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Bell System

TECHNICAL REFERENCE

PROTECTIVE CONNECTING ARRANGEMENTS CAU/SU3/ SU4/SU6

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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 CAU, SU3, SU6 dated November 1969.

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TECHNICAL REFERENCE

PROTECTIVE CONNECTING ARRANGEMENTS CAU, SU3, SU4, SU6

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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 unit 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 CAU and SU6 provide the means for connecting customer-provided equipment, typically alarm systems, to the telecommunications network via a line to a local, foreign exchange, or WATS central office.

Protective Connecting Arrangement CAU provides for one-way outgoing voice transmission when the customer-provided automatic alarm system is connected to the telecommunications network.

Protective Connecting Arrangement SU6 is used where two-way voice transmission is required. Protective Connecting Arrangements CAU and SU6 are offered for speech transmission only and shall not be used for data transmission.

Protective Connecting Arrangement SU3 provides for control and testing by the customer of the customer-provided equipment from a remote telephone set equipped with an appropriate tone signaling device. Protective Connecting Arrangement SU3 cannot be used alone; it is used only with Protective Connecting Arrangement CAU or SU6.

Protective Connecting Arrangement SU4 is the combination of CAU plus SU3. There is no assigned code for the combination of SU6 and SU3.

In addition to the above, Protective Connecting Arrangement SU6AQ provides many of the same features and is preferable to any of the above because it uses equipment of more recent design (see PUB 42210).

1.3 Ordering and Identification

The protective connection services described in this Technical Reference are identified by the Bell System as Uniform Service Order Codes (USOCs) CAU, SU3, SU6, and SU4. When ordering service, the customer should specify CAU, SU6, SU4, or SU6 with SU3. The local Telephone Company business office or marketing representative will provide information regarding availability and rates for these services.

2. DESCRIPTION

2.1 Functions

The major functions of these protective connecting arrangements are:

(a) To prevent the introduction to the telecommunications network of hazardous voltages which could cause harm to Telephone Company personnel and facilities.

(b) To provide isolation against longitudinal imbalance.

(c) To limit abnormally high speech and signal levels.

(d) To provide speech transmission to and/or from the telecommunications network.

(e) To provide network control signaling to the telecommunications network, including dc dial pulses, on-hook, off-hook, etc.

(f) To respond to ringing signals from the telecommunications network and seize the telephone line (SU4 or SU6 with SU3).

2.2 Physical

Protective Connecting Arrangements CAU and SU6 consist of a printed wiring board assembly housed in an apparatus box, measuring approximately 6-7/8 inches wide, 7-

3/8 inches high, and 3-3/8 inches deep, intended for wall mounting, weighing approximately 4 pounds and with a light olive gray finish (Fig. 1). Mounting brackets are contained within the apparatus box to accommodate the optional Protective Connecting Arrangement SU3.

A 15-pin female receptacle is provided at the bottom of the arrangement to connect the speech, pulsing, power supply, and signaling unit control leads to the customer-provided equipment by means of a mating plug and cable to be furnished by the customer (eg, ITT-Cannon Electric or Cinch No. DA-19603-403 or DA15P-33C equipped with a Hood No. DA-51225-1, Fig. 3). The Telephone Company installer will make connections to the telephone line and associated telephone instrument.

2.3 Interface Leads

Six interface leads (CT, CR, OH1, OH2, B1+, and B2-) per circuit are required by the customer for Protective Connecting Arrangements CAU and SU6 for the customer's use (Fig. 2). Two additional leads (CY1 and CY2) may be used to provide an indication that the customer's plug is mating properly with the interface connector. When Protective Connecting Arrangement SU3 is provided, seven additional interface leads (TD1, TD2, ETD, COM, RTD, RE, and SRU) are provided. Technical information pertaining to these leads is discussed in Section 4.

The leads and their functions are as follows:

Lead	Functional Designation	Functions
CT, CR	Customer Tip, Customer Ring	Transmission
OH1, OH2	Off-Hook 1, Off-Hook 2	Off-Hook and dialing
B1+, B2-	Battery Positive, Battery Negative	DC power
CY1, CY2		Continuity (optional)
SRU	Set Ring-Up	Control leads used for Protective Connecting Arrangement SU3 only
TD1	Tone Detect 1	
TD2	Tone Detect 2	
COM	Common	
RE	Reset	
RTD	Reset Tone Detector	
ETD	Enable Tone Detector	

3. OPERATION

3.1 Outgoing Call

CAU and SU6

Assuming power has been supplied to the protective connecting arrangement through leads B1+ and B2-, the customer-provided equipment can initiate a call by providing a contact closure between leads OH1 and OH2 (Fig. 2). (NOTE: A call in progress with the associated telephone set may not be terminated by providing the closure between OH1 and OH2.) The line seizure and dial pulse relays in the connecting arrangement operate and seize the line. The contact closure between OH1 and OH2 must be maintained throughout the automatic cycle except during dial pulsing. With Protective Connecting Arrangement CAU, the customer-provided equipment must wait for 5 seconds before outpulsing to increase the probability that dial tone has been received. With Protective Connecting Arrangement SU6, the customer-provided equipment may wait for 5 seconds before outpulsing or preferably detect dial tone across leads CT and CR. After the 5 seconds or when dial tone is detected, the customer-provided equipment may generate network address signals by momentarily interrupting the closure between leads OH1 and OH2 (Fig. 4).

The customer-provided equipment must provide an announcement or other means of delaying the main message to permit the calling party to respond to ringing and answer the call. For Protective Connecting Arrangements CAU and SU6 the main message is then applied to leads CT and CR. During the operation of Protective Connecting Arrangements CAU and SU6, the associated telephone set is placed in a monitor condition enabling the customer to check the progress of a call without interfering with dialing or transmission.

With SU3

When Protective Connecting Arrangement SU3 is used, there is another method available to delay the main message.

After the number has been outpulsed, there should be a closure between leads OH1 and OH2 and between ETD and COM. The customer-provided equipment can then

momentarily close lead SRU to B1+ to cause a pulsed 2125 Hz tone to be transmitted over the telephone line as an identification tone. This tone is pulsed on and off at a 1 to 2 pulse-per-second rate. This tone will be transmitted for approximately 20 seconds. During this 20-second period, the called party should acknowledge receipt of the 2125 Hz tone by sending a 1475 Hz control tone.

One method the called party may use to accomplish this is to press the "3" button on his Touch-Tone® telephone for at least two seconds. This causes a 1475 Hz and 695 signal to be transmitted to the control unit. The protective connecting arrangement contains a filter to reject the 695 Hz component. If the 1475 Hz control signal is received during the 20-second period, a closure will be applied between leads TD1 and TD2 and a continuous 2125 Hz tone will be transmitted to the called party to acknowledge the receipt of a 1475 Hz tone. The customer-provided equipment can be arranged to start his announcement immediately upon receipt of the closure between TD1 and TD2. To start the announcement, the customer-provided equipment must provide a closure between leads RTD and COM. This stops the 2125 Hz tone and starts the message cycle. The connecting arrangement removes the closure between leads TD1 and TD2. (Status of leads at this time: OH1 closed to OH2, open between TD1 and TD2, RTD closed to COM, ETD closed to COM.)

If the customer-provided equipment wants the connecting arrangement to respond to a 1475 Hz tone during the announcement, the customer-provided equipment must disconnect lead ETD from COM while maintaining the closure between RTD and COM. If the called party sends a 1475 Hz tone, the announcement will be interrupted and there will be a closure between leads TD1 and TD2. At this time, no 2125 Hz tone will be sent. This closure may be used to reset the customer's equipment.

If the customer-provided equipment wants the connecting arrangement to respond to a 1475 Hz tone after the announcement is completed, the customer-provided equipment must open the closure between RTD and COM after the announcement while maintaining the closure between ETD and COM. This starts the 2125 Hz pulsing tone and a 20-second timer. If the called party signals with a 1475 Hz control tone within 20 seconds of the removal of the closure between RTD and COM, there will be a closure between TD1 and TD2. This closure may be used to reset the customer's equipment. If no closure is received within 20 seconds between TD1 and TD2, the customer's equipment should disconnect by removing the closure between OH1 and OH2.

If during the initial 20-second period after SRU was closed to COM the customer does not receive a closure between leads TD1 and TD2 at least 20 seconds after SRU was closed to COM, the customer-provided equipment should disconnect by removing the closure between OH1 and OH2 and start a new calling sequence. (A minimum on-hook period of two seconds must be provided between successive call cycles to cause the protective connecting arrangement to release the telephone line.)

3.2 Incoming Call

Incoming calls to the telephone associated with Protective Connecting Arrangements CAU and SU6 are handled in the normal manner. Protective Connecting Arrangement SU3 enables the Protective Connecting Arrangement CAU or SU6 to receive incoming calls from a remote telephone set for test purposes. When the customer dials the number assigned to the line of the telephone set associated with the protective connecting arrangement, the connecting arrangement detects the 20 Hz ringing and seizes the telephone line. The connecting arrangement answers the calling party by transmitting a 2125 Hz tone that is pulsed on and off at a 1 to 2 pulse-per-second rate. This pulsed tone will be transmitted for approximately 20 seconds. The calling party may signal this arrangement with a 1475 Hz control tone during the 20-second period that the connecting arrangement is sending the pulsed 2125 Hz identification tone. (One method of doing this is to press the "3" button on his Touch-Tone® telephone. See Section 3.1.) If a 1475 Hz tone is not received within 20 seconds after the connecting arrangement has answered the call, the connecting arrangement will automatically disconnect from the telephone line.

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When the 1475 Hz tone is received, a contact closure is provided between leads TD1 and TD2 to the customer-provided equipment. This closure may be used to start the customer-provided equipment. After detection of the 1475 Hz tone, a continuous 2125 Hz tone is transmitted to the calling party indicating that 1475 Hz tone was received. The customer-provided equipment may then close leads OH1 and OH2 to start the alarm reporting cycle, close lead RTD to COM to stop the 2125 Hz tone, and start the message cycle. The connecting arrangement then removes the closure between leads TD1 and TD2.

If the customer-provided equipment opens lead ETD from COM during the announcement (as predetermined by design of the customer's equipment), the calling party may signal the connecting arrangement with a second 1475 Hz tone (dial 3). This second tone may be used to reset the customer-provided equipment via leads TD1 and TD2. The connecting arrangement will not send a 2125 Hz tone at this time. After the announcement is completed or cancelled, the customer-provided equipment may open lead RTD from COM to start the 2125 Hz pulsing tone again. The calling party may again signal with a 1475 Hz tone to reset the customer-provided equipment.

3.3 Disconnect

The automatic call cycle is terminated when the customer-provided equipment goes on-hook by removing the closure between leads OH1 and OH2 (closure between OH1 and OH2 inhibits any other disconnect). When Protective Connecting Arrangement SU3 is provided, the called party may terminate the alarm cycle by transmitting a 1475 Hz control tone to the protective connecting arrangement. (This will give a closure on TD1 and TD2; the customer must then remove the closure between OH1 and OH2.) In addition, with Protective Connecting Arrangement SU3 any incoming call will be automatically disconnected if a 1475 Hz tone is not received within 20 seconds after the connecting arrangement has answered the line. Typical tone sources, when provided by the Telephone Company, are tone-equipped handsets, tonepads, and Touch-Tone telephone sets (digit 3). A minimum on-hook period of two seconds must be allowed between successive call cycles to cause the connecting arrangement to release the telephone line.

4. SPECIFIC DESIGN CONSIDERATIONS

4.1 Transmission Path (Leads CT and CR)

4.11 Insertion Loss

Protective Connecting Arrangement CAU contains an amplifier to provide unidirectional transmission from the customer-provided equipment to the telephone line. The amplifier provides unity gain ± 2 dB over the voice-frequency range of 300 to 3000 Hz.

The insertion loss of Protective Connecting Arrangement SU6 is a nominal 6 dB over 300 to 3000 Hz. No voice signal amplification is provided for Protective Connecting Arrangement SU6.

4.12 Impedance

Protective Connecting Arrangements CAU and SU6 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 likewise should be 600 ohms for optimum speech transmission performance.

4.13 Bandwidth

The nominal voice-frequency bandwidth of the telecommunications network extends from about 300 to about 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 DC Signals

The customer's equipment should not present any dc current on the CT and CR leads into the protective connecting arrangement.

4.15 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 from 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 for Protective Connecting Arrangement CAU and -2 dBm for Protective Connecting Arrangement SU6. This limit has been set so that when the average loss of loops in the Bell System is considered (including the insertion loss of the protective connecting arrangement), the limit of -12 dBm at the 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 (for Protective Connecting Arrangement CAU) if the maximum meter swing does not exceed 85 dBrn and will, in almost all cases, not exceed -2 dBm (for Protective Connecting Arrangement SU6) if the maximum meter swing does not exceed 91 dBrn. With the additional damping of measuring Method B, the power averaged over any 3-second interval will not exceed -8 dBm (for Protective Connecting Arrangement CAU) if the maximum meter swing does not exceed 83 dBrn and -2 dBm (for Protective Connecting Arrangement SU6) if the maximum meter swing does not exceed 89 dBrn.

4.16 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 ensure a proper measurement technique, the control settings on these meters should be as shown below.

Western Electric 3-Type Noise Measuring Set

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

Hewlett-Packard Transmission and Noise Measuring Set Model 3555B

Control	Setting
INPUT (Switch)	NOISE/BRDG
FUNCTION (Pushbutton)	VF/Nm-600 BAL
NOISE WTG (Switch)	3 kHz 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.)

* 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 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.

4.18 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 be at least 18 dB below the power specified in Paragraph 4.14.

(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.

4.19 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 Off-Hook (Leads OH1 and OH2)

A closure between these leads is provided by the customer-provided equipment to cause line seizure. These leads are also pulsed (opened and closed) by the customer's dialing equipment in order to produce dial pulses on the telephone line.

The pulses received from the customer-provided equipment must have the following characteristics (Figure 4):

(a) Rate: nominal 10 pulses-per-second (8 min., 11 max.)

(b) Percent Break Interval: nominal 61 (58 min., 64 max.)

(c) Interdigital Time: minimum of 600 milliseconds

(d) Contact Bounce: 0.001 second total interval on make or break.

Customer-provided connecting leads and contacts across leads OH1 and OH2 should have a maximum total resistance of 50 ohms. The customer's equipment should provide appropriate contact protection.

4.22 Continuity (Leads CY1 and CY2) (optional)

Leads CY1 and CY2 are connected in the protective connecting arrangement to provide an indication that the customer's plug is mating properly with the interface connector of the connecting arrangement.

4.23 Battery (Leads B1+ and B2-)

Leads B1+ and B2- are used to supply customer-provided dc power to the protective connecting arrangement. The customer-provided equipment should be isolated from ground and should supply the following:

(a) Voltage: 18 ±3V dc

(b) Current Requirements: (assuming 21V dc applied)

Current	Protective Connecting Arrangement CAU or SU6	Protective Connecting Arrangement SU4 or SU3 with SU6
Standby	3 mA	12 mA
Operating	58 mA	82 mA
Initial Surge	1 amp (max.)	1 amp (max.)
RC Time Constant	.02 second	.02 second

THE FOLLOWING ADDITIONAL LEADS ARE UTILIZED WHEN PROTECTIVE CONNECTING ARRANGEMENT SU3 IS PROVIDED.

4.24 Set Ring-Up (Lead SRU)

A momentary closure between leads SRU and B1+ enables the 1475 Hz detector, starts transmission of pulsed 2125 Hz tone, and starts the 20-second disconnect timer. (Used when SU3 is used for originating a call.)

4.25 Tone Detector (Leads TD1 and TD2)

An isolated contact closure is provided by Protective Connecting Arrangement SU3 after a 1475 Hz tone is received. This closure is maintained until the tone detector is once again disabled as described in Section 4.29.

4.26 Common (Lead COM)

Lead COM is used to energize leads RE, RTD, or ETD when it is desired to perform their associated functions.

4.27 Reset (Lead RE)

A momentary closure between leads RE and COM by the customer's equipment will cause immediate disconnect during the 20-second interval if leads OH1 and OH2 are not connected together.

4.28 Reset Tone Detector (Lead RTD)

A momentary closure between leads RTD and COM will reset the tone detector and 20-second timer. A continuous closure to lead COM is required to keep the 20-second timer reset and to enable the 2125 Hz oscillator.

4.29 Enable Tone Detector (Lead ETD)

Lead ETD is normally closed to lead COM but may be opened to enable the tone detector while lead RTD is closed to lead COM. This permits the protective connecting arrangement to receive a 1475 Hz tone while the message is being transmitted.

4.3 Grounding

Protective Connecting Arrangements CAU, SU3, SU4, and SU6 are normally ungrounded and customer-provided signaling and power supply ground connections to the connecting arrangement should be isolated from ground. It is expected that the customer's equipment where required will comply with applicable electrical codes, eg, the National Electrical Code (NEC).

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 arrangement.

5.2 Telecommunications Network Characteristics

5.21 End-to-end Electrical Loss

The end-to-end electrical loss of a connection is a function of the impedance of both end terminations, the losses of the serving central offices, and the facilities connecting central 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.

5.22 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 customer-provided 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 the proper protective connecting arrangement by code (CAU, SU6, SU4, or SU6 with SU3) 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 (CAU, SU6, SU4, or SU6 with SU3).

(b) Connecting the equipment to the 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 device 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 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 his 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 customer-provided 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's "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) Description of the trouble

(e) Uniform Service Order Code (USOC) CAU, SU6, SU4, or SU6 with SU3

(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 — 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 CONNECTOR — the Telephone Company-provided connecting point to which the customer brings and connects the mating plug and cable of his equipment to 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.

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.

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.

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 Network 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 — 1975," by American Telephone and Telegraph Company, New York, New York.

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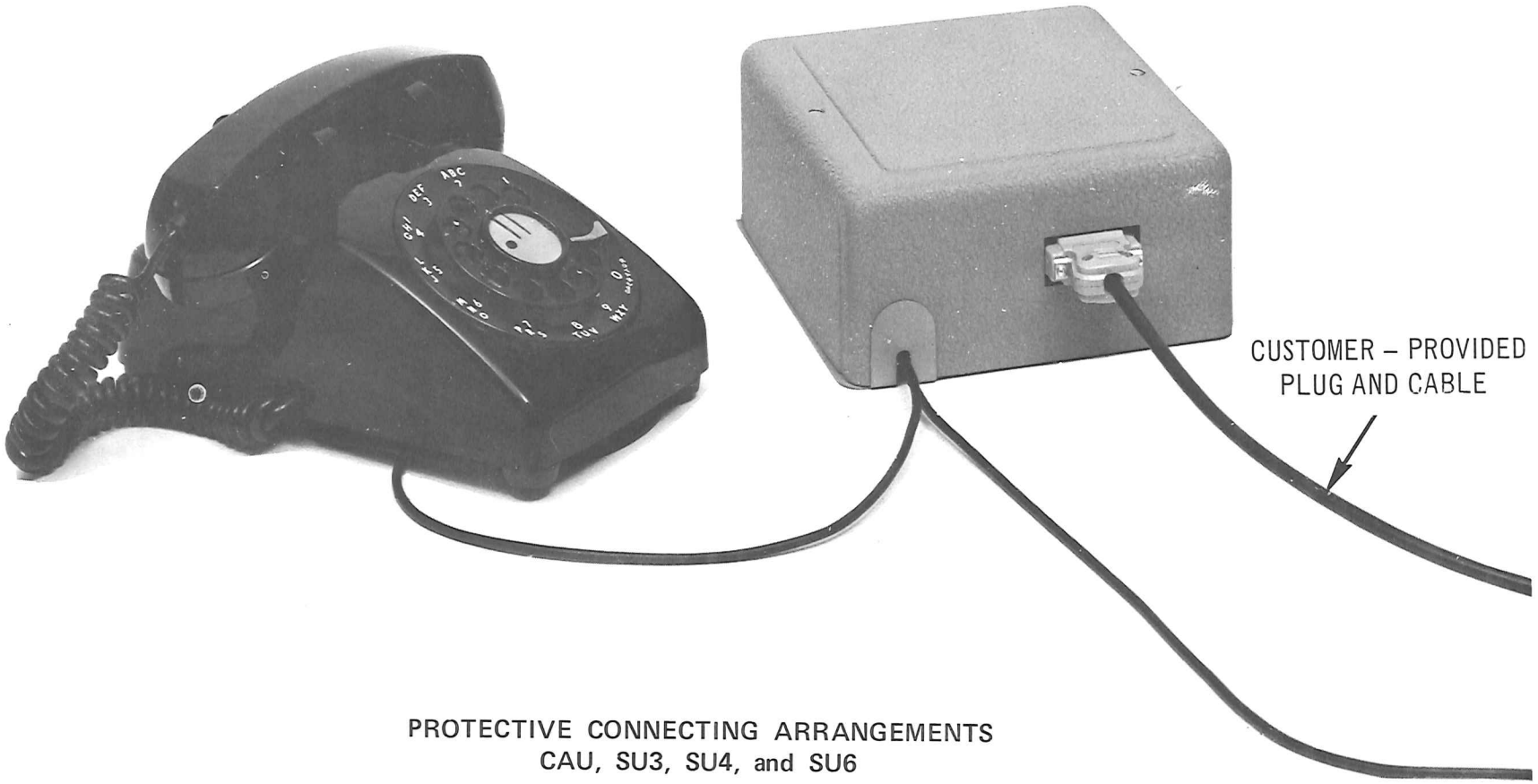
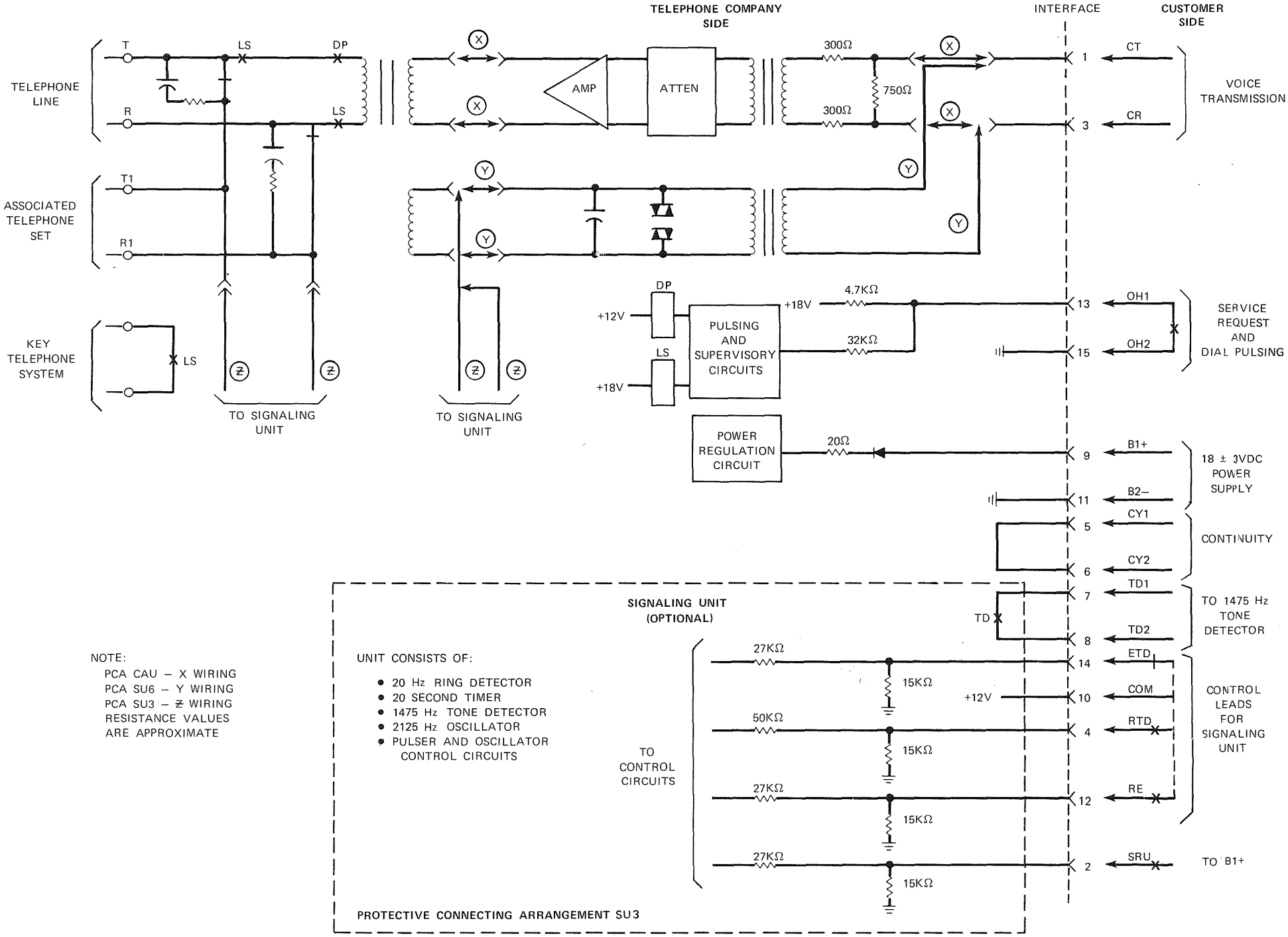
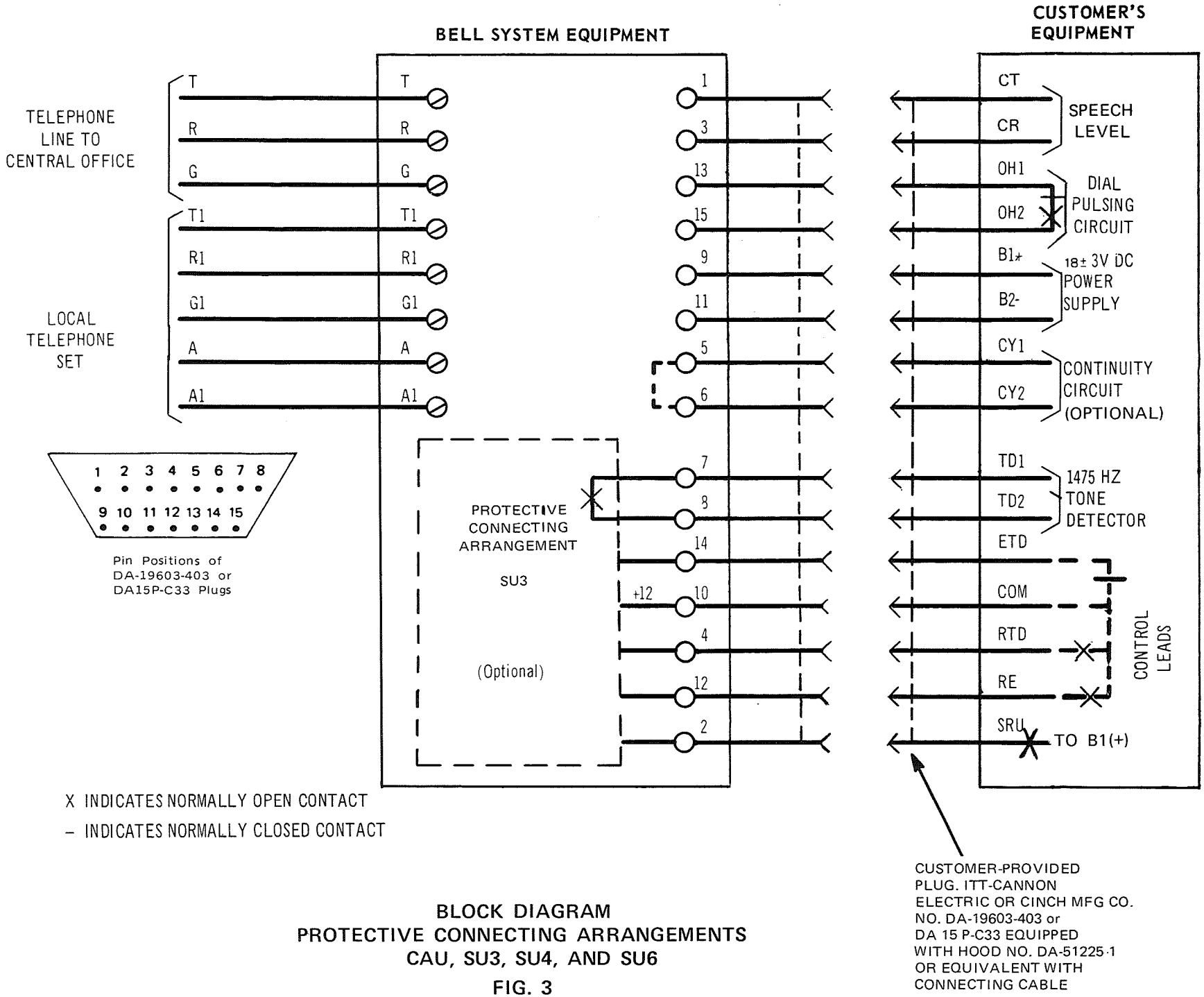


PROTECTIVE CONNECTING ARRANGEMENTS
CAU, SU3, SU4, and SU6
FIG. 1

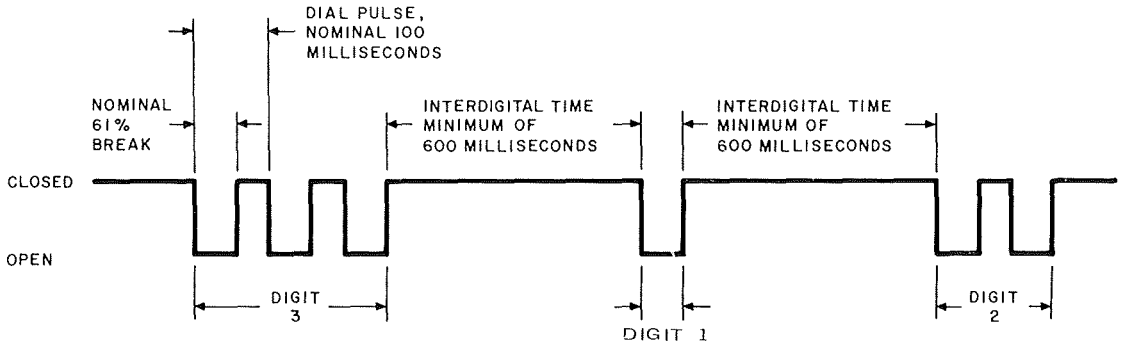


SIMPLIFIED SCHEMATIC – PROTECTIVE CONNECTING ARRANGEMENTS CAU, SU3, SU4, AND SU6



BLOCK DIAGRAM
PROTECTIVE CONNECTING ARRANGEMENTS
CAU, SU3, SU4, AND SU6
FIG. 3

TYPICAL PATTERN OF DIAL PULSES EXPECTED
FROM CUSTOMER–PROVIDED EQUIPMENT
OVER LEADS OH1 AND OH2 (DIALING NUMBER 312)



DIAL PULSE RATE–NOMINAL 10 PULSES PER SECOND (8 MIN–11 MAX.)
PERCENT BREAK–NOMINAL 61 (58 MIN–64 MAX.)
INTERDIGITAL TIME–MINIMUM OF 600 MILLISECONDS

DIAL PULSE CHARACTERISTICS
FIG. 4