

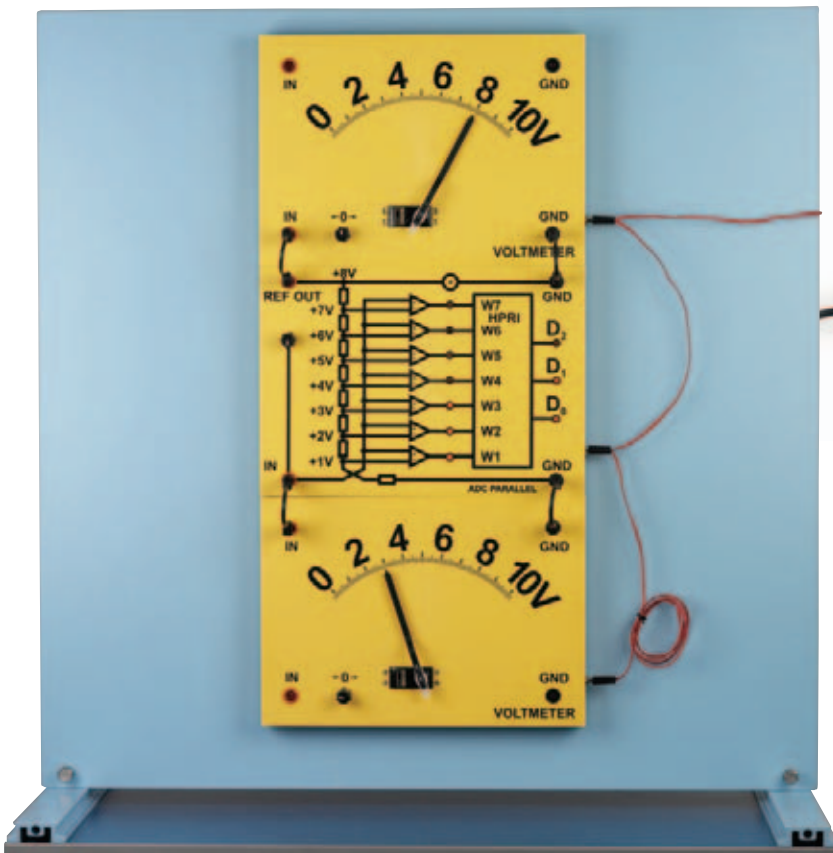


compact system logic

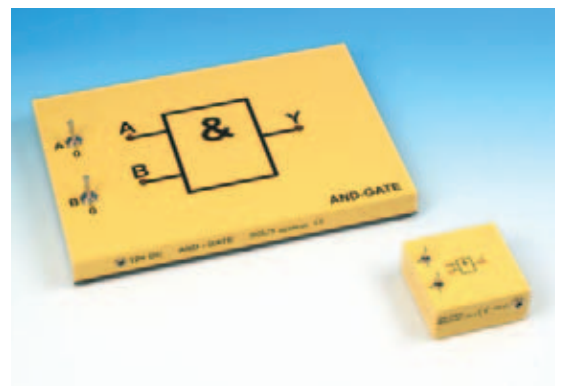
“compact” logic system - from AND gates to AD converters

Demo experiments with the magnetic panel for logic (MPL) and/or student experiments with magnetic module blocks for logic (MBL)

This system, consisting of 28 modules and a 12-V plug-in transformer, facilitates both demo and student experiments dealing with the basic concepts of digital technology. All sorts of experiments, from Boolean algebra to the fundamentals of computer measurement systems, may be carried out.



Experiment: Parallel ADC- on a magnetic panel as a demo experiment or horizontally as a student experiment



All of the MPL and MBL modules...

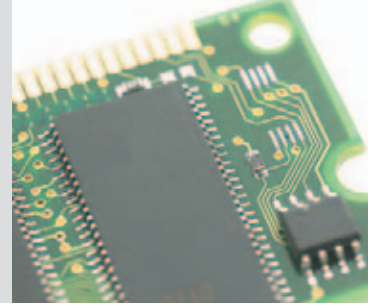
- are labelled with circuitry symbols or diagrams on the top face.
- include toggle switches for setting input states, which are displayed by LEDs (LED diameter: 5 mm for MPL modules, 3 mm for MBL modules).
- have LEDs for indicating all output states as well as important intermediate values.
- are manufactured from yellow ABS plastic and stick to steel panels thanks to built-in neodymium magnets.
- have a built-in DC jack for supplying them with 12 V DC (e.g. using 12-V-DC plug-in transformer P3130-1P).

Dimensions of MPL elements: 310x220x27 mm
Dimensions of MBL elements: 84x84x39 mm

Special attention was also paid in designing this system so that demo and student experiments are set up in exactly the same way.

All of the MPL and MBL modules...

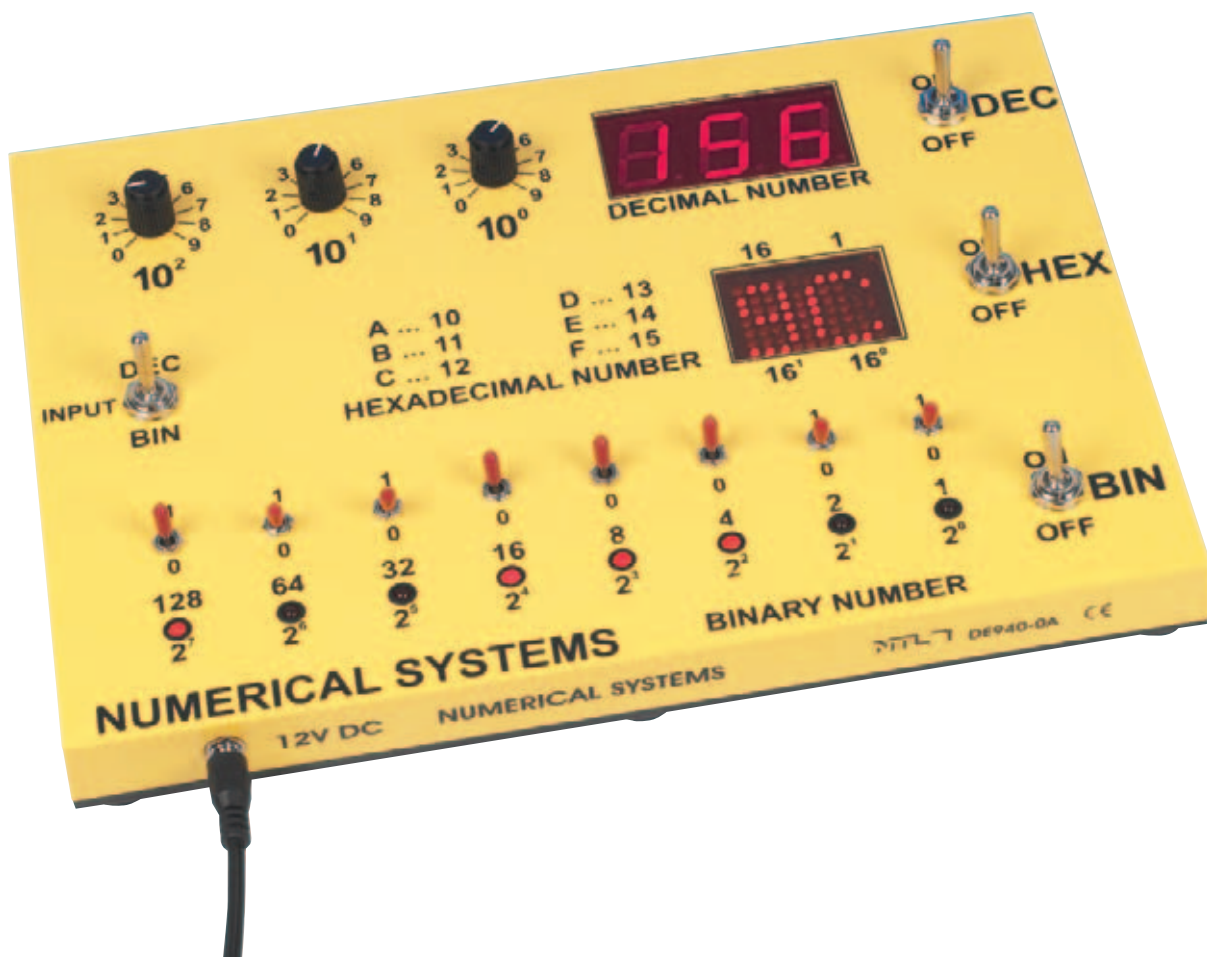
compact system logic



The system includes five groups:

- Number systems
- Universal elements
- Simple and complex gate functions
- Dynamic functions
- Interface to the analogue world: DAC and ADC

NUMBER SYSTEMS



DE940-0A MPL Number systems

This panel is used to demonstrate the number systems used in information technology (binary and hexadecimal numbers).

Range: 0 ... 255 or 8 bits

Toggle switches are used to activate the displays showing the particular number entered. Input may be entered either as decimal or binary numbers with a toggle switch for mode selection.

Three rotating knobs are available for selecting decimal digits, while binary numbers are entered by setting toggle switches. Numbers are

shown on two LED displays: a three-digit, seven-segment display (26 mm) for decimal numbers and a two-digit alphanumeric display for hexadecimal numbers (22 mm).

Eight LEDs (5 mm) display binary values.

See page 442 for a list of possible experiments.

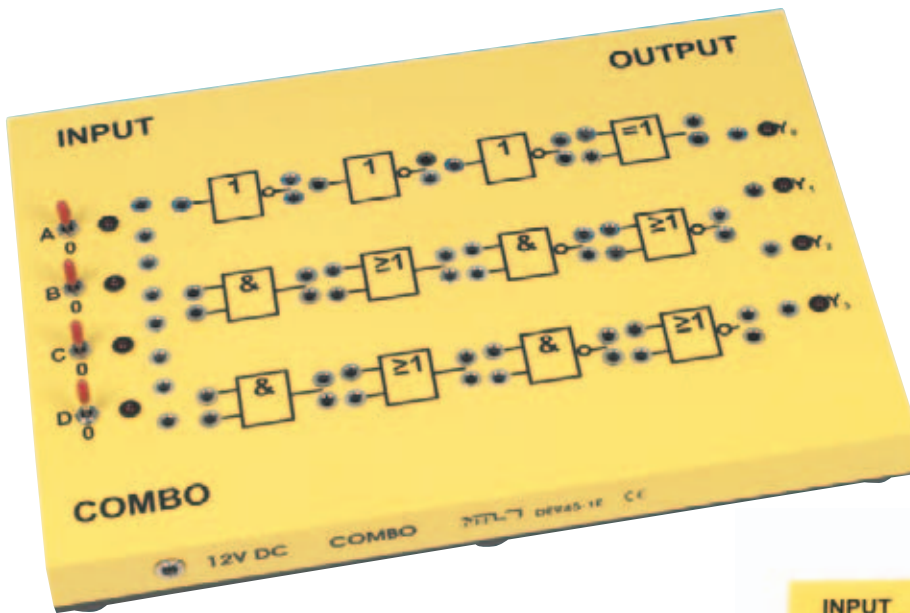
Additionally required:

P3130-1P Mains transformer 12V DC / 2A



compact system logic

UNIVERSAL ELEMENTS



DE945-1E MPL Combo

This panel includes the following logic gates, each of which has two 4-mm input jacks and two 4-mm output jacks:

- 2 AND gates
 - 2 OR gates
 - 2 NAND gates
 - 2 NOR gates
 - 1 EXOR gate
- as well as

3 NOT gates, each of which has one 4-mm input jack and one 4-mm output jack.

Input: four toggle switches with 5-mm LED displays and two 4-mm jacks

Output: four 5-mm LEDs with 4-mm jacks

Input and output elements as well as the individual gates are connected by means of 4-mm connecting leads.

Applications:

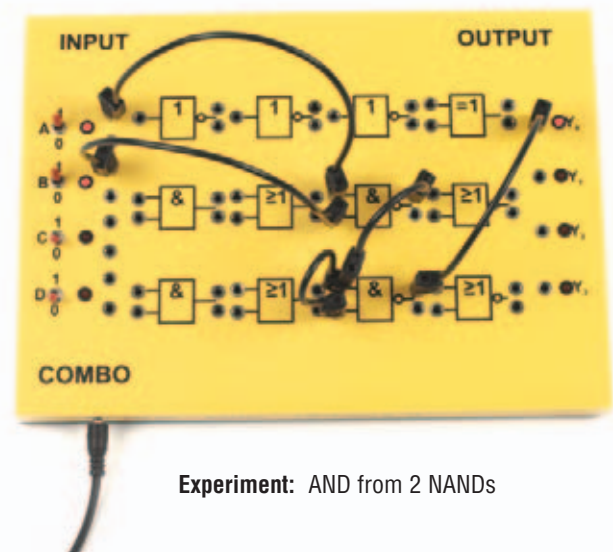
Introduction to basic logical expressions, combining logic gates, circuit design of EXOR gates, De Morgan's law, full and half adders, verifying the laws of Boolean algebra, coder and decoder circuits and RS flip flops (instructions for 30 example circuits).

Additional devices, such as a logic analyzer, may be connected by means of the 4-mm jacks.

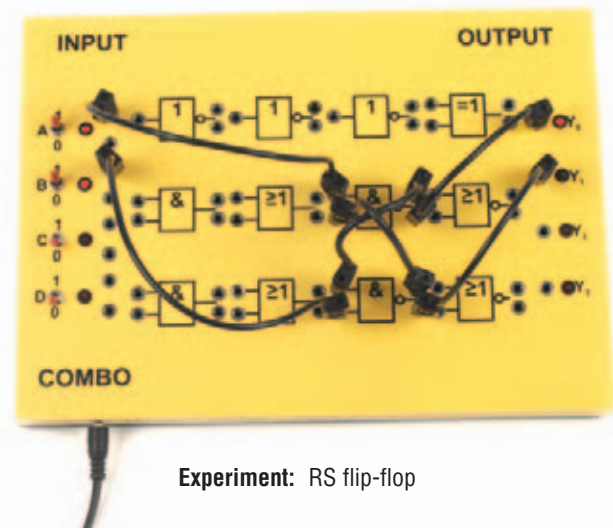
See page 442 for a list of possible experiments.

Additionally required:

- 3x P3310-2S Connecting leads, 25 cm, black, set of 6
- 1x P3130-1P Mains transformer 12V DC / 2A

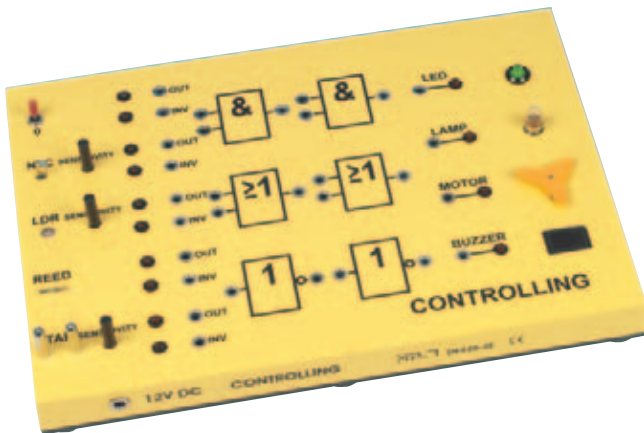
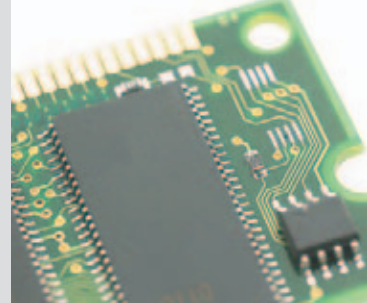


Experiment: AND from 2 NANDs



Experiment: RS flip-flop

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Applications:

Motor control; model of an alarm system, a fire detector, air conditioning system, heating control system and other circuits (instructions for 12 example circuits).

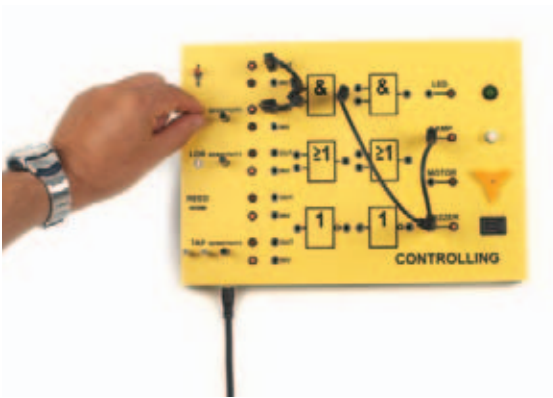
See page 442 for a list of possible experiments. Additional devices, such as a logic analyzer, may be connected by means of the 4-mm jacks.

DE945-2E MPL Controlling

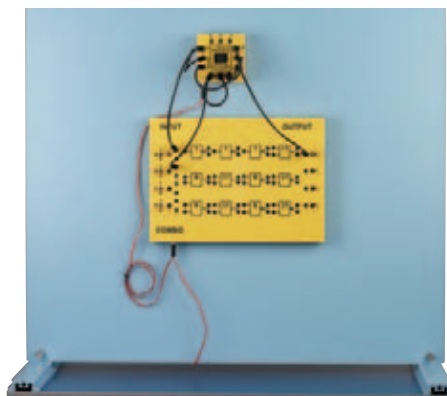
This panel is used to demonstrate practical applications of digital technology in electronic and electromechanical control systems. Input may be selected from five different, independent signal sources: a toggle switch; an NTC thermistor, used as a temperature sensor; an LDR, used as a light detector; a Reed relay contact (gas-filled magnetic switch); and a pressure-sensitive contact. Potentiometers are available for setting the sensitivity of the NTC thermistor, LDR and pressure-sensitive inputs. All output is accessible either as a direct or inverted signal and the current state is displayed in each case by an LED. Output terminals are protected against short-circuiting and suited to being directly connected to the logic gates. Logic gates: 2 NOT gates, 2 AND gates and 2 OR gates. Four control elements are available for each output signal: an LED (5 mm, green), an E10 light bulb, a drive motor and an electromechanical buzzer. The signal amplifiers for these elements are built into the MPL module. Current output state is displayed by LEDs. Input and output elements as well as the individual gates are connected by means of 4-mm connecting leads.

Additionally required:

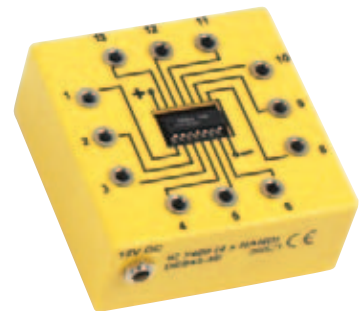
- 2x P3310-2S Connecting leads, 25 cm, black, set of 6
- 1x P3410-1K Round bar magnet, 10x50 mm
- 1x P3320-1I Light bulb, 10 V/50 mA, E10
- P3130-1P Mains transformer 12V DC / 2A



Experiment: Fire detector



Experiment: OR from 3 NANDs



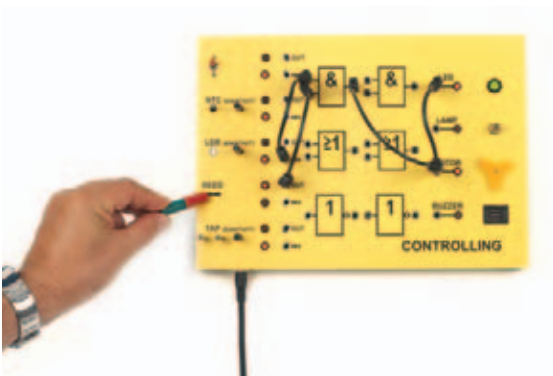
DE943-4E IC-7400 (4 NANDs)

This industry-standard IC (IC 7400) may be controlled by means of 12 4-mm jacks. Integrated Schmitt trigger circuits allow for a variety of digital and analogue signal sources to be directly connected to it (ON-OFF or Reed switch, NTC, PTC, LDR etc.). This module is designed to demonstrate the relationship between simple logic gates and industrial applications of integrated circuits.

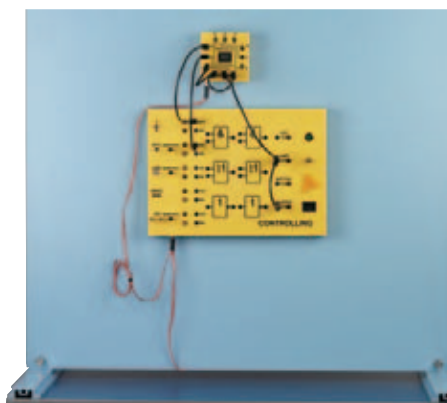
See page 442 for a list of possible experiments.

Additionally required:

- DE945-1E MPL Combo or
- DE945-2E MPL Controlling
- P3310-2S Connecting leads, 25 cm, black, set of 6
- P3130-1P Mains transformer 12V DC / 2A
- DP130-4A Junction cable, 4 DC plugs



Experiment: Motor control

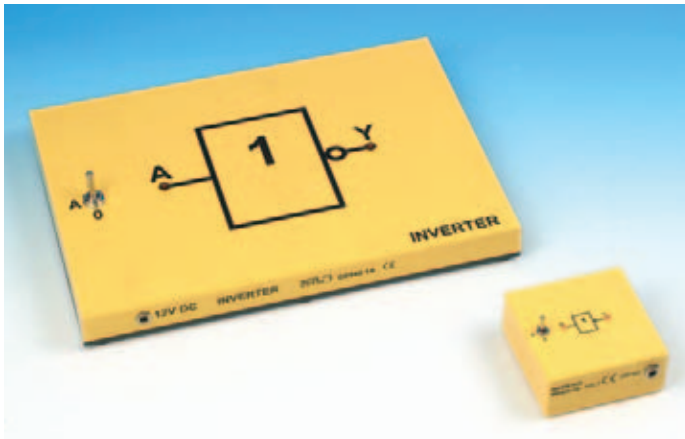


Experiment: Fire detector (AND from 2 NANDs)

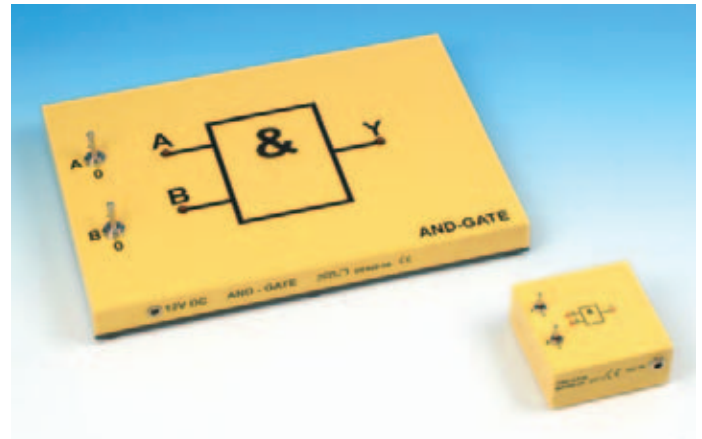


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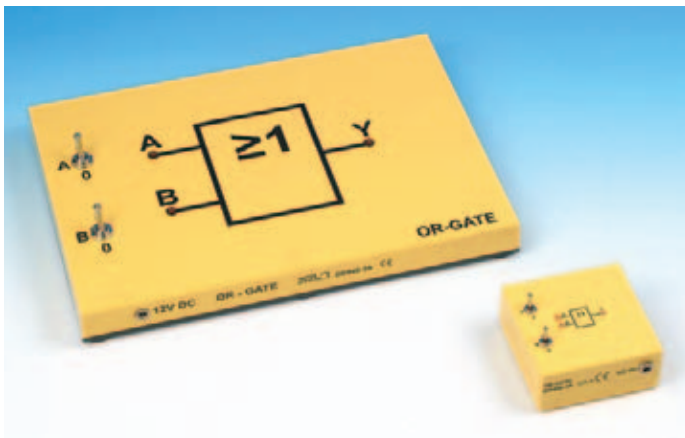
SIMPLE AND COMPLEX GATE FUNCTIONS



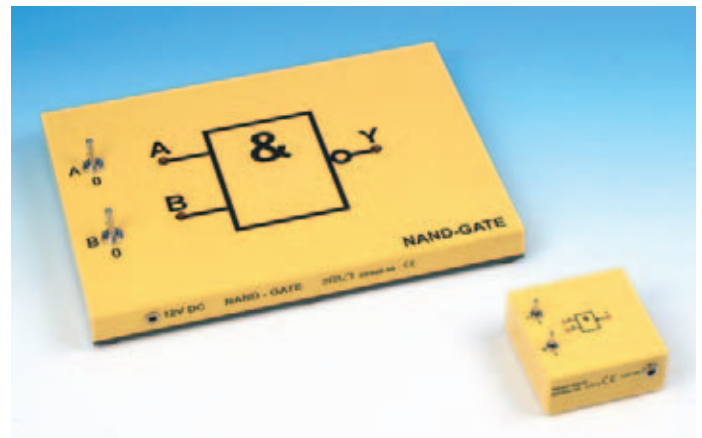
DE940-1A MPL INVERTER (NOT gate)
MB400-1A MBL INVERTER (NOT-gate)



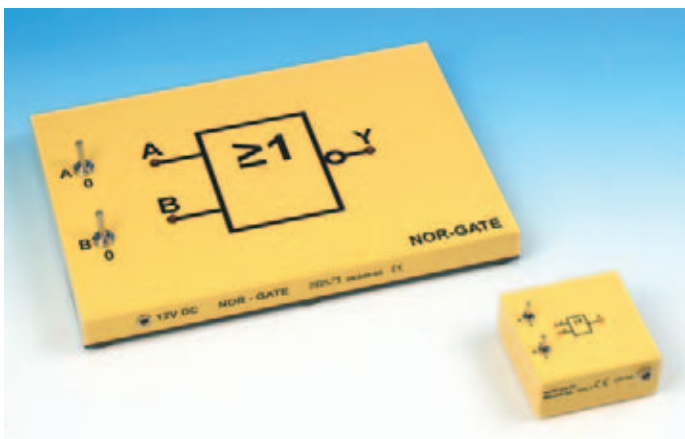
DE940-2A MPL AND-gate
MB400-2A MBL AND-gate



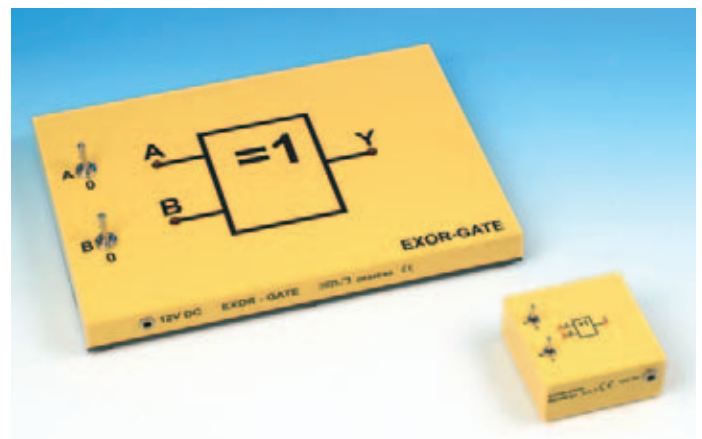
DE940-3A MPL OR-gate
MB400-3A MBL OR-gate



DE940-4A MPL NAND-gate
MB400-4A MBL NAND-gate

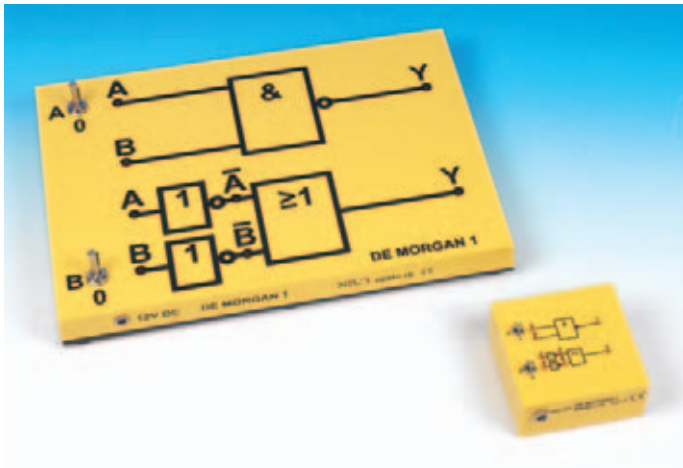
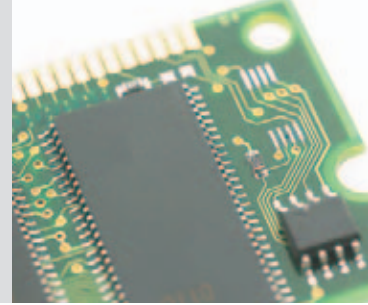


DE940-5A MPL NOR-gate
MB400-5A MBL NOR-gate



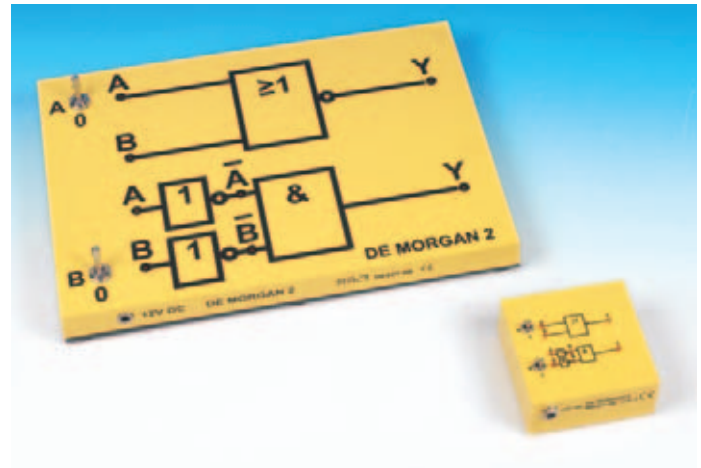
DE940-6A MPL EXOR-gate
MB400-6A MBL EXOR-gate

compact system logic



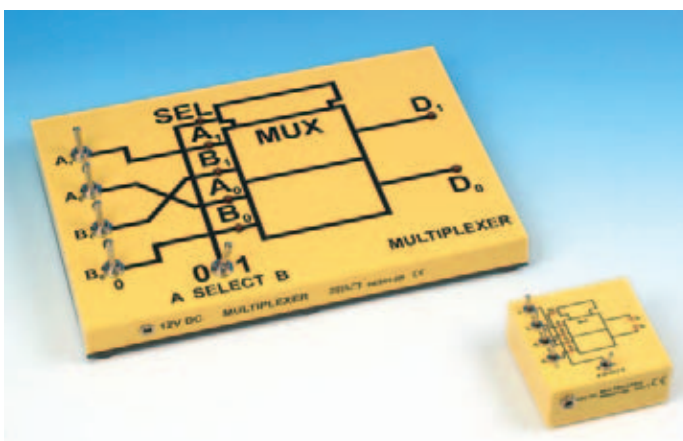
DE941-1B MPL De Morgan 1
MB401-1B MBL De Morgan 1

Demonstrates that two logical expressions are equivalent: in the upper circuit, input signals are put through a NAND gate, while in the lower circuit the same signals are negated and pass through an OR gate. The circuits are arranged one on top of the other. When the toggle switches for input signals A or B are thrown, LEDs display the switch state in each case. The lower circuit displays the inverted input signals after the NOT gates. The LEDs at the output terminals show that the two circuits result in the same values.



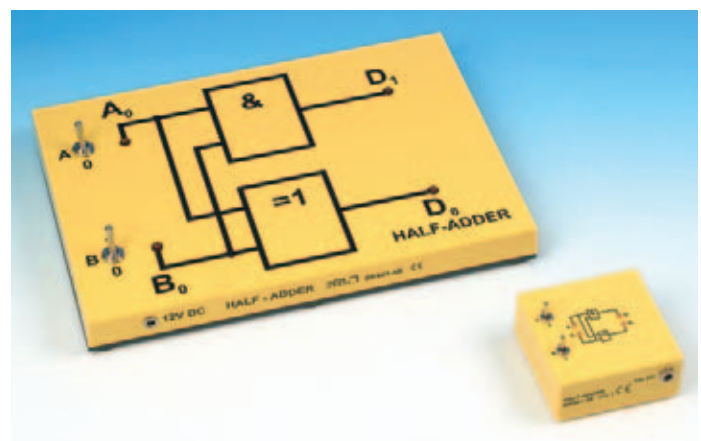
DE941-2B MPL De Morgan 2
MB401-2B MBL De Morgan 2

Module analogous to MPL De Morgan 1 DE941-1B. In the upper circuit, input signals are put through a NOR gate, while in the lower circuit the same signals are negated and pass through an AND gate.



DE941-5B MPL Multiplexer
MB401-5B MBL Multiplexer

The multiplexer is used to select one of two two-bit numbers. A display is selected using the "A select B" toggle switch. The two-bit binary number resulting from A0 and A1 or from B0 and B1 is then displayed at the output terminals D0 and D1. All switch states are indicated by LEDs.

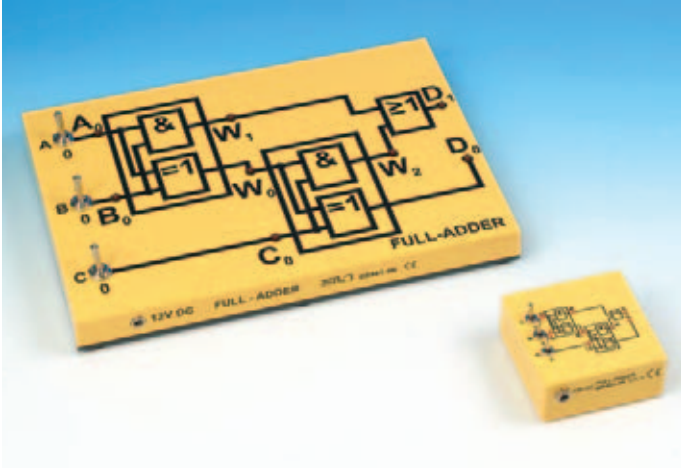


DE941-3B MPL Half-adder
MB401-3B MBL Half-adder

The half adder, used to add together two one-bit binary numbers, consists of an AND and an EXOR gate. The output signals indicate the sum and carry bit.

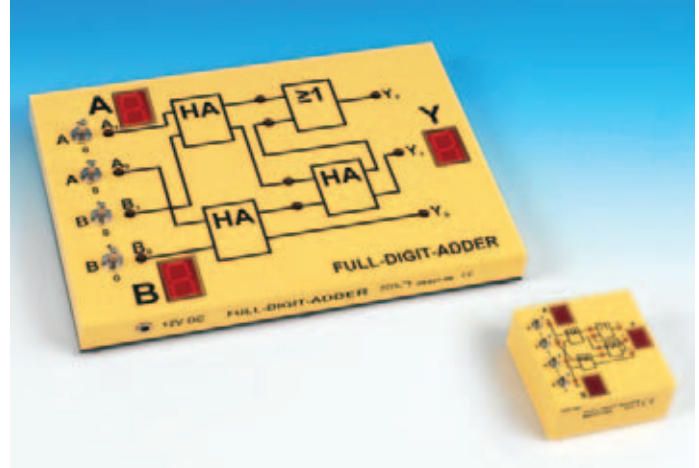


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DE941-4B MPL Full-adder
MB401-4B MBL Full-adder

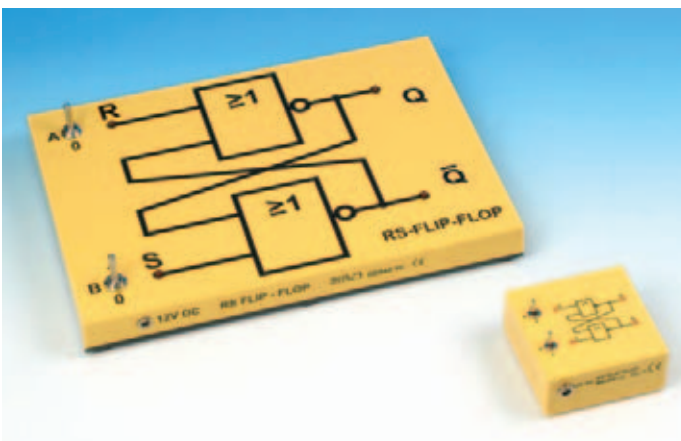
Combining two half adders with an OR gate allows the addition of three one-bit binary numbers. Three input toggles are available, while three intermediary values are displayed by LEDs. As with the half adder, two output displays show the sum and carry bit.



DE941-6B MPL Two-bit full adder
MB401-6B MBL Two-bit full adder

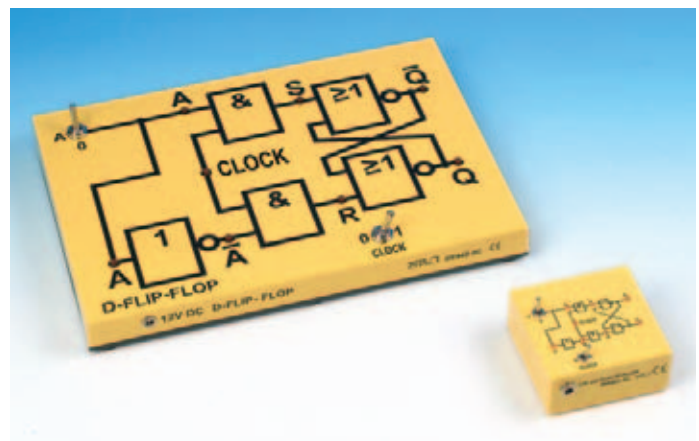
Allows the addition of two two-bit binary numbers. The equivalent decimal numbers are displayed by a separate 7-segment display (MPL: 26 mm; MBL 13 mm). Since numbers from 0 to 3 may be entered, the sum is always a number from 0 to 6, which is displayed by a 7-segment decimal display and, as a binary, by three LEDs. Four intermediate values are displayed by LEDs.

DYNAMIC FUNCTIONS



DE942-1C MPL RS-flip-flop
MB402-1C MBL RS-flip-flop

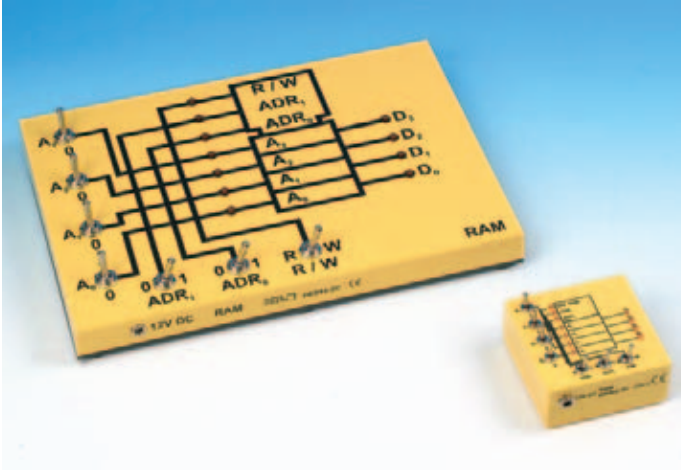
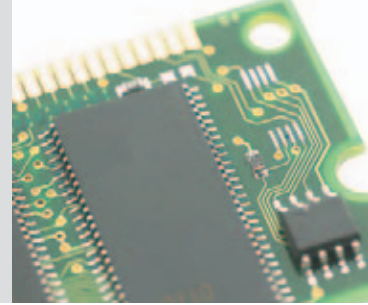
The simplest memory element, consisting of two NOR gates, with the output from the second feeding the first, and two inputs and outputs.



DE942-2C MPL D-flip-flop
MB402-2C MBL D-flip-flop

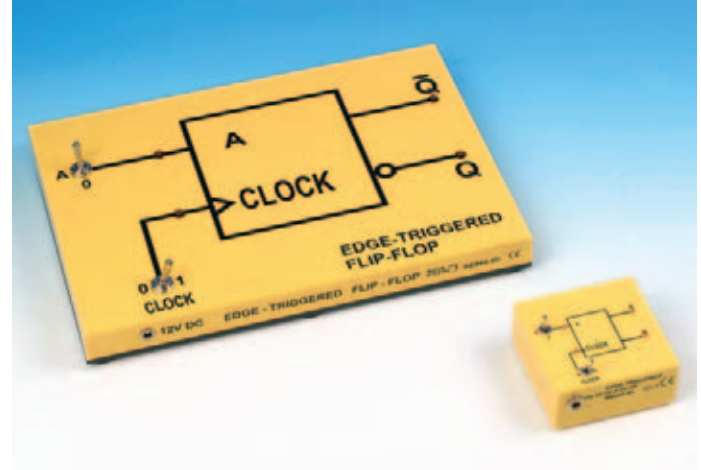
Here the RS flip flop has been expanded to include two AND gates controlled by a clock (thus also termed a transparent D flip-flop) Inverting the input signal serves as a substitute for a reset input switch. Intermediate values are displayed by LEDs.

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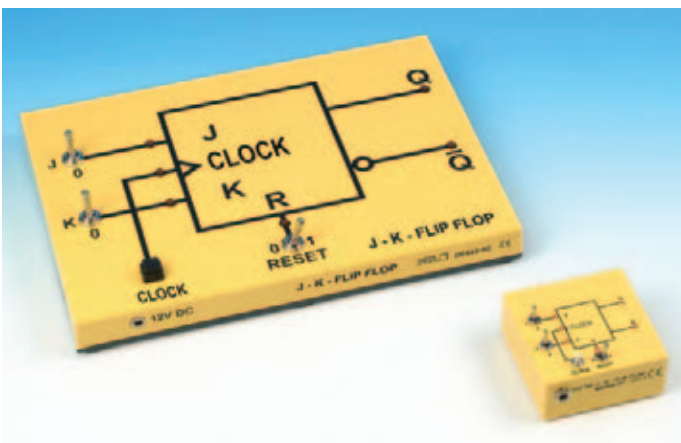
DE942-3C MPL RAM
MB402-3C MBL RAM

Made up of a number of D flip-flops. Used to demonstrate how a memory cell is addressed and a 4-bit value stored in it. Includes a double-throw switch for selecting read or write mode.



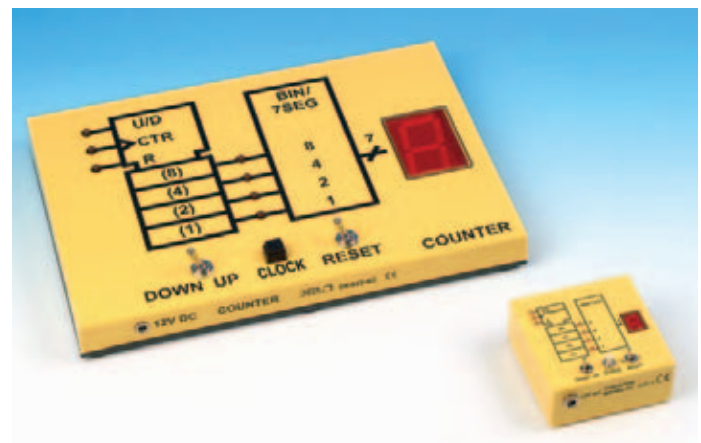
DE942-4C MPL Edge-triggered flip-flop
MB402-4C MBL Edge-triggered flip-flop

Memory module accepting data from input A only when the state of the clock input changes.



DE942-5C MPL JK-flip-flop
MB402-5C MBL JK-flip-flop

Also known as a master-slave flip-flop. The state of output Q only changes when the clock button is pushed. This module serves as the basis for a BCD (binary coded decimal) counter such as is used in counter modules DE942-6C and MB402-6C.



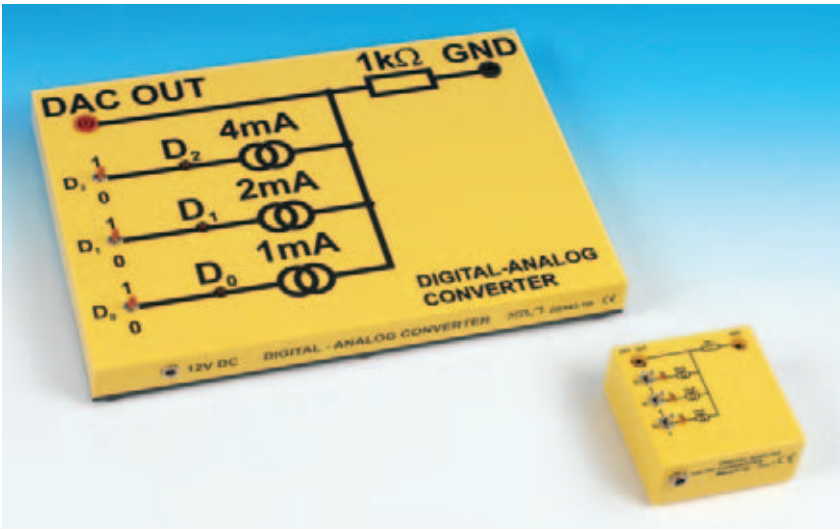
DE942-6C MPL Counter
MB402-6C MBL Counter

Reversible decade (BCD) counter. Numbers are represented as 4-bit binary numbers (by LEDs) and as decimal numbers by a 7-segment display. Counting impulse is triggered by a clock button.



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INTERFACE TO THE ANALOGUE WORLD: DAC AND ADC

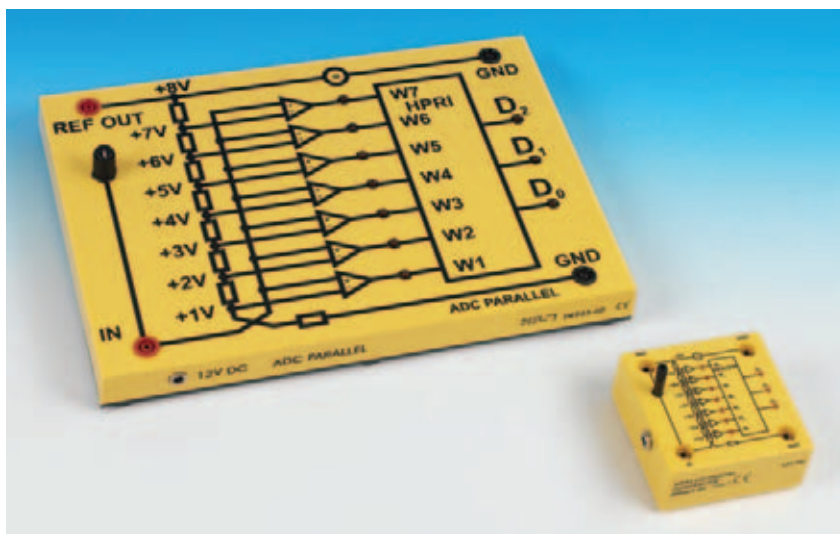


DE943-1D MPL DAC MB403-1D MBL DAC

Three-bit digital-analogue converter.

Digital input is made by means of three toggle switches.

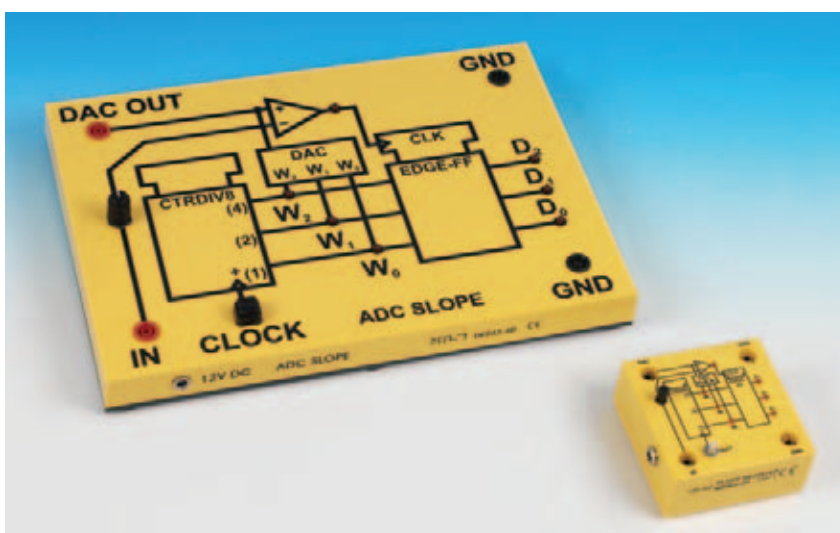
At the analogue output terminal, an equivalent DC voltage signal is emitted which may be displayed by using an analogue measuring instrument, such as MPL Voltmeter DE943-5D, with a range of 10 V DC.



DE943-2D MPL Parallel ADC MB403-2D MBL Parallel ADC

This three-bit, parallel analogue-digital converter converts analogue signals (i.e. electrical potential) into digital values.

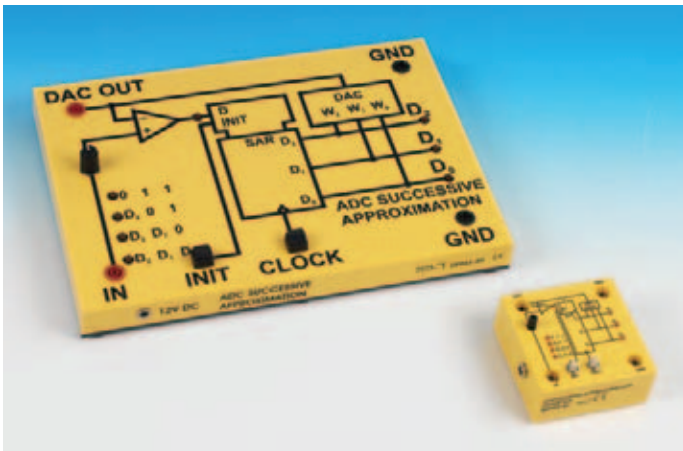
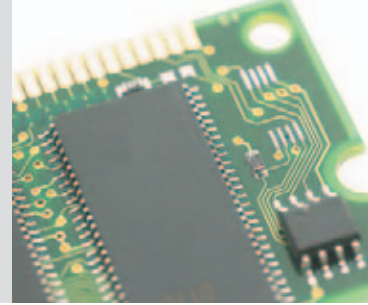
The input voltage, regulated by a potentiometer, is compared with eight reference voltage levels generated by a voltage divider. The output states of the seven comparators are displayed by LEDs. Input voltage and reference voltage (8 V) may be displayed using an external analogue measuring instrument, such as MPL Voltmeter DE943-5D, with a range of 10 V DC.



DE943-3D MPL Slope ADC MB403-3D MBL Slope ADC

This type of analogue-digital converter requires only one comparator for measuring voltage. In this case the reference voltage provided by the DAC is increased by increments using a clock button until it is higher than the applied voltage. The counter value then serves as the voltage level to be measured; a potentiometer is set to this level and the binary numeric equivalent is displayed by three LEDs. The comparator value is also displayed by an LED. Input voltage and reference voltage may be displayed using an external analogue measuring instrument, such as MPL Voltmeter DE943-5D, with a range of 10 V DC.

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DE943-4D MPL ADC Successive approximation
MB403-4D MBL ADC Successive approximation
 In this analogue-digital converter, the counter of the slope ADC is replaced by a successive approximation register (SAR). Measurement is done using nested intervals, simulated electronically, and allows AD conversion at a rate of one clock cycle per bit. The voltage to be applied is set using a potentiometer. Measurement begins when the INIT button is pushed, after which the clock button need only be pushed three times. The comparator value and the binary number corresponding to the value measured are displayed by LEDs. Input voltage and reference voltage may be displayed using an external analogue measuring instrument, such as MPL Voltmeter DE943-5D, with a range of 10 V DC.



DE943-5D MPL Voltmeter, 10 V/DC
 Remote-control measuring instrument, 10 V DC measuring range, accuracy class of 1.5. Two 4-mm input jacks; digits 26 mm tall
MB404-1M MBL Voltmeter, 10 V/DC
 Analogue measuring instrument, 10 V DC measuring range, accuracy class of 1.5. Two 4-mm input jacks; scale length: approx. 75 mm



P3130-1P Mains transformer 12V DC / 2A
 Output voltage: 12 V DC/24 VA supplied by 5.5-mm hollow DC plugs
 Voltage source: 100 ... 240 V AC/50...60 Hz
 Dimensions: 90x60x37 mm



P3210-1C Multimeter, analogue
 Moving coil instrument including overload protection
AC/DC voltage ranges: 100 mV ... 30 V along with 1-mV range for using the multimeter as a highly sensitive galvanometer
AC/DC current ranges:
 100 μ A ... 3 A and 10 A
 Powered by four AA batteries (supplied)
 Dimensions: approx. 120x160x50 mm



DE710-00 Universal multimeter "inno", magnetic
 Durable remote-control measuring instrument with three insertable double scales
 Arc length of scale: approx. 200 mm
 Digit height: 26 mm
 LED display indicates measuring units and type of current
Measuring ranges: 1 mV, 1 ... 30 V (DC), 1 V ... 30 V (AC)
DC A/AC A: 100 μ A ... 10 A
 Dimensions: approx. 260x230x60 mm
 Weight: approx. 2.7 kg



compact system logic

Experiments on the topic of: LOGIC

DE949-1S Experiment manual "Logic", b/w booklet
DE949-1C Experiment manual "Logic", CD-ROM

MPL Number systems DE940-0A (4 experiments):
 EIC 0.01 Decimal number system
 EIC 0.02 Binary number system
 EIC 0.03 Hexadecimal number system
 EIC 0.04 Converting between number systems

MPL COMBO DE945-1E (30 experiments)

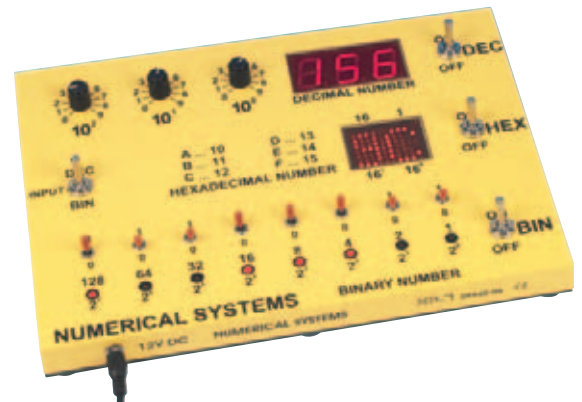
- EIC 1.1.01 NOT-gate
- EIC 1.1.02 AND-gate
- EIC 1.1.03 OR gate
- EIC 1.1.04 NAND gate
- EIC 1.1.05 NAND gate from AND and NOT gates
- EIC 1.1.06 NOR gate
- EIC 1.1.07 NOR gate from OR and NOT gates
- EIC 1.1.08 EXOR gate
- EIC 1.1.09 EXOR gate 1 (with AND gate)
- EIC 1.1.10 EXOR gate 2 (with OR gate)
- EIC 1.1.11 NOT gate from NAND gates
- EIC 1.1.12 AND gate from NAND gates
- EIC 1.1.13 OR gate from NAND gates
- EIC 1.1.14 NOT gate from NOR gates
- EIC 1.1.15 AND gate from NOR gates
- EIC 1.1.16 OR gate from NOR gates
- EIC 1.1.17 De Morgan 1 (NAND)
- EIC 1.1.18 De Morgan 2 (NOR)
- EIC 1.1.19 RS flip-flop from 2 NAND gates
- EIC 1.1.20 RS flip-flop from 2 NOR gates
- EIC 1.1.21 RS flip-flop (NAND) with a switch and cycle
- EIC 1.1.22 RS flip-flop (NOR) with a switch and cycle
- EIC 1.1.23 D flip-flop from NAND gates
- EIC 1.1.24 D flip-flop from NOR gates
- EIC 1.1.25 Half adder 1
- EIC 1.1.26 Half adder 2
- EIC 1.1.27 Half adder with EXOR gate
- EIC 1.1.28 Full adder
- EIC 1.1.29 Coder circuit (decimal - binary)
- EIC 1.1.30 Decoder circuit (binary - decimal)

MPL CONTROLLING DE945-2E (12 experiments)

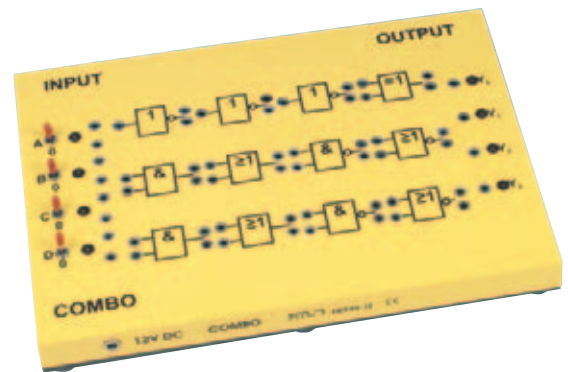
- EIC 1.2.01 Door control
- EIC 1.2.02 Motor control
- EIC 1.2.03 Light control
- EIC 1.2.04 Double security circuit
- EIC 1.2.05 Heating control
- EIC 1.2.06 Thermal protection
- EIC 1.2.07 Fire detector
- EIC 1.2.08 Air conditioning control
- EIC 1.2.09 Alarm system 1
- EIC 1.2.10 Alarm system 2
- EIC 1.2.11 Washing machine control
- EIC 1.2.12 Refrigerator

IC 7400 (4 NANDs) DE943-4E (6 experiments):

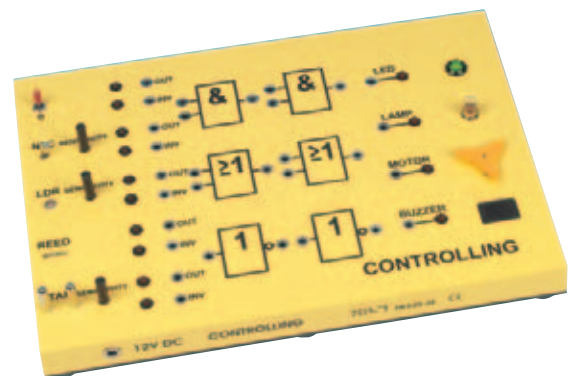
- EIC 1.3.01 AND from 2 NANDs
- EIC 1.3.02 NOT from 2 NANDs
- EIC 1.3.03 NOR from 3 NANDs
- EIC 1.3.04 OR from 3 NANDs
- EIC 1.3.05 Fire detector (AND from 2 NANDs)
- EIC 1.3.06 Light control (OR from 3 NANDs)



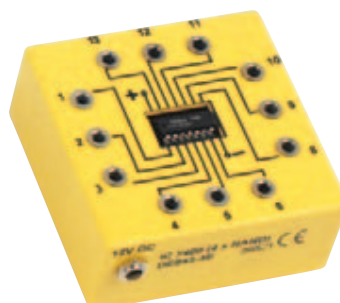
DE940-0A MPL Number systems



DE945-1E MPL COMBO

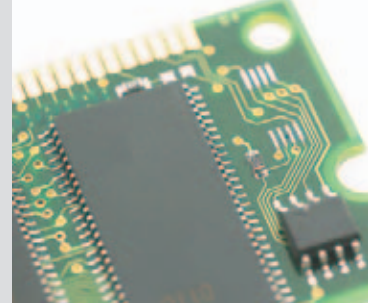


MPL CONTROLLING DE945-2E



IC 7400 (4 x NANDs) DE943-4E

compact system logic



Simple and complex gate functions (12 experiments):

- EIC 2.01 INVERTER (NOT gate)
- EIC 2.02 AND gate
- EIC 2.03 OR gate
- EIC 2.04 NAND gate
- EIC 2.05 NOR gate
- EIC 2.06 EXOR gate
- EIC 2.07 De Morgan 1
- EIC 2.08 De Morgan 2
- EIC 2.09 Multiplexer
- EIC 2.10 Half adder
- EIC 2.11 Full adder
- EIC 2.12 Two-bit full adder

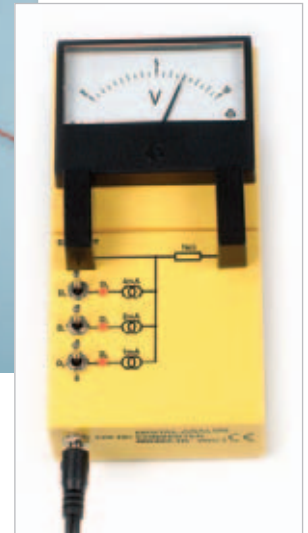
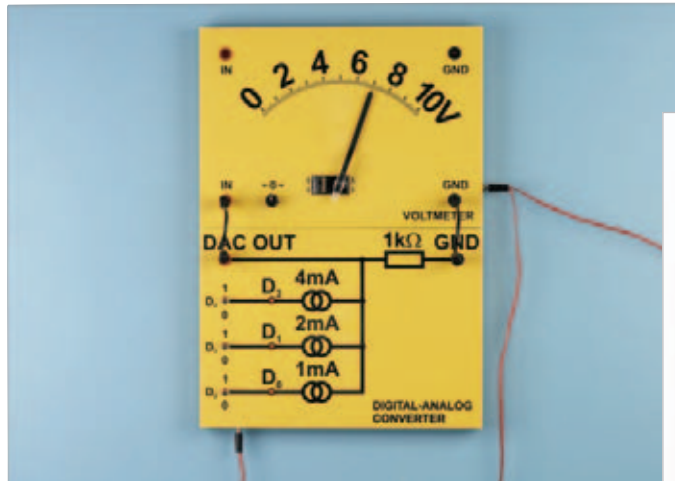
Dynamic functions (6 experiments):

- EIC 3.01 RS flip-flop
- EIC 3.02 D flip-flop
- EIC 3.03 RAM
- EIC 3.04 Edge-triggered flip-flop
- EIC 3.05 JK flip-flop
- EIC 3.06 Counter

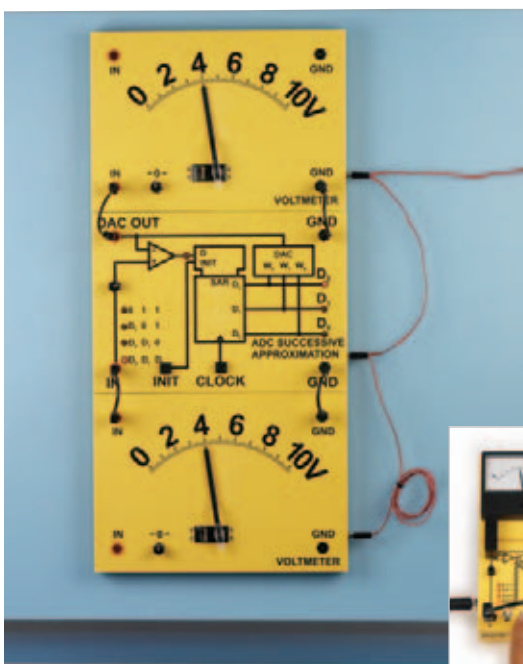
Interface to the analogue world (4 experiments):

- EIC 4.01 DAC
- EIC 4.02 Parallel ADC
- EIC 4.03 Slope ADC
- EIC 4.04 Successive approximation ADC

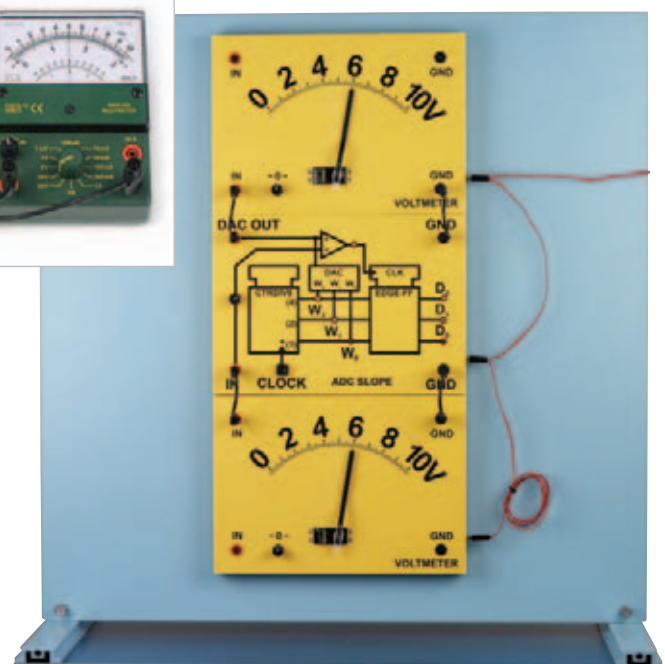
Experiment: DA converter - as a demo and a student experiment



Note: Our "inno" measuring instruments (e.g. DE710-00) may be used if available



Experiment: Slope ADC - as a demo and a student experiment



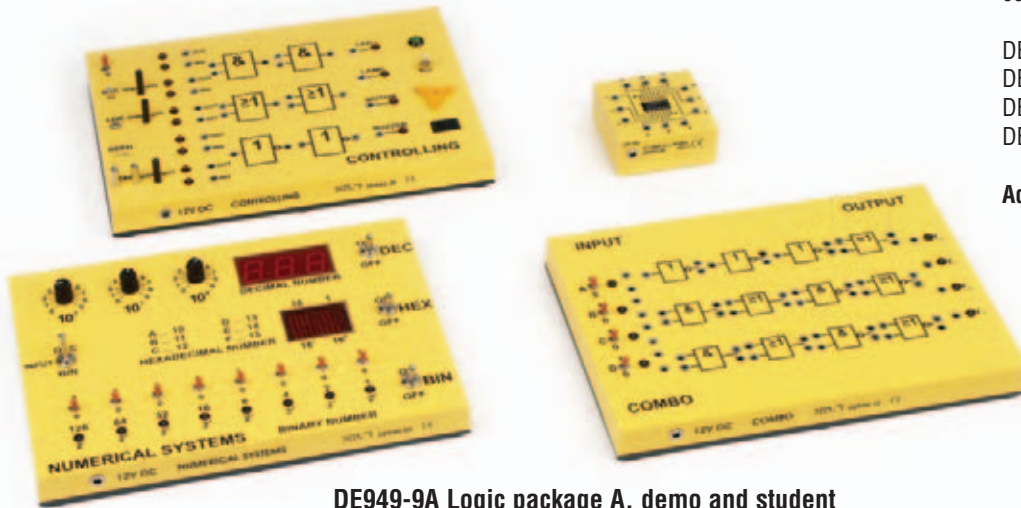
Experiment: Successive approximation ADC - as a demo and a student experiment



compact system logic

UNIVERSAL LOGIC SYSTEM

An introductory package with the most devices from each area



DE949-9A Logic package A, demo and student

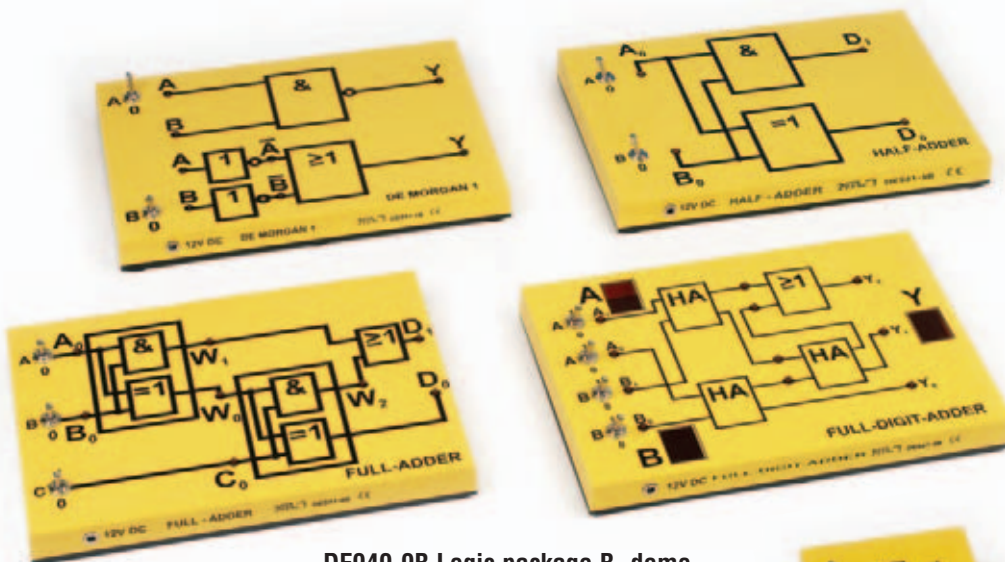
DE949-9A Logic package A

consisting of:

- DE940-0A Number systems
- DE945-1E Combo
- DE945-2E Controlling
- DE943-4E IC 7400 (4 NANDs)

Additionally required:

- 2x P3310-2S Connecting leads, 25 cm, black, set of 6
- 1x P3410-1K Round bar magnet, 10x50 mm
- 1x P3320-1I Light bulb, 10 V/50 mA, E10
- P3130-1P Mains transformer 12V DC / 2A
- DP130-4A Junction cable, 4 DC plugs



DE949-9B Logic package B, demo

DE949-9B

Logic package B
consisting of:

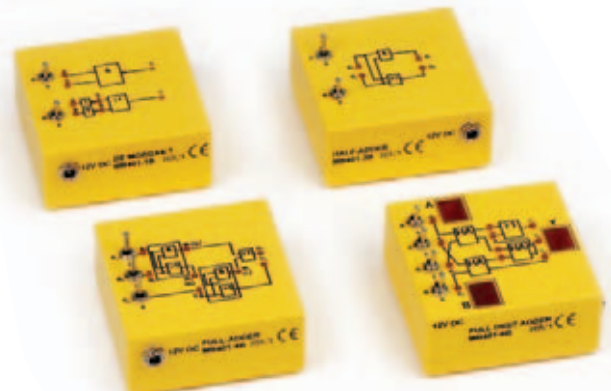
- DE941-1B De Morgan 1
- DE941-3B Half-adder
- DE941-4B Full-adder
- DE941-6B Two-bit full adder

MB409-9B

- MB401-1B
- MB401-3B
- MB401-4B
- MB401-6B

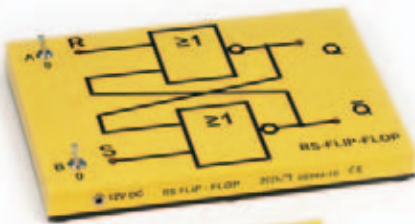
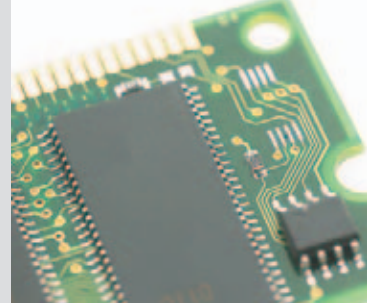
Additionally required:

- P3130-1P Mains transformer 12V DC / 2A



MB409-9B Logic package B, student

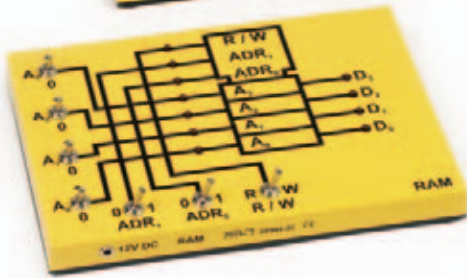
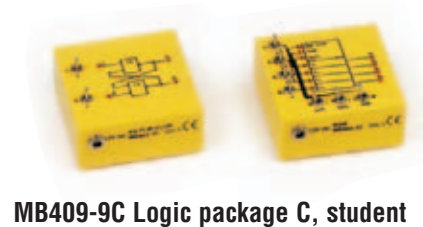
compact system logic



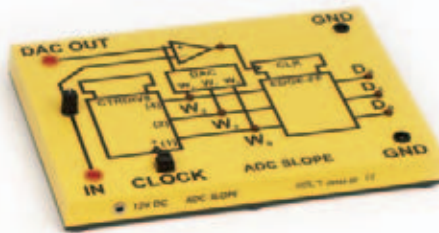
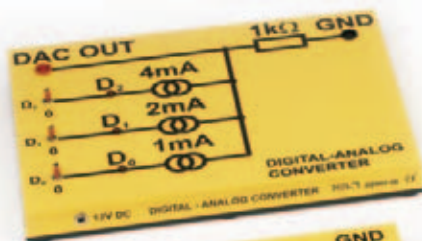
DE949-9C Logic package C **MB409-9C**
consisting of:

DE942-1C RS-flip-flop MB402-1C
DE942-3C RAM MB402-3C

Additionally required:
P3130-1P Mains transformer 12V DC / 2A



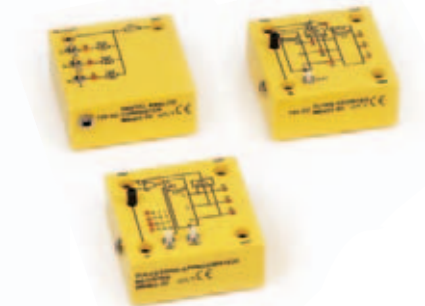
DE949-9C Logic package C, demo



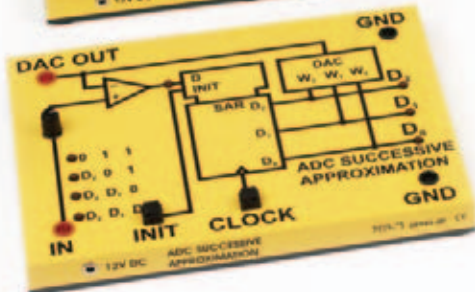
DE949-9D Logic package D **MB409-9D**
consisting of:

DE943-1D DAC MB403-1D
DE943-3D Slope ADC MB403-3D
DE943-4D Successive approximation ADC MB403-4D

Additionally required:
P3310-2S Connecting leads, 25 cm, black, set of 6
P3130-1P Mains transformer 12V DC / 2A
DP130-4A Junction cable, 4 DC plugs
2 Voltmeters, 10 V DC (e.g. DE943-5D or MB404-1M)



MB409-9D Logic package D, student



DE949-9D Logic package D, demo



P3130-1P Mains transformer
12V DC / 2A

Output voltage: 12 V DC/24 VA supplied by 5.5-mm hollow DC plugs
Voltage source: 100 ...240 V AC/50...60 Hz
Dimensions: 90x60x37 mm



Accessories for the universal LOGIC system:

DE943-5D MPL Voltmeter, 10 V DC

MB404-1M MBL Voltmeter, 10 V DC