What is an 8/20µs Waveform?

Transients can be coupled onto communication and power circuits in a variety of ways. Figure 1 shows three coupling methods onto a power circuit, using lightning as an example source:

- Galvanic coupling is a direct electrical connection.
- Magnetic coupling occurs when the magnetic field of a current carrying conductor induces a current onto an adjacent conductor. This is one reason why burying power cables is not considered adequate protection.
- Capacitive coupling is where the transient voltage is coupled due to the inherent capacitance between two circuits. Nearby power circuits can be a source for magnetic and capacitive coupled transients onto communication circuits, particularly when run together on cable trays or raceways.

The reason why lightning poses such a threat is because it can couple significant amounts of energy onto adjacent conductors using any one of these methods. For example, a lightning discharge several hundred feet from a power transmission line, railroad track or pipeline can magnetically and capacitively couple sufficient energy to disrupt operations and destroy information or equipment.

Due to the random nature of most disturbances and the variable characteristics of the transmission media, transients exhibit wide waveform variations. However, field and laboratory measurements, confirmed by theoretical calculations, have lead to the selection of a small number of waveshapes that are representative of the majority of transients encountered in practice. To assist the industry, Standard bodies such as ANSI/IEEE C62.41 define typical location Categories A, B & C (Figure 2).

In addition to the above waveforms, four others are commonly used:

- CCITT K17, 10/700µs unidirectional impulse for the energy absorption specification of telephone protection equipment. This waveform is most representative of the long tail impulse characteristic of higher capacitance telephone lines.
- IEC, 10/350µs current impulse for service entrance power SPDs. This waveshape is thought to better represent the effects of a direct, galvanically coupled, lightning discharge.
- 5/50ns EFT burst - used to measure immunity of equipment from electromagnetic interference.
- 10/1000µs - sometimes used as a measure to test an SPDs energy handling ability.

These waveshapes define the short-circuit current characteristic of the generator (effectively the generator's internal impedance). It is also common to define the open circuit voltage characteristic of the generator. For example, for an IEEE C62.41 Category B test, this is 6kV 1.2/50µs. The 8/20µs waveform is perhaps the most commonly quoted waveform. Put simply, it is the short-circuit current from a generator with a 1.2/50µs open-circuit voltage. The 8/20µs specifies that the current rises from 10% to 90% of peak in 8µs and then decays to 50% of its peak in 20µs (taken from the 10% rise point and not the peak).

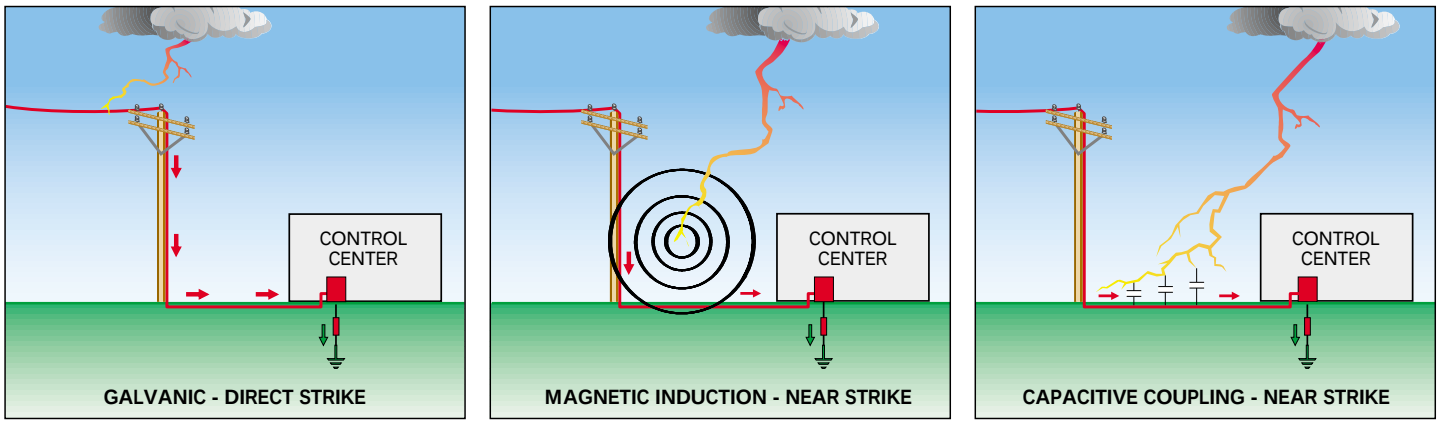
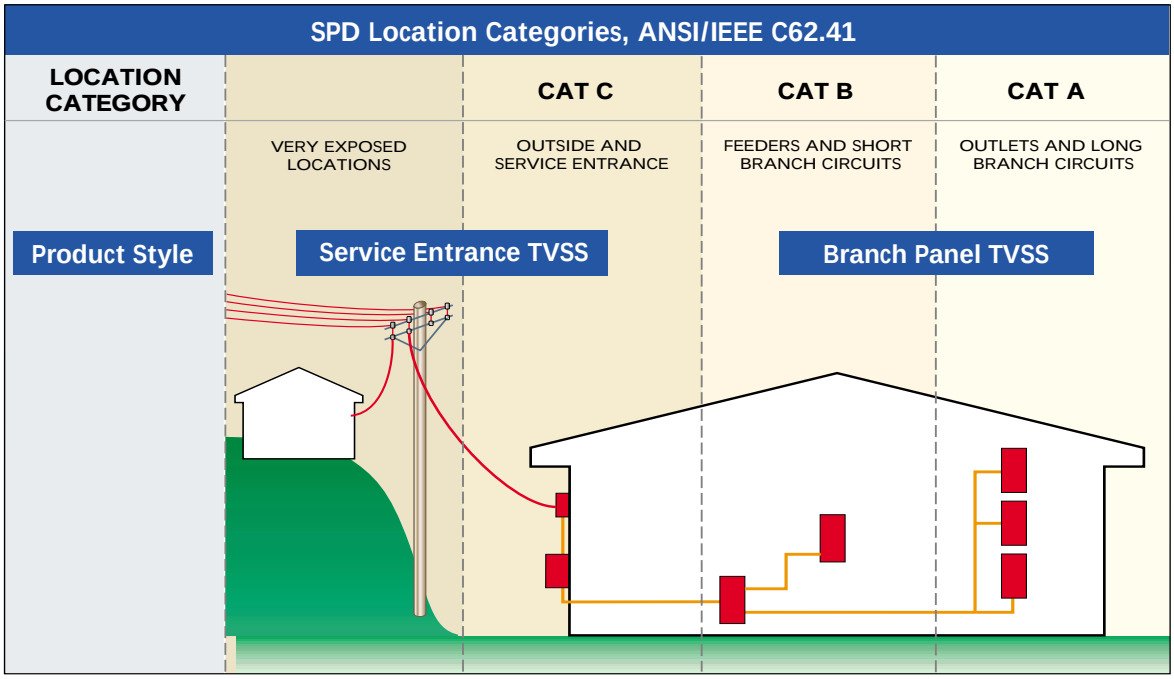
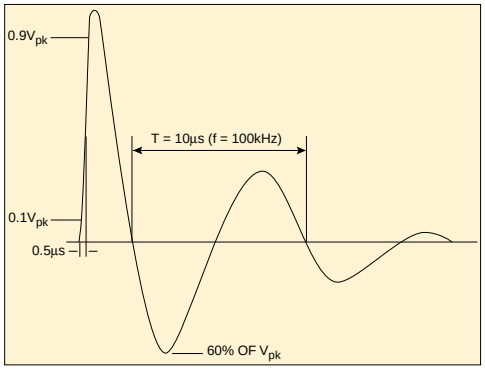


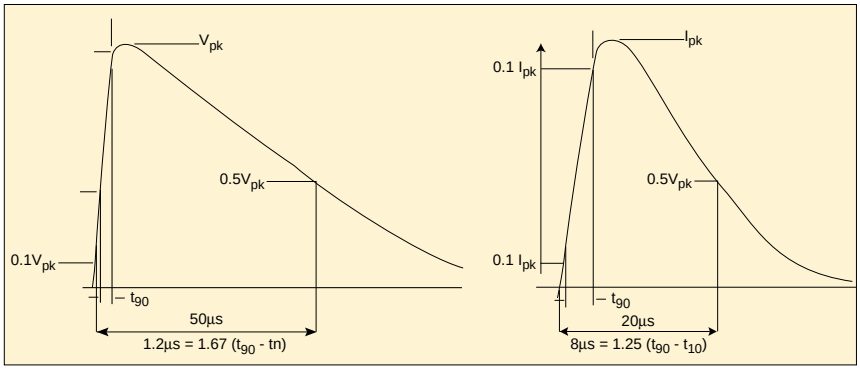
Figure 1. Example of transient coupling methods onto power circuits



Category	Location	Characteristics
A1	Outlets & long branch circuits - Low exposure	2kV / 70A Ring wave (0.5µ-100kHz)
A2	Outlets & long branch circuits - Medium exposure	4kV / 130A Ring wave (0.5µ-100kHz)
A3	Outlets & long branch circuits - High exposure	6kV / 200A Ring wave (0.5µ-100kHz)
B1	Feeders and short branch circuits - Low exposure	2kV / 170A Ring wave, or 2kV / 1kA Combination wave (1.2/50µs-8/20µs)
B2	Feeders and short branch circuits Medium exposure	4kV / 330A Ring wave, or 4kV / 2kA Combination wave (1.2/50µs-8/20µs)
B3	Feeders and short branch circuits High exposure	6kV / 500A Ring wave, or 6kV / 3kA Combination wave (1.2/50µs-8/20µs)
C1	Outside and Service Entrance - Low exposure	6kV / 3kA Combination wave (1.2/50µs-8/20µs)
C2	Outside and Service Entrance - Medium exposure	10kV / 5kA Combination wave (1.2/50µs-8/20µs)
C3	Outside and Service Entrance - High exposure	20kV / 10kA Combination wave (1.2/50µs-8/20µs)



ANSI C62.41 Category A test pulse - 0.5µs 100kHz open circuit voltage ringwave.



ANSI C62.41 Category B test pulse - 1.2/50µs unidirectional open circuit voltage waveform, and resultant 8/20µs current discharge waveform.