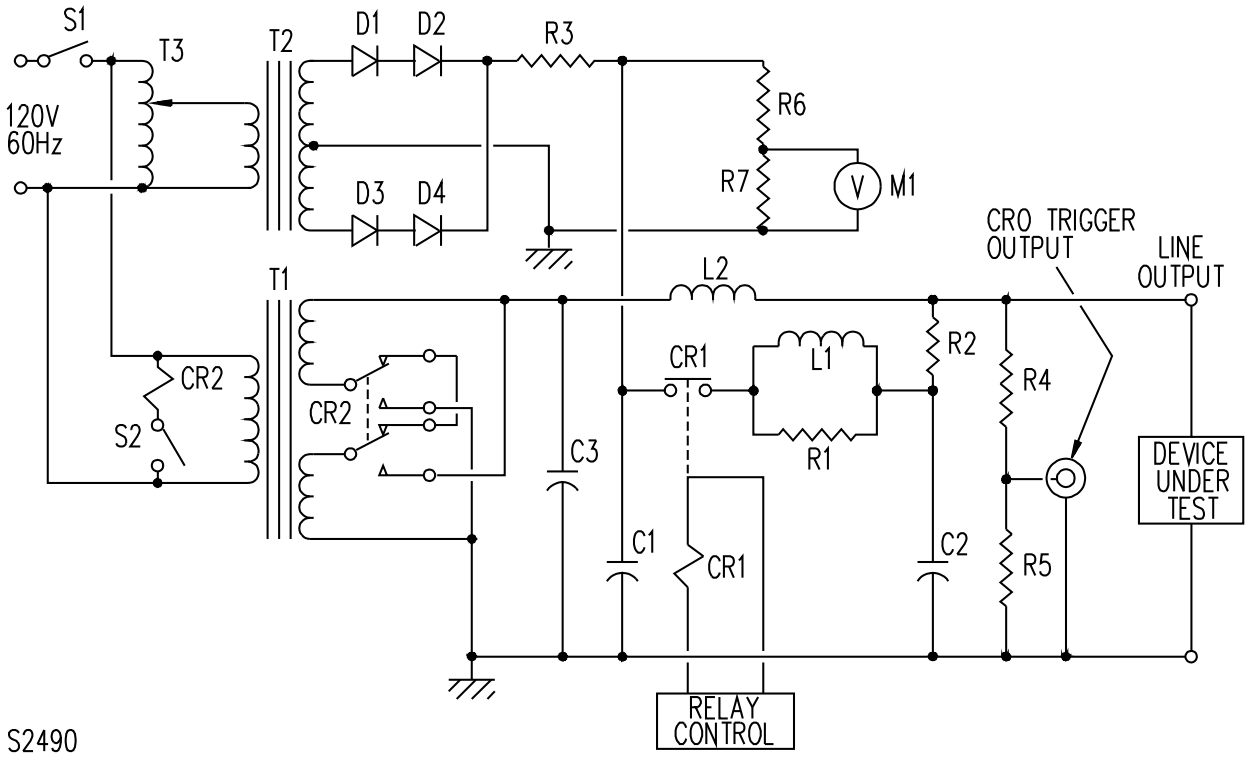
47.2.2 For this test, the unit is to be connected to a transient generator, consisting of a 2 kilovolt-ampere isolating power transformer and control equipment that produces the transients described in 47.2.3. See Figure 47.1. The output impedance of the transient generator is to be 50 ohms.

Figure 47.1
Transient generator circuit



C1	– Capacitor, 0.025 µF, 10 kV	R1	– Resistor, 22 Ohms, 1 W, composition
C2	– Capacitor, 0.006 µF, 10 kV	R2	– Resistor, 12 Ohms, 1 W, composition
C3	– Capacitor, 10 µF, 400 V	R3	– Resistor, 1.3 Megohms (12 in series, 110K Ohms each, 1/2 W)
CR1	– Relay, coil 24V, DC. Contacts, 3-pole, single throw, each contact rated 25 A, 600 V, AC maximum: All three poles wired in series	R4	– Resistor, 47 K Ohms (10 in series, 4.7 K Ohms each, 1/2 W)
		R5	– Resistor, 470 Ohms, 1/2 W
CR2	– Relay, coil 120 V, AC. Contacts DPDT. Provides either 120 V or 240 V test circuit.	R6	– Resistor, 200 Megohms, 2 W, 10 kV
		R7	– Resistor, 0.2 Megohms (2 in series, 100 K Ohms each, 2 W, carbon)
D1 – D4	– Diodes, 25 kV PIV each	S1	– Switch, SPST
L1	– Inductor 15 µH [33 turns, 22 AWG wire, wound on 0.835 inch (21.2 mm) diameter PVC tubing]	S2	– Switch, SPST, key-operated, 120 V, AC, 1 A
		T1	– Transformer, 2 kVA, 120 V primary, 1:1 (120 V or 240 V output)
L2	– Inductor, 70 µH [45 turns, 14 AWG wire, wound on 2.375 inch (60.33 mm) diameter PVC tubing]	T2	– Transformer, 90 VA, 120/15,000 V
M1	– Meter, 0 – 20 V, DC	T3	– Meter, 0 – 20 V, DC

47.2.3 The transients produced are to be oscillatory and are to have an initial peak voltage of 6000 volts. The rise time is to be less than 1/2 microsecond. Successive peaks of the transient are to decay to a value of not more than 60 percent of the value of the preceding peak.

47.2.4 The unit is to be subjected to 500 oscillatory transient pulses induced at a rate of 6 transients per minute. Each transient pulse is to be induced 90 degrees into the positive half of the 60 hertz cycle. A total of 250 pulses are to be applied so that the polarity of the transients is positive with reference to earth ground, and the remaining 250 pulses are to be negative with respect to earth ground.

47.3 Internally induced transients

47.3.1 The product is to be energized in the standby condition while connected to a source of supply in accordance with 29.3.1. The supply source is to be interrupted a total of 500 times. Each interruption is to be for approximately 1 second at a rate of not more than 6 interruptions per minute. At the conclusion of the test, the product shall operate for its intended signaling performance. Standby power shall be connected during this test.

47.4 Input/output circuit transients

47.4.1 The unit is to be energized in the normal standby condition while connected to a source of supply in accordance with 29.3.1. All input/output circuits are to be tested as specified in 47.4.2.

Exception: A circuit or cable that interconnects equipment located within the same room need not be subjected to this test.

47.4.2 Input/output circuits are to be tested as specified in 47.4.3 – 47.4.5. The signaling equipment connected to these circuits shall:

a) Not false alarm,

b) Operate as intended, and

c) As appropriate, retain required stored memory (such as date, type, and location of a signal transmission) within the unit

when subjected to transient voltage pulses as described in 47.4.3. Supplemental information stored within the unit need not be retained.

Exception: Transients applied to the modem or interface module of packet switched data network systems shall not affect the operation of the system except for the modem or interface module circuit. Failure of the packet switched data network signaling circuit is acceptable if the loss of communication is annunciated at the receiving station.

47.4.3 For this test, each input/output circuit is to be subjected to five different transient waveforms having peak voltage levels in the range of 100 to 2400 volts, as delivered into a 200 ohm load. A transient waveform at 2400 volts shall have a pulse rise time of 100 volts per microsecond, a pulse duration of approximately 80 microseconds, and an energy level of approximately 1.2 joules. Other applied transients shall have peak voltages representative of the entire range of 100 to 2400 volts, with pulse durations from 80 to 110 microseconds, and energy levels not less than 0.3 joule or greater than 1.2 joules. The transient pulses are to be coupled directly onto the input/output circuit conductors of the equipment under test.

47.4.4 The equipment is to be subjected to 60 transient pulses induced at a maximum rate of six pulses per minute as follows:

a) Twenty pulses (two at each transient voltage level specified in 47.4.3) between each input/output circuit lead or terminal and earth ground, consisting of ten pulses of one polarity, and ten of the opposite polarity (total of 40 pulses), and

b) Twenty pulses (two at each transient voltage level specified in 47.4.3) between any two input/output circuit leads or terminals consisting of ten pulses of one polarity and ten pulses of the opposite polarity.

47.4.5 At the conclusion of the test, the equipment shall comply with the requirements of the Normal Operation Test, Section 30.

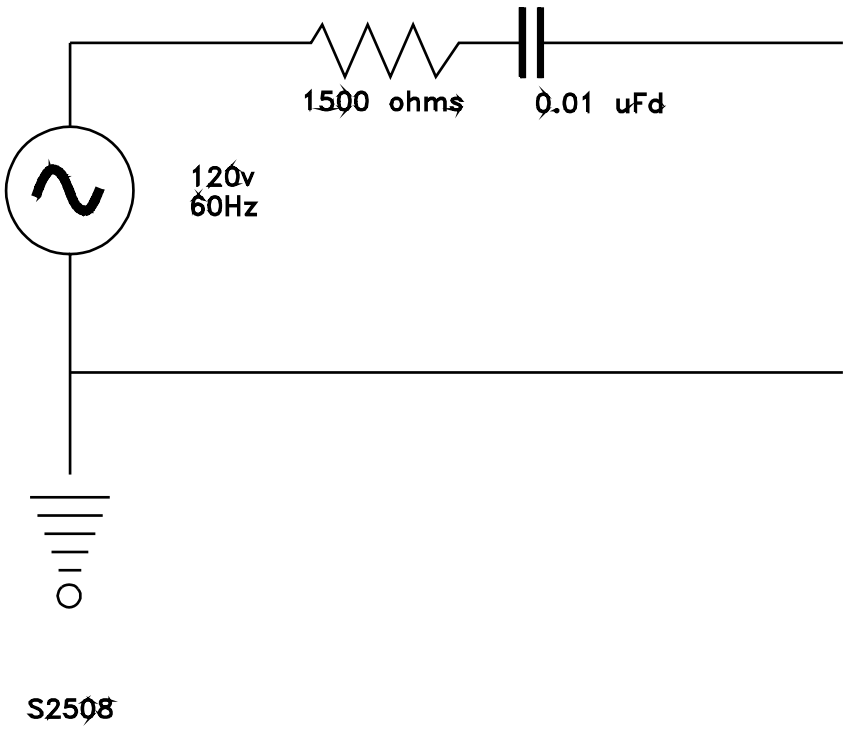
48 AC Induction Test

48.1 Police station connected burglar alarm units shall not false alarm and shall operate as intended when subjected to an alternating current induced in any signal leads, initiating device leads, loops, DC power leads, or in any other leads which extend throughout the premises wiring.

Exception: AC power leads and any leads consisting of conductors insulated from and surrounded by a shielding conductive surface grounded at one or more ends are exempted from this test.

48.2 To determine compliance with the requirements in 48.1, the product is to be energized from a source of rated voltage and frequency in accordance with 29.3.1, and an AC (60 hertz) current is to be injected into each circuit extending from the product. The AC signal current shall be induced as illustrated in Figure 48.1 to simulate induction from AC power sources.

Figure 48.1
AC induction test circuit



49 Polymeric Materials Test

49.1 Polymeric materials used as an enclosure or for the support of current-carrying parts shall comply with the applicable portion of the Standard for Polymeric Materials – Use in Electrical Equipment Evaluations, UL 746C.

50 Battery Replacement Test

50.1 The battery connections of a police station connected burglar alarm unit shall withstand removal and replacement from the battery terminals without any reduction in contact integrity. Batteries used for principal power shall be subjected to 50 cycles and standby batteries to 10 cycles of removal and replacement.

50.2 For this test, a product is to be installed as intended in service and the battery connections removed and replaced as recommended by the manufacturer. The product then shall comply with the requirements of the Normal Operation Test, Section 30.

51 Drop Test

51.1 As a result of being dropped onto a hardwood floor, as described in 51.2, the electrical spacings within a portable cord-connected high-voltage product shall not have been reduced below the limits specified in Spacings, General, Section 27, and Components, Section 28. No high-voltage live parts shall be exposed. See 9.2.4 and 9.2.5.

51.2 A sample of a portable cord-connected high-voltage product is to be dropped four times from a height of 3 feet (0.9 m) onto a hardwood floor. If it has corners, it is to be dropped on a different corner each time, selecting the corners that appear to be most susceptible to damage. If the product has no corners, it is to be dropped on the four portions that appear to be most susceptible to damage. If the product is intended to use internally mounted batteries, the batteries shall be in place for this test.

51.3 Following the test described in 51.2, the product then is to be wrapped in bleached cheesecloth having an area 14 – 15 square yards to the pound (26 – 28 m^2/kg) and having a count of 32 by 28, and energized 3 hours at rated voltage in accordance with 29.3.1. There shall not be molten metal or flame emitted from the unit, as evidenced by ignition or charring of the cheesecloth. The product shall also comply with the requirements of the Dielectric Voltage-Withstand Test, Section 44.

52 Strain Relief Test

52.1 Supply cord

52.1.1 When tested as described in 52.1.2, the strain relief means provided on the flexible cord shall withstand for 1 minute without displacement, a pull of 35 pounds-force (156 N) applied to the cord. During this test the connections within the product are to be disconnected.

52.1.2 A 35 pound (15.8 kg) weight is to be secured to the cord and supported by the product so that the strain relief means will be stressed from any angle that the construction of the product permits. There shall not be movement of the cord sufficient to indicate that stress would have been transmitted to the internal connections.

52.2 Field-wiring leads

52.2.1 Each lead employed for field connections shall withstand a pull of 10 pounds-force (44.5 N) for 1 minute without evidence of damage or of transmittal of stress to the internal connections.

53 Ignition Through Bottom-Panel Openings Test

53.1 General

53.1.1 Both of the bottom-panel constructions described in 11.1.4 are acceptable without test. Other constructions are acceptable if they comply with the requirements specified in 53.2.1 – 53.3.3.

53.1.2 These tests do not apply to low-voltage power limited products or to products in which an internal fault does not produce flame, molten metal, flaming or glowing particles, or flaming drops. See the Abnormal Operation Test, Section 46.

53.2 Hot, flaming oil

53.2.1 Openings in a bottom panel shall be so arranged and sufficiently small in size and few in number that hot, flaming No. 2 furnace oil poured three times onto the openings from a position above the panel is extinguished as it passes through the openings.

53.2.2 A sample of the complete, finished bottom panel is to be securely supported in a horizontal position several inches above a horizontal surface under a hood or other area that is well ventilated but free from drafts. One layer of bleached cheesecloth having an area of 14 – 15 square yards to the pound (26 – 28 m^2/kg) and a count of 32 by 28 is to be draped over a shallow, flat-bottomed pan that is of sufficient size and shape to completely cover the pattern of openings in the panel but is not to be large enough to catch any of the oil that runs over the edge of the panel or otherwise does not pass through the openings. The pan is to be centered under the pattern of openings in the panel. The center of the cheesecloth is to be 2 inches (50.8 mm) below the openings. Use of a metal screen or wired-glass enclosure surrounding the test area is recommended to reduce the risk of injury to persons and damage due to splattering of the oil.

53.2.3 A small metal ladle [preferably not more than 2-1/2 inches (63.5 mm) in diameter] with a pouring lip and a long handle whose longitudinal axis is to remain horizontal during pouring is to be partially filled with 10 milliliters of No. 2 furnace oil, which is a medium-volatile distillate having an API gravity of 32 – 36 degrees, a flash point of 110 – 190°F (43 – 88°C), and an average calorific value of 136,900 Btu per gallon (39.7 MJ/L) (see Specification for Fuel Oil, ASTM D396-92). The ladle containing the oil is to be heated and the oil ignited. After burning for 1 minute, all of the hot, flaming oil is to be poured from a position 4 inches (102 mm) above the openings and at a rate of approximately, but not less than, 1 milliliter per second in a steady stream onto the center of the pattern of openings.

53.2.4 Five minutes after completion of the pouring of the oil, the cheesecloth is to be replaced with a clean piece and a second 10 milliliters of hot, flaming oil is to be poured from the ladle onto the openings. Five minutes later, the cheesecloth is to be replaced again and a third identical pouring is to be made. The openings are not acceptable if the cheesecloth is ignited as a result of any of the three pourings.

53.3 Molten PVC and copper

53.3.1 Openings in a bottom panel shall be arranged and sufficiently small in size and few in number so that molten polyvinyl chloride and copper dripping onto the openings from above the panel do not pass through the openings in sufficient quantity to ignite cheesecloth below the openings.

53.3.2 A sample of the complete, finished bottom panel is to be securely supported in a horizontal position 2-1/2 inches (63.5 mm) above a horizontal firebrick or other nonflammable surface located under a hood or in a well ventilated area. Two layers of bleached cheesecloth having an area of 14 – 15 square yards to the pound (26 – 28 m^2/kg) and having a count of 32 by 28 is to be placed on the nonflammable surface. The cheesecloth is to cover somewhat more area than that immediately under the pattern of openings in the panel. Use of a metal screen or wired glass enclosure surrounding the test area is recommended to reduce the risk of injury to persons and other damage due to splattering of the molten materials.

53.3.3 A bare 12 inch (305 mm) length of 12 AWG (3.3 mm^2) solid copper wire and a 12 inch length of 12 AWG stranded copper wire insulated with 1/32 inch (0.8 mm) of PVC are to be melted simultaneously at an even rate by means of an oxy-acetylene torch and allowed to drop from a point 6 inches (152 mm) above the pattern of openings in the panel. The panel openings are not acceptable if the cheesecloth is ignited.

54 Mechanical Strength Tests for Enclosures

54.1 The external enclosure of a product containing high-voltage circuits or other than power limited circuits shall withstand a force of 25 pounds (111 N) for 1 minute without permanent distortion to the extent that spacings are reduced below the values specified in 27.2 – 27.5, without transient distortion that results in the enclosure contacting live parts, and without causing openings that expose uninsulated high- or low-voltage live parts. The force is to be applied by the curved side of a 1/2 inch (12.7 mm) diameter steel hemisphere. Any openings that occur during application of the force are to be evaluated according to the requirements specified in 9.2.4 and 9.2.5.

54.2 The external enclosure of a product containing only low-voltage power-limited circuits shall be subjected to the test of 58.1, except that the applied force shall be 10 pounds (44 N).

54.3 The external enclosure of a product containing high-voltage circuits or other than power-limited circuits shall withstand an impact of 5 foot-pounds (6.78 J) without permanent distortion to the extent that spacings are reduced below the values specified in 27.2 – 27.5, without transient distortion that results in the enclosure contacting live parts, and without causing openings that expose uninsulated high- or low-voltage live parts. The impact is to be applied by means of a solid, smooth, steel sphere 2 inches (50.8 mm) in diameter and weighing approximately 1.18 pounds (0.54 kg) falling freely from rest through a vertical distance of 51 inches (1.31 m). Any openings resulting from the impact are to be evaluated according to the requirements specified in 9.2.4 and 9.2.5.

54.4 The external enclosure of a product containing only low-voltage power-limited circuits is to be subjected to the test described in 54.3, except that the impact is to be 2 foot-pounds (2.7 J), and the sphere is to fall freely from rest through a vertical distance of 20-13/32 inches (0.52 m).

55 Special Terminal Assemblies Tests

55.1 General

55.1.1 To determine compliance with the requirements in 16.2.3.1 and 16.2.3.2, representative samples of the terminal assembly shall comply with the requirements in 55.2.1 – 55.5.2.

Exception: Terminals complying with the requirements in any of the standards specified in 16.2.1.2 are not required to be subjected to these tests.

55.2 Disconnection and reconnection

55.2.1 If a wire is to be disconnected for testing or routine servicing and then reconnected, each terminal to be subjected to 20 alternate disconnections and reconnections prior to the tests described in 55.2.2 – 55.5.2.

55.2.2 A terminal connection shall withstand, without separating from the wire, the application of a straight pull of 5 pounds-force (22.2 N), applied for 1 minute to the wire in the direction that would most likely result in pullout.

55.2.3 Six terminal assemblies using the maximum wire size and six using the minimum wire size are to be subjected to this test. If a special tool is required to assemble the connection it is to be used, in accordance with the manufacturer's instructions. Each sample is to be subjected to a gradually increasing pull on the wire until the test pull of 5 pounds-force (22.2 N) is attained.

55.3 Flexing test

55.3.1 The wire attached to a terminal shall withstand five right angle bends without breaking.

55.3.2 Six terminal assemblies employing the maximum wire size and six with the minimum wire size are to be subjected to this test. The terminal is to be rigidly secured to prevent any movement. With each wire in 3 pounds-force (13.3 N) tension and held at a point 3 inches (76.2 mm) from the terminal-to-wire junction, each wire is to be bent at a right angle from its nominal position. The wires are to be assembled to the terminals using any special tool required, according to the manufacturer's instructions.

55.4 Millivolt drop test

55.4.1 The millivolt drop across a terminal connection using the maximum and minimum wire sizes intended to be employed, and with the terminals connected in series, shall not be greater than 300 millivolts with the maximum current specified by the manufacturer flowing through the terminal connections and the circuit connected to rated voltage.

55.4.2 Six terminal assemblies employing the maximum wire sizes and six assemblies employing the minimum sizes are to be subjected to this test. The wires are to be assembled to the terminals, using any special tool, if required, according to the manufacturer's instructions. The millivolt drop then is to be measured by using a high impedance millivoltmeter.

55.5 Temperature test

55.5.1 The maximum temperature rise on a terminal junction using the maximum and minimum wire sizes with which the terminal is intended to be employed shall not be greater than 30°C (54°F) based on an ambient temperature of 25°C (77°F).

55.5.2 Six terminal assemblies employing the maximum wire size and six employing the minimum size are to be subjected to this test. The wire is to be assembled to the terminals using any special tools, if required, according to the manufacturer's instructions. The maximum current to which the wire will be subjected in service is then to be passed through the series connection of the terminals. The maximum temperature rise then is to be measured by the thermocouple method after temperatures have stabilized.

POLICE STATION RECEIVING AND TRANSMITTING UNITS

56 General

56.1 The requirements in Sections 57 – 61 cover police station alarm receiving and transmitting units for the connection of an alarm system to a police department:

a) Directly;

b) Through a central station complying with the Standard for Central-Station Burglar-Alarm Systems, UL 611, or the Standard for Central-Station Alarm Services, UL 827; or

c) Through a residential monitoring station complying with UL 611, UL 827, or both.

56.2 Police station alarm receiving and transmitting units shall comply with the construction and performance requirements specified in Sections 7 – 55 and 57 – 61.

57 Common Requirements

57.1 The connection between the protected premises and the police station is usually predicated on the use of transmission wires or cables leased from the local telephone or telegraph company.

57.2 The receiving equipment and the subscriber's equipment shall include operating instructions in a form that will be convenient for reference. See Marking, General, Section 109.

57.3 The protected premises alarm controls shall be such that the act of opening and closing the protected premises in the prescribed manner does not transmit an alarm.

57.4 Signals shall be indicated both audibly and visually at the receiving equipment.

57.5 To permit normal opening and closing, the transmitted signal may be delayed up to 45 seconds after the alarm has been initiated.

58 Direct-Connected Units

58.1 The requirements in 58.2 – 58.4 apply if each alarm system is connected directly to an individual receiving unit in the police station or central station.

58.2 The alarm transmission circuit lines outside the protected premises shall be arranged to actuate an alarm or trouble signal at the police station or central station to which they are connected if these lines are opened or shorted.

58.3 Switches shall be provided for silencing the audible alarm, but the visual signal shall be retained until the circuit is restored. Restoration of the alarm circuit to normal operation shall be clearly indicated. The silencing of the audible signal for a single protected premises on the system shall not disable the audible signal for an alarm from any other protected premises on the same system.

58.4 The audible signal at the police station or central station may be common to as many as 100 separate protected premises, but the visual signal shall be individual to each premises and shall be clearly marked.

59 Transmitter-Connected Units

59.1 If alarm systems are connected by coded transmitters on a common alarm transmission circuit to a recording unit in the police station or central station, the requirements in 59.2 – 59.13 shall apply.

59.2 Each subscriber's premises shall have at least one code transmitter. Not more than 25 code transmitters may be connected in any one station circuit, and each transmitter shall give an individual distinct signal readily distinguishable as coming from that circuit rather than from any other such circuit in the police station or central station.

59.3 The transmitting mechanism shall be enclosed in a protected cabinet and shall have sufficient mechanical strength to prevent the defeat of the mechanism, using ordinary tools, before three rounds have been transmitted. See the Mercantile Premises Alarm Systems, Attack Tests, Section 69, and 71.1.