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DMS-100 Family

DMS-100 Ringing System

General Description

BASE15 and up Standard 06.01 October 2000

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- added statement indicating that an NT2X27AB is required when using CODED C30 ringing and an NT2X27AA is required when using CODED C ringing.

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About this document

When to use this document

This document describes the DMS-100 ringing system. It is intended as a general reference for operating company personnel responsible for engineering, administration, and maintenance of the DMS-100 ringing system.

How to check the version and issue of this document

The version and issue of the document are indicated by numbers, for example, 01.01.

The first two digits indicate the version. The version number increases each time the document is updated to support a new software release. For example, the first release of a document is 01.01. In the *next* software release cycle, the first release of the same document is 02.01.

The second two digits indicate the issue. The issue number increases each time the document is revised but rereleased in the *same* software release cycle. For example, the second release of a document in the same software release cycle is 01.02.

To determine which version of this document applies to the software in your office and how documentation for your product is organized, check the release information in *Product Documentation Directory*, 297-8991-001.

This document is written for all DMS-100 Family offices. More than one version of this document may exist. To determine whether you have the latest version of this document and how documentation for your product is organized, check the release information in *Product Documentation Directory*, 297-8991-001.

References in this document

The following documents are referred to in this document:

- *Product Documentation Directory*, 297-8991-001
- *Subscriber Carrier Module-100 Rural General Description*, 297-1001-064

- *DMS-100 Provisioning Manual, 297-1001-450*
- *Peripheral Modules Maintenance Guide, 297-1001-592*
- *SMS Maintenance Manual, 297-8231-550*
- *SMU Maintenance Manual, 297-8241-550*
- *Hardware Description Manual, 297-8991-805*
- *DMS-1 Urban System Description, 363-2051-100*
- *DMS-1 Urban Circuit Pack Description, 363-2051-101*
- *SERVORD Reference Manual*
- *Office Parameters Reference Manual*
- *Log Report Reference Manual*
- *Translations Guide*
- *Card Replacement Procedures*
- *Customer Data Schema Reference Manual*

What precautionary messages mean

The types of precautionary messages used in NT documents include danger, warning, and caution messages. Danger, warning, and caution messages indicate possible risks.

Examples of the precautionary messages follow.

DANGER

Possibility of personal injury



DANGER

Risk of electrocution

Do not open the front panel of the inverter unless fuses F1, F2, and F3 have been removed. The inverter contains high-voltage lines. Until the fuses are removed, the high-voltage lines are active, and you risk being electrocuted.

WARNING

Possibility of equipment damage

**DANGER****Damage to the backplane connector pins**

Align the card before seating it, to avoid bending the backplane connector pins. Use light thumb pressure to align the card with the connectors. Next, use the levers on the card to seat the card into the connectors.

CAUTION

Possibility of service interruption or degradation

**CAUTION****Possible loss of service**

Before continuing, confirm that you are removing the card from the inactive unit of the peripheral module. Subscriber service will be lost if you remove a card from the active unit.

How commands, parameters, and responses are represented

Commands, parameters, and responses in this document conform to the following conventions.

Input prompt (>)

An input prompt (>) indicates that the information that follows is a command:

```
>BSY
```

Commands and fixed parameters

Commands and fixed parameters that are entered at a MAP terminal are shown in uppercase letters:

```
>BSY CTRL
```

Variables

Variables are shown in lowercase letters:

```
>BSY CTRL ctrl_no
```

The letters or numbers that the variable represents must be entered. Each variable is explained in a list that follows the command string.

Responses

Responses correspond to the MAP display and are shown in a different type:

```
FP 3 Busy CTRL 0: Command request has been submitted.  
FP 3 Busy CTRL 0: Command passed.
```

The following excerpt from a procedure shows the command syntax used in this document:

- 1 Manually busy the CTRL on the inactive plane by typing

```
>BSY CTRL ctrl_no
```

and pressing the Enter key.

where

ctrl_no

is the number of the CTRL (0 or 1)

Example of a MAP response:

```
FP 3 Busy CTRL 0: Command request has been submitted.  
FP 3 Busy CTRL 0: Command passed.
```

1 DMS-100 ringing overview

Introduction

The DMS-100 ringing system performs automatic number identification (ANI) and coin functions and supports the following three ringing systems used in North America:

- Bell Canada
- Bell operating company (BOC)
- Rural Electrification Association (REA)

The DMS-100 ringing signal is based on a 6-second (s) cycle. The cycle is divided into 12 time slots, which are the smallest divisions of the ringing cycle. The duration of each time slot is software controlled and is typically set to 0.5 s. In many DMS-100 peripherals, the ringing cycle is further divided into larger divisions consisting of one or more time slots.

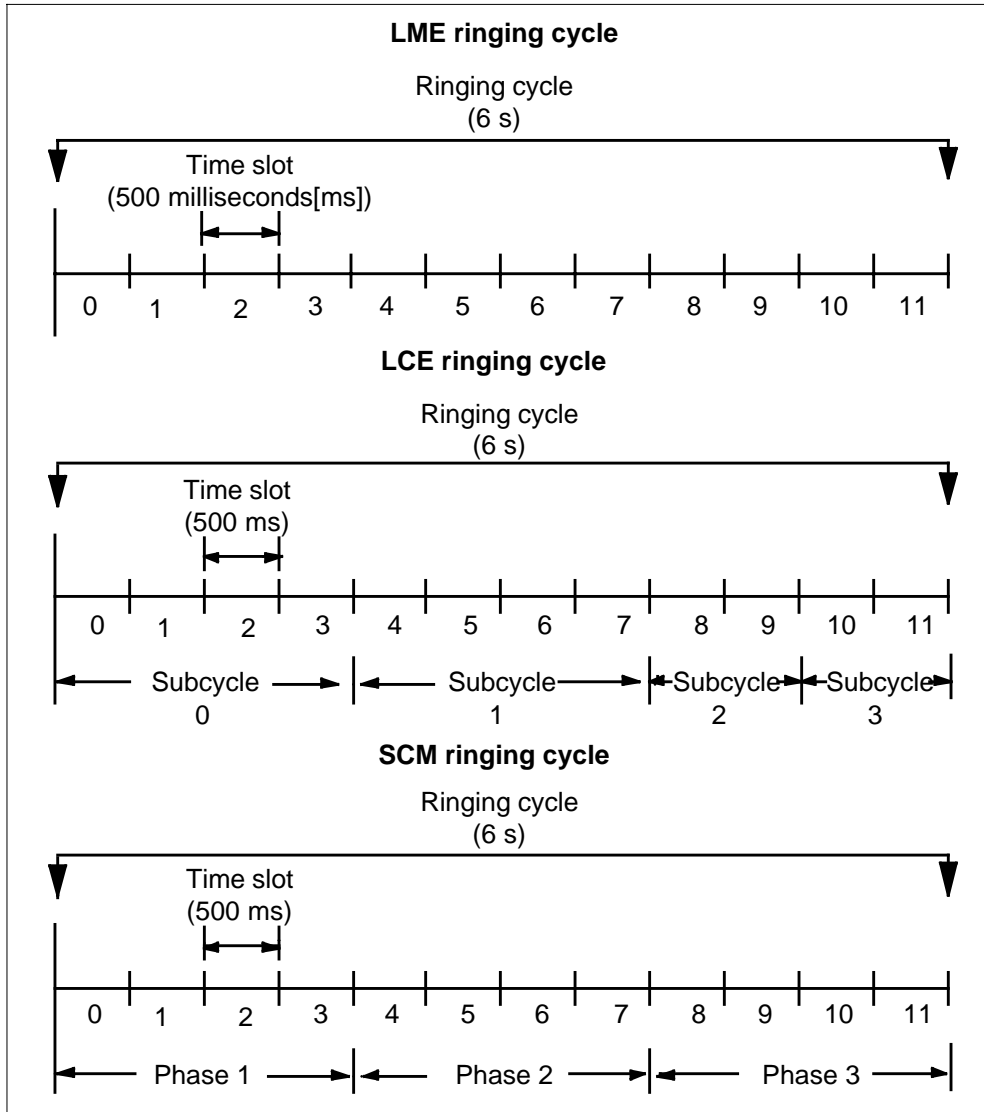
The DMS-100 line module equipment (LME), line concentrating equipment (LCE), and Subscriber Carrier Module (SCM) each use a distinctive ringing cycle format. For example, each subdivides the ringing cycle differently.

The ringing cycle in the LME is divided into 12 time slots, which are typically set to 0.5 s each. The ringing cycle in the Line Concentrating Module (LCM), like the LME, is also divided into 12 time slots. However, the LCM ringing cycle is further divided into four subcycles. The subcycles consist of one or more time slots.

The ringing cycle in the SCM, like the LME and LCM, is divided into 12 time slots. It is further subdivided into three phases consisting of four time slots of 2 s each.

A diagram of each of the DMS-100 ringing cycle formats is shown in the following figure.

Figure 1-1 Illustration of a DMS-100 ringing cycle



Note: The time slot duration for LCE ringing varies with the ringing scheme. If ringing is superimposed or coded, all time slot durations are 500 ms. If frequency selective ringing (FSR) is used, time slot 0 is 60 ms, time slot 1 is 65 ms, time slot 2 is 75 ms, and the remainder of the time slots are 45 ms each. The total duration for the ringing cycle remains 6 s.

Operating company personnel can define the time slot and subcycle durations according to the type of ringing scheme being used.

Normal and immediate ringing

The DMS-100 switch applies power ringing to a line in either normal or immediate ringing mode. In the normal ringing mode, the DMS-100 switch

applies power ringing at the start of the next available ringing cycle. If power ringing can not be applied during the first time slot of a ringing cycle, the DMS-100 switch will try to schedule power ringing during the first time slot of the next ringing cycle. This can cause delays in power ringing of up to 6 s in LCMs and up to 8 s in line modules (LM). To reduce these delays, an immediate ringing mode is available.

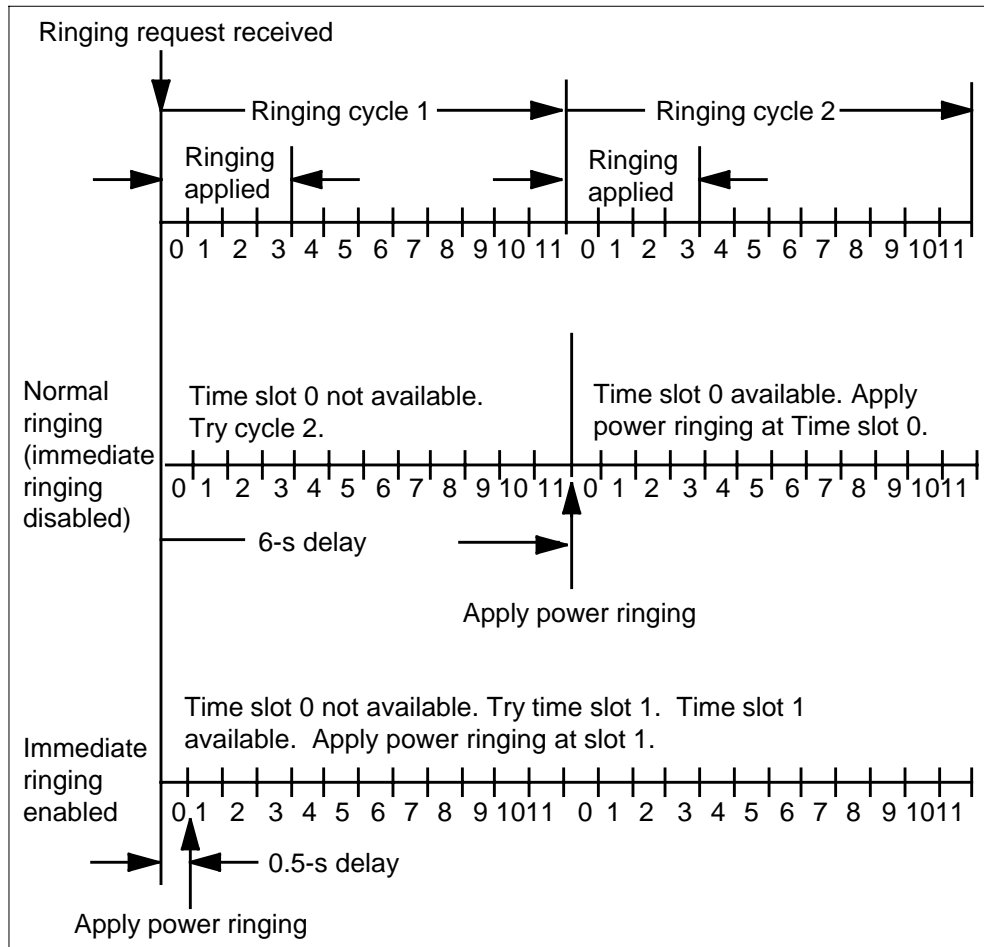
In the immediate ringing mode, the DMS-100 switch applies power ringing during the next available time slot of the ringing portion of the ringing cycle. If power ringing cannot be applied during the first time slot of the ringing portion of a ringing cycle, the DMS-100 switch will try to schedule power ringing during the next time slot of the ringing portion of the same ringing cycle. The DMS-100 switch attempts to schedule power ringing during each time slot of the ringing portion of a ringing cycle until power ringing can be applied, or the ringing portion of the ringing cycle expires. If power ringing can not be applied during this ringing cycle, the DMS-100 will try the next ringing cycle.

Immediate ringing is enabled or disabled by office parameter IMMEDIATE_RING_ENABLE in table OFCENG.

Note: When changing the office parameter IMMEDIATE_RING_ENABLE in table OFCENG to Y, consideration must be given to the value datafilled for office parameter ALLOW_RINGING_ON_TIP_SIDE. When this office parameter is set to Y, a considerable amount of ring slots are reserved for tip side ringing functionality. This may delay the next available time slot in the ringing portion of the ring cycle. For more information on office parameter ALLOW_RINGING_ON_TIP_SIDE, refer to *Office Parameters Reference Manual*.

An illustration of normal and immediate ringing for a 1FR (1 flat rate is a standard line option) is shown in the following figure. This illustration is not specific to any ringing type. It illustrates the differences in normal and immediate ringing on a 1FR line when time slot 0 of the ringing cycle is unavailable.

Figure 1-2 Normal versus immediate ringing on 1FR line



The effects of immediate ringing on the power ringing signal differ between LME and LCE. In LME, when immediate ringing is enabled, the DMS-100 schedules power ringing during the next available time slot in the ringing portion of the ringing cycle. Ringing is removed at the end of the last time slot in the ringing portion of the ringing cycle.

For example, in Figure 1-2, "Normal versus immediate ringing on 1FR line." immediate ringing is enabled on the LME, the first power ringing burst applies at the start of time slot 1 and continues to the end of time slot 3. This results in a ringing burst truncated to 1.5 s rather than a complete 2-s burst.

In LCE, like LME, when immediate ringing is enabled, the DMS-100 schedules power ringing during the next available time slot in the ringing portion of the ringing cycle. Ringing is removed when the 2-s burst has completed.

For example, in the following figure, ringing is enabled on the LCE, the first ringing burst applies at the beginning of time slot 1 and continues to the end of time slot 4. The initial ringing burst is 2 s.

ANI and coin functions

The DMS-100 ringing bus also provides voltages for ANI and coin functions. The ANI and coin voltages include:

- +48 V
- -48 V
- +130 V
- -130 V

Types of ringing

The DMS-100 switch supports the following types of ringing:

- frequency selective ringing
- superimposed ringing
- coded ringing
- distinctive ringing
- teen ringing
- Japan ringing

Each ringing type is described in the paragraphs that follow.

Frequency selective ringing

Frequency selective ringing is used for service to single party, 2-party, and multiparty up to eight parties. In the frequency selective scheme, each ringer on the line is tuned to a specific ringing signal frequency. When a subscriber is called, the DMS-100 switch applies to the line the ringing signal where the called subscriber's ringer is tuned. The called subscriber's ringer, which is tuned to the applied ringing signal, rings. The remaining ringers on the line, which are not tuned to the applied ringing signal, reject the ringing signal and remain silent.

Note: Revertive ringing is not supported for FSR lines.

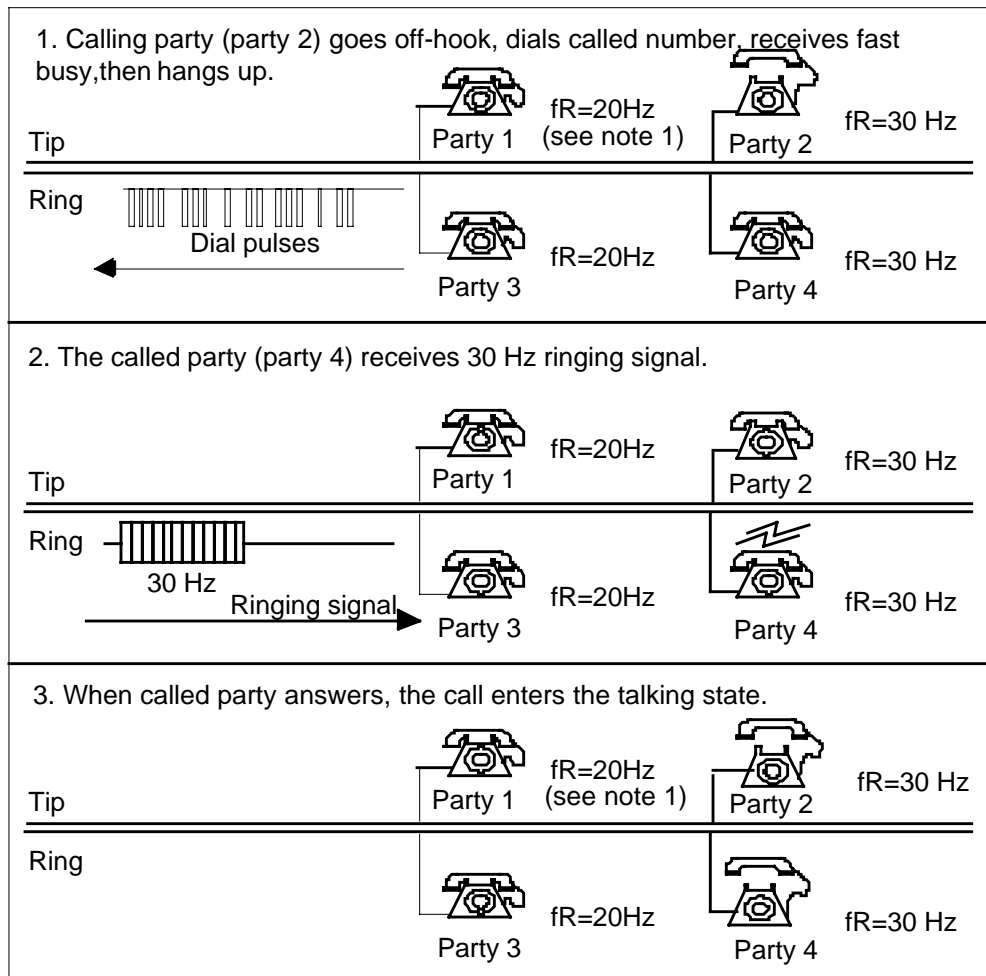
Revertive calls from FSR lines are permitted. The originator of the revertive call receives a treatment, either a tone or an announcement, indicating the call is placed to another party on the same line. The terminating party also receives a treatment. When both parties are off-hook, the talk path is established.

The treatments for FSR revertive calls are defined in table TMTCNTL, subtable LNT, in the following tuples:

- originator revertive multiparty frequency with three or more parties (ORMF)
- originator revertive frequency with two parties (ORAF)
- terminating party (TRRF)

The following figure illustrates the sequence of events that occur when a revertive call is made on a multiparty, FSR line.

Figure 1-3 Revertive call on multiparty, FSR line



Note 1: fR indicates the ringer's tuned frequency.

Note 2: The previous diagram does not show the ground connection of the tip and ring ringing circuits. These grounds are provided at the subscriber's location.

The frequencies used in the frequency selective ringing scheme are as follows:

- harmonic ringing: 16-2/3 Hz, 25 Hz, 33-1/3 Hz, 50 Hz, 66-2/3 Hz
- synchronmonic ringing (20 Hz base): 20 Hz, 30 Hz, 42 Hz, 54 Hz, 66 Hz
- synchronmonic ringing (16 Hz base): 16-2/3 Hz, 30 Hz, 42 Hz, 54 Hz
- decimonic ringing: 20 Hz, 30 Hz, 40 Hz, 50 Hz, 60 Hz.

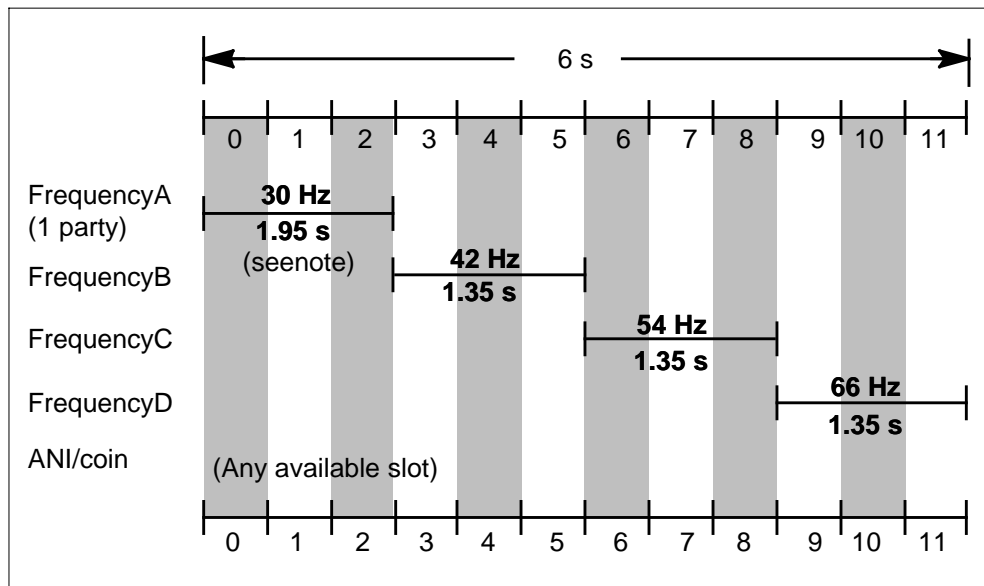
Frequency selective ringing is used by Rural Electrification Association (REA) offices. The following figures illustrate the REA frequency selective ringing timing for the following types of ringing:

- synchronmonic
- harmonic
- decimonic

Synchronmonic ringing

The following figure illustrates the relationship between the synchronmonic ringing signals and the DMS-100 ringing cycle.

Figure 1-4 Synchronmonic ringing

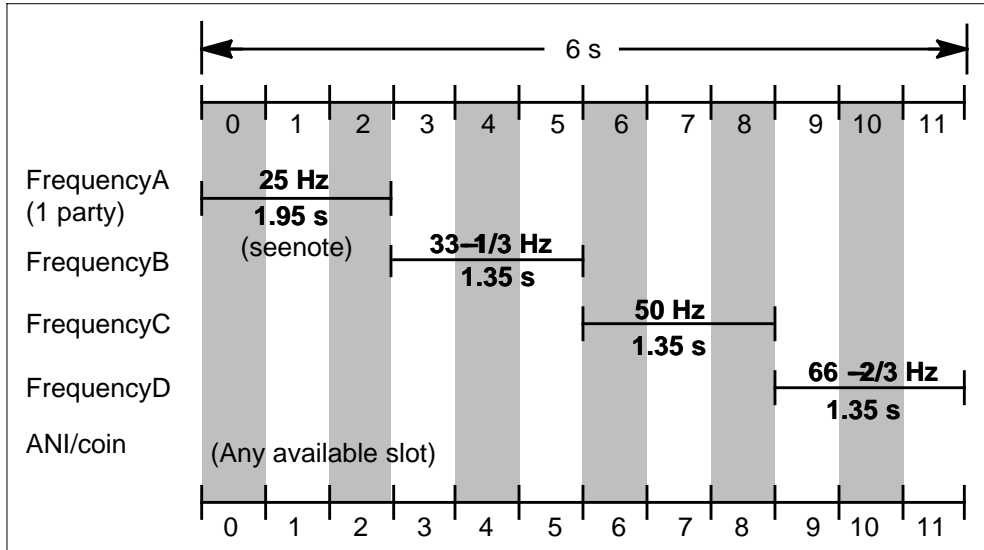


Note: Available frequencies are 16-2/3 Hz, 20 Hz, 30 Hz, 42 Hz, 54 Hz and 66 Hz. Any four of the available six frequencies, in any order, can be assigned to frequencies A through D: however, 16 Hz and 20 Hz can not be used simultaneously.

Harmonic ringing

The following figure illustrates the relationship of the harmonic ringing signals with the ringing cycle.

Figure 1-5 Harmonic ringing

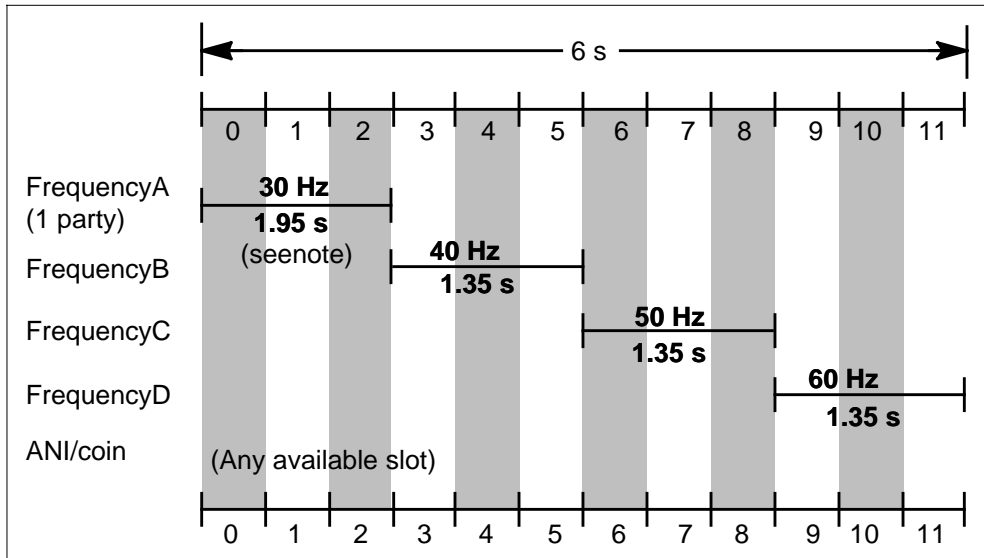


Note: Available frequencies are 16-2/3, 25, 33-1/3, 50, and 66-2/3 Hz. Any four of these, in any order, can be assigned to frequencies A through D.

Decimonic ringing

The following figure illustrates the relationship between the decimonic ringing signals and the ringing cycle.

Figure 1-6 Decimonic ringing



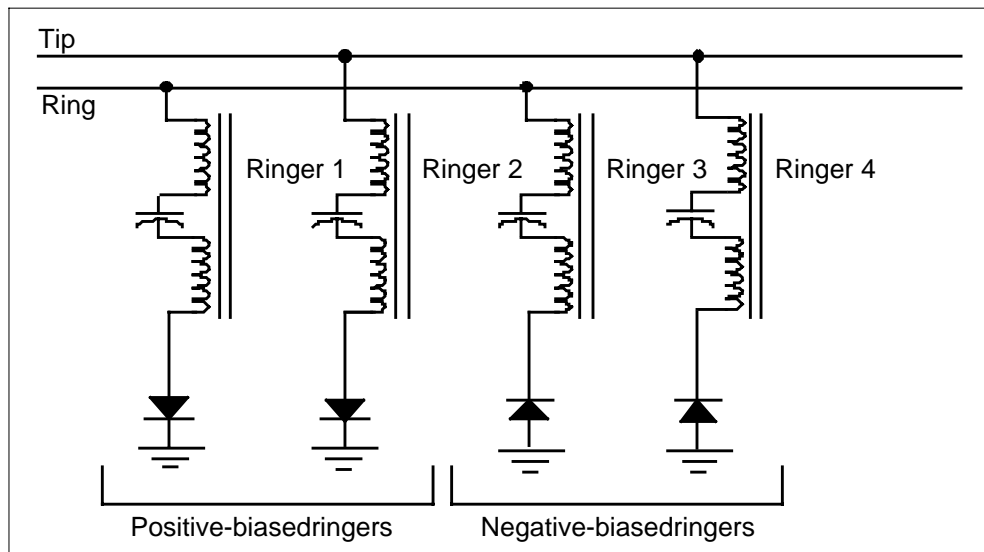
Note: Available frequencies are 20 Hz, 30 Hz, 40 Hz, 50 Hz, and 60 Hz. Any four of these, in any order, can be assigned to frequencies A through D.

Superimposed ringing

Superimposed ringing is a form of selective ringing which uses a positive or negative biased 20 Hz ringing signal and polarizing devices, such as gas tubes, at the receiving end for full or semi-ringer selection. In the fully selective configuration, a maximum of four parties can be connected to one line, with two on the tip side and two on the ring side.

The ringer connections of the fully selective ringing scheme is illustrated in the following figure.

Figure 1-7 Fully selective ringer configuration - superimposed ringing



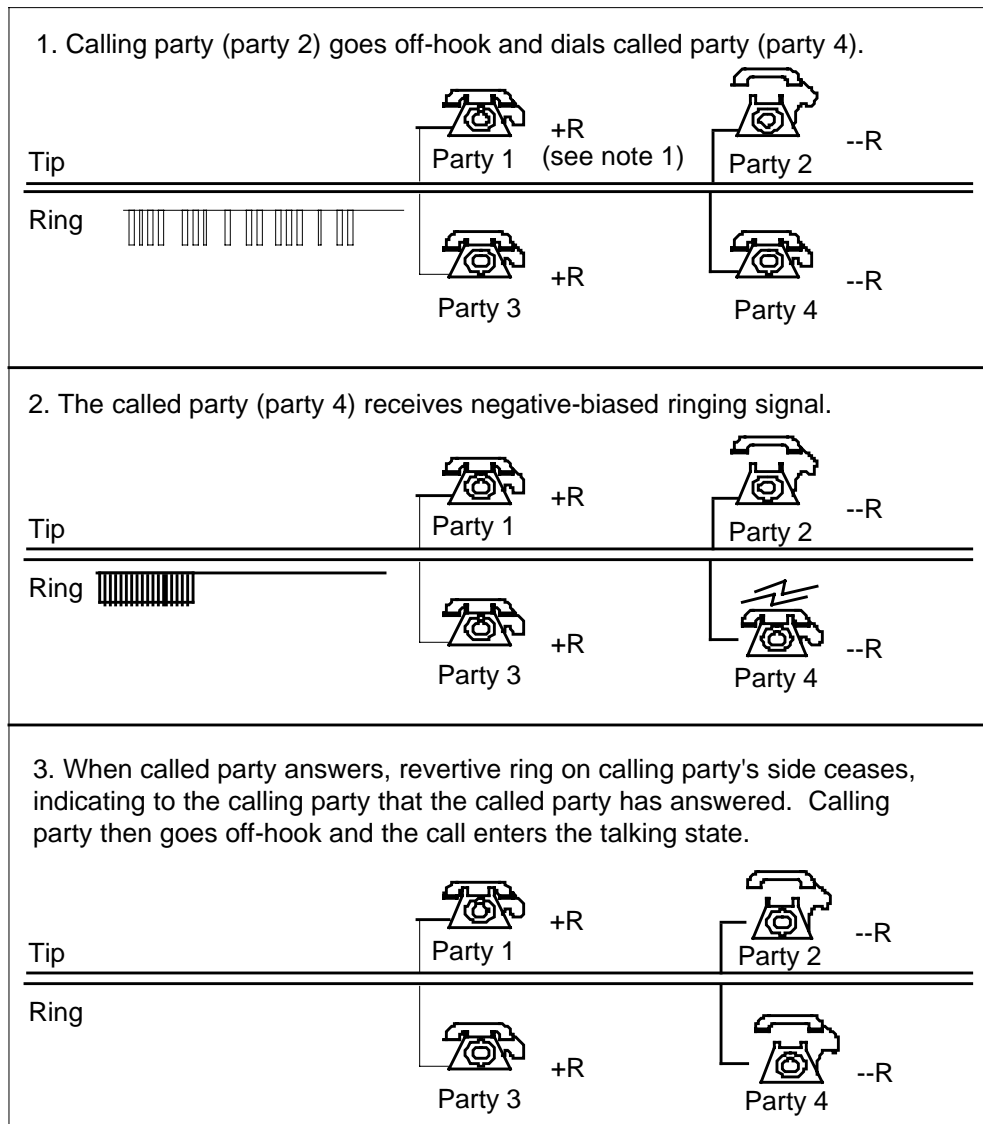
On both the tip and ring side, the ringer of one party is polarized for a positive-biased ringing signal, while the ringer of the other party is polarized for a negative-biased signal. A positive-biased ringing signal applied to the tip side, for example, rings only the party on the tip side with the positive-biased ringer.

In the semi-selective configuration, a maximum of eight parties can be connected to one line, with four on the tip side and four on the ring side. On each side, two ringers are polarized for a positive-biased ringing signal, while the other two are polarized for a negative-biased ringing signal. A positive-biased ringing signal applied to the tip side, for example, in the semi-selective configuration, rings only the two parties with ringers polarized for a positive ringing signal. Because two parties ring simultaneously, a single ring (code 1) and a 2-ring (code 2) ringing scheme is used to distinguish between the two parties.

Revertive calls (calls from a subscriber on a multiparty line to another subscriber on the same party line) are permitted in the superimposed scheme. The calling party receives revertive ringing while the called party is being rung if the calling party is on the opposite side, tip or ring, of the called party, or the calling party is on the same side but with the opposite polarity of the called party.

If the calling party is on the same side with the same polarity as the called party, the calling party, after going on-hook, is rung simultaneously with the called party.

The following figure illustrates a call being placed from the tip side of a multiparty, superimposed ringing line to a party on the ring side of the same line with a negatively-biased ringer.

Figure 1-8 Call on multiparty superimposed ringing line

Note 1: +R indicates positive-biased ringers and -R indicates negative biased ringers.

Note 2: This diagram does not show the ground connections of the tip and ring circuits. These grounds are provided at the subscriber's location.

The dc component of the superimposed ringing signal determines the ringer selection. The following table lists the values of both the ac and dc components of the superimposed ringing signals.

Table 1-1 Superimposed ringing signal - ac and dc components>

ac	dc	Frequency (Hz)
86	-38	20
86	+36	20
86	-52	20
86	+52	20
105	+52	20
105	-52	20

The following figures illustrate the relationship between the ringing signal and the DMS-100 ringing cycle.

Figure 1-9 LCE superimposed reverteive ringing with no immediate ring

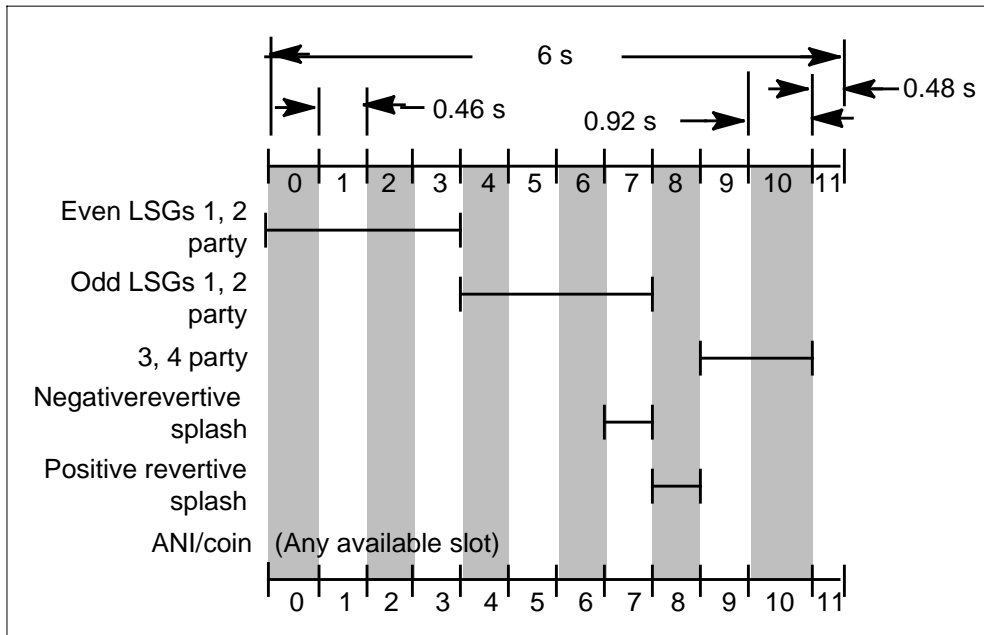


Figure 1-10 LCE superimposed revertive ringing with immediate ring enabled

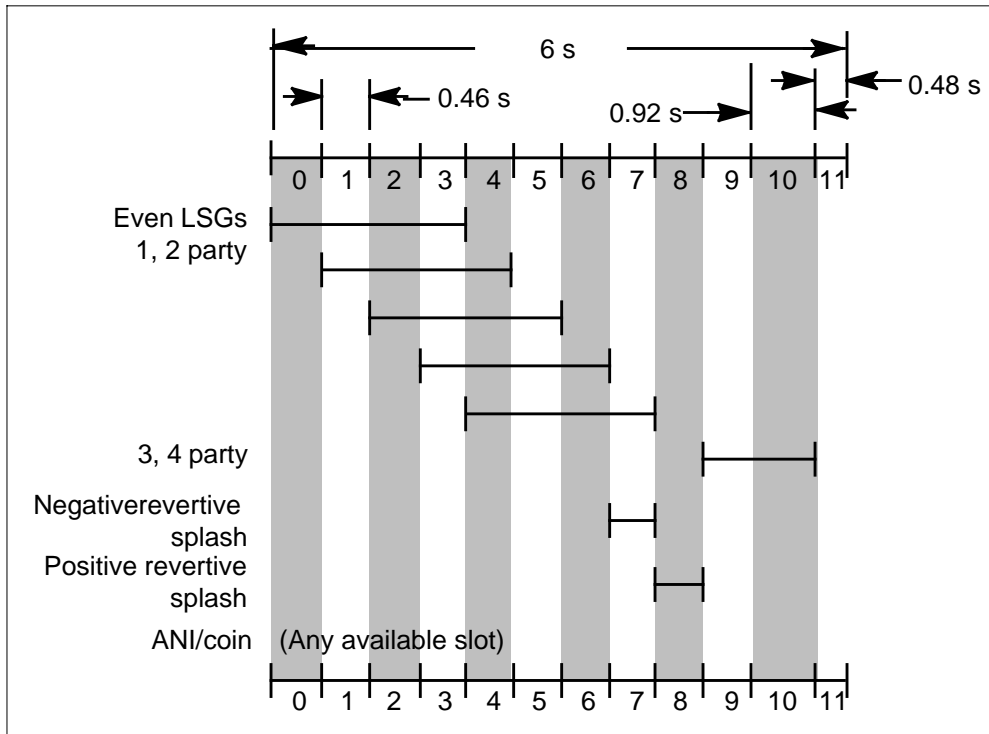


Figure 1-11 LCE superimposed revertive ringing with no immediate ring

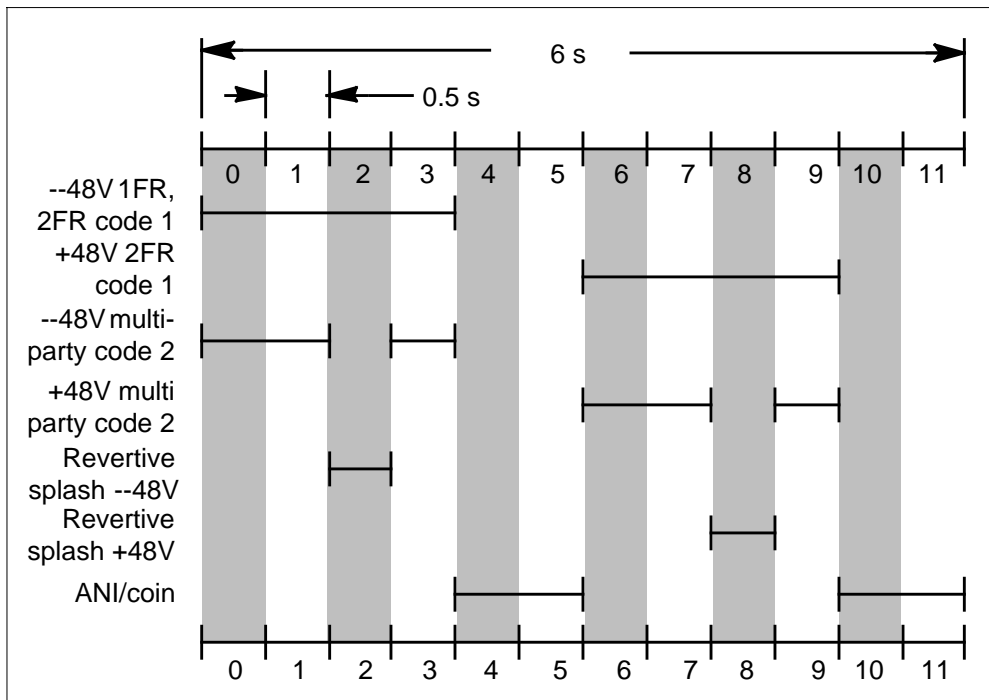
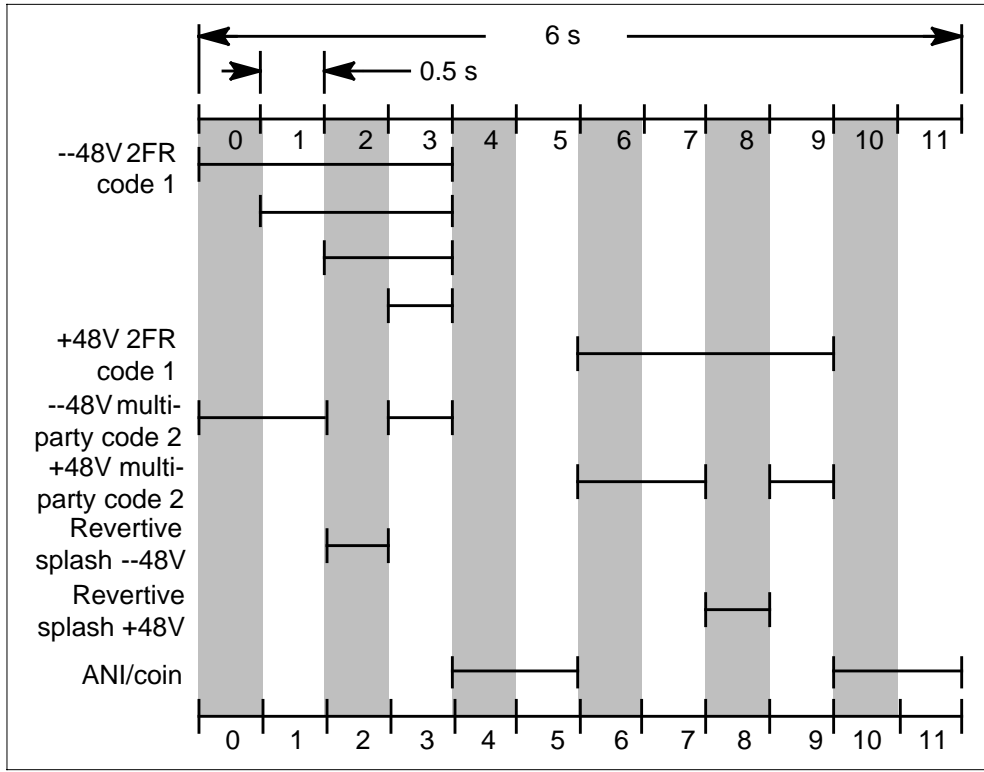
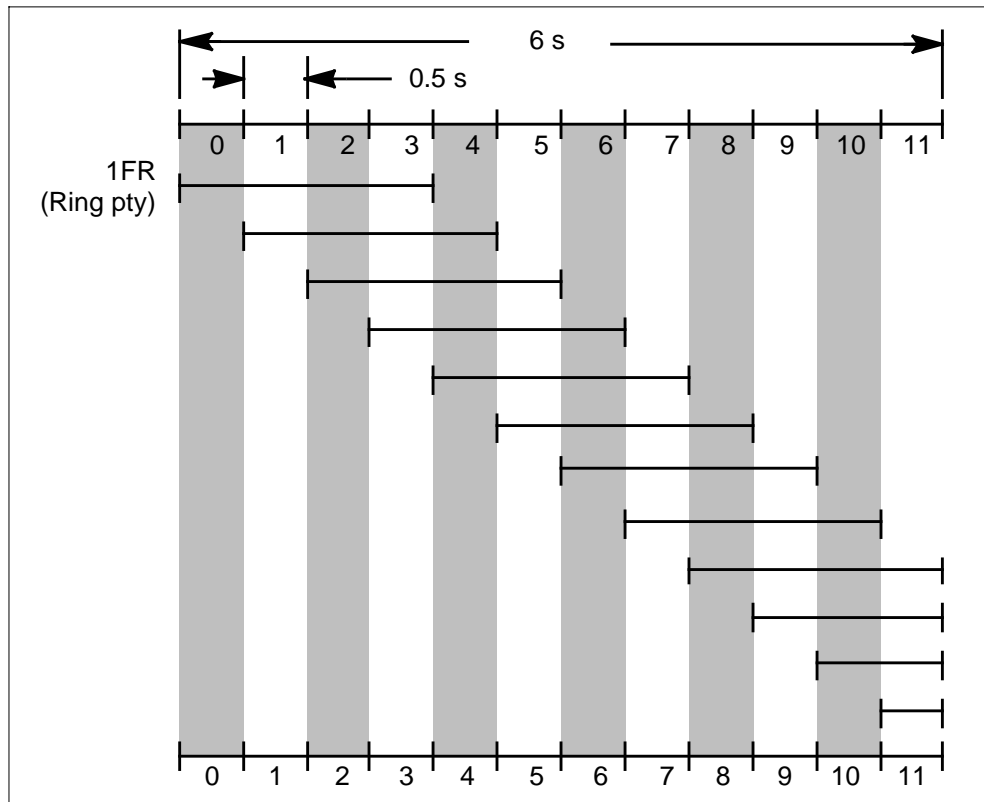


Figure 1-12 LCE superimposed revertive ringing with immediate ring enable



For the LCM of the LCE frame/cabinet with coded immediate ringing and the central control (CC) Patch TLA67, power ringing will be applied within 0.5 s of the start ring back illustrated in the following figure.

Figure 1-13 LCE superimposed revertive ringing with immediate ring enable

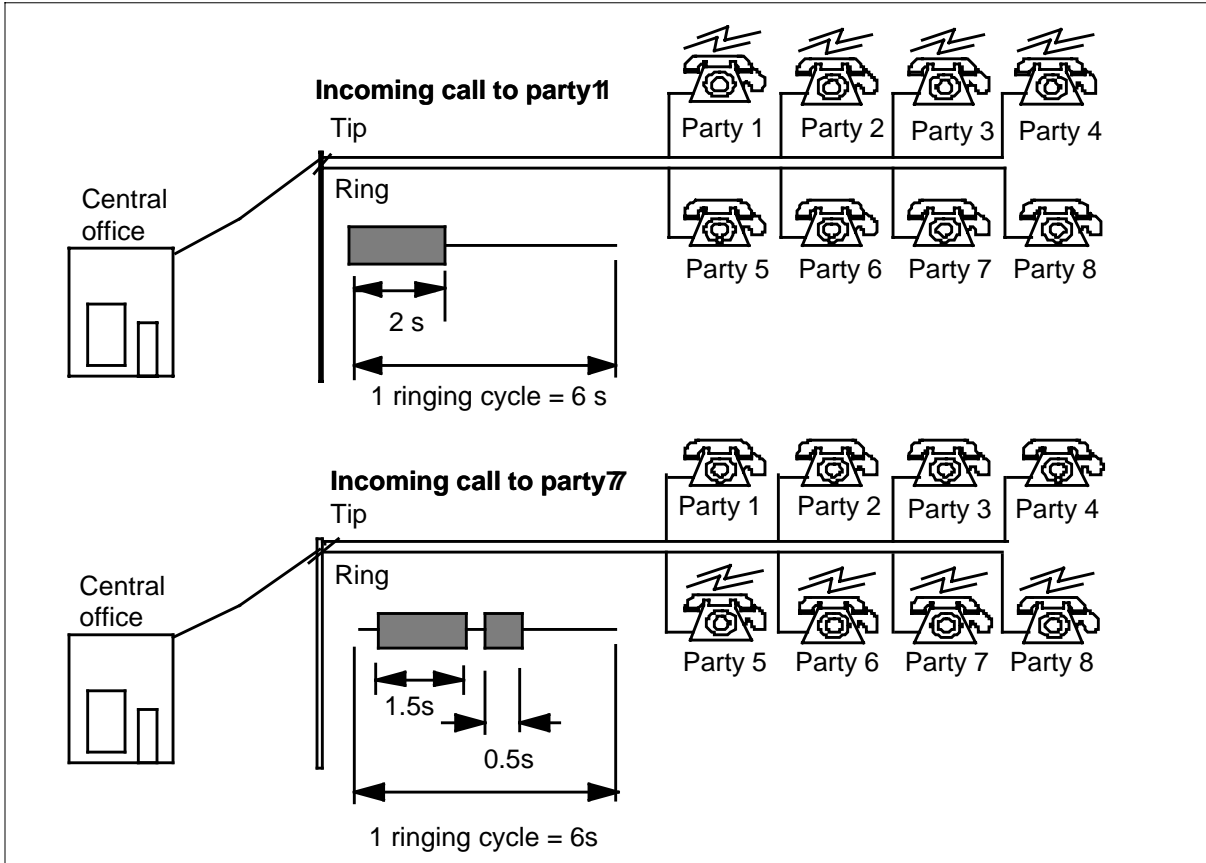
Note 1: CC Patch TLA67 does not allow the use of NT6X17 line cards for 2-party lines in the office.

Note 2: ANI/coin will use any available slots.

Coded ringing

Coded ringing is used on multiparty lines to distinguish individual parties from other parties on the tip or ring side of the line. In a multiparty configuration, one to ten subscribers can be connected to one line; that is, five on the tip side and five on the ring side. A special ringing code is available for each party on the tip and ring sides of the line, which is five codes per side. When a subscriber on a multiparty line rings, the ringing code for the called subscriber is applied to the tip or ring side of the line, depending on which side of the line the called subscriber is connected. All subscribers on the same side of the line as the called subscriber receive the ringing code for the called party. The called party, upon identifying his or her ringing code, answers the call. The following figure illustrates ringing on a coded ringing, multiparty line.

Figure 1-14 Ringing on multiparty coded ringing line



Subscribers on multiparty lines can make calls to other subscribers on the same line by placing a revertive call. In a revertive call, the originating subscriber dials the called number. The DMS-100 then routes the originator to treatment, which can be a busy tone or an announcement. The treatment given is defined in table TMTCNTL. A description of the treatment table is found in the *Customer Data Schema Reference Manual*. Upon receiving busy tone or announcement, the originator goes on-hook within a specified time and the called party is rung.

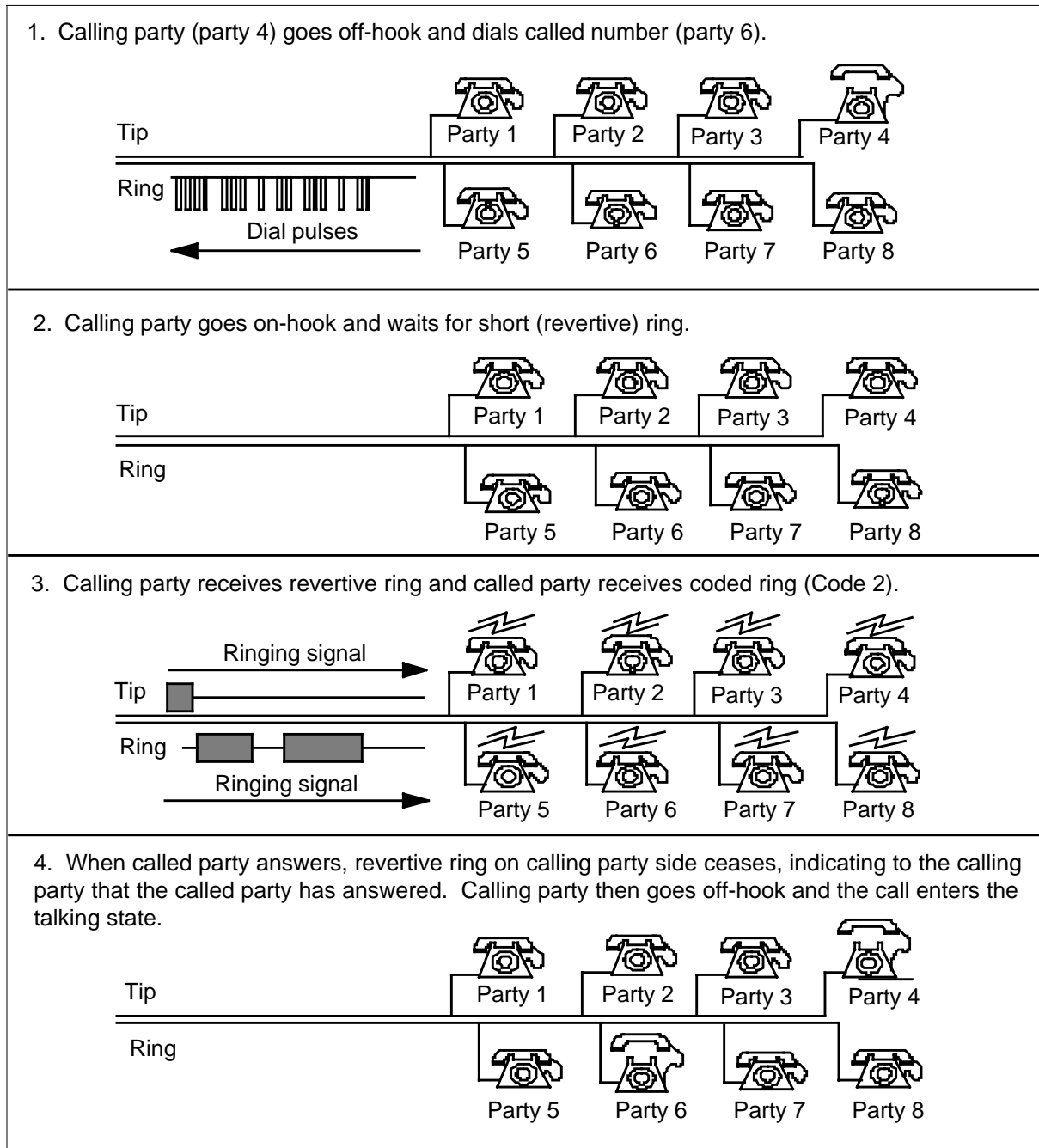
An announcement also can also be sent to the terminating party when the call is answered, notifying them they are receiving a call from someone on their party. This treatment also is defined in table TMTCNTL.

If the calling and called subscribers are on the same side of the line (tip or ring), the calling party waits for the called party to answer (physical ringing stops) and then goes off-hook to talk. If the calling and called parties are on opposite sides of the line, the calling party receives a revertive splash ring while the called party receives the coded ring of the called party. Revertive ringing can be enabled or disabled by office parameter REVRING in table

OFCENG. Office parameter REVRING is described in *Office Parameters Reference Manual*.

The following figure illustrates the sequence of events that occurs when a revertive call is made on a coded ringing, multiparty line.

Figure 1-15 Revertive call on coded ringing multiparty line



The following ringing codes are used in the coded ringing scheme:

- ring party, 1R, 2FR
- tip party, 2FR
- multiparty, code 1
- multiparty, code 2
- multiparty, code 3 distinctive ring
- multiparty, code 4
- multiparty, code 5
- revertive splash ring party
- revertive splash tip party
- ANI/coin
- teen ringing, code 1
- teen ringing, code 2
- teen ringing, code 3

The ringing signal patterns for each type of coded ringing as they occur over the ringing cycle are illustrated in the following figures.

Figure 1-16 LME/LCE coded ringing patterns - immediate ring disabled

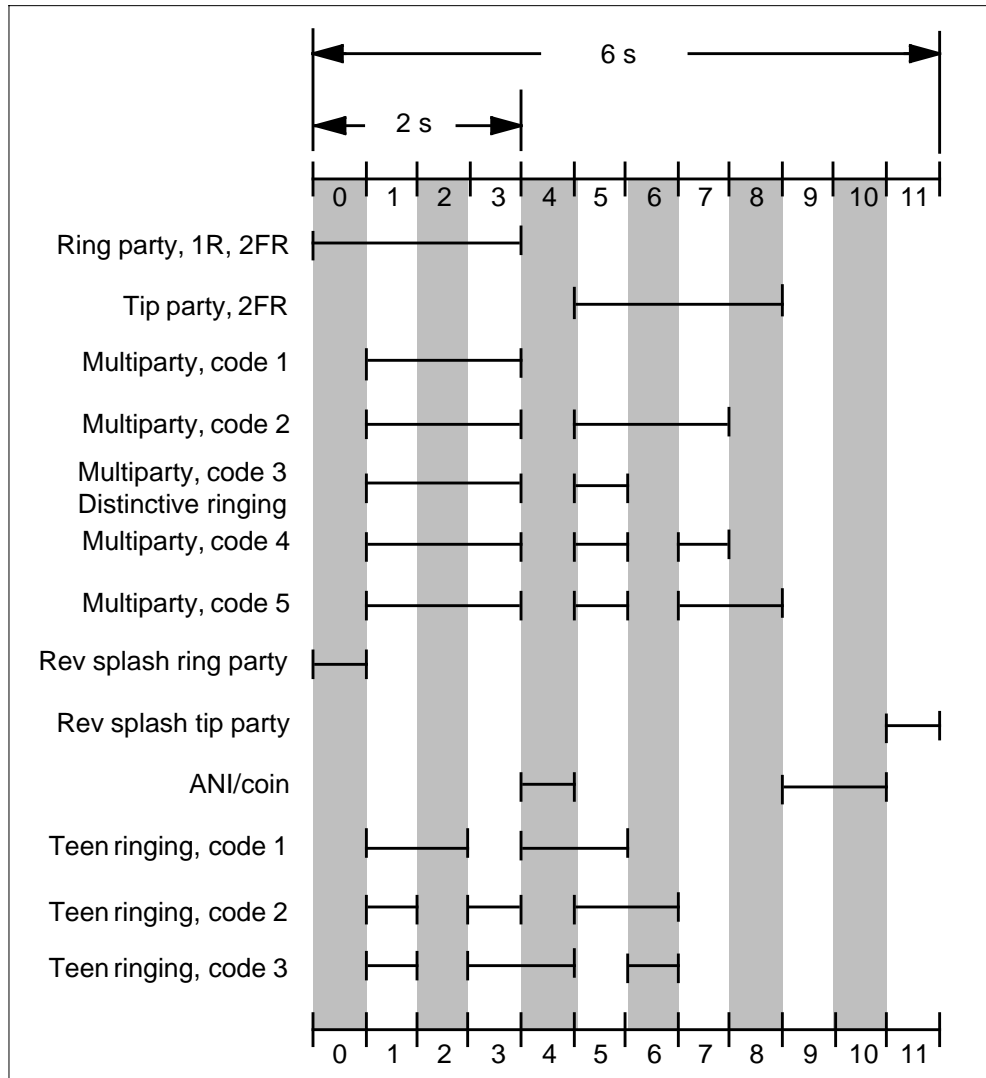
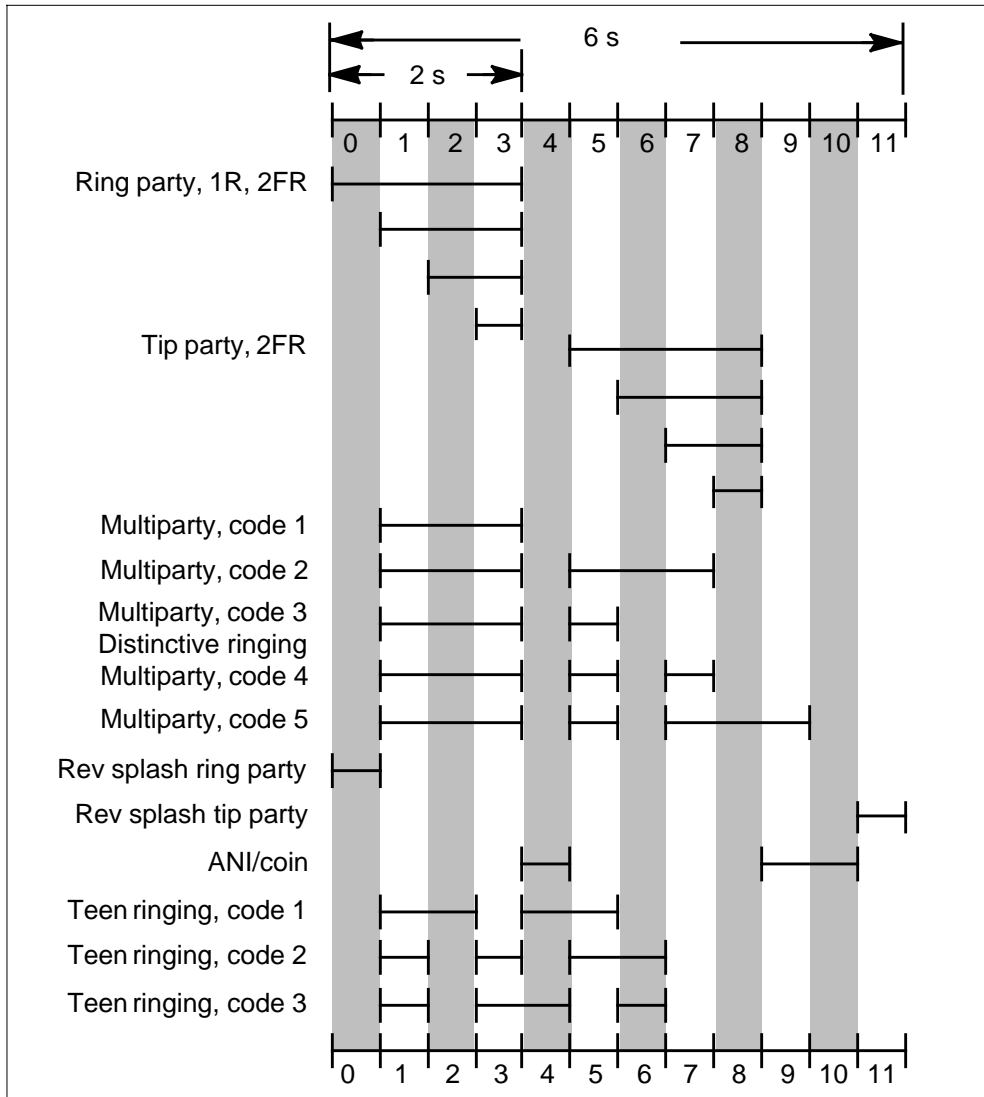


Figure 1-17 LME/LCE coded ringing patterns with immediate ring enabled



Distinctive ringing

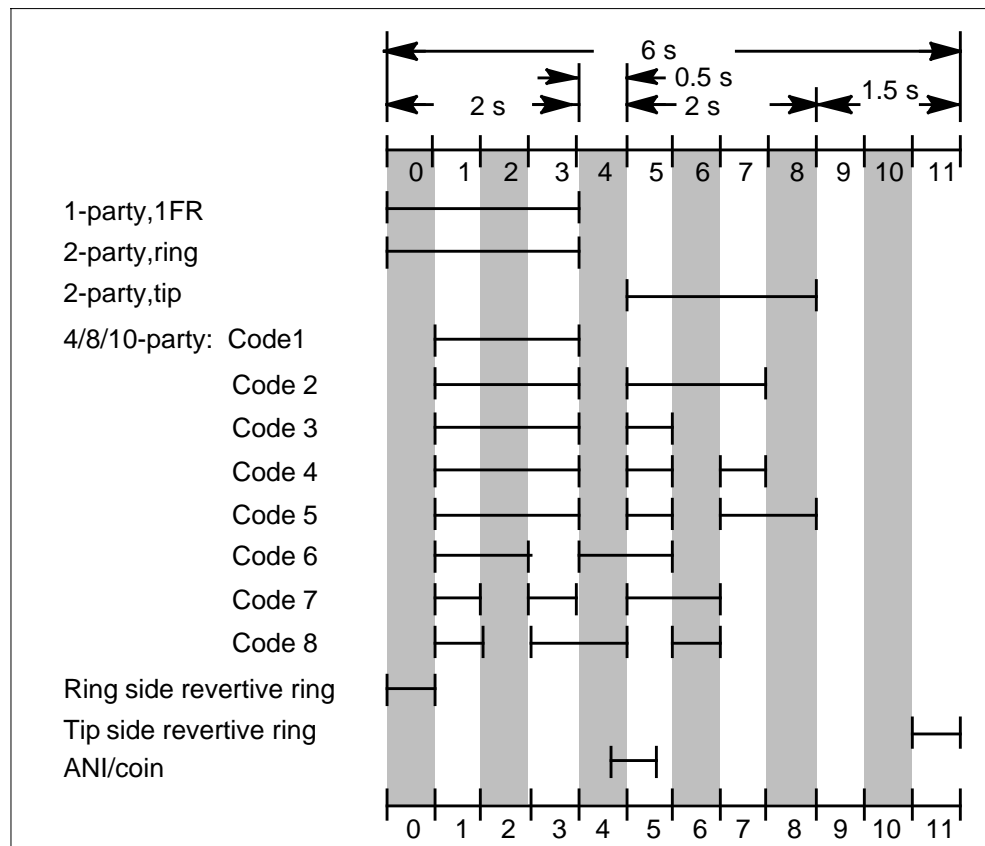
Distinctive ringing is used by Meridian Digital Centrex (MDC) subscribers to distinguish different types of incoming calls. It is also used for message waiting (MWT) and custom local area signaling services (CLASS) message waiting indicator (CMWI) features. Ringing codes are used to distinguish:

- station calling
- ring again and call back queuing
- Scopedial precedence ringing
- ring splash for call forwarding

Distinctive ringing is supported by the coded ringing, decimonic scheme at 20 Hz, and the REA frequency selective scheme at 30 Hz.

The following figures illustrate the relationship between the distinctive ringing signals and the DMS-100 ringing cycle for the coded ringing and frequency selective ringing schemes.

Figure 1-18 Distinctive ringing patterns - coded ringing scheme



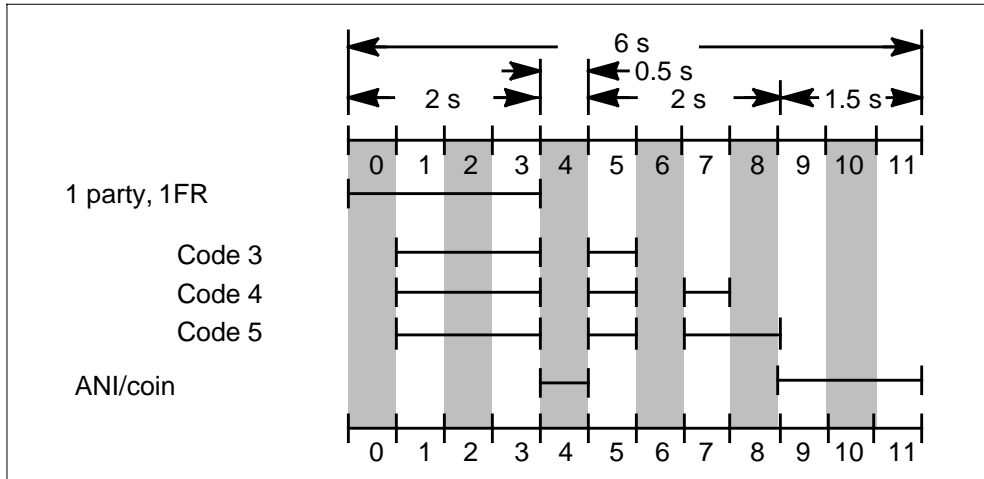
Note 1: Coded 30 Hz ringing does not support 2/4/8/10 multiparty lines or revertive ringing.

Note 2: Coded 20/30 Hz ringing for the LCM of the LCE frame/cabinet supports 2/4/8/10 multiparty lines with patterns shown in figure "LME/LCE coded ringing patterns - immediate ring disabled" and the figure "LME/LCE coded ringing patterns with immediate ring enabled." This can be accomplished using switch settings for 20/30 Hz and a 2,2,1,1 cadence.

Note 3: Coded 30 Hz ringing for LMEs does not support 2/4/8/10 multiparty or revertive ringing.

Note 4: Ring codes 2 and 6 have the same cadence but different timing, making them very similar; therefore, do not assign these codes to the same line.

Figure 1-19 Distinctive ringing patterns - frequency selective scheme

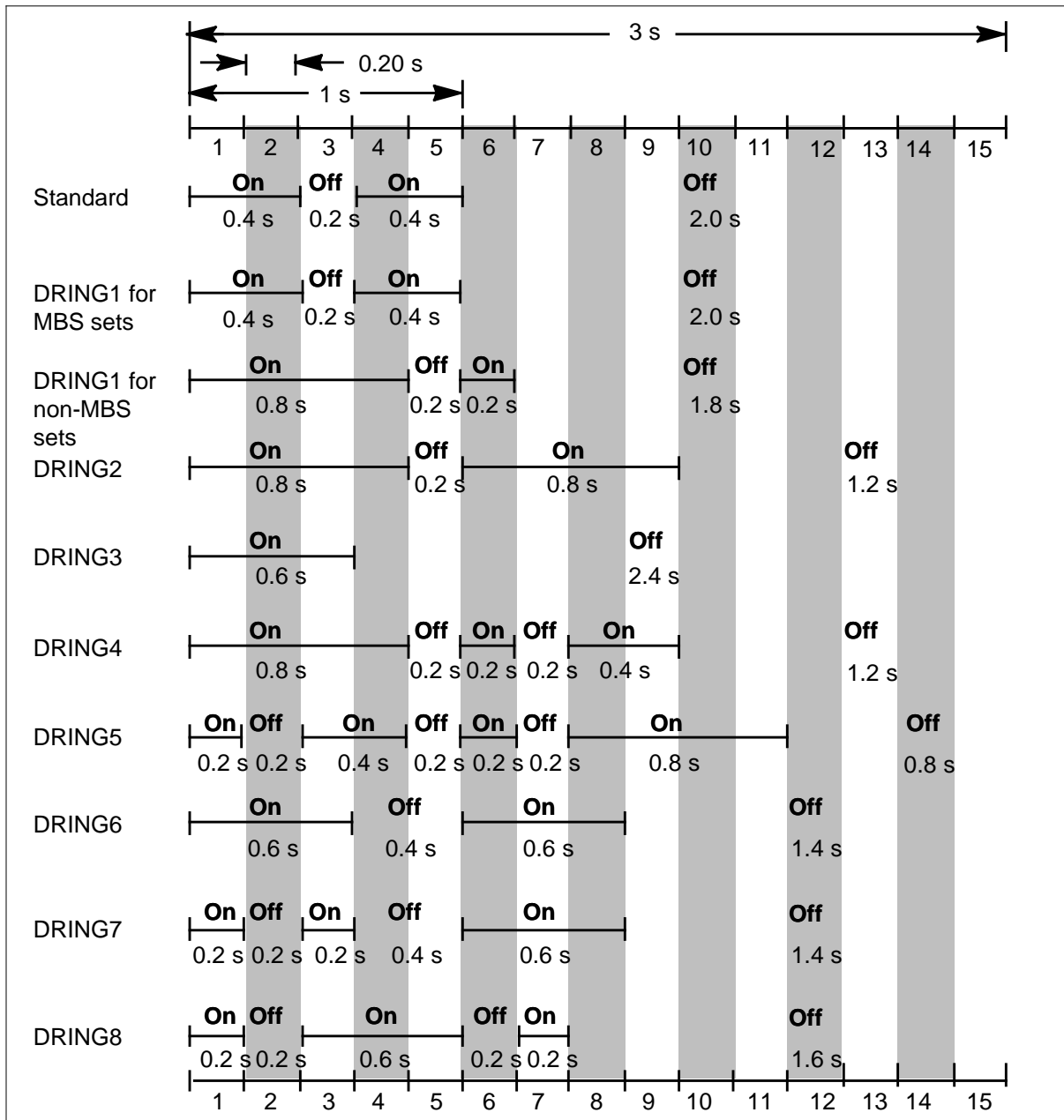


Note: Coded 30 Hz ringing for LMEs does not support 2/4/8/10 multiparty or revertive ringing.

Distinctive ringing (ringing type C3C)

The ringing signal for markets that have adopted the C3C ringing type (such as Malaysia and Australia) is based on a 3 s cycle. The following figure illustrates the distinctive ringing pattern for C3C ringing. There is no distinctive ring 0 since this is considered to be standard ringing. Note that distinctive ringing 1 (DRING1) for MBS sets differs from DRING1 for non-MBS sets, but the remaining DRING patterns are the same.

Figure 1-20 Distinctive ringing patterns for the C3C ringing type



Teen ringing

Teen ringing, introduced by feature package NTX219, allows up to 4 directory numbers (DN) to be assigned to one line without the need for additional equipment at the subscriber's end. Special ringing patterns are used to distinguish between the called numbers.

In the teen ringing configuration, a primary directory number (PDN) and up to three secondary directory numbers (SDN) are assigned to a subscriber's line. When the PDN is called, standard 1FR ringing is applied to the line (2-s ring, 4-s silence). When a SDN is called, one of the following three special ringing patterns is applied:

- 2 long rings
- 2 short rings, 1 long ring
- 1 short ring, 1 long ring, 1 short ring

Teen ringing is supported in superimposed ringing, coded ringing, and frequency selective ringing using 30 Hz ringing schemes.

The following figures illustrate the relationship between the teen ringing signal and the DMS-100 switch ringing cycle for superimposed, coded 20 Hz, and coded 30 Hz ringing.

Figure 1-21 Teen ringing - superimposed ringing scheme

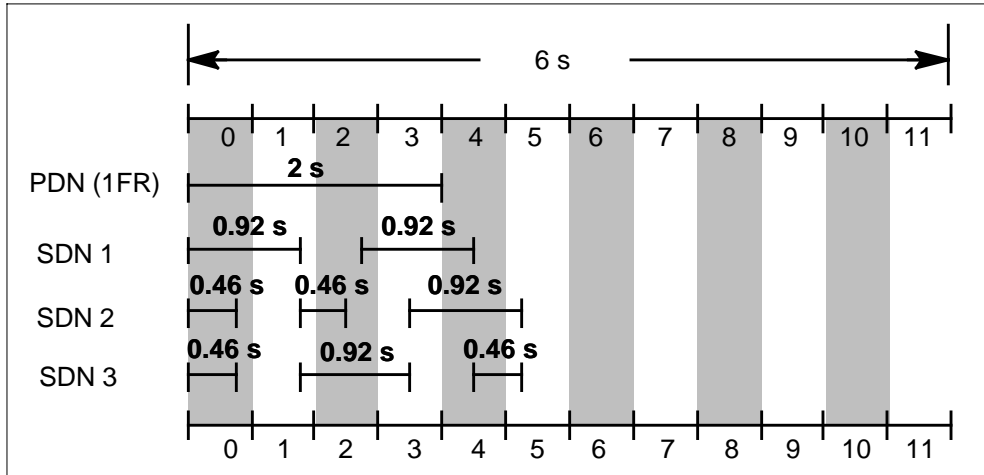


Figure 1-22 Teen ringing - coded ringing scheme

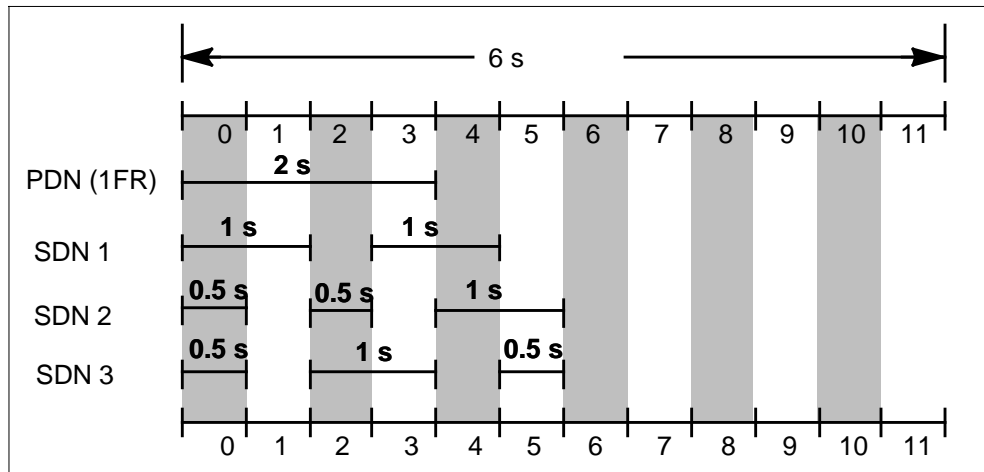
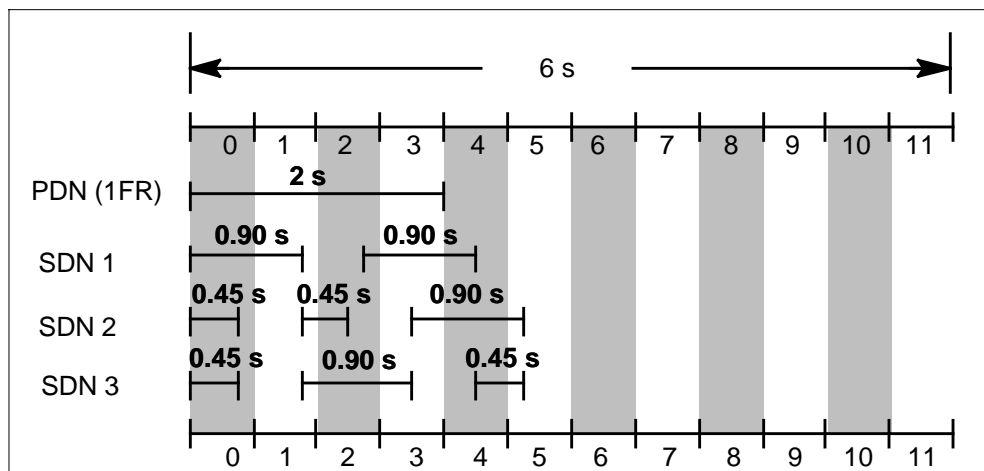


Figure 1-23 Teen ringing - frequency selective 30 Hz



In SCMs the teen ringing follows the coded 20 Hz pattern, with long rings being 1s and short rings being 0.5 s.

Japan ringing (ringing type C3D)

This section describes physical ringing for DMS-100 switching equipment provisioned in the Japanese public switching telephone network. The physical ringing patterns described in this section are used for Japanese plain ordinary telephone system (POTS) lines and Meridian business set (MBS) lines.

Ringing is provided for NT6X33 and NT6X21 line cards on remote line concentrating modules (RLCM).

The standard ring cycle for the public switching telephone network in Japan is a total cycle time of 6 seconds. The diagram that follows shows distinctive

ringing and feature ringing. Note that some values of ON and OFF have a +/-0.0625 second range caused by hardware use in the LCM layer.

The earlier C3D ring patterns change as a result of the conversion to the new time slot format. The following table describes the ring codes.

Table 1-2 C3D Ring Patterns

Code	Ring Code Name
0	Ring Code 0—Standard Ring
1	Ring Code 0—Standard Ring (Delayed)
2	Distinctive Ring Code 1
3	Distinctive Ring Code 2 and Special Ring
4	Distinctive Ring Code 3 and Ring Again
5	Distinctive Ring Code 4 and Precedence Ring
6	Distinctive Ring Code 5 and International Ring Again
7	Call Forward Ring Splash
8	CPE Activation Ring (CAR)
9	Not Used
10	Continuous Ring
11	Not Used
12	Distinctive Ring Code 6 and Teen Service 1
13	Distinctive Ring Code 7 and Teen Service 2
14	Distinctive Ring Code 8 and Teen Service 3

Figure 1-24 Ringing patterns

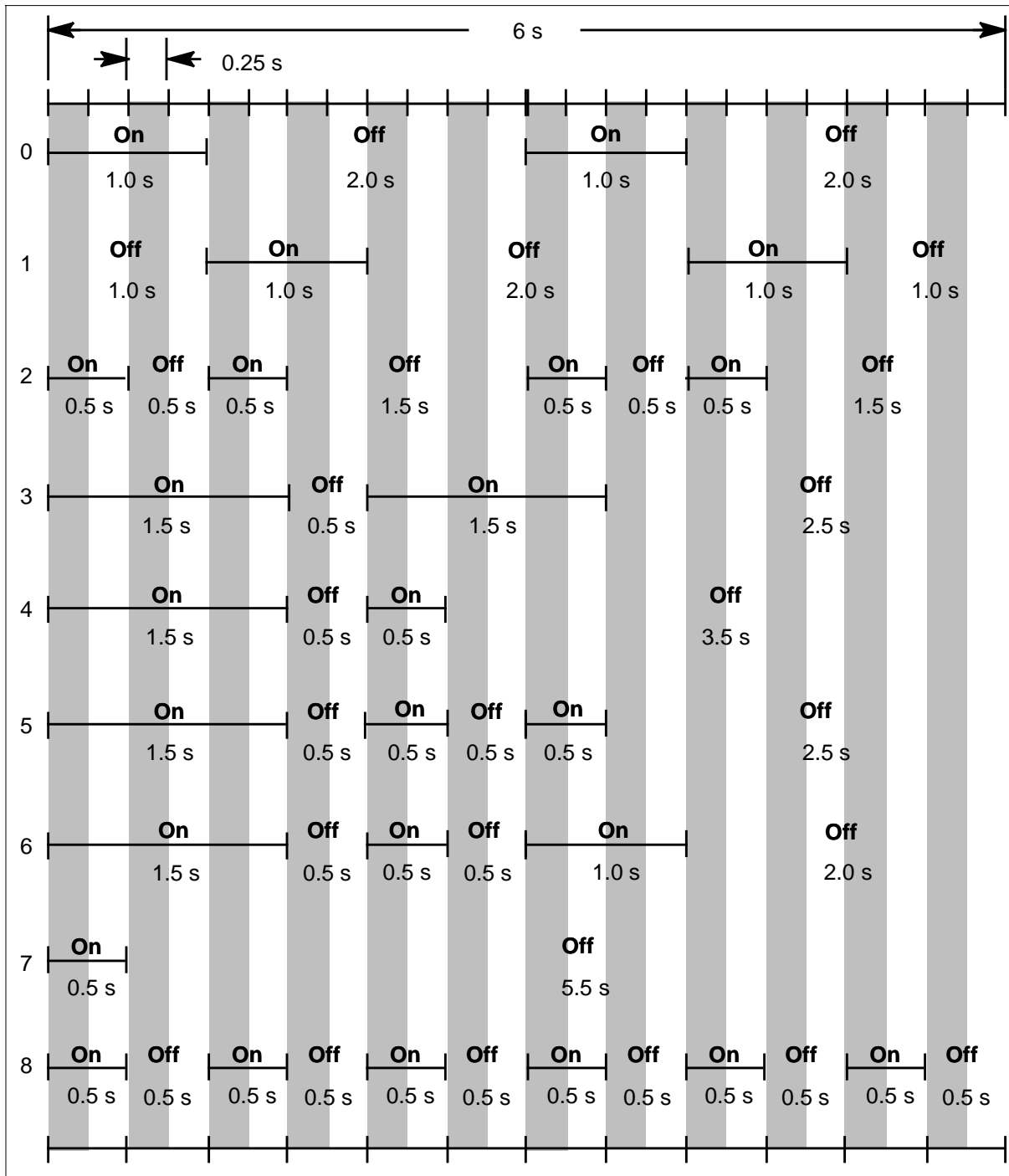
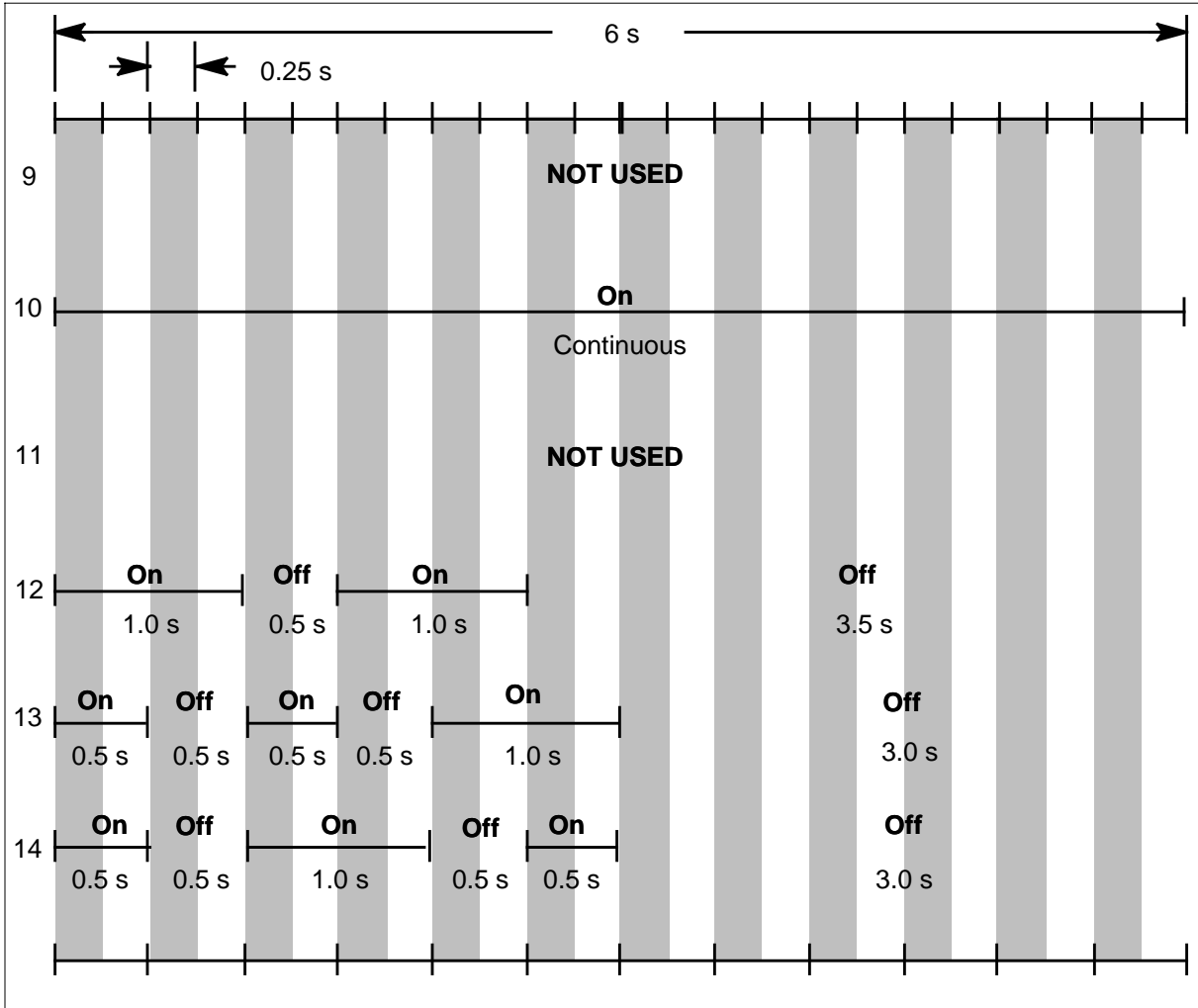


Figure 1-25 Ringing patterns (cont'd)



Note 1: Ring patterns 2 to 8 use a 6-s cycle provided by the NT6X60BA ringing generator. Ringing patterns 0 and 1 are repeated twice within the 6-s cycle.

Note 2: To download the C3D ringing pattern data, complete the required One Night Process (ONP). For more information, refer to the *One Night Process Software Delivery Procedures*, 297-8991-303.

United Kingdom ringing

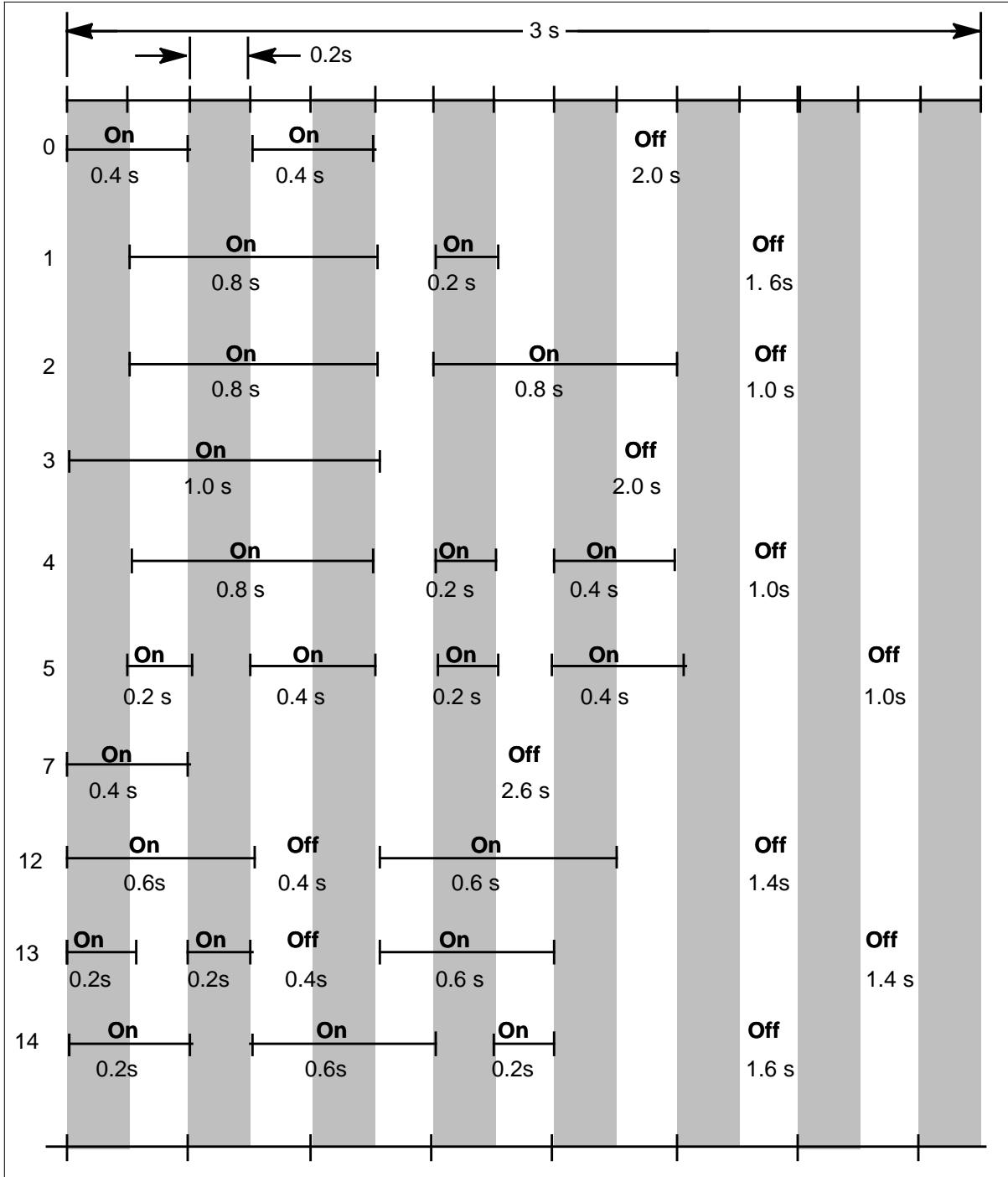
United Kingdom ringing is ring type C3C, based on a total cycle time of 3.0 s. Standard United Kingdom ringing is ring code 0, shown in the following table.

Table 1-3 Standard United Kingdom Ringing

Ring code	ON	OFF	ON	OFF
0	0.4 s	0.2 s	0.4 s	2.0 s

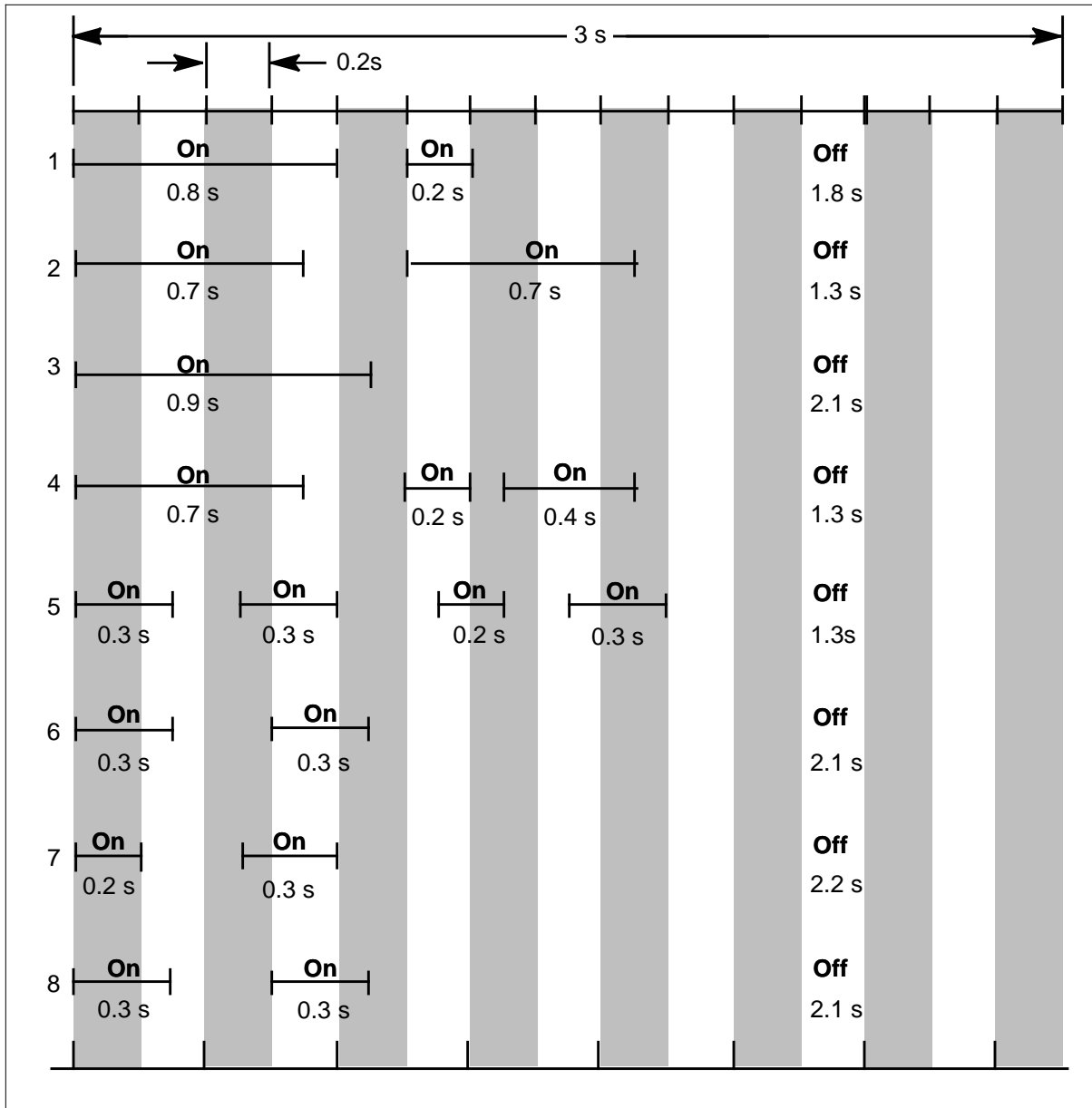
There are only ten different ring codes used in United Kingdom ringing. All ten United Kingdom ringing patterns are described in the following figure.

Figure 1-26 United Kingdom Ringing patterns



There are eight distinct ringing patterns for the United Kingdom. The following figure describes these ringing patterns.

Figure 1-27 United Kingdom distinctive ringing patterns



Ringling characteristics

The following tables provide a summary of DMS-100 switch ringing characteristics according to PM type.

Table 1-4 Summary of ringing in peripheral modules (Sheet 1 of 2)

PM type	RG PEC	Ring type supported	Maximum lines ring
LMC RLM	NT2X27	20 Hz single party Coded Frequency selective Superimposed	15 lines (1FR). Hard coded. Depends on loop.
LCM, RSC	NT6X30	20 Hz single party Coded Frequency selective Superimposed	25 - 28 lines (1FR) (based on 3 ringers/line and short loop length). The actual number varies because LCM software allows new ring requests to be added until the ringing generator is near its maximum.
OPM, RLCM	NT6X60	20 Hz single party Coded Frequency selective Superimposed	25 - 28 lines (1FR) (based on 3 ringers/line and short loop length). The actual number varies because LCM software allows new ring requests to be added until the ringing generator is near its maximum.
SCM-100U; SCM-100R	QPP426, QPP435, QPP430	20 Hz single party Coded Frequency selective Superimposed	5 lines/phase (IFR)
SCM-100S	----	20 Hz single party Coded Frequency selective Superimposed	5 lines/phase (IFR)

Table 1-4 Summary of ringing in peripheral modules (Sheet 2 of 2)

PM type	RG PEC	Ring type supported	Maximum lines ring
UEN	NTNP44	20 Hz single party Coded	16 ADSL DMT Combo Line cards per shelf/ 4 loops each for a total of 64 loops in shelf.
	NTNP50	20 Hz single party Coded	16 POTS line cards per shelf/ 32 POTS loops for a total of 512 loops in shelf. 4 shelves per Universal Edge equipment (UEE) frame

The following table provides a summary of NT2X27 ringing generator parameters.

Table 1-5 Ringing generator parameters - NT2X27 (Sheet 1 of 2)

Ringing type	RG PEC	Frequency	Voltage	Maximum ring lines
Bell (86 V)	NT2X27AA	20 Hz	-52 V dc	15
		20 Hz	-40 V dc	15
		20 Hz	+40 V dc	15
Decimonic	NT2X27AB	20 Hz	87 V ac	15
		20 Hz	105 V ac	12
		30 Hz	110 V ac	9
		40 Hz	115 V ac	6
		50 Hz	125 V ac	4
		60 Hz	125 V ac	4
Harmonic	NT2X27AC	20 Hz	87 V ac	15
		16.67 Hz	105 V ac	15
		25 Hz	110 V ac	11
		33.33 Hz	115 V ac	7
		50 Hz	125 V ac	4
		66.67 Hz	125 V ac	3

Table 1-5 Ringing generator parameters - NT2X27 (Sheet 2 of 2)

Ringling type	RG PEC	Frequency	Voltage	Maximum ring lines
Synchronomic 16	NT2X27AD	20 Hz	87 V ac	15
		16 Hz	105 V ac	15
		30 Hz	110 V ac	9
		42 Hz	115 V ac	6
		54 Hz	125 V ac	4
		66 Hz	125 V ac	3
Synchronomic	NT2X27AE	20 Hz	87 V ac	15
		20 Hz	105 V ac	12
		30 Hz	110 V ac	9
		42 Hz	115 V ac	6
		54 Hz	125 V ac	4
		66 Hz	125 V ac	3
Bell (105 V)	NT2X27AF	20 Hz	-52 V dc	15
		20 Hz	-40 V dc	15
		20 Hz	+40 V dc	15

The following table provides a summary of NT6X30 ringing generator parameters.

Table 1-6 Ringing generator parameters - NT6X30 (Sheet 1 of 2)

Ringling type	RG PEC	Frequency	Voltage	Maximum ring lines
Bell (86 V)	NT6X30AA	20 Hz	-52 V dc	24 - 28
		20 Hz	-40 V dc	24 - 28
		20 Hz	+40 V dc	24 - 28
Decimonic	NT6X30AA	20 Hz	87 V ac	24
		20 Hz	105 V ac	8
		30 Hz	110 V ac	
		40 Hz	115 V ac	
		50 Hz	125 V ac	
		60 Hz	125 V ac	

Note: Maximum number of ringing lines is based on three ringers for each line and a short loop length.

Table 1-6 Ringing generator parameters - NT6X30 (Sheet 2 of 2)

Ringling type	RG PEC	Frequency	Voltage	Maximum ring lines
Harmonic	NT6X30AA	20 Hz	87 V ac	24
		16.67 Hz	105 V ac	8
		25 Hz	110 V ac	
		33.33 Hz	115 V ac	
		50 Hz	125 V ac	
		66.67 Hz	125 V ac	
Synchronomic 16	NT6X30AA	20 Hz	87 V ac	24
		16 Hz	105 V ac	8
		30 Hz	110 V ac	
		42 Hz	115 V ac	
		54 Hz	125 V ac	
		66 Hz	125 V ac	
Synchronomic	NT6X30AA	20 Hz	87 V ac	24
		20 Hz	105 V ac	8
		30 Hz	110 V ac	
		42 Hz	115 V ac	
		54 Hz	125 V ac	
		66 Hz	125 V ac	
Bell (105 V)	NT6X30AA	20 Hz	-52 V dc	9
		20 Hz	-40 V dc	9
		20 Hz	+40 V dc	9

Note: Maximum number of ringing lines is based on three ringers for each line and a short loop length.

The following table provides a summary of NT6X60 ringing generator parameters.

Table 1-7 Ringing generator parameters - NT6X60 (Sheet 1 of 2)

Ringling type	RG PEC	Frequency	Voltage	Maximum ring line
Bell (86 V)	NT6X60AA	20 Hz	-52 V dc	24 - 28
		20 Hz	-40 V dc	24 - 28
		20 Hz	+40 V dc	24 - 28
Decimonic	NT6X60AA	20 Hz	87 V ac	24
		20 Hz	105 V ac	8
		30 Hz	110 V ac	
		40 Hz	115 V ac	
		50 Hz	125 V ac	
		60 Hz	125 V ac	
Harmonic	NT6X60AA	20 Hz	87 V ac	24
		16.67 Hz	105 V ac	8
		25 Hz	110 V ac	
		33.33 Hz	115 V ac	
		50 Hz	125 V ac	
		66.67 Hz	125 V ac	
Synchronomic 16	NT6X60AA	20 Hz	87 V ac	24
		16 Hz	105 V ac	8
		30 Hz	110 V ac	
		42 Hz	115 V ac	
		54 Hz	125 V ac	
		66 Hz	125 V ac	

Note: Maximum number of ringing lines is based on three ringers for each line and a short loop length.

Table 1-7 Ringing generator parameters - NT6X60 (Sheet 2 of 2)

Ringling type	RG PEC	Frequency	Voltage	Maximum ring line
Synchronomic	NT6X60AA	20 Hz	87 V ac	24
		20 Hz	105 V ac	8
		30 Hz	110 V ac	
		42 Hz	115 V ac	
		54 Hz	125 V ac	
		66 Hz	125 V ac	
Bell (105 V)	NT6X60AA	20 Hz	-52 V dc	9
		20 Hz	-40 V dc	9
		20 Hz	+40 V dc	9

Note: Maximum number of ringing lines is based on three ringers for each line and a short loop length.

Each POTS 32 NTNP50 line card has a dedicated ringing generator. The following table lists the characteristics of the on board ringing generator.

Table 1-8 Ringing generator characteristics - UEN

Characteristic	Value	Purpose
Input	-48 V	Input power
Output	86 Vrms at nominal 20 Hz, superimposed on a dc offset equal to the talk battery voltage	Ringing voltage output. The ringing generator is capable of ringing 15 VA or 15 REN (ringing equivalent number) at the shortest loop length.
		Coded ringing
	Frequencies of 25 Hz or 50 Hz are software selectable	Alternate output frequencies
Zero crossing indicator		Indicates the output dc voltage zero crossing to prolong life of ringing relays
dc feed resistances	205 Ω nominal	

The following table provides a summary of ringing generator power specifications in the NTNP50 POTS 32 line card.

Table 1-9 Ringing generator power specifications - NTNP50

Parameter	Minimum	Nominal	Maximum	Units
Supply Voltage	36	48	75	V dc
Supply Current	0.3		0.8	Amps

The following table provides a summary of the compatibility of DMS-100 ringing types.

Table 1-10 Compatibility of DMS-100 ringing types

Ringing type	Immediate ring	Distinctive ring
Superimposed	Yes (see notes 1-3)	No
Coded	Yes	Yes
Frequency selective	Yes (see note 4)	No
Immediate ringing	---	No
Distinctive ringing	No	---

Note 1: There can be no more than 2FRs, that is, no 4FRs, 8-party or 10-party.

Note 2: All 6X30 DIP switch settings must be set with switch 2 and 3 on (1) and switches 4 through 8 off (0).

Note 3: LCMs will not support immediate ringing on frequency selective ringing lines unless all ringing time slots have the same frequency.

Note 4: LCMs will not support immediate ringing on superimposed ringing lines unless all ringing time slots have the same dc offset.

The following table provides a summary of the compatibility of teen ringing types.

Table 1-11 Compatibility of teen ringing

Ringing type	Teen ringing
Immediate ringing	Yes
Distinctive ringing	Yes

Provisioning ringing generators

This section describes considerations that must be given to ringing when provisioning DMS-100 lines peripherals. You can find guidelines for provisioning lines peripheral modules by referring to the *Provisioning Manual*.

When assigning lines to line peripherals, pay close attention to the number and type of lines assigned to each peripheral to prevent ringing generator overload conditions.

Although Table 1-4, "Summary of ringing in peripheral modules" on page 1-32 states the maximum number of lines each ringing generator can ring simultaneously, the actual value will vary depending on the characteristics of the line. Specifically, the typical line impedance (consisting of loop resistance, capacitance, and inductance), the number of ringers on the line, and the type of ringers on the line affect the number of lines a ringing generator can ring.

When assigning lines to peripheral modules (PM), in addition to the considerations listed in *Provisioning Manual* you must consider the typical loop length and the number of ringers per line in your office when using traffic study data for provisioning peripherals. Determine the maximum number of lines you expect to be rung simultaneously at any given time and compare to the maximum number of lines stated in the Table 1-4, "Summary of ringing in peripheral modules." which are based on three ringers per line and a short loop length.

If it appears the ringing generator may be overloaded, you should consider redistributing the load to other PMs to prevent the possibility of call blocking due to ringing generator overload.

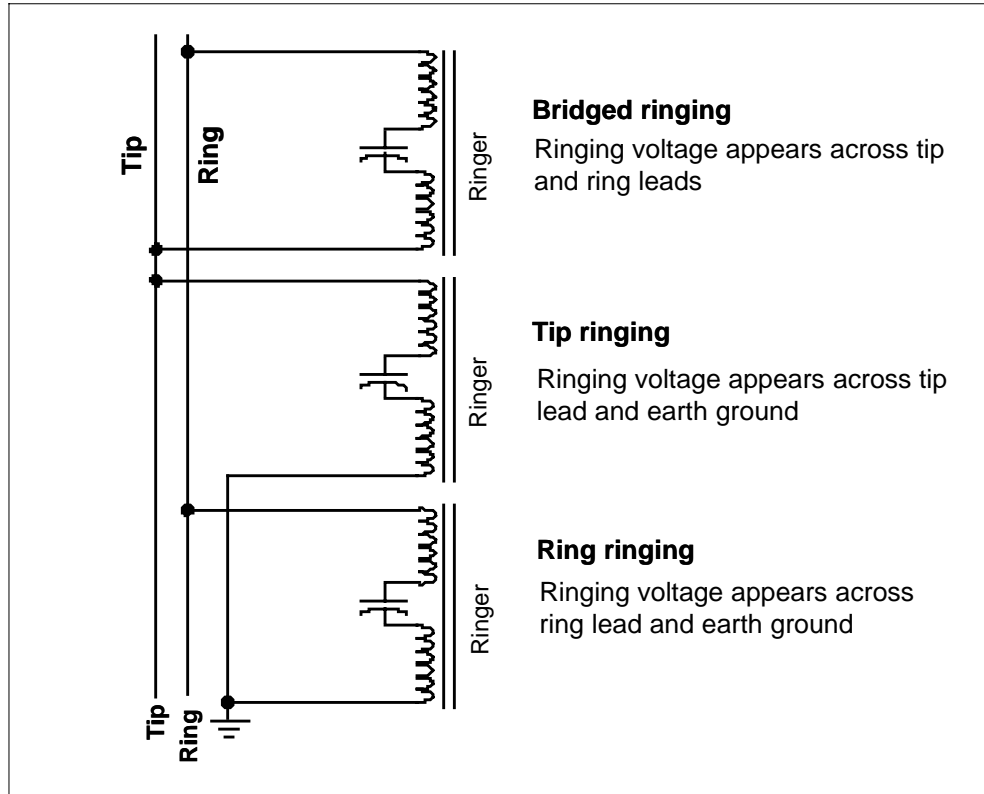
Ringer configurations

The following ringer configurations are used with the DMS-100 switch:

- bridged
- tip
- ring

Each of these configurations is illustrated in the following figure.

Figure 1-28 Ringer configurations



Bridged ringing

In the bridged ringing configuration, the subscriber ringer is connected across tip and ring. The ringing signal is applied across tip and ring. The ring lead acts as the signal source and the tip lead acts as the signal return.

Tip ringing

In the tip ringing configuration, the subscriber ringer is connected across the tip lead and earth ground. The earth ground is provided at the subscriber location. In this configuration, the ringing signal is applied to the tip lead only. The tip lead acts as the signal source and earth ground acts as the signal return path.

Ring ringing

In the ring ringing configuration, the subscriber ringer is connected across the ring lead and earth ground. The earth ground is provided at the subscriber location. In this configuration, the ringing signal is applied to the ring lead only. The ring lead acts as the signal source and the earth ground acts as the signal return path.

Audible ring back signal

Audible ring back indicates to the calling party the called party is being rung. For all calls, the ring back signal is generated by the tone card in the peripheral unit hosting the calling party.

The ring back signal in the DMS-100 switch operates on a 6-s cycle, which is similar to but independent of the ringing cycle. The ring back signal is close to, but not synchronized with, the DMS-100 switch ringing cycle. An illustration of the timing between the audible ringing signal and the power ringing signal is illustrated in the following figures.

Note: Because audible ringing and power ringing are driven by two different peripherals, the two ringing cycles are not synchronized.

Figure 1-29 Timing of audible and power ringing signals - immediate ringing disabled

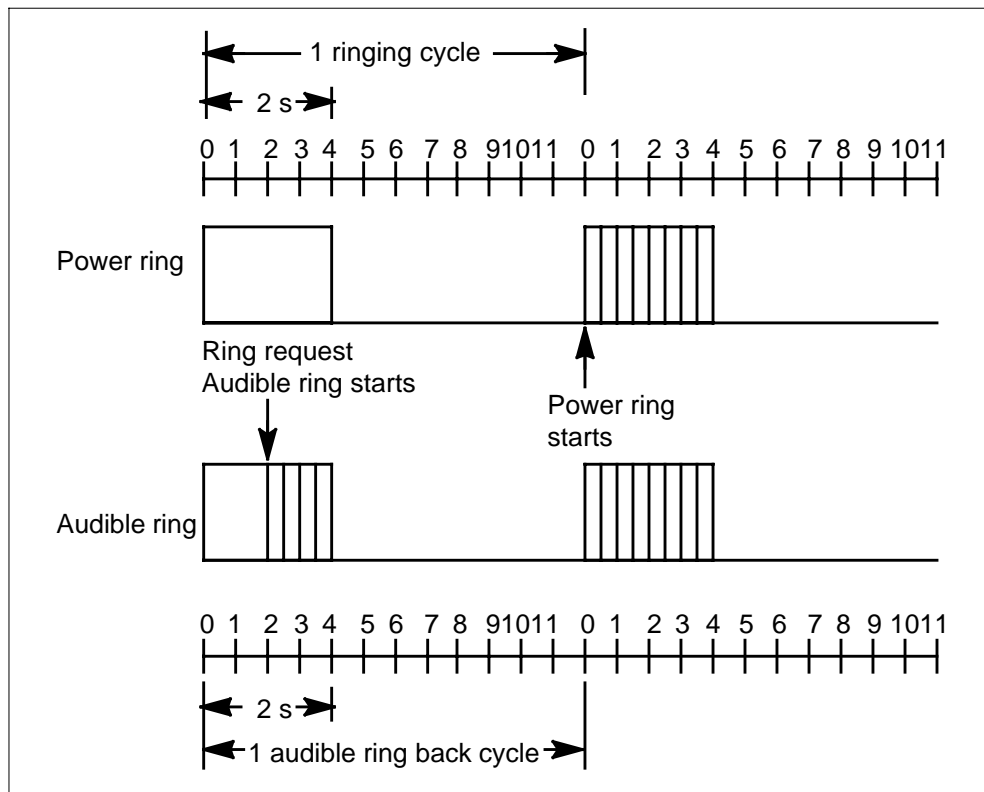
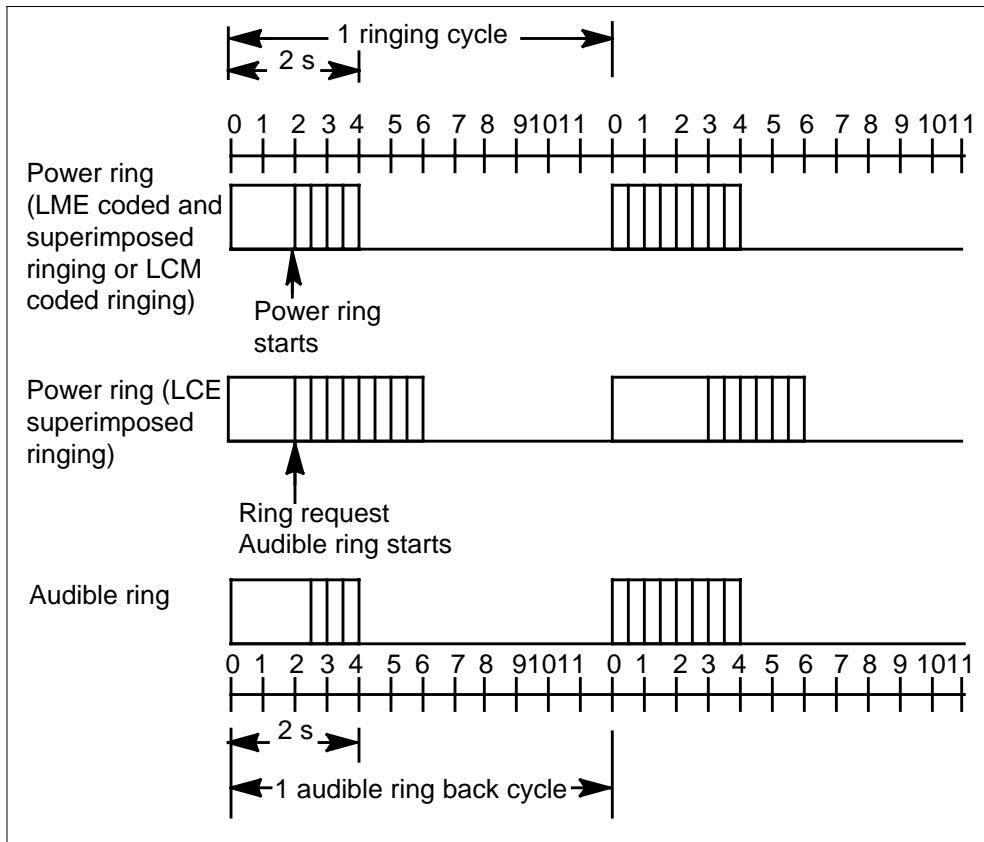


Figure 1-30 Timing of audible and power ringing signals - immediate ringing enabled



Ringling in the UEN

In the UEN, there is no external ringing generator. Instead, each line card (line subgroup) contains a ringing generator. The zero crossings of the ringing sinusoid are monitored and coordinate several control operations that are synchronized to the ringing signal. The TDM software can change the state of the ringing relays at the coder-decoders (CODEC) to the zero crossing.

2 Ringing in Series I peripherals

Ringling types supported by LM and RLM

As mentioned previously, Series I peripherals are nonconcentrating. This class of peripherals includes the line module (LM) and the remote line module (RLM). This part of this document describes the ringling system in the LM and RLM.

The LM and RLM support the following types of ringling:

- 20 Hz single party
- coded
- superimposed
- frequency selective

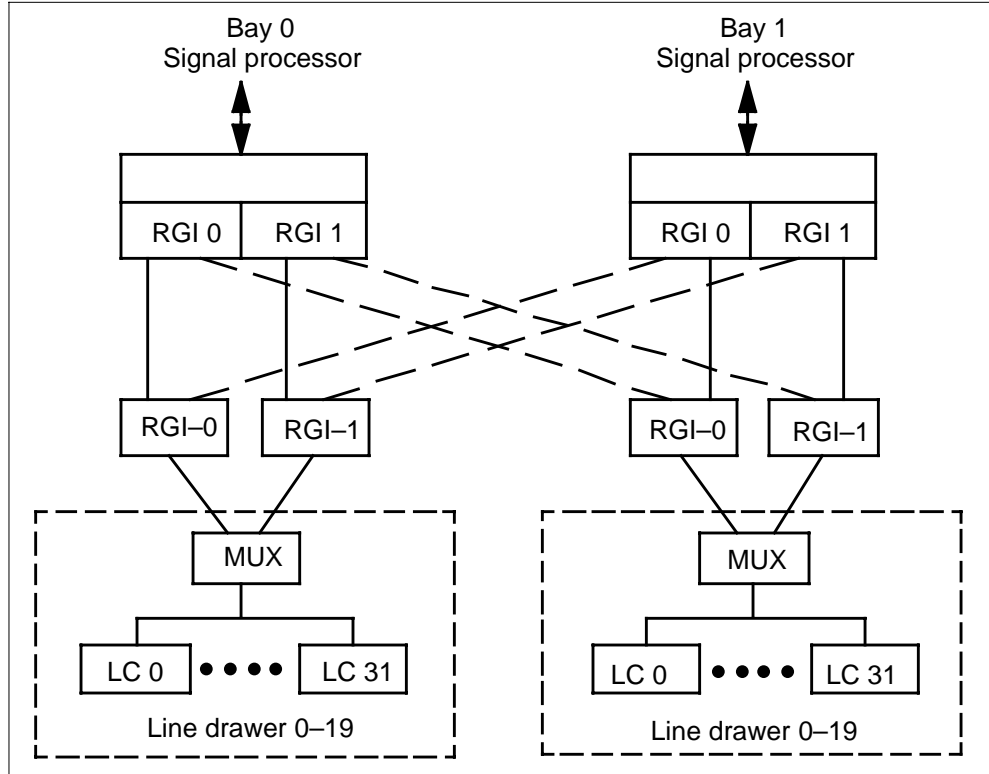
LM and RLM ringling configuration

The Series I peripheral ringling system consists of the following components:

- ringling generator interface (RGI) (NT2X27)
- line module power converter (NT2X05)
- ring multiplexer (MUX) (NT2X20 or NT2X02)
- ring bus

The basic architecture is illustrated in the following figure.

Figure 2-1 Series I peripheral ringing system architecture



LM and RLM ringing hardware

Ringing hardware for the LM and RLM is described next.

Ring generator interface

The NT2X27 RGI card interfaces the LM or RLM signal processor (SP) with ringing generators. The RGI card communicates with the signal processor over a bi-directional data bus (NT2X16/NT2X02). The signal processor sends information on the active ringing generator and the ringing type to the RGI over the bi-directional data bus. Upon receiving the information, the RGI retrieves the appropriate ringing drive signal from its on-board memory and applies the signal as a pulse-width modulated signal to the ring generator amplifier input.

Six versions of the RGI are available to support the following ringing schemes:

- 20 Hz BOC (87 V RMS) - NT2X27AA
- decimonic MF ringing - NT2X27AB
- harmonic MF ringing - NT2X27AC
- synchronomic 16 Hz ringing - NT2X27AD

- synchrononic MF - NT2X27AE
- 20 Hz BOC coded ringing (105 V RMS) - NT2X27AF

The RGI card also monitors ring generator output levels and reports any problems to the line module controller (LMC) through the signaling processor (SP).

Line module power converter

The ring generator is actually part of a LM/RLM power converter. The power converter supplies both a regulated +24V for use in the LM/RLM shelf and a programmable ac/dc voltage. The programmable source is capable of producing ac or dc outputs at a wide range of voltages and frequencies. The programmable source is the ring generator portion of the power converter.

The ringing generator receives a pulse-width modulated drive signal from the RGI. The drive signal drives a 4-transistor balanced-bridge amplifier that drives the ringing bus in the LM/RLM shelf. The amplifier bridge is balanced for a drive signal of 50 percent duty cycle (50 percent on, 50 percent off) results in zero output.

Output voltage magnitude, polarity, and frequency are controlled by the duty cycle and frequency of the drive signal from the RGI.

Ring multiplexer

The ring MUX multiplexes the outputs of the ring generators onto the line drawer internal ring bus. Each line drawer has a ring MUX (NT2X20/NT2X02). The ring MUX receives messages from the LM/RLM controller through the signal processor instructing it to connect the line drawer internal ring bus to the appropriate ring generator.

Ring bus

The ring bus brings the ringing signal to all of the line cards in the line drawer. A ringing relay on each line card attaches and detaches the subscriber tip or ring lead to the ringing bus under the control of the LM/RLM controller so that ringing voltages can be applied.

LM and RLM ringing process

The LM and RLM contain several processors that carry out call processing tasks under the direction of the DMS-100 central control (CC). The following describes the processors associated with ringing and the tasks they perform in the ringing process.

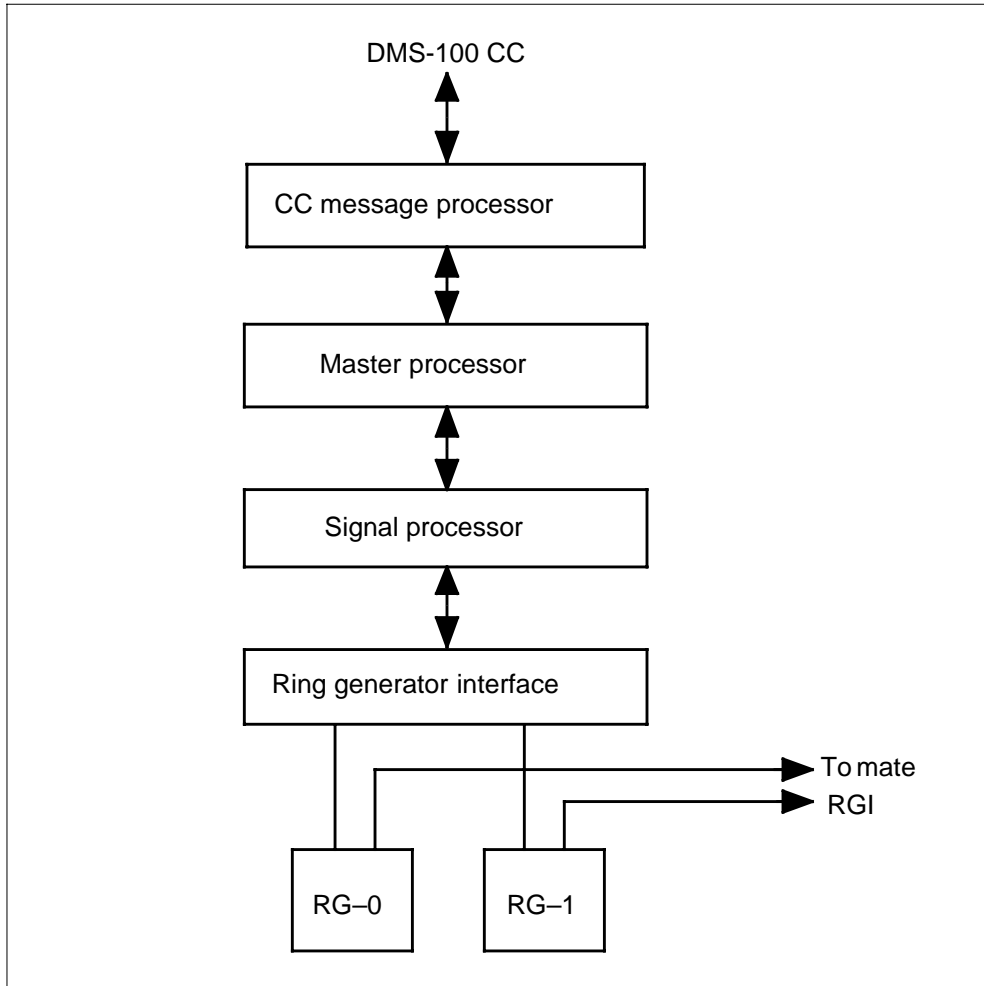
LM and RLM processors associated with ringing

The following LM/RLM processors are associated with ringing:

- master processor
- CC message processor
- signal processor

The following figure illustrates a simplified block diagram of the relationship of these processors with the ringing function of the LM and RLM.

Figure 2-2 Simplified block diagram of LM/RLM ringing system



CC message processor

The CC message processor exchanges messages between the DMS-100 CC and the LM or RLM master processor.

Master processor

The LM and RLM master processor is the main processor. It contains the software that performs the tasks requested by the DMS-100 CC. Under the direction of the DMS-100 CC, the master processor directs the activities of the subordinate processors in the LM and RLM.

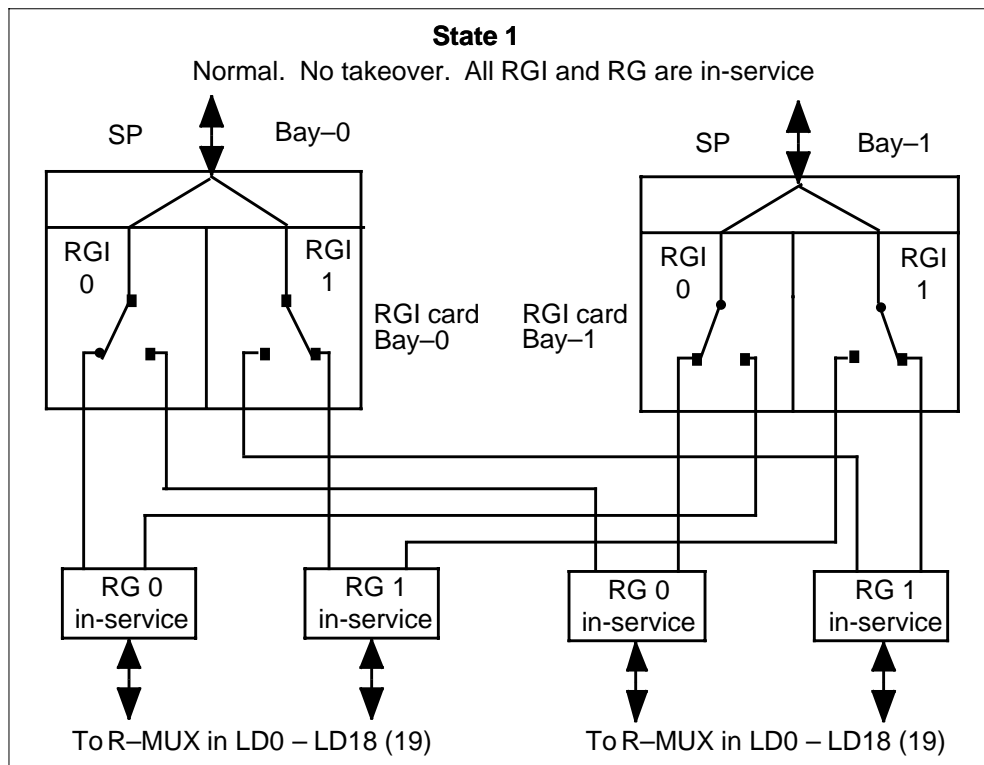
Signal processor

The signal processor interfaces the master processor with the control units on the line side of the LM or RLM, including the ringing generator interface.

SP and RGI interactions

The LM and RLM each contain one signal processor (SP) (NT2X25), one RGI (NT2X27), and two ringing generators (NT2X05) in each bay; two SPs, two RGIs, and four ringing generators in each unit. The signal processor and RGI in each bay control the two ringing generators in their own bay. Crossover circuits are provided between RGI cards in both bays to allow either SP/RGI in one bay to take over the ringing generator in both bays if either SP or RGI in either bay becomes inoperative. This configuration is illustrated in the following figure.

Figure 2-3 Normal ringing configuration in LM/RLM



In normal operation, the signal processor and RGI in each bay control both ringing generators in their own bay, RG 0 and RG 1. This configuration is

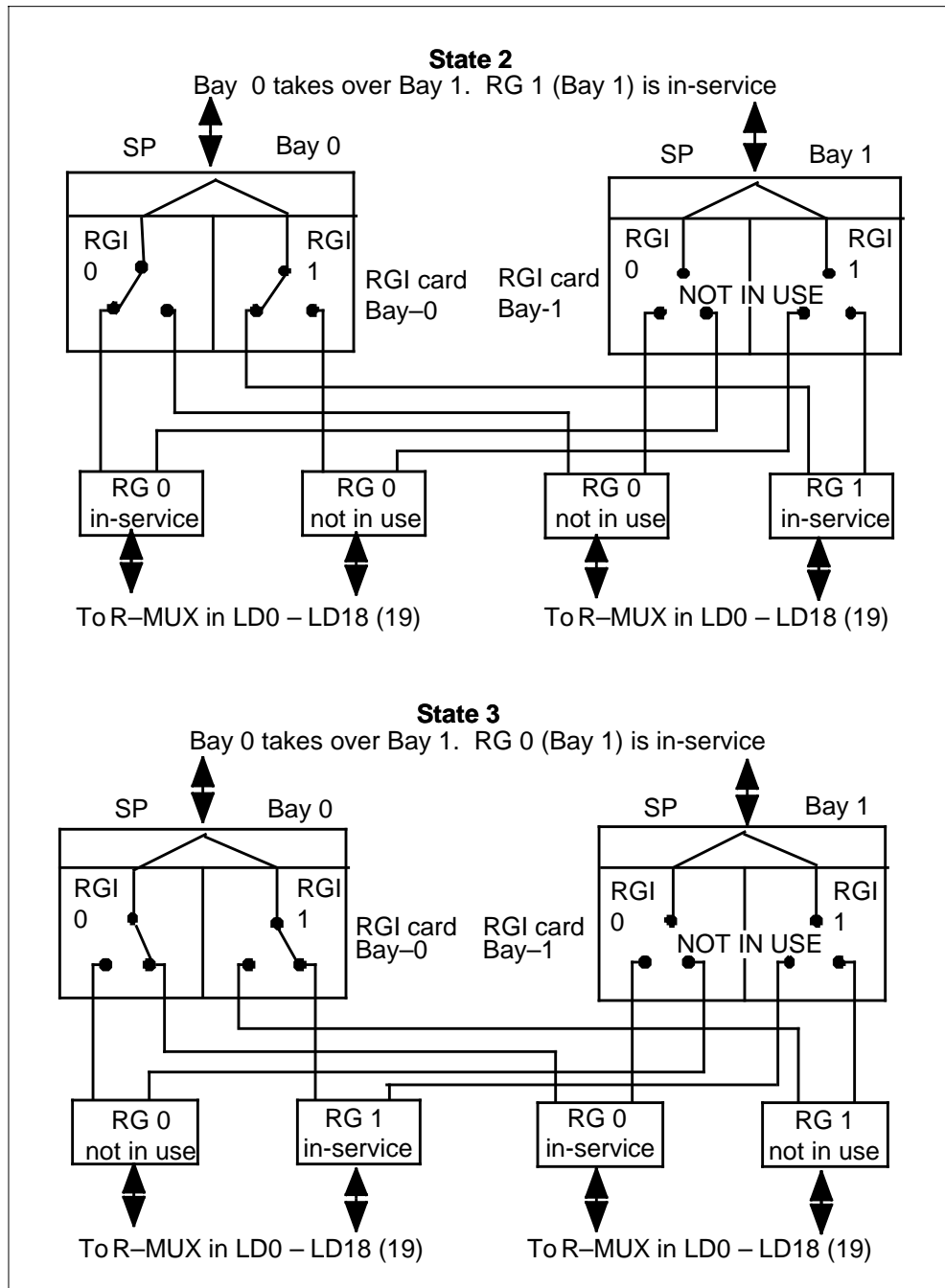
maintained as long as the signal processor and RGI in each bay operate properly.

Ringling takeover

If a fault occurred in the signal processor or RGI in either bay, the mate bay would take over the ringing control function in both bays. If a fault occurred in the RGI of bay 1, for example, the LM or RLM would report the fault to the DMS-100 CC. The CC would then send a takeover command to the LM or RLM controller. In response, the LM or RLM controller would disconnect the RGI in bay 1 from its ringing generators and switch one RGI link in bay 0 from its ringing generator to a ringing generator in bay 1 over the crossover circuitry.

This takeover configuration is illustrated in the following figure. In this configuration, only one ringing generator in each bay is operational. This configuration is maintained as long as the fault in the RGI persists.

Figure 2-4 Takeover configurations in LM/RLM



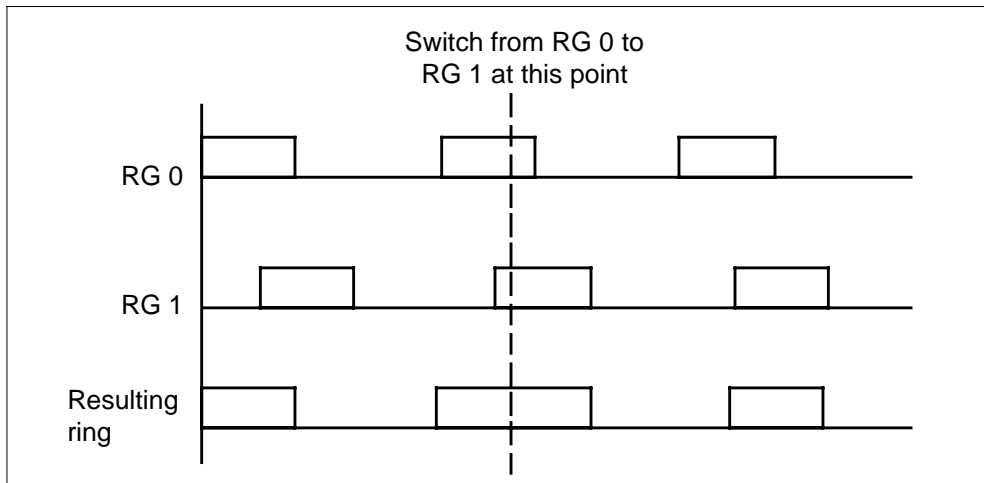
Ringling take back

If the fault clears, the DMS-100 CC sends a take back command to the LM, instructing the LM/RLM to restore the normal ringling configuration.

If operating company personnel repair the RGI fault and return the unit to service, the DMS-100 CC, upon seeing that the RGI is now in-service, issues a take back command to the LM or RLM controller. In response, the LM or RLM controller disconnects the bay 0 RGI link to the bay 1 ringing generator over the crossover link and reconnects it to the other ringing generator in its own bay. It then reconnects the RGI links in bay 1 to the ringing generators in bay 1. This resumes the normal configuration as illustrated in Figure 2-3, "Normal ringing configuration in LM/RLM" on page 2-5.

Some calls in the ringing state during take back are switched to the other ringing generator. Because the LM or RLM ringing generators are not synchronized, this can result in noticeable discontinuity in the ringing cadence for ringing lines switched to the other ringing generator. The following figure illustrates a possible result of switching ringing generators on a ringing line.

Figure 2-5 Switching ringing generators - possible effect on ringing lines



Ringling generator capacity

The LM and RLM software limits the number of lines the ringing generator can ring simultaneously to 15 lines. When a ringing request is received, the LM and RLM software examines the next 12 time slots and determines the appropriate time slots of the ringing cycle for the schedule ringing request. It then checks the number of lines the ringing generator is currently servicing during those time slots to determine if the new request can be added without exceeding the 15-line limit.

If the limit is reached, the LM and RLM software will queue the ringing request for up to two seconds. If the request can not be scheduled within the two-second queueing period, the call is blocked and the called party is routed to the treatment facility and receives the fast busy (T120) tone. An associated log report is output at the DMS-100.

Ringling generator takeover and take back

Both ringling generators in each bay provide ringling signals for the lines in the LM or RLM bay. The signal processor and RGI program the ringling generators and, through the ring multiplexer, connect each ringling generator output to the appropriate line. If either ring generator fails, the SP/RGI restricts ringling to the alternate RG. The ringling system can still function in this configuration. However, the ringling capacity in the affected bay is reduced.

LM and RLM ringling generator parameters

The NT2X05 power converter +24 V card used in the LM or RLM as the ringling generator has the following operating parameters:

Table 2-1 LM/RLM ringling generator parameters

Parameter	Value
Frequency (programmable range)	0 to 67Hz
Maximum current	350 mA
Overvoltage shutbacks	Over 165 V for more than 1.5 seconds
Voltage detect	+/-20 V nominal
Current detect	+/-10 mA nominal
Overcurrent shutback	+/-350 mA nominal

3 Ringing in Series II peripherals

Ringling in the subscriber carrier module

This chapter describes the ringing systems in DMS-100 peripherals belonging to the subscriber carrier module (SCM) and the line concentrating module (LCM) families.

The SCM is a family of lines peripherals that provides a digital interface between the DMS-100 and the subscriber loop concentrator of the subscriber carrier system. Currently, the following three subscriber loop concentrators are used with the DMS-100:

- DMS-1 Urban (DMS-1U)
- DMS-1 Rural (DMS-1R)
- SLC-96

A special type of SCM is available for each of the subscriber carrier loop concentrators as follows:

- SCM-100U (SMU) - DMS-1U
- SCM-100R (SMR) - DMS-1R
- SCM-100S (SMS) - SLC-96

A description of the ringing system in each of the three subscriber loop concentrator configurations follows.

SCM-100U

The SCM-100U provides a digital interface between the DMS-100 and the remote terminal (RT) of the DMS-1U system (refer to *DMS-1 Urban System Description*, for a description of the DMS-1U). The term RT is used to describe the DMS-1U in its stand-alone configuration (also called the universal configuration). The term remote concentrator urban (RCU) is used to describe the DMS-1U when it is fully integrated into the DMS-100 switch (the SCM-100U is the peripheral module that integrates the DMS-1U into the DMS-100 switch). This document concentrates on the ringing system of the integrated configuration.

3-2 Ringing in Series II peripherals

The SCM-100U was introduced into the DMS-100 by feature package NTX387. You can find documentation on the SCM-100U by referring to the *SMU Maintenance Manual*

Ringling types supported by SCM-100U

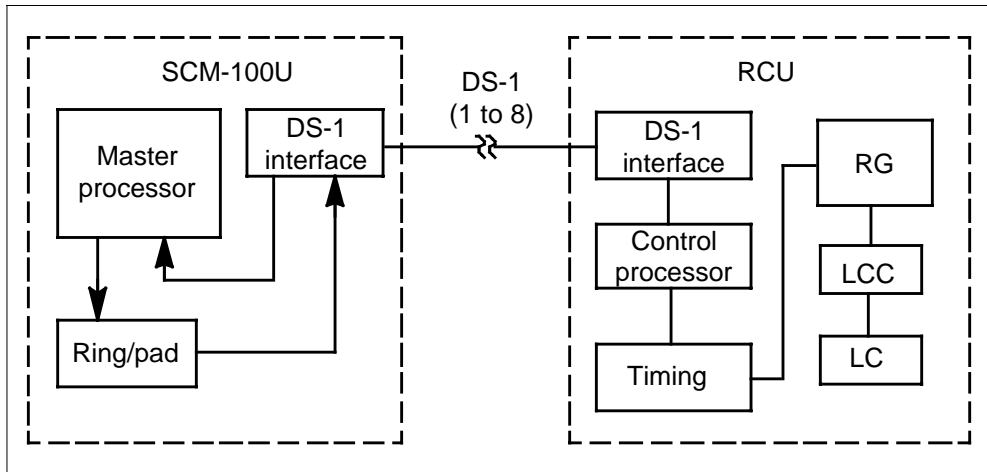
The SCM-100/RCU system supports the following types of ringing:

- 2-second ring, 4-second silence for single party
- 2-second ring, 4-second silence for multiparty
- coded ringing for multiparty
- revertive ringing for multiparty.

SCM-100U/RCU ringing configuration

The following figure illustrates the configuration of the ringing system in the SCM-100U/RCU system.

Figure 3-1 SCM-100U/RCU ringing configuration



Note: This diagram shows only the hardware associated with ringing.

Ringling hardware

The SCM-100U/RCU ringling system involves the hardware components listed in the following table.

Table 3-1 SCM-100U ringling hardware

Peripheral	Component PEC	Component Name
SCM-100U	NTMX77	Unified processor
	NT6X80	Ring/pad
	NT6X85	DS-1 interface
RCU	NT3A86	DS-1 interface
	NT3A31	Control processor
	NT3042	Timing
	NT3A39	Ringling generator

Note: Line card controllers and line cards are also part of the ringling hardware in the RCU. Refer to DMS-1U documentation for a complete listing of these components.

SCM-100U components associated with ringling

A detailed functional description of the circuit cards in the SCM-100U can be found by referring to the *SMU Maintenance Manual*. A brief description of the function of the SCM-100U circuit cards associated with the ringling system is in the following table.

Table 3-2 SCM-100U ringling hardware component description

Component	Description
NT6X02	Control complex. The SCM-100U control complex coordinates call processing between the RCU and the DMS-100. The control complex directs the RCU to establish connections, collect digits, apply ringling, and disconnect calls under the direction of the DMS-100 CC.
NT6X80	Ring/pad. The ring/pad circuit card provides pulse coded modulation (PCM) samples of ringling signals. The control complex, upon determining the type of ringling required for a given line, accesses the sample PCM signal from the ring/pad card memory.
NT6X85	DS-1 interface. The DS-1 interface card converts parallel data from the control complex to a serial format for transmission over the DS-1 links to the RCU.

RCU components associated with ringing

A detailed functional description of the circuit cards in the RCU is in *DMS-I Urban Circuit Pack Descriptions*. A very brief description of the RCU components associated with ringing is in the following table.

Table 3-3 RCU ringing hardware component description

Component	Description
NT3A68	DS-1 interface. The DS-1 interface card converts the serial data from the DS-1 links to parallel data for use by the RCU controller.
NT3A31	Control processor. The control processor controls the functions of the RCU and responds to commands from the SCM-100U. The RCU control processor performs line supervision, common equipment audits, and backup equipment switchover independently of the SCM-100U. Under direction of the SCM-100U, the control processor performs channel assignments and takedowns, signaling, and maintenance functions.
NT3A42	Timing. The timing card provides timing for RCU and buffers the control and monitoring messages between the control processor and other cards in its shelf.
NT3A39	Ringing generator. The ringing generators provide a 20 Hz ringing signal superimposed on +/-48 V.
LCC	Line card controller. The line card controller interfaces four line cards at the RCU with the common equipment in the RCU. The line card controller transfers PCM samples and control information, handles signaling, receives ringing samples, and performs maintenance functions on its associated line cards.

Ringing generator capacity

The RCU ringing generator is capable of ringing up to 50 lines simultaneously. The number of lines that can be rung during one ringing cycle depends on the ringing type used. Since the SCM-100U schedules ringing during all three phases of the ringing cycle, it is possible to ring up to 150 lines, or 50 lines per phase, during one cycle for single-party ringing. Again, this depends on the ringing type.

Ringing generator takeover/take back

The RCU has duplicated ringing generators. One ringing generator is active, while the mate is standby. A monitor and alarm circuit in the ringing generator monitors the ringing generator output, controls ringing generator switchover relays, shuts down the faulty ringing generator, and reports a ringing generator alarm.

In the event that the monitor circuit detects a fault, the monitor and alarm circuit raises a ringing generator alarm and operates the switchover relays to switch the standby ringing generator to the active ringing generator. The monitor and alarm circuit then activates a shut-down circuit in the faulty ringing generator, which disconnects the faulty generator from the power source and lights the shut-down light-emitting diode (LED) on the ringing generator faceplate. The faulty ringing generator can be reset manually by the reset switch.

If the power converter on the other side has failed, an automatic reset circuit on the faulty ringing generator automatically attempts to restart the faulty generator every 10 seconds.

SCM-100R

The SCM-100R provides a digital interface to the remote concentrator terminal (RCT) of the DMS-1R system.

The SCM-100R was introduced into the DMS-100 system by feature package NTX213. Feature package NTX213 is documented in *Subscriber Carrier Module-100 Rural General Description*.

Ringling types supported by SCM-100R

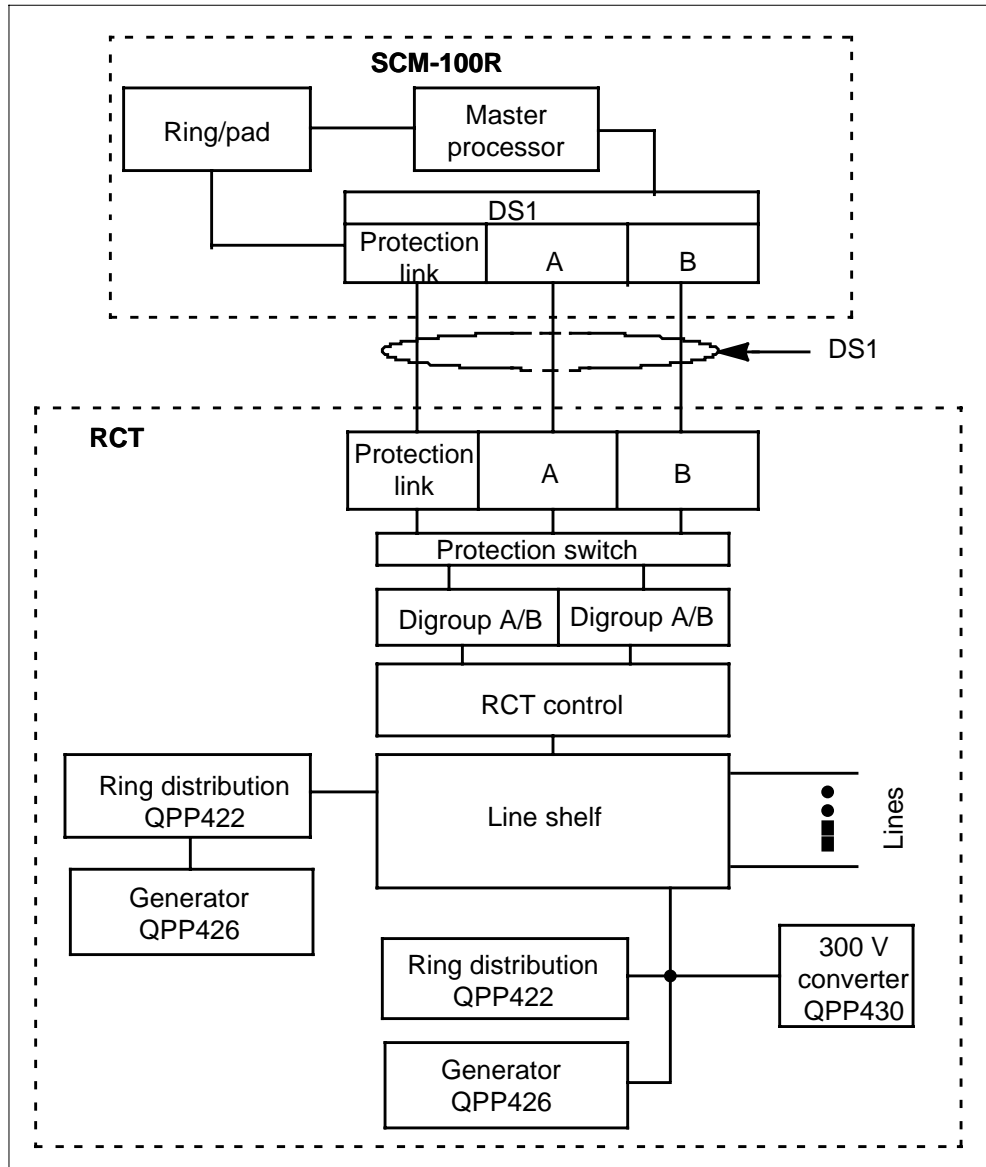
The SCM-100R supports the following types of ringling:

- coded
- superimposed
- frequency selective

SCM-100R/RCT ringling configuration

The SCM-100R/RCT ringling configuration is shown in the following figure.

Figure 3-2 SCM-100R/RCT ringing configuration



Ringling hardware

The SCM-100R/RCT hardware is listed in the following table.

Table 3-4 SCM-100R/RCT ringling hardware

Peripheral	Component PEC	Component Name
SCM-100R	NT6X45	Unified processor
	NT6X80	Ring/pad
	NT6X50	DS-1 interface
RCT	QPP436, QPP437	DS-1 repeaters
	QPP428, QPP498	Protection switch
	QPP419	Digroup cards
	QPP417	Address control remote
	QPP413	Driver
	QPP426	Ringling generator
	QPP435	Positive ringling generator
	QPP430	300 V converter
	QPP422	Ring distribution

SCM-100R ringling hardware

Following is a brief functional description of the ringling hardware associated with the SCM-100R/RCT ringling system. A detailed description of the SCM-100R hardware can be found by referring to *Subscriber Carrier Module-100 Rural General Description*.

Table 3-5 SCM-100R ringling hardware component description (Sheet 1 of 2)

Component	Description
NT6X45	Control complex. The SCM-100R control complex coordinates call processing between the RCT and the DMS-100. The control complex directs the RCT to establish connections, collect digits, apply ringling, and disconnect calls under the direction of the DMS-100 CC.

Table 3-5 SCM-100R ringing hardware component description (Sheet 2 of 2)

Component	Description
NT6X80	Ring/pad. The ring/pad circuit card provides PCM samples of ringing signals. The control complex, upon determining the type of ringing required for a given line, accesses the sample PCM signal from the ring/pad card memory.
NT6X85	DS-1 Interface. The DS-1 interface card converts parallel data from the control complex to a serial format for transmission over the DS-1 links to the RCT.

RCT ringing hardware

Following is a brief functional description of the RCT ringing hardware.

Table 3-6 RCT ringing hardware component description

Component	Description
QPP436/437	DS-1 repeaters: The DS-1 repeaters regenerate the DS-1 signals to produce standard level input signals and monitor the incoming signal for proper level, and for errors, generating alarms when errors are detected.
QPP428/498	Protection switch: The protection switch controls the communications over the protection line, switching communications from a faulty link to the protection link.
QPP419	Digroup card: The digroup cards interface the DS-1 signals with the address and control signals in the RCT.
QPP417	Address control remote: The address control remote card interfaces the digroup cards with the drivers, local switch, and line test circuits.
QPP417	Driver: The driver card controls the flow of PCM data between the line shelves and the digroup cards.
QPP426	Ringing generator: The ringing generator provides single-frequency ringing power to the subscriber lines.
QPP435	Positive ringing generator: The positive ringing generator provides 20 Hz ringing signal superimposed on +54 VDC for superimposed ringing.
QPP430	300 V converter: The 300 V converter provides ringing voltage for frequency selective lines.
QPP422	Ring distribution card: The ring distribution card distributes the ringing signals to the line shelves.

Ringling generator capacity

Following are the capacities for the RCT ringling generators.

- QPP426—20 ringers/5 lines at a time
- QPP435—21 ringers/5 lines at a time
- QPP430—20 ringers/5 lines at a time

Ringling generator takeover

The RCT can be provisioned with backup ringling generators and power converters. In the backup configuration, the backup unit takes over if the primary unit fails. Relays switch the ringling bus between the active and standby ringling generators.

Circuitry on the primary ringling generator monitors the output of the active ringling generator for failures. If a failure is detected, the monitoring circuitry operates the relays to switch the active (faulty) ringling generator offline and the standby ringling generator online. A ringling generator alarm is raised.

If the standby ringling generator is not provisioned, or is unavailable because of a fault, circuitry on the faulty ringling generator will attempt to reset the ringling generator automatically at 10-second intervals. If the reset fails, the ringling bus, in this case, will be unavailable and call processing by the RCT will be impacted.

SCM-100S

The SCM-100S provides a digital interface between the DMS-100 and the AT Technologies, Inc. Subscriber Loop Carrier (SLC) 96. In the SCM-100S system, the SLC-96 is referred to as the remote concentrator SLC-96 (RCS). Refer to the documentation provided by AT Technologies, Inc. for a description of the SLC-96.

The SCM-100S was introduced into the DMS-100 system by feature package NTX398. You can find documentation on the SCM-100S by referring to the *SMS Maintenance Manual*

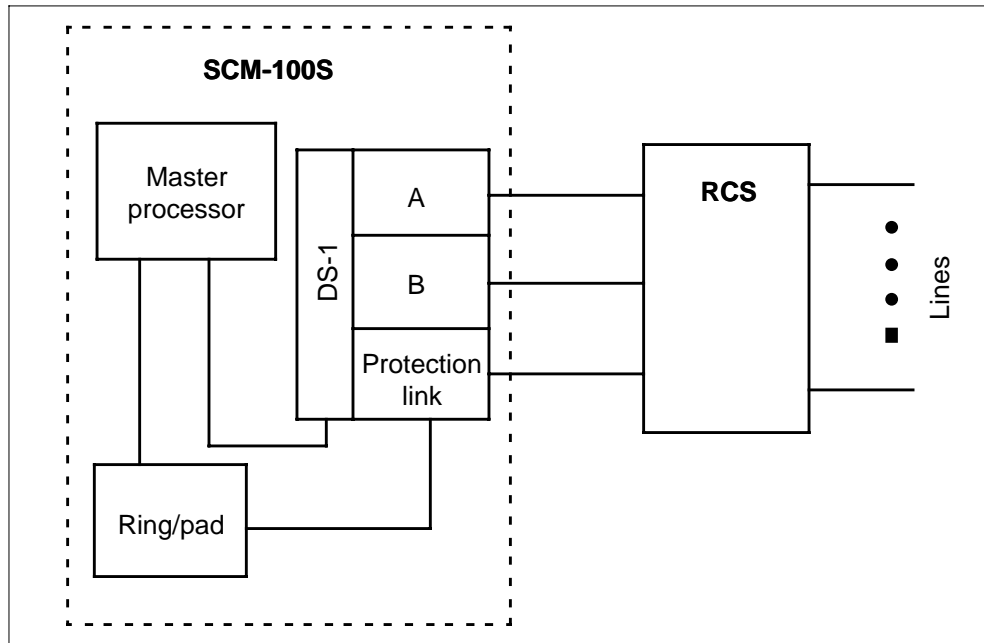
Ringling types supported by SCM-100S

The SCM-100S supports all currently available ringling schemes.

SCM-100S ringling configuration

The SCM-100S/RCS ringling configuration is illustrated in the following figure.

Figure 3-3 SCM-100S/RCS ringing configuration



SCM-100S ringing hardware

The SCM-100S/RCS hardware is listed in the following table.

Table 3-7 SCM-100R/RCT ringing hardware

Peripheral	PEC	Name
SCM-100S	NT6X45	Master processor
	NT6X80	Ring/pad
	NT6X50	DS-1 interface

The following table contains brief functional descriptions of the ringing hardware associated with the SCM-100S/RCS ringing. A detailed description of the SCM-100S hardware can be found in the *SMS Maintenance Manual*

Table 3-8 SCM-100R ringing hardware component description

Component	Description
NT6X45	Control complex. The SCM-100S control complex coordinates call processing between the RCS and the DMS-100. The control complex directs the RCS to establish connections, collect digits, apply ringing, and disconnect calls under the direction of the DMS-100 CC.
NT6X80	Ring/pad. The ring/pad circuit card provides PCM samples of ringing signals. The control complex, upon determining the type of ringing required for a given line, accesses the sample PCM signal from the ring/pad card memory.
NT6X85	DS-1 Interface. The DS-1 interface card converts parallel data from the DMS-100 CC to a serial format for transmission over the DS-1 links to the RCS.

RCS hardware

The RCS consists of the SLC-96, manufactured by AT Technologies, Inc. For a detailed description of the SLC-96, refer to documentation provided by AT Technologies, Inc.

Ringling generator capacity

The RCS ringing generator can ring a maximum of 5 lines per phase, 15 per ringing cycle for single-party ringing.

Ringling generator takeover

The RCS is equipped with two ringing generators. One ringing generator serves as the active unit and the other the standby. If the active ringing generator fails, the standby ringing generator is brought online and a ringing generator alarm is raised.

LCM ringling functional description

A clear understanding of the LCM ringing operation requires a basic knowledge of the LCM hardware architecture. Each shelf of an LCM contains five physical line drawers; a total of 10 line drawers make up each LCM. Each physical line drawer can be further subdivided into two logical drawers, sometimes called line subgroups (LSG). Each logical drawer contains up to 32 line cards connecting to a bus interface card (BIC) located in the physical line drawer. The status of logical drawers is shown at the MAP when the LCM is posted.

3-12 Ringing in Series II peripherals

Also on each shelf is a control complex made up of a power converter, processor, and digroup control card; the term unit is used to describe this control complex. When both units are in-service, unit 0 supports the even-numbered logical drawers in the LCM. Unit 1 supports the odd-numbered logical drawers.

The LCM ringing operation is provided by two ringing generators, RG 0 and RG 1, located at the top of the LCE frame shown in Figure 3-4, "LCE frame" on page 3-13. The ringing generators provide ringing to both LCMs in an LCE frame. Under normal operations, the frequency generator circuit in RG 0 supplies ringing frequency to the even-numbered LCM in the frame (LCM 00 in Figure 3-4, "LCE frame."). Similarly, RG 1 supplies ringing frequency to the odd-numbered LCM (LCM 01 in Figure 3-4, "LCE frame."). The LCM is also capable of switching ringing generators. A single ringing generator can supply ringing frequency to all line drawers in the LCE frame.

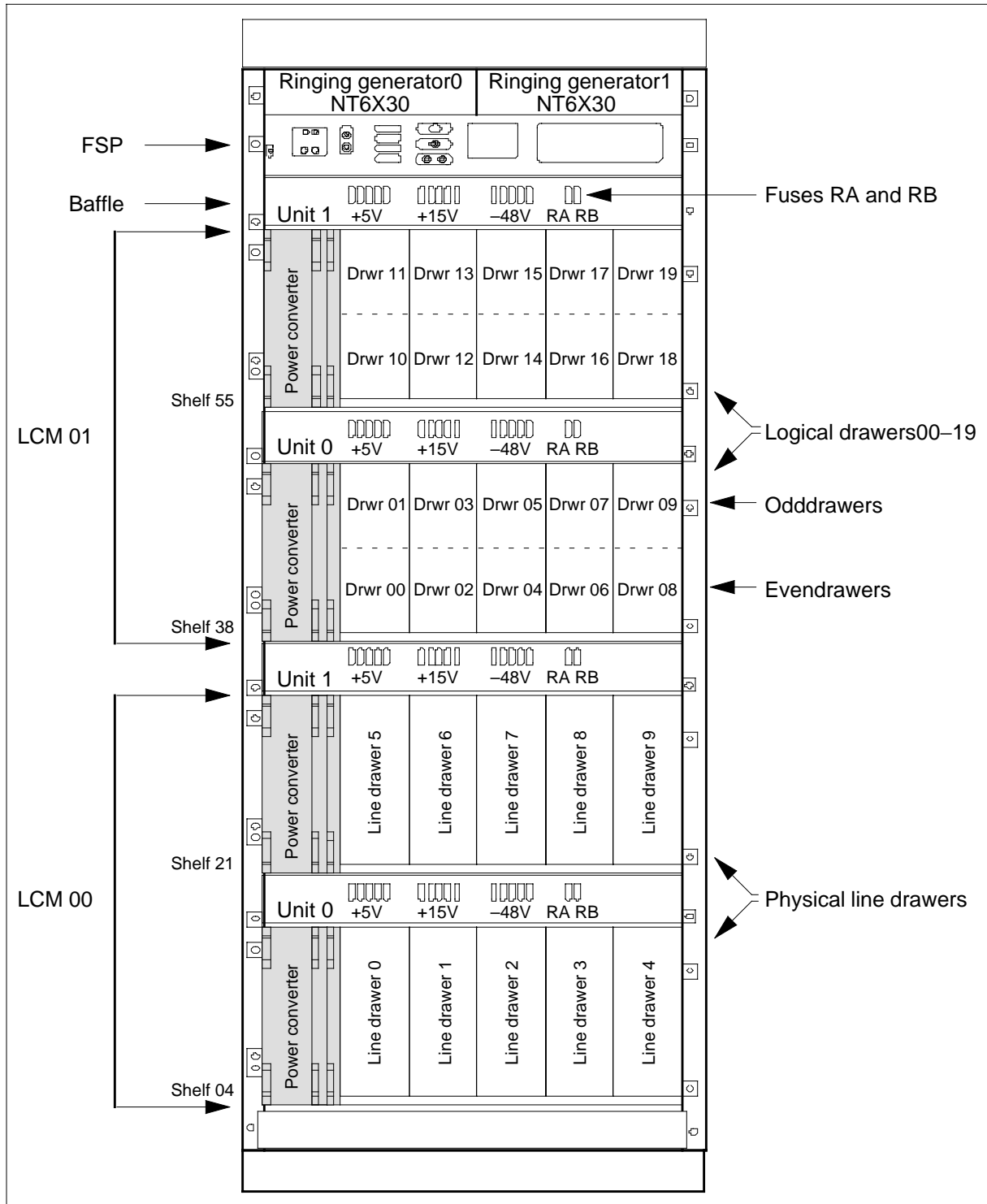
The ringing generator also contains an ANI/coin circuit that provides four voltages for ANI/coin operations. The ANI/coin circuit in RG 0 serves unit 0 of both LCMs. The ANI/coin circuit in RG 1 serves unit 1 of both LCMs. If a failure occurs in either one of the ANI/coin circuits, both LCMs are switched to the takeover mode of operation. In takeover mode, the remaining ANI/coin circuit is capable of serving both LCMs in the frame.

Ringing input is fused at the RA and RB fuses located in the baffles above each LCM shelf (see Figure 3-4, "LCE frame."). Each fuse controls all the even- or odd-numbered logical drawers in an LCM shelf. The following table identifies the fuse associated with each grouping of even or odd logical drawers.

Table 3-9 RA and RB fuse connections

Logical drawer grouping	LCM 0 Shelf 04	LCM 0 Shelf 21	LCM 1 Shelf 38	LCM 1 Shelf 55
Even drawers	RA	RB	RA	RB
Odd drawers	RB	RA	RB	RA

Figure 3-4 LCE frame



Ringing generator control

The LCM is provisioned with two ringing generators. Each unit of the LCM can connect to either ringing generator. The SWRG command available at the MAP terminal switches a unit or both units from one ringing generator to the other.

LCM processors monitor status bits from the ringing generators. If a problem is detected, system software attempts to resolve any trouble condition by a variety of methods including switching ringing generators.

Ringing generator capacity

The LCM continuously monitors the output current of the ringing generators and reacts when the current exceeds a predetermined threshold. The number of lines that the ringing generator can ring simultaneously is not restricted to a fixed value. The actual number depends on the number of ringers attached to each line and the length of the subscriber loop.

Types of ringing supported

The LCM support the following types of ringing:

- 20 Hz single party
- superimposed ringing
- frequency selective ringing
- coded ringing
- distinctive ringing
- teen ringing

Note: 20 Hz single party ringing, distinctive ringing and teen ringing are patterns applied by the software to a particular output of the ring generator. Frequency selective ringing, coded ringing and superimposed ringing are addressed through switch settings.

Ringing configuration

The LCM ringing system consists of the following components:

- LCM processor card (NT6X51)
- ringing generator (located on NT6X30)
- ringing amplifier (located on NT6X30)
- power converter (NT6X53)
- bus interface controller (NT6X54)
- digroup controller (NT6X52)
- line card

The following paragraphs describe the function of LCM hardware components only as they relate to the LCM ringing system.

NT6X51 processor

The NT6X51 processor card schedules ringing and controls the relays on the power converter card (NT6X53), the bus interface card (NT6X54), and the line card. The relays operate in accordance with information from the DMS-100 CC and the ringing generator.

Note: The NT6X51 processor card exercises no control over the ringing generator. The processor card controls only the relays that route the ringing generator output. The ringing generator sends status bits to the processor about ringing generator activity and condition.

NT6X30 ringing generator

Manually-set switches on the NT6X30 card select a pre-programmed combination of ringing frequency, ringing signal amplitude and subcycle cadence. Because these parameters are manually set, the ringing generators in the LCE can provide only one type of ringing for each LCE. However, the ringing generators can be set to any ringing scheme available.

The ringing generator also generates ANI/coin voltages to provide automatic number identification and coin operations.

NT6X53 power converter

The primary function of the NT6X53 power converter card is to provide power to a single LCM shelf; in the event of a power converter failure, the NT6X53 card is capable of supplying power to both shelves in the LCM. A secondary function provided by the NT6X53 power converter is the selection of ringing generator output. The ringing generator multiplexer relays allow either ringing generator to provide ringing signals to all LSGs in each LCM if a ringing generator fails. The operation of the ringing generator multiplexer for a ringing generator switch is described in Section , "Ringing generator control" on page 3-14.

The NT6X53 power converters support the selection of ANI/coin functions through a relay network controlled by the LCM processor. Relays on the power converter can select one of four ANI/coin voltages provided by the ringing generator. Current from ANI/coin sources is routed through a current detector circuit, which sends information to the processor for functions such as the coin presence test.

Note: Because of the ringing generator multiplex circuits, the LCM unit must be manually busy (ManB) or system busy (SysB) before removing the NT6X53 card.

NT6X54 bus interface

The NT6X54 bus interface card (BIC) multiplexes and demultiplexes PCM samples and control messages to and from the LCM line cards over the 32-channel digroups. It also contains relays that switch ringing or ANI/coin voltages to the line cards. Under the direction of the LCM processor card, the bus interface card ringing relays connect the ringing generator output to the appropriate line card ringing bus. The BIC also provides the capability to reverse the ring bus within the drawer.

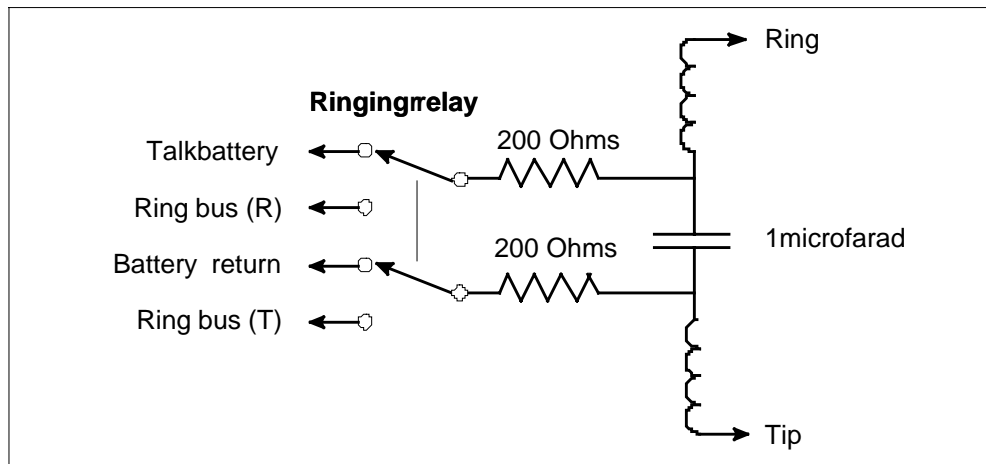
NT6X52 digroup control

The digroup control card instructs the line card, through PCM codes, to operate or release its ringing relay. This operation is described next.

Line card functional description

The line circuit card provides voice and signaling interfacing between the subscriber line and the DMS-100. In the ringing system, the line card contains a ringing relay that connects the subscriber line to the ringing bus as illustrated in the following figure. Under the direction of the LCM processor card, the line circuit card achieves ringing by connecting the subscriber line to the ringing bus. The ringing relay is alternately operated and released to establish the proper ringing cadence (ringing and silence periods) on the subscriber line.

Figure 3-5 Line card bias circuit



The LCM uses the following line cards:

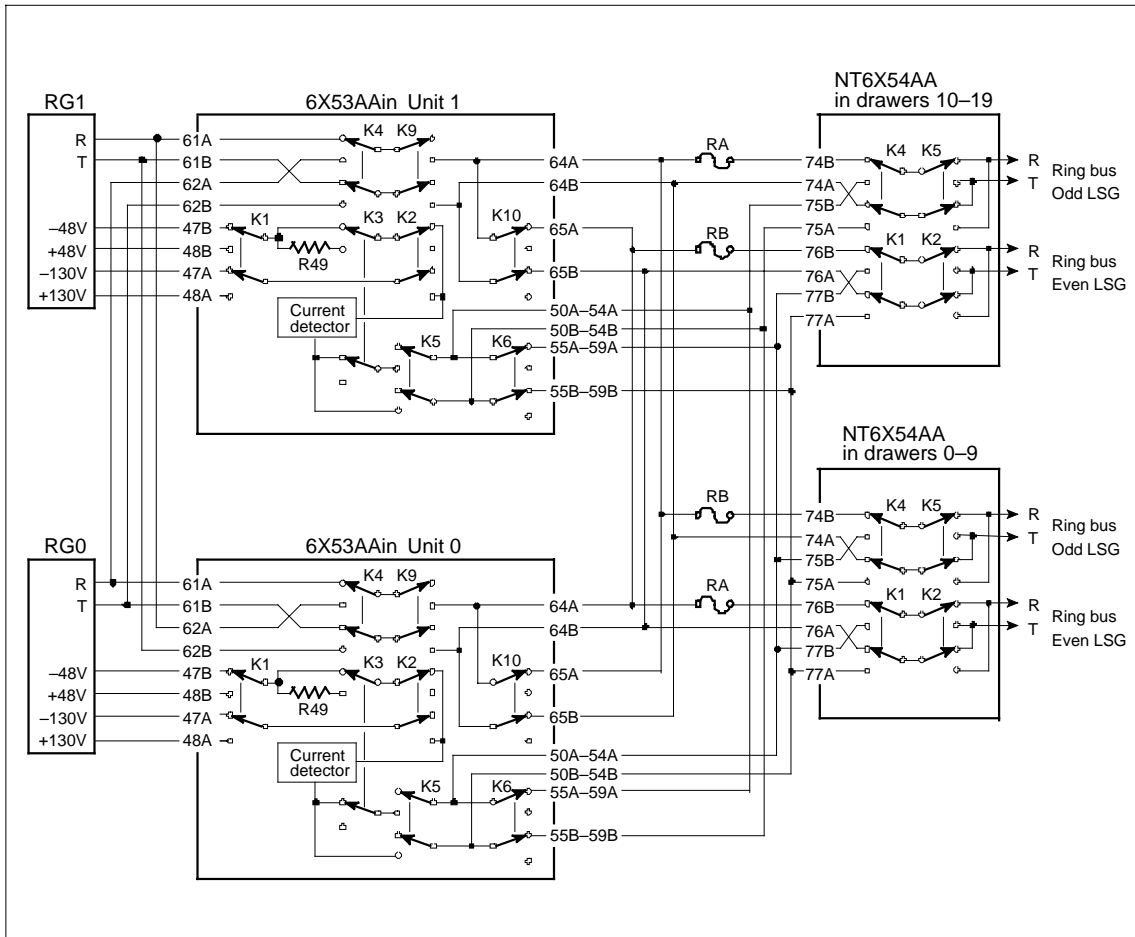
- NT6X17 - Type A
- NT6X18 - Type B (needs NT6X23 if +48 V option is used)
- NT6X19 - Message waiting (needs NT6X20 -150V power supply)
- NT6X21 - P-phone
- NT6X71 - Data

Detailed ringing schematic

The schematic in the Figure 3-6, "Detailed ringing schematic" on page 3-18 shows the signal path from the ringing generators to the line drawers located in both units of the LCM. This signal path includes the NT6X53AA power converters in both LCM units and the NT6X54AA BICs in the line drawers. The schematic shows ringing generator outputs to only one LCM for clarity; the outputs shown in this figure connect to both LCMs in the LCE. Also, only two BICs are shown in the schematic; however, the connections are actually made to the BIC in each of the 10 line drawers in the LCM.

As illustrated by the detailed schematic, the ringing generator provides two important functions. The ringing generator generates both ringing signals and ANI/coin signals. These functions are described next.

Figure 3-6 Detailed ringing schematic



Ringling signals

Ringling and ANI/coin voltages enter the LCM through the NT6X53 power converter. Relays on the power converter provide a control function for ringling that is completely independent of the power supply function. Relay K4 on the NT6X53 power converter selects between the ringling voltages provided by the two ringling generators (see Figure 3-6, "Detailed ringling schematic."). The SRG (select ringling generator) control signal shown in figure "Status and control bits for LCM ringling" drives this function.

When an LCM unit is in-service, relays K5 and K9 on the NT6X53 power converter and relays K6 and K10 on the power converter in the mate unit are activated. This operation is driven by the PWRACT (power activity) control signal. Activation of these relays connects the in-service unit to its own ring and ANI/coin buses and disconnects the mate unit from these buses (the disconnect function is performed by the MPWACT control signal shown in Figure 3-7, "Status and control bits for LCM ringling" on page 3-20). If, however, the mate unit is busy, the in-service unit is connected to both its own ring and ANI/coin buses and those belonging to its mate.

Each NT6X54 BIC has two sets of relays, one for each LCM unit, used to control the ring bus for a single logical drawer. Relay K4 on the BIC selects between ringling and ANI/coin voltages for the odd-numbered logical drawer. Relay K1 performs the same function for the even-numbered logical drawer. Relays K5 and K2 are used to reverse the ring bus within the drawer; this operation allows for tip-side ringling on NT6X17 line cards.

A ringling generator also sends status bits to the LCM processor card, NT6X51, providing information about its activity and condition. These status bits are described next and illustrated in Figure 3-7, "Status and control bits for LCM ringling."

XOVER

The crossover bit is generated shortly before the waveform of the ringling signal crosses zero. This event is used by the processor card (NT6X51) to time the operation of ringling relays.

F1 and F0

These two binary bits together define which of four subcycles the ringling generator is on. Some ringling schemes use different types of ringling during each subcycle.

CUR

The current bit is normally high and goes low when the ringling generator load exceeds a predetermined threshold. This occurrence indicates the ringling load is approaching the ringling generator capacity for the ringling slots in progress.

RMS

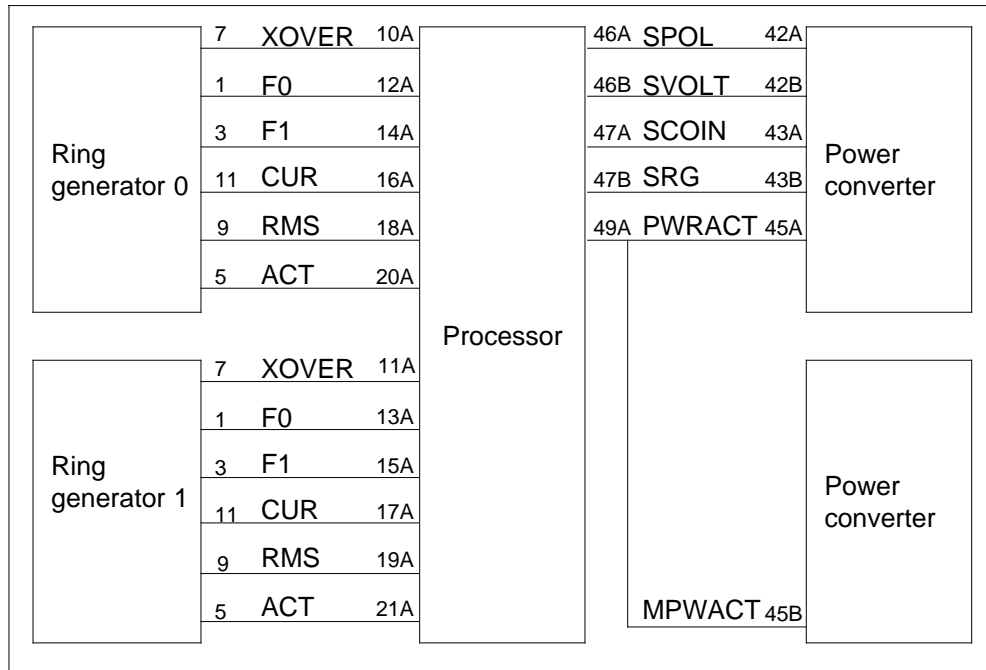
This normally low bit goes high to indicate a low ringing voltage condition. This occurrence indicates a trouble condition to which the system will respond.

ACT

RG 0 provides ANI/coin voltages to the even-numbered units (unit 0 of both LCMs) in the LCE frame. RG 1 provides ANI/coin voltages to the odd-numbered units (unit 1 of both LCMs). The ANI/coin trouble (ACT) bit is normally low and goes high when a problem occurs with any of the ANI/coin voltages.

If all four units in the LCE are in-service and the ACT bit of RG 0 goes high, the even-numbered units are system-busied (SysB). This action causes the odd-numbered units to go into takeover mode and sets them to an in-service trouble (ISTb) state. If the ACT bit to RG 1 then goes high, ANI/coin functions are disabled, but other calls continue to be processed by the ISTb units.

Figure 3-7 Status and control bits for LCM ringing



Note 1: The pin numbers shown in the previous figure are located on the back of the ringing generator.

Note 2: The signals shown in the previous figure are distributed to all four processor cards in the LCE frame; only one processor card is shown here for clarity.

ANI/coin signals

ANI/coin signals are transmitted from the NT6X53 on a two-wire bus, but, unlike bridged ringing signals, they are not returned in the loop. Instead ANI/coin signals are directed to ground at the subscriber premises and current is recovered at the ground window of the central office. ANI/coin signals may be applied to both tip and ring together or just to the tip lead.

Automatic number identification is a system whereby a calling number is identified automatically and transmitted to the automatic message accounting (AMA) office equipment for billing. The ringing generator provides four voltages for ANI/coin functions. The ANI function uses +48 V and -48 V to identify individual parties on a party line of up to four parties. Coin phones use +130 V to indicate coin collect operations, -130 V to indicate coin return, and -48 V for a coin presence test.

As shown in Figure 3-6, "Detailed ringing schematic" on page 3-18 the ringing system supports separate ringing and ANI/coin buses from the ringing generator to the line drawers. However, at the drawer level, only one bus is used to send either ANI/coin or ringing signals to the line drawers. Unlike ringing signals, ANI/coin signals from both ringing generators are not selectable within the NT6X53 power converter. Ringing generator 0 provides ANI/coin voltages for LCM unit 0, and ringing generator 1 provides ANI/coin voltages for LCM unit 1. If a failure occurs in the ANI/coin circuitry on the ringing generator, the LCM unit it serves enters a system-busy state, forcing the remaining LCM unit to go into takeover mode. The unit in takeover now supplies ANI/coin and ringing signals to all drawers in the LCM.

Relay K1 on the power converter selects between positive and negative voltages; this function is driven by the SPOL (select polarity) control signal shown in the figure "Status and control bits for LCM ringing". Relay K2 selects between 48 V dc and 130 V dc and is driven by control signal SVOLT (select voltage) shown in the Figure 3-7, "Status and control bits for LCM ringing" on page 3-20 Relay K3 (SCOIN control signal in Figure 3-7, "Status and control bits for LCM ringing.") selects between applying voltage on the tip and ring leads together or only on the tip lead. For 48 V selections, a tip-only application is provided through resistor R49.

As shown in Figure 3-6, "Detailed ringing schematic" on page 3-18 all current from ANI/coin sources is routed through a current detector. This circuit sends a signal to the NT6X51 processor card indicating either the presence or absence of current on the ANI/coin bus. This method is used by the processor to make decisions about coin presence tests and automatic number identification.

Ringing process

The LCM/RLCM ringing process performs the following tasks:

- ringing synchronization
- ringing generator output zero-crossing detection
- ringing scheduling

Ringing synchronization task

The ringing synchronization task performs the following functions:

- waits for messages from the ringing schedule task to operate or release ringing relays
- informs the ringing schedule tasks of upcoming subcycle transitions
- measures the time between subcycle transitions
- verifies that the ringing generator is not overloaded

Ringing generator output zero-crossing detection

In order to minimize unwanted voltage and current transients when ringing relays are operated, the synchronization task operates the relays only when the ringing generator output crosses its DC offset voltage. The zero-crossing detection task alerts the ringing synchronization task that a zero crossing of the ringing generator output is upcoming shortly before the actual zero crossing occurs. If the ringing synchronization task must operate or release a ringing relay, it does so at that time.

Ringing schedule task

The ringing schedule task performs the following functions:

- accepts or rejects ringing and ANI/coin requests from the DMS-100 CC
- processes ringing and ANI/coin cancel messages from the DMS-100 CC
- processes the ringing and ANI/coin request messages.

Accepting/rejecting ringing and ANI/coin requests

Upon receiving a ringing or ANI/coin request from the DMS-100 CC, the ringing schedule task verifies that the request is directed to a valid line. If the line is valid, the ringing schedule task queues the request for processing, then instructs the line supervision processes to monitor the line and report when the line is answered.

Processing ringing and ANI/coin cancel messages

Upon receiving a ringing cancel request from the DMS-100 CC, the ringing schedule task sends a message to the ringing synchronization task instructing it to release the ringing relay for the line.

Upon receiving a ANI/coin cancel message, the ringling schedule task sends a message to the ringling synchronization task instructing it to release the ANI/coin voltage relay from the line.

Ringling and ANI/coin messaging

Ringling and ANI/coin requests that are queued by the ringling schedule task are processed by a ringling state machine or ANI/coin state machine that is driven by the ringling schedule task. The ringling schedule task drives the ringling and ANI/coin state machines through state transitions (changes in ringling signal or ANI/coin voltage applications). State machine transitions are caused by one of four events.

- The ringling schedule task receives a time-out message: A timer set by a previous state machine on a specific line timed out, and a time-out message was sent to the ringling schedule task. In response, the ringling schedule task activates the ringling or ANI/coin state machine specified in the time-out message.
- The ringling schedule task receives a message from another task: A message indicating that an event has occurred was received from a state machine or another task. The ringling schedule task then activates the ringling or ANI/coin state machine specified in the message.
- The ringling schedule task received a time-out message indicating a slot transition: The ringling schedule task then performs the following tasks:
 - determines the length of the next time slot from a table of time slot lengths stored in memory, which is indexed by slot numbers
 - sets a timer to the length of the next time slot as found in the timeslot table
 - invokes the ANI/coin state machine for any ANI/coin processes required for this time slot
 - checks the ringling service queue for any transition requests for this time slot and invokes the ringling state machine for any lines requiring ringling state transitions
 - invokes the ANI/coin state machine for the ANI/coin function if an ANI/coin function is required for this time slot

If no ANI/coin function is required for this time slot, the ringling schedule task attempts to service the next ANI/coin request in the queue. The ringling schedule task checks to see if the ringling bus in the Line Drawer requiring the ANI/coin function is idle for the next slot (or the next two slots if it is 4-party ANI/coin function). If the ringling bus is idle, the ringling schedule task services the request.

- The ringling schedule task received a subcycle transition message from the ringling synchronization task: The value of the time slot number is updated

to the time slot corresponding to the subcycle transition. This ensures that the time slot transitions are synchronized with the subcycle transitions.

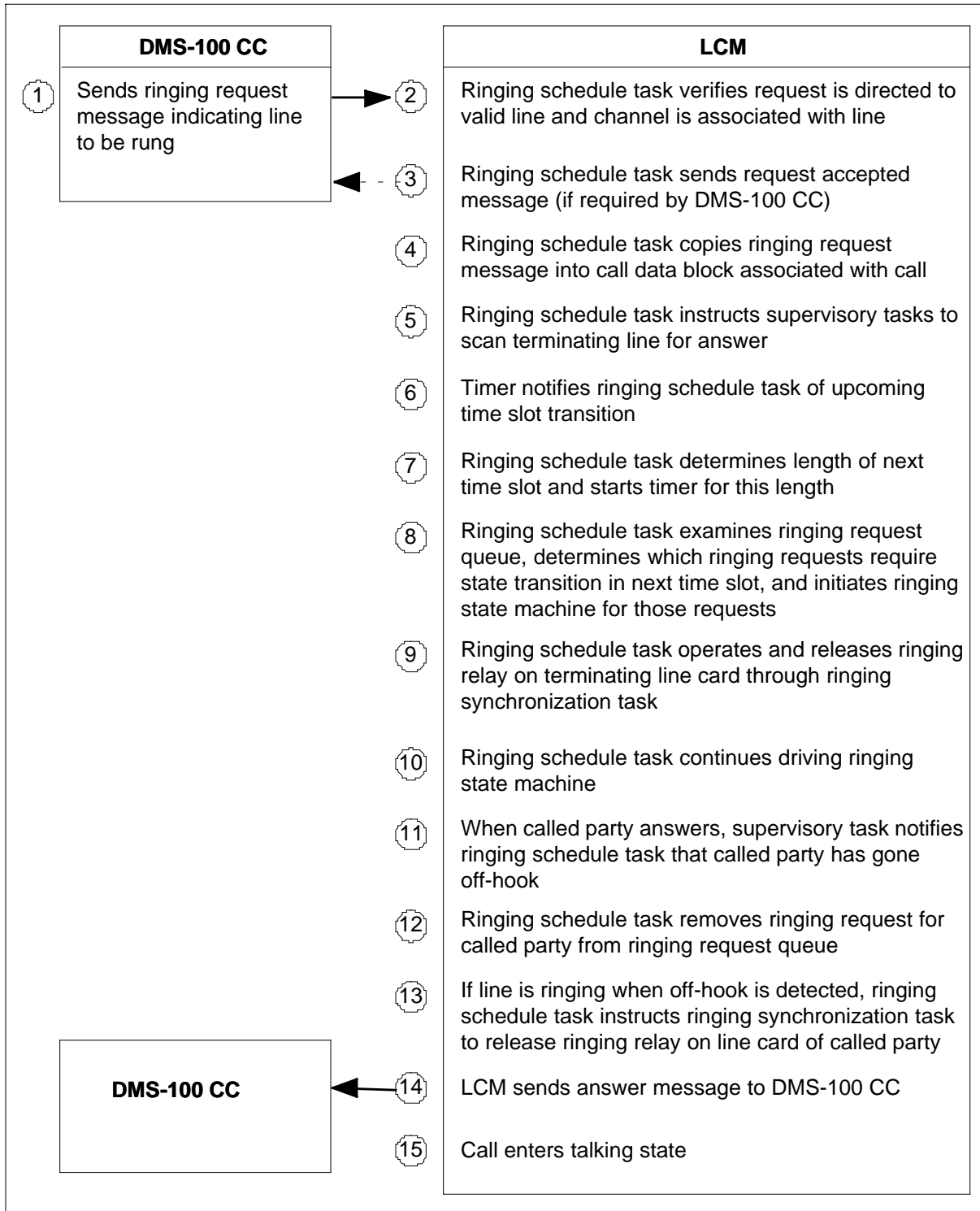
Ringing sequence flowchart

This section describes the sequence of events that occur in the ringing processes of the LCM during normal operation (non-ESA). In the "Ringing sequence diagram" figure, the following attributes of the call are assumed:

- call is terminating on a LCM
- call is entering the ringing phase
- terminating line is 1FSR
- terminating line is idle
- immediate ringing is disabled

As the call enters the ringing state, the sequence of events shown in the following figure occur.

Figure 3-8 LCM ringing sequence diagram



Ringing generator configuration change procedure

Follow this procedure to change the ringing configuration in host and remote line concentrating module (LCM) configurations. During this procedure, the LCM units enter an in-service trouble (ISTb) state because of ringing cadence differences. The ISTb state clears after you or the system starts a test. Perform this procedure during a low traffic period.

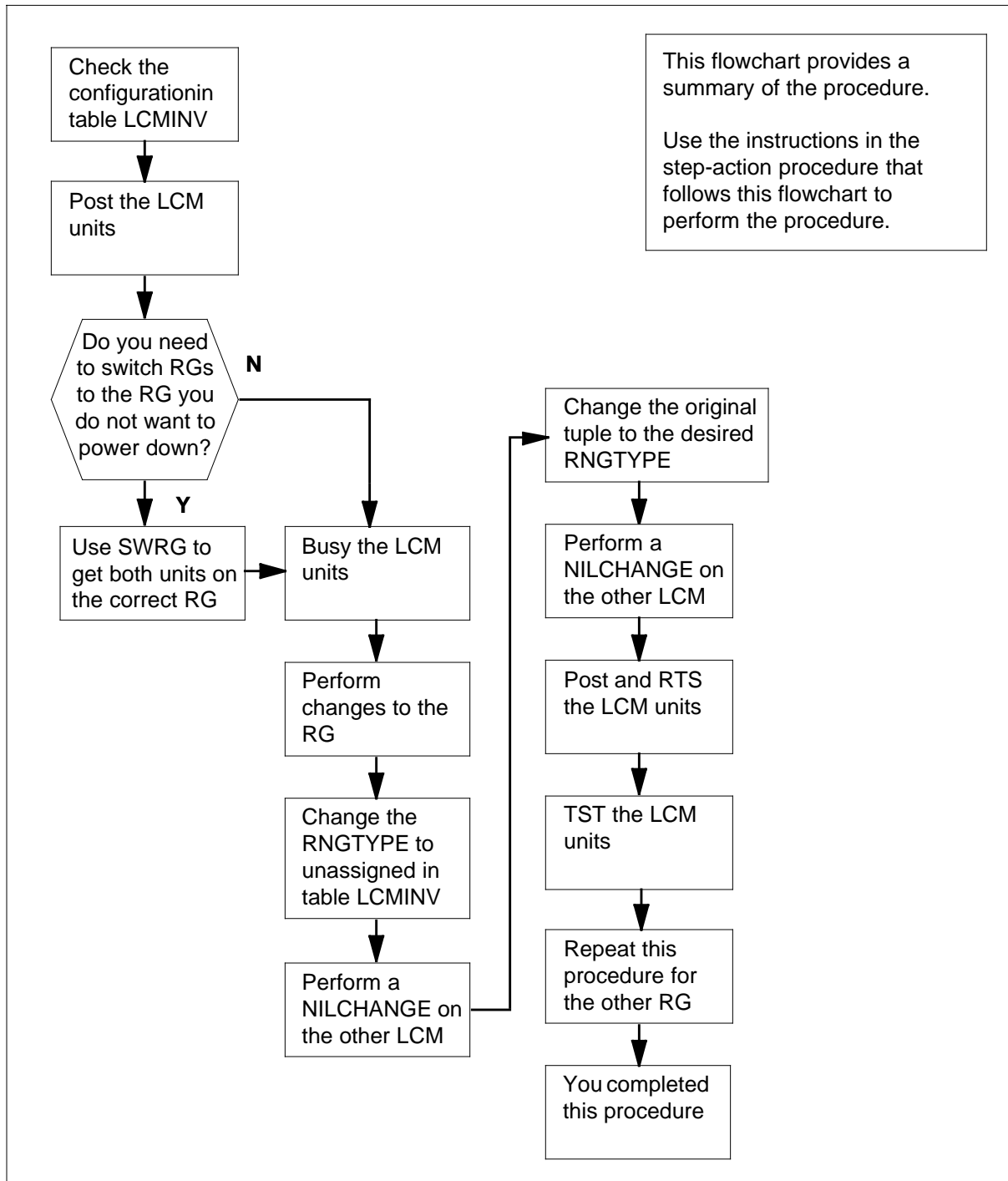
The test lines off the LCM that you modify for this procedure should be set up and in good working order before beginning this procedure. Use the test lines during this procedure to test the changes in the ringing scheme.

In the unlikely event that something occurs and obstructs the ringing system, back out of the procedure by reversing the steps you entered. If a serious problem exists, such as an E1 outage, immediately contact Emergency Technical Assistance Support (ETAS).

Dual LCM configuration

This procedure describes how to reconfigure the ringing generators in host and remote switching center (RSC) dual LCM configurations. The procedure begins with the reconfiguration of ringing generator 1 and then reconfigures ringing generator 0. For the following procedure, the LCM site is HOST. The frame number is 0. The units affected are 0 and 1. These values are for example only. Operating company personnel must use site, frame, and unit LCM values for the affected LCMs.

Figure 3-9 Summary of Dual LCM ringing generator configuration change procedure



Procedure 3-1 Dual LCM ringing generator configuration change procedure**At the MAP terminal**

- 1 To access table LCMINV, type
> **TABLE LCMINV**
and press the Enter key.
- 2 To position on the tuple for the first LCM, type
> **POS HOST 0 0**
and press the Enter key.

Example of a MAP display:

```
>POS HOST 0 0
HOST 00 0      LCE      4      1  P      29 6X04AA XLCM11BD      LTC      0
N      3 256K 256K
LCM Y      [F] REA 20 30 40 50 HLCM      (16)(18)(17)(19)$
```

↑
RNGTYPE is set to frequency selective (F).

For more information about ringing types, refer to chapter "DMS-100 ringing overview" in this document and the *Customer Data Schema Reference Manual*.

- 3 Check the RNGTYPE for the LCM. The previous example shows a RNGTYPE of frequency selective.
- 4 To check the RNGTYPE for the other LCM in the LCE frame, type
> **POS HOST 0 1**
and press the Enter key.

Example of a MAP display:

```
>POS HOST 0 1
HOST 00 1      LCE      38      1  P      29 6X04AA XLCM11BD      LTC      0
N      8 256K 256K
LCM Y      [F] REA 20 30 40 50 HLCM      (0)(2)(1)(3)$
```

↑
RNGTYPE is set to frequency selective (F).

- 5 To quit the table, type
> **QUIT ALL**
and press the Enter key.
- 6 To access the PM level of the MAP terminal, type
> **MAPCI;MTC;PM**
and press the Enter key.

Example of a MAP display:

```
PM      SysB      ManB      OffL      Cbsy      ISTb      InSv
      0      0      0      0      3      39
```


- 7 To post the the first LCM in the frame or cabinet, type
 > **POST LCM 0 0**
 and press the Enter key.

Example of a MAP display:

```

          SysB   ManB   OffL   Cbsy   ISTb   InSv
    PM          0     0     0     0     3     39
    LCM         0     0     0     0     0     4

LCM   HOST 00 0  InSv  Links_OOS: CSide 0 , PSide 0
Unit0: InSv
Unit1: InSv
          /RG: 0
          /RG: 0
Drwr:  01  23  45  67  89  11  11  11  11  11  RG: Pref 0 InSv
          ..  ..  ..  ..  ..  10  23  45  67  89  Stby 1 InSv
          ..  ..  ..  ..  ..  ..  ..  ..  ..  ..
    
```

Both units use ringing generator 0 (RG-0).

- 8 Are the units in the LCM aligned to use RG-0?

If both LCM units	Do
are aligned and both use RG-0	step 10
are not aligned or both do not use RG-0	step 9

- 9 To get an LCM unit to use RG-0, type
 > **SWRG UNIT unit_no**
 and press the Enter key.

where

unit_no

is the unit number you want to switch to RG-0 (0 or 1)

If the SWRG does not pass, contact ETAS and do not continue with this procedure.

Example of a MAP display:

```

swrg unit 0
LCM HOST 00 1 Unit 0 SWRG Passed
    
```

Note: Perform this step for each LCM unit that needs to use RG-0.

- 10 To busy unit 1 of the first LCM, type
 > **BSY UNIT 1**
 and press the Enter key.

Example of a MAP response:

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```

                SysB   ManB   OffL   CBsy   ISTb   InSv
    PM           0       0       0       0       3       39
    LCM          0       0       0       0       0       4

    LCM  HOST 00 0  InSv  Links_OOS: CSide 0 , PSide 0
    Unit0: InSv      Takeover /RG: 0
    Unit1: ManB      /RG: 0
                11 11 11 11 11  RG: Pref 1 InSv
    Drwr:  01 23 45 67 89 10 23 45 67 89      Stby 0 InSv
    .. .. .
    bsy unit 1
    LCM HOST 00 1 Unit 1 Bsy Passed
  
```

Note: It is necessary to busy the unit so that the mate unit enters a takeover.

- 11 To post the second LCM in the frame or cabinet, type

> **POST LCM 0 1**

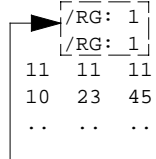
and press the Enter key.

Example of a MAP display:

```

                SysB   ManB   OffL   CBsy   ISTb   InSv
    PM           0       0       0       0       3       39
    LCM          0       0       0       0       0       4

    LCM  HOST 00 1  InSv  Links_OOS: CSide 0 , PSide 0
    Unit0: InSv
    Unit1: InSv
                11 11 11 11 11  RG: Pref 0 InSv
    Drwr:  01 23 45 67 89 10 23 45 67 89      Stby 1 InSv
    .. .. .
  
```



Both units use ringing generator 1 (RG-1).

- 12 Are the units in the LCM aligned to use RG-0?

If both LCM units

Do

are aligned and both use RG-0 step 14

are not aligned or both do not use RG-0 step 13

- 13 To get an LCM unit to use RG-0, type

> **SWRG UNIT unit_no**

and press the Enter key.

where

unit_no

is the unit number you want to switch to RG-0 (0 or 1)

Example of a MAP display:

```

    swrg unit 0
    LCM HOST 00 1 Unit 0 SWRG Passed
  
```

Note: Perform this step for each LCM unit that needs to use RG-0. The result of switching ringing generators will result in a MAP terminal display like the following.

Example of a MAP display:

```

                SysB   ManB   OffL   CBsy   ISTb   InSv
PM              0     0     0     0     3     39
LCM             0     0     0     0     0     4

LCM  HOST 00 1  InSv  Links_OOS: CSide 0 , PSide 0
Unit0: InSv
Unit1: InSv
                /RG: 0
                /RG: 0
Drwr: 01 23 45 67 89 10 23 45 67 89  RG: Pref 0 InSv
                .. .. .. .. ..  Stby 1 InSv

```

Both units now use ringing generator 0 (RG-0).

- 14 To busy unit 1 of the second LCM, type
 > **BSY UNIT 1**
 and press the Enter key.

At the LCE frame/cabinet

15



WARNING

Static electricity damage

Before removing the ringing generator or any cards, put on a wrist strap and connect it to the wrist strap grounding point on the left side of the frame supervisory panel of the LCM. This protects the equipment against damage caused by static electricity.



WARNING

Equipment damage

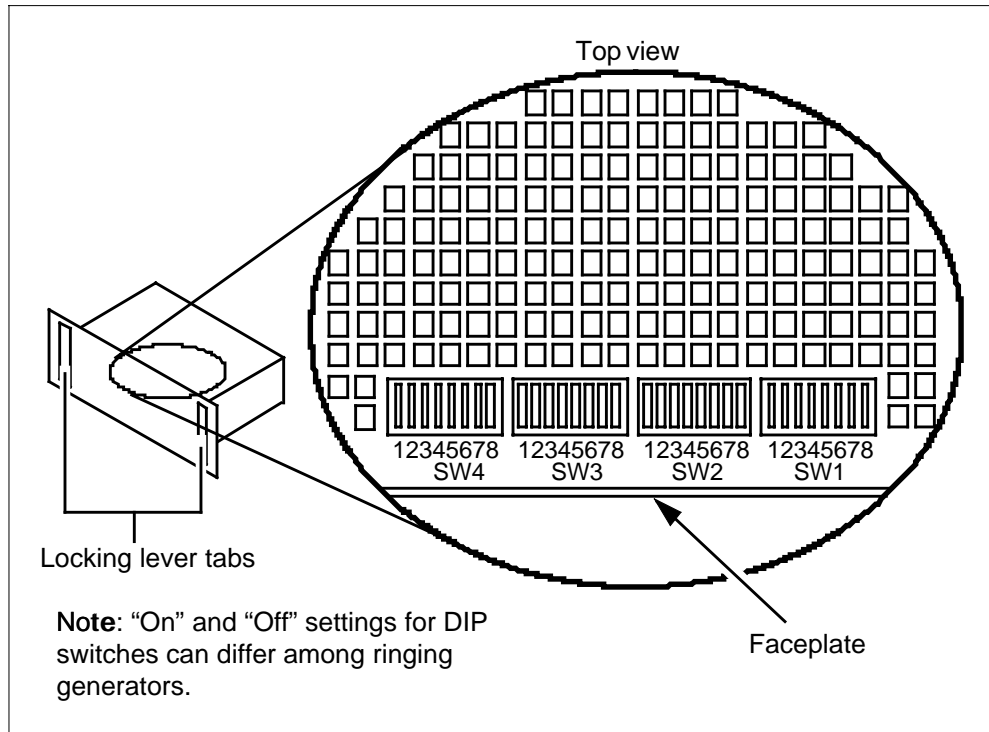
Take the following precautions when removing or inserting a card:

1. Do not apply direct pressure to the components.
2. Do not force the cards into the slots.

Put on a wrist strap.

- 16 Power down, remove, and make the dual in-line package (DIP) switch changes to RG-1.

Refer to the *Hardware Description Manual*, 297-8991-805 for information on DIP switch settings for the ringing generator. The following figure shows the DIP switch layout for the NT6X30AA ringing generator. Refer to the DIP switch layout and settings for the ringing generator used in your office.



- 17 Reseat RG-1 and restore power.

At the MAP terminal

- 18 To quit the PM level of the MAP terminal, type
`> QUIT ALL`
 and press the Enter key.

- 19 To access table LCMINV, type
`> TABLE LCMINV`
 and press the Enter key.

Example of a MAP response:

```
CI:
TABLE: LCMINV
```

- 20 To position on the tuple for the first LCM, type
`> POS HOST 0 0`
 and press the Enter key.

- 21 To change the ringing scheme, type
`> CHA LCMTYPE`
 and press the Enter key.

Example of a MAP response:

```
ENTER Y TO CONTINUE PROCESSING OR N TO QUIT
```

Enter Y to continue processing the change request and press the Enter key.

Example of a MAP response:

```
LCMTYPESEL: LCM
```

Example of a MAP response:

Press the Enter key to leave this entry as it is.

Example of a MAP response:

```
RGEQUIP: Y
```

Press the Enter key to leave this entry as it is.

Example of a MAP response:

```
RNGTYPE: F
```

Enter UNASSIGNED and press the Enter key.

Press Enter when the system prompts you to change the value of other fields in the tuple. This avoids making any other changes. The system will prompt you to verify the change. See the following MAP response.

```
TUPLE TO BE CHANGED:
  HOST 00 0  LCE 4  1  N  26 6X04AA XLCM11BD  LGC  0
      N      5 256K 256K
      LCM Y  UNASSIGNED  HLCM          ( 0) ( 2) ( 1) ( 3)$
  ENTER Y TO CONFIRM, N TO REJECT OR E TO EDIT.
```

Enter Y to confirm the tuple change request and press the Enter key.

22 Immediately position on the second LCM. Type

```
> POS HOST 0 1
```

and press the Enter key.

23 To perform a static data update (NILCHANGE), type

```
> CHA
```

and press the Enter key.

Example of a MAP response:

```
ENTER Y TO CONTINUE PROCESSING OR N TO QUIT
```

Enter Y to continue processing the change request and press the Enter key.

Press the Enter key as a response to the system prompts. When you press Enter with no change to the values, you avoid changing any values in the tuple. The NILCHANGE request updates static data in the LCM units.

Example of a MAP display:

```
TUPLE TO BE CHANGED:
  HOST 00 0  LCE 4  1  N  26 6X04AA XLCM11BD  LGC  0
      N      5 256K 256K
      LCM Y  F BOC 20 30 40 50 HLCM          ( 0) ( 2) ( 1) ( 3)$
  ENTER Y TO CONFIRM, N TO REJECT OR E TO EDIT.
```

Enter Y and press the Enter key to confirm the NILCHANGE request.

24 Repeat steps 20 and 21 on the first LCM, but enter the desired value in field RNGTYPE instead of UNASSIGNED.

25 Repeat steps 22 and 23 to perform another static data update (NILCHANGE) on the second LCM.

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- 26** To exit table LCMINV, type
> **QUIT ALL**
and press the Enter key.
- 27** To enter the PM level of the MAP terminal, type
> **MAPCI;MTC;PM**
and press the Enter key.
- 28** To post the first LCM and return it to service, type
> **POST LCM 0 0**
and press the Enter key.
> **RTS UNIT 1**
and press the Enter key.
- 29** To post the second LCM and return it to service, type
> **POST LCM 0 1**
and press the Enter key.
> **RTS UNIT 1**
and press the Enter key.
- 30** The following steps complete the procedure and change the ringing configuration for RG-0 on the same LCM frame or cabinet.
- 31** Are the units in the LCM aligned to use RG-1?
- | If both LCM units | Do |
|---|-----------|
| are aligned and both use RG-1 | Step 33 |
| are not aligned or both do not use RG-1 | Step 32 |
- 32** To get an LCM unit to use RG-1, type
> **SWRG UNIT unit_no**
and press the Enter key.
where
unit_no
is the unit number you want to switch to RG-1 (0 or 1)

```
swrg unit 1  
LCM HOST 00 0 Unit 1 SWRG Passed
```

Perform this step for each LCM unit that needs to use RG-1.
- 33** To test the ringing generator and LCM unit, type
> **TST UNIT 1**
and press the Enter key.
- 34** To busy unit 0 of the second (currently posted) LCM, type
> **BSY UNIT 0**
and press the Enter key.

35 To post the first LCM, type
 > **POST LCM 0 0**
 and press the Enter key.

36 Are the units in the LCM aligned to use RG-1?

If both LCM units	Do
are aligned and both use RG-1	Step 38
are not aligned or both do not use RG-1	Step 37

37 To get an LCM unit to use RG-1, type
 > **SWRG UNIT unit_no**
 and press the Enter key.

where

unit_no

is the unit number you want to switch to RG-1 (0 or 1)

Example of a MAP response:

```
swrg unit 1
LCM HOST 00 0 Unit 1 SWRG Passed
```

Perform this step for each LCM unit that needs to use RG-1.

Note: The recommended RG assignment for the LCM is RG-0.

38 To test the ringing generator and LCM unit, type
 > **TST UNIT 1**
 and press the Enter key.

39 To busy unit 0 of the first LCM, type
 > **BSY UNIT 0**
 and press the Enter key.

At the LCE frame/cabinet

40



WARNING

Static electricity damage

Before removing any cards, put on a wrist strap and connect it to the wrist strap grounding point on the left side of the frame supervisory panel of the LCM. This protects the equipment against damage caused by static electricity.



WARNING

Equipment damage

Take the following precautions when removing or inserting a card:

1. Do not apply direct pressure to the components.
2. Do not force the cards into the slots.

Put on a wrist strap.

41 Power down, remove, and make the DIP switch changes to RG-0.

42 Reseat RG-0 and restore power.

Refer to the *Hardware Description Manual*, 297-8991-805 for information on DIP switch settings for the ringing generator.

At the MAP terminal

43 To return unit 0 of the first (currently posted) LCM to service, type

> **RTS UNIT 0**

and press the Enter key.

44 To return unit 0 of the second LCM to service, type

> **POST LCM 0 1**

and press the Enter key.

> **RTS UNIT 0**

and press the Enter key.

45 Use the SWRG command to align the RGs to the recommended RG assignment for each LCM. Type

> **SWRG UNIT PM**

and press the Enter key.

Repeat this step for the other unit.

Note: The recommended RG assignment for LCM 0 is RG-0. The recommended RG assignment for LCM 1 is RG-1.

Refer to Figure 3-4, "LCE frame" on page 3-13 for an illustration of the LCM units and the RGs.

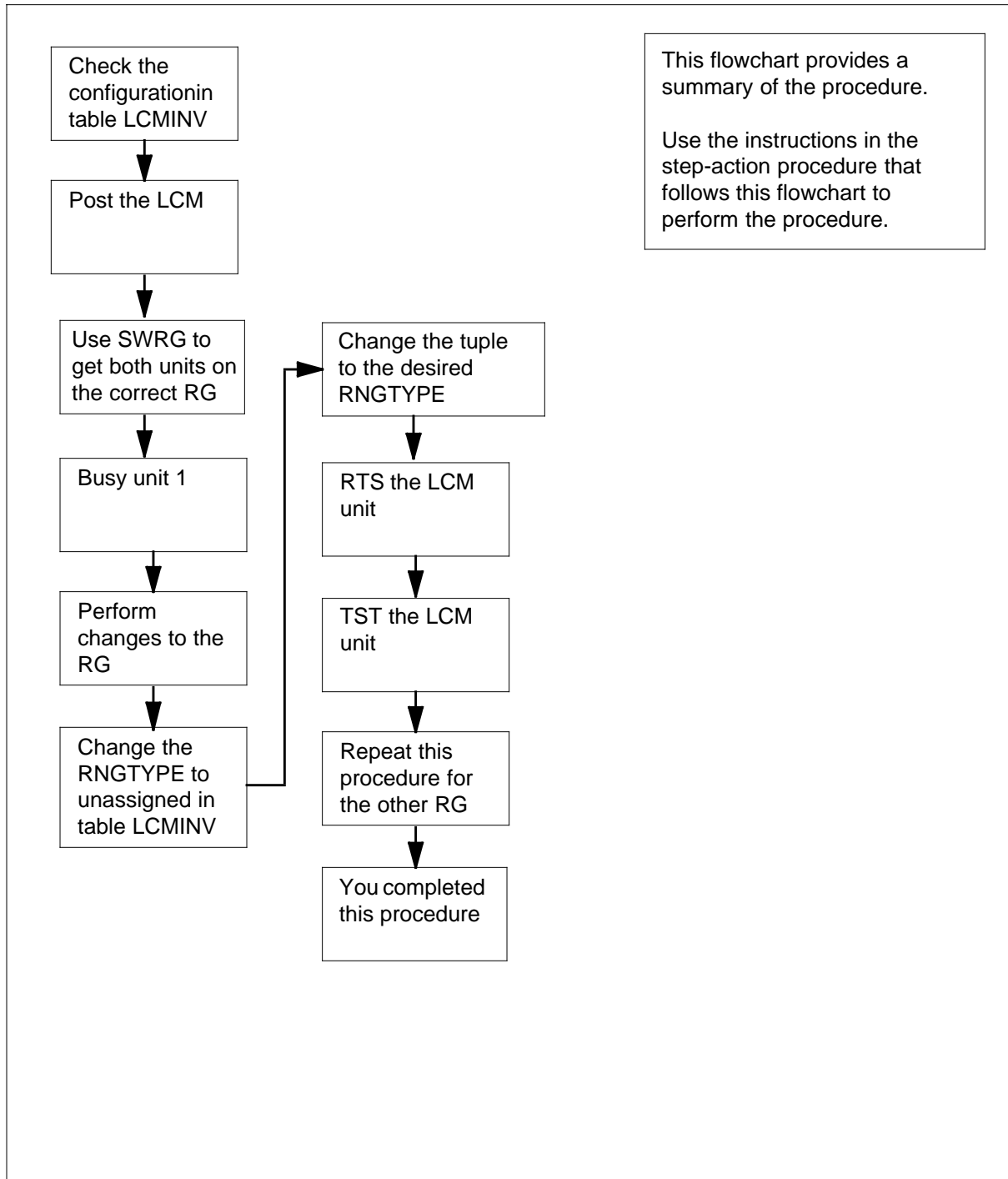
- 46 To test the LCM units, type
> **POST LCM 0 0**
and press the Enter key.
> **TST UNIT 0**
and press the Enter key.
> **POST LCM 0 1**
and press the Enter key.
> **TST UNIT 0**
and press the Enter key.
Note: This step tests the ringing generators.
- 47 You completed this procedure.

Single LCM configuration

This procedure describes how to reconfigure the ringing generators in peripheral modules (PM) in a single LCM configuration. The procedure begins with the reconfiguration of ringing generator 1 and then reconfigures ringing generator 0. For the following procedure, the LCM site is RLCM. The frame number is 0. The unit number for the LCM is 0. These values are for example only. Operating company personnel should use site, frame, and unit values for the affected single LCM PMs.

Perform this procedure during a period of low traffic. In the unlikely event that something happens and obstructs the ringing system, back out of the procedure by reversing the steps you entered. If a serious problem exists, such as an E1 outage, immediately contact Emergency Technical Assistance Support (ETAS).

Figure 3-10 Summary of Single LCM ringing generator configuration change procedure



Procedure 3-2 Single LCM ringing generator configuration change procedure

At the MAP terminal

- 1 To access table LCMINV, type
 > **TABLE LCMINV**
 and press the Enter key.
- 2 To position on the tuple for the LCM, type
 > **POS RLCM 0 0**
 and press the Enter key.

Example of a MAP display

```
>POS RLCM 0 0
RLCM 00 0      RLCM 4      1 P      29 6X04AA XLCM11BD      LTC 0
N      3 256K 256K
LCM Y      [F] REA 20 30 40 50 HLCM      (16)(18)(17)(19)$
```

↑
 RINGTYPE is set to frequency selective (F).

For more information about ringing types, refer to the *Customer Data Schema Reference Manual* and chapter "DMS-100 ringing overview" in this document.

- 3 Check the RINGTYPE for the LCM. The previous example shows a RINGTYPE of frequency selective.
- 4 To quit the table, type
 > **QUIT ALL**
 and press the Enter key.
- 5 To access the PM level of the MAP terminal, type
 > **MAPCI ;MTC ;PM**
 and press the Enter key.

Example of a MAP display:

```
PM      SysB  ManB  OffL  CBsy  IsTb  InSv
      0      0      0      0      0      39
```

- 6 To post the LCM, type
 > **POST LCM RLCM 0 0**
 and press the Enter key.

Example of a MAP display

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```

                SysB   ManB   OffL   Cbsy   ISTb   InSv
    PM           0     0     0     0     3     18
    LCM          0     0     0     0     1     0

LCM   RLCM 00 0  InSv  Links_OOS: CSide 0 , PSide 0
Unit0: InSv      /RG: 0
Unit1: InSv      /RG: 0
                11  11  11  11  11  RG: Pref 0 InSv
Drwr:  01  23  45  67  89  10  23  45  67  89  Stby 1 InSv
      ..  ..  ..  ..  ..  ..  ..  ..  ..  ..
    
```

Both units use ringing generator 0 (RG-0).

- 7 Are the units in the LCM aligned to use RG-0?

If both LCM units	Do
are aligned and both use RG-0	Step 9
are not aligned or both do not use RG-0	Step 8

- 8 To get an LCM unit to use RG-0, type

```
> SWRG UNIT unit_no
```

and press the Enter key.

where

unit_no

is the unit number you want to switch to RG-0 (0 or 1)

Example of a MAP response:

```
swrg unit 1
LCM RLCM 00 0 Unit 1 SWRG Passed
```

Note: Perform this step for each LCM unit that needs to use RG-0.

- 9 To busy unit 1 of the LCM, type

```
> BSY UNIT 1
```

and press the Enter key.

At the frame

10



WARNING

Static electricity damage

Before removing any cards, put on a wrist strap and connect it to the wrist strap grounding point on the left side of the frame supervisory panel of the LCM. This protects the equipment against damage caused by static electricity.



WARNING

Equipment damage

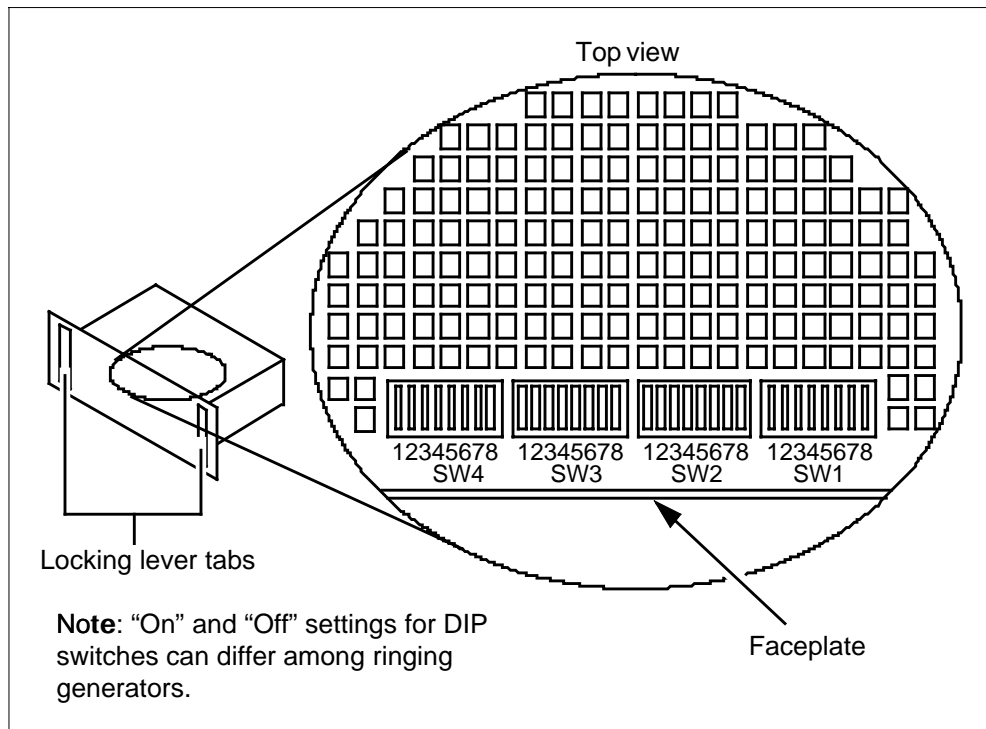
Take the following precautions when removing or inserting a card:

1. Do not apply direct pressure to the components.
2. Do not force the cards into the slots.

Put on a wrist strap.

11 Power down, remove, and make the DIP switch changes to RG-1.

Refer to the *Hardware Description Manual*, 297-8991-805 for information on DIP switch settings for the ringing generator. The following figure shows the DIP switch layout for the NT6X30AA ringing generator. Refer to the DIP switch layout and settings for the ringing generator used in your office.



- 12 Reseat RG-1 and restore power.

At the MAP terminal

- 13 To quit the PM level of the MAP terminal, type

> QUIT ALL

and press the Enter key.

- 14 To access table LCMINV, type

> TABLE LCMINV

and press the Enter key.

Example of a MAP response:

```
CI:
TABLE: LCMINV
```

- 15 To position on the tuple for the LCM, type

> POS RLCM 0 0

and press the Enter key.

- 16 To change the ringing scheme, type

> CHA LCMTYPE

and press the Enter key.

Example of a MAP response:

```
ENTER Y TO CONTINUE PROCESSING OR N TO QUIT
```

Enter Y to continue processing the change request and press the Enter key.

Example of a MAP response:

```
LCMTYPESEL: LCM
```

Press the Enter key to leave this entry as it is.

Example of a MAP response:

```
RGEQUIP: Y
```

Press the Enter key to leave this entry as it is.

Example of a MAP response:

```
RNGTYPE: F
```

Enter UNASSIGNED and press the Enter key.

Press Enter when the system prompts you to change the value of other fields in the tuple. This avoids making any other changes. The system will prompt you to verify the change. See the following MAP response.

Example of a MAP response:

```
TUPLE TO BE CHANGED:
RLCM 00 0 RLCM 4 1 B 26 6X04AA XLCM04AH LTC 1
N 3 256K 256K
LCM Y UNASSIGNED RLCM (0)(2)(1)(3)$ N Y N 6X50AA
ENTER Y TO CONFIRM, N TO REJECT OR E TO EDIT.
```

Enter Y to confirm the tuple change request and press the Enter key.

- 17 Repeat steps 15 and 16, but enter the desired value in field RNGTYPE instead of UNASSIGNED.

- 18 To exit table LCMINV, type
> **QUIT ALL**
and press the Enter key.
- 19 To access the PM level of the MAP terminal, type
> **MAPCI;MTC;PM**
and press the Enter key.
- 20 To post and return to service the LCM unit, type
> **POST LCM RLCM 0 0**
and press the Enter key.
> **RTS UNIT 1**
and press the Enter key.
- 21 The following steps complete the procedure for RG-0.
- 22 Are the units in the LCM aligned to use RG-1?

If both LCM units	Do
are aligned and both use RG-1	Step 24
are not aligned or both do not use RG-1	Step 23

- 23 To get an LCM unit to use RG-0, type
> **SWRG UNIT unit_no**
and press the Enter key.
where
unit_no
is the unit number you want to switch to RG-1 (0 or 1)

Example of a MAP response:

```
swrg unit 1
LCM RLCM 00 0 Unit 1 SWRG Passed
```

Note: Perform this step for each LCM unit that needs to use RG-1.

- 24 To test the LCM unit and ringing generator, type
> **TST UNIT 1**
and press the Enter key.
- 25 To busy unit 0 of the LCM, type
> **BSY UNIT 0**
and press the Enter key.

At the frame

26



WARNING

Static electricity damage

Before removing any cards, put on a wrist strap and connect it to the wrist strap grounding point on the left side of the frame supervisory panel of the LCM. This protects the equipment against damage caused by static electricity.



WARNING

Equipment damage

Take the following precautions when removing or inserting a card:

1. Do not apply direct pressure to the components.
2. Do not force the cards into the slots.

Put on a wrist strap.

27 Power down, remove, and make the DIP switch changes to RG-0.

28 Reseat RG-0 and restore power.

Refer to the *Hardware Description Manual*, 297-8991-805 for information on DIP switch settings for the ringing generator.

At the MAP terminal

29 To return unit 0 to service, type

```
> RTS UNIT 0
```

and press the Enter key.

30 Use the SWRG command to align the RGs to the recommended RG assignment for the LCM. Type

```
> SWRG UNIT unit_no
```

and press the Enter key.

where

unit_no

is the unit number you want to switch

31 To test the LCM unit and ringing generator, type

```
> TST UNIT 0
```

and press the Enter key.

32 You completed this procedure.

Ringing in the Universal Edge 9000

The architecture of the POTS functionality in the Universal Edge 9000 (UEN) borrows heavily from the LCM. This is because the time division multiplexing (TDM) software functions the same as that of the LCM in the DMS-100 system. The UEN

- interfaces to an LGC, LTC, or RCC2
- provides redundancy down to the node level (for example, each unit in the node can take over the mate unit's call processing in the event of a failure)
- concentrates voice channels (that is, more in-service lines are supported in UEN than there are voice channels to the host PM)
- supports World line card (WLC) POTS line cards

Each UEN DMS frame contains up to four physical UEN DMS shelves. Each UEN DMS shelf consists of 21 card positions that contain up to:

- 16 multi-circuit line cards
- 2 TDM (voice) control cards
- 2 data control cards (future)

Slot 1 contains two half-height cards:

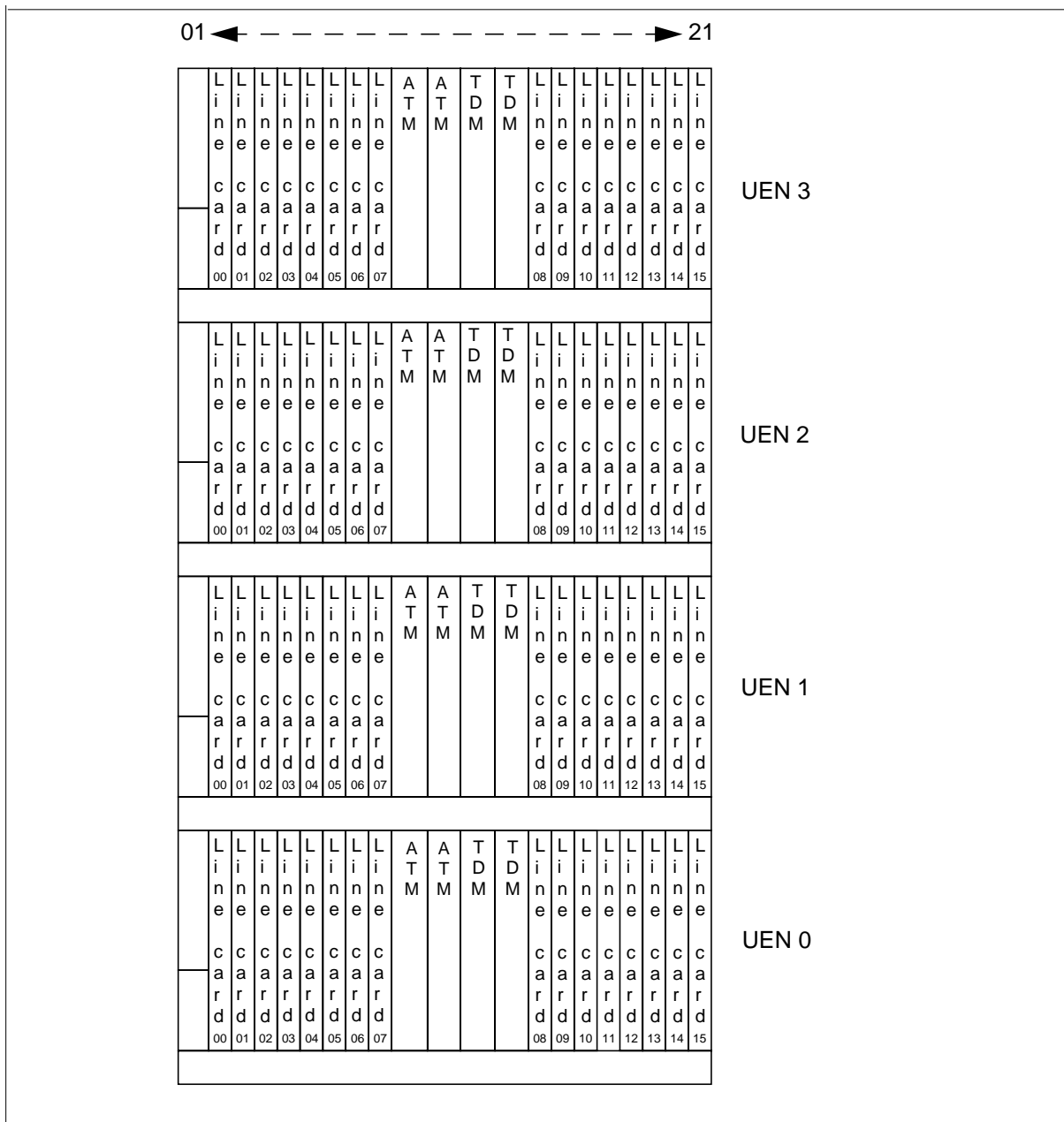
- one power input/output card
- one shelf interconnect card

Each UEN shelf consists of 16 line cards that offer voice service. The UEN shelf also contains two TDM common equipment cards. The TDM cards are redundant and able to support from 2-6 DS-30B connections in each shelf to the host PM, for a maximum of 12 DS-30B in each frame.

Each line card with voiceband services has its own ringing generator. There are no hardware resources present in the shelf to synchronize operation of these ring generators. Hardware and software resources on the line card and at the TDM interface cards monitor the operation of the ringing generator on each line card to detect and report overload and failure conditions.

The following figure provides a front view of the UEN shelf assembly showing slot assignments and line card / line subgroup numbering schemes.

Figure 3-11 UEN shelf and line card layout



Note 1: NTNP44 supports a maximum of 4 lines.

Note 2: NTNP50 supports a maximum of 32 lines.

Note 3: Line card numbering 0 - 15 represents line subgroup (LSG) numbers as viewed from the MAP terminal.

Ringling in the Remote Line Concentrating Module

The Remote Line Concentrating Module (RLCM) is a repackaged LCM located remotely from the central office and connected to it by DS-1 links. The RLCM consists of the following components:

- one LCM
- host interface equipment shelf (contains the ringling generator cards)
- frame supervisory panel
- remote maintenance module

Because only one LCM is provisioned in the RLCM, RG 0 serves unit 0 and RG 1 serves unit 1. Otherwise, ringling in the RLCM is the same as in the LCM.

Ringling in the Outside Plant Module and OPAC

The Outside Plant Module (OPM) is a repackaged RLCM located remotely from the host office and connected to the host over DS-1 links. The OPM consists of the following components:

- LCM
- host interface equipment shelf (contains ringling generator cards)
- environmental control unit
- battery control unit
- rectifiers
- power control unit
- frame supervisory panel
- remote maintenance module

Ringling in the OPM is the same as in the RLCM.

The Outside Plant Access Cabinet (OPAC) is like the OPM but it is cabinetized for outdoor installations.

Ringling in the Remote Switching Center

The Remote Switching Center (RSC) is a DMS-100 remote that can support up to 5760 lines. The RSC consists of components:

- remote cluster controller
- remote maintenance module
- line concentrating modules in LCE bays

The call control functions at the RSC are performed by the LCMs. Ringling in the RSC, therefore, is the same as in the LCM.

4 Administration of DMS ringing

Assigning ringing to line modules

This section describes the administration of the DMS-100 ringing system. Administration of the ringing system involves assigning ringing types to peripheral modules (PM) by datafilling the inventory tables in the DMS-100 data store (DS). In this section, the data tables involved in administering the DMS-100 ringing system are listed and the procedure for datafilling each table is provided.

The following sections describe administration of ringing to line modules (LM) and remote line modules (RLM).

Assigning ringing type to PM

The LMs and RLMs in the DMS-100 are packaged in the line module equipment (LME) frames and remote line equipment (RLE) cabinets. The LME contains two LMs and four ringing generators, two for each LM. The RLE also contains two LMs and four ringing generators.

The LME and RLE can support the following types of ringing:

- coded 20 Hz
- coded 30 Hz
- superimposed
- frequency selective

Note: Only one type of ringing can be assigned to each LME or RLE.

Ringing is assigned to each LME or RLE by installing the appropriate ringing generators, ringing generator interface, and line cards in the LME or RLE and by datafilling the appropriate ringing information in table LMRNG.

Ringling generators

Following is a list of the LME and RLE ringling generators and the ringling types each supports:

- NT2X27AA - coded and superimposed
- NT2X27AB - decimonic and coded (30 Hz)
- NT2X27AC - harmonic
- NT2X27AD - synchronomonic 16
- NT2X27AE - synchronomonic 20
- NT2X27AF - BOC (105 VRMS)

The ringling generators installed in the LM or RLM must be compatible with the ringling type assigned to the LM or RLM.

Ringling generator interface

The NT2X27 ringling generator interface (RGI) provides the interface between the LM and RLM signalling processor and ringling generator. There are six versions of the RGI:

- NT2X27AA - 20 Hz Bell (87V RMS)
- NT2X27AB - decimonic MF
- NT2X27AC - harmonic MF
- NT2X27AD - synchronomonic 16 Hz
- NT2X27AE - synchronomonic MF
- NT2X27AF - 20 Hz bell coded ringling (105 V RMS)

Note: For coded ringling, when 20 Hz coded ringling is to be used (ring type set to C in field RNGTYPE of table LMRNG), use the NT2X27AA RGI. When 30 Hz coded ringling is to be used (ring type set to C30), use the NT2X27AB RGI.

Line cards

In addition to appropriate ringling generators, the LM and RLM also must contain the proper line cards to support the ringling assigned to the LM or RLM. The type of line card required depends on the line class code and ringling code assigned to the line. Line class codes and ringling codes are described in

the *SERVORD Reference Manual*. Information regarding the relationship between line cards and ringing types is summarized in the following table.

Table 4-1 Line class codes by line card type and ring code

Line class code	Ringers		Coded ringing		Superimposed ringing		Frequency selective	
	Bridged (B) Divided (D)	Line card	Ring code	Line card	Ring code	Line card	Ring code	
1FR	B or D	A	0	A	0	A	0	
2FR	D	A	0	A	0	B	1-5	
2FR	B	--	--	--	--	A or B (note 1)	1-5	
4FR	D	B	1-4	B	1-4	B	1-5	
4FR	B	B	1-4	--	--	A or B (note 1)	1-5	
8FR	D	B	1-5	B	1-4	B	1-5	
10FR	D	B	1-5	--	--	--	--	

Note 1: Type A line card is recommended for these applications.

Note 2: Type A line card can not be used for 2FR divided ringing when CC patch TLA67 is used (in LCMs).

Table LMRNG

Table LMRNG contains ringing data for LM and RLM. A description of the fields in table LMRNG, as well as a sample of datafill in table LMRNG, is in the *Customer Data Schema Reference Manual*.

Assigning ringing to line concentrating modules

Assigning ringing to a line concentrating module (LCM) or remote line concentrating module (RLCM) involves setting up the ringing generators for the appropriate ringing signal, inserting the appropriate line cards, and datafilling table LCMINV.

Setting up the LCM or RLCM ringing generators

The ringing generators in the LCM and RLCM are programmed by dual inline package (DIP) switches on the ringing generator card. These switches must be manually set to program the RG for the proper ringing signal.

Line cards

As with the LM and RLM, the LCM and RLCM must contain line cards that support the ringing type assigned to them. The LCM and RLCM use the same line cards as the LM and RLM. The table "Line class codes by line card type and ring code" lists the line cards and the ringing types they support.

When assigning ringing to an LCM or RLCM, you must ensure that compatible line cards are installed.

Table LCMINV

Table LCMINV contains information on LCMs and RLCMs, including ringing information. A description of Table LCMINV and a sample of datafill from Table LCMINV are in the *Customer Data Schema Reference Manual*. In an LCE, both LCMs must be assigned the same ringing type. Also, the ringing type datafilled in table LCMINV must match the ringing scheme set by the DIP switches on the ringing generators.

Assigning ringing to SCM-100R

The SCM-100R supports the following type of ringing:

- 20 Hz single party
- superimposed
- frequency selective
- coded

In order to assign ringing to the SCM-100R, the appropriate ringing generators and line cards must be installed at the RCT, and table RCTINV must be datafilled.

Ringling generators

The RCT in the SCM-100R system uses the following ringing generators:

- QPP426A - 20 Hz
- QPP426C - 25Hz
- QPP426C - 30 Hz
- QPP430 - frequency selective ringing
- QPP433 - 20 Hz superimposed

The appropriate ringing generators must be installed in the RCT to support the type of ringing assigned to the SCM-100R.

Line cards

The RCT uses the following line cards:

- QPP405 - single party remote
- QPP497 - universal remote
- QPP409 - universal coin remote
- QPP440 - frequency selective remote
- QPP445 - superimposed remote
- QPP541 - frequency selective remote

All line cards installed in the RCT must support the type of ringing assigned to the SCM-100R. The following table lists the compatibility between the RCT ringing generators and line cards.

Table 4-2 RCT ringing generator and line card compatibility

Ringing generator	Line card				
	QPP405	QPP407	QPP409	QPP440	QPP445
QPP426	X	X	X		X
QPP430				X	
QPP435					X

Table RCTINV

Table RCTINV contains information on the RCT, including ringing information. Refer to the *Customer Data Schema Reference Manual* for a description of table RCTINV and sample datafill from table RCTINV.

Assigning ringing to SCM-100S

Assigning ringing to the SCM-100S system involves installing the appropriate ringing generators and line cards at the SLC-96 and datafilling table RCSINV.

Ringing generators and line cards

To assign ringing to the SCM-100S, the ringing generators and line cards in the SLC-96 must support the type of ringing desired in the SCM-100S system. Refer to the documentation associated with the SLC-96 for information on the ringing generators and line cards.

Table RCSINV

Table RCSINV contains information on the RCS, including ringing information. A description of table RCSINV, as well as sample datafill from table RCSINV, is in the *Customer Data Schema Reference Manual*.

Assigning ringing to SCM-100U

Assigning ringing to the SCM-100U involves installing the proper ringing generators and line cards at the DMS-100U and datafilling table RCUINV.

Ringling generator

The remote concentrator terminal (RCT) uses the NT3A39 ringing generator, which supports single-party 20 Hz ringing and multiparty coded ringing. A description of the NT3A39 ringing generator is in *DMS-1 Urban Circuit Pack Descriptions*.

Line cards

The RCT uses the following line cards:

- NT3A10AA - single-party 20 Hz
- NT3A10AB - frequency selective ringing
- NT3A27AA - coin line circuit card

The line cards in the RCU must support ringing assigned to the SCM-100U.

Table RCUINV

Table RCUINV contains information on the RCU, including ringing information. When assigning ringing to the SCM-100U, datafill the ringing data in table RCUINV. A description of RCUINV and a sample of its datafill is in the *Customer Data Schema Reference Manual*.

Assigning ringing to the OPM

Assigning ringing to the OPM is similar to assigning ringing to an RLCM, except ringing generators are in the HIE shelf. As with the RLCM, the ringing generators and line cards must be compatible with the type of ringing assigned to the OPM.

Assigning ringing to the RSC

The RSC consists of LCM or RLCM and a remote cluster controller. Ringing in the RSC is assigned to each LCM or RLCM. Assigning ringing to the LCM and RLCM in the RSC is similar to assigning ringing to LCM and RLCM on the DMS-100, except the ringing generators may be located in the remote miscellaneous equipment (RME) frame or cabinet.

As with the LCM and RLCM, the ringing generators and line cards must be compatible with the ringing assigned to the LCM or RLCM in the RSC.

Assigning ringing to lines

Ringling is assigned to lines by first placing them on the PM that supports the appropriate ringing type. This is done by physically wiring the lines to line

cards on the appropriate PM and by using SERVORD to affect the changes. A description of SERVORD is in the *SERVORD Reference Manual*.

Setting immediate ring enable

Immediate ring enable can be enabled or disabled by setting parameter IMMEDIATE_RING_ENABLE in table OFCENG to Y (yes) or N (no). Instructions on setting parameter IMMEDIATE_RING_ENABLE can be found by referring to *Office Parameters Reference Manual*.

Revertive ringing

Revertive ringing on multi-party lines can be enabled or disabled, or allowed for 4-party, superimposed, and operator number identification (ONI) by office parameter REVRING in table OFCENG. Office parameter REVRING is described in the *Office Parameters Reference Manual*.

Teen ringing tables

The following tables must be datafilled in order to activate teen ringing.

- CLLI
- STN
- LENFEAT
- DN

Instructions for datafilling these tables to activate the teen ringing feature can be found by referring to feature package NTX219 in the *Translations Guide*.

Distinctive ringing tables

The following tables must be datafilled in order to activate distinctive ringing.

- OFCOPT
- CUSTSTN
- LMRNG
- LCMINV

Table OFCOPT

To enable distinctive ringing, office parameter DSR_OFFICE in table OFCOPT must be set to Y (yes).

Table CUSTSTN

Table CUSTSTN identifies the options associated with the types of Meridian Digital Centrex calls receive distinctive ringing. For each type of call to receive distinctive ringing, datafill in table CUSTSTN the options associated with the call type.

Table LMRNG

Table LMRNG defines the ringing type for each LM or RLM. Coded 30 Hz ringing is required for distinctive ringing. Entering the C30 in the LMRNG_SELECTOR field will provide the coded 30 Hz ringing for the LM or RLM.

Table LCMINV

Field LMRNG_SELECTOR in table LCMINV defines the ringing type for each LCM or RLCM. Coded 30 Hz ringing is required for distinctive ringing. Entering C30 in field LMRNG_SELECTOR of table LCMINV will provide coded 30 Hz ringing for the LCM or RLCM.

Note: Ringing generator DIP switches must be set to correspond with the ringing type selected in Table LCMINV

5 Ringing system maintenance

Ringling user interface

The DMS-100 user interface allows ringing generators to be serviced from the DMS-100 MAP terminal. Commands at the PM level of the MAP terminal allow the ringing generators of most line PMs to be posted, manually busied, tested, returned to service, and be made offline.

Ringling generator overload control

Software controls in the DMS-100 peripherals limit the loading on the ringing generators. The controls implemented vary among the Series I and Series II peripherals. A description of the ringing generator load controls implemented in the Series I and Series II peripherals follows.

RG overload control - Series I peripherals

Series I peripherals consist of the line module (LM) and remote line module (RLM). Ringing bus monitors in the LM and RLM monitor the voltage and current on the ringing bus.

The ringing bus current monitor reacts when excessive current passes through the bus. The current monitor reacts in the following three stages:

1. Detects ringing current at 10 mA.
2. Reports over current condition at 350 mA.
3. Limits the output current (shutback) at 800 mA.

The ringing bus voltage monitor reacts when the ringing voltage on the ringing bus is too low or too high. The voltage monitor reacts in two stages:

1. Detects ringing voltage at +/- 20 V.
2. Detects overvoltage condition when voltage exceeds 150 V for more than 1.5 seconds (s).

When the current or voltage threshold is exceeded, the LM software stops processing any further ringing requests until the current or voltage falls below the threshold. Incoming calls during the ringing generator overload state are blocked.

RG overload control - Series II peripherals

Series II peripherals are all of the LCM-based peripherals. As with the Series I peripherals, the ringing bus on the Series II peripherals is monitored by current and voltage monitors, which react when current and voltage thresholds on the ringing bus are exceeded.

The current monitor detects current through the ringing bus. When the current threshold is exceeded, the current monitor notifies the PM software, which stops processing any additional ringing requests until the current level drops below the threshold or ringing on one or more lines is canceled.

The voltage monitor detects the voltage on the ringing bus and reacts when the bus voltage exceeds an upper limit or falls below a lower limit.

Troubleshooting

This section provides troubleshooting information for the DMS-100 ringing system. Specifically, the section describes logs and alarms associated with the ringing system and provides guidelines for clearing some of the most common customer complaints regarding ringing.

Log reports associated with ringing

The following classes of logs are associated with ringing:

- pre-trip
- no ring current
- drawer slot occupied
- ring slot occupied
- subcycle order failure
- ringing time-out
- bad CP IO msg
- ringing trouble

Following is a description of these classes of logs.

Pre-trip

Pre-trips can be caused by spurious off-hook signals on the terminating line. These signals appear as instantaneous shunts from tip to ring and are usually experienced on lines having high capacitance and low resistance (no lower than 1900 Ohms).

Ringing pre-trip occurs when the DMS-100 switch detects on-hook within a predetermined interval of time after detecting an off-hook. After the DMS-100 switch detects an off-hook on a line, it resupervises the line for off-hook to

determine if the ringing trip was valid. If the line is found to be on-hook after ringing trip, the DMS-100 switch generates a pre-trip log report.

To reduce the possibility of these spurious signals from being interpreted as a valid answer, the duration of the off-hook signal considered as a valid off-hook has been changed throughout the development of the DMS-100 switch. The following table lists the duration of an off-hook signal considered as a valid answer in relation to the DMS-100 BCS release.

Note: The times given are the durations of the off-hook signal after filtering in the line card. These times are not the durations of the off-hook signal on the loop itself.

Table 5-1 DMS-100 switch responses to ring trips

BCS	Ring trip duration	Meaning
Pre-BCS 21	0ms - 70 ms	Ignore
	71 ms - 80 ms	Trip ring (audible and power). Apply fast busy to calling party and output LINE113 log report
	81 ms and up	Consider as a valid answer. Trip ring (audible and power) and scan for on-hook
BCS21 through BCS23	0 ms - 70 ms	Ignore
	71 ms - 200 ms	Trip ring (audible and power). Apply fast busy to calling party and output LINE113 log report
BCS23 and beyond	0 ms - 70 ms	Ignore
	71 ms and up	Consider as a valid answer. Trip ring (audible and power) and scan for on-hook
Note: An off-hook detected anytime after the pre-trip interval is considered a valid ring trip.		

No ring current

The no-ring-current logs appear when the LM or line concentrating module (LCM) fails to detect ringing current. Although the result of the log is the same, the events leading up to the output of the log message differs between the LM and LCM. Following is a description.

LM When ringing occurs, the line card is instructed to encode the ringing waveform instead of the transmit voice signal. The line card then sends a digital representation of the ringing waveform through PCM data to the PM software. The PM software examines this data to determine the presence of the ringing voltage. If no ringing voltage is detected (the line card does not send the digital representation of the ringing signal back to the PM), the no-ring-current log is generated

LCM When ringing occurs, the line cards in the LCM continuously monitor the status of the ringing relay and the ringing voltage applied to the line. When the ringing relay is operated, the LCM software monitors the status of the ringing relay. If the ringing relay does not operate, the no-ring-current log message is output.

Drawer slot occupied

The drawer-slot-occupied log indicates that the ringing generator could not be accessed. The reason the ringing generator cannot be accessed differs for LM and LCM. A description of each follows.

LM The ringing buses in the LM can be accessed by both ringing generators in the LM. If a previous request results in ringing generator (RG) 1 being applied to the ringing bus in a line drawer, requests for RG 0 must wait in the awaiting schedule queue until the bus is free. If the wait is greater than 2 s, the ringing request times out and the drawer-slot-occupied log is generated.

LCM When the ringing current on the ringing generator exceeds a predetermined threshold, the ringing generator toggles the state of a control signal to the processor card (NT6X51). The control signal indicates to LCM software the current threshold on the ringing generator has been exceeded. When this threshold is exceeded, subsequent ringing requests are denied rather than queued, and the call is blocked, giving the subscriber the fast busy tone.

Ring slot occupied log

The ring-slot-occupied log indicates that a ringing time slot assigned to ringing has been given another function, such as ANI/coin or LM maintenance, resulting in a ringing fault.

Subcycle order failure

The subcycle-order-failure log applies only to the LCM. This log indicates an incorrect progression of the ringing subcycles has occurred.

Ringing time-out

This log is an information only log and does not indicate a problem. It indicates a subscriber allowed the called party to ring for a period of time greater than that specified by office parameter RNG_TMEOUT_NO_OF_SEC. This parameter is described in *Office Parameters Reference Manual*. In this

situation, the ringing resources are tied up unnecessarily for the duration of RNG_TMEOUT_NO_OF_SEC, when other ringing requests may be blocked. To avoid this, set RNG_TMEOUT_NO_OF_SEC to as short a period as practical.

Bad CP IO msg

The bad-CP-IO-msg log accompanies LINE logs 205, 205, and 206. It indicates the DMS-100 central control (CC) has received a corrupted message from the PM. The report indicates the line equipment number (LEN) associated with the faulty line and can be used to troubleshoot ringing complaints. This log is usually associated with the LINE113 log. A description of the LINE113 log is in *Log Report Reference Manual*.

Ringling generator status

Ringling generator status can be determined when the MAP terminal is in the display or no display mode. The following example shows a posted LCM and reveals the status of the ringling generators adjacent to the drawer numbers with the MAP terminal in the display mode.

```

CM      MS      IOD  Net      PM      CCS      Lns      Trks      Ext      APPL
.      .      .      .      .      .      .      .      .      .

      LCM      SysB  ManB  OffL  CBsy  ISTb  InSv
0 Quit      PM      2      0      21     1     35     46
2 Post_     LCM      0      0      4      0     10     4
3 ListSet
4 SwRg_     LCM HOST 00 0  ISTb  Links OOS: Cside 0 Pside 0
5 Trnsl_   Unit0: ISTb      /RG: 0
6 Tst      Unit1: ISTb      /RG: 0
7 Bsy_
8 RTS_     Drwr: 01 23 45 67 89 01 23 45 67 89  RG: Pref 0 InSv
9 OffL_
10 LoadPM_
11 Disp_
12 Next
13
14 QueryPM
15
16
17
18
      userid
Time 09:52 >

```

When the MAP terminal is in the no-display mode, operating company personnel can enter the QUERYPM command after the LCM is posted and obtain the status of the ringling generators for that LCM. The following MAP display is in response to the QUERYPM command.

```
PM Type: LCM Int. No.: 2 Status index: 0 Node_No: 36
Memory Size - Unit 0: 256K , Unit 1: 256K
Loadnames: LCMINV - BBB , Unit0: XLCM05AK, Unit1: XLCM05AK
LCM HOST 00 0 is included in the list of LCM types
scheduled for a REX test.
REX on LCM HOST 00 0 has not been performed.
Node Status: {OK, FALSE}
Unit 0 Status: {OK, FALSE} /RG: 0
Unit 1 Status: {OK, FALSE} /RG: 0
Ring Generator Status:
RG 0 Status: {OK} Preferred
RG 1 Status: {OK} Standby
RG in Overload : No
Site Flr RPos Bay_id Shf Description Slot EqPEC
HOST 01 C05 LCE 00 51 LCM 00 0 6X04AA
World Line Card Template(s) in use:
6X17BA 6X18BA
Services : NEUTRAL
```

The diagram consists of three rectangular callout boxes with arrows pointing to specific lines in the text above. The first box, located to the right of the 'Unit 0 Status' line, contains the text 'Identifies which ringing generator is selected.' and has an arrow pointing to the '/RG: 0' field. The second box, located to the right of the 'Ring Generator Status' section, contains the text 'Identifies current resource of ringing generator and if that ringing generator is preferred or standby for this LCM.' and has an arrow pointing to the 'RG 0 Status: {OK} Preferred' line. The third box, located to the right of the 'World Line Card Template(s) in use:' section, contains the text 'Indicates if the ringing generator is in overload.' and has an arrow pointing to the 'RG in Overload : No' line.

Ringing generator alarms

When a failure occurs in a ringing generator, an alarm is posted under the PM header of the MAP display, unless a higher level alarm already exists, in which case the higher level alarm is displayed.

Replacing ring generators

Replacing a faulty ringing generator or replacing a ringing generator for verification purposes is described in *Card Replacement Procedures*.

When you replace a ringing generator in an LCM or RLCM, you must ensure that the DIP switch settings on the replacement generator correspond to the ringing type assigned to the PM. A description of the switch settings is available in the *Hardware Description Manual*.

Ringing maintenance and troubleshooting

Problems in the DMS-100 ringing system can be isolated using the DMS-100 MAP. At the PM level, the ringing system circuit cards can be made offline and tested. At the line test position, tests, including a ringing test, can be performed on subscriber lines. The loop resistance and capacitance of subscriber lines also can be measured from the LTP level.

Note: A troubleshooting procedure for isolating ringing problems is located in the *Peripheral Modules Maintenance Guide* and covers situations where a loss of ringing is experienced.

In addition to the DMS-100 MAP terminal, feature package NTX215 allows a DMS-100 to be monitored by a No. 2 SES. This feature can be used to monitor calls through the DMS-100 to isolate intermittent ringing problems.

DMS-100 Family
DMS-100 Ringing System
General Description

Product Documentation-Dept3423
Nortel Networks
PO Box 13010
RTP, NC 22708-3010
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Electronic mail: cits@nortelnetworks.com

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