

SEMI G23-0996

TEST METHOD FOR INDUCTANCE OF INTERNAL TRACES OF SEMICONDUCTOR PACKAGES

NOTE: This entire document was revised in 1996.

1 Purpose

This test method describes the measurement method for the inductance of internal traces of semiconductor packages.

2 Scope

2.1 This test method is applicable for the measurement of package inductance that is greater than 0.5 nH.

2.2 This document describes the measurement of a pin grid array, one of the package types, as a sample.

2.3 This test method is also applicable to other types of packages.

2.4 The inductance in this document is limited to that of internal traces only and does not contain the portions contributed by the exposed areas such as pins and wires.

2.5 This document uses SI units.

3 Limitation

It is not practical to apply this test method for fine-pitch packages where traces or pads (point A of Figure 1) cannot be connected to with two probes.

4 Referenced Documents

None.

5 Terminology

5.1 *internal inductance (of packages)* — Inductance of the circuit that comprises the signal path starts from the shoulder or in the center of the outside lead (point A of Figure 1) and ends at the end of the lead on the cavity side of the lead (point B of Figure 1). The return path is made by tying all other traces (except for the target trace in the same electric potential) together. The target trace is tied to the return path at the bonding finger (see Figure 2).

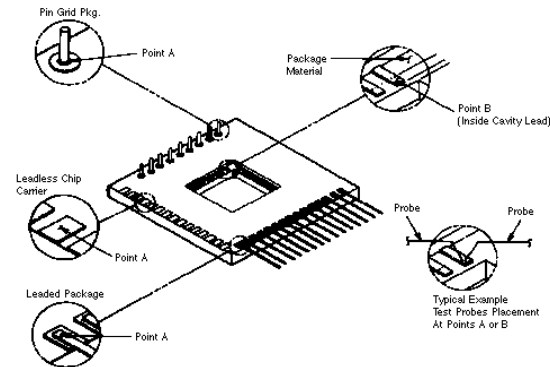


Figure 1
Internal Inductance Measurement

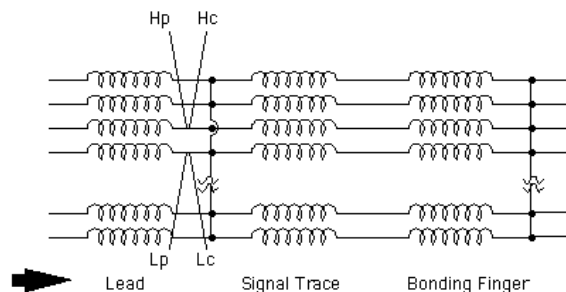


Figure 2
Concept of Internal Inductance

5.2 *four-point probe* — The probe consists of four coaxial measuring terminals, H_c (current high), H_p (potential high), L_c (current low) and L_p (potential low), to measure impedance. Independent coaxial cables are used between the package being measured and the measurement instrument to minimize the effect caused by mutual inductance (between terminals) and/or interferences from the measured signals (see Figures 3 and 6).

6 Summary of Method

Fabricate the package to be measured. Then measure the inductance of internal traces using the four terminal probe method.

7 Interference

7.1 It is desirable that an operator who is familiar with the measuring system, measuring method, and

principles, conduct the actual measurement to get the best result.

7.2 To get an accurate measurement, maintain equal probe angle and distance.

8 Apparatus

8.1 LCR Meter

8.1.1 Four terminal probe attachment capability

8.1.2 Capable of measuring at the frequency of 10 MHz or higher

8.1.3 Measurement error of less than 0.1 nH for the measurement range more than 1 nH at the measurement frequency

8.2 *Four Terminal Probe* — See Figure 3.

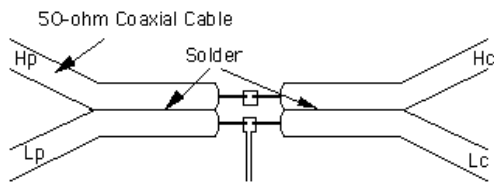


Figure 3
Configuration of Four Terminal Probe

8.2.1 *Residual Inductance* — less than 1 nH

9 Material

9.1 Copper Plate

9.1.1 *Plating* — gold

9.1.2 *Thickness* — 2 mm or thicker

9.2 *Insulator* — such as Teflon

9.3 Silver Foil

9.3.1 *Thickness* — around 50 μm

9.4 Solder or Conductive Paste

9.4.1 *Resistivity* — $10^{-4} \Omega \cdot \text{m}$ or less

10 Test Specimens

10.1 *Preparation of Sample* — Conduct the circuit by measuring the trace as a signal path and the rest, which has a different potential from this signal path, will be the return path, as follows:

10.1.1 All the bonding fingers shall be soldered or pasted together at the bond finger area to form a short circuit.

NOTE 1: The short circuit area shall be 0.5 mm from the tip of the bond fingers. The entire bond fingers shall not be short circuited (see Figure 4).

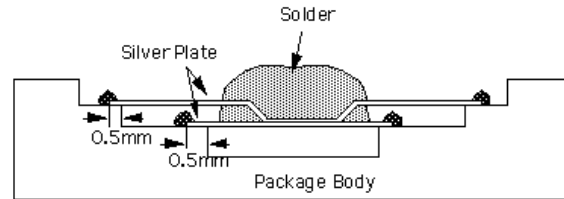


Figure 4
Sample Preparation (Part of Bonding Finger)

10.1.2 Short all pins or leads except for the ones with the same potential as the trace being measured.

NOTE 2: The location for the short circuit shall be as close as possible to the bottom of the pins or the braze pad of the leads to minimize the inductance caused by the pins or leads.

NOTE 3: In case of Pin Grid Array packages, it is recommended to press 50 μm thickness silver foil, which is the same size of package, through the pins. In case of Flat Packages, it is recommended to solder silver foil (or a copper foil) at the braze pads of the leads.

11 Preparation of Apparatus

Before starting the measurement, warm up the instruments as specified in the manual.

12 Calibration

Before starting the measurement, calibrate the instruments as specified in the manual.

13 Procedures

13.1 Measurement of Residual Inductance

13.1.1 Set the LCR meter to the inductance measurement mode.

13.1.2 Measure the inductance by conducting the four terminal probe on the gold plated copper plate as shown in Figure 5.

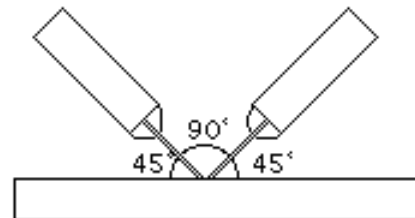


Figure 5
Measurement of Residual Inductance