

## Power Resistor for Mounting onto a Heatsink Thick Film Technology



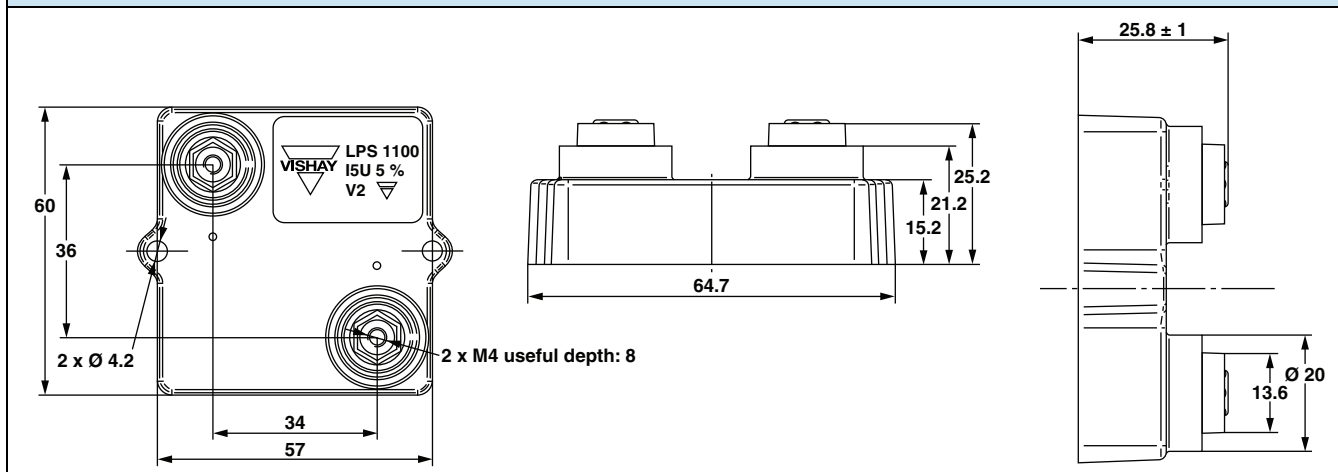
### FEATURES

- LPS high power: 1100 W
- Wide resistance range: 1  $\Omega$  to 1.3 k $\Omega$  E24 series
- Non inductive
- Easy mounting
- Low thermal radiation of the case
- Compliant to RoHS Directive 2011/65/EU



**RoHS**  
COMPLIANT

### DIMENSIONS in millimeters



### Notes

- Tolerances unless stated:  $\pm 0.2$  mm
- Power dissipation is 1100 W by using a water cooled heatsink at  $T_{\text{water}} = 15$   $^{\circ}\text{C}$  of  $R_{\text{th}} = 0.059$   $^{\circ}\text{C/W}$  (25  $^{\circ}\text{C}$  to the nearest point of the resistor onto heatsink) and  $R_{\text{th}}$  contact estimated at 0.07  $^{\circ}\text{C/W}$ .

### MECHANICAL SPECIFICATIONS

|                                      |                                                |
|--------------------------------------|------------------------------------------------|
| <b>Mechanical Protection</b>         | Insulated case and resin for potting UL 94 V-0 |
| <b>Resistive Element</b>             | Thick film                                     |
| <b>End Connections</b>               | Screws M4                                      |
| <b>Tightening Torque Connections</b> | 2 Nm                                           |
| <b>Tightening Torque Heatsink</b>    | 2 Nm                                           |
| <b>Maximum Torque</b>                | 2.5 Nm                                         |
| <b>Weight</b>                        | 79 g $\pm 10$ %                                |

### ENVIRONMENTAL SPECIFICATIONS

|                          |                                                     |
|--------------------------|-----------------------------------------------------|
| <b>Temperature Range</b> | - 55 $^{\circ}\text{C}$ to + 200 $^{\circ}\text{C}$ |
| <b>Climatic Category</b> | 55/200/56                                           |

### ELECTRICAL SPECIFICATIONS

|                                                                                                                         |                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Resistance Range</b>                                                                                                 | 1 $\Omega$ to 1.3 k $\Omega$                                                                          |
| <b>Tolerances</b>                                                                                                       | $\pm 1$ % to $\pm 10$ %                                                                               |
| <b>Power Rating and Thermal Resistance</b>                                                                              | 1100 W at + 25 $^{\circ}\text{C}$<br>On heatsink<br>$R_{\text{th(j-c)}}$ : 0.039 $^{\circ}\text{C/W}$ |
| <b>Temperature Coefficient (- 55 <math>^{\circ}\text{C}</math> to + 200 <math>^{\circ}\text{C}</math>), IEC 60115-1</b> | $\pm 150$ ppm/ $^{\circ}\text{C}$                                                                     |
| <b>Dielectric Strength IEC 60115-1, 1 min, 10 mA max.</b>                                                               | 7 kV <sub>RMS</sub> or 12 kV <sub>RMS</sub>                                                           |
| <b>Insulation</b>                                                                                                       | $\geq 10^4$ M $\Omega$                                                                                |
| <b>Inductance</b>                                                                                                       | $\leq 0.1$ $\mu\text{H}$                                                                              |

| PERFORMANCE              |                                                                                                                                                                                                                                                                      |                                                                                                                         |
|--------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| TESTS                    | CONDITIONS                                                                                                                                                                                                                                                           | REQUIREMENTS                                                                                                            |
| Momentary Overload       | IEC 60115-1: 2 x Pr/10 s for heatsink with $R_{th(h-a)} \geq 0.26 \text{ }^{\circ}\text{C/W}$ (maximum power: 700 W)<br>1.6 x Pr/1 s for heatsink with $0.26 \text{ }^{\circ}\text{C/W} > R_{th(h-a)} \geq 0.059 \text{ }^{\circ}\text{C/W}$ (maximum power: 1800 W) | $\pm (0.25 \% + 0.05 \Omega)$                                                                                           |
| Rapid Temperature Change | AEC-Q200 conditions: IEC 60115-1/IEC 60068-2-14, Test Na 50 cycles (- 55 °C to + 200 °C)                                                                                                                                                                             | $\pm (0.5 \% + 0.05 \Omega)$ for all the ohmic values                                                                   |
|                          | 1000 cycles (- 55 °C to + 200 °C)                                                                                                                                                                                                                                    | $\pm (5 \% + 0.05 \Omega)$ for $R < 38 \text{ } \Omega$<br>$\pm (0.5 \% + 0.05 \Omega)$ for $R \geq 38 \text{ } \Omega$ |
| Load Life                | AEC-Q200 conditions: IEC 60115-1<br>1000 h (90/30) Pr                                                                                                                                                                                                                | $\pm (5 \% + 0.05 \Omega)$ for $R < 38 \text{ } \Omega$<br>$\pm (0.5 \% + 0.05 \Omega)$ for $R \geq 38 \text{ } \Omega$ |
| Humidity (Steady State)  | AEC-Q200 conditions: IEC 60115-1, 1000 h RH 85 %/85 °C                                                                                                                                                                                                               | $\pm (0.5 \% + 0.05 \Omega)$                                                                                            |
| Mechanical Shock         | AEC-Q200 conditions: MIL-STD-202 method 213 condition D (100 g's/6 ms 3.75 m/s)                                                                                                                                                                                      | $\pm (1 \% + 0.05 \Omega)$                                                                                              |
| Vibration                | AEC-Q200 conditions: MIL-STD-202 method 204 condition D (5 g, 20 min 10/2000 Hz)                                                                                                                                                                                     | $\pm (1 \% + 0.05 \Omega)$                                                                                              |
| Climatic Sequence        | AEC-Q200 conditions: IEC 60115-1 (55/200/56)                                                                                                                                                                                                                         | $\pm (1 \% + 0.05 \Omega)$                                                                                              |

## RECOMMENDATIONS FOR MOUNTING ONTO A HEATSINK

- Surfaces in contact must be carefully cleaned.
- The heatsink must have an acceptable flatness: From 0.05 mm to 0.1 mm/100 mm.
- Roughness of the heatsink must be around 6.3  $\mu\text{m}$ . In order to improve thermal conductivity, surfaces in contact (ceramic, heatsink) should be coated with a silicone grease (type SI 340 from Blue Star Silicones). Thermal film (type Q-pad II from Berquist) is also possible, easier and faster to install than grease but with a lower efficiency for the power dissipation.
- The fastening of the resistor to the heatsink is under pressure control of two screws tightened at 2 Nm for full power availability.

|                               |          |
|-------------------------------|----------|
| Tightening Torque on Heatsink | LPS 1100 |
|                               | 2 Nm     |

- The following accessories are supplied with each product:
  - 2 screws CHC M4 x 25 class 8.8 and 2 M4 contact lock washers for heatsink mounting
  - 2 screws TH M4 x 6/6 and 2 M4 contact lock washers for connections. 2 off CHC M4 x 16/16 class 8

## CHOICE OF THE HEATSINK AND THE THERMAL INTERFACE

The user must choose the heatsink according to the working conditions of the component (power, room temperature). Maximum working temperature must not exceed 200 °C. The dissipated power is simply calculated by the following ratio:

$$P = \frac{\Delta T}{[R_{th(j-c)}] + [R_{th(c-h)}] + [R_{th(h-a)}]}$$

P: Expressed in W

$\Delta T$ : Difference between maximum working temperature and room temperature or fluid cooling 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: 0.039 °C/W.

$R_{th(c-h)}$ : Thermal resistance value measured between outer side of the resistor and upper side of the heatsink. This is the thermal resistance of the interface (grease, thermal pad), and the quality of the fastening device.

$R_{th(h-a)}$ : Thermal resistance of the heatsink.

### Example:

$R_{th(c-h)} + R_{th(h-a)}$  for LPS 1100 power dissipation 850 W at + 18 °C fluid temperature.

$$\Delta T \leq 200 \text{ }^{\circ}\text{C} - 18 \text{ }^{\circ}\text{C} = 182 \text{ }^{\circ}\text{C}$$

$$R_{th(j-c)} + R_{th(c-h)} + R_{th(h-a)} = \frac{\Delta T}{P} = \frac{182}{850} = 0.214 \text{ }^{\circ}\text{C/W}$$

$$R_{th(j-c)} = 0.039 \text{ }^{\circ}\text{C/W}$$

$$R_{th(c-h)} + R_{th(h-a)} = 0.214 \text{ }^{\circ}\text{C/W} - 0.039 \text{ }^{\circ}\text{C/W} = 0.175 \text{ }^{\circ}\text{C/W}$$

|                                  | CONFIG. 1:<br>WATER COOLING<br>HEATSINK CP15 AND<br>THERMAL GREASE SI340 | CONFIG. 2:<br>AIR COOLING<br>HEATSINK P207/250 AND<br>THERMAL GREASE SI340 | CONFIG. 3:<br>WATER COOLING<br>HEATSINK CP15 AND<br>THERMAL PAD Q-PAD II | CONFIG. 4:<br>AIR COOLING<br>HEATSINK P207/250 AND<br>THERMAL PAD Q-PAD II |
|----------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------------------------------|
| Power Dissipation (W)            | 1100                                                                     | 350                                                                        | 650                                                                      | 285                                                                        |
| T° Resistive Element (°C)        | 200                                                                      | 200                                                                        | 200                                                                      | 200                                                                        |
| R <sub>th(j-c)</sub> max. (°C/W) | 0.039                                                                    | 0.039                                                                      | 0.039                                                                    | 0.039                                                                      |
| R <sub>th(c-h)</sub> typ. (°C/W) | 0.070                                                                    | 0.201                                                                      | 0.187                                                                    | 0.315                                                                      |
| R <sub>th(h-a)</sub> max. (°C/W) | 0.059                                                                    | 0.260                                                                      | 0.059                                                                    | 0.260                                                                      |
| Fluid T° (°C)                    | 15 (water)                                                               | 25 (air)                                                                   | 15 (water)                                                               | 25 (air)                                                                   |

**Note**

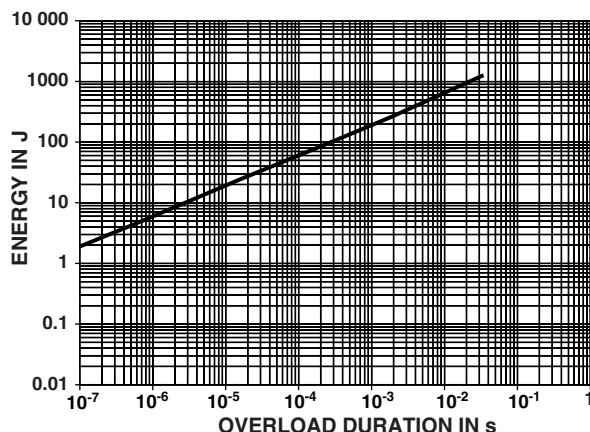
- Configuration 1: Water cooling heatsink (CP15 from Lytron with water flow rate 4LPM and thermal grease Si340 from BlueStar Silicones)
- Configuration 2: Air cooling heatsink P207/250 from Semikron and thermal grease Si340 from BlueStar Silicones
- Configuration 3: Water cooling heatsink (CP15 from Lytron with water flow rate 4LPM and thermal pad Q-pad II from Berquist)
- Configuration 4: Air cooling heatsink P207/250 from Semikron and thermal pad Q-pad II from Berquist

**OVERLOAD**

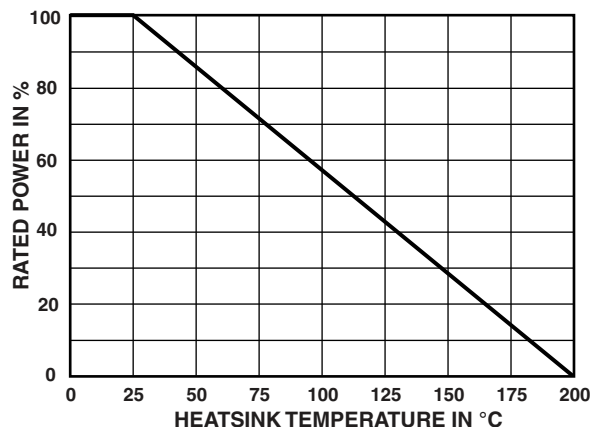
In any case the applied voltage must be lower than  $U_l = 6600\text{ V}$ .

**Short time overload:**  $2 \times P_r/10\text{ s}$  for heatsink with  $R_{th(h-a)} \geq 0.26\text{ °C/W}$  (maximum power: 700 W) and  $1.6 \times P_r/1\text{ s}$  for heatsink with  $0.26\text{ °C/W} > R_{th(h-a)} \geq 0.059\text{ °C/W}$  (maximum power: 1800 W).

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

**ENERGY CURVE**

**POWER RATING**

The temperature of the case should be maintained within the limit specified in the following figure. To optimize the thermal conduction, contacting surfaces should be coated with silicone grease or thermal film, and heatsink mounting screws tightened to 2 Nm.


**PACKAGING**

Box of 15 units

**MARKING**

Series, style, ohmic value (in  $\Omega$ ), tolerance (in %), manufacturing date, Vishay Sfernice trademark.

| ORDERING INFORMATION |       |                  |            |                                               |           |                |
|----------------------|-------|------------------|------------|-----------------------------------------------|-----------|----------------|
| LPS                  | 1100  | 1 k $\Omega$     | $\pm 1\%$  | xxx                                           | BO15      | e              |
| MODEL                | STYLE | RESISTANCE VALUE | TOLERANCE  | CUSTOM DESIGN                                 | PACKAGING | LEAD (Pb)-FREE |
|                      |       |                  | $\pm 1\%$  | Optional on request: special TCR, shape, etc. |           |                |
|                      |       |                  | $\pm 2\%$  |                                               |           |                |
|                      |       |                  | $\pm 5\%$  |                                               |           |                |
|                      |       |                  | $\pm 10\%$ |                                               |           |                |



GLOBAL PART NUMBER INFORMATION

|              |                                                               |   |                                                                                                                                                                                                                                                            |   |   |   |                                           |   |                                               |   |                      |   |   |  |
|--------------|---------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|-------------------------------------------|---|-----------------------------------------------|---|----------------------|---|---|--|
| L            | P                                                             | S | 1                                                                                                                                                                                                                                                          | 1 | 0 | 0 | H                                         | 4 | 7                                             | R | 0                    | J | B |  |
| GLOBAL MODEL | DIELECTRIC                                                    |   | OHMIC VALUE                                                                                                                                                                                                                                                |   |   |   | TOLERANCE                                 |   | PACKAGING                                     |   | SPECIAL              |   |   |  |
| LPS 1100     | L = Dielectric strength 7 kV<br>H = Dielectric strength 12 kV |   | The first three digits are significant figures and the last digit specifies the number of zeros to follow. R designates decimal point.<br>48R7 = 48.7 $\Omega$<br>47R0 = 47 $\Omega$<br>1001 = 1 k $\Omega$<br>4R70 = 4.7 $\Omega$<br>R240 = 0.24 $\Omega$ |   |   |   | F = 1 %<br>G = 2 %<br>J = 5 %<br>K = 10 % |   | B = Box 15 pieces<br>N = Box 15 pieces<br>n/a |   | As applicable<br>ZAx |   |   |  |



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