International Journal of Scientific Engineering and Science
Volume 3, Issue 7, pp. 28-29, 2019. ISSN (Online): 2456-7361

Reinforcing a Bridging Connection Design for Electronic IC Device with Complex Wire Layout Requirement

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***Abstract*—** *The integration of bridge connection line on an electronic integrated circuit (IC) package construction is an expansion in the packaging design to improve known assembly limitations particularly on some instances that a long wire connection inside the IC device is inevitable. The technicality of the idea is to replace the identified longest wire connection with an alternative wiring technique and incorporating a conductive interconnects in the device layout where it will be a junction for the wiring of silicon die and input/output (I/O) leads. In this case, the length of the wire can be limited and controlled to a certain distance during IC assembly, that which its behavior on the actual device and assembly can be more predictable and manufacturable.*

***Keywords*—** *Package design; IC; wirebond; bridging connection; wire sweep; electronics.*

I. INTRODUCTION

The electronic packaging design is a crucial part in integrated circuit (IC) assembly due to the fact that it needs to balance the requirement of the customer versus manufacturability and productivity of the device. There are circumstances that contradiction between the requirements from one another take place leading to some instances of inevitable design rule violations. Commonly, these violations in the design are potential causes of gross assembly/production rejections or otherwise an escapee of this reject can affect the functionality and reliability of the device at the end user's application.

An extended or longer wiring layout between silicon die and input/output (I/O) leads or terminals or pins is one example of design rule violations that could affect the functionality of the device. An over extended layout in the wire is known in assembly to easily misplaced or be disturbed during the process of plastic encapsulation. When a wire sway or wire sweep in Fig. 1 happens, it will hit or become electrically shorted to the neighbouring or adjacent wire or connections, eventually causing device malfunction.

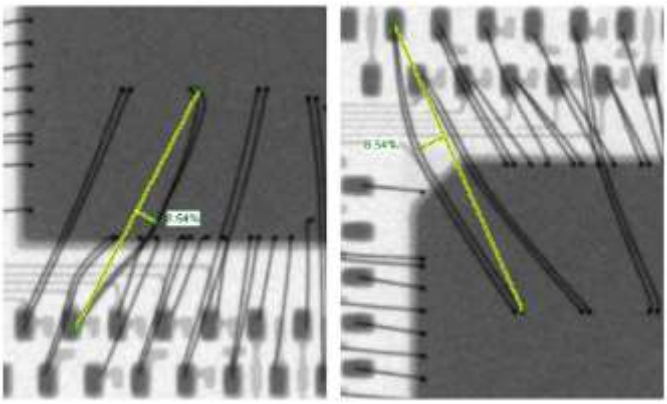

Fig. 1. X-ray images showing wire sweep or sway on actual IC package.

II. MATERIALS AND METHODS

A. Design Solution

An electronic IC packaging design of wirebond bridging connection is incorporated in the current design of electronic IC wherein the long wire connection is modified into a different wiring technique, as illustrated in Fig. 2. The design is comprised of a conductive pads located at the available spaces inside the leadframe die paddle where it will be the junction between the wiring from the silicon die and the I/O pin.

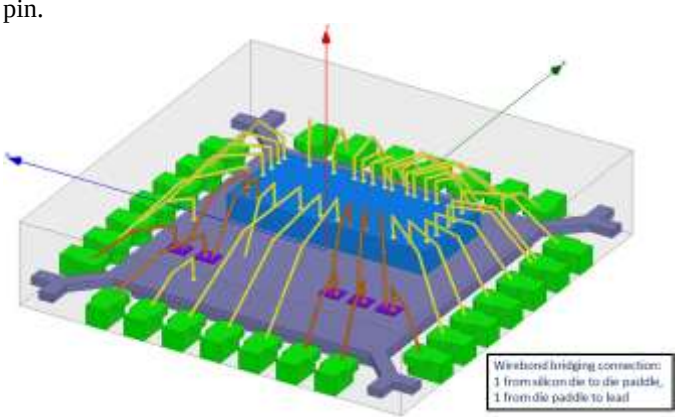

Fig. 2. Electronic IC package design with wirebond bridging connection.

The wiring connection is split into two segments of wire with shorter length – the 1st wiring is between the silicon die and conductive pads; and the 2nd wiring connection is on the conductive pads and defined I/O pins. It is important to lessen the wire length since it is more robust in structure than an over-extended wiring. In this case, the wire swaying scenario is minimized and can be controlled to a certain level.

B. Conductive Pads Construction

The conductive pads shown in Fig. 3 is composed of two layers of material wherein the 1st or outer layer where the wire is bonded or connected is composed of a conductive material,

and the 2nd half is designed to be non-conductive. The second layer non-conductive material could be glue or die attach film (DAF) that is not conductive, to avoid electrical shorting of the first layer and the ground die paddle.

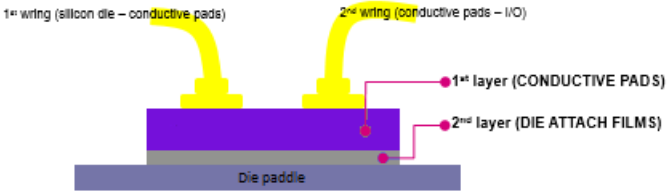

Fig. 3. Cross-sectional view of the conductive pads.

The 1st layer can be alumina wafer which is a common material used in IC assembly as dummy wafers. This material has a conductive characteristic which will let electrical continuity between the two wirings, and also capable with intermetallic bonding for wiring stability. The second layer is suggested to be non-conductive, as earlier explained, with DAF as a more suitable option. The DAF material is composed of silica fillers and plastic polymers which in turn is a non-conductive material used in IC assembly. In addition, this material has a good adhering characteristics between the silicon pads and the leadframe die paddle.

C. Application on Actual QFN Leadframe Device

A quad flat no-leads (QFN) leadframe device intended for power applications is required to maintain certain length of wire in the right portion of I/O leading to an over extended wire connection to the opposite side of the device as shown in the left photo of Fig. 4. Through incorporating the design as shown on the right photo of Fig. 4, the length is significantly reduced into a manageable length satisfying the design rule for maximum wire length, and at the same time conforming to the electrical and functional requirement of the device.

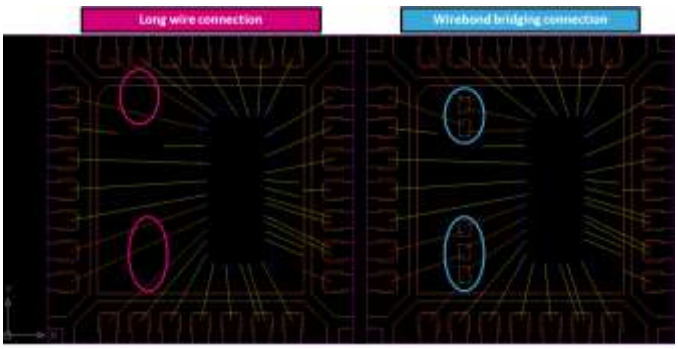

Fig. 4. (Left) A QFN device with over-extended wire connection.
(Right) Actual application of the conductive pads versus given design.