BERGER LAHR

Technical Documentation

Product manual

Braking resistor controller

UBC60

Document: 0098441113326

Edition: V1.01, 08.2006

Berger Lahr GmbH & Co. KG
Breslauer Str. 7
D-77933 Lahr

a company of Schneider Electric

Important information

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

See safety section for additional critical instructions.

Not all product variants are available in all countries.
Please consult the current catalogue for information on the availability of product variants.

We reserve the right to make changes during the course of technical developments.

All details provided are technical data and not promised characteristics.

In general, product names must be considered to be trademarks of the respective owners, even if not specifically identified as such.

0098441113326, V1.01, 08.2006

Table of Contents

0098441113326, V1.01, 08.2006

0098441113326, V1.01, 08.2006

Writing conventions and symbols

Work steps

If work steps must be carried out in sequence, they are shown as follows:

- ■ Special prerequisites for the following work steps
- ▶ Step 1
- ◁ Important response to this work step
- ▶ Step 2

If a response to a work step is specified, this will inform you that the step has been carried out correctly.

Unless otherwise stated, the individual instruction steps must be carried in the given sequence.

Lists

Lists can be sorted alphanumerically or by priority. Lists are structured as follows:

- Point 1
- Point 2
  - – Subpoint to 2
  - – Subpoint to 2
- Point 3

Making work easier

Information on making work easier can be found at this symbol:

This offers supplementary information on making work easier.
See the chapter on safety for an explanation of the safety instructions.

0098441113326, V1.01, 08.2006

0098441113326, V1.01, 08.2006

1 Introduction

1.1 Overview of product properties

General

The braking resistor controller, also referred to below as UBC (Universal braking resistor controller), converts braking energy (energy generated by braking a mass in motion) to heat.

During deceleration (braking) the braking energy generates an increase in the supply voltage. A braking resistor controller applies a resistance to the increased voltage. This dissipates the excess braking energy faster.

This makes it possible to brake larger masses faster.

Features

The braking resistor controller has the following features:

- ready in 25 ms
- status displayed with LEDs ("Ready" and "Warning")
- status output with relay (READY_OUT and NO_FAULT_OUT)
- application with voltages that comply with the requirements for PELV
- protection of the internal braking resistor by I^2t monitoring and by monitoring the temperature
- connection of an external braking resistor
- One braking resistor controller per power supply unit is permissible
- Mounting on top-hat rail
- IP20 plastic housing

External braking resistor

An external braking resistor is required if the excess braking energy cannot be dissipated via the internal braking resistor. In this case the internal braking resistor is disabled.

Available products

The braking resistor controller can operate with products in which the supply voltage is no greater than 50 V_{DC} (PELV) and that allow energy recovery to the supply voltage.

0098441113326, V1.01, 08.2006

1.2 Unit overview

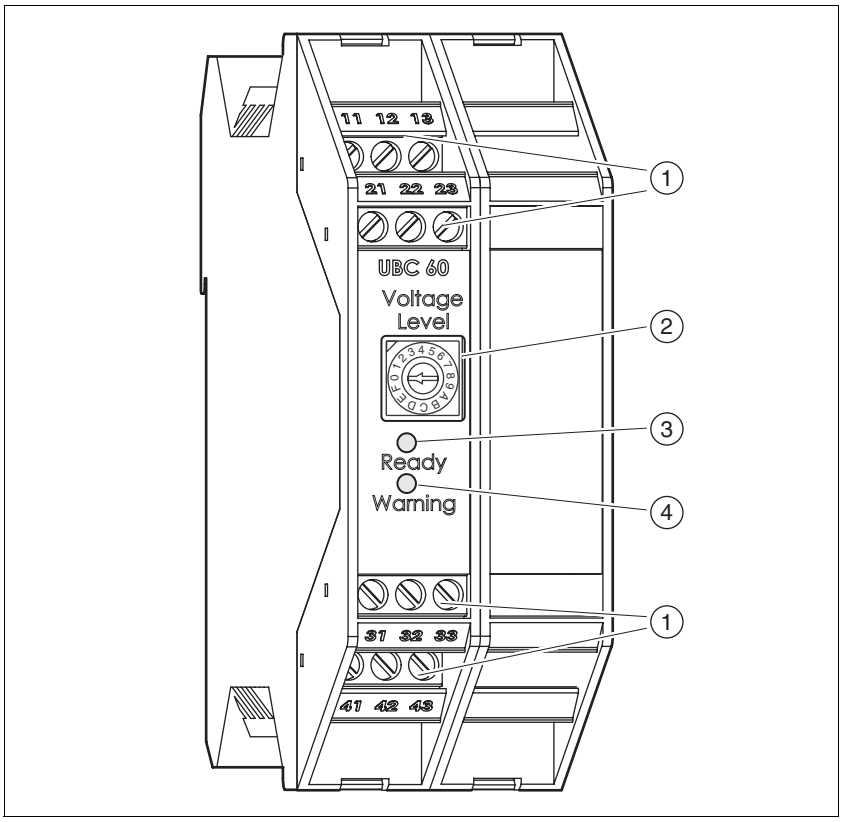

Figure 1.1 Unit overview

(1) Connections
(2) Rotary switch for setting the response threshold
(3) LEDs for status display

1.3 Documentation and literature references

The following user manuals are available for this product:

- **Product manual**, describes the technical data, installation, commissioning and all operating modes and operating functions.

The user's manuals can also be found in the Internet at http://www.schneider-motion.com/doku.

0098441113326, V1.01, 08.2006

1.4 Directives and standards

CE mark

With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC directives.

EC Machine Directive

The drive systems described here are not machines as defined by the EC Machine Directive (98/37/EEC) but components for installation in machines. They do not have moving parts designed for specific purposes. However, they can be components of a machine or system.

The manufacturer must certify that the complete system conforms to the machine directive with the CE mark.

EC EMC Directive

The EC Electromagnetic Compatibility Directives (89/336/EEC) applies to products that cause electromagnetic interference or whose operation may be be adversely affected by electromagnetic interference.

Conformity with the EMC Directive can only be expected of drive systems after correct installation in the machine. The information on ensuring electromagnetic compatibility given in the chapter on "Installation" must be followed to ensure that the drive system in the machine or system is EMC-compatible and that the product can legally be operated.

EC Low-Voltage Directive

The EC Low-Voltage Directive (73/23/EEC) lays down safety requirements for 'electrical apparatus' as protection against the risks that can originate in such devices and can be created in response to external influences.

The drive systems described here comply with the EN 50178 Standard as per the Low-Voltage Directive.

Declaration of conformity

The declaration of conformity certifies that the drive system complies with the specific EC directive.

Relevant standards

EN 60204-1: Electrical equipment of machines, General requirements

EN 60529: IP degrees of protection

Standards for compliance with EMC limit values

EN 61000-4-1: Measuring and test procedures, overview

EN 61800-3: Variable-speed electrical drives

0098441113326, V1.01, 08.2006

1.5 Declaration of conformity

EC Declaration of Conformity
Year 2006

BERGER LAHR

BERGER LAHR GmbH & Co.KG
Breslauer Str. 7
D-77933 Lahr

☐ according to EC Directive Low Voltage 73/23/EEC, changed by CE Marking Directive 93/68/EEC
☐ according to EC Directive on Machinery 98/37/EEC
☒ according to EC Directive EMC 2004/108/EEC

We declare that the products listed below meet the requirements of the mentioned EC Directives with respect to design, construction and version distributed by us. This declaration becomes invalid with any modification on the products not authorized by us.

Designation:	Braking Resistor Control
Type:	UBC 60
Product number:	ACC3EA001
Applied harmonized standards, especially:	EN 50178:1998 EN 61800-3:2001, second environment according to Berger Lahr EMC test conditions
Applied national standards and technical specifications, especially:	Berger Lahr EMC test conditions 200.47-01 EN Product documentation
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/ Signature:	30 June 2006
Name/ Department:	Wolfgang Brandstätter/R & D

0098441113326, V1.01, 08.2006

2 Safety

2.1 Qualification of personnel

Only technicians who are familiar with and understand the contents of this manual and the other relevant manuals are authorised to work on and with this drive system. The technicians must be able to detect potential dangers that may be caused by setting parameters, changing parameter values and generally by the mechanical, electrical and electronic equipment.

The technicians must have sufficient technical training, knowledge and experience to recognise and avoid dangers.

The technicians must be familiar with the relevant standards, regulations and safety regulations that must be observed when working on the drive system.

2.2 Intended use

The drive systems described here are products for general use that conform to the state of the art in technology and are designed to prevent any dangers. However, drives and drive controllers that are not specifically designed for safety functions are not approved for applications where the functioning of the drive could endanger persons. The possibility of unexpected or unbraked movements can never be totally excluded without additional safety equipment. For this reason personnel must never be in the danger zone of the drives unless additional suitable safety equipment prevents any personal danger. This applies to operation of the machine during production and also to all service and maintenance work on drives and the machine. The machine design must ensure personal safety. Suitable measures for prevention of property damage are also required.

In the system configuration described the drive systems must be used in industrial applications only and must have a fixed connection only.

In all cases the applicable safety regulations and the specified operating conditions, such as environmental conditions and specified technical data, must be observed.

The drive system must not be commissioned and operated until completion of installation in accordance with the EMC regulations and the specifications in this manual.

To prevent personal injury and damage to property damaged drive systems must not be installed or operated.

Changes and modifications of the drive systems are not permitted and if made all no warranty and liability will be accepted.

The drive system must be operated only with the specified wiring and approved accessories. In general, use only original accessories and spare parts.

The drive systems must not be operated in an environment subject to explosion hazard (ex area).

0098441113326, V1.01, 08.2006

2.3 General safety instructions

⚠ WARNING

Risk of injury by loss of control!

A failure may result in unbraked movement of the attached drive systems because of overvoltage.

- The assessment of error possibilities must also include unexpected delays and the failure of signals or functions.
- Check that measures taken are effective.

Failure to follow these instructions can result in death or serious injury.

▶ Observe the general safety instructions in the product manuals of the drive systems.

2.4 Monitoring functions

The monitoring functions in the product protect the system and reduce the risks involved in a system malfunction. These monitoring functions are not sufficient for personal protection.
The following errors and limit values can be monitored:

Monitoring	Task	Protective function
I^2t monitoring	Warning or shutdown on overload	Device protection
Overtemperature	Monitoring device for overtemperature	Device protection

Table 2.1 Monitoring functions

0098441113326, V1.01, 08.2006

3 Technical Data

3.1 Environmental conditions

Ambient operating temperature

Temperature when using the internal braking resistor [1)]	[°C]	0 ... +50
Temperature when using the internal braking resistor with a power reduction of 0.5 W per Kelvin	[°C]	+45 ... +50
Temperature when using an external braking resistor [1)]	[°C]	0 ... +60

1) no icing

Ambient climate for transport and storage

The environment during transport and storage must be dry and dust-free. The maximum oscillation and shock stress must be within the specified limits. The bearing and transport temperature must remain within the specified range.

Temperature	[°C]	-25 ... +70

Pollution degree

Pollution degree	2

Relative humidity

The relative humidity is allowed as follows:

rel. humidity	corresponding to IEC60721-3-3, class 3K3, 5% - 85%, no condensation permissible

Vibration and shock loading

The strength during oscillation stress on the units corresponds to EN 50178 Section 9.4.3.2 and EN 61131 Section 6.3.5.1.

Oscillation and vibration	As per IEC/EN 60068-2-6: 1.5 mm peaks of 3 ... 13Hz, 1 g from 13 ... 150Hz
Shock loading	As per IEC/EN 60068-2-27: 15 g for 11 ms

EMC

Emission	EN61800 category C3, second environment (industrial area)
Noise immunity	EN61800 second environment (industrial area)

IP degree of protection

Degree of protection as per DIN EN 60052-9-1	IP20

0098441113326, V1.01, 08.2006

3.2 Mechanical data

3.2.1 Dimensions

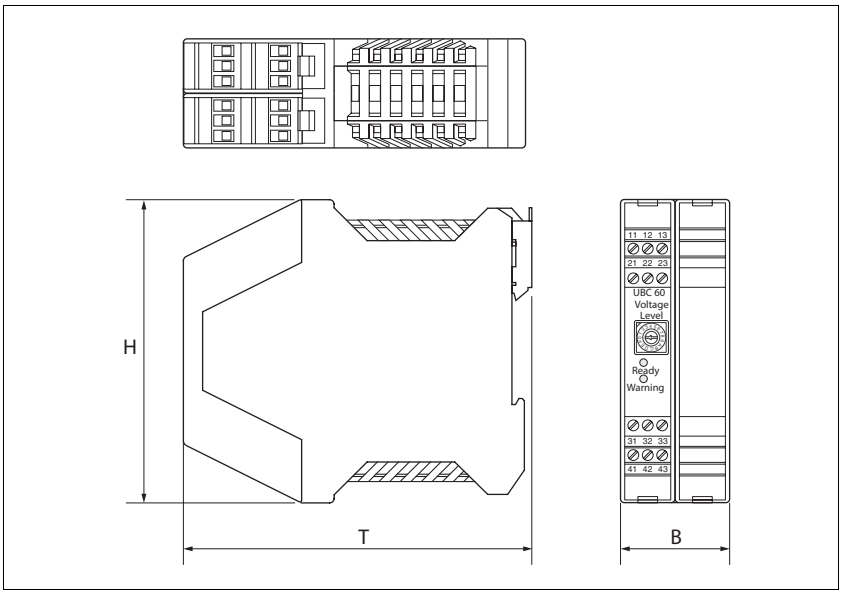

Figure 3.1 Dimensions

H	[mm]	99
B	[mm]	35
T	[mm]	114.5
Weight	[kg]	0.16

0098441113326, V1.01, 08.2006

3.3 Electrical Data

3.3.1 General

Switch position	Response threshold [V]	max. peak output internal [W]	I^2t warning [s]	I^2t shut-down [s]	max. peak output external [W]	min. external resistance value [Ω]
0	28	167	6.0	12.0	420	1.89
1	30	191	5.2	10.5	450	1.98
2	32	218	4.6	9.2	480	2.08
3	34	246	4.1	8.2	510	2.29
4	36	276	3.6	7.3	540	2.41
5	38	307	3.3	6.5	570	2.53
6	40	340	2.9	5.9	600	2.65
7	42	375	2.7	5.3	630	2.79
8	44	412	2.4	4.9	660	2.93
9	46	450	2.2	4.5	690	3.07
A	48	490	2.0	4.1	720	3.23
B	50	532	1.9	3.8	750	3.39
C	53	596	1.7	3.4	795	3.56
D	56	665	1.5	3.0	840	3.73
E	59	739	1.4	2.7	885	3.92
F [1)]	62	816	1.2	2.5	930	4.12

1) Factory setting

Switch position — The switch position is the position that can be set with the rotary switch "Voltage Level".

Response threshold — The response threshold defines the voltage value from which the braking resistor controller is activated.

Max. peak output internal — The value defines the max. peak output when using the internal braking resistor.

I^2t warning — The value defines a continuous switching time after which a warning is output by the I^2t monitoring (when using the internal braking resistor only). The times are extended with pulsed operation.

I^2t shutdown — The value defines a continuous switching time after which the internal braking resistor is shut down by the I^2t monitoring. The times are extended with pulsed operation.

Max. peak output external — The value defines the max. peak output when using an external braking resistor.

min. external resistance value — The value defines the minimum possible resistance value of the external braking resistor.

0098441113326, V1.01, 08.2006

3.3.2 Connections

Terminals Individual wires must be connected with wire end ferrules only.

Max. cross section	[mm^2]	2.5
	[AWG]	12

Supply voltage The connection is protected against polarity reversal.

Voltage range	[V]	18 ... 65
Switching thresholds	[V]	28 ... 62
Switching hysteresis	[V]	1
Max. continuous output internal	[W]	10
power loss	[W]	approx. 1
Peak energy to warning	[Ws]	1000
Peak energy to shutdown	[Ws]	2000
Temperature to warning	[°C]	>90
Temperature to shutdown	[°C]	>100
Internal resistance value	[Ω]	approx. 4.71
Primary fuse	[A]	15/16 [1)]

1) fusible links of class CC or J as per UL 248-4, alternatively miniature circuit-breakers with B or C-characteristic. 15/16A specification: circuit breakers are available with 16A nominal current, UL fuses with 15A.

external braking resistor The connection is protected against short circuit and overload.

Max. permissible peak current	[A]	15
Overload detection	[A]	>20
Max. total switching time after which the resistance is shut down	[s]	5
Max. switching time with which the resistance can be operated	[%]	50
Max. resistance value	[Ω]	4.7

The maximum continuous output depends on the external braking resistor and its cooling.

Signal outputs The signal outputs are switched via 2 relays and are electrically isolated from the power connection.

max. switching voltage	[V_{DC}]	35
max. switching current	[mA]	100

0098441113326, V1.01, 08.2006

4 Installation

4.1 Electromagnetic compatibility, EMC

⚠ WARNING

Interference with signals and devices may cause injury

Distorted signals can cause unexpected device responses.

- Install the wiring in accordance with the EMC requirements.
- Check compliance with the EMC requirements, particularly in an environment subject to strong interference.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The product and the system are subject to electromagnetic interference. If suitable precautions are not taken, the interference will affect the signals from the control lines and system parts and adversely affect the operating reliability of the system.

Before operation the electromagnetic compatibility of the system must be checked and assured. The EMC requirements in the product manuals for the drive systems must also be observed.

EMC measures

The requirements of the EC Directives for EMC noise immunity in accordance with DIN EN 61800-3 for the second environment are met when the following measures are taken during installation.

- To maintain the limit values for the EMC interference resistance and interference radiation the product must be earthed. It can be earthed by mounting it on an earthed top-hat rail or via the terminals.

4.2 Mechanical installation

Braking Resistor Controller

Heat is generated in the braking resistor controller. When selecting the installation site make sure that heat accumulation can be dissipated.

external braking resistor

When using an external braking resistor note the following:

- The surface of the external braking resistor may become very hot. Protection to prevent contact may be necessary.
- Heat-sensitive or flammable components must not be installed close to it.
- A braking resistor with shutdown on overtemperature is recommended.

Mounting

▶ Mount the braking resistor controller in a vertical position. This is particularly important for cooling the device.

0098441113326, V1.01, 08.2006

4.3 Electrical installation

⚠ DANGER

Electric shock from incorrect power supply unit.

The +24VDC and VDC supply voltages are connected with many exposed signals in the drive system.

- Use a power supply unit that meets the requirements for PELV (Protective Extra Low Voltage)
- Connect the negative output of the power supply unit to PE.

Failure to follow these instructions will result in death or serious injury.

Wiring diagram

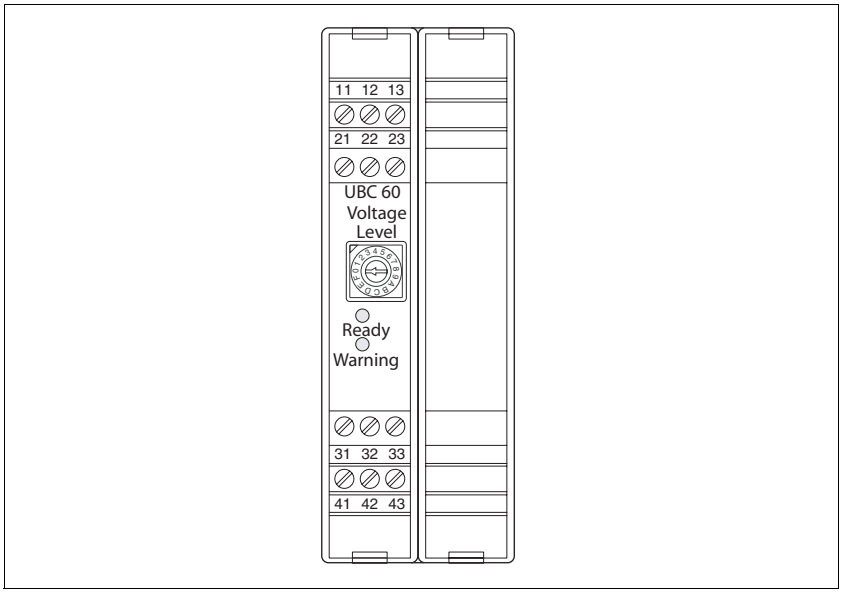

Figure 4.1 Wiring diagram for braking resistor controller

Terminal	Signal	Description	I/O
22, 32	0VDC	Reference potential to VDC	I
23, 33	VDC	Supply voltage (+) 1)	I
21, 31, 41	SHLD	Shield 2)	
11	READY_OUT	Ready	O
12	COM	Reference potential at READY_OUT and NO_FAULT_OUT	
13	NO_FAULT_OUT	Temperature prewarning	O
42, 43	RBE	external braking resistor	O

1) Connections 22 and 23 or connections 32 and 33 may be used.
2) One of the three connections is sufficient when it is earthed via the terminals.

0098441113326, V1.01, 08.2006

4.3.1 Connection of power supply

The braking resistor controller must be connected parallel to the PELV circuit.

Cable specifications

- minimum cross-section: 1.5 mm^2

Fuses

The braking resistor controller requires fuses if the maximum current of the power supply is greater than 16 A.

- If there is a fuse in the PELV circuit, the braking resistor controller can be connected behind the fuse.
- If there are two or more fuses in the PELV circuit, the braking resistor controller must be fused separately. See also chapter 4.3.5 “Wiring examples“

▶ Connect the braking resistor controller corresponding to the terminal assignment.

4.3.2 Connection of signal outputs

The signal outputs READY_OUT and NO_FAULT_OUT are used to indicate the current operating status or error status.

▶ Connect the signal outputs to the master controller corresponding to the terminal assignment.

4.3.3 Connection of external braking resistor

An external braking resistor can be connected as an alternative to the internal braking resistor. When selecting an external braking resistor pay particular attention to the impulse strength.

▶ Connect the external braking resistor corresponding to the terminal assignment.

Cable specifications

- minimum cross-section: 1.5 mm^2
- Maximum cable length: 3m

For more information see chapter 5.1 “Rating“.

4.3.4 Checking installation

After completion of all steps we recommend checking the installation to prevent any errors before operation of the system.

▶ Check in detail:

- Is the power supply correctly connected?
- Is PE correctly connected?

0098441113326, V1.01, 08.2006

4.3.5 Wiring examples

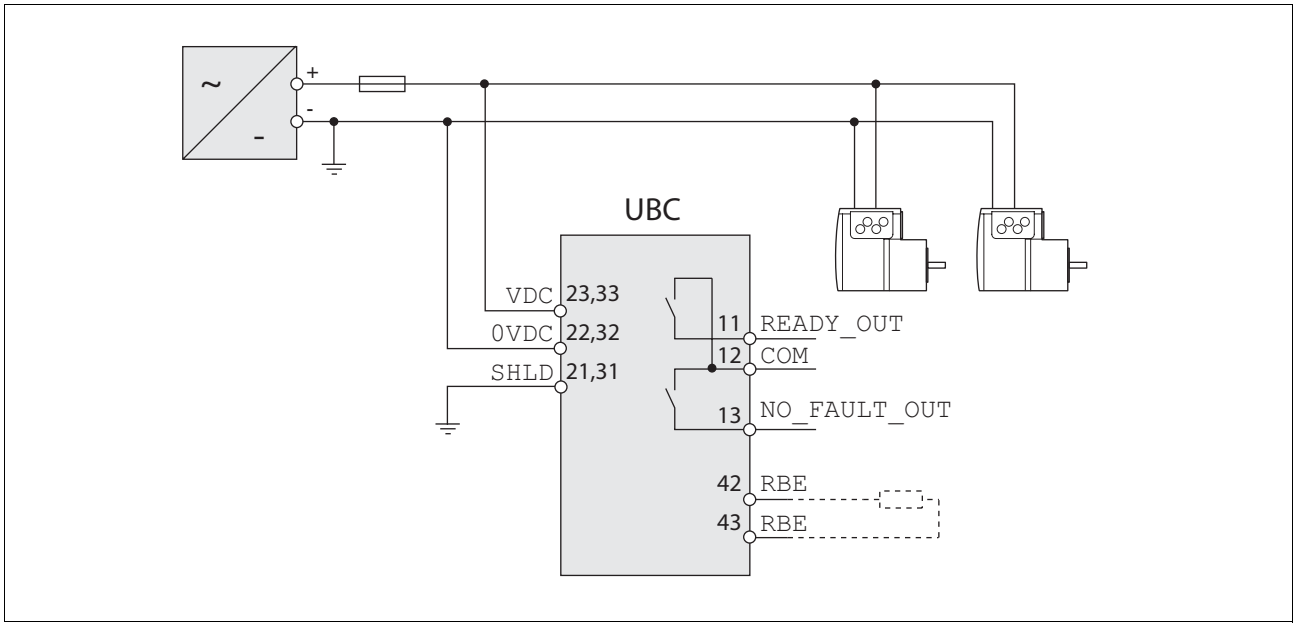

Figure 4.2 Connection of UBC with 1 fuse at power supply unit

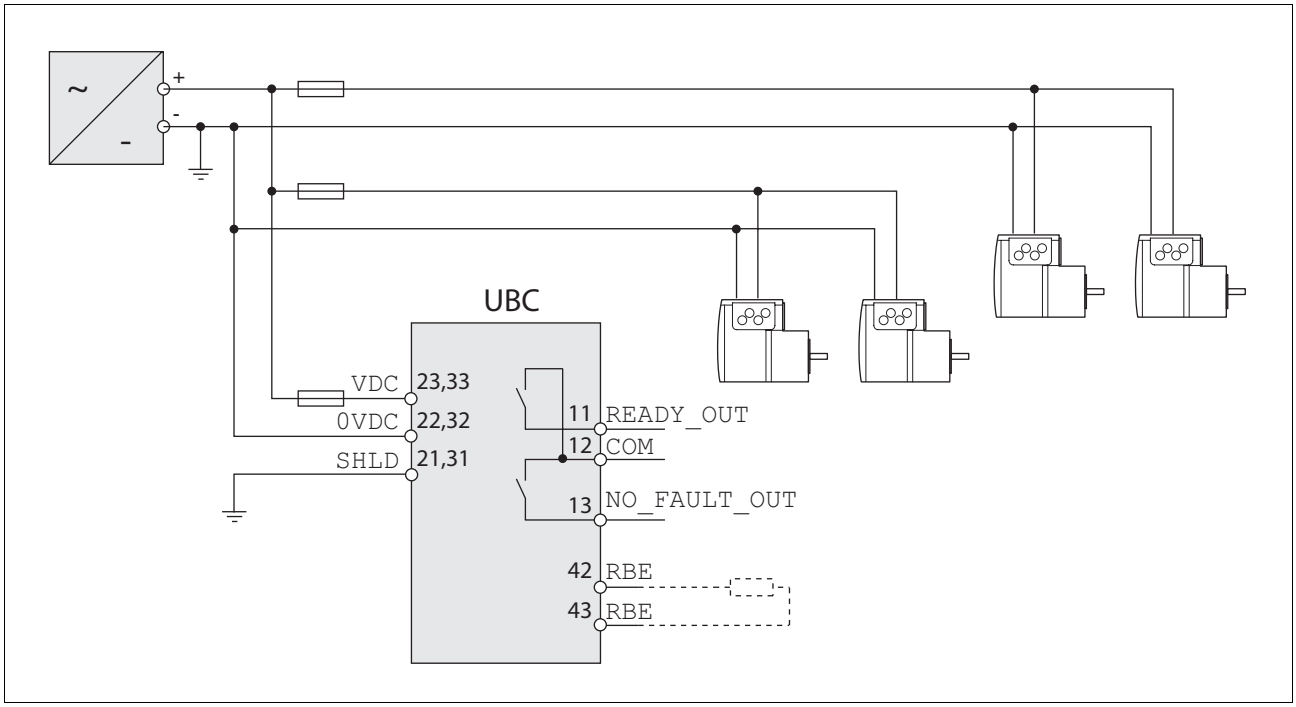

Figure 4.3 Connection of UBC with 2 or more fuses at power supply unit

0098441113326, V1.01, 08.2006

5 Commissioning

5.1 Rating

The rating clarifies the question of whether the generated braking energy can be braked during braking.

Procedure Proceed as follows for rating.

(1) The braking energy that can be absorbed during braking must be defined.

(2) The absorbed braking energy is weakened by losses. The energy absorption by mechanical and electrical losses must be defined.

(3) In addition, the capacitors in the PELV circuit also absorb energy. This energy absorption must also be defined.

(4) The excess braking energy for absorption must be absorbed by the braking resistor controller. It is also necessary to check whether the permissible peak energy, peak output and continuous output will be exceeded.

(5) If the permissible peak energy, peak output or continuous output of the internal braking resistor is exceeded, check whether an external braking resistor is required. If an external braking resistor is used, check again whether the permissible peak energy, peak output and continuous output of the external braking resistor is exceeded.

For assistance with conversion of units see chapter 7.1 “Units and conversion tables“.

0098441113326, V1.01, 08.2006

5.1.1 Determining the braking energy that must be absorbed

If the total moment of inertia of the mass that must be absorbed is known and the mass must be braked to a standstill, use the following formula:

$W_B = 1/2 * J * (2 * \pi * n/60)^2$

W_B = braking energy to be absorbed in Ws
J = total moment of inertia in kgm^2
n = speed in 1/min

5.1.2 Determining the energy by losses

Electrical losses WE The electrical losses W_E in the drive can be estimated from the peak power of the drive. The maximum power loss is around 10% of peak power for a typical efficiency factor of 90%. If the current on braking is lower, the power loss will be reduced accordingly.

Mechanical losses W_M The mechanical losses result from absorption by friction, which occurs when the system is running. Mechanical losses can be ignored if the system requires a much longer time to coast to a stop than the time required to stop the system under braking. The mechanical losses can be calculated from the load torque and the speed from which the motor is to stop.

5.1.3 Determining the energy absorbed by the capacitors

The energy absorption of the capacitors in the PELV current circuit can be calculated as follows:

$W_C = 1/2 * C * (U_{SW}^2 - U_0^2)$

W_C = energy absorption in the capacitors in Ws
C = capacity of capacitors in F
U_{SW} = response threshold
U_0 = voltage of PELV circuit before braking

0098441113326, V1.01, 08.2006

5.1.4 Monitoring the internal braking resistor

The peak energy, peak output and continuous output must be checked.

Peak energy Use the following formula:

$W_{B2} = W_B - W_E - W_M - W_C$

W_{B2} = excess braking energy to be absorbed in Ws
W_B = braking energy to be absorbed in Ws
W_E = electrical losses in Ws
W_M = mechanical losses in Ws
W_C = braking energy that the capacitors can absorb in Ws

This gives:

- W_{B2} is negative or 0 Ws

  Result:
  no excess braking energy for absorption.

  Measure:
  a braking resistor controller is not required.

- W_{B2} is >0 Ws and <2000 Ws

  Result:
  the max. peak energy is not exceeded.

  Measure:
  the excess braking energy for absorption can be absorbed by the braking resistor controller. However, the peak output and continuous output must be checked.

- W_{B2} is >2000 Ws

  Result:
  the max. peak energy is exceeded.

  Measure:
  the excess braking energy for absorption cannot be absorbed by the braking resistor controller. The braking energy that must be absorbed must be reduced (e.g. lower speed, lower moment of inertia) or the use of an external braking resistor must be considered.

0098441113326, V1.01, 08.2006

Peak output

The max. peak output depends on the switch position, see chapter 3.3 “Electrical Data“.

$P_p = W_{B2} / t_B$

P_p = resulting peak output in W
W_{B2} = excess braking energy for absorption in Ws
t_B = specified deceleration time in s (one braking)

This gives:

- P_p is less than the max. peak output

  Result:
  the max. peak output is not exceeded.

  Measure:
  the resulting peak output can be absorbed by the braking resistor controller. However, the continuous output must be checked.

- P_p is greater than the max. peak output

  Result:
  the max. peak output is exceeded.

  Measure:
  the resulting peak output cannot be converted by the braking resistor controller. The deceleration time t_B must be extended or the use of an external braking resistor must be considered.

Continuous output

$P_{cont} = W_{B2} / T$

P_{cont} = resulting continuous output in W
W_{B2} = excess braking energy for absorption in Ws
T = cycle time in s

This gives:

- P_{cont} is <10 W

  Result:
  the continuous output is not exceeded.

  Measure:
  the resulting continuous output can be absorbed by the braking resistor controller.

- P_{cont} is >10 W

  Result:
  the continuous output is exceeded.

  Measure:
  the resulting continuous output cannot be converted by the braking resistor controller. The deceleration time t_B must be extended, the cycle time T must be extended or the use of an external braking resistor must be considered.

0098441113326, V1.01, 08.2006

5.1.5 Monitoring the external braking resistor

If the permissible peak energy, peak output or continuous output of the internal braking resistor is exceeded, check whether an external braking resistor is required. If an external braking resistor is used, check again whether the permissible peak energy, peak output and continuous output of the external braking resistor is exceeded.

The limit values for the external braking resistors can be found in chapter 3.3.2 “Connections“.

Resistance value

The resistance value R is derived from the required peak output and the voltage of the switching threshold.

$R = U^2 / P_{max}$

U : Switching threshold [V]
P_{max} : Peek power [W]
R: Resistance [Ohm]

Figure 5.1 Calculating the resistance R of an external braking resistor

Peak energy

The max. peak energy is given by the technical data of the braking resistor in use.

Use the following formula:

$W_{B2} = W_B - W_E - W_M - W_C$

W_{B2} = excess braking energy to be absorbed in Ws
W_B = braking energy to be absorbed in Ws
W_E = electrical losses in Ws
W_M = mechanical losses in Ws
W_C = braking energy that the capacitors can absorb in Ws

This gives:

- W_{B2} is less than the max. peak energy

  Result:
  the max. peak energy is not exceeded.

  Measure:
  the excess braking energy for absorption can be absorbed by the external braking resistor. However, the peak output and continuous output must be checked.

- W_{B2} is greater than the max. peak energy

  Result:
  the max. peak energy is exceeded.

  Measure:
  select an external braking resistor with suitable technical data.

0098441113326, V1.01, 08.2006

Peak output

The max. peak output is given by the technical data of the braking resistor in use.

$P_p = W_{B2} / t_B$

P_p = resulting peak output in W
W_{B2} = excess braking energy for absorption in Ws
t_B = specified deceleration time in s (one braking)

This gives:

- P_p is less than the max. peak output

  Result:
  the peak output is not exceeded.

  Measure:
  the resulting peak output can be converted by the external braking resistor. However, the continuous output must be checked.

- P_p is greater than the max. peak output

  Result:
  the peak output is exceeded.

  Measure:
  the deceleration time t_B must be extended or select an external braking resistor with suitable technical data.

Continuous output

The max. continuous output is given by the technical data of the braking resistor in use.

$P_{cont} = W_{B2} / T$

P_{cont} = resulting continuous output in W
W_{B2} = excess braking energy for absorption in Ws
T = cycle time in s

This gives:

- P_c is less than the max. continuous output

  Result:
  the continuous output is not exceeded.

  Measure:
  the resulting continuous output can be converted by the external braking resistor.

- P_{cont} is greater than the max. continuous output

  Result:
  the continuous output is exceeded.

  Measure:
  the deceleration time t_B must be extended, the cycle time T must be extended or select an external braking resistor with suitable technical data.

0098441113326, V1.01, 08.2006

5.1.6 Example calculation

Assumed

Intelligent compact drive IclA IFA61
nominal voltage U_0 = 24 V
peak current = 7 A
peak output = 168 W
power loss = 16.8 W (10%)
moment of inertia J = 0.0001 kgm^2
speed of rotation n = 3000 1/min
response threshold U_{SW} = 56 V
deceleration time t_B = 0.1 s
capacity C = 1500 µF
cycle time T = 2 s

Determining the braking energy that must be absorbed

$W_B = 1/2 * J * (2 * \pi * n/60)^2$

$W_B = 1/2 * 0.0001 * (2 * \pi * 3000/60)^2$

$W_B = 4.935$ Ws

Determining the mechanical losses

Mechanical losses are neglected.

Determining the electrical losses

W_E = power loss * t_B

$W_E = 16.8$ W * 0.1 s

$W_E = 1.68$ Ws

Determining the energy absorbed by the capacitors

$W_C = 1/2 * C * (U_{SW}^2 - U_0^2)$

$W_C = 1/2 * 0.0015$F * (56 V - 24 V)

$W_C = 1.92$ Ws

Monitoring the peak energy

$W_{B2} = W_B - W_E - W_M - W_C$

$W_{B2} = 4.935$ Ws - 1.68 Ws - 1.92 Ws

$W_{B2} = 1.335$ Ws

the excess braking energy for absorption can be absorbed by the braking resistor controller. However, the peak output and continuous output must be checked.

Monitoring the peak output

$P_p = W_{B2} / t_B$

$P_p = 1.335$ Ws / 0.1 s

$P_p = 13.35$ W

the resulting peak output can be absorbed by the braking resistor controller. However, the continuous output must be checked.

Monitoring the continuous output

$P_{cont} = W_{B2} / T$

$P_{cont} = 1.335$ Ws / 2 s

$P_{cont} = 0.668$ W

the resulting continuous output can be absorbed by the braking resistor controller. An external braking resistor is not required.

0098441113326, V1.01, 08.2006

5.2 Setting rotary switch

The setting of the rotary switch depends on the conditions of the area of application. Because of the many different system setups only recommendations for the setting can be made.

Settings to the rotary switch must be made only in non-powered status.

Recommendations

We recommend setting the rotary switch with a voltage value about 4 V below the shut-off threshold of the product. If there are several products in the PELV circuit, use the lowest shut-off threshold.

The tolerances of the power supply units must also be taken into account.

5.3 Checking settings

Self-test

During start-up the system checks whether an external braking resistor is connected. The "Warning" LED shows whether the internal or external braking resistor is used.

- Single flash: external braking resistor is used.
- Double flash: internal braking resistor is used.

After the test the "Ready" LED (green) is on and the "Warning" LED (yellow) is off.

Function test

▶ Test the function of the braking resistor controller under realistic conditions.

0098441113326, V1.01, 08.2006

5.4 Status displays

The various operating states are displayed by two LEDs and two relays. The table below shows an overview.

Operating status	LED "Ready"	LED "Warning"	Relay READY_OUT	Relay NO_FAULT_OUT
ready, no error	lights	off	closed	closed
braking resistor active	lights	lights	closed	closed
voltage <19.2 V	off	off	open	open
overtemperature warning 1)	lights	off/on/flashing	closed	open
overtemperature shutdown 1)	off	flashing	open	open
I^2t warning 1)	lights	off/on/flashing	closed	open
I^2t shutdown 1)	flashing	off	open	open
time exceeded 2)	flashes simultaneously with "Warning" LED	flashes simultaneously with "Ready" LED	open	open
Short circuit 2)	flashes alternately with "Warning" LED	flashes alternately with "Ready" LED	open	open

1) only when using the internal braking resistor
2) only when using an external braking resistor

Reset error The overtemperature shutdown, I^2t shutdown, time exceeded and short circuit error states remain until the power is shut off. The braking resistor controller is no longer active in these operating states. The braking resistor controller is ready for operation again after correction of the error and switching on the power.

0098441113326, V1.01, 08.2006

0098441113326, V1.01, 08.2006

6 Service, maintenance and disposal

6.1 Service address

If you cannot resolve the fault yourself please contact your appointed sales partner. Have the following details available:

- Type, identification number and serial number of the product (type plate)
- Type of fault (possibly with fault number)
- Previous and concurrent conditions
- Your own ideas regarding the cause of the fault

Include this information if you return the product for inspection or repair.

If you have any questions please contact your local dealer. Your dealer will be happy to give you the name of a customer service outlet in your area.

http://www.berger-lahr.com

6.2 Replacement of products

Observe the following procedure when changing the products.

- ▶ Note the settings.
- ▶ Switch off all power supplies. Make sure that power is no longer connected (safety instructions).
- ▶ Label all connections and remove the product.
- ▶ Note the identification number and the serial number from the product nameplate for later identification.
- ▶ Install the new product as specified in chapter 4 “Installation“
- ▶ Carry out commissioning in accordance with chapter 5 “Commissioning“.

6.3 Maintenance

The product is maintenance free.

You cannot carry out repairs yourself. The repair should only be carried out by a certified customer service organisation. No warranty or liability is accepted for repairs made by the customer.

0098441113326, V1.01, 08.2006

6.4 Shipping, storage, disposal

Shipping The product must be protected against shocks during transport. Use the original packaging for this purpose.

Storage Store the product only under the specified, approved environmental conditions for room temperature and humidity.
Protect the product against dust and dirt.

Disposal The product consists of various materials that can be recycled and must be disposed of separately. Dispose of the product in accordance with local regulations

0098441113326, V1.01, 08.2006

7 Glossary

7.1 Units and conversion tables

The value in the specified unit (left column) is calculated for the desired unit (top row) with the formula (in the field).

Example: conversion of 5 metres [m] to yards [yd]
5 m / 0.9144 = 5.468 yd

7.1.1 Length

	in	ft	yd	m	cm	mm
in	-	/ 12	/ 36	* 0.0254	* 2.54	* 25.4
ft	* 12	-	/ 3	* 0.30479	* 30.479	* 304.79
yd	* 36	* 3	-	* 0.9144	* 91.44	* 914.4
m	/ 0.0254	/ 0.30479	/ 0.9144	-	* 100	* 1000
cm	/ 2.54	/ 30.479	/ 91.44	/ 100	-	* 10
mm	/ 25.4	/ 304.79	/ 914.4	/ 1000	/ 10	-

7.1.2 Mass

	lb	oz	slug	kg	g
lb	-	* 16	* 0.03108095	* 0.4535924	* 453.5924
oz	/ 16	-	* $1.942559*10^{-3}$	* 0.02834952	* 28.34952
slug	/ 0.03108095	/ $1.942559*10^{-3}$	-	* 14.5939	* 14593.9
kg	/ 0.453592370	/ 0.02834952	/ 14.5939	-	* 1000
g	/ 453.592370	/ 28.34952	/ 14593.9	/ 1000	-

7.1.3 Force

	lb	oz	p	dyne	N
lb	-	* 16	* 453.55358	* 444822.2	* 4.448222
oz	/ 16	-	* 28.349524	* 27801	* 0.27801
p	/ 453.55358	/ 28.349524	-	* 980.7	* $9.807*10^{-3}$
dyne	/ 444822.2	/ 27801	/ 980.7	-	/ $100*10^{3}$
N	/ 4.448222	/ 0.27801	/ $9.807*10^{-3}$	* $100*10^{3}$	-

7.1.4 Power

	HP	W
HP	-	* 745.72218
W	/ 745.72218	-

0098441113326, V1.01, 08.2006

7.1.5 Rotation

	1/min (RPM)	rad/s	deg./s
1/min (RPM)	-	* π / 30	* 6
rad/s	* 30 / π	-	* 57.295
deg./s	/ 6	/ 57.295	-

7.1.6 Torque

	lb·in	lb·ft	oz·in	Nm	kp·m	kp·cm	dyne·cm
lb·in	-	/ 12	* 16	* 0.112985	* 0.011521	* 1.1521	* $1.129*10^{6}$
lb·ft	* 12	-	* 192	* 1.355822	* 0.138255	* 13.8255	* $13.558*10^{6}$
oz·in	/ 16	/ 192	-	* $7.0616*10^{-3}$	* $720.07*10^{-6}$	* $72.007*10^{-3}$	* 70615.5
Nm	/ 0.112985	/ 1.355822	/ $7.0616*10^{-3}$	-	* 0.101972	* 10.1972	* $10*10^{6}$
kp·m	/ 0.011521	/ 0.138255	/ $720.07*10^{-6}$	/ 0.101972	-	* 100	* $98.066*10^{6}$
kp·cm	/ 1.1521	/ 13.8255	/ $72.007*10^{-3}$	/ 10.1972	/ 100	-	* $0.9806*10^{6}$
dyne·cm	/ $1.129*10^{6}$	/ $13.558*10^{6}$	/ 70615.5	/ $10*10^{6}$	/ $98.066*10^{6}$	/ $0.9806*10^{6}$	-

7.1.7 Moment of inertia

	lb·in²	lb·ft²	kg·m²	kg·cm²	kp·cm·s²	oz·in²
lb·in²	-	/ 144	/ 3417.16	/ 0.341716	/ 335.109	* 16
lb·ft²	* 144	-	* 0.04214	* 421.4	* 0.429711	* 2304
kg·m²	* 3417.16	/ 0.04214	-	* $10*10^{3}$	* 10.1972	* 54674
kg·cm²	* 0.341716	/ 421.4	/ $10*10^{3}$	-	/ 980.665	* 5.46
kp·cm·s²	* 335.109	/ 0.429711	/ 10.1972	* 980.665	-	* 5361.74
oz·in²	/ 16	/ 2304	/ 54674	/ 5.46	/ 5361.74	-

7.1.8 Temperature

	°F	°C	K
°F	-	(°F - 32) * 5/9	(°F - 32) * 5/9 + 273.15
°C	°C * 9/5 + 32	-	°C + 273
K	(K - 273.15) * 9/5 + 32	K - 273.15	-

7.1.9 Conductor cross section

AWG	1	2	3	4	5	6	7	8	9	10	11	12	13
mm²	42.4	33.6	26.7	21.2	16.8	13.3	10.5	8.4	6.6	5.3	4.2	3.3	2.6

AWG	14	15	16	17	18	19	20	21	22	23	24	25	26
mm²	2.1	1.7	1.3	1.0	0.82	0.65	0.52	0.41	0.33	0.26	0.20	0.16	0.13

0098441113326, V1.01, 08.2006

7.2 Terms and Abbreviations

DOM (**D**ate **o**f **m**anufacturing), the nameplate of the device shows the date of manufacture in the format DD.MM.YY,
e.g. 31.12.06 (31. December 2006).

EMC Electromagnetic compatibility.

LED Light-Emitting Diode

PELV Protective Extra Low Voltage, functional low voltage with safe isolation.

Protection class The protection class is a standardised specification for electrical equipment that describes the protection against the ingress of foreign bodies and water (for example, IP20).

0098441113326, V1.01, 08.2006

0098441113326, V1.01, 08.2006

8 Index

0098441113326, V1.01, 08.2006

T

U

0098441113326, V1.01, 08.2006