5.1 NEW CONCEPTS

5.1.1 Introduction

Historically, the interface between the tester’s pin electronics (driver, comparator, DC circuits) and the device under test (DUT) has not received too much attention, apart from mechanical considerations. Figure 5-1 shows a block diagram of a typical test setup. We will go into more details on many of the components shown later in this chapter.

But as usual any chain is only as strong as its weakest link [1], [2]. In this case it means that even the best performing, highest bandwidth, most accurate tester will work unless all components between the tester pins and DUT are interfaced in the same high performance way.

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1 For production test, electrical performance has so far usually taken a back seat compared to life time considerations (number of device insertions before damage to the interface occurs), compatibility with a certain handler, ruggedness, and material cost.
fail to reliably sort good devices from bad ones or give accurate characterization results if the connection between tester and device – i.e. the interface – does not perform equally well: the tester has no direct knowledge about the “real” device itself – it only “sees” it through the interface. Thus if the interface degrades the signals sent to or coming back from the device, the device may fail the test even though it is actually behaving perfectly fine – resulting in costly yield loss in production test, or unnecessary and time consuming design respins because of inaccurate characterization data. Or an interface with insufficient bandwidth could hide sudden glitches in the device output so a faulty device escapes detection, increasing the failure rate at the customer. Because it increases test accuracy, solid and clean high-performance interface design also helps to achieve cross-platform correlation of test results, important for large device manufacturers and test houses that aim to retain second-source capability with regard to the test platforms used.

Figure 5-1: Simplified typical block diagram of a single channel in an automated test setup: Drv = driver, Cmp = comparator (receiver), R = driver impedance (matched to line impedance), T = termination circuitry, DC = DC measurement unit. Details are explained throughout this chapter.

Often the tester including the connection (printed circuit board, cables, relays, receiver, see Figure 5-1) was considered to be a simple capacitive load on the DUT’s output. This still lingers for example when one sees printed circuit board (PCB) vendors specify the “total capacitance” of each of their traces on a PCB [3]. Unfortunately this simple picture completely ignores the way an electric signal travels along the transmission path between DUT and tester electronics (see Figure 5-1), and it cannot account for any effects that occur within the order of (or less than) one or a few times the propagation delay of the path. Since in a typical dielectric ($\varepsilon_r \approx 4$) the signal propagation speed is ($c$ is the speed of light):

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\varepsilon_r = \frac{c}{v}
\]

2 The dielectric constant $\varepsilon_r$ describes the polarizability of a material (dielectric, insulator) in an electric field. For a capacitor it gives the ratio of the capacitance with the dielectric compared to the case where the material is replaced by vacuum (or, for practical purposes, air). It also determines the propagation speed of electromagnetic waves in this material, as shown in formula (1).