# Equation for the 10/350 μs Surge Test Waveform



In 1987 I wrote a computer program to fit equations to the three-point definitions of surge test waveforms in IEC and ANSI engineering standards.[1] Later, I became aware of a surge test waveform with a 10/350 μs waveshape that is intended to simulate a direct lightning strike.[2] In March 1992, I made some numerical models of this lightning test waveform propagating in a network of cables and two varistors.[3] I used the following equation to represent the current, I, in the 10/350 μs wave:

$$I = A\, I_p\, (t/\tau_1)^{10}\ \exp(-t/\tau_2) / [\ 1 + (t/\tau_1)^{10}\ ]$$

where $A = 1.075$

$\tau_1 = 19\ \mu s$

$\tau_2 = 485\ \mu s$

$I_p$ is the peak current in amperes and t is the time in seconds.

posted at **www.rbs2.com/ten.pdf** on 8 Jan 2008

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1 Standler, "Equations for Some Transient Overvoltage Test Waveforms," *IEEE Trans. Electromagnetic Compatibility,* Vol. 30, pp. 69-71, Feb 1988; Standler, *Protection of Electronic Circuits from Overvoltages,* New York: Wiley-Interscience, 434 pp., May 1989. Republished by Dover Publications, December 2002. See pages 80-108 of my book.

2 Deutches Bundesamt für Wehrtechnik und Beschaffung, VG 96 901, Teil 4, "Schutz gegen Nuklear-Elektromagnetischen Impuls und Blitzschlag, Allgemeine Grundlagen, Bedrohungsdaten," October 1985. See also: Peter Hasse and Johannes Wiesinger, "Neues aus der Blitzschutztechnik," *etz,* Vol. 108, pp. 612-618, July 1987. This 10/350 μs wave was later included in IEC standards 61312-1 and 61643-1.

3 Standler, "Calculations of Lightning Surge Currents Inside Buildings," *IEEE International Symposium on Electromagnetic Compatibility,* Anaheim, CA, pp. 195-199, 19 August 1992. This publication does *not* include the equation for the 10/350 μs wave.