

**Documentation**

## **External brake resistor AX2090-BW5x**

**Accessories for Beckhoff servo drive AX5000**

**Version:** 1.3  
**Date:** 2018-03-14

**BECKHOFF**



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# 1 Foreword

## 1.1 Notes on the documentation

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

It is essential that the documentation and the following notes and explanations are followed when installing and commissioning the components.

It is the duty of the technical personnel to use the documentation published at the respective time of each installation and commissioning.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

### Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

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EP1590927, EP1789857, DE102004044764, DE102007017835

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## 1.2 Documentation issue status

Version	Comment
1.3	<b>Chapter update:</b> Appropriate use <b>1.3</b> ; For your safety <b>2</b> ; Product identification <b>3</b> ; Technical data <b>6</b>
1.2	<b>Chapter update:</b> 5.5.1
1.1	General update
1.0	First published

## 1.3 Appropriate use

The brake resistors from the AX2090-BW5x-xxxx series are exclusively designed for direct application with an AX5000 series servo drive or the AX5021 brake module. They are designed for installation as components in electrical installations and machines together with the servo drive or the brake module, and this is their only purpose.

 <b>WARNING</b>	<p><b>Caution – Risk of injury!</b></p> <p>Basically, electronic devices are not fail-safe. The machine manufacturer is responsible for ensuring that the connected motors and the machine are brought into a safe state in the event of a fault in the drive system.</p>
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The external brake resistors of the AX2090-BW5x-xxxx series are able to convert the dynamic energy generated during braking of a servomotor into heat. The series covers a wide continuous power and peak power range. The built-in temperature switch enables the system to respond immediately to any overload of the brake resistor through analysis in the AX5000 or the PLC. All brake resistors of the AX2090-BW5x-xxxx series are UL and CSA approved.

### Improper use

The external brake resistor AX2090-BW5x-xxxx is **not** suitable for use in the following areas:

- in ATEX zones without a suitable housing
- in areas with aggressive environments (e.g. aggressive gases or chemicals)

The relevant standards and directives for EMC interference emissions must be complied with in residential areas. The servo drives may only be installed in housings and control cabinets with appropriate shielding attenuation.

## 2 For your safety

Read the section on safety and heed the notices to protect yourself against personal injury and material damages.

### Liability limitations

All the components of the external brake resistor AX2090-BW5x-xxxx are supplied in certain hardware and software configurations appropriate for the conditions of the application. Unauthorized modifications to the hardware and/or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

**In addition, the following actions are excluded from the liability of Beckhoff Automation GmbH & Co. KG:**

- Failure to comply with this documentation
- Improper use
- Untrained personnel
- Use of unauthorized spare parts

### 2.1 Staff qualification

Only technical personnel with knowledge of control and automation technology may carry out any of the illustrated work steps on the Beckhoff software and hardware, in particular on the external brake resistor AX2090-BW5x-xxxx.

The technical personnel must have knowledge of drive technology and electrical systems and must also know how to work safely on electrical equipment and machines.

**This also includes:**




- production planning and
- securing of the working environment (e.g. securing the control cabinet against being switched on again).

The technical personnel must be familiar with the current and necessary standards and directives for the automation and drive environment.


## 2.2 Description of symbols

In this documentation the following symbols are used with an accompanying safety instruction or note. The safety instructions must be read carefully and followed without fail!



### Symbols that warn of personal injury:

 <b>DANGER</b>	<p><b>Serious risk of injury!</b></p> <p>This is an extremely dangerous situation. Disregarding the safety notice will lead to serious permanent injuries or even death.</p>
 <b>WARNING</b>	<p><b>Risk of injury!</b></p> <p>This is a dangerous situation. Disregarding the safety notice may lead to serious injuries.</p>
 <b>CAUTION</b>	<p><b>Personal injuries!</b></p> <p>This is a dangerous situation. Disregarding the safety notice may lead to minor injuries.</p>

### Symbols that warn of damage to property or equipment:

 <b>Attention</b>	<p><b>Warning of damage to property or the environment!</b></p> <p>This notice indicates disturbances in the operational procedure that could damage the product or the environment.</p>
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### Symbols indicating further information or tips:

 <b>Note</b>	<p><b>Tip or pointer!</b></p> <p>This notice provides important information that will be of assistance in dealing with the product or software. There is no immediate danger to product, people or environment.</p>
	<p><b>UL note!</b></p> <p>This symbol indicates important information regarding UL certification.</p>



## 2.3 Safety rules

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations and guidelines.

 <p><b>DANGER</b></p>	<p><b>Serious risk of injury through electric shock!</b></p> <p>Due to the DC link capacitors dangerous voltage (<math>&gt; 890V_{DC}</math>) may persist at the DC link contacts “ZK+ and ZK- (DC+ and DC-)” and “RB+ and RB-“ after the servo drive has been disconnected from the mains supply. After disconnecting the servo drive wait at AX5101 - AX5125 and AX520x; 5 minutes, at AX5140/AX5160/AX5172; 15 minutes, at AX5190/AX5191; 30 minutes and at AX5192/AX5193; 45 minutes and measure the voltage at the DC link contacts ZK+ and ZK- (DC+ and DC-). The device is safe once the voltage has fallen below 50 V.</p>
 <p><b>WARNING</b></p>	<p><b>Caution - Risk of injury through hot surfaces!</b></p> <p>The temperature of the brake resistor housing surface may reach over 200 °C. Please ensure that the housing has cooled down below 40 °C before touching it.</p>
	<p><b>UL-Listing!</b></p> <p>It is essential to observe directives and standards if you wish to operate an AX5000 in an economic area that requires a UL-Listing.</p>

### 3 Product identification

#### Scope of supply

The scope of delivery may vary depending on the ordered configuration. Before installing the device please ensure that all ordered components were delivered and that they are undamaged. In the event of any damage please contact the carrier immediately and document the damage.

#### The scope of supply always includes:

- Brake resistor of the appropriate performance class
- Technical documentation (this documentation)
- Packaging

#### Name plate

Figure	Pos.-No.	Description
<p><b>BECKHOFF</b> Huelshorstweg 20 Phone: + 49 52 46 / 9 63 - 0 Automation GmbH &amp; Co. KG D-33415 Verl Fax: + 49 52 46 / 9 63 - 188 Germany www.beckhoff.com info@beckhoff.com</p> <p>Catalog No. : AX2090 - BW50 - 0600 Serial No. : FZECQU 400 x 65 E No. : E212934</p> <p>1 Type power at 40° C : 600 W 2 Resistance : 47 Ω 3 Switching temperature : 180 °C 4 Product No : 217269</p> <p>5  6  7  Made in Germany</p>	1	Type power at 40 °C
	2	Resistance
	3	Switching temperature
	4	Product no
	5	Barcode
	6	UL-Recognized Component – certification
	7	CE – certification
	8	E no.
	9	Serial no.
	10	Catalog no.

#### Type key

Figure	Pos.-No.	Description
<p>AX2090-BW5x-yyyy</p>	1	Drive Technology Accessories
	2	BW = brake resistor
	3	Servo drive AX5000
	4	0 = AX5000 up to 12 A rated channel current 1 = AX5118 up to AX5140 2 = AX5160 up to AX5172 3 = AX5190 up to AX5191 4 = AX5192 up to AX5193
	5	AX5000

## 4 Mechanical installation

### 4.1 Mounting positions and distances

(A) = vertical installation is only permitted according to the diagram (terminal box facing downwards).  
 (B) = horizontal installation


Assignment of the device classes	
<p>The diagram shows two views of a device. On the left, labeled 'A', is a vertical installation with the terminal box at the bottom. On the right, labeled 'B', is a horizontal installation with the terminal box on the right side. The device has a grid-like front panel.</p>	<p>The diagram shows two views of a device. On the left, labeled 'A', is a vertical installation with the terminal box at the bottom. On the right, labeled 'B', is a horizontal installation with the terminal box on the right side. The device has a grid-like front panel.</p>
AX2090-BW50-xxxx AX2090-BW51-1000	AX2090-BW51-3000 and AX2090-BW51-6000 AX2090-BW52-3000 and AX2090-BW52-6000 AX2090-BW53-3000 and AX2090-BW53-6000 AX2090-BW54-3000 and AX2090-BW54-6000

**For all mounting positions the following minimum distances must be adhered to:**

200 mm to adjacent components, walls etc. and 300 mm to components, ceilings etc. above. If the device is installed vertically (A), the minimum distance to components, floors etc. below is 200 mm in order to allow unobstructed flow of air to the brake resistor.

## 5 Electrical installation

### 5.1 Important notes

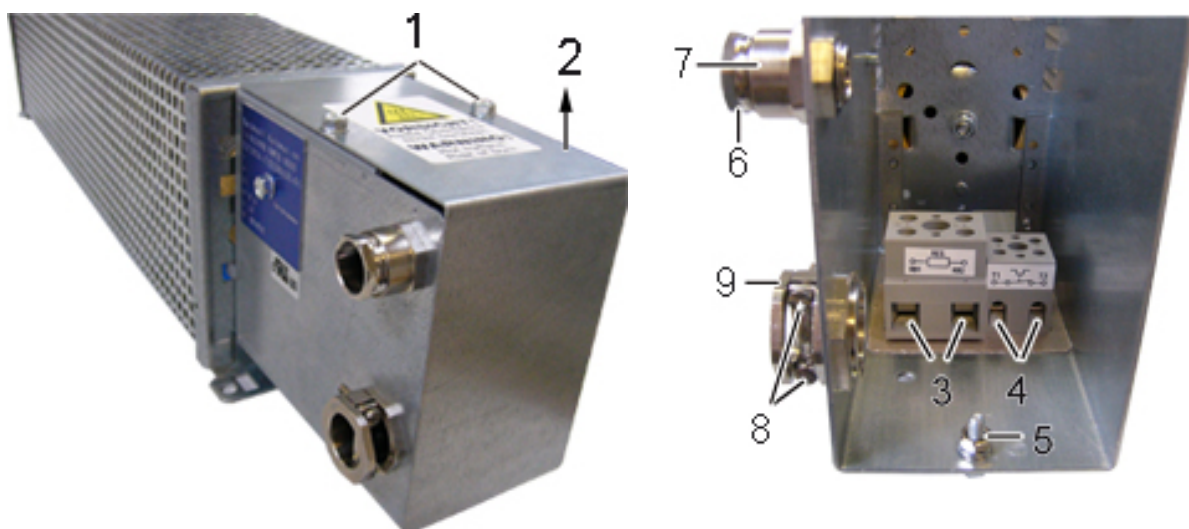
 <b>DANGER</b>	<p><b>Serious risk of injury through electric shock!</b></p> <p>Only staff qualified and trained in electrical engineering are allowed to wire up the brake resistors.</p> <ul style="list-style-type: none"> <li>• Check the assignment of the servo drive and the brake resistor. Compare the rated voltage and the rated current of the devices.</li> <li>• Always make sure that the brake resistors are de-energized during assembly and wiring, i.e. no voltage may be switched on for any piece of equipment which is to be connected. Ensure that the control cabinet remains turned off (barrier, warning signs etc.). The individual voltages will only be turned on again during commissioning.</li> <li>• Due to the DC link capacitors, the DC link contacts "ZK+ and ZK- (DC+ and DC-)" and "RB+ and RB-" may be subject to dangerous voltages exceeding <math>890V_{DC}</math>, even after the servo drive was disconnected from the mains supply. Wait 5 minutes for the AX5101 - AX5125 and AX520x; 15 minutes for the AX5140/AX5160/AX5172; 30 minutes for the AX5190/AX5191; 45 minutes for the AX5192/AX5193 after disconnecting, and measure the voltage at the DC links "ZK+ and ZK- (DC+ and DC-)". The device is safe once the voltage has fallen below 50 V.</li> </ul>
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### 5.2 Connection the brake resistor

Remove the two screws (1) and remove the cover (2) in direction of the arrow. Connect an adequately dimensioned cable (see chapter "Cables") to the connections (3) of the resistor and the earthing stud (5) and take it out of the terminal box through the strain-relief assembly (9). Ensure adequate strain relief with the two screws (8). Connect the other side of the cable to the DC link contact connector "X2" of the AX5000. The connector is supplied with the AX5000. Connect the earthing cable to the earthing conductor of the control cabinet.


Connect an adequately dimensioned cable to the potential-free N/C contact (4) of the temperature switch and take it out of the terminal box through the strain-relief assembly (7) (see chapter "Temperature switch"). Ensure adequate strain relief with the nut (6).

Install the cover (2) in reverse order.



### 5.3 Cables

Beckhoff offers pre-assembled cables for safe, faster and flawless installation of the motors. Beckhoff cables have been tested with regard to the materials, shielding and connectors used. They ensure proper functioning and compliance with statutory regulations such as EMC, UL etc. The use of other cables may lead to unexpected interference and invalidate the warranty.

 <b>WARNING</b>	<p><b>Caution - Fire hazard!</b></p> <p>The brake resistors can reach temperatures of almost 200 °C. Therefore, ensure adequate thermostability of the cables! Cables with inadequate thermostability can cause a cable fire!</p>
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 <b>Attention</b>	<p><b>EMC safety</b></p> <p>Use only shielded cables.</p>
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Type	Brake resistor		Temperature switch	
	[mm <sup>2</sup> ]	[AWG]	[mm <sup>2</sup> ]	[AWG]
AX2090-BW50-0300	1,5	16	0.75	18
AX2090-BW50-0600	1,5	16	0.75	18
AX2090-BW50-1600	1,5	16	0.75	18
AX2090-BW51-1000	2,5	12	0.75	18
AX2090-BW51-3000	2,5	12	0.75	18
AX2090-BW51-6000	2,5	12	0.75	18
AX2090-BW52-3000	4,0	12	0.75	18
AX2090-BW52-6000	4,0	12	0.75	18
AX2090-BW53-3000	6,0	12	0.75	18
AX2090-BW53-6000	6,0	12	0.75	18
AX2090-BW54-3000	6,0	12	0.75	18
AX2090-BW54-6000	6,0	12	0.75	18

We recommend wire end sleeves.

## 5.4 Temperature switch



**Attention**

### Destruction of the brake resistor!

The temperature switch is exclusively used for temperature monitoring. The brake resistor is not switched off.

The temperature switch has a potential-free N/C contact, which enables immediate response to any overload of the brake resistor through analysis in the AX5000 or the PLC. Connect the cable directly to a free input of plug "X06". Then parameterize it such that the AX5000 stops the motor(s) with an emergency ramp or the PLC reads and processes this input.

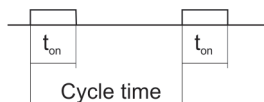
Type	Switching temperature	Switching current 24 VDC or 230 VAC
	[°C]	[A]
AX2090-BW50-0300	180	2
AX2090-BW50-0600	180	2
AX2090-BW50-1600	180	2
AX2090-BW51-1000	180	2
AX2090-BW51-3000	85	2
AX2090-BW51-6000	85	2
AX2090-BW52-3000	85	2
AX2090-BW52-6000	85	2
AX2090-BW53-3000	85	2
AX2090-BW53-6000	85	2
AX2090-BW54-3000	85	2
AX2090-BW54-6000	85	2

## 5.5 Short-term capacity

Brake resistors are usually not operated continuously, but only exposed to short-time duty. In the following section the permitted short-term capacity is calculated based on the continuous power, overload factor and duty cycle.

### 5.5.1 Duty cycle

The duty cycle is a relative value that depends on the switch-on time ( $t_{on}$ ) and the cycle time. Cycle times up to 120 sec. are used directly in the calculation. Should the cycle time exceed 120 sec., the maximum relevant cycle time of 120 sec. is used in the calculation.



$$\text{duty cycle} = \frac{t_{on}}{\text{Cycle time}} \times 100 \%$$

#### Sample 1

$T_{on} = 60 \text{ s}$   
 Cycle time = 280 s  
**Duty cycle = 50%**

#### Sample 2

$T_{on} = 40 \text{ s}$   
 Cycle time = 100 s  
**Duty cycle = 40 %**



**Note**

### Further information of external brake resistors:

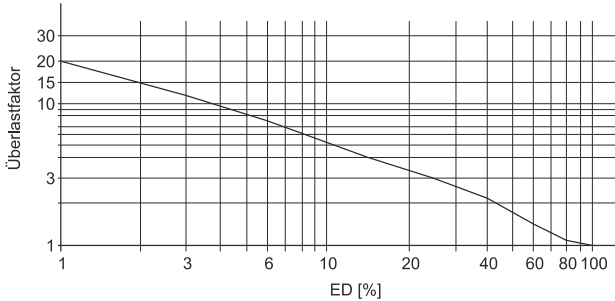
For further information on the configuration and diagnostics of external brake resistors, please refer to the function description of the servo drive AX5000: "Diagnostic of external brake resistors".

### 5.5.2 Overload factor

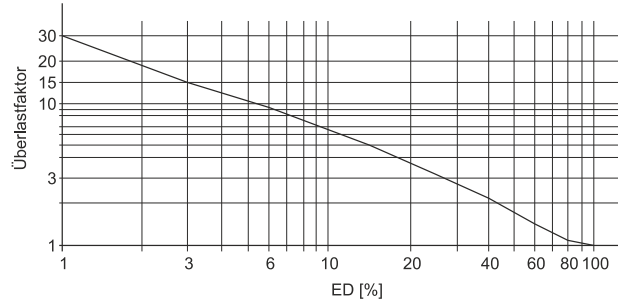
AX2090-BW51-3000 and AX2090-BW51-6000  
 AX2090-BW52-3000 and AX2090-BW52-6000  
 AX2090-BW53-3000 and AX2090-BW53-6000  
 AX2090-BW54-3000 and AX2090-BW54-6000

AX2090-BW50-xxxx and AX2090-BW51-1000

Overload factor depending on duty circle



Overload factor depending on duty circle

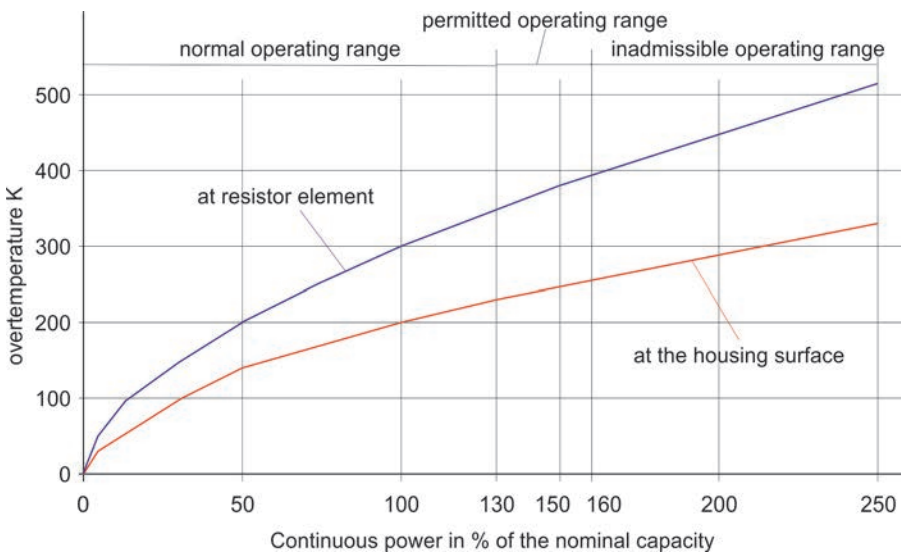


#### Calculation formula

Short-term capacity = continuous power x overload factor

### 5.6 Overtemperature and continuous power at 100% duty cycle

If your application requires a higher continuous power than the specified nominal capacity, you can accept this state if a higher brake resistor temperature is permitted. The following diagram shows the overtemperature v. the continuous power.



Normal operating range, max. 130%	Permitted operating range, max. 160%	Inadmissible operating range, more than 160%
This operating range is recommended for maximum service life and error-free operation.	This operating range is still permitted, although it results in shorter service life with higher failure probability	In this operating range there is a risk of destruction of the brake resistor through overheating. Due to the high temperatures the adjacent components are also at risk.



**Attention**

#### Destruction of the brake resistor and adjacent components

Always ensure adequate ventilation of the brake resistor, since the temperatures of the housing surface may exceed 200 °C.

## 6 Technical data

### Dimensions

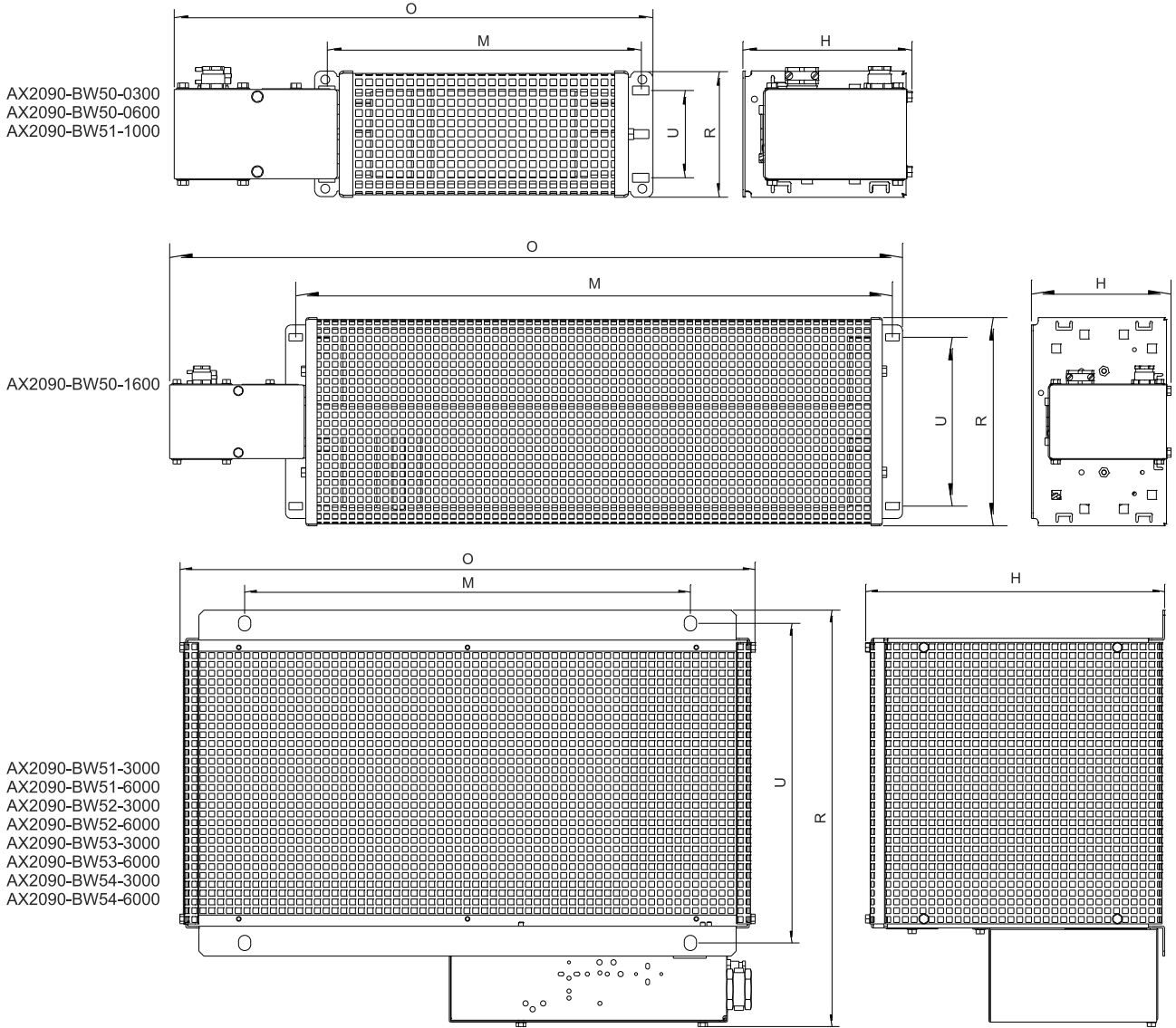
Type <sup>1)</sup>	Type power [W] * at 40 °C	Resistance [Ω]	O [mm]	R [mm]	H [mm]	M [mm]	U [mm]	Weight [kg]	AX5000
AX2090-BW50-0300	300	47	349	92	120	230	64	2	AX5x01-AX5112
AX2090-BW50-0600	600	47	549	92	120	430	64	3	AX5x01-AX5112
AX2090-BW50-1600	1600	47	649	185	120	530	150	5,8	AX5x01-AX5112
AX2090-BW51-1000	1000	23	749	92	120	630	64	4	AX5118-AX5140
AX2090-BW51-3000	3000	23,4	490	355	255	380	270	8	AX5118-AX5140
AX2090-BW51-6000	6000	23,2	490	455	255	380	370	12	AX5118-AX5140
AX2090-BW52-2000	3000	13,2	490	355	255	380	270	8	AX5160-AX5172
AX2090-BW52-6000	6000	13,0	490	455	255	380	370	12	AX5160-AX5172
AX2090-BW53-3000	3000	10,2	490	355	255	380	270	8	AX5190-AX5191
AX2090-BW53-6000	6000	10	490	455	255	380	370	12	AX5190-AX5191
AX2090-BW54-3000	3000	6,6	490	355	255	380	270	8	AX5192-AX5193
AX2090-BW54-6000	6000	6,5	490	455	255	380	370	12	AX5192-AX5193

\*) 4% decrease in performance per 10K temperature difference

<sup>1)</sup> All external brake resistor have the protection class IP20



**Technical drawings**



## 7 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

### **Beckhoff's branch offices and representatives**

Please contact your Beckhoff branch office or representative for local support and service on Beckhoff products!

The addresses of Beckhoff's branch offices and representatives round the world can be found on her internet pages:

<http://www.beckhoff.com>

You will also find further documentation for Beckhoff components there.

### **Beckhoff Headquarters**

Beckhoff Automation GmbH & Co. KG

Huelshorstweg 20  
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e-mail:	info@beckhoff.com

### **Beckhoff Support**

Support offers you comprehensive technical assistance, helping you not only with the application of individual Beckhoff products, but also with other, wide-ranging services:

- support
- design, programming and commissioning of complex automation systems
- and extensive training program for Beckhoff system components

Hotline:	+49(0)5246/963-157
Fax:	+49(0)5246/963-9157
e-mail:	support@beckhoff.com

### **Beckhoff Service**

The Beckhoff Service Center supports you in all matters of after-sales service:

- on-site service
- repair service
- spare parts service
- hotline service

Hotline:	+49(0)5246/963-460
Fax:	+49(0)5246/963-479
e-mail:	service@beckhoff.com