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

Automatisches Alarmsystem mit Überwachungssignalanalyse

Système d'alarme automatique avec analyse d'un signal de surveillance

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a receiving station for use in a communication system and to a method of checking for an effective power margin in a communication system.

[0002] 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.

[0003] 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.

[0004] 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.

[0005] US-A-4 754 261 discloses an apparatus for evaluating installation of components of a wireless alarm system. A central station can receive alarm signals from a plurality of satellite stations. During installation, the central station can be manually placed in an installation mode in which a characteristic of the received alarm signal is impaired so that a received signal of greater quality than in a normal operating mode is required to trigger the alarm.

[0006] 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.

[0007] 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.

[0008] 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.

[0009] 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 sys-

tem 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.

[0010] 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.

[0011] 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.

[0012] 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

[0013] According to the present invention there is provided a receiving station (6; 6a; 6b) for use in a communication system, which receiving station comprises receiving means (20; 20a) for receiving signals from a remote transmitting station, the receiving station being operable to determine whether or not there is an effective power margin for reception of signals,

characterised by control means (30, 32; 38a, 42a; 38b, 42a) that can determine whether a signal received from said remote transmitting station is of a supervision or a non-supervision type, and that performs a test in response to identification of a supervision signal to determine whether or not a non-supervision signal from that remote transmitting station would have the effective power margin over said supervision signal.

[0014] Further features are set out in claims 2 to 8 and 12 to 14 to which attention is hereby directed. There is also provided a communications system comprising a receiving station as aforesaid. Further features of the communication system are set out in claims 10 and 11. There is also provided an alarm system comprising a communications system as aforesaid.

[0015] According to another aspect of the present invention there is provided a method of checking for an effective power margin in a communication system comprising a receiving station (6; 6a; 6b) having receiving means for receiving signals of a supervision and a non-supervision type from at least one remote transmitting station (4), which method comprises the steps of:

(1) receiving a signal from said remote transmitting station (4);
(2) determining whether said signal is of a supervision or non-supervision type; and
(3) when said signal is of a supervision type performing a test to determine whether or not a non-supervision signal from that remote transmitting station (4) would have the effective power margin over said supervision signal.

[0016] Further steps are set out in claims 18 to 31 to which attention is hereby directed.

[0017] A 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.

[0018] 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 predetermined 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.

[0019] A 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.

[0020] 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.

[0021] A third aspect of the present invention is based on the premise of a 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.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

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

[0023] 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 communication 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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.

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] 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 affected by multiple transmissions.

[0043] 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.

[0044] 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.

[0045] Reference is now made to the flowchart of Fig-

ure 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 12, 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.

[0046] 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.

[0047] 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.

[0048] 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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.

[0054] 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 13, 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 13 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.

[0055] 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.

[0056] 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.

[0057] The output signal of comparator U3 is input to 13 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.

[0058] 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.

[0059] 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.

[0060] It may also be desired to only perform the automatic self-test function 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 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.

[0061] 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. A receiving station (6; 6a; 6b) for use in a communication system, which receiving station comprises receiving means (20; 20a) for receiving signals from a remote transmitting station, the receiving station being operable to determine whether or not there is an effective power margin for reception of signals,

   characterised by control means (30, 32; 38a, 42a; 38b, 42a) that can determine whether a signal received from said remote transmitting station is of a supervision or a non-supervision type, and that performs a test in response to identification of a supervision signal to determine whether or not a non-supervision signal from that remote transmitting station would have the effective power margin over said supervision signal.

2. A receiving station as claimed in claim 1, further comprising modifying means (30) controllable by said control means (30, 32; 38a, 42a; 38b, 42a) to modify an operational parameter of said receiving station (6; 6a; 6b) as part of said test.

3. A receiving station as claimed in claim 2, wherein upon receipt by said receiving means (20; 20a) of a subsequent supervision signal from said remote transmitting station, said test is passed and said control means (30, 32; 38a, 42a; 38b, 42a) returns the operational parameter of the receiving station (6; 6a; 6b) to normal and passes said supervision signal on for subsequent processing.

4. A receiving station as claimed in claim 2 or 3, wherein the operational parameter of said receiving station (6; 6a; 6b) remains modified by said control means (30, 32; 38a, 42a; 38b, 42a) upon receipt by said receiving means (20; 20a) of a supervision signal from a different remote transmitting station.

5. A receiving station as claimed in claim 4, wherein said control means (30, 32; 38a, 42a; 38b, 42a) determines the test as passed for the different remote transmitting station as the supervision signal from that station was successfully received whilst the operational parameter was modified, and passing it on for subsequent processing.

6. A receiving station as claimed in claim 2, 3, 4 or 5, wherein said control means (30, 32; 38a, 42a; 38b, 42a) returns the operational parameter of said receiving station (6; 6a; 6b) to normal if another supervision signal from said remote transmitting station is not received by said receiving means (20; 20a) within a predetermined time period from receipt of said supervision signal, the time period being such that at least a part of a non-supervision signal can be received whilst the operational parameter is not modified.

7. A receiving station as claimed in any of claims 2 to 6, wherein said control means (30, 32; 38a, 42a; 38b, 42a) comprises a supervision routine for monitoring the type of signal determined by the control means and for controlling the operational parameter of said receiving station (6; 6a; 6b) in response to said type.

8. A receiving station as claimed in any of Claims 2 to 7, wherein modification of the operational parameter is by inhibiting the sensitivity of said receiving station (6; 6a; 6b), for example by reducing the input signal sensitivity.

9. A communications system comprising a receiving station (6; 6a; 6b) as claimed in any of Claims 1 to 8 and a plurality of remote transmitting stations (4) each of which comprises transmitting means for transmitting supervision signals and non-supervision signals.

10. A communications system as claimed in claim 9, wherein said supervision signal and said subse-

quent supervision signal are correlated to one another.

11. A communications system as claimed in claim 9, wherein said supervision signal and said subsequent supervision signal are identical to one another.

12. A receiving station (6a) as claimed in claim 1, further comprising for use in said test, means (38a, 42a) for processing an output electrical signal representative of said supervision signal at a first sensitivity level and at a second sensitivity level lower than said first for subsequent comparison, a difference between said first and second sensitivity levels representative of said effective power margin.

13. A receiving station as claimed in claim 11, further comprising, for said subsequent comparison, means (42a) for determining whether said output electrical signal is substantially identical or correlated at said first and second sensitivity levels, substantial identity or correlation evidencing the existence of said effective power margin.

14. A receiving station as claimed in claim 1, further comprising means (38b) for measuring the strength of the supervision signal received by said receiving means and for comparing said strength with a predetermined threshold, said predetermined threshold being representative of said effective power margin.

15. A communications system comprising a receiving station (6b) as claimed claim 12, 13 or 14, and a plurality of remote transmitting stations (4) each of which comprises transmitting means for transmitting supervision signals and non-supervision signals.

16. An alarm system (2) comprising a communications system as claimed in any of claims 9 to 11 or claim 15, wherein each remote transmitting station (4) of said plurality of remote transmitting stations further comprises a respective alarm sensor, the arrangement being such that, in use, each remote transmitter emits a non-supervision signal upon receipt of a signal from its respective alarm sensor, said receiving station being responsive to said non-supervision signal to raise an alarm, and wherein each remote transmitting station emits a supervision signal periodically to initiate said test to provide monitoring of said effective power margin over time.

17. A method of checking for an effective power margin in a communication system comprising a receiving station (6; 6a; 6b) having receiving means for receiving signals of a supervision and a non-supervision type from at least one remote transmitting station (4), which method comprises the steps of:

(1) receiving a signal from said remote transmitting station (4);
(2) determining whether said signal is of a supervision or non-supervision type; and
(3) when said signal is of a supervision type performing a test to determine whether or not a non-supervision signal from that remote transmitting station (4) would have the effective power margin over said supervision signal.

18. A method as claimed in claim 17, further comprising the step of emitting a supervision signal periodically to initiate said test to monitor said signal power safety margin over time.

19. A method as claimed in claim 17 or 18, wherein said test comprises the steps of modifying an operational parameter of said receiving station (6; 6a; 6b) by an amount representative of said effective power margin, and awaiting reception of a subsequent supervision signal from that remote transmitting station (4) whilst the operational parameter is modified.

20. A method as claimed in claim 19, further comprising the step of returning the operational parameter of said receiving station (6; 6a; 6b) to normal if said subsequent supervision signal is from the same remote transmitting station as said supervision signal.

21. A method as claimed in claim 20, further comprising the step of maintaining the modified operational parameter when a supervision signal is received from a different remote transmitting station.

22. A method as claimed in claim 21, further comprising the steps determining the test as passed for the different remote transmitting station as the supervision signal from that station was successfully received whilst the operational parameter was modified, and passing it on for subsequent processing.

23. A method as claimed in claim 19, 20, 21 or 22, further comprising the steps of:

(a) measuring a predetermined time period from receipt of said supervision signal, and
(b) returning the operational parameter of said receiving station to normal at the end of said predetermined time period if no subsequent supervision signal is received from that remote transmitting station, the predetermined time period being such that at least a part of a non-supervision signal can be received whilst the operational parameter is not modified.

24. A method as claimed in any of claims 17 to 23, wherein the step of modifying the operational parameter comprises the step of inhibiting the sensitivity of the receiving station (6), for example by reducing the input signal sensitivity.

25. A method as claimed in claim 17, wherein said test comprises the steps of processing an output electrical signal representative of said supervision signal at a first sensitivity level and at a second sensitivity level lower than said first for subsequent comparison, a difference between said first and second sensitivity levels representative of said effective power margin.

26. A method as claimed in claim 25, further comprising the step of determining whether said output electrical signal is substantially identical or correlated at said first and second sensitivity levels, substantial identity or correlation evidencing the existence of said effective power margin.

27. A method as claimed in claim 26, further comprising the step of rejecting said signal when substantial identity or correlation is not established.

28. A method as claimed in claim 17 wherein said test comprises the steps of measuring the strength of the supervision signal received by said receiving means, and comparing said strength with a predetermined threshold, said predetermined threshold being representative of said effective power margin.

29. A method as claimed in claim 28, further comprising the steps of rejecting said supervision signal as not validly received when said strength is lower than said predetermined threshold and providing an output signal to indicate that said test has not been passed by that remote transmitting station.

30. A method as claimed in any of claims 17 to 29, further comprising the step of accepting all non-supervision signals and passing them on for subsequent processing.

31. A method as claimed in any of claims 17 to 30, further comprising the step of transmitting said supervision and non-supervision signals wirelessly with electromagnetic waves between said remote transmitting station and said receiver.

Patentansprüche

1. Empfangsstation (6; 6a; 6b) für die Verwendung in einem Kommunikationssystem, wobei die Empfangsstation Empfangsmittel (20; 20a) zum Empfangen von Signalen von einer entfernten Sendestation umfasst und so betreibbar ist, dass sie feststellt, ob es für den Empfang von Signalen einen Effektivleistungsbereich gibt,

gekennzeichnet durch Steuermittel (30, 32; 38a, 42a; 38b, 42a), die feststellen können, ob ein von der entfernten Sendestation empfangenes Signal von einem Überwachungs- oder Nichtüberwachungstyp ist, und in Reaktion auf die Identifizierung eines Überwachungssignals einen Test ausführen, um festzustellen, ob ein Nichtüberwachungssignal von der entfernten Sendestation den Effektivleistungbereich über dem Überwachungssignal hätte.

2. Empfangsstation nach Anspruch 1, die ferner Modifikationsmittel (30) umfasst, die von den Steuermitteln (30, 32; 38a, 42a; 38b, 42a) steuerbar sind, um als Teil des Tests einen Betriebsparameter der Empfangsstation (6; 6a; 6b) zu modifizieren.

3. Empfangsstation nach Anspruch 2, bei der dann, wenn die Empfangsmitteln (20; 20a) ein nachfolgendes Überwachungssignal von der entfernten Sendestation empfangen, der Test bestanden ist und die Steuermittel (30, 32; 38a, 42a; 38b, 42a) die Betriebsparameter der Empfangsstation (6; 6a; 6b) auf normal zurückstellen und das Überwachungssignal für eine weitere Verarbeitung weiterleiten.

4. Empfangsstation nach Anspruch 2 oder 3, bei der der Betriebsparameter der Empfangsstation (6; 6a; 6b) durch die Steuermittel (30, 32; 38a, 42a; 38b, 42a) modifiziert bleibt, wenn die Empfangsmittel (20; 20a) von einer anderen entfernten Sendestation ein Überwachungssignal empfangen.

5. Empfangsstation nach Anspruch 4, bei der die Steuermittel (30, 32; 38a, 42a; 38b, 42a) feststellen, dass der Test für die andere entfernte Sendestation bestanden worden ist, wenn das Überwachungssignal von dieser Station erfolgreich empfangen wurde, während der Betriebsparameter modifiziert war, und es für eine nachfolgende Verarbeitung weiterleiten.

6. Empfangsstation nach Anspruch 2, 3, 4 oder 5, bei der die Steuermittel (30, 32; 38a, 42a; 38b, 42a) den Betriebsparameter der Empfangsstation (6; 6a; 6b) auf normal zurückstellen, wenn die Empfangsmittel (20; 20a) innerhalb einer vorgegebenen Zeitspanne seit dem Empfang des Überwachungssignals kein weiteres Überwachungssignal von der entfernten Sendestation empfangen haben, wobei die Zeitspanne derart ist, dass wenigstens ein Teil eines Nichtüberwachungssignals empfangen werden kann, während der Betriebsparameter nicht modifiziert ist.

7. Empfangsstation nach einem der Ansprüche 2 bis 6, bei der die Steuermittel (30, 32; 38a, 42a; 38b, 42a) eine Überwachungsroutine zum Überwachen des Signaltyps, der durch die Steuermittel bestimmt wird, und zum Steuern des Betriebsparameters der Empfangsstation (6; 6a; 6b) in Reaktion auf den Typ umfassen.

8. Empfangsstation nach einem der Ansprüche 2 bis 7, bei der die Modifikation des Betriebsparameters durch Verhindern des Ansprechens der Empfangsstation (6; 6a; 6b), beispielsweise durch Reduzieren der Eingangssignal-Empfindlichkeit, erfolgt.

9. Kommunikationssystem, mit einer Empfangsstation (6; 6a; 6b) nach einem der Ansprüche 1 bis 8 und mehreren entfernten Sendestationen (4), wovon jede Sendemittel umfasst, die Überwachungssignale und Nichtüberwachungssignale senden.

10. Kommunikationssystem nach Anspruch 9, bei dem das Überwachungssignal und das nachfolgende Überwachungssignal miteinander korreliert sind.

11. Kommunikationssystem nach Anspruch 9, bei dem das Überwachungssignal und das nachfolgende Überwachungssignal gleich sind.

12. Empfangsstation (6a) nach Anspruch 1, die ferner für den Test zu verwendende Mittel (38a, 42a) umfasst, die ein elektrisches Ausgangssignal, das das Überwachungssignal darstellt, auf einem ersten Empfindlichkeitspegel und auf einem zweiten Empfindlichkeitspegel, der niedriger als der erste ist, verarbeiten, um sie anschließend zu vergleichen, wobei eine Differenz zwischen dem ersten und dem zweiten Empfindlichkeitspegel den Effektivleistungsbereich repräsentiert.

13. Empfangsstation nach Anspruch 11, die ferner für den nachfolgenden Vergleich Mittel (42a) umfasst, die feststellen, ob das elektrische Ausgangssignal bei dem ersten und bei dem zweiten Empfindlichkeitspegel im Wesentlichen gleich oder korreliert ist, wobei eine wesentliche Gleichheit oder Korrelation das Vorhandensein des Effektivleistungsbereichs bedeutet.

14. Empfangsstation nach Anspruch 1, die ferner Mittel (38b) umfasst, die die Stärke des Überwachungssignals messen, das von den Empfangsmitteln empfangen wird, und diese Stärke mit einem vorgegebenen Schwellenwert vergleichen, wobei der vorgegebene Schwellenwert den Effektivleistungsbereich repräsentiert.

15. Kommunikationssystem, mit einer Empfangsstation (6b) nach Anspruch 12, 13 oder 14 und mehreren entfernten Sendestationen (4), wovon jede Sendemittel umfasst, die Überwachungssignale und Nichtüberwachungssignale senden.

16. Alarmanlage (2), die ein Kommunikationssystem nach einem der Ansprüche 9 bis 11 oder Anspruch 15 umfasst und bei der jede entfernte Sendestation (4) der mehreren entfernten Sendestationen ferner einen entsprechenden Alarmsensor umfasst, wobei die Anordnung derart ist, dass im Betrieb jeder entfernte Sender bei Empfang eines Signals von seinem entsprechenden Alarmsensor ein Nichtüberwachungssignal sendet, wobei die Empfangsstation in Reaktion auf das Nichtüberwachungssignal einen Alarm auslöst, und bei der jede entfernte Sendestation periodisch ein Überwachungssignal sendet, um den Test auszulösen, um die Überwachung des Effektivleistungsbereichs über die Zeit hinweg zu schaffen.

17. Verfahren zum Prüfen eines Effektivleistungsbereichs in einem Kommunikationssystem, das eine Empfangsstation (6; 6a; 6b) mit Empfangsmitteln zum Empfangen von Signalen eines Überwachungs- und eines Nichtüberwachungstyps von wenigstens einer entfernten Sendestation (4) umfasst, wobei das Verfahren die folgenden Schritte umfasst:

    (1) Empfangen eines Signals von der entfernten Sendestation (4);
    (2) Feststellen, ob das Signal von einem Überwachungs- oder Nichtüberwachungstyp ist; und
    (3) wenn das Signal von einem Überwachungstyp ist, Ausführen eines Tests, um festzustellen, ob ein Nichtüberwachungssignal von der entfernten Sendestation (4) den Effektivleistungsbereich über dem Überwachungssignal hätte.

18. Verfahren nach Anspruch 17, das ferner den Schritt umfasst, bei dem ein Überwachungssignal periodisch gesendet wird, um den Test auszulösen, um den Signalleistungs-Sicherheitsbereich über die Zeit hinweg zu überwachen.

19. Verfahren nach Anspruch 17 oder 18, bei dem der Test die folgenden Schritte umfasst: Modifizieren eines Betriebsparameters der Empfangsstation (6; 6a; 6b) um einen Betrag, der den Effektivleistungsbereich repräsentiert, und Warten auf den Empfang eines nachfolgenden Überwachungssignals von der entfernten Sendestation (4), während der Betriebsparameter modifiziert ist.

20. Verfahren nach Anspruch 19, das ferner den Schritt umfasst, bei dem der Betriebsparameter der Emp-

fangsstation (6; 6a; 6b) auf normal zurückgestellt wird, falls das nachfolgende Überwachungssignal von derselben entfernten Sendestation wie das Überwachungssignal stammt.

21. Verfahren nach Anspruch 20, das ferner den Schritt umfasst, bei dem der modifizierte Betriebsparameter beibehalten wird, wenn ein Überwachungssignal von einer anderen entfernten Sendestation empfangen wird.

22. Verfahren nach Anspruch 21, das ferner die folgenden Schritte umfasst: Feststellen, ob die andere entfernte Sendestation den Test bestanden hat, wenn das Überwachungssignal von dieser Station erfolgreich empfangen wurde, während der Betriebsparameter modifiziert war, und Weiterleiten des Signals für eine nachfolgende Verarbeitung.

23. Verfahren nach Anspruch 19, 20, 21 oder 22, das ferner die folgenden Schritte umfasst:

(a) Messen einer vorgegebenen Zeitspanne ab dem Empfang des Überwachungssignals und
(b) Zurückstellen des Betriebsparameters der Empfangsstation auf normal am Ende der vorgegebenen Zeitspanne, falls von der entfernten Sendestation kein nachfolgendes Überwachungssignal empfangen wird, wobei die vorgegebene Zeitspanne derart ist, dass wenigstens ein Teil eines Nichtüberwachungssignals empfangen werden kann, während der Betriebsparameter nicht modifiziert ist.

24. Verfahren nach einem der Ansprüche 17 bis 23, bei dem der Schritt des Modifizierens des Betriebsparameters den Schritt umfasst, bei dem ein Ansprechen der Empfangsstation (6) verhindert wird, beispielsweise durch Reduzieren der Eingangssignal-Empfindlichkeit.

25. Verfahren nach Anspruch 17, bei dem der Test die folgenden Schritte umfasst: Verarbeiten eines elektrischen Ausgangssignals, das das Überwachungssignal repräsentiert, bei einem ersten Empfindlichkeitspegel und bei einem zweiten Empfindlichkeitspegel, der niedriger als der erste ist, um sie anschließend zu vergleichen, wobei eine Differenz zwischen dem ersten und dem zweiten Empfindlichkeitspegel den Effektivleistungsbereich repräsentiert.

26. Verfahren nach Anspruch 25, das ferner den Schritt umfasst, bei dem festgestellt wird, ob das elektrische Ausgangssignal bei dem ersten und bei dem zweiten Empfindlichkeitspegel im Wesentlichen gleich oder korreliert ist, wobei die wesentliche Gleichheit oder Korrelation das Vorhandensein des Effektivleistungsbereichs bedeutet.

27. Verfahren nach Anspruch 26, das ferner den Schritt umfasst, bei dem das Signal zurückgewiesen wird, wenn eine wesentliche Gleichheit oder Korrelation nicht vorliegt.

28. Verfahren nach Anspruch 17, bei dem der Test die folgenden Schritte umfasst: Messen der Stärke des Überwachungssignals, das von den Empfangsmitteln empfangen wird, und Vergleichen der Stärke mit einem vorgegebenen Schwellenwert, der den Effektivleistungsbereich repräsentiert.

29. Verfahren nach Anspruch 28, das ferner die folgenden Schritte umfasst: Zurückweisen des Überwachungssignals als nicht gültig empfangen, wenn die Stärke niedriger als der vorgegebene Schwellenwert ist, und Bereitstellen eines Ausgangssignals, um anzugeben, dass der Test von der entfernten Sendestation nicht bestanden worden ist.

30. Verfahren nach einem der Ansprüche 17 bis 29, das ferner den Schritt umfasst, bei dem alle Nichtüberwachungssignale akzeptiert und für eine nachfolgende Verarbeitung weitergeleitet werden.

31. Verfahren nach einem der Ansprüche 17 bis 30, das ferner den Schritt umfasst, bei dem die Überwachungs- und Nichtüberwachungssignale drahtlos mittels elektromagnetischer Wellen zwischen der entfernten Sendestation und dem Empfänger gesendet werden.

Revendications

1. Station réceptrice (6 ; 6a ; 6b) pour une utilisation dans un système de communication, station réceptrice qui comprend des moyens de réception (20 ; 20a) pour recevoir des signaux à partir d'une station émettrice distante, la station réceptrice pouvant fonctionner pour déterminer s'il existe ou pas une marge de puissance effective concernant la réception de signaux ;

caractérisée par des moyens de commande (30, 32 ; 38, 42a ; 38b, 42a) qui peuvent déterminer si un signal reçu provenant de ladite station émettrice distante est de type de surveillance ou de non surveillance, et qui réalise un essai en réponse à l'identification d'un signal de surveillance pour déterminer si un signal de non surveillance provenant de cette station émettrice distante aura ou non la marge de puissance effective sur ledit signal de surveillance.

2. Station réceptrice selon la revendication 1, consistant de plus à modifier un moyen (30) pouvant être

commandé par lesdits moyens de commande (30, 32 ; 38a, 42a ; 38b, 42a) pour modifier un paramètre fonctionnel de ladite station réceptrice (6 ; 6a ; 6b) en tant que partie dudit essai.

3. Station réceptrice selon la revendication 2, dans laquelle, lors d'une réception par lesdits moyens récepteurs (20 ; 20a) d'un signal de surveillance ultérieur provenant de ladite station émettrice distante, ledit essai est réussi et lesdits moyens de commande (30, 32 ; 38a, 42a ; 38b, 42a) renvoient le paramètre fonctionnel de la station réceptrice (6 ; 6a ; 6b) à normal et font passer ledit signal de surveillance au traitement suivant.

4. Station réceptrice selon la revendication 2 ou 3, dans laquelle le paramètre fonctionnel de ladite station réceptrice (6 ; 6a ; 6b) reste modifié par lesdits moyens de commande (30, 32 ; 38a, 42a ; 38b, 42a) lors d'une réception par lesdits moyens récepteurs (20 ; 20a) d'un signal de surveillance provenant d'une station d'émission distante différente.

5. Station réceptrice selon la revendication 4, dans laquelle lesdits moyens de commande (30, 32 ; 38a, 42a ; 38b, 42a) déterminent l'essai comme réussi pour la station émettrice distante différente lorsque le signal de surveillance provenant de cette station a été reçu avec succès alors que le paramètre opérationnel a été modifié, et en le faisant passer au traitement suivant.

6. Station réceptrice selon la revendication 2, 3, 4 ou 5, dans laquelle lesdits moyens de commande (30, 32 ; 38a, 42a ; 38b, 42a) renvoient le paramètre fonctionnel de ladite station réceptrice (6 ; 6a ; 6b) à normal si un autre signal de surveillance provenant de ladite station émettrice distante n'est pas reçu par lesdits moyens récepteurs (20 ; 20a) pendant une période de temps prédéterminée depuis la réception dudit signal de surveillance, la période de temps étant telle qu'au moins une partie d'un signal de non surveillance peut être reçu alors que le paramètre fonctionnel n'est pas modifié.

7. Station réceptrice selon l'une quelconque des revendications 2 à 6, dans laquelle les moyens de commande (30, 32 ; 38a, 42a ; 38b, 42a) comprennent un sous-programme de surveillance pour contrôler le type de signal déterminé par les moyens de commande et pour commander le paramètre fonctionnel de ladite station réceptrice (6 ; 6a ; 6b) en réponse audit type.

8. Station réceptrice selon l'une quelconque des revendications 2 à 7, dans laquelle une modification du paramètre fonctionnel se fait en inhibant la sensibilité de ladite station réceptrice (6 ; 6a ; 6b), par exemple, en réduisant la sensibilité du signal d'entrée.

9. Système de communication comprenant une station réceptrice (6 ; 6a ; 6b) selon l'une quelconque des revendications 1 à 8 et une pluralité de stations émettrices distantes (4), dont chacune comprend un moyen émetteur pour émettre des signaux de surveillance et des signaux de non surveillance.

10. Système de communication selon la revendication 9, dans lequel ledit signal de surveillance et ledit signal de surveillance suivant sont corrélés l'un à l'autre.

11. Système de communication selon la revendication 9, dans lequel ledit signal de surveillance et ledit signal de surveillance suivant sont identiques.

12. Station réceptrice (6a) selon la revendication 1, comprenant de plus pour une utilisation dans ledit essai, des moyens (38a, 42a) pour traiter un signal électrique de sortie représentatif dudit signal de surveillance à un premier niveau de sensibilité et à un deuxième niveau de sensibilité inférieur audit premier à des fins comparatives ultérieures, une différence entre lesdits premier et deuxième niveaux de sensibilité étant représentative de ladite marge de puissance effective.

13. Station réceptrice selon la revendication 11, comprenant de plus, à des fins comparatives ultérieures, un moyen (42a) pour déterminer si ledit signal électrique de sortie est sensiblement identique ou corrélé auxdits premier et deuxième niveaux de sensibilité, une identité ou une corrélation importante mettant en évidence l'existence de ladite marge de puissance effective.

14. Station réceptrice selon la revendication 1, comprenant de plus un moyen (38b) pour mesurer la force du signal de surveillance reçu par ledit moyen récepteur et pour comparer ladite force avec un seuil prédéterminé, ledit seuil prédéterminé étant représentatif de ladite marge de puissance effective.

15. Système de communication comprenant une station réceptrice (6b) selon la revendication 12, 13 ou 14, et une pluralité de stations émettrices distantes (4), dont chacune comprend des moyens d'émission pour émettre des signaux de surveillance et des signaux de non surveillance.

16. Système d'alarme (2) comprenant un système de communication selon l'une quelconque des revendications 9 à 11 ou selon la revendication 15, dans lequel chaque station émettrice distante (4) de ladite pluralité de stations émettrices distante com-

prend de plus un détecteur d'alarme respectif, la disposition étant telle que, pendant l'utilisation, chaque émetteur distant émet un signal de non surveillance après réception d'un signal provenant de son détecteur d'alarme respectif, ladite station réceptrice étant sensible audit signal de non surveillance afin de déclencher une alarme, et dans lequel chaque station émettrice distante émet un signal de surveillance périodiquement pour amorcer ledit essai en vue de fournir un contrôle de ladite marge de puissance effective pendant un certain temps.

17. Procédé pour vérifier une marge de puissance effective dans un système de communication comprenant une station réceptrice (6 ; 6a ; 6b) ayant un moyen récepteur pour recevoir des signaux de type de surveillance et de non surveillance provenant d'au moins une station émettrice distante (4), procédé qui comprend les étapes consistant à :

(1) recevoir un signal de ladite station émettrice distante (4) ;
(2) déterminer si ledit signal est de type de surveillance ou de non surveillance ; et
(3) réaliser, quand ledit signal est de type de surveillance, un essai pour déterminer si un signal de non surveillance provenant de cette station émettrice distante (4) aura ou non la marge de puissance effective par rapport audit signal de surveillance.

18. Procédé selon la revendication 17, comprenant de plus l'étape consistant à émettre un signal de surveillance périodiquement afin d'amorcer ledit essai pour contrôler ladite marge de sécurité de puissance du signal en fonction du temps.

19. Procédé selon la revendication 17 ou 18, dans lequel ledit essai comprend les étapes consistant à modifier un paramètre fonctionnel de ladite station réceptrice (6 ; 6a ; 6b) par une quantité représentative de ladite marge de puissance effective, et attendre la réception d'un signal de surveillance ultérieur provenant de cette station émettrice distante (4) tout en modifiant le paramètre fonctionnel.

20. Procédé selon la revendication 19, comprenant de plus l'étape consistant à renvoyer le paramètre fonctionnel de ladite station réceptrice (6 ; 6a ; 6b) à normal si ledit signal de surveillance suivant provient de la même station émettrice distante que ledit signal de surveillance.

21. Procédé selon la revendication 20, comprenant de plus l'étape consistant à maintenir le paramètre fonctionnel modifié quand un signal de surveillance est reçu à partir d'une station émettrice distante différente.

22. Procédé selon la revendication 21, comprenant de plus les étapes déterminant l'essai réussi concernant la station émettrice distante différente lorsque le signal de surveillance provenant de cette station a été reçu avec succès alors que le paramètre fonctionnel a été modifié, et le faisant passer au traitement suivant.

23. Procédé selon la revendication 19, 20, 21 ou 22, comprenant de plus les étapes consistant à :

(a) mesurer une période de temps prédéterminée à partir de la réception dudit signal de surveillance ; et
(b) renvoyer le paramètre fonctionnel de ladite station réceptrice à normal à la fin de ladite période de temps prédéterminée si aucun signal de surveillance suivant n'est reçu provenant de cette station émettrice distante, la période de temps prédéterminée étant telle qu'au moins une partie d'un signal de non surveillance peut être reçue alors que le paramètre fonctionnel n'est pas modifié.

24. Procédé selon l'une quelconque des revendications 17 à 23, dans lequel l'étape consistant à modifier le paramètre fonctionnel comprend l'étape consistant à inhiber la sensibilité de la station réceptrice (6), par exemple en réduisant la sensibilité du signal d'entrée.

25. Procédé selon la revendication 17, dans lequel ledit essai comprend les étapes consistant à traiter un signal électrique de sortie représentatif dudit signal de surveillance à un premier niveau de sensibilité et à un deuxième niveau de sensibilité inférieur audit premier à des fins de comparaison ultérieures, une différence entre lesdits premier et deuxième niveaux de sensibilité étant représentative de ladite marge de puissance effective.

26. Procédé selon la revendication 25, comprenant de plus l'étape consistant à déterminer si ledit signal électrique de sortie est sensiblement identique ou corrélé auxdits premier et deuxième niveaux de sensibilité, une identité ou une corrélation sensible mettant en évidence l'existence de ladite marge de puissance effective.

27. Procédé selon la revendication 26, comprenant de plus l'étape consistant à rejeter ledit signal quand une identité ou corrélation sensible n'est pas établie.

28. Procédé selon la revendication 17, dans lequel ledit essai comprend les étapes consistant à mesurer la

force du signal de surveillance reçu par ledit moyen récepteur, et comparer ladite force avec un seuil prédéterminé, ledit seuil prédéterminé étant représentatif de ladite marge de puissance effective.

29. Procédé selon la revendication 28, comprenant de plus les étapes consistant à rejeter ledit signal de surveillance comme non reçu de façon valide quand ladite force est inférieure audit seuil prédéterminé, et fournir un signal de sortie pour indiquer que ledit essai n'a pas été réussi par cette station émettrice distante.

30. Procédé selon l'une quelconque des revendications 17 à 29, comprenant de plus l'étape consistant à accepter tous les signaux de non surveillance et à les faire passer au traitement suivant.

31. Procédé selon l'une quelconque des revendications 17 à 30, comprenant de plus l'étape consistant à émettre lesdits signaux de surveillance et de non surveillance par radiodiffusion avec des ondes électromagnétiques entre ladite station émettrice distante et ledit récepteur.

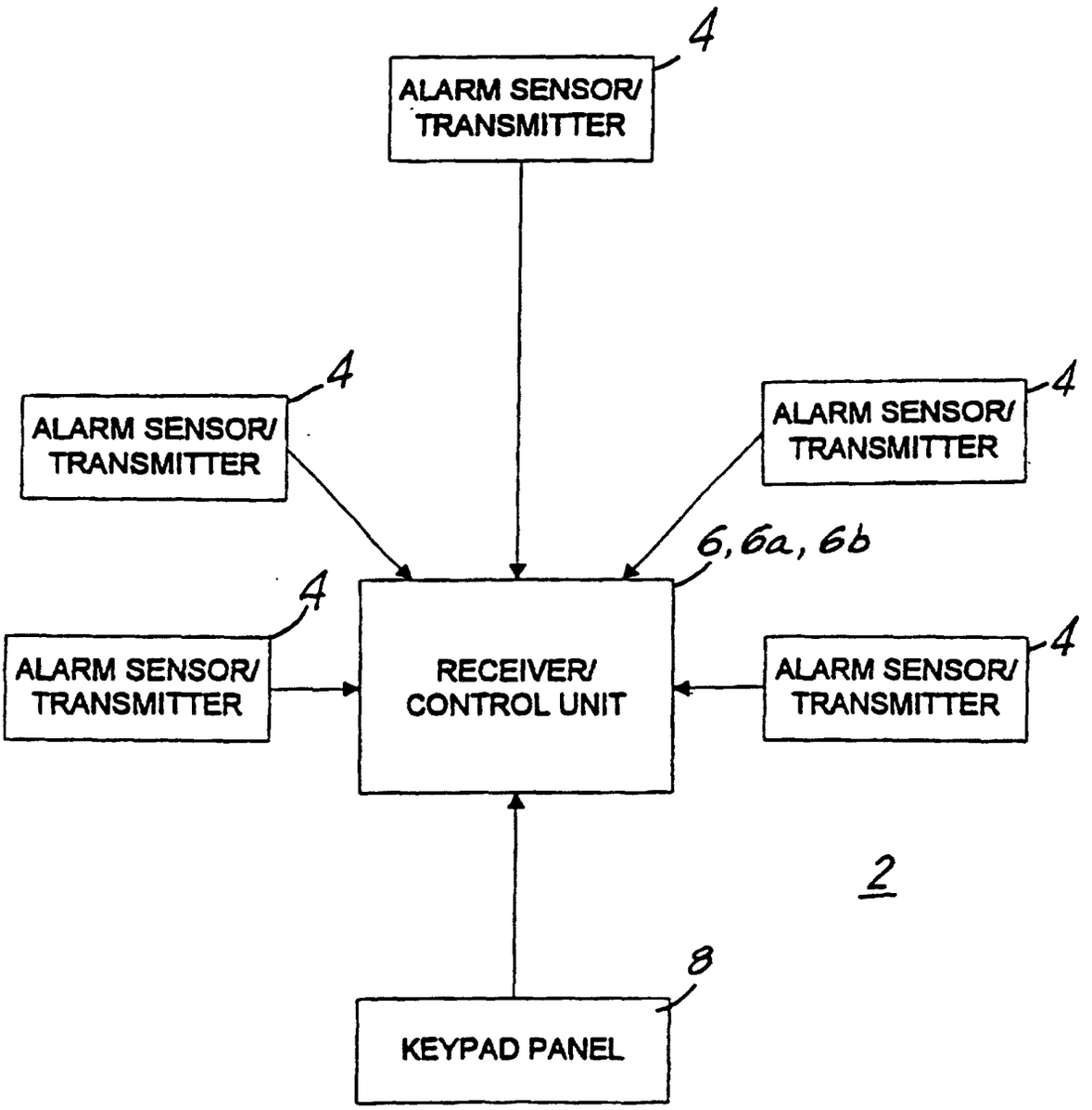

4
ALARM SENSOR/ TRANSMITTER
4
ALARM SENSOR/ TRANSMITTER
4
ALARM SENSOR/ TRANSMITTER
6, 6a, 6b
4
ALARM SENSOR/ TRANSMITTER
RECEIVER/ CONTROL UNIT
4
ALARM SENSOR/ TRANSMITTER
2
8
KEYPAD PANEL

FIG.1

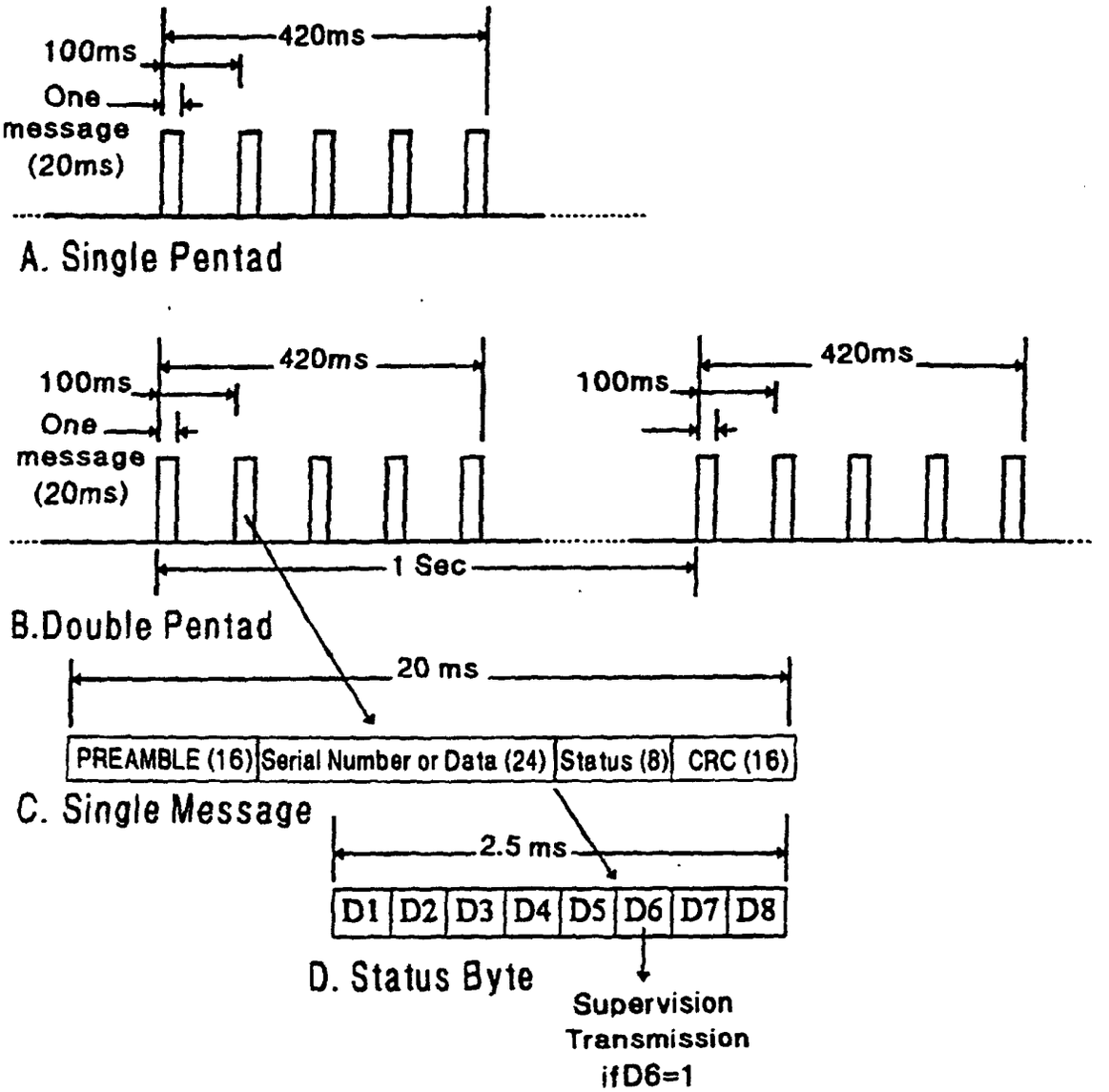

100ms
420ms
One message (20ms)
A. Single Pentad
100ms
420ms
One message (20ms)
100ms
420ms
1 Sec
B.Double Pentad
20 ms
PREAMBLE (16)
Serial Number or Data (24)
Status (8)
CRC (16)
C. Single Message
2.5 ms
D1
D2
D3
D4
D5
D6
D7
D8
D. Status Byte
Supervision Transmission if D6=1

FIG.2

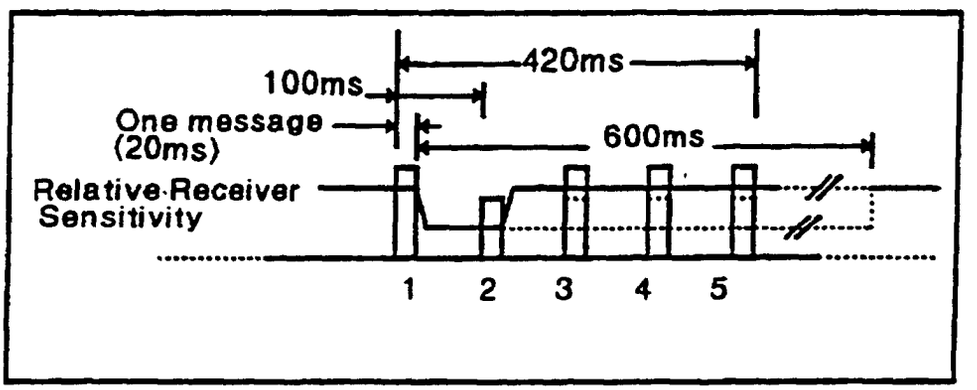
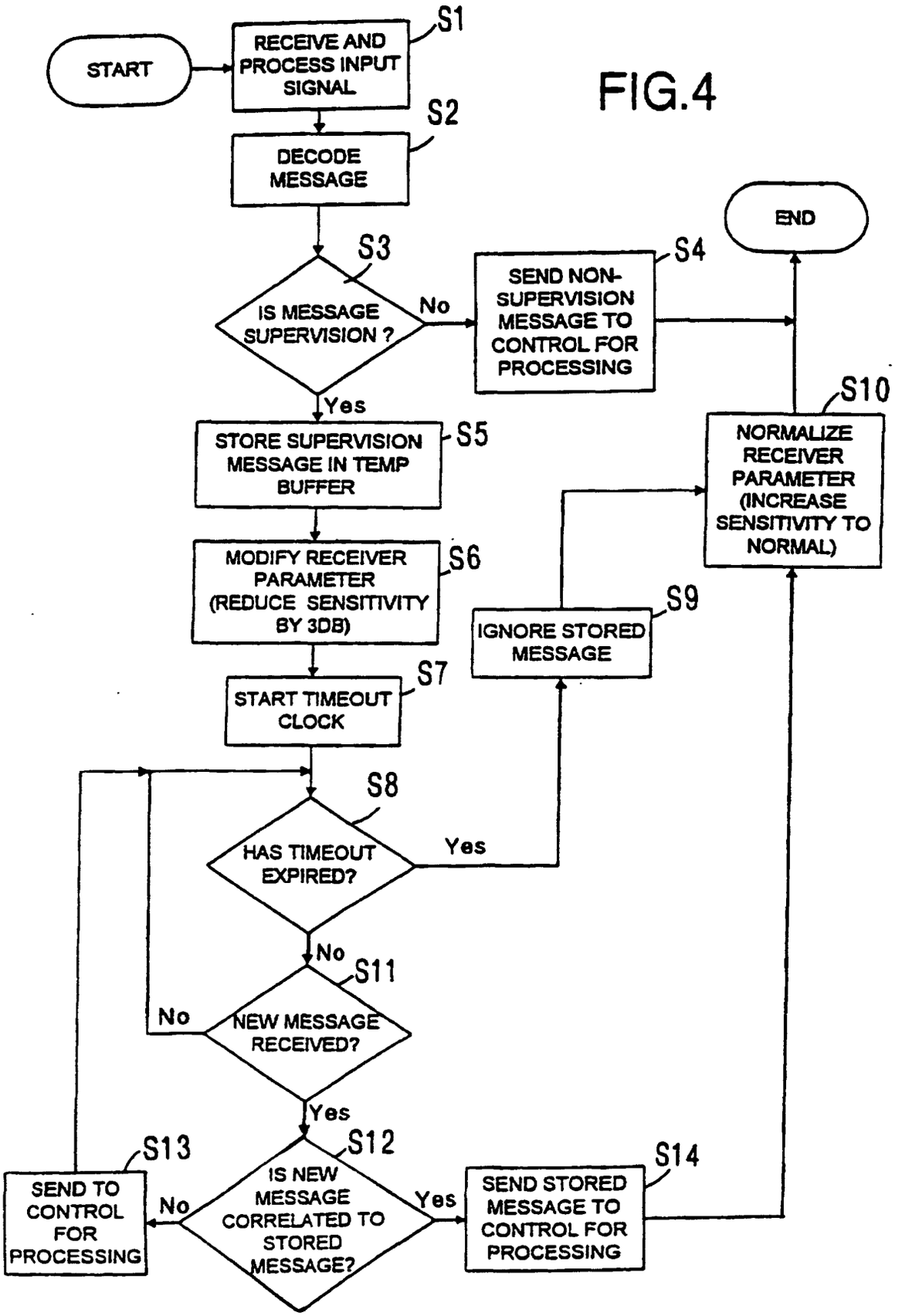

420ms
100ms
One message
(20ms)
600ms
Relative Receiver
Sensitivity
1
2
3
4
5

FIG.3

FIG.4


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

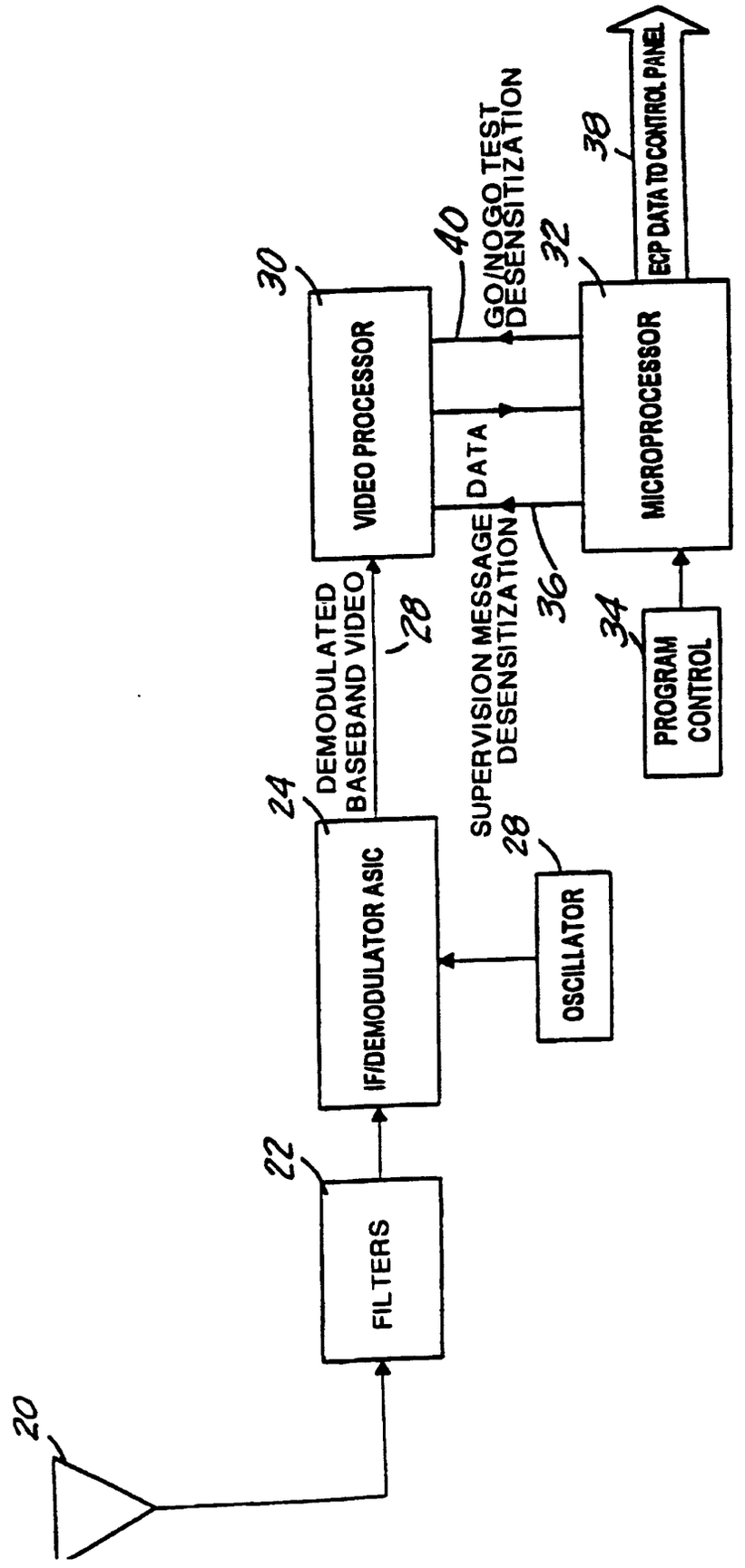

20
FILTERS
22
IF/DEMODULATOR ASIC
24
OSCILLATOR
28
DEMODULATED BASEBAND VIDEO
28
SUPERVISION MESSAGE DESENSITIZATION
36
VIDEO PROCESSOR
30
DATA
GO/NOGO TEST DESENSITIZATION
40
MICROPROCESSOR
32
PROGRAM CONTROL
34
ECP DATA TO CONTROL PANEL
38

FIG.5

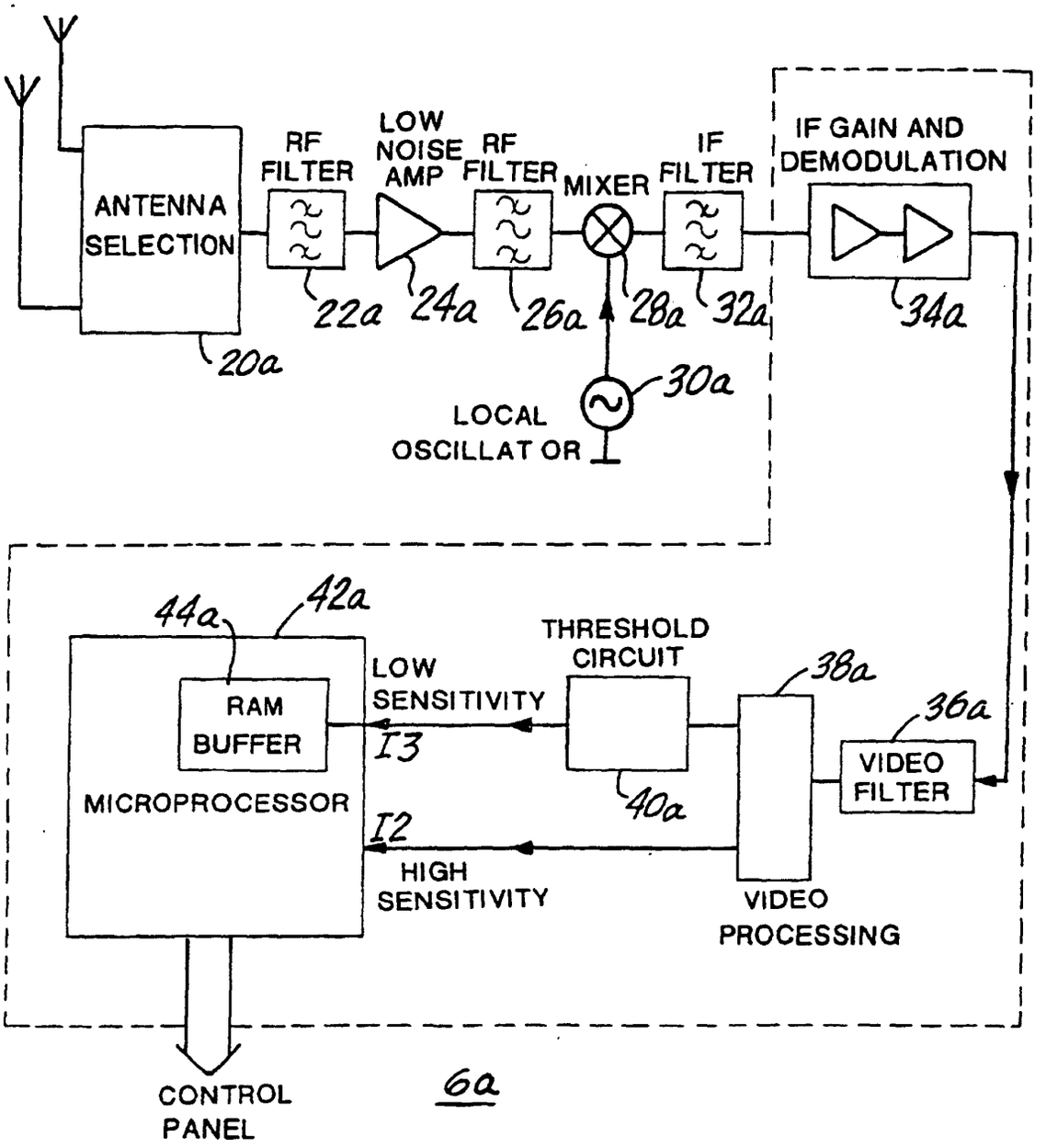

ANTENNA SELECTION
RF FILTER
LOW NOISE AMP
RF FILTER
MIXER
IF FILTER
IF GAIN AND DEMODULATION
22a
24a
26a
28a
32a
34a
20a
30a
LOCAL OSCILLATOR
44a
42a
RAM BUFFER
MICROPROCESSOR
LOW SENSITIVITY
I3
THRESHOLD CIRCUIT
38a
36a
VIDEO FILTER
40a
I2
HIGH SENSITIVITY
VIDEO PROCESSING
CONTROL PANEL
6a

FIG.6

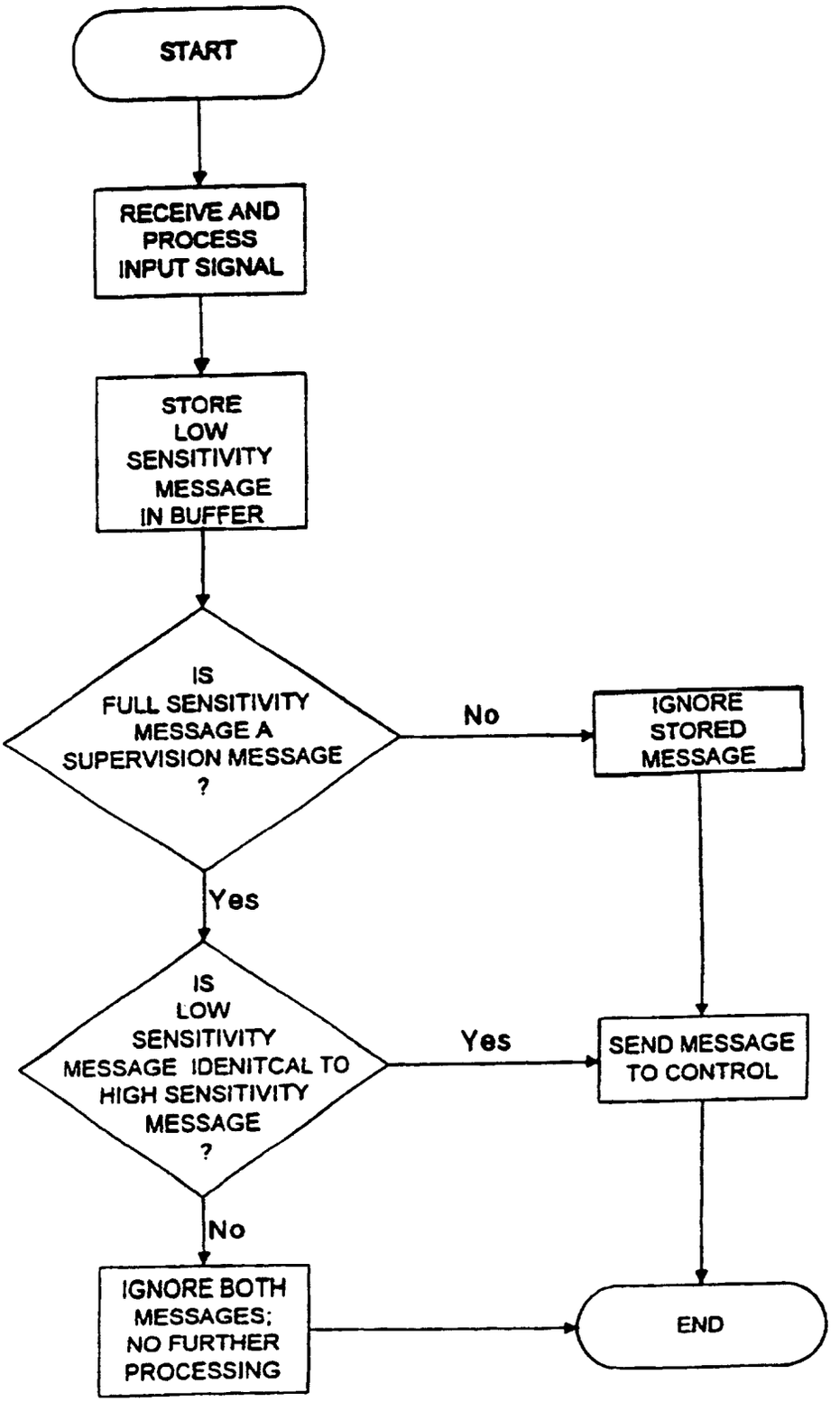

START
RECEIVE AND PROCESS INPUT SIGNAL
STORE LOW SENSITIVITY MESSAGE IN BUFFER
IS FULL SENSITIVITY MESSAGE A SUPERVISION MESSAGE ?
No
IGNORE STORED MESSAGE
Yes
IS LOW SENSITIVITY MESSAGE IDENITCAL TO HIGH SENSITIVITY MESSAGE ?
Yes
SEND MESSAGE TO CONTROL
No
IGNORE BOTH MESSAGES; NO FURTHER PROCESSING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

FIG.7

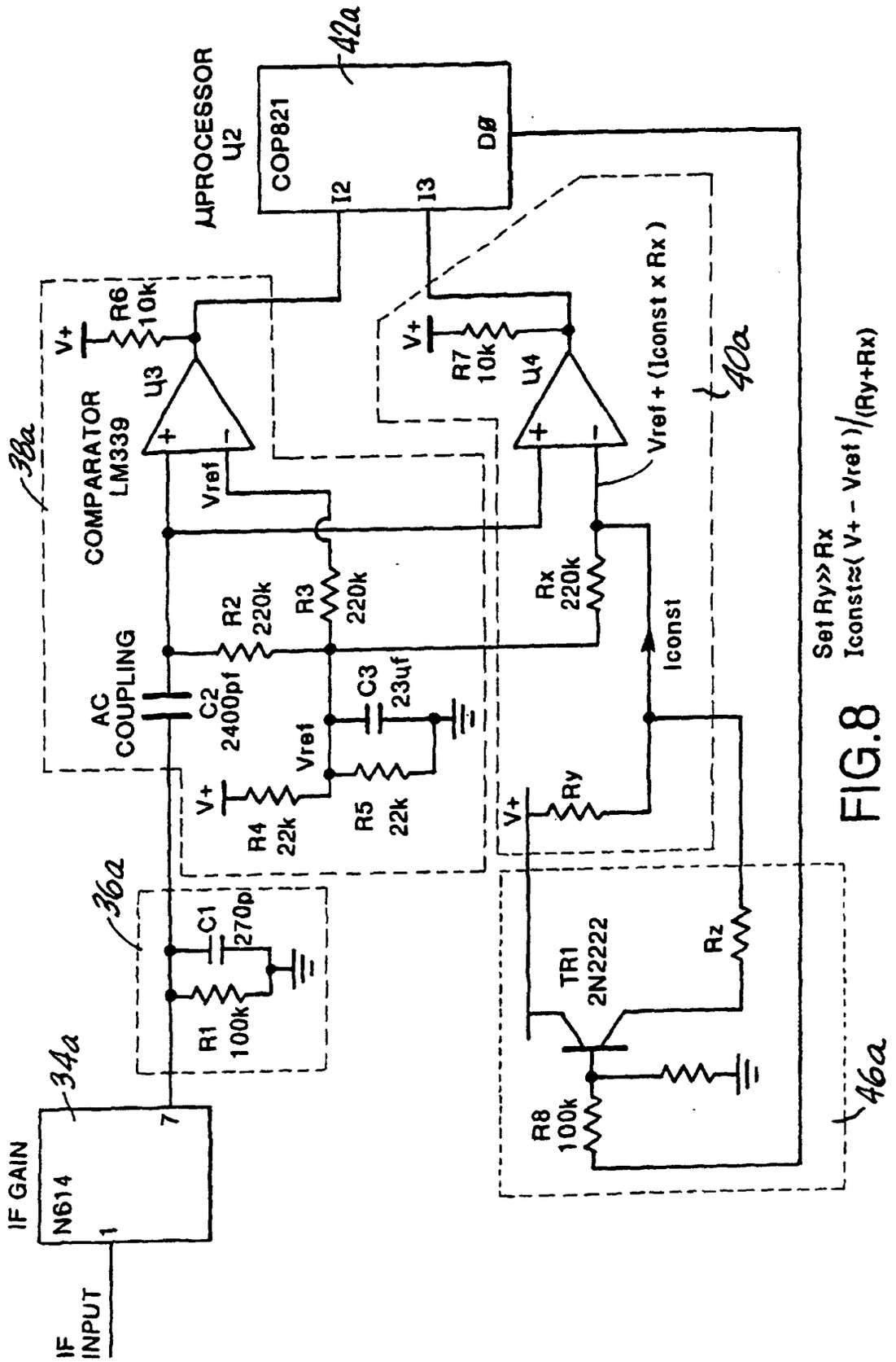

μPROCESSOR
U2
COP821
I2
I3
D0
42a
V+
R6
10k
U3
COMPARATOR
LM339
38a
Vref
R2
220k
R3
220k
AC
COUPLING
C2
2400pf
C3
23uf
R4
22k
R5
22k
36a
C1
270p
R1
100k
34a
IF GAIN
N614
IF
INPUT
R7
10k
U4
Vref + (Iconst x Rx)
40a
Rx
220k
Iconst
Ry
TR1
2N2222
Rz
R8
100k
46a
Set Ry>> Rx
Iconst≈(V+ – Vref)/(Ry+Rx)

FIG.8

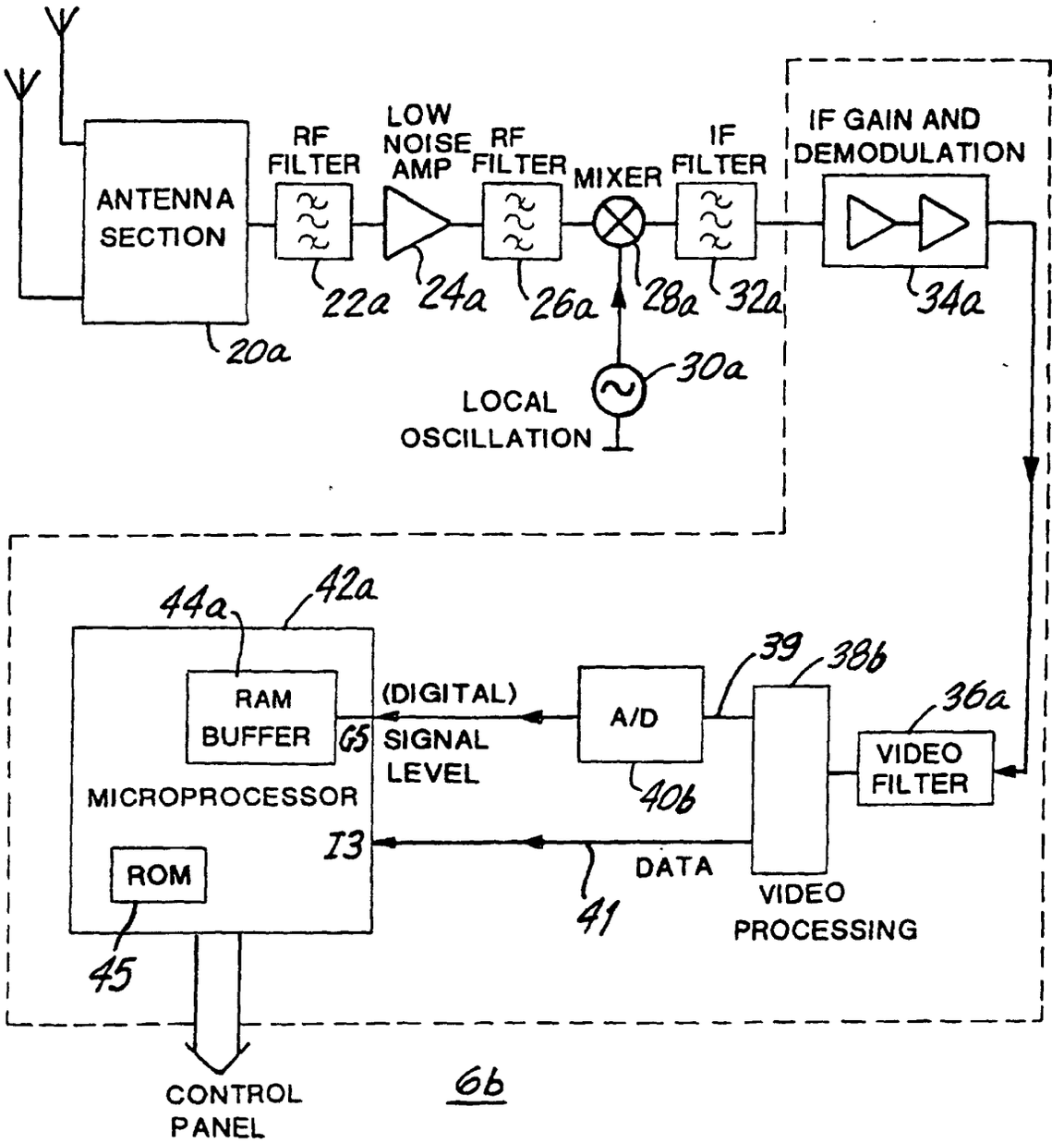

ANTENNA SECTION
20a
RF FILTER
22a
LOW NOISE AMP
24a
RF FILTER
26a
MIXER
28a
IF FILTER
32a
IF GAIN AND DEMODULATION
34a
LOCAL OSCILLATION
30a
44a
42a
RAM BUFFER
65
(DIGITAL) SIGNAL LEVEL
A/D
39
38b
40b
36a
VIDEO FILTER
MICROPROCESSOR
ROM
45
I3
DATA
41
VIDEO PROCESSING
CONTROL PANEL
6b

FIG.9

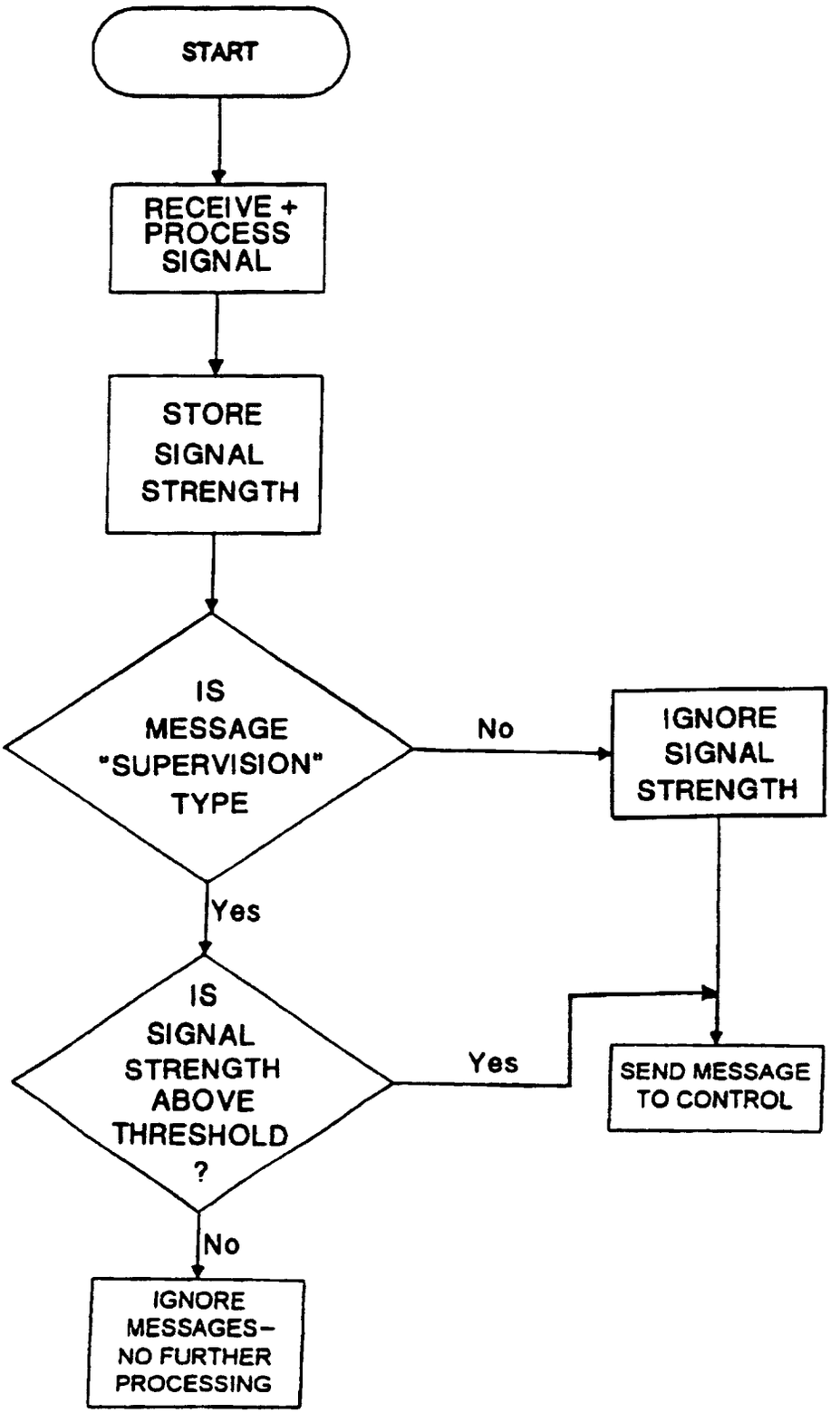

START
RECEIVE + PROCESS SIGNAL
STORE SIGNAL STRENGTH
IS MESSAGE "SUPERVISION" TYPE
No
IGNORE SIGNAL STRENGTH
Yes
IS SIGNAL STRENGTH ABOVE THRESHOLD ?
Yes
SEND MESSAGE TO CONTROL
No
IGNORE MESSAGES– NO FURTHER PROCESSING

FIG.10

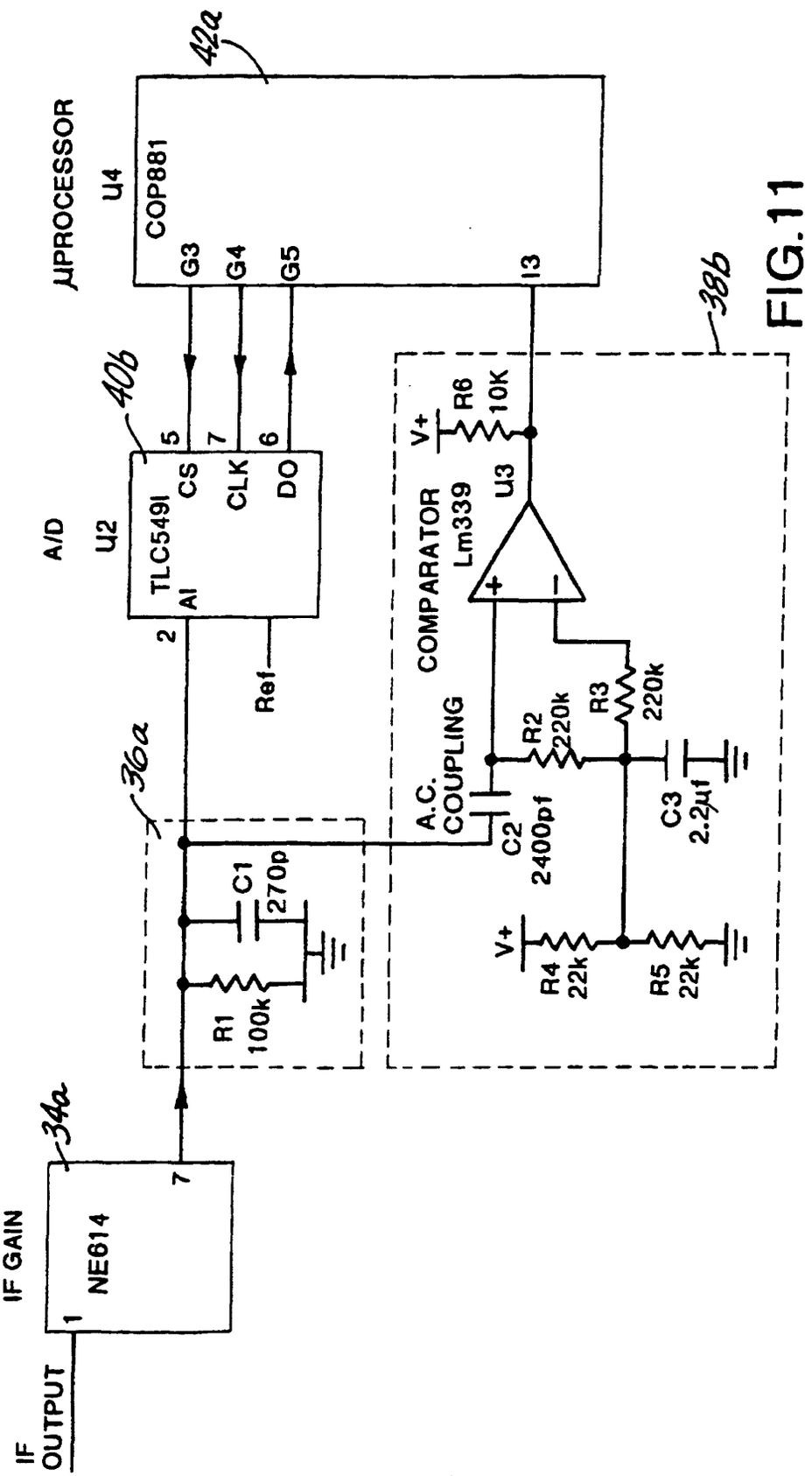

42a
μPROCESSOR
U4
COP881
G3
G4
G5
I3
38b
40b
A/D
U2
TLC549I
CS
CLK
DO
AI
5
7
6
2
Ref
V+
R6
10K
U3
COMPARATOR
Lm339
+
−
R2
220k
R3
220k
C3
2.2μf
A.C.
COUPLING
C2
2400pf
36a
C1
270p
R1
100k
V+
R4
22k
R5
22k
34a
IF GAIN
NE614
7
1
IF
OUTPUT

FIG.11