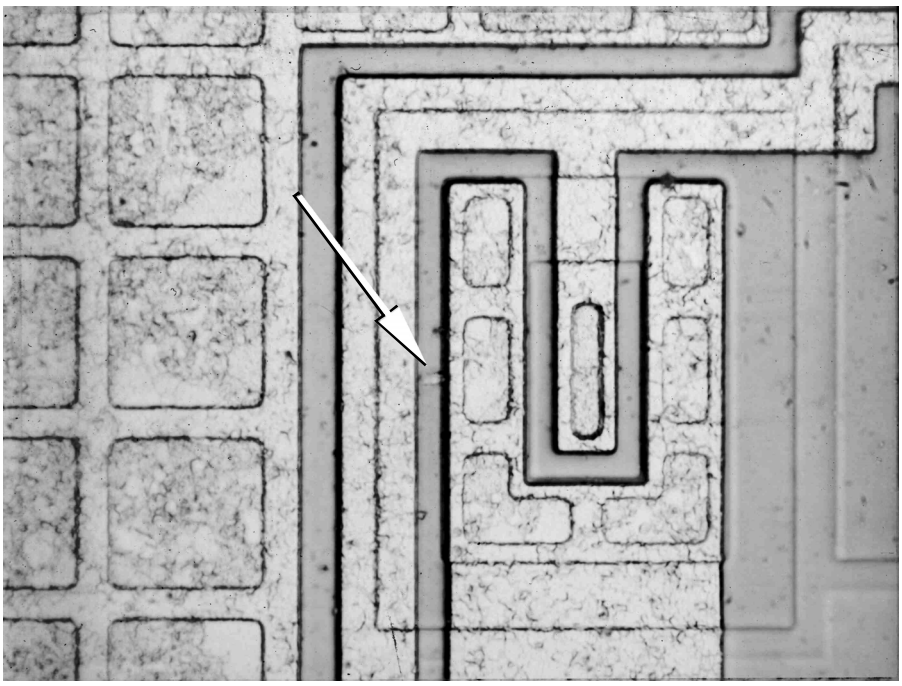
Measurement/Searching techniques/Experiment

Identifying failed components

The first part of the investigation was to identify the damaged components using normal service techniques. The component most damaged was a transmission IC. The plastic coating on top of the IC was then removed using chemical etching to expose the die. The die was then inspected using an optical microscope and photographed. Typical field damage can be seen in Figure 2.7-2.



Miti(08)_F2.7-2

Figure 2.7-2 – Damage to the transmission IC by lightning strikes

This damage is due to a breakdown between a conductor track and a ground as a result of an impulse overvoltage.

Replicating field damage in the laboratory

In an attempt to replicate this damage, different types of lightning surges, as recommended in Rec. ITU-T K.21, were applied to the telephone. No damage could be caused using up to 4 kV 10/700 µs waveshape, without external surge protective devices (SPDs), i.e., an inherent test voltage of 4 kV. When the voltage was further increased, damage could be caused but it was a different type of damage.

The next type of test was to investigate whether the operation of a GDT or sparkgap could cause a very high dV/dt and replicate damage to the IC. This test was performed with a GDT or sparkgap across the line or line to earth. Voltages as high as 6 kV could not damage the IC.

The next experiment was to check if high voltages (up to 100 kV) applied longitudinally could cause high charging currents and damage the IC due to the capacitance of the phone to earth. The charging currents did not cause damage but when one side of the line discharged to earth, the damage was replicated.