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H4K KFF K1L
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(56) Documents cited
GB 2246649 A GB 2176637 A GB 1459851 A
EP 0104886 A2

(58) Field of search
UK CL (Edition K) G4A AFMD, H4K KFF KTL KYX
INT CL[5] G06F 11/34, H04M 1/24 3/10 3/22

(54) **Recording error events particularly in radiotelephones**

(57) An error event is recorded by storing a counter value representing the number of times the error event has occurred and by storing a time related to the error event. In detail a method of recording an error event having one of a plurality of error types comprises determining a numeric error code related to the error type, in response to a trigger derived from the error event, calculating a memory location (133) correlated to the numeric error code, incrementing a counter value which represents the number of times the error type has occurred, and marking a time related to the error event. In a portable radiotelephone the counter value and the time marked are stored in a non-volatile memory location (133) so that an error history containing the frequency of an error type and the time of the latest occurence of the error type can be retrieved. The built in error record (133) assists diagnosis.

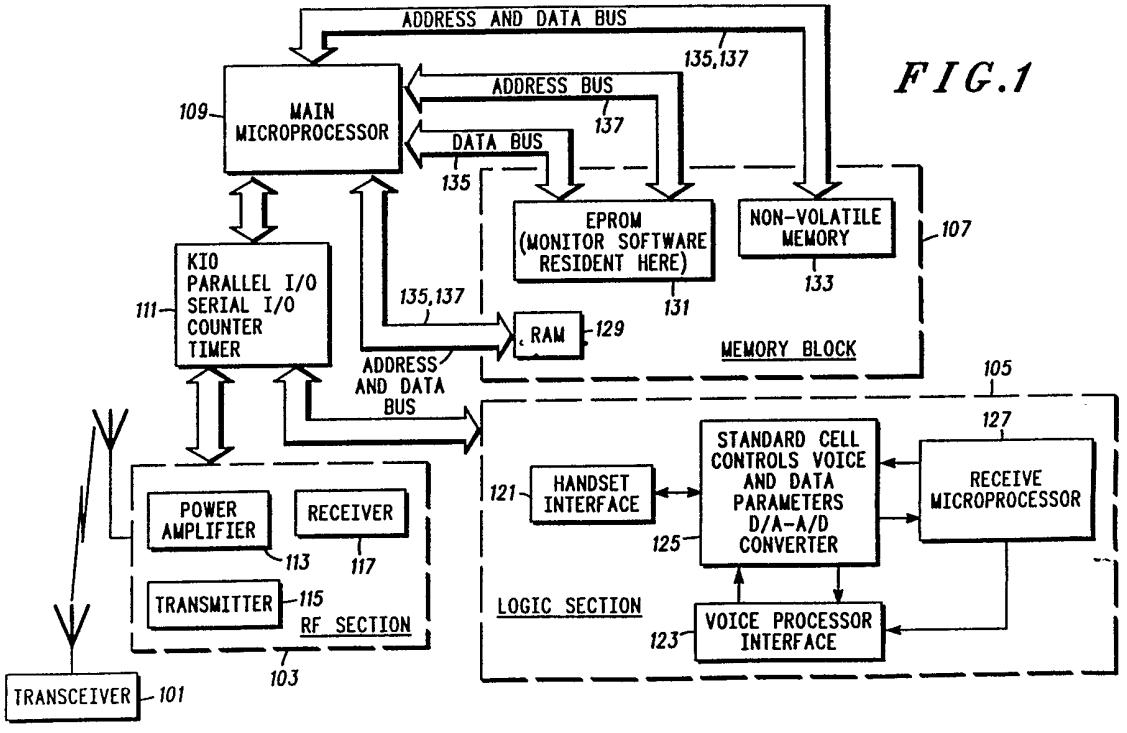


FIG.1

GB 2 252 475 A

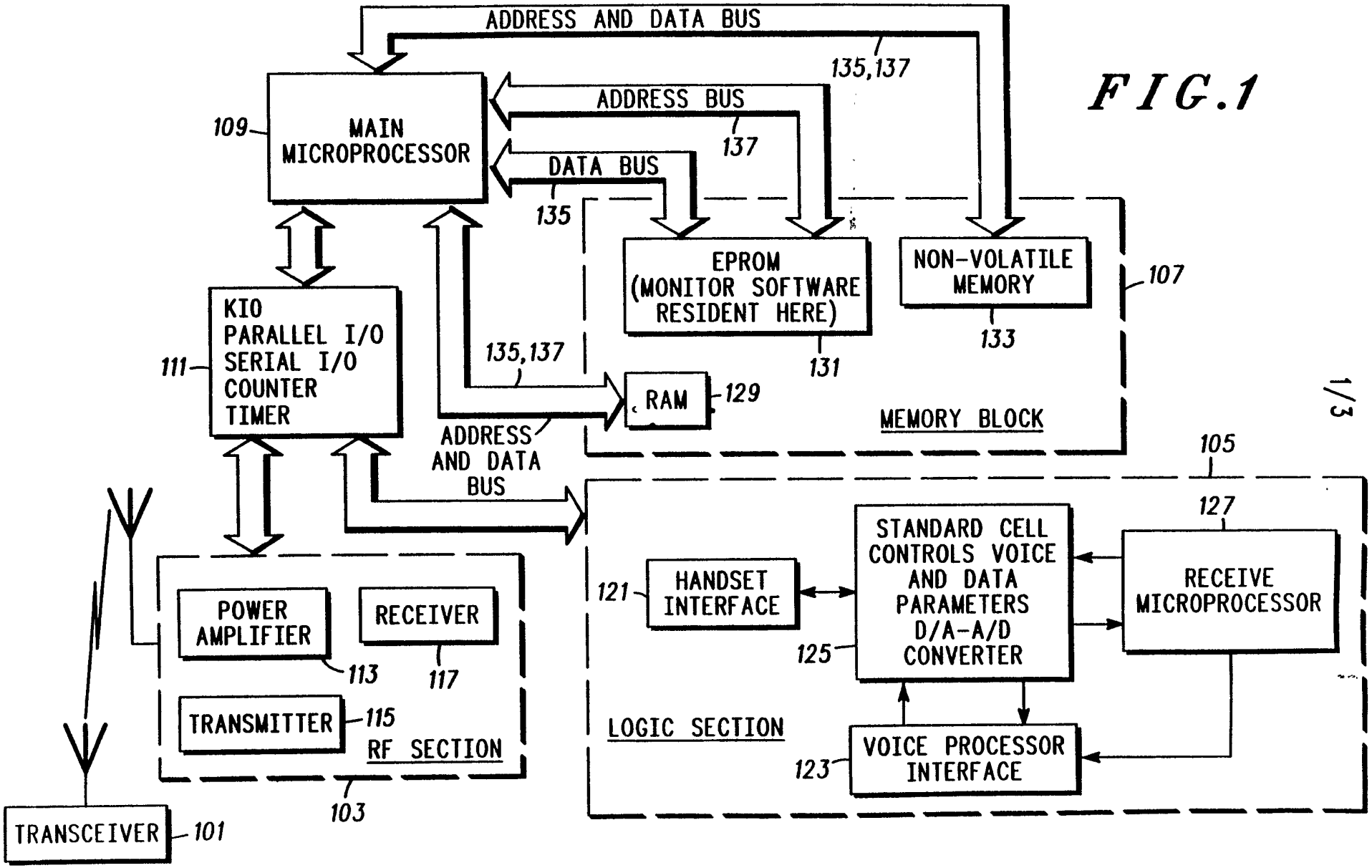

ADDRESS AND DATA BUS
135,137
ADDRESS BUS
137
DATA BUS
135
109
MAIN MICROPROCESSOR
EPROM (MONITOR SOFTWARE RESIDENT HERE)
131
NON-VOLATILE MEMORY
133
107
KIO
PARALLEL I/O
SERIAL I/O
COUNTER
TIMER
111
135,137
RAM
129
MEMORY BLOCK
ADDRESS AND DATA BUS
105
127
STANDARD CELL CONTROLS VOICE AND DATA PARAMETERS D/A-A/D CONVERTER
RECEIVE MICROPROCESSOR
121
HANDSET INTERFACE
125
POWER AMPLIFIER
113
RECEIVER
117
TRANSMITTER
115
RF SECTION
103
LOGIC SECTION
VOICE PROCESSOR INTERFACE
123
TRANSCEIVER
101

FIG. 1

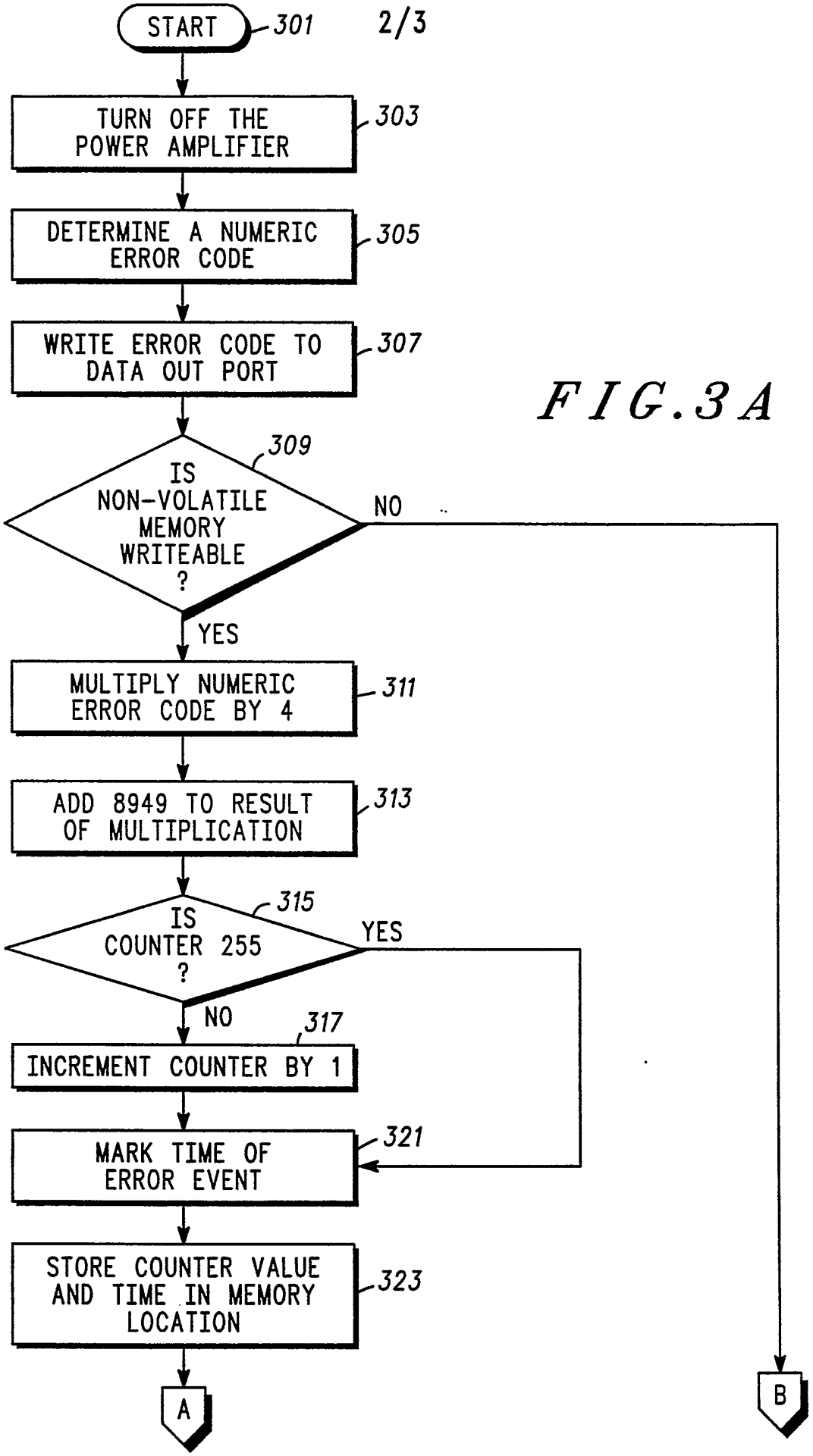

START
301
TURN OFF THE POWER AMPLIFIER
303
DETERMINE A NUMERIC ERROR CODE
305
WRITE ERROR CODE TO DATA OUT PORT
307
IS NON-VOLATILE MEMORY WRITEABLE ?
309
NO
YES
MULTIPLY NUMERIC ERROR CODE BY 4
311
ADD 8949 TO RESULT OF MULTIPLICATION
313
IS COUNTER 255 ?
315
YES
NO
INCREMENT COUNTER BY 1
317
MARK TIME OF ERROR EVENT
321
STORE COUNTER VALUE AND TIME IN MEMORY LOCATION
323
A
B

FIG. 3A

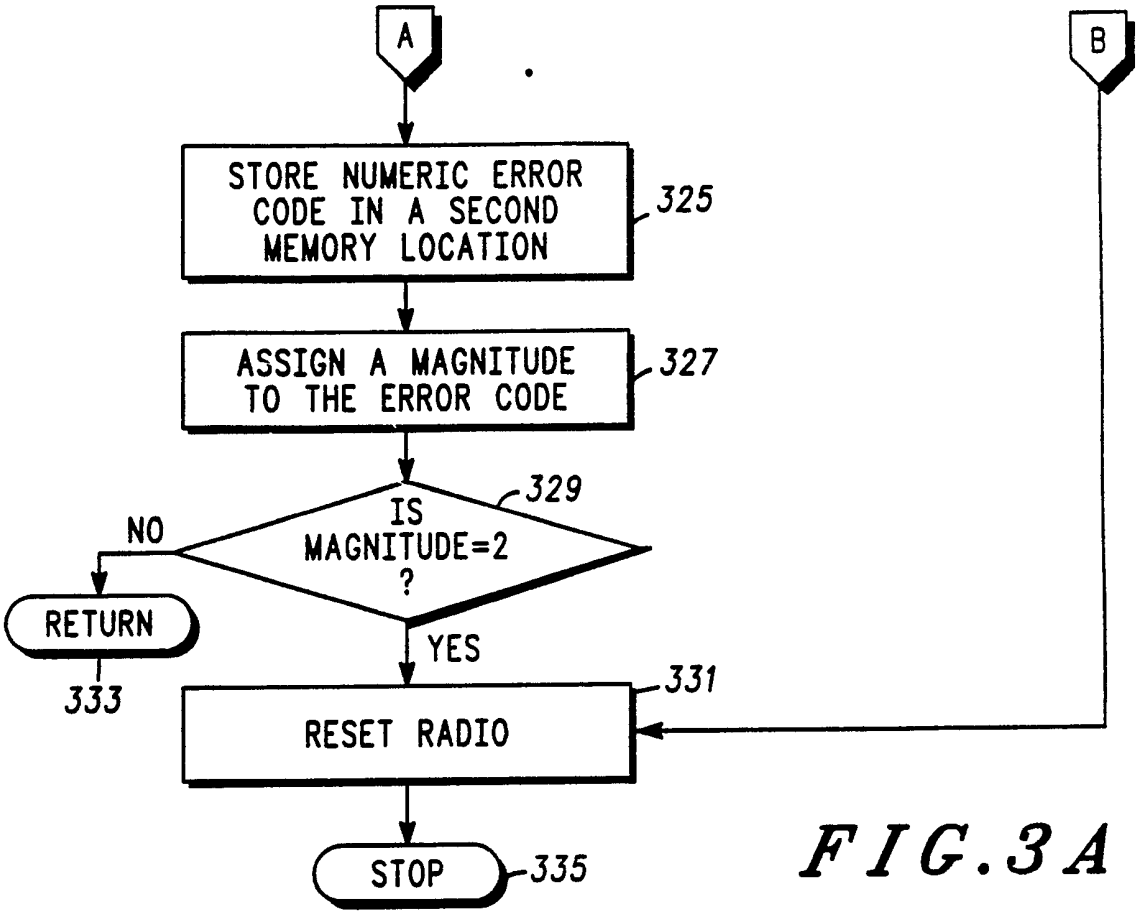
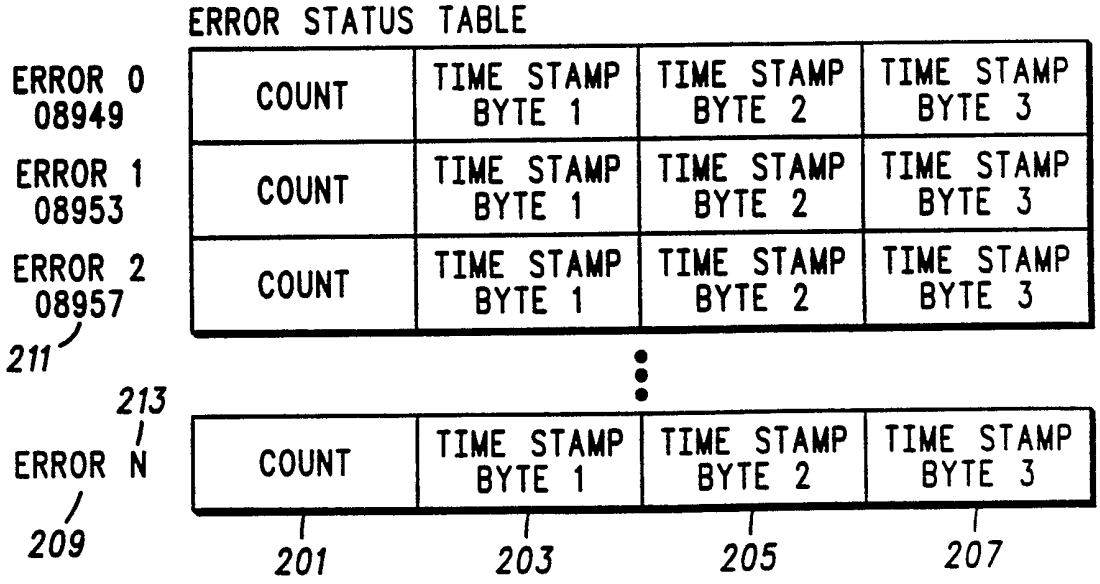

A
B
STORE NUMERIC ERROR CODE IN A SECOND MEMORY LOCATION
325
ASSIGN A MAGNITUDE TO THE ERROR CODE
327
IS MAGNITUDE=2 ?
329
NO
YES
RETURN
333
RESET RADIO
331
STOP
335

FIG.3A

FIG.2


ERROR STATUS TABLE
ERROR 0 08949
ERROR 1 08953
ERROR 2 08957
211
213
ERROR N
209
COUNT
TIME STAMP BYTE 1
TIME STAMP BYTE 2
TIME STAMP BYTE 3
201
203
205
207

Error Recording Method and Apparatus

Field of the Invention

This invention relates generally to data acquisition and more specifically to a method of and and an apparatus for data acquisition for use in diagnostics of mobile and portable radiotelephone equipment.

Background of the Invention

As electronic systems increase in complexity, they become more difficult for technicians to detect the cause of problems which may occur in the system. Therefore, there is a need for a comprehensive diagnostic system which includes a built-in error recording method and apparatus to assist the technicians in discovering problems.

Electronic systems typically contain a limited amount of diagnostic capability. There are two basic types of diagnostic systems. The first type of system has a large number of sensors in the system and can record a large amount of useful information, however, this system is usually external to the operational electronic system and only operates in the lab. It is very useful in making intelligent diagnoses of problems which occur in the testing environment. However, not all field problems can be reproduced in a testing environment, therefore, this system can not diagnose all of the problems which may exist.

The second type of diagnostic system is operable in the field. This system records only a limited amount of information, such as the latest type of error coded as a particular error code number. When the electronic system is returned to the laboratory because of a problem, the technician can access this error code. In a complex electronic system this error code, representing the latest type of error in time, is not always representative of the problem which had been occurring in the field. The technician has no way of

knowing if this is the true problem and often spends hours tracking an incorrect problem.

Although these two diagnostic systems are well suited for their applications, when a complicated electronic system is returned to a technician frequently there is no communication between the user of the electronic system and the technician in the lab as to the problem which is occurring. This can be caused by language barriers as well as distance between the user and the technician. Therefore, there is a need for a comprehensible technique of automatically recording errors in the field so that the a technician can make a intelligent diagnosis of the problems which exist.

Summary of the Invention

The present invention encompasses a method of recording an error event having one of a plurality of error types, in response to a trigger derived from the error event. A numeric error code related to the error type is determined and in response to the trigger, a memory location correlated to the numeric error code is calculated. A counter value which represents the number of times the error type has occurred is incremented in response to the step of determining the numeric error code. A time related to the error event is marked. The counter value and the time is then stored in the memory location.

In one aspect the invention provides a method of recording an error event having one of a plurality of error types, in response to a trigger derived from the error event, the method comprising the steps of:

determining a numeric error code related to the error type;

calculating, in response to the trigger, a memory location correlated to said numeric error code;

incrementing a counter value which represents the number of times the error type has occurred and in response to said step of determining said numeric error code;

marking a time related to the error event; and

storing said counter value and said time in said calculated memory location.

In another aspect, the invention provides a radiotelephone having a power amplifier, a non-volatile memory, a data output port and a microprocessor and an error event recorder responsive to a trigger derived from an error event having a plurality of error types, and including:

means for turning off, in response to the trigger, the power amplifier;

means for determining a numeric error code related to the error type;

means for multiplying said numeric error code by a first predetermined numeric value; and

means for adding a second predetermined numeric value to a result of said step of multiplying, thereby deriving a first location in the non-volatile memory.

means for incrementing a counter value which represents the number of times the error type has occurred and in response to said step of determing said numeric error code;

means for marking a time related to the error event; and

means for storing said counter value and said time in said first location in the non-volatile memory.

Brief Description of the Drawings

FIG. 1 is a block diagram of a radio frequency data transmission system which may utilize the current invention.

FIG. 2 is the format of data acquisition.

FIG. 3 is the process flow chart of acquiring and storing the data.

Description of a Preferred Embodiment

A radio telephone system conveying signals between a fixed site transceiver 101 and a portable transceiver 103 is shown in FIG. 1. The portable transceiver 103 is contained in a portable radiotelephone, such as model number TZ803 available from

Motorola, Inc.. The portable radiotelephone includes a logic section 105, a main microprocessor 109, a memory block 107 and killer input and output (KIO) controller 111, such as model number Z84C9008VEC available from Zilog.

The portable transceiver 103 is responsible for receiving and transmitting the signals between the fixed site transceiver 101 and the portable radiotelephone. The receiver 117 receives the signals from the fixed site transceiver 101 and distributes the received signals to the logic section 105. The main microprocessor 109 sends signals via the KIO controller 111 to the power amplifier 113, the power amplifier 113 amplifies the signals allowing the transmitter 115 to transmit to the fixed site transceiver 101.

The main microprocessor 109 is responsible for controlling the data paths of the receive signals and monitoring the portable radiotelephone for errors. Upon receiving signals from the transceiver 103, the KIO controller 111 transmits the received signals to the logic section 105. Within the logic section 105 a standard cell application specific integrated circuit (ASIC) 125 controls the voice and data parameters and also contains digital to analog converters and analog to digital converters for control signals to and from the power amplifier 113. The receive microprocessor 127, such as a model number 6805 available from Motorola, Inc., detects the received voice signals and data signals, transmitting the voice signals to the optional voice processor 123 and the data signals to the main processor 109. The optional voice processor interface block 123 is responsible for scrambling and unscrambling the voice signals for privacy. Then the voice signals are transferred to the handset interface 121. The handset interface 121 transfers the voice signals to the user of the portable radiotelephone. The handset interface 121 also receives voice signals from the user. This voice signals are transferred to the optional voice processor 123 for scrambling. These signals are transferred into the standard cell ASIC 125 which converts the voice signals to analog signals. The analog signals are sent back to the power amplifier 113 and the transmitter 115 for transmission back to the fixed site transceiver 101.

In the memory block 107 there is an EPROM 131 which contains call processing and error monitoring software. The error monitoring software is used by the main processor 109 to monitor the conditions and check for errors of the memory block 107, the logic section 105, the portable transceiver 103, the parallel and serial ports, the counters and the timers contained in the KIO 111. Upon finding an occurrence of an error event the monitoring software jumps to an error recording routine and stores the errors in the non-volatile memory 133 according to the method included in the invention .

The error recording routine stores related information in the non-volatile memory 133 according to the form described in FIG. 2. In the preferred embodiment, there are fifty-six error types which are checked by the monitoring software. Each error type has a distinct address location in the non-volatile memory 133. At each distinct location there are four bytes of information stored. The first byte 201 contains an 8 bit counter which represents the number of occurrences of this type of error up to a value of two-hundred-fifty-five occurrences. The next three bytes of information 203, 205, 207 contain a time stamp representing the time at which the last error type has occurred. The binary numbers stored in these three bytes 203, 205, 207 represent the number of minutes of operation of the portable radiotelephone since its release from the factory. The third byte 207 contains the most significant byte and the first byte 203 contains the least significant byte.

FIG. 3 is a process flow chart of the error recording routine which is activated after an error event has been found by the main monitoring routine. The first step of the routine 303 turns off the power amplifier to eliminate any possibility of undesired or improper transmissions. The second step 305 determines a numeric error code related to the error type. Next, the error code is written out serially to a data line which can be externally monitored at 307. This is done for testing purposes in the lab when the non-volatile memory 133 is not operational. Next, in block 309 the non-volatile memory 133 is checked to see if it is operational. If the non-volatile memory 133 is not operational

then the radiotelephone is reset at 331 and the process is stopped at 335. If the non-volatile memory 133 is operational an address correlated to the error code is created for a location in the non-volatile memory 133. The first step in creating this address is to multiply the numeric error code by four at 311. The next step is to add the base address of 8949 to the result of the previous multiplication at 313. This multiplication and addition forms the non-volatile memory location address. Next, the value of the counter in byte 201 is compared to two-hundred-fifty-five at 315. This comparison is done to avoid incrementing the counter in byte 201 to zero, since two-hundred-fifty-five is the highest value which an eight bit counter can count. If the counter of byte 201 is equal to two-hundred-fifty-five, then the counter value is not changed. If the counter value is less than two-hundred-fifty-five, then it is incremented by one at 317. The counter value represents the number of times the error type determined at 305 has occurred. The time at which the error event occurred is marked at 321. Both the counter value and the marked time of the error are stored in the calculated memory location at 323. The numeric error code is stored in a second memory location which contains the latest error type at 325. Next, the type of error is assigned a magnitude at 327 by using the numeric error code as a pointer in a look-up table which contains the appropriate magnitude for the error. Then, the magnitude is compared at 329 to the number two. If the magnitude is less than two, the error is considered non-fatal and the program jumps to the main monitoring program and the operation of the radiotelephone is uninterrupted at 333. If the magnitude of the error is determined to be greater than two, the error is considered fatal and the entire radiotelephone is reset at 331.

The fifty-six addresses which are correlated to the error code form a table in the non-volatile memory 133. This table of the errors, containing the error type, the most current time of an occurence of the error type, and the number of occurrences of this error type, is available through the handset interface 121.

Claims

1. A method of recording an error event having one of a plurality of error types, in response to a trigger derived from the error event, the method comprising the steps of:

determining a numeric error code related to the error type;

calculating, in response to the trigger, a memory location correlated to said numeric error code;

incrementing a counter value which represents the number of times the error type has occurred and in response to said step of determining said numeric error code;

marking a time related to the error event; and

storing said counter value and said time in said calculated memory location.

2. A method of recording an error event in accordance with claim 1 further comprising the step of storing the error type in a second memory location.

3. A method of recording an error event in accordance with claim 1 further comprising the steps of:

assigning, in response to said step of storing, a magnitude to said error type; and

selecting a reset if said magnitude of said error type exceeds a predetermined magnitude.

4. A method of recording an error event in accordance with claim 3 further comprising the step of returning to a main program if said predetermined magnitude exceeds said magnitude of said error type.

5. A method of recording an error event as claimed in any preceding claim, in a radiotelephone having a power amplifier, a non-volatile memory, a data output port and a microprocessor, in response to a trigger derived from the error event, the method comprising:

turning off, in response to the trigger, the power amplifier;

determining a numeric error code related to the error type;

multiplying said numeric error code by a first predetermined numeric value; and

adding a second predetermined numeric value to a result of said step of multiplying, thereby deriving a first location in the non-volatile memory.

6. A method of recording an error event in accordance with claim 5 further comprising the step of writing, in response to the trigger, said numeric error code to the data output port.

7. A method of recording an error event in accordance with claim 5 further comprising the steps of:

determining, in response to the trigger, if the non-volatile memory will accept data; and

stopping, in response to a determination of no acceptance of data, the recording of the error event.

8. A radiotelephone having a power amplifier, a non-volatile memory, a data output port and a microprocessor and an error event recorder responsive to a trigger derived from an error event having a plurality of error types, and including:

means for turning off, in response to the trigger, the power amplifier;

means for determining a numeric error code related to the error type;

means for multiplying said numeric error code by a first predetermined numeric value; and

means for adding a second predetermined numeric value to a result of said step of multiplying, thereby deriving a first location in the non-volatile memory.

means for incrementing a counter value which represents the number of times the error type has occurred and in response to said step of determing said numeric error code;

means for marking a time related to the error event; and

means for storing said counter value and said time in said first location in the non-volatile memory.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9123183.7

Relevant Technical fields

(i) UK Cl (Edition K) G4A (AFMD), H4K (KFF, KTL, KYX)

(ii) Int CL (Edition 5) G06F 11/34; H04M 1/24, 3/10, 3/22

Search Examiner
G N CHAPMAN

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
6 APRIL 1992

Documents considered relevant following a search in respect of claims 1 TO 8

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A,E	GB 2246649 A (GRANADA), Note page 4 lines 13-21	
A	GB 2176637 A (SONY), Note page 2 lines 6 to 19	
X	GB 1459851 (XEROX), Note page 11 line 38 to page 12 line 6	1
X	EP 0104886 A2 (XEROX), Note page 2 lines 1-12	1

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

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