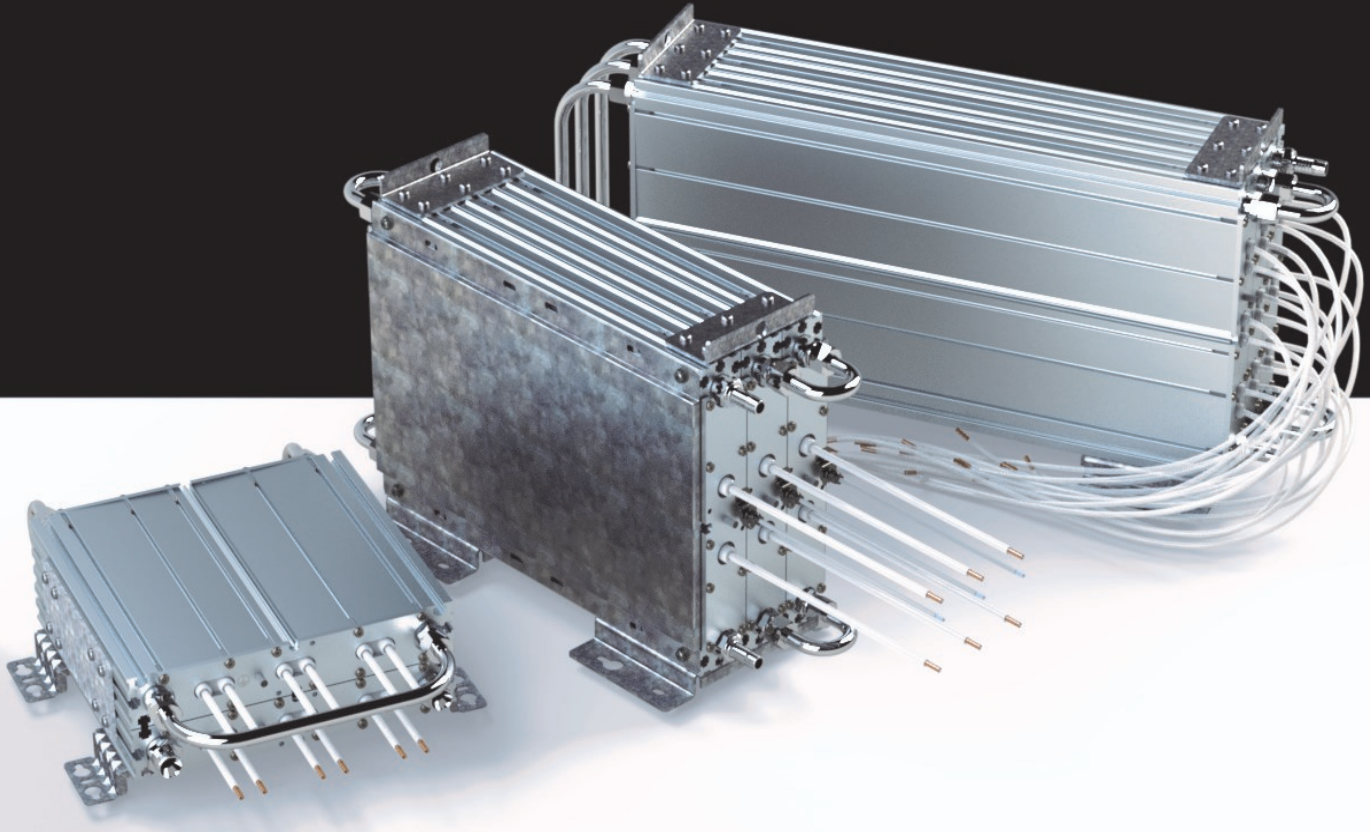




DANOTHERM™



CBW-H / CBW-V

- Water cooled resistors

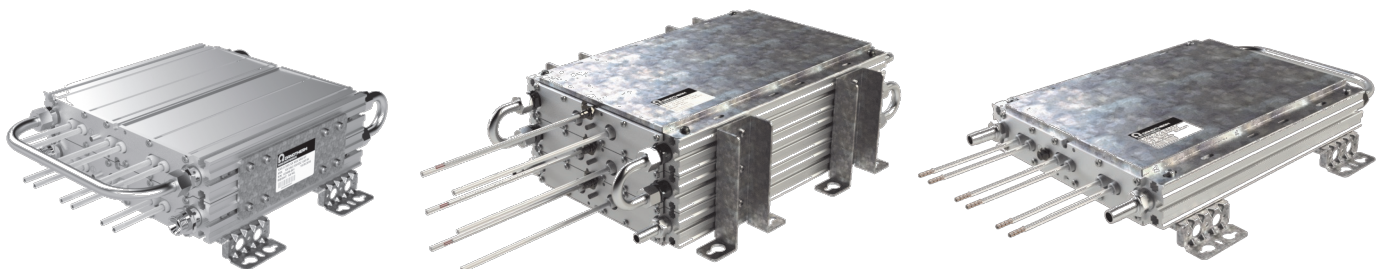
- General-purpose applications
- High pulse load and High average load
- Compact Construction; small dimensions
- Fully insulated; no external live parts
- High IP Classes
- Low thermal drift, 100ppm
- Fail Safe capabilities on request
- Low noise
- Thermal models for all types available on request
-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

CBW Water cooled

CBW-H C(H)(T)	R [Ω] min - max $\pm 10\%$	Max. nom. Power at Inlet water temperature and delta T. T surface 190°C								
		20°C Inlet temperature delta T coolant:			40°C Inlet temperature delta T coolant:			50°C Inlet temperature delta T coolant:		
		10	20	40	10	20	40	10	20	40
CBW 180	0.04 - 13	1200	1150	1050	1050	1000	930	960	930	860
CBW 210	0.05 - 2000	1650	1600	1500	1450	1400	1300	1350	1300	1200
CBW 260	0.07 - 2000	2350	2300	2150	2050	2000	1850	1950	1850	1700
CBW 330	0.09 - 2000	2950	2850	2700	2600	2500	2300	2400	2300	2150
CBW 400	0.11 - 2000	3550	3450	3200	3100	3000	2800	2900	2800	2550
CBW 460	0.14 - 2000	4100	4000	3750	3600	3500	3250	3400	3250	3000
CBW 560	0.18 - 110	4950	4800	4500	4350	4200	3900	4050	3900	3600
CBW 660	0.22 - 130	5900	5700	5350	5200	5000	4650	4800	4650	4300
CBW 760	0.27 - 150	6700	6500	6100	5900	5700	5300	5500	5300	4900
CBW 860	0.31 - 180	7650	7450	6950	6750	6500	6050	6250	6050	5550
CBW 960	0.35 - 220	8500	8250	7700	7450	7200	6700	6950	6700	6150

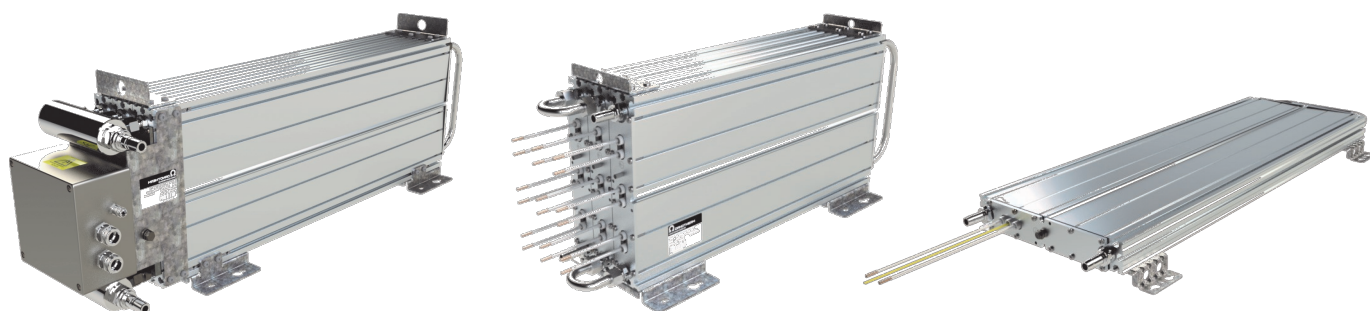
Construction and salient properties

- Compact dimensions
- Nominal power range from 1200W–8500W
- Energy levels from 27kJ-675kJ 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 guard.
- Cable (AWG 14–AWG4) or box connection up to 50mm²
- Multiple case housings (2 or 3 housings)
- Customized to your needs and application (OEM versions available)
- For UL approval, consult Danotherm



General specifications

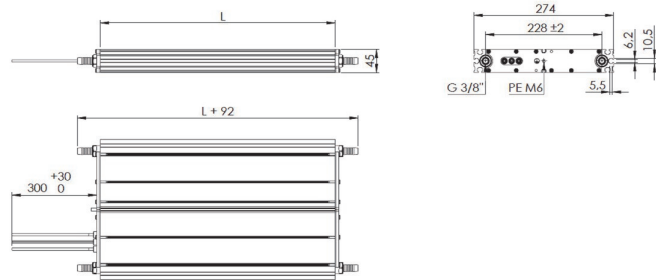
Temperature Coefficient:		100 ppm/K
Dielectric strength		3500 VAC @ 1 minute
Insulation Resistance:		> 20MΩ / case housing
Overload:@ 1 sec pulse / hour		70 - 250 x (depending on resistor)
Overload:@ 5 sec pulse / hour		20 - 60 x (depending on resistor)
Environmental:		- 40 °C - 70 °C
Cooling		The nominal power of the resistors refers to cooling conditions as per table 1 with inlet temperature and temperature increase. (delta T)
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	Cable version	UL: 1000VAC. IEC: 1000VAC / 1400VDC
	conn. Box	UL: 600VAC. IEC: 690VAC / 1100VDC
Time constant for heating up resistor		1000 - 3000s
Thermal switch (optional)	Thermal switch	130 / 160 / 180 / 200 °C. 2.5A. 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



Mechanical drawings

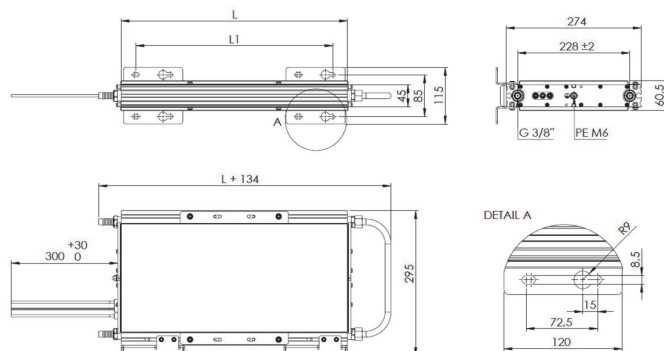
Cable connection type with water nipples

P_n	Pulse* 5/120	Type	$L \pm 2$	Weight (SiO ₂)	Resistance Range
W	kW		mm	kg	Ω
1200	5.5	CBW 180	180	3,1	0.04 - 13
1650	5.3	CBW 210	210	3,6	0.05 - 2000
2350	11.3	CBW 260	260	4,5	0.07 - 2000
2950	24.4	CBW 330	330	5,9	0.09 - 2000
3550	34	CBW 400	400	7,3	0.11 - 2000
4100	41	CBW 460	460	8,5	0.14 - 2000
4950	58	CBW 560	560	10	0.18 - 110
5900	76	CBW 660	660	12	0.22 - 130
6700	92	CBW 760	760	13,8	0.27 - 150
7650	105	CBW 860	860	16	0.31 - 180
8500	135	CBW 960	960	17,8	0.35 - 220



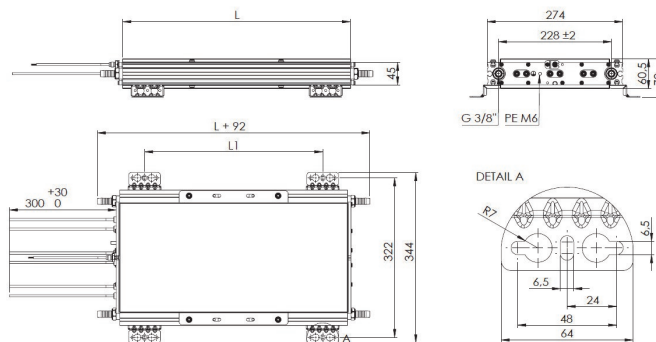
Cable connection type with water return pipe and side isolation plate

P_n	Pulse* 5/120	Type	$L \pm 2$	$L1 \pm 2$	Weight (SiO ₂)	Resistance Range
W	kW		mm	mm	kg	Ω
1200	5.5	CBW-V 180	180	120	3,1	0.04 - 13
1650	5.3	CBW-V 210	210	150	3,6	0.05 - 2000
2350	11.3	CBW-V 260	260	200	4,5	0.07 - 2000
2950	24.4	CBW-V 330	330	270	5,9	0.09 - 2000
3550	34	CBW-V 400	400	340	7,3	0.11 - 2000
4100	41	CBW-V 460	460	400	8,5	0.14 - 2000
4950	58	CBW-V 560	560	500	10	0.18 - 110
5900	76	CBW-V 660	660	600	12	0.22 - 130
6700	92	CBW-V 760	760	700	13,8	0.27 - 150
7650	105	CBW-V 860	860	800	16	0.31 - 180
8500	135	CBW-V 960	960	900	17,8	0.35 - 220

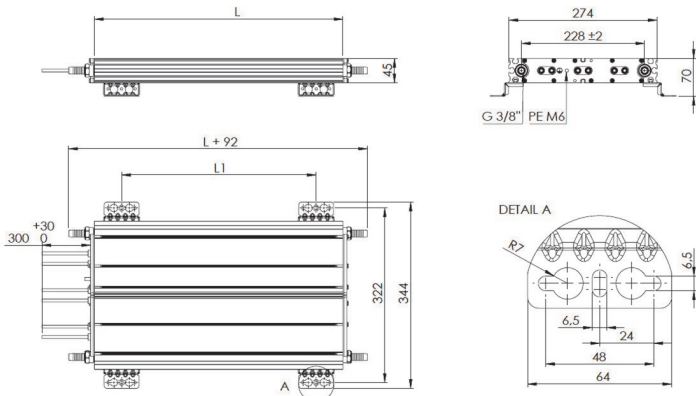


Cable connection type with water nipples and side isolation plate

P_n	Pulse* 5/120	Type	$L \pm 2$	$L1 \pm 2$	Weight (SiO ₂)	Resistance Range
W	kW		mm	mm	kg	Ω
1200	5.5	CBW-H 180	180	80	3,9	0.04 - 13
1650	5.3	CBW-H 210	210	110	4,2	0.05 - 2000
2350	11.3	CBW-H 260	260	160	5,1	0.07 - 2000
2950	24.4	CBW-H 330	330	230	6,7	0.09 - 2000
3550	34	CBW-H 400	400	300	8,2	0.11 - 2000
4100	41	CBW-H 460	460	360	9,2	0.14 - 2000
4950	58	CBW-H 560	560	460	11	0.18 - 110
5900	76	CBW-H 660	660	560	12,8	0.22 - 130
6700	92	CBW-H 760	760	660	14,6	0.27 - 150
7650	105	CBW-H 860	860	760	16,8	0.31 - 180
8500	135	CBW-H 960	960	860	18,6	0.35 - 220

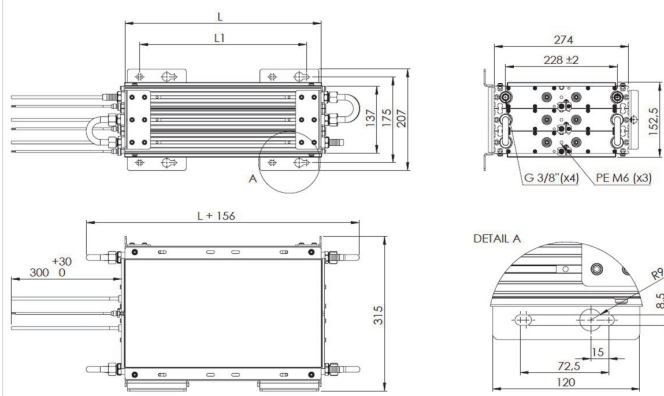


Cable connection type with water connection nipples



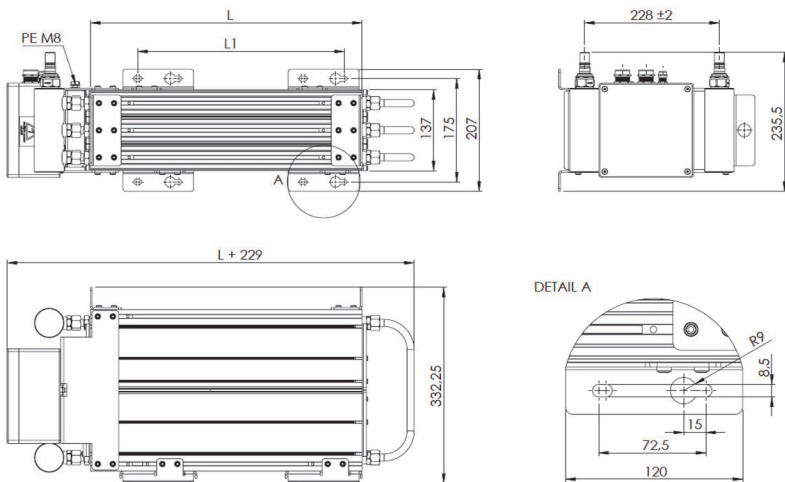
P_n	Pulse * 5/120	Type	$L \pm 2$	$L1 \pm 2$	Weight (SiO ₂)	Resistance Range $3 \times R$
W	kW		mm	mm	kg	Ω
1200	5.5	CBW-H 180	180	70	3,9	0.10 - 4
1650	5.3	CBW-H 210	210	110	4,2	0.14 - 500
2350	11.3	CBW-H 260	260	160	5,1	0.20 - 500
2950	24.4	CBW-H 330	330	230	6,7	0.30 - 1000
3550	34	CBW-H 400	400	300	8.2	0.50 - 1000
4100	41	CBW-H 460	460	360	9.2	0.60 - 1000
4950	58	CBW-H 560	560	460	11	0.70 - 35
5900	76	CBW-H 660	660	560	12.8	0.80 - 43
6700	92	CBW-H 760	760	660	14.6	0.95 - 50
7650	105	CBW-H 860	860	760	16.8	1.10 - 60
8500	135	CBW-H 960	960	860	18,6	1.20 - 70

Cable connection type with water series connections and nipples



$P_n /$ housing	Pulse* 5/120	Type	$L \pm 2$	$L1 \pm 2$	Weight (SiO ₂)	Resistance Range
W	kW	Type	mm	mm	kg	$3 \times R \Omega$
3550	34	CBW-V 400	400	340	18	0.50 - 1000
4100	41	CBW-V 460	460	400	20.5	0.60 - 1000
4950	58	CBW-V 560	560	500	23.5	0.70 - 35
5900	76	CBW-V 660	660	600	27	0.80 - 43
6700	92	CBW-V 760	760	700	30.5	0.95 - 50
7650	105	CBW-V 860	860	800	35.5	1.10 - 60
8500	135	CBW-V 960	960	900	39	1.20 - 70

Box connection type with water manifold connections and nipples



$L \pm 2$	$L1 \pm 2$	Weight (SiO ₂)	Resistance Range
mm	mm	kg	$R \Omega$
400	340	8.2	0.11 - 2000
460	400	9.2	0.14 - 2000
560	500	11	0.18 - 110
660	600	12.8	0.22 - 130
760	700	14.6	0.27 - 150
860	800	16.8	0.31 - 180
960	900	18,6	0.35 - 220

Applications

CBW water cooled power resistors are used in applications where there are high power pulse loads and or high average power. The resistor elements are embedded in sand. This functions as a high thermal capacitor that can absorb high energy peaks. The energy is conducted by the sand and absorbed into the water. About 90% of the total dissipation will be captured by the water, the rest is expelled into the air. It is very well possible to isolate the aluminium housing and by that forcing almost all power dissipation into the water.

CBW resistors are used in wind turbine applications as filter resistor and on board of medium power traction, like trams, as brake resistor. In some tram systems, the re-generated power is used for heating up the inside of the tram during cold days.

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 .

Flow L/h	ΔT water					ΔT water/glycol 60/40				
	10	15	20	25	30	10	15	20	25	30
7 kW	710	470	350	280	240	1070	710	530	420	360
6 kW	610	400	300	240	200	920	600	450	360	300
5 kW	510	340	250	200	170	770	510	380	300	260
4 kW	400	270	200	160	130	600	410	300	240	200
3 kW	300	200	150	120	100	450	300	230	180	150
2 kW	200	130	100	80	70	300	200	150	120	110
1 kW	100	65	50	40	35	150	100	80	60	50

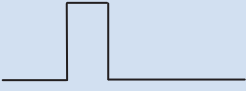
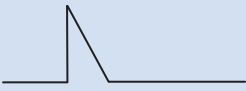
Pressure drop

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 liters per hour the pressure drop is 55mBar per channel, 110mBar in total for 2 cooling tubes in series.

Water connections

The aluminium housing has treaded wire hole G 3/8" for the water connections. The resistor housing can be fitted with water connection nipples.



CBW-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]
CBW-H 180 13R	17.5	60	5.5	70	3.4	80	2.1	90	1.3	100
CBW-H 210 100R	19.4	55	5.3	60	3.6	70	2.6	85	1.8	100
CBW-H 260 60R	46	65	11.3	75	6.9	80	4.5	95	3	110
CBW-H 330 40R	78	75	24.4	100	15	110	9.3	130	5.7	150
CBW-H 400 30R	115	85	34	110	20.8	120	12.7	140	7.8	160
CBW-H 460 20R	140	90	41	110	25	130	15.4	150	9.4	170
CBW-H 560 15R	215	100	58	120	34	140	20.4	160	12.3	180
CBW-H 660 14R	295	110	76	130	44	150	26.1	170	15.4	190
CBW-H 760 12R	370	120	92	140	52	160	30.7	180	18	200
CBW-H 860 10R	440	120	105	140	61	160	35.5	180	20.8	200
CBW-H 960 9R0	580	140	135	160	75	170	42.4	190	23.2	200
	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]
CBW-H 180 13R	37	60	12	75	7	80	4.3	90	2.7	100
CBW-H 210 100R	40	55	11	65	7	70	4.8	80	3.2	95
CBW-H 260 60R	94	70	23	75	14	80	8.8	95	5.7	110
CBW-H 330 40R	165	80	51	100	30.9	120	18.9	130	11.3	150
CBW-H 400 30R	240	90	71	110	43	130	25.9	140	15.5	160
CBW-H 460 20R	295	90	85	110	51	130	30.8	150	18.5	170
CBW-H 560 15R	450	110	120	130	70	140	41.5	160	24.3	180
CBW-H 660 14R	620	120	160	140	91	150	53	170	30.9	190
CBW-H 760 12R	760	120	190	140	110	160	63	180	36.3	200
CBW-H 860 10R	900	130	225	150	125	160	73	180	41.5	200
CBW-H 960 9R0	1200	140	280	160	155	180	87	190	46.1	200

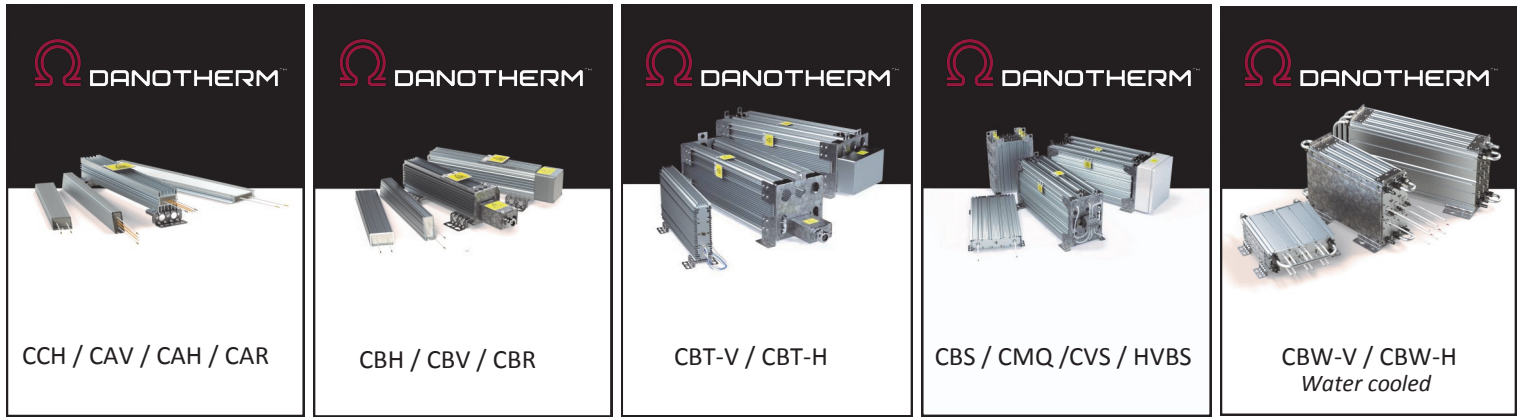
The table above shows pulse power ratings for typical resistor sizes/lengths and typical ohmic values.

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.

Overview of the ALPHA resistor family (IP00-IP65)



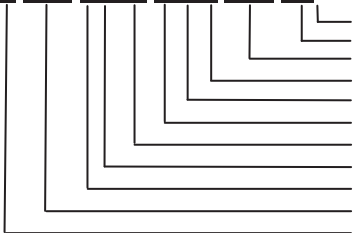
Power: 60-410W	Power: 85W-1.7kW	Power: 410W-12kW	Power: 445W-15kW	Power: 860W-25kW
	9-150kJ @5s	25-550kJ @5s	80kJ-2.5MJ @5s	6.4kJ-1.1MJ @5s
- Applications				
Charge / Discharge	High Pulse load	High Pulse load	High Pulse load	Short recovery time
Brake	Brake	Brake	Brake	Brake
Filter	Filter	Filter	Medium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

Other resistor types from Danotherm (IP00-IP66)



Multi purpose	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

CBW-H 400 C H 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 / 6=160 / 7=180 / 8=200°C / 9=PT 100
- 0=cable connection, 2=connection box type
- T=Thermal switch optionally (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

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DAN EN 15.5028.R4
 28022017

