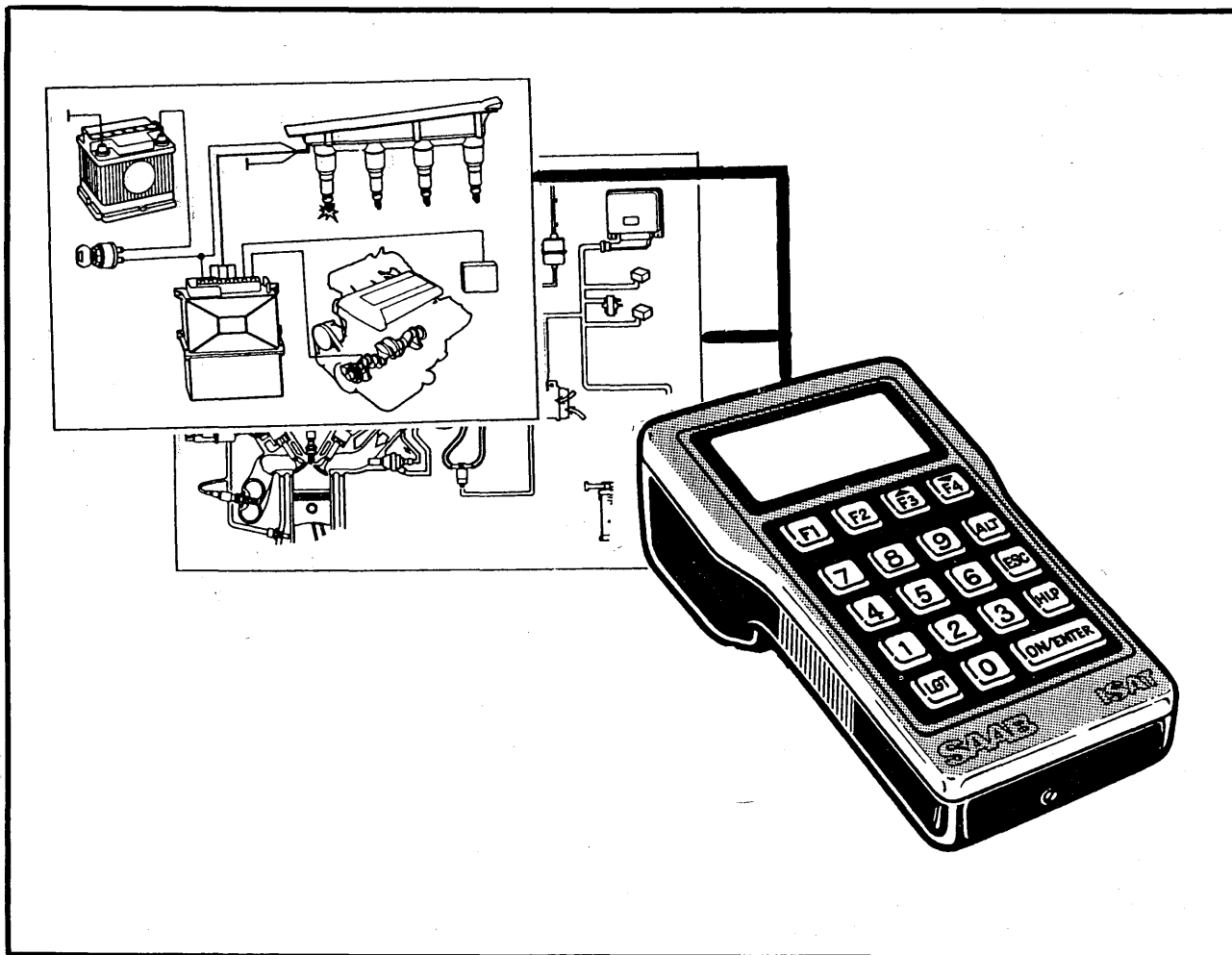


Press F1 to access the functions under DIAG.

Continue moving through the menu in this way until you get to the desired function. Remember: use the function keys to move down through the menu, the ALT key to move to the right on any given level, and the ESC key to move to the left through the menu.

Using the ESC key when a page to the extreme left of the menu is on the display will effect a move up to the next level of the menu.





System diagnostics

The DIAG function on the menu enables ISAT to tap into the integral self-diagnostics function in the ECU of one or more systems. The data can then be displayed on ISAT, stored in memory or recalled at a later juncture.

ISAT's diagnosis function also enables you to enter special command codes for controlling system functions.

Connecting ISAT to the car

Two diagnostics sockets are provided underneath and near the front of the passenger seat.

The black socket is for the engine electronics (DI-APC, LH) and the green one for the chassis electronics (ACC 2, EDU).

Plug diagnostics lead set 86 10 701 into ISAT's DIAG socket and the other end into the appropriate 10-pin diagnostics socket on the car (for details see the appropriate section of the Workshop Service Manual for the system concerned). For M88 variants equipped with a 4-pin diagnostics socket, use diagnostics lead set 86 10 693.

For further details of connecting ISAT to the car, see the appropriate section of the Workshop Service Manual for the system concerned.

ISAT can either be held in the hand or (with the TSI module removed) hooked onto the door window lowered to a convenient height.

Fault-diagnosis work

Before starting work, find the fault-diagnosis chart in the appropriate section of the Workshop Service Manual for the system concerned.

The fault-diagnosis chart for the system gives particulars of which diagnostics socket is to be used, the system no. for ISAT, which error codes are used for the system, what action should be taken to rectify a fault, etc. Details are also given of the command codes to be entered on ISAT for controlling different system functions.

To transfer self-diagnostics data from ECU to ISAT

Note

For all diagnosis work, the ignition key must be in the Drive position with the engine off.

- 1 Switch on ISAT and press F1 (DIAG).
- 2 Decide whether you want to transfer fault data from just one system ECU (ONE) or from all systems (ALL).

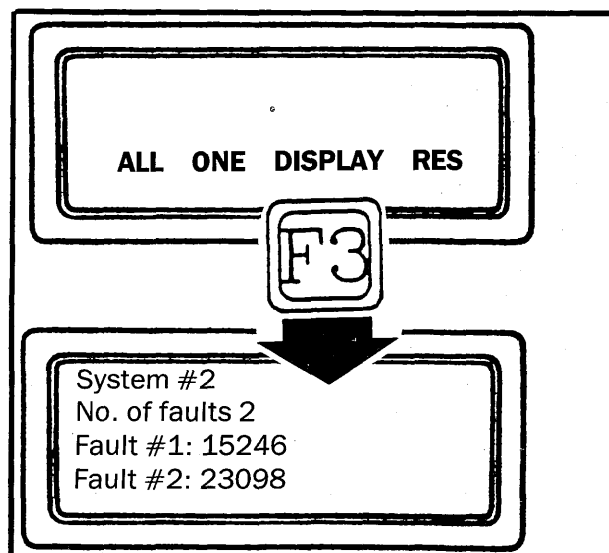
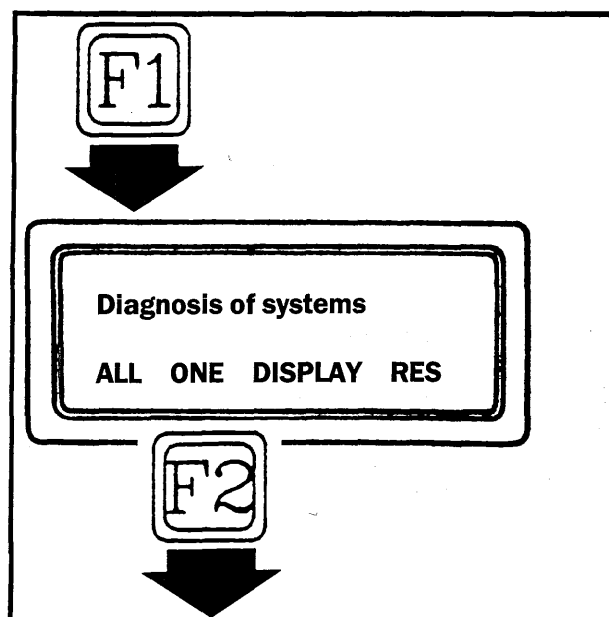
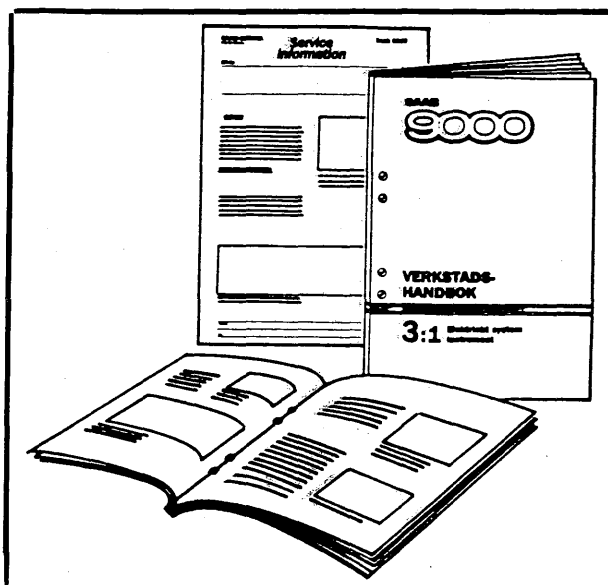
Follow the prompts on the display until the operation has been completed.

Note

After the data have been transferred to ISAT and the diagnosis function has been completed, communication with the ECU (ECUs) must be terminated by selecting the menu page for TERMINATE (see the menu flowchart fold-out on page 43).

Displaying the results

- 1 To display the self-diagnostics results, press F3 (DISPLAY).
(If diagnosis of just one system was selected, the results will be displayed automatically.)
- 2 Use the F3 and F4 keys to scroll the display up or down to run through the error codes.

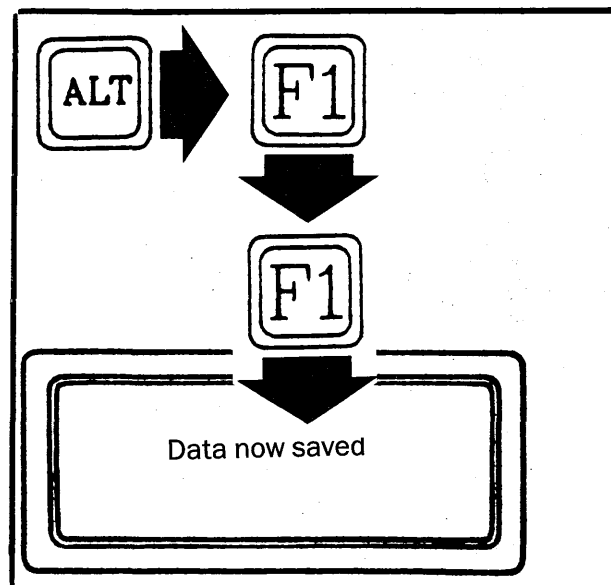


Saving the fault data

If you wish to save the fault data for recall and analysis at a later time, proceed as follows.

- 1 Press the ALT key and then F1 (SAVE).
- 2 Because any fault data already stored in the memory will be destroyed when new data are saved, ISAT asks for the instruction to be confirmed. Acknowledge by pressing F1 (YES).

The fault data have now been stored in ISAT's memory (EEROM).



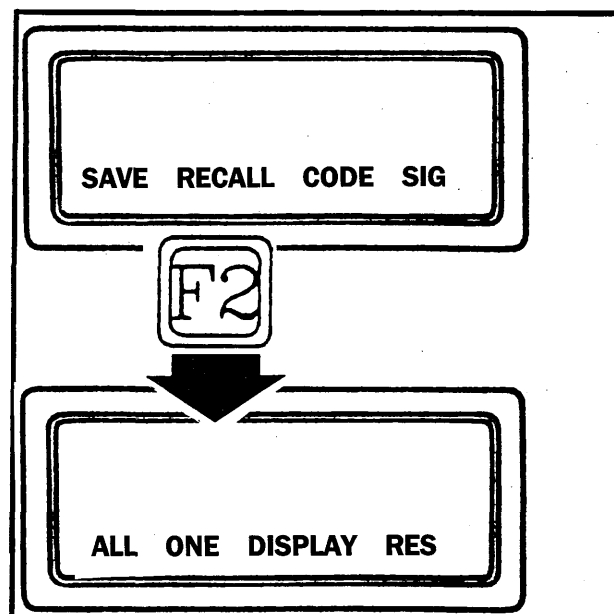
Recalling data from the memory

- 1 Call up menu page SAVE RECALL CODE SIG and press F2 (RECALL).

When the DATA have been retrieved, ALL ONE DISPLAY RES will appear on the display.

- 2 Press F3 (DISPLAY) to display the fault data retrieved.

Use F3 and F4 to scroll the data as required.



Deleting fault data in ISAT's memory

There is no special function for clearing ISAT's fault-data memory.

All existing fault data will be destroyed when new data are saved using the SAVE function.

Clearing fault data from the system (ECU)

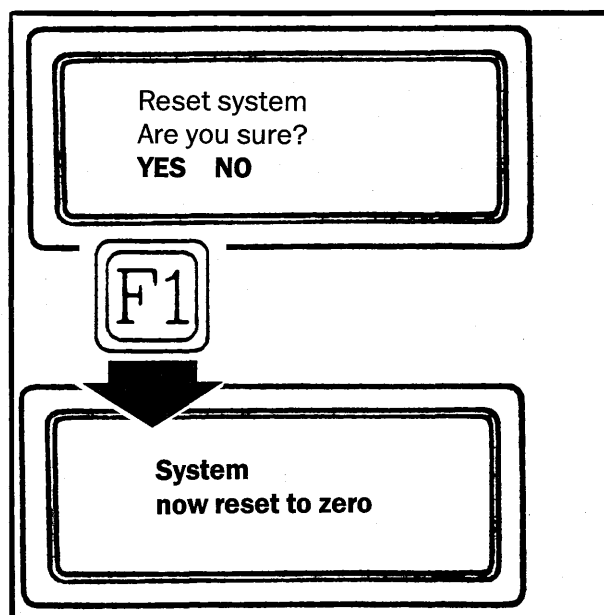
Once the diagnosis function has been completed, with fault data having been copied to ISAT, the fault data must be cleared from the ECU for the diagnosed system. Only one system can be reset at a time.

- 1 Call up menu page ALL ONE DISPLAY RES and press F4 (RES).

ISAT now asks which system (1-7) is to be reset. Enter the appropriate number for the system and then press the ON/ENTER key.

ISAT now gives you the chance to change your mind by asking whether you definitely want to reset the system, thus deleting the fault data.

- 2 Confirm by pressing F1 (YES), whereupon the fault data will be cleared from the system's ECU.



Note

After the fault data in the ECU for the selected system have been cleared, the link between ISAT and that system must be terminated. Call up the menu page for TERMINATE (see menu flowchart on page 43) and press the appropriate function key.

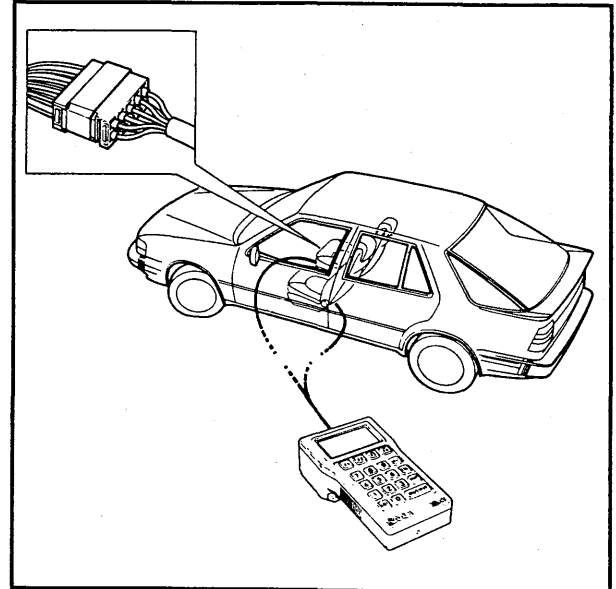
Example**Diagnosis of Saab DI****Note**

For details of the fault-diagnosis procedure and the meaning of the error codes, see the appropriate section of the Workshop Service Manual for the system concerned.

The car's electronics are divided into two main systems: 1 (black) for the power-train electronics and the other (green) for the chassis electronics.

Connect the Saab DI test lead set to the socket (black) for the power-train electronics.

On M88 cars this socket is a 4-pin connector, which means that the special diagnostics lead set supplied with the tester (n/a US) must be used.



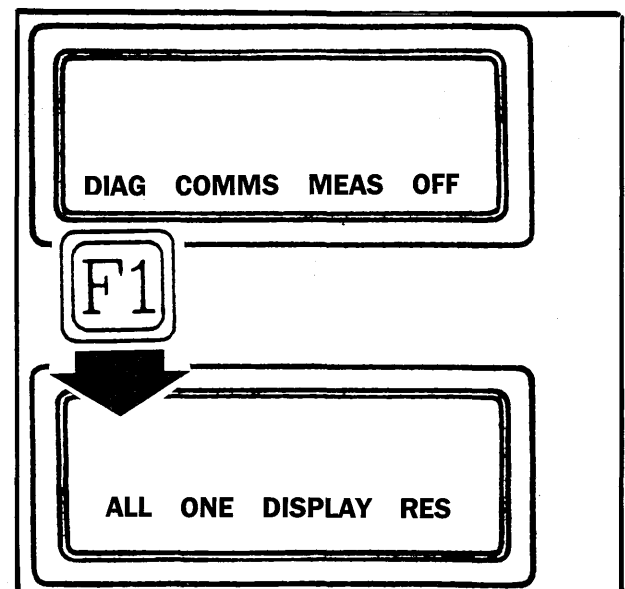
- 1 With the engine off, turn the ignition key to the Drive position.

Switch the tester on. The ISAT version will now be displayed together with the main menu DIAG COMMS MEAS OFF.

We want the diagnosis function, so to select DIAG we press the key underneath it.

- 2 Press F1.

ISAT now displays the first menu page on the next level: ALL ONE DISPLAY RES.



If we press the HLP key, the display tells us that to diagnose one system we need to select ONE.

3 Press F2.

The display now tells us to select the system to be diagnosed.

Note

Each system has been assigned a system number between 1 and 7. To find the system number we must refer to the appropriate section of the Workshop Service Manual for the system concerned.

Saab DI has system no. 2.

ISAT is waiting for us to enter the system number.

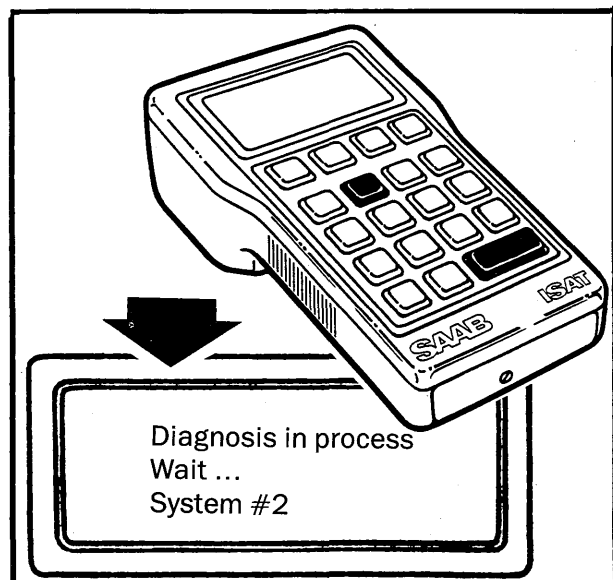
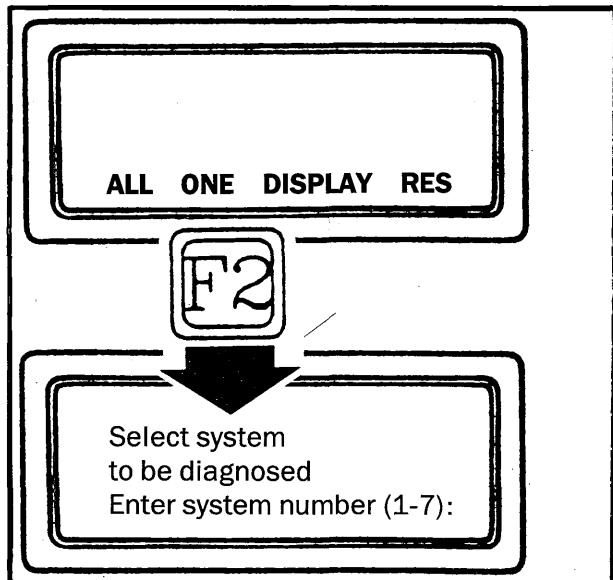
4 Press the '2' key followed by the ON/ENTER key to instruct the tester to execute the function.

ISAT now taps into the ECU for the DI system and retrieves the fault data on any intermittent or permanent faults in the system. The display confirms that diagnosis of system 2 is in process and tells us to wait.

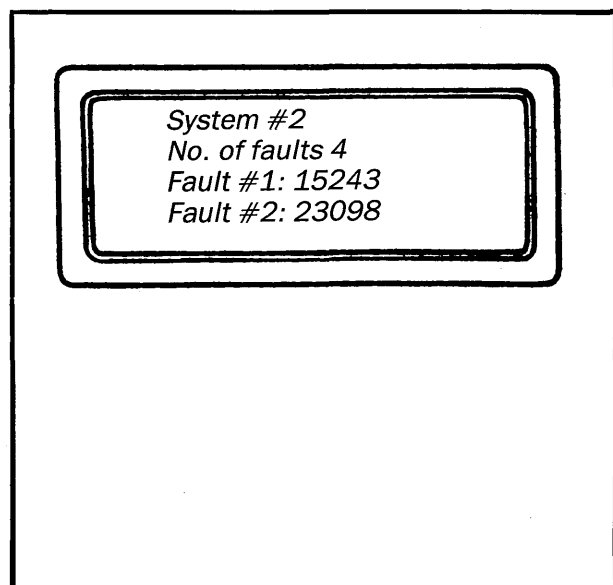
When ISAT has completed the diagnosis, the number of faults retrieved from the ECU, together with the error code for each fault, will be displayed.

In this example, ISAT has copied four faults from the ECU into the ISAT memory.

Two of the faults, together with the error codes, are shown on the display.



Diagnosis of system 2 in process.



- 5 To view the remaining two faults, press F3 to scroll the text up on the display.

The two remaining faults together with their error codes will now appear on the display.

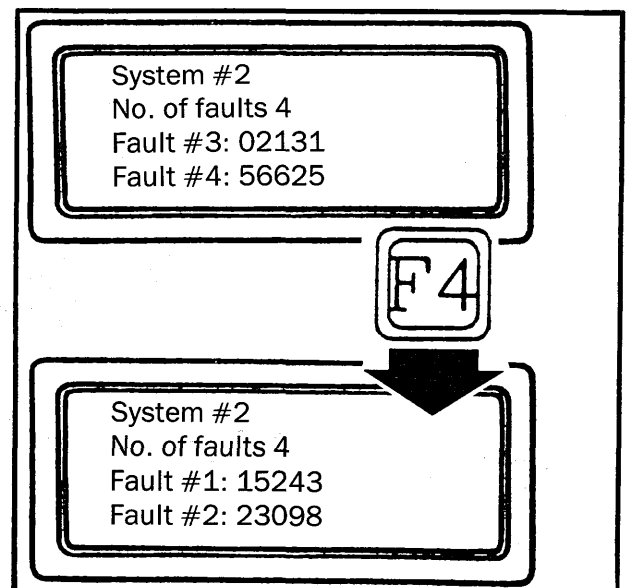
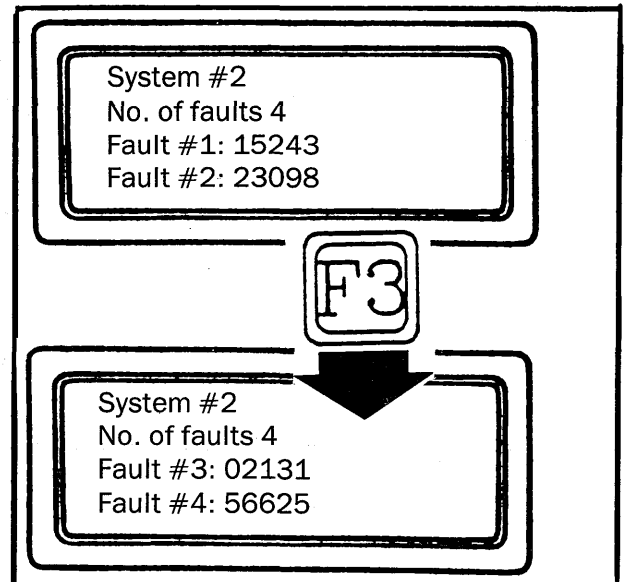
Note

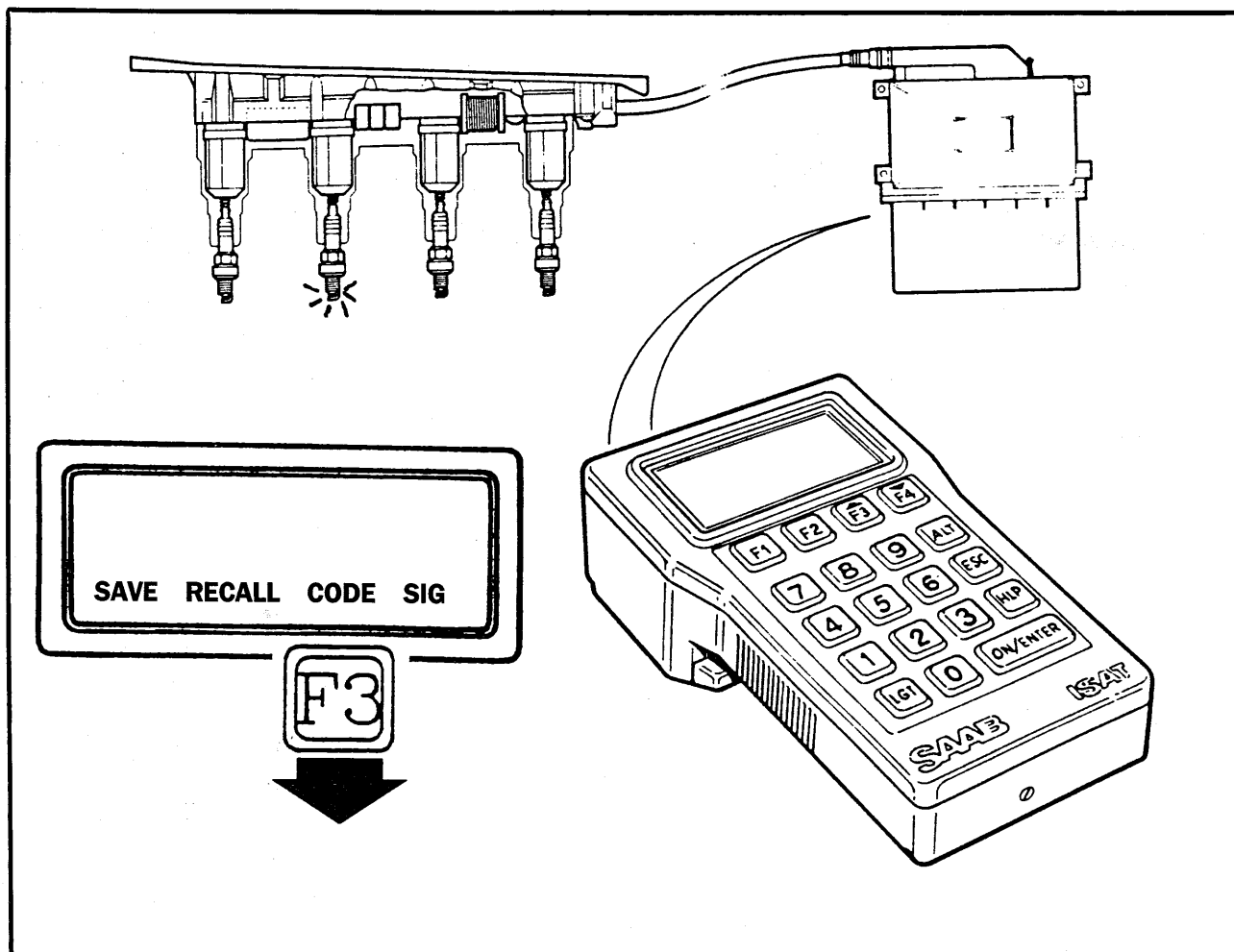
The faults are not displayed in any logical sequence, so you decide the order in which to rectify them yourself.

- 6 To scroll the display down again, press F4.

Note

If ISAT is unable to complete the diagnosis, a message giving the reason will be shown on the display, e.g. 'system 2, contact not made'. Other communications problems in the form of outside interference can also arise, e.g. interference from high-tension lines, radio transmitters, thunderstorms, etc.





Command codes

In the appropriate section of the Workshop Service Manual for the system concerned, a list is given of the 3-figure command codes or control signals that can be entered via the ISAT keypad to activate certain functions in the system.

If the first figure of the command code is changed to a 2, the command will be repeated continuously. ISAT indicates that a command is being repeated continuously by displaying a star that moves along the bottom line of the display.

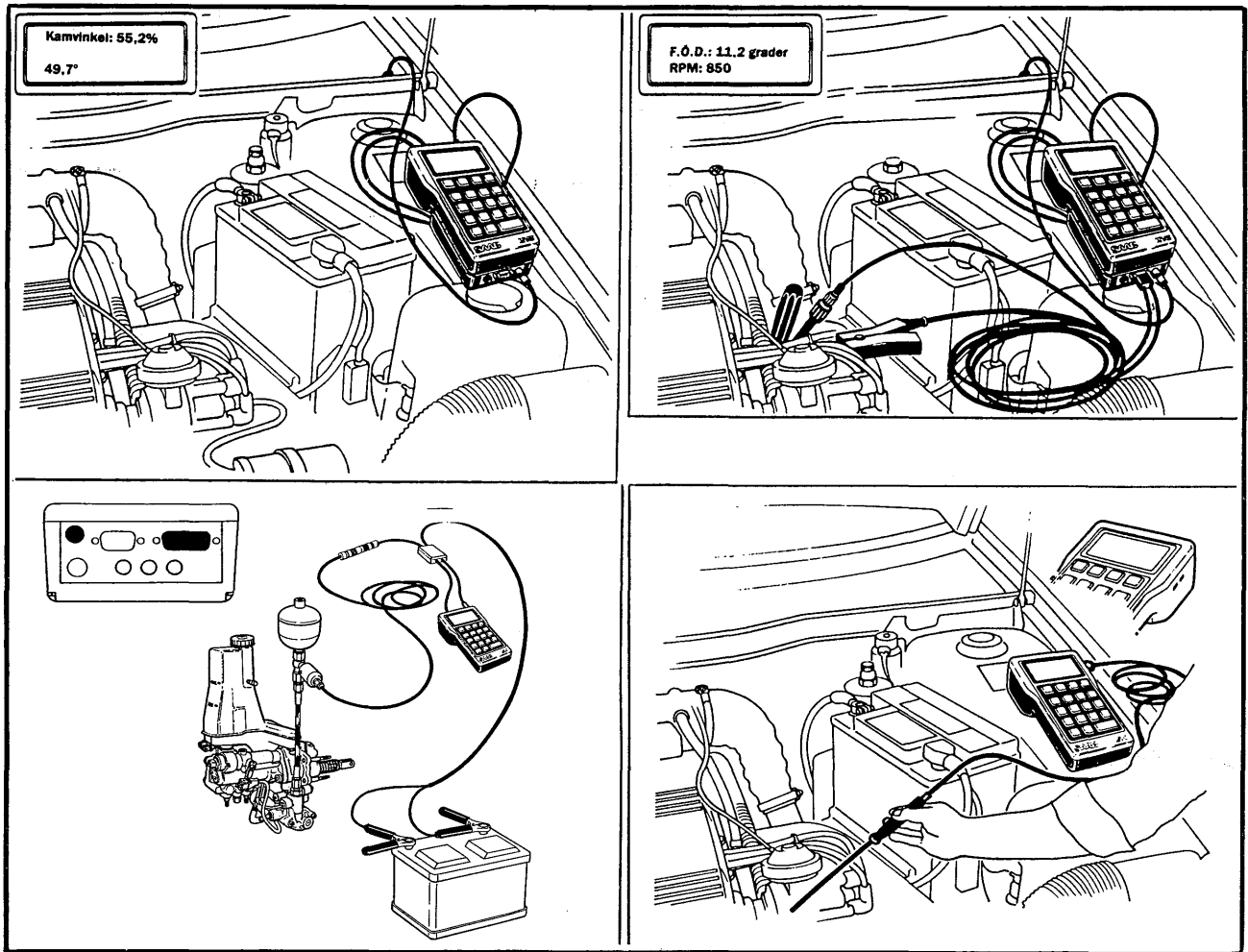
Note

The engine must be off and the ignition switch in the Drive position.

- 1 Call up menu page: SAVE RECALL CODE SIG.
- 2 Press F3 (CODE) and key in the desired code. Press ON/ENTER to execute the command.

Note

After the required system functions have been activated, the link between ISAT and the system must be terminated. To do this, call up the menu page TERMINATE and press the appropriate function button. Switching off the ignition will also terminate the link between ISAT and the system.

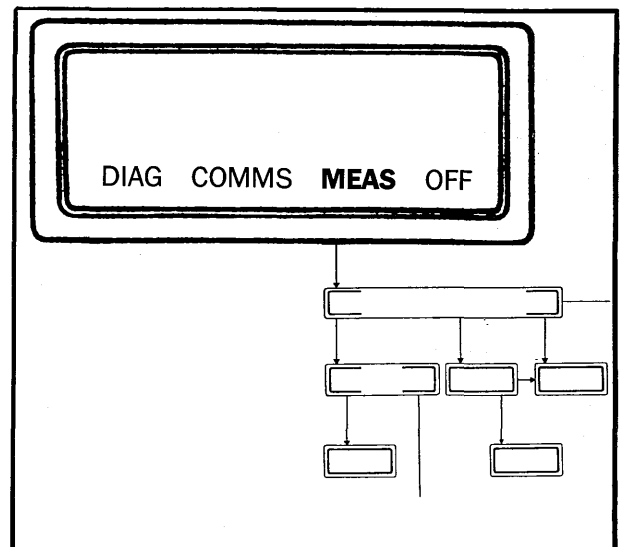


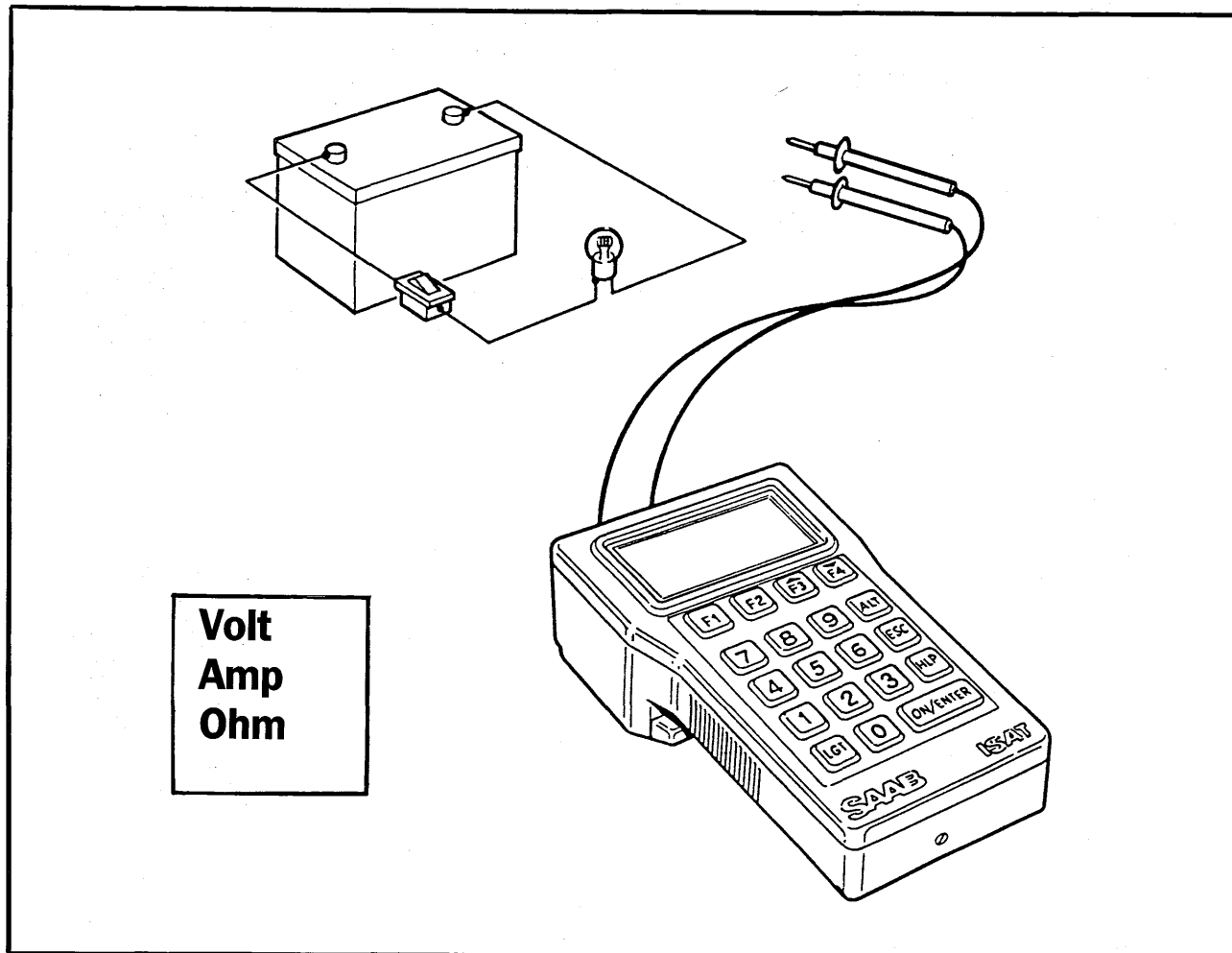
Measuring functions

The following measuring functions are available when MEAS on the main menu is selected by pressing F3:

- Multimeter functions (voltage, current and resistance) plus sampling
- Pulse width and frequency
- TSI functions (timing, dwell angle, rpm, AIC)
- Lambda control
- Temperature (°C, °F)
- Pressure
- Compression

Refer to the menu flowchart on page 43.





Multimeter functions

Just one of many functions incorporated in ISAT is that of a multimeter, for measuring voltage, current and resistance.

ISAT has an autoranging function, which selects the correct measuring range automatically.

Measuring ranges:

Voltage: -126 to +126 V d.c

Current: -10 to +10 A d.c. (up to 600 A with current tongs)

Resistance: 0 - 256 kohm

For details of accuracy, see the Technical Data section.

Note

When ISAT is being used purely as a multimeter, and is not connected to the TSI or diagnostics socket on the car, it takes its power from the internal battery. In normal use, power consumption is very low and the battery should last for a long time.

However, because power consumption is high when low-value resistances are being measured, such measurements should only be made when the tester is connected to the car's power supply via the diagnostics or TSI socket. If the tester has not been used (no key pressed) for about eight minutes, it will switch itself off automatically. When switched on again by means of the ON/ENTER switch, ISAT will revert to the mode it was in immediately before it was switched off.

For instructions on how to replace the battery, see page 42.

Measuring current (Example)

- 1 Press F1 (MULTI).

The menu VOLT AMP OHM SAMP will now be displayed. From this menu we can measure voltage, current or resistance, or select the function for sampling the measured values.

- 2 Press F2 (AMP) to measure current.

Choosing the measuring range (AMP)

We must now choose the appropriate measuring range:

F1 (<10 A) = 0 - 10 A

F2 (<100 A) = 10 - 100 A

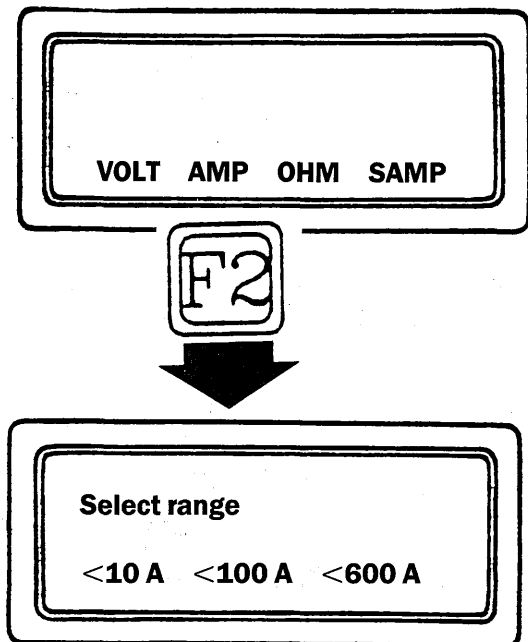
F3 (<600 A) = 100 - 600 A

Note

To avoid damaging ISAT, test lead set 86 10 719 supplied with the tester must **always** be used for measuring current. (A 10-A fuse is fitted inside the red plug.)

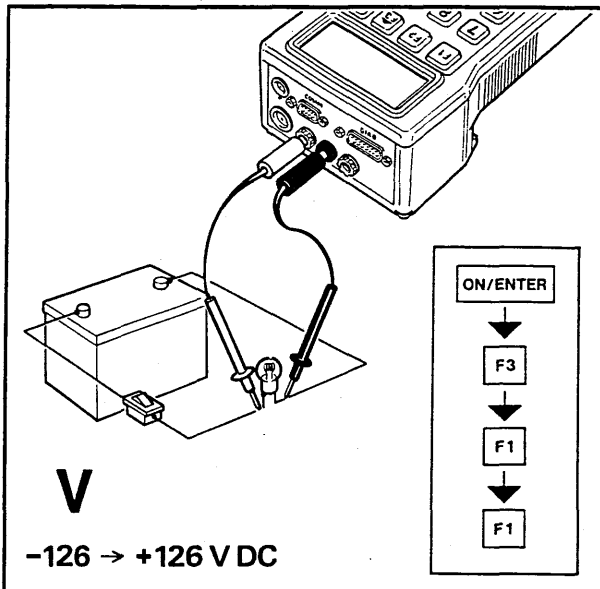
Measuring of current higher than 8 A must not exceed 30 seconds.

Current tongs 86 10 743 must be used for measuring current higher than 10 A.

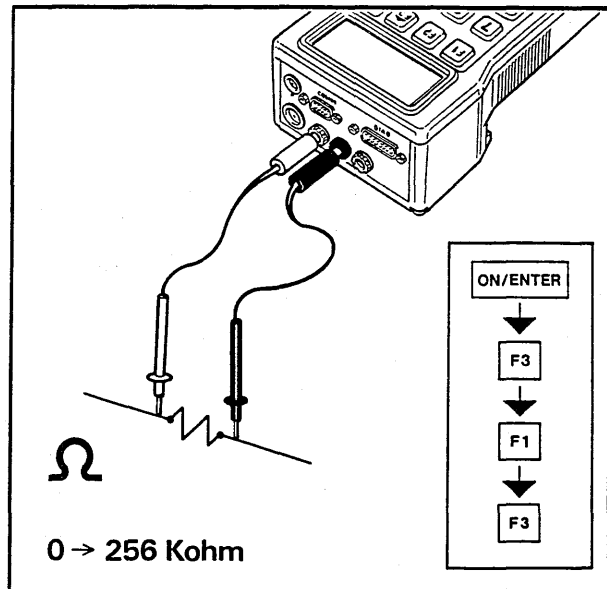


To replace the fuse in DMM test lead

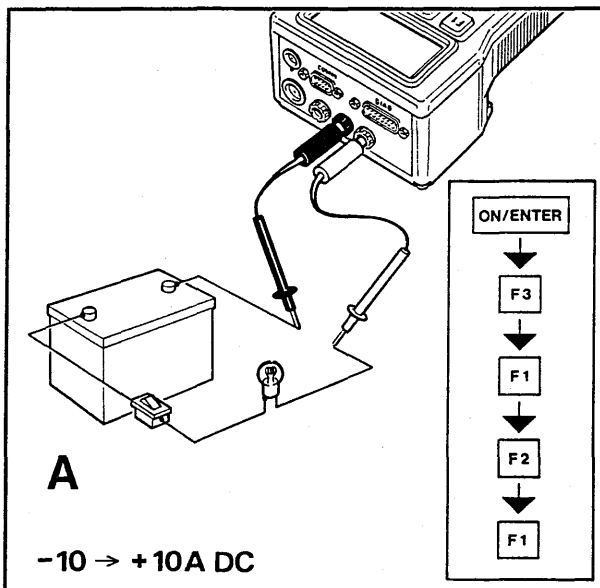
- 1 Unscrew the pin from the red plug and remove the fuse.
- 2 Fit a new 10-A fuse and screw back the pin.



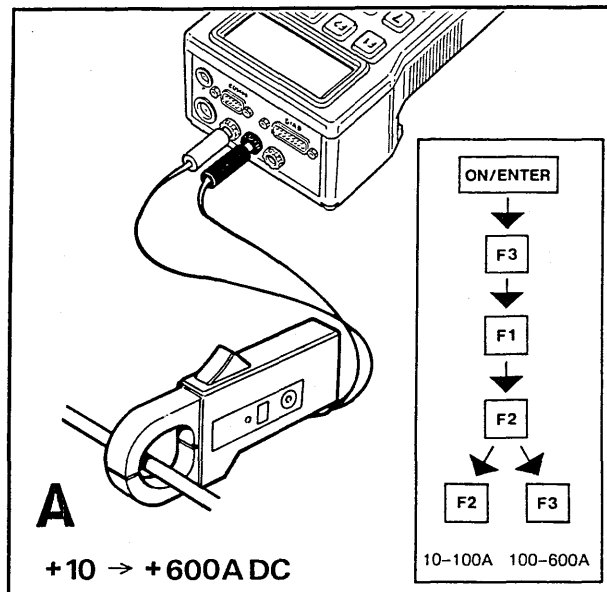
Measuring voltage



Measuring resistance



Measuring current



Current tongs 86 10 743 must be used to measure current greater than 10 A

For measuring voltage and resistance, the test leads must be connected to the black and red ports; for measuring current, to the black and white ports.

The current tongs must be connected to the black and red ports (voltage). Remember to select the measuring range on the tongs.

Sampling of measured values

To check a signal or function by measuring the current, voltage or resistance, the ISAT multi-meter functions (VOLT AMP OHM) will usually be used, whereby readings will be obtained for the instantaneous values of the the units measured.

However, for more reliable testing of a series of measurements taken over a given period, the sampling function (SAMP on the menu) can be used to display minimum, average and maximum values.

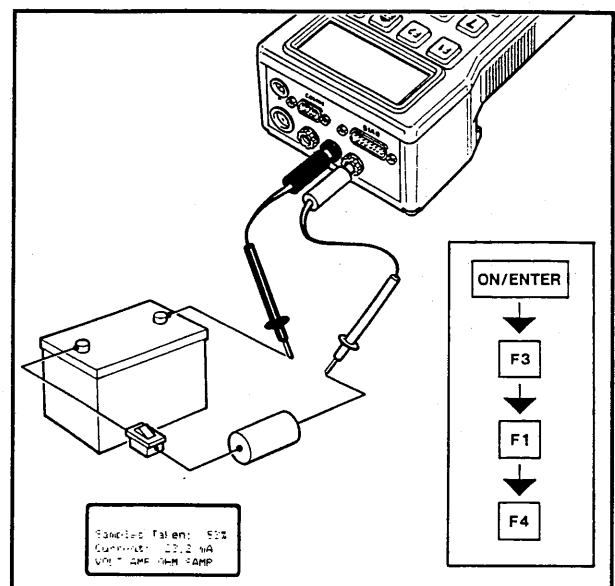
The sampling function can also be used to detect current or voltage surges (transients) caused by a function or source of interference outside the circuit being tested.

The sampling function can also be used for temperature or pressure readings.

Note

For measuring voltage or resistance, the test leads must be connected to the black and red ports; and for measuring current, to the black and white ports.

- 1 Connect test lead set 86 10 719 to ISAT's DMM ports.
- 2 Switch the tester on and advance through the menu to select the unit to be measured (VOLT AMP OHM SAMP).
- 3 Connect the test probes to the appropriate measuring points and press F4 (SAMP).



Four sampling-frequency options, ranging from five to 100 Hz, will now be shown on the display.

Depending on which frequency is selected, ISAT will measure at regular intervals the instantaneous value of the selected unit 1,000 times, i.e. at a frequency of 5 Hz, measurements will be recorded five times a second.

Thus, the time taken by the sampling function will vary with the frequency selected:

$$5 \text{ Hz: } (1,000/5) = 200 \text{ s} = 3 \text{ min } 20 \text{ s}$$

$$10 \text{ Hz: } (1,000/10) = 100 \text{ s} = 1 \text{ min } 40 \text{ s}$$

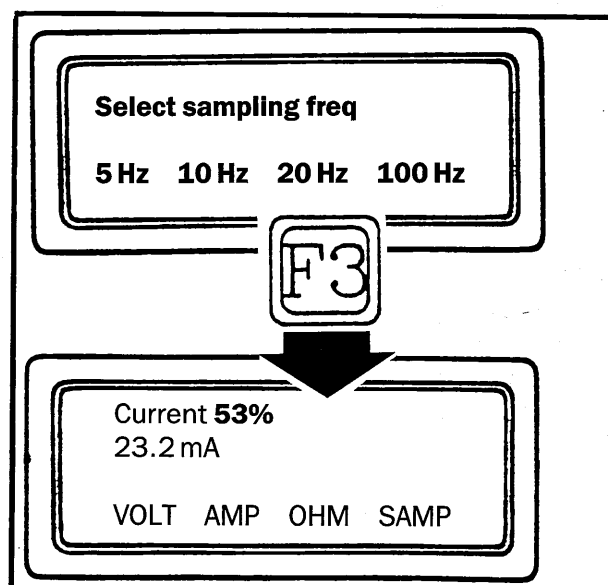
$$20 \text{ Hz: } (1,000/20) = 50 \text{ s}$$

$$100 \text{ Hz: } (1,000/100) = 10 \text{ s}$$

- 4 Select the sampling frequency by pressing the appropriate function key.

During sampling, ISAT will display and update continually the number of measurements taken as a percentage of the total.

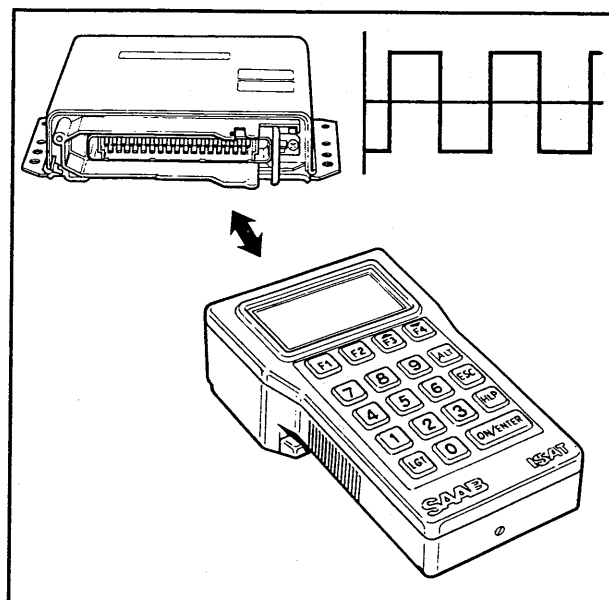
- 5 After completed sampling, read off the values from the display. Maximum, average and minimum values are shown.



Measuring pulse width and frequency

For measuring pulse width and frequency, test lead set 8610719 must be connected to the black and red ports.

- 1 Call up menu page:
MULTI PULS TSI TEMP and press F2 (PULS).
- 2 Connect the test probes to the appropriate measuring points and read off the pulse width and frequency.



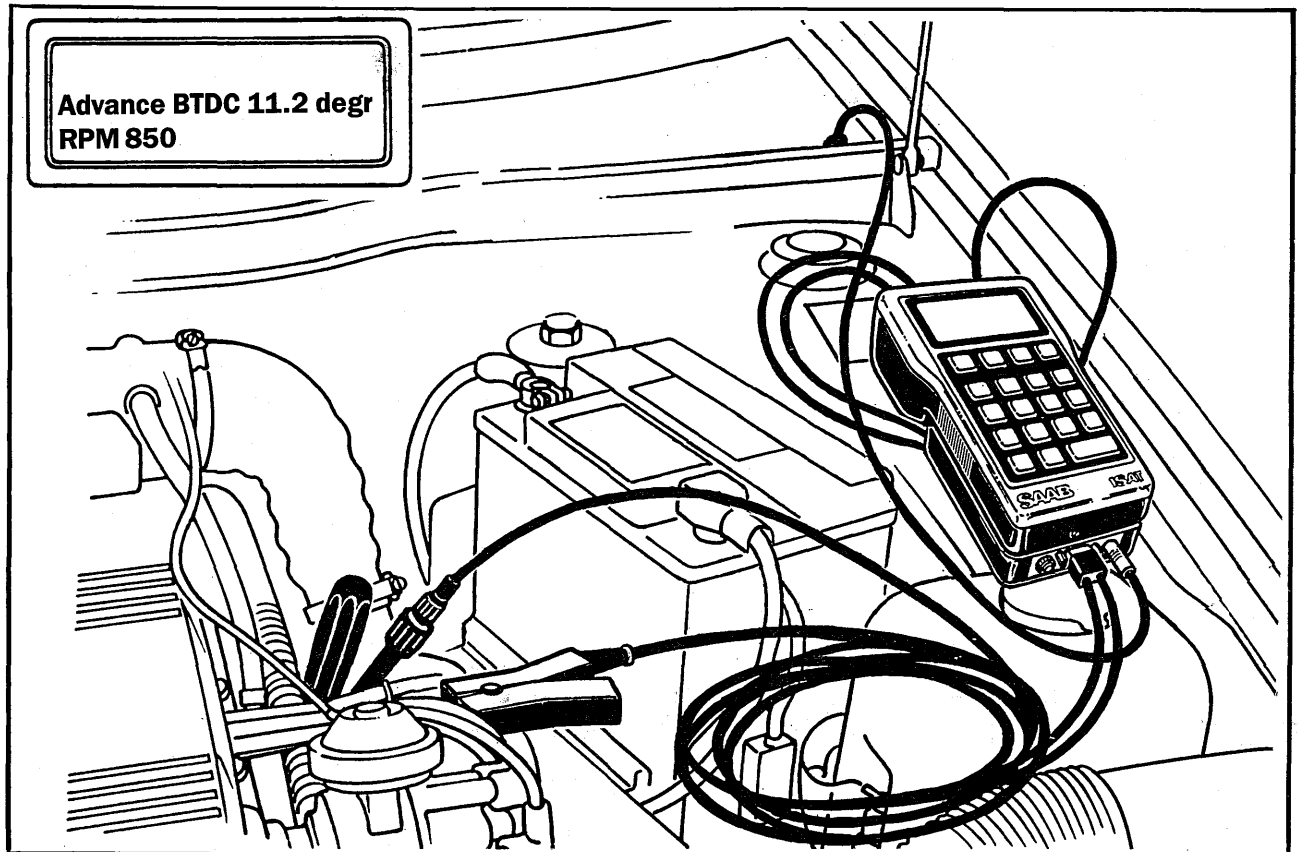
TSI functions

The following TSI functions are available:

Ignition timing (IGN)
Dwell angle (DWELL)
Engine speed (RPM)
Pulse ratio (AIC)
Lambda (LAMB)

} with TSI module
connected

For details of how to adjust these settings, refer to the appropriate section of the Workshop Service Manual.



Timing (IGN)

To freeze the display for five seconds to make it easier to note the reading, press ON/ENTER at any time during testing.

To check the timing with the TSI module connected, proceed as follows:

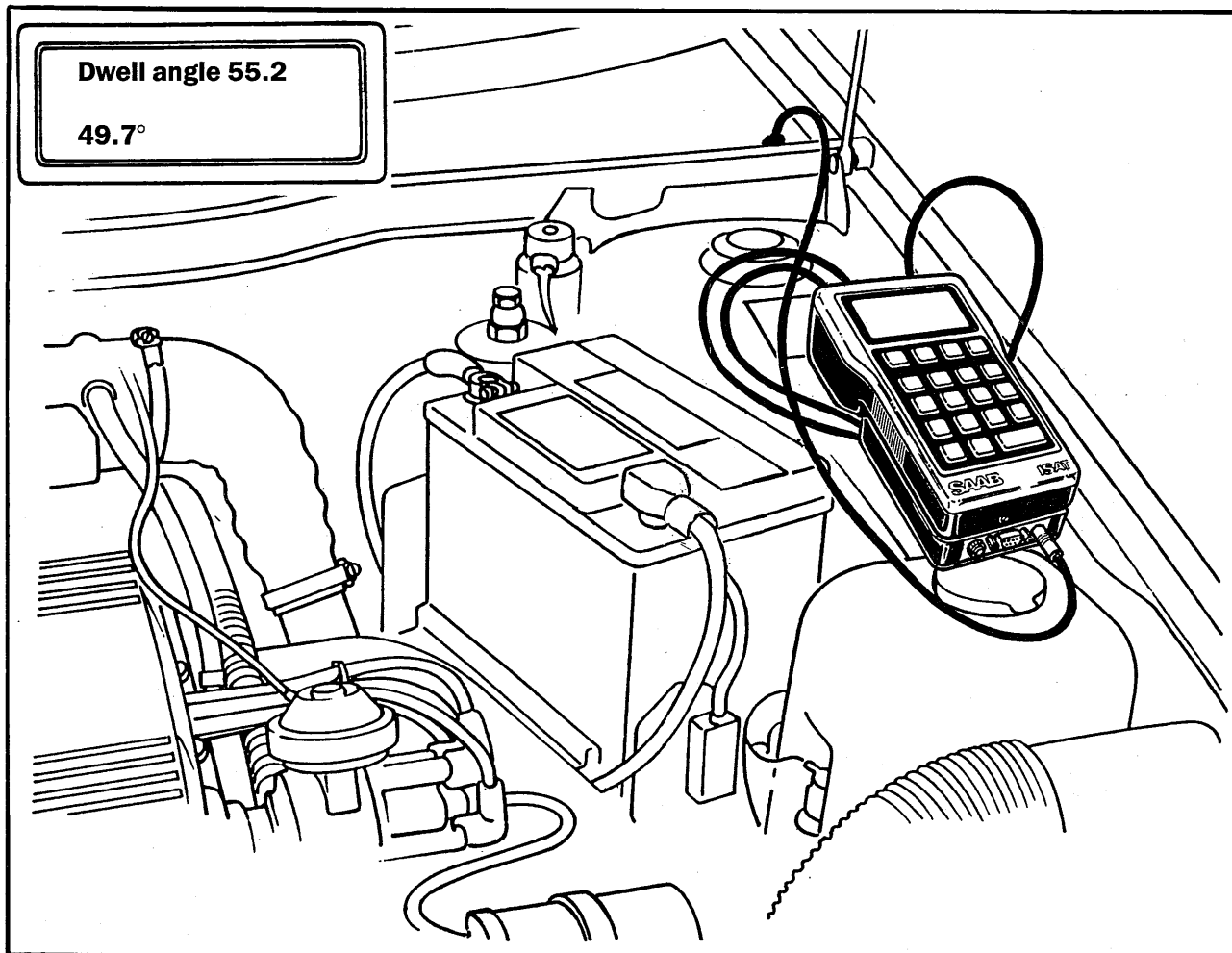
- 1 Connect test lead set 86 10 727 between the TSI module and the TSI socket in the car.
- 2 Position TDC sensor 88 19 005 in the opening in the flywheel cover and connect it to the lead from the current tongs (86 10 735).
- 3 Connect current tongs 86 10 735 to the TSI module and clamp the tongs onto the HT lead for no. 1 cylinder.
- 4 Switch on ISAT, advance through the menu and select IGN.

- 5 Start the engine and read off the ignition advance from the display.

To make it easier to adjust the timing, engine RPM is also shown on the display.

Note

The timing can also be checked by connecting stroboscope 86 10 958 to the TSI module. Note the timing by means of the mark on the flywheel.



Dwell angle

To check the dwell angle on cars with mechanical breaker points, proceed as follows (TSI module connected):

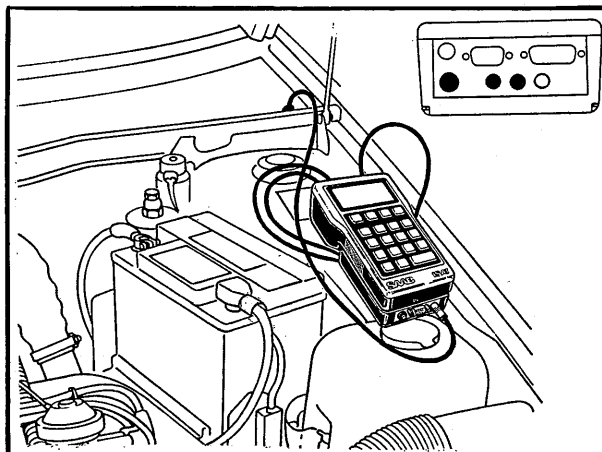
- 1 Connect test lead set 86 10 727 between the TSI module and the car's TSI socket.
- 2 Switch on ISAT, advance through the menu and select DWELL.
- 3 Start the engine and read off the dwell angle from the display.

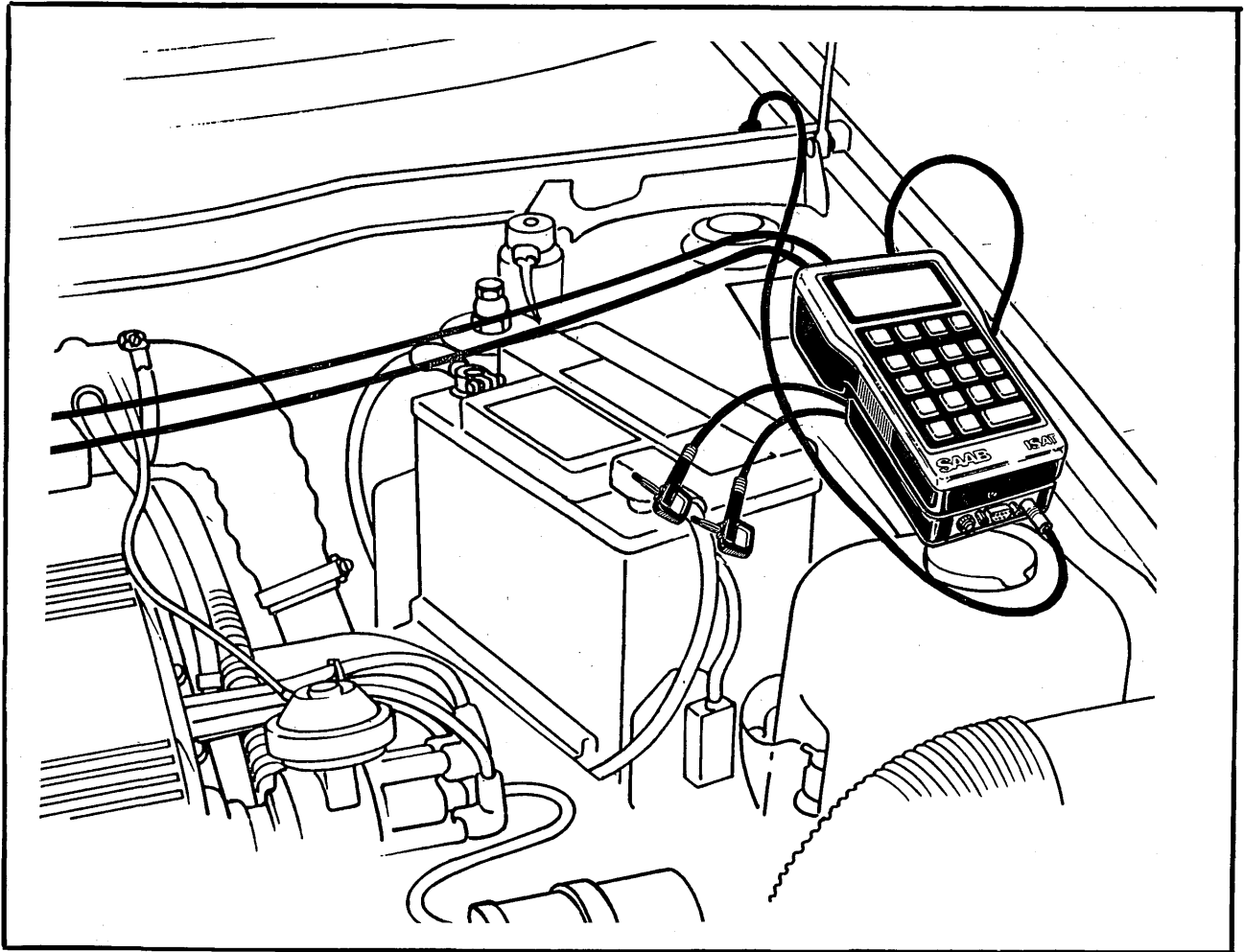
Engine RPM is also shown.

Measuring engine RPM

With the TSI module connected, check engine RPM as follows:

- 1 Connect TSI lead set 86 10 727 between the TSI module and the car's TSI socket.
- 2 Switch on ISAT, advance through the menu and select RPM.
- 3 Start the engine and read off engine RPM from the display.





Pulse ratio of AIC valve (LH 2.2)

With the TSI module connected, and the test probes on test lead set 86 10 719 connected to the AIC-valve connector, the setting of the AIC valve can be tested.

Note that for this test the right-angle banana plugs must be unplugged from the tester.

Connect the red lead to pin 2 (blue/red) and the black lead to pin 3 (yellow/red) of the connector. If test lead set 86 10 727 is connected between the TSI module and the car's TSI socket, engine RPM will also be displayed.

For details of specified values and how to adjust the setting, see section 2:3 of the Workshop Service Manual.

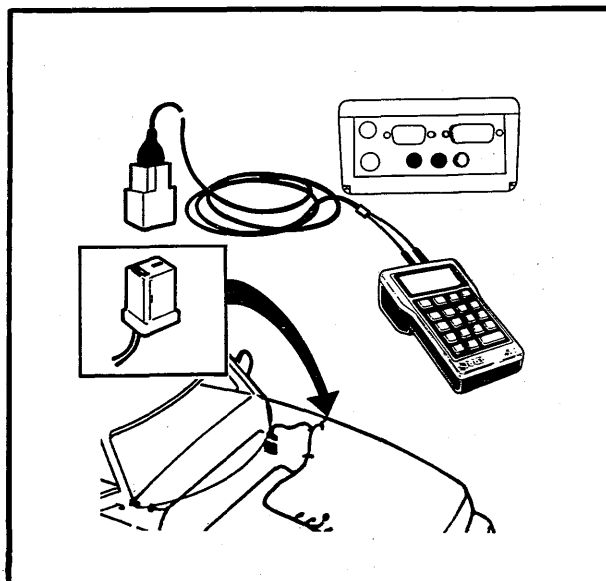
Lambda function

Cars with catalytic converter

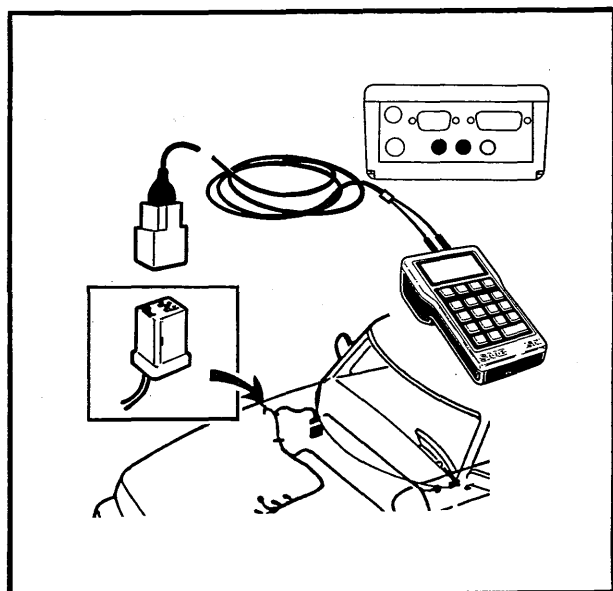
To check the Lambda function on cars with catalytic converter, proceed as follows:

B201 engine

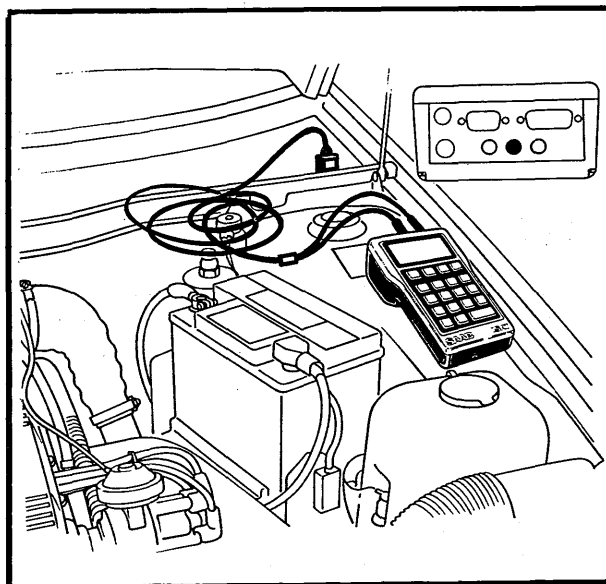
- 1 Connect test lead set 86 10 776 between the Lambda connector (see picture) and the black and red DMM ports on ISAT.
- 2 Switch on ISAT, advance through the menu and select LAMBDA. Press F1 (B201).
- 3 Start the engine and read off the pulse ratio, e.g. 60% corresponds to a pulse ratio of 60:40.



Saab 900, B201



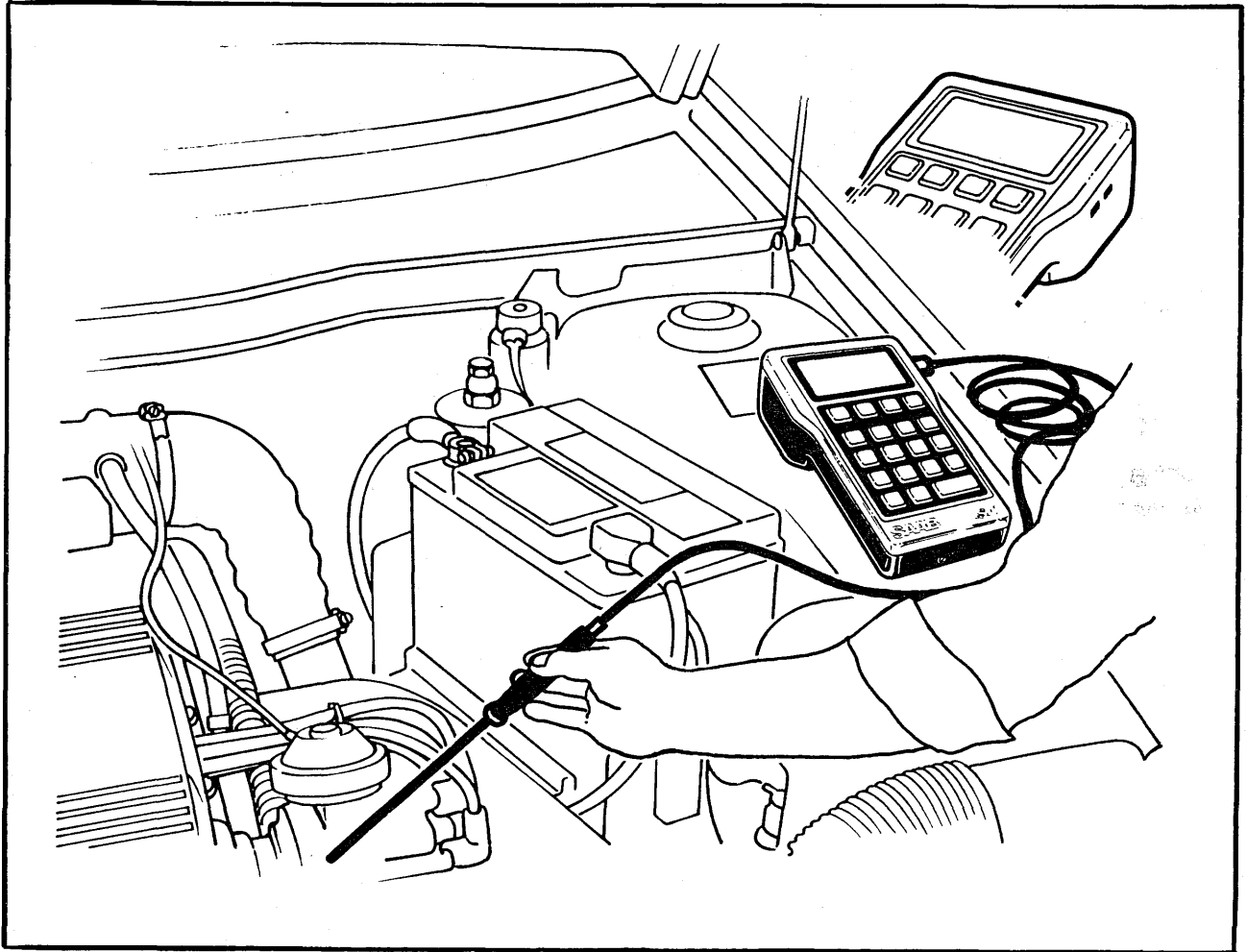
Saab 900, B202



Saab 9000, B202

B202 engine (LH 2.2)

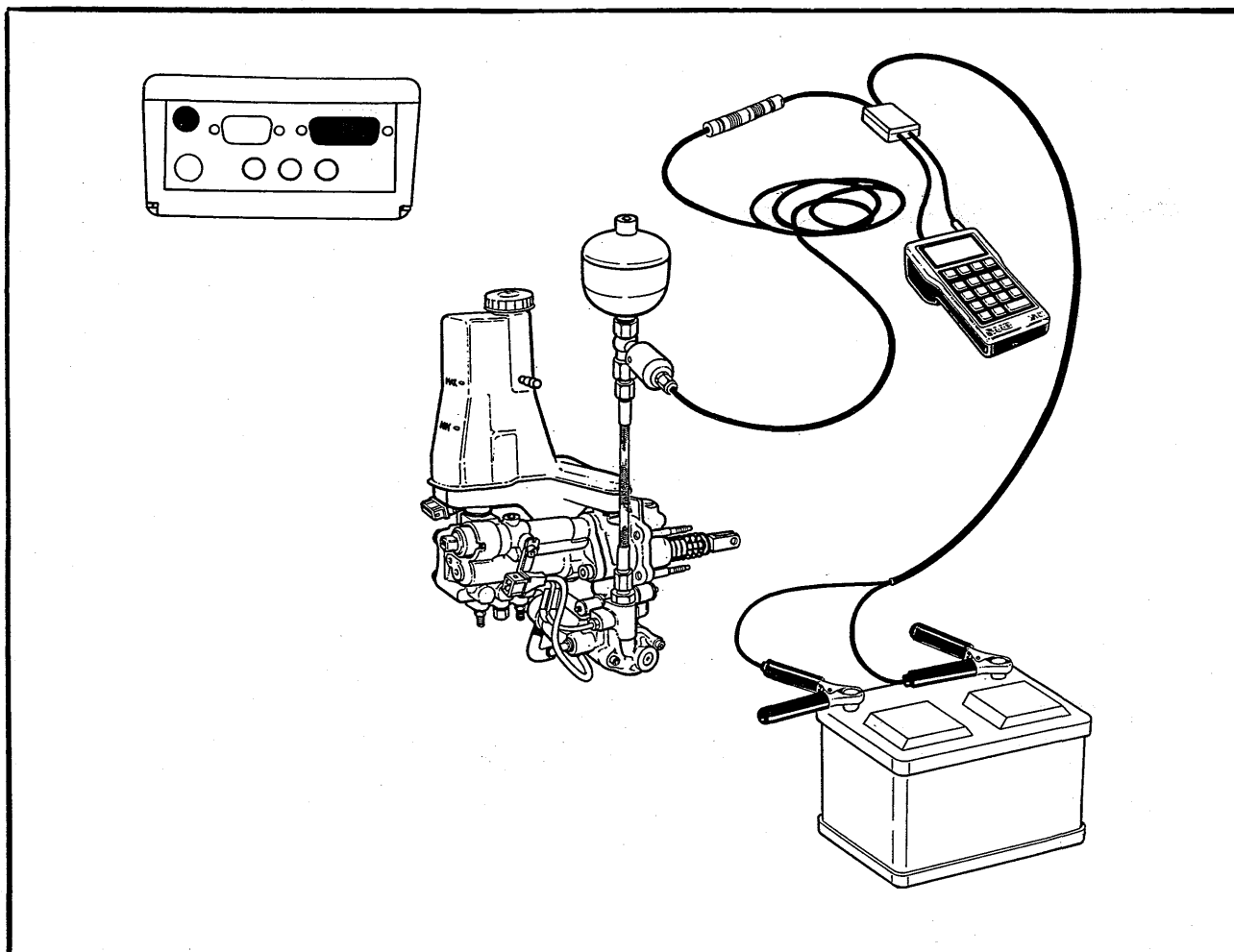
- 1 Connect test lead set 86 10 784 between the Lambda connector (see picture) and the black and red DMM ports on ISAT.
- 2 Switch on ISAT, advance through the menu and select LAMBDA. Press F2 (B202).
- 3 Start the engine and check the Lambda function by noting the proportion of time that RICH and LEAN are displayed.



Measuring temperature

Temperatures ranging from -40°C to $+400^{\circ}\text{C}$ (-40°F to $+755^{\circ}\text{F}$) can be measured.

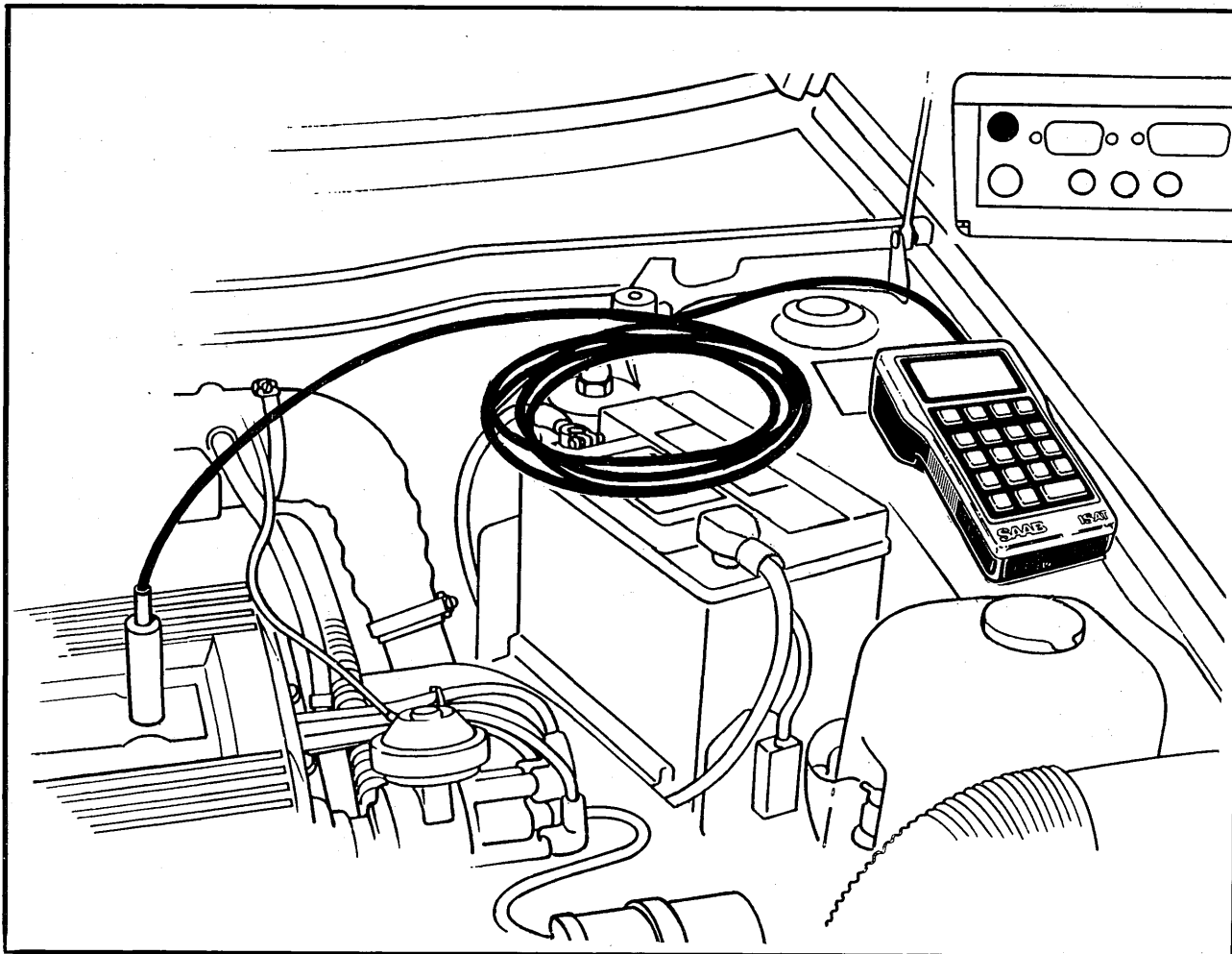
- 1 Connect temperature sensor 86 10 750 into the socket in the right-hand edge of the tester.
- 2 Call up menu page:
MULTI PULS TSI TEMP and press F4 (TEMP).
- 3 Place the sensor probe in or on the relevant component and read off the temperature after the reading has stabilized.



Measuring pressure

ISAT pressure-sensor module 86 10 990 and the pressure sensor included in the LH or ABS tester kit are used to measure pressure.

- 1 Connect the module to ISAT's pressure port (P), to the diagnosis socket, to the pressure-sensor lead and to the battery terminals (watch the polarity: red to '+').
- 2 Connect the pressure sensor to the port in the circuit to be measured.
- 3 Call up menu: MULTI PULS TSI TEMP and press the ALT key.
- 4 Press F1 (PRESS), select the appropriate range and read off the pressure.



Compression testing

With pressure sensor 86 10 974 and adaptor lead 86 10 982, ISAT can be used to measure the compression in the individual cylinders.

- 1 Disconnect the HT leads (cars with DI: remove the ignition cartridge) and remove the sparkplugs. Connect the pressure sensor to no. 1 cylinder.

The reading will remain on the display.

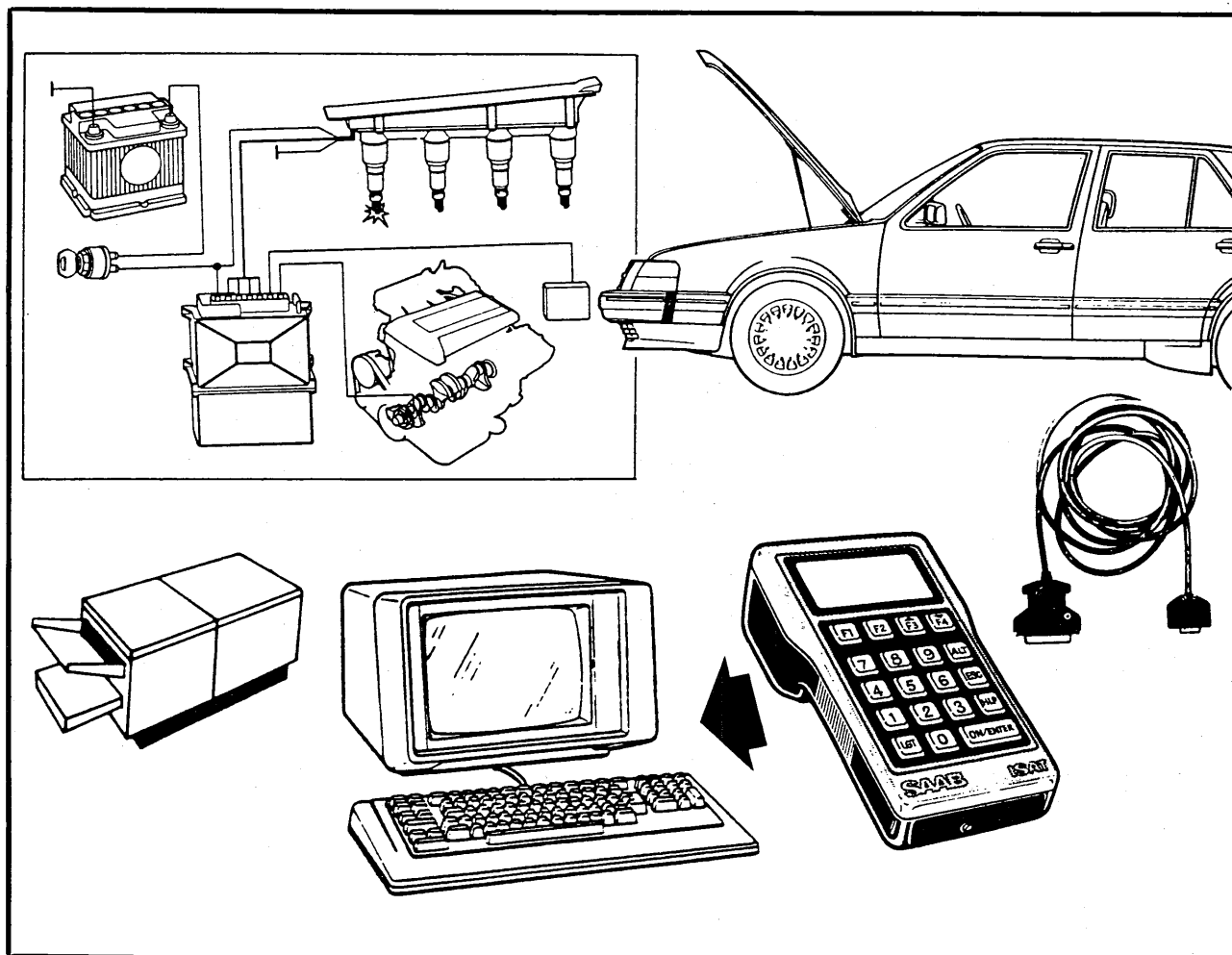
- 4 Move the sensor to the next cylinder and repeat the test.

Repeat until all cylinders tested.

Note

Unplug the connector from the amplifier module or the connector in the power feed to the ignition cartridge, as appropriate.

- 2 Connect the pressure sensor to ISAT using the adaptor lead.
- 3 Advance through the menu by pressing F3 (MEAS), followed by the ALT key and F2 (COMP). Crank the starter motor until a reading is displayed (after five revs of the starter, ISAT displays the mean value of the three highest values during the next five revs of the starter motor).



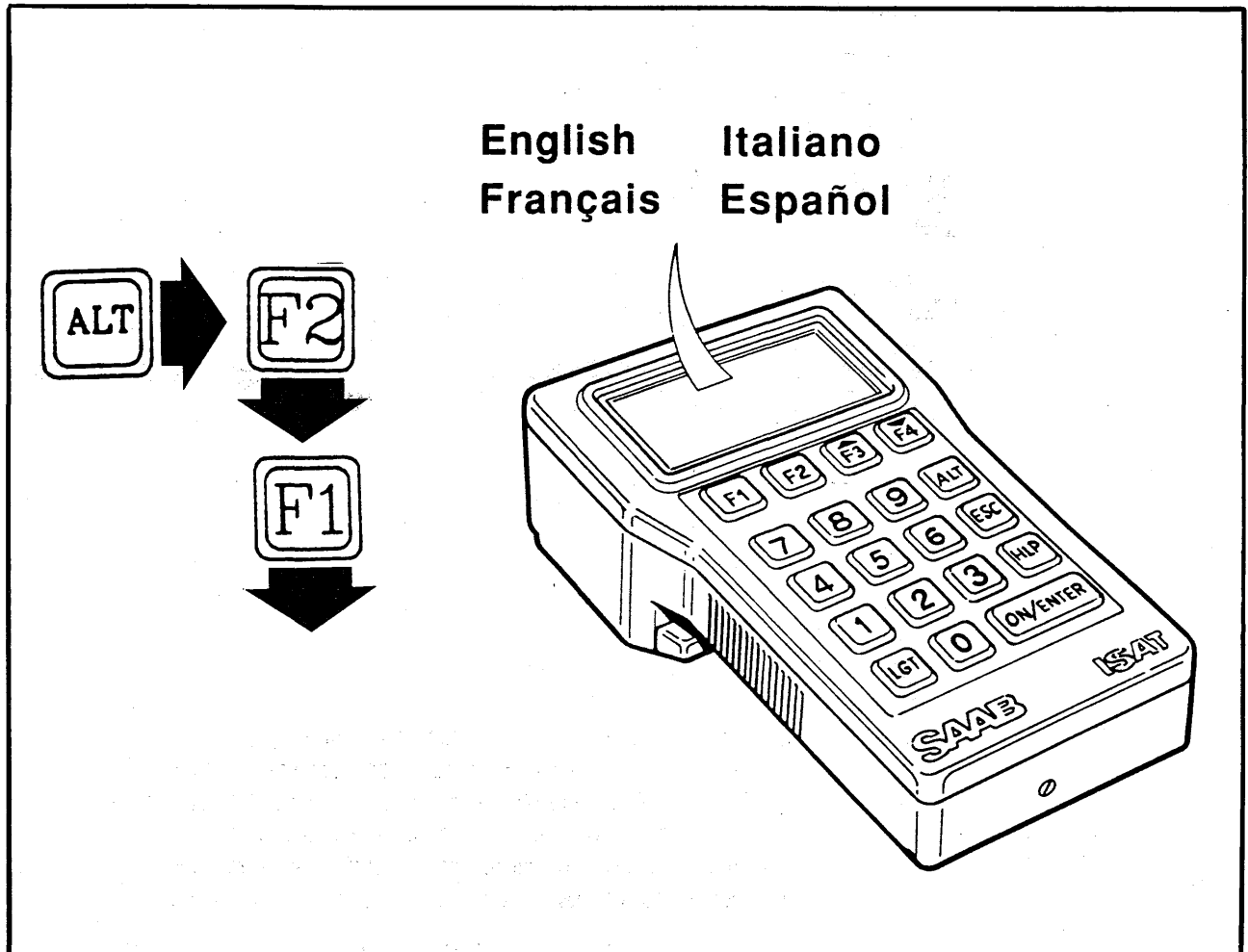
Linking ISAT to other computer equipment

One of the basic design criteria for ISAT was that the tester should have almost unlimited scope for further development. One development, which is already well advanced, is the facility for linking ISAT to other computer equipment, such as a PC compatible, a mainframe computer, a printer/plotter, or a modem.

This opens the door to storing an unlimited volume of fault data or test data for subsequent processing and analysis. The data can also be presented in the form of graphs or charts for output on a printer or plotter.

In the absence of a computer in the immediate locality, ISAT can be connected to a modem so that data can be transferred to a computer at a remote location.

To access data communications, press F2 (COMMS) on the main menu and select the required function from the menu page: SEND PRINT PC.



English Italiano
 Français Español

Selecting the system language

The following options for ISAT's system language are available:

English & French
 Part no. 86 10 891

Swedish & Finnish
 Part no. 86 10 883

German & Italian
 Part no. 86 10 909

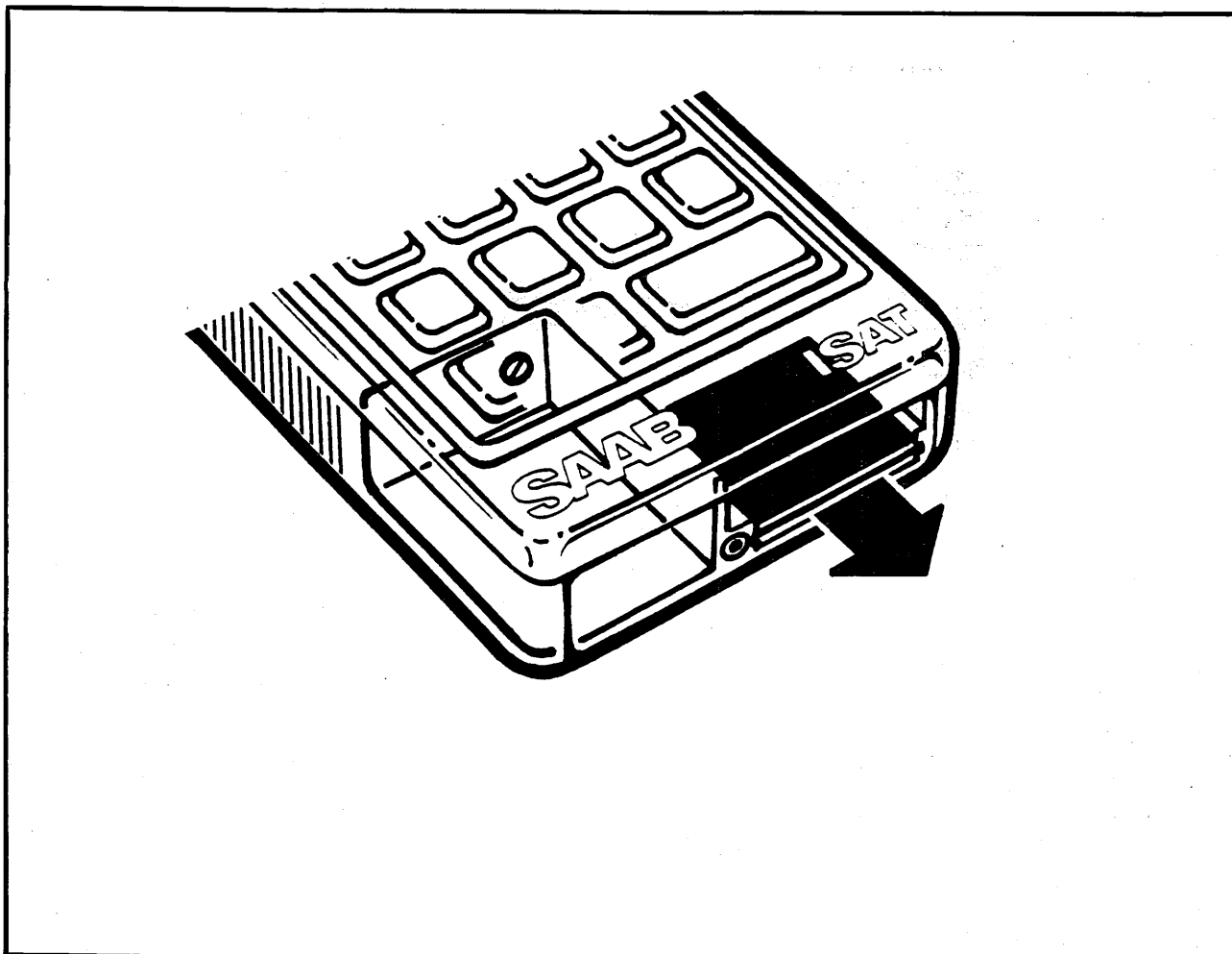
Spanish & Dutch
 Part no. 86 10 917

Note

The system language chosen will remain operative unless changed by a new option being chosen using the selection procedure above.

To load the required system language, first make sure that the appropriate control program board (see above) is fitted and then select the language as follows:

- 1 Call up the main menu:
 DIAG COMMS MEAS OFF
- 2 Press ALT and then F2 (LANG). Choose the language by pressing F1 or F2 as appropriate.



Changing the control program

Notice of the need to change the control program will usually be given by Saab following an update of one or more of the tester functions.

The upgraded control program board will be supplied complete with details of the amendments made, the new version number and the procedure for dealing with the board to be replaced.

The ISAT control program is contained on a plug-in EPROM printed circuit board, which is readily accessible behind the cover in the bottom edge of the tester casing.

To change the control-program board:

- 1 Remove the cover.

Note

Take care not to bend or twist the board as this can damage the printed circuit, causing ISAT to malfunction.

- 2 Withdraw the board carefully using a piece of wire hooked through the hole or holes near the edge of the board.

- 3 Slide in the new board.

Note

It is critically important to the reliability of the tester that the small piece of foam plastic is positioned between the board and the cover.

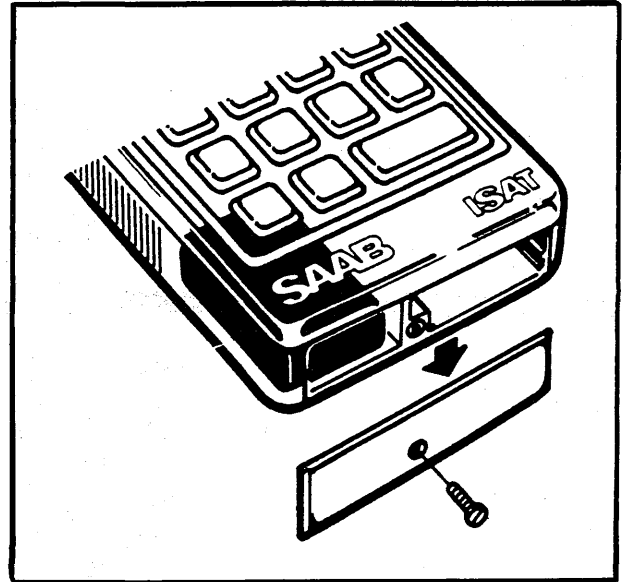
- 4 Switch on ISAT and make sure that the correct version number appears on the display.

Replacing the battery

- 1 Remove the cover.
- 2 Take out and disconnect the battery.
- 3 Fit the new/recharged battery.

Note

It is critically important to the reliability of the tester that the small piece of foam plastic is positioned between the board and the cover.



Self-testing mode

ISAT incorporates a self-testing mode to enable a simple function check of the tester to be made.

- 1 From the main menu page, press ALT and then F1 (TEST).

ISAT will now run through the self-testing procedure automatically. On completion, one of the following messages will be displayed:

- All functions OK

This signifies that the tester is functioning properly.

- ISAT malfunction

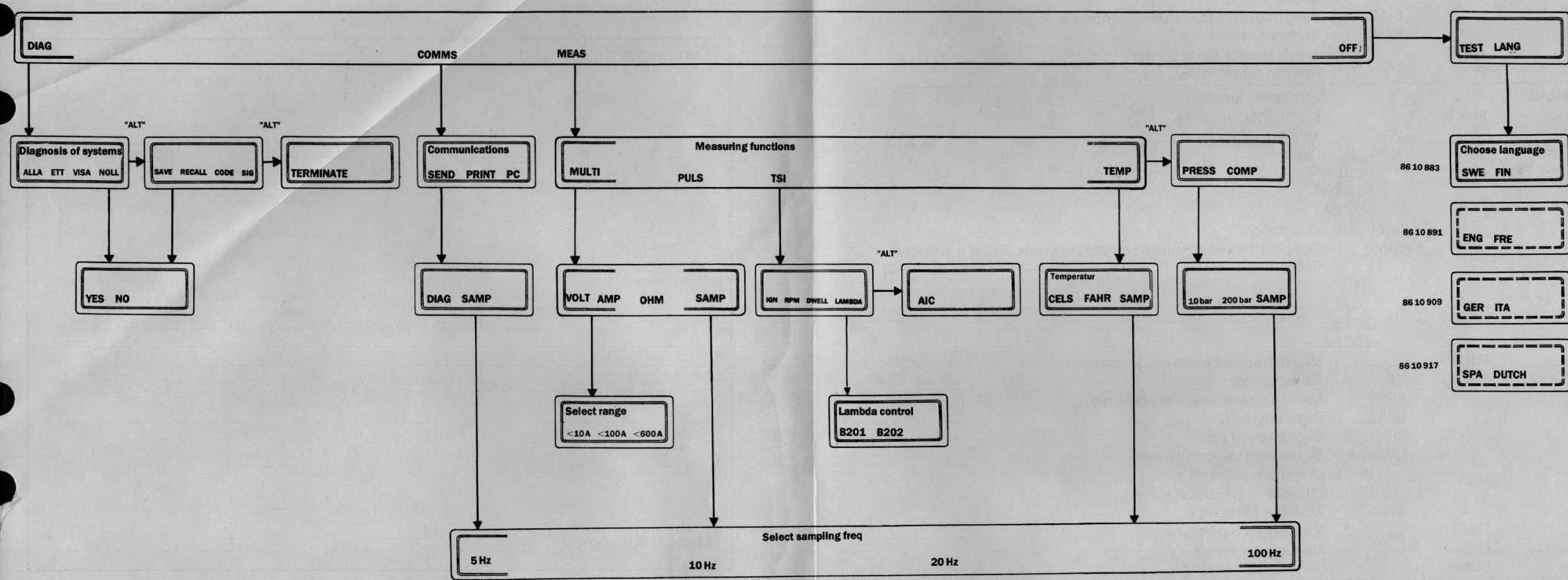
If this message is displayed switch off the tester, switch it on again and repeat the self-testing function.

If 'ISAT malfunction' is displayed again, return the tester to Saab for repair/replacement.

Menu functions

DIAG			Copies fault data from self-diagnostics function in ECU
	ALL		Copies fault data from all system ECUs connected
	ONE		Copies fault data from the selected system ECU
	DISPLAY		Displays fault data (error codes)
	RES		Resets ECU (deletes fault data in ECU)
	SAVE		Stores the fault data (error codes) in ISAT memory
	RECALL		Recalls fault data (error codes) from ISAT memory
	CODE		Sends a three-figure command code to ECU
	SIG		Sends low-high-low signal down signal lead in diagnosis lead set
	Terminate		Terminates link with ECU (at end of ONE, RES or CODE function)
COMMS			Communication with PC or printer
	SEND		Sends results' file
		DIAG	Fault data from ECU's self-diagnostics
		SAMP	Sampled values
	PRINT		Sends results' file to printer
	PC		Remote control of ISAT via PC
MEAS			Measuring functions
	MULTI		Multimeter functions
		VOLT	Voltage
		AMP	Current
			<10 A
			<100A
			<600A
		OHM	Resistance
		SAMP	Samples measured values and stores results in ISAT's memory (RAM)
			5 Hz
			10 Hz
			20 Hz
			100 Hz
	PULS		Measures pulse width and frequency
	TSI		TSI functions
		IGN	Ignition timing (degrees advanced)
		DWELL	Dwell angle
		RPM	Engine speed (rpm)
		LAMBDA	Signal from Lambda sensor
		B201	CI system - pulse ratio
		B202	LH system - integrator signal
		AIC	AIC-valve pulse ratio
	TEMP		Measures temperature
	PRESS		Measures pressure
	COMP		Compression testing
OFF			Switches tester off
LANG			Selects system language
	SWE	Swedish	} 86 10 883 (I)
	FIN	Finnish	
	ENG	English	} 86 10 891 (II)
	FRE	French	
	GERM	German	} 86 10 909 (III)
	ITAL	Italian	
	SPAN	Spanish	} 86 10 917 (IV)
	DUTCH	Dutch	
TEST			ISAT self-testing mode

ISAT menu flowchart





SAAB

Saab-Automobile AB
Trollhättan, Sweden



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