

DESCRIPTION

INFRARED DETECTOR AND PROCESS FOR FABRICATING THE SAME

TECHNICAL FIELD

The present invention is directed to an infrared detector, more particularly to an infrared sensor including an infrared sensor element and an associated electronic circuit commonly mounted on a single circuit block, and a process of fabricating the infrared detector.

BACKGROUND ART

WO 2004/00198 A1 discloses a prior infrared detector which comprises a circuit block carrying an infrared sensor element, and a case accommodating therein the circuit block. The circuit block is prepared as an injection molded plastic body or so-called molded interconnect device (MID) for mounting, in addition to the infrared sensor element, various electronic components constituting a signal processing circuit which provides a detection output. In order to make the infrared detector compact, i.e., to arrange various electronic components within a limited space, the circuit block is specifically designed into a rather complicated three-dimensional shape in correspondence with the number and kinds of the electronic components, and is therefore fabricated only at an increased cost. Also for electrical connection of the infrared sensor element to the electronic components, the three-dimensional circuit block has to incorporate a correspondingly complicated circuit pattern or conductors, thereby adding an additional fabrication cost. Therefore, there is a demand for fabricating the compact circuit block or the infrared detector at a reduced cost.

DISCLOSURE OF THE INVENTION

In view of the above problem, the present invention has been accomplished to provide an infrared detector which is capable of being fabricated at a reduced cost, yet assuring optimum performance. The infrared detector in accordance with the present invention includes a circuit block carrying an infrared sensor element and electronic components, and a case enclosing the circuit block. The circuit block is composed of a dielectric resin layer and a first substrate which is formed with a circuit pattern for mounting the electronic components. The dielectric resin layer is formed in its top with a recess which defines around its periphery with a shoulder for supporting opposite ends of the

infrared sensor. The recess defines a thermal insulation space below the infrared sensor to give a reliable output without being adversely affected by heat developed at the electronic components. The feature of the present invention resides in that the first substrate is integrated to the lower end of the dielectric resin layer with at least one of the electronic components being molded into the dielectric resin layer below the recess to make the circuit block of a unified mold structure. Thus, a substantial part or all of the electronic components can be molded into the dielectric layer to realize the circuit block of a simple and low profile structure, while retaining an advantage of keeping the infrared sensor element sufficiently away from the electronic components and an associated electronic circuit, thereby assuring to give the infrared detector which is simple in construction, economical in cost, and reliable in the infrared detection.

Preferably, the dielectric resin layer is made of a thermo-setting resin mixed with an inorganic filler intermingled in order to give a consolidated structure to the circuit block while embedding the electronic components successfully at the same time of curing the thermo-setting resin.

The dielectric resin layer is preferred to comprise a first resin layer formed with the recess, and a second resin layer embedding therein at least one of the electronic components. In this connection, a shield layer is disposed between the first and second resin layers for connection with a circuit ground of the circuit pattern, and functions to shield the infrared sensor from the electronic circuit in order to give a reliable infrared detection.

The shield layer is preferred to be deposited on top of a second substrate of a thermosetting resin, and be disposed between the first and second resin layers. The second substrate is heat-pressed together with the first and second resin layers so as to be integrated with the first and second resin layers to realize the circuit block.

Alternatively, the shield layer may be a copper foil which is deposited on the second resin layer so as to be integrated into between the first and second resin layers when the first and second resin layers are heat-pressed to form the circuit block.

Further, the circuit block is preferably formed with through-holes extending through the first and second resin layers for electrical connection of the infrared sensor element, the shield layer, and the circuit pattern.

The electronic components may be composed of a plurality of discrete chips which are mounted on a top surface of the first substrate and are molded into the dielectric resin layer.

When the electronic components are composed of a plurality of discrete chips mounted on a top surface of the first substrate, and an integrated circuit chip mounted on a bottom surface of the first substrate, it is preferred that the discrete chips are molded into the dielectric resin layer, while the integrated circuit chip is exposed outwardly of the dielectric resin layer.

When the electronic components are all assembled into an integrated circuit chip, the integrated chip is preferred to be molded into the dielectric resin layer.

Preferably, a spacer is disposed between a base of the detector and the circuit block. The circuit block may be formed on its bottom with lands which are electrically connected respectively to terminal pins extending through the base, while the spacer is formed with openings through which the terminal pins extend respectively for connection with the lands. Thus, the electronic circuit formed on the lower side of the dielectric layer is connected to the terminal pins in a suitable manner.

The base carries the terminal pins composed of a power supply terminal pin, a ground terminal pin, and a signal output terminal pin all extending through the base. At least one of the terminal pins extends through the circuit block for electrical connection with lands which are formed on top of the first resin layer to mount the infrared sensor element. In this instance, one or more of the terminal pins can be bonded on top of the circuit block for easy electrical connection.

Preferably, a top shield projects on top of the circuit block in order to electrically shield the infrared sensor element from at least one of the power supply terminal pins and the signal output terminal pin, thereby protecting the infrared sensor element from receiving undesired electrical signal transmitted through the terminal pins and therefore assuring reliable infrared radiation at the infrared sensor element.

The top shield may be configured to have its lower end embedded into the top end of the circuit block to give an improved shield effect of shielding over a wide range from within the circuit block.

Preferably, the top shield is electrically connected to the shield layer, i.e., the circuit ground of the electronic circuit. In this connection, the top shield projects in a perpendicular relation to a plane of the shield layer from the shield layer and has its upper end above a top surface of the first resin layer where the infrared sensor is mounted.

The top shield may have its top covered with a bulged portion of the first resin layer so as to be integrated into the circuit block and electrically insulated from conductors on top of the circuit block.

The top shield may be formed on an end wall of the first resin layer so that it can be easily realized in the form of a deposited layer on the end wall.

Further, the present invention discloses a unique process of fabricating the infrared sensor. The process is particularly advantageous for fabricating a plurality of the circuit blocks only through a simple molding and embedding technique. The process utilizes a first resin sheet, a first substrate formed with plural sets of discrete circuit patterns, and a second resin sheet. The process comprises the steps of mounting electronic components on each of the discrete circuit patterns, and stacking the first resin sheet and the first substrate with the second resin sheet interposed therebetween. Then, the first resin sheet, the second resin sheet, and the first substrate are heat-pressed together to form a consolidated body in which the electronic components are molded into the cured second resin sheets or the second resin layer. The consolidated body is drilled to form through-holes and followed by being formed on its top with plural sets of lands. Each set of the lands are interconnected to each corresponding one of the circuit patterns by way of the through-holes. After mounting an infrared sensor element on each set of the lands for electrical connection therewith, the consolidated body is cut into a plurality of circuit blocks each having the infrared sensor element and each the circuit pattern. Thus, a plurality of circuit blocks can be obtained by a simple molding technique, and yet at the same time of integrating the electronic components into each of the circuit blocks. Thereafter, each circuit block is mounted on a base and a plurality of terminal pins are inserted into the through-holes and the base to make electrical connections between the terminal pins to the electronic circuit.

Alternatively, the infrared sensor element may be mounted on each of the circuit blocks after the consolidated body is cut into a plurality of the circuit blocks.

These and still other advantageous features of the present invention will become more apparent from the following description of the preferred embodiments when taken in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an infrared detector in accordance with a first embodiment of the present invention;

FIG. 2 is an exploded perspective view of the above infrared detector;
FIG. 3 is a circuit diagram of the above infrared detector;
FIG. 4 is an exploded perspective view of a circuit block utilized in the above infrared detector;
FIG. 5 is a sectional view of the above circuit block;
FIGS. 6A and 6B are plan views illustrating circuit patterns respectively on the top and bottom faces of a first substrate forming a part of the above circuit block;
FIG. 7, composed of FIGS. 7(A) to 7(E), are sectional views illustrating process of fabricating the circuit block;
FIG. 8, composed of FIGS. 8(A), 8(B) and 8(C), are perspective views illustrating the electrical connection at the bottom of the circuit block;
FIG. 9 is a sectional view illustrating a modification of the above circuit block;
FIG. 10 is an exploded sectional view illustrating another modification of the above circuit block;
FIG. 11 is a sectional view illustrating a further modification of the circuit block;
FIG. 12 is a perspective view of a still further modification of the circuit block;
FIG. 13 is a perspective view of an infrared detector in accordance with a second embodiment of the present invention;
FIG. 14 is an exploded perspective view of the above infrared detector;
FIG. 15 is a sectional view of the above infrared detector; and
FIG. 16, composed of FIGS. 16(A) to 16(E), are sectional views illustrating the fabrication of the circuit block utilized in the above infrared detector.

BEST MODE FOR CARRYING OUT THE INVENTION

Referring now to FIGS. 1 to 3, there is shown an infrared detector unit in accordance with a first embodiment of the present invention. The infrared detector is designed to determine a presence of an object or human body emitting an infrared radiation, and includes circuit block **10** carrying a thermal infrared sensor element **100** and a signal processing circuit **200** which is configured to receive a sensor output from the sensor element **100** to analyze the amount of the infrared radiation received at the sensor element for determination of the presence of the object. The infrared sensor element **100** provides a minute electric current in the order of several picoamperes, which is amplified about 4000 times in the signal processing circuit **200** to give an output signal indicative of the presence of the object. The signal processing circuit **200** is realized by electronic components and, as shown in FIG. 3, includes a current-voltage conversion circuit **202** for conversion of the sensor output into a

corresponding voltage, a band-pass amplifier **204** which amplifies the voltage within a predetermined frequency range, and a window comparator **206** which compares the amplified voltage with a predetermined threshold to give the output signal. The thermal infrared sensor element **100** is made of a metal such as titanium nitride which gives a varying electric resistance in proportion to the amount or intensity of the incident infrared radiation.

As shown in FIG. 2, the infrared detector comprises a base **300** supporting thereon the circuit block **10** and carrying a plurality of terminal pins, namely, a power supply terminal pin **302**, a signal output pin **304**, and a ground terminal pin **306**, and a cap **310** fitted on the base **300** to surround the circuit block **10**. The cap **310** is formed in its top with an opening **312** for receiving an optical lens **314** collecting the infrared radiation to the sensor element **100**.

As best shown in FIGS. 4 and 5, the circuit block **10** includes a first substrate **20** and a dielectric layer composed of a first resin layer **30** and a second resin layer **40**, which are integrated into a consolidated structure to be assembled on the base **300**. The first substrate **20** is formed with circuit patterns on which the electronic components are mounted to realize the signal processing circuit **200**. In the present embodiment, the electronic components are composed of a plurality of discrete chips **22** mounted on top of the first substrate **20**, and an integrated circuit chip **24** mounted on the bottom of the first substrate **20**. For this purpose, the first substrate **20** is formed on its top and bottom respectively with the circuit patterns **26** and **28** which are electrically connected with the discrete chips **22** and the integrated circuit chip **24**, as shown in FIGS. 6A and 6B, to establish the signal processing circuit **200** therewith. The first substrate **20** is integrated to the lower end of the second resin layer **40** with the discrete chips **22** molded into the second resin layer **40**, as will be discussed in detail hereinafter.

The first resin layer **30** is formed in its center with a recess **32** which defines on its periphery shoulder bearing opposite ends of the sensor element **100**. The first resin layer **30** is also formed on its top with lands **34** at portions including the shoulder for electrical connection with the sensor element **100** as well as the signal processing circuit **200** on the first substrate **20**. The recess **32** defines an air gap which is responsible for thermally isolating the sensor element **100** effectively from the signal processing circuit **200** at the lower end of the circuit block **10**, thereby assuring reliable infrared detection free from the heat generated at the electronic components.

A second substrate **50** is interposed between the first resin layer **30** and the second resin layer **40**, and is formed on its top with a shield layer **52** which is connected with the circuit patterns **26** and **28** to define a circuit ground of the signal processing circuit **200** and to shield the infrared sensor element **100** from the signal processing circuit **200**, particularly to prevent capacitive coupling between the infrared sensor element and the signal processing circuit **200**. Thus, the infrared sensor **100** is well protected from noise or leak from the signal processing circuit **200** for reliable infrared detection. The second substrate **50** is assembled together with the first resin layer **30**, the second resin layer **40**, and the first substrate **20** to form the consolidated structure. The shield layer **52** is additionally formed with top shields **54** which project upwardly through the first resin layer **30** for shielding the sensor element **100** effectively from the upper ends of the power supply terminal pin **302** and the signal output terminal pin **304**. For this purpose, each of the top shields **54** extends perpendicular to a plane of the shield layer **52** to have its upper end projected above the top ends of the terminal pins as well as the lands **34** connecting with the sensor elements and with the terminal pins. The top shields **54** give an additional shielding effect of protecting the infrared sensor element **100** from making capacitive coupling with the terminal pins which are exposed on top of the first resin layer **30** and lead to the signal processing circuit **200**, and is particularly effective when the terminal pins are soldered at their respective top ends to the lands **34** on top of the circuit block **10**.

The circuit block **10** is formed with a plurality of plated through-holes **12**, **14** and **16** which receive the terminal pins **302**, **304** and **306** respectively for electrical connection of the sensor element **100** to the signal processing circuit **200** on the first substrate **20**. One or more of the through holes are connected to the corresponding land **34** for electrical connection of the sensor element **100** to the signal processing circuit **200**.

A spacer **60** is held between the base **300** and the circuit block **10** and is formed with a center cavity **62** for accommodating the integrated circuit chip **24** projecting on the bottom of the circuit block **10** for electrically isolate the chip **24** and the associate circuit pattern **28** from the base **300**.

Now referring to FIGS. 7A and 7B, the fabrication of the circuit block **10** is explained in details. Prior to explaining the process of fabricating the circuit block **10**, it is mentioned that a plurality of semi-products of the circuit blocks are made simultaneously in a single molding process by use of a first bulk substrate formed with plural sets of discrete circuit patterns each defining the circuit pattern

on top of the first substrate **20**, and a second bulk substrate formed with a plurality of the shield layers **52**. Namely, the first and second bulk substrates are an aggregation of the first substrates **20**, and an aggregation of the second substrates **50**, respectively. For the sake of simplicity, the figures are depicted to show only one semi-product of the circuit block. In this connection, the first and second bulk substrates may be referred to simply as the first substrate **20** and the second substrate **50**, respectively.

After soldering the electronic component chips **22** on top of the bulk substrate, i.e., on each of the first substrates **20**, it is held in a molding die together with a plurality of thermosetting resin sheets **42** each in the form of a prepreg of epoxy resin impregnated with an organic filler of silica (SiO_2), and the second bulk substrate having plural sets of the shield layers **52**, and another set of thermosetting resin sheets **33** of the same prepreps, as shown in FIG. 7(A), to give a stack in the mold. Then, the stack is heat-pressed in vacuum at 100°C at a pressure of 3 MPa so as to melt the resin sheets **43** and **33** such that the discrete chips **22** are molded in melted resin sheets **43**. At the same time, the top shields **54** project through the melted resin sheets **32**. Then, the stack is heated up to a temperature of 175°C to cure the melted resin sheets **33** and **43** to give a consolidated body in which the first substrate **20** is secured to the second substrate **50** through the second resin layer **40** made of the cured resin sheets **43**, while the discrete chips **22** are molded into the second resin layer **40**, and in which the first resin layer **30** made of the cured resin sheets **33** is secured on top of the second substrate **50** with the top shields **54** projecting above the first resin layer **30**, as shown in FIG. 7(B). In this molding process, the recesses **32** are formed in the first resin layer **30**. The organic filler is mixed in the epoxy resin, preferably in a high proportion, for example, in an amount of 85 wt% to give toughness and sufficient tensile strength to the resulting cured layers.

Then, a drilling is made to give a plurality of through-holes **12**, **14** and **16** extending vertically through the consolidated body, as shown in FIG. 7(C). Subsequently, the consolidated body is deposited on its top and bottom face respectively with conductive layers of copper, for example, which are subsequently etched to give the lands **34** on top of the first resin layer **30** and the circuit patterns **28** on the bottom of the first substrate **20**, as shown in FIG. 7(D). In this process, the through-holes **12**, **14**, **16** are plated to make electrical interconnection between the lands and the circuit patterns on the first substrate **20**. Thereafter, the integrated circuit chips **24** are attached on each of the circuit patterns **28** by a so-called flip-chip mounting, as shown in FIG. 7(E), and the

infrared sensor elements **100** are mounted on the first resin layer **30** in such a manner that each sensor element bridges over the corresponding recess **32** and is secured at its opposite ends to the lands **34** on the periphery of the recess. Thus obtained consolidated body is then cut into a plurality of the circuit blocks **10** each of which is subsequently mounted on the base **300** with the terminal pins **302**, **304** and **306** extending through the corresponding through holes **12**, **14** and **16**, and with the spacer **60** interposed between the base **300** and the circuit block **10**. The terminal pins are soldered at their upper ends to the corresponding lands **34** on top of the circuit block **10** to complete the electrical connection of the infrared sensor element **100** on top of the circuit block **10** to the signal processing circuit **200** on the bottom of the circuit block **10**. Finally, the cap **310** is fitted on the base **300** to surround the circuit block **10** to realize the infrared detector.

Alternatively, the infrared sensor element **100** may be mounted on the first resin layer **30** after the consolidated body is cut into the circuit blocks **10**.

When the electronic components forming the signal processing circuit **200** are composed only of the discrete chips **22**, the first substrate **20** is formed with a circuit pattern only on its top. In this case, the spacer **60** is not necessary to thereby reduce the overall height of the detector.

FIGS. 8(A) to 8(C) illustrate a modification of the above embodiment in which the integrated circuit chip **24** is wire-bonded to the bottom of the circuit block **10**, or the first substrate **20**. In this case, the center cavity **62** of the spacer **60** is filled by a resin **64** to encapsulate the chip **24** within the spacer **60**.

FIG. 9 illustrates another modification of the above embodiment in which the top shield **54** has its top end covered by a bulged portion **35** of the first resin layer **30** in order to protect the top shield **54** from undesired conduction with the lands **34** on the top of the circuit block **10**.

Although the top shields **54** are formed integral with the shield layer **52** in the above embodiment, it is equally possible to insert separate top shields **54** into corresponding holes **37** in the first resin layer **30** after molding the circuit block **10**, as shown in FIG. 10.

Further, as shown in FIG. 11, the top shield **54** may be configured to project from the shield layer **52** and extend upwardly along an end wall of the first resin layer **30** surrounding the recess **32**.

FIG. 12 illustrates a still further modification of the above embodiment in which each of the through-holes **12**, **14** and **16** is configured to have a beveled upper edge coated with the plated beveled shield **18** which functions to shield the infrared sensor element **100** from the depressed upper end of the terminal pin in

order to eliminate the capacitive coupling between the infrared sensor element **100** and the terminal pin leading to the signal processing circuit **200**. The beveled shield **18** may be added only to one or both of the through-holes **12** and **14** respectively receiving the power supply terminal pin **302** and the signal output terminal pin **304**.

FIGS. 13 to 15 illustrate an infrared detector in accordance with a second embodiment of the present invention which is basically identical to the first embodiment except that the terminal pins **302**, **304** and **306** are connected respectively at their upper ends to corresponding lands formed on the bottom of the circuit block **10**, and that the integrated circuit chip **24** is molded in the second resin layer **40**. Like parts are designated by like reference numerals and duplicated explanations are not made herein. The integrated circuit chip **24** is flip-mounted on the first substrate **30** and is molded into the second resin layer **40** at the time of mold-forming the first resin layer **30** and the second resin layer **40** while integrating the first substrate **20** and the second substrate **50** into the resulting consolidated structure. The discrete chips **22** are mounted on the bottom of the first substrate **20** or the bottom of the consolidated structure. The bottom of the first substrate **20** is formed with the lands **27** (only two of which is seen in FIG. 15) which are soldered to the upper ends of the respective terminal pins **302**, **304** and **306** at the time of mounting the circuit block **10** on the base **300**. The discrete chips **22** are held within a cavity of the spacer **60** to be spaced from the upper end of the base **300**. The spacer **60** is formed in its outer periphery with notches **63** through which the terminal pin extends in such a manner as to be capable of being viewed for inspection. In this embodiment, since the top of the circuit block **10** is free from any electrical connection to the terminal pins, no top shields as utilized in the first embodiment is necessary. When the electronic components forming the signal processing circuit **200** can be all realized by the integrated circuit chip **24** to be molded into the circuit block **10**, the first substrate **20** is formed with a circuit pattern only on its top and is formed on its bottom only with the lands **27** for connection with the terminal pins.

FIGS. 16(A) to 16(E) illustrate the steps of forming the circuit block without using the second substrate **50** but with the use of the shield layer **52** in the form of a foil. First, the shield layer **52** is laminated over the first substrate **20** mounting the integrated chip **24** together with a plurality of resin sheets **43** each in the form of the prepreg to give a stack, as shown in FIG. 16(A). The stack is placed in a molding die and is heat-pressed in a like manner as

explained with reference to the first embodiment to give a semi-consolidated body in which the resin sheets **43** are melted and cured to form the second resin layer **40** embedding therein the integrated chip **24**, as shown in FIG. 16(B). Then, as shown in FIG. 16(C), a copper foil **39** is laminated over the semi-consolidated body with a plurality of additional resin sheets **33** interposed therebetween. The resulting stack is again heat-pressed to melt and cure the additional resin sheets **33** to obtain a consolidated body in which the additional sheets **33** are cured to give the first resin layer **30** by means of which the copper foil **39** is secured to the semi-consolidated body. Subsequently, the consolidated body or the circuit block **10** is drilled to provide through-holes **12**, as shown in FIG. 16(D). Thereafter, the copper foil **39** is etched out to give lands **34** on top of the circuit block **10** for electrical connection with the infrared sensor element **100**, while the first substrate **30** is formed on its bottom with a circuit pattern on which the discrete chips **22** are mounted, as shown in FIG. 16(E). The through-holes **12** are plated to establish electrical interconnection between the infrared sensor element **100** and the signal processing circuit realized by the chips **22** and **24** at the bottom of the circuit block **10**. Thus obtained circuit block **10** is mounted on the base **300** and is surrounded by the cap **310** to give the infrared detector. It is noted in this connection that the processes as explained with reference to FIGS. 16(A) to 16(E) can be suitably combined with the processes explained with reference to FIGS. 7(A) to 7(E) to fabricate the circuit block of the first embodiment or the second embodiment.

Although the above embodiments show the use of the infrared sensor element which exhibits an electrical resistance varying in response to the amount or changing rate of the amount of the incident radiation, it is equally possible to utilize an infrared sensor of a type exhibiting a varying permittivity, of a thermopile type generating a thermal electromotive force, or of a pyroelectric type generating a voltage difference in response to the change rate of the amount of the infrared radiation.

CLAIMS:

1. An infrared detector comprising:
a circuit block (10) carrying an infrared sensor element (100) and electronic components (22, 24); and
a case (300, 310) enclosing said circuit block,
said circuit block comprising a dielectric resin layer (30, 40) and a first substrate (20) formed with a circuit pattern (26) and mounting said electronic components, said dielectric resin layer being formed in its top with a recess (32) which defines around its periphery a shoulder for supporting opposite ends of said infrared sensor element, said recess defining a heat insulation space below said infrared sensor element,
said first substrate is integrated to the lower end of said dielectric resin layer with at least one of said electronic components being molded into said dielectric resin layer below said recess to make said circuit block of a unified mold structure, characterized in that
said dielectric resin layer comprises a first resin layer (30) formed with said recess, and a second resin layer (40) embedding said at least one of the electronic components (22, 24) therein,
a shield layer (52) being disposed between said first and second resin layers for connection with a circuit ground of said circuit pattern.
2. The infrared detector as set forth in claim 1, wherein
said dielectric resin layer is made of a thermo-setting resin and an inorganic filler intermingled with said thermo-setting resin.
3. The infrared detector as set forth in claim 1, wherein
said shield layer is deposited on top of a second substrate (50) made of a thermosetting resin.
4. The infrared detector as set forth in claim 3, wherein
said second substrate is made of a thermosetting resin and is disposed between said first and second resin layers, said second substrate being heat-pressed

together with said first and second resin layers so as to be integrated with said first and second resin layers to realize said circuit block.

5. The infrared detector as set forth in claim 1, wherein said shield layer is made of a copper foil deposited on said second resin layer.

6. The infrared detector as set forth in claim 5, wherein said copper foil is formed on said second resin layer and is integrated into between said first and second resin layers when said first and second resin layers are heat-pressed to form said circuit block.

7. The infrared detector as set forth in claim 1, wherein said infrared sensor element, said shield layer, and said circuit pattern are electrically interconnected by way of through-holes (12, 14, 16) respectively extending through said first and second resin layers.

8. The infrared detector as set forth in claim 1, wherein said electronic components are composed of a plurality of discrete chips (22) which are mounted on a top surface of said first substrate and are embedded into said dielectric resin layer.

9. The infrared detector as set forth in claim 1, wherein said electronic components are composed of a plurality of discrete chips (22) mounted on a top surface of said first substrate, and an integrated circuit chip (24) mounted on a bottom surface of said first substrate, said discrete chips being molded into said dielectric resin layer, and said integrated circuit chip being exposed outwardly of said dielectric resin layer.

10. The infrared detector as set forth in claim 1, wherein said electronic components are assembled into an integrated circuit chip which is molded into said dielectric resin layer.

11. The infrared detector as set forth in claim 1, wherein said case comprises a base (300) and a cap (310) fitted on said base, a spacer (60) being interposed between said base and said circuit block, said circuit block being formed on its bottom with lands (12) which are electrically connected respectively to terminal pins (302, 304, 306) extending through said base, said spacer being formed with openings through which said terminal pins extend respectively for connection with said lands..

12. The infrared detector as set forth in claim 1, wherein said case comprises a base (300) and a cap (310) fitted on said base, said base carrying a power supply terminal pin(302), a ground terminal pin (306), and a signal output terminal pin (304) all extending through said base, at least one of said terminal pins extending through said circuit block for electrical connection with lands (12) which are formed on top of said first resin layer to mount said infrared sensor element.

13. The infrared detector as set forth in claim 12, wherein a top shield (54) projects on top of said circuit block to electrically shield said infrared sensor element from at least one of said power supply terminal pins and said signal output terminal pin.

14. The infrared detector as set forth in claim 13, wherein said top shield has its lower end embedded into top end of said circuit block.

15. The infrared detector as set forth in claim 13, wherein said top shield is electrically connected to said shield layer.

16. The infrared detector as set forth in claim 13, wherein

said top shield projects in a perpendicular relation to a plane of said shield layer from said shield layer and has its upper end above a top surface of said first resin layer where said infrared sensor is mounted.

17. The infrared detector as set forth in claim 13, wherein said top shield has its top covered with a bulged portion of said first resin layer.

18. The infrared detector as set forth in claim 13, wherein said top shield is formed on an end wall of said first resin layer.

19. A process of fabricating an infrared detector, said process comprising the steps of:

preparing a first resin sheet (33);

preparing a first substrate (20) formed with a plurality of discrete circuit patterns (26);

mounting electronic components (22) on each of said discrete circuit patterns (26);

stacking said first resin sheet (33) and said first substrate (20) with a second resin sheet (43) interposed therebetween, and with a shield layer (52)

interposed between said first resin sheet (33) and said second resin sheet (43), said shield layer (52) being connected to a circuit ground of said circuit patterns (26);

heat-pressing said first resin sheet, said second resin sheet, and said first substrate together to form a consolidated body in which said electronic components are molded into cured said second resin layer;

forming through-holes (12, 14, 16) in said consolidated body;

forming plural sets of lands (34) on top of said consolidated body;

interconnecting each set of said lands to each corresponding one of said circuit patterns by way of said through-holes;

mounting an infrared sensor element (100) on each set of said lands for electrical connection therewith;

cutting said consolidated body into a plurality of circuit blocks (10) each having each said circuit pattern;

mounting each of said circuit blocks on a base (300); and

inserting a plurality of terminal pins (302, 304, 306) respectively into said through-holes to make electrical connections between said terminal pins to said electronic circuit; and
mounting each said infrared sensor element on each set of said lands before or after cutting said consolidated body.

20. A process as set forth in claim 19, wherein
each said infrared sensor is mounted on each set of said lands before cutting said consolidated body to make electrical connections therebetween.

21. A process as set forth in claim 19, wherein
after said consolidated body is cut into a plurality of said circuit blocks each having said circuit pattern, each said infrared sensor is mounted on each set of said lands on said each circuit block for electrical connection therebetween.