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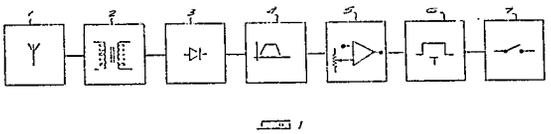
(54) Method and apparatus for protecting electrical equipment.

(57) The invention relates to a method of and apparatus for protecting electrical or electronic equipment from electromagnetic interference. Such a method includes the initial steps of detecting the electromagnetic interference, and generating an input signal which represents the interference. The level of the input signal is then compared to a predetermined threshold level, and an output signal is generated to initiate a protective measure, such as interrupting the power supply to the equipment, in the event of the input signal level exceeding the predetermined threshold. The apparatus for protecting the equipment includes detection means (1) for detecting the electromagnetic interference, and generating a representive input signal, level detection means (5) for comparing the input signal level to a threshold level, and control means (6,7) for generating an output signal to initiate a protective measure.



EP 0 357 343 A2

Description

Method and Apparatus For Protecting Electrical Equipment

This invention relates to a method and apparatus for preventing electrical and electronic equipment from reacting falsely to the effects of electromagnetic interference.

Electrical and electronic equipment is often affected by transient electromagnetic interference in communication and mains supply lines. Lightning and switching surges are prime examples of such interference. In many cases this will cause the malfunctioning of such equipment by creating a false alarm signal or condition to which it will respond.

A familiar example of this phenomenon may occur in a home burglar alarm. In the event of a lightning strike in the vicinity, surges may be induced in the mains supply lines and in the burglar alarm signal or sensor lines. The alarm may react in the same way as it reacts when disturbed by an intruder, by going into an alarm mode. A series of such false alarms will reduce the effectiveness of the burglar alarm. In the event of stormy weather, for instance, the setting off of a burglar alarm will be interpreted as being caused by lightning rather than by an intruder, which may not always be the case.

Likewise, a false triggering caused by lightning or switching surges could have disastrous effects in the case of a factory fire alarm. A control room could be unnecessarily doused with carbon dioxide gas, for instance, or an overhead sprinkler system could be activated. This will occur in cases where lightning or switching surges create a false alarm condition.

The more often an alarm is falsely triggered the less effective it is in fulfilling its purpose.

SUMMARY OF THE INVENTION

According to the invention there is provided a method of protecting electronic or electrical equipment from electromagnetic interference including the steps of detecting the electromagnetic interference, generating an input signal representative of the interference, comparing the level of the input signal to a predetermined threshold level, and generating an output signal to initiate at least one protective measure in the event of the level of the input signal exceeding the predetermined threshold.

Electromagnetic interference may be detected in at least one electrical supply conductor connected to the equipment, or may be detected by an independent antenna.

The input signal may be filtered to reject frequency components thereof falling outside a predetermined frequency band.

The predetermined frequency range may correspond, for example, to the electromagnetic frequency spectrum of lightning.

The protective measure may comprise providing a reset signal to the equipment, or may comprise interrupting the power supply to the equipment for a predetermined period. or.

Further according to the invention, apparatus for protecting electronic or electrical equipment from electromagnetic interference comprises detection means for detecting the electromagnetic interference and generating an input signal representative of the interference; level detection means for comparing the level of the input signal to a predetermined threshold level; and control means responsive to the level detection means for generating an output signal in the event of the level of the input signal exceeding the predetermined threshold.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a schematic diagram representing the main functional components of apparatus according to the invention in block form;

Figure 2 shows a circuit diagram of a first embodiment of the invention; and

Figure 3 illustrates a second embodiment of the invention.

DESCRIPTION OF EMBODIMENTS OF THE INVENTION

In Figure 1, each main functional component of an electromagnetic interference circuit according to the invention is shown in block form. The detection means comprises a suitable antenna 1 which is intended to pick up electromagnetic interference. This may comprise a specially adapted antenna, or alternatively may be constituted by any power or signal lines of the apparatus to be protected, which perform the function of detecting electromagnetic interference.

An input circuit 2 decouples and galvanically insulates the antenna 1 from the rest of the circuitry. The decoupled signal is then rectified in a rectification stage 3 so that both positive and negative excursions of the signal may be detected. The rectified signal is then fed to a frequency discrimination stage 4 and a level detection stage 5. The frequency discrimination stage 4 allows the circuitry to detect a specific source of interference, such as lightning, having a known or predicted interference frequency spectrum, and to discriminate between this source and another source having a different frequency or frequency spectrum, such as the 50Hz or 60Hz mains supply frequency. The function of frequency discrimination is performed by the combined action of the antenna 1, the input circuit 2, and further filtering means incorporated in the frequency discrimination stage 4.

The level detection stage 5 performs the function of determining whether the magnitude of the interference signal exceeds a predetermined level, and if so, generates an output pulse which triggers timing means 6. Factors influencing the level of detection include the efficiency or gain of the antenna 1, the gain of the input and decoupling circuit 2 (if any) and the actual choice of the detection threshold of the level detector 5.

The output pulse from the level detector 5 is converted to an output signal having a duration

which is set by the timing means 6. The output signal in turn actuates switching means which are incorporated in an interface block 7. The interface block 7 provides a link between the protection circuit and the electrical or electronic apparatus requiring protection, and can also serve to isolate the protection circuit galvanically from the equipment it protects. The switching means resets the apparatus in the event of it being falsely triggered by lightning, or prevents the false triggering of the apparatus in the first place.

Two specific embodiments of the apparatus described above will now be described. Referring to Figure 2, a circuit diagram embodying the functional blocks of Figure 1 is shown. The antenna means 1 comprises live and earth leads 10 and 11 which are connected to mains and earth lines, respectively, which power the electrical equipment (not shown) requiring protection. Electromagnetic interference occurring in or between the live and earth leads 10 and 11 will thus be detected. An extended signal lead can be used in place of the live lead 10, or an independent antenna having selected frequency response characteristics can be employed.

The input circuit 2 comprises two decoupling capacitors 12 and a signal-type transformer 14. The capacitors 12 in conjunction with the transformer 14 provide galvanic isolation between the protection circuit and the outside world. A full-wave bridge rectifier 16 is coupled to the secondary of the transformer 14.

The frequency discrimination means 4 is provided by low pass filters 20 located on either side of a zener diode 18. The low pass filters 20 are designed so that they primarily let through only signals having the frequency characteristics of lighting.

The zener diode 18 has a selected threshold voltage and acts as the level detection stage 5. It has a voltage rating chosen to give the desired level of discrimination. Only input (interference) signals having a sufficiently high level will be passed by the zener diode to the following stages.

The output signal from the filter 20 located after the zener diode 18 is fed into the base of a transistor 22. The transistor 22 provides a negative-going pulse to a timer 24, which provides an output signal having a predetermined time delay, set by an RC network. The output signal from the timer 24 passes through a light emitting diode 26. The light emitting diode 26 provides a visual indication of the period for which the timer holds its output signal on.

A relay 28 is energised by the output signal from the timer. The relay actuates contacts 30. The contacts 30 are accessible to the user of the electrical of electronic equipment through output leads 32, and can be used in various ways. The contacts can be wired in series with the power supply to the equipment to be protected, for example, or can be connected to a reset or disable/enable input of the equipment. In the case of the electronic equipment being a burglar alarm, the switch 30 will operate to reset the alarm or to prevent the alarm from reacting to external stimuli for a time set by the timing device 24. Alternatively, the output signal of the timer can be applied directly to a reset input of the equipment. For example, this output signal can be detected by hardware or software in computer-based equipment. The timing device 24 can be set to deliver an output signal for a time period equivalent to the maximum likely duration of electromagnetic interference caused by a lightning strike, for example.

Figure 3 shows an alternative, second embodiment of the interference prevention circuit. An antenna 110 is provided in the form of a pick-up wire which senses interference relative to a reference mains earth lead 112. The output of the antenna is connected via a decoupling capacitor 114 and a resistor 116 to a full wave rectifier bridge 118. The bridge output is connected to an opto-isolator 120. The decoupling function of the circuit is thus performed both by the capacitor 114 and the opto-isolator 120, which provide galvanic isolating between the circuit and the outside world. The frequency discrimination function of the circuit is performed by the RC high pass filter formed by the capacitor 114 and the resistor 116, and the high frequency cut-off of the opto-isolator 120.

The output of the opto-isolator 120 is fed to the base of a transistor 122 via a pair of resistors 124 and 126. The values of these resistors, together with the value of the resistor 116, are selected to determine the discrimination threshold of the circuit, that is, the magnitude of the input signal which is required in order to turn the transistor 122 on.

When a sufficiently large input (interference) signal is detected, the transistor 122 turns on, and provides a negative going pulse to the trigger input of a timer 128. As in the first embodiment, the timer 128 provides an output signal having a preset duration, which is determined by an RC network. The output of the timer is fed to a light emitting diode 130, which provides a visual indication of the period for which the timer holds its output signal on. A relay 132 is engergised, via a current limiting resistor 134, by the output of the timer 128, and operates contacts 136 which are, again, accessible to the user of the electrical or electronic equipment to be protected via output leads 138.

As mentioned previously, the output signal of the timer 128 can be applied directly to the protected equipment as a reset signal. This is useful where speed is important, and where galvanic isolation is not required.

The invention is not confined to alarm applications, but may be used to reset or protect any electronic or electrical equipment, such as computer installations, which may be affected by transient electromagnetic interference. The invention may also form part of a whole electrical protection scheme, incorporating additional circuitry. It will be understood that "protect" and "protection" are used in a broad sense in this specification, and it is intended to convey that the invention can provide protection against malfunctioning or error conditions, as well as protection against damage in certain cases.

Claims

1. A method of protecting electronic or electrical equipment from electromagnetic interference characterised in that it includes the steps of detecting the electromagnetic interference, generating an input signal representative of the interference, comparing the level of the input signal to a predetermined threshold level, and generating an output signal to initiate at least one protective measure in the event of the level of the input signal exceeding the predetermined threshold.

2. A method according to claim 1 characterised in that the electromagnetic interference is detected in at least one electrical supply conductor (10,11) connected to the equipment.

3. A method according to claim 1 characterised in that the electromagnetic interference is detected by an antenna (1; 110).

4. A method according to any one of claims 1 to 3 characterised in that it includes the step of filtering the input signal to reject frequency components thereof falling outside a predetermined frequency range.

5. A method according to claim 4 characterised in that the predetermined frequency range corresponds to the electromagnetic frequency spectrum of lightning.

6. A method according to any one of claims 1 to 5 characterised in that the protective measure comprises interrupting the power supply to the equipment for a predetermined period.

7. A method according to any one of claims 1 to 6 characterised in that the protective measure comprises applying a reset signal to the equipment.

8. Apparatus for protecting electronic or electrical equipment from electromagnetic interference characterised in that it comprises:
detection means (1) for detecting the electromagnetic interference and generating an input signal representative of the interference;
level detection means (5) for comparing the level of the input signal to a predetermined threshold level; and
control means (6, 7) responsive to the level detection means for generating an output signal in the event of the level of the input signal exceeding the predetermined threshold.

9. Apparatus according to claim 8 characterised in that it includes switch means (7; 28; 136) responsive to the output signal of the control means to interrupt an electrical circuit of the equipment.

10.Apparatus according to claim 8 or claim 9 characterised in that it is adapted to apply the output signal directly to a reset input of the equipment.

11.Apparatus according to any one of claims 8 to 10 characterised in that the control means (6, 7) includes timer means (6; 24; 128) responsive to the level detection means (5; 18; 122, 124, 126) and adapted to generate an output signal having a predetermined duration.

12.Apparatus according to any one of claims 8 to characterised in that the detection means (1) comprises at least one electrical supply conductor (10, 11) connected to the equipment.

13.Apparatus according to any one of claims 8 to 11 characterised in that the detection means comprises an independent antenna (110).

14.Apparatus according to any one of claims 8 to 13 characterised in that it includes filter means (4; 20; 114, 116)adapted to filter the input signal to reject frequency components thereof falling outside a predetermined frequency range.

15.Apparatus according to claim 14 characterised in that the predetermined frequency range corresponds to the electromagnetic frequency spectrum of lightning.

16.Apparatus according to any one of claims 8 to 15 characterised in that the level detection means (5) oomprises a zener diode (18) having a selected threshold voltage.

17.Apparatus according to any one of claims 8 to 16 characterised in that it includes decoupling means (2; 12; 14; 114, 120) for galvanically isolating the detection means from the level detection means.

18.Apparatus according to claim 17 characterised in that the decoupling means comprises at least one capacitor (12; 114).

19.Apparatus according to claim 17 or claim 18 characterised in that the decoupling means comprises at least one isolating transformer (14).

20.Apparatus according to claim 17 characterised in that the decoupling means comprises an opto-isolator (120).

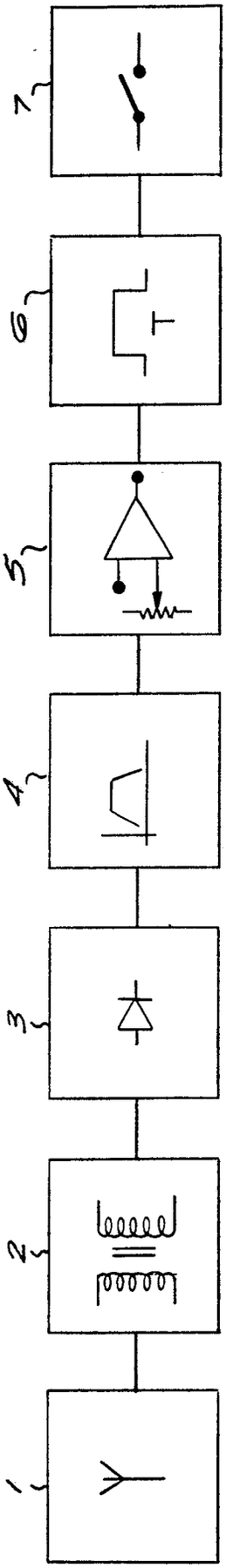


Fig. 1

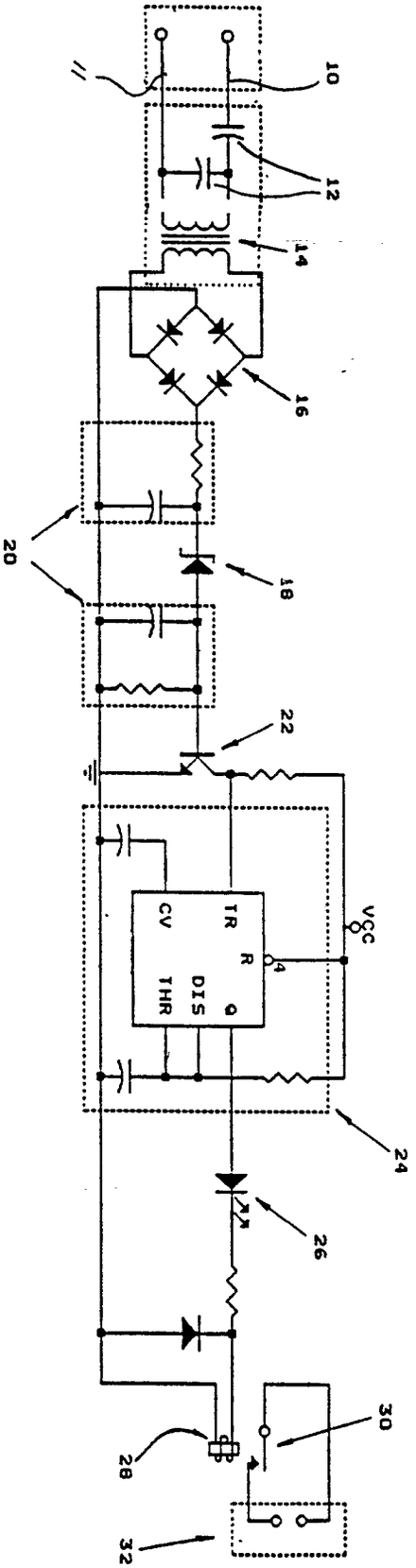


FIG 2

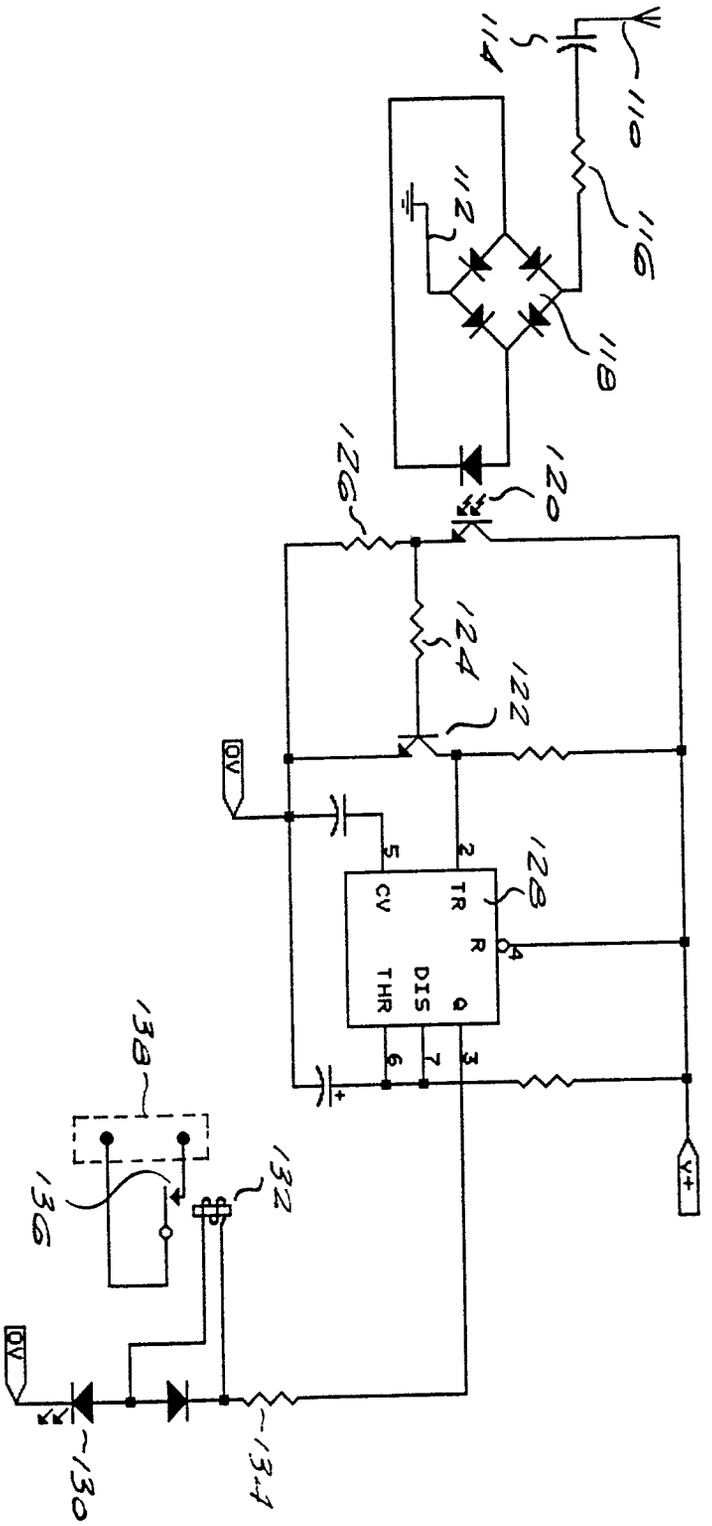

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FIG 3