VISHAY INTERTECHNOLOGY, INC.

INTERACTIVE
data book

THICK FILM POWER RESISTORS

VISHAY SFERNICE

VSE-DB0019-0302

Notes:

1. To navigate:
   a) Click on the Vishay logo on any datasheet to go to the Contents page for that section. Click on the Vishay logo on any Contents page to go to the main Table of Contents page.
   b) Click on the products within the Table of Contents to go directly to the datasheet.
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VISHAY INTERTECHNOLOGY, INC.

DATA BOOK

THICK FILM POWER RESISTORS

Vishay Sfernice

www.vishay.com

VISHAY INTERTECHNOLOGY, INC.

DISCRETE SEMICONDUCTORS	**RECTIFIERS**	Schottky (single, dual) Standard, Fast and Ultra-Fast Recovery (single, dual) Clamper/Damper Bridge Superectifier®
	SMALL-SIGNAL DIODES	Schottky and Switching (single, dual) Tuner/Capacitance (single, dual) Bandswitching PIN
	ZENER & SUPPRESSOR DIODES	Zener Diodes (single, dual) TVS (TransZorb® Automotive, Arrays)
	MOSFETs	Power MOSFETs JFETs
	RF TRANSISTORS	Bipolar Transistors (AF and RF) Dual Gate MOSFETs MOSMICs®
	OPTOELECTRONICS	IR Emitters, Detectors and IR Receiver Modules Opto Couplers and Solid State Relays Optical Sensors LEDs and 7 Segment Displays Infrared Data Transceiver Modules Custom products
	ICs	Power ICs Analog Switches
PASSIVE COMPONENTS	**CAPACITORS**	Tantalum Capacitors Solid Tantalum Capacitors Wet Tantalum Capacitors Ceramic Capacitors Multilayer Chip Capacitors Disc Capacitors Film Capacitors Power Capacitors Heavy Current Capacitors Aluminum Capacitors
	RESISTIVE PRODUCTS	Foil Resistors Film Resistors Thin Film Resistors Thick Film Resistors Metal Oxide Film Resistors Carbon Film Resistors Wirewound Resistors Variable Resistors Cermet Variable Resistors Wirewound Variable Resistors Conductive Plastic Variable Resistors Networks/Arrays Non-Linear Resistors NTC Thermistors PTC Thermistors
	MAGNETICS	Inductors Transformers
INTEGRATED MODULES	**DC/DC CONVERTERS**	
STRESS SENSORS AND TRANSDUCERS	**STRAIN GAGES AND INSTRUMENTS**	
	PHOTOSTRESS® INSTRUMENTS	
	TRANSDUCERS	Load Cells Weighing Systems

ONE OF THE WORLD'S LARGEST MANUFACTURERS OF DISCRETE SEMICONDUCTORS AND PASSIVE COMPONENTS

Vishay Sfernice Thick Film Power Resistors

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In particular above recommendations apply to all devices designated as “Life critical” by US drug administration or equivalent in other countries.
These products are sold to the buyer on the condition that it agrees to hold VISHAY S.A. harmless against any claim based on the use of this product in such application and to indemnify any loss that it may incur as a result of such claim.
In any case VISHAY S.A. strongly recommend the integration of a “First proof failure” security system.

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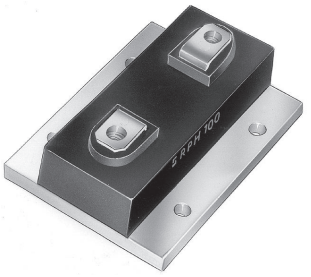
TO 220 CASE

MODEL	DATA SHEETS	POWER RATING	RESISTANCE RANGE STANDARD SERIES	TOLERANCES	TEMP. LIMITS	TYPICAL TCR	DIMENSIONS	PAGE NO.
	NO.	W	Ω	%	°C	ppm/°C	mm	
RTO 20	50005	25°C 20W	0.046Ω to 1MΩ	± 1% to ± 10%	- 55°C + 155°C	± 150 R > 1Ω	10.1 x 15 x 4.5	2
RTO 50	500035	25°C 50W				± 300 R < 1Ω	10.1 x 15 x 4.5	5

FOR MOUNTING ONTO A HEATSINK 5W TO 50W

RCH 5	50006	25°C 5W	0.24Ω to 1MΩ	± 1% to ± 10%	- 55°C + 125°C	± 150 R > 1Ω	16.6 x 9 x 15	17
RCH 10		10W					19 x 11 x 15	17
RCH 25		25W				± 250	28 x 14 x 15	17
RCH 50		50W				R > 1Ω	47.8 x 15.5 x 15	17



100W

RPH 100	50046	25°C 100W	0.092Ω to 1MΩ	± 1% to ± 10%	- 55°C + 125°C	± 300 < 1Ω ± 150 > 1Ω	65.5 x 46.7 x 21.6	8

SOT 227 B CASE - 20W TO 200W

MODEL	DATA SHEET	POWER RATING AT 25°C	RESISTANCE RANGE	TOLERANCE FOR EACH RESISTOR	ELECTRICAL DIAGRAMS	TEMP. LIMITS	TYPICAL TCR	DIMENSIONS	PAGE NO.
	NO	W	Ω	%		°C	ppm/°C	mm	
RTOP 200	50045	200W	0.046Ω to 1MΩ	± 1% to ± 10%	R	- 55°C + 125°C	± 300 R < 1Ω ± 150 R > 1Ω	38 x 25 x 10	21
RTOP 100		100W			R				21
DRTOP 100		100W	0.092Ω to 1MΩ		R2 R1				21
DRTOP 50		50W							21
TRTOP 40		40W	0.046Ω to 1MΩ						21
TRTOP 30		30W							21
QRTOP 35		35W							21
QRTOP 20		20W							21

HIGH POWER FOR MOUNTING ONTO A HEATSINK - 250W AND 500W

MODEL	DATA SHEET	POWER RATING	RESISTANCE RANGE STANDARD SERIES	TOLERANCES	TEMP. LIMITS	TYPICAL TCR	DIMENSIONS	PAGE NO.
	no	W	Ω	%	°C	ppm/°C	mm	
RPS 250D	50007	70°C 250W	0.24Ω to 1MΩ	± 1% to ± 10%	- 55°C +125°C	± 300 < 1Ω ± 150 > 1Ω	73 x 60 x 24.5	11
RPS 500	50047	70°C 500W						14

Power Resistor Thick Film Technology

The well known TO 220 package is compact and easy to mount.

FEATURES

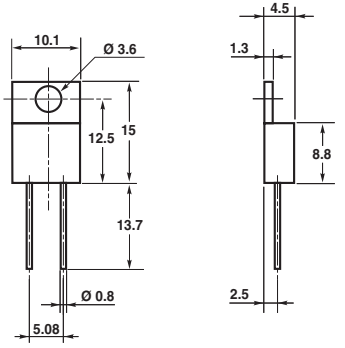
- 20 Watt at 25°C Heatsink Mounted
- High Power Dissipation to size ratio
- Wide Resistance Range
- Negligible Inductance
- Easy Mounting
- TO220 package: Compact and easy to mount.

Two versions of this thick film resistor are available:

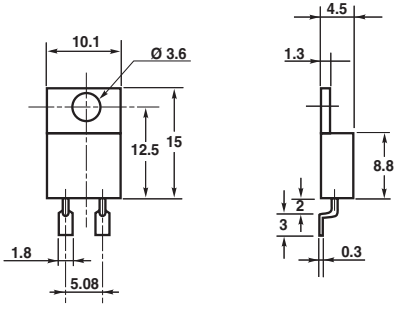
- A Radial Leaded version for PCB Mounting.
- A Flat Lead version for Surface Mounting.

DIMENSIONS in millimeters

RTO 20F - LEADED



RTO 20C - FOR SURFACE MOUNTING



• Tolerance unless otherwise specified: ± 0.4mm

MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated Case
Resistive Element	Thick Film
Connections	Tinned copper
Weight	2g max.

DIMENSIONS

Standard Package	TO 220 Insulated case

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	- 55°C to + 155°C
Climatic Category	55/155/156
Sealing	Sealed container Solder immersion

ELECTRICAL SPECIFICATIONS	
Resistance Range	0.046Ω to 1MΩ
Tolerances (Standard)	± 1% to ± 10%
Dissipation and Associated:	Onto a heatsink
Thermal Resistance	20W at + 25°C R_{TH} (j-c): 6.5°C/W free air: 2W at + 25°C
Temperature Coefficient	See Performance table
Standard	± 150ppm/°C
Limiting Element Voltage	250V
Dielectric Strength	2000V_{RMS} (Between Terminals and Heatsink)
Insulation Resistance	≥ 10^6 MΩ
Inductance	≤ 0.1 µH
Critical Resistance	3.12 kΩ

For technical questions, contact sfer@vishay.com
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PERFORMANCE		
TESTS	**CONDITIONS**	**TYPICAL DRIFTS**
Momentary Overload	2Pr/5s Us < 1.5UL	± (0.25% ± 0.05)
Climatic Sequence	5 cycles	± (0.5% ± 0.05) nominal power Pn - 55°C to + 155°C
Load Life	1000h Pr at + 25°C	± (1% ± 0.05)
Humidity (Steady State)	56 days R.H. 95%	± (0.5% ± 0.05)
High Temperature Exposure	1000h - 40% Pr at + 100°C	± (0.5% ± 0.05)

SPECIAL FEATURES			
Resistance Values	≤ 0.046	≤ 0.1	≤ 0.5
Tolerances	± 1% at ± 10%		
Temperature Coefficient **Standard**	± 300ppm/°C	± 250ppm/°C	± 150ppm/°C

CHOICE OF THE HEATSINK

The user must choose according to the working conditions of the component (power, room temperature).

Maximum working temperature must not exceed 155°C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{TH}\,(j\text{-}c) + R_{TH}\,(c\text{-}a)]} \quad (1)$$

P: expressed in W

ΔT: difference between maximum working temperature and room temperature.

R_{TH}: (j-c): thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component: (Special Features Table)

R_{TH}: (c-a): thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink itself (type, shape) and the quality of the fastening device.

Example:

R_{TH}: (c-a) for RTO 20 power rating 10W at ambient temperature + 25°C.

Thermal resistance R_{TH} (j-c): 6.5°C/W

Considering equation (1) we have:

$\Delta T = 155°C - 25°C = 130°C$

$R_{TH}\,(j\text{-}c) + RTH\,(c\text{-}a) = \frac{\Delta T}{P} = \frac{130}{10} = 13°C/W$

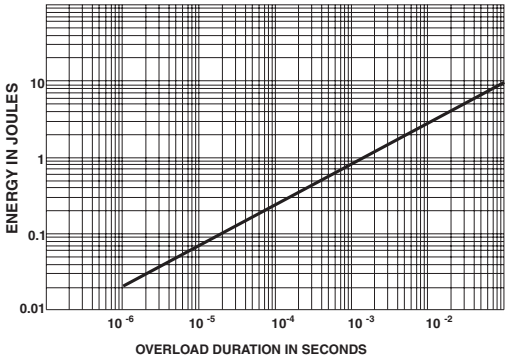
$R_{TH}\,(c\text{-}a) = 13°C/W - 6.5°C/W = 6.5°C/W$

OVERLOADS

In any case the applied voltage must be lower than the maximum overload voltage of 375V.

The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.

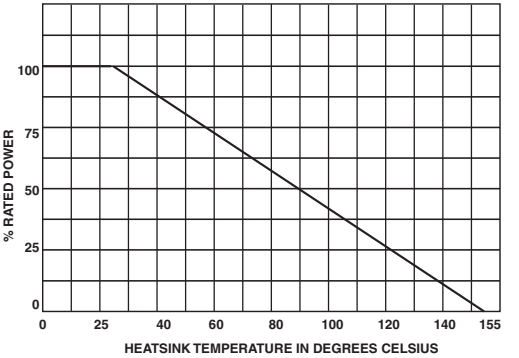
ENERGY CURVE



POWER RATING CHART

The temperature of the heatsink should be maintained within the limits specified.

To improve the thermal conductivity, surfaces in contact should be coated with a silicone grease and the torque applied on the screw for tightening should be around 1Nm.



MARKING

Model, Style, Resistance Value (in Ω), Tolerance (in %), Manufacturing Date, VISHAY trademark.

PACKAGING

Tube of 50 units

ORDERING INFORMATION

RTO	20	F	100k	± 10%	xxx
MODEL	STYLE	CONNECTIONS	RESISTANCE VALUE	TOLERANCE	CUSTOM DESIGN
		F: Radial Leads C: Surface Mount		± 1% ± 2% ± 5% ± 10%	Optional on request: special TCR, shape etc.

Power Resistor, Thick Film Technology

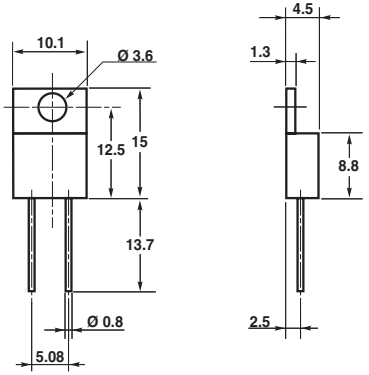
FEATURES

- 50 Watt at 25°C Heatsink Mounted
- Adjusted by sand trimming
- Leaded or surface mount versions
- High power to size ratio
- Non inductive element

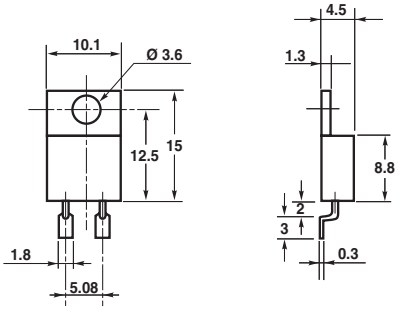
Because of the knowledge and experience in Thick Film technology, Vishay Sfernice has been able to develop a high power resistor in a TO 220 package called RTO 50. The special design of this component allows the dissipation of 50W when mounted on a heatsink. The ohmic value is adjusted by sand trimming. This process does not generate hot spots as in laser trimming, which could lead to microcracks on each side of the curve. This process improves the reliability and the stability of the resistor and at the same time gives a good overload capability.

DIMENSIONS in millimeters

RTO 50F - LEADED



RTO 50C - FOR SURFACE MOUNTING



• Tolerance unless otherwise specified: ± 0.4mm

MECHANICAL SPECIFICATIONS

Mechanical Protection	Molded
Resistive Element	Thick Film
Connections	Tinned copper alloy
Weight	2g max.

DIMENSIONS

Standard Package	TO 220 Insulated Case

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	- 55°C to + 155°C
Climatic Category	55/155/156
Sealing	Sealed container Solder immersion

ELECTRICAL SPECIFICATIONS	
Resistance Range	0.046Ω to 1MΩ
Tolerances Standard	± 1% to ± 10%
Dissipation and Associated	Onto a heatsink
Thermal Resistance	50W at + 25°C R_{TH} (j-c): 2.6°C/W free air: 2.25W at + 25°C
Temperature Coefficient	See Performance table
Standard	± 150ppm/°C
Limiting Element Voltage	300V
Dielectric Strength	2000V_{RMS}
Insulation Resistance	≥ 10^6 MΩ
Inductance	≤ 0.1 µH
Critical Resistance	1.8 kΩ

PERFORMANCE		
TESTS	**CONDITIONS**	**TYPICAL DRIFTS**
Momentary Overload	2Pr/5s Us < 1.5UL	≤ ± (0.25% ± 0.05Ω)
Climatic Sequence	CEI 68214 Tests Na 5 cycles - 55°C to + 155°C	≤ ± (0.5% ± 0.05Ω)
Load Life	1000h Pr at + 25°C	≤ ± (1% ± 0.05Ω)
Humidity (Steady State)	MIL STD 202 Method 103 B Cond. D	≤ ± (0.5% ± 0.05Ω)
Vibration	MIL STD 202 Method 204 Cond. D	≤ ± (0.2% ± 0.05Ω)
Terminal Strength	MIL STD 202 Method 211 Cond. A1	≤ ± (0.2% ± 0.05Ω)
High Temperature Exposure	MIL STD 202 Method 108 A Cond. D 1000 h at	≤ ± (0.5% ± 0.05Ω)

SPECIAL FEATURES			
Resistance Values	≥ 0.046Ω	≥ 0.1Ω	≥ 0.5Ω
Tolerances	± 1% at ± 10%		
Temperature Coefficient **Standard**	± 300ppm/°C	± 250ppm/°C	± 150ppm/°C

CHOICE OF THE HEATSINK

The user must choose according to the working conditions of the component (power, room temperature).

Maximum working temperature must not exceed 155°C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{TH}\,(j\text{-}c) + R_{TH}\,(c\text{-}a)]} \quad (1)$$

P: expressed in W

T: difference between maximum working temperature and room temperature.

R_{TH}: (j-c): thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component: (Special Features Table)

R_{TH}: (c-a): thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink itself (type, shape) and the quality of the fastening device.

Example:

R_{TH}: (c-a) for RTO 50 power rating 13 W at ambient temperature + 30°C.

Thermal resistance R_{TH} (j-c): 25°C/W

Considering equation (1) we have:

$\Delta T \leq 155°C - 30°C \leq 125°C$

$RTH\ (j\text{-}c) + RTH\ (c\text{-}a) = \frac{\Delta T}{P} = \frac{125}{13} = 9.6°C/W$

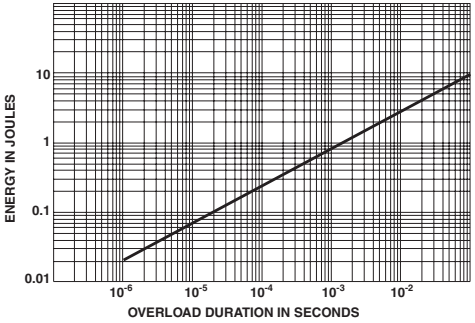
$RTH\ (c\text{-}a) \leq 9.6°C/W - 2.6°C/W \leq 7°C/W$

OVERLOADS

The applied voltage must always be lower than the maximum overload voltage of 450V.

The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.

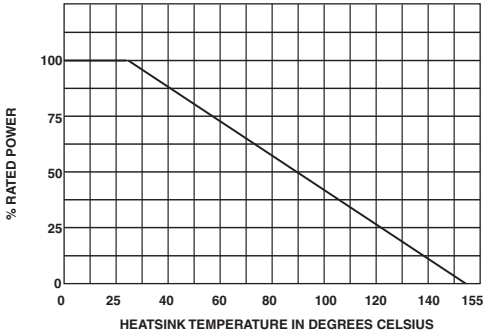
ENERGY CURVE



POWER RATING CHART

The temperature of the heatsink should be maintained within the limits specified.

To improve the thermal conductivity, surfaces in contact should be coated with a silicone grease and the torque applied on the screw for tightening should be around 1Nm.



MARKING

Model, Style, Resistance Value (in), Tolerance (in %), Manufacturing Date, VISHAY trademark.

PACKAGING

Tube of 50 units

ORDERING INFORMATION

RTO	**50**	**F**	**100 kΩ**	**± 1%**	**xxx**
MODEL	STYLE	CONNECTIONS	RESISTANCE VALUE	TOLERANCE	CUSTOM DESIGN
		F: Leaded C: Surface Mount		± 1% ± 2% ± 5% ± 10%	Optional on request: special TCR, shap, etc.

Power Resistor for Mounting onto a Heatsink
Thick Film Technology

FEATURES

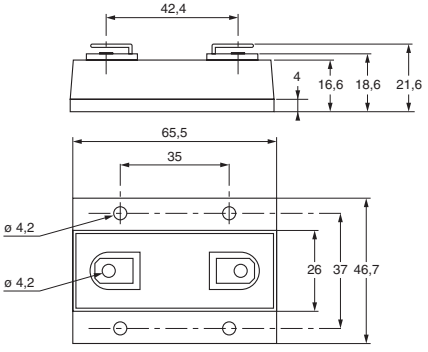
- High power rating
- Low thermal radiation of the case
- Wide ohmic value range
- Easy mounting
- High overload capabilities
- Reduced size and weight

This new style has been developed as an extension to RCH range. Through the use of thick film technology, a non-inductive solution for power resistors is available which are rated up to 100W at + 25°C. Two types of terminations are possible: screw or "Faston" type connectors and their position prevents any risk of an electrical arc to the heatsink. This resistor series can replace and offer advantages to standard wirewound devices.

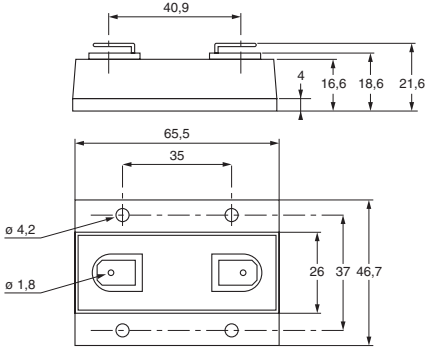
DIMENSIONS in millimeters

RPH 100

V Connections



F Connections ("Faston" type)



MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated case
Substrate	Alumina on metallic base of nickel coated aluminum
Resistive Element	Cermet
End Connections	V connections: screws M4 x 6 F connections: Faston type
Tightening Torque Connections	1Nm
Tightening Torque Heatsink	3 Nm
Weight	60g

ENVIRONMENTAL SPECIFICATIONS

Thermal Resistance	R_{TH} (j-c) 0.55°C/W
Temperature Range	- 55°C + 125°C
Climatic Category	55/125/56

ELECTRICAL SPECIFICATIONS

Resistance Range	0.092Ω to 1MΩ E24 series
Tolerances	± 1% to ± 10%
Power Rating:	
Continuous	100W at 25°C chassis mounted 0.45°C/W 10W at 25°C Free air
Momentary	400W at 25°C for 5 seconds
Temperature Coefficient	
Standard	± 300ppm/°C < 1Ω ± 150ppm/°C > 1Ω
Limiting Element Voltage	1900 V_{RMS}
Dielectric Strength	5kV_{RMS}
Insulation Resistance	> 10^6MΩ
Inductance	< 0.1 µH

For technical questions, contact sfer@vishay.com

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Revision 20-Mar-02

PERFORMANCE		
TESTS	**CONDITIONS**	**TYPICAL DRIFTS**
Short Time Overload	4 Pn/5 seconds	< ± (0.25 % ± 0.05Ω)
Rapid Temperature Change	5 cycles - 55°C + 125°C	< ± (0.25 % ± 0.05Ω)
Load Life (chassis mounted 0.45°C/W)	Pn at 25°C 1000 hours	< ± (0.5% ± 0.05Ω)
Humidity (steady state)	56 days 95% R.H.	< ± (0.5% ± 0.05Ω)

RESISTANCE VALUE IN RELATION TO TOLERANCE AND TCR		
Ohmic Value	< 1Ω	> 1Ω
Standard Tolerance	± 5%	± 5%
Standard T.C.R.	± 300ppm/°C	± 150ppm/°C
Tolerances On Request	± 1% - ± 2%	

CHOICE OF THE HEATSINK

The user must choose according to the working conditions of the component (power, room temperature).

Maximum working temperature must not exceed 125°C. The dissipated power is simply calculated by the following ratios:

$$P = \frac{\Delta T}{[R^{TH}(j\text{-}c) + R^{TH}(c\text{-}a)]} \quad (1)$$

P: expressed in W

ΔT: difference between maximum working temperature and room temperature.

R_{TH}: (j-c): thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component: 0.55°C/W.

R_{TH}: (c-a): thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink itself (type, shape) and the quality of the fastening device.

Example:

R_{TH} (c-a) for RPH 100 power rating 80W at ambient temperature + 40°C.

Thermal resistance R_{TH} (j-c): 0.55°C/W

Considering equation (1) we have:

$\Delta T \leq 125°C - 40°C \leq 85°C$

$RTH\ (j\text{-}c) + R_{TH}\ (c\text{-}a) = \frac{\Delta T}{P} = \frac{85}{80} = 1.06°C/W$

$RTH\ (c\text{-}a) \leq 1.06°C/W - 0.55°C/W \leq 0.51°C/W$

RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

Surfaces in contact must be carefully cleaned.

The heatsink must have an acceptable flatness: from 0.05mm to 0.1mm/100mm.

Roughness of the heatsink must be around 6.3µm.

In order to improve thermal conductivity, surfaces in contact (alumina, heatsink) should be coated with a silicone grease (type SI 340 from Rhône-Poulenc or Dow 340 from Dow Corning).

The fastening of the resistor to the heatsink is under pressure control of four screws (not supplied).

Tightening torque: 3Nm

In order to improve the dissipation, either forced-air cooling or liquid cooling may be used.

Do not forget to respect an insulation value between two resistors (dielectric strength in dry air 1kV/mm).

OVERLOADS

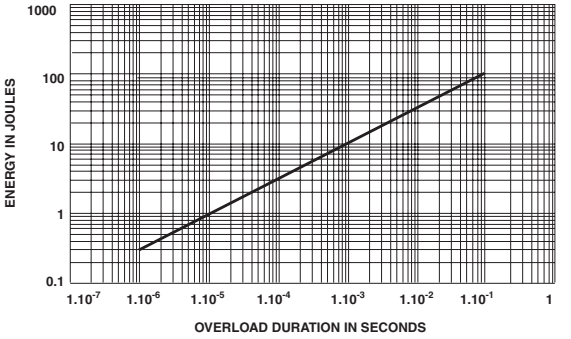
In any case the applied voltage must be lower than 2.5Un.

U maxi < 2Un < 3800V.

Short time overload: 4 Pn/5 seconds.

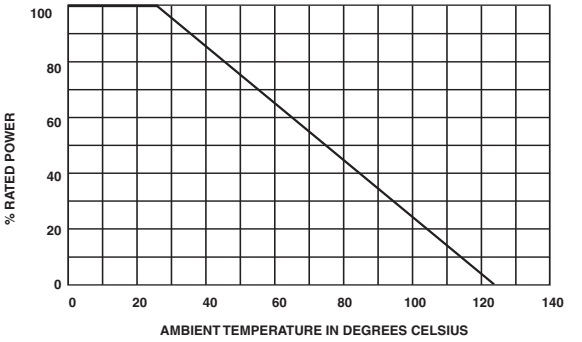
Accidental overload: The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.

ENERGY CURVE



POWER RATING CHART

For resistor mounted onto a heatsink with thermal resistance of 0.45°C/W.



MARKING

Series, style, ohmic value (in Ω), tolerance (in %), manufacturing date, SFERNICE trade mark.

ORDERING INFORMATION

MODEL	STYLE	RESISTANCE VALUE	TOLERANCE	CONNECTIONS	CUSTOM DESIGN
RPH	100	3.3KΩ	± 5%	V	
			Optional ± 1% ± 2 % ± 5%	Optional V: screw M4 F: Faston type	Options on request T.C.R., shape, etc.

Power Resistor for Mounting onto a Heatsink
Thick Film Technology

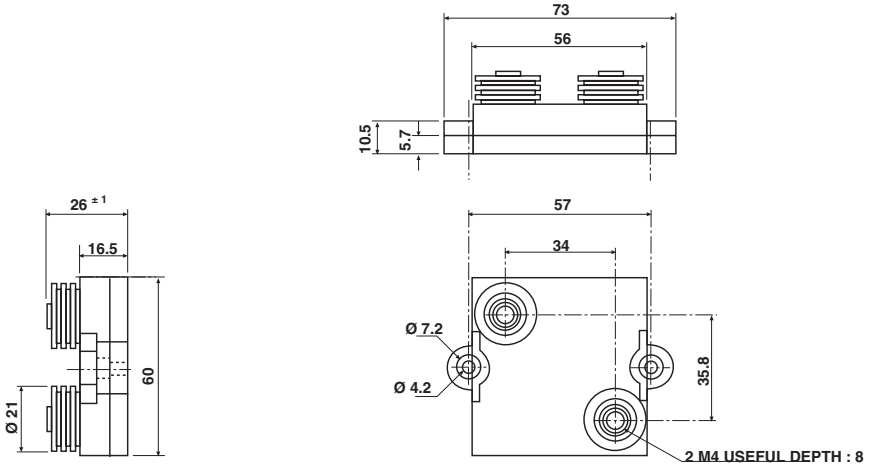
FEATURES

- High power rating
- High overload capability
- Easy mounting
- Low thermal radiation of the case

Developed for specific applications such as railroad electrical traction, this series can bear short overloads as high as fifteen times the nominal power. Designed to be mounted onto a heatsink, compact and hermetically sealed, these power resistors exhibit remarkable characteristics.

DIMENSIONS in millimeters

RPS 250D



• Tolerance unless stated: ± 0.2mm

MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated case
Substrate	Alumina onto aluminum base
Resistive Element	Cermet
End Connections	Screws M4, (M5 on request)
Tightening Torque on connections	2Nm
Weight	170g ± 10%

ENVIRONMENTAL SPECIFICATIONS

Thermal Resistance	R_{TH} (j-c) 0.22°C/W
Temperature Range	- 55°C + 125°C
Climatic Category	55/125/56

ELECTRICAL SPECIFICATIONS

Resistance Range	0.24Ω to 1M E24 series
Tolerances	± 1% to ± 10%
Power Rating chassis mounted **250W** **1000W**	 at 50°C continuous at 25°C for 10 seconds
Temperature Coefficient **Standard**	 ± 250ppm/°C < 1 ± 150ppm/°C > 1
Limiting Element Voltage	5kVRMS
Dielectric Strength	L connections 7kVRMS H connections 14kVRMS
Insulation Resistance	> 10^6MΩ
Inductance	< 50 nH
Capacitance **Resistor** **/ground**	< 40pF < 120pF

PERFORMANCE		
TESTS	**CONDITIONS**	**TYPICAL DRIFTS**
Momentary Overload	4 Pr/10 s	< ± (0.25% ± 0.05Ω)
Climatic Sequence	5 cycles - 55°C + 125°C	< ± (0.25% ± 0.05)
Load Life	1000h Pr at 70°C	< ± (0.5% ± 0.05Ω)
Humidity (steady state)	56 days R.H. 95%	< ± (0.5% ± 0.05Ω)

RESISTANCE VALUE IN RELATION TO TOLERANCE AND TCR		
Ohmic Value	< 1Ω	> 1Ω
Standard Tolerance	± 5%	± 5%
Standard T.C.	± 250ppm/°C	± 150ppm/°C
Tolerance On Request	± 1% - ± 2% - ± 10%	

CHOICE OF THE HEATSINK

The user must choose the heatsink according to the working conditions of the component (power, room temperature). Maximum working temperature must not exceed 125°C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{TH}\,(j\text{-}c) + R_{TH}\,(c\text{-}a)]} \quad (1)$$

P: expressed in W

T: difference between maximum working temperature and room temperature.

R_{TH}: (j-c): thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component (see specifications environmental paragraph).

R_{TH}: (c-a): thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink, depending on the heatsink itself (type, shape) and the quality of the fastening device.

Example:

R_{TH}: (c-a) for RPS 250 power dissipation 180W at + 50˚C room temperature.

$\Delta T \leq 125°C - 50°C \leq 75°C$

$R_{TH}\,(j\text{-}c) + RTH\,(c\text{-}a) = \frac{\Delta T}{P} = \frac{75}{180} = 0.42°C/W$

$R_{TH}\,(j\text{-}c) = 0.22°C/W$

$R_{TH}\,(c\text{-}a) \leq 0.42°C/W - 0.22°C/W \leq 0.20°C/W$

RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

Surfaces in contact must be carefully cleaned. The heatsink must have an acceptable flatness: from 0.05mm to 0.1mm/100mm.

Roughness of the heatsink must be around 6.3µm. In order to improve thermal conductivity, surfaces in contact should be coated with a silicone grease (type SI 340 from Rhône-Poulenc or Dow 340 from Dow Corning).

The fastening of the resistor to the heatsink is under pressure control of two screws (tightening torque 3 Nm).

In order to improve the dissipation, either forced-air cooling or liquid cooling may be used.

Do not forget to respect an insulation value between two resistors (dielectric strength in dry air 1kV/mm).

In any case the hot spot temperature, measured locally on the case must not exceed 125°C.

Test should be performed by the user.

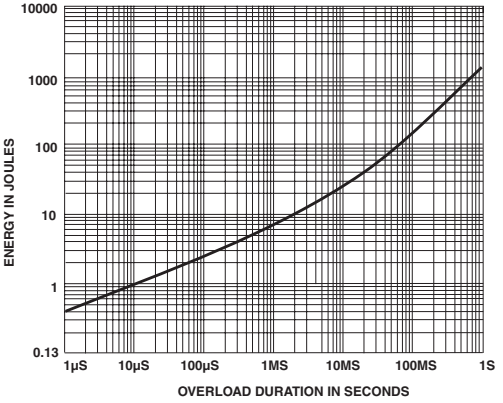
OVERLOADS

In any case the applied voltage must be lower than 2.5Un. U maxi < 2.5Un < 12500V.

Short time overload: 4 Pn/10 seconds

Accidental overload: The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.

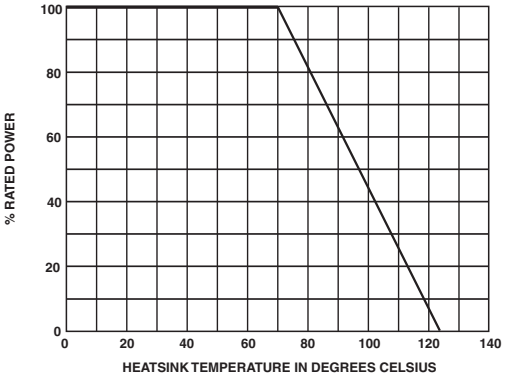
ENERGY CURVE



POWER RATING CHART

The temperature of the heatsink should be maintained in the limit specified.

To improve the thermal conductivity, surfaces in contact should be coated with a silicone grease.



MARKING

Series. style, ohmic value (in). tolerance in %, manufacturing date, VISHAY trademark

ORDERING INFORMATION

RPS	250D	H	100Ω	± 10%	xxx
MODEL	STYLE	CONNECTIONS	RESISTANCE VALUE	TOLERANCE	CUSTOM DESIGN
		Optional H: dielectric strength 14 kV L: dielectric strength 7 kV		Optional ± 1% ± 2% ± 5% ± 10%	Options on request special T.C., shape, etc.

Power Resistors for Mounting onto a Heatsink Thick Film Technology

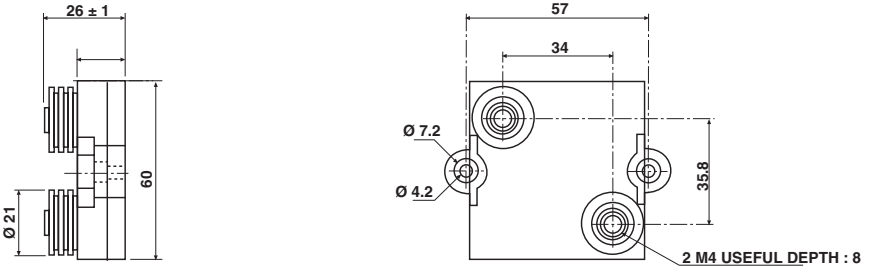
FEATURES

- High power rating
- High overload capability
- Easy mounting
- Low thermal radiation of the case
- No partial discharge

This range has been developed specifically for electrical traction applications and is capable of dissipating 500W at +70°C. The remarkable performance characteristics are evident when used in severe pulse conditions. The copper base allows easy mounting on the heatsink and provides optimal dissipation conditions.

DIMENSIONS in millimeters

RPS 500D



• Tolerance unless stated: ± 0.2mm

MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated case
Substrate	Alumina onto base of nickel coated copper
Resistive Element	Cermet
End Connections	Screws M4 (M5 on request)
Tightening Torque on Connections	2Nm
Tightening Torque on Heatsink	4Nm
Weight	250g ± 10%

ENVIRONMENTAL

Thermal Resistance	RTH (j-c) 0.11°C/W
Temperature Range	- 55°C to + 125°C
Climatic Category	55/125/56

ELECTRICAL SPECIFICATIONS

Resistance Range	0.24 to 1M E24 series
Tolerances	± 1% to ± 10%
Power Rating **Chassis mounted**	500W at 70°C continuous 1000W at 25°C for 10 seconds
Temperature Coefficient **Standard**	± 300ppm/°C < 1Ω ± 150ppm/°C > 1Ω
Limiting Element Voltage	5kVRMS
Dielectric Strength	L:7kVRMS - H: 14kVRMS
Partial Discharge	Inception voltage 2.5kVRMS
Insulation Resistance	> 10^6MΩ
Inductance	< 50 nH

For technical questions, contact sfer@vishay.com

Document Number: 50047
Revision 20-Mar-02

PERFORMANCE		
TESTS	**CONDITIONS**	**TYPICAL DRIFTS**
Momentary Overload	2Pn/10 seconds	< ± (0.25% ± 0.05Ω)
Climatic Sequence	5 cycles - 55°C to + 125°C	< ± (0.25% ± 0.05Ω)
Load Life (chassis mounted)	1000 hours 500 W/70°C	< ± (0.5% ± 0.05Ω)
Humidity (steady state)	56 days 95% R.H.	< ± (0.5% ± 0.05Ω)

RESISTANCE VALUE IN RELATION TO TOLERANCE AND TCR		
Ohmic	< 1Ω	> 1Ω
Standard Tolerance	± 5%	± 5%
Standard T.C.R.	± 300ppm/°C	± 150ppm/°C
Tolerance On Request	± 1% - ± 2% - ± 10%	

CHOICE OF THE HEATSINK

The user must choose the heatsink according to the working conditions of the component (power, room temperature). Maximum working temperature must not exceed 125°C.

The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{TH}\,(j\text{-}c) + R_{TH}\,(c\text{-}a)]} \quad (1)$$

P: expressed in W

ΔT: difference between maximum working temperature and room temperature.

R_{TH}: (j-c): thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component: 0.11°C/W.

R_{TH}: (c-a): thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink, depending on the heatsink itself (type, shape) and the quality of the fastening device.

RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

Surfaces in contact must be carefully cleaned.

The heater must have an acceptable flatness: from 0.05mm to 0.1mm/100mm.

Roughness of the heatsink must be around 6.3µm.

In order to improve thermal conductivity, surfaces in contact (alumina, heatsink) should be coated with a silicon grease (type SI 340 Rhône-Poulenc or Dow Corning).

The fastening of the resistor to the heatsink is under pressure control of two screws. Tightening torque: 4Nm.

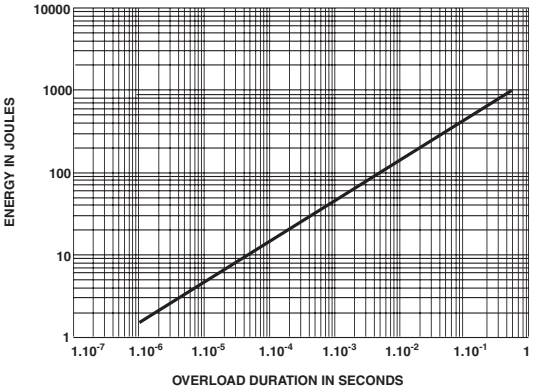
The following accessories are supplied with each product: 2 off M 4 x 16, 2 off M4 TE 4 x 0.6 and 2 off M4 washers.

OVERLOADS

Short time overload: 2Pn/10 seconds

Accidental overload: The values indicated in the graph below are applicable to resistors in air or mounted onto a heatsink.

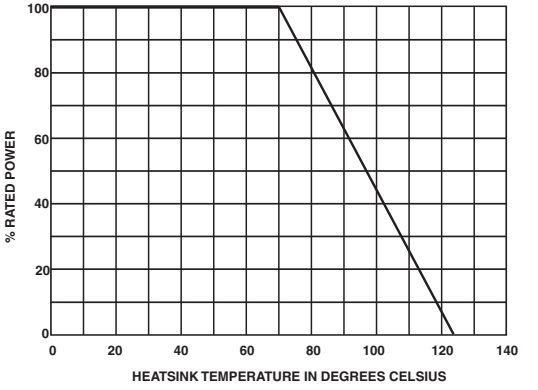
ENERGY CURVE



POWER RATING CHART

The heatsink temperature should be maintained at the values specified in fig. 2.

To optimise the thermal conduction, contacting surfaces should be coated with silicone grease and heatsink mounting screws tightened to 4Nm.



MARKING

Series, style, ohmic value (in), tolerance (in), tolerance (in %), manufacturing date, VISHAY trade mark.

ORDERING INFORMATION

RPS	500D	H	100Ω	± 10%	xxx
MODEL	STYLE	CONNECTIONS	RESISTANCE VALUE	TOLERANCE	CUSTOM DESIGN
		Optional H: dielectric strength 14kV L: dielectric strength 7kV		Optional ± 1% ± 2% ± 5% ± 10%	Options on request T.C.R., shape, etc.

Power Resistors, for Mounting onto a Heatsink
Thick Film Technology

Manufactured in cermet thick film technology, these power resistors exhibit remarkable characteristics and the series includes 4 types ranging from 5W to 50W

Designed to be mounted onto a heatsink, the resistors can bear high short time overloads and 3 types of terminations are available.

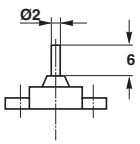
The resistors are non inductive and are particularly suitable for high frequency operation and cut-out circuits.

FEATURES

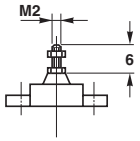
- 5 Watt to 50W
- High power rating
- High overload capabilities
- High stability at rated power
- Wide resistance range
- High thermal capacity
- Easy mounting
- Reduced size and weight
- High insulation: $10^6 M\Omega$

DIMENSIONS in millimeters

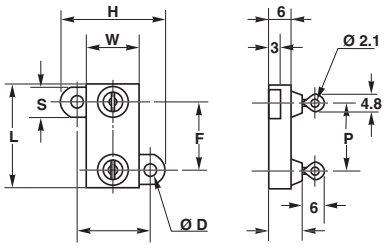
RCH...R



RCH...V



RCH...S



• General Tolerance: ± 0.3mm

DIMENSIONS				
MODEL	**RCH 5**	**RCH 10**	**RCH 25**	**RCH 50**
L	16.6	19	28	47.8
W	9	11	14	15.5
H	16.4	20.6	27.5	29.4
P Leads pitch	10.2	12.7	18.3	30.5
F Connections pitch	11.3	14.3	18.3	39.7
T	12.5	15.9	19.8	21.4
S	5.3	5	7.7	8
Ø D	2.4 M2	2.4 M2	3.2 M3	3.2 M3
WEIGHT (g)	4	5	7	12

MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated Case
Substrate	Alumina
Resistive Element	Cermet
Connections	Tinned copper alloy

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	- 55°C to + 125°C
Climatic Category	55/125/56

ELECTRICAL SPECIFICATIONS

Resistance Range	0.24Ω to 1MΩ E24 series
Standard Resistance Tolerances	± 1%, ± 2%, ± 5%, ± 10%
Power Rating	
Chassis Mounted	5W to 50W
Unmounted	2W to 5.5W
Temperature Coefficient	± 150ppm/°C (R > 1Ω)
Insulation Resistance	10^6 MΩ
Total Inductance	≤ 0.1µH

PERFORMANCE

TESTS	CONDITIONS	TYPICAL DRIFTS
Momentary Overload	2Pr/5s Us < 2 UL	< ± (0.25% ± 0.05Ω)
Climatic Sequence	5 cycles nominal power Pn - 55°C to + 155°C	< ± (0.25% ± 0.05Ω)
Load Life	1000h Pr at + 25°C	< ± (0.5% ± 0.05Ω)
Humidity (Steady State)	56 days R.H. 95%	< ± (0.5% ± 0.05Ω)

RESISTANCE VALUE IN RELATION TO TOLERANCE AND TCR

Resistance Value	< 1Ω	> 1Ω
Standard Tolerances	± 5% ± 10%	
Standard T.C.	± 250ppm/°C	± 150ppm/°C
Tolerance on Request	± 1% to ± 2%	

SPECIAL FEATURES

MODEL	RCH 5	RCH 10	RCH 25	RCH 50
Power Rating-Chassis Mounted	5W	10W	25W	50W
Power Rating-Unmounted	2W	2.5W	4W	5.5W
Thermal Resistance RTH (j-c)	4.8°C/W	3.2°C/W	1.4°C/W	0.8°C/W
Limiting Element Voltage (V_{RMS})	160V	250V	550V	1285V
Max. Overload Voltage (V_{RMS})	320V	500V	1100V	2500V
Dielectric Strength (V_{RMS}) 50Hz	3000V	3000V	3500V	3500V
Critical Resistance	5120Ω	6250Ω	12100Ω	33024Ω

RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

Surfaces in contact must be carefully cleaned.

The heatsink must have an acceptable flatness: from 0.05mm to 0.1mm/100mm.

Roughness of the heatsink must be around 6.3μm. In order to improve thermal conductivity, surfaces in contact (alumina, heatsink) are coated with a silicone grease (type SI 340 from Rhône-Poulenc or Dow 340 from Dow Corning).

The fastening of the resistor to the heatsink is under pressure control of two screws (not supplied).

Tightening Torque	RCH 5	RCH 10	RCH 25	RCH 50
on heatsink	0.5Nm	0.6Nm	0.7Nm	1Nm

In order to improve the dissipation, either forced-air cooling or liquid cooling may be used.

A low thermal radiation of the case allows several resistors to be mounted onto the same heatsink.

Do not forget to respect an insulation value between two resistors (dielectric strength in dry air 1kV/mm).

In any case the hot spot temperature, measured locally on the case must not exceed 125°C.

Tests should be performed by the user.

CHOICE OF HEATSINK

The user must choose the heatsink according to working conditions of the component (power, room temperature). Maximum working temperature must not exceed 125°C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[RT_H (j\text{-}c) + RT_H (c\text{-}a)]} \quad (1)$$

P: Expressed in W

ΔT: Difference between maximum working temperature and room temperature.

R_{TH}: (j-c): Thermal resistance value measured between resistance layer and outer side of the resistor.

It is the thermal resistance of the component (See Special Features table).

R_{TH}: (c-a): Thermal resistance value measured between outer side of the resistor and room temperature.

It is the thermal resistance of the heatsink depending on the heatsink itself (type, shape) and the quality of the fastening device.

Example:

R_{TH}: (c-a) for RCH 25 power rating 20W at ambient temperature + 50°C.

$\Delta T \leq 125°C - 50°C \leq 75°C$

R_{TH} (j-c) = 1.4°C/W (Special Features)

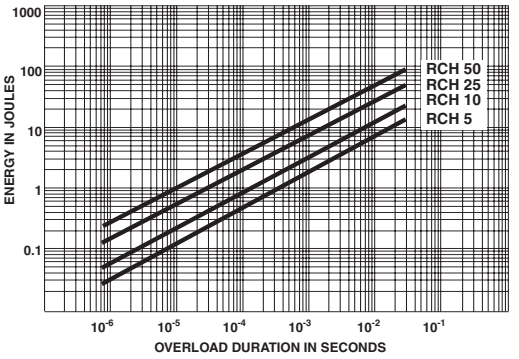
$R_{TH} (j\text{-}c) + R_{TH} (c\text{-}a) = \frac{\Delta T}{P} = \frac{75}{20} = 3.75°C/W$

$R_{TH} (c\text{-}a) \leq 3.75°C/W - 1.4°C/W \leq 2.35°C/W$

OVERLOADS

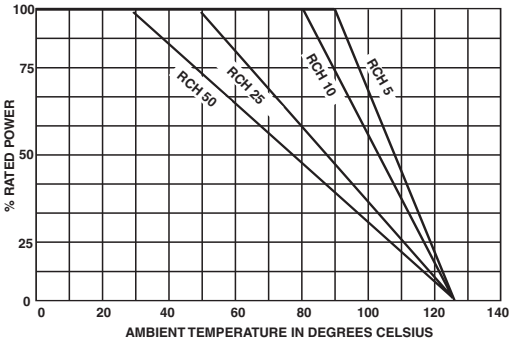
The applied voltage must always be lower than the maximum overload voltage as shown in the special features table.
The values indicated on the graph below are applicable to resistors in air or mounted onto a heatsink.

ENERGY CURVE



POWER RATING CHART

For resistors mounted onto heatsink and thermal resistance of 1°C/W.
To improve the thermal conductivity, surfaces in contact should be coated with a silicone grease.



MARKING

Model, Style, Resistance Value (in), Tolerance (in %), Manufacturing Date, VISHAY trade mark.

ORDERING INFORMATION

RCH	25	3.3k	± 5%	R	xxx
MODEL	STYLE	RESISTANCE VALUE	TOLERANCE	CONNECTIONS	CUSTOM DESIGN
			Optional ± 1% ± 2% ± 5% ± 10%	Optional S: Flat with hole R: Round lead V: M2 screw	Optional

Power Resistors for Mounting onto a Heatsink Thick Film Technology

FEATURES

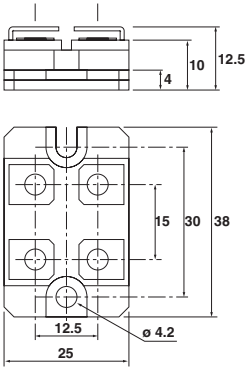
- Up to 4 different ohmic values in the same case
- 1% tolerance available
- High power rating
- Wide ohmic value range
- Non inductive
- Easy mounting
- Low thermal radiation of the case
- Standard Isotop case (SOT 227 B)

This series of thick film power resistors include modules which can incorporate up to 4 different resistor values in the same SOT 227B package. Two types of terminations are available along with a 4 terminal device for measurement applications in the case of the single resistor version. This product range benefits from Vishay Sfernice's experience in thick film power resistor technology i.e high power: volume ratio, low tolerance or individual resistors and excellent overload capabilities (due to the trimming technique).

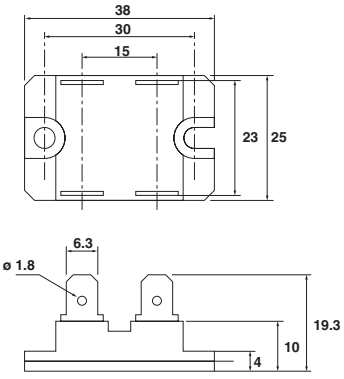
DIMENSIONS in millimeters

RTOP

V Connections



F Connections ("Faston" type)



• **Tolerances unless otherwise specified: ± 0.3mm**

MECHANICAL SPECIFICATIONS

Mechanical Protection	Insulated case
Substrate	Alumina on insulated base (excluding QRTOP series)
Resistive Element	Cermet
End Connections	V connections: screw M4 x 6 F connections: Faston type
Tightening Torque Connections	1 Nm
Tightening Torque Heatsink	2 Nm

ENVIRONMENTAL SPECIFICATIONS

Temperature Range	- 55°C to + 125°C
Climatic Category	55/125/56

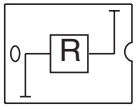
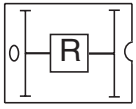
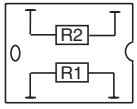
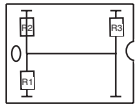
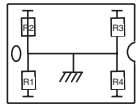
ELECTRICAL SPECIFICATIONS

Resistance Range	0.046 to 1MΩ
Standard Tolerance	± 1% to ± 10%
Power Rating	20W to 200W at + 25°C
Temperature Coefficient	
Standard	± 300 ppm/°C (R < 1) ± 150 ppm/°C (R > 1)
Insulation Resistance	> 10^6MΩ

PERFORMANCE

TESTS	CONDITIONS	TYPICAL DRIFTS
Momentary Overload	2.5Pn/5 seconds	< ± (0.25% ± 0.05Ω)
Rapid Temperature Change	5 cycles - 55°C +125°C	< ± (0.25% ± 0.05Ω)
Load Life	Pn at 25°C 1000 hours	< ± (0.5% ± 0.05Ω)
Humidity (steady state)	56 days 95% R.H.	< ± (0.5% ± 0.05Ω)

SPECIAL FEATURES

MODEL	RTOP 200	RTOP 100	DRTOP 100	DRTOP 50	TRTOP 40	TRTOP 30	QRTOP 35	QRTOP 20
Power Rating at + 25°C **chassis mounted resistors** **unmounted resistors**	200W 5W	100W 5W	100W 3.5W	50W 3.5W	40W 2W	30W 2W	35W 1.5W	20W 1.5W
Thermal Resistance (per resistor)	0.5°C/W	1°C/W	0.5°C/W	1°C/W	0.83°C/W	1.11°C/W	0.71°C/W	1.25°C/W
Limiting Voltage	1500V	1500V	500V	500V	300V	300V	300V	300V
Dielectric Strength **connections/chassis**	2500V	2500V	2500V	2500V	2500V	2500V	base = common	
Dielectric Strength **connections/resistors**	-	-	4000V	4000V	4000V	4000V	4000V	4000V
Ohmic Value Range	0.046 to 1MΩ		0.092 to 1MΩ		0.046 to 1MΩ		0.046 to 1MΩ	
Tolerance	± 1% to ± 10%		± 1% to ± 10%		± 1% to ± 10%		± 1% to ± 10%	
Electrical Diagrams	  Shunt Version						 Grounded base	

CHOICE OF HEATSINK

The user must choose the heatsink according to the working conditions of the component (power, room temperature).

Maximum working temperature must not exceed 125°C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{TH}\,(j\text{-}c) + R_{TH}\,(c\text{-}a)]} \quad (1)$$

- P: expressed in W
- ΔT: difference between maximum working temperature and room temperature.
- R_{TH}: (j-c): thermal resistance value measured between resistive layer and outer side of the resistor. It is the thermal resistance of the component (see Table Special Features).
- R_{TH}: (c-a): thermal resistance value measured between outer side of the resistor and room temperature. It is the thermal resistance of the heatsink depending on the heatsink itself (type, shape) and the quality of the fastening device.

Example:

R_{TH}: (c-a) for RTOP 200 power rating 130W at ambient temperature + 30°C.

Thermal resistance (see table 1) R_{TH} (j-c): 0.5°C/W

$\Delta T \leq 125°C - 30°C - \leq 95°C$

$$RTH\,(j\text{-}c) + RTH\,(c\text{-}a) = \frac{\Delta T}{P} = \frac{95}{130} = 0.73°C/W$$

$RTH\,(j\text{-}c) \leq 0.5°C/W$

$RTH\,(c\text{-}a) \leq 0.73°C/W - 0.5°C/W \leq 0.23°C/W$

RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

Surfaces in contact must be carefully cleaned.

The heatsink must have an acceptable flatness: from 0.05mm to 0.1mm/100mm.

Roughness of the heater must be around 6.3µm.

In order to improve thermal conductivity, surfaces in contact (alumina, heatsink) are laid on with a silicone grease (type SI 340 from Rhône-Poulenc or Dow 340 from Dow Corning).

Tightening torque on heater: 2 Nm

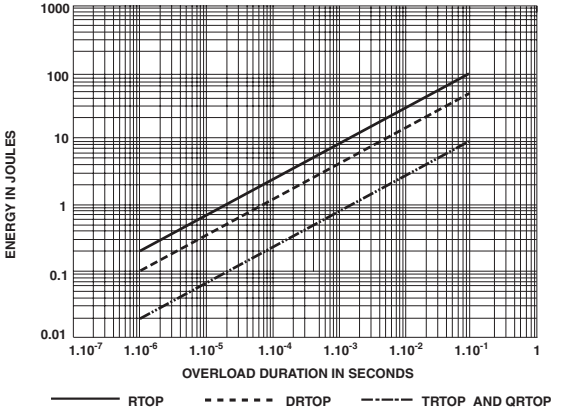
For the electrical connections, it is recommended to use M4 x 6 screws and if necessary a washer of 1mm thickness. The recommended screw tightening torque is 1 Nm.

OVERLOADS

The applied power is 2.5 x rated power for 5 s with a max voltage of 2 x nominal voltage.

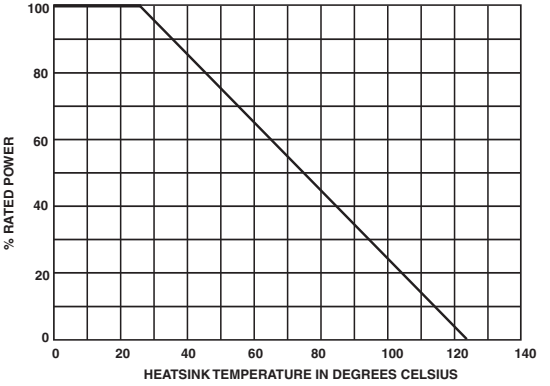
Accidental overload: The values indicated in the graph below are applicable to resistors in air or mounted onto a heatsink. In case of multi-resistor devices, (DRTOP, TRTOP and QRTOP) the results apply to each resistor value in the device.

ENERGY CURVE



POWER RATING CHART

The temperature of the heater should be maintained in the limit specified. To improve the thermal conductivity, surfaces in contact should be laid on with a silicon grease and the torque applied on the screw for tightening should be around 2 Nm.



MARKING

Series, style, ohmic value (in), tolerance (in %), manufacturing date, VISHAY trade mark.

ORDERING INFORMATION

RTOP	200	3.2	± 1%		± %	V	
		R1	T1	R2	T2		
MODEL	STYLE	OHMIC VALUE	ABSOLUTE TOLERANCE PER RESISTOR			CONNECTIONS	CUSTOM DESIGN
RTOP	100		Optional	To be precise		V: Screw	Optional
DRTOP	50		± 1%	for each		F: “Faston” type	
TRTOP	40		± 2%	resistor		VS} RTOP	
QRTOP	30		± 5 %			FS} Shunt	
	35		± 10 %				
	20						

WORLDWIDE SALES CONTACTS

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