Pulse & Overload Capability of Wirewound Resistors

Modern electronic circuits and devices are more sensitive than ever to transients, and this has led to an increased need for transient protection. Designers are often faced with a difficult task in terms of the level of protection required and the ability of the individual components to withstand given transients or pulses. Whilst there is a great deal of information available on the capability of semiconductors, other components, such as resistors, are often neglected or misunderstood by designers.

As resistors are often located in areas likely to experience transients, with power supplies or lighting circuits for example, their transient or pulse capability is a critical issue.

The most common type of resistors used for transient protection are wirewound resistors. However, this is a product range for which pulse capability data is not often given on data sheets. To overcome this, the following pages detail the pulse handling and overload characteristics of TT electronics most popular wirewound resistors.

In addition to providing a comprehensive range of standard wirewound resistors, TT electronics has worked closely with designers to custom build resistors for specific protection applications.

- **Data given for Metal Clad, axial Cement and Vitreous Enamelled wirewounds**
- **Detailed pulse graphs**
- **Custom parts available**

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Overloading of Wirewound Resistors

In order to limit their temperature rise, wirewound resistors have maximum continuous power ratings. However they also have an overload rating, often referred to as Short Term Overload on data sheets.

This varies according to the product type and is specified as a multiple of the rated power applied for a specified time. The overload ratings for the most popular axial wirewound resistors are given below;

Type:	Overload: (Multiple of rated power)	Duration:
W20 Series	10	5 Seconds
WH Series	5	5 Seconds
WA80 Series	5	5 Seconds
W31	10	5 Seconds

For example, the W22 is rated as a 6 Watt device, however it is capable of dissipating 60 Watts for 5 seconds. In terms of energy, this corresponds to 300 Joules.

It might be thought that this device is capable of handling 300 Joules irrespective of the pulse width. However because it takes a finite time for the heat produced to be properly distributed throughout the resistor body, it is necessary to impose limits on the applied pulse energy so as to prevent excessive stresses due to thermal shock damaging the component.

For example, if we consider a W22 0R22 subjected to 200 Volts for 1.5 milliseconds.

Using $E = V^2t/R$, the energy is 270 Joules.

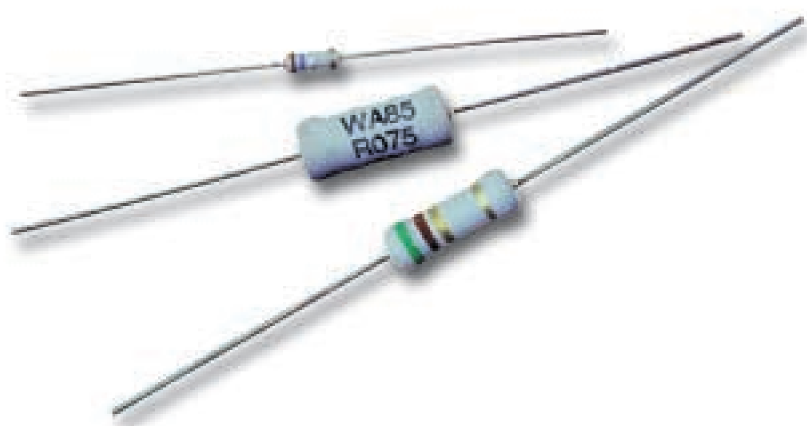
This is within the 300 Joules quoted above, but because it would take longer than 1.5 ms for the heat produced in the wire to flow into the surrounding materials, the temperature of the wire would rise far beyond that intended.

If the wire is subjected to temperatures beyond its operating limits the resistance value of the component may change excessively, the coating can be damaged and in extreme cases the wire can melt.

For these reasons we have produced the “Energy Capability” and “Overload Rating” graphs which should be referred to for all pulse applications. (The term pulse implies a single pulse applied to a resistor, which is not already dissipating power and is in an ambient temperature of 70°C or less.)

For pulses of up to 100ms duration the “Energy Capability” graph should be used. For longer pulses (>100ms) the “Overload Rating” graph should be used. However the energy applied in the first 100ms should not exceed that allowed on the “Energy Capability” Graph. For very short pulses, <1ms, reference should be made to the 1.2/50μs table. ”Overload Rating” graphs are not provided for the WA80 and W31 Series; for these products the table above should be used.

It is important to realise that forced air-cooling and/or heat sinks have no effect on overload ratings within the first few seconds.



Repetitive or Superimposed Pulses

As there is a maximum temperature to which the wire can rise during an overload, if the resistor is already dissipating heat, then the pulse energy applied should be less than that allowed by the graph.

Using the formula below we can estimate the "equivalent" energy of a pulse applied to a resistor that is already dissipating power.

Eap = E x (1 + Pav / Pr)

Where:

Eap = Equivalent pulse energy

E = Known pulse energy

Pr = Resistor power rating

Pav = Mean power being dissipated

It should also be noted that for repetitive pulses the average power dissipated must not exceed the continuous power rating of the resistor.

Limiting Element Voltage (L.E.V)

The L.E.V is the maximum continuous voltage that can be applied to a resistor.

Generally for lower values the power rating is exceeded before the L.E.V is reached. With higher values the L.E.V imposes limitations on the applied power.

For example, consider a W23 43K0. The voltage required to dissipate the rated power of 9 Watts is 622 Volts. However the L.E.V of the part is only 500 Volts. Therefore, as this cannot be exceed for continuous operation, the power is limited to 5.81 Watts.

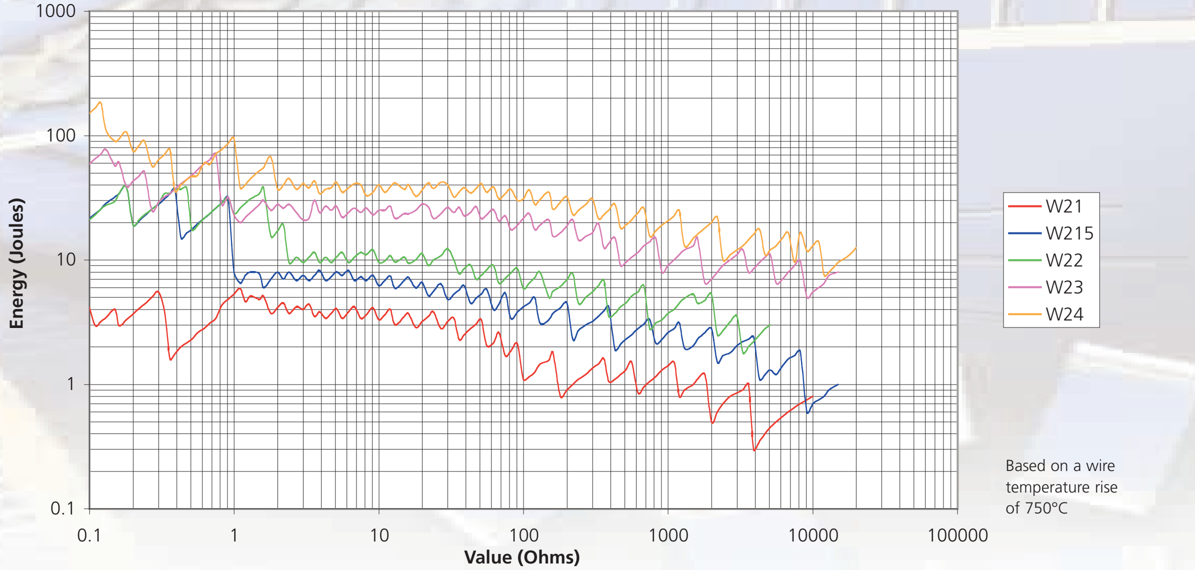
Whilst the L.E.V cannot be exceed for continuous conditions, wirewound resistors are capable of withstanding 3 times their L.E.V for pulse applications.

Graphs

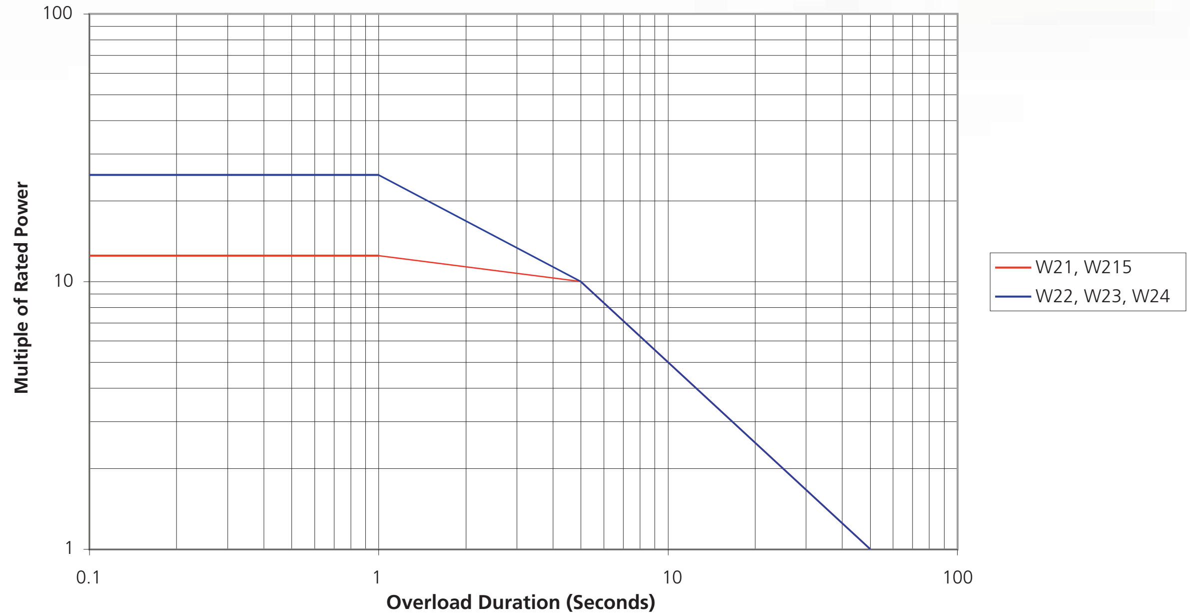
The following pages contain the "Energy Capability" and "Overload Rating" graphs described above for the most popular types of wirewound resistor. Information is also available on request for tubular resistors and other wirewound products. In addition to this, TT electronics are able to offer custom design parts to meet specific customer requirements.

For any additional information or to discuss your specific requirements please contact the Resistor Applications Team.

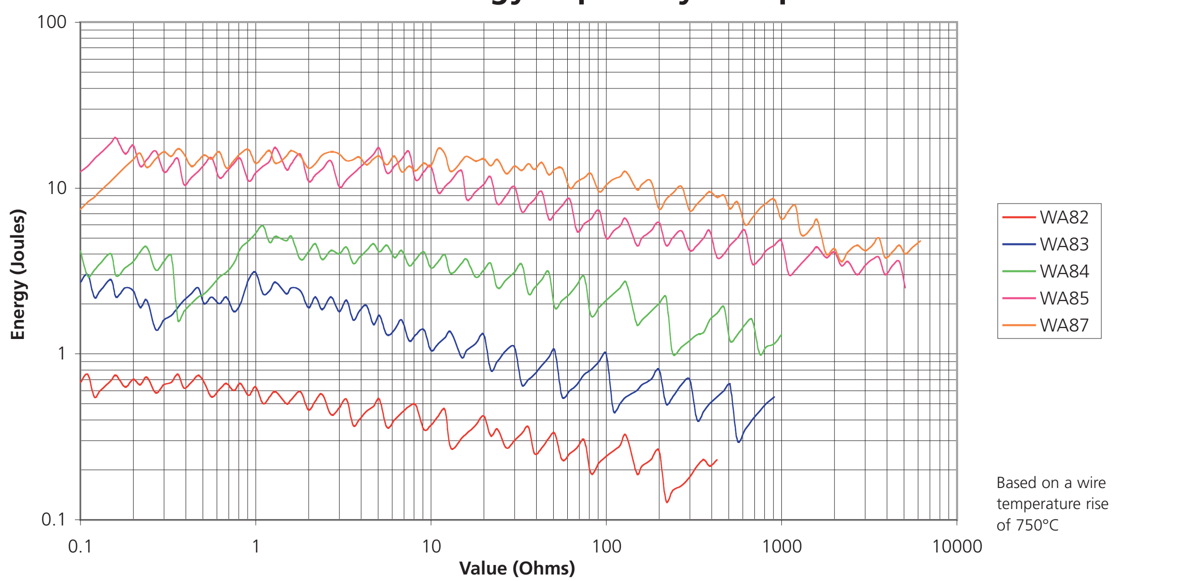
W20 Series "Energy Capability" Graph



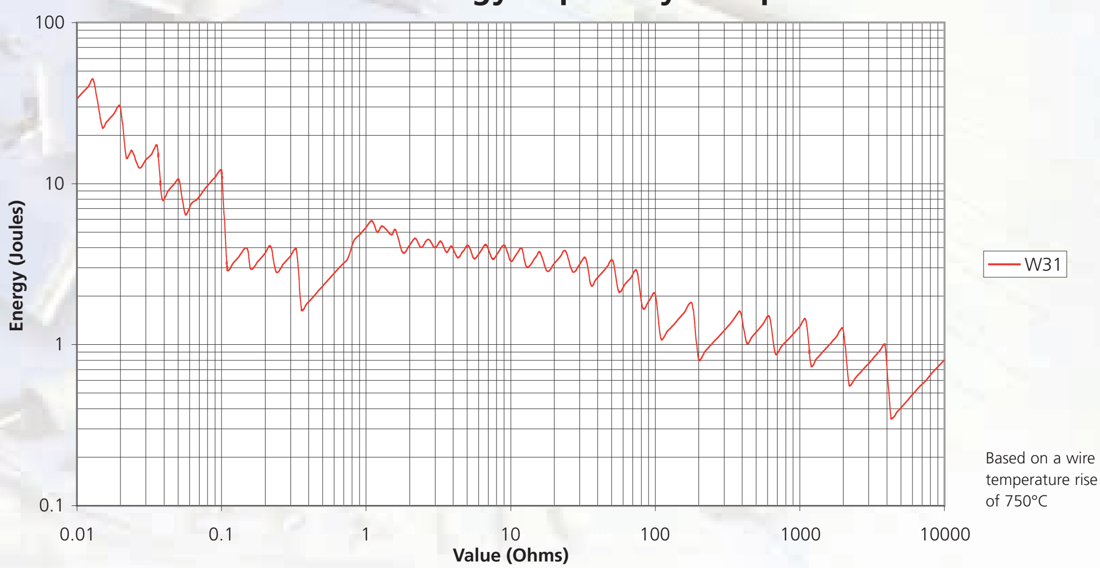
W20 Series "Overload Rating" Graph



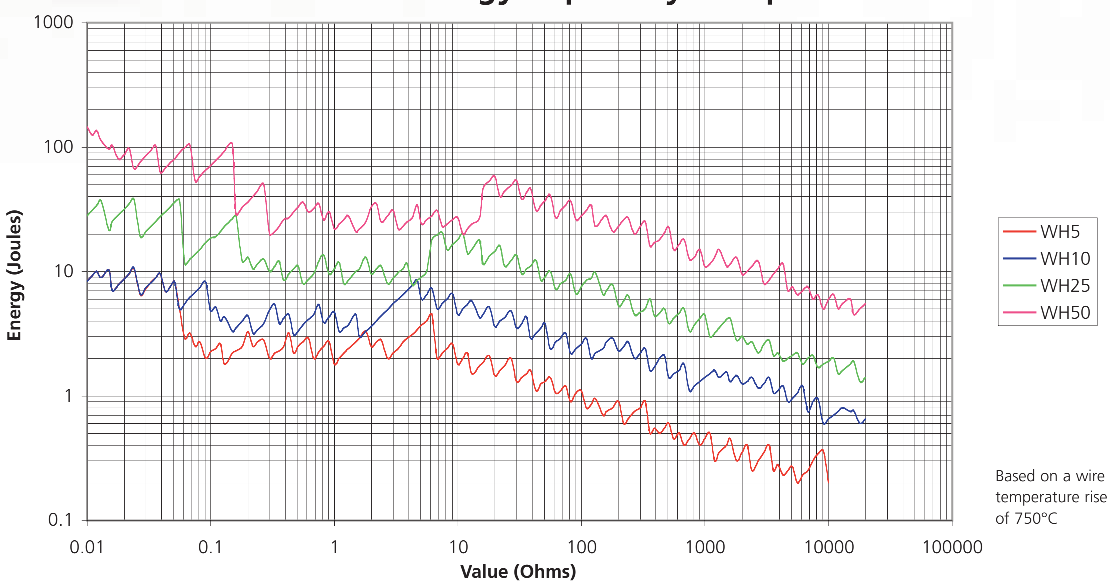
WA80 Series "Energy Capability" Graph



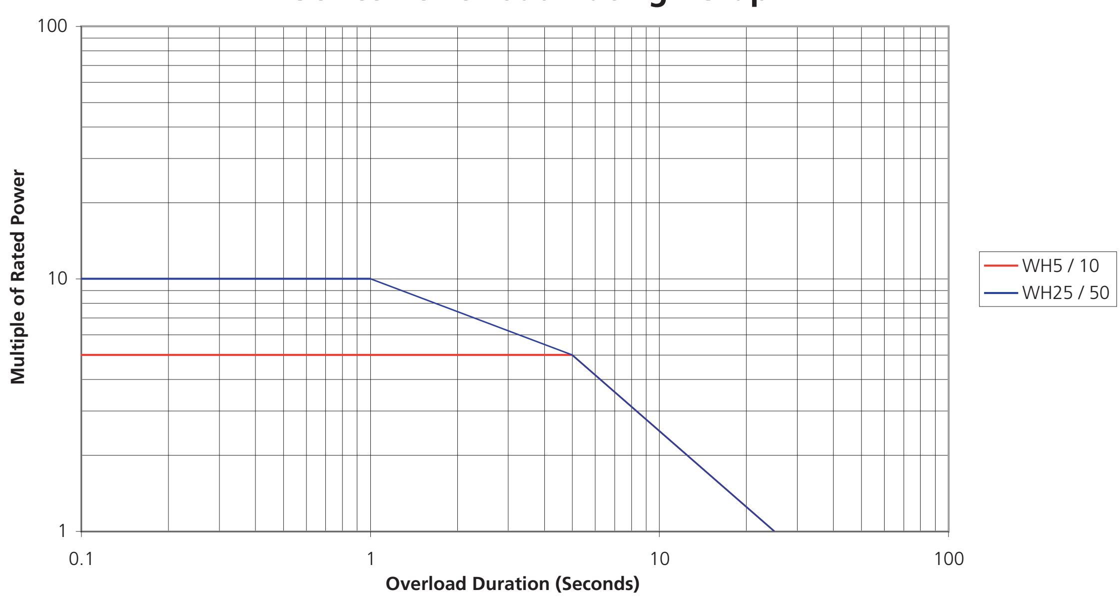
W31 Series "Energy Capability" Graph



WH Series "Energy Capability" Graph



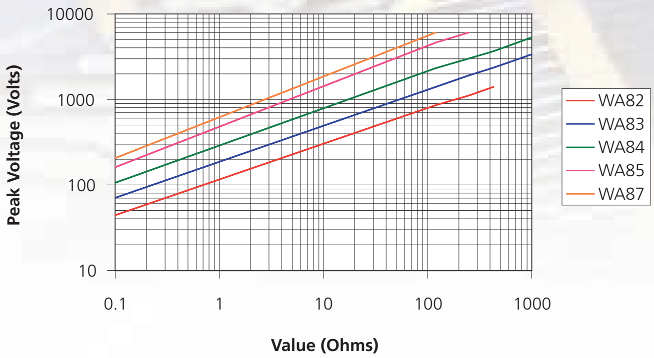
WH Series "Overload Rating" Graph



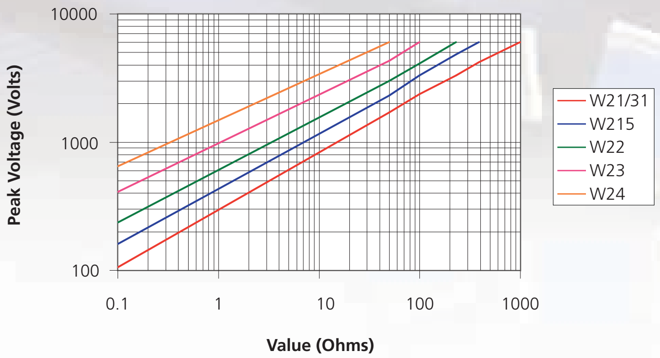
1.2/50µs Voltage Capability

The graphs below give the maximum voltage that may be applied in the form of a 1.2/50µs pulse as defined in IEC 61000-4-5 and ANSI C62.41. This has a 1.2µs risetime and decays exponentially with a 50% amplitude pulse width of 50µs. The maximum permitted resistance change is 2%. Voltages above 6kV have not been tested.

WA80 Series 1.2/50µs Graph



W21 Series & W31 1.2/50µs Graph



Further Information

For additional information or to discuss your specific requirements please contact our Resistor Applications Team using the contact details below.

Note: Graphs are based on theoretical data.

TT electronics has over 60 years experience in designing and manufacturing resistive components.

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