1 Introduction

This section provides a brief description of the robotic arm, its controller, the teach pendant, available interchangeable fingers, and operational specifications. Successive sections contain instructions and procedures for installation and setup, service, preventive maintenance, and calibration. A listing of the ORCA system command set is also included in a later section of this manual. Appendices are included that list the replacement parts and required tools as well as error codes and messages.

Description

The SAGIAN Optimized Robot for Chemical Analysis (ORCA system) is a robotic system that offers flexible and reliable automated sample preparation and/ or transport capabilities. It has been designed specifically for the analytical laboratory in that it employs a rectilinear work volume to adapt easily to existing laboratory layouts, and a tool vector that increases dexterity and optimizes accessibility of the ORCA system arm to objects within the work envelope. The robot is a six-axis (rail, reach, height, bend, twist, and grip) articulated (i.e., jointed) arm that travels horizontally along a precision rail to access positions within its work space. The rail can be one, two, or three meters long. Interchangeable fingers allow the robot to grasp and manipulate different sample containers or tools for transferring liquids and pipetting reagents.

The controller serves a dual purpose. It provides power to the robot and acts as the interface between the ORCA system and an HP Vectra or a comparable computer that is equipped with the Methods Development Software 2.0 (MDS 2.0) used to send commands to system modules and peripherals.

The teach pendant allows the user to interact with the robot to control its position within the work envelope. This allows for quick and easy teaching of motions, racks, and frames. The teach pendant is a joystick that allows each axis to be controlled independently simply by changing the orientation of the pendant. The joystick design also provides fine and coarse control of robot movement by controlling the speed at which the arm moves during the teaching process. The speed is determined by the magnitude of the deflection of the joystick—the greater the deflection, the faster the robot moves.

The ORCA system can move samples among various modules that are necessary to complete an application. Modules are such things as a balance, vortex, centrifuge, solid-phase extractor, or liquid dispenser which can communicate with the host computer through industry standard IEEE-488 (HP-IB) or RS-232 interfaces. Workstations that have no computer interface can be controlled through switch closures using commercially available switch/control units, e.g., the HP 3488A. Modules are held in place on the bench top or on optional optical-grade platforms.

MDS 2.0 is a Microsoft® Windows-based software package that allows the ORCA system to perform specific tasks known as procedures, each of which may consist of a series of module entries (for example, robot motions), other workstation operations (for example, weighing, vortexing, centrifuging), logic, and/or other procedures. Motions are taught by moving the robot arm to different positions within its work space to perform a necessary function. This is accomplished through the use of the joystick teach pendant. Motions, workstation operations, and logic can then be tied together in the MDS 2.0 programming language (similar to PC Basic) to create procedures. Procedures can, in turn, be joined in many different ways to create unique higher-level programs that perform a complete analysis. Data can be collected and stored by the software for future interpretation.

Fingers and Tools

The robot can use any of the following:

1. Standard fingers (for gripping)
2. Fixed/remote dispenser
3. 1.0-ml pipettor

In addition, finger “blanks” are available that allow the user to design and manufacture custom end-effectors.

Specifications

Degrees of Freedom

Six—rail, reach, height, bend, twist, grip

Speed

4 sec (1 in. up, 12 in. over, 1 in. down, then back to original position in reverse order) at maximum robot speed (100 arbitrary units)

Each axis is independently programmable to speeds between 1 and 100 arbitrary units.

Repeatability (Precision)

± 2s mm

Dwell Time between Robot Positions

< 50 ms

Lifting Capacity (Payload)

0.5 kg continuous, 1.5 kg transient

Vertical Deflection

< 1.5 mm at continuous payload (0.5 kg)

Rail Lengths

1 m 2m 3m

Finger Travel

0–4 cm (standard)

0–8 cm (optional)

Maximum Reach

54 cm (21.3 in.)—measured from the front face of the pinch rack to the center of the shoulder.

Maximum Height

78 cm (30.7 in.)—measured from the front face of the pinch rack (null tool) to the base of the rail mini-platform.

Position Detection

Optical encoders

Motor Control

Digitally controlled DC servomotors

Interface

IEEE-488 (HP-IB)

Operating Temperature

5 to 38°C (41 to 100°F)

Storage (Non-operating) Temperature

40 to 70°C (-40 to 158°F)

Operating Humidity

0–95% Relative Humidity (non-condensing) at 40°C (104°F)

Storage (Non-operating) Humidity

Up to 90% Relative Humidity at 65°C (149°F)

Input Voltage

100-120 VAC (+5%, -10%)

220-240 VAC (+5%. -10%)

Frequency Range

48–63 Hz

Power Consumption

350 VA

Controller Line Fuse

6A

Weight

Robot Arm: 8 kg (17.6 lb.)

Robot Controller: 6.8 k~ (15 lb.)

Rail Assembly: 22.7 kg (50 lb.)

Platform: 40.9 kg (90 lb.)