Standard Module #SP-01-17

Description: IRB-580 Robot with 6-axis Hollow-Wrist Manipulator, S4P Controller, Conveyor Tracking, and Analog Paint Regulation (APR)

The IRB-580 Hollow-Wrist finishing robot is specifically designed for spray painting applications. The 6-axis manipulator features strength, speed, efficiency, and the latest in AC servo drives to provide position repeatability and an expanded work envelope at an economical price. The S4P controller features ABB BaseWare™ with RAPID™ basic programming language and PaintWare™ programming language specifically developed for finishing applications. Analog Paint Regulation (APR), with in-arm transducers, is included to provide analog control of gun functions from within the robot program. The ABB IRB-580 robot includes features that provide both short and long range cost benefits over competitive models. Some of these are:

- Symmetrical manipulator arm design that eliminates the need to specify right-hand or left-hand machine and simplifies program mirroring.
- Counterbalanced manipulator design to reduce the load on the servo motors. This design allows the servo motors to be run at full speed without overheating that would shorten servo motor life. Full speed moves during non-painting portions of the programs reduces cycle times and increases production.
- Flexible stainless steel Titeflex cable carries the motor cables, and purge air between the purge box and the manipulator. This single cable is factory wired and installed into both the purge box and the manipulator so that the installer does not have to deal with large conduit, explosion proof electrical fittings, and explosion proof packings. Installation time and cost is reduced and servicing is simplified because the robot manipulator can be easily moved if required.
- The software package used provides for function and interface expandability and greater flexibility in communications with external devices such as programmable controllers, computers, and networking.
- All ABB painting robots use a unique joystick programming pendant instead of hard to use X-Y-Z keys to move the robot arms during programming. Operators enjoy working with the pendant and are able to write programs quicker and more accurately. Programming time and costs are reduced.
- S4P robot controller with the same architecture as the S4 controllers used with ABB welding and material handling robot models. This provides savings from common spare parts inventories, quicker maintenance and operator training, and even quicker familiarity of the painting robot for operators having previous ABB robot experience.
- Ethernet network interface installed in the robot controller to facilitate inter-connection to other controllers and an external computer or PLC.
- The Analog Paint Regulation (APR) System consists of software mounted in the robot controller and electro-pneumatic transducers that are mounted in the vertical arm of the robot manipulator. The proximity of the transducers, which are controlled from within the robot program, to the spray gun provides quick gun response for better programs and
reduced paint consumption that a remote transducer panel can not. Material cost is reduced.

- Conveyor Tracking Software allows the operator to write robot programs on a stationary part. During production the software automatically tracks the moving part on the conveyor and adjusts for conveyor speed changes. Programming is simplified because the operator writes the program on a stationary part so programming time and costs are reduced.

The IRB-580 Hollow-Wrist Finishing Robot consists of the following components:

**Robot Manipulator**

The Model 580 robot manipulator, (Fig. 1), is composed of the base, vertical arm, horizontal arm, and Hollow-Wrist. The manipulator features:

- Hollow-Wrist, with endless rotation of axis #4, for easier hose routing with 22 lb. (10 kg) payload capacity
- Viton wrist seals for resistance to aggressive solvents
- Six (6) AC brushless servo controlled axes
- Brakes on all axes
- Mechanical stops on lower arm axis #2
- 1000mm vertical arm and 1220mm horizontal arm for a large work envelope
- Counter balanced manipulator arms for reduced load on servo motors
- Absolute positioning
- Electro-mechanical transducers mounted in the vertical robot arm to control spray gun atomizing, fan, and air to an air piloted remote fluid regulator
- Pilot valves mounted on the vertical robot arm for controlling spray gun
- Hose guide with cover
- Purge unit for intrinsically safe installations
- Spray gun trigger valve mounted in vertical arm for quick response
Robot Controller

The Model 580 S4P robot controller, (Fig. 2), operates the manipulator and provides connection points for communication with external devices. The controller features:

- Main transformer 440-600 volts
- 110V AC service outlet inside controller
- Rotary servo disconnect switch with door interlock
- Operator panel on front of cabinet
- 24 Mb RAM memory
- 1.44 Mb floppy disk drive
- RAPID programming language
- BaseWare™ Software Package with conveyor tracking and encoder board
- ProcessWare™ Software Package consisting of:
  - PaintWare™ Basic w/ spray gun control software
  - Brush control software
- Ethernet network interface
- Digital 24V DC 16/16 I/O cards w/ Harting connector
- Automatic diagnostic test at start-up
- 7m cable between controller and purge unit
- 6m cable between manipulator and purge unit

(* Longer cables available at additional cost if necessary)
**Purge Unit**

The purge unit applies an air pressure internally into the robot manipulator, which permits it to be installed in hazardous areas. The unit provides the connection point for cables from the controller to the manipulator and operates from a control circuit in the controller and a pressure switch in the manipulator base. Stainless steel Titeflex purge cables serve the dual function of carrying the electronic control wiring and the purge air from the unit to the manipulator base.

**Programming Unit**

The hand-held programming unit, (Fig. 3), provides the operator with the means to control all of the functions of the robot. The unit is designed to withstand hostile environments and is equipped with the following:
- Membrane buttons to give the operator tactile feedback
- Incremental joystick programming handle
- LCD display
- 5 user definable keys for operator programming of frequently used commands
- Emergency stop button
- Live-man enabling switch
- 10m programming unit to controller cable

![Fig. 3](image)

**Analog Paint Regulation (APR)**

The Analog Paint Regulation (APR) system provides open loop regulation of the shape of the spraying fan and the fluid flow from a spray gun from within the robot program.

**Features and Benefits:**
- Cost effective way to add analog control of spraying pattern.
- Paint and air control valves placed in the vertical robot arm close to the spray gun gives fast response times.
- Open loop system.
- Simple installation and use.
- Easy trimming.
- Explosion proof by partly integration in purged area of robot vertical arm.
- Easy maintenance.
Analog Paint Regulation (APR) (continued)

System Operation
The system operates by controlling the spray gun fan air, atomizing air, and paint flow. The values of these parameters are set in the robot program as 'brushes' where each brush holds a certain setting for the 3 parameters.

When a program is executed, the selected brush will be sent to the analog outputs. These outputs control the fan air, atomizing air, and paint supply for the spray gun via electro-pneumatic transducers. The spraying pattern given in the program will then be applied to the product being processed.

As the program proceeds, new brushes with different settings can be sent to the analog outputs, resulting in a paint stroke, e.g. as shown below.

Adding features such as color change capabilities, dual gun control, etc can expand the functionality of the system. These options are described in separate product descriptions.

A complete Analog Paint Regulation (APR) system consists of the following components:

Analog Paint Regulation (APR) Software
The Analog Paint Regulation (APR) software is the control software necessary to control and operate the transducers. The software includes control of the transducers for the spray gun and enables the brush programming and control feature.

APR Control Electronics
The control electronics is located on a circuit board in the robot vertical arm and in the control cabinet. The control electronics converts digital control signals from the control software to current levels for controlling the transducers etc.

Electro-pneumatic Transducers in Vertical Arm
Electro-pneumatic transducers are used to convert the electronic control signals to air pressures where a certain current from the control system will give a certain airflow. The transducers control the fan air and atomizing air directly and the paint flow via a remote air piloted paint regulator supplied by others.
Analog Paint Regulation (APR) (continued)

Component Layout
The illustration below shows the location of the different components on the manipulator. The transducers and gun on/off control valve are located on the robot vertical arm, and the fluid control valve is located behind the spray gun at the arm wrist joint. A cover (not shown in illustration) protects the transducers and gun on/off valve.

Analog Paint Regulation (APR) Programming
Programming the Analog Paint Regulation (APR) function is simple. By setting up the required number of brushes, and including these brushes in the program, the pattern of the spray gun will change as the program is running. The values in each brush may be edited by simply changing the values of the 3 paint parameters until the required pattern is obtained.

Analog Paint Regulation (APR) System Trimming
The Analog Paint Regulation (APR) software includes a number of parameters for trimming the system.

Gun on/off delay compensation is used for trimming the switching points for the spray gun to compensate for physical delays in gun and supply hoses.

Paint flow on/off adjustment is used for trimming the switching time of the paint flow in relation to the gun on/off signal.

Air on/off adjustment is used to set the time when the atomizing and fan air are switched in relation to the gun on/off.

Brush change timing is used for trimming the point where the gun is controlled by a new brush to make sure that the new spraying pattern hits at the correct point on the object.
Conveyor Tracking

Conveyor Tracking is an extremely useful feature when the robot is operating on a moving conveyor line and means that the robot program will 'follow' the object on the conveyor. The paint result will then be independent of the speed of the conveyor.

In a robot program, all points in space for the robot are referred to a 'zero point' (origo) located in the center of the arm rotation point. With conveyor tracking, the position of this point will be shifted parallel with the conveyor. The path of the program will be shifted in relation to the zero point, and full synchronization between the robot program and object is thereby obtained.

Conveyor tracking offers following functions:

- Full synchronization between robot program and object on conveyor.
- Conveyor speed may be changed, stopped and even run backwards without affecting the finishing result.
- Program points may be entered on a stationary object. The program may be tested on a stationary or moving object.
- Constant TCP speed, relative to the object, independent of conveyor speed.
- The tracking is only restricted by the physical reach of the robot arm. The position of the object on the conveyor is always available in the robot controller. By dividing the programs into sections and set conditions for start of these sections in relation to the position of the object, programs may be made for objects, which extend the reach of the robot arm. Programs may thereby be made, e.g. for objects, which are much longer than the reach of the robot arm.

To be able to use the tracking function, an encoder must be installed on the conveyor.

Documentation

- User's Guide containing Programming and Basic Operation Manuals
- RAPID™ Reference Manual
SPECIFICATIONS

Manipulator Technical Data

Robot Axes: 6 AC Servo
Payload Capacity: 22 lb. max. (10kg max.)
Reach: 61.6" (1,570mm)
Repeatability: +/- 0.01" (+/- 0.3mm")
Maximum Speed: 78.7 in/sec (2.0m/sec)

Working Range and Axis Speed:

<table>
<thead>
<tr>
<th>Movement</th>
<th>Axis</th>
<th>Range</th>
<th>Max. Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Rotation</td>
<td>1</td>
<td>300º</td>
<td>112º/sec</td>
</tr>
<tr>
<td>Lower Arm</td>
<td>2</td>
<td>145º</td>
<td>112º/sec</td>
</tr>
<tr>
<td>Upper Arm</td>
<td>3</td>
<td>95º</td>
<td>112º/sec</td>
</tr>
<tr>
<td>Wrist Roll 4</td>
<td>4</td>
<td>∞º</td>
<td>415º/sec</td>
</tr>
<tr>
<td>Wrist Roll 5</td>
<td>5</td>
<td>∞º</td>
<td>400º/sec</td>
</tr>
<tr>
<td>Wrist Rotation</td>
<td>6</td>
<td>920º</td>
<td>560º/sec</td>
</tr>
</tbody>
</table>

Manufacturing Standard: ISO-9001
Brakes: All Axes
Robot Base Dimensions: 31.5" (800mm) diameter
Weight: 1,453 lb. (660kg)

S4P Control System Technical Data

Physical Data
Ambient Temperature: +41º F (+5º C) to +125º F (+52º C)
Relative Humidity: 95% maximum
Cabinet Dimensions: 21.7" deep x 31.5” wide x 50.4” high
      550mm deep x 800mm wide x 1,280mm high
Weight: 529 lb. (240kg)
Power Supply: 200-600VAC, 50/60Hz, 3 PH, +10%, -15%
Mains Fuse: 25A max.
Power Consumption: 4.5kVA max. (0.3kVA with motors off)

Memory Data
3 1/2" Disk Mass Storage: 1.44Mb
RAM Storage: 24Mb
I/O Capacity: Digital 24V DC 16/16 I/O card w/ Harting connector

Environmental Requirements
Manipulator Protection Class: IP67
Controller Protection Class: IP54
SPECIFICATIONS (continued)

Explosion Protection
Manipulator: Pressure FM/NFPA 496
Programming Unit: Intrinsically Safe

Purging/Overpressure System
Protection Gas: Instrument Air
Minimum Supply Pressure: 72.5 PSI (5 bar)
Purge Air Consumption: 17.6 CFM (500l/min)
Operation Air Consumption: 0.4 to 0.8 CFM (10 to 20 l/min)
Purge Time: 3.0 min

Software Functions
BaseWare™ Operator System
RAPID™ Programming Language
PaintWare™ Paint Finishing Programming Language