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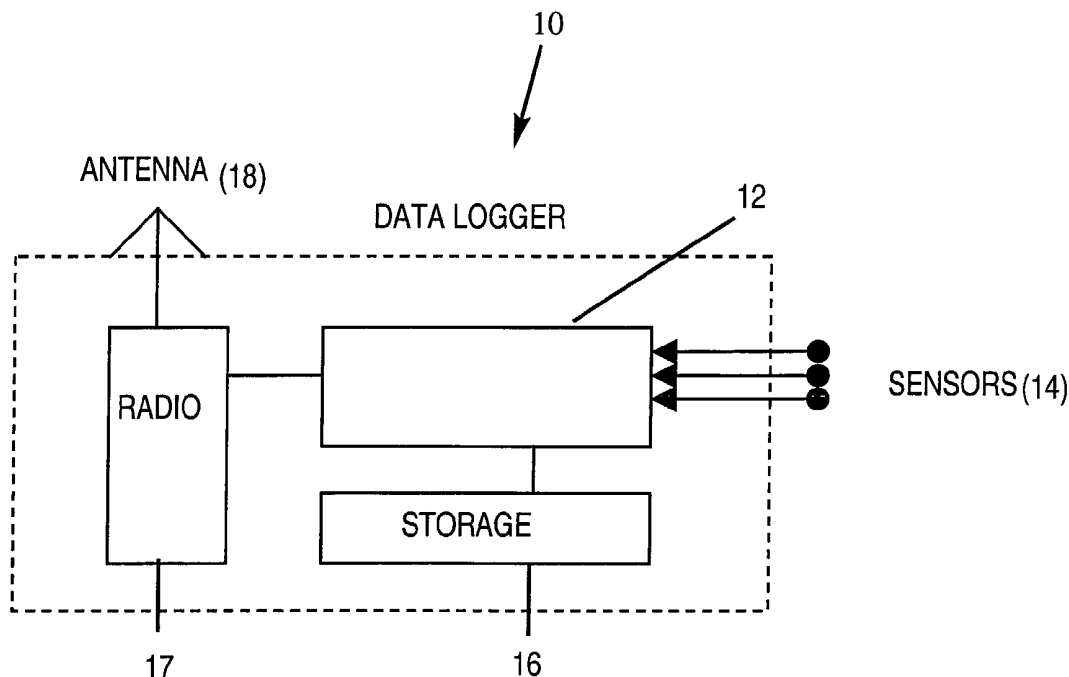
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(54) Title: DATA LOGGER FOR MONITORING A CONSIGNMENT OF GOODS



(57) Abstract: A portable data logger (10) for monitoring goods (21), whether transportable or insitu, the logger (10) including: measurement means (12) for measuring at least one predetermined parameter of, or proximate, the goods; storage means (16) for storing data representative of the measured parameter; and radio communication means (17) for transmitting the stored data to a data collection device in response to a trigger event.



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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**DATA LOGGER FOR MONITORING A CONSIGNMENT OF GOODS****FIELD OF THE INVENTION**

The present invention relates generally to the monitoring of goods, whether transportable or insitu, and in particular relates to an overall system therefor and its component parts, such as a portable data logger, and to a data logging method, suitable for monitoring a consignment of goods. The data logger is especially useful for monitoring sensitive or perishable goods as they pass along a supply chain, for example from a source, such as a supplier, to a destination, such as an end retailer. It will therefore be convenient to describe the invention with reference to that example application. It should be understood however that the invention is intended for broader application and use.

**BACKGROUND OF THE INVENTION**

Today there exists a growing need to safely transport goods over relatively large distances and provide some certainty that these goods have not been effected by environmental changes that could cause serious degradation in quality. These environmental changes may include such factors as temperature, humidity, physical shock, contamination, etc. The sensitivity of foods to spoilage has also increased as consumers demand more natural unprocessed foods which have no preservatives added.

Most goods today are transported with no monitoring at all. Some very expensive goods rely on clumsy and mechanical systems that require physical handling and interpretation at the point of delivery to determine if the goods may have been effected by environmental extremes. These systems are either inadequate, time consuming or expensive, which further adds to difficulties or expense to the transported goods.

Codes and/or regulations are being established, with which food companies and other perishable goods providers must comply, in order to transport these sensitive goods. The existing systems are becoming inadequate to meet these new codes, from both a capability and cost perspective.

There also exists another need to monitor relatively stationary goods, for example goods residing or being stored or displayed in a supermarket. It is not

uncommon for a customer to find goods passed their use-by date. Certainly, where fresh meats and other foods are stored and displayed, such as in the 'small goods' section of a supermarket, customers desire the freshest goods. To date, there does not exist a reliable way of determining whether the goods have  
5 been effected by storage, environmental conditions, or contaminated with unwanted chemicals..

There therefore remains a need for a relatively simple, flexible, convenient and inexpensive way of monitoring goods, such as a data logging device, or monitoring system which can be used to monitor selected parameters.

## 10 SUMMARY OF THE INVENTION

In one aspect, the present invention provides a portable data logger for monitoring a consignment of goods. The data logger includes measurement means for measuring at least one predetermined parameter of, or proximate, the goods, storage means for storing data representative of the measured parameter  
15 and radio communication means for transmitting the stored data to a data collection device in response to a trigger event.

The data logger of the invention may be packed with the goods to be transported to enable continuous monitoring of the predetermined parameter throughout the supply chain from the source to the destination.

20 The predetermined parameter may be temperature, humidity, physical shock, contamination, or any other parameter which is considered important to the goods being transported. The measurement means may include a sensor of the necessary type to measure the parameter of interest.

The sensor may be built into the data logger or may be a separate device  
25 which is connected to the data logger. One or more sensors may be employed according to the parameters to be measured.

In embodiments where the sensor or sensors are separate devices, the data logger may be provided with inputs capable of receiving a variety of sensor types corresponding to the parameters to be measured. Suitable sensors for  
30 measuring temperature, humidity, shock or vibration are well known in the art and may be employed in conjunction with the data logger of the present invention.

Preferably, however, a sensor of the relevant type is incorporated into a single package together with the data logger, thus reducing manufacturing costs and facilitating easy packing of the data logger together with the goods to be transported. It is also preferable, in one form, to provide the logger as a  
5 disposable device, for ease of use.

In one application, the data logger is placed within a box or carton containing the goods such that, in use, one or more parameters of the environment within the box or carton are measured. Alternatively, or in addition, if the goods are shock sensitive, the data logger may include an accelerometer  
10 which is attached directly to the goods or to an item of packaging of the goods.

In one embodiment the radio communication means includes a radio transmitter or transceiver. In such an embodiment the transmitter or transceiver can transmit the stored data to the data collection device and can receive data from the data collection device, or other source. The communication means may  
15 be actively powered, or passively powered, by way of a suitable interrogation field

A transceiver also enables the data logger to be programmed to operate in a required manner. For example, in a preferred embodiment the measurement means includes a microprocessor running suitable application software for controlling operation of the data logger. In this embodiment the application  
20 software may be remotely programmable via the transceiver. Alternatively, or in addition, the measurement means may be remotely programmable for selection of the parameter to be measured. Further, the frequency of the measurements may also be programmable such that measurements are taken at predetermined time intervals. The period between measurements would be dependent upon the  
25 parameter being measured and the nature of the goods being transported. For example, if physical shock is to be detected, the period between measurements would need to be very short. On the other hand, if the parameter being measured is unlikely to vary very rapidly, the frequency of measurement may be reduced.

In a preferred embodiment the trigger event is an interrogation signal  
30 received by the transceiver. Alternatively, the trigger signal may be separate from the interrogation signal. The interrogation signal would be received from a data

collection device. The data logger may include security features for verifying that the interrogation signal is an authorised interrogation signal. In this way, it is possible to ensure that the logged data is being delivered only to a valid destination. Security codes and/or encryption techniques may be used as  
5 appropriate.

In one embodiment the data logger includes means for storing consignment data relating to the goods. This can facilitate identification of the goods at the point of delivery or at checkpoints, or hand-over points, along the chain of delivery. Preferably, the consignment data is loadable into the storage  
10 means via the transceiver.

In one embodiment the communication means is controllable on a time basis. The communication means may be switched to an inactive state for a predetermined time period in order to save power. The device would typically be battery operated so it is advantageous to conserve power wherever possible.  
15 The predetermined time period may be set such that the communication means is switched back on when the goods are expected to arrive at their destination. The communication means may at that time become responsive to an interrogation signal from a data collection device.

In another aspect, the present invention also provides a method of  
20 monitoring goods, whether static or transportable, such as a consignment of goods during transport. The method includes the steps of placing a portable data logger, of the type described above, with the consignment of goods prior to transport and, upon arrival of the consignment at its destination, retrieving the stored data from the data logger.

25 That data can then be analysed and reports produced to indicate the integrity of the goods delivered. This may be done by comparing the measured parameters to threshold values, beyond which the goods should not be subjected. For example, perishable food products should be kept below 4°C whilst frozen foods should be kept below minus 18°C.

30 In a further aspect, the present invention provides a system of monitoring goods, including at least one data logger as disclosed above, an interrogation

terminal adapted to communicate with the at least one data logger, wherein at least a part of the communication between the data logger and the terminal is based on Bluetooth technology and / or the communication is periodic.

In one embodiment, at least one of the data logger(s) of the system disclosed is the mobile communication device as disclosed in co-pending patent application docket number P14091 filed by the present applicant and filed 27 March 2001, and entitled "Container Surveillance System and Related Method". In this regard, the mobile communication device and disclosure is incorporated herein by reference.

10 In still another aspect, at least one medium or path of communication used in relation to the present invention is based on Bluetooth technology. It is to be understood that, within the scope of the present invention, any type of receiver or transceiver can be used. However, Bluetooth technology based device(s) have been realised to provide advantages, at least in as much as they are based on a relatively sophisticated technology, able to be packaged in relatively small devices, and which can be manufactured using mass production techniques, and thus the cost per unit can be relatively low, even enabling the devices to be disposable / consumable rather than being re-usable. In an alternate form, the devices may be re-usable, however.

20 Throughout this specification, by monitoring, we mean evasive, non-evasive, passive and / or active monitoring. Any parameters may be monitored as determined or selected appropriate to the particular application of the present invention. Some exemplary applications, which are not to be taken as limiting of the invention, are temperature, pressure, vapour, environment, chemical, optical, physical, electrical.

#### BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention will now be described with reference to the accompanying drawings. It should be understood, however, that the data logger described is especially useful for monitoring sensitive or perishable goods as they pass along a supply chain, for example from a source, such as a supplier, to a destination, such as an end retailer. It will therefore be

convenient to describe the invention with reference to that example application and it should be understood however that the invention is intended for broader application and this description is given by way of illustration only. Equally, the data logger, may be a tag, mobile communication device or other suitable device, such as that disclosed in corresponding patent application docket number P14091 filed by the present applicant and filed 27 March 2001, and entitled "Container Surveillance System and Related Method". In this regard, subject matter of the corresponding application is incorporated herein by reference.

In the drawings:

10 Figure 1 is a schematic block diagram of a portable data logging device in accordance with a preferred embodiment of the invention; and

Figure 2 shows an example of data being collected from the portable data logging device of Figure 1, wherein the device has been previously packed within a parcel of goods.

#### 15 DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawings, Figure 1 shows a schematic diagram of a portable data logging device 10 for monitoring a consignment of goods 21 (Figure 2) during transport from a source such as a supplier to a destination such as a retailer.

20 The device includes measurement means 12 receiving signals from sensors 14, for measuring at least one predetermined parameter of the goods 21, or of the environment surrounding the goods 21, being transported. Data representative of the measured parameter is stored within storage means 16. A processor within the measurement means 12 operates according to application software store within the storage means 16.

Radio communication means 17 is provided for transmitting the stored data to a data collection device (depicted as a notebook computer 22 in Figure 2). The radio communication means 17 also includes an antenna 18 for reception and transmission of radio frequency signals 24,26.

30 Figure 2 shows a number of parcels 20 upon delivery to their destination. Each parcel, and specifically parcel 21 in the present example, includes a data



logging device according to the invention. The data collection device 22 transmits an interrogation signal 24 via its antenna 26 to the data logging device 21. The data logging device 21 detects the interrogation signal 24 and, in response thereto, transmits a signal 26 representing the stored data.

5       As the data logging device 10 is microprocessor based, the application software for controlling the device may be modified according to the specific requirements of the particular goods being transported or of the specific delivery chain. Factors such as the measurement frequency and selection of the parameter to be measured may be programmed within variables assigned in the  
10 application software. A standard data logging hardware module may then be developed for a variety of applications so that merely the sensor needs to be changed according to the parameter or parameters to be measured.

With growing capabilities and miniaturisation of wireless technologies, the present invention enables the construction of a low cost, multi sensor, miniature,  
15 programmable and disposable data logger that can be remotely analysed without physical connection to any data analysis system.

The logging device uses a radio transceiver for the final data extraction at the point of goods delivery. As the device is extremely small and cost effective it can be simply packed with the goods prior to transport, therefore monitoring the  
20 actual environmental conditions surrounding the goods.

The logging device preferably uses the latest processor technology to minimise size and power requirements but has the capability to accept a variety of sensors depending on the requirements of the transported goods.

The processor and the wireless communication system enables remote  
25 programming of both the application software and data parameters within the data logger to very precisely match the requirements of the environmental measurements to be made during the transit time of the goods. These parameters could for example define temperature limits that the device should pay special attention to during logging or monitor for severe physical shock that could  
30 damage fragile goods.

As the device may be programmable with a large data storage capacity, the data logger can also be programmed with the full consignment information to identify the goods at the point of delivery.

The logging device can also be used to mark, eg. by storing a date/time record, the hand-over of the goods from one transport company to the next in a chain of delivery. This could further assist in the identification of damage and the carrier involved for insurance processing.

The data logging device may be equipped with core permanent software that would enable some basic functions to be performed after manufacture of the device, these functions may include:

- Providing access to sensor inputs via the remote radio link to quickly check accuracy and reliability of measured parameters.
- Providing for downloading of application software to define the specific function of the device.
- Providing self checking of all memory devices to verify integrity of storage areas.

The Radio transceiver of the logging device would be controlled by the application software allowing it to be switched off for pre-determined times to further reduce power demands on the device and also to prevent transmission during transportation by air, thus preventing possible interference with aircraft instrumentation.

The logging device, once programmed for the transportation requirements and maximum duration, would start collecting pre-defined sensor data at predetermined intervals. The data would be encoded to minimise data storage requirements and stored into permanent memory until the goods are delivered to their destination. At a pre-defined time, programmed into the device, the radio transceiver would be turned on, at which point it would start checking for an interrogation signal from the data collecting device located at the goods delivery point. When the interrogation signal is detected, the two devices would check their security codes to ensure that the logged data is being delivered to a valid destination. After verification of the security codes, the data collection device

would request the transfer of all stored data. The data received may then be automatically analysed and a report may be provided to the receiver of the goods to indicate the integrity of the delivered goods.

It can thus be seen that the present invention provides, at least in its preferred embodiments, a portable, wireless, programmable data logger for monitoring environmental parameters of a consignment of goods. Being wireless, the data logger may be interrogated whilst it remains within the parcel or package containing the goods. There is no need for physical connection, or even physical access, to the data logger to retrieve the stored information. Being programmable, the data logger is extremely flexible in terms of the parameters to be measured and how and when it measures those parameters. Since such data loggers would be manufactured in large numbers, reduced manufacturing costs would allow them to be produced as disposable items. In this way, there is no need for the data logger to be returned to the consignor for subsequent re-use with another consignment. Once the information has been retrieved from the data logger it can be disposed of.

Although a preferred embodiment of the invention is described herein in detail, it will be understood by those skilled in the art that variations may be made thereto without departing from the spirit of the invention or the scope of the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A portable data logger for monitoring goods, whether transportable or insitu, the logger including:

measurement means for measuring at least one predetermined parameter of, or proximate, the goods;

storage means for storing data representative of the measured parameter;  
and

radio communication means for transmitting the stored data to a data collection device in response to a trigger event.

2. A portable data logger according to claim 1 wherein the radio communication means includes a radio transceiver.

3. A portable data logger according to claim 2 wherein the trigger event is an interrogation signal received by the transceiver.

4. A portable data logger according to any one of the preceding claims wherein the measurement means includes application software for controlling operation of the data logger.

5. A portable data logger according to claim 4 wherein the application software is remotely programmable via the communication means.

6. A portable data logger according to any one of the preceding claims wherein the measurement means is remotely programmable via the communication means for selection of the parameter to be measured.

7. A portable data logger according to any one of the preceding claims wherein the measurement means is programmable to take measurements at predetermined time intervals.

8. A portable data logger according to any one of the preceding claims wherein the measurement means includes an input capable of receiving a variety of sensor types for measurement of a corresponding variety of parameters.
9. A portable data logger according to any one of the preceding claims further including means for storing consignment data relating to the goods, and wherein the consignment data is loadable via the communication means.
10. A portable data logger according to any one of the preceding claims, further including means for storing transfer data representing hand-over points in a chain of delivery, said transfer data being receivable by the data logger via the communication means.
11. A portable data logger according to any one of the preceding claims wherein the communication means is controllable on a time basis.
12. A portable data logger according to claim 11 wherein the communication means is switchable to an inactive state for a predetermined time period.
13. A portable data logger according to any one of the preceding claims wherein the communication means is responsive to the interrogation signal after a predetermined time.
14. A portable data logger according to any one of the preceding claims further including security means for verifying that the interrogation signal is an authorised interrogation signal prior to transmitting the stored data.
15. A portable data logger according to any one of the preceding claims wherein the measurement means measures the predetermined parameter of environmental conditions surrounding the goods.

16. A portable data logger according to any one of the preceding claims, wherein the goods monitored are in transit.

17. A portable data logger according to claim 11, 12, 13 or 16, wherein the predetermined time period is set such that the communication means is switched back on when the goods are expected to arrive at their destination.

18. A method of monitoring goods, whether transportable or insitu, the method including the steps of:

- providing a portable data logger, according to any one of the preceding claims, proximate the goods;

- intermittently, periodically or at predetermined times, sending an interrogation signal from an interrogating terminal,

- monitoring, by the interrogating terminal for a communication event from a datalogger,

- initiating datalog communication between the data logger and terminal upon sensing the communication event in order to obtain information related to the goods, wherein

- a portion of the datalog communication is based on Bluetooth technology.

19. A system of monitoring goods, including

- at least one data logger as claimed in any one of claims 1 to 17,

- an interrogation terminal adapted to communicate with the at least one data logger, wherein

- at least a part of the communication between the data logger and the terminal is based on Bluetooth technology.

20. A system as claimed in claim 19, adapted for use with containerised goods or the retailing of goods.

21. A data logger as claimed in any one of claims 1 to 17, wherein the communications means includes, at least in part, Bluetooth technology.
22. A data logger as herein disclosed.
23. A system as herein disclosed.

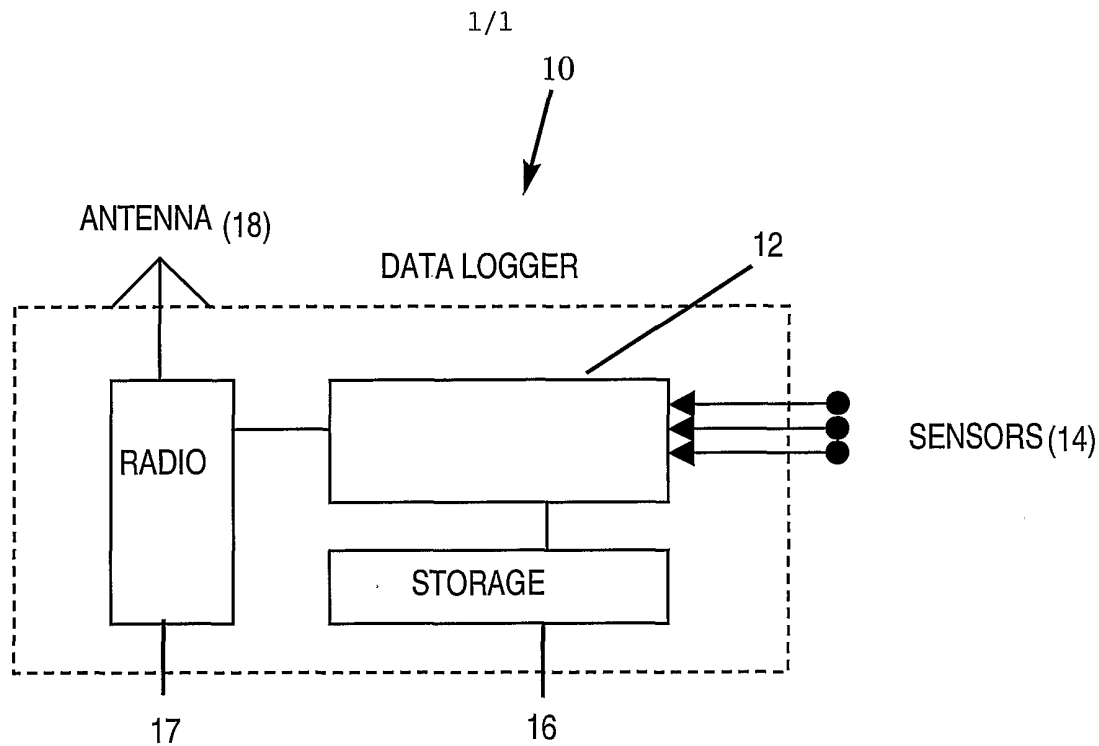


FIGURE 1

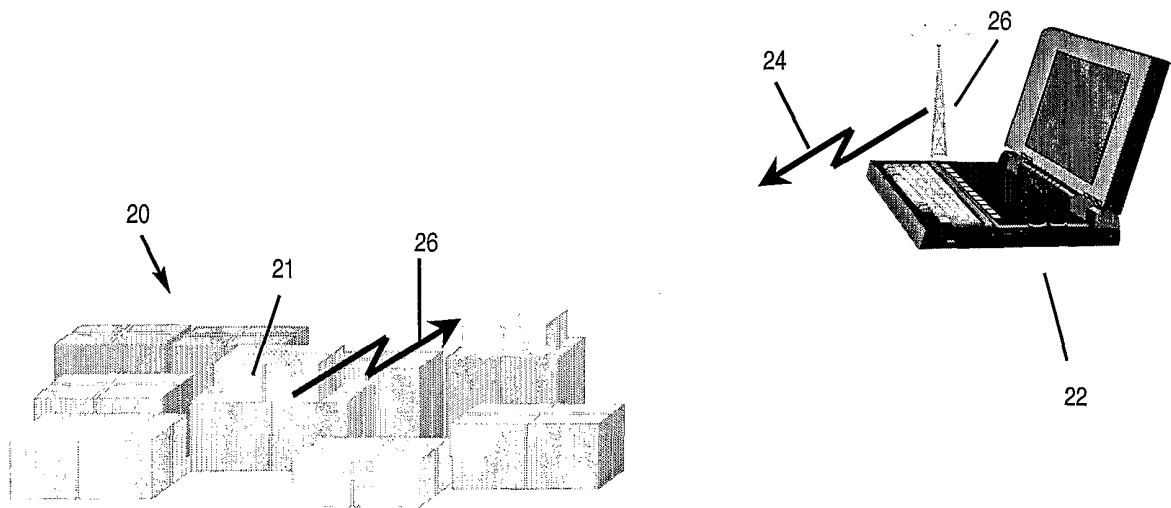


FIGURE 2



## INTERNATIONAL SEARCH REPORT

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|---|---|---|
| <b>A. CLASSIFICATION OF SUBJECT MATTER</b>  |   |   |
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| According to International Patent Classification (IPC) or to both national classification and IPC   |   |   |
| <b>B. FIELDS SEARCHED</b>   |   |   |
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| .   |   |   |
| 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 practicable, search terms used)  |   |   |
| DWPI IPC G08B/-, G01D/-, G01N 33/00 - 33/18, 37/00, B65D 79/02, B60P 3/20, G06F 19/00, 17/40, G07C 5/- & keywords log, radio, portable, trigger, memory and similar terms.  |   |   |
| <b>C. DOCUMENTS CONSIDERED TO BE RELEVANT</b>   |   |   |
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| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex   |   |   |
| <p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p> |   |   |
| Date of the actual completion of the international search   |   | Date of mailing of the international search report  |
| 6 September 2001  |   | 19 SEPTEMBER 2001                                   |
| Name and mailing address of the ISA/AU  |   | Authorized officer                                  |
| AUSTRALIAN PATENT OFFICE<br>PO BOX 200, WODEN ACT 2606, AUSTRALIA<br>E-mail address: pct@ipaustalia.gov.au<br>Facsimile No. (02) 6285 3929  |   | SOOSA GNANASINGHAM<br>Telephone No : (02) 6283 2172 |

## INTERNATIONAL SEARCH REPORT

International application No.

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| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT |  |                       |
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**INTERNATIONAL SEARCH REPORT**  
Information on patent family members

International application No.  
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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

| Patent Document Cited in<br>Search Report |          | Patent Family Member |          |    |         |
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| US  | 5729203  | NONE                 |          |    |         |
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| EP  | 902401   | NONE                 |          |    |         |
| END OF ANNEX                              |          |                      |          |    |         |