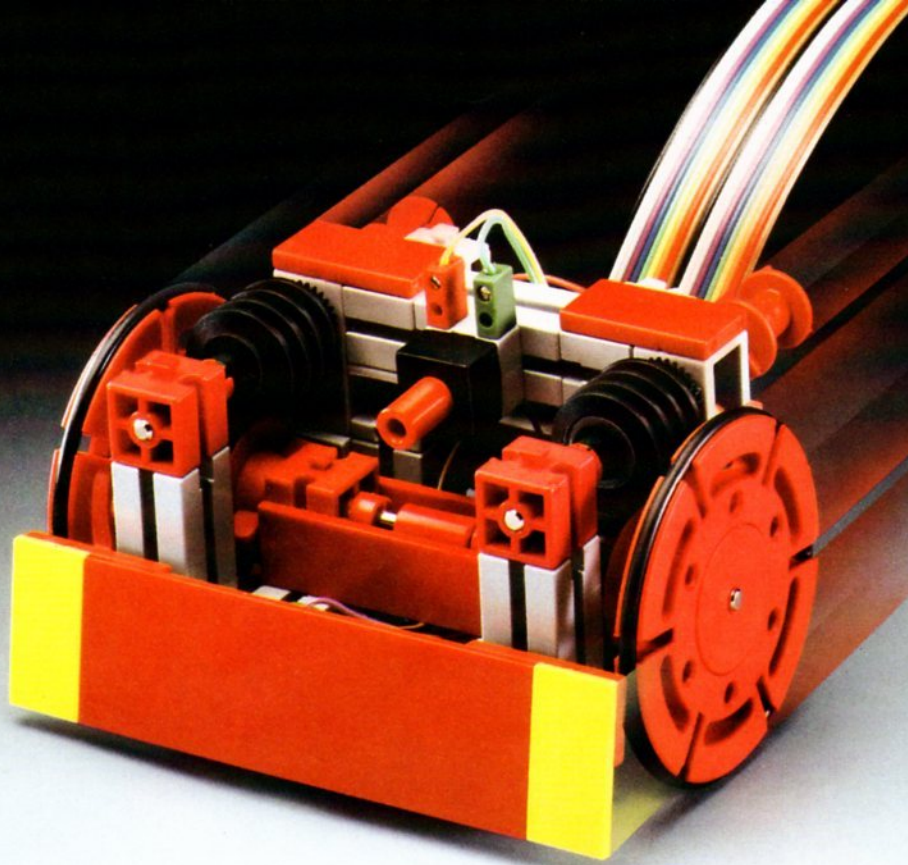


Man and Machine

fischertechnik[®] [®]
COMPUTING



Computing Experimental. The new computing construction kit from fischertechnik. Measuring. Controlling. Adjusting. Just like it's done in industry with real machines and robots. Experimenting. Simulating. Understanding. Learning. Knowing. Understand and apply computers and computer programs by means of experiments.



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fischertechnik computing Experimental

Article No. 30 573

suitable for:

Commodore C64, C128
IBM PC, XT, AT and
Compatibles

ATARI 520 ST, 1040 ST,

(vis. Basic System Diagram, page 12/13)

Technical Equipment:

- 2 motors
- 2 gear units
- Worm wheels and toothed wheels (pinion gears)
- 2 large disc wheels, 1 jackwheel
- 3 mini-scanners
- 1 lamp
- 1 photoresistor (light measurement)
- 1 hot conductor (temperature measurement)
- 1 fischertechnik Interface
- 1 fischertechnik power supply
- Software- and adaptercoupon

Experiments

- Motors and switches (an introduction).
- Switching with light.
- Measuring and evaluating incidence of light.
- Measuring and adjusting temperature.
- Robotics
- Turtle: motion strategies and route planning.
- Turtle: sensors for light and obstacles.

Guide

Introduction to the programming of machines and robots. Experiments with the computer on the subject of "Measuring - Controlling - Adjusting". Prospects for methods of "Artificial Intelligence".

Hints on further experiments in connection with the fischertechnik design building-block system (modular construction system) and the fischertechnik computing construction kit.

Suggestions and Exercises.

All of the experiments are described in detail. Only minimum skills in computing and BASIC are required.

Beyond the Future

Software

Interface commands, turtle graphic orders and display storage commands in each case as an extension to the BASIC instruction set.

Display instruments as experimenting tools.

Programming the models in BASIC, clear representation of the programming principles, for this reason also suitable as learning software.

Complete documentation of the programs.

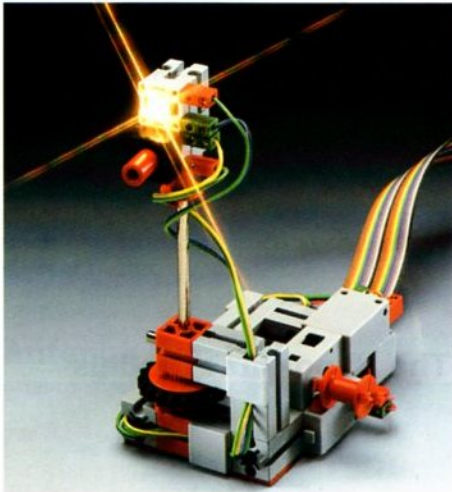
Interface

An original fischertechnik computing Interface (vis. page 10/11) is included in the computing Experimental construction kit. All of the other fischertechnik computing models can also be controlled with it.

Power Supply

Special power supply included.

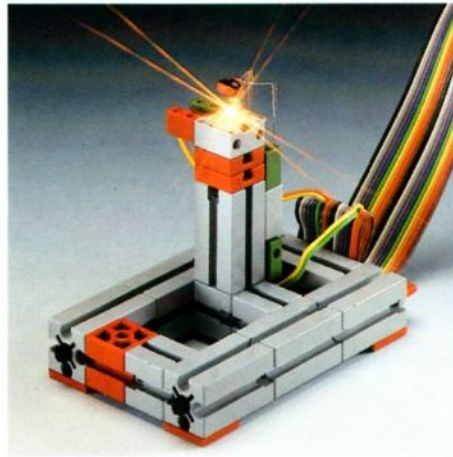
The Computer Eye



A photoresistor is hidden behind the shield of the receiver and converts brightness into a suitable input quantity for the computer. Can the computer see? It depends on the analysis program. Be surprised by fischer's hard- and software technology combination.

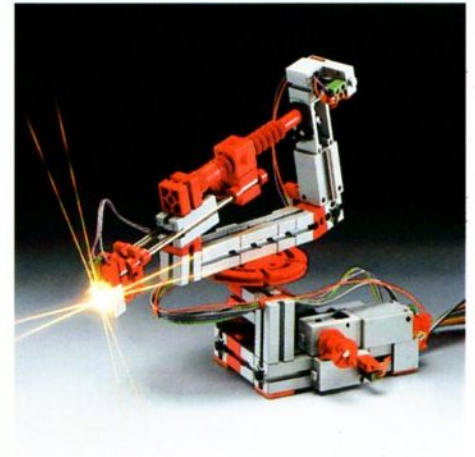


Thermometer and Temperature Control



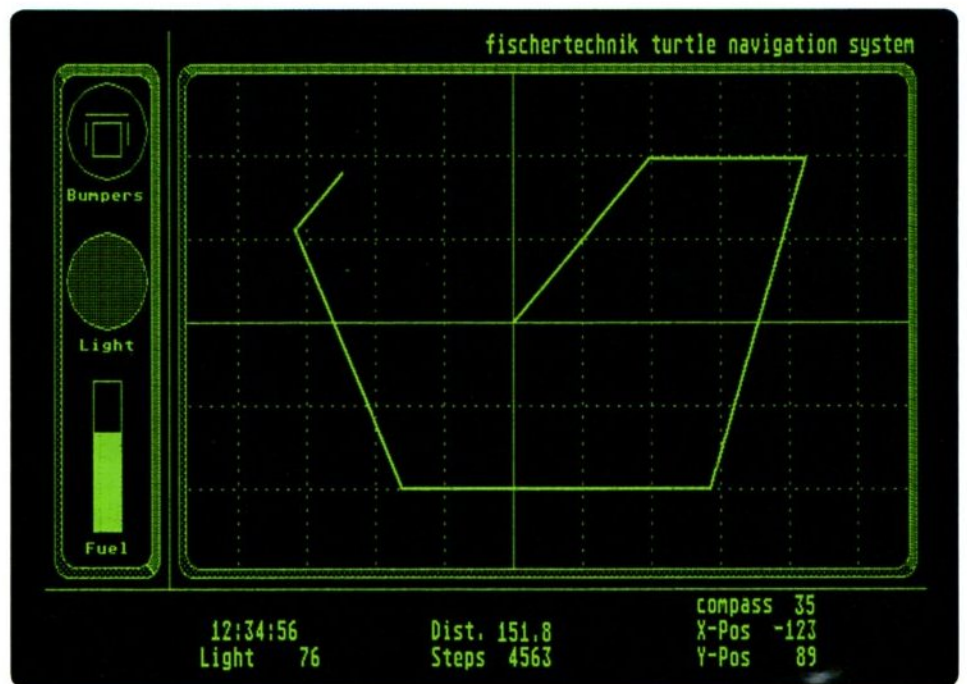
A hot conductor reacts to the ambient temperature by changing its electrical resistance. In this way a thermometer can be set up with display representation. The temperature can, however, also be adjusted: by controlling the heating, by cooling it down and by restricting the flow of heat.

The Welding Robot



The welding robot can swing its arm in stages of 9° . The arm advancing is controlled by a second motor. The welding tongs are operated via a third output on the interface.

The programming of robot movements is explained by means of the model. In a serial-model modification the robot is guided by sensors.



The Turtle

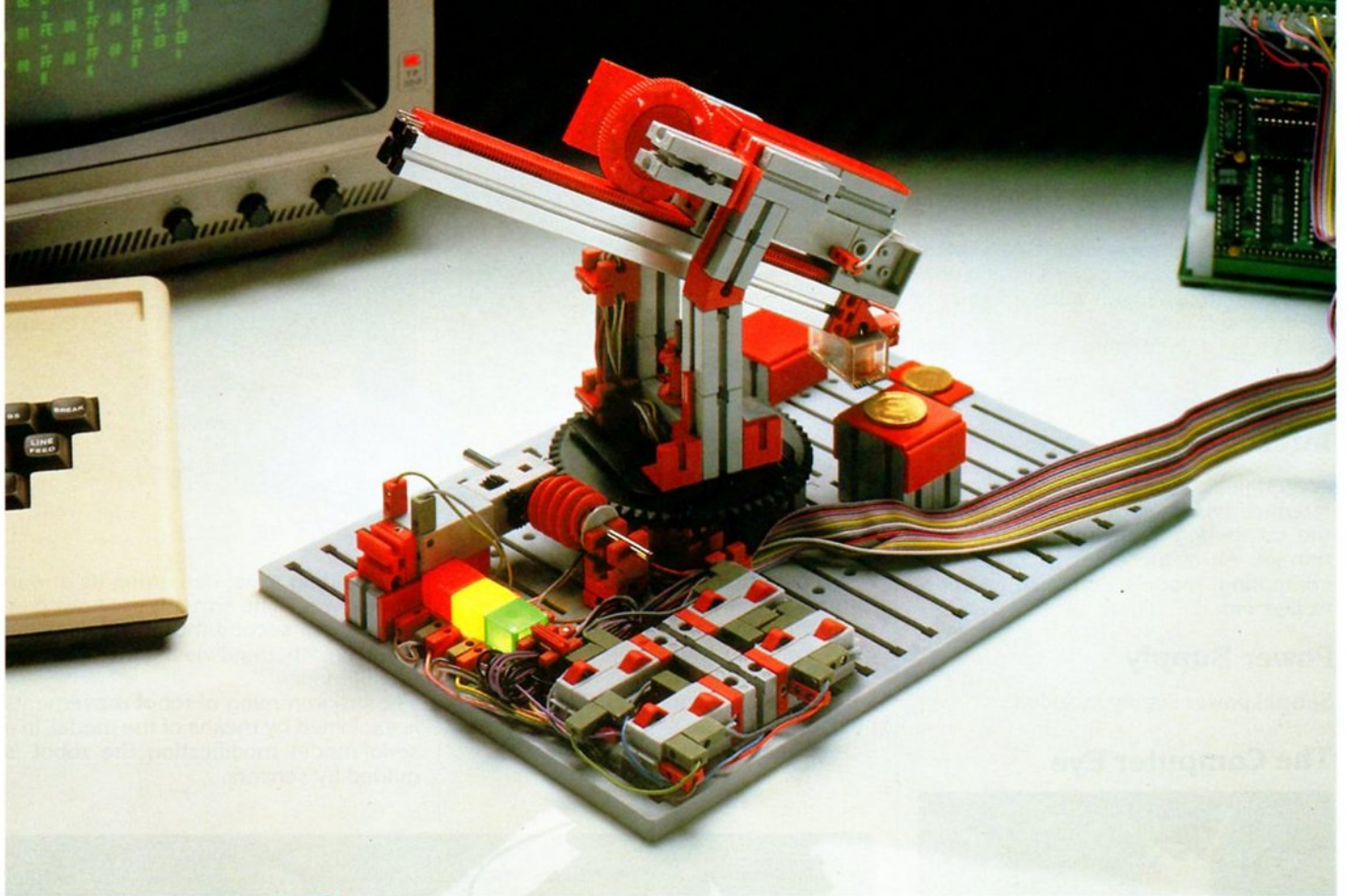
The turtle (vis. illustration top left) puts the basic concept of a mobile robot into effect. It obeys four elementary commands:

Move a few steps forward. Turn at an angle to the right.
Move a few steps backward. Turn at an angle to the left.

(See also following graphics.)

The turtle, which is easy to program and yet efficient, has proven its ability for a long time. LOGO and some "Turtle Graphics" extensions (e.g. UCSD-PASCAL) use it. The turtle from fischertechnik, however, is realistic and – beyond this – it even has "sense organs". Computer-controlled, it explores its environment. The methods of artificial intelligence are used in the fischertechnik turtle.

with fischertechnik computing



The fischertechnik computing construction kit brings life to the computer. Step by step. From the simple lights equipment to the dual axis robot, this program with its 10 models introduces you systematically to control technology. Robots, automatons and graphics equipment can be constructed, programmed and controlled with the fischertechnik computing construction kit.



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computing Construction Kit

Article No. 30 554

Technical Equipment:

- 2 mini-motors
- 2 gear units
- 1 electromagnet
- 3 lamps
- 8 scanners
- 2 potentiometers
- Flat-belt connection cable with multiple connector for the interface.
- Detailed construction and programming guide.

The 10 possible models

Traffic Lights:

A simple prelude to controlling robots. Within the framework of this program, the output commands to the interface are explained to you.

Pedestrian Lights:

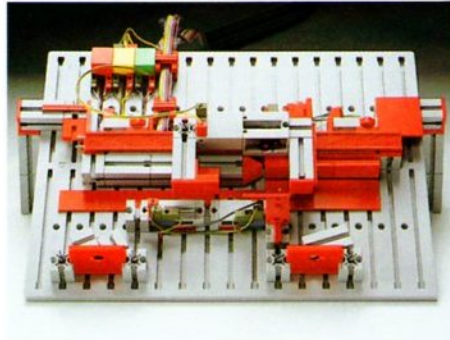
The input via the interface is added. Now the time for an operation is no longer only determined by your computer, but also by signals from the environment.

Lift for Materials:

Entirely depending on the key operations on the model, the program controls the lift, thus bringing it to the floor required. In this program many of your own ideas can be fulfilled because: who hasn't been annoyed about an elevator control system?

More creative Computer Fun

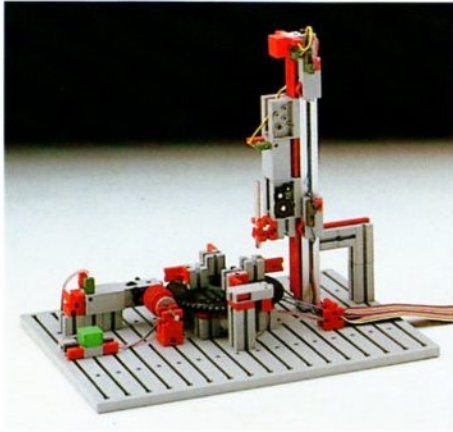
Sorting Equipment:



Owing to available measuring results, the computer can make decisions. It is shown here taking sorting equipment as an example: it keeps long and short modules apart.

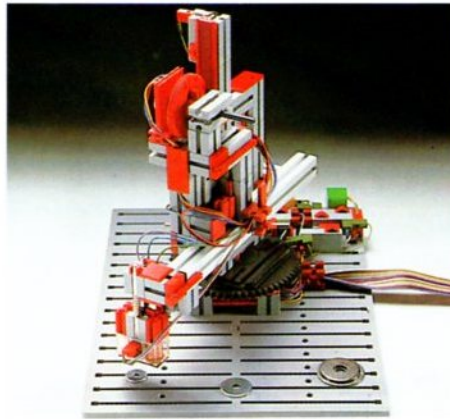
The robot's movements are entered via the model's command keyboard and the robot is controlled immediately. The program does not only pass the control commands on to the output channels, but also stores the robot's position at the press of a button. Owing to the motion table being laid out in this way, the program flow can then be repeated in any possible sequence.

Tool Machine:



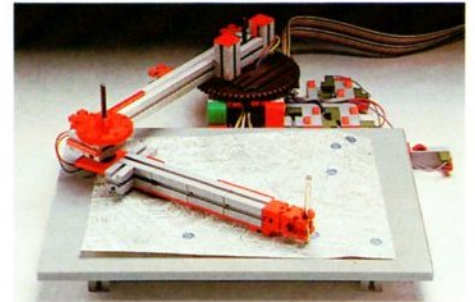
This program brings in movement. Two motor movements at once must be adjusted to one another. On reaching their respective required positions both movements cause input signals to be given which are monitored by the program. A further step in the program: controlling the turning direction on a direct-current motor.

Tower of Hanoi:



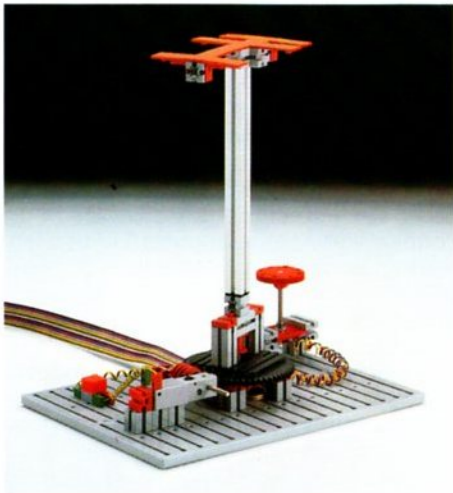
The first robot in the fischertechnik computing construction kit. It can be controlled when the construction is turned and the gripping arm is lifted. This robot is used for the "Tower of Hanoi" problem: it reacts. Here recursive programming is combined with control technology.

Graphics Tablet:



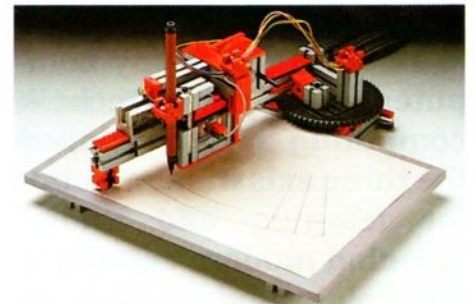
A change of topic: Not only automatons and robots can be represented by means of fischertechnik computing: fully operable instruments from the field of computer graphics can also be constructed. The graphics tablet serves the purpose of transferring an original to the computer's display storage.

Antenna Rotator:



Fine adjustment and positioning can be studied using the aerial-rotor model. The key to this is the potentiometers that are connected to the interface's analog inputs. In addition to this, the programming of control loops is shown on the model.

Plotter:



A simple plotter model with which computer graphics can be put on paper. The program in the example shows the production of a cake graphics display with automatic scaling of the sector values for the angle area specified.

Teach-in Robot:



A different biaxial robot that is controlled by means of a programming system that can be used universally.

Solar-Cell Tracking:

This ambitious program from the scientific field constantly aligns a Cardanic suspension in such a way that the supporting frame of the solar cell stands at a vertical angle to the incidence of the sunlight. It is controlled selectively, either via the computer's real time clock or using the fast-motion procedure.

with fischertechnik computing



Controlling robots is a challenge for any computer owner. fischertechnik computing has developed the three axis training robot for learning and understanding modern computer technology quickly. Its design, which is modelled on industry, makes it possible for this model to be programmed and controlled as it would be in a real work situation.



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Training Robot

Article No. 30 572

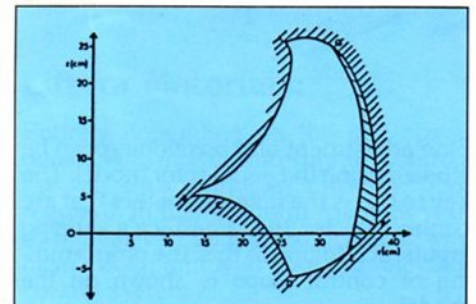
Technical Equipment:

- 3 S-motors, 6.8 volts, – for moving the 3 robot axes.
- 1 mini-motor, 6.8 volts – for driving the gripping hand.
- 3 infrared fork light barriers for positioning the three robot axes.
- 4 scanners for defining the normal position.
- 1 emergency off scanner.
- 4 lamps for indicating operation visually.

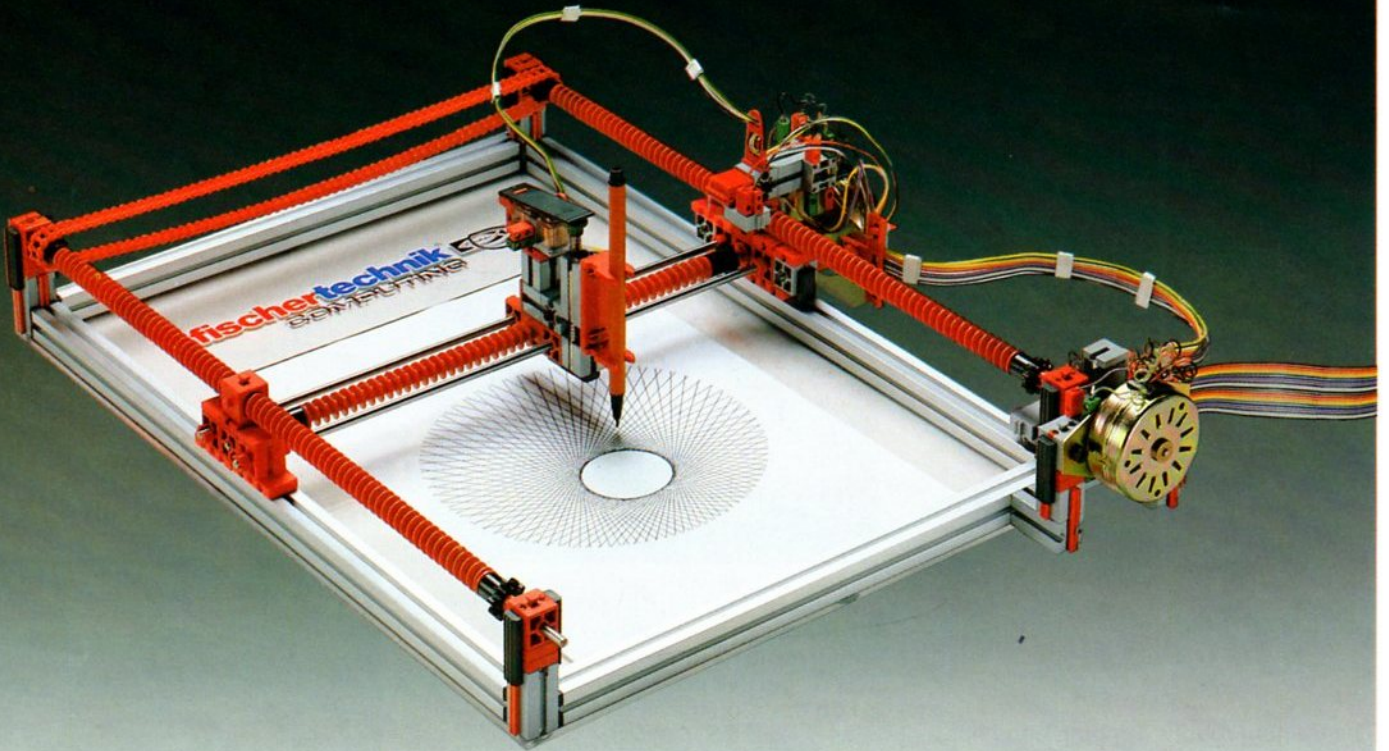
- Structural parts for various grippers (for cylindrical and rectangular parts).
- Flat-belt connection cable with a multiple connector for the interface.
- Detailed construction and programming guide.
- Coupon for program diskette corresponding to the computer model.

Model of a triaxial industrial robot designed with a bent arm. Position compensation for grippers during all stages of movement. Large working space, vis. above graphics. The structural parts for the fischertechnik training robot can be combined and supplemented with all other fischertechnik components. It is connected to the computer via fischertechnik computing Interfaces (vis. page 10/11).

The guide booklet provides you with an introduction to robot geometry and acquaints you with the robot's working space.



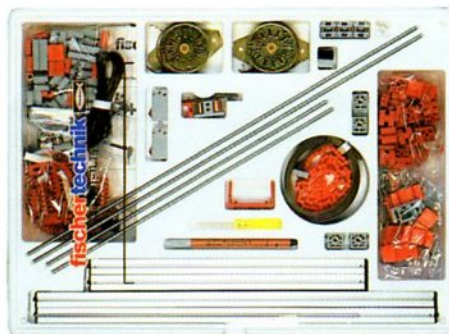
More Computer Know-How



Two pieces of professional graphics equipment. The plotter puts graphics displays up to a size of DIN A4 on paper. Bipolar stepping motors make precise positioning of 0.5 mm possible. The scanner scans display image originals digitally. With the software supplied on the diskette for this, display image evaluation and pattern recognition are possible. The two models, which are designed to teach, can also be used as functional units.



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Plotter/Scanner

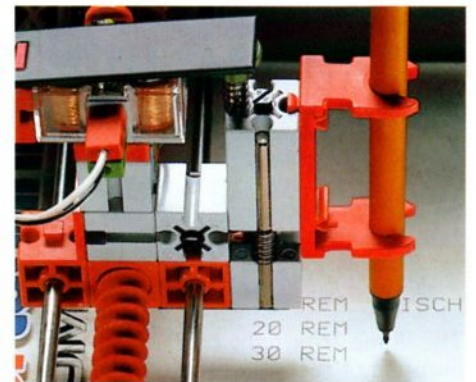
Article No. 30 571

Technical Equipment:

- 2 bipolar stepping motors with a 7.5 degree stepping angle. Operating voltage: 6.8 volts =.
- Electromagnetic print head with fibre-type refill.
- Read head with a lamp and a photo-resistor.
- 2 scanners for recognizing the end positions.
- Transparent acrylic plate with a visual DIN A4 document stop.
- Flat-belt connection cable with a multiple connector for the interface.

- Detailed construction and programming guide.
- Coupon for program diskette corresponding to the computer model.

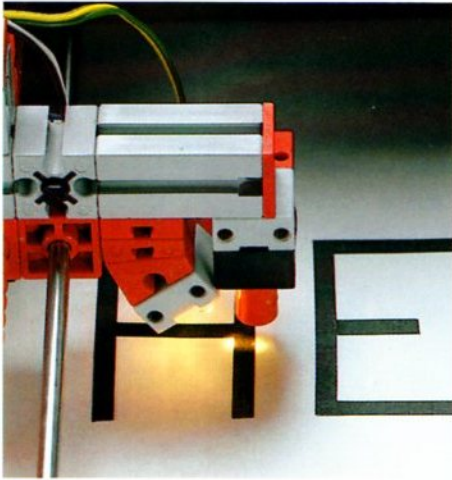
Print Head



The plotter's print head is positioned with a precision of 0.5 mm. This is taken care of by the drive system, which operates with stepping motors and spindles. The "printing pen" is lowered onto the paper by means of an electromagnet. The spring bearings compensate for unevenness.

More Computer Success

Read Head



The scanner's read head consists of lighting equipment and a photoresistor. The photoresistor reacts to the amount of light reflected by the original. In this way bright and dark points on the original produce different input data, which can be processed in a display image evaluation.

Software

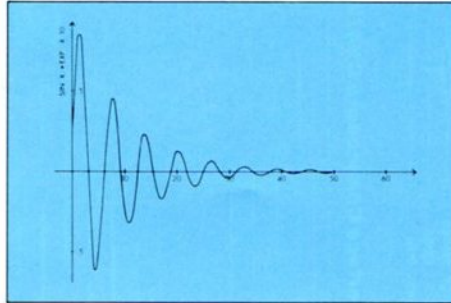
Step:

With this program it can be demonstrated how the stepping motors are controlled using a selectable delay system. Parallel to this, the operation of a stepping motor is explained in the guidebook.

Plot:

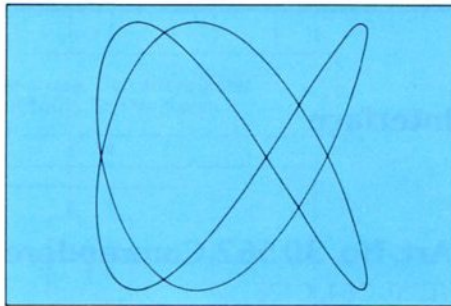
BASIC program for controlling the plotter. The starting point for your individual plotter software. Includes sub-programs for plotter movements, straight lines, rectangles, hatchings, circles, ellipses and arcs. In addition to this, a complete ASCII letter library that can be supplemented by 128 more special characters. Further to this, the software includes sub-programs for drawing scale axes, including labelling and scaling.

Function:



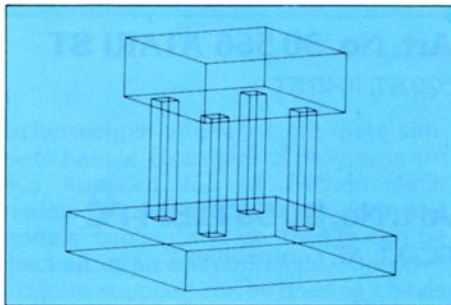
This program is based on PLOT and scales and draws any function of an independent variable whatsoever.

Param. F.:



This program is also based on PLOT and it scales and draws a two-dimensional function of a common parameter.

D 3:



Owing to the definition of the shape of the edge of a body, the latter is drawn in any line of vision as an edge model. The representation is optimized to suit the plotter area. 3-D display image.

Char. Design:

With this program you can change and supplement the PLOT character set. The characters are designed on the display screen.

Scanner:

Program for scanning originals visually up to a size of DIN A4. The individual points (step size approximately 2 mm) are allotted brightness values that are stored away in the computer. After scanning is completed the data can be stored on a diskette by specifying a file name and thus be dumped.

B & W:

By choosing a suitable limit value between the extreme values of brightness indicated by the computer, a digital black-and-white display image is produced on the display screen.

D. PIC:

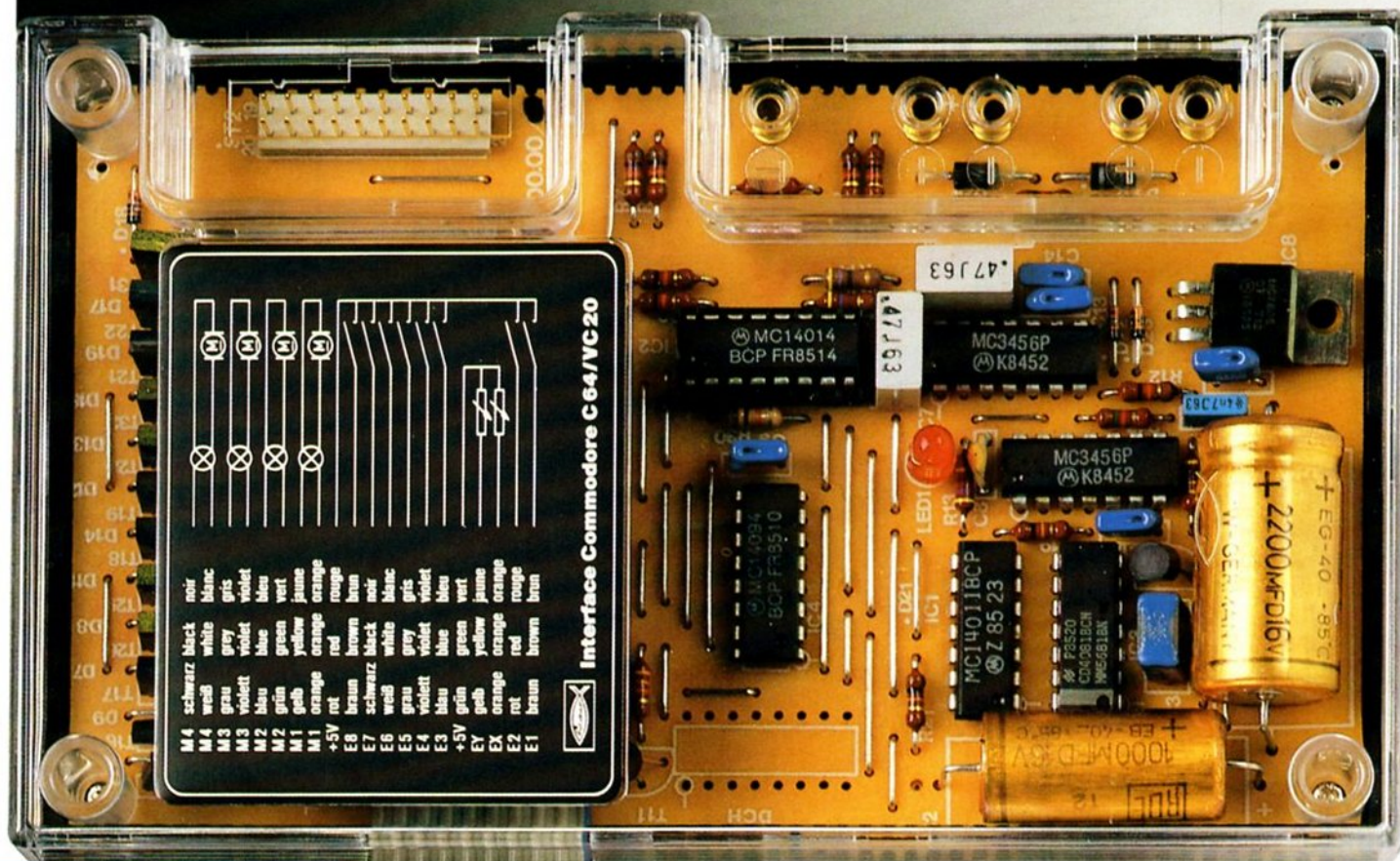
In this program an additional choice can be made between three different resolutions in x and y direction and – again by choice – it can be optimized on the display screen.

Color:

Here, with the aid of suitable limit values that are to be determined, up to 16 colors can be represented on the display screen. The computer's entire range of colors can be selected. As is the case with the preceding program, three resolution stages can be differentiated and optimized on the display screen.

Pattern:

This pattern recognition program searches for a black circle that is filled-in and located on the original. The sensor travels along the line of the circle and evaluates the positional data. According to this data, identical and shifted circles and also circles that are different in size can be recognized using the same method.



All computing models can be connected to almost any home and personal computer using fischertechnik interfaces.

Of course, also to IBM-PC and ATARI ST.

The interface hardware is supplemented by a suitable software package. Using both, input and output become possible via the interface.



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Interface

Art. No. 30 562 Commodore
VC20, C64, C128

Art. No. 30 563 Apple II
II, II+, IIe, IIeuroplus, IIGS, compatibles

Art. No. 30 566 ATARI ST
520 ST, 1040 ST

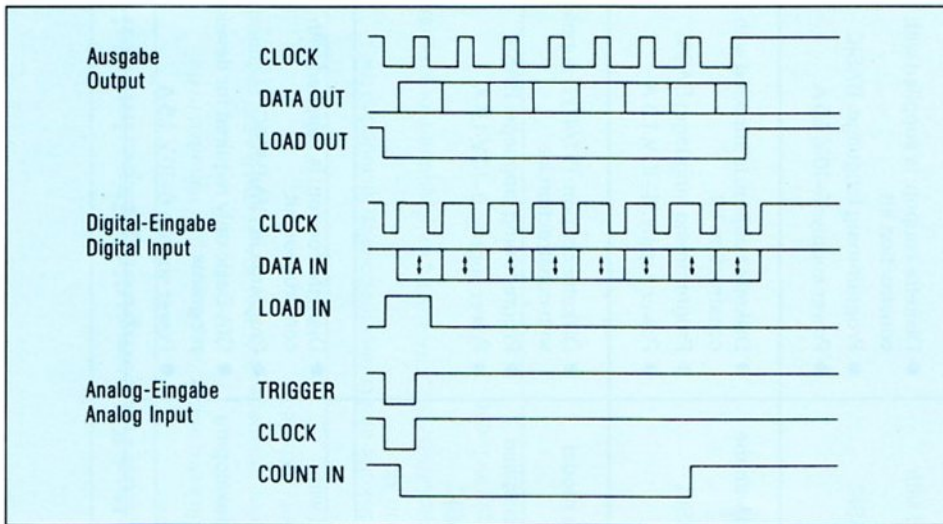
Art. No. 30 567 IBM-PC
PC, XT, AT, compatibles

Technical Equipment:

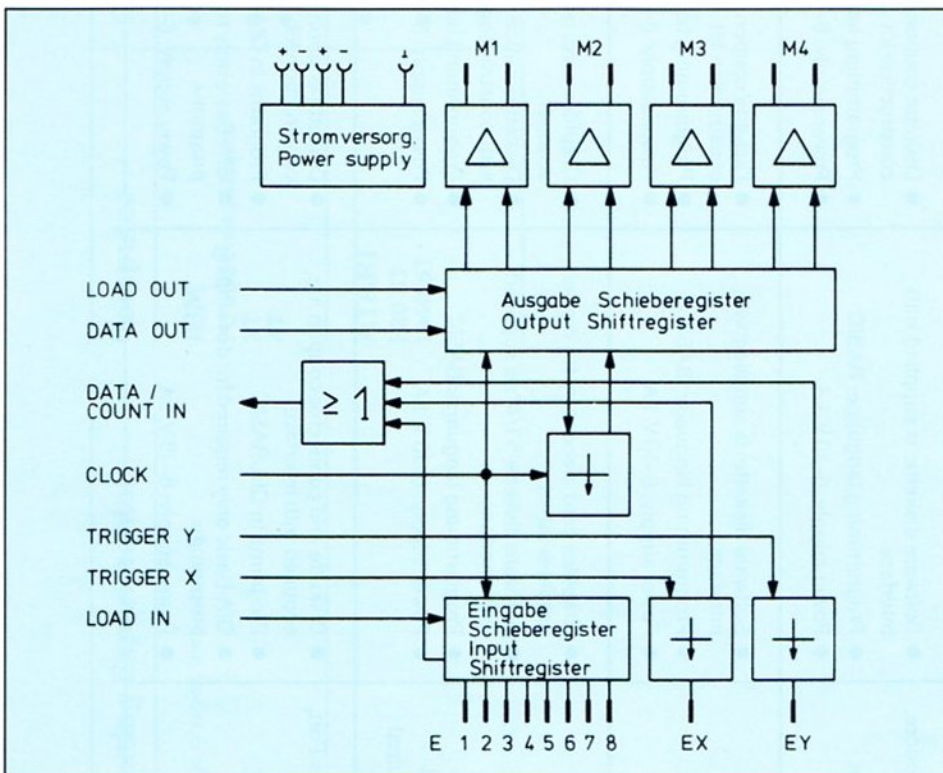
- 4 outputs for connecting motors, lamps, electromagnets ... (M1 to M4). Output polarity controllable. Power rating: 1 amp permanent current, 1.5 amps peak current.
- 8 inputs for digital signals (E1 to E8). Owing to internal cabling, it is possible to connect both electromagnetic articles (scanners, switches, relays) for positive logic and TTL outputs.
- 2 inputs for analog signals (Ex and Ey). The following equipment can be connected: emitters with resistance values between 0 and 5 kΩ e.g. potentiometers, photoresistors etc. Monitoring circuit for data stream. If the computer's data signals stop, the interface renders all of the outputs inactive after 0.5 seconds. But the signals remain stored. Monitoring circuit for the software. In the case of serious syntactical errors, the monitoring circuit also responds, but without delay. The monitoring circuit also reacts to the interface being under-supplied, whether it is due to overloading or whether the power pack has a voltage that is too low.

The logical Connection

Pulse Diagram

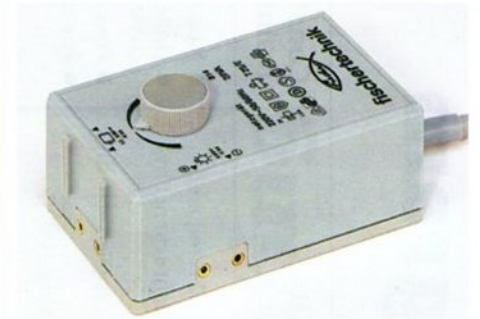


Block Diagram



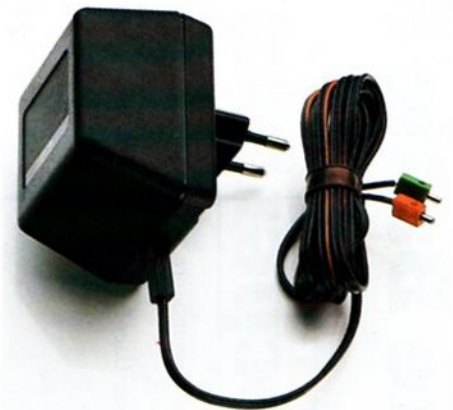
The Power Supply for fischertechnik computing Models

fischertechnik provides special DC-power supplies for use with the different kits. Ask your dealer for more information.



Technical Specifications:

computing Experimental	6-10 V, 1 A
computing Kit	6-10 V, 1 A
Training Robot	6-10 V, 1.5 A
Plotter/Scanner	6-10 V, 2 A



fischertechnik Interfaces are quite simple to handle. Examples of programs are also supplied for all fischertechnik models. With a diagnosis program the models' cabling and operability can be checked in an easy manner. The drive program supplied can be used as a basis for your own model and program ideas. fischertechnik computing interfaces can be combined with the structural parts and the electronics modules from fischertechnik's design construction kits: Electromechanics and Electronics.

with fischertechnik computing

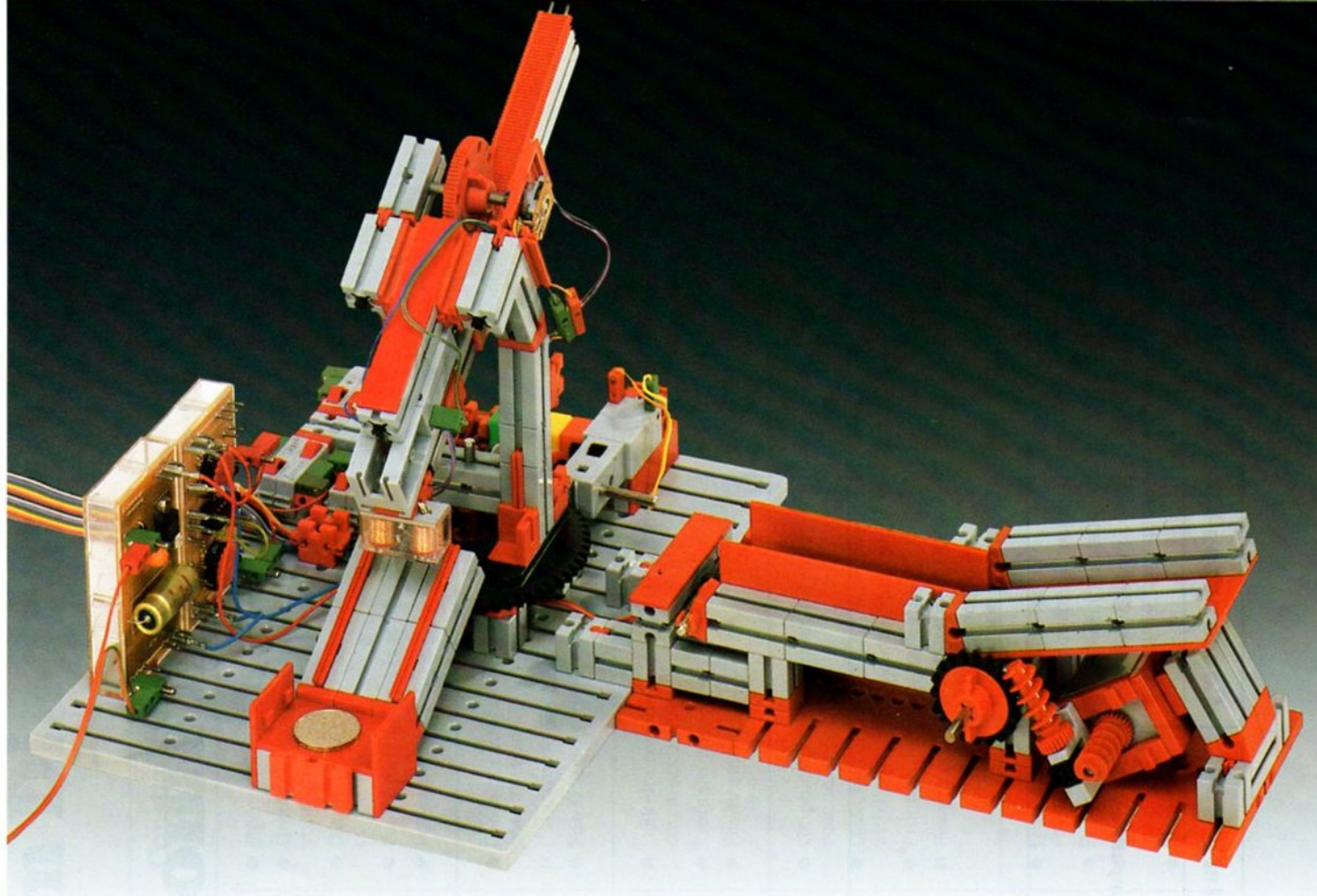
The Basic System Diagram

Computer	Interface	Construction Kit: computing	Construction Kit: Plotter/Scanner	Construction Kit: Training Robot
Commodore VC20	fischertechnik Interface Commodore, Art. No. 30 562 <ul style="list-style-type: none"> ● Computer connection: User-Port 	<ul style="list-style-type: none"> ● Memory expansion: 8 K required ● Graphics system: Adapt graphics tablet by yourself ● Software diskette: is supplied with interface ● Programming language: BASIC ● Power supply: 6-10 V, 1 A 	<ul style="list-style-type: none"> ● Memory expansion: 32 K required ● Graphics system: Adapt scanner by yourself ● Diskette coupon: is supplied with the construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 2 A 	<ul style="list-style-type: none"> ● Memory expansion: 32 K required ● Diskette coupon: is supplied with construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 1.5 A
Commodore C 64 C 128* * Operation in mode 64	<ul style="list-style-type: none"> ● fischertechnik Interface Commodore, Art. No. 30 562 ● Computer connection: User-Port 	<ul style="list-style-type: none"> ● Software diskette: is supplied with interface ● Programming language: BASIC ● Power supply: 6-10 V, 1 A 	<ul style="list-style-type: none"> ● Diskette coupon: is supplied with construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 2 A 	<ul style="list-style-type: none"> ● Diskette coupon: is supplied with construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 1.5 A
Apple II, II+, IIe, IIeuroplus, II GS and Apple compatibles	fischertechnik Interface Apple, Art. No. 30 563 <ul style="list-style-type: none"> ● Computer connection: Game-Controller-Port 	<ul style="list-style-type: none"> ● Software diskette: is supplied with interface ● Programming language: BASIC ● Power supply: 6-10 V, 1 A 	<ul style="list-style-type: none"> ● Diskette coupon: is supplied with the construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 2 A 	<ul style="list-style-type: none"> ● Diskette coupon: is supplied with the construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 1.5 A
IBM PC XT AT compatibles	fischertechnik Interface IBM, Art. No. 30 567 <ul style="list-style-type: none"> ● Computer connection: Centronics-Parallel-Port ● Operating system: MS-DOS or PC-DOS starting from version 2 ● IBM-BASICA or GW-BASIC required 	<ul style="list-style-type: none"> ● Graphics card: necessary for model graphics tablet ● Software diskette 5 1/4": is supplied with interface ● Programming language: BASIC ● Power supply: 6-10 V, 1 A 	<ul style="list-style-type: none"> ● Graphics card: necessary for model scanner ● Diskette coupon: (5 1/4") is supplied with construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 2 A 	<ul style="list-style-type: none"> ● Diskette coupon: (5 1/4") is supplied with construction kit ● Programming language: BASIC ● Power supply: 6-10 V, 1.5 A
ATARI 520 ST 1040 ST	fischertechnik Interface Centronics-Port, Art. No. 30 566 <ul style="list-style-type: none"> ● Computer connection: Centronics-Parallel-Port ● Operating system: TOS + GEM 	<ul style="list-style-type: none"> ● Diskette and connector-coupon are supplied with interface ● Programs in GfA-BASIC ● GfA-Basic only required for developing programs ● Power supply: 6-10 V, 1 A 	<ul style="list-style-type: none"> ● Diskette coupon: is supplied with construction kit ● Programs in GfA-BASIC ● GfA-Basic only required for developing programs ● Power supply: 6-10 V, 2 A 	<ul style="list-style-type: none"> ● Diskette coupon: is supplied with construction kit ● Programs in GfA-BASIC ● GfA-Basic only required for developing programs ● Power supply: 6-10 V, 1.5 A

Computer	Construction Kit computing Experimental
Commodore C 64 C 128* *Operation in mode 64	<ul style="list-style-type: none"> ● Interface, diskette and connector-coupon included in the construction kit ● Programming language: BASIC ● Power supply included

Computer	Construction Kit computing Experimental
IBM PC and compatibles XT AT	<ul style="list-style-type: none"> ● Interface, diskette and connector-coupon included in the construction kit ● Programming language: IBM-BASICA or GW-BASIC required ● Power supply included
ATARI 520 ST 1040 ST	<ul style="list-style-type: none"> ● Interface, diskette and connector-coupon included in the construction kit ● Programs in GfA-BASIC, GfA-BASIC only required for program development ● Power supply included

fischertechnik computing

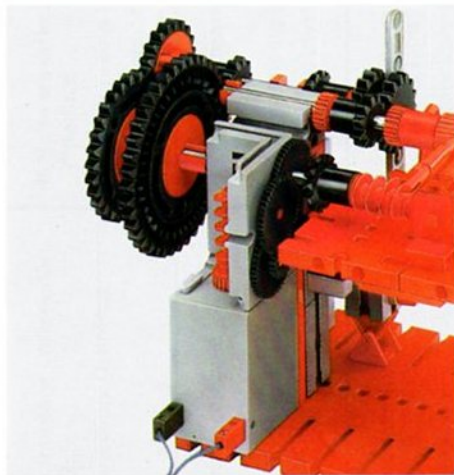


fischertechnik is a leading trademark for creative and innovative product ideas. Ranging from the technical construction-kit system – with which anyone can construct, play, experiment and learn – and computer periphery equipment which you can design and program yourself, to realistic simulation models. Today fischertechnik provides everyone with an interesting technical challenge.



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fischertechnik Construction Kits



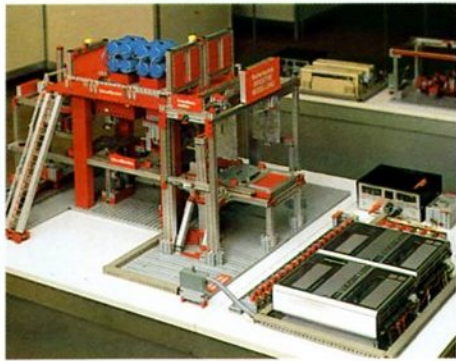
The constructing and playing system you can construct, play and experiment with limitlessly. Everything can be combined and extended with other components. Start. Statics. Motor + gear unit. Electromechanics. Electronics. Pneumatics. The unlimited technology program. fischertechnik. The perfect synthesis of one system.

fischertechnik computing + Constructions Kits

fischertechnik computing can be combined with all other fischertechnik construction kits. For example, the "Pick & Place" program shows you how the "Teach-in Robot" from the computing construction kit can be combined with a "Supply Conveyor Belt". The conveyor belt has been constructed from the fischertechnik design construction kits and, with the aid of a photoresistor, it can scan optically. The sensitivity of the scanning is adjusted on the electronics modules and the output signals are passed on to the interface. "Pick & Place" is only one example of the versatility of construction within fischertechnik systems. With some imagination a new fischertechnik dimension is attained in this way, giving creativity the chance to blossom (vis. above illustration).

Industrial Models

fischertechnik plan & simulation



On a small scale, plan and simulate functionally. Later, on a large scale, carry things out quickly and perfectly. Present processes and sequences three-dimensionally. Simulate movement positions and conditions. Plan logistical functions. Verify large projects on a small scale. Test out functions, gain fresh knowledge.



In contrast to a drawing, the functionally practical demonstration and simulation models from fischertechnik's development department "plan & simulation" permit you to have real three-dimensional representation. As a result of this, loading and unloading systems, material flow and other logistical functions can be planned.

Three special Learning Manuals for the Classroom

Three classroom manuals are available for use with the computing kit, Physics applications, Electronic applications, and Computer Literacy/General Science applications. These manuals will contain expanded assembly instructions, student activities, and teacher lesson plans. They are referenced to leading classroom textbooks where appropriate.

Physics applications of the fischertechnik robotics kit

I. Introductory activities

1. Structural Design
2. The light bulb
3. The Switch
4. The potentiometer
5. Motor Operation
6. The gear box
7. Worm gear and bearing
8. The rack and pinion
9. The electromagnet
10. Light sensors
11. Temperature sensor

II. Physics activities

1. The computerized astrolabe
2. Modeling an intersection with traffic lights
3. The graphic panel
4. Extension to the aerial rotor
5. The tower of Hanoi
6. Model of automatic focusing
7. Robotics

III. Appendices

- A. Installing the fischertechnik interfacing module
- B. Assembling the ribbon cable
- C. Coding and function of the ribbon cable wires
- D. fischertechnik robotic computing kit parts list

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- E. Robot and circuit diagrams
- F. BASIC listings of the fischertechnik software
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Electronics applications of the fischertechnik robotics kit

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3. Program control of Input/Output devices

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III. Analog input

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IV. Circuit logic gates

9. Introduction to logic gates
10. Logic gates

V. Electronic applications

11. Using potentiometers to control rotary antennas
12. Sensing electromagnetic waves
13. Measuring weather conditions

J.P.M. Steerman

ROBOTIK mit dem Homecomputer



Der Einstieg in die faszinierende Welt der Robotertechnik

elaktor

VI. Appendices

- A. Installing the fischertechnik interfacing module
- B. Assembling the ribbon cable
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- E. Robot and circuit diagrams
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General science applications computer literacy of the fischertechnik robotics kit

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1. Direct control of output devices
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II. Physical science applications

3. Electromagnetism

III. Computer science applications

4. Applications of FOR/NEXT statements
5. Applications of IF/THEN statements
6. Flowcharts & Conditional statement
7. Reprogramming the lift

IV. Problem solving applications

8. Remotely controlled robots
9. Tower of Hanoi

V. Robotics applications

10. What can people do better than robots (and visa versa)

Appendices

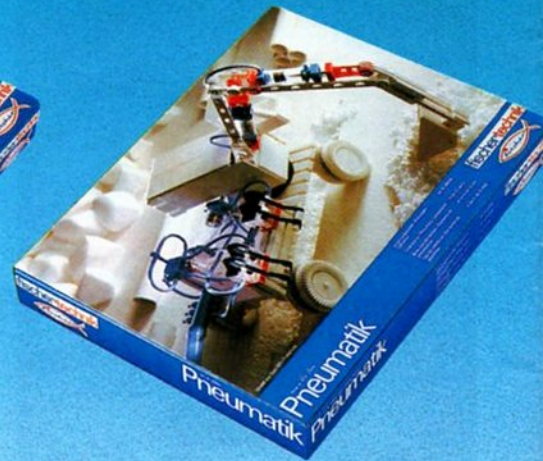
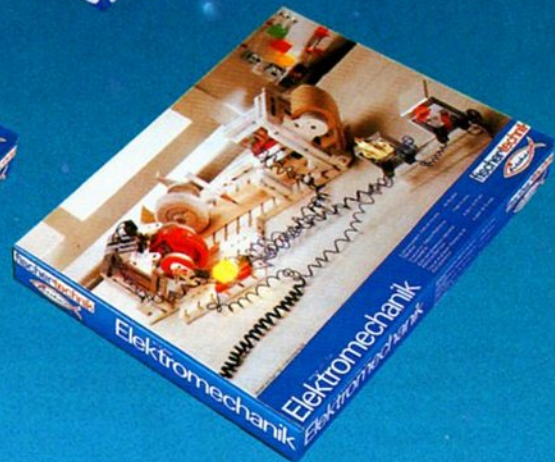
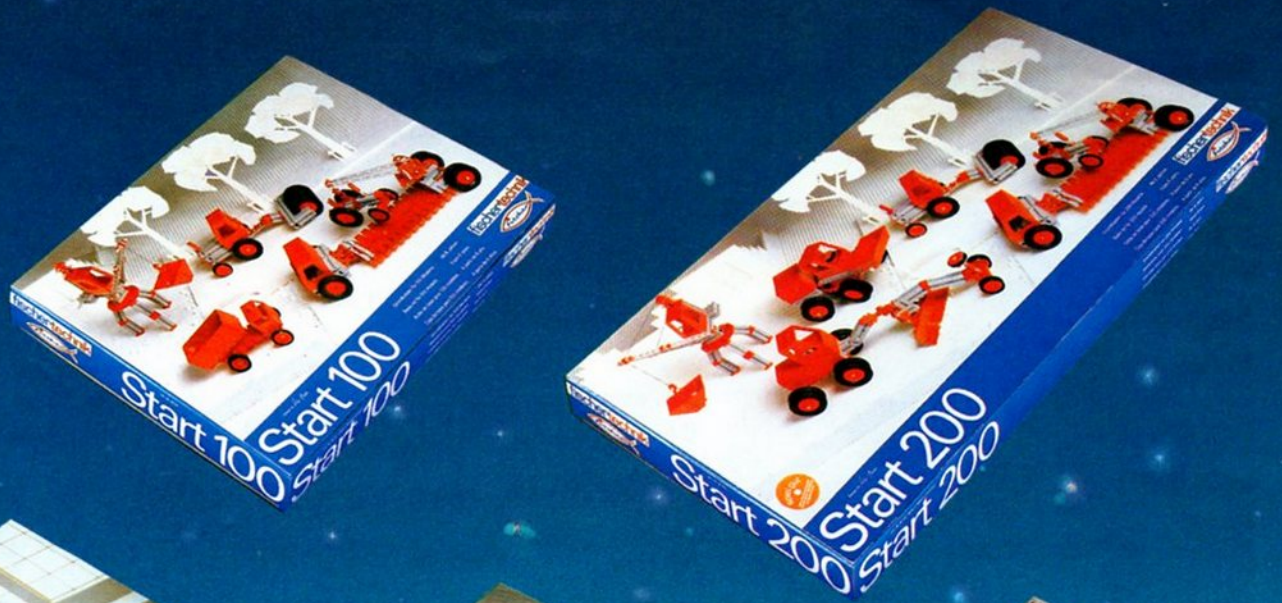
- A. Installing the fischertechnik interface module
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The newsletter is designed as a means of sharing ideas and information for users of the fischertechnik products. Your ideas, suggestions and contributions are welcome. We want to hear how you are using fischertechnik.

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