Thick Film Power Resistors: D2TO-H and LTO-H High Energy Series

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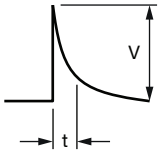
Vishay Sfernice offers a wide range of thick film power resistors. Among them are the D2TO35, LTO100, and LTO150 series devices, which can dissipate power from 35 W up to 150 W and offer a wide range of ohmic values. Vishay has introduced high energy versions of these resistors: the D2TO35H, LTO100H, and LTO150H series.

The energy curve in the devices' datasheets shows the maximum energy during a short pulse that can be applied to each product. The pulse capability of Vishay's resistors is a key specification for many customer applications.

In all documents, we define the pulse as a short time overload (lower than 200 ms). Engineered to handle high energy levels effortlessly, these advanced resistors feature an innovative design that enables them to absorb 30 % more energy than conventional alternatives. This enhanced energy absorption results in greater durability and efficiency, making them well-suited for high stress environments.

In this application note, we use the example of our D2TO and LTO resistors families to explain a method for evaluating whether or not a resistor is appropriate for a given application. This method can be used for each resistor type using the corresponding pulse curve and limiting voltage from the corresponding datasheet.

If we take the following example: a capacitor with a capacitance C is charged to a given voltage V and discharged through a resistor *R*. The calculation of the energy stored by the capacitor for one pulse is represented below by the formula and voltage curve:



Units:
E = energy in J
t = time in s
V = voltage in V
R = resistance in Ω
C = capacity in F

$E = \frac{1}{2} \times C \times V^2$

$t = R \times C$

Capacitor discharge

If we examine the energy curves in the datasheets of the different resistors, we can identify the maximum accidental pulse energy that each device can support.

For repetitive pulses, a safety coefficient k is applied.

SERIES	ENERGY (J) FOR 100 ms PULSE		
	ACCIDENTAL	REPETITIVE	SAFETY COEFFICIENT k
D2TO35	11.7	5.8	0.5
D2TO35H	15.2	10.6	0.7
LTO100	35.6	24.9	0.7
LTO100H	51.6	36.1	0.7
LTO150	58	40.6	0.7
LTO150H	75.5	52.8	0.7

In our example introduced above, we have C = 770 µF and *R* = 130 Ω.

$t = RC \Rightarrow t = 130 \times 770.10^{-6} \Rightarrow t = 0.1$

APPLICATION NOTE

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CASE 1

A capacitor charged to 150 V is discharged through a D2TO35:

$$E = \frac{1}{2} CV^2 \Rightarrow E = \frac{1}{2} \times 770.10^{-6} \times 150^2 \Rightarrow E = 8.66 \text{ J}$$

	D2TO35	D2TO35H
Energy capability for 0.1 s (J)	5.8	10.6
Quantity of pieces needed	2	1

Since the D2TO35H version is more energy efficient than the D2TO35, only one component is needed.

CASE 2

A capacitor charged to 300 V is discharged through a LTO100:

$$E = \frac{1}{2} CV^2 \Rightarrow E = \frac{1}{2} \times 770.10^{-6} \times 300^2 \Rightarrow E = 34.65 \text{ J}$$

	LTO100	LTO100H
Energy capability for 0.1 s (J)	24.9	36.1
Quantity of pieces needed	2	1

Since the LTO100H version is more energy efficient then the LTO100, only one component is needed.

CASE 3

A capacitor charged to 350 V is discharged through a LTO150:

$$E = \frac{1}{2} CV^2 \Rightarrow E = \frac{1}{2} \times 770.10^{-6} \times 350^2 \Rightarrow E = 47.16 \text{ J}$$

	LTO150	LTO150H
Energy capability for 0.1 s (J)	40.6	52.8
Quantity of pieces needed	2	1

Since the LTO150H version is more energy efficient than the LTO150, only one component is needed.

As demonstrated, the number of components required in the system is directly influenced by the specific application and the level of energy stress applied. In the case of resistors, variations in energy input can significantly impact the design, potentially requiring additional elements to ensure structural integrity and optimal performance.

To avoid any damage to the resistor by excessive pulse loading, the specifics of the customer's application must be checked.

Please feel free to refer to our online configurator for more information:
www.vishay.com/en/resistors/high-and-medium-power-thick-film-selector/

APPLICATION NOTE