Installation and Operational Instructions for ROBA®-brake-checker plus DC Type 028.100.2

(B.0281002.EN)

Guidelines on the Declaration of Conformity

A conformity evaluation has been carried out for the product in terms of the EU Low Voltage Directive 2014/35/EU and the Electromagnetic Compatibility (EMC) Directive 2014/30/EU. The Declaration of Conformity is laid out in writing in a separate document and can be requested if required.

Guidelines on the EMC Directive (2014/30/EU)

The product cannot be operated independently according to the EMC directive.
Only after integration of the product into an overall system can this be evaluated in terms of the EMC.
For electronic equipment, the evaluation has been verified for the individual product in laboratory conditions, but not in the overall system.

Guidelines on the Machinery Directive (2006/42/EC)

The product is a component for installation into machines according to the Machinery Directive 2006/42/EC.
The product can fulfil the specifications for safety-related applications in coordination with other elements.
The type and scope of the required measures result from the machine risk analysis.
The product then becomes a machine component and the machine manufacturer assesses the conformity of the safety device to the directive. It is forbidden to start use of the product until you have ensured that the machine accords with the regulations stated in the directive.

Guidelines on the ATEX Directive

Without a conformity evaluation, this product is not suitable for use in areas where there is a high danger of explosion. For application of this product in areas where there is a high danger of explosion, it must be classified and marked according to Directive 2014/34/EU.

Safety and Guideline Signs

DANGER

Immediate and impending danger, which can lead to severe physical injuries or to death.

CAUTION

Danger of injury to personnel and damage to machines.

Guidelines on important points.

General Safety Guidelines

DANGER

Danger of death! Do not touch voltage-carrying lines and components.

DANGER

Danger of burns when touching hot surfaces

CAUTION

- Danger from devices caused by short-circuits and earth short-circuits at the terminals
- Electronic devices cannot be guaranteed fail-safe.

During the risk assessment required when designing the machine or system, the dangers involved must be evaluated and removed by taking appropriate protective measures.

To prevent injury or damage, only professionals and specialists are allowed to work on the devices. They must be familiar with the dimensioning, transport, installation, initial operation, maintenance and disposal according to the relevant standards and regulations.

General Safety Guidelines

Only carry out installation, maintenance and repairs in a de-energised, disengaged state and secure the system against inadvertent switch-on.

Before product installation and initial operation, please read the Installation and Operational Instructions carefully and observe the Safety Regulations. Incorrect operation can cause injury or damage.

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Application

ROBA®-brake-checker plus DC monitoring modules are used to operate DC consumers.
Motion monitoring of the armature disk for released ROBA-stop® safety brakes is possible.

- Consumer operation with overexcitation and/or power reduction
- Controlled holding voltage (on reduction)
- Simple adjustment of holding voltage and overexcitation time via a DIP switch
- Fast or slow disconnection
- Armature disk motion recognition (release and drop-out recognition)
- Preventative function monitoring (Wear recognition and error recognition, functional reserve)
- Wide input voltage range
- Maximum output current I = 10 A / 5 A
- Maximum overexcitation current I_O = 20 A / 10 A
- Automatic reduction of the holding voltage U_H
- Electrical isolation of performance terminal and control terminal

CAUTION

The ROBA®-brake-checker plus DC with integrated DC-side disconnection is not suitable for being the only safety disconnection in applications!

Function

The ROBA®-brake-checker plus DC monitoring module is intended for use with an input voltage of 24 or 48 VDC. The module monitors the movement of the armature disk and emits the determined switching condition via control terminal 3 (signal output).
Critical conditions (line breakages, wear) can be recognised and the respective signal can be emitted via control terminal 7 (error output).

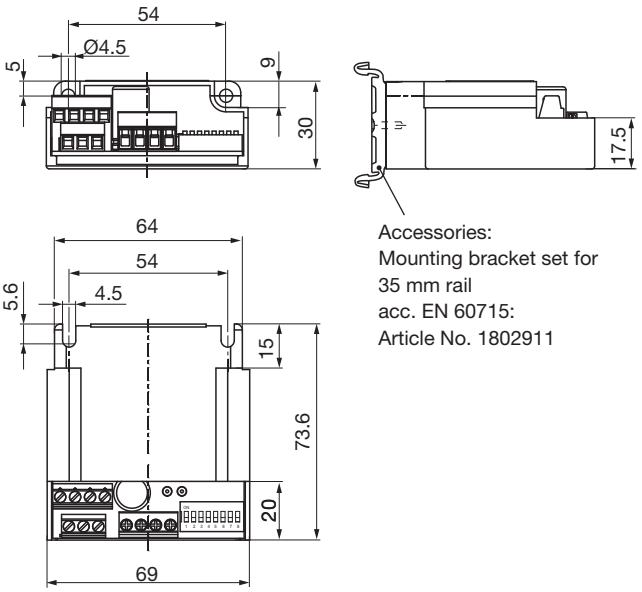
After a brake-specific overexcitation time period, the integrated automatic voltage mechanism mode adjusts to the pre-set holding voltage. The automatic voltage mechanism mode can be switched off using a DIP switch.

In case of switched-off automatic voltage mechanism mode, the overexcitation time can be adjusted manually to 150 ms, 450 ms, 1 s, 1.5 s, and 2 s using the DIP switch.

It is possible to select between fast and slow switch-off via the input S/L on the control terminal.

Louder switching noises are generated on the brakes in case of fast switch-off than in case of slow switch-off.

Dimensions (mm)



Accessories:
Mounting bracket set for 35 mm rail
acc. EN 60715:
Article No. 1802911

Preventative function monitoring

Through the monitoring of different parameters, the ROBA®-brake-checker plus DC recognises safety critical operating conditions of the brake in advance, as well as acute faults (e.g. line breakage). Faults are determined as they occur and are notified to the user as a warning before the brake can no longer be operated.
The preventative function monitoring signalises a fault (brake does not open or close, line interruption) or a warning (e.g. wear, increased temperature) via the output **Fault**.
In case of a fault, operation of the brake is usually no longer possible.
In case of a warning, the operation of the brake is still possible; an imminent failure of the brake is probable.

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Technical Data				24 VDC Type 2/028.100.2	48 VDC Type 4/028.100.2
Input voltage Power Terminal	SELV/PELV,	U_I	[VDC]	18 - 30	42 - 54
Input voltage Control terminal		U_I	[VDC]	24 (19 - 28)	
Output voltage	± 5%	U_O	[VDC]	Input voltage U_I	
		U_H	[VDC]	4, 6, 8, 12, 16	8, 12, 16, 24, 32
Output current	at ≤ 45 °C	I	[A]	10	5.0
	at max. 70 °C	I	[A]	5	2.5
Device fuses				1.2 × I_O, fast acting	
Protection				Protection IP65 components, IP20 terminals	
Power terminals				Power terminals 4 mm² (AWG 20-12) max. tightening torque for screws: 0.5 Nm	
Control terminals				Nominal cross-section 1.5 mm² (AWG 30 -14), max. tightening torque for screws: 0.5 Nm	
Ambient temperature			[°C]	-30 to +70	
Storage temperature			[°C]	-40 to +105	
Conformity markings				CE	
Installation conditions				The installation position can be user-defined. Please ensure sufficient heat dissipation and air convection! Do not install near to sources of intense heat!	

Only for variant 24 VDC (Type 2/028.100.2)

The tolerances from the signal terminals and power terminals differ in their upper voltage limit values. Whilst the supply voltage on the power terminal and therefore on the load can have a maximum voltage of 30 VDC, only a maximum supply voltage of 28 VDC may be applied to the signal terminal.
Under these prerequisites, both terminals can be operated with one supply voltage (see connection example).

The ROBA®-brake-checker plus DC monitoring module must be adjusted for the respective brake before initial operation.
For appropriate parameters please see in the documentation of the respective brake.

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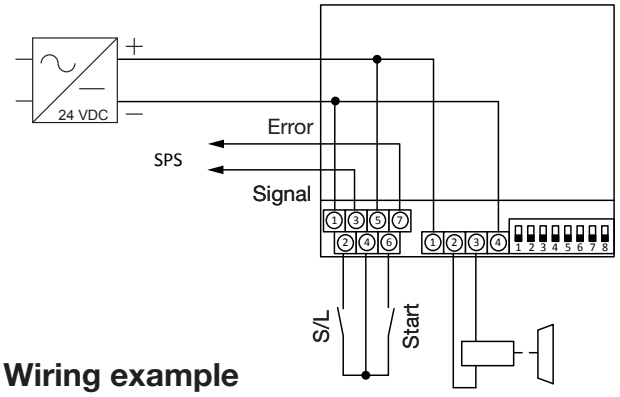
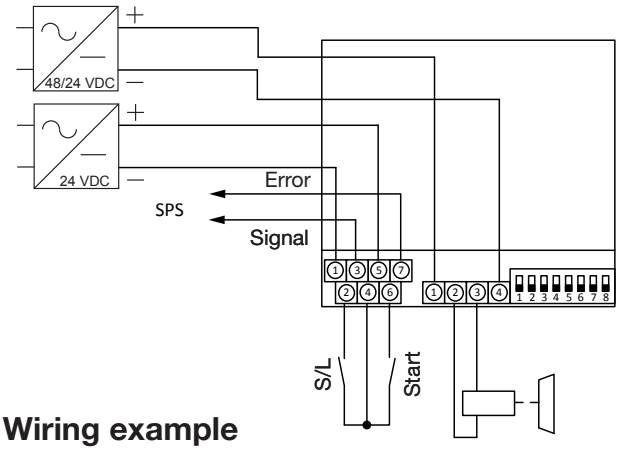
Electrical Connection	
Power Terminal	
1	Supply voltage +24 VDC / +48 VDC
2	Output voltage +
3	Output voltage –
4	Supply voltage 0 VDC

Electrical Connection	
Control terminal (electrically insulated)	
1	Supply voltage 0 VDC
2	Switch-off fast/slow (input)
3	Signal (output)
4	24 VDC (auxiliary voltage for bridging)
5	Supply voltage +24 VDC
6	Start (input)
7	Error (output) max. 300 mA



Wiring example
(without electrical isolation)



Wiring example
(with electrical isolation)

Inputs			
S/L	2	0 VDC (low)	Slow switch off
		24 VDC (high) [1]	Fast switch off
Start	6	0 VDC (low)	Brake is not energised
		24 VDC (high)	Brake is energised

Outputs			
Signal	3	0 VDC (low)	Brake is not energised, movement of the armature disk for closing the brake.
		24 VDC (high)	Brake energised, movement of the armature disk for opening the brake.
Error	7	24 VDC (high)	No errors
		0 VDC (low)	Brake does not open or close, line interruption, false detection
Warning [2]			Preventative function monitoring (Wear recognition and error recognition, functional reserve)

1) 24 VDC control signal or control terminal 4 (auxiliary voltage for bridging)
2) Rectangular signal 10 Hz / 24 Vpp

Operation

For the operation of the ROBA®-brake-checker plus DC monitoring module, the overexcitation time and the switch-off mode must be adjusted after connection of the brake and the supply lines.

These settings should be implemented in a de-energised state at the DIP switch. An adjustment change in energised state is not adopted until the end of the subsequent brake cycle (switch-off).

Always observe the valid settings on the DIP switch of the ROBA®-brake-checker plus DC monitoring module.
In case of an invalid or incorrect setting, the ROBA®-brake-checker plus DC monitoring module does not function.

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Switch-ON

Brake switch-on occurs with a connected supply voltage (control and power terminal) by closing of start (Input) on the signal side using the voltage 24 VDC (auxiliary voltage for bridging) or a 24 VDC control signal applied there. A green light-emitting diode emits a signal when the device is switched on. After the changeover from overexcitation voltage to holding voltage, the diode continues to illuminate at reduced brightness.

Switch-OFF

If short switching times are required, please switch DC-side (bridge between control terminal 2 and 4) Here, the ROBA®-brake-checker plus DC monitoring module limits the switch-off voltage to approx. 60V. DC-side disconnection is signalized by the red light-emitting diode flashing at the moment of switch-off.

If a longer brake engagement time or a quieter switching noise is required, please switch to freewheeling operation (manufacturer-side setting).

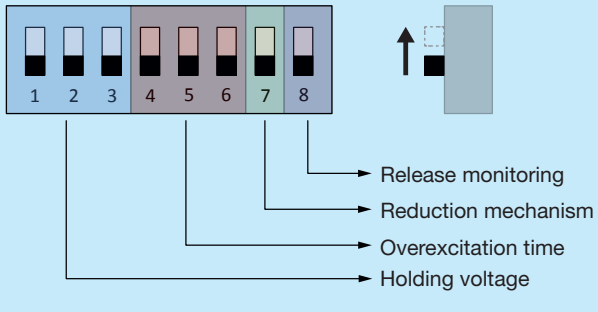
Device Fuses

Installation of a device protection fuse into the mains fuse of the ROBA®-brake-checker plus DC monitoring module.

Short-circuits or earth short-circuits can lead to ROBA®-brake-checker plus DC monitoring module failures. After fuse elements have reacted to a malfunction, the ROBA®-brake-checker plus DC monitoring module must be checked for functional and operational safety (overexcitation voltage, switch-off voltage, response delay time, holding voltage). The same procedure is to be carried out after coil failure.

Adjustments DIP switch

The 8 positions DIP switch mounted onto the device is split up into several different functional areas:



Holding voltage U_H

The holding voltage can be adjusted via the DIP switch. The switches may only be switched in de-energised state and may only be adjusted as depicted.

The set holding voltage value U_H should equal 3 times the drop-out voltage of the safety brake .

DIP switch	Holding voltage U_H [VDC]	
	24	48
	4	8
	6	12
	8	16
	12	24
	16	32
	no power reduction	

Manufacturer-side setting

If the brakes are operated in power reduction mode, then additional times must be observed in order to ensure reduction of the current.

Design 24 VDC Minimum recommended reduction times prior to switch-off [ms]						
Reduced voltage	**[VDC]**	**16**	**12**	**8**	**6**	**4**
Current range	**< 5 A**	100	120	140	150	160
	> 5 A	200	250	300	350	400

Design 48 VDC Minimum recommended reduction times prior to switch-off [ms]						
Reduced voltage	**[VDC]**	**32**	**24**	**16**	**12**	**8**
Current range	**< 5 A**	150	170	200	250	300
	> 5 A	300	340	400	500	600

Reliability nominal values

MTTF	140 years at 60 °C
	200 years at 40 °C
Duration of use	20 years

The basis of the MTTF calculation forms (if available) the information of the component manufacturer supplemented by the information from the Siemens standard SN 29500. For the calculation, a simplified Parts-Count procedure has been used (EN ISO 13849-1)

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Overexcitation

Increased wear (an enlarged air gap) as well as coil heat-up lengthen the separation time t_2 of the brake. Therefore, when dimensioning the overexcitation time t_O, please select at least double the separation time t_2 on each brake size (catalogue values).

The overexcitation time t_O can be adjusted via the DIP switch to 150 ms, 450 ms, 1 s, 1.5 s and 2 s ± 1 %. The DIP switches may only be switched in de-energised state and may only be adjusted as depicted. The voltage reduction mechanism (DIP switch 7) must be deactivated.

DIP switch	Overexcitation time t_O [s]
	0.15
	0.45
	1.00
	1.50
	2.00

Manufacturer-side setting

Voltage reduction mechanism

After a brake-specific overexcitation time period, the intelligent automatic voltage mechanism mode adjusts to the pre-set holding voltage. Manual adjustment of the overexcitation time is not necessary.

DIP switch	Overexcitation time t_O [s]
	**OFF** (manually)
	**ON** (automatically)

Manufacturer-side setting

Release Monitoring

The release monitoring recognises the movement of the armature disk for opening the brake after switch-on as well as the movement of the armature disk for closing the brake after switch-off.

The release monitoring can be deactivated for certain applications in order to prevent errors.
Possible applications:

- Parallel operation of several brakes
- Damped brakes
- Unspecific brakes

DIP switch	Release monitoring
	**OFF**
	**ON**

Manufacturer-side setting

In order to ensure correct monitoring, brakes <50 W may not be reduced below 12 VDC.

Time delays

During detection and processing of different brake conditions, input and output signal delays can occur .

Switch-on delay	Normal operation	≤ 4 ms
	Malfunction	≤ 4 ms
Delay time		≤ 4 ms
Signal delay		≤ 20 ms

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Coil Capacity

The values for the **maximum coil nominal capacity** stated in the Table are guideline values for a switching frequency of maximum 1 cycle per minute and for maintenance of the permitted current I.

Design 24 VDC

Holding Voltage U_H [VDC]	Coil voltage U_N [VDC]	Coil capacity P_N Type 2/028.100.2 ≤ 45 °C [W]	Coil capacity P_N Type 2/028.100.2 ≤ 75 °C [W]	Operation with overexcitation	Operation with power reduction
4	4	13	7	x	
	6	30	15	x	x
	8	53	27	x	x
	12	120	60	x	x
	16	270	135	x	x
	24	480	240		x
6	6	30	15	x	
	8	53	27	x	x
	12	120	60	x	x
	16	213	107	x	x
	24	480	240		x
8	8	53	27	x	
	12	120	60	x	x
	16	213	107	x	x
	24	480	240		x
12	12	120	60	x	
	16	213	107	x	x
	24	480	240		x
16	16	160	80	x	
	24	360	180		x

Design 48 VDC

Holding Voltage U_H [VDC]	Coil voltage U_N [VDC]	Coil capacity P_N Type 4/028.100.2 ≤ 45 °C [W]	Coil capacity P_N Type 4/028.100.2 ≤ 75 °C [W]	Operation with overexcitation	Operation with power reduction
8	8	13	7	x	
	12	30	15	x	x
	16	53	27	x	x
	24	120	60	x	x
	32	270	135	x	x
	48	480	240		x
12	12	30	15	x	
	16	53	27	x	x
	24	120	60	x	x
	32	270	135	x	x
	48	480	240		x
16	16	53	27	x	
	24	120	60	x	x
	32	270	135	x	x
	48	480	240		x
24	24	120	60	x	
	32	270	135	x	x
	48	480	240		x
32	32	180	90	x	
	48	320	160		x

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If the switching frequency is higher than 1 cycle per minute or if the overexcitation time t_O is longer than double the separation time t_2, please observe the following:

$P \leq P_N$

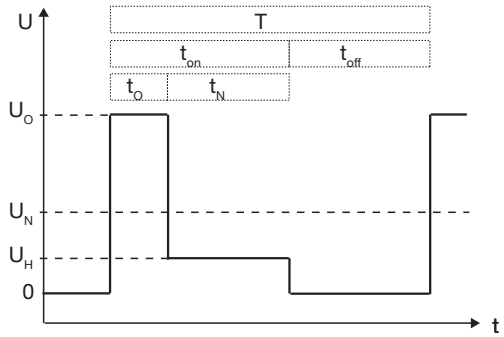
The coil capacity P must not be larger than P_N or the rated current I which flows through the ROBA®-brake-checker plus DC Type 2/028.100.2 monitoring module must not be exceeded, otherwise the coil and the ROBA®-brake-checker plus DC Type 2/028.100.2 monitoring module may fail due to thermal overload.

Calculations:

P	[W]	RMS coil capacity dependent on switching frequency, overexcitation and duty cycle $P = \frac{P_O \times t_O + P_N \times t_N}{T}$
P_N	[W]	Coil nominal capacity (catalogue values, Type tag)
P_O	[W]	Coil capacity on overexcitation $P_O = \left(\frac{U_O}{U_N}\right)^2 \times P_N$
P_H	[W]	Coil capacity at power reduction $P_H = \left(\frac{U_H}{U_N}\right)^2 \times P_N$
t_O	[s]	Overexcitation time
t_H	[s]	Time of operation with reduction in capacity
t_N	[s]	Time of operation with coil nominal voltage
t_{off}	[s]	Time without voltage
t_{on}	[s]	Time with voltage
T	[s]	Total time ($t_O + t_N + t_{off}$)
U_O	[V]	Overexcitation voltage
U_H	[V]	Holding voltage
U_N	[V]	Coil nominal voltage
I	[V]	RMS current dependent on switching frequency, overexcitation time and duty cycle

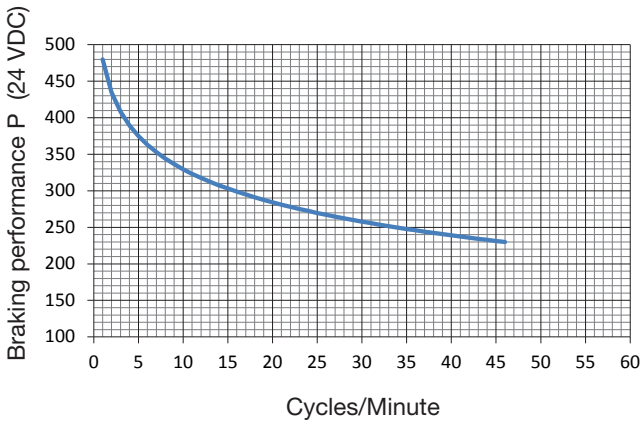
$$I = \sqrt{\frac{P \times P_N}{U_N^2}}$$

Time Diagram:



Cycle frequency

In order to prevent thermal overload, an upper cycle limit must be observed for especially high-performance brakes in operation with fast switch-off.



For brakes, which do not require overexcitation, the holding voltage may be lower than the nominal voltage, e.g. on power reduction to reduce the coil temperature.

EMC-compatible Installation

- Avoid antennae effects: Keep the supply cables as short as possible; do not form rings or loops with the cables!
- Mount good earth connections onto the metal body of the brake.
- Lay control cables separately from power cables or from strongly pulsating supply cables.
- A voltage drop can occur when operating using long lines.
  ▸ Check the holding voltage on the respective brake.
- In case of operation of the ROBA®-brake-checker plus DC monitoring module in living and small business areas, special precautions must be taken in order to keep to the correct limit values for these areas in line with the complete system, (for example by installing a Würth ferrite WE74271221).

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Malfunctions / Breakdowns

Malfunction	Possible Causes	Solutions
Brake does not release	No supply voltage available	Check voltage at the supply and signal terminals
	Brake line interrupted	Inspect the brake feed line (check feed-through)
	Unpermitted setting on the DIP switch	Check the DIP setting (valid settings)
	Line voltage drop on long line	Deactivate release monitoring (DIP), apply supply voltage, Check output voltage at the brake output (power terminals 2 + 3) (Multimeter)
	Start signal missing	Check the voltage at the start (input)
No signal (output) (brake has audibly opened)	Release monitoring deactivated	Activate release monitoring (DIP setting)
	Non-specified brake, brake worn, brake does not release, movement of the armature disk too low	Check brake and replace if necessary, check error output
Error (Continuous signal)	Brake is not opened, brake will not be recognised	Check the supply/output voltage (power terminal) to the brake
	Brake does not close, brake is not recognised	Check the supply/output voltage (power terminal) to the brake
	Brake feed line interrupted	Inspect the brake feed line (check feed-through)
Warning (Rectangular signal)	Wear limit reached	Check the brake and replace if necessary.
	Supply voltage too low	Check or increase supply/output voltage (power terminal) to the brake
	Coil temperature of the brake too high	Check or increase supply/output voltage (power terminal) to the brake
Overexcitation time not reached	DIP switch for the voltage reduction mechanism is activated	Deactivate the DIP switch for voltage reduction mechanism

Standards

Product standard
VDE 0160/DIN EN 50178:1998-04
Electronic equipment for use in power installations

EMC inspections
EN 61000-6-2:2006-03 Interference immunity
EN 61000-6-4:2007-09 Interference emission

Insulation coordination
acc. VDE 0110 / EN 60664:2008-01
Pollution degree 2
Rated insulation voltage 63 VDC

Reliability nominal values
SN 29500, T = 60 °C / failure rates, components
EN ISO 13849-1

Intended Use

mayr®-rectifiers have been developed, manufactured and tested as electronic equipment in compliance with the DIN EN 50178 standard and in accordance with the EU Low Voltage Directive. During installation, operation and maintenance of the product, the standard requirements must be observed. *mayr*®-rectifiers are for installation in systems, machines and devices and must only be used in the situations for which they are ordered and confirmed. The products are designed for installation into electrical control cabinets and terminal boxes. Using them for any other purpose is not allowed.

Disposal

Electronic accessories
Products which have not been disassembled can be disposed of under Code No. 160214 (mixed materials) or components under Code No. 160216 (Code No. acc. 200/532/EG) , or can be disposed of by a certified disposal firm.

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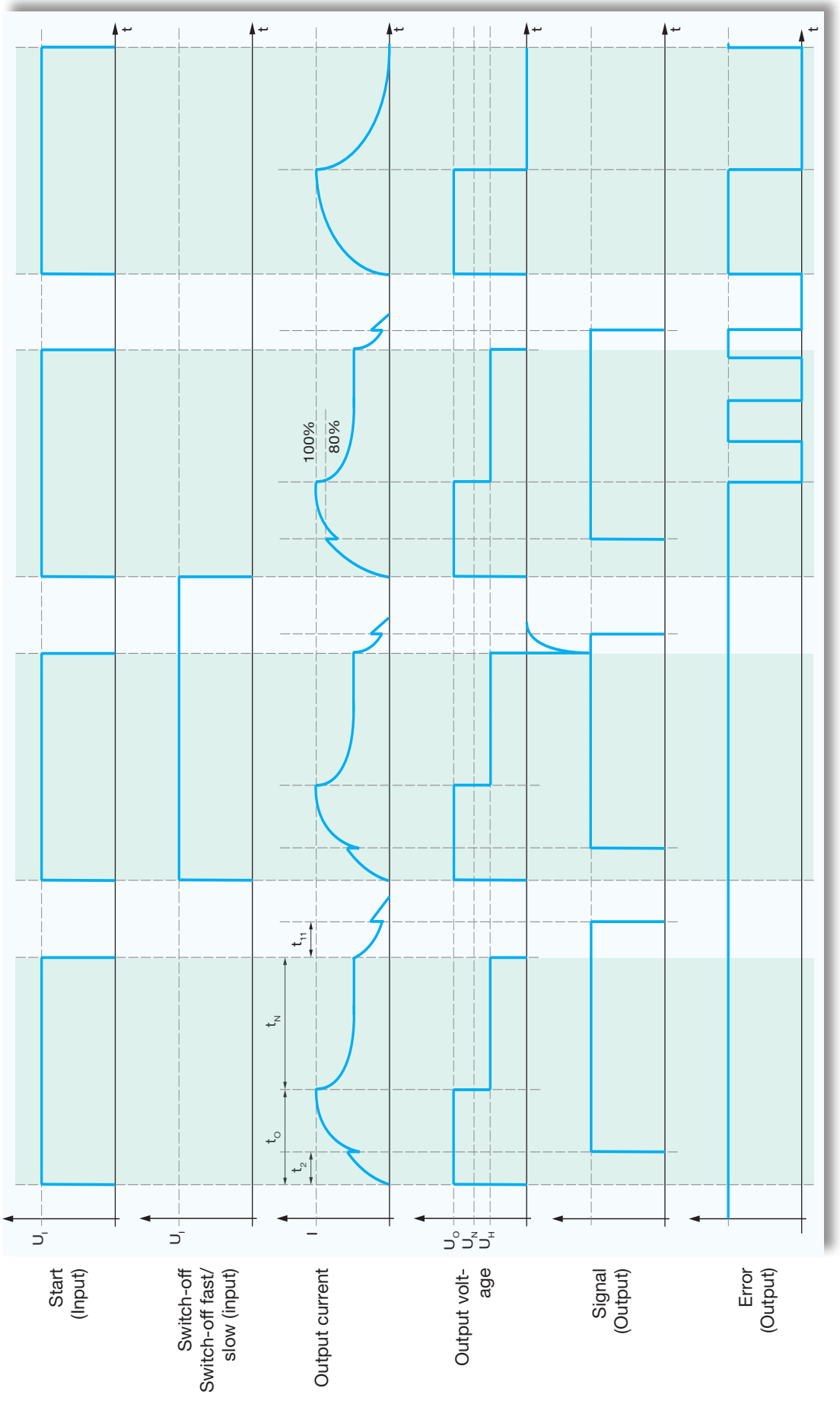
Functional sequence diagram



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