

Robotics, CNC and FMS



Features

- Extensive range of integrated training equipment
- Robots - SCARA and Articulated types
- Automatic materials handling equipment
- Modular manufacturing systems
- CNC Mill and Lathe
- ISO G & M code programming
- Wide range of material processing workcells

In 1921 the word “robot” came into use having been derived from the Czech word “robota,” meaning hard labour and servitude.

Even before this time, the handling of various materials had been undertaken using some form of automation as a substitute for human effort.

Today, the majority of mass-produced items are made using very complex and highly sophisticated manufacturing systems. These employ many types of versatile robotic mechanisms that can be programmed to be used for different applications. The number of robotic systems in manufacturing now runs into millions and their use has extended to other areas, such as medical, and domestic and where human activity would not be possible. Robots are used for dangerous tasks such as bomb disposal, handling hazardous chemicals, and exploring the depths of the sea.

The Feedback range of Robotic and CNC trainers covers many of the techniques used in materials handling, machining processes and the manufacture, handling and assembly of components. These trainers involve electrical, hydraulic and pneumatic devices that are used to make fully working, industrially representative systems but on a much smaller scale and at lower cost.

This versatile range of products is available as separate modules that can be configured as the system of your choice or as a pre-configured workcell.

The range includes SCARA and Articulated Robots which are used in conjunction with CNC machining stations and conveyors to form workcells that perform various manufacturing operations. A computer is supplied, pre-loaded with specialised WALLI software, which is used to program the individual equipments. The program sequences are then executed to complete the workcell task.

Subject Coverage

- Robot movements
 - Radial
 - Tangential
 - Horizontal
 - Vertical
- Spatial co-ordinates
- Rectilinear or Cartesian robots
- Kinematics
- Geometry of movement
- Mechanisms & Power Sources
- Sensors & Measurement Devices
- Robot Control Systems
- Workcell organisation
- Programming Robotic & CNC Devices
- Programming ISO codes
- Demonstration programs
- Component part loading and unloading

Robotics, CNC and FMS

Features

- WALLI Software specifically designed for ease of programming
- Programming for all Robot and CNC systems
- Individual program settings for Robot axis position
- Test programmed manoeuvre function
- Graphical representation of programmed position
- Dynamic Data Exchange (DDE)
- Robot simulators provide all axis moves with the recording of axis data

The screenshot displays the WALLI software interface with several windows:

- MENTOR (NOT-CONNECTED) - Keyboard Control:** A table showing axis positions for various lines. The 'Now' row is highlighted in yellow.
- Main:** A window displaying the program code, including remarks and instructions like 'DISPENSE PART 1' and 'MOVE MENTOR THROUGH POSITION'.
- MENTOR - Plan:** A graphical view showing a red robot arm in a top-down perspective.
- MENTOR - Elevation:** A graphical view showing a red robot arm in an elevation perspective.
- SL-MENTOR:** A small table at the bottom right showing current axis positions.

Line	Waist	Shldr	Elbow	Wrist	Wrist	Grip	(Elev)	(Rotn)
Pickup	127	85	111	118	118	1	118	127
	127	46	48	108	110	1	109	126
	127	46	48	154	158	134	156	126
	127	85	111	118	118	64	118	127
Rejected	127	165	41	118	118	64	118	127
	0	85	171	41	118	64	79	89
	0	20	128	118	118	64	118	127
	0	70	73	118	118	0	118	127
Accepted	127	85	207	118	118	0	118	127
	107	85	111	118	118	64	118	127
	68	85	111	118	118	64	118	127
	68	20	58	118	118	64	118	127
	68	20	58	118	118	0	118	127
	127	85	111	118	118	0	118	127
Now	0	85	171	41	118	64	79	89

X	Y	Z	Elev	Rotn	Grip
295	40	660	110	40	Shut

WALLI software PC screen showing Mentor Robot program listing and mimic of robot position

System Benefits

- Common Robot and CNC programming software
- Simple line-by-line program instruction coding
- Actual Robot move checked line by line avoids errors
- Modular system provides for extensions & reconfiguration
- Choice of pre-configured workcells
- Student groups may program off-line minimising hardware and associated costs
- Software enables non-standard equipment to be used through DDE

WALLI for Windows is a fully integrated package enabling control of a system, starting with a single robot, and building up to a workcell with up to eight active devices (robots, mills, lathes and expansion boxes).

A considerable number of peripheral devices including conveyors, indexing tables, sensors and gauges may be controlled as part of the workcell.

The robot product range can be controlled in several ways depending on the training approach adopted: by simulators; control pendants or by software. The Simulators are small, hand-sized models of the robot which represent the main axis and provide direct movement of the actual robot when the model is repositioned. Control pendants provide direct axis control through the use of push-buttons. Each axis is capable of forward and reverse positioning, and when the pendant is in use, the complex nature of robot positioning can be examined. The third method of control is through WALLI software whereby the individual axis moves can be set in a program. When a new program line is generated it will be a copy of the previous line. This is edited to provide the next move in the sequence. Adding further lines successively builds up the program for a robot manoeuvre. Whenever a program line is selected the robot will move to the corresponding position unless it has been put off-line. This relatively uncomplicated approach to programming that results in a program block, is applied not only to the robots but also to the CNC Mill and Lathe. The programming routines (blocks) for each of the machines are put into a sequence for the particular workcell operation and appear as process steps within the Main window of the software. The activity of any of the processing machines within the workcell can be monitored: there can be more than one monitoring window open at any one time. Branching of the program to the various routines occurs in response to sensor or gauge signals from around the workcell. WALLI is a multi-tasking program, and up to 16 routines may be run simultaneously.

The Mill and Lathe are programmed with ISO format G and M codes and a large number of CNC programs may be run as required.

An advanced feature of WALLI is Dynamic Data Exchange (DDE) which enables it to share data with other Windows programs that support DDE.

Complete Mentor Package 35-001-USB



The Mentor is a stand-alone bench-top robot ideal for studying the principles behind 'Robotics' with a requirement for knowledge of electronics, mechanics and software engineering.

The Mentor is an anthropomorphic robot, having six degrees of freedom including the gripper. dc motors drive the main axes, each axis position being controlled through the use of a closed loop control system, and the axes collectively define the position of the gripper in space. The in-built individual axis controllers constantly monitor the gripper position and hold the position until a new move command is received. This articulated arm is similar to the human arm and is widely used in industry.

Programming may be written by direct data entry for each axis using WALLI for windows software, or by incrementing the axes by selecting them and using the + and - keys or the scroll bar.

A more simplified approach is to use the Mentor simulator which is a hand-sized version of the robot arm with moveable main joints. Alternatively, the robot's motors may be switched off and the arm moved by hand (lead-by-nose).

Easy-to-use software, a helpful manual, on-screen assistance and simulator enable the robot to be unpacked and running programs within minutes. The manual includes program examples and suggested robot experiments on accuracy, repeatability etc. Full information about the control systems is also provided.

To extend the program of Robotic study into applications, a Basic Workcell (35-119) is recommended. The items supplied in the workcell are: workpieces, conveyor, horizontal gauge and infra-red sensors.

Features

- Five axes human arm configuration, plus gripper
- Built-in control system
- Ready to run using hand controlled simulator
- Easy to program using WALLI software
- Robust metal construction with an arm reach in excess of 400mm
- Can lift 1Kg at full reach
- Maximum base to gripper height 780mm fully extended

System Benefits

- Robotics training at low cost
- Simple initial set-up and run procedure
- Comprehensive instruction manual including sample programs
- USB communications
- Easy-to-use programming software
- 'Lead-by-nose' or simulator control simplifies manoeuvres



Mentor simulator

Complete Gryphon Package 35-002-C

Features

- Uses WALLI Software specifically designed for ease of programming
- Demonstration programming routines provided
- Ease of demonstration using the Gryphon's Simulator
- Digital encoders on all axes for greater accuracy
- Larger operating envelope than the Mentor
- Air operated gripper
- Speed controlled movement with four speed settings
- Bench top mounting

System Benefits

- Forms a complete working system
- Simple line by line program instruction coding with WALLI software
- Includes industrial computer pre-loaded with WALLI software



The Gryphon Robot is the largest in the range, standing at 970mm tall from the base to the centre of the gripper with the arm fully extended. The Mentor stands at 780mm to the centre of the gripper from the mounting base.

Like the Mentor, the Gryphon is an anthropomorphic robot with six degrees of freedom, including the gripper, and can be mounted on a bench-top. The Gryphon has digital encoders on each axis and offers higher positional accuracy. It is therefore suited to applications requiring greater precision.



The complete package includes all that is required to set-up and control the Gryphon Robot including an industrial PC with VDU, WALLI software, robot controller, compressor, simulator and manual. Included in the manual is full information on the control system and computer interface. Also included are program examples and suggested experiments and exercises. The Gryphon is supplied with a two-fingered gripper that is operated by compressed air. A parallel-acting or vacuum gripper are available as optional extras.

In the controller there is one microprocessor to monitor the positions of the axes. Two more are used to control the motors, and another is used to supervise the first three and to communicate with the host computer.

Programming may be accomplished in several ways. Data for each axis may be entered directly on-screen or the selected axis may be incremented, either with the scroll bar and + and - keys. Alternatively, the Gryphon may be moved by using the simulator (shown left) or by 'lead-by-nose'.

To extend the program of Robotic study into Applications, a Basic Workcell (35-119) is recommended (see inside back page).



Gryphon simulator

Complete Serpent 1 Package 35-003-C & Serpent 2 35-004-C

The Serpent is a SCARA type robot with the working axis in the horizontal plain. This type of robot is used extensively in industry in 'pick and place' applications. SCARA is an acronym for Selectivity Compliant Articulated Robotic Arm, which means there is a small amount of compliance in the plane of operation.

The Serpent has three horizontal axes that are controlled by dc motors and a fourth (the end effector) that moves in the vertical plane under the force of compressed air; the vertical travel being controlled by two adjustable mechanically positioned end stops. The rotational position of the end effector is controlled from a motor situated above the back of the mounting column and connected by belts. This arrangement maintains a constant angle of the end-effector relative to the bench as the arm moves around.

The complete Serpent package includes all that is required to set-up and control the robot including an industrial PC with VDU, Serpent Simulator, air compressor, two types of gripper - two fingered and suction type, robot controller, WALLI software and manual.

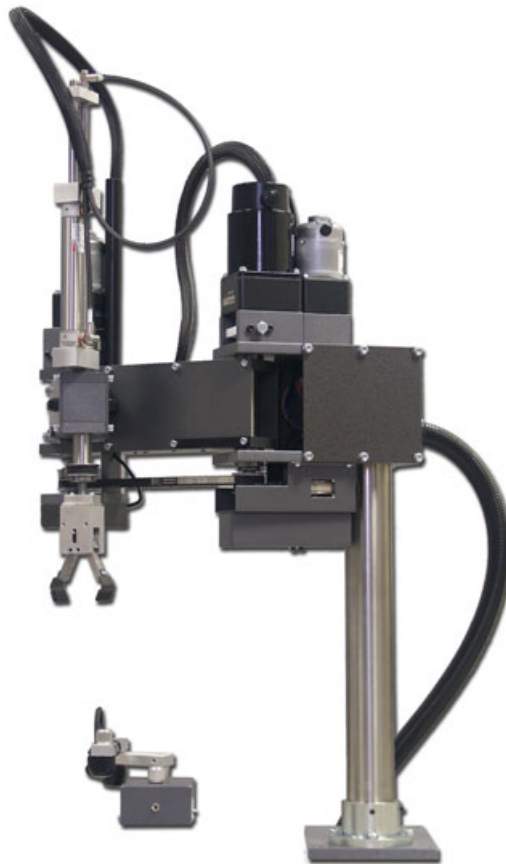
Programming the Serpent may be from the computer by setting the data for each axis using WALLI software, or by manual control of each axis using the appropriate push-button situated on the robot arm.

A more simplified approach is to use the Serpent simulator, which is a hand size version of the robot arm with movable main joints. When connected the robot follows the movement of the simulator.

Easy-to-use software, helpful manual, on-screen assistance and simulator enable the robot to be unpacked and running programs within minutes. The manual includes program examples and suggested robot experiments on accuracy, repeatability etc. Full information on the control systems is also provided.

Serpent 1 has a reach of 552mm and Serpent 2 a reach of 802mm from the centre of the column to the end effector.

To extend the program of Robotic study into Applications, the Basic Workcell (35-119) is recommended (see inside back page).



Features

- dc motors and encoders on three axes
- Air operated cylinder on fourth – vertical axis
- Adjustable operating height
- Designed for 'pick and place' applications
- Uses WALLI Software specifically designed for ease of programming

System Benefits

- Provides training on the function of 'pick & place' robots
- Simple initial set-up and run procedure
- Comprehensive instruction manual including sample programs
- Easy-to-use programming software
- Simulator control simplifies robot manoeuvres



Serpent simulator

Complete CNC Mill Package 35-005-C

Features

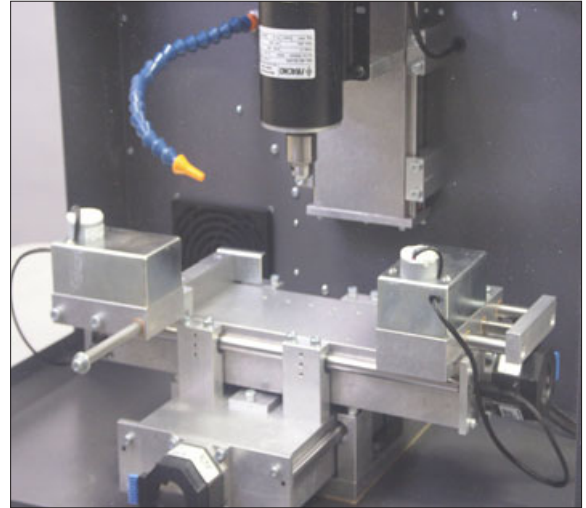
- Small scale fully functional milling machine
- Uses WALLI Software specifically designed for ease of programming
- Demonstration programming routines provided
- Stepper motor drives on all axes
- Programmable motorised component vice
- Access doors interlocked for safety
- Emergency 'stop' button provided
- Bench-top mounted system

System Benefits

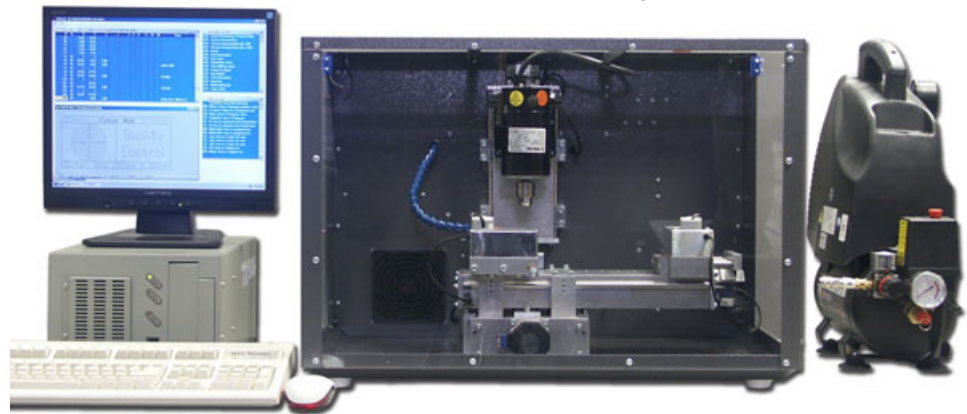
- Provides CNC lathe training at low cost
- Easy to use WALLI programming software
- Programming examples provided
- Graphical simulation – view program without cutting material
- Software supports ISO G & M codes
- Produces finished components
- Comprehensive instruction manual including exercises
- Complete working system

The CNC Mill is representative of much larger industrial milling machines, providing training at low-cost on their use and programming. The mill is equipped with the majority of features found on its industrial counterpart.

Components in soft materials can be produced to verify program routines without the worry of serious damage and cost of repair associated with an industrial unit.



View of CNC Mill through transparent cover



Before machining a new design it is reassuring to check the program carefully by simulation.

The WALLI software provides an on-screen graphical representation of the actual part as it would be machined by the program, showing the machining sequences as the program runs from start to finish. The whole machining sequence may be run through in single step, if required, to allow each machining step to be examined.

A further check is to run the program with the WALLI Draw program that uses a pen instead of a cutter and the drawing table provided with the mill. A trace is made of the cutting sequence showing up any errors in the programming.

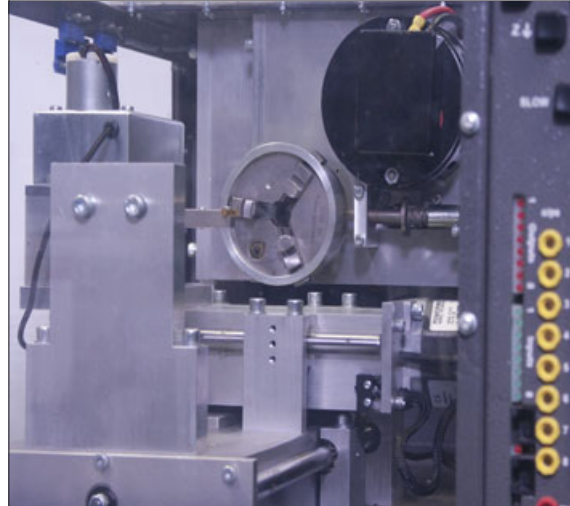
Material is supplied with the mill for machining, comprising wax blocks and plastic discs with three coloured layers. When the three layer material is cut, the middle layer is revealed in a colour that contrasts with the outer layer.

The X, Y and Z axes are controlled by open loop stepper motors whilst the vice is driven with dc motors to clamp the workpiece; the clamping force being applied continuously whilst machining takes place.

The complete package includes all that is required to set-up and control the CNC Mill including an industrial PC with VDU, WALLI software, compressor, user manual and accessories. Included in the manual is information on the control system and computer interface. Also included are program examples and suggested experiments and exercises.

Complete Cyber Lathe Package 35-006-C

The Cyber Lathe has been designed to teach the operation and programming of CNC machine tools at low cost. Representing an industrial unit but on a much smaller scale the Cyber Lathe has the majority of functions found on its industrial counter part. Using the WALLI software supplied, the Lathe is programmed using industry standard ISO format G and M codes. The software also provides a simulation feature to test the program without cutting any material.



Side view of Cyber Lathe through transparent cover



The complete Cyber Lathe is ideal for the training of students in the use of CNC programmable machine tools, and provides a safe and low-cost means of achieving this. The WALLI software makes it easy to program, providing software routines that simplify and enhance the learning experience. Such functionality as program simulation and 'Wizards' speeds the student through the exercise of cutting real material with a fully tested program.

In simulation, the program is run on-screen with a virtual workpiece displayed before, during and after the complete program cycle. Errors in programming can be seen instantly as deviations in the outline of the displayed view. The final view is of the machined virtual workpiece. The software 'Wizards' simplify the entry of code for roughing-out and for thread and arc cutting.

The complete package includes all that is required to set-up and control the CNC Mill including an industrial PC with VDU, WALLI software, user manual and accessories. Included in the manual is information on the control system and computer interface. Also included are program examples and suggested experiments and exercises.

Features

- Bench top mounting
- Miniature version of an industrial lathe
- ISO format programming
- Automatic tool changer
- Motorised chuck
- Access doors interlocked for safety
- Emergency stop button provided

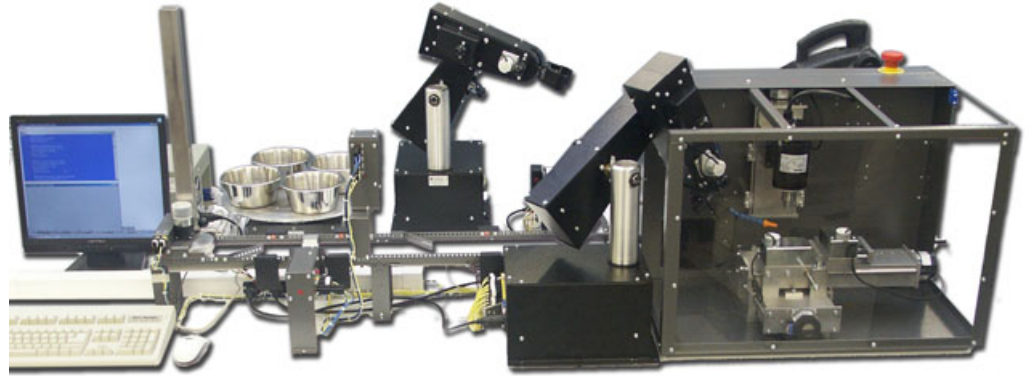
System Benefits

- Provides CNC lathe training at low cost
- Easy to use WALLI programming software
- Programming examples provided
- Graphical simulation – view program without cutting material
- Software supports ISO G & M codes
- Produces finished components
- Comprehensive instruction manual including exercises
- Complete working system

Flexible Manufacturing System W1 35-011

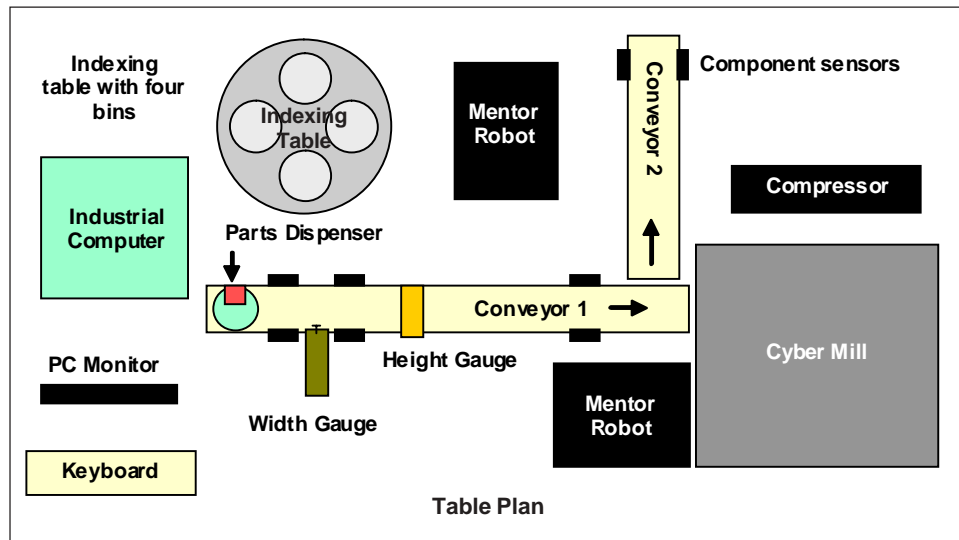
Features

- Fully operational FMS
- Stages of manufacture can be examined from raw material to finished part
- Uses WALLI Software specifically designed for ease of programming
- Demonstration programming routines provided
- Mobile Bench top mounted system



System Benefits

- Pre-tested workcell
- Simplified programming using WALLI software
- Software supports ISO format programming - G and M codes
- Includes industrial computer pre-loaded with WALLI Software
- Produces machined components

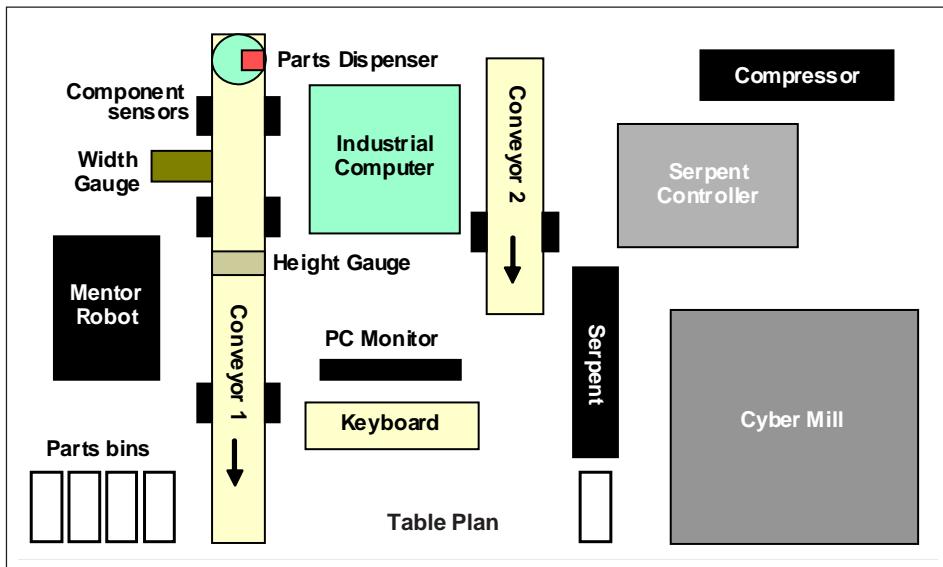


There are three manufacturing systems available, each one is designed to demonstrate the special requirements of equipment that is needed to perform a specific manufacturing process. The geographic layout of the equipment involved is an important aspect of the planning of an efficient manufacturing system and can be examined in detail using this range of FMS products.

The 35-011 is a complete system that comprises of a mobile table and a fixed layout of equipment for the study of a small manufacturing system. The layout has been chosen to form a compact workcell which involves the dispensing of unfinished parts, material detection, material sizing, parts positioning, milling, and finally, the loading of the part into an appropriate completion bin. Two conveyors with material sensors, one fitted with width and height gauging, and two Mentor robots are used to move the part around the manufacturing system. The overall control of the process sequence is performed by an industrial PC running WALLI software programmed with the individual routines of the robots and the mill, which are then triggered by the part detection sensors at the relevant stages of the process.

The overall size of the table surface is 2,404 x 1,201mm with a height from the floor to the working surface of 710mm.

Flexible Manufacturing System W4 35-014



This versatile system offers the opportunity to study the complexities of setting-up and programming two simultaneously operating workcells.

The first system involves a handling and sorting process using a Mentor Robot and Conveyor 1. This system performs the process of gauging a part for tolerance on width and height as it travels down the conveyor towards the final set of part sensors. Once a part has reached this position the robot takes the part and places it into the appropriate bin positioned at the end of the conveyor. The choice of bin is determined by the dimensions recorded previously by the computer from the height and width gauges.

The second process utilises a Serpent Robot, Conveyor 2 and a Cyber Mill. The Serpent is a SCARA device which moves the workpiece from the Conveyor to the Mill. The part is then machined. Finally, the Serpent is used to remove the finished part from the Mill and to place it in the parts bin.

The part used is a plastic disc that has three layers, the central layer is a different colour to the outsides. Several discs are placed on Conveyor 2, they are moved until one is detected at the end of the conveyor. The Serpent Robot then picks up the part with a vacuum gripper and places it into the vice on the Cyber Mill. It can then be cut to the appropriate design. Once the milling process is complete the Serpent Robot picks-up the finished part and places it in a storage bin.

The overall size of the table surface is 2,404 x 1,201mm with a height from the floor to the working surface of 710mm.

Features

- Two independent processes
- Fully operational FMS
- Two Robots - SCARA and Arthropomorphic types
- ISO format programming of milling machine
- Supplied on a mobile table
- Complete working system

System Benefits

- Provides CNC Mill training
- Easy to use WALLI programming software
- Programming examples provided
- Software supports ISO G & M codes
- Produces complete components
- Comprehensive instruction manual including exercises

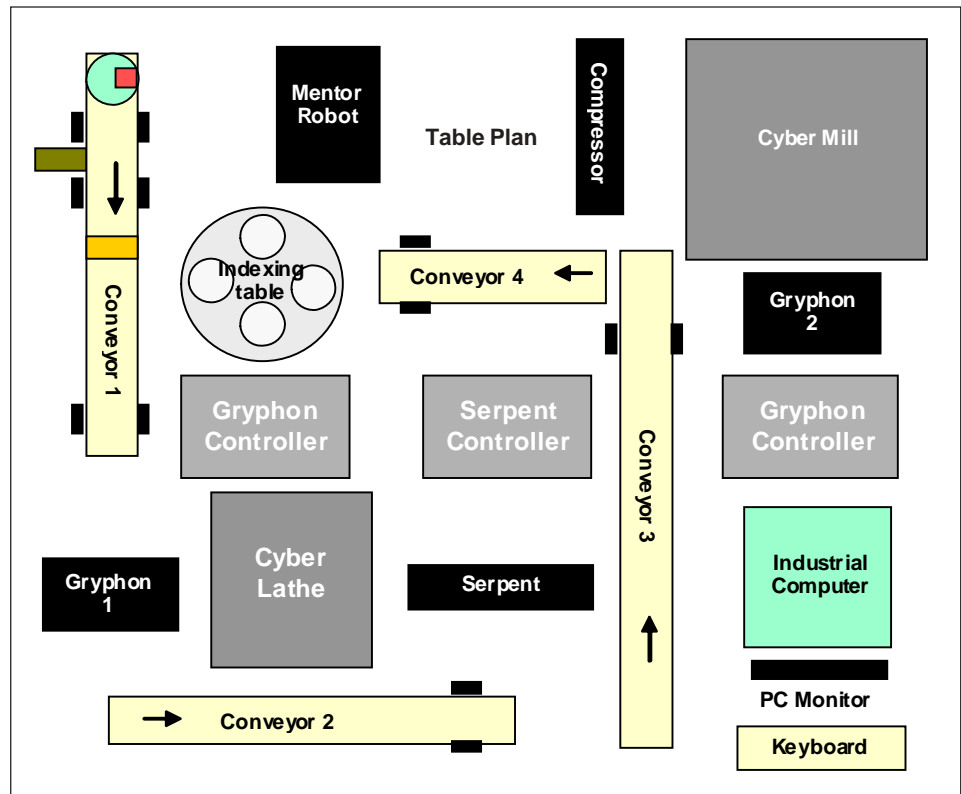
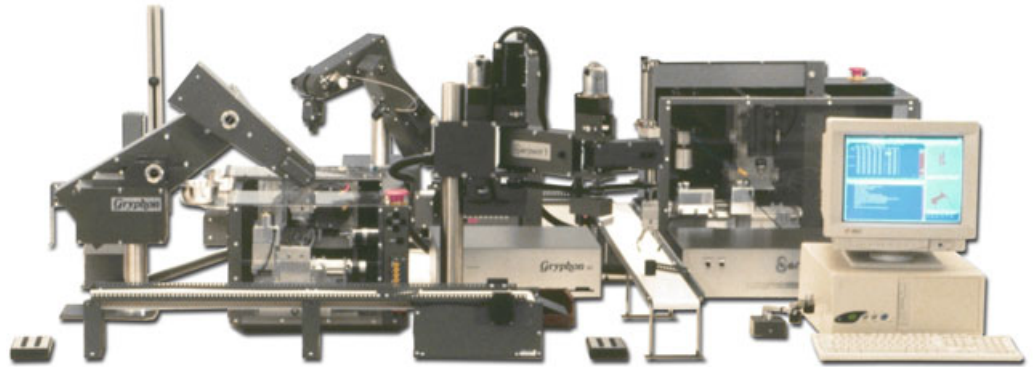
Flexible Manufacturing System W7 35-017

Features

- Four Robot System
- CNC Mill and Lathe
- Four conveyors
- Stages of manufacture can be examined from raw material to finished part
- Fully operational FMS
- Uses WALLI Software specifically designed for ease of programming
- Demonstration programming routines provided
- Mobile Bench-top mounted system

System Benefits

- Pre-tested workcell
- Simplified programming using WALLI software
- Software supports ISO format programming - G and M codes
- Includes industrial computer pre-loaded with WALLI Software
- Extensive programming opportunities
- Produces machined components



This comprehensive FMS system provides many opportunities to implement various system programming scenarios and to study the individual operations of each stage of the manufacturing process. The four robots, (2 Gryphon, a Mentor and a Serpent), each perform tasks that are suited to their design. The individual robot activity within the workcell can therefore be investigated. The system demonstrates a fully automated production process for the manufacture of small machined components utilising independently controlled conveyors, two CNC machines and four robots.

The industrial computer is supplied with WALLI software pre-loaded and includes routines for the individual robots and CNC machines to perform the operations necessary to carry-out the full process performed by the workcell. These routines and the full workcell operation are tested prior to the system leaving the factory. Although the workcell program is pre-determined, (the main program being a fixed statement of the workcell function), the subroutines that control the Lathe and Mill may be edited so that a new part is produced through their action. Any change in the shape or size of the billet of material used in the manufacturing process will affect the operations performed by the robot handling the material. Therefore the parameters will need to be adjusted accordingly.

Flexible Manufacturing System W7 35-017 (continued)

In this system the process performed is as follows-

The part is dispensed onto Conveyor 1 where it has the width and height measured as it moves down to the sensor at the end of the conveyor. Gryphon 1 picks up the part from Conveyor 1 and places it in the chuck of the Cyber Lathe for machining. Once the machining process is complete the Gryphon removes the part from the Lathe and places it onto Conveyor 2, where it is moved to the end of the conveyor. The Serpent robot picks-up the part from Conveyor 2 and places it onto Conveyor 3, where it moves to the end of the conveyor. Gryphon 2 picks-up the part and places it into the vice of the Cyber Mill to perform the milling process. When the part has been milled the Gryphon picks-up the part from the vice and places it on Conveyor 4. It is then moved to the conveyor 'end' sensor. The Mentor Robot picks-up the part and, depending on the component design, places it into the appropriate bin on the indexing table. The movement of parts is continuous with several parts in the system at the same time, but all at different stages in the manufacturing process.

This product is supplied as two mobile tables of overall size 2,404 x 1,201mm with a height from the floor to the working surface of 710mm. When in use, the two tables are bolted together to form one large mobile unit.

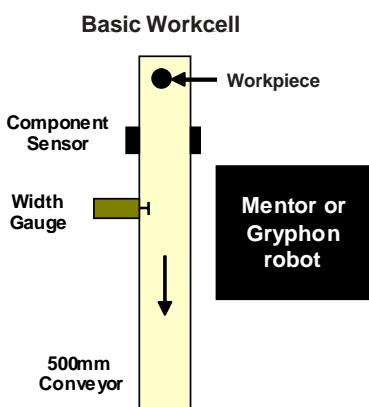
Cell Definition	
GRYPHON	RJ45 Board - Device 1
CYBER LATHE	RJ45 Board - Device 2
SERPENT I/EC	RJ45 Board - Device 3
GRYPHON 2	RJ45 Board - Device 4
CYBER MILL	RJ45 Board - Device 5
MENTOR	RJ45 Board - Device 6
Conveyor 1	Serial From MENTOR Latched Output 1
Conveyor 2	Serial From CYBER LATHE Latched Output 8
Conveyor 3	Serial From GRYPHON 2 Latched Output 7
Conveyor 4	Serial From GRYPHON 2 Latched Output 8
Index Table 1	Serial From MENTOR Latched Output 7
Dispenser 1	Zero Sensor To MENTOR Input 7 Start From MENTOR Output 2 Free To MENTOR Digital Input 1 Mounted on Conveyor 1
Width Gauge 1	Start From MENTOR Output 5 Read From MENTOR Output 6 Out to MENTOR Digital Input 3
Height Gauge 1	Start From MENTOR Output 3 Read From MENTOR Output 4 Out to MENTOR Digital Input 2
Digital Sensor 1	Output to MENTOR Digital Input 4
Digital Sensor 2	Output to MENTOR Digital Input 5
Digital Sensor 3	Output to MENTOR Digital Input 6
Digital Sensor 4	Output to CYBER LATHE Digital Input 8
Digital Sensor 5	Output to GRYPHON 2 Digital Input 7
Digital Sensor 6	Output to GRYPHON 2 Digital Input 8

WALLI software screen showing the interconnection of components in the W7 system

Basic Workcell 35-119

The Basic Workcell is intended for use with the Mentor and Gryphon robots to extend their activity beyond understanding the principles of robotics to a working application.

The cell components consist of a 500mm conveyor, horizontal gauging unit, infra-red component sensor and assorted workpieces. These components can be configured to form a basic workcell which then performs the function of parts movement, component sizing and component detection within the parts movement process. Programming of the workcell is performed using WALLI software which provides an uncomplicated approach to writing a control program for the relevant workcell operation.



A typical layout of the workcell components is shown opposite complete with a robot but without the controlling PC.

The cell operation is not defined in a WALLI program as the intention is for the student to configure the components and to write a program that performs the intended process. One possible process sequence would be to use the robot to pick the workpiece from a storage bin and to place it on the conveyor. The conveyor is run so that the workpiece passes the component sensor which detects it after a predetermined distance the workpiece is stopped in front of the width gauge to be measured.

This value is stored by the computer. The component is moved on and then stopped after a pre-determined distance, the robot then removes the part and places it in a storage bin.

A variation on this process would be to use different sizes of workpieces so that the final activity is one of part selection.

Features

- Individual components
- Configurable system layout
- Requires programs to be developed
- Programming using easy to use WALLI software

Ordering Information

Complete Mentor Package	35-001-USB
Complete Gryphon Package	35-002-C
Complete SCARA Package (Serpent 1)	35-003-C
Complete SCARA Package (Serpent 2)	35-004-C
Complete CNC Mill Package	35-005-C
Complete Cyber Lathe Package	35-006-C
FMS Table W1	35-011
FMS Table W4	35-014
FMS Table W7	35-017
Basic Workcell (for use with 35-001, 35-002, 35-003 & 35-004)	35-119

Feedback Instruments Limited

Park Road, Crowborough, E. Sussex,
TN6 2QR, England.

Telephone: +44 (0) 1892 653322

Fax: +44 (0) 1892 663719

E-mail: feedback@fdbk.co.uk

Website: www.fbk.com



Feedback Incorporated

437 Dimmocks Mill Road, Suite 27,
Hillsborough, NC 27278, USA

Telephone: (919) 644 6466

Fax: (919) 644 6470

E-mail: info@feedbackinc.com

Website: www.fbk.com

