Technology Assessment Program

NIJ Standard for Direct Connect Police Annunciator Panels

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ACKNOWLEDGMENTS

This standard was formulated by the Law Enforcement Standards Laboratory of the National Bureau of Standards under the direction of Lawrence K. Eliason, Chief of LESL and Daniel E. Frank, Manager, Security Systems Program. Suggestions and editorial contributions were made by Jacob J. Diamond, former Chief of LESL. Technical research was performed by Maris Juberts under the supervision of Gerard N. Stenbakken. The preparation of this standard was sponsored by the National Institute of Justice, Lester D. Shubin, Standards Program Manager. The standard has been reviewed and approved by the Technology Assessment Program Advisory Council (TAPAC) and adopted by the International Association of Chiefs of Police (IACP) as an IACP standard.

FOREWORD

This document, NIJ Standard-0320.00, Direct Connect Police Annunciator Panels, is an equipment standard developed by the Law Enforcement Standards Laboratory of the National Bureau of Standards. It is produced as part of the Technology Assessment Program of the National Institute of Justice. A brief description of the program appears on the inside front cover.

This standard is a technical document that specifies performance and other requirements equipment should meet to satisfy the needs of criminal justice agencies for high quality service. Purchasers can use the test methods described in this standard themselves to determine whether a particular piece of equipment meets the essential requirements, or they may have the tests conducted on their behalf by a qualified testing laboratory. Procurement officials may also refer to this standard in their purchasing documents and require that equipment offered for purchase meet the requirements. Compliance with the requirements of the standard may be attested to by an independent laboratory or guaranteed by the vendor.

Because this NIJ standard is designed as a procurement aid, it is necessarily highly technical. For those who seek general guidance concerning the selection and application of law enforcement equipment, user guides have also been published. The guides explain in nontechnical language how to select equipment capable of the performance required by an agency.

NIJ standards are subjected to continuing review. Technical comments and recommended revisions are welcome. Please send suggestions to the Program Manager for Standards, National Institute of Justice, U.S. Department of Justice, Washington, DC 20531.

Before citing this or any other NIJ standard in a contract document, users should verify that the most recent edition of the standard is used. Write to: Chief, Law Enforcement Standards Laboratory, National Bureau of Standards, Washington, DC 20234.

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NIJ STANDARD
FOR
DIRECT CONNECT POLICE ANNUNCIATOR PANELS

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NIJ STANDARD FOR DIRECT CONNECT POLICE ANNUNCIATOR PANELS

1. PURPOSE AND SCOPE

This standard establishes performance requirements and test methods for direct connect police annunciator panels intended for use in monitoring the status of intrusion alarm systems located at residential or commercial premises. The alarm signals are transmitted over leased telephone lines to the police department. The panel provides an audible and visible alarm to indicate a change in status of the intrusion alarm system at the premises being protected. The performance characteristics addressed are those that affect the reliability of the device with emphasis on those attributes that affect false alarm susceptibility and tamper resistance.

2. CLASSIFICATION

For the purposes of this standard, direct connect police annunciator panels are classified into two types based upon the method of connecting the incoming subscriber's alarm transmission lines to the system.

2.1 Type I—Discrete Self Contained Panels

Type I annunciator panels incorporate a separate input for each subscriber connection. The telephone transmission lines connect directly to the panel, which also contains a main power supply and a standby supply. The display and control function for subscriber connection may be one of the following: a separate alarm module with a status or indicator display and an acknowledge button; a separate status indicator lamp with a common alarm and acknowledge module for all connections; or a separate lamp-switch (acknowledge) control.

2.2 Type II—Consolidated Panels

Type II annunciator panels provide inputs for each subscriber connection in a remote receiver cabinet (not physically part of the display portion of the panel). These panels use a common alarm and acknowledge control for all subscriber connections and include a power supply and a standby supply. The panel may use a separate wire for each connection from the remote receiver cabinet to the individual status indicator lights, or the transmission of alarm signals from the remote receiver cabinet to the display panel, may be accomplished by means of time division multiplexing with each subscriber connection identified by a numerical electronic readout.

3. DEFINITIONS

3.1 Acknowledge

Action taken to indicate that the operator is aware of a change in status on the alarm panel. Normally this is done by pushing a button that usually silences the audible alarm.

3.2 Alarm Receiver Module

Circuitry usually packaged as an identifiable unit which accepts a subscriber's connection and converts the subscriber's electrical signals into the electrical signals required by the display portion of the annunciator panel. The alarm receiver module may include line supervision functions as well.

3.3 Alarm State

The condition of a sensor of an intrusion alarm system that causes a control unit in the secure state to transmit an alarm signal.

3.4 Annunciator Panel

An alarm system monitoring device that consists of a number of visible signals such as "flags" or lamps indicating the status of an alarm system or systems. Each circuit is usually labeled to identify the location and condition being monitored. In addition to the visible signal, an audible signal is usually associated with the device. When an alarm condition is reported, a signal is indicated visibly, audibly, or both. The visible signal is generally maintained until reset either manually or automatically.

3.5 Direct Connection (Also Police Connection or Circuit)

The direct link by which an alarm system is connected to an annunciator installed in a police station. An example of a direct connection is a leased telephone line.

3.6 Electromagnetic Interference (EMI)

The impairment of the reception of a wanted electromagnetic signal or the creation of a spurious electromagnetic signal by an electromagnetic disturbance. This can be caused by radiative electromagnetic interference sources, such as lightning or radio transmitters, or conducted electromagnetic interference transmitted through power lines from other electrical devices.

3.7 End-of-Line Resistance

A technique of monitoring the transmission line and the status of an alarm system control unit connected to an annunciator panel. The alarm signal transmission line is terminated at the alarm control unit with one resistance to indicate a secure state and a different resistance to indicate an alarm state. Other resistances, including an open or short circuit, indicate line trouble or tampering.

3.8 Interrogation and Reply Transmission System

An alarm transmission system used to achieve inherent line supervision. The transmitter at one end of the signal transmission line sends out a coded interrogation signal to a device or control unit; the device or control unit must reply with a properly coded transmission signal within a specified period of time.

3.9 Line Supervision (Line Security)

Electronic protection of an alarm transmission line accomplished by sending a continuous or coded signal through the circuit. A change in the circuit characteristics, such as a change in impedance due to the circuit's having been tampered with, will be detected by a monitoring circuit. The monitoring circuit initiates an alarm if the change exceeds a predetermined amount.

3.10 Monologue Transmission Systems

A transmission system that transmits a coded transmission signal in one direction only.

3.11 Polarity Reversal Transmission

A commonly used technique of transmitting alarm system control unit status information from a subscriber to the monitoring station using a dc signal over a two-conductor alarm signal transmission line. In the secure state, one line is positive with respect to the other. In the alarm state, the lines change polarity with respect to each other. Line trouble is indicated when line current drops below a certain level.

3.12 Pulse Transmission

A technique for transmitting alarm unit status information over a two-conductor alarm signal transmission line (e.g., leased telephone lines) using low-frequency pulses (1–20 Hz). An alarm signal is indicated by a change in the pulse rate. Line trouble is indicated by the absence of any pulses.

3.13 Remote Receiver Cabinet

A portion of a type II annunciator panel that provides terminals for alarm signal receiving and processing.

3.14 Reset

To restore a device to its original (normal) condition after an alarm or trouble signal.

3.15 Secure State

The condition of an alarm system in which all sensors and control units are ready to respond to an intrusion.

3.16 Subscriber's Equipment

For the purposes of this standard, the subscriber's equipment is that portion of an alarm system usually installed at the protected premises that transmits the alarm signal and interfaces with one or more sensor devices and any transmission line supervision signals.

3.17 Tamper Switch

A switch that initiates an alarm signal if an attempt is made to gain access to the interior of a protected piece of equipment. This switch is usually activated by an attempt to remove the cover of the equipment.

3.18 Time Division Multiplexing

A technique of transmitting several channels of independent information over a single circuit on a time-sharing basis by sampling, at specific intervals, the data being transmitted and received.

4. REQUIREMENTS

4.1 Acceptance Criteria

The direct connect police annunciator panel meets the requirements of this standard if the annunciator panel display portion and all of the alarm receiver modules defined in section 5.1 of this standard pass all of the tests required by this standard.

4.2 User Information

The following information shall be supplied to the user by the manufacturer or distributor:

(a) Nominal operating voltage.
(b) Type of transmission signals the panel will accept.
(c) Classification (sec. 2).
(d) Complete installation, wiring, and adjustment procedures, including any installation restrictions.
(e) Operating instructions.
(f) Standby power requirements, including battery identification, and minimum period of standby operation that is guaranteed using the specified battery.
(g) For rechargeable batteries, the minimum time to fully recharge the batteries if the equipment includes an integral battery charging unit.
(h) The operation of transmission line features including the maximum input current for end-of-line resistance alarm receiver modules and equipment tamper protection features.
(i) Certification of compliance with this standard.

4.3 Material and Configuration

The materials, parts, and components of the direct connect police annunciator panel and any required ancillary equipment shall comply with the requirements of Underwriters' Laboratories, Standard UL 365 "Police Station Connected Burglar Alarm Units and Systems" [1][1], sections 4 through 12.

[1] Numbers in brackets refer to references in appendix A.

The annunciator panel or display panel shall have the capability of being mounted in a 48.26-cm (standard 19 in) rack or cabinet in accordance with EIA Standard RS-310-B "Racks, Panels, and Associated Equipment" [2]. This requirement may be satisfied by providing special adaptors or conversion kits for a unit designed for wall mounting or desk-top use.

4.4 Functional Requirements

All Type I and II annunciator panels shall meet the requirements of sections 4.4.1 through 4.4.4 for each type of transmission signal that is used. Type I and II annunciator panels that incorporate holdup alarm circuits shall meet the requirements of section 4.4.5. In addition to the above requirements Type II annunciator panels shall meet the requirements of sections 4.4.6 and 4.4.7 as appropriate for the item under test.

4.4.1 Alarm/Secure Indication

When tested in accordance with section 5.6.1, the annunciator panel shall indicate an alarm state for the alarm receiver circuit being tested. An audible signal shall be generated in conjunction with the visible indication. Operating the acknowledge switch shall silence the audible signal, but a visible indication of the alarm shall remain until reset after the alarm signal source has been returned to the secure state.

4.4.2 Line Trouble

When tested in accordance with section 5.6.2, the annunciator panel shall indicate line trouble for the alarm receiver circuit being tested with a different visible indication than for an alarm condition. An audible signal shall be generated in conjunction with the visible indication. Operating the acknowledge switch shall silence the audible signal, but the visible indication shall remain until reset after the line trouble has been corrected.

4.4.3 AC and DC Power On Indication

When tested in accordance with section 5.6.4, the annunciator panel or power supply shall give a visible and audible indication that ac power has been lost and that the panel is working on standby batteries. Operating the acknowledge switch shall silence the audible signal only. The panel shall automatically switch back to the ac power supply when power is restored. Restoration of ac power shall be signalled with a visible and an audible indication.

4.4.4 Manual Disable

When the annunciator panel is tested in accordance with section 5.6.6, indications of intermittent line trouble shall be disabled for the alarm connection under test. Note: Only the line trouble indication shall be disabled. The alarm indication shall still operate if a valid alarm signal is received.

4.4.5 Holdup or Other Alarm Conditions

When tested in accordance with section 5.6.3, annunciator panels having a separate transmission signal for holdup shall have a visible holdup alarm indication which is different than for alarm and line trouble. An audible signal shall be generated in conjunction with the visible indication. Operating the acknowledge switch shall silence the audible signal, but a visible indication of the holdup alarm shall remain until reset after the alarm signal source has been returned to the secure state.

4.4.6 Annunciator System Status Alarm for Type II Panels

When tested in accordance with section 5.6.5, the annunciator panel display shall signal a system status alarm warning in response to each of the conditions listed in the test. A visible indication shall be accompanied by an audible warning signal. Operating the acknowledge switch shall silence the audible signal, but the visible indication shall remain until reset after the alarm signal source has been returned to the secure state.

4.4.7 Numerical Display for Type II Panels

When tested in accordance with section 5.6.5, annunciator panels that incorporate numerical displays shall provide the following display functions:

(a) The panel shall be capable of continually displaying for at least 1 s each subscriber number with its status condition sequentially. The data shall be for acknowledged status changes. A change of status condition is either a new alarm, trouble indication, or restoration to a secure state.

(b) The circuit number shall disappear from the continuous display sequence if restoration to a secure state has taken place.

(c) The panel shall be capable of interrupting the display sequence described in (a) above for each subsequent status change until acknowledgment occurs.

(d) The panel shall include a printer that automatically prints, as a minimum, the date, time, circuit or subscriber connection identification number, and status condition code for each change in status.

4.5 Alarm Signal Sensitivity

All direct connect annunciator panels shall accept polarity reversal alarm transmission signals. This requirement may be satisfied for annunciator panels designed specifically for use with other alarm signal transmission techniques by use of a separate alarm receiver module that accepts polarity reversal alarm signals.

All direct connect annunciator panels shall respond properly to alarm signals when operated with a maximum series line resistance of 5 kΩ per circuit. The alarm signal sensitivity requirements for each type of transmission are presented in the sections that follow.

4.5.1 Polarity Reversal Technique

When tested in accordance with section 5.7.1, polarity reversal equipment shall have a threshold current no greater than 5 mA.

4.5.2 End-of-Line Resistance Technique

When tested in accordance with section 5.7.2, end-of-line resistance equipment shall have a threshold current of from 5 to 10 mA inclusive in the normal secure state and a threshold current of from 10 to 20 mA in the alarm state (alarm resistor shorted).

4.5.3 Low-Frequency Pulser Technique

When tested in accordance with section 5.7.3, equipment using low-frequency pulse transmitters shall have a threshold current no greater than 2-mA peak.

4.5.4 Alternating-Current Line-Carrier Technique

When tested in accordance with section 5.7.4, the sensitivity of the receiver shall be such that the annunciator panel responds properly to alarm transmission signals at input signal levels down to one-tenth the amplitude (–20 dB) of the transmitted signal.

4.5.5 Interrogation and Reply Technique

When tested in accordance with section 5.7.5, the transmitter output signal level at the annunciator panel and subscriber's equipment shall be above 200 mV (–10 dBm) into a 600-Ω telephone line. The sensitivity of the receiver in the subscriber's equipment and the annunciator panel shall be such that the system responds properly to transmission signal levels at one-tenth the amplitude (–20 dB) of the transmitted signal level.

4.5.6 Combination of Two or More Transmission Techniques

When tested in accordance with section 5.7.6, each section of the alarm receiver module of annunciator panels that accepts two or more types of transmission signals for increased line security shall function properly and satisfy the requirements of the individual transmission techniques specified in the sections 4.5.1 through 4.5.5.

4.6 Receiver Alarm Time Delay

When tested in accordance with section 5.8, the annunciator panel shall not latch onto an alarm or line trouble indication lasting 1 s or less.

4.7 Stability Requirement

When tested in accordance with sections 5.9.1 through 5.9.7 the annunciator panel shall meet the requirements of sections 4.4.1, 4.4.2 and 4.4.4. There shall be no alarms other than those appropriate for each test.

4.8 Electromagnetic Susceptibility Requirement

When subjected to radiated electromagnetic fields, conducted interference and simulated lightning voltage surges on the transmission lines in accordance with section 5.10, the annunciator panel shall not indicate any alarms.

4.9 Tamper Switch

Each remote receiver cabinet for Type II panels, or any remotely located annunciator panel equipment shall incorporate tamper switch protection. When tested in accordance with section 5.11, the tamper switch shall not cause the system to signal an alarm until the cover or cover screw, whichever actuates the tamper switch, has moved at least 1.5 mm (0.06 in) and shall cause the panel to signal an alarm before the cover has moved a sufficient distance to permit a direct line-of-sight to electrical circuits or adjustment controls.

5. TEST METHODS

5.1 Sampling

Three alarm receiver modules for each type of transmission technique used with the annunciator panel shall be selected at random for testing. Three alarm receiver modules shall be of the polarity reversal type, and three additional modules for each additional transmission technique used. Each annunciator panel shall be complete including the power supply.

5.2 Test Conditions

Unless otherwise specified, all tests shall be performed with the annunciator panel operated at its specified nominal operating voltage and in a typical laboratory ambient environment. In all cases, the annunciator panel shall be allowed to warm up for a minimum of 5 min after being turned on, or as specified by the manufacturer, before any tests are performed.

5.3 Test Equipment

5.3.1 Alarm Signal Source

In the tests that follow, an alarm signal source is required for each type of transmission to be tested. It is necessary to use matching subscriber's equipment or manufacturer supplied test sources for tests of annunciator panels incorporating interrogation reply transmission techniques. For all other tests, matching subscriber's equipment or alarm signal source circuits may be used to generate the alarm signal providing that the source duplicates the manufacturer-specified transmission and line supervision signals.

5.3.2 Decade Resistors

The decade resistors shall have a variable resistance range from 0 to 9 kΩ with steps of 10 Ω. The values of the decade resistor shall have an uncertainty of less than 1 percent.

5.3.3 DC Milliammeter

The dc milliammeter shall have the capability of measuring current levels as high as 130 mA with an uncertainty of less than 3 percent.

5.3.4 Differential Input Oscilloscope

The oscilloscope shall have a high-impedance differential-input amplifier or plug-in amplifier with a bandwidth from dc to at least 1 MHz. Input resistance shall be 1 MΩ or higher while input capacitance shall be 50 pF or less. The common-mode rejection ratio shall be at least 500:1 for ac or dc signals. The

oscilloscope shall have the capability of measuring test signals over a range of 1 mV to 100 V with an uncertainty of less than 5 percent.

5.3.5 Voltmeter

The voltmeter shall have a differential input with an input resistance of 1 MΩ or higher. It shall be capable of measuring dc test signals over a range of 10 mV to 100 V with an uncertainty of less than 2 percent, and 10 Hz to 10 kHz ac signals over a range of 1 mV to 130 V with an uncertainty of less than 3 percent.

5.3.6 Environmental Test Chamber

The environmental test chamber(s) shall be of a size sufficient to accommodate the annunciator panel and the remote receiver cabinet for Type II panels and be capable of maintaining any temperature in the range 0 to 50 °C (32 to 122 °F) within ±2 °C (±3.6 °F). A recorder shall continuously record the temperature during the tests with an accuracy of ±1 °C (±1.8 °F).

The humidity test chamber(s) shall be capable of maintaining any humidity in the range from 20 percent to at least 90 percent relative humidity within ±2 percentage points over the entire range of relative humidity at 30±5 °C (86±9 °F). A recorder shall continuously record the relative humidity and temperature during the test with an uncertainty of less than 1 percent.

5.3.7 Pulse Generator

The pulse generator shall have a pulse width control capable of adjusting pulse width over the range of 0.2 to 5 s. Output impedance shall be 50 Ω or less and pulse amplitude adjustable up to 15 V. Pulse activation may be controlled manually or with a timer (either a built-in or external add-on).

5.3.8 Time Interval Measuring Instrumentation

The time interval measuring instrumentation shall consist of an electronic timer, chart recorder, storage oscilloscope, or similar equipment capable of measuring time delay intervals with an uncertainty of less than 0.2 ms.

5.3.9 Adjustable Regulated Power Supply

The regulated power supply shall be capable of providing 50 V dc maximum output with 0.1 percent regulation, 10 mV or less ripple, and a current of at least 50 mA.

5.3.10 High-Voltage Power Supply

The high-voltage power supply for the lightning surge test shall be capable of charging the 3.3-μF capacitor to 600 V dc in 10 s or less.

5.4 Material and Configuration Test

Examine the materials and components of each direct connect police annunciator panel and any required ancillary equipment to determine conformance with sections 4 through 12 of Underwriters' Laboratories Standard UL 365 [3]. Then, examine the annunciator panel and associated equipment to determine compliance with Electronics Industries Association Standard RS-310-B [1].

5.5 Sample Preparation

Set up the equipment on a work bench in the order shown in figure 1. When testing a Type II panel, place the remote receiver cabinet next to the work bench and the annunciator panel on top of the work bench. Use an alarm signal source appropriate for the item under test. Connect the decade resistor in series with the signal transmission line and adjust to 0 Ω for the initial test setup. Connect a 600-Ω resistor across the output terminals of the transmitter when testing ac signal transmission techniques.

Measure transmission signal voltage levels with a high impedance differential input voltmeter or oscilloscope as instructed in each test.

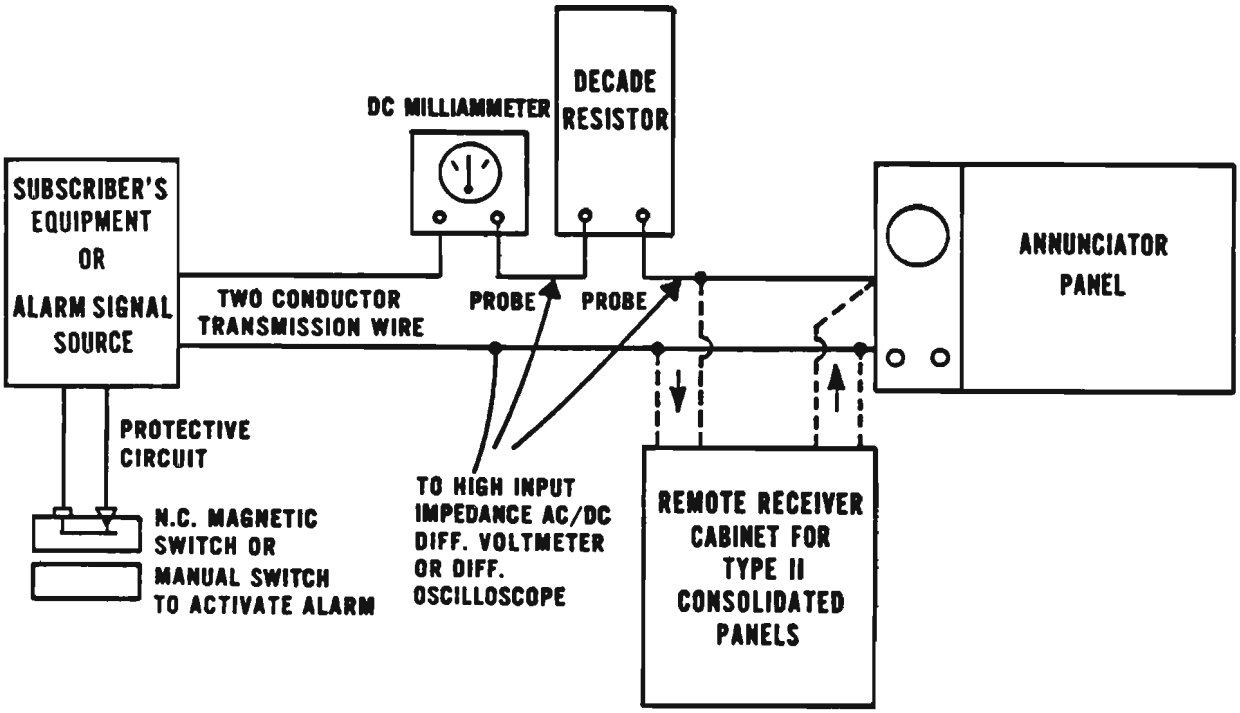

FIGURE 1. *Equipment setup for testing annunciator panels.*

5.6 Functional Tests

Set up the annunciator panel and matching alarm signal source as instructed in section 5.5. Set the decade resistor to 5 kΩ for this test. Connect transmission lines and, if necessary, adjust the transmission signal level as instructed by the manufacturer.

5.6.1 Alarm/Secure Indication

Apply power to the annunciator panel and adjust the alarm signal source to the secure state. Observe whether the annunciator panel indicates a secure state for the alarm circuit being tested.

Generate an alarm signal and note whether visual and audible alarm indications appear for the alarm circuit being tested. Operate the acknowledge switch and verify that the audible alarm is silenced.

Remove the alarm signal and observe whether the annunciator panel resets automatically and whether it acknowledges the return to a secure state with an audible signal.

5.6.2 Line Trouble

Short the transmission lines together. Observe whether a visual and audible line trouble indication appears for the alarm receiver being tested.

Operate the acknowledge switch and verify that the audible alarm is silenced.

Remove the short and observe whether the annunciator panel resets automatically and whether it acknowledges the removal of the short with an audible signal.

Repeat all of the above tests for line trouble, but disconnect the transmission lines at the input terminals to the alarm receiver module instead of shorting the transmission lines.

5.6.3 Holdup

If the annunciator panel has a separate circuit for holdup, use a matching alarm signal source. Activate the holdup alarm and verify proper annunciator panel response characteristics as in the previous two sections (5.6.1 and 5.6.2).

If alarms other than holdup are transmitted to the annunciator panel, check panel response characteristics for each type of alarm.

5.6.4 AC and DC Power On Indication

Interrupt the ac power for the annunciator panel and verify that the proper response is obtained. Operate the acknowledge switch and verify that the audible alarm is silenced. Reestablish the ac power and record the response.

5.6.5 Annunciator System Status (Type II Panels)

Observe the annunciator panel alarm indication, in response to the following actions:

(a) Open the remote receiver cabinet door.
(b) Interrupt the power between the annunciator panel and the remote receiver cabinet.
(c) Interrupt the signals on the line between the annunciator panel and the remote receiver cabinet.
(d) Lower the battery voltage below the minimum specified by manufacturer when operating in standby. (Use an adjustable power supply in place of the battery for this test.)
(e) Place a burned lamp in the panel.

For Type II annunciator panels using a numerical display readout, record whether the equipment is capable of the following modes of operation:

(a) Continuously displaying each subscriber number sequentially with its status condition for at least 1 s upon a change of status condition.
(b) Removing the circuit number from the display sequence for all alarm circuits that have returned to the secure state.
(c) Interrupting the display sequence for new status change until an acknowledgment occurs.
(d) Automatically print on the hard copy device as a minimum the date, time, circuit or subscriber connection identification number, and status condition code for each change in status.

5.6.6 Manual Disable

Cause line trouble on the transmission line to which the alarm receiver module is connected. Manually disable the line trouble indicator at the annunciator panel in accordance with manufacturer's instructions. Cause the line trouble condition to alternate between active and inactive and verify that the indication of line trouble is in fact disabled. Manually enable the connection in accordance with the manufacturer's instructions and return transmission to a secure state.

5.7 Alarm Signal Sensitivity Tests

Set up the sample police annunciator panels as described in section 5.5; additional instructions are included in each description of the individual sensitivity tests. Select and perform the sensitivity tests described below as appropriate for the types of transmission techniques employed by the panel.

5.7.1 Polarity Reversal Technique

Figure 2 shows the electrical schematic for testing the polarity reversal alarm receiving circuits. Use the high-impedance differential-input oscilloscope or voltmeter to measure the amplitude of the transmission

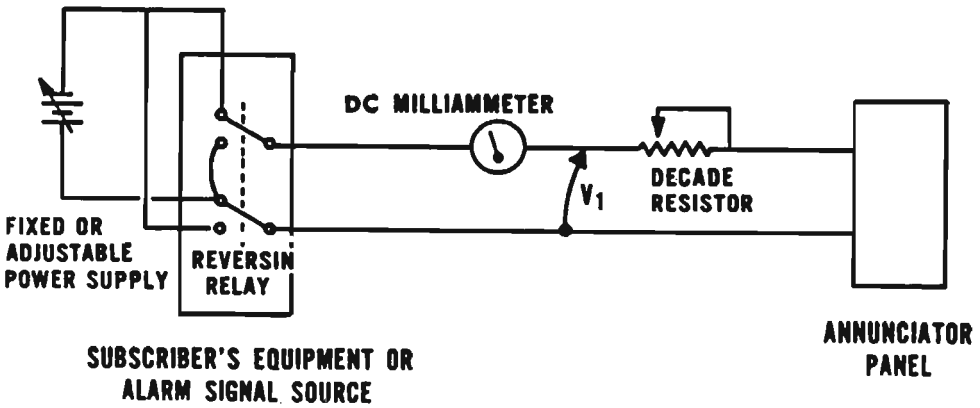

FIGURE 2. *Test circuit for polarity reversal transmission systems.*

signal. If the alarm signal source uses a variable power supply for powering transmission lines, perform the sensitivity measurements at the 20-V dc level.

Initially set the decade resistor to 0 Ω. With all power on, adjust the alarm signal source to the secure state. Note whether the annunciator panel indicates a secure state for the alarm circuit being tested. Increase the decade resistor in increments of 100 Ω until line trouble is indicated. Record the decade resistance, voltage, and current at this point. Repeat the measurement two additional times and calculate the threshold current as the average value of the three current readings.

Set the decade resistor to 5 kΩ. Activate the alarm signal source to transmit an alarm signal (polarity reversal). Repeat this test two additional times and record the results for each test.

5.7.2 End-of-Line Resistance Technique

Figure 3 shows the electrical schematic for testing end-of-line resistance alarm receiving modules. If the annunciator panel uses a variable voltage power supply for powering the transmission line, set the voltage to 20 V dc; otherwise, use the fixed voltage provided. Note: Before performing the following test, calculate the maximum input current to the alarm receiver module by dividing the voltage of the transmission line power supply by R_{L1} (defined below). If the input current is less than the value specified by the manufacturer in conformance with section 4.2 proceed with the test. If the calculated current is greater than the manufacturer's maximum value reduce the voltage of the transmission line power supply until a safe value of maximum input current is achieved. Perform the sensitivity measurements as follows:

Use values specified by the manufacturer for loading resistors R_{L1} and R_{L2} for a line resistance of 5 kΩ Connect the normally open alarm contacts of the alarm signal source across resistor R_{L2}. Initially set the decade resistor to 0 Ω.

Apply power to all instrumentation and equipment to be tested. Generate an alarm signal and note whether the annunciator panel indicates line trouble for the alarm circuit being tested.

Increase the decade resistor in increments of 100 Ω until the line trouble indication disappears and an alarm state is indicated. Record the voltage, V_1; decade resistance; and current, I, at this point.

Continue to increase the decade resistor until a secure indication is achieved. Record the voltage, V_1; decade resistance; and current, I, at this point.

Continue to increase the decade resistor until line trouble is again indicated. Record the voltage, V_1; decade resistance; and current, I, at this point.

Repeat the above measurements two additional times and calculate the average values for the recorded data.

Record the average currents at each display status change and the threshold current separating the detection bands of receiver operation.

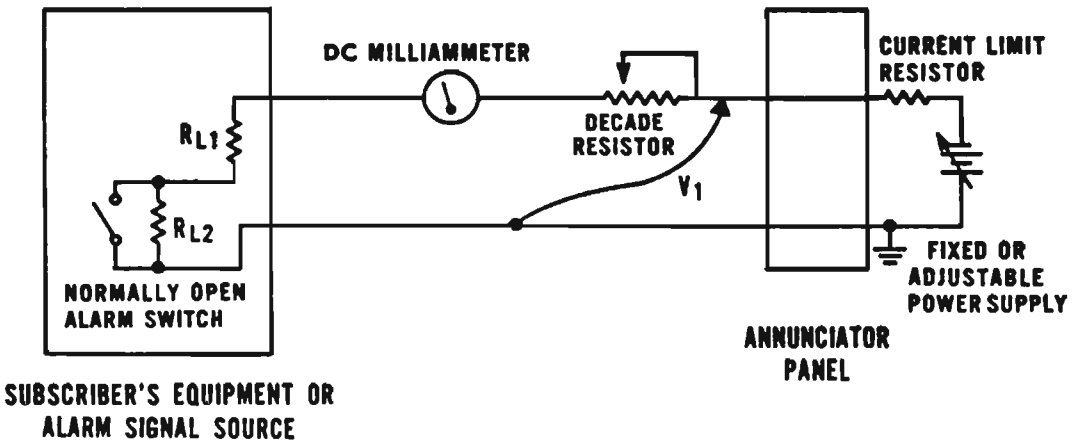

FIGURE 3. *Test circuit for end-of-line resistance transmission systems.*

5.7.3 Low-Frequency Pulser Technique

Figure 4 shows the electrical schematic for testing dc pulser type alarm receiver modules. Use the internal power supply or provide a power supply as specified by the manufacturer for the subscriber's equipment.

Set the decade resistor to 0 Ω. With all power on, set the alarm signal source to the secure state and adjust the transmitter output signal to maximum or to the level specified by the manufacturer. Note whether the annunciator panel indicates a secure state for the alarm circuit being tested. Increase the decade resistor in increments of 100 Ω until line trouble is indicated. Record the transmitter signal level, V_1; voltage drop across the decade resistor, V_2; receiver signal level, V_3; and the decade resistance at this point. Calculate the peak current, I, during each pulse. Repeat the measurements two additional times and calculate the average values for the recorded data.

Return the decade resistor to 0 Ω and generate an alarm signal (different pulse rate). Note whether the annunciator panel indicates an alarm state. Increase the decade resistor in increments of 100 Ω until line trouble is indicated. Record the transmitter signal level, V_1; the voltage drop across the decade resistor, V_2; receiver signal level, V_3; and the decade resistance at this point. Calculate the peak current, I, during each pulse. Repeat the measurements two additional times and calculate the average values for the recorded data. Record the average value of the current as the threshold current.

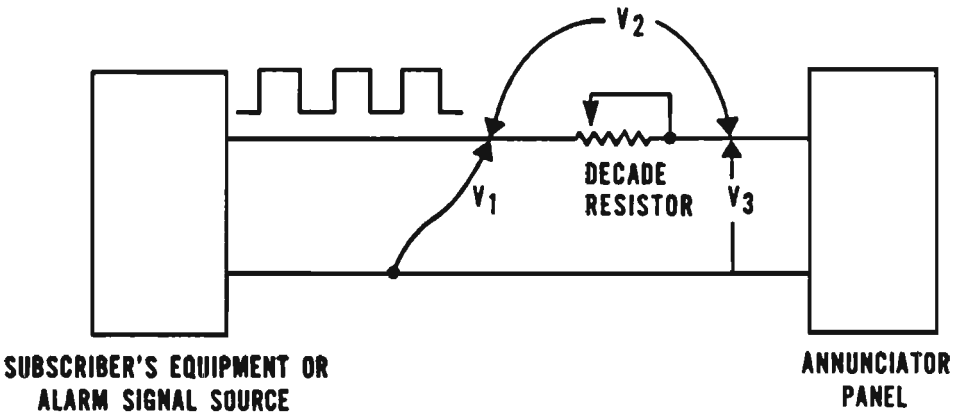

FIGURE 4. *Test circuit for dc pulser type transmission systems.*

5.7.4 Alternating-Current Line-Carrier Technique

Figure 5 shows the electrical schematic for testing ac transmission alarm receiving modules. In some cases, the use of special measuring instrumentation might be necessary to measure signal transmission characteristics. However, in most cases a high input impedance differential voltmeter or oscilloscope is all that is needed. Consult with the manufacturer if any questions arise.

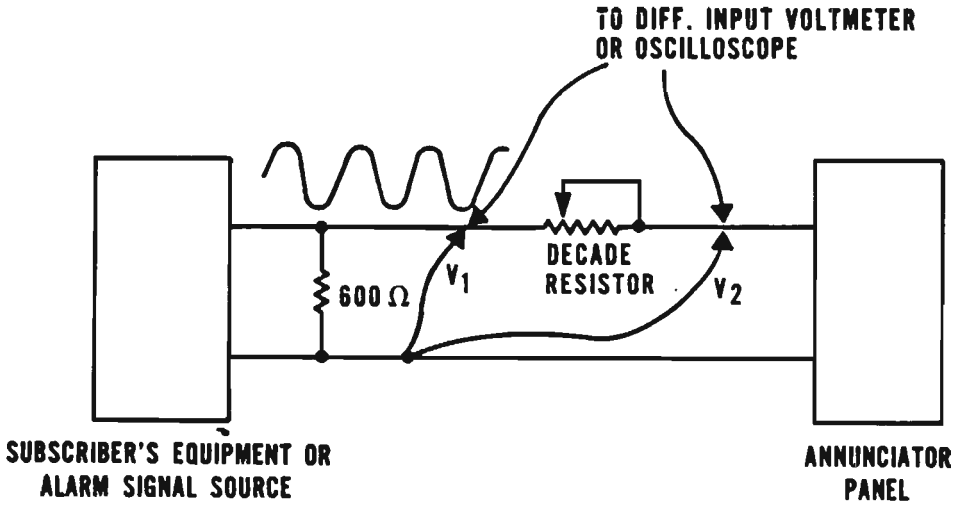

FIGURE 5. *Test circuit for ac transmission systems.*

Set the decade resistor to 0 Ω. With all power on, adjust the alarm signal source to the secure state and, if necessary, adjust the signal level or frequency tuning at either the transmitter or receiver modules as specified by the manufacturer. Note whether the annunciator panel indicates a secure state for the alarm circuit being tested. Increase the decade resistor in increments of 100 Ω until line trouble is indicated. Record the transmitter signal level, V_1; receiver signal level, V_2; and the decade resistance at this point. V_2 represents the receiver threshold sensitivity level. Repeat the measurements two additional times and calculate the average values for the recorded data.

Return the decade resistor to 0 Ω and generate an alarm signal. Note whether the annunciator panel indicates an alarm state. Increase the decade resistor in increments of 100 Ω until line trouble is indicated. Record the transmitter signal level, V_1; receiver signal level, V_2; and the decade resistance at this point. Repeat the measurements two additional times and calculate the average values for the recorded data.

Calculate the amount of transmission signal loss, $(20 \log_{10} (V_2/V_1))$ in dB, that the receiver can tolerate before indicating line trouble for both alarm status states.

If the annunciator panel is capable of receiving other ac alarm status signals, such as holdup, also perform the above transmission sensitivity tests for these signals.

5.7.5 Interrogation and Reply Technique

For annunciator panels with an interrogation and reply transmission system, perform the threshold sensitivity tests at both the subscriber's equipment receiver and annunciator panel receiver. Initially place the 600-Ω resistor across the output terminals of the annunciator panel transmitter. Deactivate the reply transmitter in the subscriber's equipment and monitor the receiver for its response to the interrogation signal. Follow the test procedure used to make sensitivity measurements for the appropriate transmission technique. Record the transmitter signal level, receiver signal level, and decade resistance when the receiver no longer responds to the interrogation signal. Repeat the measurements two additional times and calculate the average values for the recorded data.

To test receiver sensitivity at the annunciator panel, place the 600-Ω resistor across the output terminals of the subscriber's equipment transmitter. Deactivate the transmitter in the annunciator panel. Initiate a reply transmission of the subscriber's equipment and monitor the annunciator receiver module for its response to the reply signal. Again follow the test procedure used to make sensitivity measurements for the appropriate transmission technique. Record transmitter signal level, receiver signal level, and decade resistance when the receiver no longer responds to the reply signal. Repeat the measurements two additional times and calculate the average values for the recorded data. Consult the manufacturer if technical help is needed in order to perform this test.

Some interrogation and reply systems operate only with continuous signals. For these systems, both the transmitter and receiver modules must be operational at each end. Therefore the test system should be duplicated at each end. Under these conditions the receiver sensitivity measurements can be made simultaneously instead of sequentially as described above. Consult the manufacturer if technical help is needed in order to perform this test.

5.7.6 Supplementary Line Security Transmission Techniques

This test is used to evaluate transmission techniques where a superimposed second transmission signal is used to increase transmission line security above that which can be normally obtained with a single transmission signal. Initially set the decade resistor to 0 Ω. With all power on, adjust the alarm signal source to a secure state and adjust the transmission signals to the levels specified by the manufacturer. Note whether the annunciator panel indicates a secure state for the alarm circuit being tested. Increase the decade resistor in increments of 100 Ω until line trouble is indicated. Record the decade resistance and two of the following items:

(a) If one of the transmission signals uses a direct current technique, measure the average current with a dc milliammeter.

(b) If a dc pulse signal is present, measure the pulse amplitude and calculate the current in the line during each pulse (knowing the line resistance makes this possible).

(c) If an ac transmission technique is used, measure the transmitted signal level, V_1, and the receiver signal level, V_2, (peak-to-peak or RMS) and calculate the amount of signal loss, $(20 \log_{10} (V_2/V_1))$ in dB, that the receiver can tolerate before line trouble is indicated.

The above three test methods are described in sections 5.7.1 through 5.7.4. Perform each test three times and calculate the average values for the recorded data.

Return the decade resistor to 0 Ω and generate an alarm signal. Note whether the annunciator panel indicates an alarm state for the alarm circuit being tested. Perform the test procedure as described for the secure state above, and calculate the average values for the alarm state signal sensitivity using the procedure in this paragraph but substituting the term "alarm state" for "secure state."

5.8 Receiver Alarm Time Delay

Set up the annunciator panel according to section 5.5. Set the decade resistor to 1 kΩ and, if necessary, adjust the transmitter signal to the level specified by the manufacturer. Adjust the alarm signal source to a secure state. Connect a single pole single throw reed relay switch in series with one wire of the transmission line as shown in figure 6, A. Drive the relay with a pulse generator so that the reed switch opens for $1^{+0}_{-0.1}$ s and then closes again. Use the time interval measuring instrumentation specified in section 5.3.8 to measure the amount of time the switch remains open. Activate the pulse generator every 10 s for 1 min (six on-off cycles of the relay) and record whether the annunciator responds with a latched-on line trouble indication. Connect the single pole single throw reed relay switch across the transmission wires as shown in figure 6, B. Invert the output pulse from the generator and drive the relay so that the reed switch closes for $1^{+0}_{-0.1}$ s and then opens again. Activate the pulse generator every 10 s for 1 min (six on-off cycles of the relay) and record whether the line trouble indication latches on.

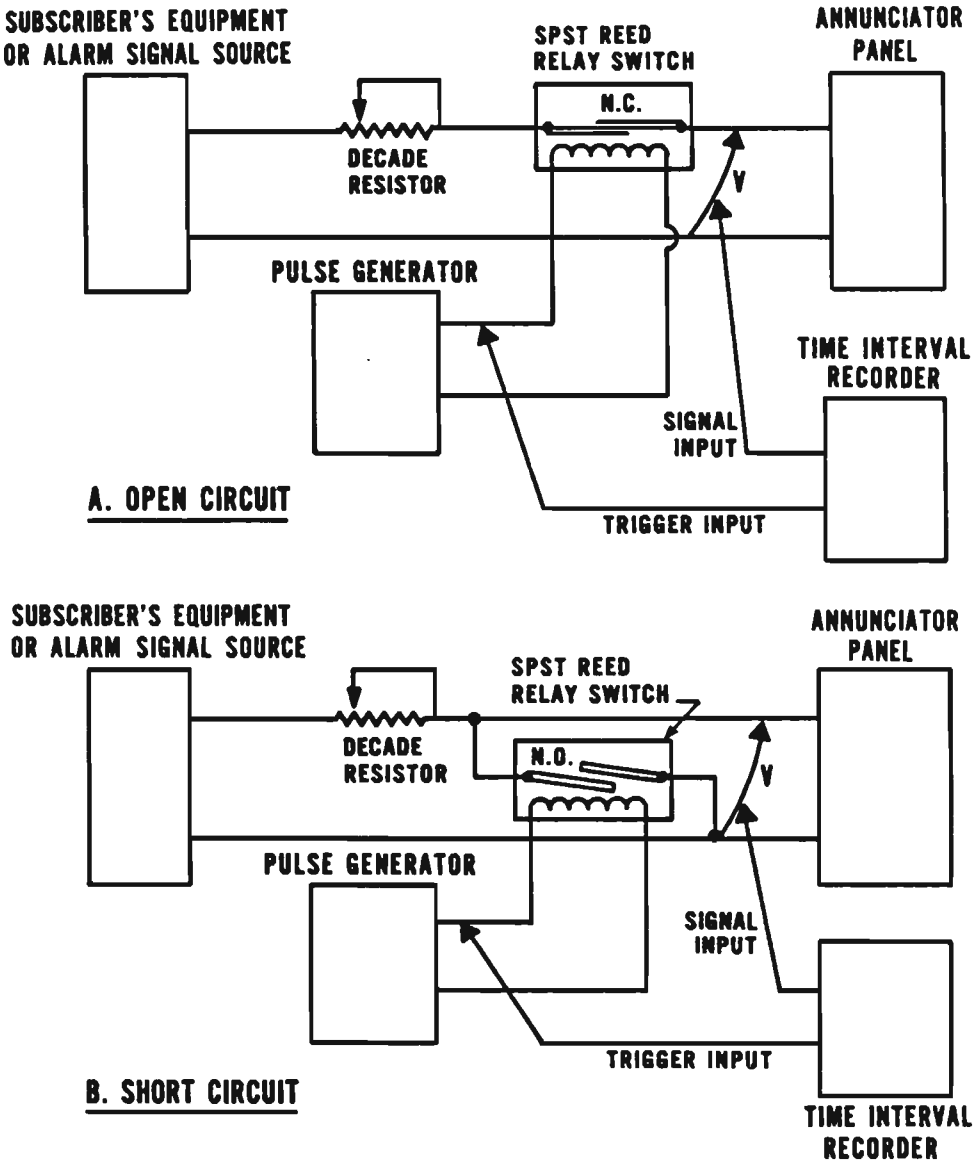

FIGURE 6. *Test circuit for measuring alarm response time delay.*

5.9 Stability Tests

Set up the police annunciator panel according to section 5.5. Use the bench for mounting the equipment unless instructed otherwise in each test. Set the decade resistor to 1 kΩ for these tests. Adjust the alarm signal source to a secure state, and, if necessary, adjust the transmission signal level as instructed by the manufacturer for normal operation.

5.9.1 High-Voltage Test

Connect the annunciator panel power cord to a variable voltage power supply. Adjust the power supply for a voltage of 110±1 percent of the normal operating voltage and perform the receiver operability tests in accordance with sections 5.6.1 through 5.6.3.

5.9.2 Low-Voltage Test

Adjust the variable power supply for a voltage of 85±1 percent of the normal operating voltage and perform the receiver operability tests in accordance with sections 5.6.1 through 5.6.3.

5.9.3 Standby Power Operation Test

Disconnect the annunciator panel from the power line and permit it to operate from its fully charged standby power supply. Observe whether there are any false indications of alarms other than an indication of power failure. After 1 min, reconnect it to the power line and again observe whether there any indications of alarms. Repeat the test two additional times. Disconnect the annunciator panel from the power line and allow it to operate continuously from the standby power supply for the period of time specified by the manufacturer (sec. 4.2) minus the length of time required to perform the receiver operability tests of sections 5.6.1 through 5.6.3. Upon completion of the required operating period, perform the receiver operability tests in accordance with sections 5.6.1 through 5.6.3. Allow the batteries to discharge to a level where the annunciator panel will not operate. Reconnect the annunciator panel to the power line voltage and again perform the receiver operability tests according to sections 5.6.1 through 5.6.3. Allow it to operate continuously for the period of time specified by the manufacturer to fully recharge the batteries. Then repeat the initial standby power operation test.

5.9.4 Shock Test

Disconnect the annunciator panel from the power line voltage and standby power and place the unit on a work bench with a horizontal solid wooden top at least 4-cm (1-5/8 in) thick or on a floor having at least the same rigidity as the work bench top. Large receiver consoles for Type II panel units should be tested standing upright on the floor. Using one edge of the unit as a pivot, lift the opposite edge until it forms an angle of 45° with the bench top, or the lifted edge has been raised 10 cm (4 in) above the horizontal surface, or the lifted edge is just below the point of perfect balance, whichever condition occurs first. Then let the unit drop back freely to the flat surface. Repeat, using other practical edges of the same horizontal side as the pivot edges for a total of four drops.

Repeat the entire procedure with the unit resting on other sides until it has been dropped a total of four times on each side on which the unit could be practically placed during servicing. Reconnect power and perform the receiver tests in accordance with sections 5.6.1 through 5.6.3 as appropriate.

5.9.5 High-Temperature Test

Place the annunciator panel in an environmental chamber at a temperature of 50±2 °C (122±3.6 °F). Allow it to remain at that temperature for a minimum of 4 h, and then while at that test temperature, perform the receiver operability tests in accordance with sections 5.6.1 through 5.6.3. The alarm signal source, instrumentation and decade resistance box shall be located outside the environmental chamber. The annunciator panel shall be arranged so that the acknowledge switch can be actuated from outside of the chamber.

5.9.6 Low-Temperature Test

Place the annunciator panel in an environmental chamber at a temperature of 0±2 °C (32±3.6 °F). Allow it to remain at that temperature for a minimum of 4 h, and then while at that test temperature, perform the receiver operability tests in accordance with sections 5.6.1 through 5.6.3. The alarm signal

source, instrumentation and decade resistance box shall be located outside the environmental chamber. The annunciator panel shall be arranged so that the acknowledge switch can be actuated from outside of the chamber.

5.9.7 High-Humidity Test

Place the annunciator panel in an environmental chamber at a relative humidity of 85±2 percent and at a temperature of 30±5 °C (86±9 °F). Allow it to remain at that humidity for 24 h, and while at the test humidity, perform the receiver operability tests in accordance with sections 5.6.1 through 5.6.3. The alarm signal source, instrumentation and decade resistance box shall be located outside the environmental chamber. The annunciator panel shall be arranged so that the acknowledge switch can be actuated from outside of the chamber.

5.10 Electromagnetic Susceptibility Tests

The radiated electromagnetic susceptibility test shall be performed in a shielded room (EMI test chamber). The conducted susceptibility and lightning surge tests may be performed without an EMI test chamber; however, the test site should be located away from sensitive instruments. The conducted radio-frequency signals and voltage spikes on the power lines can interfere with the operation of such instruments.

5.10.1 Conducted Electromagnetic Susceptibility Tests

Connect the annunciator panel and alarm signal source as shown in figure 7. The 600-Ω resistor across the output terminals of the transmitter is used if the equipment uses an ac signal transmission technique. The fixed 510-Ω resistors are in series with each transmission wire. Adjust the transmission signal as instructed by the manufacturer for normal operation, and place the alarm signal source in the secure state. Observe whether the annunciator panel indicates any condition other than secure during the performance of the tests.

Subject the annunciator panel to power line conducted interference in accordance with test methods CS01, CS02, and CS06 of MIL-STD-462 [3]. Maintain a test level of 1- to 3-V rms as required, either manually or automatically, over the entire frequency test range.

Determine the level of susceptibility of the panel for each frequency at which the panel indicates an alarm state or line trouble. Manually tune to the frequency at which the unit indicated an alarm, and raise the signal level from the lowest output level until the panel indicates an alarm. The threshold susceptibility level is that signal level for which the panel will not indicate an alarm for a 10-percent reduction in the signal level.

Repeat test CS02 on the transmission lines leading into one of the annunciator panel's alarm receiver module. Couple the interference signals to the annunciator side of each 510-Ω resistor. Since the transmission line is connected to the alarm signal source, check for any malfunctioning of the transmitter during the test. Determine whether any alarm indications are originating in the annunciator panel or in the transmitter.

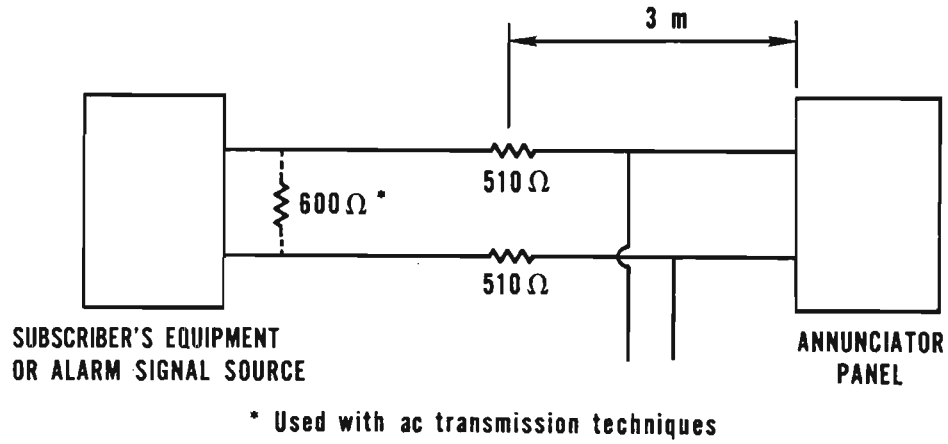

FIGURE 7. *Test circuit for conducted and radiated EMI tests.*

5.10.2 Radiated Electromagnetic Susceptibility Test

Connect the annunciator panel and alarm signal source as shown in figure 7. The alarm signal source, instrumentation, and line resistors shall be located outside of the EMI test chamber during testing. If a remote receiver cabinet is used, place it in the test chamber. Arrange the annunciator panel so that the acknowledge switch can be actuated from outside of the chamber if the panel does not reset automatically.

Subject the annunciator panel and remote receiver cabinet, if used, to radiation in accordance with test method RS03 of MIL-STD 462 [2]. Use an electric field of 1 V/m for frequencies in the range from 14 kHz to 2 MHz and 3 V/m for frequencies in the range from 2 MHz to 12 GHz.

Determine the susceptibility of the panel for each frequency or frequency band at which the panel indicates an alarm state or line trouble. The susceptibility level is that signal level for which the panel will not indicate an alarm for a 10-percent reduction in signal level. Monitor the alarm signal source for any malfunctions during testing. Determine whether the alarm indications are originating in the annunciator panel or in the transmitter.

5.10.3 Lightning Surge Test

Connect the lightning surge test circuit to the oscilloscope, with the output of the circuit terminated in a 600-Ω resistor. Operate the circuit and examine the pulse shape. If necessary, change the values of the nominal 33-Ω resistor and 0.1-μF capacitor to get a 600±30 V pulse with a rise time of 10±2 μs and a decay time to one-half maximum of 1.6±0.2 ms.

Connect the annunciator panel and the alarm signal source as shown in figure 8. Place the alarm signal source in the secure state. Remove the 600-Ω terminating resistor and connect the lightning simulation test circuit across transmission lines at points A and B. Apply five test surges of each polarity to the annunciator panel, with at least a 15-s interval between surges to insure that the 3.3-μF capacitor in the pulse circuit is fully charged. Reconnect the 600-Ω terminating resistor across the output of the lightning simulation test circuit and repeat the test with the lightning surge simulator circuit connected between ground and, respectively, points A and B. Record any alarm or line trouble indications.

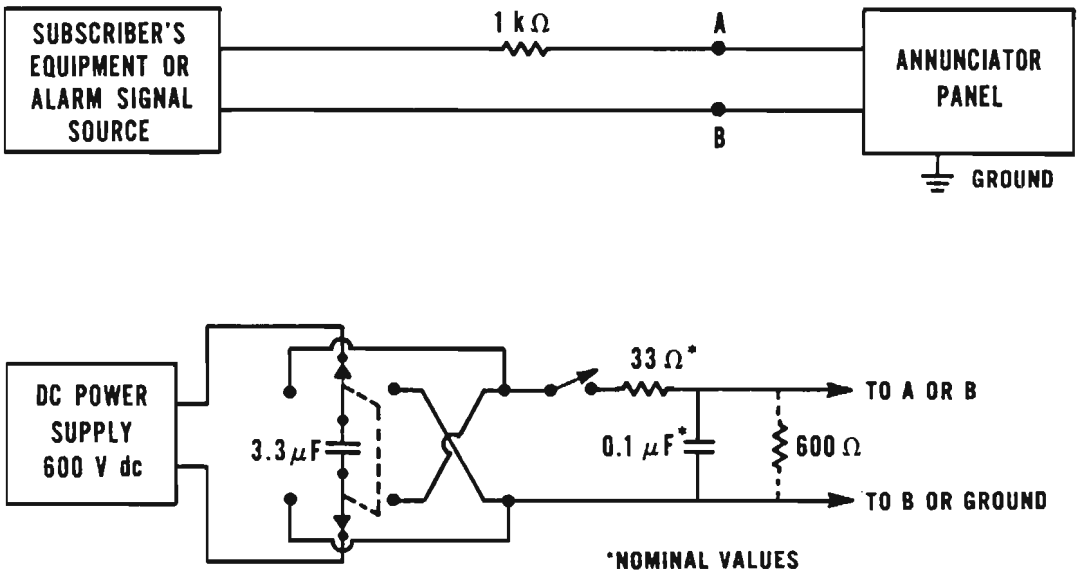

FIGURE 8. *Equipment setup and circuit for performing lightning simulation test.*

5.11 Tamper Switch Test (Type II Remote Cabinet)

Connect the remote cabinet to the annunciator panel, so that operation of the tamper switch on the cabinet door will be indicated. If the remote receiver cabinet has a hinged cover, swing it open until the tamper switch is first actuated, and measure the displacement of the cover opposite the hinge. If the unit has a nonhinged cover, move one side until the tamper switch first actuates, and measure the displacement of that side of the cover. Repeat this for each of the other three sides. If an unhinged cover cannot be moved

one side at a time, then move it uniformly until the tamper switch first actuates, and measure the movement of the cover. If the unit has a tamper switch actuated by the motion of a cover screw, retract the screw until the tamper switch is actuated, and measure the displacement of the screw.

In each case, examine the unit while the cover is lifted to the position just sufficient to actuate the tamper switch, and determine if there is a direct line of sight to any internal adjustment control or electrical circuitry.

APPENDIX A—REFERENCES

[1] Police station connected burglar alarm units and systems. 1st ed. UL Standard 365; 1979 February 16. Underwriters' Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.

[2] Racks, panels, and associated equipment. EIA Standard RS-310-B; December 1972. Electronics Industries Association, Engineering Department, 2001 Eye Street, NW., Washington, DC 20006.

[3] Measurements of electromagnetic interference characteristics. MIL-STD-462; 1968 August 1 and Notice 3, 1971 February 9. Naval Publication and Form Center, 5801 Tabor Avenue, Philadelphia, PA 19120.