QuadTech

Application Note

How Much is One Joule?

The Digibridge product specification states that, "The instrument is protected from charged capacitors with a stored energy up to 1 joule at 60 volts or less." But, how much energy is a joule? The IEEE Standard Dictionary of Electrical and Electronic Terms, second ed. defines it as:

> joule (1) (general) The unit of work and energy in the International System of Units (SI). The joule is the work done by a force of 1 newton acting through a distance of 1 meter, or 1 joule = 1 watt-second.
>
> Example: A 60 watt light bulb uses 60 joules of energy every second.
> Example: If you apply 12 newtons to lift a pumpkin 1-meter you expend 12 joules of energy.

How does this relate to the voltage stored in a capacitor? Is the quantity independent of capacitance? Basic physics and electronics books show equations for the energy of a capacitor that look like:

$$W = \frac{CV^2}{2}$$

W: work or energy, in joules
C: capacitance, in Farads
V: voltage, in volts

One joule is found to be dependent upon both voltage and capacitance. Now a relationship between the two can be worked out and plotted as a graph with the following results:

$$V^2 = \frac{2}{C} \quad \text{at 1 joule,} \quad \text{or} \quad V = \sqrt{\frac{2}{C}} \quad \text{or} \quad C = \frac{2}{V^2}$$

Other Definitions of Relevance:

Joule's Law: When electricity flows through a substance, the rate of evolution of heat in watts equals the resistance of the substance in ohms times the square of the current in amperes.

Joule Heat: The heat that evolves when current flows through a medium having electrical resistance as given by Joule's Law.

One Joule of a Curve!

The graph in Figure 1 illustrates the voltage and capacitance specification that a QuadTech 1659, 1692, 1689, or 1693 Digibridge instrument will meet. Any point below the curve is within specification. The front-end protection of these instruments is multi-faceted (consisting of protection diodes, spark gap and a fuse) to accommodate the various types of discharge possible.

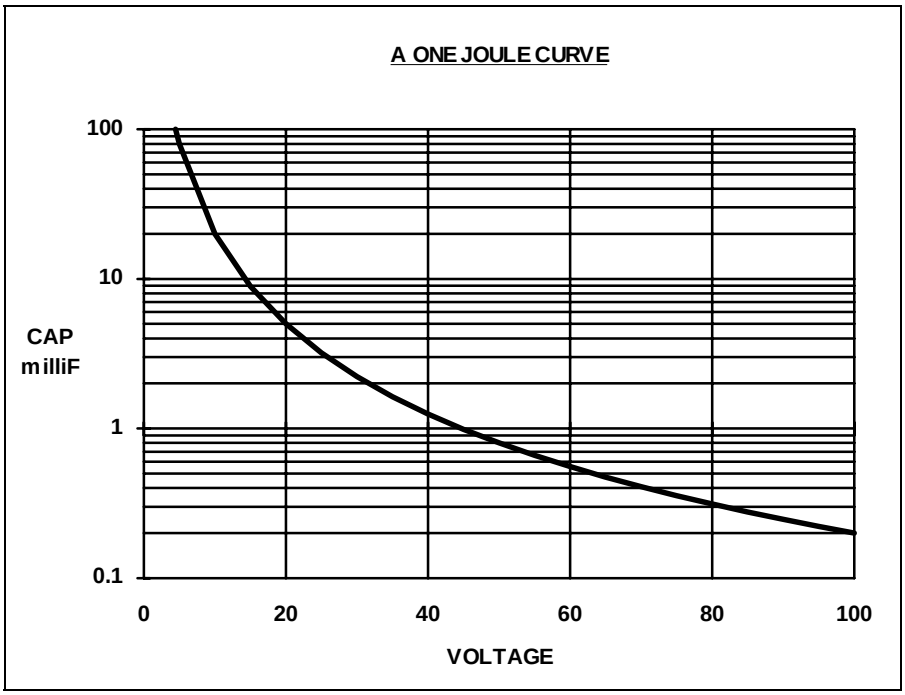

Figure 1: QuadTech Digibridge C vs. V Curve

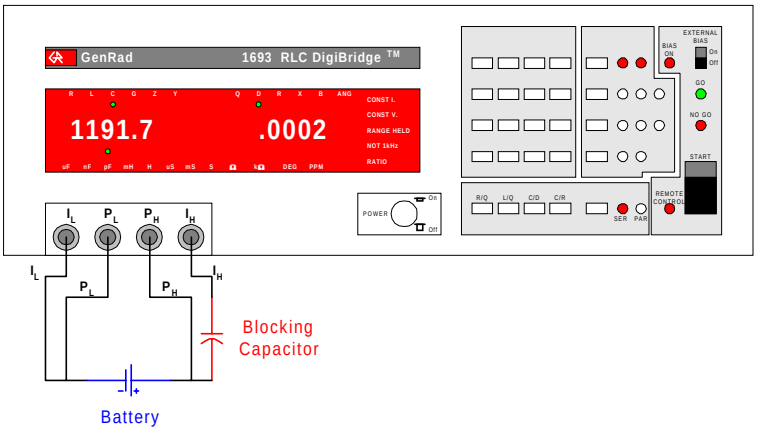

Figure 2: QuadTech 1693 Digibridge

For complete product specifications on the precision Digibridge Line or any of QuadTech's products, visit us at http://www.quadtech.com/products. Call us at 1-800-253-1230 or email your questions to info@quadtech.com.

Telephone: 1- 800-253-1230, Website: http://www.quadtech.com
Printed in U.S.A. P/N 035045/A2 September 2003