TAS Apollo 802
ISDN Emulator
Operations Manual

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This manual applies to Apollo Software Cartridge: AT&T 1.02, NT 1.01

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FEEDBACK...

We welcome any comments, suggestions, or questions you may have concerning this manual. In addition to the items listed below, please feel free to mention any other topic or area of concern that is of interest to you.

1. Did you find this manual useful and informative?

2. Was the manual easy to follow?

3. Did you require additional information that was not contained in this manual? If so, please tell us what information can be added to assist you.

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5. Did you feel the information in this manual was correct from a technical standpoint? If not, what areas can be improved and/or adjusted?

6. Please indicate any other comments or suggestions.

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ABOUT THIS MANUAL...

This manual contains all the information you need to install and operate the TAS Apollo 802 ISDN Emulator. The manual is structured as follows:

The **Introduction** section provides an overview of Apollo features and functions, and details the Apollo installation procedure. Be sure to read this section before operating the unit.

The **Local Operation** section describes the Apollo front panel and menus in detail, and describes the procedures for placing end-to-end calls, injecting impairments, and performing BERT tests. This section also contains sample test procedures.

The **Menu Reference** section contains detailed information about each Apollo menu parameter. The organization of this section matches the Apollo menu structure to facilitate easy reference.

The **Remote Operation** section describes the Apollo GPIB and RS-232 remote control interfaces. This section provides an overview of the Apollo command set and command syntax, and contains sample remote control procedures. This section also documents the RS-232/GPIB Command Translator feature.

The **Remote Commands Summary** section contains a quick reference to the entire Apollo command set and a detailed reference for each command. This section documents the format of each command, and contains examples of command usage.

The **Error Codes** section documents the status codes that you may encounter while using the Apollo.

The **Technical Specifications** section contains detailed specifications and connector pin assignments.

The **Glossary** contains a list of telecommunications industry acronyms.

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1.0. INTRODUCTION

1.1. Overview

The TAS Apollo 802 ISDN Emulator provides end-to-end ISDN switching capability along with bit oriented impairments, such as framing errors and D-echo (E-bit) manipulation. Apollo 802 effectively tests ISDN TA/TE devices, such as ISDN telephones and ISDN terminal adapters. By combining switching capability with impairments, Apollo dramatically reduces the cost and complexity of ISDN TA/TE test configurations.

1.2. Apollo Features

ISDN Network Simulation - Apollo provides two NT terminations for ISDN TA/TE access, and supports switching functionality for end-to-end call placement. Switching functionality makes it easy to conduct performance testing of ISDN CPE devices and verify call control software.

Network Impairments - Apollo provides two network impairments to test conformance to CCITT I.430 standards. These impairments are framing errors and E-bit manipulation. Injecting framing errors corrupts the frame synchronization required by ISDN CPE devices. E-bit manipulation provides user-programmability of the D-echo bit channel. These features allow I.430 conformance testing to be performed quickly and easily. Apollo 802 also allows manual control over the I.430 Activation/Deactivation sequence.

Built-In NT Status Monitor - Apollo displays the network states for each NT termination. The displays indicate Layer 1 network states (G states) and indicate when Layer 2 (LAPD) is established.

Built-In Call Progress Monitor - The built-in call progress monitor displays network side Q.931 call states for easy verification of terminal software operation.

B and D Rear Panel I/O - Rear panel access allows B channel monitor/insertion capability and D channel monitor capability. Independent digital ports exist for the B and D channels, as well as an analog port for B channel information.

S/T Line Monitor and S/T Trigger - The S/T line monitor supports oscilloscope connection. This port allows monitoring of the 192 kb/s bit stream on the ISDN S/T interface. The S/T trigger is programmable, which enables you to zoom in on any section of the bit stream.

Remote Control - RS-232 and IEEE-488 (GPIB) control are standard with Apollo. Remote control commands are simple and easy to use, and are the same regardless of the remote control method. This makes it easy to include Apollo in automatic test systems.

RS-232/GPIB Command Translator - Apollo can act as the GPIB controller in an automatic test system. The controller issues commands to Apollo via RS-232, and Apollo controls the rest of the test station via GPIB. This allows any standard PC to act as a GPIB controller without additional GPIB control hardware or software.

Software Cartridge - The feature set for Apollo resides on a plug-in software cartridge. You can easily add new test capabilities and different switches as they become available.

1.3. Apollo Applications

1.3.1. ISDN TA/TE Testing

Figure 1-1 shows a typical Apollo application. In this setup, the Apollo 802 ISDN Emulator provides end-to-end call switching functionality and network impairments that allow extensive ISDN TA/TE testing to be performed. The TAS Gemini 1022 Dual Terminal Emulator performs performance testing on the devices. The PC can be used to remotely control the entire test configuration.

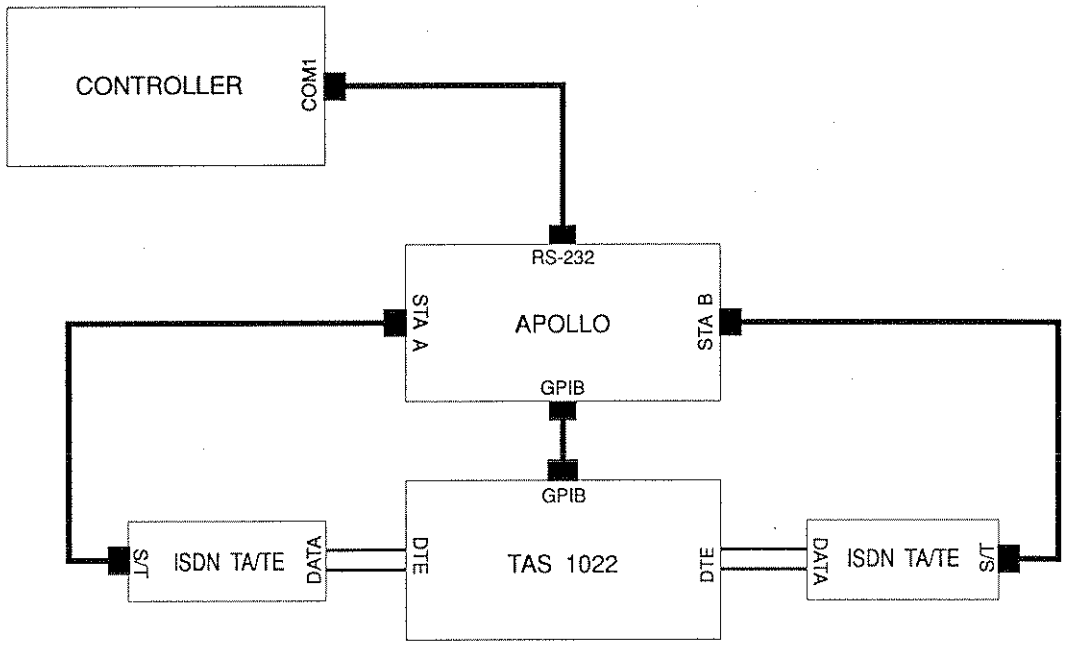

Figure 1-1. Typical Apollo Test Setup

1.3.2. Testing ISDN PC Card Terminal Adapters

Figure 1-2 shows a test setup that uses Apollo to perform BERT testing on an ISDN PC card terminal adapter. In this configuration, the TAS 1022 Dual Terminal Emulator performs BERT testing between the device under test and the Apollo rear panel. Rear panel I/O allows data transmitted (received) from the ISDN device to be received (transmitted) via the rear panel. These connections can be made after end-to-end call setup is completed.

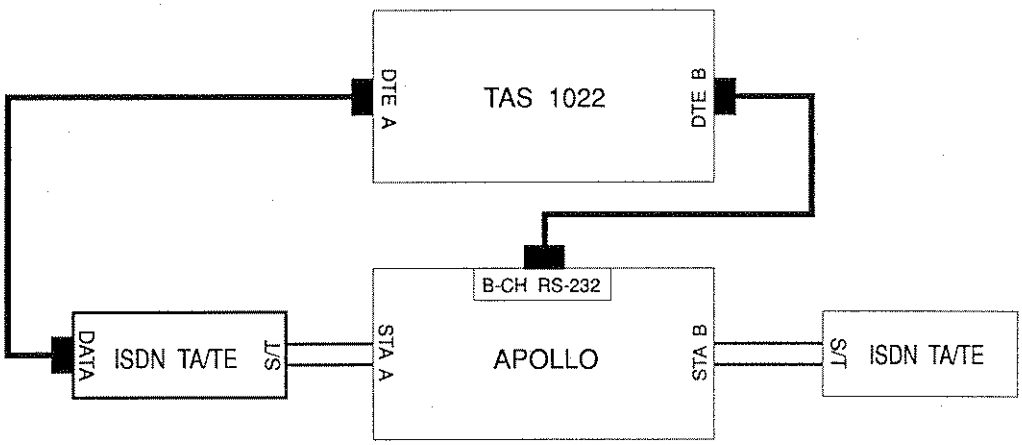

Figure 1-2. Testing ISDN PC Card Terminal Adapters

1.3.3. S/T Line Monitoring

Figure 1-3 shows Apollo configured for monitoring the 192 kb/s S/T line signal. Both transmit and receive directions can be displayed for full diagnostic capabilities. A programmable trigger allows you to zoom in on bits you want to view.

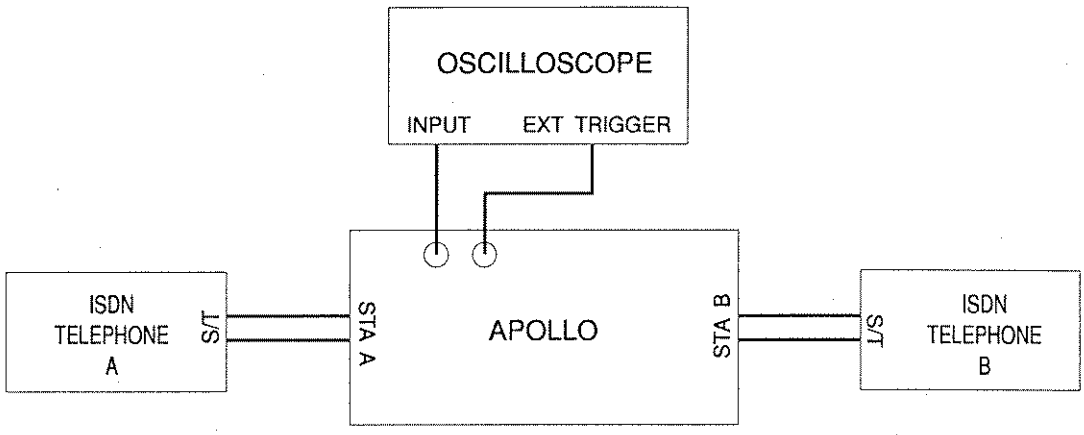

Figure 1-3. S/T Line Monitoring

1.3.4. ISDN TA/TE Analog Testing

Apollo's analog input/output allows the testing of transmit and receive frequency responses using the continuous spectrum or sinusoidal method per IEEE P269. Figure 1-4 and Figure 1-5 illustrate how the continuous spectrum measurement is made. Apollo's internal codec acts as the reference codec in these configurations.

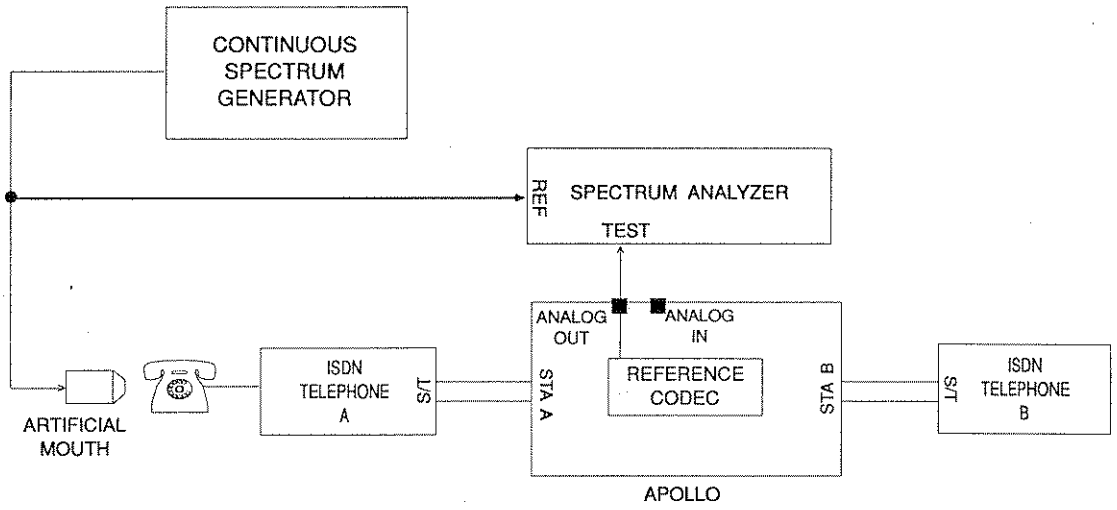

Figure 1-4. Measuring Transmit Frequency Response

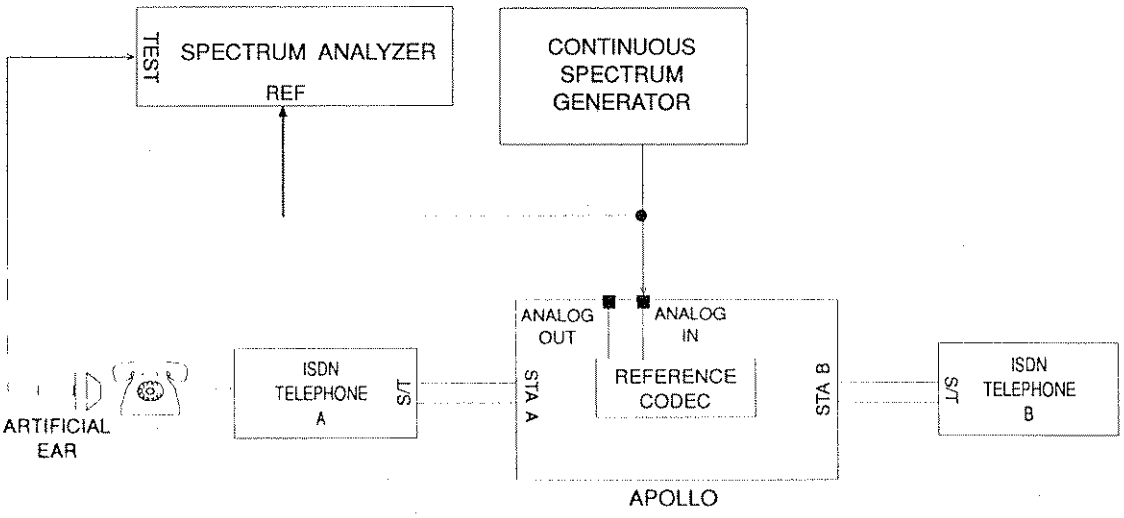

Figure 1-5. Measuring Receive Frequency Response

1.3.5. Protocol Analysis

Apollo allows protocol analysis to be performed using protocol analyzers that do not have an S/T interface. This is shown in Figure 1-6. In the illustration, the test setup is using Apollo's rear panel for protocol analysis. In this configuration, D channel information associated with one station's ISDN TA/TE is transmitted to an external protocol analyzer via the rear panel.

NOTE: The B channel protocol analysis may be performed in a similar manner.

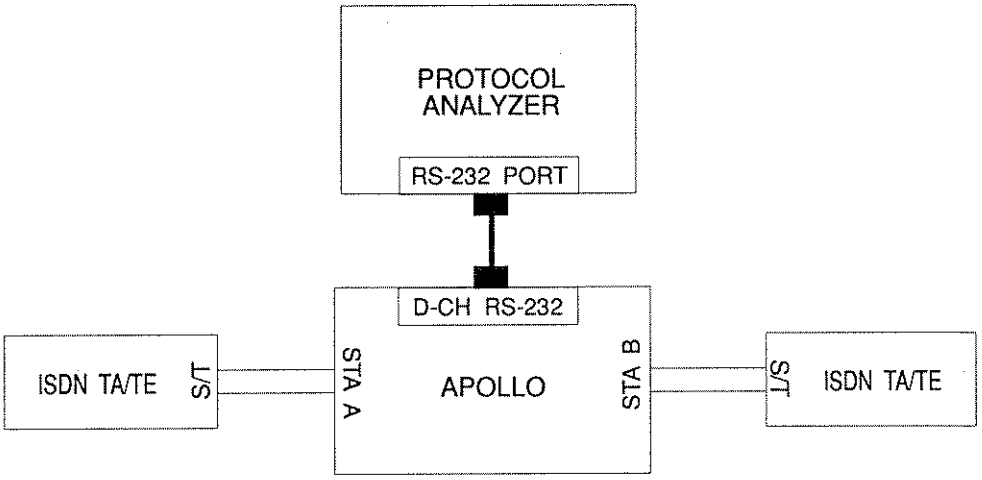

Figure 1-6. Rear Panel Protocol Analysis

1.4. Guided Tour

The front panel keys and displays provide access to most of Apollo's features. You can configure network options, inject impairments, and save and recall test configuration files by using the front panel.

1.4.1. Front Panel Description

Figure 1-7 shows the Apollo front panel. The following section describes each front panel feature.

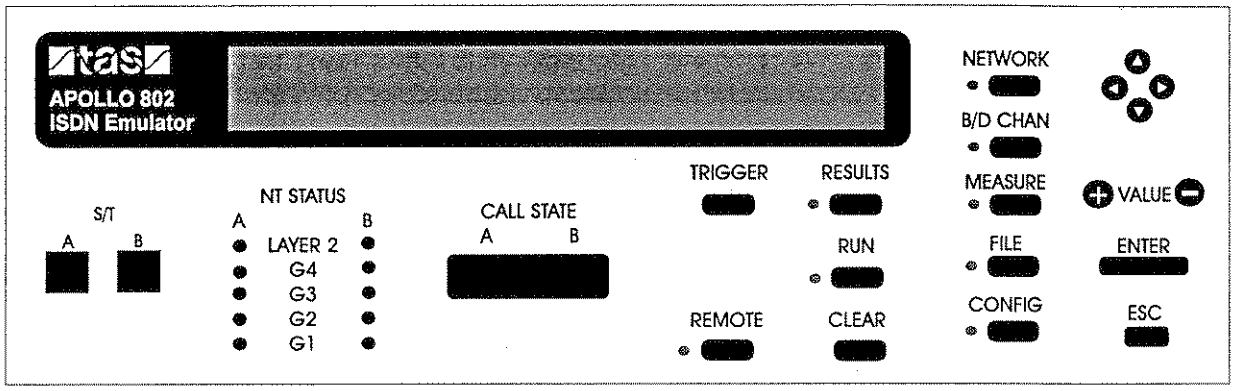

Figure 1-7. Apollo Front Panel

The MAIN DISPLAY shows all control menus and test results.

The NT STATUS MONITOR provides network side Layer 1 (G- state) status and Layer 2 (LAPD) establishment indication for each NT termination. The Layer 2 LED is illuminated when the network responds to a SABME message from an ISDN TA/TE.

The CALL STATE display indicates the network side Layer 3 state throughout the life of a call. These states change as a result of the network sending/receiving Q.931 messages. These states are listed below and described in the following section.

- **NULL** indicates that a call does not exist.
- **INIT** (Bellcore National ISDN, CCITT, and Northern Telecom) indicates that Apollo has received a setup request, but has not yet determined if more call establishment information is required.
- **OVLP** indicates that Apollo has received some call establishment information, but not all that is required.
- **OTCP** indicates that Apollo has received all required call establishment information, and is attempting to place the call.

- **DLVD** indicates that the call has been delivered and end-user alerting has begun.
- **PRES** indicates that Apollo has sent a setup message to the end user, but no reply has yet been received.
- **RECD** indicates that a call has arrived and end-user alerting has begun.
- **CNRQ** indicates that the network has received a CONNect message from the user, but has not responded.
- **INCP** indicates that the end user has acknowledged receipt of the information required for the call to proceed, and Apollo is awaiting further response.
- **ACT** indicates that end-to-end communication exists.
- **DISC** indicates that either the user or the network has requested that the call be disconnected.
- **REL** indicates that the network has initiated the release of the call (i.e., disconnected the B channel) and is awaiting user acknowledgment.
- **ABRT** (CCITT, Northern Telecom and NPN) indicates that Apollo received a disconnect request after it presented a call to the end user, but before the end user responded.

The MODULAR JACKS located at the lower left side of the panel are the access ports for ISDN TA/TE devices.

The NETWORK key selects the **NETWORK** menu. This menu allows selection of network configuration parameters, such as B channel allocation, phone number, and TEI assignment. It also allows selection of network impairments.

The **B/D CHAN** menu controls the source of data destined for ISDN TA/TE B and D channels, or rear panel ports. For example, the source of the data destined for an ISDN TA/TE B channel may come from a far-end ISDN TA/TE B channel, an external piece of equipment connected to the rear panel, an internally generated signal, or the near-end ISDN TA/TE B channel itself (loopback). The rear panel sources can come from any of the B or D channels.

The **MEAS** menu selects the RMS measurement parameters. These parameters include measured channel, and averaging time. Measurement results are also displayed in this menu.

The FILE key selects the **FILE SAVE/RECALL** menu.

The CONFIG key selects the **CONFIGURATION** menu. This menu displays Apollo software version and status, identifies the ISDN switch, and allows selection of the coding scheme, Apollo operating modes and bus control modes.

The MENU NAVIGATION keys, located at the far right side of the panel, allow you to scroll between lines (up, down) or fields (left, right) of a menu.
The VALUE keys allow you to edit parameter values.

The ENTER key accesses a submenu. An ENTER symbol appears at the right side of each menu item that has a submenu.

The ESC key exits a submenu.

The RESULTS, RUN, and CLEAR keys are reserved for future use.

The TRIGGER key is used to actually inject framing errors onto the transmitted signal.

The REMOTE key enables/disables remote control operation. When remote operation is enabled, menu parameters cannot be changed from the front panel. The menu navigation keys, however, can still be used to view parameter values.

1.4.2. Rear Panel Description

Figure 1-8 shows the rear pannel. The following section provides a description of each feature.

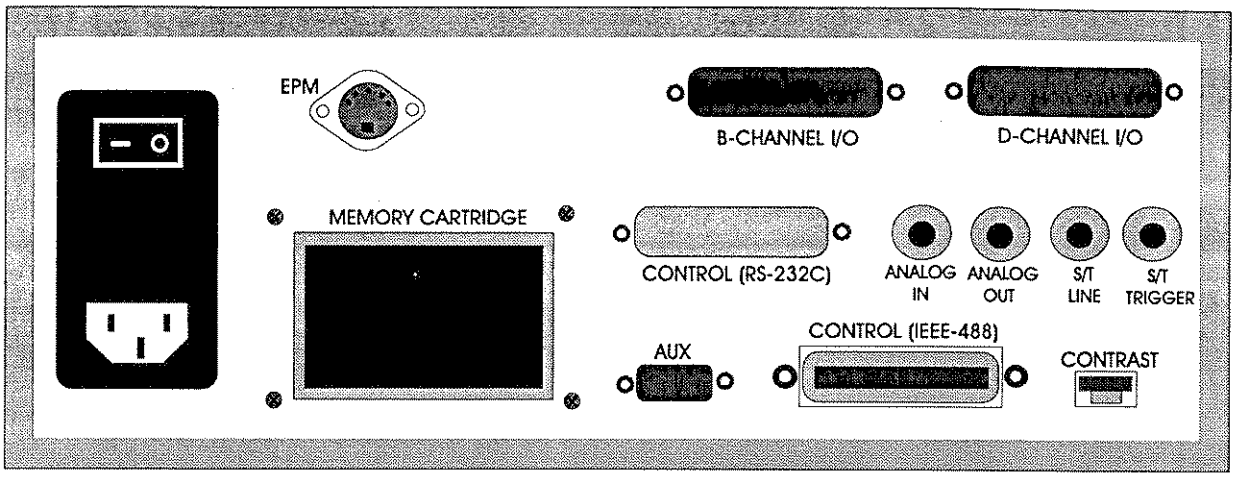

Figure 1-8. Apollo Rear Panel

The B-CHANNEL I/O port provides the interface for external equipment that is receiving or transmitting information from or to an ISDN TA/TE on a B channel. This is an RS-232C port configured as a DCE providing a 64 kb/s clock.

The D-CHANNEL I/O port provides the interface for external equipment that is receiving D channel information from an ISDN TA/TE. This is an RS-232C port configured as a DCE providing a 16 kb/s clock.

The ANALOG OUT port provides the interface for external equipment to receive B channel information in an analog form.

The ANALOG IN port provides the interface for external equipment to supply B channel information in an analog form.

The S/T LINE port provides an oscilloscope interface for monitoring the 192 kb/s S/T line signal.

The S/T TRIGGER port provides a programmable trigger so you can easily focus on a selected group of bits.

The DISPLAY CONTRAST potentiometer controls the intensity of the front panel LCD display.

The CONTROL (IEEE 488) port allows an external GPIB controller to control Apollo. Apollo's RS-232/GPIB translator also uses this port to control other GPIB instruments.

The CONTROL (RS-232C) port allows an external computer to control Apollo via RS-232 Carriage Return/Line Feed or RS-232 ACK/NAK protocol. The AUX port is reserved for future use.

The MEMORY CARTRIDGE port accepts Apollo software cartridges. These cartridges contain the Apollo feature set.

The AC VOLTAGE SELECTION SWITCH permits selection of 90-130 VAC or 180-250 VAC operation.

NOTE: Be certain that the setting of the switch agrees with your local power line.

The AC SWITCH/RECEPTACLE ASSEMBLY contains the AC on/off switch and the AC power connector.

The POWER FEED SOCKET supplies phantom power to the terminal equipment when it is connected to the external power supply.

1.5. Installation

Before you install Apollo, make sure that you have the following items:

- Apollo unit.
- AC power cord (two power cords are provided for hardware models with rear panel Power Feed Socket))
- Apollo software cartridge.
- Operations manual.
- GPIB cable.
- Two RJ 45 (eight contact) cables.

To install Apollo, perform the following steps:

1. Verify the power cord is detached from Apollo, and that the power switch on the upper left side of the rear panel is in the off (**O**) position.
2. For hardware models up to 1.13 (without power feed socket) check the AC voltage selection switch on the upper left side of the rear panel.
3. Verify the setting of this switch is consistent with your AC power source. The **115** setting covers the 90 VAC to 130 VAC range, and the **230** setting covers the 190 VAC to 250 VAC range.

> **WARNING:** This switch must be set properly or serious system damage may occur.
>
> For certain hardware models that are equipped with the rear panel Power Feed Socket, the AC will accept a universal voltage input, which ranges from 85 to 265 VAC.

4. Locate the Apollo software cartridge and insert it into the MEMORY CARTRIDGE slot in the rear panel.
5. Plug one end of the AC power cord into the Apollo.
6. Plug the other end of the AC power cord into the AC source.
7. Set the AC power switch to the on (**-**) position.
8. Apollo now executes its power-up diagnostic sequence, and briefly displays the following message on the MAIN DISPLAY.

```
Apollo 802
ISDN Emulator
```

9. If an error is detected Apollo will show the appropriate status code on the main display. If Apollo has lost the contents of its battery-backed

memory, it will display the following message:

```
Apollo 802
Memory lost, restore from default.
```

10. Press the ESC key to clear the message and restore Apollo's default settings.
11. Consult the *Local Operation* section of the manual for further information. If you intend to use a computer or data terminal to control Apollo, also consult the *Remote Operation* section.

2.0. LOCAL OPERATION

Apollo provides two control options: local and remote. For local control, use Apollo's front panel keys and displays to set up and execute tests. For remote control, attach a computer or terminal to one of Apollo's control interfaces (RS-232 or GPIB) and use the computer or terminal to set up and execute tests. This section of the manual describes the Apollo local operations. The *Remote Operation* section describes the Apollo remote control protocols and commands.

The REMOTE indicator must be off in order to perform local operation. This indicator and the REMOTE key are located on the lower middle section of the Apollo front panel. If the REMOTE indicator is on, press the REMOTE key to turn it off.

2.1. Menus Overview

Apollo provides a convenient and easy-to-use menu structure that accesses all of its functions. Figure 2-1 through Figure 2-6 diagram the Apollo menu structure. The keys on the right side of the Apollo front panel allow you to control the Apollo menus, and the MAIN DISPLAY shows the menu information. Apollo has five main menus: **NETWORK**, **B/D CHAN**, **MEASURE**, **FILE**, and **CONFIG**. Each of these menus is represented by a key on the Apollo panel. To access the associated menu, simply press the key. Use the UP, DOWN, LEFT, and RIGHT menu navigation keys to traverse the selected menu. The + and - keys edit the value of the menu items. The ENTER key accesses a submenu and the ESC key exits a submenu. In summary, the rules for operating the Apollo menus are as follows:

- Press the NETWORK, B/D CHAN, MEASURE, FILE, or CONFIG key to select a menu.
- Press the ENTER key to enter a submenu.
- Press the ESC key to exit a submenu.
- Press the UP or DOWN key to scroll up or down within a menu.
- Press the LEFT or RIGHT key to position the cursor within a menu line.
- Press the + or - key to change the value of the current menu parameter.
- Apollo displays a carriage return symbol at the right side of a menu parameter to indicate that a submenu is present.
- When you return to a menu, Apollo displays the same menu or submenu line that it displayed when you exited the menu.
- If you press the menu key for the currently selected menu, Apollo positions the cursor at the top level and first line of the menu.

2.1.1. Network Menu

Select network configuration parameters and any desired impairment options from the **NETWORK** menu. Configuration parameters are selected from the **CONFIGURATION** submenu, while impairment options are selected from the **IMPAIRMENTS** submenu.

Select network options from the **CONFIGURATION** submenu. These options include assigning telephone numbers, assigning TEI values, selecting B channel allocation, and manipulating the Activation/Deactivation sequences.

Select network impairments from the **IMPAIRMENTS** submenu. The impairments include injecting framing errors and corrupting the D-echo (E) bit.

2.1.2. B/D Chan Menu

The **B/D CHAN** menu allows you to control the source of data destined for an ISDN TE/TA. Under the **B/D CHAN** menu, select which data is transmitted from the rear panel to external equipment.

Select from the **STATION A** submenu the source of data transmitted to an ISDN TE/TA plugged into station A. For example, instead of an end-to-end connection, an internally generated tone may be sent to the device. You can also set up a loopback condition, in which the data transmitted to Apollo on station A, channel B1 is transmitted from Apollo on station A, channel B1. The factory default provides end-to-end connectivity.

Select options from the **STATION B** submenu that are identical to those for station A; these options, however, affect equipment plugged into station B.

From the **REAR PANEL** submenu, select the source of data destined for external equipment connected via the rear panel. Data from either station side may be monitored. Digital output ports allow both B and D channel monitoring. B channel data is also available from an analog port. Select the station you wish to monitor and its corresponding trigger (for oscilloscope monitoring). Some Apollo models also provide a Power Feed socket on the rear panel, which allows for an external power source (see Section 1, "Rear Panel Description").

2.1.3. Measure Menu

The **MEASURE** menu allows you to set the parameters to perform an RMS measurement. These parameters include the averaging time, and the measured B channel. The results of the measurement are also displayed under this menu.

2.1.4. File Menu

The **FILE** menu allows you to save and recall Apollo test setups. Test setups can be user-defined or TAS-defined. User-defined test setups are saved in nonvolatile read/write memory (RAM). TAS-defined setups are stored in read-only memory (ROM). Apollo provides five user-defined files and one TAS-defined file(Factory default).

Apollo allows you to create your own test definitions and save them to RAM files. You can also create and save a label along with each RAM file to help identify the file contents.

Recall TAS-defined and user-defined Apollo test configurations on the RECALL line of the **FILE** menu. Select the file by using the + or - key and pressing

ENTER to recall the file. Apollo prompts you to press ENTER again to recall the file, or to press ESC to return to the menu.

Save Apollo test configurations on the SAVE line of the **FILE** menu. To save a file, use the + or - key to select the target file (**file0** - **file4**). Next, select the LBL field and use the String Editor to enter a label for the file that you wish to save. Finally, press ENTER. Apollo then prompts you to press ENTER again to save the file, or to press ESC to return to the menu.

2.1.5. Apollo Configuration Menu

The **CONFIG** menu allows you to check Apollo operating status, set remote control protocol options and to select the coding scheme. The following section provides a description of the CONFIG menu and each submenu.

The first menu line displays the Apollo status, model number, and software cartridge version. These fields are read-only.

The next menu line is ISDN switch field displays the switch being emulated, as well as the generic release.

SWITCH	GENERIC RELEASE	
CCITT	(Blue Book)	(for CCITT)
DMS -100	(BCS 31)	(for Northern Telecom)
NPN	(INS - NET 64)	(for NPN)
NATL_ISDN -1	(TR268 Issue 3)	(for Natl. ISDN)
SWISS_NET	N/A	(for Switzerland)
NET_3	(ETS 300 102-1)	(for Europe)

Analog Coding allows user to select A-law or μ-law coding for transmitting and receiving data.

Remote Protocol allows you to select one of three options for computer control of Apollo. These options are GPIB (IEEE-488), RS-232 ACK/NAK, and RS-232 CR/LF. The *Remote Operation* section fully details Apollo's remote control capabilities.

PROTOCOL RESPONSE MODE allows you to set Apollo for **verbose** or **terse** command responses. Verbose responses are more readable on the computer-Apollo control link. Terse responses contain fewer characters, simplify command decoding at the computer, and generally result in faster execution of test control programs.

CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: switched
[ENTER] [ESC]
STATION A STATION B
[ENTER] [ESC]
B1: Voice-CSD B2: Voice-CSD
PHONE #: 5550123
TEI ASSIGNMENT: auto
SUPERVISORY SIGNALING ENABLED: yes
ACTIVATE/DEACTIVATE: auto

CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: switched
[ENTER] [ESC]
STATION A **STATION B**
[ENTER] [ESC]
B1: Voice-CSD B2: Voice-CSD
PHONE #: 5559876
TEI ASSIGNMENT: auto
SUPERVISORY SIGNALING ENABLED: yes
ACTIVATE/DEACTIVATE: auto

CONFIGURATION **IMPAIRMENTS**
[ENTER] [ESC]
IMPAIRED/MONITORED STATION: A
E-BIT PATTERN: norm
FRAMING ERRORS: none

Figure 2-1. Network Menu

CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: non-switched
[ENTER] [ESC]
STATION A STATION B
[ENTER] [ESC]
ACTIVATE/DEACTIVATE: auto

CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: non-switched
[ENTER] [ESC]
STATION A **STATION B**
[ENTER] [ESC]
ACTIVATE/DEACTIVATE: auto

CONFIGURATION **IMPAIRMENTS**
[ENTER] [ESC]
IMPAIRED/MONITORED STATION: A
E-BIT PATTERN: norm
FRAMING ERRORS: none

Figure 2-2. NPN Network Menu

STATION A STATION B REAR PANEL
[ENTER] [ESC]
B1 SOURCE SELECTION: manual
[ENTER] [ESC]
B1 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: 10.0 dBm FREQUENCY: 1004 Hz
B2 SOURCE SELECTION: manual
[ENTER] [ESC]
B2 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
D SOURCE: apollo

STATION A **STATION B** REAR PANEL
[ENTER] [ESC]
B1 SOURCE SELECTION: manual
[ENTER] [ESC]
B1 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
B2 SOURCE SELECTION: manual
[ENTER] [ESC]
B2 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
D SOURCE: apollo

STATION A STATION B **REAR PANEL**
B-CH RD SOURCE: ab1
B-CH SRD SOURCE: ab1
D-CH RD SOURCE: atx
ANALOG SOURCE: ab1
MONITOR SOURCE: atx
SYNC.BIT: 1

Figure 2-3. B/D CHAN Menu

LEVEL: ***.* dBm
AVERAGING TIME: 125 ms
MEASURED CHANNEL: ab1

Figure 2-4. MEASURE Menu

RECALL: factory default
[ENTER] [ESC]
Press <enter> to recall setup,
or <esc> to return to previous menu.
SAVE: file0 LBL:
[ENTER] [ESC] (SAVE field)
Press <enter> to save setup,
or <esc> to return to previous menu.
[ENTER] [ESC] (LBL field)
EDIT RANGE: A-Z

Figure 2-5. FILE Menu

STATUS: Ok MODEL: 802 VER: *.** (FOR AT&T)
STATUS: Ok MODEL: 802_NAT VER *.** (FOR BELLCORE NATL ISDN)
STATUS: Ok MODEL: 802_CCITT VER *.** (FOR CCITT)
STATUS: Ok MODEL: 802_NT VER *.** (FOR NORTHERN TELECOMM)
STATUS: Ok MODEL: 802_NPN VER *.** (FOR NPN)
STATUS: Ok MODEL: 802_SWISS VER * ** (FOR SWITZERLAND)
STATUS: Ok MODEL: 802_ NET3 VER * ** (FOR EUROPE)
ISDN SWITCH: SWISSNET 2
ANALOG CODING: mu law
REMOTE PROTOCOL:gpib

ADDRESS: 1
PROTOCOL RESPONSE MODE: VERBOSE

Figure 2-6. CONFIG Menu

2.2. Placing End-to-End Calls

Apollo has factory default settings so that end-to-end calls can be placed immediately. Simply turn the unit on, plug in two ISDN TA/TEs, and begin dialing. The factory default phone number for station A is 5550123. The number for station B is 5559876.

During call origination and tear-down, appropriate network side state changes are visible in the NT STATUS and CALL STATE displays.

2.2.1. Changing Phone Numbers

To change the default phone number settings, enter the **NETWORK** menu, select CONFIGURATION, and press the ENTER key twice. Use the LEFT or RIGHT keys to select the appropriate station. Press the ENTER key again. Use the DOWN key to scroll to PHONE NUMBER. Next, use the LEFT or RIGHT keys to select the digit you wish to change. Use the + or - keys to change the digit value.

A slightly different sequence is required to alter the number of digits contained in the phone number. First, follow the above procedure until PHONE # is displayed. Next, press the ENTER key. This causes Apollo to prompt you for an EDIT RANGE. Two edit ranges are provided; one indicates a string of allowable phone number digits, and the other indicates an ins/del mode. The + and - keys toggle between these choices.

To alter a phone number's length, choose ins/del and press the ESC key. The original phone number is displayed again. To lengthen the phone number, press the + key. To shorten the phone number, press the - key. When the desired length is obtained, press the ENTER key, the + or - key, and the ESC key. You may now assign the desired digit values.

2.3. Injecting Impairments

Apollo provides two types of network impairments for testing ISDN TA/TE devices. These impairments are framing errors and D-echo bit manipulation. FRAMING ERRORS test the ISDN TA/TE's ability to conform to CCITT I.430's frame alignment procedure by removing the second bipolar violation required for synchronization. Apollo provides two distinct framing error modes: continuous and discrete.

In continuous mode, every frame transmitted from Apollo to the ISDN TA/TE contains a framing error. In discrete mode, a preset number of consecutive frames is transmitted with framing errors. This preset number of frames is 1, 2, or 3.

D-echo bit manipulation tests an ISDN TA/TE's ability to conform to CCITT I.430's D-Channel access procedure by allowing you to control the contents of the D-echo bit. Apollo provides two distinct D-echo bit manipulation modes: inverted and predefined.

In inverted mode, Apollo inverts the D channel bit sent by the ISDN TA/TE and inserts the inverted value in the D-echo bit position. In predefined mode, Apollo inserts the appropriate bit of a user-defined pattern in the D-echo bit position. User-defined patterns are in the following form:

```
x # of ones followed by a zero.
```

The value of x ranges from 1 to 15.

2.3.1. Setting the Framing Error Test Parameters

To enter framing error parameters, enter the **NETWORK** menu, select impairments, and press the ENTER key. Next, press the + or - key to select the impaired station. Press the DOWN key until FRAMING ERRORS is selected. Pressing the + and - keys scrolls through the following framing error selections: none, 1, 2, 3, or cont. Select the desired framing error parameter.

If cont is chosen, continuous framing errors are automatically injected onto the chosen station. If you select 1, 2, or 3, the framing errors are injected by pressing the TRIGGER key. When the TRIGGER key is pressed, the corresponding number of consecutive frames is transmitted with framing errors.

2.3.2. Setting the D-echo Bit Manipulation Parameters

To enter D-echo bit manipulation parameters, enter the **NETWORK** menu, select impairments, and press the ENTER key. Press the + or - key to select the impaired station. Now press the DOWN key to select E-BIT PATTERN. Pressing the + and - keys scrolls through the following E-bit pattern selections: norm, inv, 1one, 2one, 3one,.....,15one.

If inv is selected, Apollo inverts the D-channel bit sent by the ISDN TA/TE and inserts it into the E-bit position. If you select one of the preset patterns, Apollo inserts the appropriate bit of the pattern into the E-bit position.

2.4. Performing BERT Tests Using Apollo

Bit Error Rate/Throughput (BERT) testing is a useful method of determining the performance of communications systems. Figure 2-7 shows an example of how Apollo can be used to provide switching functions so BERT testing can be performed between two stand-alone ISDN TA/TE devices.

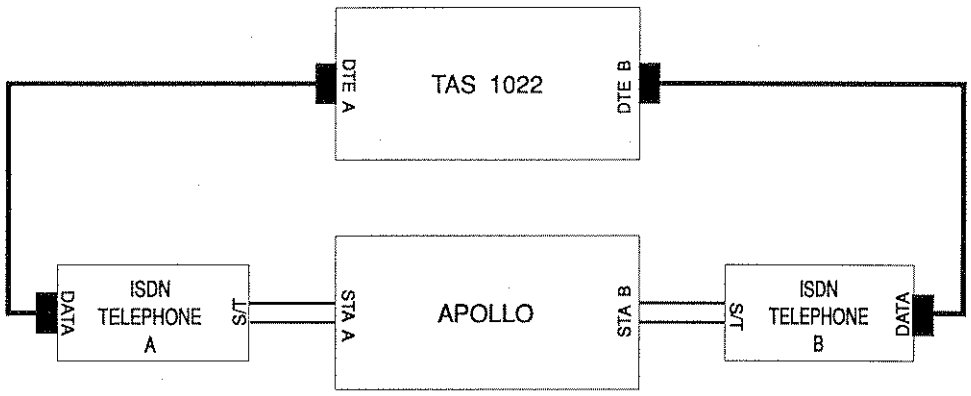

Figure 2-7. BERT Testing With Apollo

For PC plug-in card ISDN TAs, however, this configuration is not always useful because there is no accessible RS-232 port for a BERT tester. Typically, some special arrangement must be made to allow BERT testing. Such arrangements include custom hardware fixtures and software packages. Apollo can help reduce the number of these special fixtures by providing B channel access via the rear panel. This is shown in Figure 2-8.

In Figure 2-8, a TAS Gemini 1022 Dual Terminal Emulator is performing BERT testing. One Gemini port is connected to an aforementioned special test fixture, while the other is connected to the B-CHANNEL I/O connector on Apollo's rear panel. You can configure Apollo so that just before an end-to-end connection is made, a connection is made between one of the stations and the rear panel.

To make this connection, enter the **B/D CHAN** menu, select the station where the device under test is connected, and press the ENTER key. Next, use the UP and DOWN keys to select the B-channel over which the BERT test takes place. Press the + or - key to select MANUAL and press the ENTER key. If channel B1 is selected, a B1 SOURCE: prompt appears. Use the + and - keys to select extd as the B1 source. Press the ESC key twice and use the LEFT and RIGHT keys to select REAR PANEL. Now press the ENTER key.

Next, for the B-CH RD SOURCE, use the + and - keys to select the station and channel over which the BERT test takes place. For example, ab1 refers to station A, channel B1. A connection now exists between one ISDN TA/TE and the rear

panel. This connection exists only after call setup is completed. This configuration can be used to perform BERT testing over any of the B channels. For a complete description of all **B/D CHAN** menu parameters, see the *Apollo Menu Reference* section.

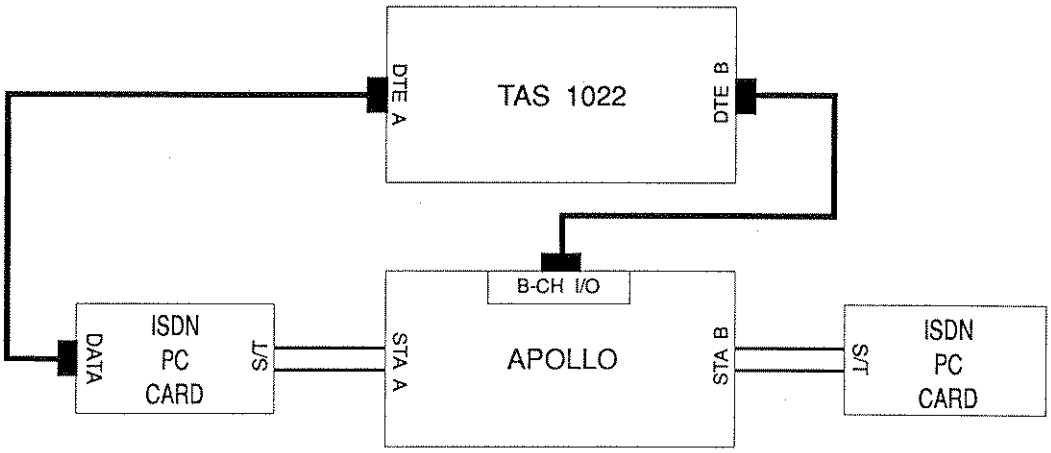

Figure 2-8. APOLLO Rear Panel BERT Testing

2.5. Performing ISDN TA/TE Analog Telephone Tests

Audio/analog tests are required to determine the performance of ISDN telephones. Apollo acts as the NT and the reference codec for ISDN telephone testing.

Figure 2-9 shows the setup for the transmit frequency response measurement using the continuous spectrum method per IEEE P269. Testing may be performed on either ISDN telephone after a call is completed between the telephones.

If the telephone at station A is the device under test, enter the **B/D CHANNEL** menu. Select the **REAR PANEL** submenu and press ENTER. Use the ARROW keys to move to the **ANALOG SOURCE** menu line, and select ab1 (if the telephone is transmitting on channel B1) by using the +/- keys. The ab1 setting directs the voice information that Apollo receives from station A, channel B1, to the Analog Out port on the rear panel.

The ISDN telephone at station B is tested in a similar manner.

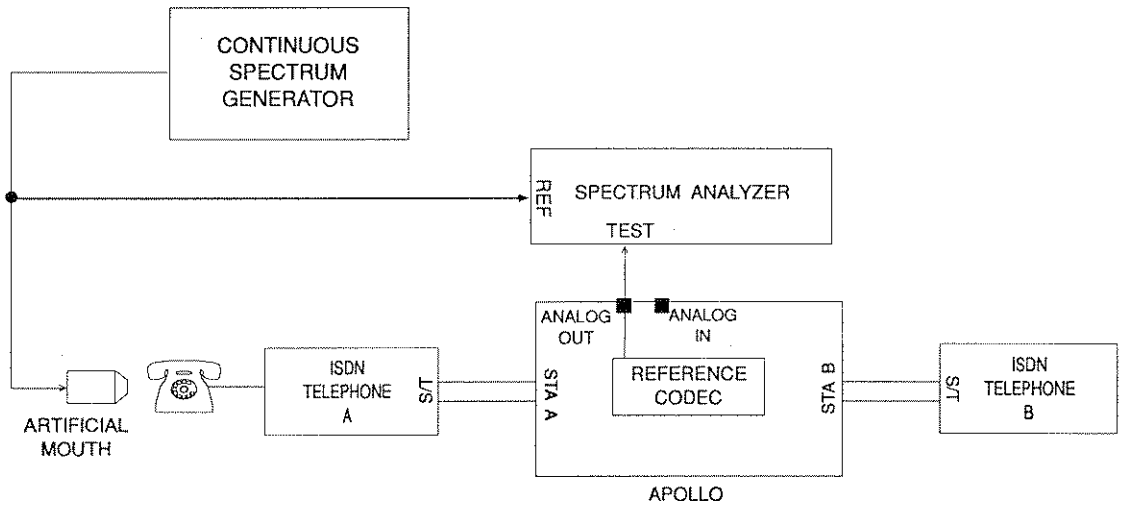

Figure 2-9. Measuring Transmit Frequency Response

Figure 2-10 shows the setup for the receive frequency response measurement using the continuous spectrum method per IEEE P269. Testing may be performed on either ISDN telephone after a call is completed between the telephones.

If the telephone at station A is the device under test, enter the **B/D CHANNEL** menu and select the **STATION A** submenu.

If the telephone receives the call on channel B1, press ENTER and use the ARROW keys to get to the **B1 SOURCE** menu line. At the **B1 SOURCE** menu line, select exa. The exa setting selects the rear panel's Analog In port as the source of information sent to the telephone via channel B1.

The ISDN telephone at station B is tested in a similar manner.

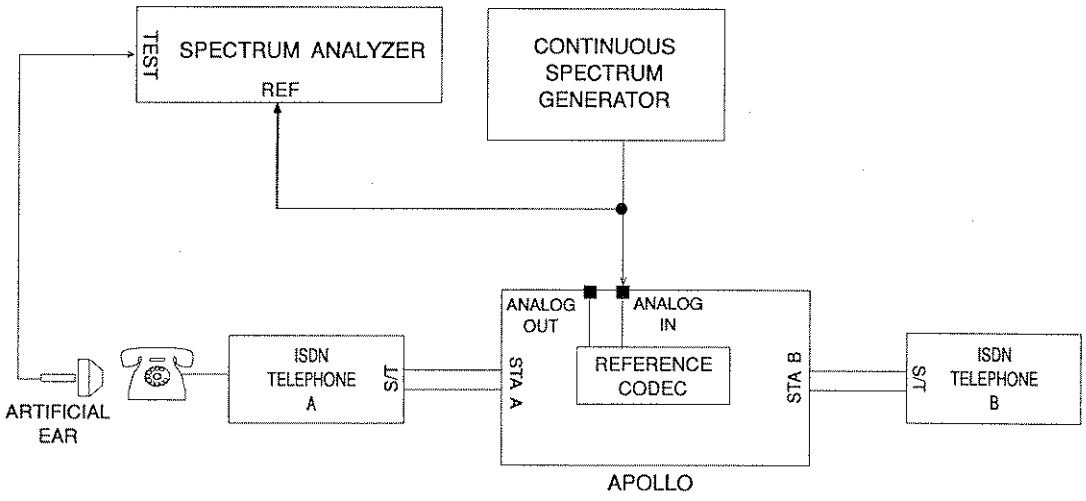

Figure 2-10. Measuring Receive Frequency Response

2.5.1. Performing Protocol Analysis

Apollo provides two ways to support protocol analysis. One method, illustrated in Figure 2-11, requires a protocol analyzer that has an S/T interface.

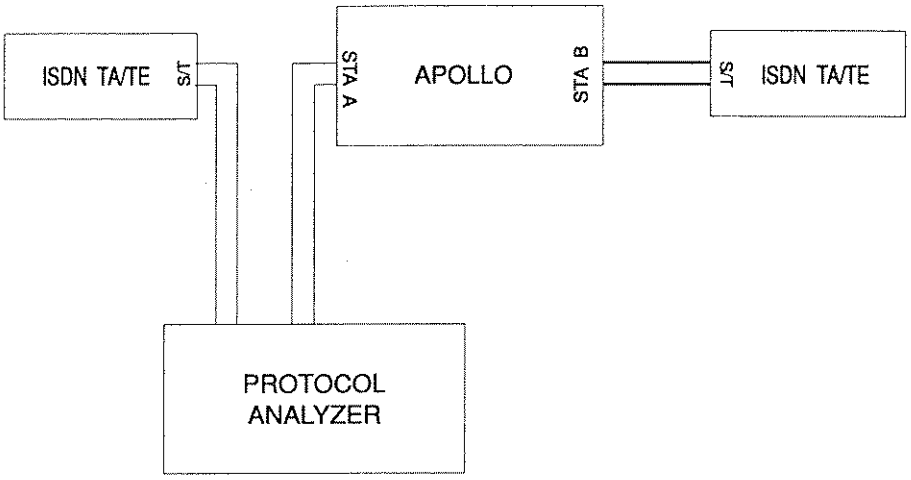

Figure 2-11. Protocol Analysis

As an alternative, Apollo transmits D channel information (associated with one station's ISDN TA/TE) out of the D channel I/O connector on the rear panel. By providing this capability, Apollo allows the use of protocol analyzers that do not have S/T interfaces. This is shown in Figure 2-12.

To get the D channel information out the rear of the unit, enter the **B/D CHANNEL** menu, select **REAR PANEL**, and press the ENTER key. Press the DOWN key twice until **D-CH RD SOURCE** is selected. Use the +/- keys to select the station side and direction of the D channel information you wish to monitor. For example, atx refers to D channel information Apollo is transmitting to station A.

NOTE: B channel protocol analysis may be performed in a similar manner.

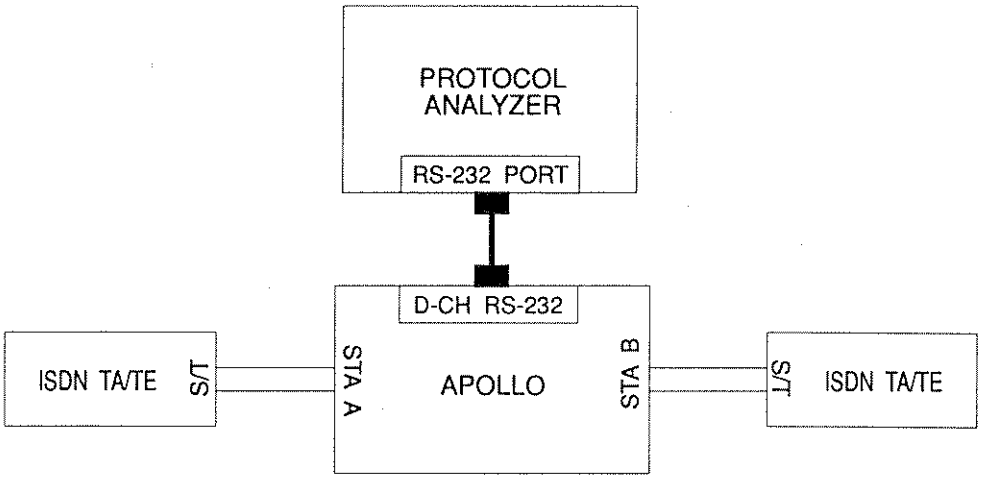

Figure 2-12. Rear Panel Protocol Analysis

3.1. Network Menu

The **NETWORK** menu allows you to select network configuration and impairment options. The **CONFIGURATION** and **IMPAIRMENTS** submenus are under the **NETWORK** menu. Configuration options include such parameters as phone number, TEI value, activation/deactivation status, B channel allocation, and supervisory signaling status. Impairment options include such parameters as E-bit manipulation and framing error injection. Figure 3-1 shows the **NETWORK** menu layout.

CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: switched
[ENTER] [ESC]
STATION A STATION B
[ENTER] [ESC]
B1: Voice-CSD B2: Voice-CSD
PHONE #: 5550123
TEI ASSIGNMENT: auto
SUPERVISORY SIGNALING ENABLED: yes
ACTIVATE/DEACTIVATE: auto

CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: switched
[ENTER] [ESC]
STATION A **STATION B**
[ENTER] [ESC]
B1: Voice-CSD B2: Voice-CSD
PHONE #: 5559876
TEI ASSIGNMENT: auto
SUPERVISORY SIGNALING ENABLED: yes
ACTIVATE/DEACTIVATE: auto

CONFIGURATION **IMPAIRMENTS**
[ENTER] [ESC]
IMPAIRED STATION: A
E-BIT PATTERN: norm
FRAMING ERRORS: none

Figure 3-1. Network Menu

CONFIGURATION IMPAIRMENTS

[ENTER] [ESC]
SIMULATION MODE: non-switched
[ENTER] [ESC]
STATION A STATION B
[ENTER] [ESC]
ACTIVATE/DEACTIVATE: auto
CONFIGURATION IMPAIRMENTS
[ENTER] [ESC]
SIMULATION MODE: non-switched
[ENTER] [ESC]
STATION A **STATION B**
[ENTER] [ESC]
ACTIVATE/DEACTIVATE: auto
CONFIGURATION **IMPAIRMENTS**
[ENTER] [ESC]
IMPAIRED STATION: A
E-BIT PATTERN: norm
FRAMING ERRORS: none

Figure 3-2. NPN Network Menu

3.1.1. CONFIGURATION Submenu

The **CONFIGURATION** submenu allows you to change network configuration parameters, such as telephone numbers and TEI assignments for each station.

SIMULATION MODE displays the simulation configuration. In the switched mode, Apollo makes connections based upon completion of Q.931 call setup message exchanges.

NPN SIMULATION MODE selects the simulation configuration. The selections are switched or non-switched.

In non-switched mode, Apollo disables layer 2 and layer 3 signaling. Two-end-to-end connections are provided: one between Station A, Channel B1 and Station B, Channel B1, and the other between Station A, Channel B2, and Station B, Channel B2.

In the switched mode, Apollo makes connections based upon completion of Q.931 call setup message exchanges.

3.1.2. STATION A Submenu

STATION A submenu selects configuration options for station A. Upon entering the submenu, channel configuration options are displayed. These options are only for the B channels. Options for each B channel selection are **No Service**, **Voice**, **CSD** (circuit switched data), and **Voice\|CSD**.

NOTE: There are no allocation selections for the D channel. Passing of Q.931 signaling information is always supported on the D channel.

PHONE # selects the phone number for this station. Phone numbers consist of a quoted string of up to 20 characters from the character set 012345678*#. The Apollo String Editor, described at the end of this section, may also be used to change the length of a phone number.

TEI ASSIGNMENT selects the TEI assignment mode for this station. Two modes are supported: **auto** and **fixed**. In the **auto** mode, Apollo automatically assigns a TEI value upon ISDN TA/TE TEI Assignment request. In the **fixed** mode, press the ENTER key to enter the **TEI** submenu. You can now select a predefined TEI value that Apollo assigns upon ISDN TA/TE TEI Assignment request. The predefined TEI value ranges from **0** to **126**.

SUPERVISORY SIGNALING ENABLE selects the supervisory signaling status for this station. If yes is selected, supervisory signaling is enabled. If no is selected, supervisory signaling is disabled.

ACTIVATE/DEACTIVATE selects the Activation/Deactivation mode for this station. Allowable parameters are **auto**, **I0**, **I2**, and **I4**. In the **auto** mode, Apollo proceeds through the Activation/Deactivation sequence as specified in CCITT I.430. In the **I0**, **I2**, and **I4** modes, Apollo is transmitting INFO0, INFO2, and INFO4 respectively, regardless of the signal it is receiving.

3.1.3. STATION B Submenu

STATION B submenu selects configuration options for station B. Upon entering the submenu, channel configuration options are displayed. These options are only for the B channels. Options for each B channel selection are **No Service**, **Voice**, **CSD** (circuit switched data), and **Voice\|CSD**.

NOTE: There are no allocation selections for the D channel. Passing of Q.931 signaling information is always supported on the D channel.

PHONE # selects the phone number for this station. Phone numbers consist of a quoted string of up to 20 characters from the character set 012345678*#. The

Apollo String Editor, described at the end of this section, may also be used to change the length of a phone number.

TEI ASSIGNMENT selects the TEI assignment mode for this station. Two modes are supported: **auto** and **fixed**. In the **auto** mode, Apollo automatically assigns a TEI value upon ISDN TA/TE TEI Assignment request. In the **fixed** mode, press the ENTER key to enter the **TEI** submenu. You can now select a predefined TEI value that Apollo assigns upon ISDN TA/TE TEI Assignment request. The predefined TEI value ranges from **0** to **126**.

SUPERVISORY SIGNALING ENABLE selects the supervisory signaling status for this station. If **yes** is selected, supervisory signaling is enabled. If **no** is selected, supervisory signaling is disabled.

ACTIVATE/DEACTIVATE selects the Activation/Deactivation mode for this station. Allowable parameters are auto, I0, I2, and I4. In the auto mode, Apollo proceeds through the Activation/Deactivation sequence as specified in CCITT I.430. In the I0, I2, and I4 modes, Apollo is transmitting INFO0, INFO2, and INFO4 respectively, regardless of the signal it is receiving.

3.1.4. IMPAIRMENTS Submenu

The **IMPAIRMENTS** submenu allows you to select network impairments, such as E-bit manipulation and framing errors.

IMPAIRED STATION selects the station to be impaired. The options are **A** or **B**.

E-BIT PATTERN selects the pattern transmitted in the D-echo bit (E-bit) channel. Parameter values are **norm**, **inv**, and **X ONES followed by a ZERO**, where x ranges from 1 to 15. When **norm** is selected, Apollo transmits (in the E-bit channel) unprocessed D channel information received from the corresponding station. When **inv** is selected, Apollo inverts the D channel information and then transmits it in the E-bit channel. Note that Apollo begins inverting the D channel information only after receiving the opening HDLC flag.

When **X ONES followed by a ZERO** is selected, Apollo transmits a repetitive pattern consisting of X ONES followed by a ZERO. For example, if 7 ONES followed by a ZERO is selected, Apollo is repetitively transmitting an E-bit pattern of 7 ONES, 1 ZERO, 7 ONES, 1 ZERO, etc.

If Apollo receives a D channel message while transmitting a repetitive pattern, Apollo suspends the pattern and returns to normal echo until an idle D channel is detected. Once an idle D channel is detected, Apollo returns to transmitting the repetitive pattern.

FRAMING ERRORS selects the framing error mode. Parameter values are **norm**, **1**, **2**, **3**, and **cont**. If **norm** is selected, framing errors are not introduced. If **1**, **2**, or **3** is selected, then that number of consecutive frames is transmitted with framing errors when the TRIGGER key is pressed. For example, if 2 is selected, two consecutive frames are transmitted with framing errors when the TRIGGER key is pressed. If **cont** is selected, framing errors are introduced into every frame transmitted by Apollo.

3.2. B/D CHAN Menu

The **B/D CHAN** menu controls the source of data destined for ISDN TA/TE B channels, or rear panel ports. For example, the source of data destined for an ISDN TA/TE B channel may come from a far-end ISDN TA/TE B channel, an external piece of equipment connected to the rear panel, an internally generated signal, or the near-end ISDN TA/TE B channel itself (loopback). The rear panel sources can stem from any of the B or D channels.

The **B/D CHAN** menu contains three submenus. The **STATION A** submenu controls the source of B channel data destined for station A, while the **STATION B** submenu controls identical information for station B. The **REAR PANEL** submenu controls the source of data destined for external equipment connected to the rear of the Apollo unit. Figure 3-2 shows the **B/D CHAN** menu organization.

STATION A STATION B REAR PANEL
[ENTER] [ESC]
B1 SOURCE SELECTION: manual
[ENTER] [ESC]
B1 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
B2 SOURCE SELECTION: manual
[ENTER] [ESC]
B2 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
D SOURCE: apollo
STATION A **STATION B** REAR PANEL
[ENTER] [ESC]
B1 SOURCE SELECTION: manual
[ENTER] [ESC]
B1 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
B2 SOURCE SELECTION: manual
[ENTER] [ESC]
B2 SOURCE: int
[ENTER] [ESC]
SOURCE: tone
[ENTER] [ESC]
LEVEL: -10.0 dBm FREQUENCY: 1004 Hz
D SOURCE: apollo
STATION A STATION B **REAR PANEL**
B-CH RD SOURCE: ab1
B-CH SRD SOURCE: ab1
D-CH RD SOURCE: atx
ANALOG SOURCE: ab1

Figure 3-2. B/D CHAN Menu

3.2.1. STATION A Submenu

The **STATION A** submenu controls the source of B channel data destined for station A.

B1 SOURCE sets the channel B1 source selection mode. The options are **auto** or **manual**. If you select **auto**, Apollo automatically assigns this channel when making an end-to-end connection. If you choose **manual**, a connection exists between this channel and another entity after end-to-end call setup is completed. This entity may be an external device or a virtual device inside Apollo.

If **manual** is selected, press the ENTER key to advance to the submenu. Several options exist that allow you to choose the entity. The options are **bb1**, **bb2**, **ab1**, **ab2**, **extd**, **exstd**, **exa**, and **int**. If you select **bb1**, the source of data transmitted to this B channel is the data Apollo receives from station B, channel B1. (Note that data received from a station and channel may be transmitted back to that same station and channel, thereby establishing a loopback configuration.)

If **bb2** is selected, the source of data transmitted to this B channel is data Apollo receives from station B, channel B2. Choosing **ab1** selects data from station A, channel B1, and choosing **ab2** selects data from station A, channel B2.

If **extd** is selected, the source of data transmitted to this B channel is data Apollo receives from the transmit data lead on the rear panel, B channel (RS-232) connector. If you select **exstd**, the source of data transmitted to this B channel is data Apollo receives from the secondary transmit data lead on the rear panel, B channel (RS-232) connector.

If **exa** is selected, the data is taken from the analog-in rear panel BNC connector. (Note that these analog signals are encoded as mu-law PCM samples.)

If **int** is selected, the data is internally generated by Apollo. Press the ENTER key to access the internal submenu.

Internally generated data consists of a programmable tone (sine wave) or a programmable data pattern. The options are **tone** or **patt**. If **tone** is selected, a sine wave is transmitted to this B channel. Press the ENTER key to display the following **tone** options: level in dBm, and frequency.

The dBm level of the internally generated sine wave ranges from **-40.0 dBm** to **0.0 dBm**, in 0.1 dBm steps. This level is the RMS value of the signal referenced to a 600 ohm impedance. The frequency of the internally generated sine wave varies between **300 Hz** and **3,200 Hz** in 1 Hz intervals.

NOTE: Internally generated tones are encoded as mu-law PCM samples.

If you select **patt**, an 8-bit pattern is generated. Press the ENTER key to select the pattern. Pattern ranges are between **00h** and **FFh**.

B2 SOURCE sets the channel B2 source selection mode. The options are **auto** or **manual**. If you select **auto**, Apollo automatically assigns this channel when making an end-to-end connection. If you choose **manual**, then a connection exists between this channel and another entity after end-to-end call setup is completed. This entity may be an external device or a virtual device inside Apollo.

If **manual** is selected, press the ENTER key to retrieve the submenu. Several options exist that allow you to choose the entity. These options are **bb1**, **bb2**, **ab1**, **ab2**, **extd**, **exstd**, **exa**, and **int**. If you select **bb1**, the source of data transmitted to this B channel is data Apollo receives from station B, channel B1. (Note that data received from a station and channel may be transmitted back to that same station and channel, thereby establishing a loopback configuration.)

If **bb2** is selected, the source of data transmitted to this B channel is data that Apollo receives from station B, channel B2. Choosing **ab1** selects data from station A, channel B1, and choosing **ab2** selects data from station A, channel B2

If **extd** is selected, the source of data transmitted to this B channel is data Apollo receives from the transmit data lead on the rear panel B channel (RS-232) connector. If you select **exstd**, the source of data transmitted to this B channel is data Apollo receives from the secondary transmit data lead on the rear panel B channel (RS-232) connector.

If you select **exa**, the data is taken from the analog-in rear panel BNC connector. (Note that these analog signals are encoded as mu-law PCM samples.)
If **int** is selected, the data is internally generated by Apollo. Press the ENTER key to access the internal submenu.

Internally generated data consists of a programmable tone (sine wave) or a programmable data pattern. The options are **tone** or **patt**. If **tone** is selected, a sine wave is transmitted to this B channel. Press the ENTER key to display the following **tone** options: level in dBm, and frequency.

The dBm level of the internally generated sine wave ranges from **-40.0 dBm** to **0.0 dBm**, in 0.1 dBm steps. This level is the RMS value of the signal referenced to a 600 ohm impedance. The frequency of the internally generated sine wave varies between **300 Hz** and **3,200 Hz** in 1 Hz intervals. (Note that these internally generated tones are encoded as mu-law PCM samples.)
If you select **patt**, an 8-bit pattern is generated. Press the ENTER key to select the pattern. Pattern ranges are between **00h** and **FFh**.

D SOURCE displays the source of data transmitted to the D channel of station A. When **apollo** is displayed, then Apollo generates all signaling information being transmitted to station A.

3.2.2. STATION B Submenu

The **STATION B** submenu contains the same selection parameters as the **STATION A** submenu; the parameter selections, however, affect station side B.

3.2.3. REAR PANEL Submenu

The **REAR PANEL** submenu controls the source of data destined for external equipment connected to the rear of the Apollo unit.

B-CH RD SOURCE selects the data source that is transmitted by the receive data lead on the rear panel B channel (RS-232) connector. The options are **ab1**, **ab2**, **bb1**, and **bb2**. If **ab1** is chosen, the data Apollo receives from station A, channel B1 is transmitted by the receive data lead. If you choose **ab2**, the data Apollo receives from station A, channel B2 is transmitted by the receive data lead. Choosing **bb1** selects data from station B, channel B1, and choosing **bb2** selects data from station B, channel B2.

B-CH SRD SOURCE selects the data source that is transmitted by the secondary receive data lead on the rear panel B channel (RS-232) connector. The options are **ab1**, **ab2**, **bb1**, and **bb2**. If you choose **ab1**, the data Apollo receives from station A, channel B1 is transmitted by the secondary receive data lead. If you choose **ab2**, the data Apollo receives from station A, channel B2 is transmitted by the secondary receive data lead. Choosing **bb1** selects data from station B, channel B1, and choosing **bb2** selects data from station B, channel B2.

D-CH RD SOURCE selects the data source that is transmitted by the receive data lead on the rear panel D channel (RS-232) connector. The options are **atx**, **arx**, **btx**, and **brx**.

If **atx** is chosen, the D channel data Apollo transmits to station A is transmitted by the receive data lead. If you choose **arx**, the D channel data Apollo receives from station A is transmitted by the receive data lead. Choosing **btx** selects D channel data transmitted to station B, and choosing **brx** selects D channel data received from station B.

NOTE: Selecting data for the receive data lead automatically selects data on the secondary receive data lead. In this scenario, if a station's transmit data is placed on the receive data lead, that same station's receive data is transmitted on the secondary receive data lead.

For example, by selecting **atx** as the D-CH RD source, **arx** is automatically transmitted on the secondary receive data lead. If **brx** is chosen for the D-CH RD source, then **btx** is automatically transmitted on the secondary receive data lead.

ANALOG SOURCE selects the data source that is transmitted on the analog-out BNC rear panel connector. The options are **ab1**, **ab2**, **bb1**, and **bb2**. If you choose **ab1**, the data that Apollo receives from station A, channel B1 is transmitted out the analog port. If you choose **ab2**, the data Apollo receives from station A, channel B2 is transmitted out the analog port. Choosing **bb1** selects data from station B, channel B1, and choosing **bb2** selects data from station B, channel B2.

NOTE: When performing the digital-to-analog conversion for this port, Apollo assumes mu-law PCM samples have been sent by the ISDN TA/TE.

MONITOR SOURCE selects the station being monitored via the S/T trigger BNC rear panel connector. The options are **atx, arx**, **btx** and **brx**. **Atx** refers to the 192 kb/s signal that Apollo is transmitting to station A. **Arx** refers to the 192 kb/s signal that Apollo is receiving from station A. **Btx** refers to the 192 kb/s signal that Apollo is transmitting to station B. **Brx** refers to the 192 kb/s signal that Apollo is receiving from station B.

SYNC BIT selects which bit in the S/T bit stream triggers the oscilloscope. The value range for SYNC Bit is **1** to **48**.

3.3. MEASURE Menu

RMS measurement parameters are selected from the **MEASURE** menu. These parameters include measured channel, and averaging time. Measurement results are also displayed in this menu. Figure 3-3 shows the **MEASURE** menu.

```
LEVEL: ***.* dBm
AVERAGING TIME: 125 ms
MEASURED CHANNEL: ab1
```

Figure 3-3. MEASURE Menu

LEVEL displays the measured RMS level from -40.0 to 0.0 in 0.1 dBm increments. An under range condition is indicated by dashes (---.- dBm), while an over range condition is indicated by plus symbols (+++.+ dBm).

AVERAGING TIME selects the amount of time that elapses before the result is computed. Options are **125 ms** (milliseconds), **250 ms**, **500 ms**, **1.0 s** (seconds), and **2.0s**.

MEASURED CHANNEL selects the channel to be measured. Any of the four B channels may be measured. The channel selection is encoded as follows: **ab1** for station A, channel B1; **ab2** for station A, channel B2; **bb1** for station B channel B1; and **bb2** for station B, channel B2.

3.4. FILE Menu

The **FILE** menu allows you to quickly save or recall Apollo test configuration files. These files contain the settings of each of the parameters contained in the **NETWORK, B/D CHAN** and **MEASURE** menus.

The SAVE function stores the current test configuration in a read/write memory file. Apollo saves read/write memory file contents in battery-backed, random-access memory (RAM).

The RECALL function loads a set of test parameters from read/write memory or from read-only memory (ROM). Figure 3-4 shows the **FILE** menu.

RECALL: factory default
[ENTER] [ESC]
Press <enter> to recall setup,
or <esc> to return to previous menu.
SAVE: file0 LBL:
[ENTER] [ESC] (SAVE field)
Press <enter> to save setup,
or <esc> to return to previous menu.
[ENTER] [ESC] (LBL field)
EDIT RANGE: A-Z

Figure 3-4. FILE Menu

The FILE RECALL function loads a read/write file (**file0** to **file4**) or a ROM file. The ROM files have a descriptive name and a label for easy identification.

To recall a test configuration, select the target file in the RECALL field and press the ENTER key. Apollo presents the following prompt:

```
Press <enter> to recall setup,
or <esc> to return to previous menu.
```

If you wish to recall the file, press the ENTER key in response to the prompt. If you do not wish to complete the recall operation, press the ESC key.

The FILE SAVE function stores the current test configuration in one of the five read/write memory files (**file0** to **file4**). The LBL field accepts a descriptive label for the file contents. Use the Apollo String Editor to enter the contents of the LBL field.

To save the current test configuration, select the target file in the SAVE field, and enter the file label in the LBL field. Next, position the cursor at the SAVE field and press ENTER. Apollo presents the following prompt:

```
Press <enter> to save setup,
or <esc> to return to previous menu.
```

If you wish to save the test configuration, press the ENTER key in response to the prompt. If you do not wish to complete the save operation, press the ESC key.

The following items are not saved in test configuration files: **CONFIG** menu contents and **FILE** menu contents.

3.5. CONFIG Menu

The **CONFIG** menu has two main functions. It allows you to read the current Apollo operating status, model number, and software version number. The **CONFIG** menu also allows you to set Apollo for GPIB or RS-232 remote control and set the analog coding.

Figure 3-5 shows the **CONFIG** menu layout.

STATUS: Ok MODEL: 802_VER: *.** (FOR AT&T)
STATUS: Ok MODEL: 802_NAT VER *.** (FOR BELLCORE NATL ISDN)
STATUS: Ok MODEL: 802_CCITT VER *.** (FOR CCITT)
STATUS: Ok MODEL: 802_NT VER *.** (FOR NORTHERN TELECOMM)
STATUS: Ok MODEL: 802_NPN VER *.** (FOR NPN)
STATUS: Ok MODEL:802_SWISS VER *.** (FOR SWITZERLAND)
STATUS: Ok MODEL:802_NET3 VER *.** (FOR EUROPE)
ANALOG CODING: mu-law or a-law
REMOTE PROTOCOL: gpib
[ENTER] [ESC]
ADDRESS: 1
PROTOCOL RESPONSE MODE: VERBOSE

Figure 3-5. CONFIG Menu

The STATUS field shows the current Apollo operating status. If the status is OK, Apollo has not detected any problems with its circuitry or software. If Apollo detects a system error, it displays the error code in this field.

The MODEL field shows the Apollo model number:

- 802 for AT&T
- 802_NT for Northern Telecom
- 802_NAT for National ISDN
- 802_CCITT for CCITT
- 802_NPN for NPN
- 802_SWISS for Switzerland
- 802_NET3 for Europe

The VER field shows the Apollo software cartridge version.

The ISDN switch field displays the switch being emulated, as well as the generic release.

SWITCH	GENERIC RELEASE	
CCITT	(Blue Book)	(for CCITT)
DMS -100	(BCS 31)	(for Northern Telecom)
NPN	(INS - NET 64)	(for NPN)
NATL_ISDN -1	(TR268 Issue 3)	(for Natl. ISDN)
NET3	(ETS 300 102-1)	(for Europe)
SWISSNET	n/a	(for Switzerland)

This parameter determines the type of coding Apollo will use to transmit or receive analog signals. Both mu-law and A-law are supported.

The REMOTE protocol parameter determines the command link control protocol. The choices are **crlf** (carriage return/line feed), **acknak**, and **gpib**.
If **crlf** is selected, the carriage return/line feed protocol will be used. **crlf** uses the RS-232 serial control port and does not provide error control.

The **crlf** selection contains a submenu that allows you to set BAUD RATE, DATA (# data bits), PARITY, and STOP (# stop bits) options. For more information on this protocol, see the *Remote Operation* section.

If **acknak** is selected, the acknak protocol will be used. **acknak** uses the RS-232 serial control port and provides error control.

The **acknak** selection contains a submenu that allows you to set BAUD RATE, ADDRESS, DATA (# data bits), PARITY, and STOP (# stop bits) options. For more information on this protocol, see the *Remote Operation* section.

If **gpib** is selected, the General Purpose Instrumentation Bus (IEEE-488) protocol will be used. **gpib** uses the GPIB parallel control port.

The **gpib** selection contains a submenu that allows you to set the ADDRESS. For more information on this protocol, see the *Remote Operation* section.

The PROTOCOL RESPONSE MODE parameter directs Apollo to provide either **verbose** or **terse** responses to remote port commands. Verbose responses include the command name and subcommand name. Terse responses include only the response value. For more information on verbose and terse responses, see the *Remote Operation* section.

3.6. Apollo String Editor

The File labels (**FILE**) requires you to enter or modify text strings. The Apollo String Editor allows you to create and modify these text strings.

The String Editor allows you to set a character to any 8-bit binary value. This feature enables you to enter ASCII printable characters, ASCII nonprintable (control) characters, and non-ASCII 8-bit quantities. An ASCII printable character can be entered directly, or you can enter the hexadecimal value of the character. You can enter an ASCII control character (0 to 1F hex) as a control character sequence (^+character), or you can enter the hexadecimal equivalent. You must enter characters in the 7F to FF hex range as hexadecimal values. For example, the character sequence ABC<RETURN> can be represented by any of the following strings:

- ABC^M
- ABC<0D>
- <41><42><43><0D>

Apollo interprets the sequences contained in each character string and stores each string as a sequence of 8-bit values.

3.6.1. Entering a String

To enter a string, use the LEFT and RIGHT keys to position the cursor, and use the + or - key to select the character value. As you press the + or - key, the String Editor scrolls through the list of characters in the current edit range. Apollo shows the current edit range on the top line of the display, in the Edit field. Continue to scroll through the list until you reach the desired character.

3.6.2. Changing the Edit Range

Press the ENTER key to change the edit range. Apollo displays the following **EDIT RANGE** menu:

```
Select editing mode...
EDIT RANGE:
```

Use the + or - key to select the edit range and then press the ESC key to return to the character string. Table 3-1 defines each of the edit range choices:

IDENTIFIER	RANGE
A-Z	upper case alphabetic
a-z	lower case alphabetic
0-9	decimal digits
^\...	^_`{|}~!"#$%&'()*+,-./:;<=>?@[\] and SPACE
ins/del	insert and delete
all	all printable ASCII characters

Table 3-1. String Edit Ranges

3.6.3. Inserting and Deleting Characters

To insert characters in a string, perform the following steps:

1. Select the **ins/del** edit range.
2. Position the cursor at the point in the string where you wish to insert characters.
3. Press the + key to insert a space at the cursor position.

To delete characters from a string, perform the following steps:

1. Select the **ins/del** edit range.
2. Position the cursor at the point in the string where you wish to delete characters.
3. Press the - key to delete the character at the cursor position.

3.6.4. Entering Printable ASCII Characters

To enter a printable ASCII character, select the edit range that contains the character. Next, press the + or - key until you locate the character.

3.6.5. Entering ASCII Control Characters

The String Editor provides two options for entering ASCII control characters. You can enter a control character as a **^+character** sequence, or you can enter the hexadecimal value of the control character. To enter the control character as a **^+character** sequence, perform the following steps:

1. Select the **^\...** edit range.
2. Enter the **^** character.
3. Select the appropriate edit range.
4. Enter the desired character.

For example, to enter the control character <CARRIAGE RETURN>, you must enter the sequence **^M**. Apollo interprets this sequence as **<CONTROL>+M**.
To enter a control character as a hexadecimal value, perform the following steps:

1. Select the **^\...** edit range.
2. Enter the **<** character.
3. Select the **A-Z** or **0-9** edit range.
4. Enter the hex value for the character.
5. Enter the **>** character.

For example, to enter the control character <CARRIAGE RETURN>, you must enter the sequence **<0D>**.

If you wish to enter the hex values for several characters in sequence, you can enclose the sequence with a single pair of brackets. For example, to enter the sequence <CARRIAGE RETURN><LINE FEED>, you can enter **<0D 0A>**.

Table 3-2 lists each ASCII control character and its String Editor implementation.

CHAR	HEX	NAME
^@	00	NUL
^A	01	SOH
^B	02	STX
^C	03	ETX
^D	04	EOT
^E	05	ENQ
^F	06	ACK
^G	07	BEL
^H	08	BS
^I	09	HT
^J	0A	LF
^K	0B	VT
^L	0C	FF
^M	0D	CR
^N	0E	SO
^O	0F	SI
^P	10	DLE
^Q	11	DC1 (XON)
^R	12	DC2 (sometimes XON)
^S	13	DC3 (XOFF)
^T	14	DC4 (sometimes XOFF)
^U	15	NAK
^V	16	SYN
^W	17	ETB
^X	18	CAN
^Y	19	EM
^Z	1A	SUB
^[	1B	ESC
^\	1C	FS
^]	1D	GS
^^	1E	RS
^-	1F	US

Table 3-2. ASCII Control Character Codes

3.6.6. Entering Non-ASCII Characters

Non-ASCII characters have 8-bit hex values from 80 to FF hex. These characters are entered as hexadecimal values. The procedure for entering these characters is the same procedure for entering the hex values for ASCII control characters.

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4.0. REMOTE OPERATION

4.1. Overview

A computer or terminal can control Apollo by issuing commands to Apollo's GPIB or RS-232 remote control port. Apollo supports three control link protocols:

- RS-232 CR/LF
- RS-232 ACK/NAK
- GPIB

CR/LF (carriage return/line feed) is a simple command-line protocol that allows you to control Apollo from a dumb terminal or a computer. In addition to being easiest to implement, the CR/LF protocol provides a convenient way to practice using the Apollo command set.

ACK/NAK is a more sophisticated serial control protocol that includes error checking and command retransmission.

GPIB (General Purpose Instrumentation Bus) is the IEEE 488 industry-standard parallel-bus instrument control protocol.

Apollo's remote control features can be used to design computer-controlled automatic test procedures for data communications equipment, or to access and control an Apollo unit at a remote location via modem link.

Figure 4-1 shows Apollo being used in an ISDN TA/TE test system. In this configuration, a computer controls Apollo, a TAS Gemini 1022 Dual Terminal Emulator, and other test equipment via the GPIB. The control bus originates at the computer and is connected to each piece of test equipment. This type of configuration is simple to set up and operate, provided that the computer has GPIB controller capability.

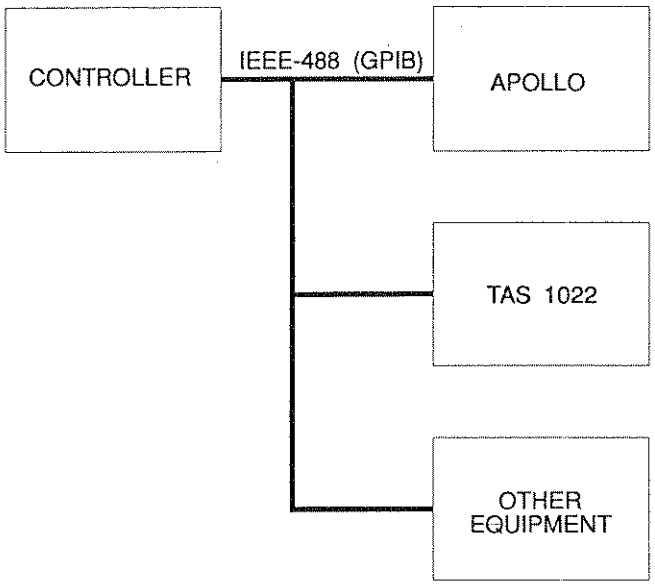

Figure 4-1. GPIB ISDN TA/TE Test System

Figure 4-2 shows a typical RS-232 control application. This type of setup can be used when Apollo is the only instrument to be controlled, or when a GPIB control computer is not available.

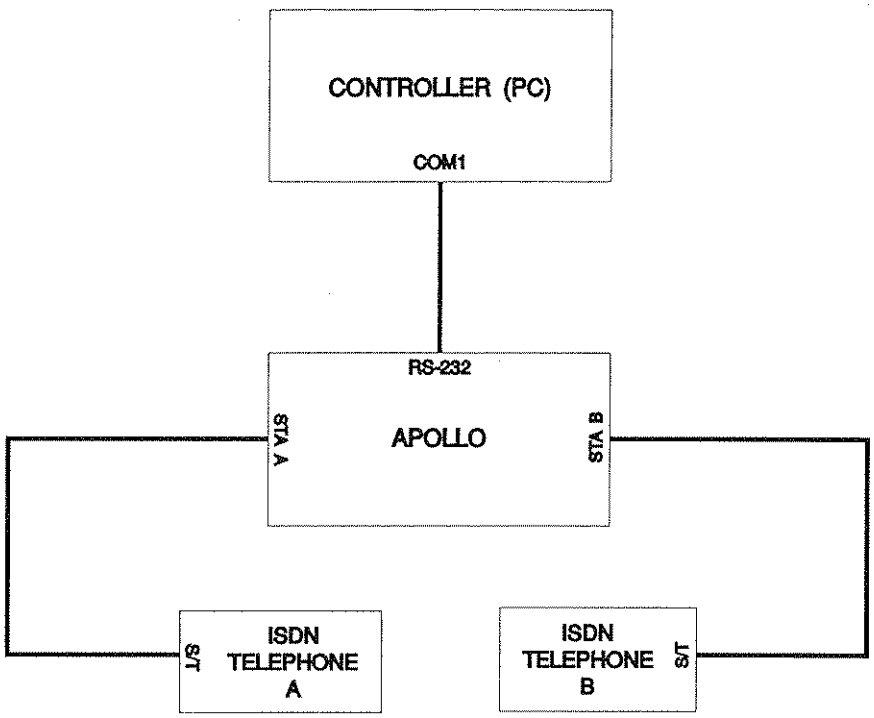

Figure 4-2. RS-232 Control of Apollo

Apollo can also be controlled via modem link. In Figure 4-3, a computer at a central site directs Apollo to perform a series of tests. The computer sends commands to Apollo via a modem link.

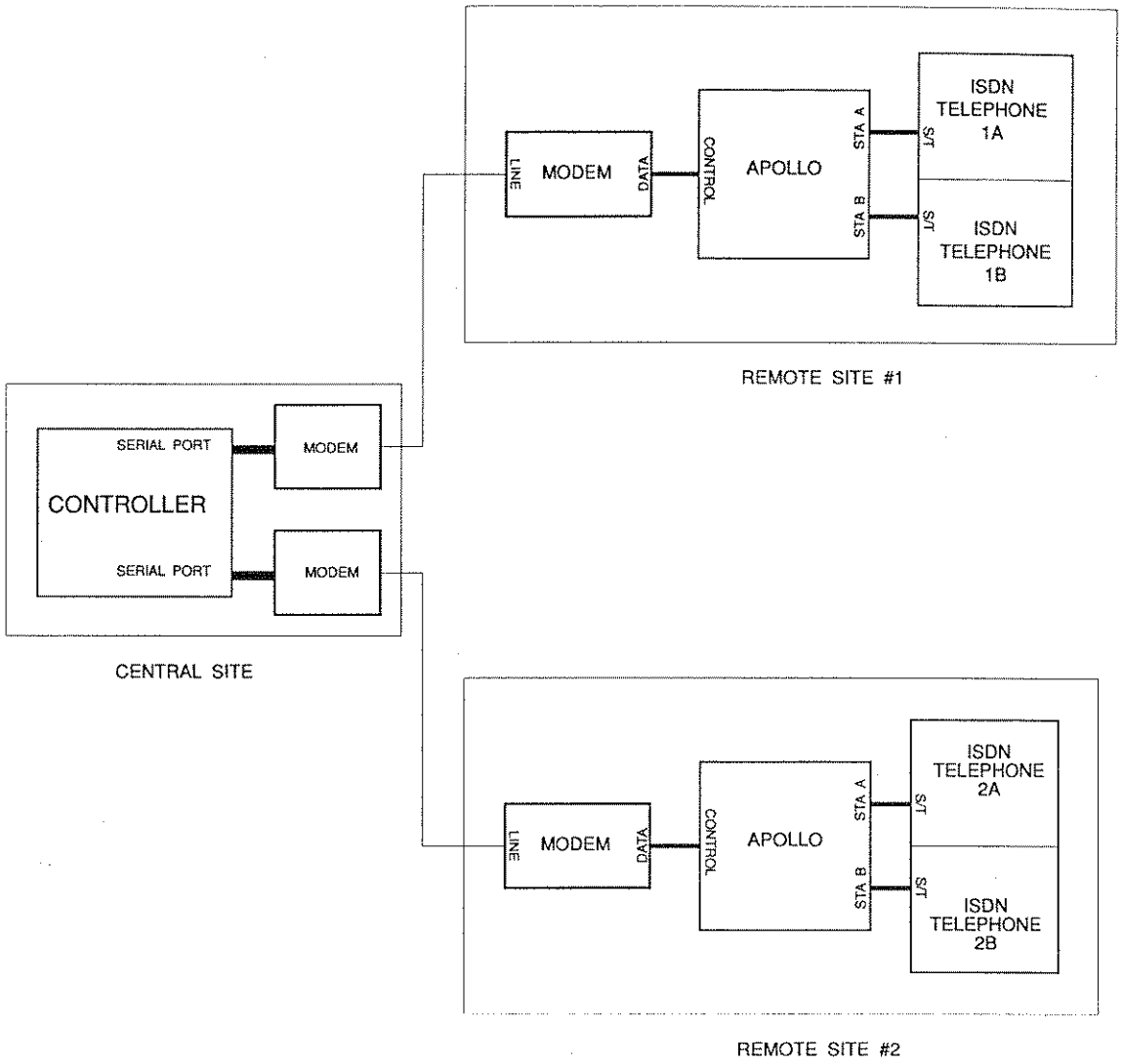

Figure 4-3. Apollo Control via Modem Link

Apollo includes a built-in RS-232/GPIB protocol converter. This allows a computer to control instruments attached to Apollo's GPIB port by sending commands to Apollo's RS-232 port. The advantage of this configuration is that a computer does not have to be a GPIB controller to control GPIB instruments. Since Apollo performs the bus conversion, a computer can control Apollo and several GPIB instruments from a single serial port.

4.2. Overview of Apollo Commands

Apollo commands are arranged in functional groups. As an example, the following operations might be required to automatically change phone numbers and inject framing errors. The command group(s) associated with each test operation is listed in parentheses.

- Check Apollo status, model #, and software version (cnfg).
- Set network parameters for changing phone numbers (ntwk).
- Set impairment parameters for injecting framing errors (ntwk).

The following brief descriptions outline the function of each Apollo command group. For a complete description, refer to the *Apollo Remote Commands Reference* section.

CNFG reports Apollo status, model #, and software cartridge version. CNFG commands also determine command response format and determines the coding scheme.

MEAS selects RMS measurement parameters, including measured channel, and # of samples. MEAS commands also request measurement results.

NTWK selects network configuration parameters, such as phone number, TEI value, and others. NTWK commands also select impairment parameters, such as impaired station, # of framing errors, E-bit selection, and more.

CHAN controls items under the **B/D CHAN** menu, including selection of B and D channel sources.

RPIO selects rear panel sources.

4.3. Configuring Apollo for Remote Control

Before you can control Apollo from a remote terminal or computer, the remote control configuration must be set. The remote configuration can be set only via the Apollo front panel. To set the remote control configuration, perform the following steps:

1. Select the **CONFIG** menu.
2. Use the DOWN or UP key to scroll to the **REMOTE PROTOCOL** menu line.
3. Select the desired protocol (**gpib**, **crlf**, or **acknak**).
4. Press the ENTER key and set the options for the remote control program that you selected.

For example, to configure Apollo for RS-232 CR/LF control, select REMOTE PROTOCOL: **crlf**, and press ENTER to select the **crlf** submenu. Next, set the BAUD RATE, DATA, PARITY, and STOP options for the CR/LF protocol.

For more information on the Apollo **CONFIG** menu, see the *Menu Reference* section. For detailed information on each of the Apollo link control protocols, refer to the *Remote Control Protocols* section.

4.4. Sending Commands to Apollo

4.4.1. Command Types

Apollo supports three distinct types of commands: SET commands, REPORT commands, and EXECUTE commands.

SET commands simply assign a value to an Apollo configuration parameter. For example, the command that sets the station A phone number to 1234567 is a SET command. If Apollo receives a SET command without a parameter value, it returns the current setting of the parameter.

REPORT commands return a value. For example, the command that returns the measured value for an RMS measurement is a REPORT command.

EXECUTE commands instruct Apollo to perform an operation. For example, the command that instructs Apollo to actually inject framing errors is an EXECUTE command. EXECUTE commands do not return a value.

4.4.2. Command Sequence

To execute an Apollo command, a controller must execute a simple three-step sequence:

1. Check for any pending command response. Apollo does not execute a new command if the result from a previous command has not been read.
2. Send the command to the Apollo.
3. Read the command response from the Apollo.

4.4.3. Command Messages

An Apollo command message consists of one or more command frames. A command frame consists of a command group name and one or more commands. A backslash precedes and follows each command frame. A colon follows the command group name, and a comma follows each command except the last command. Apollo ignores white space within the command frame. The command frame has the following syntax:

```
/command group: command1, command2, ..., commandn/
```

All of the commands within a command frame must belong to the same command group. An example of a command group is ntwk:

```
/NTWK: PHA="5551212", TASNA=FIXED, TEIA=120, ACTA=AUTO/
```

The above command sets the following network options:

- SET station A phone number = 5551212.
- SET station A TEI assignment mode = FIXED.
- SET station A TEI = 120.
- SET station A Activation/Deactivation mode = AUTO.

NOTE: All of the commands in the previous example are SET commands. An example of a REPORT command is: `/MEAS: LVL/`

This command instructs Apollo to report the measured RMS level.

If Apollo receives a SET command without a parameter value, it returns the current value of the parameter. For example, the following message tells Apollo to return the value of the Pha parameter:

```
/NTWK: PHA/
```

A similar command was used to SET the PHA parameter:

```
/NTWK: PHA="5551212"/
```

An example of an EXECUTE command is:

```
/NTWK: TRGFE/
```

This command tells Apollo to inject framing errors at the assigned station.
A command message can contain more than one command frame. For example, the following command message tells Apollo to SET the station A phone number to 5551212, and REPORT the RMS measurement results.

```
/NTWK: PHA="5551212" /MEAS: LVL/
```

A single backslash separates the NTWK command group from the MEAS command group.

4.4.4. Response Messages

Apollo provides an explicit response to each command message it receives. A command message can be one of three types:

- A command completion message.
- A value message.
- An error message.

Apollo returns a command completion message in response to a SET command or EXECUTE command. The command completion message is:

```
/C/
```

Apollo returns a value message in response to a REPORT command. The form of the value message is:

```
/command group: command=value/
```

For example, if the controller sends the message:

```
/MEAS: LVL/
```

Apollo might respond with:

```
/MEAS: LVL=-100/
```

This response indicates that Apollo measured an RMS level of -10.0 dBm.
Apollo returns an error message when it detects a problem with command syntax, or when it detects an internal processing error. The form of the error message is:

```
/command group: Exxx/
```

where *xxx* is the error number.

For example, if the controller sends the message:

```
/NTWK: ABC/
```

Apollo responds with:

```
/NTWK: E006/
```

This response indicates that Apollo has detected a command error. Specifically, ABC is an illegal command

4.4.5. Response to a Multiple-Command Message

Apollo returns only one response for each command message it receives. If the command message contains multiple commands, Apollo responds to the last command in the message. For example, if the controller sends the command:

```
/NTWK: PHA/MEAS: LVL/
```

Apollo responds with the message:

```
/MEAS: LVL=nnnnnnn/
```

where *nnnnnnn* is the RMS level measured at the corresponding station and B channel. Note that Apollo did not return completion messages for the ntwk**:pha** command, since it preceded the LVL command. A REPORT command should always be the last command in a command message, since Apollo supplies a response for only the last command. In addition, a command message should contain only one REPORT command. If one of the commands in a multiple command message results in an error, Apollo ceases processing the command message and reports the error. For example, if the controller sends the message:

```
/NTWK: PHA="555121C" /MEAS: LVL/
```

Apollo responds with:

```
/PHA: E001/
```

Apollo responds with an error message because the ntwk command resulted in a value error. In the example, Apollo did not execute the meas command, since this command followed the command that contained the error.

4.4.6. Terse Responses

If the PROTOCOL RESPONSE MODE is **terse**, Apollo does not include the slashes, command group name, or parameter name in the response. The following command transactions illustrate the format of terse responses.

```
Command:    /NTWK: PHA="5551212"/

Response:   C

Command:    /MEAS: LVL/

Response:   -100

Command:    /NTWK: ABC/

Response:   E006
```

4.5. Injecting Framing Errors

The following example shows you how to construct a test procedure that injects a framing error in three consecutive frames being transmitted to station side B. The procedure consists of several test operations. Each operation, in turn, results in one or more Apollo command messages. The description of the test procedure includes a description of each test operation, a brief description of each command message, and a brief description of each command.

Figure 4-4 shows the equipment configuration. Apollo station A is connected to ISDN telephone A, and station B is connected to ISDN telephone B.

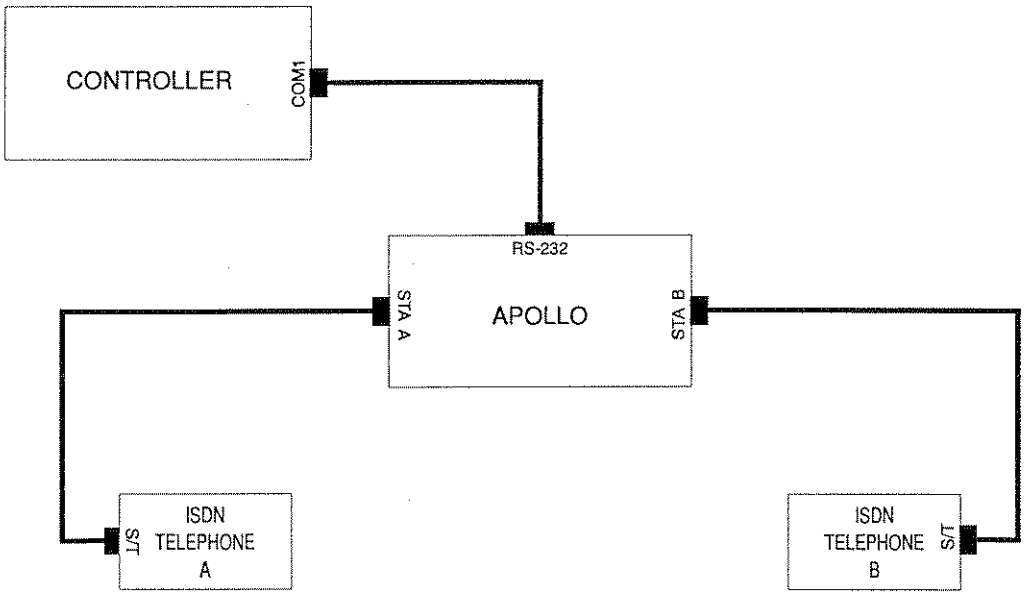

Figure 4-4. Injecting Framing Errors

4.5.1. Test Operation #1: Verify Apollo Configuration and Status

Verify the Apollo model number.

```
/CNFG: MODL/
```

Verify the version of the Apollo software cartridge.

```
/CNFG: VERS/
```

Read the result of the power-up diagnostics.

```
/CNFG: STAT/
```

Set the VERBOSE response option.

```
/CNFG: RESP=VERBOSE/
```

4.5.2. Test Operation #2: Set the Framing Error Parameters

```
/NTWK: IMPST=A, FE=3, TRGFE/
```

1. Set the impaired station to **a**.
2. Set the # of consecutive frames containing framing errors to **3**.
3. Trigger (i.e., inject) the framing errors.

4.6. Changing TEI Values

The following example shows you how to construct a test procedure that selects the TEI value assigned to station B. The equipment configuration is the same as for the injecting framing errors example discussed above.

4.6.1. Test Operation #1: Verify Apollo Configuration and Status

Verify the Apollo model number.

```
/CNFG: MODL/
```

Verify the version of the Apollo software cartridge.

```
/CNFG: VERS/
```

Read the result of the power-up diagnostics.

```
/CNFG: STAT/
```

Set the VERBOSE response option.

```
/CNFG: RESP=VERBOSE/
```

4.6.2. Test Operation #2: Set New TEI Value

```
/NTWK: TASNB=FIXED, TEIB=100/
```

1. Set the TEI Assignment mode for station B to **fixed**.
2. Set station B TEI to **100**.

4.7. Performing a B Channel RMS Measurement

The following example shows you how to construct a test procedure that performs an RMS measurement on the contents of station A, channel B1. The equipment configuration is the same as for the two previous examples.

4.7.1. Test Operation #1: Verify Apollo Configuration and Status

Verify the Apollo model number.

```
/CNFG: MODL/
```

Verify the version of the Apollo software cartridge.

```
/CNFG: VERS/
```

Read the result of the power-up diagnostics.

```
/CNFG: STAT/
```

Set the VERBOSE response option.

4.7.2. Test Operation #2: Set RMS Measurement Parameters & Read the Results

```
/CNFG: CODE=MU/

/MEAS: CHAN=AB1, AVGT=1000, LVL/
```

1. Set the coding scheme to mu-law
2. Set the measured channel to **ab1** (station A, channel B1).
3. Set the averaging time to **1,000** milliseconds.
4. Read the measured value.

4.8. Remote Control Protocols

Apollo provides three remote control protocol options: RS-232 CR/LF, RS-232 ACK/NAK, and GPIB. The command syntax remains the same, regardless of the remote protocol. The remote control protocol determines only the method by which Apollo receives commands and provides responses.

To control Apollo from a computer or terminal, you must first set the remote protocol options. These options reside in the **CONFIG** menu, under REMOTE PROTOCOL. Use the REMOTE PROTOCOL option to select the protocol and then access a submenu to set the options for the protocol you select. See the *Menu Reference* section for further information.

4.8.1. RS-232C CR/LF Protocol

The Apollo RS-232 CR/LF is the simplest and quickest remote control protocol. You can use this protocol to control Apollo from a data terminal or a computer. The RS-232 CR/LF protocol does not perform error checking, so this protocol should not be used unless the control terminal or computer is collocated with the Apollo.

Apollo provides a > prompt when it is ready to receive a command. To enter a command , simply type the command and press CARRIAGE RETURN. Apollo executes the command and provides a response. After Apollo provides the response, it sends another > prompt to indicate that it is again ready to receive a command.

4.8.2. ACK/NAK Protocol

The Apollo ACK/NAK protocol supports RS-232 multipoint communication between a controller and one or more TAS devices. ACK/NAK also detects command transmission errors, and provides for retransmission of corrupted commands. ACK/NAK is well-suited for applications in which Apollo is not collocated with the controller, such as when Apollo is controlled remotely via a modem link.

The controller initiates all ACK/NAK protocol transactions. To effect a command transaction with Apollo, the controller must perform the following operations:

1. Poll the Apollo for a pending response.
2. Send the command to Apollo.
3. Poll Apollo for the command response.

ACK/NAK Command Transaction Example

The following example illustrates a command transaction between a controller and Apollo.

First, the controller polls for any pending response. This ensures that the Apollo response buffer is empty so that Apollo can process the next command.

[addr]p<ENQ>

The Apollo response buffer is empty, so it responds:

[addr]<EOT>

Next, the controller sends the command to Apollo:

[addr]s<ENQ><SOH><STX>/NTWK:Pha="1"/<ETX>[checksum]

Apollo receives the command, does not detect any errors, and responds:

[addr]<ACK>

Next, the controller polls for the response to the command:

[addr]p<ENQ>

Apollo has finished executing the command, so it responds:

[addr]<SOH><STX>/C/<ETX>[checksum]

NOTE: [addr] is the device address. The address can be any decimal number from 0 to 99. If the address is less than 10, the controller must left-pad the address with a space.

[checksum] is the message checksum. The message checksum is a three-digit decimal number. [checksum] is the two's complement of the module 256 sum of all characters from the first address character through the <ETX> character. For example, if the checksum is 201, then the block checksum should be 055 (256-201).

<ENQ> is the ASCII ENQUIRE control character (05H).

<EOT> is the ASCII END OF TRANSMISSION control character (04H).

<SOH> is the ASCII START OF HEADER control character (01H).

<STX> is the ASCII START OF TEXT control character (02H).

<ETX> is the ASCII END OF TEXT control character (03H).

Polling for a Response

When Apollo receives a command from the controller, it executes the command and prepares a response. The controller must poll Apollo to receive this response. The poll sequence is:

[addr]p<ENQ>

The poll message results in one of the following:

- Apollo does not respond.
- Apollo has no response waiting.

  [addr]<EOT>

- Apollo provides a response.

  [addr]<SOH><STX>[response]<ETX>[checksum]

Apollo does not respond to a poll if one of the following conditions exists:

- The Apollo configuration is not proper. For example, Apollo does not respond if its ACK/NAK address does not match the address contained in the poll message.
- Apollo is currently processing a command.
- The poll message has been corrupted by an error.

If the controller does not receive a response from Apollo, it should poll again. Apollo responds with [addr]<EOT> if it has no response pending.

Sending Commands to Apollo

To send a command to Apollo, the controller must assemble and send a SELECT message. The format of the SELECT message is shown below.

[addr]s<ENQ><SOH><STX>[command]<ETX>[checksum]

The select message yields one of three possible results:

- Apollo does not respond to the message.
- Apollo detects an error in the message and responds with:

  [addr]<NAK>

- Apollo receives the message, does not detect any errors, and responds with:

  [addr]<ACK>

Apollo does not respond to the SELECT message if the Apollo address does not match the address contained in the SELECT message.

Apollo responds with a negative acknowledgment (NAK) if it detects a transmission error in the SELECT message (bad checksum), or if the message is too long (greater than 512 characters). If Apollo detects a transmission error in the message, the controller should send the message again.

Receiving Responses from Apollo

Apollo provides a command response when it is polled by the controller. If the controller detects a transmission error in the Apollo response, it should perform the following steps:

1. Poll Apollo until Apollo responds with [addr]<EOT>.
2. Send the message again.
3. Poll Apollo again for the response.

4.8.3. GPIB Protocol

The Apollo GPIB protocol supports a parallel bus control architecture in which Apollo is one of the devices being controlled. The controller must meet all IEEE 488 electrical and mechanical specifications.

The controller initiates all GPIB protocol transactions. In order to communicate with Apollo, a GPIB controller must perform the following operations:

1. Poll Apollo for a pending response (serial poll).
2. Send the message to Apollo.
3. Poll Apollo for the command response (serial poll).

Apollo provides a GPIB status byte to indicate its current state. Possible states include:

- IDLE - 02H.
- BUSY - 01H.
- READY TO RESPOND (RTR) - 04H or 44H.

IDLE indicates that Apollo does not have a message to send and is ready to accept a command.

BUSY indicates that Apollo is currently processing a command. Apollo does not accept a new command until it has finished processing the current command and has provided the response to the controller.

READY TO RESPOND (RTR) indicates that Apollo currently has a message to send to the controller. Apollo is always Ready to Respond when it finishes processing a command.

When Apollo is ready to respond, it activates the service request line (SRQ) and sets the RTR status to 44 hex. After the controller conducts the serial poll, SRQ goes inactive, and Apollo sets the RTR status to 04 hex. Figure 4-5 shows a flowchart for a typical bus controller sequence.

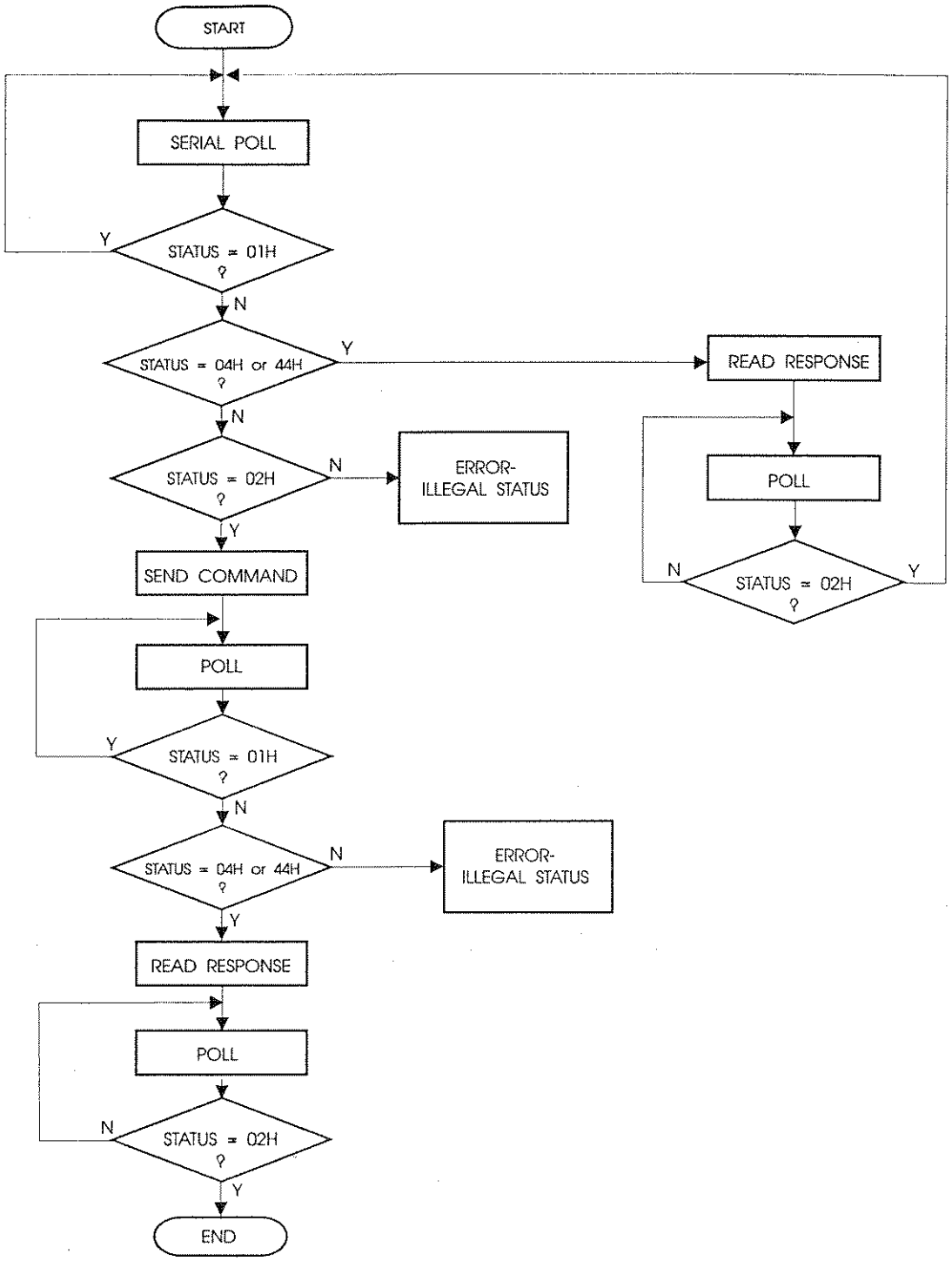

Figure 4-5. GPIB Controller Sequence

Polling for a Response

The controller must conduct a serial poll to receive a command response from Apollo. The following example shows the typical GPIB sequence required to achieve a serial poll of Apollo. Your actual bus sequence may be different:

1. ATN active.
2. UNT - (UNTalk).
3. UNL - (UNListen).
4. SPE - (Serial Poll Enable).
5. MTA - (Apollo My Talk Address).
6. Controller programmed to listen.
7. ATN inactive.
8. Apollo sends status.
9. ATN active.
10. SPD - (Serial Poll Disable).
11. UNT - (UNTalk).

Always conduct a serial poll before sending a command to Apollo. If Apollo has a pending message to send, it does not accept a new command.

Sending Commands to Apollo

The following example shows the typical GPIB sequence required to send a command to Apollo. Your actual bus sequence may be different.

1. ATN active.
2. UNT - (UNTalk).
3. UNL - (UNListen).
4. MLA - (Apollo My Listen Address).
5. Controller programmed to talk.
6. ATN inactive.
7. Controller sends command to Apollo and asserts EOI with last command character.
8. ATN active.
9. UNL - (UNListen).

Command strings must not be terminated with CARRIAGE RETURN or CARRIAGE RETURN+LINE FEED. The controller must signal the end of a command message by asserting EOI (end of interrupt) while it sends the last character of the message.

Some commands require several seconds of Apollo processing time. While Apollo completes most commands in less than 100 msec, some commands may require up to 3 seconds. The controller should conduct serial polls until the Apollo status is RTR.

Receiving Responses from Apollo

The following example shows the typical GPIB sequence required to receive a command from Apollo. Your actual bus sequence may be different.

1. ATN active.
2. UNT - (UNTalk).
3. UNL - (UNListen).
4. MTA - (Apollo My Talk Address).
5. Controller programmed to listen.
6. ATN inactive.
7. Apollo sends data to controller.
8. Controller reasserts control when EOI goes active.
9. ATN active.
10. UNT - (UNTalk).

Apollo does not terminate its response message with a CARRIAGE RETURN or CARRIAGE RETURN+LINE FEED. Apollo signals the end of a response message by raising EOI while it sends the last character of the response.

4.9. Using the RS-232/GPIB Translator Feature

Apollo's RS-232/GPIB Translator allows you to control GPIB instruments from an RS-232 control port. Figure 4-6 shows an application example. In the example, a TAS Gemini 1022 Dual Terminal Emulator is attached to the GPIB port of the Apollo unit.

The controller encloses each TAS 1022 command within an Apollo GPIB command and sends the command to Apollo. Apollo receives the GPIB command, extracts the TAS 1022 command portion, and issues the command from its GPIB port. Apollo then encloses the TAS 1022 command response within a GPIB command response and provides the response to the controller.

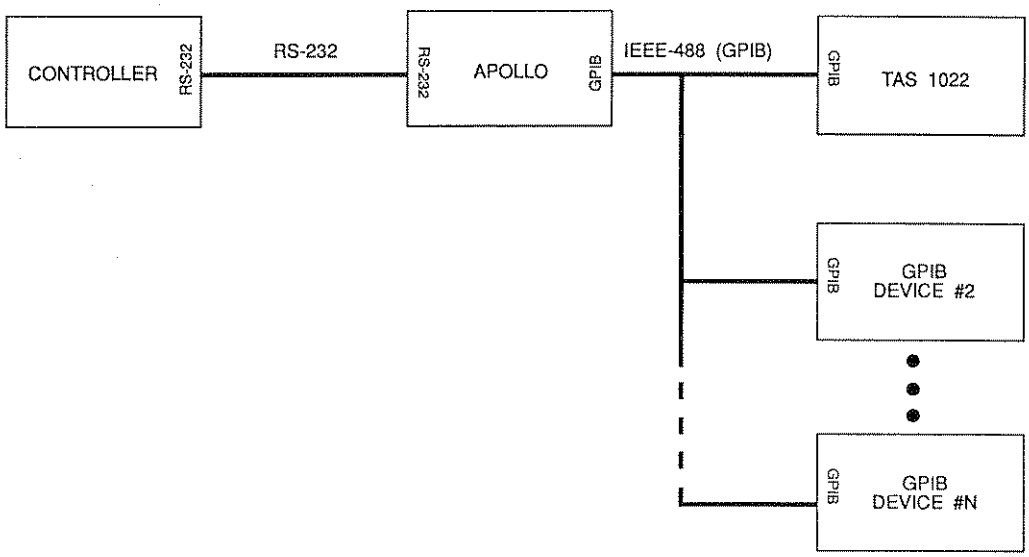

Figure 4-6. Apollo RS-232/GPIB Translator Configuration

The RS-232/GPIB Translator supports both TAS instruments and instruments from other manufacturers. As with any GPIB application, several instruments may coexist on the bus.

The GPIB command group controls the operation of the RS-232/GPIB Translator. The Translator commands are available whenever Apollo is controlled via its RS-232 control port. The Translator commands are not available when Apollo is controlled via its GPIB port. For specific information on the GPIB command group, see the *Apollo Remote Commands Reference* section.

When the RS-232/GPIB Translator is active, Apollo acts as a GPIB controller to control the devices attached to the GPIB bus. Apollo supports the following GPIB controller functions:

- Controller initialization.
- Device addressing.
- Device status check.
- Data transfer.
- Auxiliary functions, such as Go To Local and Local Lockout.

To effect a data transaction with a GPIB device, the controller must perform the following operations:

1. Initialize the GPIB.
2. Set the device address.
3. Initialize the device.
4. Poll the device (if applicable).
5. Send the command.
6. Get the response (if applicable).
7. Restore the device (if applicable).

4.9.1. Initializing the Apollo GPIB Controller

The PON command initializes the Apollo GPIB controller to its power-on condition. This command is useful for establishing the state of the controller if it is hung up by an anomalous bus condition. For example, if the GPIB cable falls off of a device in the middle of a transaction, you can use the PON command to reinitialize the Apollo GPIB controller.

```
Command:  /GPIB: PON/

Response: /C/
```

4.9.2. Setting GPIB Addresses

Every device on the GPIB must have a unique primary (talker/listener) address. The MADDR command sets the address of the Apollo GPIB controller, and the ADDR command selects a GPIB device for a bus transaction. Apollo supports all GPIB primary addresses (0 to 30). Apollo does not support secondary addresses.

4.9.3. Setting the Controller Address

The MADDR command sets the Apollo GPIB controller address.

```
Command:   /GPIB: MADDR=0/

Response: /C/
```

4.9.4. Setting the Device Address

The ADDR command selects a GPIB device for bus transactions. Apollo performs transactions with only one GPIB device at a time, so a new device address must be set for each different device. If you wish to perform transactions with only one device, it is not necessary to set the device prior to each transaction.

```
Command:   /GPIB: ADDR=4/

Response: /C/
```

4.9.5. Clearing the GPIB

The controller clears the GPIB by issuing the INTERFACE CLEAR (IFC) command to Apollo. When Apollo receives the IFC command, it issues the IFC command on the GPIB. The interface clear command signals all devices to abort bus transitions and place their bus drivers in a passive state. The controller should issue the Interface clear before any GPIB transactions occur, or after a device time-out occurs.

```
Command:   /GPIB: IFC/

Response: /C/
```

4.9.6. Setting the Input Termination Condition

The input terminator marks the end of a message from a GPIB device to the Apollo GPIB controller. Apollo supports four input termination conditions: the carriage return character, the line feed character, the carriage return/line feed character sequence, and the GPIB end-of-interrupt (EOI) signal. The INPUT TERMINATION CONDITION (ITC) command tells Apollo which terminator to use.

Input terminators may differ from device to device. The controller must select the appropriate input terminator before starting a transaction with a device. The Apollo GPIB controller strips the input terminator from any GPIB message that it receives.

```
Command:   /GPIB: ITC=eoi/

Response: /C/
```

4.9.7. Setting the Device Time-out

If a GPIB device does not respond to a command within a specified time period, Apollo returns a DEVICE TIME-OUT error message to the controller. The DEVICE TIME-OUT (DTO) command determines the time-out length. The default time-out length is 10 seconds.

```
Command:    /GPIB: DTO=10/

Response:   /C/
```

4.9.8. Initializing a GPIB Device

The controller issues a REMOTE ENABLE command to Apollo to force a GPIB device to accept remote commands. When Apollo receives the command, it asserts the REMOTE ENABLE lead on the GPIB and places the device's address (as determined by the ADDR command) on the bus. The REMOTE ENABLE command overrides the device's front panel local/remote switch setting.

```
Command:    /GPIB: REN=1/

Response:   /C/
```

4.9.9. Selective Device Clear

The implementation of the SELECTIVE DEVICE CLEAR command is left to the manufacturer of the GPIB device. Some GPIB devices do not respond to this command.

```
Command:    /GPIB: CLR/

Response:   /C/
```

4.9.10. Execute Trigger

The implementation of DEVICE TRIGGER is left to the GPIB device manufacturer. Some GPIB devices do not respond to this command.

```
Command:    /GPIB: TRIG/

Response:   /C/
```

4.9.11. Locking Out the Device's Front Panel

The controller can issue a LOCAL LOCKOUT command to Apollo to disable the front panel of a GPIB device. For most GPIB devices, the local lockout command must follow a remote enable command. The ADDR command determines the target of the LOCAL LOCKOUT command.

```
Command:    /GPIB: LLO/

Response:   /C/
```

4.9.12. Polling a GPIB Device

The controller can conduct a serial poll of a GPIB device to determine the device's status. The controller conducts the serial poll by issuing a SERIAL POLL (SPOLL) command to Apollo. Apollo then issues a SERIAL POLL command on the GPIB and returns the serial poll status byte to the controller. The ADDR command determines the target device for the serial poll.

Seven out of the eight bits in the status byte (B0-B5 and B7) are determined by the GPIB device manufacturer. Bit B6 indicates the state of the GPIB Service Request (SRQ) line.

```
Command:    /GPIB:SPOLL/

Response:   /GPIB:SPOLL=xx/

            (xx is the hex-coded value of device's
            status byte)
```

4.9.13. Performing Command Transactions

Apollo provides two ways to perform a command transaction with a GPIB device. The OUT and IN commands can be used to control GPIB devices from virtually any manufacturer. The TAS SEND (TSND) command is designed to perform transfers with TAS devices. The OUT command transfers messages to a GPIB device, and the IN command transfers messages from a GPIB device. The TSND command transfers a message to the GPIB device, retrieves the response from the device, and returns the response to the controller.

Setting the Message

The MESSAGE (MSG) command specifies the message to be sent to a GPIB device.

```
Command:    /GPIB: MSG="/RN, L500/"/

Response:   /C/
```

Sending the Message

The OUT command causes Apollo to transfer the contents of the message buffer to the selected device. The ADDR command selects the device. Apollo applies the selected command terminator to the end of the message. The ITC command specifies the command terminator.

```
Command:    /GPIB: OUT/

Response:   /C/
```

Receiving Messages from a Device

The IN command directs Apollo to receive a message from the selected GPIB device and to provide the message to the controller. Apollo collects the entire message, up to the input terminator. If Apollo does not receive the entire message before the device time-out interval expires, Apollo sends a Device Time-out status code to the controller.

```
Command:    /GPIB: IN/

Response:   /GPIB: IN=/C//
```

4.9.14. Performing OUT/IN Transfers Using TAS SEND (TSND)

The TSND command can be used in lieu of separate OUT and IN commands, and is designed to be used to control TAS Telephone Network Simulators and Loop Emulators. The TSND command directs Apollo to send a message to a GPIB device, collect the response, and forward the response to the controller. The ADDR command selects the device. The MSG command specifies the message to be sent to the device. Before executing the TSND command, the controller must poll the device to ensure that it is idle (SPOLL=02).

```
Command:    /GPIB: TSND/

Response:   /GPIB: TSND=/C//
```

4.9.15. Encoding GPIB Messages

The controller must encode all GPIB messages (MSG contents) according to Apollo String Coding Conventions. These conventions are summarized as follows:

- All GPIB messages must be enclosed within quotes.
- Each printable ASCII character (0x20 to 0x7E) may be entered directly, or may be represented by its hexadecimal value. For example, the character "A" may be represented as A or as <41>.
- An ASCII control character (0x00 to 0x1F) may be represented by its hex value or by a forward slash followed by the control character. For example, the CARRIAGE RETURN control character may be represented as <0D> or as ^M.
- Each 8-bit value from 0x7F to 0xFF must be represented by its hexadecimal value. For example, the 8-bit value 0x7F must be represented as <7F>.

Apollo uses each of the following five characters to interpret message strings:

```
< > \ " ^
```

If any of these characters is used in a message string, it must be preceded by a forward slash (\).

4.9.16. String Encoding Example

GPIB MSG strings must be encoded according to the Apollo String Coding Conventions before they are transmitted to Apollo. The MSG string

```
"hello, world"<CR><LF>
```

could be encoded in any of the following ways:

```
\"hello, world\"<0D><0A>

\"hello, world\"^M^J

<22>hello, world<22><0D>< 0A>
```

4.9.17. Decoding GPIB Responses

When Apollo receives a message from a GPIB device, it encodes the message and transfers it to the controller. Apollo encodes messages according to the Apollo String Coding Conventions.

- Apollo encloses the message within quotes.
- Apollo passes printable ASCII characters (0x20 to 0x7E) to the controller without encoding.
- Apollo represents ASCII control characters by their hexadecimal values. For example, the CARRIAGE RETURN character is represented by <OD>.
- Apollo represents each 8-bit quantity in the range 0x7F to 0xFF by its hexadecimal value. For example, the quantity 0xA2 is represented by <A2>.
- Apollo precedes each of the five characters (< > " \ >) with a forward slash (\).

4.9.18. Restoring Front Panel Control

The GO TO LOCAL (GTL) command returns the GPIB device to front panel control. Some devices also revert to front panel control in response to a REMOTE ENABLE (REN=0) command.

```
Command:    /GPIB: GTL/

Response:   /C/
```

4.9.19. Example #1: Performing a Transaction Using OUT and IN

The following example shows a complete command transaction with a GPIB device. In the example, the OUT command transfers data to the device, and the IN command transfers data from the device to the controller.

Initialize the Apollo GPIB controller.

```
Command:    /GPIB: PON, MADDR=0, IFC/

Response:   /C/

Effect:     Reset the Apollo GPIB controller to
            power-on defaults, set the Apollo GPIB
            controller address to 0, and clear the
            GPIB.
```

Initialize the GPIB device.

```
Command:    /GPIB: ADDR=1, ITC=eoi, DTO=15, REN=1,
            LLO/

Response:   /C/

Effect:     Set the GPIB device address to 0, set
            the input termination condition to
            eoi, set the DEVICE TIME-OUT to 15
            seconds, enable the device for remote
            control, and lock out the device's
            front panel.
```

Poll the GPIB device to ensure it is idle before sending the message.

```
Command:    /GPIB: SPOLL/

Response:   /GPIB: SPOLL=XX/

Effect:     Perform a serial poll of the GPIB
            device at ADDR=1.
```

Place the message to be sent to the GPIB device into the message buffer, and send the message.

```
Command:    /GPIB: MSG="CURRENT=100", OUT/

Response:   /C/

Effect:     Place the device command into the
            message buffer and send the command.
```

Perform serial polls of the device.

```
Command:    /GPIB: SPOLL/

Response:   /GPIB: SPOLL=XX/

Effect:     Perform serial poll to get device
            status XX.
```

Get the response from the GPIB device.

```
Command:    /GPIB: IN/

Response:   /GPIB: IN=OKAY/

Effect:     Get the response message "OKAY" from
            the GPIB device.
```

Restore the device to front panel control.

```
Command:    /GPIB: GTL, REN=0/

Response:   /C/

Effect:     Restore front panel control, disable
            remote control.
```

4.9.20. Example #2: Command Transaction Using TSND

The following example shows a command transaction that uses the TSND command. Note that TSND automatically polls the device for a response after transferring the command message. TSND also eliminates the need for the IN command. The TSND command is designed to work with TAS Telephone Network Simulators and Loop Emulators.

Initialize the Apollo GPIB controller.

```
Command: /GPIB: PON, MADDR=0, IFC/

Response: /C/

Effect:     Reset the Apollo GPIB controller to
            power-on defaults, set the Apollo GPIB
            controller address to 0, and clear the
            GPIB.
```

Initialize the GPIB device.

```
Command:    /GPIB: ADDR=1, ITC=eoi, DTO=15/

Response:   /C/

Effect:     Set the GPIB device address to 0, set
            the input termination condition to
            eoi, and set the DEVICE TIME-OUT to 15
            seconds.
```

Poll the GPIB device to ensure that it is idle before sending the message. Poll until the device status is **02**.

```
Command:    /GPIB: SPOLL/

Response:   /GPIB: SPOLL=xx/

Effect:     Perform a serial poll of the GPIB
            device at ADDR=1. If the status is
            READY TO RESPOND (04 or 44), the
            controller must execute an IN command
            to clear the device response buffer.
```

Place the message to be sent to the GPIB device into the message buffer and send the message.

```
Command:    /GPIB: MSG="/IO, Z/", TSND/

Response:   /GPIB: TSND=/C//

Effect:     Place the device command into the
            message buffer and start the command
            transaction.  The Apollo GPIB
            controller returns the response it
            received from the GPIB device; in this
            case, the device is a TAS 1010 Channel
            Simulator.
```

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5.0. Apollo Remote Commands Reference

5.1. Overview

The Apollo *Remote Commands Reference* section describes the commands available for setting and reading parameter values, executing operations, and reading results from Apollo. This section consists of a Commands Quick Reference and Command Manual pages. The Quick Reference is designed to help those who are familiar with the Apollo command set easily find and use commands. The Command Manual pages provide a complete description of each command group and all commands within each group.

You should be thoroughly familiar with the *Remote Operation* section of this manual before attempting to use Apollo remote commands. The *Remote Operation* section provides the details of the Apollo command message format and syntax.

Since Apollo contains two independent NT station terminations, many basic Apollo commands can apply to station A or station B. For example, the command /NTWK: PHA="5551212"/ tells Apollo to assign the phone number 5551212 to station A, while the command /NTWK: PHB="5551212"/ tells Apollo to assign the phone number 5551212 to station B.

Rather than show two separate commands, the command reference inserts a **j** in the command as a place holder for the **A** or **B**. When using the command, insert **A** or **B** in place of the **j**. Similarly, a lower-case **b** is used to represent each of the two B channels. When using the command, be sure to substitute **B1** or **B2** for the lower-case **b**.

Apollo commands are divided into three types: SET, REPORT, and EXECUTE. In the Commands Quick Reference, these three types are abbreviated as S, R, and E.

5.2. Apollo Commands Quick Reference

CMD	TYPE	VALUES	DESCRIPTION
CNFG			*Apollo Configuration*
MODL	R	802 for AT&T	model #
		802_CCITT for CCITT	model #
		802_NAT for Bellcore Natl ISDN	model #
		802_NPN for NPN	model #
		802_NT for Northern Telecom	model #
OPT	R	nnnnnnnn	options
VERS	R	1.xx	version number
STAT	R	nnn	power-up status
RESP	S	verbose, terse	response mode
LOC	E		force to local
REM	E		force to remote
LOCK	E		disable REMOTE key
CODE	S	mu, a	coding
MEAS			*RMS Measurment Parameters*
CHAN	S	ab1, ab2, bb1, bb2	measured channel
AVGT	S	125, 250, 500, 1000, 2000	averaging time
LVL	R	400 to 0	RMS level
NTWK			*Network Configuration*
MODE	S	sw, nsw	simulation mode (NPN only)
IMPST	S	a, b	impaired/monitored station
Cjb	S	ns, csv, csd, csvlcsd	B channel allocation
PHj	S	see Note 1	phone number
TASNj	S	auto, fixed	tei assignment
TEIj	S	0 to 126	tei value
SUPVj	S	y, n	supervisory signaling enable
ACTj	S	auto, 10, 12, 14	activation/deactivation mode
EBIT	S	see Note 2	E-bit pattern
FE	S	none, cont, 1, 2, 3	framing errors
TRGFE	E		injects framing errors

NOTE 1: Phone numbers consist of quoted strings of up to 20 characters made up of the following characters: 0123456789*#.

NOTE 2: E-bit selections are norm, inv, and X ONES followed by a ZERO, where X can range from 1 to 15.

CMD	TYPE	VALUES	DESCRIPTION
CHAN			***B/D Chan Commands***
SmjBb	S	auto, manual	channel source selection
SjBb	S	see Note 3	manual sources
IjBb	S	tone, patt	internal source types
LjBb	S	-400 to 0	internal tone level
FjBb	S	300 to 3200	internal tone frequency
PjBb	S	00 - FF	internal pattern
RPIO			***Rear Panel Sources***
BRD	S	ab1, ab2, bb1, bb2	B Ch primary digital source
BSRD	S	ab1, ab2, bb1, bb2	B Ch secondary digital source
DRD	S	atx, arx, btx, brx	D Ch primary digital source
ASRC	S	ab1, ab2, bb1, bb2	analog source
MSRC	S	atx, arx, btx, brx	S/T monitor source
SYNC	S	1 to 48	S/T line trigger bit
FILE			***File Save and Recall***
FNAM	S	see Note 4	file name
FLBL	S	sssssssssss	12-character file label
FSAV	E		save file
FRCL	E		recall file
GPIB			***RS-232/GPIB Command Translator***
ADDR	S	0 to 30	set device address
MADDR	S	0 to 30	set controller address
CLR	E		selective device clear
GTL	E		go to local
IFC	E		interface clear
LLO	E		device trigger
PON	E		controller power-on reset
IN	R	string	get input from device
OUT	E		transfer message to device
SPOLL	R	string	serial poll
TSND	R	string	TAS-specific cmd transaction
DTO	S	0 to 100 sec	set device time-out
ITC	S	eoi, cr, lf, crlf	set input terminator
MSG	S	string	set output message
REN	S	0, 1	remote enable

NOTE 3: Manual source selections are ab1, ab2, bb1, bb2, extd, extstd, exa, and int.
NOTE 4: FNAM options are the read/write files file0, file1, file2, file3, and file4.

5.3. Apollo Configuration (CNFG)

Command Group Format:

```
/CNFG: command(s)/
```

Command Group Description:

Commands in the CNFG group report and/or set Apollo configuration options, signal coding selections, and status.

Commands:

CODE, LOC, LOCK, MODL, OPT, REM, RESP, STAT, VERS

Commands Description:

CODE selects the type of coding the Apollo is using to transmit and receive signals. Both mu-law and A-law are supported.

```
Command:    /CNFG: CODE= mu/
Response:
```

LOC (local) forces Apollo to accept front panel commands.

```
Command:    /CNFG: LOC/
Response:   /C/
```

LOCK disables the front panel REMOTE key. The LOCK command must follow a REM command, i.e., Apollo must already be in the REMOTE control mode.

```
Command:    /CNFG: LOCK/
Response:   /C/
```

MODL reports the Apollo model number.

```
Command:    /CNFG: MODL/
Response:   /CNFG: MODL=802/ (for AT&T)
Response:   /CNFG: MODL=802_NAT/ (for Bellcore Natl
ISDN)
Response:   /CNFG: MODL=802_CCITT/ (for CCITT)
Response:   /CNFG: MODL=802_NT/ (for Northern
Telecom)
Response:   /CNFG: MODL=802_NPN/ (for NPN)
Response:   /CNFG: MODL=802_SWISS/ (for Switzerland)
Response:   /CNFG: MODL=802_NET3/ (for Europe)
```

OPT reports the Apollo options list.

```
Command:    /CNFG: OPT/
Response:   /CNFG: OPT=00000000/
```

REM forces Apollo to remote control mode.

```
Command:    /CNFG: REM/
Response:   /C/
```

RESP sets the Apollo response mode. The response options are VERBOSE and TERSE.

```
Command:    /CNFG: RESP=VERBOSE/
Response:   /C/
```

STAT reports the Apollo status. See the *Status Codes* section for status code definitions.

```
Command:    /CNFG: STAT/
Response:   /CNFG: STAT=000/
```

VERS reports the Apollo software cartridge version number.

```
Command:    /CNFG: VERS/
Response:   /CNFG: VERS=X.XX/
```

5.4. RMS Measurement (MEAS)

Command Group Format:

```
/MEAS: command(s)/
```

Command Group Description:

The MEAS command group sets RMS measurement parameters and reports the measurement results.

Commands:

AVGT, CHAN, LVL

Commands Description:

AVGT selects the amount of time that elapses before computing the result. Options are **125** (milliseconds), **250**, **500**, **1000** , and **2000**.

```
Command:    /MEAS: AVGT=1000/
Response:   /C/
```

CHAN selects the channel to be measured. Any of the four B channels may be measured. The channel selection is encoded in the following manner: ab1 for station A, channel B1; ab2 for station A, channel B2; bb1 for station B, channel B1; and bb2 for station B, channel B2.

```
Command:    /MEAS: CHAN=ab1/
Response:   /C/
```

LVL requests that the measured level be reported back to the controller. Decimal points are not transmitted across the link. A received value of -100 refers to a measured RMS level of -10.0 dBm. An under range condition is indicated by dashes (----), while an over range condition is indicated by plus symbols (++++).

```
Command:    /MEAS: LVL/
Response:   /MEAS: LVL= -100/
```

5.5. Network Configuration/Impairments (NTWK)

Command Group Format:

```
/NTWK: command(s)/
```

Command Group Description:

The NTWK command group sets the network configuration and impairment parameters.

Commands:

The configuration commands are:
ACTj, MODE, Cjb, MODE (for NPN only), PHj, SUPVj, TASNj, TEIj

The impairment commands are:
IMPST, EBIT, FE, TRGFE

All of the NTWK commands are described in the following section.

Commands Description:

ACTj selects the Activation/Deactivation mode. The allowable parameters are **auto**, **I0**, **I2**, and **I4**. In **auto** mode, Apollo steps through the Activation/Deactivation sequence as specified in CCITT I.430. In **I0**, **I2**, and **I4** modes, Apollo is transmitting INFO0, INFO2, and INFO4 respectively, regardless of the signal it is receiving from the corresponding station.

```
Command:    /NTWK: ACTA=auto/
Response:   /C/
```

CjB selects the configuration option for the B channels. The options are **ns** (no service), **csv** (voice), **csd** (circuit switched data), and **csv|csd**.

```
Command:    /NTWK: CAB1=csv/
Response:   /C/
```

NOTE: There are no allocation selections for the D channel. Passing of Q.931 signaling information is always supported on the D channel.

EBIT selects the pattern transmitted in the D-echo bit (E-bit) channel. The parameter values are **norm**, **inv**, and **X ONES followed by a ZERO**, where x can range from 1 to 15. When **norm** is selected, Apollo transmits (in the E-bit channel) unprocessed D channel information received from the corresponding station. When **inv** is selected, Apollo inverts the D channel information and

transmits it in the E-bit channel. Note that Apollo begins inverting the D channel information only after receiving the opening HDLC flag.

When **X ONES followed by a ZERO** is selected, Apollo transmits a repetitive pattern consisting of X ONES followed by a ZERO. For example, if 7 ONES followed by a ZERO is selected, Apollo is repetitively transmitting an E-bit pattern of 7 ONES, 1 ZERO, 7 ONES, 1 ZERO, etc.

NOTE: If Apollo receives a D channel message while transmitting a repetitive pattern, Apollo suspends the pattern and returns to normal echo until an idle D channel is detected. Once an idle D channel is detected, Apollo returns to transmitting the repetitive pattern.

```
Command:    /NTWK: EBIT=7/
Response:   /C/
```

FE selects the framing error mode. Parameter values are **norm**, **cont**, **1**, **2**, and **3**. If **norm** is selected, no framing errors are introduced. If **cont** is selected, framing errors are introduced into each frame transmitted by Apollo. If **1**, **2**, or **3** is selected, then that number of consecutive frames is transmitted with framing errors when the framing errors are triggered. For example, if 2 is selected, two consecutive frames are transmitted with framing errors when the framing errors are triggered.

```
Command:    /NTWK: FE=1/
Response:   /C/
```

IMPST selects the station to be impaired. The options are **A** or **B**.

```
Command:    /NTWK: IMPST=A/
Response:   /C/
```

MODE (for NPN only) selects the type of operation. The options are switched or non-switched. In the switched mode, Apollo makes connections based upon completion of Q.931 call setup message exchange.

In non-switched mode, Apollo disables Layer 2 and Layer 3 signaling, and provides two end-to-end connections. One connection is between Station A, Channel B1 and Station B, Channel B1. The other connection is between Station A, Channel B2 and Station B, Channel B2.

```
Command:    /NTWK: MODE=sw/
Response:   /C/
```

MODE for non NPN users is a display function which operates only in switched mode.

PHj selects the phone number for each station side. The phone numbers consist of a quoted string of up to 20 characters from the character set 012345678*#.

```
Command:    /NTWK: PHA="5551212"/
Response:   /C/
```

SUPVj selects supervisory signaling status. If **yes** is selected, supervisory signaling is enabled. If **no** is selected, supervisory signaling is disabled.

```
Command:    /NTWK: SUPVB=y/
Response:   /C/
```

TASNj selects the TEI assignment mode. Two modes are supported: **auto** and **fixed**. In **auto** mode, Apollo automatically assigns a TEI value upon ISDN TA/TE TEI Assignment request. In **fixed** mode, you can select a predefined TEI value that Apollo assigns upon ISDN TA/TE TEI Assignment request.

```
Command:    /NTWK: TASNA=fixed/
Response:   /C/
```

TEIj selects the predefined TEI value when operating in **fixed** TEI assignment mode. The allowable TEI values are **0** to **126**.

```
Command:    /NTWK: TEIB=100/
Response:   /C/
```

TRGFE triggers injection of framing errors.

```
Command:    /NTWK: TRGFE/
Response:   /C/
```

5.6. B/D Channel (CHAN)

Command Group Format:

```
/CHAN: command(s)/
```

Command Group Description:

The chan command group selects the source of data destined for each station. This data can come from the other station, from external equipment connected via the rear panel, or be internally generated. Internally generated data consists of a programmable tone (sine wave) or a programmable data pattern. Four independent signals may be simultaneously generated, with each signal transmitted over a different B channel. These data sources provide data to the station only after end-to-end call setup is completed.

Commands:

SMjBb, SjBb, IjBb, LjBb, FjBb, PjBb

Commands Description:

SMjBb sets the B channel source selection mode. The options are **auto** or **manual**. If you select **auto**, Apollo assigns B channels at each station side and automatically makes an end-to-end connection between the two stations. If you choose **manual**, then a connection exists between one station side and another entity after end-to-end call setup is completed. This entity may be an external device or a virtual device inside Apollo.

```
Command:    /CHAN: SMbB2=auto/
Response:   /C/
```

Sjbb selects the B channel data source when manual mode is elected. The options are **bb1**, **bb2**, **ab1**, **ab2**, **extd**, **exstd**, **exa**, and **int**. If you select **bb1**, the source of data transmitted to the corresponding station and B channel is data Apollo receives from station B, channel B1. (Note that data received from a station and channel may be transmitted back to that same station and channel, thereby establishing a loopback configuration.)

If you select **bb2**, the source of data transmitted to the corresponding station and B channel is data Apollo receives from station B, channel B2. Choosing **ab1** selects data from station A, channel B1, and choosing **ab2** selects data from station A, channel B2.

If you select **extd**, the source of data transmitted to the corresponding station and B channel is data Apollo receives from the transmit data lead on the rear panel, B channel (RS-232) connector. If you select **exstd**, the source of data transmitted to

the corresponding station and B channel is data Apollo receives from the secondary transmit data lead on the rear panel, B channel (RS-232) connector.

If you select **exa**, the data is taken from the analog-in rear panel BNC connector. (Note that these analog signals will be pcm encoded based on the coding selection made with the CONFIG menu.)

If you select **int**, the data is internally generated by Apollo. Internally generated data consists of either a programmable tone (sine wave) or a programmable data pattern. Four independent signals may be simultaneously generated. Each signal is transmitted over a different B channel. (Note that these analog signals will be pcm encoded based on the coding selection made with the CONFIG menu.)

```
Command:    /CHAN: SaB1=bb1/
Response:   /C/
```

Ijbb selects the internal signal source. The options are **tone** or **patt**. If you select **tone**, then a sine wave is transmitted to the corresponding station and B channel. If you select **patt**, an 8-bit pattern is transmitted.

```
Command:    /CHAN: IbB1=tone/
Response:   /C/
```

Ljbb selects dBm level of the internally generated sine wave. This level is the RMS value of the signal referenced to a 600 ohm impedance. The supported level range is from **-40.0 dBm** to **0.0 dBm**, in 0.1 dBm steps. Decimal points are not transmitted across the link. A level of -10.0 dBm is represented by -100.

```
Command:    /CHAN: LaB2=-100/
Response:   /C/
```

Fjbb selects the frequency of the internally generated sine wave. Frequencies between **300 Hz** and **3,200 Hz** are supported in 1 Hz intervals.

```
Command:    /CHAN: FaB1=1004/
Response:   /C/
```

Pjbb selects the 8-bit pattern. Pattern ranges may be between **00**h and **FF**h.

```
Command:    /CHAN: PbB2=AA/
Response:   /C/
```

5.7. Rear Panel (RPIO)

Command Group Format:

```
/RPIO: command(s)/
```

Command Group Description:

The RPIO command group selects the sources of data destined for the rear panel connectors. This command group also selects which station is monitored via the S/T line BNC jack on the rear panel, and sets the corresponding trigger bit parameter.

Commands:

BRD, BSRD, DRD, ASRC, MSRC, SYNC

Commands Description:

BRD selects the data source that is transmitted on the receive data lead on the rear panel B channel (RS-232) connector. The options are **ab1**, **ab2**, **bb1**, and **bb2**. If you choose **ab1**, data Apollo receives from station A, channel B1 is transmitted on the receive data lead. If you choose **ab2**, data Apollo receives from station A, channel B2 is transmitted on the receive data lead. Choosing **bb1** selects data from station B, channel B1, and choosing **bb2** selects data from station B, channel B2.

```
Command:    /RPIO: BRD=ab1/
Response:   /C/
```

BSRD selects the data source that is transmitted on the secondary receive data lead on the rear panel B channel (RS-232) connector. The options are **ab1**, **ab2**, **bb1**, and **bb2**. If you choose **ab1**, the data Apollo receives from station A, channel B1 is transmitted on the secondary receive data lead. If you choose **ab2**, data Apollo receives from station A, channel B2 is transmitted on the secondary receive data lead. Choosing **bb1** selects data from station B, channel B1, and choosing **bb2** selects data from station B, channel B2.

```
Command:    /RPIO: BSRD=bb1/
Response:   /C/
```

DRD selects the data source that is transmitted on the receive data lead on the rear panel D channel (RS-232) connector. The options are **atx**, **arx**, **btx**, and **brx**. If you choose **atx**, D channel data Apollo transmits to station A is transmitted on the receive data lead. If you choose **arx**, D channel data Apollo receives from station A is transmitted on the receive data lead. Choosing **btx** selects D channel data

transmitted to station B. Choosing **brx** selects D channel data received from station B.

```
Command:    /RPIO: DRD=atx/
Response:   /C/
```

NOTE: Selecting data for the receive data lead automatically selects data on the secondary receive data lead. In this scenario, if a station's transmit data is placed on the receive data lead, that same station's receive data is transmitted on the secondary receive data lead.

For example, by selecting **atx** as the D-CH RD source, **arx** is automatically transmitted on the secondary receive data lead. If **brx** is chosen for the D-CH RD source, **btx** is automatically transmitted on the secondary receive data lead.

ASRC selects the data source that is transmitted out the analog-out BNC rear panel connector. The options are **ab1**, **ab2**, **bb1**, and **bb2**. If you choose **ab1**, the data Apollo receives from station A, channel B1 is transmitted out the analog port. Similarly, if you choose **ab2**, data Apollo receives from station A, channel B2 is transmitted out the analog port. Choosing **bb1** selects data from station B, channel B1, and choosing **bb2** selects data from station B, channel B2. Note that in performing the digital-to-analog conversion for this port, Apollo assumes mu-law PCM samples have been sent by the ISDN TA/TE.

```
Command:    /RPIO: ASRC=ab1/
Response:   /C/
```

MSRC selects the station being monitored via the S/T trigger BNC rear panel connector. The options are **atx**, **arx**, **btx** and **brx**. **Atx** refers to the 192 kb/s signal Apollo is transmitting to station A. **Arx** refers to the 192 kb/s signal Apollo is receiving from station A. **Btx** refers to the 192 kb/s signal Apollo is transmitting to station B. **Brx** refers to the 192 kb/s signal Apollo is receiving from the station B.

```
Command:    /RPIO: MSRC=atx/
Response:   /C/
```

SYNC selects which bit in the S/T bit stream triggers the oscilloscope via the S/T trigger BNC rear panel connector. The value range for sync is **1** to **48**.

```
Command:    /RPIO: SYNC=1/
Response:   /C/
```

5.8. File Save/Recall (FILE)

Command Group Format:

```
/FILE: command(s)/
```

Command Group Description:

The FILE command group saves and recalls Apollo configuration files.

Commands:

FNAM, FLBL, FSAV, FRCL

Commands Description:

FNAM selects the file to be saved or recalled. FNAM options are the read/write files **file0**, **file1**, **file2**, **file3**, and **file4**.

```
Command:    /FILE: FNAM=file2, FLBL="test_a", FSAV/
Response:   /C/
```

FLBL sets the file label for a read/write file. FLBL is an ASCII string of up to 12 characters.

```
Command:    /FILE: FNAM=file2, FLBL="myfile", FSAV/
Response:   /C/
```

FSAV saves the current Apollo configuration to a read/write file. Use the FNAM command to select the target file.

```
Command:    /FILE: FNAM=file0, FLBL="myfile", FSAV/
Response:   /C/
```

FRCL recalls the Apollo configuration file specified by the FNAM command.

```
Command:    /FILE: FNAM=file0, FRCL/
Response:   /C/
```

5.9. RS-232/GPIB Command Translator (GPIB)

Command Group Format:

```
/GPIB: command(s)/
```

Command Group Description:

The GPIB command group controls the operation of the Apollo RS-232/GPIB command translator. Before using the command translator, you should be familiar with GPIB operation and terminology.

Commands:

ADDR, MADDR, CLR, GTL, IFC, LLO, TRIG, PON, IN, OUT, SPOLL, TSND, DTO, ITC, MSG, REN

Commands Description:

ADDR sets the address of the GPIB device to be controlled by Apollo. Apollo controls one GPIB talker/listener device at a time. The range for ADDR is **0** to **30**.

```
Command:    /GPIB: ADDR=2/
Response:   /C/
```

MADDR sets the GPIB address of the Apollo GPIB controller. This address should be different from the GPIB device addresses. The range for MADDR is **0** to **30**.

```
Command:    /GPIB: MADDR=0/
Response:   /C/
```

CLR directs Apollo to issue a selective device clear to a GPIB instrument.

```
Command:    /GPIB: ADDR=2, CLR/
Response:   /C/
```

GTL directs Apollo to issue a Go To Local command to the selected device.

```
Command:    /GPIB: GTL/
Response:   /C/
```

IFC directs Apollo to issue an Interface Clear command. The Interface Clear command directs all GPIB devices to cease bus transactions and place bus drivers in a passive state.

```
Command:    /GPIB: IFC/
Response:   /C/
```

LLO directs Apollo to issue a Local Lockout command to the selected device. The Local Lockout command tells the device to disable front panel control.

```
Command:    /GPIB: LLO/
Response:   /C/
```

TRIG directs Apollo to issue an Execute Trigger command to the selected device.

```
Command:    /GPIB: TRIG/
Response:   /C/
```

PON resets the Apollo GPIB controller to its power-on condition.

```
Command:    /GPIB: PON/
Response:   /C/
```

IN transfers data from the GPIB device to the RS-232 controller. To execute this command, Apollo issues an Input command to the GPIB device and accepts input until it detects the input termination condition. Apollo then forwards the data to the RS-232 controller.

```
Command:    /GPIB: IN/
Response:   /GPIB: IN="12.0 VOLTS"/
```

OUT transfers data from the RS-232 controller to the selected GPIB device. Before executing the OUT command, use the MSG command to specify the data to be transferred.

```
Command:    /GPIB: MSG="LEVEL=-10", OUT/
Response:   /C/
```

SPOLL directs Apollo to execute a serial poll of the selected device and return the result. SPOLL returns either the (hex) value of the GPIB device's status byte, or returns an Apollo Device Time-out status code.

```
Command:    /GPIB: ADDR=12, SPOLL/
Response:   /GPIB: SPOLL=04/
```

TSND directs Apollo to execute a command/response transaction with a TAS GPIB device. Before executing TSND, use the SPOLL command to ensure that the TAS device is idle.

```
Command:    /GPIB: MSG="/IO, L-230/", TSND/
Response:   /GPIB: TSND="/C/"/
```

DTO sets the GPIB Device Time-out. If the Apollo GPIB controller does not receive a response from the device before the end of the device time-out interval, Apollo returns a Device Time-out status code. The range for DTO is **1** to **100** seconds.

```
Command:    /GPIB: DTO=10/
Response:   /C/
```

ITC specifies the interface termination condition that the Apollo GPIB controller applies to incoming data. ITC options are **eoi**, **cr**, **lf**, and **crlf**. Apollo strips input termination characters from the input.

```
Command:    /GPIB: ITC=cr/
Response:   /C/
```

MSG specifies the message to be used in the OUT or TSND command. MSG is an ASCII string of up to 256 characters.

```
Command:    /GPIB: MSG="VOLTAGE=15"/
Response:   /C/
```

REN controls the state of the Apollo GPIB controller Remote Enable signal. Apollo activates Remote Enable if REN=**1**, and deactivates Remote Enable if REN=**0**.

```
Command:    /GPIB: REN=1/
Response:   /C/
```

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6.0. APOLLO ERROR CODES

Apollo provides status codes to indicate its current state of operation. In some cases, Apollo displays a status code on the front panel to indicate an error condition. Status codes are also available on the remote control (GPIB or RS-232) interfaces. For more information on reading status codes, see the CNFG command group in the *Remote Commands Reference* section.

Status Code	Description
000	all is well with Apollo
001	command value error
002	command syntax error
003	command group syntax error
004	command failure
005	undefined command group
006	undefined command
007	could not recall file
008	GPIB device time-out
009	GPIB in incorrect state during TSND
010	RS-232/GPIB translator cannot be used
011	power-up failure
012	power-up calibration failure
013	EPROM checksum failure
014	internal software errors
015	reserved
016	reserved
017	reserved
018	reserved
019	command not accepted in local mode

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7.0. TECHNICAL SPECIFICATIONS

7.1. General

AC Power Requirements (for Units Without Power Feed Socket)

Voltage	115/230 VAC (selectable) (115 VAC for 90 to 130 V operation, 230 VAC for 180 to 250 V operation)
Frequency	48-63 Hertz
Dissipation	50 watts maximum

AC Power Requirements (for Units With Power Feed Socket)

Voltage	85 to 265 VAC
Frequency	48-63 Hertz
Dissipation	50 watts maximum

Operating Environment

Temperature	0 to 50 degrees C (32 to 122 degrees F)
Humidity	10% to 90% noncondensing

Dimensions and Weight

Height	3.5 inches
Width	11.5 inches
Depth	14.5 inches
Weight	9 pounds (maximum)

7.2. Remote Control Interfaces

IEEE-488

Capabilities	talker/listener, controller

RS-232

Data Rates	300, 1200, 2400, 4800 bps
Character Size	7 or 8 bits
Parity	odd, even, none
Stop Bits	1, 1.5, or 2

7.3. S/T Interface

As per CCITT I.430 (Blue Book).

7.4. Switch Simulation

AT&T

The simulated switch for AT&T is 5ESS 5E5 generic: simulation supports only single terminal operation (point-to-point) for circuit switching.

CCITT

The simulated switch for CCITT is as defined in Recommendation Q.931 (1988 Blue Book); simulation supports only single terminal operation (point-to-point) for circuit switching.

Northern Telecom

The simulated switch for Northern Telecom is DMS-100 BCS31 generic: simulation supports two TEIs for point-to-point operation for circuit switching. Only functional signaling is supported.

National ISDN

The simulated switch for National ISDN 1 is as defined in Bellcore TR - TSY 000268 Issue 3, May 1989: simulation supports only single terminal operation (point-to-point) for circuit switching.

NPN

The simulated switch for NPN is INS - NET 64; simulation supports only single terminal operation (point to point) for circuit switching.

Net 3

The simulated switch for Net 3 is as defined in ETS 300 102-, simulation supports only single terminal operation (point to point) for circuit switching.

7.5. B/D Channel Ports

Interfaces (B and D Channels)

Type	RS-232 (DCE)
Data Format	synchronous
Clock Source	internal
Flow Control	none

Internal Clock

Data Rates	B channel = 64 Kbps, D channel = 16 Kbps
Accuracy	+/- 0.01%

7.6. Internal Signal Generation

Coding	A-law or mu-law
Frequency	300 to 3,200 Hz
Frequency Accuracy	+/- 1 Hz
Level	-40.0 to 0.0 dBm
Level Accuracy	+/- 0.5 dBm

7.7. Internal Pattern Generation

Pattern Range	00 to FF (Hex)

7.8. RMS Measurement

Level	-40.0 to 0.0 dBm
Accuracy	+/- 0.5 dBm

7.9. Scope Monitor Levels and Trigger

Monitored Level	5x actual line signal
Programmable Trigger	TTL

7.10. Analog I/O

Coding	A-law or mu-law
Input Frequency	300 to 3,200 Hz
Input Impedance	600 ohms
Input Level	-40.0 to 0.0 dBm
Output Frequency	300 to 3,200 Hz
Output Impedance	600 ohms
Output Level	-40.0 to 0.0 dBm

7.11. Power Feed Option Power Supply (for Units with Rear Panel Power Feed Sockets)

AC Input Voltage:	115 VAC (range 103 to 126 VAC) 230 VAC (range 202 to 248 VAC)
Frequency:	50 to 60 Hertz
Dissipation:	12 watts at 300 mA
DC Voltage:	Dual, isolated 40 VDC outputs with short circuit protection

7.12. Interface DTE A and DTE B Pin Assignments

PIN	SIGNAL	RS-232 CIRCUIT	SOURCE	V.24 CIRCUIT
1	Protective Ground	AA	---	101
2	Transmit Data	BA	DTE	118
3	Receive Data	BB	DCE	104
4	Request to Send	CA	DTE	105
5	Clear to Send	CB	DCE	106
6	Data Set Ready	CC	DCE	107
7	Signal Ground	AB	---	102
8	Carrier Detect	CF	DCE	109
9	NC			
10	NC			
11	NC			
12	Secondary Carrier Det.	SCF	DCE	122
13	Secondary Clear to Send	SCB	DCE	121
14	Secondary transmit Data	SBA	DTE	118
15	Modem Provided Transmit Clock	DB	DCE	114
16	Secondary Receive Data	SB	DCE	119
17	Receive Clock	DD	DCE	115
18	NC			
19	Secondary Req. Send	SCA	DTE	120
20	Data Terminal Ready	CD	DTE	108.2
21	Signal Quality Detector	CG	DCE	110
22	Rind Indicator	CE	DCE	125
23	Data Rate Selector	CH	DCE	111
24	Terminal Provided Transmit Clock		DA	DTE 113
25	Unassigned			DCE

7.13. RS-232 Control Port Pin Assignments

PIN	SIGNAL	RS-232 CIRCUIT	SOURCE	V.24 CIRCUIT
1	Protective Ground	AA	---	101
2	Transmit Data	BA	DTE	118
3	Receive Data	BB	DCE	104
4	Request to Send	CA	DTE	105
5	Clear to Send	CB	DCE	106
6	Data Set Ready	CC	DCE	107
7	Signal Ground	AB	---	102
20	Data Terminal Ready	CD	DTE	108.2

7.14. GPIB Control Port Pin Assignments

PIN	FUNCTION
1	DIO1
2	DIO2
3	DIO3
4	DIO4
5	EOI
6	DAV
7	NRFD
8	NDAC
9	IFC
10	SRQ
11	ATN
12	Frame Ground
13	DIO5
14	DIO6
15	DIO7
16	DIO8
17	Signal Ground
18	Signal Ground
19	Signal Ground
20	Signal Ground
21	Signal Ground
22	Signal Ground
23	Signal Ground
24	Signal Ground

7.15. AUX Port Pin Assignments

PIN	FUNCTION
1	Reserved
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Reserved
8	Reserved
9	Reserved

7.16. Power Feed Pin Assignments

PIN	FUNCTION
1	Ground
2	NC
3	+40 VDC
4	+40 VDC
5	Ground

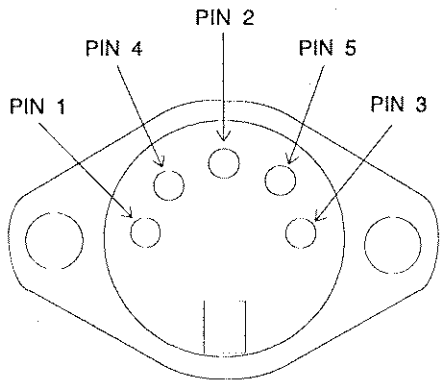

Figure 7-1. Power Feed Pin Locations

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8.0. SDL DIAGRAMS

This section contains Specification Description language (SDL) diagrams for several switches that illustrate the call processing logic in the TAS ISDN Emulator.

8.1. NATL-ISDN SDL Diagrams

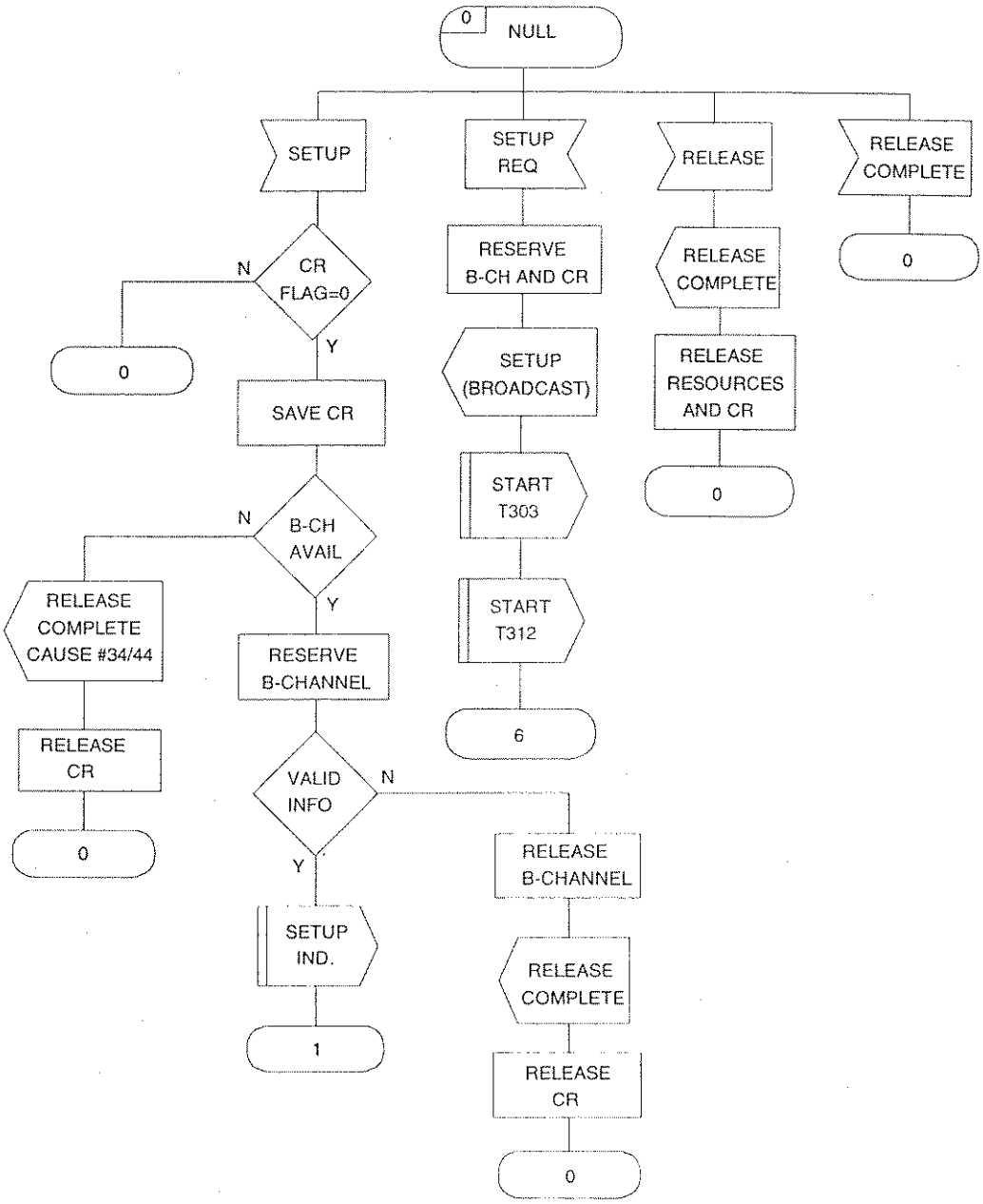

Figure 8-1. NATL-ISDN Call Control SDL Diagram - Network Side (1 of 8)

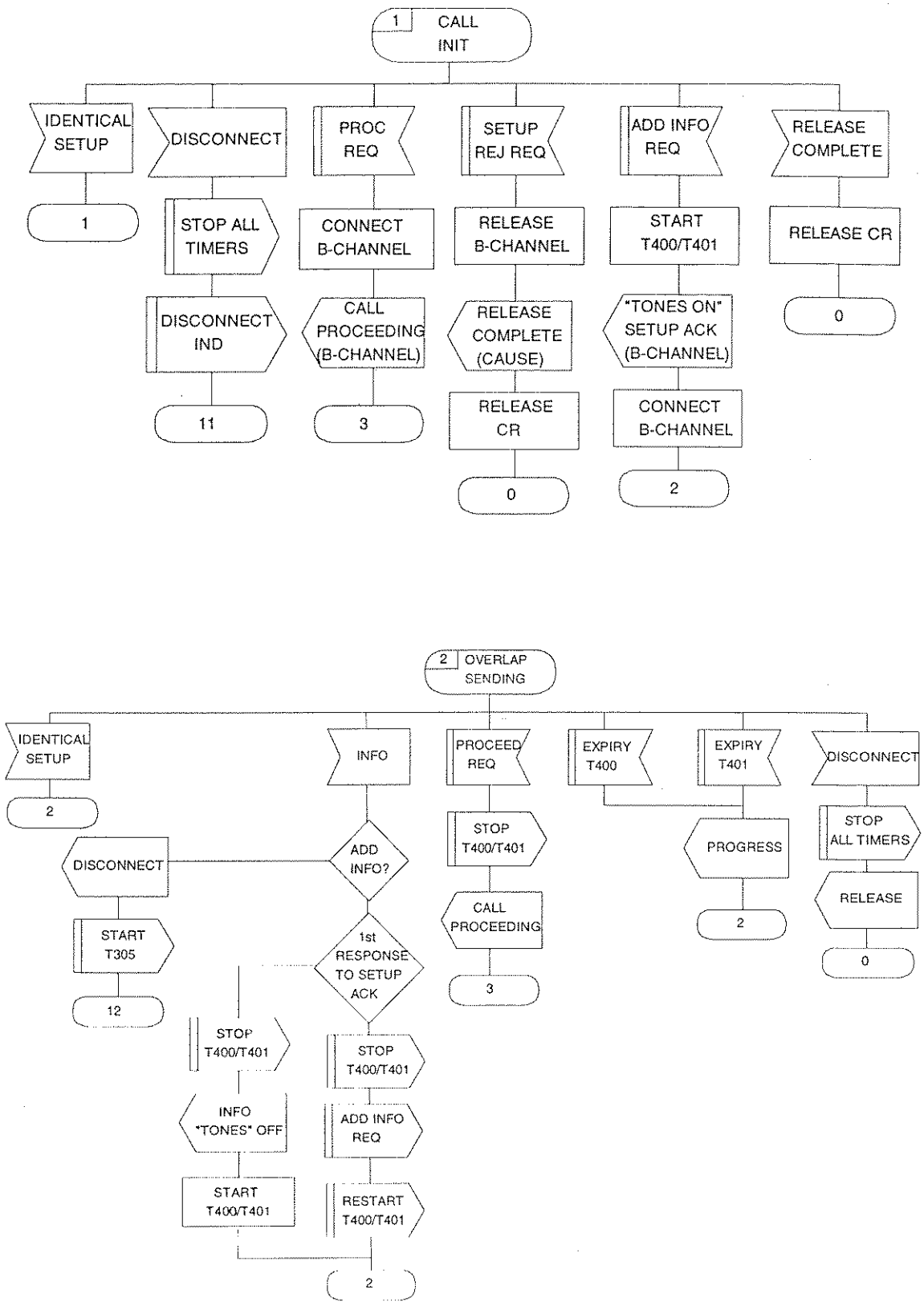

Figure 8-2. NATL-ISDN Call Control SDL Diagram - Network Side (2 of 8)

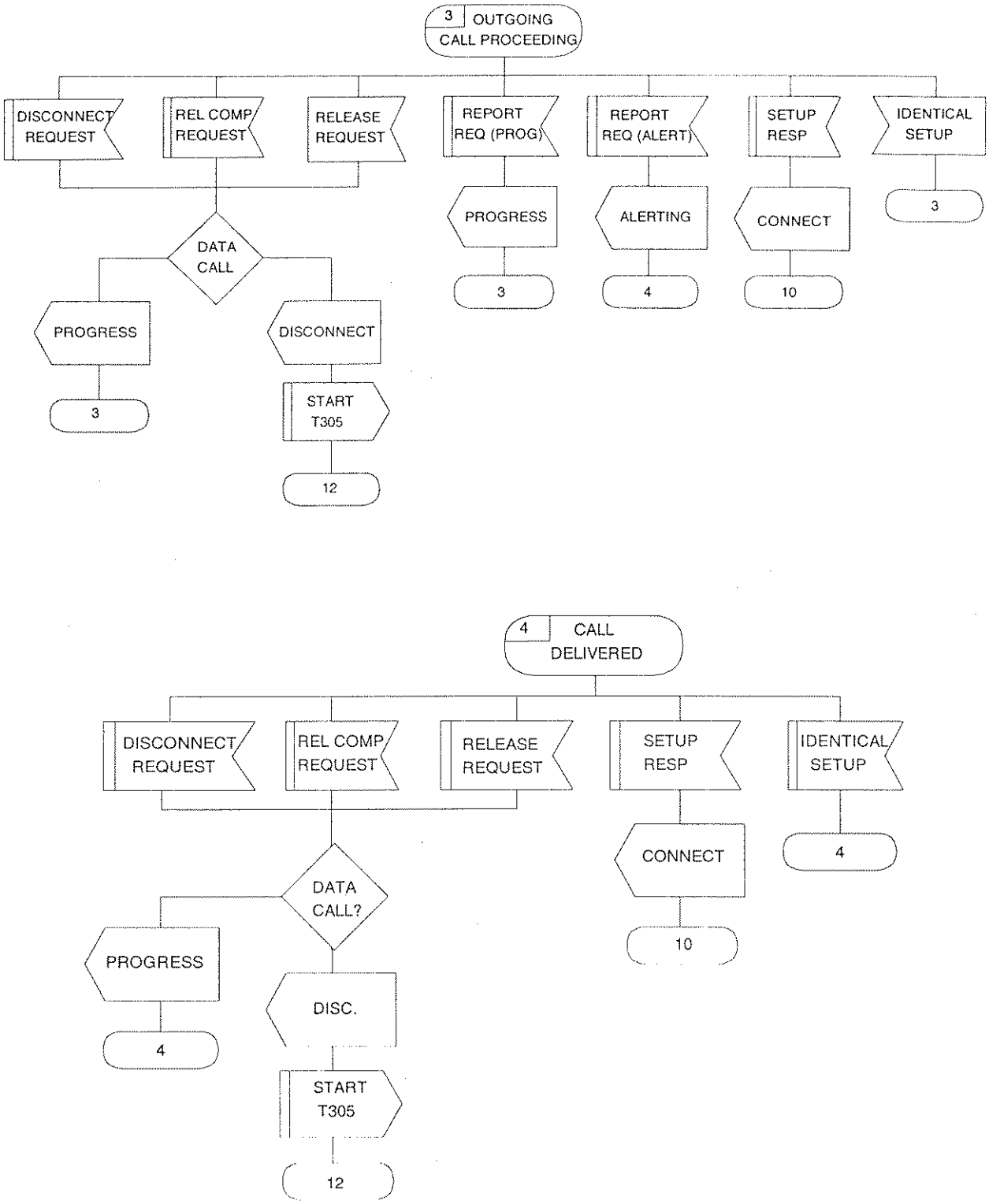

Figure 8-3. NATL-ISDN Call Control SDL Diagram - Network Side (3 of 8)

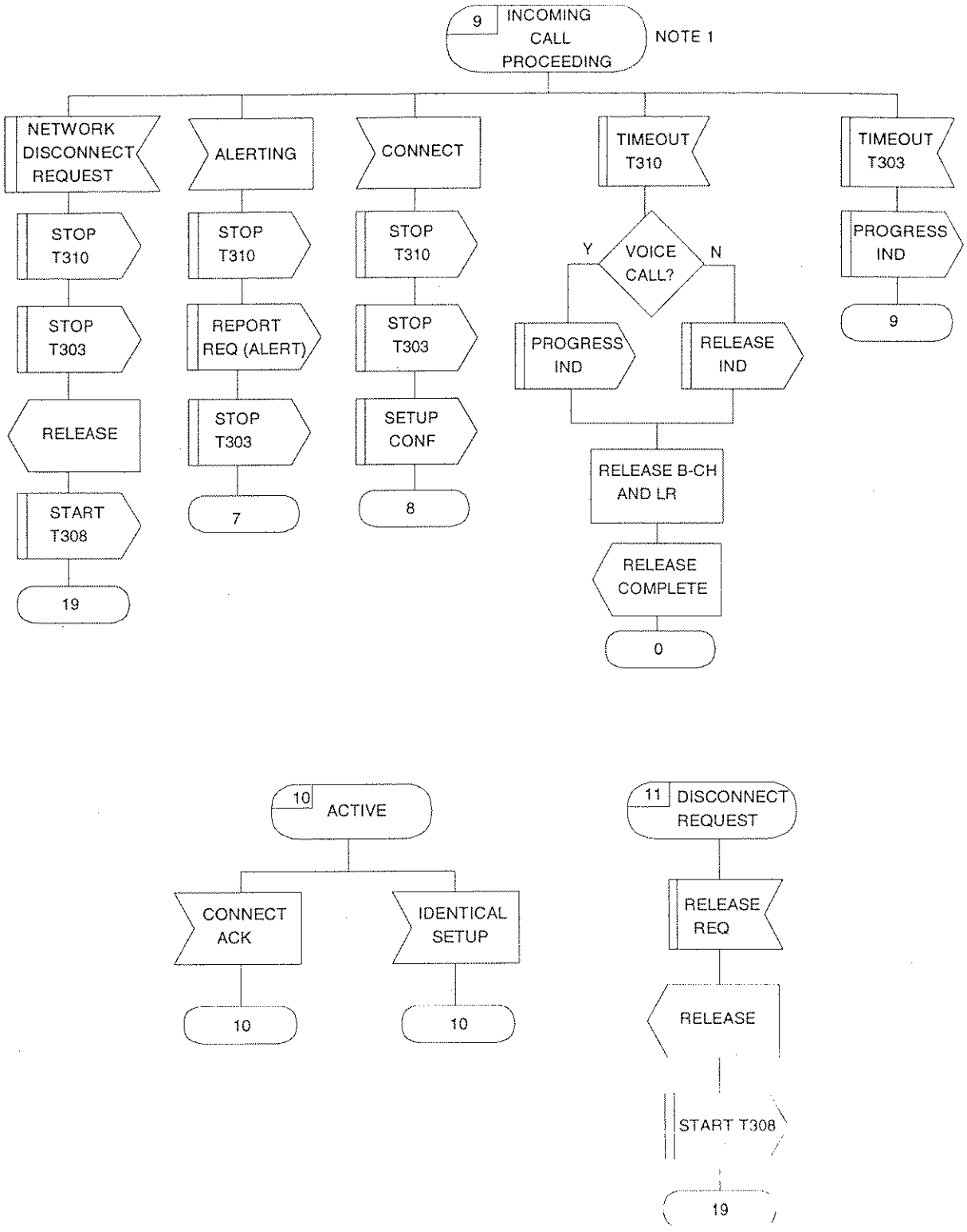

Figure 8-4. NATL-ISDN Call Control Diagram - Network Side (4 of 8)

NOTE 1: A separate state machine exists for each user whichhas responded to the incoming setup with a call proc.

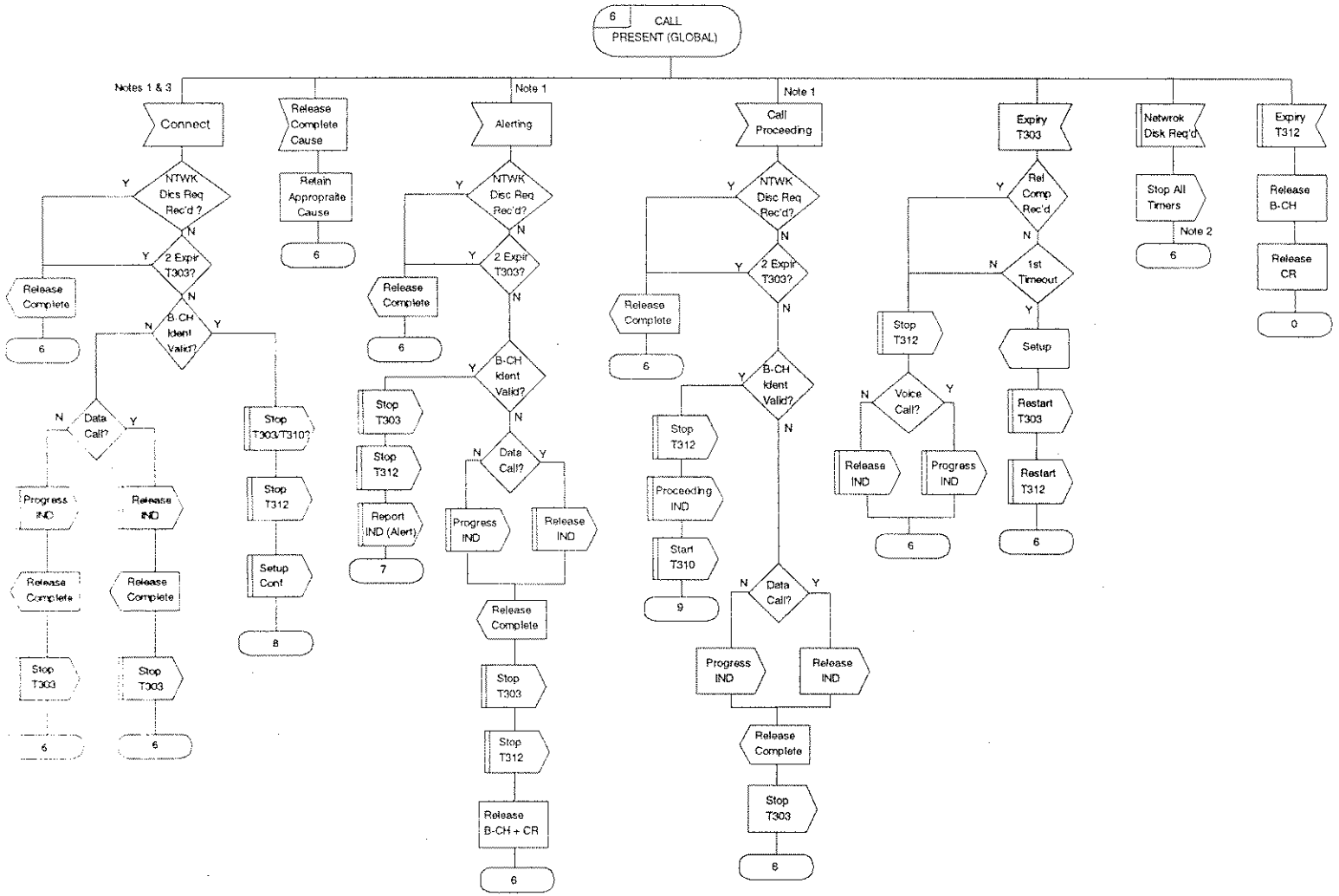

Figure 8-5. NATL-ISDN Call Control SDL Diagram - Network Side (5 of 8)

Note 1: Call Proc alert and connect are received on a specific data link. A new state machine for the indicated terminal has to be setup.

Note 2: Call clearing shall be initiated for each terminal which has responded by sending a network disconnect request.

Note 3: When the first connect message is received the network should initiate non-selected user clearing for all other users which have responded by sending a non-select request.

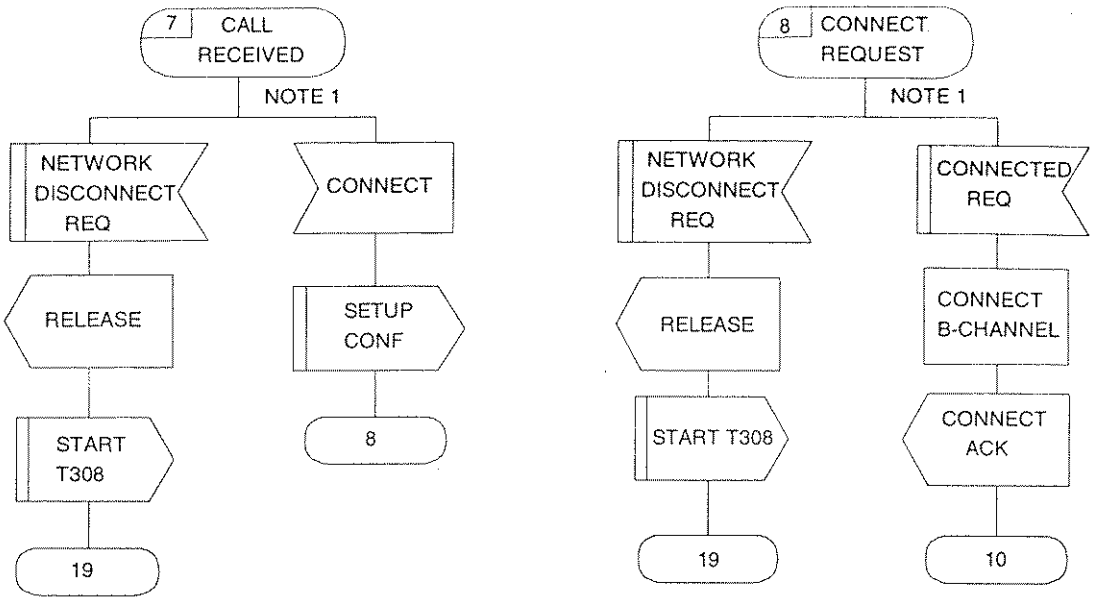

Figure 8-6. NATL ISDN Call Control SDL Diagram - Network Side (6 of 8)

NOTE 1: A separate state machine exists for each user on a point to multipoint interface.

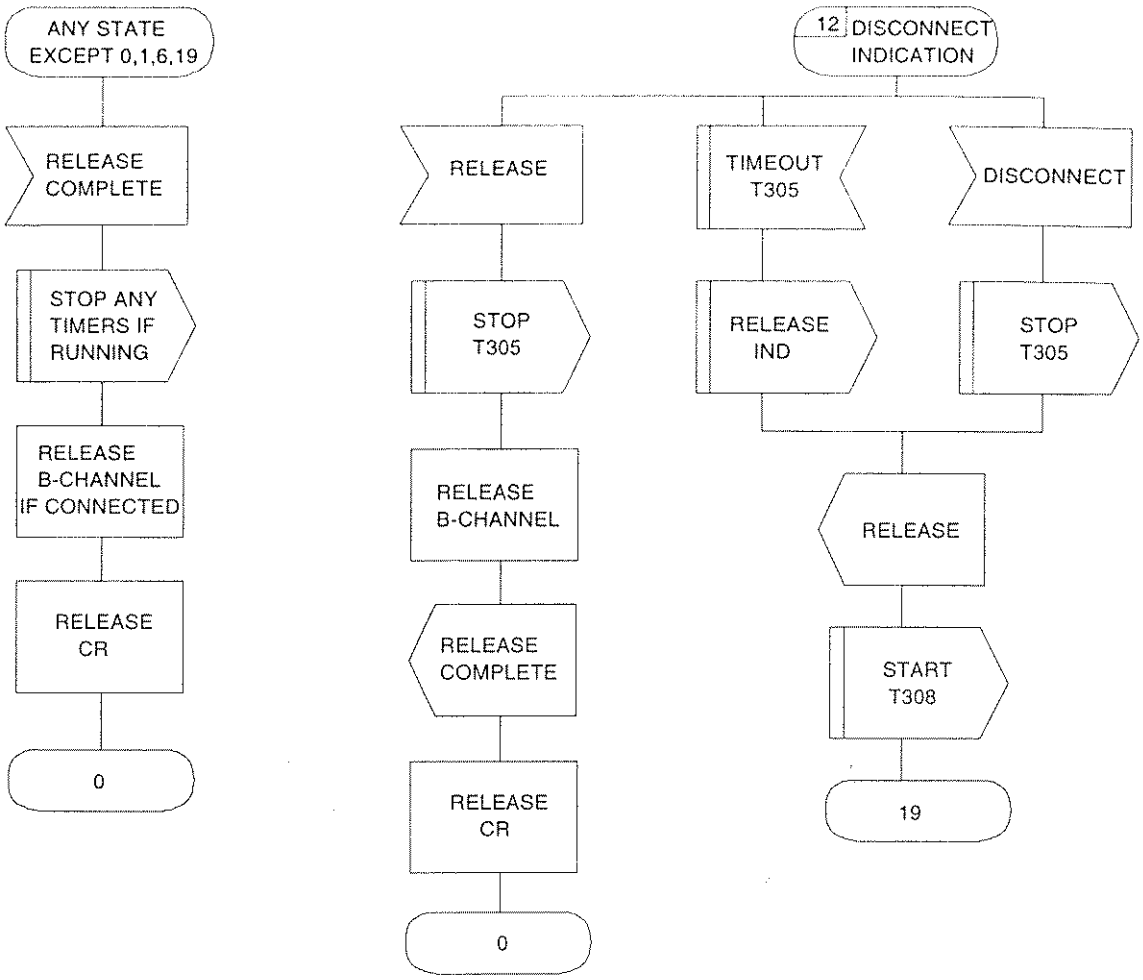

Figure 8-7. NATL-ISDN Call Control SDL Diagram - Network side (7 of 8)

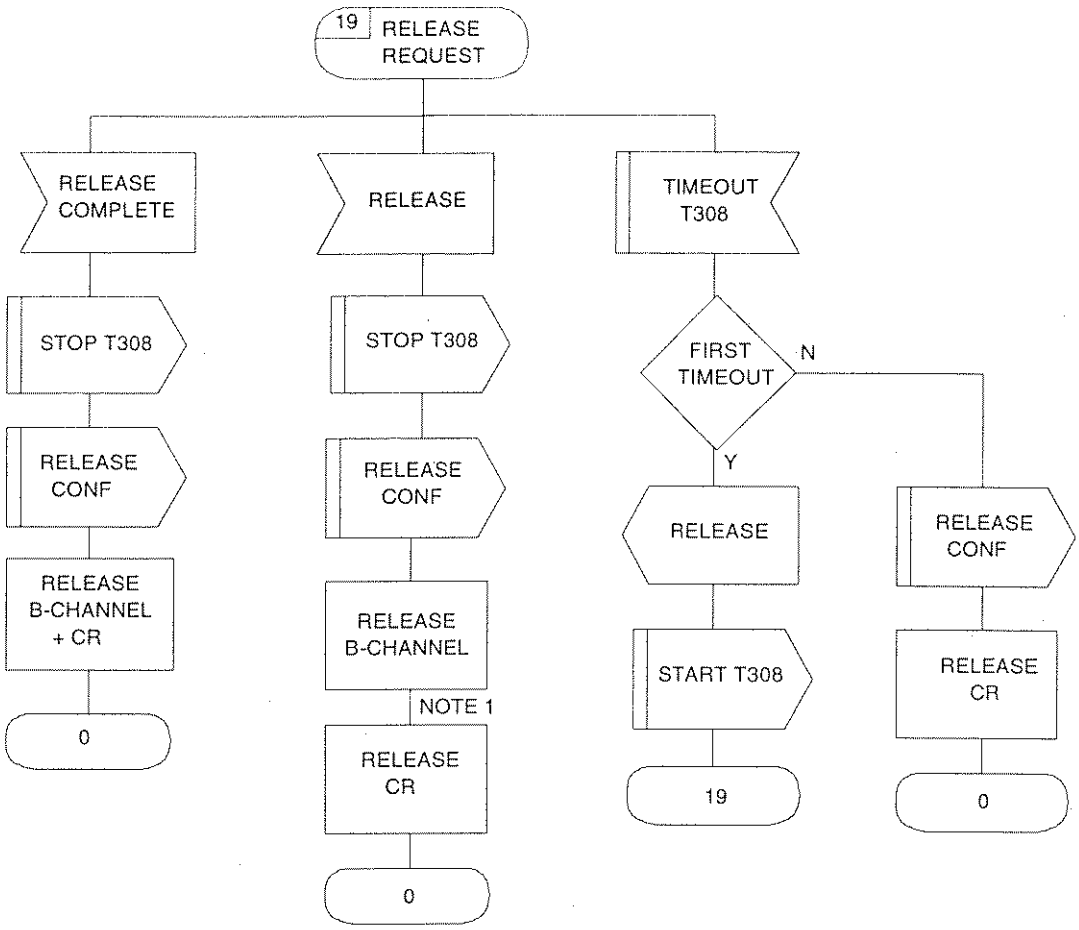

Figure 8-8. NATL-ISDN Call Control SDL Diagram - Network Side (8 of 8)

NOTE 1: The CR should not be reused right away for a new call. Otherwise, the release complete for the network will be mistaken as a reject to the new call.

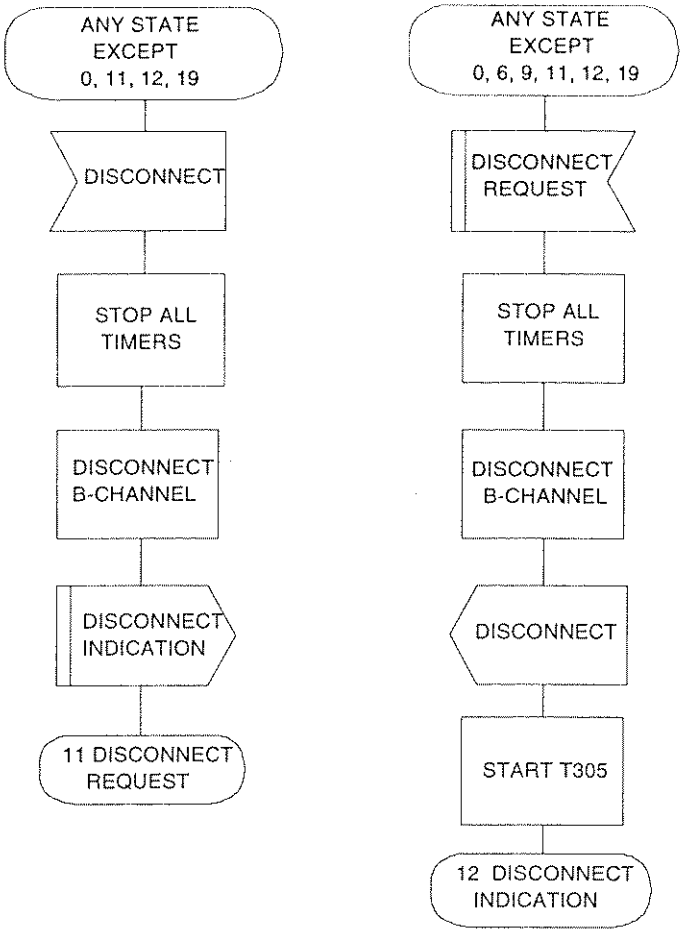

Figure 8-9. NATL-ISDN Detailed Protocol Control - Network Side (19 of 21)

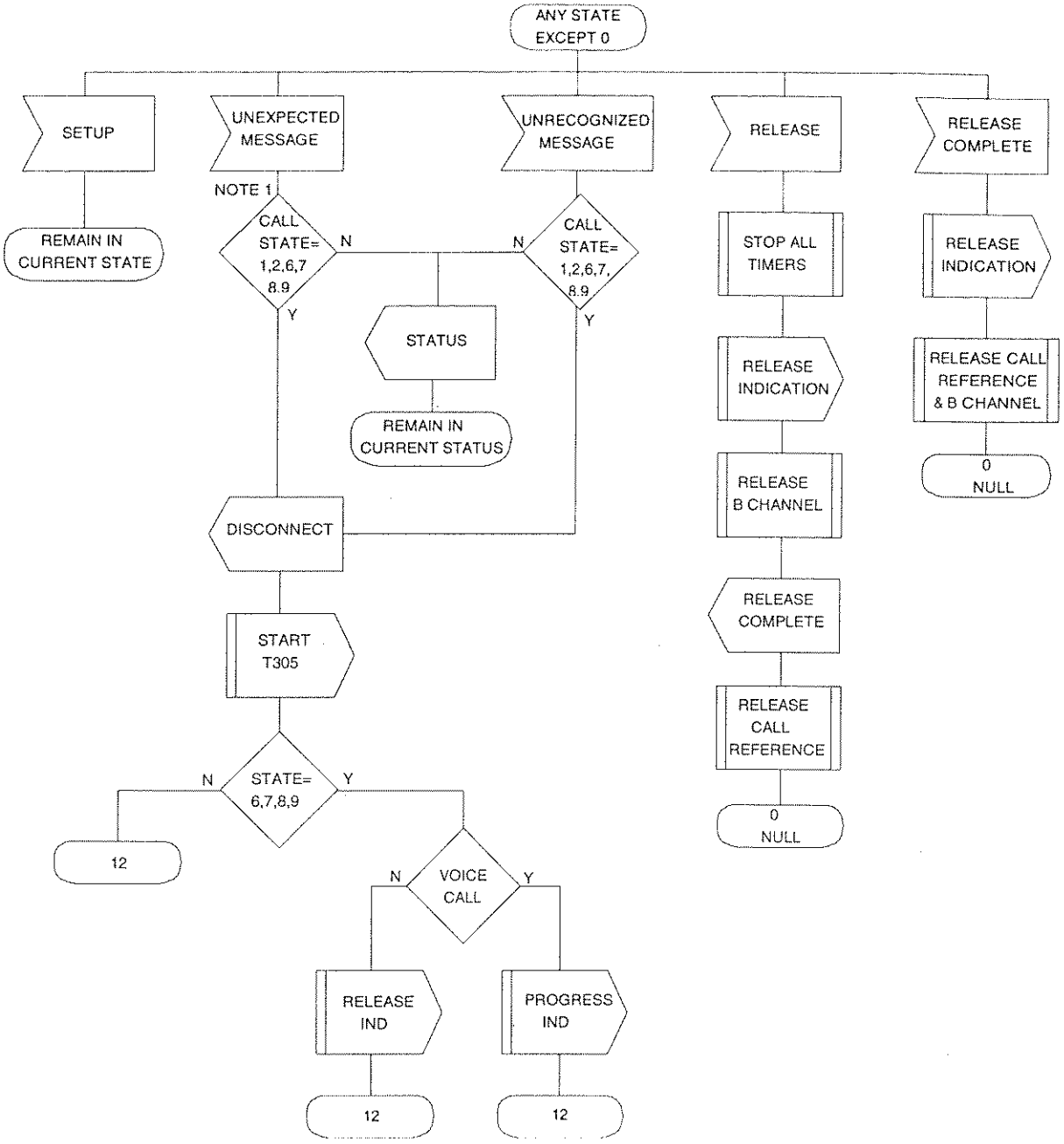

Figure 8-10. NATL-ISDN Detailed Protocol Control - Network Side (20 of 21)

NOTE 1: Except release or release complete messages.

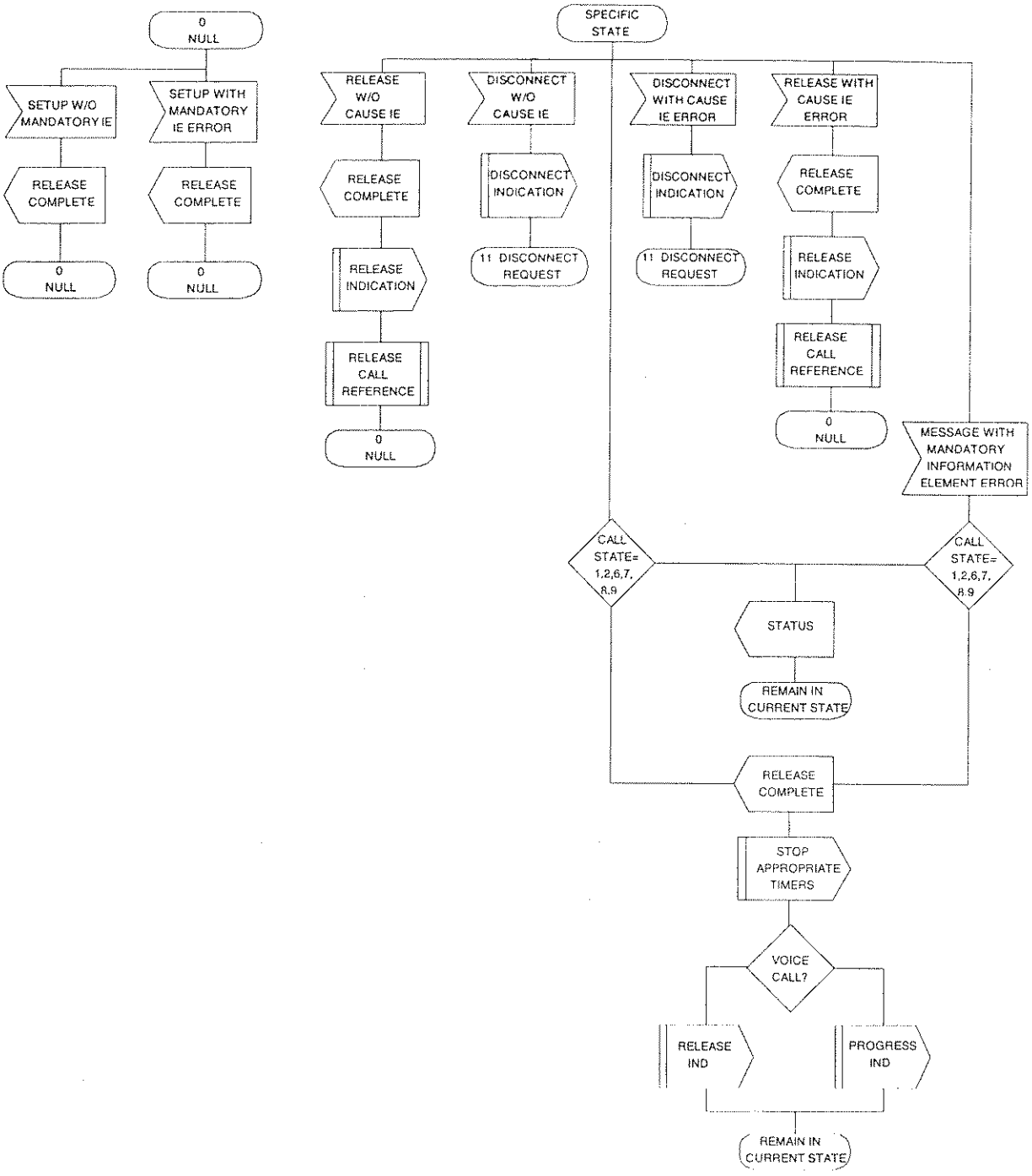

Figure 8-11. NATL-ISDN Detailed Protocol Control - Network Side (21 of 21)

8.2. TAS NPN SDL Diagrams

This section contains Specification Description Language (SDL) diagrams illustrating the call processing logic in the TAS NPN ISDN Emulator

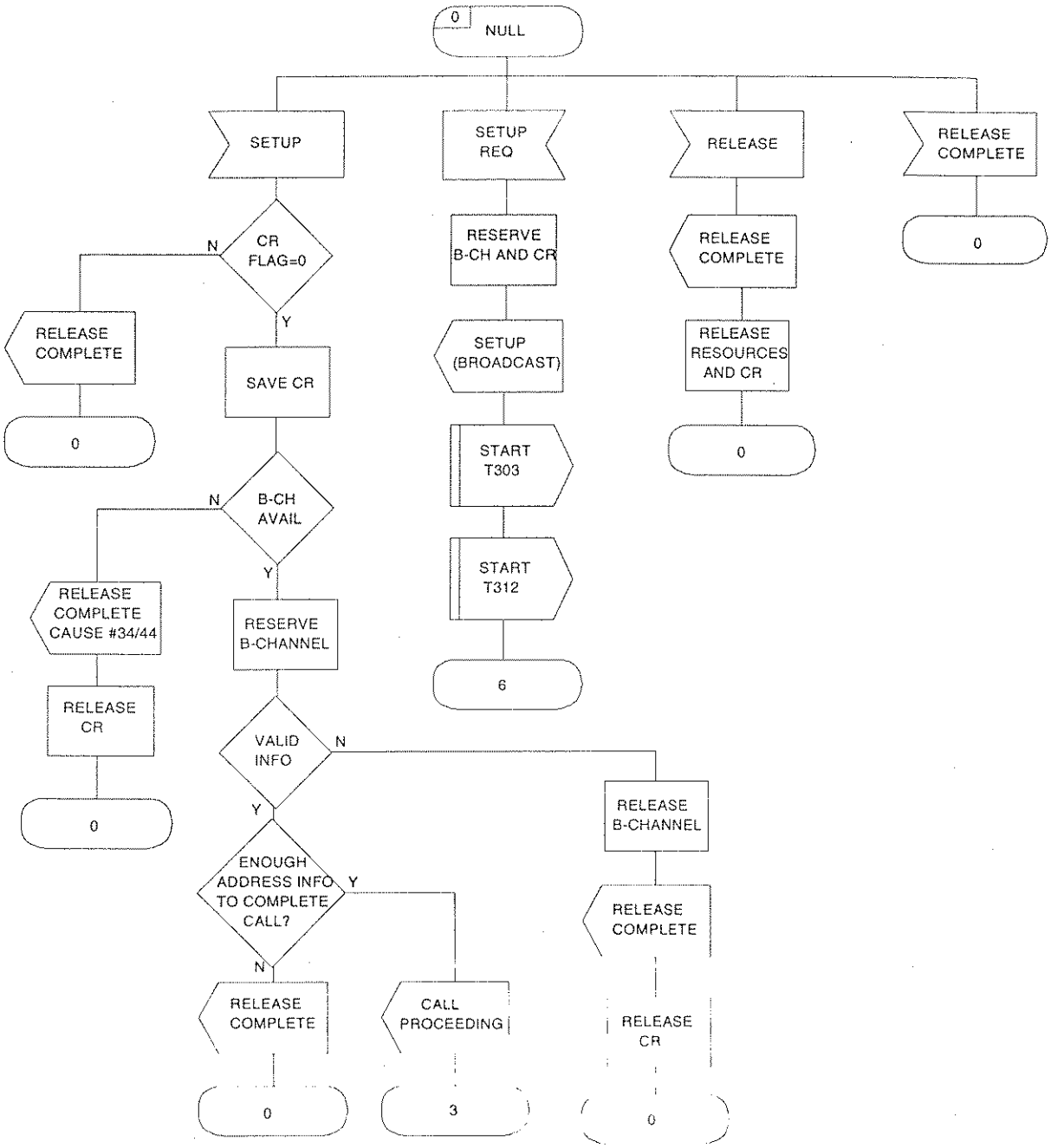

Figure 8-12. NPN Call Control SDL Diagram - Network Side (1 of 8)

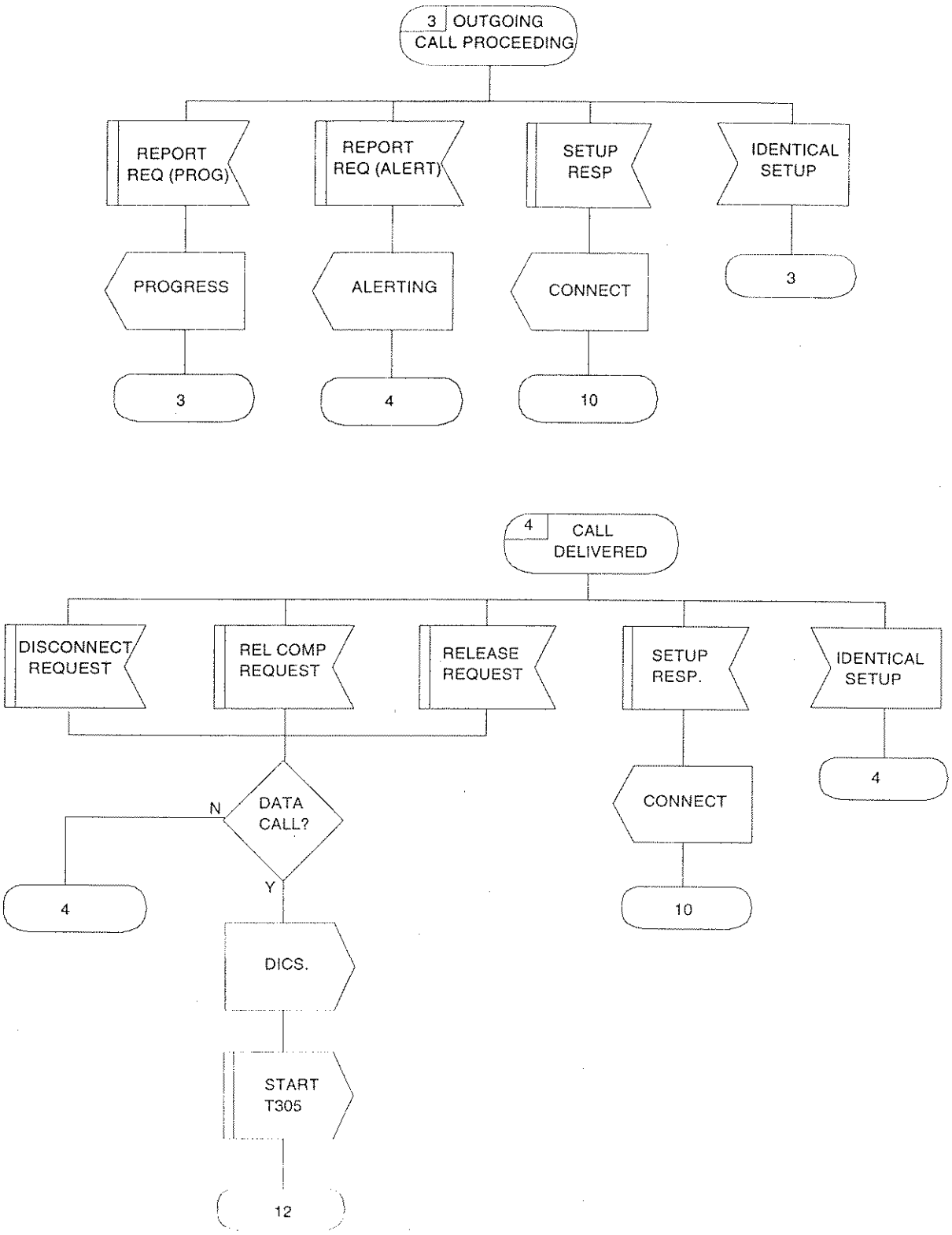

Figure 8-13. NPN Call Control SDL Diagram - Network Side (2 of 8)

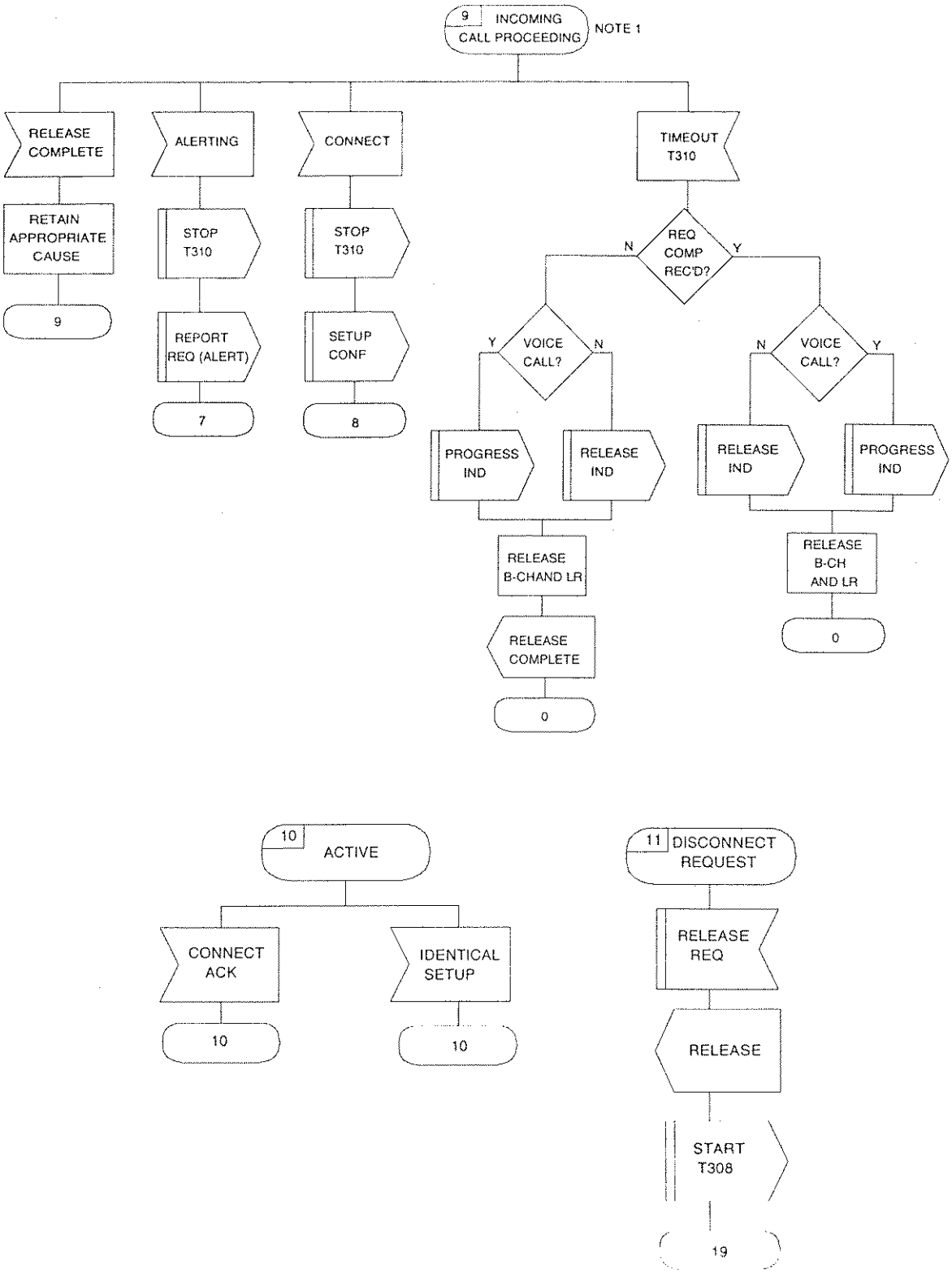

Figure 8-14. NPN Call Control SDL Diagram - Network Side (3 of 8)

NOTE 1: A separate state machine exists for each user which has responded to the incoming setup with a call proc.

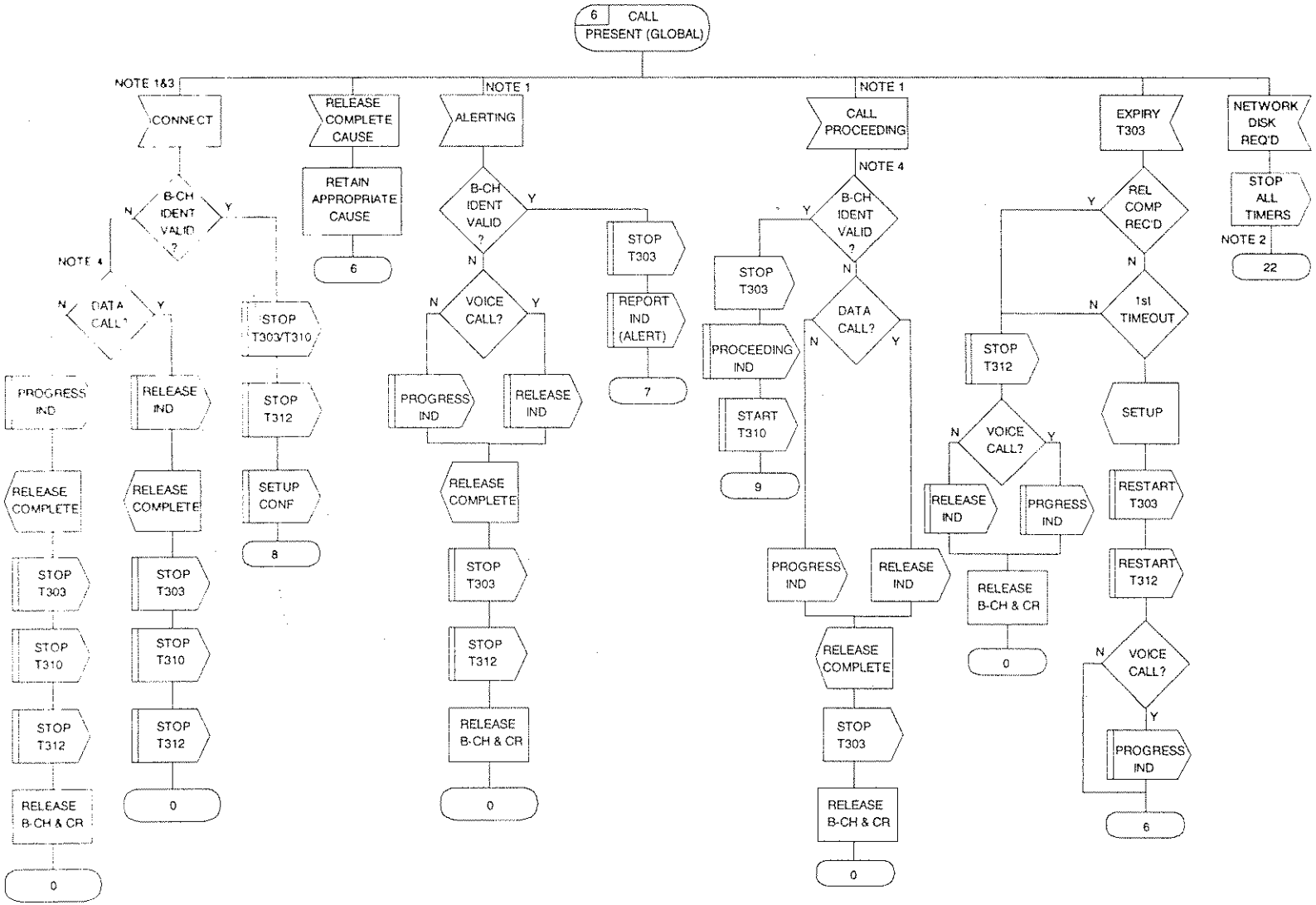

Figure 8-15. NPN Call Control SDL Diagram - Network Side (4 of 8)

NOTE 1: Call proc alert and connect are received on a specific data link. A new state machine for the indicated terminal has to be set-up.

NOTE 2: Call clearing shall be initiated for each terminal which has responded by sending a network disconnect request.

NOTE 3: When the first connect message is received the network should initiate non-selected user clearing for all other users which have responded by sending a non-select request.

NOTE 4: If the B-channel identification is missing it is considered valid (for BCS 29 compatibility)

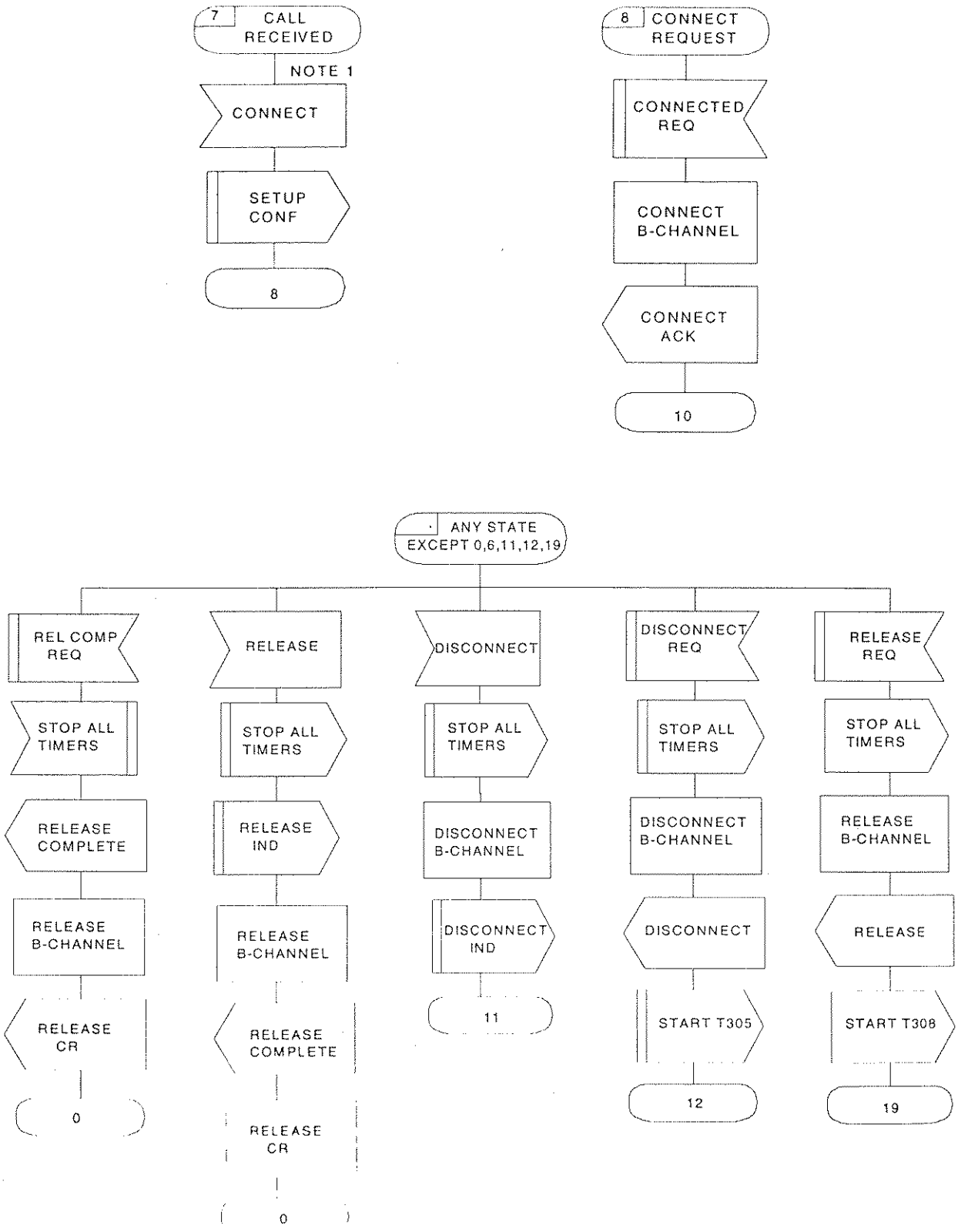

Figure 8-16. NPN Call Control SDL Diagram - Network Side (5 of 8)

NOTE 1: A separate state machine exists for each user on a point to multipoint interface.

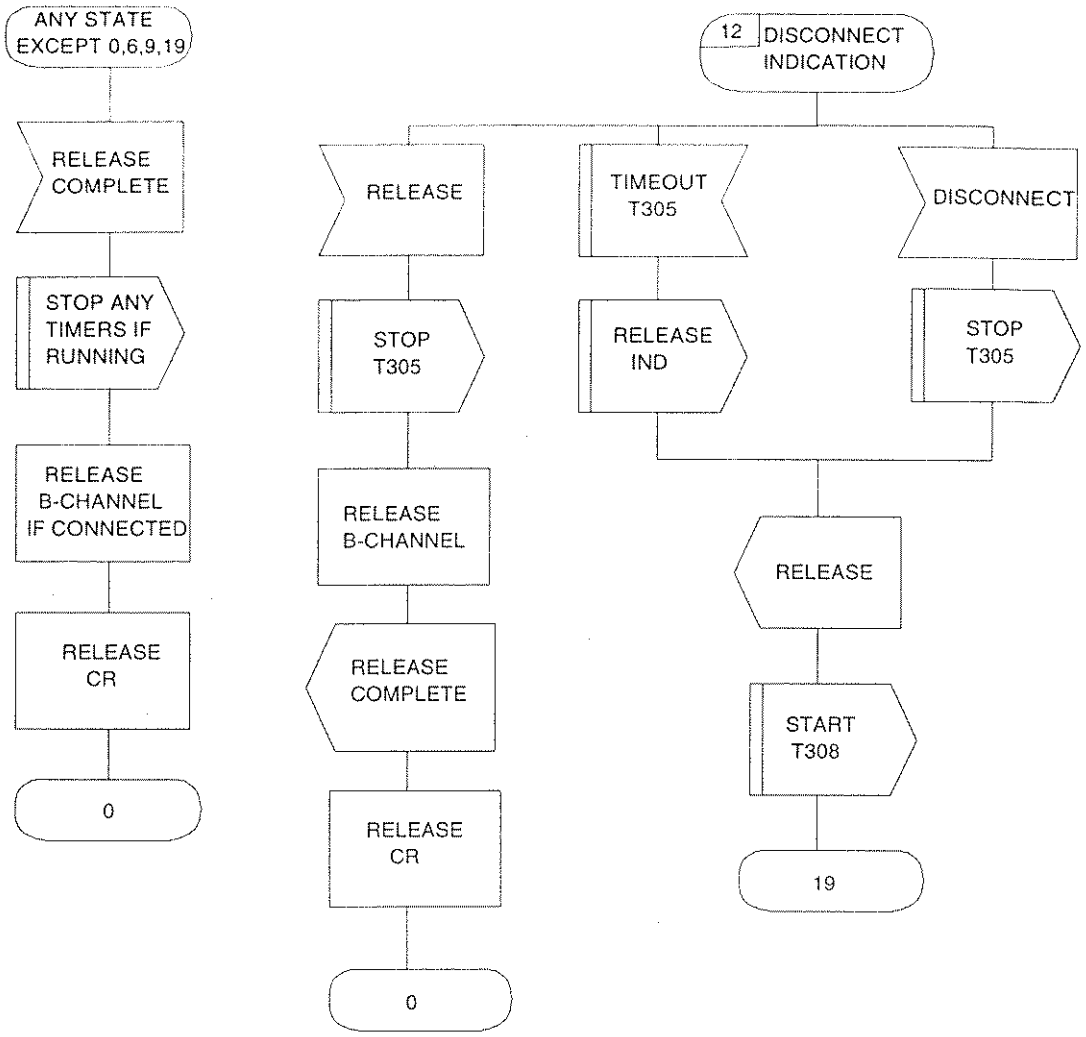

Figure 8-17. NPN Call Control SDL Diagram - Network Side (6 of 8)

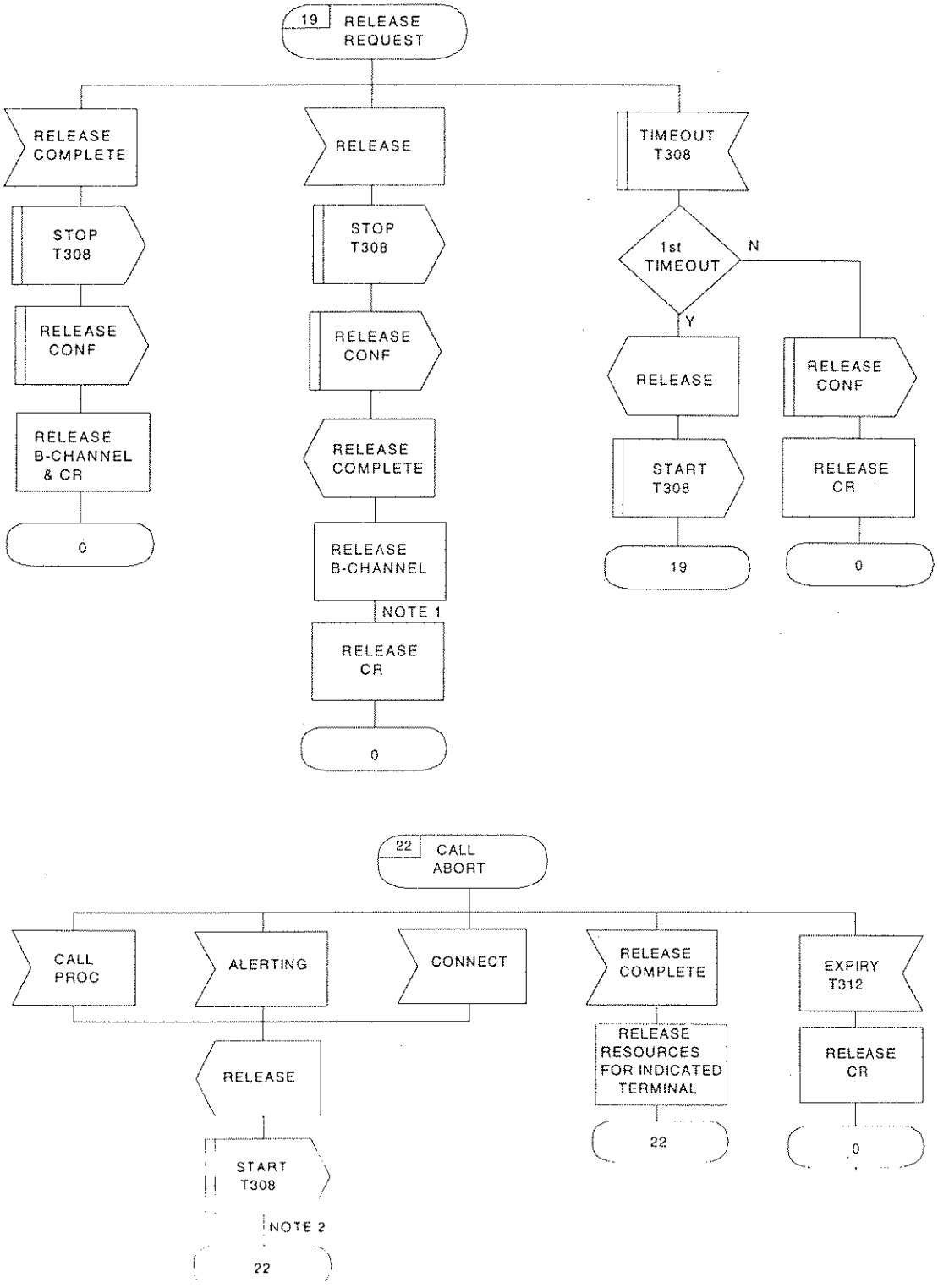

Figure 8-18. NPN Call Control SDL Diagram - Network Side (7 of 8)

NOTE 1: The CR should not be reused right away for a new call otherwise the release complete for the network will be mistaken as a reject to the new call.

NOTE 2: A separate state machine (IE State = N19) and T308 is kept for each terminal which has responded.

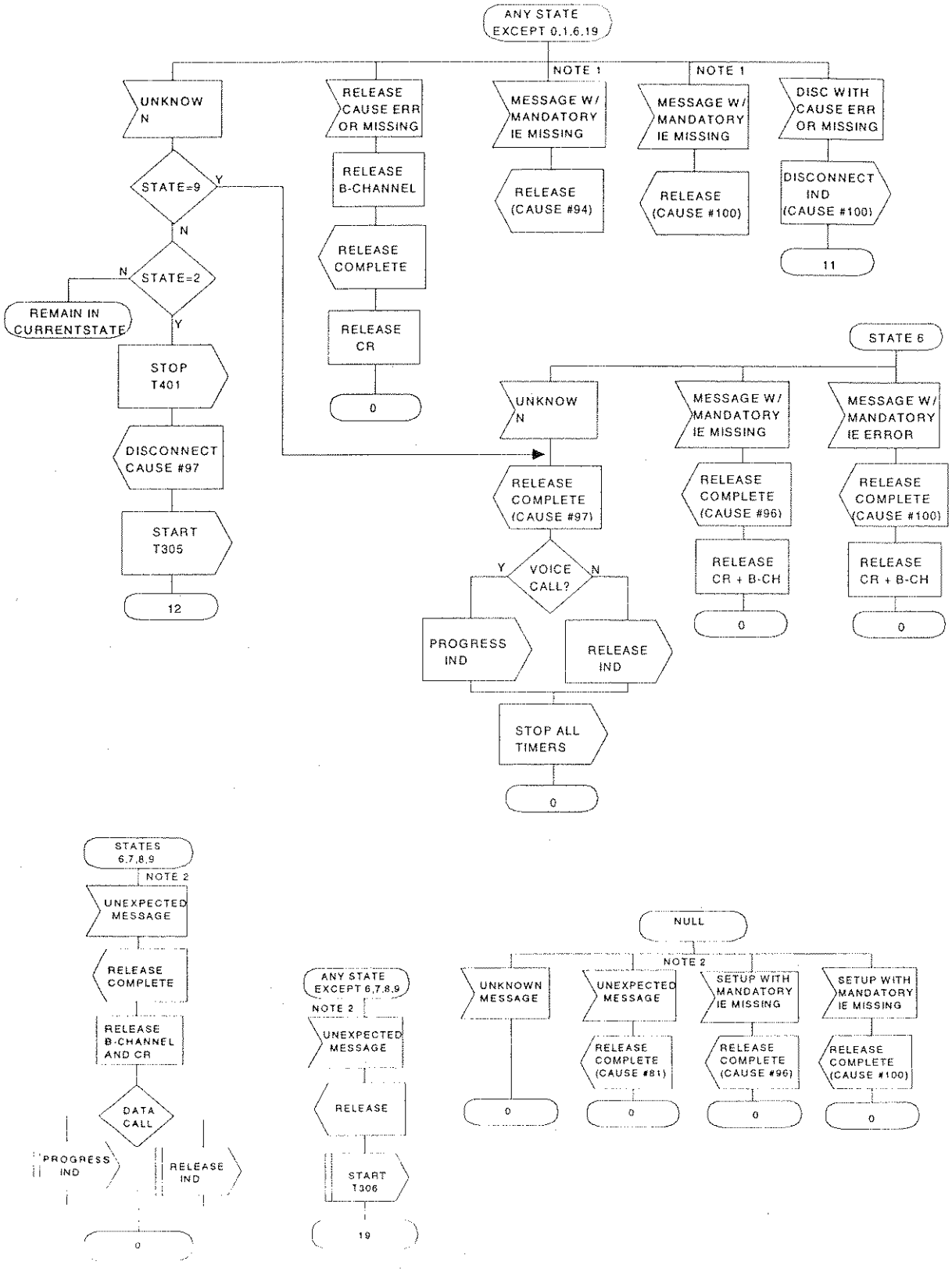

Figure 8-19. NPN Call Control SDL Diagram - Network Side (8 of 8)

NOTE 1: Except disconnect and complete.

NOTE 2: Except release complete.

8.3. CCITT SDL Diagrams

This section contains Specification Description Language (SDL) diagrams illustrating the call processing logic in the TAS CCITT ISDN Emulator.

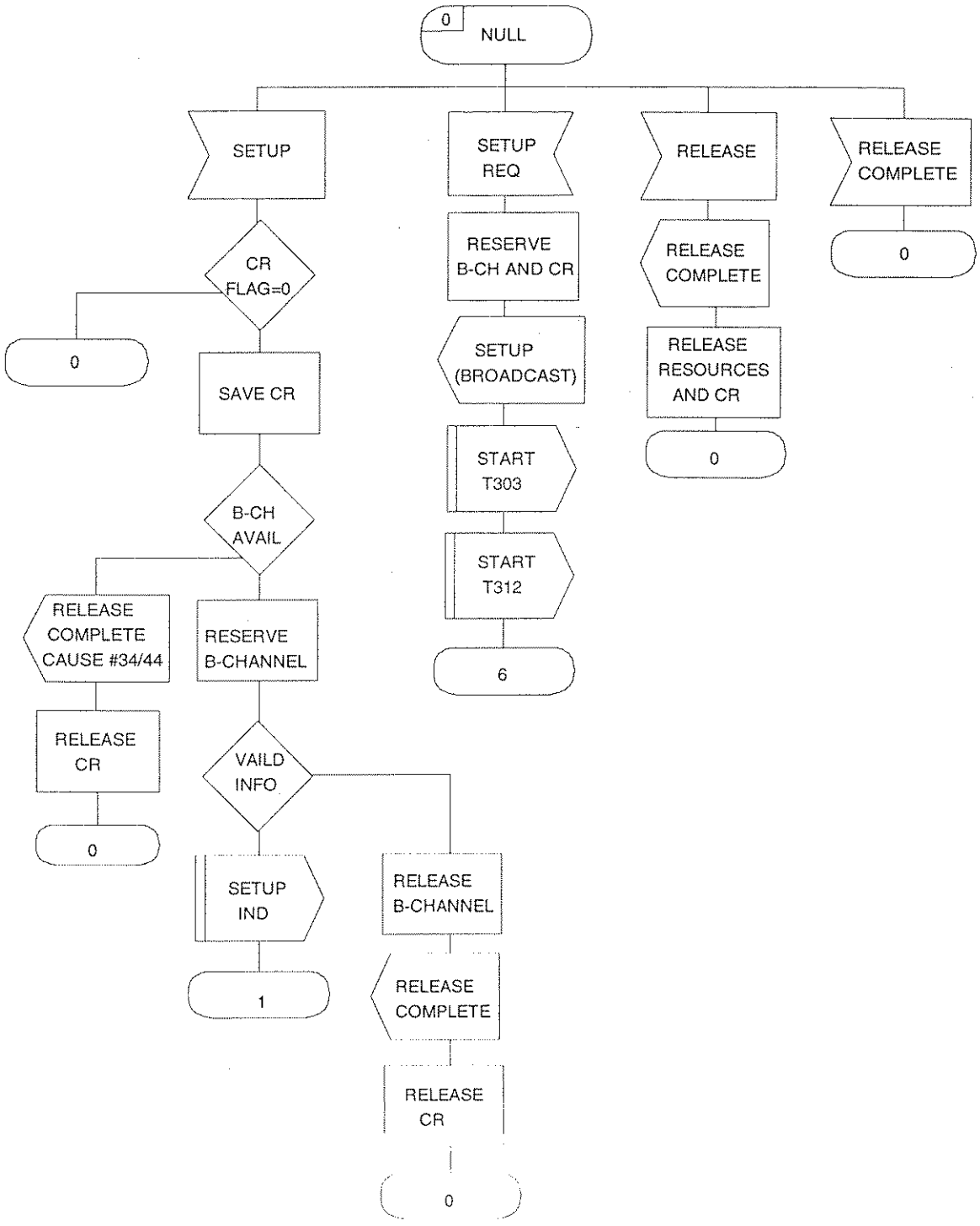

Figure 8-20. CCITT Call Control SDL Diagram - Network Side (1 of 9)

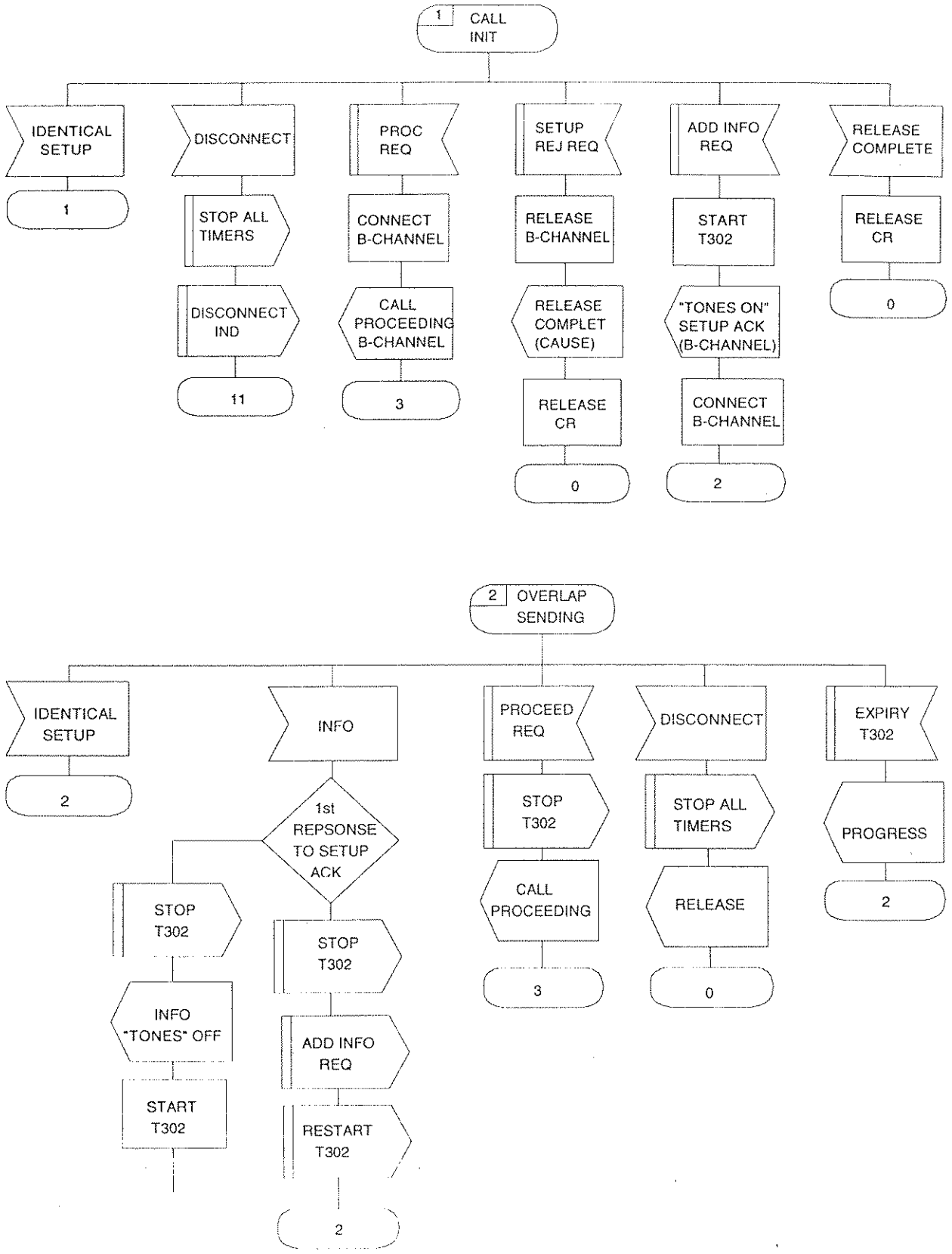

Figure 8-21. CCITT Call Control SDL Diagram - Network Side (2 of 9)

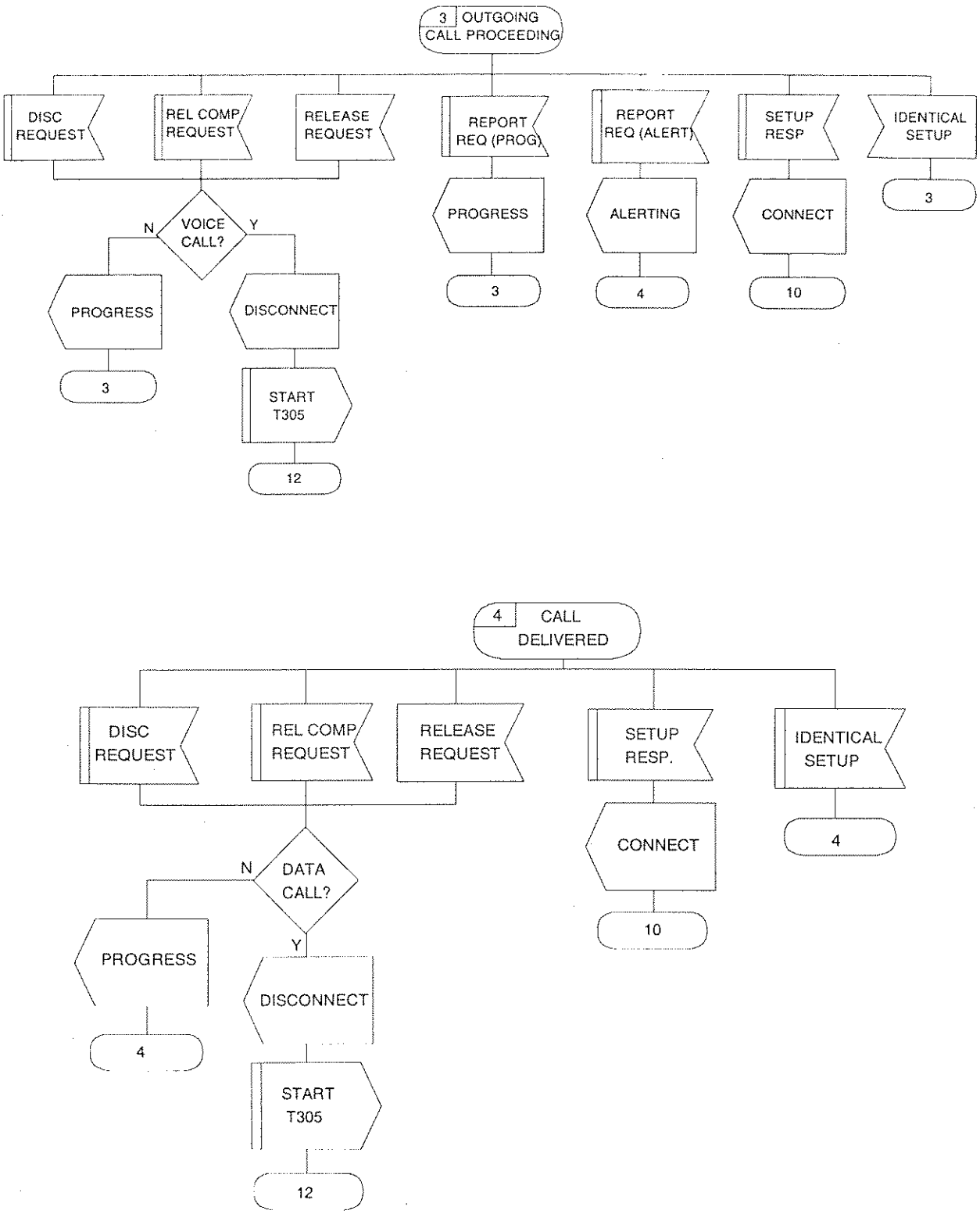

Figure 8-22. CCITT Call Control SDL Diagram - Network Side (3 of 9)

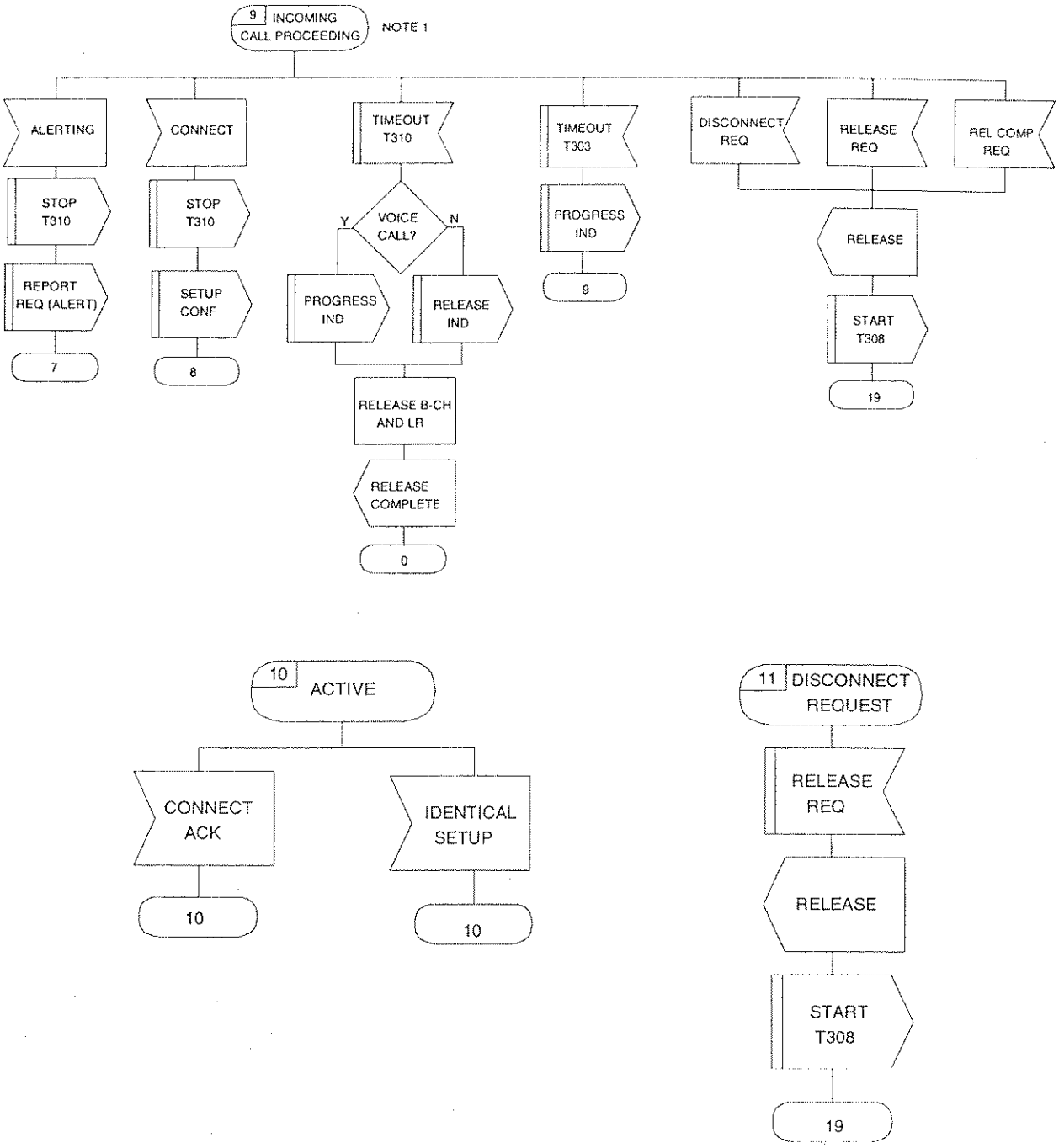

Figure 8-23. CCITT Call Control SDL Diagram - Network Side (4 of 9)

NOTE 1: A separate state machine exists for each user which has responded to the incoming setup with a call proc.

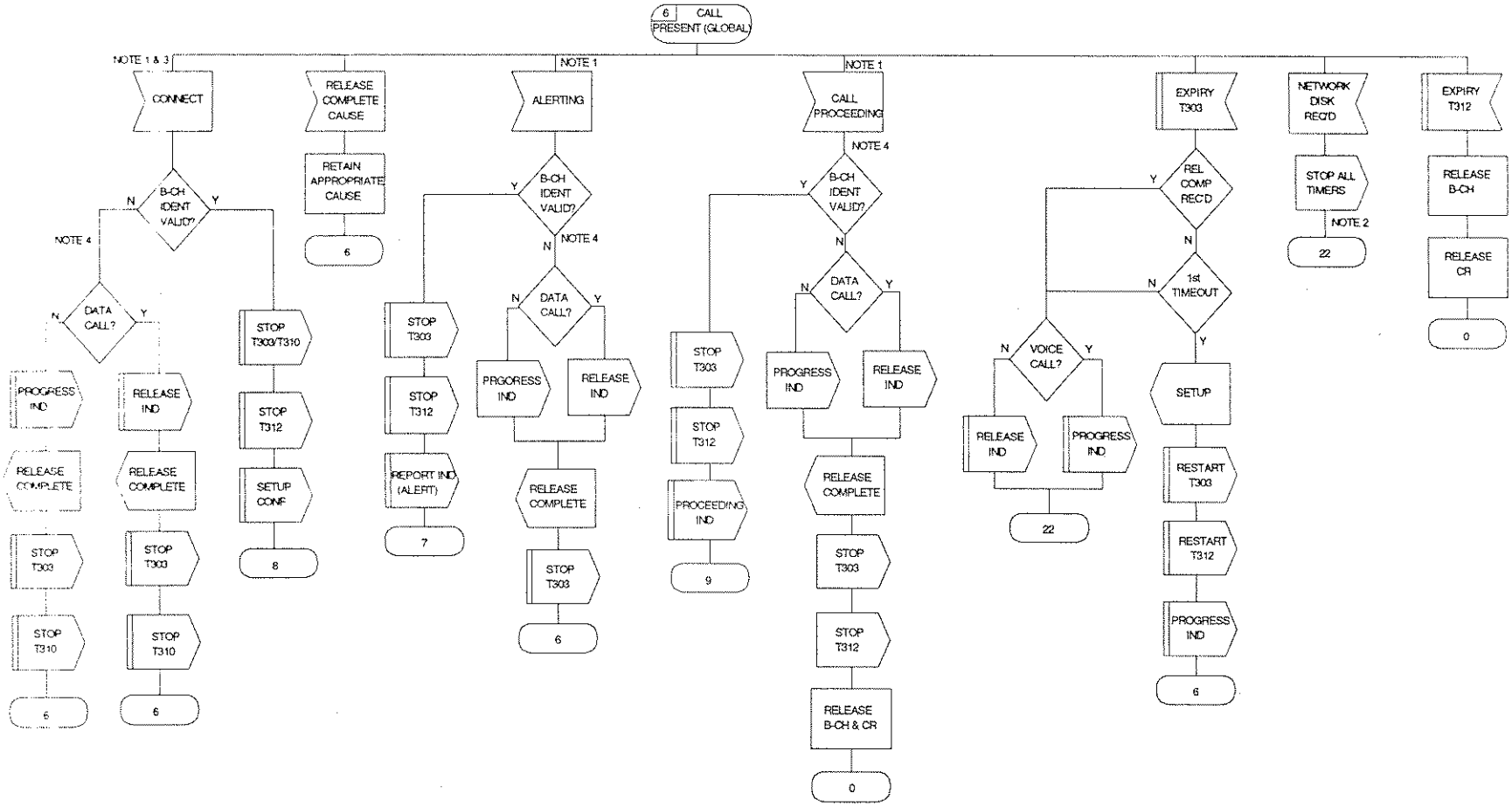

Figure 8-24. CCITT Call Control SDL Diagram - Network Side (5 of 9)

NOTE 1: Call proc alert and connect are received on a specific data link. A new state machine for the indicated terminal has to be set-up.

NOTE 2: Call clearing shall be initiated for each terminal which has responded by sending a network disconnect request.

NOTE 3: When the first connect message is received the network should initiate non-selected user clearing for all other users which have responded by sending a non-select request.

NOTE 4: If the b-channel identification is missing it is considered valid (for BCS 29 compatibility).

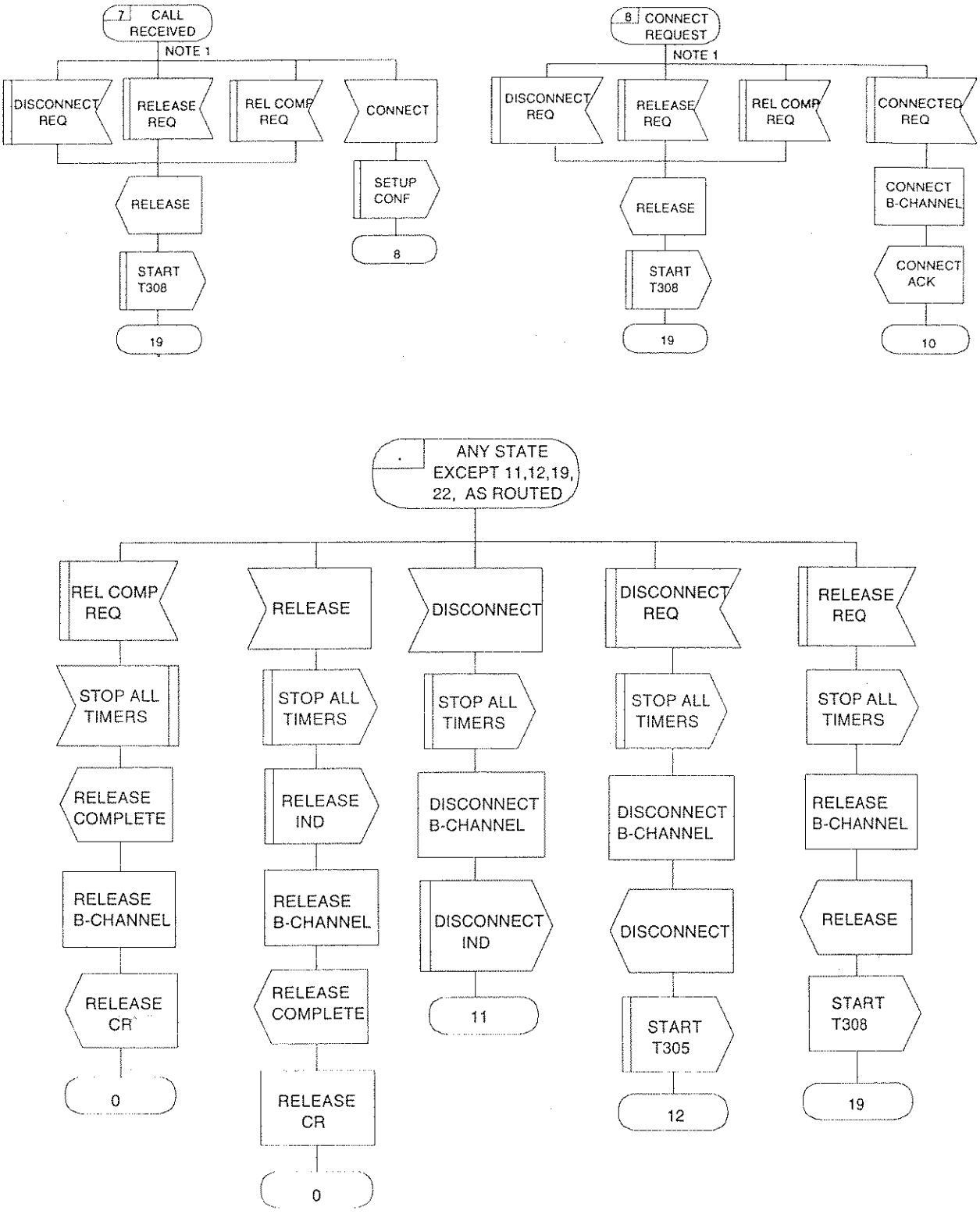

Figure 8-25. CCITT Call Control SDL Diagram - Network Side (6 of 9)

NOTE 1: A separate state machine exists for each user on a point to multipoint interface.

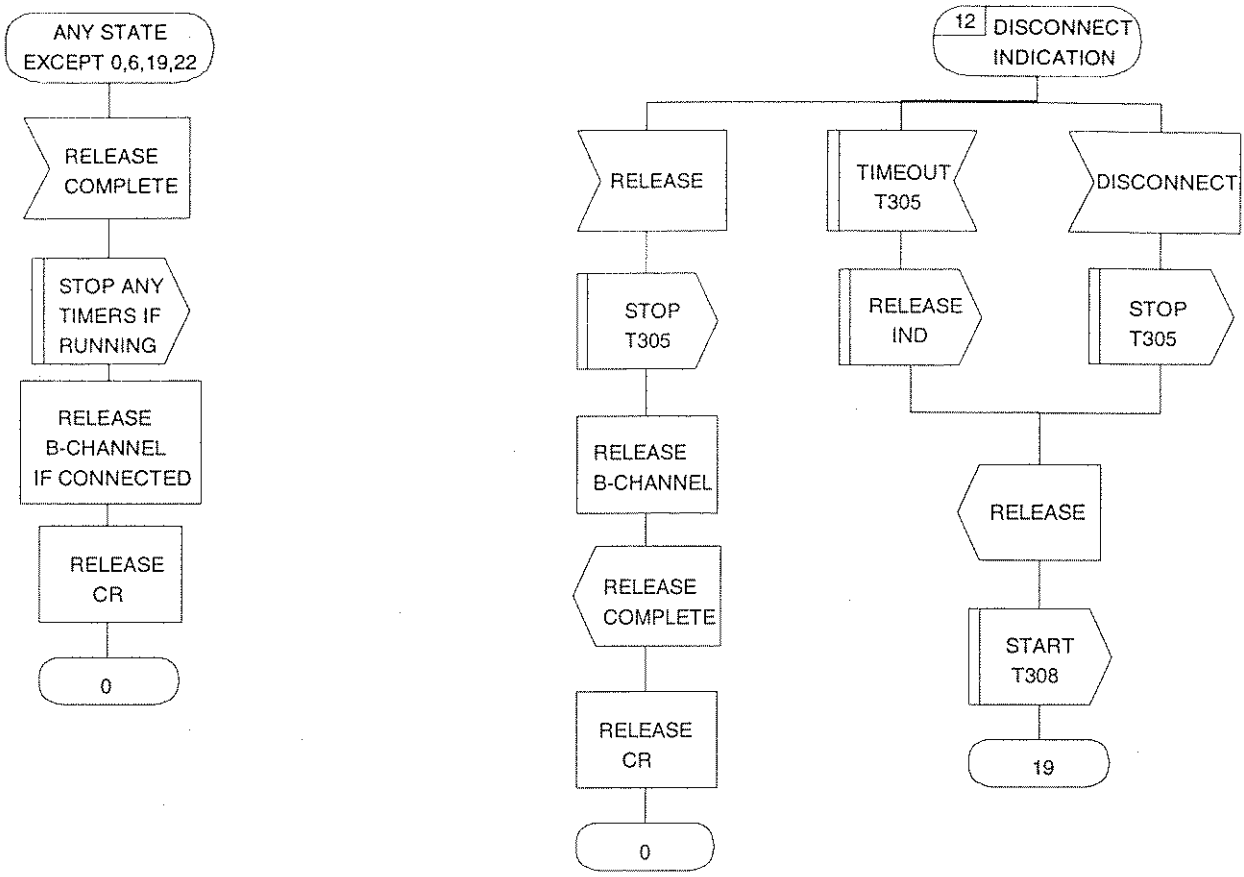

Figure 8-26. CCITT Call Control SDL Diagram - Network Side (7 of 9)

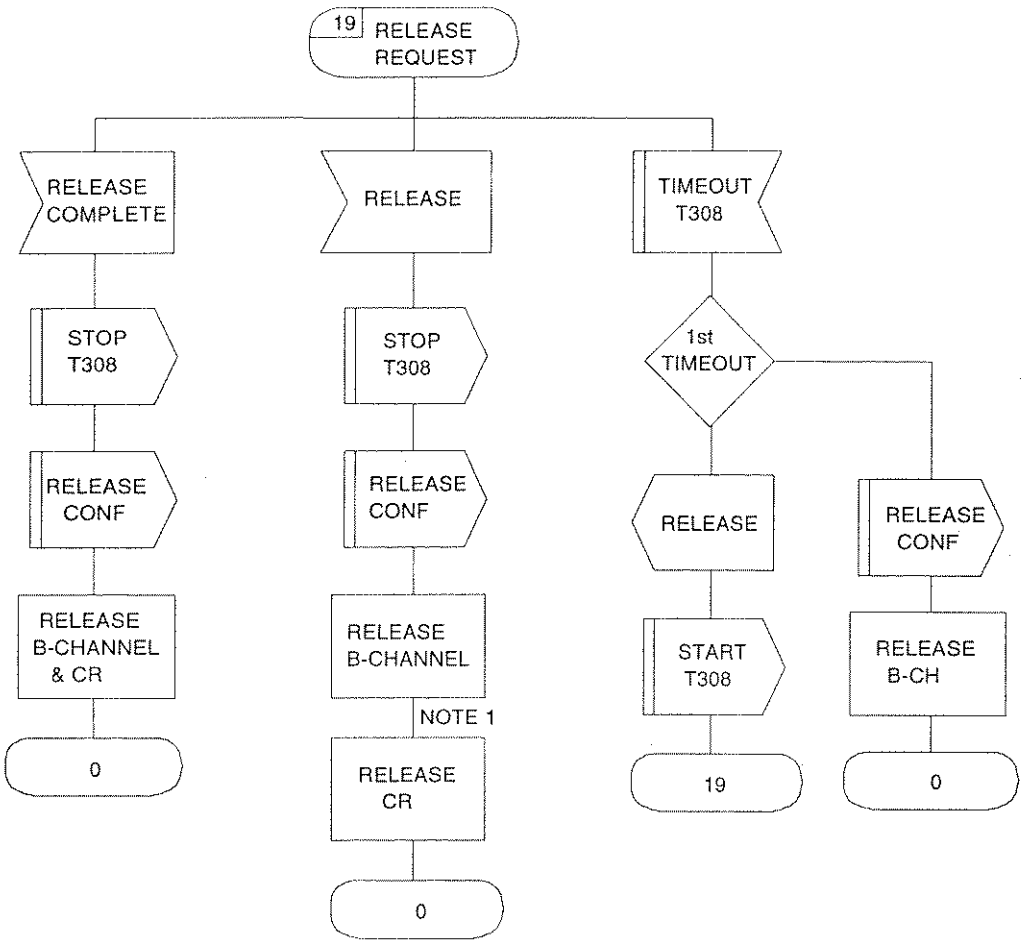

Figure 8-27. CCITT Call Control SDL Diagram - Network Side (8 of 9)

NOTE 1: The CR should not be reused right away for the new call. Otherwise the release complete for the network will be mistaken as a reject to the new call.

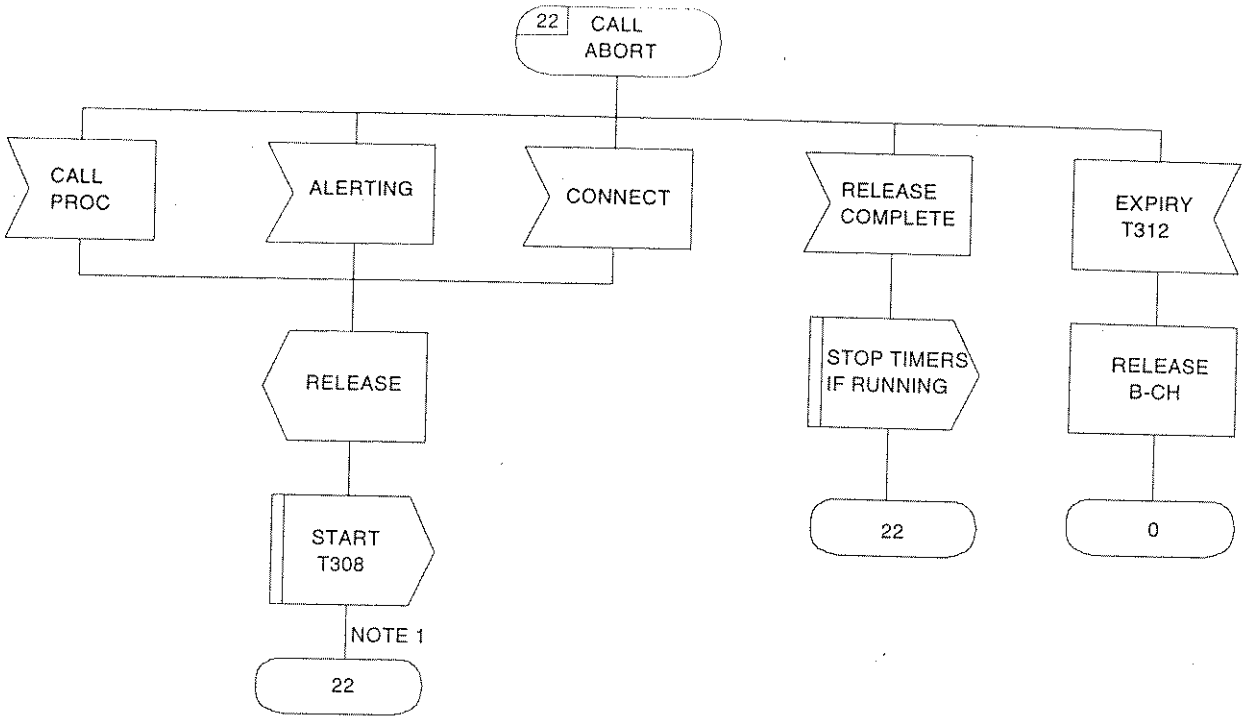

Figure 8-29. CCITT Call Control SDL Diagram - Network Side (9 of 9)

NOTE 1: A separate state machine (I.E. State=N19) and T308 are kept for each terminal which has responded.

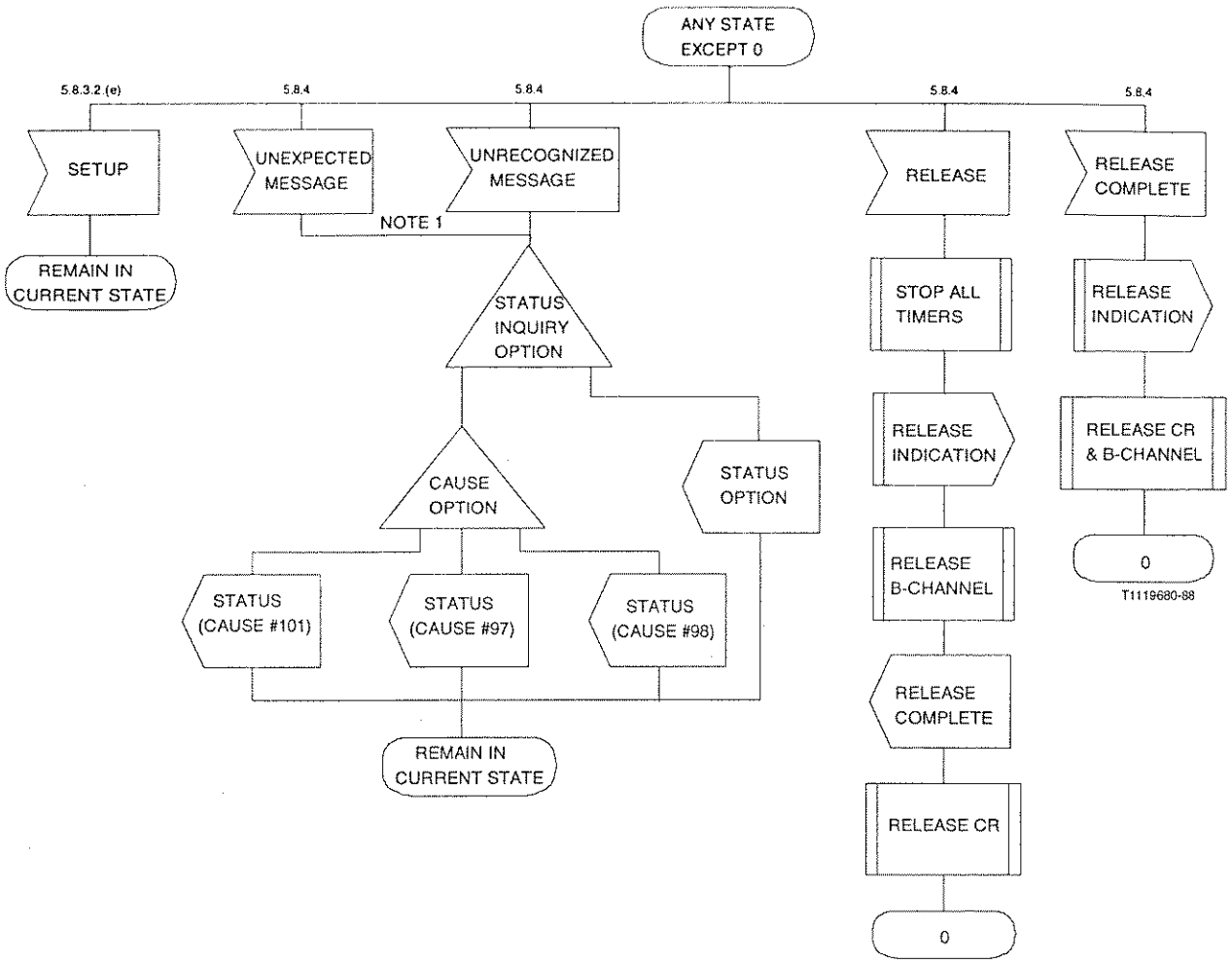

Figure 8-30. CCITT Error Handling SDL Diagram (1 of 2)

NOTE 1: Except release or release complete.

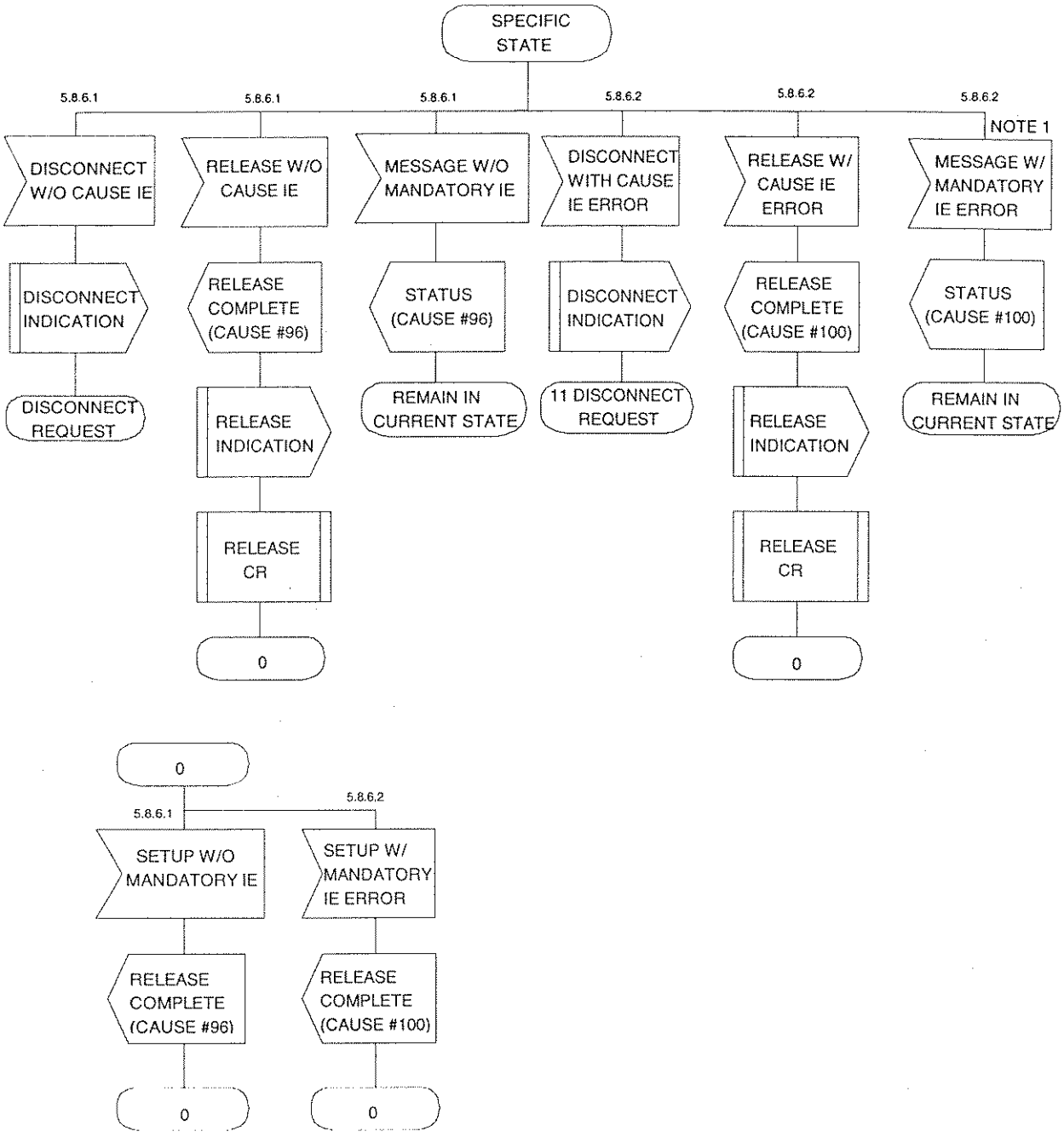

Figure 8-31. CCITT Error Handling SDL Diagram (2 of 2)

NOTE 1: Except setup, release and disconnect.

GLOSSARY OF TELECOMMUNICATIONS INDUSTRY ACRONYMS

This glossary contains many of the most commonly used acronyms in the telecommunications industry. It is designed to serve as a useful reference tool as you peruse this TAS document. No single TAS manual contains all the acronyms listed here. The acronyms are listed in alphabetical order.

ABM	Asynchronous Balanced Mode
ACA	Automatic Circuit Assurance
ACD	Automatic Call Distribution
ACF	Advanced Communications Function
ACK/NAK	Acknowledge Character/Negative Acknowledge Character
ACU	Automatic Calling Unit
A/D	Analog-to-Digital (conversion)
AIOD	Automatic Identification of Outward Dialing
AM	Amplitude Modulation
ANC	All-Number Calling
ANI	Automatic Number Identification
ANSI	American National Standards Institute
ARQ	Automatic Request for Repeat or Retransmission
ASCII	American Standard Code for Information Interchange
ASM	Algorithmic State Machine
ASR	Automatic Send/Receive
AVD	Alternate Voice/Data
AWG	American Wire Gauge
BALT	Balance and Long-Term (Tests)
BCC	Block Check Character
BCD	Binary-Coded Decimal

BER	Bit Error Rate
BERT	Bit Error Rate Test or Throughput
BH	Busy Hour
BNC	British Naval Connector or Baby N Connector
BSC	Binary Synchronous Communications
CAD	Computer-Aided Design
CAE	Computer-Aided Engineering
CAI	Computer-Aided Instruction
CAM	Computer-Aided Manufacturing
CBX	Computerized Branch Exchange
CCETT	Centre Commun D'Etudes de Telediffusion et Tlecommunications (research branch of the French postal and telecommunications service)
CCIS	Command Control Information System
CCITT	International Telegraph and Telephone Consultative Committee (from the French Committee Consultatif Internationale Telegraphique et Telephonique)
CCSA	Common Control Switching Arrangement
CCW	Channel Command Word
CDR	Call Data Reporting (port)
CFT	Combined Function Terminal
CICS	Customer Information Control System
CIM	Computer-Integrated Manufacturing
CO	Central Office (in telephony, the telephone company switching facility or center at which the subscriber's local loops terminate)
COMSAT	Communications Satellite Corporation

CONUS	Continental United States
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
CR/LF	Carriage Return/Line Feed
CRT	Cathode-Ray Tube
CSD	Circuit Switched Data
CSM	Configuration Switching Module
CSU	Channel Service Unit
CTS	Clear to Send
D/A	Digital-to-Analog (conversion)
DAA	Data Access Arrangement
DACS	Digital Access and Cross-Connect System
DBMS	Data Base Management System
DCD	Data Carrier Detect or Dynamic Computer Display
DCE	Data Communications Equipment
DCM	Digital Circuit Multiplication
DCU	Data Command Unit, Digital Control Unit, or Data Control Unit
DDCMP	Digital Data Communications Message Protocol
DDS	Digital Data Service
DFI	Dual Frequency Interference
DI	Data Input, Demand Indicator, or Digital Input
DIP	Dual In-Line Pin or Package
DLC	Data Link Control or Data Line Card
DLI	Data Line Interface
DMA	Direct Memory Access

DNA	Digital Network Architecture
DOMSAT	Domestic Communications Satellite
DOS	Disk Operating System
DOV	Data Over Voice
DP	Dial Pulse
DPC	Data Processing Center
DSA	Distributed Systems Architecture
DSL	Digital Subscriber Loop
DSN	Distributed Systems Network
DSP	Digital Signal Processor or Display Systems Protocol
DSR	Data Set Ready
DSS	Direct Station Selection
DSU	Data Service Unit
DSX	Digital Signal Cross-Connect
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-frequency
DTR	Data Terminal Ready
DTS	Digital Termination System
EAS	Extended Area Service
EBCDIC	Extended Binary-Coded Decimal Interchange
ECC	Error Correcting Code
EDC	Error Detecting Code
EDI	Electronic Data Interchange
EDP	Electronic Data Processing
EDT	Engineer Design Test or Energy Dissipation Test

EIA	Electronics Industries Association, Energy Information Administration, or Environmental Impact Appraisal
EOA	End of Address
EOB	End of Block
EOI	End of Interrupt
EOM	End of Message (indicator)
EOT	End of Transmission or Tape
EPROM	Erasable Programmable Read-Only Memory
ERL	Echo Return Loss
ESD	Electrostatic Discharge
ESS	Electronic Switching System
ETX	End of Text
EXT	External
FEP	Front-End Processor
FIR	Finite Impulse Response
FTP	File Transfer Protocol
FX	Foreign Exchange
FXO	Foreign Exchange Office
FXS	Foreign Exchange Station
GPIB	General Purpose Interface or Instrumentation Bus
HDX	Half Duplex
HDLC	High-Level Data Link Control
HF	High Frequency
HVDC	High Voltage Direct Current
IA	Integrated Analog

IC	Interconnect Carrier
IDDD	International Direct Distance Dialing
IDN	Integrated Digital Network
IEEE	Institute of Electrical and Electronics Engineers
IMD	Intermodulation Distortion
INT	Internal
I/O	Input/Output
IRQ	Interrupt Request
ISDN	Integrated Services Digital Network
IVDT	Integrated Voice/Data Terminal
IVDW	Integrated Voice/Data Workstation
KP	Keypulse
KSR	Keyboard Send/Receive
KTS	Key Telephone System
LAN	Local Area Network
LAP	Link Access Procedure
LAPB	Link Access Procedure Balanced
LAPD	Link Access Procedure on D Channel
LATA	Local Access and Transport Area
LCD	Liquid Crystal Display
LDM	Limited Distance Modem
LEC	Local Exchange Carrier
LED	Light-Emitting Diode
LF	Low Frequency
LLC	Logical Link Control

LPC	Linear Predictive Coding
LRC	Longitudinal Redundancy Check
LSB	Least Significant Bit
LSD	Low Speed Data or Least Significant Digit
LSI	Large-Scale Integration
MAC	Media Access Control
MF	Medium Frequency (300 to 3 MHz)
MSB	Most Significant Bit
MSU	Modem Sharing Unit
MUT	Modem-Under-Test
MUX	Multiplexer
NCTE	Network Channel Terminating Equipment
NEMA	National Electrical Manufacturer's Association
NEXT	Near End Crosstalk
NSB	National Science Board or Nuclear Standards Board
NT	Network Termination
NTU	Network Terminating Unit
OH	Off-Hook
OHRC	Off-Hook Relay Control
OS	Operating System
OSI	Open Systems Interconnection
PAM	Pulse Amplitude Modulation
P/AR	Peak to Average Ratio
PBX	Private Branch Exchange
PC	Personal Computer

PCM	Pulse Code Modulation
PIC	Polyethylene Insulated Cable
PLI	Powerline Interference
PMC	Program Memory Cartridge
POI	Point of Interface
POR	Power-On Reset
PROM	Programmable Read-Only Memory
PSD	Packet Switched Data
PSTN	Public Switched Telephone Network
PWM	Pulse Width Modulation
QOS	Quality of Service
RAM	Random Access Memory
RDT	Recall Dial Tone
RFI	Request for Information or Radio Frequency Interference
RI	Ring Indicator
RLC	Resistor Inductor Capacitor
RLSD	Received Line Signal Detector
RMS	Root-Means-Squared
RO	Receive Only
ROM	Read-Only Memory
ROTL	Remote Office Test Line
RPG	Report Program Generator
RTR	Ready to Respond
RTS	Request to Send
RXA	Receive Analog

RXD	Receive Data
SAA	Systems Application Architecture
SABM	Set Asynchronous Balanced Mode
SABME	Set Asynchronous Balanced Mode Extended
SCA	Short Code Address
SCPC	Single Channel Per Carrier
SDA	Source Data Automation
SDLC	Synchronous Data Link Control
SDN	Software-Defined Network
SF	Single Frequency
SHF	Super High Frequency
SIP	Single In-Line Package
SNA	Systems Network Architecture
SNR	Signal-to-Noise Ratio
SOM	Start of Message
SOP	Standard Operating Procedure
SQ	Signal Quality
SRQ	Service Request Line
SSCP	System Services Control Point
SSN	Switched Service Network
STX	Start of Text (of message)
TA	Terminal Adaptor
TACS	Total Access Communications System
TAN	Trunk Appearance Number
TC	Transmit Clock

TCAM	Telecommunications Access Method
TCP	Transmission Control Protocol
TD	Transmitted Data
TDM	Time Division Multiplex
TE	Terminal Equipment
TEI	Terminal End Point Identifier
THL	Trans-Hybrid Loss
TIMS	Transmission Impairments Measurement Set
TLP	Transmission Level Point
TPT	Test Progress Tone
TSPS	Time Sharing Programming System
TTL	Transistor-Transistor Logic
TTS	Transmission Test Set
TTU	Terminal Time Unit
TXD	Transmitted Data or Telephone Exchange, Digital
TXE	Telephone Exchange, Electronic
TTY	Teletypewriter or Bell System Teletypewriter Service
UBC	Universal Buffer Controller
UC	Unit Call
UCD	Uniform Call Distribution
UCW	Unit Control Word
UDB	Up Data Buffer
UDLC	Universal Data Link Control
UNCOL	Universal Computer-Oriented Language
UOC	Ultimate Operating Capability

UP	Utility Path
USE	Unit Support Equipment
UY	Unit Years
VAC	Volts Alternating Current
VAN	Value-Added Network
VBD	Voice Band Data
VCO	Voltage Control Oscillator
VFD	Vacuum Florescent Display
VHSIC	Very High Speed Integrated Circuit
VLF	Very Low Frequency
VLSI	Very Large-Scale Integration
VMX	Voice Message Exchange
WOM	Write Optional Memory
XT	Cross Talk
ZA	Zero Adjusted

The acronym definitions are excerpted from the IEEE Standard Dictionary of Electrical and Electronics Terms; Webster's New World Dictionary of Computer Terms; the Datapro Report on Telecommunications; and numerous TAS publications. This glossary was updated on June 22, 1994.

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