Standard test waveforms

IEC 61000-4-5 defines the 1.2/50µs V – 8/20µs I combination wave. It also refers to the CCITT (ITU K.17) 10/700µs wave to be applied to telecom ports. IEC 61000-4-12 defines the waveform for the ring wave.

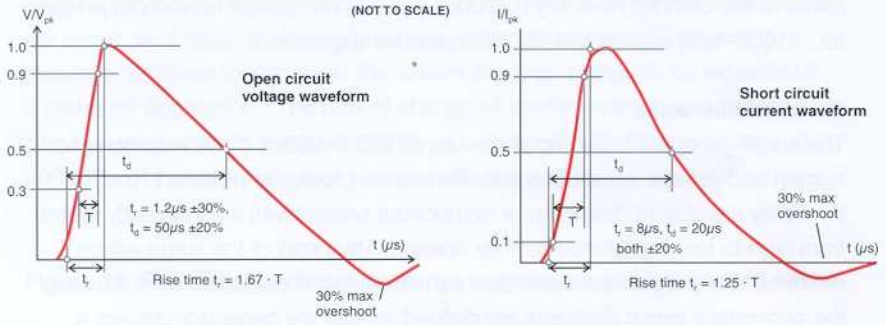
Combination wave

The surge generator called up in the test to IEC 61000-4-5 has a combination of current and voltage waveforms specified, since protective devices in the EUT (or if they are absent, flashover or component breakdown) will inherently switch from high to low impedance as they operate. Thus part of the surge will be delivered into a high impedance and part into a low impedance. The values of the generator's circuit elements are defined so that the generator delivers a 1.2/50µs voltage surge across a high-resistance load (more than 100Ω) and an 8/20µs current surge into a short circuit (Figure 18).

These waveforms must be maintained with a coupling/decoupling network in place, but are not specified with the EUT itself connected, and for coupling devices for signal lines this requirement is waived. Since the surge waveform is specified as both a voltage and current, it has to be calibrated into both an open circuit and a short circuit.

Figure 17 The Schaffner Best Compact Test System
for Burst, ESD, Surge and Transient benchtop compliance testing

Figure 18 The combination surge waveform



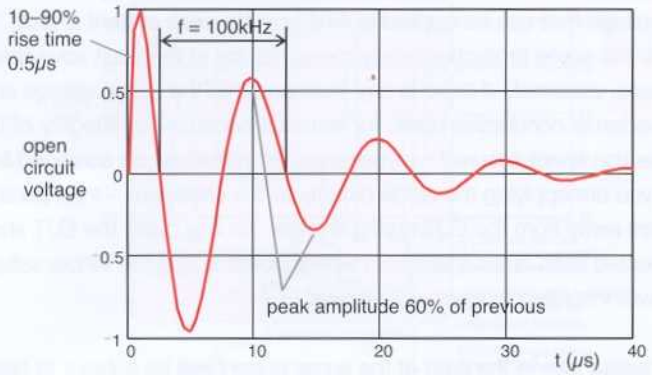
Ring wave

Measurements have shown that most surge voltages in indoor supply systems have oscillatory waveforms. Even if it is unidirectional to start with, an incoming surge excites the natural resonances of the system. The frequency of oscillation can vary between 1–500 kHz and can have different amplitudes and waveforms at various places in the system.

IEC 61000-4-12 defines a "ring wave" with the characteristics shown in Figure 19. It is said to be representative of a wide range of electromagnetic environments of residential and industrial installations. Despite this, it has not found favour with product committees who are responsible for choosing basic standard tests and, as a result, it is not widely applied in product testing.

Generator output impedance Z	Minimum repetition period	Application
12Ω	10s	EUT supply ports connected to major feeders; application between communication ports on cabinets interconnected with 10m long screened data comms cables
30Ω	6s	EUT supply ports connected to outlets
200Ω	1s	I/O ports, unless the test involves protection devices or filters, in which case 12Ω or 30Ω is applicable

Figure 19 The ring wave



Telecom waveforms

For ports connected to telecommunications lines, a further 10/700μs surge is required. The voltage waveform is specified in the same way as for the combination wave above, with a front time of 10μs ±30% and a time to half value of 700μs ±20%.

No current waveform is shown, instead the component values of the waveform generator are provided. The generator has an output resistance of 25Ω which may be provided either internally or by external coupling resistors (see top diagram of Figure 21).

Practical aspects of surge application

Because of the lower frequency spectrum content of the surge waveforms, surge testing is more tolerant of layout variations, and the standards are fairly relaxed in this respect. The cable between the EUT and the coupling/decoupling network should be 2m or less in length (1m for the ring wave). For the combination wave and telecom wave there are no other explicit restrictions on the layout. The ring wave test is best carried out over a ground plane, but even this can be waived for table-top equipment if the earthing connections are well controlled.