39.3.4 Where a transformer does not limit the current of I_{max}, and when the maximum current through the load resistor cannot be maintained for 5 seconds due to current-limiting devices (opening of thermal link power supply foldback, PTC varistor effect, and similar devices) the current load resistor shall be adjusted to a value which will produce a current just above the I_{max} value indicated in Table 39.1 or Table 39.2. The results are in compliance when the I_{max} value stated in Table 39.1 or Table 39.2 cannot be maintained for more than 5 seconds.

39.4 VA_{max} (not inherently limited circuits only)

39.4.1 In order to determine VA_{max}, the product is to be energized from a rated source of supply and the circuit under test open-circuited. A variable load resistor, initially set to draw rated circuit current, is then to be connected across the circuit, the circuit voltage and current recorded, and the load removed. The resistance of the load is then to be incrementally decreased, momentarily reconnected across the circuit while recording the voltage and current, and then removed. This procedure is to be repeated until the load resistance has been reduced to a short circuit. Using the recorded voltage and current, the volt-ampere output under each load condition is to be calculated. The load resistor is then to be adjusted to that value which produced the maximum volt-ampere calculated and then connected to the circuit. After 1 minute, the voltage and current are again to be measured. The results of this test are acceptable if the calculated volt-ampere output of the circuit after 1 minute does not exceed the value specified in Table 39.1 or Table 39.2, as appropriate.

40 Electrical Supervision Test

40.1 General

40.1.1 Open circuit, short circuit, ground fault, and/or wire pair reversal conditions applied to wires connected to any components of an access control system installed outside its controlled/protected/restricted area, or accessible from outside its controlled/protected/restricted area, shall not result in the operation of the access point actuator device allowing access to the secured area.

Exception: This requirement can be waived if the product is provided with enclosure cover and rear tamper supervision as described in 40.1.2.

40.1.2 Any cover, door, panel, or mounting means shall be electrically supervised if it gives access to any relays, terminals, controls, or related components that might be subject to tampering outside of a secured area. When a cover, door, panel, or mounting means is opened or removed, either an alarm signal shall activate, or the access function shall not operate.

Exception: Tamper protection need not be provided for a request-to-exit device intended to render free exit from inside the secured area if tampering with the device cannot cause the device's field of view to extend beyond the secured area.

40.1.3 A malfunction or loss of primary power shall be shown by de-energization of an ″AC power on″ indicator, visible from the exterior of the product. The location and function of the indicator must be described in the product installation instructions and the component shall be marked in accordance with 71.1(k).

40.2 Power interruption

40.2.1 The interruption and restoration of the electrical supply shall not result in false operation of the product.

41 Standby Power

41.1 Products that provide a secondary power source shall be able to operate without primary power based on the level tests in 41.3 – 41.6.

41.2 All products will be tested to the minimum performance level parameters of Table 8.1. Products that perform beyond the minimum back up requirements are tested to confirm the manufacturers performance claims.

41.3 Level I – No Secondary Power Source.

41.4 Level II Test – Shall continue to operate as intended at full load for a minimum of 30 minutes while the product operates a minimum of one cycle of its intended function every minute.

41.5 Level III Test – Shall continue to operate as intended at full load for a minimum of 2 hours while the product operates a minimum of one cycle of its intended function every minute.

41.6 Level IV Test – Shall continue to operate as intended at full load for a minimum of 4 hours while the product operates a minimum of one cycle of its intended function every minute.

41.7 Instructions for the replacement of batteries shall be on the product, and the polarity shall be indicated.

42 Undervoltage Operation Test

42.1 An access control product shall operate as intended while energized at 85 percent of its rated voltage.

42.2 A product which uses rechargeable (secondary) batteries for standby power shall be tested for operation at 85% of nominal battery voltage while operating from standby power.

43 Overvoltage Operation Test

43.1 An access control product shall withstand 110 percent of its rated supply voltage continuously without damage during the standby condition and shall operate as intended at the increased voltage.

44 Variable Ambient Test

44.1 With the unit energized from rated voltage and connected to maximum rated load, an access control product intended for indoor use shall function as intended at the test voltage with its related equipment at ambient temperatures of 0° and 49°C (32° and 120°F).

44.2 The exposure to each of the above temperatures shall be 4 hours or more.

45 Humidity Test

45.1 With the unit energized from rated voltage and connected to maximum rated load, an access control product shall function as intended during and after an exposure of 24 hours to air having a relative humidity of 85 ±5 percent and a temperature of 30 ±2°C (86 ±3°F).

45.2 Cord-connected products powered from a high-voltage source shall comply with the requirements in the Leakage Current Tests for Cord-Connected Products, Section 46, following exposure to high humidity.

46 Leakage Current Test for Cord-Connected Products

46.1 Where a cord-connected product is powered by a source greater than 42.4 V peak, the leakage current at any exposed surface, or between any accessible part and earth ground, or any other accessible part with an open potential of greater than 42.4 V peak shall not be more than the values shown in Table 46.1 when tested in accordance with 46.2 – 46.8, immediately after exposure to the Humidity Test, Section 45.

Table 46.1
Maximum leakage current

Type of product[a]	Maximum leakage current[b], (mA)
Two-wire cord-connected portable or stationary product	0.50
Three-wire (including grounding conductor) cord-connected, portable product	0.50
Three-wire (including grounding conductor) cord-connected, stationary or fixed product	0.75

[a] Products which incorporate a loss-of-ground detector which dependably opens the live conductors are exempted from the requirements of this table.

[b] If an electromagnetic radiation suppression filter is necessary for the equipment to function as intended, the leakage current shall not be more than 2.5 mA if the equipment complies with the following conditions:

1) The equipment is provided with grounding means in accordance with the applicable requirements for cord-connected equipment in Section 17.

2) With the filter removed from the equipment, the leakage current does not exceed the limits specified in this table, as applicable.

3) The equipment is marked in accordance with 71.12.

46.2 With regard to the requirements in 46.1, leakage current refers to all currents, including capacitively coupled currents that are capable of being conveyed between exposed conductive surfaces of the equipment and ground, or between exposed conductive surfaces of the equipment.

46.3 Leakage currents from all exposed surfaces are to be measured to the grounded supply conductor individually as well as collectively where exposed surfaces are simultaneously accessible, and from one exposed surface to another where the exposed surfaces are simultaneously accessible. A part is considered to be an exposed surface unless it is guarded by an enclosure determined to protect against the risk of electric shock. Surfaces that can be readily contacted by one or both hands of a person at the same time are determined to be simultaneously accessible. For the purpose of these requirements, one hand is determined to be able to contact parts simultaneously when the parts are within a 4 by 8 inches (102 by 203 mm) rectangle, and two hands of a person are determined to be able to contact parts simultaneously when the parts are no more than 6 feet (1.8 m) apart.

46.4 Where a conductive surface other than metal is used for the enclosure or part of the enclosure, the leakage current is to be measured using a metal foil having dimensions of 3.94 by 7.88 inches (10 by 20 cm) in contact with the surface. Where the surface is less than 3.94 by 7.88 inches (10 by 20 cm), the metal foil is to be the same size as the surface. The metal foil is not to remain in place long enough to affect the temperature of the product.

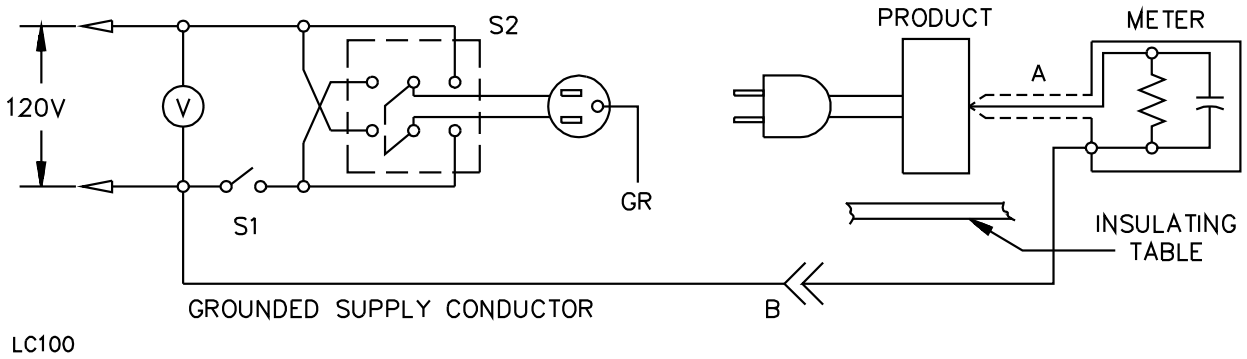
46.5 The measurement circuit for the leakage current test is to be as illustrated in Figure 46.1. The measurement instrument is defined in (a) – (c). The meter used for a measurement need only indicate the same numerical value for the particular measurement as would the defined instrument. The meter is not required to have all of the attributes of the defined instrument.

a) The meter is to have an input impedance of 1500 W resistive shunted by a capacitance of 0.15 µF;

b) The meter is to indicate 1.11 times the average of the full-wave rectified composite waveform of voltage across the resistor or current through the resistor;

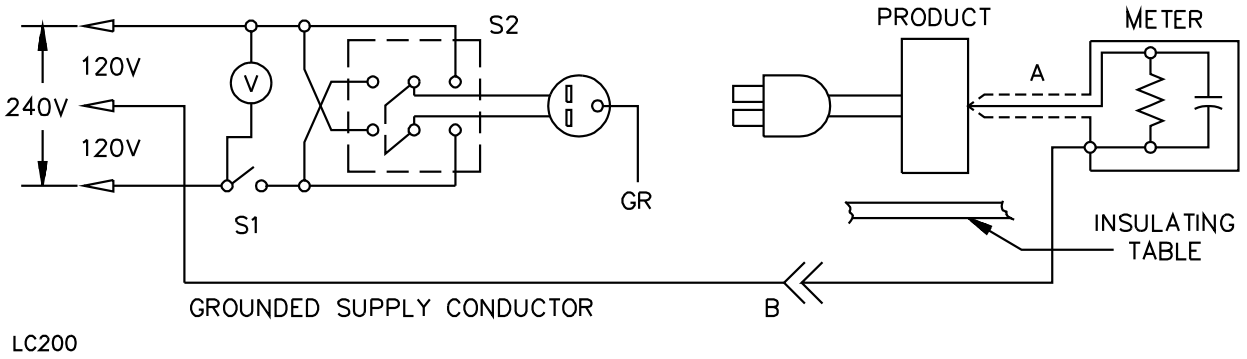
c) Over a frequency range of 0 – 100 kHz, the measurement circuitry is to have a frequency response (ratio of indicated to actual value of current) that is equal to the ratio of the impedance of a 1500-W resistor shunted by a 0.15 µF capacitor to 1500 W. At an indication of 0.5 or 0.75 mA, the measurement is to have an error of not more than 5% at 60 Hz.

Figure 46.1
Leakage current measurement circuits



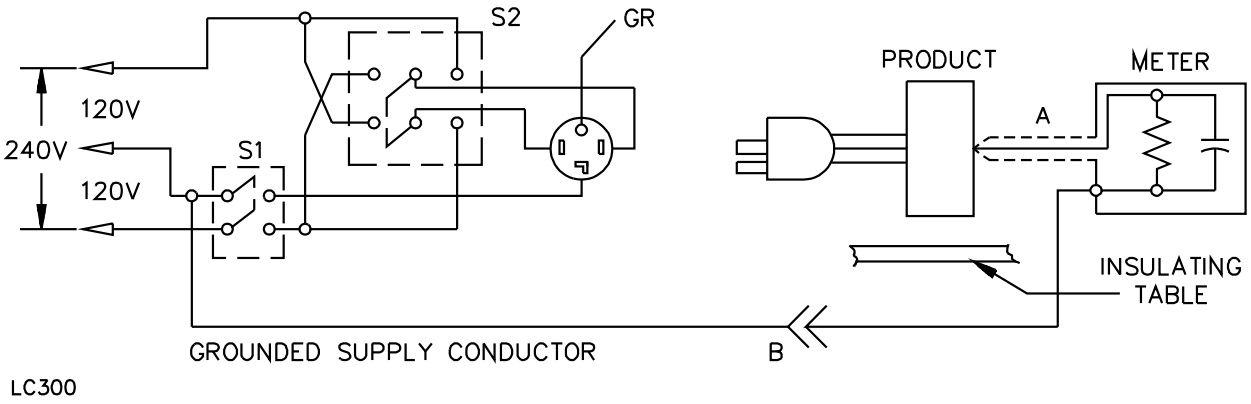
LC100

Circuit A: Product intended for connection to a 120- or 208-volt power supply.



LC200

Circuit B: 240- or 208-volt product intended for connection to a 3-wire, grounded neutral power supply.



Circuit C: 240- or 208-volt product intended for connection to a 3-wire, grounded neutral power supply.

A – Probe with shielded lead. Under some circumstances where higher frequency components are present, shielding of measuring instrument and its leads may be necessary.

B – Separated and used as clip when measuring currents from one part of a product to another.

46.6 Unless the meter is being used to measure the leakage current from one part of a product to another, the meter is to be connected between the accessible parts and the grounded supply conductor.

46.7 Systems of interconnected equipment with individual connections to primary power shall have each piece of equipment tested separately. Systems of interconnected equipment with one common connection to primary power shall be treated as a single piece of equipment. Equipment designed for multiple (redundant) supplies shall be tested with only one supply connected.

46.8 A sample of the product is to be tested in the as-received condition initially with all switches indicated below closed, but with its grounding conductor, when provided, open at the attachment plug. A product that has not been energized for a minimum of 48 hr prior to the test, and that is at room temperature, is determined to be in the as-received condition. The supply voltage is to be the maximum voltage marked on the product, in accordance with 34.5.1, but not less than 120 or 240 V. The test sequence (with regard to Figure 46.1) is to be as follows:

a) With switch S1 open, the product is to be connected to the measuring circuit. Leakage current is to be measured using both positions of switch S2, and with the product switching devices in all of their normal operating positions;

b) Switch S1 is then to be closed, energizing the product, and within 5 s the leakage current is to be measured using both positions of switch S2 and with the product switching devices in all their normal operating positions;

c) Leakage current is to be monitored until thermal stabilization occurs. Both positions of switch S2 are to be used in determining this measurement. Thermal stabilization is to be obtained by operation of the product as in the Temperature Test, Section 52.

47 Electric Shock Current Test

47.1 If the open circuit potential between any part that is exposed only during operator servicing and either earth ground or any other exposed accessible part exceeds 42.4 volts peak, the part shall comply with the requirements of 47.2, 47.3, and 47.4, as applicable.

47.2 The continuous current flow through a 500-ohm resistor shall not exceed the values specified in Table 47.1 when the resistor is connected between any part that is exposed only during operator servicing and either earth ground or any other exposed accessible part.

Table 47.1
Maximum current during operator servicing

Frequency, hertz[a]	Maximum current through a 500-ohm resistor, milliamperes peak
0 – 100	7.1
500	9.4
1000	11.0
2000	14.1
3000	17.3
4000	19.6
5000	22.0
6000	25.1
7000 or more	27.5

[a] Linear interpolation between adjacent values may be used to determine the maximum current corresponding to frequencies not shown. The table applies to repetitive nonsinusoidal waveforms.

47.3 The duration of a transient current flowing through a 500-ohm resistor connected as described in 47.2 shall not exceed:

a) The value determined by the following equation:

$$T \leq \left(\frac{20\sqrt{2}}{I}\right)^{1.43}$$

in which:

T is the interval, in seconds, between the time that the instantaneous value of the current first exceeds 7.1 milliamperes and the time that the current falls below 7.1 milliamperes for the last time; and

I is the peak current in milliamperes; and

b) 809 milliamperes, regardless of duration.

The interval between occurrences shall be equal to or greater than 60 seconds if the current is repetitive. Typical calculated values of maximum transient current duration are shown in Table 47.2.

Table 47.2
Maximum transient current duration

Maximum peak current (I) through 500-ohm resistor, milliamperes	Maximum duration (T) of waveform containing excursions greater than 7.1 milliamperes peak
7.1	7.26 seconds
8.5	5.58
10.0	4.42
12.5	3.21
15.0	2.48
17.5	1.99
20.0	1.64
22.5	1.39
25.0	1.19
30.0	919 milliseconds
40.0	609
50.0	443
60.0	341
70.0	274
80.0	226
90.0	191
100.0	164
150.0	92
200.0	61
250.0	44
300.0	34
350.0	27
400.0	23
450.0	19
500.0	16
600.0	12
700.0	10
809.0	8.3

47.4 The maximum capacitance between the terminals of a capacitor that is accessible during operator servicing shall comply with the following equations:

$$C = \frac{88{,}400}{E^{1.43}(\ln E - 1.26)} \quad for \quad 42.4 \leq E \leq 400$$

$$C = 35{,}288E^{-1.5364} \text{ for } 400 \leq E \leq 1000$$

in which:

C is the maximum capacitance of the capacitor in microfarads and

E is the potential in volts across the capacitor prior to discharge.

E is to be measured 5 seconds after the capacitor terminals are made accessible, such as by the removal or opening of an interlocked cover, or the like. Typical calculated values of maximum capacitance are shown in Table 47.3.

Table 47.3
Electric shock – stored energy

Potential in volts, across capacitance prior to discharge	Maximum capacitance in microfarads
1000	0.868
900	1.02
800	1.22
700	1.50
600	1.90
500	2.52
400	3.55
380	3.86
360	4.22
340	4.64
320	5.13
300	5.71
280	6.40
260	7.24
240	8.27
220	9.56
200	11.2
180	13.4
160	16.3
140	20.5
120	26.6
100	36.5
90	43.5
80	53.8
70	68.0
60	89.4
50	124.0
45	150.0

Table 47.3 Continued on Next Page

Table 46.3 Continued

Potential in volts, across capacitance prior to discharge	Maximum capacitance in microfarads
42.4	169.0

47.5 With reference to the requirements in 47.2 and 47.3, the current is to be measured while the resistor is connected between ground and:

a) Each accessible part individually and

b) All accessible parts collectively if the parts are simultaneously accessible.

The current also is to be measured while the resistor is connected between one part or group of parts and another part or group of parts, if the parts are simultaneously accessible.

47.6 With reference to the requirements in 47.5, parts are considered to be simultaneously accessible if they can be contacted by one or both hands of a person at the same time. For the purpose of these requirements, one hand is to be considered to be able to contact parts simultaneously if the parts are within a 4 by 8 inch (102 by 203 mm) rectangle; and two hands of a person are considered to be able to contact parts simultaneously if the parts are not more than 6 feet (1.8 m) apart.

47.7 Electric shock current refers to all currents, including capacitively coupled currents.

47.8 If the product has a direct-current rating, measurements are to be made with the product connected in turn to each side of a 3-wire, direct-current supply circuit.

47.9 Current measurements are to be made:

a) With any operating control, or adjustable control that is subject to user operation, in all operating positions and

b) Either with or without a vacuum tube, separable connector, or similar component in place.

These measurements are to be made with controls placed in the position that causes maximum current flow.

48 Overload Test

48.1 General

48.1.1 An access control product other than that operating from a primary battery shall operate as intended after 50 cycles of intended operation at a rate of not more than 15 cycles per minute while connected to a source of supply adjusted to 115 percent of the rated test voltage. Each cycle shall begin with the product energized in the normal standby condition, followed by intended operation, and then restoration to normal standby.

48.1.2 Rated test loads are to be connected to the output circuits of the product. The test loads are to be remote indicators, relays, electric locking devices, or the equivalent, intended for connection to the product. If an equivalent load is employed for an intended inductive load, a power factor of 60 percent is to be used. The rated loads are to be established with the product connected to a source of supply in accordance with 34.5.1. The voltage then is to be increased to 115 percent of the initial value.

48.1.3 For DC circuits, an equivalent inductive test load is to have:

a) The required DC resistance for the test current and

b) The inductance (calibrated) necessary to obtain a power factor of 60 percent when the test load is connected to a 60-Hz AC voltage equal to the rated DC test voltage.

The resultant AC current shall be equal to 0.6 times the DC current when the load is connected first to an AC voltage and then to a voltage equal to the rms value of the AC source.

48.2 Separately energized circuits

48.2.1 A separately energized circuit, such as a dry contact, that does not receive energy from the product shall operate as intended after 50 cycles of signal operation at a rate of not more than 15 cycles per minute.

48.2.2 The circuit is to be connected to a voltage source in accordance with 34.5.1 and with 150 percent rated current loads at 0.6 power factor applied to the output circuits.