

Bell System

# TECHNICAL REFERENCE

PROTECTIVE CONNECTING  
ARRANGEMENTS C2ACP/C2AKS

INTERFACE SPECIFICATION  
REVISED **February** 1975



**Bell System Voice Communications  
TECHNICAL REFERENCE**

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**Protective  
Connecting  
Arrangements**

**C2ACP  
C2AKS**

**Interface  
Specification**

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**Revised  
February 1975**

ENGINEERING DIRECTOR-CUSTOMER EQUIPMENT SYSTEMS



## NOTICE

This Technical Reference is published by American Telephone and Telegraph Company as a guide for the designers and manufacturers of customer-provided systems and equipment which connect with Bell System communications systems or equipment. American Telephone and Telegraph Company reserves the right to revise this Technical Reference for any reason, including, but not limited to, conformity with standards promulgated by ANSI, EIA, CCITT, or other standards; utilization of new advances in the state of the technical arts; or to reflect changes in the design of equipment or services described therein. The limits of responsibility and liability of the Bell System with respect to the use of customer-provided equipment and systems are set forth in the appropriate tariff regulations.

This Technical Reference supersedes and replaces Bell System Voice Communications Technical Reference for Voice Connecting Arrangements C2ACP and C2AKS dated April, 1971.

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**TECHNICAL REFERENCE**  
**PROTECTIVE CONNECTING ARRANGEMENTS C2ACP AND C2AKS**  
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## **1. GENERAL**

### **1.1 Introduction**

FCC tariffs and corresponding intrastate tariffs filed by the Bell System Companies provide for the electrical connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to the Bell System telecommunications network by means of a protective connecting arrangement. The connecting arrangement includes circuit elements to provide network control signaling functions as well as certain other network protection functions and is furnished, installed, and maintained by the Telephone Company. In addition, the tariffs require compliance by the customer-provided equipment with network protection criteria specified therein.

### **1.2 Application**

Protective Connecting Arrangements C2ACP and C2AKS provide the means for automatically connecting customer-provided terminal equipment to the telecommunications network via a station line to a local exchange, foreign exchange or WATS central office line (Fig. 1). These arrangements permit network address signaling performed by customer-provided dc dial pulsing or tone address signaling. Protective Connecting Arrangements C2ACP and C2AKS are only intended for voice and tone address signal transmission and are not offered for the transmission of data signals.

Protective Connecting Arrangement C2ACP provides a line-only connection, typically for use with customer-provided key telephone systems. Also available for use with customer-provided key telephone systems is Voice Connecting Arrangement STP which is described in Technical Reference — PUB 42212.

Protective Connecting Arrangement C2AKS provides a bridged connection to a line terminated on a Telephone Company telephone set, typically for use with customer-provided call extending equipment.

### **1.3 Power Outage Provisions**

Protective Connecting Arrangements C2ACP and C2AKS are normally powered by a Telephone Company-provided power supply

which operates from commercial power. Connecting arrangement power outage protection can be provided by a Telephone Company battery backup system, a customer-provided power supply and battery backup system using Connecting Arrangement VCP, or a Telephone Company-provided telephone transfer system. These options are described in detail in Technical Reference Notice PUB 42607.

### **1.4 Ordering and Identification**

The protective connection services described in this Technical Reference are identified by the Bell System as Uniform Service Order Codes (USOC) C2ACP and C2AKS. When ordering these services, the customer should specify these codes. One protective connecting arrangement should be ordered for each station line which is to be connected. The local Telephone Company business office or marketing representative will provide information regarding availability and rates for these services. When ordering service, the customer should specify whether provision is to be made for any of the power outage protection methods described in Paragraph 1.3.

## **2. DESCRIPTION**

### **2.1 Functions**

The major functions of these protective connecting arrangements are:

- (a) To protect Telephone Company personnel and facilities from hazardous voltages which may be applied by the customer-provided equipment.
- (b) To provide isolation against longitudinal imbalance.
- (c) To limit abnormally high speech and tone address signal levels from the customer-provided equipment.
- (d) To provide for network control signaling to the network, including dc dial pulses, on-hook, off-hook, etc.
- (e) To provide for accepting call supervisory signals from customer-provided equipment.

- (f) To provide indication of ringing to customer-provided equipment for incoming calls.

## 2.2 Physical

Protective Connecting Arrangement C2ACP or C2AKS consists of an 8-inch printed wiring board (Fig. 2). This board is mounted in a panel which typically mounts in an apparatus cabinet or on a relay rack. When power is supplied by the Telephone Company, the associated 24-volt rectifier power supply requires a grounded outlet connection to a non-switched, customer-furnished, nominal  $117 \pm 12$  volt,  $60 \pm 1$  Hz source, fused at 15 amperes.

## 2.3 Interface Leads

Six interface leads per circuit are normally provided from Protective Connecting Arrangements C2ACP and C2AKS to the Interface Connecting Block for the customer's (Fig. 1). One additional lead is provided with Protective Connecting Arrangement C2AKS when the arrangement is associated with a Telephone Company key telephone system line. Technical information pertaining to these leads is discussed in Sections 3 and 4.

The leads and their functions are as follows:

<u>Lead Designation</u>	<u>Function</u>
CT } CR }	Voice transmission and tone address signaling
CS } CG }	Service request, answer/disconnect, and dc dial pulsing
C1 } C2 }	Incoming ringing
CA }	Customer's equipment supervision (C2AKS only)

Leads from these protective connecting arrangements will be terminated on a Telephone Company-provided Interface Connecting Block conveniently located to permit testing maintenance, trouble isolation, and ease of connection to the customer-provided equipment. The customer must provide and install the conductors and make the necessary connections of his equipment to the protective connecting arrangement at this block.

The typical Interface Connecting Block is shown in Fig. 3. This "quick connect," "66" type connecting block utilizes tin-plated spring clip terminal strips which accommodate unstripped, insulated conductors of 20 to 26 gauge. A Reliable Electric R714B Tool or equivalent is used to press the insulated wire down into the slot. The spring pressure of the clip cuts away the insulation and makes the electrical connection. The Telephone Company will provide bridging clips between the second and third terminals of the block to interconnect the leads. The clips should be removed by the customer's representative when it is necessary to test toward the customer-provided equipment and then replaced to restore the circuit to service.

As a customer option, the Telephone Company may provide as the interface a male 50-pin Amphenol-type connector which can accommodate up to five connecting arrangement terminations (Fig. 4). The pin assignments are given in Table A. An Amphenol No. 57-10500-7 plug, Cinch No. 223-32-50-023 plug or equivalent shall be provided by the customer as a mating connector. This connector may be installed at a location specified by the customer (subject to the limitation below) for which there may be an additional service charge.

The customer-provided equipment must be located so that the maximum external loop resistance, including contact resistance, across the CS and CG leads measured at the block or connector shall not exceed 100 ohms when indicating a closure.

## 3. OPERATION

### 3.1 Incoming Call From the Central Office

On an incoming call from the central office, the protective connecting arrangement will detect incoming ringing and provide a contact closure over the C1 and C2 leads to the customer-provided equipment (Fig. 5). The closure is held during the ringing interval of the ringing cycle and is released during the silent interval. To answer a call, the customer-provided equipment shall provide a contact closure across the CS and CG leads. The connecting arrangement responds by signaling

the central office to trip the ringing and cuts through the transmission path over the CT and CR leads. When Protective Connecting Arrangement C2AKS is associated with a key telephone system, a closure may be applied to the CA and CG leads in order to indicate the line is busy at the appearance of the line on the Telephone Company key telephone sets.

### **3.2 Outgoing Call to the Central Office**

On an outgoing call to the central office, the customer-provided equipment provides an off-hook indication by closing a contact across the CS and CG leads. The closure causes the protective connecting arrangement to seize the line to the central office and cut through the talking path over the CT and CR leads.

For Protective Connecting Arrangement C2AKS, a closure may be applied on the CA and CG leads to provide busy indication to the associated key system. However, since Protective Connecting Arrangement C2AKS does not indicate to the customer-provided equipment when the station is in use by the key system, it is recommended that this arrangement not be used for outgoing calls to avoid double connection.

When the central office is ready to receive dc dial pulses or tone address signals, dial tone is returned on the CT and CR leads. The customer can then transmit dc dial pulse information over the CS and CG leads which is repeated to the central office by the network control circuitry in the protective connecting arrangement. If the customer subscribes to TOUCH-TONE<sup>®</sup> service from the serving central office, the customer may optionally transmit tone address signals over the CT and CR leads.

### **3.3 Disconnect**

A disconnect by the customer-provided equipment (removing the contact closure on the CS and CG leads and the CA and CG leads, if provided) will restore the arrangement and subsequently the central office trunk to the idle condition.

A disconnect by the distant party is not relayed to the protective connecting arrangement by the serving central office. If the customer-provided equipment does not

disconnect after the distant party has disconnected, the serving central office, after a period of time which varies according to the type of office, will assume that a new call is being initiated and return dial tone. In some cases a "permanent signal" tone will be returned.

## **4. S P E C I F I C D E S I G N CONSIDERATIONS**

### **4.1 Transmission Path**

#### **4.11 Insertion Loss**

The insertion loss of Protective Connecting Arrangement C2ACP or C2AKS is a nominal 1 dB over the voice-frequency range of 300 to 3000 Hz. No voice signal amplification is provided.

#### **4.12 Impedance**

Protective Connecting Arrangements C2ACP and C2AKS are transformer-coupled to the line and, while the impedance of the CT and CR leads is a function of the impedance of the line to the central office, for design purposes, the input impedance of these arrangements should be considered to be 600 ohms. Therefore, the impedance of the customer-provided equipment should be 600 ohms for optimum speech transmission performance.

#### **4.13 Bandwidth**

The normal voice-frequency bandwidth of the telecommunications network extends from about 300 to 3000 Hz. In general, an end-to-end connection may be expected to have a loss characteristic which increases on either side of this band. These protective connecting arrangements do not limit this bandwidth.

#### **4.14 Signal Power Level**

The tariffs state that the average power (in any 3-second interval) delivered at the central office should not exceed -12 dBm in order to prevent excessive noise and crosstalk from interfering with other services. To meet this specification, the maximum available power for a customer-provided source when averaged over any 3-second interval (measured at the CT and CR leads with a 600 ohm load substituted for the connecting arrangement) should not

exceed -8 dBm. This limit has been set so that when the average loss of station lines in the Bell System is considered (including the insertion loss of the protective connecting arrangements), the limit of -12 dBm at the local central office will be met.

Using measuring Method A (see Paragraph 4.15), the power averaged over any 3-second interval will, in almost all cases, not exceed -8 dBm if the maximum meter swing does not exceed 85 dBm. With the additional damping of measuring Method B, the power averaged over any 3-second interval will not exceed -8 dBm if the maximum meter swing does not exceed 83 dBm.

#### 4.15 Measuring Maximum Available Inband Power

The measuring methods described below are satisfactory for estimating the maximum power averaged over a 3-second interval to determine that the inband signal power criteria specified in Paragraph 4.14 are being met.

##### Method A

Operate the customer-provided equipment into a 600 ohm load, (this assumes that the customer-provided equipment has a 600 ohm source impedance), bridged by a Hewlett-Packard Transmission and Noise Measuring Set — Model 3555B, or a Western Electric 3-Type Noise Measuring Set or the equivalent.\* To insure a proper measurement technique, the control settings on these meters should be as shown below:

Western Electric 3-Type  
Noise Measuring Set

<u>Control</u>	<u>Setting</u>
FUNCTION (Switch)	BRDG
NORM/DAMP (Switch)	DAMP
WTG (Plug-in Network)	3Kc FLAT

Hewlett-Packard Transmission  
and Noise Measuring Set  
Model 3555B

<u>Control</u>	<u>Setting</u>
INPUT (Switch)	NOISE/BRDG
FUNCTION (Pushbutton)	VF/Nm-600 BAL
NOISE WTG (Switch)	3kHz FLAT
NORM/DAMP (Switch)	DAMP

##### Method B

The accuracy of Method A can be somewhat improved by increasing the size of the damping capacitance in the Western Electric 3-Type Noise Meter by 150 microfarads. To do this, connect the negative lead of a 150 microfarad capacitor to either terminal of the NORM/DAMP switch and connect the positive lead to ground. This allows the meter to more nearly approximate a 3-second averaging meter. (NOTE: This modification does not necessarily hold for the Model 3555B or noise meters other than the Western Electric 3-Type.)

#### 4.16 Signal Power Distribution

The telecommunications network incorporates tone signaling devices that are used for network control functions. These devices, which are connected at all times to the telephone circuit, are designed to detect a single-frequency tone at 2600 Hz. They are, however, relatively insensitive to energy at this frequency if sufficient energy is present at the same time at other frequencies in the voiceband.

In order to prevent the interruption or disconnection of a call, or interference with network control signaling, it is necessary that the signal applied by the customer-provided equipment to the protective connecting arrangement at no time have energy solely in the 2450 to 2750 Hz band. If signal power is in the 2450 to 2750 Hz band, it must not exceed the power present at the same time in the 800 to 2450 Hz band.

\* These meters do not have a 3-second averaging time but, when used to measure speech, they give a reliable estimate of a 3-second average. The use of meters with shorter time constants, such as VU meters or standard voltmeters, is not recommended.

#### 4.17 Out-of-Band Signal Power Limits

To protect other services, it is necessary that the signal which is applied by the customer-provided equipment to the Telephone Company interface, located on the customer's premises, meet the following limits:

- (a) The power in the band from 3995 Hz to 4005 Hz shall not exceed 26 dB below one milliwatt.
- (b) The power in the band from 4005 Hz to 10,000 Hz shall not exceed 16 dB below one milliwatt.
- (c) The power in the band from 10,000 Hz to 25,000 Hz shall not exceed 24 dB below one milliwatt.
- (d) The power in the band from 25,000 Hz to 40,000 Hz shall not exceed 36 dB below one milliwatt.
- (e) The power in the band above 40,000 Hz shall not exceed 50 dB below one milliwatt.

#### 4.18 Tone Address Signaling

When TOUCH-TONE service has been ordered by the customer, Protective Connecting Arrangements C2ACP and C2AKS permit customer-provided tone address signals to be transmitted to a central office TOUCH-TONE receiver for the purpose of network address signaling. The signaling code for the Bell System TOUCH-TONE calling system provides for 16 distinct signals. Each signal is composed of two voiceband frequencies, one from each of two mutually exclusive frequency groups of four frequencies each. The signal frequencies are spaced and selected on the basis that the two frequencies of any valid signal combination are not harmonically related. The frequency pairs assigned for the signaling are as follows:

<u>Nominal High Group Frequencies (Hz)</u>					
	<u>1209</u>	<u>1336</u>	<u>1477</u>	<u>1633</u>	
<u>Nominal</u>	<u>697</u>	1	2	3	Spare
<u>Low Group</u>	<u>770</u>	4	5	6	Spare
<u>Frequencies</u>	<u>852</u>	7	8	9	Spare
<u>(Hz)</u>	<u>941</u>	*	0	#	Spare

In order for the central office receiver to properly register the digits, the tone address

signals shall meet the following requirements (measured by the customer into a 600 ohm test termination on the CT and CR leads at the interface):

##### 1. Signal Levels

Nominal level per frequency: -6 to -4 dBm

Minimum level Low Group: -10 dBm  
per frequency High Group: -8 dBm

Maximum difference in levels  
between frequencies: 4 dB

Maximum level per frequency  
pair: +2 dBm

##### 2. Frequency Deviation

Tone frequencies should be within  $\pm 1.5$  percent of their nominal values.

##### 3. Extraneous Frequency Components

The total power of all extraneous frequencies accompanying the signal should be at least 20 dB below the signal power, in the voiceband above 500 Hz.

##### 4. Voice Suppression

Voice energy from the telephone transmitter or other source should be suppressed at least 45 dB during tone signal transmission (ie, transmitter should be muted). In the case of automatic dialing, the suppression should be maintained continuously until pulsing is completed.

##### 5. Rise Time

Each of the two frequencies of the signal should attain at least 90 percent of full amplitude within 5 ms, and preferably within 3 ms for automatic dialers, from the time that the first frequency begins.

##### 6. Pulsing Rate

Minimum duration of  
two-frequency tone signal: 50 ms

Minimum interdigital time: 45 ms

Minimum cycle time (period): 100 ms

7. Tone Leak

Tone leak during signal off time should be less than -55 dBm.

8. Transient Voltages

Peak transient voltages generated during tone signaling should be no greater than 12 dB above the zero-to-peak voltage of the composite two-frequency tone signal.

#### 4.19 Signal Limiting

A voice signal limiter is incorporated in the transmission path of the protective connecting arrangements to protect the Bell System telecommunications network from applications of abnormally high signal levels. This has no effect on normal voice or normal tone address signal levels.

This limiter does not abrogate the customer's responsibility to meet the network protection criteria, as prescribed in the tariffs and as outlined in Paragraph 4.14.

## 4.2 DC Signaling Paths

### 4.21 Service Request Path (Leads CS and CG)

The CS and CG leads will provide a means of answering an incoming call, initiating an outgoing call, and transmitting dc dial pulse information to the protective connecting arrangement from the customer-provided equipment which should provide a dry contact closure, eg, dc isolation from foreign potentials. The CS lead has a maximum potential of 26 volts dc through 5830\* ohms. The CG lead is grounded at the protective connecting arrangement but cannot be used by the customer to ground his equipment.

The CS and CG leads will offer the customer-provided equipment a maximum noninductive load of 5\* milliamperes. The minimum open circuit insulation resistance of the customer-provided dry contact between the CS and CG leads, and from either lead to ground, should be 100,000 ohms. When indicating a closure, the maximum external loop resistance including contact resistance across the CS and CG leads measured at the Interface Connecting Block toward the customer-provided equipment shall not exceed 100\* ohms.

The dc dial pulses shall be generated on the CS and CG leads at a nominal rate of 10 pulses-per-second, with a minimum of 8 pulses-per-second and a maximum of 11 pulses-per-second (see Fig. 6). The percent break shall be a minimum of 58 percent and a maximum of 64 percent. The minimum interdigital time shall be 600 milliseconds.

### 4.22 Signal Alerting Path (Leads C1 and C2)

The C1 and C2 leads provide a contact closure to the customer's equipment during the ringing interval of the central office ringing cycle on an incoming call. The closure is opened during the silent interval. However, line signal transients, noise, and other conditions can cause false operation of the detection circuitry. Therefore, the customer's equipment should be designed to ignore closures on these leads of less than 100 milliseconds. The customer's equipment load on the C1 and C2 leads shall not exceed 250 milliamperes, noninductive. The maximum voltage which may be applied by the customer-provided equipment is 50 volts RMS. The customer's equipment shall provide appropriate contact protection.

### 4.23 Customer's Equipment Supervisory Path (Leads CS and CG)

The CA and CG leads (Protective Connecting Arrangement C2AKS only) will provide a means for the customer-provided equipment to busy out appearance of the line on associated Telephone Company key telephone system stations. The CA and CG leads will offer a maximum inductive load of 70 milliamperes. The customer's equipment should present an open circuit resistance which shall exceed 15,000 ohms, and a short circuit resistance including the external loop resistance which shall not exceed 50 ohms.

\* These figures are changes from the previous values as a result of improved equipment design.

### 4.3 Grounding

Protective Connecting Arrangement C2ACP or C2AKS is provided with a common signal ground (a metallic cold water pipe or other approved ground) which is always bonded to the electric power ground and telephone protector ground, where present. Although the CG lead is grounded at the protective connecting arrangement, it is not permitted to derive the main ground for the customer's equipment through this lead. The general grounding requirements for the customer-provided equipment are covered in Paragraph 5.2

## 5. GENERAL DESIGN CONSIDERATIONS

### 5.1 Foreign and Surge Voltage Protection

Where telephone lines are exposed to power line contact, lightning exposure, power line induction, or a rise in ground potential exceeding 300 volts RMS, protective devices are installed at the central office and on the customer's premises. These devices will provide a path to ground for foreign voltages that exceed about 600 volts peak.

The manufacturer is responsible for designing his equipment and facilities in such a way so that foreign and hazardous voltages from his equipment and facilities are not applied to the protective connecting arrangements.

### 5.2 Grounding

It is expected that the customer's equipment will be grounded in accordance with applicable electrical codes, eg, National Electrical Code (NEC), and should be bonded to the ground electrode to which the telephone protector is grounded but not using the telephone ground clamp. Provisions should be made within the customer's equipment for connecting together all internal signal grounds. This connection shall be isolated from both the grounding (green) conductor run with the power supply primary conductors and the chassis or frame of the customer-provided equipment.

The customer's signal ground may be obtained with a proper connection to a metallic cold water pipe, using a single No. 14 AWG, or larger copper conductor. The other end should

be connected to the ground return terminal of the customer's equipment. Proper attention should be given to providing the lowest possible resistance connection at each end of the circuit. It is imperative that this ground be connected at the same location to the water piping system or ground electrode as the telephone protector or signal ground lead but not using the Telephone Company ground clamp. This lead shall not be fused.

### 5.3 Telecommunications Network Characteristics

#### 5.31 End-to-End Electrical Loss

The end-to-end electrical loss of a connection is a function of the impedances of both end terminations and the losses of the interoffice trunks, the serving central offices, and the facilities to the serving offices. The information found in the REFERENCES in Appendix B may be used to determine statistical loss distributions for different types of calling patterns on the telephone network.

#### 5.32 Nonlinearities

Nonlinearities such as compression, clipping, phase shift, and harmonic distortion can exist on the telecommunications network. Normally, these are insignificant for speech transmission. It is expected that harmonic distortions caused by the network will result in single tones which are no greater than about 5% of the fundamental.

## 6. SERVICE RESPONSIBILITIES

### 6.1 Responsibility of the Manufacturer

The manufacturer of the terminal equipment is responsible for the following:

- a) Informing the purchaser as to which protective connecting arrangement his equipment has been designed to work with.
- b) Advising the purchaser to order this protective connecting arrangement by code (C2ACP or C2AKS) from the Telephone Company.
- c) Providing information to the purchaser that specifies installation, operational, routine maintenance, and repair procedures which, if

properly employed by the purchaser, will assure compliance with this Technical Reference.

- d) All patent or other liability arising out of the use, offering or distribution of such equipment by or to them.

## **6.2 Responsibility of the Customer**

The tariffs regulating the connection of customer-provided terminal equipment or communications systems through connecting arrangements to the telecommunications network state that the operating characteristics of such equipment or systems shall be such as not to interfere with any of the services offered by the Telephone Company. Such use is subject to the further provisions that the equipment or systems provided by a customer do not endanger the safety of Telephone Company employees or the public; damage, require change in or alteration of, the equipment or systems or other facilities of the Telephone Company; interfere with the proper functioning of such equipment or systems or facilities; impair the operation of the telecommunications network or otherwise injure the public in its use of the Telephone Company's services. Upon notice from the Telephone Company that the equipment or system provided by a customer is causing or is likely to cause such hazard or interference, the customer shall take such steps as shall be necessary to remove or prevent such hazard or interference.

The customer desiring to use customer-provided equipment is responsible for the following:

- a) Informing the Telephone Company of his intention to use such a device and ordering the protective connecting arrangement by code (C2ACP or C2AKS).
- b) Connecting the equipment to the interface connecting block or interface connector.
- c) Assuring that the equipment in use continues to comply with all the requirements of the applicable tariffs and this Technical Reference.
- d) Following the installation, operational, routine maintenance and repair procedures specified by the manufacturer.

- e) Removing the equipment from use if the customer detects that it is defective or if the Telephone Company notifies the customer that the equipment is causing a hazard or interference as specified above.

## **6.3 Responsibility of the Telephone Company**

The Telephone Company shall not be responsible for the installation, operation or maintenance of any customer-provided terminal equipment. Long distance message telecommunications service is not represented as adapted to the use of customer-provided equipment and where such equipment is connected to Telephone Company facilities, the responsibility of the Telephone Company shall be limited to the furnishing of facilities suitable for long distance message telecommunications service and to the maintenance and operation of such facilities in a manner proper for such telecommunications services. Subject to this responsibility the Telephone Company shall not be responsible for (i) the through transmission of signals generated by the customer-provided equipment or for the quality of, or defects in, such transmission, (ii) the reception of signals by customer-provided equipment, or (iii) address signaling where such signaling is performed by customer-provided tone-type signaling equipment.

The Telephone Company shall not be responsible to the customer or otherwise if changes in minimum network protection criteria contained in the tariffs and in this Technical Reference, or in any of the facilities, operations or procedures of the Telephone Company render any customer-provided equipment obsolete or require modification or alteration of such equipment or otherwise affect its use or performance.

## **7. MAINTENANCE OF SERVICE**

Maintenance of equipment supplied by the Telephone Company shall be done only by the Telephone Company.

When trouble is experienced with this service, the customer should disconnect the terminal equipment to determine whether the service impairment is located in the customer-

provided equipment or in the equipment provided by the Telephone Company. If the terminal equipment is determined to be defective, the customer shall immediately discontinue its use until such time as the customer has it repaired. If the tests indicate that the trouble is in the Telephone Company-provided equipment, a trouble report should be promptly referred to the Telephone Company "Repair Service" whose number can be found in the front of the telephone directory. The repair attendant should be given:

- (a) Customer's name
- (b) Customer's address

- (c) Listed telephone number
- (d) Uniform Service Order Code (USOC) C2ACP, C2AKS
- (e) Description of the trouble
- (f) Customer's contact for additional information

The customer shall be responsible for the payment of a service charge for visits by the Telephone Company to the customer's premises where the service difficulty or trouble report results from the use of customer-provided equipment.

## APPENDIX A

### GLOSSARY

**ADDRESS SIGNALS** — denotes dc dial pulses or appropriate pairs of tone signals transmitted to a central office that represent the telephone number of the distant party.

**COMMUNICATIONS SYSTEM** — denotes channels and other facilities which are capable, when not connected to the Long Distance Message Telecommunications Service, of communications between customer-provided terminal equipment or Telephone Company stations.

**CUSTOMER** — the term "Customer" denotes the person, firm or corporation which orders service and is responsible for the payment of charges and compliance with Telephone Company regulations.

**CUSTOMER-PROVIDED TERMINAL EQUIPMENT** — denotes devices or apparatus and their associated wiring, provided by a customer, which do not constitute a communications system and which, when connected to the communications path of the telecommunications network, are so connected either electrically, acoustically, or inductively.

**DIAL PULSE RATE** — repetition of pulses for switching purposes, usually expressed in pulses-per-second.

**INTERDIGITAL TIMING** — the minimum time required between digits for the switching equipment to respond to the last digit received and ready itself for receiving the next digit.

**INTERFACE CONNECTING BLOCK** — the Telephone Company-provided connecting point to which the customer brings and connects the leads of his equipment and to which the Telephone Company brings and connects leads from the protective connecting arrangement.

**NETWORK CONTROL SIGNALING** — denotes the transmission of signals used in the telecommunications network which perform functions such as supervision (control, status, and charging signals), address signaling (dialing), calling and called number identification, audible tone signals (call progress signals indicating reorder or busy conditions, alerting, coin denominations, coin collect and coin return tones) to control the operation of switching machines in the telecommunications network.

**NETWORK CONTROL SIGNALING UNIT** — denotes the terminal equipment furnished, installed, and maintained by the Telephone Company for the performance of network control signaling. (See Note below.)

**OFF-HOOK SUPERVISION** — the conditioning of the interface leads by the customer-provided equipment which indicates that it is answering or originating a call.

**ON-HOOK SUPERVISION** — the conditioning of the interface leads by the customer-provided equipment which indicates that it has disconnected and is idle.

NOTE: Under the tariff regulations, the terms "connecting arrangement" and "network control signaling unit" are separate and distinct from each other; however, the term "connecting arrangement" is generally used to include the functions of network control signaling.

**PERCENT BREAK** — the period of time of an open interval in a dial pulse sequence compared to the total time of an open and closed interval, expressed as a percentage.

**PROTECTIVE CONNECTING ARRANGEMENT** — protective equipment provided by the Telephone Company to accomplish the electrical connection of customer-provided equipment with the telecommunications network. It is designed to transmit speech signals as contrasted to one designed to transmit data signals.

**SUPERVISORY SIGNALS** — signals used to initiate a request for service by the calling party (off-hook); to notify the called party that he is being called (ringing); to indicate an answered call (off-hook); to indicate a disconnect (on-hook); and to recall an operator or distant party to a connection (switchhook flash).

**TELECOMMUNICATIONS NETWORK** — central office switching equipment, associated interoffice and intraoffice facilities, and terminal equipment which provide Long Distance Message Telecommunications Service or private line service.

**TELEPHONE COMPANY** — denotes the American Telephone and Telegraph Company, the Long Lines Department, its concurring carriers, and its connecting carriers, either individually or collectively.

## APPENDIX B REFERENCES

Some references describing various transmission characteristics of the telecommunications network are listed below:

- \* (a) McAdoo, K.L., "Speech Volumes on Bell System Message Circuits — 1960 Survey," Bell System Technical Journal (BSTJ), Vol. 42, No. 5 (September 1963), P. 1999.
- \* (b) Gresh, P.A., "Physical and Transmission Characteristics of Customer Loop Plant," BSTJ, Vol. 48, No. 10 (December 1969), P. 3337.
- \* (c) Breen, C., and Dahlbom, C.A., "Signaling Systems for the Control of Telephone Switching," BSTJ, Vol. 39, No. 6 (November 1960), P. 1381.
- \* (d) Bodle, D.W., and Gresh, P.A., "Lightning Surges in Paired Telephone Cable Facilities," BSTJ, Vol. 40, No. 2 (March 1961), P. 547.
- \*\* (e) Bell System Data Communications Technical Reference — PUB 41007 — 1969-1970 Switched Telecommunications Connection Survey (Reprints of Bell System Technical Journal articles) — April, 1971.
- \*\*\* (f) "Principles of Electricity Applied to Telephone and Telegraph Work," by American Telephone and Telegraph Company, New York, New York.
- \*\*\* (g) "Switching Systems," by American Telephone and Telegraph Company, New York, New York.
- (h) "Notes on Transmission Engineering," by United States Independent Telephone Association, Washington, D.C.
- \*\*\* (i) "Transmission Systems for Communications," by Bell Telephone Laboratories, Inc.
- \*\*\* (j) "Notes on Distance Dialing — 1968," by American Telephone and Telegraph Company, New York, New York.

\* These journal may be purchased by writing to:

Bell Telephone Laboratories, Inc.  
Circulation Supervisor  
Mountain Avenue, Room 3C109  
Murray Hill, New Jersey 07974

\*\* These references may be purchased by writing to:

American Telephone and Telegraph Company  
Supervisor — Information Distribution Center  
195 Broadway, Room 208  
New York, New York 10007

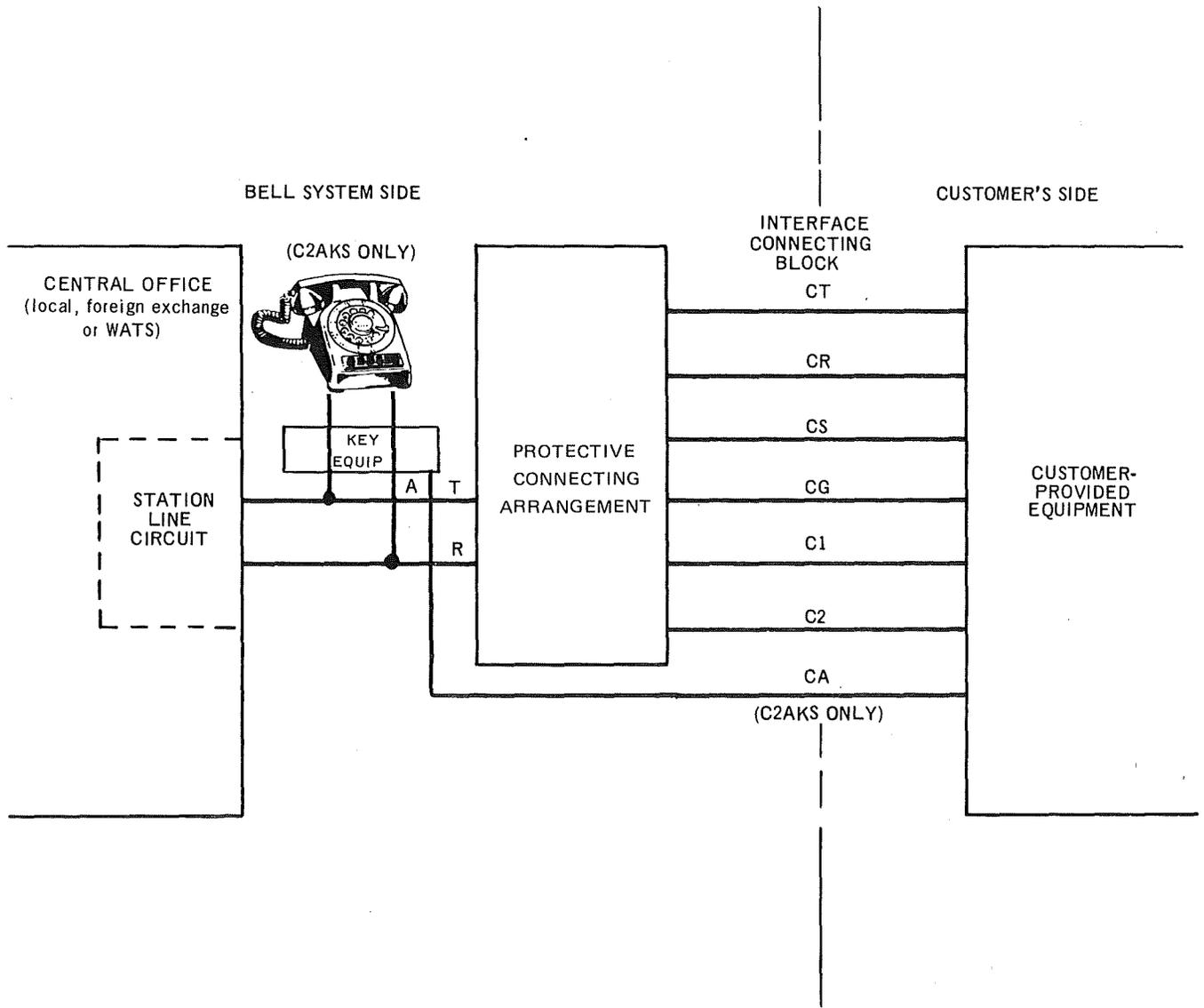
\*\*\* These publications may be purchased by writing to:

Western Electric Company, Inc.  
Commercial Relations  
P.O. Box 1579  
Newark, New Jersey 07102

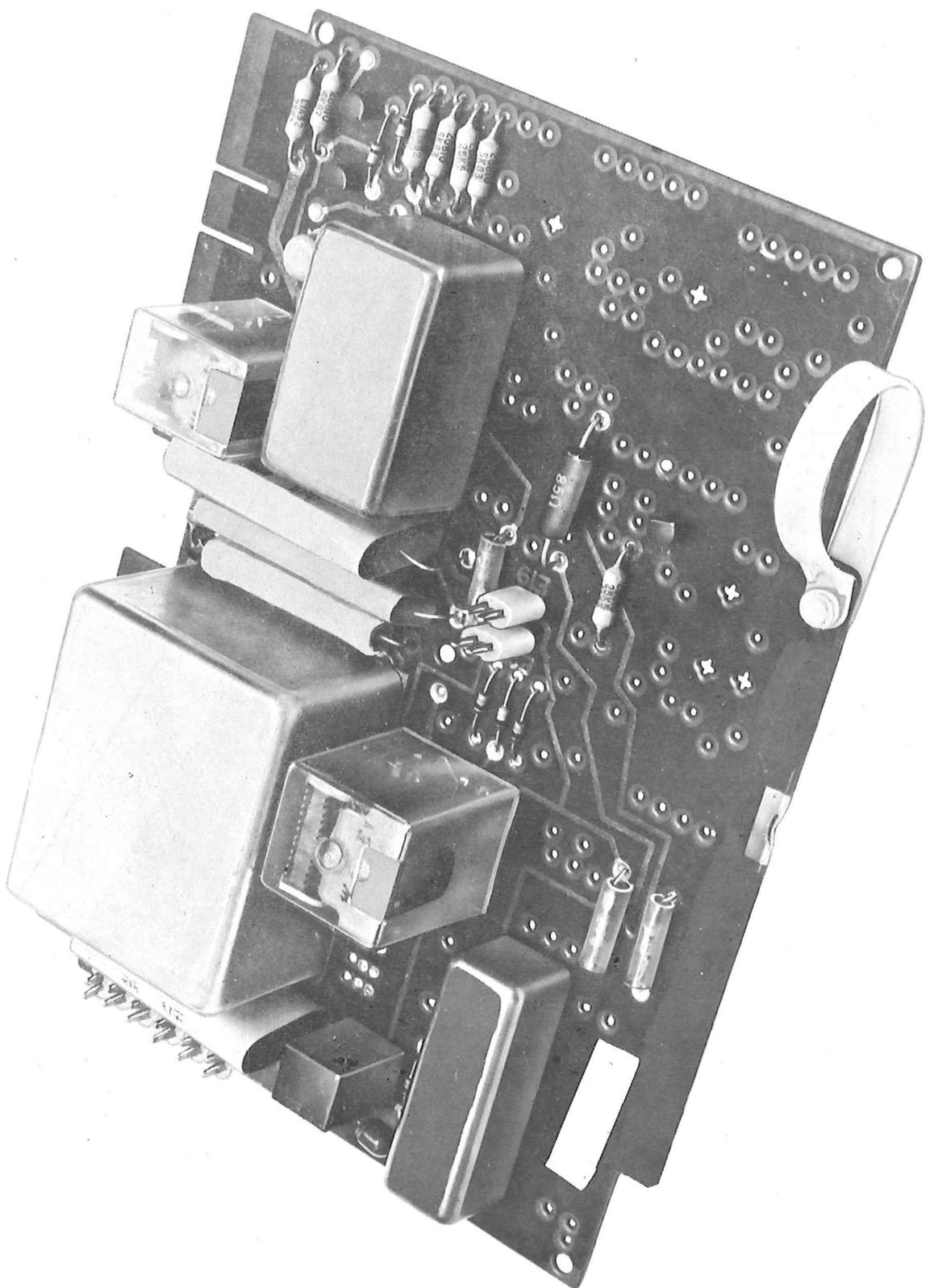
TABLE A

SPECIAL INTERFACE CONNECTION INFORMATION

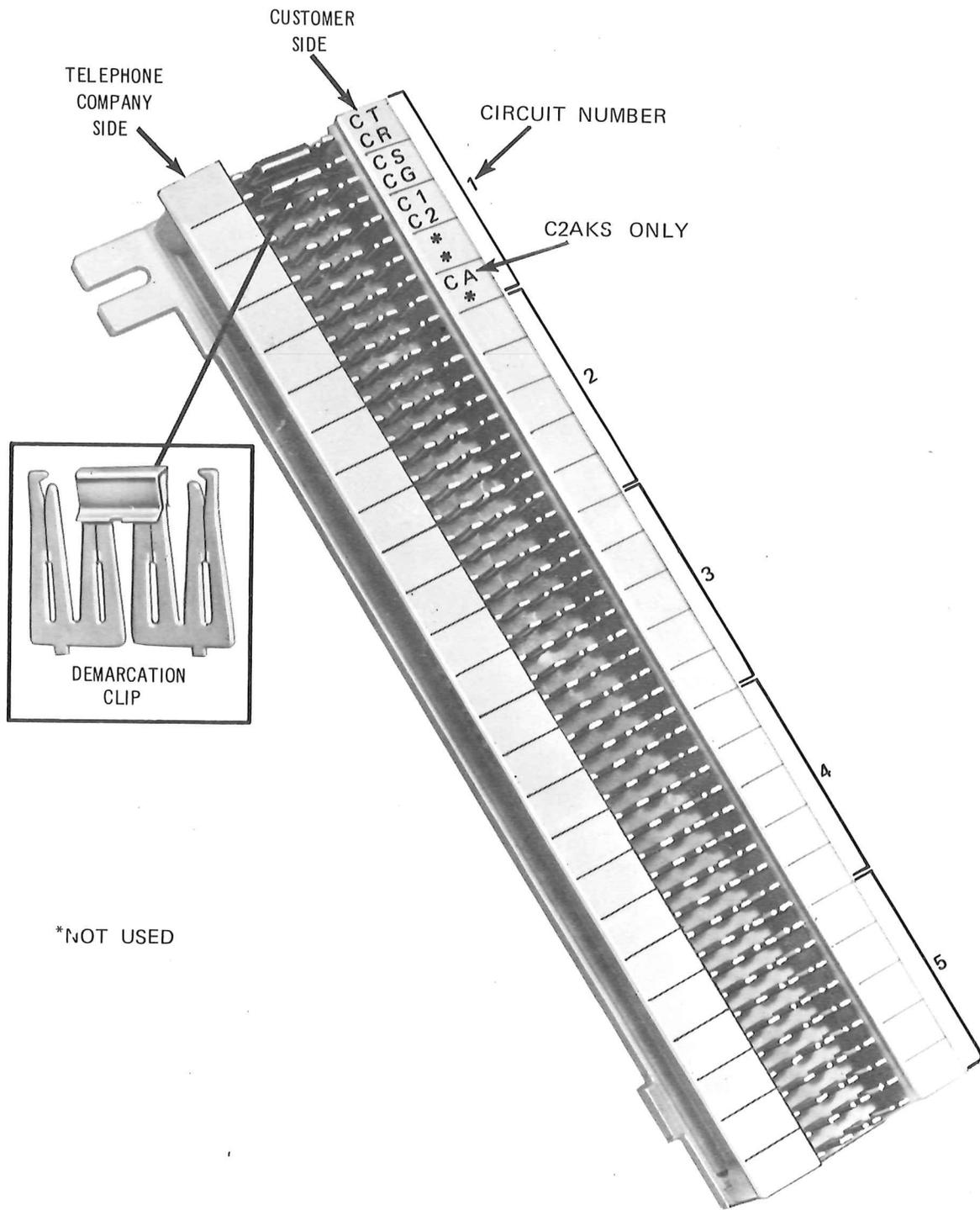
CIRCUIT NO.	LEAD DESIG.	QUICK CONNECT TERM. NO.	CONNECTOR PIN NO.
1	CT	1	26
	CR	2	1
	CS	3	27
	CG	4	2
	C1	5	28
	C2	6	3
	NOT USED	7	29
	NOT USED	8	4
	CA	9	30
	NOT USED	10	5
2	CT	11	31
	CR	12	6
	CS	13	32
	CG	14	7
	C1	15	33
	C2	16	8
	NOT USED	17	34
	NOT USED	18	9
	CA	19	35
	NOT USED	20	10
3	CT	21	36
	CR	22	11
	CS	23	37
	CG	24	12
	C1	25	38
	C2	26	13
	NOT USED	27	39
	NOT USED	28	14
	CA	29	40
	NOT USED	30	15
4	CT	31	41
	CR	32	16
	CS	33	42
	CG	34	17
	C1	35	43
	C2	36	18
	NOT USED	37	44
	NOT USED	38	19
	CA	39	45
	NOT USED	40	20
5	CT	41	46
	CR	42	21
	CS	43	47
	CG	44	22
	C1	45	48
	C2	46	23
	NOT USED	47	49
	NOT USED.	48	24
	CA	49	50
	NOT USED	50	25



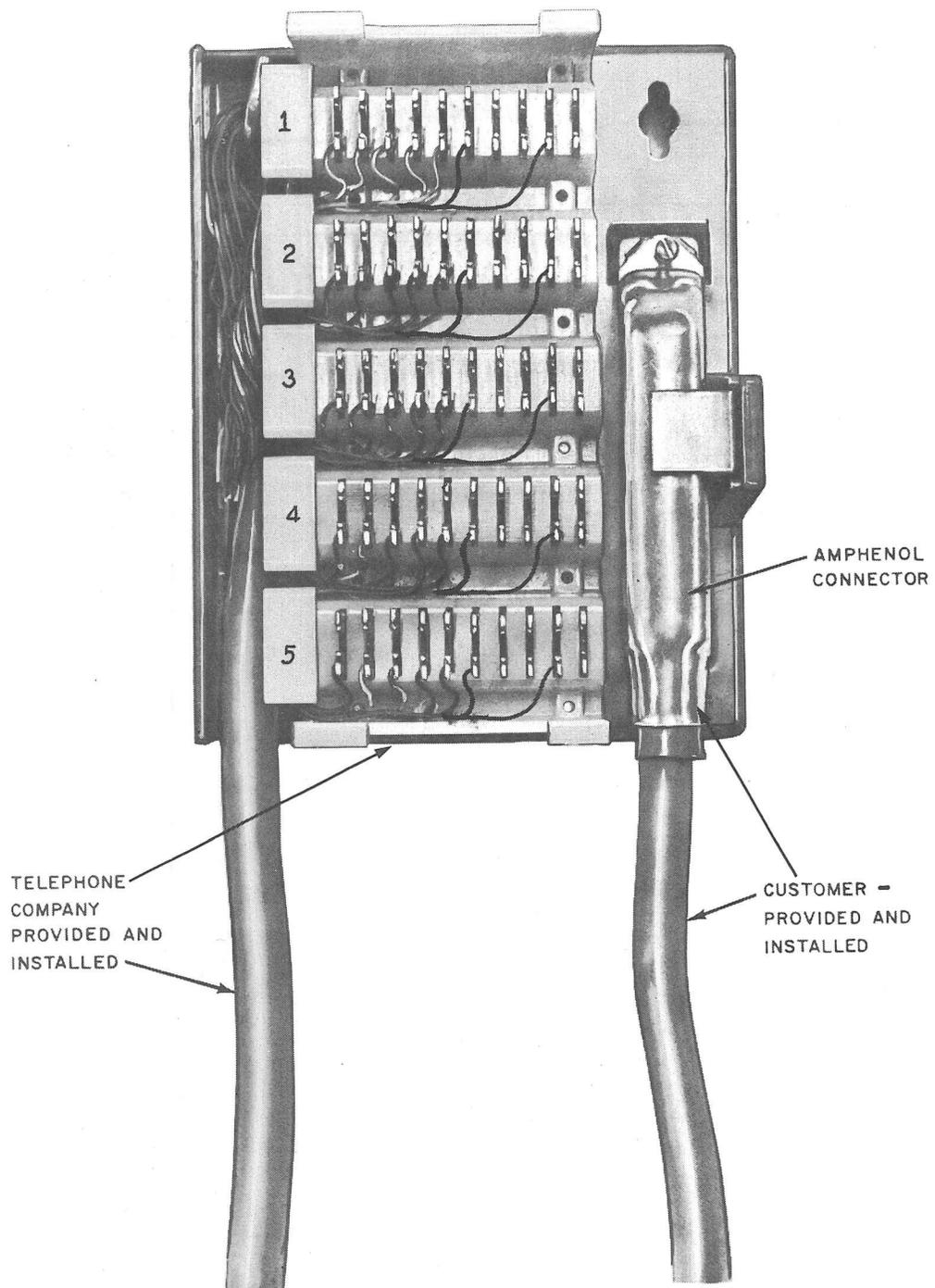
BLOCK DIAGRAM – PROTECTIVE CONNECTING ARRANGEMENTS C2ACP AND C2AKS  
 FIGURE 1



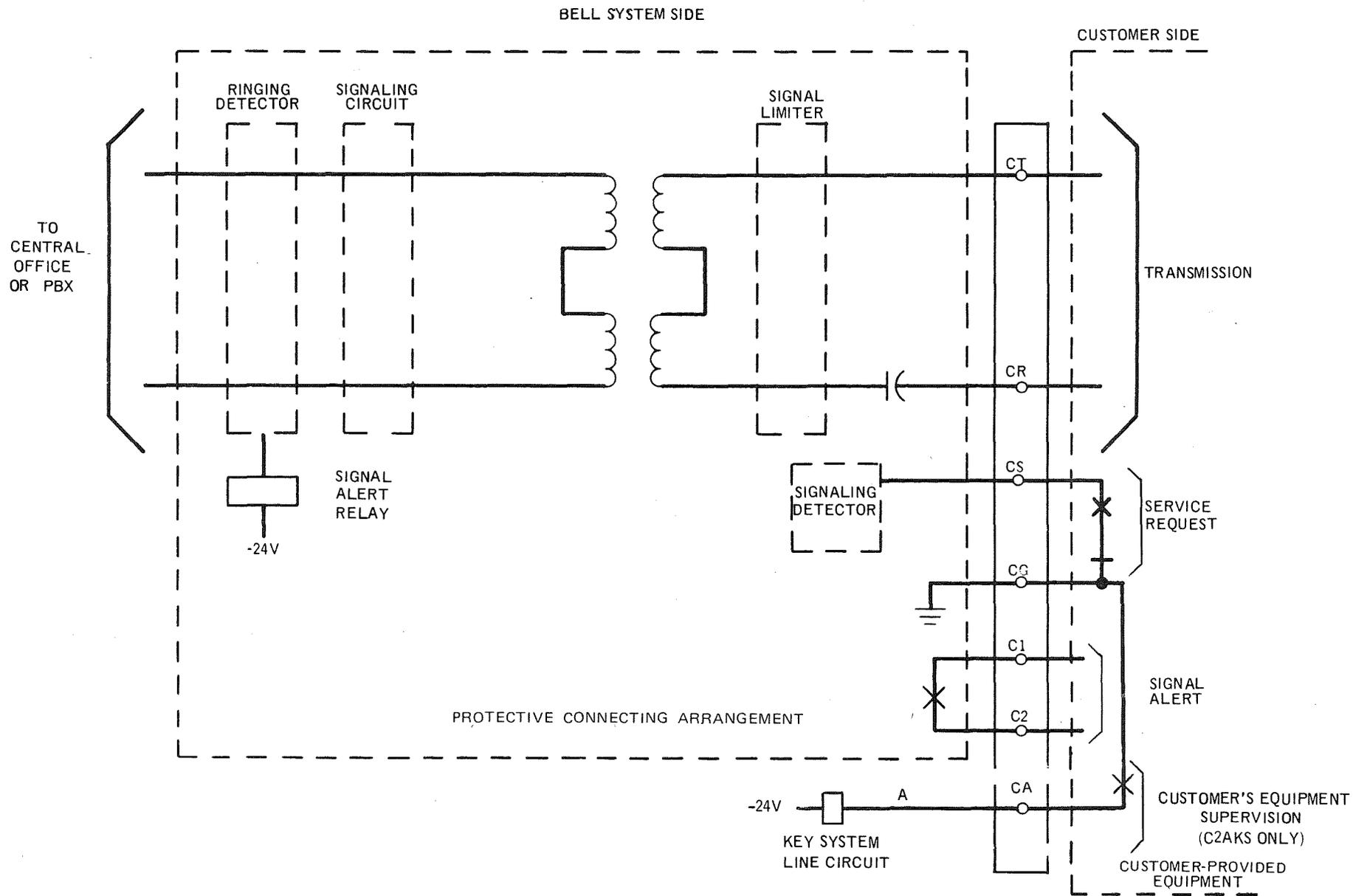
PROTECTIVE CONNECTING ARRANGEMENTS C2ACP AND C2AKS  
FIGURE 2



TYPICAL INTERFACE CONNECTING BLOCK  
 FIG. 3

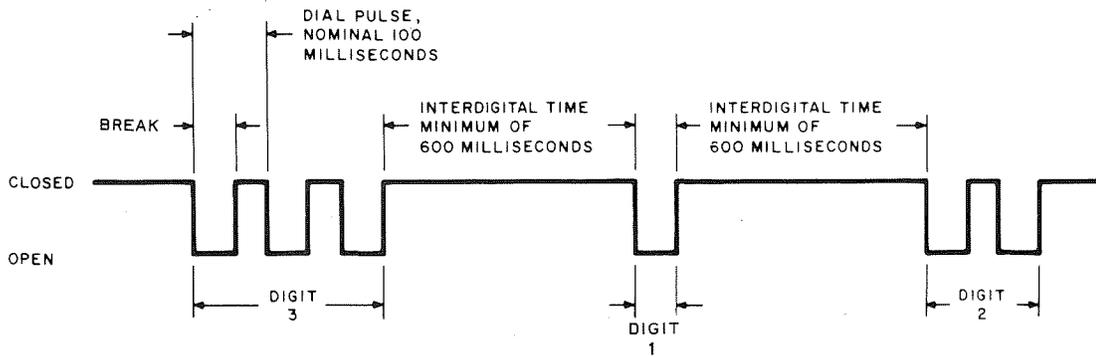


SPECIAL INTERFACE CONNECTING BLOCK  
FIG. 4



SIMPLIFIED SCHEMATIC – PROTECTIVE CONNECTING ARRANGEMENTS C2ACP AND C2AKS  
FIGURE 5

TYPICAL PATTERN OF DIAL PULSES EXPECTED  
FROM CUSTOMER-PROVIDED EQUIPMENT  
OVER LEADS CS AND CG (DIALING NUMBER 312)



DIAL PULSE RATE: NOMINAL 10 PULSES - PER SECOND (8 MIN. - 11 MAX.)  
PERCENT BREAK: 58 MIN. - 64 MAX.  
INTERDIGITAL TIME: MINIMUM OF 600 MILLISECONDS

DIAL PULSE CHARACTERISTICS  
FIG. 6