Mounting Instructions and Thermal Considerations

1. HEATSINK SPECIFICATION

The mounting area on the heatsink and the bottom of the LPS must be free of particles. Surfaces in contact must be carefully cleaned in order to obtain the maximum thermal conductivity between the component and the heatsink.
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 µm.

2. CHOICE OF THE THERMAL INTERFACE

In order to improve thermal conductivity, surfaces in contact should be coated with a silicone grease or a thermal film. The function of this element is to minimise the thermal interface resistance by filling the potential air voids. Since the thermal resistance of air is very high, these voids will substantially degrade performance. Therefore, it is important to use a thermal interface material to fill these air voids. Several materials are available to reduce thermal resistance between the resistor and heatsink surface.

Thermal grease is an addition of thermally conductive particles with a fluid typically, a silicone oil. The final consistency is like a grease.

We recommend to use for the thermal grease:

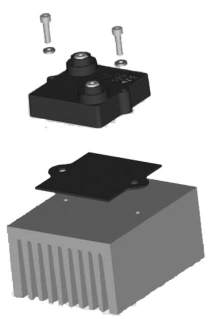
- SI 340 from BlueStar Silicones (thermal conductivity at 25 °C = 0.41 W/mK - dielectric strenght = 15 kV/mm) or
- Dow 340 from Dow Corning (thermal conductivity = 0.59 W/mK - dielectric strength = 8.3 kV/mm).

Thermal interface can be applied either to the base area of the component or the area of the heatsink.

Thermal film, an alternative to thermal grease, is easier and faster to install than the grease. Moreover, you can use different times the same thermal films and this element allows to have uniform thickness. These thermally conductive pads are available in sheet form or in pre-cut shapes. These pads utilize silicone rubber binder combined with a variety of materials such as aluminum oxide, boron nitride or magnesium oxide to provide good thermal conductivity. For the thermal interface, we recommend to use Q-PAD II from Berquist (thermal conductivity = 2.5 W/mK; non-insulated). Q-Pad II is available with special dimensions for the LPS (Vishay description: 52338833 Rev B; P/N Berquist: BG422257; thickness: 0.152 mm). The Q-Pad II film is not electrically insulated. Electrically insulated version: Poly-Pad K10 from Berquist (R_{TH} = 1.3 W/mK).

3. MOUNTING THE RESISTOR

Avoid any movement of the resistor once positioned on the heatsink. The fixing screws are inserted and evenly tightened by hand (around 0.5 Nm) or by electric or pneumatic screwdrivers with a torque of 0.5 Nm. After, the screws are tightened again to the final torque. The use of torque wrenches with automatic release is recommended. The two step procedure must be strictly followed to allow the component base-plate to relax and conform to the heatsink. The bus-bars must be mounted onto the connections of the power resistor with the recommended torque. The cross sections of the bus-bars must be sufficiently large to avoid heating of the module by bus-bar resistive losses. Stress to the power resistor from bus-bar forces must be minimized during assembly, transportation and operation.



Mounting assembly for LPS

MOUNTING INFORMATION

MOUNTING	SCREW	TORQUE VALUES RECOMMENDED (Nm)
Resistor on heatsink	M4	2
Connexions	M4	2

Note

- Maximum torque: 2.5 mm

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4. THERMAL CONSIDERATIONS

For reliable operation it is crucial not to exceed the maximum specified temperature for the resistive element

THERMAL INFORMATION ON LPS RESISTORS		
	MAXIMAL TEMPERATURE FOR RESISTIVE ELEMENT	THERMAL RESISTIVITY BETWEEN RESISTIVE ELEMENT AND CASE $R_{TH\ (j-c)}$
LPS300	120 °C	0.112 °C/W
LPS600	155 °C	0.112 °C/W
LPS800	175 °C	0.112 °C/W

Excessive resistive temperatures will cause a drift of the resistance value or reduced component life. Proper thermal design followed by temperature measurements to verify the design, and consistent mounting procedures will avoid these problems. The film temperature (T_j) is related to the case temperature (T_C) by the parameter "Thermal resistance" $R_{TH\ (j-c)}$. Thermal resistance is expressed in °C/W. In other words, the thermal resistance $R_{TH\ (j-c)}$ is the temperature rise (°C) between the film and the case per W applied.

5. 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 120 °C. The dissipated power is simply calculated by the following ratio:

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

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 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 thermal interface, the heatsink (type, shape) and the quality of the fastening device.

Example:

$R_{TH\ (c-a)}$ for LPS 300 power dissipation 180 W at + 50 °C room temperature.

$\Delta T \leq 120\ °C - 50\ °C = 70\ °C$

$R_{TH\ (j-c)} + R_{TH\ (c-a)} = \frac{\Delta T}{P} = \frac{70}{180} = 0.388\ °C/W$

$R_{TH\ (j-c)} = 0.112\ °C/W$

$R_{TH\ (c-a)} = 0.388\ °C/W - 0.112\ °C/W = 0.276\ °C/W$

6. MECHANICAL PROPERTIES

PARAMETER		VALUE	UNIT
Dimensions		65.2 x 60 x 25.8	mm
Clearance distance in air	Termination to base	14.7 min.	mm
	Termination to term	40 min.	mm
Surface creepage distance	Termination to base	30 min.	mm
	Termination to term	83 min.	mm

The clearance distance in air is defined as the shortest direct path between the terminals and the base and between terminals.

The surface creepage distance is the shortest path along the plastic housing between the terminals and the base and between the terminals.

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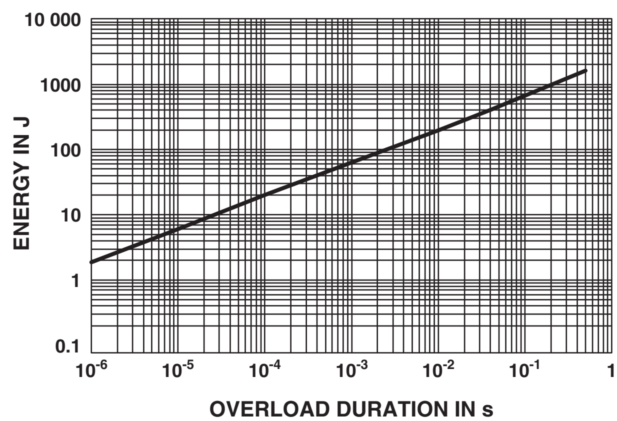
7. OVERLOAD

In any case the applied voltage must be lower than U_L = 5000 V.

Short time overload: LPS300: 4 x P_r/10 s, LPS600: 2 x P_r/10 s, LPS800: 1.5 x P_r/10 s

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

ENERGY CURVE



Single pulse:

These informations are for a single pulse on a cold resistor at 25 °C (not already used for a dissipation) and for pulses of 100 ms maximum duration.

The formula used to calculate E is:

$$E = P \times t = \frac{U^2}{R} \times t$$

with:

- E (J): Pulse energy
- P (W): Pulse power
- t (s): Pulse duration
- U (V): Pulse voltage
- R (W): Resistor

The energy calculated must be less than that allowed by the graph.

Repetitive or Superimposed Pulses:

The following formula is used to calculate the “equivalent“ energy of a repetitive pulse or the “equivalent energy“ of a pulse on a resistor that is already dissipating power.

The formula used to calculate E is:

$$E = P \times t = \frac{U^2}{R} \times t$$

with:

- E_c (J): Equivalent pulse energy
- E (J): Known pulse energy
- P_r: Resistor power rating
- P_a: Mean power being dissipated

The energy calculated must be less than that allowed by the graph and the average power dissipated (P_a) must not exceed the continuous power of resistor.