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# ADVANCE PRINTING

## BCM32000 DESCRIPTION, INSTALLATION, AND MAINTENANCE DIGITAL TRANSMISSION SYSTEMS

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**1. GENERAL**

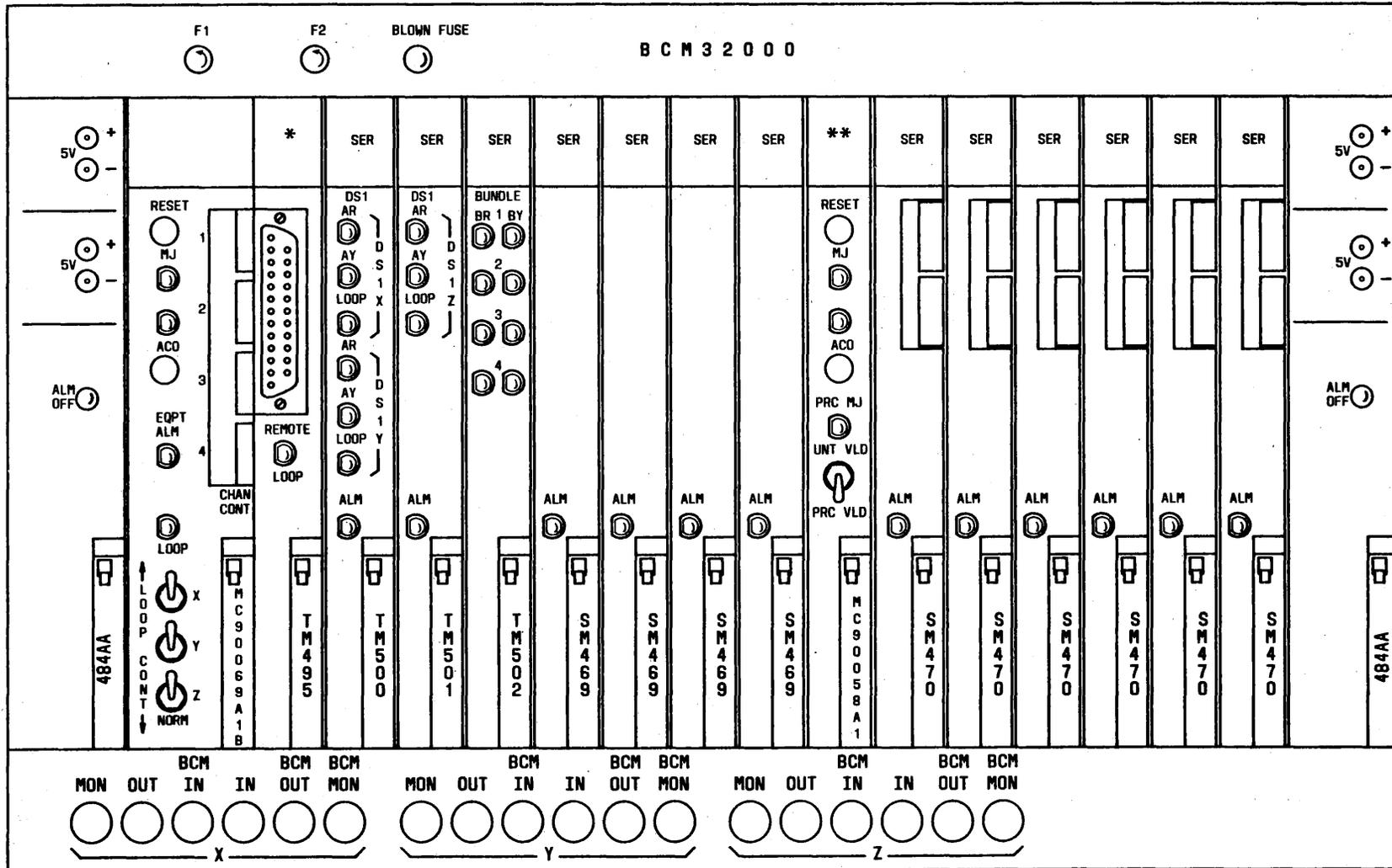
**1.01** The BCM32000 (Fig. 1) is a stand alone low bit rate voice (LBRV) terminal which occupies one equipment shelf. At customer locations the BCM32000 may be mounted in a cabinet, along with accessories. (See Fig. 2.) The BCM32000 uses ADPCM (adaptive differential pulse code modulation) technology to obtain 2:1 compression of 64 kb/s voiceband channels (see AT&T Technical PUB 54070). The effective capacity of a digital facility is doubled with virtually no loss of subjective quality by compressing 64 kb/s digital pulse code modulated channels into 32 kb/s channels. The BCM32000 works equally well with signaling tones and voiceband data up to 4.8 kb/s. It can also pass digital data, video, and program audio signals at their normal rate without compression.

**1.02** This practice is reissued to include the following enhancements to the BCM32000 equipment:

- MC90058A1 Common Processor
- Alarm Handling.

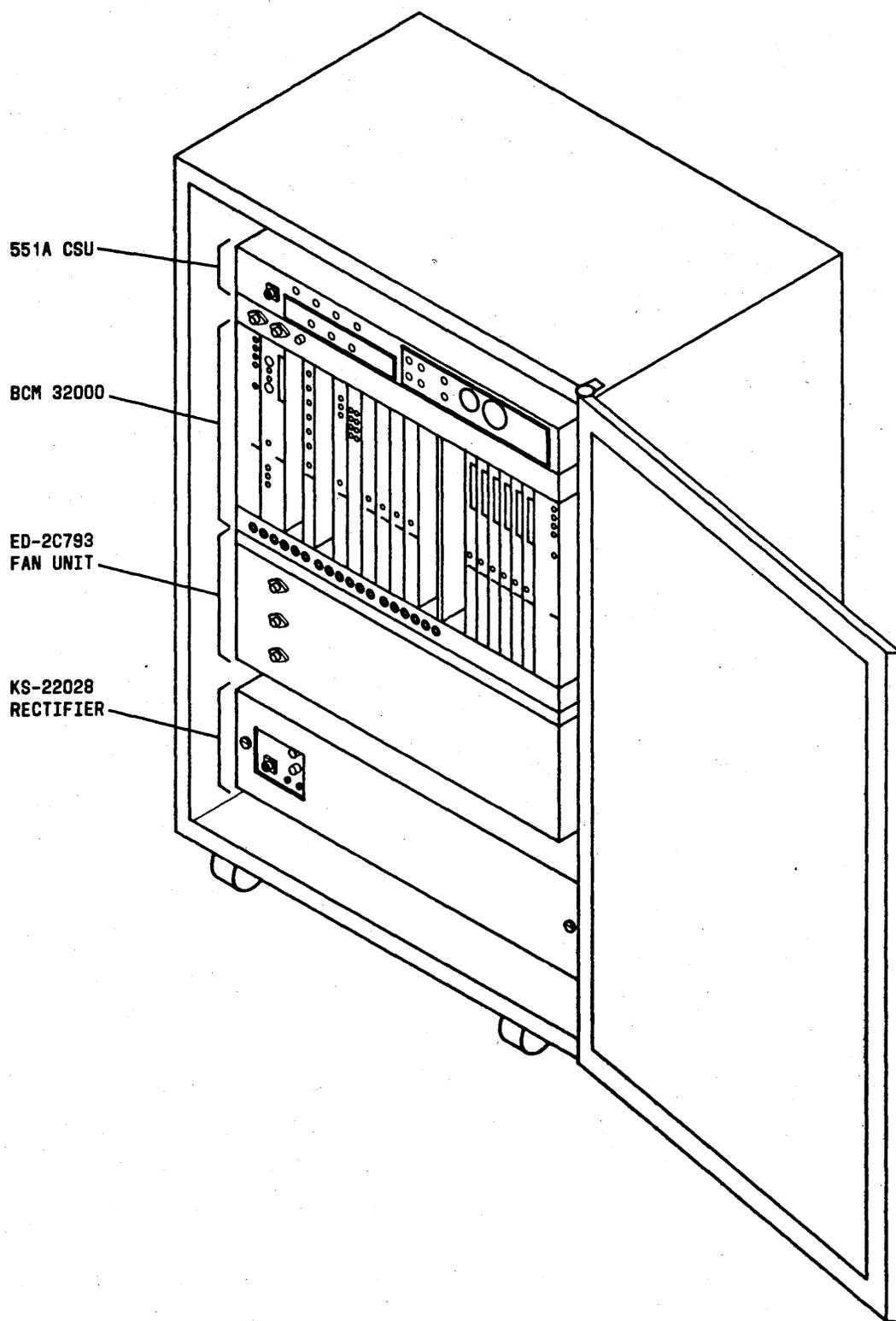
Information has been added for synchronization and trouble clearing. The tables for channel configuration have been reorganized. Revision arrows are used to emphasize significant changes.

**1.03** This practice provides a functional description, a physical description, engineering con-



\* REQUIRED IN ALL SHELVES SERVED BY THE COMMON PROCESSOR.  
 \*\* REQUIRED IN SHELF 1 ONLY FOR MULTISHELF PROCESSOR APPLICATIONS.

Fig. 1—BCM32000 With Optional Jack Panel and With Bundling and Echo Canceling Options Installed



551A CSU

BCM 32000

ED-2C793  
FAN UNIT

KS-22028  
RECTIFIER

Fig. 2—BCM32000 Cabinet Version

siderations, installation instructions, and maintenance procedures for the BCM32000.

## 2. FUNCTIONAL DESCRIPTION

### A. General

**2.01** The BCM32000 compresses two 1.544 Mb/s DS1 digital signals into one DS1 digital signal. Additional circuit packs and options may be added to provide echo canceling for each voiceband channel. The compressed DS1 signal is compatible with existing T1 lines and higher order facilities that carry multiples of DS1 signals. The BCM32000 operates in two directions of transmission. Lines x and y input uncompressed signals that are then compressed and transmitted on line z for one direction of transmission. Line z inputs compressed signals that are uncompressed and divided between lines x and y for the other direction of transmission.

**2.02** A typical DS1 signal consists of up to twenty-four 64 kb/s voice-frequency channels. The BCM32000 converts each voice channel from 64 kb/s to 32 kb/s in one direction of transmission and from 32 kb/s to 64 kb/s in the other direction of transmission. Channels carrying voiceband data at 4.8 kb/s or less are compressed like the voice channels. Channels carrying voiceband data at higher rates, digital data, or video can be routed through the BCM32000 without being compressed. Up to forty-eight 64 kb/s channels on two DS1 lines can be compressed and transmitted over a single DS1 facility.

### B. Theory of Operation

**2.03** Conventional digital transmission techniques convert a 4-kHz analog voice grade signal into a 64 kb/s digital pulse code modulated signal. The ADPCM algorithm performs additional signal processing at the transmit end to remove redundant information and to more efficiently encode the information into 32 kb/s channels. The result is a 32 kb/s signal that carries sufficient information for excellent voice transmission. The process is reversed at the receive end.

### C. Overview of Operation

**2.04** There are two modes of operation available with the BCM32000. They are bundle signaling (Fig. 3) and robbed-bit signaling (Fig. 4). There are two types of alarm handling the BCM32000 can use

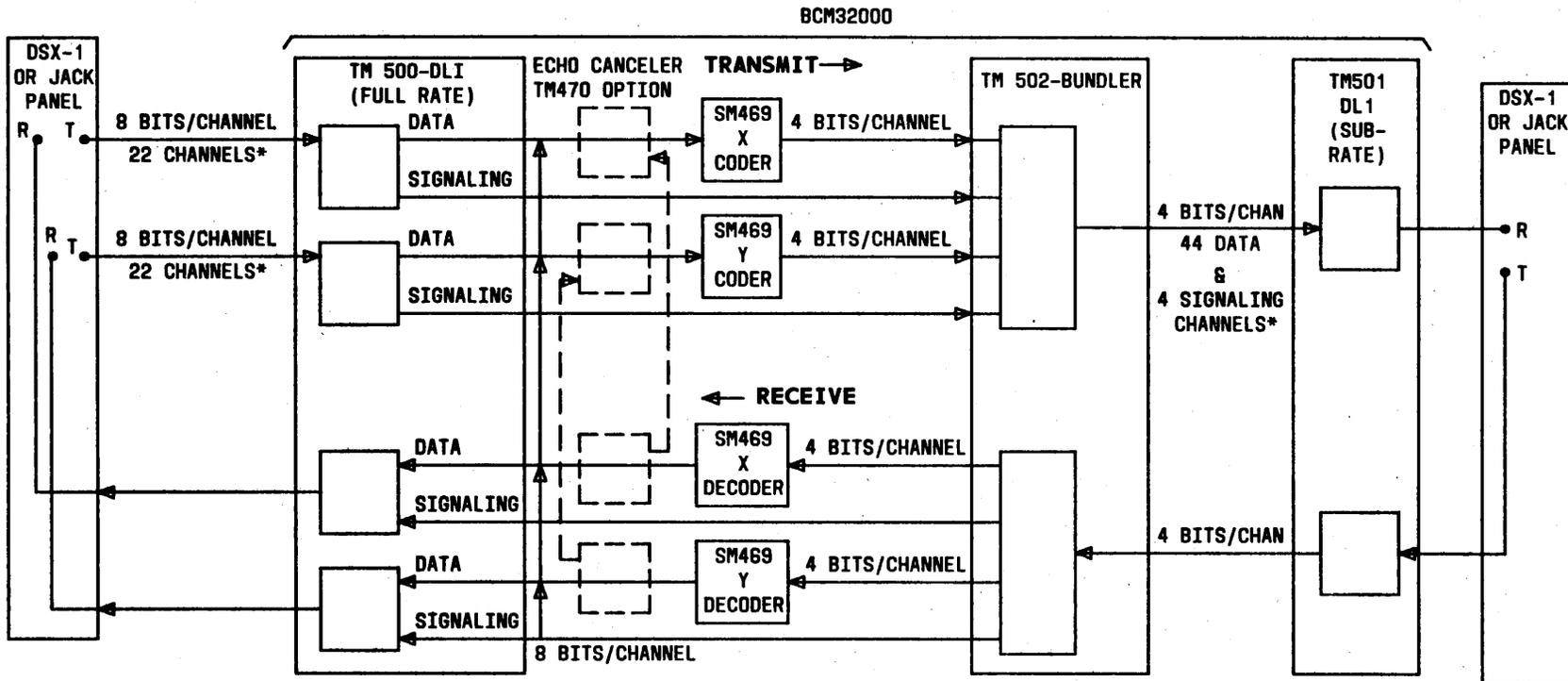
in either mode of operation, terminal alarms or alarm transparency. The code of AMC (alarm maintenance and control) circuit pack determines the mode of operation and type of alarm handling used. Cabinet versions of the BCM32000 may have an optional 551A CSU (channel service unit) connected to line z. Echo canceling may be used with either mode. The next few paragraphs give an overview of the data, signaling, and control signal flow for these two modes. Data signals are those bits which carry the information being transmitted by the channels. Signaling signals are those bits that accompany data bits on a T1 line and carry such information as on-hook, off-hook, and dialed number. Control signals are used within the BCM to supply clock, apply options, and react to alarm conditions.

### Bundle Signaling Mode

**2.05** The bundle signaling mode is selected by installing a TM502 bundler circuit pack and using MC90069A1B, MC90105A1, or MC90069A1 [rated Discontinued Availability (DA)] AMC circuit pack. The MC90069A1B is used for the terminal alarms feature with or without the processor option. The MC90069A1 (rated DA) can only be used with the terminal alarms feature without the processor option. The MC90105A1 is used for the transparency alarms feature with or without the processor option. The MC90069A1 can be ungraded to any of the other bundle AMC pack codes by changing one firmware IC (integrated circuit) chip on the circuit pack with one of two replacement ICs. One IC chip is for the terminal alarms feature and the other IC chip is for the transparency alarms feature. Both ICs support the processor option (see AMC MC90xxxA1 Processor or Alarms Retrofit). Bundle signaling may be used at any time, but it must be used when line z of the BCM is connected to a Digital Access Cross-Connect System (DACS)(Fig. 5). The BCM groups the compressed signals into four 384 kb/s bundles.

**2.06** The maximum capacity of each bundle is 11 compressed channels plus a delta channel for signaling. If signaling is not used on any channel in the bundle, the bundle has a capacity of 12 channels. When the bundle signaling mode is used, each compressed channel is coded at a full 32 kb/s. Each channel that is transmitted uncompressed takes the place of two compressed channels (Fig. 6).

**2.07** In the transmit direction, as shown in Fig. 3, two full rate DS1 signals enter the full-rate

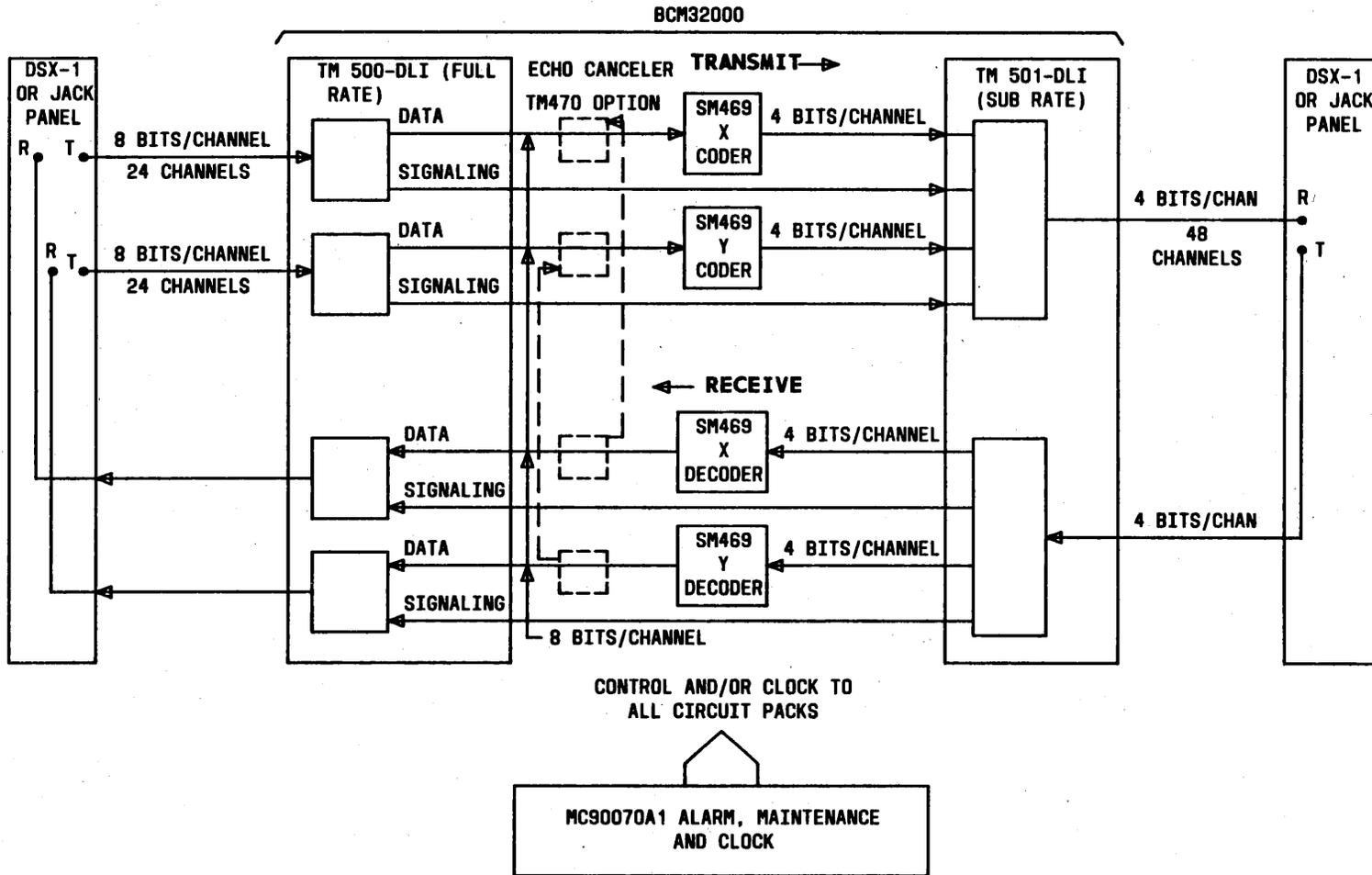


\* UP TO 48 CHANNELS MAY BE TRANSMITTED IF NO SIGNALING IS USED

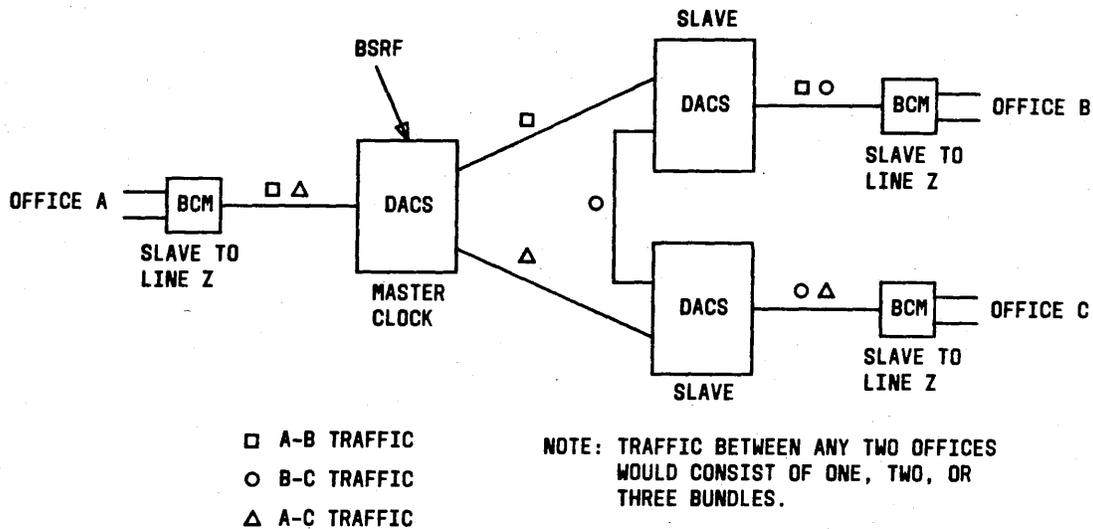
CONTROL AND/OR CLOCK TO ALL CIRCUIT PACKS



Fig. 3—Bundling Mode Signal Flow



◆ Fig. 4—Robbed-Bit Signaling Mode Signal Flow ◆



◆Fig. 5—Typical DACS Arrangement◆

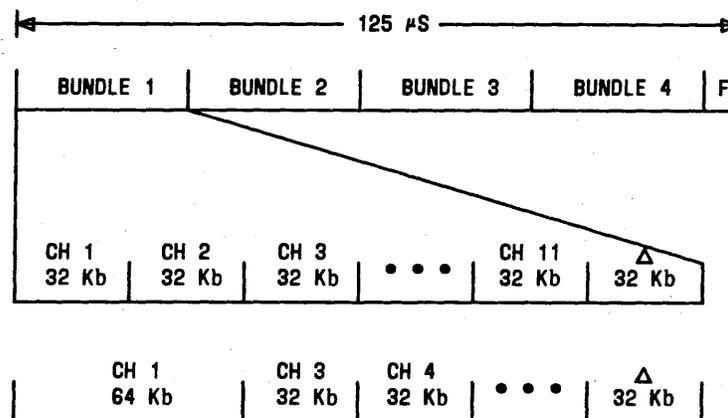


Fig. 6—Bundle Format

digital line interface (DLI), circuit pack TM500. The full-rate DLI separates the data bits from the signaling bits. Data bits are routed to codec circuit packs, SM469. There are four SM469 circuit packs (Fig. 1). From left to right their uses are: decoder for line x, decoder for line y, coder for line x, and coder for line y. The coder for each line uses an adaptive differential pulse coded modulation (ADPCM) algorithm to convert 8-bit per channel words to 4-bit per channel words. The signaling bits from TM500 and coded bits from the coders are combined in the bundler circuit pack TM502. The combined compressed signal is routed to the sub-rate DLI, circuit pack TM501. The

output of TM501 is T1 compatible and can be transmitted over any DS1 facility.

2.08 In the receive direction the process is reversed. The compressed signal is separated into two signals which are further separated into data and signaling rails. Data rails are decoded by their respective decoders then recombined with signaling in circuit pack TM500.

**Robbed-Bit Signaling Mode**

2.09 ◆Robbed-bit signaling is selected by omitting circuit pack TM502 and using the

MC90070A1B, MC90104A1, or MC90070A1 [rated Discontinued Availability (DA)] AMC circuit pack. The MC90070A1B is used for the terminal alarms feature with or without the processor option. The MC90070A1 (rated DA) can only be used with the terminal alarms feature without the processor option. The MC90104A1 is used for the transparency alarms feature with or without the processor option. The MC90070A1 can be retrofitted to any of the other robbed-bit AMC pack codes by changing two firmware chips on the circuit pack. One chip is for the terminal alarm feature and the other chip is for the transparency alarm feature. Both ICs support the processor option (see AMC MC90xxxA1 Processor or Alarms Retrofit). Robbed-bit signaling cannot be used with line z connected to a DACS. Compressed channels are coded with four bits for five out of six frames. During the sixth frame (signaling frame), the channel is coded with only three bits with the remaining bit used for signaling. This allows a full 24 compressed channels per digroup. Uncompressed channels in the robbed-bit mode must be on line x. When line x has an uncompressed channel, the corresponding channel on line y is not allowed.

**2.10** In the transmit direction, as shown in Fig. 4, two full rate DS1 signals enter the full-rate digital line interface (DLI), circuit pack TM500. The full-rate DLI separates the data bits from the signaling bits. Data bits are routed to codec circuit packs, SM469. There are four SM469 circuit packs (Fig. 1). From left to right their uses are: decoder for line x, decoder for line y, coder for line x, and coder for line y. The coder for each line uses an adaptive differential pulse coded modulation (ADPCM) algorithm to convert 8-bit per channel words to 4-bit per channel words. The signaling bits from TM500 and coded bits from the coders are combined in the sub-rate DLI, circuit pack TM501. The output of TM501 is a DS1 signal that can be transmitted over any DS1 facility.

**2.11** In the receive direction the process is reversed. The sub-rate signal is separated into two compressed signals which are further separated into data and signaling leads. Data leads are decoded by their respective decoders then recombined with signaling in circuit pack TM500.

#### Echo Canceler

**2.12** The echo canceler can be used in either the bundled or robbed-bit signaling mode. Echo cancellation takes place in the channels on the non-

compressed side. The echo tail length (canceling delay) can be set on a per digroup (24 channels) basis for 16 milliseconds (ms) or 32 ms. Echo cancellation per digroup is selected by installing circuit packs coded SM470 into the appropriate slots. An option switch on the AMC pack determines the echo canceling delay tail length. The first three echo canceler slots on the left apply to digroup x, and the next three slots apply to digroup y. Figures 3 and 4 show the transmit data from circuit pack TM500 going to the coders. The same signal is also routed to each installed SM470 circuit pack. The coders can accept inputs from one of two paths, one from TM500 and one from an SM470. An SM470 installed in the first or second slot for either digroup x or digroup y grounds a lead in the associated coder which causes the coder to accept data from the echo cancelers instead of circuit pack TM500.

**2.13** When echo canceling is used, data from the decoder is bridged to each SM470 in the associated digroup. The echo of this received signal is calculated and subtracted from the transmit signal. Thus when echo cancellation is employed at one end of transmission, it benefits the customer at the other end. Options on circuit packs SM470 activate or deactivate echo canceling on a per-channel basis. Echo canceling also can be turned on or off on a per-channel basis if the BCM unit is controlled by the MC90058A1 common processor. The **prov-ec** command is used to set the echo canceling configuration via the processor.

#### D. Options

**2.14** The purpose of this paragraph is to describe the switches used to set options, and to list by circuit pack the options available. Specific settings are provided in the "Option and Install" subheading under "INSTALLATION." Option switches are DIP switches containing up to eight rocker switches. The switches are numbered 1 through 8. To set a switch to the open option setting, depress the DIP switch away from the number. To set a switch to the closed option setting, depress the DIP switch toward the number. The switch positions that select various options typically represent a binary number. Some switches contain more than one option. For example, the switch for digroup x on circuit pack TM500 uses positions 1 through 3 for equalization, positions 4 and 5 for line coding and framing formats, and does not use positions 6 through 8. Table A lists switches,

their locations, and describes the options they control.

#### E. Digital Line Interface

2.15 There are two digital line interface (DLI) circuit packs. Circuit pack TM500 is a dual full rate DLI for lines x and y, and circuit pack TM501 is a sub-rate DLI for line z. Both DLIs provide equalization to accommodate from zero to 655 feet of cable length between the BCM and the DSX-1 or equivalent. The DLIs also adapt to various line and framing formats. These formats are discussed under the compatibility heading. Finally, the DLIs react to switches (located on the alarm maintenance and con-

trol circuit pack) for looping the lines they interface during trouble isolation.

#### F. Codec

2.16 There are four codec, SM469, circuit packs (Fig. 1). From left to right their uses are decoder for line x, decoder for line y, coder for line x, and coder for line y. The coder for each line uses a special algorithm to convert 8-bit per channel words to 4-bit per channel words. The decoder reconstructs an 8-bit word from a coded 4-bit word.

TABLE A

#### OPTION SWITCHES

CIRCUIT PACK	SWITCH LOCATION	OPTIONS
SM-469	None	None
SM-470	Faceplate	Selects per channel echo canceling.
MC90069A1 MC90069A1B MC90105A1 or MC90070A1 MC90070A1B MC90104A1	Faceplate or processor template number	Selects combinations of through or compressed channels with or without signaling.
	Inside bottom-center	Rockers 1 through 6 select clock reference. Rockers 7 (line X) and 8 (line Y) select echo canceler tail length.
TM500	Inside near top	Rockers 1 through 3 select equalization value for line X. Rockers 4 and 5 select line coding and framing format for line X. Rockers 6 through 8 are unused.
	Inside near bottom	Same as above for line Y.
TM-501	Inside near center	Same as above for line Z.
TM-502	None	None

**G. Echo Canceler**

**2.17** Echo canceling may be used on any channel serviced by the BCM. Circuit pack SM470 (for 16 or 32 ms) is used to estimate the echo and subtract it from the transmitted signal.

**H. Alarm, Maintenance, and Controls**

**2.18** The AMC circuit pack provides maintenance functions for the BCM32000. The CFA (carrier failure alarm) alarms used by the BCM32000 are similar to those used on a D-type channel bank. A DS1 red alarm (AR) indicates that the terminal cannot frame on the incoming signal. A DS1 yellow alarm (AY) is a response to a signal from the distant terminal that has a DS1 red alarm. Lines x, y, and z are equipped with red and yellow facility alarm LEDs. Lines x, y, and z may be looped by using the looping switch on AMC circuit pack (Fig. 1). A green summary LED lights to indicate that a line is looped. An additional green (LOOP) LED for line z is on TM501, and two LOOP LEDs (one for line x and one for line y) are on TM500.

**2.19** The red, yellow, and green LEDs for lines x and y are located on circuit pack TM500. The red, yellow, and green LEDs for line z are located on circuit pack TM501. Circuit pack TM502 has red and yellow alarms for each bundle. A bundle red (BR) alarm indicates that the terminal cannot frame on the incoming bundle framing pattern. A bundle yellow (BY) alarm is a response to a signal from the distant terminal which has a bundle red alarm. A red EQP ALM LED on the AMC circuit pack indicates a hardware failure on one or more circuit packs in the BCM32000. An ALM LED lights on other circuit packs that have a hardware failures. The EQP ALM LED on the AMC lights whenever an ALM LED lights. The MJ ALM LED on the AMC circuit pack lights whenever any alarm lights in the BCM32000.

**2.20** The BCM32000 has several relay closures to provide alarm indications external to the BCM. ♦The contacts in the relay are normally powered open and close under an alarm condition or power failure. These are isolated dry contacts (no power or ground) and are limited to 1 amp 55 V dc supplied by the remote alarm equipment. It is assumed compatible remote alarm equipment is being

used (if not, the relay contacts may burn out).♦ Available alarms are:

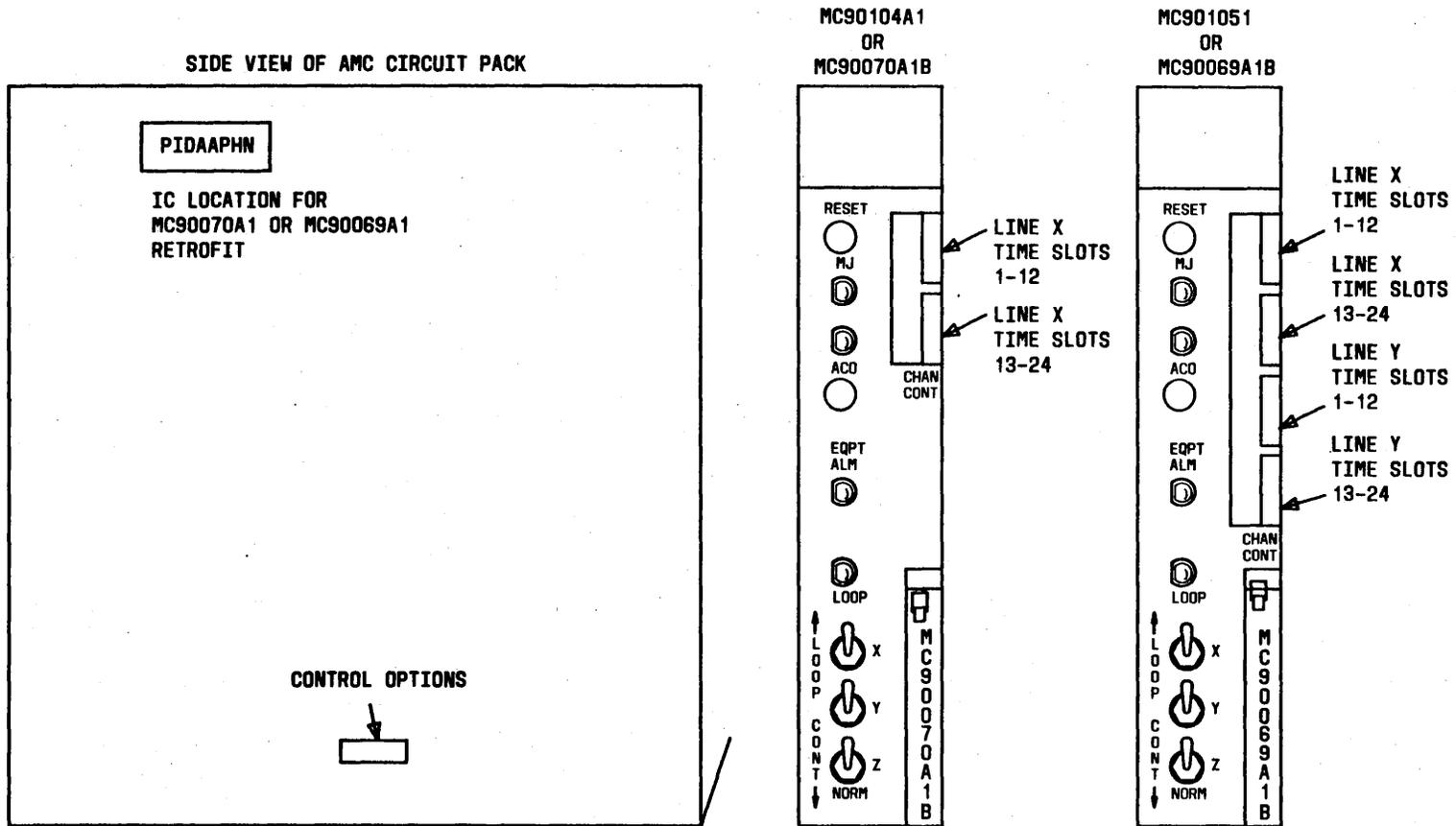
- Major audible
- Major visual
- Line x failure carrier group alarm (CGA)
- Line y failure (CGA)
- Line z failure (CGA)
- Equipment failure.

Wiring information for connecting alarms is provided under "INSTALLATION" in this practice.

**2.21** The AMC circuit pack has an ACO pushbutton, a RESET pushbutton, and three looping toggle switches (Fig. 7). The ACO pushbutton is used to silence office alarms. A green LED associated with the ACO button lights whenever the ACO button is depressed. If the BCM is in an alarm condition, the ACO LED remains lighted until the alarm is cleared or a new alarm occurs. The RESET pushbutton is used to condition the logic circuitry to a sane starting point. Any service carried by the BCM is put "on hook" whenever the RESET pushbutton is depressed. For this reason the button is recessed to prevent accidental use. The RESET pushbutton should be used during start up procedures and when a circuit pack is replaced. It may also be used as a first step in trouble clearing. The looping toggle switches are normally in the down position. Moving a toggle switch to the up position loops the associated line toward the BCM (Fig. 8), and lights the summary LOOP LED on the AMC circuit pack and the associated LOOP LED on circuit pack TM500 or TM501. Whenever a line is looped, the BCM32000 applies an "all ones" signal to the transmit path (to connecting equipment) of the digital line.

**I. Facility Alarm Handling**

**2.22** ♦The BCM facility can be made to pass carrier failure alarms on the full rated x or y digital lines as though the facility was not used (transparent to alarms), or it can pass alarms (terminal alarms) to connecting equipment. These alarms are the D-type channel bank DS1 red alarm (AR) and DS1 yellow alarm (AY) discussed in the previous section. The



◆Fig. 7—MC90069A1B and MC90070A1B Circuit Packs◆

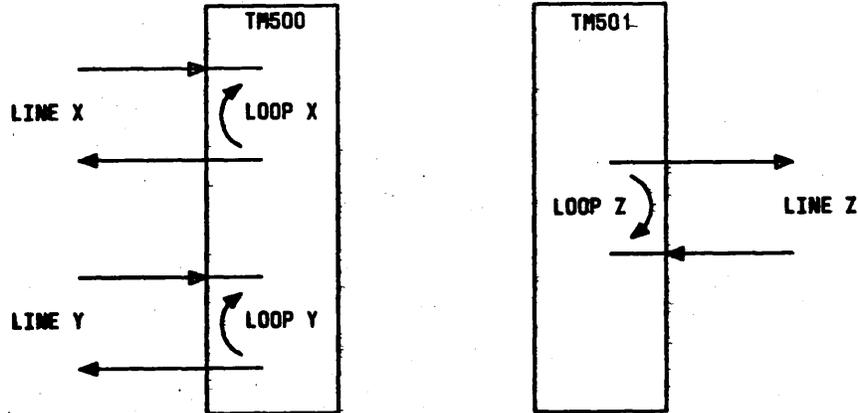


Fig. 8—Loop Functions

choice of alarm handling is a matter of where maintenance activities are normally done.

**Transparency**

**2.23** When the BCM facility is used for point-to-point connection of two D4 channel banks and the BCM shelves are collocated with the D4 banks, the transparency of alarms feature may be desired. This allows normal D4 maintenance from the channel banks. If there is a red (AR) alarm at the D4 bank, the connecting BCM unit should be examined. Then at the BCM, the trouble can be isolated as depicted in Fig. 9. When using alarm transparency, expect an additional 1 to 3 seconds of delay for alarms to activate or clear. Normal alarm delay is about 2.5 seconds.

**2.24** If using the alarm transparency option, the MC90105A1 (for bundle mode) or MC90104A1 (for robbed-bit mode) AMC circuit pack must be used, and two backplane wiring straps must be made or it will not work (see Connect Alarm Transparency Straps in INSTALLATION section of this document). These straps should be removed if going back to the terminal alarm handling feature.

**2.25** The transparency feature **cannot be used with DACS** equipment connected to line z of the BCM facility. To use the transparency feature, the framing format for line z is set for extended superframe format (Fe). The x and y DS1 line framing formats at both ends should be the normal D4 pattern. The Fe format has a 4 kb data link which passes maintenance information. The red alarm con-

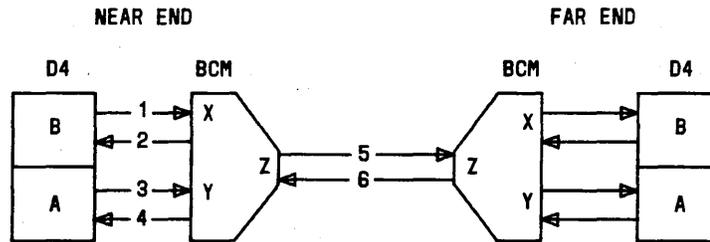
dition is detected at either the x or y input line of a BCM unit. This condition is sent to the far end BCM unit via the Fe data link on line z. Then the far end BCM unit sends an all ones AIS signal to the connecting equipment which causes a red alarm at the D4 bank.

**2.26** The yellow alarm condition (AY) is handled in the normal D4 maintenance scheme. The yellow alarm is sent to the BCM from a local connecting equipment with a red alarm condition. The yellow alarm signal is then passed through the BCM system to the far end equipment.

**Terminal Alarms**

**2.27** The terminal alarm handling is consistent with the present digital network alarm scheme. If the BCM loses input framing on line x or y, it has a red alarm (AR) condition, does normal trunk processing on the affected channels on line z and passes a yellow alarm signal back to the connecting equipment. If the connecting equipment loses framing from the output of the BCM line x or y, the connecting equipment will declare a red alarm and pass a yellow alarm signal back to the BCM. The BCM will declare a yellow alarm and truck process the affected channels on line z. The BCM that receives truck conditioned channels on line z will take no special action (no alarms are lighted and no signals are passed to connecting equipment) and thus it is not aware of the trouble on the far end full rate line x or y. Trunk processing causes all affected channels to go on-hook for two second then back to an off-hook state. This causes the connecting switching equip-

TRANSPARENCY ALARMS



CASE BAD LINE NUMBERS	D4 BANK				NEAR BCM						FAR BCM						D4 BANK				
	A		B		X		Y		Z		X		Y		Z		A		B		
	AR	AY	AR	AY	AR	AY	AR	AY	AR	AY	AR	AY	AR	AY	AR	AY	AR	AY	AR	AY	
1				ON	ON							ON								ON	
2			ON			ON															ON
3		ON					ON						ON					ON			
4	ON						ON											ON			
5*		ON		ON					ON		ON		ON	ON	ON		ON		ON		
6**	ON		ON			ON		ON	ON							ON		ON		ON	
1 & 2			ON		ON	ON															ON
1 & 3		ON		ON	ON		ON					ON		ON				ON		ON	
1 & 4	ON			ON	ON			ON				ON						ON	ON		
2 & 3		ON	ON			ON	ON							ON				ON			ON
2 & 4	ON		ON			ON		ON										ON		ON	
3 & 4	ON						ON	ON										ON			
5 & 6***	ON		ON			ON		ON	ON			ON		ON	ON	ON		ON		ON	

\*FOR BUNDLING, ALL NEAR END BY AND ALL FAR END BR LAMPS WILL LIGHT ON BCMs.  
 \*\*FOR BUNDLING, ALL NEAR END BR AND ALL FAR END BY LAMPS WILL LIGHT ON BCMs.  
 \*\*\*FOR BUNDLING, ALL NEAR AND FAR END BR LAMPS WILL LIGHT ON BCMs.

◆Fig. 9—Transparency Trouble Alarm Indications◆

ment to drop all affected calls and prevents these channels from being used.

**2.28** When line z fails, the BCM that loses input framing will declare a red alarm condition on line z (if bundle signaling mode is used all four bundle red alarm lamps will light) and returns a yellow alarm signal to the far end BCM shelf. The BCM will send an AIS signal out on both full rate lines x and y. If the connecting equipment cannot recognize this signal (like a D4 Bank), it will declare a red alarm and return a yellow alarm to the BCM lines x and y. The far end BCM will light a yellow alarm on line z (if bundle signal mode is used, all four bundle yellow

alarms will light) and pass a yellow alarm signal on both x and y full rate lines causing a yellow alarm on the connecting equipment. The BCM shelves do not trunk process channels when line z fails. The connecting equipment is responsible to properly condition the channels when line z fails (a D4 Bank will trunk process the channels with a red or yellow alarm condition). Trunk processing causes all affected channels to go on-hook for 2 seconds then back to an off-hook state. This causes the connecting switching equipment to drop all affected calls and prevents these channels from being used. A special signal is then returned on the DS1 line that is recognized by the

connecting carrier equipment as a yellow alarm condition.

**2.29** The terminal feature should be used with DACS and all BCM applications in a D4 framing format digital hierarchy network. To use the terminal feature, the DS1 line format for all lines (x, y, and z) must be set for D4 format. The MC90069A1B (for bundle mode, MC90069A1, rated DA, without processor option) or MC90070A1B (for robbed-bit mode, MC90070A1, rated DA, without processor option) AMC pack must be used for terminal alarms feature.

#### J. Clock and Synchronization

**2.30** The BCM32000 can use its own clock as the reference clock or it can synchronize with any one of the three incoming DS1 signals. The clock and choice of reference are controlled by option switches on the AMC circuit pack.

**2.31** The choice of which DS1 line or internal clock should be determined by the clock stratum level of the connecting equipment. A stratum clock level is a measure of accuracy with respect to the standard clock reference for digital network synchronization. There are four stratum levels (1 highest, 4 lowest) used in digital networks. AT&T Technical Reference PUB 60110 has design guidelines for the Digital Synchronization Network Plan. The BCM32000 timing should be slaved to connecting equipment with a stratum 3 or better system clock. If this is not available, BCM internal timing may be used.

**2.32** For best error free performance of a digital network, all components of the system must be synchronized to one clock reference. As an example, if two D4 channel banks are connected with a BCM32000 system, one of these components must be optioned for internal timing and the others must be slaved to this component. If the east D4 bank is optioned for internal timing or is considered the master synchronization reference component, the east BCM unit must be slaved to either the X or Y input lines. The west BCM unit must be slaved to the Z facility line, and the west D4 bank must be loop timed (slaved) from either the X or Y line from the west BCM unit.

**2.33** In general, the synchronization reference should be obtained from a component with highest stratum level and all other network components must use the same source for timing control. If

all components have the same stratum level, one component must be chosen as the master reference and all other components must be slaved to this master clock source. Figure 10 shows some applications for BCM32000 synchronization.

#### K. BCM32000 Common Processor

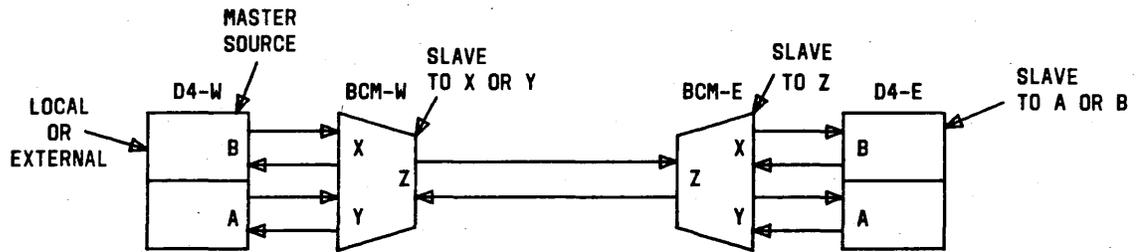
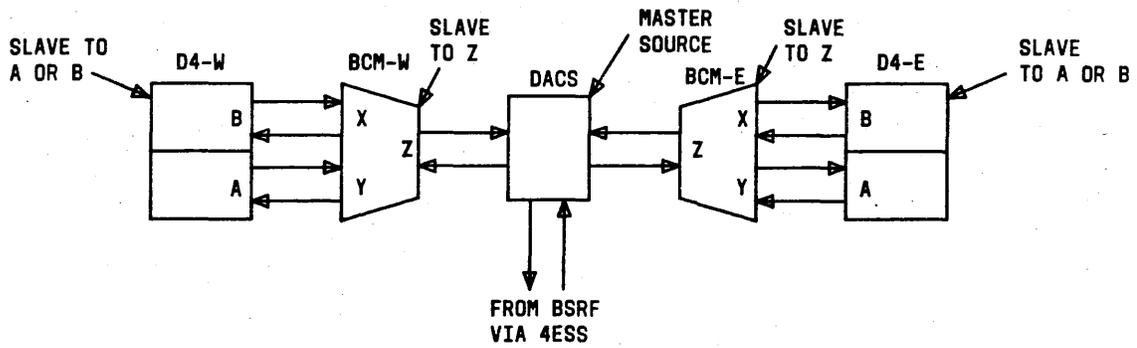
**2.34** The BCM32000 has an optional common processor that can be used to monitor the BCM performance, check the status of the BCM configuration, perform trouble isolation tasks, and set options normally done with faceplate mini switches. One processor can serve seven BCM units in a multishelf system. One MC90058A1 processor is required in system 1 (unit zero), and one TM495 processor interface circuit pack is required in each unit. One interface to the processor is a standard TTY RS232-C connection on the processor interface circuit pack in unit 0 to an ASCII terminal. The processor can also be interfaced with a modem for remote communication. The connection for a modem is made at the backplane of unit 0 with a standard modem RS232 connector. Only one interface is allowed, either the TTY or modem. The processor only controls BCM units in the same bay. The far end of the span served by a BCM32000 system cannot be controlled by the local processor. The MC90069A1 and MC90079A1 (both rated DA) AMC circuit packs cannot be used with the processor option.

#### Recommended Terminals

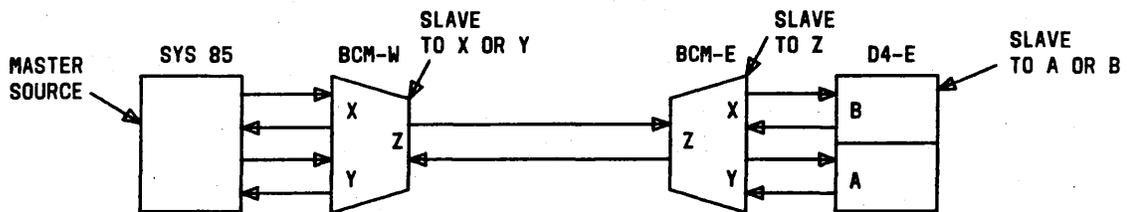
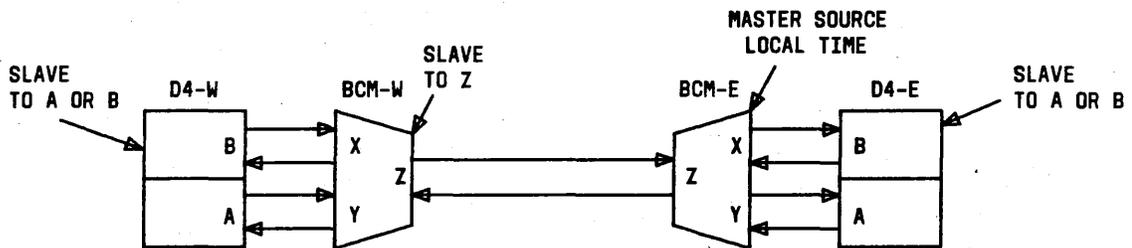
**2.35** Any terminal that is capable of transmitting and receiving ASCII characters can be used with the MC90058A1 processor. The terminal must have the following features to operate correctly:

- Standard RS-232-C interface
- 1200 baud data rate
- Full duplex data
- 7 data bits, 1 even parity and one stop bit
- Lower and upper case characters.

**2.36** The BCM32000 processor command set is written in AT&T Man Machine Language (MML), which is a standard human/machine equipment interface language. The processor uses 26 commands that are divided into three classes of status, provi-



NOTE: If both end D4 banks have external sources then slave both end BCMs to X or Y.



◆Fig. 10—BCM32000 Synchronization Examples◆

sioning, and operational commands. The status commands request information on the BCM units or processor and generate a printout of the results in a predefined format. Table B lists the status commands with a brief description of their usage. The provisioning commands are used to configure the BCM systems to meet the requirements of the user's system application. Table C lists the provisioning commands with a brief description of their usage.

The operational commands affect the operation of the BCM systems and are used to perform maintenance activities, monitor performance, and provide user assistance. Table D lists the operational commands with a brief description of their usage.

2.37 The inter-shelf wiring between BCM units served by a processor is made via connectorized cable on the backplane of each shelf. The maxi-

**TABLE B**  
**STATUS COMMANDS**

<b>PROCESSOR STATUS COMMAND</b>	
<b>EXPLANATION OF INPUTS</b>	<b>CORRESPONDING OUTPUTS (NOTE)</b>
<p><b>status:unit=[unit#]</b> <b>status:u=[unit#]</b></p> <p>This command causes a printout of the status of the unit(s) specified. The &amp; symbol (see Paragraph 2.40) can be used to display multiple units. <b>DEFAULT:</b> None</p>	
<p><b>status:proc</b></p> <p>This command provides printout of processor status. <b>DEFAULT:</b> None</p>	
<p><b>status-alm:unit=[unit#] or status-alm:proc</b> <b>status-alm:u=[unit#] or status-alm:proc</b></p> <p>These commands provide a printout of alarm conditions for unit(s) specified or processor. The &amp; symbol can be used to display multiple units. <b>DEFAULT:</b> None</p>	
<p><b>status-ec:unit=[unit#]</b> <b>status-ec:u=[unit#]</b></p> <p>This command provides printout of echo canceler status for unit(s) specified. The &amp; symbol can be used to display multiple units. <b>DEFAULT:</b> None</p>	
<p><b>status-frame</b></p> <p>This command provides a status printout of all units installed in the frame. <b>DEFAULT:</b> None</p>	
<p><b>status-perf:unit=[unit#]</b> <b>status-perfu=[unit#]</b></p> <p>This command provides a printout of performance statistics such as error rates, bipolar violations, etc. for the unit(s) specified. The &amp; symbol can be used to display multiple units. <b>DEFAULT:</b> None</p>	
<p><b>status-perfclr</b></p> <p>This command provides a printout of performance auto-clear status for each unit. The printout includes on/off and time for auto-clear. If a unit is not equipped a message is printed. <b>DEFAULT:</b> None</p>	

\* The # symbol represents any number you would like to use depending on the units installed. The processor can service a maximum of seven units, which are numbered 0 through 6.

**TABLE C**  
**PROVISION COMMANDS**

<b>PROCESSOR PROVISIONING COMMANDS</b>
EXPLANATION OF INPUTS AND CORRESPONDING OUTPUTS (NOTE)
<p><b>prov-chan:unit=[unit#];bundle=[1 2 3 4],[template#]</b>  <b>prov-chan:u=[unit#];b=[1 2 3 4],[template#]</b></p> <p>This command sets the bundles on the unit(s) specified to one of 64 possible configurations. Multiple units and bundles may be specified by using the &amp; symbol. Bundle configurations, 0 through 63, are discussed beginning in Paragraph 4.05.  <b>DEFAULT:</b> bundle=1&amp;&amp;4 (1 through 4)</p>
<p><b>prov-chan:unit=[unit#];group=[1 2],[template#]</b>  <b>prov-chan:u=[unit#];g=[1 2],[template#]</b></p> <p>This command sets the groups on the unit(s) specified to one of 64 possible configurations. Multiple units and groups may be specified by using the &amp; symbol. Robbed-bit configurations, 0 through 63, are discussed beginning in Paragraph 4.10.  <b>DEFAULT:</b> group=1&amp;2</p>
<p><b>prov-ec:unit=[unit#];digroup=[x y];channel=[chan#],[on off]</b>  <b>prov-ec:unit=[unit#];d=[x y];c=[chan#],[on off]</b></p> <p>This command turns the echo canceling feature for a specific channel on or off as specified. Multiple units, digroups, and channels may be specified by using the &amp; symbol.  <b>DEFAULT:</b> digroup=x&amp;y ; channel=1&amp;&amp;24</p>
<p><b>prov-local:unit=[unit#]</b>  <b>prov-local:u=[unit#]</b></p> <p>This command causes the rocker switch positions on the face plates of the AMC and echo canceling circuit packs to control the configuration of the unit(s) specified. Provision commands listed above will have no affect while this command is valid.  <b>DEFAULT:</b> None</p>
<p><b>prov-remote:unit=[unit#];bundle=[1 2 3 4],[template#]</b>  or  <b>prov-remote:unit=[unit#];group=[1 2],[template#]</b>  <b>prov-remote:u=[unit#];b=[1 2 3 4],[template#]</b>  or  <b>prov-remote:u=[unit#];g=[1 2],[template#]</b></p> <p>This command removes the local control for any unit specified and allows the processor to control channel configuration and EC settings. Unless the default is used, each bundle or group must have the channel template specified or the command will not be accepted.  <b>DEFAULT:</b> bundles 1&amp;&amp;4 or groups 1&amp;2 and template 0</p>
<p><b>prov-threshold:unit=[unit#];digroup=[x y],[0 6]</b>  <b>prov-threshold:u=[unit#];d=[x y],[0 6]</b></p> <p>This command sets the specified digroup(s) echo canceler threshold to 0 or 6 dB. If the d=[x y] is left out the entire unit is set to the same threshold.  <b>DEFAULT:</b> digroup=x&amp;y</p>

\* The # symbol represents any valid entry. Valid numbers for [unit#] are 0 through 6, valid entries for d=[x|y] are x or y, valid numbers for g=[1|2] are 1 or 2, valid entries for b=[1|2|3|4] are 1 through 4, and valid numbers for channels are 1 through 24.

**TABLE D**  
**OPERATIONAL COMMANDS**

<b>PROCESSOR OPERATIONAL COMMAND</b> <b>EXPLANATION OF INPUTS CORRESPONDING OUTPUTS (NOTE)</b>
<p style="text-align: center;"><b>MENU</b></p> <p>This command prints a table of all commands, except repeat, and categorizes the commands into five processor execution levels.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>aco:unit=[unit#] or aco:proc</b> <b>aco:u=[unit#] or aco:proc</b></p> <p>This command is used to silence office audible alarms caused by a major alarm from a BCM unit or processor failure.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>almclr:unit=[unit#] or almclr:proc</b> <b>almclr:u=[unit#] or almclr:proc</b></p> <p>This command is used to reset error source registers (ESR's) and clears the performance counters of a BCM unit or processor level.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>help or</b> <b>help "command-name"</b></p> <p>The help command prints a list of commands, except repeat, available to the user. The help "command-name" prints the proper syntax required to use the command of interest.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>install:number=[max#]</b> <b>install:n=[max#]</b></p> <p>This command is used to set the number of BCM units that are to be addressed (or controlled) by the processor. The [max#] value can be 1 for one BCM unit, up to 7 for a total of seven BCM units under processor control.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>loop:unit=[unit#]:line=[x y z],[loop norm]</b> <b>loop:u=[unit#]:l=[x y z],[loop norm]</b></p> <p>This command is used to loop or remove a loop (norm) on any of the three digital line digroups X, Y, or Z of a BCM unit. In the looped state, the output is looped to the input of the line and an all ones signal is transmitted towards the connecting facility. To remove a loop (norm), both the remote loop and the loop switches on the Alarm Maintenance Control circuit pack must be in the "NORM" state.</p> <p><b>DEFAULT:</b> Line=x&amp;y&amp;z</p>

**TABLE D (Contd)**  
**OPERATIONAL COMMANDS**

<b>PROCESSOR OPERATIONAL COMMAND</b>
<b>EXPLANATION OF INPUTS CORRESPONDING OUTPUTS (NOTE)</b>
<p style="text-align: center;"><b>mask-reports:unit=[unit#],[yes no]</b> <b>mask-reports:u=[unit#],[yes no]</b></p> <p>This command is used to inhibit (yes) or allow (no) all BCM unit autonomous status reports from being printed. However, the unit, processor, and frame status will continue to be updated.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>monitor:unit=[unit#],[yes no]</b> <b>monitor:u=[unit#],[yes no]</b></p> <p>This command is used to turn on (yes) or turn off (no) the processor monitoring of a BCM unit. When on, the processor audits the BCM units via the processor interface circuit packs. The processor database will be updated with the BCM unit equipment configuration when the monitor is turned on. When the monitor is turned off, the processor does not audit the BCM unit.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>password</b></p> <p>This command is used to change the current password. The user is prompted to enter the old password, then the new password, and will have to login after the new password has been accepted.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>perfclr:unit=[unit#]</b> <b>perfclr:u=[unit#]</b></p> <p>This command is used to clear all performance monitor counters of the BCM unit selected.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>perfclr-auto:unit=[unit#],[on off];time=[hr],[min]</b> <b>perfclr-auto:u=[unit#],[on off];t=[hr],[min]</b></p> <p>This command clears the performance monitors once a day at the time specified in the command. The values for hour "hr" and minute "min" are 0 to 23 and 0 to 59 respectively.</p> <p><b>DEFAULT:</b> Time=previously set time or 0 hr 0 min</p>
<p style="text-align: center;"><b>re</b></p> <p>This command is used to repeat the last command. If the last command was not valid, the repeat command will not work.</p> <p><b>DEFAULT:</b> None</p>

TABLE D (Contd)  
OPERATIONAL COMMANDS

PROCESSOR OPERATIONAL COMMAND
EXPLANATION OF INPUTS CORRESPONDING OUTPUTS (NOTE)
<p style="text-align: center;"><b>reset:unit=[unit#] or reset:proc</b> <b>reset:u=[unit#] or reset:proc</b></p> <p>This command is used to reset the processor or BCM unit. A unit reset is service affecting and causes an on-hook signaling state on all channels for the duration of the reset. A processor reset will not affect service but should be done with caution. The processor reset activity depends on the position of the switch setting on the faceplate of the processor circuit pack. If the switch is in the "PROC VALID" position, the processor checks the integrity of its database and downloads the BCM unit equipment configuration if OK. If not the units configuration is read into the database. If the processor switch is in the "UNIT VALID" position, the processor reads the BCM units configuration into the database. A message will print saying you have 10 seconds to switch the toggle switch to the PROC VALID position before the database is overwritten for this reset.</p> <p><b>DEFAULT:</b> None</p>
<p style="text-align: center;"><b>set:time=[hr],[min]:date=[mo],[day],[yr]:zone=[zone]</b> <b>set:t=[hr],[min]:d=[mo],[day],[year]:z=[zone]</b></p> <p>This command is used to set the time of the processor clock. The hour, minute, day, month, year, and time zone are reset with this command. The [zone]s are [EST CST  MST  PST  EDT  CDT  MDT  PDT  GMT].</p> <p><b>DEFAULT:</b> date=previous date before execution zone=previous zone entered</p>
<p style="text-align: center;"><b>test-ec:unit=[unit#]:digroup=[x y]:channel=[chan#]</b> <b>test-ec:u=[unit#]:d=[x y]:c=[chan#]</b></p> <p>This command is used to perform echo canceler tests on a per-channel level. This is a service affecting test. An OK or a report indicating the channel(s) and digroup(s) that failed the test will be printed.</p> <p><b>DEFAULT:</b> digroup=x&amp;y; channel=1&amp;&amp;24</p>
<p style="text-align: center;"><b>time</b></p> <p>This command prints the date, time, and time zone read from the processors clock.</p> <p><b>DEFAULT:</b> None</p>

\* The # symbol represents any valid entry. Valid numbers for u=[unit#] are 0 through 6, valid entries for l=[x|y] are x or y, valid numbers for g=[1|2] are 1 or 2, valid entries for b=[1|2|3|4] are 1 through 4, and valid numbers for channels are 1 through 24.

imum distance from the shelf containing the processor is limited to 11 feet for each of the 6 connecting BCM units. The processor and processor interface unit obtain  $\pm 5$  V dc power from the 484AA power unit serving the common units.

### Login Procedure

**2.38** The login procedure is a security method that prevents unauthorized personnel from tampering with the BCM32000 processor system. When the processor is first powered up, the user is prompted for the login and password. The login is set to "bcm32000" and the password is "hello". The password can be changed by using the "password" command after logging in.

**2.39** Subsequent logins require the user to reference these names for successful entry into the BCM32000 processor system. If the login was successful, the processor prompts with a welcome message and version of the processor firmware load. The processor is then ready to accept commands. If the login was not correct, the processor prompts an incorrect login message and requests another login. After completing a BCM32000 processor session, the user should log off by holding the CONTROL key and pressing the "d" key (control d). After logging off, autonomous reports continue to be displayed for all units being monitored (if the autonomous reports are not masked for the units).

### L. Processor Syntax

**2.40** The processor accepts commands typed in lower case, from a terminal connected to the processor interface unit on the BCM shelf that has the common processor circuit pack. Each request consists of one of the 26 command words followed by parameter blocks that specify the intended action. An example of the general format is shown below:

```
<command word>:<block1>:block2><:<block3>
      |--- parameter part ---|
      <                block                >
      |<identifier>=<value>,<condition>|
```

The left and right arrows are not typed when requesting a command, but indicate where the data would be used for a command in this example. The basic parameter part contains one to three blocks, each of which are preceded by a colon (:). The data in

a block identifies what BCM units are being addressed and the desired parameter to be assigned. Multiple parameters in a block are separated by a comma (.). The experienced user can do multiple assignments by repeating these blocks on a command line.

**2.41** All commands, except "MENU", are to be typed in lower case or a syntax error will be generated. Spaces are allowed between parameters. The parameter names (e.g., unit, channel,...) can be abbreviated with their first letter. A single ampersand (&) allows the user to specify multiple values associated with a parameter name and a double ampersand (&&) allows a range to be selected. For example "prov-chan:u=1&4&5:b=1&&4,1" could be used for bundle mode command to provision channels on units 1, 4, and 5; bundles 1 through 4 (on each unit) with channel template number 1. Some commands have default values. If a parameter name has a default value, and the value is not entered, the processor assigns the default value. Tables B, C, and D show the abbreviated command form and give the default values for each command.

**2.42** If a command is valid and the request was completed, the processor responds with an "OK" or "PF-PRINTOUT FOLLOWS" message. If the command name is correctly typed but the rest of the line has an error, the response is "?E Usage [command]". In general, if there is an error, the processor replies with a "?E" followed by an explanation of the error. If a correctly typed command was entered during an unusual system configuration, the processor responds with "NG" followed by an audit.

### M. Processor Usage

**2.43** The next few paragraphs describe how to use the processor to control BCM32000 systems and give some recommendations for modes of operation of the systems. The function of the processor is to allow provisioning of the channel and echo canceler options remotely (not from faceplate mini switches) and monitor system performance.

**2.44** The best feature of the processor is that it can be connected to a modem. This allows control of both ends of a BCM system from a central location (both ends must have a processor connected to a modem). This saves time and manpower if service requirements change frequently (e.g., using DACS to switch bundles). It is also convenient for mainte-

nance activities. When the monitor is turned on for a BCM system, performance data is stored and can be examined with the "status-perf" command. The "status:unit" command shows the equipment and line status for the unit. Locate the line or equipment failures from a central location and dispatch crafts personnel to the area of the failure.

**2.45** If service requirements do not change, set channel and echo canceling option configuration with the faceplate mini switches. The BCM system is then put in the local control mode with the "prov-local" command. All the maintenance features can still be used.

**2.46** When provisioning the BCM system remotely with the processor, it is recommended to leave the monitor on (monitor command). This saves the configuration of the BCM system if the unit takes a power hit. The processor prints autonomous reports about all BCM units that have the monitor on. When using the processor for maintenance or provisioning this can be annoying. Turn off these autonomous reports while doing these activities using the "mask-reports" command, but remember to turn them back on when the job is completed.♦

#### N. Power

**2.47** The BCM converts -48 V office power to  $\pm 5$  V power. The BCM without echo canceling uses one 484AA power unit and consumes 92 watts in the robbed-bit signaling mode and 101 watts in the bundling mode. When the BCM is equipped with echo canceling, two 484AA power units are used (Fig. 1) and the power consumption is an additional 12 watts for each echo canceler circuit pack installed. When echo canceling is not used, only the 484AA unit near the left end of the shelf is used.

**2.48** The cabinet version of the BCM has provisions for an optional KS-22028, L1 power unit. This power unit converts a standard 115 V ac to -48 V. When the terminal site has its own -48 V source, the -48 V is connected directly to the BCM shelf. The fans which are standard equipment in BCM cabinets use 18 watts. The 551A CSU which is optional uses 12 watts. If the KS-22028, L1 power unit is used, the 115 V ac line should supply 10 amps.

#### O. Compatibility

**2.49** The BCM is compatible with D1D, D2, D3, and D4 channel banks. However, since time slots and channel slots are not the same for D1D and D2 channel banks, care should be taken when setting per-channel options on the BCM. Table E compares the BCM time slot number with the channel unit number for D1D, D2, D3, and D4 channel banks.

**2.50** The BCM has options to select the following line coding formats:

- **Bipolar**—The bipolar format is currently used throughout the telephone network. The bipolar format insures 1s density for repeaters by providing a 1 in the second least significant bit of an 8-bit channel containing all 0s.
- **Bipolar Eight Zeros Substitution (B8ZS)**—The B8ZS format substitutes a special 1s-0s pattern to replace eight 0s in a row. This special pattern is replaced with all 0s at the end of the transmission path by equipment configured with B8ZS, thus providing a clear channel for data.

**2.51** The BCM has options to select the following framing formats:

- **D4**—The D4 framing format may be used with bipolar or B8ZS line formats.
- **Extended superframe format (ESF or Fe)**—The Fe format may also be used with either the bipolar or B8ZS line formats. The Fe framing format replaces the 8 kb/s framing bits found in the D4 format with a 2 kb/s signal for framing, a 2 kb/s error detection code word, and a 4 kb/s signal for supervisory maintenance information. Fe is almost non-existent in the network at this time.

#### P. 551A Channel Service Unit (CSU)

**2.52** The CSU (Fig. 2) provides transmit and receive pairs to interface the T1 digital line (line z). The CSU contains a 206- or 236-type line repeater, as well as circuitry for removing bipolar violations, fault-locating, order wire, and remote or local looping. The CSU is described in detail in AT&T Practice 314-646-100.

**TABLE E**  
**TIME SLOT NUMBERING ASSIGNMENTS**

BCM32000 TIME SLOTS	ASSIGNED CHANNEL NUMBER		
	D1D CHANNEL BANK	D2 CHANNEL BANK	D3 AND D4 CHANNEL BANKS
1	1	12	1
2	13	13	2
3	2	1	3
4	14	17	4
5	3	5	5
6	15	21	6
7	4	9	7
8	16	15	8
9	5	3	9
10	17	19	10
11	6	7	11
12	18	23	12
13	7	11	13
14	19	14	14
15	8	2	15
16	20	18	16
17	9	6	17
18	21	22	18
19	10	10	19
20	22	16	20
21	11	4	21
22	23	20	22
23	12	8	23
24	24	24	24

### 3. PHYSICAL DESCRIPTION

#### A. BCM32000 Shelf

**3.01** The BCM32000 (Fig. 1) is 10 inches (25.4 cm) high, 12 inches (30.5 cm) deep, and mounts in a standard 23-inch (58.5 cm) wide bay. It may be mounted in a 26-inch (66 cm) wide bay by using an ED-2C780-30-G4 adapter. There are 10 holes on each side. The BCM32000 shelf houses 8 to 16 circuit packs depending on the modes of operation. The BCM circuit packs take up a little more than half the width of the unit, and the echo canceler circuit packs take up to six of the remaining slots. When echo canceling is not used, a blank filler occupies the right end of the shelf.

**3.02** Two 5-amp, green indicator fuses, F1 and F2, and a FUSE ALM lamp are located at the top left of the BCM32000 shelf. The fuses are 70D type (comcode 100203355) and the lamp is a GE327 (comcode 403680010).

#### B. BCM32000 Cabinet

**3.03** The BCM32000 cabinet (Fig. 2) is designed for customer premise applications. The cabinet is 42 inches (106 cm) high, 31 inches (79 cm) wide, and 24 inches (60 cm) deep. The cabinet is free-standing and has provisions for the BCM32000 shelf, a 551A CSU, an ED-2C793 fan unit, and a KS-22028, L1 rectifier.

### C. Optional Jack Panel

**3.04** When DSX-1 cross-connects are used, no additional jacks are needed. However in small applications an optional jack panel (ED-2C780-30, G3) may take the place of the DSX-1 cross-connect jacks. The jack panel is about an inch high and contains 18 jacks. The jack panel mounts just under the BCM32000 (Fig. 1). The digital line connections at the backplane of the BCM unit are the same whether or not this jack panel is used. The cable connection to the jack panel is hard-wired from the factory when this option is ordered.

### D. MC90069A1B-( ) or MC90105A1-( )—Bundling Alarm, Maintenance, and Control

**3.05** The alarm, maintenance, and control (AMC) circuit pack, MC90105A1-( ), MC90069A1B-( ), or MC90069A1-( ) (rated DA) is used in the bundle signaling mode. The MC90069A1 (without the processor option) or MC90069A1B (with or without the processor option) AMC pack is used when the BCM32000 has terminal alarm handling. The MC90105A1 (with or without the processor option) AMC pack is used when the BCM32000 has transparency alarm handling. The faceplate (Fig. 7) provides for channel control options, alarm indications, a RESET pushbutton, an ACO pushbutton for silencing office alarms, and LOOP CONT keys for looping lines x, y, or z.

**3.06** On the component side of the circuit pack is an option switch containing eight rockers for selecting reference clock and echo tail times. The location of this switch in relation to the faceplate lever is shown in Fig. 7.

### E. MC90070A1B-( ) or MC90104A1-( )—Robbed-Bit Alarm, Maintenance, and Control

**3.07** The alarm, maintenance, and control (AMC) circuit pack, MC90070A1B, MC90104A1-( ), or MC90070A1-( ) (rated DA) is used in the robbed-bit signaling mode. The MC90070A1 (without the processor option) or MC90070A1B (with or without the processor option) AMC pack is used when the BCM32000 has terminal alarm handling. The MC90104A1 (with or without the processor option) AMC pack is used when the BCM32000 has transparency alarm handling. The faceplate (Fig. 7) provides for channel control options, alarm indications, a RESET pushbutton, an ACO pushbutton for silenc-

ing office alarms, and LOOP CONT keys for looping lines x, y, or z.

**3.08** On the component side of the circuit pack is an option switch containing eight rockers for selecting reference clock and echo tail lengths. The location of this switch in relation to the faceplate lever is shown in Fig. 7.

### F. TM500 Full-Rate Digital Line Interface For Lines X and Y

**3.09** Circuit pack TM500 (Fig. 1) is the digital line interface for lines x and y. The faceplate of TM500 contains AR (DS1 red alarm), AY (DS1 yellow alarm), and LOOP LEDs for both lines. It also contains an ALM LED that indicates a probable equipment failure of the circuit pack.

**3.10** On the component side of the circuit pack is an option switch for line x and an option switch for line y containing eight rockers each for selecting equalization, line format, and framing format. The locations of these switches in relation to the faceplate lever are shown in Fig. 11.

### G. TM501 Sub-Rate Digital Line Interface For Line Z

**3.11** Circuit pack TM501 (Fig. 1) is the digital line interface for line z. The faceplate of TM501 contains AR, AY, and LOOP LEDs for line z. It also contains an ALM LED that indicates a probable equipment failure of the circuit pack.

**3.12** On the component side of the circuit pack is an option switch containing eight rockers for selecting equalization, line coding format, and framing format. The location of the switch in relation to the faceplate lever is shown in Fig. 12.

### H. TM502—Bundler

**3.13** Circuit pack TM502 is the bundler circuit pack. It contains no options. The faceplate of TM502 contains a BR (bundle red) and a BY (bundle yellow) LED for each of the four bundles (Fig. 1).

### I. SM469—Codec

**3.14** Circuit pack SM469 is a codec circuit pack. There are four such circuit packs in a BCM32000. The faceplate of circuit pack SM469 has one LED labeled ALM that indicates an equipment

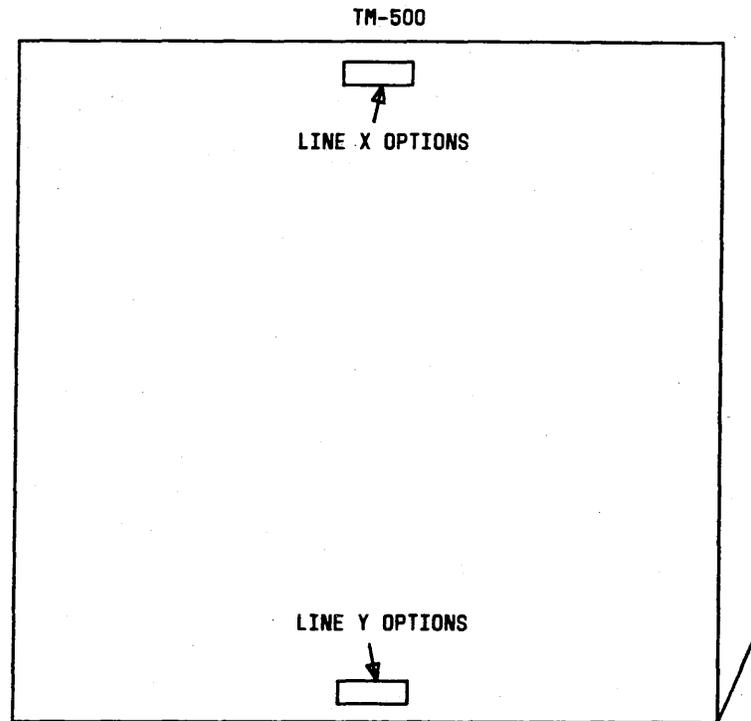


Fig. 11—Circuit Pack TM-500 Options

failure that is probably internal to the circuit pack. Circuit pack SM469 has no options.

#### J. SM470—Echo Canceler

**3.15** ♦Circuit pack SM470 is an echo canceler circuit pack that provides 16 ms or 32 ms echo tail lengths. The echo canceler tail length is determined by an option switch in the AMC circuit pack and the number of SM470 packs used. ♦ There are up to six SM470s in a BCM32000. The faceplate of circuit pack SM470 has one LED labeled ALM that indicates an equipment failure that is probably internal to the circuit pack. The faceplate of circuit pack SM470 has two sets of rockers to select per-channel echo canceling.

#### K. 484AA Power Unit

**3.16** The 484AA power unit (Fig. 1) is a plug-in unit. The faceplate of this unit has provisions for measuring voltage that is supplied to the circuit packs. The ALM OFF LED lights when there is a power unit failure or when the lever used to install the unit is not in the fully upright position.

#### L. MC90058A1 Common Processor

**3.17** The MC90058A1 common processor is an optional circuit pack used along with the TM495 processor interface pack to control and configure up to seven BCM32000 shelves. The AMC packs MC90069A1 and MC90070A1 (both rated DA) cannot be used with the processor option. The processor (Fig. 13) is installed in the slot between the codec and echo cancelers on unit 0 (shelf 1). Only one processor is needed for up to seven BCM units.

**3.18** The faceplate of the processor provides alarm indications, a RESET pushbutton, an ACO pushbutton for silencing office alarms, and a safety catch toggle mode select switch. The RESET is used to recover from an insane state and/or reinitialize the processor. The red MJ LED lights when there is a carrier failure or a circuit pack failure (except the processor). The green ACO lamp lights when the ACO pushbutton was used to silence alarms. The red PRC MJ lamp lights when the processor pack fails.

**3.19** The UNT VLD/PRC VLD toggle switch controls the processor reset mode. This is a safety

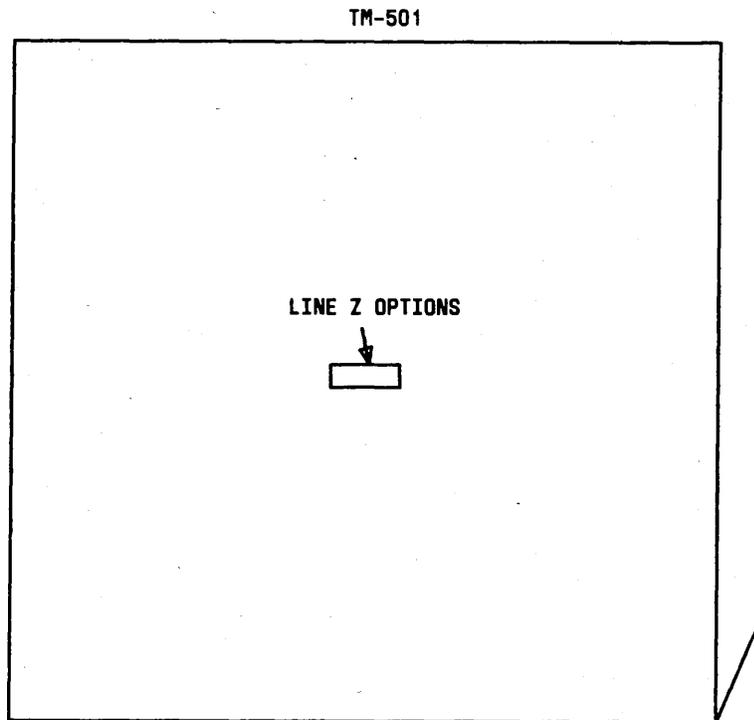


Fig. 12—Circuit Pack TM-501 Options

catch switch that must be pulled before switching positions. In the unit valid position, the processor will copy each BCM unit equipage configuration into its database on a processor reset. But it does not read the channel template number options set by the faceplate mini switches. Use this position when the processor is not used to set channel and echo canceling configuration or when retrofitting a BCM32000 with a new processor. In the processor valid position, the processor writes each unit equipage from the database on a processor reset. This writes channel template and echo canceling configurations to the BCM units. Use this position when the processor is used to set channel and echo canceling configurations.

**M. TM495 Processor Interface**

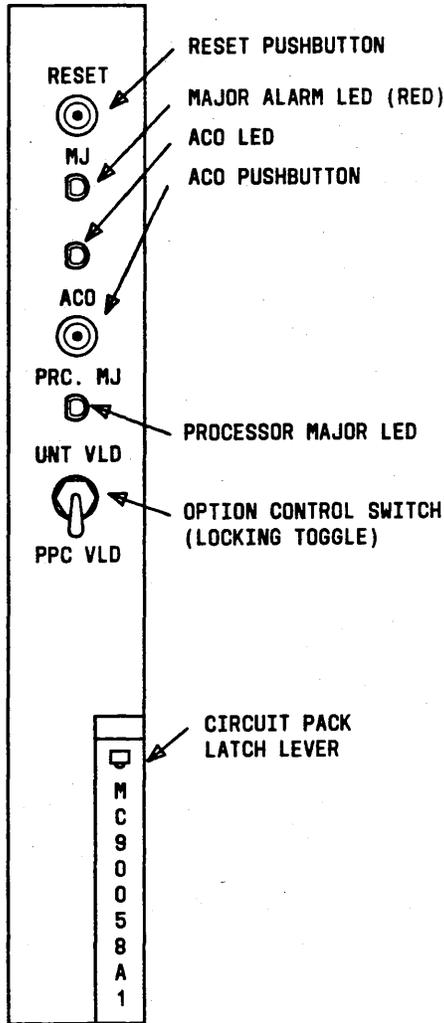
**3.20** ♦The optional TM495 processor interface circuit pack (Fig. 14) is required in each BCM unit that is served by the MC9058A1 common processor. This pack provides the interface between the processor and BCM32000 unit or shelf. One processor interface (PI) circuit pack is required in the slot be-

tween the AMC (alarm, maintenance, and control) and the TM500 circuit packs of each BCM unit.

**3.21** The faceplate of the PI circuit pack has a green **REMOTE LOOP** LED that lights when any of the DS1 lines (X, Y, or Z) are looped remotely by the processor. A 25-pin female connector provides a RS-232-C interface between the processor and a terminal (not to be used with a modem). This connection is to be used only on the PI in the same shelf with the MC9058A1 common processor.♦

**N. 551A Channel Service Unit (CSU)**

**3.22** The CSU is an option with the cabinet version of the BCM32000. The 551A CSU (Fig. 2) is 2 inches (5 cm) high by 21 inches (53 cm) wide by 12 inches (30 cm) deep. It consists of an aluminum chassis that houses two plug-in modules. The plug-in on the left is a signal monitor, and the plug-in on the right is a 206- or 236-type repeater. The chassis and both plug-ins contain jacks for monitoring or looping the DS1 signal. The CSU is described in detail in AT&T Practice 314-646-100.



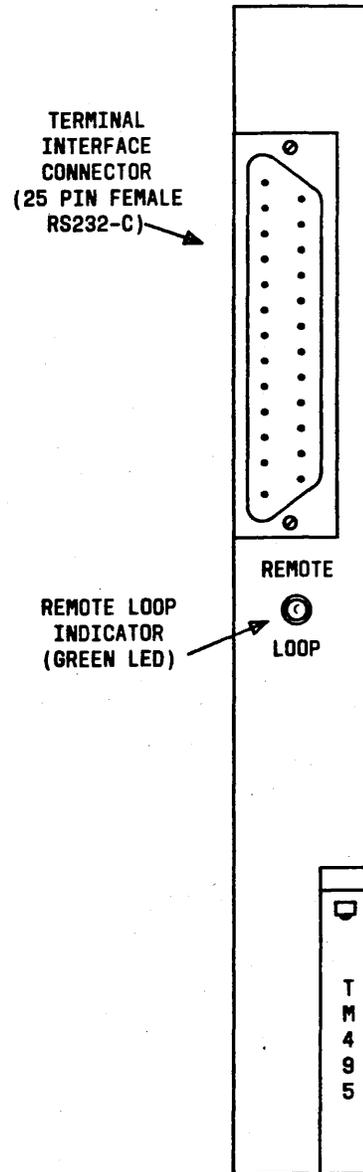
◆Fig. 13—MC90058A1 Common Processor Circuit Pack◆

**O. Fan Unit**

3.23 The fan unit is 21 inches (53 cm) wide by 6 inches (15 cm) high by 9 inches (23 cm) deep. The unit contains three fans, each of which is powered by -48 V through a 1/3-amp fuse. The fans run continuously to maintain the temperature in the cabinet version of the BCM32000. The unit also contains a replaceable air filter that should be changed once per year or more often if conditions are dusty.

**P. Power Unit**

3.24 The cabinet version has provisions for a power unit for offices that do not provide -48 V. The power unit is a 117 V ac to -48 V rectifier. It is 23



◆Fig. 14—TM495 Processor Interface Circuit Pack◆

inches (58 cm) wide by 6 inches (15 cm) high by 8 inches (20 cm) deep. An input cord that connects to a 117 V ac standard grounded plug and output leads for -48 V connect to the back of the power unit. A portion of the front is used for a faceplate that includes an ON-OFF switch, GRD, 48 V pin jacks, and fuse access.

**Q. Heat Baffle**

**3.25** The optional heat baffle is used when BCM shelves are stacked in a bay. The baffle is 3 inches high, has 2 mounting holes per side, and is used above each BCM shelf in the bay.

**4. ENGINEERING CONSIDERATIONS**

**4.01** The information under this heading provides directions for designing the BCM32000 portion of a system. The procedure under the "INSTALLATION" heading assumes that the engineer will provide the actual switch positions to the craft for optioning the circuit packs. The following paragraphs will guide the engineer in determining those options. The last subheading in this section supplies specifications, sparing, and fail rates.

**A. Design Check List**

**4.02** Preparations should be made for, or decisions made on, the following items concerning the BCM32000:

- Power requirements are described under the "Power" subheading of "Functional Description". Leads between power source and BCM should be 12-gauge wire. Ground is connected to terminal 1, -48 feed to terminal 6, and -48 return to positive terminal 2 of terminal strip TS3.
- Because of heat dissipation, not more than 5 BCM shelves are recommended in a 7-foot bay. Heat baffles are optional, but should be used when air flow is restricted or shelves are mounted with heat generating equipment. Heat baffles should be used above each BCM when they are stacked in a bay.
- Alarm connections available are listed under the "Alarm, Maintenance, and Controls" subheading of "Functional Description". The presence of an alarm condition is indicated by a short between the normally open contacts of the relays. Alarm connections are made in the "INSTALLATION" part of this practice.
- Cable lengths to DSX-1 or equivalent are limited to 655 feet. It is recommended that ABAM cable be used.

- Line coding and framing formats are discussed under the "Compatibility" subheading of "Functional Description".
- Robbed-bit signaling or bundling mode must be selected. The mode selected determines the circuit packs used at each end of the span.
- Option switch settings (channel configuration, line z coding and framing format) on AMC circuit packs must agree at both ends of the span.
- Configurations of through or compressed channels are limited to configurations available on option switches (see "Selectable Options" below).
- If echo canceling is used, the length of echo tails must be selected for lines x and y. Available tails are 16 and 32 milliseconds.
- The reference for the system clock must be selected. If line x or y is used as reference at one BCM32000, the BCM32000 at the other end will probably use line z as reference clock. If a DACS is used between the BCM32000s and the DACS provides the reference clock, then both BCM32000s will use line z as reference clock. In general, the system should be referenced from one clock source. One component of the system should be used for the reference clock and all other connecting equipment should obtain timing from this component.
- If a 551A CSU is used in the cabinet version, refer to AT&T Practice 314-646-100 to determine connections for strap options.

**B. Channel Template Numbering**

**4.03** There are 64 different channel configurations that the BCM can support in either the bundling or robbed-bit mode of operation. When the MC90058A1 common processor is not used, the channel configuration or "channel template" is set by opening or closing mini switches located on the faceplate of AMC circuit pack. When the processor is used to control the BCM system, the "prov-chan" processor command is used to set the channel template. The channel template number can be in the range of 0 to 63. The relation between channel template num-

ber and switch positions is a six bit binary number where a "one" means an open switch and a "zero" means a closed switch. The switch place (1 to 6) corresponds to the digit place. The following illustrates how to convert between switch settings and channel template number:

mini switch position						
6	5	4	3	2	1	
b6	b5	b4	b3	b2	b1	(bit is "1" if
x	x	x	x	x	x	switch is open,
32	16	8	4	2	1	"0" if closed)
+	+	+	+	+	+	= template number

For example, a channel template "0" would have all switches closed. A channel template "63" would have all switches open. Open switches "1, 2, 3, and 6" would have a channel template "39". Open switches "4 and 5" would have a channel template "24".

### C. Selectable Options

**4.04** Once the bundling or robbed-bit signaling mode is selected, proceed to paragraph 4.05 to option the bundle AMC circuit pack, or paragraph 4.11 to option the robbed-bit AMC circuit pack. Then continue with selecting options on remaining circuit packs.

#### MC90069A1B or MC90105A1 AMC (Bundle Signaling Mode)

**4.05** This circuit pack is used at each end of the span when the bundling mode is selected. The MC90105A1 (with or without the common processor option) AMC must be used for transparency alarm handling, and the MC90069A1 (rated DA, used without the processor option) or MC90069A1B (with or without the common processor option) AMC must be used for terminal alarm handling. The option settings for all bundle signaling AMC circuit packs (Fig. 7) are the same. Perform the following steps to determine option switch positions for both ends of the span. Perform each step in order unless directed by a step to do otherwise.

1. Start with all rockers on switch to OPEN.

2. What will control timing reference?
    - A. Local BCM—Specify rocker 5 be closed.
    - B. Line x—Specify rockers 1 and 6 be closed.
    - C. Line y—Specify rockers 2 and 6 be closed.
    - D. Line z—Specify rockers 3 and 6 be closed.
  3. Will echo canceling be used?
    - A. Yes—Continue with Step 4.
    - B. No—STOP! You are finished with option switch inside circuit pack.
  4. What is the echo tail length for line x?
    - A. Not used for line x—Continue with Step 5.
    - B. 16 milliseconds—Continue with Step 5.
    - C. 32 milliseconds—Specify rocker 7 be closed.
  5. What is the echo tail length for line y?
    - A. Not used for line y—STOP! All option switches inside circuit pack are set.
    - B. 16 milliseconds—STOP! All option switches inside circuit pack are set.
    - C. 32 milliseconds—Specify rocker 8 be closed.
  6. STOP! All option switches inside circuit pack are set.
- 4.06** Each bundle consists of up to 12 channels. There are 64 configurations or templates for each bundle. Bundle options are set using the rockers on the faceplate switches or commands from the optional MC90058A1 common processor unit.
- Switch 1 is for bundle 1, channels 1 through 12 of line x.
  - Switch 2 is for bundle 2, channels 13 through 24 of line x.
  - Switch 3 is for bundle 3, channels 1 through 12 of line y.

- Switch 4 is for bundle 4, channels 13 through 24 of line y.

**Note 1:** In order to insure that bundle alarms are not simulated during installation and testing, select a bundle option with no signaling.

**Note 2:** The signaling relays on 4 E&M channel units chatter if they are in channels not carrying signaling while connected to a bundle configured for signaling.

**4.07** The steps below are designed to determine as quickly as possible the available configurations that meet the needs for any bundle. These steps are therefore followed once for each bundle.

**4.08** ♦The BCM32000 configurations can be set using the faceplate mini switches or with commands from an optional processor unit. The steps give both methods for bundle group channel configuration. If the processor is used to set configuration, the switches do not need to be set. It is recommended to set the switches for a system that is expected to use the same configuration for a long time. This saves the setup in case of a processor failure. There are three tables associated with bundle mode channel provisioning. Table F shows the switch position and processor template numbers for signaling and through channels (noncompressed 64 kb channels). Table G shows the switch position and processor template numbers for no signaling and through channels. Table H has a listing of all template numbers and corresponding channel configurations.♦

**4.09** One special situation is discussed here to supplement the steps below. It is possible to send a clear 768 kb/s channel through the BCM for video or other applications. A 768 kb/s signal represents 12 full rate channels. The 768 kb/s signal may be carried on the first 12 or the last 12 channels of line x or line y. No other channels may be used on a line carrying a 768 kb/s signal. If line x is carrying a 768 kb/s signal, switches 1 and 2 are set. If line y is carrying the 768 kb/s signal, switches 3 and 4 are set.

**4.10** Follow the steps below in accordance with system requirements for each bundle. Perform each step in order unless directed by a step to do otherwise.

1. Read the four preceding paragraphs before continuing with Step 2.
2. Does bundle being set apply to a line carrying a 768 kb/s signal?
  - A. Yes—Continue with Step 3.
  - B. No—Continue with Step 10.
3. Is 768 kb/s signal in the first or last 12 channels of the line?
  - A. First 12—Continue with Step 4.
  - B. Last 12—Continue with Step 7.
4. On switch 1 for line x (3 for line y), specify rockers 1 and 2 be closed (others open) or if the processor is used to provision the bundle, the template number is 60. Go to Step 21 for processor command syntax.
5. On switch 2 for line x (4 for line y), specify rocker 2 be closed (others open) or if the processor is used to provision the bundle, the template number is 61. Go to Step 21 for processor command syntax.
6. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.
7. On switch 1 for line x (3 for line y), specify rocker 1 be closed (others open) or if the processor is used to provision the bundle, the template number is 62. Go to Step 21 for processor command syntax.
8. On switch 2 for line x (4 for line y), specify all rockers be open or if the processor is used to provision the bundle, the template number is 63. Go to Step 21 for processor command syntax.
9. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.
10. Are signaling bits used on any channel in the bundle being specified? (Assume yes if unknown.)

TABLE F  
BUNDLE CHANNEL PROVISIONING WITH SIGNALING (NOTE)

PROCESSOR PROV-CHAN TEMPLATE NUMBER	BUNDLE SWITCHES OPEN (ALL OTHERS CLOSED)	AVAILABLE CHANNEL CONFIGURATIONS											
		1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24
SIGNALING CHANNELS — NO THROUGH CHANNELS													
0	NONE	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	—
SIGNALING CHANNELS PLUS ONE THROUGH CHANNEL													
1	1	T-N	—	C-S	C-S	—							
2	2	T-S	—	C-S	C-S	—							
45	1,3,4,6	—	—	C-S	C-S	T-N							
SIGNALING CHANNELS PLUS TWO THROUGH CHANNELS													
3	1,2	T-N	T-N	—	—	C-S	C-S	C-S	C-S	C-S	C-S	C-S	—
4	3	T-N	T-S	—	—	C-S	C-S	C-S	C-S	C-S	C-S	C-S	—
5	1,3	T-S	T-S	—	—	C-S	C-S	C-S	C-S	C-S	C-S	C-S	—
21	1,3,5	T-N	—	T-N	—	C-S	C-S	C-S	C-S	C-S	C-S	C-S	—
46	2,3,4,6	T-N	—	—	—	C-S	C-S	C-S	C-S	C-S	C-S	C-S	T-N
57	1,4,5,6	—	—	—	C-S	T-N	T-N						
SIGNALING CHANNELS PLUS THREE THROUGH CHANNELS													
6	2,3	T-N	T-N	T-N	—	—	—	C-S	C-S	C-S	C-S	C-S	—
7	1,2,3	T-N	T-N	T-S	—	—	—	C-S	C-S	C-S	C-S	C-S	—
8	4	T-N	T-S	T-S	—	—	—	C-S	C-S	C-S	C-S	C-S	—
9	1,4	T-S	T-S	T-S	—	—	—	C-S	C-S	C-S	C-S	C-S	—
22	2,3,5	T-N	—	T-N	—	T-N	—	C-S	C-S	C-S	C-S	C-S	—
47	1,2,3,4,6	T-N	T-N	—	—	—	—	C-S	C-S	C-S	C-S	C-S	T-N
49	1,5,6	T-N	—	T-N	—	—	—	C-S	C-S	C-S	C-S	C-S	T-N
58	2,4,5,6	T-N	—	—	—	—	—	C-S	C-S	C-S	C-S	T-N	T-N
SIGNALING CHANNELS PLUS FOUR THROUGH CHANNELS													
10	2,4	T-N	T-N	T-N	T-N	—	—	—	—	C-S	C-S	C-S	—
11	1,2,4	T-N	T-N	T-N	T-S	—	—	—	—	C-S	C-S	C-S	—
12	3,4	T-N	T-N	T-S	T-S	—	—	—	—	C-S	C-S	C-S	—
13	1,3,4	T-N	T-S	T-S	T-S	—	—	—	—	C-S	C-S	C-S	—
14	2,3,4	T-S	T-S	T-S	T-S	—	—	—	—	C-S	C-S	C-S	—
23	1,2,3,5	T-N	—	T-N	—	T-N	—	T-N	—	C-S	C-S	C-S	—
48	5,6	T-N	T-N	T-N	—	—	—	—	—	C-S	C-S	C-S	T-N
59	1,2,4,5,6	T-N	T-N	—	—	—	—	—	—	C-S	C-S	C-S	T-N
50	2,5,6	T-N	—	T-N	—	T-N	—	—	—	C-S	C-S	C-S	T-N

Note: C=COMPRESSED, T=THROUGH, S=SIGNALING, N=NO SIGNALING, —=UNUSED.

▶ TABLE F ◀ (Contd)  
 BUNDLE CHANNEL PROVISIONING WITH SIGNALING (NOTE)

PROCESSOR PROV-CHAN TEMPLATE NUMBER	BUNDLE SWITCHES OPEN (ALL OTHERS CLOSED)	AVAILABLE CHANNEL CONFIGURATIONS											
		1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24
SIGNALING CHANNELS PLUS FIVE THROUGH CHANNELS													
15	1,2,3,4	T-N	T-N	T-N	T-N	T-N	—	—	—	—	—	C-S	—
16	5	T-N	T-N	T-N	T-N	T-S	—	—	—	—	—	C-S	—
17	1,5	T-N	T-N	T-N	T-S	T-S	—	—	—	—	—	C-S	—
18	2,5	T-N	T-N	T-S	T-S	T-S	—	—	—	—	—	C-S	—
19	1,2,5	T-N	T-S	T-S	T-S	T-S	—	—	—	—	—	C-S	—
20	3,5	T-S	T-S	T-S	T-S	T-S	—	—	—	—	—	C-S	—

**Note:** C=COMPRESSED, T=THROUGH, S=SIGNALING, N=NO SIGNALING, —=UNUSED.

- A. Yes—Continue with Step 11.
- B. No—Continue with Step 16.
- 11. Are there any through (64 kb) channels in bundle being specified?
  - A. Yes—Continue with Step 12.
  - B. No—Continue with Step 14.
- 12. Using Table F, choose one of the available configurations for the number of through channels in the bundle. Specify rocker switch positions or if the processor is used to provision the bundle, find the channel template number. Go to Step 21 for processor command syntax.
- 13. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.
- 14. Specify all rockers on bundle switch be set to CLOSED or if the processor is used to provision the bundle, the channel template number 0. Go to Step 21 for processor command syntax.
- 15. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.
- 16. Are there any through channels in bundle being specified?
  - A. Yes—Continue with Step 17.
  - B. No—Continue with Step 19.
- 17. Using Table G, choose one of the available configurations for the number of through channels in the bundle. Specify rocker switch positions or if the processor is used to provision the bundle, find the channel template number. Go to Step 21 for processor command syntax.
- 18. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.
- 19. Specify rockers 4 and 5 to open on bundle switch being set (others CLOSED) or if the processor is used to provision the bundle, the template number is 24. Go to Step 21 for processor command syntax. (This setting provides for 12 compressed channels with no signaling.)
- 20. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.

♦ TABLE G ♦  
BUNDLE CHANNEL PROVISIONING WITHOUT SIGNALING (NOTE)

PROCESSOR PROV-CHAN TEMPLATE NUMBER	BUNDLE SWITCHES OPEN (ALL OTHERS CLOSED)	AVAILABLE CHANNEL CONFIGURATIONS											
		1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24
NO SIGNALING CHANNELS — NO THROUGH CHANNELS													
24	4,5	C	C	C	C	C	C	C	C	C	C	C	C
NO SIGNALING CHANNELS — ONE THROUGH CHANNEL													
25	1,4,5	T	—	C	C	C	C	C	C	C	C	C	C
36	3,6	—	C	C	C	C	C	C	C	C	C	C	T
NO SIGNALING CHANNELS — TWO THROUGH CHANNELS													
26	2,4,5	T	T	—	—	C	C	C	C	C	C	C	C
32	6	T	—	T	—	C	C	C	C	C	C	C	C
37	1,3,6	T	—	—	C	C	C	C	C	C	C	C	T
51	1,2,5,6	—	—	C	C	C	C	C	C	C	C	T	T
NO SIGNALING CHANNELS — THREE THROUGH CHANNELS													
27	1,2,4,5	T	T	T	—	—	—	C	C	C	C	C	C
33	1,6	T	—	T	—	T	—	C	C	C	C	C	C
38	2,3,6	T	T	—	—	—	C	C	C	C	C	C	T
42	2,4,6	T	—	T	—	—	C	C	C	C	C	C	T
52	3,5,6	T	—	—	—	C	C	C	C	C	C	T	T
NO SIGNALING CHANNELS — FOUR THROUGH CHANNELS													
28	3,4,5	T	T	T	T	—	—	—	—	C	C	C	C
34	2,6	T	—	T	—	T	—	T	—	C	C	C	C
39	1,2,3,6	T	T	T	—	—	—	—	C	C	C	C	T
43	1,2,4,6	T	—	T	—	T	—	—	C	C	C	C	T
53	1,3,5,6	T	T	—	—	—	—	C	C	C	C	T	T
55	1,2,3,5,6	T	—	T	—	—	—	C	C	C	C	T	T
NO SIGNALING CHANNELS — FIVE THROUGH CHANNELS													
29	1,3,4,5	T	T	T	T	T	—	—	—	—	—	C	C
35	1,2,6	T	—	T	—	T	—	T	—	T	—	C	C
40	4,6	T	T	T	T	—	—	—	—	—	C	C	T
44	3,4,6	T	—	T	—	T	—	T	—	—	C	C	T
54	2,3,5,6	T	T	T	—	—	—	—	—	C	C	T	T
56	4,5,6	T	—	T	—	T	—	—	—	C	C	T	T
NO SIGNALING CHANNELS — SIX THROUGH CHANNELS													
30	2,3,4,5	T	T	T	T	T	T	—	—	—	—	—	—
31	1,2,3,4,5	—	—	—	—	—	—	T	T	T	T	T	T
41	1,4,6	T	T	T	T	T	—	—	—	—	—	—	T

**Note:** C=COMPRESSED, T=THROUGH, —=UNUSED.

TABLE H

TEMPLATES 0-35 FOR BCM32000 WITH BUNDLE (NOTE)

CHANNEL OR CHANNEL	1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24	OPEN SWITCHES ALL OTHERS CLOSED	
Template#														
0	32s	32s	—	yes	NONE									
1	64n	—	32s	32s	—	yes	1							
2	64s	—	32s	32s	—	yes	2							
3	64n	64n	—	—	32s	32s	32s	32s	32s	32s	32s	—	yes	1,2
4	64n	64s	—	—	32s	32s	32s	32s	32s	32s	32s	—	yes	3
5	64s	64s	—	—	32s	32s	32s	32s	32s	32s	32s	—	yes	1,3
6	64n	64n	64n	—	—	—	32s	32s	32s	32s	32s	—	yes	2,3
7	64n	64n	64s	—	—	—	32s	32s	32s	32s	32s	—	yes	1,2,3
8	64n	64s	64s	—	—	—	32s	32s	32s	32s	32s	—	yes	4
9	64s	64s	64s	—	—	—	32s	32s	32s	32s	32s	—	yes	1,4
10	64n	64n	64n	64n	—	—	—	—	32s	32s	32s	—	yes	2,4
11	64n	64n	64n	64s	—	—	—	—	32s	32s	32s	—	yes	1,2,4
12	64n	64n	64s	64s	—	—	—	—	32s	32s	32s	—	yes	3,4
13	64n	64s	64s	64s	—	—	—	—	32s	32s	32s	—	yes	1,3,4
14	64s	64s	64s	64s	—	—	—	—	32s	32s	32s	—	yes	2,3,4
15	64n	64n	64n	64n	64n	—	—	—	—	—	32s	—	yes	1,2,3,4
16	64n	64n	64n	64n	64s	—	—	—	—	—	32s	—	yes	5
17	64n	64n	64n	64s	64s	—	—	—	—	—	32s	—	yes	1,5
18	64n	64n	64s	64s	64s	—	—	—	—	—	32s	—	yes	2,5
19	64n	64s	64s	64s	64s	—	—	—	—	—	32s	—	yes	1,2,5
20	64s	64s	64s	64s	64s	—	—	—	—	—	32s	—	yes	3,5
21	64n	—	64n	—	32s	32s	32s	32s	32s	32s	32s	—	yes	1,3,5
22	64n	—	64n	—	64n	—	32s	32s	32s	32s	32s	—	yes	2,3,5
23	64n	—	64n	—	64n	—	64n	—	32s	32s	32s	—	yes	1,2,3,5
24	32n	32n	32n	no	4,5									
25	64n	—	32n	32n	32n	no	1,4,5							
26	64n	64n	—	—	32n	32n	32n	32n	32n	32n	32n	32n	no	2,4,5
27	64n	64n	64n	—	—	—	32n	32n	32n	32n	32n	32n	no	1,2,4,5
28	64n	64n	64n	64n	—	—	—	—	32n	32n	32n	32n	no	3,4,5
29	64n	64n	64n	64n	64n	—	—	—	—	—	32n	32n	no	1,3,4,5
30	64n	64n	64n	64n	64n	64n	—	—	—	—	—	—	no	2,3,4,5
31	—	—	—	—	—	—	64n	64n	64n	64n	64n	64n	no	1,2,3,4,5
32	64n	—	64n	—	32n	32n	32n	32n	32n	32n	32n	32n	no	6
33	64n	—	64n	—	64n	—	32n	32n	32n	32n	32n	32n	no	1,6
34	64n	—	64n	—	64n	—	64n	—	32n	32n	32n	32n	no	2,6
35	64n	—	32n	32n	no	1,2,6								

See note at end of table.

▶TABLE H4 (Contd)

## TEMPLATES 36-59 FOR BCM32000 WITH BUNDLE (NOTE)

CHANNEL OR CHANNEL	1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24	OPEN SWITCHES ALL OTHERS CLOSED	
Template#														
36	—	32n	32n	64n	no	3,6								
37	64n	—	—	32n	32n	64n	no	1,3,6						
38	64n	64n	—	—	—	32n	32n	32n	32n	32n	32n	64n	no	2,3,6
39	64n	64n	64n	—	—	—	—	32n	32n	32n	32n	64n	no	1,2,3,6
40	64n	64n	64n	64n	—	—	—	—	—	32n	32n	64n	no	4,6
41	64n	64n	64n	64n	64n	—	—	—	—	—	—	64n	no	1,4,6
42	64n	—	64n	—	—	32n	32n	32n	32n	32n	32n	64n	no	2,4,6
43	64n	—	64n	—	64n	—	—	32n	32n	32n	32n	64n	no	1,2,4,6
44	64n	—	64n	—	64n	—	64n	—	—	32n	32n	64n	no	3,4,6
45	—	—	32s	32s	64n	yes	1,3,4,6							
46	64n	—	—	—	32s	32s	32s	32s	32s	32s	32s	64n	yes	2,3,4,6
47	64n	64n	—	—	—	—	32s	32s	32s	32s	32s	64n	yes	1,2,3,4,6
48	64n	64n	64n	—	—	—	—	—	32s	32s	32s	64n	yes	5,6
49	64n	—	64n	—	—	—	32s	32s	32s	32s	32s	64n	yes	1,5,6
50	64n	—	64n	—	64n	—	—	—	32s	32s	32s	64n	yes	2,5,6
51	—	—	32n	64n	64n	no	1,2,5,6							
52	64n	—	—	—	32n	32n	32n	32n	32n	32n	64n	64n	no	3,5,6
53	64n	64n	—	—	—	—	32n	32n	32n	32n	64n	64n	no	1,3,5,6
54	64n	64n	64n	—	—	—	—	—	32n	32n	64n	64n	no	2,3,5,6
55	64n	—	64n	—	—	—	32n	32n	32n	32n	64n	64n	no	1,2,3,5,6
56	64n	—	64n	—	64n	—	—	—	32n	32n	64n	64n	no	4,5,6
57	—	—	—	32s	64n	64n	yes	1,4,5,6						
58	64n	—	—	—	—	32s	32s	32s	32s	32s	64n	64n	yes	2,4,5,6
59	64n	64n	—	—	—	—	—	32s	32s	32s	64n	64n	yes	1,2,4,5,6

See note at end of table.

## 21. Enter (all on one line)

prov-remote:unit=[unit#]:  
bundle=[1|2|3|4],[template#]

prov-remote:u=0:b=1,1:b=2,2:b=3,3:b=4,4  
prov-remote:u=0:b=1&2,1:b=3&4,2 prov-remote:u=  
0&&4:b=1&&4,0

to set channel configuration in bundle of BCM unit being provisioned. If the unit is already in the prov-remote mode, used **prov-chan:** command with the same parameters as above. The **help:** "command name" command can be entered to find syntax for the "command name" processor command. Each bundle must be assigned a template number. The following are examples of abbreviated prov-remote bundle commands (see Processor Syntax).

**Note:** To use the processor commands, a terminal must be connected to the processor interface unit and the user must login.

22. STOP! Bundle specifications are complete. If all four bundles have not yet been specified, repeat procedure from Step 1 for next bundle.

▶TABLE H▶ (Contd)

TEMPLATES 60-63 FOR BCM32000 WITH BUNDLE  
FOR 768 Kb/s PASS-THROUGH (NOTE)

CHANNEL OR CHANNEL	1	2	3	4	5	6	7	8	9	10	11	12	OPEN SWITCHES ALL OTHERS CLOSED
	13	14	15	16	17	18	19	20	21	22	23	24	
Template# 60 & 61 used as a pair	64n	For template 60 3,4,5,6  For template 61 1,3,4,5,6											
<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>For 768 kb/s pass-through of Digroup X, Bundle 1 uses template# 60 and Bundle 2 uses template# 61.</li> <li>For 768 kb/s pass-through of Digroup Y, Bundle 3 uses template# 60 and Bundle 4 uses template# 61.</li> <li>The delta channel is disabled in the bundles providing 768 kb/s pass-through.</li> </ol>													
Template# 62 & 63 used as a pair	—	—	—	—	—	—	—	—	—	—	—	—	For template 62 2,3,4,5,6  For template 63 1,2,3,4,5,6
<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>For 768 kb/s pass-through of Digroup X, Bundle 1 uses template# 62 and Bundle 2 uses template# 63.</li> <li>For 768 kb/s pass-through of Digroup Y, Bundle 3 uses template# 62 and Bundle 4 uses template# 63.</li> <li>The delta channel is disabled in the bundles providing 768 kb/s pass-through.</li> </ol>													

*Note:* "n" = No signaling on the full-rate or sub-rate channel.  
 "s" = Signaling on the full-rate or sub-rate channel.  
 "—" = Channel unavailable for service.  
 "yes" = Delta channel.  
 "no" = No delta channel.  
 "32" = 32 kb/s coding.  
 "64" = Pass-through at 64 kb/s.

**MC90070A1B or MC90104A1 AMC (Robbed-Bit Signaling Mode)**

**4.11** This circuit pack is used when the robbed-bit signaling mode is selected. ♦The MC90104A1 (with or without the common processor option) AMC must be used for transparency alarm handling, and the MC90070A1 (rated DA, used without the processor option) or MC90070A1B (with or without the common processor option) AMC must be used for terminal alarm handling. The option settings for all robbed-bit signaling AMC circuit packs are the same. ♦ Perform the following steps in accordance with line records to set option switch inside the robbed-bit signaling AMC circuit pack (Fig. 7):

1. Start with all rockers on switch to OPEN.
2. What will control timing reference?
  - A. Local BCM—Specify rocker 5 be closed.
  - B. Line x—Specify rockers 1 and 6 be closed.
  - C. Line y—Specify rockers 2 and 6 be closed.
  - D. Line z—Specify rockers 3 and 6 be closed.
3. Will echo canceling be used?
  - A. Yes—Continue with Step 4.
  - B. No—STOP! All options inside circuit pack are set.
4. What is the echo tail length for line x?
  - A. 16 milliseconds—Continue with Step 5.
  - B. 32 milliseconds—Specify rocker 7 be closed.
5. What is the echo tail length for line y?
  - A. 16 milliseconds—STOP! All options inside circuit pack are set.
  - B. 32 milliseconds—Specify rocker 8 be closed.
6. STOP! All options inside circuit pack are set.

**4.12** The option switches on the faceplate of the AMC circuit pack are used to select one of the 64 available channel configurations of through or

compressed channels. ♦The channel configuration can also be set using commands from an optional MC90058A1 common processor unit. ♦ Through channels may or may not carry signaling. The faceplate has two sets of rockers numbered 1 through 8. The upper set applies to the first 12 channels in line x (group 1 for processor commands). The lower set applies to channels 13 through 24 of line x (group 2 for processor commands). When a channel in line x is compressed, the channel with the same number in line y is compressed. When a channel in line x is a through channel, the channel with the same number in line y is not used. No through channels are permitted in line y.

**4.13** ♦If the processor is used to set configuration, the switches do not need to be set. It is recommended to set the switches for a system that is expected to use the same configuration for a long time. This saves the setup in case of a processor failure. There are two tables associated with robbed-bit mode channel provisioning. Table I shows the switch position and processor template numbers for signaling and through channels (noncompressed 64 kb channels). Table J has a listing of all template numbers and corresponding channel configurations. ♦

**4.14** The steps below are designed to help identify, as quickly as possible, the available channel configuration that is needed. Both methods, processor commands or switch setting, for robbed-bit channel configuration setting are listed.

1. Read the preceding three paragraphs before continuing.
2. Which group of channels are being provisioned?
  - A. Group 1 (channels 1 through 12 of line x)—Continue with Step 3.
  - B. Group 2 (channels 13 through 24 of line x)—Continue with Step 5.
3. Will there be any through channels in group 1 (channels 1 through 12 of line x)?
  - A. Yes—Continue with Step 4.
  - B. No—Specify all rockers in upper switch be CLOSED, or if the processor is used to provision the group, the channel template number

TABLE I  
ROBBED-BIT CHANNEL PROVISIONING (NOTE)

PROCESSOR PROV-CHAN TEMPLATE NUMBER	SWITCHES OPEN (ALL OTHERS CLOSED)	AVAILABLE CHANNEL CONFIGURATIONS											
		1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24
ROBBED-BIT SIGNALING WITH THROUGH CHANNELS													
0	NONE	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
ROBBED-BIT SIGNALING WITH ONE THROUGH CHANNEL													
1	1	T-N	C-S	C-S	C-S								
2	2	T-S	C-S	C-S	C-S								
36	3,6	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	T-N
ROBBED-BIT SIGNALING WITH TWO THROUGH CHANNELS													
3	1,2	T-N	T-N	C-S	C-S	C-S							
4	3	T-N	T-S	C-S	C-S	C-S							
5	1,3	T-S	T-S	C-S	C-S	C-S							
32	6	T-N	C-S	T-N	C-S	C-S	C-S						
37	1,3,6	T-N	C-S	C-S	T-N								
38	2,3,6	T-S	C-S	C-S	T-N								
50	2,5,6	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	T-N	T-N
ROBBED-BIT SIGNALING WITH THREE THROUGH CHANNELS													
6	2,3	T-N	T-N	T-N	C-S	C-S	C-S						
7	1,2,3	T-N	T-N	T-S	C-S	C-S	C-S						
8	4	T-N	T-S	T-S	C-S	C-S	C-S						
9	1,4	T-S	T-S	T-S	C-S	C-S	C-S						
33	1,6	T-N	C-S	T-N	C-S	T-N	C-S	C-S	C-S	C-S	C-S	C-S	C-S
34	2,6	T-N	C-S	T-N	C-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
38	1,2,3,6	T-N	T-N	C-S	C-S	T-N							
40	4,6	T-N	T-S	C-S	C-S	T-N							
41	1,4,6	T-S	T-S	C-S	C-S	T-N							
47	1,2,3,4,6	T-N	C-S	T-N	C-S	C-S	T-N						
51	1,2,5,6	T-N	C-S	T-N	T-N								
52	3,5,6	T-S	C-S	T-N	T-N								
ROBBED-BIT SIGNALING WITH FOUR THROUGH CHANNELS													
10	2,4	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
11	1,2,4	T-N	T-N	T-N	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
12	3,4	T-N	T-N	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
13	1,3,4	T-N	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
14	2,3,4	T-S	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S

Note: C=COMPRESSED, T=THROUGH, S=SIGNALING, N=NO SIGNALING.

♦ TABLE I ♦ (Contd)  
ROBBED-BIT CHANNEL PROVISIONING (NOTE)

PROCESSOR PROV-CHAN TEMPLATE NUMBER	SWITCHES OPEN (ALL OTHERS CLOSED)	AVAILABLE CHANNEL CONFIGURATIONS											
		1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24
<b>ROBBED-BIT SIGNALING WITH FOUR THROUGH CHANNELS (Contd)</b>													
35	1,2,6	T-N	C-S	T-N	C-S	T-N	C-S	T-N	C-S	C-S	C-S	C-S	C-S
42	2,4,6	T-N	T-N	T-N	C-S	C-S	T-N						
43	1,2,4,6	T-N	T-N	T-S	C-S	C-S	T-N						
48	5,6	T-N	C-S	T-N	C-S	T-N	C-S	C-S	C-S	C-S	C-S	C-S	T-N
53	1,3,5,6	T-S	T-N	C-S	T-N	T-N							
54	2,3,5,6	T-N	T-S	C-S	T-N	T-N							
62	2,3,4,5,6	T-N	C-S	T-N	C-S	T-N	T-N						
<b>ROBBED-BIT SIGNALING WITH FIVE THROUGH CHANNELS</b>													
15	1,2,3,4	T-N	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	C-S	C-S
16	5	T-N	T-N	T-N	T-N	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
17	1,5	T-N	T-N	T-N	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
18	2,5	T-N	T-N	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
19	1,2,5	T-N	T-S	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
20	3,5	T-S	T-S	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S	C-S
44	3,4,6	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	C-S	C-S	T-N
49	1,5,6	T-N	C-S	T-N	C-S	T-N	C-S	T-N	C-S	C-S	C-S	C-S	T-N
55	1,2,3,5,6	T-N	T-N	T-N	C-S	T-N	T-N						
56	4,5,6	T-N	T-N	T-S	C-S	T-N	T-N						
57	1,4,5,6	T-N	T-S	T-S	C-S	T-N	T-N						
58	2,4,5,6	T-S	T-S	T-S	C-S	T-N	T-N						
63	1,2,3,4,5,6	T-N	C-S	T-N	C-S	T-N	C-S	C-S	C-S	C-S	C-S	T-N	T-N
<b>ROBBED-BIT SIGNALING WITH SIX THROUGH CHANNELS</b>													
21	1,3,5	T-N	T-N	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	C-S
22	2,3,5	T-N	T-N	T-N	T-N	T-N	T-S	C-S	C-S	C-S	C-S	C-S	C-S
23	1,2,3,5	T-N	T-N	T-N	T-N	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S
24	4,5	T-N	T-N	T-N	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S
25	1,4,5	T-N	T-N	T-S	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S
26	2,4,5	T-N	T-S	T-S	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S
27	1,2,4,5	T-S	T-S	T-S	T-S	T-S	T-S	C-S	C-S	C-S	C-S	C-S	C-S
28	3,4,5	C-S	C-S	C-S	C-S	C-S	C-S	T-N	T-N	T-N	T-N	T-N	T-N
29	1,3,4,5	C-S	C-S	C-S	C-S	C-S	C-S	T-S	T-S	T-S	T-S	T-S	T-S
45	1,3,4,6	T-N	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	C-S	T-N
59	1,2,4,5,6	T-N	T-S	T-S	T-N	C-S	C-S	C-S	C-S	C-S	C-S	T-N	T-N

**Note:** C=COMPRESSED, T=THROUGH, S=SIGNALING, N=NO SIGNALING.

♦ TABLE I ♦ (Contd)  
**ROBBED-BIT CHANNEL PROVISIONING (NOTE)**

PROCESSOR PROV-CHAN TEMPLATE NUMBER	SWITCHES OPEN (ALL OTHERS CLOSED)	AVAILABLE CHANNEL CONFIGURATIONS											
		1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24
<b>ROBBED-BIT SIGNALING WITH SEVEN THROUGH CHANNELS</b>													
46	2,3,4,6	T-N	T-N	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	T-N
60	3,4,5,6	T-N	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	C-S	T-N	T-N
<b>ROBBED-BIT SIGNALING WITH EIGHT THROUGH CHANNELS</b>													
61	1,3,4,5,6	T-N	T-N	T-N	T-N	T-N	T-N	C-S	C-S	C-S	C-S	T-N	T-N
<b>ROBBED-BIT SIGNALING WITH TWELVE THROUGH CHANNELS</b>													
30	2,3,4,5	T-N	T-N	T-N	T-N	T-N	T-N	T-N	T-N	T-N	T-N	T-N	T-N
31	1,2,3,4,5	T-S	T-S	T-S	T-S	T-S	T-S	T-S	T-S	T-S	T-S	T-S	T-S

**Note:** C=COMPRESSED, T=THROUGH, S=SIGNALING, N=NO SIGNALING.

- is 0. Go to Step 7 for processor command syntax or Step 8 for switch settings.
- 4. Using Table I, choose one of the available configurations for the number of through channels in group 1 (channels 1 through 12 of line x). Specify upper rocker switch positions or if the processor is used to provision the group 1, find the channel template number. Go to Step 7 for processor command syntax or Step 8 for switch settings.
- 5. Will there be any through channels in channels in group 2 (channels 13 through 24 of line x)?
  - A. Yes—Continue with Step 6.
  - B. No—Specify all rockers in lower switch be CLOSED, or if the processor is used to provision the group, the channel template number is 0. Go to Step 7 for processor command syntax or Step 8 for switch settings.
- 6. Using Table I, choose one of the available configurations for the number of through channels in group 1 (channels 1 through 12 of line

x). Specify upper rocker switch positions or if the processor is used to provision the group 1, find the channel template number. Go to Step 7 for processor command syntax or Step 8 for switch settings.

7. Enter (all on one line)

**prov-remote:unit=[unit#]: group=[1|2],[template#]**

to set channel configuration in group of BCM unit being provisioned. If the unit is already in the prov-remote mode, used **prov-chan:** command with the same parameters as above. The **help:** "command name" command can be entered to find syntax for the "command name" processor command. Both groups must be assigned a template number. The following are examples of abbreviated prov-remote robbed-bit commands (see Processor Syntax).

prov-remote:u=0:g=1,1:g=2,2    prov-remote:u=0:g=1&2,0  
 prov-remote:u=0&&4:g=1&2,0

**Note:** To use the processor commands, a terminal must be connected to the processor interface unit and login must be completed.

TABLE J

TEMPLATES 0-18 FOR BCM32000 WITH ROBBED-BIT SIGNALING (NOTE)

LINE X CHANNEL OR CHANNEL	1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24	OPEN SWITCHES ALL OTHERS CLOSED
Template#													
0 X	32s	32s	32s	None									
Y	32s	32s	32s										
1 X	64n	32s	32s	32s	1								
Y	—	32s	32s	32s									
2 X	64s	32s	32s	32s	2								
Y	—	32s	32s	32s									
3 X	64n	64n	32s	32s	32s	1,2							
Y	—	—	32s	32s	32s								
4 X	64n	64s	32s	32s	32s	3							
Y	—	—	32s	32s	32s								
5 X	64s	64s	32s	32s	32s	1,3							
Y	—	—	32s	32s	32s								
6 X	64n	64n	64n	32s	32s	32s	2,3						
Y	—	—	—	32s	32s	32s							
7 X	64n	64n	64s	32s	32s	32s	1,2,3						
Y	—	—	—	32s	32s	32s							
8 X	64n	64s	64s	32s	32s	32s	4						
Y	—	—	—	32s	32s	32s							
9 X	64s	64s	64s	32s	32s	32s	1,4						
Y	—	—	—	32s	32s	32s							
10 X	64n	64n	64n	64n	32s	32s	32s	32s	32s	32s	32s	32s	2,4
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	32s	
11 X	64n	64n	64n	64s	32s	32s	32s	32s	32s	32s	32s	32s	1,2,4
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	32s	
12 X	64n	64n	64s	64s	32s	32s	32s	32s	32s	32s	32s	32s	3,4
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	32s	
13 X	64n	64s	64s	64s	32s	32s	32s	32s	32s	32s	32s	32s	1,3,4
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	32s	
14 X	64s	64s	64s	64s	32s	32s	32s	32s	32s	32s	32s	32s	2,3,4
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	32s	
15 X	64n	64n	64n	64n	64n	32s	32s	32s	32s	32s	32s	32s	1,2,3,4
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	
16 X	64n	64n	64n	64n	64s	32s	32s	32s	32s	32s	32s	32s	5
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	
17 X	64n	64n	64n	64s	64s	32s	32s	32s	32s	32s	32s	32s	1,5
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	
18 X	64n	64n	64s	64s	64s	32s	32s	32s	32s	32s	32s	32s	2,5
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	

See note at end of table.

TABLE J4 (Contd)

TEMPLATES 19-35 FOR BCM32000 WITH ROBBED-BIT SIGNALING (NOTE)

LINE X CHANNEL OR CHANNEL	1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24	OPEN SWITCHES ALL OTHERS CLOSED
Template#													
19 X	64n	64s	64s	64s	64s	32s	32s	32s	32s	32s	32s	32s	1,2,5
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	
20 X	64s	64s	64s	64s	64s	32s	32s	32s	32s	32s	32s	32s	3,5
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	
21 X	64n	64n	64n	64n	64n	64n	32s	32s	32s	32s	32s	32s	1,3,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
22 X	64n	64n	64n	64n	64n	64s	32s	32s	32s	32s	32s	32s	2,3,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
23 X	64n	64n	64n	64n	64s	64s	32s	32s	32s	32s	32s	32s	1,2,3,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
24 X	64n	64n	64n	64s	64s	64s	32s	32s	32s	32s	32s	32s	4,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
25 X	64n	64n	64s	64s	64s	64s	32s	32s	32s	32s	32s	32s	1,4,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
26 X	64n	64s	64s	64s	64s	64s	32s	32s	32s	32s	32s	32s	2,4,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
27 X	64s	64s	64s	64s	64s	64s	32s	32s	32s	32s	32s	32s	1,2,4,5
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	32s	
28 X	32s	32s	32s	32s	32s	32s	64s	64s	64s	64s	64s	64s	3,4,5
Y	32s	32s	32s	32s	32s	32s	—	—	—	—	—	—	
29 X	32s	32s	32s	32s	32s	32s	64n	64n	64n	64n	64n	64n	1,3,4,5
Y	32s	32s	32s	32s	32s	32s	—	—	—	—	—	—	
30 X	64n	64n	64n	2,3,4,5									
Y	—	—	—	—	—	—	—	—	—	—	—	—	
31 X	64s	64s	64s	1,2,3,4,5									
Y	—	—	—	—	—	—	—	—	—	—	—	—	
32 X	64n	32s	64n	32s	32s	32s	6						
Y	—	32s	—	32s	32s	32s							
33 X	64n	32s	64n	32s	64n	32s	32s	32s	32s	32s	32s	32s	1,6
Y	—	32s	—	32s	—	32s	32s	32s	32s	32s	32s	32s	
34 X	64n	32s	64n	32s	64s	32s	32s	32s	32s	32s	32s	32s	2,6
Y	—	32s	—	32s	—	32s	32s	32s	32s	32s	32s	32s	
35 X	64n	32s	64n	32s	64n	32s	64n	32s	32s	32s	32s	32s	1,2,6
Y	—	32s	—	32s	—	32s	—	32s	32s	32s	32s	32s	

See note at end of table.

♦TABLE J♦ (Contd)

## TEMPLATES 36-53 FOR BCM32000 WITH ROBBED-BIT SIGNALING (NOTE)

LINE X CHANNEL OR CHANNEL	1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24	OPEN SWITCHES ALL OTHERS CLOSED
Template#													
36 X	32s	32s	64n	3,6									
Y	32s	32s	—										
37 X	64n	32s	32s	64n	1,3,6								
Y	—	32s	32s	—									
38 X	64s	32s	32s	64n	2,3,6								
Y	—	32s	32s	—									
39 X	64n	64n	32s	32s	64n	1,2,3,6							
Y	—	—	32s	32s	—								
40 X	64n	64s	32s	32s	64n	4,6							
Y	—	—	32s	32s	—								
41 X	64s	64s	32s	32s	64n	1,4,6							
Y	—	—	32s	32s	—								
42 X	64n	64n	64n	32s	32s	64n	2,4,6						
Y	—	—	—	32s	32s	—							
43 X	64n	64n	64s	32s	32s	64n	1,2,4,6						
Y	—	—	—	32s	32s	—							
44 X	64n	64n	64n	64n	32s	32s	32s	32s	32s	32s	32s	64n	3,4,6
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	32s	—	
45 X	64n	64n	64n	64n	64n	32s	32s	32s	32s	32s	32s	64n	1,3,4,6
Y	—	—	—	—	—	32s	32s	32s	32s	32s	32s	—	
46 X	64n	64n	64n	64n	64n	64n	32s	32s	32s	32s	32s	64n	2,3,4,6
Y	—	—	—	—	—	—	32s	32s	32s	32s	32s	—	
47 X	64n	32s	64n	32s	32s	64n	1,2,3,4,6						
Y	—	32s	—	32s	32s	—							
48 X	64n	32s	64n	32s	64n	32s	32s	32s	32s	32s	32s	64n	5,6
Y	—	32s	—	32s	—	32s	32s	32s	32s	32s	32s	—	
49 X	64n	32s	64n	32s	64n	32s	64n	32s	32s	32s	32s	64n	1,5,6
Y	—	32s	—	32s	—	32s	—	32s	32s	32s	32s	—	
50 X	32s	64n	64n	2,5,6									
Y	32s	—	—										
51 X	64n	32s	64n	64n	1,2,5,6								
Y	—	32s	—	—									
52 X	64s	32s	64n	64n	3,5,6								
Y	—	32s	—	—									
53 X	64n	64n	32s	64n	64n	1,3,5,6							
Y	—	—	32s	—	—								

See note at end of table.

▶TABLE J4 (Contd)

TEMPLATES 54-63 FOR BCM32000 WITH ROBBED-BIT SIGNALING (NOTE)

LINE X CHANNEL OR CHANNEL	1 OR 13	2 OR 14	3 OR 15	4 OR 16	5 OR 17	6 OR 18	7 OR 19	8 OR 20	9 OR 21	10 OR 22	11 OR 23	12 OR 24	OPEN SWITCHES ALL OTHERS CLOSED
Template#													
54 X	64n	64s	32s	64n	64n	2,3,5,6							
Y	—	—	32s	—	—								
55 X	64n	64n	64n	32s	64n	64n	1,2,3,5,6						
Y	—	—	—	32s	—	—							
56 X	64n	64n	64s	32s	64n	64n	4,5,6						
Y	—	—	—	32s	—	—							
57 X	64n	64s	64s	32s	64n	64n	1,4,5,6						
Y	—	—	—	32s	—	—							
58 X	64s	64s	64s	32s	64n	64n	2,4,5,6						
Y	—	—	—	32s	—	—							
59 X	64n	64n	64n	64n	32s	32s	32s	32s	32s	32s	64n	64n	1,2,4,5,6
Y	—	—	—	—	32s	32s	32s	32s	32s	32s	—	—	
60 X	64n	64n	64n	64n	64n	32s	32s	32s	32s	32s	64n	64n	3,4,5,6
Y	—	—	—	—	—	32s	32s	32s	32s	32s	—	—	
61 X	64n	64n	64n	64n	64n	64n	32s	32s	32s	32s	64n	64n	1,3,4,5,6
Y	—	—	—	—	—	—	32s	32s	32s	32s	—	—	
62 X	64n	32s	64n	32s	64n	64n	2,3,4,5,6						
Y	—	32s	—	32s	—	—							
63 X	64n	32s	64n	32s	64n	32s	32s	32s	32s	32s	64n	64n	1,2,3,4,5,6
Y	—	32s	—	32s	—	32s	32s	32s	32s	32s	—	—	

Note: "n" = No signaling on the full-rate or sub-rate channel.  
 "s" = Signaling in the full-rate or sub-rate channel.  
 "32" = 32 kb/s coding.  
 "64" = Pass-through at 64 kb/s on Line X.  
 "—" = Channel on Line Y unavailable for service because of 64 pass-through channel on Line X.

8. STOP! Specifications for the group are complete. If both groups have not yet been specified, repeat procedure from Step 1 for next group.

**TM500 Full-Rate Digital Line Interface**

4.15 Perform the following steps in accordance with system needs. Perform each step in order unless directed by a step to do otherwise. Refer to Fig. 11 for locations of option switches.

1. Is BCM wired to a DSX-1 or to an optional jack panel?

A. DSX—Continue with Step 2.

B. Jack panel—Continue with Step 5.

2. What is the cable length between the BCM and the DSX-1 for line x?

A. 0 to 133 feet—Specify rocker 3 be open, 1 and 2 closed on option switch x.

B. 134 to 267 feet—Specify rocker 2 be open, 1 and 3 closed on option switch x.

C. 268 to 400 feet—Specify rockers 3 and 2 be open, 1 closed on option switch x.

- D. 401 to 533 feet—Specify rocker 1 be open, 2 and 3 closed on option switch x.
- E. 534 to 655 feet—Specify rockers 1 and 3 be open, 2 closed on option switch x.
3. What is the cable length between the BCM and the DSX-1 for line y?
- A. 0 to 133 feet—Specify rocker 3 be open, 1 and 2 closed on option switch y.
- B. 134 to 267 feet—Specify rocker 2 be open, 1 and 3 closed on option switch y.
- C. 268 to 400 feet—Specify rockers 3 and 2 be open, 1 closed on option switch y.
- D. 401 to 533 feet—Specify rocker 1 be open, 2 and 3 closed on option switch y.
- E. 534 to 655 feet—Specify rockers 1 and 3 be open, 2 closed on option switch y.
4. Continue with Step 6.
5. Specify rocker 3 be open, rockers 1 and 2 closed, on both x and y option switches.
6. What is the framing format of the signal on line x? (If unknown, use D4.)
- A. Fe—Specify rocker 5 be open on option switch x.
- B. D4—Specify rocker 5 be closed on option switch x.
7. What is the framing format of the signal on line y?
- A. Fe—Specify rocker 5 be open on option switch y.
- B. D4—Specify rocker 5 be closed on option switch y.
8. What is the line coding used on line x? (If unknown, use bipolar).
- A. B8ZS—Specify rocker 4 be open on option switch x.
- B. Bipolar—Specify rocker 4 be closed on option switch x.
9. What is the line coding used on line y?
- A. B8ZS—Specify rocker 4 be open on option switch y.
- B. Bipolar—Specify rocker 4 be closed on option switch y.
10. STOP! All options on TM500 are set. (The last three rockers on x and y switches are not used.)

#### TM501 Sub-Rate Digital Line Interface

**4.16** Perform the following steps in accordance with office records to set options for line z. Perform each step in order unless directed by a step to do otherwise. Refer to Fig. 12 for location of option switch.

1. Is BCM wired to a DSX-1 or to an optional jack panel?
- A. DSX—Continue with Step 2.
- B. Jack panel—Continue with Step 4.
2. What is the cable length between the BCM and the DSX-1 for line z?
- A. 0 to 133 feet—Specify rocker 3 be open, 1 and 2 closed on option switch z.
- B. 134 to 267 feet—Specify rocker 2 be open, 1 and 3 closed on option switch z.
- C. 268 to 400 feet—Specify rockers 3 and 2 be open, 1 closed on option switch z.
- D. 401 to 533 feet—Specify rocker 1 be open, 2 and 3 closed on option switch z.
- E. 534 to 655 feet—Specify rockers 1 and 3 be open, 2 closed on option switch z.
3. Continue with Step 5.
4. Specify rocker 3 be open, rockers 1 and 2 closed, on option switch for line z.

5. What is the line coding used on line z? (If unknown, use bipolar.)
  - A. B8ZS—Specify rocker 5 be open on option switch z.
  - B. Bipolar—Specify rocker 5 be closed on option switch z.
6. What is the framing format of the signal on line z? (If unknown, use D4.)
  - A. Fe—Specify rocker 4 be open on option switch z.
  - B. D4—Specify rocker 4 be closed on option switch z.
7. STOP! All options on TM501 are set. (The last three rockers on switch are not used.)

**D. Echo Canceler**

**4.17** Provide the craft with the location of each SM470 circuit pack and with the settings of the rockers on the faceplate of each circuit pack. There are six slots for echo canceler circuit packs. The three on the left are for line x, and the three on the right are for line y. When communicating these positions to the craft, translate these positions to slots 1, 2, and 3 for line x, and slots 4, 5, and 6 for line y.

**4.18** Echo canceling can be provided for channels 1 through 12, channels 13 through 24, or all 24 channels in a line. In addition to this general provision, echo canceling can be disabled on any channel. The location of the circuit packs determines which groups of channels have echo canceling. The state of the faceplate switches determines which channels in a group have echo canceling. If a rocker on the faceplate is assigned to a channel, then the channel has echo canceling when the rocker is in the open position. The tail length is already specified when the options on the alarm and control circuit pack are chosen. Echo canceling is omitted by omitting the SM470 circuit packs.

**4.19** ♦When the MC90058A1 common processor is not used, echo canceling for a channel is selected by opening a rocker switch on the faceplate of the SM470 circuit pack. The SM470 circuit pack slot (numbered left to right) and rocker switch numbers

corresponds to the channel and digital line to be optioned with echo canceling. The “prov-ec” command is used to set echo canceling with the common processor. To find the relation between the desired echo canceling option and switch settings use Table K. Find the tail length, digital line (X or Y), and rocker switch for the channel of interest. The rocker switches are numbered 1-8. If channels 17-24 are served by a rocker switch, channel 17 is on rocker 1 and channel 24 is on rocker 8. For example, if 16 ms echo canceling only on channel 22 of line X that is configured for 16 ms tail length, open switch 2 on the lower rocker switch set of the echo canceler circuit pack installed in EC slot 2. The control option switches 7 and 8 in the AMC circuit pack determines the tail length for lines X and Y, respectively. An open switch selects 16 ms and a closed switch selects 32 ms.

**4.20** A single SM470 pack is used to provide 16 ms tail length for each group of 12 channels. Two packs are required to provide 32 ms tail length for one group. However, due to the tandeming process used on the echo canceler design, 3 SM470 pack are sufficient to provide 32 ms tail for both groups in the line (24 channels).

**Note:** Always provision tail length in “worst case” terms; i.e., if the longest expected tail length is 24 ms, provision 32 ms tails for that group. A 32 ms tail length echo canceler will handle a circuit with an actual tail length of 2 ms; but a 16 ms tail echo canceler will not work on a channel with an actual tail length of 17 ms.♦

**16-Millisecond Tail Length for Line X or Y**

- 4.21** Choose one of the configurations below to provide 16 ms tail length for line x or line y.
- To provide echo canceling for all 24 channels, specify circuit packs SM470 be installed in slots 1 and 2 for line x or slots 4 and 5 for line y. Figure 15 shows which rockers apply to which channels.
  - To provide echo canceling for channels 1 through 12, specify circuit pack SM470 be installed in slot 1 for line x or slot 4 for line y. Figure 16 shows which rockers apply to which channels.

▶TABLE K◀  
ECHO CANCELER SWITCH SETTINGS

TAIL LENGTH	CHANNELS SERVED	EC SLOT	DIGITAL LINE	UPPER 1-8 ROCKER SET	LOWER 1-8 ROCKER SET
16 ms for channels 1-24	1-16	1	X	1-8	9-16
	17-24	2	X	17-24	NA
	1-16	4	Y	1-8	9-16
	17-24	5	Y	17-24	NA
16 ms for channels 1-12 or 13-24	1-12	1	X	1-8	9-12 (switches 1-4)
	13-24	2	X	13-20	21-24 (switches 1-4)
	1-12	4	Y	1-8	9-12 (switches 1-4)
	13-24	5	Y	13-20	21-24 (switches 1-4)
32 ms for channels 1-24	1-8	1	X	1-8	NA
	9-16	2	X	9-16	NA
	17-24	3	X	17-24	NA
	1-8	4	Y	1-8	NA
	9-16	5	Y	9-16	NA
	17-24	6	Y	17-24	NA
32 ms for channels 1-12 or 13-24	1-8	1	X	1-8	NA
	9-12	2	X	9-12 (switches 1-4)	NA
	1-8	4	Y	1-8	NA
	9-12	5	Y	9-12 (switches 1-4)	NA
	13-20	2	X	13-20	NA
	21-24	3	X	21-24 (switches 1-4)	NA
	13-20	5	Y	13-20	NA
	21-24	6	Y	21-24 (switches 1-4)	NA

- To provide echo canceling for channels 13 through 24, specify circuit pack SM470 be installed in slot 2 for line x or slot 5 for line y. Figure 17 shows which rockers apply to which channels.

#### 32-Millisecond Tail Length for Line x or y

**4.22** Choose one of the configurations below to provide 32 ms tail length for line x or line y.

- To provide echo canceling for all 24 channels, specify circuit packs SM470 be installed in slots 1, 2, and 3 for line x or slots 4, 5, and 6 for line y. Figure 18 shows which rockers apply to which channels.
- To provide echo canceling for channels 1 through 12, specify circuit packs SM470 be installed in slots 1 and 2 for line x or slots 4 and 5 for line y. Figure 19 shows which rockers apply to which channels.

- To provide echo canceling for channels 13 through 24, specify circuit packs SM470 be installed in slots 2 and 3 for line x or slots 5 and 6 for line y. Figure 20 shows which rockers apply to which channels.

#### E. Specifications

**4.23** This section provides a list of specifications, an explanation of recommended spares, and an abbreviated explanation of expected failure rates.

**4.24** Specifications for the BCM32000 are given in Table L.

**4.25** Table M shows the sparing requirements for BCM3200 circuit packs.

**4.26** The failure rates for BCM32000 circuit packs have been established. By combining the failure rates of all circuit packs installed for a given configuration, the mean time between failures (MTBF)

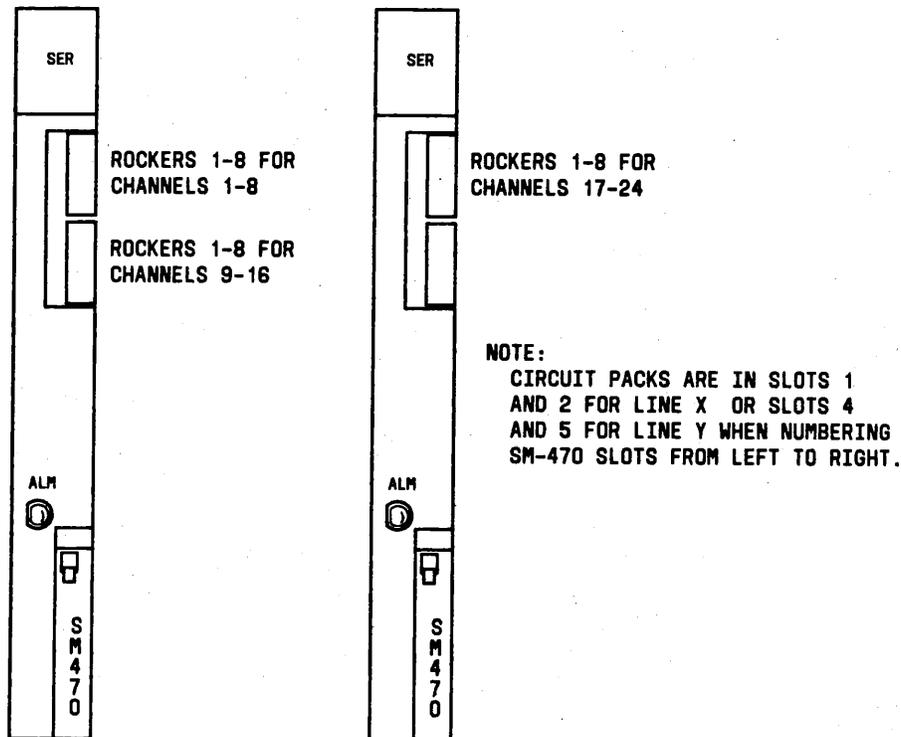


Fig. 15—16-MS Tail for Channels 1 Through 24

can be calculated for that configuration. (See Table N.)

**5. INSTALLATION**

**5.01** This section provides the procedures for unpacking, mounting, and connecting the BCM as well as optioning and installing circuit packs.

**A. Unpack and Accept**

**5.02 Procedure**

**Warning 1:** Completely remove top and sides of crate to unpack BCM32000 shelf. Pins may be bent if BCM32000 is lifted out.

**Warning 2:** When handling the circuit pack units, wear a ground wrist strap. The strap prevents electrostatic discharges. A connection point for the grounding strap is located on the bottom right side of each shelf.

**Warning 3:** Handle the circuit pack units by the edges or the faceplate to prevent damaging the components.

**Warning 4:** When using a knife to open cardboard packages, be careful not to cut too deep.

**5.03** To unpack the cabinet version, use a pinch bar to remove the top of the crate. Take out the small packages on the top which contain any connectors and cables ordered with the BCM. Use the pinch bar to remove the front of the crate. The cabinet should then slide off of its skid.

**5.04** Remove circuit packs from shelf, and examine all pins and connectors for damage.

**B. Mount BCM32000 Shelf**

**5.05 Procedure**

1. Is bay in which BCM will be mounted a standard 23-inch or a 26-inch bay?

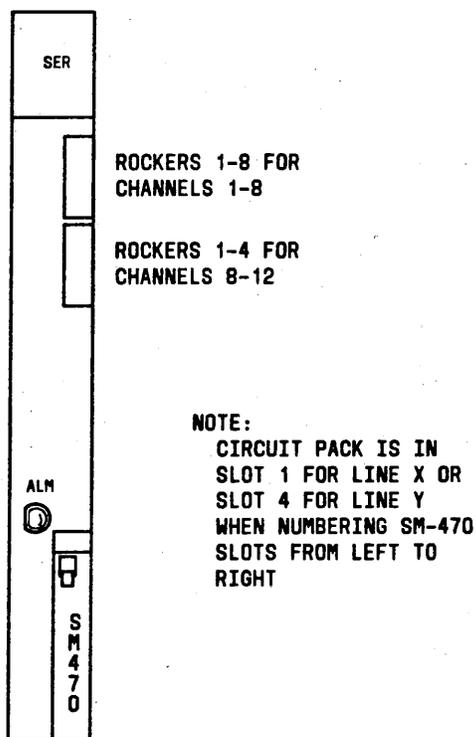


Fig. 16—16-MS Tail for Channels 1 Through 12

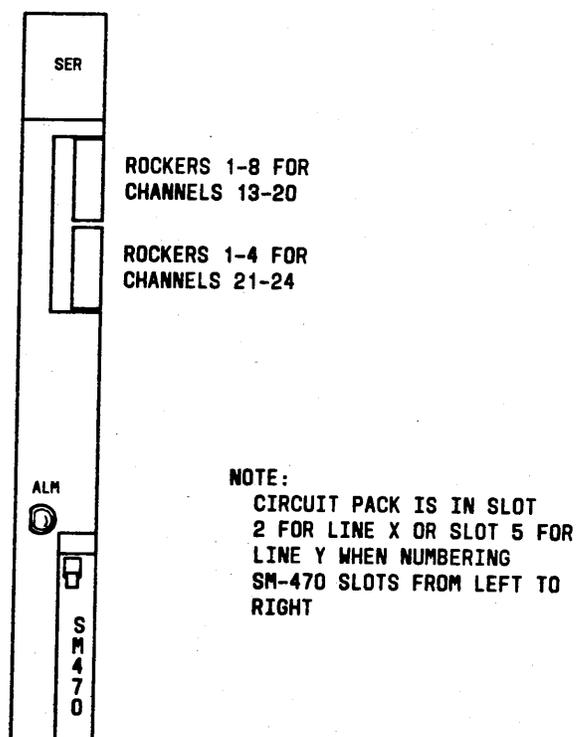


Fig. 17—16-MS Tail for Channels 13 Through 24

A. 23-inch—Continue with Step 3.

B. 26-inch—Continue with Step 2.

2. Obtain two ED-2C780-30-G4 adapters and connect them (one at each side) to the bay, using an appropriate screw in the top and bottom of each adapter.
3. Hold BCM in place and install appropriate screws through the flange of the BCM to the bay or adapter. Use a screw at the top and bottom of each side.

#### C. Connect Power

**5.06** The BCM connects to  $-48$  V. There is one connection for the BCM function and another optional connection that must be made if echo canceling is used.

1. Remove power from the cables supplying  $-48$  V to BCM. (This will probably require removing a fuse from a nearby battery distribution fuse board.)

2. At the back of the BCM locate TS3 (Fig. 21).

3. Connect lead attached to position 1 (Fig. 21) to frame ground by bolting it to the frame or the mounting adapter.

4. Use wire gauge specified by engineering to connect  $-48$  V hot lead to position 6 and  $-48$  V return to position 2 of TS3.

5. If echo canceling is used, connect specified gauge wires to  $-48$  V hot on position 4 and  $-48$  V return to position 3 of TS3.

6. Restore power removed in Step 1.

7. Use voltmeter to verify  $-48$  V between positions 2 and 6, and if echo canceling is used,  $-48$  V between positions 3 and 4. Actual voltage under load may range from  $-48$  V to  $-54$  V.

#### D. Connect Transmission Cables

**5.07** Transmission cables will usually run from the BCM to a DSX-1. In small offices an optional

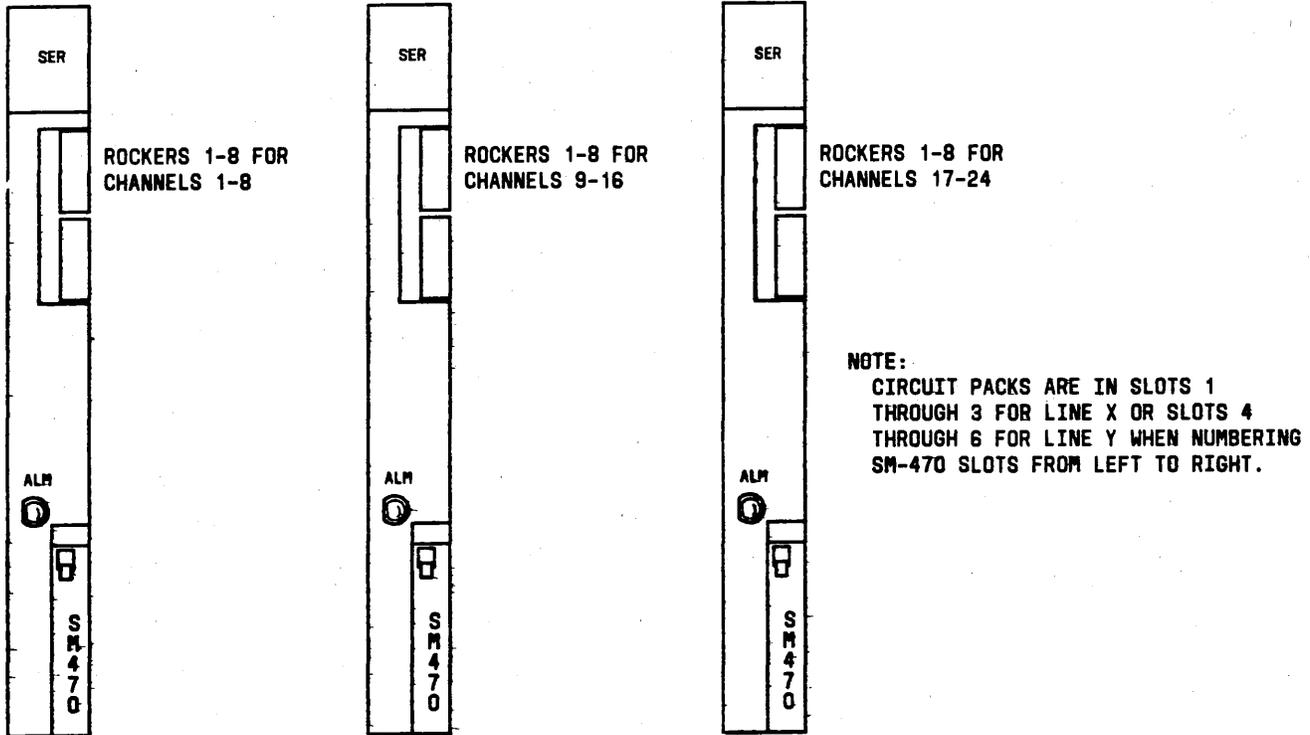


Fig. 18—32-MS Tail for Channels 1 Through 24

jack panel built under the BCM takes the place of the DSX-1. In the latter case, transmission cables for lines x and y are run directly to a D-type channel bank or equivalent, and the cables for line z are run directly to the repeated line or equivalent. The twisted pairs for receive and transmit leads must be run in different shielded cables. Each digital line has two associated pairs. A transmit pair comes out of the equipment and a receive pair goes into the equipment. The transmit (XMT) pair is designated T and R (Tip and Ring). The receive (RCV) pair is designated T1 and R1 (Tip1 and Ring1). The transmit pair comes from local connecting equipment and is transmitted to the far end BCM unit (Fig. 22). The receive pair comes from the far end BCM unit and goes to local connecting equipment.

1. Locate TS1 at the back of the BCM (Fig. 21).
2. Connect the transmit tip (T) cable for line x to pin 30.
3. Connect the transmit ring (R) cable for line x to pin 29.

4. Connect the receive tip (T1) cable for line x to pin 28.
5. Connect the receive ring (R1) cable for line x to pin 27.
6. Connect the transmit tip (T) cable for line y to pin 26.
7. Connect the transmit ring (R) cable for line y to pin 25.
8. Connect the receive tip (T1) cable for line y to pin 24.
9. Connect the receive ring (R1) cable for line y to pin 23.
10. Connect the receive tip (T1) cable for line z to pin 21.
11. Connect the receive ring (R1) cable for line z to pin 20.

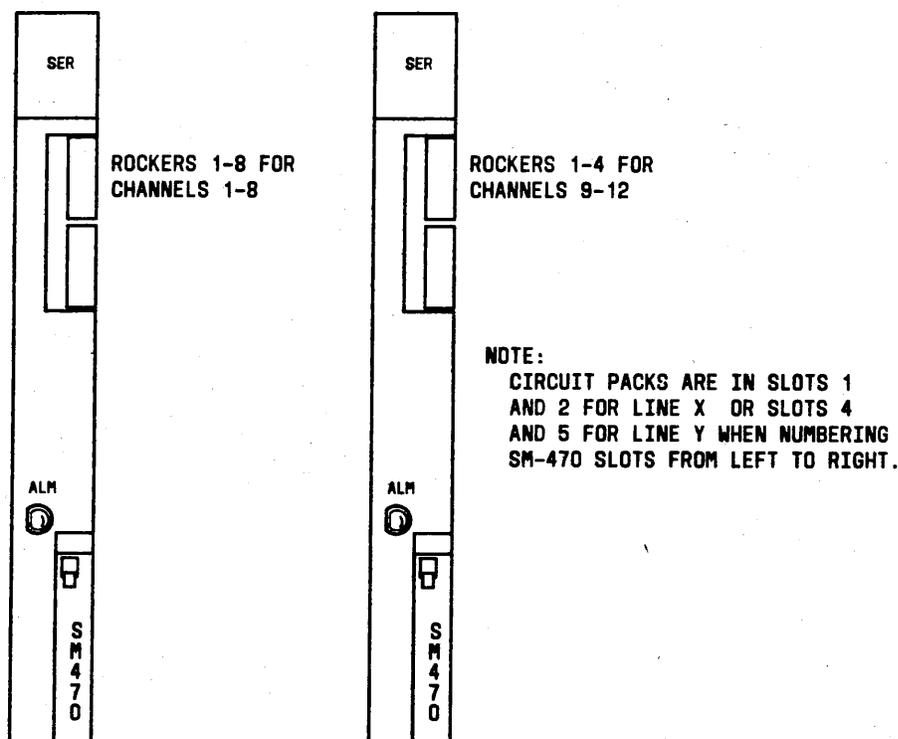


Fig. 19—32-MS Tail for Channels 1 Through 12

12. Connect the transmit tip (T) cable for line z to pin 19.
13. Connect the transmit ring (R) cable for line z to pin 18.

#### E. Connect Alarms

**5.08** ♦The alarm connections on a BCM unit are controlled by relays. The contacts in the relay are normally powered open and close under an alarm condition or power failure. These are isolated dry contacts (no power or ground) and are limited to 1 amp 55 V dc supplied by the remote alarm equipment. It is assumed compatible remote alarm equipment is being used (if not, the relay contacts may burn out). ♦There are several alarm connections available. All of them may not be used in every office. The steps below are written as if all of them are to be connected. ♦Steps 8 and 9 should only be done to a BCM shelf that is equipped with the MC90058A1 common processor circuit pack. ♦Skip the steps that do not apply.

1. Locate terminal strip TS2 (Fig. 21).

2. Connect pins 11 and 12 to the remote CFA (carrier failure alarm) alarm pair for line X.
3. Connect pins 14 and 15 to the remote CFA alarm pair for line Y.
4. Connect pins 8 and 9 to the remote CFA alarm pair for line Z.
5. Connect pins 5 and 6 to the remote alarm pair for BCM equipment failure.
6. Connect pins 1 and 2 to the alarm pair for office audible.
7. Connect pins 3 and 4 to the alarm pair for office visual.
8. ♦Connect pins 10 and 25 to the remote alarm pair for processor audible alarm.
9. Connect pins 7 and 22 to the remote alarm pair for processor visual alarm.

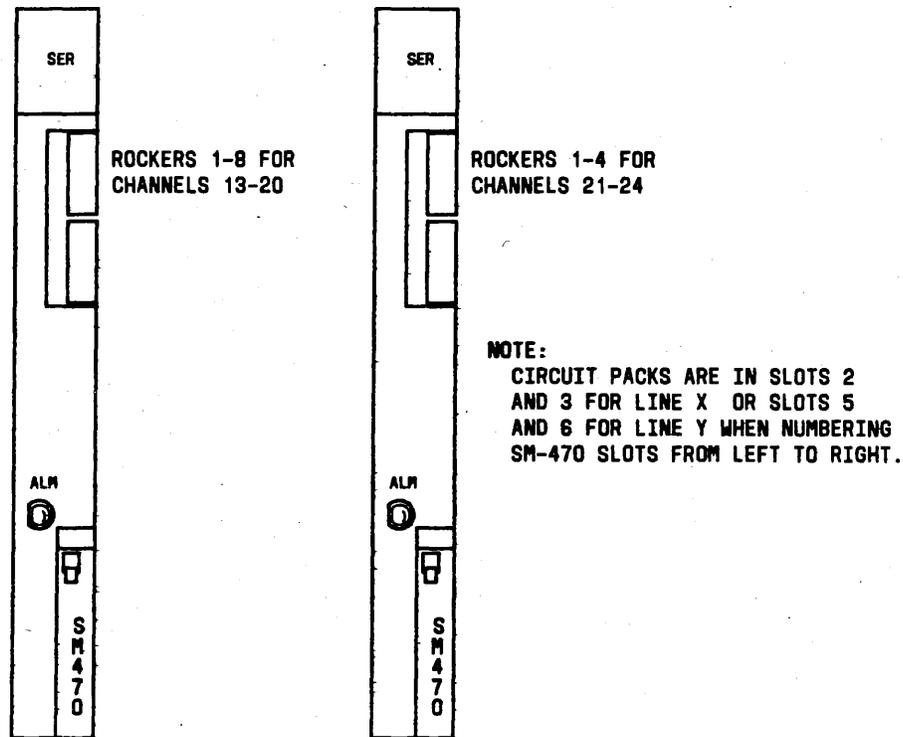


Fig. 20—32-MS Tail for Channels 13 Through 24

**F. Connect Alarm Transparency Straps**

5.09 If system is using the transparency alarm handling feature, the two straps in these steps must be installed on terminal strip TS2. If system is using the terminal alarm handling feature, these two straps must not be present. The following steps are done for transparency or removed for terminal alarm handling.

1. Locate terminal strip TS2 (Fig. 21).
2. Connect strap between pins 29 and 30.
3. Connect strap between pins 26 and 27.♦

**G. Processor Modem Connections**

5.10 ♦A BCM shelf equipped with a MC90058A1 common processor can be controlled by a terminal attached to the processor interface circuit pack at the equipment bay or from a remote location via a modem, but not both. The faceplate RS232 connection is for TTY interface only; the backplane RS232 connection is for modem interface only. These steps

should be done when the processor is to be controlled from a remote location and contain instructions for modem connections. If the processor is not used or is to be controlled by a terminal at the equipment bay, these steps do not apply. If changing from a remote location control to equipment bay control, the connections in these steps should be removed.

1. At backplane of unit 0 (one with processor) locate jack connector J1. This is the jack that looks like the one on the faceplate of the processor interface pack.
2. Connect 25 pin plug of RS232 cable from modem to J1.
3. Connect modem to telephone line per modem instructions. The modem must be set up for 1200 baud with even parity (see Recommended Terminals).♦

**H. Option and Install Circuit Packs**

5.11 The steps below provide an orderly procedure for optioning and installing circuit packs (ex-

TABLE L

SPECIFICATIONS FOR BCM32000		
Physical	Dimensions	23 inches wide 10 inches high 12 inches deep
	Construction	Modular shelf and backplane — plug-in circuit packs
Power	No options	92 watts
	Bundler Option	Add 9 watts
	Echo Canceling	Add 12 watts per echo circuit pack
	CSU (Cabinet)	Add 12 watts
	FAN (Cabinet)	Add 18 watts
	Rectifier (Cab)	10 amps
Heat	Fans	Not required for shelf—standard equipment with cabinet
	Baffles	Always recommended, required if shelf is mounted above heat producing equipment or airflow is restricted through shelf
Environment	Temperature	Operate between 2° C and 38° C — short term operation between 2° C and 49° C — Store between -40° C and 66° C
	Humidity	Operate between 20% and 55% — Short term operation between 20% and 80%

TABLE L (Contd)

SPECIFICATIONS FOR BCM32000		
Echo	Tail Length	16 or 32 msec
	Echo Return Loss Enhancement (ERLE) - Residual Control Inactive	32 dB at -10 dBm0 White noise per CCITT G.165 35 dB at -10 dBm0 for a 1 KHz tone
	ERLE - Residual Control Active	Infinite
	Adaptive Convergence Time	Less than 250 msec for at least 25 dB of ERLE
	Near-end Speech Detection Threshold	-6 dB or 0 dB

TABLE M

RECOMMENDED SPARES FOR BCM32000

NUMBER OF PLUG-INS PER CIRCUIT PACK CODE PER OFFICE	RECOMMENDED SPARES PER CIRCUIT PACK CODE PER OFFICE
1-4	1*
5-10	2
11-20	3
21-40	4
41-80	5
81-160	6
161-320	7

\* A minimum of two circuit packs per code should be on hand during installation and turnup procedures.

TABLE N

BCM32000 HARDWARE RELIABILITY SUMMARY

BCM32000 CONFIGURATIONS	MTBF (YRS)	PROJECTED OUTAGE IN MIN/YR			
		PER CHANNEL	PER GROUP	PER DIGROUP	PER SYSTEM
Robbed-bit mode	4.5	13.4	13.3	13.0	10.3
Robbed-bit and 16 ms echo	2.9	14.8	14.2	13.1	10.3
Robbed-bit and 32 ms echo	2.6	15.2	13.4	13.0	10.3
Bundle mode	4.2	15.4	15.3	15.0	12.0
Bundle mode and 16 ms echo	2.8	16.8	16.2	15.1	12.0
Bundle mode and 32 ms echo	2.4	17.2	15.4	15.0	12.0

cept the processor and processor interface circuit packs). The choice of circuit packs and options should have been made by the engineer based on other parts of this practice. It is recommended to set faceplate switch options even if the BCM shelf(ves) are to be controlled by the MC90058A1 common processor. The "Provisioning" section of this practice covers the processor commands used. When using the processor, do the following steps then continue with the "BCM Processor Retrofit and Growth" procedures. When installing circuit packs, use the following procedure:

- Wear a grounded wrist strap while handling circuit packs.
  - Remove protective plastic cover from plug-in connectors on circuit packs.
  - With locking lever down, push circuit pack firmly into position. Then finish seating circuit pack by lifting locking lever. (A metal clip holds the locking lever in place.)
1. Install four SM469 circuit packs in positions shown in Fig 1.
  2. Will BCM use echo canceling?
    - A. Yes—Continue with Step 3.
    - B. No—Continue with Step 5.
  3. Install as many echo canceler circuit packs as specified in exact slots specified. Slots are specified 1, 2, 3, 4, 5, or 6.
  4. Set rockers on the faceplate of each circuit pack as specified. If no settings are given, set all rockers to OPEN which provides echo canceling for all channels.
  5. If bundling mode is used, install circuit pack TM502 in position shown in Fig. 1. Otherwise, continue with Step 6.
  6. Locate option switch inside circuit pack TM501 (Fig. 12.)
  7. Set rockers on switch as specified by engineer.
  8. Install circuit pack in slot shown in Fig. 1.
  9. Locate option switch for line x inside circuit pack TM500 (Fig. 11).
  10. Set rockers on switch as specified by engineer.
  11. Locate option switch for line y inside circuit pack TM500 (Fig. 11).
  12. Set rockers on switch as specified by engineer.
  13. Install circuit pack in slot shown in Fig. 1.
  14. Locate option switch inside AMC circuit pack using Fig. 7.

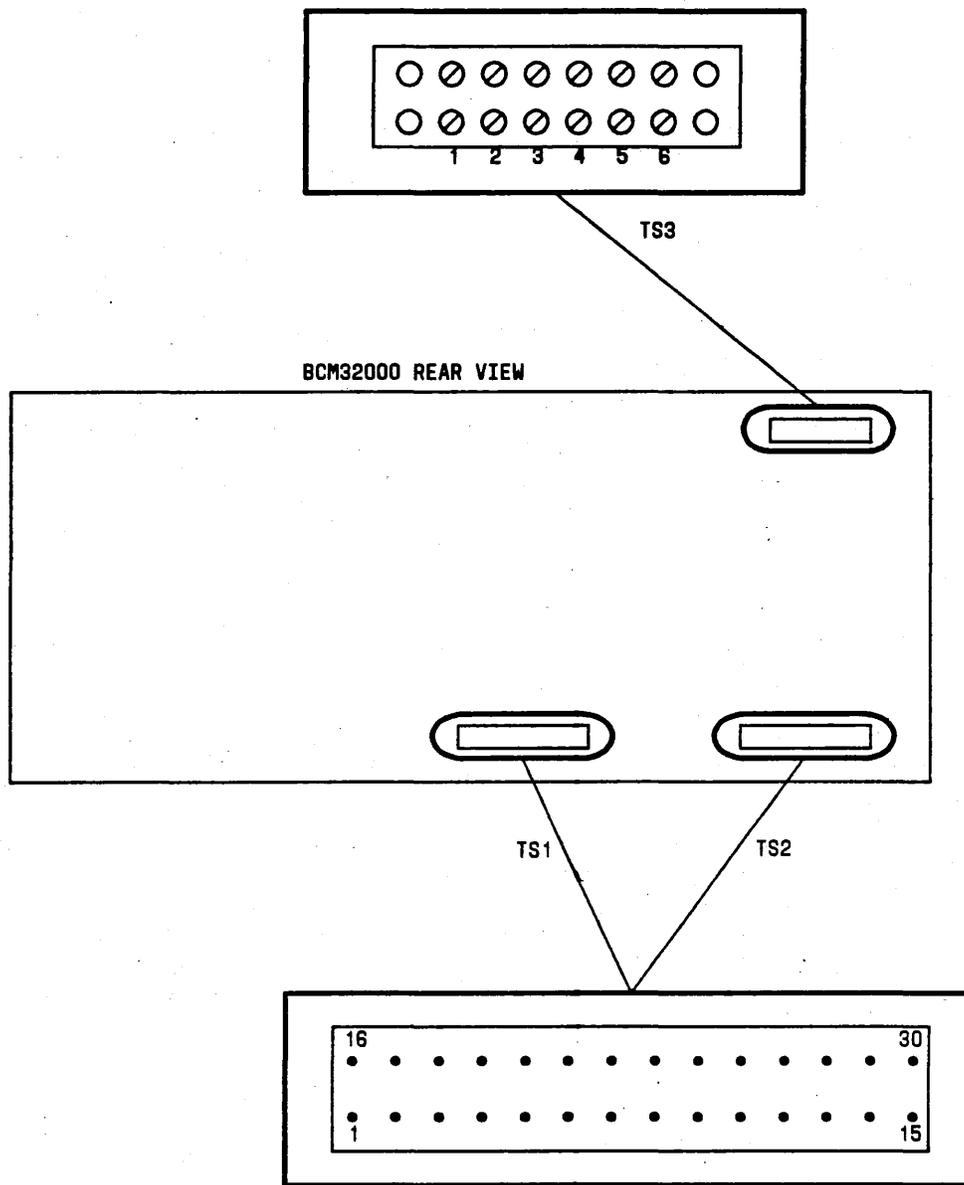
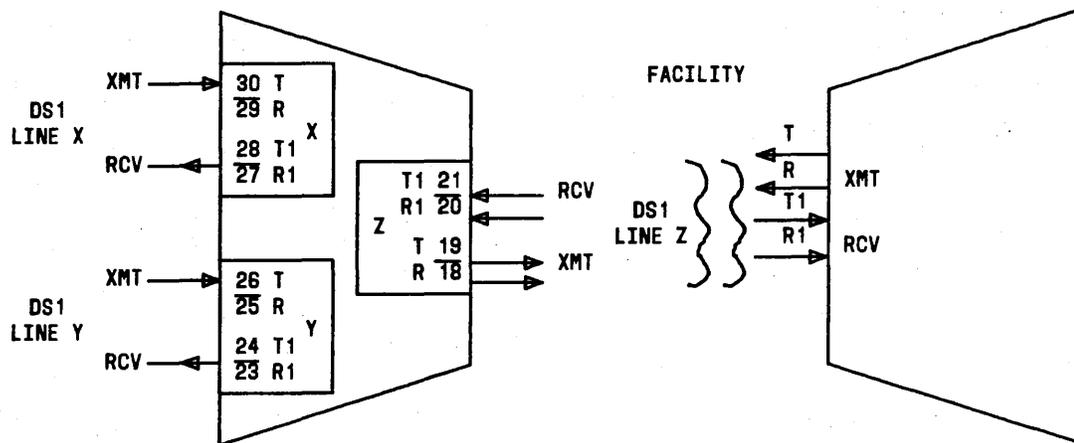


Fig. 21—Connections for Back of BCM32000

- 15. Set rockers on switch as specified by engineer.
- 16. Install circuit pack in slot shown in Fig. 1.
- 17. Set rocker on faceplate of pack just installed as specified by engineer.
- 18. Seat but do not latch 484AA power unit in slot at the left of alarm and control circuit pack. (ALM OFF indicator should light.)
- 19. Latch power unit. (ALM OFF should go out.)
- 20. Is BCM going to use echo canceling?
  - A. Yes—Install power unit at far right of BCM making sure the ALM OFF indicator operates as stated above. STOP! Installation is complete.
  - B. No—STOP! Installation is complete.



◆Fig. 22—Digital Line Connections on TS14◆

### I. BCM Processor Retrofit and Growth

**5.12** ◆This section gives procedures for adding BCM shelves to a processor, the initial growth of a processor controlled BCM unit, and retrofit of a processor to a BCM unit. For new and added BCM units, the shelf should have been mounted, the power, transmission and alarm connections should have been made, and finally the circuit packs except the MC90058A1 and TM495 should have been installed. The MC90058A1 and TM495 processor interface circuit packs are to be installed in the following Growth and Retrofit procedures. Backplane connectorized cable connections are to be made for multishelf processor applications and adding BCM shelves. Use the Provisioning procedures for new and added BCM shelves under control of the processor.

#### Multishelf Connections

**5.13** All multishelf wiring is done at the backplane of the BCM shelf. There are two cable assemblies with connectorized jacks that fit onto backplane

wire-wrap pins. Cable assembly 1 is about 8 feet long and has 1 big set of connectors at one end and 6 small sets of connectors along the length. This connector is used on the backplane pins of the processor interface circuit pack of all BCM shelves. Cable assembly 2 is about 2 feet long and connects between the BCM shelves. Up to six of these cables are used. Two 100 ohm 1/8-watt resistor termination assembly is required in the last BCM shelf. If less than six BCM units are connected to the processor, the extra length of cable assembly one should be tied to the bay. These procedures are written for a 7 BCM multishelf connections. Figure 23 shows pin locations for backplane wiring options. Skip the Steps that do not apply, but always do Step 14.

1. At backplane of BCM shelf 0, the one with the processor, locate pin group labeled **04-042**.

**Note:** Pin groups are five columns wide, labeled at the top, and for this procedure are to be counted from left to right as 4 3 2 1 0. The columns have a top half and a bottom half. The

rows in the top half count from 56 to 32, top to bottom. The rows in the bottom half count from 24 to 1, top to bottom.

2. Connect jack JOB, on end of cable assembly one, to pins on columns 1 and 0 in rows 56 through 42 at top half of pin group 04-042.
3. Connect jack JOC next to JOB in columns 1 and 0, rows 56 through 42.
4. Connect jack JOA below JOB in columns 1 and 0, rows 41 through 32.
5. At backplane of BCM shelf 1, connect J1 to columns 3 and 2 in rows 56 through 54 at top half of pin group 04-042.
6. Connect J1G next to J1 in columns 1 and 0, row 54.
7. Repeat Steps 5 and 6 for each BCM shelf. The number of the jack corresponds to the shelf (e.g. J1 shelf 1, J2 shelf 2, etc...).
8. Tie off any extra length of cable assembly one.
9. At backplane of shelf 0, connect JX end of cable assembly two to columns 1 and 0 in rows 24 through 21 on bottom half of pin group 04-042.
10. At backplane of shelf 1, connect JY end of cable assembly two to columns 1 and 0 in rows 24 through 21 on bottom half of pin group 04-042.
11. At backplane of shelf 1, connect JX end of another cable assembly two to columns 1 and 0 in rows 24 through 21 on bottom half of pin group 04-108.
12. At backplane of shelf 2, connect JY end of cable assembly two to columns 1 and 0 in rows 24 through 21 on bottom half of pin group 04-042.
13. Repeat Steps 11 and 12 for shelves 2 3, 3 4, 4 5, and 5 6.
14. At backplane of shelf 6 (or last shelf being served by the processor), connect JZ resistor termination connector to columns 1 and 0 in

rows 24 through 21 on bottom half of pin group 04-108.

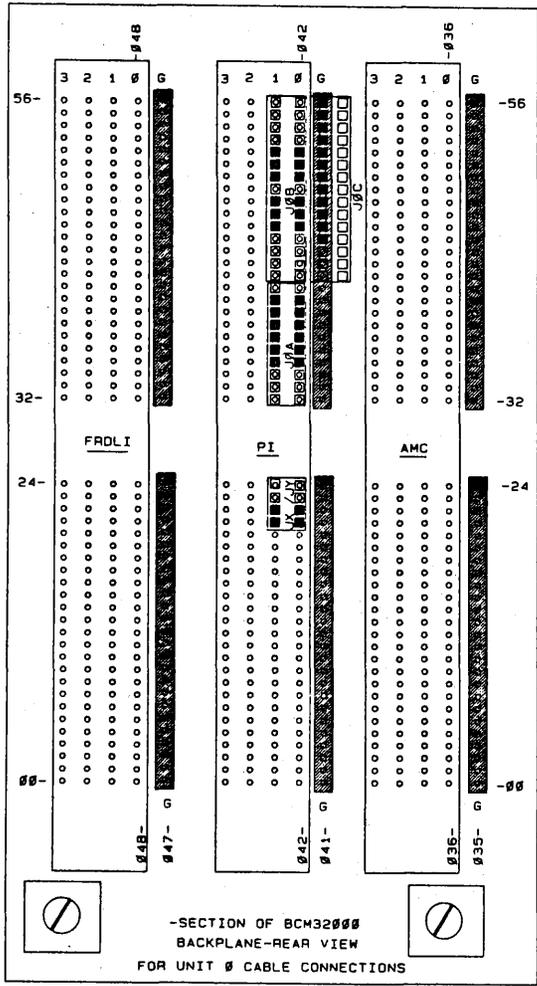
#### J. AMC MC90xxxA1 Processor or Alarms Retrofit

**5.14** The Alarm, Maintenance, and Control circuit packs MC90069A1 (for bundle signaling mode) or MC90070A1 (for robbed-bit signaling) was designed to support terminal alarms without the processor option (both are rated DA). The MC90069A1 bundle signaling AMC pack can be upgraded to MC90069A1B to handle the processor option (MC90069A1B), or upgraded to MC90104A1 to handle both the TRANSPARENCY ALARMS and processor option. Similarly, the MC90070A1 robbed-bit signaling AMC pack can be upgraded to MC90070A1B to handle the processor option, or MC90104A1 to handle both TRANSPARENCY ALARMS and processor option.

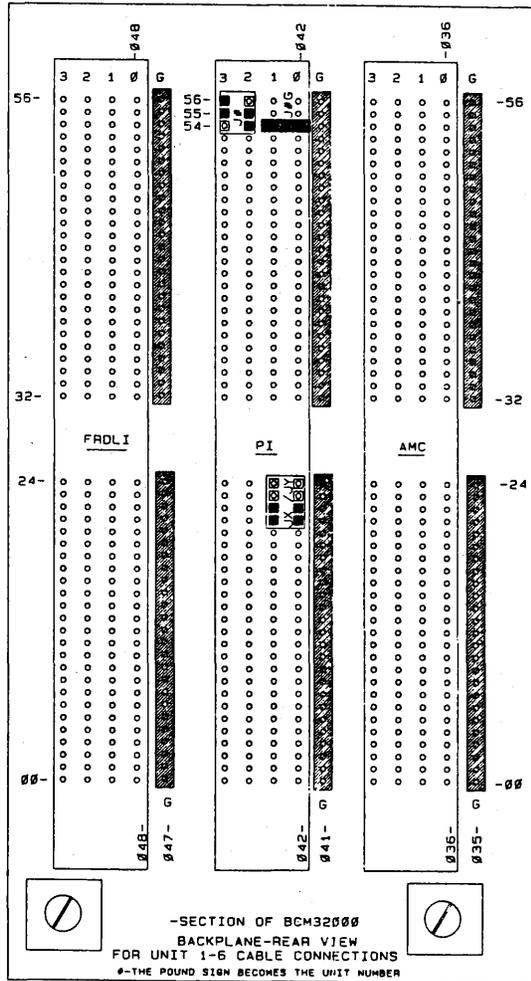
**5.15** The AMC circuit pack can be upgraded to any of the other codes (with the same signaling mode, bundle or robbed-bit) by changing an IC chip (PID AAPHW) on the circuit pack to one of two firmware IC chips. One IC chip (PID AAPHY) is for the processor option with terminal alarms and the other chip is for both the processor option and transparency alarms (PID AAPAJ).

**5.16** It is recommended to have the PICS (Plug-in Inventory Control System) center perform these changes but the retrofit can be done in the field using the following procedures. The steps are written to upgrade the AMC pack for transparency alarms, or processor option, or both. Change back simply by replacing the chip with the proper code for the type of options required. Figure 7 shows the location of the chip involved in an AMC retrofit.

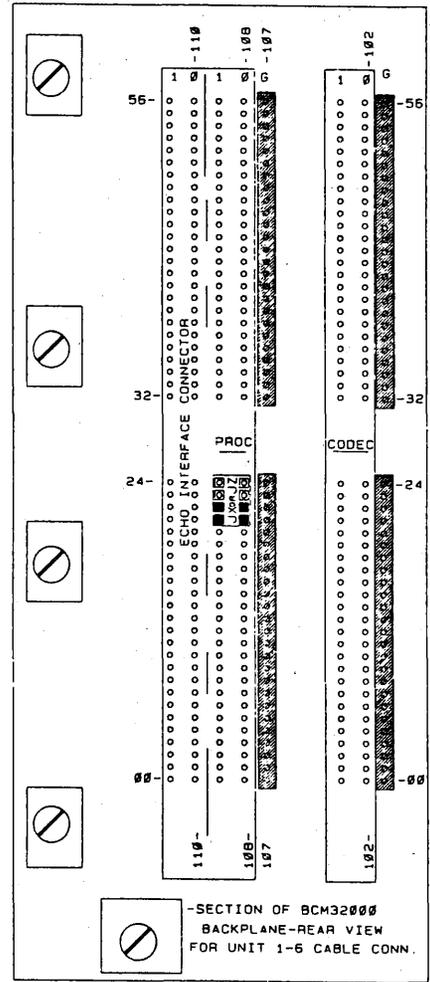
1. Obtain retrofit parts kit and grounding strap. Find a properly grounded working area and ground yourself to the working surface.
2. Choose a time when no service is on the BCM system. If possible, have switching personnel busy out all channels on the BCM system.
3. Power down common circuit packs on BCM shelf by unlatching 484AA power pack at left side of the shelf.



A



B



C

◆Fig. 23—Processor Multishelf Backplane Connections◆

**Caution:** *This Step will interrupt service on all channels that are active on this BCM unit.*

4. Remove AMC circuit pack and place it on grounded working surface.
5. What type of retrofit is required?
  - A. Transparency Alarms (can support the processor option)—Continue with Step 8.
  - B. Terminal Alarms with the Processor Option—Continue with Step 6.
6. Locate processor IC chip (Fig. 7) labeled PID AAPHW; note where the pin 1 orientation notch is, and remove this IC with a chip extractor tool. Carefully install PID AAPHY IC with the proper orientation using the extractor tool.

**Warning:** *Static discharge can destroy ICs. When handling circuit packs (inserting or removing) or when working on the backplane, always wear a wrist strap or heel strap and stand on a ground dissipating floor mat.*

7. Continue with Step 9.
8. Locate alarm IC chip (Fig. 7) labeled PID AAPHW; note where the pin 1 orientation notch is, and remove this IC with a chip extractor tool. Carefully install PID AAPAJ IC with the proper orientation using the extractor tool.

**Warning:** *Static discharge can destroy ICs. When handling circuit packs or when working on the backplane, always wear a wrist strap or other approved grounding arrangement.*

9. Paste a new MC90xxxA1() label over the old code on the faceplate of the AMC pack.
10. Install AMC pack in BCM shelf and latch locking lever.

**Note:** If adding the MC90058A1 and/or TM495 processor circuit packs at this time, con-

tinue with the procedures in "Growth and Retrofit" before restoring power.

11. Restore power to shelf by latching 484AA power pack. STOP! AMC retrofit is complete.

#### Growth and Retrofit

**5.17** These procedures can be used for initial installation (growth) and/or to retrofit single and multishelf processor controlled BCM systems or to add an existing BCM unit to a multishelf arrangement. The multishelf connection procedures should be done before these steps are used. If adding a BCM shelf(ves) to the processor, start at Step 8. After completing these steps, use the Provisioning procedures to establish processor control of the BCM units.

1. Choose a time when no service is on the BCM system. If possible, have switching personnel busy out all channels on the BCM system.

**Caution:** *The next Step will interrupt service on all channels that are active on this BCM unit.*

2. Power down common circuit packs on BCM shelf 0 (the shelf where the MC90058A1 processor is being installed) by unlatching 484AA power pack at the left side of BCM shelf.
3. Install MC90058A1 common processor in slot between codec pack(s) and echo cancelers (last slot on right if echo canceling option is not equipped).
4. Set toggle switch on processor to UNIT VLD position. This is a safety catch switch that must be pulled to change position.
5. Install TM495 processor interface pack between alarm, maintenance, and control pack and the TM500 pack.

**Note:** If the BCM unit is equipped with a MC90069A1 or MC90070A1 AMC circuit pack, the circuit pack must be changed or retrofit to MC90069A1B or MC90070A1B. See "AMC90xxxA1 Processor or Alarms Retrofit" procedures.

6. Restore power on BCM common circuit packs by latching 484AA power pack at the left side of BCM shelf.
7. Go to next BCM shelf if required or STOP.
8. Choose a time when no service is on the BCM system. If possible, have switching personnel busy out all channels on the BCM system.

**Caution:** *The next Step will interrupt service on all channels that are active on this BCM unit.*

9. Power down common circuit packs on BCM shelf by unlatching 484AA power pack at the left side of BCM shelf.
10. Install TM495 processor interface pack between alarm, maintenance, and control pack and the TM500 pack.

**Note:** If the BCM unit is equipped with a MC90069A1 or MC90070A1 AMC circuit pack, the circuit pack must be changed or retrofit to MC90069A1B or MC90070A1B. See "AMC90xxxA1 Processor or Alarms Retrofit" procedures.

11. Restore power on BCM common circuit packs by latching 484AA power pack at the left side of BCM shelf.
12. Repeat this procedure from Steps 7 as required.

### Provisioning

**5.18** These procedures are used to establish control of BCM units with the MC90058A1 common processor. Before using these steps all circuit pack and wiring needed to support the processor must be completed. Read Processor Syntax section for assistance in using processor commands.

1. Set toggle switch on MC90058A1 to the UNIT VLD position. This switch has a safety catch and must be pulled to change positions.
2. Make RS-232 connection from terminal to processor interface circuit pack on same shelf as the processor and login (see terminal and login sections).

3. Enter **install:number=#** command, where # is the number of BCM units (1 to 7) to be controlled by the processor.
4. Enter **reset:proc** to load the BCM units equipage into the processor database.
5. Set toggle switch on MC90058A1 to the PRC VLD position.
6. Obtain channel template numbers and echo canceling settings from office records. If this data is not available, the settings can be determined from faceplate mini switch positions on the AMC pack and echo canceler packs. Compare open switch positions on the AMC pack to the data in Tables F, G, or I, (Tables F and G for bundling or Table I for robbed bit) to find channel template numbers for each bundle or group. See Echo Canceler under ENGINEERING CONSIDERATIONS to find channels with echo canceling.

7. Use the command (all on one line)

```
prov-remote:unit=[unit#]:bundle=1,[template#]
:bundle=2,[template#]:bundle=3,[template#]
:bundle=4,[template#]
```

for bundling settings, or

```
prov-remote:unit=[unit#]:group=1,[template#]
:group=2,[template#]
```

for robbed-bit settings.

8. Use the command (all on one line)

```
prov-ec:unit=[unit#]:digroup=[1|2]
:channel=[chan#],[on|off]
```

for echo canceler settings.

9. It is recommended to turn the monitor on for a BCM unit controlled by the processor. Use the command

```
monitor:unit=[unit#],[yes,no]
```

to turn on (yes) the monitor.

10. Use the command

**prov-threshold:unit=[unit#]:digroup=[xty],[0|6]**

to set the echo cancelers threshold (0 or 6 dB) on digroup X or Y in unit "[unit#]".

11. Repeat Steps 6, 7, 8, 9, and 10 for all BCM shelves served by the common processor.
12. Use the command (all on one line)

**set:time=[hr],[min]:date=[mo],[day],[year]  
:zone=[zone]**

to set the date if required. Then STOP!

### K. Provisioning Change With Processor

**5.19** These steps are used to change provision options on BCM32000 units controlled by a common processor. Remember to make these changes to the BCM units at both ends of the transmission system.

1. Establish terminal interface with MC90058A1 common processor via modem or processor interface RS-232 connection on same shelf with the processor. Login to the processor (see Login Procedures).

**Note:** The toggle switch on MC90058A1 must be in the PRC VLD position.

2. Obtain channel template numbers and echo canceling settings from office records. These settings can be found using procedures in the ENGINEERING CONSIDERATIONS section.
3. Use the command (all on one line)

**prov-chan:unit=[unit#]:bundle=[1|2|3|4],[template#]**  
for bundling settings, or

**prov-chan:unit=[unit#]:group=[1|2],[template#]**

for robbed-bit settings.

**Note:** If the BCM unit is not in the remote mode (controlled by the processor), use the **prov-remote** command and specify the channel template for each bundle or group.

4. Use the command (all on one line)

**prov-ec:unit=[unit#]:digroup=[xty]  
:channel=[chan#],[on/off]**

for echo canceler settings.

5. Use the command

**prov-threshold:unit=[unit#]:digroup=[xty],[0|6]**

to set echo cancelers threshold (0 or 6 dB).

6. Enter any other commands required. Tables B, C, and D give syntax and an explanation of processor commands. Use **status:unit** to verify channel templates and **status-ec** to verify echo canceler settings. Use **status-perf** to look at system performance records and **perfclr** to clear performance records.

7. Repeat Steps 2 through 6 for all BCM shelves served by the common processor if required. To log off, hold the CONTROL key and press d key ( Control d). Then STOP!♦

### L. Testing

**5.20** The BCM32000 has self-testing capability. If alarms occur once the BCM is connected end-to-end or in the configuration explained below, refer to Part 7 in this practice. ♦These preservice tests are to be done at the BCM shelf and include actions that cannot be done with the MC90058A1 common processor. Therefore, always do the following tests at the BCM shelf. Perform the Processor Testing procedures for the processor. ♦ For single-ended testing with no DS1 signal connections to lines x, y, or z, perform the following steps:

1. Use a digital voltmeter to measure voltage at 5 V jacks at the top of the 484AA power unit(s).
  - Voltage should be between 4.8 and 5.2 volts.
  - Corrective actions for out of limits voltages are: (1) Check -48 V power supply (paragraph 5.06). (2) Replace power unit.
2. The following tests can be made with or without the echo canceler option.

3. Loop DS1 x, DS1 y, and DS1 z by setting the LOOP CONT x, y, and z toggle switches on the AMC circuit pack, up to the LOOP position.
  - On TM501:  
LOOP LED—on.  
All others—off.
  - On TM502 if installed:  
All LEDs—off.
  - On each SM469:  
ALM—off.
4. Wait 13 seconds.
5. Push and hold the RESET button on the AMC circuit pack.
6. Verify that the circuit pack LEDs agree with the following lists:
  - On the AMC circuit pack:  
LOOP—on  
All others—off.
  - On TM500:  
All LEDs—on
  - On TM501:  
All LEDs—on.
  - On TM502 if installed:  
All LEDs—off.
  - On each SM469:  
ALM—on.
7. Release RESET button.
8. Verify that the circuit pack LEDs agree with the following lists:
  - On the AMC circuit pack:  
LOOP—on  
All others—off.
  - On TM500:  
Both LOOP LEDs—on  
All others—off.
  - On TM501:  
LOOP LED—on.  
All other LEDs—off.
  - On TM502 if installed:  
All LEDs—off.
  - On each SM469:  
ALM—off.
9. Unloop DS1 x and DS1 y by setting the LOOP CONT x and y toggle switches on the AMC circuit pack down to the NORM position.
10. After approximately 5 seconds, verify that the circuit pack LEDs agree with the following table:
  - On the AMC circuit pack:  
MJ—on  
LOOP—on  
All others—off.
  - On TM500:  
Both AR LEDs—on  
All other LEDs—off.
  - On TM501:  
LOOP LED—on.  
All other LEDs—off.
  - On TM502 if installed:  
All LEDs—off.
  - On each SM469:  
ALM—off.
11. Push the ACO button on the AMC circuit pack.

12. Verify that the circuit pack LEDs agree with the following lists:

- On the AMC circuit pack:

MJ—on

ACO—on

LOOP—on

All others—off.

- On TM500:

Both AR LEDs—on

All other LEDs—off.

- On TM501:

LOOP LED—on.

All other LEDs—off.

- On TM502 if installed:

All LEDs—off.

- On each SM469:

ALM—off.

13. Loop DS1 x, DS1 y, and DS1 z by setting the LOOP CONT x, y, and z toggle switches on the AMC circuit pack up to the LOOP position.

14. After waiting 13 seconds, all LEDs on the BCM32000 except LOOP LEDs on TM500, TM501, and the AMC circuit pack should be off as shown in Step 8 above.

5.21 The above test setup could be left in place until lines x and y are connected to a D-type channel bank or equivalent, and line z has been connected through to the BCM at the far end.

#### Processor Testing

5.22 ♦The following tests are to be done only if the BCM shelf(ves) are controlled with the MC90058A1 common processor. It is assumed that all BCM units to be tested have been installed into the

processor database and the previous manual tests have been done for each BCM shelf.

1. Connect RS-232 from terminal interface to TM495 processor interface unit circuit pack on the BCM shelf with the common processor and login (see terminal and login sections).
2. Use the `reset:proc` command to reset the MC90058A1 common processor.
3. Use `status:proc` command to verify no processor alarms are on.
4. Use `status-frame` command to verify that all equipped units have no alarms.
5. Use the `status:unit` command for each BCM unit to verify proper equipage, no alarms are on, lines X Y and Z are looped local, and the channel-control number is correct.♦

## 6. MAINTENANCE

6.01 The BCM32000 shelf has no periodic maintenance requirements. The cabinet version has a fan filter that should be changed once per year or more often under dusty conditions. ♦If the BCM is equipped with the MC90058A1 processor option, system performance can be displayed using the `status-perf` command. For this command to work, the BCM unit must have the monitor on. It is recommended to always have the monitor on for a processor controlled BCM unit. The `monitor` command is used to turn on or off the unit monitor.♦

## 7. TROUBLE CLEARING

7.01 This part provides trouble-clearing procedures for responding to alarms and trouble reports. All alarms on the BCM are major (service affecting) alarms. Alarms on the BCM may be classified as power, transmission, and equipment alarms. Power alarms involve blown fuses. Transmission alarms occur as red or yellow alarm LEDs on circuit packs TM500, TM501, or TM502. A DS1 yellow alarm (AY) is a reaction to a special signal from the far-end terminal that has a red alarm. ♦The DS1 red alarm (AR) at the connecting D4 bank can have two meanings depending on the alarm handling option used, terminal or transparent (see Facility Alarm Handling section). For alarm transparency, a red alarm at the D4 bank indicates that somewhere in the BCM

system the incoming DS1 signal framing was lost, either the near end or far end or line z. For transparency, the digital line trouble can be isolated as depicted in Fig. 9. For terminal alarms, a DS1 red alarm (AR) at the BCM unit indicates that the BCM cannot frame on the incoming DS1 signal (a connecting D4 bank will have a yellow alarm). Therefore a red alarm indicates trouble between the far-end transmitter and the near-end receiver, and a yellow alarm indicates trouble between the near-end transmitter and the far-end receiver. In the bundling mode circuit pack TM502 is installed. Circuit pack TM502 has a BR and a BY alarm for each of the four bundles. The BR and BY alarms have the same meaning per bundle as the AR and AY alarms have per line. Table O lists the BCM terminal alarms handling response the BCM makes to those alarms.

**Note:** If a facility alarm clears after looping, either the facility is defective or framing formats at the two ends of the facility do not match.

**7.02** An equipment alarm occurs when an internal diagnostic test discovers a problem. When an equipment alarm is detected, the EQP ALM LED on the AMC circuit pack lights. The ALM LED on other circuit packs may also light. A major alarm occurs whenever any other alarm on the BCM32000 is active.

**7.03** The procedure below is based on locating and replacing defective BCM plug-in circuit packs. All switch options (on faceplate or on the printed circuit board) must be set on replacement circuit pack. When all possible plug-ins have been replaced, the trouble-clearing help ends. At this point the craft should look for broken wires, bent pins, crimped connectors, etc. If a CSU is in the cabinet version and the trouble is on line z, the trouble may be in the CSU. The CSU or digital line is likely defective if the AR and AY alarms are off when line z is looped. Several BCM failures may indicate a power failure.

**7.04** The trouble clearing procedures are divided into three parts. The first part (Trouble Clearing Via Modem) is intended to be used when the BCM unit is equipped with a MC90058A1 common processor that is connected to a central maintenance center via the modem option. These tests should be done before sending a craftsman to the BCM equipment bay. The second part (Trouble Clearing at the BCM Equipment Bay) is intended to be done at the BCM32000 equipment bay. These tests are used for all

BCM units (with or without the processor option). The third part (Processor Failure) is intended to be used to clear MC90058A1 common processor troubles. This should be used after the first and/or second parts have been used to determine that the processor has troubles.

#### A. Trouble Clearing Via Modem

**7.05** These tests are to be used at a central maintenance location for a BCM unit that is equipped with the MC90058A1 common processor and has the modem option. The tests are intended to find the cause of the trouble (equipment or line failure) prior to sending a craftsman to the BCM equipment bay.

**7.06** It is assumed that the modem is connected correctly and the terminal being used is compatible with the processor (see Processor Modem Connections and Recommended Terminals).

1. Dial up and log on the BCM processor (see Login Procedure).

**Note 1:** If login cannot be made, either a fuse on the BCM unit with the processor is blown or there is a modem connection trouble.

2. Enter **status-frame** command. Look under the EQUIPPED and ALARMS columns of the printout.

**Note 2:** For multishelf arrangement, an equipped unit with a BLOWN FUSE will not have a "yes" under the EQUIPPED column.

**Note 3:** The **aco:unit=[unit#]** or **aco:proc** can be used to silence office alarms.

3. Determine if a BLOWN FUSE symptom is present (Notes 1 and 2)?

A. Yes—Have a craftsman replace the blown fuse using the Trouble Clearing at the BCM Equipment Bay procedures.

B. No—Continue with Step 4.

4. What equipment has a "yes" in the ALARMS column?

**TABLE O**  
**RESPONSE TO BCM32000 ALARMS**

ALARM	BCM32000 RESPONSE
(AR) DS1 Red Alarm on Line x or y	Return DS1 yellow signal in affected line x or y Condition signaling* in affected channels in line z Condition data† in affected channels in line z
(AY) DS1 Yellow Alarm on Line x or y	Condition signaling in affected channels in line z Condition data in affected channels in line z
(AR) DS1 Red Alarm on Line z	Return DS1 yellow signal in line z Send all 1s in both lines x and y
(AY) DS1 Yellow Alarm on Line z	Send DS1 yellow signal in both lines x and y
(BR) Bundle Red Alarm	Return bundle yellow alarm signal in affected bundle Condition signaling in affected channels of bundle in line x or y Send all 1s in affected channels of bundle in line x or y
(BY) Bundle Yellow Alarm	Condition signaling in affected channels of bundle in line x or y

\* Condition signaling means:

1. Set signaling bit A=0 for 2 seconds followed by A=1 until the trouble is cleared.
2. Set signaling bit B=1.
3. If ABCD signaling is implemented, let A=C and B=D when conditioning is required.

† When data is conditioned, data bits are inserted that translate to a low level audible signal for each affected channel in a D-type channel bank or equivalent.

A. None—STOP! Test completed. To log off hold the CONTROL key then press “d” key (CONTROL d).

B. PROCESSOR—Continue with Step 5.

C. UNIT—Continue with Step 9.

5. For common processor alarms, enter **reset:proc** command. This generates an autonomous report.
6. Enter **status-frame** command.
7. Does the PROCESSOR have “yes” in the ALARMS column?
  - A. Yes—Have a craftsperson do the Processor Failure procedure at the BCM equipment bay. Continue with Step 8.
  - B. No—Processor trouble is cleared. Continue with Step 8.
8. To log off hold the CONTROL key then press “d” key (CONTROL d). STOP! Test is complete.
9. For BCM unit alarms, enter **status-alm:unit=[unit#]** command for alarmed unit.
10. Determine if a CGA alarm or EQUIPMENT alarm is present.
  - A. CGA—Continue with Step 11.

**Note 4:** If bundle signaling mode and all four bundles have alarms, continue with Step 11 and loop line z.

B. EQUIPMENT—Have a craftsperson do the Trouble Clearing at the BCM Equipment Bay procedures. Then do Step 8.

11. Enter **loop:unit=[unit#]:line=[xlyz],loop** to loop the line with the “yes” under DEVICE-ALM.
12. Does alarm clear (repeat Step 9 if necessary)?
  - A. Yes—Trouble is on the line that was just looped. Refer trouble to appropriate group. After the line or connecting equipment is re-

paired, the line must be unlooped (**,norm** instead of **,loop** in Step 11). Then do Step 8.

B. No—Have a craftsperson do the Trouble Clearing at the BCM Equipment Bay procedures. Then do Step 8.♦

## B. Trouble Clearing at the BCM Equipment Bay

**7.07** These procedures are to be done at the BCM equipment bay. These tests can be done for all BCM units (with or without the processor option) and are based on LED alarm indications.

**7.08** ♦If BCM unit(s) are controlled with the MC90058A1 common processor, use the status commands to locate the cause of the alarm. Since equipment failures require replacing circuit packs, the following procedures can be used to clear BCM unit failures. The processor commands used to help clear troubles are “status-frame” to find BCM unit or processor trouble, “status-alm:proc or status-alm:unit=[unit#]” to look at equipment status; “reset:proc or reset:unit=[unit#]” to reset equipment; “loop:unit=[unit#]:line=[xlyz],[norm or loop]” to unloop or loop a DS1 line; and “aco:unit or aco:proc” to silence office alarms. A terminal must be connected to the processor interface circuit pack (modem connection must be removed if used) and the user must log on before using the processor.♦

**7.09** All alarms are covered in one procedure in order to reach the correct solution to the trouble as quickly as possible. The procedure below is written for one trouble at a time. Follow each step in order unless directed by a step to do otherwise. Processor commands that correspond with the step are enclosed in parentheses.

1. Is BLOWN FUSE lamp at top of BCM panel lighted (the processor will not work if its fuse is blown and for multishelf arrangement, an equipped unit with a blown fuse looks unequipped with the “status-frame” command)?

A. Yes—Continue with Step 2.

B. No—Continue with Step 11.

2. Replace fuse with extended indicator with a 5-amp (green) indicator fuse.

3. Did fuse hold?

- A. Yes—STOP! Procedure is complete.
- B. No—Unseat all circuit packs that apply to blown fuse. (F2 applies to all SM470 circuit packs, and F1 applies to all other circuit packs.)
4. Replace blown fuse.
  5. Did fuse hold?
    - A. Yes—Continue with Step 8.
    - B. No—Replace 484AA power unit for blown fuse. (F1 applies to power unit at the far left.)
  6. Replace blown fuse.
  7. Did fuse hold?
    - A. Yes—Continue with Step 10.
    - B. No—Look for wiring trouble such as bent pins or crimped connectors. The help for this trouble ends here.
  8. Determine which circuit pack causes the fuse to blow by seating circuit packs one at a time.
  9. Replace circuit pack determined above, and the fuse.
  10. Install remaining circuit packs. STOP! This procedure is complete.
  11. Is EQP ALM on the AMC circuit pack, or PROC MJ on MC90058A1 common processor lighted (“status-alm:unit=[unit#]” or status-alm:proc” processor command)?
    - A. Yes on the AMC circuit pack—Continue with Step 12.
    - B. Yes on MC90058A1 processor—STOP! Use Processor Failure procedures to clear processor trouble. This procedure is complete.
    - C. No—Continue with Step 17.
  12. Depress RESET pushbutton on the AMC circuit pack. (“reset:unit=[unit#]” processor command).
  13. Did EQP ALM LED on the AMC circuit pack extinguish and remain off (“status-alm:unit=[unit#]” processor command)?
    - A. Yes—STOP! This trouble clearing procedure is complete.
    - B. No—Continue with Step 14.
  14. Are ALM LEDs on any other circuit packs lighted (“status:unit=[unit#]” processor command)?
    - A. Yes—Continue with Step 15.
    - B. No—Continue with Step 16.
  15. Replace circuit packs as needed per Table P. (STOP! This ends the help for clearing this trouble.)
  16. Replace circuit packs in list below one at a time, and depress RESET (“reset:unit=[unit#]” processor command) pushbutton each time until ALM stays off or until list is exhausted. (STOP! This ends the help for this trouble.)
    - AMC circuit pack
    - TM500
    - TM501
    - TM502 (if installed)
    - SM469 (one at a time from left to right)
    - SM470 (one at a time from left to right).
  17. What type of alarm do you have (“status-alm:unit=[unit#]” processor command)?
    - A. Line x or y (AR or AY on TM500)—Continue with Step 18.
    - B. Line z (AR or AY on TM501)—Continue with Step 21.
    - C. BUNDLE 1, 2, 3, or 4 (BY or BR on TM502)—Continue with Step 24 if line z is not alarmed.

**Note:** If this is a new installation, verify that line coding format and framing options are the same at both ends and the same type of codec circuit packs are used at both ends. A mismatch causes alarms that clear when the BCM is looped.

18. Loop alarmed line by moving associated key on the AMC circuit pack to the up position ("loop:unit=[unit#]:line=[xyz],loop" processor command).
19. Did red and yellow alarms clear after 13 seconds ("status-alm:unit=[unit#]" processor command)?
- A. Yes—Trouble is probably not in your terminal. Unloop line and refer trouble to appropriate line or equipment group. (STOP! This ends procedure for this trouble.)
- B. No—Replace circuit pack TM500, and depress RESET pushbutton on the AMC circuit pack.
20. Did red and yellow alarms clear after 13 seconds?
- A. Yes—Return defective circuit pack for repair, and unloop line. (STOP! This ends procedure for this trouble.)
- B. No—Replace the AMC circuit pack and depress RESET pushbutton on the AMC circuit pack. (STOP! This ends procedure for this trouble.)
21. Loop line z by moving the associated key on the AMC circuit pack to the up position ("loop:unit=[unit#]:line=z,loop" processor command).
22. Did red and yellow alarms clear after 13 seconds ("status-alm:unit=[unit#]" processor command)?
- A. Yes—Trouble is not in your terminal. Unloop line and refer trouble to appropriate line or equipment group. (STOP! This ends procedure for this trouble.)
- B. No—Replace circuit pack TM501, and depress RESET pushbutton on the AMC circuit pack.
23. Did red and yellow alarms clear after 13 seconds?
- A. Yes—Return defective circuit pack for repair, and unloop line. (STOP! This ends procedure for this trouble.)
- B. No—Replace the AMC circuit pack and depress RESET pushbutton on the AMC circuit pack. (STOP! This ends procedure for this trouble.)
24. Do all four bundles have alarm?
- A. Yes—Continue with Step 25.
- B. No—Continue with Step 27.
25. Loop line z by moving the associated looping key on the AMC circuit pack to the up position ("loop:unit=[unit#]:line=z,loop" processor command).
26. Did alarms clear in 13 seconds ("status:unit=[unit#]" processor command)?
- A. Yes—Trouble is not in BCM. Unloop line z and refer trouble to appropriate line or equipment group. (STOP! This ends procedure for this trouble.)
- B. No—Replace circuit packs in list below one at a time and depress RESET pushbutton each time until alarm stays off or until list is exhausted. Then unloop line z. (STOP! This ends the help for this trouble.)
- TM502
  - TM501
  - AMC.
27. The trouble is probably on the other side of a DACS as shown in Fig. 5. If DACS is not used or if it cannot be determined that a trouble exists on the line, follow this procedure beginning with Step 25.

**C. Processor Failure**

**7.10** ♦ These procedures are to be done at the BCM equipment bay. The test applies only to BCM units with the processor option. Ensure Trouble Clearing Via Modem or Trouble Clearing at the BCM Equipment Bay procedures are completed before doing these tests. It is assumed the terminal being used is compatible with the processor (see Recommended Terminals).

1. Connect terminal to TM495 processor interface circuit pack with RS-232 cable and log on (see Login Procedure).

**Note:** If a modem connection is made, mode connection must be removed before using the terminal (see Processor Modem Connections).

2. Push RESET button on the MC90058A1 processor circuit pack. This generates an autonomous failure report.
3. What type MAJOR ALARM:PROCESSOR alarm has occurred?

PROCESSOR VALID SWITCH IN ILLEGAL POSITION

**TABLE P**

**REPLACEMENT CIRCUIT PACKS**

CIRCUIT PACKS WITH ALM LIGHTED	READING FROM LEFT TO RIGHT, REPLACE CIRCUIT PACKS ONE AT A TIME, AND DEPRESS RESET PUSHBUTTON ON ALARM AND CONTROL EACH TIME UNTIL ALM STAYS OFF OR LIST IS EXHAUSTED.
TM-500	TM-500, SM-469 (1 THROUGH 4)*, AND AMC90...
TM-501	TM-501, SM-469 (1 THROUGH 4)*, AND AMC90...
TM-502	TM-502, TM-501, SM-469 (1 THROUGH 4)*, AND AMC90...
SM-469(1)*	SM-469(1)*, TM-500, TM-502 (IF INSTALLED), TM-501, AND AMC90...
SM-469(2)*	SM-469(2)*, TM-500, TM-502 (IF INSTALLED), TM-501, AND AMC90...
SM-469(3)*	SM-469(3)*, TM-500, TM-502 (IF INSTALLED), TM-501, AND AMC90...
SM-469(4)*	SM-469(4)*, TM-500, TM-502 (IF INSTALLED), TM-501, AND AMC90...
SM-470 (1)	SM-470 (1)*, SM-470 (2 AND 3 IF INSTALLED), TM-501, AND AMC90...
SM-470 (2)	SM-470 (2)*, SM-470 (1 AND 3 IF INSTALLED), TM-500, TM-501, AND AMC90...
SM-470 (3)	SM-470 (3)*, SM-470 (1 AND 2 IF INSTALLED), TM-500, TM-501, AND AMC90...
SM-470 (4)	SM-470 (4), SM-470 (5 AND 6 IF INSTALLED), TM-500, TM-501, AND AMC90...
SM-470 (5)	SM-470 (5)*, SM-470 (4 AND 6 IF INSTALLED), TM-500, TM-501, AND AMC90...
SM-470 (6)	SM-470 (6)*, SM-470 (4 AND 5 IF INSTALLED), TM-500, TM-501, AND AMC90...

\* Count slots for circuit pack type from left to right.

Go to Step 4.

**EXERCISE FAILURE**

Go to Step 5.

**PROCESSOR:UNIT AUDIT FAILURE**

Go to Step 7.

**PROCESSOR CIRCUIT PACK ALARM ACTIVE**

Go to Step 26.

4. Set toggle switch on MC90058A1 processor circuit pack to PROC VLD position (switch must be pulled to change setting).
5. Push RESET button on MC90058A1 processor circuit pack.
6. Wait at least 15 seconds. Does alarm clear?
  - A. Yes—Stop! This procedure is complete.
  - B. No—Continue with Step 26.
7. What type of AUDIT FAILURE is identified in alarm message (refer to line in alarm message that begins with AUDIT FAILURE and write down which unit#)?
  - A. AUDIT FAILURE:ECHO CANCELER EQUIPAGE—Continue with Step 21.
  - B. AUDIT FAILURE:REMOTE ECHO CANCELER CONTROL—Continue with Step 24.
  - C. All other AUDIT FAILURES (Note)—Continue with Step 8.

**Note:** These AUDIT FAILURES are not to be confused with EQPT ALM:AUDIT FAILURES which cause LEDs to light on the circuit packs. The equipment alarms are covered in Trouble Clearing at the BCM Equipment Bay procedures.

8. Are rockers 7 and 8 on block of rockers on printed wiring board of the AMC circuit pack set per office records (CLR card)?

A. Yes—Continue with Step 10.

B. No—Set rockers 7 and 8 to the proper position. Continue with Step 9.

9. Does alarm clear?

A. Yes—Stop! This procedure is complete.

B. No—Continue with Step 10.

10. Enter **status:unit**=[unit#] for unit with AUDIT FAILURE.

11. Is unit remotely provisioned (“yes” in REMOTE PROVISION column)?

A. Yes—Continue with Step 12.

B. No—Continue with Step 14.

12. Record channel control template numbers for each group or each bundle.

13. Enter **status-ec:unit**=[unit#] and record echo canceling options for line x and y.

14. Replace TM495 processor interface circuit pack.

15. Is unit remotely provisioned?

A. Yes—Continue with Step 16.

B. No—Continue with Step 18.

16. With information from Step 12, provision channel template as follows:

for robbed-bit signaling mode enter (all on one line)

**prov-remote:unit**=[unit#]:**group**=1,[template#]:  
**group**=2,[template#]

for bundle signaling mode enter (all on one line)

**prov-remote:unit**=[unit#]:**bundle**=1,[template#]  
**:bundle**=2,[template#]:**bundle**=3,[template#]  
**:bundle**=4,[template#]

17. Enter (all on one line)

prov-ec:unit=[unit#]:digroup=[xty]  
:channel=[chan#],[onloff]

to set echo canceler options with information from Step 13. The following is an abbreviated example that can be used to turn on echo cancelers for channels 1 through 12 , turn off 14 17 and 23 , and turn on the rest of the channels on digroup x of unit 0 (see Processor Syntax).

prov-ec:u=0:d=x:c=1&&12,on:c=14&17&23,off

- 18. Does alarm clear?
  - A. Yes—Stop! This procedure is complete.
  - B. No—Continue with Step 19.
- 19. Push RESET button on MC90058A1 processor circuit pack.
- 20. Does alarm clear?
  - A. Yes—Stop! This procedure is complete.
  - B. No—Continue with Step 26.
- 21. Are EC circuit packs SM470 installed according to office records (CLR card)?
  - A. Yes—Perform Steps 8 through 20.
  - B. No—Continue with Step 22.
- 22. Install EC pack correctly.
- 23. Does alarm clear?
  - A. Yes—Stop! This procedure is complete.
  - B. No—Perform Steps 8 through 20.
- 24. Replace EC packs, one at a time, starting with the left-most EC pack and see if alarm clears after each replacement.

- 25. Does alarm clear?
  - A. Yes—Stop! This procedure is complete.
  - B. No—Perform Steps 10 through 20.
- 26. Remove power on unit 0 (unit with processor circuit pack) by pulling locking lever on 484AA power converter at left side of the BCM shelf.
- 27. Remove processor circuit pack MC90058A1 (lift locking lever).
- 28. Insert new processor circuit pack (lock locking lever).
- 29. Place toggle switch to UNT VLD on new processor (pull the switch to set it).
- 30. Restore power to unit by locking 484AA locking lever.
- 31. Does a message appear on the terminal (last line is PROCESSOR VALID SWITCH IN ILLEGAL POSITION)?
  - A. Yes—Continue with Step 32.
  - B. No—Refer trouble to supervisor.
- 32. Press carriage return key and log in if necessary (LOGIN is "bcm32000" and PASSWORD is "hello". Use "password" command to change the password and "set" command to set the time).
- 33. Place toggle switch to PROC VLD on new processor.⚡

**8. ISSUING ORGANIZATION**

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