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(54) **Automatic self-testing alarm system with supervision signal analysis**

(57) A self-testing data communications system suitable for use with an alarm system. In a first aspect the communications system is capable of modifying an operational parameter such as the input signal sensitivity of a receiver located at a monitoring station during receipt of a supervision signal from a remote alarm device, in order to ensure that a non-supervision alarm signal will be properly received when the operational parameter is again returned to its normal state. In a second aspect, the receiving element of the communications system is capable of receiving the message simultaneously at two different sensitivity levels, and during a supervision message, the lower sensitivity path is used in order to ensure that non-supervision alarm messages are received with an adequate signal margin. In a third aspect, the receiving element of the communications system is capable of measuring the signal strength (RSSI) of the received message signal and comparing it, if it is a supervision message, to a predetermined threshold value. When the supervision RSSI signal is above the threshold, the received message is passed to the control as being validly received; when the supervision RSSI signal is not above the threshold, then the message is ignored.

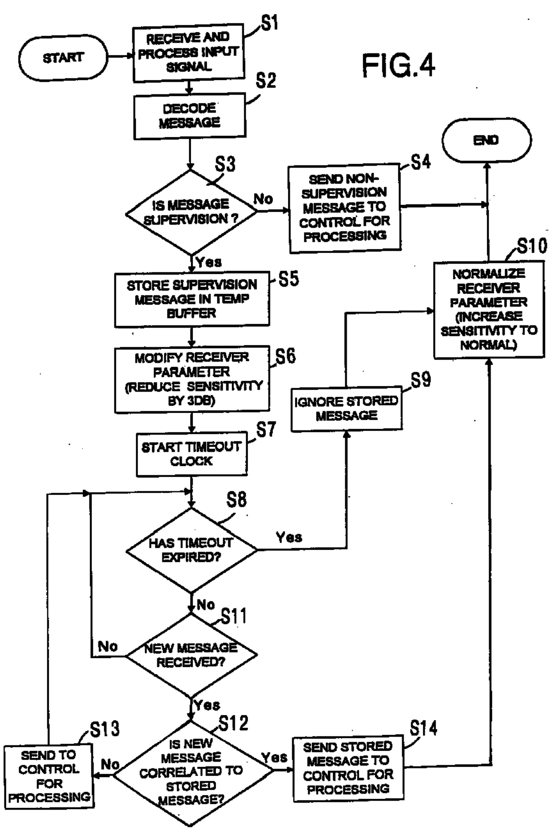

FIG.4

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Description

BACKGROUND OF THE INVENTION

The present invention relates to communications devices and protocols such as those used in alarm systems having multiple sensors in communications with one or more receiver/control units; and in particular in a first aspect to such alarm systems wherein an operational parameter of the receiver, such as its input signal sensitivity, is modified during the reception of a supervision signal from an associated transmitting sensor device in order to ensure there is adequate margin between the transmitter and the receiver during normal alarm signal transmission operations.

The present invention also relates in particular in a second aspect to such alarm systems wherein the receiving unit of the system automatically provides an indication as to the signal strength of a transmitted supervision signal by providing simultaneous decoding of an incoming message signal at two different sensitivity levels.

The present invention also relates in particular in a third aspect to such alarm systems wherein the receiving unit of the system automatically provides an indication as to the signal strength of a received supervision signal by measuring the signal strength of the signal and comparing it against a predetermined threshold.

Most radio frequency (RF) wireless security systems available today, such as those manufactured by ADEMCO, generally employ a multiplicity of transmitter products which transmit information to a common receiver/control. The information transmitted typically describes the state of various transducers associated with each transmitter, such as smoke, motion, breaking glass, shock and vibration detectors; door, window and floor mat switches; etc. These transmitter products are designed to be low in cost and are typically send-only devices, as opposed to send/receive, or transceiver, devices which are significantly more expensive. In order to meet basic regulatory agency requirements, the transmitters are required to transmit periodic supervision transmission signals in order for the control to monitor proper operation of all of the transmitters in a given system. The supervision signal (as well as an alarm signal) has a unique identification code embedded in its data message, which serves to identify to the system control which particular transmitting device has sent that supervision (or alarm) message. Typically, when a supervision signal is properly received and detected by the receiver unit, the transmitter identification code is supplied to the system control for further processing.

For life safety applications, the RF wireless system must also comply with more stringent regulations, such as the Underwriters Laboratories regulation UL864. This regulation additionally requires that the supervision signal be reduced in transmission power level below that of the alarm (normal, non-supervision) signal transmission by a minimum of 3dB or by other equivalent means, to ensure that the alarm signal has an effective power margin over that of the periodic supervision signals from each transmitter in the system.

To employ transmitter-only products that would accurately transmit an alarm signal at the maximum allowable level and to reduce that power level by a minimum of 3dB during the periodic supervision signal transmission would add significant additional cost to each transmitter product. Furthermore, most transmitter circuits were designed prior to the advent of the regulations such as the UL864 requirement, making it necessary to redesign and replace all of the transmitter circuits presently on the market despite the fact that they already meet all of the other applicable UL, FCC, and other regulatory requirements.

It would therefore be advantageous in a first aspect to employ an alarm system which effectively reduces the transmission power level of the supervision signal below that of the normal alarm signal by a minimum of 3dB and therefore ensures that the alarm signal has an effective minimum 3dB margin over that of the periodic supervision signals from each transmitter in the system, without modification to existing transmitter devices already in commercial use.

In the alternative, it would also be advantageous in a second aspect to employ an alarm system that utilizes automatic testing of the received supervision signal without modifying its receive sensitivity or other operational parameter for subsequent messages, but rather by performing such tests in real-time on the first detected supervision message. It would therefore be advantageous to employ an alarm system which receives the system supervision messages at a sensitivity below a normal alarm signal and therefore ensures that the alarm signal has an effective margin over that of the periodic supervision messages from each transmitter in the system, without modification to the transmitters already in commercial use.

Also in the alternative, it would further be advantageous in a third aspect to employ an alarm system that utilizes a method of measuring the signal strength of received messages and to compare the measured signal strength against a predetermined threshold, which must be exceeded for the supervision message to be accepted as valid.

It is therefore an object of the first aspect of the present invention to provide a communications system suitable for use with an alarm system which provides for effectively reducing the supervision signal strength without actual modification of the supervision signal generated by the transmitting device. It is a further object of the first aspect of the present invention to provide a method of modifying an operational parameter of the receiver, such as changing the receiver sensitivity, during a supervision transmission sequence to accomplish these objectives. It is a still further object of the first aspect of the present invention to provide for the logical prevention of the transmitter identification code from being sent to the system control during a multi-message supervision transmission sequence from that transmitter after one of those messages has been properly received at the normal sensitivity level and if none of the subsequent supervision messages from that same transmitter during that same transmission sequence have been properly received at the reduced sensitivity level. It is a still further object of the first aspect of the present invention to provide for the logical allowance of the transmitter identification code to be sent to the system control during a multi-message supervision transmission sequence from that transmitter after one of those messages has been properly received at the normal sensitivity level and if any one of the subsequent supervision messages from that same transmitter during that same transmission sequence has been properly received at the reduced sensitivity level. It is yet a further object of the first aspect of the present invention to provide for the application of an effective maximum time limit that the receiver sensitivity can be maintained in the reduced state in order to ensure that all subsequent normal alarm transmissions are received and processed at full receiver sensitivity. It is a still further object of the first aspect of the present invention to provide for the automatic allowance of one or more transmitter identification codes to be sent to the system control, whether they are supervision or alarm transmissions, if they are properly received within the maximum time delay in which the receiver sensitivity is maintained in its reduced state.

It is an object of the second aspect of the present invention to provide two signal paths within the receiver such that a supervision message may be received at a lower sensitivity level compared to the sensitivity at which the alarm messages are received. It is still a further object of the second aspect of the present invention to provide for the logical prevention of the transmitter identification code from being sent to the system control during a supervision transmission from that transmitter if a supervision message is received at the high sensitivity level but is not properly received at the reduced sensitivity level. It is still a further object of the second aspect of the present invention to provide for the logical allowance of the transmitter identification code to be sent to the system control if a supervision message is received at both the high and low sensitivity levels. It is yet a further object of the second aspect of the present invention to ensure that alarm messages are always received and sent to the control system at the high sensitivity level.

It is an object of the third aspect of the invention to provide for the logical prevention of the transmitter identification code from being sent to the system control during a supervision transmission from that transmitter if the received signal level of a supervision message does not exceed the predetermined threshold. It is still a further object of the third aspect of the present invention to provide for the logical allowance of the transmitter identification code to be sent to the system control if the received signal level of a supervision message exceeds the predetermined threshold. It is yet a further object of the third object of the present invention to ensure that alarm messages are always received at the maximum sensitivity and sent to the control system, i.e. alarm messages are always received at full sensitivity and not subjected to the predetermined threshold. It is still a further object of the third aspect of the present invention to provide a method which can operate on data formats wherein multiple messages are sent at each transmission event and where the format contains a specific bit to indicate a supervision message and may utilize single or multiple messages.

It is a still further object of all aspects of the present invention to provide an effective method of differentiating between supervision and normal alarm transmissions.

SUMMARY OF THE INVENTION

In accordance with these and other objects, the first aspect of the present invention is a data communications method and system comprising a plurality of remote devices comprising means for transmitting supervision signals and non-supervision signals, and a receiving station comprising means for receiving the supervision signals and the non-supervision signals, the receiving means having at least one operational parameter capable of being modified, and processing means for modifying the operational parameter of the receiving means in response to the receipt of a supervision signal. Each of the supervision signals comprise at least first and second messages correlated to each other, and the processing means modifies the operational parameter of the receiving means in response to the receipt of a first message from a supervision signal. If a subsequent message correlated to the first message is received while the operational parameter of the receiving means is modified, the processing means allows the supervision signal to be further processed by the receiving station as a successfully received supervision signal and returns to normal the modified operational parameter of the receiving means. The processing means also returns to normal the modified operational parameter of the receiving means after a predetermined time has elapsed if a subsequent message correlated with the first message is not received while the operational parameter of the receiving means is modified, and the supervision signal is not further processed by the receiving station as a successfully received supervision signal. When, however, a subsequent message not correlated with the first message is received while the operational parameter of the receiving means is modified, the subsequent message is further processed by the receiving station as a successfully received message and the modified operational parameter is maintained by the receiver.

In one preferred embodiment of this first aspect of the invention, the operational parameter capable of being modified is the input signal sensitivity of the receiver means, and the input signal sensitivity is so modified by being reduced. In this case, the input signal sensitivity of the receiver is returned to normal by being increased to normal operating level. Further, the subsequent message is determined to be correlated to the first message when they are identical to each other. The remote devices and the receiving means communicate by radio frequency electromagnetic wave transmission, and at least one of the remote devices is associated with an alarm sensor.

Thus, the first aspect of the present invention is based on the premise that instead of reducing the maximum allowable power of the periodic supervision signal transmissions, an equivalent means is to reduce the receiver sensitivity by an amount equivalent to reducing the transmitting power by 3dB, but only during receipt of supervision signals, and to provide full receiver sensitivity when receiving non-supervision alarm signals. This invention provides a unique method of accomplishing the stated objectives effectively without compromising the security of the system.

The first requirement of the receiver in this first aspect of the invention is that it have the ability of changing the receive sensitivity by at least 3dB to meet the applicable regulatory agency requirements. The receiver implemented in the present invention is a superheterodyne-type receiver and the circuit used to alter its sensitivity is common knowledge to those skilled in the art of narrow-band, short-range, RF superheterodyne receivers, and need not be discussed in any detail here. It is sufficient to say that the receiver sensitivity is altered between two pre-determined values by the logic 1 or logic 0 state of a microprocessor output connecting to that portion of the receiver circuits which determine the receiver sensitivity. This allows the receiver sensitivity to be under control of the microprocessor software.

Software control of the receiver sensitivity applied during a so-called test mode is disclosed in U.S. Patent No. 4,754,261. During this test mode, the receiver sensitivity is significantly reduced. This provides additional margin for all of the transmitters in the system since during normal modes of operation full sensitivity is restored to the receiver. The first aspect of the present invention provided herein is a method of differentiating supervision signals from non-supervision alarm signals, reducing the receiver sensitivity a required amount during reception of the supervision signal, and applying full receiver sensitivity during reception of non-supervision alarm signals. This is done per each transmitter in the system during normal modes of operation.

The second aspect of the present invention is a data communications method and system comprising a plurality of remote devices comprising means for transmitting supervision signals and non-supervision signals, and a receiver providing means for receiving signals at two different sensitivity levels, the supervision signals being processed at a lower sensitivity level, and the alarm messages being processed at the normal sensitivity level. In particular, the second aspect of the present invention is a method for automatically testing a communications system, wherein the communications system comprises a plurality of remote transmitting devices and a receiving station having a receiver associated therewith, and wherein each of the remote transmitting devices is capable of transmitting a supervision signal and a non-supervision signal. The method comprises the steps of receiving at the receiving station a signal from a transmitting device, processing the received signal at a first sensitivity level and providing a first output signal representative thereof, and processing the received signal at a second sensitivity level and providing a second output signal representative thereof, wherein the second sensitivity level is lower in magnitude than the first sensitivity level. It is then determined if the received signal is a supervision signal or a non-supervision signal by analyzing the first output signal. When the received signal is determined to be a supervision signal, then it is determined if the second output signal is correlated to the first output signal, and the first output signal is subsequently processed as being part of a validly received supervision signal when the second output signal is determined to be correlated to the first output signal, and the first output signal is not subsequently processed as being part of a validly received supervision signal when the second output signal is determined to be not correlated to the first output signal. When the received signal is determined to be a non-supervision signal, then the first output signal is subsequently processed as being part of a validly received non-supervision signal.

In one preferred embodiment of this second aspect of the invention, the remote devices and the receiving means communicate by radio frequency electromagnetic waves transmission and at least one alarm sensor is associated with each alarm transmitter. Thus, this second aspect of the present invention is based on the premise that instead of reducing the radiated power of the transmitted periodic supervision signals, it is equivalent to receive supervision signals at reduced sensitivity while maintaining full sensitivity for alarm transmissions. This second aspect of the invention provides a unique method of accomplishing the stated objectives without compromising the integrity of alarm signals. The first requirement of the receiver is that it have the ability to receive signals at two distinct sensitivity levels, at least 3dB different to meet applicable regulatory agency requirements. The receiver implemented in the present invention uses a superheterodyne architecture, although those skilled in the art will recognize that all receiver types may be applied equally well in this invention. It is important to note that the receiver sensitivity is most cost-effectively controlled by means of introduction of a threshold or clipping level in the video processing circuitry after the incoming RF signal is demodulated and reduced to its original baseband content. The video processing circuit output is two identical baseband signals except that one of the signals has been subjected to a 3dB higher threshold than the other. These two baseband signals are connected to input ports on a microprocessor, providing the microprocessor with two signal inputs which are received at different sensitivities. Those skilled in the art will recognize that control of sensitivity at baseband is the most cost effective method, although creation of two distinct paths at an earlier point in the receiver is possible albeit less desirable for reasons of cost and complexity. The signal received at high sensitivity is used by the microprocessor to obtain timing and synchronization information during a preamble portion of the message, the timing information is then used by the microprocessor to clock-in the subsequent data and CRC portions of the message into both microprocessor input ports. The signal received into the reduced sensitivity port is stored in RAM in the microprocessor. The signal received at the high sensitivity port is checked for proper CRC and it is determined whether or not the message is of a supervision type. If the message is a non-supervision message then it is passed directly to the control panel for further processing. If the CRC is good and the message is a supervision type, then the stored data in RAM from the reduced sensitivity port are read and the CRC is computed, if it is correct, and is identical to (correlated with) the message received at the high sensitivity port, then this message is passed to the control for further processing. If the CRC does not compute or the stored message does not match the high sensitivity message, then the message is not processed any further, and the supervision transmission fails to be received.

The third aspect of the present invention is a method for automatically testing a communications system, the communications system comprising a plurality of remote transmitting devices and a receiving station having a receiver associated therewith, each of the remote transmitting devices capable of transmitting a supervision signal and a non-supervision signal. The method comprises the steps of receiving at the receiving station a signal from a transmitting device, generating an RSSI (received signal strength indication) signal indicative of the signal strength of the received signal, and determining if the received signal is a supervision signal or a non-supervision signal. When the received signal is determined to be a supervision signal, then it is determined if the generated RSSI signal is above a predetermined threshold level, and the received signal is subsequently processed as being a validly received supervision signal when the RSSI signal is above the predetermined threshold level. The received signal is not processed as being a validly received supervision signal when the generated RSSI signal is not above the predetermined threshold level. When the received signal is determined to be a non-supervision signal, then the received signal is subsequently processed as being part of a validly received non-supervision signal without determining if the received signal is above the predetermined threshold level.

This third aspect of the present invention is implemented by a system comprising a plurality of remote devices, each of the remote devices comprising means for transmitting supervision signals and non-supervision signals, and a receiving station. The receiving station comprises means for receiving the supervision signals and the non-supervision signals, means for generating an RSSI signal indicative of the signal strength of the received signal, signal type determination means for determining if the received signal is a supervision signal type or a non-supervision signal type, comparison means for comparing the RSSI signal to a predetermined threshold, and means for disallowing further processing of the received signal when the signal type determination means indicates that the received signal is a supervision type signal and when the comparison means indicates that the RSSI signal is below the predetermined threshold.

BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a block diagram of the preferred embodiment of all three aspects of the present invention;

FIGURE 2 is a timing diagram of the supervision and alarm messages processed by the preferred embodiment of all three aspects of the present invention;

FIGURE 3 is a timing diagram of the reduced receiver sensitivity executed by the preferred embodiment of the first aspect of the present invention;

FIGURE 4 is a flowchart of the operation of the preferred embodiment of the first aspect of the present invention;

FIGURE 5 is a block diagram of the receiver/control unit according to the preferred embodiment of the first aspect of the present invention;

FIGURE 6 is a block diagram of the receiver/control unit according to the preferred embodiment of the second aspect of the present invention;

FIGURE 7 is a flow chart of the operation of the preferred embodiment of the second aspect of the present invention;

FIGURE 8 is a detailed schematic of the processing portion of the block diagram of Figure 6;

FIGURE 9 is a block diagram of the receiver/control unit according to the preferred embodiment of the third aspect of the present invention;

Figure 10 is a flow chart of the operation of the preferred embodiment of the third aspect of the present invention; and

Figure 11 is a detailed schematic of the processing portion of the block diagram of Figure 9.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The following discussion of the overall system and supervision and alarm messages apply to all three aspects of the present invention. Referring to Figure 1, an alarm system 2 is shown, which includes a receiver/ control unit 6 in communications with a plurality of remote devices 4, each of which comprise an alarm sensor and a data transmitting unit. The alarm sensors are well known in the prior art and include, for example, motion detectors, fire or smoke sensors, glass breakage sensors, door or window entry sensors, and the like. In the preferred embodiment, the alarm system 2 operates in a so-called "wireless" fashion by electromagnetic wave transmission (radio frequency in particular) between the remote devices 4 and the receiver/ control unit 6. The transmitter units housed within each remote device 4 are also well known in the art, and transmit supervision and alarm message signals, to be described below, by modulating a high frequency RF signal (e.g. 345 MHz). The modulated RF signal is received, processed and decoded by the receiver/ control unit 6 so that the control unit is provided with the data from the remote devices 4 and may act accordingly; e.g. by sounding an alarm speaker, dialing a police or fire station, etc. Further description of this type of wireless alarm system may be found in U.S. Patent No. 4,754,261 to Marino, which is owned by the assignee of the present invention and is incorporated by reference herein.

The remote devices 4 are configured to transmit supervision signals and alarm signals in accordance with protocol known in the art. The supervision signals function to provide periodic "test" signals to the receiver/control unit 6 for the purpose of ensuring that each remote device 4 configured with the system 2 is in proper communication with the receiver/ control unit 6. Since it is possible in this type of system that a remote device 4 may only transmit an alarm signal at a time of an emergency (i.e. when a window associated with the sensor is broken), it is imperative that the system 2 maintain a periodic method of ensuring that a device 4 is in proper communication with the receiver/ control unit 6 so potential problems may be attended to promptly.

Thus, a supervision signal is periodically sent from each remote device 4 in the system to the receiver/control unit 6 for monitoring purposes. A supervision transmission sequence typically consists of a single pentad, which is a single group of five identical messages, as shown in section A of Figure 2. Each message is approximately 20 ms in duration and is repeated every 100 ms as shown in Figure 2. A normal, non-supervision alarm signal, which is transmitted typically only when a change in status of the alarm sensor occurs (e.g. when a door is opened), consists of a double pentad, which is two groups of five identical messages separated in time by approximately 1 second. This is shown in section B of Figure 2.

Each identical message is 64 bits long and has a 16-bit preamble, 24 bits of transmitter serial number or keypad data, a single 8-bit status byte, and a 16-bit CRC (Cyclical Redundancy Character), as shown in section C of Figure 2. The status byte contains 8 data bits, shown as D1-D8 in section D of Figure 2, which convey specific information. In this case, D8=1 signifies that the received message was from a transmitter which is capable of generating supervision transmissions, whereupon D1-D4 represent the state of up to 4 sensor inputs to that transmitter, D5 indicates the state of that transmitter's battery, and D6 = 1 indicates that the received message was part of a supervision single pentad transmission. In this manner, the receiver circuitry is provided with coded information from the transmitter unit which enables it to determine if the message is part of a supervision signal or part of a normal, non-supervision alarm signal.

In the first aspect of the invention, when the receiver detects that the present message is part of a supervision pentad, the sensitivity of the receiver is immediately reduced. Figure 3 illustrates how the receiver sensitivity is changed during reception of a supervision pentad. Starting with full receiver sensitivity, the first message of the pentad is properly received and analyzed. If this message is determined to be that of a supervision transmission (that is, D6 = 1) then the message is temporarily stored in a receiver buffer memory and the receiver sensitivity is immediately lowered to at least 3dB below the full level. The lowered sensitivity level will remain in effect until a subsequent supervision message is properly received at this lowered level which matches the first message received at the full sensitivity level, or following a pre-determined time delay of 600 ms, whichever occurs first. If during this interval of reduced sensitivity, a supervision transmission is successfully received which does not match that which initiated the interval (i.e. the message stored in the receiver), then the supervision message for the non-matching transmitter ID is immediately sent to the control unit for subsequent processing.

It is possible for a signal (alarm or supervision) to be received from a different remote device 4 during the time that the receiver is in reduced sensitivity as a result of detecting the reception of a supervision signal. That is, a second received signal may be interleaved with a first received signal. In order for the receiver to properly process the interleaved second signal, the timeout period used for waiting for the next supervision message must be greater than the time for one pentad but less than the time before the second pentad of an alarm transmission can start. This will ensure receipt of (the second) transmission at the full sensitivity level even if it occurred slightly later than an interleaved first supervision transmission since a double pentad is always associated with alarm transmissions but only single pentads are used in supervision transmissions. From Figure 2 it can be seen that this time delay must be greater than 400 ms (in order to allow at worst case the last of the remaining four messages to be detected), but less than 1 second (in order to bring the receiver back up to full sensitivity prior to the next pentad, if the transmission is a double pentad). Thus, a delay of 600 ms is used in this embodiment.

A typical scenario is illustrated in Figure 3 in which the first supervision message results in a reduction of the receiver sensitivity level and the second supervision message, matching the first message, is properly received. In this case proper reception of the supervision message at the reduced sensitivity level has been established for that particular transmitter allowing the receiver to send the supervision message for that transmitter ID to the control. However, also evident in Figure 3 is the continuation of the lowered sensitivity level if the second, third, etc. message fails to be properly received due to the lowered sensitivity. If all of the remaining four messages fail to be properly received at this reduced level, the required margin for that transmitter is assumed inadequate. In that case the supervision message for that transmitter ID will not be sent to the control. The control will thus be in receipt of only those supervision messages per transmitter ID in the system which can be received at the reduced sensitivity level, meeting the UL864 requirement.

This flow of operation of this first aspect of the present invention is illustrated by the flowchart set forth in Figure 4. In step S1, the (RF) input signal is processed to provide a digital data signal. In step S2, the digital data signal is decoded to analyze the status bit D6 to determine if the message is supervision or non-supervision alarm. If step S3 determines the message to be non-supervision, then the message is sent to the control for processing at step S4 and the process is ended. If however, the message was determined to be a supervision message, then it is stored in a temporary buffer at step S5, and the receiver sensitivity is reduced by 3dB at step S6. A timeout clock, which in the preferred embodiment is 600ms as explained above, is then initiated at step S7. The process loops in a wait state via steps S8 and S11 until the timeout expires at step S8 or a new message is received at step S11.

If the timeout has expired without a new message being received while the receiver is in the reduced sensitivity state, then the stored message is ignored at step S9, the receiver sensitivity is increased back to normal at step S10, and the process is ended. In this case, since the supervision message was not properly received and detected while the receiver was in the reduced sensitivity state, then the transmitter ID associated with that supervision message is, in effect, thrown out, and the receiver control unit is never informed of its initial reception at the full sensitivity level. Thus, although the supervision signal was strong enough to be detected at the normal sensitivity level, it could not be received at the effective reduction of 3dB in signal strength, and the UL864 test is not met for that remote device 4.

If however, a new message is received at step S11, then it is analyzed at step S12 to determine if it is the same as the message stored in the temporary buffer; that is, if it is from the same transmitter device or if has been received from a different transmitting device which has in effect interleaved its message stream with that of the originally received message. If the message is from a different transmitter, then it is sent to the control by step S13 (since it was successfully received at the reduced sensitivity level), and the wait state continues with steps S8 and S11. The timeout clock is not reset, since the receiver is still waiting for the next supervision message which matches that which initiated the reduction in sensitivity. Thus, if a new message matching the stored message is not received within the timeout period, the receiver sensitivity is increased to normal and the process ends with the stored message being ignored.

If, however, step S12 determines that the new message matches the stored message, then the test has passed and the message is sent to the control by step S14 for subsequent processing. The receiver sensitivity is increased back to normal and the process is exited.

Figure 5 illustrates the circuit block diagram for the receiver/ control unit 6 of the first aspect of the present invention. An RF signal is received at the antenna 20, and is filtered by section 22 and demodulated by section 24 in conjunction with a 355.7MHz oscillator 26 in accordance with techniques well known in the art. A demodulated baseband video signal 28 is fed to a video processor circuit 30, which has programmable sensitivity for accomplishing the objectives of this invention. Reference is again made to U.S. Patent No. 4,754,261 for further details. A microprocessor 32, along with appropriate ROM memory device 34 configured to store the program embodied by the flowchart of Figure 4, is connected to the video processor 30 for supplying appropriate control signals thereto for controlling the receiver sensitivity. In particular, when a message is determined by the microprocessor to be a supervision message, the state of control signal 36 is changed to indicate to the video processor that the sensitivity of the receiver unit should be reduced by 3dB. This control signal is again toggled in accordance with processing described above in order to return the receiver sensitivity to normal when required.

The transmitter identification data, along with other data pertinent for operation of the alarm system, is sent to the control unit (not shown here) for subsequent processing as described above via the ECP data bus 38, which is a four line interface comprising a ground and power line, and send and receive data lines in accordance with techniques well known in the art.

Control signal 40 allows for manual control of the receiver sensitivity, if desired, by means of the keypad panel 8 or the like, in order to place the system into a test mode for device installation purposes as described in the aforementioned Patent No. 4,754,261.

The preferred embodiment of the first aspect of the present invention has been described with reference to the reduction of the receiver sensitivity in order to provide an impaired transmission/reception function and thus test the margin of operation of the system to ensure it will perform according to applicable regulatory requirements. It is contemplated that this may also be implemented by modifying other operational parameters of the receiver in order to obtain similar results. For example, as disclosed in the above-mentioned U.S. Patent No. 4,754,261 to Marino, the clipping level of a shaping circuit used in conjunction with the receiver may be altered as a result of the detection of a supervision message, the baud rate of the receiver may be modified in order to put a higher demand on the system operation, etc.

Moreover, it is contemplated that while the preferred embodiment of this first aspect of the present invention utilized supervision messages in a supervision signal which are identical to each other, it is possible to utilize supervision messages which correlate to each other in some predetermined fashion, rather than requiring them to be identical. Thus, supervision messages may be encoded with indicia representing the source of transmission, but may differ from each other in other ways. The system can be easily adapted to analyze the relationship between supervision messages to determine if they are properly correlated, thus determining that they were transmitted from the same source and allowing further processing of the message where appropriate.

Thus, while particular embodiments of the first aspect of the present invention have been shown and described, various modifications will be apparent to those skilled in the art, and therefore it is not intended that the first aspect of the invention be limited to the disclosed embodiment, or to details thereof, and departures may be made therefrom within the spirit and scope of the present invention. For example, although single groups of five identical messages are used in this embodiment for supervision transmissions and two groups of five identical messages for normal, alarm transmissions, other schemes could be equally used. For example, two or more identical, or different, messages per group for supervision transmissions, and an equal or greater number of identical, or different messages, per more than one group for the normal, alarm transmissions. In addition the length and periodicity of the transmissions can also be different and still conform to the methods disclosed herein.

The second aspect of the present invention will now be described in detail. Figure 1 again illustrates the block diagram of the system utilized by this second aspect of the invention; however, receiver/ control unit 6a is utilized (as shown in Figure 6) rather than the receiver/ control unit 6 of the first aspect of the invention. In addition, with reference again to Figure 2, the message format utilized by the second aspect of the present invention is illustrated and operates as described above. In this second aspect, during the preamble portion of a received message, the microprocessor decoding algorithm determines the necessary timing information required for subsequent decoding of the data portion and CRC of the message. This timing and initial decode is determined using the high sensitivity port of the microprocessor shown in Figure 6.

When the microprocessor in the receiver of Figure 6 decodes a non-supervision (D6=0) message on the high sensitivity port it is immediately sent to the control panel, however if a supervision message is decoded (D6=1) then the microprocessor checks the RAM buffer which contains the data received at reduced sensitivity. This data has been clocked into the buffer using the timing information derived from the message on the high sensitivity port. If the supervision message in the buffer correlates (is identical to) the message received on the high sensitivity port then the message is sent to the control panel. If the correlation is not exact then this particular supervision message fails and is not sent to the control panel. Thus alarm (non-supervision) messages are received at full sensitivity, and all supervision messages are subject to an additional threshold to ensure adequate system margin.

This method does not rely for its success on multiple supervision or alarm messages to be sent at each alarm event, nor is this method adversely effected by multiple transmissions.

Those skilled in the art will recognize that depending on signal traffic probability, it may be necessary to provide sufficient RAM in order to buffer several low sensitivity messages for comparison with the high sensitivity counterpart.

Figure 6 illustrates the circuit block diagram for the receiver/ control unit 6a of this second aspect of the present invention. The receiver 6a comprises an antenna selection circuit 20a, an RF filter 22a, a low noise amplifier 24a, a second RF filter 26a, a mixer 28a, a local oscillator 30a, an IF filter 32a, an IF gain and demodulation circuit 34a, and a video filter 36a, which are all well known in the art of RF receivers. In addition, a demodulated baseband video signal is fed from the video filter 36a to a video processing circuit 38a and threshold circuit 40a which function to provide two outputs which have been subjected to different sensitivity thresholds. These data outputs are connected to two input ports of a microprocessor 42a. The reduced sensitivity port is followed by an adequately sized buffer 44a to store the received data should the data be from a supervision signal and further correlation is required.

Reference is now made to the flowchart of Figure 7. The input signal is received and processed by the aforementioned components, and two data signals are derived; one at full, or normal receiver sensitivity, which is input to the microprocessor at port I2, and a second signal at reduced sensitivity, which is input to the microprocessor at port I3. The low sensitivity data message is stored in the RAM buffer 44a. Concurrently, the microprocessor examines the D6 bit of the full sensitivity signal input at I2. If it is determined to be a non-supervision signal, then the reduced sensitivity data message stored in the RAM 44a is ignored, and the full sensitivity message from I2 is sent to the control. If, however, it is determined that the full received data message is a supervision type, then the microprocessor 42a compares the low sensitivity message stored at RAM 44a with the full sensitivity message, and if they are correlated, then the test has passed and the message is sent to the control. If however, the signals are not found to be correlated, then they are ignored, the test is considered to have failed, and the control is not provided with information that the supervision message were received.

In the preferred embodiment of this second aspect of the invention, correlation of the reduced sensitivity supervision signal and full sensitivity supervision signal is found when the two signals match identically. However, it is contemplated that there may be a degree of variance tolerable in a given system, and this may be designed into the comparison routine if desired.

The preferred embodiment of this second aspect of the invention has been described with reference to a system wherein a single message is transmitted at each transmission event and includes in the message a specific bit to designate a supervision message. Those skilled in the art will recognize that a message is often repeated to improve probability of reception and in addition a specific supervision bit may not be included. In this type of system a supervision transmission may be differentiated from an alarm transmission by the number of repeats of each message. There are regulatory requirements that a supervision message be repeated less often than an alarm message. In these cases, the system described in the present invention will discern whether a message is a supervision type by counting the number of repeats of a received message before deciding whether or not to perform the comparison of low sensitivity and high sensitivity messages.

Figure 8 illustrates the detailed schematic of the dotted line portion of Figure 6. IF/demodulator integrated circuit 34, which in the preferred embodiment is a Philips NE614, utilizes the IF input signal and provides at its output a demodulated data signal to the low pass filter 36a formed by R1 and C1. The low pass filter 36a reduces the noise content of the video output signal. The filtered video signal is then AC coupled via capacitor C2 to the non-inverting inputs of the U3 and U4 comparators (LM339), which quantize the signal to a logic level suitable for input to the microprocessor 42a. The combination of R4 and R5 form a voltage divider, which sets a slicing level for the reference voltage applied to the inverting input to the U3 comparator. Capacitor C3 provides an AC ground for the U3 comparator reference input.

The reference voltage applied to the inverting input on comparator U4 is modified by means of injection of additional current via resistor Ry. Thus, the reference voltage to U4 is offset by an amount determined by the values of Rx and Ry. Typically, Ry will be much larger than Rx or may be replaced by a true current source.

The output signals of each comparator U3, U4 are input to the microprocessor 42a input ports I2 and I3, respectively. The microprocessor in the preferred embodiment is a COP881 available from National Semiconductor. In particular, the output from U3 is fed to port I2 of the microprocessor, and is the normal sensitivity signal. The output from U4, which has been subjected to a higher comparison threshold than that at U3, is fed to port I3 of the microprocessor. This represents the low sensitivity input signal, which is stored in an internal RAM 44a for subsequent comparison if desired, as described above.

The microprocessor 42a may optionally control the threshold applied to U4 with a transistor switch TR1 and Rz, as shown in the optional control circuit of Figure 8. When desired, the threshold voltage applied to the inverting input of comparator U4 may be varied by programming an appropriate data bit D0. When D0 is a low logic level, then the transistor TR1 is in the off state, and the threshold applied to U4 is unchanged. When, however, the D0 bit is set to a high logic level, then the transistor TR1 is turned on, and the reference voltage at U4 is varied in accordance with the value of the resistor Rz. Thus, the threshold for analyzing supervision signals as described herein may be varied via software control, and may be varied for any particular data message received from a transmitter. This may be expanded even further, for example by utilizing multiple control circuits 46a in parallel connection to the reference voltage input of U4. The resistor Rz on each additional control circuit may vary, and each individual control circuit 46 may be controlled by a different bit output from the microprocessor 42a (e.g. D1, D2, etc.). As such, a graduated threshold may be available for use with different environments by programming the appropriate bit to control the desired control circuit 46a and change the reference voltage accordingly.

The third aspect of the present invention will now be described in detail. Again, Figure 1 illustrates the block diagram of the system utilized by this third aspect of the invention; however, receiver/ control unit 6b is utilized (as shown in Figure 9) rather than the receiver/ control unit 6 of the first aspect of the invention or receiver/control 6a of the second aspect of the invention. In addition, with reference again to Figure 2, the message format utilized by this third aspect of the present invention is illustrated and operates as described above. In this third aspect, during the preamble portion of a received message, a decoding algorithm implemented with a microprocessor determines the necessary timing information required for subsequent decoding of the data portion and CRC of the message.

Figure 9 illustrates the circuit block diagram for the receiver/ control unit 6b of this third aspect of the present invention. The receiver/ control unit 6b is similar to the receiver/ control unit 6a, and like reference numerals are used for like components accordingly. Thus, the receiver 6b comprises an antenna selection circuit 20a, an RF filter 22a, a low noise amplifier 24a, a second RF filter 26a, a mixer 28a, a local oscillator 30a, an IF filter 32a, an IF gain and demodulation circuit 34a, and a video filter 36a, which are all well known in the art of RF receivers. In addition, a demodulated baseband video signal is fed from the video filter 36a to a video processing circuit 38b. The video processing circuit 38b provides a received signal strength indication (RSSI) signal 39 in analog format which is indicative of the signal strength of the received signal. RSSI measurement circuits are well known in the art, as set forth for example in U.S. Patents No. 4,620,114; 5,390,365; and 5,423,064. The video processing circuit 38b also outputs to a port I3 on the microprocessor 42a the processed received signal. The analog RSSI signal 39 is processed by an A/D converter 40b, well known in the art, and the resulting digital data word indicative of the signal strength of the received signal is input to the microprocessor port G5 for further processing. The A/D port is followed by an adequately sized RAM buffer 44a to store the digital RSSI data word should the data message on signal 41 be determined to be a supervision type and further processing is required.

Reference is now made to the flowchart of Figure 10. The input signal is received and processed by the aforementioned RF components, and two data signals are derived; the actual data signal 41, which is input to the microprocessor 42a at port I3, and the digital RSSI data word, which is input serially to the microprocessor at port G5. The RSSI data word is then stored in the internal RAM buffer 44a. Concurrently, the microprocessor examines the D6 bit of the signal input at I3. If it is determined to be a non-supervision (alarm) signal, then the RSSI word stored in the RAM 44a is ignored, and the message from I3 is sent to the control. If, however, it is determined that the received data message is a supervision type, then the microprocessor 42 compares the RSSI word stored at RAM 44a with a predetermined threshold stored in a non-volatile buffer 45, and if the RSSI word is above the predetermined threshold, then the test has passed and the supervision message is sent to the control. If however, the RSSI word is not above the predetermined threshold, then the received signal is ignored, the test is considered to have failed, and the control is not provided with information that the supervision message was received. Thus, the transmitter identification data and other status data are sent to the control system if the message is an alarm type or if it is a supervision type received with adequate signal level.

The threshold value used for comparison against the measured RSSI word may be ascertained in various ways. In one embodiment, the RSSI threshold may be preset at the factory by typical programming techniques. Alternatively, the RSSI threshold may be programmed by the system installer, who may take measurements during initial operation of the system to determine the proper threshold to use in accordance with the particular environment. Thirdly, the microprocessor may be configured with techniques known in the art to make certain measurements of received signals, and determine an average threshold to use accordingly.

Figure 11 illustrates the detailed schematic of the dotted line portion of Figure 9. IF/demodulator integrated circuit 34, which in the preferred embodiment is a Philips NE614, utilizes the IF input signal and provides at its output a demodulated data signal to the low pass filter 36a formed by R1 and C1. The low pass filter 36a reduces the noise content of the video output signal. The filtered video signal is then AC coupled via capacitor C2 to the non-inverting input of the U3 comparator (LM339), which quantizes the signal to a logic level suitable for input to the microprocessor 42a. The combination of R4 and R5 form a voltage divider, which sets a slicing level for the reference voltage applied to the inverting input to the U3 comparator. Capacitor C3 provides an AC ground for the U3 comparator reference input.

The output signal of comparator U3 is input to I3 of the microprocessor 42a. The microprocessor in the preferred embodiment is a COP881 available from National Semiconductor. In particular, the output from U3 is fed to port I3 of the microprocessor, and is at the normal sensitivity level.

The filtered demodulated data signal is also input to an analog-to-digital (A/D) circuit 40b, which provides a digital output representative of the input signal in accordance with techniques well known in the art. In the preferred embodiment, a Texas Instruments TLC549I is used. A serial digital data word is then input to the port G5 of the microprocessor 42a for storage in the internal RAM 44a and subsequent analysis as described above.

The preferred embodiment has been described with reference to a system wherein a single message is transmitted at each transmission event and includes in the message a specific bit to designate a supervision message. Those skilled in the art will recognize that a message is often repeated to improve probability of reception and in addition a specific supervision bit may not be included. In this type of system a supervision transmission may be differentiated from an alarm transmission by the number of repeats of each message. There are regulatory requirements that a supervision message be repeated less often than an alarm message. In these cases, the system described in the present invention will discern whether a message is a supervision type by counting the number of repeats of a received message before deciding whether or not to perform the RSSI analysis.

It may also be desired to only perform the automatic self-test functions of any of the three aspects of the present invention as herein described on certain remote devices rather than on each one. That is, regulatory requirements may only mandate that life safety devices or applications be tested in this manner, while other devices in the system need not meet such rigorous communications standards. In such a system, the processing circuitry and software is provided with further intelligence in order to determine which supervision messages are to undergo testing and/or analysis in accordance with any of the three aspects of the present invention. This may be accomplished by designating a flag bit in the message as a test/no-test bit, wherein a logic true indicates that the transmission margin be tested, and a logic false indicates that the test need not be done. Alternatively, the processor may implement a look-up table programmed with the identity of each device which is to undergo the transmission margin test, and thus utilize the device identification code to access the table and process the message accordingly.

Further, although the preferred embodiment has been described in conjunction with a wireless RF system, the invention can be easily applied to traditional wired systems such as local area networks (LANs) and the like, wherein it may be necessary or desired to test the margin of operation between the transmitter and receiver functions.

Claims

1. In a communications system comprising a plurality of remote transmitting devices and a receiving station having a receiver associated therewith, said receiver having at least one modifiable operational parameter, each of said remote transmitting devices capable of transmitting a supervision signal having a plurality of correlated supervision messages and a non-supervision signal having a plurality of correlated non-supervision messages, a method for automatically testing the communications system comprising the steps of:

   a) receiving at said receiving station a first message from a transmitting device;
   b) determining if said first message is a supervision message or a non-supervision message; and
   c) modifying an operational parameter of the receiver when said first message is determined to be a supervision message.

2. The method of claim 1 further comprising the steps of:

   d) receiving a subsequent message;
   e) determining if said subsequent message is correlated to said first message; and
   f) returning the modified operational parameter of said receiver to normal when said subsequent message is determined to be correlated to said first message.

3. The method of claim 2 further comprising the step of subsequently processing said first message as being part of a validly received supervision signal when said subsequent message is determined to be correlated to said first message.

4. The method of claim 2 further comprising, when said subsequent message is not correlated to said first message, the steps of (i) maintaining the modified operational parameter of said receiver, (ii) processing said subsequent message as being part of a validly received signal, and (iii) waiting to receive a further subsequent message.

5. The method of claim 1 further comprising the steps of returning the modified operational parameter of said receiver to normal and ignoring said first message when, after a predetermined time, no subsequent message has been received which is correlated to said first message.

6. In an alarm system comprising a plurality of remote transmitting devices and a receiving station having a receiver associated therewith, said receiver having at least one modifiable operational parameter, each of said remote transmitting devices capable of transmitting a supervision signal having a plurality of correlated supervision messages and an alarm signal having a plurality of correlated alarm messages, a method for automatically testing the alarm system comprising the steps of:

   a) receiving at said receiving station a first message from a transmitting device;
   b) determining if said first message is a supervision message or an alarm message;
   c) modifying an operational parameter of the receiver when said first message is determined to be a supervision message;
   d) receiving a subsequent message;
   e) determining if said subsequent message is correlated to said first message;
   f) when said subsequent message is determined to be correlated to said first message, then performing the steps of

      returning the modified operational parameter of said receiver to normal, and
      subsequently processing said first message as being part of a validly received supervision signal;

   g) when said subsequent message is determined to be not correlated to said first message, then performing the steps of

      maintaining the modified operational parameter of said receiver,
      processing said subsequent message as being part of a validly received signal, and
      waiting to receive a further subsequent message; and

   (h) returning the modified operational parameter of said receiver to normal and ignoring said first message when, after a predetermined time, no subsequent message has been received which is correlated to said first message.

7. The method of claim 2 or 6 wherein the receiver operational parameter modification step comprises the step of reducing the input signal sensitivity of the receiver.

8. The method of claim 7 wherein the receiver operational parameter normalization step comprises the step of returning the receiver input signal sensitivity to normal.

9. A data communications system comprising:

(a) a plurality of remote devices, each of said remote devices comprising means for transmitting supervision signals and non-supervision signals; and
(b) a receiving station comprising:

(i) means for receiving said supervision signals and said non-supervision signals, said receiving means having at least one operational parameter capable of being modified;
(ii) processing means for modifying said operational parameter of said receiving means in response to the receipt of a supervision signal.

10. The system of claim 9 wherein each of said supervision signals comprise first and second messages correlated to each other, and wherein said processing means modifies the operational parameter of said receiving means in response to the receipt of a first message from a supervision signal, and wherein said processing means returns to normal the modified operational parameter of said receiving means if a subsequent message correlated to said first message is received while the operational parameter of said receiving means is modified.

11. The system of claim 10 wherein said supervision signal is further processed by said receiving station as a successfully received supervision signal if a subsequent message correlated with said first message is received while the operational parameter of said receiving means is modified.

12. The system of claim 11 wherein said processing means returns to normal the modified operational parameter of said receiving means after a predetermined time has elapsed if a subsequent message correlated with the first message is not received while the operational parameter of said receiving means is modified.

13. The system of claim 12 wherein said supervision signal is not further processed by said receiving station as a successfully received supervision signal if a subsequent message correlated with the first message is not received while the operational parameter of said receiving means is modified after a predetermined time has elapsed.

14. The system of claim 13 wherein, when a subsequent message not correlated with the first message is received while the operational parameter of said receiving means is modified, said subsequent message is further processed by said receiving station as a successfully received message and the modified operational parameter is maintained by said receiver.

15. The system of claim 14 wherein at least one of said remote devices is associated with an alarm sensor.

16. A receiving station system for use in a data communications system comprising a plurality of remote devices, each of said remote devices having a transmitter for transmitting a supervision signal comprising a plurality of correlated supervision messages and a non-supervision signal, said receiving station comprising:

(a) a receiver for communications with each of the remote devices, said receiver having at least one operational parameter capable of being modified,
(b) processing means operatively associated with said receiver for processing messages received from each of the remote devices, said processing means being configured to decode a first message received from a remote device and execute a supervision routine if said first message is determined to be a supervision message;

wherein said supervision routine causes the modification of the at least one operational parameter capable of being modified.

17. The system of claim 16 wherein said supervision routine further causes the modified operational parameter of said receiver to be returned to normal and to further process said first message when a subsequent message received from a remote device is determined to be correlated with the first message.

18. The system of claim 16 wherein, when a subsequent message is not received which is correlated with said first message, said supervision routine further causes the modified operational parameter of said receiver to remain so modified, to further process said subsequent message as a successfully received message, and to wait for additional subsequent messages.

19. The system of claim 16 wherein said supervision routine further causes the modified operational

parameter of said receiver to return to normal and to ignore said first message when, within a predetermined time that the operational parameter of said receiver has been so modified, no subsequent message has been received which is correlated with said first message.

20. The system of claim 14 or 17 wherein the at least one operational parameter capable of being modified is the input signal sensitivity of the receiver, and wherein the input signal sensitivity is so modified by being reduced.

21. The system of claim 20 wherein the input signal sensitivity of the receiver is returned to normal by being increased to normal operating level.

22. The system of claim 16 which is suitable for use in an alarm system, and wherein said non-supervision signals are alarm signals comprising alarm messages encoded with alarm status data.

23. In a communications system comprising a plurality of remote transmitting devices and a receiving station having a receiver associated therewith, each of said remote transmitting devices capable of transmitting a supervision signal and a non-supervision signal, a method for automatically testing the communications system comprising the steps of:

a) receiving at said receiving station a signal from a transmitting device;

b) processing said received signal at a first sensitivity level and providing a first output signal representative thereof;

c) processing said received signal at a second sensitivity level and providing a second output signal representative thereof, said second sensitivity level being lower in magnitude than said first sensitivity level;

d) determining if said received signal is a supervision signal or a non-supervision signal by analyzing said first output signal;

e) when said received signal is determined to be a supervision signal, then performing the steps of:

i) determining if said second output signal is correlated to said first output signal;
ii) subsequently processing said first output signal as being part of a validly received supervision signal when said second output signal is determined to be correlated to said first output signal; and
iii) not subsequently processing said first output signal as being part of a validly received supervision signal when said second output signal is determined to be uncorrelated to said first output signal; and

f) when said received signal is determined to be a non-supervision signal, then subsequently processing said first output signal as being part of a validly received non-supervision signal.

24. The method of claim 2, 8 or 23 wherein said second output signal or subsequent message is determined to be correlated to said first output signal or message when they are identical to each other.

25. The method of claim 23 wherein said communications system is an alarm system, at least one of said remote transmitting devices is associated with an alarm sensor, and wherein said non-supervision signal from said transmitting device associated with an alarm sensor is an alarm signal comprising alarm messages encoded with alarm sensor data.

26. A self-testing data communications system comprising

a) a plurality of remote devices, each of said remote devices comprising means for transmitting supervision signals and non-supervision signals;
b) a receiving station comprising:

i) means for receiving said supervision signals and said non-supervision signals;
ii) first processing means for providing at a first sensitivity level a first output signal representative of said received signal;
iii) second processing means for providing at a second sensitivity level a second output signal representative of said received signal, said second sensitivity level being lower in magnitude than said first sensitivity level;
iv) means for determining if said received signal is a supervision signal or a non-supervision signal; and
v) means for comparing said first output signal to said second output signal to determine if they are correlated.

27. The system of claim 26 wherein said first output signal is further processed by said receiving station as a successfully received supervision signal when said comparison means indicates that said first output signal and said second output signal are correlated.

28. The system of claim 26 wherein said first output signal is not further processed by said receiving station as a successfully received supervision signal when said comparison means indicates that said first output signal and said second output signal are not correlated.

29. The system of claim 21 or 26 wherein said first output signal is determined to be correlated to said second output signal when they are identical to each other.

30. A receiving station system for use in a data communications system comprising a plurality of remote devices, each of said remote devices having a transmitter for transmitting supervision signals and non-supervision signals, said receiving station comprising:

a) means for receiving said supervision signals and said non-supervision signals;
b) first processing means for providing at a first sensitivity level a first output signal representative of said received signal;
c) second processing means for providing at a second sensitivity level a second output signal representative of said received signal, said second sensitivity level being lower in magnitude than said first sensitivity level;
d) means for determining if said received signal is a supervision signal or a non-supervision signal; and
e) means for comparing said first output signal to said second output signal to determine if they are correlated.

31. In a communications system comprising a plurality of remote transmitting devices and a receiving station having a receiver associated therewith, each of said remote transmitting devices capable of transmitting a supervision signal and a non-supervision signal, a method for automatically testing the communications system comprising the steps of:

a) receiving at said receiving station a signal from a transmitting device;
b) generating an RSSI signal indicative of the signal strength of said received signal;
c) determining if said received signal is a supervision signal or a non-supervision signal;
d) when said received signal is determined to be a supervision signal, then performing the steps of:

i) determining if said RSSI signal is above a predetermined threshold level;
ii) subsequently processing said received signal as being a validly received supervision signal when said RSSI signal is above said predetermined threshold level; and
iii) not processing said received signal as being a validly received supervision signal when said RSSI signal is not above said predetermined threshold level; and

e) when said received signal is determined to be a non-supervision signal, then subsequently processing said received signal as being part of a validly received non-supervision signal without determining if said received signal is above said predetermined threshold level.

32. The method of claim 1, 6, 23, or 31 wherein said transmitting devices and said receiver communicate with electromagnetic wave transmission.

33. The method of claim 32 wherein said electromagnetic wave transmission is radio frequency wave transmission.

34. The method of claim 1 or 31 wherein said communications system is an alarm system, at least one of said remote transmitting devices is associated with an alarm sensor, and wherein said non-supervision signal from said transmitting device associated with an alarm sensor is an alarm signal comprising alarm messages encoded with alarm sensor data.

35. A self-testing data communications system comprising

a) a plurality of remote devices, each of said remote devices comprising means for transmitting supervision signals and non-supervision signals;
b) a receiving station comprising:

i) means for receiving said supervision signals and said non-supervision signals;
ii) means for generating an RSSI signal indicative of the signal strength of the received signal;
iii) signal type determination means for determining if said received signal is a supervision signal type or a non-supervision signal type;
iv) comparison means for comparing said RSSI signal to a predetermined threshold;
v) means for disallowing further processing of said received signal when said signal type determination means indicates that said received signal is a supervision type signal and when said comparison means indicates that said RSSI signal is below said predetermined threshold.

36. The system of claim 9, 16, 26 or 35 wherein said remote devices and said receiving means communicate by electromagnetic wave transmission.

37. The system of claim 36 wherein said electromagnetic wave transmission is radio frequency wave transmission.

38. The system of claim 9, 26 or 35 wherein at least one of said remote devices is associated with an alarm sensor.

39. A receiving station system for use in a data communications system comprising a plurality of remote devices, each of said remote devices having a transmitter for transmitting supervision signals and non-supervision signals, said receiving station comprising:

a) means for receiving said supervision signals and said non-supervision signals;
b)means for generating an RSSI signal indicative of the signal strength of the received signal;
c) signal type determination means for determining if said received signal is a supervision signal type or a non-supervision signal type;
d) comparison means for comparing said RSSI signal to a predetermined threshold; and
e) means for disallowing further processing of said received signal when said signal type determination means indicates that said received signal is a supervision type signal and when said comparison means indicates that said RSSI signal is below said predetermined threshold.

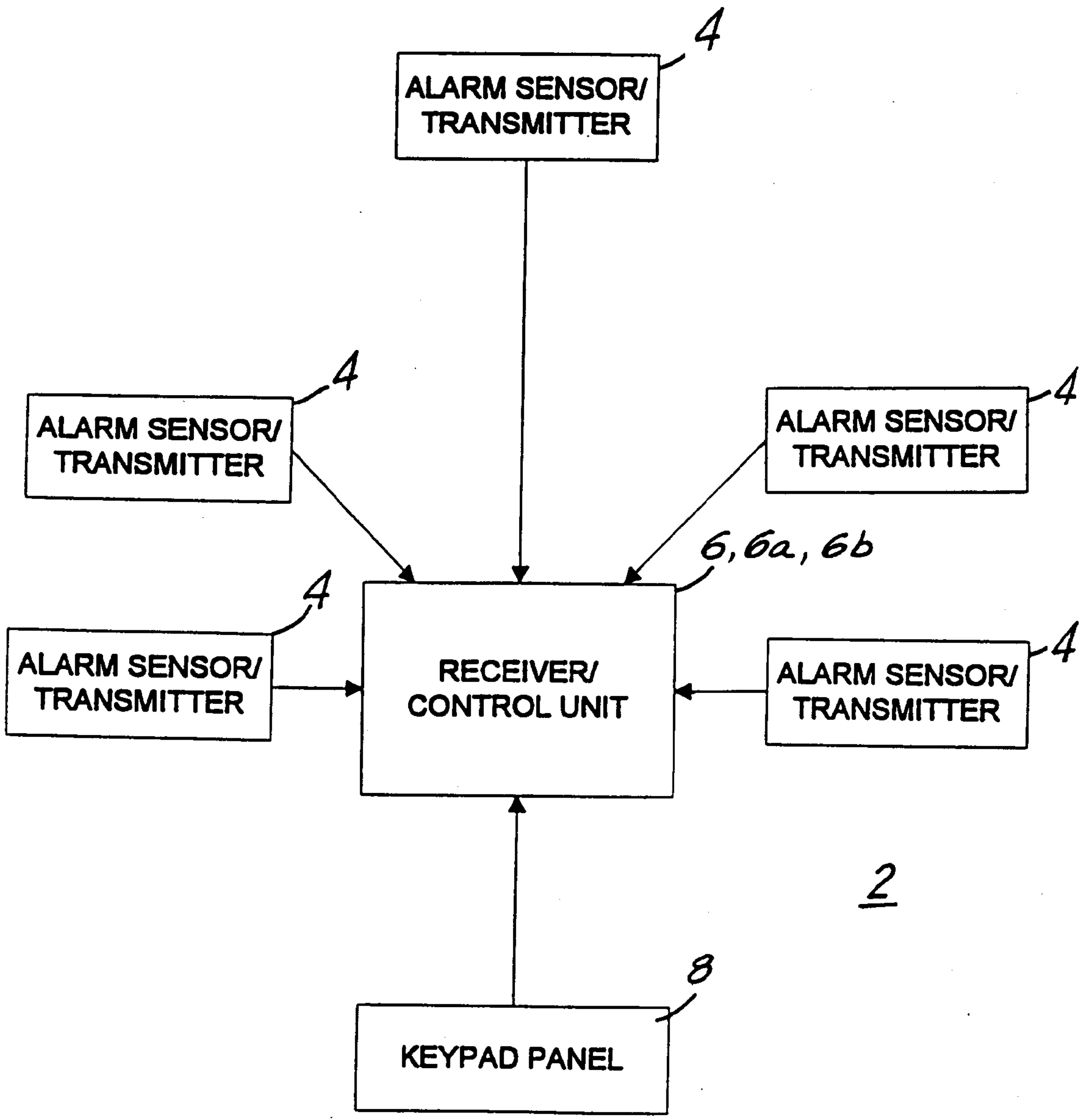
4
ALARM SENSOR/ TRANSMITTER
4
ALARM SENSOR/ TRANSMITTER
4
ALARM SENSOR/ TRANSMITTER
6, 6a, 6b
4
ALARM SENSOR/ TRANSMITTER
RECEIVER/ CONTROL UNIT
4
ALARM SENSOR/ TRANSMITTER
2
8
KEYPAD PANEL

FIG.1

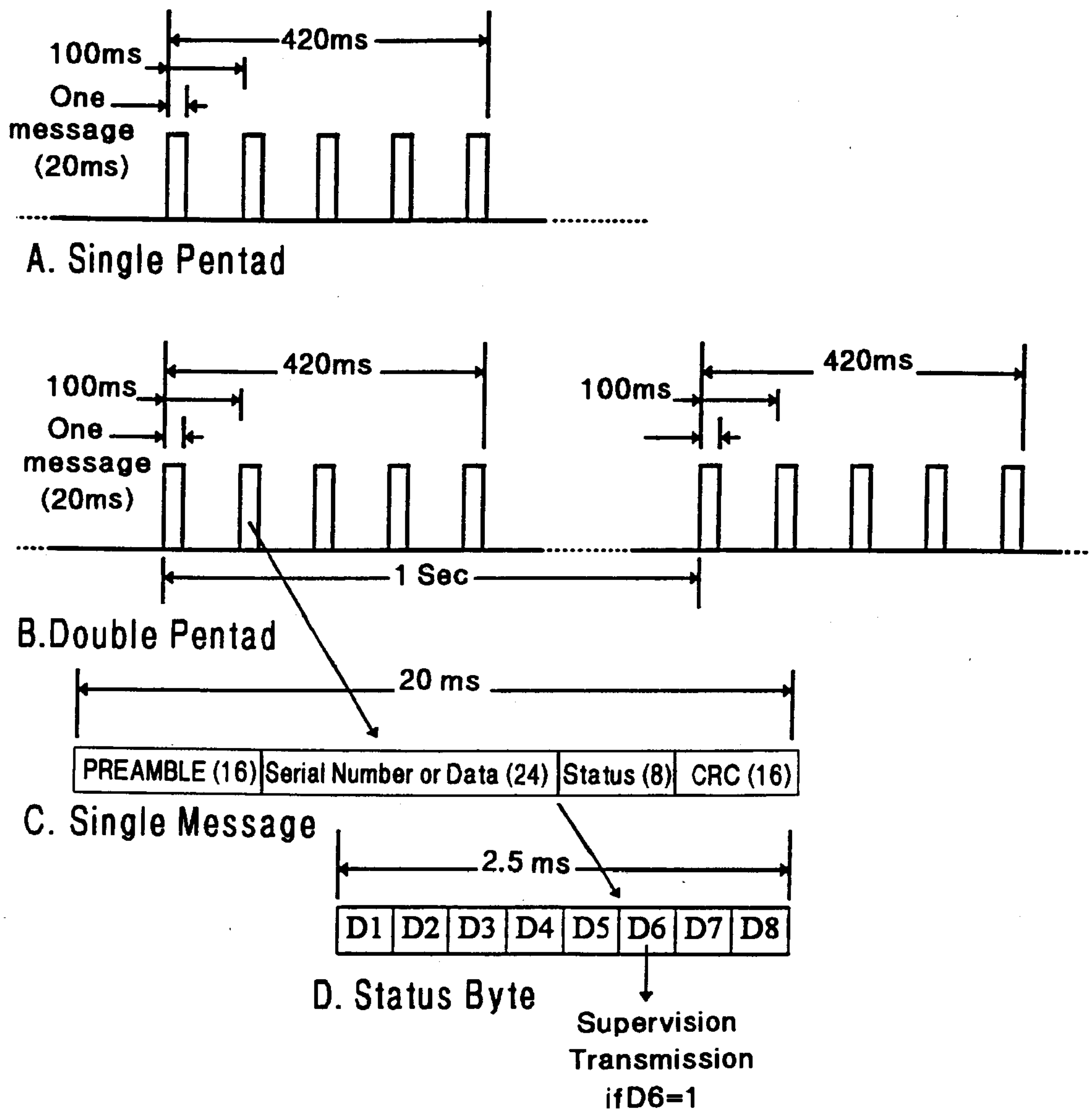
100ms
One message (20ms)
420ms
A. Single Pentad
100ms
One message (20ms)
420ms
100ms
420ms
1 Sec
B.Double Pentad
20 ms
PREAMBLE (16)
Serial Number or Data (24)
Status (8)
CRC (16)
C. Single Message
2.5 ms
D1
D2
D3
D4
D5
D6
D7
D8
D. Status Byte
Supervision Transmission ifD6=1

FIG.2

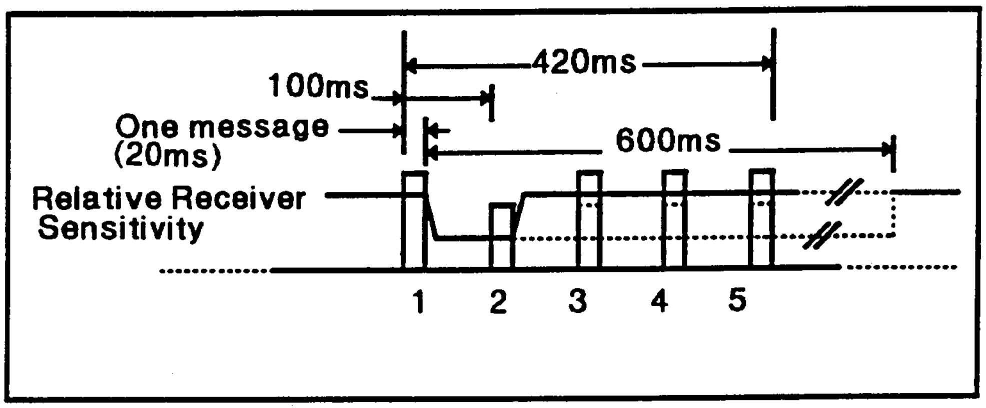
420ms
100ms
One message
(20ms)
600ms
Relative Receiver
Sensitivity
1
2
3
4
5

FIG.3

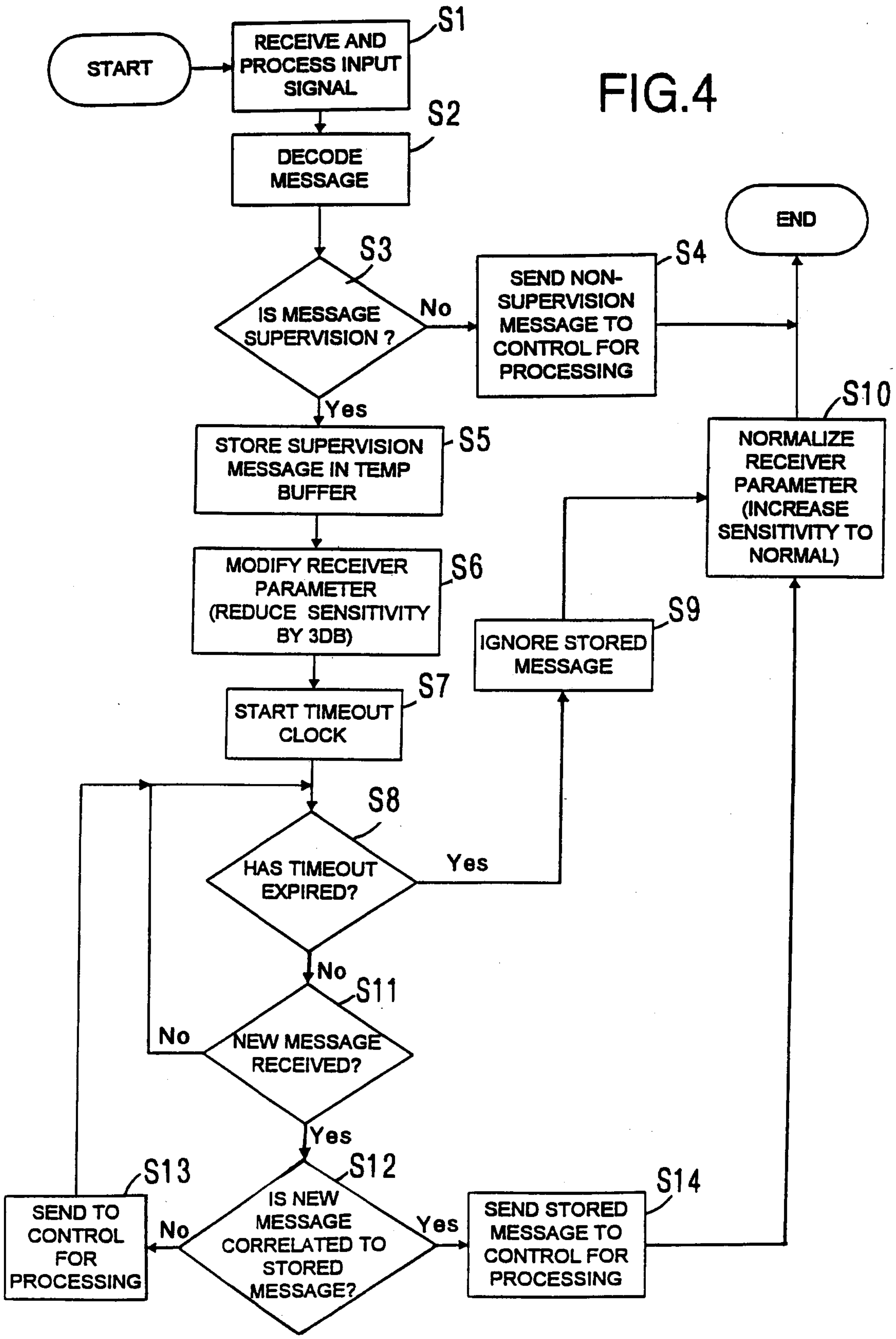
START
RECEIVE AND PROCESS INPUT SIGNAL
S1
DECODE MESSAGE
S2
IS MESSAGE SUPERVISION ?
S3
No
Yes
SEND NON-SUPERVISION MESSAGE TO CONTROL FOR PROCESSING
S4
END
STORE SUPERVISION MESSAGE IN TEMP BUFFER
S5
MODIFY RECEIVER PARAMETER (REDUCE SENSITIVITY BY 3DB)
S6
START TIMEOUT CLOCK
S7
HAS TIMEOUT EXPIRED?
S8
Yes
No
IGNORE STORED MESSAGE
S9
NORMALIZE RECEIVER PARAMETER (INCREASE SENSITIVITY TO NORMAL)
S10
NEW MESSAGE RECEIVED?
S11
No
Yes
IS NEW MESSAGE CORRELATED TO STORED MESSAGE?
S12
No
Yes
SEND TO CONTROL FOR PROCESSING
S13
SEND STORED MESSAGE TO CONTROL FOR PROCESSING
S14

FIG.4

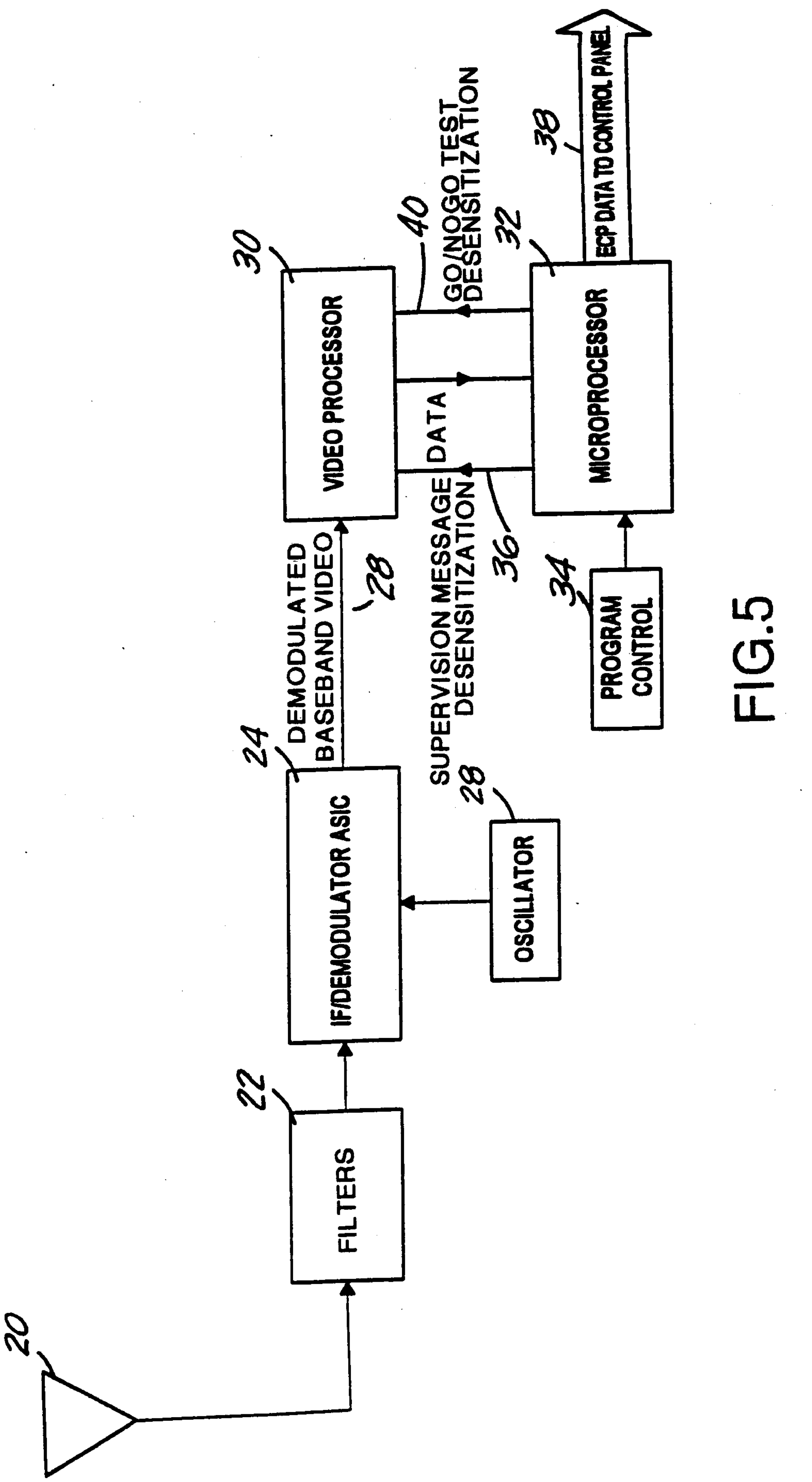
20
FILTERS
22
IF/DEMODULATOR ASIC
24
OSCILLATOR
28
DEMODULATED
BASEBAND VIDEO
28
SUPERVISION MESSAGE
DESENSITIZATION
36
VIDEO PROCESSOR
30
DATA
GO/NOGO TEST
DESENSITIZATION
40
MICROPROCESSOR
32
PROGRAM
CONTROL
34
ECP DATA TO CONTROL PANEL
38

FIG.5

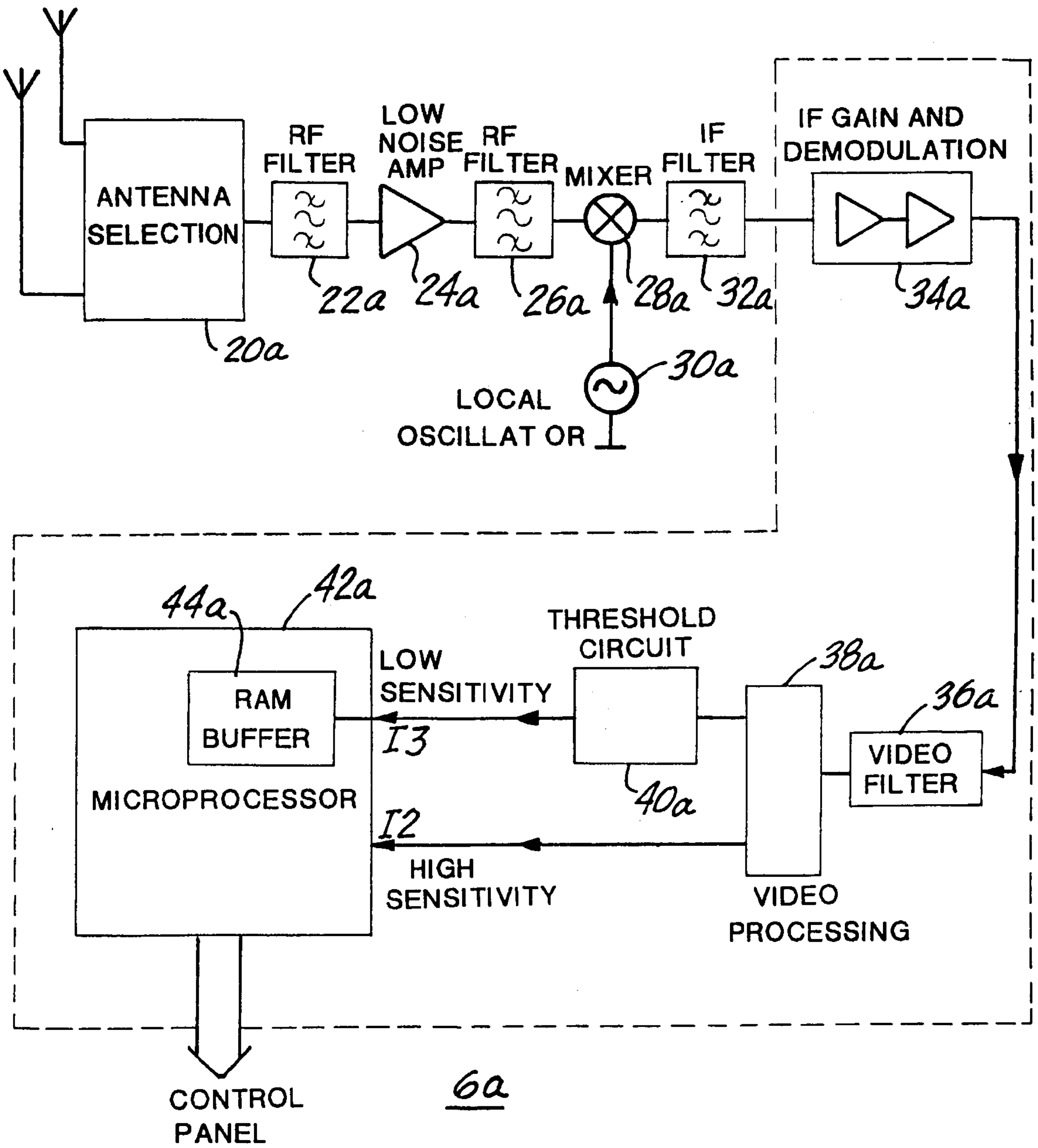
ANTENNA SELECTION
RF FILTER
LOW NOISE AMP
RF FILTER
MIXER
IF FILTER
IF GAIN AND DEMODULATION
20a
22a
24a
26a
28a
32a
34a
30a
LOCAL OSCILLATOR
44a
42a
RAM BUFFER
MICROPROCESSOR
LOW SENSITIVITY
I3
THRESHOLD CIRCUIT
40a
38a
36a
VIDEO FILTER
I2
HIGH SENSITIVITY
VIDEO PROCESSING
CONTROL PANEL
6a

FIG.6

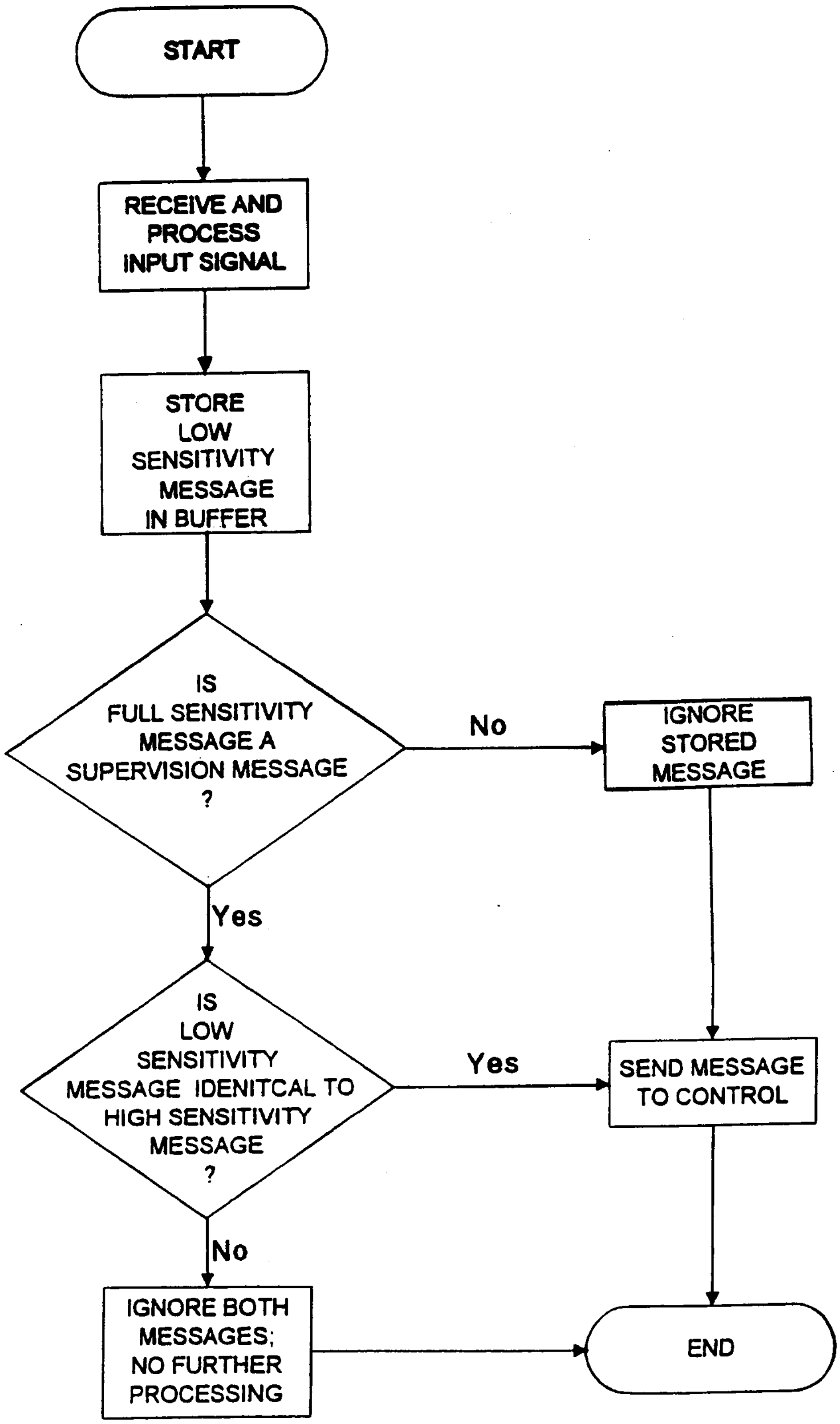
START
RECEIVE AND PROCESS INPUT SIGNAL
STORE LOW SENSITIVITY MESSAGE IN BUFFER
IS FULL SENSITIVITY MESSAGE A SUPERVISION MESSAGE ?
No
IGNORE STORED MESSAGE
Yes
IS LOW SENSITIVITY MESSAGE IDENITCAL TO HIGH SENSITIVITY MESSAGE ?
Yes
SEND MESSAGE TO CONTROL
No
IGNORE BOTH MESSAGES; NO FURTHER PROCESSING
END

FIG.7

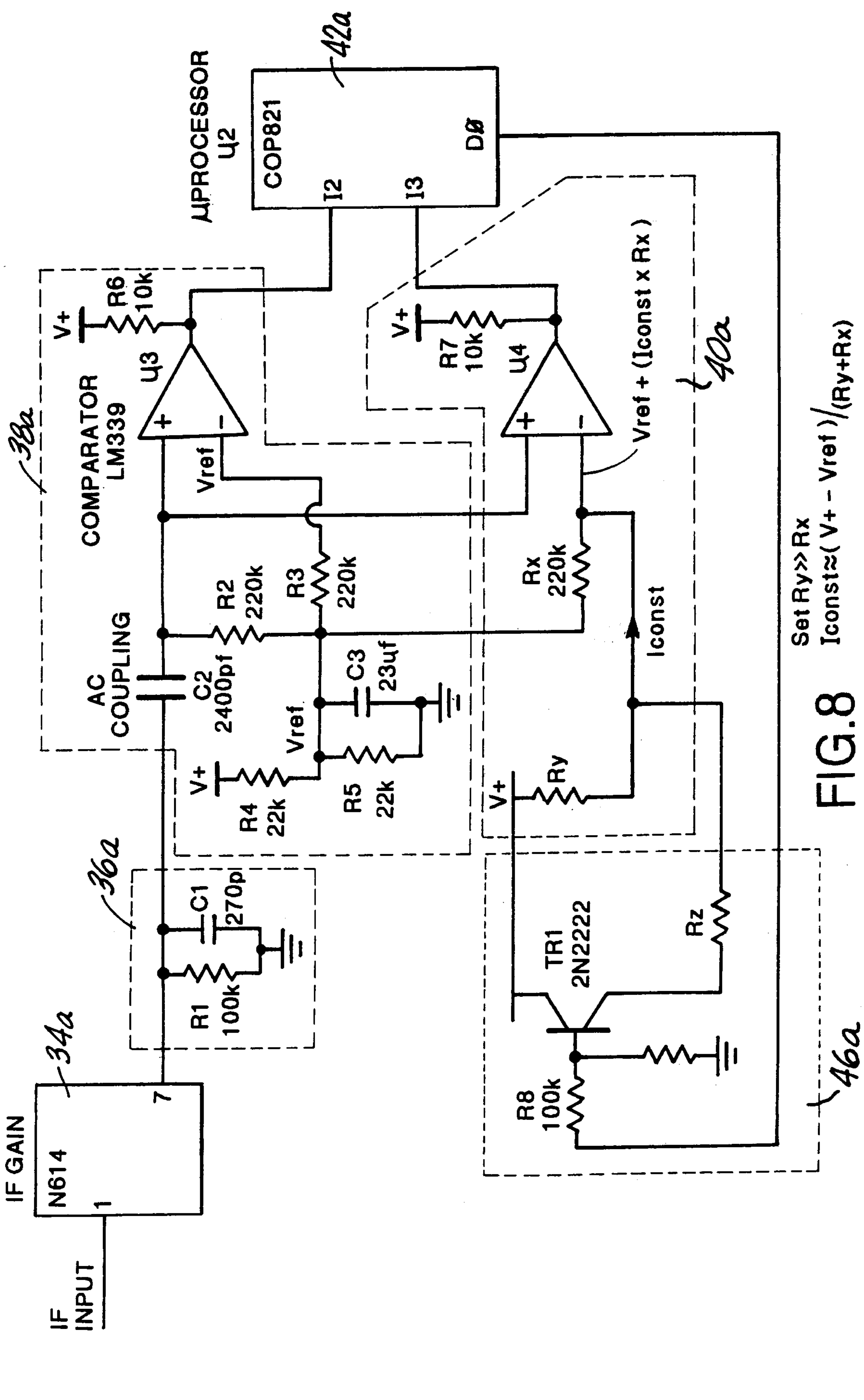
IF INPUT
IF GAIN
N614
1
7
34a
36a
C1
270p
R1
100k
38a
COMPARATOR
LM339
AC
COUPLING
C2
2400pf
R2
220k
R3
220k
C3
23uf
Vref
V+
R4
22k
R5
22k
U3
R6
10k
μPROCESSOR
U2
COP821
I2
I3
DØ
42a
V+
R7
10k
U4
Vref + (Iconst x Rx)
40a
Rx
220k
Iconst
Ry
Rz
TR1
2N2222
R8
100k
46a
Set Ry>>Rx
Iconst≈(V+ – Vref)/(Ry+Rx)

FIG.8

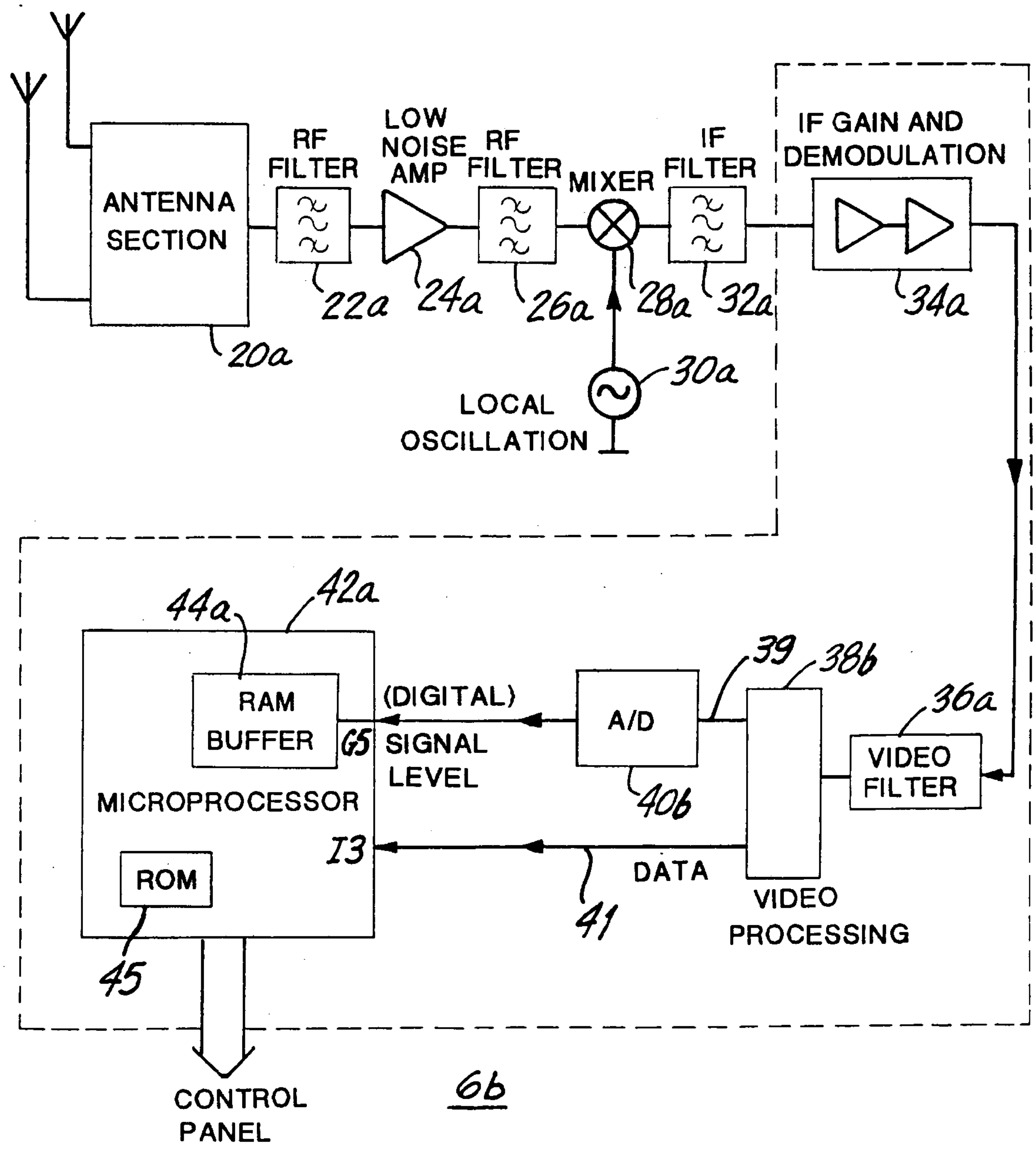
ANTENNA SECTION
20a
RF FILTER
22a
LOW NOISE AMP
24a
RF FILTER
26a
MIXER
28a
IF FILTER
32a
LOCAL OSCILLATION
30a
IF GAIN AND DEMODULATION
34a
VIDEO FILTER
36a
VIDEO PROCESSING
38b
39
A/D
40b
(DIGITAL) SIGNAL LEVEL
DATA
41
MICROPROCESSOR
42a
RAM BUFFER
44a
G5
I3
ROM
45
CONTROL PANEL
6b

FIG.9

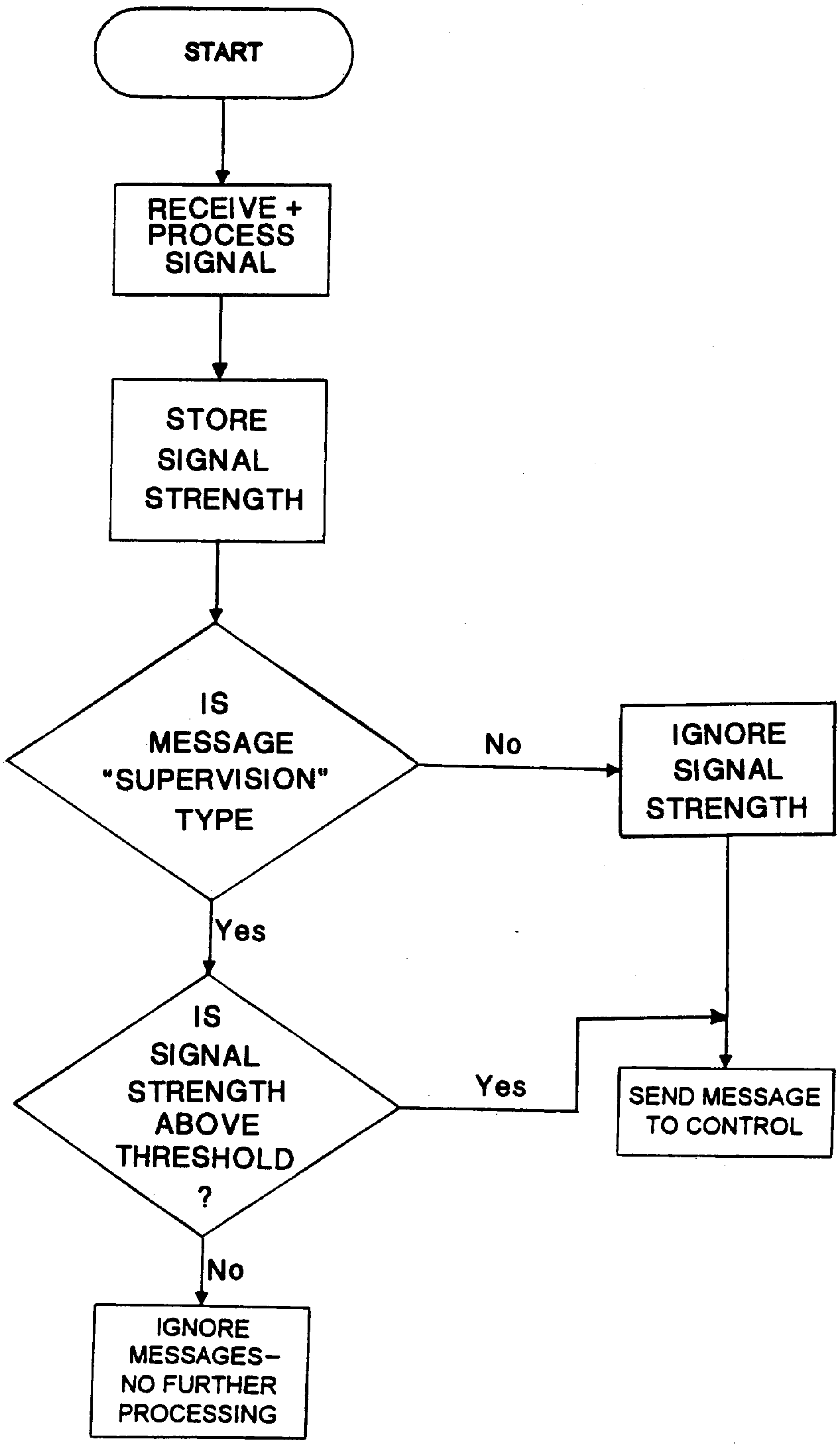
START
RECEIVE + PROCESS SIGNAL
STORE SIGNAL STRENGTH
IS MESSAGE "SUPERVISION" TYPE
No
IGNORE SIGNAL STRENGTH
Yes
IS SIGNAL STRENGTH ABOVE THRESHOLD ?
Yes
SEND MESSAGE TO CONTROL
No
IGNORE MESSAGES– NO FURTHER PROCESSING

FIG.10

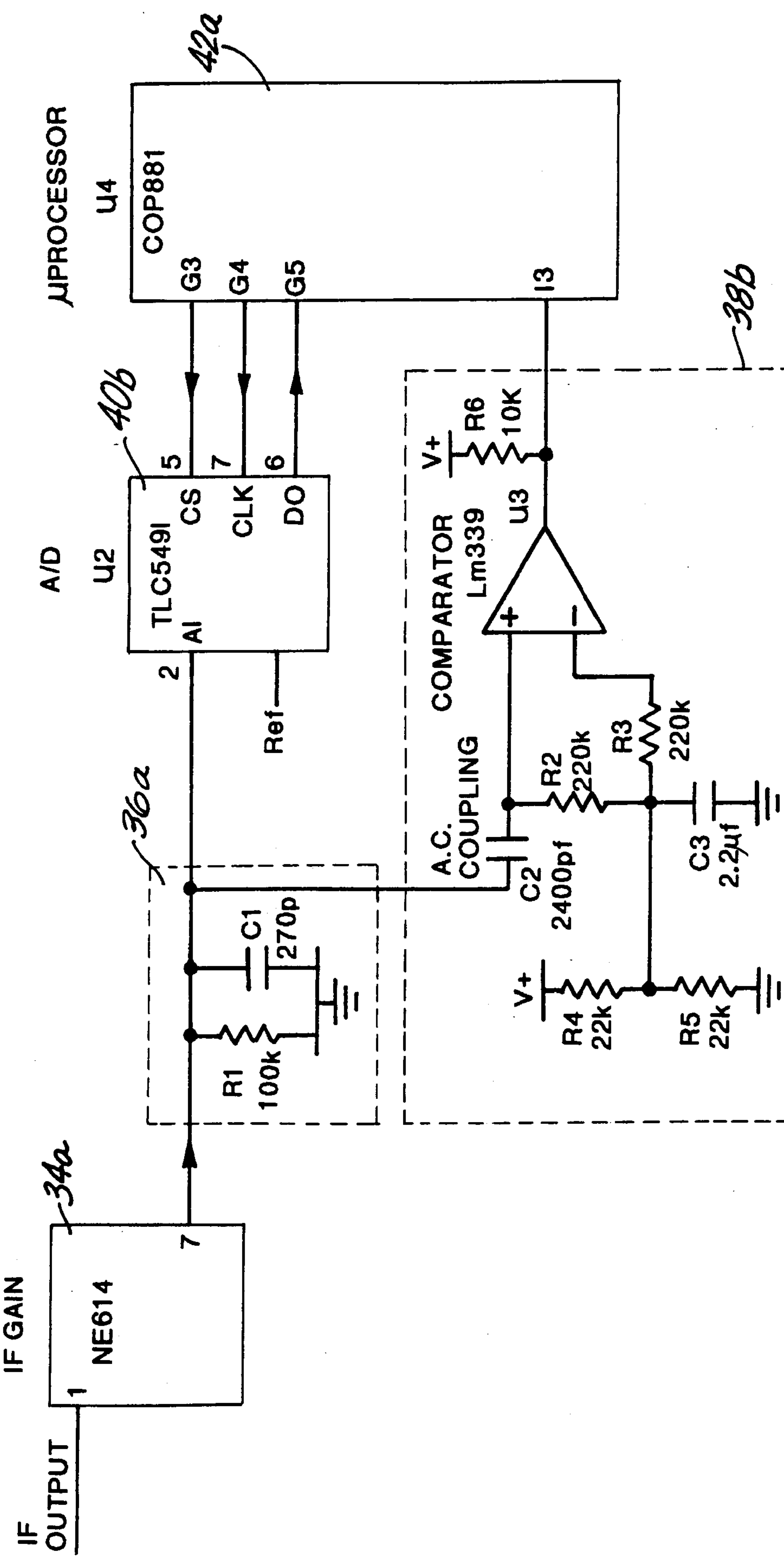
μPROCESSOR
U4
COP881
42a
G3
G4
G5
I3
A/D
U2
TLC549I
40b
CS
CLK
DO
AI
5
7
6
2
Ref
IF GAIN
NE614
34a
1
7
IF OUTPUT
36a
R1 100k
C1 270p
38b
A.C. COUPLING
C2 2400pf
COMPARATOR Lm339
U3
V+
R6 10K
R2 220k
R3 220k
C3 2.2μf
V+
R4 22k
R5 22k

FIG.11