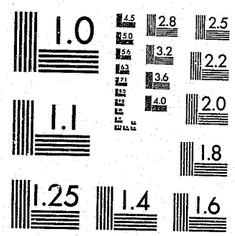

U.S. Department of Justice
National Institute of Justice

NIJ National Institute of Justice
Technology Assessment Program

Telephone Dialers with Digitally Coded Messages

NIJ Standard-0323.00

ABOUT THE TECHNOLOGY ASSESSMENT PROGRAM

The Technology Assessment Program is sponsored by the Office of Development, Testing, and Dissemination of the National Institute of Justice (NIJ), U.S. Department of Justice. The program responds to the mandate of the Justice System Improvement Act of 1979, which created NIJ and directed it to encourage research and development to improve the criminal justice system and to disseminate the results to Federal, State, and local agencies.

The Technology Assessment Program is an applied research effort that determines the technological needs of justice system agencies, sets minimum performance standards for specific devices, tests commercially available equipment against those standards, and disseminates the standards and the test results to criminal justice agencies nationwide and internationally.

The program operates through:

The *Technology Assessment Program Advisory Council* (TAPAC) consisting of nationally recognized criminal justice practitioners from Federal, State, and local agencies, which assesses technological needs and sets priorities for research programs and items to be evaluated and tested.

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James K. Stewart, Director
National Institute of Justice

Technology Assessment Program

NIJ Standard for Telephone Dialers with Digitally Coded Messages

NIJ Standard-0323.00

A Voluntary National Standard Promulgated by the National Institute of Justice

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FOREWORD

This document, NIJ Standard-0323.00, Telephone Dialers With Digitally Coded Messages, 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.

Lester D. Shubin
Program Manager for Standards
National Institute of Justice

NIJ STANDARD FOR TELEPHONE DIALERS WITH DIGITALLY CODED MESSAGES

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NIJ STANDARD FOR TELEPHONE DIALERS WITH DIGITALLY CODED MESSAGES

1. PURPOSE AND SCOPE

The purpose of this standard is to establish performance requirements and test methods for digital dialers. These dialers are intended to dial one or more preprogrammed telephone numbers and to transmit digitally coded messages in response to an actuation. These alarm messages are transmitted to special digital signal receivers via the ordinary switched telephone network. Emphasis in this standard is on characteristics that influence the ability of the dialer to perform its intended function reliably and some factors that affect false alarm susceptibility.

Dialers that have received FCC approval may be connected directly to the telephone network [1,2][1]; otherwise, a registered protective circuit must be used [3]. In conformance with existing State or local ordinances, prior permission may be required, in writing, from those whose telephone numbers are to be dialed, before such numbers may be programmed into the dialer.

Dialers with the audio monitoring option may be subjected to further restrictions. Federal criminal law prohibits the manufacture, distribution, possession, and advertising of audio monitoring equipment primarily useful for the surreptitious interception of communications. State legislation varies amongst jurisdictions and may create additional prohibitions. Manufacturers, sellers, installers, and users are advised to become familiar with the relevant Federal and State prohibitions against surreptitious interceptions of oral communications and against the possession, sale, or use of equipment primarily useful for such a purpose.

2. CLASSIFICATION

This standard does not classify dialers by type. The dialers covered by this standard operate on (nominally) 115-V ac power (with a battery as an optional standby power supply), and transmit digitally coded messages. The dialers may come as modules, as units that stand alone in their own cabinets intended to be connected to an intrusion alarm control unit, or as elements to be incorporated into an intrusion alarm control unit. This standard does not distinguish among any of these forms and only defines tests for the dialer portion of any composite system. The control unit portion of any composite system must satisfy its own standard, NIJ Standard-0321.00 [4]. Several options may be available with each dialer.

2.1 Option I—Local Alarm

When the dialer is in an alarm state, a local alarm is activated. This can be an alarm annunciator (an electronic siren, external bell, etc.) provided with the dialer or control circuitry (dry contact switched, power source, etc.) for an alarm annunciator.

2.2 Option II—Tamper Protection

The dialer is supplied in a key-locked cabinet with a tamper switch that activates the dialer if unauthorized entry to the cabinet is attempted.

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

2.3 Option III—Line Checking

The dialer has circuitry to automatically check the telephone line for selected usability conditions. If the telephone line is unusable, a local alarm is activated.

2.4 Option IV—Extension Phone Disconnect

The dialer has the capability to deactivate all extension phones connected to the telephone line intended for alarm message transmittal.

2.5 Option V—Audio Monitoring

In the alarm state, the dialer has the capability of picking up sounds from the protected premises through microphones for a period of time following an alarm transmission.

2.6 Option VI—Supervisory Opening and Closing Capability

An opening report is sent to the central station when the dialer is switched from the secure mode to the access mode. A closing report is sent when the dialer is switched from the access mode to the secure mode.

2.7 Option VII—Abort Signal Capability

An abort signal is sent to the central station if the sensor or control unit is reset before transmission of the alarm signal is completed.

2.8 Option VIII—Secure Signal Capability

A secure signal is sent to the central station to indicate that the alarm system has reached the secure state.

2.9 Option IX—Standby Power

The dialer continues to operate from internal standby power when the normal ac power fails.

3. DEFINITIONS

3.1 Abort

The cancellation of the transmission of an alarm message due to the alarm system being reset prior to the completion of the alarm signal interchange.

3.2 Acknowledgment Signal

A signal that signifies the completion of a connection to the receiver. The acknowledgment signal is sent from the receiver to the dialer over the connecting circuit.

3.3 Break Interval

An on-hook (open circuit) signal of approximately 40-ms duration, as part of a dialing pulse train.

3.4 Chatter

The rapid (undesirable) repeated switching of a dialing pulse train.

3.5 Decibel with 1-mW Reference (dBm)

A unit expressing power level in decibels, above or below a reference level of 1 mW.

3.6 Dialing Pulses

A series of interruptions of the current flow in the customer's loop in the telephone switching network. This pulse train registers at the telephone switching equipment as digits of the telephone number dialed.

3.7 Interdigital Timing

The time between digits. The switching equipment uses this time to prepare for receiving the next digit.

3.8 Make-Interval

An off-hook (closed circuit) signal of approximately 60-ms duration, as part of a dialing pulse train.

3.9 Off-Hook Signal

A signal by the dialer to the telephone line, equivalent to a model 500-type telephone with the cradle button up (line voltage becomes 6 V).

3.10 On-Hook Signal

A signal by the dialer to the telephone line represented by an open circuit. This is equivalent to a model 500-type telephone with the cradle button down (line voltage becomes 48 V).

3.11 Secure State

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

3.12 Shutdown Signal

A signal sent by the receiver that signifies the successful decoding of an alarm message and commands the dialer to disconnect itself from the telephone line and go into an appropriate mode.

3.13 Talking Battery

The dc voltage supplied by the telephone company central office to the customer's loop for the operation of the carbon transmitter in the handset of a telephone and to enable the distinguishing of dialing pulses.

3.14 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.

4. REQUIREMENTS

4.1 Acceptance Criteria

A dialer that transmits digital messages satisfies the requirements of this standard if all sample specimens (sec. 5.1) pass all of the tests required by this standard.

4.2 User Information

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

(a) Full installation and operation instructions (for all modes of operation), instructions for setting the phone number(s) to be dialed, minor troubleshooting and routine testing, a recommended maintenance schedule, and any installation restrictions.
(b) Options included (sec. 2).

(c) Signal characteristics necessary to activate the dialer.
(d) Standby power requirements, including the identification of usable battery types, the maximum period of standby operation, and the minimum time required to fully recharge a completely discharged battery if the equipment includes an integral battery charging unit.
(e) Description of tamper protection and/or other optional features (sec. 2).
(f) Nominal operating voltages.
(g) The alarm code(s) and transmission format(s).
(h) Instructions to be followed by the user in order to comply with the rules of the FCC concerning connection of terminal equipment to the telephone network.
(i) Programming instructions, if a preprogrammed module is not provided by the manufacturer, distributor, or dealer.
(j) Certification of compliance with this standard.

4.3 Transmission Signal Requirements

4.3.1 Digital Code

The information transmitted by the dialer shall be in digital code.

4.3.2 Acknowledgment Signal

When tested in accordance with section 5.4.1, the dialer shall transmit its message only after it receives an acknowledgment signal from the central station. The dialer shall be capable of detecting such a signal at a level of –30 dBm or lower.

4.3.3 Alarm Message Content

When tested in accordance with section 5.4.2, the dialer shall transmit as a minimum a distinctive identification, an alarm code, and utilize a transmission verification technique (e.g., bit-by-bit comparison, check sum, etc.) as a part of each message.

4.3.4 Shutdown Signal

When tested in accordance with section 5.4.3, the dialer shall disconnect from the telephone line after the receipt of a shutdown signal from the receiver and then go to an appropriate mode. This signal is an indication of the successful decoding of the message. The dialer shall be capable of detecting such a signal at a level of –30 dBm or lower.

4.4 Telephone Interface Requirements

4.4.1 Dialable Digits

The dialer shall be capable of dialing a minimum of seven digits.

4.4.2 Telephone Line Control

When tested in accordance with section 5.5.1, the dialer shall be able to disconnect an incoming call and seize the telephone line for its own use.

4.4.3 Maximum On-the-Telephone Line Time

When tested in accordance with section 5.5.2, the dialer shall not be on-line for the transmission of a single message for more than 5 min.

4.4.4 Multiple Attempts to Send an Alarm Message

When tested in accordance with section 5.5.3, if the acknowledgment signal is not received, the dialer shall wait 15 s, go on-hook, and attempt to send the alarm again. If the acknowledgment signal is not received again, the dialer shall make not more than eight more tries to transmit the same message—a total of 10 attempts. If the acknowledgment signal is received, but the shutdown signal is not received, the same procedure applies.

4.4.5 Pulse Time Interval Requirement

When tested in accordance with section 5.5.4, the combined time interval for a break interval and its preceding or following make interval shall lie in the range 91–125 ms. In addition, the ratio of the break interval to either of the combined time intervals shall be not less than 0.58 or more than 0.64, in conformity with telephone company regulations [5].

For a single break pulse, the break interval shall be not less than 53 ms or more than 80 ms. The time interval between the final pulse (break-to-make) of a given digit and the beginning of the first pulse of the next digit (interdigital interval) shall be not less than 600 ms or more than 3 s [5].

4.4.6 Chatter, Spurious Breaks, and Spurious Makes Requirement

When tested in accordance with section 5.5.5, the duration of pulse chatter shall not exceed 3 ms after the initial make-to-break or break-to-make transition of any pulse. Spurious breaks shall not occur in the time interval starting 100 ms before the first make-to-break transition and ending 100 ms after the last break-to-make transition of any pulse train that represents a digit. The duration of spurious breaks shall not exceed 1 ms; the separation between spurious breaks shall be at least 100 ms. The duration of spurious makes during the break interval shall not exceed 10 μs [5].

4.4.7 Dialing Impedance Requirement

When tested in accordance with section 5.5.6, the resistance of the device during the make state, as measured at the telephone terminals, shall be not more than 300 Ω and during the break state, the resistance shall exceed 150 kΩ [5].

4.5 Functional Performance

When tested in accordance with section 5.6, the dialer shall correctly dial the programmed telephone number(s) and transmit the correct alarm message(s) upon receiving the acknowledgment signal. Upon receipt of the shutdown signal the dialer shall disconnect and be ready for another activation. If more than one alarm code is to be transmitted during the activation, the dialer shall continue to transmit until all codes are sent without disconnecting and redialing.

4.6 Local Alarm (Option I) Requirement

If an integral electronic siren is provided, then the manufacturer's specification shall govern the output. If only a control is provided, it shall consist of a contact closure rated not less than 2 Amps at 110 nominal ac voltage or a voltage that when tested in accordance with section 5.7 will deliver at least 12-V dc to a 6-Ω load.

4.7 Tamper Protection (Option II) Requirement

If the dialer is in an enclosure, the dialer shall signal an alarm if an attempt is made to gain access to the dialer while it is in the secure state. When tested in accordance with section 5.8, 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 signal an alarm before the cover has moved a sufficient distance to permit a direct line of sight to electrical circuits or adjustment controls.

4.8 Line Checking (Option III) Requirement

If this option is provided, when tested in accordance with section 5.9, the dialer shall have a contact closure or other suitable means of actuating a local annunciator in the event that the dialer detects an unusable telephone circuit. As a minimum, the dialer shall check the telephone circuit for being shorted or open.

4.9 Extension Phone Disconnect (Option IV) Requirement

If this option is provided, the dialer shall be able to disconnect an outgoing call and seize the telephone line for its own use when tested in accordance with section 5.10.

4.10 Audio Monitoring (Option V) Requirement

If this option is provided, the dialer, at the completion of its alarm message, shall provide audio from the protected premises for at least 5 min or until it receives a shutdown signal.

4.11 Supervisory Opening and Closing Capability (Option VI) Requirement

If this option is provided, the dialer, when tested in accordance with section 5.12, shall activate and transmit the proper coded message and then go to an appropriate mode.

4.12 Abort Signal Capability (Option VII) Requirement

If this option is provided, the dialer shall transmit the abort signal when tested in accordance with section 5.13.

4.13 Secure Signal Capability (Option VIII) Requirement

If this option is provided, the dialer shall activate and transmit the secure signal upon achieving the secure state when tested according to section 5.14. This option is in addition to option VI and does not replace the supervisory closing signal.

4.14 Standby Power (Option IX) Requirement

When tested in accordance with section 5.15, the dialer shall not actuate as a result of ac power being interrupted and restored. Following operation from the standby power for the period of time specified by the manufacturer, section 4.2(d), the dialer shall still meet the requirements of sections 4.4 through 4.5. If the unit incorporates an integral battery charging circuit, the dialer shall meet the requirements of this standard when power is restored, and the charging circuit shall fully recharge the batteries in the period of time specified by the manufacturer, section 4.2(d).

4.15 Stability Requirement

When tested for supply voltage variations, mechanical shock, temperature, and humidity (sec. 5.16), the dialer shall continue to operate correctly (sec. 4.5) and shall not falsely actuate.

4.16 Electromagnetic Susceptibility Requirement

When subjected to radiated electromagnetic fields, conducted interference, and simulated lightning voltage surges on the telephone lines in accordance with section 5.17, the dialer shall meet the requirements of section 4.5 and shall not falsely actuate.

5. TEST METHODS

5.1 Sampling

Three dialers shall be selected at random for testing. A matching receiving unit shall be supplied by the manufacturer to display the alarm messages, to provide options interface (such as audio), and to provide the acknowledgment and shutdown signals to the dialer when these signals are not being supplied by other test equipment. Units with seriously damaged packaging or other obvious damage that would normally result in the units being returned should be excluded from tests.

5.2 Test Conditions

5.2.1 Test Environment

Unless otherwise specified, all tests shall be performed with the dialer operated at its specified normal operating voltage and in a typical laboratory ambient environment. In all cases, the dialer 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.

5.2.2 Test Setup

The test equipment shall be connected to the dialer terminals through a loading circuit shown in figure 1. The signals are measured across the 600±6-Ω resistor. The 48±5-V talking battery is connected, with the polarity indicated, in series with the loop resistance of the telephone lines which is simulated by a nominal 200-Ω resistor in each side of the circuit. During the tests the positive side of the talking battery may be grounded, or it may be allowed to float, depending on the characteristics of the test instruments. The polarity of the connections to the dialer shall be in accordance with the manufacturer's directions. If there is a terminal for grounding the dialer, then the terminal shall be grounded; if not, then the dialer case shall be grounded.

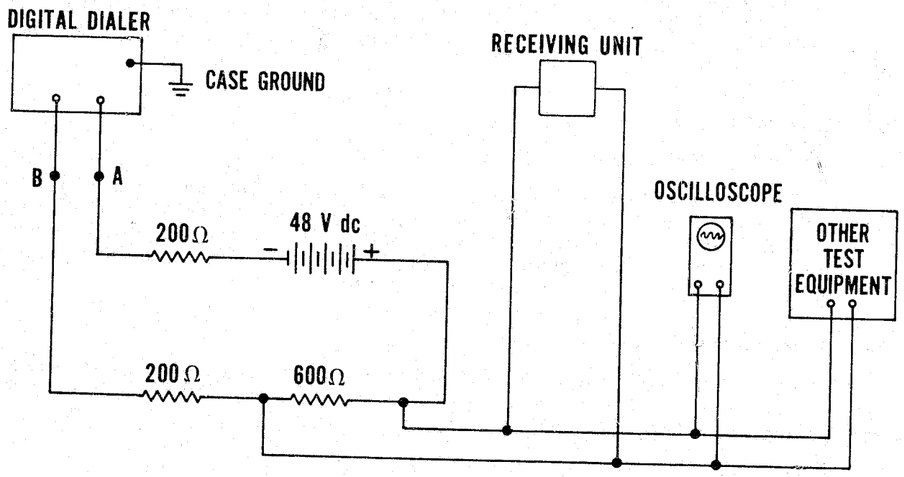

FIGURE 1. *Test equipment connection to dialer's telephone terminals.*

5.3 Test Equipment

5.3.1 Environmental Test Chamber

The environmental test chamber(s) shall be of a size sufficient to accommodate the dialer and any associated enclosure 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 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.

5.3.2 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.

5.3.3 Oscilloscope and Camera

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. A data recording camera compatible with the oscilloscope shall be used.

5.3.4 Time Interval Measuring Instrumentation

The time interval measuring instrumentation shall be an electronic timer or similar equipment capable of measuring time intervals with an uncertainty of 1 ms or less. For time intervals longer than 10 s, a stopwatch with an error of not more than 1/2 s may be used.

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.

5.4 Transmission Signal Tests

5.4.1 Acknowledgment Signal and Digital Code Test

Connect a signal generator through a momentary contact switch to the circuit shown in figure 1 in place of the "receiving unit." Set the frequency of the generator to that of the acknowledgment signal specified by the manufacturer. Activate the dialer. After the dialer has completed the dialing of the preprogrammed telephone number, apply a –30-dBm signal from the generator to the dialer. Observe whether the dialer produces a correct alarm message transmission.

5.4.2 Alarm Message Content

Following the test procedure outlined in section 5.4.1, use the oscilloscope and camera to obtain a record of the alarm message. Observe whether the alarm message includes an identification code, an alarm code, and a transmission checking technique.

5.4.3 Shutdown Signal

Follow the test procedure outlined in section 5.4.1. Set the frequency of the signal generator to that of the shutdown signal specified by the manufacturer. After the dialer has completed the transmission of an alarm message, apply a –30-dBm shutdown signal to the dialer. Observe whether the dialer goes off line and if it is ready for another alarm signal triggering.

5.5 Telephone Interface Tests

5.5.1 Telephone Line Control Test

Connect the dialer to the telephone lines in accordance with the manufacturer's instructions. From a telephone not on the same line, place a call to the telephone number associated with the line the dialer uses. While the phone is ringing, activate the dialer. Verify that the requirements of sections 4.4.2 and 4.5 are met.

5.5.2 Maximum On-the-Telephone Line Time Test

Activate the dialer. Using an appropriate signal generator or the manufacturer-supplied receiver, send the acknowledgment signal to the dialer. At the end of the alarm message do not permit the shutdown signal to be sent. Measure the time from activation of the dialer until it finally disconnects from the simulated telephone line. Consult the manufacturer if technical help is needed in order to perform this test.

5.5.3 Multiple Attempts to Send an Alarm Message Test

Disconnect the receiver from the circuit of figure 1. Activate the dialer. Observe the dialer performance for conformance to section 4.4.4. Using an appropriate signal generator or the manufacturer-supplied receiver as shown in figure 1, send the acknowledgment signal when appropriate after the dialer is

activated but do not permit the shutdown signal to be sent. Again observe the dialer performance for conformance to section 4.4.4. Consult the manufacturer if technical help is needed in order to perform this test.

5.5.4 Dial Pulse Timing Test

Connect the equipment as shown in figure 1. Program the dialer to dial a test phone number of all "zeros" in accordance with the instructions provided by the manufacturer. Use the oscilloscope and camera to obtain a record of the dialing pulses. Set the oscilloscope sweep rate at 50 ms/cm to obtain at least four (make-to-break and break-to-make) transitions of the "zero" pulses on the oscilloscope screen. Take at least four photographs of the "zero" pulses. Repeat the above test after reprogramming the dialer to dial a test phone number of all "ones." From the photographs measure the duration of the make and break intervals and the interdigital spacing.

5.5.5 Chatter Test

By means of an oscilloscope (as in sec. 5.5.4), examine the dialing pulses for any spurious makes or breaks. Take at least four photographs of the pulse trace; examine these for spurious breaks or makes and if any are observed, determine their duration and separations. The oscilloscope trace intensity and sweep rate will need adjusting to insure that any short-duration chatter has not been missed.

5.5.6 Dialing Impedance Test

With the dialer in the secure state, use an ohmmeter to measure the open-contact (break) impedance as seen at the telephone terminals of the dialer. Activate the dialer in accordance with the manufacturer's instructions, and measure the closed-contact (make) impedance at the same terminals. During these measurements the dialer should not be connected to any other apparatus.

5.6 Functional Performance Test

Program the telephone number, the identification code and the alarm code into the dialer in accordance with the manufacturer's instructions. Following the manufacturer's instructions, activate each channel, one at a time, and observe the phone number dialed, observe the function of the dialer for conformance to the requirements of sections 4.3 through 4.5.

5.7 Local Alarm (Option I) Test

If a contact closure is provided, determine from the relay type the contact rating. If a voltage output is provided, measure the open circuit voltage with the control circuit actuated. If this voltage is 12-V dc or more connect a 6-Ω resistor (at least 25 W) across the output terminals and again measure the output voltage.

5.8 Tamper Protection (Option II) Test

If the enclosure 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, lift 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 lifted one side at a time, then lift or move it uniformly until the tamper switch first actuates, and measure the movement of the cover. If the device 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.

5.9 Line Checking (Option III) Test

Connect the dialer to the test circuit of figure 1. Monitor the local alarm actuating circuit. Short the dialer terminals from "A" to "B." Actuate the dialer. Note the status of the local alarm actuating circuit. Remove the short. Repeat the above test but open the circuit first at "A" and then at "B" as separate tests.

5.10 Extension Phone Disconnect (Option IV) Test

Connect the dialer to the telephone lines in accordance with the manufacturer's instructions. From a telephone on the same line (an extension phone), place a call. While the call is in progress, actuate the dialer. Verify that the requirements of sections 4.5 and 4.9 are met.

5.11 Audio Monitoring (Option V) Test

Program the dialer to dial a working telephone number. Connect a microphone to the dialer in accordance with the manufacturer's instructions. Connect the dialer to the telephone line. Actuate the dialer. Using a signal generator or a receiving unit at the dialed phone provide an acknowledgment signal (see sec. 5.4.1). Measure the length of time that audio is available over the phone line from the dialer. Repeat the above test except that after 2 min of audio, transmit a shutdown signal (see sec. 5.4.3) to the dialer. Observe whether or not the dialer disconnects from the phone line.

5.12 Supervisory Opening and Closing Capability (Option VI) Test

Connect the dialer as shown in figure 1. Activate the supervisory closing option. Observe the dialer for correct telephone number dialed, correct transmission message sent, and correct shutdown, in accordance with sections 4.3, 4.4, 4.5, and 4.11. Activate the supervisory opening option. Observe the dialer for correct telephone number dialed, correct transmission message sent and correct shutdown, in accordance with sections 4.3, 4.4, 4.5, and 4.11. Repeat the above test as many times as necessary to test each of the activation modes usable after a supervisory closing is transmitted.

5.13 Abort Signal Capability (Option VII) Test

With the dialer connected to the telephone simulation circuit of figure 1, activate the dialer for an intrusion alarm transmission. While this transmission is in progress, activate the abort mode. Verify that the alarm signal transmission ceases and that an abort code is transmitted.

5.14 Secure Signal Capability (Option VIII) Test

With the dialer connected as in figure 1, activate the secure signal transmission. Observe the dialer for correct functioning in accordance with the requirements of sections 4.3, 4.4, 4.5, and 4.13.

5.15 Standby Power (Option IX) Test

While operating the control unit from the ac power line disrupt the ac power and permit the control unit to operate from its fully charged standby power supply. Observe whether it activates, wait 1 min, reconnect the ac power, and again observe whether it activates. Repeat this connect and disconnect test two additional times. Then allow the unit to operate continuously from the standby power supply for the period of time specified by the manufacturer in accordance with section 4.2(d). Upon completion of the required operating period, test the unit in accordance with section 5.6 while still operating on standby power.

If the unit incorporates a battery charging circuit, connect it to line voltage and again test the unit in accordance with section 5.6. Allow dialer to operate continuously for the period of time specified by the manufacturer as required to fully charge the batteries [sec. 4.2(d)] and then repeat the standby power operation test as described in the preceding section.

5.16 Stability Tests

Set up the dialer according to section 5.2.2. Use a work bench for mounting the equipment unless instructed otherwise in each test.

5.16.1 High-Voltage Test

Connect the control unit to a variable voltage power supply. Adjust the power supply for a voltage of 110±1 percent of the nominal operating voltage as specified by the manufacturer, section 4.2(f), and perform the test of section 5.6.

5.16.2 Low-Voltage Test

Adjust the variable voltage power supply for a voltage of 85±1 percent of the nominal operating voltage as specified by the manufacturer, section 4.2(f), and perform the test of section 5.6.

5.16.3 Shock Test

Disconnect the dialer from the power line voltage and standby power, and place the unit on a 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. 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 the power and then test in accordance with section 5.6.

5.16.4 High-Temperature Test

Place the dialer 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 test in accordance with section 5.6. The instrumentation shall be located outside the environmental chamber. The dialer shall be arranged so that the reset switch can be actuated from outside of the chamber.

5.16.5 Low-Temperature Test

Place the dialer 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 test in accordance with section 5.6. The instrumentation shall be located outside the environmental chamber. The dialer shall be arranged so that the reset switch can be actuated from outside the chamber.

5.16.6 High-Humidity Test

Place the dialer 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 test in accordance with section 5.6. The instrumentation shall be located outside the environmental chamber. The dialer shall be arranged so that the reset switch can be actuated from outside the chamber.

5.17 Electromagnetic Susceptibility Tests

The radiated electromagnetic susceptibility test shall be performed in a shielded room (EMI test chamber). The conducted electromagnetic 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 radiofrequency signals and voltage spikes on the power lines can interfere with the operation of such instruments.

5.17.1 Conducted Electromagnetic Susceptibility Tests

Connect the dialer as shown in figure 2. Observe whether the dialer activates during the performance of the tests.

Subject the dialer to power line conducted interference in accordance with test methods CS01, CS02, and CS06 of MIL-STD-462 [6]. Maintain a test level of 1- to 3-V rms, either manually or automatically, over the entire frequency test range.

Determine the level of susceptibility of the unit for each frequency at which the unit falsely actuates. Manually tune to the frequency at which the unit indicated an alarm, and raise the signal level from the lowest output level until the unit actuates. The threshold susceptibility level is that signal level for which the dialer will not actuate for a 10-percent reduction in the signal level from the level that does cause an actuation.

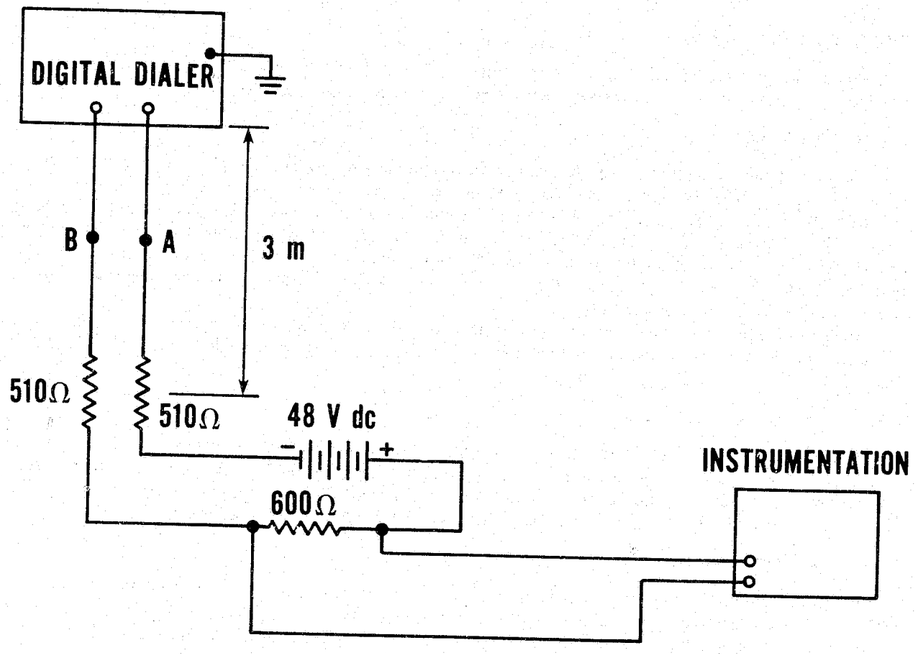

FIGURE 2. *Test circuit setup for conducted and radiated EMI tests.*

Repeat test CS02 on the transmission lines. Couple the interference signals to the side of each 510-Ω resistor (points A and B of fig. 3).

5.17.2 Radiated Susceptibility Test

Connect the dialer as shown in figure 2. The instrumentation and line resistors shall be located outside of the EMI test chamber during testing. Arrange the unit so that the reset switch can be actuated from outside of the shielded room if the unit does not reset automatically.

Subject the dialer to radiation in accordance with test method RS03 of MIL-STD-462 [6]. 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 unit for each frequency or frequency band at which the unit actuates. The susceptibility level is that signal level for which the dialer will not actuate for a 10-percent reduction in signal level from the level that does cause an actuation.

5.17.3 Lightning Surge Test

Connect the lightning surge test circuit to the oscilloscope, with the output of the circuit terminated in a 600-Ω resistor as shown in figure 3. 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 dialer as shown in figure 1. Place the dialer 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 control unit, with at least a 15-s interval between surges

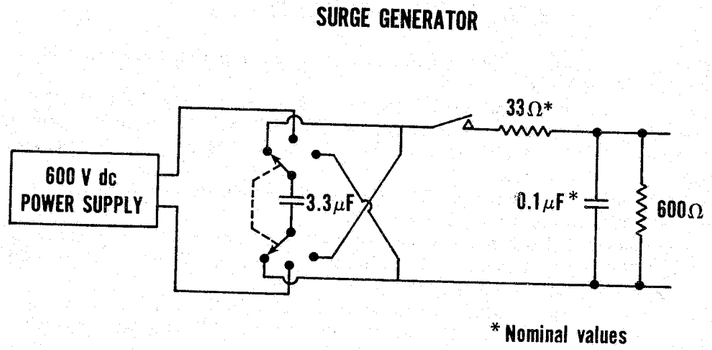

FIGURE 3. *Simulated lightning surge generation circuit.*

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 dialer actuations. Finally, perform the functional performance test of section 5.6, once for each channel (alarm message type).

APPENDIX A—REFERENCES

[1] Connection of terminal equipment to the telephone network. Code of Federal Regulations. Pt. 68, Title 47; revised as of 1977 October 1.

[2] Standard plugs and jacks. Federal Register. 41:28694; 1976 July 12. Revision of 47 CFR 68.104.

[3] Protective connecting arrangements CAU/SU3/SU4/SU6. Bell System Voice Communications, Technical Reference PUB 42201; 1975 October. American Telephone and Telegraph Co., Piscataway, NJ.

[4] Control units for intrusion alarm systems. NIJ Standard-0321.00. National Institute of Justice, U.S. Department of Justice, Washington, DC 20531.

[5] Electrical characteristics of Bell System network facilities at the interface with voiceband auxiliary and data equipment. Bell System Communications, Preliminary Technical Reference PUB 47001; 1976 August. American Telephone and Telegraph Co., Piscataway, NJ.

[6] 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.

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