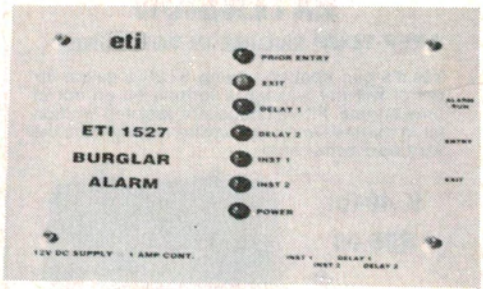
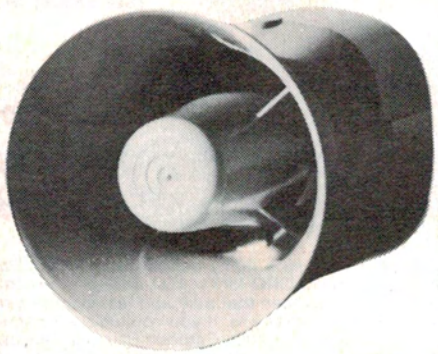
HOME BURGLAR ALARM MODULE

Part 1

Having to pay out a lot of money for an expensive home burglar alarm control could leave you feeling . . . er . . . robbed. With this simple alarm module it will cost you precious little to set up a comprehensive alarm system.

Robert Irwin





BURGLARY HAS, in recent times, become an all too common fact of life. City and suburban homes have become a favourite target for the break and enter thief. It is probably a safe bet that at least half our readers have come home from work or a night out somewhere only to find that their house has been broken into and their valuable and often personal possessions have been stolen.

A lot of people say that the worst aspect of a burglary is the feeling of violation, often much more traumatic than the actual loss suffered. The saddest thing is that most people still cling to that old adage "it doesn't matter what you do, if they want to get in they will".

While it is true that even the most sophisticated and expensive alarm system can be circumvented by very clever professional thieves, the statistics show that the majority of break and enters are done by rather clumsy amateurs who would probably have been put off by even the most rudimentary security measures.

The ETI-1527 burglar alarm module was developed from a design by Dick Smith Electronics and is intended to be the control centre for a comprehensive low cost burglar alarm system which includes many features found only in the much more expensive commercial units.

The cost of having a burglar alarm installed in an average home can range from around $500 to $2000 or more. With the ETI-1527 module an average home can be protected for about $100 or so depending on the type and number of sensors used. This board can form the basis of burglar alarm systems which can be as simple or complicated as you like.

Design details

The alarm has four sectors, that is, four inputs, which allow four separate alarm circuits to be wired up. Each of these circuits can contain a number of sensors. This will allow plenty of flexibility in the design of a sensing system for your particular needs. The types of sensors available and the installation of sensors will be covered in detail in later sections of this article. For now, let us examine the board itself.

The inputs are designed to be loaded by a 22k load resistor. Either shorting this resistor out or open circuiting the input will cause an alarm condition to be generated. This means that both N/O and N/C sensors can be used on the same input.

The use of four inputs allows the premises you are tyring to protect to be divided up into four sectors which can then be treated as separate circuits and wired accordingly.

Two of the sectors are provided with an entry delay and these can be used for the front and back doors to allow you to enter the premises without setting off the alarm immediately. The other two sectors are triggered straight away if a sensor is disturbed.

Apart from entry and exit delays the circuit also provides for an adjustable alarm run time. This allows you to set the time the siren or bell sounds after the alarm is triggered. After the alarm has sounded for this preset time the circuit will automatically rearm itself. If the input which triggered the alarm in the first place is still active then the

HOW IT WORKS — ETI-1527

The circuit contains four input points. To ensure freedom from RF induction in the lines going out to the sensors two capacitors are paralleled up across the input terminals. A ceramic and a greencap were used in tandem to provide adequate suppression at all frequencies. The inputs are all identical and are connected to the inputs of four window comparators formed by the op-amps of IC1 and IC2. Each window comparator is made up from a pair of op-amps.

The threshold levels for the comparators is set by a resistive divider network formed by R5, R6 and R7. The voltage at the junction of R7 and R6 is 7.3 V and the voltage at the junction of R5 and R6 is 4.7 V. These are the upper and lower threshold voltages of the comparator respectively.

For the input of the alarm to be in the sealed state the input to the comparators must lie between the threshold voltages. This is accomplished with two 22k resistors. Each input has a 22k resistor connected between the input to the comparator and the positive supply rail (R1, R2, R3, R4). The external load resistor (not shown in the circuit diagram) is then used to connect from the comparator input to ground thus creating a voltage divider which holds the input at 6 V. If the load resistor is shorted out then the voltage will swing towards ground. If the resistor is open circuited then the voltage will swing to the positive rail. In either case a threshold will be exceeded causing the output of one or other of the op-amps in the window comparator to swing high. The diode pairs D1 and D2, D3 and D4, D5 and D6, D7 and D8, are used to OR the outputs of the op-amp pairs.

The output from the diodes is fed, via a capacitor, to one input of the flip-flops formed from pairs of cross-coupled NOR gates. The action of the capacitors is to provide the lock-out function but more will be said about this later. The remaining input on each of the flip-flops is tied via R16 and RV1 to ground. These resistors along with C13 provide the exit delay function.

At turn on the capacitor will initially be discharged and will therefore have no voltage drop across it. The voltage at the junction of C13 and R16 will then initially be pulled up to the positive rail. This forces the output of the flip-flops low regardless of the state of the input circuitry thus disabling the alarm triggering circuitry. As C13 charges, the voltage at R16 will fall. When it falls below the switching point of the CMOS (around 6 V) the output of the flip-flops will be dependent on the input from the comparators and thus the circuit will be in the armed state. The time taken for C13 to charge will be dependent on the setting of RV1 and thus the exit delay can be varied by varying RV1.

IC5a forms an inverter to drive the exit delay LED which is turned on while the exit delay is active. While the exit delay is active the lock out facility can operate. If a particular input is in the sealed state initially then the output of the comparator for that input will be low and therefore the output from the flip-flop which is connected to the appropriate sector LED will be high and the LED will be off.

If, however, an input is unsealed in the exit period, the output from the corresponding comparator will be high. Since the coupling capacitors (C9, C10, C11 and C12) are initially discharged the voltage at the input of the flip-flops will be high also. This will cause the appropriate sector LED to light. The coupling caps will charge through the 470k resistors and the voltage will drop. When the voltage drops past the switching point of the CMOS the LED will go off. The input then looks sealed to the flip-flops and the alarm can then be armed without the unsealed input causing it to trigger. This sector will then be locked out until it is sealed.

The remaining gating circuitry is dedicated to the alarm triggering logic. The inputs are divided up into two instant trigger inputs and two delayed trigger inputs. The outputs of the flip-flops for the instant inputs are ORed together by D9 and D10 and fed to one input of a NOR gate, IC5b. The delayed input trigger signals are ORed by D11 and D12 and are then fed via R26 and RV2 to a capacitor, C14. When a delay input is triggered the output of the appropriate flip-flop goes high and C14 will begin to charge.

The time taken to charge depends on the setting of RV2. The positive side of C14 is connected to the other input of the NOR gate, IC5b. This creates a time delay from when the input is triggered until the capacitor charges enough to switch the NOR gate.

Diode D14 provides a discharge path for C14 via R18. When the alarm is triggered the output of IC6c goes high. This provides a pulse which triggers the latch formed by IC6a and b. This has three effects. Firstly, the output of the inverter formed by IC6d goes low which turns on the siren and bell circuitry. Secondly, the output from IC6b goes low and resets the input flip-flops. The third thing that happens is that the latch formed by IC5c and d is set which causes the prior entry LED to light. This latch is only reset at power up by C21 and R29.

When the alarm is triggered the output of IC6a goes high. This causes C22 to begin charging through R28 and RV3. When the cap voltage reaches the CMOS switching level the latch is reset and the siren and bell is turned off. The alarm will then arm as if it were switched on again except that the prior entry LED will remain lit.

When the siren and bell circuit is triggered the transistors, Q1 and Q2, are turned on. Q2 then turns on Q3 which will activate a dc bell and will sink up to 1 A. Q1 enables the two LM555s which form the siren drive circuit. IC8 is configured as an astable which puts out a square wave signal. IC7 is used to modulate the frequency of IC8 by producing a low frequency sinusoidal type signal. The overall effect is to produce a piercing modulated siren type signal. This is then buffered by Q4 to provide the drive to run a 4 ohm speaker.

The board requires a nominal 12 V dc supply which is then filtered by C19 and C18. D1 provides protection against connecting the battery the wrong way round and ZD1 gives overvoltage protection.

circuit will lock this out and only re-arm those sectors which are not active. This feature also means that if you wish to leave a window open at night but you still want to have the rest of the house protected you can simply turn on the alarm with the appropriate window open and the circuit will lock out that input.

To indicate the state of the alarm, seven LEDs are provided. A power on indication is given to show that dc power is being applied. At turn on, four red LEDs indicate whether each sector is sealed or unsealed. After a short time any unsealed sectors are locked out and the LEDs are extinguished. Once armed these same LEDs will indicate which sector was triggered if an alarm is sounded.

If the alarm is triggered then another LED will light to indicate that there has been prior entry. The remaining LED indicates that the exit delay is active. This display will allow you to easily determine the state of the alarm and see if it has been triggered.

The circuit also has an on board siren ▶

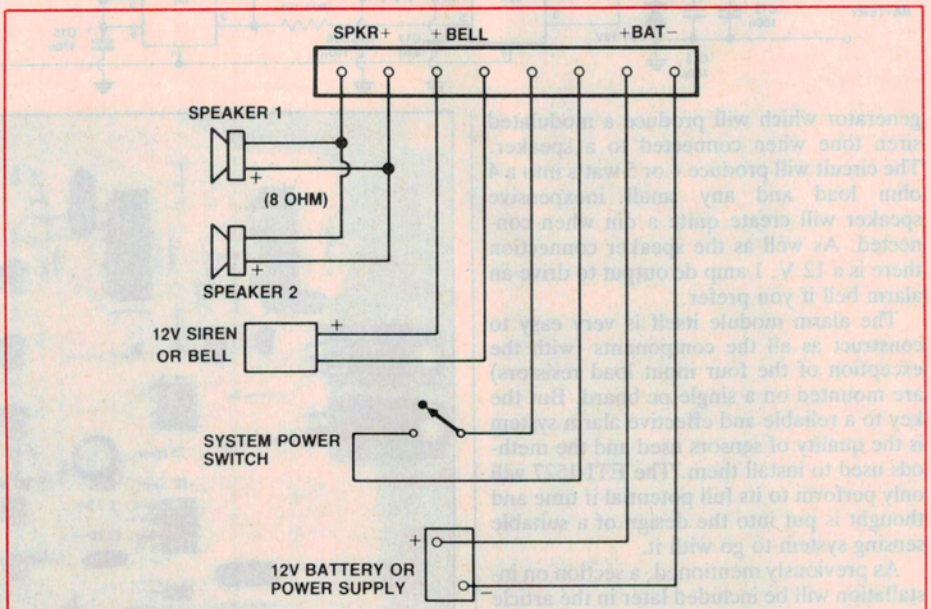
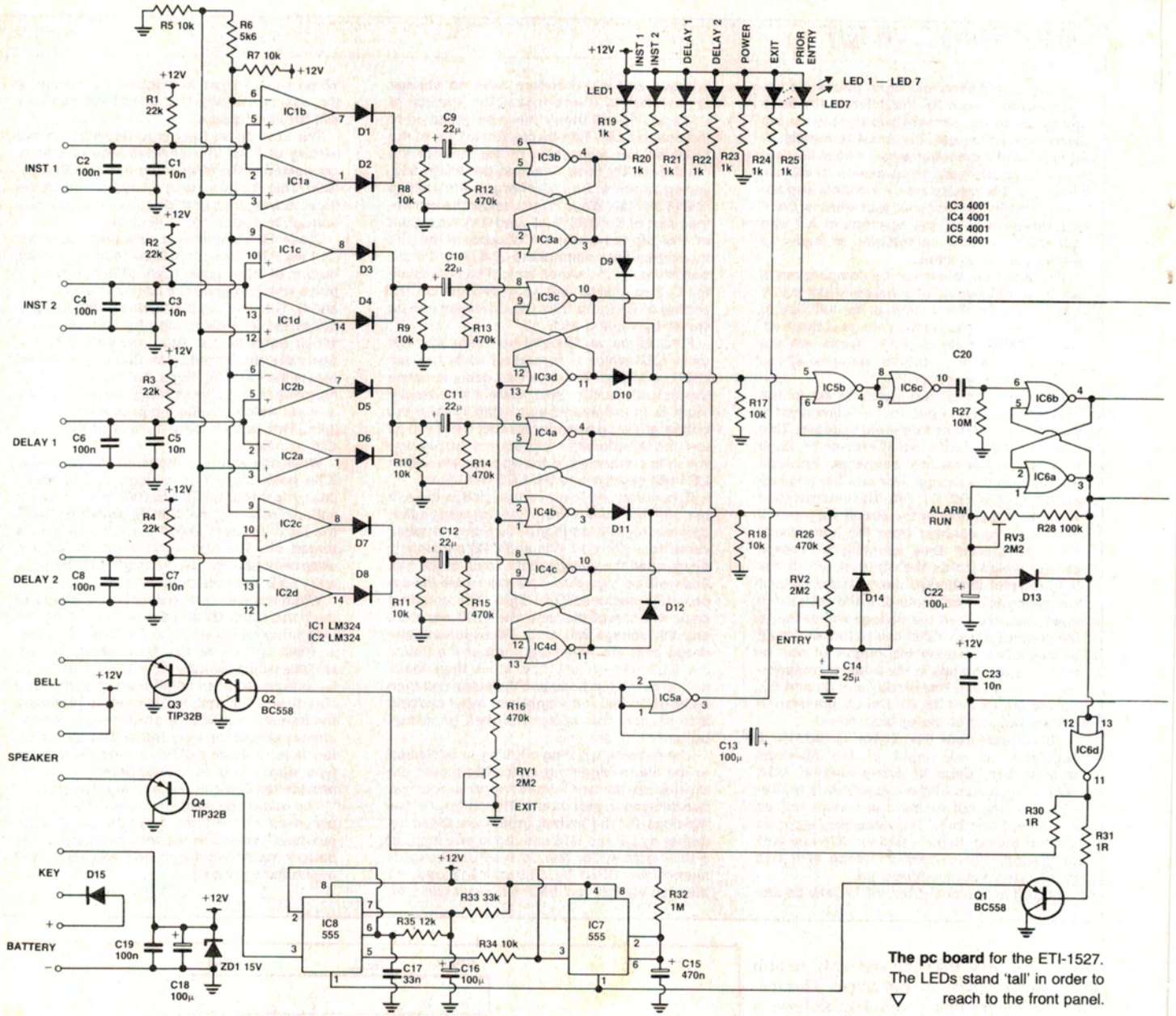


Figure 1. Wiring up the power supply and sirens to the module.

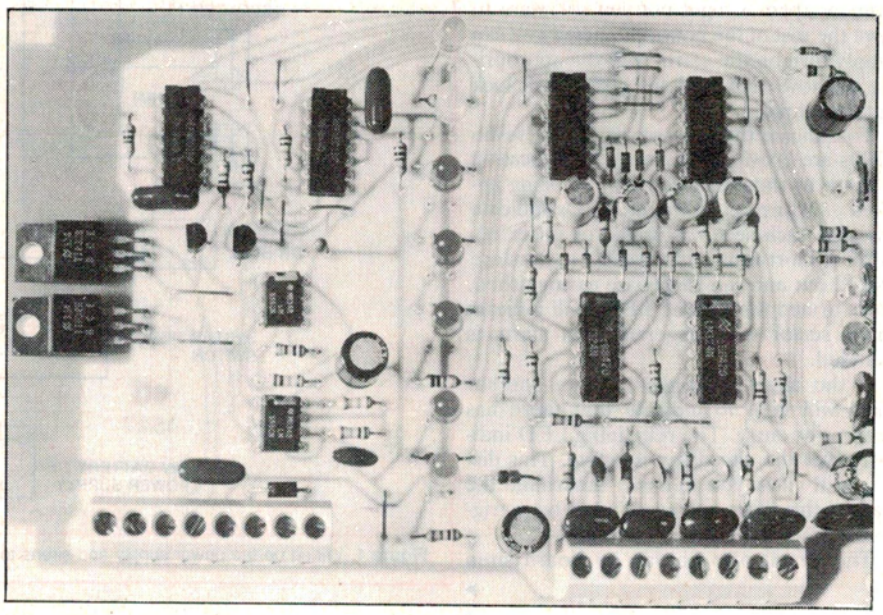


The pc board for the ETI-1527. The LEDs stand 'tall' in order to reach to the front panel. ▽

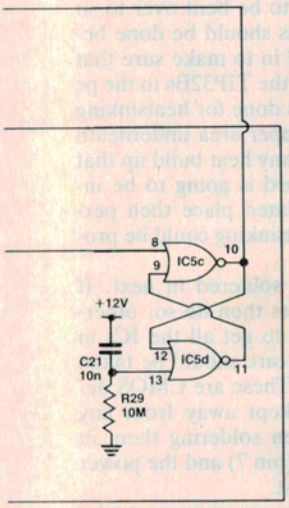
generator which will produce a modulated siren tone when connected to a speaker. The circuit will produce 4 or 5 watts into a 4 ohm load and any small inexpensive speaker will create quite a din when connected. As well as the speaker connection there is a 12 V, 1 amp dc output to drive an alarm bell if you prefer.

The alarm module itself is very easy to construct as all the components (with the exception of the four input load resistors) are mounted on a single pc board. But the key to a reliable and effective alarm system is the quality of sensors used and the methods used to install them. The ETI-1527 will only perform to its full potential if time and thought is put into the design of a suitable sensing system to go with it.

As previously mentioned, a section on installation will be included later in the article but if you are seriously considering installing your own alarm system then a bit of background reading wouldn't go astray.



For a guide to components and kits for projects, see SHOPAROUND this issue.



PARTS LIST — ETI-1527

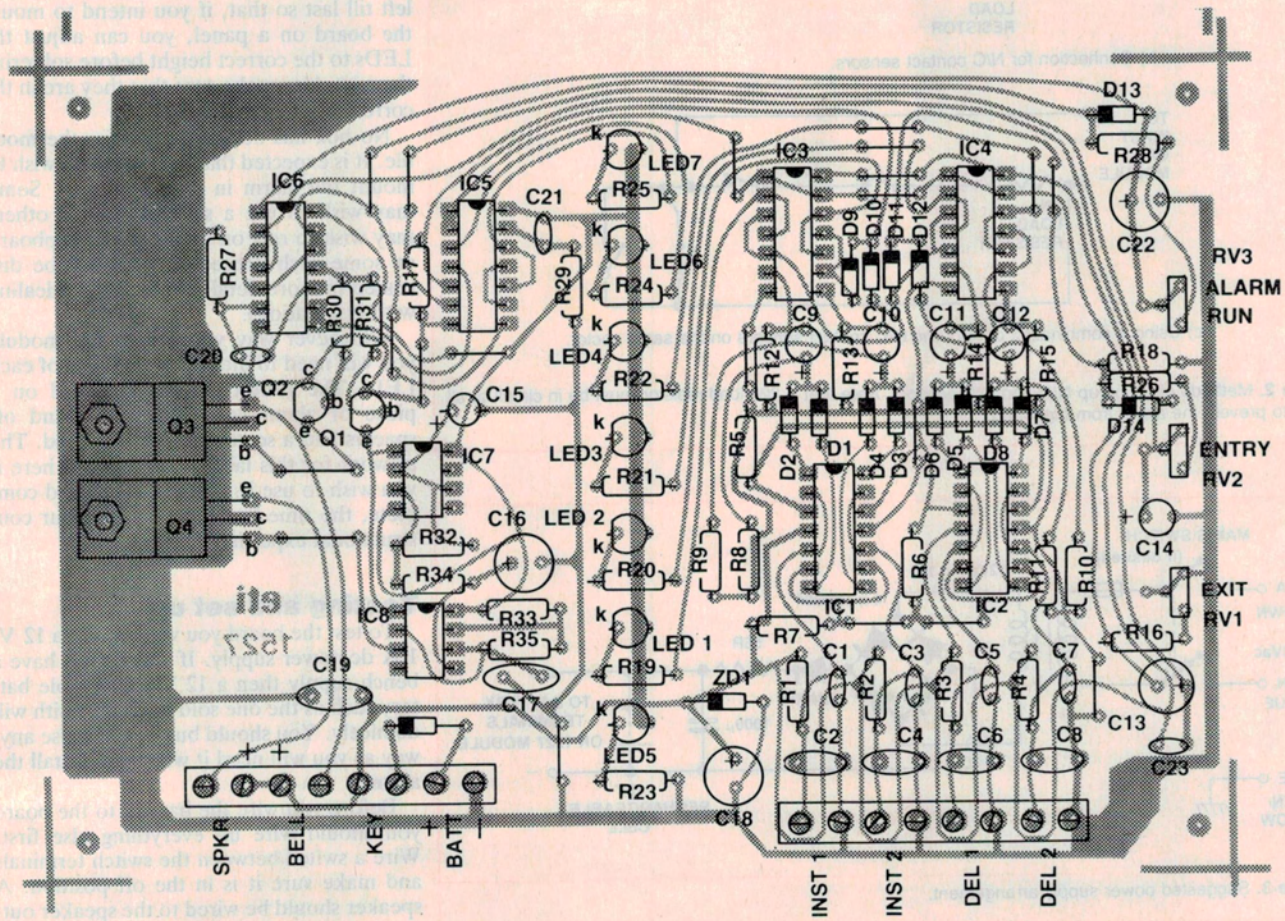
Resistors.....all ¼ W, 5%
R1, 2, 3, 4.....22k
R5, 7, 8, 9, 10, 11, 17, 18, 34.....10k
R6.....5k6
R12, 13, 14, 15, 16, 26.....470k
R19, 20, 21, 22, 23, 24, 25.....1k
R27, 29.....10M
R28.....100k
R30, 31.....1R
R32.....1M
R33.....33k
R35.....12k
RV1, 2, 3.....1M miniature trim.

Capacitors
C1, 3, 5, 7.....10n ceramic
C2, 4, 6, 8, 19, 20..100n greencap
C9, 10, 11, 12, 14..22µ 16 V electro.
C13, 16, 18, 22.....100µ 16 V electro.
C15.....470n 16 V tag tantalum
C17.....33n greencap
C21, 23.....10n greencap

Semiconductors
IC1, 2.....LM324
IC3, 4, 5, 6.....4001B
IC7, 8.....LM555
Q1, 2.....BC558
Q3, 4.....TIP32B
D1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.....1N914
D15.....1N4004
ZD1.....15V 400 mW zener
LED1, 2, 3, 4.....5 mm red LED
LED5, 7.....5 mm green LED
LED6.....5 mm yellow LED

Miscellaneous
ETI-1527 pc board; ETI-1527 front panel (if required); 7 x 5 mm LED mounting grommets and washers; 300 mm tinned copper wire; 2 x ½" 6BA nuts and bolts; 2 x 8 way pc board mount terminal block.

Price estimate: $28-$30

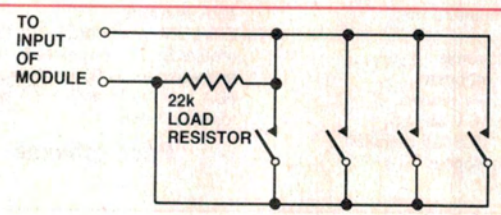


The Australian Standards Association puts out a useful booklet called *A guide to the selection and application of intruder alarm systems*. This booklet can be obtained from the ASA and gives a good background to the types and uses of the various sensors available. The NRMA and other insurance companies may also be able to help you with information on security systems. For now, let's get on with the construction of the board.

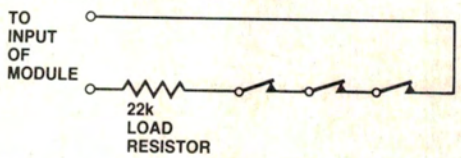
Construction

Begin by carefully examining the pc board. Make sure there are no broken or shorted tracks. A magnifying glass is very handy for this. Once you are satisfied that the pc board is in good shape then you can start soldering in components. Start by soldering in the two eight-way terminal blocks. These should be located so that the connection clamp openings face the edge of the board.

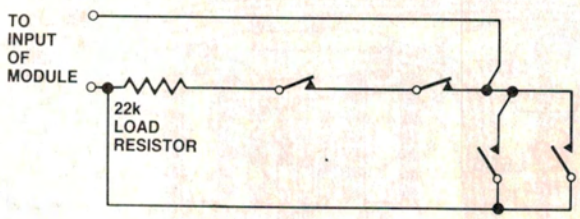
Next you can locate and solder in the 20 wire links. These should be made with tinned copper wire. The resistors can then be soldered in followed by the capacitors. Take careful note of the polarity of all the electrolytics and the tantalum caps. These will only work if put in the right way round.



a) Connection for N/O contact sensors.



b) Connection for N/C contact sensors.



c) Using a combination of N/O and N/C contact sensors on the same sector.

Figure 2. Methods of wiring up N/O and N/C sensors. Note that a 22k load resistor must be in circuit at all times to prevent the alarm from triggering.

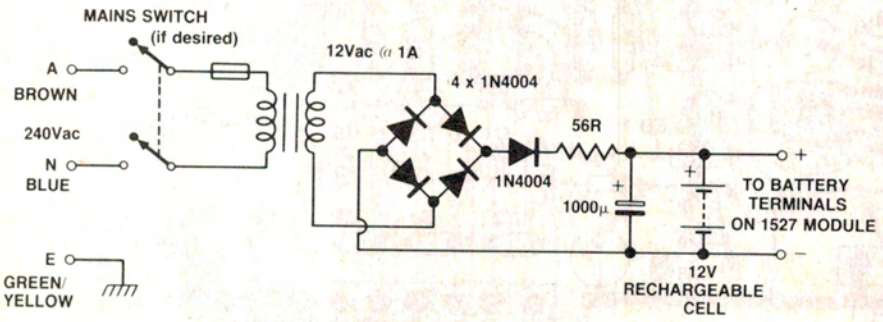


Figure 3. Suggested power supply arrangement.

Solder in the three miniature trimpots. The diodes can be put in next. These also need to be put in the correct way round so take careful note of the overlay diagram.

The rectifier diode and the Zener should not be confused with the 1N914 small signal diodes. The four transistors can be soldered in next.

The TIP32Bs need to be bent over to sit flat on the board. This should be done before they are soldered in to make sure that the holes line up. Bolt the TIP32Bs to the pc board securely. This is done for heatsinking reasons. The large copper area underneath them acts to dissipate any heat build up that may occur. If the board is going to be installed in an unventillated place then perhaps a bit of extra heatsinking could be provided.

The ICs should be soldered in next. If you wish to use sockets then do so, otherwise take special care to get all the ICs in the right way. Special care should be taken with the HEF4001Bs. These are CMOS devices and should be kept away from any static discharges. When soldering them in solder the ground pin (pin 7) and the power supply pin (pin 14) first.

The only remaining components to be soldered in are the LEDs. These should be left till last so that, if you intend to mount the board on a panel, you can adjust the LEDs to the correct height before soldering them in. Also make sure that they are in the correct way round.

No box has been specified for the module. It is expected that everyone will wish to mount the alarm in their own way. Some may wish to use a security box or others may wish to rely on hiding it in a cupboard or some such procedure (this will be discussed in more detail in the section dealing with installation).

Whichever way you mount the module you will need to mark the functions of each LED. The prototype was mounted on a piece of aluminium plate with stand off spacers and a scotchcal label attached. The artwork for this label is reproduced here if you wish to use it. With the pc board complete, the time has come to test your constructional expertise . . .

Testing and set up

To test the board you will require a 12 V, 1 A dc power supply. If you do not have a bench supply then a 12 V rechargable battery such as the one sold by Dick Smith will do nicely. You should buy one of these anyway as you will need it when you install the alarm.

Before you wire the battery to the board you should wire up everything else first. Wire a switch between the switch terminals and make sure it is in the off position. A speaker should be wired to the speaker out-

put terminals in series with a 100 ohm resistor. The resistor will attenuate the volume of the siren so that you don't have the police arresting you for noise pollution.

All the trimpots should be set to minimum (fully counter-clockwise). The battery can now be connected. Make sure you connect it the right way round. OK! Brace yourself for any loud noises and/or smoke and flick the switch. If you are lucky the board will be still intact and all the LEDs except for the prior entry LED will be lit. The siren should not go off. If this is the state of affairs then so far so good.

After a few seconds the four red LEDs should got out. After about 30 seconds or so the yellow exit delay LED should go out leaving the power indicator as the only LED lit. If all this happens correctly then heave a sigh of relief and switch off.

Wire in 22k load resistors across each of the four input terminals. Make sure they are in securely and are not touching one another. Switch on again. This time only the power and exit delay LEDs should light. After the exit delay has expired the yellow LED should go out. The alarm is now in the armed state.

Short out the resistor on one of the instant inputs and leave it shorted. The siren should sound immediately and the appropriate red LED should light to show that that sector is unsealed. The green prior entry LED should also come on and stay on. After about 20 seconds or so the siren should stop and the alarm will re-arm itself as if it had just been switched on.

The sector LED should go out about five seconds after the siren has turned off. This indicates that the sector has been locked out. The other three sectors will be re-activated after the exit delay period has expired. The prior entry LED will stay on to indicate that the alarm has been triggered. It will only be reset when the alarm is turned off.

The only thing left to do on the board is to set up the time delays. If you haven't yet decided where to install the module then you had better read the installation guide first and then come back to this section.

Firstly, get a watch with a second hand (or a digital watch if you would prefer a high tech approach!) and measure the time taken for you to leave the house from wherever the alarm will be situated. Also measure the time taken for you to open the front (or back) door and get to the alarm. The exit and entry delays can now be set to cover these measured times. Give yourself a fair bit of leeway as you may come in with your hands full one day and not be able to get to the alarm in time.

The alarm run time is a matter to decide yourself. It should be long enough to ensure that someone will be alerted but not long enough to annoy the neighbours too much if a false alarm occurs in the middle of the night. Once you have set the alarm up satisfactorily you can turn your attention to the problems of installation. Read the installation section thoroughly before buying or attempting to mount any sensors. ●

The installation section forms Part 2 next month.

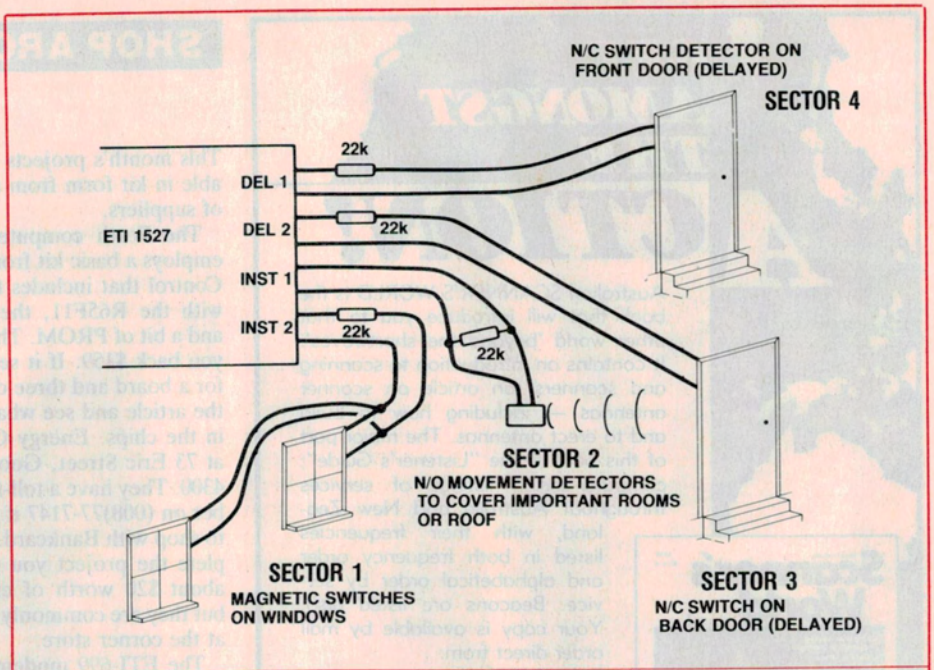
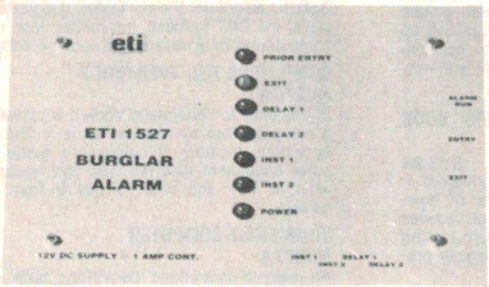
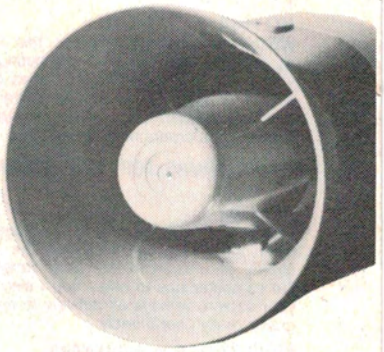


Figure 4. Typical application of the ETI-1527 module. Note that the entry and exit points are connected to the 'delay' inputs on the module.

HOME BURGLAR ALARM MODULE

Part 2





Securing your home takes some careful thought and preparation. Once you've built your ETI-1527 burglar alarm you need to determine your exact needs and use a little camouflaging ingenuity for installation.

Robert Irwin

LAST MONTH I described the design and construction of the ETI-1527 burglar alarm. The following paragraphs are intended as a guide to those hardy adventurers who wish to install their own burglar alarm system. Although primarily intended for use with the ETI-1527 burglar alarm module the comments are mostly general and may help those of you who, perish the thought, are using an alternative control module.

Sensors

Firstly, let's have a look at the types of sensors available. The most commonly used type of sensor is the 'switch' or 'contact' type of detector. The favourite from this group is the magnet reed switch which uses the proximity of a small magnet to operate a reed relay. These are mainly used to detect the opening of a door or window.

In such cases the relay is mounted on the door or window surround and the magnet is mounted on the moving section in such a way that when the door or window is closed the magnet and reed are in close proximity and the reed switch is kept closed. When the door or window is opened the magnet will be moved away from the reed and the relay will drop out thus breaking the circuit.

The magnet reed switch has the advantages of being cheap and relatively easy to install. If installed correctly and used correctly the magnetic switch is also reasonably resistant to false alarms.

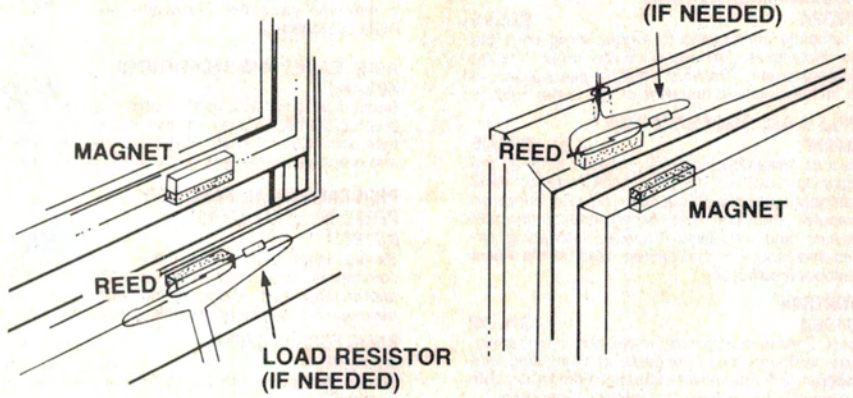
The one major disadvantage is that it can be fairly easily circumvented by someone who knows how. By clever mounting and disguising, however, this problem can be minimized.

An example of a mechanical contact switch is a plunger or lever operated switch. These switches operate in a similar way to the switch that operates the courtesy light on your car when you open the door. The physical action of opening a door or window actuates a plunger or arm to throw a switch. These types of switches are used in similar applications to that of the magnetic reed switches.

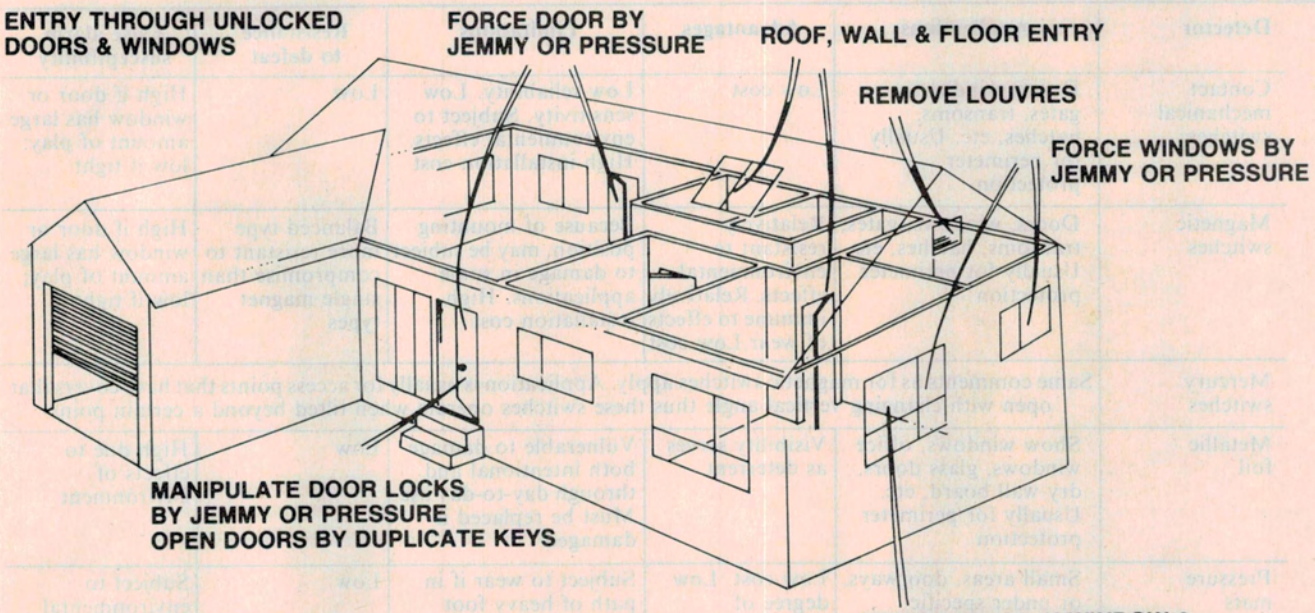
A mercury tilt switch can also be used to detect entry through windows which pivot upwards to open. These switches use a drop of mercury to make electrical contact between points in a sealed glass bulb. The switches have the disadvantage that they can easily be set off if the wind unduly rattles the window and should only be used when this sort of problem could not occur.

Another type of contact switch which is not used on doors or windows is the pressure mat. These are large flat mats with electrical contacts inside. These respond to the pressure of someone walking on them and can be hidden under carpets or rugs and can be placed in hallways or in such a position that someone attempting to take a valuable item, such as your TV, will have to tread on the pressure mat first.

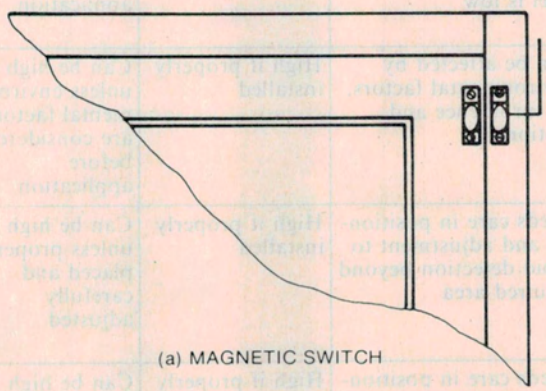
One form of detector which is commonly used where large glass areas need to be protected is metallic foil. This comes in the form of metal foil tape which is stuck on a window or glass door and then connected ▶



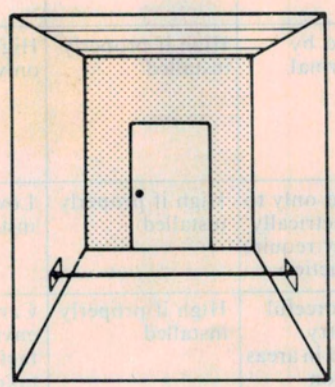
Reed switches should be securely mounted on doors and windows. If possible the switch and magnet should be mounted inside the door or window surround and the wires hidden. If you want, the load resistor for the sector input can be hidden inside the door or window surround to protect it from tampering.



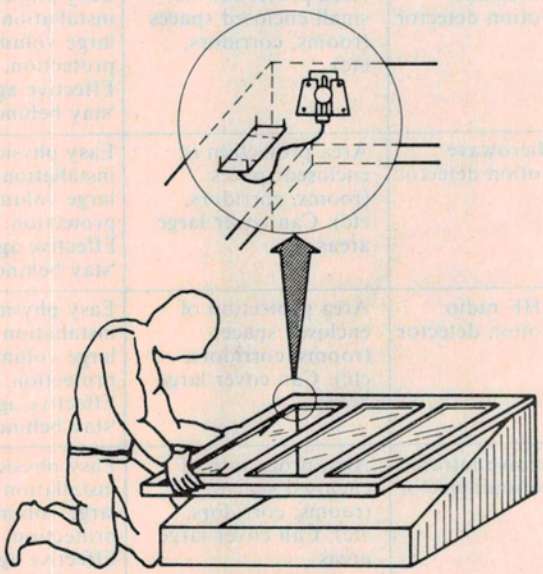
Common methods of breaking into a house. Your alarm system should cover each of these entry points.



(a) MAGNETIC SWITCH



(b) TRIP SWITCH



(c) MERCURY SWITCH

Switch detectors have electrical contacts that make or break an electrical circuit in response to a physical movement; they are usually used for perimeter protection.

COMPARISON OF INTRUDER DETECTORS

Detector	Applications	Advantages	Limitations	Resistance to defeat	False alarm susceptibility
Contact mechanical switches	Doors, windows, gates, transoms, hatches, etc. Usually for perimeter protection	Low cost	Low reliability. Low sensitivity. Subject to environmental effects. High installation cost	Low	High if door or window has large amount of play; low if tight
Magnetic switches	Doors, windows, gates, transoms, hatches, etc. Usually for perimeter protection	Relatively resistant to environmental effects. Relatively immune to effects of wear. Low cost	Because of mounting position, may be subject to damage in some applications. High installation cost	Balanced type more resistant to compromise than single magnet types	High if door or window has large amount of play; low if tight
Mercury switches	Same comments as for magnetic switches apply. Application is usually for access points that have covers that open with changing vertical angle thus these switches operate when tilted beyond a certain point				
Metallic foil	Show windows, office windows, glass doors, dry wall board, etc. Usually for perimeter protection	Visibility serves as deterrent	Vulnerable to damage both intentional and through day-to-day use. Must be replaced if damaged	Low	High due to effects of environment
Pressure mats	Small areas, doorways, or under specific objects for point protection	Low cost. Low degree of maintenance. Adaptable to wide variety of shapes and sizes	Subject to wear if in path of heavy foot traffic. Subject to effects of humidity and standing water	Low	Subject to environmental conditions
Acoustic detector	Area protection of enclosed spaces (rooms, vaults, etc), glass breakage detectors	Not affected by air movement	Must be used in stable noise environment where background level is low	High if properly installed	Can be high depending on the type and application
Ultrasonic motion detector	Area protection of small enclosed spaces (rooms, corridors, etc)	Easy physical installation for large volume protection. Effective against 'stay behinds'	Can be affected by environmental factors, air turbulence and motion	High if properly installed	Can be high unless environmental factors are considered before application
Microwave motion detector	Area protection of enclosed spaces (rooms, corridors, etc). Can cover large areas	Easy physical installation for large volume protection. Effective against 'stay behinds'	Needs care in positioning and adjustment to avoid detection beyond required area	High if properly installed	Can be high unless properly placed and carefully adjusted
UHF radio motion detector	Area protection of enclosed spaces (rooms, corridors, etc). Can cover large areas	Easy physical installation for large volume protection. Effective against 'stay behinds'	Needs care in positioning and adjustment to avoid detection beyond required area	High if properly installed	Can be high unless properly placed and carefully adjusted
Passive infrared motion detector	Area protection of enclosed spaces (rooms, corridors, etc). Can cover large areas	Easy physical installation for large volume protection. Effective against 'stay behinds'	Can be affected by changes in thermal environment	High if properly installed	High for receive only sensors
Capacitance detector	Primarily point protection for safes, filing cabinets, valuable objects	Detection field confined to the specific object	Can be applied only to objects not electrically grounded. May require special construction	High if properly installed	Low if properly installed
Vibration detector	Primarily point protection for safes, vaults, show cases, etc. Limited to perimeter protection when installed to protect walls or ceilings, etc	Requires low maintenance. High degree of reliability when properly applied	Detects only forceful attempts at entry. Cannot be used in areas of high vibration (traffic, construction, etc)	High if properly installed	Can be high if environmental factors are not taken into account. May be triggered by minor earth tremors, sonic booms or trains

back to the alarm.

If the window is broken, the foil will break and thus break the electrical contact. The problem with metal foil is that it can easily be damaged by routine cleaning of the window. A protective coating is generally put over the foil after it is attached to the window to get round this problem.

All of these sensors rely on an intruder opening, tilting or in some other way physically disturbing the protected area.

If the intruder gains entry to the premises without setting off these detectors the following group of sensors can be implemented. These consist of several different types of motion detector.

The main types use either microwave, radio wave, ultrasonic or infrared energy to detect the motion of an intruder in a specific area. Each type of sensor works on different principles and has different properties. Therefore, despite the fact that they all detect the same thing, their individual suitability to a particular situation will vary.

Microwave detectors use a high frequency electromagnetic field to sense motion. They require both a transmitter and a receiver to operate. The shape of the field can be made either directional or omnidirectional and each manufacturer will have different specifications on field pattern and range.

Since microwaves will penetrate most building materials (wood, glass, plastic) these detectors must be mounted with care to ensure that their range does not exceed the desired area. Otherwise the sensor may pick up motion outside the building and cause a false alarm.

This penetration power of microwaves can, if you are careful, be used to advantage. The sensor can be mounted inside a wall cavity or cupboard and still protect the desired area.

In complete contrast, ultrasonic motion detectors will not penetrate walls and can therefore, be completely contained in a room. Their use, though, still requires much care to be effective as this lack of penetration means that large objects, such as a lounge, can create blank spots in the room where the ultrasonic field will not penetrate.

Any obstructions in the room, such as an intricate chandelier, may distort the field and make it less effective. As with the microwave sensor, the ultrasonic sensor needs a transmitter and receiver.

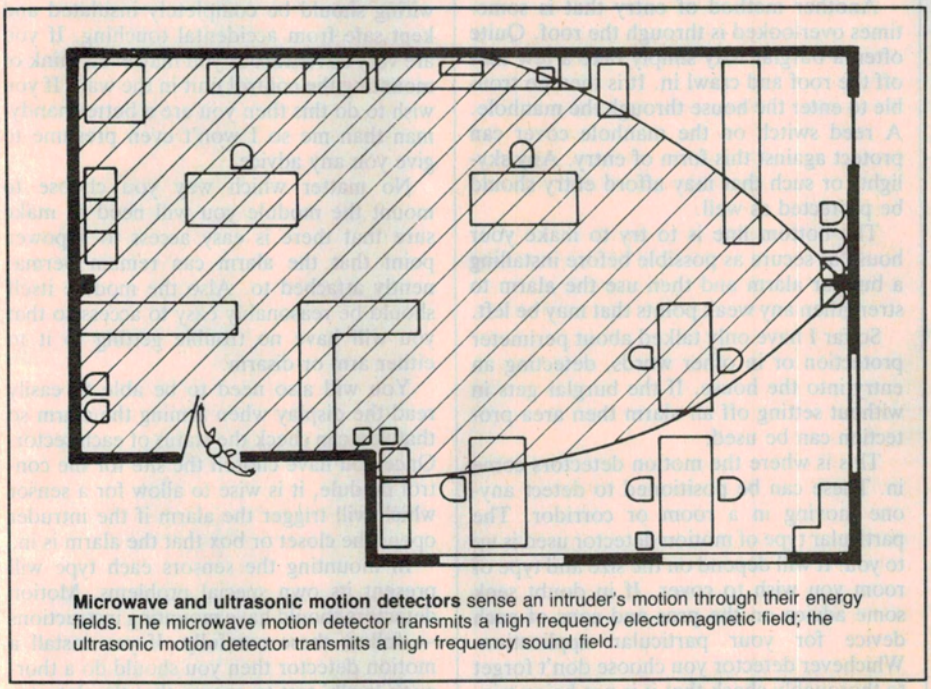
Radio frequency motion detectors generate a field of UHF radio waves. The generated power changes when a moving object enters the field and thus these detectors do not need a receiver. The field is omnidirectional and has a penetration power better than that of microwave detectors so extra care must be taken.

UHF radio sensors are quite often used to give coverage of two or more rooms at the same time. It should be noted that these waves will not penetrate metal. The power of these detectors is usually variable and coverage areas of up to 20 m diameter are usual. Due to the penetration and reflection off metal surfaces, the actual field shape in a particular application is unpredictable and is usually adjusted by trial and error.

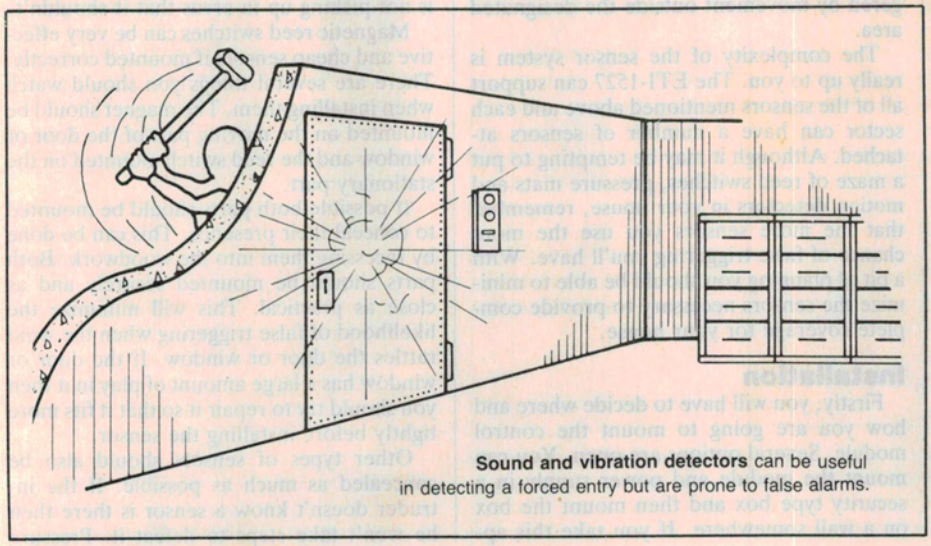
One of the most common motion detectors is the passive infrared sensor. These sensors detect the presence of a moving infrared source. Ambient temperatures or stationary heat sources will not set the detector off but the heat from a human body will at a range of up to 10 m. This type of detector uses the difference between room temperature and body temperature so on very hot days in a hot room the range can be severely limited.

Infrared systems use optical focusing to tailor the coverage of the sensor and so are limited to line of sight. This can sometimes be a problem in odd shaped rooms or areas with large objects in them which may obscure the view. Being passive detectors they do not emit any field of their own and so, unlike all the other motion detectors, they cannot be detected.

Some special types of sensors are available for special applications. Sound and vibration detectors can be used to detect someone trying to break or cut through a wall. These are very prone to false alarms if not mounted in a place where they will not ▸

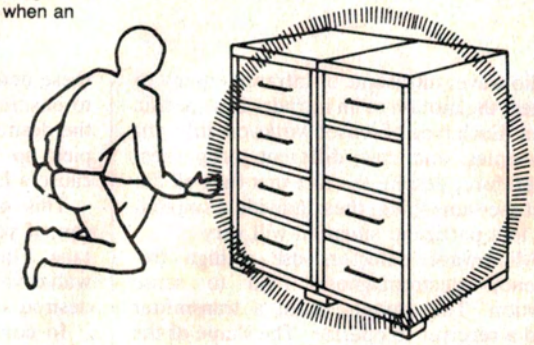


Microwave and ultrasonic motion detectors sense an intruder's motion through their energy fields. The microwave motion detector transmits a high frequency electromagnetic field; the ultrasonic motion detector transmits a high frequency sound field.



Sound and vibration detectors can be useful in detecting a forced entry but are prone to false alarms.

A capacitance detector detects a change in the electrical field surrounding an object when an intruder enters that field and causes the alarm to operate.



pick up sound or vibration from traffic in the street or other common disturbances.

For protection of safes or filing cabinets a capacitance detector can be used. These sensors will detect the change in capacitance when an intruder approaches a metal object such as a safe.

The above is a summary of the more common types of detectors used. It is wise to check out the manufacturers for information regarding particular products. If you decide to use infrared motion detectors, for instance, do get some information about the different brands as each will have different specifications. One type may be more suited to your application than another.

Defining the security problem

The first thing to do when you are thinking about installing a burglar alarm system is to take a good look at the premises you are trying to protect and to isolate the problem areas.

Start with the doorways. If your front and back doors are solid and well mounted and have a good deadlock correctly installed then there is little need to have advanced security measures on these. A magnetic reed switch correctly mounted should be adequate protection. If the doors contain glass panels then metal foil could be used on these. If the door is not all that secure then perhaps use a pressure mat under the carpet inside the door to give added protection.

The next problem area (and often the most neglected) is windows. Most people spend large sums of money putting expensive deadlocks on their doors but have no adequate locking facilities on the windows. In the majority of break-ins the intruders enter through inadequately secured windows or doors either by simply opening them because they weren't even locked or by jemmying them open because the locking devices (or hinges) weren't secure enough.

The golden rule here, is to make sure your windows can't easily be forced open and to make sure you lock them when you go out. If you are not sure then take a jemmy bar and play criminal (to your own windows not the neighbours!!!). You may be surprised at how easy it is to get in!

As far as electronic security for your windows goes, well installed magnetic reed switches can be used to great effect. If you wish, metal foil can be used to protect against someone breaking the glass.

Another method of entry that is sometimes overlooked is through the roof. Quite often a burglar may simply take a few tiles off the roof and crawl in. It is then no trouble to enter the house through the manhole. A reed switch on the manhole cover can protect against this form of entry. Any skylights or such that may afford entry should be protected as well.

The bottom line is to try to make your house as secure as possible before installing a burglar alarm and then use the alarm to strengthen any weak points that may be left.

So far I have only talked about perimeter protection or in other words, detecting an entry into the house. If the burglar gets in without setting off an alarm then area protection can be used.

This is where the motion detectors come in. These can be positioned to detect anyone moving in a room or corridor. The particular type of motion detector used is up to you. It will depend on the size and type of room you wish to cover. If in doubt seek some advice on the pros and cons of each device for your particular application. Whichever detector you choose don't forget to thoroughly check that it is not being triggered by movement outside the designated area.

The complexity of the sensor system is really up to you. The ETI-1527 can support all of the sensors mentioned above and each sector can have a number of sensors attached. Although it may be tempting to put a maze of reed switches, pressure mats and motion detectors in your house, remember that the more sensors you use the more chance of false triggering you'll have. With a bit of planning you should be able to minimize the sensors necessary to provide complete coverage for your house.

Installation

Firstly, you will have to decide where and how you are going to mount the control module. Several options are open. You can mount the module and power supply in a security type box and then mount the box on a wall somewhere. If you take this approach then make very sure that it is extremely difficult to break into the box or cut any wire coming from the box. The easiest way to do this is to run any exposed wires in metal conduit which is securely attached to the wall.

Another way is to conceal the control module in a closet or other such place. If you do this then make sure that it is not going to be obviously discovered by a mass of wires emerging from the hiding place. If you are going to hide the module then a security box is not necessary but some form of box should be used to protect the electronics.

The power supply will also have to be mounted in a box for safety as any mains wiring should be completely insulated and kept safe from accidental touching. If you are very adventurous you may even think of mounting the control unit in the wall. If you wish to do this then you are a better handyman than me so I won't even presume to give you any advice.

No matter which way you choose to mount the module you will need to make sure that there is easy access to a power point that the alarm can remain permanently attached to. Also the module itself should be reasonably easy to access so that you will have no trouble getting to it to either arm or disarm.

You will also need to be able to easily read the display when arming the alarm so that you can check the status of each sector. Once you have chosen the site for the control module, it is wise to allow for a sensor which will trigger the alarm if the intruder opens the closet or box that the alarm is in.

In mounting the sensors each type will present its own special problems. Motion detectors should have mounting instructions — follow these carefully. If you install a motion detector then you should do a thorough 'walk' test to ensure that the detector is not picking up in areas that it shouldn't.

Magnetic reed switches can be very effective and cheap sensors if mounted correctly. There are several things you should watch when installing them. The magnet should be mounted on the moving part of the door or window and the reed switch mounted on the stationary part.

If possible both parts should be mounted to conceal their presence. This can be done by recessing them into the woodwork. Both parts should be mounted securely and as close as practical. This will minimize the likelihood of false triggering when the wind rattles the door or window. If the door or window has a large amount of play in it then you should try to repair it so that it fits more tightly before installing the sensor.

Other types of sensors should also be concealed as much as possible. If the intruder doesn't know a sensor is there then he won't take steps to defeat it. Pressure

mats are easily hidden under carpets or rugs and may never be noticed if there are no tell-tale wires running out.

As far as wiring goes the golden rule is conceal the wires and make them as inaccessible as possible. Ideally wires should be run into the sensor via the wall cavities. If this is not possible then concealment under skirting boards and architraves will do. All wiring, as far as possible, should be done with good quality, heavy duty stranded wire to minimize voltage drops and rf pickup.

If it is necessary to run wires in the open (in the roof or under the floor) then the wires should be run in well secured metal conduit to prevent access. All joins in the wires should be securely soldered and insulated and connections should be as secure as possible to prevent them working loose and causing a false alarm. The load resistors needed on the inputs can be put anywhere in the circuit path but if possible they should also be conealed to prevent someone bypassing the sensors.

The alarm siren or bell is something that you should also pay attention to. There are various noise makers on the market and any security company should be able to show you a few. A siren generator is built into the module so a simple horn speaker can be used.

Whatever you use you should mount on the outside of the building in an out of the way and inaccessible place. It should be mounted securely and if possible with a steel cover to prevent tampering. Any wiring to the siren should be made inaccessible either by running it in conduit or taking it straight through the wall. The alarm will be useless if the intruder can simply disconnect the siren. It is wise to use two separate sirens and mount them in different parts of the building.

Once you have installed your alarm give the whole system an extensive check. This is in both your own interests and your neighbours'. If your alarm system constantly puts out false alarms then the people around you will pretty quickly start ignoring the alarm. They may get upset about the noise so make sure the system is working reliably. If you find you are getting false alarms every time your fridge switches on or every time a taxi uses its radio near your house then you will probably have to add some suppression to the power supply lines and the input lines.

Remember

This article has tried to give a few general guidelines for installing your ETI-1527 module and sensors. If you want some additional information then ring around insurance companies and security agencies. The local police should also be able to put you on to any crime prevention authorities which will be able to advise you on any problems you may have.

It is important to understand that an alarm system is only one part of creating secure premises. You should inform your neighbours to the fact that you have installed an alarm system and organize for them to inform the police in the event of an alarm. You should also familiarize yourself and anyone else who will have access to the alarm of its correct usage. If used correctly and in conjunction with a few good door and window locks this alarm system should minimize your chances of being robbed. Beware, though, as some people who have spent a lot of money on extensive security alarms have found out. "The most sophisticated burglar alarm in the world is totally useless if you don't turn it on."

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