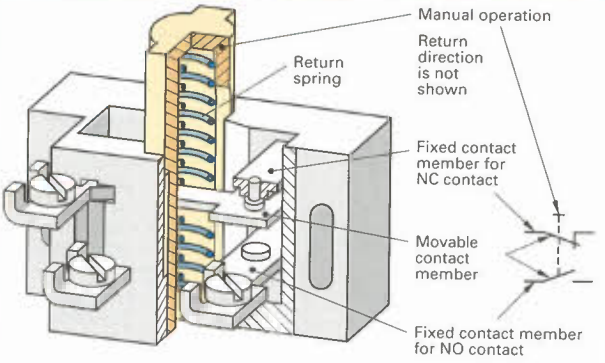
Circuit Symbols



Push-button switch, structure and circuit symbols

Electrical equipment, such as devices, machines, components and lines, is represented in circuit diagrams by graphical **circuit symbols**. These symbols show the effect of a component, but they do not reveal its structure.

Circuit symbol elements are circuit symbols for parts of components, e.g. lines.

Circuit symbols for complete components, e.g. switches, are very often composed of several circuit symbol elements.

There are simplified circuit symbols for particular types of diagrams (special circuit symbols, simplified circuit symbols).

General circuit symbols

cf. EN 60617-4 (1997-08)

Circuit symbol	Description	Circuit symbol	Description	Circuit symbol	Description
	Conductor, in general		Fuse, in general		Mechanical connection (alternative symbols)
	1. Connection, in general 2. Terminal, e.g. clamp 3. Symbol for gas filling		Resistor, in general		Limitation, in general
	Terminal, e.g. disconnectable clamp		Heating element		Shielding
1. 2.	Single conductor tap		Resistor, variable		Bordering line, separating line
1. 2.	Double conductor tap		Active resistance with tap		Lamp outlet
	Conductor crossing		Indicator light		Signal light, lamp, in general
	Socket, in general		Inductance, coil, phase coil		Ringer, bell in general
	1. Measuring instrument or device 2. Measuring system 3. Stator 4. Rotor 5. Sleeve, housing		As above, non-standard	Wh	kWh-meter, in general
	Movable contact members		Choke with tap		Capacitor
	Manual drive (optional symbols)		Choke with iron core		Galvanic cell (long dash: positive pole, short dash: negative pole)
	Normally open contact, manually actuated		As above, with air gap		Semiconductor diode
	Normally closed contact, manually actuated		Transformer for single-phase A.C., impedance transformer		Luminescence diode, LED
			Permanent magnet	12 V	Accumulator battery 12 V
			Surge arrester	12 V − +	(Optional symbols)

General Circuit Symbols

Circuit symbol	Description	Circuit symbol	Description	Circuit symbol	Description
General circuit symbols					cf. EN 60617-2 (1997-08)
	Variability, in general	Shape 1 / Shape 2	Resistor with movable contact as potentiometer		Polarised capacitor, e.g. electrolyte capacitor
	Adjustability, in general				Unpolarised electrolyte capacitor (only if required)
Types of variability or adjustability					
	Continuously	ϑ	PTC-resistor		Earthing, grounding
	Stepwise	ϑ	NTC-resistor		Body, mass (alternative symbols)
	Under the influence of a physical quantity, linear	V	Resistor, voltage-dependent (reverse)	a) b)	Protective conductor terminal (standard-dependent)
	As above, non-linear		**Inductance** continuously variable		Ideal voltage generator (voltage source)
Examples					Ideal current generator (current source)
	Resistance variable		**Capacitor** adjustable		
	Adjustable as voltage divider				
Circuit symbols for switching equipment					cf. EN 60617-7 (1997-08)
a) b) c)	Extended contact making: a) NO contact b) NC contact c) single pole double throw		Symbol for "held open or held closed"		SPDT single pole double throw w/o break
	Contact pin		Forced actuation, e.g. EMERGENCY OFF	a) b)	Maintained contact, single break a) normally open b) normally closed
	Receptacle	S	selective (delayed) acting	a) b)	a) Twin break contact NO b) Twin break contact NC
Symbol		**Examples**		a) b)	Contact action retarded after coil: a) de-energized NOTO b) energized NOTC
	Automatic return (only if required)		NC contact, stop element	a) b)	Wiper, contact making when a) energised b) reverting
	Non-automatic return (only if required)		Single pole double throw SPDT	a) b)	Limit switch a) NO contact b) NC contact
a) b)	Delay a) to the left b) to the right		Two-way NO contact		
	Mechanical locking	1 2	Double contact elements: NO contact 1 closes before 2		
a) b)	If required: a) contactor function b) trigger function				

NO normally open, NC normally closed, NOTO normally open, timed open, NOTC normally open, timed closed

Additional Circuit Symbols, Switches in Energy Plants

Drives

Circuit symbol	Description
	Manual drive, in general
	As above, by pushing
	As above, by pulling
	As above, by turning
	As above, by tilting
	As above, removable, e.g. socket spanner
	Other drive, e.g. foot pedal
	Drive for EMERGENCY-OFF switch
	Actuation through proximity
	Actuation through contact
	Electromagnetic drive with deferred acceleration
	As above, with deferred deceleration
	Drive for surge relay
	Thermal actuation, e.g. of a motor protection relay
	As above, of a three-phase device
	Electromagnetic actuation, e.g. for overcurrent protection (not very common)

Electronic switches

Circuit symbol	Description
	a) Electronic switch b) Electronic contactor
	Semiconductor contactor

Disconnectors, load break switches and circuit breakers

Circuit symbol	Description
	a) Disconnector, isolator b) Load-break switch
	Circuit breaker
	Load-break switch with automatic actuation, e.g. by a measuring relay
	NO contact of a contactor (only if required for distinction)

Temperature-sensitive switches

Circuit symbol	Description
	a) Thermal contact, e.g. with bimetallic release b) NO contact of motor protection relay
	Gas-filled starter for fluorescent lamp with thermal contact

Position indication

Circuit symbol	Description
	In general, e.g. with numbering (position 2 is the basic position)
	As above (optional symbol)

Blocking and locking

Circuit symbol	Description
	Switch lock with mechanical release
	As above, with electromagnetic release
	PB-maintained contact switch
	Blocking, in one direction
	As above, in both directions

Fuses

Circuit symbol	Description
	Fuse with marking of the mains connection
	Fuse disconnector

Shut-off devices (valves)

Circuit symbol	Description
	Shut-off device, in general, e.g. closed
	Shut-off device, open

Clutches, brakes

Circuit symbol	Description
	Clutch, disengaged
	As above, engaged
	Brake, applied
	Brake, released (vented)

Examples

Circuit symbol	Description
	Manual drive with 4 positions (2 and 3 are locking positions)
	Valve with sensor and cam drive
	Centrifugal clutch, engages at speeds > *n*
	Thermally actuated PB-maintained NC contact of a motor protection relay
	NC contact of a proximity switch actuated by a permanent magnet

Measuring Instruments and Devices cf. EN 60617-8 (1997-08)

Circuit symbol	Description
	Measuring instrument or device, indicating
	Measuring device in general, recording in particular
	Integrating measuring device, counter in particular
	Signal transducer, in general
	Measuring device with path
	Measuring device with tap
	Measuring device with sum and difference computation
	Measuring device with product computation
	Measuring device with quotient computation

Symbol

	Display, in general
	Display with pointer deflecting to both sides
	Indication by vibration
000	Digital display (numerical)
	Recording logger
	Short response delay
	Long response delay
	Pulse counter

Circuit symbol	Description
	Max. value indication
	Min. value indication
	Sense of the rotating field
	Direction of measuring value transmission
	Contact making
	Clock

Examples

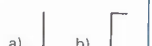
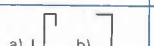
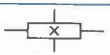
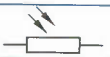
	Measuring instrument w/o identification of the measured quantity
	Measuring instrument with deflection to both sides
A	Ammeter, in general
V	Voltmeter, in general
V	Voltmeter shown with interior wiring
mV	Voltmeter with unit indication in millivolt
	Pulse counter, electric actuation
V-A-Ω	Multiplex instrument with unit indication
	Zero indicator for A.C. current
	Synchronoscope (synchronous indication)
	Slow-response ammeter with stay-set indication of max. value

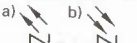
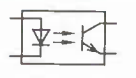
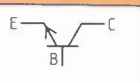
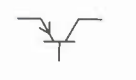
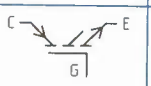
Circuit symbol	Description
W-var	Dual-line recorder for active and reactive power
kWh	Three-conductor three-phase meter
Ω	Resistance measuring bridge
	Measuring device displaying curves, oscilloscope

Measuring transducer

	Resistance position indicator, in general
Δl	Strain gauge
	Thermocouple, in general
	As above, thick line = negative pole
	Galvanic measuring cell, e.g. pH-electrode
	Conductivity electrodes
	Magnetic transmitter with movable coil
	Inductive transmitter with variable coupling, in general
	Capacitive transmitter
	Angle position transmitter and receiver

Semiconductor Components cf. EN 60617-5 (1997-08)

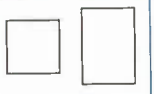
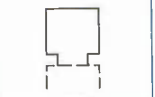
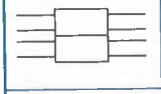
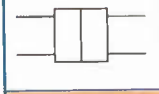
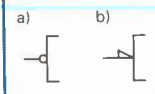
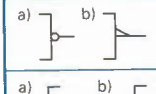
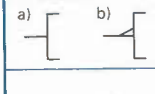
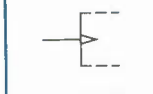
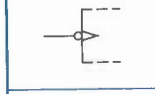
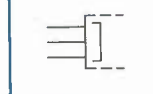
Circuit symbol	Description
General structural elements	
	Framing (only if required)
	Semiconductor zone with terminals w/o rectifying effect
	P-region affects n-zone
	N-region affects p-zone
	Semiconductor diode
Symbol	
	Breakdown effect, a) in one direction b) in both directions
	a) Schottky effect b) Tunnel effect
	Radiation a) light b) ionising
Semiconductors w/o rectifying effect	
	Magnetoresistor (flux density-controlled resistor)
	Hall-effect generator
	Photoresistor
	Peltier element
Diodes	
	Diode, temperature-sensitive
	Flux density-sensitive (magnetic diode)
	Tunnel diode
	Capacitance diode
	Schottky diode

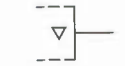
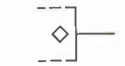
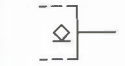
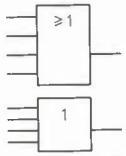
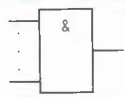
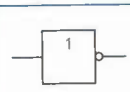
Circuit symbol	Description
	Zener diode
	Zener diodes, connected in inverse
	a) Luminescence diode (LED) b) Photodiode
	Radiation detector, e.g. for g-rays
	Photovoltaic cell
	Optocoupler, here with LED and photo-transistor
Bipolar transistors	
	n-p-n transistor (E, C, B only for explanation)
	p-n-p transistor
	Schottky transistor
	UJT with n-base (double-base transistor)
	p-n-p phototransistor
	IGBT, enhancement mode with n-channel
	IGBT, depletion mode with n-channel (C, E, G only for explanation)
Unipolar transistor	
	Normally off-channel (enhancement mode)
	Insulated gate (IG)
	JFET with n-channel (terminal indications only for explanation)

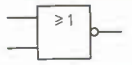
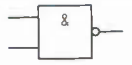
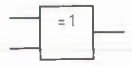
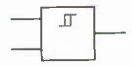
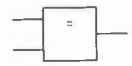
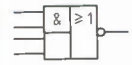
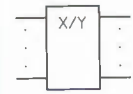
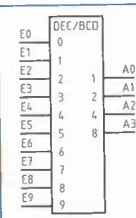
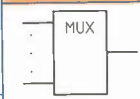
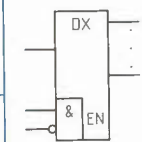
Circuit symbol	Description
	JFET with p-channel
	Depletion mode IGFET with n-channel, substrate internally linked to the source
	Enhancement mode IGFET with p-channel and substrate terminal
	Dual-gate depletion mode IGFET with n-channel and substrate connection
Thyristors	
	Thyristor, in general
	p-gate thyristor (most common type)
	n-gate thyristor
	GTO thyristor, turn-off type
	Thyristor tetrode
	Reverse-conducting p-gate-thyristor
	Voltage-controlled thyristor
	Reverse-blocking thyristor diode (four-layer diode)
	Diac
	Triac (two-directional thyristor triode)
	Ditriac

TM

Binary Elements 1 cf. EN 60617-12 (1999-04)

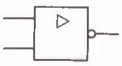
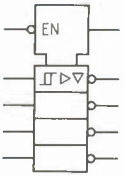
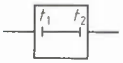
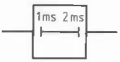
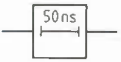
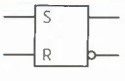
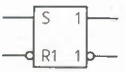
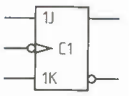
Circuit symbol	Description
Outlines (basic shapes)	
	Element outlines (arbitrary side proportions)
	Control block outline
	Output block outline
	Two assemblies w/o logic connection (extensible)
	Two assemblies with logic connection (extensible)
Inputs, outputs, connections	
	Inverting input
	Inverted output
	Non-inverting input
	Dynamic input, non-inverted
	As above, however inverted
	Delayed (deferred) output
	Collection (of all connections), only if necessary
	Linking w/o binary signal

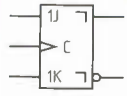
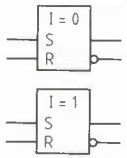
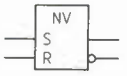
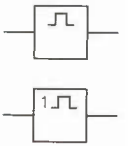
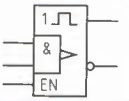
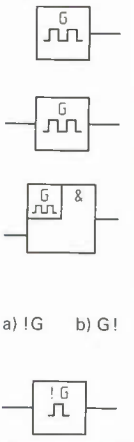
Circuit symbol	Description
	Three-state output, (H or L or high-impedance)
	Open output
	Open output of the L-type (e.g. open collector of n-p-n transistor)
Symbol	
&	AND
≥ 1	OR
1	OR, if unmistakable
E	Extension
EN	Enable
D, J, K, R, S, T	Type of input
→	Shifting input, forward
←	As above, however reverse
+	Counting input, forward
−	As above, however reverse
C	Control, clock input
CT	Contents, counter reading
I	Input
O, Q	Output
M	Mode
G, V	AND, OR
A	Addresses
Combinational elements	
	OR elements with 4 inputs Optionally, if there is no risk of confusion.
	AND element
	NOT element, inverter

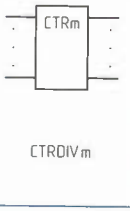
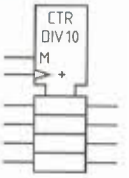
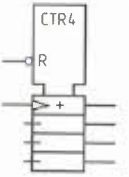
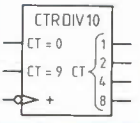
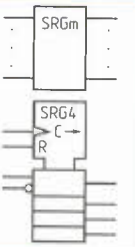
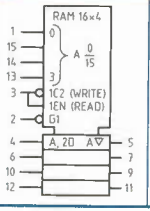
Circuit symbol	Description
	NOR element
	NAND element
	XOR element, exclusive OR element (anticoincidence)
	Schmitt trigger (threshold element)
	ExNOR element, exclusive NOR element (equivalence)
	AND-OR inverter
Code converter	
	Code converter, in general X and Y can be replaced by codes.
	Code converter, decimal BCD code. A0 and A1 assume state 1 if E3 assumes state 1.
Multiplexer, demultiplexer, converter	
	Multiplexer, in general
	Demultiplexer, with release logic

DAC and ADC, see pages 88 and 89.

Binary Elements 2 cf. EN 60617-12 (1999-04)

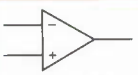
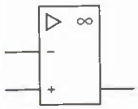
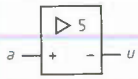
Circuit symbol	Description
Power elements	
	Driver with inverted output
	As above (alternative symbol)
	Bus driver with 4 threshold inputs, enable circuit and inverted three-state outputs
Delay elements	
	Delay, in general t_1 and t_2 can be replaced by quantity specifications inside or outside the box.
	Switch-on delay of 1 ms Switch-off delay of 2 ms
	Delay of 50 ns
Bistable elements	
	RS flip-flop As above, however with dominant S input As above, however with dominant R input
	$\overline{R}S$ flip-flop, dominant $\overline{R}$ input
	Edge-triggered JK flip-flop (npe negative pulse edge)

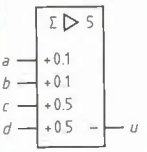
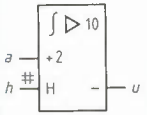
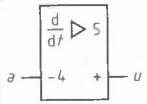
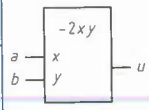
Circuit symbol	Description
	Dual edge-triggered JK flip-flop (master-slave flip-flop) As above, however with additional $\overline{S}$ input and $\overline{R}$ input
	RS flip-flop, initial state 0 when switched on As above, however initial state 1
	RS flip-flop, retentive
Monostable elements	
	Mono-flop, retriggerable, in general As above, however not retriggerable
	Mono-flop, AND inputs and release input, 2 outputs
Astable elements	
	Astable element, in general As above, but controlled Optional symbol Identification for pulse generator a) synchronous start-up b) stop after the last impulse

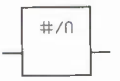
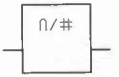
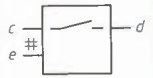
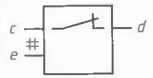
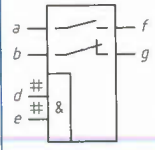
Circuit symbol	Description
Meters	
	Meter with 2^m cycle length, e.g. CTR4 for 4-bit counter Identifies counters with cycle lengths m, e.g. CTRDIV 10 decade counter
	Synchronous counter 0 up to 9 with parallel charging
	Asynchronous counter for 4 bits with identification of the asynchronous process (only if required)
	Decade counter CT numbers: Counter reading for the internal 1 of the connection
Shift register	
	Shift register with m stages, e.g. SRG8 4-bits shift register with serial input and parallel output
Memories	
	Random access memory (ROM) 16 x 4 bits, three-state-outputs

TM

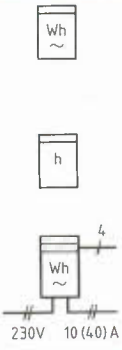
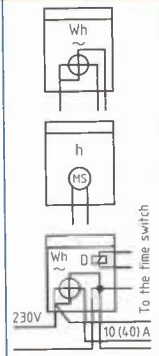
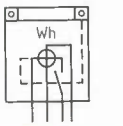
Analog Information Processing, Meters and Tariff Switchgears

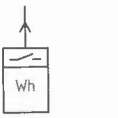
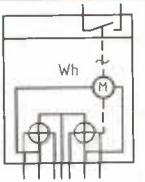
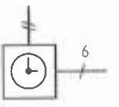
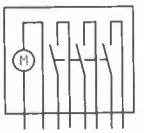
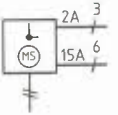
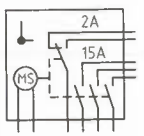
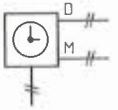
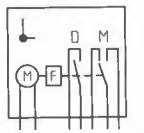
Symbol	Description
Identification signs cf. EN 60617-13	
–	Inverting
+	Non-inverting
∩	Analog signal
#	Digital signal
Σ	Summation
∫	Integrating
R	Reset
S	Set
H	Hold
$\frac{d}{dt}$	Building the derivative
Examples	
	Operation amplifier, blank, common symbol in practice
	As above, standard symbol
	Inverting amplifier $u = -5 \cdot a$

Symbol	Description
	Summation amplifier $u = -5 \cdot (0.1\ a + 0.1\ b + 0.5\ c + 0.5\ d)$ $V = 5$
	Integrating amplifier If $h = 0$ $u = -10 \int_0^t 2\ a\ dt$
	Differentiating amplifier $u = 5 \frac{d}{dt} (-4\ a)$
	Multiplier $u = -2\ ab$

Symbol	Description
	Digital/analog converter (D/A converter, DAC)
	Analog/digital converter (A/D converter, ADC)
	Normally open contact (closed as long as $e = 1$)
	Normally closed contact (open as long as $e = 1$)
	NO and NC contact (switch when $d = 1$ and $e = 1$, that is $d \wedge e = 1$)

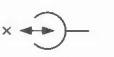
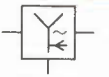
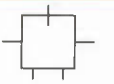
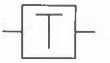
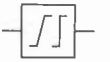
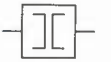
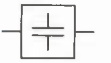
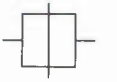
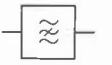
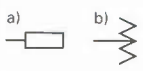
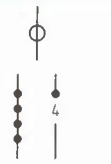
Meters and tariff switchgears

Shape 1	Shape 2	Description
		Single-phase A.C. meter Time meter with synchronous motor Single-phase A.C. dual-tariff meter
		Four-wire three-phase current reactive power meter, only reference counting
		Prepayment meter with power meter and coin counter

Shape 1	Shape 2	Description
		Encoder meter with 1 pulse per 0.1 kWh
		Tariff switchgear, e.g. for ripple control system
		Timer with synchronous operation
		Tariff time switch with self-winding clockwork D Dual-tariff switch M Maximum switch

Electroacoustic Converters and Aerial Systems

TM

Circuit symbol	Description	Circuit symbol	Description	Circuit symbol	Description
Electroacoustic converters					
	Microphone, in general		Transducer head, in general		Recording head for 1 channel
	Receiver, in general		Transducer head, simplified		As above, simplified
	Loudspeaker, in general		Erase head		Read/write/erase head
	Intercom system		Playback head, light-sensitive		As above, simplified
Aerial systems					RGA
	Aerial, in general		Feed combiner		Quad distributor
	Dipole aerial		Fixed attenuator		Optional symbol
	Folded dipole in general		Equaliser		Single tap
	LMS aerial incl. transmitter		Transmitter		Optional symbols
	LMSU aerial incl. transmitter		Separative element		Dual tap
	Dipole aerial incl. transmitter		Rejection circuit, band-stop filter, channel stop, carrier frequency trap		Optional symbols
	Parabolic aerial (dish)				
	Power supply unit		Low-pass		Line termination, adapted
	Optional symbol		High-pass		Aerial receptacle (not suitable for installation diagram)
	Earth bar		Band-pass		Optional symbols, e.g. for 4 receptacles
	Modulator to channel ...		Double distributor		Aerial receptacle with termination resistor
	Combiner, in general		Optional symbol		Optional symbol

The German Directives on Design, Structure, Acceptance and Operation of Collective Aerials (RGA) have been established by the Arbeitskreis Rundfunk-Empfangsantennen (working group broadcasting aerials). In addition, circuit symbols for overview diagrams, e.g. for amplifiers, are used.

Circuit Symbols for Installation Circuit Diagrams and Installation Diagrams 1

Circuit symbol	Description
	Line, a) in general, b) power line, c) installed line
	As above, movable
	Underground, buried cable
	Overhead line
	Surface-mounted
	In plaster
	Flush-mounted
	Insulated in pipe
	Underwater conductor, submarine cable
	Ascending line
	Descending line
	Ascending and descending line
	Junction box for radio and broadcasting television
	Socket, in general
	Connecting socket
IP44	Power service box, protection IP 44
	Distribution
IP42	Switch, e.g. three-pole, protection IP 42
	Circuit breaker
m	Motor protection switch, motor starter
	RCD, ELCB, GFCI fault current circuit breaker
	Star-delta switch

Circuit symbol	Description
	Protective earth conductor PE
	Neutral conductor N
	PEN conductor
	As above, with vertical lines
	Common in practice for PE and PEN
	Telephone line
	Broadcasting line
	Line to be installed subsequently
	Optical fibre line
a) b) c)	Cut-off switch a) single-pole b) double-pole c) three-pole
	Dimmer (cut-off switch)
	Sensor switch (cut-off switch)
	Group switch, single-pole
	Double pole double throw DPDT
	Three-way switch with illumination
	Four-way switch
	Push-button
	Illuminated push-button
PIR	Motion sensor (passive infrared)
a) b)	Single outlet a) without, b) with earthing contact
	Double outlet

Circuit symbol	Description
3	Multi-outlet, e.g. 3 outlets
3, N, PE	Three-phase outlet with earthing contact
	Shielded line
	Shielded coaxial line
	Line with two conductors
	Collection of lines
5	As above, simplified representation
	Switch outlet
	Lock or key-lock outlet
	Outlet with insulated transformer, e.g. for shaver
35 A	Meter with circuit breaker 35 A
	Time switch, e.g. for current tariff changeover
t	Time relay, e.g. automatic staircase lighting switch
	Latching relay
	Luminaire outlet, in general
	Lamp, in general
	Fixture for fluorescent lamp
	As above for 2 lamps
	Flood light, in general
	Spot light
	Emergency luminaire in standby mode

Circuit Symbols for Installation Circuit Diagrams and Installation Diagrams 2

Circuit symbol	Description
5 × 36 W	Luminous row, e.g. with five 36-W lamps
10 × 5 × 36 W	Luminous field, e.g. with 10 x 5 36-W lamps
Electrical household appliances	
E	Electrical appliance, in general
E	Electrical appliance, switchable
	Food processor
	Electric cooker, in general
	Microwave cooker
	Oven
	Warming plate
	Infrared grill
	Domestic hot water storage tank
	Water heater
	Washing machine
	Dryer
	Dish washer
*	Refrigerator
**	Deep freezer
***	Freezer
*	Air conditioner

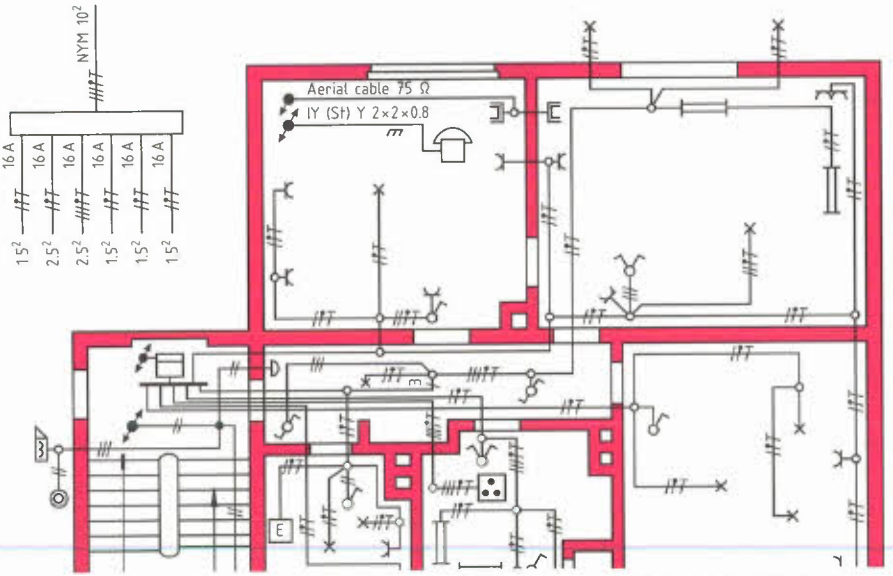
Circuit symbol	Description
Heating, ventilation, motor	
	Room heating, in general
	Storage heater, in general
	Infrared radiator
M	Motor, in general
	Fan, compressor
Signalling and telecommunication devices	
	Telecommunication socket
	Aerial socket
Distributor	
MDF	Main distributing frame MDF
DF	Surface-mounted distributing frame
Telecommunication devices	
	In general
	Coupling stage, in general
	Selection stage, in general
	Automatic call unit
	Manual exchange
Remote-control devices	
	Remote-control transmitter, in general
	Remote-control centre, in general

Circuit symbol	Description
Signal devices	
	Ringer
	Gong
	Buzzer
	Siren
	Horn
6	Signal lamp board, e.g. for 6 signals
	Ringing and switch-off panel
	Door opener
	Electric clock, slave clock in particular
	Master clock
	Card control device
	Radiation detectors
	Guard alarm
Lx <	Daylight control
Broadcasting, television	
	Loudspeaker
	Radio receiver
	Television set
	Aerial, in general
	Amplifier

Installation Circuit Diagrams

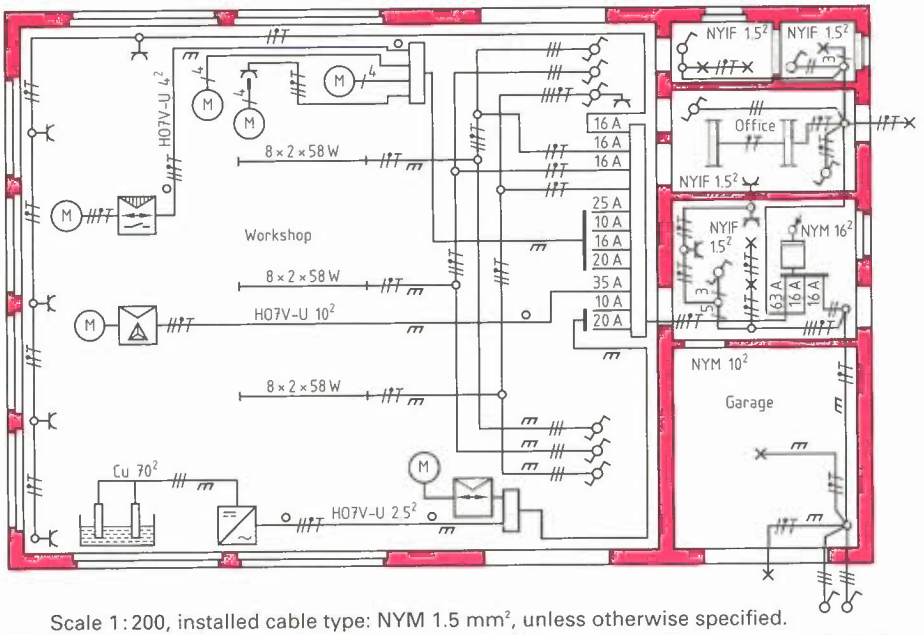
Electrical installation of a residential building

This is a sample of the graphic representation of the installation, not of the execution.



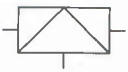
Scale 1:200, installed cable type: NYIF 1.5 mm², unless otherwise specified.

Electrical installation of a workshop



Scale 1:200, installed cable type: NYM 1.5 mm², unless otherwise specified.

Circuit Symbols for Overview Diagrams

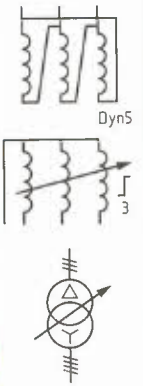
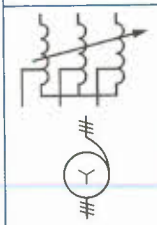
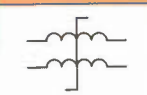
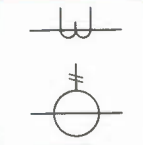
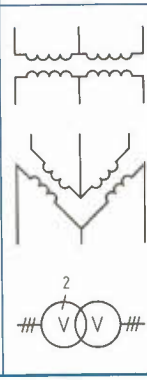
Circuit symbol	Description
Basic shapes	
	Functional unit, in general
	Optional symbol
	Converter, inverter, in general
	Memory, storage
	Controller, still common in practice
	Controller acc. to EN 61082
	Adjuster in general
	Modulator, demodulator, mixer
	as above, optional symbol
	Motor starter
	Delay element, in general
Symbol	
	Indicates the direction of transmission; only required, if from right to left or bottom to top
	Simultaneous transmission
	Successive transmission
	Value limitation
	Amplification
	Filtering

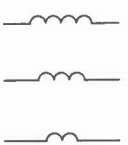
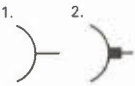
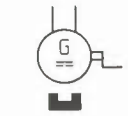
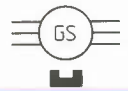
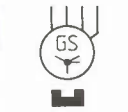
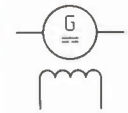
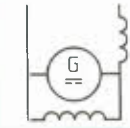
Circuit symbol	Description
	Telecopying
	Image transmission
	Sound transmission
	Wireless transmission
	Telephone dial
	Radar
Generators	
	Generator, oscillator, in general
	Sine-wave generator for 4 kHz
	Sine-wave generator with adjustable frequency
	Sawtooth generator
Detectors and alarm devices	
	Indicating unit with both-side deflection and illumination
	Pointer-type detector
	Motion sensor (passive infrared)
Amplifiers, receivers, transmitters	
	Amplifier, in general
	Optional symbol
	Amplifier, variable
	Receiver, in general
	Transmitter, sender, in general

Circuit symbol	Description
Acoustic devices	
	Magnetic tape drive
	Intercom unit for hands-free speaking
Memory, storage	
	Magnetic storage, in general
	Magnetic tape storage
Power supply, converters	
	Rectifier
	Inverter
	Constant-voltage regulator
	Frequency converter, in general
	Frequency multiplier, *n*-times
Telephony	
	Telephone set, in general
	with key-pad
	Multiplex telephone
	Dialling centre
	Fax (facsimile transmitter and receiver)
	Multiplexer with analog/digital conversion

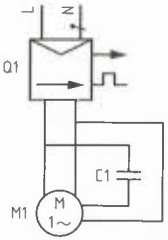
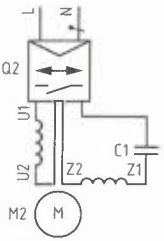
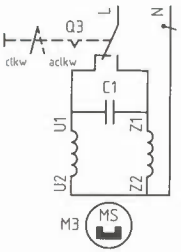
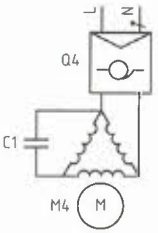
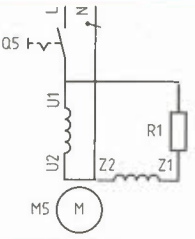
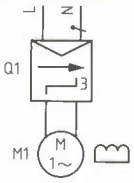
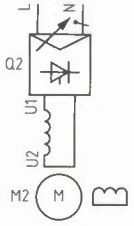
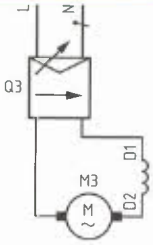
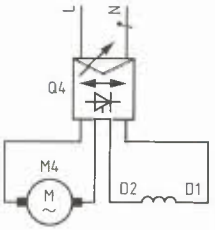
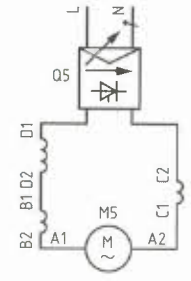
Coils, Transformers, Transductors, Rotating Generators

Circuit symbol	Description
Chokes	
	Single-phase choke, coil Optional symbol Optional symbol, for overview diagrams in particular Three-phase choke in star connection for overview diagrams
Single-phase transformers	
	Transformer with separate winding, also voltage transformer Optional symbol, particularly for overview diagrams Optional symbol, with shielding and polarity marking Single-phase transformer, stepwise voltage adjustment Optional symbol Single-phase transformer with variable coupling, phase position is marked
	Autotransformer Optional symbol As above, with voltage adjustment

Circuit symbol	Description
Three-phase transformers	
	Three-phase transformer, configuration Dyn5, secondary winding adjustable in three steps Optional symbol, particularly for overview diagrams
	Three-phase autotransformer, continuously adjustable voltage Optional symbol
Transductors	
	Transductor choke
Measuring transducer	
	Current transformer Optional symbol, particularly for overview diagrams
	Voltage transformer in V-connection As above, representation showing the V-shape As above, for overview diagrams

Circuit symbol	Description
Rotating generators	
	**Windings** in general, externally excited, in shunt connection In series connection Interpole winding, compensation winding
	Carbon brush, e.g. at the commutator, optional symbols
	Hand generator (D.C. generator with crank drive)
	Three-phase synchronous generator with permanent magnet excitation, wire ends led out
	As above, however in Y-connection, neutral point led out As above, however in △ connection and with exiting winding
	Externally exited D.C. generator with exciting winding
	As above, with permanent magnet excitation and interpole winding
	Compound-wound generator

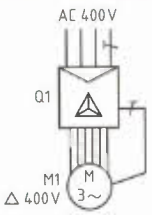
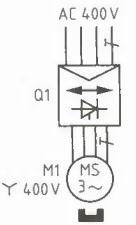
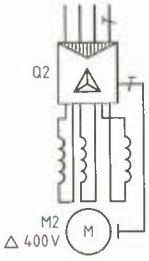
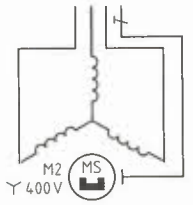
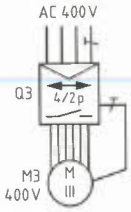
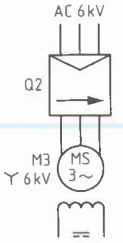
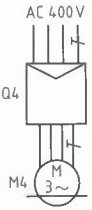
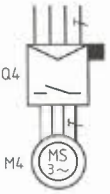
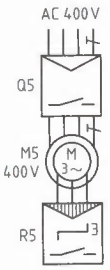
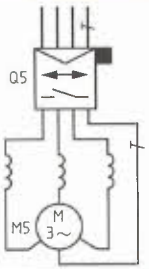
Single-phase A.C. Motors and Starters cf. EN 60617-6 (1997-08)

Circuit diagram	Description, explanation
Capacitor motors	
	Capacitor motor with run capacitor and starter for only one direction of rotation with electro-magnetic and thermal cut-out. The circuit symbols of motor starter parts, such as switches, could optionally be shown instead of the starter symbol.
	Capacitor motor with run capacitor and motor starter with contactor for both directions of rotation. The motor starter can optionally be shown as described above.
	Synchronous capacitor motor, excited by a permanent magnet, with motor starter for clockwise and counterclockwise rotation. The motor starter could optionally be shown by the starter symbol. (M motor, S synchronous)
	Three-phase current motor, as capacitor motor, Steinmetz circuit, with motor starter including an autotransformer for initial voltage reduction.
Motor with auxiliary phase from resistive material, starting motor	
	Single-phase A.C. motor with auxiliary winding from resistive material, single-pole switch as motor starter. In the case of starting motors, R1 and phase Z1Z2 are dispensed with.
Shaded-pole motors	
	Shaded-pole motor with motor starter for three steps (0 and 2 speeds), e.g. with a preresistor.
	Shaded-pole motor with motor starter, continuously variable, e.g. for voltage adjustment, with thyristor circuit for speed control.
Single-phase series-wound motor	
	Single-phase series-wound motor (universal motor) with motor starter for only one direction, continuously variable, e.g. for voltage adjustment, with autotransformer (optionally with brush symbol).
	Single-phase series-wound motor (universal motor) with motor starter for both directions, continuously variable through thyristor circuit (optionally with brush symbol).
	Single-phase series-wound motor with inter-pole winding B1B2 and/or compensation winding C1C2. Motor starter for only one direction, continuously variable through thryristor circuit.

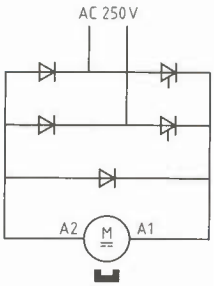
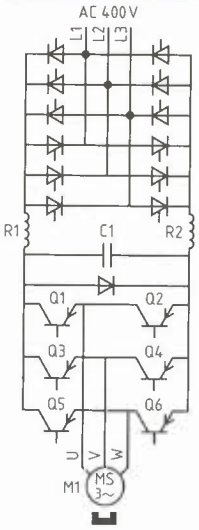
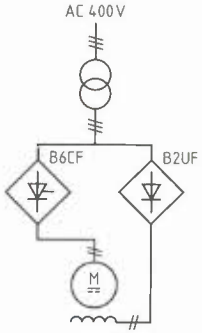
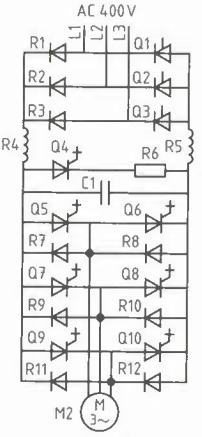
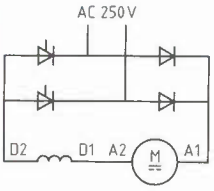
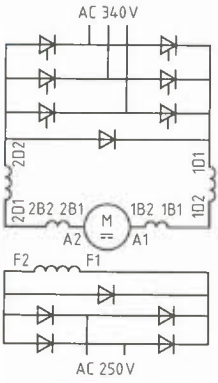
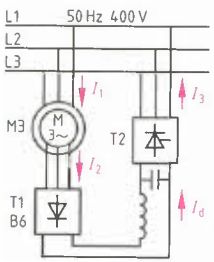
TM

Three-phase Motors and Starters

cf. EN 60617-6 (1997-08)

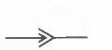
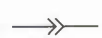
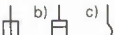
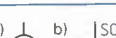
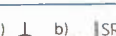
Circuit diagram	Description, explanation	Circuit diagram	Description, explanation
Three-phase induction motor (squirrel-cage motor)		**Three-phase synchronous motors**	
	Three-phase induction motor with motor starter for star-delta starting, manual star-delta switch. The motor starter could optionally be shown by its circuit diagram.		Three-phase synchronous motor with permanent magnetic excitation, starter for both directions with thyristor circuit, e.g. for frequency control The starter could optionally be shown by its circuit diagram.
	As above, shown in detail, however with automatic changeover from star to delta. The phase coils could also be arranged in star or delta configuration. The motor starter could optionally be shown by its circuit diagram.		Detailed representation of the motor. Stator winding connected in star. The stator phases could also be shown in another configuration, e.g. side by side.
	Pole-changing three-phase induction motor with 3 phase coils, motors starter for pole reversal with contactors for both directions. The motor starter could optionally be shown by its circuit diagram.		Three-phase synchronous motor with D.C. excitation and motor starter for only one direction, e.g. with converter. The starter could optionally be shown by its circuit diagram.
	Three-phase linear motor with starter, in general. The motor starter could optionally be shown by its circuit diagram.		Synchronised three-phase motor, e.g. reluctance motor (motor with salient poles and amortisseur). Motor starter as contactor circuit with automatic cut-out (shown as black square)
Slip-ring induction motor		**Three-phase commutator motor**	
	Slip-ring induction motor, stator controlled by contactor circuit, automatic starting by rotor starter with three-step contactor circuit. The motor starters could optionally be shown by their circuit diagrams.		Three-phase series-wound motor with motor starter for both directions and contactor circuit with automatic tripping device (shown as black square). The motor starter could optionally be shown by its circuit diagram.

Motors With A.C./D.C. Drive Systems

Circuit diagram	Description	Circuit diagram	Description
D.C. motors		**Rotating field motors (synchronous or asynchronous)**	
	D.C. motor for 220 V D.C. with permanent magnet excitation (externally excited D.C. motor) connected to converter circuit B2HKF (single-phase bridge converter, half-controlled on the cathode side with suppressor diode). Representation for circuit diagram.		Synchronous motor with permanent magnet excitation, e.g. servo-motor, connected to converter for pulse width modulation with constant voltage D.C. link (voltage source inverter). The converter consists of the mains converter B6AB6 (fully controlled six-pulse converter) for four-quadrant operation and energy recovery, the constant voltage D.C. link with suppressor diode and the machine current converter B6C consisting of transistors for pulse width modulation (PWM).
	Externally excited D.C. motor with exciting winding. Armature connected to converter circuit B6CF (six-pulse bridge converter with suppressor diode), exciting winding connected to uncontrolled converter circuit B2UF (single-phase bridge rectifier with suppressor diode). Representation for overview diagrams.		Three-phase induction motor connected to converter for pulse width modulation with constant voltage D.C. link (voltage source inverter). The converter consists of the mains converter B6HA (six-pulse bridge converter, half-controlled on the anode side) without energy recovery, the constant-voltage D.C. link R4, R5, C1 with brake circuit Q4, R6 and the machine current converter B6C consisting of turn-off thyristors (GTO) or IGBTs and reactive power diodes.
	D.C. series-wound motor for 220 V DC connected to converter circuit B2HA (two-pulse circuit, half-controlled on the anode side).		
	Externally excited D.C. motor for 440 V D.C. with auxiliary series winding (compound motor) and interpole winding. The stator is connected to a converter circuit B6CF (fully controlled six-pulse bridge converter with suppressor diode), the excitation winding for 220 V D.C. is connected to an uncontrolled converter circuit B2UF.		Slip-ring motor with constant voltage D.C. link at the rotor side. The rotor voltage is rectified by the rectifier B6. This D.C. voltage is converted by T2 (inverter B6C) inverted into the A.C. voltage of the mains frequency. The slip energy is recovered.

Further converter circuits in section AS "Circuits for Rectifiers and Converters", Half-controlled Converters", Fully Controlled Converters", "D.C. Choppers, Voltage Source Inverters", "Voltage Source Inverters" (page 309 contd.).

Comparison of Circuit Symbols 1

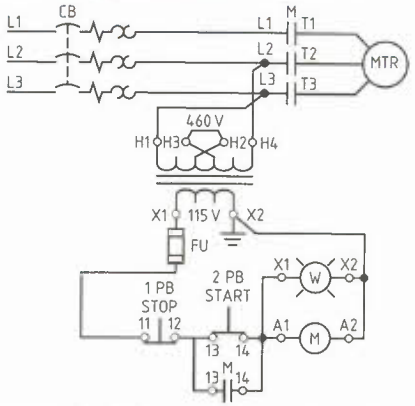
USA, e.g. ANSI, NEMA	Europe, common in practice, e.g. DIN EN	Description
General electrical equipment		
a)  b) 		Resistor, active resistor (RES from resistance)
a)  b) 		Capacitor
a)  b) 		Diode
a)  b) 		Zener diode
	a)  b) 	Male-female connection
a)  b) c)		Melting fuse
		Polarised voltage-regulative diode
a) b)		Signal lamp
a)  b)	a)  b)	Earth, ground
a)  b)		Electromechanical drive, e.g. for contactor
a)  b) SO		Drive with deferred acceleration
a)  b) SR		Drive with deferred deceleration
		Square-wave-generator
		Three-phase induction motor

USA, e.g. ANSI, NEMA	Europe, common in practice, e.g. DIN EN	Description
Switching elements		
a)  b)	a)  b)	Normally open contact NO
a)  b)		Normally closed contact NC
a) b)		Single pole double throw SPDT
	a) b)	Normally open contact (NO) time-delayed
Control devices		
		Normally open push button, activated by pressing
		Normally closed push-button, activated by pressing
		Limit switch (normally open contact)
		Limit switch (normally closed contact)
		2-position selector switch (activated by pressing), PB-maintained contact
		Proximity switch (NO contact)
a) b)		Manostat, normally closed (p von pressure)
		Push-button with NO and NC contact
		Float switch, normally closed

ANSI American National Standard Institute, NEMA National Electrical Manufacturer Association, DIN EN Deutsches Institut für Normung Europa-Norm (German institute for standardisation and European standards).
* identification sign, e.g. colour or device. PB push-button, LS limit switch.

Comparison of Circuit Symbols 2

USA, e.g. ANSI, NEMA	Europe, common in practice, e.g. EN	Description
Relays, contactors, switches, example		
SO		Time relay 1 NC contact, 1 NO contact
		Contactor with 3 NO contacts
OL		Three-pole contactor with motor protection relay
OL		Three-pole contactor with 2 auxiliary contacts and an overload relay
		Motor starter with magnetic and thermal trip characteristic
DISC		Three-pole disconnector
CB		Three-pole circuit breaker



Example of a circuit diagram: motor starter (acc. to Moeller)

USA, e.g. ANSI, NEMA	Europe, common in practice, e.g. EN	Description
Analog and binary elements		
	a) b)	Amplifier, in general
		Operation amplifier
a) b) A	&	AND element
a) b) OR	a) b) ≥1	OR element
a) b) OE	=1	XOR element, anticoincidence
a) b) A	&	NAND element
OR	a) b) 1 1	NOT element, inverter
OE	=	ExNOR element, equivalence
	EN	Inverter with three-state output (H, L and high impedance)
	#/∩	Digital/analog converter DAC
	∩/#	Analog/digital converter, ADC
	DX	Demultiplexer
	MUX	Multiplexer

ANSI American National Standard Institute, NEMA National Electrical Manufacturer Association, EN Europa-Norm (European Standards), MTR = motor.

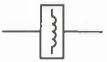
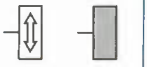
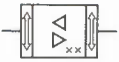
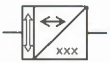
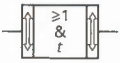
Hydraulic and Pneumatic Controls

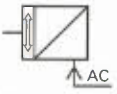
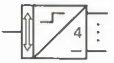
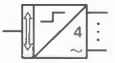
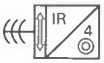
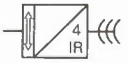
Symbol	Description
Lines	
	Working line
	Control line
	Leakage pipe, vent pipe
	Line connection
	Line crossing
	Electric line
Functional symbols	
	Hydraulic, pneumatic
	Flow directions
	Direction of rotation
	Adjustability
Pumps, compressors, motors	
	Fixed displacement pump with 1 flow direction
	Variable displacement pump with 2 flow directions
	Compressor
	Hydraulic motor with 1 flow direction
	Pneumatic motor with 1 flow direction
Cylinder	
	Single action
	With return spring
	Double action
	End cushioning on both sides

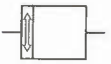
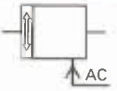
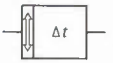
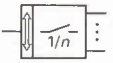
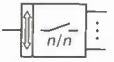
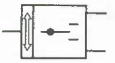
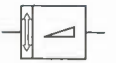
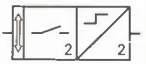
Symbol	Description
Directional valves	
	Number of rectangles = number of circuits; 2 switch positions
	Connections are marked with dashes.
	1 flow direction
	2 blocked connections
	2 flow directions
Codes	
The first digit indicates the number of controlled connections, the second digit the number of switch positions.	
2 a b 1 3	Example: 3/2-way valve — 2 switch positions (a and b); 3 connections (1...3)
a b	2/2-way valve
a b	3/2-way valve
	4/2-way valve
	4/3-way valve
	5/2-way valve
Stop valves	
	Check valves
	Throttle check valve
Pressure valve	
	Pressure-limiting valve

Symbol	Description
Flow-control valves	
	Throttle valve, adjustable
	2-way flow control valve
Directional valve actuation	
	By spring
	By muscle power, in general
	By push-button
	By lever
	By foot pedal
	By key switch
	By follower roll
	By electromagnet with 1 winding
	2 reverse windings
M	By electric motor
	Hydraulic pilot control under pressure
	Pneumatic pilot control under pressure
Energy transmission	
	Pressure source, hydraulic or pneumatic
M	Electric motor
	Tank, container
	Reservoir
	Filter
	Water separator
	Oiler
	Preparation unit

Circuit Symbols for the European Installation Bus KNX/EIB

Circuit symbol	Description
Basic equipment	
	Voltage supply VS
	Choke C
	Power supply unit PU, voltage supply via choke
	Bus coupler
	Connector
	Line coupler LC, range coupler RC, line amplifier LA, xx: LC, RC or LA
	Interface xxx shall be replaced by com, USB, RS 232, IP
	Gateway EIB to ISDN
	Logic module
Sensors	
	Key sensor, e.g. key switch with 2 NO contacts
	Dimmer sensor, e.g. 2 channels

Circuit symbol	Description
	General sensor with auxiliary voltage, e.g. A.C.
	Louvre sensor, e.g. 2 channels
	Binary sensor, e.g. 4 channels, e.g. for D.C.
	Binary sensor, e.g. 4 channels, e.g. for A.C.
	IR transmitter for battery operation e.g. 4 channels
	IR receiver/ decoder, e.g. 4 channels
	Exposure sensor
	Temperature sensor
	Smoke detector
	Motion sensor (passive infrared)
	Time sensor, clock
	Time value switch, timer

Circuit symbol	Description
	Wind velocity sensor
Actuators	
	Actuator, in general
	Actuator with auxiliary voltage
	Actuator with time delay
	Actuator, switching device binary output *n* channels, not potential-free
	Actuator, *n* channels, potential-free
	Louvre actuator, louvre switch, 2 channels
	Dimmer actuator
	Analog actuator
Other elements	
	Switching device with e.g. binary input, binary output, e.g. 2 channels
	Indication unit, information display

Symbols in Process Engineering

Symbol	Description
Lines	
1 mm	Line for main product
0.5 mm	Line for secondary product
0.25 mm	Control line
	Line crossing
	Line tap
	Double tap
Flow direction arrows	
	Flow direction, in general
	Entry, exit of important materials
Fittings	
	Stop fitting, in general
	As above (angled type)
	As above (three-way type)
	Gate valve
	Butterfly valve
Conveying equipment	
	Pump, in general
	Compressor, vacuum pump, in general
	Steady-flow conveyor, in general
	Screw conveyor
Tanks, vessels	
	Tank, vessel, in general
	Spherical vessel
Columns, reactors	
	Column (series connection of identical internals), in general
	Tank with static bed
	Tank with fluidised bed
Heating and cooling	
	Heating or cooling, in general
	Heat exchanger with crossed flow lines
	As above, w/o crossing
	As above, with pipe coil
	Twin-pipe heat exchanger
	Boiler
	Extraction hood
	Chimney
Crushing	
	Crusher, in general
	Mill, in general
	Impact crusher
	Gyratory crusher
Screening, sifting	
	Screen classifier, rake, in general
	Sifter, in general
Filtering	
	Filtration device, in general
	Gas filter, air filter, in general
Separators	
	Separator, in general
	Centrifugal separator, cyclone
	Electrostatic separator
Centrifuges	
	Centrifuge, in general
	As above, with basket
Drying	
	Drier, in general
	Atomising drier
Sorting	
	Sorting device, in general