

Bell System

TECHNICAL REFERENCE

PROTECTIVE CONNECTING
ARRANGEMENT SU7QW

INTERFACE SPECIFICATION
REVISED APRIL 1975



**Bell System Voice Communications
TECHNICAL REFERENCE**

**Protective
Connecting
Arrangement**

SU7QW

**Interface
Specification**

**Revised
April 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 Arrangement SU7QW dated revised May, 1971.

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**TECHNICAL REFERENCE
PROTECTIVE CONNECTING ARRANGEMENT SU7QW**

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1. GENERAL

1.1 Introduction

F.C.C. 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 Arrangement SU7QW provides the means for automatically connecting a customer-provided dc dial pulse repertory dialer, which requires no voice transmission path, to the telecommunications network via a station line to a local, foreign exchange, or PBX/Centrex station line where such lines are physically terminated in equipment located on the customer's premises or an OUTWATS central office line. The connecting arrangement also has provisions for connection of an associated Telephone Company-provided telephone set which provides all of the other normal telephone station functions, e.g., transmission, switchhook, manual dialing (in lieu of the repertory dialing), and ringing.

Protective Connecting Arrangement SU7QW supersedes and replaces Voice Connecting Arrangement SU7 which was described in Technical Reference — Voice Connecting Arrangement SU7 dated December 1969. In addition to internal improvements in the protective connecting arrangement itself, this arrangement provides the customer with the option of providing dc power to operate the protective connecting arrangement or of having the Telephone Company provide, by means of a low voltage ac transformer, power to operate the connecting arrangement.

When the auxiliary features such as receiver muting during dial pulsing or the option of a customer-provided source of power are not required, Connecting Arrangement AD1 may be specified. This arrangement is described in Technical Reference — Connecting Arrangement AD1 — PUB 42213.

1.3 Ordering and Identification

The protective connection service described in this Technical Reference is identified by the Bell System as Uniform Service Order Code (USOC) SU7QW. When ordering this service, the customer should specify this code. One protective connecting arrangement should be ordered for each telephone set which is to be connected to the customer-provided equipment. The local Telephone Company business office or marketing representative will provide information regarding availability and rates for this service. When ordering, the customer should specify a power option (ie, Telephone Company or customer-provided power).

2. DESCRIPTION

2.1 Functions

The major functions of this protective connecting arrangement 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 provide vice-only transmission to and from telecommunications network by means of the associated telephone set.
- (d) To provide for network control signaling to the telecommunications network, including dc dial pulses, on-hook, off-hook, etc.

2.2 Physical

Protective Connecting Arrangement SU7QW consists of a connecting arrangement and an

associated telephone set. The protective connecting arrangement consists of printed circuit boards housed in an apparatus box measuring approximately 9 inches square and 3 inches deep and is intended for either shelf or wall mounting. It weighs approximately 4 pounds, has a metal base, and has a molded plastic cover with a light olive-gray finish (see Fig. 1).

A 15-pin female receptacle is provided at the bottom of the arrangement to connect the dial pulse, muting, and power leads to the customer-provided equipment by means of a plug furnished by the customer (see Fig. 2 and 3).

2.3 Interface Leads

Protective Connecting Arrangement SU7QW provides, at the interface connector, a pair of leads for dial pulses, a pair of leads for muting the associated telephone set receiver during dialing, and a pair of leads to be used when the customer elects to provide dc power to operate the connecting arrangement (see Fig. 2 and 3).

These leads are described in more detail in the following paragraphs and in Section 4 and are connected to the protective connecting arrangement by means of a customer-provided cable terminated in a customer-provided plug, Cinch No. DA-19603-403 equipped with a Hood No. DA-51225-1 or equivalent. Connections should be made to the leads specified below and in Figures 2 and 3.

Dial Pulse (Leads OH1 and OH2)

Leads OH1 and OH2 are provided for connection to the dial pulse contacts (or transistor switch) in the customer-provided dial pulse repertory dialer for address signaling purposes.

Muting (Leads MU1 and MU2)

Leads MU1 and MU2 are provided for connection to the muting contacts (or transistor switch) in the customer-provided dial pulse repertory dialer for suppressing dial clicks in the receiver of the associated Telephone Company-provided telephone set.

Battery (Leads B1+ and B2-)

Leads B1+ and B2- provide the means for a connection of an optional customer-provided dc power source to provide power to the protective connecting arrangement. The Telephone Company (at the customer's option) may provide a power source for the connecting arrangement. In this case, a low voltage ac transformer is plugged into a customer-provided 60 Hz, 117 volt ac outlet and connected to Telephone Company terminals in the connecting arrangement. This ac power, which is current-limited, is converted to dc power in the connecting arrangement where it is used to operate the connecting arrangement. When the Telephone Company transformer is used as the primary power source, a customer-provided rechargeable battery may be "floated" across leads B1+ and B2- to provide emergency power during failure of commercial ac power.

3. OPERATION

3.1 Incoming Call from the Central Office

Protective Connecting Arrangement SU7QW does not respond to or affect incoming calls from the central office. Incoming calls are handled using the associated Telephone Company-provided telephone set in the normal manner.

3.2 Outgoing Call to the Central Office

To make an outgoing call with the customer-provided repertory dialer (assuming power has been applied to the protective connecting arrangement and leads OH1 and OH2 are closed), the customer goes off-hook with the handset of the associated Telephone Company telephone set and, after receiving dial tone, operates the dialer to outpulse the desired telephone number. The dialer pulsing contacts open and close leads OH1 and OH2 causing relay PR to repeat the pulses over leads R and R1 to the telephone line. The muting (off-normal) contacts, if provided, from the customer-provided dialer close and open leads MU1 and MU2 causing relay RU to repeat closures on leads A and A2 to mute the telephone set receiver during dialing.

To prevent a false dial pulse, power must be applied to the connecting arrangement and leads OH1 and OH2 must be closed before the associated telephone set goes off-hook. If a power failure occurs, the connecting arrangement automatically connects the associated telephone set across the line so the customer can dial manually using the telephone set dial.

3.3 Disconnect

To disconnect a call established using Protective Connecting Arrangement SU7QW, the customer goes on-hook with the associated telephone set.

4. SPECIFIC DESIGN CONSIDERATIONS

4.1 Transmission Path

No voice transmission or tone address signaling path is provided in Protective Connecting Arrangement SU7QW. All transmission functions are provided by the associated Telephone Company-provided telephone set.

4.2 DC Signaling Paths

4.2.1 Dial Pulse (Leads OH1 and OH2)

Leads OH1 and OH2 should be normally closed and are used to provide a path for customer-provided dial pulses which, in order to register properly in any type of Bell System switching equipment, must have the following characteristics (see Fig. 4):

- (a) Rate: 8 to 11 pulses-per-second (nominally 10 pps)
- (b) Break: 58 to 64 percent of total make-plus-break duration (61% nominal)
- (c) Minimum make: 34 milliseconds
- (d) Minimum break: 55 milliseconds
- (e) Interdigital time: 600 milliseconds minimum
- (f) Contact bounce: 1 millisecond maximum total interval on make or break.

Customer-provided connecting leads and contacts (or transistor switches) across leads OH1 and OH2 should have a maximum total resistance (closed circuit) of 50 ohms maximum and a minimum insulation resistance (open circuit) of 500k ohms. The open circuit voltage across leads OH1 and OH2 is 12 volts maximum and the short circuit current is 5 milliamperes maximum.

4.2.2 Muting (Leads MU1 and MU2)

Leads MU1 and MU2 should be normally open and are used to provide muting of dial pulse transients (clicks) in the receiver of the associated telephone set. Customer-provided contacts (or transistor switches) across leads MU1 and MU2 should have an insulation resistance (open of 500k ohms minimum and a contact and connecting lead total resistance operated (closed) of 50 ohms maximum. The open circuit voltage across leads MU1 and MU2 is 22 volts maximum and the short circuit current is 22 milliamperes maximum.

Leads MU1 and MU2 should be closed before dial pulse leads OH1 and OH2 open, should remain closed during the dial pulse train, and should open after the last pulse (after leads OH1 and OH2 are closed).

4.3 Battery Leads (Leads B1+ And (B2-)

Leads B1+ and B2- are used to supply customer-provided dc power to the connecting arrangement when the Telephone Company-provided ac power transformer is not provided. The customer-provided equipment should be isolated from ground and should supply the following:

- (a) Voltage: 21 ± 5 volts dc (ripple must fall within these limits)
- (b) Operating Current: 55 milliamperes maximum
- (c) Standby Current: 12 milliamperes
- (d) Initial Surge: 1 ampere (upon application of power)

When the Telephone Company-provided ac power transformer is being used as the primary power source, a customer-provided rechargeable battery (18 volts, 150-500

milliampere-hour) may be "floated" across leads B1+ and B2- to provide for emergency power. A charging current of 2.5 milliamperes is available to keep the battery charged under normal conditions.

4.4 Grounding

Protective Connecting Arrangement SU7QW is 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 will comply with applicable electrical codes such as 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.

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 SU7QW 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 SU7QW.
- 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 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. 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 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 customer believes that the problem is being caused by the Telephone Company 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) Uniform Service Order Code (USOC) SU7QW
- (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 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 to 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., 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., "Lighting 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 — 1975," by American Telephone and Telegraph Company, New York, New York.

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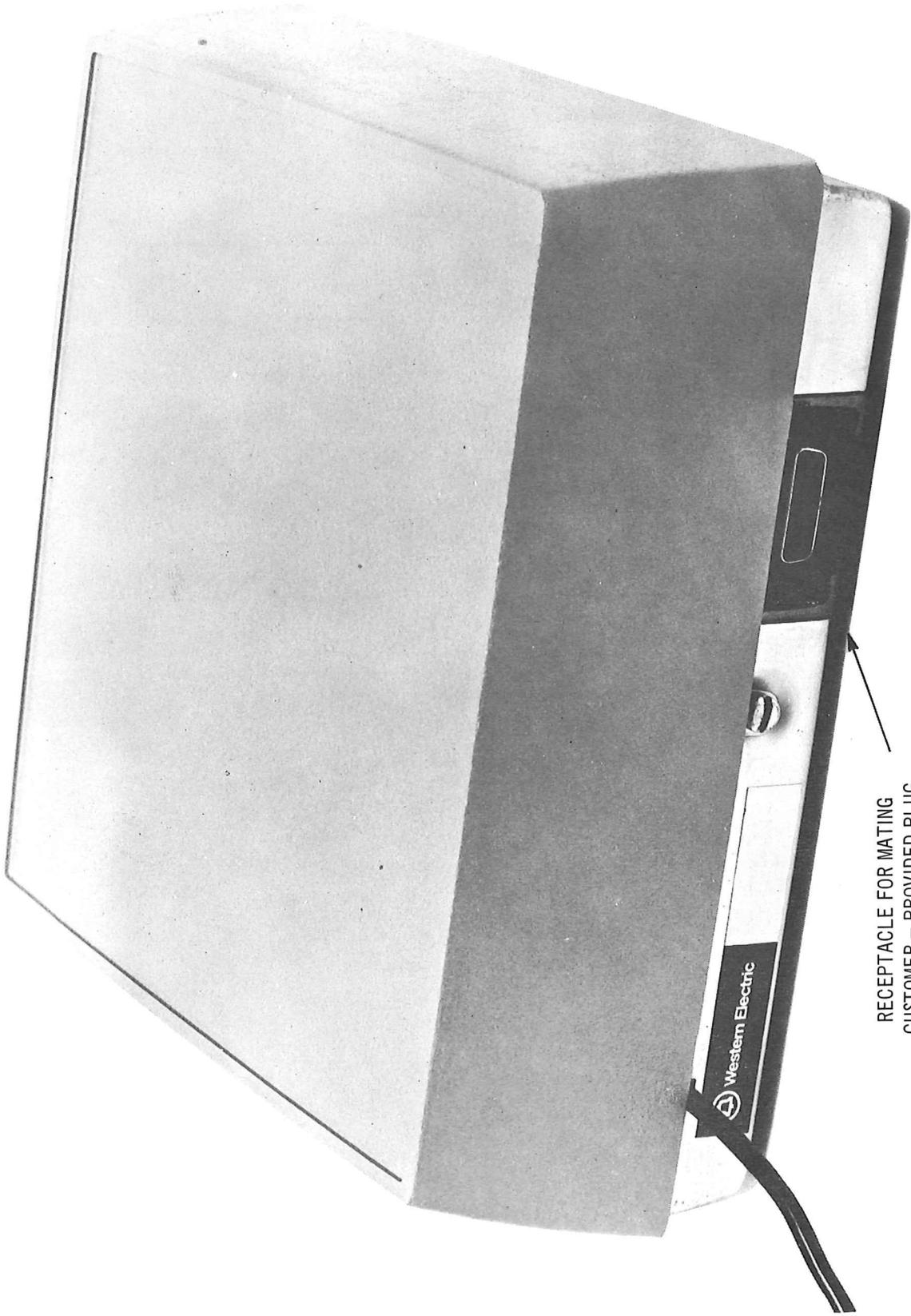
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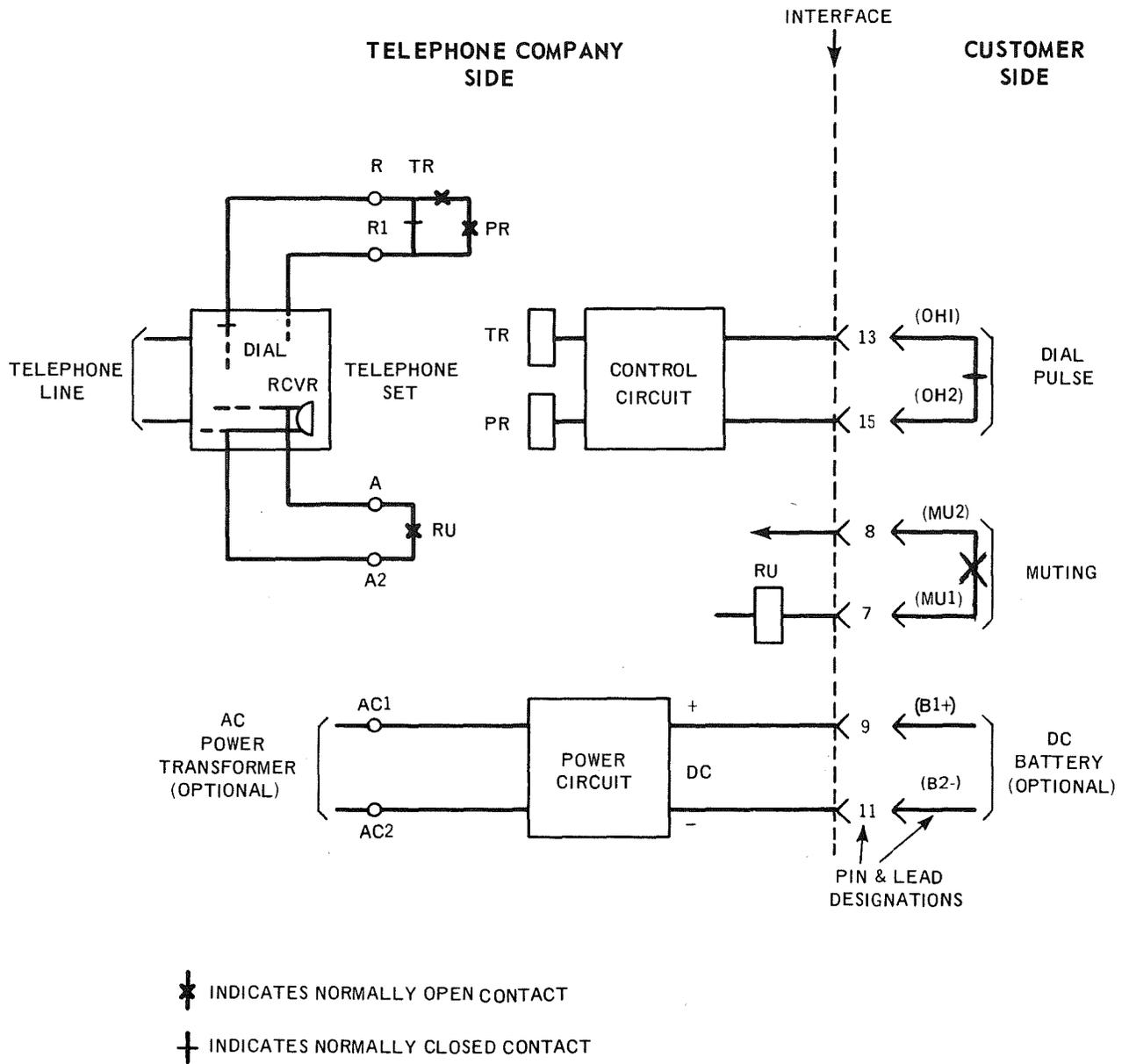
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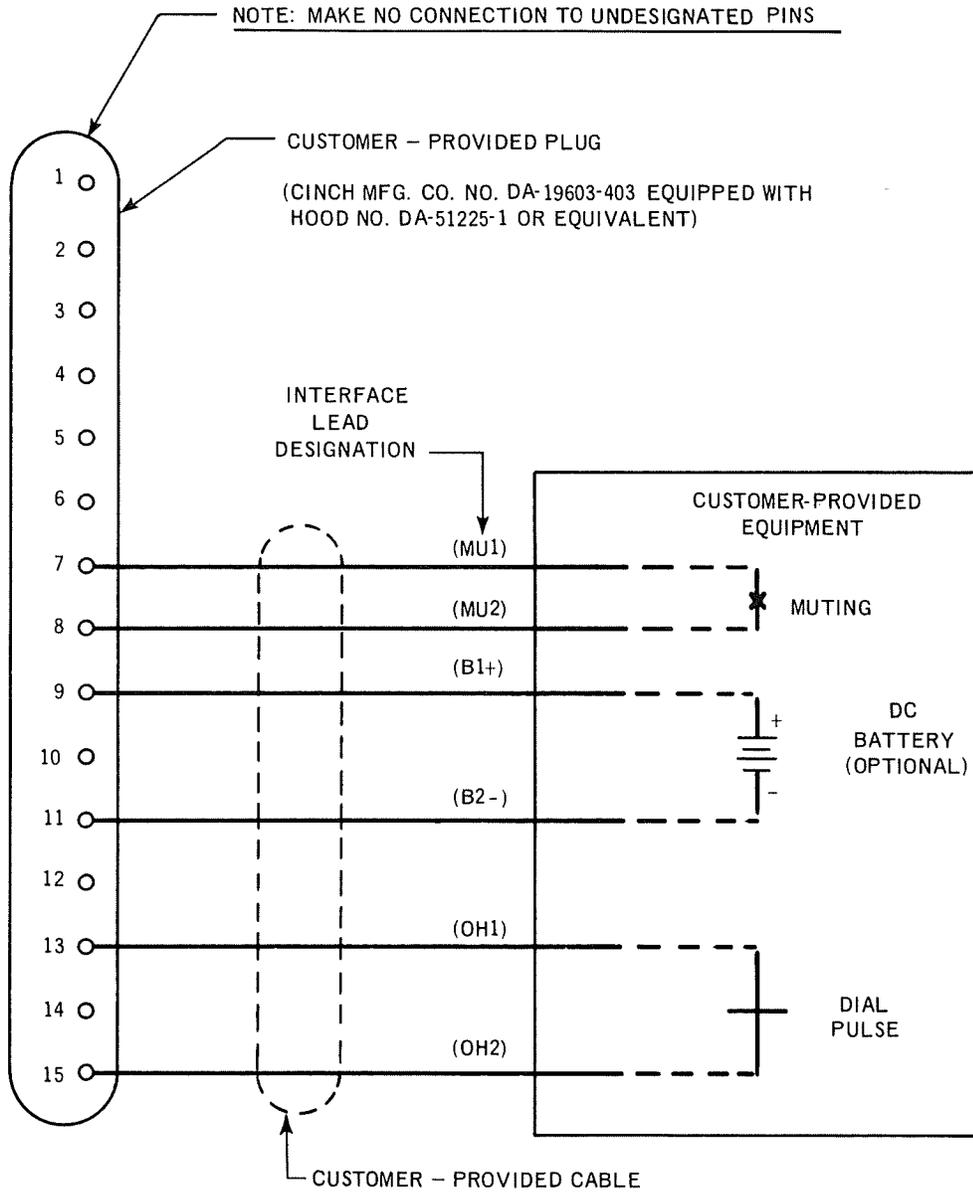
RECEPTACLE FOR MATING
CUSTOMER - PROVIDED PLUG

PROTECTIVE CONNECTING ARRANGEMENT SU70W

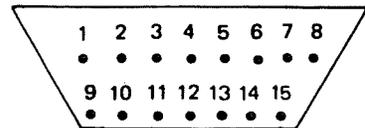
FIG. 1



PROTECTIVE CONNECTING ARRANGEMENT SU7QW
 BLOCK DIAGRAM
 FIG. 2



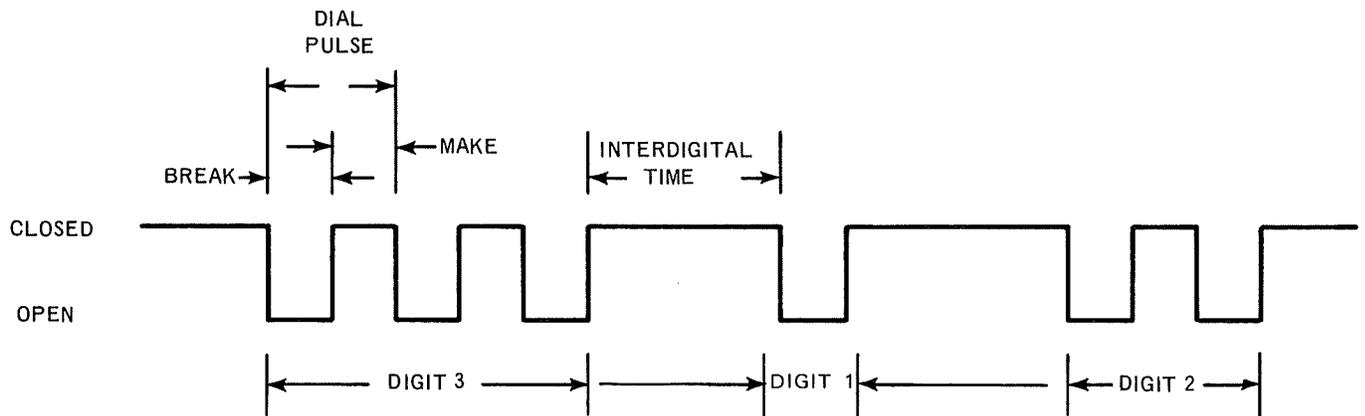
- * INDICATES NORMALLY OPEN CONTACT
- + INDICATES NORMALLY CLOSED CONTACT



Pin Positions of DA-19603-403 Plug

**PROTECTIVE CONNECTING ARRANGEMENT SU7QW
TYPICAL CONNECTIONS TO BE PROVIDED BY THE CUSTOMER
FIG. 3**

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



DIAL PULSE RATE: 8 – 11 PULSE-PER-SECOND (nominally 10 pps)
PERCENT BREAK: 58 - 64 PERCENT OF TOTAL MAKE-PLUS-BREAK nominally 61%
INTERDIGITAL TIME: 600 MILLISECONDS MINIMUM

PROTECTIVE CONNECTING ARRANGEMENT SU7QW
DIAL PULSE CHARACTERISTICS

FIG. 4