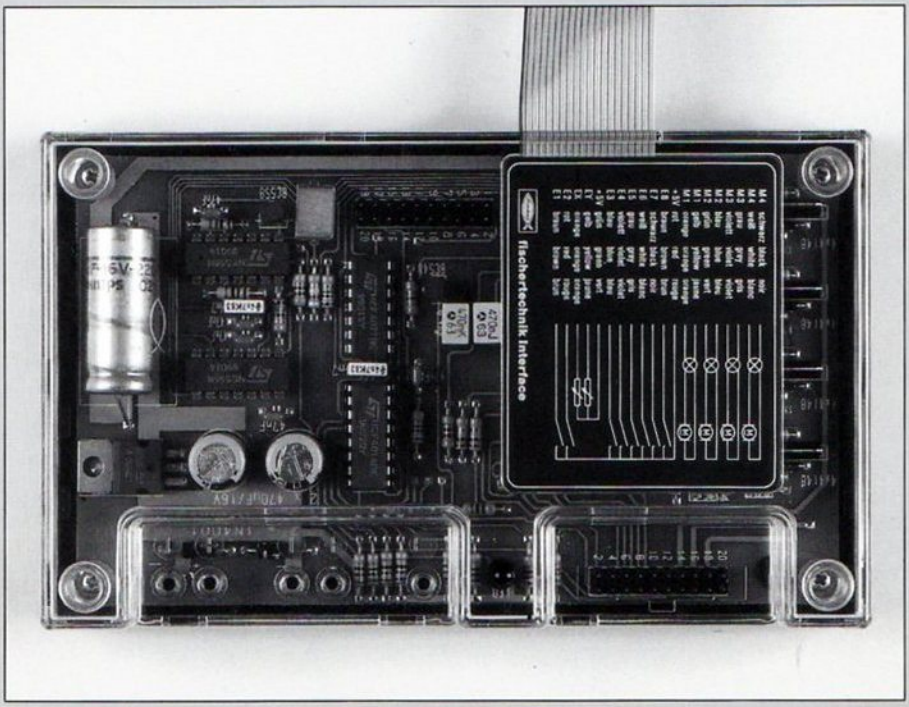
INTERFACE



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COMPUTING INTERFACE

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English Version
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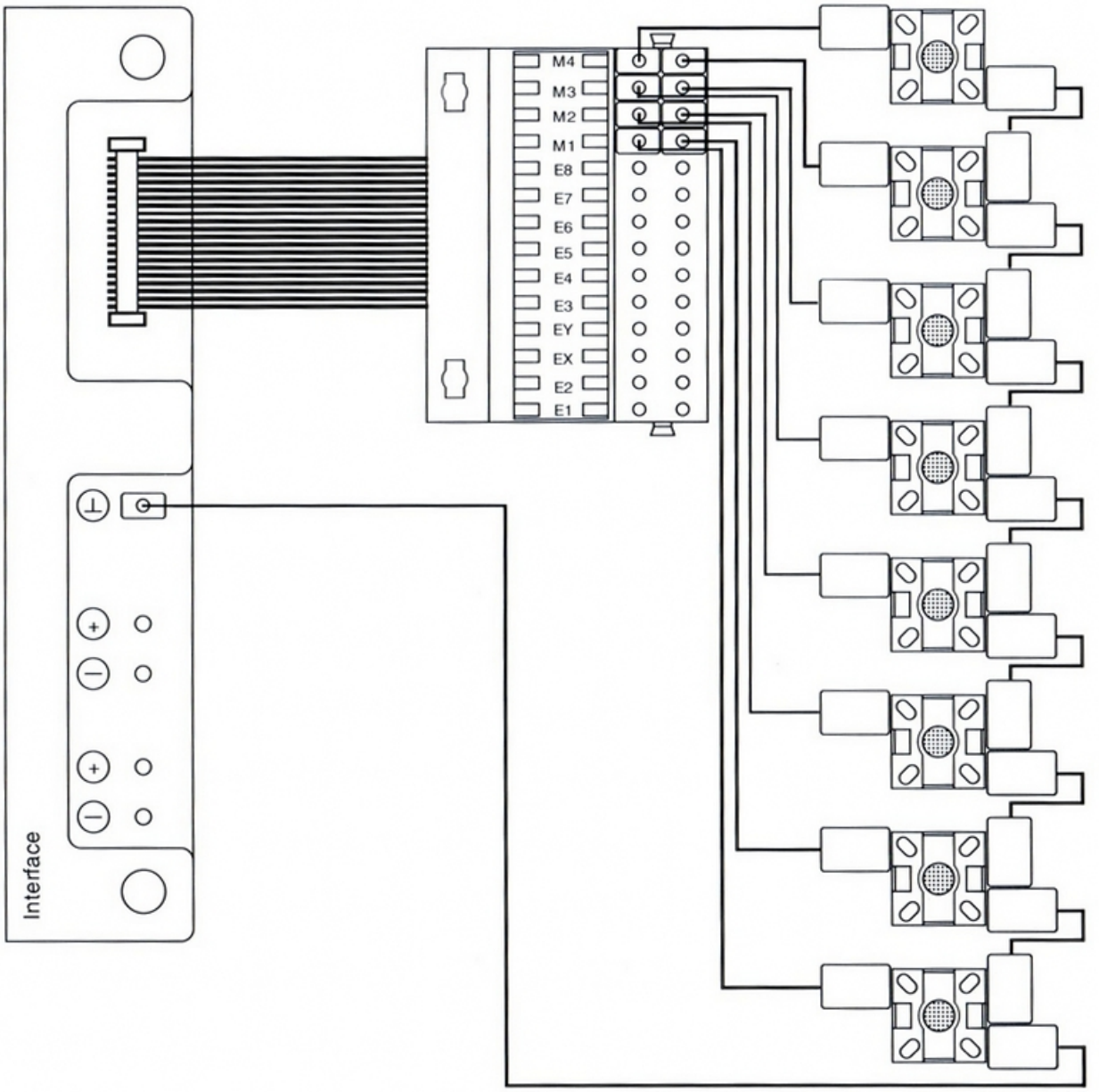
The fischertechnik computing interface

The fischertechnik computing interface has been developed to allow computer owners to control fischertechnik models with a computer. It forms the link between the computer and the electrical components in the fischertechnik kits.

What do you need to control the models? First, the fischertechnik model as the actual "performer". Second, a computer, which controls and coordinates all the processes. Finally, the interface which links the computer to the fischertechnik models, since the computer ports cannot provide enough power on their own to supply a motor, for example. The interface can supply all the power needed by both the motors and the lamps. It enables four motors or eight lamps to be controlled (in other words it has four "outputs").

Connection diagram for 8 lamps



When you control one of your models by hand, you can see what the model is doing and react accordingly; the computer, on the other hand, is “blind”. Since it - or, to be more precise, the control program - requires information on the model’s behavior (e.g. on the position of a slide), switches or photo-sensors are used in many of the models. This “feedback” enables the program to determine the state of the model and respond as necessary. The interface can interrogate up to eight of these “inputs”, process them and pass them on in a form which is meaningful to the computer.

The interface also has two ports for measuring resistances, to which you can connect photo-sensors, potentiometers or photo-resistors, for example.

In addition, the interface protects the ports of the computer if you make a mistake when wiring up a model. It also incorporates an automatic timer, which cuts off the power to the motors if the computer stops sending control commands. You will often wish to make changes when testing the control software. The timer stops the model automatically, so that you don't have to interrupt the power supply to the interface every time you want to modify the program. The model carries on again as normal as soon as the computer sends more commands.

Important! *The interface has been constructed using integrated CMOS circuits. You should always eliminate any electrostatic charge which may have built up by touching a grounded metal object (such as a radiator), to protect your equipment from flashover voltages.*

Power supply

Power is supplied to the model and the interface by a separate power supply unit. We recommend using the fischertechnik 230V~ / 8V⎓ power supply (Part no. 30180). The interface has two pairs of jacks marked (+) and (-). The two (+) jacks and the two (-) jacks are connected in parallel inside the interface. It therefore does not matter which of each pair you use. It is however important to connect the interface to the power supply correctly, since it will not work if it is connected the wrong way round; the red plug must be connected to a (+) jack and the green plug to a (-) jack.

You can also use other fischertechnik power supplies instead if you wish.

Connecting the computer to the interface

Lay out the interface and the cables in front of you and look for the printer port at the back of the computer. It must be a 25-pin socket connector. You can't confuse it with the serial interface, as this has a 25-pin plug connector. If your computer has more than one parallel printer interface, it doesn't matter which one you use.

An adapter is provided for connecting the interface to the printer interface of the computer. It takes the form of a small printed circuit board with two plug-in connectors. One of these connectors matches the computer, while the other consists of two rows of 10 pins each in a small casing. The plug on the end of the gray connecting cable must be connected here. On the top side of the plug is a small, central lug, which fits exactly into the recess in the plug-in connector on the printed circuit board. This is designed to prevent the plug from being inserted the wrong way round.

Important! *The computer should always be switched off before the interface is connected or disconnected.*

Never use the original disk with the fischertechnik software; you should always make a backup copy first and work with that instead!

Connecting the interface to the model

The interface must now be connected to the model. The construction kits include a 20-pin, multicolored ribbon cable. At one end of this cable is a 20-pin plug, which must be connected to the interface. This plug likewise has a lug which fits into the recess in the casing of the interface, so that once again you cannot insert it the wrong way round. The cable colors are printed on the casing as well, just to make sure.

The Profi-Computing kit comes supplied with a 28-pin socket connector, to which you must connect the color-coded ribbon cable as described in the construction kit manual. You can then use this socket connector to connect the models with fischertechnik plugs.

You should take your time about preparing and wiring the interface, and be sure to work very carefully and accurately. You could save yourself a lot of problems later on and avoid possibly damaging the interface. Do not connect the plug to the interface until you have unmade all the connections and checked them again.

If you are not using the interface, there is no need to unplug it. Of course, as long as the interface is plugged in, you won't be able to connect a printer to the same port. You can get round this if necessary by using a different printer port instead (PC).

If something really does not work, or if the interface doesn't react the way you expect it to, you can test it extremely simply using the interface diagnosis function. The check list at the end of this description contains all the most common types of problem.

Combination with the Profi Sensoric kit and other components

All the various switches can be connected to the interface inputs - mini-switches, large press switches, reversing switches and reed contacts. Be careful when using switches which you have constructed yourself from hinged blocks and springs. They cause above-average contact bounce; you should get the control program to check them several times and consider the result valid only if the same value appears two or three times in a row.

The analog inputs of the interface (EX and EY) can be connected to all sensors with a resistance between 0 and 5 kΩ (e.g. potentiometers, photo-transistors, photo-resistors, NTC resistors, etc.).

The motor outputs of the interface can be loaded with a continuous current of up to 1 A. All fischertechnik motors, lamps and electromagnets can be connected to them. One additional lamp may be connected in parallel with the motors for indicating operation.

The input signals of the interface (E1 - E8) are TTL-compatible, in other words the output signals of integrated digital components in the TTL family can be supplied to the inputs of the interface. The ground cable of the circuit constructed with the TTL components must be connected to the ground jack (⊥) of the interface. CMOS circuits can also be connected to the interface, providing they are operated with a supply voltage of 5 V.

Pin assignment

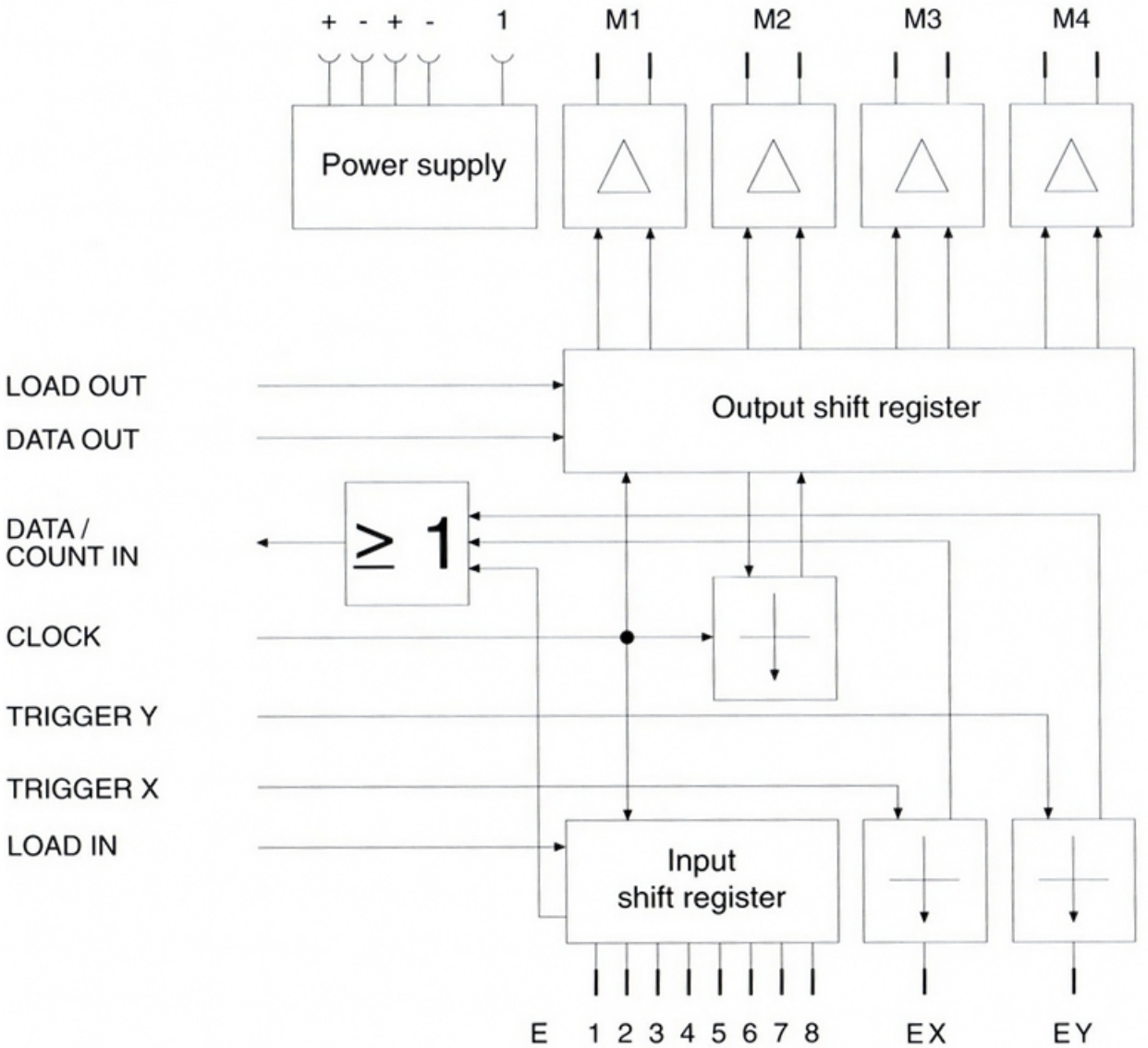
The interface uses 6 data lines and the BUSY line of the printer port. The assignment of the PC connector is shown below:

Interface Signal	Drucker-Signal	Pin
LOAD-OUT	Datenbit 1	2
LOAD-IN	Datenbit 2	3
DATA-OUT	Datenbit 3	4
CLOCK	Datenbit 4	5
TRIGGER-X	Datenbit 5	6
TRIGGER-Y	Datenbit 6	7
DATA/COUNT-IN	Busy	11

Operation of the interface

If you want to write programs for controlling a model yourself, you will probably find this information useful; we have assumed, however, that you already know something about digital technology and programming. Let us start by taking a look at the block diagram:

Block diagram



On the left-hand side are the lines between the interface and the computer. As you can see, these lines have very little in common with the outputs M1 to M4 or with the inputs E1 to E8 and EX or EY.

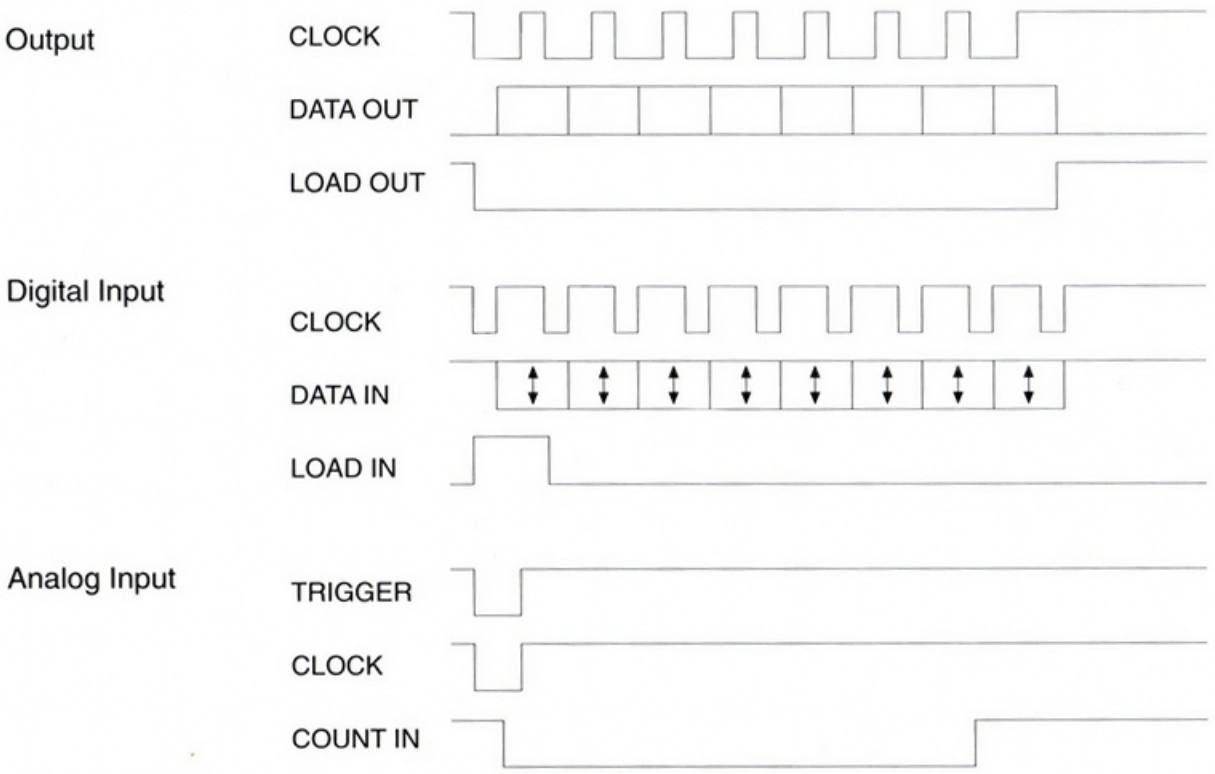
Since fewer lines are available at the computer interface than are required to control the models, the data is transmitted serially (consecutively) between the computer and the interface. This makes it possible to link two interfaces together if desired (see next chapter). As a result, only three data lines are required to control the output. Eight would be necessary if we were to use a parallel interface instead.

Control of outputs M1 to M4

The DATA-OUT, CLOCK and LOAD OUT lines are responsible for controlling motors M1 to M4. The data for all four motors is always transmitted by each output, namely two bits per motor (on/off, counterclockwise/clockwise). Eight bits are thus sent to the interface in total. The current state of all the motors must therefore be buffered in the computer. The bits of the output word are applied sequentially to the DATA-OUT line. The output begins with the most significant bit (M4). Each low-high transition on the CLOCK line causes the bit to be transferred to the shift register of the interface. The next bit is then applied to DATA-OUT and a new CLOCK pulse is generated, and so on until all eight bits have been transmitted. This procedure is shown in the timing diagram below.

Up to this point, the interface outputs still have their old states, because the output amplifiers are controlled by a memory register inserted in the circuit, and not directly by the shift register. The data is not transferred from the shift register to the memory register until a low-high transition occurs on the LOAD-OUT line.

Timing diagram



Timing diagram of the fischertechnik interface

Whether or not the power amplifiers are also turned on by this data depends on the enabling control of the memory register. The enabling control circuit comprises a retriggerable monoflop, which is driven by the CLOCK line pulses and which generates an enable signal with a length of 0.5 seconds. If no data is transferred for a period of more than 0.5 seconds, the monoflop flips back to its stable state and disables the outputs. If the program stops, or if data is not transferred due to an error in the program, the model is stopped to prevent it from being damaged. The monoflop is also disabled by the output shift register if an invalid data pattern is received (e.g. simultaneous clockwise and counterclockwise rotation of a motor).

Reading inputs E1 to E8

The principle by which the signals at inputs E1 to E8 are read into the computer is the same as for the output, except that the transmission direction is reversed. A LOAD-IN pulse causes the values at the inputs to be transferred to a shift register; they are then sent to the computer sequentially by the CLOCK pulses (E8 is the first bit to be transmitted and E1 the last bit). The bits must then be evaluated in the computer.

Since the CLOCK line is used for both transmission directions, the monoflop which enables the outputs is also activated for data inputs. A malfunction of the output shift register cannot be caused by reading in data with the common CLOCK signal, since LOAD-OUT remains set to high level.

Reading the analog inputs EX and EY

The analog inputs comprise two monoflop circuits, whose timing element is the resistor connected to EX or EY. The higher the resistance, the longer will be the LOW time at the COUNT-IN output. The program can determine the length of this low pulse with the aid of a counter cycle, for example. The monoflop pulse is triggered by the TRIGGER-X and TRIGGER-Y lines. Since both the monoflop outputs are switched to the CLOCK-IN line, the EX and EY inputs must be interrogated one at a time. The number of counter cycles in the program which correspond to a particular resistance at the analog input depends on the speed at which the processor works and on the software; the relationship between the result and the resistance value is always linear.

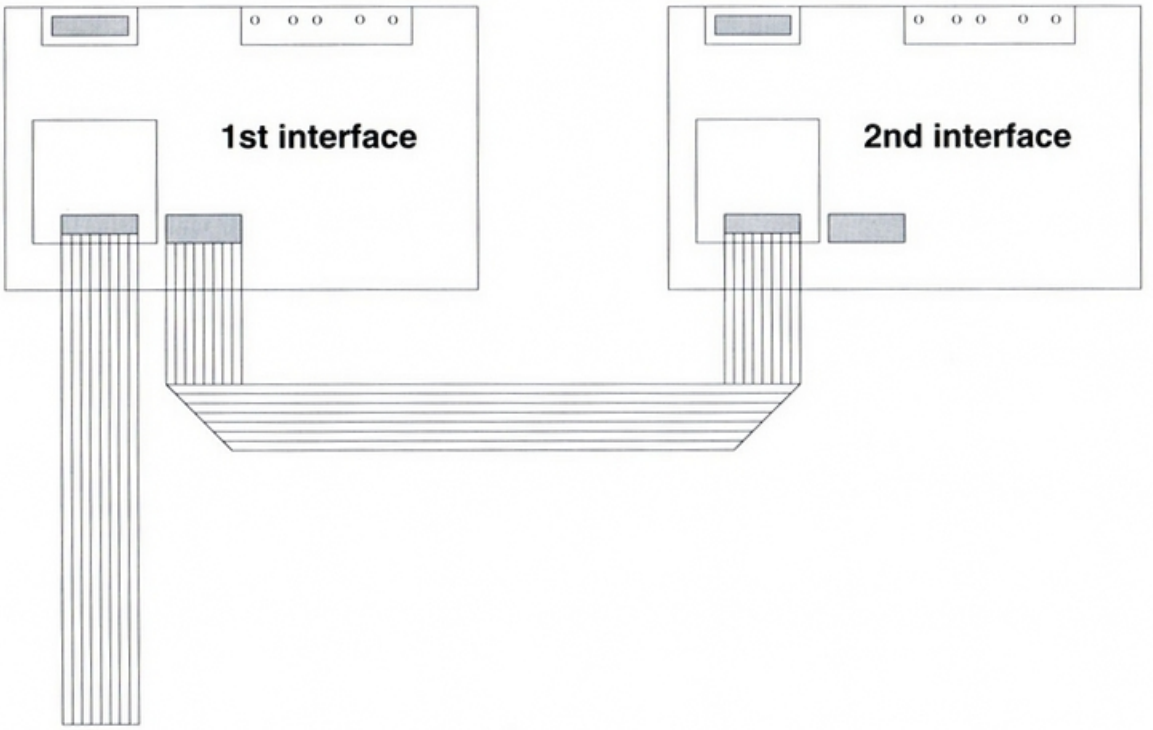
Using two interfaces with one computer

If the number of interface inputs or outputs is not sufficient for large projects, you can connect two interfaces to the same computer, and of course control both of them using the "Lucky logic" software. (This is not possible, however, if your computer is an Amiga 3000.) The two interfaces are connected together with a plug-in connector. The first interface must remain connected to the computer.

To connect the second interface, first unscrew the cover of the first interface and then connect the plug of the second interface to the spare post connector. Finally, screw the first interface back together again.

This combination of two interfaces enables you to control up to 8 motors (or 16 lamps) and to interrogate 16 input lines. The analog inputs of the second interface cannot be used however; only the two analog inputs of the first interface are available.

Connection diagram



Connection to computer

Technical data

- 4 outputs for connection of fischertechnik motors, electromagnets or lamps (M1 to M4). Polarity of output reversible. Load capacity: 1 A continuous current, 1.5 A peak current

- 8 inputs for digital signals (E1 to E8). Internal wiring permits connection of both electromagnetic devices in positive logic (switches and relay contacts) and TTL outputs. Built-in overvoltage protection

- 2 inputs for analog signals (EX and EY), for connection of sensors with resistances between 0 and 5 kΩ, e.g. potentiometers, photo-resistors, NTC resistors, etc.

- Data flow from computer monitored. Outputs disabled if no data signals received for 0.5 seconds (signals remain stored)

- Connection for second interface: 8 outputs and 16 inputs then available

- Connection to computer via printer interface.

Check list: Problems and possible causes

Problem	Possible cause
The diagnostic program displays 1 for E1 to E8, although no model is connected.	The interface is not connected to the computer or is not being supplied with power (the power supply unit is not connected).
One of the inputs E1 to E8 shows the opposite result from what you would expect when the switch is actuated.	The opening and closing functions of the switch have been reversed.
One of the inputs E1 to E8 always shows 0, although it is connected and has been actuated.	Check for a fault in the wiring, e.g. plug loose, wiring incorrect, cable defective.
One of the inputs E1 to E8 always shows 1, even though no model is connected.	The input gate IC 4014 is probably defective, e.g. due to overvoltage or electrostatic charging.
A motor output does not work.	Check for a fault in the wiring, e.g. plug loose, wiring incorrect, cable defective.
A motor output only works in one direction.	The power stage of the interface is defective.
A motor rotates very slowly or only works intermittently.	The power supply unit is overloaded by too many motors (use either a second power supply unit or the power supply Part no. 30180). The power supply unit has not been turned up far enough when using the adjustable output.

If you have any further questions, don't hesitate to get in touch with us at:

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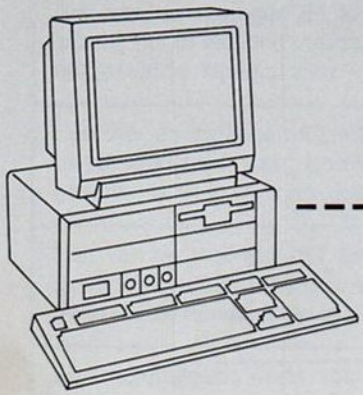

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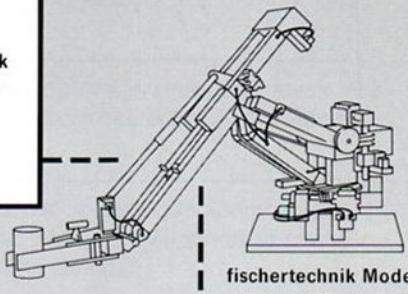

fischertechnik Model
or
fischertechnik Kit
PROFI COMPUTING
30490

fischertechnik
LUCKY LOGIC
30521

Process Control
Software

fischertechnik
SPECIAL
POWER-SUPPLY
30180

Zusätzlich erforderlich: Software LUCKY-LOGIC (Art. Nr. 30521) Netzgerät (empfohlen Art. Nr. 30180 POWER SUPPLY).

Accessories required: LUCKY-LOGIC software (Ref. no. 30521) Power pack (we recommend Power-Supply, ref. no. 30180)

Nécessitent en plus: Logiciel LUCKY-LOGIC (art. n° 30521) Bloc d'alimentation (nous recommandons l'art réf. n° 30180 POWER-SUPPLY)

Verder zijn nodig: LUCKY LOGIC software (art. nr. 30521) Voedingseenheid (aanbevolen art. nr. 30180 POWER-SUPPLY)

Complemento indispensable: Software LUCKY-LOGIC (art. núm. 30521) Bloque de alimentatión (recomendamos art. núm. 30180 POWER-SUPPLY)

Accessori richiesti: Software LUCKY-LOGIC (n. d'ordinazione 30521) Alimentatore di corrente (consigliato: n. 30180 POWER-SUPPLY)

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