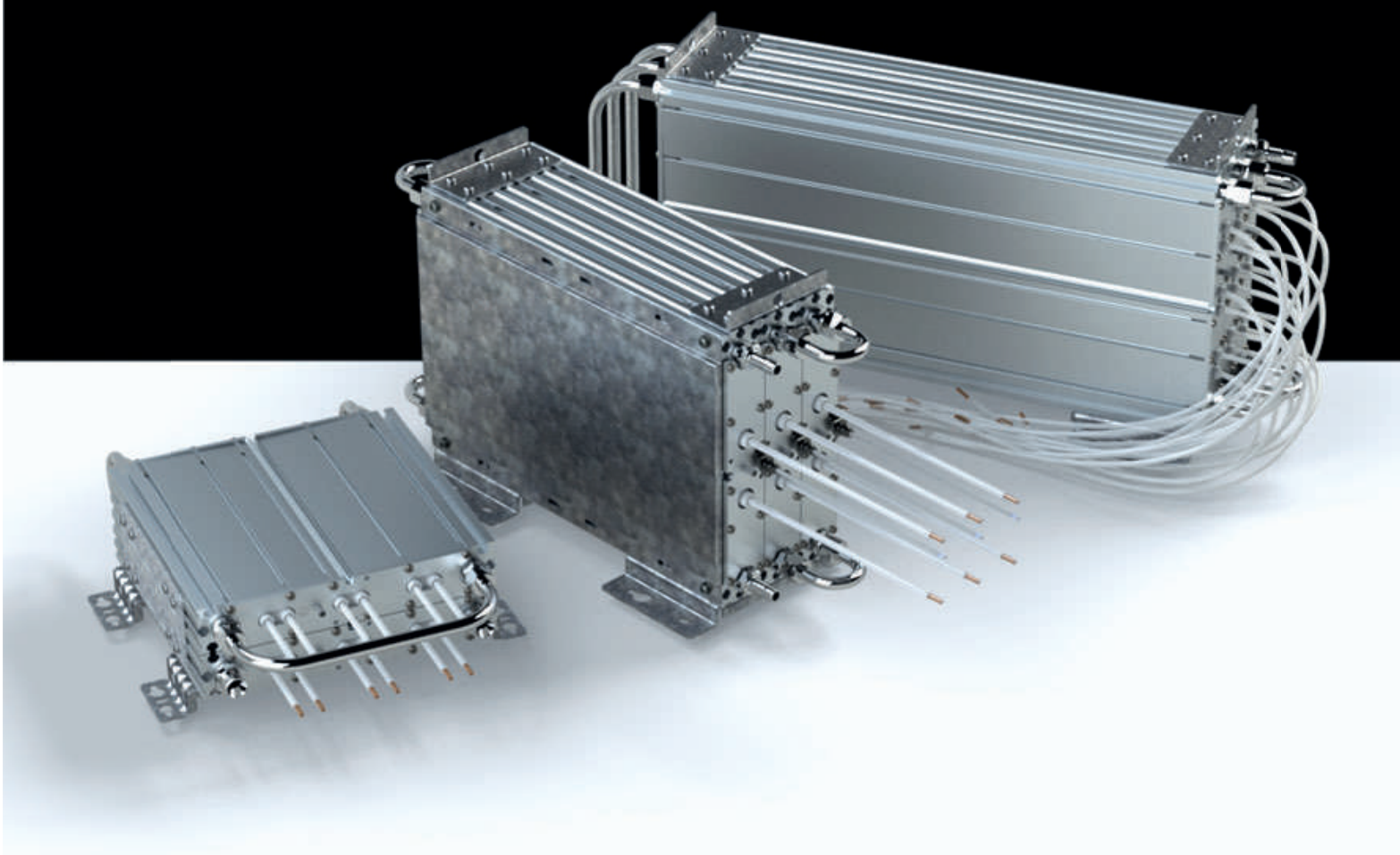
DANOTHERM™

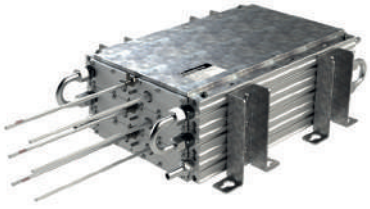


CBW

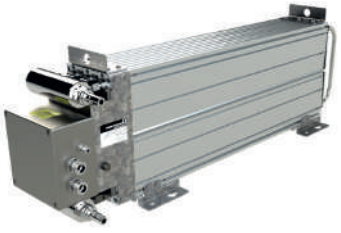
Type	Ohm range R [Ω] min-max	Nominal power at inlet temperature and delta T, hotspot surface temp 190°C								
		20°C inlet temperature			40°C inlet temperature			50°C inlet temperature		
		10	20	40	10	20	40	10	20	40
CBW 180	0.04 - 13	1200	1150	1050	1050	1000	930	960	930	860
CBW 210	0.05 - 2000	1650	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

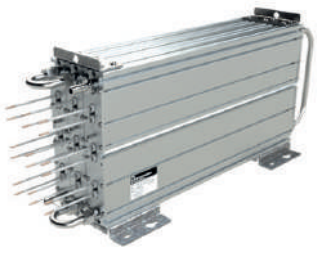
Construction and salient properties

- 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 300mm (AWG 14—AWG4) with sleeves 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



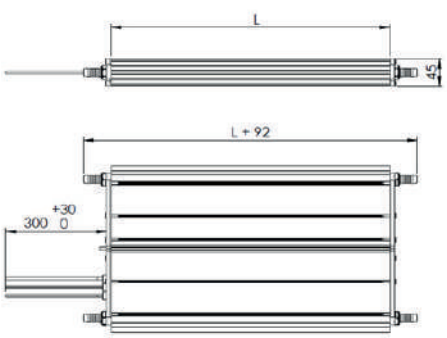
Temperature Coefficient:		100 ppm/K
Dielectric strength		3500 VAC @ 1 minute
Insulation Resistance:		> 20MΩ / case housing
Overload: @ 1 sec pulse / hour		70 - 250 x (depending on resistor)
Overload: @ 5 sec pulse / hour		20 - 60 x (depending on resistor)
Environmental:		- 40 °C / +70 °C
De-rating cable 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	box version	UL: 600VAC / 850VDC ; IEC: 690VAC / 975VDC
	cable version	1000VAC / 1400VDC
Time constant		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 @ 250VAC cos φ=1
Dielectric voltage		2000VAC (3500VAC between TS and R)
Temperature requirements on cables	IP 21	80°C
	IP 65	90°C

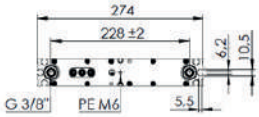




CBW ... with water nipples, IP54

with or without thermal switch

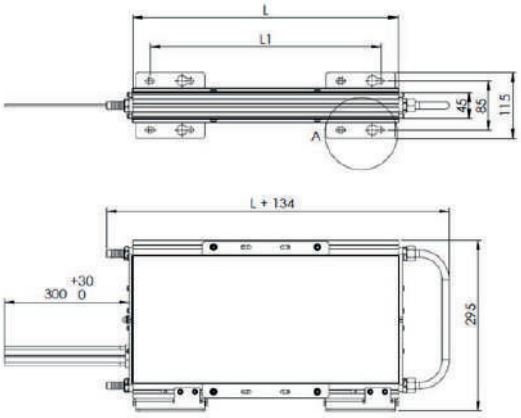


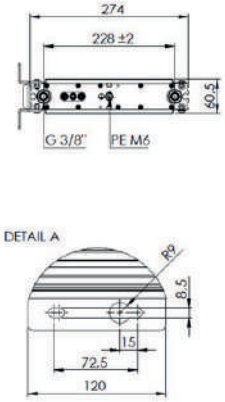


Type	L ± 2 mm	Weight g
CBW 180	180	3,1
CBW 210	210	3,6
CBW 260	260	4,5
CBW 330	330	5,9
CBW 400	400	7,3
CBW 460	460	8,5
CBW 560	560	10
CBW 660	660	12
CBW 760	760	13,8
CBW 860	860	16
CBW 960	960	17,8

CBW-V ... with water return pipe and side isolation

with or without thermal switch

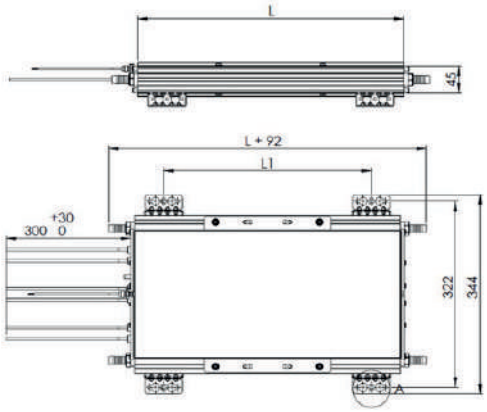


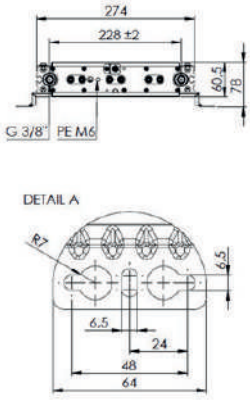


Type	L ± 2 mm	L1 ± 2 mm	Weight g
CBW-V 180	180	120	3,1
CBW-V 210	210	150	3,6
CBW-V 260	260	200	4,5
CBW-V 330	330	270	5,9
CBW-V 400	400	340	7,3
CBW-V 460	460	400	8,5
CBW-V 560	560	500	10
CBW-V 660	660	600	12
CBW-V 760	760	700	13,8
CBW-V 860	860	800	16
CBW-V 960	960	900	17,8

CBW-H ... with water nipples and side isolation

with or without thermal switch



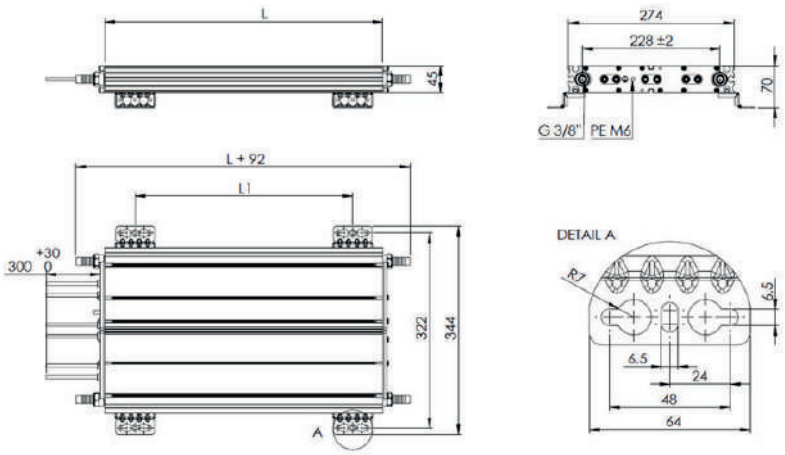


Type	L ± 2 mm	L1 ± 2 mm	Weight g
CBW-H 180	180	80	3,9
CBW-H 210	210	110	4,2
CBW-H 260	260	160	5,1
CBW-H 330	330	230	6,7
CBW-H 400	400	300	8.2
CBW-H 460	460	360	9.2
CBW-H 560	560	460	11
CBW-H 660	660	560	12.8
CBW-H 760	760	660	14.6
CBW-H 860	860	760	16.8
CBW-H 960	960	860	18,6

3-in-1 CBW-H cable connection with water nipples

with or without thermal switch

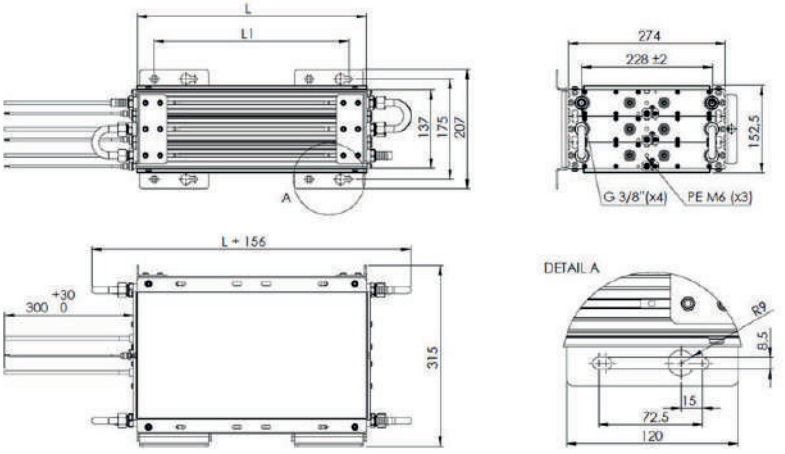
Type	L ± 2 mm	L1 ± 2 mm	Weight g
CBW-H 180	180	70	3,9
CBW-H 210	210	110	4,2
CBW-H 260	260	160	5,1
CBW-H 330	330	230	6,7
CBW-H 400	400	300	8.2
CBW-H 460	460	360	9.2
CBW-H 560	560	460	11
CBW-H 660	660	560	12.8
CBW-H 760	760	660	14.6
CBW-H 860	860	760	16.8
CBW-V 960	960	900	17,8



CBW-V ... C 0.3 cable connection with water series connection

with or without thermal switch

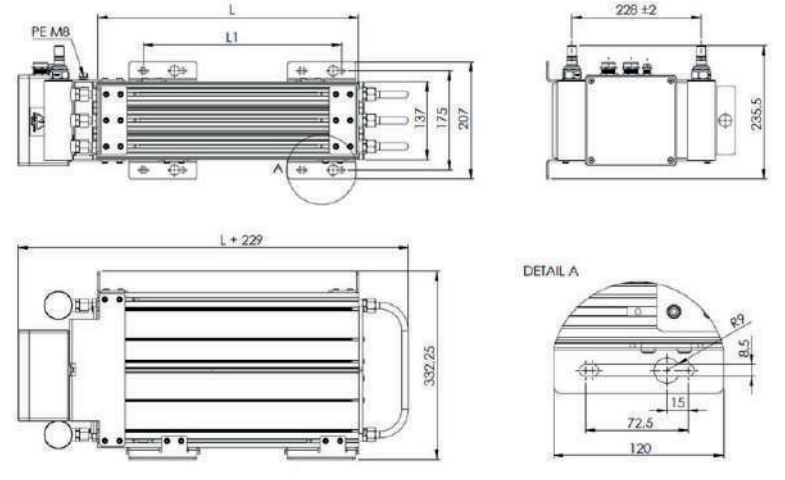
Type	L ± 2 mm	L1 ± 2 mm	Weight g
CBW-V 400	400	340	23.0
CBW-V 460	460	400	26.5
CBW-V 560	560	500	31.0
CBW-V 660	660	600	37.0
CBW-V 760	760	700	42.5
CBW-V 860	860	800	49.0
CBW-V 960	960	900	54.5



CBW-V ... B 2.3 box connection, with water manifold and nipples

with or without thermal switch

Type	L ± 2 mm	L1 ± 2 mm	Weight g
CBW-V 400	400	340	46.5
CBW-V 460	460	400	50.1
CBW-V 560	560	500	54.6
CBW-V 660	660	600	60.6
CBW-V 760	760	700	66.0
CBW-V 860	860	800	72.6
CBW-V 960	960	900	78.0



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	Δ T water					Δ T 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

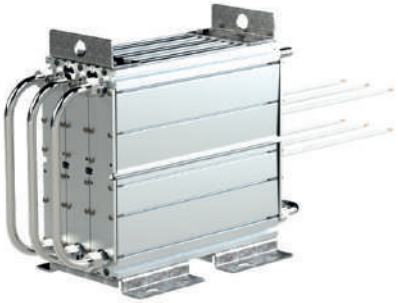
The aluminium housing has treaded wire hole G 3/8" for the water connections. The resistor housing can be fitted with water connection nipples.

P 97551

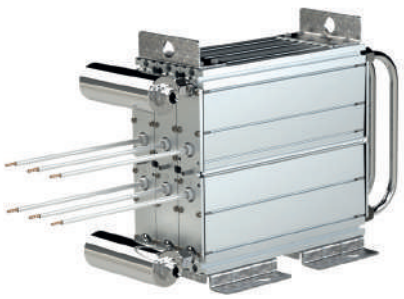
P97552

P97448

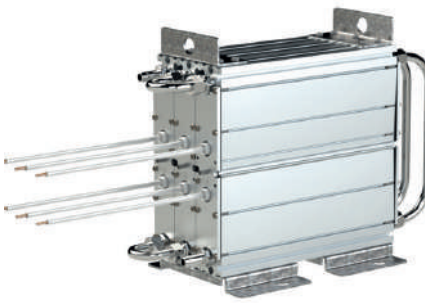
P36383



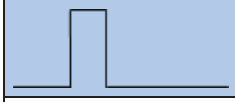
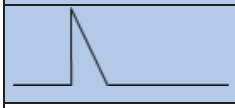
Water return connection back



Water inlet manifold front



Series water connections front

Type	Square pulse each 120seconds, ambient temperature 40°C.									
	duty 1 second kW	Max temp °C	duty 5 seconds kW	Max temp °C	duty 10 seconds kW	Max temp °C	duty 20 seconds kW	Max temp °C	duty 40 seconds 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
Type	Triangular pulse each 120seconds, ambient temperature 40°C.									
	duty 1 second kW	Max temp °C	duty 5 seconds kW	Max temp °C	duty 10 seconds kW	Max temp °C	duty 20 seconds kW	Max temp °C	duty 40 seconds 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.