SCORBASE Level 5

for SCORBOT-ER V and ER VII
ACL Version

REFERENCE GUIDE

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Introduction

SCORBASE is an advanced robotics control software package, for use with the **SCORBOT** robotic system. **SCORBASE**'s menu-driven structure and off-line capabilities provide a user-friendly tool for robot programming.

SCORBASE Level 5 is intended for use with both the **SCORBOT-ER V** and **SCORBOT-ER VII**; it is functionally comparable to **SCORBASE** Level 5 for the **SCORBOT-ER III**. You can also program and operate the **SCORBOT-ER V** and **VII** by means of the Advanced Control Language (ACL).

ACL and **SCORBASE** differ greatly in nature and use. The ACL environment is available by directly accessing the controller from a standard terminal, or by using Advanced Terminal Software (ATS), whereas the **SCORBASE environment is a PC-based software package.**

ACL enables structured programming of complex tasks and applications through the use of variables, mathematical algorithms and functions. ACL is a multi-tasking environment with priorities, inter-task communication and full process control, and provides a high level of user control over controller features and internal operations.

ACL requires the use of specific formats and syntax, which may remind you of programming in BASIC or PASCAL. ATS serves to simplify your programming tasks.

SCORBASE, on the other hand, is a menu-oriented programming environment. **SCORBASE** supplies the proper command formats and continuously prompts you to provide the function and value selections.

SCORBASE is not as versatile as ACL, and is therefore recommended as an entry tool, especially for users already familiar with the **SCORBOT-ER III and its environment.**

SCORBASE Level 5 offers all programming options available in previous **SCORBASE** versions, as well as several improvements. Most notable are enhanced variable operations, the use of a speed controlled conveyor, a timer facility, and a greater range of speed selections.

Some of the basic features of **SCORBASE** Level 5 include:

- Control and real-time status display of up to 11 axes: 5 robot axes, a gripper and up to 5 peripheral axes.

- Full support and real-time status display of 16 inputs and 16 outputs, including user defined text for each I/O status.

- Position definition and display, as well as manual robot movement, in either joints coordinates (encoder units) or cartesian coordinates (X,Y,Z, pitch and roll).

- Position and movement definition for robot and peripheral equipment either separately or together.

- Robot movement definition as regular, linear or circular, with 90 active speed settings.

- User-defined number of program lines (400 default).

- Interrupt programming for handling responses to changes in input status.

- Extensive variable programming.

- Saving and loading of programs and position tables either separately or together.

- Simulation of program execution in an off-line mode.

Starting SCORBASE Level 5

LOADING SCORBASE

1. Power on the controller (always do so before loading **SCORBASE**).

2. Start your computer with a regular DOS diskette. If your computer is an IBM PS/2, you must use DOS 3.3 or later.

3. Insert the Level 5 diskette into drive A and type:

    ```
    SCOR_ER5    or
    GO
    ```

    When **SCORBASE** Level 5 has loaded, the Main Menu is displayed on your screen.

    Refer to Appendix A, "Command Line Options," for altering **SCORBASE** start-up options.

CONTROLLER SET-UP

If the controller has not been properly setup for **SCORBASE** operation, the following is displayed:

```
Controller not setup for SCORBASE operation!
Press <ESC> to exit
Press <F2> to setup controller
```

Note that the controller setup procedure erases the User RAM contents. If you have previous work in User RAM and wish to save it, press < Esc> and use the ATS (Advanced Terminal Software) Backup Manager.

Press F2 to initiate the controller setup procedure.

```
SCORBASE Controller Setup
ARE YOU SURE(Y/N)? N
```

If you wish to abort the setup, press N or < Enter> to cancel and recall the original message. You can then press < Esc> to exit.

Press Y to initiate the controller setup procedure. **SCORBASE** prompts you for additional information. Press < Enter> to accept the displayed defaults, or enter new values according to your specific configuration.

```
SCORBASE Controller Setup

How many axes are installed? ..

Is expanded memory installed (Y/N)? Y

Robot type :    ER V   / ER V PLUS / ER VII

Speed Controlled Conveyor :  not used / orange / gray

Does the controller have an auxiliary RS232 board(Y/N)? N

WARNING ! USER RAM WILL BE ERASED !!
ARE YOU SURE(Y/N)? N
```

SCORBASE then performs the configuration and downloads to the controller the programs needed for **SCORBASE** operation.

If a speed controlled conveyor is not installed, and if more than six axes are installed, the following is displayed:

```
PERFORMING CONFIGURATION

DOWNLOADING SERVICE PROGRAMS
MOVE is valid
MOVEL is valid
MOVEC is valid
OPEN is valid
CLOSE is valid
MOVED is valid
GSENS is valid
MVMAX is valid
-DONE-
>
```

(MVMAX will not appear if only 6 axes are installed).

If a speed controlled conveyor is installed, the configuration includes additional programs and the following is displayed:

```
PERFORMING CONFIGURATION
DOWNLOADING SERVICE PROGRAMS
MOVE is valid
MOVEL is valid
MOVEC is valid
OPEN is valid
CLOSE is valid
MOVED is valid
GSENS is valid
MVMAX is valid
MCONV is valid
PICKO is valid
-DONE-
Conveyor should be connected to axis 11
>
```

The controller is now ready for **SCORBASE**.

Note that your response to the number of axes installed determines the number of the axis to which the speed controlled conveyor should be connected. For example, if ten axes are installed, the system will display:

```
Conveyor should be connected to axis 10
```

If **SCORBASE** is loaded while the controller is turned off, or if no communication exists between the controller and the computer, **SCORBASE** assumes that the controller is not connected or is turned off, and the system enters the off-line mode. The following message is displayed:

```
CONTROLLER NOT RESPONDING
```

When in the off-line mode, you can activate the on-line mode by resetting **SCORBASE**. Press:

```
<Ctrl>+C   or   <Ctrl>+<Break>
```

If a functioning controller is connected, the on-line mode is activated.

If the controller is reset or repowered during **SCORBASE** operation, **SCORBASE** must also be reset by pressing:

```
<Ctrl>+C   or   <Ctrl>+<Break>
```

During the resetting of **SCORBASE**, no user data is lost.

OPERATING KEYS

Throughout **SCORBASE**, the following keys are used to activate screens and en-

ter commands and options.

< PgUp> or   Recalls the screen previously displayed.
    < Esc>

    < Esc>   Cancels a command line which has been activated.

  < Enter>   Accepts commands, options and field entries.

< backspace>   Erases field entries which have been typed, but not yet accepted.

CHAPTER **2**

Main Menu

Once **SCORBASE** Level 5 has been loaded, the Main Menu screen is displayed.

```
SCORBASE LEVEL 5 ROBOTICS SOFTWARE FOR ER-V ver 2.43  (C)copyright ESHED ROBOTEC
                               ┤MAIN MENU├

    ┌─────────────────────────────┐      ┌─────────────────────────────┐
    │ TEACH POSITIONS      (f1)   │      │ EDIT PROGRAM         (f2)   │
    └─────────────────────────────┘      └─────────────────────────────┘
    ┌─────────────────────────────┐      ┌─────────────────────────────┐
    │ PROGRAM HANDLING     (f3)   │      │ RUN PROGRAM          (f4)   │
    └─────────────────────────────┘      └─────────────────────────────┘
    ┌─────────────────────────────┐      ┌─────────────────────────────┐
    │ HOME                 (f5)   │      │ RUN CELL CONTROL     (f6)   │
    └─────────────────────────────┘      └─────────────────────────────┘
    ┌─────────────────────────────┐
    │ I/O SETUP            (f7)   │
    └─────────────────────────────┘

    ┌─────────────────────────────┐
    │ EXIT TO DOS    (Shift+f9)   │
    └─────────────────────────────┘

       ▐ROBOT HAS NOT BEEN HOMED, PLEASE SELECT 'HOME' MENU.▌
```
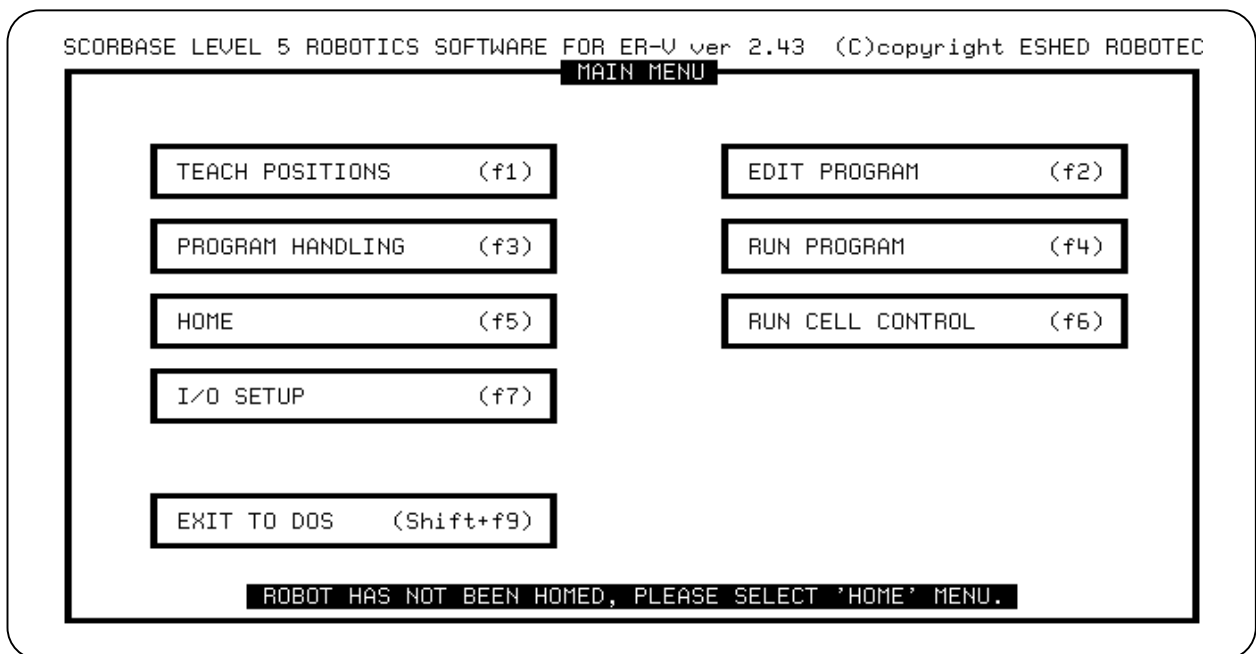
SCREEN SELECTION

To select an option, press either the function key or the first letter of the desired option. For example, pressing either F1 or T activates the Teach Positions screen. Exit to DOS can only be activated by pressing < Shift> + F9.

TEACH POSITIONS   (F1)

From this screen you can control the robot movements directly and teach the robot positions.

Note that the controller (and not the PC) performs all the movements and the re-

cording and storing of the positions. **SCORBASE** serves as an interface between the user and the controller.

| EDIT PROGRAM (F2) | This module lets you write and edit your robot programs. The programs are created by **SCORBASE** and maintained in the PC RAM. |

| PROGRAM HANDLING (F3) | This module enables you to save and load programs and positions tables to and from disk(ette). It also lets you merge programs and position tables. |

| RUN PROGRAM (F4) | This module enables you to run your program. Since the current program is maintained only in the PC, the commands which control robot movement and I/O status are translated into the ACL format and sent sequentially to the controller. |

| HOME (F5) | This screen enables you to home the robot, and configure and home the peripheral equipment. Since the **SCORBOT** should be homed each time the controller is turned on, begin each working session by first activating the Home screen and performing the necessary operations. |

| RUN CELL CONTROL (F6) | This module lets you run your **SCORBASE** program together with a complete runtime screen display reporting the status of inputs and outputs. The report includes the names you assigned to the various I/O ports. |

| I/O SETUP (F7) | This screen is used to assign text to both the on and off states of each input and output port. |

```
EXIT TO DOS          (Shift+F9)
```

Press < Shift> + F9 to exit to DOS. **SCORBASE** will prompt you:

```
ARE YOU SURE (Y/N)? N
```

If changes to the program or position table have been made but not yet saved to disk, the following message will also flash on the screen:

```
WARNING !! CHANGES NOT SAVED
```

To exit to DOS, press Y. Any other key is regarded as no.

ADDITIONAL MAIN MENU MESSAGES

After loading **SCORBASE**, you will briefly see one of the following messages at the bottom of the screen.

```
ROBOT IS NOW SET UP FOR ER-V
ROBOT IS NOW SET UP FOR ER Vplus
ROBOT IS NOW SET UP FOR ER VII
```

Make sure the **SCORBOT** identified by **SCORBASE** is in fact the robot which is installed. If it is incorrect, you must reconfigure the controller according to the procedure described in Appendix B.

After loading **SCORBASE** you may also see the message:

```
CONTROLLER NOT RESPONDING
```

This indicates that communication with the controller has not been established and **SCORBASE** is operating in the off-line mode. If a controller is connected but not identified by **SCORBASE**, do the following:

• Make sure the controller is properly connected to a power supply and the power switch is turned on.

• Make sure the controller Reset button is not depressed.

• Make sure the RS-232C cable is properly connected to the controller and the PC.

• Press and release the Reset Button.

At the bottom of the screen you may see an additional message:

```
ROBOT HAS NOT BEEN HOMED. PLEASE SELECT 'HOME' MENU.
```

This message is displayed until the robot is successfully homed.

CHAPTER **3**

Teach Positions Screen

This screen allows you to move the robot, and to teach and define the various types of positions and movements.

USER INTERFACE

As you can see, the Teach Positions menu has two sides. **Only one side is active at a time!**

The active side is indicated by the highlighted frame around it. Use the left arrow key < ←> to activate the left side of the menu, and the right arrow key < →> to activate the right side. Or use the space bar to toggle the currently active side.

The left side of the menu contains the commands which directly control movements and outputs, while the right side contains the commands for teaching and reaching positions.

Most of the commands are activated by a two letter code, which usually represents the two initial letters of the commands themselves. The code letters are bolded in the screen display. For example, to activate the Record Position command, type RP.

Whenever the system responds to a command by displaying dots and a cursor, you must type in a number or variable and press < Enter> .

COORDINATES DISPLAY

The current robot location is continuously displayed at the bottom of the screen. You can change the **coordinate display** system by typing CC when either side of the menu is active.

After you press CC, the cursor jumps to the option line. You have the following choices:

```
DISPLAY : XYZ  / ROBOT / PERIPHERAL / OFF
```

Use the left and right arrow keys to highlight your choice, and then press < Enter> .

The position display options are as follows:

XYZ:

X	Y	Z	PITCH	ROLL
168.7	.0	504.2	-63.5	.0

```
                        TEACH POSITIONS MENU
      ┌─── ↓ ACTIVE ↓ ────────────────┐ ┌──────────────────────────────┐
      │ 1/Q   move base      right / left │ │ CC    Change Coordinate display │
      │ 2/W   move shoulder  up / down    │ │ RP    Record Position...         │
      │ 3/E   move elbow     up / down    │ │ RR    Record Relative position...│
      │ 4/R   move wrist-pitch up / down  │ │ TP    Teach Position... (xyz)    │
      │ 5/T   move wrist-roll  right / left│ │ TR    Teach Relative position...(xyz)│
      │ 7/U   move axis 7      + / -      │ │ RB/RH Record roBot/peripHeral pos.│
      │ 8/I   move axis 8      + / -      │ │ GL    Go Linear to position...   │
      │ OG/CG Open / Close Gripper        │ │ GC    Go Circular to pos# through pos│
      │ F/S   Fast/Speed 10    movement   │ │ GP    Go to Position ...         │
      │ ON/OF turn Output #. oN / oFf     │ │ GH    Go Home                    │
      │ CN/CF Control oN /Control oFf     │ │ SC/ST Start Conveyor/STop conveyor│
      └───────────────────────────────────┘ └──────────────────────────────┘
      │ X/J cartesian/joint │ <-SPACE-> change active side │ L List/del pos │ <ESC> MAIN │

                     DISPLAY : XYZ / ROBOT / PERIPHERAL / OFF .
                        X        Y      Z     PITCH    ROLL
                        168.7      .0   504.2   -63.5      .0
```

ROBOT:

AX-1	AX-2	AX-3	AX-4	AX-5
0	0	0	0	0

PERIPHERAL:

AX-7	AX-8	AX-9	AX-10	AX-11
0	0	0	0	0

OFF: NO DISPLAY

SCORBASE Level 5 supports programming and operation in two coordinate systems: vertically articulated (robot axes) and cartesian (XYZ).

The **XYZ** display shows the cartesian coordinates in values accurate to a tenth of a millimeter, and the pitch and roll in values accurate to a tenth of a degree.

The **robot** display shows the robot joints position in encoder pulses.

The **peripheral** display shows the position of axes 7 through 11 in encoder pulses.

Off cancels the display of coordinates.

MANUAL CONTROL

The **left side of the menu** contains the commands for direct control of the servo axes and the outputs.

You can change the **manual movement coordinate system** by typing X (for cartesian) or J (for joint). The change in coordinates is reflected in the command definitions in the left side of the menu. Base, shoulder and elbow, for example, become X, Y, Z. In the screen shown at the beginning of this chapter, the movement coordinates are joint. In the screen shown here they are cartesian.

The choice of movement coordinates determines the functionality of the manual movement keys, as shown in the chart below.

Keys	Robot – Joints Movement	XYZ – Cartesian Movement
1/Q	Robot base moves right and left.	Tip of gripper moves in the X+ and X– directions.
2/W	Shoulder moves up and down.	Tip of gripper moves in the Y+ and Y– directions.
3/E	Elbow moves up and down.	Tip of gripper moves in the Z+ and Z– directions.
4/R	Wrist moves pitch up and down.	Pitch changes without changing the location of the gripper's tip.
5/T	Wrist rolls right and left.	
7/U	Axis no. 7 moves forward and backwards.	
8/I	Axis no. 8 moves forward and backwards.	

The robot will continue to move as long as the activating key is depressed.

If connected, a teach pendant can also be used for manual movements.

XYZ control of a vertically articulated robot such as the **SCORBOT** is achieved by **SCORBASE** converting the cartesian coordinates to joint coordinates. The XYZ coordinate system has a point of origin located at the center of the robot base.

Additional Direct Mode Commands

OG/CG **O**pen/**C**lose **G**ripper

These commands open and close the gripper.

F/S **F**ast/**S**peed 10 movement

These commands set the speed for manual robot move-ment.

```
1/Q    move    X          +  /  -
2/W    move    Y          +  /  -
3/E    move    Z          up / down
4/R    move wrist-pitch up / down
5/T    move wrist-roll  right / left
7/U    move axis 7       +  /  -
8/I    move axis 8       +  /  -
OG/CG Open / Close Gripper
F/S   Fast/Speed 10    movement
ON/OF turn Output #. oN / oFf
CN/CF Control oN /Control oFf

X/J cartesian/joint  <-SPACE-> change
```

Type F to set the fastest speed (10). This is the default speed.
Type S, and then enter any speed from 1 (slowest) to 9.9.

ON/OF   turn **O**utput #. o**N** / o**F**f

These commands switch the specific output port on and off.

Type ON or OF to activate the command, and type in a specific output number at the prompt.

CN/**CF**   **C**ontrol o**N** / **C**ontrol o**F**f

This command switches servo control of the axes on and off.

The **SCORBOT** controller produces error signals that switch off the servo control, and therefore halt axis movement, in the event of a error such as a hardware problem or the robot hitting an obstacle.
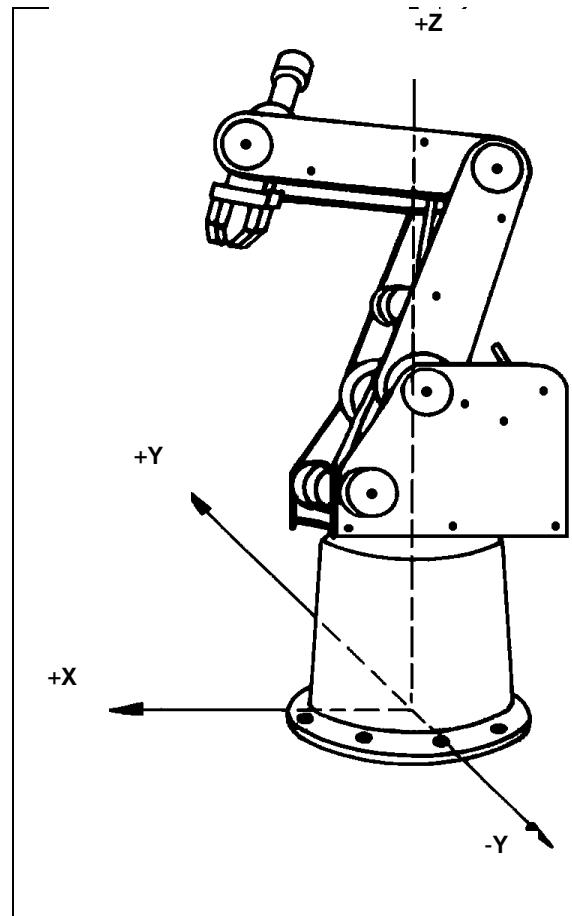
SCORBOT XYZ Coordinate System

When such an error occurs, the fol

```
ARM DISABLED
```

To resume normal operation, type CN to reactivate servo control.

Manual Movement of Peripheral Axes

As you can see, the menu shows keys to control only 8 axes: five robot axes (1-5), the gripper (6), and two peripheral axes (7-8). However, **SCORBASE supports up to 11 axes**. Peripheral axes defined as axes 7 though 11 can be moved manually by using the function keys, as shown in the chart below. These keys are operative only when the left side of the screen is active.

Keys   **Movement**

F1 / F2   Axis 7 moves forward and backwards.

F3 / F4   Axis 8 moves forward and backwards.

F5 / F6   Axis 9 moves forward and backwards.

F7 / F8   Axis 10 moves forward and backwards.

F9 / F10   Axis 11 moves forward and backwards.

TEACHING POSITIONS

The **right side of the menu** contains the commands for teaching and reaching the desired positions.

CC   **C**hange **C**oordinate display

For a complete explanation, refer to the section, "Coordinates Display," at the beginning of this chapter.

RP   **R**ecord **P**osition . . .

This command records the current joints position of both the robot axes and the peripheral axes. A maximum of 400 positions can be recorded. At the prompt, type in a valid position number and press < Enter> .

RR   **R**ecord **R**elative position . . .

This command records (in joints values) the current position of the robot arm and peripheral axes relative to another position. Make sure you have first recorded the reference position. The format for recording a relative position is:

```
RECORD POSITION (1-400) ...  RELATIVE TO ...
```

If the reference position changes, the relative position also moves.

At the Record Position and Relative To prompts, type in valid position numbers and press < Enter> .

If you simply press < Enter> without specifying a number for the reference position, the position you record will be relative to the current position of the axis. For example:

```
RECORD POSITION 12 RELATIVE TO CURRENT
```

If your position is relative to current, you are prompted to define values for the relative movement of each axis. The format is as follows:

```
        RECORD POSITION (1-400) ... RELATIVE TO CURRENT
        AXIS 1  = 0         .....
        AXIS 2  = 0         .....
        AXIS 3  = 0         .....
        AXIS 4  = 0
        .....
        AXIS 5  = 0
        .....
        AXIS 7  = 0
        .....
        .
        .
```

```
┌─────────────────── ↓ ACTIVE ↓ ───────────────┐
│ CC     Change Coordinate display              │
│ RP     Record Position...                     │
│ RR     Record Relative position...            │
│ TP     Teach Position... (xyz)                │
│ TR     Teach Relative position...(xyz)        │
│ RB/RH  Record roBot/peripHeral pos.           │
│ GL     Go Linear to position...               │
│ GC     Go Circular to pos# through pos        │
│ GP     Go to Position ...                     │
│ GH     Go Home                                │
│ SC/ST  Start Conveyor/STop conveyor           │
└───────────────────────────────────────────────┘
```

Pressing < Enter> without specifying a value for a particular axis accepts the offset default value, which in all the instances above is 0.

A position which is **relative to current** means the specified offset will be computed from wherever the robot is located at the time it is sent to the relative position.

Note that the number of axes displayed depends on the controller configuration.

TP   **T**each **P**osition. . . (xyz)

This command enables you to record (teach) a position according to its XYZ location.

When defining a position using the cartesian coordinate system, you specify the location of the tip of the robot's gripper (in XYZ distance from the point of origin). To complete the definition, you must also specify the pitch and roll of the gripper (in degrees).

You are prompted to complete the command as follows:

```
CURRENT POSITION                    TEACH POSITION (x,y,z)
X(MM)       =168.7
Y(MM)       =0.0
Z(MM)       =504.20
PITCH (DEG)=-63.5
ROLL (DEG) =0.00
RECORD POSITION (1-400) ...
SPECIFY PERIPHERAL LOCATION FOR POSITION [#] (Y/N)? N
```

Pressing < Enter> for a coordinate accepts the default value. The default is always the current value of this coordinate, as displayed. For example:

```
X (mm) = 168.7 .....
```

You may now enter a new X coordinate, or press < Enter> to accept the de-

fault, which is 168.7.

The prompt for the peripheral location is given only if peripheral axes have been defined.

TR **T**each **R**elative position . . .(xyz).

This command allows you to teach a position which is relative to another position by an XYZ offset.

You are prompted to complete the command as follows:

```
TEACH RELATIVE POSITION (x,y,z)
X (MM)        =0.00
Y (MM)        =0.00
Z (MM)        =0.00
PITCH (DEG)   =0.00
ROLL (DEG)    =0.00
RECORD POSITION (1-400) .... RELATIVE TO ...
SPECIFY RELATIVE PERIPHERAL LOCATION FOR POSITION[#] (Y/N)?N
```

Pressing < Enter> for a coordinate accepts the offset default value, which in all the instances above is 0.

Pressing < Enter> without specifying a reference position creates a position which is relative to the current position.

A position which is **relative to current** means the specified offset will be computed from wherever the robot is located at the time it is sent to the relative position.

The prompt for the peripheral location is given only if peripheral axes have been defined. If the position is relative to current, you are prompted for offset values for the peripheral axes. If the position is relative to another position, the peripheral location offset values are recorded automatically.

RB **R**ecord ro**B**ot position

This command allows you to record a position for the robot axes only (without the peripherals). You are prompted to complete the command as follows:

```
RECORD ROBOT POSITION (1-400) ...
```

After you have entered a position number (22, for example), a prompt appears:

```
CLEAR PERIPHERAL POSITION[22] (Y/N)? Y
```

- Press < Enter> or Y to clear the peripheral position. The peripherals will not move when you send the robot to this recorded position.

- Press N to leave the peripheral position at its last setting. Note that the peripherals axes may move, depending on their previously recorded position.

RH   **R**ecord perip**H**eral position

This command allows you to record a position for the peripheral axes only (without the robot). The format for recording such a position is:

```
RECORD PERIPHERAL POSITION (1-400) ...
```

Type in a valid position number (33, for example) and press < Enter> . You are then prompted:

```
CLEAR ROBOT POSITION[33] (Y/N)? Y
```

- Press < Enter> or Y to clear the robot position. The robot will not move when you send the peripheral to this recorded position.

- Press N to leave the robot position at its last setting. Note that the robot axes may move, depending on their previously recorded position.

GL   **G**o **L**inear to position. . .

This command sends the robot along a straight line from the current to the specified position. The linear motion applies only to the robot axes, although peripheral axes might also move as a result of the command.

GC   **G**o **C**ircular to position # through position

This command sends the robot in a circular path to the first specified position through the second one. The circular motion applies only to the robot although peripheral axes might also move as a result of the command.

GP   **G**o to **P**osition . . .

This command sends the robot and/or the peripheral axes to the position specified. Type GP to activate the command, and enter a specific position number at the prompt.

GH   **G**o **H**ome

This command sends the robot to its Home position.

SC/ST   **S**tart **C**onveyor/**ST**op Conveyor

These commands start and stop the movement of the speed controlled conveyor. The conveyor moves at the speed defined in the Home screen.

This command will not appear in the menu if a speed controlled conveyor has not been configured.

Axis Groups

SCORBASE recognizes two groups of axes for referencing positions: One group contains the robot axes (1 through 5), and the other contains the peripheral axes (7 through 11).

When recording positions from the Teach Positions screen, the RP and RR commands refer to both the robot and the peripherals, while the TP, TR and RB commands refer only to the robot position. The RH command refers only to the peripheral's position.

The commands GP, GL and GC can execute movement only to previously recorded positions.

The teach pendant can be used to perform robot movements and position recording. See Chapter 4, "Using the Teach Pendant with **SCORBASE**."

LIST/DELETE POSITION SCREEN

This screen allows you to display, delete and print the positions. To activate this screen, select the L option in the Teach Positions screen.

Note that the listing operations display the position table stored in the controller. This requires extensive communication with the controller and may result in a delay in response time.

The operations available in this screen are:

LP **L**ist **P**osition . . .

Displays the coordinates of the specified position using the currently active coordinate display system.

LF **L**ist **F**rom position . . .

Displays a list of the positions starting from the specified position, using the currently active coordinate display system.

If there are more positions listed than can be displayed in one screen, the system will pause and prompt you:

```
PRESS <ESC> TO EXIT LISTING / ANY OTHER KEY TO CONTINUE
```

Pressing any other key moves the display down one screen.
Pressing < PgUp> moves the display up one screen.
Pressing < Enter> moves the display down one position.

PP **P**rint **P**osition (to printer)

Prints the Position Table on a connected printer. The positions will be printed using the currently active coordinate display system.

CC **C**hange **C**oordinate display : XYZ / ▮ROBOT▮ / PERIPHERAL

Changes the coordinate system in which the positions are listed.

When you press CC, the cursor jumps to the option line. Use the left and right

```
                    LIST / DELETE POSITION

LP    List Position ...              DP    Delete Position ...
LF    List From position ...         DF    Delete From pos ... to pos ...
PP    Print Position (to printer)    DA    Delete All

              <ESC> RETURN TO TEACH POSITIONS MENU

CC    Change Coordinate display :  XYZ / ROBOT / PERIPHERAL .
  #      AX-1     AX-2     AX-3     AX-4     AX-5
```

arrow keys to make your selection, and press < Enter> .

The listing last requested will now be displayed according to the coordinate dis-

play system you have selected.

DP **D**elete **P**osition . . .

Deletes the position specified.

DF **D**elete **F**rom position . . . to position . . .

Deletes the positions specified.

DA **D**elete **A**ll positions

Deletes from controller memory all the recorded positions.

Before executing any of the deletion commands, the system will prompt you for confirmation:

```
ARE YOU SURE (Y/N)? N
```

Press Y to delete. Any other key will be regarded as no.

CHAPTER 4

Using a Teach Pendant with SCORBASE

The teach pendant (TP) can be used alongside the **SCORBASE** software. For a detailed description of the teach pendant operation, refer to the **SCORBOT** *User's Manual.*

If you want to use the TP to record positions for later use with **SCORBASE**, make sure the controller is connected to a computer and the **SCORBASE** software is loaded. When **SCORBASE** has control of the controller, position operations (by means of the TP or PC) are routed to special **SCORBASE** position vectors within the controller.

When you record a position with the TP, robot positions (Group A) and peripheral positions (Group B) must be recorded separately.

Use the Group Select to select the axes group. For a robot position, press the Group Select key until the TP screen displays the letter A. For a peripheral position, press the Group Select key until the TP screen displays the letter B.

If you want a position to define both the robot and the peripheral location, you must record this position twice, once for each group. For example, if you want to record Position 6 for both groups:

• Press the Group Select key until the A is displayed.

• Press the Record Position key, press 6 and then [Enter] (to record Position 6).

• Press the Group Select key to change to Group B, and again record position 6.

Similarly, Go Position commands execute movement of the robot and/or the peripherals according to the group or groups selected.

Note: If you alter the coordinate system for manual movement from the Teach Positions screen, the change will affect the operation of the TP. However, if you alter the movement system from the TP, the Teach Positions screen will not reflect the change.

CHAPTER 5

Edit Program Screen

The Edit Program Screen allows you to write and edit your robotic programs. The **SCORBASE** programs are edited and stored in the PC.

```
                          EDIT PROGRAM
                          ───────────

OG/CG Open/Close Gripper        RP    Record present Pos. as pos. ...
GP    Go to Position ... fast/speed #. PH   set present Position as Home !!
W     Wait ... 10ths of seconds    SH    Search Home !!
J     Jump to line #...           SA    Set Axis #. to zero
IL    If Limit switch #. jump to ...  RT    Reset Timer
II    If Input #. on/off jump/call ... SV   Set Variable. to.../sensor/timer
OI    On input Interrupt#. on/off          computation(+,* etc.)
         call sub #.. / jump to line .. IF   IF variable. <=> .... jump to...
DI/EI Disable/Enable input Interrupt. SS   Set Subroutine #..
ON/OF turn Output #. oN/oFf        RS    Return from Subroutine
RE/PR REmark : / PRint :           CS    Call Subroutine #..
RB    Ring Bell                    OM    On Motor#. error, jump... c/s/o
CN/CF Control oN / Control oFf     SC/ST Start Conveyor/STop conveyor
GL/GC Go Linear/Circular to position..

  ctrl-I/ctrl-R Insert/Replace line...  │ L List/delete/edit │ <ESC> MAIN MENU

1
```

USER INTERFACE

As described in the preceding chapter, you create a program line by typing the two activating letters. These letters are bolded in the screen display for easy reference. For example, to activate the Call Subroutine command, type CS.

When you are prompted to enter a value or an option, you may also press < Enter> to accept the default setting as your choice.

SCORBASE Level 5 provides a large number of program editing commands.

PROGRAM COMMANDS

OG/**CG** **O**pen/**C**lose **G**ripper

These commands open and close the gripper.

  GP **G**o to **P**osition . . . fast/speed #.

This command sends the robot to the specified position at the specified speed. At the Go Position prompt, enter a number or a variable.

If you press < Enter> instead of specifying a position, **SCORBASE** automatically enters the next sequential default position number.

After you enter the position number, you are prompted for a speed. Press < Enter> or F to enter the fastest speed. If you press S, you must also include a speed value. Type in a number from 1 (slowest) to 9.9, or a variable, and < Enter> .

  W **W**ait . . . 10 ths of seconds

This command halts program execution for the specified time. For example:

```
WAIT 4 10TH OF SECONDS        Delay of 0.4 seconds
WAIT 600 1OTHS OF SECONDS     Delay of one minute
```

At the Wait prompt, type a number or a variable, and press < Enter> .

   J **J**ump to line # . . .

This command causes the program to jump to the specified line.

 IL **I**f **L**imit switch #. jump to . . .

This command causes the program to jump to the specified line if the specified limit switch is depressed (on). At the Limit switch # prompt, enter a number from 1 through 11, or a variable. (1-5 are located on the robot arm; 7–11 are on the peripherals). Then type the line number to jump to and press < Enter> .

 II **I**f **I**nput #. on/off jump/call . . .

This command causes the program to jump to the specified line or to call a subroutine if the state of the tested input matches the status requested (on or off).

At the Input # prompt, type a number or a variable. Then press < Enter> or N for on, or F for off.

At the jump/call prompt, press < Enter> or J for the program to jump to another line, or press C for the program to call a subroutine.

At the next prompt, enter the line number to jump to, or the number of the subroutine to call.

OI   **O**n input **I**nterrupt#. on/off
         call sub #. . / jump to line . .

This command sets the condition for an input interrupt service. The service (Call Subroutine or Jump to Line) will be performed whenever the condition (input status) is satisfied, regardless of the current program flow.

At the # prompt, enter a specific input number or a variable. Or press < Enter> to accept **any** input interrupt.

At the oN/oFf prompt, press < Enter> or N for the on state, or F for off. (ON causes an interrupt when the input switches on, while OFF causes an interrupt when the input switches off).

At the Call/Jump prompt, you can do either of the following:

- Press < Enter> or C to call a subroutine. Then enter the subroutine number or variable.

  If you enter a variable, the subroutine selected is determined by the value of the variable at the time the interrupt command is initially processed, and not when the actual interrupt is executed.

- Press J to jump to a specific line. Then press < Enter> to jump to the **next** line, or enter a specific line number.

An interrupt command causes the program to abandon (interrupt) the command it is currently executing (which can also be a movement or a delay) and to immediately execute the command specified for this interrupt. If the specified command is a Call Subroutine, the program will resume from the point where it was suspended as soon as the subroutine completes its execution.

Examples:

```
ON INPUT INTERRUPT #1 ON JUMP TO LINE 1
```

When input 1 is turned ON , the program is suspended and reactivated from line 1.

```
ON INPUT INTERRUPT #5 ON CALL SUBROUTINE # 5
```

When input 5 is turned on, the program immediates calls subroutine #5. If any axes are moving when the interrupt occurs, they will stop. When the subroutine is completed (Return from Subroutine command is reached), the axes will reassume the position and status that were interrupted, and the program will continue from the point where it was interrupted.

```
ON INPUT INTERRUPT ANY OFF CALL SUBROUTINE # 60
```

Whenever any of the inputs is turned off, an immediate call to subroutine 60 will occur.

DI/EI   **D**isable /**E**nable input **I**nterrupt .

The Disable Interrupt command causes the specified input interrupt to become inactive. When an interrupt is inactive, it is disregarded until the Enable Interrupt command reactives it.

At the # prompt, enter an input number or variable, or press < Enter> to accept **all** input interrupts.

Example:

If subroutine #5 is an interrupt servicing subroutine, and you do not want another interrupt command to interfere with the execution of the subroutine, structure your program as follows:

```
SET SUBROUTINE #5
DISABLE INPUT INTERRUPT # ALL
.
.
.
.
ENABLE INPUT INTERRUPT # ALL
RETURN FROM SUBROUTINE
```

ON/OF   turn **O**utput #. o**N**/o**F**f

This command sets or resets the specified output. At the # prompt, enter an output number or a variable, and press < Enter> .

RE   **RE**mark :

You can insert a comment (remark) line into the program for explanation and documentation. Type in any text of up to 48 characters.

PR   **PR**int :

This command prints text on the screen at run time. A maximum of 48 characters can be printed in one command line.

RB   **R**ing **B**ell

When executed, this command sounds a beep using the computer's internal loudspeaker.

CN/CF   **C**ontrol o**N** /**C**ontrol o**F**f

These commands switch the axes servo control on and off.

GL   **G**o **L**inear to position . . .

This command sends the robot to the specified position along a linear path. The robot gripper tip will move in a straight line from the current location to the specified location. The options for responding to position and speed prompts are the same as for the Go to Position command.

GC   **G**o **C**ircular to position . . .

This command sends the robot to the first specified position along a circular path through the second specified position.

You are prompted to enter the two positions as follows:

```
GO CIRCULAR TO POSITION # ... THROUGH POS # ...
```

The options for responding to the position and speed prompts are the same as for the Go to Position command with the following exceptions:

- You cannot use a variable for the speed value.

- For the second position, you must enter a specific number or variable. (There is no default option.)

RP **R**ecord present **P**osition as Position . . .

When executed at run time, this command records the current location of the robot arm as the specified position. At the prompt, enter a specific number or variable and press < Enter> . Note that you can overwrite positions using this command.

This command is very useful in palletizing applications.

PH Set present **P**osition as **H**OME !!

When executed at run time, this command **changes the Home position** of the robot. All current axes positions are reset to 0.

Use this command with caution! It immediately changes the physical location of all the recorded positions.

SH **S**earch **H**ome !!

This command sends the robot to search for its actual home location; that is, the **SCORBASE** checks the home microswitch on each axis as in the homing procedure.

SA **S**et **A**xis #. to Zero

This command resets the position of the axis specified by setting its value to 0. This command is very useful for performing a cyclical motion of an accessory, such as a conveyor or a rotary table.

RT **R**eset **T**imer

This command resets the value of the **SCORBASE** timer to 0.

SCORBASE contains a timer which measures time in units of tenths of a second. The timer operates for approximately 50 minutes, from either the time **SCORBASE** is loaded, or the point at which the timer is reset.

To use the timer, it must be assigned to a variable, using the SV command. For example:

```
Set Variable T3 = Timer
```

The value of the variable is the time measured since the RT command was executed. The value can be checked by using the IF command. Actions can then be generated according to the time measured. For example:

```
IF T3 > 30 JUMP TO LINE 66
```

SV   **S**et **V**ariable. to . . . /sensor/timer
         computation(+ ,* etc.)

This command allows you to assign a value to a variable. For a detailed explanation of the use of variables in **SCORBASE**, refer to Chapter 6, "Variable Programming."

To set the value of the variable, type SV. At the prompt, enter the name of the variable. The name may be either one or two letters, or a letter and a digit.

SCORBASE then prompts you to select one of four options for setting the variable value:

```
Number or variable / Sensor / Timer / Computation
```

- Press N to set the variable to a number or to the value of another variable. Type a valid integer (any value, -32767 through + 32767) or a variable name, and press < Enter> .

- Press S to set the variable to the value of the **gripper sensor**. During operation the specified variable is set to the value (in millimeters) of the gripper opening.

- Press T to set the variable to the value of the **SCORBASE timer**. During operation the variable is set to the timer value (in tenths of a second).

- Press C to set the variable to the result of a specified **computation**. A computation consists of two arguments and an operator. An argument can be either an integer or a variable.

SCORBASE prompts you for the first argument:

```
SET VARIABLE A = .
```

Enter an integer or a variable name, and press < Enter> . This example uses the variable BB. **SCORBASE** then prompts you for the operator:

```
SET VARIABLE A = BB ..
```

Enter an operator, and press < Enter> . Pressing < Enter> without an operator enters the plus sign (for addition). This example uses the plus sign. SCORBASE then prompts you for the second argument:

```
SET VARIABLE A = BB + ......
```

Enter an integer or a variable name, and press < Enter> .

```
SET VARIABLE A = BB + 2
```

The following operators can be used with the Set Variable command:

Arithmetic Operators

+	Addition
*	Multiplication
–	Subtraction
/	Division
M	Modulus (returns the remainder of the first argument divided by the second); displayed as MOD
P	Power (raises the first argument to the power of the second argument); displayed as POWER

Comparison (Boolean) Operators

=	Equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to
<>	Not equal

The result of a comparison operation is 1 (true) if the relation is correct. Otherwise the value is 0 (false).

Logical operators

A	And
O	Or
X	Exclusive or; displayed as XOR

The result of a logical operation is 1 (true) or 0 (false). Any operand with a non-zero value is considered true, while a zero value is considered false.

Examples:

```
SET VARIABLE Z1 = Z – 15

SET VARIABLE D1 = E * Z

SET VARIABLE DD = DD + 1

SET VARIABLE DS = A MOD 3

SET VARIABLE T = MM XOR NN

SET VARIABLE M = M XOR 1     (M = NOT (M))

SET VARIABLE QK = Q >= 15

SET VARIABLE V1 = V <> 1

SET VARIABLE R = 3 POWER 2
```

IF   **IF** Variable . < = > . . . . jump to line . . .

This command is used to compare the values of variables, and to activate other commands depending on the result of that comparison..

At the prompt, enter the variable name. Then enter the comparison operator. Pressing < Enter> without a comparison operator enters the > (greater than) sign. Then enter the second variable name, or a number. Then enter the line number to jump to if the comparison condition is true.

The comparison operators used for this command are the same as those used for the Set Variable command.

Example:

```
IF VARIABLE CO <= 0 JUMP TO LINE 7
```

SS **S**et **S**ubroutine #. .

The command marks the beginning of the specified subroutine. You can program up to 64 subroutines. At the # prompt, enter any number from 1 though 64.

During normal program flow, the program will skip over (without executing) the lines containing a subroutine definition. The only way to execute a subroutine is to use the Call Subroutine command.

RS **R**eturn from **S**ubroutine

This command marks the end of a subroutine. At run-time it terminates the execution of the subroutine, and the program resumes execution at the line which follows the Call Subroutine command.

CS **C**all **S**ubroutine # . .

This command activates (calls) the specified subroutine. At the # prompt, enter any number from 1 though 64.

OM **O**n **M**otor #. error, jump . . . c/s/o

This command allows you to receive information about motor errors and to respond with a jump to a another command line (for sounding an alarm or stopping the robot, for example).

At the # prompt, enter a number. Or press < Enter> to accept any motor error. (Note that the command line will show Motor ALL Error.)

At the jump prompt, enter a line number. If you simply press < Enter> without specifying a line number, the following will be displayed:

```
ON MOTOR 1 ERROR JUMP TO NEXT  Continuously/Single/Off
```

This defines a jump to the **next line** of the program. Should a motor error occur on the specified motor during its execution of any movement, the movement will be aborted. The program will jump to the next line and continue running.

At the c/s/o prompt, you have the following options:

- Press C or < Enter> . For example:

    ```
    ON MOTOR 1 ERROR JUMP TO 37   CONT.
    ```

Any motor error on axis 1 which occurs subsequent to this command causes the program to jump to line 37. This jump occurs in the form of an interrupt.

- Press S. For example:

    ```
    ON MOTOR 1 ERROR JUMP TO 37    SING.
    ```

Only the first occurence of a motor error on axis 1 subsequent to this command causes a jump to line 37. The second occurrence will cause the program to halt and display a motor error message.

- Press O. For example:

    ```
    ON MOTOR 1 ERROR JUMP TO 37    OFF
    ```

This command cancels the effect of any preceding motor error instructions in the program relating to motor 1.

SC/ST   **S**tart **C**onveyor/**ST**op conveyor

These commands start and stop the movement of the speed controlled conveyor. The conveyor's speed is defined in the Home screen.

This command will not appear in the menu if a speed controlled conveyor has not been configured.

Program Editing Commands

ctrl-I   **I**nsert line . . .

This command allows you to insert lines into a program.

Type < Ctrl> + I. You are then prompted for the line at which you wish to insert command lines. All command entries are subsequently inserted, until you press < Enter> to exit the insert mode.

When program lines are inserted, all previously entered Jump commands are automatically updated.

ctrl-R   **R**eplace line . . .

This command allows you to replace a command line.

Type < Ctrl> + R. At the prompt, enter the line number. The command line specified is displayed and you are prompted for the new command. Pressing < Enter> without a new command leaves the original line unchanged.

L   **L**ist/Delete/Edit

Press L to activate the List/Delete/Edit screen.

In addition to editing your programs in the List/Delete/Edit screen, you might find it is easier to write your programs from this screen since more program lines can be displayed. All of the commands described in the Edit Program screen are active in the List/Delete/Edit screen.

< Esc>   Returns you to the Main Menu.

LIST/DELETE/EDIT SCREEN

The List/Delete/Edit screen is activated by pressing L from the Edit Program screen. It is similar to the List/Delete Position screen called from the Teach Positions screen.

```
                          LIST / DELETE / EDIT

LL  List Line...                    DL   Delete Line ...
LF  List From line ...              DF   Delete From line ... to line ...
PP  Print Program (to printer)      DA   Delete All

 ctrl-I/ctrl-R Insert/Replace line...│ <ESC> return to edit program menu

1
```

LL   **L**ist **L**ine . . .

Displays the command line specified.

LF   **L**ist From **L**ine . . .

Displays the command lines starting from the line specified.

If there are more positions listed than can be displayed in one screen, the system will pause and prompt you:

    PRESS <ESC> TO EXIT LISTING / ANY OTHER KEY TO CONTINUE

Pressing any other key moves the display down one screen.
Pressing < PgUp> moves the display up one screen.
Pressing < Enter> moves the display down one line.

PP   **P**rint **P**rogram (to printer)

Prints the program on a connected printer.

DL   Delete Line . . .

Deletes the command line specified.

DF   **D**elete **F**rom line . . . to line . . .

Deletes the command lines specified.

DA Delete **A**ll lines

Deletes from memory all the recorded lines.

Before executing any of the deletion commands the system will display all lines specified and prompt you for confirmation:

```
ARE YOU SURE (Y/N)? N
```

Press Y to delete. Any other key will be regarded as no.

Variable Programming

SCORBASE Level 5 allows extensive variable programming. Variables are useful for creating loops and subroutines in robot programs. They let you write commands that change as the state of the robot or its environment changes during program execution.

Up to 962 variables can be used by **SCORBASE** Level 5. Variables are referred to by names of one letter, two letters, or a letter and a digit (for example: A or AB or B1).

Variables can have integer values from -32767 through + 32767.

When programming in **SCORBASE**, you can specify a variable instead of a numeric value in most editing commands. You **cannot use** a variable to specify a Jump To line number (in the J, IL, II and OI commands), or in the Set Subroutine command. The following commands accept variables, in the fields marked with a dot:

```
GO POSITION ● SPEED# ●
WAIT ● 10THS OF SECONDS
IF LIMIT SWITCH # ●
IF INPUT # ● ON/OFF
ON INPUT INTERRUPT # ●
DISABLE / ENABLE INPUT INTERRUPT # ●
TURN OUTPUT # ● ON/OFF
GO LINEAR/CIRCULAR TO POSITION ●
RECORD PRESENT POSITION AS POSITION # ●
SET AXIS # ● TO ZERO
SET VARIABLE ● TO ●
IF VARIABLE ● <=> ●
```

Before using a variable in a command, be sure you have defined it using the SV (Set Variable) command.

Note: If, at run time, the program encounters a variable whose value is not defined or is out of range, an error message is displayed:

```
VALUE IS OUT OF RANGE
```

Examples:

```
GO POSITION A FAST
```

Whenever this command is executed, the robot is sent to position A (recorded in the Positions Table). The value of A is determined at run time.

```
TURN ON OUTPUT PP
```

This command will turn on output number PP (according to the value of PP at run time).

Examples of short programs:

The following program moves the gripper consecutively from one position to the next, waits 5 seconds at each position, and continues until it reaches the one hundredth position in the Positions Table.

```
1   SET VARIABLE CP 1
2   SET VARIABLE W 50
3   GO POSITION CP  * FAST
4   WAIT W  10THS OF SECONDS
5   SET VARIABLE CP = CP + 1
6   IF VARIABLE CP <= 100 JUMP TO 3
```

The following program sequentially scans all 16 inputs, and sends the robot to the positions which correspond to the ON inputs.

```
1   SET VARIABLE I TO 1
2   SET VARIABLE L TO 16
3   IF INPUT #I ON CALL SUB. 1
4   SET VARIABLE I = I + 1
5   IF VARIABLE I <= L JUMP TO 3
6   JUMP TO LINE #1
7   SET SUBROUTINE #1
8   GO POSITION I SPEED #8
9   RETURN FROM SUBROUTINE
```

CHAPTER 7

Program Handling Screen

This screen enables you to load (restore) and save (backup) **program lines** and **position tables**. Program lines can be transferred between IBM/PC memory and disk(ette)s. Position tables can be transferred between controller memory and disk(ette)s. In **SCORBASE** Level 5 position tables and program lines can be loaded and saved in either separate or combined operations.

The option lines at the top left of the screen let you select the specific modes in

```
┌──────────────────── PROGRAM HANDLING ────────────────────┐
│  MODE : LINES / POSITIONS / BOTH .    Working Directory :C:\ _____ │
│                                                           │
│  NAME: _____                                 │
│                              ┌──────────────────────────┐ │
│                              │                          │ │
│   ┌─────────────────────┐    │                          │ │
│   │   SAVE      (f3)     │    │                          │ │
│   └─────────────────────┘    │                          │ │
│   ┌─────────────────────┐    │                          │ │
│   │   LOAD      (f5)     │    │                          │ │
│   └─────────────────────┘    │                          │ │
│   ┌─────────────────────┐    │                          │ │
│   │   DELETE    (f7)     │    │                          │ │
│   └─────────────────────┘    │                          │ │
│   ┌─────────────────────┐    │                          │ │
│   │   CATALOG   (f9)     │    │                          │ │
│   └─────────────────────┘    │                          │ │
│  ┌──────────────────────┐    │                          │ │
│  │ <ESC> RETURN TO MAIN MENU │ └──────────────────────────┘ │
│  └──────────────────────┘                                 │
└───────────────────────────────────────────────────────────┘
```

which the loading and saving operations are performed. To move from one option line to another use the up < ↑> and down < ↓> arrow keys.

Use the left < ←> and right < →> arrow keys to highlight the field you want to activate, and press < Enter> . Leaving the option line without pressing < Enter> will accept the selection last recorded for that option. Depending upon your responses, additional option lines may appear, as described in this chapter.

MODE : LINES / POSITIONS / BOTH

This option line allows you to select the mode in which the load and save operations are performed.

LINES   When loading or saving in this mode, only the program lines are affected.

POSITIONS   When loading or saving in this mode, only the positions are affected.

BOTH   When loading or saving in this mode, both the position table and the program commands are affected. This is the default.

Note that the restore and backup operations of the **SCORBASE** Position Table involve extensive communication with the robot controller. The process can take up to two minutes. Remember that the Position Table is also stored in the controller's BBRAM. Therefore, it will not be erased even if you have exited to DOS or shut off power.

Working Directory :   C:\

The default is the directory from which you have activated **SCORBASE**. To alter the directory, simply type the new directory and press < Enter> . The directory definition may include a drive specification (A:, B:).

This entry is written to disk. Therefore, the new directory remains the default, even if you have exited to DOS or shut off power.

NAME :

Use this option to assign a name to a program you have created. You can then use this file name when performing save, load or delete operations.

When you type in the file name, do not use more than 8 characters, and do not use an extension. The first character of the file name may not be a number.

All program files saved by **SCORBASE** Level 5 are automatically assigned the file name extension .L5 . All **SCORBASE** position tables are saved with the file name extension .POS .

LINES : REPLACE / INSERT

This option line will appear if you have selected the LINES mode. The selection you now make will affect only the loading operation.

REPLACE   The program you are loading will replace the pro-
                                 gram currently residing in memory.
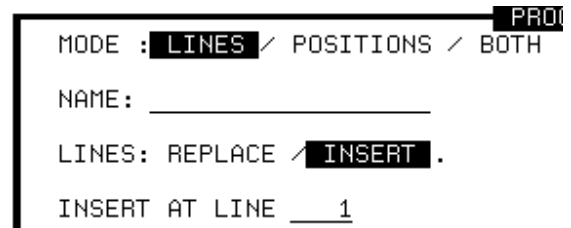
INSERT :   The program you are loading will be inserted into
                                 the program currently residing in memory.

If you select INSERT, an additional option line will appear:

INSERT AT LINE : _____

Your response determines where the program is to be inserted. If you enter the
line number which follows the end of the currently residing program (displayed
as the default), the loaded program is then appended to the end of the current
program.

When using INSERT to load a
program, the Jump commands
in the original program are up-
dated accordingly. The inser-
tion of large programs into
large programs may take up to
two minutes because of the ex-
tensive updating.

```
                                                    ▌PRO◖
     MODE :▐LINES▌/ POSITIONS / BOTH

     NAME: _____

     LINES: REPLACE /▐INSERT▌.

     INSERT AT LINE ___1
```

After making your selections in the mode option lines, you may select the following operations. Press the function key corresponding to your choice.

| SAVE (F3) | Saves on disk(ette) lines or positions or both, depending on the mode selected. |

| LOAD (F5) | Loads from disk(ette) lines or positions or both, depending on the mode selected. |

| DELETE (F7) | Deletes from disk(ette) either lines or positions or both, depending on the mode selected. |

Before the deletion the system will prompt you for confirmation:

```
ARE YOU SURE (Y/N)?  N
```

Press Y to confirm. Any other key is regarded as no.

| CATALOG (F9) | Displays a list (catalog) of all the **SCORBASE** programs and/or position tables on your diskette, depending on the mode selected. |

Note the file name extensions, which represent either a program file (.L5) or a position table (.POS).

The catalog is displayed according to the mode you selected. If you have selected LINES, only the program files appear in the catalog. If you have selected POSITIONS, only position files appear in the catalog.

| <Esc> RETURN TO MAIN MENU |

CHAPTER 8

Home Screen

This screen is used for configuring and homing the robot and peripheral equipment.

```
        HOME MENU
        ─────────

1/Q   move base        right / left
2/W   move shoulder    up / down
3/E   move elbow       up / down
4/R   move wrist-pitch up / down
5/T   move wrist-roll  right / left
7/U   move axis 7      + / -  not connected
8/I   move axis 8      + / -  not connected
OG/CG Open / Close Gripper
F/S   Fast/Speed 10    movement
ON/OF turn Output #. oN / oFf
CN/CF Control oN /Control oFf
H     set present position as Home
D     Define gripper sensor  not installed
P     Peripheral equipment setup
CS    Conveyor Speed 30    mm/sec.(connected to axis#11)
    PRESS 'G' KEY TO HOME THE ROBOT
  ANY OTHER KEY WILL STOP THE ROBOT
  <ESC> RETURN TO MAIN MENU
                              STOP
```

Many of the commands in the Home screen are identical to those found on the left side of the Teach Positions screen. The function keys for moving the peripherals are also active. Note that manual movement of the axes is determined by the coordinate system last activated in the Teach Positions screen.

Additional **SCORBASE** features found in the Home screen are:

G   PRESS 'G' KEY TO HOME THE ROBOT

The **SCORBOT** should be homed each time the controller is turned on. To perform the fixed home search, press G. During the homing procedure, **SCORBASE** displays messages stating whether each of the joints has reached its fixed home position. If a joint has not found its home location, the homing program automatically runs once more.

If the homing is not fully successful, the following message is displayed:

```
ROBOT IS NOT AT HOME !
```

When the robot has reached its home position, the following message is displayed:

```
ROBOT IS AT HOME
```

To stop the homing while the operation is in progress, press any key. For an immediate **brake**, press **B**.

CS **C**onveyor **S**peed 30   mm/sec (connected to axis#11)

To set the speed of the speed controlled conveyor, type CS. You are then prompted:

```
NEW CONVEYOR SPEED :....
```

Enter a value, from -200 through + 200. Entering a negative value will cause the conveyor to move in a reverse direction.

Note that this command line will not appear in the Home Menu if a speed controlled conveyor has not been configured.

P **P**eripheral Equipment Setup

The homing of axes 7 though 11, depends upon the peripheral equipment you have connected. To define the peripheral equipment, press P. The Peripheral Setup screen is displayed.

```
┌──────────────────── PERIPHERAL SETUP ────────────────────┐
│                                                          │
│  AXIS  7  : Not connected / Slidebase / Rotary table / Conveyor / Other │
│                                                          │
│  AXIS  8  : Not connected / Slidebase / Rotary table / Conveyor / Other │
│                                                          │
│  AXIS  9  : Not connected / Slidebase / Rotary table / Conveyor / Other │
│                                                          │
│  AXIS 10  : Speed Controlled Conveyor                    │
│                                                          │
│  AXIS 11                                                 │
│                                                          │
│                                                          │
│   press <ESC> to perform peripheral setup and return to main screen │
└──────────────────────────────────────────────────────────┘
```

The number of axes displayed is determined by the configuration you defined for the controller.

If a speed conveyor has already been defined, it will automatically appear at the specified axis. All other equipment, including a conveyor as a standard peripheral, should be specified in this screen.

Using the arrow keys and < Enter> to make your selections, define the specific equipment installed at each axis.

```
┌─────────────────────────┤ PERIPHERAL SETUP ├─────────────────────────┐
│                                                                       │
│   AXIS  7  : Not connected / Slidebase / Rotary table / Conveyor / Other │
│             Slidebase type : 24" (610mm) / 48" (1220mm) / 72" (1830mm) │
│             Home type : No homing / Hard home / Microswitch            │
│                                                                       │
│   AXIS  8  : Not connected / Slidebase / Rotary table / Conveyor / Other │
│             Rotary table type : STANDARD / LARGE                       │
│             Home type : No homing / Hard home / Microswitch            │
│                                                                       │
│   AXIS  9  : Not connected / Slidebase / Rotary table / Conveyor / Other │
│             Conveyor type : ORANGE / GRAY                              │
│             Home type : No homing / Hard home / Microswitch            │
│                                                                       │
│   AXIS 10  : Speed Controlled Conveyor                                 │
│                                                                       │
│                                                                       │
│   AXIS 11                                                              │
│                                                                       │
│                                                                       │
│   ─── press <ESC> to perform peripheral setup and return to main screen ─── │
└───────────────────────────────────────────────────────────────────────┘
```

The factory-set homing procedure defaults are as follows:

Slidebase: The slidebase is moved to one side until it cannot move any further.

Rotary-table: Search for microswitch is performed.

Conveyor: No search is performed.

Not connected: No search is performed.

When you exit this menu, this setup is recorded in the SETUP.ROB file and placed on your disk(ette). The next time you load **SCORBASE** the correct peripheral setup will automatically be configured. You do not need to repeat the setup operation unless you physical alter a peripheral or its axis connection.

Refer to Appendix C, "Peripheral Configuration Files."

D   **D**efine gripper sensor   `not installed`

A sensor mounted within the gripper can be used to control the amount of force exerted by the gripper when executing a Close Gripper (CG) command. The sensor is connected to the **SCORBOT** controller through one of the 16 input ports. When the force reaches a predefined threshold, the sensor sends an ON signal to the input.

This command allows you to define which input port is used for the sensor connection.

Press D. You are then prompted:

    IS GRIPPER SENSOR CONNECTED (Y/N)? Y

Press Y or < Enter> to connect a gripper sensor. Otherwise, press N.

If a gripper sensor is connected, the following prompt is then displayed:

    GRIPPER SENSOR CONNECTED TO INPUT (1 - 16) ..

Enter the number of the input port. Your response (input 4, for example) is then reflected in the menu line:

    Define gripper sensor   `input 4`

During the execution of Close Gripper commands, this input will now be checked.

H   set present position as **H**ome

If you want to start the robot from a position other than its fixed home, move the robot to the desired position, and press H.

Be careful when using this command. Altering the home position may invalidate other positions you have recorded. If you use a home position other than standard home, you can record only joint positions; the XYZ coordinate system is invalid.

< Esc>   Press < Esc> to exit the Home screen.

Run Program Screen

This screen enables you to run the programs you have created.

```
┌──────────────────────────┤ RUN PROGRAM ├──────────────────────────┐
│  ┌─────────┐  ┌────────────────────────┐  ┌──────────────────────┐  ┌─────────┐  │
│  │   RUN   │  │ RUN SINGLE LINE  (f1)  │  │  JUMP TO LINE #. (f2) │  │  ROBOT  │  │
│  └─────────┘  └────────────────────────┘  └──────────────────────┘  └─────────┘  │
│  ┌─────────┐  ┌────────────────────────┐  ┌──────────────────────┐  ┌─────────┐  │
│  │  STOP   │  │ RUN SINGLE CYCLE (f3)  │  │  BRAKE        <B>     │  │   I/O   │  │
│  └─────────┘  └────────────────────────┘  └──────────────────────┘  └─────────┘  │
│  ┌─────────┐  ┌────────────────────────┐  DISPLAY PROGRAM : OFF / ON / PRINTER .  │
│  │  ERROR  │  │ RUN CONTINUOUSLY (f5)  │  LINE : OFF LINE / ON LINE.              │
│  └─────────┘  └────────────────────────┘                                         │
│  ┌──────────────────────────────────────────────────────────────────────────┐  │
│  │                                                                            │  │
│  │                                                                            │  │
│  │                                                                            │  │
│  │                                                                            │  │
│  │                                                                            │  │
│  └──────────────────────────────────────────────────────────────────────────┘  │
└────────────────────────────────────────────────────────────────────────────────┘
```

RUN OPTIONS

To move from one option line to another, use the up $< \uparrow >$ and down $< \downarrow >$ arrow keys. Use the left $< \leftarrow >$ and right $< \rightarrow >$ arrow keys to highlight the field you want to activate, and press $<$ Enter$>$. Leaving the option line without pressing $<$ Enter$>$ will accept the selection last recorded for that option.

DISPLAY PROGRAM : OFF / ON / PRINTER

This option allows you to select the mode of display during program execution.

OFF   Program lines will not be displayed on screen. This is the default.

ON	Program lines will be displayed on screen.
PRINTER	Program lines will be displayed on screen and printed on a connected printer. This option is very useful for studying the program flow.

LINE : OFF LINE / ON LINE

This option allows you to choose whether your programs will run in the on line or off line mode.

ON LINE	When the program runs on line, the robot, peripherals and I/Os execute all program commands. This is the default.
OFF LINE	When the program runs off line, all the commands for executing actions are suppressed. The robot arm is not moved and the outputs are not switched. The robot can even be disconnected when this mode is active.
	When the program is running off line, it will halt at the commands which test the state of the inputs or limit switches, and will prompt you for a simulated status.
	Example:
	When the program reaches this line:
	``` IF INPUT #1 ON JUMP TO LINE 25 ```
	It will stop and prompt:
	``` IS INPUT #1 ON (Y/N)? ```
	You can thus simulate the actual execution of the program.

Note that the off line option in this screen can also be used when the **SCORBASE** system is connected to a controller and is in the on line mode.

RUN ACTIONS

RUN SINGLE LINE	(F1)	Executes the current program line. The line is displayed in the program window.

RUN SINGLE CYCLE	(F3)	Executes the program once.

RUN CONTINUOUSLY	(F5)	Executes the program in an endless loop. When it reaches the last line, the program jumps automatically to line 1.

JUMP TO LINE #.	(F2)	After pressing F2 you must enter a line number. The program will jump to the specified command line and execute it.

BRAKE	<B>	Pressing B immediately stops program execution.

Pressing any key will cause the program execution to stop after completing the current command.

Pressing B also stops the movement of the speed controlled conveyor.

PROGRAM STATUS REPORTS

The left side of the screen contains the dynamic program reports. The highlighted field indicates the running status of the current program.

RUN

STOP

ERROR

The right side of the screen contains the command reports. The highlighted field indicates the type of command currently being executed by the program.

| ROBOT |

Indicates movement of the robot or the peripherals.

| I/O |

Indicates commands related to the inputs, outputs and limit switches.

The window at the bottom of the screen displays the program lines and various messages. The program is displayed if the Display mode is active or if the program is executed in Run Single Line mode. When the program is stopped (STOP is highlighted), the next command to be executed is displayed.

I/O Setup Screen

This screen lets you define the text or names you want associated with the input and output ports and their states.

```
┌──────────────────── I/O SETUP ────────────────────┐
│                                                    │
│      INPUTS                        OUTPUTS         │
│                                                    │
│   ON        OFF                  ON        OFF     │
│  1:_____  _____            1:_____  _____  │
│  2:_____  _____            2:_____  _____  │
│  3:_____  _____            3:_____  _____  │
│  4:_____  _____            4:_____  _____  │
│  5:_____  _____            5:_____  _____  │
│  6:_____  _____            6:_____  _____  │
│  7:_____  _____            7:_____  _____  │
│  8:_____  _____            8:_____  _____  │
│  9:_____  _____            9:_____  _____  │
│ 10:_____  _____           10:_____  _____  │
│ 11:_____  _____           11:_____  _____  │
│ 12:_____  _____           12:_____  _____  │
│ 13:_____  _____           13:_____  _____  │
│ 14:_____  _____           14:_____  _____  │
│ 15:_____  _____           15:_____  _____  │
│ 16:_____  _____           16:_____  _____  │
│                                                    │
└────────────────────────────────────────────────────┘
```

The **SCORBOT** controller has 16 input and 16 output ports. You can assign different names or text to the ON and OFF status of each port.

To move from one text field to another, use the following keys:

< ↓>	Moves to the next field.
< ↑>	Moves to the previous field.
< Home>	Moves to the first field in the screen.
< End>	Moves to the last field in the screen.
< Tab> < Tab>	Toggles between the input and output fields.

To insert text, bring the cursor to the desired field, type in the text, and press < Enter> . If you leave the field without pressing < Enter> , the text will not be recorded. You can change the existing name in a field simply by typing in new text and pressing < Enter> . A name may contain up to 8 characters.

The text assigned to each I/O is displayed accordingly when a program is executed from the Run Cell Control screen.

Example:
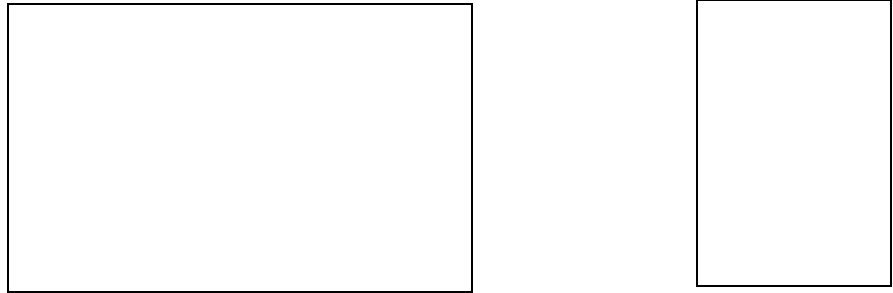
As long as output 1 is on, the text **LAMP on** is displayed. While output 1 is off, the text: lamp off appears. Similarly, **BUZZ on** and buzz off are displayed according to the status of input 2

Press < Esc> to return to the Main Menu screen.

When you exit the I/O Setup screen, the I/O setup is automatically saved on your disk(ette) under the filename: SETUP.IO . It is not attached to any specific program.

When you reload **SCORBASE** Level 5, the I/O setup is automatically loaded.

If the SETUP.IO file is not present in the current directory when **SCORBASE** Level 5 is loaded, all text entries are initialized as blanks.

CHAPTER 11

Run Cell Control Screen

This screen allows you to execute your **SCORBASE** program while a full run time report of the I/O status is displayed.

```
 _____
|  INPUTS               ┌─────── RUN CELL CONTROL ───────┐        OUTPUTS     |
|  ┌───┐   ┌───────┐  ┌──────────────┐  ┌──────────────┐  ┌───────┐  ┌───┐    |
| 1│   │   │  RUN  │  │ RUN LINE (f1)│  │ JUMP TO (f2) │  │ ROBOT │ 1│   │    |
| 2│───│   └───────┘  └──────────────┘  └──────────────┘  └───────┘ 2│───│    |
| 3│───│   ┌───────┐  ┌──────────────┐  ┌──────────────┐  ┌───────┐ 3│───│    |
| 4│───│   │ STOP  │  │ RUN CYCLE(f3)│  │ BRAKE    <B> │  │  I/O  │ 4│───│    |
| 5│───│   └───────┘  └──────────────┘  └──────────────┘  └───────┘ 5│───│    |
| 6│───│   ┌───────┐  ┌──────────────┐                             6│───│    |
| 7│───│   │ ERROR │  │ RUN CONT.(f5)│  DISPLAY: OFF / ON / PRINTER.7│───│    |
| 8│───│   └───────┘  └──────────────┘                             8│───│    |
| 9│───│   └────────────────────────────────────────────────────┘ 9│───│    |
| 0│───│   ┌────────────────────────────────────────────────────┐ 0│───│    |
| 1│───│   │                                                    │ 1│───│    |
| 2│───│   │                                                    │ 2│───│    |
| 3│───│   │                                                    │ 3│───│    |
| 4│───│   │                                                    │ 4│───│    |
| 5│───│   │                                                    │ 5│───│    |
| 6│   │   └────────────────────────────────────────────────────┘ 6│   │    |
|  └───┘                                                            └───┘    |
 ────────────────────────────────────────────────────────────────────────────
```

The center portion of this screen is very similar to the Run Program screen. For a description of the function keys and options, refer to Chapter 9.

On the left and right sides of the screen you will find the Cell Control I/O report fields. The fields on the left report the status of input ports, while those on the right report output status.

The text appearing in the I/O report fields is determined by the definitions you recorded in the I/O Setup screen. When an I/O port is on, its corresponding field is highlighted (in reverse video) and the assigned text is displayed. When an I/O port is off, the field simply displays the assigned text for this status.

The report fields are constantly updated as long as the PC is connected to the controller. Even when you are not running a program, the I/O report is active.

Commmand Line Options

When loading **SCORBASE** Level 5, you can enter several command line options. The complete syntax for loading this software is:

```
SCOR5 [ /Llnum /Ttnum /Ccomnum /Oprnum ] [ progname /R ] [
/H ]
```
or
```
GO [ /Llnum /Ttnum /Ccomnum /Oprnum ] [ progname /R ] [ /H ]
```

The options within brackets [ ] are strictly optional and can be omitted. During normal operation the default values are used. Once you have entered an option, it overrides the default settings.

SIZE OPTIONS

/L Defines the maximum number of available program lines.

Default : 400

Maximum : 10000 (or memory limit)

/T Defines the maximum number of text lines (PRINT and REMARK statements) available when writing a program.

Default : 50

Maximum : 1000 (or memory limit)

Example:

```
SCOR_ER5 /L2000        or
GO /L2000
```

This command loads **SCORBASE** Level 5 and allow the use of up to 2000 lines. The number of positions available is always 400.

Note that when you execute partial load and save operations, **SCORBASE** creates a temporary copy of the program. If you have defined a setup which uses a very large number of lines, you may be unable to execute these partial operations due to memory size limitations.

DEVICE OPTIONS

/C Defines the RS-232 port used for communication with the robot controller

/C1 : COM1

/C2 : COM2

/O Defines the parallel printer port to be used when printing.

/O1 : PRN1

/O2 : PRN2

/O3 : PRN3

Example:

```
SCOR_ER5 /C2      or
GO  /C2
```

SCORBASE Level 5 will be loaded with the robot communications on COM2.

AUTOMATIC RUN OPTIONS

progname If you specify a program name, the program (FILE.L5 for example) will automatically be loaded, together with its position table (FILE.POS). If a position file does not exist, the position table currently in the controller will be used.

/R If you add this option, the program will automatically start running as soon as it is loaded. When execution of the program is completed, **SCORBASE** will return control to the DOS operating system.

/H Instructs the system to run the HOME program before activating the Main Menu.

Example:

```
SCOR_ER5 TEST /R      or
GO TEST /R
```

The **SCORBASE** Level 5 program named TEST will automatically be load and executed. When execution of TEST is completed, **SCORBASE** will return control to the DOS operating system.

SCORBASE
Controller Configuration

SCORBASE operation is closely linked with the controller. **SCORBASE** performs some commands itself and communicates others to the controller for execution.

To use **SCORBASE**, the controller must be properly configured, and the controller's battery backed-up User RAM must contain the programs and position vectors which support **SCORBASE** operation.

When you load **SCORBASE**, it checks for a valid controller configuration. If an invalid configuration is detected, **SCORBASE** will automatically prompt you to provide the information it needs to create the proper configuration. Refer to Chapter 1.

SCORBOT controllers are factory configured to meet **SCORBASE** requirements. However, user operation, memory reconfiguration or memory battery failure may alter the configuration. The installation of additional driver cards, or the expansion of system memory, require reconfiguration of the controller.

CONFIGURATION PROCEDURE
FOR SCORBASE CONTROLLER

The easiest method for configuring the controller is provided by the Advanced Terminal Software (ATS), as described below. Refer to the ACL *Reference Guide* for complete ATS operating instructions.

1. Make sure your controller and computer are properly connected and switched on.

   Start you computer with a DOS diskette. If your computer is PS/2, you must use DOS 3.3 or later.

Insert the ATS diskette into drive A.

Type: `GO`   `<Enter>`

The ATS main screen will appear:

2. Once ATS has loaded, press < Enter> to receive the > prompt, if it is not al-
    ready displayed.

    If the prompt does not appear, it means ATS is not properly communicating
    with the controller. If this happens, refer to the **SCORBOT** *User's Manual* for in-
    structions on making the proper connections.

3. Press < Alt> + H to view the list of ATS function key operations. Note the
    < Ctrl> functions for controller set-up. You will need to use < Ctrl> + F2 to
    create the proper **SCORBASE** configuration.

    Note: Performing the next step will erase all user programs and position from
    battery backed-up User RAM. If you have such programs, use the ATS Backup
    Manager to save your data before continuing.

4. Press < Ctrl> + F2.

    The system will now prompt you through the controller configuration procedure.

    ```
    SCORBASE Controller Configuration
    ARE YOU SURE (Y/N)? N
    ```

    Press Y to begin.

    How many axes are installed? ..

    Type in the number of axes installed and press < Enter> . A standard controller
    with 4 driver cards has 8 axes. If additional driver cards are installed in the con-
    troller, enter the corresponding number of axes.   Do not enter a number
    which is greater than the actual number of axes installed.

    Is expanded memory installed? (Y/N)? Y

    Press < Enter> or Y if your controller has the standard 128K byte memory.

    Press N if your controller has only 32K byte memory.

    ```
    Robot type :    ER V    ER V PLUS / ER VII
    ```

    Use the left and right arrow keys to highlight the type of robot installed, and
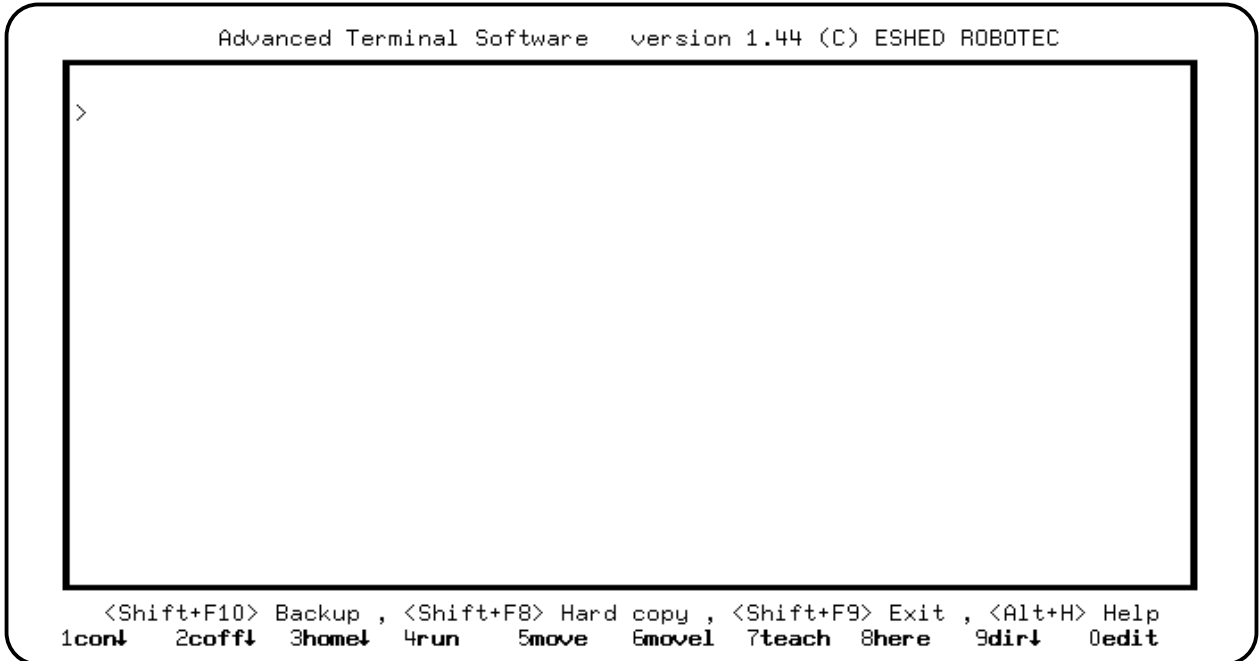   press < Enter> **.**

    ```
    Speed Controlled Conveyor :  not used / orange / gray
    ```

Use the left and right arrow keys to highlight the type of conveyor installed, and press < Enter> .

```
Does the controller have an auxiliary RS232 board(Y/N)? N
```

Press Y only if an RS232 board is installed in the controller.

```
WARNING ! USER RAM WILL BE ERASED !!
ARE YOU SURE (Y/N)? N
```

```
         Advanced Terminal Software    version 1.44 (C) ESHED ROBOTEC

    >




















    <Shift+F10> Backup , <Shift+F8> Hard copy , <Shift+F9> Exit , <Alt+H> Help
   1con↓    2coff↓   3home↓   4run     5move    6movel   7teach  8here    9dir↓    0edit
```

Press Y to initiate the configuration. ATS performs the configuration and down-loads to the controller the programs necessary for **SCORBASE** operation.

If the speed controlled conveyor is not installed, and if more than six axes are in-stalled, the following is displayed on your screen:

```
PERFORMING CONFIGURATION

DOWNLOADING SERVICE PROGRAMS
MOVE is valid
MOVEL is valid
MOVEC is valid
OPEN is valid
CLOSE is valid
MOVED is valid
GSENS is valid
MVMAX is valid
-DONE-
>
```

(MVMAX will not appear if only 6 axes are installed).

If the speed controlled conveyor is installed, additional programs are down-loaded, and the following is displayed.

```
PERFORMING CONFIGURATION

DOWNLOADING SERVICE PROGRAMS
MOVE is valid
MOVEL is valid
MOVEC is valid
OPEN is valid
CLOSE is valid
MOVED is valid
GSENS is valid
MVMAX is valid
MCONV is valid
PICKO is valid
-DONE-
Conveyor should be connected to axis 11
>
```

SCORBASE reminds you that the speed controlled conveyor must be connected to the highest number axis installed.

SCORBASE CONTROLLER CONFIGURATION DESCRIPTION

Once established, the **SCORBASE** controller configuration includes:

1. Servo axes configuration:

    - Axes 1 through 5 : Robot axes (group A).

    - Axis 6 : Servo gripper.

    - Axes 7 through 11 : Peripherals (group B).

    Standard controllers have 2 axes (7, 8) in group B.

2. Predefined positions:

- Position 0 : Home position of Group A (the robot).

- Position 00 : Home position of Group B (the peripherals).

- Position vector SCORA[464] for Group A.

- Position vector SCORB[464] for Group B.

3. Programs necessary for **SCORBASE** operation, such as:

- MOVE

- MOVEL

- MOVEC

- OPEN

- CLOSE

- MOVES

- GSENS