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CONTRIBUTION

TITLE: Draft Proposed Revision of T1.409-1996

SOURCE: Verizon

PROJECT: Special Access Lines

CONTACT: Trone Bishop
Verizon
Room 6E
13100 Columbia Pike
Silver Spring, MD 20904
email: trone.t.bishop.jr@verizon.com
Tel: 301-236-3754

ABSTRACT: This contribution provides updated text for the proposed revision of T1.409-1996 -- *Network-to-Customer Installation Interfaces – Analog Voicegrade Special Access Lines Using E&M Signaling*. The R1 version includes changes approved at the August 2001 meeting of the T1E1.3 Working Group.
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ANSI
T1.409-200X
Revision of
T1.409-1996

draft American National Standard
for Telecommunications –

Network-to-Customer Installation Interfaces – Analog Voicegrade Special Access Lines Using E&M Signaling

Secretariat

Alliance for Telecommunications Industry Solutions

Approved [ ]

American National Standards Institute, Inc.

Abstract

This standard provides signaling requirements for the analog voicegrade interface between telecommunication carriers and customer installations when E&M signaling is used across the interface. These requirements are intended to assist carriers, manufacturers, and users of products to be used with telecommunication networks to understand the parameters of the existing networks. This standard is a revision of T1.409-1996, which is replaced in its entirety.

Foreword (This foreword is not a part of American National Standard T1.409-200x.)

This standard is one of a series of telecommunication network-to-customer installation interface standards developed by Technical Subcommittee T1E1 of Accredited Standards Committee T1, Telecommunications. It covers special access lines using E&M signaling. Committee T1 standards serve the public interest through promoting understanding between carriers, end customers, and manufacturers.

This standard will be useful to those engaged in the provisioning or operation of telecommunications equipment or services that share a boundary at the Network Interface. It establishes requirements for interfacing and connecting with telecommunication carrier networks. Compliance should provide compatibility in most installations. Conformance with the standard does not guarantee interface compatibility or acceptable performance under all possible operating conditions. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identified as having distinct compatibility or performance advantages.

There is one annex in this standard. It is informative and is not considered a part of this standard.

This is the third issue of the standard covering analog voicegrade special access lines using E&M signaling. This standard supersedes T1.409-1996 in its entirety. Most of the revisions were editorial in nature, that is, they are intended to provide information or to improve clarity. One technical revision was made - a normative reference to TIA/EIA-IS-968 was added for connectors (see clause 4).

Suggestions for the improvement of this standard are welcome. They may be addressed to the Alliance for Telecommunications Industry Solutions 1200 G Street, NW, Suite 500, Washington, DC 20005.

The standard was processed and approved for submittal to ANSI by Accredited Standards Committee T1 on Telecommunications. Committee approval of the standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, Accredited Standards Committee T1 had the following members:

E. R. Hapeman, Chair

W.R. Zeuch, Vice-Chair

S. D. Barclay, Secretary

Organization Represented	*Name of Representative*
[To be provided at publication]	

At the time it approved this standard Technical Subcommittee T1E1 on Interfaces, Power and Protection for Networks had the following members:

E. J. Eckert, Chair

R. L. Townsend, Vice-Chair

Organization Represented	*Name of Representative*

[To be provided at publication]

Working Group T1E1.3, which developed this standard, had the following members:

Trone Bishop, Chair and Editor
Maynard Wright, Vice Chair

Paul Bauer
Richard Bobilin
William Buckley
Mike Cook
Phil Dillon
Frinel Fainaru
Sean Iwasaki
Gunter Neumeier
Reagan Rice
Chris Simanonis
Edwin Soltysiak
Rick Townsend

draft American National Standard
for Telecommunications –

Network to Customer Installation Interfaces – Analog Voicegrade Special Access Lines Using E&M Signaling

1 Scope

This standard provides specifications for E&M signaling interfaces between telecommunication carrier networks and customer installations. In this standard, the telecommunication carrier network is referred to as the Network and the customer premises wiring and equipment as the Customer Installation (CI). The interface between the Network and the CI will be known as the Network Interface (NI). The NI is the same as the demarcation point defined in Part 68 of the FCC Rules and Regulations.

This standard covers interfaces between Network and CI equipment units located in the same building that employ dc signaling methods known collectively as E&M signaling. E&M signaling methods use different leads for dc signaling and analog voicegrade signal transmission. Four methods of E&M signaling are covered:

- Type I – CI Originates on the M Lead;
- Type I – CI Originates on the E Lead;
- Type II – CI Originates on the M Lead;
- Type II – CI Originates on the E Lead.

These E&M signaling methods are illustrated in Figures 1 through 4.

E&M signaling interfaces are typically used with services, such as private network trunks (e.g., PBX tie trunks), that provide dedicated transmission and signaling paths between two CIs or between a network switching node and a CI. Many different signaling protocols may be used with E&M signaling. Signaling protocols are not covered by this standard, but are covered in other documents. For example, signaling protocols for PBX tie trunks are covered in ANSI/TIA/EIA-464-B, *Requirements for private branch exchange (PBX) switching equipment*.

Intermediate carrier-to-carrier-network interfaces that use E&M signaling are not addressed in this standard; however, this standard may be referenced for those interfaces when applicable. In such cases, the CI specifications would apply to one carrier network, the network specifications would apply to the other carrier network, and physical connection would be made in a manner mutually agreed upon by the carriers.

This standard also does not cover the voicegrade transmission performance of the network or the CI.

The voltages and currents described in this standard are those encountered during the normal operation of the interface. Abnormal voltages and currents caused by the network environment or the CI environment are not covered.

2 Normative reference

The following standard contains provisions that, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below.

TIA/EIA-IS-968-2001, *Telecommunications - Telephone Terminal Equipment - Technical Criteria to Prevent harms to the Telephone Network.*

3 Definitions, abbreviations, acronyms, and symbols

3.1 Definitions

3.1.1 break interval: In dial-pulse signaling, that portion of the dial pulse in which the pulsing circuit is on-hook.

3.1.2 carrier: An organization that provides telecommunications service to the public.

3.1.3 customer installation (CI): All telecommunication equipment and wiring on the customer side of the network interface.

3.1.4 dial pulse (DP): An interruption in the direct current of a signaling system to provide address information.

3.1.5 dial-pulse period: One complete cycle of a dial pulse, consisting of fall time, break interval, rise time, and make interval.

3.1.6 dial pulse signaling; A method of transmitting a telephone address over a direct-current path. The dc current is interrupted at the transmitting end in a defined pattern. The number of interruptions in the dc current specifies the address digit.

3.1.7 interdigit interval: In dial-pulse signaling, the time from the end of the last on-hook of one digit to the beginning of the first on-hook of the next digit.

3.1.8 make interval: In dial-pulse signaling, that portion of the dial pulse in which the pulsing circuit is off-hook.

3.1.9 network: A combination of transmission and signaling equipment used to establish communication paths.

3.1.10 network interface (NI) – demarcation point: The point of connection between a telecommunication carrier network and the CI.

3.1.11 percent break: In dial-pulse signaling, the ratio of the break time to the dial-pulse period.

3.1.12 private branch exchange (PBX): A private switching system that is a part of a customer installation (CI).

3.1.13 voicegrade: A term used to qualify a channel, facility, or service that is suitable for the transmission of speech, data, or facsimile signals; generally with a frequency range of about 300 to 3000 Hz.

3.2 Abbreviations, acronyms, and symbols

A	ampere
ac	alternating current
ANSI	American National Standards Institute
CI	customer installation
dBm	decibels referenced to 1 milliwatt
dc	direct current
DP	dial pulse
EIA	Electronic Industries Association
FCC	Federal Communications Commission
FIC	Facility Interface Code
Hz	hertz
kΩ	kilohm
NCI	Network Channel Interface (Code)
NI	Network Interface
Ω	ohm
PBX	Private Branch Exchange
R	ring conductor
SB	signal battery (lead)
SG	signal ground (lead)
T	tip conductor
TIA	Telecommunications Industry Association
V	volt

4 General information

4.1 E&M signaling methods

All E&M signaling methods permit two-state (on-hook or off-hook) dc signaling to be transmitted independently in both directions across the NI. DC signaling is performed over leads different from the leads used for voicegrade signal transmission. Four to eight leads may be used to connect the CI to the Network. The number of leads across the NI depends on the number of transmission pairs used and the type of E&M signaling employed.

In this document, the two sides of an E&M signaling interface will be referred to as Side A and Side B. This terminology is consistent with that used in the FCC Rules and Regulations. CIs that originate on the M lead are located on Side A of an interface. CIs that originate on the E lead are located on Side B of an interface. Side A and Side B of E&M signaling interfaces are illustrated in Figures 1 through 4.

4.1.1 Transmission leads

Voicegrade transmission across the NI may be either two-wire or four-wire. If two-wire transmission is used, two conductors commonly called tip (T) and ring (R) are used to transmit and receive voicegrade signals to and from the CI. If four-wire transmission is used, four conductors commonly designated T, R, T1 and R1 are used. The T and R leads transmit voicegrade signals from the CI to the network and the T1 and R1 leads transmit voicegrade signals from the network to the CI.

4.1.2 E&M signaling types

Two types of E&M signaling methods, traditionally called Type I and Type II, are covered in this document.[1)]

Type I E&M signaling methods are ground return configurations that use two dc signaling leads, called the E lead and the M lead. One lead is used by the network to signal dc state changes to the CI and the other lead is used by the CI to signal state changes to the network. Equipment on Side A of a Type I interface applies a negative dc voltage to the M lead to send an off-hook signal across the NI and applies a ground to the M lead to send an on-hook signal. Equipment on Side B of the interface applies ground to the E lead to send an off-hook signal across the NI and supplies an open circuit to the E lead to send an on-hook signal.

Type II E&M signaling methods are looped (metallic return) signaling configurations that use four dc signaling leads, called E, M, SG, and SB. The E and SG leads are used to signal in one direction across the NI and the M and SB leads are used to signal in the opposite direction across the NI. Equipment located on Side A of the interface provides a low-resistance connection between the M and SB leads to send an off-hook signal across the NI and a high-resistance connection between the same two leads to send an on-hook signal. Equipment located on Side B of the interface uses the E and SG leads in the same manner to send on-hook and off-hook signals across the NI.

Table 1 summarizes the signaling methods described above.

[1)] The single-lead signaling associated with Type I interfaces is a potential source of interference, particularly if the current exceeds 50 mA. The Type II interfaces provides separation between switching and signaling power systems and are less likely to cause interference to other circuits.

Table 1 – E & M signaling states

Type	Side A to Side B			Side B to Side A		
	Lead(s)	On-hook	Off-hook	Lead(s)	On-hook	Off-hook
I	M	Ground	Battery	E	Open	Ground
II	M, SB	Open	Closed	E, SG	Open	Closed

4.1.3 Signaling lead resistance

The maximum permitted equipment to equipment resistance for the interfaces described in this standard is 150 Ω per conductor. This standard allocates 75 Ω per conductor for CI wiring and 75 Ω per conductor for network wiring.

Network and CI equipment shall work with any resistance between 0 Ω and 150 Ω per conductor between the CI equipment and the network equipment. CI equipment and network equipment shall meet the requirements of this document with any resistance from 0 Ω and 75 Ω per conductor between the equipment and the NI.

4.2 CI terminal equipment and wiring

This standard assumes that CI terminal equipment meets the requirements of TIA/EIA-IS-968-2001 which contains technical criteria to protect the network from harm. This standard also assumes that the customer premises wiring meets the technical requirements in Part 68 of the FCC Rules.

4.3 Network interface codes

Network Interface codes are used to identify interface specifications associated with specific network interfaces. These codes provide information about the number of interface conductors, the signaling protocol, the electrical characteristics, and the transmission levels at the NI. There are two methods of describing interfaces:

- *Facility Interface Codes (FICs):* These codes were originally developed to describe the interfaces in Part 68 of the FCC Rules and Regulations and are used for non-access services;
- *Network Channel Interface (NCI) codes:* These codes were originally developed to describe the interfaces associated with access services and are now also used to describe the interfaces associated with some non-access services.

The FICs and NCI codes for the four methods of E&M signaling covered by this document are given in Table 2.

Table 2 – FICs and NCI codes

Type	CI originates	Transmission	NCI	FIC
I	M	2-wire	04EA2-M	· TL11M
I	E	2-wire	04EA2-E	· TL11E
I	M	4-wire	06EA2-M	· TL31M · TC31M
I	E	4-wire	06EA2-E	· TL31E · TC31E
II	M	2-wire	06EB2-M	· TL12M
II	E	2-wire	06EB2-E	· TL12E
II	M	4-wire	08EB2-M	· TL32M · TC32M
II	E	4-wire	08EB2-E	· TL32E · TC32E

4.4 Physical connection at the NI

Depending on the number of transmission pairs and the E&M signaling type used, four, six or eight conductors may be used across the NI to connect the CI to the network. The four possible NI wiring configurations are shown in Figure 5.

When the physical connection of the CI to the network at the NI is accomplished by means of jacks and plugs, such connectors shall meet the connector requirements in TIA/EIA-IS-968-2001. Any of the applicable connector wiring configurations described in Committee T1 Technical Report Number 5 (see Annex A) may be used.

4.5 Test circuits

All test circuits and all numerical values (e.g., voltages) shown for test circuits are for purposes of the specific test under consideration and may not represent actual operating conditions.

In this standard, the words *contact* and *contacts* are used to indicate the device that opens and closes a circuit for supervisory or dial-pulse signals. The words *contact* or *contacts* can refer to either metallic contacts or to solid-state circuit elements that perform the same function.

4.6 Requirement categories

In accordance with ANSI guidelines, two categories of criteria are specified in this standard; requirements and recommendations. Requirements are designated by the word *shall* and recommendations by the word *should*. The requirements generally specify the acceptable levels for compatibility between the network and the CI. Recommendations represent goals currently identifiable as having distinct compatibility or performance advantages.

5 Characteristics common to all E&M signaling interfaces

5.1 Network characteristics

5.1.1 Transmission conductors

The network shall not apply a dc voltage between any of the transmission conductors shown in Figure 5 or between any transmission conductor and ground.

5.1.2 Voicegrade transmission path

If both the CI and the network are sending on-hook to the NI, a voiceband transmission path may not be provided by the network.

The network should provide a voicegrade transmission path in both directions of transmission within 300 milliseconds after the network sends an off-hook to the NI or within 300 milliseconds after the CI sends an off-hook to the NI.

NOTE – If the network equipment uses a single frequency (SF) signaling method, the establishment and maintenance of the transmission path is more complex than described in this subclause. Until both the network and the CI are sending steady off-hooks to the NI, two types of transmission paths can exist in one or both directions of transmission:

- a normal voicegrade transmission path;
- a limited voicegrade transmission path that has a loss notch at the network inband signaling frequency. The most common network inband signaling frequency is 2600 Hz.

Before, during, and after transitions between sending on-hook and off-hook to the NI by either the CI or the network, previously established transmission paths can be temporarily interrupted and/or changed in type in one or both directions of transmission.

5.1.3 ac Voltages on signaling leads

No significant ac voltage shall be applied between the E, M, SB, or SG lead and ground (open circuit voltage ≤ 5 V peak) by the network.

5.1.4 Nominal –48 volt dc voltages

All nominal –48 volt dc voltages specified in this document shall be maintained within the range of –42.75 V dc and –56.7 V dc.

5.2 Customer installation characteristics

5.2.1 Transmission conductors

The CI shall not apply a dc voltage between any of the transmission conductors shown in Figure 5 or between any transmission conductor and ground.

5.2.2 Transmission path

When the CI is sending an on-hook signal to the NI, the CI shall not deliver power into a 600 Ω termination between the tip and ring conductors at the NI greater than –55 dBm.

The CI shall not deliver voicegrade signals into a 600 Ω load between the tip and ring conductors at the NI that have power in the 2450 Hz to 2750 Hz frequency band unless an equal or greater amount of power is present in the 800 Hz to 2450 Hz frequency band.

5.2.3 ac Voltages on signaling leads

No significant ac voltage shall be applied between the E, M, SB, or SG lead and ground (open circuit voltage ≤ 5 V peak) by the CI.

5.2.4 Nominal –48 volt dc voltages

All nominal –48 volt dc voltages specified in this document shall be maintained within the range of –42.75 V dc and –56.7 V dc.

6 Type I E&M signaling – CI originates on the M lead

6.1 Network characteristics

6.1.1 Type I Side B characteristics

The network shall provide the Type I Side B characteristics of clause 11.

6.1.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the network should be between 42 percent and 78 percent break generated by a contact operating between 8 and 12 pulses per second. During the break interval, the on-hook conditions of 11.3 shall be provided. During the make interval and the interdigit interval, the off-hook conditions of 11.4 shall be provided.

6.2 Customer installation characteristics

6.2.1 Type I Side A characteristics

The CI shall provide the Type I Side A characteristics of clause 10.

6.2.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the CI shall be between 52 percent and 64 percent break generated by a contact operating at a rate of 8 to 11 pulses per second. During the break interval, the on-hook conditions of 10.2 shall be met. During the make interval and the interdigit interval, the off-hook conditions of 10.3 shall be met.

7 Type I E&M signaling – CI originates on the E lead

7.1 Network characteristics

7.1.1 Type I Side A characteristics

The network shall provide the Type I Side A characteristics of clause 10.

7.1.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the network should be between 42 percent and 78 percent break generated by a contact operating between 8 and 12 pulses per second. During the break interval, the on-hook conditions of 10.2 shall be provided. During the make interval and the interdigit interval, the off-hook conditions of 10.3 shall be provided.

7.2 Customer installation characteristics

7.2.1 Type I Side B characteristics

The CI shall provide the Type I Side B characteristics of clause 11.

7.2.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the CI shall be between 52 percent and 64 percent break generated by a contact operating at a rate of 8 to 11 pulses per second. During the break interval, the on-hook conditions of 11.3 shall be met. During the make interval and the interdigit interval, the off-hook conditions of 11.4 shall be met.

8 Type II E&M signaling – CI originates on the M lead

8.1 Network characteristics

8.1.1 Type II Side B characteristics

The network shall provide the Type II Side B characteristics of clause 13.

8.1.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the network should be between 42 percent and 78 percent break generated by a contact operating between 8 and 12 pulses per second. During the break interval, the on-hook conditions of 13.3 shall be provided. During the make interval and the interdigit interval, the off-hook conditions of 13.4 shall be provided.

8.2 Customer installation characteristics

8.2.1 Type II Side A characteristics

The CI shall provide the Type II Side A characteristics of clause 12.

8.2.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the CI shall be between 52 percent and 64 percent break generated by a contact operating at a rate of 8 to 11 pulses per second. During the break interval the on-hook requirements of 12.3 shall be met. During the make interval and the interdigit interval, the off-hook requirements of 12.4 shall be met.

9 Type II E&M signaling – CI originates on the E lead

9.1 Network characteristics

9.1.1 Type II Side A characteristics

The network shall provide the Type II Side A characteristics of clause 12.

9.1.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the network should be between 42 percent and 78 percent break generated by a contact operating between 8 and 12 pulses per second. During the break interval, the on-hook conditions of 12.3 shall be provided. During the make interval and the interdigit interval, the off-hook conditions of 12.4 shall be provided.

9.2 Customer installation characteristics

9.2.1 Type II Side B characteristics

The CI shall provide the Type II Side B characteristics of clause 13.

9.2.2 Sending dial pulses to the NI

Dial pulses sent to the NI by the CI shall be between 52 percent and 64 percent break generated by a contact operating at a rate of 8 to 11 pulses per second. During the break interval, the on-hook requirements of 13.3 shall be met. During the make interval and the interdigit interval, the off-hook requirements of 13.4 shall be met.

10 Type I E&M signaling – Side A characteristics

10.1 Open-circuit dc voltages – E lead

The open-circuit dc voltage from the E lead to ground applied by Side A at the NI shall be between –21 and –56.7 V. The open-circuit E-lead dc voltage at the NI should be nominal –48 V.[2)]

10.2 Sending on-hook to the NI

When sending an on-hook to the NI, Side A shall apply dc ground to the M lead. The voltage drop between the M lead and ground at the NI shall be less than (1 + 75xI) V with any current, I, less than or equal to 0.05 amperes flowing with the test circuit of Figure 6 connected to the M lead.

10.3 Sending off-hook to the NI

The following criteria apply to Side A when it is sending an off-hook signal to the NI:

– The open-circuit voltage from the M lead to ground provided by Side A at the NI shall be nominal –48 V dc;

– The voltage on the M lead provided by Side A at the NI shall not drop more than (5 + 75xI) V dc from its open circuit voltage with any current, I, less than or equal to 0.085 amperes flowing in the M lead;

The following Side A characteristics also apply at the NI:

– The peak short-circuit current provided by Side A with the M lead shorted to ground shall not exceed 4.0 amperes. The peak short-circuit current should not exceed 2.0 amperes;

– The steady-state short-circuit current provided by Side A with the M lead shorted to ground should be ≤ 50 milliamperes.

10.4 Detection of on-hook from the NI

Side A shall detect 20 kΩ or greater connected between the E lead and ground at the NI as an on-hook.

10.5 Detection of off-hook from the NI

Side A shall detect 75 Ω or less connected in series with a 3-volt battery[3)] connected between the E lead and ground as an off-hook. The polarity of the battery shall be such as to oppose the potential of the E lead detector.

The following Side A characteristics also apply at the NI:

– Side A shall limit the current in the E lead to ≤ 100 milliamperes with any resistance between 0 and 500 Ω connected between the E lead and ground. The current in the E lead should be limited to ≤ 50 milliamperes;

– Side A shall provide at least 2 milliamperes in the E lead with an off-hook applied to the E lead.

[2)] Equipment that does not meet the objective of nominal –48 volts may be incompatible with some signaling test sets and some signaling lead status indicators.

[3)] The 3-volt battery represents a 2-volt drop across the contact on Side B of the NI plus a 1-volt ground potential difference.

10.6 Switching transients – M lead

Side A of the NI shall ensure that the voltage from the M lead to ground does not exceed 80 V dc at any time. For relay contact implementations, a power dissipation capability of at least 0.5 watts shall be provided in the protection shunt path.

10.7 Switching transients – E lead

Side A of the NI shall ensure that the transient voltage between the E lead and ground resulting from the operation of the E-lead contact on Side B of the NI does not exceed:

- 300 V peak;
- A rate of change of 1 volt per microsecond;
- An 80-volt magnitude for longer than 10 milliseconds after the operation of the contact.

11 Type I E&M signaling – Side B characteristics

11.1 Open-circuit dc voltages – E lead

Side B shall not apply a significant dc voltage between the E lead and ground (open-circuit magnitude ≤ 5 V) at the NI.

11.2 Open-circuit dc voltages – M lead

The magnitude of the open-circuit dc voltage between the M lead and ground applied by Side B at the NI shall be ≤ 5 V.

11.3 Sending on-hook to the NI

When sending an on-hook signal to the NI, Side B shall provide a resistance between the E lead and ground at the NI ≥ 20 kΩ.

11.4 Sending off-hook to the NI

When sending an off-hook signal to the NI, Side B shall apply a dc ground to the E lead. The voltage drop between the E lead and ground at the NI shall be ≤ (2 + 75xI) V with any current, I, less than or equal to 0.1 ampere flowing with the test circuit of Figure 7 connected to the E lead.

11.5 Detection of on-hook from the NI

- Side B shall detect both of the following conditions at the NI as an on-hook: 75 Ω or less in series with a ±2-volt dc battery[4)] applied from the M lead to ground;
- 20 kΩ or greater connected between the M lead and ground.

11.6 Detection of off-hook from the NI

Side B shall meet the following criteria to detect an off-hook at the NI:

- Side B shall detect a voltage between –36.5 and –56.7 V in series with 75 Ω or less applied to the M lead at the NI as an off-hook signal;
- Side B shall not detect 5 V peak ac superimposed on ±5 V dc between the M lead and ground at the NI as an off-hook signal.

Side B shall permit at least 2 milliamperes of current to flow in the M lead with –36.5 V dc applied to the M lead through 75 Ω or less at the NI.

4) The 2-volt battery represents a 1-volt drop across the contact on Side A of the NI plus a 1-volt ground potential difference.

12 Type II E&M signaling – Side A characteristics

12.1 Open-circuit dc voltages – M and SB leads

Side A shall not apply a significant dc voltage between the M or SB lead and ground (open-circuit magnitude ≤ 5 V dc) at the NI.

12.2 Open-circuit dc voltages – E and SG leads

Side A shall apply ground to the SG lead. The open-circuit dc voltage between the SG lead and ground at the NI shall be ≤ 5 volt dc.

The open-circuit voltage from the E lead to ground applied by Side A at the NI shall be between –21 and –56.7 V dc. The open-circuit E-lead dc voltage should be nominal –48 V.[5)]

12.3 Sending on-hook to the NI

To send an on-hook to the NI, Side A shall provide a high-resistance connection between the M and SB leads. The magnitude of the current in the M lead at the NI shall be ≤ 100 microamperes under the following conditions:

– the M lead grounded and –56.7 V dc plus 5 V peak ac superimposed applied to the SB lead at the NI;

– the M lead grounded and the SB lead open circuited at the NI.

When sending an on-hook to the NI, the magnitude of the current provided by Side A in the M lead shall be ≤ 24 microamperes when the SB lead is open and the M lead is connected to any dc source between –12 and +12 V at the NI.

12.4 Sending off-hook to the NI

Side A shall meet the following conditions to send an off-hook to the NI:

– Side A shall provide a low-resistance connection between the M and SB leads at the NI. The voltage drop between the M and SB leads at the NI shall be ≤ (2 + 150×I) V with any current, I, less than or equal to 0.05 amperes flowing in the M lead;

– With 0 to 50 milliamperes of current flowing in the SB lead, Side A shall ensure that the difference between the magnitude of the current in the M lead and the magnitude of the current in the SB lead is ≤ 10%.

12.5 Detection of on-hook from the NI

Side A shall detect 20 kΩ or greater connected between the E and SG leads at the NI as an on-hook.

12.6 Detection of off-hook from the NI

Side A shall detect 150 Ω or less connected in series with a 2-volt battery applied between the E and SG leads at the NI as an off-hook. The polarity of the battery shall be such as to oppose the potential of the E lead detector.

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5) Equipment that does not meet the objective of nominal –48 volts may be incompatible with some signaling test sets and some signaling lead status indicators.

Side A shall also provide the following characteristics at the NI:

- The dc voltage between the SG lead and ground shall be ≤ (5 + 75xI) V with any current, I, less than or equal to 0.05 amperes flowing with the test circuit of Figure 6 applied to the SG lead;
- The current in the E lead shall be ≤ 100 milliamperes with any resistance between 0 and 500 Ω connected between the E and SG leads at the NI. The current in the E lead should be ≤ 50 milliamperes;
- The current in the E lead shall be ≥ 2 milliamperes with an off-hook applied to the NI.

12.7 Switching transients – M and SB leads

If transient protection is provided for the M and SB leads by Side A, the protection method shall not introduce a capacitive impedance between the M and SB leads or between the M lead and ground.

12.8 Switching transients – E and SG leads

Side A shall ensure that the transient voltage between the E and SG leads resulting from the operation of the contact connected between the E and SG leads on Side B does not exceed:

- 300 V peak;
- a rate of change of 1 volt per microsecond;
- an 80-volt magnitude for longer than 10 milliseconds after the operation of the contact.

13 Type II E&M signaling – Side B characteristics

13.1 Open-circuit dc voltages – E and SG Leads

Side B shall not apply a significant dc voltage between the E lead or SG lead and ground (open-circuit voltage ≤ 5 V) at the NI.

13.2 Open-circuit dc voltages – M and SB leads

The following criteria apply to the open-circuit dc voltages applied by Side B to the M and SB leads at the NI:

- The open-circuit dc voltage between the M lead and ground shall be between –12 V and +12 V;
- The open-circuit dc voltage between the M lead and ground should be between –5 V and +5 V;
- The open-circuit dc voltage from the SB lead to ground shall be nominal –48 V.

13.3 Sending on-hook to the NI

Side B shall provide the following conditions at the NI to send an on-hook to the NI:

- A high-resistance connection shall be provided between the E and SG leads. With the SG lead connected to ground and –56.5 V dc plus 5 V peak ac superimposed applied to the E lead, the resistance from the E lead to ground shall be ≥ 500 kΩ;
- The leakage resistance from the SG lead to ground shall be ≥ 100 kΩ.

13.4 Sending off-hook to the NI

Side B shall provide the following conditions at the NI to send an off-hook to the NI:

a) Side B shall provide a low-resistance connection between the E and SG leads. The dc voltage between the E and SG leads at the NI shall be ≤ (2 + 150xI) V with any current, I, less than or equal to 0.05 amperes flowing in the E lead;

b) With Side B providing a connection as described in (a) between the E and SG leads and with the SG lead open-circuited, the Side B leakage resistance from the E lead to ground shall be ≥ 100 kΩ.

13.5 Detection of on-hook from the NI

Side B shall detect 20 kΩ or greater connected between the M and SB leads at the NI as an on-hook.

13.6 Detection of off-hook from the NI

Side B shall detect 150 Ω or less connected in series with a 2-volt battery applied between the M and SB leads at the NI as an off-hook. The polarity of the battery shall be such as to oppose the potential of the SB lead.

The following Side B characteristics also apply at the NI:

- Side B shall ensure that the voltage between the SB lead and ground at the NI shall not decrease more than (25 + 75xI) V from the open circuit voltage with any current, I, less than or equal to 0.05 ampere flowing in the SB lead;
- Side B shall limit the current in the SB lead to ≤ 100 milliamperes with any resistance between 0 and 500 Ω connected between the SB and M leads at the NI. The current in the SB lead under this condition should be ≤ 50 milliamperes;

– The current in the SB lead provided by Side B shall be ≥ 2 milliamperes with an off-hook as defined in the first paragraph applied between the M and SB leads;

– Side B shall limit the peak short-circuit current with the SB lead shorted to ground to ≤ 2 amperes;

– Side B should limit the steady-state short-circuit current with the SB lead shorted to ground to ≤ 50 milliamperes.

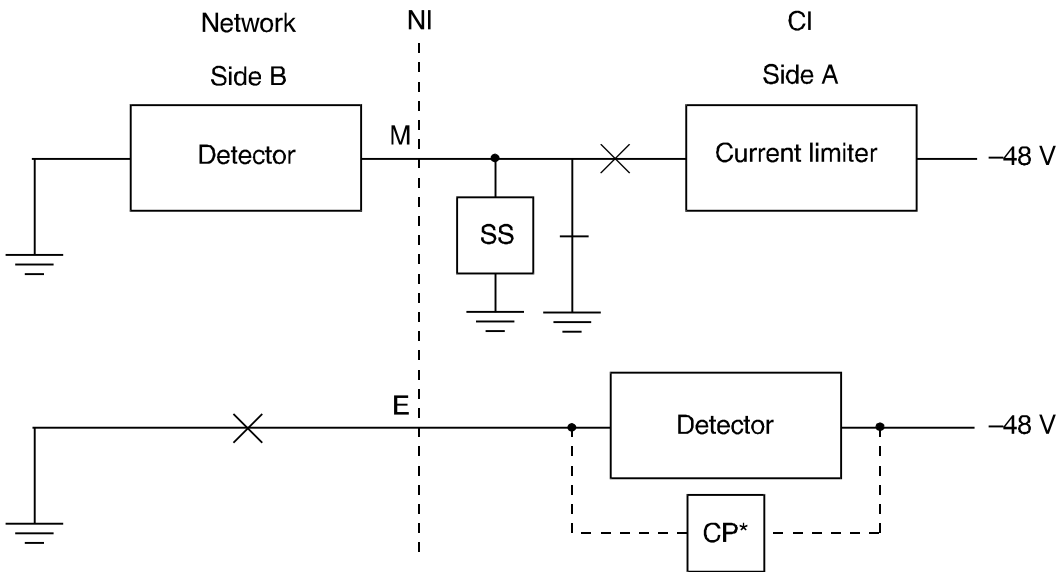
13.7 Switching transients – M and SB leads

Side B shall ensure that the transient voltage at the NI between the M and SB leads resulting from the operation of the contact connected between the M and SB leads on Side A of the NI does not exceed:

– 300 V peak;

– a rate of change of 1 volt per microsecond;

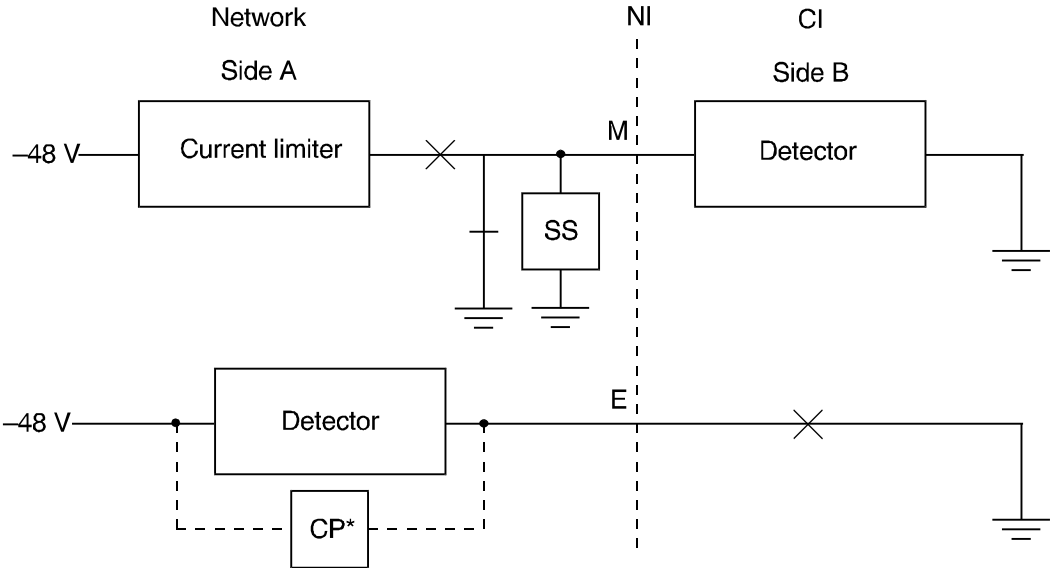
– an 80-volt magnitude for longer than 10 milliseconds after the operation of the contact.



*Contact protection (CP) required if the detector is inductive

SS – Surge suppression

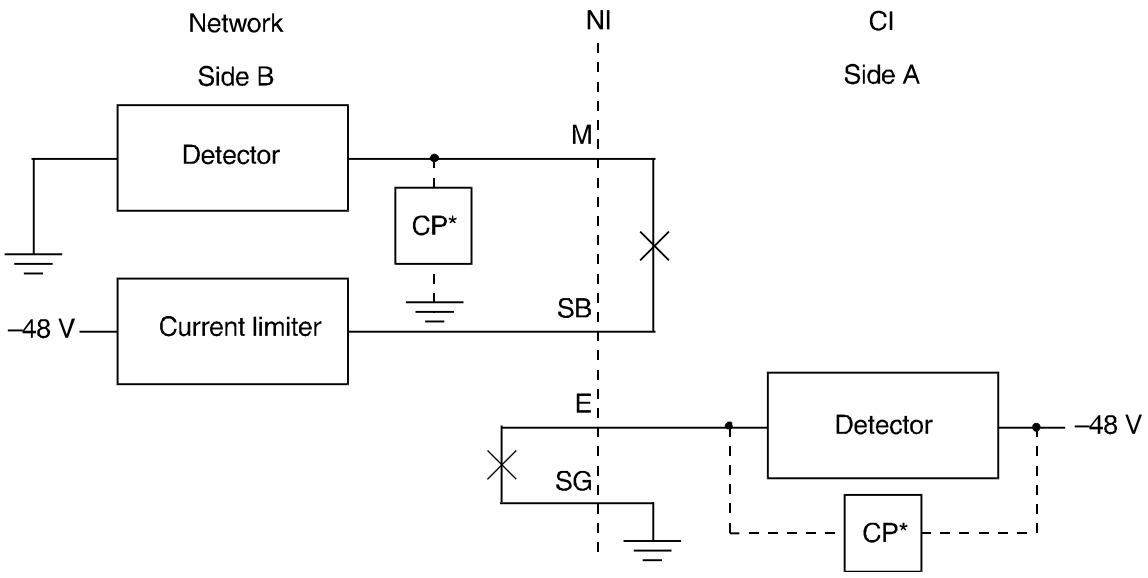
Figure 1 – Type I E&M interface – CI originates on M lead



* Contact protection (CP) required if the detector is inductive

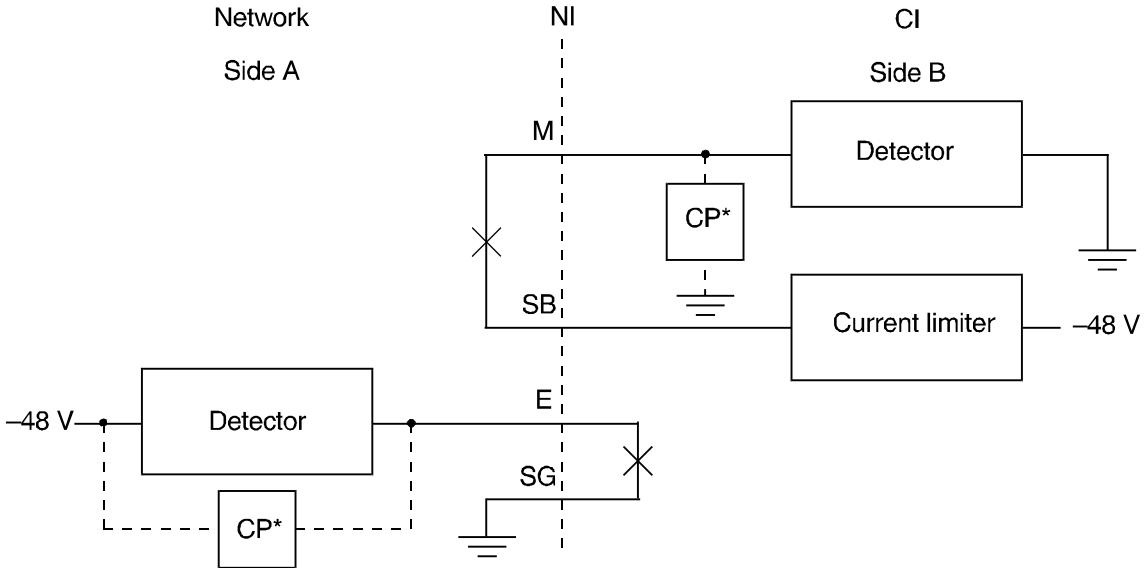
SS – Surge suppression

Figure 2 – Type I E&M interface – CI originates on E lead



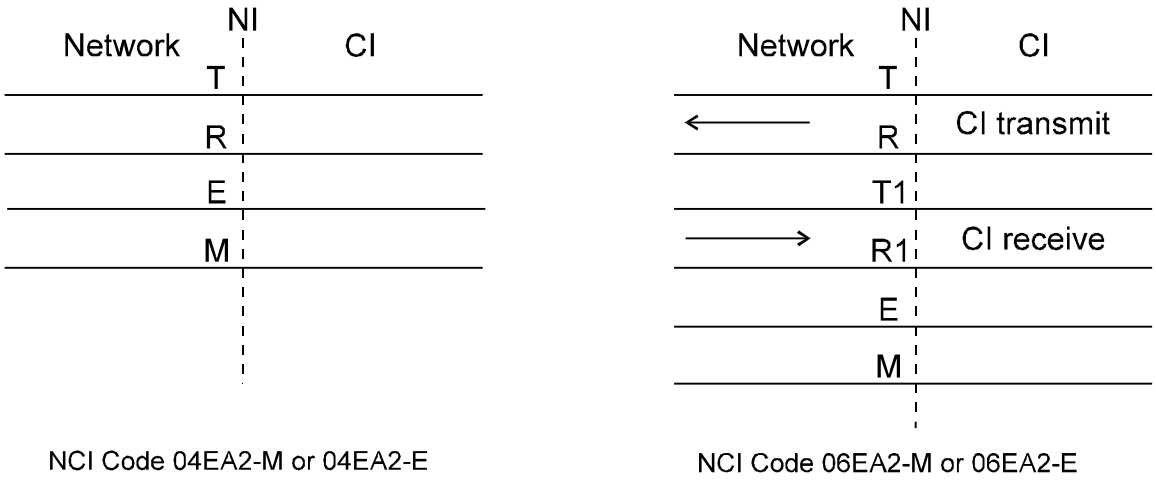
* Contact protection (CP) required if the detector is inductive.

Figure 3 – Type II E&M interface – CI originates on M lead

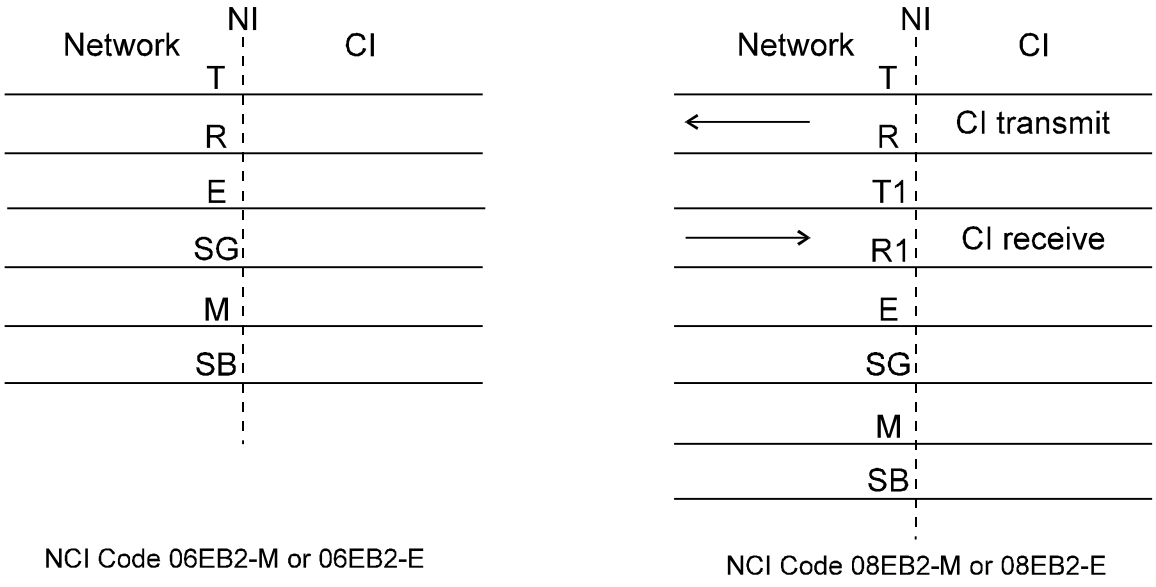


* Contact protection (CP) required if the detector is inductive.

Figure 4 – Type II E&M interface – CI originates on E lead

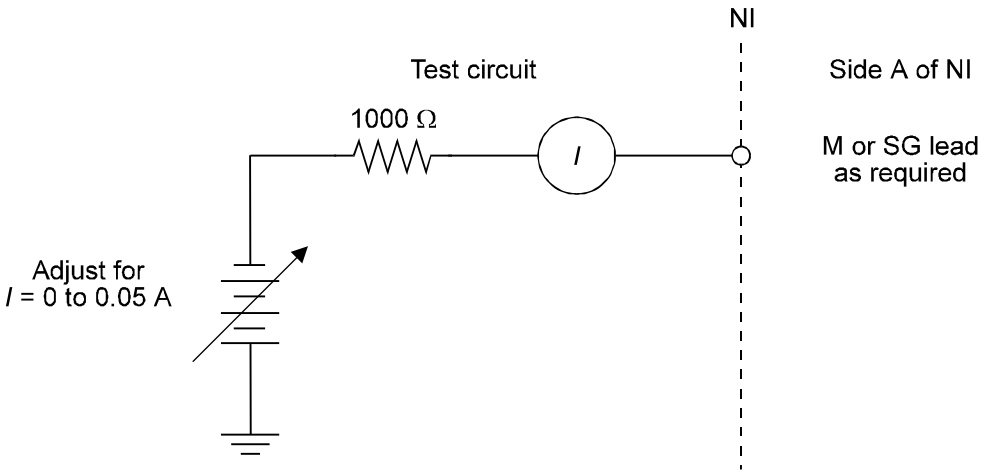


(a) Type I NI wiring configurations



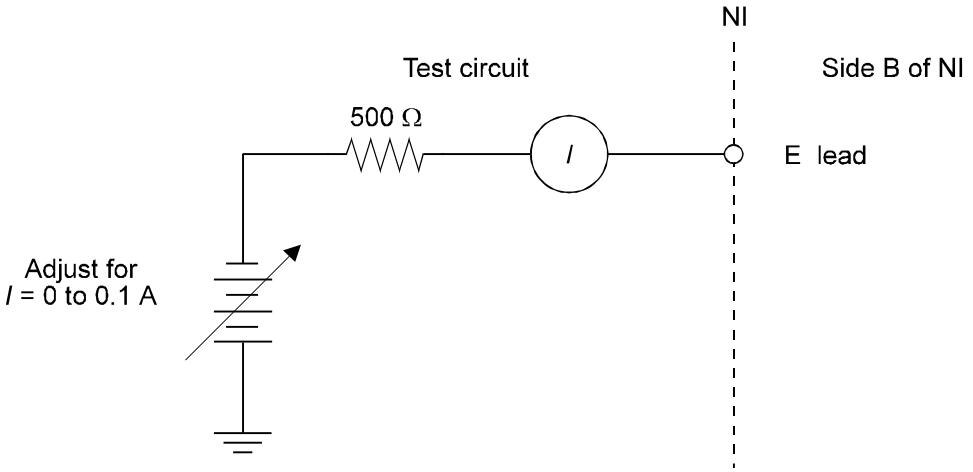
(b) Type II NI wiring configurations

Figure 5 – E&M signaling NI wiring configurations



NOTE – Positive side of test circuit battery must be connected to the signaling ground on Side A of the NI.

Figure 6 – M or SG lead ground test circuit



NOTE – Positive side of test circuit battery must be connected to the signaling ground on Side B of the NI.

Figure 7 – E lead ground test circuit

Annex A
(informative)

Bibliography

ANSI/TIA/EIA 464-B-1996, *Requirements for Private Branch Exchange (PBX) switching equipment*.[6)]

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Code of federal regulations, Title 47, FCC Rules and Regulations, Part 68, *Connection of Terminal Equipment to the Telephone Network,* Federal Communications Commission, Washington, DC, 1998.[8)]

[6)] Available from Electronic Industries Alliance, telephone: 1 (703) 907-7500, or see http://www.eia.org, or call Global Engineering Documents 1-800-854-7179.

[7)] Available from Alliance for Telecommunications Industry Solutions, 1200 G Street, NW, Suite 500, Washington, DC 20005, or see http://www.atis.org.

[8)] Available from the Superintendent of Documents, U. S. Government Printing Office, P.O. Box 371954, Pittsburgh, PA, 15250, by calling International Transcription Services, Inc. at 202-857-3800, or see http://www.fcc.gov.