Measurement/Searching techniques/Experiment

Investigation

The scenario is that a negative surge exceeding –70 V will drive the –70 V supply more negative due to current being conducted via the diode which clamps the incoming line to the –70 V supply rail. If the –70 V rail becomes too negative, it can cause semiconductor "latch up" of the SLIC. "Latch up" is a failure mechanism in semiconductor devices where externally applied transients exceeding the maximum supply voltage result in the triggering of internal parasitic transistors forming a thyristor-type structure. This internal thyristor can conduct appreciable current and typically results in the rapid destruction of the device.

The network operator investigated damage to the external thyristor protection circuit, to the diode which clamps the incoming line to the –70 V supply rail, and to the SLIC, by electrically characterizing these components and then de-encapsulating those components with degraded characteristics and inspecting them under an optical microscope. The SLIC showed signs of significant damage consistent with "latch up" indicating that the power supply was supplying current conducted to ground via the SLIC. The thyristor protection circuit had no signs of damage.

Surges were applied to a working circuit to verify this scenario. Figure 2.10-3 shows negative surges applied to an unprotected circuit. The generator surge (–191 V) causes a surge of –100 V on the b leg of the circuit. The difference of 91 V is due to the voltage drop on the coupling metal oxide varistor (MOV). The surge has caused the –70 V rail to be driven more negative (–70 V to –96 V). After a few surges, permanent damage has occurred.

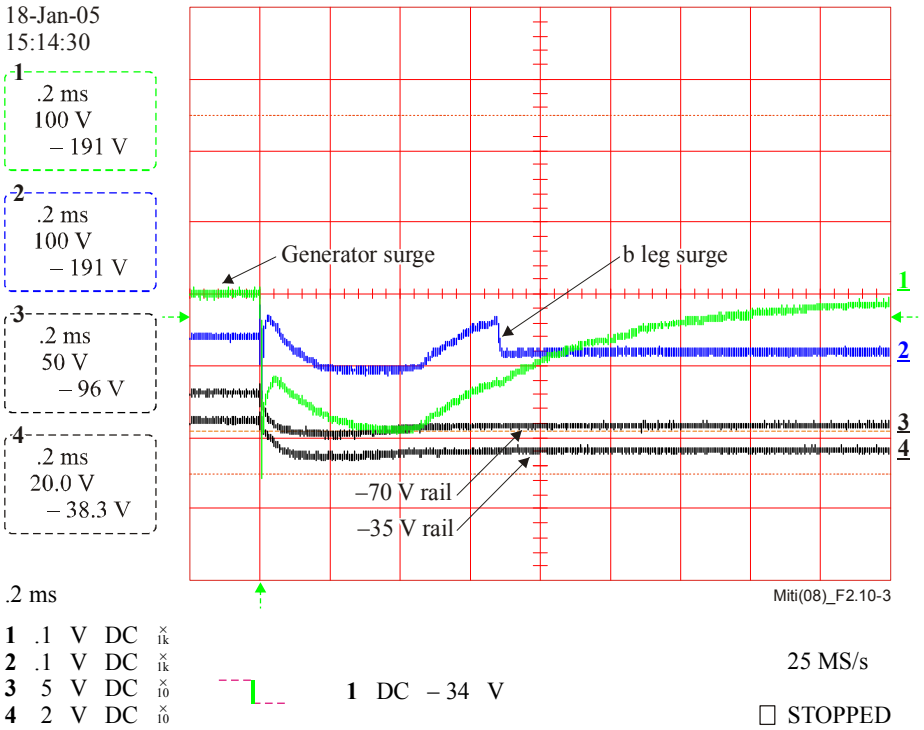

Figure 2.10-3 – Waveforms during a damaging surge