REMOTE OFFICE TEST LINE (ROTL)
DESCRIPTION AND THEORY OF OPERATION
NO. 3 ELECTRONIC SWITCHING SYSTEM

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1. GENERAL

1.01 This section describes, in physical and functional terms, the equipment and operation of the ***Remote Office Test Line (ROTL)*** unit for No. 3 Electronic Switching System (ESS) offices. The functions which the ROTL can provide and the interfaces between ROTL, No. 3 ESS, and control center are described. A description of the communications sequence and expected responses for each type of ROTL function is also given.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 The ROTL is a feature provided for most types of switching systems. It is used in a trunk maintenance program in conjunction with a Centralized Automatic Reporting on Trunks (CAROT) system. CAROT is a computerized system which automatically controls trunk testing in a number of remote offices simultaneously. The ROTL performs the trunk access and conditioning function in the switching offices. The basic ROTL function is to set up a connection on a specified trunk to a far-end test line (FETL), report call setup progress, and connect near-end measuring equipment, all under the direction of the CAROT controller (Fig. 1).

1.04 A No. 3 ESS ROTL unit may function as a near-end office, a far-end office, or both. As a near-end office, the ROTL can selectively test any outgoing or 2-way trunk in the No. 3 ESS office. This testing consists of performing transmission tests which are initiated by CAROT and which are configured by the ROTL hardware, the ROTL software in the No. 3 ESS, and the No. 3 ESS switching equipment. Optionally, local manual control may be exercised by accessing the ROTL on a dial-up basis via a local Manually Controlled Interrogator/ROTL Control Unit (MCI/RCU), or a ROTL system test set (H-310-150) (Fig. 1). As a far-end office, ROTL provides two 105-type test line terminations for testing incoming trunks.

1.05 The No. 3 ESS ROTL departs considerably from the traditional equipment configurations for large office ROTLs. All the equipment necessary to support the various test functions is self contained in a single unit occupying 8 inches of panel space (Fig. 2). The No. 3 ESS ROTL utilizes a consolidated microprocessor design which combines with the No. 3 ESS software and switching equipment to provide the required basic ROTL responder, tone detector,

and 105-type terminating test line functions. The microprocessor-based miniaturized ROTL (Mini-ROTL) hardware package will be referred to in this document as ***Mini-ROTL.***

2. PHYSICAL DESCRIPTION

2.01 Equipment, wiring, and apparatus for the Mini-ROTL are concentrated on a single 8-inch panel, to provide a unit 8 inches high and 10 inches deep for mounting in a 23-inch wide frame. Mounting bracket adapters are provided for mounting the unit in 25-inch wide ESS frames. Circuit pack locations are shown in Fig. 3.

2.02 Circuit packs for the Mini-ROTL (including two -48 volt dc-to-dc power converters) are contained in three apparatus mounting units: a 98C and a 104C apparatus housing for BELLPAC-type backplane interconnections and a 58B apparatus mounting for standard edgeboard interconnections. The two -48 volt power converters (208B and 208G power units) are AR-type PWB cards and plug into the 58B apparatus mounting. A -48 volt power fuse panel is provided on the No. 3 ESS frame in which the Mini-ROTL is mounted. An office alarm circuit closure is also provided when the fuse opens. Presence of each of the six operating voltages (±5, ±12, and ±15) is indicated by individual light-emitting diodes (LEDs) contained on the circuit pack adjacent to the 208G power unit. This circuit pack also contains a power ON/OFF switch. The area of the mounting panel above the 58B apparatus mounting contains a miscellaneous jack panel with two Electronic Industries Association (EIA) compatible connectors, two 238A jacks, a 274L holding inductor, and a 761A loudspeaker. Space for future growth of the Mini-ROTL is provided in the 98C apparatus housing.

3. FUNCTIONAL DESCRIPTION

INTRODUCTION

3.01 The No. 3 ESS ROTL is accessible via dialed-up connections. A regular directory number (DN) is assigned as the ROTL access number. The test center (Fig. 1) initiates a test by originating a call to the ROTL office via the direct distance dialing (DDD) network or local switching machine. The call is processed by the central office switching equipment in the same manner as for 100-type and 102-type test lines in No. 3 ESS. After successfully accessing the ROTL, the test center can request a number of different test configurations by sending MF priming as shown in Fig. 4.

NO. 3 ESS ROTL FEATURES

3.02 The general features provided in the No. 3 ESS ROTL are as follows:

- Trunk transmission tests to new 100-type (combined milliwatt and balanced termination), 102-type, and 105-type test lines
- Connection appraisal tests to new 100-type, 102-type, and 105-type test lines
- Hit detection during tests to new 100-type and 105-type test lines
- Balance and long term (BALT) test
- Remote trunk make-busy and restore
- Security callback unlock
- Trunk make-busy status request.

No provision is made for testing to operational test lines. These features are summarized in Table A.

A. Trunk Transmission Tests

3.03 The No. 3 ESS ROTL is capable of making transmission measurements to new 100-type, 102-type, and 105-type far-end transmission test lines. The transmission measuring circuits perform loss and noise measurements and self checks on an originating and terminating basis in a manner similar to the J94052A (52A) responder. Far-to-near transmission loss and near-end noise measurements are made in conjunction with the new 100-type test line. Only far-to-near loss measurements are made with the 102-type test lines. The 105-type test line provides for 2-way transmission loss and noise measurements, noise with tone, gain slope, and class 5 office return loss sequence measurements.

3.04 Loss measurements are made of 1004 Hz (0 dBm0) and at 404, 1004, and 2804 Hz (-16 dBm0) with an accuracy of ±0.1 dB. Noise is measured with C-message weighting and also with C-notched weighting in the presence of a -16 dBm0

1004 Hz tone. Accuracy of noise measurements is ±1.0 dB.

B. Connection Appraisal Tests

3.05 The connection appraisal feature provides for conducting a transmission test on a connection set up from the No. 3 ESS office to the distant test line with normal routing and trunk selection. The directory number of the far-end transmission test line is included in the priming information (described in paragraph 3.13). When priming is complete, an originating line circuit is seized and a test line in a far-end office is dialed up. When the test line is seized, the test sequence proceeds in a manner similar to a routine transmission test.

C. Hit Detection

3.06 During transmission tests to new 100-type or 105-type test lines, the occurrence of supervisory hits is detected and noted, but testing is continued until ROTL receives a recycle command. If a supervisory hit is detected, ROTL returns a 60 interruptions per minute (IPM) low tone in response to the recycle command and waits for a second recycle command. The ROTL then recycles normally.

D. Balance Testing

3.07 The balance and long term test (BALT) feature provides those functions required at the originating (outgoing, class 5) office end of a trunk which permit certain manual measurements to be made at the terminating end of the trunk, normally a class 4 office. After the No. 3 ESS ROTL obtains a connection over the desired trunk to the class 4 office and receives a signal from it, the ROTL provides 10 seconds of 1 kHz tone followed by a quiet termination. This sequence permits a measurement of 1-way loss and the measurement and adjustment of terminal balance in the class 4 office. For the first minute of the quiet termination, the control location may request ROTL recycle or disconnect. After that time, No. 3 ESS connects the incoming ROTL BALT test call to a high tone trunk until it disconnects. Two simultaneous BALT call connections are permitted, one connected to each of the two quiet termination circuits provided in a No. 3 ESS office. The second connection can be established after the first minute of quiet termination of the first call.

E. Remote Trunk Make-Busy and Restore

3.08 The No. 3 ESS ROTL provides a means for making busy and restoring to service the trunks to which it provides test access. The term "make-busy" means to place the trunk in the "locked-out idle" state. The term "restored" means the trunk has been returned to the "active-idle" state. Only trunks in the "active-idle" state can be remotely placed in the "locked-out idle" state. Only trunks in the "locked-out idle" state can be remotely restored to the "active-idle" state. To prevent unauthorized remote locations from taking trunks out of service, security provisions (paragraph 3.11) require an unlock procedure to enable use of the make-busy and restore function. Make-busy and restore operation may be initiated by CAROT control or by manual control.

CAROT Control

3.09 When certain failures are detected by CAROT during the course of routine automatic transmission tests, CAROT may request the No. 3 ESS ROTL to place that trunk in the maintenance-busy state. A verification that the requested make-busy action has occurred is normally returned to CAROT. If the requested action would cause the allowable number of made-busy trunks in the group to be exceeded, the action is denied by No. 3 ESS ROTL and a distinctive indication is returned to CAROT.

Manual Control

3.10 In the No. 3 ESS ROTL, provision is made for trunk make-busy and restoral to service upon request from an authorized manual position as verified by callback (paragraph 3.11). Verification of either make-busy or restoral is returned to the requesting point. Manual requests for make-busy are processed even if the allowable number of made-busy trunks in a group is exceeded. A distinctive indication that this has occurred, however, is returned to the requesting point.

F. Security Callback Unlock

3.11 The No. 3 ESS ROTL provides security against unauthorized use to make trunks busy or restore trunks to service. Prior to attempting to condition a trunk, the test center must request that the ROTL perform a security callback. Upon receipt of a make-busy and restore authorization (security callback) request containing

a user identification digit, the No. 3 ESS ROTL will originate a callback connection. From tables in memory, No. 3 ESS obtains the directory number corresponding to this user, places a DDD call to the user location, and connects the call to the Mini-ROTL for call disposition analysis. The No. 3 ESS also remembers if the user is authorized to just reach the make-busy limit in a trunk group or to exceed the limit. The No. 3 ESS ROTL will not take a make-busy or restore action unless a special unlocking signal is received over this callback connection. Only one security callback routine is required during the time a user is connected to the ROTL.

G. Trunk Make-Busy Status Request

3.12 In addition to conditioning trunks, any test center can request the maintenance busy status of either a single trunk or a trunk group. A trunk is considered maintenance busy if it is in any of the following states: locked-out idle, locked-out busy, high and wet, or disabled. A single trunk request is followed by the trunk identity (trunk group and member) and it asks if that trunk is currently available to customer traffic. A group request asks if any trunk in the group is maintenance busy and if so, if there are more trunks made-busy than the automatic maintenance limit permits in the group.

ROTL COMMUNICATION

3.13 Communication between the No. 3 ESS ROTL and the test center involves the transfer of information from the test center to control the ROTL, and the transfer of status information and test results from ROTL to the test center. The ROTL priming information is sent by 2-out-of-6 MF signals and includes the following information:

(a) Type of test to be made (transmission tests, trunk status request, connection appraisal, etc)

(b) Trunk identity

(c) Terminating test line number.

Priming information format for No. 3 ESS ROTL is shown in Fig. 4. In addition to the MF control signals, a 1300 Hz recycle command signal (1.0 to 1.2 seconds) is also used. Status information sent from ROTL to control to indicate call set-up progress includes the following signals:

(a) 2225 Hz test progress tone (TPT) (0.5 second minimum duration)

(b) Two-burst TPT (each tone and quiet separation interval of 520 ±80 ms)

(c) 60 IPM low tone (busy)

(d) 120 IPM low tone (reorder).

A. Test Initiation

3.14 In general, signaling begins when the test center is connected to the ROTL. When successfully accessed, the ROTL will return TPT after a minimum delay of 300 ms. Duration of the TPT is 15 seconds on initial ROTL seizure and 0.5 second after ROTL recycle (minimum) or until ROTL is ready to receive priming information. Removal of TPT is an indication to the test center to initiate tests on any trunk that ROTL can access. The test center initiates a test by sending ROTL a stream of MF digits which specifies the required information (Fig. 4). After receiving the priming information, ROTL proceeds to establish the connections required for the requested test.

3.15 Specific responses are required at key points in the call set-up process. Trunk measurements are begun only after all of the required connection confirmation signals have been received at the test center. If ROTL returns a signal which indicates that its progress has been blocked, the test center will normally send a recycle signal to ROTL. After ROTL recycles, another test can be requested by the test center. The ROTL testing is terminated when the access trunk between it and control is released. This also causes ROTL to recycle. All measurements from all tests on the trunk under test (TUT) are sent back to the test center in the form of frequency shift data signals. These signals consist of a guard band of 1200 Hz, followed by a data band of 2200 Hz (the duration of which is proportional to the measurement for the TUT), followed by a trailing guard band of 1200 Hz.

B. Transmission Tests

3.16 Upon removal of TPT by ROTL, the control location sends priming information (Fig. 4) specifying the test to be performed. The No. 3

ESS ROTL then returns one of the following information signals as an indication of its success in identifying and seizing the specified trunk for test:

(a) TPT (0.5 second minimum)—Trunk is seizable

(b) 60 IPM low tone (4 seconds)—Trunk cannot be seized, normally because it is busy for some reason

(c) 120 IPM low tone (4 seconds)—Request cannot be processed for one of the following reasons:

(1) Priming information error (ROTL cannot understand the priming)

(2) TUT port not defined

(3) TUT port busy.

If other than TPT is returned by ROTL, the ROTL waits for receipt of a recycle command at the conclusion of that signal. If 120 IPM low tone is returned, the control location may either send a recycle command to cause ROTL to recycle or send a ring-forward command (100 ±30 ms of 1300 Hz tone) in response to which ROTL returns a guard-data-guard signal. The length of the data portion specifies the trouble encountered. (See Table F.) A recycle command from control then resets the ROTL.

3.17 If the trunk is successfully seized, the ROTL proceeds to set up a connection over the trunk to the specified far-end test line. Indications of the disposition of the far-end test line connection attempt returned by ROTL to the control location are as follows:

(a) TPT (0.5 second minimum)—Far-end test line has been seized. This means TPT has been received from a 105-type test line or 1000 Hz has been received from a 100-type or 102-type test line. For a 105-type test, removal of TPT indicates that the far-end test line responder is connected.

(b) 60 IPM low tone—Far-end test line is busy.

(c) 120 IPM low tone—Reorder received from far-end office or one of the following ROTL call setup failures:

(1) No path TUT to TUT port

(2) No transmitter available

(3) No transmitter path

(4) TUT connection hardware failure

(5) Transient call record not available

(6) TUT port now busy

(7) TUT unseizable

(8) Priming and translation trunk groups differ

(9) Priming digits unintelligible.

If other than TPT is returned by ROTL, the ROTL waits for receipt of a recycle command at the conclusion of that signal. If 120 IPM low tone is returned, the control location may either send a recycle command to cause ROTL to recycle or send a ring-forward command (100 ±30 ms of 1300 Hz tone) in response to which ROTL returns a guard-data-guard signal. The length of the data portion specifies the trouble encountered. (See Table F.) A recycle command from control then resets the ROTL.

3.18 If the far-end test line is successfully seized, the ROTL sends a report on the near-end responder (after a minimum 500 ms quiet period) as follows:

(a) TPT (0.5 second minimum)—Responder is available and seizure request has been made. Removal of TPT indicates that the near-end responder is connected.

(b) 120 IPM low tone—Answer supervision has not been received on the TUT.

Normally at the conclusion of transmission tests on a particular trunk, the control location sends a release command to the responder, which causes the ROTL to recycle. If the control location desires to make the tested trunk busy, it sends a release-and-make-busy command to the responder. If a supervisory hit has been detected, the ROTL

will not respond to a release-and-make-busy command and will not make the trunk busy. Upon receipt of a recycle command, the ROTL returns a 60 IPM low tone and waits for a second recycle command.

C. Connection Appraisal Tests

3.19 For a connection appraisal test, the ROTL originates a call in a subscriber-like manner, using digits contained in the priming information sent from the control location. The sequence of signals is identical to that for trunk transmission tests with the following variations:

(a) The "trunk disposition" response becomes the "originating line disposition" response.

(b) There is no monitoring for supervisory hits.

(c) The overall connection, instead of a particular trunk, is measured.

(d) There is no make-busy capability.

D. Trunk Make-Busy and Restoral

3.20 When the priming information from the control location specifies a trunk make-busy or restoral function, the ROTL responds with one of the following:

(a) TPT (0.5 second minimum)—Trunk is now made maintenance busy or trunk is now made maintenance idle (restored)

(b) Two-burst TPT—Trunk is made maintenance busy and the maintenance-busy limit is now exceeded (response to a manual request only)

(c) 60 IPM low tone—Request refused for one of the following reasons:

(1) Local condition prevents requested action, or

(2) Maintenance-busy limit has been reached or exceeded.

(d) 120 IPM low tone—Indicates one of the following conditions:

(1) Priming information error, or

(2) Security callback for make-busy authorization has not been made.

This sequence may also be entered from the transmission test sequence when, at the conclusion of the transmission test, the control location sends a release-and-make-busy command to the near-end responder. The possible ROTL replies are as follows:

(a) TPT (0.5 second minimum)—Trunk is now maintenance busy

(b) 60 IPM low tone—Request refused for one of the following reasons:

(1) Local condition prevents requested action, or

(2) Maintenance-busy limit has been reached or exceeded

(c) 120 IPM low tone—Security callback for make-busy authorization has not been made

(d) Quiet, then returns 60 IPM low tone for 4 seconds on receipt of recycle command—Supervisory hit was detected during transmission test; no action has been taken.

In each case, the control location sends a recycle command to enable the ROTL to complete its recycle procedure and return TPT.

E. Trunk Status Request

3.21 When the priming information from the control location specifies a trunk status request, the ROTL is interrogated as to the maintenance-busy status of a specific trunk, or as to the maintenance-busy count status of a trunk group. For an individual trunk, the ROTL responds with one of the following:

(a) TPT (0.5 second minimum)—The trunk specified is not in the maintenance-busy count

(b) 60 IPM low tone—The specified trunk is in the maintenance-busy count

(c) 120 IPM low tone—Priming information error.

For a trunk group status request, the ROTL responds with one of the following:

(a) TPT (0.5 second minimum)—No trunks in the specified trunk group are in the maintenance-busy count

(b) Two-burst TPT—Count of maintenance-busy trunks in the specified trunk group is greater than zero but less than the allowable limit

(c) 60 IPM low tone—Count of maintenance-busy trunks in the specified trunk group is at or above the limit

(d) 120 IPM low tone—Priming information error.

F. Security Callback

3.22 When the priming information from the control location requests a security callback (callback unlock request), the ROTL responds with one of the following:

(a) TPT (0.5 second minimum)—ROTL has accepted and is processing the request

(b) 60 IPM low tone—Caller identification number is not currently valid

(c) 120 IPM low tone—Priming information error.

When the request is accepted, ROTL then originates a call by using the stored callback number corresponding to the caller identifier contained in the priming information. The disposition of this call is reported to the control location as follows:

(a) TPT (0.5 second minimum)—Confirmation signal (1000 Hz) has been received and unlock is completed

(b) 60 IPM low tone—Callback line is busy at the control location

(c) 120 IPM low tone—Paths to the callback line at the control location are busy or one of the following conditions:

(1) TUT port is busy

(2) TUT port is undefined

(3) Call setup denied.

After receiving a disposition signal, the control location sends a recycle command to the ROTL. The ROTL returns TPT and recycles.

G. Balance and Long Term (BALT) Tests

3.23 When priming information from the control location specifies a BALT test, the ROTL responds with one of the following:

(a) TPT (0.5 second minimum)—Trunk has been seized

(b) 60 IPM low tone—Trunk is unseizable (usually some form of busy)

(c) 120 IPM low tone—Request cannot be processed for one of the following reasons:

(1) Priming information error

(2) TUT port not defined

(3) TUT port busy.

When the specified trunk has been seized, the ROTL attempts to establish a connection over the designated trunk to the far-end location specified in the priming information and reports the disposition of the attempted call as follows:

(a) TPT (0.5 second minimum)—1000 Hz signal received from far-end

(b) 60 IPM low tone—Far-end is busy

(c) 120 IPM low tone—Reorder received from far-end office or one of the following ROTL call setup failures:

(1) No path TUT to TUT port

(2) No transmitter available

(3) No transmitter path

(4) TUT connection hardware failure

(5) Transient call record not available

(6) TUT port now busy

(7) TUT unseizable

(8) Priming and translation trunk groups differ

(9) Priming digits unintelligible.

When the call is answered at the far-end, the ROTL waits for a 1000 Hz signal (nominally 0 dBm0 for 1 second) from the far-end over the TUT as a command to proceed. Upon receipt of the signal from the far-end, ROTL applies 1004 Hz at 0 dBm0 for 10 seconds on the TUT, followed by a quiet termination. After the first minute of quiet termination, the ROTL does not accept any commands, including recycle command, over the access connection. A continuous high tone is returned as an indication of this condition. The TUT connection can be maintained for up to 30 minutes. If ROTL is unable to provide the tone and quiet sequence on receipt of the far-end signal, 120 IPM low tone is returned as an indication of one of the following:

(a) A tone-and-quiet circuit is not available

(b) Answer supervision has not been received on the TUT

(c) No path to TUT port

(d) TUT connection hardware failure.

ROTL FUNCTIONS

3.24 The No. 3 ESS ROTL functions required to provide features listed in Table A comprise:

(a) Those functions implemented in the Mini-ROTL circuitry

(b) Those functions implemented by the ROTL software in No. 3 ESS and by the No. 3 ESS switching equipment.

Division of ROTL functions between the two groups is listed in Table B. Interaction of the two functional groups is facilitated by a message channel over which information is exchanged between the Mini-ROTL and the 3A Central Control (3A CC). This message channel provides the link which joins the Mini-ROTL with a part of the No. 3 ESS software and hardware to form the functional No. 3 ESS ROTL. A functional block diagram of the No. 3 ESS ROTL is given in Fig. 5.

ROTL INTERFACES

3.25 Interfacing between the No. 3 ESS and the Mini-ROTL sections of the ROTL (Fig. 5) provide for the following specific functions:

(a) Trunk connections for transmission tests

(b) A separate circuit for connection appraisal tests

(c) A message channel between Mini-ROTL and the 3A CC.

A description of these interfaces follows:

A. Trunk Connections

3.26 Separate circuits are provided at the Mini-ROTL (Fig. 5) to which No. 3 ESS connects the following:

(a) The incoming ROTL call

(b) The TUT or security callback call

(c) Incoming 105-type test line calls.

The idle state of circuits for incoming ROTL calls provides resistive continuity of approximately 1500 ohms. When notified that a connection has been made, the Mini-ROTL removes the resistive termination. The connection is then generally, though not necessarily always, capacitively coupled. The idle state of the circuit for the TUT or security callback call is an open circuit. When notified that a security callback user ID is valid, Mini-ROTL applies a hold coil which remains connected for the remainder of the security callback call. When notified that a TUT connection is about to be made, the Mini-ROTL provides resistive continuity of approximately 1500 ohms. When notified that the TUT connection has (or has not) been made, the Mini-ROTL removes the resistive termination and the connection is generally capacitively coupled. Supervision for the TUT connection is provided by the No. 3 ESS portion of the ROTL (Table B). Buildout pads for transmission measurements are provided in the Mini-ROTL where required. Incoming 105-type test line calls are connected to the Mini-ROTL as a 2-line series completion group arranged for terminating-only service. The Mini-ROTL trips ringing and monitors loop current for disconnect. The message channel is not used for incoming

105-type test line calls. No special action by No. 3 ESS is required for 105-type test line calls.

B. Connection Appraisal

3.27 The No. 3 ESS provides the Mini-ROTL with an outgoing subscriber-type loop (Fig. 5) over which the Mini-ROTL can place an outgoing call using dial-pulsing (500 ohms dc with the loop closed). The idle or on-hook condition is an open circuit. During transmission tests, the Mini-ROTL provides a high ac impedance bridge with dc holding.

C. Message Channel

3.28 The message channel (Fig. 5) is a half-duplex standard EIA interface utilizing American Standard Code for Information Interchange (ASCII) characters and connecting to a port on a No. 3 ESS teletypewriter controller (TTYC). The channel is normally implemented on a shared basis with an existing No. 3 ESS TTYC operating at 110 baud. To avoid blockages and delays due to competition for TTYC use, however, an additional TTYC exclusively for ROTL usage may be optionally provided. The dedicated arrangement may be optionally specified to operate at 300 baud. The standard EIA/ASCII format between the TTYC and Mini-ROTL provides a means of interfacing at that point with a standard terminal for testing the Mini-ROTL circuit. Figure 6 specifies the standard 7-bit ASCII code notation.

3.29 The message channel unites the Mini-ROTL with the No. 3 ESS sections of the ROTL to form a functional entity. The channel must be initially established by the No. 3 ESS. Once the channel is established, messages may be originated by either the Mini-ROTL or the No. 3 ESS. Most messages exchanged between the Mini-ROTL and the 3A CC (via a TTYC) are single value messages and are passed as pairs of characters consisting of a character plus its complement. Some messages specifying test requests received by ROTL, as defined in Fig. 4, are sent by Mini-ROTL to the No. 3 ESS as data blocks. Format of these data blocks is shown in Fig. 7. The actual data bytes are ASCII characters corresponding to the digits received with KP and ST (Fig. 4) deleted. The cyclic redundancy code bytes (CRC1 and CRC2) are computed by the Mini-ROTL and sent to the TTYC where they are recomputed. If the computed CRC values are the same as the received ones, it is assumed the message suffered no errors in transmission. If the computed and received CRC values do not agree, it is assumed an error in transmission has occurred, and the message is not acknowledged. Tables C, D, and E define each message by name, ASCII character, and character complement. Table F lists error messages returned on receipt of ring forward signal.

3.30 The simplified 2-character messages sent from Mini-ROTL to the 3A CC (Table C) consist of ASCII characters for capital letters plus their complements (which are numbers and symbols). All of these are printing characters on data terminals. The simplified 2-character messages sent from the 3A CC to Mini-ROTL (Table E) consist primarily of numbers and symbols, the complements of which are symbols and capital letters, respectively. A few messages in this category consist of lower case letters, the complements of which are nonprinting control characters. This arrangement permits use of a data terminal connected to the message channel interface (Fig. 5) for testing purposes.

3.31 The protocol for message exchange on the message channel is as follows. A 2-character message of acknowledgment is returned by the entity receiving a message which satisfies the complementary relationship. The actual content of data block type messages is examined later by the No. 3 ESS as the ROTL sequence proceeds. If a 2-character message which does not have the complementary relationship, or a data block having an unacceptable format, is received, no message is returned. After waiting approximately 2 or 3 seconds for an acknowledgment, the message originator repeats the message. If no response is received within 2 or 3 seconds on the second try, the originator assumes the receiving end is not functioning and executes a disconnect and reset routine.

NO. 3 ESS ROTL SOFTWARE

3.32 The No. 3 ESS ROTL software, initially available in the 3E3 Generic, is a resident program. When call processing routines have determined that an incoming call is for the ROTL, control is passed to ROTL program which seizes the message channel, seizes the ROTL terminal appearance, and connects the incoming call to the ROTL terminal appearance. After the connection is established, the ROTL program notifies the

Mini-ROTL via the message channel and supervises the call for disconnect.

3.33 Requests for trunk status, trunk make-busy and restoral, connection of ROTL for security callback requests, connection of ROTL to a TUT, and all such related requests are passed from the Mini-ROTL via the message channel for execution by the ROTL program. After executing the request, an appropriate reply is passed to the Mini-ROTL via the message channel to indicate either successful execution or the reason for failure.

3.34 Terminating calls to 105-type test lines are handled by normal call processing routines.

3.35 When a call terminating to the ROTL is released, a holdover timer for the message channel will be initiated to keep the channel available for reseizure of ROTL in a 2-minute interval.

4. CALL SETUP SEQUENCES

INTRODUCTION

4.01 The sequences for various types of No. 3 ESS ROTL action are described in this part. In general, an incoming ROTL or 105-type test line call is first established. For an incoming ROTL call (Fig. 5), the Mini-ROTL receives and processes the required information, which is then passed to No. 3 ESS via the message channel. The No. 3 ESS takes the required action and returns progress messages to the Mini-ROTL. When a trunk is to be tested, No. 3 ESS connects the trunk to the Mini-ROTL after successful outpulsing. The Mini-ROTL diagnoses the call disposition, returns appropriate responses to control, and conducts measurements as directed by control. The No. 3 ESS provides a 2-line series completion group for incoming 105-type test line calls. When the call is connected, Mini-ROTL is notified via ringing signal over the seized line.

INCOMING ROTL CALL

4.02 A ROTL call begins when the test center originates a call on one of its subscriber loops to the ROTL office. The call is processed with the central office switching equipment in the same manner as a regular call. If the local office is not the ROTL office, the call is routed to the ROTL via the DDD network or local switching. This call enters the ROTL office on an incoming trunk (Fig. 1). If the ROTL is in the local office, the ROTL office connects the proper receiver to the subscriber loop to collect the DN. At the ROTL office, the digits are collected and translated and control is passed to the ROTL program for processing the call. The call setup sequence then proceeds in the following steps:

(1) No. 3 ESS detects that an incoming call is for ROTL.

(2) No. 3 ESS seizes the ROTL test line appearance. Failure to seize the ROTL test line results in the return of a 60 IPM busy tone until the caller disconnects.

(3) No. 3 ESS activates the TTY channel to the Mini-ROTL if it is not already active. If the channel cannot be successfully established, the No. 3 ESS returns a 60 IPM busy tone until the caller disconnects.

(4) No. 3 ESS tests the ROTL front end (Fig. 5) for continuity and connects the call to the ROTL front end. On a failure of continuity or a failure in connection, No. 3 ESS returns 120 IPM reorder tone until the caller disconnects and releases the ROTL test line. [Refer to paragraph 4.09 (b).]

(5) No. 3 ESS informs Mini-ROTL via the message channel that a ROTL call is connected.

(6) Mini-ROTL applies TPT toward control location and begins monitoring for a recycle or drop access trunk command from control. [Refer to parallel process RDMON, paragraph 4.10 (b).]

(7) No. 3 ESS monitors for incoming ROTL call disconnect [paragraph 4.09 (a)].

(8) Mini-ROTL continues application of TPT for a minimum of 15 seconds on initial connection*, 0.5 seconds on ROTL recycle, and until the ROTL user is granted service.

*On initial connection, 15 seconds of TPT is returned and continued until the ROTL user is granted service. During the 15-second period, Mini-ROTL looks for the presence of a carrier indicating a diagnostic user. Carrier present for 2 seconds causes Mini-ROTL to remove TPT and go into the diagnostic mode.

(9) Mini-ROTL removes TPT and begins an overall 3-minute timeout [paragraph 4.10 (a)].

(10) The diagnostic sequence is described in paragraph 6.01. If a diagnostic user is not indicated, Mini-ROTL receives priming digits from control location on termination of TPT.

(11) Mini-ROTL checks validity of the priming information. If priming is invalid, Mini-ROTL returns 120 IPM reorder tone and waits for a recycle command [paragraph 4.10 (b)].

(12) Mini-ROTL interprets the priming information to determine if the request is:

(a) A connection appraisal request,

(b) A security callback request,

(c) A make-busy or restore request,

(d) A trunk-busy status request, or

(e) An MF receiver test.

A valid request which is not one of the above is either a normal transmission test or a BALT test (Fig. 4), and ROTL proceeds with a trunk test sequence.

During the progress of the call setup sequence (steps 1 through 12), both the Mini-ROTL and the No. 3 ESS are performing parallel processes to provide overall timing and monitoring functions.

A. Trunk Test Sequence

4.03 When an incoming ROTL call is determined to require a trunk test sequence (from Step 12, paragraph 4.02), the setup proceeds in the following steps:

(1) Mini-ROTL passes the information received in priming digits from the control location to the No. 3 ESS via the message channel. This information specifies:

(a) Normal seizure or override maintenance busy,

(b) Trunk group and member number,

(c) State of the trunk for test (this value currently must be zero, but the digit is reserved for possible future implementation),

(d) Far-end test line address digits, and

(e) Type of request (100-type, 102-type, or 105-type test lines or BALT).

(2) No. 3 ESS responds with a status message indicating to the Mini-ROTL whether the specified trunk is seizable or unseizable, whether the connection can be made to the TUT port, and whether the Mini-ROTL is understood. If the trunk is unseizable or if the connection cannot be made, the Mini-ROTL returns proper response to control and waits for recycle [paragraph 4.10 (b)].

(3) When the trunk is seizable, Mini-ROTL returns a burst of TPT to control and places continuity on the TUT front end. No. 3 ESS attempts a call setup on the TUT. If outpulsing facilities are unavailable, No. 3 ESS sends a call setup failure identification message to Mini-ROTL and resets. The Mini-ROTL returns proper response to control and waits for recycle [paragraph 4.10 (b)].

(4) No. 3 ESS makes continuity checks and attempts to connect the TUT to Mini-ROTL for tone detector monitoring of call disposition. If connection to TUT front end is unsuccessful, No. 3 ESS notifies Mini-ROTL of connection failure and resets. The Mini-ROTL then removes the continuity condition, returns 120 IPM low tone to control, and waits for recycle command [paragraph 4.10 (b)].

(5) No. 3 ESS notifies the Mini-ROTL when connection to the TUT front end has been made. The Mini-ROTL then removes the TUT front-end continuity condition and determines whether the test is a BALT test or a normal transmission test. The BALT test sequence continues with paragraph 4.04.

(6) Mini-ROTL returns proper tone responses to control, according to tone detector indications. If the far-end connection is not successful, the Mini-ROTL waits for a recycle command [paragraph 4.10 (b)].

(7) When the far-end connection is made, the Mini-ROTL requests and receives from No. 3 ESS the supervisory state of the TUT. If answer supervision is not received from the far-end, No. 3 ESS resets, and Mini-ROTL sends proper tone response to control and waits for a recycle command [paragraph 4.10 (b)].

(8) When answer supervision has been received from the far-end, Mini-ROTL applies a "responder seized" response to control and tells No. ESS to begin monitoring for supervisory hits on the TUT for calls to 100-type and 105-type test lines.

(9) The control location conducts tests using the responder(s) while the Mini-ROTL monitors for a responder release or a release-and-make-trunk-busy command [paragraph 4.10(c)].

B. BALT Test Sequence

4.04 At a point in the trunk test sequence (Step 5, paragraph 4.03) when the Mini-ROTL determines that the test is a BALT test, the sequence proceeds from that point as follows:

(1) Mini-ROTL returns proper tone responses to control according to tone detector indications, and continues to look for a 1 kHz indication.

(2) When the 1 kHz signal is received, Mini-ROTL tells No. 3 ESS to connect TUT to a tone/quiet termination.

(3) No. 3 ESS attempts to connect TUT to a tone/quiet termination circuit. If the connection attempt is not successful, or if answer supervision has not been received on the TUT, No. 3 ESS notifies the Mini-ROTL, resets and drops the TUT. The Mini-ROTL then returns 120 IPM low tone to control and waits for a recycle command [paragraph 4.10 (b)].

(4) No. 3 ESS notifies Mini-ROTL of successful connection and begins a 30-minute timeout. The TUT is disconnected on receipt of a recycle command or a disconnect on the ROTL access connection, on loss of answer supervision from the TUT, or at expiration of the 30-minute timeout.

(5) Mini-ROTL begins a 1.2 minute timer, and is alert to recycle commands or ROTL call disconnect messages from No. 3 ESS during this interval.

(6) At expiration of the 1.2 minute timeout, the Mini-ROTL sends a control-transfer message to No. 3 ESS and resets all ROTL port conditions. The No. 3 ESS assumes control of the ROTL call and attempts to connect the call to a high tone trunk. If connection to the high tone trunk is not successful, No. 3 ESS sends 120 IPM low tone on the ROTL connection and allows normal call processing to control the connection. This action results finally in disconnect. [Refer to paragraph 4.09 (b).]

(7) When the high tone trunk connection is made, No. 3 ESS frees the ROTL access port for another incoming ROTL call and continues to monitor the present incoming connection for disconnect. On receipt of disconnect, the associated TUT is also disconnected.

C. Connection Appraisal Test Sequence

4.05 When the incoming ROTL call is determined to be a connection appraisal request (from Step 12, paragraph 4.02), the incoming ROTL call setup proceeds in the following steps:

(1) No. 3 ESS performs only caller disconnect (ROTL) detection during this type of test.

(2) Mini-ROTL originates a call on an originating line just as a normal subscriber (by going off-hook and dial pulsing). No. 3 ESS handles this as a normal call.

(3) Mini-ROTL performs connection appraisal tests without additional No. 3 ESS action.

(4) Mini-ROTL terminates the call by going on-hook on the originating line in response to a recycle command from the control location [paragraph 4.10 (b)].

D. Security Callback Sequence

4.06 When the incoming ROTL call is determined to be a security callback request (from Step

12, paragraph 4.02), the incoming ROTL call setup proceeds as follows:

(1) Mini-ROTL informs No. 3 ESS that it has a security callback request and specifies the caller identification digit.

(2) No. 3 ESS checks the current validity of the caller identification digit. If the digit is not currently valid, No. 3 ESS informs the Mini-ROTL. The Mini-ROTL returns 60 IPM low tone to control and waits for a recycle command [paragraph 4.10 (b)].

(3) No. 3 ESS marks the current ROTL user as authorized to reach or to exceed a trunk group maintenance busy limit and retains this mark until the ROTL user disconnects.

(4) No. 3 ESS informs Mini-ROTL that the caller identification is valid and Mini-ROTL returns a burst of TPT to control.

(5) Mini-ROTL places the hold coil across the TUT port and notifies No. 3 ESS that continuity conditions are established.

(6) Mini-ROTL enables the tone detector to monitor the callback call disposition.

(7) No. 3 ESS looks up a directory number corresponding to the caller identification digit and attempts to originate a call to that number.

(8) Mini-ROTL monitors disposition of the callback call, sends appropriate responses to the control location, and waits for a recycle command [paragraph 4.10 (b)].

E. Make-Busy or Restore Sequence

4.07 When the incoming ROTL call is determined to be a make-busy or restore request (from Step 12, paragraph 4.02), the call setup proceeds as follows:

(1) Mini-ROTL determines whether make-busy authorization has been established via a security callback call during the time the using control location has been connected to the ROTL. If authorization has not been established, the Mini-ROTL sends 120 IPM low tone to the control location and waits for a recycle command [paragraph 4.10 (b)].

(2) If authorization has been established, Mini-ROTL passes the trunk identification and the action request (make trunk busy or restore trunk) to the No. 3 ESS.

(3) No. 3 ESS takes appropriate action, returns a disposition message to the Mini-ROTL, and resets.

(4) Mini-ROTL returns a proper tone response to the control location and waits for a recycle command [paragraph 4.10 (b)].

F. Trunk-Busy Status Request Sequence

4.08 When the incoming ROTL call is determined to be a trunk-busy status request (from Step 12, paragraph 4.02) the call setup proceeds as follows:

(1) Mini-ROTL informs No. 3 ESS that this is a status request for a trunk or trunk group and passes the trunk or trunk group identification.

(2) No. 3 ESS passes the requested trunk status information to the Mini-ROTL and resets.

(3) Mini-ROTL sends a proper tone response to the control location and waits for a recycle command [paragraph 4.10 (b)].

G. Timing, Recycle, and Monitor Functions

4.09 During the progress of an incoming ROTL call, the No. 3 ESS ROTL performs various timing and monitoring functions for each phase of the call setup sequence. Those functions provided by the No. 3 ESS are as follows:

(a) ROTL Disconnect Monitor (RDM)—The No. 3 ESS monitors the incoming ROTL call for disconnect. When disconnect occurs, the No. 3 ESS sends a disconnect message to the Mini-ROTL and Mini-ROTL resets all ROTL port conditions.

(b) Disconnect Timeout (HOLD)—When a ROTL call disconnect occurs, the No. 3 ESS begins a 2-minute timeout before releasing the TTY channel. If another ROTL call comes in, the 2-minute timer is cleared and a new call setup sequence begins. If the 2-minute timeout occurs before another incoming ROTL call, No. 3 ESS clears the timer and releases the TTY channel.

4.10 During the call setup progress of an incoming ROTL call and the subsequent tests conducted by the control location, the Mini-ROTL performs timing and monitor functions as follows:

(a) Mini-ROTL Overall Timeout (TIME)—Beginning with removal of TPT when a user is granted service (Step 9, paragraph 4.02), the Mini-ROTL initiates an overall 3-minute timeout for completion of the call setup and all testing on that particular test connection.

(b) Recycle or Drop Access Trunk Monitor (RDMON)—Beginning with application of TPT (Step 6, paragraph 4.02) when an incoming ROTL call is connected to the ROTL front end, the Mini-ROTL monitors for receipt of a command to recycle (RCY) or to drop the access trunk (DAT).

(c) Monitor for Responder Release or Release-and-Make-Trunk-Busy (RLMB) Command—While the control location conducts tests during a trunk test sequence (Step 9, paragraph 4.03), the Mini-ROTL monitors for a responder release command or a release-and-make-trunk-busy command. Receipt of a release command results in a normal recycle routine. On receipt of an authorized release and make busy command, where no hits have been detected during a 100-type or 105-type test, the sequence proceeds as in Steps 2 through 4, paragraph 4.07.

105-TYPE TEST LINE CALL

4.11 Incoming 105-type test line calls to a No. 3 ESS ROTL office are handled by normal call processing routines. Two simultaneous call conditions are possible with 2225 Hz test progress tone returned until a call is granted responder service. A call progresses in the following sequence:

(1) No. 3 ESS receives an incoming call to a 105-type test line number and applies ringing signal on tip and ring toward the Mini-ROTL.

(2) Mini-ROTL trips ringing and begins to monitor loop current.

(3) No. 3 ESS then begins a monitor for the incoming 105-type test line call disconnect.

(4) Mini-ROTL returns TPT for a minimum of 1.0 second, until the responder is connected.

(5) Upon termination of the TPT, the 105-type test line is used to perform the required tests while the Mini-ROTL monitors for either a responder release command, the lack of an MF command during an 18-second responder idle period, or the absence of loop current.

(6) When either a responder release command has been received or the responder has been idle for 18 seconds without a command, the Mini-ROTL drops the connection on this test line by opening the loop to No. 3 ESS.

(7) Mini-ROTL then resets all conditions on this test line front end and assigns the responder to the next user.

5. POWER

5.01 Power is provided for the Mini-ROTL via two -48 volt dc-to-dc power converters. The two power converters, types 208B and 208G, are powered from the -48 volt office supply via a single fuse which is provided in the ESS mounting frame. Circuit packs in the Mini-ROTL are supplied with six operating voltages from the -48 volt converters. These are: +5 volts, -5 volts, +12 volts, -12 volts, +15 volts, and -15 volts.

6. MAINTENANCE

MINI-ROTL DIAGNOSTIC SEQUENCE

6.01 The No. 3 ESS ROTL is provided with a feature which allows testing the internal working of the Mini-ROTL from a data terminal on a dial-up or directly connected basis. After the No. 3 ESS connects an incoming ROTL call to the Mini-ROTL and the Mini-ROTL detects that it is a diagnostic request, the Mini-ROTL notifies the No. 3 ESS. The No. 3 ESS in turn makes the two 105-type test lines busy to incoming traffic until the diagnostic user disconnects. If a 105-type test line call is parked at the time of the diagnostic request, No. 3 ESS waits for the call to disconnect and then makes it busy to incoming calls. This procedure is followed because the Mini-ROTL cannot independently service 105-type test line calls during a diagnostic sequence. Because a dial-up diagnostic request is not recognized until ROTL is given active service, testing on an active 105-type test line would be concluded before No. 3 ESS is notified of a ROTL diagnostic request. A connector is also located on the Mini-ROTL (Fig. 5) which allows

direct connection of a data terminal using an EIA interface for exercising the Mini-ROTL diagnostic sequence. A direct-connection diagnostic request is recognized only when there are no incoming calls connected (ROTL or 105-type test line). The Mini-ROTL dial-up diagnostic sequence proceeds (from Step 9, paragraph 4.02) in the following steps:

(1) Mini-ROTL begins monitoring for continued presence of the carrier and tells No. 3 ESS that this is a diagnostic user.

(2) No. 3 ESS makes the two 105-type test lines busy to incoming traffic (if idle); and disconnects existing calls and makes the lines busy when they disconnect (if in service). No message is sent to the Mini-ROTL at this point. No. 3 ESS proceeds to the HOLD timeout sequence [paragraph 4.09(b)].

(3) Mini-ROTL enters a diagnostic mode and expects no communication from No. 3 ESS.

(4) Upon receipt of a disconnect, the No. 3 ESS restores the 105-type test lines to service and resets.

(5) On loss of diagnostic user carrier, the Mini-ROTL resets the ROTL port.

6.02 A check of the Mini-ROTL MF receiver can be made from a manual control device by sending the MF digit string shown for "MF Receiver Test" in Fig. 4. If the digits are received successfully, a burst of TPT is returned. If the digits are not received successfully, a burst of 120 IPM low tone is returned.

7. GLOSSARY

7.01 The following terms and definitions are used in this section:

ACK—Acknowledgment.

ASCII—American Standard Code for Information Interchange

BALT—Balance and long term test.

Baud—A unit of signaling speed; the speed in bauds is equal to the number of signaling elements or symbols per second.

CAROT—Centralized Automatic Reporting on Trunks.

Class 5 Office—The central office trunking entities where telephone loops are terminated for purposes of interconnection to each other and to the network are called "end offices" and are designated as class 5 offices.

DDD—Direct distance dialing.

DGCAR—Diagnostic carrier.

DN—Directory number.

EIA—Electronic Industries Association.

ESS—Electronic Switching System.

FETL—Far-end test line.

IPM—Interruptions per minute.

LED—Light emitting diode.

MB—Make-busy.

MCI—Manually controlled interrogator.

Mini-ROTL—The microprocessor based miniaturized ROTL.

RCU—ROTL control unit.

RDM—ROTL disconnect monitor.

ROTL—Remote Office Test Line.

TPT—Test progress tone.

TTYC—Teletypewriter controller.

TUT—Trunk under test.

0 dBm0—The signal level which produces a 1-milliwatt (0 dBm) power level at a zero transmission level reference point (0 TLP).

3A CC—3A Central Control.

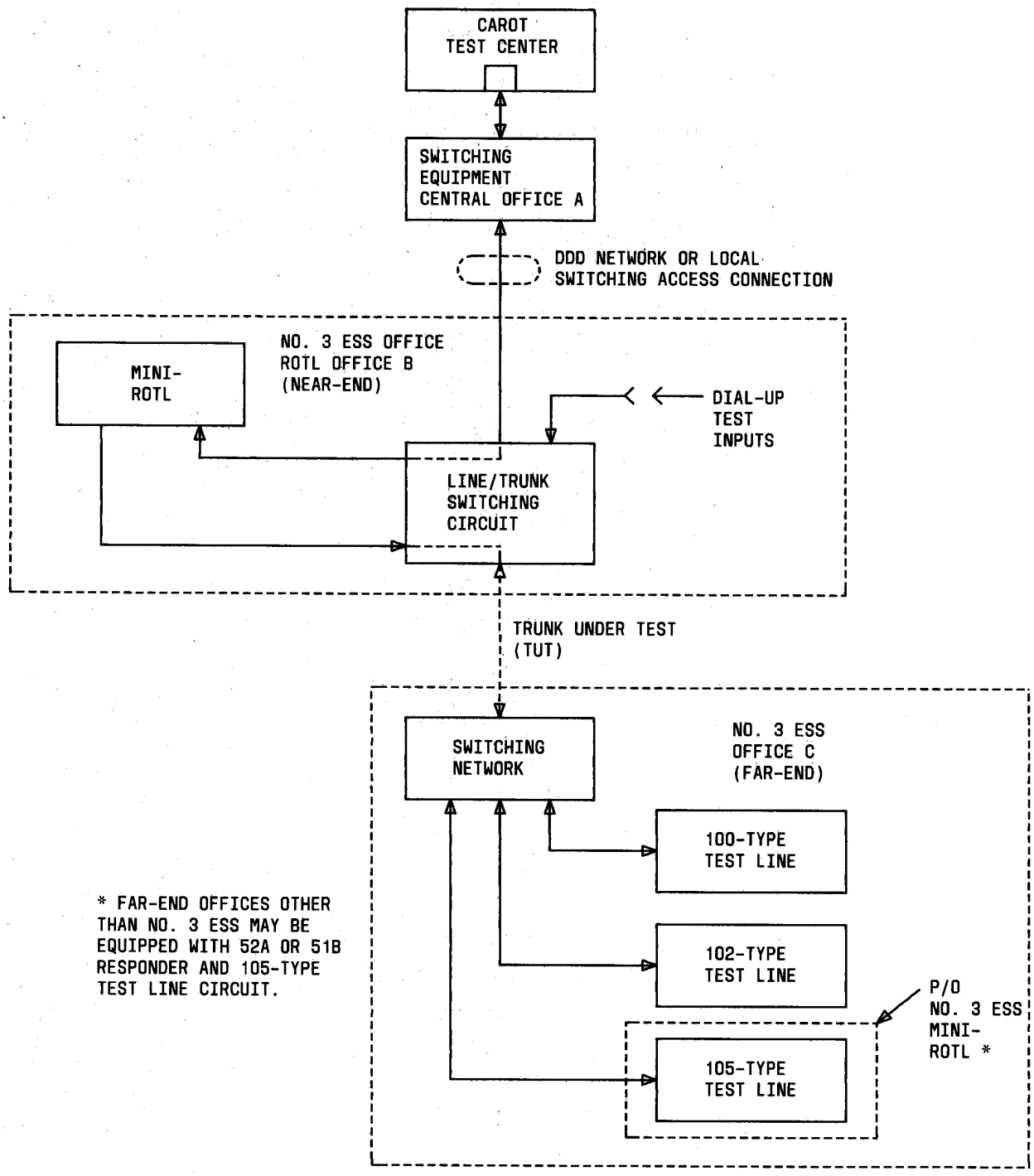


Fig. 1—No. 3 ESS ROTL Application

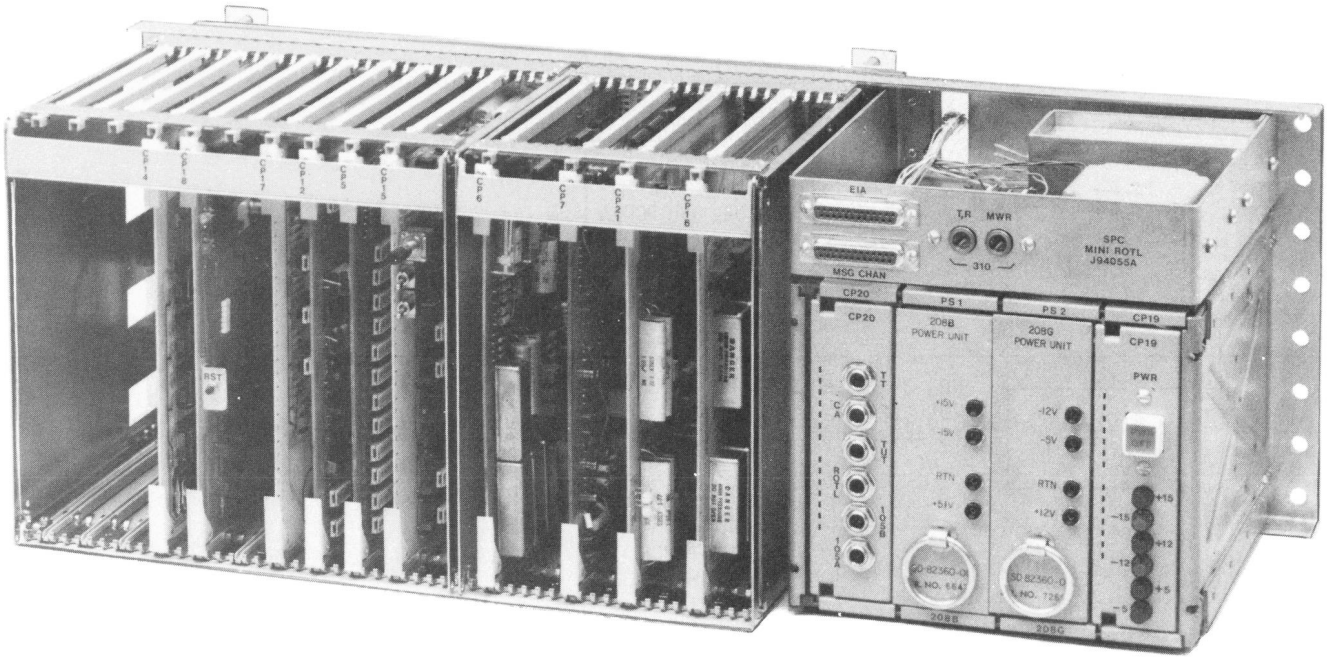


Fig. 2—Front Panel View of No. 3 ESS Mini-ROTL

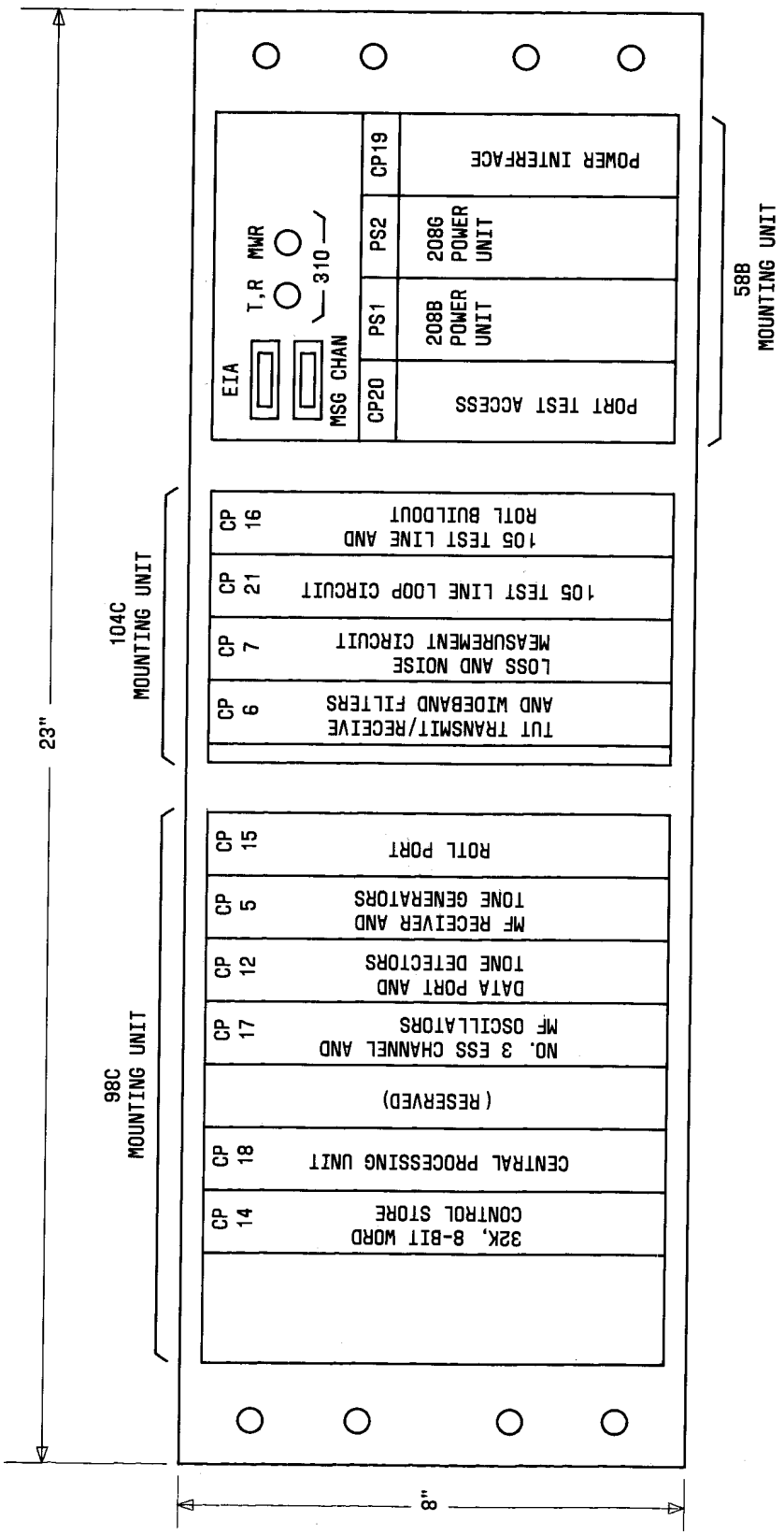


Fig. 3—Circuit Pack Locations for No. 3 ESS Mini-ROTL

ROTL USAGE			DIGITS TRANSMITTED TO ROTL MF RECEIVER																					
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	22
TRANSMISSION TESTS		100-TYPE	KP	0	0	* TRUNK STATE	GROUP NUMBER			MEMBER NUMBER			⎧FAR-END TEST LINE NUMBER (11 DIGITS MAX)⎫										[ST]		
		102-TYPE	KP	0	2																				
		105-TYPE	KP	0	5																				
	OVERRIDE MADE-BUSY	100-TYPE	KP	1	0																				
		102-TYPE	KP	1	2																				
		105-TYPE	KP	1	5																				
BALANCE AND LONG TERM TESTS			KP	4	0																				
	OVERRIDE MADE-BUSY		KP	4	1																				
MAKE-BUSY & RESTORE	MAKE TRK REMOTE BUSY		KP	5	0								ST												
	RESTORE TRUNK REM BUSY		KP	5	1																				
TRUNK STATUS REQUEST	INDIVIDUAL TRUNK		KP	5	2																				
	TRUNK GROUP BY TRUNK		KP	5	3																				
	TRUNK GROUP BY GROUP		KP	5	4					ST															
CALL-BACK UNLOCK REQUEST			KP	5	5	ID	ST																		
CONNECTION APPRAISAL	100-TYPE		KP	6	0	⎧FAR-END TEST LINE PROBE NUMBER (12 DIGITS MAX)⎫							[ST]												
	102-TYPE		KP	6	2																				
	105-TYPE		KP	6	5																				
MF RECEIVER TEST			KP	7	6	1	2	3	4	5	6	7	8	9	0	ST									

*
0 = LOCAL (CURRENT REQUIRED VALUE)
1 = BYPASS (RESERVED BUT NOT IMPLEMENTED)

Fig. 4—Digit Format for No. 3 ESS ROTL—Test Priming Information

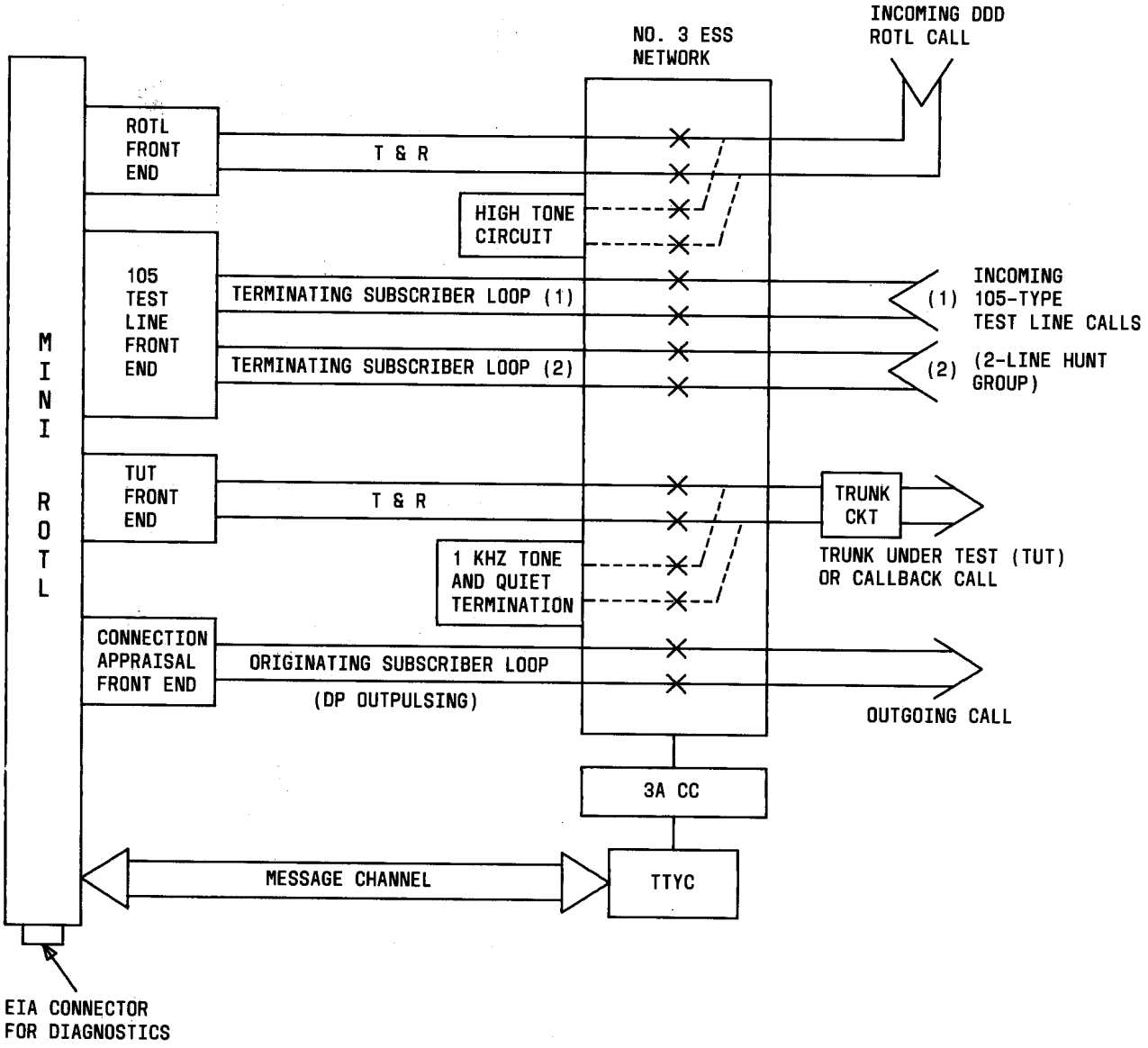


Fig. 5—No. 3 ESS ROTL Functional Diagram

Most Significant Digit	Column	Row	Least Significant Digit 0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
		Binary bits 4321	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
		Binary bits 8765																
0		*P000	NUL	SOH	STX	ETX	EOT	ENQ	ACK	BEL	BS	HT	LF	VT	FF	CR	SO	SI
1		*P001	DLE	DC1	DC2	DC3	DC4	NAK	SYN	ETB	CAN	EM	SUB	ESC	FS	GS	RS	US
2		*P010	SP	!	"	#	$	%	&	'	(	)	*	+	,	−	.	/
3		*P011	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4		*P100	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5		*P101	P	Q	R	S	T	U	V	W	X	Y	Z	[	\	]	^	_
6		*P110	`	a	b	c	d	e	f	g	h	i	j	k	|	m	n	o
7		*P111	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	DEL

NOTES:

1. *P = EVEN PARITY BIT. VALUE DEPENDS ON OTHER BITS. P = 1 IF SUM OF OTHER BITS IS ODD, IF PARITY IS NOT USED, P = 1 ALWAYS.
2. HANDWRITTEN SEQUENCE OF BITS: MSB P 7 6 5 4 3 2 1 LSB (MINI-ROTL TRANSMITTED CHARACTERS USE P = 0 EXCEPT FOR CHARACTER COMPLEMENTS WHERE P = 1)
3. TRANSMITTED SEQUENCE (8/11 CODE): LSB START 1 2 3 4 5 6 7 8 MSBP STOP STOP → TIME
4. LOGIC 0 = "SPACE", LOGIC 1 = "MARK"
5. THE FOLLOWING CONTROL CODES ("FUNCTION" CODES) ARE OPERABLE ON MOST TELETYPEWRITER MODELS:
   CR CARRIAGE RETURN LF LINE FEED HT HORIZONTAL TAB VT VERTICAL TAB BEL SIGNAL BELL

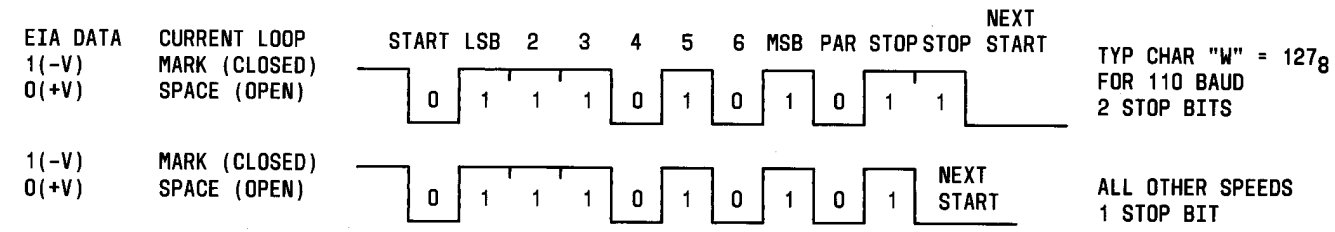
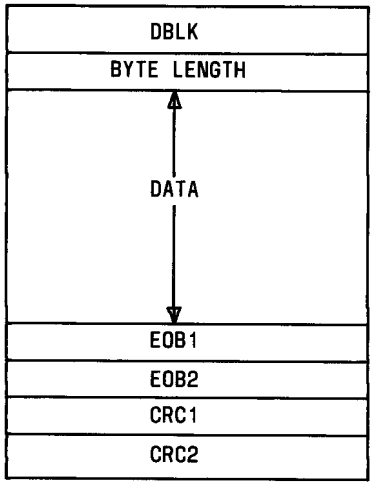


Fig. 6—ASCII Character Format



DATA TERMINAL PRINTOUT OF DATA BLOCK
MESSAGE APPEARS AS FOLLOWS:

f (BYTE LENGTH)† [PRIMING DIGITS] (NUL)* (RS)* (CRC 1)† CRC 2)†

DBLK = 66 (HEX) - ASCII f

BYTE LENGTH = N - AN 8-BIT BINARY NUMBER SPECIFYING NUMBER OF DATA CHARACTERS PLUS 6 (MAXIMUM 68 BYTES) (MAXIMUM 26 BYTES FOR MINI-ROTL)

DATA - 7-BIT ASCII VALUES FOR NUMERICAL PRIMING DIGITS WITH PARITY BIT ALWAYS ZERO

EOB1 = Ø - ASCII (NUL)
EOB2 = 1E (HEX) - ASCII (RS)
CRC1 = CYCLIC REDUNDANCY CODE - LOW BYTE
CRC2 = CYCLIC REDUNDANCY CODE - HIGH BYTE

NOTE: Ø = ZERO
O = LETTER
* INDICATES NONPRINTING CHARACTER
† MAY BE PRINTING OR NONPRINTING CHARACTER

Fig. 7—TTY Channel Data Block Message Format

TABLE A

NO. 3 ESS ROTL FEATURES

FEATURE	MEASUREMENT CAPABILITY/DESCRIPTION
1. Trunk Transmission Tests	New 100-Type Test Line — Far-to-near 1 kHz loss. — Near-end noise. 102-Type Test Line — Far-to-near 1 kHz loss. 105-Type Test Line — Two-way 1 kHz loss (0 dBm0). — Two-way noise. — Noise with tone. — Gain slope (—16 dBm0 loss at 404 Hz, 1004 Hz, and 2804 Hz). — Class 5 office return loss sequence.*
2. Connection Appraisal Tests	New 100-Type Test Line — Far-to-near 1 kHz loss. — Near-end noise. 102-Type Test Line — Far-to-near 1 kHz loss. 105-Type Test Line — Two-way 1 kHz loss (0 dBm0). — Two-way noise. — Noise with tone. — Gain slope (—16 dBm0 loss at 404 Hz, 1004 Hz, and 2804 Hz). — Class 5 office return loss sequence.*
3. Hit Detection	ROTL monitors for a change in far-end trunk supervision from off-hook to on-hook during tests on outgoing or 2-way trunks to new 100-type and 105-type test lines.
4. Balance and Long Term (BALT) Test	Provides a sequenced 1 kHz tone and quiet termination.
5. Remote Trunk Make-Busy and Restore	"Made-busy" means the trunk is in the remote maintenance busy condition. "Restored" means the remote maintenance busy condition has been removed from the trunk.
6. Security Callback Unlock	Provides security against unauthorized use to make trunks busy or restore trunks to service.
7. Trunk Make-Busy Status Request	Determines the maintenance busy status of a specific trunk, or the maintenance busy count status of a specific trunk group.

*This sequence provides the termination and dialogue required to permit return loss measurements to be conducted by a responder equipped with the return loss measurement option at the other end of the trunk under test. The Mini-ROTL performs no actual return loss measurements but instead returns a minimum data measurement signal at the appropriate time.

TABLE B

DIVISION OF ROTL FUNCTIONS BETWEEN NO. 3 ESS AND MINI-ROTL

No. 3 ESS Functions

1. Provide all call switching functions including trunk under test (TUT) seizure.
2. Provide all supervisory functions on both incoming and outgoing connections including indication or notification of disconnect.
3. Establish message channel.
4. Provide tone and termination circuit for TUT and high-tone termination for incoming ROTL call during BALT sequence.
5. Perform security callback using stored directory number identified by single user digit.
6. Perform trunk make-busy and restore operation.
7. Provide 2-line terminating hunt group for incoming 105-type test line calls.
8. Monitor TUT for supervisory hits on tests to 100-type and 105-type test lines.

Mini-ROTL Functions

1. Provide continuity conditions for No. 3 ESS connections.
2. Receive and decode MF priming from control.
3. Receive recycle and disconnect commands from control.
4. Provide tone detector function for call disposition reporting.
5. Report test sequence progress and call disposition to control location.
6. Provide test progress tone for calls terminated and waiting to be served.
7. Perform subscriber line call origination functions for connection appraisal.
8. Perform subscriber line call terminating functions for incoming 105-type test line calls.
9. Provide diagnostic program for testing itself.
10. Provide the basic measurement functions in the same format as the 52-type responder.

TABLE C

MESSAGES TRANSMITTED FROM MINI-ROTL TO 3A CC

MESSAGE NAME	ASCII CHARACTERS W	ASCII CHARACTERS $\overline{W}$	DEFINITION
ACK	O	Ø	Message received and defined.
BHM	M	2	Begin monitoring for supervisory hits.
CHT	I	6	Connect incoming BALT call to high tone circuit and assume control of BALT call.
CRS	C	<	Continuity conditions are set on TUT front end.
CTQ	Q	.	Connect BALT trunk (TUT) to tone-and-quiet termination circuit.
DGN	G	8	ROTL request is for diagnostic procedures.
DRR	D	;	Disconnect incoming ROTL call and reset.
HRR	H	7	Report hit detection status for TUT and reset ROTL.
RMB	B	=	Trunk make-busy request via responder command.
RR	R	-	Reset all ROTL test request connections and parameters.
SQZ	L	3	Major sequence error—both units clear everything.
SSR	S	, (comma)	Report TUT supervisory state.

Note: An 8-bit character is used. The eighth bit normally used for parity, is always "zero" in the character (W) and always "one" in the complement ($\overline{W}$).

TABLE D

DATA BLOCK MESSAGES TRANSMITTED FROM MINI-ROTL TO 3A CC (DBLK)

MESSAGE NAME	ASCII CHARACTERS	DEFINITION
MBT	[Data Bytes (Fig. 7) consist of ASCII characters corresponding to the digits received (Fig. 4) with KP and ST deleted.]	Trunk make-busy or restore request (trunk data).
SCB		Security callback request (caller ID).
STT		Trunk busy status request (trunk data).
TTT		Trunk test (test data).

TABLE E

MESSAGES TRANSMITTED FROM 3A CC TO MINI-ROTL

MESSAGE NAME	ASCII CHARACTERS		DEFINITION*
	W	$\overline{W}$	
AKK	Ø	O	Message acknowledged.
ASN	9	F	No answer supervision (on-hook) received on TUT.
ASR	8	G	Answer supervision (off-hook) received on TUT.
CSD	Λ	!	Callback setup denied.
DUM	?	@	Input error (do not understand message).
GLB	ℒ	(DC3)	Trunk group MB count at or above the limit.
GSB	s	(FF)	Trunk group MB count greater than zero, less than limit.
GZB	z	(ENQ)	No trunks in group are in MB count.
IDI	5	J	User make-busy ID ***not*** currently valid.
IDV	)	V	User make-busy ID ***is*** currently valid.
MBX	x	(BEL)	Trunk has been made maintenance-busy, limit exceeded.
MBY	m	(DC2)	Trunk has been made maintenance-busy.
MCC	<	C	Message channel is connected.
NPA	7	H	No path available from TUT to TUT port or to tone and quiet circuit.
NXA	\	#	No transmitter available.
NXP	[	$	No transmitter path available.
PND	#	\	TUT port not defined.
PTC	4	K	Place continuity on TUT port.
RCC	-	R	ROTL call is connected.
RCD	;	D	ROTL call is disconnected.
RLM	”	]	Request refused because limit has been reached.
RSB	e	(SUB)	Trunk is service busy—request refused.
RTI	k	(DC4)	Trunk is restored to idle.
RTS	c	(FS)	Request refused because of trunk state.
SQX	3	L	Major sequence error—both units clear everything with no wait for acknowledgment.
TCC	+	T	TUT port connection is made.
TCN	a	(RS)	Transient call record not available.
THD	6	I	Hit detected on TUT.
TGD	$	[	Priming trunk group and translations trunk group differ.

* The Mini-ROTL ignores the parity bit on received characters.

TABLE E (Contd)

MESSAGES TRANSMITTED FROM 3A CC TO MINI-ROTL

MESSAGE NAME	ASCII CHARACTERS		DEFINITION*
	W	$\overline{W}$	
THF	' (apos.)	X	TUT connection setup hardware failure.
THN	:	E	No hit detected on TUT.
TMB	b	(GS)	Trunk is in MB count.
TNB	i	(SYN)	Trunk is not in MB count.
TPB	&	Y	TUT port is not available (OOS).
TQB	(	W	Tone and quiet circuit not available.
TQC	.	Q	BALT TUT is connected to tone and quiet.
TUN	%	Z	TUT is unseizable (busy, etc).
TUS	, (comma)	S	TUT is seized.

* The Mini-ROTL ignores the parity bit on received characters.

TABLE F

ERROR MESSAGES RETURNED ON RECEIPT OF RING FORWARD SIGNAL

DATA BURST (ms)	NOISE MEASUREMENT VALUE*	MESSAGE NAME	DEFINITION
9	18	—	No additional information.
17	22	DUM	Input error (do not understand message).
25	26	WTR	Wrong tone received.
33	30	TUN	TUT is unseizable (busy, etc).
41	34	TPB	TUT port is not available.
49	38	NPA	No path available to TUT port or tone/quiet circuit.
57	42	NXA	No transmitter available.
65	46	NXP	No transmitter path available.
73	50	THF	TUT connection setup hardware failure.
81	54	TQB	Tone and quiet circuit not available.
89	58	ASN	No answer supervision received on TUT.
97	62	PND	TUT port not defined.
105	66	RTS	Request refused because of trunk state.
113	70	TCN	Transient call record not available.
121	74	RSB	Request refused—trunk is service busy.
129	78	NCB	No security callback successfully completed.
137	82	RLM	Refused because busy limit has been reached.
145	86	CSD	Callback setup denied.
153	90	TGD	Priming and translation trunk groups differ.

*A manual control device can obtain these error messages by sending a "near-end noise measurement request—small ROTL" and receiving these displayed values.