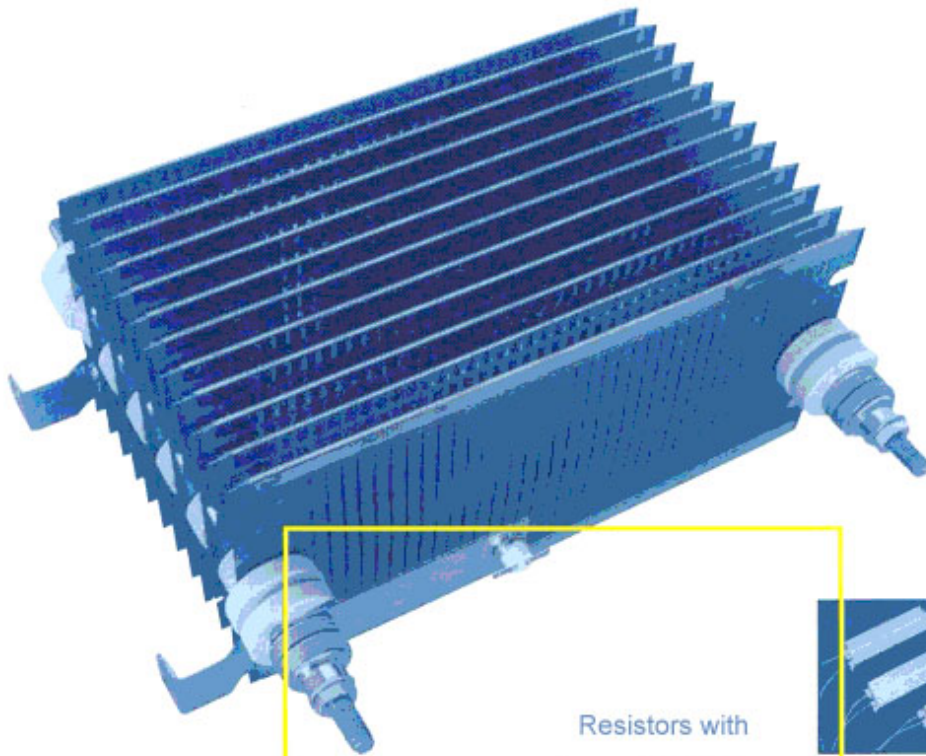


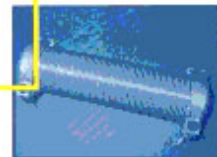
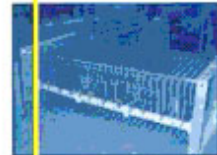
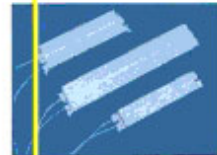
# Technical Catalog



Resistors with  
cast iron  
steel grid and  
wire elements

ALL SYSTEMS

Starting, control,  
slip and  
braking resistors,  
for drives in  
conveying and  
vehicle technology



## General

Resistors are modules or devices in electrical engineering that utilize the property of conductors to impede the flow of current.

Power resistors limit the electricity flow and convert electrical energy to heat.

## Application

Main applications for power resistors are:

### Resistors for drive engineering

- **Starting resistors or starters** limit the starting current in motor circuits and start the motor by being switched off stepwise.
- **Control resistors** are suited to reduce the motor speed. The speed can be controlled by switching different steps on and off.
- **Slip resistors** reduce the motor speed. Depending on the load, the motor lags behind its nominal speed. The drive is "softer", mechanical load surges are attenuated and the impact on the system is reduced.
- **Braking resistors** convert the energy of masses in motion to heat by electrically braking the motor driven by kinetic energy.

### Resistors for power engineering

- **Neutral grounding resistors** installed between the neutral point of a generator or transformer and the functional earth, they limit the ground-fault current to admissible values in case of a defect.
- **Damping resistors** in filter circuits. Installed in parallel to the reactance coils, they dampen the circuits and enlarge the filter band width.
- **Load resistors** in simulated test circuits act as substitute loads instead of real loads and allow to simulate operating conditions.

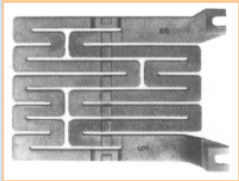
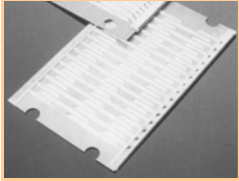
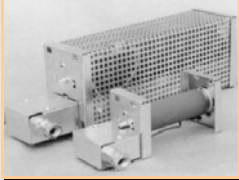







## Designs

The classification below is based on the type of resistor conductor used:

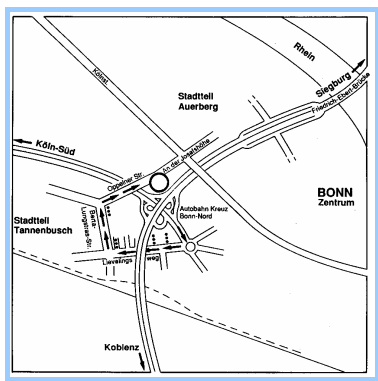
- **Cast iron resistors** consist of individual elements with wave-pattern cast conductors complete with connection and fixing points. Elements of a similar shape in one system with different ohm values are assembled by means of the corresponding mounting elements to form banks, and provided with terminal connections. The banks are available with and without housing.
- **Steel grid resistors** use sheet plates made from AlCr or chromium nickel steel as conductor material with slots or punches to create conductor strips in a wave pattern. As with the cast iron resistors, here too elements with different ohm values can be combined to form modules or banks.
- **Wire-wound resistors** are available in numerous designs. The resistor wire is generally wound around ceramic bodies and provided with terminal connections. In addition, the wire can be fixed with ceramic masses (cement-coated or vitreous enamel resistors), or embedded in ceramic masses.
- **Strip/ribbon-wound resistors** use ribbons or sheet strips as resistor conductors. They are high-performance resistors because the design affords large surfaces at comparably low material weights.
- **Encapsulated resistors** are mostly manufactured on the basis of wire-wound resistors in a heat dissipating housing which are embedded in ceramic, mostly powder-type masses. Special designs include thick-film resistors and thin-film resistors mounted on cooling elements. Due to the low mass of the resistor material, both are only of limited suitability for short-term, high-load operation, i.e. they offer only limited pulse resistance.

**GINO supplies high-performance resistors for all possible applications, and designs and manufactures customized special resistors.**



<p>Cast iron resistors, systems Siemens 3PR3., 3PR2., K48, GINO, AEG, BBC</p> <p>Spare parts for superseded systems available</p>	Cast iron resistors		1
<p>Steel grid resistors, systems Siemens 3PS3, 3PS1, GINO</p>	Steel grid resistors		2
<p>Cement-coated tube resistors, Siemens 3PP1, wire-wound frames, wire grid system AEG</p>	Wire-wound resistors		3
<p>Starter series 3PA1</p>	Starters, oil-cooled		4
<p>Controllers with and without resistors</p>	Starters Control resistors		5
<p>Braking resistors for drives with frequency converter</p>	Braking resistors		6
<p>Braking and protective resistors, roof and underfloor mounting, with natural and forced air cooling</p>	Transportation systems Train resistors		7
<p>Equipment for testing stations, generating set testing stations, mobile load testers</p>	Load resistors Testing resistors		8
<p>Grounding resistors for low and medium-voltage units, damping resistors for filter circuits</p>	Grounding resistors Damping resistors		9
<p>Full-vision crane cabins in simple or insulated design, control platforms for crane cabins</p>	Complementary products Crane cabins Control platforms		10

GINO  
Gielen + Nothnagel GmbH  
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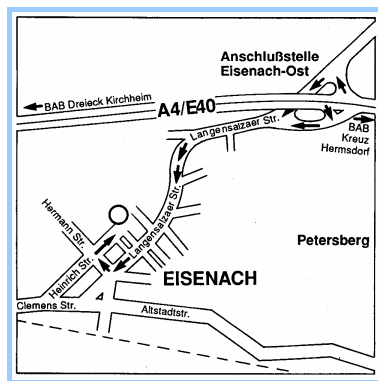
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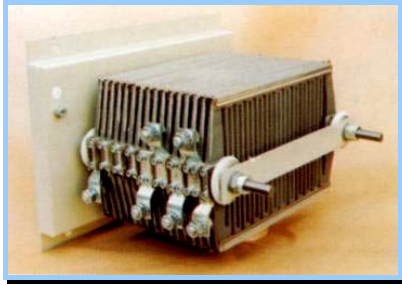
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**Table of contents**

**Systems**

Siemens 3PR3..... page 1.1  
 Siemens 3PR2..... page 1.12  
 Siemens K48 ..... page 1.15  
 GINO ..... page 1.19  
 AEG ..... page 1.23  
 BBC ..... page 1.27

**Other cast iron elements**

AEG/ABB/BBC ..... page 1.29  
 Klöckner..... page 1.29  
 Alstom Unelec ..... page 1.29  
  
 P&O ..... page 1.30  
 Sachsenwerk..... page 1.30  
 General Electric..... page 1.30  
 Others..... page 1.30

**Application**

Cast iron resistors are used in drive engineering in combination with motor starters or contactor controls for the starting and stepping of the three-phase slip-ring rotor or three-phase motors. They can also be applied as slip, series or load resistors. Cast iron resistors are characterized by high overload capacity and are mainly used for short-term or intermittent operation.

**Systems**

GINO GmbH is the only manufacturer of cast iron resistors who manufactures and supplies nearly all standard systems used on the European market and also spares for superseded models from AEG, BBC, ABB and others. All systems supplied by Siemens to date are completely available. For new units, only the systems GINO and Siemens 3PR3.. should be used.

**Codes and standards**

The units comply with the applicable specifications of VDE regulations VDE 0100 and VDE 0660. They conform with the EEC Low Voltage Directive of 19 February 1973.

**Protection classes**

Pursuant to DIN 40 050/IEC 144 IP00, IP10, IP13, IP20, IP23 are available depending on the system in question.

**Operating modes**

**KB**

Short-term operation, with subsequent cooling down

**AB**

Intermittent operation with regular On/Off time  $t_a/t_r$ , indicated as duty factor in %.

$$ED = \frac{t_a}{t_a + t_r} \cdot 100 [\%]$$

**DB**

Continuous operation

**Insulation**

The rated insulation voltage is 1500V AC/1800V DC at a pollution degree 3 pursuant to VDE 0110.

**Resistance to climatic changes**

Cast iron resistors are resistant to climatic changes pursuant to DIN 50 010 T1 and suited for indoor and outdoor installation at varying conditions of condensation, without protection against weathering at low pollution impact. The admissible ambient temperature ranges from -25 to +45°C and the admissible altitude for installation is of up to 1000 m above sea level.

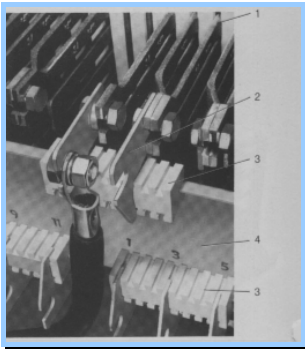
At higher temperatures or higher altitudes, the load rating and/or the rated voltage must be reduced as a function of the operating mode KB/AB/DB or the installation altitude.

**Design**

3PR3 resistors are equipped with cast iron resistor elements 3PY6 which are installed in a steel sheet housing. Ceramic strips hold and insulate the resistor elements inside the housing. A heat shield separates the resistor zone from the terminal zone. Connecting pieces screwed to the resistor elements supported on ceramic hold strips are used for connecting the cables. Each resistor element can be provided with a connection. Changes or supplements regarding the connections are easy, even retroactively.

Elements WE4,7 through to WE90 are mechanically sufficiently stable to be installed without additional fixture.

Elements WE125 through to WE700 are mounted with an acid-proof compound. The resistors are available as standard banks, special banks or banks with double elements in 5 box sizes.



1 Ceramic spacer  
 2 Connecting pieces  
 3 Ceramic strips for connection  
 4 Support plate for ceramic strips with terminal marking

**Resistors**

**with standard banks**

The number of components for such units is already defined. A subsequent adjustment of the stepping is still possible at the place of installation within certain limits. A resistor set usually comprises several single or three-strand boxes. The terminal marking at the boxes is uniform so that the connection diagram of a resistor set is easy to set up.

Standard bank units facilitate the warehousing of spare parts for larger systems.

**Resistors with special banks**

The number of components of these units is optimized for each individual application where standard bank units are not economical or too large in size.

**Resistors with double banks**

For short-term and starting operations the use of double elements is often advantageous. Elements with the symbol DWE have double the storage capacity of standard WE elements. Compared with the number of elements of WE units, the number of installable elements is reduced by 6 (3x2).

The design is adjusted for each individual application. Standard sizes are not available.

**Standard resistors**

1. Single-strand standard bank resistors with uniform number of WE elements.
2. Three-strand standard bank resistors with uniform number of WE elements.
3. Three-strand standard bank resistors with partly increased no. of WE elements. Here, the first two resistor steps can be loaded with 1.4 times the current indicated in the tables. They are preferably used as end step for resistors in intermittent operation.

**Installation**

The resistors shall be installed horizontally such that the resistor elements between the ceramic strips are in upright position and the cooling air can rise freely between them.

The load values indicated in the tables apply for natural air cooling. Care must be taken that the cooling air has unrestricted access from the bottom and can exit freely at the top. The place of installation must have good venting. In particular in case of indoor installation care must be taken that the ambient air does not heat to temperatures above 45°C.

The indicated loads result in temperature rises of up to 260 K. For a temperature rise of max. 200 K the load must be reduced by 25% (current value x 0.866). In particular in case of intermittent operation with high duty factor or continuous operation, additional external venting with a fan can increase the rating and thus the admissible load.

The admissible loss for three stacked boxes is of about:

Size	Admissible loss
3PR3 0	4.0 kW
3PR3 2	6.0 kW
3PR3 4	8.0 kW
3PR3 6	11.0 kW
3PR3 8	13.0 kW

**Connection**

After taking off the side panel, the incoming cables can be inserted from below and directly connected to the terminal connections of the resistor elements.

Connecting bolts.....M12  
 Cable diameter up to ..... 1 x 150 mm<sup>2</sup>  
   2 x 120 mm<sup>2</sup>  
 Adm. continuous current.....400 A

The heat dissipated by the resistors must be considered for connection. Lines or cables should be inserted into each box individually from the side such that they are not located in the area of the outflowing dissipated heat or heat radiation.

For the maximum loads, DIN VDE 0298 T3/4 must be observed.

Where required, lines or cables suited for elevated temperatures shall be used or the ends of standard PVC cables/lines shall be covered with a heat-resistant insulating sleeve.

**Maintenance**

The resistors are maintenance-free. In case of strong dust formation, however, occasional cleaning with compressed air should be done to preserve the insulation against the grounded housing elements.

**Accessories, spare parts**

The circuit diagrams shown on page 1.9 indicate the position of the connections. The connections can also be moved or supplemented retroactively. In this context care must be taken that the connections always rest on a ceramic support and that each ceramic support is fixed with at least two connecting elements.

When required, an additional connection kit 3PY6 can be supplied.

The corresponding kits are available to increase the protection class retroactively.

When ordered together with the resistor, the kits are mounted at the workshop so that posterior mounting work is no longer required.

**Type key**

3PR3 ①②③ - ④⑤

3PR3 = system name

① = size :

- 0 = 3x3 or 1x13 elements
- 2 = 3x5 or 1x19 elements
- 4 = 3x7 or 1x25 elements
- 6 = 3x9 or 1x31 elements
- 8 = 3 x 11 or 1x37 elements

② ③ = protection class

- 01 = IP00, all sizes
- 02 = IP10, all sizes
- 03 = IP13, only sizes 6 and 8
- 04 = IP23, only size 8
- 05 = IP20, all sizes

④ ⑤ = order supplement, no. of elements

When stacked, the number of boxes is indicated by a number separated from the system name with a slash:

- 2 boxes 2/3PR3..
- 3 boxes 3/3PR3..

**Operating values**

The load values for the elements indicated in the tables are applicable for individual installation.

For stacked installation of 2 or 3 boxes the load values indicated in the tables must be reduced:

**2 stacked boxes**  
current value x 0.9

**3 stacked boxes**  
current value x 0.83

**Dimensions** of the elements and diagram for

**Planning the elements**  
for short-term operation on page 1.10

**Standard elements**

Resistance values			Admissible load cycle duration 120 s and duty factor of					Max. Short-circuit current	Current-time integral I <sup>2</sup> t	Weight	offset at bottom		offset at top		Order no. 3PY6 201-
Rat.value	Cold value	Hot value	100%	60%	40%	25%	15%				ca. kg	Descr.	Order no.	Descr.	
mΩ	mΩ	mΩ	A	A	A	A	A	kA	kA <sup>2</sup> s	ca. kg	WE		WE		
4.7	4.2	5.5	334	428	514	646	799	12	38.2	1.0	WE 4,7	3A	WE 4,7/0	4A	
6.5	5.9	7.7	284	364	437	549	679	10	28.6	1.1	WE 6,5	3B	WE 6,5/0	4B	
9.0	8.1	10.6	242	309	371	467	577	9	20.8	1.17	WE 9	3C	WE 9/0	4C	
12.5	11.3	14.8	205	262	315	396	490	7.5	14.9	1.17	WE 12,5	3D	WE 12,5/0	4D	
17.5	15.8	20.7	173	222	266	335	414	6	9.66	0.97	WE 17,5	3E	WE 17,5/0	4E	
24	21.8	28.3	148	189	227	286	354	5.3	7.07	1.07	WE 24	3F	WE 24/0	4F	
34	30	40.1	124	159	191	240	197	4	4.74	0.9	WE 34	3G	WE 34/0	4G	
47	42	55.5	106	135	162	204	253	3.5	3.42	0.93	WE 47	3H	WE 47/0	4H	
65	59	77	90	195	138	174	215	3	2.47	0.94	WE 65	3J	WE 65/0	4J	
90	81	106	70	98	117	148	183	2.5	1.79	0.92	WE 90	3K	WE 90/0	4K	
125	113	148	65	83	100	125	155	2.1	1.08	0.88	WE 125	3L	WE 125/0	4L	
175	158	207	55	70	84	106	131	1.7	0.77	0.83	WE 175	3M	WE 175/0	4M	
240	220	280	47	60	72	90	112	1.4	0.57	0.78	WE 240	3N	WE240/0	4N	
360	320	420	37	49	59	74	91	0.9	0.38	0.77	WE 360	3P	WE 360/0	4P	
500	450	590	32	41	50	63	77	0.8	0.22	0.7	WE 500	3R	WE 500/0	4R	
700	630	830	27	35	42	53	65	0.65	0.16	0.64	WE 700	3S	WE 700/0	4S	

**Double elements**

Resistance values			Admissible load Cycle time 120 s and duty factor of					Max. Short-circuit current	Current-time integral I <sup>2</sup> t	Weight	offset at the bottom		offset at the top		Order no. 3PY6 201-
Rat.value	Cold value	Hot value	100%	60%	40%	25%	15%				ca. kg	Descr.	Order no.	Descr.	
mΩ	mΩ	mΩ	A	A	A	A	A	kA	kA <sup>2</sup> s	ca. kg	DWE		DWE		
2.35	2.1	2.75	478	612	735	924	1143	24	153	2	DWE 4,7	5A	DWE 4,7/0	6A	
3.25	2.95	3.85	406	520	624	785	971	20	114	2.2	DWE 6,5	5B	DWE 6,5/0	6B	
4.5	4.05	5.3	345	442	530	667	825	18	83	2.2	DWE 9	5C	DWE 9/0	6C	
6.25	5.65	7.4	293	375	450	566	700	15	59.5	2.3	DWE 12,5	5D	DWE 12,5/0	6D	
8.75	7.9	10.4	248	317	381	479	593	12	38.6	2	DWE 17,5	5E	DWE 17,5/0	6E	
12	10.8	14.2	211	270	324	408	504	10.6	28.3	2.1	DWE 24	5F	DWE 24/0	6F	
17	15	20.1	177	226	272	342	423	8	19	1.8	DWE 34	5G	DWE 34/0	6G	
23.5	21	27.8	151	193	232	292	361	7	13.7	1.85	DWE 47	5H	DWE 47/0	6H	
32.5	29.5	38.5	128	164	196	247	306	6	9.87	1.9	DWE 65	5J	DWE 65/0	6J	
45	40.5	53	109	139	167	210	260	5	7.17	1.8	DWE 90	5K	DWE 90/0	6K	
62.5	56.5	74	92	117	141	178	220	4.2	4.32	1.7	DWE 125	5L	DWE 125/0	6L	
87.5	79	104	77	98	118	148	184	3.4	3.09	1.65	DWE 175	5M	DWE 175/0	6M	
120	110	140	64	82	98	123	153	2.8	2.29	1.5	DWE 240	5N	DWE240/0	6N	

## Cast iron resistors: system Siemens 3PR3.. selection and order data

Element	Load A <sup>1)</sup> per strand for 3 stacked resistors and a duty factor d.f. of (cycle time 120 s)						Resistance values Ω for resistor size 3PR3①01-..					Order supplement 3PR3①01- ④⑤
	100%	60%	40%	25%	15%	5%	0	2	4	6	8	

### 1-strand resistors in standard bank design

WE	100%	60%	40%	25%	15%	5%	0	2	4	6	8	④⑤
4.7	275	350	420	535	660	980	0.06	0.09	0.12	0.15	0.18	1A
6.5	230	300	355	450	550	830	0.09	0.12	0.16	0.2	0.24	1B
9	200	255	305	390	480	710	0.12	0.17	0.23	0.28	0.34	1C
12.5	170	215	260	330	410	600	0.16	0.24	0.31	0.39	0.46	1D
17.5	140	180	220	275	335	510	0.23	0.33	0.44	0.55	0.65	1E
24	120	155	185	235	290	430	0.31	0.46	0.6	0.75	0.89	1F
34	100	130	160	195	240	365	0.44	0.65	0.85	1.0	1.3	1G
47	86	110	135	168	205	305	0.61	0.89	1.18	1.45	1.75	1H
65	73	95	115	143	175	260	0.85	1.24	1.63	2.0	2.4	1J
90	63	82	100	124	150	225	1.17	1.7	2.25	2.8	3.35	1K
125	53	70	85	105	127	190	1.6	2.4	3.1	3.9	4.6	1L
175	45	60	70	88	108	160	2.3	3.3	4.4	5.5	6.5	1M
240	38	50	60	74	91	135	3.1	4.6	6.0	7.5	8.9	1N
360	31	39	48	60	74	110	4.7	6.8	9.0	11.1	13.3	1P
500	26	33	40	51	63	90	6.5	9.5	12.5	15.5	18.5	1R
700	22	28	34	43	53	78	9.1	13.3	17.5	21.7	26.0	1S

### 3-strand resistors in standard bank design

WE	100%	60%	40%	25%	15%	5%	0 3x	2 3x	4 3x	6 3x	8 3x	④⑤
4.7	275	350	420	535	660	980	0.014	0.023	0.03	0.04	0.05	3A
6.5	230	300	355	450	550	830	0.019	0.032	0.04	0.06	0.07	3B
9	200	255	305	390	480	710	0.027	0.045	0.06	0.08	0.1	3C
12.5	170	215	260	330	410	600	0.037	0.062	0.09	0.11	0.14	3D
17.5	140	180	220	275	335	510	0.052	0.087	0.12	0.15	0.19	3E
24	120	155	185	235	290	430	0.072	0.12	0.17	0.21	0.26	3F
34	100	130	160	195	240	365	0.1	0.17	0.24	0.30	0.37	3G
47	86	110	135	168	205	305	0.14	0.23	0.33	0.42	0.52	3H
65	73	95	115	143	175	260	0.195	0.32	0.45	0.58	0.72	3J
90	63	82	100	124	150	225	0.27	0.45	0.63	0.81	1.0	3K
125	53	70	85	105	127	190	0.37	0.62	0.87	1.12	1.4	3L
175	45	60	70	88	108	160	0.52	0.87	1.22	1.55	1.9	3M
240	38	50	60	74	91	135	0.72	1.2	1.65	2.15	2.6	3N
360	31	39	48	60	74	110	1.1	1.8	2.5	3.2	4.0	3P
500	26	33	40	51	63	90	1.5	2.5	3.5	4.5	5.5	3R
700	22	28	34	43	53	78	2.1	3.5	4.9	6.3	7.7	3S

### 3-strand resistors with upgraded end step starting with size 4

The end step can take on 1.4 times the current

WE	100%	60%	40%	25%	15%	5%	0	2	4 3x	6 3x	8 3x	④⑤
4.7/9	200	255	305	390	480	710	-	-	0.055	0.07	0.09	4C
6.5/12.5	170	215	260	330	410	600	-	-	0.075	0.1	0.12	4D
9/17.5	140	180	220	275	335	510	-	-	0.1	0.14	0.17	4E
12.5/24	120	155	185	235	290	430	-	-	0.15	0.19	0.24	4F
17.5/34	100	130	160	195	240	365	-	-	0.2	0.27	0.34	4G
24/47	86	110	135	168	205	305	-	-	0.28	0.38	0.47	4H
34/65	73	95	115	143	175	260	-	-	0.4	0.52	0.65	4J
47/90	63	82	100	124	150	225	-	-	0.55	0.72	0.9	4K
65/125	53	70	85	105	127	190	-	-	0.75	1.0	1.25	4L
90/175	45	60	70	88	108	160	-	-	1.05	1.4	1.75	4M
125/240	38	50	60	74	91	135	-	-	1.95	1.9	2.4	4N
175/360	31	39	48	60	74	110	-	-	2.2	2.9	3.6	4P
240/500	26	33	40	51	63	90	-	-	3.0	4.0	5.0	4R
360/700	22	28	34	43	53	78	-	-	4.2	5.6	7.0	4S

<sup>1)</sup> For individual installation, the current values can be multiplied by 1.2 and for 2 stacked boxes by 1.1



**Starter resistors**

**Order data**

for first-time order:

Complete order number and in addition:

- motor rating
- for AC motors:
  - Rotor standstill voltage
  - Rated rotor current
- for DC motors:
  - Rated voltage
  - Rated current
- starting load factor
- number of starting steps
- application
- load torque
- moment of inertia
- speed

for re-order:

Complete order number and in addition  
- serial no. of the unit already supplied

Admissible operating values				Resistor data							
Rotor standstill voltage for AC motors <b>max.3000 V</b>											
or rated voltage for DC motors: <b>max.1800 V</b>											
Motor rating for starting load factor f =				Starter energy kJ	Starting time s	Starting frequency 1/h	Max. no. of steps for		No. of boxes	Order No. 3PR3 . ③ . . . . .	Weight IP00 ca. kg
2.0 kW	1.4 kW	1.0 kW	0.7 kW				AC	DC			
30	40	60	80	1200	20	10	2	8	1	3PR300③-9WA0	28
45	60	90	120	2250	25	10	3	10	1	3PR320③-9WA0	35
65	90	130	180	3200	25	10	5	15	1	3PR340③-9WA0	44
80	110	160	220	4100	25	10	7	20	1	3PR360③-9WA0	51
100	140	200	280	5250	25	10	8	20	1	3PR380③-9WA0	61
115	160	230	320	7100	30	10	10	20	2	3PR340③-9WA1	88
135	190	270	380	8900	33	10	10	20	2	3PR360③-9WA1	102
170	240	340	480	11200	33	10	10	20	2	3PR380③-9WA1	122
210	300	420	600	17700	25	10	10	20	3	3PR380③-9WA2	183
280	400	560	800	23000	25	10	10	20	4	3PR380③-9WA3	244
350	500	700	1000	28800	25	10	10	20	5	3PR380③-9WA4	305
420	600	840	1200	35500	25	10	10	20	6	3PR380③-9WA5	366
500	700	1000	1400	46500	45	10	10	20	8	3PR380③-9WA7	488
570	800	1140	1600	53200	45	10	10	20	9	3PR380③-9WA8	549
630	900	1260	1800	58500	45	10	10	20	10	3PR380③-9WB0	610
700	1000	1400	2000	64300	45	10	10	20	11	3PR380③-9WB1	671

③ supplement with the corresponding protection class (cf. type key)

**Slip resistors**

Motor rating in kW  
for speed reduction in %

3-strand resistors

Size	5%	10%	15%	25%
0	56	29	20	11
2	98	49	32	20
4	135	67	46	27
6	175	88	56	32
8	220	110	67	42

1-strand resistors

Size	5%	10%	15%	25%
0	77	36	25	15
2	120	56	37	23
4	160	77	53	31
6	196	98	63	36
8	240	120	78	74

**Control resistors**

**Order data**

for first-time order:

- Complete order number and in addition:
- motor rating
  - power requirement at highest speed
  - speed reduction in %
  - torque characteristic (const., linear, square-law)
  - for AC motors:
    - Rotor standstill voltage
    - Rotor rated voltage
  - for DC motors:
    - Rated voltage
    - Rated current
  - starting load factor f
  - number of starting steps
  - application
  - load torque
  - moment of inertia
  - speed

for re-order:

- Complete order number and in addition
- serial no. of the unit already supplied

**Admissible operating values**

Rotor standstill voltage for AC motors: **max.3000 V**

Rated voltage for AC motors: **max.1800 V**

Actual currency required in kW at highest speed and						Installation	No. of boxes	Order No. 3PR3 . ③ . - . . . .	Weight IP00 ca. kg
Speed reduction at constant load torque			Speed reduction at square-law rising load torque						
25%	50%	75%	25%	50%	75%				
kW	kW	kW	KW	kW	kW				
21	14	10	24	-	-	Individual Installation	1	3PR340 ③-9WA0	44
34	23	17	43	-	-		1	3PR360 ③-9WA0	51
43	29	21	50	36	29		1	3PR380 ③-9WA0	61
50	35	25	56	40	32	max. 2 stacked boxes	2	3PR340 ③-9WA1	88
60	40	30	68	50	40		2	3PR360 ③-9WA1	102
75	50	37	80	60	50		2	3PR380 ③-9WA1	122
72	48	36	83	60	49	max. 3 stacked boxes 1)	3	3PR360 ③-9WA2	153
90	60	45	105	75	60		3	3PR380 ③-9WA2	183
120	80	60	140	100	80		4	3PR380 ③-9WA3	244
150	100	75	175	125	100		5	3PR380 ③-9WA4	305
180	120	90	210	150	120		6	3PR380 ③-9WA5	366
210	140	105	245	175	140		7	3PR380 ③-9WA6	427
270	180	135	315	225	180		9	3PR380 ③-9WA8	549
300	200	150	350	250	200		10	3PR380 ③-9WB0	610
360	240	180	420	300	240		12	3PR380 ③-9WB2	732
450	300	230	490	375	300		15	3PR380 ③-9WB5	915
540	360	270	630	450	360	18	3PR380 ③-9WB8	1098	
720	480	360	840	600	480	24	3PR380 ③-9WC5	1464	
900	500	450	1050	750	600	30	3PR380 ③-9WD2	1830	
1080	720	540	1260	900	720	36	3PR380 ③-9WD8	2200	

③ supplement protection class (cf. type key)

1) for 2 stacked boxes, load reduction 18%, for 3 stacked boxes load reduction 30%

## Cast iron resistors: system Siemens 3PR3.. accessories

### Kits

#### to upgrade the protection class

The units in the tables above can be supplied and/or adjusted to protection classes IP10, IP20, sizes 6 and 8 also to IP13, and size 8 to IP23.

When ordering the upgrade together with the basic resistor, the units will be supplied completely assembled.

When ordering the kits at a later date, installation must be done by the customer.

The kits must be selected in consideration of the type, installation and the number of boxes.

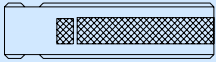
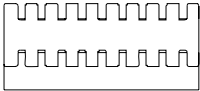
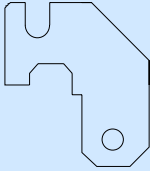
#### Example for ordering:

for a resistor 3PR3801- consisting of 7 boxes, upgrade to protection class IP23 for installation with 2 x 3 and 1 x 1 unit, 2 kits 3 x stacked and 1 kit for individual installation must be ordered.

Resistor type	Individual installation		2 stacked boxes		3 stacked boxes	
	Order no.	Weight ca. kg	Order no.	Weight ca. kg	Order no.	Weight ca. kg
<b>Kit for protection class IP 10</b> consisting of cover and side grids						
3PR3 00	3PX6 223-0A	1.2	3PX6 223-0B	1.8	3PX6 223-0C	2.4
3PR3 20	3PX6 223-2A	1.4	3PX6 223-2B	2.1	3PX6 223-2C	2.9
3PR3 40	3PX6 223-4A	1.6	3PX6 223-4B	2.5	3PX6 223-4C	3.4
3PR3 60	3PX6 223-6A	2.0	3PX6 223-6B	3.0	3PX6 223-6C	4.1
3PR3 80	3PX6 223-8A	2.4	3PX6 223-8B	3.4	3PX6 223-8C	4.6
<b>Kit for protection class IP13</b> consisting of a single-piece housing and side panels						
3PR3 60	3PX6 224-6A	9.6	3PX6 224-6B	13.5	3PX6 224-6C	17.4
3PR3 80	3PX6 224-8A	10.6	3PX6 224-8B	15.3	3PX6 224-8C	25.0
<b>Kit for protection class IP20</b> consisting of cover and side grids and bottom plate						
3PR3 00	3PX6 226-0A	2.6	3PX6 226-0B	3.9	3PX6 226-0C	5.0
3PR3 20	3PX6 226-2A	3.3	3PX6 226-2B	4.9	3PX6 226-2C	6.5
3PR3 40	3PX6 226-4A	4.2	3PX6 226-4B	6.3	3PX6 226-4C	8.2
3PR3 60	3PX6 226-6A	5.0	3PX6 226-6B	7.6	3PX6 226-6C	10.0
3PR3 80	3PX6 226-8A	5.8	3PX6 226-8B	8.5	3PX6 226-8C	11.5
<b>Kit for protection class IP23</b> consisting of terminal box and side panels						
3PR3 80	3PX6 225-8A	14.6	3PX6 225-8B	19.6	3PX6 225-8C	30

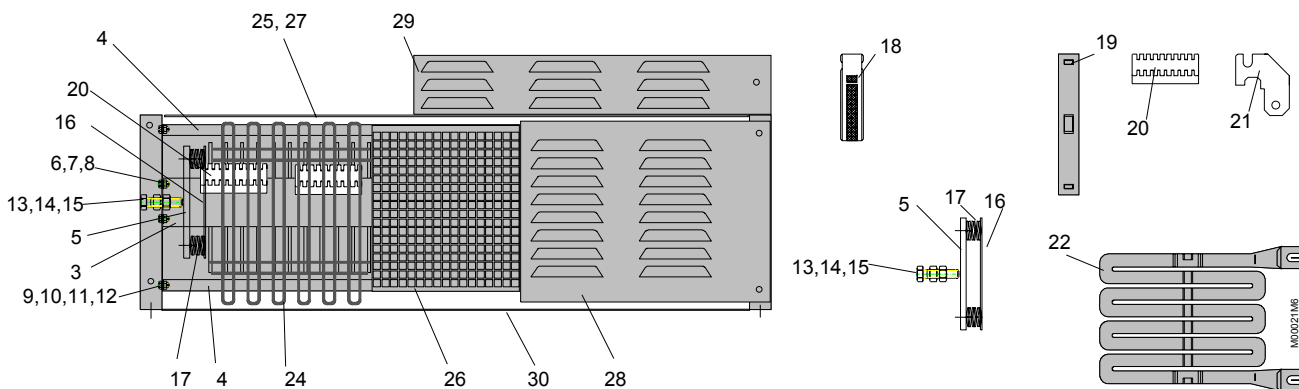
### Accessories and spare parts

For resistors 3PR3.. and cast iron elements 3PY6 ..

Description		Remark	Order no.	Weight Ca. kg
Connection kit		Each kit: 3 ceramic holders 6 connecting pieces 2 connecting bolts M10	3PY6 204 – 1A	1.1
Ceramic Spacer		2 pcs. required per element	3PY6 203 – 0A	0.11
Ceramic holder for connecting pieces			3PY6 204 – 1C	0.19
Connecting piece with bolt M12			3PY6 204 – 1D	0.15
Filler compound, 1 bag, 1 kg	Mix 600 g with 75 g of water to a low viscous compound and process immediately. Pot life ca. 30 min	Resistor elements WE 125 .. WE 700 are fixed with compound between the ceramic spacers. When ordering these elements for the first time, always order the necessary amount of compound. Amounts required: 3PR3 00 - 0.6 kg 3PR3 20 - 0.8 kg 3PR3 40 - 0.8 kg 3PR3 60 - 1.0 kg 3PR3 80 - 1.2 kg	3PX6 206 – 0A	1.0

Item	Description	Order no.
1	Side panel, left	GSM115
2	Side panel, right	GSM116
<b>3</b>	<b>Mounting rail</b>	
3.1	341 mm for 3PR30	GSM059
3.2	461 mm for 3PR32	GSM060
3.3	581 mm for 3PR34	GSM061
3.4	696 mm for 3PR36	GSM062
3.5	811 mm for 3PR38	GSM063
<b>4</b>	<b>Guide rail</b>	
4.1	341 mm for 3PR30	GSM117
4.2	461 mm for 3PR32	GSM118
4.3	581 mm for 3PR34	GSM119
4.4	696 mm for 3PR36	GSM120
4.5	811 mm for 3PR38	GSM121
5	Clamping member A600 717	
6	Hex.nut DIN 933-M6x16	NSS933-0064
7	Spring washer DIN 137.B6	NSF137-0041
8	Hex.nut DIN 934.M8	NMS934-0041
9	Hex.bolt DIN 933-M8x20	NSS933-0095
10	Disk DIN 125-A8,4	NSS125-0053
11	Serrated lock washer DIN 6796-A8,4	NSZ6797-0031
12	Hex.nut DIN 934-M8	NMS934-0051
13	Hex.bolt DIN 933-M10x55	NSS933-0064
14	Hex.nut DIN 934-M10 (2x)	NMS934-0061
15	Spring washer DIN 137-B10	NSF137-0061
16	Holder A640 727	
17	Spring washer DIN 2093-34x16.3x1.5	
18	Ceramic spacer	3PY6 203-0A
19	Shim	GSZ009
20	Ceramic holder	3PY6 204-1C
21	Connecting piece with bolt	3PY6 204-1D
22	Cast iron element	3PY6 201-...
23	Spacer tube DIN 2440-3/8"x 80	
<b>24</b>	<b>Cover grids, IP10 for</b>	
24.1	3PR30	A 640 616
24.2	3PR32	A 640 615
24.3	3PR34	A 640 614
24.4	3PR36	A 640 613
24.5	3PR38	A 640 612

Item	Description	Order no.
<b>25</b>	<b>Cover grid, top, IP10 for</b>	
25.1	3PR30	A 640 620
25.2	3PR32	A 640 619
25.3	3PR34	A 640 618
25.4	3PR36	A 640 617
25.5	3PR38	A 640 611
<b>26</b>	<b>Perforated plate, IP20 for</b>	
26.1	3PR30	B 600 423
26.2	3PR32	B 600 425
26.3	3PR34	B 600 404
26.4	3PR36	B 600 405
26.5	3PR38	B 600 407
<b>27</b>	<b>Perforated plate, top, IP 20 for</b>	
27.1	3PR30	A 600 422
27.2	3PR32	A 600 424
27.3	3PR34	A 600368
27.4	3PR36	A 600 369
27.5	3PR38	A 600 370
<b>28</b>	<b>Slotted plate, IP13/23 for</b>	
28.1	3PR36	A 600 502
28.2	3PR38	A 600 500
<b>29</b>	<b>Cover, IP13/23, for</b>	
29.1	3PR36	A 600 503
29.2	3PR38	A 600 501
<b>30</b>	<b>Bottom plate, perforated, IP20/23</b>	
30.1	3PR30	A 600 522
30.2	3PR32	A 600 521
30.3	3PR34	A 600 520
30.4	3PR36	A 600 519
30.5	3PR38	A 600 486
<b>w/o pic.</b>	<b>Cable bushing for IP20/23</b>	
	3PR30	A 600 526
	3PR32	A 600 525
	3PR34	A 600 524
	3PR36	A 600 523
	3PR38	B 600 375
<b>w/o pic.</b>	<b>Compound 1 kg</b>	3PX6 206 - 0A

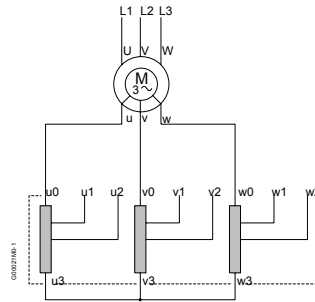


**Typical circuit**

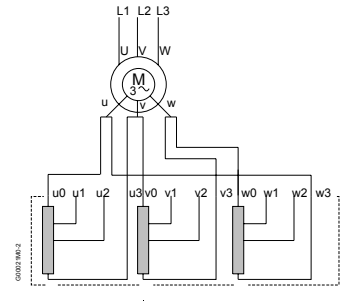
Three-strand resistors with 3 symmetrical resistor steps:

1 <sup>st</sup> step	2 <sup>nd</sup> step	3 <sup>rd</sup> step	
U <sub>0</sub> -U <sub>1</sub>	U <sub>1</sub> -U <sub>2</sub>	U <sub>2</sub> -0	U <sub>2</sub> -U <sub>3</sub>
V <sub>0</sub> -V <sub>1</sub>	V <sub>1</sub> -V <sub>2</sub>	V <sub>2</sub> -0	V <sub>2</sub> -V <sub>3</sub>
W <sub>0</sub> -W <sub>1</sub>	W <sub>1</sub> -W <sub>2</sub>	W <sub>2</sub> -0	W <sub>2</sub> -W <sub>3</sub>

In the case of a starter with switch or contactor contacts, the end contacts and/or contacts of the end step contactor connect the sliprings of the motor u-v-w (pursuant to DIN 42400: K-L-M).



Y connection



Delta connection

**Terminal markings**

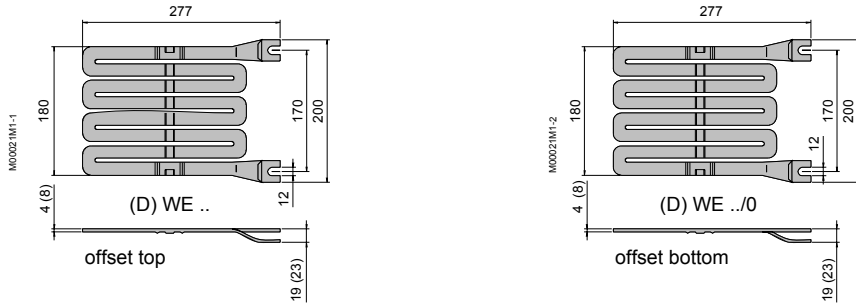
Marking of the terminals and corresponding proportionate values of the overall resistance

**Single-strand**

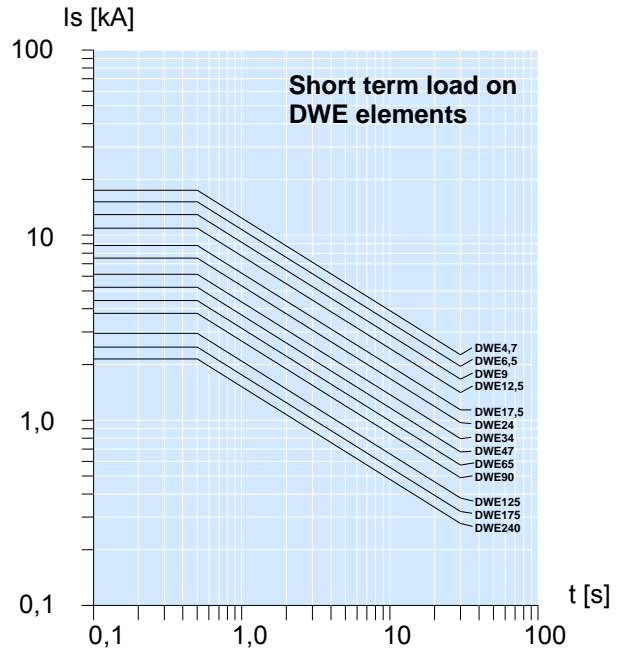
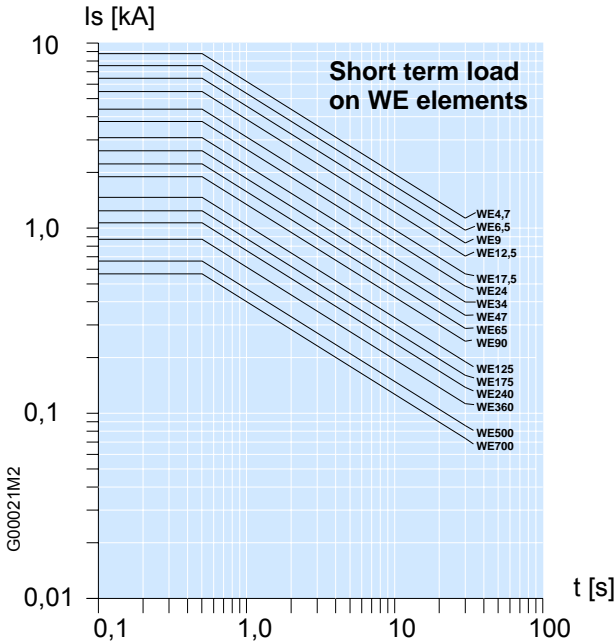
3PR3 0	Terminal markings Prop. values in % of the overall resistance	G00021M0-3
		0 1 2 3 4 5 7 9 11 13 0 7,7 15 23 31 38 54 69 85 100%
3PR3 2	Terminal markings Prop. values in % of the overall resistance	G00021M0-3
		0 1 2 3 4 5 7 9 11 15 19 0 5,2 10,5 16 21 26 37 47 58 79 100%
3PR3 4	Terminal markings Prop. values in % of the overall resistance	G00021M0-3
		0 1 2 3 4 5 7 9 11 13 17 21 25 0 4 8 12 16 20 28 36 44 52 68 84 100%
3PR3 6	Terminal markings Prop. values in % of the overall resistance	G00021M0-3
		0 1 2 3 4 5 7 9 11 13 15 17 19 23 27 31 0 3,2 6,5 10 13 16 23 29 35 42 48 55 61 74 87 100%
3PR3 8	Terminal markings Prop. values in % of the overall resistance	G00021M0-3
		0 1 2 3 4 5 7 9 11 13 15 17 19 21 25 29 33 37 0 2,7 5,4 8 11 13,5 19 24 30 35 40 46 52 57 68 78 89 100%

**Three-strand**

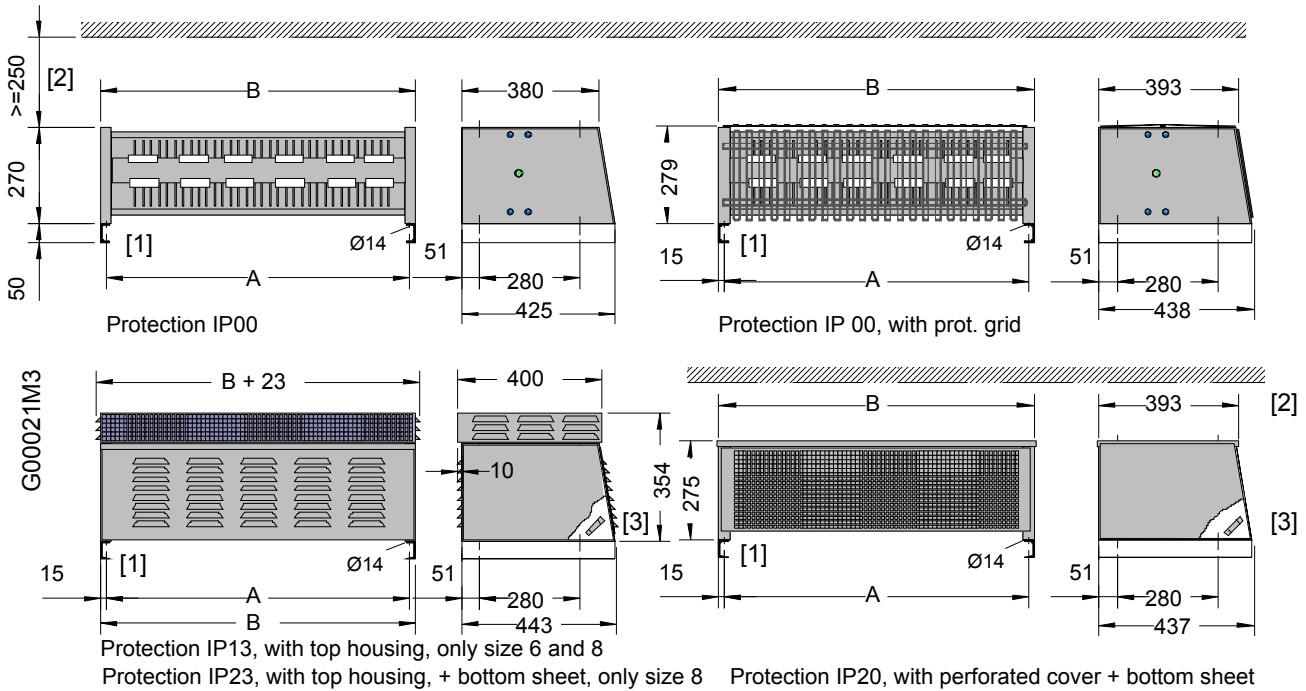
3PR3 0	Terminal markings Prop. values in % of the overall resistance	G00021M0-4
		0 1 2 3 0 33 66 100%
3PR3 2	Terminal markings Prop. values in % of the overall resistance	G00021M0-4
		0 1 2 3 5 0 20 40 60 100%
3PR3 4	Terminal markings Prop. values in % of the overall resistance	G00021M0-4
		0 1 2 3 5 7 0 14 28 43 71 100%
3PR3 6	Terminal markings Prop. values in % of the overall resistance	G00021M0-4
		0 1 2 3 5 7 9 0 11 22 33 55 78 100%
3PR3 8	Terminal markings Prop. values in % of the overall resistance	G00021M0-4
		0 1 2 3 5 7 9 11 0 9 18 27 45 64 82 100%



Cast iron elements WE, WE/0



Short-term loads acting on cast iron elements

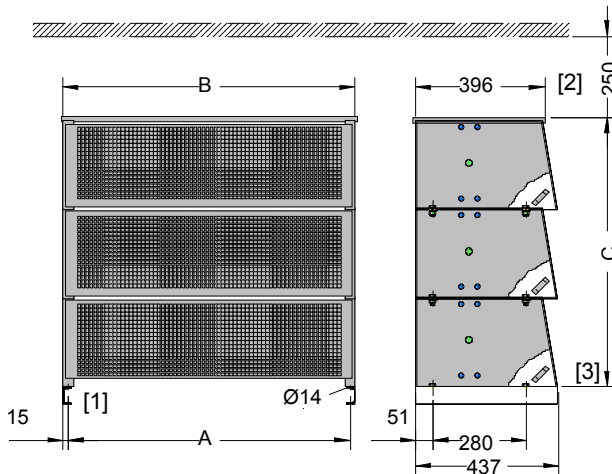
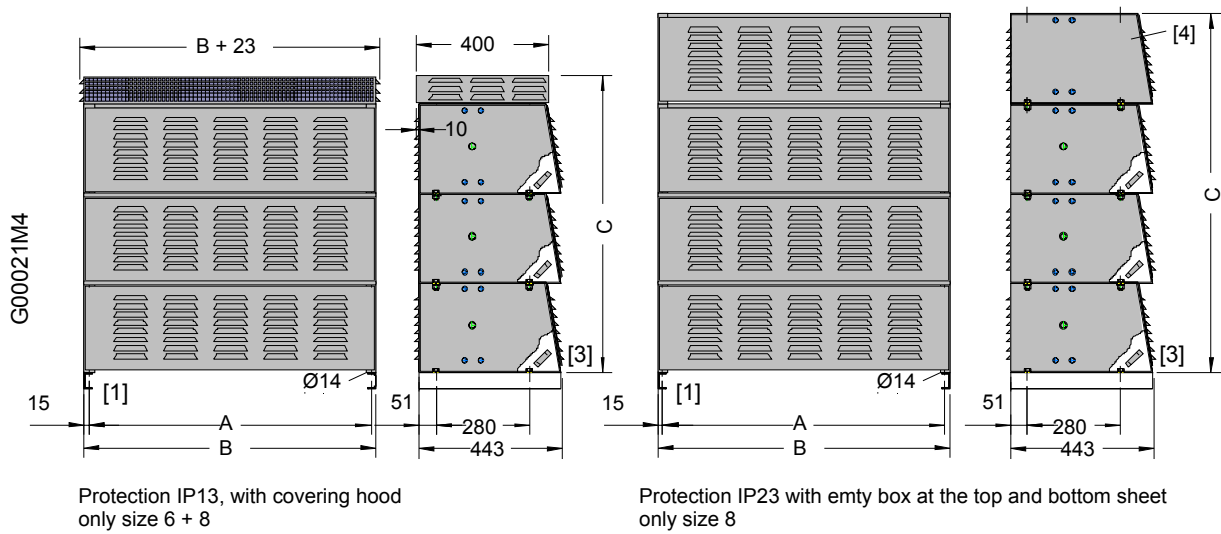
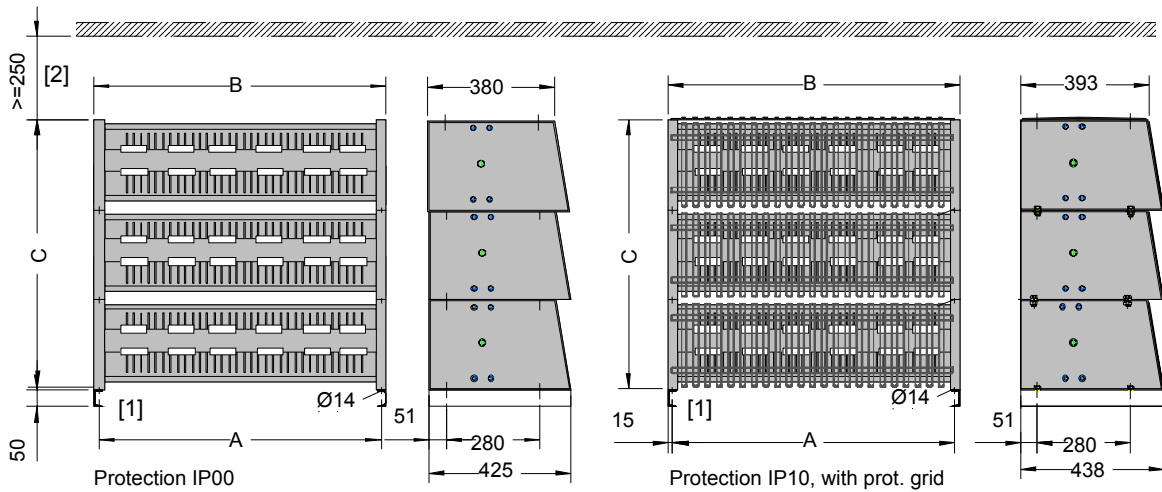


Resistors 3PR3 for individual installation

Widths		
Type	A	B
3PR30	375	405
3PR32	495	525
3PR34	615	645
3PR36	730	760
3PR38	845	875

Weights ca kg					
Type	IP00	IP10	IP20	IP13	IP23
3PR30	28	29	31	-	-
3PR32	35	36	38	-	-
3PR34	44	46	48	-	-
3PR36	51	53	56	61	-
3PR38	61	63	67	72	76

- [1] Bottom clearance  $\geq 50$  mm
- [2] Top clearance minimum 250 mm
- [3] Cable bushing  
only for protection classes IP 20 and IP 23



Type	Weight ca. kg				
	IP00	IP10	IP20	IP13	IP23
2/3PR30..	56	58	60	-	-
2/3PR32..	70	72	75	-	-
2/3PR34..	88	91	94	-	-
2/3PR36..	102	105	110	116	-
2/3PR38..	122	125	131	137	142
3/3PR30..	84	86	89	-	-
3/3PR32..	105	108	112	-	-
3/3PR34..	132	135	140	-	-
3/3PR36..	153	157	163	170	-
3/3PR38..	183	188	195	208	213

Cast iron resistors for stacked installation

Widths mm		
Type	A	B
3PR30	375	405
3PR32	495	525
3PR34	615	645
3PR36	730	760
3PR38	845	875

Dimension C mm for stacked installation		
Protection	2 boxes	3 boxes
IP 00	540	810
IP10	549	819
IP 13	623	893
IP 20	545	815
IP 23	812	1082

- [1] Bottom clearance  $\geq 50$  mm  
The hexagonal nuts required for fastening M12 x 25 are not included in the scope of supply.
- [2] Minimum spacing at the top  $\geq 250$  mm
- [3] Cable bushing  
for protection classes IP 20 and IP 23
- [4] Terminal box, without resistor

## Cast iron resistors: system Siemens 3PR2.. selection tables

**Superseded system,  
do not use for new units**

### System description

The system 3PR2 .. is the predecessor system of 3PR3 .. and its structure is largely the same.

The elements are identical and can be replaced by those from system 3PR3. Only the housings and their design vary from those of the series 3PR3 ..

### Type key

**3PR2** ① ② ③ - ④ ⑤

3PR2 = system name

① = Size :

0 = 3x3 or 1x13 elements  
2 = 3x5 or 1x19 elements  
4 = 3x7 or 1x25 elements  
6 = 3x9 or 1x31 elements  
8 = 3 x 11 or 1x37 elements

② ③ = Protection class

02 = IP00  
03 = IP10  
04 = IP13  
41 = IP23

④ ⑤ = Order supplement, no. of elements

For stacked installation, the number of boxes is indicated by a number separated from the system name by a slash:

2 boxes: 2/3PR2..

3 boxes: 3/3PR2..

Element	Load A <sup>1)</sup> per strand for 3 stacked resistors and a cycle duty factor of (cycle time 120 s)	Resistance values Ω for resistor size										Order supplement 3PR2①02-
		3PR2①02-..										

### 3-strand resistors with standard banks

WE	100%	60%	40%	25%	15%	5%	0	2	4	6	8	④ ⑤
							3x	3x	3x	3x	3x	
4.7	275	350	420	535	660	980	0.014	0.023	0.03	0.04	0.05	3A
6.5	230	300	355	450	550	830	0.019	0.032	0.04	0.06	0.07	3B
9	200	255	305	390	480	710	0.027	0.045	0.06	0.08	0.1	3C
12.5	170	215	260	330	410	600	0.037	0.062	0.09	0.11	0.14	3D
17.5	140	180	220	275	335	510	0.052	0.087	0.12	0.15	0.19	3E
24	120	155	185	235	290	430	0.072	0.12	0.17	0.21	0.26	3F
34	100	130	160	195	240	365	0.1	0.17	0.24	0.30	0.37	3G
47	86	110	135	168	205	305	0.14	0.23	0.33	0.42	0.52	3H
65	73	95	115	143	175	260	0.195	0.32	0.45	0.58	0.72	3J
90	63	82	100	124	150	225	0.27	0.45	0.63	0.81	1.0	3K
125	53	70	85	105	127	190	0.37	0.62	0.87	1.12	1.4	3L
175	45	60	70	88	108	160	0.52	0.87	1.22	1.55	1.9	3M
240	38	50	60	74	91	135	0.72	1.2	1.65	2.15	2.6	3N
360	31	39	48	60	74	110	1.1	1.8	2.5	3.2	4.0	3P
500	26	33	40	51	63	90	1.5	2.5	3.5	4.5	5.5	3R
700	22	28	34	43	53	78	2.1	3.5	4.9	6.3	7.7	3S

### 3-strand resistors with upgraded end step starting from size 4

The end step can be loaded with 1.4 times the current

WE	100%	60%	40%	25%	15%	5%	0	2	4	6	8	④ ⑤
									3x	3x	3x	
4.7/9	200	255	305	390	480	710	-	-	0.055	0.07	0.09	4C
6.5/12.5	170	215	260	330	410	600	-	-	0.075	0.1	0.12	4D
9/17.5	140	180	220	275	335	510	-	-	0.1	0.14	0.17	4E
12.5/24	120	155	185	235	290	430	-	-	0.15	0.19	0.24	4F
17.5/34	100	130	160	195	240	365	-	-	0.2	0.27	0.34	4G
24/47	86	110	135	168	205	305	-	-	0.28	0.38	0.47	4H
34/65	73	95	115	143	175	260	-	-	0.4	0.52	0.65	4J
47/90	63	82	100	124	150	225	-	-	0.55	0.72	0.9	4K
65/125	53	70	85	105	127	190	-	-	0.75	1.0	1.25	4L
90/175	45	60	70	88	108	160	-	-	1.05	1.4	1.75	4M
125/240	38	50	60	74	91	135	-	-	1.95	1.9	2.4	4N
175/360	31	39	48	60	74	110	-	-	2.2	2.9	3.6	4P
240/500	26	33	40	51	63	90	-	-	3.0	4.0	5.0	4R
360/700	22	28	34	43	53	78	-	-	4.2	5.6	7.0	4S

<sup>1)</sup> In case of individual installation, the current values can be multiplied by 1.2, and for 2 stacked boxes by 1.1-



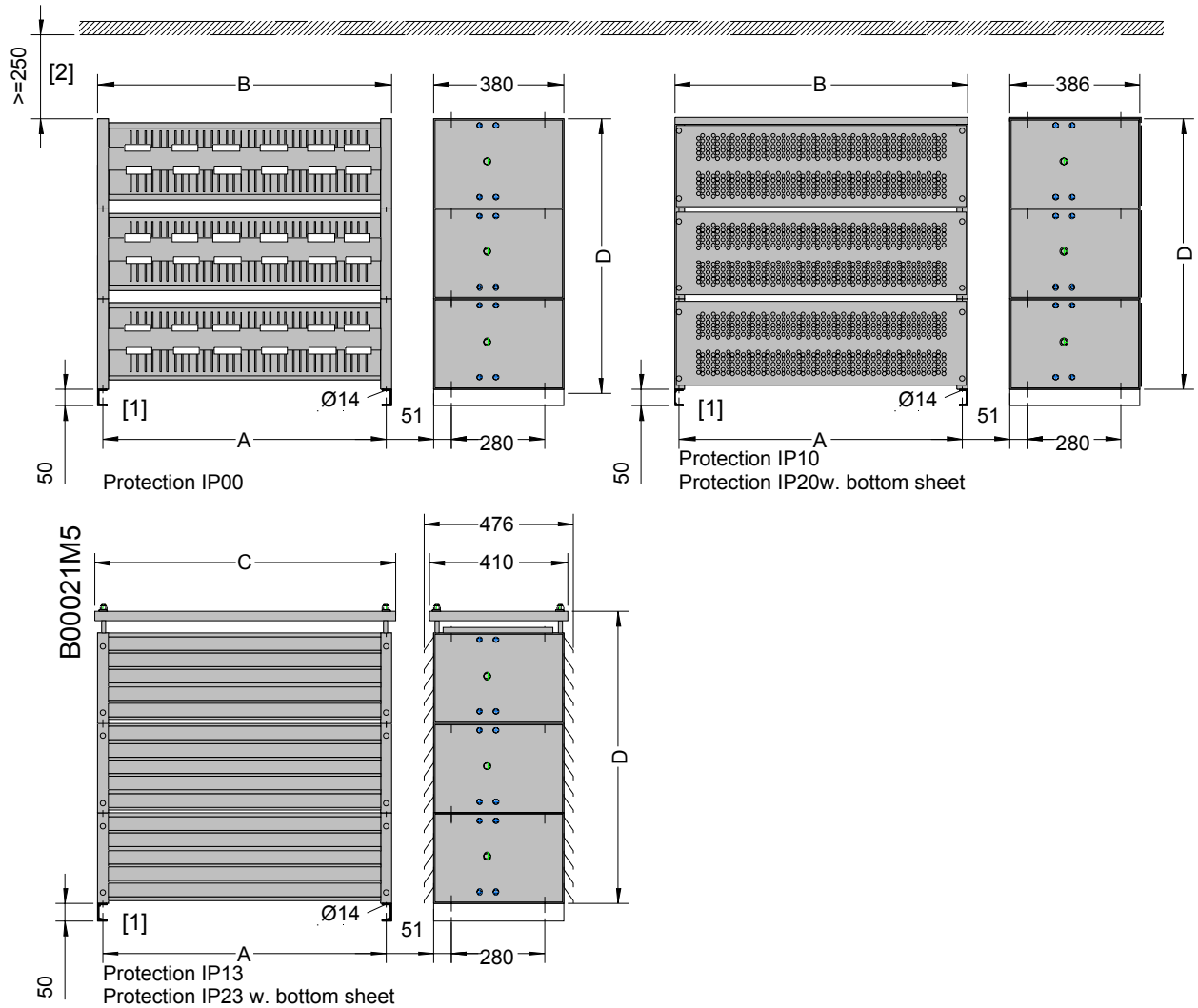
# Cast iron resistors: system Siemens 3PR2.. housed resistors dimensions and weights

**Housed resistors 3PR2,**  
1 to 3 stacked boxes

**Protection IP00:** bank with side panel  
**Protection IP10:** housing with perforated sheet cover, bottom open  
**Protection IP13:** housing with weather protection grid and roof, bottom open  
**Protection IP23:** housing with weather protection grid, roof and bottom open  
**Painting:** RAL 7032 light gray

Size	Dim. A	Dim. B	Dim. C
3PR20..	375	405	455
3PR22..	495	525	575
3PR24..	610	645	695
3PR26..	730	760	810
3PR28..	845	875	925

Protection	Dim. D		
	1 box	2 boxes	3 boxes
IP 00	330	660	990
IP 10	332	662	992
IP 13	423	753	1083
IP 20	332	662	992
IP 23	423	753	1083



Size 3PR2..	No. of elements	Protect.	Weight kg
002-④⑤	9	IP00	30
003-④⑤	9	IP10	34
004-④⑤	9	IP13	38
202-④⑤	15	IP00	38
203-④⑤	15	IP10	43
204-④⑤	15	IP13	47
402-④⑤	21	IP00	46
403-④⑤	21	IP10	53
404-④⑤	21	IP13	58
602-④⑤	27	IP00	54
603-④⑤	27	IP10	62
604-④⑤	27	IP13	68
802-④⑤	33	IP00	63
803-④⑤	33	IP10	72
804-④⑤	33	IP13	78
841-④⑤	33	IP23	80

Size 3PR2..	No. of elements	Protect.	Weight kg
402-④⑤	2x21	IP00	93
403-④⑤	2x21	IP10	103
404-④⑤	2x21	IP13	114
602-④⑤	2x27	IP00	109
603-④⑤	2x27	IP10	121
604-④⑤	2x27	IP13	133
802-④⑤	2x33	IP00	126
803-④⑤	2x33	IP10	140
804-④⑤	2x33	IP13	154
841-④⑤	2x33	IP23	158

Size 3PR2..	No. of elements	Protect.	Weight kg
602-④⑤	3x27	IP00	163
603-④⑤	3x27	IP10	180
604-④⑤	3x27	IP13	196
841-④⑤	3x33	IP23	201
802-④⑤	3x33	IP00	189
803-④⑤	3x33	IP10	209
804-④⑤	3x33	IP13	227
841-④⑤	3x33	IP23	232

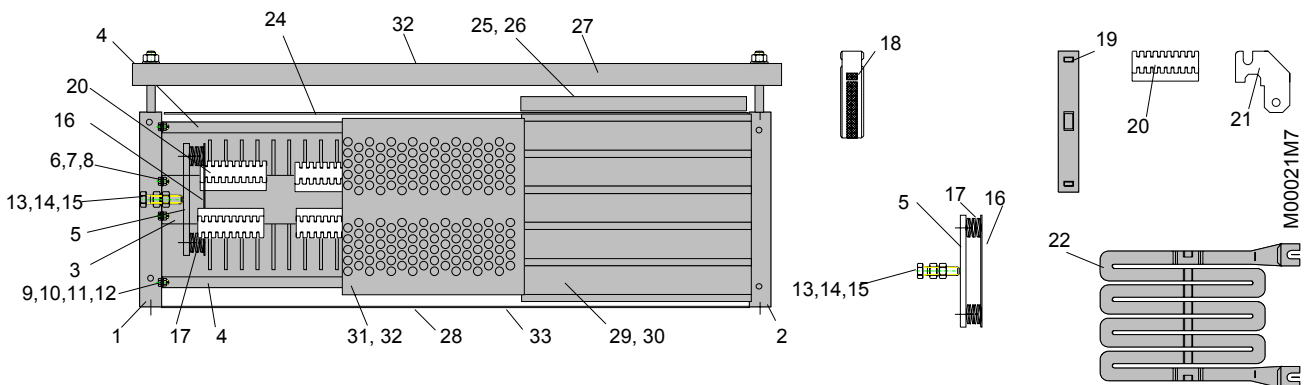
[1] Bottom clearance  $\geq 50$  mm  
 The hexagonal nuts required for fastening M12 x 25 are not included in the scope of supply.  
 [2] Minimum spacing at the top  $\geq 250$  mm

④⑤ Order supplement as per selection table page 1.12

Cast iron resistors: system Siemens 3PR2.. spare and mounting parts

Item	Description	Order No.
1	Side panel, left	GSZ057
2	Side panel, rights	GSZ058
<b>3</b>	<b>Mounting rail</b>	
3.1	341 mm for 3PR20	GSM059
3.2	461 mm for 3PR22	GSM060
3.3	581 mm for 3PR24	GSM061
3.4	696 mm for 3PR26	GSM062
3.5	811 mm for 3PR28	GSM063
<b>4</b>	<b>Guide rail</b>	
4.1	341 mm for 3PR20	GSM064
4.2	461 mm for 3PR22	GSM065
4.3	581 mm for 3PR24	GSM066
4.4	696 mm for 3PR26	GSM067
4.5	811 mm for 3PR28	GSM068
5	Clamping member A600 717	
6	Hex.bolt DIN 933-M6x16	NSS933-0064
7	Spring washer DIN 137.B6	NSF137-0041
8	Hex.nut DIN 934-M8	NMS934-0041
9	Hex.bolt DIN 933-M8x20	NSS933-0095
10	Washer DIN 125-A8,4	NSS125-0053
11	Serrated lock washer DIN 6796-A8,4	NSZ6797-0031
12	Hex.nut DIN 934-M8	NMS934-0051
13	Hex.bolt DIN 933-M10x55	NSS933-0064
14	Hex.nut DIN 934-M10 (2x)	NMS934-0061
15	Spring washer DIN 137-B10	NSF137-0061
16	Holder A640 727	
17	Disc spring DIN 2093-34x16.3x1.5	
18	Ceramic spacer	3PY6 203-0A
19	Shim	GSZ009
20	Ceramic holder	3PY6 204-1C
21	Connecting piece with screw	GSZ006
22	Cast iron element	3PY6 201-...
23	Spacer tube DIN 2440-3/8"x 80	
<b>24</b>	<b>Cover sheet perforated IP10/20 for</b>	
24.1	3PR20	GSM070
24.2	3PR22	GSM071
24.3	3PR24	GSM072
24.4	3PR26	GSM073
24.5	3PR28	GSM074
<b>25</b>	<b>Cover collar IP 13 for</b>	
25.1	3PR20	GSM075
25.2	3PR22	GSM076
25.3	3PR24	GSM077
25.4	3PR26	GSM078
25.5	3PR28	GSM079

Item	Description	Order No.
<b>26</b>	<b>Cover collar IP 13 for</b>	
26.1	3PR20	GSM080
26.2	3PR22	GSM081
26.3	3PR24	GSM082
26.4	3PR26	GSM083
26.5	3PR28	GSM084
<b>27</b>	<b>Rain roof IP13/23 for</b>	
27.1	3PR20	GSM085
27.2	3PR22	GSM086
27.3	3PR24	GSM087
27.4	3PR26	GSM088
27.5	3PR28	GSM089
<b>28</b>	<b>Bottom sheet IP 23 for</b>	GSM
28.1	3PR20	GSM090
28.2	3PR22	GSM091
28.3	3PR24	GSM092
28.4	3PR26	GSM093
28.5	3PR28	GSM094
<b>29</b>	<b>Weathering protection grid IP13 for</b>	
29.1	3PR20	GSM105
29.2	3PR22	GSM106
29.3	3PR24	GSM107
29.4	3PR26	GSM108
29.5	3PR28	GSM109
<b>30</b>	<b>Weathering protection grid IP23 for</b>	
30.1	3PR20	GSM110
30.2	3PR22	GSM111
30.3	3PR24	GSM112
30.4	3PR26	GSM113
30.5	3PR28	GSM114
<b>31</b>	<b>Longitud. sheet w/o perforation for</b>	
31.1	3PR20	GSM095
31.2	3PR22	GSM096
31.3	3PR24	GSM097
31.4	3PR26	GSM098
31.5	3PR28	GSM099
<b>32</b>	<b>Longitudinal sheet, perforated for</b>	
32.1	3PR20	GSM100
32.2	3PR22	GSM101
32.3	3PR24	GSM102
32.4	3PR26	GSM103
32.5	3PR28	GSM104
<b>w/o pic.</b>	<b>Compound 1 kg</b>	<b>3PX6 206 - 0A</b>



**Superseded system,  
do not use for new units**

**System description**

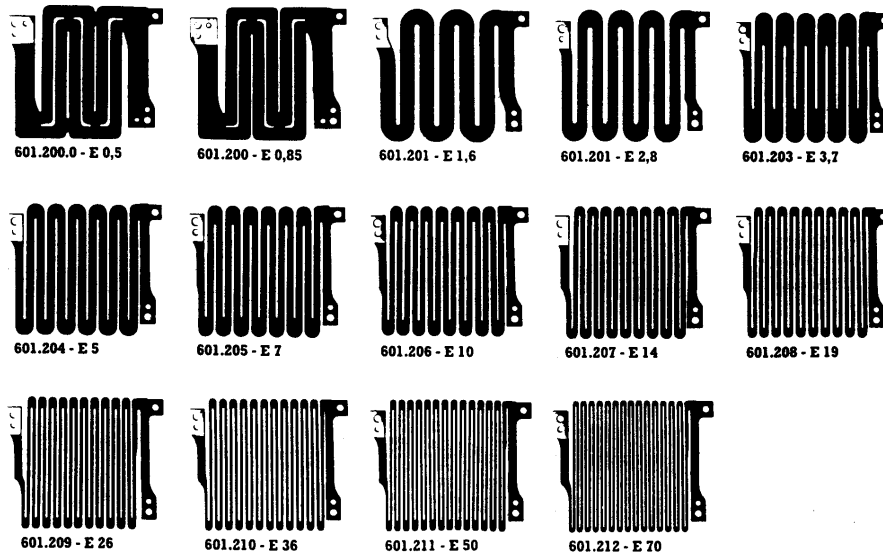
- Cast iron elements with terminal lugs are stacked between slate webs, fixed with special compound and pressed together by means of two end plates and tensioning bolts.
- The elements have ground connections and are switched in series by means of screwed connections.
- The connections are designed as terminal lugs which can be moved retroactively.

**Designs**

Banks with side elements, open, protection class IP00  
Housed resistors protection classes IP20 and IP23

**Surface protection**

Base paint and synthetic resin cover coat RAL 7032 light gray, alternatively hot-dip galvanized, without painting.



Technical data of the cast iron elements E..												
GINO description		Siemens description		Resistance value		Admissible current at duty factor in %						Current-time integral I²t [kA²s]
Code	Element No.	3PY6 201-	Type	cold Ω	hot Ω	Cycle time 120 s						
						100%	60%	40%	25%	15%	5%	
GSE0,5	601.200.0	2A	E0,5	0.005	0.065	260	338	404	494	650	910	28.6
GSE0,85	601.200	2B	E0,85	0.0085	0.011	200	260	311	380	500	700	28.6
GSE1,6	601.201	2C	E1,6	0.016	0.021	145	188	225	276	363	508	19.2
GSE2,8	601.202	2D	E2,8	0.028	0.036	110	143	171	209	275	385	10.4
GSE3,7	601.203	2E	E3,7	0.037	0.048	96	125	149	182	240	336	5.74
GSE5	601.204	2F	E5	0.050	0.065	82	107	127	156	205	287	5.18
GSE7	601.205	2G	E7	0.070	0.090	70	91	109	133	175	245	3.93
GSE10	601.206	2H	E10	0.100	0.130	58	75	90	110	145	203	1.69
GSE14	601.207	2I	E14	0.140	0.180	50	65	78	95	125	175	1.34
GSE19	601.208	2K	E19	0.190	0.250	42	55	65	80	105	147	0.75
GSE26	601.209	2L	E26	0.260	0.340	36	47	56	68	90	126	0.74
GSE36	601.210	2M	E36	0.360	0.470	31	40	48	59	78	109	0.5
GSE50	601.211	2N	E50	0.500	0.650	26	34	40	49	65	91	0.24
GSE70	601.212	2P	E70	0.700	0.910	22	29	34	42	55	77	0.17

**Three-phase standard resistors K48-../D** supplements according to table below

K48-4/..		K48-6/..		K48-8/..		K48-10/..		K48-12/..		Element Type	Admissible load [A] 1 – 3 stacked boxes At d.f. [%] , cycle time 120 s					
3 x 3		3 x 5		3 x 7		3 x 9		3 x 11			100%	60%	40%	25%	15%	5%
3 x Ω	Type <sup>1)</sup>	3 x Ω	Type <sup>1)</sup>	3 x Ω	Type <sup>1)</sup>	3 x Ω	Type <sup>1)</sup>	3 x Ω	Type <sup>1)</sup>							
0.025	D0,25	0.04	D1,4	0.06	D0,6	0.07	D0,7	0.09	D0,9	E0,85	200	260	310	380	500	700
0.04	D0,4	0.08	D0,8	0.11	D1,1	0.14	D1,4	0.17	D1,7	E1,6	145	188	225	276	363	508
0.08	D0,8	0.14	D1,4	0.2	D2	0.25	D2,5	0.31	D3,1	E2,8	110	143	170	209	275	385
0.11	D1,1	0.19	D1,9	0.26	D2,6	0.33	D3,3	0.4	D4	E3,7	96	125	149	182	240	336
0.15	D1,5	0.25	D2,5	0.35	D3,5	0.45	D4,5	0.55	D5,5	E5	82	107	127	156	205	287
0.21	D2,1	0.35	D3,5	0.5	D5	0.63	D6,3	0.77	D7,7	E7	70	91	109	133	175	245
0.30	D3	0.50	D5	0.7	D7	0.9	D9	1.1	D11	E10	58	75	90	110	145	203
0.42	D4,2	0.70	D7	1.0	D10	1.2	D12	1.5	D15	E14	50	65	78	95	125	175
0.57	D5,7	1.0	D10	1.3	D13	1.7	D17	2.1	D21	E19	42	55	65	80	105	147
0.78	D7,8	1.3	D13	1.8	D18	2.3	D23	2.9	D29	E26	36	47	56	68	90	126
1.10	D11	1.8	D18	2.5	D25	3.2	D32	4	D40	E36	31	40	48	59	78	109
1.50	D15	2.5	D25	3.5	D35	4.5	D45	5.5	D55	E50	26	34	40	49	65	91
2.10	D21	3.5	D35	4.9	D49	6.3	D63	7.7	D77	E70	22	29	34	42	55	77

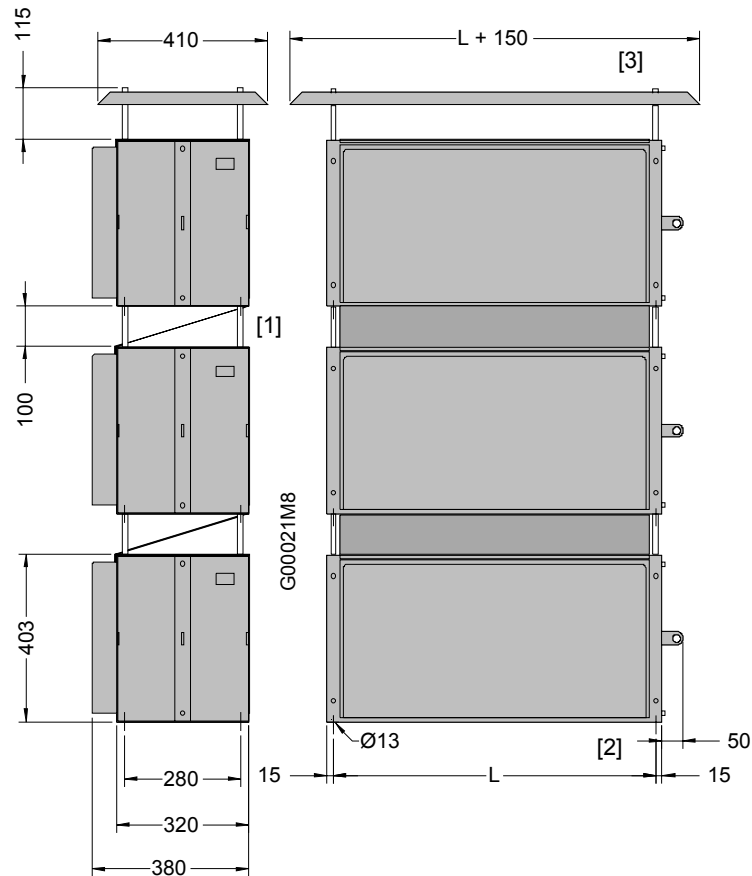
**Three-phase standard resistors K48-../N..** with partially upgraded end steps,

K48-8/..		K48-10/..		K48-12/..		Element Type	100%	60%	40%	25%	15%	5%						
3 x (2+5) = 3 x 7		3 x (2+7) = 3 x 9		3 x (2+9) = 3 x 11									Admissible load [A] 1 – 3 stacked boxes At d.f. [%] , cycle time 120 s					
3 x Ω	Type <sup>1)</sup>	3 x Ω	Type <sup>1)</sup>	3 x Ω	Type <sup>1)</sup>													
0.06	N0,6	0.07	N0,7	0.09	N0,9	E0,85	200	260	310	380	500	700						
0.11	N1,1	0.14	N1,4	0.18	N1,8	E1,6	145	188	225	276	363	508						
0.17	N1,7	0.23	N2,3	0.28	N2,8	E1,6+E2,8	110	143	170	209	275	385						
0.22	N2,2	0.29	N2,9	0.37	N3,7	E1,6+E3,7	96	125	149	182	240	336						
0.30	N3	0.40	N4	0.5	N5	E2,8+E5	82	107	127	156	205	287						
0.42	N4,2	0.55	N5,5	0.7	N7	E3,7+E7	70	91	109	133	175	245						
0.60	N6	0.80	N8	1.0	N10	E5+E10	58	75	90	110	145	203						
0.85	N8,5	1.1	N11	1.4	N14	E7+E14	50	65	78	95	125	175						
1.2	N12	1.5	N15	1.9	N19	E10+E19	42	55	65	80	105	147						
1.6	N16	2.1	N21	2.6	N26	E14+E26	36	47	56	68	90	126						
2.2	N22	2.9	N29	3.6	N36	E19+E36	31	40	48	59	78	109						
3.0	N30	4.0	N40	5.0	N50	E26+E50	26	34	40	49	65	91						
4.2	N42	5.6	N56	7.0	N70	E36+E70	22	29	34	42	55	77						

With the exception of the units in lines 1 and 2, the first two resistance steps can be loaded with 1.4 times the current

**Single-phase standard resistors K48-../E**

K48-4/..		K48-6/..		K48-8/..		K48-10/..		K48-12/..		Element Type	Admissible load [A] 1 – 3 stacked boxes At d.f. [%] , cycle time 120 s					
12		18		24		30		36			100%	60%	40%	25%	15%	5%
Ω	Type <sup>1)</sup>	Ω	Type <sup>1)</sup>	Ω	Type <sup>1)</sup>	Ω	Type <sup>1)</sup>	Ω	Type <sup>1)</sup>							
0.10	E1	0.15	E1,5	0.2	E2	0.25	E2,5	0.3	E3	E0,85	200	260	310	380	500	700
0.19	E1,9	0.3	E3	0.4	E4	0.48	E4,8	0.6	E6	E1,6	145	188	225	276	363	508
0.33	E3,3	0.5	E5	0.7	E7	0.85	E8,5	1.0	E10	E2,8	110	143	170	209	275	385
0.44	E4,4	0.7	E7	0.9	E9	1.1	E11	1.3	E13	E3,7	96	125	149	182	240	336
0.60	E6	0.9	E9	1.2	E12	1.5	E15	1.8	E18	E5	82	107	127	156	205	287
0.84	E8,4	1.25	E12,5	1.7	E17	2.1	E21	2.5	E25	E7	70	91	109	133	175	245
1.2	E12	1.8	E18	2.4	E24	3.0	E30	3.6	E36	E10	58	75	90	110	145	203
1.7	E17	2.5	E25	3.3	E33	4.2	E42	5.0	E50	E14	50	65	78	95	125	175
2.3	E23	3.4	E34	4.5	E45	5.7	E57	6.8	E68	E19	42	55	65	80	105	147
3.1	E31	4.7	E47	6.2	E62	7.8	E78	9.3	E93	E26	36	47	56	68	90	126
4.3	E43	6.5	E65	8.6	E86	11	E110	13	E130	E36	31	40	48	59	78	109
6.0	E60	9.0	E90	12	E120	15	E150	18	E180	E50	26	34	40	49	65	91
8.4	E84	1.25	E125	16.8	E168	21	E210	25	E250	E70	22	29	34	42	55	77



Size	Dim. L mm
K48-4	375
K48-6	490
K48-8	605
K48-10	725
K48-12	840

Size	No. of elements	Protection	Code GSG1.. <sup>1)</sup>	Weight ca. kg
K48-4	9	IP00	110-	30
K48-4	9	IP10	112-	35
K48-4	9	IP23	114-	39
K48-6	15	IP00	120-	38
K48-6	15	IP10	122-	45
K48-6	15	IP23	124-	50
K48-8	21	IP00	130-	51
K48-8	21	IP10	132-	60
K48-8	21	IP23	134-	65
K48-10	27	IP00	140-	65
K48-10	27	IP10	142-	75
K48-10	27	IP23	144-	81
K48-12	33	IP00	150-	78
K48-12	33	IP10	152-	90
K48-12	33	IP23	154-	96

Size	No. of elements	Protection	Code GSG1.. <sup>1)</sup>	Weight ca. kg
2/K48-8	2x21	IP00	230-	99
2/K48-8	2x21	IP10	232-	120
2/K48-8	2x21	IP23	234-	125
2/K48-10	2x27	IP00	240-	125
2/K48-10	2x27	IP10	242-	150
2/K48-10	2x27	IP23	244-	156
2/K48-12	2x33	IP00	250-	151
2/K48-12	2x33	IP10	252-	180
2/K48-12	2x33	IP23	254-	186

Size	No. of elements	Protection	Code GSG1.. <sup>1)</sup>	Weight ca. kg
3/K48-10	3x27	IP00	340-	186
3/K48-10	3x27	IP10	342-	225
3/K48-10	3x27	IP23	344-	231
3/K48-12	3x33	IP00	350-	225
3/K48-12	3x33	IP10	352-	270
3/K48-12	3x33	IP23	354-	276

Up to 3 boxes may be stacked.

[1] For protection class IP00 the boxes can be mounted directly on top of each other, for protection class IP20/23 spacer bolts and heat conducting plate shall be used

[2] Bottom clearance minimum 65 mm

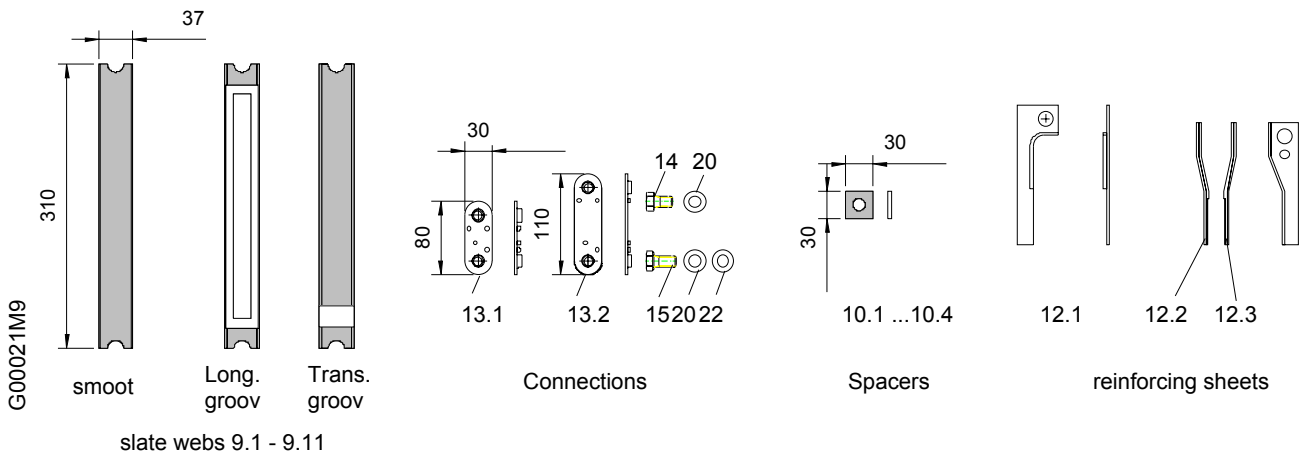
[3] Roof clearance for  
1 box minimum 65 mm,  
2 and 3 boxes minimum 250 mm

<sup>1)</sup> Order supplement according to selection table

Cast iron resistors: system Siemens K48..., spare and mounting parts

Item	Description	Siemens description	Code
1	Side panel, left	-	GSM042
2	Side panel, right	-	GSM043
3	Pressure rail	-	GSM044
4	Pressure rail	-	GSM045
5	Retaining clip	-	GSM046
<b>6</b>	<b>Longitudinal rails</b>	-	
6.1	375 mm	-	GSM047
6.2	490 mm	-	GSM048
6.3	605 mm	-	GSM049
6.4	725 mm	-	GSM050
6.5	840 mm	-	GSM051
7	Resistor elements E..	3PY6 201-..	gem. Seite 1.15
<b>8</b>	<b>Threaded bolts</b>	-	
8.1	405 mm	-	GSM052
8.2	520 mm	-	GSM053
8.3	635 mm	-	GSM054
8.4	755 mm	-	GSM055
8.5	870 mm	-	GSM056
<b>9</b>	<b>Slate webs</b>		
9.1	15 mm thick, smooth	3PY6 203-1D	GSM001
9.2	22 mm thick, smooth	-	GSM002
9.3	15 mm thick, smooth, 1 transv.groove	3PY6 203-1E	GSM003
9.4	22 mm thick, smooth, 1 tr.groove	-	GSM004
9.5	15 mm thick, 1 long.groove	3PY6 203-1A	GSM005
9.6	22 mm thick, 1 long.groove	-	GSM006
9.7	15 mm thick, 1 long. + 1 tr.groove	3PY6 203-1B	GSM007
9.8	15 mm thick, 1 long. + 1 tr.groove	-	GSM008
9.9	15 mm thick, 1 long. + 2 tr.groove	3PY6 203-1C	GSM009
9.10	15 mm thick, 2 long. grooves	-	GSM010
9.11	22 mm thick, 2 long. grooves	-	GSM039

Item	Description	Siemens description	Code
<b>10</b>	<b>Spacers</b>		
10.1	1 mm	3PY6 202-1	GSM011
10.2	3 mm	3PY6 202-3	GSM012
10.3	6 mm	3PY6 202-6	GSM013
10.4	20 mm	3PY6 202-20	GSM014
11	Interim layer		GSZ011
<b>12</b>	<b>Reinforcing sheets</b>		
12.1	Straight	3PY6 206-0B	GSM017
12.2	Offset	3PY6 206-0C	GSM016
12.3	Offset	3PY6 206-0A	GSM015
13	Connections		
13.1	Long	3PY6 202-0B	GSZ002
13.2	Short	3PY6 202-0A	GSZ001
14	Hex.bolt DIN 933-M12x20	-	-
15	Hex.bolt DIN 933-M12x25	-	-
16	Hex.nut DIN 933-M8x20	-	-
17	Hex.nut DIN 934-M12	-	-
18	Hex.nut DIN 934-M16	-	-
19	Spring ring DIN 127-B16	-	-
20	Spring washer DIN 137-B12	-	-
21	Spring washer DIN 137-B8	-	-
22	Washer DIN 125-A13	-	-
No pic.	Connection	3PY6 202-0C	GSM040
No pic.	Connection	3PY6 202-0D	GSM041
No pic.	Compound, 1 kg in bag	3PX6 206-0A	GSZ003



# Cast iron resistors: system GINO, elements

## System description

- Cast iron elements with and without reinforcement, mounted on insulated support brackets
- Elements contacted at the head by means of screw-type connections, direct parallel switching of elements possible
- Connections can be moved retroactively

## Designs

- Open banks for installation, free support bracket ends, protection class IP 00
  - Open banks with longitudinal rail for inserting into housing, protection class IP 00
  - Banks with side panels, open, prot. IP00
  - Housed resistors, protection IP20 and IP23
  - Housed resistors, protection IP20 and IP23
- Special designs with cable box, metallurgical plant design**

## Surface protection

Base coat and synthetic resin top coat RAL 7032 light gray, alternatively hot-dip galv., w/o painting.

**The number of elements in the units depends on the requirements.** This allows for an optimum customized design that cannot be obtained with standard banks. After selection of the elements as a function of the ohm value and load, the required size is selected depending on the required no. of elements.

GINO offers the dimensioning of the units as a free service.

To this effect, only the technical data of the intended application are needed:

## Examples for applications and data needed:

### Braking resistors for frequency converter drives

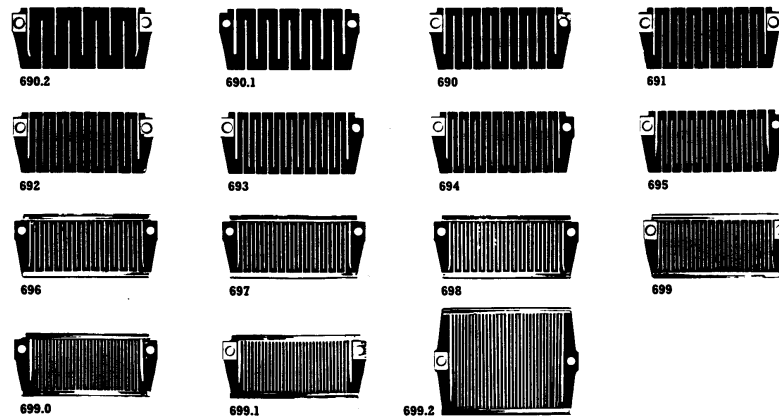
Ohm value, intermediate circuit voltage, braking capacity, duration and frequency

## Resistors for slip-ring conductors:

Motor rating, rotor standstill voltage, nominal rotor current.

## Type of resistor:

- Slip resistor: Slip at nominal load [%]
- Starter resistor: starting load factor, starting frequency and duration, type of machine, where required, load and inertia moment, speed
- Control resistor: Like starter resistor, additionally speed reduction and torque curve of the machine.
- Crane resistor: type of drive (hoisting/driving), switchgear.



## Technical data of the cast iron system GINO

Description		Resistance value		Admissible current at duty factor in % Cycle time 120 s						Current-time integral
Code	Element-No.	cold Ω	hot Ω	100%	60%	40%	25%	15%	5%	I <sup>2</sup> t [kA <sup>2</sup> s]
GWE12	690.2	0,012	0,016	160	200	250	296	368	531	11,3
GWE18	690.1	0,018	0,023	130	163	203	240	299	431	8,7
GWE25	690	0,025	0,033	110	138	172	203	253	365	7,6
GWE35	691	0,035	0,045	95	119	148	176	218	315	4,6
GWE45	692	0,045	0,058	85	106	133	157	195	282	3,5
GWE60	693	0,060	0,078	75	94	117	139	173	249	2,0
GWE75	694	0,075	0,097	65	81	102	120	150	216	1,2
GWE85	695	0,085	0,110	60	75	94	111	138	199	1,1
GWE100	696	0,100	0,130	55	69	86	102	127	182	0,97
GWE130	697	0,130	0,169	50	63	78	93	115	166	0,49
GWE150	698	0,150	0,195	45	56	70	83	104	149	0,58
GWE200	699	0,200	0,260	40	50	63	74	92	133	0,39
GWE320	699.0	0,320	0,420	31	39	48	57	71	103	0,24
GWE400	699.1	0,400	0,520	28	35	44	52	64	93	0,17
GWE750	699.2	0,750	0,970	25	31	39	46	58	83	0,13
<b>Special elements with high storage capacity / high current time integral</b>										
GWE7,5	690.20	0,0075	0,010	175	221	269	338	435	750	43
GWE11,7 <sup>1)</sup>	690.1RBW	0,0117	0,0156	139	176	214	269	346	596	21,8
GWE15,4 <sup>1)</sup>	690.RBW	0,0154	0,0205	114	147	179	225	289	498	15,9
GWE20 <sup>1)</sup>	690.0	0,020	0,027	105	148	179	225	290	499	10,5
GWE29,7 <sup>1)</sup>	692.RBW	0,0297	0,040	81	111	134	169	217	374	7,4
GWE40 <sup>2)</sup>	692.0	0,040	0,053	81	114	138	173	223	384	5,3
GWE52	691.0	0,052	0,070	76	115	140	176	226	389	3,6
GWE90	698.1	0,090	0,120	52	77	94	118	152	261	2,7 <sup>2)</sup>
GWE140	698.0	0,140	0,187	40	71	86	108	139	239	1,1 <sup>2)</sup>

The load values are mean values for a final temperature rise of ca. 400°C.

They apply for resistors in housings.

The values in the table are valid for the thermal equilibrium reached after ca. 20 minutes intermittent or continuous operation.

To optimally adjust the units to the intended application, the number of elements installed will follow

the requirements based on ohm values, loads and duty factor.

For short-term operation, a larger load value can be calculated in view of the heat storage capacity. For operation times >= 3 s, the current-time integral indicated in the table (i<sup>2</sup>t) can be used as a basis for load calculation.

Example:

Short-term operation

Load 590 A – 10 s

i<sup>2</sup>t = 0.59<sup>2</sup> x 10 = 3.48 kA<sup>2</sup>s

Selection: element GWE 45

1) Elements cannot be fitted with stiffener, max. current peak 1 kA

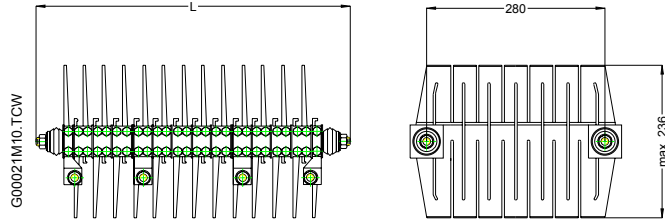
2) for 450 K temperature rise

# Cast iron resistors: system GINO, open banks, housed resistors

## Resistor banks IP00

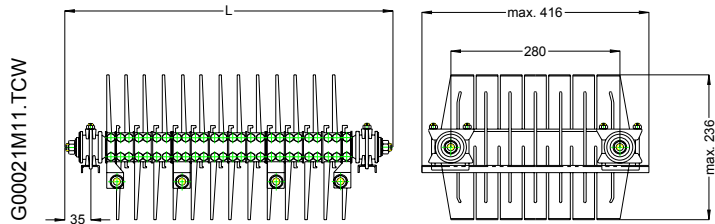
### Free support bracket ends

Type	No. of elements	Code	Dim. L	Weight Kg
0/369.400	10	GWP110	230	11
0/369.410	14	GWP120	280	15
0/369.420	18	GWP130	340	19



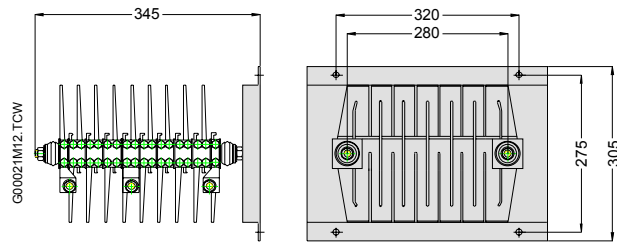
### With support rail

Type	No. of elements	Code	Dim. L	Weight Kg
0/369.0	24	GWP140	470	33
0/369.1	36	GWP150	620	45
0/369.2	48	GWP160	770	59



### With bracket for wall mounting

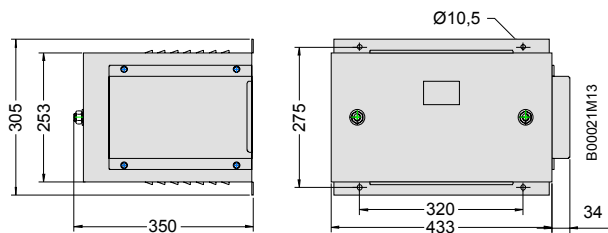
Type	No. of elements	Code	Weight kg
369.400	10	GWG110	15.2
369.410	14	GWG120	19.2
369.420	18	GWG130	23.2



## Resistors in small housings

- Protection class IP20: wall mounting
- Protection class IP23: upright mounting

Type	No. of elements	Code	Weight kg
369.402	10	GWG114	23
369.412	14	GWG124	26
369.422	18	GWG134	30





## Cast iron resistors: system GINO, housed resistors

**Protection IP00:** Bank with side panels

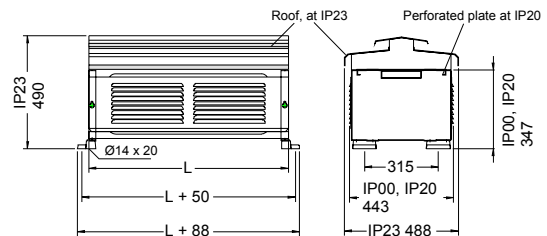
**Protection IP20:** Housing with perforated sheet cover, bottom open

**Protection IP23:** Housing with louvered sheet and roof, bottom open

Size	No. of elements	Dim. L
4	24	550
5	36	700
6	48	850

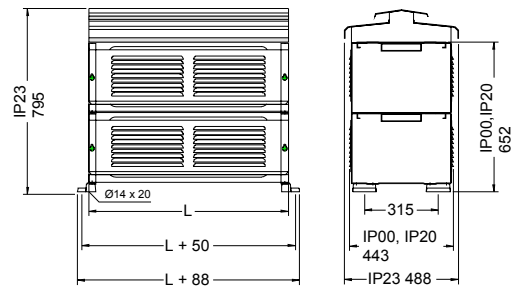
### Housed resistors individual housings

Type	No. of elements	Protection	Code	Weight kg
1/369.00	24	IP10	GWG140	48
1/369.01	24	IP20	GWG142	53
1/369.02	24	IP23	GWG144	59
1/369.10	36	IP10	GWG150	61
1/369.11	36	IP20	GWG152	67
1/369.12	36	IP23	GWG154	75
1/369.20	48	IP10	GWG160	76
1/369.21	48	IP20	GWG162	83
1/369.22	48	IP23	GWG164	91



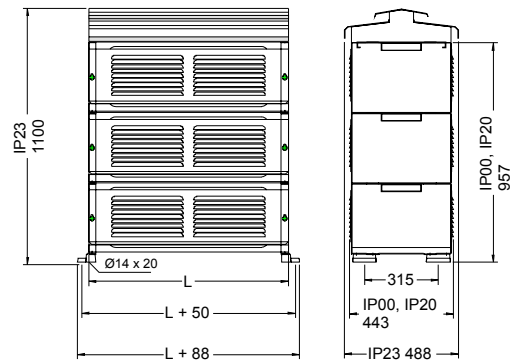
### Housed resistors 2 stacked boxes

Type	No. of elements	Protection	Code	Weight kg
2/369.00	2 x 24	IP10	GWG240	93
2/369.01	2 x 24	IP20	GWG242	101
2/369.02	2 x 24	IP23	GWG244	107
2/369.10	2 x 36	IP10	GWG250	118
2/369.11	2 x 36	IP20	GWG252	128
2/369.12	2 x 36	IP23	GWG254	136
2/369.20	2 x 48	IP10	GWG260	147
2/369.21	2 x 48	IP20	GWG262	159
2/369.22	2 x 48	IP23	GWG264	171



### Housed resistors 3 stacked boxes

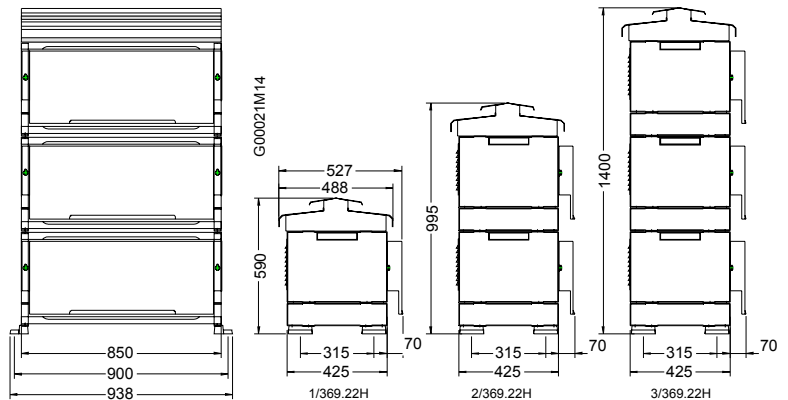
Type	No. of elements	Protection	Code	Weight kg
3/369.00	3 x 24	IP10	GWG340	138
3/369.01	3 x 24	IP20	GWG342	148
3/369.02	3 x 24	IP23	GWG344	154
3/369.10	3 x 36	IP10	GWG350	175
3/369.11	3 x 36	IP20	GWG352	189
3/369.12	3 x 36	IP23	GWG354	197
3/369.20	3 x 48	IP10	GWG360	219
3/369.21	3 x 48	IP20	GWG362	236
3/369.22	3 x 48	IP23	GWG364	244



### Housed resistors, metallurgical plant design

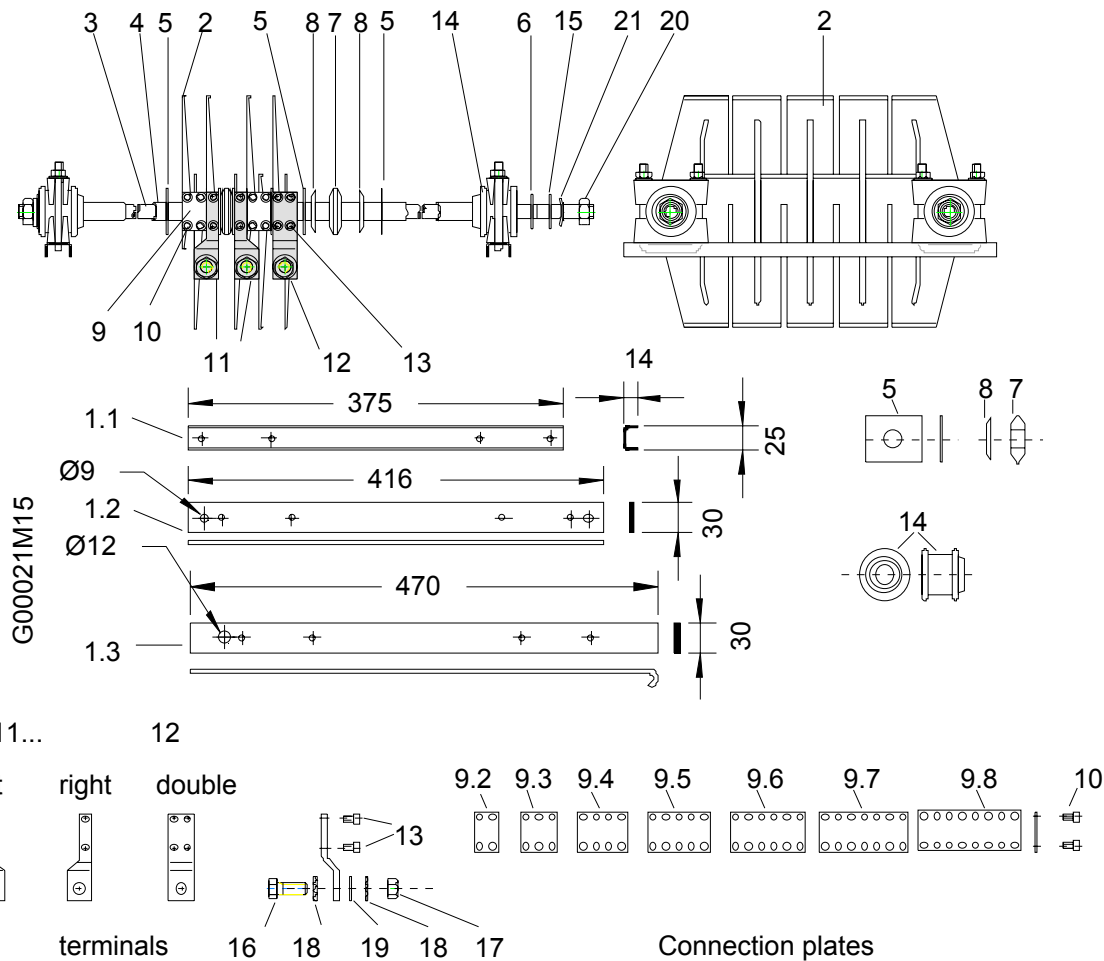
1 to 3 stacked boxes

Type	No. of elements	Protection	Code	Weight kg
1/369.22H	1 x 48	IP23	GWG169	99
2/369.22H	2 x 48	IP23	GWG269	178
3/369.22H	3 x 48	IP23	GWG369	263



Item	Description	DK No.	Code
<b>1</b>	<b>Support rails</b>		
1.1	Plug-in support rail, complete	166.311.0	GWM001
1.2	Plug-in rail, complete	166.311.1	GWM002
1.3	Screw rail, complete	166.311.2	GWM003
2	Resistor element	690 – 699.2	GWE12-750
<b>3</b>	<b>Support bracket</b>		
3.1	M14x470 for size 4	152.607.0	GWM004
3.2	M14x620 for size 5	152.607.1	GWM005
3.3	M14x770 for size 6	152.607.2	GWM006
<b>4</b>	<b>Insulating tube</b>		
4.1	Laminated paper size 4	156.114.3	GWM007
4.2	Laminated paper size 5	156.114.4	GWM008
4.3	Laminated paper size 6	156.114.5	GWM009
4.4	Mica paper size 4	156.130	GWM010
4.5	Mica paper size 5	156.131	GWM011
4.6	Mica paper size 6	156.132	GWM012
<b>5</b>	<b>Mica disc</b>		
5.1	0.5 mm	135.000.0	GWM038
5.2	1.0 mm	135.000.1	GWM039
6	Laminated paper disc	132.481	GWZ030
7	Insulator for phase separation	131.220	GWZ024
8	Sheet washer for item (2x erf.)	166.910.0	GWZ026
<b>9</b>	<b>Connecting plates</b>		
9.2.1	for 2 elements, copper	154.302	GWZ004
9.2.2	for 2 elements, galvanized steel	151.302	GWZ005
9.3.1	for 3 elements, copper	154.303	GWZ006
9.3.2	for 3 elements, galvanized steel	151.303	GWZ007
9.4.1	for 4 elements, copper	154.304	GWZ008
9.4.2	for 4 elements, galvanized steel	151.304	GWZ009
9.5.1	for 5 elements, copper	154.305	GWZ010
9.5.2	for 5 elements, galvanized steel	151.305	GWZ011
9.6.1	for 6 elements, copper	154.306	GWZ012
9.6.2	for 6 elements, galvanized steel	151.306	GWZ013
9.7.1	for 7 elements, copper	154.307	GWZ014
9.7.2	for 7 elements, galvanized steel	151.307	GWZ015

Item	Description	DK No.	Code
9.8.1	for 8 elements, copper	154.308	GWZ016
9.8.2	for 8 elements, copper	151.308	GWZ017
10	Cap screw for connecting plate, DIN 912-M6x10	-	NSZ912-0051
<b>11</b>	<b>Terminals</b>		
11.1	Terminal M8 right	166.810	GWZ018
11.2	Terminal M8 left	166.811	GWZ019
11.3	Terminal M12 right	166.810.1	GWZ020
11.4	Terminal M12 left	166.811.1	GWZ021
<b>12</b>	<b>Double terminals</b>		
12.1	Double terminal M8	166.812	GWZ022
12.2	Double terminal M12	166.812.1	GWZ023
13	Cap screw for connection, DIN 912-M6x15	-	NSZ912-0052
14	Insulator for bearing rail	131.219.1	GWZ025
15	Plain washer 35 x 14.2 x 2.5	151.320	GWZ031
16.1	Hexagonal screw DIN933-M8 x 20	-	NSS933-0095
16.2	Hexagonal screw DIN933-M12 x 25	-	NSS933-0153
17.1	Hexagonal nut DIN 934-M8	-	NMS934-0051
17.2	Hexagonal nut DIN 934-M12	-	NMS934-0071
18.1	Serrated lock washer DIN 6798-A 8.4	-	NSF6798-0025
18.2	Serrated lock washer DIN 6798-A 12.5	-	NSF6798-0041
19.1	Plain washer DIN 125-A 8.4	-	NSS125-0053
19.2	Plain washer DIN 125-A 13	-	NSS125-0073
20	Hexagonal nut DIN 934-M14	-	NMS934-0081
21	Spring washer DIN 137-B14	-	NSF137-0081



## Cast iron resistors: system AEG, system description, elements

### System description

- Cast iron elements with and without reinforcement, ends with open eyes, mounted on insulated support brackets
- Elements replaceable without requiring dismantling of the complete bank
- Contacts via spring pressure on the ground contact areas of the eyes
- Separate connecting sheets possible at any point between the elements
- Opposite side connections routed to the front

### Designs

- Open banks for installation, free support bracket ends, protection IP 00
- Banks with side panels, open, protection IP00
- Housed resistors, protection IP20 and IP23

### Surface protection

- Primer and synthetic resin top coat RAL 7032 light gray
- alternative hot-dip galvanizing, unpainted.



600.91 - E 10



600.92 - E 14



600.93 - E 20



600.94 - E 28



600.95 - E 40



600.96 - E 55



600.97 - E 80



600.98 - E 110



600.99 - E 175



600.910 - E 235



600.911 - E 340



600.912 - E 470



600.913 - E 670

### Technical data of the cast iron elements type E, system AEG

GINO description		AEG. Description	Resistance value		Admissible current at cyclic duty factor in % Cycle time 120 s						Current-time integral I <sup>2</sup> t [kA <sup>2</sup> s]
Code	Element No.		cold Ω	hot Ω	100%	60%	40%	25%	15%	5%	
GAE10	600.91	E10	0.010	0.013	200	236	291	350	420	644	28
GAE14	600.92	E14	0.014	0.018	169	199	246	296	355	544	14
GAE20	600.93	E20	0.020	0.026	141	166	205	247	296	454	6.56
GAE28	600.34	E28	0.028	0.036	119	140	173	208	250	383	4.57
GAE40	600.95	E40	0.040	0.052	100	118	146	175	210	322	3.64
GAE55	600.96	E55	0.055	0.071	83	98	121	145	174	267	2.83
GAE80	600.97	E80	0.080	0.104	70	83	102	122	147	225	2.03
GAE110	600.98	E110	0.110	0.143	60	71	87	105	126	193	1.65
GAE175	600.99	E175	0.175	0.227	47	55	68	82	99	151	1.32
GAE235	600.910	E235	0.235	0.303	41	48	60	72	86	132	0.98
GAE340	600.911	E340	0.340	0.440	34	40	50	59	71	109	0.85
GAE470	600.912	E470	0.470	0.590	30	35	44	52	63	97	0.52
GAE670	600.913	E670	0.670	0.850	25	30	36	44	53	80	0.29

The load values are mean values for final temperature rises of ca. 400°C. They apply for resistors in housings with up to 3 stacked resistors.

The values in the table only apply for the thermal equilibrium reached after an operating time of ca. 20 minutes in intermittent or continuous operation.

For short-term operation, a higher load value can be used due to the heat storage capacity.

For operating times  $\geq 3$  s, the current-time integral shown in the table ( $i^2t$ ) can be used to calculate the load.

Example:

Short-term operation

Load 590 A – 10 s

$i^2t = 0.59^2 \times 10 = 3.48 \text{ kA}^2\text{s}$

Selection element GAE 40 with  $i^2t = 3.64 \text{ kA}^2\text{s}$

Unit with same-type elements

P112/W112		P118/W118		P124/W124		P130/W130		Admissible load A					
No. of elements								1 – 3 stacked boxes					
3 x 4		3 x 6		3 x 8		3 x 10		Duty factor in % at cycle time 120 s					
3 x Ω	Order suppl.	3 x Ω	Order suppl.	3 x Ω	Order suppl.	3 x Ω	Order suppl.	100%	60%	40%	25%	15%	5%
0.040	G0,040	0.06	G0,06	0.08	G0,08	0.10	G0,10	200	236	291	350	420	644
0.056	G0,056	0.84	G0,84	0.11	G0,11	0.14	G0,14	169	199	246	296	355	544
0.080	G0,080	0.12	G0,12	0.16	G0,16	0.20	G0,20	141	166	205	247	296	454
0.112	G0,112	0.17	G0,17	0.22	G0,22	0.28	G0,28	119	140	173	208	250	383
0.160	G0,160	0.24	G0,24	0.32	G0,32	0.40	G0,40	100	118	146	175	210	322
0.220	G0,220	0.33	G0,33	0.44	G0,44	0.55	G0,55	83	98	121	145	174	267
0.320	G0,320	0.48	G0,48	0.64	G0,64	0.80	G0,80	70	83	102	122	147	225
0.440	G0,440	0.66	G0,66	0.88	G0,88	1.10	G1,10	60	71	87	105	126	193
0.700	G0,700	1.00	G1,00	1.40	G1,40	1.80	G1,80	47	55	68	82	99	151
0.940	G0,940	1.40	G1,40	1.90	G1,90	2.40	G2,40	41	48	60	72	86	132
1.340	G1,340	2.00	G2,00	2.70	G2,70	3.40	G3,40	34	40	50	59	71	109
1.900	G1,900	2.80	G2,80	3.80	G3,80	4.70	G4,70	30	35	44	52	63	97
2.700	G2,700	4.00	G4,00	5.40	G5,40	6.70	G6,70	25	30	36	44	53	80

With upgraded end step, end step admissible for 1.4 times the value shown in the table

		P118/W118		P124/W124		P130/W130		Admissible load A					
No. of elements								1 – 3 stacked boxes					
		3 x 6		3 x 8		3 x 10		Duty factor in % at cycle time 120 s					
		3 x Ω	Order suppl.	3 x Ω	Order suppl.	3 x Ω	Order suppl.	100%	60%	40%	25%	15%	5%
		0.10	VG 0,10	0.14	VG 0,14	0.18	VG 0,18	141	166	205	247	296	454
		0.14	VG 0,14	0.20	VG 0,20	0.25	VG 0,25	119	140	173	208	250	383
		0.20	VG 0,20	0.27	VG 0,27	0.36	VG 0,36	100	118	146	175	210	322
		0.28	VG 0,28	0.38	VG 0,38	0.50	VG 0,50	83	98	121	145	174	267
		0.40	VG 0,40	0.54	VG 0,54	0.72	VG 0,72	70	83	102	122	147	225
		0.56	VG 0,56	0.76	VG 0,76	1.00	VG 1,00	60	71	87	105	126	193
		0.85	VG 0,85	1.21	VG 1,21	1.60	VG 1,60	47	55	68	82	99	151
		1.20	VG 1,20	1.70	VG 1,70	2.15	VG 2,15	41	48	60	72	86	132
		1.70	VG 1,70	2.30	VG 2,30	3.10	VG 3,10	34	40	50	59	71	109
		2.35	VG 2,35	3.30	VG 3,30	4.20	VG 4,20	30	35	44	52	63	97
		3.35	VG 3,35	4.60	VG 4,60	6.10	VG 6,10	25	30	36	44	53	80

Example for ordering

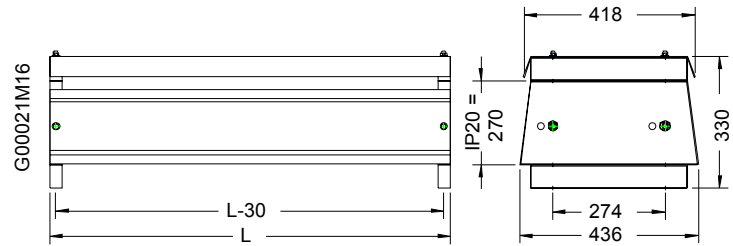
housed resistor  
 protection IP 20  
 3-phase  
 3 x 0.33 Ω  
 size W118-20-G0,33  
 Code: GAG132-G0,33 (cf. page 1.25)

# Cast iron resistors: system AEG, three-phase standard resistors, dimensions and weights

## Housed resistors, individual installation

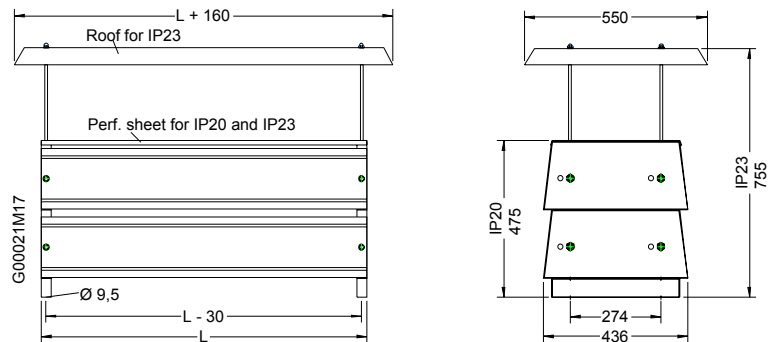
Size	No. of elements	Protection	Code <sup>1)</sup>	Weight
P106	6	IP00	GAG110-	17
W106-20	6	IP20	GAG112-	20
W106-23	6	IP23	GAG114-	22
P112	12	IP00	GAG120-	28
W112-20	12	IP20	GAG122-	32
W112-23	12	IP23	GAG124-	35
P118	18	IP00	GAG130-	38
W118-20	18	IP20	GAG132-	43
W118-23	18	IP23	GAG134-	46
P124	24	IP00	GAG140-	52
W124-20	24	IP20	GAG142-	56
W124-23	24	IP23	GAG144-	60
P130	30	IP00	GAG150-	62
W130-20	30	IP20	GAG152-	68
W130-23	30	IP23	GAG154-	72

Size	No. of elements	Dim. L mm
106	6	350
112	12	495
118	18	660
124	24	825
130	30	980



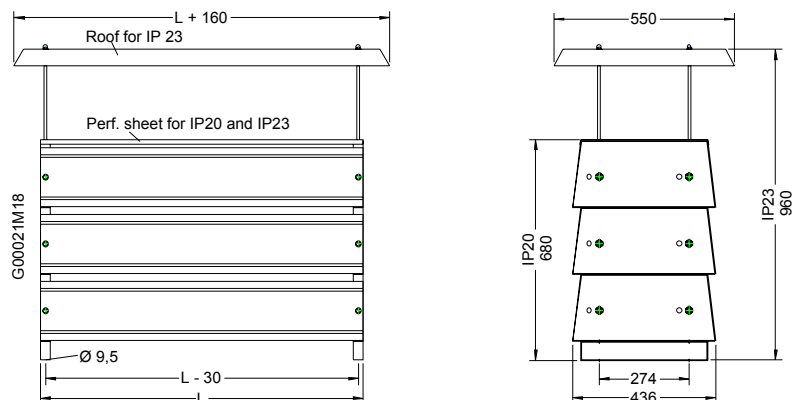
## Housed resistors, 2 stacked boxes

Size	No. of elements	Protection	Code. 1)	Weight kg
2P118	2x18	IP00	GAG230-	76
2W118-20	2x18	IP20	GAG232-	86
2W118-23	2x18	IP23	GAG234-	91
2P124	2x24	IP00	GAG240-	104
2W124-20	2x24	IP20	GAG242-	112
2W124-23	2x24	IP23	GAG244-	120
2P130	2x30	IP00	GAG250-	124
2W130-20	2x30	IP20	GAG252-	136
2W130-23	2x30	IP23	GAG254-	144



## Housed resistors, 3 stacked elements

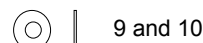
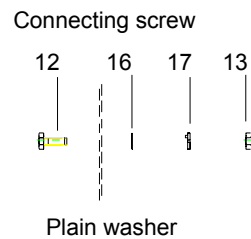
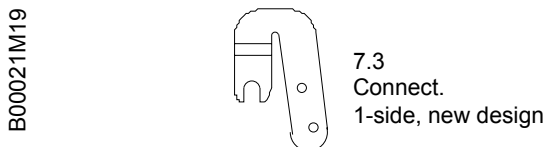
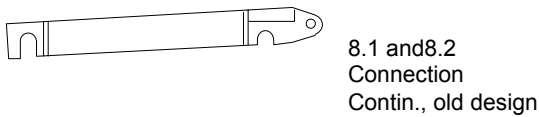
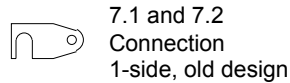
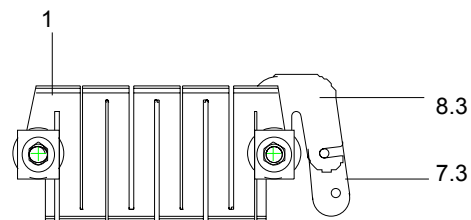
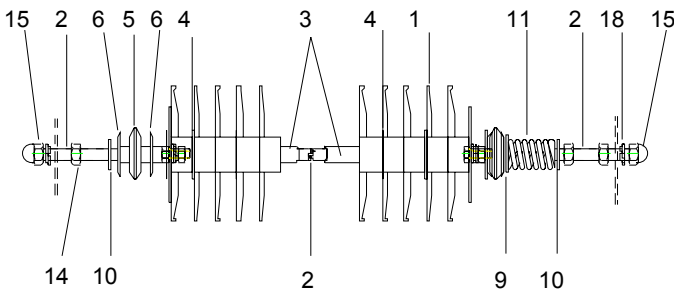
Size	No. of elements	Protection	Code <sup>1)</sup>	Weight kg
3P124	3x24	IP00	GAG340-	166
3W124-20	3x24	IP20	GAG342-	168
3W124-23	3x24	IP23	GAG344-	180
3P130	3x30	IP00	GAG350-	186
3W130-20	3x30	IP20	GAG352-	204
3W130-23	3x30	IP23	GAG354-	216



<sup>1)</sup> Order supplement as per selection table, see order example on page 1.24

Item	Description	DK No.	Code
1	Resistor element	600.90 .. 913	GAE ...
2	Support bracket		
2.1	320 mm for P/W 106	152.607.25	GAM001
2.2	465 mm for P/W 112	152.607.26	GAM002
2.3	630 mm for P/W 118	152.607.27	GAM003
2.4	795 mm for P/W 124	152.607.28	GAM004
2.5	950 mm for P/W 130	152.607.29	GAM005
3	Insulating tube		
3.1	for support bracket 320 mm	156.114.7	GAM006
3.2	for support bracket 465 mm	156.114.8	GAM007
3.3	for support bracket 630 mm	156.114.9	GAM008
3.4	for support bracket 795 mm	156.114.0	GAM009
3.5	for support bracket 950 mm	156.114.1	GAM010
4	Mica washer	135.000.18	GAM011
5	Ceramic insulator	131.220.7	GAM012
6	Disc washer	166.910.1	GAM013

Item	Description	DK No.	Code
7	Connecting plate, single-side		
7.1	1.5 mm, old design	562.612.05	GAM015
7.2	2.0 mm, old design	562.612.03	GAM016
7.3	New design	562.612.06	GAM017
8	Connecting plate, continuous		
8.1	1.5 mm, old design	652.612.04	GAM018
8.2	2.0 mm, old design	652.612.02	GAM019
8.3	New design	562.612.07	GAM020
9	Plain washer 44 x 19 x 2	562.600.08	GAM053
10	Plain washer 35 x 14.2 x 2.5	151.320	GAZ002
11	Pressure spring	141.601.2	GAM014
12	Hexagonal screw DIN 933-M10	-	NSS933-0124
13	Hexagonal nut DIN 934-M10	-	NMS934-0061
14	Hexagonal nut DIN 934-M14	-	NMS934-0081
15	Cap nut DIN 1587-M14	-	NMH1587-0051
16	Plain washer DIN 1235-A10,5	-	NSS125-0063
17	Spring washer DIN 137-B10	-	NSF137-0061
18	Spring washer DIN 137-B14	-	NSF137-0081



Mica washer



## Cast iron resistors: replacement for BBC units of the series GW1 – GW3

### System description

In replacement of the old BBC units we offer cast iron elements of the system AEG (see 1.23 and following) installed in housings of the system GINO (page 1.19 and following).

- Cast iron elements with and without reinforcement, ends with open eyes, mounted on insulated support brackets
- Elements can be replaced without requiring complete dismantling of the bank
- Contacts by spring pressure on the ground contact areas of the eyes
- Separate connecting plates possible at any point between the elements
- Opposite side connections routed to the front

### Designs

- Open banks for installation, free support bracket ends, protection IP 00
- Banks with side panels, open, protection IP00
- Housed resistors, protection IP20 and IP23

### Surface protection

- Primer and synthetic resin top coat RAL 7032 light gray
- Alternatively hot-dip galvanizing, unpainted.

### Three-phase standard resistors, model GW □-□-G.. with same-type elements,

GW 1-8 order suppl.		Size				Element Type AEG	Admissible load A 1 – 3 stacked boxes					
No. of elements		3 x 9		3 x 11			Duty factor in % at cycle time 120 s					
3 x 7		3 x 9		3 x 11			100%	60%	40%	25%	15%	5%
3 x Ω	Order suppl.	3 x Ω	Order suppl.	3 x Ω	Order suppl.							
0.60	G0,6	0.08	G0,08	0.10	G0,10	E10	200	236	291	350	420	644
0.10	G0,1	0.12	G0,12	0.14	G0,14	E14	169	199	246	296	355	544
0.13	G0,13	0.17	G0,17	0.21	G0,21	E20	141	166	205	247	296	454
0.19	G0,19	0.24	G0,24	0.30	G0,3	E28	119	140	173	208	250	383
0.27	G0,27	0.35	G0,35	0.43	G0,43	E40	100	118	146	175	210	322
0.38	G0,38	0.49	G0,49	0.59	G0,59	E55	83	98	121	145	174	267
0.55	G0,55	0.71	G0,71	0.87	G0,87	E80	70	83	102	122	147	225
0.70	G0,7	0.90	G0,90	1.10	G1,10	E110	60	71	87	105	126	193
1.22	G1,22	1.56	G1,56	1.92	G1,92	E175	47	55	68	82	99	151
1.04	G1,64	2.10	G2,10	2.57	G2,57	E235	41	48	60	72	86	132
2.31	G2,31	2.97	G2,97	3.64	G3,64	E340	34	40	50	59	71	109
3.00	G3,0	3.87	G3,87	4.73	G4,73	E470	30	35	44	52	63	97
4.40	G4,4	5.67	G5,67	6.95	G6,95	E670	25	30	36	44	53	80

### Three-phase standard resistors, model GW □-□-N..

with upgraded final steps, final step admissible for 1.4 times the value indicated in the table

GW 1-8 order suppl.		Size				Element Type AEG	Admissible load A 1 – 3 stacked boxes					
No. of elements		3 x 9		3 x 11			Duty factor in % at cycle time 120 s					
3 x 7		3 x 9		3 x 11			100%	60%	40%	25%	15%	5%
3 x Ω	Order suppl.	3 x Ω	Order suppl.	3 x Ω	Order suppl.							
0.11	N0,11	0.15	N0,15	0.19	N0,19	E10+E20	141	166	205	247	296	454
0.16	N0,16	0.22	N0,22	0.22	N0,22	E14+E28	119	140	173	208	250	383
0.23	N0,23	0.30	N0,30	0.30	N0,30	E20+E40	100	118	146	175	210	322
0.32	N0,32	0.43	N0,43	0.43	N0,43	E28+E55	83	98	121	145	174	267
0.47	N0,47	0.63	N0,63	0.63	N0,63	E40+E80	70	83	102	122	147	225
0.61	N0,61	0.81	N0,81	0.81	N0,81	E55+E110	60	71	87	105	126	193
1.03	N1,03	1.38	N1,38	1.38	N1,38	E80+E175	47	55	68	82	99	151
1.37	N1,37	1.84	N1,84	1.84	N1,84	E110+E235	41	48	60	72	86	132
1.20	N1,20	2.66	N2,66	2.66	N2,66	E175+E340	34	40	50	59	71	109
2.62	N2,62	3.48	N3,48	3.48	N3,48	E235+E470	30	35	44	52	63	97
3.81	N3,81	5.17	N5,17	6.33	N6,33	E340+E670	25	30	36	44	53	80

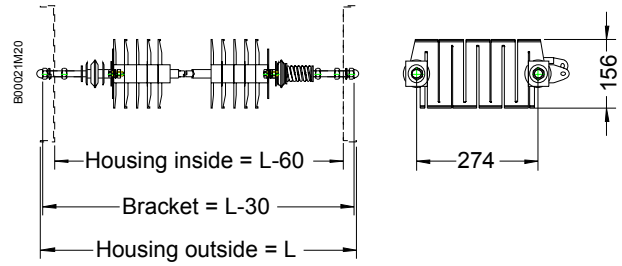
### Example for order:

housed resistor  
protection IP20  
3-phase  
3 x 0.10 Ω  
size GW 3-12-G0,10  
Code:GBG132-G0,10 (see page 1.28)

# Cast iron resistors: replacement for BBC units of the series GW1 – GW3

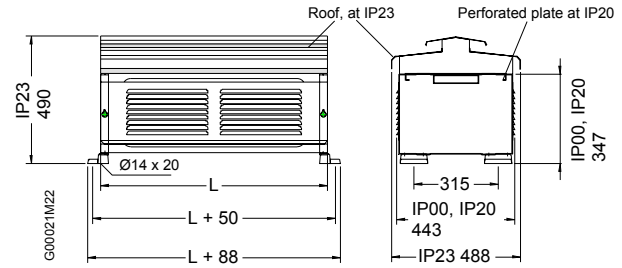
Resistor banks IP00, free support bracket ends

Size	No. of elements	Dim. L mm	Code <sup>1)</sup>	Weight kg
GW 1-8	21	550	GBP110-	36
GW 2-10	27	700	GBP120-	45
GW 3-12	33	850	GBP130-	55



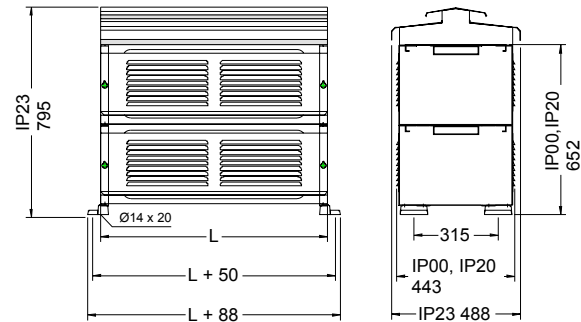
Housed resistors, individual installation

Size	No. of elements	Protoc.	Code <sup>1)</sup>	Weight kg
GW1-8-00	21	IP00	GBG110-	48
GW1-8-20	21	IP20	GBG112-	53
GW1-8-23	21	IP23	GBG114-	59
GW2-10-00	27	IP00	GBG120-	58
GW2-10-20	27	IP20	GBG122-	65
GW2-10-23	27	IP23	GBG124-	72
GW3-12-00	33	IP00	GBG130-	68
GW3-12-20	33	IP20	GBG132-	76
GW3-12-23	33	IP23	GBG134-	85



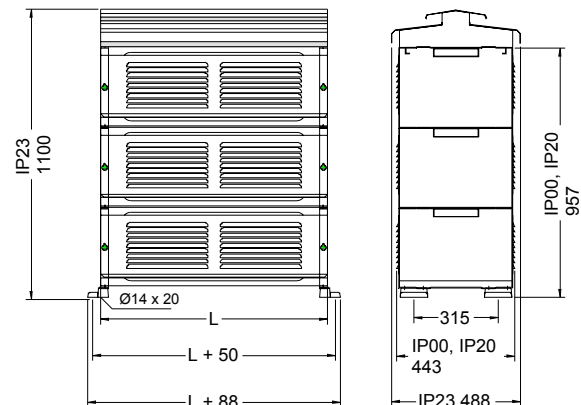
Housed resistors, 2 stacked boxes

Size	No. of Elements	Protoc.	Code <sup>1)</sup>	Weight kg
2/GW1-8-00	2x21	IP00	GBG210-	93
2/GW1-8-20	2x21	IP20	GBG212-	100
2/GW1-8-23	2x21	IP23	GBG214-	106
2/GW2-10-00	2x27	IP00	GBG220-	113
2/GW2-10-20	2x27	IP20	GBG222-	123
2/GW2-10-23	2x27	IP23	GBG224-	130
2/GW3-12-00	2x33	IP00	GBG230-	133
2/GW3-12-20	2x33	IP20	GBG232-	146
2/GW3-12-23	2x33	IP23	GBG234-	154



Housed resistors, 3 stacked boxes

Size	No. of elements	Protoc.	Code <sup>1)</sup>	Weight kg
3/GW1-8-00	3x21	IP00	GBG310-	137
3/GW1-8-20	3x21	IP20	GBG312-	148
3/GW1-8-23	3x21	IP23	GBG314-	154
3/GW2-10-00	3x27	IP00	GBG320-	167
3/GW2-10-20	3x27	IP20	GBG322-	182
3/GW2-10-23	3x27	IP23	GBG324-	189
3/GW3-12-00	3x33	IP00	GBG330-	196
3/GW3-12-20	3x33	IP20	GBG332-	215
3/GW3-12-23	3x33	IP23	GBG334-	223



<sup>1)</sup> Order supplements as per selection table, see order example on page 1.27



## Cast iron resistor elements, various systems, available spare parts

### System AEG B-elements

3 supporting lugs  $\varnothing 25$  mm, open at the bottom, spacing 2x105 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
B19	30	100	600.10	GAEB30
B20	34	90	600.11	GAEB34
B21	47	80	600.12	GAEB47
B22	59	70	600.13	GAEB59
B23	74	60	600.14	GAEB74
B24	98	57	600.15	GAEB98
B25	91	54	600.16	GAEB91
B26	110	50	600.17	GAEB110
B27	142	42	600.18	GAEB142
B28	177	36	600.19	GAEB177

### System AEG D-elements

3 supporting lugs  $\varnothing 14$  mm, open at the top, spacing 2x108 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
D35 o. A	48	40	600.22	GAED48-0
D35 A.re.	48	40	600.22	GAED48-1
D35 A.lks.	48	40	600.22	GAED48-2
D34 o. A	68	35	600.23	GAED68-0
D34 A.re.	68	35	600.23	GAED68-1
D34 A.lks.	68	35	600.23	GAED68-2
D33 o. A	112	22	600.24	GAED112-0
D33 A.re.	112	22	600.24	GAED112-1
D33 A.lks.	112	22	600.24	GAED112-2
D32 o. A	165	20	600.25	GAED165-0
D32 A.re.	165	20	600.25	GAED165-1
D32 A.lks.	165	20	600.25	GAED165-2
D31 o. A	277	15	600.26	GAED277-0
D31 A.re.	277	15	600.26	GAED277-1
D31 A.lks.	277	15	600.26	GAED277-2

A.= Anschluss, o.= ohne, re = rechts, lks = links

### System AEG EG-elements

2 supporting lugs  $\varnothing 18$  mm, closed, spacing 274 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
EG7	7	182	600.70	GAEG7
EG10	10	148	600.71	GAEG10
EG14	14	125	600.72	GAEG14
EG20	20	105	600.73	GAEG20
EG28	28	90	600.74	GAEG28
EG40	40	75	600.75	GAEG40
EG55	55	64	600.76	GAEG55
EG80	80	53	600.77	GAEG80
EG110	110	45	600.78	GAEG110

### System AEG EK-elements

2 supporting lugs  $\varnothing 18$  mm, geschlossen, spacing 274 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
EK38	38	60	600.81	GAEK38
EK54	54	50	600.82	GAEK54
EK75	75	42	600.83	GAEK75
EK105	105	36	600.84	GAEK105
EK140	140	30	600.85	GAEK140
EK200	200	26	600.86	GAEK200
EK280	280	22	600.87	GAEK280
EK400	400	18	600.88	GAEK400
EK500	500	16	600.89	GAEK500

### Special elements AEG

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
nv	52,5	nv	609.984.0	GXE52,5-11
279K	100	nv	609.985.0	GXE100-12
272K	300	nv	609.985.1	GXE300-12
774K	600	nv	609.985.2	GXE600-12
Eb20 137	300	nv	609.986.0	GXE300-13
nv	32	31	600.63	GAE32
nv	160	nv	600.33	GAE160

### Other Systems

Description	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
V&H	100	54	603.75	GVK100
BBC	80	nv	603.331	GBE80

### System BBC (ABB), MA-elements

2 supporting lugs  $\varnothing 22$  mm, open at the bottom, spacing 282 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
MA1	15	195	602.00/23	GBE15
MA1/1	15	195	602.00/18	GBE15/1
MA2	23	156	602.01/23	GBE23
MA2/1	23	156	602.01/18	GBE23/1
MA3	34	130	602.02/23	GBE34
MA3/1	34	130	602.02/18	GBE34/1
MA4	43	115	602.03/23	GBE43
MA4/1	43	115	602.03/18	GBE43/1
MA5	56	99	602.04/23	GBE56
MA5/1	56	99	602.04/18	GBE56/1
MA6	76	83	602.05/23	GBE76
MA6/1	76	83	602.05/18	GBE76/1
MA7	100	73	602.06/23	GBE100
MA7/1	100	73	602.06/18	GBE100/1
MA8	140	61	602.07/23	GBE140
MA8/1	140	61	602.07/18	GBE140/1
MA9	200	51	602.08/23	GBE200
MA9/1	200	51	602.08/18	GBE200/1
MA10	280	43	602.09/23	GBE280
MA10/1	280	43	602.09/18	GBE280/1
MA11	400	36	602.09/23	GBE400

### System ABB (ASEA)

2 supporting lugs  $\varnothing 21$  mm, open at the bottom, 30° inclin, spacing 250 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
5108	11,6	nv	602.12	GDE11,6
570	18,0	97	602.13	GDE18
647	31,0	76	602.14	GDE31
734	51,0	58	602.15	GDE51
823	85,0	46	602.16	GDE85
915	140	30	602.17	GDE140
1010	240	27	602.18	GDE240
-	84	nv	602.26	GDE84
-	150	nv	602.27	GDE150
-	285	nv	602.29	GDE285

### System Klöckner

2 lugs  $\varnothing 20$  mm, open at the bottom, spacing 320 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
5133GS8	18,5	120	603.01	GKE18,5
5132GS8	40	80	603.02	GKE40
5131GS8	70	65	603.03	GKE70
5130GS8	110	45	603.04	GKE110
5129GS8	184	35	603.05	GKE184
5128GS8	295	24	603.06	GKE295

### System Klöckner

2 supporting lugs  $\varnothing 20$  mm, open at the bottom, spacing 227 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
nv	17	106	603.11	GKE17
nv	35	83	603.12	GKE35
5390GS5	53	60	603.13	GKE53
5389GS5	107	42	603.14	GKE107
5843GS5	280	26	603.15	GKE280
5388GS5	450	19	603.16	GKE450
5844GS5	600	16	603.17	GKE600

### System Alstom-Unelec

GF: 2 supporting lugs  $\varnothing 22$  mm, open at the bottom, spacing 2 x 100 mm

Descrip-tion	Resistance m $\Omega$ cold	Nominal current A 100%df.	Element No.	Code
GF N°1	14			GUEG14
GF N°2	19			GUEG18
GF N°3	25			GUEG24
GF N°4	31			GUEG31
GF N°5	30			GUEG30
GF N°6	34			GUEG34
GF N°8	47			GUEG47
GF N°9	50			GUEG50
GF N°10	69			GUEG69
GF N°11	78			GUEG78
GF N°12	91			GUEG91
GF N°13	98			GUEG98
GF N°14	120			GUEG120

## Cast iron resistor elements, various systems, available spare parts

### System Alstom-Unelec

3 supporting lugs  $\varnothing$  22 mm, closed, spacing 2 x 100 / 55 mm high

Bezeichnung	Widerstand m $\Omega$ kalt	Nennstrom A 100% ED	Element Nr.	Artikel-Nr.
NP N°1	40			GCE55-F
NP N°2	55			GUEN55
NP N°3	75			GCE75-F
NP N°4	100			GUEN100
NP N°5	135			GUEN135
NP N°6	190			GUEN190
NP N°7	270			GUEN270
NP N°10	10			GUEN10

### Spare and mounting parts for Alstom-Unelec resistors

Description	Code
<b>Insulated support brackets</b>	
GFTNS 551 mm	GUM01
GFTZ 393 mm	GUM02
NP-A 156 mm	GUM03
NP-B 190 mm	GUM04
NP-C 220 mm	GUM05
NP-D 258 mm	GUM06
NP-F 304 mm	GUM07
NP-H 360 mm	GUM08
NP-K 404 mm	GUM09
NP-L 462 mm	GUM10
<b>Mica washers</b>	
57x22x2 mm	GUM11
47x22x0,5 mm	GUM12
29x15x0,5 mm	GUM13
29x15x1 mm	GUM14
48x22x1 mm	GUM15

Description	Code
<b>Connecting pieces</b>	
GF 2 mm 200/320 A	GUM16
GF 5 mm 500A	GUM17
NP 1 mm 80 A	GUM18
Spacer bushing	GUM19
<b>Mounting kits for</b>	
NP-A	GUM20
NP-B	GUM21
NP-C	GUM22
NP-D	GUM23
NP-F	GUM24
NP-H	GUM25
NP-K	GUM26
NP-L	GUM27
GFT-Z	GUM30
GFT-NS	GUM31

### System P&O,

2 supp.lugs  $\varnothing$  17 mm, open at the bottom, spacing 295 mm

Description	Resistance m $\Omega$ cold	Nom.curr. A 100% d.f. <sup>1)</sup>	Element No.	Code
PO-000	3.0	372	603.81	GPE3
PO-00	6.7	250	603.82	GPE6,7
PO-0	11.2	190	603.83	GPE11,2
PO-1	20.0	140	603.84	GPE20
PO-2	38.0	103	603.85	GPE38
PO-3	49.0	91	603.86	GPE49
PO-4	66.0	78	603.87	GPE66
PO-5	74.0	74	603.88	GPE74
PO-6	97.0	65	603.89	GPE97
PO-7	130	56	603.690	GPE130
PO-8	240	41	603.891	GPE240
PO-9	350	34	603.892	GPE350
PO-10	600	26	603.893	GPE600
PO-3 to PO-10: reinforced on 2 sides				

1) Valid for spaced installation, resistance increase at full load ca. 30 %

### Sachsenwerk

Description	Resistance m $\Omega$ cold	Nom.curr. A 100% d.f. <sup>1)</sup>	Element No.	Code
Size 385 x 150, 3 supporting lugs $\varnothing$ 16, open, spacing 2 x 175 mm				
G14	20	135	605.01	GCE20
G13	40	75	605.02	GCE40
G12	70	60	605.03	GCE70
-	40	nv	605.12	GCE40-1
-	70	nv	605.13	GCE70-1
Size 200 x 100, 2 supporting lugs $\varnothing$ 16, open, spacing 175 mm				
K7	24	61	605.22	GCE24
K4	75	34	605.25	GCE75
Size ca. 210 x 70, 3 supporting lugs, closed, spacing ca. 2 x 98,5 mm				
-	40	nv	605.41	GCE40-3
-	55	nv	605.42	GCE55
-	75	nv	605.43	GCE75-1
-	100	nv	605.44	GCE100
-	135	nv	605.45	GCE135
-	190	nv	605.46	GCE190
-	270	nv	605.47	GCE270

### Sachsenwerk

Bezeichnung	Widerstand m $\Omega$ kalt	Nennstrom A 100% ED <sup>1)</sup>	Element Nr.	Artikel-Nr.
Größe 250 x 106, 2 supp. lugs $\varnothing$ 25, open at the bottom, spacing 200 mm				
G2	6	164	606.02	GXE6-1
G3	10	127	606.03	GXE10-1
G4	16	105	606.04	GXE16-1
G5	30	73	606.05	GXE30-1
G6	53	56	606.06	GXE53-1
Size 243 x 243, 3 supporting lugs $\varnothing$ 21, closed, spacing 203 x 203 mm				
37529	15	125	606.10	GXE15-1
38085	20	107	606.11	GXE20-1
37858B	25	90	606.12	GXE25-1
37784	40	84	606.13	GXE40-1
37517	50	68	606.14	GXE50-1
37528	60	62	606.15	GXE60-1
38136	80	54	606.16	GXE80-1
35400	100	48	606.17	GXE100-1
36057	150	39	606.18	GXE150-1
36058	200	45	606.19	GXE200-1
Size ca. 300 x 140, 2 supporting lugs $\varnothing$ 22 closed, spacing 275 mm				
-	140	90	606.25	GXE140-2

### System General Electric, size ca.337 x 150 mm max.

3 supp.lugs  $\varnothing$  19 mm, centered, spacing 2x147.5 mm,

Description	Resistance m $\Omega$ cold	Nom.curr. A 100% d.f. <sup>1)</sup>	Element No.	Code
SG1	10	180	607.02	GGE10
SG2	20	130	607.03	GGE20
SG3	30	110	607.04	GGE30
SG4	40	85	607.05	GGE40
SG6	60	75	607.06	GGE60
SG8	80	65	607.07	GGE80
SG12	120	53	607.13	GGE120
SG18	180	43	607.14	GGE180
SG22	220	39	607.15	GGE220

### Special elements TBT

Size ca. 220 x 205 mm, 2 supp. lugs  $\varnothing$  16, spacing 200 mm

Description	Resistance m $\Omega$ cold	Nom.curr. A 100% d.f. <sup>1)</sup>	Element No.	Code
-	26	n/a	609.93	GXE26-6
-	47	n/a	609.94	GXE47-6
-	75	n/a	609.95	GXE75-6
-	120	n/a	609.96	GXE120-6
-	110	n/a	609.980.0	GXE110-7
-	300	n/a	609.980.1	GXE300-7
-	375	n/a	609.980.2	GXE375-7
-	41	n/a	609.981.0	GXE41-8
-	30,5	n/a	609.981.1	GXE30,5-8

### Special elements ÖBB

Size 385 x 150, 3 supp. lugs  $\varnothing$  16, open at the bottom, spacing 2 x 175 mm

Description	Resistance m $\Omega$ cold	Nom.curr. A 100% d.f. <sup>1)</sup>	Element No.	Code
E56	40	n/a	609.982.0	GXE40-9
E42	53.7	n/a	609.982.1	GXE53,7-9
E32	92.4	n/a	609.982.2	GXE92,4-9
E24	119.6	n/a	609.982.3	GXE119,6-9
E16	206	n/a	609.982.4	GXE206-9
-	50	n/a	609.983.0	GXE50-10
-	18	n/a	609.983.2	GXE18-10
-	10.5	n/a	609.983.3	GXE10,5-10
-	49	n/a	609.983.4	GXE49-10

### Siemens

Size 215 x 215, 2 lugs  $\varnothing$  21 closed, spacing 150 mm

Description	Resistance m $\Omega$ cold	Nom.curr. A 100% d.f. <sup>1)</sup>	Element No.	Code
C3	31	86	601.00	GSEC31
C6	63	61	601.02	GSEC63
g/508039	74	58	601.03	GSEC74
f/502039	90	50	601.04	GSEC90
C10	101	48	601.05	GSEC101
C16	163	38	601.06	GSEC163
c/502021	199	34	601.07	GSEC199
Größe 270 x 222, 2 lugs $\varnothing$ 25 closed, spacing 192 mm				
D4	46	76	601.10	GSED46
D7	73	60	601.12	GSED73
D11	111	49	601.14	GSED111
D16	203	36	601.16	GSED203



## Table of Contents

### Systems

Siemens 3PS3	pages 2.1-2.7
Siemens 3PS1	pages 2.8-2.11
GINO	pages 2.12-2.18

### Application

In drive engineering, steel grid resistors are suited for application in combination with motor starters or contactor controls for the starting and control of alternating current slip ring rotors or direct current motors.

They are equally suited as slip, series or load resistors.

These resistors exhibit a particularly high vibration resistance and low weight. Due to the large surface of the resistor elements in relation to their mass they are preferably used in continuous operation or intermittent operation with high duty factors.

### Systems

As the authorized supplier for the Siemens steel grid resistors, system 3PS3, GINO manufactures and supplies spare parts and units for the superseded system Siemens 3PS1 as well as its own GINO/ESE system.

### Standards

The resistors comply with the specifications of the applicable VDE standards VDE 0100 and VDE 0660. They conform with the EEC Low Voltage Directive of 19 February 1973.

### Protection

Pursuant to DIN 40 050/IEC 144 IP00, IP10, IP13, IP20, IP23 are available as a function of the respective system.

### Operating modes

#### KB

Short-time operation, with subsequent cooling down

#### AB

Intermittent operation with regular on/off times  $t_a/t_r$ , indicated as the duty factor, d.f., in %.

$$d.f. = \frac{t_a}{t_a + t_r} \cdot 100 [\%]$$

#### DB

Continuous operation

### Insulation

The rated insulation voltage is 1000V AC/1200V DC at a pollution degree of 3 pursuant to VDE 0110.

Test voltage 3.5 kV – 50 Hz – 1 min

### Resistor tolerance

The resistance values indicated in the tables are nominal values.

A nominal value is approx. 10% higher than the cold resistance value. The manufacturing tolerance is  $\pm 10\%$ .

This means that the ohm values of the resistors in cold condition are  $R_{cold} = 0.9R_{nom} \pm 10\%$ .

The hot resistance value is of about 1.15 x nominal value  $\pm 10\%$ .

### Resistance to climatic changes

Steel grid resistors are suited for climates A, F H, M and T pursuant to DIN 50 010 T1, climatic class "General" pursuant to IEC 721-2-1 and climatic classes J3, A and F2 pursuant to Siemens standard SN29070T1 and thus suited for indoor and outdoor installation with varying conditions of condensation, without protection against weathering at low pollution impact. The admissible ambient temperature range is -25 to +45°C and the admissible elevation is of up to 1000 m above sea level.

At higher temperatures or higher altitudes the load rating and/or the rated voltage must be reduced as a function of the operating mode KB/AB/DB or the installation altitude.

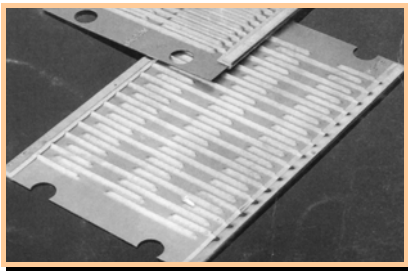
**Design**

Steel grid resistors 3PS3 consist of resistor elements made from high-alloyed steel sheet. The resistor material is largely resistant to corrosion due to the high chromium content and resistant to scaling even at elevated temperatures. Insulating bushings made from creepage-proof, temperature-cycle resistant ceramic material isolate the elements from each other and from the housing. Welded-in bridges connect the elements. Welded-on terminal lugs enable the connection of cables or lines by means of M12 cap screws.

The housings are of the same design as those for cast iron resistors 3PR3. Therefore, also a combination of both systems is possible.

The housings are not provided with painting as all elements are made from galvanized or stainless steel sheet.

The plates of the resistor elements are punched to obtain conductors of different dimensions thus resulting in elements with different resistance values in the range from 0.01 to 3.2 ohm. As punching does not lead to material loss, the thermal capacity of all elements is the same. A reinforcement made from corrosion-free sheet insulated with mica film at the upper and lower end serves to stabilize the element.



Five sizes with up to 30 elements which can in turn be supplied in single or three-strand design are available:

Size	No. of elements	
	1-strand	3-strand
3PS30	12	3 x 4
3PS32	16	3 x 5
3PS34	21	3 x 7
3PS36	26	3 x 8
3PS38	30	3 x 10

**Standard resistors**

Standard resistors are equipped with a fixed number of uniform elements and provided with uniform terminal markings (cf. page 2.6). For larger units, this will facilitate spare part warehousing.

**Available standard resistors:**

Single-strand resistors with standard banks and uniform number of resistor group elements.

Threes-strand standard bank resistors with uniform number of resistor group elements.

Three-strand standard bank resistors with partly upgraded resistor group elements. Here, the first two resistor steps can take on 1.4 times the current of the value indicated in the tables. They are preferably used as the final step in resistors for intermittent operation.

**Installation**

The resistors shall be installed horizontally such that the resistor elements are upright and the cooling air can rise freely between these elements.

The load values indicated in the tables refer to natural air cooling. Care must be taken that the cooling air has unrestricted access from below and can freely leave the resistor at the top. The place of installation must have good venting. In particular for indoor installation care must be taken that the ambient air does not heat up to temperatures above 45°C.

The indicated loads result in temperature rises of up to 260 K. For a temperature increase of max. 200 K, the rating must be reduced by 25% (current value x 0.866). Additional external venting with a fan may increase the rating and thus also the admissible load, in particular in the case of intermittent operation with a high duty factor.

**The admissible loss** for three stacked resistor boxes is of about:

Size	Admissible loss
3PS3 0	7.4 kW
3PS3 2	10.8 kW
3PS3 4	14.2 kW
3PS3 6	17.5 kW
3PS3 8	20.0 kW

**Connection**

After taking off the side panels, the incoming cables can be inserted from below and directly connected to the terminal connections of the resistor elements.

Connecting screws ..... M12  
 Cable diameter up to 1 x 150 mm<sup>2</sup>  
 2 x 120 mm<sup>2</sup>  
 Adm. continuous current.....400 A

The heat dissipated by the resistors must be considered for connection. Lines or cables should be inserted in each box individually from the side such that they are not located in the area of the outflowing dissipated heat or heat radiation. For the admissible load, DIN VDE 0298 T3/4 must be observed.

Where required, lines or cables suited for elevated temperatures shall be used or the ends of standard PVC cables/lines shall be covered with a heat-resistant insulation sleeve.

**Maintenance**

The resistors are maintenance-free. In case of strong dust formation, however, occasional cleaning with compressed air should be done to preserve the insulation against the grounded housing elements.

**Accessories, spare parts**

The circuit diagrams shown on page 2.6 indicate the position of the connections. The corresponding kits can be supplied for a posterior increase of the protection class. When ordered together with the resistor, these kits will already be mounted at the workshop so that no ulterior mounting work will be needed.

**Type key**

3PS3 ①②③ - ④⑤

3PS3 = System name

① = size :

- 0 = 3 x 4 or 1 x 12 elements
- 2 = 3 x 5 or 1 x 16 elements
- 4 = 3 x 7 or 1 x 21 elements
- 6 = 3 x 8 or 1 x 26 elements
- 8 = 3 x 10 or 1 x 30 elements

②③ = protection class

- 00 = IP00, all sizes
- 01 = IP10, all sizes
- 02 = IP13, only sizes 6 and 8
- 03 = IP23, only size 8
- 04 = IP20, all sizes

④⑤ = PO supplement, no. of elements

## Steel grid resistors: system Siemens 3PS3.., elements

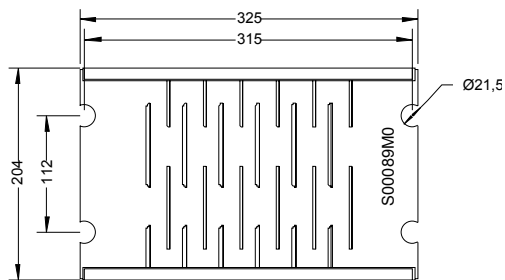
### Operating values

The load values for the elements indicated in the tables are applicable for 2 or 3 stacked boxes.

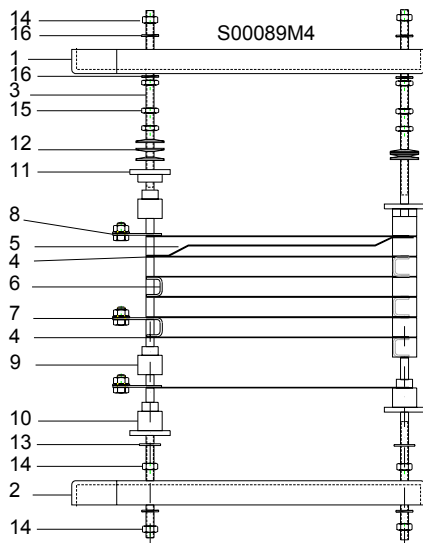
For individual installation the current values can be multiplied by 1.2 and for two stacked boxes by 1.1.

### Steel grid elements, technical data

Element description	Resistance values			Admissible load Cycle time 120 s and duty factor of					Without connecting bridge		With connecting bridge	
	Rated value mΩ ± 10%	Cold value mΩ ± 10%	Hot value ca. mΩ	100% A	60% A	40% A	25% A	15% A	Code 3PY6 301	Weight kg	Code 3PY6 301	Weight kg
WG 10	10	9	11.5	260	310	360	435	550	-3A	0.65	-4A	1.05
WG 15	15	13,5	17.3	210	250	295	350	450	-3B	0.65	-4B	1.05
WG 22	22	19.8	25.3	175	210	243	295	370	-3C	0.65	-4C	1.05
WG 32	32	28.8	36.3	145	170	202	244	306	-3D	0.65	-4D	1.05
WG 46	46	41,4	52.9	122	145	168	205	256	-3E	0.65	-4E	1.05
WG 68	68	61.2	78.2	100	120	140	168	210	-3F	0.65	-4F	1.05
WG 100	100	90	115	82	97	114	295	173	-3G	0.65	-4G	1.05
WG 150	150	135	173	67	79	93	244	142	-3H	0.65	-4H	1.05
WG 220	220	198	253	55	65	77	92	117	-3J	0.6	-4J	1.00
WG 320	320	288	368	46	54	64	77	97	-3K	0.6	-4K	1.00
WG 460	460	414	529	38	45	53	64	81	-3L	0.58	-4L	0.98
WG 680	680	612	782	32	38	44	54	66	-3M	0.58	-4M	0.98
WG 1000	1000	900	1150	26	31	36	44	55	-3N	0.58	-4N	0.98
WG 1500	1500	1350	1730	21	25	30	35	46	-3P	0.6	-4P	1.00
WG 2200	2200	1980	2530	18	21	24	30	37	-3R	0.6	-4R	0.98
WG 3200	3200	2880	3680	15	17	20	25	30	-3S	0.58	-4S	0.98



Steel grid element 3PY6 301- ..



Item	Description	Siemens name.	DK No.	Code
1	Side panel, left			BSM14
2	Side panel, right			BSM15
3	Support bracket			
3.1	370 mm for size 0			BSM16
3.2	490 mm for size 2			BSM17
3.3	610 mm for size 4			BSM18
3.4	725 mm for size 6			BSM19
3.5	840 mm for size 8			BSM20
4	Steel grid element WG			
4.1	- with connecting bridge	3PY6301-3A..S		BSE3A..S
4.2	- w/o connecting bridge	3PY6301-4A..S		BSE4A..S
5	Connecting bridge	3PY6305-OL	A600.427	BSM08
6	Connection piece	3PY6305-OK	A6500.426	BSM07
7	Connection piece with connection	3PY6304-OG	A600.429	BSM06
8	Connection piece	3PY6304-OF	A600.430	BSM05
9	Insulating bushing	3PY6302-OB	1527075	BSM01
10	Insulating bushing	3PY6302-OE	15271035	BSM03
11	Locking bushing	3PY6302-OD	15271036	BSM02
12	Disc spring	3PY6303-OA	1385081	BSM04
13	Washer DIN 9021- A10,5			NSK9021-0041
14	Hexagonal nut DIN 934-M10			NMS934-0061
15	Hexagonal nut DIN 439-B M10			NMS439-0012
16	Spring lock washer DIN 127-B10			NRF172-0061

## 1-strand resistors in standard bank design

Element	Load A <sup>1)</sup> for 3 stacked resistors (cycle time 120 s) and a duty factor d.f. of					Number of elements					PO no. supplement 3PS3①②③- ④⑤
	100%	60%	40%	25%	15%	12	16	21	26	30	
						① 0	① 2	① 4	① 6	① 8	
WG 10	260	310	360	435	550	0.12	0.16	0.21	0.26	0.3	-1A
WG 15	210	250	295	350	450	0.18	0.24	0.315	0.39	0.45	-1B
WG 22	175	210	243	295	370	0.264	0.352	0.462	0.572	0.66	-1C
WG 32	145	170	202	244	306	0.384	0.512	0.672	0.832	0.96	-1D
WG 46	122	145	168	205	256	0.552	0.736	0.966	1.196	1.38	-1E
WG 68	100	120	140	168	210	0.816	1.088	1.428	1.768	2.04	-1F
WG 100	82	97	114	138	173	1.2	1.6	2.1	2.6	3	-1G
WG 150	67	79	93	112	142	1.8	2.4	3.15	3.9	4.5	-1H
WG 220	55	65	77	92	117	2.64	3.52	4.62	5.72	6.6	-1J
WG 320	46	54	64	77	97	3.84	5.12	6.72	8.32	9.6	-1K
WG 460	38	45	53	64	81	5.52	7.36	9.66	11.96	13.8	-1L
WG 680	32	38	44	54	66	8.16	10.88	14.28	17.68	20.4	-1M
WG 1000	26	31	36	44	55	12.0	16	21.0	26.0	30.0	-1N
WG 1500	21	25	30	35	46	18.0	24	31.5	39.0	45.0	-1P
WG 2200	18	21	24	30	37	26.4	35.2	46.2	57.2	66.0	-1R
WG 3200	15	17	20	25	30	38.4	51.2	67.2	83.2	96.0	-1S

## 3- strand resistors in standard bank design

Element	Load A <sup>1)</sup> per strand for 3 stacked resistors (cycle time 120 s) and a duty factor d.f. of					Number of elements					PO no. supplement 3PS3①②③- ④⑤
	100%	60%	40%	25%	15%	3 x 4	3 x 5	3 x 7	3 x 8	3 x 10	
						① 0	① 2	① 4	① 6	① 8	
WG 10	260	310	360	435	550	3 x 0,04	3 x 0,05	3 x 0,07	3 x 0,08	3 x 0,1	-3A
WG 15	210	250	295	350	450	3 x 0,06	3 x 0,075	3 x 0,11	3 x 0,12	3 x 0,15	-3B
WG 22	175	210	243	295	370	3 x 0,088	3 x 0,11	3 x 0,154	3 x 0,18	3 x 0,22	-3C
WG 32	145	170	202	244	306	3 x 0,128	3 x 0,16	3 x 0,224	3 x 0,26	3 x 0,32	-3D
WG 46	122	145	168	205	256	3 x 0,184	3 x 0,23	3 x 0,322	3 x 0,37	3 x 0,46	-3E
WG 68	100	120	140	168	210	3 x 0,272	3 x 0,34	3 x 0,48	3 x 0,54	3 x 0,68	-3F
WG 100	82	97	114	138	173	3 x 0,4	3 x 0,5	3 x 0,71	3 x 0,8	3 x 1,0	-3G
WG 150	67	79	93	112	142	3 x 0,6	3 x 0,75	3 x 1,0	3 x 1,2	3 x 1,5	-3H
WG 220	55	65	77	92	117	3 x 0,88	3 x 1,1	3 x 1,5	3 x 1,8	3 x 2,2	-3J
WG 320	46	54	64	77	97	3 x 1,28	3 x 1,6	3 x 2,2	3 x 2,6	3 x 3,2	-3K
WG 460	38	45	53	64	81	3 x 1,84	3 x 2,3	3 x 3,2	3 x 3,7	3 x 4,6	-3L
WG 680	32	38	44	54	66	3 x 2,72	3 x 3,4	3 x 4,8	3 x 5,4	3 x 6,8	-3M
WG 1000	26	31	36	44	55	3 x 4,0	3 x 5,0	3 x 7,0	3 x 8,0	3 x 10,0	-3N
WG 1500	21	25	30	35	46	3 x 6,0	3 x 7,5	3 x 10,5	3 x 12,0	3 x 15,0	-3P
WG 2200	18	21	24	30	37	3 x 8,8	3 x 11,0	3 x 15,0	3 x 17,6	3 x 22,0	-3R
WG 3200	15	17	20	25	30	3 x 12,8	3 x 16,0	3 x 22,0	3 x 25,6	3 x 32,0	-3S
Connection diagram see page 2.6: V901846 -						-0	-2	-4	-6	-8	

## 3- strand resistors with upgraded end step

Elements	Load A <sup>1)</sup> per strand For 3 stacked resistors (cycle time 120 s) and duty factor d.f. of					Number of elements			PO no. supplement 3PS3①②③- ④⑤
	100%	60%	40%	25%	15%	3 x (2+5)	3 x (2+6)	3 x (3+7)	
						① 4	① 6	① 8	
WG 10 + WG 22	260 / 175	310 / 210	360 / 243	435 / 295	550 / 370	3 x 0,14	3 x 0,15	3 x 0,18	-4C
WG 15 + WG 32	210 / 145	250 / 170	295 / 202	350 / 244	450 / 306	3 x 0,20	3 x 0,22	3 x 0,27	-4D
WG 22 + WG 46	175 / 122	210 / 145	243 / 168	295 / 205	370 / 256	3 x 0,28	3 x 0,32	3 x 0,39	-4E
WG 42 + WG 68	145 / 100	170 / 120	202 / 140	244 / 168	306 / 210	3 x 0,41	3 x 0,47	3 x 0,57	-4F
WG 46 + WG 100	122 / 82	145 / 97	168 / 114	205 / 138	256 / 173	3 x 0,6	3 x 0,69	3 x 0,84	-4G
WG 68 + WG 150	100 / 67	120 / 79	140 / 92	168 / 112	210 / 142	3 x 0,9	3 x 1,0	3 x 1,25	-4H
WG 100 + WG 220	82 / 55	97 / 65	114 / 77	138 / 93	173 / 117	3 x 1,4	3 x 1,5	3 x 1,85	-4J
WG 200 + WG 320	67 / 46	79 / 54	92 / 64	112 / 77	142 / 97	3 x 1,9	3 x 2,2	3 x 2,7	-4K
WG 220 + WG 460	55 / 48	65 / 45	77 / 53	93 / 64	117 / 81	3 x 2,7	3 x 3,2	3 x 3,9	-4L
WG 320 + WG 680	46 / 32	54 / 38	64 / 44	77 / 54	97 / 66	3 x 4,0	3 x 4,7	3 x 5,7	-4M
WG 460 + WG 1000	38 / 26	45 / 31	53 / 36	64 / 44	81 / 55	3 x 6,0	3 x 6,9	3 x 8,4	-4N
WG 680 + WG 1500	32 / 21	38 / 25	44 / 30	54 / 35	66 / 46	3 x 9,0	3 x 10,4	3 x 12,5	-4P
WG 1000 + WG 2200	26 / 18	31 / 21	36 / 24	44 / 30	55 / 37	3 x 13,0	3 x 15,0	3 x 18,4	-4R
WG 1500 + WG 3200	21 / 15	25 / 17	30 / 20	35 / 25	46 / 30	3 x 19,0	3 x 22,0	3 x 27,0	-4S
Connection diagram see page 2.6 : V 901 847 -						-4	-6	-8	

② = number of boxes, ③ = protection class, see page 2.1

<sup>1)</sup>For individual installation, the current values can be multiplied by 1.2 and for 2 stacked boxes by 1.1

**Resistors for hoisting gear drives**

**PO data**

for first-time order:

- Full purchase order number and in addition
- type of drive (hoisting/driving, etc.)
- motor rating
- rotor standstill voltage
- contactor current
- circuit arrangement
- duty factor

for re-ordering:

- Full purchase order number and additionally:
- serial number of the resistor already supplied

Circuit arrangement uk			Circuit arrangement ak, csak			Circuit arrangement eh, csk			Circuit arrangement ek			No. of boxes	Resistor data Order no. 3PS3...②③-3Z	Weight IP00 ca. kg
Duty factor at cycle time 120 s			Duty factor at cycle time 120 s			Duty factor at cycle time 120 s			Duty factor at cycle time 120 s					
60 %	40 %	25 %	60 %	40 %	25 %	60 %	40 %	25 %	60 %	40 %	25 %			
Suited for motor rating up to			Suited for motor rating up to			Suited for motor rating up to			Suited for motor rating up to					
kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW	kW			
11	15	21	9	12	15.5	5.5	7.5	10.5				1	3PS34②③-3Z	23
15	20	28	12	16	22	7.5	10	14				1	3PS36②③-3Z	28
19	25	35	15	20	28	9.5	12.5	17				1	3PS38②③-3Z	32
30	38	54	28	34	48	16	21	30	10	15	21	2	2/3PS34②③-3Z	46
40	50	72	36	45	65	24	30	43	22	27	39	2	2/3PS36②③-3Z	56
48	60	87	48	60	87	29	36	52	28	36	52	2	2/3PS38②③-3Z	64
63	80	116	63	80	116	38	48	69	38	48	69	3	3/3PS36②③-3Z	84
66	85	122	66	85	122	43	54	80	43	54	80	3	3/3PS38②③-3Z	96
88	110	160	88	110	160	67	71	105	67	71	105	4	4/3PS38②③-3Z	128
115	143	210	115	143	210	75	95	137	75	95	137	5	5/3PS38②③-3Z	160
143	176	253	143	176	253	93	115	167	93	115	167	6	6/3PS38②③-3Z	192
170	210	308	170	210	308	110	135	200	110	135	200	7	7/3PS38②③-3Z	224
200	240	352	200	240	352	130	158	230	130	158	230	8	8/3PS38②③-3Z	256
230	280	410	230	280	410	150	180	260	150	180	260	9	9/3PS38②③-3Z	288

③ supplement with protection class (see type key)

**Kits to upgrade the protection class**

The resistors listed in the above tables are available with protection class IP10, IP20, sizes 6 and 8 and also with IP13, and size 8 with IP23 or can be upgraded to said class.

When ordering the upgrade together with the standard resistor, the resistors are supplied fully assembled.

In case of subsequent ordering of the kits, the conversion is done by the customer.

The kits must be selected in consideration of the type, installation and number of boxes.

Example for order:

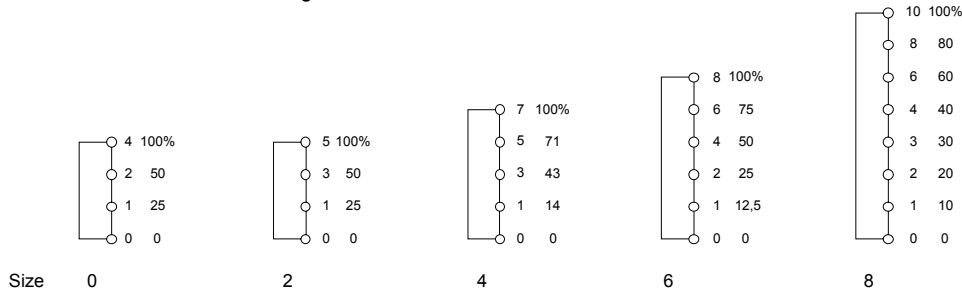
Resistor 7/3PS3803- consisting of 7 boxes, upgrade to protection class IP23 for installation with 2 x 3 and 1 x 1 unit requires ordering of 2 kits 3 x stacked boxes and 1 kit for the individual unit.

For resistor	Individual installation		2 stacked boxes		3 stacked boxes	
	Order number	Weight ca. kg	Order number	Weight ca. kg	Order number	Weight ca. kg
<b>Kit for protection class IP 10</b> consisting of top and side grids						
3PS3 0	3PX6 223-0A	1.2	3PX6 223-0B	1.8	3PX6 223-0C	2.4
3PS3 2	3PX6 223-2A	1.4	3PX6 223-2B	2.1	3PX6 223-2C	2.9
3PS3 4	3PX6 223-4A	1.6	3PX6 223-4B	2.5	3PX6 223-4C	3.4
3PS3 6	3PX6 223-6A	2.0	3PX6 223-6B	3.0	3PX6 223-6C	4.1
3PS3 8	3PX6 223-8A	2.4	3PX6 223-8B	3.4	3PX6 223-8C	4.6
<b>Kit for protection class IP13</b> consisting of one-piece housing and side panels						
3PS3 6	3PX6 224-6A	9.6	3PX6 224-6B	13.5	3PX6 224-6C	17.4
3PS3 8	3PX6 224-8A	10.6	3PX6 224-8B	15.3	3PX6 224-8C	25.0
<b>Kit for protection class IP20</b> consisting of top and side grids, bottom plate and cable bushing						
3PS3 0	3PX6 226-0A	2.6	3PX6 226-0B	3.9	3PX6 226-0C	5.0
3PS3 2	3PX6 226-2A	3.3	3PX6 226-2B	4.9	3PX6 226-2C	6.5
3PS3 4	3PX6 226-4A	4.2	3PX6 226-4B	6.3	3PX6 226-4C	8.2
3PS3 6	3PX6 226-6A	5.0	3PX6 226-6B	7.6	3PX6 226-6C	10.0
3PS3 8	3PX6 226-8A	5.8	3PX6 226-8B	8.5	3PX6 226-8C	11.5
<b>Kit for protection class IP23</b> consisting of terminal box, side and bottom plates and cable bushing						
3PS3 8	3PX6 225-8A	14.6	3PX6 225-8B	19.6	3PX6 225-8C	30

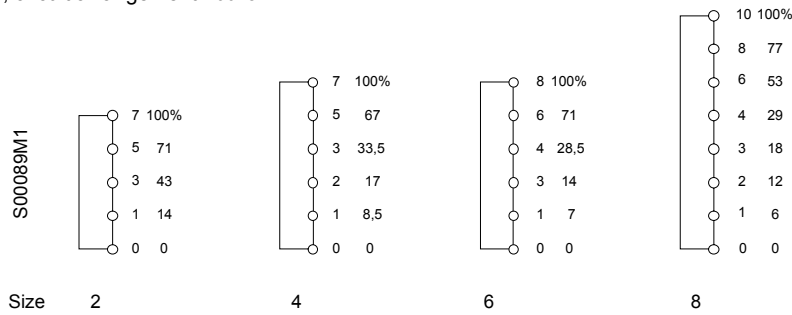
Steel grid resistors: system Siemens 3PS3..  
connection diagrams, dimensions of resistors for individual installation

**Connection diagrams**

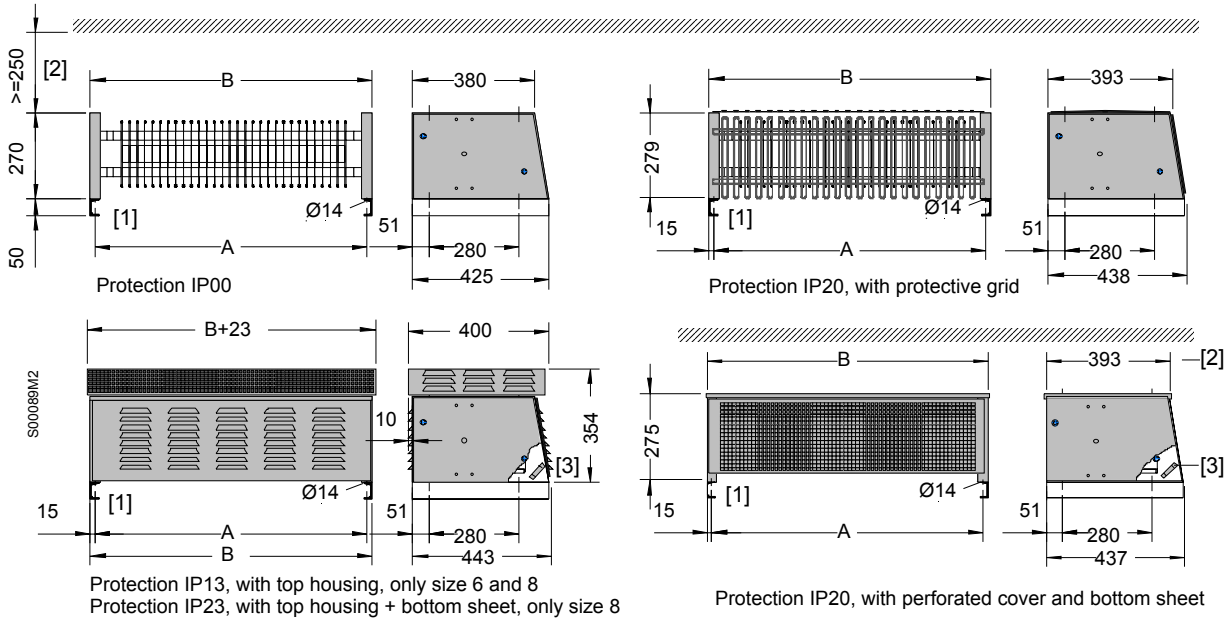
- a) 1-phase resistors are provided with terminal connections as required, please indicate number and position in your order.
- b) 3-phase standard resistors, uniform installation, circuit arrangement V901846 -



- c) 3-phase standard resistors, upgraded installation, circuit arrangement V901847 -



**Steel grid resistors for individual installation**



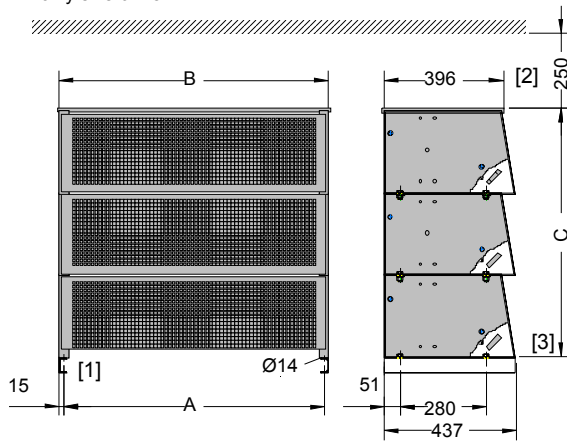
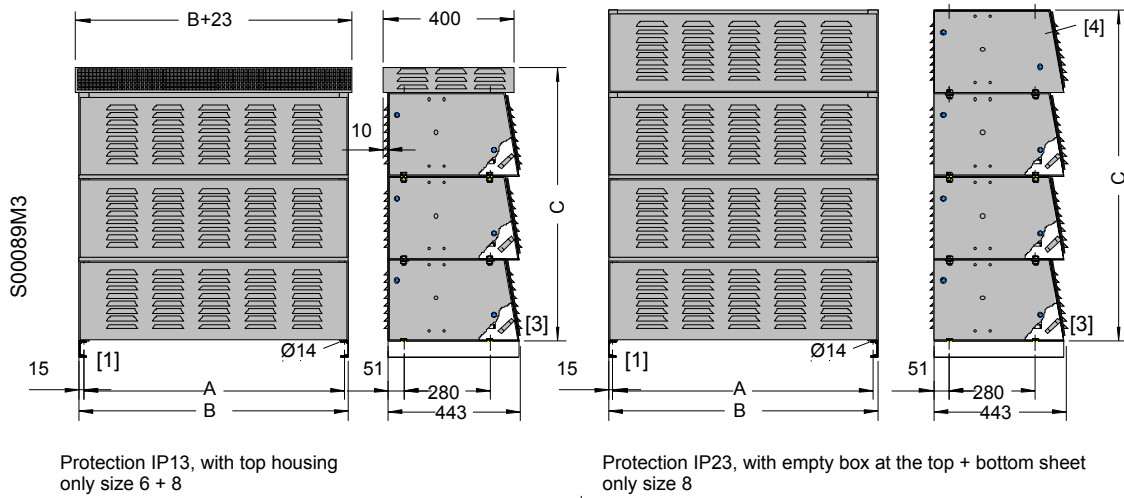
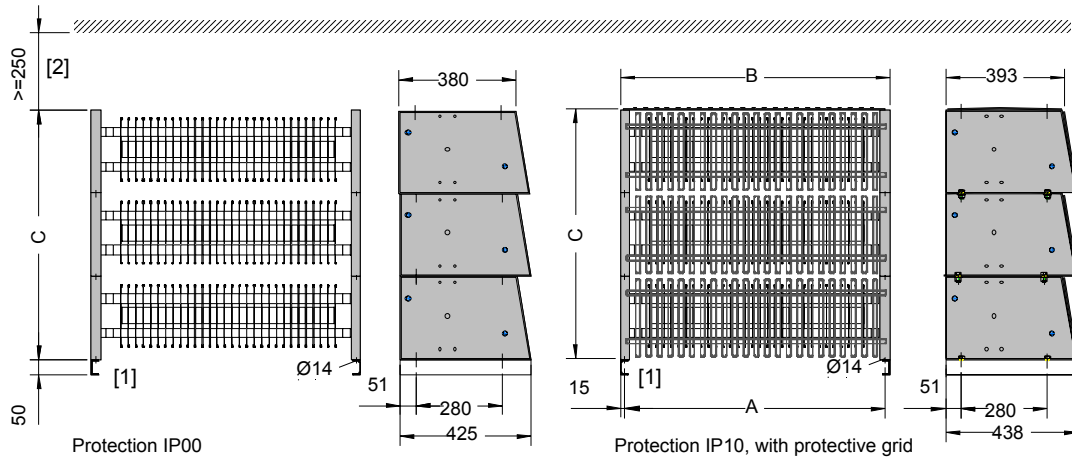
Width Type	A	B
3PS30②③-	375	405
3PS32②③-	495	525
3PS34②③-	615	645
3PS36②③-	730	760
3PS38②③-	845	875

Weight ca. kg Type	Weight ca. kg			
	IP00	IP10	IP13	IP23
3PS30②③-	16	19	-	-
3PS32②③-	19	23	-	-
3PS34②③-	23	28	-	-
3PS36②③-	28	34	38	-
3PS38②③-	32	39	43	47

- [1] Bottom clearance  $\geq 50$  mm
- [2] Top clearance minimum 250 mm
- [3] Cable bushing only for protection classes IP 20 and IP 23



# Steel grid resistors: system Siemens 3PS3.. dimensions



Type	Weight ca. kg			
	IP00 ②③=00	IP10 ②③=01	IP13 ②③=02	IP23 ②③=03
2/3PS30②③-	32	37	-	-
2/3PS32②③-	38	41	-	-
2/3PS34②③-	46	54	-	-
2/3PS36②③-	56	65	70	-
2/3PS38②③-	64	75	79	84
3/3PS32②③-	48	54	-	-
3/3PS32②③-	57	65	-	-
3/3PS34②③-	69	80	-	-
3/3PS36②③-	84	97	101	-
3/3PS38②③-	96	110	121	126

Width mm		
Type	A	B
3PS30②③-	375	405
3PS32②③-	495	525
3PS34②③-	615	645
3PS36②③-	730	760
3PS38②③-	845	875

Dimension C mm stacked install.		
Protection	2 boxes	3 boxes
IP 00	540	810
IP10	549	819
IP 13	623	893
IP 20	545	815
IP 23	812	1082

- [1] Bottom clearance  $\geq 50$  mm  
The hexagonal nuts M12 x 25 required for fastening are not included in the scope of supply.
- [2] Minimum top clearance  $\geq 250$  mm
- [3] Cable bushing  
for protection classes IP 20 and IP 23
- [4] Terminal box, without resistor

## Design

The 3PS1 steel grid resistors are the precursors of the 3PS3 series and should no longer be used for new installations. The design is similar to that described for 3PS3. In terms of the resistance values the resistor elements are identical to the 3PS3 elements. Only the internal structure of the systems and the design of the terminal connections is slightly different from 3PS3.

The housings are not provided with a paint coat as all elements are made from galvanized or corrosion-resistant steel sheet.

Four sizes with up to 27 elements in single or three-strand design are available:

Size	Number of elements	
	1-strand	3-strand
3PS101	9	3 x 3
3PS102	15	3 x 5
3PS103	21	3 x 7
3PS104	27	3 x 9

## Standard resistors

Standard resistors have a fixed number of components with uniform elements and uniform terminal markings. In the case of larger units, this facilitates spare part warehousing.

### Standard resistors available:

Three-strand resistors with standard banks and uniform elements with resistor groups.

Three-strand resistors with standard banks with partly upgraded installation of resistor groups. Here, the first resistor step can be loaded with 1.4 times the current values indicated in the tables. They are preferably used as final step in resistors for intermittent application.

### Installation

The resistors shall be installed horizontally in such a way that the resistor elements are in vertical position and the cooling air can freely move upwards between them. The load values indicated in the tables are applicable for natural air cooling. In this context it must be ensured that the cooling air has unrestricted access at the bottom and can freely leave the resistor at the top. The place of installation must have good ventilation. In particular in case of indoor installation care must be taken that the ambient air does not heat up to temperatures above 45°C. The indicated loads result in temperature rises of up to 260 K. For a temperature rise of max. 200 K, the rating must be reduced by 25% (current value x 0.866). Additional forced venting with a fan can improve the rating and thus also the admissible load, in particular in intermittent operation with a high duty factor or in continuous operation.

## Connection

After taking off the side panels, the incoming cables can be inserted from below and directly connected to the resistor elements.

Connecting screws M12	
Cable diameter up to	1 x 150 mm <sup>2</sup> 2 x 120 mm <sup>2</sup>
Adm. continuous current	400 A

The heat dissipated by the resistors must be considered for connection. Lines or cables should be inserted in each box individually from the side such that they are not located in the area of the outflowing dissipated heat or heat radiation. For the admissible load, DIN VDE 0298 T3/4 must be observed.

Where required, lines or cables suited for elevated temperatures shall be used or the ends of standard PVC cables/lines shall be covered with a heat-resistant insulation sleeve.

### Maintenance

The resistors are maintenance-free. In case of strong dust formation, however, occasional cleaning with compressed air should be done to preserve the insulation against the grounded housing elements.

### Accessories, spare parts

The circuit diagrams shown on page 2.6 indicate the position of the connections. The corresponding kits can be supplied for a posterior upgrade of the protection class. When ordered together with the resistor, these kits will already be mounted at the workshop so that no ulterior mounting work will be needed.

### Type key

3PS10①② - ③④

3PS1 = System name

① = size :

1 = 3 x 3 or 1 x 9 elements  
2 = 3 x 5 or 1 x 15 elements  
3 = 3 x 7 or 1 x 21 elements  
4 = 3 x 9 or 1 x 27 elements

② = protection class

0 = IP00, all sizes  
1 = IP10, all sizes  
2 = IP13, only sizes 3 and 4  
3 = IP23, only size 4  
4 = IP20, all sizes

③④ = order supplement, no. of elements

Resistors comprising more than one box are marked with the preceding number of boxes separated by a slash:  
3/3PS10.....

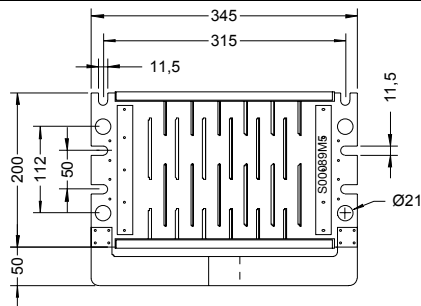
**Operating values**

The load values for the elements indicated in the tables are applicable for stacked installation of 2 or 3 boxes.

For individual installation the current values can be multiplied by 1.2 and in case of 2 stacked boxes by 1.1.

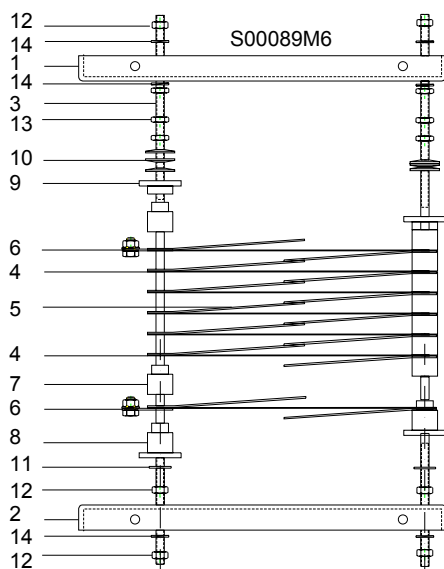
**Steel grid elements, technical data**

Element description	Resistance values			Admissible load Cycle time 120 s and a duty factor of					Without connecting bridge		With connecting bridge	
	Rated value mΩ ± 10%	Cold value mΩ ± 10%	Hot value ca. mΩ	100% A	60% A	40% A	25% A	15% A	Code 3PY6 301	Weight kg	Code 3PY6 301	Weight kg
WG 10	10	9	11.5	260	310	360	435	550	-0A	0.65	-2A	1.05
WG 15	15	13.5	17.3	210	250	295	450	450	-0B	0.65	-2B	1.05
WG 22	22	19.8	25.3	175	210	243	295	370	-0C	0.65	-2C	1.05
WG 32	32	28.8	36.3	145	170	202	244	306	-0D	0.65	-2D	1.05
WG 46	46	41.4	52.9	122	145	168	205	256	-0E	0.65	-2E	1.05
WG 68	68	61.2	78.2	100	120	140	168	210	-0F	0.65	-2F	1.05
WG 100	100	90	115	82	97	114	295	173	-0G	0.65	-2G	1.05
WG 150	150	135	173	67	79	93	244	142	-0H	0.65	-2H	1.05
WG 220	220	198	253	55	65	77	92	117	-0J	0.6	-2J	1.00
WG 320	320	288	368	46	54	64	77	97	-0K	0.6	-2K	1.00
WG 460	460	414	529	38	45	53	64	81	-0L	0.58	-2L	0.98
WG 680	680	612	782	32	38	44	54	66	-0M	0.58	-2M	0.98
WG 1000	1000	900	1150	26	31	36	44	55	-0N	0.58	-2N	0.98
WG 1500	1500	1350	1730	21	25	30	35	46	-0P	0.6	-2P	1.00
WG 2200	2200	1980	2530	18	21	24	30	37	-0R	0.6	-2R	0.98
WG 3200	3200	2880	3680	15	17	20	25	30	-0S	0.58	-2S	0.98



Steel grid element 3PY6 301- 0· without connecting elements and -2· with connecting elements.

For new resistors, elements with terminal connections and connecting elements of the system 3PS3 are supplied.



Spare parts only for replacement in existing resistors, complete banks for new resistors 3PS1 are designed like 3PS3 resistors (page 2.7).

Item	Description	Siemens name	DK No.	Code
	Side panel, left			BSM21
2	Side panel, right			BSM22
3	Support bracket			
3.1	335 mm for size 1			BSM47
3.2	485 mm for size 2			BSM48
3.3	635 mm for size 3			BSM49
3.4	785 mm for size 4			BSM50
4	Steel grid element WG			
4.1	- w/o connecting bridge	3PY6301-0A..S		BSE...0A..S
4.2	- with connecting bridge	3PY6301-2A--S		BSE...2A..S
5	Connecting bracket			
5.1	For resistor group 10 to 32: 3mm thick	3PY6305-OC	A600104	BSM12
5.2	For resistor group 46 et seq., 1.5 mm thick	3PY6305-OD	A600101	BSM13
6	Connecting elements			
6.1	offset	3PY6304-OA	A600107	BSM10
6.2	Straight	3PY6304-OB	A600108	BSM11
7	Insulating bushing	3PY6302-OB	1527075	BSM01
8	Insulating bushing	3PY6302-OE	15271035	BSM03
9	Counter-bushing	3PY6302-OD	15271036	BSM02
10	Disc spring	3PY6303-OA	1385081	BSM04
11	Washer DIN 9021- A10.5			NSK9021-0041
12	Hexagonal nut DIN 934-M10			NMS934-0061
13	Hexagonal nut DIN 439-B M10			NMS439-0012
14	Spring washer DIN 127-B10			NRF172-0061

**3- strand resistors in standard packaging**

Element	Load A <sup>1)</sup> per strand for stacked installation of 3 resistors (cycle time 120 s) and a duty factor of					Number of elements				Order supplement 3PS1①② <sup>1)</sup> - ③④
	100%	60%	40%	25%	15%	3 x 3	3 x 5	3 x 7	3 x 9	
						Resistance values Ω for resistor sizes				
						① 1	① 2	① 3	① 4	
WG 10	260	310	360	435	550	3 x 0,031	3 x 0,053	3 x 0,075	3 x 0,1	-3A
WG 15	210	250	295	350	450	3 x 0,046	3 x 0,078	3 x 0,11	3 x 0,14	-3B
WG 22	175	210	243	295	370	3 x 0,067	3 x 0,115	3 x 0,16	3 x 0,21	-3C
WG 32	145	170	202	244	306	3 x 0,100	3 x 0,165	3 x 0,23	3 x 0,30	-3D
WG 46	122	145	168	205	256	3 x 0,140	3 x 0,235	3 x 0,33	3 x 0,42	-3E
WG 68	100	120	140	168	210	3 x 0,210	3 x 0,345	3 x 0,48	3 x 0,62	-3F
WG 100	82	97	114	138	173	3 x 0,30	3 x 0,5	3 x 0,71	3 x 0,91	-3G
WG 150	67	79	93	112	142	3 x 0,45	3 x 0,75	3 x 1,0	3 x 1,3	-3H
WG 220	55	65	77	93	117	3 x 0,66	3 x 1,1	3 x 1,5	3 x 2,0	-3J
WG 320	46	54	64	77	97	3 x 0,96	3 x 1,6	3 x 2,2	3 x 3,0	-3K
WG 460	38	45	53	64	81	3 x 1,40	3 x 2,3	3 x 3,2	3 x 4,0	-3L
WG 680	32	38	44	54	66	3 x 2,0	3 x 3,4	3 x 4,8	3 x 6,0	-3M
WG 1000	26	31	36	44	55	3 x 3,0	3 x 5,0	3 x 7,0	3 x 9,0	-3N
WG 1500	21	25	30	35	46	3 x 4,5	3 x 7,5	3 x 10,5	3 x 13,0	-3P
WG 2200	18	21	24	30	37	3 x 6,6	3 x 11,0	3 x 15,0	3 x 20,0	-3R
WG 3200	15	17	20	25	30	3 x 9,6	3 x 16,0	3 x 22,0	3 x 29,0	-3S

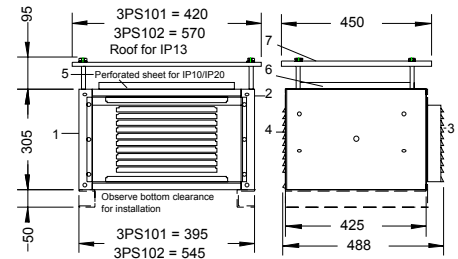
**3- strand resistors with upgraded end step**

Elements	Load A <sup>1)</sup> per strand For stacked installation of 3 resistors (cycle time 120 s) and a duty factor of					Number of elements		Order no. supplement 3PS1①② <sup>1)</sup> - ③④
	100%	60%	40%	25%	15%	3 x (2+5)	3 x (3+6)	
						Resistance values Ω for resistor size		
						① 3	① 4	
WG 10 + WG 22	260 / 175	310 / 210	360 / 243	435 / 295	550 / 370	3 x 0,14	3 x 0,17	-4C
WG 15 + WG 32	210 / 145	250 / 170	295 / 202	350 / 244	450 / 306	3 x 0,20	3 x 0,25	-4D
WG 22 + WG 46	175 / 122	210 / 145	243 / 168	295 / 205	370 / 256	3 x 0,28	3 x 0,35	-4E
WG 42 + WG 68	145 / 100	170 / 120	202 / 140	244 / 168	306 / 210	3 x 0,41	3 x 0,51	-4F
WG 46 + WG 100	122 / 82	145 / 97	168 / 114	205 / 138	256 / 173	3 x 0,6	3 x 0,75	-4G
WG 68 + WG 150	100 / 67	120 / 79	140 / 92	168 / 112	210 / 142	3 x 0,9	3 x 1,1	-4H
WG 100 + WG 220	82 / 55	97 / 65	114 / 77	138 / 93	173 / 117	3 x 1,4	3 x 1,6	-4J
WG 200 + WG 320	67 / 46	79 / 54	92 / 64	112 / 77	142 / 97	3 x 1,9	3 x 2,4	-4K
WG 220 + WG 460	55 / 48	65 / 45	77 / 53	93 / 64	117 / 81	3 x 2,7	3 x 3,4	-4L
WG 320+ WG 680	46 / 32	54 / 38	64 / 44	77 / 54	97 / 66	3 x 4,0	3 x 5,0	-4M
WG 460 + WG 1000	38 / 26	45 / 31	53 / 36	64 / 44	81 / 55	3 x 6,0	3 x 7,4	-4N
WG 680 + WG 1500	32 / 21	38 / 25	44 / 30	54 / 35	66 / 46	3 x 9,0	3 x 11,0	-4P
WG 1000 + WG 2200	26 / 18	31 / 21	36 / 24	44 / 30	55 / 37	3 x 13,0	3 x 16,0	-4R
WG 1500 + WG 3200	21 / 15	25 / 17	30 / 20	35 / 25	46 / 30	3 x 19,0	3 x 24,0	-4S

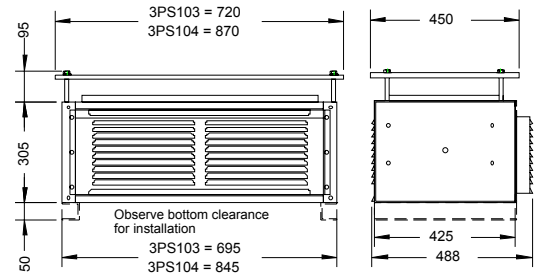
<sup>1)</sup> ② = protection class, see type key page 2.8

## Steel grid resistors: system Siemens 3PS1.. dimensions, housing elements

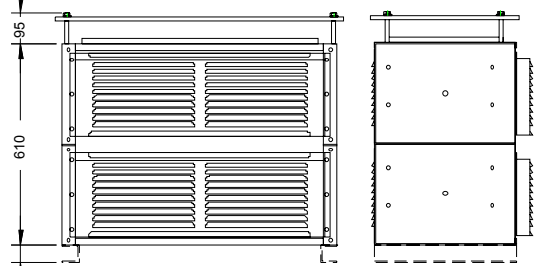
Sizes 1 and 2, individual installation				
Size 3PS10**	No. of elements	Protection	Code <sup>1)</sup> BSG21**	Weight kg
12-	9	IP00	10-	23
13-	9	IP10	11-	26
14-	9	IP13	13-	28
22-	15	IP00	20-	35
23-	15	IP10	21-	38
24-	15	IP13	23-	40



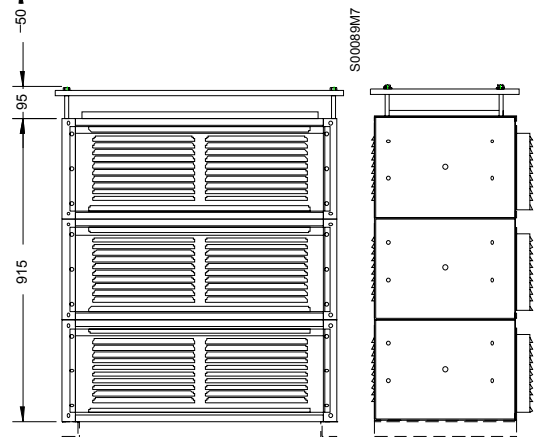
Sizes 3 and 4, individual installation				
Size 3PS10**	No. of elements	Protection	Code <sup>1)</sup> BSG21**	Weight kg
32-	21	IP00	30-	40
33-	21	IP10	31-	44
34-	21	IP13	33-	47
42-	27	IP00	40-	56
43-	27	IP10	41-	60
44-	27	IP13	43-	63



Sizes 3 and 4, two stacked boxes				
Size 2/3PS10**	No. of elements	Protection	Code <sup>1)</sup> BSG22**	Weight kg
32-	2 x 21	IP00	30-	83
33-	2 x 21	IP10	31-	86
34-	2 x 21	IP13	33-	89
42-	2 x 27	IP00	40-	115
43-	2 x 27	IP10	41-	118
44-	2 x 27	IP13	43-	121



Size 4, three stacked boxes				
Size 2/3PS10**	No. of elements	Protection	Code <sup>1)</sup> BSG23**	Weight kg
42-	3 x 27	IP00	40-	173
43-	3 x 27	IP10	41-	176
44-	3 x 27	IP13	43-	179



Housing elements					
Item	Description	Code	Item	Description	Code
1	Side panel, left	BSM21			
2	Side panel, right	BSM22			
3	Cable box		6	Cover collar IP13	
3.1	For 3PS101*	BSM23	6.1	For 3PS1013	BSM35
3.2	For 3PS102*	BSM24	6.2	For 3PS1023	BSM36
3.3	For 3PS103*	BSM25	6.3	For 3PS1033	BSM37
3.4	For 3PS104*	BSM26	6.4	For 3PS1043	BSM38
4	Longitudinal plate, rear		7	Roof IP13	
4.1	For 3PS101*	BSM27	7.1	For 3PS1013	BSM39
4.2	For 3PS102*	BSM28	7.2	For 3PS1023	BSM40
4.3	For 3PS103*	BSM29	7.3	For 3PS1033	BSM41
4.4	For 3PS104*	BSM30	7.4	For 3PS1043	BSM42
5	Cover sheet IP10		8	Guide plate	
5.1	For 3PS1011	BSM31	8.1	For 3PS101*	BSM43
5.2	For 3PS1021	BSM32	8.2	For 3PS102*	BSM44
5.3	For 3PS1031	BSM33	8.3	For 3PS103*	BSM45
5.4	For 3PS1041	BSM34	8.4	For 3PS104*	BSM46

# Steel grid resistors, system GINO (ESE)

## Structure

Like the Siemens systems, the steel grid resistors of the GINO system are composed of elements made from high-alloyed steel sheet X10CrAl13 or, alternatively, chromium nickel steel NiCr 18 9 (AISI 304). The printed circuit boards of the resistor elements are punched to obtain conductors of different dimensions thus obtaining a total of 48 resistance values which allow optimal adjusting to the customer's individual requirements.

The elements are reinforced with stainless steel sheets and micanite insulation and exhibit high vibration tolerances which allow even rough operating conditions.

Up to 30 elements are mounted on support brackets and insulated by way of mica tubes.

Ceramic insulators separate the elements from each other on the one side while metallic spacer tubes establish the contact among the elements on the other side. Spring washer banks maintain the contact pressure even in case of longitudinal elongation of the support brackets due to heating up. Screw-type element connections ensure the contact even in case of high currents (elements NW8 –NW48).

Each element can be equipped with a screw-type connection which can also be moved afterwards. However, the connections are preferably applied according to a pair number of elements so that all of them are located on one side of the bank.

Both open banks with free support bracket ends and housed resistors with and without wiring are available. The elements can be combined with GINO wire-wound frame DEE (see pages 3.8) so that also higher ohm values can be realized.

Special designs for both heavy-duty conditions (maritime climate, offshore operation) and elevated operating voltages of up to 3 kV are available.

For high permanent loads, units with fan cooling are available.

## Designs

### Individual elements

with terminal connections for mounting by customer or for installation in resistors type key: NW (mΩ)

### Open banks

Support brackets in 4 lengths, suited for taking up 3 to 30 elements.

### BEP①②③④⑤⑥-resistance value

- ① No. of banks, single banks always 1
- ② = size

Size	Bracket length mm	Max. no. of elements
2	220	5
3	310	10
4	410	15
5	510	20
7	720	30

③ = protection (banks always 0 = IP00)

⑤⑥ = No. of elements

**Rated voltage:** 750 V AC VDE0110

Insulation class III/3

**Resistance to climatic changes** pursuant to DIN 50010 T1, suited for indoor and outdoor installation with varying conditions of condensation, without protection against weathering at low pollution impact. Due to the high chromium content, elements made from X10CrAl13 only corrode at the surface. The function and service life are not affected by this.

### Special designs

#### Design M

Maritime climate, connections, bolts, nuts and connecting elements made from stainless steel.

#### Design O

Offshore, elements, connections and all erection components made from stainless steel.

### Housed resistors BEG

in 4 sizes, different protection classes, with and without wiring, design with painted or galvanized steel sheet or corrosion-free stainless steel sheet. The housings can be stacked up to 4 high (in exceptional cases up to 6 high). Special housings according to customer requirements available.

### Type key:

**BEG(T)①②③④⑤-⑥⑦①**

T optionally = Thermal switch

NC-contact 220 V AC – 6 A (AC1-load)  
(older version: T instead of hyphen)

① number of boxes (1-6)

② size 2, 3, 4, 5, 7

③ protection class

for banks size 2, 3, 4, 5, 7

0	IP00
2	IP20
3	IP13
4	IP23

④⑤ no. of elements

⑥ Resistance value (e.g. 4R7 )

⑦ design option

without appendix = standard, base coat, painted

Z = galvanized, painted – maritime climate design.

V = stainless steel, unpainted - offshore design

Tables of the permissible loads, p. 2.16

### Installation

The units shall be installed horizontally such that the resistor elements are upright and the cooling air can rise freely between them.

### Housings without resistors

#### Type key

**BEL①②③ - ⑦**

① = No. of boxes (1-6)

② size 2, 3, 4, 5, 7

③ protection

for banks size 2, 3, 4, 5, 7

0	IP00
2	IP20
3	IP13
4	IP23

⑦ = design Z or V (s.o.)

### Admissible loads

The load values indicated in the tables are applicable for natural cooling and installation in up to 3 stacked housings.

The maximum load that can be taken on be the housing size may not be exceeded.

Care must be taken that the cooling air has unrestricted access from the bottom and can leave the unit freely at the top. The place of installation must have good venting. In particular in case of indoor installation care must be taken that the ambient air does not heat up to values above 45°C.

The indicated loads result in temperature rises of up to 260K (element temperatures in the top housing of up to 400°C). For a temperature increase of max. 200 K, the rating must be reduced by 25% (current values x 0.866).

In case of individual installation, the current values can be increased by up to 10% and for 2 stacked units by up to 5 %.

Additional forced venting by a fan, in particular in case of intermittent operation at high d.f. or in continuous operation, increases the admissible load by up to 1.4 to 1.6 times.

### Connection

The bottom box is higher than those on top and the wired units are provided with a bolt-type or modular terminal block which enable connection to standard lines and cables outside of the heat zone.

Wiring is done with tin-coated solid conductors or tin-coated copper lead with silicone rubber insulation.

### Threaded terminals

Rated current up to A	Terminal	Code
63	M6	BEZ001
100	M8	BEZ002
200	M10	BEZ003
400	M12	BEZ004

### Modular terminals

Rated current up to A	Line up to mm <sup>2</sup>	Code
34	4	BEZ005
44	6	BEZ006
61	10	BEZ022
82	16	BEZ007
135	35	BEZ008
207	70	BEZ009
250	95	BEZ010

Unwired units can be connected directly to the banks after taking off the side panels. In this context, the heat emanating from the units must be taken into account and the lines may have to be inserted from the side. Where necessary, heat-resistant lines or standard PVC lines/cables protected by a heat-resistant insulating sleeve shall be used.

# Steel grid resistors, system GINO, elements made from AlCr steel

X10CrAl13 (German mat.-no. 1.4724) is a heat-resistant special alloy that is largely corrosion resistant to all standard environmental impact. Slight surface corrosion is possible but does not affect the function and service life.

**Material data:**

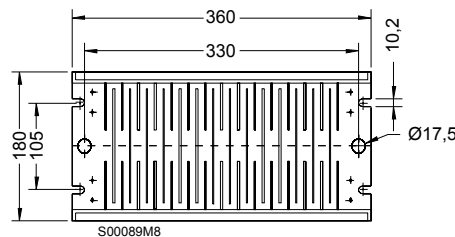
Specific resistance: .....  $0.9 \Omega \cdot \text{mm}^2 \cdot \text{m}^{-1}$   
 Specific heat: .....  $0.46 \text{Ws} \cdot \text{g}^{-1} \cdot \text{K}^{-1}$   
 Density .....  $7.7 \text{g} \cdot \text{cm}^3$   
 Hot resistance: ..... ca.  $1.18 R_{20}$

**Order description = Code**

BEE (rated value)  
 e.g. element with rated value 12 m  $\Omega$   
 BEE12

Rated value m $\Omega$	R <sub>20</sub> m $\Omega$ ±10%	R <sub>270</sub> m $\Omega$ ±10%	R <sub>420</sub> m $\Omega$ ±10%	Cont. current A <sup>1)</sup>	Admissible load A in intermittent operation, cycle time 120 s					Current-time integral kA²s
					60 % d.f.	40 % d.f.	25 % d.f.	15 % d.f.	5 % d.f.	
8	7.7	8.2	8.5	251	290	334	402	503	841	5.30
9	8.8	9.4	9.7	234	270	311	375	468	784	3.63
10	10.1	10.8	11.1	218	251	289	348	435	728	3.39
12	11.7	12.4	12.9	199	229	263	317	396	663	2.70
14	13.5	14.3	14.8	184	212	244	294	368	615	2.47
16	15.5	16.4	17.0	172	198	228	274	343	574	1.51
18	17.7	18.8	19.5	173	199	229	276	345	577	2.99
21	20.4	21.7	22.5	145	167	193	232	290	485	1.15
24	23.5	25.0	25.9	149	172	198	238	298	498	1.97
27	27.1	28.8	29.8	138	159	183	221	275	461	1.86
31	31.1	31.1	34.2	129	149	171	206	257	430	1.31
36	35.7	38.0	39.3	120	138	158	191	238	398	1.27
41	41.2	43.7	45.3	111	128	147	176	220	368	1.15
48	47.3	50.2	52.0	104	119	137	165	205	343	0.82
55	54.3	57.7	59.8	96.1	110	127	152	190	318	0.73
63	62.7	66.6	68.9	89.0	102	117	141	176	294	0.66
72	71.9	76.4	79.1	83.0	95.2	109	132	164	274	0.48
83	82.7	87.8	90.9	77.0	88.2	101	122	152	254	0.41
95	95	101	105	71.4	81.2	93.8	113	140	235	0.36
110	109	116	120	64.6	74.2	85.3	103	128	214	0.47
130	126	134	138	60.2	69.1	79.5	95.7	119	200	0.40
150	145	154	159	55.5	63.8	73.3	88.2	110	184	0.33
170	166	176	183	55.2	63.3	72.8	87.6	109	183	0.33
190	191	203	211	50.3	57.7	66.3	79.7	99.5	166	0.27
220	220	234	242	46.1	52.9	60.7	73.0	91.0	152	0.22
280	252	268	278	43.8	50.3	57.7	69.4	86.5	144	0.19
290	291	309	320	40.4	46.3	53.1	63.9	79.6	133	0.16
340	335	356	268	37.8	43.3	49.6	59.6	74.3	124	0.14
390	385	409	423	34.6	39.6	45.4	54.5	67.9	113	0.11
450	442	470	486	32.0	36.6	42.0	50.4	62.8	105	0.11
510	508	539	558	30.3	34.6	39.6	47.5	59.2	98.8	0.10
590	585	621	643	27.9	31.9	36.5	43.8	54.5	90.9	0.082
670	673	715	740	25.5	29.1	33.3	39.9	49.6	82.8	0.069
770	777	825	854	23.7	27.0	30.9	37.0	46.0	76.7	0.059
890	892	948	981	21.8	24.8	28.4	34.0	42.2	70.4	0.048
1100	1023	1087	1126	20.3	23.1	26.4	31.6	39.2	65.3	0.041
1200	1177	1250	1295	18.8	21.4	24.4	29.2	36.2	60.3	0.035
1400	1354	1439	1490	17.4	19.7	22.5	26.9	33.3	55.5	0.029
1600	1555	1653	1711	16.2	18.3	20.9	24.9	30.9	51.4	0.024
1800	1791	1903	1970	15.0	16.9	19.2	23.0	28.5	47.3	0.020
2100	2062	2191	2268	13.8	15.6	17.7	21.1	26.1	43.4	0.017
2400	2368	2518	2605	12.7	14.3	16.2	19.3	23.9	39.7	0.014
2800	2726	2897	2999	11.7	13.2	14.9	17.8	22.0	36.4	0.011
3200	3128	3324	3441	10.9	12.2	13.8	16.4	20.2	33.5	0.010
3600	3437	3652	3781	10.2	11.0	12.2	14.1	17.2	27.9	0.0062
4000	3947	4193	4341	9.3	10.1	11.1	12.9	15.7	25.5	0.0051
4600	4544	4796	4998	8.6	9.3	10.2	11.8	14.4	23.3	0.0041
5300	5214	5539	5735	7.9	8.5	9.4	10.9	13.2	21.4	0.0035

<sup>1)</sup> The admissible load value relates to the hot resistance and 0.6 W/cm<sup>2</sup> element surface



## Steel grid resistors, system GINO, elements made from chromium nickel steel

X5 NiCr18 9 (Germ. material no. 1.4301) is a corrosion-free stainless steel resistant to heat up to ca. 470 °C. The hot resistance rises substantially when heated up.

### Material data:

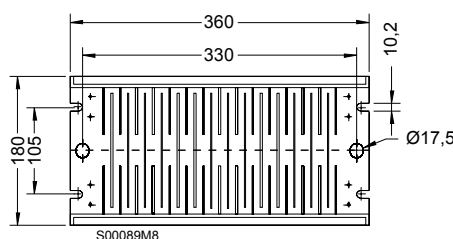
Specific resistance: ..... 0.73  $\Omega \cdot \text{mm}^2 \cdot \text{m}^{-1}$   
 Specific heat: ..... 0.5  $\text{Ws} \cdot \text{g}^{-1} \cdot \text{K}^{-1}$   
 Density ..... 7.9  $\text{g} \cdot \text{cm}^3$   
 Hot resistance: ..... ca. 1.37  $R_{20}$

### Order description = Code

BEE (rated value)V  
 e.g. element with rated value 12 m  $\Omega$   
 BEE12V

Rated value m $\Omega$	$R_{20}$ m $\Omega$ $\pm 10\%$	$R_{270}$ m $\Omega$ $\pm 10\%$	$R_{420}$ m $\Omega$ $\pm 10\%$	Cont. current A <sup>1)</sup>	Admissible load A in intermittent operation, cycle time 120 s					Current- time integral kA <sup>2</sup> s
					60 % d.f.	40 % d.f.	25 % d.f.	15 % d.f.	5 % d.f.	
7	6.2	7.9*	8.6	250	291	337	408	511	859	7.28
8	7.2	9.2	9.9	231	269	312	378	473	795	4.99
9	8.2	10.5	11.3	216	251	291	352	442	742	4.66
10	9.5	12.1	13.1	197	229	265	321	402	675	3.71
12	10.9	13.9	15.1	183	212	246	298	373	626	3.39
14	12.5	16.0	17.3	170	198	229	278	348	585	2.28
16	14.4	18.4	19.9	171	199	231	279	350	587	4.11
18	16.6	21.2	22.9	144	167	194	234	294	493	1.58
21	19.1	24.4	26.4	148	172	199	241	302	506	2.71
24	22.0	28.1	30.4	137	159	184	223	279	469	2.59
27	25.2	32.2	34.8	128	149	172	208	261	438	1.80
31	29.0	37.0	40.1	119	138	159	193	241	405	1.75
36	33.4	42.7	46.1	110	128	148	178	223	375	1.58
41	38.3	48.9	52.9	103	119	138	167	208	350	1.13
48	44.1	56.3	60.9	95.2	110	127	154	193	324	1.01
55	50.8	64.9	70.2	88.2	102	118	143	178	299	0.90
63	58.3	74.5	80.5	82.3	95.3	110	133	166	279	0.66
72	67.0	85.6	92.6	76.3	88.3	102	123	154	258	0.57
83	77.0	98.4	106	70.7	81.8	94.4	114	143	239	0.50
95	88.6	113	122	64.0	74.2	85.8	104	130	218	0.65
110	102	130	141	59.7	69.2	80.0	96.7	121	203	0.55
130	117	149	162	55.1	63.9	73.8	89.3	112	187	0.46
150	135	172	186	54.6	62.9	73.0	88.4	111	186	0.46
170	155	198	214	49.9	57.8	66.8	80.7	101	169	0.37
190	179	229	247	45.6	52.8	61.0	73.7	92.3	155	0.30
220	205	262	283	43.4	50.3	58.0	70.1	87.7	147	0.26
260	236	302	326	40.0	46.3	53.5	64.6	80.8	135	0.23
290	271	346	374	37.5	43.3	50.0	60.4	75.5	127	0.19
340	312	399	431	34.3	39.6	45.7	55.1	68.9	115	0.16
390	359	459	496	31.7	36.6	42.2	51.0	63.7	107	0.16
450	412	526	569	30.0	34.6	39.9	48.1	60.1	101	0.14
510	474	606	655	27.7	31.9	36.7	44.3	55.3	92.6	0.11
590	456	698	754	25.2	29.1	33.5	40.4	50.4	84.4	0.094
670	630	805	870	23.5	27.0	31.1	37.5	46.8	78.2	0.081
770	724	925	1000	21.6	24.8	28.6	34.4	42.9	71.8	0.065
890	830	1060	1147	20.1	23.1	26.6	32.0	39.9	66.7	0.056
1100	955	1220	1319	18.7	21.4	24.6	29.5	36.8	61.6	0.048
1200	1099	1404	1518	17.2	19.7	22.6	27.2	33.9	56.6	0.040
1400	1262	1612	1743	16.0	18.3	21.0	25.2	31.4	52.5	0.033
1600	1453	1856	2007	14.8	16.9	19.4	23.3	29.0	48.3	0.028
1800	1673	2137	2311	13.7	15.6	17.8	21.4	26.6	44.3	0.024
2100	1921	2454	2654	12.6	14.3	16.3	19.6	24.3	40.5	0.019

<sup>1)</sup> The admissible load relates to the heat resistance and 0.6 W/cm<sup>2</sup> element surface

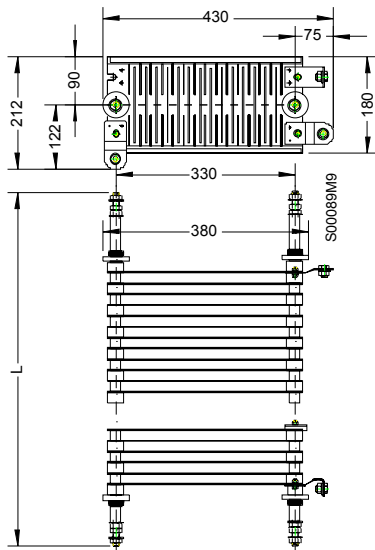




# Steel grid resistors, system GINO, banks, housed resistors, dimensions

Steel grid banks for installation, protection class IP00

Description	No. of elements	Weight kg	Code
E203	3	3.4	BEP12003
E204	4	4.2	BEP12004
E205	5	5.0	BEP12005
E306	6	5.8	BEP13006
E307	7	6.6	BEP13007
E308	8	7.4	BEP13008
E309	9	8.2	BEP13009
E310	10	9.0	BEP13010
E411	11	9.8	BEP14011
E412	12	10.6	BEP14012
E413	13	11.4	BEP14013
E414	14	12.2	BEP14014
E415	15	13.0	BEP14015
E516	16	13.8	BEP15016
E517	17	14.6	BEP15017
E518	18	15.4	BEP15018
E519	19	16.2	BEP15019
E520	20	17.0	BEP15020
E721	21	17.8	BEP17021
E722	22	18.6	BEP17022
E723	23	19.4	BEP17023
E724	24	20.2	BEP17024
E725	25	21.0	BEP17025
E726	26	21.6	BEP17026
E727	27	22.6	BEP17027
E728	28	23.4	BEP17028
E729	29	24.2	BEP17029
E730	30	25.0	BEP17030



**Type key:** BEP1②④⑤-⑥  
 BEP1 = installation bank  
 protection class IP00  
 ② = size

Size	Bracket length L mm	Max. no. of elements
2	220	05
3	310	10
4	410	15
5	510	20
7	720	30

④⑤ = No. of elements  
 ⑥ Resistance value (e.g. 4R7)

Housings for steel grid banks

Protection class IP00, only side panels, w/o resistor bank

Description	for bank	Code	Weight ca. kg
A12	E2⑤⑥	BEL120	7
A13	E3⑤⑥	BEL130	7
A14	E4⑤⑥	BEL140	7
A15	E5⑤⑥	BEL150	7
A17	E7⑤⑥	BEL170	7
A25	E3⑤⑥	BEL250	13
A27	E5⑤⑥	BEL270	13
A37	E7⑤⑥	BEL370	19
A47	E3⑤⑥	BEL470	25
A57	E5⑤⑥	BEL570	31
A67	E7⑤⑥	BEL670	37

Protection class IP20 Side elements, front and back wall, perforated plate top, without resistor bank

Description	for bank	Code	Weight ca. kg
B12	E2⑤⑥	BEL122	11.0
B13	E3⑤⑥	BEL132	11.5
B14	E4⑤⑥	BEL142	12.3
B15	E5⑤⑥	BEL152	13.5
B17	E7⑤⑥	BEL172	15.2
B25	E3⑤⑥	BEL252	19.2
B27	E5⑤⑥	BEL272	22.8
B37	E7⑤⑥	BEL372	33.0
B47	E3⑤⑥	BEL472	43.0
B57	E5⑤⑥	BEL572	53.0
B67	E7⑤⑥	BEL672	63.0

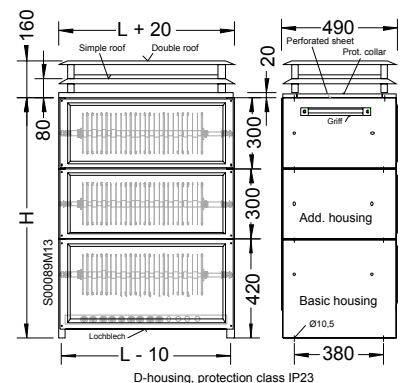
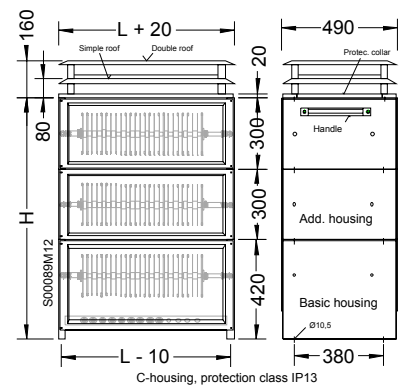
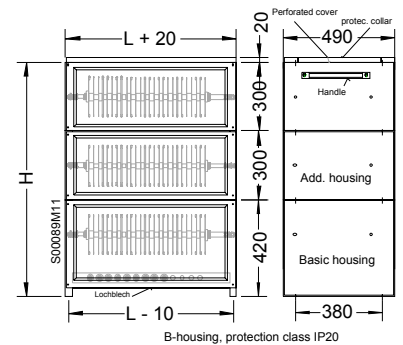
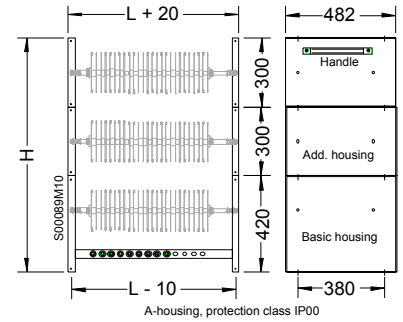
Protection class: IP13, side elements, front and back wall, roof, without resistor bank

Description	for bank	Code	Weight ca. kg
C12	E2⑤⑥	BEL123	13.3
C13	E3⑤⑥	BEL133	14.3
C14	E4⑤⑥	BEL143	15.5
C15	E5⑤⑥	BEL153	18.0
C17	E7⑤⑥	BEL173	21.5
C25	E3⑤⑥	BEL253	26.5
C27	E5⑤⑥	BEL273	31.3
C37	E7⑤⑥	BEL373	41.5
C47	E3⑤⑥	BEL473	51.5
C57	E5⑤⑥	BEL573	61.5
C67	E7⑤⑥	BEL673	71.5

Protection class IP23, side elements, front and back wall, perforated plate top and bottom, roof, without resistor bank

Description	for bank	Code	Weight ca. kg
D12	E2⑤⑥	BEL124	13.8
D13	E3⑤⑥	BEL134	14.8
D14	E4⑤⑥	BEL144	16.0
D15	E5⑤⑥	BEL154	18.4
D17	E7⑤⑥	BEL174	22.0
D25	E3⑤⑥	BEL254	27.0
D27	E5⑤⑥	BEL274	31.8
D37	E7⑤⑥	BEL374	42.0
D47	E3⑤⑥	BEL474	52.0
D57	E5⑤⑥	BEL574	62.0
D67	E7⑤⑥	BEL674	72.0

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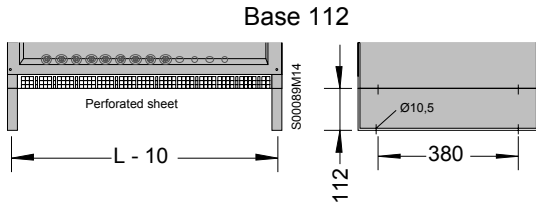


No. of boxes ②	Dimension H
1	420
2	720
3	1020
4	1320
5	1620
6	1920

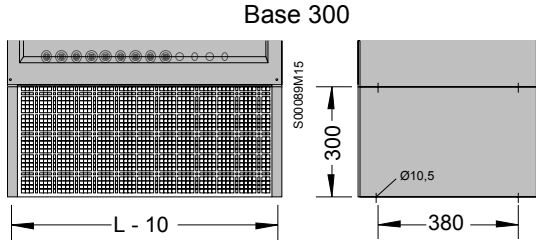
Housings with 3 boxes are shown

# Steel grid resistors, system GINO, housing elements

## Base for individual housing, Code BEZ026

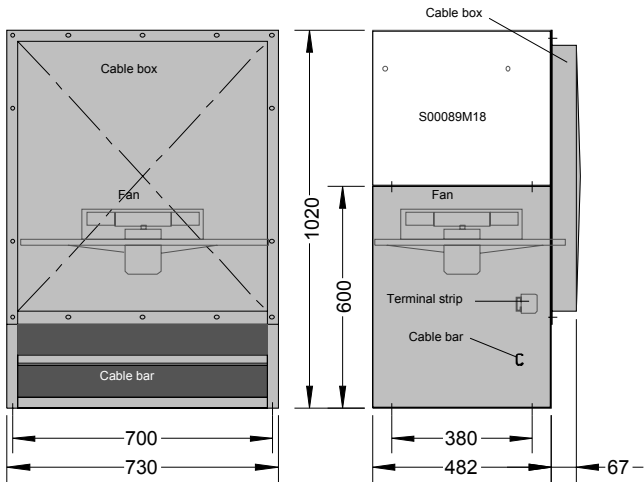


## Base for multiple housings, Code BEZ027



## Underfloor fan

Size	Code	Description
7-1 to 65 kW	BEM081-1	Fan 400 V 3 Ph/50Hz 0.155 kW – 0.35 A 2000 m³/h at 50 Pa, 72 dB(A)
7-2 to 130 kW	BEM081-2	Fan 400 V 3 Ph/50Hz 1.0 kW – 2.1 A 4000 m³/h at 250 Pa, 90 dB(A)



## Tables of admissible loads

40°C ambient temperature,  
160 K Temperature rise,  
Exhaust air temperature ca. 200°C

### Standard housing IP20 Installation on solid floor

Size	No. of boxes	kW
B13	1	2.7
B15	1	4.8
B25	2	6.3
B17	1	7.0
B27	2	9.1
B37	3	10.9
B47	4	12.4
B57	5	13.7
B67	6	14.9

### Standard housing IP13, IP23 Installation on solid floor

Size		No. of boxes	kW
IP13	IP23	1	2.7
C13	D13	1	4.7
C15	D15	1	6.1
C25	D25	2	6.8
C17	D17	1	8.9
C27	D27	2	10.6
C37	D37	3	12.1
C47	D47	4	13.4
C57	D57	5	14.5
C67	D67	6	14.5

### Standard housing with base IP20 Elevated installation

Size	Base height	kW
B13	112 mm	5.7
B15	112 mm	10.3
B25	300 mm	13.5
B17	112 mm	15.2
B27	300 mm	19.9
B37	300 mm	23.7
B47	300 mm	26.9
B57	300 mm	29.8
B67	300 mm	32.5

### Standard housing with simple roof and base, IP13, IP23

Size		Base height	kW
IP13	IP23	112 mm	6.1
C13	D13	112 mm	9.0
C15	D15	112 mm	11.8
C25	D25	300 mm	11.7
C17	D17	112 mm	15.4
C27	D27	300 mm	18.3
C37	D37	300 mm	20.8
C47	D47	300 mm	23.1
C57	D57	300 mm	25.1
C67	D67	300 mm	25.1

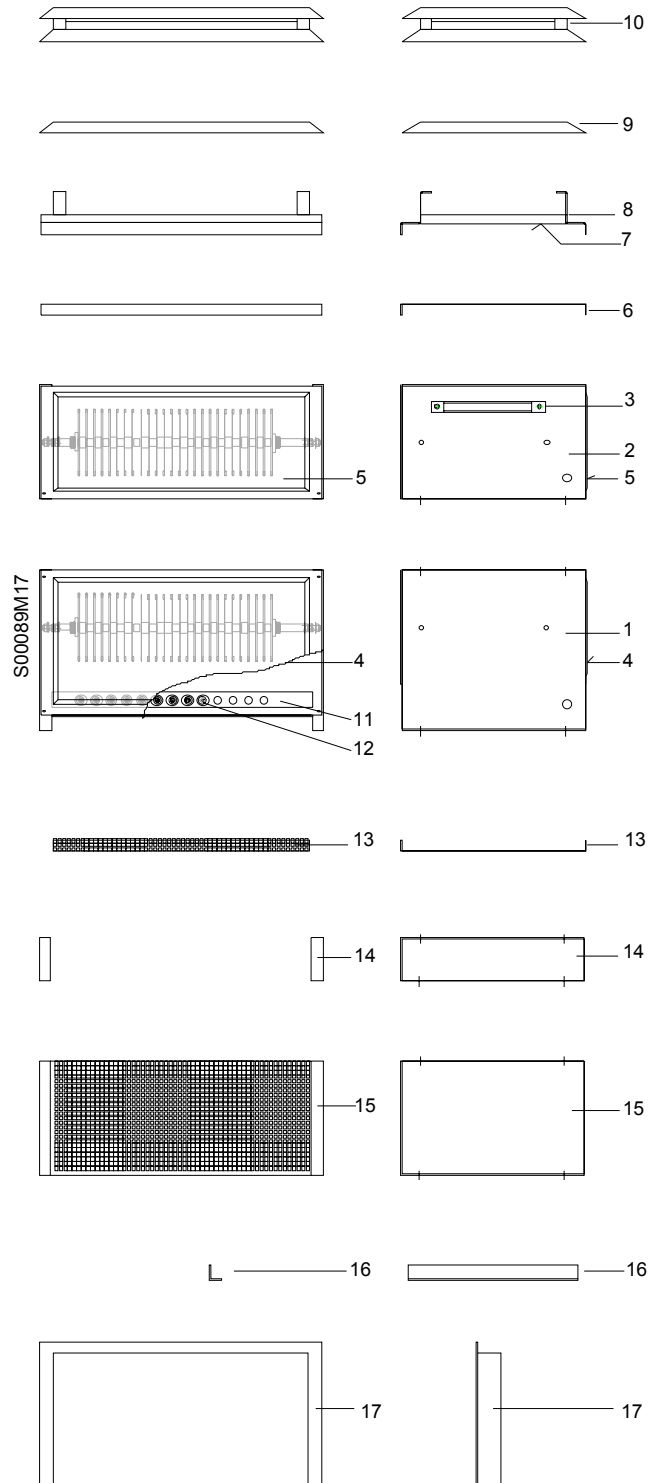
### Standard housing with double roof and base, IP13, IP23

Size		Base height	KW
IP13	IP23	112 mm	8.2
C13	D13	112 mm	13.1
C15	D15	112 mm	17.2
C25	D25	300 mm	17.8
C17	D17	112 mm	23.4
C27	D27	300 mm	27.8
C37	D37	300 mm	31.6
C47	D47	300 mm	35.0
C57	D57	300 mm	38.1
C67	D67	300 mm	38.1

# Steel grid resistors, system GINO, housing elements

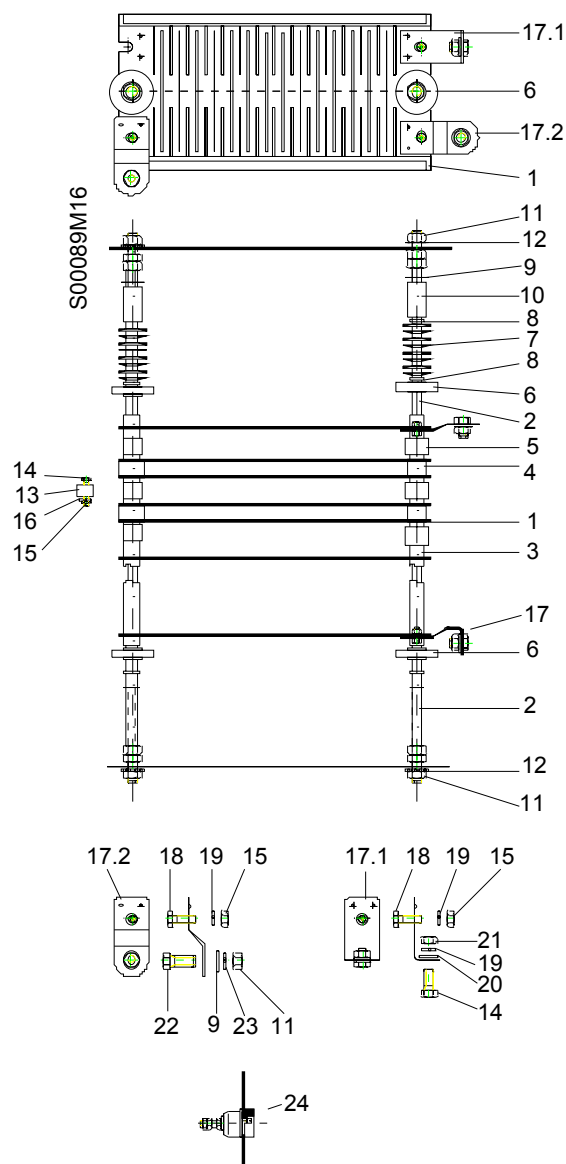
## Housing elements

Item	Description	Weight ca. kg	Code
1	Side panel, height 420 mm	3.88	BEM021
2	Side panel, height 300 mm	2.88	BEM022
3	Handle	0.26	BEM074
4	Longitudinal sheet for basic housing		
4.1	Size 3, 380 x 320 mm	1.02	BEM023
4.2	Size 5, 380 x 520 mm	1.65	BEM024
4.3	Size 7, 380 x 730 mm	2.30	BEM025
5	Longitudinal sheet for additional housing		
5.1	Size 3, 330 x 320 mm	0.86	BEM026
5.2	Size 5, 330 x 520 mm	1.37	BEM027
5.3	Size 7, 330 x 730 mm	1.92	BEM028
6	Perforated plate, top for IP20		
6.1	Size 3	0.32	BEM077
6.2	Size 5	0.52	BEM078
6.3	Size 7	0.73	BEM079
7	Longitudinal sheet, top, for IP23		
7.1	Size 3		BEM090-3
7.2	Size 5		BEM090-5
7.3	Size 7		BEM090-7
8	Roof support frame		
8.1	Size 3, 320 mm	1.43	BEM032
8.2	Size 5, 520 mm	1.94	BEM033
8.3	Size 7, 720 mm	2.47	BEM034
9	Roof		
9.1	Size 3, 320 mm	1.38	BEM038
9.2	Size 5, 520 mm	2.18	BEM039
9.3	Size 7, 720 mm	3.08	BEM040
10	Double roof		
10.1	Size 3, 320 mm		BEM080-3
10.2	Size 5, 520 mm	3.36	BEM080-5
10.3	Size 7, 720 mm	4.40	BEM080-7
11	Terminal strip board 270 mm, for size 3		
11.1	For 8 bolt-type terminals 63 A	0.28	BEM041
11.2	For 7 bolt-type terminals 100 A	0.27	BEM042
11.3	For 6 bolt-type terminals 200 A	0.26	BEM043
11.4	For 4 bolt-type terminals 400 A	0.26	BEM044
	Terminal strip board 470 mm, for size 5		
11.5	For 14 bolt-type terminals 63 A	0.47	BEM045
11.6	For 12 bolt-type terminals 100 A	0.47	BEM046
11.7	For 10 bolt-type terminals 200 A	0.43	BEM047
11.8	For 8 bolt-type terminals 400 A	0.43	BEM048
	Terminal strip board 680 mm, for size 7		
11.9	For 21 bolt-type terminals 63 A	0.66	BEM049
11.10	For 18 bolt-type terminals 100 A	0.66	BEM050
11.11	For 16 bolt-type terminals 200 A	0.62	BEM051
11.12	For 12 bolt-type terminals 400 A	0.61	BEM052
12	Bolt-type terminals DIN 46260 form D		
12.1	M6 63 A steel, galvanized	0.06	BEM053-0
12.2	M6 63 A stainless steel	0.06	BEM053
12.3	M8 100 A steel galvanized	0.10	BEM054-0
12.4	M8 100 A stainless steel	0.10	BEM054
12.5	M10 200 A steel, galvanized	0.16	BEM055-0
12.6	M10 200 A stainless steel	0.16	BEM055
12.7	M12 400 A steel, galvanized	0.28	BEM056-0
12.8	M12 400 A stainless steel	0.28	BEM056
13	Perforated plate, bottom for IP20/IP23		
13.1	For size 3	0.42	BEM077U
13.2	For size 5	0.68	BEM078U
13.3	For size 7	0.95	BEM079U
14	Base, height 112 mm		
14.1	For size 3		BEM088-3
14.2	For size 5		BEM088-5
14.3	For size 7		BEM088-7
15	Base height 300 mm, with perforated plate		
15.1	For size 3		BEM089-3
15.2	For size 5		BEM089-5
15.3	For size 7		BEM089-7
16	Bracket to reinforce the housing fixture for size 7		
17	Cable box for size 7		
18	Name plate		
18.1	Neutral	-	BEM073N
18.2	GINO	-	BEM073G



# Steel grid resistors, system GINO, spare and mounting components

Item	Description	Weight ca. kg	Code
1	Resistor element NW ..	0.5	BEE**
2	Support bracket for bank, with M12		
2.1	For E2**, length 220 mm	0.18	BEM001
2.2	For E3**, length 310 mm	0.23	BEM002
2.3	For E5**, length 510 mm	0.38	BEM003
2.4	For E7**, length 720 mm	0.53	BEM004
3	Insulating tube,		
3.1	For E2**, length 150 mm	0.015	BEM005
3.2	For E3**, length 240 mm	0.024	BEM006
3.3	For E5**, length 440 mm	0.044	BEM007
3.4	For E7**, length 650 mm	0.065	BEM008
4	Spacer tube Ø 18 x 22 x length 18 mm	0.018	BEM009
5	Spacer ring, ceramic material		
5.1	Unglazed	0.035	BEM010
6	Ring-type insulator, end insulation or phase separation	0.05	BEM011
7	Spring washer		
7.1	A18 steel	0.012	BEM012
7.2	A10 V2A	0.012	BEM012V
8	Washer DIN 126-17.5	-	NSS126-0021
9	Washer 12.9 x 34.5 x 2 mm thick	-	BEM...
10	Spacer tube Ø for support bracket		
10.1	Ø 18 x 22 x length 10 mm	0.010	BEM013
10.2	Ø 18 x 22 x length 40 mm	0.040	BEM014
11	Hexagonal nut DIN 934-M12	-	NMS934-0071
12	Serrated lock washer DIN6798-A13	-	NSF6798-0041
13	Spacer tube for screw-type connection		
13.1	Ø 11 x 18 x length 13 mm	0.022	BEM013
13.2	Ø 11 x 18 x length 40 mm	0.023	BEM014
14	Hexagonal nut for element screw connection		
14.1	63 A, DIN 933-M6x30	-	NSS933-
14.2	100 A, DIN 933-M8x30	-	NSS933
14.3	200 A, DIN 933-M10x30	-	NSS933
15	Hexagonal nut for element screw connection		
15.1	63 A, DIN 439-M6	-	NMS439-
15.2	100 A, DIN 439-M8	-	NMS439
15.3	200 A, DIN 439-M10	-	NMS439
16	Spring washer for element screw connection		
16.1	63 A, DIN 127-B6	-	NRF127-
16.2	100 A, DIN 127-B8	-	NRF127-
16.3	200 A, DIN 127-B10	-	NRF127-
17	Connecting pieces		
17.1.1	63 A, steel, galvanized	0.081	BEM17
17.1.2	63 A, stainless steel	0.081	BEM17V
17.1.3	100 A, steel, galvanized	0.093	BEM18
17.1.4	100 A, stainless steel	0.093	BEM18V
17.1.5	200 A, steel, galvanized	0.115	BEM19
17.1.6	200 A, stainless steel	0.115	BEM19V
17.2.1	400 A, steel, galvanized	0.135	BEM20
17.2.2	400 A, stainless steel	0.135	BEM20V
18	Hexagonal nut DIN 933-M10 x 12	0.018	NSS933-0061
19	Spring-type washer		
19.1	For 63 A, DIN 127-B6	0.003	NRF933-
19.2	For 100 A, DIN 127-B8	0.003	NRF933-
19.3	For 200 A, DIN 127-B10	0.003	NRF933-
20	Plain washer		
20.1	For 63 A, DIN 125-A6	-	NSS125-
20.2	For 100 A, DIN 125-A8	-	NSS125-
20.3	For 200 A, DIN 125-A10	-	NSS125-
21	Hexagonal nut		
21.1	63 A, DIN 934-M6	-	NMS934-
21.2	100 A, DIN 934-M8	-	NMS934-
21.3	200 A, DIN 934-M10	-	NMS934-
22	Hexagonal nut DIN 934-M12x30	0.038	NSS933-0155
23	Spring-type washer DIN 127-B12	-	NRF127-
w/o fig.	Element connection 400 A		
	With connection		
	items 13 to16 + 17.2.1, galvanized	0.21	BEM015
	dto. items 13 to16 + 17.2.1, V2A.	0.21	BEM015V
	w/o connection items 13 to16, galv.	0.21	BEM016
	dto. items 13 to16, V2A	0.21	BEM016V
w/o fig.	GINO name plate		BEM073G
	Name plate neutral		BEM073N
24	Bolt-type terminals DIN 46260 Form D		
24.1	M6 galvanized steel, 63 A		BEM053-0
24.2	M8 galvanized steel, 100 A		BEM054-0
24.3	M10 galvanized steel, 200 A		BEM055-0
24.4	M12 galvanized steel, 400 A		BEM056-0
24.5	M6 stainless steel, 63 A		BEM053
24.6	M8 stainless steel, 100 A		BEM054
24.7	M10 stainless steel, 200 A		BEM055
24.8	M12 stainless steel, 400 A		BEM056



## Wire-wound resistors, general



Cement-coated tube resistors



Encapsulated wire-wound resistors type Ohm-i in a housing

### Application

Wire-wound resistors use wire made from special alloys as resistor conductor. Properties like tolerance and temperature coefficient can be adjusted by selecting the appropriate wire and material.

Wire-wound resistors are mainly used for applications in the lower load range up to several kilowatt at low current and/or higher ohm values.

### Systems

With the exception of the range of very small ratings at low application temperatures, wire-wound resistors are always wound on heat-resistant carriers with insulating properties or embedded in such masses. Very thick wires can also be used without a carrier. The resulting elements are comparable to the designs of cast iron or steel grid resistors (wire grid system AEG).

GINO manufactures and supplies all designs for high-performance resistors starting at about 100 W:

**Tube resistors consist of a wire wound on a ceramic carrier tube.** Plain wire is wound on the tube at a specific spacing as resistor conductor. The wire is then embedded in a layer made from special cement compound which will fix and protect the wire and ensure good heat distribution. The roughness of the cement allows for a larger surface and improved cooling. In pulse operation, the cement will also take on energy.

Alternatively, tubes can also be provided with insulating oxidized wire wound turn to turn. Although this saves the cement coating the wire remains unprotected. In case of strong heat formation, the turns will loosen and could slip on top of each other in case of perturbations or rub against each other in case of vibrations which could damage the oxide layer and result in turn-to-turn fault. GINO manufactures mainly tube resistors with cement-coated winding. The cement coat is annealed in an oven after application and drying which gives a high strength and excellent resistance against high moisture.

### Siemens 3PP1 resistors

are air-cooled resistors with cylinder resistors 3PY6. The compact design is particularly suited for intermittent operation in many applications (starting resistors, excitation resistors and field discharge resistors in magnetic control units, braking resistors).

**Cylinder resistors PZ and PC** feature a ceramic support body with grooves to take on the wire winding. PZ without grooves require cement coating if thin wires are used. PZ with different wire winding can be easily combined with other systems and are therefore particularly suited as system components. Resistors of the **3PP1 system** are composed of PZ resistor elements.

**Wire-wound frames** are flat elements with ceramic supports with wire windings at the top and bottom of a carrier frame. The ceramic carriers are provided with grooves to take on the wire.

For ceramic supports without grooves, the windings have to be fixed with cement coating like with the PZ elements. Thanks to the uniform design, wire-wound frames are equally suited as system resistors. With a similar design as GINO steel grid resistors, GINO wire-wound frames can be combined with each other and with the steel grid resistors. In this context, a wire-wound frame takes the place of two steel grids.

**Wire grids, system AEG**, are system elements that match the AEG cast iron resistor system. The elements are resistant to breaking and exhibit a lower temperature coefficient of the electrical resistor than cast iron elements.

**Vitreous enameled resistors** are wire-wound resistors on ceramic tubes whose windings are then coated in a baking oven with a glazing that affords protection against environmental effects.

**Wire-wound resistors in aluminum housing** are high-load resistors wound on a ceramic tube and cast into the bore of an aluminum section that takes on the excess heat of the resistor or dissipates it.

**Ohm-i resistors** are encapsulated resistors in an aluminum housing with high protection class and non-detachable connection lines, mainly designed for applications requiring high overload capacity and a high protection class.

### Codes and standards

The resistor wires used comply with the specifications of DIN 17471, whereby separate standards exist for the alloys.

They meet the applicable regulations VDE 0100 and VDE 0660 and conform with the EEC Low Voltage Directive dated 19 February 1973.

### Protection classes available

pursuant to DIN 40050/IEC144, IP00 as well as IP20 and IP23 for the 3PP1 units are available.

## Table of Contents

<b>Cement-coated tube resistors</b>	page 3.2
<b>Siemens 3PP1 resistors</b>	page 3.6
<b>Cylinder resistors PZ, PC</b>	page 3.9
<b>Wire-wound frames for steel grid system</b>	page 3.11
<b>Wire-wound frame, system AEG</b>	page 3.13
<b>Wire grids, system AEG</b>	page 3.14
<b>Wire grids, housed resistors</b>	page 3.15
<b>Vitreous enameled resistors GRF/GRV</b>	page 3.17
<b>Wire-wound resistor RB in aluminum housing</b>	page 3.18
<b>Encapsulated wire-wound resistors Ohm-i</b>	page 3.20

# Wire-wound resistors, cement coated tube resistors, selection table, normal sizes

## System description

- Tubes made from ceramic material resistant to thermal cycling with spaced (pitch) winding made from CuNi 44 wire.
- Terminal clamp at both ends, optionally with adjustable or non-adjustable pick-off.
- High storage capacity afforded by energy-storing ceramic material and the cement coating
- High overload capacity in short-term and intermittent operation.

## Designs

- Tubes without side panels, protection IP00.
- Tube with bracket and centering disks for upright installation, protection IP00.
- 1 to 3 tube resistors complete with side panels, protection IP00.
- 1 to 3 tube resistors complete with side panels and perforated plate, protection IP20.
- 1 to 3 tube resistors complete with side panels and perforated plate and terminal connection, protection IP20.

## Insulation:

Nominal voltage 660 V VDE 0110  
Insulation class III/3

## Surface

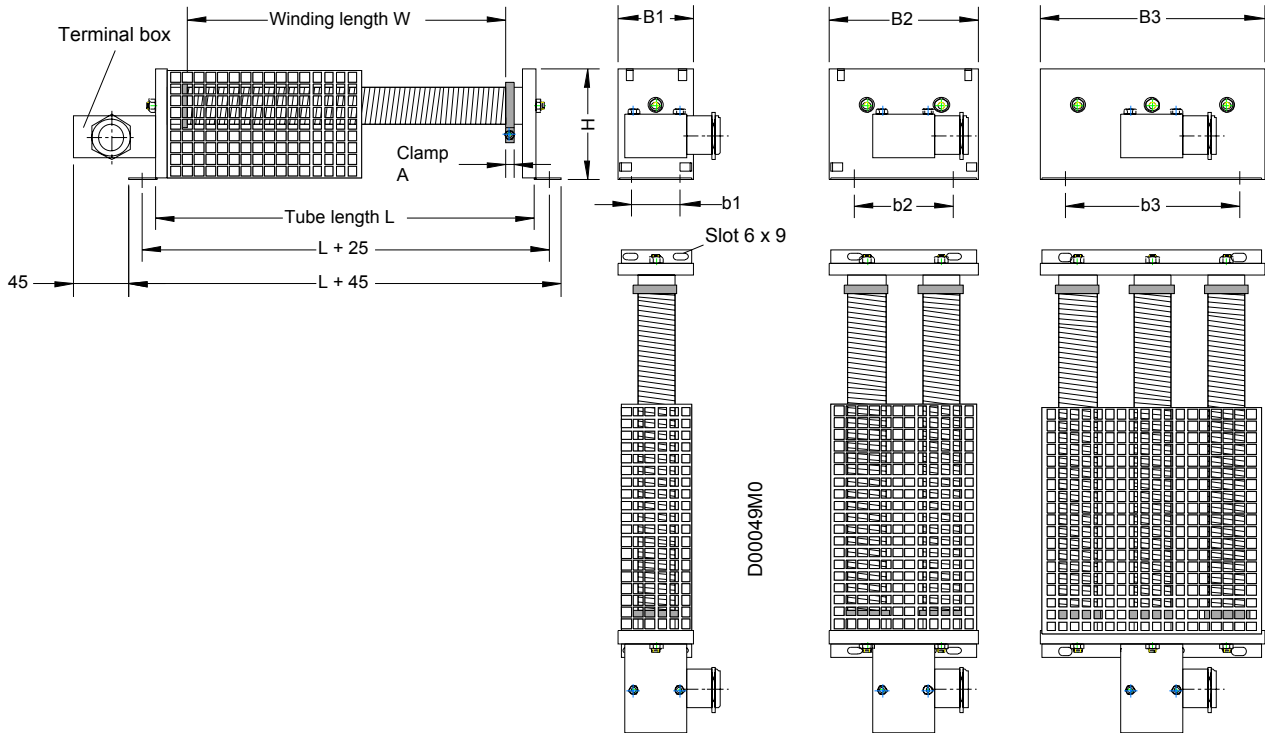
Sendzimir galvanized, no painting

## Purchase order description, type code:

**DEZ(T)** ①②③④⑤⑥-⑦

T = Option, Thermal switch,  
NC-contact, 6 A, AC resistive load  
(previous version: T instead of slash).

- ① = number of tubes, 1-3
- ②③ = tube diameter in mm
- ④⑤ = tube length in cm
- ⑥ = design
- 0 = only tube
- 1 = tube with side panels
- 2 = tube with side panels and terminal
- 3 = tube with side panels and terminal box
- 4 = tube with side panels and perforated plate
- 5 = tube with side panels, perforated plate and terminal
- 6 = tube with side panels, perforated plate and terminal box, previous design, use code 8 instead
- 7 = tube with bracket and centering disks
- 8 = tube resistor, housed IP20, with terminals and cable lug, new design, use instead of code 8
- 9 = like as 8, but including 750 mm cable
- ⑦ = Ohm value, int. usage, e.g. 2R7

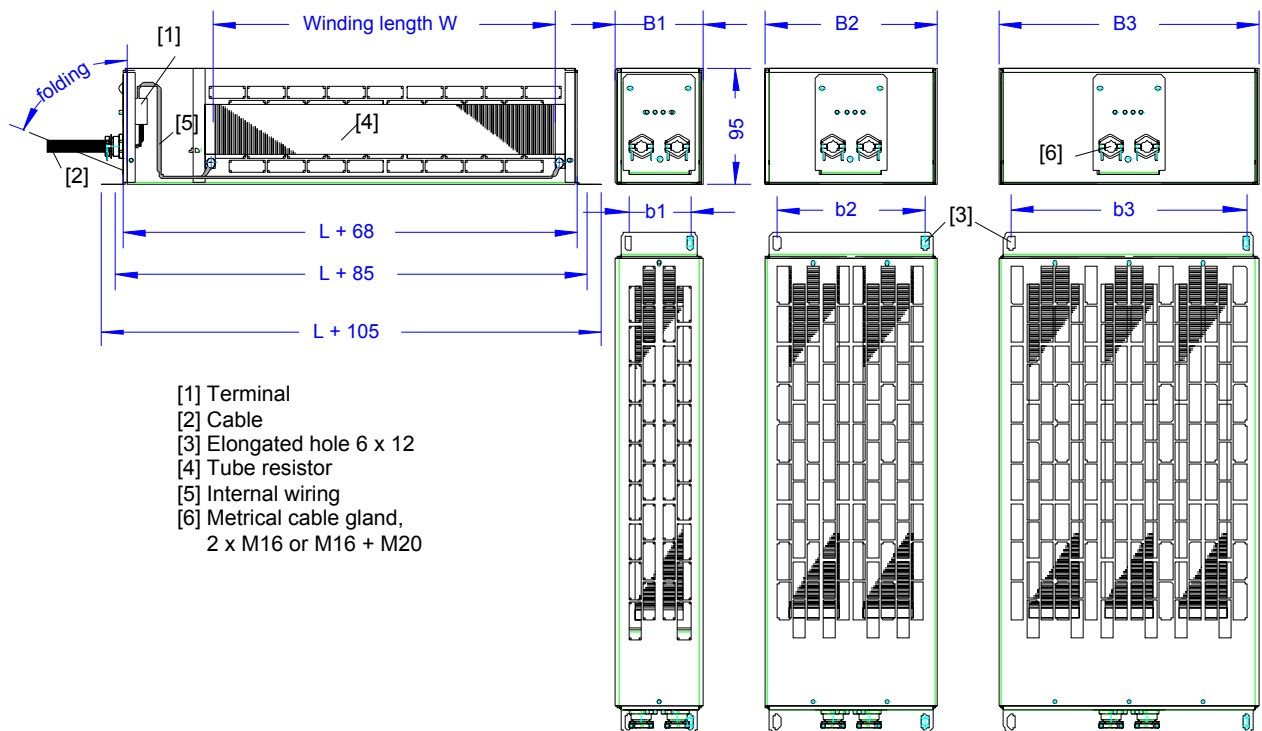


Previous design 6 only for spare parts, use design 8 instead, see page 2.3

Length L mm	100	120	100	120	160	200	300	400	200	300	400	500	600
Tube Ø mm	20		30			40		60					
Rating W	35	45	55	70	95	125	270	370	250	400	550	700	850
Clamp width A mm	6				8				10				
Winding length W mm	70	90	70	90	125	165	265	365	165	265	360	460	560
Connection	M3		M4			M4			M5				
H	90				90				120				
B1	60				90								
b1	40				70								
B2	120				180								
b2	80				140								
B3	180				270								
b3	140				230								

# Wire-wound resistors, housed tubes, new design

© = Design 8, wire-wound tube resistor in housing IP20,  
with perforated cover, terminals inside, metrical cable gland with cable relief



- [1] Terminal
- [2] Cable
- [3] Elongated hole 6 x 12
- [4] Tube resistor
- [5] Internal wiring
- [6] Metrical cable gland,  
2 x M16 or M16 + M20

Single tube resistor  
DEZ1...

Double tube resistor  
DEZ2...

Triple tube resistor  
DEZ3...

Tube length L mm	100	160	200	300	400	200	300	400	500	600	200	300	400	500	600
Tube Ø mm	30					45 <sup>1)</sup>					85 <sup>1)</sup>				
Rating Watt	55	95	125	170	230	170	255	350	425	510	320	480	640	800	960
Tube Ø mm	35 <sup>1)</sup>					60					-				
Rating Watt	65	105	135	200	265	250	400	550	700	850	-	-	-	-	-
Tube Ø mm	40					65 <sup>1)</sup>					-				
Rating Watt	75	120	150	225	300	250	375	500	625	750	-	-	-	-	-
Clamp width mm	6		8			8		10			8		10		
Winding length W mm	70	125	165	265	365	165	265	360	460	560	165	265	360	460	560
Connection	M4					M5					M5				
H	95					120					140				
B1	70					95					120				
b1	50					70					95				
B2	140					180					240				
b2	115					155					215				
B3	210					270					360				
b3	190					245					335				

<sup>1)</sup>Special size

# Wire-wound resistors, cement coated tube resistors, selection table, normal sizes

Tube Ø Mm	20	20	30	30	30	30	40	40	60	60	60	60	60
Length mm	100	120	100	120	160	200	300	400	200	300	400	500	600
Rating W	35	45	55	70	95	125	270	370	250	400	550	700	850
Resistance Ω±10%	Rated current A												
0.12	17.1	-	-	-	-	-	-	-	-	-	-	-	-
0.15	15.3	17.4	-	-	-	-	-	-	-	-	-	-	-
0.18	14.0	15.9	17.1	-	-	-	-	-	-	-	-	-	-
0.22	12.6	14.3	15.5	17.6	-	-	-	-	-	-	-	-	-
0.27	11.4	12.9	14.0	15.9	-	-	-	-	-	-	-	-	-
0.33	10.3	11.7	12.6	14.3	16.9	-	-	-	-	-	-	-	-
0.39	9.5	10.8	11.6	13.2	15.5	17.9	-	-	-	-	-	-	-
0.47	8.7	9.8	10.6	12.0	14.2	16.3	-	-	-	-	-	-	-
0.56	7.9	9.0	9.7	11.0	13.0	14.9	-	-	-	-	-	-	-
0.68	7.2	8.2	8.8	10.0	11.8	13.5	-	-	-	-	-	-	-
0.82	6.6	7.4	8.0	9.1	10.7	12.3	-	-	17.4	-	-	-	-
1.0	5.9	6.7	7.3	8.2	9.7	11.2	16.3	-	15.8	-	-	-	-
1.2	5.4	6.1	6.6	7.5	8.9	10.2	14.9	17.5	14.4	-	-	-	-
1.5	4.8	5.5	5.9	6.7	7.9	9.1	13.3	15.6	12.9	16.3	-	-	-
1.8	4.4	5.0	5.4	6.1	7.2	8.3	12.2	14.3	11.8	14.9	17.4	-	-
2.2	4.0	4.5	4.9	5.6	6.5	7.5	11.0	12.9	10.6	13.5	15.7	17.8	-
2.7	3.6	4.1	4.4	5.0	5.9	6.8	9.9	11.7	9.6	12.2	14.2	16.0	17.7
3.3	3.3	3.7	4.0	4.5	5.3	6.1	9.0	10.5	8.7	11.0	12.8	14.5	16.0
3.9	3.0	3.4	3.7	4.2	4.9	5.6	8.3	9.7	8.0	10.1	11.8	13.3	14.7
4.7	2.7	3.1	3.4	3.8	4.5	5.1	7.5	8.8	7.3	9.2	10.7	12.1	13.4
5.6	2.5	2.8	3.1	3.5	4.1	4.7	6.9	8.1	6.7	8.4	9.8	11.1	12.3
6.8	2.3	2.6	2.8	3.2	3.7	4.3	6.3	7.3	6.0	7.7	8.9	10.1	11.1
8.2	2.1	2.3	2.5	2.9	3.4	3.9	5.7	6.7	5.5	7.0	8.1	9.2	10.1
10	1.88	2.1	2.3	2.6	3.1	3.5	5.2	6.1	5.0	6.3	7.4	8.3	9.2
12	1.71	1.94	2.1	2.4	2.8	3.2	4.7	5.5	4.5	5.8	6.7	7.6	8.4
15	1.53	1.74	1.88	2.1	2.5	2.9	4.2	4.9	4.1	5.2	6.0	6.8	7.5
18	1.40	1.59	1.71	1.94	2.3	2.6	3.8	4.5	3.7	4.7	5.5	6.2	6.8
22	1.26	1.43	1.55	1.76	2.1	2.4	3.5	4.1	3.4	4.3	5.0	5.6	6.2
27	1.14	1.29	1.40	1.59	1.87	2.1	3.1	3.7	3.0	3.8	4.5	5.1	5.6
33	1.03	1.17	1.26	1.43	1.69	1.94	2.8	3.3	2.7	3.5	4.1	4.6	5.1
39	0.95	1.08	1.16	1.32	1.55	1.79	2.6	3.1	2.5	3.2	3.7	4.2	4.6
47	0.87	0.98	1.06	1.2	1.42	1.63	2.4	2.8	2.3	2.9	3.4	3.8	4.2
56	0.79	0.90	0.97	1.1	1.30	1.49	2.2	2.6	2.1	2.7	3.1	3.5	3.9
68	0.72	0.82	0.88	1.00	1.18	1.35	1.98	2.3	1.91	2.4	2.8	3.2	3.5
82	0.66	0.74	0.80	0.91	1.07	1.23	1.80	2.1	1.74	2.2	2.6	2.9	3.2
100	0.59	0.67	0.73	0.82	0.97	1.12	1.63	1.92	1.58	2.0	2.3	2.6	2.9
120	0.54	0.61	0.66	0.75	0.89	1.02	1.49	1.75	1.44	1.82	2.1	2.4	2.6
150	0.48	0.55	0.59	0.67	0.79	0.91	1.33	1.56	1.29	1.63	1.90	2.15	2.4
180	0.44	0.50	0.54	0.61	0.72	0.83	1.22	1.43	1.18	1.49	1.74	1.96	2.2
220	0.40	0.45	0.49	0.56	0.65	0.75	1.10	1.29	1.06	1.35	1.57	1.78	1.96
270	0.36	0.41	0.44	0.50	0.59	0.68	0.99	1.17	0.96	1.22	1.42	1.60	1.77
330	0.33	0.37	0.40	0.45	0.53	0.61	0.90	1.05	0.87	1.10	1.28	1.45	1.60
390	0.30	0.34	0.37	0.42	0.49	0.56	0.83	0.97	0.80	1.01	1.18	1.33	1.47
470	0.27	0.31	0.34	0.38	0.45	0.51	0.75	0.88	0.73	0.92	1.07	1.21	1.34
560	0.25	0.28	0.31	0.35	0.41	0.47	0.69	0.81	0.67	0.84	0.98	1.11	1.23
680	0.23	0.26	0.28	0.32	0.37	0.43	0.63	0.73	0.60	0.77	0.89	1.01	1.11
820	0.21	0.23	0.25	0.29	0.34	0.39	0.57	0.67	0.55	0.70	0.81	0.92	1.01
1000	-	0.21	0.23	0.26	0.31	0.35	0.52	0.61	0.50	0.63	0.74	0.83	0.92
1200	-	-	0.21	0.24	0.28	0.32	0.47	0.55	0.46	0.58	0.67	0.76	0.84
1500	-	-	-	0.21	0.25	0.29	0.42	0.49	0.41	0.52	0.60	0.68	0.75
1800	-	-	-	-	0.23	0.26	0.38	0.45	0.37	0.47	0.55	0.62	0.68
2200	-	-	-	-	0.21	0.24	0.35	0.41	0.34	0.43	0.50	0.56	0.62
2700	-	-	-	-	-	0.21	0.31	0.37	0.30	0.38	0.45	0.51	0.56
3300	-	-	-	-	-	-	0.28	0.33	0.27	0.35	0.41	0.46	0.51
3900	-	-	-	-	-	-	0.26	0.31	0.25	0.32	0.37	0.42	0.47
4700	-	-	-	-	-	-	0.24	0.28	0.23	0.29	0.34	0.38	0.42
5600	-	-	-	-	-	-	0.22	0.26	0.21	0.27	0.31	0.35	0.39
6800	-	-	-	-	-	-	-	0.23	-	0.24	0.28	0.32	0.35
8200	-	-	-	-	-	-	-	-	-	0.22	0.26	0.29	0.32
10000	-	-	-	-	-	-	-	-	-	-	0.23	0.26	0.29
12000	-	-	-	-	-	-	-	-	-	-	0.21	0.24	0.27
15000	-	-	-	-	-	-	-	-	-	-	-	0.22	0.24
18000	-	-	-	-	-	-	-	-	-	-	-	-	0.22



# Cement-coated tube resistors, selection table , special sizes

Tube Ø mm	35	35	35	45	45	65	65	65	65	85	85
Tube length mm	100	135	330	160	300	300	400	500	600	400	600
Rating W	70	90	250	150	290	430	600	800	1000	850	1350
Resistance $\Omega_{\pm 10\%}$	Rated current A										
0,22	17,84										
0,27	16,10										
0,33	14,56	16,5									
0,39	13,40	15,2									
0,47	12,20	13,8									
0,56	11,18	12,7		16,4							
0,68	10,15	11,5		14,9							
0,82	9,24	10,5		13,5							
1	8,37	9,5	15,8	12,2	17,0						
1,2	7,64	8,7	14,4	11,2	15,5	18,9					
1,5	6,83	7,7	12,9	10,0	13,9	16,9					
1,8	6,24	7,1	11,8	9,1	12,7	15,5					
2,2	5,64	6,4	10,7	8,3	11,5	14,0	16,5				
2,7	5,09	5,8	9,6	7,5	10,4	12,6	14,9	17,2			
3,3	4,61	5,22	8,7	6,7	9,4	11,4	13,5	15,6		16,0	
3,9	4,24	4,80	8,0	6,2	8,6	10,5	12,4	14,3	16,0	14,8	18,6
4,7	3,86	4,38	7,3	5,6	7,9	9,6	11,3	13,0	14,6	13,4	16,9
5,6	3,54	4,01	6,7	5,18	7,2	8,8	10,4	12,0	13,4	12,3	15,5
6,8	3,21	3,64	6,1	4,70	6,5	8,0	9,4	10,8	12,1	11,2	14,1
8,2	2,92	3,31	5,5	4,28	5,9	7,2	8,6	9,9	11,0	10,2	12,8
10	2,65	3,00	5,0	3,87	5,4	6,6	7,7	8,9	10,0	9,2	11,6
12	2,42	2,74	4,56	3,54	4,92	6,0	7,1	8,2	9,1	8,4	10,6
15	2,16	2,45	4,08	3,16	4,40	5,4	6,3	7,3	8,2	7,5	9,5
18	1,97	2,24	3,73	2,89	4,01	4,89	5,8	6,7	7,5	6,9	8,7
22	1,78	2,02	3,37	2,61	3,63	4,42	5,2	6,0	6,7	6,2	7,8
27	1,61	1,83	3,04	2,36	3,28	3,99	4,7	5,4	6,1	5,6	7,1
33	1,46	1,65	2,75	2,13	2,96	3,61	4,26	4,92	5,5	5,1	6,4
39	1,34	1,52	2,53	1,96	2,73	3,32	3,92	4,53	5,06	4,67	5,9
47	1,22	1,38	2,31	1,79	2,48	3,02	3,57	4,13	4,61	4,25	5,4
56	1,12	1,27	2,11	1,64	2,28	2,77	3,27	3,78	4,23	3,90	4,91
68	1,01	1,15	1,92	1,49	2,07	2,51	2,97	3,43	3,83	3,54	4,46
82	0,92	1,05	1,75	1,35	1,88	2,29	2,71	3,12	3,49	3,22	4,06
100	0,84	0,949	1,58	1,22	1,70	2,07	2,45	2,83	3,16	2,92	3,67
120	0,76	0,866	1,44	1,12	1,55	1,89	2,24	2,58	2,89	2,66	3,35
150	0,68	0,775	1,29	1,00	1,39	1,69	2,00	2,31	2,58	2,38	3,00
180	0,62	0,707	1,18	0,913	1,27	1,55	1,83	2,11	2,36	2,17	2,74
220	0,56	0,640	1,07	0,826	1,15	1,40	1,65	1,91	2,13	1,97	2,48
270	0,51	0,577	0,962	0,745	1,04	1,26	1,49	1,72	1,92	1,77	2,24
330	0,46	0,522	0,870	0,674	0,94	1,14	1,35	1,56	1,74	1,60	2,02
390	0,42	0,480	0,801	0,620	0,86	1,05	1,24	1,43	1,60	1,48	1,86
470	0,39	0,438	0,729	0,565	0,79	0,957	1,13	1,30	1,46	1,34	1,69
560	0,35	0,401	0,668	0,518	0,72	0,876	1,04	1,20	1,34	1,23	1,55
680	0,32	0,364	0,606	0,470	0,65	0,795	0,9	1,08	1,21	1,12	1,41
820	0,29	0,331	0,552	0,428	0,59	0,724	0,855	0,988	1,10	1,02	1,28
1000	0,26	0,300	0,500	0,387	0,54	0,656	0,775	0,894	1,00	0,92	1,16
1200	0,24	0,274	0,456	0,354	0,49	0,599	0,707	0,816	0,913	0,842	1,061
1500	0,22	0,245	0,408	0,316	0,44	0,535	0,632	0,730	0,816	0,753	0,949
1800	0,20	0,224	0,373	0,289	0,40	0,489	0,577	0,667	0,745	0,687	0,866
2200		0,202	0,337	0,261	0,36	0,442	0,522	0,603	0,674	0,622	0,783
2700			0,304	0,236	0,33	0,399	0,471	0,544	0,609	0,561	0,707
3300			0,275	0,213	0,30	0,361	0,426	0,492	0,550	0,508	0,640
3900			0,253	0,196	0,27	0,332	0,392	0,453	0,506	0,467	0,588
4700			0,231		0,25	0,302	0,357	0,413	0,461	0,425	0,536
5600			0,211		0,23	0,277	0,327	0,378	0,423	0,390	0,491
6800						0,251	0,297	0,343	0,383	0,354	0,446
8200						0,229	0,271	0,312	0,349	0,322	0,406
10000							0,245	0,283	0,316	0,292	0,367
12000							0,224	0,258	0,289	0,266	0,335
15000								0,231	0,258	0,238	0,300
18000								0,211	0,236	0,217	0,274

# Resistors system Siemens 3PP1

## Design

Siemens 3PP1 resistors are made from wire-wound resistor elements 3PY6 0. The casings available in 5 sizes for natural air cooling consist of a base plate with support structure for the resistor elements. The connections of the resistor elements are wired to terminals. The resistor banks are intended for wall mounting and can be supplied with or without protective housing.



Protection IP00, for installation in control cabinets



Protection IP20, screen-protected but not water-protected



Protection IP23, drip-proof

**Surface:** CEP base coat + synthetic resin cover layer RAL 7032.

## Application

3PP1 resistors are suited as starting, slip, series and load resistors. For installation in a control cabinet, the loss must be considered.

## Installation

3PP1 units are intended for wall mounting. They shall be mounted such that the resistor body is upright and the cooling air can pass unobstructed from bottom to top. Above the air exit, sufficient safety clearance shall be ensured as the heated cooling air may exhibit a temperature rise of up to 200 K.

## Climate

The resistors are suited for indoor and outdoor installation in industrial and maritime atmosphere pursuant to DIN 50 010/T1.

## Ambient temperature:

-25 to +45°C up to 1000 m above seal level. At higher temperatures the continuous duty is to be reduced by 3% for each additional 5°C.

For installation higher than 1000 m above seal level, the continuous duty  $P_d$  must be reduced, too:

$$P_h = P_d \cdot e^{\frac{h-1000}{8000}}$$

h = geodesic height m

## Rated insulation voltage:

500 V AC / 600 V DC pursuant to DIN VDE 0110 insulation class III/3.

When used as a starting resistor in rotor circuits, the rotor standstill voltage pursuant to DIN VDE 0660 T102 may be twice as high.

## Maintenance

3PP1 units are maintenance-free. When used in dust-laden atmosphere, conductive contaminants and varying exposure to condensation, regular cleaning will be required as a function of the pollution degree. Cleaning should be followed by a check of the insulation resistance (1000 VDC,  $R_{ISOL} \gg 1k\Omega/V$ ).

## Cable and power line entry

For connection, insulated power lines or cables with high resistance to heat shall be used or covered with temperature-resistant insulating sleeve at the connections. The entries are provided with rubber nozzle which can be replaced by metal cable glands, where required.

## Connections

Permanent current up to A	Terminal	Conductor diameter up to	Protective conductor terminal
25	M5	6 mm <sup>2</sup>	M5
100	2 x M5	25 mm <sup>2</sup>	M5

## Power line entries

Size 3PP1	Rubber grommet Number x Ø mm	Alternative: bolt/nut connection
32	3 x 16	PG16
33	3 x 16	PG16
34	4 x 20	PG21
35	4 x 20	PG21
36	5 x 20	PG21

## Type code

3PP1 ①②③-④⑤⑥

①② = size, 32 to 36

③ = protection 5 = IP00

6 = IP20

7 = IP23

④ = Number and nominal current of terminals

Code ④	Number of terminals	
	Up to 25 A	Up to 100 A
0	4	2
1	8	4
2	12	6
3	16	8
4	20	10
5	24	12
6	30	15
7	36	18

⑤ = Type supplements B through M for load, series and slip resistors according to the selection table, additional indication K2Y or K3Y required

⑥ = Full text purchase order supplements, as the type code only designates the size of the unit.

Selection table for resistors for continuous duty

Load resistors, purchase order code <b>K2Y</b> Continuous duty kW	Slip resistors, purchase order code <b>K3Y</b> Motor rating for continuous speed reduction					No. Resist- tor ele- ments	Weight ca. kg	Type code	
	5 %	10 %	15 %	20 %	25 %			<b>3PP1</b> ①②③-④⑤⑥ Size ①②	Code letter ⑤
0.25	4.2	2.1	1.4	1.0	0.8	3	2,5	<b>32</b>	<b>B</b>
0.30	-	-	-	-	-	4	3,0	<b>33</b>	<b>C</b>
0.50	8.0	4.0	2.7	2.0	1.6	6	3,5	<b>33</b>	<b>D</b>
0.80	16	7.5	5.0	3.7	3.0	10	6,5	<b>34</b>	<b>F</b>
1.2	22	11	7.3	5.5	4.4	15	10	<b>35</b>	<b>G</b>
1.7	30	15	10	7.5	6.0	21	11	<b>35</b>	<b>H</b>
2.1	38	19	12,5	9.5	7.6	27	16	<b>36</b>	<b>J</b>
2.4	44	22	15	11	9.0	30	17	<b>36</b>	<b>K</b>
2.9	52	26	18	13	10.5	36	18	<b>36</b>	<b>L</b>
3.2	62	31	21	15.5	12.5	40	19	<b>36</b>	<b>M</b>

© Full text order supplement: **K2Y**  
 • Application  
 • Resistance value(s)  
 • Rated voltage or current  
 • Switchgear, terminal description, possibly wiring diagram

© Full text order supplement: **K3Y**  
 • Application  
 • Motor rating or actual rating at nominal load  
 • Rotor voltage and current  
 • Switchgear, terminal description, possibly wiring diagram

For **re-ordering** of equipment already supplied, indicate the complete purchase order no. and the S/N of the unit.  
3PP3 units also available.

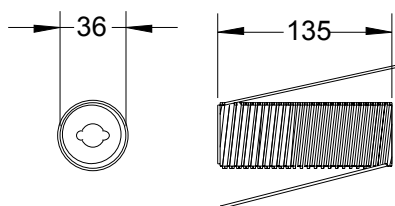
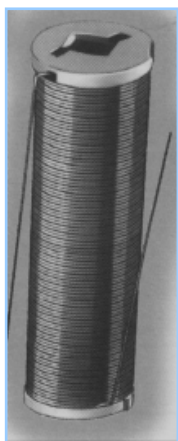
Selection table for starting resistors

Motor rating Starting load factor f				Nominal current up to A	Starter energy kJ	Starting time z=2 s	Starting fre- quency 1/h	No. of re- sistor elements	No. of steps m	No. of terminals max.	Size ①②	Weight ca. kg	Order supple- ment - ④⑤⑥
2.0	1.4	1.0	0.7										
2.3	3	4.5	6.0	40	45	10	15	3	2	6	32	2.5	<b>-1BZ</b>
2.3	3	4.5	6.0	40	45	10	15	3	4	12	33	3.0	<b>-2CZ</b>
4.5	6	9	12	40	115	13	15	6	2	6	33	3.5	<b>-1DZ</b>
4.5	6	9	12	40	115	13	15	6	4	12	33	3.5	<b>-2DZ</b>
4.5	6	9	12	150	115	13	15	6	2	6	33	5.5	<b>-2DZ</b>
4.5	6	9	12	150	115	13	15	6	4	12	34	5.5	<b>-5DZ</b>
7	9	14	18	40	175	13	15	9	2	6	34	6.5	<b>-1FZ</b>
7	9	14	18	40	175	13	15	9	4	12	34	6.5	<b>-2FZ</b>
7	9	14	18	150	175	13	15	9	2	6	34	6.5	<b>-2FZ</b>
7	9	14	18	150	175	13	15	9	4	12	34	6.5	<b>-5FZ</b>
12	15	24	30	150	400	15	15	15	2	6	35	10	<b>-2GZ</b>
12	15	24	30	150	400	15	15	15	4	12	35	10	<b>-5GZ</b>
15	21	30	42	150	540	15	15	21	2	6	35	11	<b>-2HZ</b>
15	21	30	42	150	540	15	15	21	4	12	35	11	<b>-5HZ</b>
23	30	46	60	150	800	15	15	30	2	6	36	17	<b>-2KZ</b>
23	30	46	60	150	800	15	15	30	4	12	36	17	<b>-5KZ</b>
30	40	60	80	150	1080	15	15	39	2	6	36	19	<b>-2MZ</b>
30	40	60	80	150	1080	15	15	39	4	12	36	19	<b>-5MZ</b>

© Full text order supplement: **K1Y**  
 • Application  
 • Rotor voltage and current  
 • Starting load factor  
 • For centrifugal load drive speed and moment of inertia

For **re-ordering** of units already supplied, indicate the full order number and the S/N of the unit.

## Resistor body 3PY6 001-



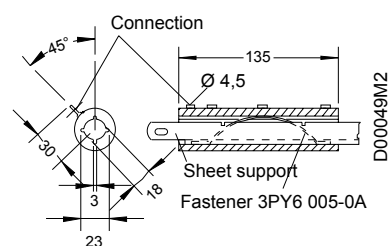
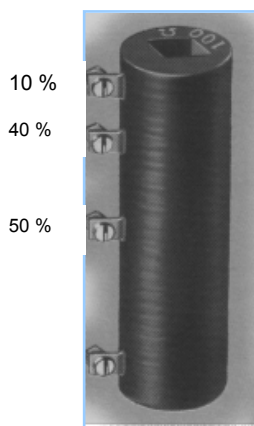
## Resistor elements with threaded body and uncoated wire winding

Resistance value $\Omega \pm 10\%$	Wire $\varnothing$ mm	Wind-ings	Load values A at d.f. % and cycle time 120 s or 600 s at 5% d.f. <sup>1)</sup>					Order no.	
			100%	60%	40%	25%	15%		5%
Wire NiCr 3020, spec. resistance $1.04 \Omega \cdot \text{mm}^2/\text{m}$ , density $7.9 \text{ g/cm}^3$ , spec. heat $0.5 \text{ J/(g}\cdot\text{K)}$									
270	0.25	118	0.54	0.54	0.54	0.55	0.59	0.55	3PY6 001-0A
190	0.30	118	0.64	0.64	0.65	0.67	0.72	0.67	3PY6 001-0B
140	0.35	118	0.75	0.77	0.81	0.90	1.05	0.90	3PY6 001-0C
107	0.40	118	0.86	0.86	0.88	0.93	1.04	0.93	3PY6 001-0D
Wire CuNi 44, spec. resistance $0.49 \Omega \cdot \text{mm}^2/\text{m}$ , density $8.9 \text{ g/cm}^3$ , spec. heat $0.42 \text{ J/(g}\cdot\text{K)}$									
91.5	0.3	118	0.9	0.93	0.94	0.96	1.04	0.96	3PY6 001-1A
67.5	0.35	118	1.1	1.10	1.11	1.16	1.27	1.16	3PY6 001-1B
51.8	0.4	118	1.2	1.20	1.22	1.29	1.43	1.29	3PY6 001-1C
33.4	0.5	118	1.5	1.51	1.56	1.68	1.91	1.68	3PY6 001-1D
23.4	0.6	118	1.9	1.93	2.02	2.21	2.55	2.21	3PY6 001-1E
7.1	0.9	81	3.4	3.57	3.84	4.36	5.21	4.43	3PY6 001-2H
5.8	1.0	81	3.8	4.03	4.38	5.01	6.02	5.12	3PY6 001-2J
4.8	1.1	81	4.1	4.39	4.80	5.54	6.70	5.70	3PY6 001-2K
4.1	1.2	81	4.5	4.86	5.36	6.22	7.55	6.44	3PY6 001-2L
16.6	0.5	62	2.2	2.22	2.29	2.46	2.80	2.46	3PY6 001-3A
11.7	0.6	62	2.6	2.65	2.76	3.02	3.49	3.03	3PY6 001-3B
8.6	0.7	62	3.1	3.19	3.36	3.73	4.37	3.75	3PY6 001-3C
2.2	1.4	62	6.1	6.7	7.5	8.8	10.7	9.23	3PY6 001-3J
1.7	1.6	62	7	7.8	8.8	10.4	12.8	11.15	3PY6 001-3K
3.2	0.9	41	5	5.2	5.7	6.4	7.7	6.51	3PY6 001-4C
2.6	1.0	41	5.6	5.9	6.5	7.4	8.9	7.54	3PY6 001-4D
1.35	1.4	41	8	8.8	9.8	11.5	14.1	12.11	3PY6 001-4G
1.05	1.6	41	9	10.0	11.3	13.3	16.4	14.33	3PY6 001-4H
0.84	1.8	41	10	11.3	12.8	15.2	18.8	16.67	3PY6 001-4J
0.68	2.0	41	11.5	13.1	14.9	17.9	22.2	20.00	3PY6 001-4K
1.87	1.0	30	6.6	7.0	7.6	8.7	10.5	8.88	3PY6 001-5A
1.55	1.1	30	7.3	7.8	8.6	9.9	11.9	10.14	3PY6 001-5B
0.75	1.6	30	10.5	11.7	13.2	15.6	19.2	16.72	3PY6 001-5E
0.49	2.0	30	13.5	15.3	17.5	21.0	26.1	23.48	3PY6 001-5G
0.41	2.2	30	14.5	16.6	19.1	23.0	28.7	26.22	3PY6 001-5H
0.55	1.6	23	12.5	13.9	15.7	18.5	22.8	19.9	3PY6 001-6C
0.36	2.0	23	16	18.2	20.8	24.9	30.9	27.8	3PY6 001-6E
0.3	2.2	23	17	19.5	22.4	26.9	33.6	30.7	3PY6 001-6F

## Vitreous enameled resistor elements with fixed taps connections

Resistance value $\Omega \pm 10\%$	Load values A at d.f. % and cycle time 120 s or 600 s at 5% d.f. <sup>1), 2)</sup>					Order no.	
	100%	60%	40%	25%	15%		5%
Wire NiCr 6015, spec. Resistance $1.13 \Omega \cdot \text{mm}^2/\text{m}$ , density $8.2 \text{ g/cm}^3$ , spec. Heat $0.46 \text{ J/(g}\cdot\text{K)}$							
320	0.5	0.6	0.65	0.85	1.10	1.85	3PY6002-0D
500	0.4	0.48	0.52	0.68	0.88	1.20	3PY6002-0F
630	0.36	0.42	0.46	0.61	0.79	0.95	3PY6002-0G
800	0.32	0.38	0.41	0.54	0.70	0.75	3PY6002-0H
1000	0.28	0.33	0.36	0.47	0.60	0.60	3PY6002-0J
1600	0.22	0.26	0.28	0.37	0.37	0.37	3PY6002-0L
2000	0.20	0.24	0.26	0.30	0.30	0.30	3PY6002-0M
3200	0.16	0.18	0.18	0.18	0.18	0.18	3PY6002-0P
5000	0.12	0.12	0.12	0.12	0.12	0.12	3PY6002-0R
10000	0.06	0.06	0.06	0.06	0.06	0.06	3PY6002-0U

## Resistor body 3PY6 002- with tapping



## Accessories

Description	Weight kg	Order no.	
<b>Adjusting clamp</b>	Without connecting wire	0.02	3PY6 004-0A
	With heat-insulated connecting wire 190 mm	0.03	3PY6 004-0B
<b>Sheet support</b>	For 1 x 3PY6	0.02	3PY6 003-0A
	For 2 x 3PY6	0.04	3PY6 003-0B
<b>Sheet frame without support and without tensioning bracket</b>			
	For 1 to 4 x 3PY6	1.2	3PY6 003-0J
	For 5 to 6 x 3PY6	1.3	3PY6 003-0K
	For 7 to 8 x 3PY6	1.4	3PY6 003-0L
	For 9 to 10 x 3PY6	1.6	3PY6 003-0M
<b>Tensioning bracket</b>	For 3PY6 002-	0.02	3PY6 005-0A

1) Wire temperature rise 350 K in ventilated housing at 50 mm installation spacing  
2) Load values at 5% d.f. limited by the maximum admissible voltage drop 600V

# Wire-wound resistors, resistor cylinders PZ, PC

## Resistor cylinders PZ and PC

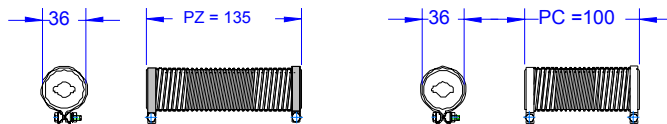
Standardized winding body made from porcelain with grooves as supports for the winding. The groove leads the wire thus reliably preventing faults between turns.

## System description

- Two sizes  
**PZ = Ø 35 x 135 mm long** and  
**PC = Ø 35 x 100 mm long** each with  
pitch  $s = 1.0/1.5/2.0/3.0/4.0/5.0$  mm enable the use of resistor wires from Ø 0.1 to Ø 2.2 mm
- Winding with bare wire made from CuNi 44 pursuant to DIN 17471
- Clamp connection at both ends
- Pick-off optional

## Models

- Individual elements for installation, IP00
- Up to 4 elements on sheet support
- Support frame with 4 elements for installation instead of a cast iron element, system GINO



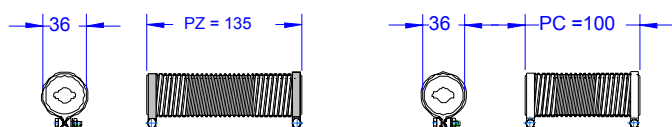
With wire CuNi 44

PZ11, 119 windings, s = 1 mm			PC1, 87 windings, s = 1 mm			Wire Ø mm	Current A at d.f. % and cycle time 120 s					
Resistance Ω±10%	DK- No.	Code	Resistance Ω±10%	DK No.	Code		100	60	40	25	15	5
767	640.10	DGP11-767R	561	641.10	DGP1-561R	0.1	0.17	0.17	0.17	0.17	0.17	0.19
341	640.11	DGP11-341R	250	641.11	DGP1-250R	0.15	0.32	0.32	0.32	0.32	0.33	0.39
192	640.12	DGP11-192R	140	641.12	DGP1-140R	0.2	0.49	0.49	0.49	0.49	0.51	0.66
123	640.13	DGP11-123R	90	641.13	DGP1-90R	0.25	0.69	0.69	0.69	0.70	0.75	1.00
85	640.14	DGP11-85R	62	641.14	DGP1-62R	0.3	0.9	0.90	0.91	0.93	1.01	1.40
63	640.15	DGP11-63R	46	641.15	DGP1-46R	0.35	1.1	1.10	1.11	1.16	1.27	1.81
48	640.16	DGP11-48R	35	641.16	DGP1-35R	0.4	1.3	1.31	1.33	1.40	1.55	2.26
38	640.17	DGP11-38R	28	641.17	DGP1-28R	0.45	1.5	1.51	1.54	1.64	1.85	2.74
31	640.18	DGP11-31R	22	641.18	DGP1-22R	0.5	1.6	1.62	1.66	1.79	2.03	3.05
21	640.19	DGP11-21R	16	641.19	DGP1-16R	0.6	2	2.04	2.12	2.32	2.69	4.12
16	640.190	DGP11-16R	11	641.190	DGP1-11R	0.7	2.3	2.36	2.50	2.77	3.24	5.05

PZ12, 82 windings; s = 1.5			PC2, 60 windings, s = 1.5 mm			Wire Ø mm	Current A at d.f. % and cycle time 120 s					
Resistance Ω±10%	DK- No.	Code	Resistance Ω±10%	DK No.	Code		100	60	40	25	15	5
59	640.201	DGP12-59R	43	641.201	DGP2-43R	0.3	0.9	0.90	0.91	0.93	1.01	1.40
43	640.200	DGP12-43R	32	641.200	DGP2-32R	0.35	1.1	1.10	1.11	1.16	1.27	1.81
33	640.20	DGP12-33R	24	641.20	DGP2-24R	0.4	1.4	1.41	1.43	1.50	1.67	2.43
26	640.21	DGP12-26R	19	641.21	DGP2-19R	0.45	1.7	1.71	1.75	1.86	2.10	3.10
21.2	640.22	DGP12-21R2	15.5	641.22	DGP2-15R5	0.5	1.9	1.92	1.98	2.12	2.41	3.62
14.7	640.23	DGP12-14R7	10.7	641.23	DGP2-10R7	0.6	2.4	2.44	2.55	2.79	3.22	4.94
10.8	640.24	DGP12-10R8	7.9	641.24	DGP2-7R9	0.7	2.8	2.88	3.04	3.37	3.95	6.15
8.3	640.25	DGP12-8R3	6.0	641.25	DGP2-6R	0.8	3.2	3.32	3.55	3.98	4.72	7.44
6.5	640.26	DGP12-6R5	4.8	641.26	DGP2-4R8	0.9	3.6	3.78	4.07	4.62	5.51	8.78
5.3	640.27	DGP12-5R3	3.9	641.27	DGP2-3R9	1.0	3.9	4.13	4.49	5.14	6.18	9.92
4.4	640.28	DGP12-4R4	3.2	641.28	DGP2-3R2	1.1	4.3	4.60	5.04	5.81	7.02	11.4
3.7	640.29	DGP12-3R7	2.7	641.29	DGP2-2R7	1.2	4.7	5.07	5.60	6.49	7.89	12.8

PZ13, 62 windings, s = 2 mm			PC3, 46 windings, s = 2 mm			Wire Ø mm	Current A at d.f. % and cycle time 120 s					
Resistance Ω±10%	DK No.	Code	Resistance Ω±10%	DK No.	Code		100%	60%	40%	25%	15%	5%
16.0	640.300	DGP13-16R	11.7	641.300	DGP3-11R7	0.5	1.94	1.96	2.02	2.17	2.47	3.7
11.1	640.30	DGP13-11R1	8.1	641.30	DGP3-8R1	0.6	2.55	2.60	2.71	2.96	3.42	5.3
8.1	640.31	DGP13-8R1	6.0	641.31	DGP3-6R	0.7	3.19	3.28	3.46	3.84	4.50	7.0
6.2	640.32	DGP13-6R2	4.6	641.32	DGP3-4R6	0.8	3.65	3.79	4.05	4.54	5.38	8.5
4.9	640.33	DGP13-4R9	3.6	641.33	DGP3-3R6	0.9	4.1	4.30	4.64	5.26	6.28	10.0
4.0	640.34	DGP13-4R	2.9	641.34	DGP3-2R9	1.0	4.5	4.77	5.18	5.93	7.13	11.4
3.3	640.35	DGP13-3R3	2.4	641.35	DGP3-2R4	1.1	5.0	5.35	5.86	6.76	8.17	13.2
2.8	640.36	DGP13-2R8	2.0	641.36	DGP3-2R	1.2	5.4	5.83	6.43	7.46	9.06	14.7
2.36	640.37	DGP13-2R36	1.74	641.37	DGP3-1R74	1.3	5.9	6.42	7.13	8.32	10.1	16.6
2.04	640.38	DGP13-2R04	1.50	641.38	DGP3-1R5	1.4	6.4	7.02	7.83	9.19	11.2	18.4
1.77	640.39	DGP13-1R77	1.30	641.39	DGP3-1R3	1.5	6.8	7.51	8.42	9.92	12.2	20.1
1.56	640.390	DGP13-1R56	1.15	641.390	DGP3-1R15	1.6	7.3	8.12	9.14	10.8	13.3	22.0

# Wire-wound resistors, wire-wound frame, system GINO, with CuNi 44 wire



With wire CuNi 44

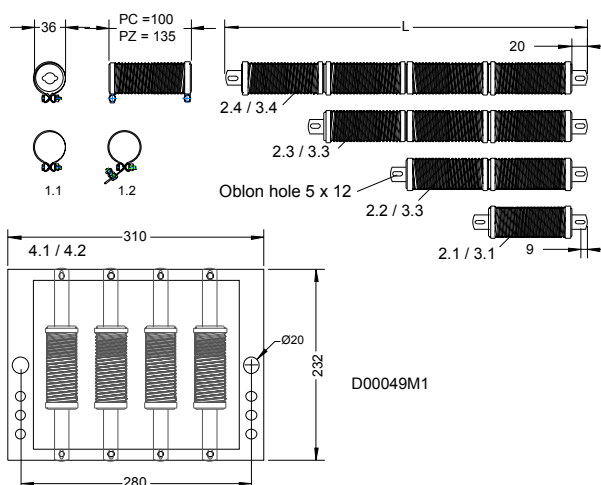
PZ14, 41 windings, s = 3 mm			PC4, 29 windings, s = 3 mm			Wire Ø mm	Current A at d.f. % and cycle time 120 s					
Resistance Ω±10%	DK- No.	Code	Resistance Ω±10%	DK- No.	Code		100	60	40	25	15	5
5,50	640.403	DGP14-5R5	3,8	641.403	DGP4-3R8	0,7	3,2	3,29	3,47	3,85	4,51	7,0
4,20	640.402	DGP14-4R2	2,9	641.402	DGP4-2R9	0,8	3,9	4,05	4,32	4,86	5,75	9,1
3,30	640.401	DGP14-3R3	2,3	641.401	DGP4-2R3	0,9	4,7	4,93	5,31	6,03	7,20	11,5
2,70	640.400	DGP14-2R7	1,9	641.400	DGP4-2R7	1,0	5,5	5,83	6,34	7,25	8,72	14,0
2,22	640.40	DGP14-2R22	1,55	641.40	DGP4-1R55	1,1	6,1	6,53	7,15	8,24	9,96	16,1
1,90	640.410	DGP14-1R9	1,30	641.410	DGP4-1R3	1,2	6,6	7,12	7,86	9,12	11,08	18,0
1,59	640.42	DGP14-1R59	1,11	641.42	DGP4-1R11	1,3	7,2	7,84	8,70	10,15	12,4	20,2
1,37	640.43	DGP14-1R37	0,95	641.43	DGP4-0R95	1,4	7,8	8,55	9,54	11,20	13,7	22,5
1,19	640.44	DGP14-1R19	0,83	641.44	DGP4-0R83	1,5	8,3	9,17	10,28	12,11	14,9	24,5
1,05	640.45	DGP14-1R05	0,73	641.45	DGP4-0R73	1,6	8,9	9,90	11,15	13,2	16,2	26,8
0,93	640.460	DGP14-0R93	0,65	641.460	DGP4-0R65	1,7	9,4	10,52	11,89	14,1	17,4	28,8
0,83	640.47	DGP14-0R83	0,58	641.47	DGP4-0R58	1,8	10,0	11,25	12,77	15,2	18,8	31,2
0,74	640.48	DGP14-0R74	0,52	641.48	DGP4-0R52	1,9	10,6	11,99	13,66	16,3	20,2	33,6

PZ15, 30 windings; s = 4 mm			PC5, 21 windings, s = 4 mm			Wire Ø mm	Current A at d.f. % and cycle time 120 s					
Resistance Ω±10%	DK- No.	Code	Resistance Ω±10%	DK- No.	Code		100	60	40	25	15	5
1,90	640.502	DGP15-1R9	1,4	641.502	DGP5-1R4	1,0	5,60	5,94	6,45	7,38	8,87	14,2
1,60	640.501	DGP15-1R6	1,1	641.501	DGP5-1R1	1,1	6,30	6,74	7,38	8,51	10,29	16,6
1,30	640.500	DGP15-1R3	1,0	641.500	DGP5-1R0	1,2	7,30	7,88	8,69	10,09	12,25	19,9
0,90	640.50	DGP15-0R9	0,6	641.50	DGP5-0R6	1,5	9,60	10,60	11,89	14,01	17,2	28,3
0,76	640.51	DGP15-0R76	0,54	641.51	DGP5-0R54	1,6	10,5	11,68	13,15	15,6	19,2	31,6
0,54	640.530	DGP15-0R54	0,38	641.530	DGP5-0R38	1,9	12,4	14,03	15,98	19,1	23,7	39,3
0,44	640.540	DGP15-0R44	0,31	641.540	DGP5-0R31	2,1	13,7	15,58	17,79	21,3	26,5	44,1
0,40	640.55	DGP15-0R40	0,28	641.55	DGP5-0R28	2,2	14,4	16,52	18,97	22,8	28,5	47,6

PZ16, 24 windings, s = 5 mm			PC6, 17 windings, s = 5 mm			Wire Ø mm	Current A at d.f. % and cycle time 120 s					
Resistance Ω±10%	DK- No.	Code	Resistance Ω±10%	DK- No.	Code		100%	60%	40%	25%	15%	5%
1,08	640.607	DGP16-1R08	0,78	641.607	DGP6-0R78	1,2	8,10	8,74	9,64	11,19	13,59	22,1
0,92	640.606	DGP16-0R92	0,66	641.606	DGP6-0R66	1,3	9,10	9,90	10,99	12,83	15,6	25,5
0,80	640.605	DGP16-0R8	0,57	641.605	DGP6-0R57	1,4	10,1	11,08	12,36	14,50	17,8	29,1
0,69	640.604	DGP16-0R69	0,50	641.604	DGP6-0R5	1,5	10,9	12,04	13,50	15,91	19,5	32,1
0,61	640.603	DGP16-0R61	0,44	641.603	DGP6-0R44	1,6	11,6	12,90	14,53	17,2	21,2	34,9
0,54	640.602	DGP16-0R54	0,39	641.602	DGP6-0R39	1,7	12,4	13,87	15,69	18,62	23,00	38,06
0,48	640.601	DGP16-0R48	0,35	641.601	DGP6-0R35	1,8	13,1	14,74	16,73	19,92	24,66	40,91
0,43	640.600	DGP16-0R43	0,31	641.600	DGP6-0R31	1,9	13,8	15,61	17,78	21,23	26,34	43,78
0,39	640.611	DGP16-0R39	0,28	641.611	DGP6-0R28	2,0	14,5	16,48	18,83	22,55	28,02	46,68
0,35	640.610	DGP16-0R35	0,25	641.610	DGP6-0R25	2,1	15,3	17,47	20,02	24,03	29,91	49,91
0,32	640.62	DGP16-0R32	0,23	641.62	DGP6-0R23	2,2	16,0	18,35	21,08	25,35	31,62	52,85

## Accessories

Item	Description	DK No.	Code
1.1	Bronze clamp with bolts	166.840.2	DGZ001
1.2	As item 1.1 with add. terminal connection	166.840.3	DGZ002
	As item 1.2 with 200 mm connection line	166.840.1	DGZ003
2.1	Sheet support for 1 x PZ element L = 175	166.320.1	DGZ004
2.2	Sheet support for 2 x PZ elements L = 312	166.320.2	DGZ005
2.3	Sheet support for 3 x PZ elements L = 450	166.320.3	DGZ006
2.4	Sheet support for 4 x PZ elements L = 588	166.320.4	DGZ007
3.1	Sheet support for 1 x PC element L = 140		DGZ014
3.2	Sheet support for 2 x PC elements L = 242		DGZ015
3.3	Sheet support for 3 x PC elements L = 345		DGZ016
3.4	Sheet support for 4 x PC elements L = 448		DGZ017
4.1	Support frame for 4 x PZ elements, installation instead of cast iron element, system GINO	166.322.0	DGZ008
4.2	Support frame for 4 x PC elements, installation instead of a cast iron element, system GINO		DGZ018
-	Bolt clamp M6 for items 4.1 and 4.2	166.841.7	DGZ009
-	Fixing brackets, 1 set		DGZ019



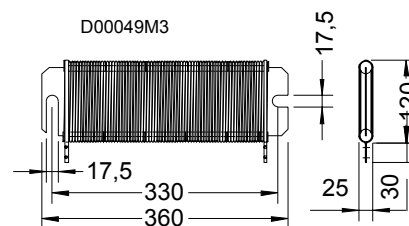
## Wire-wound resistors, wire-wound frame, system GINO, with CuNi 44 wire

**Wire-wound frames** use a galvanized steel sheet<sup>1)</sup> as a carrier which is provided with grooved ceramic supports at the top and bottom to take on the winding with bare resistor wire.

They are compatible with the GINO steel grid system and can be installed instead of the steel grid elements where higher resistance values are required. One wire-wound frame requires the space of two steel grids so that max. 15 wire-wound frames instead of 30 steel grids can be installed. In addition to the terminal connections at both ends, the wire-wound frames can optionally be tapped at any place (complete winding) or provided with adjustable pick-offs.

With the corresponding fasteners the wire-wound frames can also be used as single resistors for multiple applications. The resistor materials used pursuant to DIN 17471 and the many wire dimensions available give a wide range of possible resistance values per element. In particular the elements with CuNi 44 wire exhibit highly constant resistance values during temperature rise. CuNi 44 is largely resistant to corrosion and also suited for installation in maritime climates.

**CuNi 44 wire** is available on stock, the elements can therefore be supplied on **short notice**.



**Elements with CuNi 44 wire, spec. resistance 0.49  $\Omega$ -mm<sup>2</sup>/m, density 8.9 g/cm<sup>3</sup>, spec. Heat 0.42 J/(g·K), TC -40 ... + 80 ppm**

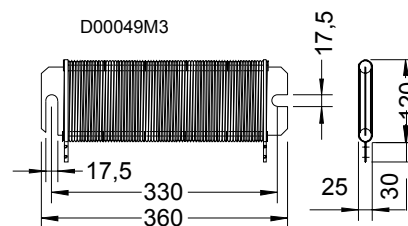
Resistance $\Omega$	Wire $\varnothing$ mm	Wire weight g	Cont. current A	Current in intermittent operation with d.f. % at 120 s cycle time					DK No.	Code
				60%	40%	25%	15%	5%		
<b>71 windings</b>										
68	0.4	20	1.6	1.6	1.6	1.7	1.9	2.8	660.00	DEEK71-68
44	0.5	31	2.2	2.3	2.3	2.5	2.9	4.3	660.01	DEEK71-44
30	0.6	44	2.9	3.0	3.1	3.4	4.0	6.1	660.02	DEEK71-30
22	0.7	60	3.7	3.8	4.0	4.5	5.2	8.2	660.03	DEEK71-22
17	0.8	78	4.5	4.7	5.0	5.7	6.7	10.6	660.04	DEEK71-17
13	0.9	99	5.4	5.7	6.1	7.0	8.3	13.2	660.05	DEEK71-13
11	1	122	6.3	6.7	7.3	8.4	10.1	16.1	660.06	DEEK71-11
9.0	1.1	148	7.3	7.8	8.6	9.9	12.0	19.3	660.07	DEEK71-9
7.6	1.2	176	8.3	9.0	9.9	11.5	14.0	22.8	660.08	DEEK71-7R6
6.5	1.3	207	9.2	10.0	11.1	13.0	15.8	25.9	660.09	DEEK71-6R5
5.6	1.4	240	9.9	10.9	12.1	14.3	17.4	28.6	660.10	DEEK71-5R6
4.9	1.5	275	10.6	11.7	13.1	15.5	19.0	31.3	660.11	DEEK71-4R9
4.3	1.6	313	11.3	12.6	14.2	16.8	20.7	34.1	660.12	DEEK71-4R3
3.8	1.7	354	12.1	13.5	15.2	18.1	22.4	37.0	660.13	DEEK71-3R8
3.4	1.8	396	12.7	14.3	16.3	19.4	24.0	39.8	660.14	DEEK71-3R4
2.7	2	489	14.3	16.3	18.6	22.2	27.6	46.0	660.15	DEEK71-2R7
<b>96 windings</b>										
91	0.4	26	1.6	1.6	1.6	1.7	1.9	2.8	661.00	DEEK96-91
58	0.5	41	2.2	2.3	2.3	2.5	2.9	4.3	661.01	DEEK96-58
41	0.6	59	2.9	3.0	3.1	3.4	4.0	6.1	661.02	DEEK96-41
30	0.7	80	3.7	3.8	4.0	4.5	5.2	8.2	661.03	DEEK96-30
23	0.8	105	4.5	4.7	5.0	5.7	6.7	10.6	661.04	DEEK96-23
18	0.9	132	5.4	5.7	6.1	7.0	8.3	13.2	661.05	DEEK96-18
15	1	164	6.1	6.4	7.0	8.0	9.6	15.4	661.06	DEEK96-15
12	1.1	198	6.8	7.3	7.9	9.2	11.1	17.9	661.07	DEEK96-12
10	1.2	236	7.4	8.0	8.8	10.3	12.5	20.3	661.08	DEEK96-10
8.6	1.3	276	8.0	8.7	9.7	11.3	13.8	22.5	661.09	DEEK96-8R6
7.4	1.4	321	8.6	9.5	10.6	12.4	15.2	24.9	661.10	DEEK96-7R4
6.5	1.5	368	9.2	10.2	11.4	13.4	16.5	27.2	661.11	DEEK96-6R5
5.7	1.6	419	9.8	10.9	12.3	14.6	18.0	29.6	661.12	DEEK96-5R7
<b>142 windings</b>										
136	0.4	39	1.6	1.6	1.6	1.7	1.9	2.8	662.00	DEEK142-136
87	0.5	61	2.2	2.3	2.3	2.5	2.9	4.3	662.01	DEEK142-87
61	0.6	88	2.9	3.0	3.1	3.4	4.0	6.1	662.02	DEEK142-61
45	0.7	120	3.5	3.6	3.8	4.2	4.9	7.7	662.03	DEEK142-45
34	0.8	157	4.0	4.2	4.5	5.0	5.9	9.4	662.04	DEEK142-34
27	0.9	196	4.5	4.7	5.1	5.8	6.9	11.0	662.05	DEEK142-27
22	1	245	5.0	5.3	5.8	6.6	7.9	12.7	662.06	DEEK142-22
18	1.1	296	5.5	5.9	6.5	7.5	9.0	14.6	662.07	DEEK142-18
15	1.2	352	6.1	6.5	7.2	8.4	10.2	16.5	662.08	DEEK142-15
<b>192 windings</b>										
182	0.4	52	1.6	1.6	1.6	1.7	1.9	2.8	663.00	DEEK192-182
117	0.5	82	2.2	2.2	2.3	2.4	2.8	4.1	663.01	DEEK192-117
81	0.6	118	2.6	2.7	2.8	3.0	3.5	5.4	663.02	DEEK192-81
60	0.7	160	3.0	3.1	3.3	3.7	4.3	6.7	663.03	DEEK192-60
46	0.8	209	3.5	3.6	3.8	4.3	5.1	8.1	663.04	DEEK192-46

1) Also available in stainless steel

## Wire-wound resistors, wire-wound frame system GINO with NiCr 3020 wire

**Wire-wound frames** with NiCr 3020 wire allow higher ohm values at the same wire diameter or at same ohm value the thicker wire will result in a larger mass and thus in a higher impulse load capacity. Wire-wound frames made from NiCr 3020 are also used in cases where the corrosion resistance of CuNi 44 is not sufficient in view of the atmospheric load.

The supply of wire-wound frames with NiCr 3020 is limited as not all wire dimensions are available on stock.



### Elements with wire NiCr 3020, spec. resistance 1.04 Ω·mm<sup>2</sup>/m, density 7.9 g/cm<sup>3</sup>, spec. heat 0.5 J/(g·K), TC 360...300 ppm

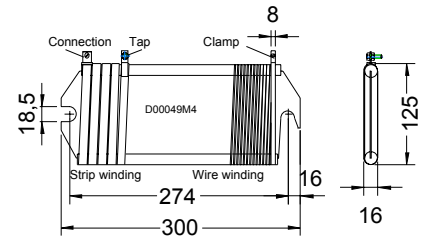
Resistance Ω	Wire Ø mm	Wire weight g	Cont. Current A	Current during intermittent operation with d.f. % at 120 s cycle time					DK No.	Code
				60%	40%	25%	15%	5%		
<b>71 windings</b>										
145	0.4	17	1.1	1.1	1.1	1.2	1.3	2.0	664.00	DEEC71-145
93	0.5	27	1.5	1.6	1.6	1.7	2.0	3.0	664.01	DEEC71-93
64	0.6	39	2.0	2.1	2.2	2.4	2.8	4.3	664.02	DEEC71-64
47	0.7	53	2.6	2.6	2.8	3.1	3.7	5.7	664.03	DEEC71-47
36	0.8	69	3.1	3.3	3.5	3.9	4.7	7.4	664.04	DEEC71-36
29	0.9	88	3.7	3.9	4.2	4.8	5.8	9.3	664.05	DEEC71-29
23	1	109	4.4	4.6	5.1	5.8	7.0	11.3	664.06	DEEC71-23
19	1.1	131	5.0	5.4	5.9	6.9	8.4	13.5	664.07	DEEC71-19
16.1	1.2	156	5.7	6.2	6.9	8.0	9.8	15.9	664.08	DEEC71-16R1
13.7	1.3	184	6.3	6.9	7.7	9.1	11.1	18.2	664.09	DEEC71-13R7
11.8	1.4	213	6.8	7.5	8.5	9.9	12.2	20.1	664.10	DEEC71-11R8
10.3	1.5	244	7.3	8.1	9.2	10.8	13.3	22.0	664.11	DEEC71-10R3
9.1	1.6	278	7.8	8.7	9.8	11.7	14.4	23.9	664.12	DEEC71-9R1
8.0	1.7	314	8.3	9.3	10.6	12.6	15.6	25.9	664.13	DEEC71-8
7.2	1.8	352	8.8	9.9	11.3	13.5	16.7	27.8	664.14	DEEC71-7R2
5.8	2.0	434	9.8	11.1	12.8	15.3	19.1	31.9	664.15	DEEC71-5R8
<b>96 windings</b>										
194	0.4	23	1.1	1.1	1.1	1.2	1.3	2.0	665.00	DEEC96-194
124	0.5	36	1.5	1.6	1.6	1.7	2.0	3.0	665.01	DEEC96-124
86	0.6	52	2.0	2.1	2.2	2.4	2.8	4.3	665.02	DEEC96-86
63	0.7	71	2.6	2.6	2.8	3.1	3.7	5.7	665.03	DEEC96-63
48	0.8	93	3.1	3.3	3.5	3.9	4.7	7.4	665.04	DEEC96-48
38	0.9	118	3.7	3.9	4.2	4.8	5.8	9.3	665.05	DEEC96-38
31	1	145	4.2	4.5	4.9	5.6	6.8	11.0	665.06	DEEC96-31
26	1.1	176	4.6	5.0	5.5	6.3	7.7	12.4	665.07	DEEC96-26
22	1.2	209	5.0	5.4	6.0	7.0	8.5	13.9	665.08	DEEC96-22
18.3	1.3	245	5.5	6.0	6.7	7.8	9.6	15.7	665.09	DEEC96-18R3
15.8	1.4	285	5.9	6.5	7.3	8.6	10.6	17.3	665.10	DEEC96-15R8
13.8	1.5	327	6.3	7.0	7.9	9.3	11.5	19.0	665.11	DEEC96-13R8
12.1	1.6	372	6.8	7.6	8.5	10.1	12.5	20.7	665.12	DEEC96-12R1
<b>142 windings</b>										
290	0.4	35	1.1	1.1	1.1	1.2	1.3	2.0	666.00	DEEC142-290
185	0.5	54	1.5	1.6	1.6	1.7	2.0	3.0	666.01	DEEC142-185
129	0.6	78	2.0	2.1	2.2	2.4	2.8	4.3	666.02	DEEC142-129
95	0.7	106	2.4	2.5	2.6	2.9	3.5	5.4	666.03	DEEC142-95
72	0.8	139	2.8	2.9	3.1	3.5	4.2	6.6	666.04	DEEC142-72
57	0.9	176	3.1	3.3	3.6	4.1	4.9	7.8	666.05	DEEC142-57
46	1	217	3.5	3.7	4.0	4.6	5.6	9.0	666.06	DEEC142-46
38	1.1	263	3.8	4.1	4.5	5.2	6.3	10.3	666.07	DEEC142-38
32	1.2	313	4.2	4.5	5.0	5.8	7.1	11.6	666.08	DEEC142-32
<b>192 windings</b>										
387	0.4	46	1.1	1.1	1.1	1.2	1.3	2.0	667.00	DEEC192-387
248	0.5	73	1.5	1.5	1.6	1.7	1.9	2.9	667.01	DEEC192-248
172	0.6	105	1.8	1.8	1.9	2.1	2.4	3.8	667.02	DEEC192-172
126	0.7	142	2.1	2.2	2.3	2.6	3.0	4.7	667.03	DEEC192-126
97	0.8	186	2.4	2.5	2.7	3.0	3.6	5.7	667.04	DEEC192-97



## Wire-wound resistors, wire-wound frames, system AEG

**Wire-wound frames** of the system **AEG** are applicable as replacement and complement for the equipment of the AEG system. They can be installed in the same housing as the cast iron elements.  
Not all wire and strip dimensions are on stock, therefore some products may not be available on short notice.

**Resistor material NiCr 3020**  
Spec. resistance ..... 1.04  $\Omega \cdot \text{mm}^2/\text{m}$ ,  
Density ..... 7.9 g/cm<sup>3</sup>,  
Spec. heat ..... 0.5 J/(g·K),  
TC ..... 360...300 ppm



Resistance $\Omega \pm 10\%$	Resistance reduction per tap $\Omega$	Current A at intermittent operation d.f. %, cycle time 120 s						Wire $\emptyset$	Strip Width x Thickness	AEG code	Code
		100%	60%	40%	25%	15%	5%				
575	7.8	0.72	0.72	0.72	0.75	0.81	1.1	0.3	-	106.071.837	DAE575
420	5.7	0.90	0.90	0.92	0.96	1.06	1.5	0.35	-	106.071.838	DAE420
320	4	1.10	1.11	1.13	1.2	1.3	2.0	0.4	-	106.071.839	DAE320R
205	2.8	1.5	1.6	1.6	1.7	2.0	3.0	0.5	-	106.071.840	DAE205
160	2.2	1.1	1.1	1.1	1.2	1.3	2.0	0.4	-	106.071.841	DAE160R
100	1.4	1.5	1.6	1.6	1.7	2.0	3.0	0.5	-	106.071.842	DAE100
70	1.0	2.0	2.1	2.2	2.4	2.8	4.3	0.6	-	106.071.843	DAE70
50	0.7	2.6	2.6	2.8	3.1	3.7	5.7	0.7	-	106.071.844	DAE50
38	1.4	2.6	2.6	2.8	3.1	3.7	5.7	0.7	-	106.071.845	DAE38
30	1.1	3.1	3.3	3.5	3.9	4.7	7.4	0.8	-	106.071.846	DAE30
23	0.83	3.7	3.9	4.2	4.8	5.8	9.3	0.9	-	106.071.847	DAE23
16	0.78	4.4	4.6	5.1	5.8	7.0	11.3	1.0	-	106.071.848	DAE16
12.4	0.45	5.0	5.4	5.9	6.9	8.4	13.5	1.1	-	106.071.849	DAE12,4
8.6	0.31	5.7	6.2	6.9	8.0	9.8	15.9	1.2	-	106.071.850	DAE8,6
6.3	0.23	7.2	8.0	8.9	10.5	12.9	21.2	1.4	-	106.071.851	DAE6,3
4.9	0.18	8.8	9.9	11.1	13.2	16.3	27.0	1.6	-	106.071.852	DAE4,9
4.0	-	11.3	11.4	11.5	12.1	13.4	19.4	-	10 x 0.1	106.050.628	DAE4
2.65	-	13.9	14.2	14.7	16.0	18.5	28.2	-	10 x 0.15	106.050.629	DAE2,65
2.0	-	16.0	16.6	17.7	19.8	23.3	36.7	-	10 x 0.2	106.050.630	DAE2
1.33	-	19.7	21.1	23.2	26.9	32.6	52.8	-	10 x 0.3	106.050.631	DAE1,33
1.0	-	22.7	25.1	28.2	33.3	40.9	67.4	-	10 x 0.4	106.050.632	DAE1
0.8	-	25.4	28.7	32.7	39.1	48.5	80.7	-	10 x 0.5	106.050.633	DAE0,8
0.67	-	27.7	31.9	36.8	44.3	55.3	92.6	-	10 x 0.6	106.050.634	DAE0,67

## Wire grids, system AEG, housed resistors

The **wire grids** of the AEG system can be used instead of or as replacement for AEG cast iron grids. They consist of a wave-like bent resistance wire with welded-on cast-metal eyes identical to the eyes on the cast grids. For mounting, the elements and the casings of the AEG system can be used. Both open banks and enclosed resistors identical to the cast-metal resistors are available.

Wire grids A224 to A1280 are provided with a reinforcement at the top and bottom to increase stability.

The original AEG wire grids were made from resistor material **CrAl 14 4**. This material has become very scarce on the market. To maintain availability, manufacture was changed to material **NiCr 30 20**.

Besides complying with the ohm value it is attempted to design the mass, the impulse load capacity and also the wire surface as compatible with the original elements as possible. However, this is not always feasible due to the different material characteristics. Nevertheless, replacement should be possible in most cases.

Based on physical law, the permanent current indicated in the AEG lists is too high. The values were corrected and related to a maximum of 1 W/cm<sup>2</sup> wire surface, which results in about 350 to 400 K temperature rise.

The corrosion resistance, thermal resistance and break resistance are better than with material CrAl14 4

The table for the original elements is shown below for comparison.

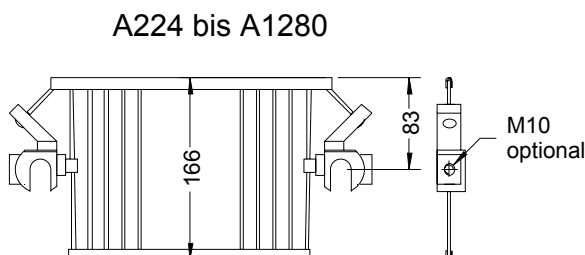
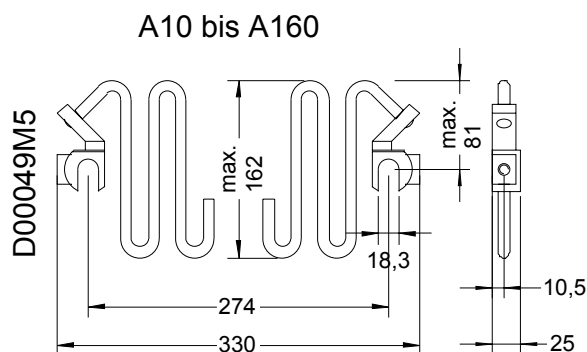
Resistance value mΩ± 10%	Hot resistance <sup>1)</sup> mΩ± 10%	Wire Ø mm	Current A at intermittent operation d.f. %, cycle time 120 s					Impulse load capacity kA <sup>2</sup> s <sup>2)</sup>	AEG code	Code	
			100%	60%	40%	25%	15%				5%
10	11.2	12	202	255	309	387	496	854	19.4	<b>A10</b>	<b>DAE10</b>
14	15.7	11	178	223	270	338	433	745	13.7	<b>A14</b>	<b>DAE14</b>
20	22.5	10	154	193	233	292	374	642	9.4	<b>A20</b>	<b>DAE20</b>
28	31.5	9	132	164	198	247	317	544	6.1	<b>A28</b>	<b>DAE28</b>
40	45	7.5	100	124	149	186	238	408	3.0	<b>A40</b>	<b>DAE40</b>
56	63	7	90,2	112	134	167	213	365	2.3	<b>A56</b>	<b>DAE56</b>
80	90	6	71.6	88.2	105	131	167	285	1.2	<b>A80</b>	<b>DAE80</b>
112	126	5.5	62.8	77.1	91.9	114	145	248	0.86	<b>A112</b>	<b>DAE112</b>
160	180	5.0	54.5	66.5	79.1	97.9	125	212	0.59	<b>A160</b>	<b>DAE160</b>
224	252	4.5	46.5	56.4	67.0	82.7	105	179	0.38	<b>A224</b>	<b>DAE224</b>
320	360	4.0	39.0	47.0	55.5	68.4	86.6	147	0.24	<b>A320</b>	<b>DAE320</b>
448	504	3.5	31.9	38.1	44.9	55.0	69.5	118	0.14	<b>A448</b>	<b>DAE448</b>
640	720	3.0	25.3	29.9	35.0	42.7	53.8	90.9	0.08	<b>A640</b>	<b>DAE640</b>
896	1006	2.7	21.6	25.3	29.5	35.9	45.1	75.9	0.05	<b>A896</b>	<b>DAE896</b>
1280	1440	2.4	18.1	21.0	24.3	29.5	36.9	62.0	0.03	<b>A1280</b>	<b>DAE1280</b>

1) 400°C average temperature  
2) 400 K temperature rise

### Comparison original AEG wire grid with wire CrAl 14 4

Resistance value mΩ± 10%	Hot resistance <sup>3)</sup> mΩ± 10%	Wire Ø mm	Current A at intermittent operation d.f. %, cycle time 120 s					Cont. current as per AEG list A <sup>4)</sup>	Impulse load capacity kA <sup>5)</sup> s <sup>5)</sup>	AEG code	Code	
			100%	60%	40%	25%	15%					5%
10	10.4	13.0	228	288	349	438	562	967	238	26.8	<b>A10</b>	n.v.
14	15	11.5	190	239	289	362	464	799	209	16.4	<b>A14</b>	n.v.
20	21	10.5	166	208	251	314	403	693	180	11.4	<b>A20</b>	n.v.
28	29	9.0	132	164	198	247	317	544	158	6.1	<b>A28</b>	n.v.
40	42	8.0	110	137	165	206	263	452	133	3.8	<b>A40</b>	n.v.
56	58	7.5	100	124	149	186	238	408	113	3.0	<b>A56</b>	n.v.
80	83	6.5	80.7	99.7	119	149	190	325	94	1.7	<b>A80</b>	n.v.
112	116	5.7	66.3	81.4	97.2	121	154	263	80	0.99	<b>A112</b>	n.v.
160	166	5.2	57.8	70.7	84.2	104	133	226	67	0.69	<b>A160</b>	n.v.
224	233	4.6	48.1	58.4	69.3	85.6	109	185	56	0.42	<b>A224</b>	n.v.
320	333	4.2	41.9	50.7	60.0	74.0	93.8	160	47	0.29	<b>A320</b>	n.v.
448	466	3.7	34.7	41.6	49.0	60.2	76.2	129	39	0.18	<b>A448</b>	n.v.
640	666	3.3	29.2	34.8	40.8	50.0	63.1	107	33	0.11	<b>A640</b>	n.v.
896	932	2.9	24.1	28.4	33.1	40.4	50.8	85.8	28	0.07	<b>A896</b>	n.v.
1280	1331	2.6	20.4	23.9	27.7	33.7	42.3	71.2	23	0.04	<b>A1280</b>	n.v.

3) 270°C average temperature  
4) Indication by AEG, based on the wire surface being relatively big, accordingly -> 1.3 W/cm<sup>2</sup> with approx. 500 to 550 K temperature rise !  
5) 400 K temperature rise



## Wire grids, system AEG, housed resistors

### Type key DAG①②③④ - ⑤

① No. of boxes stacked, 1...3

② No. of strands 1, 3

③ Size  
 1 = AEG 106, only single phase, up to 6 elements  
 2 = AEG 112, single phase, up to 12 elements, three-phase up to 9 elements  
 3 = AEG 118, single phase, up to 18 elements, three-phase up to 12 elements  
 4 = AEG 124, single phase, up to 24 elements, three-phase up to 18 elements  
 5 = AEG 130, single phase, up to 30 elements, three-phase up to 24 elements

④ Protection  
 0 = IP00  
 2 = IP20  
 4 = IP23

⑤ Order supplement acc. table

### Single-phase resistors in standard bank design

Code DAG①③④ - ⑤										Current A					
③ = 1 AEG P106/W106		③ = 2 AEG P112/W112		③ = 3 AEG P118/W118		③ = 4 AEG P124/W124		③ = 5 AEG P130/W130		1 – 3 boxes stacked					
No. Of elements										intermittent operation d.f. %, cycle time 120 s					
6	Order-supplement ⑤	12	Order-supplement ⑤	18	Order-supplement ⑤	24	Order-supplement ⑤	30	Order-supplement ⑤	100%	60%	40%	25%	15%	5%
Ω		Ω		Ω		Ω		Ω							
0,060	A 0,06	0,120	A 0,12	0,180	A 0,18	0,240	A 0,24	0,300	A 0,3	238	302	367	461	592	930
0,084	A 0,084	0,168	A 0,168	0,252	A 0,252	0,336	A 0,336	0,420	A 0,42	209	265	321	403	517	810
0,120	A 0,12	0,240	A 0,24	0,360	A 0,36	0,480	A 0,48	0,600	A 0,6	180	227	275	345	443	690
0,168	A 0,168	0,336	A 0,336	0,504	A 0,504	0,672	A 0,672	0,840	A 0,84	158	199	241	302	387	600
0,240	A 0,24	0,480	A 0,48	0,720	A 0,72	0,960	A 0,96	1,200	A 1,2	133	167	202	252	323	500
0,336	A 0,336	0,672	A 0,672	1,008	A 1,008	1,344	A 1,344	1,680	A 1,68	113	141	170	213	273	420
0,480	A 0,48	0,960	A 0,96	1,440	A 1,44	1,920	A 1,92	2,400	A 2,4	94	117	141	176	225	350
0,672	A 0,672	1,344	A 1,344	2,016	A 2,016	2,688	A 2,688	3,360	A 3,36	80	99	119	149	190	290
0,960	A 0,96	1,920	A 1,92	2,880	A 2,88	3,840	A 3,84	4,800	A 4,8	67	83	99	123	157	240
1,344	A 1,344	2,688	A 2,688	4,032	A 4,032	5,376	A 5,376	6,720	A 6,72	56	69	82	102	130	200
1,920	A 1,92	3,840	A 3,84	5,760	A 5,76	7,680	A 7,68	9,600	A 9,6	47	57	68	85	108	160
2,688	A 2,688	5,376	A 5,376	8,064	A 8,064	10,752	A 10,752	13,440	A 13,44	39	47	56	69	88	130
3,840	A 3,84	7,680	A 7,68	11,520	A 11,52	15,360	A 15,36	19,200	A 19,2	33	40	47	58	73	110
5,376	A 5,376	10,752	A 10,752	16,128	A 16,128	21,504	A 21,504	26,880	A 26,88	28	34	39	48	61	95
7,680	A 7,68	15,360	A 15,36	23,040	A 23,04	30,720	A 30,72	38,400	A 38,4	23	27	32	39	49	76

### Tree-phase resistors in standard bank design

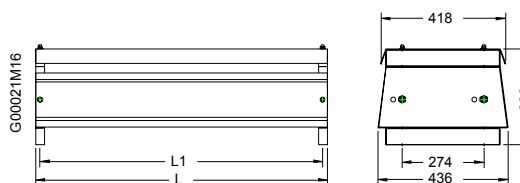
Code DAG①②③④ - ⑤								Current A					
③ = 1 AEG P112/W112		③ = 2 AEG P118/W118		③ = 3 AEG P124/W124		③ = 4 AEG P130/W130		1 – 3 boxes stacked					
No. Of elements								intermittent operation d.f. %, cycle time 120 s					
3 x 3	Ordersupp-lement ⑤	3 x 4	Ordersupp-lement ⑤	3 x 6	Ordersupp-lement ⑤	3 x 8	Ordersupp-lement ⑤	100%	60%	40%	25%	15%	5%
3 x Ω		3 x Ω		3 x Ω		3 x Ω							
0,030	A 0,030	0,05	A 0,05	0,060	A 0,060	0,080	A 0,080	238	302	367	461	592	930
0,042	A 0,042	0,07	A 0,07	0,084	A 0,084	0,112	A 0,11	209	265	321	403	517	810
0,060	A 0,06	0,10	A 0,10	0,120	A 0,12	0,160	A 0,16	180	227	275	345	443	690
0,084	A 0,084	0,14	A 0,14	0,168	A 0,168	0,224	A 0,23	158	199	241	302	387	600
0,120	A 0,12	0,20	A 0,20	0,240	A 0,24	0,320	A 0,32	133	167	202	252	323	500
0,168	A 0,168	0,28	A 0,28	0,336	A 0,336	0,448	A 0,45	113	141	170	213	273	420
0,240	A 0,24	0,40	A 0,40	0,480	A 0,48	0,640	A 0,64	94	117	141	176	225	350
0,336	A 0,336	0,56	A 0,56	0,672	A 0,672	0,896	A 0,9	80	99	119	149	190	290
0,480	A 0,48	0,80	A 0,80	0,960	A 0,96	1,280	A 1,28	67	83	99	123	157	240
0,672	A 0,672	1,12	A 1,12	1,344	A 1,3	1,780	A 1,78	56	69	82	102	130	200
0,960	A 0,96	1,60	A 1,6	1,920	A 1,9	2,560	A 2,56	47	57	68	85	108	160
1,344	A 1,344	2,24	A 2,24	2,680	A 2,7	3,560	A 3,56	39	47	56	69	88	130
1,920	A 1,92	3,20	A 3,2	3,840	A 3,8	5,120	A 5,12	33	40	47	58	73	110
2,688	A 2,688	4,48	A 4,48	5,376	A 5,4	7,120	A 7,12	28	34	39	48	61	95
3,840	A 3,84	6,40	A 6,4	7,680	A 7,7	10,20	A 10	23	27	32	39	49	76

# Wire grids, system AEG, housed resistors

## Housed resistors, single box

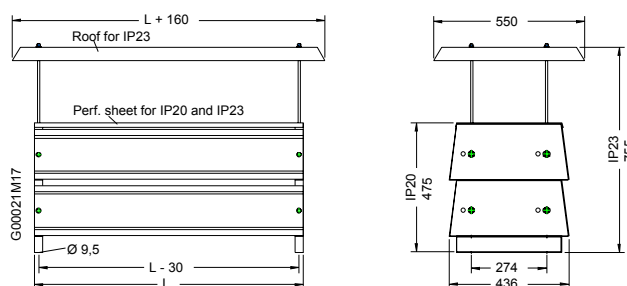
Size	No. of elements	Protection	Code <sup>1)</sup>	Weight ca. kg
P106	6	IP00	DAG1⊗10-	17
W106-20	6	IP20	DAG1⊗12-	20
W106-23	6	IP23	DAG1⊗14-	22
P112	12	IP00	DAG1⊗20-	28
W112-20	12	IP20	DAG1⊗22-	32
W112-23	12	IP23	DAG1⊗24-	35
P118	18	IP00	DAG1⊗30-	38
W118-20	18	IP20	DAG1⊗32-	43
W118-23	18	IP23	DAG1⊗34-	46
P124	24	IP00	DAG1⊗40-	52
W124-20	24	IP20	DAG1⊗42-	56
W124-23	24	IP23	DAG1⊗44-	60
P130	30	IP00	DAG1⊗50-	62
W130-20	30	IP20	DAG1⊗52-	68
W130-23	30	IP23	DAG1⊗54-	72

Size	No. of elements	Maß L mm
106	6	350
112	12	495
118	18	660
124	24	825
130	30	980



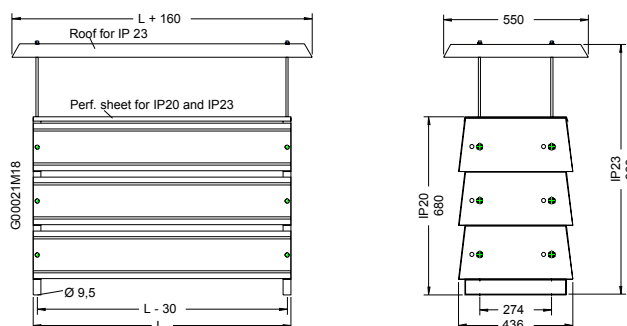
## Housed resistors, two stacked boxes

Size	No. of elements	Protection	Code <sup>1)</sup>	Weight ca. kg
2P118	2x18	IP00	DAG2⊗30-	76
2W118-20	2x18	IP20	DAG2⊗32-	86
2W118-23	2x18	IP23	DAG2⊗34-	91
2P124	2x24	IP00	DAG2⊗40-	104
2W124-20	2x24	IP20	DAG2⊗42-	112
2W124-23	2x24	IP23	DAG2⊗44-	120
2P130	2x30	IP00	DAG2⊗50-	124
2W130-20	2x30	IP20	DAG2⊗52-	136
2W130-23	2x30	IP23	DAG2⊗54-	144



## Housed resistors, three stacked boxes

Size	No. of elements	Protection	Code <sup>1)</sup>	Weight ca. kg
3P124	3x24	IP00	DAG3⊗40-	166
3P124-20	3x24	IP20	DAG3⊗42-	168
3W124-23	3x24	IP23	DAG3⊗44-	180
3P130	3x30	IP00	DAG3⊗50-	186
3W130-20	3x30	IP20	DAG3⊗52-	204
3W130-23	3x30	IP23	DAG3⊗54-	216



<sup>1)</sup> Order supplement according selection table to append, see example on page 3.14, ⊗ = complete No. of phases

# Wire-wound resistors, vitreous enameled high-performance resistors

**Vitreous enameled high-performance resistors** are wire resistors with vitreous enameled winding and connection clamps. The coating fixes the wiring and protects it from adverse conditions. Enameled resistors are resistant to weathering. The good heat conductivity of the coating allows for high loads.

The indicated load power values are applicable for 25°C ambient temperature. In Diagram 1, the temperature rise is indicated as a function of the load. At higher ambient temperatures, the rating must be reduced according to diagram 2. All percentage indications are related to the load, not the current. In case of forced venting, the load can be increased as per diagram 3. The voltage drop across the resistor may not exceed the indicated values for  $U_{max}$ .

The **insulation voltage  $U_i$**  is dependent on the type of fastener. When fastened with brackets, the creepage distance  $K$  is decisive. For  $K = 5 \text{ mm}$  :  $U_i = 1000 \text{ V}$  and for  $K = 6 \text{ mm}$  :  $U_i = 1200 \text{ V}$ .

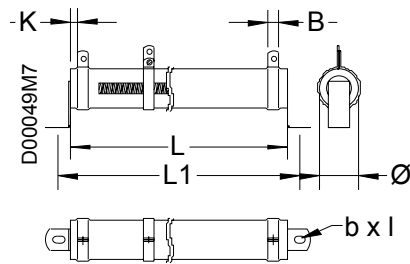
Type key

**GR** ②/③ ④-⑤±⑥

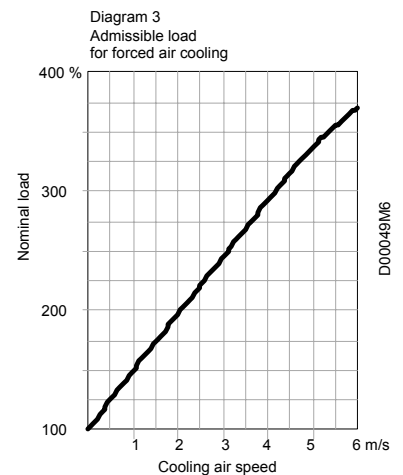
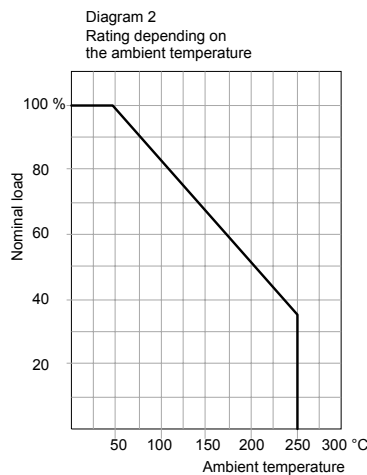
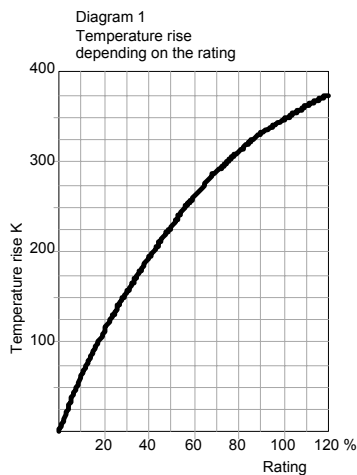
- ① Design
  - F = Fixed resistor
  - V = with pick-off
- ② Diameter (12) mm
- ③ Tube length (63) mm
- ④ Connection
  - L = soldered
  - S = screw type
  - A = plug type
- ⑤ Ohm value (2R7)
- ⑥ Tolerance 5 or 10%

**Example**

GRF 12/63L-2R7±10%



Rating W	Tube Ø mm	Tube L mm	Fastener L <sub>1</sub> mm	Creepage distance K mm	Clamp B mm	Fastener bore B x l	U <sub>max</sub> V	R <sub>min</sub> Ω±10%	R <sub>max</sub> kΩ		Order no.
									GRF	GRV	
17	10	44	58	5	6.3	3.2 x 6	270	0.8	8	1.8	GR 10 / 44 ④-⑤±⑥
22	10	55	69	5	6.3	3.2 x 6	430	0.6	12	2.7	GR 10 / 55 ④-⑤±⑥
24	12	51	65	5	6	3.2 x 6	370	1.0	12	3.3	GR 12 / 51 ④-⑤±⑥
25	10	63	77	5	6.3	3.2 x 6	550	0.6	18	3.9	GR 10 / 63 ④-⑤±⑥
28	13	51	65	5	6	3.2 x 6	370	1.0	18	3.6	GR 13 / 51 ④-⑤±⑥
30	12	63	77	5	6	3.2 x 6	550	1.0	22	4.7	GR 12 / 63 ④-⑤±⑥
30	15	51	65	6	8	4.2 x 8	370	1.0	18	3.3	GR 15 / 51 ④-⑤±⑥
32	13	63	77	5	6	3.2 x 6	550	1.0	22	5.6	GR 13 / 63 ④-⑤±⑥
36	12	76	90	5	6	3.2 x 6	750	1.0	27	5.6	GR 12 / 76 ④-⑤±⑥
38	15	63	77	6	8	4.2 x 8	550	1.0	27	5.6	GR 15 / 63 ④-⑤±⑥
40	20	50	66	6	8	5.5 x 8	360	0.3	22	4.7	GR 20 / 50 ④-⑤±⑥
45	15	76	90	6	8	4.2 x 8	750	1.0	33	6.8	GR 15 / 76 ④-⑤±⑥
48	12	102	116	5	6	3.2 x 6	1200	1.0	47	8.2	GR 12 / 102 ④-⑤±⑥
52	13	100	114	5	6	3.2 x 6	1100	1.0	47	10	GR 13 / 100 ④-⑤±⑥
60	15	100	114	6	8	4.2 x 8	1100	1.0	58	12	GR 15 / 100 ④-⑤±⑥
60	20	75	91	6	8	5.5 x 8	730	0.3	47	10	GR 20 / 75 ④-⑤±⑥
70	20	90	106	6	8	5.5 x 8	960	0.3	56	12	GR 20 / 90 ④-⑤±⑥
70	24	80	96	6	8	5.5 x 8	810	1.0	39	12	GR 24 / 80 ④-⑤±⑥
78	20	100	116	6	8	5.5 x 8	1100	0.3	56	15	GR 20 / 100 ④-⑤±⑥
85	30	75	93	6	8	5.5 x 8	730	1.0	39	15	GR 30 / 75 ④-⑤±⑥
90	24	100	116	6	8	5.5 x 8	1100	1.0	47	18	GR 24 / 100 ④-⑤±⑥
100	20	140	156	6	8	5.5 x 8	1700	0.3	82	22	GR 20 / 140 ④-⑤±⑥
110	30	100	118	6	8	5.5 x 8	1100	1.0	56	22	GR 30 / 100 ④-⑤±⑥
120	20	165	181	6	8	5.5 x 8	2100	0.5	100	27	GR 20 / 165 ④-⑤±⑥
150	24	165	181	6	8	5.5 x 8	2100	1.0	100	33	GR 24 / 165 ④-⑤±⑥
150	30	133	151	6	8	5.5 x 8	1600	1.0	78	33	GR 30 / 133 ④-⑤±⑥
170	30	152	170	6	8	5.5 x 8	1900	1.0	82	39	GR 30 / 152 ④-⑤±⑥
175	30	156	174	6	8	5.5 x 8	2000	1.0	82	42	GR 30 / 156 ④-⑤±⑥
185	30	165	183	6	8	5.5 x 8	2100	1.0	100	42	GR 30 / 165 ④-⑤±⑥
200	20	267	283	6	8	5.5 x 8	3600	1.0	150	47	GR 20 / 267 ④-⑤±⑥
225	30	200	218	6	8	5.5 x 8	2600	1.0	120	47	GR 30 / 200 ④-⑤±⑥
245	30	215	233	6	8	5.5 x 8	2900	1.0	150	56	GR 30 / 215 ④-⑤±⑥
275	30	250	268	6	8	5.5 x 8	3400	1.0	150	68	GR 30 / 250 ④-⑤±⑥
300	30	265	283	6	8	5.5 x 8	3600	1.0	180	68	GR 30 / 265 ④-⑤±⑥
375	30	330	348	12		5.5 x 8	4600	1.0	180	82	GR 30 / 330 ④-⑤±⑥

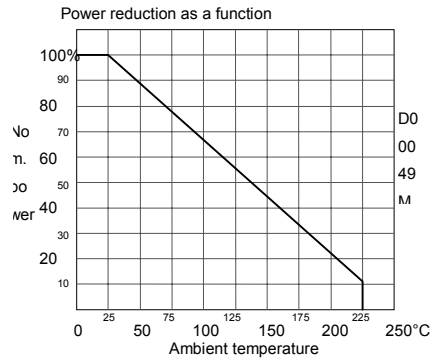


## Structure

A ceramic core made from C220 (steatite) or aluminum oxide ceramics supports a winding with copper nickel or chromium nickel wire. End caps made from stainless steel are provided with soldered or screw-type connections. The resistor wires are connected to the end caps by spot welding. The complete resistor body is grouted with epoxy resin in an anodized aluminium heat sink. The housing safely dissipates the heat that forms during operation and transfers it to the mounting surface.

For full capacity operation the resistors must be mounted on a cooling surface which is either dimensioned as indicated in the tables or provided with a thermal resistance  $R_{th} \leq R_{th\ max}$ .

The data are applicable for a wire temperature of 250°C at an ambient temperature of 25°C. At higher ambient temperatures the rating must be reduced.



## Type key

- RB ①-②-③  
 ① Size  
 ② Ohm value  
 ③ Tolerance

Example:

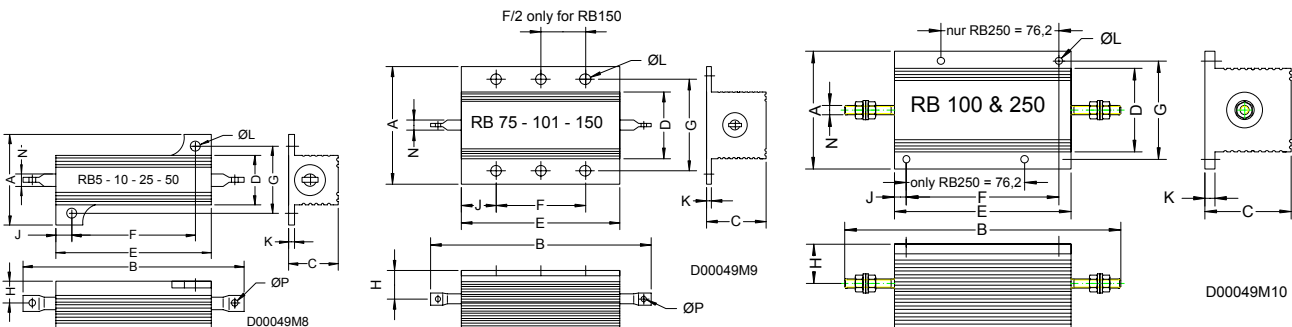
RB 50-2k2-3%

## Technical data

- Resistor tolerance  
5%, 3%, 1% (0.5 % upon request)
- Temperature range -55 to + 250°C
- Insulation resistance  
≥ 10 000 MΩ
- Temperature coefficient  
R > 20 Ω: 20 ppm  
1 Ω < R < 20 Ω: 50 ppm  
0.1 Ω < R < 1 Ω : ..... 100 ppm
- Connections  
RB5 through RB50  
Soldered connection Cu tin-coated (use high-temperature tin-lead solder),  
RB 100 and RB 250  
screwed connections stainless steel.
- Overload capacity  
5 times nominal load for 5 s
- Description on the top:  
Type, Ω value, tolerance.

Type	Rating P <sub>25</sub> at 25°C		Resistance range from – to Ω	Max. voltage U <sub>max</sub> V	Electric strength V	Cooling sheet surface		Customer-specific heat sink R <sub>th</sub> K/W	Order no.:
	With cooling surface max. W	Without cooling surface W				cm <sup>2</sup> x thickness mm	R <sub>th</sub> K/W		
RB 5	7.5	4	0.01 – 6k8	160	1500	415 x 1	4.5	14	RB 5-②-③
RB 10	12	6	0.01 – 10k	265	1500	415 x 1	5.1	6.0	RB 10-②-③
RB25	25	12.5	0.01 – 18 k	550	2500	535 x 1	3	4.0	RB 25-②-③
RB50	50	20	0.01 – 68 k	1250	2500	930 x 1,5	1.9	2.4	RB50/6-②-③
RB 75	75	35	0.1 – 50 k	1400	3500	995 x 3	1.1	1.2	RB 75-②-③
RB 101	100	40	0.1 – 70 k	1900	3500	995 x 3	1.0	0.9	RB 101-②-③
RB 100	150	75	0.1 – 100 k	1900	4500	930 x 3	0.84	0.8	RB 100-②-③
RB 150	150	55	0.1 – 100 k	2500	3500	995 x 3	1.0	0.7	RB 150-②-③
RB 250	250	100	0.1 – 120 k	2300	4500	930 x 3	0.66	0.5	RB 250-②-③

Type	Dimensions mm													Weight g	
	A	B	C	D	E	F	G	H	J	K	ØL	N	ØP		
RB 5	16.5	28.6	8.2	8.5	15.3	11.3	12.4	4	2	1.6	2.4	1.5	1.3	3,5	
RB 10	20.4	35	10	11	19	14.3	15.9	5	2.4	2.0	2.4	2	2.2	6,0	
RB25	27.2	49	14	14	27	18.3	19.8	6.5	4.4	2.0	3.2	2	2.2	14	
RB50	29.2	71	16	16	50	39.7	21.5	7.0	5.2	2.0	3.2	2	2.2	35	
RB 75	47.5	73	24	27	48	29	37.0	11.5	9.5	3.5	4.4	3	3.2	85	
RB 101	47.5	89	24	27	64	35	37.0	11.5	14.5	3.5	4.4	3	3.2	115	
RB 100	71.5	139	44.5	46	89	69.8	57.1	20	9.6	5.0	4.8	M5	-	500	
RB 150	47.5	122	24	27	97	58	37.0	11.5	19.5	3.5	4.4	3	3.2	165	
RB 250	76	178	55.6	54	114	98.4	63.5	25.5	7.8	6.3	4.8	M6	-	900	
Tolerance	± 0.2	±1.0	±0.2	±0.2	±0.5	±0.2	±0.2	±0.2	±0.5	±0.2	±0.2	±0.2	±0.2	±0.2	-



# Encapsulated wire-wound resistors RB in aluminum casing, with terminal connections

## RB25/6 and RB50/6 with longer creepage distance

### Technical data:

Type	RB 25 /6
Nominal load	25 W
Range	0.01 – 18 k
Max. voltage	550 V
Insulation resistance	>10 000 MΩ
Creepage distance	> 6.6 mm
Electric strength	3000 V AC
Tolerance	±5% (1%)
Cooling surface	535 cm <sup>2</sup> x 1 mm
Weight	13 g

Type	RB 50 /6
Nominal load	50 W
Range	0.1 – 68 k
Max. voltage	1250 V
Insulation resistance	>10 000 MΩ
Creepage distance	>10 mm
Electric strength	3000 V AC
Tolerance	±5% (1%)
Cooling surface	930 cm <sup>2</sup> x 1.5 mm
Weight	32 g

## RB106 and RB256 with longer creepage distance

### Technical data:

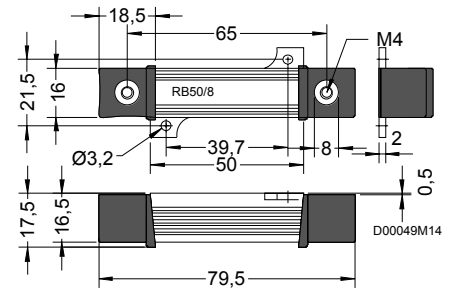
Type	RB 106
Nominal load	150 W
Range	0,01 – 100 k
Max. voltage	1900 V
Insulation resistance	>10 000 MΩ
Creepage distance	> 22 mm
Electric strength	5000 V AC
Tolerance	±5% (1%)
Cooling surface	930 cm <sup>2</sup> x 3 mm
Weight	500 g

Type	RB 256
Nominal load	250 W
Range	0.1 – 120 k
Max. voltage	2300 V
Insulation resistance	>10 000 MΩ
Creepage distance	>25 mm
Electric strength	5000 V AC
Tolerance	±5% (1%)
Cooling surface	930 cm <sup>2</sup> x 3 mm
Weight	900 g

## RB50/8 with screw-type connections

### Technical data:

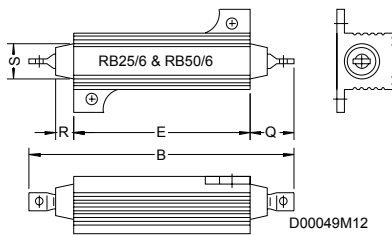
Type	RB 50/8
Nominal load	50 W
Range	0.01 – 68 k
Max. voltage	1250 V
Insulation resistance	>10 000 MΩ
max. torque for connection	1.5 Nm
Electric strength	2500 V AC
Tolerance	±5% (1%)
Cooling surface	930 cm <sup>2</sup> x 1.5 mm
Weight	52 g



### Dimensions in mm

Main dimensions identical with RB25, RB50

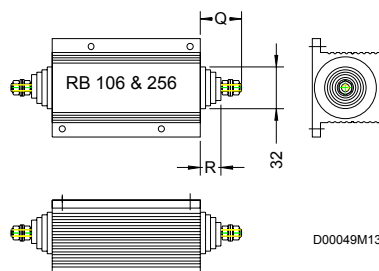
Type	B	E	Q	R	S
RB25/6	49	24	12.5	4	8
RB50/6	75	46	14.5	6.5	10
Tolerance	±1	±0.5	±1	±0.5	±0.5



### Dimensions in mm

Main dimensions identical with RB 100, RB 250

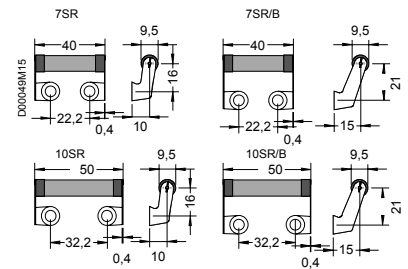
Type	Q	R
RB106	25	12
RB256	32	16
Tolerance	±0.2	



## 7SR and 10SR Exciting, discharge and balancing resistors

Wire-wound resistor with connection eyes for direct mounting on capacitors.

Type	7SR	10SR
Nominal load	10 W	13 W
Range	0.1 – 47 k	0.1 – 68 k
Max. voltage	685 V	940 V
Tolerance	±5% (1%)	
Weight	9 g	11 g
Pack. unit	10 pcs	



# Wire-wound resistors RB in aluminum housing, special designs

## Ohm-i resistors

are compact high-performance wire resistors with windings in an aluminum housing filled with ceramic grouting material. The total encapsulation affords optimum protection against environmental impact and high contact voltages so that the units can also be mounted outside of the control cabinets (VDE 0100 to be complied with). The high thermal time constant ensures high overload capacity in intermittent and short-time operation. Robustness and longevity make Ohm-i resistors ideal for manifold applications in machines and elevators as:

- Braking resistor
- Damping resistor
- Exciting or discharge resistor
- Surge suppression resistor
- Series resistor
- Load resistor



VPR resistors



VPR resistor with shielded multi-strand cable



Encapsulated resistor with connection cable

## Models

Type VPR-L = horizont. L =

Type VPR-S = upright S =

Both models are available in the range of 60 to 500 W permanent current. Larger loads can be achieved by switching several units in parallel. Units for larger loads are available upon request complete with housing made from galvanized steel sheet, with or without connection cable. Optionally, a temperature control by way of a thermostatic switch can be supplied.

## Connection

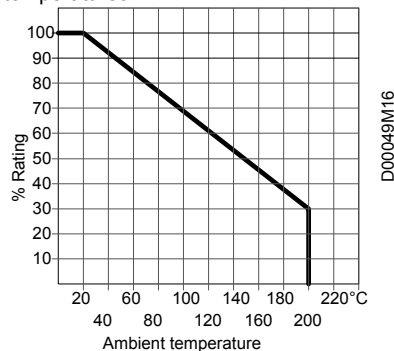
The standard resistors are provided with 500 mm connecting cables insulated with PTFE and made from pure nickel lead. Starting from VPR200-L, a shielded FEP multi-strand cable is supplied.

## Mounting

The Ohm-i resistors can be installed as self-supporting unit with spacing (e.g. on mounting racks) or directly on a mounting plate which then acts as an additional cooling surface. Any mounting position is possible, at full load however, vertical installation with connections at the bottom end is preferable. Sufficient cooling air must be available and sufficient headroom above the unit for the exiting hot air. The neighboring elements may not be sensitive to heat.

For unprotected installation within normal arm's reach, use a protection against unintended contact.

The load must be reduced at higher ambient temperatures



The resistors do not have a separate safety earth terminal. They must be mounted on a metallic bare, grounded surface or an earth terminal must be affixed to one of the fastening screws. Outside of switchgears, use designs with terminal -K or housing -G.

## Type key

VPR ①-②-③-④

- ① Size 60 ... 500 W
- ② Model  
L = horizontal  
S = vertical
- ③ Ohm value (e.g. 20R, 6R8)
- ④ optional  
K = Cable connection + length mm(-K500)  
T = thermostatic switch +temperature (-T250)  
G = Casing

Examples:

VPR200-S-20R  
VPR200-L-6R8-K500-T180

## General technical data:

Protection DIN 40 0 50	IP 54
Resistor tolerance	±10%, ±5%, ±2%, ±1%
Ambient temperature range	-40 – +200°C
Insulation resistance	>20 MΩ
Maximum surface temperature	350°C at nominal load and ambient temperature 20°C
Temperature coefficient	-80...+200 ppm
Tolerance	±5% (1%)
Heat sink sheet surface	930 cm² x 3 mm
Weight	500 g
Climate class IEC 68-1	40/155/21
Long-term stability P40, 40°C 100h	3%
Climatic sequence test IEC115-1/23	2%
Fast temperature change IEC 68 2.14 max. vibration load EN 60 068	2%
Terminals	Temperature-resistant cable
Tensile load acting on the terminals	100 N
Failure rate at T = 85°C	100 FIT

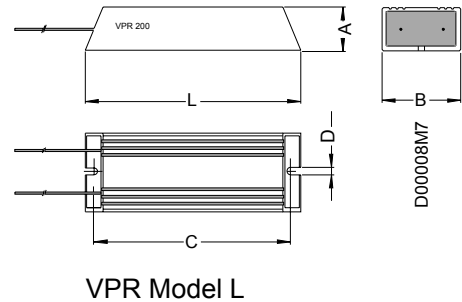
Size	Rating at 20°C W	Resistance range		max. operating voltage V AC	Test voltage kV AC	Weight g
		from Ω	to Ω			
VPR 60	60	0.10	270	800	2.5	140
VPR 80	80	0.10	1200	800	2.5	220
VPR 100	100	0.10	1400	800	2.5	240
VPR 120	120	0.10	1600	800	2.5	260
VPR 150	150	0.10	1800	800	2.5	310
VPR 200	200	0.15	2500	1000	4.0	490
VPR 300	300	0.20	3300	1000	4.0	690
VPR 400	400	0.25	4700	1000	4.0	800
VPR 500	500	0.30	7500	1000	4.0	1020



# Encapsulated wire-wound resistors Ohm-i, type VPR in aluminum housing

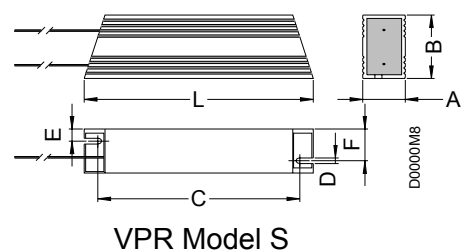
## Admissible load in intermittent periodic duty

Size	Rating in intermittent periodic duty at d.f. and cycle time 120 (240) s					
	100 %	40 %	25 %	15 %	10 %	5 %
VPR 100	100	235	370	600	900	1800
VPR 100	100	(225)	(345)	(560)	(840)	(1650)
VPR 200	200	470	740	1200	1800	3600
VPR 200	200	(450)	(690)	(1120)	(1680)	(3300)
VPR 300	300	705	1110	1800	2700	5400
VPR 300	300	(675)	(1035)	(1680)	(2520)	(4950)
VPR 400	400	940	1480	2400	3600	7200
VPR 400	400	(900)	(1380)	(2240)	(3360)	(6600)
VPR 500	500	1175	1850	3000	4500	9000
VPR 500	500	(1125)	(1725)	(2800)	(4200)	(8250)



## Dimensions

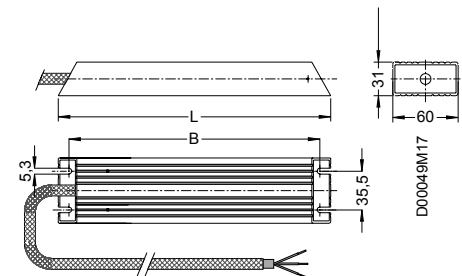
Size	Dimensions mm						
	A	B	C	D	E	F	L
VPR 60	21	40	83	4.3	8	13	102
VPR 80	21	40	133	4.3	8	13	152
VPR 100	21	40	148	4.3	8	13	167
VPR 120	21	40	165	4.3	8	13	184
VPR 150	21	40	193	4.3	8	13	212
VPR 200	31	60	147	5.3	11.5	19.5	167
VPR 300	31	60	197	5.3	11.5	19.5	217
VPR 400	31	60	247	5.3	11.5	19.5	268
VPR 500	31	60	317	5.3	11.5	19.5	337



## Design with shielded terminal Protection IP20

VPR ①-②-③-④  
④ = K...

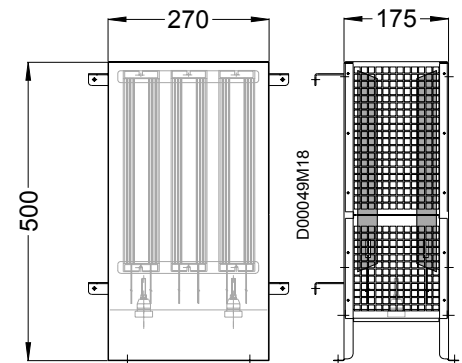
Size	Rating W	Dim. A	Dim. B
VPR 200 - L - K...	200	200	180
VPR 300 - L - K...	300	250	230
VPR 400 - L - K...	400	300	280
VPR 500 - L - K...	500	370	350



## Design with housing Protection IP 20

VPR ①-②-③-④  
④ = G...

Example: housing with 5 VPR 500-L, total continuous capacity 2500 W







## Contents

General.....	Page 4.1
Definitions and formulas.....	Page 4.2
Selection and technical data.....	Page 4.3/4.4
Diagrams, dimensions + weights.....	Page 4.5
Wiring diagrams.....	Page 4.6

## Oil-cooled resistor starter 3PA3

for three-phase motors with slip-ring rotor up to 12,800 kW

### General, application

3PA3 starters are stepped resistor starters with contactors and cast iron 3PR3 resistors in a housing filled with transformer oil.

Oil-cooled starters store the heat that forms during the starting process and slowly release it through their surface. Therefore, they are particularly suited for high-power drives that are not frequently started.

The design combines the advantages of a resistor starter with those of an economical heat carrier (oil) and a high protection class for application in difficult environments.

Robust power contactors guarantee high operational reliability and long service lives combined with low maintenance. All parts in motion are mounted outside of the oil fill and are therefore easy to maintain.

### Designs

- Single starter with stator contactor for low voltage machines up to 640 kW
- Single starter without stator contactor for low and medium-voltage machines up to 6400 kW
- Twin starter without stator contactor for low and medium-voltage machines up to 12800 kW
- Starter with plain steel plate tank
- Starter with finned tank for higher starting frequency
- Starter with additional water cooling for high starting frequency

### Standard equipment

- Stator contactor and thermal over-current relay for drives up to 640 kW, starters size 1 to 3
- Water cooled starters, size 52 to 56
- Start/Stop terminals for supervisory control
- Auxiliary switches required for the customer's control, wired to terminals
- Temperature monitoring warning at 100°C tripping at 130°C
- Standard control voltage 230V – 50/60 Hz
- Step contactors, PLC controlled, alternatively timers for starting steps
- Output step contactor(s)
- Cable inlets, connection directly to the output step contactor
- Oil level indicator
- Painting RAL 7035

### Extras

- Control transformer for different control voltage
- Electronic blocking control during starting
- Cable cover to increase the protection class to IP 55
- Oil level control
- No. of starts monitor
- Oil tank with cooling fins
- Local control and position pointer
- Anti-condensation heating
- Rotor voltage > 2000 V
- Controller for brush lifting device
- Terminal box for rotor cable
- Torque-dependent start
- Communication and visualization via PROFIBUS ([www.profibus.com](http://www.profibus.com))

### Standards and regulations

3PA3 starters meet the specifications of

- DIN VDE 0660 regulations for low-voltage switchgear
- DIN 46062 starters for direct current and alternating current slip-ring motors
- IEC 60947-4-1 low-voltage switchgear, contactors and motor starters

They conform with the European Council's Low Voltage Directive 73/234 EEC.

According to DIN 50010, T1 the starters are suited for installation in

- Closed locations
- Roofed locations
- Outdoor locations

### Protection class

IP 54 pursuant to DIN 40050 / IEC 144

### Ambient temperature

-25°C to +45°C, higher temperatures upon request

### Installation altitude

Up to 1000 m above sea level, higher altitudes upon request

### To be provided by the customer

- Plane foundation
- Oil catch basin
- Stator contactor or circuit breaker
- Line-side short circuit protection
- Thermal motor protection
- Supply and filling in of the oil fill

### Oil fill

For the oil fill, use acid-free transformer oil pursuant to DIN 51370, DIN VDE 0370.

- ESSO Univolt 56
- Shell Diala D
- DEA GK2
- Energol JS R
- BP JSH-A

Starters must not be transported with oil fill.

**Small starter glossary**

During starting, energy is taken from the grid. Half of it is used for acceleration, the other half is converted to heat in the starter.

In terms of heat balance, the starter can be compared to a tank with a hole at the bottom.

If the tank is filled with water (energy) from a vessel and if the vessel can be emptied into the tank three times, for example, then you must wait until one vessel fill has drained through the hole.

The amount of water added is equivalent to the starting energy  $W_a$ , the filling volume of the tank to the maximum admissible starting energy until reaching the final temperature, and the drained volume to the starting frequency.

The value for the starting frequency indicates the energy volume at operating temperature that is transferred at hourly rates through the starter surface – like the flow through the drain hole measured at hourly intervals.

The starter energy shown in the tables relates to a temperature rise limit of 75 K and/or a limit temperature of 110°C at +45°C ambient temperature.

**Definitions and formulas**

**Starter energy  $W_a$**

Energy which is converted into heat in the starter during the starting operation

$$W_a = 0.5f \cdot P \cdot t_a \quad [\text{kJ}]$$

**Number of starts  $z$**

Permissible number of consecutive starts with starting time  $t_a$  and time interval  $2t_a$  until reaching operating temperature

$$z = \frac{W_{a_{\max}}}{W_a}$$

**Starting time  $t_a$**

Duration of the starting process in seconds

- Drive with constant load torque

$$t_a = \frac{i \cdot n^2}{91200 \cdot (f - \frac{M_L}{M_N}) \cdot P} \quad [\text{s}]$$

- Drive with square law load torque and  $f = 1$

$$t_a = \frac{i \cdot n^2}{91200 \cdot 0,67 \cdot P} \quad [\text{s}]$$

**Starting load factor  $f$**

Ratio of the mean starting load to the starter duty rate

Half load starting	$f = 0.7$	$M_{\max}/M_n$ ca.1.0
Fan starting	$f = 1.0$	$M_{\max}/M_n$ ca.1.4
Full load starting	$f = 1.4$	$M_{\max}/M_n$ ca.1.7
Heavy starting	$f = 2.0$	$M_{\max}/M_n$ ca.2.5

**Starter factor  $ka$**

Factor for the starter calculated by dividing 1.4 times the characteristic rotor resistance of the motor by the starting load factor

$$ka = \frac{1.4k}{f}$$

**Characteristic rotor resistance  $k$**

Calculated using the rotor data for standstill voltage and rated rotor current of the motor

$$k = \frac{u_2}{i_2 \cdot \sqrt{3}}$$

**Starting frequency**

Number of starts per hour at operating temperature

**Starting steps  $n$**

Number of resistor steps of the starter, at the same time also number of the step contactors

**Starting positions  $n + 1$**

Number of the switching positions during starting

$W_{a_{\max}}$  = total starting energy admissible for the starter [kJ]

$W_a$  = starting energy per start [kJ]

$t_a$  = starting time [s]

$i$  = moment of inertia of the rotating masses related to the motor shaft [kgm<sup>2</sup>].

Conversion from speed  $n_x$  to the motor speed  $n$

$$i_n = i_x \cdot \left(\frac{n^2}{n_x^2}\right) \quad [\text{kgm}^2]$$

Conversion from straight accelerated masses to moment of inertia:

$$i_n = 91,2 \cdot m \left(\frac{v}{n}\right)^2 \quad [\text{kgm}^2]$$

$m$  = mass [kg]

$v$  = mass speed [m/s]

$M_L$  = load moment

$M_N$  = nominal moment

$n$  = nominal drive speed [min<sup>-1</sup>]

$P$  = motor rating [kW]

$i_2$  = rated rotor current [A]

$u_2$  = rotor standstill voltage [V]

**Type code**

**3PA3 ①②0-③④⑤⑥⑦-M..** accessory M10 - M50 or long text

①② = size, ..... Table 1&2

③ = rotor current characteristic ..... Table 1&2

④ = w/o stator contactor A, with stator contactor Table 3

⑤ = starter duty factor  $ka$  Table 4

⑥⑦ = starting time  $t_a$ , ..... Table 5

-M = accessory ..... Table 6

# Oil-cooled resistor starters, selection and technical data

**Table 1, selection by starting load factor**

Simple starter without stator contactor, order supplement ④ = A													
Model Order no. 3PA3 ①②	Motor rating kW at starting load				Rotor current A ③ Characteristic			Technical starter data					
	Half load starting f=0.7	Fan starting f=1	Full load starting f=1.4	Heavy load starting f=2.0	1	2 <sup>1)</sup>	3 <sup>2)</sup>	Rotor voltage up to V	Maximum starter energy W <sub>a,max</sub> kJ	Starting time t <sub>a</sub> <sup>3)</sup> s	Starting number z	Starting frequency ha 1/h	Starter positions <sup>4)</sup>
01	200	140			150	250	-						
02	450	315	225	155	250	450	630	1500	20000	20	5	1,10	7
03	640	450	320	225	250	450	630	1500	26000	20	5	1,10	7
04	900	630	450	315	450	630	-	1500	29000	20	4	1,10	7
05	1260	880	630	440	450	630	1100	1500	48600	36	3	0,45	8
06	1800	1250	900	625	630	1100	1600	2000	69000	36	3	0,40	8
07	2500	1750	1250	875	630	1100	1600	2000	106000	36	3	0,40	8
08	3600	2500	1800	1250	1100	1600	-	2000	149000	40	3	0,30	9
09	5000	3500	2500	1750	1100	1600	-	2000	220000	40	3	0,30	11
10	6400	4500	3200	2250	1100	1600	-	2000	283000	40	3	0,30	12
Double starter without stator contactor, order supplement ④ = A													
40	2 x 3600	2 x 2500	2 x 1800	2 x 1250	2 x 1100	2 x 1600	-	2000	2 x 149000	40	3	0,3	9
41	2 x 5000	2 x 3500	2 x 2500	2 x 1750	2 x 1100	2 x 1600	-	2000	2 x 220000	40	3	0,3	11
42	2 x 6400	2 x 4500	2 x 3200	2 x 2250	2 x 1100	2 x 1600	-	2000	2 x 283000	40	3	0,3	12
Starter with water cooling, without stator contactor, order supplement ④ = A													
52	1260	880	630	440	450	630	-	1500 <sup>5)</sup>	53100	36	3	2,2	8
54	2500	1750	1250	875	630	1100	-	2000	112700	36	3	3,3	8
56	5000	3500	2500	1750	1100	1600	-	2000	230400	40	3	3	11

**Table 2, choice by kind of machine**

Simple starter without stator contactor, order supplement ④ = A																		
Model Order no. 3PA3 ①②	Motor rating kW at starting load										Rotor current A ③ Characteristic			Technical starter data				
	Vertical mill w/o load f=0,7		Centrifugal pump f=0,9		Fan f=1,0		Ball mill f=1,3		Crusher f=1,8		1	2 <sup>1)3)</sup>	3 <sup>2)3)</sup>	Rotor voltage up to V <sup>7)8)</sup>	Maximum starter energy W <sub>a,max</sub> kJ	Starting number z	Starting frequency ha 1/h	Starter positions <sup>4)</sup>
	P/kW	t <sub>a</sub> /s	P/kW	t <sub>a</sub> /s	P/kW	t <sub>a</sub> /s	P/kW	t <sub>a</sub> /s	P/kW	t <sub>a</sub> /s								
01	380	10	300	10	130	20	210	10	110	14	150	250	-	1320	8000	6	2,00	6
02	1100	10	890	10	350	23	510	12	250	18	250	450	630	1500	20000	5	1,10	7
03	1500	10	960	12	400	26	670	12	290	20	250	450	630	1500	26000	5	1,10	7
04	2100	10	1200	14	560	26	930	12	400	20	450	630	-	1500	29000	4	1,10	7
05	3900	12	2300	16	1100	29	1600	16	780	23	450	630	1100	1500	48600	3	0,45	8
06	4100	16	2800	18	1300	36	2000	18	980	26	630	1100	1600	2000	69000	3	0,40	8
07	5600	18	4400	18	1800	40	2700	20	1400	29	630	1100	1600	2000	106000	3	0,40	8
08	7900	18	5500	20	2300	44	3800	20	1700	32	1100	1600	-	2000	149000	3	0,30	9
09	10500	20	7100	23	3100	48	4900	23	2300	36	1100	1600	-	2000	220000	3	0,30	11
10	11700	23	8100	26	3600	52	5600	26	2600	40	1100	1600	-	2000	283000	3	0,30	12
Double starter without stator contactor, order supplement ④ = A																		
40	12300	23	8500	26	3800	52	5900	26	2800	40	2 x 1100	2 x 1600	2000	298000	3	0,3	9	3800
41	16100	26	11200	29	5200	56	7100	32	3400	48	2 x 1100	2 x 1600	2000	440000	3	0,3	11	5200
42	16800	32	13100	32	6300	60	7300	40	4000	52	2 x 1100	2 x 1600	2000	566000	3	0,3	12	6300
Starter with water cooling, without stator contactor, order supplement ④ = A																		
52	3200	16	2500	16	1100	32	1700	16	1000	20	450	630	1500 <sup>6)</sup>	53100	3	2,2	8	3200
54	6000	18	4600	18	1900	40	2900	20	1400	29	630	1100	2000	112700	3	3,3	8	6000
56	11000	20	7400	23	3200	48	5100	23	2100	40	1100	1600	2000	230400	3	3,0	11	11000

**Technical data, starter for water cooling with service water**  
pump voltage 3/400 V – 50 Hz (different voltage upon request)

Model 3PA3 ①②	Pump rating kW	Cooling capacity kW	Cooling water inlet temperature °C	Cooling water requirement m <sup>3</sup> /h	Piping connection	Pressure drop bar
52	0.37	11	≤ 20	0.7	R1/2"	0.35
54	1.1	33.5	≤ 20	1.8	R1/2"	0.5
56	2.2	71.5	≤ 20	3.1	R1"	0.7

# Oil-cooled resistor starters, selections and technical data

**Table 3**

Starter with stator contactor, nominal voltage up to 690V, order supplement ④				
Model 3PA3 ①②	Contactora nominal current A	Adjusting range over-current relay A	Fusing up to A	Order supplement ④
Model w/o stator contactor				
<b>01</b>	170	63 - 90	250	<b>K</b>
		80 - 110	315	<b>B</b>
		110 - 135	315	<b>C</b>
		125 - 200	355	<b>D</b>
<b>02</b>	400	125 - 200	355	<b>E</b>
		200 - 320	500	<b>F</b>
		320 - 500	500	<b>G</b>
<b>03</b>	630	320 - 500	630	<b>H</b>
		400 - 630	630	<b>J</b>

**Table 4**

Starter factor, order supplement ⑤		
from	to	⑤
0.35	0.45	<b>A</b>
0.45	0.56	<b>B</b>
0.56	0.71	<b>C</b>
0.71	0.90	<b>D</b>
0.90	1.12	<b>E</b>
1.12	1.42	<b>F</b>
1.42	1.80	<b>G</b>
1.80	2.25	<b>H</b>
2.25	2.75	<b>J</b>
2.75	3.60	<b>K</b>
3.60	4.50	<b>L</b>
4.60	5.65	<b>M</b>
5.65	7.15	<b>N</b>
7.15	9.00	<b>P</b>
9.00	11.25	<b>Q</b>
11.25	14.25	<b>R</b>
14.25	18.00	<b>S</b>

**Table 5**

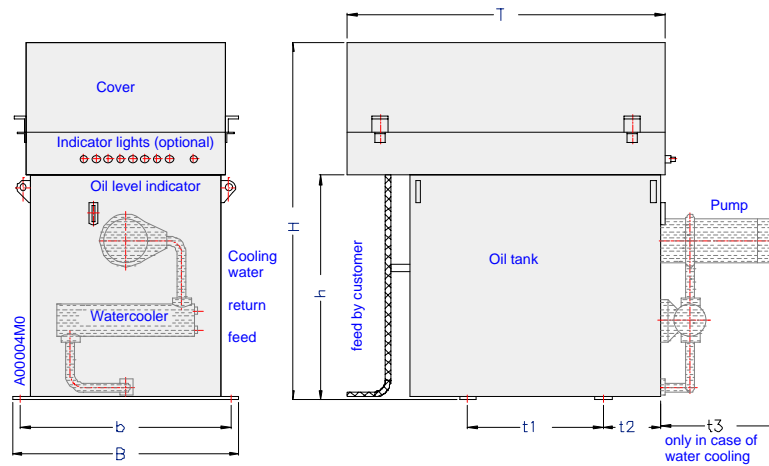
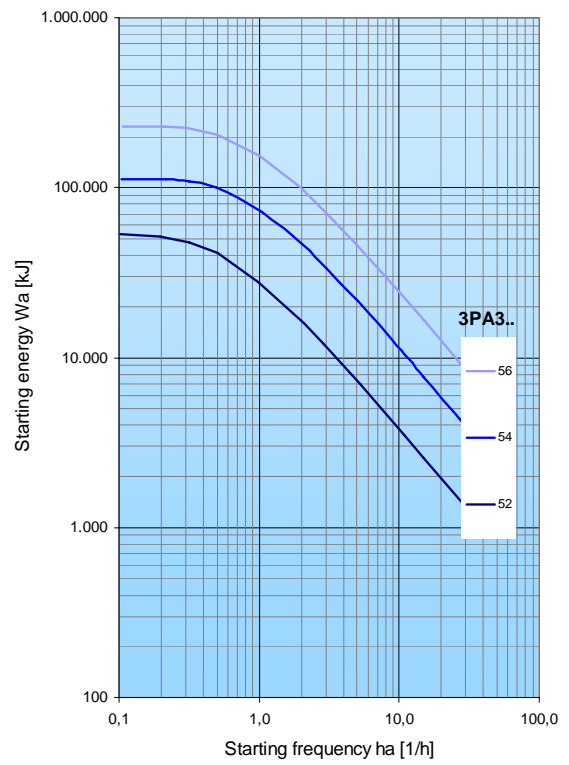
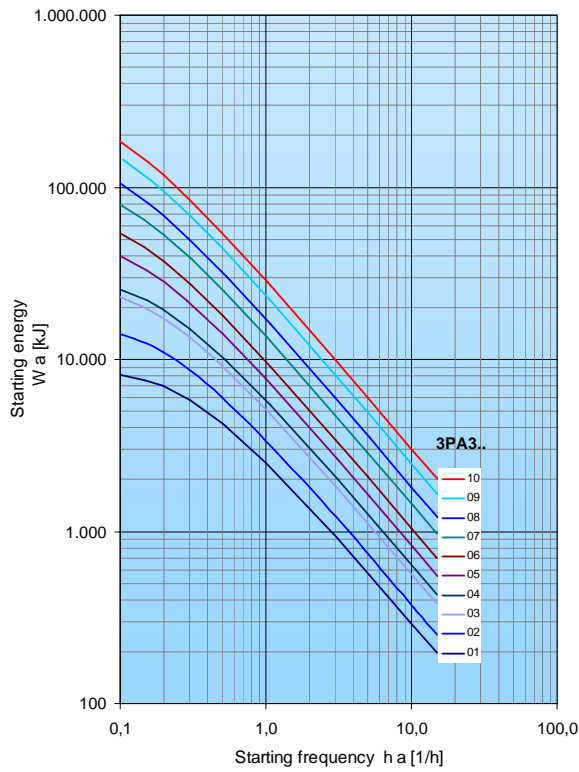
Starting time, order supplement ⑥⑦	
(ta) = sec	⑥⑦
10	<b>10</b>
12	<b>12</b>
14	<b>14</b>
16	<b>16</b>
18	<b>18</b>
20	<b>20</b>
23	<b>23</b>
26	<b>26</b>
28	<b>28</b>
32	<b>32</b>
36	<b>36</b>
40	<b>40</b>
44	<b>44</b>
48	<b>48</b>
52	<b>52</b>
56	<b>56</b>
60	<b>60</b>
65	<b>65</b>
70	<b>70</b>
80	<b>80</b>

**Table 6**

Accessoires, order supplement M..	
<b>M10</b>	Different control voltage with built-in control transformer, indicate desired control voltage in full text
<b>M20</b>	Electronic blocking control, protects the drive during starting
<b>M30</b>	Cable cover as protection against mechanical damage to starter feed cables and to increase protection to class IP55
<b>M40</b>	Level control, tripping function: changeover contact wired to terminals
<b>M45</b>	Monitoring the number of starts
<b>M50</b>	Oil tank with cooling fins, increases starting frequency by factor 3.8
<b>M60</b>	Local control and position pointer
<b>M65</b>	Anti-condensate heating for control cabinet
<b>M70</b>	Rotor voltage $\geq 2000 \text{ V}^{7)9)}$
<b>M80</b>	Brush lifting device control
<b>M82</b>	Terminal box for rotor cables
<b>M85</b>	Torque-dependent start
<b>M90</b>	Communication and visualization via PROFIBUS

- 1) reinforced design, additional weight approx. 3%
- 2) reinforced design, additional weight approx. 5%
- 3) with rotor current >1600 A select double starter
- 4) standard workshop setting if no other specification is requested
- 5) higher number of steps or multi-step starter with binary stepping upon request
- 6) for characteristic ③=2, rotor current 630 A, rotor voltage up to 2000 V
- 7) Simple starter for motor power > 5000 kW
- 8) Twin starter for motor power > 11000 kW
- 9) Rotor voltage > 4000 V upon request

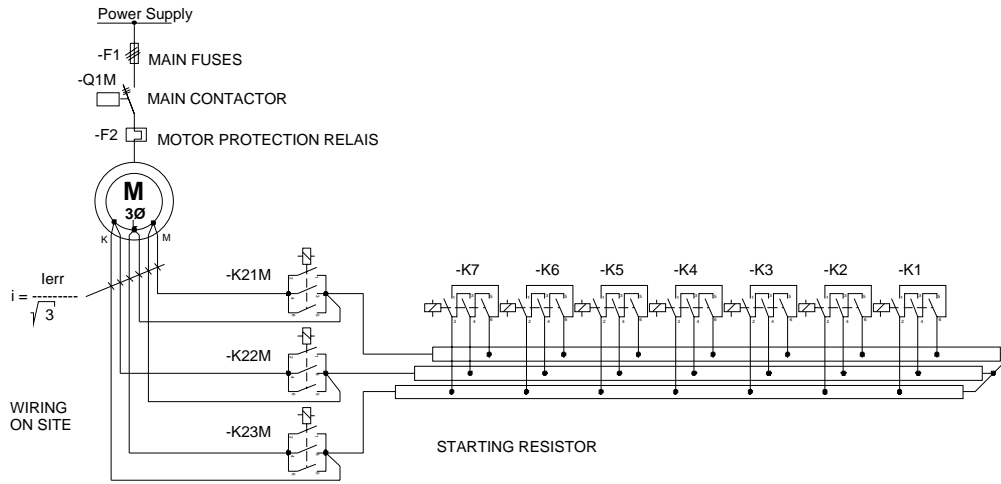
# Oil-cooled resistor starters, diagrams, dimensions and weights



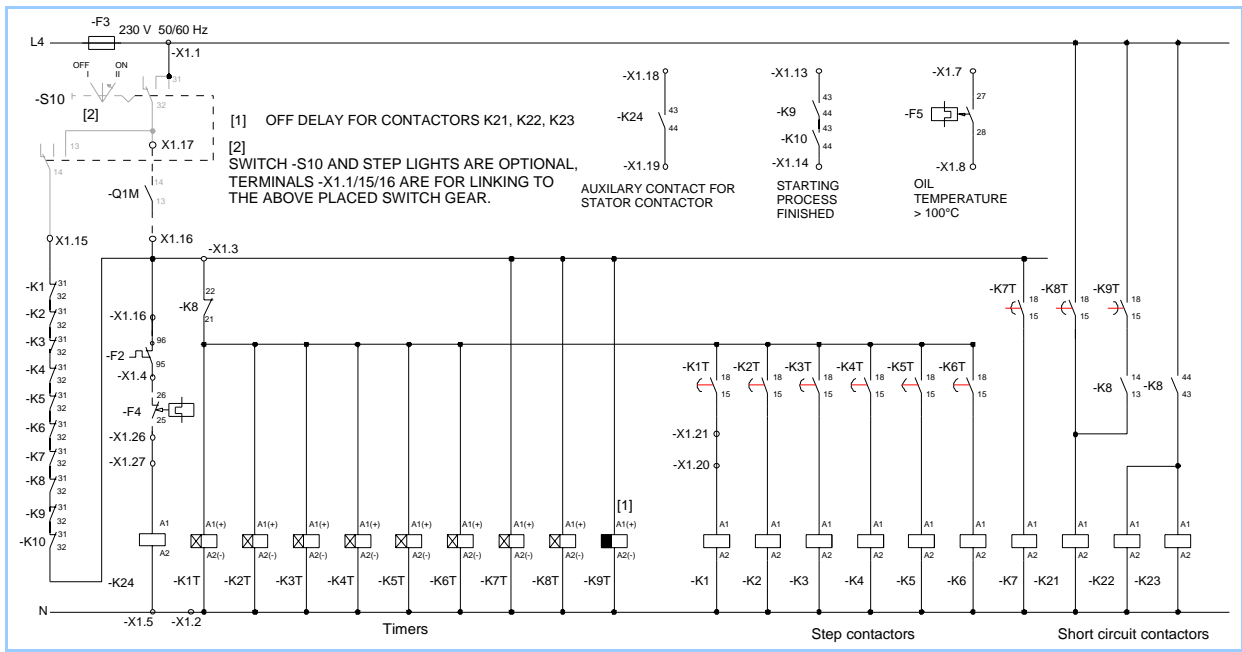
Dimensions and weights											
3PA3 Model	B	H	T	b	h	t1	t2	t3	Weight w/o oil ca. kg	Oil volume ca. l	
<b>Simple starter</b>											
01	380	900	766	350	474	280	122		100	60	
02	560	870	1101	510	439	430	202		215	145	
03	560	1155 / 1225 <sup>1)</sup>	962 / 1067 <sup>1)</sup>	510	684	430	178		282	185	
04	560	1255	962	510	784	430	178		255	205	
05	836	1257	1169	776	766	500	213		400	355	
06	951	1327	1221	891	836	580	223		480	500	
07	1048	1600	1221	988	1109	640	202		720	775	
08	1048	1630	1641	988	1139	820	322		1020	1080	
09	1118	1940	1706	1058	1449	860	334		1430	1600	
10	1118	2000	2136	1058	1509	1100	429		1690	2060	
<b>Twin starter</b>											
40	2 x 3PA308, in parallel								2040	2 x 1080	
41	2 x 3PA309, in parallel								2860	2 x 1600	
42	2 x 3PA310, in parallel								3380	2 x 2060	
<b>Starter with water cooling</b>											
52	836	1307	1169	776	816	500	213	424	470	383	
54	1048	1650	1221	988	1179	640	202	424	800	812	
56	1118	1990	1706	1058	1499	860	334	424	1560	1660	

1) Model 03 with stator contactor

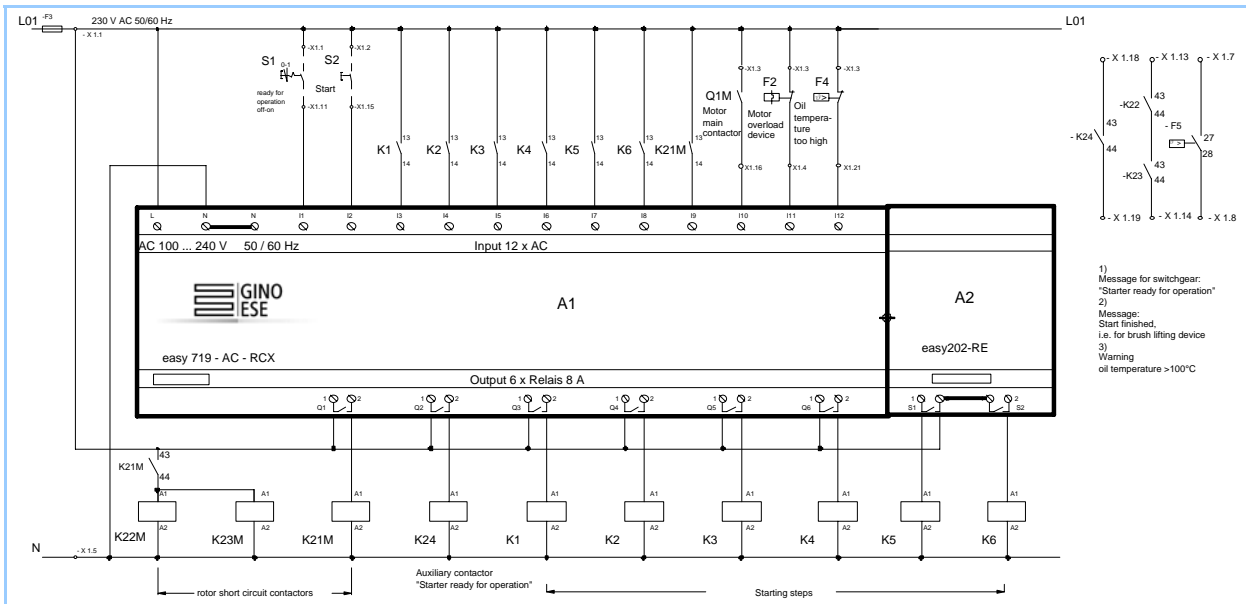
# Oil-cooled resistor starters, wiring diagrams



**Main power circuit for starter control**



**Typical circuit, starter with timer control**



**Typical circuit, starter with PLC**

Only the circuit diagram supplied with the equipment will be binding.





## Table of contents

General..... page 5.1

Selection, dimensions, weights  
..... page 5.2

### Application

Together with separate resistors, the starters start three-phase motors with slip ring rotors up to 2000 kW and rotor voltages of up to 2000 V.

Type and design of the starters can be freely selected from the resistor portfolio of this list and can thus be optimally adjusted to the individual application.

### Design

1PK4 starters are switching devices with air-break contactors and timer modules, installed in a control cabinet with feet for elevated installation. The control function is taken on by a Siemens LOGO! control or, alternatively, by means of a time relay. With the LOGO! control, the starting times can be adjusted by reprogramming with a "Yellow Card", and for the design with time relay, manually.

Stator circuit breakers and motor protection devices are not installed.

The connections of the power contactors for bridging the resistor steps shall be made by the customer on site with the resistors to be ordered separately. They are connected directly at the contactor contacts.

The door of the cabinet is equipped with lights that indicate the switching steps and a key-operated switch for ON/OFF.

Standard units are provided with air-break contactors according to Siemens, other designs are possible upon request.

The units can also be supplied as control resistors for the control of series resistors to achieve permanent speed reduction. The design will then be adjusted to the individual application.

Standard paint: synthetic resin varnish RAL 7032

### Codes and standards

Starters 3PK4 comply with the specifications for low-voltage equipment DIN VDE 0660, DIN 46 062 and IEC 292-3.

The conform with the EEC Low Voltage Directive of 19 February 1973.

### Protection

Pursuant to DIN 40 050: IP54

### Resistance to climatic changes

These starters comply with DIN 50 010 T1 and are suited for indoor and outdoor installation without protection against weathering, varying conditions of condensation, industrial and maritime atmosphere.

### Ambient temperature range

-25 to +50°C

### Rated insulation voltage

3PK 4 Size	Main circuit	max. admissible rotor standstill voltage
10 - 12	690 V AC	1320 V AC
13 - 14	750 V AC	1500 V AC
15 - 16	1000 V AC	2000 V AC

### Control voltage

Contactors and control units are designed for 230 V 50/60 Hz. A control power transformer can be added by the customer (Table 5.3). This way, inlet voltages of 550-525-500-480-460-440-415-400-380-240 and 110 V can be adjusted. Other voltages must be realized by the supplier using a series transformer.

### Control

The control of the starter is performed by an installed key switch OFF/ON (-S10 in circuit diagram on page 4.5) wired to terminals so that the control can alternatively be taken over by a higher-level switchgear.

### Position indicator

For each step, a signaling light will show the switching position of the starter. The last light indicator shows that the start is completed.

### Auxiliary switch

An auxiliary switch on the output step / short circuit contactor signals the completion of the start to external circuits. The insulation voltage of the floating contact is 690 V AC.

Max. load for auxiliary switch	
Operating voltage V	Nominal operating current AC11 $i_n$ A
230	5.6
400	3.6
500	2.5

Further auxiliary switches upon request

### Electronic blocking protection

Starters 3PK4 14 through 3PK4 16 can be equipped with electronic blocking protection. The blocking protection monitors the starting of the motor and interrupts the starting process if the motor is blocked and does not start.

### Connection

To insert the connecting cables, the casing of the starter is provided with one or two flanged plates where the requisite bores for line or cable inlet have to be made.

Protective conductor terminal connection: 1 x M8 (2 x M8 starting with size 14)

### Circuit diagrams

The basic design of the circuits is shown on page 4.5. The resistors must be ordered separately. Only the circuit diagram supplied with the respective unit shall be binding.

### Type key

#### 3PK4 ①②0-0BA③④-Z

- ①② size ..... Table 5.1
- ③④ starting time ..... Table 5.2
- Z accessories ..... Table 5.3

# Starters 1PK4, selection, dimensions, weights

## Selection

The decisive parameter is the rotor current whereby the maximum admissible rotor standstill voltage must be considered.

3PK 4 size Ø2	Max. Rotor current A	Max. rotor voltage V	Starting steps n <sup>1)</sup>
10	75	1320	5
11	125	1320	5
12	150	1320	6
13	250	1500	7
14	450	1500	8
15	630	2000	8
16	1100	2000	8

<sup>1)</sup> Number of starting steps = n - 1, equivalent to the number of rotor contactors

## Starting times

The total starting time can be calculated using the table below where it is geometrically distributed over the starting steps.

**6 steps**, step times at 41.5-25.1-15.2-9.2-5.6-3.4 %

**7 steps** step times at 36.8-24-15.6-9.9-6.6-4.3-2.8 %

**8 steps** step times at 33-22.5-15.5-10.7-7.3-5.1-3.5-2.4 %

**9 steps** step times at 29.8-21.4-15.3-11-7.9-5.6-4-2.9-2.1 % of the total time.

Unless requested otherwise by the customer, the supplier will adjust the standard time as shown in the table below. When supplied together with resistors, it will be adjusted in line with the motor rating or the calculated starting time.

Starting time s ③④	Standard for size
10	-
12	-
14	-
16	10
18	-
20	11
23	-
26	12
28	-
32	13
26	-
40	14
44	-
48	-
52	15
56	-
60	16
65	-
70	-
75	-
80	-
88	-

Other times are possible, please indicate in the order.

## Accessories and special equipment

Order supplement - Z	for size	Add. weight kg
<b>Different control voltage</b> with additional transformer supplied by us		
<b>M10</b>	11...12	5.0
	13...15	8.0
	16	17.0
<b>Blocking protection</b>		
<b>M20</b>	14	2.0
	15	2.0
	16	2.0

## Starting resistors for starters:

### Wire-wound resistors 3PP1 page 3.5

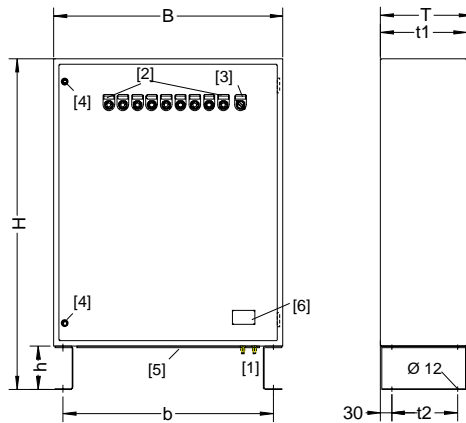
Motor ratings (full load start) 3 ... 40 kW

### Cast iron resistors 3PR3 page 1.5

Motor ratings (full load start) 40... 2000 kW

**Steel grid resistors 3PS3** starting from page 2.2 and **Steel grid resistors, system GINO** starting from page 2.12 can also be used as starting resistors in the corresponding combination.

## Dimensions and weights



- [1] Grounding connection size 10...13: 1 x M8  
14 ...16: 2 x M8
- [2] Indicator lights
- [3] On/Off switch
- [4] Door lock
- [5] flanged plates 400 x 100 without bore
- [6] Name plate

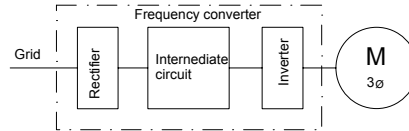
3PK 4 Size	Weight kg	Dimensions						
		B	H	T	b	h	t1	t2
10	30							
11	32	500	800	250	440	100	230	140
12	53							
13	62	600	1150	300	540	150	280	230
14	90							
15	98	800	1150	300	740	150	280	230
16	145	800	1350	300	740	150	280	230

# Braking resistors for frequency converter drives, general

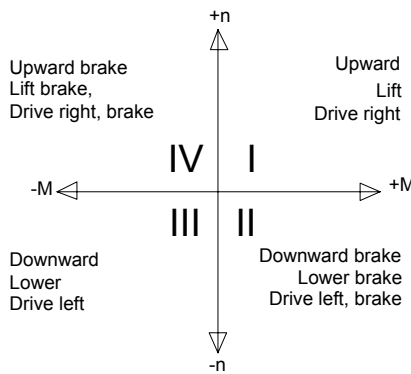


## Function

The speed of a three-phase short-circuit rotor motor can only be meaningfully controlled via a change in the frequency of the supply voltage. To this effect, frequency converters (FC) are used whose original frequency can be controlled independently from the grid frequency. The AC of the grid is converted to DC in an intermediate circuit and then to DC with adjustable frequency.



For drives operating in the I. and III. quadrant of the n/M diagram, i.e. those drives whose moment of inertia is substantially smaller than the load torque, frequency converters can be used without requiring changes. Four-quadrant drives, however, require an additional device to take on the kinetic energy.



As long as a load is acting on the motor, its armature is following the frequency of the feed voltage (slip). When the FC reduces the frequency or the motor is driven by external operating conditions (lowering, driving downhill), the rotor frequency is higher (over-synchronous) than that of the feed FC. The motor turns into a generator. The generator energy leads to a voltage increase in the intermediate circuit of the FC and must be dissipated. Energy recovery, however, is not always an economical alternative because a) the supply grid must be able to take on energy and b) the energy must be adjusted such that it can be returned to the grid. This may under certain circumstances require substantial technical adjustments which would increase the investment cost and complexity of the plant. In particular where high braking energies occur in the short-term and the entire braking energy is low in relation to the energy demand of the drive it is more economical to convert it to heat in a braking resistor.

An electronic switch (chopper) will switch on the resistor again before the voltage in the intermediate circuit reaches a value that is dangerous for the components. The resistor loads the intermediate circuit voltage. As soon as it has reached a certain level that is smaller than that of the switching voltage but larger than the grid voltage, the chopper will switch off the resistor again. This procedure will be repeated as soon as the voltage rises again whereby – as a function of the time constant of the circuit – frequencies ranging between several hundred up to several thousand Hertz are reached. The resistor is operated with a pulsed DC, removes the energy from the drive and brakes it down. The energy is converted to heat and released to the environment.

## Application

Braking resistors are used for lifting and driving gears, elevator drives, conveyors, drives on manipulators as well as all drives where fast speed changes are to be controlled and the excess energy is not consumed by the loads or losses of the machine. Resistors for smaller capacities can be installed together with the other equipment in the control unit. Due to the heat formation, resistors for larger capacities often have a separate housing and are installed separately.

## Selection

Although the kinetic energy of the drive and the braking frequency are decisive for the braking energy to be converted, the braking resistor is often dimensioned according to the size of the drive motor and the estimated braking frequency, in particular in the case of smaller drives. The ohm value is not critical but should be larger than the smallest admissible value for the FC but not larger than required for the desired load capacity. The formula below calculates the ohm value of the braking resistor. The factor 0.75 includes a reserve to ensure the requested load capacity also at (+)tolerance of the ohm value and its change during heating up.

$$R_{BR} = \frac{U_Z^2}{P_{BR}} \cdot 0,75$$

$R_{BR}$  = resistance  $\Omega$   
 $U_Z$  = intermediate (DC) circuit voltage V  
 $P_{BR}$  = braking capacity W

## Table of contents

General..... page 6.1

Designs, selection of tube resistors .....page 6.2

Selection steel grids and cast iron resistors ..... page 6.3

Dimensions of steel grid resistors ..... page 6.4

# Braking resistors for frequency converter drives, models, selection

## Designs

All resistor designs in this list can be used as braking resistors. The required capacity is one of the parameters for selection.

**Tube resistors** are suited for permanent capacities up to ca. 1700 W.

**Steel grid resistors** are particularly suited for large continuous capacities and/or high duty factors due to the large surface of the elements.

**Cast iron resistors** have a high capacity for storing energy and are preferably used for short-term or intermittent operation with short duty factor.

All designs are available in protection class IP00 for installation and with housing for protection class IP20. Steel grid and cast iron resistors are also available with protection classes IP13 and IP23.

Optional thermostatic switches protect the resistors from inadmissible heating up.

## Noise levels

Noise formation from operation at a chopper frequency within the audible range is unavoidable. Magnetostriction noise and mechanical vibrations triggered by magnetic fields form as a consequence. The lowest noise levels are found with cement-coated tube resistors. Mounting on low-resonance materials shall be preferable.

## Codes and Standards

The resistors comply with the applicable codes and standards described under the respective models.

As resistors are passive components, electromagnetic compatibility (EMC) safety falls within the responsibility of the user.

Resistors with protection class IP20 or higher generally meet the requirements of the EMC Directive.

Units with protection class IP00 and IP1x shall be protected against contact and installed such that the requirements of the EMC regulations are complied with.

Units mounted within normal arm's reach must be provided with a note warning of the hot surface.

All units comply with the EEC Low Voltage Directive 73/23ECC.

## Notes for selection

- Define or calculate ohm value
- Determine braking capacity and d.f.
- Select resistor from the tables

## Example

Motor 5.5 kW, 400 VD →  $U_z = 650$  V DC

Braking capacity 7.5 kW, 10 % d.f.

Calculate:

$$R_{BR} = 650^2 / 7500 \times 0.75 = 42 \text{ ohm}$$

or select from table

Selection:

Tube resistor DEZ26040⑥-42R

Determination of the ohm value according to intermediate circuit voltage and capacity

Braking capacity $P_{BR}$ kW	Ohm values for grid voltage $U_N$ and/or intermediate circuit voltage $U_z$					
$U_N$ V AC	230	400	420	440	460	500
$U_z$ V DC	370	650	680	715	750	810
0.37	270	810	910	1000	1200	1300
0.55	180	560	620	680	750	910
0.75	150	430	470	510	560	680
1.1	100	270	330	330	390	430
1.5	68	220	220	270	270	330
2.2	47	150	150	180	180	220
3	33	100	110	130	140	160
4	27	82	82	100	100	120
5.5	18	56	62	68	75	91
7.5	-	42	47	51	56	68
11	-	27	33	33	39	43
15	-	22	22	27	27	33
18.5	-	18	18	20	22	27
22	-	15	15	18	20	22
30	-	10	11	12	15	16
37	-	6.1	9.1	10	12	13
45	-	6.8	7.5	8.2	10	11
55	-	5.6	6.2	6.8	7.5	9.1
75	-	4.3	4.7	5.1	5.6	6.8
90	-	3.7	3.9	4.2	4.7	5.6
110	-	2.7	3.0	3.3	3.9	4.3
132	-	2.4	2.7	2.7	3.3	3.9
160	-	2.0	2.2	2.4	2.7	3.0
225	-	1.4	1.5	1.6	2.0	2.2

## Cement-coated tube resistors

Art. No	Admiss. ohm values from - to	Rating kW at d.f., cycle time 120 s						
		100%	60 %	40 %	25 %	15 %	10 %	5 %
DEZ12010⑥-⑧	47 – 270	0.035	0.05	0.07	0.11	0.18	0.27	0.5
DEZ12012⑥-⑧	47 – 390	0.045	0.065	0.09	0.14	0.23	0.34	0.65
DEZ13010⑥-⑧	47 – 680	0.055	0.08	0.11	0.175	0.28	0.42	0.8
DEZ13012⑥-⑧	47 – 820	0.07	0.1	0.14	0.225	0.36	0.54	1.0
DEZ13016⑥-⑧	47 – 1200	0.095	0.14	0.2	0.3	0.49	0.73	1.4
DEZ13020⑥-⑧	47 – 1800	0.125	0.18	0.26	0.4	0.65	0.95	1.8
DEZ16020⑥-⑧	50 – 600	0.25	0.375	0.525	0.8	1.3	1.9	3.75
DEZ14030⑥-⑧	39 – 1500	0.27	0.4	0.56	0.86	1.4	2.05	4.0
DEZ14040⑥-⑧	33 – 2200	0.37	0.55	0.75	1.18	1.9	2.8	5.5
DEZ16030⑥-⑧	27 – 1000	0.4	0.6	0.84	1.28	2.08	3.0	6.0
DEZ16040⑥-⑧	22 – 1500	0.55	0.825	1.15	1.75	2.85	4.2	8.2
DEZ16050⑥-⑧	18 – 1800	0.7	1.05	1.45	2.2	3.6	5.3	10.5
DEZ16060⑥-⑧	15 – 2200	0.85	1.25	1.78	2.7	4.4	6.5	12.7
DEZ26040⑥-⑧	10 – 2200	1.1	1.7	2.3	3.5	5.7	8.4	16.5
DEZ26050⑥-⑧	6.8 – 2200	1.4	2.1	2.9	4.4	7.2	10.5	21.0
DEZ26060⑥-⑧	4.7 – 2200	1.7	2.5	3.5	5.4	8.8	13.0	25.0

⑥ = design, see key + page 3.2, 3.3

⑧ = Ohm value

Dimensions on page 3.2, 3.3

Type key: DEZ(T) ①②③④⑤⑥-⑦

T = Option, thermal switch, NC-contact, 230 V - 6 A, AC, resistive load \*

① = no. of tubes, 1-3

②③ = tube diameter in mm

④⑤ = tube length in cm

⑥ = design

0 = only tube

1 = tube with side panels

2 = tube with side panels and terminal

3 = tube with side panels and terminal box

4 = tube with side panels and perforated plate

5 = tube with side panels, perforated plate and terminal

6 = tube with side panels, perforated plate and terminal box, previous design, use code 8 instead

7 = tube with bracket and centering disks

8 = tube resistor, housed IP20, with terminals and cable lug, new design, use instead of code 8

9 = like as 8, but including 750 mm cable

⑦ = Ohm value, int. usage, e.g. 2R7

\* only for design 4 + 8 - 9

# Braking resistors for frequency converter drives, selection steel grid and cast iron resistors

## Cast iron resistors system GINO

Article number key:

### GWG(T)①②③-④-B

T = Option, thermal switch, NC-contact,  
230 V - 6 A, AC, resistive load

① no. of boxes, 1 - 3

② size 1 - 6

③ protection class

0 = IP00

2 = IP20, w/o bottom sheet

4 = IP23, w/o bottom sheet

④ Ohm value,

(nomenclature for  $2.7 \Omega = 2R7$ )

#### Accessories

- B perforated bottom plate

#### Dimensions and weights

on pages 1.20 and 1.21

## Cast iron resistors system GINO

Art. No	Admiss. ohm values From - to	Rating kW at d.f., cycle time 120 s						
		100%	60 %	40 %	25 %	15 %	10 %	5 %
GWG11③-④	0.12 – 7.5	2.8	4.2	4.9	9.1	14.7	21.7	42
GWG12③-④	0.17 – 10	3.9	5.8	6.8	12.6	20.5	30.2	58.5
GWG13③-④	0.21 – 13.5	5.0	7.5	8.7	16.2	26.2	38.7	75
GWG14③-④	0.28 – 7.68	6.7	10	11.7	22	35	52	100
GWG15③-④	0.43 – 11.5	10	15	17.5	32.5	52.5	77	150
GWG16③-④	0.57 – 15.3	13	19.5	22.5	42.2	68	100	185
GWG25③-④	0.21 – 23	20	30	35	65	105	155	300
GWG26③-④	0.28 – 30.7	27	40	47.5	87.5	142	209	405
GWG35③-④	0.14 – 34.5	30	45	52.5	97.5	157	232	450
GWG36③-④	0.19 - 46	40	60	70	130	210	310	600

## Steel grid resistors

Article number key:

### BEG(T)①②③④⑤-⑥

T = Option, thermal switch, NC-contact,  
230 V - 6 A, AC, resistive load

① no. of boxes, 1 - 6

② size 3, 4, 5, 7

③ protection class

0 = IP00

2 = IP20, w/o bottom plate

3 = IP13, w/o bottom plate

4 = IP23, w/o bottom plate

④⑤ max. no. of resistor grids

⑥ Ohm value,

(nomenclature for  $2.7 \Omega = 2R7$ )

#### Accessories

- B perforated bottom plate

#### Dimensions and weights

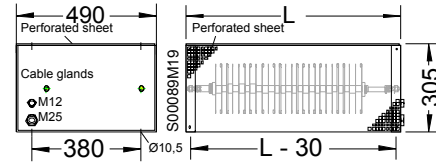
on page 6.4

## Steel grid resistors system GINO

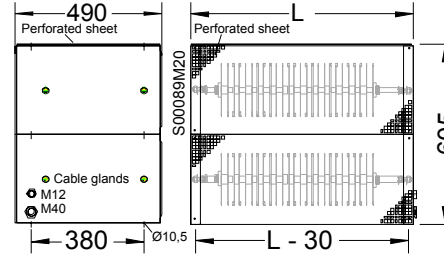
Art. No	Admiss. ohm values From - to	Rating kW at d.f., cycle time 120 s						
		100%	60 %	40 %	25 %	15 %	10 %	5 %
BEG13③06-⑥	0.66 – 19.2	2.5	3.3	3.6	4.3	9.5	13.5	26
BEG13③08-⑥	0.88 – 25.6	3.6	4.7	5.3	6.2	13.5	20	38
BEG13③10-⑥	1.21 – 32	4.5	5.8	6.6	7.7	17	25	48
BEG14③12-⑥	1.32 – 38.4	5.4	7.0	7.9	9.2	20	30	57
BEG14③14-⑥	1.54 – 44.8	6.3	8.2	9.3	10.5	24	35	67
BEG15③16-⑥	1.76 – 51.2	7.2	9.3	10.5	12.0	27	40	77
BEG15③18-⑥	1.98 – 57.6	8.1	10.5	11.9	13.5	31	45	86
BEG15③20-⑥	2.2 – 64	9.0	11.7	13.2	15.5	34	50	96
BEG17③22-⑥	2.1 – 7.04	10	13.0	14.7	17.0	38	55	107
BEG17③24-⑥	2.28 – 76.8	11	14.3	16.0	18.5	42	61	117
BEG17③26-⑥	2.47 – 83.2	12	15.6	17.5	20.5	46	66	128
BEG17③28-⑥	1.76 – 89.6	13	16.9	19.0	22	50	72	139
BEG17③30-⑥	1.89 – 96	14	18.2	20.5	24	54	78	179
BEG17③32-⑥	2 – 102	15	19.5	22.0	25	57	83	160
BEG25③36-⑥	1 – 115	16	20.8	23.5	27	61	89	171
BEG25③40-⑥	1.1 – 128	18	23.4	26.5	30	69	100	192
BEG27③44-⑥	1.2 – 140	20	26.0	29.0	34	77	111	214
BEG27③48-⑥	0.75 – 153	22	28.6	32.0	37	84	122	235
BEG27③52-⑥	0.82 – 166	23	29.9	33.5	39	88	128	246
BEG27③56-⑥	0.88 – 179	25	32.5	36.5	43	96	139	267
BEG27③60-⑥	0.95 – 192	27	35.0	39.5	46	104	150	288
BEG37③66-⑥	0.46 – 211	30	39.0	44.0	51	115	167	320
BEG37③72-⑥	0.5 – 230	32	41.6	47.0	55	123	178	340
BEG37③78-⑥	0.54 – 249	35	45.5	51.0	60	135	195	370
BEG37③84-⑥	0.59 – 268	38	49.4	55.5	65	146	212	405
BEG37③90-⑥	0.63 – 288	40	52	58.5	68	154	223	420

# Braking resistors for frequency converter drives, dimensions steel grid resistors

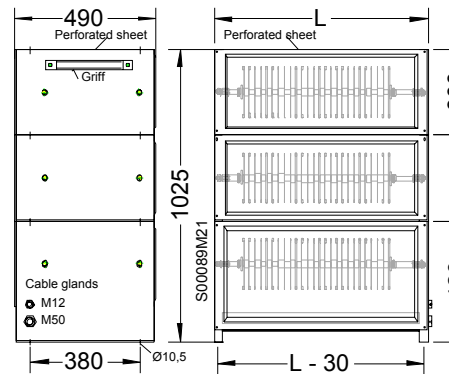
Protection IP00, w/o perf. plate			Protection IP20, with perf. plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG130..	330	13	BEG132..	330	14
BEG140..	430	18	BEG142..	430	25
BEG150..	530	22	BEG152..	530	30
BEG170..	740	30	BEG172..	740	35



Protection IP00, w/o perf. plate			Protection IP20, with perf. plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG250..	530	43	BEG252..	530	45
BEG270..	740	45	BEG272..	740	60



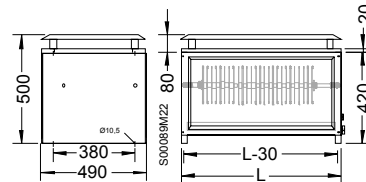
Protection IP00, w/o perf. plate			Protection IP20, with perf. plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG370..	740	92	BEG372..	740	100



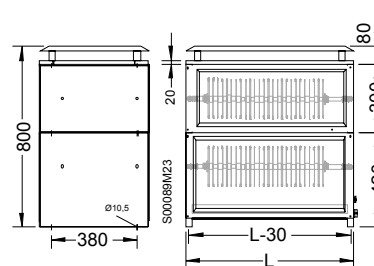
4 stacked boxes, no picture, total height 1320 mm

Protection IP00, w/o perf. plate			Protection IP20, with perf. plate		
Code	Dim. L	ca. kg	Code	Dim. L	Ca. kg
BEG470..	740	120	BEG472..	740	130

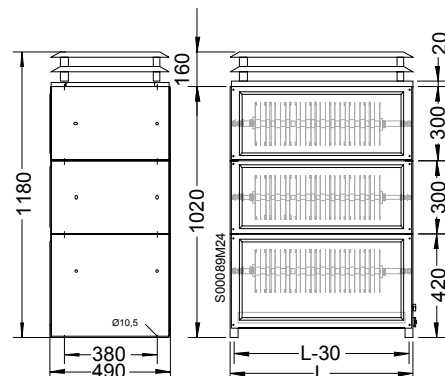
Protection IP13, w/o bottom plate			Protection IP23, w/o bottom plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG133..	330	23	BEG134..	330	23
BEG143..	430	28	BEG144..	430	28
BEG153..	530	35	BEG154..	530	35
BEG173..	740	50	BEG174..	740	50



Protection IP13, w/o bottom plate			Protection IP23, w/o bottom plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG253..	530	60	BEG254..	530	61
BEG273..	740	85	BEG274..	740	86



Protection IP13, w/o bottom plate			Protection IP23, w/o bottom plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG373..	740	120	BEG374..	740	121



4 stacked boxes, no picture, total height 1480 mm

Protection IP13, w/o bottom plate			Protection IP23, w/o bottom plate		
Code	Dim. L	ca. kg	Code	Dim. L	ca. kg
BEG473..	740	150	BEG474..	740	152



## Table of contents

Application, cooling, models... page 7.1

Requirements, standards, examples  
..... page 7.2

### Application

Following the state of the art, railbound vehicles are equipped with three-phase current motors whose acceleration, speed and braking are controlled by means of power electronics.

During braking, the kinetic energy of the vehicle is transformed into electrical energy, returned to the grid wherever possible, and thus reused.

However, this requires a grid that can take on such energy at any time. Otherwise, the grid voltage will rise and the brakes will not work.

Another method is to convert the braking energy into heat using a braking resistor.

Braking resistors are used as

- additional brake for energy return to the grid,
- to take off some stress from the mechanical brake
- and as an emergency brake resistor.

Electrical braking is wear-free and can be optimally controlled so that no abrupt changes in braking occur which the passengers may resent.

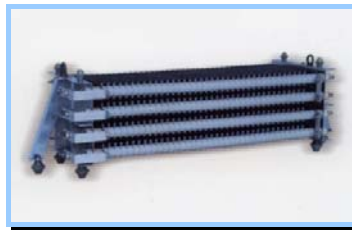
### Cooling

In view of the large amounts of heat to be dissipated, braking resistors require sufficient cooling air.

Depending on the cooling system used

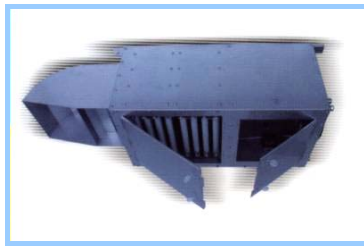
- natural air cooling and
  - forced air cooling
- braking resistors are available.

**Natural air cooling** resistors are mainly installed on the outside of the vehicle and in some cases the airstream can effectively support cooling.



Rooftop resistor for natural air cooling

**Forced air cooling** braking resistors are supplied with cooling air by a fan so that mounting inside of the vehicle is also possible.



Underfloor resistor with fan cooling

Among the resistors mounted on the outside of the vehicles, two types are available:

- **Rooftop resistors** and



- **Underfloor resistors.**



Rooftop resistors are often easier to cool but mostly result in aerodynamic and optical problems.

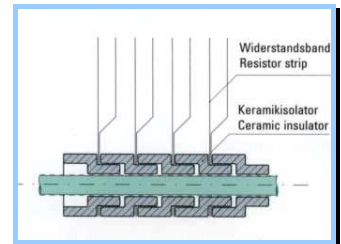
Underfloor resistors are problematic in terms of heat dissipation, in particular during standstill after braking.

### Designs

Basically all resistor designs shown in this list can be used as braking resistors. Due to their optimum adaptability in terms of mass to surface, however, strip-wound resistors are most widely used.

Regarding the design of the strips, two types are available

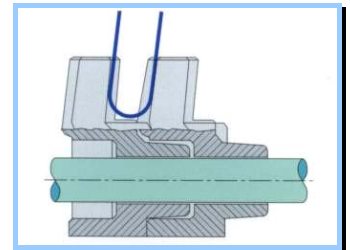
- individual strips, interconnected (mostly by spot welding),



6GN1 design, spot-welded strips mounted with ceramic insulators on support brackets

and

- continuously folded strips with connections at the beginning and end.



3PQ4 design, continuously folded strip, supported on special ceramics, enable for permanent temperatures of up to 850 °C. Patented by Siemens

Both technologies have their special fields of application and offer specific advantages for specific applications. The optimum selection is dependent on the individual requirements and design conditions. The selection and design require extensive experience and are done by GINO in cooperation with the vehicle and system developers.

# On board worldwide: braking resistors for transportation engineering

## Requirement for braking resistors

- Functional safety
- Long service life
- Compact design
- Low maintenance, easy servicing
- Vibration-resistant

Braking resistors made by GINO meet all these requirements due to

- solid structure, modern manufacturing methods and machines combined with the experience of our project engineers ensure a high quality standard,
- the use of high-grade, heat-resistant and corrosion-proof resistor materials, adjusted to the installation and environmental conditions determine the high service life of GINO braking resistors.
- The extensive experience of our design engineers ensures that the optimum solution is found as a function of the space available and the customers' requirements.
- The design is adjusted to the place of installation and considers the needs of the maintenance staff regarding fast replacement in case of defect. The housings are mainly manufactured as jointing units so that mechanically defective units can be replaced without requiring welding or special tools. Resistors are designed as withdrawable modules.

## Criteria for evaluation

- Resistor material
  - corrosion-proof
  - heat-resistant
  - not magnetizable
  - temperature coefficient of the electrical resistor adjusted to the required resistance constancy.
- Resistor surface
 

The larger the surface the better the heat dissipation under comparable cooling conditions
- Resistor mass
 

The larger the mass of the active resistor material, the higher the storage and overload capacity
- Insulation
 

Ceramic insulation in the hot area is resistant to creepage current and does not age
- Housings made from stainless steel guarantee that the unit is maintenance-free during its entire service life and is preferable to galvanized or painted surfaces. Jointing design allows for smooth replacement of defective parts. NC – manufactured parts can be produced at any time, custom-fit.

## Codes and standards

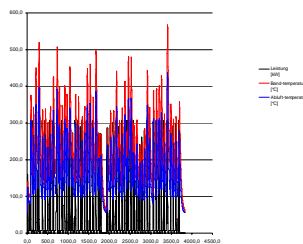
(list not complete, additional international and national standards can be taken into account)

- DIN EN 60322 / VDE0115 Part 440  
Regulations for power resistors in open design
- DIN EN 50124-1 / VDE 0115 Part107-1  
Insulation coordination, creepage and clearances for all electrical and electronic equipment
- DIN EN 61 373 / VDE 0115 Part 106  
Equipment for rail vehicles, vibration and shock tests
- DIN EN 60068-2-1  
Environmental tests: coldness
- DIN EN 60068-2-2  
Environmental tests: dry heat
- DIN EN 60068-2-3  
Environmental tests: test Ca, moist heat
- DIN EN 60068-2-52  
Environmental tests: test Kb, salt spray test
- DIN VDE 0100-410  
Protective measures, protection against electric shock
- DIN VDE 0470-1  
EN 60529  
Protection afforded by housings (IP Code)
- IEC 60077-1  
Railway applications – Electric equipment for rolling stock, Part 1: General service conditions and general rules.

## Data required for dimensioning

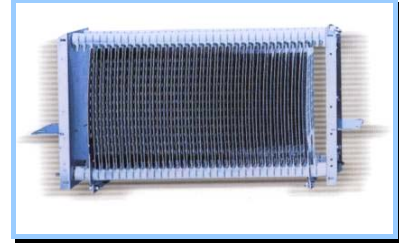
- Operating voltage  $U_w$
- Rated insulation voltage  $U_i$   
Type of insulation (simple, upgraded, double) DIN EN 50124-1
- Overvoltage class  
DIN EN 50124-1
- Impulse voltage withstand level  $U_i$   
DIN EN 50124-1
- Pollution degree  
DIN EN 50124-1
- Ambient temperature range
- Minimum resistance cold including all tolerances
- Maximum resistance hot, including all tolerances
- Rating profile  
either:  
by rating and duration or by break with cyclic operation  
or  
braking performance and duration as a factor of the drive distance, including drive and stop time as well as downhill driving with braking.
- Housing design,  
admissible maximum dimensions, admissible weight, place of installation, type of cooling

Based on these data, the resistor is dimensioned with the assistance of a computer and the resistor temperatures are simulated.



Time-dependent rating and temperature diagram

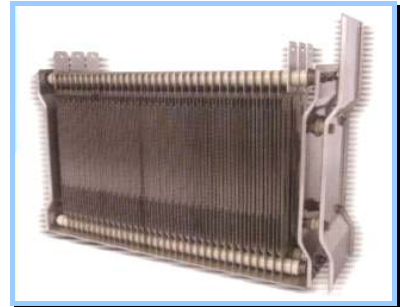
## Design examples



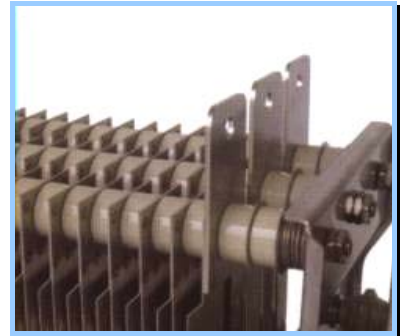
Resistor module with strip, 3PQ4 design



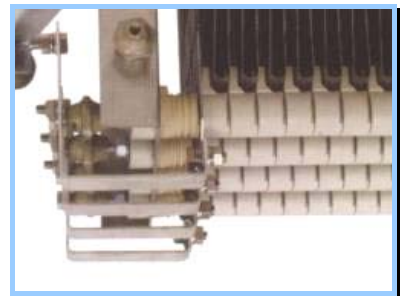
Underfloor resistor with fan cooling plug-in modules in 3PQ4 design



Plug-in frame, 6GN1 design



Detail 6GN1 design



Detail 3PQ4 design



# Load and test resistors, applications and examples



## Application

Load and test resistors are used for testing, maintenance and protection of energy sources and in testing stations:

- **Test resistors in generator testing stations**

Generators are subjected to a final test in the manufacturers testing station and have to be loaded with nominal load to this effect. Besides the return of the power into the local utility grid, this is an application for load resistors.



Load bank 200 kW, stepped.

- **Test and load resistors in airport applications**

Ground Power Units (GPU) for the power supply of aircraft on the apron or stationary supply units must be subjected to function and performance tests at regular intervals. To this effect, GINO supplies mobile power units which comprise all voltages found in aircraft applications. The connections are adjusted to those used in aircraft and the design is coordinated with the operators in consideration of the applicable standards.



Mobile GPU tester

## Table of contents

Applications and design examples..... page 8.1

Applications and design examples models, standards, order data page 8.2

- **Test resistors in switchgear testing stations**

In the development phase of non-solid state and electronic switchgears, the designed performance data have to be checked. During production, continuous quality assurance by way of random checking is required. Test resistor combinations adjusted to the individual purpose are used.



Computer-controlled load resistor 20 kW



Mobile battery unloading resistor 60 V 400 A

- **Test and load resistors in the military sector**

Here similar requirements as in the airport sector are found. GINO designs and manufactures stationary and mobile load banks following military specifications, also with IR-absorbing paint (NATO olive).



Mobile load bank

- **Base load resistors for diesel generators and diesel power plants**

Diesel generators running at too low loads do not reach their operating temperature, with soot formation. Base load resistors can prevent this.



Load resistor with fan cooling for outdoor installation 600 kW

- **Load resistors for the testing of emergency generators**

The functioning of emergency generators must be checked at regular intervals. Load resistors will provide the required minimum load.

- **Peak load reducer in wind power stations**

Strong wind often causes undesired load surges in wind power stations with asynchronous generators. If the grid cannot take on the power, the utility supplier trips the wind power station. The standstill and the subsequent restart are very costly. GINO load resistors as peak load reducers take on the excess energy and convert it to heat. The installed GINO Powermatic is capable of monitoring several wind power stations operated in parallel and to take on the excess energy in up to 4 steps, when required.



Peak load reducer 240 kW with control unit

## Designs

Load resistors can be designed as mobile or stationary units.

For cooling, usually air is used as it is available without restrictions for cooling and affords the best cooling effect due to the direct contact with the resistor conductor. At the place of installation care must be taken that fresh cooling air and hot cooling air can enter and leave the unit freely.

Only units of a few kilowatt are designed for natural air cooling. Usually, fan cooling is preferable. However, it presupposes that either the voltage to be loaded can be used to operate the fan or a suitable auxiliary power source is available.

As resistor elements you mainly find the steel grids described in chapter two of this brochure. The elements are mounted as banks and arranged in the air flow. Wiring is done with heat-resistant cables.

Together with the cooling air fan and the switching and measuring unit, the resistor unit is integrated into the sectional steel frame with steel sheet cladding. In case of difficult climatic conditions, also galvanized steel or housings completely made from stainless steel can be used. Mobile units can be equipped with rolls, mounted on trailers or vehicles.

For control purposes, the **GINO Powermatic** is available to enable for the step-wise connection and disconnection, preselection and sudden load connection as well as the control of a preselected load. Units for/with computer control are also possible. Please contact our project engineers.

## Codes and standards

Special codes and standards for load resistors do not exist. The applicable DIN and VDE regulations as well as the pertinent customer specifications will be used.

- DIN VDE 0100 / IEC 364 Regulations on the erection of power systems up to 1 kV
- DIN VDE 109 IEC664 Insulation coordination in low voltage systems
- VDE DIN 0110 Regulations for the calculation of clearance and creepage distances
- VDE DIN 0660 various parts low voltage switchgear units
- DIN 40050 IEC 144 Protection Classes

The units conform with the EEC Low Voltage Directive of 1973.

The longstanding experience of our project engineers guarantees that the design complies with the state of the art.

## Order data where relevant

- Intended application
- Rated voltage(s)
- Rated load capacity
- Admissible tolerance cold/hot
- Stepping
- Step distribution
- Available power source
- With / without switchgear
- Desired functions
  - GINO Powermatic
  - BUS control
  - SPS control
  - Computer control
- Type of interface for applications with external control
- Requisite measuring devices and their requisite accuracy.
- Local measurement / remote display
- Data logging
- Type and number of terminal connections
- Protection class
- Indoor or outdoor installation
- Stationary or mobile, if mobile, type of transport:
  - portable (depending on the size)
  - on rolls
  - vehicle up to 6 km/h
  - trailer up to 25 km/h as per German motor vehicle safety standards
  - trailer up to 80 km/h as per German motor vehicle safety standards
- Type and shade of paint coat



The specialists for resistors

# Resistors for medium voltage systems

## grounding resistors, damping resistors



Resistor modules IP00



Grounding resistors IP23

### Table of contents

Grounding resistors .....page 9.1

Grounding resistors selection ....page 9.2

Grounding resistors design examples.....page 9.3

Damping resistors for filter circuits .....page 9.4

**Grounding resistors** are used for the low-ohm grounding of the neutral point in medium voltage grids.

Compared with a solid grounding which exhibits an earth fault factor of 1.0, the earth fault factor in low-ohm grounded grids is only slightly higher with values of 1.1. to 1.4.

The earth fault factor is the ratio of the effective overvoltage values on the external conductors to the nominal voltage on the earth. The low earth fault factor ensures high operational safety in case of an earth fault.

The grounding resistor limits the fault current and the watt component of the current allows for an easy fault detection.

In compensated systems (ground-fault-neutralizer-grounded system), the location of a ground fault can be more easily determined by a short-term, low-ohm neutral point grounding system.

Grounding resistors are designed for short-term operation **KB**.

The **design criteria** are the maximum current at the connection point and the time until tripping by the higher switching level. The units are designed for operation with constant fault voltage, the energy converted in the resistor drops due to the increasing resistance value caused by higher temperatures.

In addition to the conductor voltage to the earth, the cold resistance which determines the initial current, the current flow time, the temperature rise during the operating time and the resulting hot resistance which also determines the current at the end of the operating time are the **parameters** for a grounding resistor.

The capacity of the resistor is shown by the current-time integral  $[i^2t] = \text{kA}^2\text{s}$ .

The **insulation** of the resistors is dimensioned for the system voltage.

System voltages are 12, 24, 36 and 52 kV. Depending on the climatic conditions, the pollution and the geodetic elevation at the place of installation, higher clearances and creepage distances may have to be considered.

### Protection classes

Resistors for indoor installation in electrical operating rooms are manufactured in protection classes IP00 or IP20.

For outdoor applications, the minimum protection class required is IP23.

Higher protection classes are problematic with a view to the limited ventilation for thermal stresses acting on the components, insulators and casings.

The maximum temperature pursuant to IEEESTd32-1972 is to be agreed between the manufacturer and the user. Depending on the resistor material used, high temperatures do not represent a problem for the resistor proper. Only for the housing, insulators, converters and cable sealing ends, special measures have to be taken to protect them from inadmissible temperatures.

Cast iron resistors are usually dimensioned for final temperatures of 400 to 500°C and resistors made from chromium nickel steel for temperatures up to 650°C.

### Applicable codes and standards

DIN 40050	Protection classes
DIN 57101 VDE 0101	Erection of power systems > 1 kV
DIN 57111 VDE 0111	Insulation coordination for devices in three-phase circuits > 1 kV
DIN 57 141 VDE 0141	Grounding in AC systems > 1 kV
IEC 273	Characteristics of indoor and outdoor post insulators
IEEESTd 32–1972	Requirements, Terminology and Test Procedure for Neutral Grounding Devices

### Design

GINO grounding resistors consist of the resistor banks with resistor elements made from cast iron with or without steel grid elements made from stainless steel.

This list comprises cast iron resistors of the system GINO. Alternatively, also resistors with stainless steel elements can be offered and manufactured.

One or several resistor banks are installed in an insulated module and one or several modules are arranged in one housing.

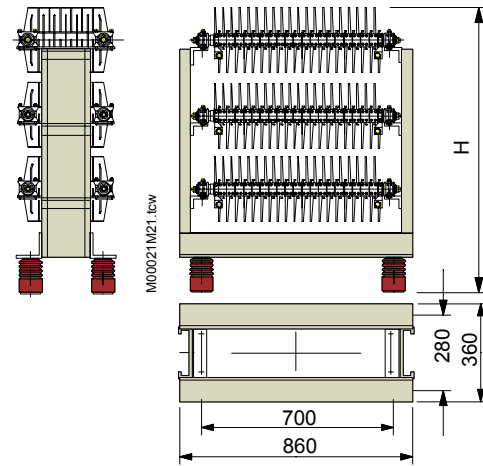
The housings are made from welded sectional steel frame with steel sheet cladding.

3-coat painting systems with 2-component paints protect the surface. Standard color is RAL 7032.

# Grounding resistors, selection, dimensions

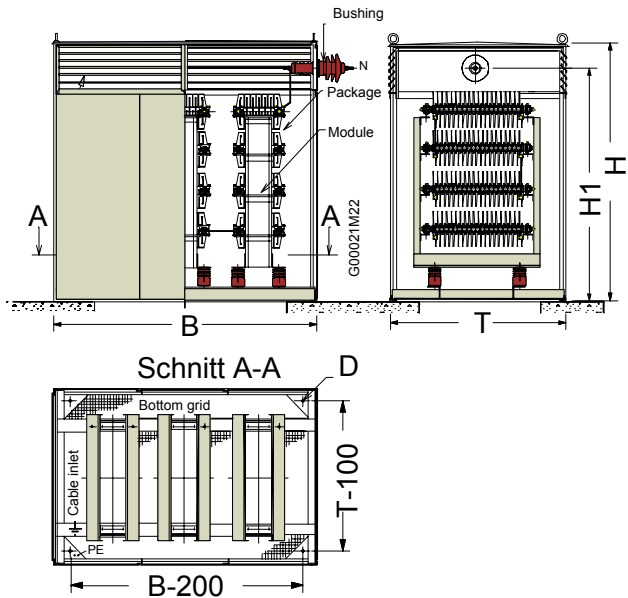
## Resistor modules, protection class IP00, indoor installation

Size	No. of banks <sup>1)</sup>	Dimension H	Weight ca. kg
System voltage 12 kV, maximum 4 kV per bank			
1202	2	850	145
1203	3	1040	210
1204	4	1310	275
1205	5	1500	340
1206	6	1750	400
System voltage 24 kV, maximum 12 kV per module, maximum 4 kV per bank			
2402	2	940	150
2403	3	1130	215
2404	4	1400	280
2405	5	1590	345
2406	6	1840	405
System voltage 36 kV, maximum 12 kV per module, maximum 4 kV per bank			
3602	2	1050	155
3603	3	1240	220
3604	4	1510	285
3605	5	1700	350
3606	6	1950	410



## Housed resistors for outdoor installation, protection class IP23

Size	Modules	Max. no. of banks	Dimensions				weight ca. kg
			B	T	H	H1	
System voltage 12 kV, maximum 4 kV per bank							
12102	1	2	800	1200	1500	1250	390
12103	1	3	800	1200	1700	1450	470
12104	1	4	800	1200	1950	1750	550
12105	1	5	800	1200	2150	1900	630
12106	1	6	800	1200	2400	2150	710
12204	2	8	1400	1200	1950	1750	1000
12205	2	10	1400	1200	2150	1900	1150
12206	2	12	1400	1200	2400	2150	1300
12304	3	12	1800	1200	1950	1750	1350
12305	3	15	1800	1200	2150	1950	1570
12306	3	18	1800	1200	2400	2150	1780
System voltage 24 kV, maximum 12 kV per module, maximum 4 kV per bank							
24104	1	4	900	1400	2100	1825	710
24105	1	5	900	1400	2300	2025	800
24106	1	6	900	1400	2550	2275	890
24204	2	8	1500	1400	2100	1825	1090
24205	2	10	1500	1400	2300	2025	1250
24206	2	12	1500	1400	2550	2275	1400
24312	3	12	2000	1400	2100	1825	1450
24315	3	15	2000	1400	2300	2025	1680
24318	3	18	2000	1400	2500	2275	1900
System voltage 36 kV, maximum 12 kV per module, maximum 4 kV per bank							
36202	2	4	1800	1700	1900	1500	890
36203	2	6	1800	1700	2100	1700	1060
36204	2	8	1800	1700	2300	1900	1230
36205	2	10	1800	1700	2500	2100	1400
36206	2	12	1800	1700	2750	2350	1550
36304	3	12	2300	1700	2300	1900	1610
36305	3	15	2300	1700	2500	2100	1830
36306	3	18	2300	1700	2750	2350	2060



### Notes

Information required:

- System voltage
- Ohmic value  $R$
- Rated earth fault current  $[I_f] = A$
- Operating time  $s$
- Cont. Current, where applicable  $[I_c] = A$
- Protection class IPxx
- Connection type (cable, bushing)

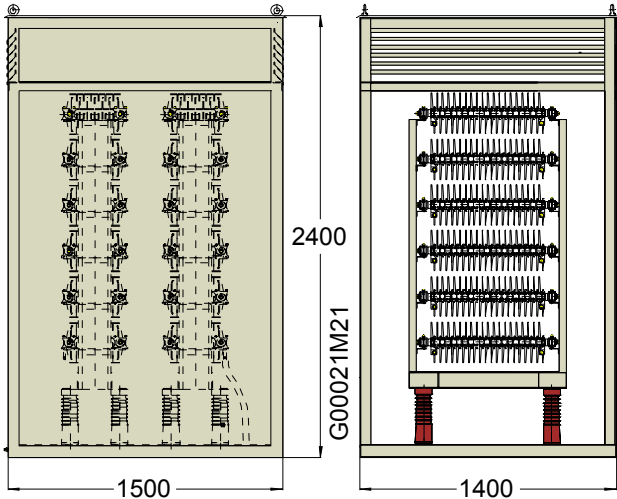
Dimensioning:

- Calculate current-time integral:  $[i^2 t] = \text{kA}^2\text{s}$
- Select element type GWE.. on page 1.19
- Calculate the number of elements  $n_{\text{Elements}} = R / R_{\text{Element}}$
- Calculate the number of banks  $n_{\text{Banks}} = n_{\text{Elements}} / 48$   
round up to full no. of banks, select even number of elements per bank, cross voltage  $I_f \cdot R_{\text{Bank}}$  per bank maximum 4 kV, increase number of banks, where required.
- Select module or housing size, observe criteria for system voltage  $I_f \cdot R_{\text{Module}} \leq 4 \text{ kV}$ .
- Additional remarks in special brochure "Neutral point grounding resistors"

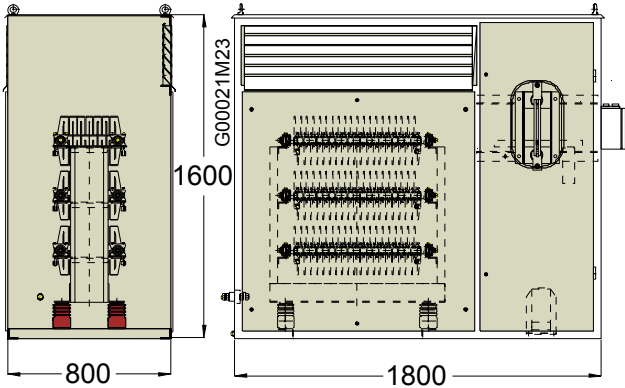
### Special designs and accessories available

- Galvanized housing, hot-dip galvanized frame, hot-dip galvanized sheet cladding, 2K PUR painting
- Steel grid elements made from chromium nickel steel instead of cast iron
- Higher protection class IP3x, IP4x, IP5x
- Indoor / outdoor bushing HV side
- Current transformer
- Higher clearances and creepage distances with insulators
- Disconnecting switch, 1-pole, different drives
- Low voltage cabinet or terminal strip

Grounding resistors, models



Grounding resistor with cast iron elements, 2 x 6 banks, IP23



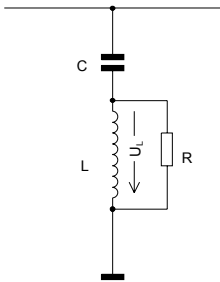
Grounding resistor IP23, with installed disconnection switch

# Damping resistors, selection, dimensions

## Application

Filter circuits are used to avoid negative effects on the grid of energy systems.

Large-scale induction smelters in aluminum or steel mills generate harmonic waves. These must be prevented from acting on the grid. To this effect filters are used, mostly in the form of T or L elements. A series resonant circuit at the inlet of the medium voltage feed consisting of a series connection of capacity and inductance acting as a load on the harmonic waves thus damping them.



To prevent hazardous switching over-voltage at the reactance coil and increase the band width of the resonant circuit, the reactance coil L is damped by resistance R.

Usually, with the design of the filter the currents  $I_{0...n}$  of the base wave and the harmonic wave  $f_{0...n}$  and the resistance value are already set.

The rating is then calculated as follows

$$P = \sqrt{\sum_0^n i^2} \cdot R = W$$

Or the complete rating and the resistance value are indicated. These values can be used to calculate the current and the direct-axis voltage  $U_L = U_R$ :

$$I = \sqrt{\frac{P}{R}} = A$$

When switching on, almost the entire loading current of the capacity can flow across the resistor depending on the position of the vector, so that a surge load capacity of about

$$E = \frac{1}{2} C \cdot \hat{U}^2 = Ws, J$$

or the derived current-time integral of

$$i^2 t = \frac{E}{R} \cdot 10^{-6} = kA^2s$$

have to be considered.

## Designs

Filter resistors are manufactured on the basis of steel grid resistors (chapter 2 of this catalog).

For the design, the requisite number of elements are assembled to form one or several banks and combined in one or several mounting frames in consideration of the insulation for the system voltage.

The mounting frames are mounted on support insulators and installed with or without housing depending on the required protection class.

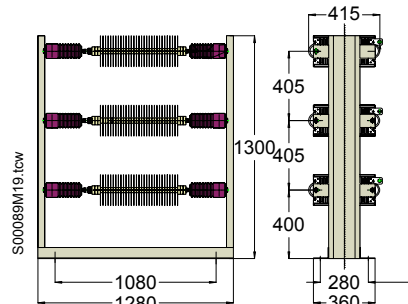
Housed resistors can be manufactured mounted on insulators with non-grounded or grounded casing.

## Order data

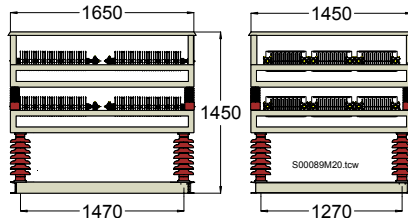
- System voltage
- Basic insulation voltage (BIL)
- Nominal capacity or currents
- Initial current and time
- Resistance value
- Admissible manufacturing tolerance
- Admissible tolerance cold/hot
- Installation altitude above sea level
- Climatic and atmospheric conditions
- Ambient temperature range
- Indoor or outdoor installation
- Protection class
- Type of terminal connection

## Design examples

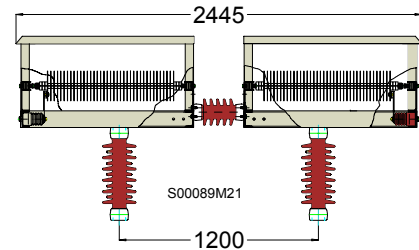
Damping resistors with steel grid elements



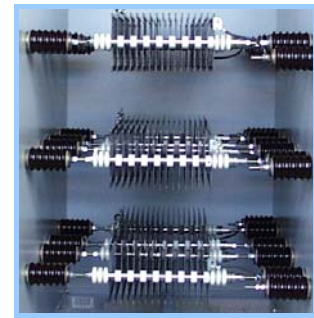
- Damping resistor IP00, three-phase



- Damping resistor 130 kW, IP00, with 2 base frames, with protective roof, insulation for outdoor installation



- Damping resistor IP00, with 2 base frames, with protective roof, insulation for outdoor installation



- Damping resistor in housing, internal view

## Crane cabins, control platforms, electrical equipment



Originally a manufacturer and supplier exclusively for cast iron resistors focussing on resistors for hoisting gear drives (crane resistors), GINO (formerly Wiemann) also produced crane cabins to round off its product portfolio. In addition to the manufacture of standard cabins, the company's longstanding experience is also used for the production of special cabins, in particular large-scale cabins for open-pit mining equipment, vehicles and container bridges. The cabins are adjusted to the individual application and requirements of the customer in cooperation with the engineers of the plants.

The company also designs and manufactures the crane operator seats and the complete electrical equipment for cabins and control platforms.

**GINO standard crane cabins** consist of the cabin body and the full-vision cabin, which can be replaced separately when damaged.

The cabin body is a fully-welded, torsion-proof frame structure with steel sheeting. The suspension is integrated into the cabin body. The cabin can be accessed from the side, from the rear and through the roof. Safety glass is used for glazing.

The high-grade, 2-component paint affords permanent protection against corrosion. Crane cabins are available in two standard widths and with a cabin body depth ranging from 800 to 2000 mm.

**Special cabins** are perfectly tailored to the individual application and location and will be manufactured following the customer's specifications:

- Cabins for container cranes
- Control platforms for open-pit mining applications
- Operator cabins for special vehicles
- Cabins with fire protection
- Cabins protected against radiation

### Table of contents

#### Standard cabins

Cabin 101 for upright or suspended installation..... page 10.2

Insulated cabin 103 for upright or suspended installation for indoor and outdoor operation ..... page 10.2

Air-conditioned cabin 104 for suspended or upright installation for indoor and outdoor operation ..... page 10.2

**Crane operator seats** ..... page 10.3  
KFS2  
ISRI 4004  
ISRI 6000/575

**Crane control units** ..... page 10.3  
KSE 92-3  
KSE 94 stationary  
KSE 94 swiveling

**Extras**..... page 10.4  
Control switches  
Control and signaling devices  
Label plates  
Wiring  
Painting  
Special designs



# Crane cabins

## Standard cabin 101



for suspended or upright installation. Simple cabin, mostly used for indoor cranes.

- Ambient temperatures from +5 ... +25°C
- Floor widths 1336 and 1536 mm
- Floor depth 800 ... 2000 mm
- Clearance 1935 mm
- Hinged door or access through the roof
- Simple glazing with laminated safety glass VSG 6.
- Main window with top-hinged sash window opening to the outside.
- Lateral cabin windows with in-swinging casement windows, hinged bottom window with foot grid.
- Lateral cabin windows swinging on the upper side and fixed at the bottom.
- Cable floor, 220 mm high with bolted bottom covers, rubber flooring, integrated control chair fixture.
- Complete with ashtray, logbook holder, operating permit display, knot rope fixture, holder for fire extinguisher
- Two-layer paint coating outside yellow RAL 1012 inside matte gray RAL 7032

### Extras

- Electrical installation
- Control seats
- Sun protection glazing
- Window wiper/washer unit
- Heating
- Air-conditioning
- Fan/venting
- Shades or blinds

## Insulated cabin 103



For suspended or upright installation, indoor and outdoor operation.

- Double-walled cabin insulated on the inside with 30 mm rock wool.
- Ambient temperatures -5 ... +35°C
- Floor widths 1336 and 1536 mm
- Floor depth 800 ... 2000 mm
- Clearance 1935 mm
- Hinged door or access through the roof
- Simple glazing or insulated glazing with laminated safety glass VSG6
- Main window with top-hinged sash window opening to the outside.
- Lateral cabin windows with in-swinging casement windows,
- Hinged bottom window with foot grid, lateral cabin windows swinging on the upper side and fixed at the bottom.
- Cable floor 220 mm high, of which 60mm insulation with bolted bottom covers, rubber flooring, integrated control chair fixture.
- Complete with ashtray, logbook holder, operating permit display, knot rope fixture, holder for fire extinguisher
- Outside three-layer paint coat yellow RAL 1012
- Inside two-layer paint coat gray matte RAL 7032



Split air conditioning

## Air-conditioned cabin 104



For suspended or upright installation. Indoor and outdoor operation at elevated temperatures.

- Double-walled cabin, insulated with 60 mm rock wool on the outside, no reduction in inside space
- Ambient temperatures -30 ... +60°C
- Floor widths 1436 and 1636 mm
- Floor depth 800 ... 2000 mm
- Clearance 1935 mm
- Hinged door or access through the roof
- Insulated glazing with double laminated safety glass 6/12/6 mm, transparent, upon request also colored glass.
- Main window with top-hinged sash window opening to the inside.
- Lateral cabin windows with swinging casement window opening to the inside, hinged bottom window with foot grid.
- Lateral cabin windows swinging at the top and with fasteners at the bottom, removable.
- Cable floor 220 mm high of which 90mm insulation, with bolted floor covers, rubber flooring, integrated control chair fixture.
- Complete with ashtray, logbook holder, operating permit display, knot rope fixture, holder for fire extinguisher.
- Outside three-layer paint coat yellow RAL 1012
- Inside two-layer paint coat gray matte RAL 7032



Compact air conditioning



# Crane operator seats, electrical equipment

**Crane operator seat KFS 2**



Crane operator seat KFS 2 is steplessly adjustable for height by means of a pressure spring (gas). The back of the seat can be fully folded onto the seat. The folded seat can then be tilted to the side at an angle of 90°. All functions can be adjusted with a lever.

Technical data:

- Adjustable height 100 mm
- Seat back
  - max. inclination 10°
  - adjustable height 120 mm

**Crane operator seat ISRI 4004**



Crane operator seat ISRI 4004 is steplessly adjustable for height by means of a pressure spring (gas) and provided with a vibration damper pressurized with oil. The back of the seat can be fully folded onto the seat. The folded seat can then be tilted to the side at an angle of 90°. All functions can be adjusted with a lever.

Technical data:

- Vibration lift 80mm
- Steplessly adjustable weight 50-130 kg
- Horizontal adjustment 150 mm
- Adjustable seat height 100 mm
- Seat back, max. inclination 20°

**Crane operator seat ISRI 6000/575**

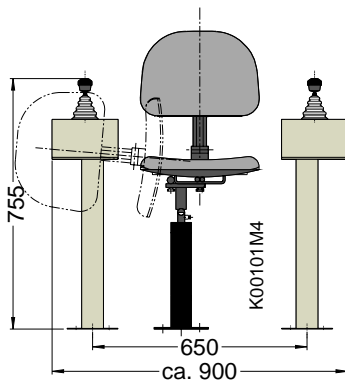


Crane operator seat ISRI 6000/575 is provided with mechanical springs and with a vibration damper pressurized with oil. The main adjustable elements are operated with springs and are positioned at an ergonomically favorable distance for manual operation.

Technical data:

- Vibration lift 95 mm
- Steplessly adjustable weight 50-130 kg
- Horizontal adjustment 150 mm
- Seat back, max. inclination 28°
- Adjustable height and inclination 65 mm
- In addition, arm rests and/or head rests are available.

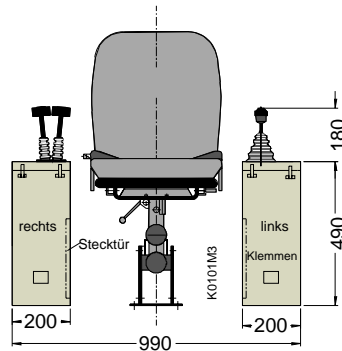
**Crane control unit KSE 92-3**



Crane control unit KSE 92-3 is an economical solution for crane cabins that are not permanently used.

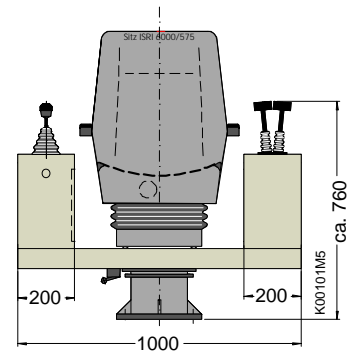
The operating consoles are installed on pillars (cable routing into the cabin floor). On the operating console, the following items can be installed, max.  
 2 pc compound drives (for 4 drives) and 20 control and signaling units.  
 The internals are wired to a terminal strip. Installation on a joint base plate is possible. The corresponding seat to be used is crane operator seat KFS 2.

**Crane control unit KSE 94, stationary**



Crane control unit KSE 94, stationary, is suited for installation in small crane cabins up to a cabin width of 1.2 m. The standard console widths are 200 and 300 mm. At a console width of 200 mm, a maximum of 2 compound drives or 1 compound drive and 1 double-lever actuator and 40 control and signaling units can be installed. At a console width of 300 mm, two additional compound drives can be installed. The internals are wired to a terminal strip. Installation on a joint base plate is possible. Crane operator seats KFS 2 or ISRI 4004 are suitable.

**Crane control unit KSE 94, swiveling**



Crane control unit KSE 94, swiveling, is suited for installation in large crane cabins as well as on open-pit mining equipment and other loading facilities. The complete unit can be turned at an angle of 270° and can be blocked in any position with a brake. The consoles can be equipped as described for the variant with stationary control unit. The design of the console can be adjusted according to the customer's request. The maximum width of the unit is 1,800 mm. Wiring is to a terminal strip. Crane operator seat type ISRI 6000/575 is used.

# Extras

## Internals

### Control switches



The control switches installed are types V64, V62, D64 or V11 made by Gessmann. Upon request by the customer, other makes are also available.

### Control and signaling devices



All standard makes are suited as control and signaling devices. Products made by ABB, Möller and SIEMENS are available on short notice.

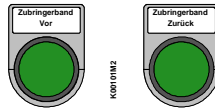
### Other internals



Depending on the design of the control unit, further components (intercom, computer screens, keyboards, measuring instruments and others) can be added.

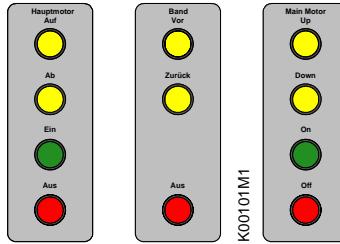
## Labeling

### Individual label plates



Labeling of the internals by means of name plates (plastic or aluminum ) in full text with plate holders.

### Engraved frames



Labeling with engraved aluminum console frames. The text is engraved and provided with a colored background.

### Wiring to terminal strip

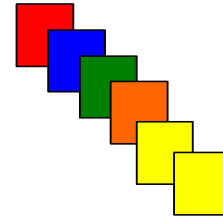


Wiring to terminal strips in the corresponding console sides. The customer can freely select the strip make.

### Wiring with loose cable ends

Wiring is done with 5 m cable ends (single-core) for direct connection.

## Painting



The standard paint coat is RAL 7032 (light gray) paint system. All other RAL colors are available upon request.

### Special designs

Upon request, we can also manufacture other console tailored to the customer's needs.

