

PRELIMINARY

**Bell System Voice Communications
TECHNICAL REFERENCE**

**Voice
Connecting
Arrangements**

**SU6AQ
STS**

**Interface
Specification**

June 1971

ENGINEERING DIRECTOR - CUSTOMER TELEPHONE SYSTEMS



PRELIMINARY

NOTICE

This Technical Reference is published by American Telephone and Telegraph Company as a guide for the designers, manufacturers, and consultants 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 similar agencies; 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 systems and equipment are set forth in the appropriate tariff regulations.

This Technical Reference supersedes and replaces Bell System Voice Communications Technical Reference for Voice Connecting Arrangement SU6 dated November 1969. The information for Voice Connecting Arrangements CAU and SU3 also contained in that reference is still valid.

If further information is required, please contact:

Engineering Director - Customer Telephone Systems
American Telephone and Telegraph Company
195 Broadway
New York, New York 10007

TECHNICAL REFERENCE

VOICE CONNECTING ARRANGEMENTS SU6AQ AND STS

TABLE OF CONTENTS

	Page No.
1. GENERAL	1
1.1 Introduction	1
1.2 Application	1
1.3 Ordering and Identification	2
2. DESCRIPTION	3
2.1 Functions	3
2.2 Physical	3
2.3 Interface Leads	4
3. OPERATION	6
3.1 Incoming Call from the Central Office	6
3.2 Outgoing Call to the Central Office	6
3.3 Disconnect	7
3.4 Power Failure	7
4. SPECIFIC DESIGN CONSIDERATIONS	8
4.1 Transmission Path	8
4.2 DC Signaling Paths	14
4.3 Battery	16
4.4 Grounding	16
5. GENERAL DESIGN CONSIDERATIONS	17
5.1 Foreign and Surge Voltage Protection	17
5.2 Telecommunications Network Characteristics	17
6. SERVICE AND MAINTENANCE CONSIDERATIONS	18
6.1 Responsibility of the Customer	18
6.2 Responsibility of the Telephone Company	19
6.3 Trouble Reporting Procedures	20

APPENDIX A - GLOSSARY

APPENDIX B - REFERENCES

APPENDIX C - WHERE TO OBTAIN REFERENCE MATERIAL

LIST OF FIGURES

Fig. 1 Photograph - Voice Connecting Arrangements SU6AQ and STS

Fig. 2 Block Diagram - Voice Connecting Arrangements SU6AQ and STS

Fig. 3 Typical connections to be provided by the customer

Fig. 4 Dial Pulse Characteristics

PRELIMINARY

VOICE CONNECTING ARRANGEMENTS SU6AQ AND STS

1. GENERAL

1.1 Introduction

F.C.C. Tariffs and corresponding intrastate tariffs filed by the Bell System provide for the direct electrical connection of customer-provided voice transmitting and receiving terminal equipment and communications systems to Bell System telecommunications network. The tariffs also provide for the indirect (acoustic or inductive) connection of such equipment or systems. Both methods require compliance with network protection criteria specified in the tariffs.

Direct electrical connection is made through a voice connecting arrangement and associated network control signaling unit furnished, installed, and maintained by the Telephone Company.

1.2 Application

Voice Connecting Arrangement SU6AQ provides the means for automatically connecting customer-provided terminal equipment or systems capable of originating and/or receiving calls, typically alarm systems, to the telecommunications network via a loop to a local foreign exchange, or WATS Central Office. An associated Telephone Company provided telephone set may be used to provide normal telephone station functions. This arrangement is only offered for speech transmission and may not be used for data transmission.

Voice Connecting Arrangement SU6AQ supersedes and replaces Voice Connecting Arrangement SU6 which was described in Technical Reference - Voice Connecting Arrangements CAU, SU3, SU6 dated November 1969. In addition to internal improvements in the voice connecting unit itself, (e.g., lower insertion loss), the new arrangement gives the customer the option of providing

dc power to operate the connecting arrangement or of having the Telephone Company provide, by means of a low voltage ac transformer, power to operate the voice connecting unit. The new arrangement also permits the customer to use tone address signals for dialing (where the customer has subscribed to Bell System TOUCH-TONE® service).

Voice Connecting Arrangement STS has all of the features of Voice Connecting Arrangement SU6AQ and, in addition, permits the customer-provided equipment to transmit supervisory tones, (e.g., answer-back tones to the distant party, by means of an automatic gain control (AGC) amplifier which assures compliance with network protection criteria.

Voice Connecting Arrangement CAU, originally known as the Alarm Coupler, and its supplemental Signaling Unit (SU3) will continue to be made available for use with customer-provided equipment previously designed to these specifications.* It is expected that the new features available in Voice Connecting Arrangements SU6AQ and STS will encourage their use and that no new designs will be based on CAU and SU3 specifications.

1.3 Ordering and Identification

The connection services described in this Technical Reference are identified by the Bell System as Voice Connecting Arrangements SU6AQ and STS. One voice connecting arrangement should be ordered for each telephone line 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 these service when ordering the customer should specify his power option.

* The combination of Voice Connecting Arrangements CAU plus SU3 has for rate purposes been assigned a Universal Service Order Code (USOC) of SU4.

® Registered Service Mark of the Bell System.

2. DESCRIPTION

2.1 Functions

The major functions of these voice connecting arrangements are:

- (a) To protect Telephone Company personnel and facilities from hazardous voltages which may be applied to the voice connecting arrangements.
- (b) To provide longitudinal isolation.
- (c) To limit abnormally high speech and tone address signal levels to the telecommunications network.
- (d) To provide speech transmission to and from the telecommunications network.
- (e) To provide for network control signaling to the telecommunications network, including dc dial pulses, tone address signals, on-hook, off-hook, etc.
- (f) To provide for an indication of ringing signals from the telecommunications network.
- (g) To provide (STS only) for transmitting supervisory tones through an automatic level control limiter to the distant party over the telecommunications network.

2.2 Physical

Voice Connecting Arrangements SU6AQ and STS consist 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 (Fig. 1). It weighs approximately 4 pounds, has a steel base and a molded plastic cover with a light olive gray finish. The cover is attached to the base with tamper-resistant screws.

A 15-pin female receptacle is provided at the bottom of the arrangement to connect the transmission, signaling, and power leads to the customer-provided equipment by means of a plug and cable to be furnished by the customer (see Figs. 2 and 3). Internal screw terminals are provided for the Telephone Company installer to make connections to the telephone line, key telephone system, associated telephone set, and power transformer (if provided).

2.3 Interface Leads

Voice Connecting Arrangement SU6AQ provides at the interface connector:

- (1) a pair of leads for two-way speech transmission and tone-address signaling,
- (2) a pair of service alerting leads (ring sense), (3) a pair of service request leads (ON and OFF-HOOK), (4) three status leads, and (5) a pair of battery leads (Fig. 2 and 3).

Voice Connecting Arrangement STS provides the same leads but the transmission pair is conditioned for supervisory tone transmission to the distant party in addition to being used for two-way voice transmission and tone-address signaling.

These leads are described in more detail in the paragraphs below and in Section 4 and are connected to the connecting arrangement by means of a customer-provided cable terminated in a customer-provided plug, Cinch No. 231-15-61-133 equipped with a Hood No. 239-13-99-069. Connections should be made only to the leads specified below and in Figures 2 and 3.

Transmission (Leads CT and CR)

Leads CT and CR provide a two-way transmission path for speech and tone-address signaling (where the customer has subscribed to TOUCH-TONE service). In addition, with Voice Connecting Arrangement STS only, these leads may be used to transmit (and receive) supervisory tones from the distant party, e.g., answer-back tone in response to a signal from the distant party.

PRELIMINARY

- 5 -

Service Request (Leads OH1 and OH2)

Leads OH1 and OH2 provide the means for the customer-provided equipment to cause line seizure and to trip ringing (off-hook) and to release the line (on-hook). These leads are also used to transmit dc dial pulse address signals to the telecommunications network.

Signal Alerting (Leads RU1 and RU2)

Leads RU1 and RU2 provide an isolated contact closure of approximately one second duration during the latter half of each 20 Hz ringing burst received from the telephone line to give a ring sense indication to the customer-provided equipment.

Status (Leads TR1, TR2, and TR3)

Leads TR1, TR2, and TR3 provide isolated contacts to the customer-provided equipment to indicate the status of the connecting arrangement. During line seizure, contacts across leads TR1 and TR2 are closed and contacts across leads TR3 and TR2 are open; when the connecting arrangement is disconnected from the line, contacts across leads TR1 and TR2 are open and contacts across leads TR3 and TR2 are closed. In the standby (disconnected) condition, the closure across leads TR3 and TR2 may be used by the customer-provided equipment to indicate continuity of the plug and cable connections between the customer-provided equipment and the connecting arrangement.

Battery (Leads B1+ and B2-)

Leads B1+ and B2- provide for a connection to the connecting arrangement of a customer-provided dc power source for operating the connecting arrangement. The Telephone Company may (at the customer's option) provide a power source for the connecting arrangement. In this case, a low voltage, current limited, ac transformer is plugged into a 60 Hz, 117 volt ac outlet provided by the customer and

is connected to Telephone Company terminals in the connecting arrangement where this ac power is converted to dc power. When the Telephone Company transformer is used, 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

In the following paragraphs, the operation of Voice Connecting Arrangements SU6AQ and STS are described and reference is made to the circuits shown in the Block Diagram (Fig. 2) and it is assumed that power is being supplied to the connecting arrangement.

3.1 Incoming Call from the Central Office

When a 20 Hz ringing signal is detected on the telephone line by the RING DETECTOR circuit, leads RU1 and RU2 close for approximately one second during each ringing cycle (the typical ringing cycle in use in the Bell System is 2 seconds on and 4 seconds off), and relay PR operates. The customer-provided equipment may cause the connecting arrangement to seize the line and trip ringing by closing (and maintaining a closure) between leads OH1 and OH2. Two-way transmission is provided immediately upon line seizure. Relay TR operates and a closure is provided between leads TR1 and TR2 and an open is provided between leads TR3 and TR2 indicating that the connecting arrangement has seized the line. The operation of relay TR disconnects talking battery from the associated telephone set (but not any bridged extension telephone sets). The connection to the telephone line will be maintained until the customer-provided equipment opens leads OH1 and OH2.

3.2 Outgoing Call to the Central Office

To initiate a call, the customer-provided equipment provides a closure between leads OH1 and OH2. After a one second delay (during which time the connecting arrangement will terminate a call originated from the associated

telephone set but not necessarily one received by the associated telephone set), the connecting arrangement will seize the telephone line and complete the two-way transmission path over leads CT and CR. The closure between leads OH1 and OH2 must be maintained for the duration of the call (except during dial pulsing). After receipt and detection of dial tone by the customer-provided equipment (or after waiting for 5 seconds if dial tone detection is not provided by the customer's equipment), the customer-provided equipment may generate network address signals either by periodically interrupting the closure across leads OH1 and OH2 or by transmitting tone-address signals over leads CT and CR. Since two-way transmission has been established, call progress signals from the telecommunications network (e.g., ring back or busy tone) will be received by the customer-provided equipment. During line seizure, contacts across leads TR1 and TR2 are closed and contacts across leads TR3 and TR2 are opened.

3.3 Disconnect

The customer-provided equipment can cause the connecting arrangement to release the telephone line by opening leads OH1 and OH2 for at least 200 milliseconds. At this time, relays PR and TR release, contacts across leads TR1 and TR2 open and across TR3 and TR2 close; and the associated telephone set is reconnected across the telephone line.

3.4 Power Failure

During commercial power failure, the associated Telephone Company provided telephone set can be used to provide emergency service. If a call is in progress through the connecting arrangement during such failures, the connecting arrangement will automatically connect the telephone line to the associated telephone set (unless stand-by dc power is provided by the customer, see Section 4.4)

4. SPECIFIC DESIGN CONSIDERATIONS

4.1 Transmission Path (Leads CT and CR)

4.11 Insertion Loss

The insertion loss of Voice Connecting Arrangement SU6AQ or STS is a nominal 3 dB at 250 Hz and 1 dB over the voice-frequency range of 300 to 3000 Hz. No voice signal amplification is provided.

4.12 Impedance

Voice Connecting Arrangements SU6AQ and STS provide about a one-to-one impedance transformation on the CT and CR leads. The impedance is a function of the voice connecting arrangement impedance and 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 and, therefore, the impedance of the customer-provided equipment should be 600 ohms for optimum voice signal power transfer across the interface.

4.13 Bandwidth

The nominal 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 voice connecting arrangements do not limit this bandwidth.

4.14 Voice 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. The maximum available power from a customer-provided 600 ohm source when averaged over any 3-second interval and measured at the CT and CR leads

should not exceed -8 dBm. This limit has been set so that when the average loss of loops in the Bell System are considered (including the insertion loss of the voice connecting arrangement), the limit of -12 dBm at the local Central Office will be met.

When these arrangements are used on foreign exchange or private line service, lower levels may be specified by the local Telephone Company.

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

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 criterion specified in Paragraph 4.14 is 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.

* These meters do not have a 3-second averaging time but, when used on 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.

PRELIMINARY

- 10 -

Western Electric 3-Type
Noise Measuring Set

Hewlett-Packard Transmission
and Noise Measuring Set
Model 3555B

<u>Control</u>	<u>Setting</u>	<u>Control</u>	<u>Setting</u>
FUNCTION (Switch)	BRDG	INPUT (Switch)	NOISE/BRDG
NORM/DAMP (Switch)	DAMP	FUNCTION (Pushbutton)	VF/Nm-600 BAL
WTG (Plug-in Network)	3Kc FLAT	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 average 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 be sensitive to 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 voice 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.

4.17 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 be at least 18 dB below the signal level specified in Paragraph 4.14.
- (b) The power in the band from 4000 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, Voice Connecting Arrangements SU6AQ and STC permit customer-provided tone address signals to be transmitted over leads CT and CR to a Central Office TOUCH-TONE receiver for the purpose of network addressing. The signaling code for the Bell System TOUCH-TONE signaling 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.

These tone address signal levels are currently under review and it is anticipated that these signal levels may be reduced in the future. Information on these future plans will be included in a forthcoming technical reference on tone addressing signaling. When these connecting arrangements are used on foreign exchange, or private line service, lower levels may be specified by the local Telephone Company.

2. Frequency Deviation

Tone frequencies should be within ± 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 (i.e., transmitter shall 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 Voice Connecting Arrangement SU6AQ to protect the Bell System telecommunications network from applications of abnormally high signal levels. This peak signal limiter has no effect on normal speech or normal tone address signal levels.

An automatic level control limiter is incorporated in the transmission path of Voice Connecting Arrangement STC to protect the Bell System telecommunications network from application of abnormally high end-to-end tone signals. It has no effect on normal speech and signal levels. Incorporation of the signal limiter in the coupler does not remove the customers responsibility to comply with the criteria in the tariffs.

4.2 DC Signaling Paths

4.21 Service Request (Leads OH1 and OH2)

Leads OH1 and OH2 provide the means for the customer-provided equipment to cause the connecting arrangement to seize and release the line and also provide the means for the customer-provided equipment to transmit dc dial pulse address signals to the telecommunications network.

Dial pulses generated by customer-provided equipment, 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 (10 nominally)
- (b) Break: 58 to 64 percent of total make-plus-break duration (61% nominally)

PRELIMINARY

- 15 -

- (c) Minimum make: 34 milliseconds
- (d) Minimum break: 55 milliseconds
- (e) Interdigital time: 600 milliseconds minimum
- (f) Contact bounce: 1.0 milliseconds maximum on total interval make or break.

The customer-provided contacts (or transistor switches) across leads OH1 and OH2 should have a total (closed circuit) resistance including leads of 50 ohms maximum and an open circuit resistance of 500,000 ohms minimum. The open circuit voltage across leads OH1 and OH2 is 22 volts maximum and the short circuit current is 15 milliamperes maximum.

4.22 Service Alerting (Leads RU1 and RU2)

Leads RU1 and RU2 provide an isolated contact closure of approximately one second duration during the latter half of each 20 Hz ringing burst received from the telephone line. The nominal ringing cycle in use in the Bell System is 2 seconds on and 4 seconds off. The isolated contacts across leads RU1 and RU2 are rated at 250 milliamperes. The maximum voltage which can be applied 28 volts dc or 50 volts ac RMS.

4.23 Status (Leads TR1, TR2, and TR3)

Leads TR1, TR2, and TR3 are isolated contacts which indicate to the customer-provided equipment the status of the connecting arrangement, e.g., it has seized the line or it has released the line. When the connecting arrangement is disconnected from the line leads TR1 and TR2 are open and leads TR3 and TR2 are closed (and may be used to monitor continuity between the customer-provided equipment, cable, and plug and the connecting arrangement).

When the connecting arrangement has seized the line, leads TR1 and TR2 are closed and TR3 and TR2 are open. These contacts are rated at 250 milliamperes. The maximum voltage which may be applied to these leads is 28 volts dc or 150 volts ac RMS.

4.3 Battery (Leads B1+ and B2-)

Leads B1+ and B2- may be used by the customer to supply dc power to the connecting arrangement. 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: 140 milliamperes maximum
- (c) Standby Current: 12 milliamperes
- (d) Initial Surge: 1 ampere

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 milliamperes-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

Voice Connecting Arrangements SU6AQ and STS are normally isolated from ground and therefore customer-provided signaling and power supply connections must be isolated from ground. It is expected that the customer's equipment voice couply 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 foreign voltages by direct contact or induction (e.g., power line crosses or lightning), protective devices are installed at the Central Office and on the customer's premises that will provide a path to ground for foreign voltages that exceed about 600 volts peak. Since the customer's equipment is connected to the telephone line through the voice connecting arrangement, the customer's equipment is protected from metallic and longitudinal surges.

The customer is responsible for providing protection, internal to his equipment and facilities, against foreign and hazardous voltages from his equipment and facilities being applied to the voice 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 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.

5.22 Nonlinearities

Nonlinearities such as compression, clipping, and harmonic distortion can exist on the telecommunications network. Normally, these are insignificant for voice 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 AND MAINTENANCE CONSIDERATIONS

6.1 Responsibility of the Customer

The tariffs permitting connection of customer-provided terminal equipment or communications systems state that where long distance message telecommunications service is available under these tariffs for use in connection with terminal equipment or communications systems, provided by a customer, 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 does 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 system or facilities 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 or make such change as shall be necessary to remove or prevent such hazard or interference.

6.2 Responsibility of the Telephone Company

The Tariffs permitting connection of customer-provided terminal equipment and communications systems state that the Telephone Company shall not be responsible for the installation, operation or maintenance of said terminal equipment or communications systems. Long distance message telecommunications service is not represented as adapted to the use of customer-provided equipment or systems and where such equipment or systems are connected to Telephone Company facilities, the responsibility of the Telephone Company shall be limited to the furnishing of facilities, including the protective connecting arrangements and network control signaling units, suitable for long distance message telecommunications service and to the maintenance and operation of such facilities in a manner proper for such 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 systems or for the quality of, or defects in, such transmission, or (ii) the reception of signals by customer-provided equipment or systems, 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 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 facilities obsolete or require modification or alteration of such equipment or systems or otherwise affect its use or performance.

6.3 Trouble Reporting Procedure

When trouble is experienced with this service, the customer should perform the necessary testing at the interface to sectionalize the difficulty, i.e., determine whether the sectionalize impairment is located in the customer-provided equipment or in the equipment provided by the Telephone Company. If the tests indicate that the trouble is in the Telephone Company-provided equipment, it should be promptly reported to the Telephone Company. Trouble reports should be called into the listed "Repair Service" number which 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) Customer's contact for additional information

If a Telephone Company service call results in the location of the trouble in the customer-provided equipment, the customer is liable to be charged for the service call.

PRELIMINARY

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.

CONNECTING ARRANGEMENT - equipment provided by the Telephone Company to accomplish the electrical connection of customer-provided equipment and the Telecommunications Network.

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 system, 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.

PRELIMINARY

- 2 -

INTERFACE CONNECTOR BLOCK - the Telephone Company-provided connecting point to which the customer brings and connects the mating plug and cable of his equipment to the voice connecting arrangement.

NETWORK CONTROL SIGNALING - denotes the transmission of signals used in the telecommunications system 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 system.

NETWORK CONTROL SIGNALING UNIT - denotes the terminal equipment furnished, installed, and maintained by the Telephone Company for the performance of network control signaling.

OFF-HOOK SUPERVISION - the conditioning of the SERVICE REQUEST leads by the customer-provided equipment which indicates a customer's telephone is answering or originating a call.

ON-HOOK SUPERVISION - the conditioning of the SERVICE REQUEST leads by the customer-provided equipment which indicates that the customer's telephone has disconnected or that the equipment 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.

PRELIMINARY

- 3 -

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 or rering); 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).

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

VOICE COUPLER - the part of Voice Connecting Arrangement which connects the transmission path from the customer-provided equipment to the telecommunications network.

VOICE CONNECTING ARRANGEMENT - a protective connecting arrangement designed to transmit speech signals as contrasted to one designed to transmit data signals.

VOICE CONNECTING UNIT - that portion of the voice connecting arrangement including the voice coupler that provides the interconnection function between the customer-provided equipment and the Telephone Company facilities.

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.

PRELIMINARY

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) Nasell, I., "The 1962 Survey of Noise and Loss on Toll Connections," BSTJ, Vol. 43, No. 2 (March 1964), p. 697.
- (c) Nasell, I., "Some Transmission Characteristics of Bell System Toll Connections," BSTJ, Vol. 47, No. 6 (July-August 1968), p. 1001.
- (d) Nasell, I., Ellison, C. R., and Homstrom, R., "The Transmission Performance of Bell System Intertoll Trunks," BSTJ, Vol. 47, No. 8 (October 1968), p. 1561.
- (e) Gresh, P. A., "Physical and Transmission Characteristics of Customer Loop Plant", BSTJ, Vol. 48, No. 10 (December 1969), p. 3337.
- (f) Alexander, A. A., Gryb, R. M., and Nast, D. N., "Capabilities of the Telephone Network for Data Transmission," BSTJ, Vol. 39, No. 3 (May 1960), p. 431.
- (g) Breen, C., and Dahlbom, C. A., "Signaling Systems for the Control of Telephone Switching," BSTJ, Vol. 39, No. 6 (November 1960), p. 1381.
- (h) Bodle, D. W., and Gresh, P. A., "Lightning Surges in Paired Telephone Cable Facilities," BSTJ, Vol. 40, No. 2 (March 1961), p. 547.

PRELIMINARY

- 2 -

- * (i) "Principles of Electricity Applied to Telephone and Telegraph Work"
by American Telephone and Telegraph Company, New York, New York.
- * (j) "Switching Systems," by American Telephone and Telegraph Company,
New York, New York.
- * (k) "Notes on Transmission Engineering," by United States Independent
Telephone Association, Washington, D. C.
- * (l) "Transmission Systems for Communications," by Bell Telephone
Laboratories, Inc.

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

PRELIMINARY

APPENDIX C

WHERE TO OBTAIN REFERENCE MATERIAL

1. Bell System Technical References

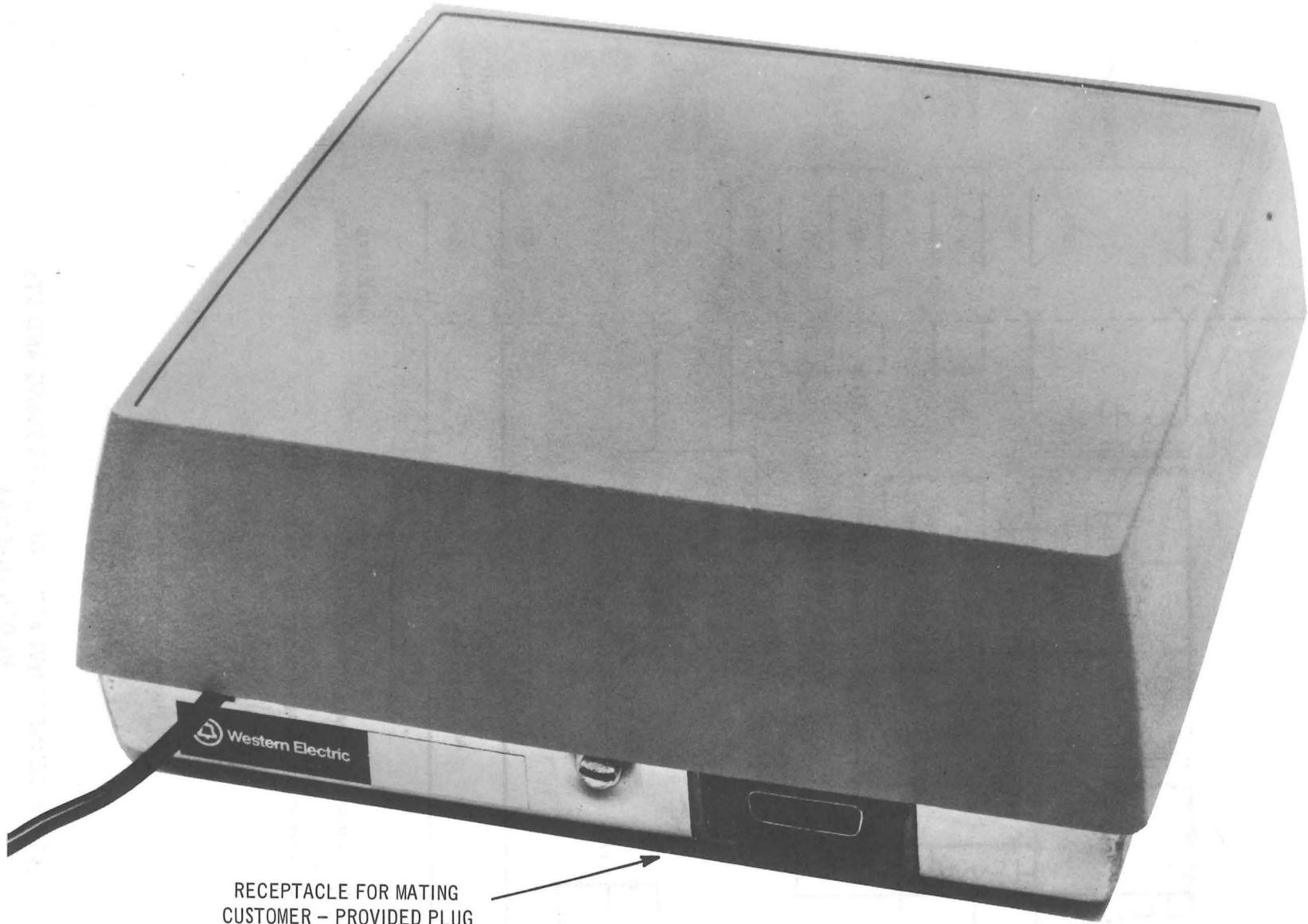
These references may be purchased by writing to:

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

2. Bell System Technical Journals (BSTJ)

These journals may be purchased by writing to:

Mr. F. J. Schwetje
Bell Telephone Laboratories, Inc.
Mountain Avenue, Room 3C115
Murray Hill, New Jersey 07974

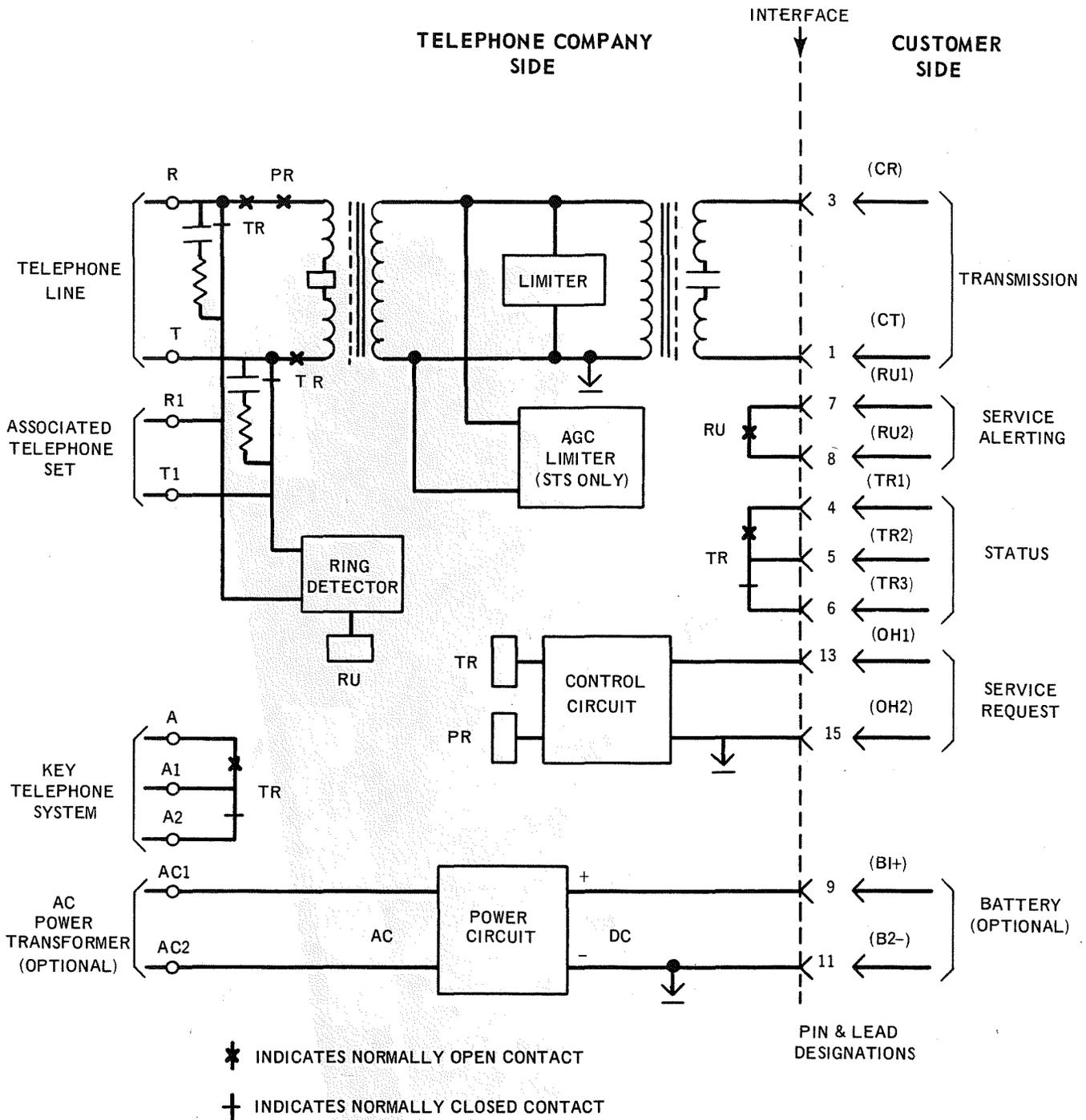


RECEPTACLE FOR MATING
CUSTOMER - PROVIDED PLUG

VOICE CONNECTING ARRANGEMENTS SU6AQ AND STS

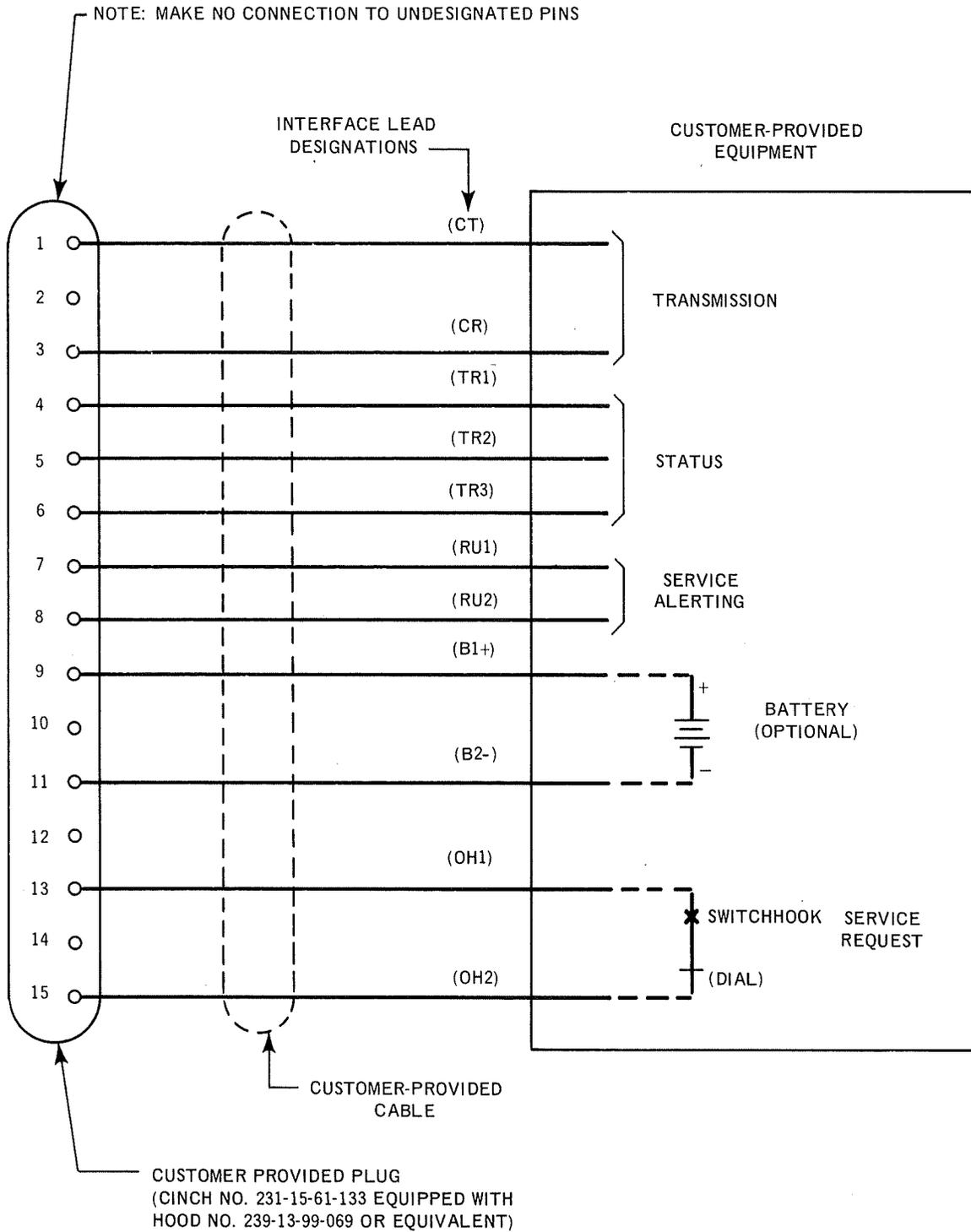
FIG. 1

PRELIMINARY



VOICE CONNECTING ARRANGEMENTS SU6AQ AND STS
BLOCK DIAGRAM
FIG. 2

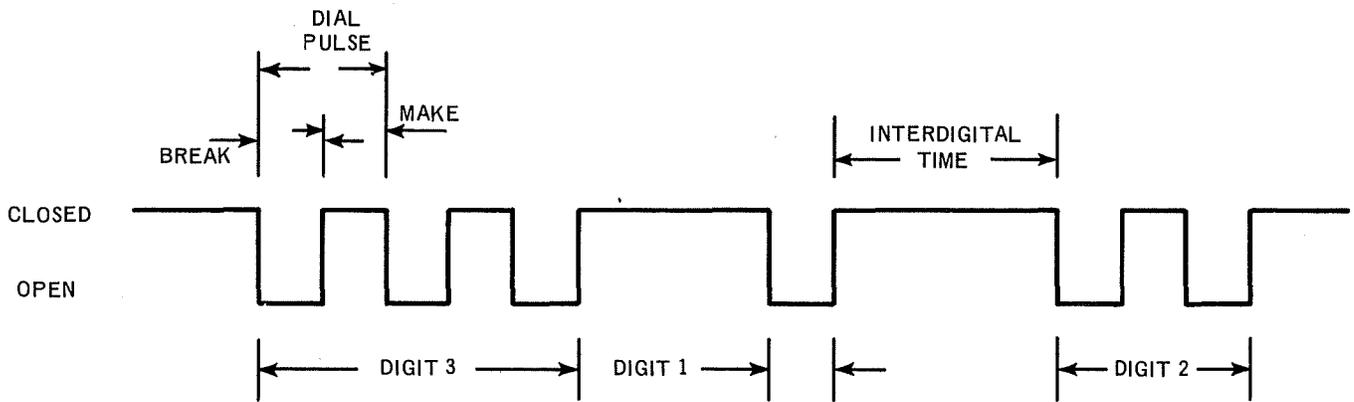
PRELIMINARY



VOICE CONNECTING ARRANGEMENTS SU6AQ AND STS
TYPICAL CONNECTIONS TO BE PROVIDED BY THE CUSTOMER
FIG. 3

PRELIMINARY

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



DIAL PULSE RATE: 8 – 11 PULSES-PER-SECOND (10 NOMINAL)

PERCENT BREAK: 58 - 64 PERCENT OF TOTAL MAKE-PLUS-BREAK INTERVAL (61% NOMINAL)

INTERDIGITAL TIME: 600 MILLISECONDS MINIMUM

DIAL PULSE CHARACTERISTICS
VOICE CONNECTING ARRANGEMENTS SU6AQ AND STS

FIG. 4