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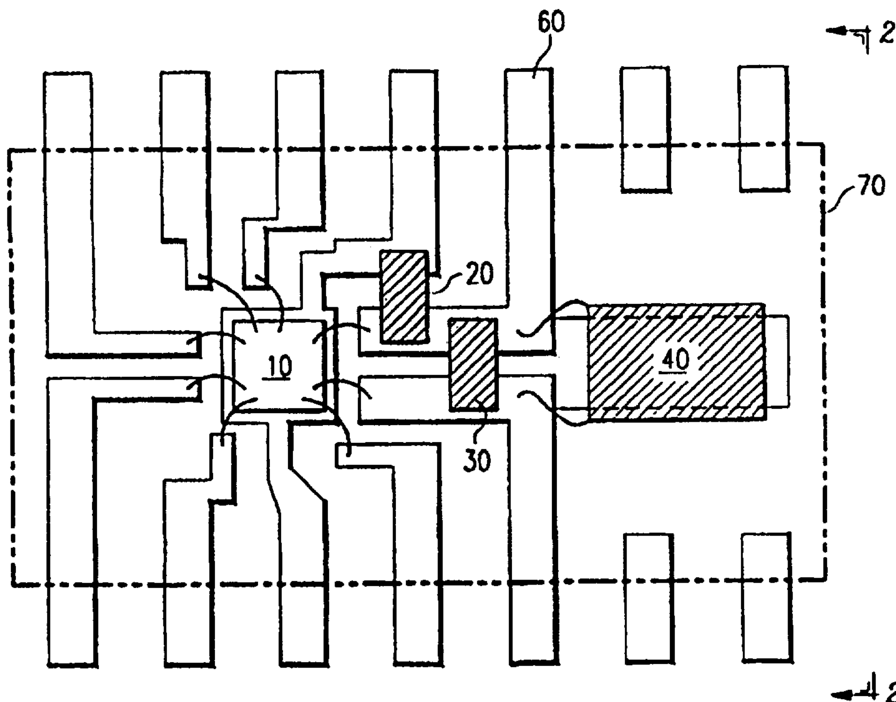

(57) Abstract

A standard package is provided in which circuit components (10) and non-integrated circuit components (20, 30, 40) are electrically connected together and then overmoulded (70). The components may be coupled together on a lead frame (60). The standard package may provide a desired electrical function by itself or it may be coupled together with other overmoulded packages or additional non-overmoulded electronic components.

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INTEGRATED SYSTEM PACKAGE

TECHNICAL FIELD OF THE INVENTION

This invention generally relates to electronic circuits and more particularly to an integrated system package having a plurality of overmolded electronic components.

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BACKGROUND OF THE INVENTION

Conventional electronic circuits are formed by electrically connecting various discrete electronic components in a particular configuration to achieve a desired electrical function. Various electronic components may include, for example, resistors, inductors, capacitors, antennas, transistors, inductors and the like. Typically, the discrete electronic components are wired together on a printed circuit board (PCB) in the configuration necessary to achieve the desired electrical function.

Electronic devices are being designed to be increasingly smaller in size. Therefore, it is necessary to provide increasingly small circuitry for such devices. The above-described conventional circuit technology, however, results in relatively large electrical circuits. One response to the decreasing size requirement of modern electronic design has been the introduction and subsequent improvement of the integrated circuit (IC). IC technology basically involves inseparably connecting circuit elements fabricated in place on and within a substrate. The resulting device is often referred to as an IC chip.

IC chips can function as certain electronic components. For example, an IC can serve as a resistor or a capacitor. However, ICs are typically limited with respect to the number of electronic components which are incorporated in the IC. Such limitations result from many aspects of electronic circuitry including, without limitation, the complexity of the particular circuit being created. Typically, one or more ICs are wired together on a PCB. Often, an IC is coupled with other non-IC circuit components on the PCB. However, size limitations are still inherent in this technology. Additionally, other problems exist such as the time and cost involved in the

assembly of a given circuit on the PCB. Although the IC may be available as a standard package and thus easily incorporated into the circuit, the other discrete non-IC components must be individually arranged and connected to form the overall circuit, Those having ordinary skill in the pertinent art will appreciate that other problems and shortcomings exist with respect to conventional electronic circuit technology.

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SUMMARY OF THE INVENTION

Therefore, a need has arisen for an electronic circuit assembly which is smaller than conventional assemblies which are typically created on printed circuit boards. A need also exists for standardizing complex electronic circuits or portions of such circuits to reduce the time and cost associated with assembling larger circuits and devices incorporating such circuits.

To achieve these and other objectives, an integrated system package is provided which includes an electrical circuit consisting of one or more electronic components which are electrically connected and then overmolded as a single unit. The electronic components may include IC and non-IC components, The standard package may provide a desired electrical function by itself or may be connected with other components on a printed circuit board, for example, as an element of a larger overall circuit.

Thus, assembly of the circuit is simplified and the relative size of the circuit is reduced. The integrated system package can also simplify, and standardize circuits which are too complex to be manufactured as an integrated circuit or otherwise do not lend themselves to assembly as integrated circuits. Other advantages will be recognized to those having ordinary skill in the art.

According to one embodiment an IC chip is electrically coupled with two capacitors and an antenna to form a transponder. The IC has an input/output option for data transfer. The other components provide the electrical function of the transponder. All of the components are overmolded to protect the components from the environment and to provide a

standard transponder package. The transponder may be incorporated in a larger circuit via a printed circuit board.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, reference may be had to the accompanying drawings, in which:

FIGURE 1 is an overmolded circuit according to an embodiment of the present invention;

FIGURE 2 is a side view of the overmolded circuit of FIGURE 1 in the direction of arrow A.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides an integrated system package in which various electronic components are coupled together and overmolded to form a standardized package. The package can provide a desired electrical function by itself or may be incorporated into a larger circuit by way of coupling the package with other components on a printed circuit board, for example.

According to an embodiment of the present invention, one or more electrical components are coupled together on a lead frame. At least one of the components is an integrated circuit chip (IC chip). Referring to FIGURES I and 2, for example, IC chip 10 is provided to perform a first electronic function. A plurality of additional electronic components 20, 30 and 40 are provided and are electrically coupled together with IC chip I 0 to form a first electrical circuit. IC chip 10 may function, for example, as a resistor. However, other types of IC chips may be incorporated into the present invention. Further, more than one IC may be incorporated into the first electrical circuit.

The plurality of additional electronic components are each non-IC components and may include such components as resistors, capacitors, inductors, antennas, and the like. Any passive device may be used. For example purposes only, component 20 is a resistor, component 30 is a capacitor, and component 40 is an antenna. The present invention is not so limited, however, and any electronic component which can be overmolded may be used.

As shown in FIGURE 2, the components are coupled together and overmolded to form a standard package. Any suitable overmolding process may be used, including

conventional overmolding processes. For example the IC chip 10 and components 20, 30 and 40 may be coupled together via coupling medium 60. Coupling medium 60 may be any conventional lead frame. For example, a dual-in-line or SO package may be used. Alternatively, the coupling medium may be a lead frame which is customized and specifically adapted to receive both IC chips and non-IC components. According to another alternative, the coupling medium may be a printed circuit board or other medium suitable for coupling the components together.

IC chip 10 and the plurality of non-IC components may be coupled together on a lead frame by conductive glue, for example. Conductive glue is manufactured by Epotek or Grace of Demetron/Degussa, for example, and is basically an epoxy filled with silver. Alternatively, other suitable bonding processes may be used. For instance, each of the IC and non-IC components may be bonded to a substrate by means of an epoxy, solder, or eutectic bond. Then the IC and non-IC components may be coupled by wire bonding using thermocompression or ultrasonic bonding techniques. The necessary leads to the resulting circuit are then connected to the conduction leads of the lead frame. The particular connections made will depend upon the circuit being created.

The first circuit 50 is preferably encapsulated by an overmolding layer 70. Overmolding layer 70 may be formed by any suitable overmolding or encapsulation process. The overmolding process is preferably conducted at a relatively low temperature and pressure so as to avoid subjecting the components to stress both during and after the overmolding process. Thus, transfer overmolding is preferable. However, other types of overmolding processes may be used. For example, the package can be encapsulated in a resin using a direct dispensing

method or by a screen printing method.. Alternately, the circuit 50 may be placed in a mold, which is then injected with a suitable molten plastic compound.

Once overmolded, the package may comprise its own discrete electronic circuit and may be used to provide a desired electronic function by itself Alternately, the package may be coupled with other similarly-formed packages, other IC components, and/or other non-IC components to form a larger second circuit.

According to another embodiment of the present invention, the above-described techniques are used to provide an overmolded standard digital input/output transponder package. This standard package may be used, for example, in the transponder arrangement described in U. S. Patent No. 5,053,774 issued to Schuermann et al. A first circuit is formed as described above and preferably comprises an IC chi '. The IC chip should have an input/output option (110) to allow data transfer and can be accessed through the leads of a lead frame. The IC chip may also have a memory section and an air interface system. The I/0 can handle incoming and outgoing data. The memory section buffers the received data before sending or shortly after receiving so as to buffer the 110 channel. The air transmittal system includes logic for transmitting data over the air to a receiver.

The IC chip may be coupled to a plurality of capacitors and antennas. For example, the IC chip may be connected to first and second capacitors having capacitances of 470pF and 120nF, respectively. An antenna may also be incorporated into the circuit. For example, an antenna having an inductance of 2.5mH may be used. Preferably, these components are integrated in a standard DIL-14 housing.

The transponder package may thus provide interrogation and response functions associated with transponders. The package may function as a contactless radio frequency identification device (RFID) for work tracking, object identification and similar applications. It may provide these electronic functions by itself with power being supplied by the capacitors. Optionally, a power supply may be incorporated in the transponder package. Further, the transponder package may be included as pact of a larger overall circuit as described above. It should be noted that the specifics of the above-described transponder package are provided by way of example only, and other transponder configurations are possible according to the present invention. For instance, the capacitance and inductance values will depend on the particular application and variables such as frequency range and environmental factors. Also, the standard overmolded transponder package can be coupled to sensors (e.g., temperature, humidity, or pressure sensors) by way of a printed circuit board. Alternately, the sensors may be included in the standard package itself.

The embodiments thus described are intended as examples and the present invention is not to be limited thereto. It will be easily recongnized by those having ordinary skill in the relevant art that various changes, substitutions and modifications can be made without departing from the scope and spirit of the present invention as defined by the following claims.

WE CLAIM:

1. An electronic device comprising:
integrated system package, which comprises:
a plurality of non-integrated circuit electronic components being electrically coupled together to form an electrical circuit; and
an overmolding layer disposed on and encapsulating said plurality of non-integrated circuit electronic components.

2. The electronic device of claim 1, wherein the integrated system package further comprises a plurality of integrated circuits being electrically coupled to the plurality of non-integrated circuit electronic components.

3. The electronic device of claim 1, wherein the integrated system package further comprises a base, the plurality of non-integrated circuit electronic components being assembled on the base and disposed between the overmolding and the base.

4. The electronic device of claim I wherein the base is a lead frame.

5. The electronic device of claim I further comprising a printed circuit board, the integrated system package being mounted on the printed circuit board.

6. The electronic device of claim 5 further comprising a plurality of additional electronic components, the integrated system package being electrically wired together with the plurality of additional electronic components on the printed circuit board.

7. The electronic device of claim 6 wherein the plurality of additional electronic components includes a plurality of sensors.

8. The electronic device of Claim 2 wherein the plurality of non-integrated circuit electronic components includes a first capacitor, a second capacitor and an antenna, and wherein the plurality of integrate circuits includes a first integrated circuit having an input/output opt and adapted for data transfer.

9. The electronic device of claim 7 wherein the first and second capacitors, the antenna, and the first integrated circuit form a transponder.

10. The electronic device of claim 7 wherein the plurality of non-integrated circuit components further includes a plurality of sensors.

11. An electronic device comprising a non-integrated circuit electronic component;

an integrated circuit electronic component, said components being coupled together; and

an over-moulding layer encapsulating said components.

12. An electronic device as claimed in Claim 11 and wherein said coupling is provided by a lend frame or lend frame portion.

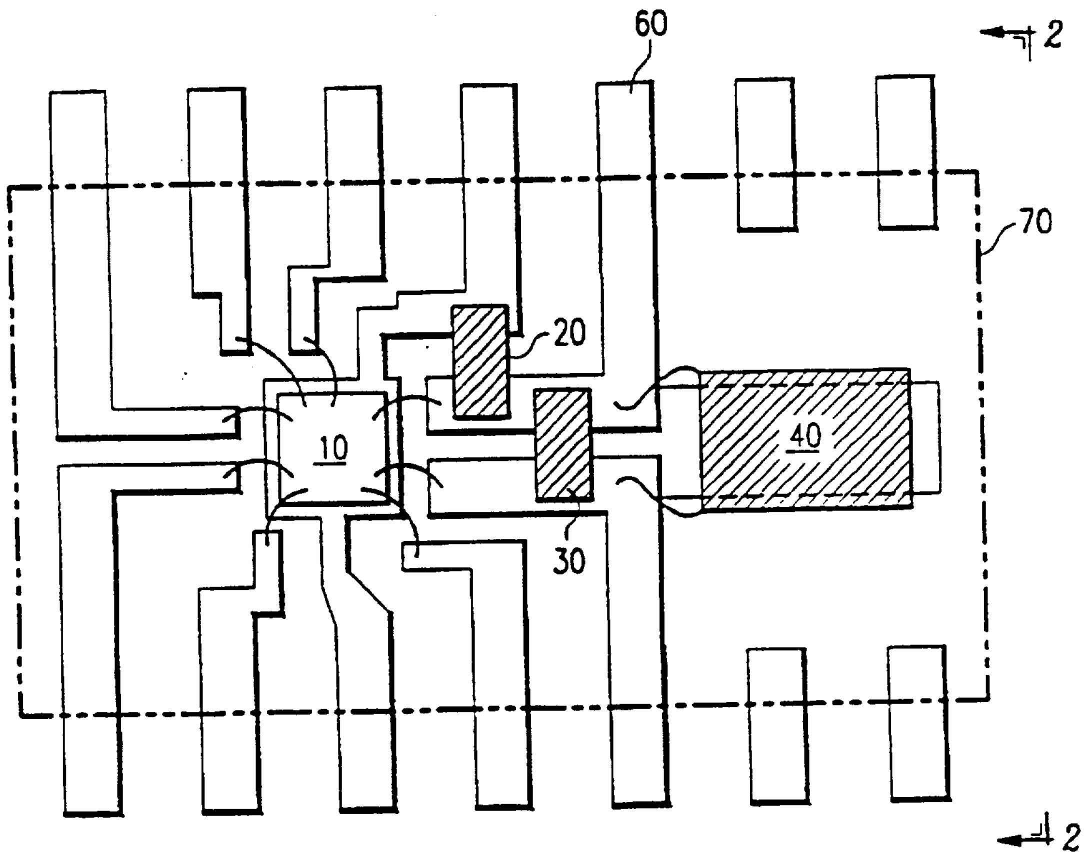

FIG. 1

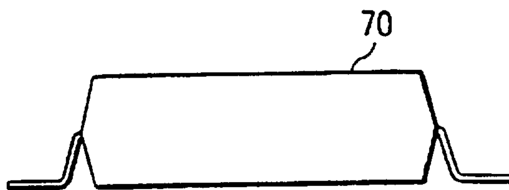

FIG. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 97/00008

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H01L25/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 44 10 212 A (TELEFUNKEN MICROELECTRON) 28 September 1995 see column 1, line 5 - column 2, line 16; figures 1,2	1-6,11, 12
X	WO 94 18700 A (INDALA CORP) 18 August 1994 see page 6, line 31 - page 9, line 5; figures 1,1A,1B	1-4,8,9, 11,12
X	PATENT ABSTRACTS OF JAPAN vol. 008, no. 200 (E-266), 13 September 1984 & JP 59 089447 A (MATSUSHITA DENKI SANGYO KK), 23 May 1984, see abstract	1-6,11, 12

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
3 March 1997	20.03.97

Name and mailing address of the ISA	Authorized officer
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 010, no. 158 (E-409), 6 June 1986 & JP 61 014731 A (KANSAI NIPPON DENKI KK), 22 January 1986, see abstract	1-3,5,6, 11
X	EP 0 615 285 A (CSIR) 14 September 1994 see page 3, line 37 - page 4, line 21; figures 1-6	1-3,11
X	PATENT ABSTRACTS OF JAPAN vol. 96, no. 03, 29 March 1996 & JP 07 306264 A (CHIKUSANYO DENSHI GIJUTSU KENKYU KUMIAI), 21 November 1995, see abstract	1,2,8,9, 11
A	PATENT ABSTRACTS OF JAPAN vol. 95, no. 006, 31 July 1995 & JP 07 066356 A (NEC CORP), 10 March 1995, see abstract	7

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INTERNATIONAL SEARCH REPORT

I.   ,mation on patent family members

Internat.   Application No
PCT/GB 97/00008

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