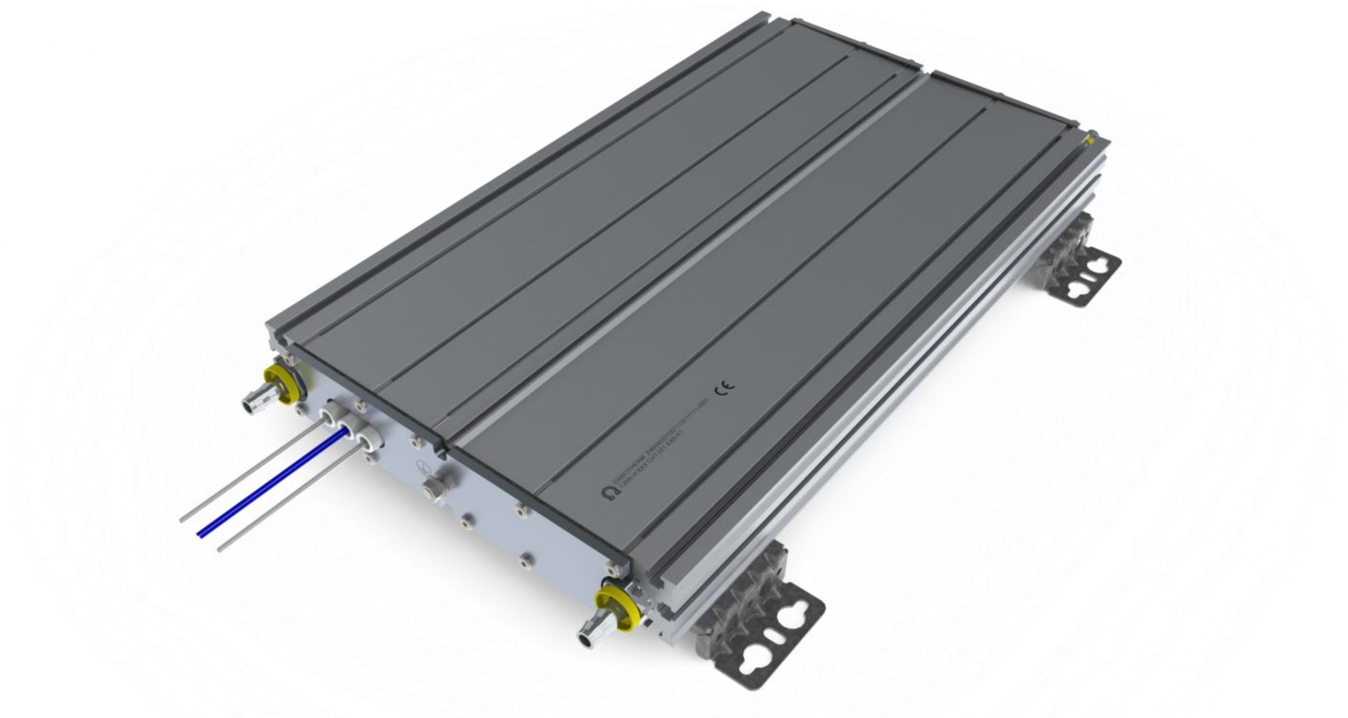
ALPHA

CBW-H / CBW-V

ALUMINIUM HOUSED COMPACT HARMONIC FILTER RESISTOR
IP50 / IP65



The **CBW** is a **Water Cooled Resistor.** It combines the advantage of water cooling with the high pulse load ability of the traditional aluminum housed Alpha resistors. The **CBW** can easily be fitted into compact constructions. It is possible to stack several resistors close without distance when resistor banks are required.

The steady state power range from **1.7kW to 6.7kW / component** (depending on the cooling).
Danotherm has developed **Thermal models** for all resistor types and resistor values. By using these models, Danotherm is able to predict the temperature rises of the resistor wire and the surface for all possible load situations.

Danotherm offer the assistance to customers to find the optimal solution for any application.

CBW resistors are optionally available with connection box in different design for different cable sizes and from IP50 to IP65.

Applications
The water cooled resistor **CBW** is very well suited as a harmonic filter resistor where continuous power dissipation is required. For other applications like **LVRT** (Low Voltage Ride Through) for wind turbines Danotherm refer to seperate brochure for CBT/CBS - model.

Construction

The resistor elements for high resistance types are wire wound on mica support sheets. Lower resistance elements are made with helix wound wire elements. The outer housing is an aluminium profile insulated with micanite sheets on all inner surfaces. The resistor elements are fixed symmetrical in the profile by ceramic insulators. This ensures a symmetric expansion of the resistors and a maximum stability to high load impulses. The aluminium profile with the fixed resistor element is filled with quarts sand. This ensures a minimum change of the resistor surface temperature even if the resistor element reaches its maximum temperature during a pulse load.

The standard cables are 300 mm PTFE, style depending on rated voltage.

General Specifications		
Temperature Coefficient		< ± 100ppm
Dielectric strength:	Standard	3500 VAC @ 1 minute
	On demand	6000 VAC @ 1 minute
Working Voltage	Standard	1000 VAC; 1400VDC
Isolation Resistance:		>20 MΩ
Temperature of cooling water		0°C - 80°C
Temperature of cooling water-glycol		0°C - 80°C
Pressure:		Working: 6 bar; Test: 10 bar
Environmental		-40°C - 90°C
De-rating depending on water inlet temp.:		Linear: 20°C = Pn to 50°C = 0,75*Pn
Thermo watch (optional)		30°C / 160°C / 180°C / 200°C, 2A, 250VAC NC
PT 100 (optional)		2 Wire/ 3 Wire; With/Without Shield; Cable 300mm

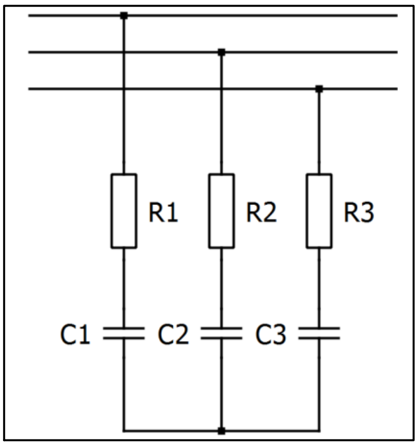
Water Cooling

Water cooling is via two extruded holes/tubes along the outer edges of the profile and heat transfer via the profile.

This ensures a simple water system and that the resistors are stackable. The centre of the resistor reaches a minor temperature increase at steady state load. If this cannot be tolerated the surface can be insulated.

CBW-C(H) (T)	min. Ohm value [mΩ]	max. Ohm value [Ω]
CBW 210	40	2500
CBW 260	60	3500
CBW 330	90	5000
CBW 400	120	7000
CBW 460	150	8000
CBW 560	190	120
CBW 660	230	150
CBW 760	280	160

Table 1



Low pass filter

Resistance Value Range

Please see table 1.

Mounting

It is recommended to mount the resistors in a vertical position with the in- and outlet at the top side to prevent air bubbles to be trapped. When the channels are in parallel the outlets should be upwards. If mounted in other direction precaution must be taken to avoid air bubbles in the cooling tubes.

Cooling liquid flow

The needed cooling liquid flow depends on the cooling liquid used and the dissipated power that the liquid needs to absorb. The formula for water flow is given by:

$$Q = \frac{P \cdot 860}{\Delta T \cdot 0{,}85}$$

Where

Q is flow in litres per hour

P is power in kW

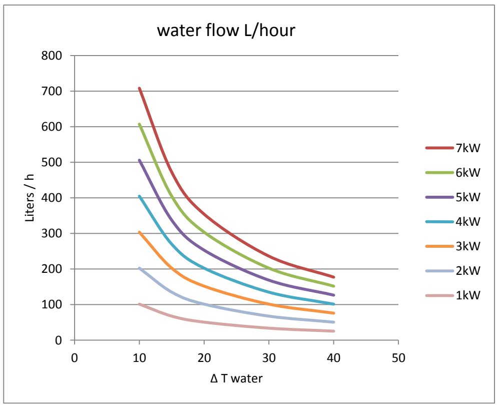
ΔT is difference in temperature between inlet and outlet ;

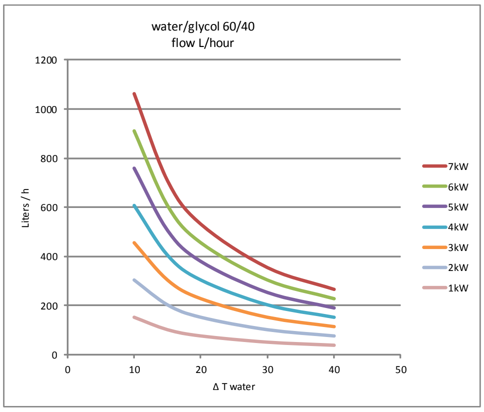
0,85 takes into account that not all water is effectively in contact with the cooling tubes.

If water/glycol 60%/40% is used then the outcome needs to be multiplied by a factor of 1,5.

flow l/h	ΔT water					ΔT water/glycol 60/40				
	10	15	20	30	40	10	15	20	30	40
7kW	708	472	354	236	177	1062	708	531	354	266
6kW	607	405	304	202	152	911	607	455	304	228
5kW	506	337	253	169	127	759	506	379	253	190
4kW	405	270	202	135	101	607	405	304	202	152
3kW	304	202	152	101	76	455	304	228	152	114
2kW	202	135	101	68	51	304	202	152	101	76
1kW	101	68	51	34	25	152	101	76	51	38

Table 2



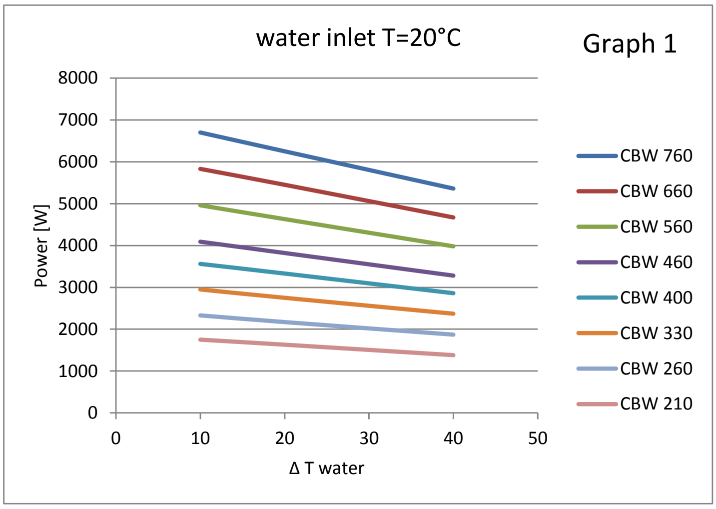


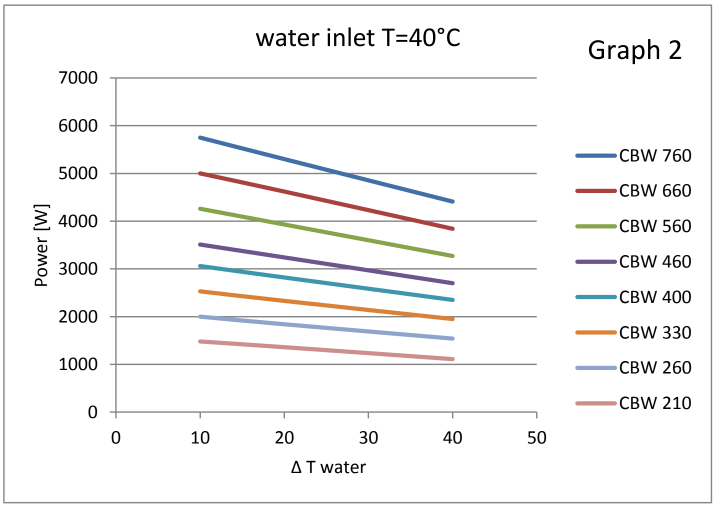
Maximum power dissipation

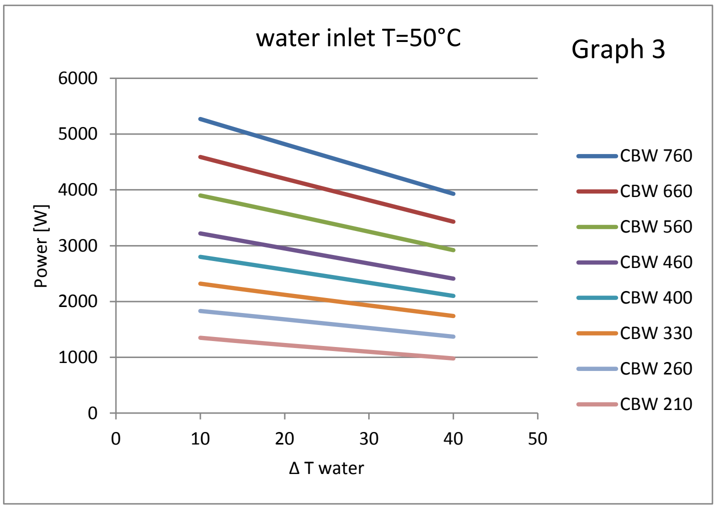
The maximum continuous power depends on the absolute value of the water inlet temperature and also on the increase of the water temperature which is directly dependent of the water flow. Table 3 shows the maximum continuous power at given water inlet temperatures and different ΔT. Graphs 1, 2 and 3 show the continuous power values at water inlet temperature of 20°C / 40°C and 50°C and all ΔT between 10 and 40°C. All values are based on the thermal model of the resistors as shown below.

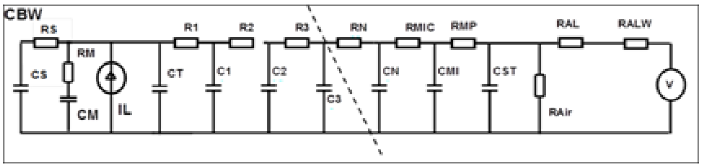
CBW-C(H) (T)	max. surface temp.	maximum power at water inlet T=20°C [W]			maximum power at water inlet T=40°C [W]			maximum power at water inlet T=50°C [W]		
		Δ T water [K]			Δ T water [K]			Δ T water [K]		
		10	20	40	10	20	40	10	20	40
CBW 210	160	1750	1630	1380	1480	1360	1110	1350	1220	980
CBW 260	170	2330	2170	1870	2000	1840	1540	1830	1680	1370
CBW 330	170	2950	2750	2370	2530	2330	1950	2320	2120	1740
CBW 400	170	3560	3330	2860	3060	2820	2350	2800	2570	2100
CBW 460	170	4090	3820	3280	3510	3240	2700	3220	2950	2410
CBW 560	170	4960	4630	3980	4260	3930	3270	3900	3580	2920
CBW 660	170	5830	5450	4670	5000	4620	3840	4590	4200	3430
CBW 760	170	6700	6250	5360	5750	5300	4410	5270	4820	3930

Table 3







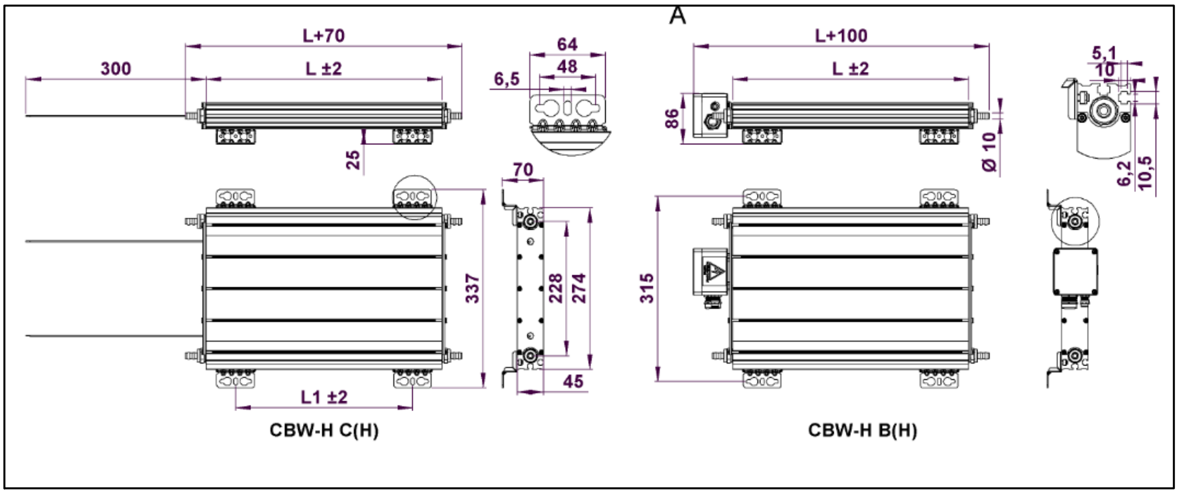


Thermal model

Pressure drop

The pressure drop depends strongly on the used water nipples. Many customers use their own water nipples so it is difficult to give standard values. For resistor CBW460 with SW22x45,5 and a flow of 120 litres per hour the pressure drop is 55mBar per channel, 110mBar in total for 2 cooling tubes in series.

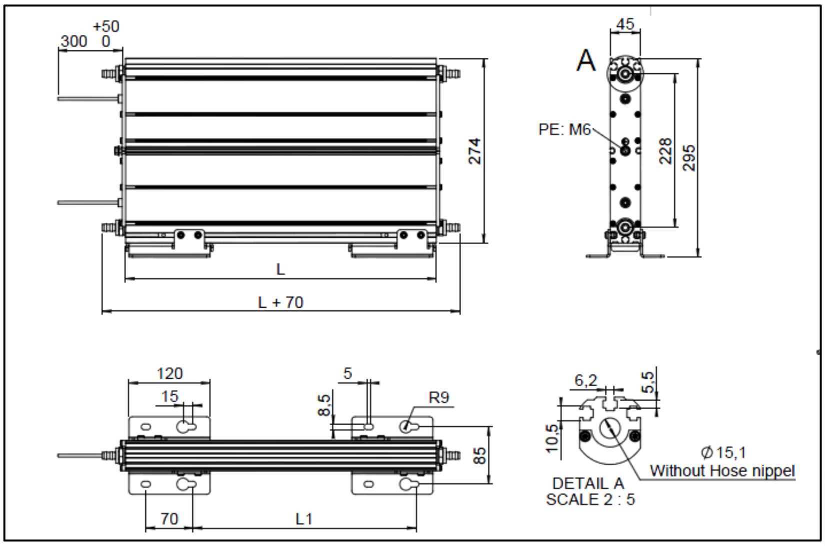
Horizontal mounting



Type	L mm	L1 mm	W Kg	Type	L mm	L1 mm	W Kg
CBW-H 210 C (H) (T)	210	110	6.4	CBW-H 560 C H (T)	560	460	14.7
CBW-H 260 C (H) (T)	260	160	7.6	CBW-H 660 C H (T)	660	560	17.1
CBW-H 330 C (H) (T)	330	230	9.2	CBW-H 760 C H (T)	760	660	19.5
CBW-H 400 C (H) (T)	400	300	10.9	CBW-H 860 C H (T)	860	760	22,0
CBW-H 460 C (H) (T)	460	360	12.3	CBW-H 960 C H (T)	960	860	24,4

Longest possible type 1000mm

Vertical mounting



Please contact Danotherm with your request

danotherm@danotherm.dk

Type identification:

Please specify your CBW resistor as follows

CBW-H 660 C (H) (T) 22R 0 0 1

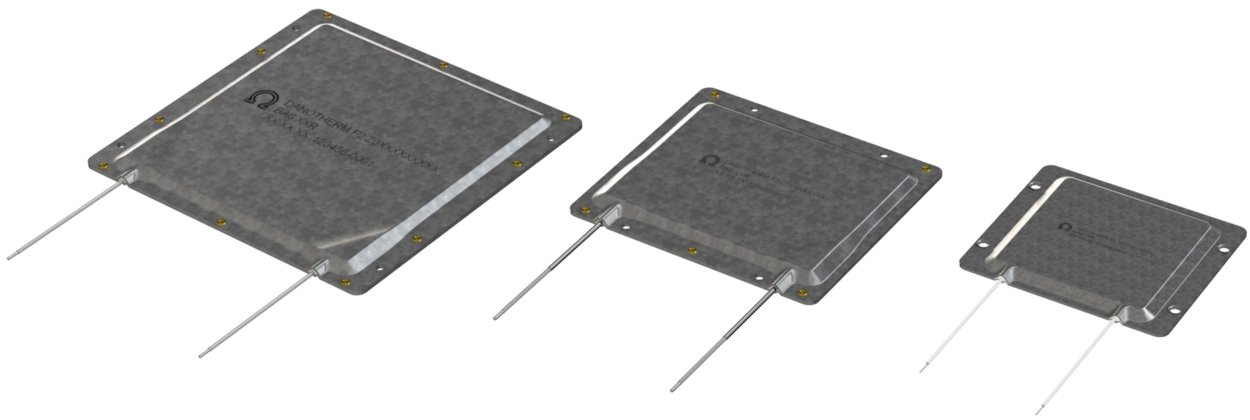
- Last digits XXX > 400: Customer specified version, otherwise:
- Number of profiles
- Thermo watch temperature: **3**=80°; **4**=100°; **5**=130; **6**=160; **7** = 180; **8** =200°C
- 2 = No grid; 3 = Protection grating
- Ohm Value (Examples: **2R2** = 2.2Ω; **22R** = 22 Ω; **220R** = 220Ω; **1K0** = 1.0 kΩ)
- **T**: Thermo watch
- **H**: Helix wire element (Specified by Danotherm)
- **C**onnection **C**: Cables **B:** IP65 Connection Box
- Length of resistor profile in mm
- **H**: Horizontally mounted profile **V:** Vertical mounted profile

Bi-Alpha

Compact Power Resistor

45-175W

(forced air cooling 2m/s)



The Bi-Alpha compact power resistors

Danotherm has developed flat power resistors for moderate power brake applications in drive systems, braking a few hundreds of watts to few kilowatts during a short time of braking.

The Bi-alpha is available in 3 sizes; Bi-Alpha 4, 5 and 6. Their nominal power is rated at 45W for size 4, 100W for size 5 and 175W for size 6. These values are valid for forced air cooling of 2m/s. By increasing the airspeed the nominal power can be increased.

Because of its low profile height they can easily be mounted at the back side of an VFC (Voltage Frequency Converter).

The Bi-Alpha is a simple construction where the resistor wire is wounded on a mica substrate and insulated by mica sheets on both sides. This element is enclosed in a metal alloy housing made from aluminium and zinc. The Bi-Alpha resistors are a cost efective solution for small to medium power drive systems.

Connection leads are insulated with high temperature silicon, rated at 250°C. IP value for each size is IP50.

Construction

The resistors are designed as follows:

The resistor elements are wire wound on a mica substrate. This substrate is insulated by two mica sheets to assure the minimum voltage breakdown. The housing is made from aluminium zinc alloy with good thermal properties. The standard cables are 300 mm AWG 18 600V. We can supply cables in specified lengths and mounted with cable shoes or connectors as required.

Simulations

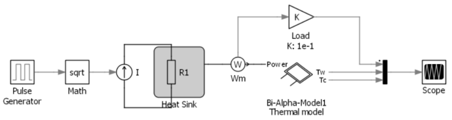
The start for each resistor selection is a power-time graph from your application. Danotherm is able to predict the temperature of the resistor by using sophisticated models.

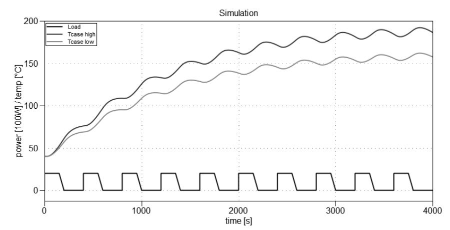
Pulse load

The ability to withstand pulse loads varies per resistor size, wire length and wire diameter. As such, it is impossible to create standard graphs that would apply for most customers applications.

At your request Danotherm performs the simulation for you based on your application.

The table shown is based on a resistor with a wire of 0.3mm. For different duty times the maximum power is noted with a repetition time of 120 seconds. The table is only valid for mentioned wire diameter. With each ohm value a different model and different pulse loads apply.

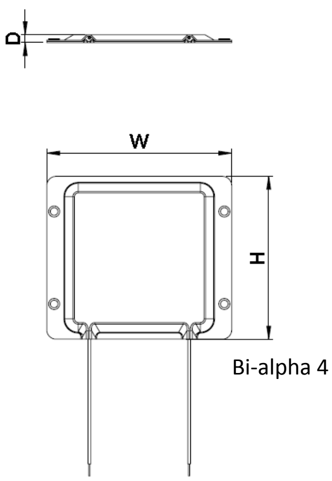




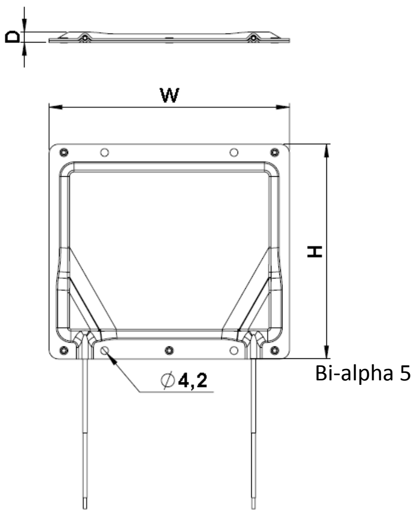
Type Bi-Alpha	P_N [W] @40°C air 2m/s	Surface temp. [°C] @40°C	Pulse load during x each 120 seconds [W] @ 40°C					R [Ω]
			1s (0.8%)	2s (1.7%)	5s (4.1%)	10s (8.3%)	40s (33%)	standard ± 10% on request ± 5%
size 4	45	250	950	500	230	140	75	6 - 600
size 5	100	250	2500	1400	700	480	260	40 - 1500
size 6	175	250	4600	2500	1200	760	460	20 - 2500

General specifications

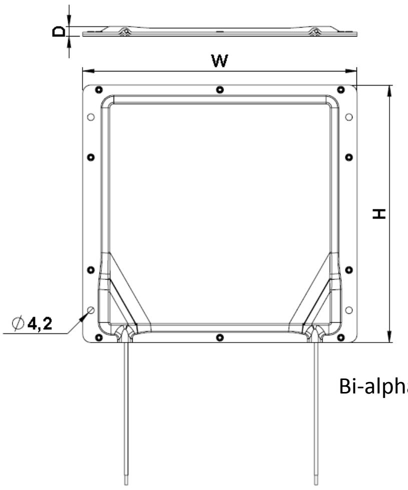
Temperature Coefficient:		< ± 100 ppm
Dielectric strength	standard	2500 VAC @ 1 minute
Working voltage	standard	600 VAC / 850 VDC
Insulation Resistance:		> 20 MΩ
Overload:@ 1 sec pulse / hour		20 - 25 x (depending on resistance)
Overload:@ 5 sec pulse / hour		5 - 7 x (depending on resistance)
Cooling:		air 2m/s
Environmental:		- 40 °C - 90 °C
De-rating:		Linear: 40 °C = Pn to 70 °C = 0,65 * Pn



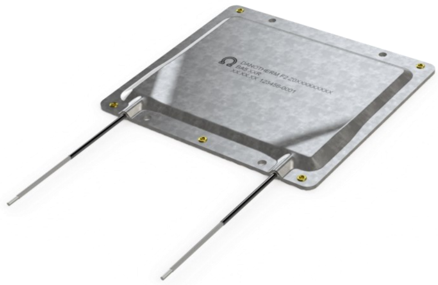
Bi-alpha 4



Bi-alpha 5



Bi-alpha 6



Bi-Alpha	W	H	D	weight
	[mm]			[g]
size 4	100	88	4,3	94
size 5	130	116	4,6	240
size 6	170	160	5,25	540

DANOTHERM™

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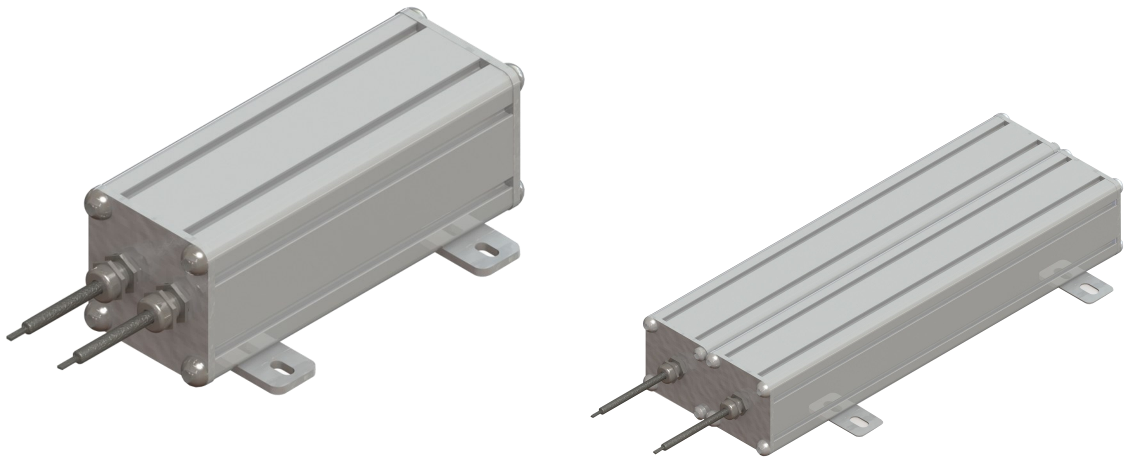
HVB70

Aluminium high pulse power air cooled Resistor

285kJ - 570kJ



HVB70 style resistors are high pulse load resistors used in crowbar and high energy dump applications like in Wind turbines. They are very compact and therefore can be used in applications where space is an issue.

The **high pulse load energy** is absorbed by the wire and then transferred to the filling, which is normally quartz sand. In general the temperature of the housing will stay very low.

The HVB70 range is build up with one or multiple extruded aluminium profiles. The connection can be with 1 meter of cable (other lengths are possible) or with a connection box with IP65 or IP66 ingress protection degree.

The maximum pulse load energy strongly depends on the resistor wire and with that the ohm value. Please, ask for separate datasheet with the ohm value you require to get precise data.

The resistors have a low **thermal drift, low noise level, are very compact, have no life parts** on the outside and require minimum maintenance

Low Voltage Ride Through (LVRT) has become an important requirement for wind farms which defines their ability to remain connected and actively contribute to grid stability during a wide range of network faults. Fault ride-through specifications listed in modern transmission and distribution grid codes, specify that wind-turbine generators must remain connected to electricity networks at voltage levels well below nominal. The dynamic braking resistor dissipates active power and boosts generator voltage, potentially avoiding the need for pitch control and dynamic reactive power compensation.

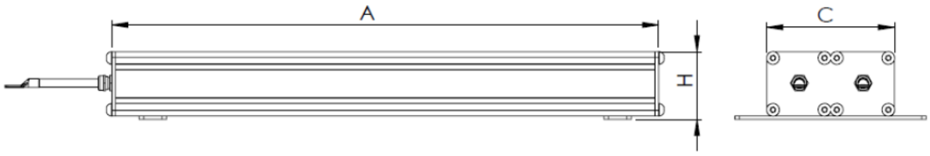
Other applications for Alpha-type aluminium-housed brake resistors (HVB 70 types) include dynamic braking in traction applications, load-dump resistors in crowbar systems and snubbers in choppers and rectifiers .

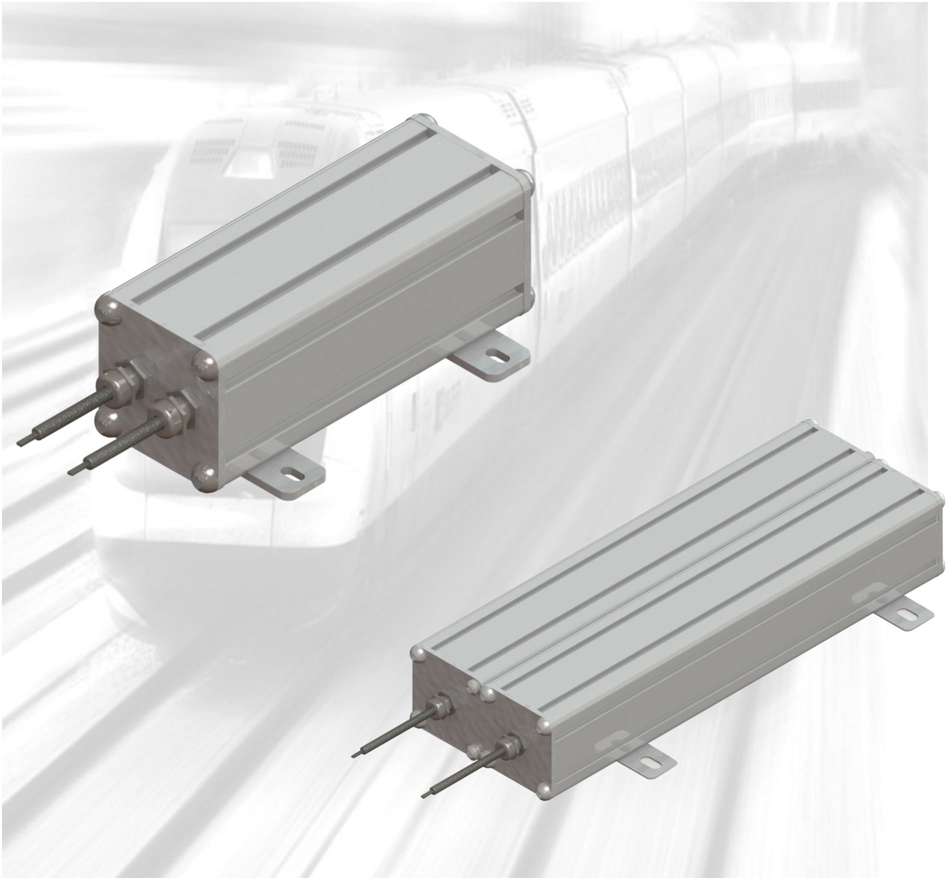
The salient features of this resistor family are:

- Small dimensions
- Low- surface temperatures
- high pulse-load capabilities
- High vibration capabilities
- No external electrically-live parts
- high IP classes
- Fail-safe capabilities (on request)
- low noise levels
- high dielectric strengths.

HVB70

Type	Ohmic value [Ω] ±5%	Energy [kJ]	Weight [kg]
HVB70.400.1	0.2 - 250	285	±5
HVB70.400.2	0.3 - 500	570	±9
General Specifications			
Insulation resistance	all types	≥40 MΩ @ 5,000 VDC	
Dielectric strength	HVB70.400.1	18,000 VAC @ 50Hz 1 min	
	HVB70.400.2	12,000 VAC @ 50Hz 1 min	
Protection degree		IP65	
Dimensions	A [mm]	C [mm]	H [mm]
HVB70.400.1	400	70	74
HVB70.400.2	400	140	74





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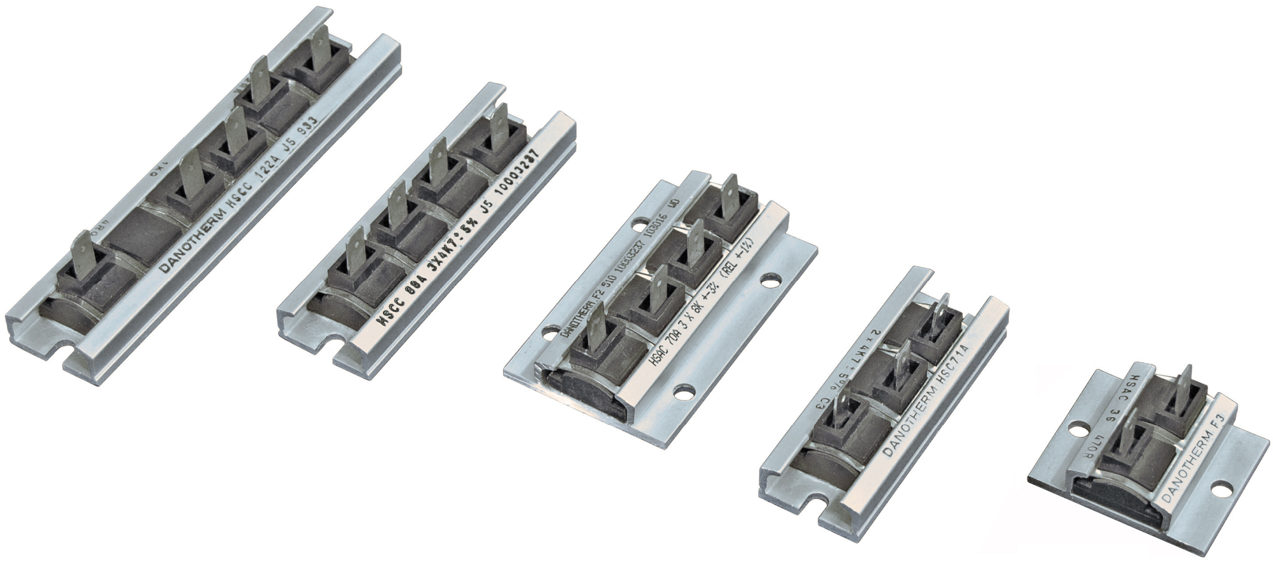
HEAT SINK COOLED

HSCC / HSAC

POWER THICK FILM RESISTORS



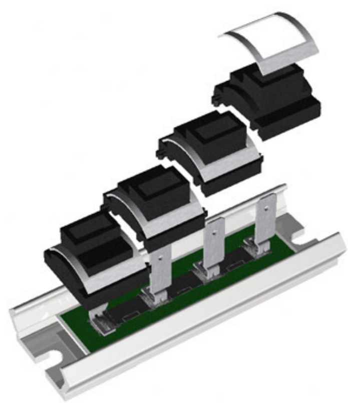
HSCC and HSAC:

POWER THICK FILM RESISTORS are supplies in a patented MODULAR construction that is ideal for customer specified RESISTOR MODULES as well as single resistors.

Construction:

The resistor body is a thick film resistor printed on ceramic Alumina. A glass cover film protects the resistor and the terminals are soldered to the substrate with 300°C solder which makes the terminations reliable even at overload conditions.

The resistor is mounted in an Aluminum Profile. High temperature plastic insulators and metal springs make a well-defined stable thermal contact between the resistor element and the aluminum profile. Between the resistor element and the profile is a heat conducting material.
The Ceramic resistor element is completely protected from mechanical damage and the resistor can be mounted to a heat sink without further notice. The below wattage curves demands the use of a heat sink compound.



Exploded view HSCC 88.

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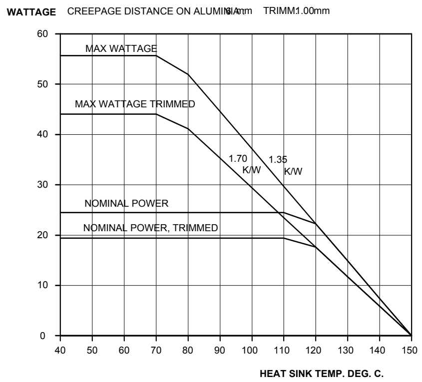
Heat Sink Cooled Power Thick Film Resistor - Type HSCC, HSAC

Specifications:

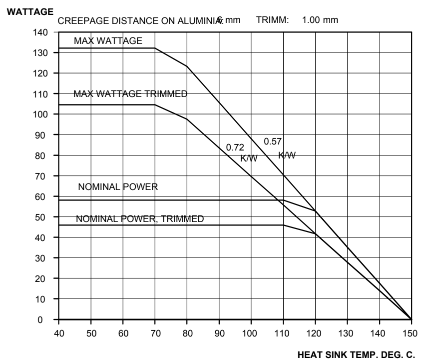
Resistor tolerance:	Standard (NON-TRIMMING) TRIMMED RESISTORS	± 15% ± 1%, ± 0.5%
Temperature Coefficients:		± 250 PPM
Test voltage for 1 min.:		6000 VDC/ 2500 VAC
Working voltage:		1100 VDC
External Creeping Distance:		12 mm
Temperature Limits:		-40°C +125°C
Insulation:		>100M^{2}OHM/500V
Air Distance Terminal./Ground		7 mm

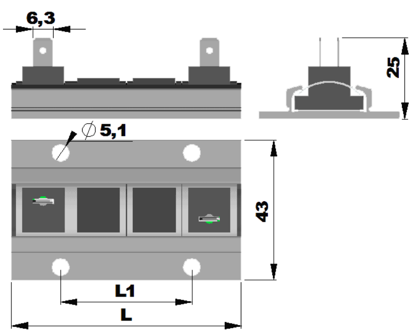
HSCC 54 / HSAC 36



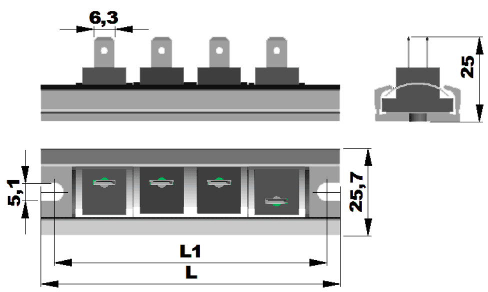
TYPE: Values for standard resistors		HSCC 54 HSAC 36	HSCC 71 HSAC 52	HSCC 88 HSAC 70	HSCC 104 HSAC 87	HSCC 122 HSAC 104
Max rated wattage	W	45	105	165	225	(MODULES)
Nominal power	W	22	50	80	105	(MODULES)
Surge load in 10 sec.*(	W	90	200	350	420	(MODULES)
Max voltage between terminal	V^	1000	2000	2500	2500	(MODULES)
Thermal Resistance	°K/W	1.12	0.47	0.3	0.22	(MODULES)
Resistance Min.	Ohm	0.3	1	1.5	2	(MODULES)
Resistance Max.	MOhm	1	2	3	4	(MODULES)
Mechanical Specifications:						
HSCC L HSCC L1	mm mm	54 46	71 63	88 80	104 96	122 114
HSAC L HSAC L1	mm mm	36 -	52 -	70 40	87 50	104 75
Weight HSCC Weight HSAC	g g	26 35	33 45	44 56	55 70	65 90

HSCC 71 / HSAC 52



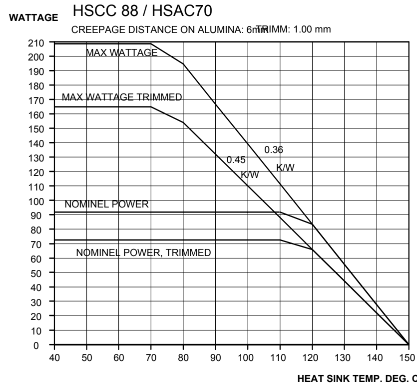


TYPE HSAC.



TYPE HSCC.

HSCC 88 / HSAC70



WATTAGE OF HSCC AND HSAC TYPES:

The curves show the wattage for each resistor at different heat sink temperatures for resistors up to about 100 KOHMS / modules. The MAX. Permanent temperature on the resistor surface is 150°C, and the MAX power or wattage is 400 mW/mm^2

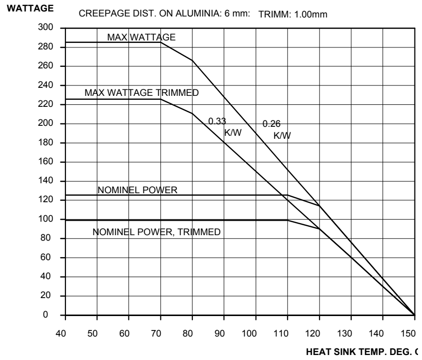
The MAX WATTAGE is the maximum constant power at which the resistor can be operated.

The NOMINAL POWER is the power at which the resistor withstand 4 times overload in 10 seconds.

Resistors can be supplied non-trimmed with resistor tolerance ±15%. If a more narrow tolerance is requested the resistor have to be trimmed. In this case the wattage has to be reduced to 70% as shown on the curves

For Modular resistors (More resistors in one package) each resistor can be loaded corresponding to the size between two terminals. The HSCC resistor shown above with 3 resistors each resistor can be loaded like a single HSCC54 resistor.

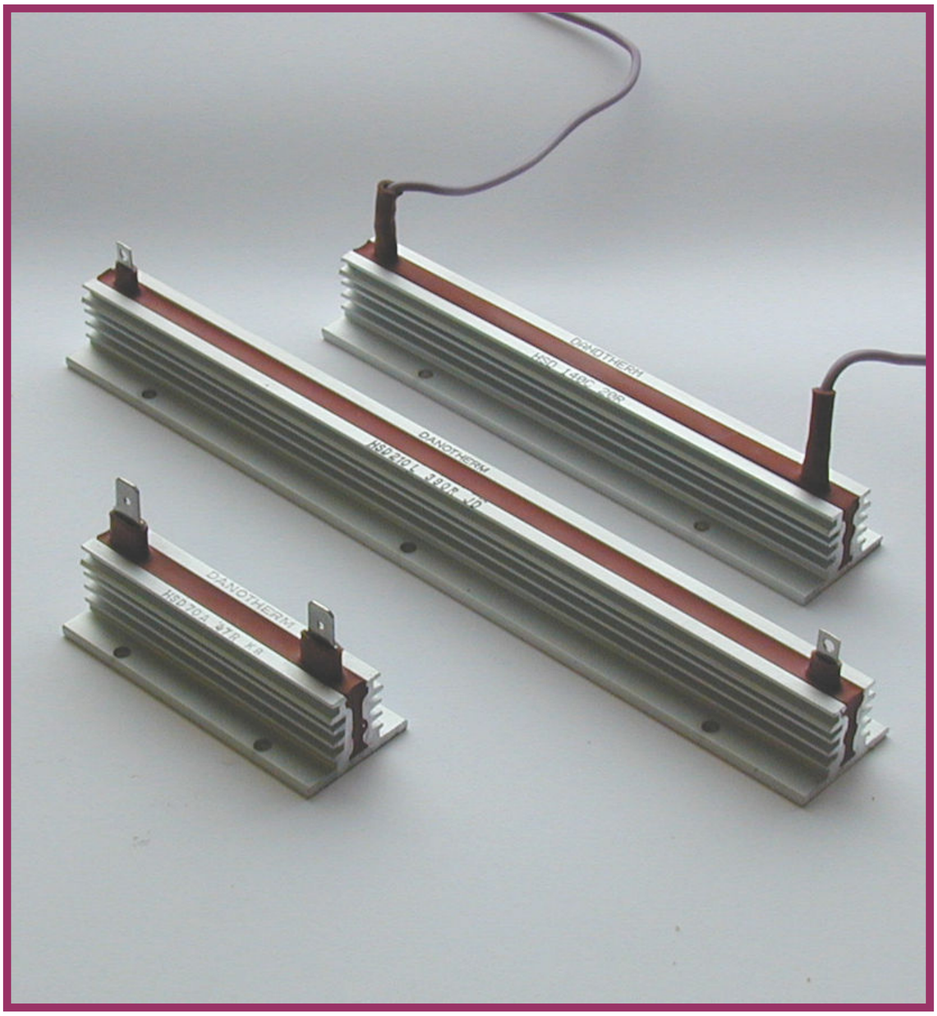
HSCC 104 / HSAC87



Aluminium Housed Wirewound Power Resistor

Type HSD

All-purpose Heat Sink Resistor for mounting on a Heat Sink chassis.



DANOTHERM

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Phone +45 36 73 22 22 . Fax +45 36 73 22 23
e-mail: danotherm@danotherm.dk
www.danotherm.dk

Aluminium Housed Wirewound Power Resistor Type HSD

Type HSD

For compact construction:
Close mounting of heat sensitive components is possible due to only a slight rise of the temperature on the aluminium profile.

Solder, Cable and "Fast-On" Termination

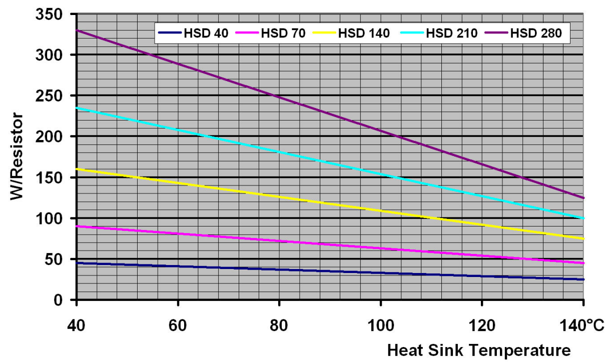
More resistors in one profile possible.

Specifications:

Power rating	12 W – 300 W	
Resistance range (standard)*	HSD 40:	R1 – 3K3
E12 values preferred for	HSD 70:	R22 – 6K8
smaller quantities	HSD 140:	R47 – 18K
	HSD 210:	R82 – 27K
	HSD 280:	1R – 39K
Resistance tolerance	± 5%/ ±10%	
Temperature Coefficients		
Normal	50 ppm–150 ppm	
Low ohmic values	400 ppm	
Dielectric strength	2500 VAC peak	
Working voltage	1200 VAC	
Test voltage	6000 VDC	

* Low-ohmic values on request # Type HSD

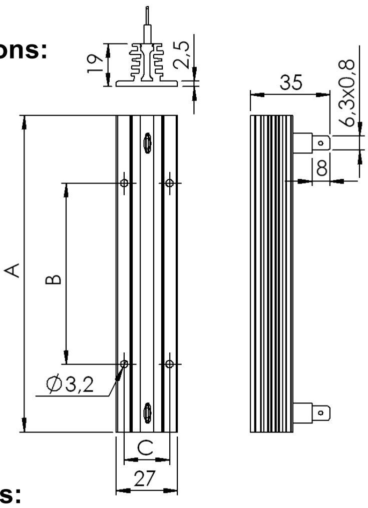
Power Dissipation:



This graph shows the maximum wattage rating for each of the five possible resistors of standard size corresponding to the heat sin temperature.
It is assumed that all resistors are equally loaded.

Mechanical specifications:

HSD	A	B	C
30	30	20	20
40	40	18.3	20
70	70	39.7	21.4
140	140	80	20
210	210	2x80	20
280	280	2x100	20



Please Order as follows:

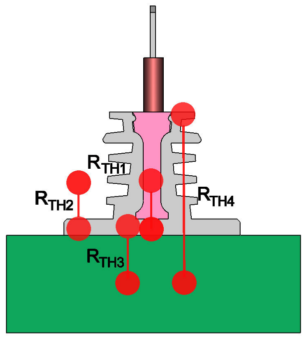
HSD 140 A 47R

- **47R: Ohmic values**
- **A: AMP terminals**
  L: Tinned lugs
  S: Screw-on terminals
  C: Cable (specified)
- **140: Size in mm.**

Insulation

Silicone Rubber + MICA. The Silicone is UL-recognized (UL 94 HB) to a working temperature of 220°C. Temperatures of up to 300°C can be endured for shorter periods. This may however cause an expansion of the silicone rubber with a possibility of reducing the dielectric strength.

Thermal Resistances:



Showing the Thermal Resistance (°C / W) between different measuring points.

R_{TH1}: Wire to Alu-house
R_{TH2}: Alu-house to air per resistor
R_{TH3}: Alu-house to heat sink per resistor
R_{TH4}: Resistor surface to heat sink per resistor

	HSD 40	HSD 70	HSD 140	HSD 210	HSD 280
R_{TH1}	4	2	1	0.75	0.5
R_{TH2}	13	8	4.6	3.3	2.9
R_{TH3}	0.2	0.1	0.05	0.03	0.02
R_{TH4}	0.4	0.28	0.14	0.09	0.075

Designing

The following equations are applied by the dimensioning of the resistors at stationary load.
If more information is required please consult Danotherm.

It's assumed that the air around the resistors is stationary. (Worst case).

Symbols employed:

W_{MAX} :	Maximum required load in resistor
T_{MAX} :	Maximum hot spot temperature requested in resistor ($T_{MAX} <$ 220°C) The lower T_{MAX} the higher reliability and lifetime.
T_{AMB} :	Ambient temperature
R_{TH} :	Thermal resistance. Refer to table Thermal resistances
T_H :	Heat sink temperature (chassis).
T :	Temperature on top of the Aluminium profile.

Following conditions are possible:

1. HSD is mounted on a heat sink:
   A. The thermal resistance R_{TH} of the heat sink is known,
   $$T = W_{MAX} \times (R_{TH4} + R_{TH})$$
   Check that:
   $$T_{MAX} = W_{MAX} \times (R_{TH} + R_{TH3} + R_{TH1}) + T_{AMB} < 220°C$$

   B. The Temperature of the Heat Sink is known,
   $$T = W_{MAX} \times R_{TH4} + T_H$$
   Check that:
   $$T_{MAX} = W_{MAX} \times (R_{TH1} + R_{TH3}) + T_H < 220°C$$
   When the HSD is used close to maximum values heat sink compound should be applies.

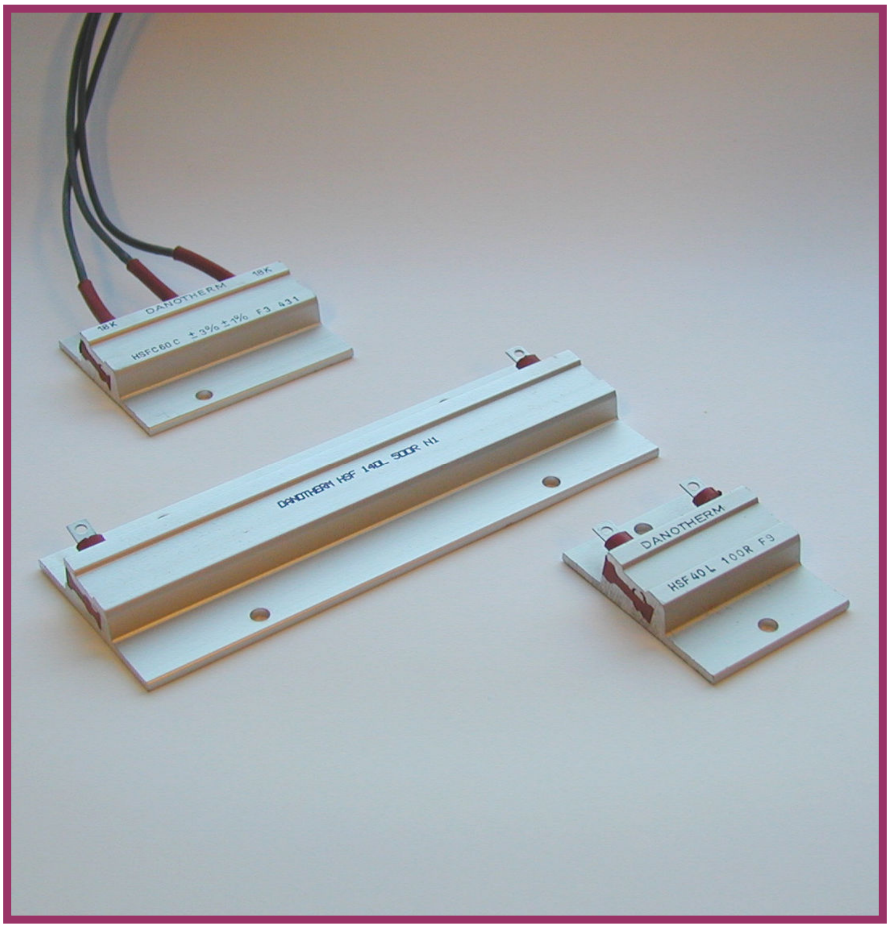
2. HSD is mounted without a heat sink:
   Check that:
   $$T_{MAX} = W_{MAX} \times (R_{TH1} + R_{TH2}) + T_{AMB} < 220°C$$

Last update 01.11.01

Aluminium Housed Wirewound Power Resistor

Type HSF

Flat Heat Sink Resistor for mounting on a Heat Sink chassis.



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Aluminium Housed Wirewound Power Resistor Type HSF

Type HSF

For compact construction:
Close mounting of heat sensitive components is possible due to only a slight rise of the temperature on the aluminium profile.

No heat sink compound is required because of large mounting surface.

Solder, Cable and “Fast-On” Termination

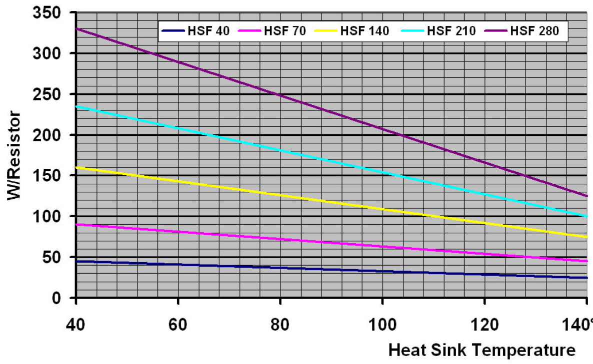
More resistors in one profile possible.

Specifications:

Power rating	12 W – 300 W	
Resistance range (standard)*	HSF 40:	R1 – 3K3
E12 values preferred for	HSF 70:	R22 – 6K8
smaller quantities	HSF 140:	R47 – 18K
	HSF 210:	R82 – 27K
	HSF 280:	1R – 39K
Resistance tolerance	± 5%/ ±10%	
Temperature Coefficients		
Normal	50 ppm–150 ppm	
Low ohmic values	400 ppm	
Dielectric strength	2500 VAC peak	
Working voltage	1200 VAC	
Test voltage	6000 VDC	

* Low-ohmic values on request # Type HSF

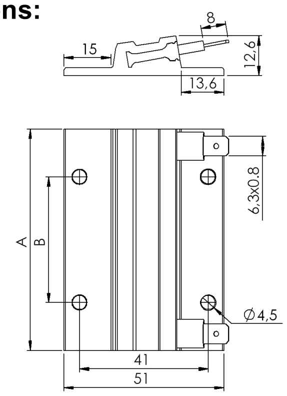
Power Dissipation:



This graph shows the maximum wattage rating for each of the five possible ressistors of standard size corresponding to the heat sin temperature.
It is assumed that all resistors are equally loaded.

Mechanical specifications:

HSF	A	B
40	40	-
70	70	39.7
140	140	80
210	210	2x80
280	280	2x100



Please Order as follows:

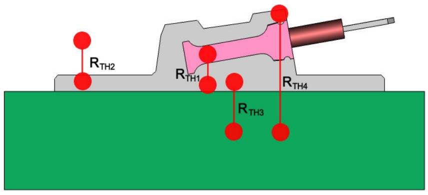
HSF 140 A 47R

- **Ohmic values** (47R)
- **A: AMP terminals**
- **L: Tinned lugs**
- **S: Screw-on terminals**
- **C: Cable (specified)**
- **Size in mm.** (140)

Insulation

Silicone Rubber + MICA. The Silicone is UL-recognised (UL 94 HB) to a working temperature of 220°C.
Temperatures of up to 300°C can be endured for shorter periods. This may however cause an expansion of the silicone rubber with a possibility of reducing the dielectric strength.

Thermal Resistances:



R_{TH1}: Wire to Alu-house
R_{TH2}: Alu-house to air
R_{TH3}: Alu-house to heat sink
R_{TH4}: Resistor surface to heat sink

Showing the Thermal Resistance (°C / W) between different measuring points.

	HSF 40	HSF 70	HSF 140	HSF 210	HSF 280
R_{TH1}	4	2	1	0.75	0.5
R_{TH2}	11	6.8	3.9	2.75	2
R_{TH3}	0.2	0.1	0.05	0.03	0.02
R_{TH4}	0.5	0.3	0.17	0.1	0.085

Designing

The following equations are applied by the dimensioning of the resistors at stationary load.
If more information is required please consult Danotherm.

It’s assumed that the air around the resistors is stationary. (Worst case).

Symbols employed:

W_{MAX} :	Maximum reguired load in resistor
T_{MAX} :	Maximum hot spot temperature reguested in resistor (T_{MAX} < 220°C) The lower T_{MAX} the higher reliability and lifetime.
T_{AMB} :	Ambient temperature
R_{TH} :	Thermal resistance. Refer to table Thermal resistances
T_H :	Heat sink temperature (chassis).
T :	Temperature on top of the Aluminium profile.

Following conditions are possible:

1. HSF is mounted on a heat sink:
   A. The thermal resistance R_{TH} of the heat sink is known,
   $T = W_{MAX} \times (R_{TH4} + R_{TH})$
   Check that:
   $T_{MAX} = W_{MAX} \times (R_{TH} + R_{TH3} + R_{TH1}) + T_{AMB} < 220°C$

   B. The Temperature of the Heat Sink is known,
   $T = W_{MAX} \times R_{TH4} + T_H$
   Check that:
   $T_{MAX} = W_{MAX} \times (R_{TH1} + R_{TH3}) + T_H < 220°C$

2. HSF is mounted without a heat sink:
   Check that:
   $T_{MAX} = W_{MAX} \times (R_{TH1} + R_{TH2}) + T_{AMB} < 220°C$

Last update 07.11.01

DANOTHERM™

Wirewound resistors

Vitreous Enamelled and Cement Coated
Round and Oval Shaped
Sigma Modular Wirewound Brake Resistors

- 15–5000W
- Solder, Screw or Fast-on terminals
- Different styles of mounting brackets
- Open type IP00 and Sigma IP20
- Increased creepage distance for high voltage applications
- Optional Live terminals (only oval shaped types)
- Wide ohm range

Round Wirewound Resistors

DANOTHERM TYPE	P nom * @25°C T=350°C	CRITICAL VOLT rms	INSU-LATION VOLT **	CRIT. RES	RMIN ± 15% ZRF/I	± 10% GRV ZRV	ZBF	RMAX GRF ZRF	GRV ZRV	GRI ZRI	ZBF	PREF
	W	V	V	kΩ	mΩ	Ω	mΩ	kΩ	kΩ	Ω	Ω	
GRF/ZRF 10/44	17	270	1000	4,2	56	0,8	-	8	1,8	22	-	P
GRF/ZRF 10/55	22	430	1000	8,4	100	0,6	-	12	2,7	33	-	
GRF/ZRF 10/63	25	550	1000	12	100	0,6	-	18	3,9	47	-	P
GRF/ZRF 12/51	24	370	1000	5,7	47	1	-	12	3,3	39	-	
GRF/ZRF 12/63	30	550	1000	10	56	1	-	22	4,7	56	-	P
GRF/ZRF 12/76	36	750	1000	15	82	1	-	27	5,6	68	-	
GRF/ZRF 12/102	48	1200	1000	30	82	1	-	47	8,2	120	-	P
GRF/ZRF 13/51	28	370	1200	4,8	56	1	-	18	3,6	47	-	P
GRF/ZRF 13/63	32	550	1200	9,4	56	1	-	22	5,6	47	-	P
GRF/ZRF 13/100	52	1100	1200	23	82	1	-	47	10	120	-	P
GRF/ZRF 15/51	30	370	1200	4,5	56	1	68	18	3,3	47	3	
GRF/ZRF 15/63	38	550	1200	7,9	56	1	100	27	5,6	56	6	P
GRF/ZRF 15/76	45	750	1200	12	82	1	150	33	6,8	68	8	
GRF/ZRF 15/100	60	1100	1200	20	82	1	220	58	12	120	12	P
GRF/ZRF 20/50	40	360	1200	3,2	56	0,3	33	22	4,7	47	4	
GRF/ZRF 20/75	60	730	1200	8,8	100	0,3	75	47	10	100	8	
GRF/ZRF 20/100	78	1100	1200	15	220	0,3	120	56	15	150	12	P
GRF/ZRF 20/140	100	1700	1200	28	220	0,3	180	82	22	220	22	P
GRF/ZRF 20/165	120	2100	1200	36	220	0,5	220	100	27	280	27	P
GRF/ZRF 20/267	200	3600	1200	64	220	1	390	150	47	470	47	P
GRF/ZRF 24/165	150	2100	1200	29	220	1	180	100	33	270	27	P
GRF/ZRF 30/75	85	730	1200	6,2	120	1	39	39	15	120	12	
GRF/ZRF 30/100	110	1100	1200	11	180	1	68	56	22	180	18	P
GRF/ZRF 30/133	150	1600	1200	17	270	1	100	78	33	220	27	P
GRF/ZRF 30/152	170	1900	1200	21	330	1	120	82	39	270	33	P
GRF/ZRF 30/156	175	2000	1200	22	330	1	120	82	42	270	33	P
GRF/ZRF 30/165	185	2100	1200	23	330	1	150	100	42	330	39	
GRF/ZRF 30/200	225	2600	1200	30	390	1	150	120	47	420	42	P
GRF/ZRF 30/215	245	2900	1200	34	470	1	180	150	56	470	47	
GRF/ZRF 30/250	275	3400	1200	42	560	1	220	150	68	560	56	
GRF/ZRF 30/265	300	3600	1200	43	560	1	220	180	68	560	68	P
GRF/ZRF 30/330	375	4600	3000	56	680	1	270	180	82	750	75	P
ZRF 45/370	600	5200	2400	45	1	1	200	-	1000	120		
ZRF 55/100	180	800	3000	3,5	150	1	120	47	-	180	18	P
ZRF 55/150	250	1200	3000	5,7	300	1	270	56	-	270	39	P
ZRF 55/215	330	1900	3000	10	560	1	560	75	-	330	47	P
ZRF 55/290	450	2700	3000	16	820	1	680	100	-	470	68	P
ZRF 55/300	450	2800	3000	17	1000	1	820	100	-	470	68	
ZRF 55/390	600	3700	3000	22	1200	1,2	1000	150	-	620	100	P
ZRF 55/400	600	3800	3000	24	1200	1,5	1000	150	-	620	100	
ZRF 55/490	800	4700	3000	27	1500	1,5	1200	180	-	750	120	P
ZRF 55/500	800	4800	3000	28	1500	2,2	1200	180	-	750	120	
ZRF 55/590	1000	5700	3000	32	1500	2,2	1500	200	-	1000	150	P

* Nominal power rating; for corrugated wire types (ZBF/GBF) allow 20% higher power.
High ohm values, exceeding critical resistance values, should be de-rated by 25%.
Induction low types should be de-rated by 50%.

** standard insulation voltage levels, higher levels on request.

Vitreous Enamelled and Cemented Power Resistors from 15W to 1000W

Danotherm Electric A/S was founded in Copenhagen in 1919. We manufacture high performance reliable electrical components and systems. Our products can be found in the most professional sectors of the industry.

Our standard program includes:

GRF/ZRF: fixed resistors for ac and dc current. Standard tolerance of ± 10% and 5% on request. Can be fitted with mounting feet and intermediate bands if required.

GRV/ZRV; resistor with one or more variable connection band.

GRI/ZRI; induction low resistors by double winding (Ayrton-Perry)

GBF/ZBF; corrugated winding for high pulse load and low ohm values. The corrugated wire functions as fins, increasing the active surface area. As a rule of thumb, the nominal power increases by some 20%. Also available in variable band types (GBV/ZBV)

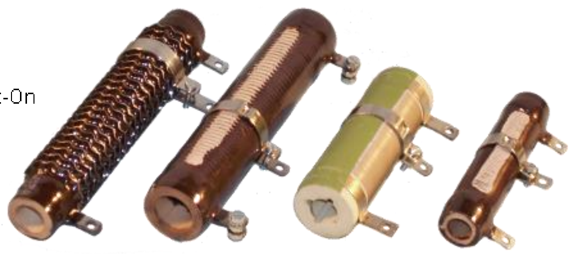
Specifications:

All-welded construction.
Tolerance:
R>1 : ±5% or 10 % (see table1)
Power rating: Based on 25°C and Horizontal mounting.
Temperature Range: -50°C – 250°C
Temperature coefficient:
Low ohm: 200 (400ppm)/°.
Medium-high ohm: <100ppm/°.
Dielectric voltage: Based on indicated creepage distance (k in table 2) from terminals to mounting bracket. 5mm: 1000V; 6mm: 1200V.
Other values than indicated are possible.
Overload:
General: 10 X in 5 seconds.

Item description

ZBF 30/330 S xxR K 000

- Drawing No. (001 = 5% tolerance; 000 = 10% tolerance.), other numbers are customized types
- Resistance tolerance J = 5%, K = 10%
- Ohmic value (16R = 16; 5k6 = 5.6k)
- **S**: Screw (order separate in bag) / **L**: Tinned / **A**: Fast-On
- **Length** of resistor body in mm
- **Diameter** of resistor body in mm
- F: Fixed resistor / **I**: Low induction / **V**: Adjustable
- **R**: Normal wire / B: Corrugated flat wire
- **G**: Vitreous Enamelled / Z: Cement coated



Materials:

Core:
Diameter 10-30 mm: Steatite C221
Porcelain C110, only certain types.
Diameter 45mm: Porcelain C410
Diameter: 55mm: Corderite C520
Steatite C221 is the optimal choice of ceramic bases material for temperatures below 350 -400°C. It has high mechanical strength and excellent DC stability. If higher temperatures can be expected porcelain C110 can be used. For our large resistor types, corderite C520 are used due to its very high stability to temperature changes.

Terminals:
FeNi42 ; has an equivalent temperature expansion coefficient likes Steatite. FeNi42. Can be soldered when it is clean from oxidation and is relatively stainless.

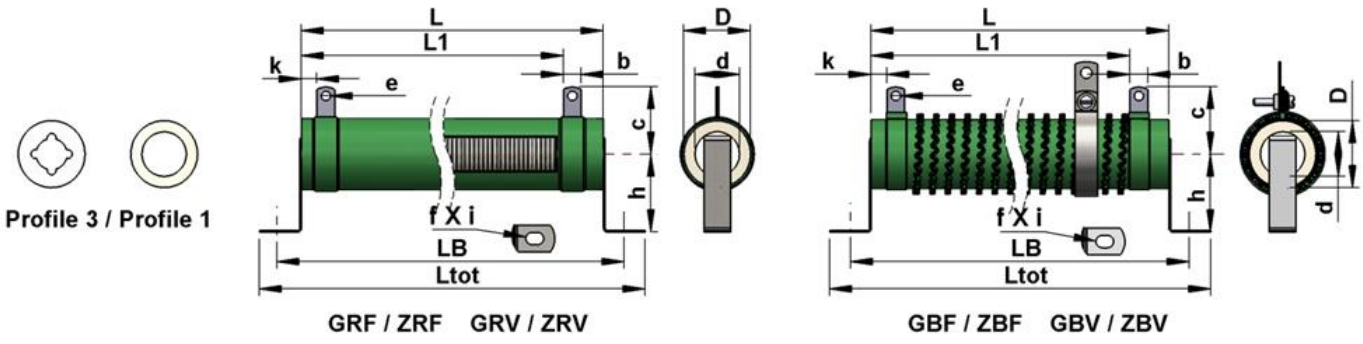
Wire:
Low Ohms: CuNi10 (T.C: 400ppm)/
CuNi23Mn (T.C: 200ppm)
Medium Ohms:
CuNi44 (T.C. < 80ppm)
High Ohms: NiCr8020; CrAlFe,
(T.C. <100ppm)

Coating:
Vitreous Enamel, excellent protection to thin wires. All Vitreous Enamelled Resistors meet the IEC 68-2-3 Ca. 56 days. Vitreous enamel can only be used on Steatite.
AlPO4 is the best choice regarding high pulse load capability and high temperature stability.

Thermal models are available
Each resistor can be provided with data sheets including an individual thermal model for simulating temperature rises during load. Please, see last page.

TYPE	Pro-file	D	L	L Tol.	d	D max	b L, S/A	e	c	k min	L1 ± 1 L, S/A	LB	f x i	Typ. Mass
		mm Ø	mm	±mm	mmØ	mm	mm	mmØ	mm	mm	mm	mm	mm	g
GRF/ZRF 10/44	1		44	0,7			4,8/6,3	3,2		5	32,3/30,8	58		11
GRF/ZRF 10/55	1	10	55	0,9	6	13	4,8/6,3	3,2	19	5	43,1/41,6	69	3,2X6	14
GRF/ZRF 10/63	1		63	1,2			4,8/6,3	3,2		5	50,9/49,4	77		15
GRF/ZRF 12/51	1		51	0,9			4,8/6,3	3,2		5	39,2/37,7	65		19
GRF/ZRF 12/63	1	12	63	1,2	5,5	16	4,8/6,3	3,2	16,5/21	5	50,9/49,4	77	3,2X6	22
GRF/ZRF 12/76	1		76	1,4			4,8/6,3	3,2		5	63,7/62,2	90		26
GRF/ZRF 12/102	1		102	2,0			4,8/6,3	3,2		5	89,2/87,7	116		34
GRF/ZRF 13/51	1		51	0,9	8,3		4,8/6,3	3,2		6	38,2/36,7	-		20
GRF/ZRF 13/63	1	13	63	1,2	5,5	17	4,8/6,3	3,2	15,5 / 20	6	49,4/48,4	-	-	24
GRF/ZRF 13/100	1		100	1,8	5,5		4,8/6,3	3,2		6	86,2/84,7	-		40
GRF/ZRF 15/51	1		51	0,9			4,8/8	3,2		6	38,2/35	65		22
GRF/ZRF 15/63	1		63	1,2			4,8/8	3,2		6	49,4/46,7	77		26
GRF/ZRF 15/76	1	15	76	1,4	10	19	4,8/8	3,2	22	6	62,7/59,5	90	4,2X8	30
GRF/ZRF 15/100	1		100	1,8			4,8/8	3,2		6	86,2/83	114		40
GRF/ZRF 20/50	1		50	0,8			4,8/8	3,2		6	37,2/34	66		40
GRF/ZRF 20/75	1		75	1,4			4,8/8	3,2		6	61,7/58,5	91		55
GRF/ZRF 20/100	1	20	100	1,8	12	24	8	4,2	22/25	6	83	116	5,5X8	70
GRF/ZRF 20/140	1		140	2,5			8			6	122,2	156		100
GRF/ZRF 20/165	1		165	3,0			8			6	146,7	181		115
GRF/ZRF 20/267	1		267	4,6			8			6	246,7	283		190
GRF/ZRF 24/165	1		165	3,0			8			6	146,7	181		155
GRF/ZRF 30/75	1		75	1,4			8			6	58,5	93		105
GRF/ZRF 30/100	1;3		100	1,8			8			6	83	118		135
GRF/ZRF 30/133	1;3		133	2,5			8			6	115,3	151		175
GRF/ZRF 30/152	1		152	2,8			8			6	134	170		200
GRF/ZRF 30/156	1	30	156	3,0	20	34	8	4,2	30	6	137,9	174	5,5X8	207
GRF/ZRF 30/165	1;3		165	3,0			8			6	146,7	183		220
GRF/ZRF 30/200	1		200	3,8			8			6	181	218		265
GRF/ZRF 30/215	1;3		215	4,2			8			6	195,7	233		285
GRF/ZRF 30/250	1;3		250	4,2			8			6	230	268		320
GRF/ZRF 30/265	1;3		265	4,6			8			6	244,7	283		350
GRF/ZRF 30/330	1;3		330	5			8			15	301	348	5.5X8	440
ZRF 45/370	1	45	370	5,5	30	50	10	5,2	39	12	341,6	-	-	950
ZRF 55/100	1		100	1,8			10			15	72	124		260
ZRF 55/150	1		150	2,5			10			15	111,2	175		355
ZRF 55/210	1		210	4,2			10			15	179,8	236		525
ZRF 55/290	1		290	4,6			10			15	258,2	317		725
ZRF 55/300	1	55	300	4,6	42	60	10	5,2	43,5	15	268	327	5,5X10	740
ZRF 55/390	1		390	5,5			10			15	356,2	418		940
ZRF 55/400	1		400	5,5			10			15	366	428		960
ZRF 55/490	1		490	6,8			10			15	454,2	517		1200
ZRF 55/500	1		500	6,8			10			15	464	527		1230
ZRF 55/590	1		590	7,6			10			15	553	618		1450

Table 2, Mechanical Specifications



Flat Oval Shaped Wirewound Resistors

DANOTHERM TYPE	P nom * T=350°C @ 25°C	CRITICAL VOLT	INSULA- TION VOLT **	RES	RMIN GFF ZFF	GFF GFI	RMAX GFF ZFF	GFV ZFV	GFI ZFI
	W	V	V	kΩ	mΩ	Ω	kΩ	kΩ	Ω
GFF/ZFF 20/50	30	360	1000	4.3	56	1	5.6	-	47
GFF/ZFF 20/80	50	810	1000	13	75	1	12	-	82
GFF/ZFF 20/90	55	960	1000	16	100	1	12	-	100
GFF/ZFF 20/100	60	1100	1000	20	120	1	15	-	120
GFF/ZFF 20/120	70	1400	1000	28	150	1	18	-	150
GFF/ZFF 27/50(-M)	40	360	1200	3.2	56	1	6.8	3.3	47
GFF/ZFF 27/80(-M)	60	810	1200	10	68	1	15	6.8	100
GFF/ZFF 27/90(-M)	65	960	1200	14	82	1	18	8.2	120
GFF/ZFF 27/100(-M)	70	1100	1200	17	100	1	22	10	150
GFF/ZFF 27/120(-M)	90	1400	1200	21	120	1	27	12	220
GFF/ZFF 27/153(-M)	110	1900	1200	32	150	1	33	15	270
ZFF 45/150(-M)	180	1900	1200	20	150	1	47	-	270
ZFF 45/200(-M)	225	2600	1200	30	180	1	68	-	330
ZFF 45/250(-M)	280	3400	1200	41	220	1	100	-	470
ZFF 78/100(-M)	180	800	3000	3.5	150	1	4.7	-	180
ZFF 78/140(-M)	250	1200	3000	5.7	300	1	5.6	-	270
ZFF 78/210(-M)	330	1900	3000	10	560	1	7.5	-	330
ZFF 78/290(-M)	450	2700	3000	16	820	1	10	-	470
ZFF 78/390(-M)	600	3700	3000	22	1200	1.2	15	-	620
ZFF 78/490(-M)	800	4700	3000	27	1500	1.5	18	-	750

TYPE	D max	d max	L	L Tol.	L1 ± 1 L1. S/A	Lb	Ltot	kmin	b L1. S/A	e	f x i	Typ. Mass
	mm	mm	mm	± mm	mm	mm	mm	mm	mm ø	mm	mm	g
GFF/ZFF 20/50	23	9.5	50	1	38.2/36.7	67	86	5	4.8/6.3	3.2	5.5x10.5	22
GFF/ZFF 20/80	23	9.5	80	1.6	67.6/66.1	97	116	5	4.8/6.3	3.2	5.5x10.5	32
GFF/ZFF 20/90	23	9.5	90	1.8	77.4/75.9	107	126	5	4.8/6.3	3.2	5.5x10.5	35
GFF/ZFF 20/100	23	9.5	100	2	87.2/85.7	117	136	5	4.8/6.3	3.2	5.5x10.5	40
GFF/ZFF 20/120	23	9.5	120	2.4	106.8/105.3	137	156	5	4.86.3	3.2	5.5x10.5	45
GFF/ZFF 27/50	30	10	50	1	37.2/35.7	67	86	6	4.8/6.3	3.2	5.5x10.5	30
GFF/ZFF 27/80	30	10	80	1.6	66.6/65.1	97	116	6	4.8/6.3	3.2	5.5x10.5	45
GFF/ZFF 27/90	30	10	90	1.8	76.4/74.9	107	126	6	4.8/6.3	3.2	5.5x10.5	48
GFF/ZFF 27/100	30	10	100	2	86.2/84.7	117	136	6	4.8/6.3	3.2	5.5x10.5	55
GFF/ZFF 27/120	30	10	120	2.4	105.8/104.3	137	156	6	4.8/6.3	3.2	5.5x10.5	65
GFF/ZFF 27/153	30	10	153	3.1	138.1/136.6	170	189	6	4.8/6.3	3.2	5.5x10.5	75
ZFF 45/150	48	12	150	3	136	170	190	6	8	4.2	6.5x10	155
ZFF 45/200	48	12	200	4	185	220	240	6	8	4.2	6.5x10	200
ZFF 45/250	48	12	250	5	234	270	290	6	8	4.2	6.5x10	250
ZFF 78/100	81	25	100	2	72	137	164	15	10	5.3	6.5x12	260
ZFF 78/140	81	25	140	2.8	111	177	204	15	10	5.3	6.5x12	355
ZFF 78/210	81	25	210	4.2	178	247	274	15	10	5.3	6.5x12	525
ZFF 78/290	81	25	290	5.8	258	327	354	15	10	5.3	6.5x12	725
ZFF 78/390	81	25	390	7.8	356	427	454	15	10	5.3	6.5x12	940
ZFF 78/490	81	25	490	9.8	454	527	554	15	10	5.3	6.5x12	1200

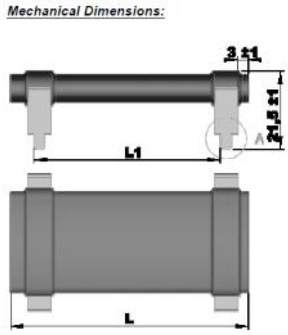
* Nominal power rating;
High ohm values, exceeding critical resistance values, should be de-rated by 25%.
Induction low types should be de-rated by 50%.

** standard insulation voltage levels, higher levels on request.

Custom designed resistors and assemblies are available on request. Details like wire configuration, creepage distance and inductance can be specified by the customers. The choice between more than 50 sizes guarantee our customer that the best resistor configuration can be found within our program. Special lengths are very well possible.

Contact our sales department or email: danotherm@danotherm.dk for special configurations.

Standard, 'Turtles' and 'M-types':
Flat Oval Shaped Vitreous Enamelled or Cement Coated Resistors can be supplied in various types: A 'Turtle' style, having 4 soldering legs to stand on, ideally suited for mounting on PCB's with good mechanical stability.
'Turtles' are offered in 78mm types. (all lengths)



M-type Oval shaped wirewound resistors have live terminals for easy electrical and mechanical connection.

Item description

ZFF 45/200 S xxR K 000

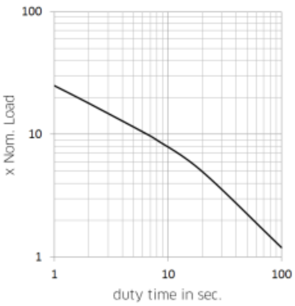
- Drawing No. (000 is standard)
- Resistance tolerance 5%, 10% or 15%
- Ohmic value (16R = 16; 5k6 = 5.6k)
- **S**: Screw / **L**: Tinned / **A**: Fast-On
- **Length** of resistor body in mm
- **Diameter** of resistor body in mm
- **F**: Fixed resistor / **I**: Low induction / **V**: Adjustable
- **F**: Flat / Oval type
- **G**: Vitreous Enamelled / **Z**: Cement coated

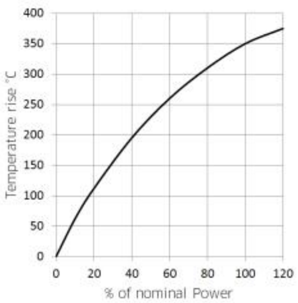
Overload Capability
Wirewound resistors can be overloaded during certain time for several their nominal power rating. Underneath curve shows the overload capability in percentage of the nominal power for pulse loads at given duration with a cycle time of 120 seconds.

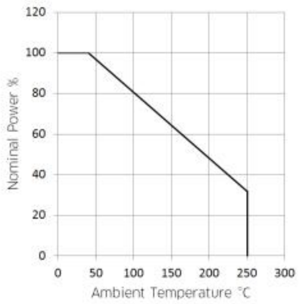
Temperature rise at constant load.
The maximum surface temperature rise is 350°C. Underneath curve shows the relation between power and surface temperature. For very dynamic power loads we suggest our Cement Coated resistors.

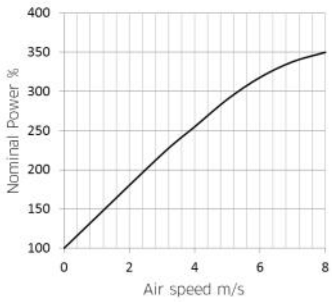
At elevated ambient temperatures the admissible maximum power dissipation must be de-rated to prevent over-heating. De-rating is done linearly from 25°C to 350°C at 100% nominal power to 0. Underneath curve shows the relation between ambient temperature and max power dissipation.

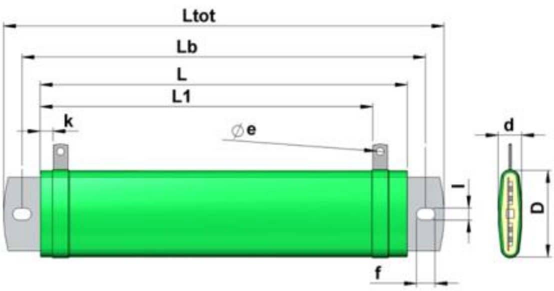
Forced air cooling increases the ability to expel heat to the ambient air. Underneath curve show the relation between airspeed and maximum admissible power dissipation.

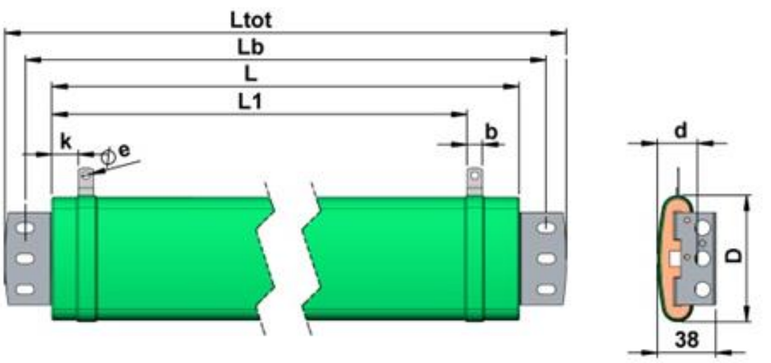




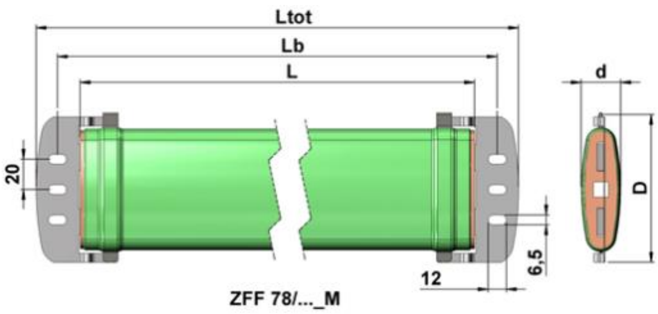








M-type Live-Terminals Wirewound Resistors



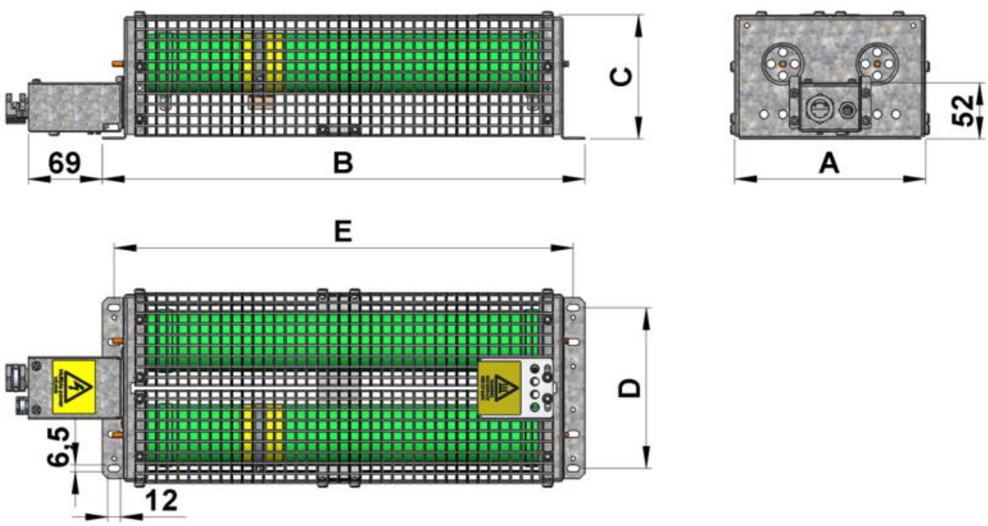
TYPE	D max	d max	L	L Tol.	Lb	Ltot	f x i	Typ. Mass
	mm	mm	mm	± mm	mm	mm	mm	g
GFF/ZFF 27/50-M	37	10	50	1	67	86	5.5x10	30
GFF/ZFF 27/80-M	37	10	80	1.6	97	116	5.5x10	45
GFF/ZFF 27/90-M	37	10	90	1.8	107	126	5.5x10	48
GFF/ZFF 27/100-M	37	10	100	2	117	136	5.5x10	55
GFF/ZFF 27/120-M	37	10	120	2.4	137	156	5.5x10	65
GFF/ZFF 27/153-M	37	10	153	3.1	169	188	5.5x10	75
ZFF 45/150-M	59	12	150	3	170	190	6.5x10	155
ZFF 45/200-M	59	12	200	4	220	240	6.5x10	200
ZFF 45/250-M	59	12	250	5	270	290	6.5x10	250
ZFF 78/100-M	96	25	100	1.8	128	156	6.5x12	260
ZFF 78/140-M	96	25	140	2.5	168	196	6.5x12	355
ZFF 78/210-M	96	25	210	4.2	238	266	6.5x12	525
ZFF 78/290-M	96	25	290	5	318	346	6.5x12	725
ZFF 78/390-M	96	25	390	5.5	418	446	6.5x12	940
ZFF 78/490-M	96	25	490	6.8	518	546	6.5x12	1200

∑ SIGMA–Modular Wirewound Brake Resistors

SIGMA is our range of **MODULAR BRAKE RESISTORS**. Thanks to the modular construction it is possible also at small quantities to supply an optimum solution to any problem concerning starter brake resistors in connection with frequency converters. The resistor components consist of fully welded wire wound ceramic resistors, which is a well-known and approved technology. The base material is corderite, which is a type of ceramic with a very high resistance to temperature changes and the wire is coated with aluminium phosphate to protect the wire and conduct the heat developed in the wire on to the ceramic core. Aluminium-phosphate is stable at 700°C.

The modular resistor cages comply with IP20 and give electrical and thermal Protection The resistors have a nominal load from 100W and upward and are particularly suitable for pulse load of 10 – 20 time or more compared to the nominal load because of the ceramic core material and an extra high weight of wire. We have developed **thermal models** corresponding to all resistor types and resistor values. By using these models we are able to calculate the temperature rises in the resistor wire for all possible load situations. Danotherm offers our assistance to our customers to find the optimum solution for any situation.

Type	Weight	Ohmic Range	Number of Resistors	Nominal Load	Pulse Load 10% E.D. 10sec	Width	Length	Height	Mount. Holes	Mount. Holes
						A	B	C	D	E
	kg	mΩ– kΩ		W	kW	mm	mm	mm	mm	mm
ZRF 55 / 100 0X1	1.1	120 - 47	1	180	1,25	89	160	115	64	135
ZRF 55 / 150 0X1	1.2	270 - 56	1	250	1,70	89	210	115	64	186
ZRF 55 / 150 0X2	2		2	500	3,40	176	210	115	150	186
ZRF 55 / 150 0X3	3.2		3	750	5,00	265	210	115	240	186
ZRF 55 / 150 0X4	3.8		4	800	5,80	176	210	230	150	186
ZRF 55 / 150 0X6	5.7		6	1200	8,70	265	210	230	240	186
ZRF 55 / 220 0X1	2.1	560 - 75	1	330	2.6	89	270	115	64	246
ZRF 55 / 220 0X2	2.9		2	650	5,20	176	270	115	150	246
ZRF 55 / 220 0X3	4.1		3	1000	7,80	265	270	115	240	246
ZRF 55 / 220 0X4	5		4	1100	8,60	176	270	230	150	246
ZRF 55 / 220 0X6	7.2		6	1500	12,50	265	270	230	240	246
ZRF 55 / 300 0X1	2.2	680 - 100	1	450	3,60	89	350	115	64	326
ZRF 55 / 300 0X2	3.5		2	900	7,20	176	350	115	150	326
ZRF 55 / 300 0X3	5.1		3	1300	10,80	265	350	115	240	326
ZRF 55 / 300 0X4	6.3		4	1500	12,00	176	350	230	150	326
ZRF 55 / 300 0X6	9		6	2200	18,00	265	350	230	240	326
ZRF 55 / 400 0X1	2.4	1000 - 150	1	600	4,80	89	450	115	64	426
ZRF 55 / 400 0X2	4.2		2	1200	9,60	176	450	115	150	426
ZRF 55 / 400 0X3	5.6		3	1800	14,40	265	450	115	240	426
ZRF 55 / 400 0X4	7.6		4	2000	16,00	176	450	230	150	426
ZRF 55 / 400 0X6	11		6	3000	24,00	265	450	230	240	426
ZRF 55 / 500 0X1	3	1200 - 180	1	800	5,80	89	550	115	64	526
ZRF 55 / 500 0X2	4.6		2	1600	11,60	176	550	115	150	526
ZRF 55 / 500 0X3	7.2		3	2400	17,40	265	550	115	240	526
ZRF 55 / 500 0X4	8.9		4	2600	19,00	176	550	230	150	526
ZRF 55 / 500 0X6	13.2		6	3800	28,50	265	550	230	240	526
ZRF 55 / 600 0X1	3.5	1500 - 200	1	1000	7,00	89	650	115	64	626
ZRF 55 / 600 0X2	5.8		2	2000	14,00	176	650	115	150	626
ZRF 55 / 600 0X3	7.6		3	3000	21,00	265	650	115	240	626
ZRF 55 / 600 0X4	10.4		4	3200	22,50	176	650	230	150	626
ZRF 55 / 600 0X6	15		6	5000	34,00	265	650	230	240	626



Each **SIGMA-MODULE** is supplied with resistor components corresponding to the actual load and according to the mechanical sizes shown in the table. In principle as many components as necessary can be mounted together. The modules can be supplied as open resistors (only resistor and mounting brackets) or with protection grating according to IP20 and with a ceramic housing connector or with a connector box. Further more it is possible to have a thermostat which works as a temperature watch and high voltage versions >400VDC.

Thermostats

The thermostat, which surveys the temperature on the resistor element, is equipped with a NC switch for warning the frequency converter if the resistor is over loaded. It is mounted on lower side of one or more resistor elements and has directly thermal contact. The standard switching temperature is 260°C. Other (lower) temperatures are possible. If the thermostat is connected to the coil of a contactor, it can work as a thermal fuse. The switch is specified to 250/380VAC, 10/5A. The thermostat is isolated from the resistor via the ceramic housing. For voltages >400VDC the thermostat is isolated with a double MICA strip.

∑ Wirewound Brake Resistors UL Approved

Type	Pnom	Max Surface Temp. @ 40°C	1s/120s	5s/120s	10s/120s	40s/120s	Ohmic Range
	W	°C	kW	kW	kW	kW	Ω - kΩ
ZRF 55/300 0A81	430	375	8	4.8	3.5	1.2	1.0 - 0.4
ZRF 55/400 0A81	575	375	12	6	4.5	1.6	1.5 - 0.9
ZRF 55/500 0A81	725	375	18	8	6	2	2.2 - 1.2
ZRF 55/600 0A81	875	375	22	10	7	2.6	2.5 - 1.5
ZRF 55/400 0A82	900	375	24	12	9	2.7	3.0 - 1.8
ZRF 55/500 0A82	1130	375	36	16	12	3.3	4.0 - 2.2
ZRF 55/600 0A82	1365	375	44	20	14	3.9	5.5 - 3.0
ZRF 55/500 0A83	1545	375	54	24	18	4.5	6.5 - 3.6
ZRF 55/600 0A83	1860	375	66	30	21	5.5	6.8 - 4.5
ZRF 55/500 0A84	2060	375	72	32	24	6	2.0 - 4.8
ZRF 55/600 0A84	2480	375	88	40	28	9.5	2.8 - 6.2
ZRF 55/500 0A86	3065	375	105	56	36	9	3.3 - 6.8
ZRF 55/600 0A86	3690	375	130	60	52	11	3.5 - 10
ZRF 55/500 0A89	4030	375	160	70	54	12	1.5 - 6.8
ZRF 55/600 0A89	4855	375	180	85	60	14	1.8 - 10

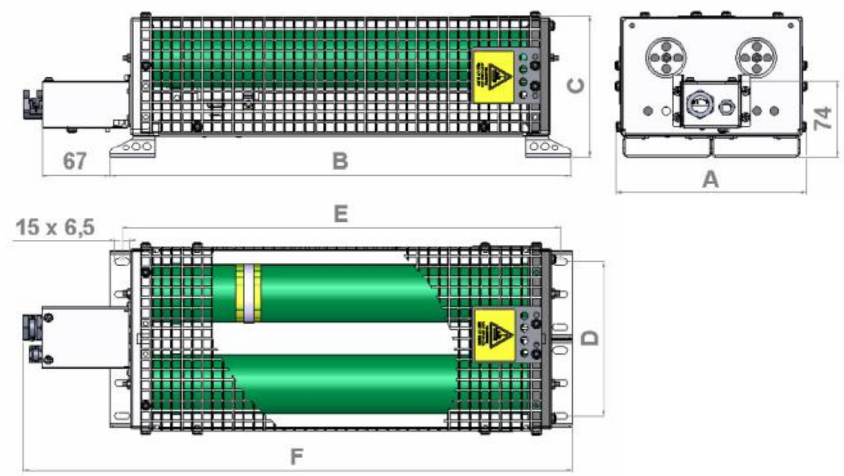
Type	A ± 2	B1 ± 2	C ± 2	D ± 1	E ± 3	F ± 3	Weight
	mm	mm	mm	mm	mm	mm	kg
ZRF 55/300 0A81	97	350	142	64	326	435	2.5
ZRF 55/400 0A81	97	450	142	64	426	535	3
ZRF 55/500 0A81	97	550	142	64	526	635	3.5
ZRF 55/600 0A81	97	650	142	64	626	735	4
ZRF 55/400 0A82	188	450	142	150	426	535	5
ZRF 55/500 0A82	188	550	142	150	526	635	5.5
ZRF 55/600 0A82	188	650	142	150	626	735	6.5
ZRF 55/500 0A83	279	550	142	240	526	635	7.8
ZRF 55/600 0A83	279	650	142	240	626	735	8.5
ZRF 55/500 0A84	188	550	252	150	526	635	9.5
ZRF 55/600 0A84	188	650	252	150	626	735	11
ZRF 55/500 0A86	274	550	252	240	526	635	14
ZRF 55/600 0A86	274	650	252	240	626	735	15
ZRF 55/500 0A89	274	550	342	240	526	635	17
ZRF 55/600 0A89	274	650	342	240	626	735	18

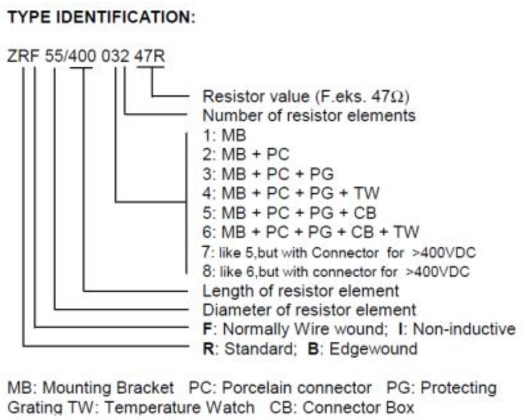
MATERIALS :

Resistor:
Ceramic Core: 20-30 mm Ø Steatite C221
55 mm Ø Corderite
Resistor Wire: CrAlFe / CrNi / CuNi
Terminals: FeNi42
Coating: Aluminiumphosphate

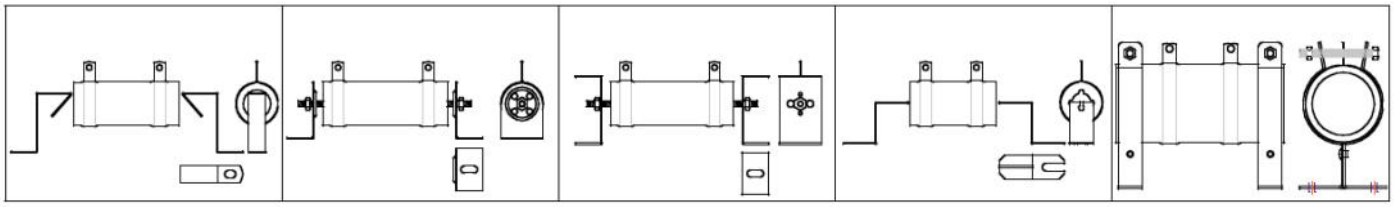
Resistor Cage:
Mounting Bracket: Steel, hot galvanized 1,5mm
Protection grating: Steel, hot galvanized 1,5mm, perforated
Connectors: Porcelain
Cables: Silicone (Silicone less possible)

Resistor tolerance:
Standard: ± 10%



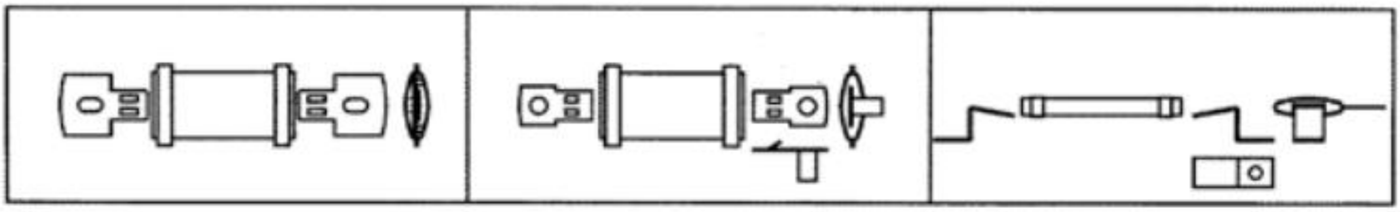


Mounting Brackets for Round Style Resistors



Mounting Brackets		Complete Sets					
Profile 1		Profile 1		30Ø Profile 3	30Ø Profile 3		55Ø
10mmØ/12mmØ:	R101	20mmØ:	R701/Length	R801/Length	30mmØ:	R107	R901
15mmØ:	R102	30mmØ:	R702/Length	(Thru bolts)			
20mmØ:	R103	55mmØ:	R703/Length				
24mmØ:	R104						
30mmØ:	R105						

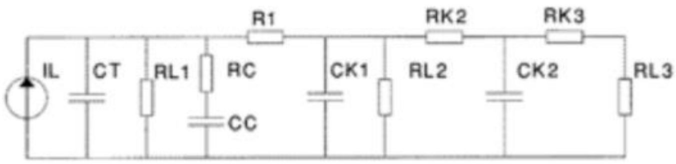
Mounting Brackets for Oval Shape Style Resistors

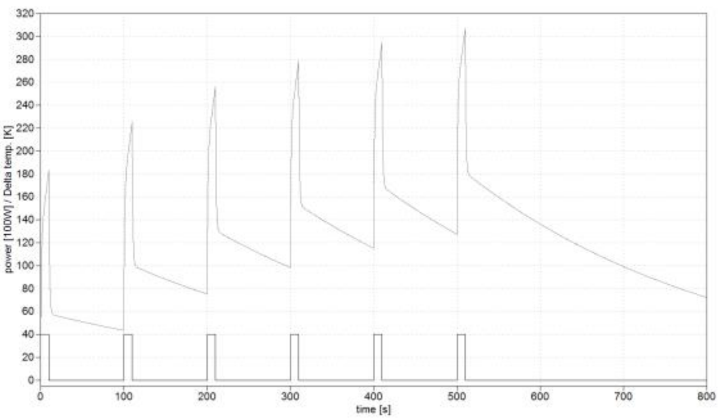


Mounting Brackets					
20mm	-	20mm	R120	20mm	R122
27mm:	R123	27mm	R120	27mm	R122
45mm	R124	45mm	-	45mm	-

Mounting brackets for Wirewound resistors need to be ordered separately.

All Danotherm Resistors can be equipped with a thermal model, which makes it possible to calculate the TEMPERATURE RISE during a specified load. Particularly by pulse loads it is possible to simulate the temperature rise by using a program as PSpice.
You can ask DANOTHERM to simulate or ask for the thermal model of your resistor to do the simulation your self.





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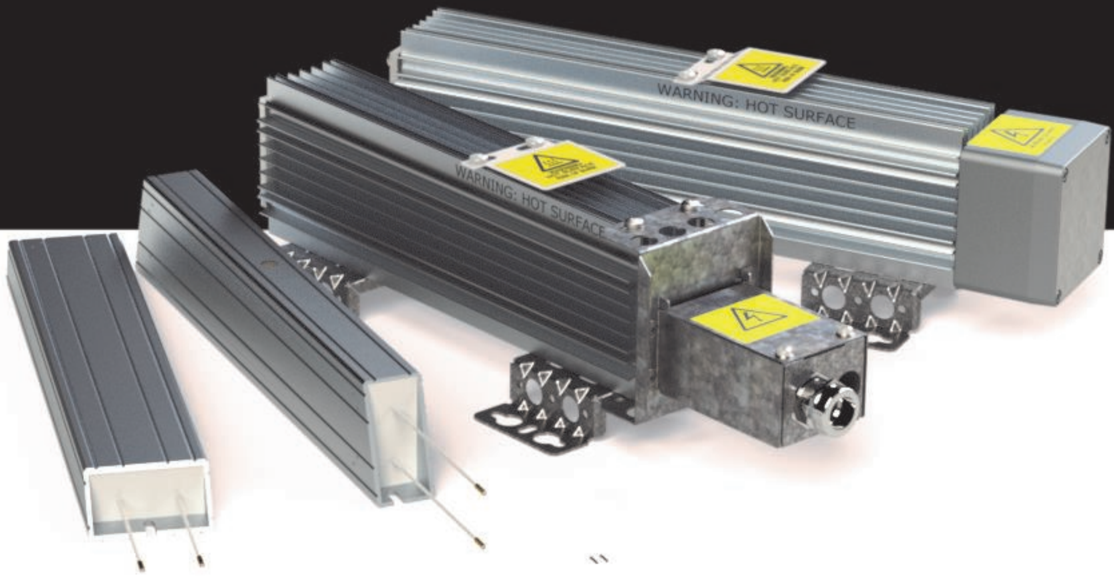


CBH / CBV / CBR-V / CBR-H

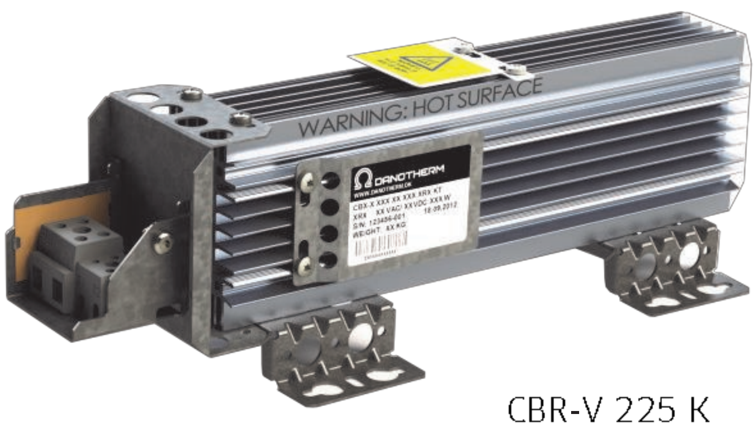
- Brake resistors

- General-purpose applications; High pulse load applications
- Compact Construction; small dimensions
- Fully insulated; no external live parts
- High IP Classes
- Low thermal drift, 100ppm
- Fail Safe capabilities on request
- Low noise
- Thermal models for all types available on request
- Resistor components are UL approved

CBH/CBV CBR-V/CBR-H	Pn [W] @ 40°C According UL508	max temp. [°C]	R [Ω] min - max	Pulse load [kW] T. Amb. = 40°C each 120s *			
				duty 1 second [kW]	duty 5 second [kW]	duty 10 second [kW]	duty 40 second [kW]
CBH / CBV 165 C	110	265	0.5 - 1000	5	1.4	0.9	0.3
CBH / CBV 215 C	155	270	0.8 - 1500	9.8	2.5	1.6	0.5
CBH / CBV 265 C	200	270	1.5 - 2000	16.6	4.0	2.4	0.6
CBH / CBV 335 C	270	280	1.8 - 2000	26.6	6.2	3.4	0.9
CBH / CBV 405 C	330	285	2.0 - 2000	34.1	8.5	4.3	1
CBR-V / H 175 C	311	265	0.8 - 1500	10.5	2.7	1.8	0.9
CBR-V / H 225 C	400	270	1.5 - 2000	18.3	4.5	2.8	1.2
CBR-V / H 295 C	525	275	1.8 - 2000	29.7	7.1	4.2	1.8
CBR-V / H 365 C	650	280	2.0 - 2000	38.4	11.3	6.7	2.4
CBR-V / H 426 C	980	285	2.4 - 2000	39.1	12.9	7.9	2.9
CBR-V / H 526 C	1220	295	3.0 - 2000	49.1	16.1	9.9	3.6
CBR-V / H 626 C	1460	305	3.5 - 2000	60.6	19.7	12	4.4
CBR-V / H 726 C	1700	310	4.0 - 2000	73.1	23.4	14.3	5.2

Construction and salient properties

- UL approved
- Compact dimensions
- Nominal power range from 110W–1700W
- Energy levels from 9kJ-150kJ per case housing (5s duty,120s cycle), depending on ohmic value
- Aluminium case housing for high IP rating
- IP50-IP65
- Internal ceramic supported wirewound spirals for lower ohmic values
- Internal mica supported wirewound elements for higher ohmic values
- Nickel-Chrome 8020 alloy for low thermal drift
- Mica insulated for high dielectric strength
- Al_2O_3 or SiO_2 filled for high thermal capacity/ high power overload capability
- Low surface temperature
- Low noise level
- High vibration withstand capability
- Thermal relief expansion mounting feet
- Optional thermal switch or PT100 element for thermal protection
- Cable (AWG 18–AWG10) or box connection up to 10mm²
- Customized to your needs and application (OEM versions available)



CBR-V 225 K

CBH / CBV / CBR cable connections IP54

with internal thermal switch

CBH/CBV CBR-V/CBR-H with Thermal switch	Pn [W] @ 40°C According UL508	max temp. [°C]	R [Ω] min - max	Pulse load [kW] T. Amb. = 40°C each 120s*			
				duty 1 second [kW]	duty 5 second [kW]	duty 10 second [kW]	duty 40 second [kW]
CBH / CBV 190 xT	85	210	0.5 - 1000	5	1.4	0.9	0.3
CBH / CBV 240 xT	120	215	0.8 - 1500	9.8	2.5	1.5	0.4
CBH / CBV 290 xT	150	220	1.5 - 2000	16.6	3.8	1.9	0.5
CBH / CBV 360 xT	200	225	1.8 - 2000	25.6	5.2	2.6	0.7
CBH / CBV 430 xT	250	230	2.0 - 2000	32.5	6.5	3.2	0.8
CBR-V / H 160 xT	280	210	0.5 - 1000	5.4	1.5	1	0.5
CBR-V / H 210 xT	360	210	0.8 - 1500	10.6	2.8	1.8	0.9
CBR-V / H 260 xT	450	225	1.5 - 2000	18.4	4.6	2.8	1.3
CBR-V / H 330 xT	570	230	1.8 - 2000	30	7.1	4.2	1.7
CBR-V / H 400 xT	680	230	2.0 - 2000	38.8	11.4	6.8	2.1
CBR-V / H 460 xT	790	240	2.4 - 2000	39.4	12.9	8	2.4
CBR-V / H 560 xT	960	250	3.0 - 2000	49.4	16.2	10	3.1
CBR-V / H 660 xT	1130	260	3.5 - 2000	60.6	19.7	12.1	3.8
CBR-V / H 760 xT	1290	260	4.0 - 2000	73.8	23.3	14.2	4.3

CBR K-box connection IP00

CBH/CBV CBR-V/CBR-H	Pn [W] @ 40°C	max temp. [°C]	R [Ω] min - max	Pulse load [kW] T. Amb. = 40°C each 120s*			
				duty 1 second [kW]	duty 5 second [kW]	duty 10 second [kW]	duty 40 second [kW]
CBR-V 175 K	235	210	0.8 - 1500	10.5	2.7	1.8	0.8
CBR-V 225 K	305	215	1.5 - 2000	18.3	4.5	2.8	1.1
CBR-V 295 K	400	220	1.8 - 2000	29.7	7.1	4.2	1.5
CBR-V 365 K	495	225	2.0 - 2000	38.4	11.3	6.7	1.9
CBR-V 426 K	750	230	2.4 - 40	39.1	12.9	7.9	2.3
CBR-V 526 K	930	235	3.0 45	49.1	16.1	9.9	2.9
CBR-V 626 K	1100	240	3.5 - 50	60.6	19.7	12	3.6
CBR-V 726 K	1300	250	4.0 - 55	73.1	23.4	14.3	4.3

* Pulse ratings for short pulses depend on the ohm value. Resistors with lower resistance value have more wire than resistors with higher resistance values. The ratings in this table refer to resistors of about 40R.

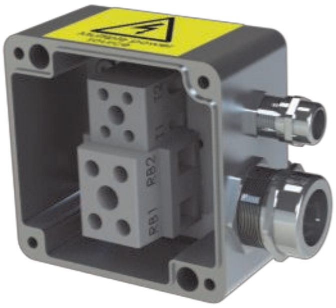
General specifications

Temperature Coefficient:		100 ppm/K
Dielectric strength		3500 VAC @ 1 minute
Isolation Resistance:		> 20MΩ / case housing
Overload:@ 1 sec pulse / hour		40 - 120 x (depending on resistor)
Overload:@ 5 sec pulse / hour		10 - 27 x (depending on resistor)
Environmental:		- 40 °C / +70 °C
De-rating cable version		Linear: 40°C = Pn to 70°C = 0.85 * Pn
De-rating TW 200°C version		Linear: 40°C = Pn to 70°C = 0.65 * Pn
De-rating vertical mounting		no de-rating
De-rating horizontal mounting		0.8 * Pn
De-rating at high altitudes	1000 m	no de-rating
	1500 m	0.94 * Pn
	3000 m	0.82 * Pn
Mounting instructions		It is recommended to keep a distance of 200mm to the nearest object to prevent heating of a neighboring component.
		If two or more brake resistors are mounted next to each other the distance between these should be 400mm. If this is less then the nominal power needs to be de-rated.
Cooling		The nominal power of the resistors refers to cooling conditions with Free Natural Air Cooling.
Vibration		Acc. To EN 60068-2-6 frequency range 1 - 100Hz Acceleration / Amplitude
	1 - 13 Hz	± 1mm
	13 - 100 Hz	@ ± 0.7G
Corrosive resistance		Acc. IEC 60721-3-3/3K3 (C2 medium) 200 hours cyclic salt mist IEC 60068-2-52
Connection recommendations		To minimize EMC interference screened cables are recommend-ed. in particular with any PWM brake pattern.
Resistance tolerance		± 10% (optional 5%)
Working voltage	Standard	UL: 600VAC. IEC: 690VAC / 1100VDC
	On request	UL: 1000VAC. IEC: 1000VAC / 1400VDC
Time constant for heating up resistor		1000s
Thermal switch (optional)	Thermal switch	130 / 160 / 180 / 200 °C. 2A. 250 VAC NC
Minimum voltage		2V
Minimum current		10mA
Rated current / voltage		2.5A @ 250 VAC cos ϕ=1
Dielectric voltage		2000VAC (3500VAC between TS and R)
Temperature requirements on cables	IP 21	80°C
	IP 65	90°C

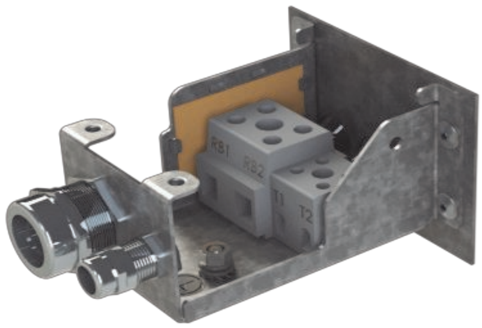
Connection boxes, only CBR types (optional)

connection boxes	IP rating	cable gland	clamping	braid (min.)	connection	TS gland	clamping	connection
			[mm]	[mm]	[mm²]	[mm]	[mm]	[mm²]
B-box	IP65	M25	9-16.6	7.5	0.75-10	M12	3-7	0.5-4
D-box	IP21	M25	9-16.6	7.5	0.75-10	M12	3-7	0.5-4
K-box	IP00	-	-	-	0.75-10	-	-	0.5-4*

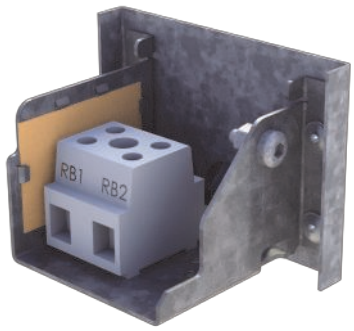
*TS with K-box optional



B-box



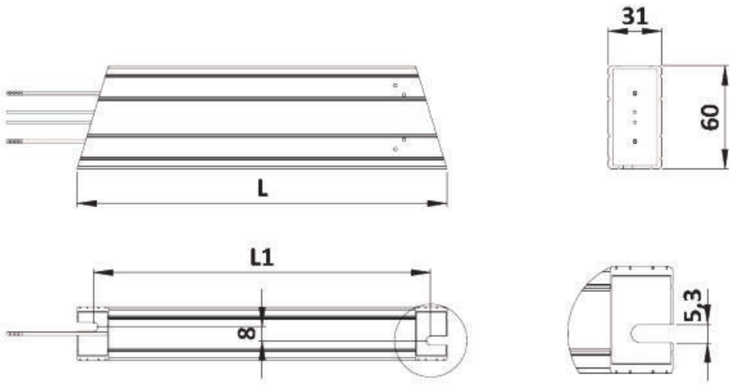
D-box



K-box

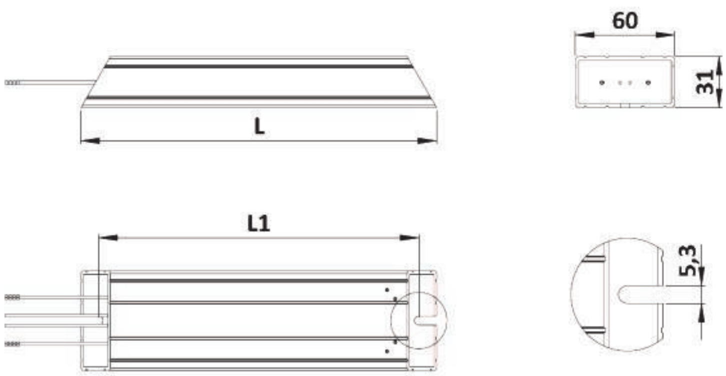
CBH / CBV Cable cable connection IP54

Type	L ± 2	L1 ± 2	Weight
	±2mm	±2mm	kg
CBH / CBV 165 C 800	165	146	0.39
CBH / CBV 215 C 800	215	196	0.63
CBH / CBV 265 C 800	265	246	0.88
CBH / CBV 335 C 800	335	316	1.2
CBH / CBV 405 C 800	405	386	1.5

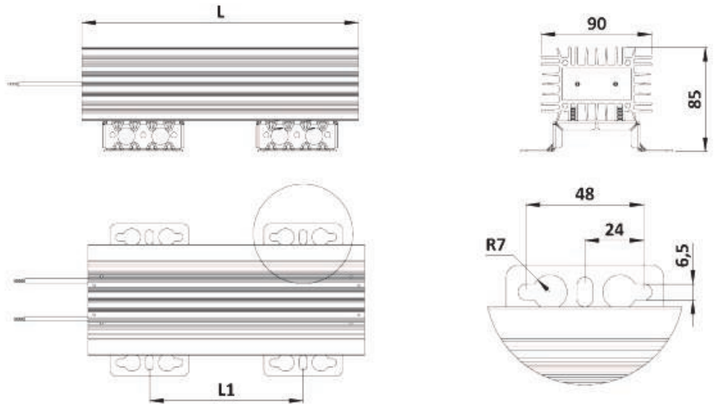


CBH/CBV cable connections IP54
with internal thermal switch

Type	L	L1	Weight
	±2mm	±2mm	kg
CBH/CBV 190 CT 800	190	171	0.5
CBH/CBV 240 CT 800	240	221	0.71
CBH/CBV 290 CT 800	290	271	0.97
CBH/CBV 360 CT 800	360	341	1.3
CBH/CBV 430 CT 800	430	411	1.6

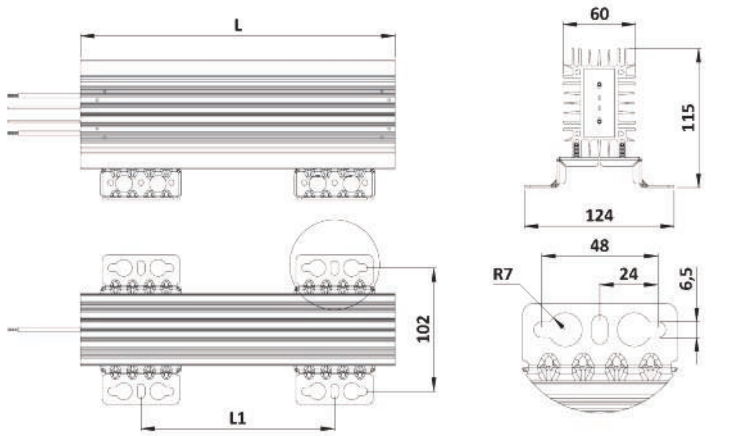


Cable connections IP54 CBR-V ... C ...



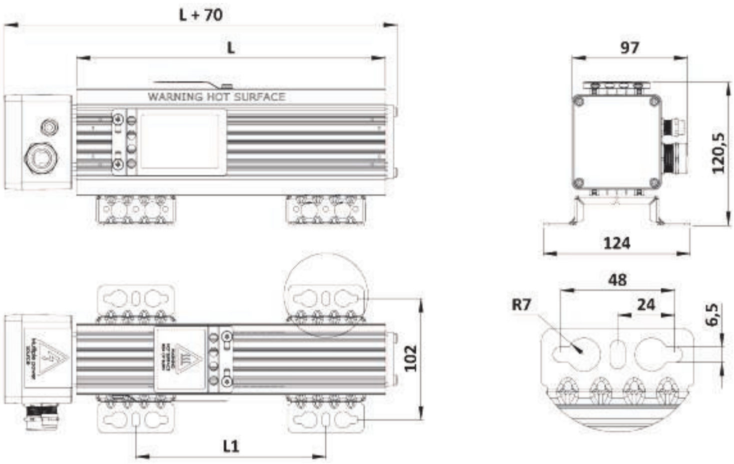
Type	L ± 2	L1 ± 2	Weight
	±2mm	±2mm	kg
CBR-V/CBR-H 175 C 001	175	75	1.5
CBR-V/CBR-H 225 C 001	225	125	1.8
CBR-V/CBR-H 295 C 001	295	195	2.3
CBR-V/CBR-H 365 C 001	365	265	2.8
CBR-V/CBR-H 426 C 001	426	326	3.2
CBR-V/CBR-H 526 C 001	526	426	3.8
CBR-V/CBR-H 626 C 001	626	526	4.5
CBR-V/CBR-H 726 C 001	726	626	5.2

Cable connections IP54 - with internal thermal switch CBR–V ... CT...



-H / -V W(T)	L	L1	Weight
	±2mm	±2mm	kg
CBR-H/CBR-V 160 CT 081	160	70	1.5
CBR-H/CBR-V 210 CT 081	210	110	1.8
CBR-H/CBR-V 260 CT 081	260	160	2.1
CBR-H/CBR-V 330 CT 081	330	230	2.6
CBR-H/CBR-V 400 CT 081	400	300	3.1
CBR-H/CBR-V 460 CT 081	460	360	3.5
CBR-H/CBR-V 560 CT 081	560	460	4.1
CBR-H/CBR-V 660 CT 081	660	560	4.8
CBR-H/CBR-V 760 CT 081	760	660	5.5

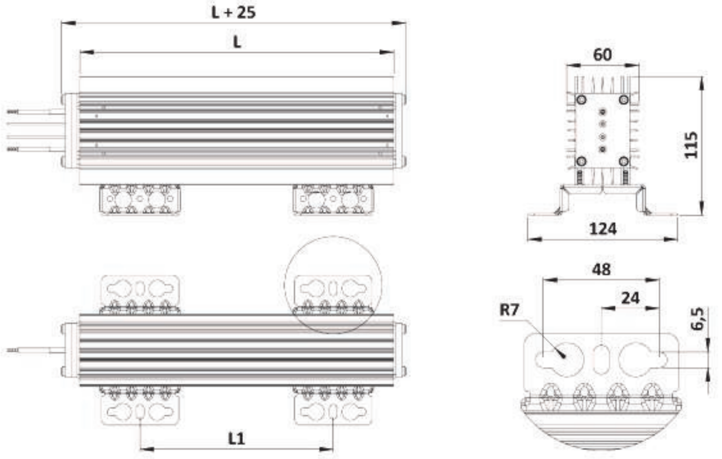
B-box connection IP54 - with internal thermal switch CBR–V ... BT...



Type	L	L1	Weight
	±2mm	±2mm	kg
CBR-V 160 B T 281	160	70	1.3
CBR-V 210 B T 281	210	110	1.8
CBR-V 260 B T 281	260	160	2.4
CBR-V 330 B T 281	330	230	3.0
CBR-V 400 B T 281	400	300	3.5
CBR-V 460 B T 281	460	360	3.9
CBR-V 560 B T 281	560	460	4.6
CBR-V 660 B T 281	660	560	5.4
CBR-V 760 B T 281	760	660	6.1

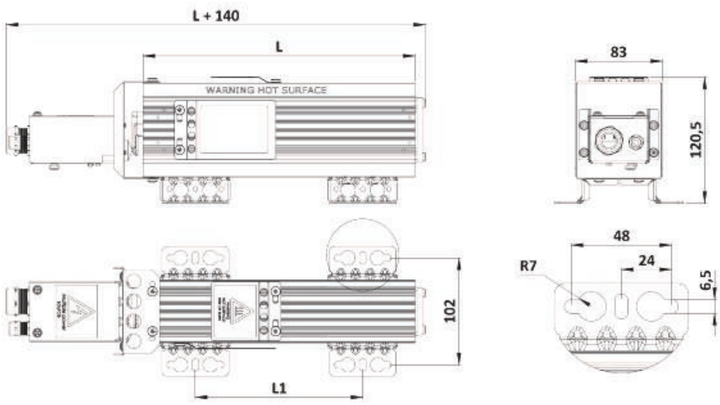
Cable connection type IP65 'W' with or without internal thermal switch CBR-V ... W ...

-H / -V W(T)	L	L1	Weight
	±2mm	±2mm	kg
CBR-H/CBR-V 160 WX 081	160	70	1.5
CBR-H/CBR-V 210 WX 081	210	110	1.8
CBR-H/CBR-V 260 WX 081	260	160	2.1
CBR-H/CBR-V 330 WX 081	330	230	2.6
CBR-H/CBR-V 400 WX 081	400	300	3.1
CBR-H/CBR-V 460 WX 081	460	360	3.5
CBR-H/CBR-V 560 WX 081	560	460	4.1
CBR-H/CBR-V 660 WX 081	660	560	4.8
CBR-H/CBR-V 760 WX 081	760	660	5.5



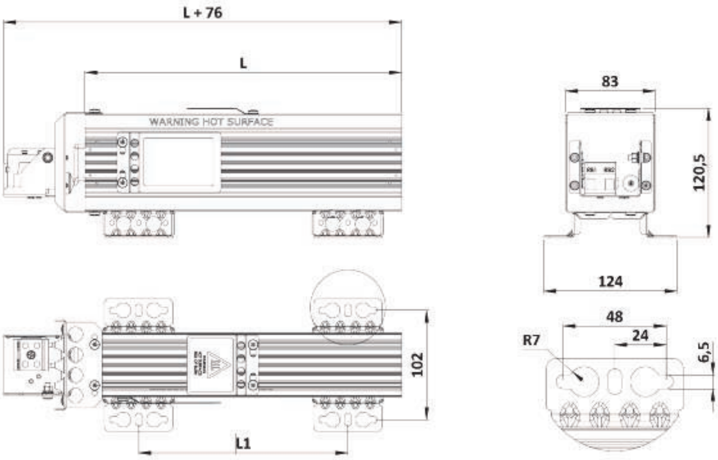
Box connection IP20/IP21 - with internal thermal switch CBR-V ... D ...

Type	L	L1	Weight
	±2mm	±2mm	kg
CBR-V 160 D T 281	160	70	1.3
CBR-V 210 D T 281	210	110	1.8
CBR-V 260 D T 281	260	160	2.4
CBR-V 330 D T 281	330	230	3.0
CBR-V 400 D T 281	400	300	3.5
CBR-V 460 D T 281	460	360	3.9
CBR-V 560 D T 281	560	460	4.6
CBR-V 660 D T 281	660	560	5.4
CBR-V 760 D T 281	760	660	6.1

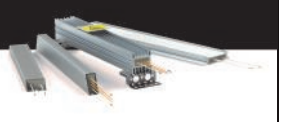


Box connection IP00 CBR-V ... K ...

Type	L	L1	Weight
	±2mm	±2mm	kg
CBR-V 175 K 201	175	75	1.3
CBR-V 225 K 201	225	125	1.8
CBR-V 295 K 201	295	195	2.4
CBR-V 365 K 201	365	265	3.0
CBR-V 426 K 201	426	326	3.5
CBR-V 526 K 201	526	426	3.9
CBR-V 626 K 201	626	526	4.6
CBR-V 726 K 201	726	626	5.4

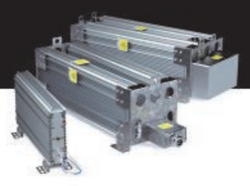


Overview of the ALPHA resistor family (IP00-IP65)

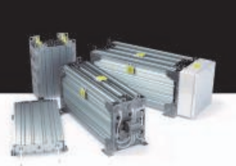


CCH / CAV / CAH / CAR

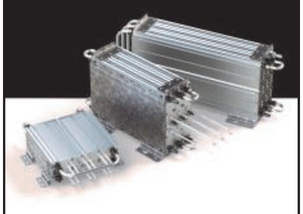
CBH / CBV / CBR



CBT-V / CBT-H



CBS / CMQ /CVS / HVBS



CBW-V / CBW-H
Water cooled

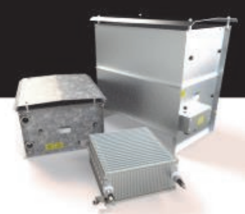
Power: 60-410W	Power: 85W-1.7kW	Power: 410W-12kW	Power: 445W-15kW	Power: 860W-25kW
	9-150kJ @5s	25-550kJ @5s	80kJ-2.5MJ @5s	6.4kJ-1.1MJ @5s
- Applications				
Charge / Discharge	High Pulse load	High Pulse load	High Pulse load	Short recovery time
Brake	Brake	Brake	Brake	Brake
Filter	Filter	Filter	Medium voltage	Filter
	Charge / Discharge	Charge / Discharge	Charge / Discharge	High Pulse load

Other resistor types from Danotherm (IP00-IP66)

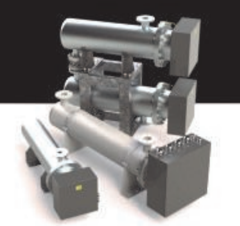
SIGMA

OHMEGA - Air

WHHB / WHBS / WHBSA



TERA



OHMEGA - Water

Multi purpurse	Outdoor & Marine	Filter	Medium & High voltage	Filter & load
Power: 100W-5kW	Power: 1-500kW	Power: 4-200kW	Power: 500W->	Power: 5kW-1MW
Ceramic wirewound	Steel tube	Wirewound	Steel grid	Steel tube

CBR-V 400 CH(T) 2 8 1 22R

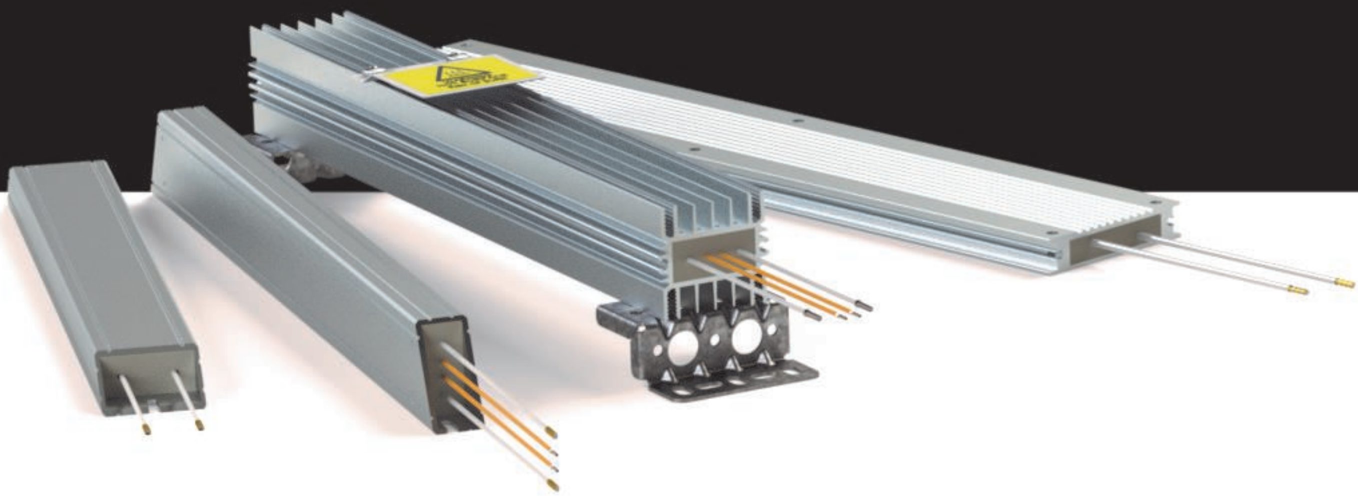
Last digits > 400: Customer specific version, otherwise:

- Ohm value (Example 2R2=2.2Ω, / 22R = 22Ω)
- Number of case style housings
- Thermal switch temp; 5=130°C / 6=160°C / 7=180°C / 8=200°C
- 0=cable connection, 2=connection box type
- T=Thermal switch (normally closed)
- Wire element H/E (TBD by Danotherm)
- Connection; C=no box / D=IP20 / B=IP65 box
- Length of resistor housing in mm
- H=horizontal mounting feet / V=vertical mounting feet
- Housing style; CBH / CBV / CBR

DANOTHERM™

Danotherm Electric A/S
Naesbyvej 20
DK-2610 Roedovre
Denmark
CVR 1012 6061

DAN EN 16.5015.R3
19022017



CCH / CAH / CAV / CAR

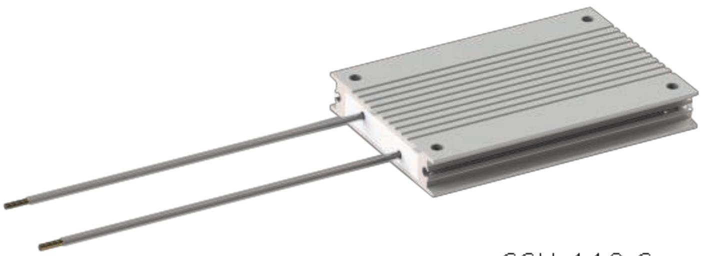
- Brake resistors

- General-purpose applications; High pulse load applications
- Compact Construction; small dimensions
- Fully insulated; no external live parts
- High IP Classes
- Low thermal drift, 100ppm
- Fail Safe capabilities on request
- Low noise
- Thermal models for all types available on request
- Resistor components are UL approved

Pn W @ 40°C According UL508									
CAH/CAV CAR	P_n W @ 40°C According UL508	max temp. °C	R Ω min - max	Pulse load W T. amb. = 40°C each 120s					
				duty 1 second W	duty 5 second W	duty 10 second W	duty 20 second W	duty 40 second W
CCH 110	100	260	2 - 1000	2500	1150	800	540	295
CCH 166	160	265	4 - 1200	5700	2380	1600	930	470
CCH 216	200	275	6 - 1500	10500	3760	2350	1180	590
CCH 270	260	280	9 - 1700	14200	5050	3080	1540	770
CCH 320	300	285	10 - 2000	18600	6320	3550	1780	890
CCH 420	390	295	13 - 2000	24700	8390	4590	2290	1160
CCH 520	480	305	16 - 2000	30300	9710	5760	2880	1440
CCH 620	570	315	20 - 2000	38100	11900	6890	3440	1720
CCH with internal thermal switch									
CCH 145 CT	80	210	2 - 1000	2540	1210	850	580	345
CCH 201 CT	120	215	4 - 1200	5780	2480	1690	920	460
CCH 251 CT	160	220	6 - 1500	10600	3940	2280	1140	570
CCH 305 CT	200	225	9 - 1700	14500	5220	2820	1410	700
CCH 355 CT	230	230	10 - 2000	19100	6550	3280	1640	820
CCH 455 CT	300	235	13 - 2000	25300	8310	4150	2080	1040
CCH 555 CT	370	245	16 - 2000	30900	10000	5170	2590	1290
CCH 655 CT	440	250	20 - 2000	38800	11800	5900	2950	1500

Construction and salient properties

- UL approved
- Compact dimensions
- Nominal power range from 80W–440W
- Energy levels from 6kJ-60J (5s duty,120s cycle), depending on ohmic value
- Aluminium case housing for high IP rating
- IP50-IP65
- Nickel-Chrome 8020 alloy for low thermal drift
- Mica insulated for high dielectric strength
- MgO or SiO_2 filled for high thermal capacity/ high power overload capability
- Low surface temperature
- Low noise level
- High vibration withstand capability
- Thermal relief expansion mounting feet (CAR type)
- Optional thermal switch or PT100 element for thermal protection
- Cable (AWG 18–AWG10) or box connection up to $10mm^2$
- Customized to your needs and application (OEM versions available)



CCH 110 C

Pn W @ 40°C According UL508								
CAH/CAV CAR	P_n W @ 40°C According UL508	max temp. °C	R min - max Ω	Pulse load kW T. amb. = 40°C each 120s				
				duty 1 second W	duty 5 second W	duty 10 second W	duty 20 second W	duty 40 second W
CAH / CAV 120 C	70	260	0.15 - 300	1070	410	320	240	170
CAH / CAV 150 C	90	260	0.3 - 600	2420	820	600	435	255
CAH / CAV 165 C	100	265	0.3 - 800	3630	1120	780	540	285
CAH / CAV 210 C	125	270	0.6 - 1200	7030	1800	1120	750	375
CAH / CAV 240 C	145	275	0.7 - 1500	9530	2350	1440	850	435
CAH / CAV 300 C	185	290	1 - 1200	12800	3150	1920	1100	550
CAH / CAV 360 C	220	305	1.2 - 2500	16700	4080	2460	1320	660
CAR 85 C	115	260	0.1 - 300	1090	420	330	250	180
CAR 115 C	150	265	0.25 - 600	2480	860	640	470	330
CAR 130 C	170	265	0.3 - 800	3750	1170	830	600	405
CAR 175 C	225	275	0.5 - 1200	7420	1910	1230	830	570
CAR 205 C	260	285	0.7 - 1400	10200	2540	1590	1050	700
CAR 265 C	335	300	1.0 - 2000	13800	3460	2140	1420	940
CAR 325 C	410	320	1.2 - 2500	18100	4460	2750	1810	1170

Cable and connection box

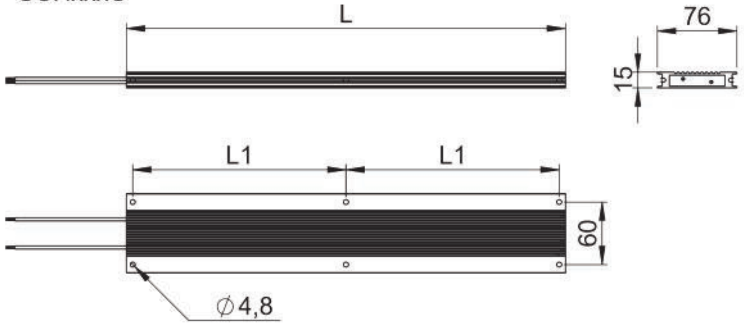
with and without thermal switch

Pn W @ 40°C According UL508								
CAH/CAV CAR	P_n W @ 40°C According UL508	max temp. °C	R min - max Ω	Pulse load kW T. amb. = 40°C each 120s				
				duty 1s second W	duty 5s second W	duty 10s second W	duty 20s second W	duty 40s second W
CAH / CAV 145 CT	60	210	0.15 - 300	1070	415	325	245	170
CAH / CAV 175 CT	75	210	0.3 - 600	2420	830	610	430	215
CAH / CAV 190 CT	80	215	0.3 - 800	3630	1120	780	460	235
CAH / CAV 235 CT	100	220	0.6 - 1200	7030	1810	1130	580	290
CAH / CAV 265 CT	110	220	0.7 - 1500	9530	2350	1340	670	335
CAH / CAV 325 CT	140	230	1 - 1200	12800	3180	1660	830	415
CAH / CAV 385 CT	165	235	1.2 - 2500	16700	3980	1990	1000	495
CAR 110 CT/K/DT	105	210	0.1 - 300	1090	425	335	260	185
CAR 140 CT/K/DT	135	210	0.25 - 600	2500	870	650	485	335
CAR 155 CT/K/DT	150	215	0.3 - 800	3750	1190	840	610	420
CAR 200 CT/K/DT	190	220	0.5 - 1200	7420	1940	1240	850	560
CAR 230 CT/K/DT	210	225	0.7 - 1400	10200	2560	1600	1060	630
CAR 290 CT/K/DT	265	235	1.0 - 2000	13800	3490	2150	1430	780
CAR 350 CT/K/DT	310	250	1.2 - 2500	18100	4500	2760	1810	930

Pulse ratings for short pulses depend on the ohm value. Resistors with lower resistance value have more wire than resistors with higher resistance values. The ratings in this table refer to resistors of about 40R.

Temperature Coefficient:		100 ppm/K
Dielectric strength		3500 VAC @ 1 minute
Isolation Resistance:		> 20MΩ / case housing
Overload:@ 1 sec pulse / hour		10 - 100 x (depending on resistor)
Overload:@ 5 sec pulse / hour		4 - 25 x (depending on resistor)
Environmental:		- 40 °C / +70 °C
De-rating cable version		Linear: 40°C = Pn to 70°C = 0.85 * Pn
De-rating TW 200°C version		Linear: 40°C = Pn to 70°C = 0.65 * Pn
De-rating vertical mounting		no de-rating
De-rating horizontal mounting		0.8 * Pn
De-rating at high altitudes	1000 m	no de-rating
	1500 m	0.94 * Pn
	3000 m	0.82 * Pn
Mounting instructions		It is recommended to keep a distance of 200mm to the nearest object to prevent heating of a neighboring component.
		If two or more brake resistors are mounted next to each other the distance between these should be 400mm. If this is less then the nominal power needs to be de-rated.
Cooling		The nominal power of the resistors refers to cooling conditions with Free Natural Air Cooling.
Vibration		Acc. To EN 60068-2-6 frequency range 1 - 100Hz Acceleration / Amplitude
	1 - 13 Hz	± 1mm
	13 - 100 Hz	@ ± 0.7G
Corrosive resistance		Acc. IEC 60721-3-3/3K3 (C2 medium) 200 hours cyclic salt mist IEC 60068-2-52
Connection recommendations		To minimize EMC interference screened cables are recommended. in particular with any PWM brake pattern.
Resistance tolerance		± 10% (optional 5%)
Working voltage		UL: 600VAC. IEC: 690VAC / 850VDC
Time constant for heating up resistor		1000s
Thermal switch (optional)	Thermal switch	130 / 160 / 180 / 200 °C. 2A. 250 VAC NC
Minimum voltage		2V
Minimum current		10mA
Rated current / voltage		2.5A @ 250 VAC cos ϕ=1 2.5A @ 24 VDC
Dielectric voltage		2000VAC (3500VAC between TS and R)
Temperature requirements on cables	IP 21	80°C
	IP 65	90°C

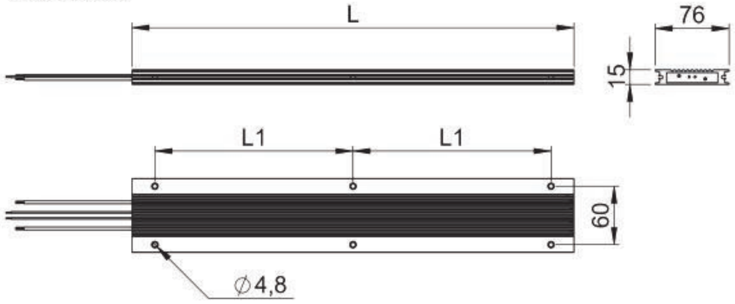
CCHxxxC



Type	L ± 2 mm	L1 ± 2 mm	Weight g
CCH 110	110	98	220
CCH 166	166	154	350
CCH 216	216	204	480
CCH 270	270	258	620
CCH 320	320	2x154	790
CCH 420	420	2x204	1050
CCH 520	520	2x241.5	1300
CCH 620	620	2x291.5	1550

CCH Cable version with thermal switch, IP54

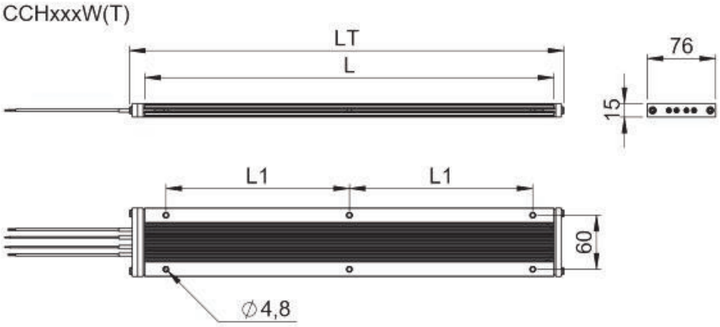
CCHxxxCT



Type	L ± 2 mm	L1 ± 2 mm	Weight g
CCH 145 CT	145	98	270
CCH 201 CT	201	154	410
CCH 251 CT	251	204	540
CCH 305 CT	305	258	620
CCH 355 CT	355	2x154	850
CCH 455 CT	455	2x204	1110
CCH 555 CT	555	2x241.5	1360
CCH 655 CT	655	2x291.5	1610

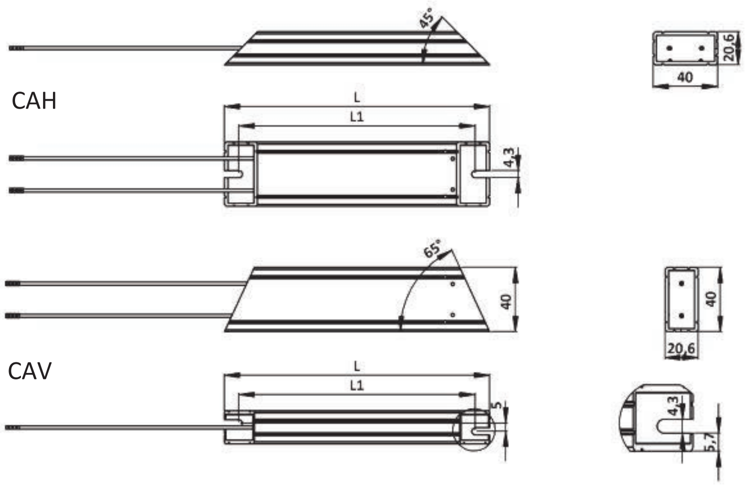
CCH Cable version IP65, thermal switch IP65

CCHxxxW(T)



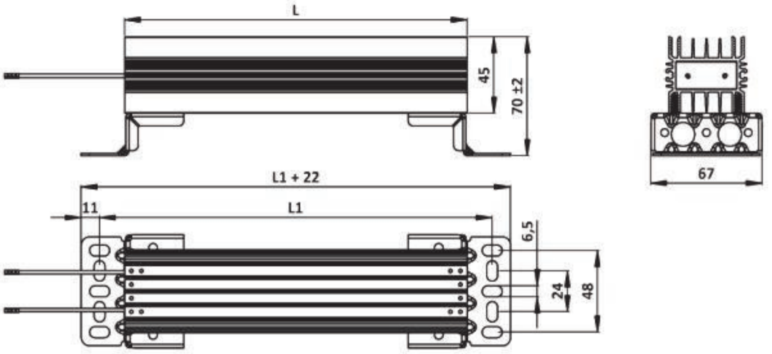
Type	L ± 2 mm	L1 ± 2 mm	Weight g
CCH 145 W(T)	145	98	270
CCH 201 W(T)	201	154	410
CCH 251 W(T)	251	204	540
CCH 305 W(T)	305	258	620
CCH 355 W(T)	355	2x154	850
CCH 455 W(T)	455	2x204	1110
CCH 555 W(T)	555	2x241.5	1360
CCH 655 W(T)	655	2x291.5	1610

Cable version IP54, thermal switch optional



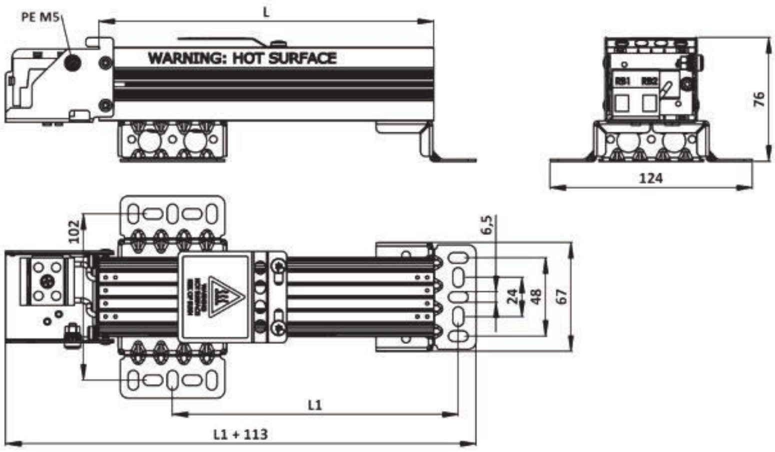
Type	L ± 2 mm	L1 ± 2 mm	Weight g
CAH / CAV 120 C	120	102	160
CAH / CAV 150 C	150	132	185
CAH / CAV 165 C	165	147	220
CAH / CAV 210 C	210	192	315
CAH / CAV 240 C	240	222	370
CAH / CAV 300 C	300	282	460
CAH / CAV 360 C	360	342	550
with thermal switch (T)			
CAH / CAV 145 CT	145	127	130
CAH / CAV 175 CT	175	157	160
CAH / CAV 190 CT	190	172	190
CAH / CAV 235 CT	235	217	280
CAH / CAV 265 CT	265	247	335
CAH / CAV 325 CT	325	307	425
CAH / CAV 385 CT	385	367	515

CAR cable type



Type	L ±2mm	L1 ±2mm	Weight g
CAR 85 C	85	115	200
CAR 115 C	115	145	280
CAR 130 C	130	160	300
CAR 175 C	175	205	380
CAR 205 C	205	235	530
CAR 265 C	265	295	600
CAR 325 C	325	355	740
with thermal switch (T)			
CAR 110 CT	110	140	155
CAR 140 CT	140	170	230
CAR 155 CT	155	185	250
CAR 200 CT	200	230	335
CAR 230 CT	230	260	470
CAR 290 CT	290	320	550
CAR 350 CT	350	380	685

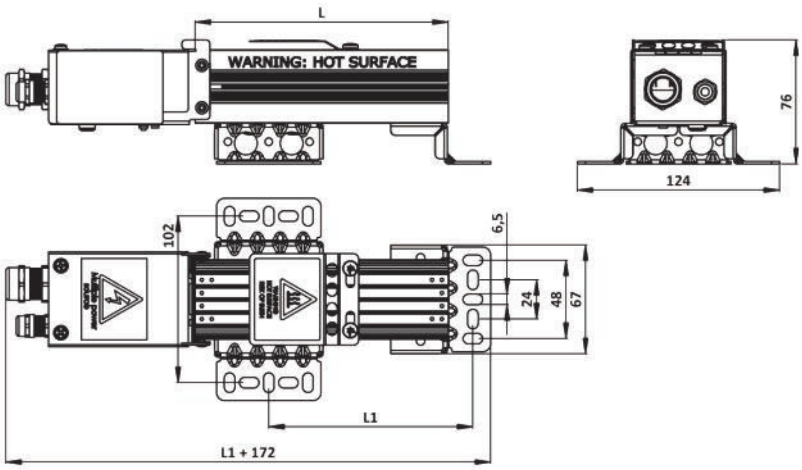
CAR K-Box



CAR Box type connection

Type	L ± 2 mm	L1 ± 2 mm	Weight g
with connection box			
CAR 115 K/-D	115	85	450/650
CAR 130 K/-D	130	100	470/700
CAR 175 K/-D	175	145	550/750
CAR 205 K/-D	205	175	700/900
CAR 265 K/-D	265	235	800/950
CAR 325 K/-D	325	195	900/1100

CAR DT-Box

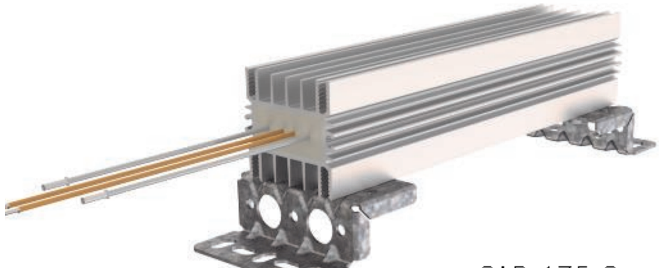


CAR Box type connection and thermal switch

Type	L ± 2 mm	L1 ± 2 mm	Weight g
with connection box			
CAR 140 K / -DT	140	110	510/720
CAR 155 K / -DT	155	125	540/760
CAR 200 K / -DT	200	170	610/810
CAR 230 K / -DT	230	200	760/960
CAR 290 K / -DT	290	260	860/1010
CAR 350 K / -DT	350	320	970/1160

CCH 110 C

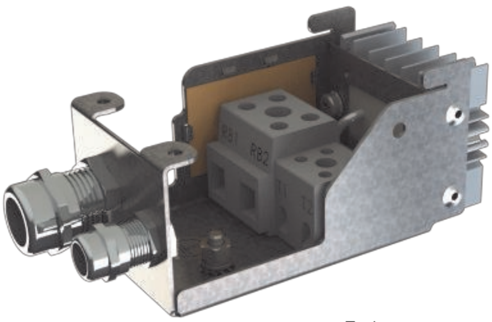
CAH 120 C



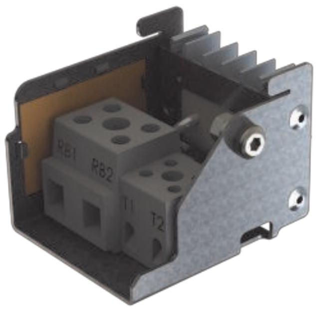
CAR 175 C

Connection boxes, only CAR types

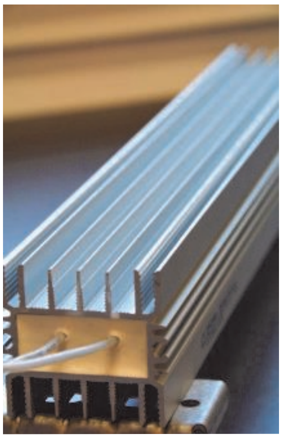
connection boxes	IP rating	cable gland	clamping	braid (min.)	connection	TS gland	clamping	connection
			mm	mm	mm²	mm	mm	mm²
D-box	IP21	M25	9-16.6	7.5	0.75-10	M12	3-7	0.5-4
K-box	IP00	-	-	-	0.75-10	-	-	0.5-4*

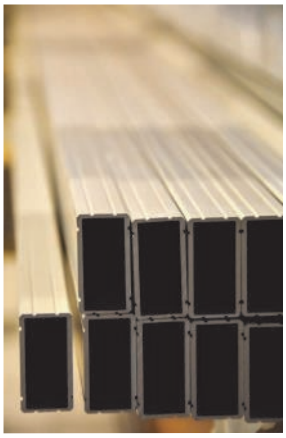


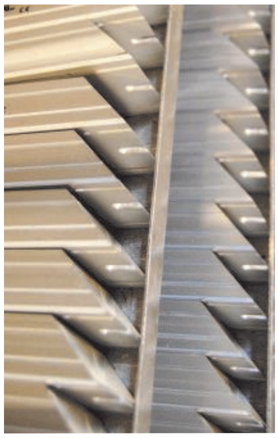
D-box



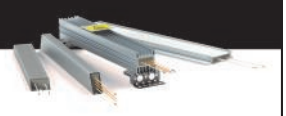
KT-box







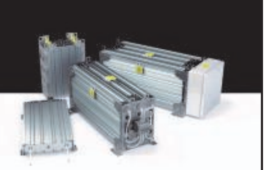
Overview of the ALPHA resistor family (IP00-IP65)



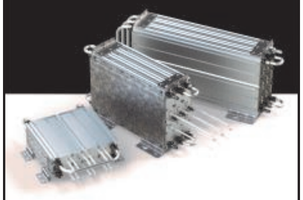
CCH / CAV / CAH / CAR

CBH / CBV / CBR

CBT-V / CBT-H



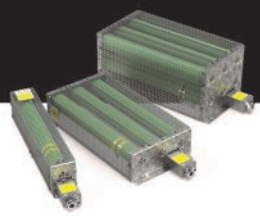
CBS / CMQ /CVS / HVBS



CBW-V / CBW-H
Water cooled

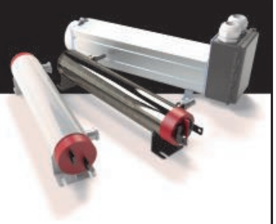
Power: 60-410W	Power: 85W-1.7kW	Power: 410W-12kW	Power: 445W-15kW	Power: 860W-25kW
	9-150kJ @5s	25-550kJ @5s	80kJ-2.5MJ @5s	6.4kJ-1.1MJ @5s
- Applications				
Charge / Discharge	High Pulse load	High Pulse load	High Pulse load	Short recovery time
Brake	Brake	Brake	Brake	Brake
Filter	Filter	Filter	Medium voltage	Filter
	Charge / Discharge	Charge / Discharge	Charge / Discharge	High Pulse load

Other resistor types from Danotherm (IP00-IP66)

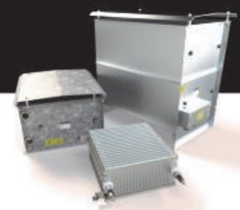


SIGMA

OHMEGA - Air



WHHB / WHBS / WHBSA



TERA

OHMEGA - Water

Multi purpurse	Outdoor & Marine	Filter	Medium & High voltage	Filter & load
Power: 100W-5kW	Power: 1-500kW	Power: 4-200kW	Power: 500W->	Power: 5kW-1MW
Ceramic wirewound	Steel tube	Wirewound	Steel grid	Steel tube

CAR 400 C(H)(T) 2 8 1 22R

'281' digits > 400: Customer specific version, otherwise:

- Ohm value (Example 2R2=2.2Ω, / 22R = 22Ω)
- Number of case style housings
- Thermal switch; 5=130°C / 6=160°C / 7=180°C / 8=200°C
- 0=cable connection, 2=connection box type
- T=Thermal switch (normally closed)
- Wire element (H, TBD by Danotherm)
- Connection; C=no box / K=IP00 / D=IP20
- Length of resistor housing in mm
- Housing style; CCH / CAH / CAV / CAR

Danotherm Electric A/S
Naesbyvej 20
DK-2610 Roedovre
Denmark
CVR 1012 6061

DAN EN 16.5026.R1
17MAY2017

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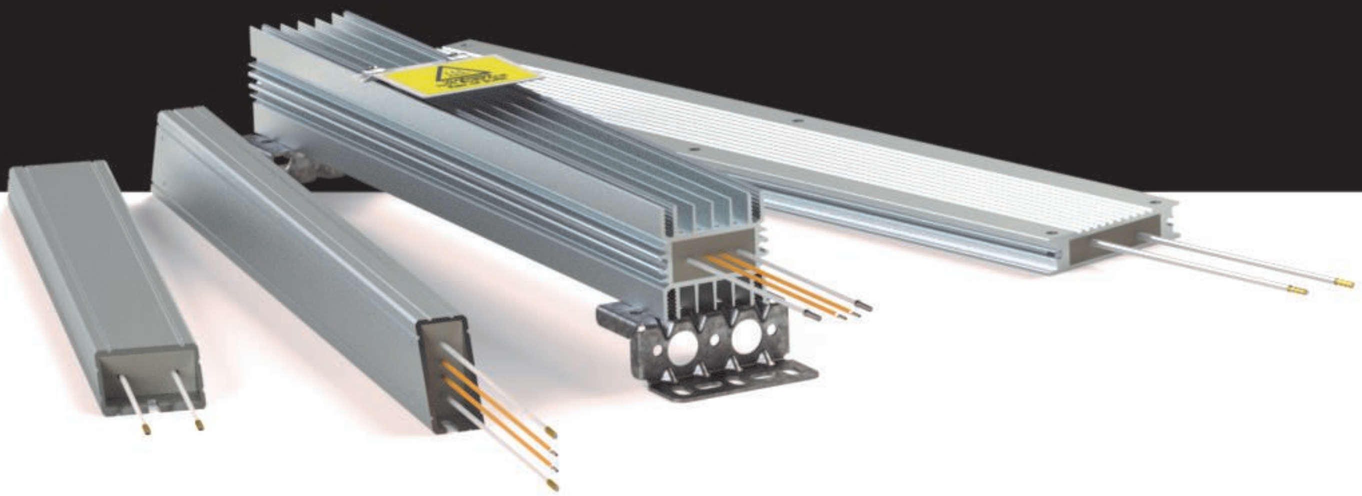


CCH / CAH / CAV / CAR

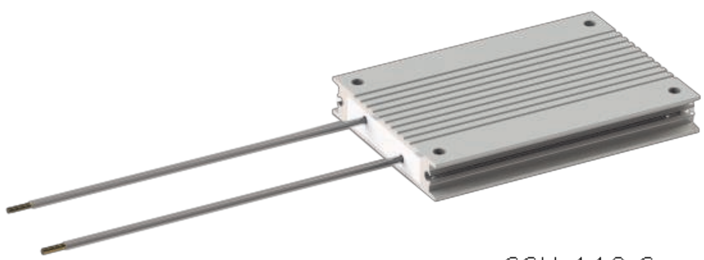
- Brake resistors

- General-purpose applications; High pulse load applications
- Compact Construction; small dimensions
- Fully insulated; no external live parts
- High IP Classes
- Low thermal drift, 100ppm
- Fail Safe capabilities on request
- Low noise
- Thermal models for all types available on request
- Resistor components are UL approved

Pn W @ 40°C According UL508								
CAH/CAV CAR	P_n W @ 40°C According UL508	max temp. °C	R Ω min - max	Pulse load W T. amb. = 40°C each 120s				
				duty 1 second W	duty 5 second W	duty 10 second W	duty 20 second W	duty 40 second W
CCH 110	100	260	2 - 1000	2500	1150	800	540	295
CCH 166	160	265	4 - 1200	5700	2380	1600	930	470
CCH 216	200	275	6 - 1500	10500	3760	2350	1180	590
CCH 270	260	280	9 - 1700	14200	5050	3080	1540	770
CCH 320	300	285	10 - 2000	18600	6320	3550	1780	890
CCH 420	390	295	13 - 2000	24700	8390	4590	2290	1160
CCH 520	480	305	16 - 2000	30300	9710	5760	2880	1440
CCH 620	570	315	20 - 2000	38100	11900	6890	3440	1720
CCH with internal thermal switch								
CCH 145 CT	80	210	2 - 1000	2540	1210	850	580	345
CCH 201 CT	120	215	4 - 1200	5780	2480	1690	920	460
CCH 251 CT	160	220	6 - 1500	10600	3940	2280	1140	570
CCH 305 CT	200	225	9 - 1700	14500	5220	2820	1410	700
CCH 355 CT	230	230	10 - 2000	19100	6550	3280	1640	820
CCH 455 CT	300	235	13 - 2000	25300	8310	4150	2080	1040
CCH 555 CT	370	245	16 - 2000	30900	10000	5170	2590	1290
CCH 655 CT	440	250	20 - 2000	38800	11800	5900	2950	1500

Construction and salient properties

- UL approved
- Compact dimensions
- Nominal power range from 80W–440W
- Energy levels from 6kJ-60J (5s duty,120s cycle), depending on ohmic value
- Aluminium case housing for high IP rating
- IP50-IP65
- Nickel-Chrome 8020 alloy for low thermal drift
- Mica insulated for high dielectric strength
- MgO or SiO_2 filled for high thermal capacity/ high power overload capability
- Low surface temperature
- Low noise level
- High vibration withstand capability
- Thermal relief expansion mounting feet (CAR type)
- Optional thermal switch or PT100 element for thermal protection
- Cable (AWG 18–AWG10) or box connection up to $10mm^2$
- Customized to your needs and application (OEM versions available)



CCH 110 C

CAH/CAV/CAR cable connection

Pn W @ 40°C According UL508								
CAH/CAV CAR	P_n W @ 40°C According UL508	max temp. °C	R min - max Ω	Pulse load kW T. amb. = 40°C each 120s				
				duty 1 second W	duty 5 second W	duty 10 second W	duty 20 second W	duty 40 second W
CAH / CAV 120 C	70	260	0.15 - 300	1070	410	320	240	170
CAH / CAV 150 C	90	260	0.3 - 600	2420	820	600	435	255
CAH / CAV 165 C	100	265	0.3 - 800	3630	1120	780	540	285
CAH / CAV 210 C	125	270	0.6 - 1200	7030	1800	1120	750	375
CAH / CAV 240 C	145	275	0.7 - 1500	9530	2350	1440	850	435
CAH / CAV 300 C	185	290	1 - 1200	12800	3150	1920	1100	550
CAH / CAV 360 C	220	305	1.2 - 2500	16700	4080	2460	1320	660
CAR 85 C	115	260	0.1 - 300	1090	420	330	250	180
CAR 115 C	150	265	0.25 - 600	2480	860	640	470	330
CAR 130 C	170	265	0.3 - 800	3750	1170	830	600	405
CAR 175 C	225	275	0.5 - 1200	7420	1910	1230	830	570
CAR 205 C	260	285	0.7 - 1400	10200	2540	1590	1050	700
CAR 265 C	335	300	1.0 - 2000	13800	3460	2140	1420	940
CAR 325 C	410	320	1.2 - 2500	18100	4460	2750	1810	1170

Cable and connection box

with and without thermal switch

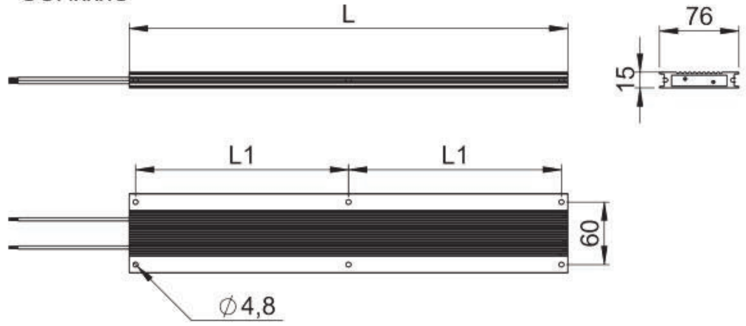
Pn W @ 40°C According UL508								
CAH/CAV CAR	P_n W @ 40°C According UL508	max temp. °C	R min - max Ω	Pulse load kW T. amb. = 40°C each 120s				
				duty 1s second W	duty 5s second W	duty 10s second W	duty 20s second W	duty 40s second W
CAH / CAV 145 CT	60	210	0.15 - 300	1070	415	325	245	170
CAH / CAV 175 CT	75	210	0.3 - 600	2420	830	610	430	215
CAH / CAV 190 CT	80	215	0.3 - 800	3630	1120	780	460	235
CAH / CAV 235 CT	100	220	0.6 - 1200	7030	1810	1130	580	290
CAH / CAV 265 CT	110	220	0.7 - 1500	9530	2350	1340	670	335
CAH / CAV 325 CT	140	230	1 - 1200	12800	3180	1660	830	415
CAH / CAV 385 CT	165	235	1.2 - 2500	16700	3980	1990	1000	495
CAR 110 CT/K/DT	105	210	0.1 - 300	1090	425	335	260	185
CAR 140 CT/K/DT	135	210	0.25 - 600	2500	870	650	485	335
CAR 155 CT/K/DT	150	215	0.3 - 800	3750	1190	840	610	420
CAR 200 CT/K/DT	190	220	0.5 - 1200	7420	1940	1240	850	560
CAR 230 CT/K/DT	210	225	0.7 - 1400	10200	2560	1600	1060	630
CAR 290 CT/K/DT	265	235	1.0 - 2000	13800	3490	2150	1430	780
CAR 350 CT/K/DT	310	250	1.2 - 2500	18100	4500	2760	1810	930

Pulse ratings for short pulses depend on the ohm value. Resistors with lower resistance value have more wire than resistors with higher resistance values. The ratings in this table refer to resistors of about 40R.

Temperature Coefficient:		100 ppm/K
Dielectric strength		3500 VAC @ 1 minute
Isolation Resistance:		> 20MΩ / case housing
Overload:@ 1 sec pulse / hour		10 - 100 x (depending on resistor)
Overload:@ 5 sec pulse / hour		4 - 25 x (depending on resistor)
Environmental:		- 40 °C / +70 °C
De-rating cable version		Linear: 40°C = Pn to 70°C = 0.85 * Pn
De-rating TW 200°C version		Linear: 40°C = Pn to 70°C = 0.65 * Pn
De-rating vertical mounting		no de-rating
De-rating horizontal mounting		0.8 * Pn
De-rating at high altitudes	1000 m	no de-rating
	1500 m	0.94 * Pn
	3000 m	0.82 * Pn
Mounting instructions		It is recommended to keep a distance of 200mm to the nearest object to prevent heating of a neighboring component.
		If two or more brake resistors are mounted next to each other the distance between these should be 400mm. If this is less then the nominal power needs to be de-rated.
Cooling		The nominal power of the resistors refers to cooling conditions with Free Natural Air Cooling.
Vibration		Acc. To EN 60068-2-6 frequency range 1 - 100Hz Acceleration / Amplitude
	1 - 13 Hz	± 1mm
	13 - 100 Hz	@ ± 0.7G
Corrosive resistance		Acc. IEC 60721-3-3/3K3 (C2 medium) 200 hours cyclic salt mist IEC 60068-2-52
Connection recommendations		To minimize EMC interference screened cables are recommend-ed. in particular with any PWM brake pattern.
Resistance tolerance		± 10% (optional 5%)
Working voltage		UL: 600VAC. IEC: 690VAC / 850VDC
Time constant for heating up resistor		1000s
Thermal switch (optional)	Thermal switch	130 / 160 / 180 / 200 °C. 2A. 250 VAC NC
Minimum voltage		2V
Minimum current		10mA
Rated current / voltage		2.5A @ 250 VAC cos ϕ=1 2.5A @ 24 VDC
Dielectric voltage		2000VAC (3500VAC between TS and R)
Temperature requirements on cables	IP 21	80°C
	IP 65	90°C

CCH Cable version, IP54

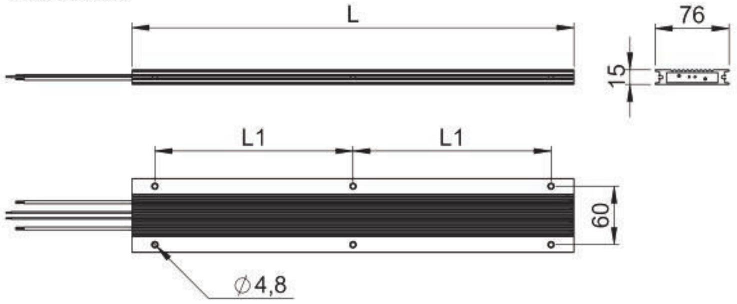
CCHxxxC



Type	L ± 2 mm	L1 ± 2 mm	Weight g
CCH 110	110	98	220
CCH 166	166	154	350
CCH 216	216	204	480
CCH 270	270	258	620
CCH 320	320	2x154	790
CCH 420	420	2x204	1050
CCH 520	520	2x241.5	1300
CCH 620	620	2x291.5	1550

CCH Cable version with thermal switch, IP54

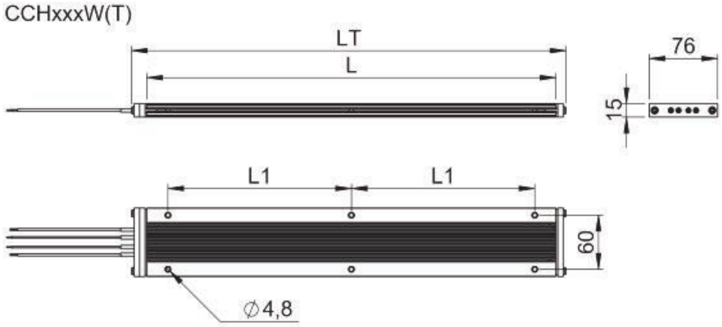
CCHxxxCT



Type	L ± 2 mm	L1 ± 2 mm	Weight g
CCH 145 CT	145	98	270
CCH 201 CT	201	154	410
CCH 251 CT	251	204	540
CCH 305 CT	305	258	620
CCH 355 CT	355	2x154	850
CCH 455 CT	455	2x204	1110
CCH 555 CT	555	2x241.5	1360
CCH 655 CT	655	2x291.5	1610

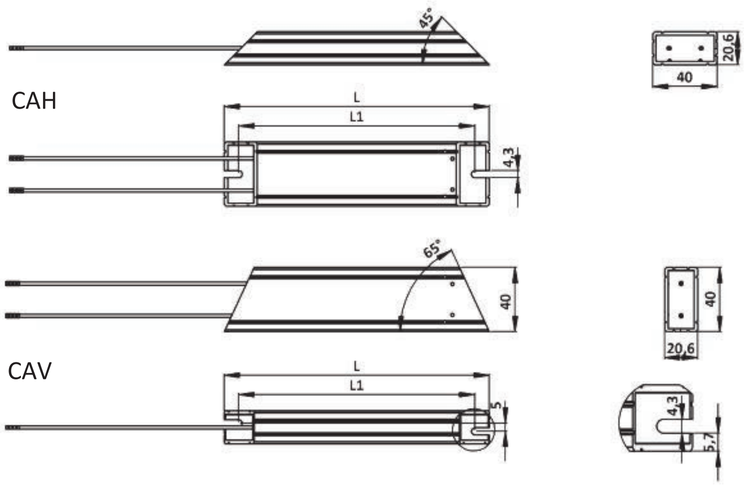
CCH Cable version IP65, thermal switch IP65

CCHxxxW(T)



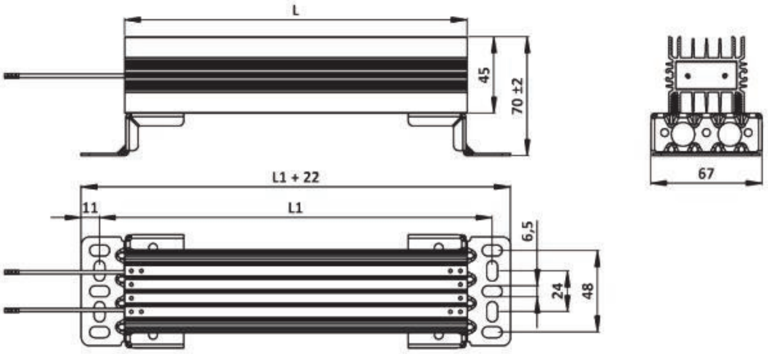
Type	L ± 2 mm	L1 ± 2 mm	Weight g
CCH 145 W(T)	145	98	270
CCH 201 W(T)	201	154	410
CCH 251 W(T)	251	204	540
CCH 305 W(T)	305	258	620
CCH 355 W(T)	355	2x154	850
CCH 455 W(T)	455	2x204	1110
CCH 555 W(T)	555	2x241.5	1360
CCH 655 W(T)	655	2x291.5	1610

Cable version IP54, thermal switch optional



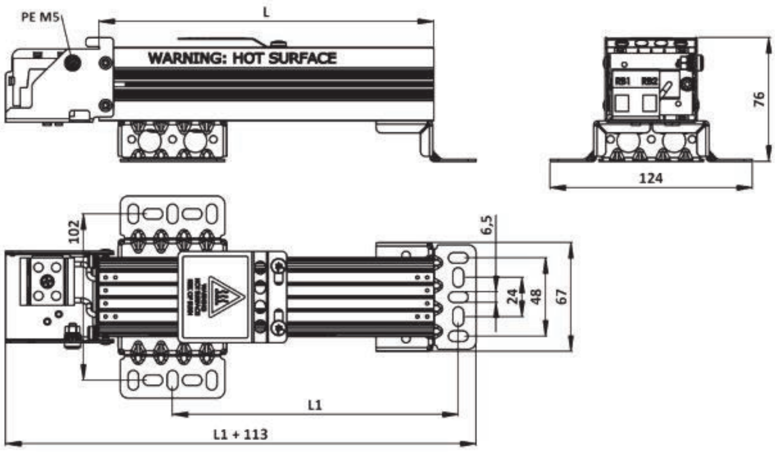
Type	L ± 2 mm	L1 ± 2 mm	Weight g
CAH / CAV 120 C	120	102	160
CAH / CAV 150 C	150	132	185
CAH / CAV 165 C	165	147	220
CAH / CAV 210 C	210	192	315
CAH / CAV 240 C	240	222	370
CAH / CAV 300 C	300	282	460
CAH / CAV 360 C	360	342	550
with thermal switch (T)			
CAH / CAV 145 CT	145	127	130
CAH / CAV 175 CT	175	157	160
CAH / CAV 190 CT	190	172	190
CAH / CAV 235 CT	235	217	280
CAH / CAV 265 CT	265	247	335
CAH / CAV 325 CT	325	307	425
CAH / CAV 385 CT	385	367	515

CAR cable type



Type	L ±2mm	L1 ±2mm	Weight g
CAR 85 C	85	115	200
CAR 115 C	115	145	280
CAR 130 C	130	160	300
CAR 175 C	175	205	380
CAR 205 C	205	235	530
CAR 265 C	265	295	600
CAR 325 C	325	355	740
with thermal switch (T)			
CAR 110 CT	110	140	155
CAR 140 CT	140	170	230
CAR 155 CT	155	185	250
CAR 200 CT	200	230	335
CAR 230 CT	230	260	470
CAR 290 CT	290	320	550
CAR 350 CT	350	380	685

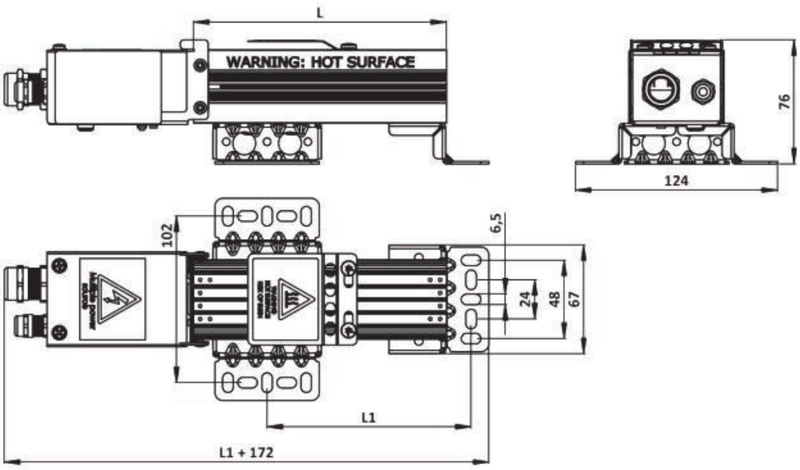
CAR K-Box



CAR Box type connection

Type	L ± 2 mm	L1 ± 2 mm	Weight g
with connection box			
CAR 115 K/-D	115	85	450/650
CAR 130 K/-D	130	100	470/700
CAR 175 K/-D	175	145	550/750
CAR 205 K/-D	205	175	700/900
CAR 265 K/-D	265	235	800/950
CAR 325 K/-D	325	195	900/1100

CAR DT-Box

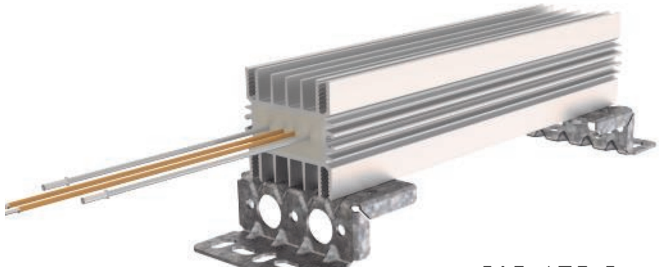


CAR Box type connection and thermal switch

Type	L ± 2 mm	L1 ± 2 mm	Weight g
with connection box			
CAR 140 K / -DT	140	110	510/720
CAR 155 K / -DT	155	125	540/760
CAR 200 K / -DT	200	170	610/810
CAR 230 K / -DT	230	200	760/960
CAR 290 K / -DT	290	260	860/1010
CAR 350 K / -DT	350	320	970/1160

CCH 110 C

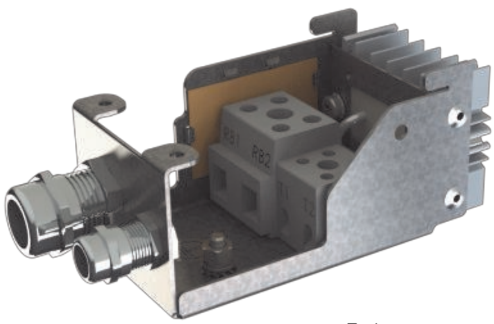
CAH 120 C



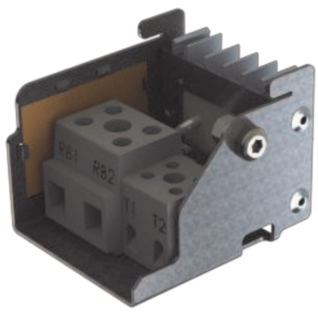
CAR 175 C

Connection boxes, only CAR types

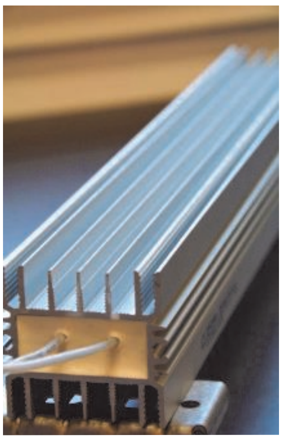
connection boxes	IP rating	cable gland	clamping	braid (min.)	connection	TS gland	clamping	connection
			mm	mm	mm²	mm	mm	mm²
D-box	IP21	M25	9-16.6	7.5	0.75-10	M12	3-7	0.5-4
K-box	IP00	-	-	-	0.75-10	-	-	0.5-4*

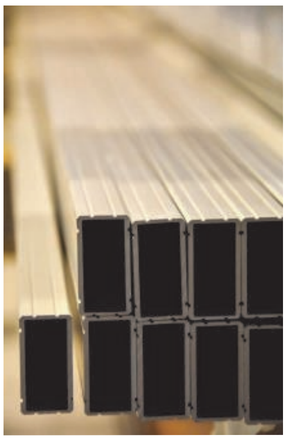


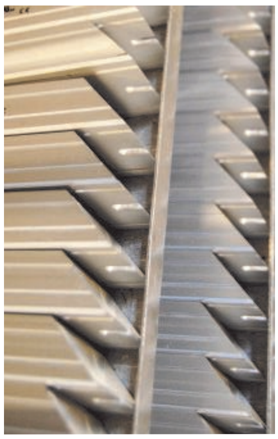
D-box



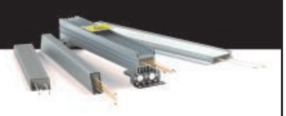
KT-box





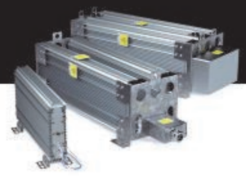


Overview of the ALPHA resistor family (IP00-IP65)

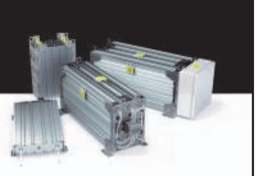


CCH / CAV / CAH / CAR

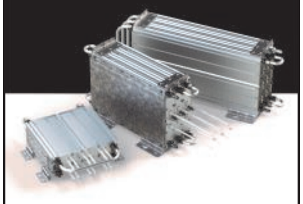
CBH / CBV / CBR



CBT-V / CBT-H



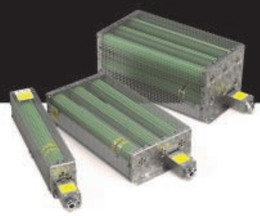
CBS / CMQ /CVS / HVBS



CBW-V / CBW-H
Water cooled

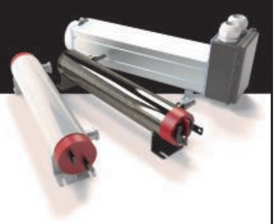
Power: 60-410W	Power: 85W-1.7kW	Power: 410W-12kW	Power: 445W-15kW	Power: 860W-25kW
	9-150kJ @5s	25-550kJ @5s	80kJ-2.5MJ @5s	6.4kJ-1.1MJ @5s
- Applications				
Charge / Discharge	High Pulse load	High Pulse load	High Pulse load	Short recovery time
Brake	Brake	Brake	Brake	Brake
Filter	Filter	Filter	Medium voltage	Filter
	Charge / Discharge	Charge / Discharge	Charge / Discharge	High Pulse load

Other resistor types from Danotherm (IP00-IP66)

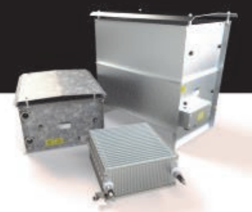


SIGMA

OHMEGA - Air



WHHB / WHBS / WHBSA



TERA

OHMEGA - Water

Multi purpurse	Outdoor & Marine	Filter	Medium & High voltage	Filter & load
Power: 100W-5kW	Power: 1-500kW	Power: 4-200kW	Power: 500W->	Power: 5kW-1MW
Ceramic wirewound	Steel tube	Wirewound	Steel grid	Steel tube

CAR 400 C(H)(T) 2 8 1 22R

'281' digits > 400: Customer specific version, otherwise:

- Ohm value (Example 2R2=2.2Ω, / 22R = 22Ω)
- Number of case style housings
- Thermal switch; 5=130°C / 6=160°C / 7=180°C / 8=200°C
- 0=cable connection, 2=connection box type
- T=Thermal switch (normally closed)
- Wire element (H, TBD by Danotherm)
- Connection; C=no box / K=IP00 / D=IP20
- Length of resistor housing in mm
- Housing style; CCH / CAH / CAV / CAR

Danotherm Electric A/S
Naesbyvej 20
DK-2610 Roedovre
Denmark
CVR 1012 6061

DAN EN 16.5026.R1
17MAY2017

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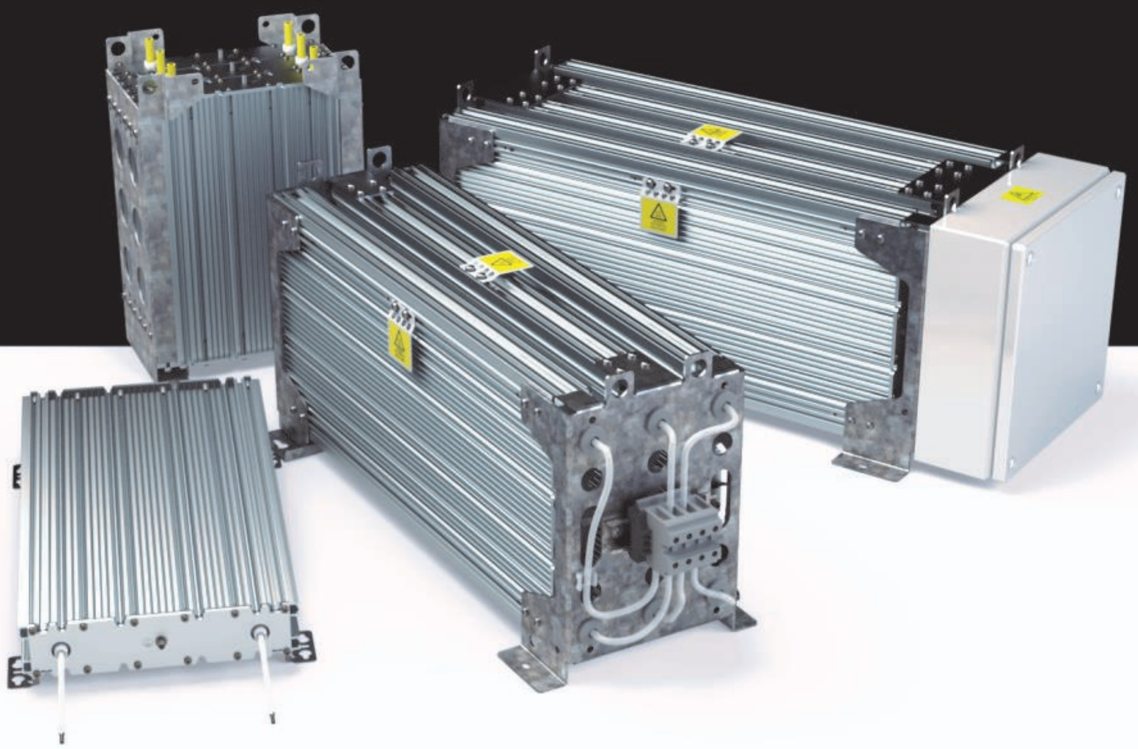


CBS / CMQ / CVS (1000V)

HVBS (3000V)

- High Energy Dump resistors

- High pulse load applications
- Compact Construction; small dimensions
- Fully insulated; no external live parts
- High IP Classes
- Low thermal drift, 100ppm
- Low noise
- Thermal models for all types available on request
- Resistor components are UL approved / pending

In this brochure the standard overview of four different aluminium case style resistors is given. Selecting the correct resistor type and options involves many considerations. Danotherm would very much like to support your choise. Together we can select the optimum resistor where all technical and commercial aspects are reviewed. Customer specific request for OEM solutions are very well possible, giving you an attractive solution.

Please, consult Danotherm. Our goal is to be a part of your success.

CBS / CMQ / CVS - 1000VAC/1400VDC

Nominal power [W] @ 40°C ambient / Ohm range min and max									
housing length	1 housing			1 housing			Ohm value		
	no Thermal switch			with Thermal switch			min -max Ω		
	CBS	CMQ	CVS	CBS	CMQ	CVS	CBS	CMQ	CVS
210	580	800	-	445	555	-	0.05-20	-	-
260	850	1100	-	685	855	-	0.07-35	-	-
330	1135	1500	-	870	1090	-	0.09-50	0.07-80	-
400	1375	1900	1995	1055	1320	1390	0.11-65	0.10-110	0.10-70
460	1585	2200	2310	1215	1520	1600	0.14-85	0.12-130	0.12-85
560	1925	2700	2830	1480	1850	1940	0.18-110	0.15-160	0.15-105
660	2270	3100	3250	1745	2180	2290	0.22-130	0.19-200	0.19-130
760	2770	3500	3670	2130	2660	2790	0.27-150	0.23-240	0.23-150
860	3190	3850	4040	2450	3060	3210	0.31-180	0.27-280	0.27-180
960	3565	4150	4350	2740	3420	3590	0.35-220	0.30-320	0.30-210
housing length	2 housings			3 housings			4 housings		
	no Thermal switch			no Thermal switch			no Thermal switch		
	CBS	CMQ	CVS	CBS	CMQ	CVS	CBS	CMQ	CVS
400	2340	2925	3070	3300	4350	4560	4400	5500	5830
460	2700	3375	3540	3800	5000	5250	5000	6500	6820
560	3270	4090	4290	4620	6050	6350	6100	8000	8400
660	3860	4825	5050	5500	7100	7450	7300	9100	9550
760	4700	5875	6160	6650	8500	8900	8800	11000	11500
860	5400	6750	7080	7660	10000	10500	10200	13000	13650
960	6060	7575	7950	8500	11200	11750	11300	14000	14700

HVBS - 3000VAC/4200VDC

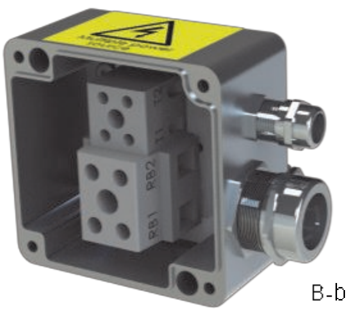
HVBS-CH-XXX	Pn [W] @ 40°C According UL508	R [Ω] min - max ± 10%	double housings	triple housings	quadruple housings
HVBS 300	850	0.05 - 30	1500		
HVBS 370	1050	0.07 - 50	1800		
HVBS 440	1250	0.09 - 70	2100	2900	3500
HVBS 520	1365	0.10 - 90	2500	3700	5000
HVBS 620	1950	0.13 - 110	3200	4800	6400
HVBS 720	2500	0.15 - 140	3600	5400	7200
HVBS 820	2900	0.19 - 170	4800	7100	9600
HVBS 920	3200	0.22 - 200	5300	7900	10600
HVBS 1000	3500	0.25 - 220	6000	8800	12000

Temperature Coefficient:		100 ppm/K
Dielectric strength	HVBS	7000VAC @ 1 minute
	Other types	3500 VAC @ 1 minute
Insulation Resistance:		> 20MΩ / case housing
Overload:@ 1 sec pulse / hour		70 - 250 x (depending on resistor)
Overload:@ 5 sec pulse / hour		20 - 60 x (depending on resistor)
Environmental:		- 40 °C - 70 °C
De-rating cable version		Linear: 40°C = Pn to 70°C = 0.85 * Pn
De-rating TW 200°C version		Linear: 40°C = Pn to 70°C = 0.65 * Pn
De-rating vertical mounting		no de-rating
De-rating horizontal mounting		0.8 * Pn
De-rating at high altitudes	1000 m	no de-rating
	1500 m	0.94 * Pn
	3000 m	0.82 * Pn
Mounting instructions		It is recommended to keep a distance of 200mm to the nearest object to prevent heating of neighbouring components.
		If two or more brake resistors are mounted next to each other the distance between these should be 400mm. If this is less then the nominal power needs to be de-rated.
Cooling		The nominal power of the resistors refers to cooling conditions with Free Natural Air Cooling.
Vibration		Acc. To EN 60068-2-6 frequency range 1 - 100Hz Acceleration / Amplitude
	1 - 13 Hz	± 1mm
	13 - 100 Hz	@ ± 0.7G
Corrosive resistance		Acc. IEC 60721-3-3/3K3 (C2 medium) 200 hours cyclic salt mist IEC 60068-2-52
Connection recommendations		To minimize EMC interference screened cables are recommend-ed. in particular with PWM brake pattern.
Resistance tolerance		± 10% (optional 5%)
Working voltage CBS / CMQ / CVS	Cable version	UL: 1000VAC. IEC: 1000VAC / 1400VDC
	Conn. Box	UL: 600VAC. IEC: 690VAC / 1100VDC
Working voltage HVBS	Cable version	IEC: 3000VAC / 4200VDC
Time constant for heating up resistor		1000 - 3000s
Thermal switch *	Thermal switch	130 / 160 / 180 / 200 °C. 2.5A. 250 VAC NC
Minimum measuring voltage		2V
Minimum measuring current		10mA
Rated current / voltage		2.5A @ 250 VAC cos ϕ=1
Dielectric voltage		2000VAC (3500VAC between TS and R)
Temperature requirements on cables	IP 21	80°C
	IP 65	90°C

* optionally in CBS / CMQ / CVS

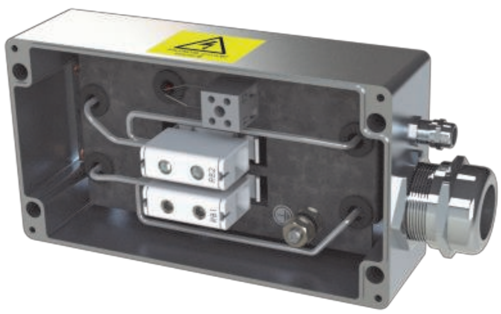
Construction and properties

- Compact dimensions
- Nominal power range from 455W–4070W
- Energy levels from 80kJ-2.5MJ per case housing (5s single pulse), depending on ohmic value
- Aluminium case housing for high IP rating
- IP50-IP65
- Internal ceramic supported wirewound spirals for lower ohmic values
- Nickel-Chrome 8020 alloy for low thermal drift
- Mica insulated for high dielectric strength
- Al_2O_3 or SiO_2 filled for high thermal capacity/high power overload capability
- Low surface temperature
- Low noise level
- High vibration withstand capability
- Thermal relief expansion mounting feet
- Optionally thermal switch or PT100 element for thermal protection guard.
- Cable (AWG 10–AWG4) or box connection up to 50mm²
- Multiple case housings (from 2-4 housings)
- Customized to your needs and application (OEM versions available)



B-box

Single-body



B-box

Multiple-housings

connection boxes	IP rating	cable gland	clamping range [mm]	braid diameter (min.) [mm]	elec. connection [mm²]
B-box (single housing)	IP65	M25	9-16.6	7.5	0.75-10
D-box	IP21	M25	9-16.6	7.5	0.75-10
G-box	IP21	M40	19-28	15	2.5-50
B-box (multiple housings)	IP65	M32	11-21	9	2.5-50
B-box (multiple housings)	IP65	M40	19-28	15	2.5-50
thermal switch (optional)	-	M12	3-7	-	0.5-4

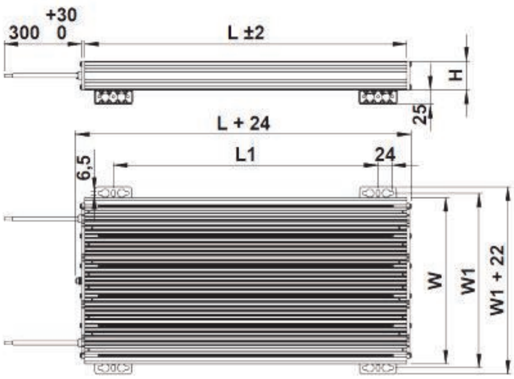
Mechanical drawings

Cable connection type IP50 CBS / CMQ / CVS -H ..C..

Length/type	CBS		CMQ		CVS	
L ± 2 mm	5s load* kW	Weight kg	5s load* kW	Weight kg	5s load* kW	Weight kg
210 CH 001 22R	16	3.6	23	5.2	-	-
260 CH 001 18R	27	4.5	46	6.5	-	-
330 CH 001 13R	45	5.7	71	8.3	-	-
400 CH 001 10R	68	7.0	120	10.3	135	12.3
460 CH 001 6R5	92	8.2	150	12.0	190	14.5
560 CH 001 6R0	120	10.0	210	14.9	265	17.9
660 CH 001 4R5	160	12.0	260	17.7	340	21.4
760 CH 001 3R5	205	14.2	350	20.2	440	25.2
860 CH 001 2R5	185	16.3	350	23.0	500	28.7
960 CH 001 2R0	255	17.6	460	26.3	510	31.6

housing case dimensions

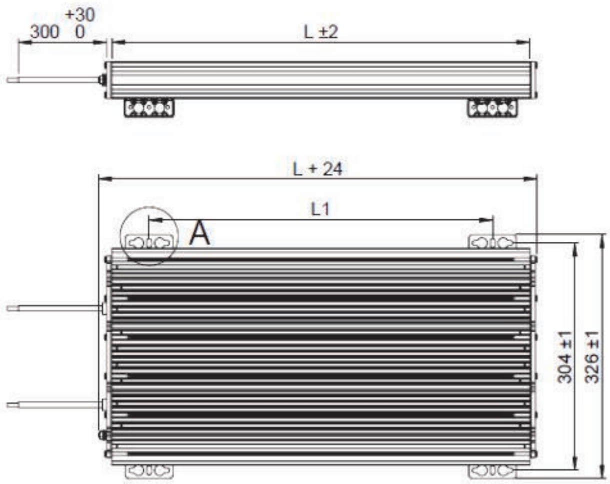
Type	H	W ± 1	W1 ± 1
CBS	47	218	230
CMQ	50	290	304
HVBS	50	290	304
CVS	60	290	304



* Pulse rating depends on resistance value

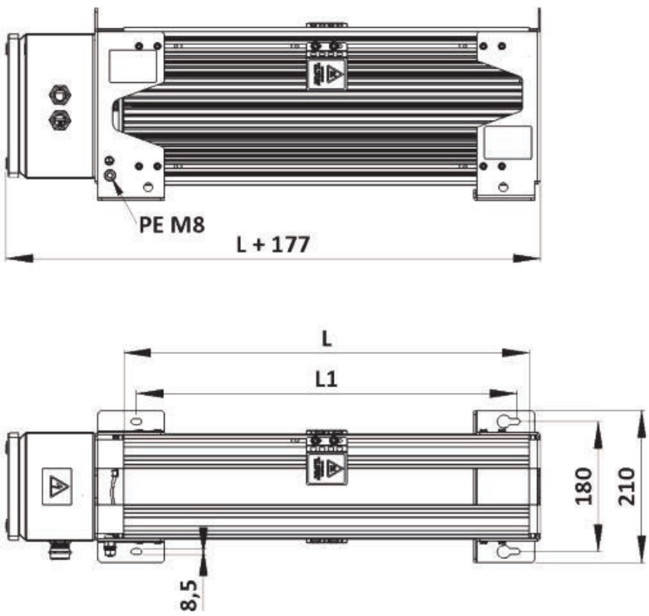
Cable connection type IP50 HVBS -H … CH… (3000VAC)

L ± 2 mm	5s load* kW	Weight kg
HVBS 300 CH 001 15R	22.4	7.5
HVBS 370 CH 001 12R	41.3	9.3
HVBS 440 CH 001 10R	66	11.3
HVBS 520 CH 001 8R0	81	13.5
HVBS 620 CH 001 6R0	120	16.5
HVBS 720 CH 001 5R0	155	19.3
HVBS 820 CH 001 4R0	185	21.8
HVBS 920 CH 001 3R5	270	24.6
HVBS 1000 CH 001 3R0	300	27.4



* Pulse rating depends on resistance value

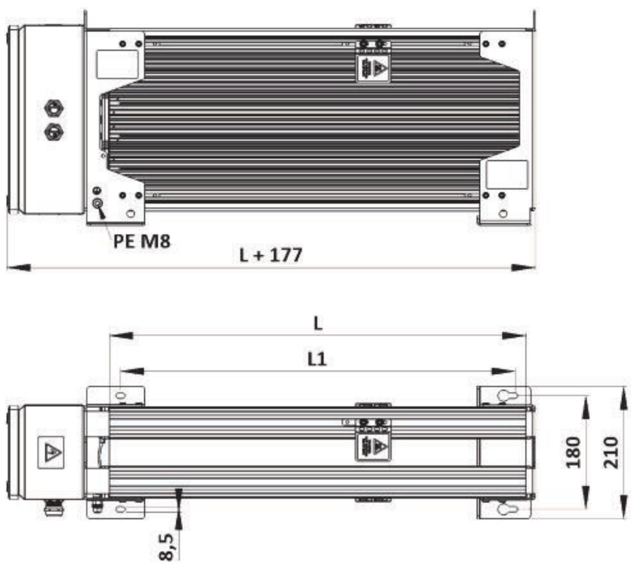
HVBS High Voltage dump resistors are only offered with HV cable connection leads and no thermal switch



CBS Double housings, connection B-Box type,

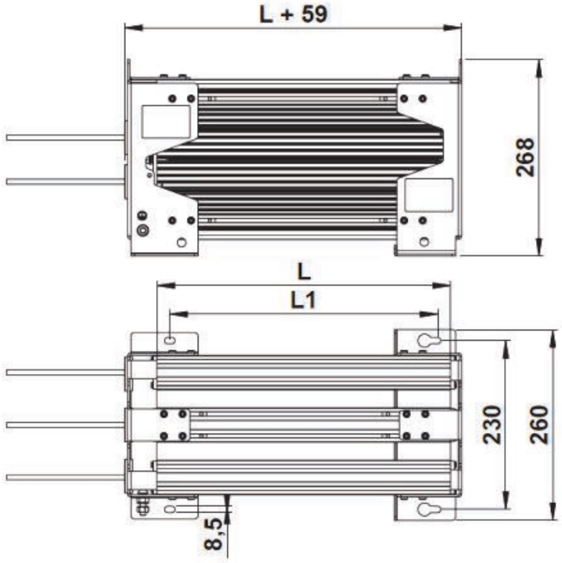
L ± 2 mm	5s load* kW	Weight kg
CBS 210 BGH 202 11R	32	9.2
CBS 260 BGH 202 9R0	54	11.0
CBS 330 BGH 202 6R5	90	13.4
CBS 400 BGH 202 5R0	136	16.0
CBS 460 BGH 202 3R3	184	18.4
CBS 560 BGH 202 3R0	240	22.0
CBS 660 BGH 202 2R3	320	26.0
CBS 760 BGH 202 1R8	410	30.4
CBS 860 BGH 202 1R3	510	34.6
CBS 960 BGH 202 1R0	510	37.2

CMQ Double housings, connection B-Box type, IP54–IP65



L ± 2 mm	5s load* kW	Weight kg
CMQ 210 BHT 2x2 11R	46	12.4
CMQ 260 BHT 2x2 9R0	92	15.0
CMQ 330 BHT 2x2 6R5	142	18.6
CMQ 400 BHT 2x2 5R0	240	22.6
CMQ 460 BHT 2x2 3R3	300	26.0
CMQ 560 BHT 2x2 3R0	420	31.8
CMQ 660 BHT 2x2 2R3	520	37.4
CMQ 760 BHT 2x2 1R8	700	42.4
CMQ 860 BHT 2x2 1R3	700	48.0
CMQ 960 BHT 2x2 1R0	920	55

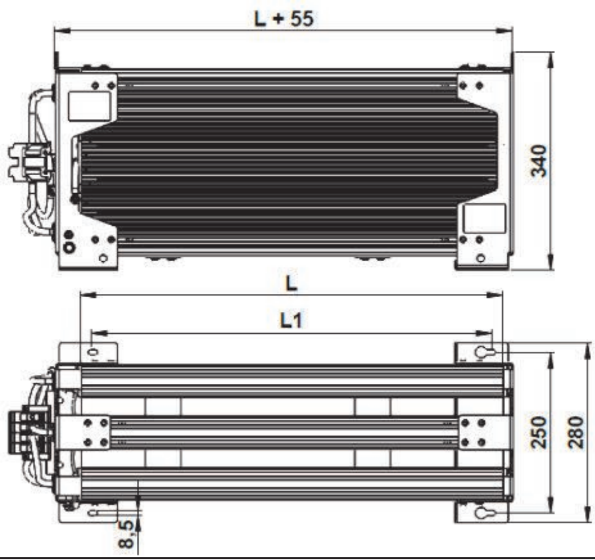
CBS Triple housings, cable type, IP50



L ± 2 mm	5s load* kW	Weight kg
CBS 210 CH 003 7R3	48	11.8
CBS 260 CH 003 6R0	81	14.5
CBS 330 CH 003 4R3	135	18.1
CBS 400 CH 003 3R3	204	22.0
CBS 460 CH 003 2R2	276	25.6
CBS 560 CH 003 3R0	360	31.0
CBS 660 CH 003 1R5	480	37.0
CBS 760 CH 003 1R2	615	43.6
CBS 860 CH 003 0R8	555	50
CBS 960 CH 003 0R7	765	54

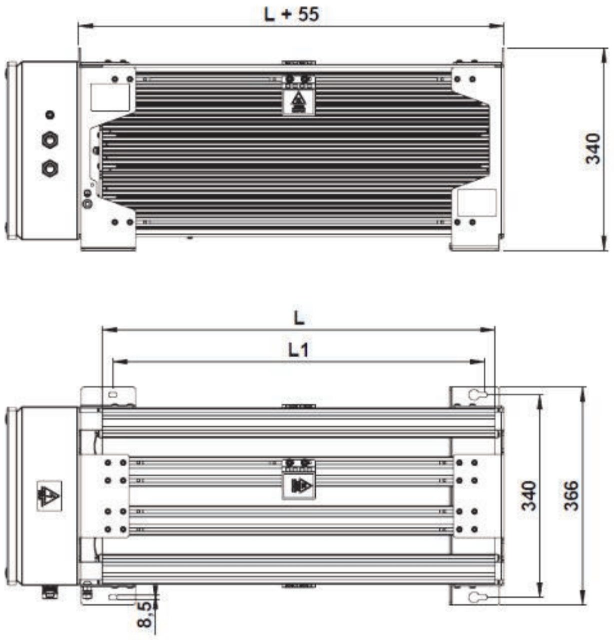
* Pulse rating depends on resistance value

CMQ Triple housings, DIN rail terminals K-type, IP00



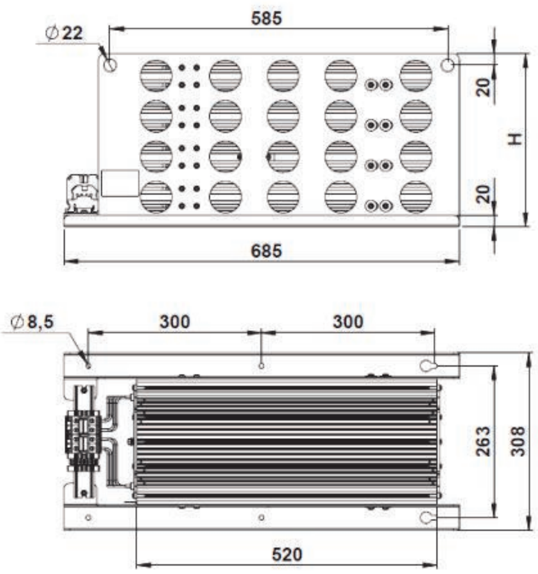
L ± 2 mm	5s load* kW	Weight kg
CMQ 210 KH 203 7R3	69	11.8
CMQ 260 KH 203 6R0	138	14.5
CMQ 330 KH 203 4R3	213	18.1
CMQ 400 KH 203 3R3	360	22.0
CMQ 460 KH 203 2R2	450	25.6
CMQ 560 KH 203 3R0	630	31.0
CMQ 660 KH 203 1R5	780	37.0
CMQ 760 KH 203 1R2	1000	43.6
CMQ 860 KH 203 0R8	1000	49.9
CMQ 960 KH 203 0R7	1380	53.8

CMQ Quadruple housings, connection B-Box type, IP54



L ± 2 mm	5s load* kW	Weight kg
CMQ 210 BHT 2x4 7R3	92	17.4
CMQ 260 BHT 2x4 6R0	180	21.0
CMQ 330 BHT 2x4 4R3	284	25.8
CMQ 400 BHT 2x4 3R3	480	31.0
CMQ 460 BHT 2x4 2R2	600	35.8
CMQ 560 BHT 2x4 3R0	840	43.0
CMQ 660 BHT 2x4 1R5	1000	51
CMQ 760 BHT 2x4 1R2	1400	60
CMQ 860 BHT 2x4 0R8	1400	68.
CMQ 960 BHT 2x4 0R7	1800	73

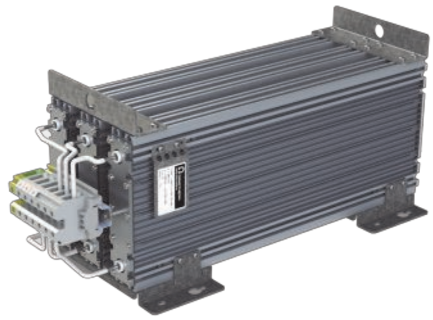
CBS Single to Quadruple housings 420/520mm, DIN rail terminals K-type, IP00



L ± 2 mm	No. cases	L ± 2 mm	H mm	Weight kg
CBS-H 420 KH 201 xxR	1	420	160	13.0
CBS-H 520 KH 201 xxR	1	520	160	13.5
CBS-H 420 KH 202 xxR	2	420	160	20.5
CBS-H 520 KH 202 xxR	2	520	160	22.5
CBS-H 420 KH 203 xxR	3	420	300	32.5
CBS-H 520 KH 203 xxR	3	520	300	34.5
CBS-H 420 KH 204 xxR	4	420	300	40.5
CBS-H 520 KH 204 xxR	4	520	300	42.5

All above tables are showing standard lengths.
Customer specified lengths are available.

CMQ / HVBS type with cable leads, IP50

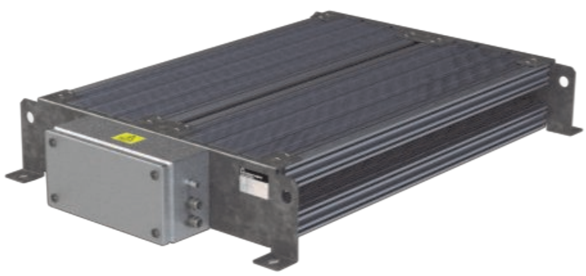


Quadruple CMQ type with DIN rail terminals, IP00

CMQ type with long connection box, IP54

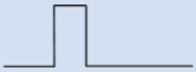
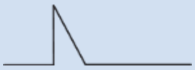
Double CMQ type with connection box, IP54

Double CMQ type with DIN rail terminals, IP00



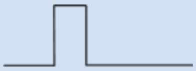
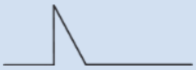
Quadruple CMQ type with connection box, IP54

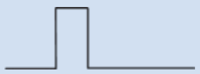
CMQ types with B-box IP54, quadruple, triple and double housings
2 cable glands M25 for resistor connection, 1 cable gland M12 for thermal switch

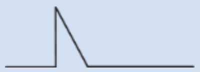
CBS	One single square pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max surface temp.	Duty 40s [kW]	Max surface temp.
CBS 210 22R	16	45	11	70	7.6	85	5.5	100
CBS 260 18R	27	65	19	75	13.1	90	9.5	120
CBS 330 13R	45	60	31	85	21.3	100	15.5	130
CBS 400 10R	68	70	44	90	31	110	21.6	140
CBS 460 6R5	92	85	59	100	40	120	28	150
CBS 560 6R0	120	85	77	100	52	120	36	150
CBS 660 4R5	160	70	100	110	66	130	46	160
CBS 760 3R5	205	95	125	110	83	130	56	170
CBS 860 2R5	255	85	155	120	100	140	67	170
CBS 960 2R0	250	95	160	110	105	140	73	170
	One single triangle pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max surface temp.	Duty 40s [kW]	Max surface temp.
CBS 210 22R	34	65	23	75	16	85	11.4	110
CBS 260 18R	57	70	40	80	27	95	20	120
CBS 330 13R	96	75	64	85	44	100	32	130
CBS 400 10R	145	80	95	95	64	110	45	140
CBS 460 6R5	195	90	125	100	83	120	57	150
CBS 560 6R0	255	90	160	100	110	120	75	160
CBS 660 4R5	340	95	215	110	140	130	95	170
CBS 760 3R5	440	100	270	120	175	140	120	170
CBS 860 2R5	540	110	330	120	210	140	140	180
CBS 960 2R0	540	100	340	120	225	140	150	180
	One single exponential pulse each 1800 seconds (e-curve)							
	τ = 5s [kW]	Max surface temp.	τ = 10s [kW]	Max surface temp.	τ = 20s [kW]	Max surface temp.	τ = 40s [kW]	Max surface temp.
CBS 210 22R	42	70	29	80	20	95	14	120
CBS 260 18R	71	75	49	90	34	110	24	140
CBS 330 13R	120	85	80	95	55	120	39	150
CBS 400 10R	180	90	115	110	79	130	55	170
CBS 460 6R5	245	100	155	120	100	140	70	180
CBS 560 6R0	310	100	200	120	135	140	92	180
CBS 660 4R5	410	110	260	130	170	150	115	200
CBS 760 3R5	530	110	330	130	215	160	145	200
CBS 860 2R5	650	120	400	140	260	170	175	210
CBS 960 2R0	670	110	420	130	275	160	190	210

The table above shows pulse power ratings for typical resistor sizes/lengths and typical ohmic values.

Formulas for e-curve : $p(t) = P_{\max}.\, e^{-2t/\tau}$ $E = \frac{\tau}{2} \cdot P_{max}$ $\tau = R \,.\, C$

CMQ	One single square pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max sur-face temp.	Duty 40s [kW]	Max surface temp.
CMQ 210 22R	23	65	16	70	11	85	8	110
CMQ 260 18R	46	75	31	85	21	100	15	130
CMQ 330 13R	71	75	47	90	32	110	23	140
CMQ 400 10R	120	85	75	100	49	120	34	150
CMQ 460 6R5	150	90	93	100	61	120	42	160
CMQ 560 6R0	210	100	130	110	83	130	57	160
CMQ 660 4R5	260	100	160	120	100	140	69	170
CMQ 760 3R5	350	110	210	120	130	150	88	180
CMQ 860 2R5	350	100	215	120	140	140	95	180
CMQ 960 2R0	460	120	275	130	175	150	115	190
	One single triangle pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max sur-face temp.	Duty 40s [kW]	Max surface temp.
CMQ 210 22R	50	65	34	75	23	85	17	110
CMQ 260 18R	100	75	66	85	44	100	31	130
CMQ 330 13R	150	80	99	90	67	110	47	140
CMQ 400 10R	250	90	160	100	105	120	71	160
CMQ 460 6R5	320	95	200	110	130	130	87	160
CMQ 560 6R0	450	100	275	120	175	140	120	170
CMQ 660 4R5	560	100	340	120	215	140	145	180
CMQ 760 3R5	740	120	450	130	280	150	185	190
CMQ 860 2R5	750	110	460	120	295	150	200	180
CMQ 960 2R0	970	120	590	140	370	160	245	200
	One single exponential pulse each 1800 seconds (e-curve)							
	τ = 5s [kW]	Max surface temp.	τ = 10s [kW]	Max surface temp.	τ = 20s [kW]	Max sur-face temp.	τ = 40s [kW]	Max surface temp.
CMQ 210 22R	62	70	42	80	29	100	21	120
CMQ 260 18R	125	85	81	100	55	120	38	150
CMQ 330 13R	185	90	125	100	83	130	58	160
CMQ 400 10R	310	100	195	120	130	140	87	180
CMQ 460 6R5	390	110	245	120	160	150	110	190
CMQ 560 6R0	540	120	340	130	220	160	145	200
CMQ 660 4R5	680	120	420	140	265	170	180	210
CMQ 760 3R5	900	130	550	150	350	180	225	220
CMQ 860 2R5	910	120	560	140	370	170	245	220
CMQ 960 2R0	1200	140	720	160	450	190	300	240

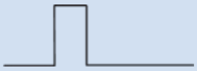
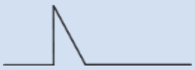
HVBS	One single square pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max surface temp.	Duty 40s [kW]	Max surface temp.
HVBS 300 15R	22.4	60	15.4	65	11	75	8	90
HVBS 370 12R	41.3	65	27.8	75	19.3	85	13.9	110
HVBS 440 10R	66	70	43.6	80	29.3	95	20.6	120
HVBS 520 8R0	81	75	54	85	37.1	100	26.6	130
HVBS 620 6R0	120	80	77	90	51	110	35.8	130
HVBS 720 5R0	155	80	98	90	65	110	45.1	140
HVBS 820 4R0	185	85	115	95	77	110	53	140
HVBS 920 3R5	270	95	165	110	105	120	69	150
HVBS 1000 3R0	300	95	180	110	115	130	77	150

	One single triangle pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max surface temp.	Duty 40s [kW]	Max surface temp.
HVBS 300 15R	48	60	33	65	23	75	16	95
HVBS 370 12R	88	65	59	75	41	90	29	110
HVBS 440 10R	145	75	93	85	62	100	43	120
HVBS 520 8R0	175	75	115	85	77	100	54	130
HVBS 620 6R0	255	80	165	90	110	110	74	140
HVBS 720 5R0	330	85	210	95	135	110	94	140
HVBS 820 4R0	400	85	250	95	160	120	110	140
HVBS 920 3R5	570	100	350	110	220	130	145	160
HVBS 1000 3R0	640	100	390	110	245	130	160	160

	One single exponential pulse each 1800 seconds (e-curve)							
	τ = 5S [kW]	Max surface temp.	τ = 10S [kW]	Max surface temp.	τ = 20S [kW]	Max surface temp.	τ = 40S [kW]	Max surface temp.
HVBS 300 15R	59	65	41	70	28	85	20	100
HVBS 370 12R	110	75	73	85	50	100	35	120
HVBS 440 10R	175	85	115	95	76	120	52	140
HVBS 520 8R0	215	85	140	100	95	120	67	150
HVBS 620 6R0	310	90	200	100	135	120	91	160
HVBS 720 5R0	400	95	255	110	170	130	115	160
HVBS 820 4R0	480	95	300	110	200	130	135	170
HVBS 920 3R5	690	110	420	120	270	150	180	180
HVBS 1000 3R0	770	110	470	130	300	150	200	190

The tables above show pulse power ratings for typical resistor sizes/lengths and typical ohmic values.

Pulse load table

CVS	One single square pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max surface temp.	Duty 40s [kW]	Max surface temp.
CVS 400 10R	135	80	83	90	52	100	35	120
CVS 460 6R5	190	90	115	95	71	110	46	130
CVS 560 6R0	265	95	155	100	97	120	63	140
CVS 660 4R5	340	100	200	110	120	120	79	150
CVS 760 3R5	440	100	255	120	155	130	99	160
CVS 860 2R5	500	110	290	120	175	130	115	160
CVS 960 2R0	510	100	300	110	180	130	120	160
	One single triangle pulse each 1800 seconds							
	Duty 5s [kW]	Max surface temp.	Duty 10s [kW]	Max surface temp.	Duty 20s [kW]	Max surface temp.	Duty 40s [kW]	Max surface temp.
CVS 400 10R	290	85	180	95	110	110	74	130
CVS 460 6R5	410	90	245	100	150	120	98	140
CVS 560 6R0	560	95	330	110	205	120	130	150
CVS 660 4R5	720	100	420	110	260	130	165	150
CVS 760 3R5	930	110	550	120	330	140	210	160
CVS 860 2R5	1050	110	620	120	370	140	235	160
CVS 960 2R0	1050	100	630	120	390	130	250	160
	One single exponential pulse each 1800 seconds (e-curve)							
	τ = 5s [kW]	Max surface temp.	τ = 10s [kW]	Max surface temp.	τ = 20s [kW]	Max surface temp.	τ = 40s [kW]	Max surface temp.
CVS 400 10R	350	95	220	100	140	120	92	150
CVS 460 6R5	490	100	295	120	185	130	120	160
CVS 560 6R0	670	110	410	120	250	140	160	170
CVS 660 4R5	860	110	510	130	320	150	205	180
CVS 760 3R5	1100	120	660	140	400	160	255	190
CVS 860 2R5	1250	120	740	140	460	160	295	200
CVS 960 2R0	1250	120	760	130	480	150	310	190

The table above shows pulse power ratings for typical resistor sizes/lengths and typical Ohm values.

Pulse load

The ability to withstand pulse-loads varies according to resistor size, length and diameter of the internal resistor wire. As such, it is impossible to create standard graphs that would apply to all customer applications. In some cases, the load-profile will be the combination of a square and a triangular pulse, such as is the case with Low Voltage Ride Through (LVRT) and Emergency Brake situations, as encountered in the Wind Power industry.

On request, Danotherm performs simulations based on the actual application and for guidance, has produced tables for various load-profiles for resistors with standard wire. The above table shown is based on a resistor with indicated ohmic value and standard wire thickness. Depending on the application, resistor construction can be adapted to optimally match the application. In the tables above, the peak powers of single rectangular, triangular and exponential pulses durations of 5 to 40 seconds.

Ingress Protection

The Ingress Protection rating (IP) value depends on the resistor and on the connection style. The basic IP rating for resistors is IP 50 but by the addition of gaskets, they can be increased to IP 54 or IP 65 which is also possible for resistors with flying leads. For resistors with connection box type B, the maximal IP value is 65. Resistors with connection boxes D and G have an IP 21 rating when mounted vertically and IP 20 when mounted horizontally.

IP values and their type-tests are well defined; for instance "IP 65" means dust cannot penetrate the box or if dust occurs internally, it will not influence the electrical properties. It should be able to withstand water jets from any direction with a certain pressure during 3 minutes; however, it does not mean that it can withstand continuous rain. If the resistor is used outdoors, then it should be protected against direct rain.

IP 65 rated resistors can be cleaned with a high pressure hose, but this can only be done when the resistor has cooled down to the ambient temperature, otherwise the water will cool the housing causing a partial vacuum inside, drawing in water.

Danotherm offers standard solutions for one to four cases combined into one compact configuration with pulse-withstand capability of 1MW (5MJ) and also OEM versions with a maximum of 20 resistors. Depending on the electrical connection, the IP class ranges from IP 00 to IP 65. Connections can be via a terminal box, DIN-rail terminals or cable lugs. These resistor types are also offered in high voltage versions and with higher ohmic values.

The salient features of Alpha resistors are that they have:

- Small dimensions
- Cool surfaces in operation
- High pulse-load capabilities
- High vibration capabilities
- No external electrically-live parts
- High IP classes
- Fail-safe capabilities (on request)
- low noise levels.

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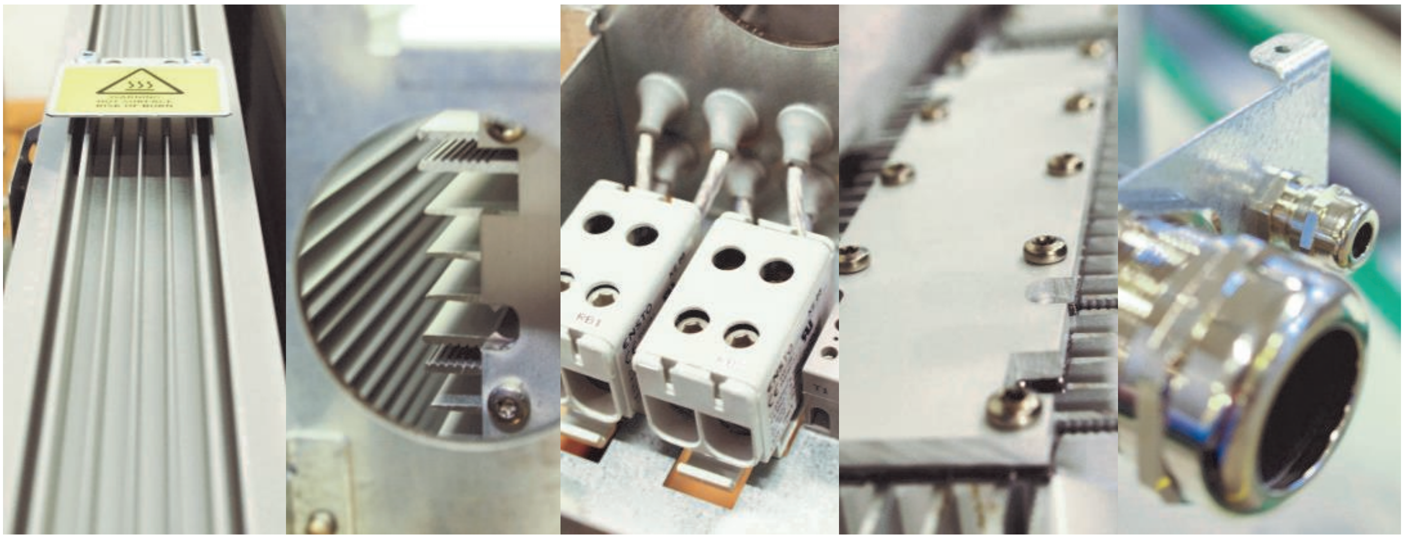
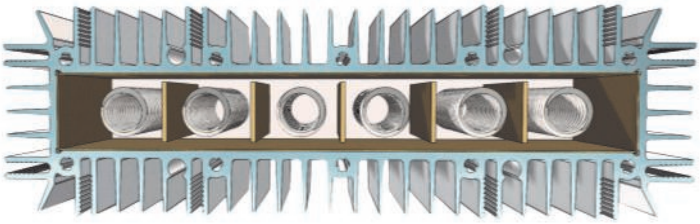
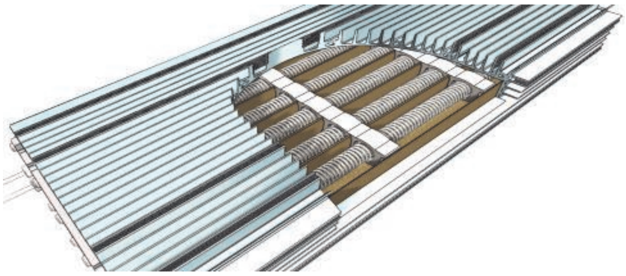
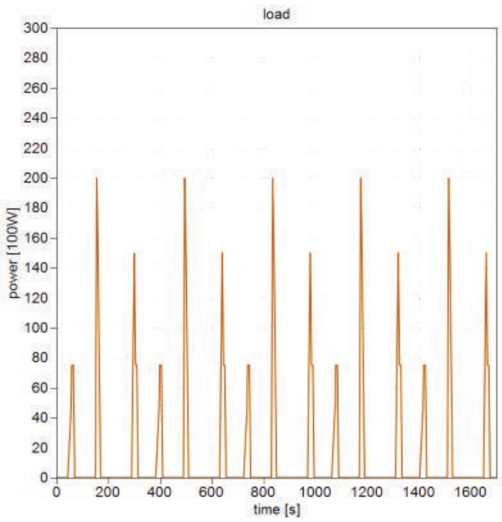


Danotherm has developed a thermal simulation method by which it is possible to optimize a resistor to a specified application. This gives following benefits:

- Short and fast engineering time, saving engineering costs
- Individual thermic model simulations can be done by Danotherm or handled by the customer. Individual thermic models are available on request.
- Simulation software for electrical circuits can be used for thermal simulations (PSpice, Matlab, Plecs or any other)
- For more complex loads a data file (like csv) can be used for input
- Optimizing the design, reducing overall size and costs
- Proof of capability is given without even building and testing samples

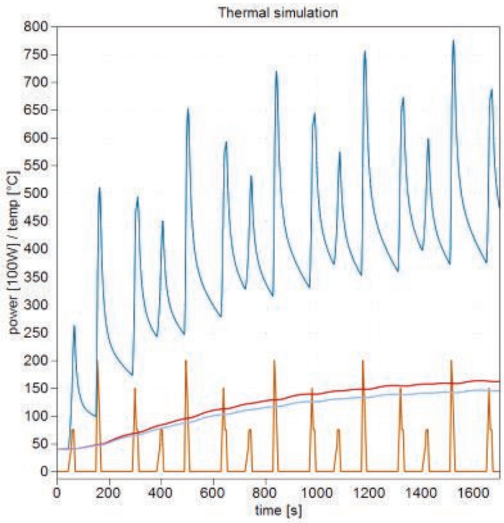






Measured on site: Brake Power saved in .cvs file.

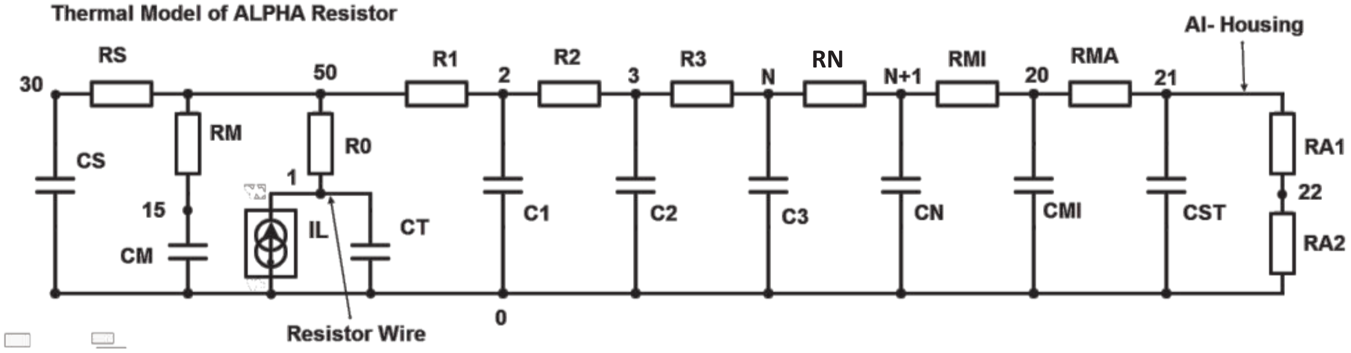
Other possibilities could be a description of a typical or worst case brake pulse and a repeat cycle.



Simulation made by Danotherm

Results of temperature simulation of specified load in a suggested resistor type.

Thermal Model of ALPHA Resistor



Danotherm resistors are used as:

- Pre-charge for DC-link (super) capacitors
- Pre-magnetization of power transformers
- Brake resistors for industrial drive systems
- Emergency stops in (gas) turbines

Danotherm resistors are used in:

- Elevators
- Escalators
- Cranes
- Vessels
- Wind turbines
- (Trolley)busses
- Trams / Metros / Trains (auxiliary circuits)
- Conveyer belts
- Transformers
- Turbines
- Excavation machines

Danotherm supports your request. The very start is your specification of the application, the load and environmental conditions. Ideally, a power-time graph is presented which forms the basis of the thermal simulation. If such graph is not available, the electrical circuit of the application is build in the simulation software. It is also possible to use a data file as input for the load. Such file can be build by measurements on the site or they come from another simulation software program.

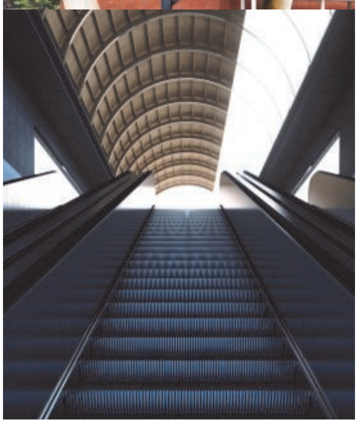
The next step is to feed the generated power losses into the thermal model. Each resistor which its physical properties gets its own, unique, thermal model. With the simulation the temperatures inside the resistor and of the outside housing surface, are simulated. Here, the maximum temperature values are observed and at the same time care is taken not to over dimension the resistor.

When the type and internal construction of the resistor is defined, the resistor will be further tailored to the customers needs. Connection boxes, connection cable sizes, cable glands, IP ratings, mounting brackets, metal surface treatment, auxiliary circuits, such as Pt100 sensors and thermal switches, are all considered.

Finally, packing and shipping is an important topic. The resistors should be safely packed to prevent damage during transport and at the same time the costs for shipping and packing must be considered. Together with our customers the best option is chosen.







Overview of the ALPHA resistor family (IP00-IP65)

CCH / CAV / CAH / CAR

CBH / CBV / CBR

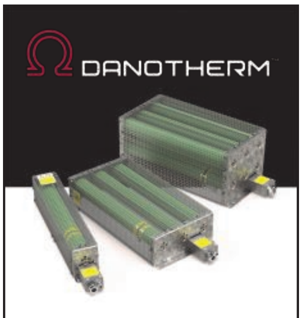
CBT-V / CBT-H

CBS / CMQ /CVS / HVBS

CBW-V / CBW-H
Water cooled

Power: 60-410W	Power: 85W-1.7kW	Power: 410W-12kW	Power: 445W-15kW	Power: 860W-25kW
	9-150kJ @5s	25-550kJ @5s	80kJ-2.5MJ @5s	6.4kJ-1.1MJ @5s
- Applications				
Charge / Discharge	High Pulse load	High Pulse load	High Pulse load	Short recovery time
Brake	Brake	Brake	Brake	Brake
Filter	Filter	Filter	Medium voltage	Filter
	Charge / Discharge	Charge / Discharge	Charge / Discharge	High Pulse load

Other resistor types from Danotherm (IP00-IP66)



SIGMA

OHMEGA - Air

WHHB / WHBS / WHBSA

TERA

OHMEGA - Water

Multi purpurse	Outdoor & Marine	Filter	Medium & High voltage	Filter & load
Power: 100W-5kW	Power: 1-500kW	Power: 4-200kW	Power: 500W->	Power: 5kW-1MW
Ceramic wirewound	Steel tube	Wirewound	Steel grid	Steel tube

CMQ-H 400 CH(T) 281 22R KT

- Thermal drift; standard T=100ppm, Tolerance; standard K=± 10%
- Ohm value (Example 2R2=2.2Ω, / 22R = 22Ω)
- Number of case style housings (1, 2, 3 or 4)
- Thermal switch temp; 5=130°C / 6=160°C / 7=180°C / 8=200°C
- 0=cable connection, 2=connection box type
- T=Thermal switch, option, (normally closed)
- Connection style; C=cable / B=IP65 box / K=DIN rail IP00
- Length of resistor housing in mm
- H=horizontal mounting feet / V=vertical mounting feet
- Housing case style; CBS / CMQ / HVBS / CVS

Danotherm Electric A/S
Naesbyvej 20
DK-2610 Roedovre
Denmark
CVR 1012 6061

DAN EN 16.5043.R1
22MAY2017

DANOTHERM™

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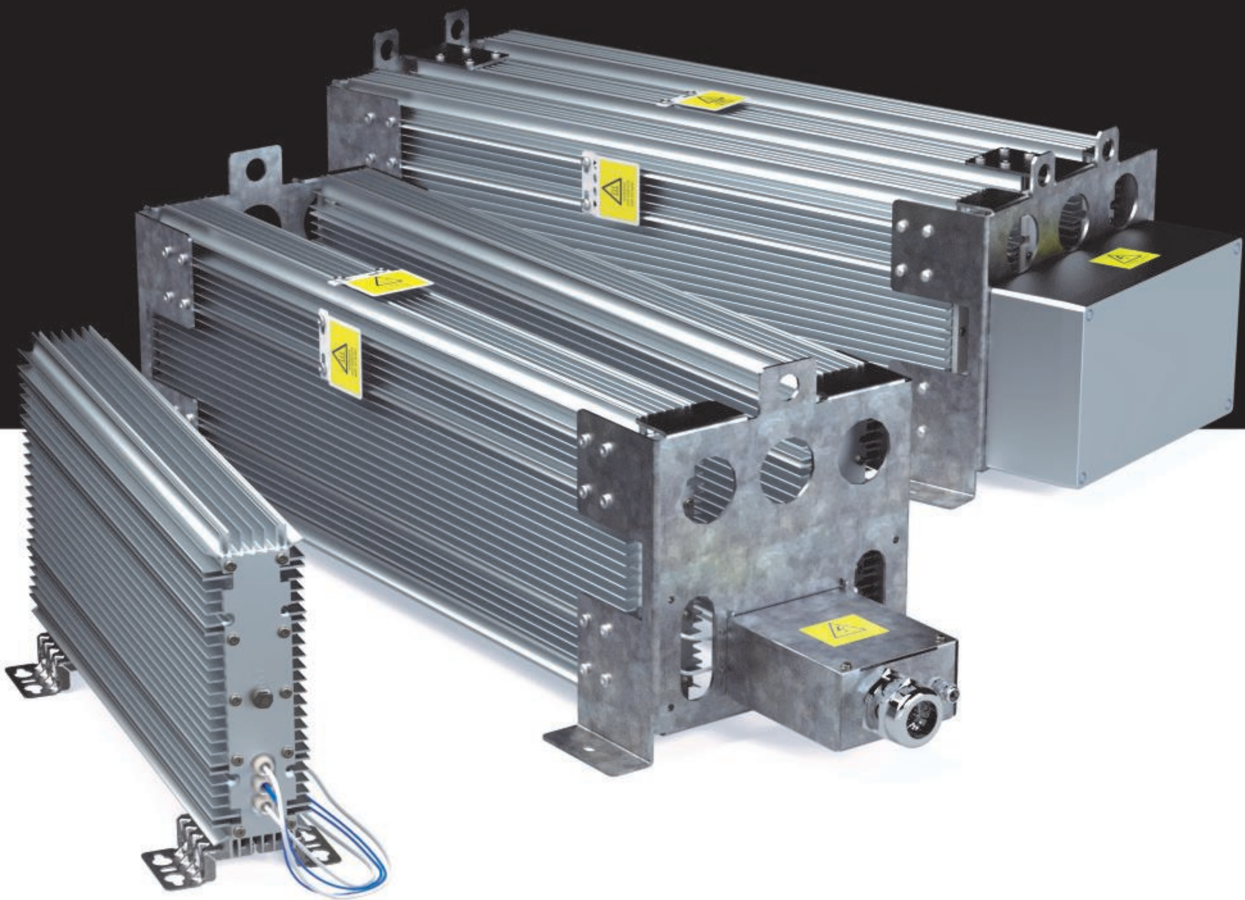


CBT-H / CBT-V

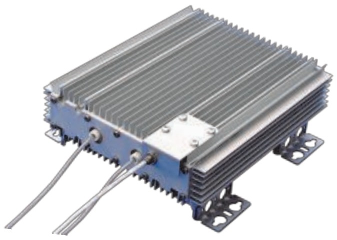
- Brake resistors

- General-purpose applications; High pulse load and High average load
- Compact Construction; small dimensions
- Fully insulated; no external live parts
- High IP Classes
- Low thermal drift. 100ppm
- Fail Safe capabilities on request
- Low noise
- Thermal models for all types available on request
- Resistor components are UL approved

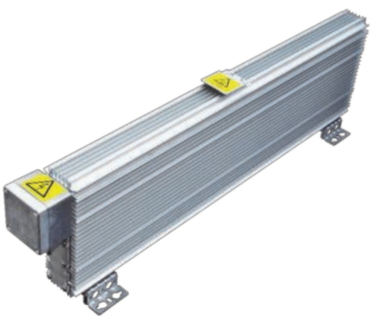
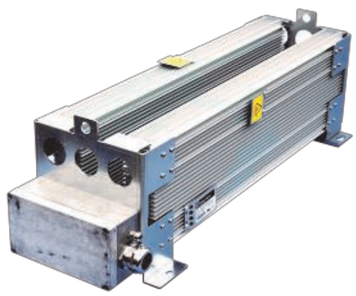
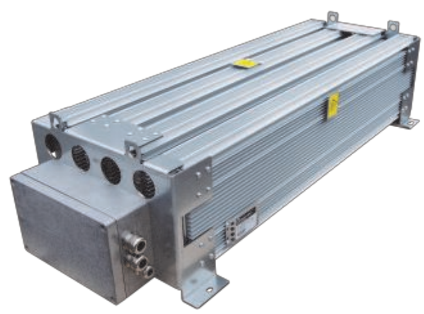
Pn [W] @ 40°C According UL508							
CBT-BH(T)-XXX	1 body Pn [W] @ 40°C According UL508	max case temp. [°C]	R [Ω] min - max	Pn [W] @ 40°C			
				1 case	2 cases	3 cases	4 cases
TS: Thermal switch	no TS		± 10%	TS 200°C	no TS, max case temp. 250°C		
CBT 180	455	270	0.04 - 13	410			
CBT 210	585	270	0.05 - 2000	530			
CBT 260	830	280	0.07 - 2000	750			
CBT 330	1350	280	0.09 - 2000	1225			
CBT 400	1650	290	0.11 - 2000	1495	2200	3000	4000
CBT 460	1900	300	0.14 - 2000	1725	2800	4200	5600
CBT 560	2310	310	0.18 - 110	2095	3500	5200	6900
CBT 660	2720	320	0.22 - 130	2470	4200	6300	8400
CBT 760	3200	330	0.27 - 150	2905	5000	7200	9600
CBT 860	3640	340	0.31- 180	3305	5500	8000	10800
CBT 960	4070	350	0.35 - 220	3695	6900	9000	12000

Construction and properties

- Compact dimensions
- Nominal power range from 455W–4070W
- Energy levels from 25kJ-550kJ per case housing (5s duty,120s cycle), depending on ohmic value
- Aluminium case housing for high IP rating
- IP50-IP65
- Internal ceramic supported wirewound spirals for lower ohmic values
- Internal mica supported wirewound elements for higher ohmic values
- Nickel-Chrome 8020 alloy for low thermal drift
- Mica insulated for high dielectric strength
- Al_2O_3 or SiO_2 filled for high thermal capacity/ high power overload capability
- Low surface temperature
- Low noise level
- High vibration withstand capability
- Thermal relief expansion mounting feet
- Optional thermal switch or PT100 element for thermal protection
- Cable (AWG 14–AWG4) or box connection up to 50mm²
- Multiple case housings (from 2-4 housings)
- Customized to your needs and application (OEM versions available)
- For UL approval, consult Danotherm

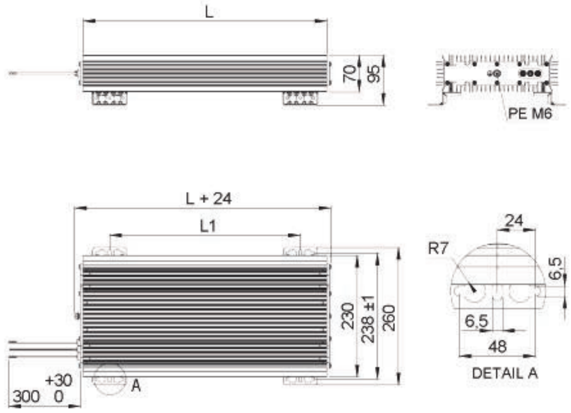


Temperature Coefficient:		100 ppm/K
Dielectric strength		3500 VAC @ 1 minute
Isolation Resistance:		> 20MΩ / case housing
Overload:@ 1 sec pulse / hour		40 - 120 x (depending on resistor)
Overload:@ 5 sec pulse / hour		10 - 27 x (depending on resistor)
Environmental:		- 40 °C / +70 °C
De-rating cable version		Linear: 40°C = Pn to 70°C = 0.85 * Pn
De-rating TW 200°C version		Linear: 40°C = Pn to 70°C = 0.65 * Pn
De-rating vertical mounting		no de-rating
De-rating horizontal mounting		0.8 * Pn
De-rating at high altitudes	1000 m	no de-rating
	1500 m	0.94 * Pn
	3000 m	0.82 * Pn
Mounting instructions		It is recommended to keep a distance of 200mm to the nearest object to prevent heating of neighbouring component.
		If two or more brake resistors are mounted next to each other the distance between these should be 400mm. If this is less then the nominal power needs to be de-rated.
Cooling		The nominal power of the resistors refers to cooling conditions with Free Natural Air Cooling.
Vibration		Acc. To EN 60068-2-6 frequency range 1 - 100Hz Acceleration / Amplitude
	1 - 13 Hz	± 1mm
	13 - 100 Hz	@ ± 0.7G
Corrosive resistance		Acc. IEC 60721-3-3/3K3 (C2 medium) 200 hours cyclic salt mist IEC 60068-2-52
Connection recommendations		To minimize EMC interference screened cables are recommend-ed. in particular with any PWM brake pattern.
Resistance tolerance		± 10% (optional 5%)
Working voltage	cable	UL: 1000VAC. IEC: 1000VAC / 1400VDC
	conn. Box	UL: 600VAC. IEC: 690VAC / 1100VDC
Time constant for heating up		1000 - 3000s
Thermal switch (optional)	Thermal switch	130 / 160 / 180 / 200 °C. 2A. 250 VAC NC
Minimum voltage		2V
Minimum current		10mA
Rated current / voltage		2.5A @ 250 VAC cos ϕ=1
Dielectric voltage		2000VAC (3500VAC between TS and R)
Temperature requirements on cables	IP 21	80°C
	IP 65	90°C

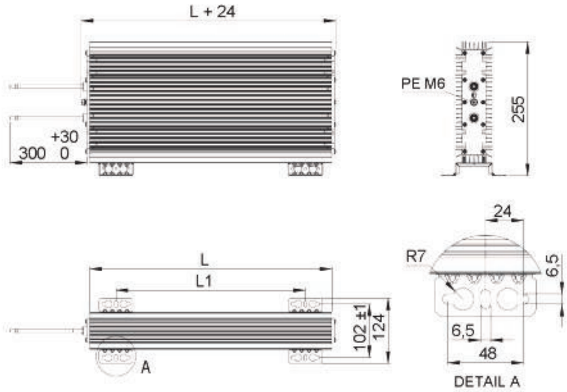
Cable connection IP50 type CBT-H ..C..1

P_n	Duty* 5/120	Horizontal type CBT -	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP50	mm	mm	kg	Ω
0.45	6	-H 180 C(H)(T) 0X1	180	70	3.1	0.04 - 13
0.58	10.1	-H 210 C(H)(T) 0X1	210	110	3.6	0.05 - 2000
0.83	17.9	-H 260 C(H)(T) 0X1	260	160	4.5	0.07 - 2000
1.35	27.5	-H 330 C(H)(T) 0X1	330	230	5.9	0.09 - 2000
1.65	37	-H 400 C(H)(T) 0X1	400	300	7.3	0.11 - 2000
1.9	48	-H 460 C(H)(T) 0X1	460	360	8.5	0.14 - 2000
2.3	58	-H 560 C(H)(T) 0X1	560	460	10	0.18 - 110
2.7	69	-H 660 C(H)(T) 0X1	660	560	12	0.22 - 130
3.2	82	-H 760 C(H)(T) 0X1	760	660	13.8	0.27 - 150
3.6	95	-H 860 C(H)(T) 0X1	860	760	16	0.31– 180
4.1	111	-H 960 C(H)(T) 0X1	960	860	17.8	0.35 - 220



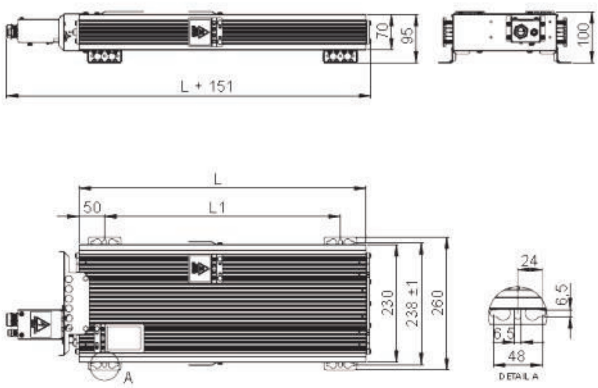
Cable connection IP50 type CBT-V..C..1

P_n	Duty* 5/120	Vertical type CBT -	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP50	mm	mm	kg	Ω
0.45	6	-V 180 C(H)(T) 0X1	180	70	3.1	0.04 - 13
0.58	10.1	-V 210 C(H)(T) 0X1	210	110	3.6	0.05 - 2000
0.83	17.9	-V 260 C(H)(T) 0X1	260	160	4.5	0.07 - 2000
1.35	27.5	-V 330 C(H)(T) 0X1	330	230	5.9	0.09 - 2000
1.65	37	-V 400 C(H)(T) 0X1	400	300	7.3	0.11 - 2000
1.9	48	-V 460 C(H)(T) 0X1	460	360	8.5	0.14 - 2000
2.3	58	-V 560 C(H)(T) 0X1	560	460	10	0.18 - 110
2.7	69	-V 660 C(H)(T) 0X1	660	560	12	0.22 - 130
3.2	82	-V 760 C(H)(T) 0X1	760	660	13.8	0.27 - 150
3.6	95	-V 860 C(H)(T) 0X1	860	760	16	0.31– 180
4.1	111	-V 960 C(H)(T) 0X1	960	860	17.8	0.35 - 220



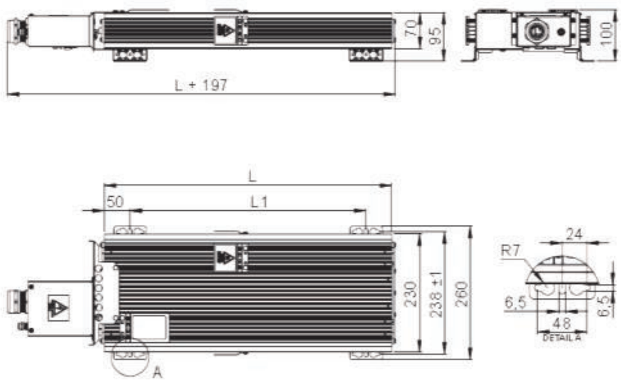
Box connection type IP20/IP21 CBT-H..D. 2.1

P_n	Duty* 5/120	Type CBT -	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP20/IP21	mm	mm	kg	Ω
0.41	6	-H 180 D(H)(T) 2X1	180	70	3.9	0.04 - 13
0.53	10.1	-H 210 D(H)(T) 2X1	210	110	4.2	0.05 - 2000
0.75	17.9	-H 260 D(H)(T) 2X1	260	160	5.1	0.07 - 2000
1.22	27.5	-H 330 D(H)(T) 2X1	330	230	6.7	0.09 - 2000
1.5	37	-H 400 D(H)(T) 2X1	400	300	8.2	0.11 - 2000
1.7	48	-H 460 D(H)(T) 2X1	460	360	9.2	0.14 - 2000
2.1	58	-H 560 D(H)(T) 2X1	560	460	11	0.18 - 110
2.5	69	-H 660 D(H)(T) 2X1	660	560	12.8	0.22 - 130
2.9	82	-H 760 D(H)(T) 2X1	760	660	14.6	0.27 - 150
3.3	95	-H 860 D(H)(T) 2X1	860	760	16.8	0.31– 180
3.7	111	-H 960 D(H)(T) 2X1	960	860	18.6	0.35 - 220



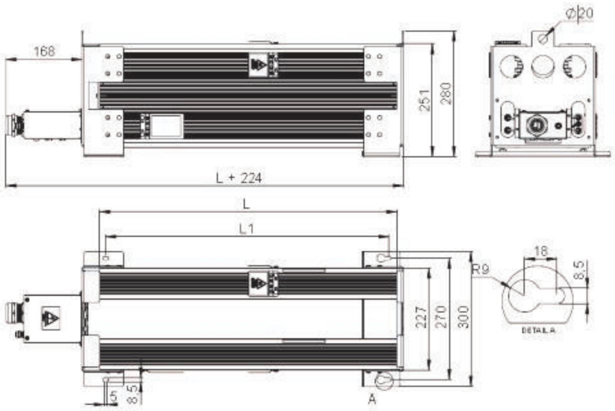
* Pulse rating depends on resistance value

Box connection IP20 / IP21 type CBT-H ..G2.1



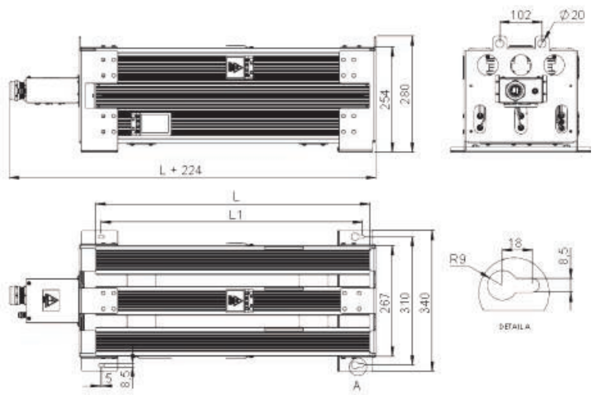
P_n	Duty* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP20/IP21	mm	mm	kg	Ω
0.45	6	-H 180 G(H)(T) 2X1	180	70	3.9	0.04 - 13
0.58	10.1	-H 210 G(H)(T) 2X1	210	110	4.2	0.05 - 2000
0.83	17.9	-H 260 G(H)(T) 2X1	260	160	5.1	0.07 - 2000
1.35	27.5	-H 330 G(H)(T) 2X1	330	230	6.7	0.09 - 2000
1.65	37	-H 400 G(H)(T) 2X1	400	300	8.2	0.11 - 2000
1.9	48	-H 460 G(H)(T) 2X1	460	360	9.2	0.14 - 2000
2.3	58	-H 560 G(H)(T) 2X1	560	460	11	0.18 - 110
2.7	69	-H 660 G(H)(T) 2X1	660	560	12.8	0.22 - 130
3.2	82	-H 760 G(H)(T) 2X1	760	660	14.6	0.27 - 150
3.6	95	-H 860 G(H)(T) 2X1	860	760	16.8	0.31– 180
4.1	111	-H 960 G(H)(T) 2X1	960	860	18.6	0.35 - 220

Box connection IP20 / IP21 type CBT-V ..G2.2



P_n	Duty* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP20/IP21	mm	mm	kg	Ω
2.0	50	-V 400 G(H)(T) 2X2	400	300	18	0.06 - 1000
2.5	60	-V 460 G(H)(T) 2X2	460	360	20.5	0.07 - 1000
3.2	80	-V 560 G(H)(T) 2X2	560	460	23.5	0.09 - 55
3.8	95	-V 660 G(H)(T) 2X2	660	560	27	0.11 - 65
4.5	110	-V 760 G(H)(T) 2X2	760	660	30.5	0.14 - 75
5.0	125	-V 860 G(H)(T) 2X2	860	760	35.5	0.16– 90
6.3	150	-V 960 G(H)(T) 2X2	960	860	39	0.18 - 110

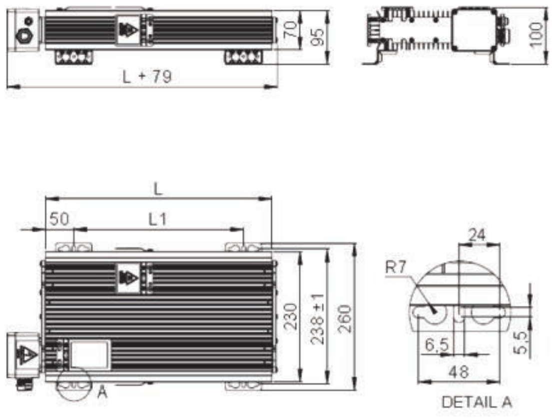
Box connection IP20 / IP21 type CBT-V ..G2.3



P_n	Duty* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP20/IP21	mm	mm	kg	Ω
2.7	70	-V 400 G(H)(T) 2X3	400	300	25.5	0.04 - 1000
3.8	90	-V 460 G(H)(T) 2X3	460	360	29	0.05 - 1000
4.7	120	-V 560 G(H)(T) 2X3	560	460	33.5	0.06 - 35
5.7	140	-V 660 G(H)(T) 2X3	660	560	39	0.07 - 45
6.5	165	-V 760 G(H)(T) 2X3	760	660	44.5	0.09 - 50
7.3	185	-V 860 G(H)(T) 2X3	860	760	51	0.10– 60
8.2	220	-V 960 G(H)(T) 2X3	960	860	57	0.12 - 70

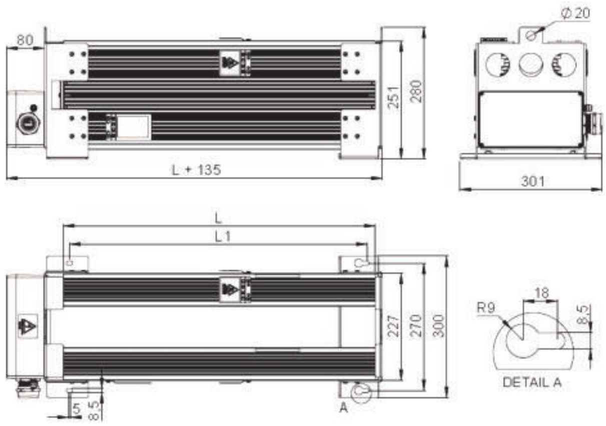
Box connection IP54 / IP65 type CBT-H ..B2.1

P_n	Pulse* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP54/IP65	mm	mm	kg	Ω
0.41	6	-H 180 B(H)(T) 2X1	180	70	3.9	0.04 - 13
0.53	10.1	-H 210 B(H)(T) 2X1	210	110	4.2	0.05 - 2000
0.75	17.9	-H 260 B(H)(T) 2X1	260	160	5.1	0.07 - 2000
1.2	27.5	-H 330 B(H)(T) 2X1	330	230	6.7	0.09 - 2000
1.4	37	-H 400 B(H)(T) 2X1	400	300	8.2	0.11 - 2000
1.7	48	-H 460 B(H)(T) 2X1	460	360	9.2	0.14 - 2000
2.0	58	-H 560 B(H)(T) 2X1	560	460	11	0.18 - 110
2.5	69	-H 660 B(H)(T) 2X1	660	560	12.8	0.22 - 130
2.9	82	-H 760 B(H)(T) 2X1	760	660	14.6	0.27 - 150
3.3	95	-H 860 B(H)(T) 2X1	860	760	16.8	0.31– 180
3.7	111	-H 960 B(H)(T) 2X1	960	860	18.6	0.35 - 220



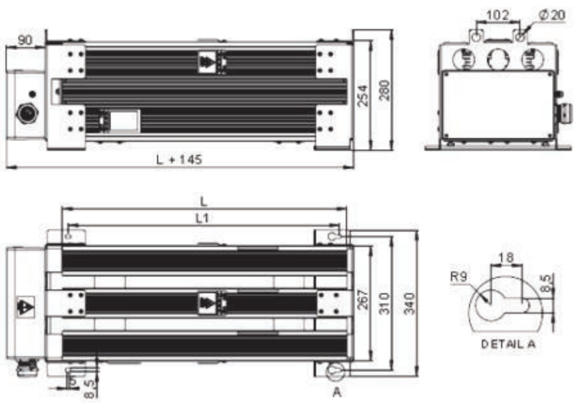
Box connection IP 54 / IP65 type CBT-V ..B2.2

P_n	Pulse* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP54/IP65	mm	mm	kg	Ω
2.0	50	-V 400 B(H)(T) 2X2	400	300	18	0.06 - 1000
2.5	65	-V 460 B(H)(T) 2X2	460	360	20.5	0.07 - 1000
3.2	80	-V 560 B(H)(T) 2X2	560	460	23.5	0.09 - 55
3.8	100	-V 660 B(H)(T) 2X2	660	560	27	0.11 - 65
4.5	110	-V 760 B(H)(T) 2X2	760	660	30.5	0.14 - 75
5.0	130	-V 860 B(H)(T) 2X2	860	760	35.5	0.16– 90
6.3	160	-V 960 B(H)(T) 2X2	960	860	39	0.18 - 110



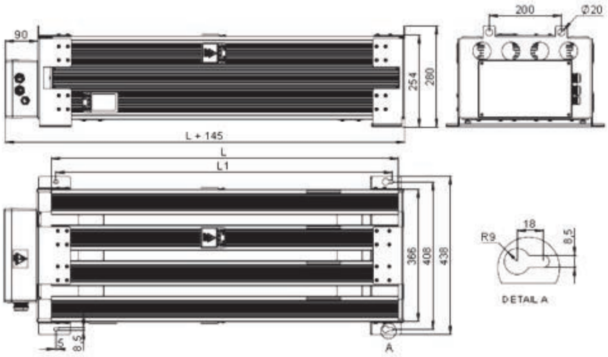
Box connection type IP 54 / IP65 CBT-V ..B2.3

P_n	Pulse* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP54/IP65	mm	mm	kg	Ω
2.7	70	-V 400 B(H)(T) 2X3	400	300	25.5	0.04 - 1000
3.8	90	-V 460 B(H)(T) 2X3	460	360	29	0.05 - 1000
4.7	110	-V 560 B(H)(T) 2X3	560	460	33.5	0.06 - 35
5.7	130	-V 660 B(H)(T) 2X3	660	560	39	0.07 - 45
6.5	150	-V 760 B(H)(T) 2X3	760	660	44.5	0.09 - 50
7.3	170	-V 860 B(H)(T) 2X3	860	760	51	0.10– 60
8.2	195	-V 960 B(H)(T) 2X3	960	860	57	0.12 - 70



* Pulse rating depends on resistance value

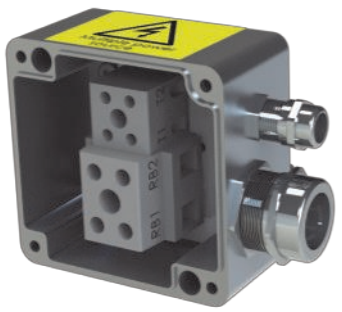
Box connection type IP54 / IP65 CBT-V ..B2.4



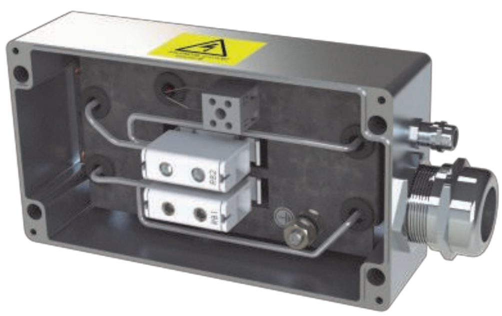
P_n	Duty* 5/120	Type CBT-	L ± 2	L1 ± 2	Weight (SiO2)	Resistance Range
kW	kW	IP20/IP21	mm	mm	kg	Ω
3.6	80	-V 400 B(H)(T) 2X4	400	300	25.5	0.36-460
5.0	110	-V 460 B(H)(T) 2X4	460	360	29	0.4-530
6.3	140	-V 560 B(H)(T) 2X4	560	460	33.5	0.5-33
7.6	170	-V 660 B(H)(T) 2X4	660	560	39	0.6-40
8.7	190	-V 760 B(H)(T) 2X4	760	660	44.5	0.66-50
9.8	210	-V 860 B(H)(T) 2X4	860	760	51	0.76-60
10.9	240	-V 960 B(H)(T) 2X4	960	860	57	0.86-60

connection boxes	IP rating	cable gland	clamping range	braid diameter (min.)	elec. connection
			[mm]	[mm]	[mm²]
B-box (single housing)	IP65	M25	9-16.6	7.5	0.75-10
D-box	IP21	M25	9-16.6	7.5	0.75-10
G-box	IP21	M40	19-28	15	2.5-50
B-box (multiple housings)	IP65	M32	11-21	9	2.5-50
B-box (multiple housings)	IP65	M40	19-28	15	2.5-50
thermal switch (optional)	-	M12	3-7	-	0.5-4

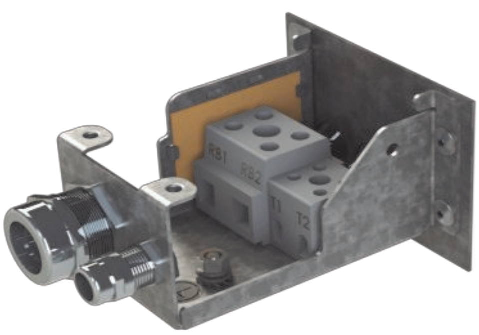
Other cable gland sizes on request



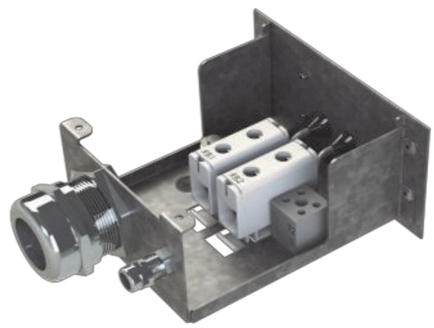
B-box
Single-body



B-box
Multiple-housings

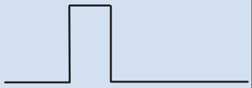
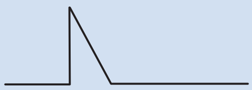


D-box



G-box

Pulse load table

CBT-H Cx(T)	Square pulse each 120 seconds, ambient temp. = 40°C									
	duty 1 second [kW]	Max temp. [°C]	duty 5 second [kW]	Max temp. [°C]	duty 10 second [kW]	Max temp. [°C]	duty 20 second [kW]	Max temp. [°C]	duty 40 second [kW]	Max temp. [°C]
CBT-H 180 15R	18.4	110	5.1	140	3	160	1.9	180	1.1	220
CBT-H 210 100R	24.7	110	6.1	130	3.8	150	2.5	190	1.7	240
CBT-H 260 60R	44	130	10.7	150	6.4	180	4	210	2.7	270
CBT-H 330 40R	71	140	22	190	13	220	8	260	4.3	280
CBT-H 400 30R	105	160	30	210	18	250	10.7	290	5.4	280
CBT-H 460 20R	128	170	36	220	21	250	12	290	6.2	290
CBT-H 560 15R	190	200	50	250	28	280	15	300	7.6	300
CBT-H 660 14R	257	230	64	270	36	300	18	300	9.2	310
CBT-H 760 12R	315	240	78	290	43	310	21.5	310	10.7	310
CBT-H 860 10R	370	250	89	300	50	320	25	320	12.4	320
CBT-H 960 9R0	480	290	110	330	56	330	28	330	14	330
	Triangle pulse each 120 seconds, ambient temp. = 40°C									
	duty 1 second [kW]	Max temp. [°C]	duty 5 second [kW]	Max temp. [°C]	duty 10 second [kW]	Max temp. [°C]	duty 20 second [kW]	Max temp. [°C]	duty 40 second [kW]	Max temp. [°C]
CBT-H 180 15R	39	110	10.7	140	6.3	160	3.8	190	2.3	220
CBT-H 210 100R	50	110	12.7	130	7.7	150	4.9	180	3.2	230
CBT-H 260 60R	90	140	22	160	13	180	8	210	5	250
CBT-H 330 40R	148	140	46	200	27	230	16	260	8.5	280
CBT-H 400 30R	217	160	63	220	37	250	21	280	10.6	280
CBT-H 460 20R	265	170	74	230	44	260	25	290	12.3	290
CBT-H 560 15R	390	200	103	260	58	290	30	300	15	300
CBT-H 660 14R	530	230	134	280	73	310	37	310	18	310
CBT-H 760 12R	645	240	160	290	86	310	43	310	22	310
CBT-H 860 10R	578	260	183	300	98	320	50	320	25	320
CBT-H 960 9R0	983	290	226	330	113	330	57	330	28	330

The table above shows pulse power ratings for typical resistor sizes/lengths and typical Ohm values.

Pulse load

The ability to withstand pulse-loads varies according to resistor size, length and diameter of the internal resistor wire. As such, it is impossible to create standard graphs that would apply to all customer applications. In some cases, the load-profile will be the combination of a square and a triangular pulse, such as is the case with Low Voltage Ride Through (LVRT) and Emergency Brake situations, as encountered in the Wind Power industry.

On request, Danotherm performs simulations based on the actual application and for guidance, has produced tables for various load-profiles for resistors with standard wire. The above table shown is based on a resistor with indicated ohm value and standard wire thickness. Depending on the application, resistor construction can be adapted to optimally match the application. In the tables above, the peak powers of trains of rectangular and triangular pulses of 120 second periods are shown for durations of 1 to 40 seconds.

Ingress Protection

The Ingress Protection rating (IP) value depends on the resistor and on the connection style. The basic IP rating for resistors is IP 50 but by the addition of gaskets, they can be increased to IP 54 or IP 65 which is also possible for resistors with flying leads. For resistors with connection box type B, the maximal IP value is 65. Resistors with connection boxes D and G have an IP 21 rating when mounted vertically and IP 20 when mounted horizontally.

IP values and their type-tests are well defined; for instance "IP 65" means dust cannot penetrate the box or if dust occurs internally, it will not influence the electrical properties. It should be able to withstand water jets from any direction with a certain pressure during 3 minutes; however, it does not mean that it can withstand continuous rain. If the resistor is used outdoors, then it should be protected against direct rain.

IP 65 rated resistors can be cleaned with a high pressure hose, but this can only be done when the resistor has cooled down to the ambient temperature, otherwise the water will cool the housing causing a partial vacuum inside, drawing in water.

Danotherm offers standard solutions for one to four cases combined into one compact configuration with pulse-withstand capability of 1MW (5MJ) and also OEM versions with a maximum of 20 resistors. Depending on the electrical connection, the IP class ranges from IP 00 to IP 65. Connections can be via a terminal box, DIN-rail terminals or cable lugs. These resistor types are also offered in high voltage versions and with higher ohmic values.

The salient features of Alpha resistors are that they have:

- Small dimensions
- Cool surfaces in operation
- High pulse-load capabilities
- High vibration capabilities
- No external electrically-live parts
- High IP classes
- Fail-safe capabilities (on request)
- low noise levels.

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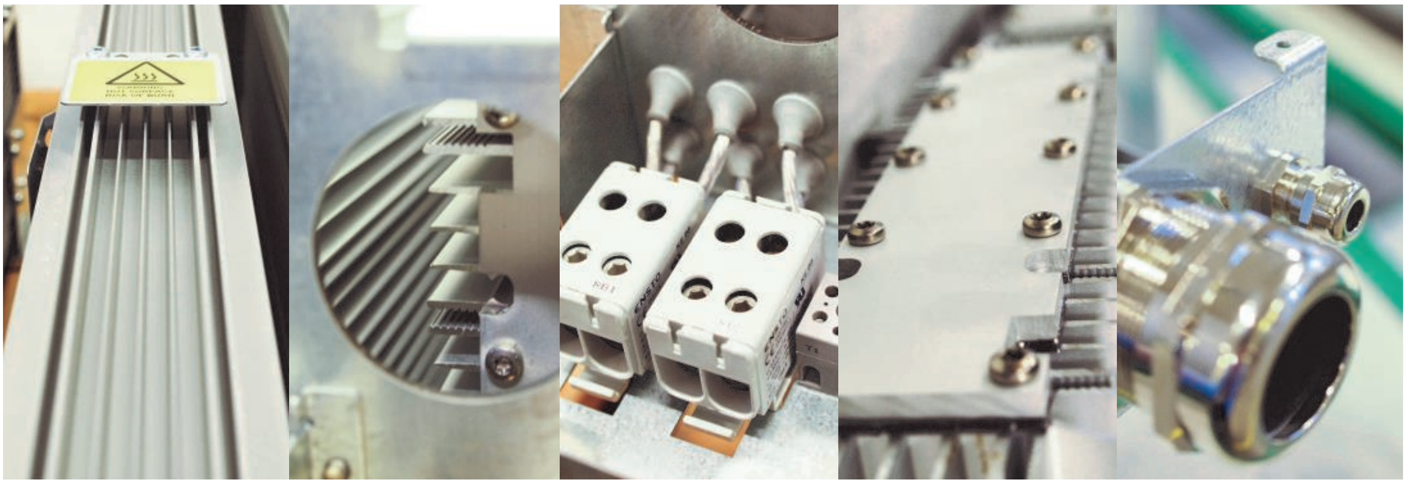
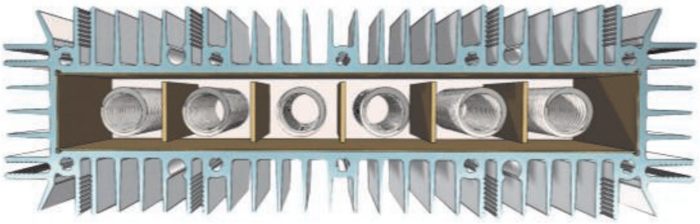
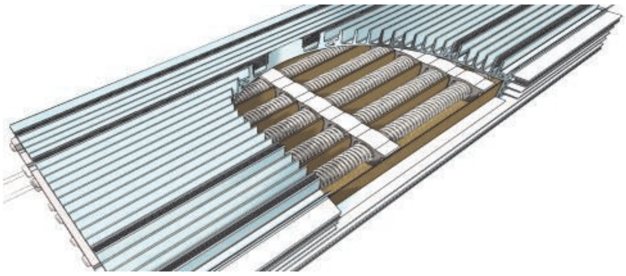
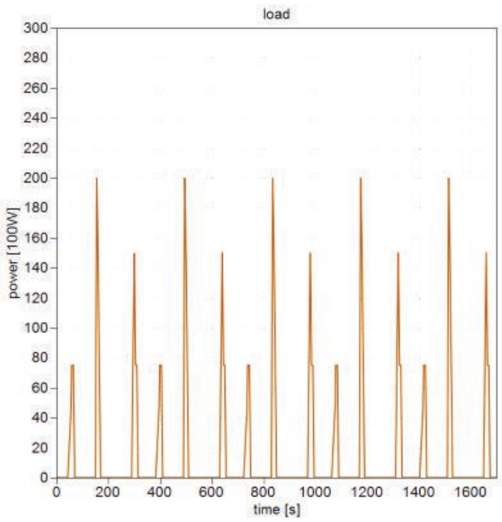


Danotherm has developed a thermal simulation method by which it is possible to optimize a resistor to a specified application. This gives following benefits

- Short and fast engineering time, saving engineering costs
- Simulation software for electrical circuits can be used for thermal simulations (PSpice, Matlab, Plecs or any other)
- Simulations can be done by the customer or if requested by Danotherm
- Simulation is based on customers application, any electrical circuit that can be simulated can be used
- For more complex loads a data file (like csv) can be used for input
- Optimizing the design, reducing overall size and costs
- Proof of capability is given without even building and testing samples

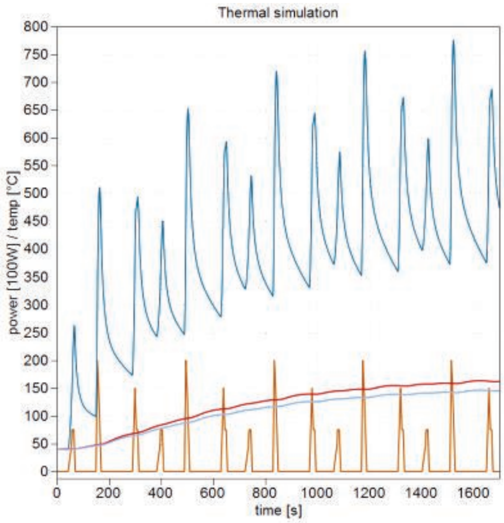






Measured on site: Brake Power stored in .cvs file.

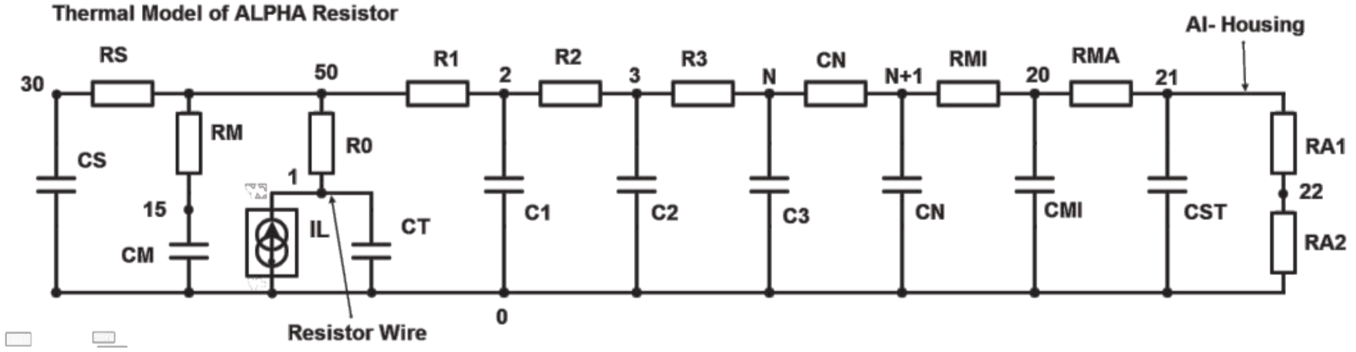
Other possibilities could be a description of a typical or worst case brake pulse and a repeat cycle.



Simulation made by Danotherm

Results of temperature simulation of specified load in a suggested resistor type.

Thermal Model of ALPHA Resistor

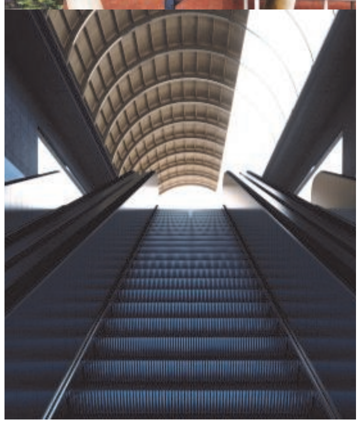


Danotherm resistors are used as:

- Pre-charge for DC-link (super) capacitors
- Pre-magnetization of power transformers
- Brake resistors for industrial drive systems
- Emergency stops in (gas) turbines

Danotherm resistors are used in:

- Elevators
- Escalators
- Cranes
- Vessels
- Wind turbines
- (Trolly)busses
- Trams / Metros / Trains (auxiliary circuits)
- Conveyer belts
- Transformers
- Turbines
- Excavation machines



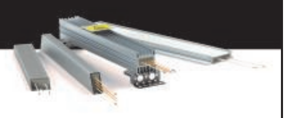
Danotherm supports your request. The very start is your specification of the application, the load and environmental conditions. Ideally, a power-time graph is presented which forms the basis of the thermal simulation. If such graph is not available, the electrical circuit of the application is build in the simulation software. It is also possible to use a data file as input for the load. Such file can be build by measurements on the site or they come from another simulation software program.

The next step is to feed the generated power losses into the thermal model. Each resistor which its physical properties has its own, unique, thermal model. With the simulation the temperatures inside the resistor and of the outside housing surface, are simulated. Here, the maximum temperature values are observed and at the same time care is taken not to over dimension the resistor.

When the type and internal construction of the resistor is defined, the resistor will be further tailored to the customers needs. Connection box-es, connection cable sizes, cable glands, IP ratings, mounting brackets, metal surface treatment, auxiliary circuits, such as PT100 sensors and thermal switches, are all considered.

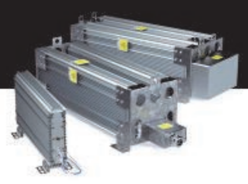
Finally, packing and shipping is an important topic. The resistors should be safely packed to prevent damage during transport and at the same time the costs for shipping and packing must be considered. Together with our customers the best option is chosen.

Overview of the ALPHA resistor family (IP00-IP65)

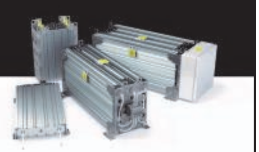


CCH / CAV / CAH / CAR

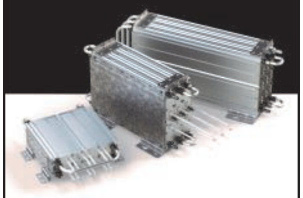
CBH / CBV / CBR



CBT-V / CBT-H



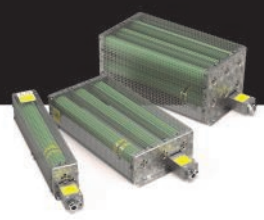
CBS / CMQ /CVS / HVBS



CBW-V / CBW-H
Water cooled

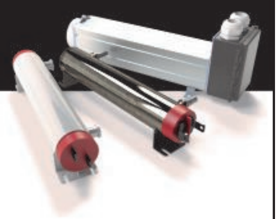
Power: 60-410W	Power: 85W-1.7kW	Power: 410W-12kW	Power: 445W-15kW	Power: 860W-25kW
	9-150kJ @5s	25-550kJ @5s	80kJ-2.5MJ @5s	6.4kJ-1.1MJ @5s
- Applications				
Charge / Discharge	High Pulse load	High Pulse load	High Pulse load	Short recovery time
Brake	Brake	Brake	Brake	Brake
Filter	Filter	Filter	Medium voltage	Filter
	Charge / Discharge	Charge / Discharge	Charge / Discharge	High Pulse load

Other resistor types from Danotherm (IP00-IP66)

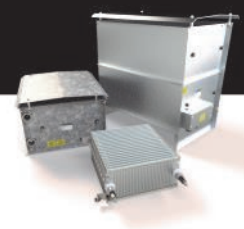


SIGMA

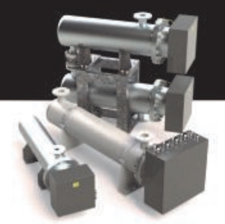
OHMEGA - Air



WHHB / WHBS / WHBSA



TERA



OHMEGA - Water

Multi purpurse	Outdoor & Marine	Filter	Medium & High voltage	Filter & load
Power: 100W-5kW	Power: 1-500kW	Power: 4-200kW	Power: 500W->	Power: 5kW-1MW
Ceramic wirewound	Steel tube	Wirewound	Steel grid	Steel tube

CBT-H 400 CH(T) 2 8 1 22R KT

Last digits > 400: Customer specific version, otherwise:

- Thermal drift; standard T=100ppm
- Tolerance; standard K=± 10%
- Ohm value (Example 2R2=2.2Ω / 22R = 22Ω)
- Number of case style housings (1, 2, 3 or 4)
- Thermal switch temp; 5=130°C / 6=160°C / 7=180°C / 8=200°C
- 0=cable connection, 2=connection box type
- T=Thermal switch (normally closed)
- Wire element (TBD by Danotherm)
- Connection; C=no box / D=IP20 / B=IP65 box
- Length of resistor housing in mm
- H=horizontal mounting feet / V=vertical mounting feet

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