ANACONDA-ERICSSON

PRODIGY

MAINTENANCE MANUAL

MAINTENANCE

1. GENERAL

1.01 This practice contains information and procedures to analyze, diagnose and correct failures and faulty conditions that may arise during operation of the Anaconda-Ericsson PRODIGY* Electronic Private Automatic Branch Exchange (PABX).

Areas covered within this practice:

- A general introduction to the PRODIGY PABX and this practice
- A description of the maintenance philosophy applied to the PRODIGY PABX
- A description of all available circuit cards
- A list of the tools and test equipment required for maintaining and troubleshooting the PRODIGY PABX
- A general theory of operations of the PRODIGY PABX
- A description of the initialization and self-test features as well as the Stall Alarm
- A description of the minor alarm conditions encountered during normal operations
- A description of and detailed operational procedure for the optional Remote Access Facility Feature
- Appendices providing references for: equipment port numbering, PCB strapping, the system memory map and the console display error messages.

1.02 Technical assistance is provided, by Anaconda-Ericcson Field Service personnel, on a 24 hour per day basis. During normal working hours (Pacific Time) service personnel may be contacted by telephoning (714) 895-3962. For emergency, after hours, service the number is (714) 761-4911. If a field service trip is required, a billing may be processed at a prescribed daily rate plus travel and living expenses.

* PRODIGY is a trademark of Anaconda-Ericcson, Inc.

DOCUMENTATION

1.03 The PRODIGY PABX is documented in accordance with telephone industry standards. Periodic engineering and marketing bulletins are issued as required. Related practices are listed in Table 1-1.

TABLE 1-1. RELATED PRACTICES

PRACTICE TITLE	PRACTICE NUMBER
Attendant Instruction Manual	7700-AI
Feature Definition Manual	7700-FD
Product Definition Manual	7700-PD
General Description Manual	7700-GD
Station User Manual	7700-SU
System Installation Manual	7700-SI
System Configuration Manual	7700-SC
System Configuration Forms	7700-SF

2.0 MAINTENANCE CONCEPT

2.01 The PRODIGY maintenance concept is based on the premise that the PABX system was correctly installed and functioning properly prior to the current system failure. Failure analysis, determination and repair is performed on a printed circuit board (PCB) level.

The PRODIGY PABX consists of various PCBs located within a 23-slot card cabinet. Proven telephone methods of troubleshooting provide the proper basis for isolating and correcting most failures.

2.02 In any sophisticated switching system, intermittent problems can develop that may result in the gradual degredation of a service or a feature, but may not necessarily generate a major system failure. Correction of these intermittent problems may require the replacement of one or more PCBs. For this reason, Anaconda-Ericsson recommends that a selection of spare PCBs be maintained for replacement purposes.

NOTE

Whenever a failure mandates a change of the Memory Expansion Card, the data existing within the current Memory Expansion Card may be saved by burning the data into a PROM. This is accomplished by the use of the CDMS programmer and the Configuration Card.

This process is of particular importance when saving the Speed Call feature data, which is contained within the non-battery protected portion of the scratchpad memory.

3.0 CIRCUIT CARDS

3.01 Figure 3-1 illustrates the PRODIGY PABX chassis, card slots and printed circuit board locations. Line and/or Trunk boards may be intermixed in slots 1 through 16. Slot 17 is reserved for the Switchtone board, slot 18 for the optional memory expansion card, and slot 19 for the Processor Board. Slot 20 is reserved for a Dual Tone Multi-Frequency (DTMF) board, and slot 21 for a possible second DTMF board. Finally, slot 22 is reserved for the Interprocessor board in case of a multi-cabinet system.

The remainder of this section presents descriptions of each of the printed circuit boards.

NOTE: The LED indicators contained on each PCB are lit by program command from the processor software. They are not controlled by the hardware logic contained on the PCB.

PCB IDENTIFICATION

SLOT NUMBER	TYPE OF CARD	MODEL NUMBER	COLOR CODE
1-16	a LINE b TRUNK	7700-62 7700-61	WHITE ORANGE
17	SWITCHTONE	7700-64	BLUE
18	MEMORY EXPANSION	7700-70	RED
19	PROCESSOR	7700-63	GREEN
20/21	DTMF	7700-67	YELLOW
22	INTERPROCESSOR	7700-73	BLACK

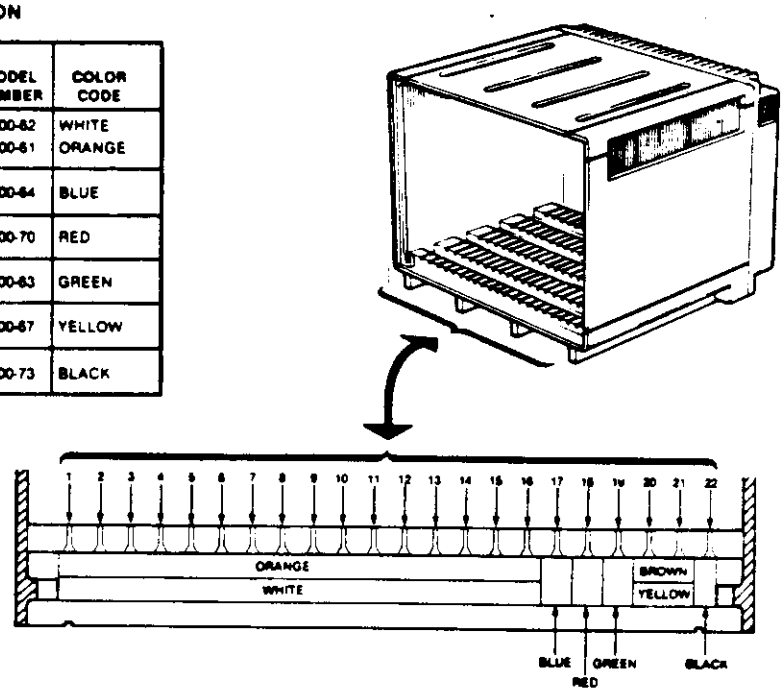


FIGURE 3-1, PABX PCB ASSIGNMENTS

3.02 LINE PCB. The Line PC board (Figure 3-2) contains the 64 transmit paths, 64 receive paths and the associated circuitry required to interface the subscriber telephone tip and ring lines to the PABX system.

The outward bound analog voice signals from the subscriber stations are fed into the Line Board transmit path through a two-to-four wire hybrid circuit. The Line Board transmit logic converts the analog voice signals into delta-modulation pulse streams for transmission over the PRODIGY dual high speed bus system to the appropriate Trunk board or receiving Line board. In like manner, the Line ~~Card~~ Board receive-path converts all received delta-modulated pulse streams and translates the received pulse streams into analog voice signals for coupling to the tip and ring pair of the called station. The Line board controls station ringing and detects off-hook conditions by means of a loop current detector.

An LED corresponding to each line on the board provides the busy status of the associated line. Additionally, under software control, the LED serves as an indicator for various diagnostic routines.

Each Line board contains the circuitry necessary to serve eight lines. Up to sixteen Line boards may be installed within a single cabinet (in any unoccupied Line or Trunk card slot). The Line board is color coded with white extractor tabs, to simplify identification.

3.03 TRUNK PCB. The Trunk PC board (Figure 3-3) is functionally similar to the Line board except that it interfaces to the central officce tip and ring circuits, rather that the tip and ring lines from the subscriber stations. In addition to performing the analog-to-digital and digital-to-analog conversion process, the Trunk board also provides loop closure, dial pulse generation, ground start signal detection and generation, and ringing and battery reversal detection.

The M-lead (meter) signal detection capability is provided for hotel/motel message registration systems. The Trunk board may interface to both positive and negative polarity systems.

The Trunk board contains LED indicators to provide a visiual indication of the status of each trunk circuit as well as signaling during certain diagnostic routines.

Four trunk circuits are provided on each Trunk board. Up to 16 Trunk boards may be installed in any line or trunk card position within a single PRODIGY PABX cabinet. The Trunk board is color coded ~~with~~ orange, to aid ~~in~~ identification. extractor tabs

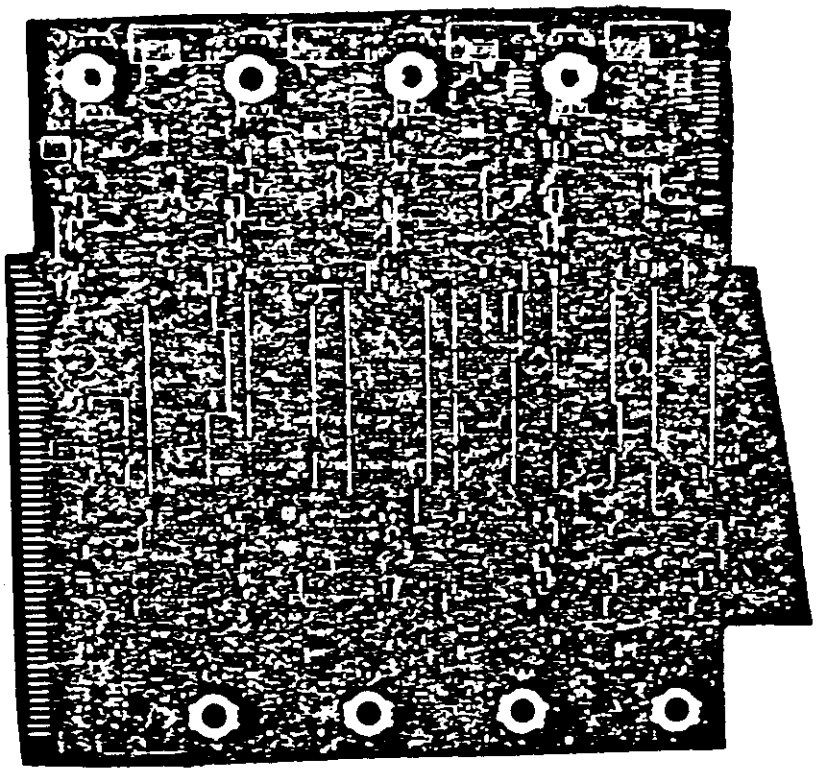


Figure 3-2. Line PC Board.

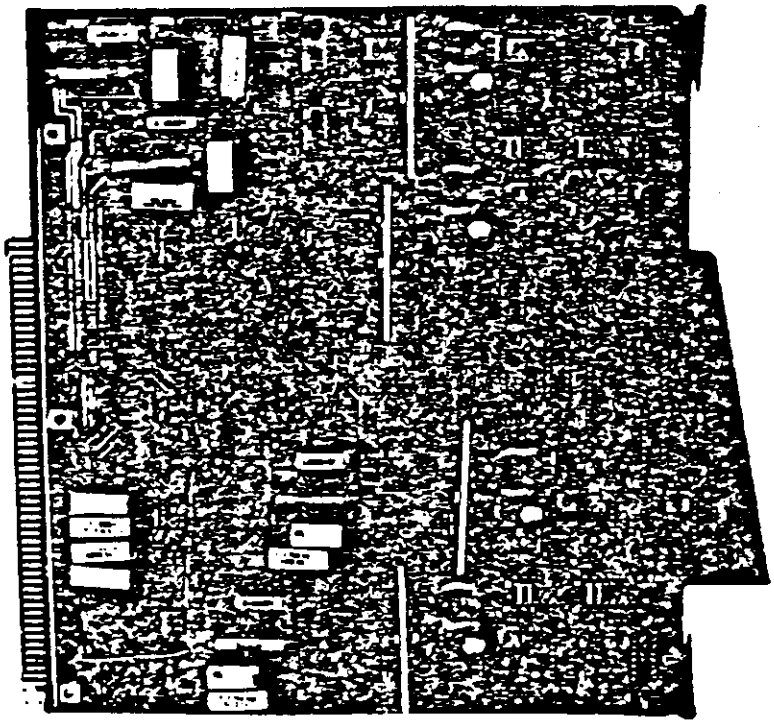


Figure 3-3. Trunk PC Board

3.04 SWITCHTONE PCB. The Switchtone PCB board (Figure 3-4) performs three major functions within the PRODIGY PABX:

- Storage of all data required to make line-to-line, line-to-trunk and trunk-to-trunk connections
- Generation of the nine call progress tones
- Generation of all clock signals required throughout the PABX system

The nine call progress tones generated by the Switchtone board are dial tone, busy tone, reorder tone, audio ring (ringback), intercept, receiver off-hook, test tone, hold and a miscellaneous tone used for the confirmation of correct operation as well as other user-defined functions. Additionally, the Switchtone board enables the PABX to provide "music-on-hold".

Delta-modulation digital bit stream patterns, for each of the Switchtone board generated tone signals, are stored in a ROM contained on the Switchtone board. A counter circuit continually addresses each of these ROM locations, thereby generating continuous frequencies for the various tones. Timing and gating logic, contained within the tone circuits, interrupts these continuous frequencies at the required rates. The nine available tones are transmitted to a multiplexer where they are under the control of the switch RAM. This configuration permits any of the tones to be interconnected.

The switch portion of the Switchtone board consists of a 16-bit by 64-word random access memory. The 64 words of memory correspond to the 64 time slots contained on the voice data bus system. Eight bits of the memory address establish the address of the line or trunk transmitting on the B Bus during the time slot. A counter sequentially addresses each of the 64 words of the switch memory. As each memory location, representing an active time slot, is addressed, the appropriate signals are output on the Address A and Address B lines to gate the correct line or trunk circuit to the voice data busses.

One Switchtone board is required per cabinet and is installed in slot 17 of the cabinet. The Switchtone board is color coded [redacted] with blue extractor tabs.

3.05 MEMORY EXPANSION PCB. The optional Memory Expansion PC board (Figure 3-5) provides the PRODIGY PABX system with two distinct memory locations:

- 2K bytes of CMOS implemented random access memory (RAM), with battery backup, utilized during moves and changes.
- 32K bytes of read only memory (ROM) for feature package(s) implementation.

The 2K bytes of RAM are comprised of four 1K x 4-bit CMOS RAM modules. The 32K bytes of ROM are comprised of eight 4K x 8-bit ROM modules.

Power for the memory ICs is provided by an onboard +5VDC power supply. In the event that commercial power to the PABX is interrupted, the onboard battery back-up (B1) will maintain standby power to the CMOS RAM ICs for up to 48 hours. Jumper W1 of the Memory Expansion Card permits removing the load from the battery backup whenever the PCB is placed in storage.

One Memory Expansion board is utilized per cabinet, and is installed in slot 18. The Memory Expansion board is color coded [redacted] with red extraction tabs.

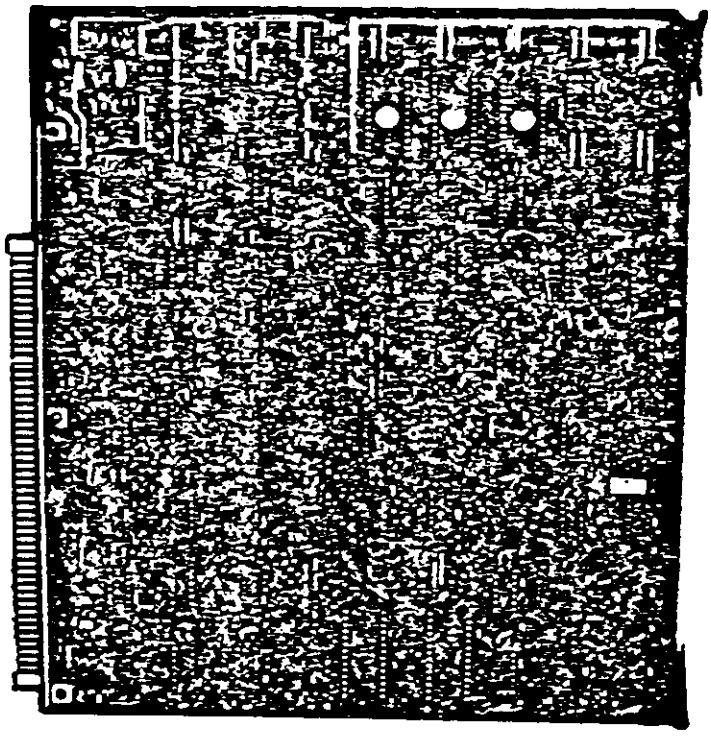


Figure 3-4. Switchtone PC Board.

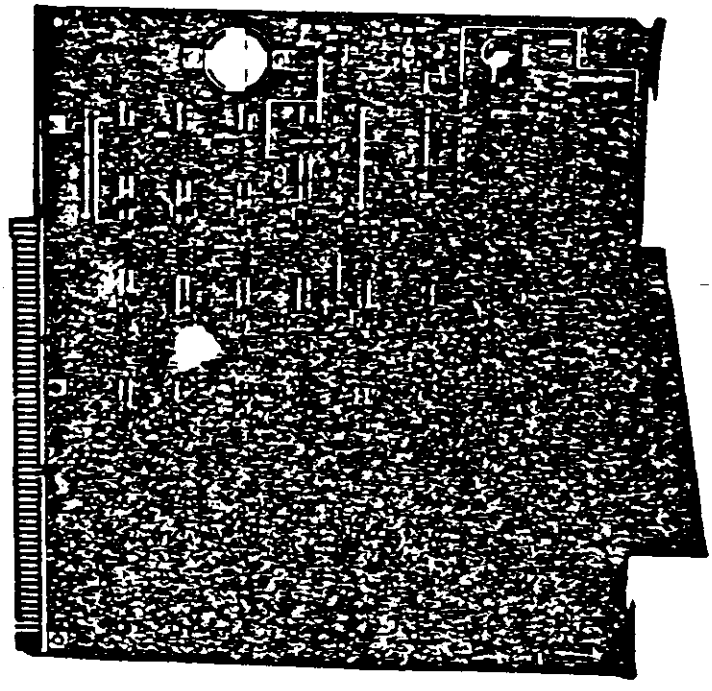


Figure 3-5. Memory Expansion PC Board.

3.06 PROCESSOR PCB. The Processor PC board (Figure 3-6) is the master control and information exchange center for the PRODIGY PABX. The Processor board:

- Reads the status conditions and dial pulses from the line and trunk boards
- Translates the dial pulses to port addresses
- Transfers the port addresses to the switch memory for time slot assignment
- Controls access to call progress tones and options,such as the DTMF decoder on the DTMF board
- Sends status information to the attendant console
- Receives control signals from the attendant console, for PABX control
- Performs system diagnostics
- Outputs alarms in the event of either failure or degredation in service

One processor board is required per cabinet and is installed in dedicated slot 19. The Processor Card is color coded [redacted] with green extractor tabs.

3.07 DUAL TONE MULTI-FREQUENCY (DTMF) PCB. The DTMF board (Figure 3-7) is an optional board installed within the PABX system to provide three functions:

- Decode dual tone multi-frequency signaling,
- Generate dual tone multi-frequency signals, via two on-board DTMF generators, and
- Detect dial tones.

As the primary function of DTMF signaling, delta-modulated representations of tone signals transmitted over the A and B voice data busses are received by the DTMF decoder chips. Each decoder chip translates one pair of received tones into the correct hexadecimal representation of the dialed digit. The translated hexadecimal value is then placed on the processor data bus, when requested, where it may be read by the processor and stored in a dialed digit register.

As a secondary function, the dial-tone-detect and DTMF-generation circuits are used by features such as call diversion wherein a call to the PABX by either an inside or outside party, is diverted to an outside number through outward dialing over a central office trunk utilizing DTMF tones.

Two DTMF Cards may be installed within a cabinet. The DTFM Cards are installed in either slot 20 or 21. The DTMF Card is color coded [redacted] with yellow extractor tabs.

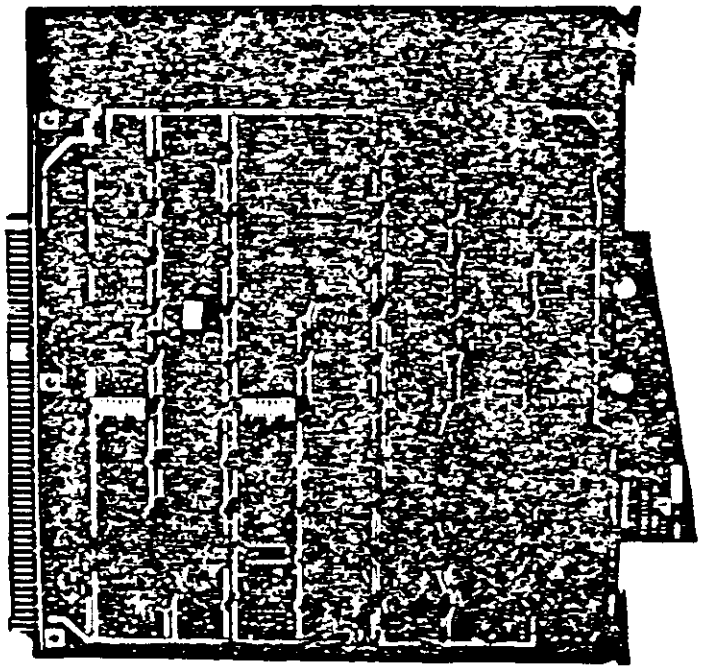


Figure 3-6. Processor PC Board.

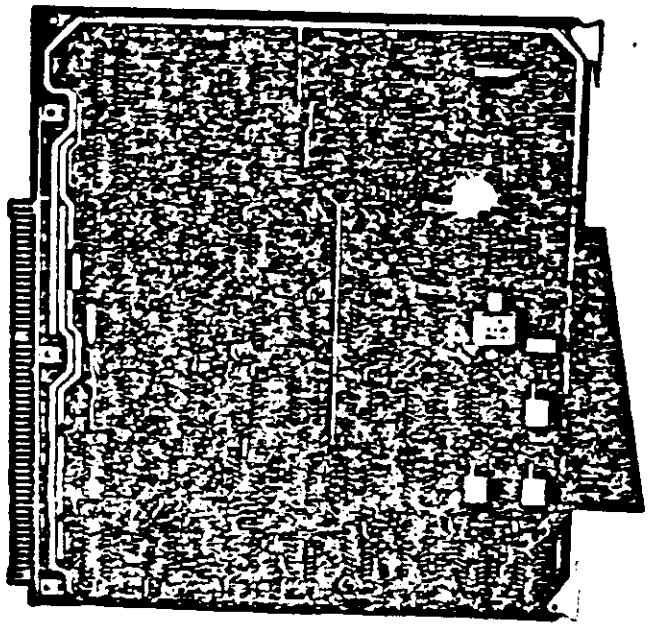


Figure 3-7. Dual Tone Multi-Frequency (DTMF) PC Board

3.08 INTERPROCESSOR PCB. The Interprocessor PC board (Figure 3-8) contains the circuitry required to expand the PRODIGY PABX beyond a single equipment cabinet (beyond 128 ports). Expansion is accomplished up to four equipment cabinets by interconnecting each cabinet with an interprocessor bus via the Interprocessor board. The interprocessor bus consists of an 8-bit parallel-data bus, four busy lines, one machine clock line from each cabinet, one multiplexed clock line from each cabinet, one delta-modulation voice line from each cabinet and fourteen control and ground lines.

One Interprocessor board is installed in slot 22 in each equipment cabinet within a multi-cabinet system. The Interprocessor board is color coded [redacted] with black extractor tabs.

3.09 CONFIGURATION ROM CARD. The Configuration ROM (Read Only Memory) card (Figure 3-9) contains the customer-specific information such as the number of lines, the number of trunks, the assigned trunk and line slot addresses, the Directory Table and all Class-of-Service data.

The Directory Table contains all data required to translate the dialed numbers into equipment port addresses coresponding to lines and trunks.

One Configuration ROM card is required per system and is installed in the Configuration Card slot located centrally in the upper part of the power supply housing in the rear of the equipment cabinet. The Configuration ROM card may be removed from the cabinet once the system [redacted] initialized.

has been

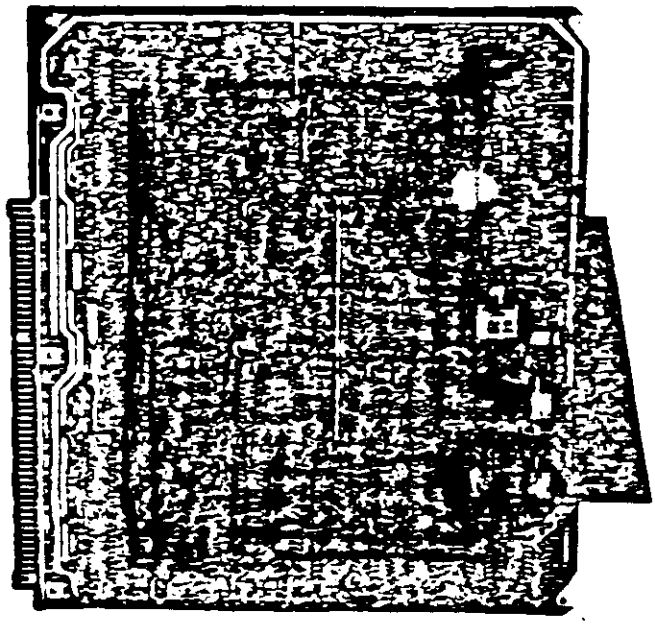


Figure 3-8. Interprocessor PC Board.

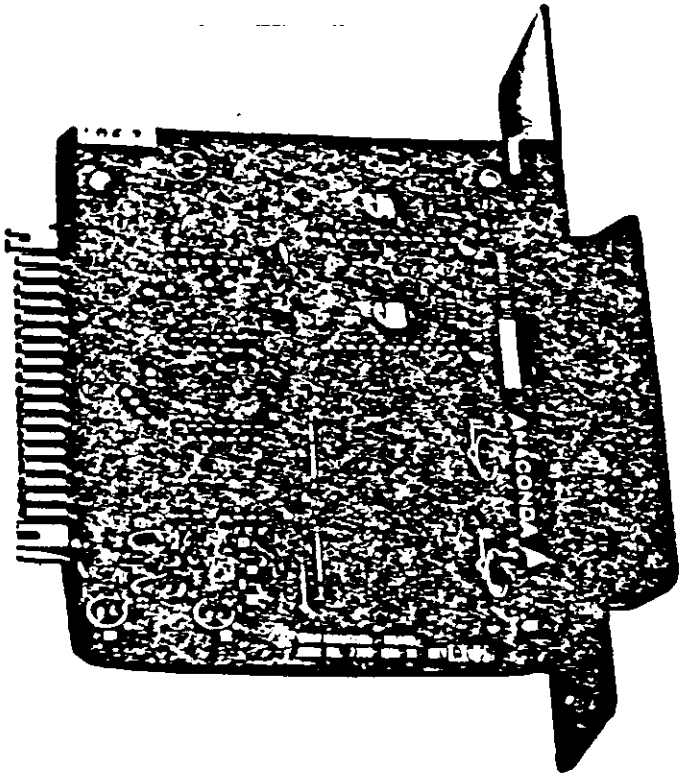


Figure 3-9. Configuration ROM Card.

4. TOOLS AND TEST EQUIPMENT

4.01 The following tools and items of test equipment are required for isolating, and correcting, potential malfunctions within the PRODIGY* PABX SYSTEM:

a) Test Telephone (500 type)

b) Digital Voltohmmeter

When installing the printed circuit boards, exercise care in proper vertical alignment prior to insertion. Proper alignment eliminates the possibility of damage to the components on the card being inserted and adjacent cards.

5.0 THEORY OF OPERATIONS

5.01 The PRODIGY PABX (Figure 5-1) is a two-way interface divice providing all required interfacing to both the station subscriber lines and the central office trunks. Incoming analog voice data from these lines or trunks is digitized, routed to the proper destination and then reconstructed to the proper analog voice signals for reception by the destination station or trunk.

5.02 The PRODIGY PABX utilizes both time division multiplexing and delta modulation techniques to accomplish the required switching. Time division multiplexing provides the signal routing function internal to the PABX by permitting the sharing of the PABX dual high speed digital bus by the system sharing of the PABX dual high speed digital bus by the system users. Sharing (multiplexing) is accomplished by permitting each user a discrete period of time, called a slot, on the bus. The delta modulation function encodes the incoming analog signal into a single weighted digital pulse stream which may be switched over the dual high speed bus (by the time division multiplexing logic) and decoded at the receiving end to reconstruct the original analog signal.

DELTA MODULATION

5.03 The PRODIGY system incorporates analog-to-digital and digital-to-analog conversion by means of a device called a Coded (coder-decoder). The encoding method used is called Continuously Variable Slope Delta (CVSD) modulation (refer to Figure 5-2). In CVSD modulation, the analog voice signal enters the Codec at the Audio-In input where is is continuously sampled and compared with the output of an Integrator by a Comparator circuit. The resulting output of the Comparator is a digital bit stream and is, therefore, a stream of values of either zero or a positive voltage levels. The digital output of the Comparator is fed to the Sampler where, at the proper clock Codec as the signal Digital Out. The Digital Out bit stream is then transmitted, over the dual high speed bus, as the encoded audio data.

5.04 The Digital Out signal is also fed to a counter and coincidence circuit (Algorithm and Slope Command) used to detect when the Sampler outputs either three successive ones or three successive zeros. Three successive ones or three successive zeros result in an increase or decrease, respectively, in the Sampler output step size.

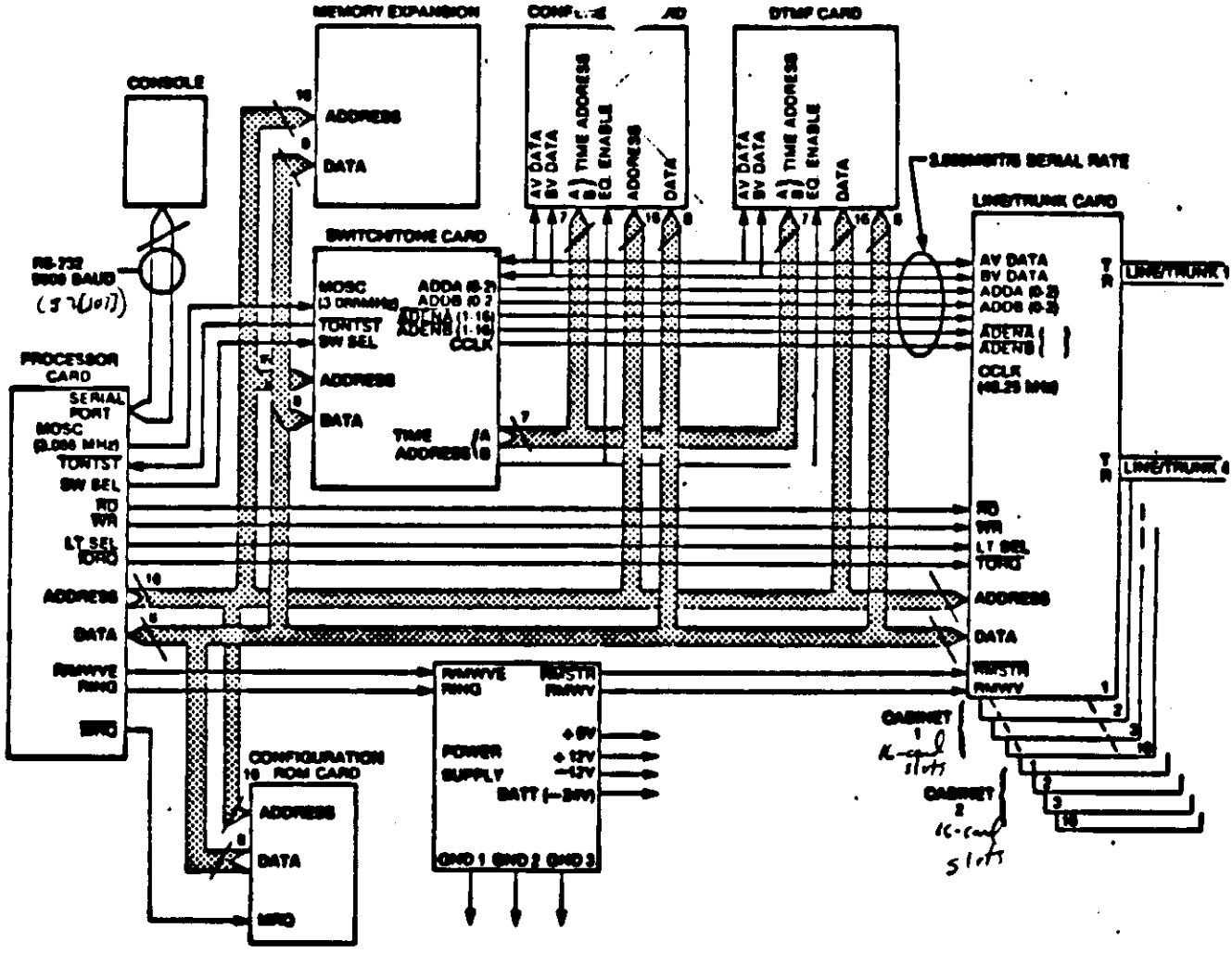


FIGURE 5-1, PRODIGY FUNCTIONAL BLOCK DIAGRAM

5.05 Figure 5-3 depicts one cycle of an audio sine wave and the resulting Sampler output generated by the CVSD encoder. Note the variation in step size shown on the curve representing the Integrator output.

5.06 Figure 5-4 is a block diagram representation of a CVSD decoder. The CVSD decoder is almost identical to the CVSD encoder with the single exception that the Comparator is not provided. In the decoding process, the digital pulse stream from the Sampler output of the encoder is clocked in to the decoder Sampler as a Digital In input. The output of the Sampler is then fed to the Pulse Amplitude Modulator where the digital bit stream is integrated to produce the reconstructed audio signal. The Algorithm and Slope Command logic provides a feedback network that allows the decoder to properly follow the slope changes generated by the encoder.

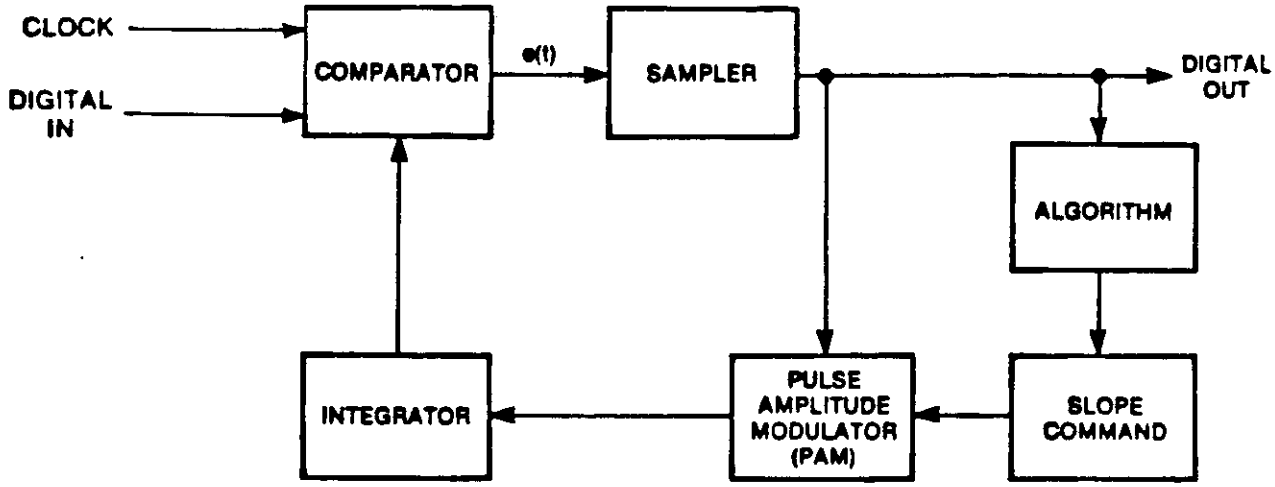


FIGURE 5-2, CVSD ENCODER BLOCK DIAGRAM

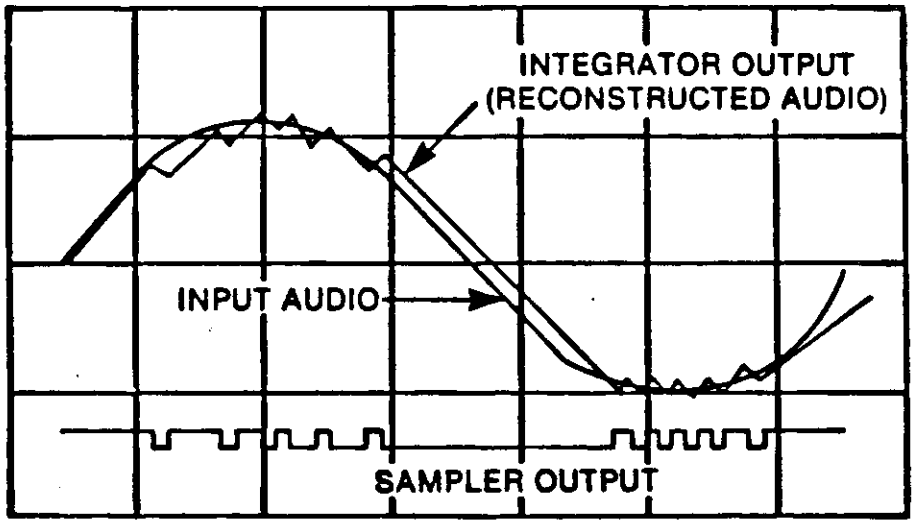


FIGURE 5-3, CVSD INPUT/OUTPUT

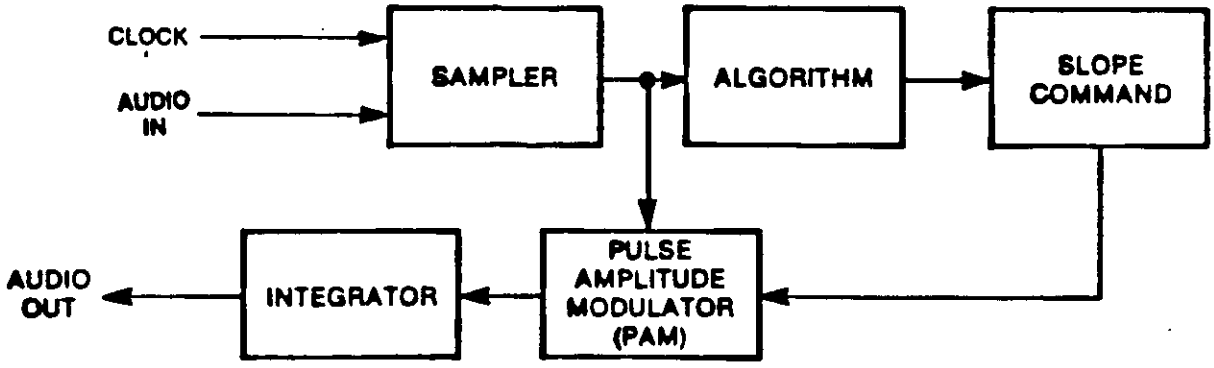


FIGURE 5-4, CVSD DECODER BLOCK DIAGRAM

GENERAL OPERATION

5.07 Analog voice signals entering the PRODIGY PABX are terminated on either a Line or Trunk Card where they are converted to the CVSD modulation digital bit streams. The CVSD bit streams are then time division multiplexed, a single bit at a time, into one of the 64 available time slots on the dual highway digital bus. (The multiplexing is performed under control of the switch portion of the Switchtone Card.) A voice connection is established between two lines, two trunks or a line and a trunk by the correct gating of their corresponding time slot. The receiving circuit then reconverts the CVSD modulation pulses to the analog voice signal and outputs the resulting signal on the tip-ring pair of the receiving line or trunk.

5.08 The time slot address information used in assigning the time slots on the dual highway digital bus is derived from the microprocessor and is transmitted to the Switchtone card, for storage in the switch memory, by means of the processor data bus. The Switchtone Card supplies this information as line or trunk addressing during each of the 64 time slots on the dual highway digital bus.

5.09 All call progress tones used in the PABX system are stored in digital form in the tone portion of the Switchtone Card. If the optional DTMF Card is installed within the PABX it decodes the dual tone multifrequency dialing signals transmits the resulting decoded values to the processor. The DTMF Card is also used to detect dial tone from an outgoing trunk and generating DTMF signals for trunk dialing in applications of call diversion.

Call progress tones and DTMF decoders are accessed in the same manner as the line and trunk ports. The port addresses of the Switchtone Card and DTMF Card are placed in the switch memory in the location corresponding to the time slot on the dual highway digital bus that is designated for the respective card.

6.0 INITIALIZATION, SELF-TEST AND STALL

INITIALIZATION START-UP PROCEDURE

6.01 Each time power is applied to the PRODIGY system, an initialization start-up sequence is performed. Because all volatile information is lost whenever power is removed from the system, a power-on sequence following a power failure is treated as an initialization start-up. The initialization start-up sequence performs two primary functions:

- A system self-test diagnostic operation to verify the system operational capabilities,
- A system initialization to prepare and initialize the system for normal operation.

If the system self-test is completed without error, the PRODIGY is then initialized and operations are commenced.

SELF-TEST

6.02 The self-test feature is provided to inform service personnel of malfunctoning equipment and to automatically place such equipment out of service. Certain equipment failures are determined to be minor failures and willnot significantly affect system operations: the failing equipment will simply be placed out of service in the system memory.

6.03 Certain equipment failures are said to be major failures. Major equipment failures prohibit the system from entering into the normal operational mode. The occurrance of a major failure triggers a one minute delay, followed by a Level 3 Recovery which performs the same initialization and sel-test and the power-on initialization.

6.04 Table 6-1 lists the tests executed by the self-test feature. The Minor Alarm LED will illuminate for 1/2 second to indicate the successful completion of a self-test and for 3 seconds to indicate a failure. By counting the number of blinks since the power-on initialization began, as well as the duration time of the LED illumination, the pass/fail status of the tests may be determined.

TABLE 6-1. SELF-TEST DIAGNOSTIC TESTS

STEP NUMBER	SUCCESSFUL COMPLETION	FAILURE		
	PABX MINOR LEDS	PABX MINOR LEDS	PABX L/T LEDS	DTMF LEDS
1. Z-80 PUSH/POP TEST (PROCESSOR CARD)	OFF	ON-PERFORM LEVEL 3 RECOVERY	ON	ON
2. CONFIGURATION PROM TEST	1/2 SEC ON	*		
3. FEATURE PROM TEST (MEMORY EXPANSION CARD)	*	3 SEC ON-CONTINUE TO NEXT TEST		
4. RAM TEST (PROCESSOR CARD)	*	ON-PERFORM LEVEL 3 RECOVERY		
5. CTC TEST (PROCESSOR CARD)	*	*		
6. PROM TEST (PROCESSOR CARD)	*	*		
7. PROM TEST (MEMORY EXPANSION CARD)	*	*		
8. CONFIGURATION CHANGE DATA TEST (EXTENDED MEMORY CARD)	*	3 SEC ON-CONTINUE TO NEXT TEST		
9. VOICE/TONE POWER SUPPLY TEST (POWER SUPPLY)	*	*		
10. SWTICH MEMORY TEST (SWITCHTONE CARD)	*	*		
11. TONE GENERATION TEST (SWITCHTONE CARD)	*	*		
12. CONFIGURATION	* 1ST ROW L/T ON OFF	*		
13. TRANSMISSION TEST	* 2ND ROW L/T OFF	*		

6.05 The console displays the results of the execution of the self-test operations. Whenever a major test fails, the console Major Alarm LED will light. The console Minor Alarm LED remains lit throughout the self-test procedure. Table 6-2 defines the state of the console LEDS during the execution of the self-test feature.

6.06 If the PRODIGY system contains the Remote Access feature, the following self-test functions are executed once every 24 hours, as defined in the configuration software:

- Line/Trunk board test (24-hours)
- Switchtone board test (24-hours)
- Extended Memory board test (24-hours)
- DTMF board test (24-hours)

- Configuration ROM test (24-hours)
- Feature Package PROM test (24-hours)

With Remote Access installed the self-tests may also be activated, on command and at any time, from an authorized attendant console or staion.

SELF-TEST OPERATIONS

6.07 The following tests are executed by the self-test feature of the PRODIGY® PABX.

6.08 Self-test ~~Test~~ 1 performs a test of the Z-80 Central Processor push/pop stack operation. Upon successful completion of Test 1, the PABX Minor Alarm LED is "blinked" and Test 2 is executed. If Test 1 fails: the console Major and Minor Alarm LEDs are illuminated, the alphanumeric display presents a "STANDBY CODE 1" message to the attendant and a Level 3 Recovery is executed. Repetitive execution of Test 1 indicates a hard failure of either the Z-80 or RAM Stack area requiring the replacement of the Processor Card.

6.09 Self-test ~~Test~~ 2 tests the Configuration ROM memory. If the test completes successfully, the PABX Minor Alarm LED is "blinked" and Test 3 is executed. If Test 2 fails, the console Major Alarm LED [illegible] the PABX Minor Alarm LED [illegible] the console alphanumeric display presents a "STANDBY CODE 2" message to the attendant, and Recovery Level 3 is executed. Repetitive failure of Test 2 indicates that the Configuration ROMs require replacing.

TABLE 6-2. CONSOLE LED INDICATIONS

LAMP	BLINK	OFF	ON
MAJOR ALARM		NORMAL	MAJOR FAILURE AT START-UP OR STALL DISPLAY SHOWS FAILING TEST
MINOR ALARM	1. START-UP HAS FINISHED 2. MINOR ALARM CONDITIONS 3. OPERATOR MAY USE FEATURE ACCESS CODES TO: (a) DISPLAY ALARM (b) RESET FOLLOWING ALARMS - COMMUNICATION LINK 1 FAILURE - COMMUNICATION LINK 2 FAILURE - TEMPORARY STORAGE CLEARED - LINE/TRUNK FAILURE - FEATURE PACKAGE FAILURE - DTMF FAILURE	NORMAL	START-UP, STALL RECOVERY AND SUBSEQUENT TIME OUT PERIOD

6.10 Self-test 3 tests the Feature Package ROM chips. Upon successful completion of this test, the PABX Minor Alamr LED is "blinked" and Test 4 is entered. If Test 3 fails, the PABX Minor Alarm is illuminated for 3 seconds and the alphanumeric display presents the attendant with a "STANDBY CODE 3" message. Failure of this test indicates that one or more of the Feature Package ROMs have failed (to a maximum of 8). The console may be used to investigate which of the ROMs have failed.

6.11 Self-test Test 4 tests the Random Access Memory (RAM) contained within the PABX Processor Card. Test 4 lasts approximately one second. Upon successful completion of Test 4, the PABX Minor Alarm LED is "blinked" and Test 5 is executed. If Test 4 fails, the console Major Alarm is illuminated the PABX Minor Alarm LED, is illuminated, the console alphanumeric display presents the attendant with a "STANDBY CODE 4" message and Level 3 Recovery is executed. Repetitive failure of this test indicates a failure in the CTC on the Processor Card requiring replacement of the memory.

6.12 Self-test Test 5 tests the Counter Timer Circuitry (CTC). When Test 5 completes successfully: the PABX Minor Alarm LED is "blinked" and Test 6 is performed. If Test 5 fails, the console Major Alarm LED is illuminated while the console alphanumeric display indicates a "STANDBY CODE 5", and Level 3 Recovery is executed. Repetitive failure of this test indicates a failure in the CTC on the Processor Card requiring replacement of the Processor Card.

6.13 Self-test Test 6 checks the ROM on the Processor Card. Upon successful completion of Test 6 the PABX Minor Alarm LED is "blinked" and Test 7 is entered. A failure in Test Alarm LED, displays a "STANDBY CODE 6" on the console and executes Level 3 Recovery procedures. Repetitive failure of Test 6 indicates a hard failure in the ROM chip set requiring replacement of either the ROM chip set or the Processor Card.

6.14 Self-test Test 7 performs a test of the program ROM on the Extended Memory Card. Successful completion of Test 7 the PABX Minor Alarm LED is "blinked" and Test 8 is executed. If Test 7 fails, the console Major Alarm LED is illuminated, the display indicates a "STANDBY CODE 7" and Level 3 Recovery is executed. Repetitive failure of Test 7 indicates a hard failure in the ROM chip set. The Extended Memory Card should be replaced.

6.15 Self-test ~~Test~~ 8 tests the configuration change data integrity. User change data is stored and cleared. If the test passes, the Minor Alarm LED is blinked and Test 9 is performed. If Test 8 fails, the PABX Minor Alarm LED is lit for 3 seconds and STANDBY CODE 8 is displayed on the console. Failure of this test indicates that either the user data last written into the configuration-change area (in the CMOS memory chips on the Extended Memory Card) has changed, the CMOS chip has developed a hard failure, or the CMOS memory has not been initialized. The configuration-change data should be examined and corrected. If the correct data cannot be stored in the CMOS memory, the CMOS memory chips must be replaced.

6.16 Self-test ~~Test~~ 9 tests the power supply for the voice and tone circuits. Upon successful completion of this test the Minor Alarm LED is blinked and Test 10 is entered. If Test 9 fails, the Minor Alarm LED is ~~illuminated~~ lit for 3 seconds, Test 10 is executed and the console displays STANDBY CODE 9.

A failure within the power supply is considered to be a minor failure due to the fact that such a failure does not prohibit the PABX from performing the self-test sequence. However, failures within the power supply may prohibit the carrying of voice and/or tone path information over any line within the system. Failure of Test 9 indicates a failure within the power supply requiring repair or replacement of the power supply in order to maintain proper system operation.

6.17 Self-test ~~Test~~ 10 performs a test of the switch memory. If the test is completed successfully, the PABX Minor Alarm LED is blinked and Test 11 is performed. If Test 10 fails to execute properly, the PABX Minor Alarm LED is lit for 3 seconds, Test 11 is entered and the console alphanumeric display presents a STANDBY CODE 10 message to the attendant.

Failure of Test 10 indicates a fault within the switch memory. This failure is considered a minor failure since it does not prevent the PABX from functionally performing its operation. However, failures within the switch memory may cause incorrect voice or tone transmissions for particular calls which would normally cause a loss of transmission for these calls. This type of failure may also result in incorrect voice path connections. A failure of Test 10 indicates that the Switch-tone Card should be replaced.

6.18 Self-test ~~Test~~ 11 tests the operation of the Tone Generator. Successful completion of Test 11 causes the PABX Minor Alarm LED to be "blinked" and Test 12 to be executed. If Test 11 results in a failure, the PABX Minor Alarm LED is ~~illuminated~~ lit for 3 seconds, Test 12 is entered and the console presents the attendant with a STANDBY CODE 11 message.

Failures within the tone generator are considered minor failures as they do not prevent the PABX from performing its functional operations. However, failures of this nature may result in incorrect or missing tones. The problem is corrected by replacing the Switchtone Card.

6.19 Self-tests 12 and 13 perform tests on the individual line/trunk group circuit cards. Test 12 performs a test of the line/trunk group configuration by matching the contents of the particular card slot with the information contained within the system configuration tables. If a PCB is in a proper slot, the first LED on the board is extinguished after all boards are tested. A PCB is determined to be in an incorrect slot if it is placed in a non-configured slot or if it is placed in a slot configured for a different type of board, (e.g., a Trunk board placed in a slot configured for a Line board). A PCB placed in a slot that is not properly configured is placed out of service. A configured slot that is vacant forces the PABX Minor Alarm LED to be lit for 3 seconds and the console to display of a "STANDBY CODE 12 and 13" message.

Test 13 performs a test of the transmision capability of the Line and Trunk PCBs and is performed only for those boards that are int the proper slots and are properly configured. (If a Line or Trunk board fails Test 12, the LEDs remain lit during Test 13 and the board is not tested.)

NOTE: a failure of Test 12 does not necessarily indicate that the board itself is faulty, since it may be improperly installed or configured. The PCB must be placed into the proper slot first, to verify whether board operation is truly faulty.

If Test 13 is successfully completed, the second LED on the board is extinguished. If a failure is detected, the second LED remains lit.

A failure of the transmission test indicates that the PCB is faulty and should be replaced. The actual ports failing Test 13 are indicated by the LED associated with that port continually "blinking".

All failures of Test 12 and/or Test 13 are considered minor failures as they do not inhibit the functional operation of the system.

Any line or trunk failure within a card forces that line or trunk out of service to the system thereby inhibiting the use of those lines or trunks.

Each of these tests causes the PABX Minor Alarm LED to be "blinked" upon completion.

STALL ALARM INTERRUPT

6.20 The "Stall Alarm Interrupt" is the highers priority interrupt in the PRODIGY system. The Stall Alarm Interrupt occurs whenever the Stall Alarm is not pulsed within a two (2) second time period. During normal system operation, the Stall Alarm is pulsed every 15 milliseconds. When activated, the Stall Alarm Interrupt:

- Disables all other interrupts,
- Illuminates the Minor Alarm LED,
- Prohibits all phones from ringing,
- Reloads the Interrupt Vector Register,
- Initializes the stack,
- Resets the Line and Trunk Cards.

LEVEL 1 RECOVERY

6.21 The Level 1 Recovery routine effectively performs a reset and continue operation. The Level 1 Recovery program presents a console display of "STANDBY" or "STANDBY CODE X" (where X = the test that failed), illuminates the Minor Alarm LED, restores the equipment status to the lines or trunks and executes the Push/Pop Test, ROM Tests, RAM Tests and CTC Tests. When the tests are complete, a 20 second timeout is initiated at the end of which normal operations are resumed. The Minor Alarm LED remains on during the recovery and the timeout.

LEVEL 2 RECOVERY

6.22 A Level 2 Recovery is performed if a second Stall Alarm Interrupt is encountered after the Level 1 Recovery has completed but prior to the expiration of the 20 second timeout. The generation of a Level 2 Recovery operation indicates that a failure exists within the system that was not cleared by the Generation Test and Line and Trunk Transmission Test, the Level 2 Recovery executes the entire self test and reinitializes the system. The console display is the same as presented during start-up. The Level 2 Recovery operation initializes a 5 second timeout, on completion of the recovery, followed by the Level 1 Recovery 20 second timeout. The Minor Alarm LED remains on during the recovery and dual timeouts.

LEVEL 3 RECOVERY

6.23 A Level 3 Recovery is executed whenever a major failure is encountered or if a Stall Alarm Interrupt" is received after a Level 2 Recovery operation has completed but prior to the 5 second timeout expiring. The Level 3 Recovery operation is essentially the same as a power-on start up operation. During Level 3 Recovery all of the self-test and initialization functions contained in the start-up sequence are executed. All alarm indications generated during the start-up sequence. A 5 second timeout is followed by the 20 second Level 1 Recovery timeout. The Minor Alarm LED remains illuminated during the recovery and both timeouts.

TROUBLE ANALYSIS

6.24 All trouble reports should be clearly understood and thoroughly evaluated prior to making any attempt at correcting a fault. A list of typical questions to consider would be:

- Does the trouble exist on all circuits, or just a single circuit?
- Does the problem arise on all calls, or just certain calls?
- Are all stations affected, or just select stations?
- What are the directory numbers of the affected stations (if all stations are not affected)?
- Is the problem related to a specific time of day?
- Has any work been performed on the equipment or in the area recently?

6.25 FACILITY TROUBLES. Problems that arise in the operation of the PRODIGY* PABX may not always be attributable to the PABX system. Alternative areas of malfunction should also be evaluated. Areas such as station apparatus, main distributing frame (MDF), local cables, aerial or underground or central office (CO) facilities should be verified as fully operational using standard procedures.

6.26 SYSTEM ALARM CONDITION. The PRODIGY PABX is equipped with LED indicators, located in two separate areas, to display test status to the maintenance personnel. The two groups of LED's provided are:

- PABX chassis LEDs (Figure 6-1 and Tables 6-3 through 6-5.
- Attendant Console LEDs (Figure 6-2)

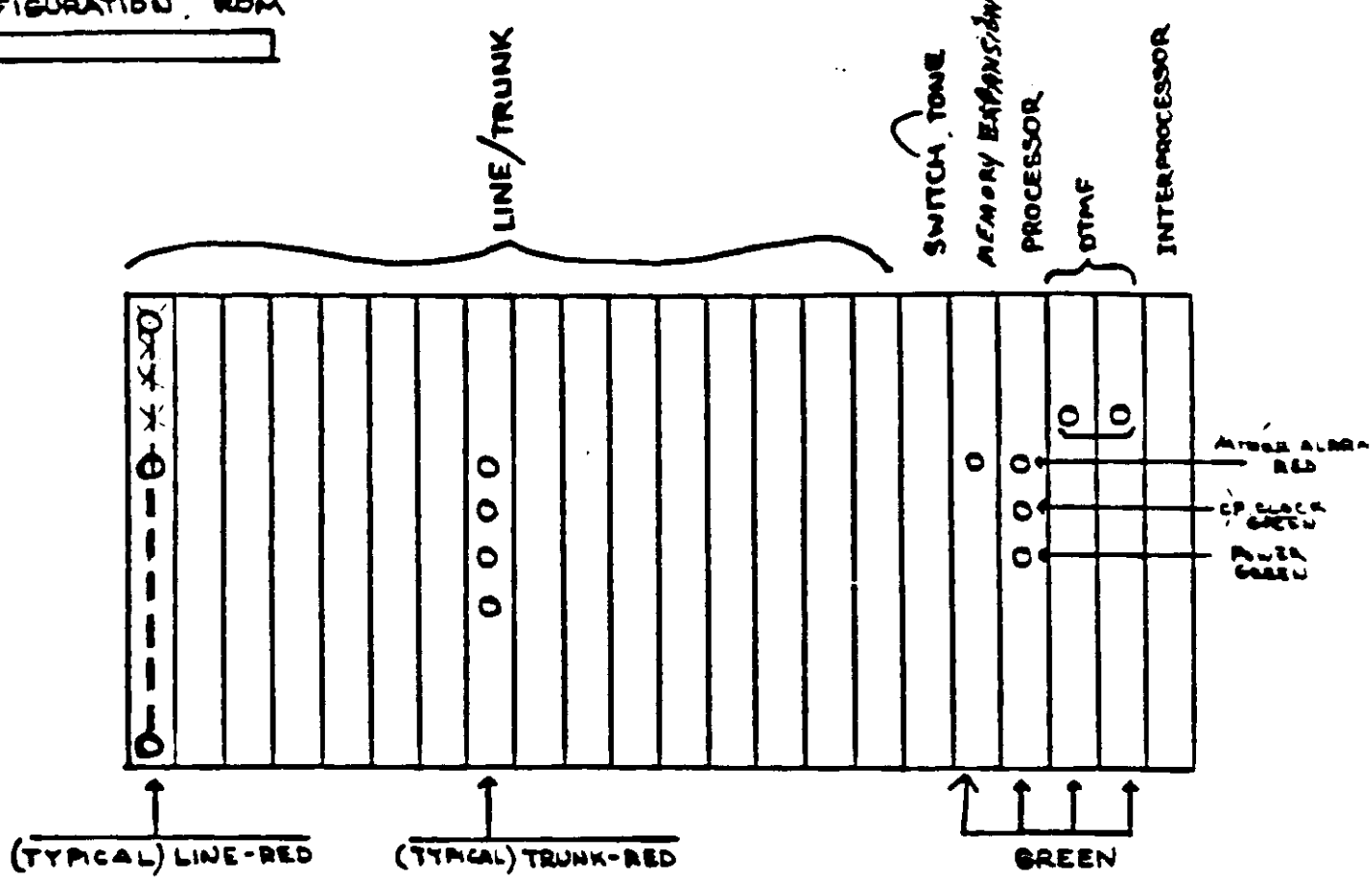


FIGURE 6-1. PABX CHASSIS LED DISPLAY

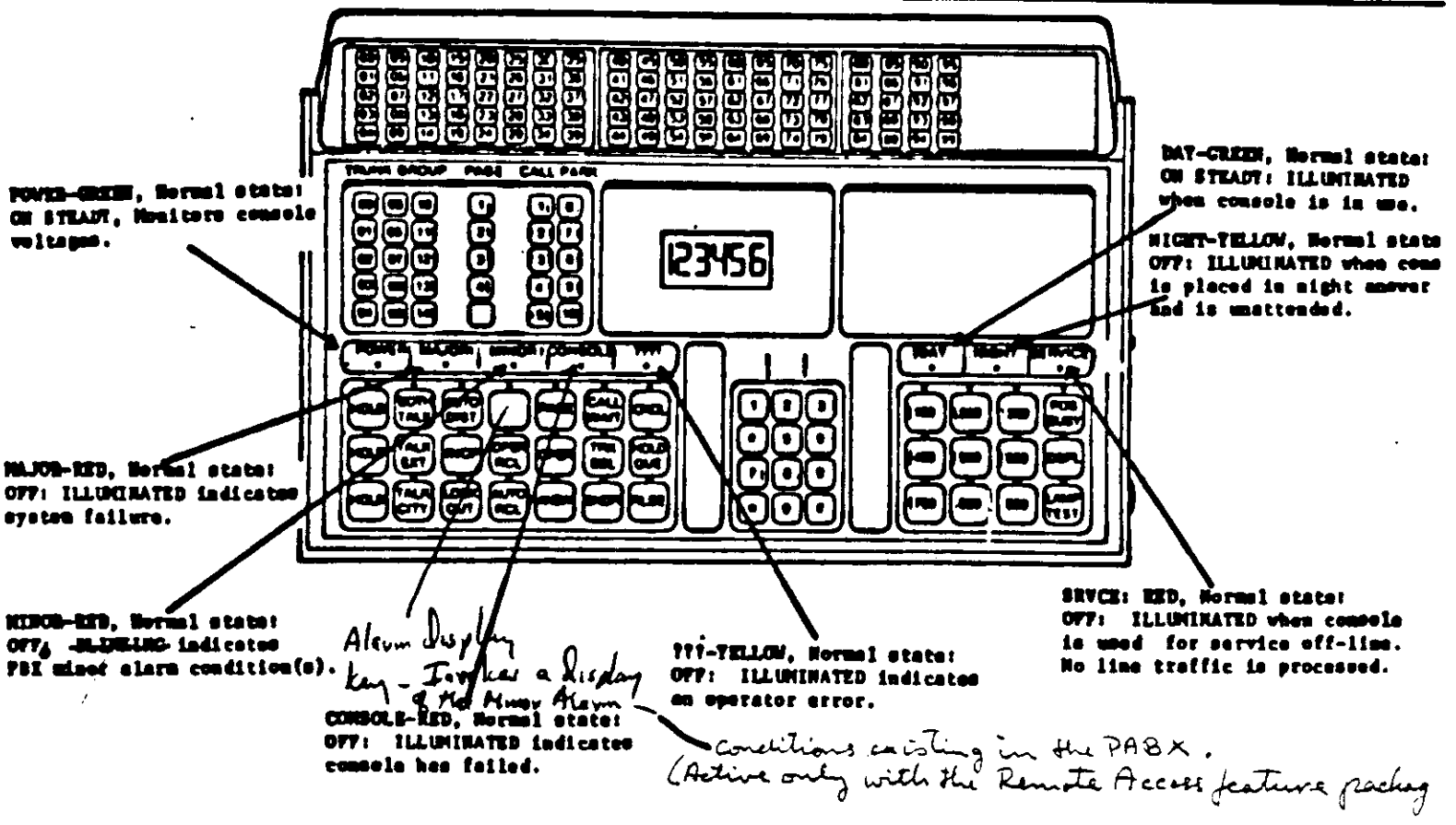


FIGURE 6-2. ATTENDANT CONSOLE LAMP IDENTIFICATION

TABLE 6-3, PABX ALARM INDICATION - START UP/RECOVERY LEVEL 3

LAMP	BLINK	OFF*	ON
POWER (PROCESSOR CARD)		NO POWER	POWER APPLIED
CP CLOCK (PROCESSOR CARD)		CLOCK NOT RUNNING	CLOCK RUNNING
MINOR ALARM (PROCESSOR CARD)	½ SECOND ON- TEST PASSED 3 SECONDS ON- TEST FAILED	TEST EXECUTING	START OF START-UP/RECOVERY TO END OF Z-80 PUSH/POP TEST
LINE/TRUNK		1st LAMP- CONFIGURATION TEST PASSED 2nd LAMP- TRANSMISSION TEST PASSED	ALL ON FROM START OF START-UP/ RECOVERY TO END OF CONFIGURATION TEST AT END OF CONFIGURATION TEST 1st LAMP ON INDICATES TEST FAILURE AT END OF TRANSMISSION TEST 2nd LAMP ON INDICATES TEST FAILURE
SWITCHTONE **		TEST EXECUTING END OF START UP RECOVERY	START OF START-UP/RECOVERY TO START OF SWITCH MEMORY TEST
EXTENDED MEMORY		"	START OF START-UP/RECOVERY TO START OF CONFIGURATION CHANGE TEST
BTMF		"	START OF START-UP/RECOVERY TO START OF BTMF TEST
INTERPROCESSOR **		"	START OF START-UP/RECOVERY TO START OF INTERPROCESSOR TEST

* LAMP MAY BE BURNED OUT
** NO LAMP ON CARD AT PRESENT

TABLE 6-4. PABX ALARM INDICATION - NORMAL OPERATION

LAMP	BLINK ***	OFF *	ON
POWER (PROCESSOR CARD)		NO POWER	POWER APPLIED
CP CLOCK (PROCESSOR CARD)		CLOCK NOT RUNNING	CLOCK RUNNING
MINOR ALARM (PROCESSOR CARD)	1. COMMUNICATION LINK 1 FAIL 2. COMMUNICATION LINK 2 FAIL 3. VOICE/TONE POWER FAILURE 4. SERVICE DEGRADATION " 5. TEMPORARY STORAGE CLEARED 6. CONFIGURATION PROM FAIL	NO MINOR ALARM	STALL ALARM INTERRUPT
LINE/TRUNK	OUT-OF-SERVICE	IDLE (ON-HOOK)	ACTIVE (OFF-HOOK)
SWITCHTone **	1. SWITCH MEMORY FAILURE 2. TONE GENERATOR " 3. TONE DETECTOR " 4. TIME SLOT "		ALL IN GOOD OPERATING CONDITION
EXTENDED MEMORY	1. FEATURE PROM FAILURE 2. CONFIGURATION CHANGE " 3. MESSAGE REGISTRATION "		ALL IN GOOD OPERATING CONDITION
SYNF	SOME DEVICES ON CARD OUT-OF-SERVICE	SOME DEVICES ON CARD OUT-OF-SERVICE/SOME BUSY	ALL IN GOOD OPERATING CONDITION
INTERPROCESSOR **		INTERPROCESSOR FAILURE	ALL IN GOOD OPERATING CONDITION

* LAMP MAY BE BURNED OUT

** NO LAMP ON CARD AT PRESENT; MINOR ALARM INDICATED BY PROCESSOR CARD MINOR ALARM LAMP

*** 1 SECOND ON/1 SECOND OFF

TABLE 6-5. PABX ALARM INDICATION - RECOVERY LEVELS 1 AND 2

LAMP	BLINK	OFF *	ON
POWER (PROCESSOR CARD)		NO POWER	POWER APPLIED
CP CLOCK (PROCESSOR CARD)		CLOCK NOT RUNNING	CLOCK RUNNING
MINOR ALARM (PROCESSOR CARD)			RECOVERY IN PROGRESS
LINE/TRUNK			
SWITCHTONE BX			ALL ON THROUGHOUT RECOVERY
EXTENDED MEMORY			
DTMF			
INTERPROCESSOR**			

* LAMP MAY BE BURNED OUT

** NO LAMP ON CARD AT PRESENT

7.0 MINOR ALARM CONDITIONS - NORMAL OPERATIONS

7.01 Upon completion of the self-test, any minor failures detected during test execution are stored in the RAM. Following initialization and system start-up, the console and PABX Minor Alarm LED's (as well as the appropriate board LED's) will blink to indicate the existance of the minor alarm condition. If all of the self-tests pass, the PABX and console Minor Alarm LED's will blink to indicate that all temporary information is lost (temporary storage is cleared) due to the initialization of the RAM.

7.02 The Display Minor Alarm function is an optional feature provided with the "Remote Access" feature package to allow display of the minor alarm conditions found on each card, within each feature package or encountered within the PABX system. Existing minor alarm conditions are displayed on the console alpha-numeric display whenever the (unmarked) Alarm Display key, in the attendant display function key field, on the console is pressed (refer to Figure 6-2). The display function is terminated when the last minor alarm conditions are displayed or the function times out. The display format is of the general form:

CP CC TYP 8 7 6 5 4 3 2 1

Where:

CP = A single digit identifier, 1 through 4, indicating the processor associated with the failure

CC = A two-digit identifier, 01 through 16, identifying the associated card slot (if applicable)

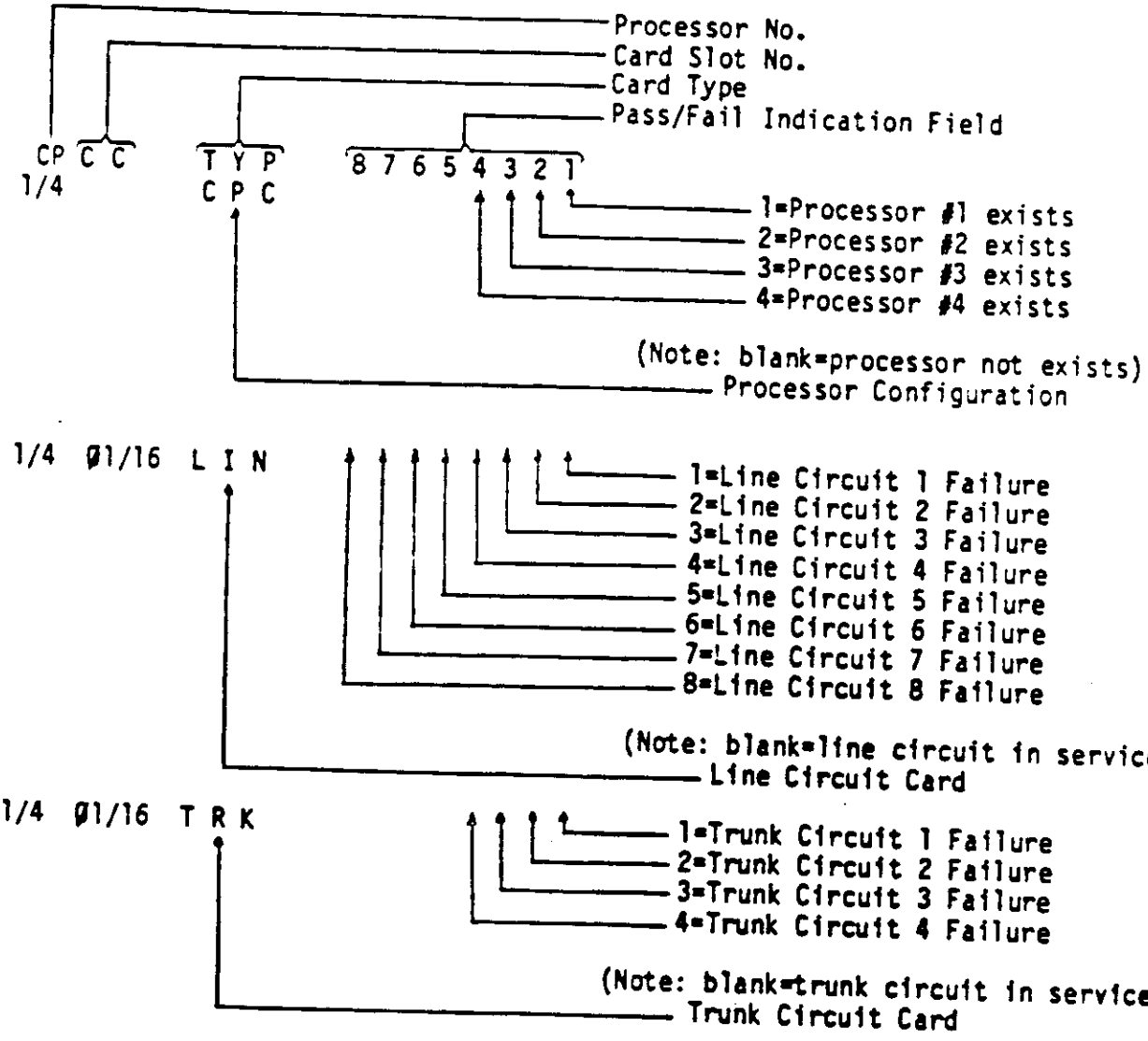
TYP = The failing card type:

- CPC = Processor Card
- LIN = Line Circuit Card
- TRK = Trunk Circuit Card
- SWT = Switchtone Card
- XMN = Extended Memory Card
- CMP = Processor Card (Link or Power Supply failure)
- DTM = DTMF CArd
- IPL = Interprocessor Card
- CPM = Configuration ROM Card
- STS = Status
- FPK = Feature Package
- END = End of display for processor 1 through 4

8-1 = A code indicating the failure encountered

The display always begins with the lowers CP and CC numbers. The complete display definition is provided in Table 7-1.

TABLE 7-1. [redacted] MINOR ALARM DISPLAY



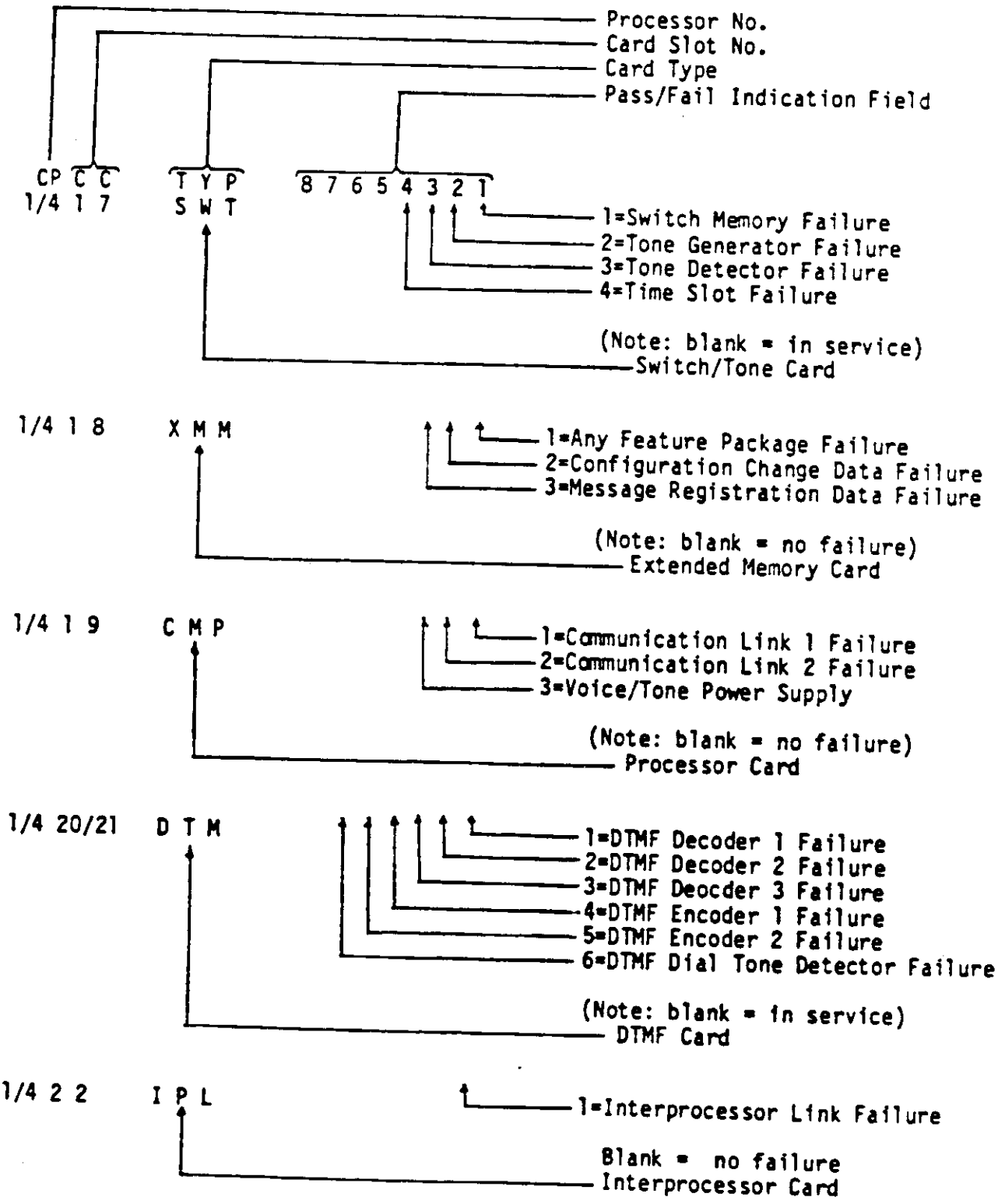
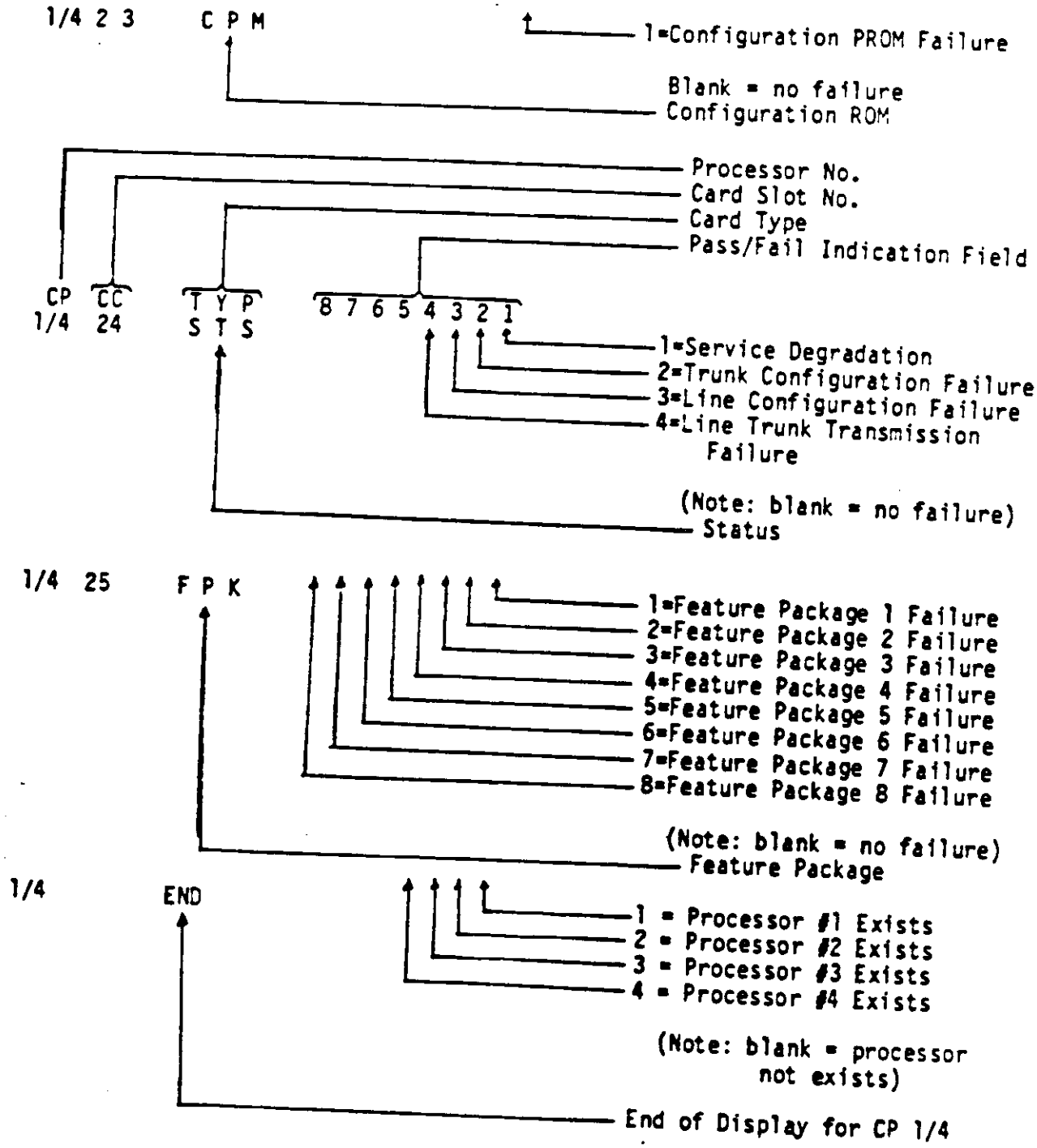

Processor No.
Card Slot No.
Card Type
Pass/Fail Indication Field
CP C C
1/4 1 7
T Y P
S W T
8 7 6 5 4 3 2 1
1=Switch Memory Failure
2=Tone Generator Failure
3=Tone Detector Failure
4=Time Slot Failure
(Note: blank = in service)
Switch/Tone Card
1/4 1 8
X M M
1=Any Feature Package Failure
2=Configuration Change Data Failure
3=Message Registration Data Failure
(Note: blank = no failure)
Extended Memory Card
1/4 1 9
C M P
1=Communication Link 1 Failure
2=Communication Link 2 Failure
3=Voice/Tone Power Supply
(Note: blank = no failure)
Processor Card
1/4 20/21
D T M
1=DTMF Decoder 1 Failure
2=DTMF Decoder 2 Failure
3=DTMF Deocder 3 Failure
4=DTMF Encoder 1 Failure
5=DTMF Encoder 2 Failure
6=DTMF Dial Tone Detector Failure
(Note: blank = in service)
DTMF Card
1/4 2 2
I P L
1=Interprocessor Link Failure
Blank = no failure
Interprocessor Card

TABLE 7-1, DISPLAY MINOR ALARM DISPLAY (CONTINUED)



8.0 REMOTE ACCESS AND MAINTENANCE FACILITY

8.01 If the optional Remote Access Feature Package is instralled in the PRODIGY system, four different functions may be invoked from a remote location by utilizing a standard 12-key Touch Tone® phone set:

- Remote maintenance,
- Directory number/COS changes,
- Minor Alarm display,
- Initiate a system restart.

8.02 This section of the practice defines the Remote Access and Maintenance Feature Package and provides step-by-step flowchart procedures for using the Remote Access facilities.

DIRECTORY NUMBER AND CLASS-OF-SERVICE CHANGES

8.03 The Directory Number and Class-Of-Service feature is a facility whereby the directory number and Class-of-Service may be changed, or temporary storage/RAM may be cleared, through the use of a 12-key Touch Tone phone via a service call from a remote sitwe. The following functions are provided by this feature package:

- Set Class-of-Service for a port (line/trunk)
- Set station or trunk directory number by port number
- Clear temporary storage/RAM
- Set the Permission to Enter Pass Code

NOTE: A directory number is not assigned to the attendant console.

FEATURE INVOKE

8.04 The Directory Number and Change-of-Service feature is invoked by dialing in to the PRODIGY system using a standard 12-key Touch Tone telephone. If the attendant console is in the Day Mode of operation, the attendant keys in the access code required to connect the incoming call to the feature. In the Night Mode of operation a dedicated trunk is allocated for this feature and the access code is entered by the remote station. An authorized passcode must then be entered to gain access to the feature. This feature package may also be activated by an authorized local station or attendant.

FEATURE RELEASE

8.05 No special code or procedure is required to release the Remote Access feature. A call disconnect releases the feature. Upon disconnect, any directory number or COS changes entered during the active state of the feature are completed.

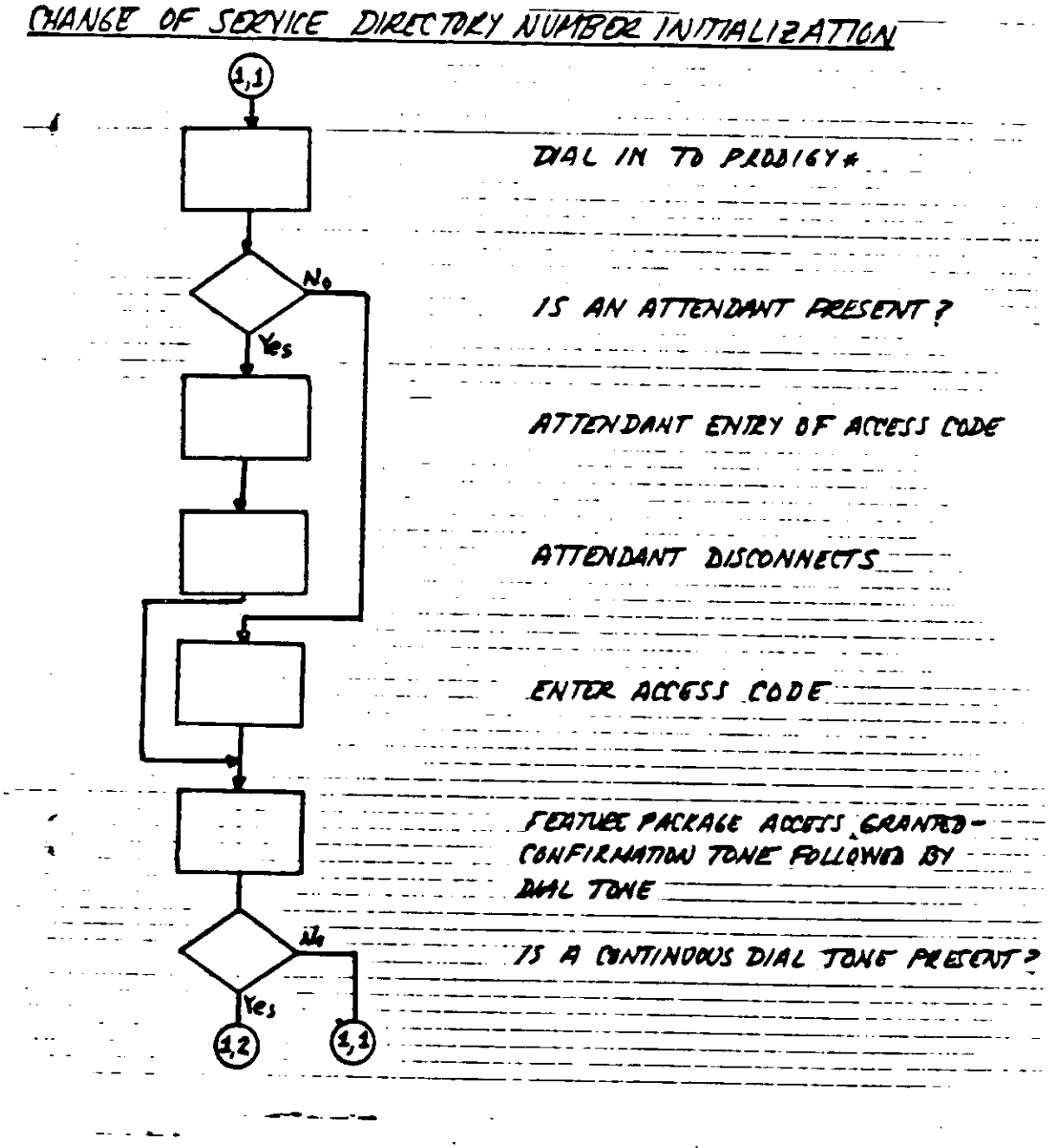


Figure 8-1. Directory and COS Feature Package Operational Flowchart.