

**QWEST Communications  
International Inc.  
Technical Publication**

**Automatic Meter Reading  
Service Interface Specifications**

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## **1. Introduction**

### **1.1 General**

This document describes an Automatic Meter Reading (AMR) Service provided by QWEST. It also provides the technical specification for a Utility (User) Terminal (UT) and a Subscriber Interface Unit (SIU) required at the utility interface and subscriber interface, respectively, with the QWEST Telecommunications Network.

### **1.2 Purpose**

The Automatic Meter Reading Service will enable the utility (water, gas or electric) to remotely access and read its meter at a subscriber's premises over the local telephone loop. Figure 1 shows the three components of the system:

- • The UT located at a utility data center.
- • The Central Office (CO) Access Control Unit (ACU) installed at the telephone company CO serving the utility's subscribers.
- • The SIU located at the subscriber's residence and connecting the utility's meter to the telephone line.

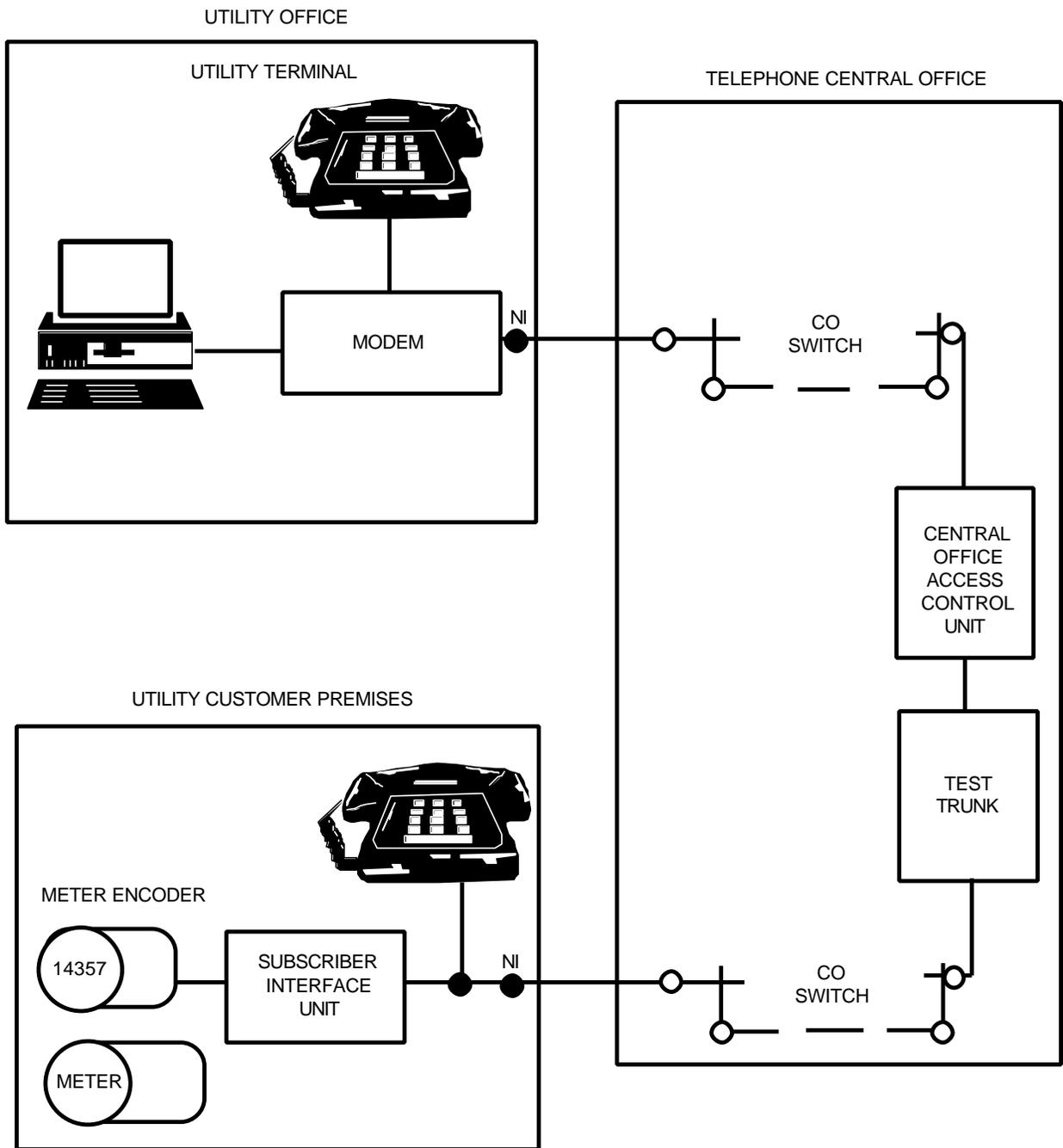
The UT and SIU are customer-provided equipment.

The criteria described herein are the minimum necessary to determine if a manufactured UT or SIU is technically suitable for interconnection to the QWEST telecommunications network and satisfies the requirements of the AMR service. Criteria are stated in terms of specific requirements and objectives. Requirements (identified by the word "shall") are generally concerned with safety and protection, signaling compatibility, and absolute minimum performance levels in such areas as transmission, signaling, and environmental durability. Objectives (identified by the word "should") represent goals for improved product performance.

This document is applicable to QWEST Communications International Inc.

### **1.3 Reason For Reissue**

To show QWEST Communications International Inc. as the owner of this publication and the one to contact concerning the content.



**Figure 1-1** Automatic Meter Reading (AMR) System

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## **2. Description of Service**

### **2.1 UT Description**

The UT is a computer that maintains a database of subscriber information, which includes each subscriber's account number, telephone number, SIU alerting tone, and a file of meter readings. The UT sequentially sends the telephone numbers of the subscribers whose meters will be accessed in a meter reading session to the ACU. Upon receipt of the meter reading data from the SIU, the UT posts the information to a file, which is subsequently used for billing purposes. The UT is customer-provided equipment.

### **2.2 ACU Description**

The primary purpose of the ACU is to control the dial-up connections during a meter reading session between the UT and each subscriber SIU. In addition, the ACU registers the number of successful accesses to SIUs for each utility and retains this information in software for subsequent retrieval by QWEST in order to bill the utility for its use of the AMR system. The ACU establishes a communications path to the SIU through a dedicated test trunk. During the meter reading session, the ACU sends each subscriber telephone number to the test trunk which, in turn, provides a ringless connection to the telephone line. Once the test trunk seizes the telephone line, the ACU activates the SIU by means of an alerting tone for a period of time. The SIU transmits the meter reading data back to the UT through the ACU. The ACU is transparent to the transmission from the SIU to the UT. If at any time during meter reading the subscriber's telephone goes off-hook, the ACU will stop the process and disconnect the SIU from the UT.

### **2.3 SIU Description**

The SIU contains ports to which utility meter encoders can be wired. The encoders are also customer-provided equipment and are physically connected to the utility meters. After the ACU has alerted the SIU, the SIU draws current from the telephone line and transmits the meter reading data for each port through the ACU to the UT. The SIU is customer-provided equipment.

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### **3. Design Requirements**

#### **3.1 General**

This section describes the physical characteristics of the UT and SIU, it also provides the interface requirements for the UT-to-ACU connection and the ACU-to-SIU connection.

#### **3.2 Physical Characteristics**

The UT and SIU, which are customer-provided equipment, shall comply with the requirements in Part 68, Subpart D of the FCC Rules and Regulations and shall meet the registration requirements of Part 68, Subpart C. The registered equipment shall conform to the requirements of Part 68, paragraph 68.312(f) and not to the requirements of paragraph 68.312(g), "Ringer Type Z Equipment". (QWEST does not support use of equipment with Z-type ringers.) Since the UT and SIU are also part of the subscriber's or customer's installation, they should also be designed in a way that allows the total installation to meet the requirements of ANSI Standard T1.401.1993. Specifically, since the SIU is additional equipment to that owned by the telephone subscriber, it should have a minimal impact on the subscriber's use of the telephone line.

The SIU serves as the interface between the subscriber telephone line and the utility meter. Because the SIU will be installed at a customer location, it should meet normal standards of easy installation, relatively long life, acceptable appearance, identification and maintainability, and rapid restoration of service. The SIU should have its identification number and alerting tone marked on it.

The SIU and the UT shall be connected to the QWEST telecommunications network on a 2-wire switched basis. The units will always be connected on the telephone customer's side of the Network Interface (NI) or station protector. In most cases the NI will be a registration jack installed near the station protector. Direct connection to the station protector is not allowed unless the connection is made by QWEST personnel.

The UT, either manually or via an automatic calling device, initiates the meter reading session by dialing the telephone number assigned to the ACU. Once the ACU answers the call, all communications between the UT and ACU shall take place using 103-type modem frequencies at 300 baud using standard ASCII code with one start bit, seven data bits, even parity, and one stop bit. This restriction does not apply to communications between the SIU and the UT. Once the SIU has been successfully alerted, the transmission from the SIU to the UT shall take place within the limitations of the voiceband channel connecting the SIU and the UT. The UT shall be in the "originate" mode prior to callback by the ACU.

#### **3.3 SIU Operational Requirements**

The SIU shall be designed to operate within idle-state voltage ranges of 0 to 105 volts dc and 0 to 250 volts combined ac and dc.

The SIU shall contain a tone detector capable of recognizing a specific ac tone on the telephone line when telephones on the subscriber line are in an on-hook position. QWEST Communications will assign the specific frequencies to be used for each meter reading application. The ac tone detector shall be sensitive to alerting frequencies to be used for each meter reading application. The ac tone detector shall be sensitive to alerting tones which may vary within a range of 1 percent of the nominal frequency generated by the ACU. The ac tone detector should recognize each alerting tone sent over the telephone line in an idle state within the range of 0.154 to 1.54 volts rms at a minimum signal-to-noise ratio of 6 dB measured in a bandwidth ranging from 200 to 3000 Hz. The ACU is the source of both the ac alerting tone and the -48 Vdc loop bias voltage. When alerted by one of thirteen available ac tones, the SIU shall draw between 12 mA and 28 mA of current within a 4-second time period. This signals a successful alert to the ACU. The ACU monitors the telephone line for changes in current. The ACU considers a current draw of 12 mA as a successful alert. If the ACU detects a current draw of less than 12 mA during a meter read or if the current on the line increases by more than 20 mA, then the ACU will terminate the connection between the UT and the SIU.

In response to an alerting tone from the ACU, the SIU should signal the appropriate encoder(s) connected to the SIU to transmit the associated meter data to the UT. This data transmission shall be completed within a time interval set by the utility using the "C" command, subject to the limitations imposed by QWEST Communications.

### **3.4 Data Transmission Requirements**

Data transmission levels transmitted by the UT and SIU shall comply with FCC Part 68 requirements concerning registered data terminal equipment connected to the telecommunications network.

This specification covers the electrical interactions at the physical interface. The electrical signals at the network interface are basically of three types: normal telephone system voltages and currents, voltages and currents due to maintenance activities, and voltages and currents that may appear at the network interface as a result of the environment (induced voltages, lightning hits, etc.). Voltages and currents that may appear at the NI as a result of the environment and that could affect the satisfactory performance of the SIU and UT are not covered in this document but are described in the following references:

- Lightning and 60 Hz Disturbances at the Bell Operating Company Network Interface, TR-EOP-000001
- Impulse Noise Tape No. 201, TR-TSY-000762
- Data Communications Using the Switched Telecommunications Network, PUB 41005

Information about the physical characteristics of the facilities between the serving end office and the network interface is provided in the following references:

- IEEE Standard Telephone Loop Performance Characteristics, ANSI/IEEE Std 820-1984
- I-Match.1 Loop Characterization Database, TR-TSY-000231

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## **4. Communications Protocol Specification**

### **4.1 Introduction**

The Automatic Meter Reading System allows a utility, using a computer or terminal, to remotely acquire meter reading data from its customer using the existing telephone line to the customer's premises. This is accomplished by first establishing a dial-up connection between the UT at the utility and the ACU at the local telephone company Central Office (CO). Commands are then sent to the ACU from the UT to cause it to connect the UT to the SIU. The SIU then obtains a reading from an encoder mounted on the customer's meter and transmits the data back to the utility via the telephone link established through the ACU.

The communications between the UT and ACU take place on a one-for-one basis, i.e., one set of meter data from one subscriber will be obtained for each telephone number and alerting tone sent to the ACU. This specification defines the information exchange between the UT and ACU required to conduct a meter reading session.

In addition to telephone numbers, other information exchange must take place between the UT and the ACU in order to initiate access to meter reading data. Communications will include a log-in phase, a setup phase, a meter telephone number access phase, and a log-off phase.

The first phase is a log-in or unlock procedure during which a security password, called an access code, is sent to the ACU and which must match a pre-established setting in the ACU before any other commands can be sent. After the UT has provided a valid unlock code message to the ACU, the ACU will disconnect and call the UT back on a designated telephone number.

During the setup phase, other setup data must then be sent to the ACU to give initial information on the following:

- The test trunk to be used to establish a connection to the customer's telephone line.
- The alerting tone frequency to be transmitted from the ACU to alert the SIU.
- The maximum time period that the SIU is to be connected to the UT.

The following paragraphs describe the protocol to be used between the UT and the ACU to enter customer telephone numbers and obtain meter reading data. Diagrams illustrating the communication at the above interface are provided in Exhibits 1 through 7. Reference to these exhibits will aid in understanding the operating sequence of the protocol described herein.

Note: The flowcharts are intended to describe in general the communications between the UT and the ACU. The following paragraphs contain specific programming information for the UT.

## 4.2 Dialing And Startup

The UT, either manually or via an automatic calling unit, dials the telephone number assigned to the ACU at the CO (see Exhibit 4-1).

After two rings of the ACU phone line, the ACU will answer the call and return 103-type answer tone and attempt to connect in the answer mode.

From this point on, all communications between the UT and the SIU shall take place using Bell 103 compatible frequencies and protocols at 300 baud (asynchronous). Both the UT and SIU shall be initialized to transmit standard ASCII code, with one start bit, seven data bits, even parity, and one stop bit. This restriction does not apply to communications between the SIU and the UT. Once the SIU has been successfully alerted, the transmission from the SIU to the UT shall take place within the limitations of the voiceband channel connecting the SIU and UT. Initially, the UT must be in the "originate" mode and the ACU in the "answer" mode.

## 4.3 Log-In Procedure

In order to access meter interface units via the ACU, the UT shall first log-in by sending an unlock code, which provides a security check to prevent unauthorized use of the meter reading system. After the security check has been validated, the ACU will call the UT back and allow it to proceed with meter reading. The unlock code will be validated against a 4-digit security code which is determined and reset by QWEST and issued to the utility.

The unlock code message is formatted as follows:

- An ASCII start of message (STX) character.
- Two ASCII digits which designate the number of characters in the message, excluding STX, the checksum, and ETX. In this case, the number of characters will be seven, designated by ASCII digits 0 and 7.
- An ASCII "I" which designates this command as an unlock code.
- One ASCII digit representing the number of the utility that is calling.
- Four ASCII digits representing the 4-digit security check code.
- One ASCII digit (0 through 4) which designates which one of five preset callback telephone numbers is to be used.
- Four ASCII digits representing the checksum of the message, calculated by summing together the numeric values of all ASCII characters in the command and retaining the four least significant digits. In this case, the numeric values of the characters from the command letter to the callback digit are used for the checksum.
- An ASCII end of message (ETX) character.

If the ACU receives a valid unlock code, it will send an acknowledge character (ACK) within 500 milliseconds. The ACU then delays 1 second and terminates the call by going on-hook. The ACU will then change to the "originate" mode, and the UT shall change to the "answer" mode. The ACU will wait for four seconds and then call the UT back using the designated callback number. The UT shall answer the incoming call within 60 seconds and return 103-type modem answer tone.

The ACU replies with a negative acknowledge character (NAK) if the unlock command is invalid in any way, either by incorrect command format or security code, unassigned utility number, or unknown callback number. The UT should attempt retransmission if the NAK is received.

The ACK or NAK reply to the unlock code will be transmitted by the ACU not more than 500 milliseconds after receipt of the ETX from the UT.

If a valid unlock code is not received within 12 seconds or if an incorrect unlock code is sent by the UT three times in succession, the ACU will send a "G" character and disconnect from the line.

#### **4.4 Setup Command Description**

"S" (Test Trunk) Command: The "S" command designates which test trunk is to be used to dial the subscriber (utility customer). The ACU can be connected up to ten test trunks on a non-simultaneous basis, and the correlation between test trunk number and actual dialed number will be determined by QWEST.

"A" (Alerting Tone) Command: The "A" command designates which alerting tone frequency is to be used to trigger a SIU to send meter reading data; this will depend on the characteristics of the SIU connected to a particular subscriber's meter. QWEST will assign the specific alerting tones to be used for each meter reading application. The correlation between alerting frequency and subscriber telephone number will be determined by the utility when the SIU is installed. Each alerting tone frequency is designated by a character. The character-to-frequency correlation is shown in Table 4-2.

"C" (Connect Time) Command: The "C" command designates the maximum period of time in seconds needed for the SIU to transmit all of its meter reading data. Any value from 01 to 99 seconds can be chosen by the utility, but values less than 10 seconds must be preceded by a leading "0" to ensure 2-digit command data. Although a value up to 99 seconds can be specified by the UT, a maximum connect-time less than 99 seconds can be programmed into the ACU at the CO by QWEST. This maximum value can have a range of 01 to 99 seconds. Unless changed by QWEST Communications, a default value of 4 seconds for the connect-time maximum value will be used by the ACU. Future customer-provided equipment (CPE) units used for meter reading with alternate operating features may require more or less time so that the amount of connect time needed must be keyed to each individual type of CPE.

#### 4.5 Setup Commands Format

After the ACU has called the UT back, the UT shall set up the characteristic data, which will be used during the meter reading session with the ACU. The sequence for the transmission of setup commands is shown in Exhibit 4-2.

The UT shall send all commands listed in Table 4-1 with the required characteristic data. These commands can be sent in any order.

COMMAND LETTER	COMMAND DATA	COMMAND MEANING
S	1 ASCII digit	Test trunk required (0 through 9)
A	1 ASCII letter	Alerting tone required (A through K, M, or Z) See Table 4-2
C	2 ASCII digits	Connect time required (01 through 99)

**Table 4-1** Setup Commands

All commands have the same format as follows:

- An ASCII start message (STX) character.
- Two ASCII digits which designate the number of characters in the message, excluding STX, the checksum, and ETX.
- An ASCII command letter from Table 4-1.
- The command data (with the correct number of ASCII characters).
- Four ASCII digits representing the checksum of the message, calculated by summing together the numeric values of all ASCII characters in the command and retaining the four least significant digits. In this case, the numeric values of the characters from the command letter to the callback digit are used for the checksum.
- An ASCII end of message (ETX) character.

The ACU replies with an ACK character if the command is received and understood.

The ACU replies with a NAK character if the command is incorrect due to incorrect format, command letter, or number of command data characters.

The ACK or NAK replies to the setup command will be transmitted by the ACU not more than 500 ms after the receipt of the ETX from the UT.

All setup commands shall be sent at least once during a meter reading session, and, if the setup commands are never sent again, this setup data will be used for every subsequent telephone access code sent. If necessary, the setup data can be changed at any time by sending the appropriate command.

ALERTING CHARACTER	ALERTING FREQUENCY (Hz)
A	252.4
B	268.7
C	285.3
D	315.5
E	330.5
F	375.2
G	468.0
H	495.8
I	520.6
J	548.0
K	562.8
M	578.4
Z	404.3

**Table 4-2** Alerting Tones

#### 4.6 Telephone Access Code

After all setup commands have been sent, the UT shall send a telephone-access command directing the ACU to dial a subscriber, alert that subscriber's SIU, and connect the SIU to the UT. The sequence for the transmission of the telephone access command message is shown in Exhibit 4-3. The format is as follows:

- An ASCII start message (STX) character.
- Two ASCII digits which designate the number of characters in the message, excluding STX, the checksum, and ETX. In this case, the number of characters will be nine, designated by ASCII digits 0 and 9.
- An ASCII "T" which designates this command as a telephone access code.
- An ASCII "1" or "0" character, designating whether or not the selected telephone line to be dialed requires the use of a metallic test access. This device is required with some types of digital loop carrier. A "0" specifies normal dialing and a "1" specifies that the metallic test access is to be used.
- The last seven digits of the subscriber telephone number.
- Four ASCII digits representing the checksum of the message, calculated by summing together the numeric values of all ASCII characters in the command and retaining the four least significant digits. In this case, the numeric values of the characters from the command letter to the callback digit are used for the checksum.

- An ASCII end of message (ETX) character.

The ACU replies with an ACK character if the command is received and understood.

The ACU replies with a NAK character if the command is incorrect due to incorrect format, command letter, or number of command data characters, or if the setup data has not been sent. The user should retransmit if there is not response or if a NAK is received.

The ACK or NAK replies to the telephone access code will be transmitted by the ACU not more than 500 ms after the receipt of the ETX from the UT.

#### **4.7 Subscriber Unit Dialing and Status Feedback**

After the telephone access code has been sent by the UT and the ACK character has been sent by the ACU to acknowledge that the command was understood, the ACU will proceed to dial the subscriber's telephone number and alert that subscriber's SIU. The transmission sequence is shown in Exhibit 4-4.

During the dialing process, the ACU will send status characters back to the UT to give indications of call progress and to nag any errors which would prevent the completion of the call or the connection to the SIU. The status characters will be one or two upper case ASCII characters and will be followed by the ENQ control character. There may be a delay of up to 1 minute after the ACK is received until the first status character is received.

The first step in the process is to dial the subscriber. If the call cannot be completed because the subscriber is using the phone or because of some other condition which produces a busy indication on the test trunk, the ACU will send back a "B" (busy) character followed by ENQ to the UT.

If the call cannot be completed due to a traffic congestion overflow condition, then the ACU will send back an "R" (overflow) character followed by ENQ to the UT.

If the call cannot be completed due the telephone number being disconnected or an erroneous number being sent, then the ACU will send back a "D" (intercept) character followed by ENQ to the UT.

If the call cannot be completed due to a failure of the test trunk, then the ACU will send back an "X" (test trunk failure) character followed by ENQ to the UT.

If the connection to the subscriber line has been successfully completed, the ACU will send an "F" (free) character.

The UT will receive the status characters (X, R, D, B, or F) not more than 1 minute after the ACK character was sent.

If the ACU detects current flow indicating that the subscriber has been off-hook for an extended period, then the ACU will send back an "I" character followed by ENQ to the UT.

If any of the conditions described above occur, preventing the beginning of the alerting sequence, then the ACU will disconnect from the subscriber's telephone line.

#### 4.8 SIU Alerting

The second step in the process of connection is the SIU alerting process (see Chapter 3, under Subsection 3) which triggers the SIU to send meter data to the UT. The ACU sends the alerting tone over the telephone line connected to the SIU for 4 seconds. An "N" (no alert) character will be sent if the SIU cannot be alerted to give meter reading data. An "M" (good alert) character will be sent if the SIU was successfully alerted by the ACU. The "N", "I", or "M" characters will be sent by the ACU to the UT not more than 5 seconds after the "F" character.

**Note:** If one of the "B", "R", "D", or "X" characters is sent, then no SIU alerting procedure will be attempted and neither the "N" nor "M" character will be sent. Also if the "I" character is sent following the "F" character, then no alerting procedure will be attempted as well.

If the dialing and alerting procedures are performed successfully (signaled by "F" then "M"), the ACU will connect the SIU to the UT. This connection will be made immediately after the "M" character has been sent, and the connection will be held until one of the following occurs:

- If the SIU draws less than 12 mA of current from the line, then the ACU will disconnect the SIU.
- If the current on the line increases by more than 20 mA, then the ACU will disconnect the SIU.
- If the connect-time set in the "C" command or the connect-time limit set by QWEST is exceeded, then the ACU will disconnect the SIU.

The ACU will send an ENQ character within 1 second after termination to indicate that it is ready for the next command.

The ENQ (ready) character will also be sent within 1 second after receipt of the "B", "R", "D", "X", or "N" characters.

**Note:** A transient condition is produced on the line for up to a few seconds in the interval between the transmission of the "M" character (good alert) to the UT and the sending of the meter data by the SIU, due to a momentary loss of carrier on the line. This occurs during the time period in which the ACU disconnects from the UT and the SIU connects to the UT. The same effect takes place between the end of SIU transmission and the receipt of the ENQ character by the UT. This may be interpreted by the UT's modem as a spurious character. To prevent this switchover effect from adversely affecting the UT, routines must be designed through UT software to handle these occurrences.

#### 4.9 Next Command Sequence

During the SIU access sequence, the ACU will have sent one of the status character combinations shown in Table C. The transmission sequence is shown in Exhibit 4-5.

CHARACTERS SENT	MEANING OF TRANSMISSION
X, ENQ	Test trunk failure, ready for command
R, ENQ	Telephone switch denied access (overflow), ready for command
D, ENQ	Telephone number not in service, ready for command
B, ENQ	Subscriber busy, ready for command
F,I, ENQ	Subscriber off-hook for extended period, ready for command
F,N, ENQ	No alert from SIU, ready for command
F,M,(SIU DATA), ENQ	Good alert, SIU data, ready for command

**Table 4-3** Status Character Combinations

Immediately after the ENQ is received, the UT can proceed with the next command sequence. The possible commands to be sent are as follows:

- To dial another subscriber's SIU, send another "T" command.
- To modify any of the setup parameters, send the "A", "S", or "C" commands.
- To obtain usage information send the "J" command.
- To end meter reading session, send an "E" (logoff) message consisting of:
  - An ASCII start of message character (STX).
  - Two ASCII digits which designate the number of characters in the message, excluding STX, the checksum, and ETX. In this case the number of characters will be "1", designated by ASCII digits 0 and 1.
  - An ASCII "E" which designates this command as the end-ACU-usage command.
  - Four ASCII digits representing the checksum of the message, calculated by summing together the numeric values of all ASCII characters in the command and retaining the four least significant digits. In this case, only the numeric value of the "E" character is used for the checksum.
- An ASCII end of message character (ETX).

If at any time during the meter reading session no valid command is received from the UT within 5 minutes of the transmission of an ACK or ENQ by the ACU, the ACU will send a "G" (goodbye) and 1 second later will disconnect, terminating the telephone connection.

In some locations the utility may have the ability to ask for the usage time. The user should check with local QWEST Communications personnel to determine if this feature is available. The sequence for the transmission of the usage data command is shown in Exhibit 4-7. The usage message is received from the ACU by sending the "J" command, whose structure is as follows:

- An ASCII "STX" which designates the start of the message;
- Two ASCII numbers which designate the number of bytes in the message, excluding the checksum and "ETX". In this case the number of bytes will be 1, designated by ASCII digits 0 and 1.
- An ASCII "J" which designates this command as the usage command;
- Four ASCII digits representing the checksum of the message, the checksum being calculated by summing together the numeric values of all ASCII characters in the command and retaining the four least significant digits. In this case only the "J" letter is summed.
- An ASCII "ETX" which designates the end of the message.

The Usage command will return a message from the ACU as described below:

FIELD CONTENT	CHARACTER COUNT	FIELD MEANING
STX	1	Start of text
61	2	Number of data characters to follow
'U'	1	Message type: 'U'
H H M M S S	6	Period 1 SIU/UT connect time
ETB	1	End of field
N N N N	4	Period 1 SIU alerts count
ETB	1	End of field
H H M M S S	6	Period 2 SIU/UT connect time
ETB	1	End of field
N N N N	4	Period 2 SIU alerts count
ETB	1	End of field
H H M M S S	6	Period 3 SIU/UT connect time
ETB	1	End of field
N N N N	4	Period 3 SIU alerts count
ETB	1	End of field
H H M M S S	6	Period 4 SIU/UT connect time
ETB	1	End of field
N N N N	4	Period 4 SIU alerts count
ETB	1	End of field
H H M M S S	6	UT/ACU Connect time
ETB	1	End of field
T T T T	4	Number of alerts attempted
ETB	1	End of field
C C C C	4	Four checksum characters
ETX	1	End of text

The "R" command will clear all totalizer registers, used to store the above information, to zero.  
 The content of this message is:

STX / 01/ R / 0052 / ETX

#### 4.10 Example of UT-to-ACU Communications

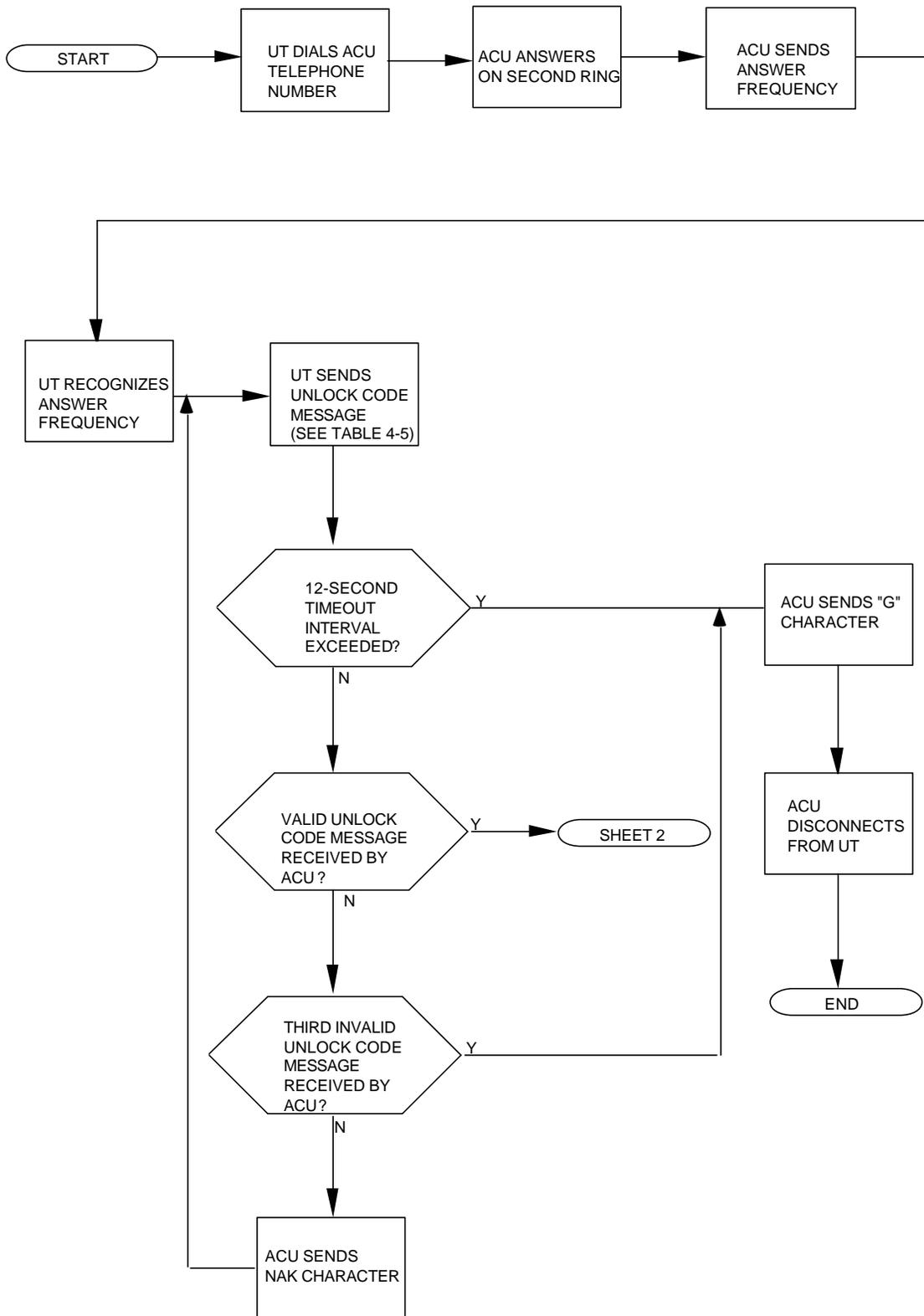
Table 4-4 indicates the communications between the UT and ACU for the following command sequence:

Connect - access one meter - then disconnect.

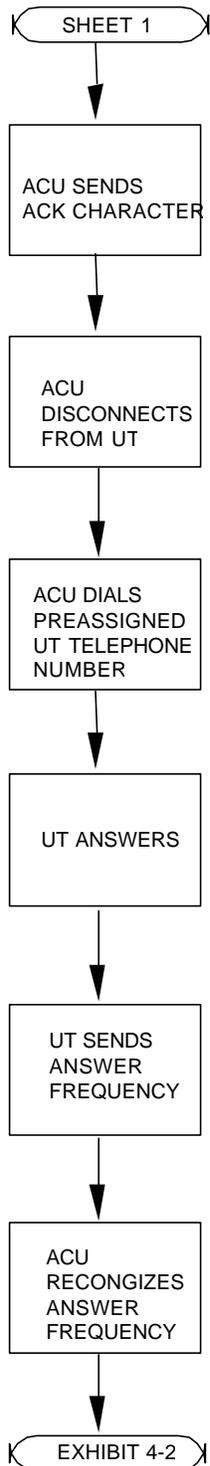
UT SENDS	ACU SENDS	MEANING OF TRANSMISSION
"STX"07I0123400371 "ETX"	ACK	Utility 0,I.D.1234, callback 0. (ACU calls back UT using a callback number designated by 0.)
"STX"02S00131"ETX"	ACK	Test trunk 0.
"STX"02AI0138"ETX"	ACK	Alert SIU with tone "I".
"STX"03C040167"ETX"	ACK	Connect SIU for 4 seconds.
"STX"09T012345670496"ETX"	ACK	No metallic test access. Telephone number is 1234567.
	F	Connecting with subscriber.
	M	Subscriber SIU connected.
	SIU data*	
	ENQ	Ready for next command.
"STX"0IE0045"ETX"	ACK	Finished with ACU.
	G	Goodbye. (ACU terminates the call.)

\* The ACU is transparent to the transmission from the SIU to the UT.

**Table 4-4** UT to ACU Communications



**Exhibit 4-1** Dialing and Unlock Code Sequence (1 of 2)

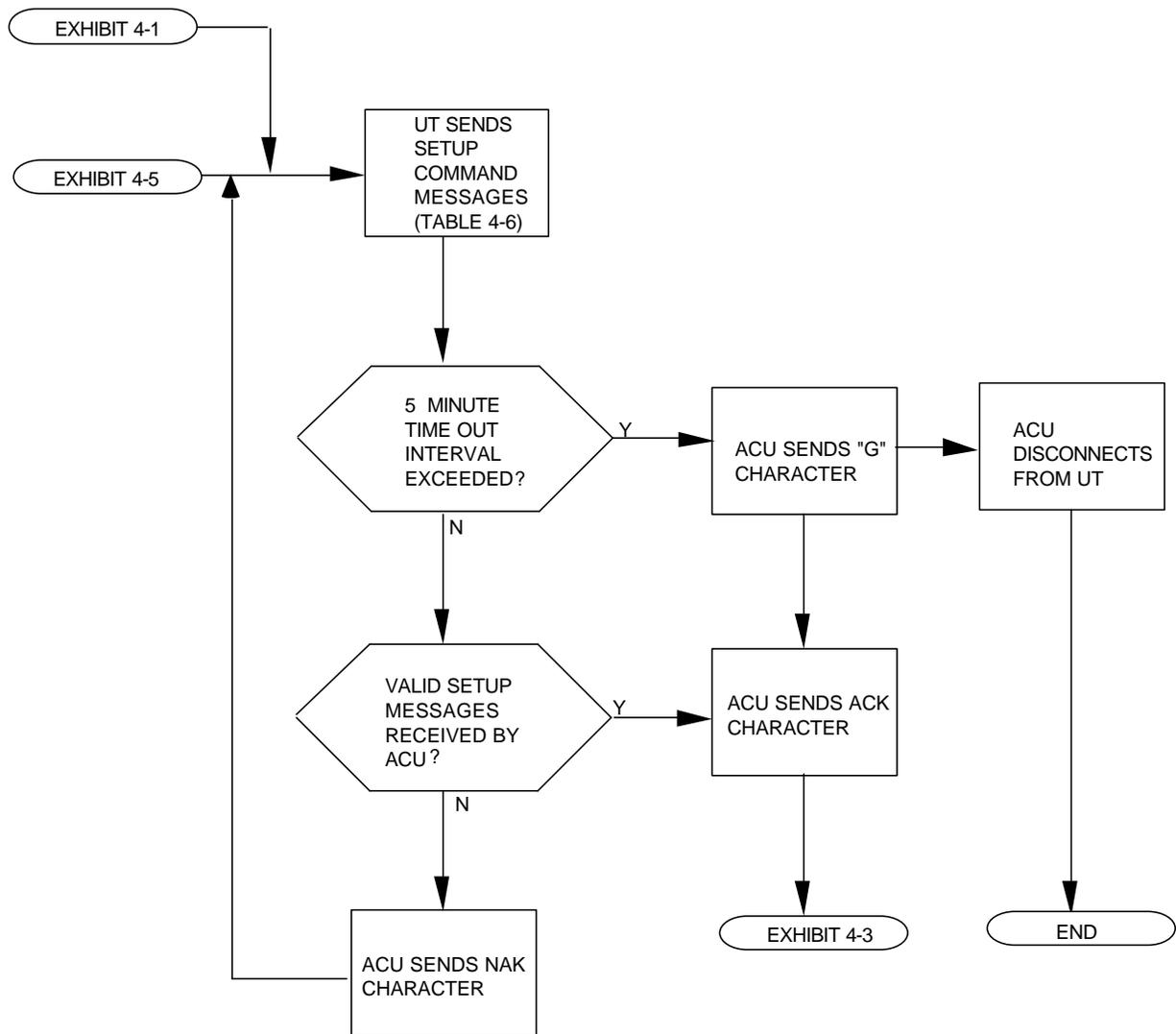


POSITION	ASCII CHARACTERS	MEANING
1	STX	Start of message
2 through 3	07	Number of characters in this message, excluding STX,, checksum, and ETX
4	I	Unlock code command
5	One digit (0 through 9)	Designated number of calling utility (QWEST-provided)
6 through 9	Four digits	Security code (U S WEST-provided)
10	One-digit (0 through 4)	Designation for one of five possible callback telephone numbers (utility-provided)
11 through 14	Four-digits	Checksum (see note 1)
15	ETX	End of message

TABLE 4-5  
UNLOCK CODE MESSAGE FORMAT

NOTE:  
The checksum is calculated by a) summing the numeric value of all ASCII characters (not including) the number of characters in the message (always positions 2 to 3) and the checksum, and b) retaining the four least significant digits.

**Exhibit 4-1** Dialing and Unlock Code Sequence (2 of 2)



**Exhibit 4-2** Telephone Access Command Message (1 of 2)

POSITION	ASCII CHARACTERS	MEANING
TEST TRUNK DESIGNATION (SEE NOTE 2)		
1	STX	Start of message
2 through 3	02	Number of characters in this message excludes STX, checksum, and ETX
4	S	Test trunk command
5	One-digit (0 through 9)	Designation of test trunk required (QWEST-provided)
6 through 9	Four-digits	Checksum (see Note 1)
10	ETX	End of Message
ALERTING TO (SEE NOTE 2)		
1	STX	Start of message
2 through 3	02	Number of characters in this message excludes STX, checksum, and ETX
4	A	Alerting tone command
5	One letter (see Table 4-7)	Alerting tone
6 through 9	Four-digits	Checksum (see Note 1)
10	ETX	End of Message
CONNECT-TIME (SEE NOTE 2)		
1	STX	Start of message
2 through 3	03	Number of characters in this message excludes STX, checksum, and ETX
4	C	Connect-time command
5 through 6	Two-digits (01 through 99)	Connect-time in seconds (see Note 3)
7 through 10	Four-digits	Checksum (see Note 1)
11	ETX	End of Message

TABLE 4-6  
SETUP COMMAND MESSAGE FORMAT

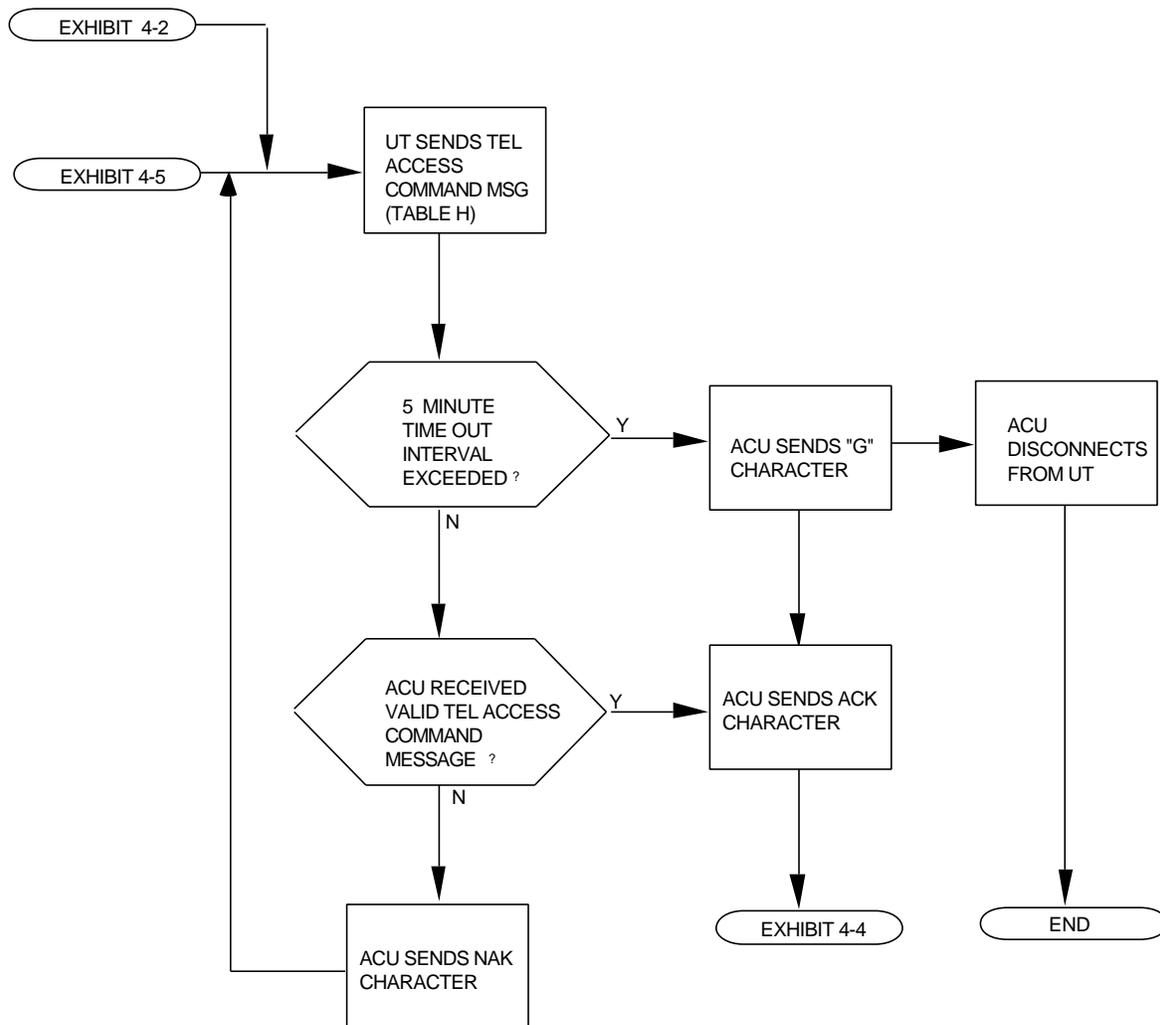
ALERTING CHARACTER	ALERTING FREQUENCY (Hz)
A	252.4
B	268.7
C	285.3
D	315.5
E	330.5
F	375.2
G	468.0
H	495.8
I	520.6
J	548.0
K	562.8
M	578.4
Z	404.3

TABLE 4-7  
ALERTING TONES

NOTES:

- 1: The checksum is calculated by a) summing the numeric value of all ASCII character between (not including) the number of characters in the message (always positions 2 to 3) and the checksum, and b) retaining the four least significant digits.
- 2: The S, A, and C command messages can be entered in any order. After the initial S, A, and C command messages have been sent during a meter reading session, these options remain fixed until changed by subsequent S, A, and/or C command messages.
- 3: The Telephone Company has the capability of setting an upper limit for the connect time. This limit cannot be overridden by the utility.

**Exhibit 4-2 Telephone Access Command Message (2 of 2)**



**NOTES:**

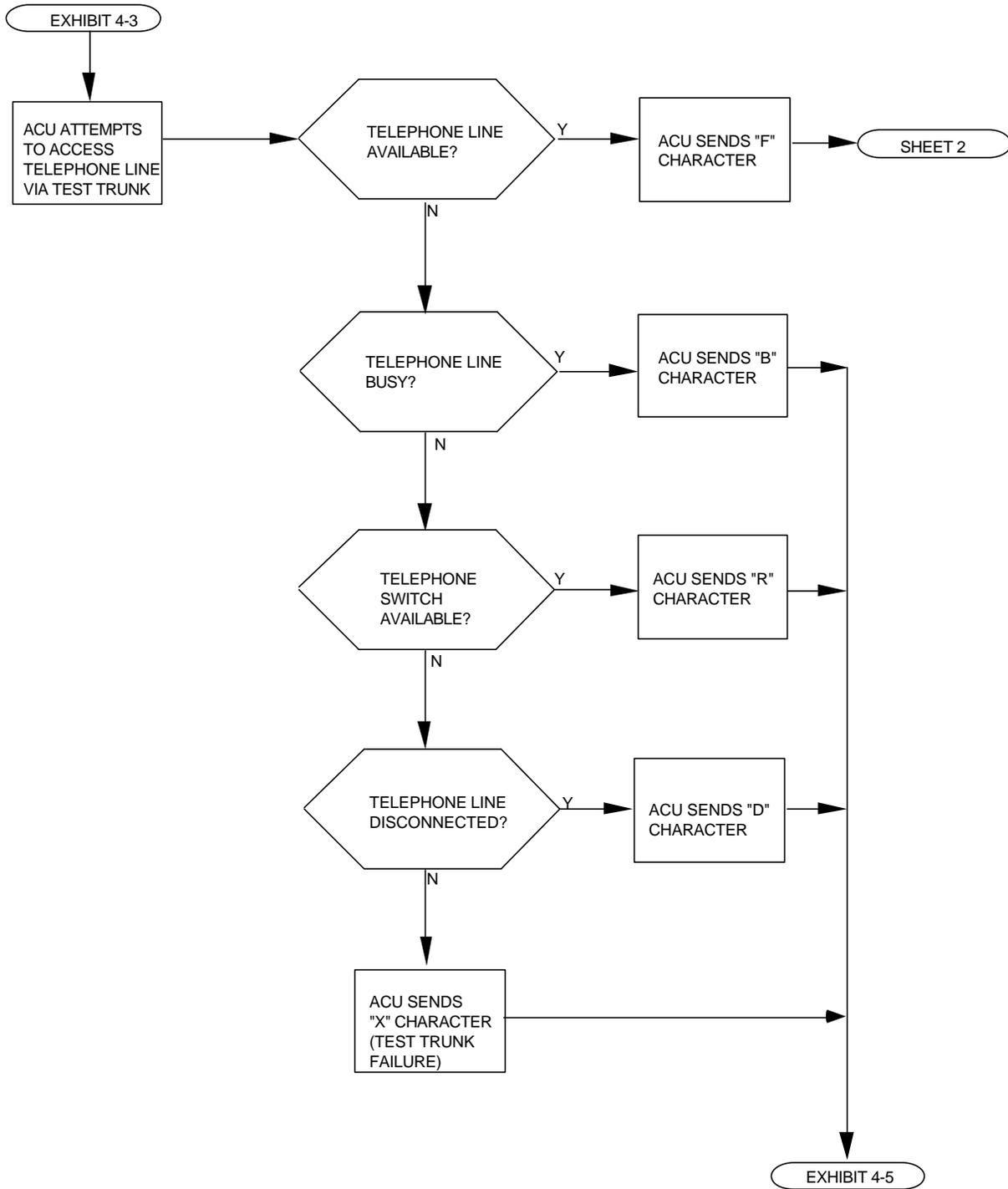
1: The checksum is calculated by a) summing the numeric value of all ASCII character between (not including) the number of characters in the message (always positions 2 to 3) and the checksum, and b) retaining the four least significant digits.

2: The metallic test access is required for some types of digital loop carrier systems.

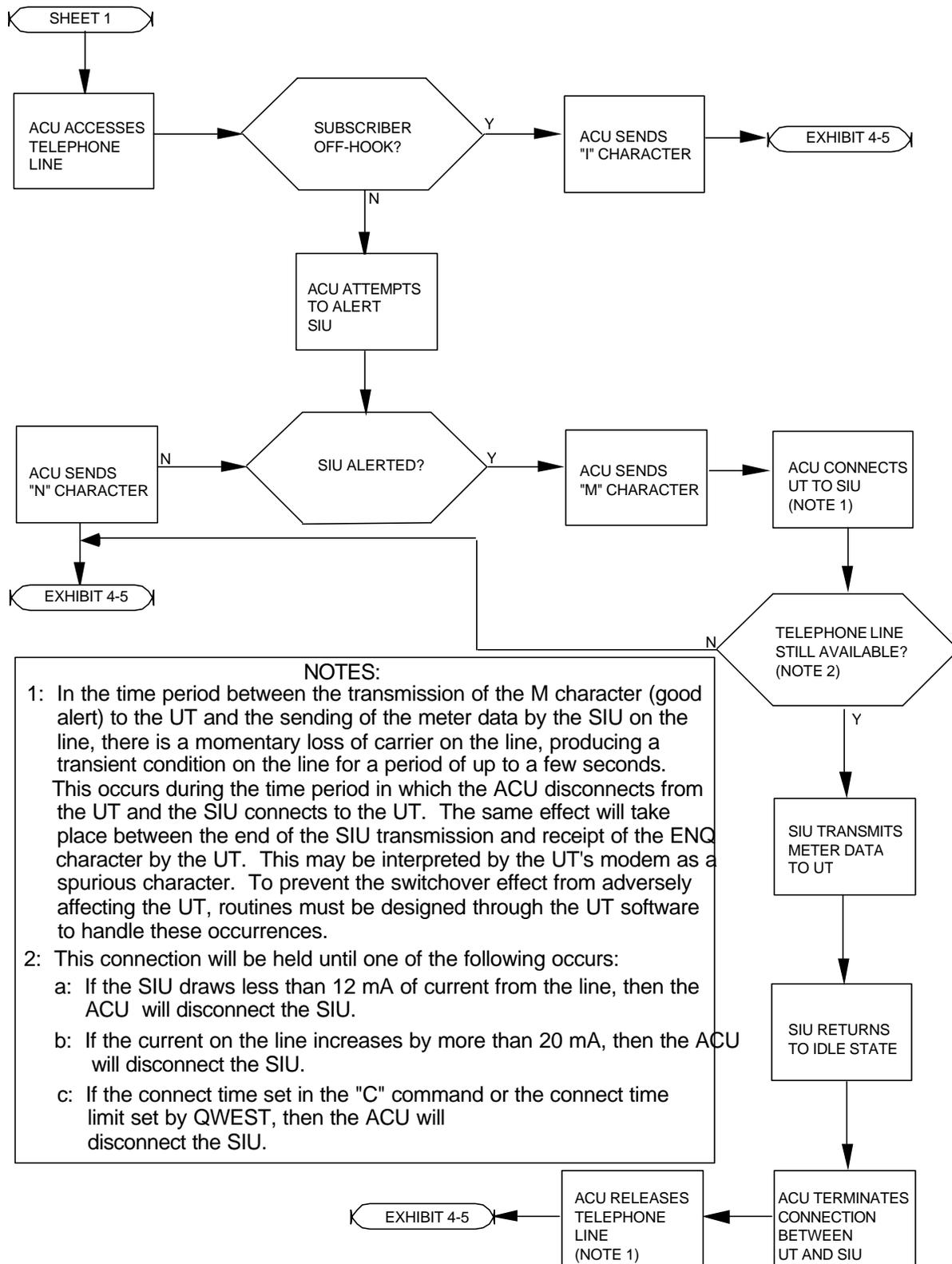
POSITION	ASCII CHARACTERS	MEANING
1	STX	Start of message
2 through 3	09	Number of characters in this message, excludes STX, checksum, and ETX
4	T	Telephone access command
5	One digit (0 to 1)	Access to subscriber line requires use of metallic test access (0 =NO; 1 = YES) (see note 2)
6 through 12	Seven digits	Subscriber telephone number (last seven digits)
13 through 16	Four digits	Checksum (see note 1)
17	ETX	End of message

TABLE 4-8  
TELEPHONE ACCESS COMMAND MESSAGE FORMAT

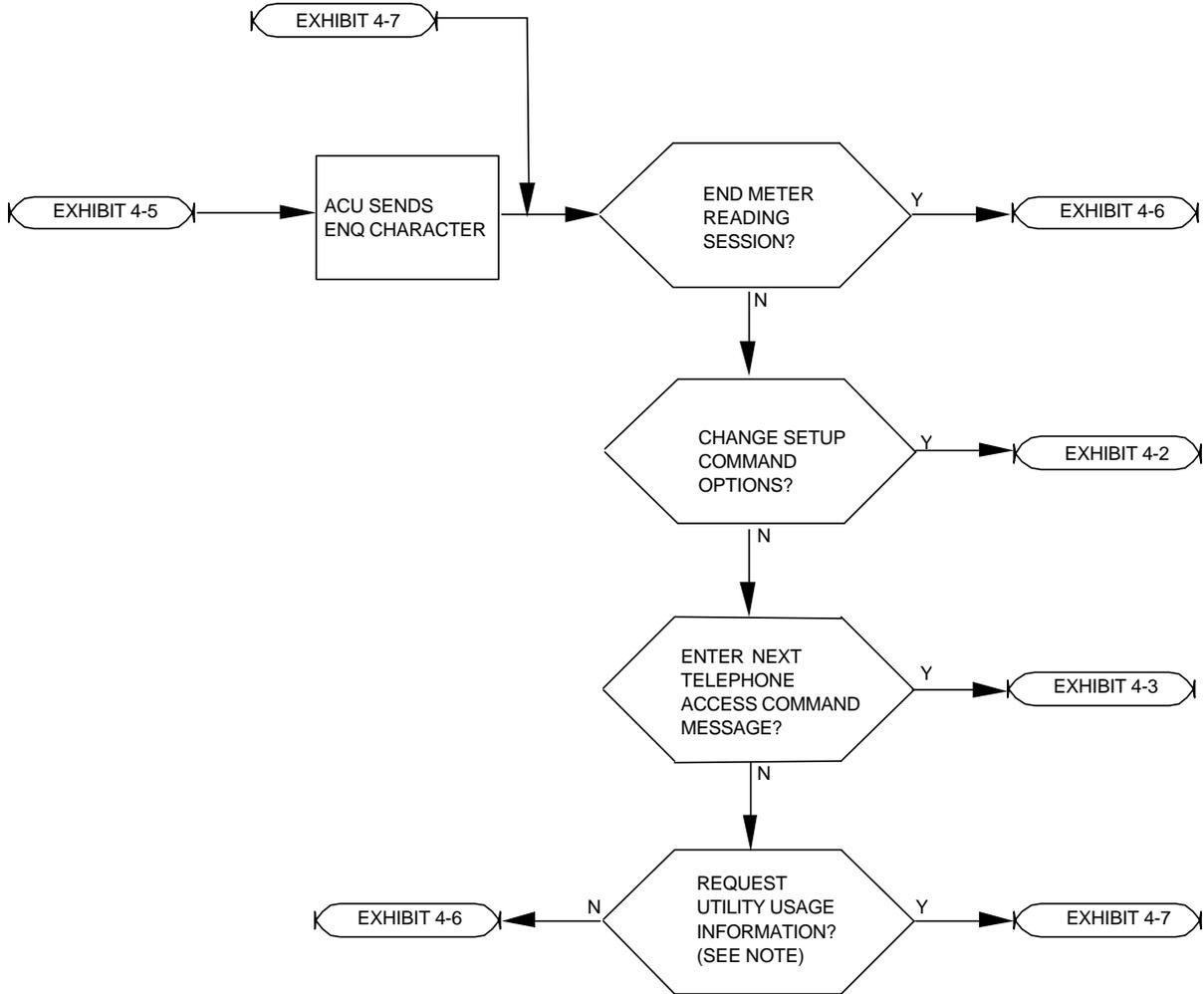
**Exhibit 4-3 Setup Command Messages**



**Exhibit 4-4** SIU Alerting and Line Status Feedback (1 of 2)

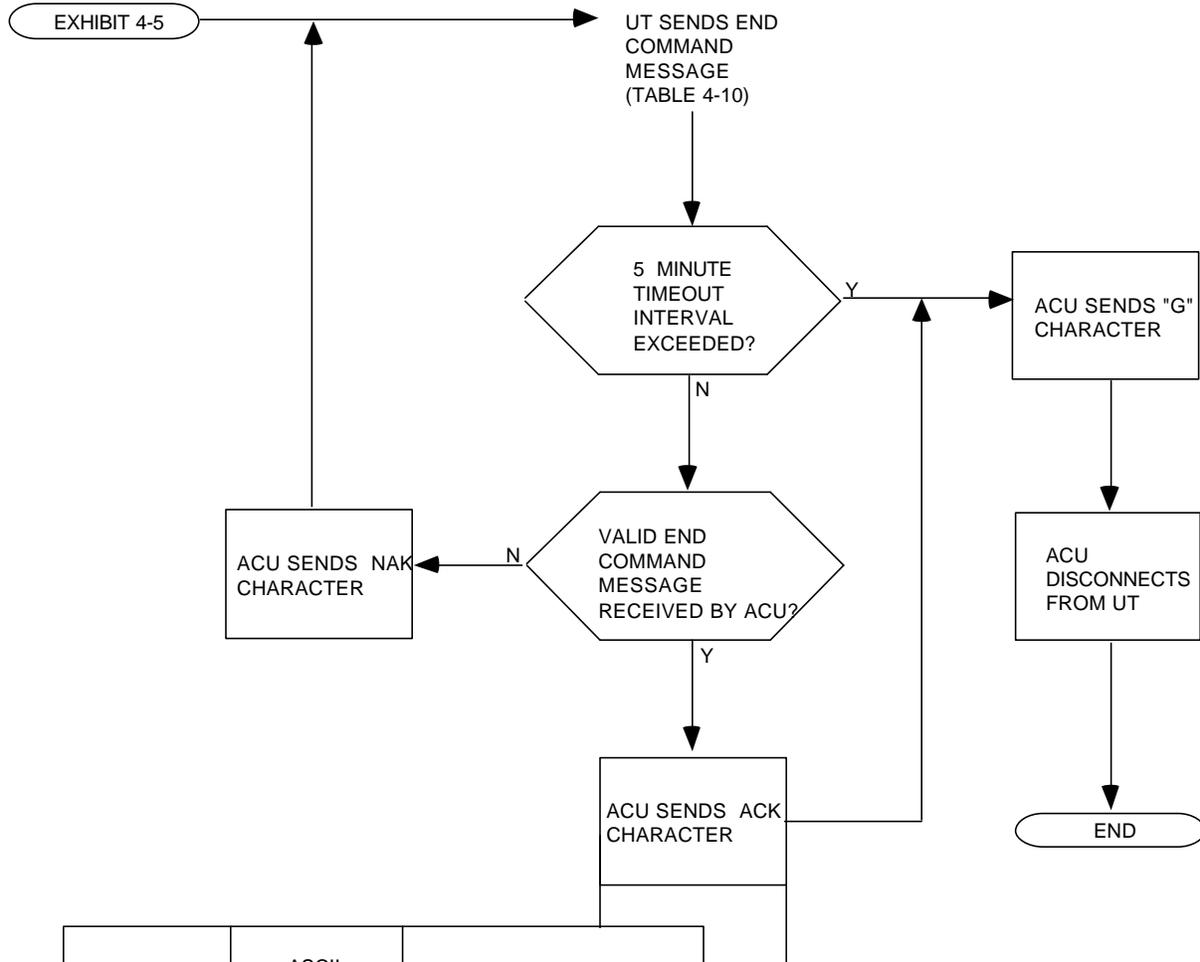


**Exhibit 4** SIU Alertine and Line Status Feedback (2 of 2)



**NOTE:**  
This feature may not be available in many locations. Utility should contact QWEST to determine status in their location.

**Exhibit 5** Next Command Sequence

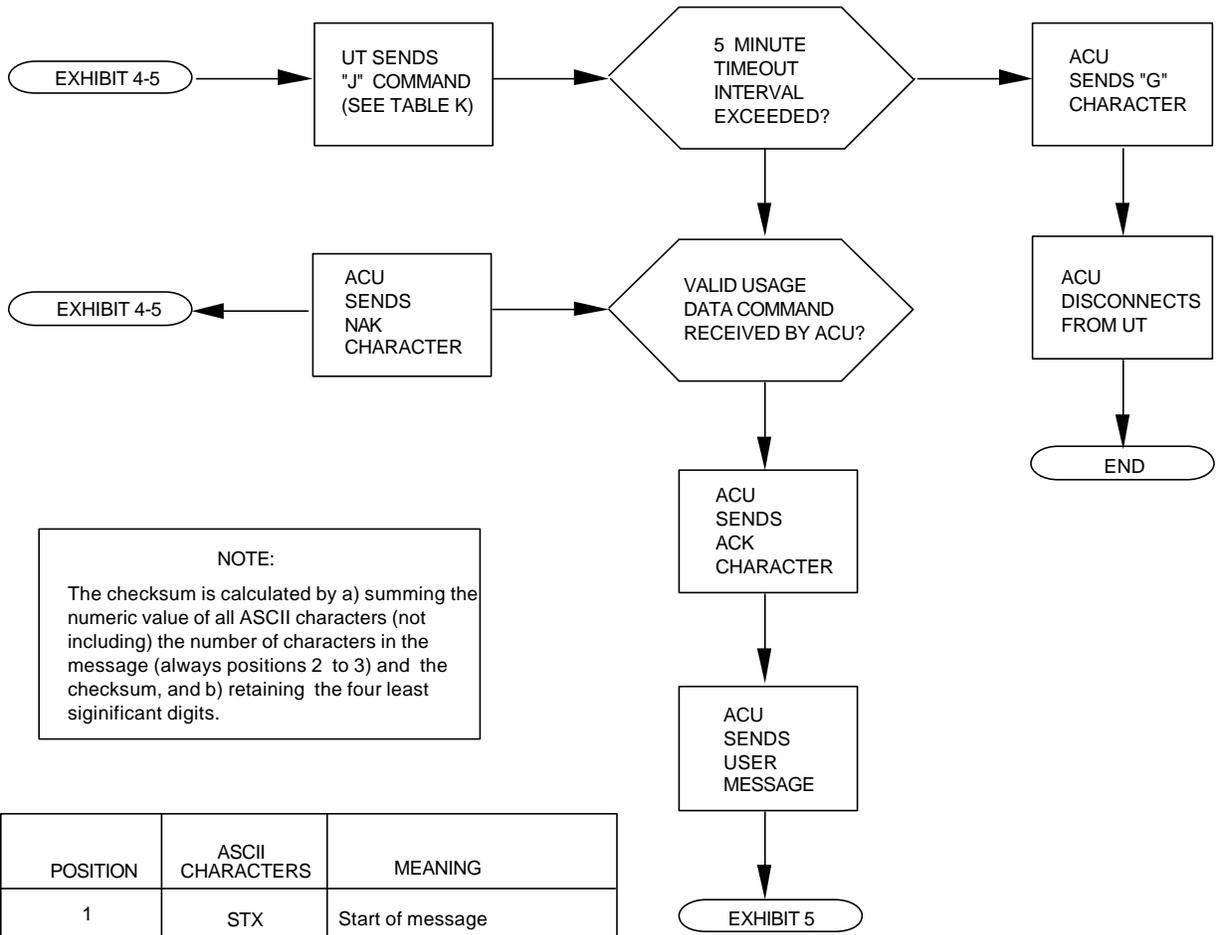


POSITION	ASCII CHARACTERS	MEANING
1	STX	Start of message
2 through 3	01	Number of characters in this message, excluding STX,, checksum, and ETX
4	E	End command
5 through 8	Four digits	Checksum (see note)
9	ETX	End of message

**NOTE:**  
 The checksum is calculated by a) summing the numeric value of all ASCII character between (not including) the number of characters in the message (always positions 2 to 3) and the checksum, and b) retaining the four least significant digits.

TABLE 4-10  
 END USAGE COMMAND MESSAGE FORMAT

**Exhibit 4-6** End Usage Command Message



**NOTE:**  
The checksum is calculated by a) summing the numeric value of all ASCII characters (not including) the number of characters in the message (always positions 2 to 3) and the checksum, and b) retaining the four least significant digits.

POSITION	ASCII CHARACTERS	MEANING
1	STX	Start of message
2 through 3	01	Number of characters in this message, excluding STX,, checksum, and ETX
4	J	Usage data command
5 through 8	Four digits	Checksum (see note)
9	ETX	End of message

TABLE 4-11  
USAGE DATA COMMAND MESSAGE FORMAT

**Exhibit 4-7 Usage Data Command Sequence**

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## **5. References**

### **5.1 American National Standards Institute Documents**

ANSI IEEE Std 820-1984     EEE Standard Telephone Loop Performance Characteristics

ANSI T1.401-1993     American National Standard for Telecommunications - Interface between Carriers and Customer Installations - Analog Voicegrade Switched Access Lines Using Loop-Start and Ground-Start Signaling.

### **5.2 QWEST Technical Publications**

PUB 41005             Data Communications Using the Switched Telecommunications Network, Bellcore

### **5.3 Telcordia Documents**

TR-TSY-000231     I-Match.1- Loop Characterization Database, Bellcore

TR-TSY-000001     Lightning and 60 Hz Disturbances at the Bell Operating Company Network Interface, Bellcore

TR-TSY-000762     Impulse Noise Tape No. 201, Bellcore

### **5.4 United States Government Documents**

Volume X, Part 68     Rules and Regulations - Connection of Terminal Equipment to the Telephone Network, Federal Communications Commission, Washington, D.C.

### **5.5 Ordering Information**

All documents are subject to change and their citation in this document reflects the most current information available at the time of printing. Readers are advised to check status and availability of all documents.

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