

STEEL TUBE WATER COOLED RESISTORS

SV14 (5-22 kW)

V14-150 (28-150 kW)

V14-250 (75-400 kW)



DAN EN 13.5004R1

Release date 05/03/2013

 **DANOTHERM**

Construction of SV14

The OHMEGA SV14-XXX-3 resistors are constructed as follows:

A resistor consists of a water tank (AISI 304) fitted with 3 resistor elements. The resistor elements are wire wound steel tube elements (AISI 316L) with a diameter of 14 mm and a length of 600 – 1800 mm.

Power rating: 5 kW to 22 kW / unit.
Standard materials are:

Resistor elements: AISI 316L with NiCr resistor wire. Water Tank: AISI 304

Connection

Power cables are connected through a M25/M40 cable gland with integrated screen connection. The range of outer diameters of the power cable is 9.0-16.6 mm/19-28 mm.

The power cables (2.5-10 mm²/2.5-50 mm²) are connected to a terminal block with screw connections. The PE is connected directly to the connector box with a screw.

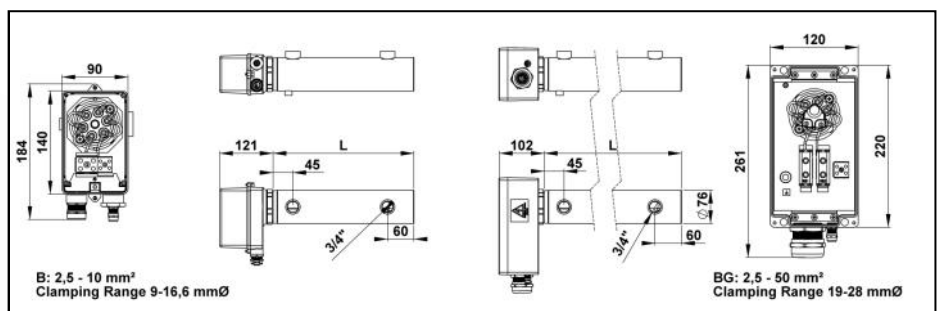
The cable for the thermo watch is connected to a terminal block (0.5-4mm²) via a M12 gland with clamping range 3 – 7 mm. The Connector Box made of Aluminum has a protection class of IP 54, Type B or IP 65, Type BG.

SV14	Continuous power [kW]	Pulse load [kW]			R [Ω]	
		duty cycle (in seconds)			Min. [Ω]	Max. [Ω]
		5/120	10/120	40/120		
SV14/600-03	5	20	15	8,5	0,67	133
SV14/800-03	9	36	27	16	1,00	200
SV14/1100-03	12	48	36	22	1,50	300
SV14/1600-03	19	77	58	36	2,33	467
SV14/1800-03	22	93	71	44	2,67	533

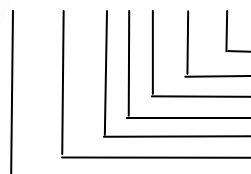
Pulse ratings depend on the ohm value. Resistors with lower ohm value have more resistor wire than resistors with high ohm value. The ratings in this table refer to a single resistor element of 40 Ω.

General Specifications	
Temperature Coefficient	<± 100 ppm
Max resistor wire temperature	1000 °C
Dielectric strength	2500 VAC 1 minute
Working Voltage	690 VAC; 1100 VDC
Isolation Resistance	> 2 MΩ
Overload	3 x in 10 sec; 10 x in 1 s
Environmental	0 - 60 °C
Thermo watch	58 - 110 °C; 20 A @ 240 VAC
Cooling (standard)	Freshwater
Working pressure	6 Bar
Test pressure	10 Bar

Mechanical data		/600	/800	/1100	/1400	/1800
L	mm	320	465	585	850	965
Weight (Empty)	kg	3	4	5	7	9
Weight incl. water	kg	4,5	6	7,5	11	13
Heat capacity of water (no flow) kJ/K	kJ/K	6	8,7	11	16	18
Min. Water flow @ PN (Max conf.) GT = 30 K	L/min	2,5	4,5	5,7	9	11
Pressure loss @ X l/min						
Water connection		3/4"				
Connection for valve		5/8"				
Connectorbox type B		Main cables 2,5 - 10 mm ² , clamping range 9 - 16,6 mm				
Connectorbox type BG		Main cables 2,5 - 50 mm ² , clamping range 19 - 28 mm				



SV14 / 600 - 03 B (T) 22R 123



(XXX): Customer specified version
Ohm value (Examples: 2R2 = 2.2 Ω; 22R = 22 Ω; 220R = 220 Ω; 2k2 = 2.2 kΩ)
T = Thermostat
B: Connector Box IP 54; BG: IP 65; S: IP 00 (no box, screw terminals)
Number of elements: 3
Length of elements
SV14: 14 mm Ø resistor elements

V14-150 Continuous power	Pulse load [kW]			Tube Length		R Ω	
	duty cycle (on/off seconds)			A		9 Elements in parallel	
	[kW]	5/120	10/120	40/120	[mm]	[mm]	Min. [Ω] Max. [Ω]
28	110	90	60	500	951	0,39	78
35	140	120	70	600	1051	0,50	100
45	180	150	90	700	1151	0,61	122
50	200	170	100	800	1251	0,72	144
60	240	200	120	900	1351	0,83	167
70	280	230	140	1000	1451	0,94	189
75	300	250	150	1100	1551	1,06	211
85	340	280	170	1200	1651	1,17	233
90	360	300	180	1300	1751	1,28	256
100	400	330	200	1400	1851	1,39	278
105	420	350	210	1500	1951	1,50	300
115	460	380	230	1600	2051	1,61	322
125	500	410	250	1700	2151	1,72	344
130	520	430	260	1800	2251	1,83	367
140	560	460	280	1900	2351	1,94	389
150	600	500	300	2000	2451	2,06	411

Pulse ratings depend on the ohm value. Resistors with lower ohm value have more resistor wire than resistors with high ohm value. The ratings in this table refer to a single element of 40 Ω.

General Specifications	
Temperature Coefficient	<± 100 ppm
Max resistor wire temperature	1000 °C
Dielectric strength	2500 VAC 1 minute
Working Voltage	690 VAC; 1100 VDC
Isolation Resistance	> 2 MΩ
Overload	3 x in 10 sec; 10 x in 1 s
Environmental	0 - 60 °C
Thermo watch	58 - 110°C; 20 A @ 240 VAC
Cooling (standard)	Freshwater
Working pressure	6 Bar
Test pressure	10 Bar



Construction of V14

The OHMEGA V14 resistors are constructed as follows:

The resistor unit consists of a water tank fitted with 24 resistor elements for V14-250 or 9 elements for V14-150. The resistors can be supplied with a number of different connections from protection class IP 00 to IP 65. The resistor elements are wire wound steel tube elements with a diameter of 14 mm. By changing the length of the resistor elements we offer a power range from 28 kW to 400 kW / unit.

Standard materials are:

Resistor elements: AISI 316L with NiCr resistor wire. Water Tank: AISI 304

Connector Box AISI 304

Other materials are available.

Multiple segments

The V14-150 and V14-250 have a flexible set up for connecting the elements. Each element has an electrical connection with standard DIN-rail terminals. By arranging the terminals it is possible to make resistor segments. In principle the V14-250 with its 24 tube elements can be arranged in 1, 2, 3, 4, 6, 8, 12 or 24 groups. The V14-150 can be arranged in 1, 3 or 9 groups.

Each segment has one or more standard terminal blocks and also two PE connection terminals per segment. The size of the terminal blocks depends on the nominal current.

If separate cables are used then each cable can be connected to its own PE connection.

For calculating the minimum and maximum ohm value the values noted in the table need to be multiplied by the number of groups.

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 liters per hour

P is power in kW

0.85 takes into account that not all water is effectively in contact with the resistor elements. If water/glycol is used than the outcome needs to be multiplied by a factor of 1.5.

Mounting

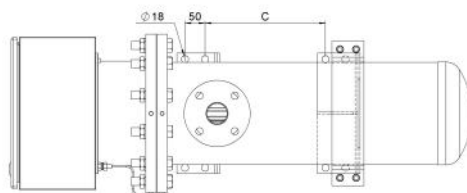
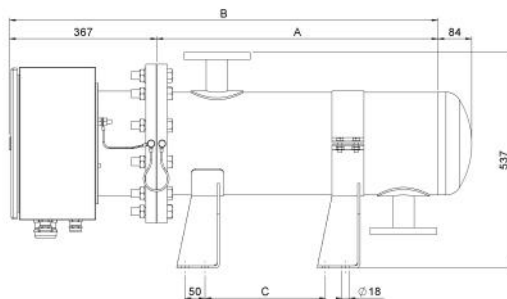
It is recommended that the resistors are mounted in a horizontal position to prevent air bubbles to be trapped. If mounted in another direction precaution must be taken to avoid air bubbles. The water outlet is opposite the connection box to prevent heating of the box by the warm water.

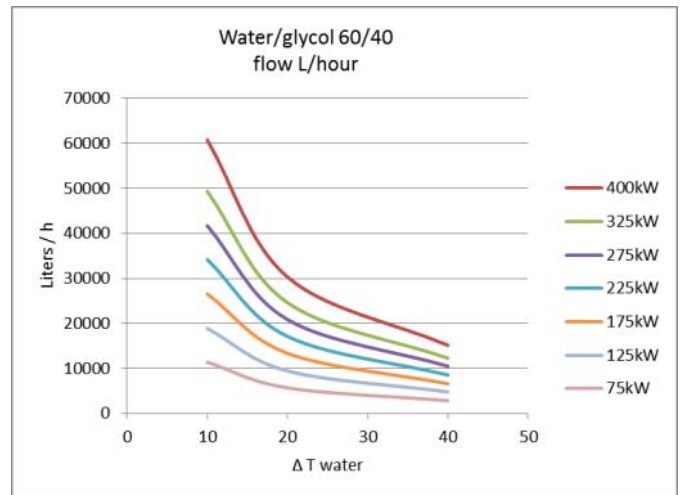
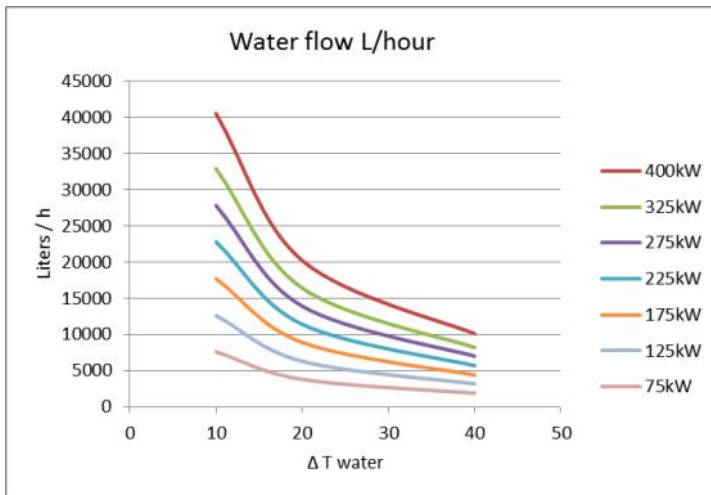
V14-250 Continuous power [kW]	Pulse load [kW] duty cycle (in seconds)			Tube length			R Ω 24 Elements in parallel	
	5/120	10/120	40/120	A	B	C		
	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]	Min. [Ω]	Max. [Ω]
75	300	250	150	500	951	t.b.d.	0,15	29
95	380	310	190	600	1051	t.b.d.	0,19	38
115	460	380	230	700	1151	t.b.d.	0,23	46
135	540	450	270	800	1251	t.b.d.	0,27	54
160	640	530	320	900	1351	t.b.d.	0,31	63
180	720	590	360	1000	1451	t.b.d.	0,35	71
200	800	660	400	1100	1551	t.b.d.	0,40	79
225	900	740	450	1200	1651	t.b.d.	0,44	88
245	980	810	490	1300	1751	t.b.d.	0,48	96
265	1060	870	530	1400	1851	t.b.d.	0,52	104
285	1140	940	570	1500	1951	t.b.d.	0,56	113
305	1220	1010	610	1600	2051	t.b.d.	0,60	121
325	1300	1070	650	1700	2151	t.b.d.	0,65	129
350	1400	1160	700	1800	2251	t.b.d.	0,69	138
375	1500	1240	750	1900	2351	t.b.d.	0,73	146
400	1600	1320	800	2000	2451	t.b.d.	0,77	154

Pulse ratings depend on the ohm value. Resistors with lower ohm value have more resistor wire than resistors with high ohm value. The ratings in this table refer to a single element of 40 Ω.

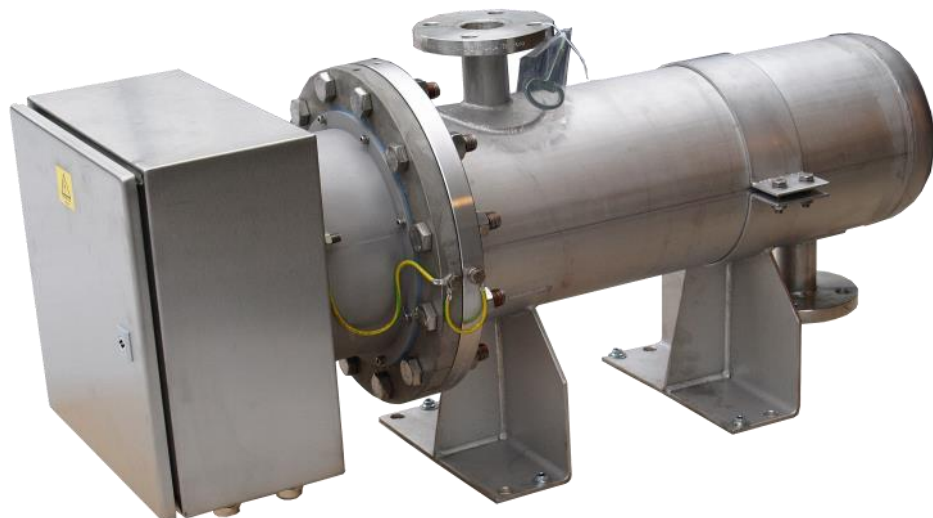
General Specifications	
Temperature Coefficient	<± 100 ppm
Max resistor wire temperature	1000 °C
Dielectric strength	2500 VAC 1 minute
Working Voltage	690 VAC; 1100 VDC
Isolation Resistance	> 2 MΩ
Overload	3 x in 10 sec; 10 x in 1 s
Environmental	0 - 60 °C
Thermo watch	58 - 110 °C; 20 A @ 240 VAC
Cooling (standard)	Freshwater
Working pressure	6 Bar
Test pressure	10 Bar

Mechanical data	V14-150	V14-250
Weight (Empty)	110 Kg	140 Kg
Weight incl. water	190 Kg	130 Kg
Heat capacity of water(no flow) kJ/K	85 kJ/K	209 kJ/K
Min. Water flow @ PN (Max conf.) GT = 30 K	35 l/min	70 l/min
Water connection	DN50	DN50

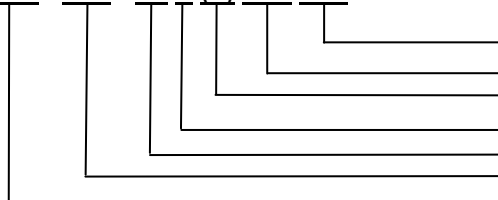




Power [kW]	Flow [liters / hour]					
	ΔT water			ΔT water/glycol 60/40		
	10	20	40	10	20	40
400	40500	20200	10100	60750	30300	15150
325	32900	16400	8200	49350	24600	12300
275	27800	13900	7000	41700	20850	10500
225	22800	11400	5700	34200	17100	8550
175	17700	8900	4400	26550	13350	6600
125	12600	6300	3200	18900	9450	4800
75	7600	3800	1900	11400	5700	2850



V14 - 250 - 24 B (T) 22R 123



(XXX): Customer specified version
 Ohm value (Examples: 2R2 = 2.2 Ω; 22R = 22 Ω; 220R = 220 Ω; 2k2 = 2.2 kΩ)
 T = Thermostat
 Connector Box: 0=IP00; D=IP20; B=IP65
 Number of elements: 9 or 24
 Ø (mm) of water tank: 150 or 250
 V14: 14 mm Ø resistor elements

Junction Box

The cable connection box has the dimensions 500x500x210 mm and is available in stainless steel 304 (standard) or 316 (option). Standard Weidmuller terminals are used for the electrical connection.

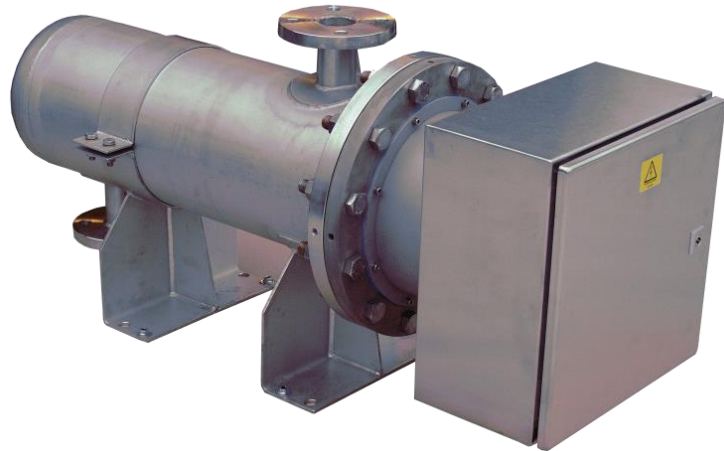
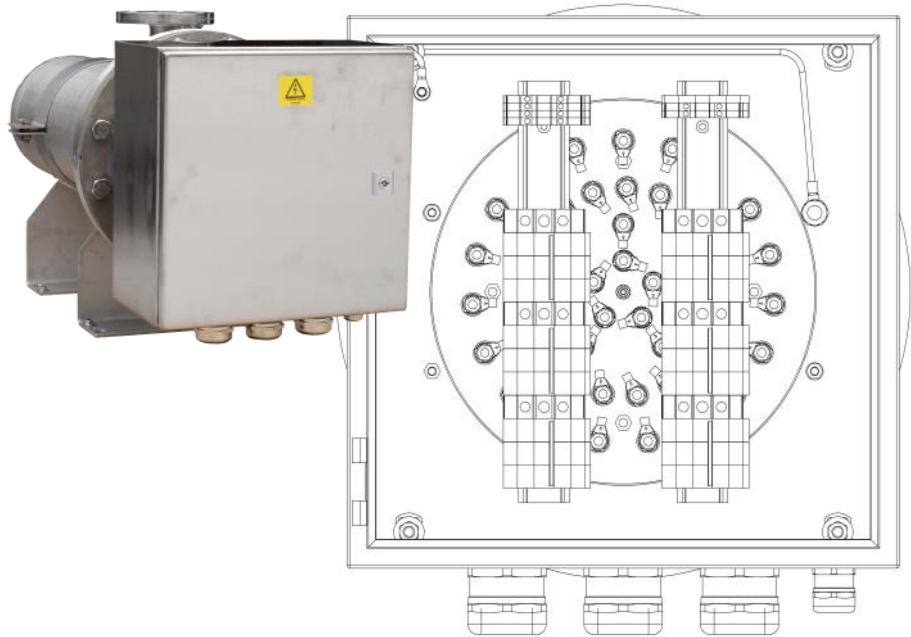
Humidity

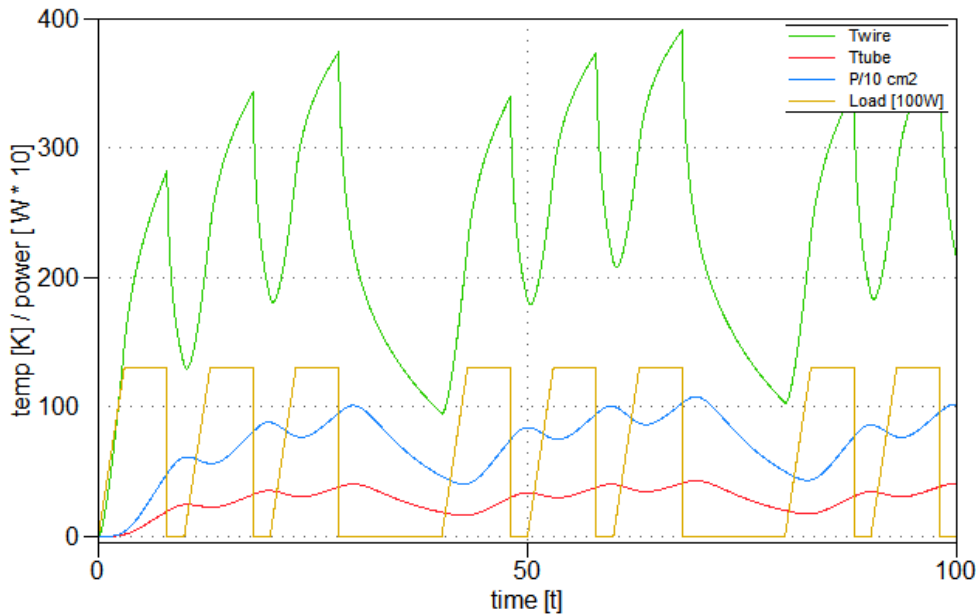


The basic construction of the resistor elements is a resistor spiral placed in a stainless steel pipe filled with magnesium oxide (MgO). MgO has excellent thermal and electrical qualities but it also absorbs water molecules from the air. If the resistor is not in use (heated up) then the water stays inside the tube and decreases the dielectric voltage strength. In applications where the resistor is used often the water molecules will be driven out of the tube by the heat. In harsh environment we offer to seal the end of the resistor tubes with hard epoxy. In this epoxy a heating cable of some 25 W is placed. Also during storage the magnesium oxide is susceptible to humidity and the epoxy is recommended.

Adjustable mounting feet

The mounting feet can be placed at any position as long as it provides a stable mounting. In this way it is possible to install the feet first and place the water vessel later. This will not only give you more flexibility but also speeds up installation. Resistors with a short length ($B < 1551$) have only one adjustable foot, longer resistors have two adjustable feet.



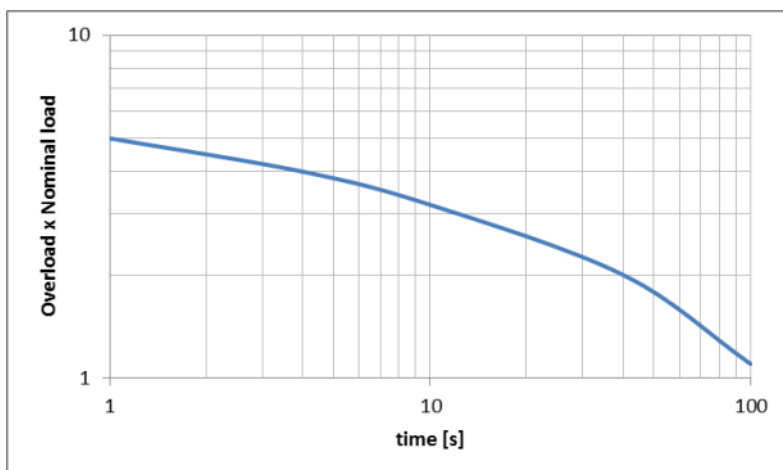
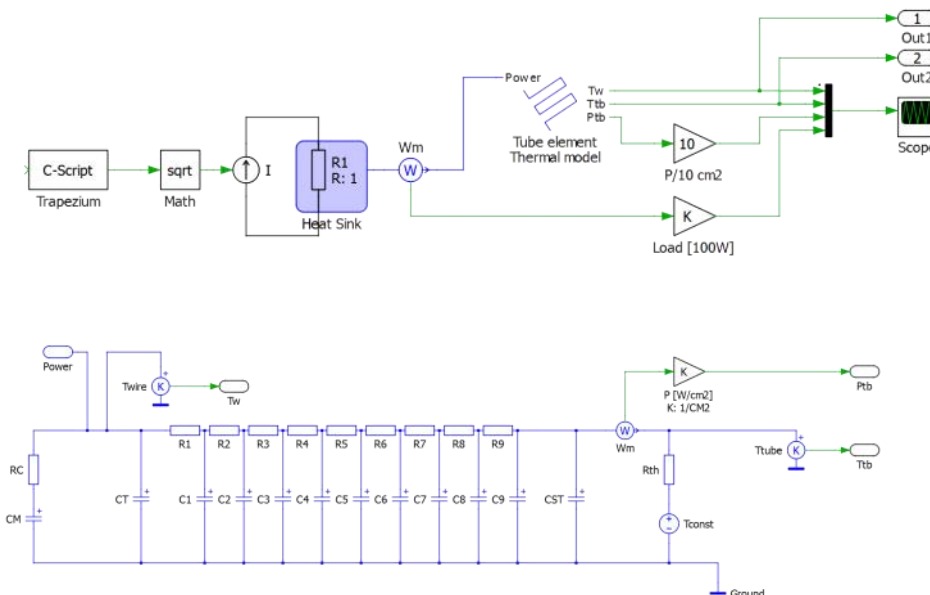


Pulse capability

During a short time the resistor can handle higher pulse loads than the nominal power. The ability to withstand pulse loads varies for resistor sizes, wire length and wire diameter. We are able to make a thermal model which can be used in a simulation program to predict the wire temperature inside the elements and the actual power, that the tube elements have to transfer to the cooling liquid. With this we can optimize your design without over dimensioning and still guarantee sufficient lifetime. At your request Danotherm will perform the simulation for you based on your application.

Thermal model

Danotherm is one of the few companies that is able to make a thermal model. Such a model predicts the various temperatures inside the resistor. The required software for the simulation can be any (electrical or thermal) program like PSpice, Plecs or Matlab/Simulink. Ask for our assistance if in doubt.



PULSE LOAD V14/SV14

The curves show the pulse load ability compared to the nominal load for the resistors under the following conditions: The load is a periodic pulse load with a constant period of 120 seconds and a pulse width from 1 to 100 sec. The tube elements are 40Ω.

SV14, V14-150 and V14-250 are water cooled high power resistors from 5 to 400 kW. They are ideally suited for dissipating brake energy on board of vessels for the main propulsion, cranes, winches and any other drive system. The resistors consist of stainless steel tube elements with 14 mm diameter and different length mounted in stainless (AISI 304 or AISI 316) water tanks. The electrical connections go from protection class IP 00 to IP 65 according to customer specifications.

It is possible to split up the resistor in smaller individual units, to obtain a more compact solution.

One mounting foot is adjustable making installation easier and more flexible. For long versions both feet are adjustable.

The construction allows the resistors to operate in a harsh environment. Special care is taken to protect the resistor elements against humidity.

All types can be offered with thermostats to monitor water temperature. The V14 types are offered with an additional thermostat to detect air bubbles.

Danotherm has developed thermal models for all resistor types and resistor values. By using these models the temperature rise inside the resistor wire and energy transfer from tube to water for all possible load applications can be simulated. We offer our assistance to our customers to find the optimum solution for any situation.

