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 II** 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
PICK0 is valid
-DONE-
Conveyor should be connecte  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.

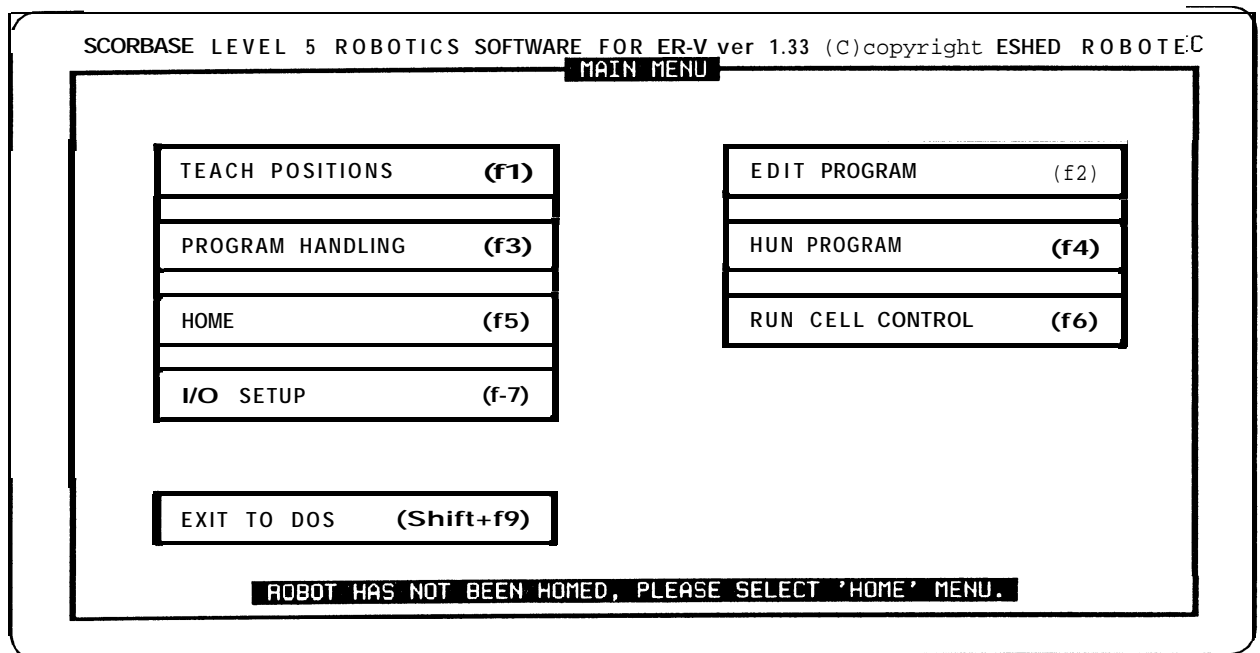## OPERATING KEYS

Throughout SCORBASE, the following keys are used to activate screens and enter 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.

Main Menu

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

```
┌─────────────────────────────────────────────────────────────────────────┐
│ SCORBASE LEVEL 5 ROBOTICS SOFTWARE FOR ER-V ver 1.33 (C)copyright ESHED ROBOTEC │
│                              ▐ MAIN MENU ▌                                 │
│   ┌───────────────────────────────┐   ┌───────────────────────────────┐   │
│   │ TEACH POSITIONS        (f1)   │   │ EDIT PROGRAM          (f2)    │   │
│   ├───────────────────────────────┤   ├───────────────────────────────┤   │
│   │ PROGRAM HANDLING       (f3)   │   │ HUN PROGRAM           (f4)    │   │
│   ├───────────────────────────────┤   ├───────────────────────────────┤   │
│   │ HOME                   (f5)   │   │ RUN CELL CONTROL      (f6)    │   │
│   ├───────────────────────────────┤   └───────────────────────────────┘   │
│   │ I/O SETUP             (f-7)   │                                       │
│   └───────────────────────────────┘                                       │
│                                                                           │
│   ┌───────────────────────────────┐                                       │
│   │ 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 Fl or T activates the Teach Positions screen. Exit to DOS can only be activated by pressing < Shift > +F9.

TEACH POSITIONS (Fl)

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 recording 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 names or text for 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 to con-
firm:

```
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 mes-
sages 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 estab-
lished 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
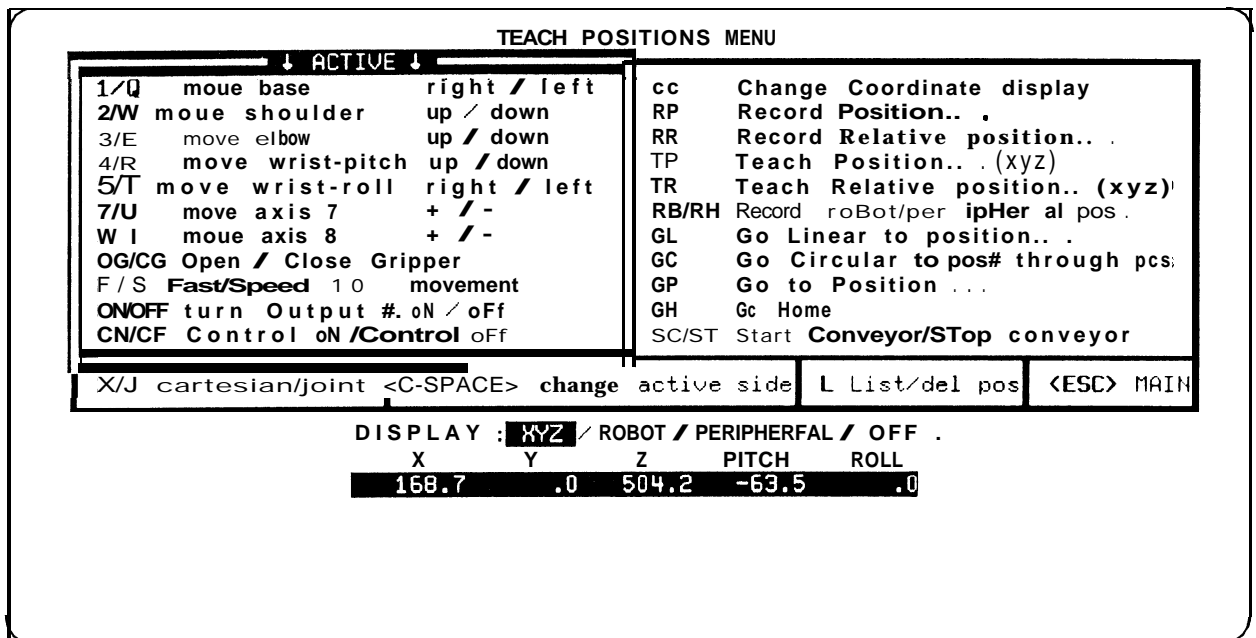   and the PC.

.   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.

Teach Positions Screen

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

```
                        TEACH POSITIONS MENU
        ┌──── ↓ ACTIVE ↓ ─────────────┐
        │ 1/Q    moue base         right / left │  cc     Change Coordinate display
        │ 2/W  moue 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/per ipHer al pos .
        │ W I    moue axis 8        + / - │       GL     Go Linear to position.. .
        │ OG/CG Open / Close Gripper │           GC     Go Circular to pos# through pcs;
        │ F / S Fast/Speed 1 0    movement │     GP     Go to Position ...
        │ ON/OFF turn Output #. oN / oFf │       GH     Gc Home
        │ CN/CF Control oN /Control oFf │        SC/ST Start Conveyor/STop conveyor
        └──────────────────────────────┘
        │ X/J cartesian/joint <C-SPACE> change active side│ L List/del pos│ <ESC> MAIN

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

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	.O	504.2	-63.5	.o

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 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

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

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

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
l/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.
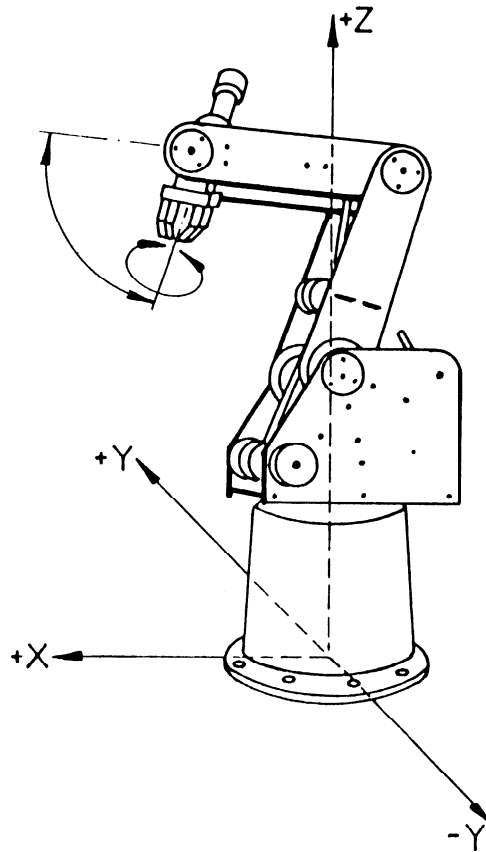
SCORBOT **XYZ Coordinate System**

Additional Direct Mode Commands

OG/CG Open/Close Gripper

These commands open and close the gripper.

F/S Fast/Speed **10** movement

These commands set the speed for manual robot movement.

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