

INTEGRATED CIRCUIT SYSTEM WITH ANTENNA

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims the benefit of U.S. Provisional Patent Application serial number 60/580,086 filed June 15, 2004, and the subject matter thereof is hereby incorporated herein by reference thereto.

This application is a Divisional of U.S. Non Provisional Patent Application serial number 10/908,973 filed June 2, 2005, now U.S. Patent No. 7,444,735, and the subject matter thereof is hereby incorporated herein by reference thereto.

FIELD OF THE INVENTION

[0001] The present invention relates generally to integrated circuits, and more particularly to radio frequency identification integrated circuit systems.

BACKGROUND OF THE INVENTION

[0002] In the stream of commerce, it is desirable to keep track of products shipped from a manufacturer or seller to a customer or end user in order to protect the product from loss or theft. Incidences of lost or misplaced cargo can detract significantly from the bottom line for both shipping companies and uninsured purchasers of lost or stolen products. Keeping track of where a particular package is located while enroute to a customer is a labor intensive task for the shipping company handling the package. In addition, the customer must rely on the shipping company to provide the current whereabouts of the product while enroute, and/or must access the shipping company's web site in order to locate that information.

[0003] Any shipping information known by the manufacturer or seller of a product is usually restricted to the information supplied at the time a shipping company takes physical possession of the product and identifies it by using, for example, an optical scanner.

[0004] While radio frequency identification (RFID) has been implemented in an effort to automate the tracking process (i.e., eliminate the reliance on a human package handler to provide the tracking information), the basic problem still remains: information cannot be easily obtained concerning the whereabouts of a package while en route. To resolve this problem, a low cost, compact, and unobtrusive means is needed to provide accurate tracking information of a package.

[0029] Referring now to FIGs. 1, 2, and 3, therein are shown an integrated circuit system 100. FIG. 1 is a plan view applicable to multiple embodiments of the integrated circuit system 100 in accordance with the present invention. FIG. 2 is a cross-sectional view of a first embodiment of FIG. 1 taken along line 2--2, which shows a first antenna system 102. FIG. 3 is a cross-sectional view of a second embodiment of FIG. 1 taken along line 3--3, which shows a second antenna system 104.

[0030] The integrated circuit system 100 includes first and second integrated circuit devices, such as first and second RFID devices 106 and 108.

[0031] For the first antenna system 102, the first RFID device 106 is connected to a first pad 110 on a substrate 112. A lower redistribution layer (RDL) 114 is formed over the substrate 112 as shown in FIG. 2 and the first pad 110, and is patterned to form a conductive path 115 as shown in FIG. 1.

[0032] A first dielectric layer 116 is deposited on the substrate 112 and over the lower RDL 114 with an opening over a portion of the lower RDL 114 as shown in FIG. 2. A bottom surface of the substrate 112 and the first and second integrated circuit devices 106 and 108, on a side opposing the lower RDL 114, remains exposed to the environment. For ease of explanation, various layers are shown as transparent and the same numbers are used to designate the same or similar elements.

[0033] A first pillar 118 is formed over the first dielectric layer 116 in the opening in the first dielectric layer 116 and is in contact with the lower RDL 114 as shown in FIG. 2.

[0034] A second dielectric layer 120 is formed over the first pillar 118 with an opening provided therein exposing a portion of the first pillar 118.

[0035] An upper RDL 122 is formed in contact with the first pillar 118 as shown in FIG. 2 and is shaped to form a coil or antenna 123 connected to the first pillar 118 at one end and to a second pillar 124 at the other as shown in FIG. 1.

[0036] The second pillar 124 is formed at the same time as the first pillar 118 and is connected to the lower RDL 114, which has patterned to form a conductive path 125 and covers a second pad 126 that is formed at the same time as the first pad 110 and also is connected to the first RFID device 106.

[0037] A cap dielectric layer 128 is formed over the second dielectric layer 120 and the upper RDL 122 formed into the antenna 123.

[0038] In the present invention, it has been discovered that a single thick dielectric layer is workable but by having the first and second dielectric layers 116 and 120 between the

substrate 112 and the antenna 123 it is possible to use multiple thinner layers to better control overall thickness. The thickness can be controlled in an otherwise thin package to provide

What is claimed is:

1. An integrated circuit system comprising:
a substrate having an integrated circuit device;
a first pad on the substrate connected to the integrated circuit device;
5 a first dielectric layer over the substrate and the first pad, the first dielectric layer
having an opening provided therein exposing the first pad;
an upper redistribution layer over the first dielectric layer;
an antenna comprising at least a portion of the upper redistribution layer, the antenna
connected to the first pad; and
10 a second dielectric layer over the first dielectric layer and over the antenna.
2. The system as claimed in claim 1 further comprising a lower redistribution
layer on the first pad and connected to the antenna.
3. The system as claimed in claim 1 further comprising forming a pillar on the
first pad and over the first dielectric layer, the pillar connected to the antenna.
- 15 4. The system as claimed in claim 1 further comprising:
a first pillar on the first pad;
a third dielectric layer over the first pillar, the third dielectric layer having an opening
provided therein exposing the first pillar; and
a second pillar on the pad in the opening in the third dielectric layer, the second pillar
20 in contact with the antenna.
5. The system as claimed in claim 1 further comprising:
forming a plurality of pillars on the pad, the plurality of pillars connected to one end
of the antenna;
forming a second pillar connected to the other end of the antenna; and
25 forming a second pad connected to the second pillar.
6. An integrated circuit system comprising:
a substrate having a radio frequency identification (RFID) integrated circuit device;
a first pad on the substrate connected to the RFID integrated circuit device;
a first dielectric layer over the substrate and the first pad, the first dielectric layer
30 having an opening provided therein exposing the first pad;
an upper redistribution layer over the first dielectric layer;

~~an antenna comprising at least a portion of the upper redistribution layer into, the~~

antenna connected to the first pad; and

a second dielectric layer over the first dielectric layer and over the antenna.

7. The system as claimed in claim 6 further comprising a lower redistribution
5 layer on the first pad and connected to the antenna.

8. The system as claimed in claim 6 further comprising a pillar on the first pad
and over the first dielectric layer, the pillar connected to the antenna.

9. The system as claimed in claim 6 further comprising:

a first pillar on the first pad;

10 a third dielectric layer over the first pillar, the third dielectric layer having an opening
provided therein exposing the first pillar; and

a second pillar on the pad in the opening in the third dielectric layer, the second pillar
in contact with the antenna.

10. The system as claimed in claim 6 further comprising:

15 a plurality of pillars on the pad, the plurality of pillars connected to one end of the
antenna;

a second pillar connected to the other end of the antenna; and

a second pad connected to the second pillar.

What is claimed is:

1. An integrated circuit system comprising:

a substrate;

an integrated circuit device connected to the substrate and having a side exposed;

5 a first pad on the substrate connected to the integrated circuit device;

a first dielectric layer over the substrate and the first pad, the first dielectric layer

having an opening provided therein exposing the first pad;

a plurality of first pillars over the first pad;

a second dielectric layer over the plurality of first pillars, the second dielectric layer

10 having an opening provided therein exposing the plurality of first pillars;

an upper redistribution layer over the second dielectric layer;

an antenna made from the upper redistribution layer, the antenna connected to the
plurality of first pillars; and

a third dielectric layer over the second dielectric layer and over the antenna.

15 2. The system as claimed in claim 1 further comprising a lower redistribution
layer in contact with the first pad and connected to the plurality of first pillars.

3. The system as claimed in claim 1 further comprising a plurality of second
pillars on the plurality of first pillars and over the second dielectric layer, the plurality of
second pillars connected to the antenna.

20 4. The system as claimed in claim 1 further comprising:

a plurality of second pillars on the plurality of first pillars;

a third dielectric layer over the plurality of second pillars, the third dielectric layer

having an opening provided therein exposing the plurality of second pillars;

and

25 a plurality of third pillars on the plurality of second pillars in the opening in the third
dielectric layer, the plurality of third pillars in contact with the antenna.

5. The system as claimed in claim 1 further comprising:

a plurality of pillars on the first pad, the plurality of pillars connected to one end of
the antenna;

30 a second pillar connected to the other end of the antenna; and

a second pad connected to the second pillar.

6. An integrated circuit system comprising:
a substrate;
an integrated circuit device connected to the substrate and having a side exposed;
a first pad on the substrate connected to the integrated circuit device;
5 a first dielectric layer over the substrate and the first pad, the first dielectric layer
having an opening provided therein exposing the first pad;
an upper redistribution layer and a lower redistribution layer in contact with each
other and connected to the first pad;
an antenna made from the upper redistribution layer, the antenna connected to the first
10 pad; and
a second dielectric layer over the first dielectric layer and over the antenna.
7. The system as claimed in claim 6 further comprising a lower redistribution
layer contacting the first pad and connected to the antenna.
8. The system as claimed in claim 6 further comprising a pillar on the first pad
15 and over the first dielectric layer, the pillar connected to the antenna.
9. The system as claimed in claim 6 further comprising:
a first pillar on the first pad;
a third dielectric layer over the first pillar, the third dielectric layer having an opening
provided therein exposing the first pillar; and
20 a second pillar on the first pillar in the opening in the third dielectric layer, the second
pillar in contact with the antenna.
10. The system as claimed in claim 6 further comprising:
a plurality of pillars on the first pad, the plurality of pillars connected to one end of
the antenna;
25 a second pillar connected to the other end of the antenna; and
a second pad connected to the second pillar.