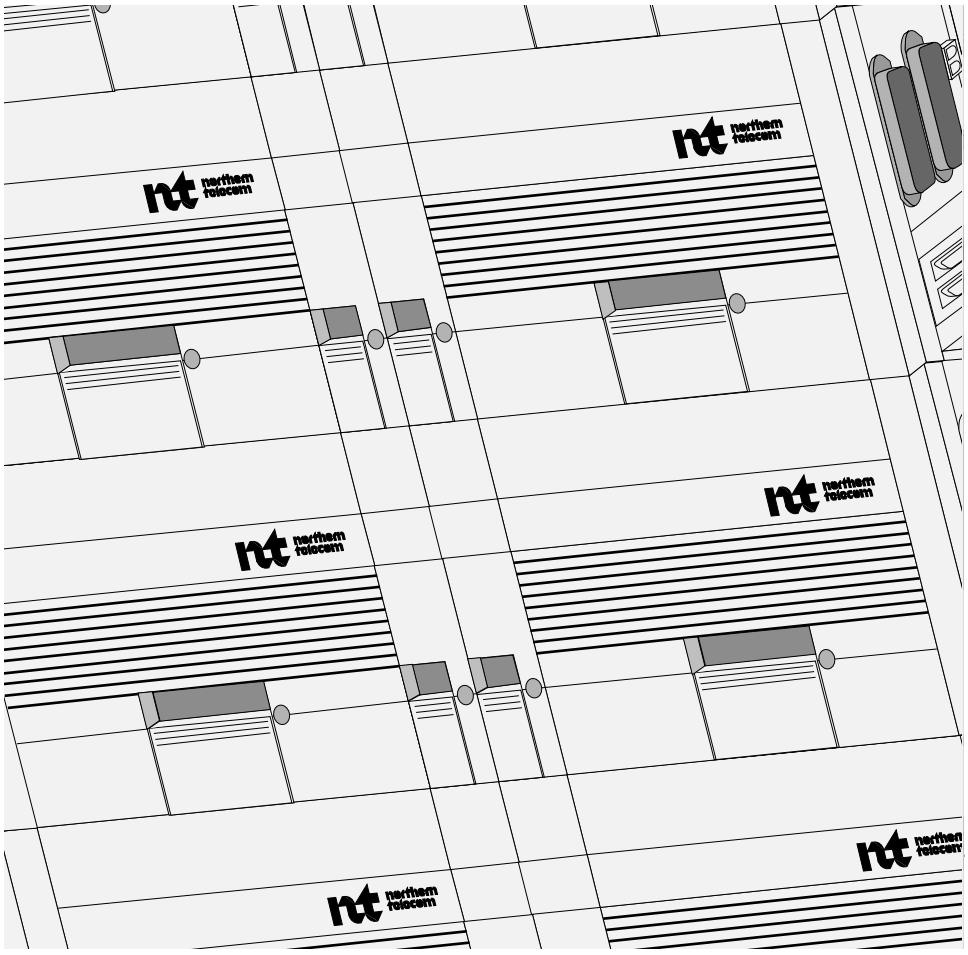
NT4K00LA **323-3001-181**

SONET Products

AccessNode

Line Card Specifications

Issue 3.0 October 1999



NORTEL NETWORKS™

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Publication number: 323-3001-181
Document release: Issue 3.0
Date: October 1999

Publication history

October 1999

AN17.20 Standard release of the document, Issue 3.0.

June 1999

AN17 Standard release of the document, Issue 2.0. Changes made to this release of the document include the following:

- addition of 3DS0 ISDN line card statistics in Chapter 2

February 1999

AN16 Standard release of the document, Issue 1.0. Changes include the following:

- removed information about FST in Chapter 2
- added information in Chapter 2 for the DMS-X interface to APC-100

June 1998

AN15 Standard 01.01 release of the document.

September 1997

AN14 Standard 01.01 release of the document.

July 1996

AN12 Standard 01.01 release of the document providing line card specifications for both North American and Hong Kong environments.

November 1995

AN11 Standard 02.01 release of the document providing line card specifications for both North American and Hong Kong environments.

May 1995

Revised AN10 Standard release that includes change in Chapter 1 to the Epsilon 2-wire line card's (NT4K65AA/AB) flash and disconnect timing specifications.

April 1995

AN10 Standard release of the document.

December 1994

AN08 Standard release of the document.

November 1994

Reissue of AN07 Standard.

April 1994

AN07 Standard release of the document.

May 1993

FWP06 Standard release of the document.

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About this document

This document provides line card specifications for both North American and Hong Kong environments. This document is written for the current release of AccessNode products.

Audience

The intended audience for this document includes the following groups:

- strategic and current planners
- provisioners
- transmission engineers
- network administrators

Terminology used in this document

This document uses the term Remote Fiber Terminal (RFT) to mean any of the following AccessNode remote terminal configurations:

- RFT in an AccessNode point-to-point configuration
- DS1-fed AccessNode (DFA) RFT
- Virtual 1344-line system
- Single-ended AccessNode
- VTBM ring node

Related documentation

For more information on the AccessNode configurations, see the following NTPs.

Engineering, Configuration, and Ordering Guide, Volume 1

- *Engineering and Ordering Information*, 323-3001-032
- *Site Installation Planning and Engineering*, 323-3001-200

Description, Volume 2A

- *Configuration and Equipment Description*, 323-3001-100

For additional information about the line cards, see the following AccessNode documents.

Engineering, Configuration, and Ordering Guide, Volume 1

- *Line Card Application and Special Services Engineering*, 323-3001-155

Description, Volume 2A

- *Signal Flow and Circuit Pack Description*, 323-3001-102

Description, Volume 2B

- *Line and Loop Testing Overview*, 323-3001-115

Operations, Administration, and Provisioning, Volume 4B

- *Provisioning and Operations Procedures*, 323-3001-310
- *Line Card Provisioning Procedures*, 323-3001-315
- *Line Card Testing Procedures*, 323-3001-316

NT4K65AA/AB/CA: Epsilon 2-wire station

This chapter describes the NT4K65AA/AB/CA Epsilon 2-wire station (E2WS) line card and lists its specifications.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 1-1
Functional description	page 1-2
Physical description	page 1-3
Maintenance and testing	page 1-3
Transient protection	page 1-4
Voice frequency transmission specifications	page 1-4
Transmission	page 1-5
Signaling	page 1-5
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Line card general description

The NT4K65AA/AB/CA E2WS line card is the source line card located at the remote fiber terminal (RFT) of the AccessNode. It can be used in the following configurations between the AccessNode RFT and the DMS SuperNode switch:

- In a universal digital loop carrier (UDLC) configuration or an integrated digital loop carrier configuration using Common Signalling Channel (GR-303 DMS/CSC) communications
- In an integrated digital loop carrier configuration using TR-08 communications

The NT4K65AB E2WS line card supports GR-303 Timeslot Maintenance Channel (GR-303 TMC) communications on the GR-303 MVI interface. The NT4K65CA line card supports 2-wire POTS for Hong Kong. NT4K65CA meets Hong Kong's CR01 standards for ringing signal frequency, input impedance, and balance impedance.

In UDLC configurations, the E2WS line card works in conjunction with an NT4K68AA office line card at the FCOT. The E2WS line card provides POTS RT: (loop start service, remote terminal in UDLC and TR-08).

Line card provisioning in either a UDLC configuration or a TR-08 configuration is performed from the operations controller (OPC). Line card provisioning in GR-303 DMS/CSC and MVI configurations is performed by updating the line inventory table from the DMS-100 maintenance administration position (MAP). Line cards can be preprovisioned before actual installation in the copper-distribution shelf.

Split- or monitored-jack access to the metallic loop on the VF side of the line card is provided through the Test-in and Test-out jacks located on the local craft access panel. Two metallic test busses are built into the equipment bay to allow switchable access from any line card Tip and Ring pair to the test jacks. A metallic test access card (MTAC) in each line drawer contains the relays which perform the switching.

Functional description

The NT4K65AA/AB/CA line card can be provisioned for "Loop St Res" service from the MAP of the DMS-100 in GR-303 DMS/MVI configurations, or "2W POTS" from the OPC in UDLC or TR-08 configurations.

In GR-303 DMS/MVI applications, there are no transmission parameters that need to be provisioned. Some signaling and call processing features need to be provisioned through the DMS-100 MAP.

In UDLC and TR-08 applications, there are no signaling or transmission options that need to be provisioned. The on-hook transmission (OHT) feature may be provisioned from the OPC if desired or left in the default mode.

Signaling is based on messages sent by the local digital switch in GR-303 DMS configurations, ABCD bits sent from the FCOT in UDLC and GR-303 MVI, and AB bits sent from the local digital switch in TR-08 configurations. For more information on signaling, see *Line Card Testing Procedures*, 323-3001-316, in *Operations, Administration, and Provisioning*, Volume 4B.

Physical description

The E2WS line card is 3.0 inches high by 3.7 inches deep, including the faceplate, and occupies one slot in the line drawer of the copper-distribution shelf. Connection to the line drawer backplane is via 2 x 15 pin box connector.

The line card faceplate includes a red LED which is turned on by the system to indicate a line card failure, provisioning mismatch, or lamp test.

Table 1-1 lists the lead designations for a 2-wire E2WS line card circuit.

Table 1-1
Lead designations for a 2-wire E2WS line card circuit

CDS slot	Connector		Line card	
	Pair	Pin	Lead	Designation
01	01	26 1	T R	Tip Ring
02	02	27 2	T R	Tip Ring
and so on				

Maintenance and testing

The E2WS line card has two types of diagnostics: quick diagnostics and full diagnostics.

A quick diagnostic is a built-in self-test (BIST) performed by the line card before the card is placed in service. The BIST does not test the voice frequency section of the line card.

A full diagnostic consists of the BIST plus the following tests performed by the test access card (TAC):

- Impedance
- On/off-hook signalling
- On-hook transmission
- Off-hook transmission
- Ringing
- Ring trip
- Noise

Bridging access to the subscriber loop is provided via the test-out relay. Isolated access to the line card is provided via the test-in relay. The test-in bus is a separate test bus from the test-out bus at the line card level. Isolated access to the subscriber loop is provided by activating both relays and connecting the test equipment to the test-out bus. Another piece of test equipment can be connected to the test-in bus for simultaneous loop and line card testing.

The line card is compatible with pair gain test controller (PGTC) and mechanized loop testing (MLT) test methods used for POTS.

Transient protection

The line card is designed to operate with any recognized primary protection, including carbon blocks. Heat coils may be present, but provide no additional benefits and are not required.

The line card automatically opens the tip and ring leads, via the protection relay, to isolate itself from excessive foreign potentials of extended duration. The relay automatically resets once the line card determines that the fault has cleared and the service can be restored safely. If the protection relay fails to interrupt the current for any reason, the loop interface circuit has fail safe characteristics.

Voice frequency transmission specifications

Table 1-2 lists the voice-frequency (VF) specifications for the NT4K65AA/AB/CA line card.

Table 1-2
NT4K65AA/AB/CA line card voice-frequency (VF) specifications

Parameter	Value (A/D or D/A during off-hook)
Idle channel noise	≤ 17 dBrnC0
1 kHz loss tolerance	± 0.5 dB
Level tracking	± 0.25 dB at +3 to –37 dBm0, 1 kHz
Intermodulation distortion (see note at bottom)	R2 > 45 dB, R3 > 47 dB
Single-frequency distortion	≤ –46 dBm0 at 1 kHz, 0 dBm0
Overload A/D level	> +3.0 dBm0
Longitudinal balance	≥ 53 dB, 200 to 3000 Hz
Interference rejection	
60 Hz rejection (North American systems)	> 20 dB (A/D)
50 Hz rejection (Hong Kong systems)	> 20 dB (A/D)
Note: Intermodulation distortion is to be measured end-to-end (A/A) in UDLC applications.	

Transmission

The NT4K65AA/AB line cards provide the following transmission attributes:

- 2 dB loss A/D and D/A
- 900 Ω + 2.16 μF input impedance in all configurations

The NT4K65CA line card provides the following transmission attributes for Hong Kong:

- 2 dB loss A/D and D/A
- 600 Ω + 2.16 μF input impedance in all configurations

Signaling

The E2WS line card provides the following signaling attributes:

- Loop start
- Forward disconnect
- Flash
- On-hook transmission
- Distinctive ringing

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current. The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops. The line card is compatible with Maintenance Terminating Units (MTU).

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. Individual pulse digits are recognized based on the interruption of loop current for a specified period of time. Filtering is provided to reject false pulses and accept proper ones under various loop impairments.

Forward disconnect

Upon a message from the switch (GR-303 DMS), ABCD bit forward disconnect signaling status (UDLC or GR-303 MVI), or AB bit forward disconnect signaling status (TR-08), the line card does the following:

- opens both tip and ring leads for 2500 ms in GR-303 DMS/MVI configurations
- opens both tip and ring leads as determined by the duration of the ABCD or AB code in UDLC and TR-08 configurations, respectively

20 Hz ringing

The high-voltage generator provides 20 Hz ringing in response to one of the following:

- an ABCD ringing code in UDLC configurations, GR-303 MVI
- an AB ringing code in TR-08 configurations
- a ring message in GR-303 DMS/CSC configurations

Note: To meet Hong Kong standards, the NT4K65CA line card provides a 25 Hz ringing signal.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides distinctive ringing patterns upon receiving messages from the local digital switch for GR-303 DMS configurations. In UDLC and GR-303 MVI configurations, the line card repeats the ringing signaling status sent from the FCOT via ABCD bits. In TR-08 configurations, the line card repeats the ringing signaling status sent from the FCOT via AB bits.

On-hook transmission

The line card allows on-hook transmission (OHT) coincidental with a terminating call and not coincidental with a terminating call. The OHT coincidental with a terminating call is allowed during the first silent interval greater than three seconds of the ringing pattern (GR-303 DMS) or during all silent intervals (UDLC, TR-08, and GR-303 MVI).

In GR-303 DMS, OHT is turned on by the DMS-100 switch whenever required. In UDLC, TR-08, and GR-303 MVI, OHT not coincidental with a terminating call and is enabled by an OSI (open switch interval). However, it can be provided at all times by selecting the FULLTIME ONHK_TX option. To save power, the default setting is OFF.

Default parameter

The following is the default parameter: FULLTIME ONHK_TX = off.

System failure

In the event of a carrier system failure, the line card closes the tip and ring leads to re-apply loop feed.

Specifications

This section provides specifications for the NT4K65AA/AB/CA line card. Table 1-3 lists the NT4K65AA/AB/CA line card's specifications.

Table 1-3
NT4K65AA/AB/CA line card specifications

Parameter	Value
Maximum total external loop resistance	1900 ohms (loop supervision only): 1470 Ω loops non-loaded or loaded and 430 Ω for the set
Loop current	≥ 20 mA
Ringer load (> 40 Vrms, 20 Hz) at the end of the loop	5 REN on loops <= 930 Ω 5 REN on loops > 930 Ω
Ring trip delay	≤ 200 ms
Address signaling:	
pulse rate	8 to 12 pps
input % break	58 to 64%
maximum load	5 C4A ringers and 15 kohm bridged
Touch tone addressing:	DTMF
Nominal off-hook loss at 1 kHz (A/D and D/A)	2 dB
Disconnect time with flash timing enabled—North American systems:	
no action taken	0 to 248 ms
hook flash	248 ms to 1200 ms (1.2 second)
on hook	> 1200 ms (1.2 second)
Disconnect time with flash timing disabled	> 248 ms
Disconnect time with flash timing enabled—Hong Kong systems:	
no action taken	0 to 128 ms
hook flash	128 ms to 800 ms
on hook	> 800 ms
Disconnect time with flash timing disabled	>128 ms
Frequency response (loss)	–0.25 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	
North American systems	900 Ω + 2.16 µF
Hong Kong systems	600 Ω + 2.16 µF

—continued—

Table 1-3 (continued)
NT4K65AA/AB/CA line card specifications

Parameter	Value
Duplex ringing cadences (North American systems) Code #40; DMS SDN code 0 Code #44; DMS SDN code 1 Code #42; DMS SDN code 2 Code #76; DMS SDN code 3 Duplex ringing cadences (Hong Kong systems) Code #50; DMS SDN code 0 Code #51; DMS SDN code 1 Code #42; DMS SDN code 2 Code #76; DMS SDN code 3	 2.0 seconds ON, 4.0 seconds OFF 800 ms ON, 400 ms OFF, 800 ms ON, 400 ms OFF 400 ms ON, 200 ms OFF, 400 ms ON, 200 ms OFF, 800 ms ON, 400 ms OFF 500 ms ON, 500 ms OFF, 1 second ON, 500 ms OFF, 500 ms ON, 3.0 seconds OFF 400 ms ON, 200 ms OFF, 400 ms ON, 3.2 seconds OFF 1.2 seconds ON, 3.0 seconds OFF 400 ms ON, 200 ms OFF, 400 ms ON, 200 ms OFF, 800 ms ON, 400 ms OFF 500 ms ON, 500 ms OFF, 1 second ON, 500 ms OFF, 500 ms ON, 3.0 seconds OFF
Input return loss (see note 1) UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Input return loss (see note 2) GR-303 DMS/CSC and TR-08 configurations	ERL ≥ 28 dB SRL ≥ 20 dB
Input return loss at FCOT (see note 3) UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Note 1: Measured with respect to 900 Ω + 2.16 µF with the FCOT end terminated in 900 Ω + 2.16 µF. ***Note 2:*** Measured with respect to 900 Ω + 2.16 µF with the 4-wire path broken ***Note 3:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 µF. The RFT end is terminated in 900 Ω + 2.16 µF.	
—end—	

Table 1-4 lists the NT4K65AA/AB line card's on-hook transmission support.

Table 1-4
On-hook transmission (OHT)

OHT type	Conditions	GR-303 DMS/CSC		TR-08		UDLC	
		A/D	D/A	A/D	D/A	A/D	D/A
Coincidental with a terminating call 1 kHz loss	Activated by ringing transmission during silent intervals	2 dB	2 dB	2 dB	2 dB	3 dB	3 dB
Not coincidental with a terminating call	Per call basis, controlled by far-end switch	yes	yes	n/a	n/a	n/a	n/a
	Activated by OSI > 6 ms (provides 15 seconds of transmission)	n/a	n/a	yes	yes	yes	yes
1 kHz loss if "on"		2 dB	2 dB	2 dB	2 dB	2 dB	2 dB

NT4K67AB/AC: Omega 2-wire station

This chapter describes the NT4K67AB/AC Omega 2-wire station (O2WS) line card and provides its specifications.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 2-2
Physical description	page 2-3
Common functions	page 2-3
Common VF transmission specifications	page 2-4
POTS	page 2-5
Coin service	page 2-13
Loop gnd bus (Loop start/ground start business) (locally switched special services - GR-303 DMS/CSC)	page 2-18
FXS (locally and non-locally switched special services)	page 2-23
Universal Voice Grade (UVG)	page 2-29
Transmission only/equalized transmission only (TO/ETO)	page 2-34
Dial pulse originating (DPO) service	page 2-38
Electronic business set (EBS) service	page 2-41
Private line automatic ringdown (PLAR) service	page 2-44
Integrated services digital network (ISDN) service	page 2-48

Line card general description

The O2WS line card is a service-adaptive line card which can be provisioned for any of the following services:

- plain old telephone service (POTS)
- coin service
- loop start or ground start locally switched special service (Loop gnd bus)
- foreign exchange station (FXS) locally and non-locally switched special services
- universal voice grade (UVG) locally switched special services
- transmission only/equalized transmission only (TO/ETO) locally switched special services
- dial pulse originating (DPO) service
- electronic business set (EBS) service
- private line automatic ringdown (PLAR) service
- integrated services digital network (ISDN) service

The O2WS line card is the source line card, typically located at the remote fiber terminal (RFT) of the AccessNode, but can also be located at the fiber central-office terminal (FCOT) in certain applications such as DID or OPS.

It can be used in the following configurations between the AccessNode RFT and the DMS SuperNode switch:

- In a universal digital loop carrier (UDLC) configuration or a digital multiplex switch configuration using Common Signalling Channel (GR-303 DMS/CSC and GR-303 MVI) communications
- In a digital multiplex switch configuration using TR-08 communications

Line card provisioning in UDLC, TR-08, or DS1 tandem configurations are performed from the operations controller (OPC). Line card provisioning in GR-303 DMS/CSC configurations is performed by updating the line inventory table from the DMS-100 maintenance administration position (MAP). Line cards can be preprovisioned before installation in the copper-distribution shelf. For GR-303 MVI, line card provisioning is performed at the switch and may require provisioning at the AccessNode (except for POTS, which is the default).

Split- or monitored-jack access to the metallic loop on the VF side of the line card is provided through the Test-In and Test-Out jacks located on the local craft access panel. Two metallic test busses are built into the equipment bay to allow switchable access from any line card Tip and Ring pair to the test jacks. A metallic test access card (MTAC) in each line drawer contains the relays that perform the switching.

Physical description

The O2WS line card is 3.0 inches high by 3.7 inches deep, including the faceplate, and occupies 1 slot in the line drawer of the copper-distribution shelf. Connection to the line drawer backplane is via 2 x 15 pin box connector.

The line card faceplate includes a red LED which is turned on by the system to indicate a line card failure, provisioning mismatch, or lamp test. Table 2-1 lists the lead designations for a 2-wire circuit.

Table 2-1
Lead designations for an O2WS 2-wire circuit

CDS slot	Connector		Line card	
	Pair	Pin	Lead	Designation
01	01	26 1	T R	Tip Ring
02	02	27 2	T R	Tip Ring
and so on				

Common functions

The following functions are common to all services offered by the NT4K67AB/AC line card.

Maintenance and testing

The line card provides the capability of performing self-diagnostic testing. Routines are downloaded to the line card to perform tests on the circuits associated with transmission, battery feed, supervision and the ringing/high voltage generator to ensure that the line card functions operate as intended.

Bridging access to the subscriber loop is provided via the test-out relay. Isolated access to the line card is provided via the test-in relay. The test-in bus is a separate test bus from the test-out bus, at the line card level. Isolated access to the subscriber loop is provided by activating both relays and connecting the test equipment to the test-out bus. Another piece of test equipment can be connected to the test-in bus for simultaneous loop and line card testing.

The line card is compatible with pair gain test controller (PGTC) and mechanized loop testing (MLT) test methods used for POTS, COIN and UVG testing.

If the line card is provisioned as a red-lined circuit, maintenance personnel can not access the line from the jack access panel. The customer must be notified before the circuit can be taken out of service. Also, none of the provisionable parameters associated with the service can be changed until the red-lined attribute is disabled.

Transient protection

The line card is designed to operate with any recognized primary protection, including carbon blocks. Heat coils may be present, but provide no additional benefits, and are not required.

The line card automatically opens the tip and ring leads, via the protection relay, to isolate itself from excessive foreign potentials of extended duration. The relay automatically resets once the line card determines that the fault has cleared and the service can be restored safely. If the protection relay fails to interrupt the current for any reason, the loop interface circuit has fail safe characteristics.

Common VF transmission specifications

Table 2-2 lists the NT4K67AB/AC line card voice-frequency (VF) specifications common to all services.

Table 2-2
NT4K67AB/AC line card voice-frequency (VF) common specifications

Parameter	Value (A/D or D/A during off-hook)
Idle channel noise	≤ 17 dBrnC0
1 kHz loss tolerance	± 0.5 dB
Level tracking	± 0.25 dB at +3 to –37 dBm0, 1 kHz
Intermodulation distortion ***(Note)***	R2 > 49 dB, R3 > 51 dB
Single-frequency distortion	≤ –46 dBm0 at 1 kHz, 0 dBm0
Overload A/D level	> +3.0 dBm0
Longitudinal balance	≥ 58 dB, 200 to 3000 Hz
Interference rejection 60 Hz rejection (North American and Japan systems) 50 Hz rejection (Hong Kong and Japan systems)	 > 20 dB (A/D) > 20 dB (A/D)
Note: To be measured end-to-end (A/A) in UDLC applications.	

POTS

This section provides functional descriptions and specifications for plain old telephone service (POTS) on the NT4K67AB/AC line card.

Functional description

The NT4K67AB/AC line card can be provisioned for “Loop St Res” (MVIPOTS) service from the MAP of the DMS-100 in GR-303 DMS or “2W POTS” from the OPC in UDLC and TR-08 configurations.

In GR-303 DMS applications, there are no transmission parameters that need to be provisioned. Some signaling and call processing features need to be provisioned through the DMS-100 MAP.

In UDLC and TR-08 applications, there are no signaling or transmission options that need be provisioned. The on-hook transmission (OHT) feature may be provisioned from the OPC if desired or left in the default mode. (See Table 2-4.)

Signaling is based on messages sent by the local digital switch (GR-303 DMS/CSC), ABCD bits sent from the FCOT (UDLC) and GR-303 MVI, or AB bits sent from a digital switch (TR-08). The line card typically is located at the RFT. For more information on signaling, see *Line Card Testing Procedures*, 323-3001-316, in *Operations, Administration, and Provisioning*, Volume 4B.

Common functions

Descriptions of the following common functions can be found under the heading, “Common functions” on page 2-3:

- Maintenance and testing
- Transient protection

Transmission

The O2WS POTS line card provides the following transmission attributes:

- 2 dB loss A/D and D/A for short loops; 0 dB loss A/D and D/A for long loops. (The switching point is determined by loop resistance.)
- 900 Ω + 2.16 µF input impedance for North American systems
- 600 Ω + 2.16 µF input impedance for Hong Kong systems
- 600 Ω + 1 µF input impedance for Japan systems
- 800 Ω || (50 nF + 100 Ω) default hybrid balance network in GR-303 DMS/CSC, or an optimized digital compromise balance network in UDLC or TR-08 configurations.
- For GR-303 DMS/MVI, the hybrid balance can be either loaded or nonloaded, as specified in the BNV field of the DMS-100 line inventory table.

Signaling

The O2WS POTS line card provides the following signaling attributes:

- Loop start
- Forward disconnect
- Flash
- On-hook transmission
- Line side answer supervision
- Distinctive ringing
- Message waiting (GR-303 DMS only)

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops. Battery boost is provided during low office battery voltage to maintain an on-hook voltage compatible with Maintenance Terminating Units (MTU).

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. Individual pulse digits are recognized based on the interruption of loop current for a specified period of time. Filtering is provided to reject false pulses and accept proper ones under various loop impairments.

Forward disconnect

Upon a message from the switch (GR-303 DMS) or ABCD/AB bit forward disconnect signaling status (UDLC, TR-08, and GR-303 MVI respectively), the line card does one of the following:

- opens both tip and ring leads for 900 ms for GR-303 DMS/CSC configurations
- opens the tip lead as determined by the duration of the ABCD/AB code for UDLC, TR-08, and GR-303 MVI configurations respectively

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides any one of seven distinctive ringing patterns (Teen Ringing) upon receiving messages from the local digital switch (GR-303 DMS).

In UDLC configurations, the line card repeats the ringing signaling status sent from the FCOT via ABCD bits; in TR-08 and GR-303 MVI configurations, it does so through AB bits sent from a digital switch.

Reminder ring

The line card provides a 500 ms burst of ringing “Reminder Ring” upon message from the local digital switch in GR-303 DMS configurations. In UDLC or GR-303 MVI configurations, the line card repeats the ringing signaling status sent from the FCOT or local digital switch via ABCD bits. In TR-08 configurations, the line card repeats the ringing signaling status sent from the digital switch via AB bits.

On-hook transmission (OHT)

The line card allows on-hook transmission (OHT) coincidental with a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental with a terminating call (such as for meter reading). The OHT coincidental with a terminating call is allowed during the long silent interval of the ringing pattern (GR-303 DMS/CSC) or during all silent intervals (UDLC, TR-08, and GR-303 MVI).

In GR-303 DMS configurations, OHT is turned on by the DMS-100 switch whenever required. In UDLC, TR-08, and GR-303 MVI configurations, OHT not coincidental with a terminating call is enabled by an OSI (open switch interval). However, it can be provided at all times by selecting the FULLTIME ONHK_TX option. The default setting is OFF in order to save power. (See the OHT specifications table on page 2-12).

> ***Note:*** In TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).

Message waiting lamp

Message waiting lamp is supported in a GR-303 DMS configuration (Loop St Res). The message waiting lamp at the subscriber set is activated by applying pulsed dc voltage to the ring side of the line at 150 volts cycled at 500 ms on, and 500 ms off while the set is on-hook. A one-second pause occurs after every fifth lamp flash.

System failure

In the event of a carrier system failure, the line card will open the tip lead for two to three seconds, then close the tip lead to re-apply loop feed.

Line Card Ringing Frequency

The following table lists the ringing frequency for North American, Hong Kong, and Japan.

Table 2-3
Line card ringing frequencies

Parameter	Frequency
North America	20Hz
Hong Kong	25Hz
Japan	16Hz

Specifications

This section provides specifications for POTS service on the NT4K67AB/AC line card.

Common specifications

Values for the following VF transmission specifications can be found under the heading, “Common VF transmission specifications” on page 2-4:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 50 Hz rejection (Hong Kong systems); 60 Hz rejection (North American systems); 50 Hz and 60 Hz rejection (Japan systems)

Unique specifications

Table 2-4 lists the NT4K67AB/AC line card signaling and VF specifications that are unique to POTS service.

Table 2-4
NT4K67AB/AC signaling and VF specifications unique to POTS service

Parameter	Value
Maximum total external loop resistance	1900 ohms: 1470 Ω non-loaded or loaded, plus 430 Ω for the set
Maximum total external loop resistance for Japan	1700 ohms (loop and terminal set) 300 Ω for the set 1400 Ω for the loop
Loop current	≥ 20 mA in forward feed ≥ 18 mA feed in reverse feed
Ringer load (> 40 Vrms, 20 Hz) at the end of the loop	5 REN on loops < 900 Ω 4 REN on loops ≥ 900 Ω 3 REN on loops ≥ 900 Ω (Japan only)
Ring trip delay	≤ 200 ms
Dial pulsing (loop dial pulsing):	
pulse rate	8 to 12 pps or 10 pps for Japan only
input % break	58 to 64%
maximum load	5 C4A ringers and 15 kohm bridged
Touch tone addressing:	DTMF
Flash timing until disconnect (North American systems)	250 ms to < 1.2 seconds
Flash timing until disconnect (Hong Kong systems)	128 ms to 800 ms
Flash timing until disconnected (Japanese systems)	200 ms to 1.2 seconds
Disconnect timing (North American systems)	
with class features disabled	250 ms
with class features enabled	>1.2 seconds
Disconnect timing (Hong Kong/Japan systems)	
with class features disabled	128 ms
with class features enabled	> 800 ms

—continued—

Table 2-4 (continued)
NT4K67AB/AC signaling and VF specifications unique to POTS service

Parameter	Value
Duplex ringing cadences (North American systems)	
Code #40; DMS SDN code 0	2.0 seconds ON, 4.0 seconds OFF
Code #44; DMS SDN code 1	800 ms ON, 400 ms OFF, 800 ms ON, 400 ms OFF
Code #42; DMS SDN code 2	400 ms ON, 200 ms OFF, 400 ms ON, 200 ms OFF, 800 ms ON, 400 ms OFF
Code #76; DMS SDN code 3	500 ms ON, 500 ms OFF, 1 second ON, 500 ms OFF, 500 ms ON, 3.0 seconds OFF
Duplex ringing cadences (Hong Kong systems)	
Code #50; DMS SDN code 0	400 ms ON, 200 ms OFF, 400 ms ON, 3.2 seconds OFF
Code #51; DMS SDN code 1	1.2 seconds ON, 3.0 seconds OFF
Code #42; DMS SDN code 2	400 ms ON, 200 ms OFF, 400 ms ON, 200 ms OFF, 800 ms ON, 400 ms OFF
Code #76; DMS SDN code 3	500 ms ON, 500 ms OFF, 1 second ON, 500 ms OFF, 500 ms ON, 3.0 seconds OFF
Duplex ringing cadences (Japan systems)	1.0 second ON, 2.0 seconds OFF, 1.0 second ON, 2.0 seconds OFF
Nominal loss at 1 kHz ***(Note 1)*** A/D and D/A	2 dB on short loops 0 dB on long loops
Nominal loss at 1kHz (Japan only)	Flow through gain provisions from DMS-X APC-100 switch RX –4 to –11dB TX 0 +2 to –7
Frequency response (loss) Frequency response (loss) Japan only	–0.1 to +0.5 dB, 400 Hz to 2800 Hz –0.25 to +0.5 dB, 404Hz to 2804Hz (Japan only)
Nominal input impedance North American systems Hong Kong systems Japan systems	 900 Ω + 2.16 μF 600 Ω + 2.16 μF 600 Ω + 1.0 μF
Input return loss (North American systems; ***Note2***)	ERL ≥ 18 dB SRL ≥ 10 dB

—continued—

Table 2-4 (continued)
NT4K67AB/AC signaling and VF specifications unique to POTS service

Parameter	Value
Input return loss (Hong Kong systems; ***Note 3***)	ERL ≥ 20 dB SRL ≥ 15 dB
Input return loss (Japan systems; ***Note 7***)	ERL ≥ 18 dB SRL ≥ 14 dB
Input return loss ***(Note 4)*** GR-303 DMS/MVI and TR-08 configurations	ERL ≥ 28 dB SRL ≥ 20 dB
Input return loss at FCOT ***(Note 5)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Hybrid balance ***(Note 6)*** GR-303 DMS/MVI and TR-08 configurations	ERL ≥ 20 dB SRL ≥ 15 dB
Hybrid balance ***(Note 8)*** Japan only IDLC CSC (Japan system)	ERL ≥ 20 dB SRL ≥ 16 dB
Note 1: The nominal loss switching point is 1065 Ω total external resistance. ***Note 2:*** Measured with respect to 900 Ω + 2.16 µF with the FCOT end terminated in 900 Ω + 2.16 µF. ***Note 3:*** Measured with respect to 600 Ω + 2.16 µF with the 4-wire path broken. ***Note 4:*** Measured with respect to 900 Ω + 2.16 µF with the 4-wire path broken. ***Note 5:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 µF. The RFT end is terminated in 900 Ω + 2.16 µF. ***Note 6:*** Measured as 4-wire return loss. The line card is terminated in 800 Ω || (50 nF + 100 Ω) with the nonloaded balance network selected and the reading adjusted for transmission loss. ***Note 7:*** Measured with respect to 600 Ω + 1µF with the 4-wire path broken. ***Note 8:*** Measured as 4 wire return loss. The line card is terminated in 150 Ω + 830 Ω || 75 nF with the nonloaded balance network selected and the reading adjusted for input signal levels.	
—end—	

Table 2-5 shows the POTS on-hook transmission support provided by the NT4K67AB/AC line card.

Table 2-5
NT4K67AB/AC POTS on-hook transmission (OHT) support

OHT type	State	GR-303 DMS/CSC		TR-08		UDLC		GR-303 MVI	
		A/D	**D/A**	**A/D**	**D/A**	**A/D**	**D/A**	**A/D**	**D/A**
Coincidental with a terminating call	n/a	no	yes	yes	yes	yes	yes	yes	yes
1 kHz loss			0 dB	2 dB	2 dB	2 dB	2 dB	2 dB	2 dB
Not coincidental with a terminating call	default	no	no	no	no	no	no	no	no
	always on	optional	optional	optional	optional	optional	optional	always on	always on
Conditions:	Per call basis, controlled by far-end switch	yes	yes	n/a	n/a	n/a	n/a	n/a	n/a
	Controlled by OSI > 100 ms, < 500 ms	n/a	n/a	yes	yes	yes	yes	yes	yes
1 kHz loss if “on”		5 dB	5 dB	2 dB	2 dB	2 dB	2 dB	2 dB	2 dB

Note 1: n/a indicates not applicable.

Note 2: In TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).

Coin service

This section provides functional descriptions and specifications for Coin service on the NT4K67AB/AC line card.

Functional description

The O2WS line card can be provisioned for coin-service applications from the switch for GR-303 DMS applications or from the OPC in UDLC, TR-08, and GR-303 MVI applications. It provides coin-first service using ground start signaling, or dial tone first and semi-post-pay using loop start signaling.

In GR-303 DMS applications, there are no transmission parameters that need to be provisioned. The type of coin service needs to be provisioned through the DMS-100 MAP.

In UDLC, TR-08, and GR-303 MVI applications, there are no signaling or transmission options that need to be provisioned.

Signaling is based on messages sent by the local digital switch (GR-303 DMS), ABCD bits sent from the FCOT (UDLC), GR-303 MVI, or local digital switch, or AB bits sent from a digital switch (TR-08). For more information on signaling, see *Line Card Testing Procedures*, 323-3001-316, in *Operations, Administration, and Provisioning*, Volume 4B.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The O2WS line card provides the following transmission attributes:

- 2 dB loss A/D and D/A
- 900 Ω + 2.16 µF input impedance
- 800 Ω || (50 nF + 100 Ω) default hybrid balance network in GR-303 DMS, or an optimized digital compromise balance network in UDLC, TR-08, and GR-303 MVI configurations.
- For GR-303 DMS/CSC configurations, the hybrid balance can be either loaded or nonloaded, as specified in the BNV field of the DMS-100 line inventory table.

Signaling

The O2WS coin RT line card provides the following signaling attributes:

- Loop start
- Ground start
- On-hook transmission (OHT)
- Tip and ring polarity reversal (Note: Polarity reversal is used instead of +48 V on the ring and ground on the tip.)
- Coin control signaling
- Positive and negative coin test

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. Individual pulse digits are recognized based on the interruption of loop current for a specified period of time. Filtering is provided to reject false pulses and accept proper ones under various loop impairments.

Ringing and coin voltages

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring or tip side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

On-hook transmission

OHT is supported on loop start applications.

The line card allows on-hook transmission (OHT) coincidental with a terminating call (such as for calling party identification in CLASS/CMS). The OHT coincidental with a terminating call is allowed during the long silent interval of the ringing pattern.

System failure

If a carrier system fails, the line card opens tip lead for 2 to 3 seconds, then closes the tip lead to provide normal battery feed.

Specifications

This section provides specifications for coin service on the NT4K67AB/AC line card.

Common specifications

See “Common VF transmission specifications” on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-6 lists the NT4K67AB/AC line card signaling and VF specifications that are unique to coin service.

Table 2-6
NT4K67AB/AC signaling and VF specifications unique to coin service

Parameter	Value
Maximum loop resistance	820 Ω loops, plus 550 Ω for the set
Loop current	> 23 mA > 17 mA during totalizer readout
Dial pulsing Loop dial pulsing: pulse rate input % break maximum load Touch tone addressing:	 8 to 12 pps 58 to 64% 5 C4A ringers and 15 kohms bridged DTMF
Nominal loss at 1 kHz A/D or D/A	2 dB
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	900 Ω + 2.16 μF

—continued—

Table 2-6 (continued)
NT4K67AB/AC signaling and VF specifications unique to coin service

Parameter	Value
Flash timing until disconnect	250 ms to < 1.2 seconds
Disconnect timing with class features disabled with class features enabled	 250 ms >1.2 seconds
Input return loss ***(Note 1)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Input return loss ***(Note 2)*** GR-303 DMS/CSC, TR-08, and GR-303 MVI configurations	ERL ≥ 28 dB SRL ≥ 20 dB
Input return loss at FCOT ***(Note 3)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Hybrid balance ***(Note 4)*** GR-303 DMS/CSC, TR-08, and GR-303 MVI configurations	ERL ≥ 20 dB SRL ≥ 15 dB
Note 1: Measured with respect to 900 Ω + 2.16 μF with the FCOT end terminated in 900 Ω + 2.16 μF. ***Note 2:*** Measured with respect to 900 Ω + 2.16 μF with the 4-wire path broken. ***Note 3:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 μF. The RFT end is terminated in 900 Ω + 2.16 μF. ***Note 4:*** Measured as 4-wire return loss. The line card is terminated in 800 Ω || (50 nF + 100 Ω) with the nonloaded balance network selected and the reading adjusted for transmission loss.	
—end—	

Table 2-7 shows the coin service on-hook transmission support provided by the NT4K67AB/AC line card.

Table 2-7
NT4K67AB/AC coin service on-hook transmission (OHT) support

OHT type	State	GR-303 DMS/CSC		TR-08		UDLC	
		A/D	D/A	A/D	D/A	A/D	D/A
Coinciden-tal with a terminating call	n/a	no	yes	yes	yes	yes	yes
1 kHz loss		-	0 dB	2 dB	2 dB	3 dB	3 dB
Not coinciden-tal with a terminating call	Default	no	no	no	no	no	no
	Always on	no	no	optional	optional	optional	optional
Conditions	Per call basis, controlled by far end switch	no	no	n/a	n/a	n/a	n/a
	Controlled by OSI > 100 ms and < 500 ms	n/a	n/a	yes	yes	yes	yes

Note 1: n/a indicates not applicable.

Note 2: In TR-08 and GR-303 MVI applications, an OSI is represented by a forward disconnect code (AB=10).

Loop gnd bus (Loop start/ground start business) (locally switched special services - GR-303 DMS/CSC)

This section provides a functional description and specifications for locally switched special services on the NT4K67AB/AC line card in GR-303 DMS/CSC configurations.

Functional description

The NT4K67AB/AC line card can be provisioned for Loop gnd bus (loop start or ground start locally switched special service) from the MAP of the DMS-100. Note the following provisioning requirements:

- The type of service (loop start/ground start) needs to be provisioned.
- There are no transmission options that need to be provisioned.

Signaling is based on messages sent by the local digital switch, with the exception of the ring pre-trip test which is done autonomously by the line card on terminating calls in ground start connections.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The O2WS line card provides the following transmission attributes:

- 2 dB loss A/D and D/A
- 900 Ω + 2.16 μF input impedance
- 800 Ω || (50 nF + 100 W) default hybrid balance network configuration
- The hybrid balance can be either loaded or nonloaded as specified in the BNV field of the DMS-100 line inventory table.

Signaling

The O2WS line card provides the following signaling attributes:

- Loop start or ground start
- Forward disconnect
- Toll diversion
- Ring pre-trip test on ground start
- On-hook transmission (loop start)
- Line side answer supervision
- Distinctive ringing

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops. Battery boost is provided during low office battery voltage to maintain an on-hook voltage compatible with maintenance terminating units in loop start applications.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected.

Individual pulse digits are recognized based on the interruption of loop current for a specified period of time. Filtering is provided to reject false pulses and accept proper ones under various loop impairments.

Forward disconnect

Upon a message from the switch, the line card opens both tip and ring leads for 900 ms for loop start lines, and opens the tip lead for 900 ms for ground start lines.

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides distinctive ringing (Teen Ringing) patterns upon messages from the local digital switch.

Reminder ring

The line card provides a 500 ms burst of ringing “Reminder Ring” upon message from the local digital switch.

On-hook transmission

The OHT applies to loop start only.

The line card allows on-hook transmission (OHT) coincidental with a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental with a terminating call (such as for meter reading). The OHT coincidental with a terminating call is allowed during the long silent interval of the ringing pattern.

The OHT not coincidental with a terminating call is turned on by the DMS-100 switch whenever required.

Message waiting

Message waiting is supported in the Loop Start option of Loop Gnd Bus service. The message waiting lamp at the subscriber set is activated by applying pulsed dc voltage to the ring side of the line at 150 volts cycled at 500 ms on, and 500 ms off while the set is on-hook. A one-second pause occurs after every fifth lamp flash.

System failure

If a carrier system fails, the line card opens tip lead for 2 to 3 seconds, then closes the tip lead to reapply loop feed.

Specifications

This section provides specifications for (loop gnd bus) locally switched special service on the NT4K67AB/AC line card.

Common specifications

See “Common VF transmission specifications” on page 2-4 for the values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-8 lists the NT4K67AB/AC line card signaling and VF specifications are unique to loop gnd bus service.

Table 2-8
NT4K67AB/AC signaling and VF specifications unique to loop gnd bus service

Parameter	Value
Maximum loop resistance (beyond RFT, excluding terminal)	820 Ω non-loaded or loaded
Loop current (in 900 Ω loop + 430 Ω terminal)	> 20 mA
Dial pulsing Loop dial pulsing: pulse rate input % break maximum load Touch tone addressing:	 8 to 12 pps 52 to 64% 5 C4A ringers and 15 kohm bridged, or 600 Ω + 0.5 µF bridged DTMF
Ringer load (>40 Vrms, 20 Hz) at the end of an 820 Ω loop	5 REN
Ring trip delay	< 200 ms
Nominal loss at 1 kHz A/D and D/A	 2 dB
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Flash timing until disconnect	250 ms to < 1.2 seconds
Disconnect timing with class features disabled with class features enabled	 250 ms >1.2 seconds
Input return loss ***(Note 1)***	ERL ≥ 28 dB SRL ≥ 20 dB
Hybrid balance ***(Note 2)***	ERL ≥ 20 dB SRL ≥ 15 dB
Note 1: Measured with respect to 900 Ω + 2.16 µF with 4 wire path broken. ***Note 2:*** Measured as 4-wire return loss. The RFT end is terminated in 800 Ω || (50 nF + 100 Ω) with the nonloaded balance network selected and the reading adjusted for transmission loss.	

Table 2-9 lists the loop gnd bus on-hook transmission support provided by the NT4K67AB/AC line card.

Table 2-9
NT4K67AB/AC loop gnd bus on-hook transmission (OHT) support

OHT type	State	GR-303 DMS/CSC	
		A/D	**D/A**
Coincidental with a terminating call	n/a	no	yes
1 kHz loss	n/a	-	0 dB
Not coincidental with a terminating call Conditions:	Default Per call basis, controlled by far end switch	no yes	no yes
1 kHz loss if “ON”	n/a	5 dB	5 dB

FXS (locally and non-locally switched special services)

This section provides a functional description and specifications for foreign exchange station (FXS) locally and non-locally switched special services on the NT4K67AB/AC line card, for UDLC or DS1 Tandem.

Functional description

The NT4K67AB/AC line card can be provisioned for FXS (locally and non-locally switched special services) from the OPC in the UDLC or DS1 tandem configurations.

There are no signaling options that need to be provisioned, except trunk conditioning (see “System failure” on page 2-25).

The transmission parameters are provisionable to match the interface to the connecting equipment and cable.

The OHT feature may be provisioned if desired, or left in the default mode.

The line card is used in a UDLC configuration with a corresponding office (sink) line card (NT4K68AA) at the FCOT. It can also be used in a DS1 tandem configuration with a corresponding sink line card of a channel bank at the far end.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The O2WS line card provides the following transmission attributes:

- Provisionable transmit and receive gain/loss
- Provisionable input impedance
- Provisionable hybrid balance network
- Provisionable transmit and receive equalization
- Provisionable on-hook transmission loss A/D and D/A (default: 10 dB loss)

The transmission settings can be provisioned from a local or remote location.

The hybrid balance network and transmit/receive equalization provisioning is facilitated by using a look-up table that gives the optimum matching of the transmission attributes and the connecting loop.

Without provisioning, the line card defaults to 0 dB A/D and D/A loss, and no transmit and receive equalization. The input impedance defaults to 600 Ω + 2.16 μF and the hybrid balance to 600 Ω + 2.16 μF (setting 38).

Signaling

The O2WS line card provides the following signaling attributes:

- Loop start and ground start
- Forward disconnect
- Toll diversion
- Ring pre-trip test
- On-hook transmission
- Distinctive ringing
- Reminder ring
- Reverse battery to support line side answer supervision

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. The state of the hook switch is sent to the far end in ABCD bits.

Forward disconnect

Upon ABCD bit forward disconnect signaling status (UDLC), the line card opens the tip lead as determined by the ABCD bits from the FCOT.

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides distinctive ringing (Teen Ringing) patterns. In UDLC, the line card repeats ringing signaling status sent from the FCOT via ABCD bits.

Reminder ring

The line card provides a 500 ms burst of ringing "Reminder Ring." In UDLC, the line card repeats ringing signaling status sent from the FCOT via ABCD bits.

On-hook transmission

The line card allows on-hook transmission (OHT) coincidental with a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental with a terminating call (such as for meter reading). The OHT coincidental with a terminating call is allowed during all silent intervals of the ringing pattern.

The OHT not coincidental with a terminating call is turned on by an OSI (open switch interval). However, it can be provided at all times by selecting the FULLTIME ONHK_TX option. The default setting is OFF to save power.

System failure

If a carrier system fails, the line card goes into one of the following trunk conditioning states:

- Open tip lead for 2-3 seconds, then connect the tip lead to ground (default)
- Open tip lead for the duration of the failure

Specifications

This section provides specifications for FXS service on the NT4K67AB/AC line card.

Common specifications

See "Common VF transmission specifications" on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-10 lists the NT4K67AB/AC line card signaling and VF specifications that are unique to FXS service.

Table 2-10
NT4K67AB/AC signaling and VF specifications unique to FXS service

Parameter	Value
Maximum external loop resistance	1250 ohms: 820 ohm loops plus 430 ohm terminal
Loop current	> 20 mA
Ringer load (> 40 Vrms, 20 Hz) at the end of an 820 ohm loop	5 REN
Ring trip delay	< 200 ms
Dial pulsing Loop dial pulsing: Pulse rate Input % break Maximum load Touch tone addressing:	 8 to 12 pps 58 to 64% 5 C4A ringers and 15 kohms bridged, through 100 ohm loop DTMF
Nominal level at 1 kHz Analog input to produce DRS* (A/D) Analog output from DRS (D/A) Minimum adjustment step * DRS = Digital reference signal	 +5.0 to –6.5 dBm +3.5 to –10.0 dBm ***(Note 1)*** 0.1 dB
Default: nominal loss at 1 kHz, A/D or D/A	0 dB
Frequency response (loss) Relative to 1kHz, A/D, D/A	–0.1 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	900 Ω + 2.16 µF (default) or 600 Ω + 2.16 µF
Flash timing until disconnect	250 ms to < 1.2 seconds
Disconnect timing with class features disabled with class features enabled	 250 ms >1.2 seconds
Input return loss ***(Note 2)***	ERL ≥ 22 dB SRL ≥ 14 dB

—continued—

Table 2-10 (continued)
NT4K67AB/AC signaling and VF specifications unique to FXS service

Parameter	Value
Input return loss at FCOT ***(Note 3)***	ERL ≥ 22 dB SRL ≥ 14 dB
Input return loss ***(Note 4)*** DS1 tandem configuration	ERL ≥ 28 dB SRL ≥ 20 dB
Hybrid balance ***(Note 5)*** DS1 tandem configuration	ERL ≥ 20 dB SRL ≥ 15 dB
Amplitude equalization A/D or D/A configuration ***(Note 6)*** 400 to 2800 Hz 300 to 3000 Hz	Equalized response, dB relative to 1 kHz –0.5 to +3.0 –1.0 to +5.0 ("–" means less loss "+" means more loss)
Maximum equalization setting range for CSA loops at 400 Hz at 2800 Hz	 –1.2 dB +1.6 dB (sufficient to equalize CSA loops)

Note 1: D/A idle channel noise is ≤ 17 dBrnC0 within the range +3.5 to –5.0 dBm.

Note 2: Measured with respect to 900 Ω + 2.16 μF or 600 Ω + 2.16 μF (depending on the nominal input impedance selected) with the FCOT end terminated in 900 Ω + 2.16 μF.

Note 3: Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 μF. The RFT end is terminated in any CSA loop with 600-ohm termination. The balance network at the RFT is provisioned from the provisioning table in *Line Card Application and Special Services Engineering*, 323-3001-155, in *Engineering, Configuration, and Ordering Guide*, Volume 1, depending on the loop make-up.

Note 4: Measured with respect to 900 Ω + 2.16 μF or 600 Ω + 2.16 μF (depending on the nominal input impedance selected) with the 4-wire path broken.

Note 5: Measured as 4-wire return loss. The line card is terminated in 800 Ω || (50 nF + 100 Ω).

Note 6: Measured between an FCOT 2-wire or 4-wire terminal interface and the network interface beyond the RFT. The RFT is terminated in any CSA loop with 600-ohm termination.

—end—

Table 2-11 lists the FXS service on-hook transmission support provided by the NT4K67AB/AC line card.

Table 2-11
NT4K67AB/AC FXS service on-hook transmission (OHT) support

OHT type	State	UDLC	
		A/D	**D/A**
Coincidental with a terminating call	n/a	yes	yes
Not coincidental with a terminating call Conditions:	Default Always on Controlled by OSI > 100 ms < 500 ms	no optional yes	no optional yes
1 kHz loss if “ON”	n/a	0 to 10 dB Default A/D, D/A 10 dB	

Universal Voice Grade (UVG)

This section provides functional descriptions and specifications for universal voice grade (UVG) locally switched special services on the NT4K67AB/AC line card in UDLC, TR-08, and GR-303 MVI configurations.

Functional description

The O2WS line card can be provisioned for UVG service from the OPC.

There are no signaling or transmission options that need to be provisioned, except the OHT feature may be provisioned if desired, or left in the default mode.

Signaling is based on ABCD bits sent from the FCOT (UDLC), or AB bits sent from a digital switch (TR-08) or local digital switch in GR-303 MVI. Typically the line card is located at the RFT. For more information on signaling, see *Line Card Testing Procedures,* 323-3001-316, in *Operations, Administration, and Provisioning*, Volume 4B.

The line card can be used at the RFT in a UDLC configuration, with a corresponding office (NT4K68AA) sink line card at the FCOT end. It can also be used in a DS1 tandem configuration with a corresponding sink line card of a channel bank at the far end.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

All transmission attributes are fixed, except the transmission gain, which is autonomously adjusted by the line card depending on the resistance of the external loop:

- The gain of the line card changes such that the total loss of the UDLC, TR-08, or GR-303 MVI carrier and the CSA loop is maintained between 2 and 5 dB.
- 600 Ω + 2.16 μF input impedance
- Compromise balance network (600 Ω + 2.16 μF)
- Provisionable on-hook transmission loss A/D and D/A (default: 10 dB loss)

Signaling

The O2WS line card provides the following signaling attributes:

- Loop start and ground start
- Forward disconnect
- Toll diversion
- Ring pre-trip test
- On-hook transmission (loop start)
- Distinctive ringing
- Reminder ring
- Reverse battery to support line side answer supervision

The above signaling options on the line card are not provisionable. The signaling states are set by the far-end via ABCD bits (UDLC), GR-303 CDS, AB bits (TR-08), and ABCD or AB bits in DS1 Tandem, as set by provisioning (default is AB bits). Toll diversion and ring pre-trip test are not available with AB bit signaling.

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. The state of the hook switch is sent to the far end via ABCD bits.

Forward disconnect

Upon ABCD/AB bit forward disconnect signaling status (UDLC, GR-303 TR-08, and GR-303 MVI, respectively), the line card opens the tip lead as determined by the ABCD/AB bits from the FCOT.

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides distinctive ringing (Teen Ringing) patterns. In UDLC configurations, the line card repeats ringing signaling status sent from the FCOT via ABCD bits.

In TR-08 and GR-303 MVI configurations, the line card repeats ringing signaling status sent from a digital switch via AB bits.

Reminder ring

The line card provides a 500 ms burst of ringing "Reminder Ring." In UDLC configurations, the line card repeats ringing signaling status sent from the FCOT via ABCD bits. In TR-08 and GR-303 MVI configurations, the line card repeats reneging signaling status sent from a digital switch via AB bits.

On-hook transmission

The line card allows on-hook transmission (OHT) coincidental with a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental with a terminating call (such as for meter reading). The OHT coincidental with a terminating call is allowed during all silent intervals of the ringing pattern.

The OHT not coincidental with a terminating call is turned on by an OSI (open switch interval). However, it can be provided at all times by selecting the FULLTIME ONHK_TX option. The default setting is OFF to save power.

> ***Note:*** In TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).

System failure

If a carrier system fails, the line card opens the tip lead for 2 to 3 seconds, then closes the tip lead to re-apply loop feed.

Specifications

This section provides specifications for UVG service on the NT4K67AB/AC line card.

Common specifications

See “Common VF transmission specifications” on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-12 lists the signaling and VF specifications are unique to UVG service on the NT4K67AB/AC line card.

Table 2-12
NT4K67AB/AC signaling and VF specifications unique to UVG service

Parameter	Value
Maximum external loop resistance	1250 ohms: 820 ohm loops plus 430 ohm terminal
Loop current	> 20 mA
Ringer load (> 40 Vrms, 20 Hz) at the end of an 820 ohm loop	5 REN
Ring trip delay	< 200 ms
Dial pulsing Loop dial pulsing: pulse rate input % break maximum load Touch tone addressing:	 8 to 12 pps 58 to 64% 5 C4A ringers and 15 kohm bridged DTMF
Total loss at 1 kHz UDLC carrier + CSA cable	2 to 5 dB
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz

—continued—

Table 2-12 (continued)
NT4K67AB/AC signaling and VF specifications unique to UVG service

Parameter	Value
Input return loss ***(Note 1)*** UDLC configurations	ERL ≥ 19 dB SRL ≥ 11 dB
Input return loss ***(Note 2)*** TR-08 configurations	ERL ≥ 28 dB SRL ≥ 20 dB
Input return loss at FCOT ***(Note 3)*** UDLC and TR-08 configurations	ERL ≥ 10 dB SRL ≥ 5 dB
Note 1: Measured with respect to 600 Ω + 2.16 μF with the FCOT end terminated in 900 Ω + 2.16 μF. ***Note 2:*** Measured with respect to 600 Ω + 2.16 μF with the 4-wire path broken. ***Note 3:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 μF. The RFT end is terminated in any CSA loop with 600-ohm termination.	
—end—	

Table 2-13 lists the UVG service on-hook transmission support provided by the NT4K67AB/AC line card.

Table 2-13
NT4K67AB/AC UVG on-hook transmission (OHT) support

OHT type	State	UDLC		TR-08		GR-303 MVI	
		A/D	D/A	A/D	D/A	A/D	D/A
Coincidental with a terminating call	n/a	yes	yes	yes	yes	yes	yes
Not coincidental with a terminating call Conditions:	Default Always on Controlled by OSI > 100 ms, < 500 ms	no optional yes	no optional yes	no optional yes	no optional yes	no always on	no always on
1 kHz loss if “ON”	n/a	0 to 10 dB Default A/D, D/A 10 dB		0 to 10 dB Default A/D, D/A 10 dB		0 to 10 dB Default A/D, D/A 10 dB	
Note 1: n/a indicates not applicable. ***Note 2***: In TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).							

Transmission only/equalized transmission only (TO/ETO)

This section provides functional descriptions and specifications for transmission only/equalized transmission only (TO/ETO) locally switched special services on the NT4K67AB/AC line card.

Functional description

The O2WS line card provides TO/ETO service when configured from the OPC. The TO/ETO service provides a 2-wire cable or terminal interface and may be used at the RFT or FCOT. It can be used in a UDLC or DS1 tandem configuration. In either configuration, the other end will be a TO/ETO interface type.

Note the following provisioning for TO/ETO service:

- There are no signaling attributes associated with this service.
- The transmission parameters are provisionable to match the TO/ETO interface to the connecting equipment and cable.
- There is no OHT feature associated with this service.
- Sealing current is provided to help maintain the integrity of the loop.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

Transmission attributes:

- Provisionable transmit and receive path OFF or ON (default: ON)
- Provisionable transmit and receive gain/loss (default: 2 dB loss)
- Provisionable transmit and receive equalization (default: No equalization)
- Provisionable input impedance (default: 600 Ω + 2.16 μF)
- Provisionable hybrid balance network (default: 600 W)

The transmission settings can be provisioned from a local or remote location.

The hybrid balance network and transmit/receive equalization provisioning is facilitated by using a look-up table that gives the optimum matching of the transmission attributes and the connecting loop.

Without provisioning, the line card defaults to 2 dB A/D and D/A loss, and no transmit and receive equalization. The input impedance defaults to 600 Ω + 2.16 μF and the hybrid balance is 600 ohm.

Sealing current

The line card provides a continuous sealing current.

System failure

If a carrier system fails, the sealing current is maintained as during normal operation. The VF transmission is disabled for the duration of the system failure.

Specifications

This section provides specifications for TO/ETO service on the NT4K67AB/AC line card.

Common specifications

See “Common VF transmission specifications” on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-14 lists the NT4K67AB/AC line card signaling and VF specifications that are unique to TO/ETO service.

Table 2-14
NT4K67AB/AC signaling and VF specifications unique to TO/ETO service

Parameter	Value
Maximum total external resistance ***(Note 1)***	1820 Ω
Maximum loop range (beyond RFT, excluding terminal)	820 Ω
Sealing current Continuous current	 20 mA ± 5 mA
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	900 Ω + 2.16 μF or 600 Ω + 2.16 μF (default)
Input return loss ***(Note 2)***	ERL ≥ 22 dB SRL ≥ 14 dB
Input return loss at FCOT ***(Note 3)***	ERL ≥ 22 dB SRL ≥ 14 dB
Input return loss ***(Note 4)*** DS1 tandem configuration	ERL ≥ 28 dB SRL ≥ 20 dB
Hybrid balance ***(Note 5)*** DS1 tandem configuration	ERL ≥ 20 dB SRL ≥ 15 dB
Amplitude equalization A/D or D/A ***(Note 6)*** 400 to 2800 Hz 300 to 3000 Hz Maximum equalization setting range for CSA loops: at 400 Hz at 2800 Hz	Equalized response, dB relative to 1 kHz –0.5 to +3.0 –1.0 to +5.0 (“–” means less loss “+” means more loss) –1.2 dB +1.6 dB (sufficient to equalize CSA loops)
—continued—	

Table 2-14 (continued)
NT4K67AB/AC signaling and VF specifications unique to TO/ETO service

Parameter	Value
Nominal level at 1 kHz Analog input to produce DRS (A/D) Analog output from DRS (D/A) Minimum adjustment step	 +5.0 to –6.5 dBm +3.5 to –10.0 dBm ***(Note 7)*** 0.1 dB
Default: nominal loss at 1kHz, A/D or D/A	2 dB
Note 1: Maximum total loop resistance is 820 ohms (maximum CSA loop) + 1000 ohms (maximum terminal resistance) = 1820 Ω. ***Note 2:*** Measured with respect to 900 Ω + 2.16 μF or 600 Ω + 2.16 μF (depending on the nominal input impedance selected) with the FCOT end terminated in 900 Ω + 2.16 μF. ***Note 3:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 μF. The RFT end is terminated in any CSA loop with 600-ohm termination. The balance network at the RFT is provisioned from the provisioning table in 323-3001-155, depending on the loop make-up. ***Note 4:*** Measured with respect to 900 Ω + 2.16 μF or 600 Ω + 2.16 μF (depending on the nominal input impedance selected) with the 4-wire path broken. ***Note 5:*** Measured as 4-wire return loss. The line card is terminated in 800 Ω || (50nF + 100 Ω). ***Note 6:*** Measured between an FCOT 2-wire or 4-wire terminal interface and the network interface beyond the RFT. The RFT is terminated in any CSA loop with 600-ohm termination. ***Note 7:*** Idle channel noise is £ 17 dBrnC0 within the range +3.5 to –5.0 dBm.	
—end—	

Dial pulse originating (DPO) service

This section provides functional descriptions and specifications for dial pulse originating (DPO) service on the NT4K67AB/AC line card.

Functional description

The O2WS NT4K67AB/AC line card provides DPO service when configured from the OPC. The DPO service provides a 2-wire cable interface and is located at the FCOT connecting to the local switch. The DPO service on the O2WS line card is used in direct inward dial (DID) applications and may be used in a UDLC configuration.

When used in a UDLC configuration, the far-end line card at the RFT must be of the dial pulse terminating (DPT) type.

The line card defaults to loop pulsing and can be provisioned to battery and ground pulsing.

Signaling is based on the status of ABCD bits sent from the RFT.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The O2WS line card provides the following transmission attribute:

- Provisionable transmit and receive gain/loss
- Provisionable input impedance
- Provisionable hybrid balance network
- Provisionable transmit and receive equalization

The transmission settings can be provisioned from a local or remote location.

The hybrid balance network and transmit/receive equalization provisioning is facilitated by using a look-up table that gives the optimum matching of the transmission attributes and the connecting loop.

Without provisioning, the line card defaults to 2 dB A/D and D/A loss, and no transmit and receive equalization. The input impedance defaults to 900 Ω + 2.16 μF and the hybrid balance to 900 Ω + 2.16 μF (setting 2).

Signaling

The O2WS line card provides the following signaling attribute:

- loop reverse battery signaling

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. The state of the hook switch is sent to the far end via ABCD bits.

System failure

If a carrier system fails, the line card goes into one of the following trunk conditioning states:

- It provides normal battery feed for 2–3 seconds, then provides reverse battery feed for the duration of the alarm or maintenance activity (this is the default state).
- It provides normal battery feed for the duration of the alarm or maintenance activity.

The DPO service always provides “idle” signaling to the far-end DPT for the duration of the alarm or maintenance activity.

Specifications

This section provides specifications for DPO service on the NT4K67AB/AC line card.

Common specifications

See “Common VF transmission specifications” on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-15 lists the NT4K67AB/AC line card signaling and VF specifications that are unique to DPO service.

Table 2-15
NT4K67AB/AC signaling and VF specifications unique to DPO service

Parameter	Value
Maximum loop resistance (beyond FCOT including internal resistance of the local switch)	1200 ohms
Loop current	> 20 mA
Dial pulse capability at input Loop dial pulsing Pulse rate Input % break Battery and ground pulsing (500/500 ohms battery and ground resistances) Pulse rate Input % break (loop resistance 0 to 100 Ω)	 8-12 pps 49-73% (with D1 leak (600 Ω + 2.0 μF) across pulsing contacts and 0 to 100 Ω loop resistance) 49-73% (with 0.5 μF+ 600 Ω across pulsing contacts and 0 to 100 Ω loop resistance) 8-12 pps 49-73%
Nominal loss at 1 kHz A/D and D/A	2 dB
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	900 Ω + 2.16 μF
Input return loss ***(Note 1)*** UDLC configuration	ERL ≥ 22 dB SRL ≥ 14 dB
Return loss at RFT ***(Note 2)***	ERL ≥ 22 dB SRL ≥ 14 dB
Note 1: Measured with respect to 900 Ω + 2.16 μF with the RFT end terminated in 900 Ω + 2.16 μF. ***Note 2:*** Measured as 2-wire input return loss at the RFT-end with respect to 900 Ω + 2.16 μF. The FCOT-end is terminated in 900 Ω + 2.16 μF.	

Electronic business set (EBS) service

This section provides functional descriptions and specifications for electronic business set (EBS) service on the NT4K67AB/AC line card.

Functional description

The O2WS NT4K67AB/AC line card provides EBS service (or P-phone) when configured by software. The EBS service provides a 2-wire cable interface and is typically used at the RFT. It can be used in a GR-303 DMS configuration only.

Only M5000-series Meridian Business Sets (MBS) or EBS telephone sets or equivalent are compatible with the EBS service on the O2WS line card.

The transmission of VF and signalling data between the line card and telephone set is done only via non-loaded cable.

There are no transmission or signaling options to be provisioned.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The O2WS line card provides the following transmission attributes for EBS service:

- 2 dB transmit and receive loss
- 900 Ω + 2.16 μF impedance
- Automated compromise hybrid balance network
- Supports CSA loop (820 Ω) and up to 1230 Ω loop of 16 kft using 26 gauge wire

In the EBS function configuration, the line card provides voice-frequency (VF) and 8 kHz transmission channels.

Signaling

The signaling states representing on-hook, off-hook and addressing information are transmitted between the line card and the telephone set via messages using an out-of-band amplitude shift key (ASK) modulating technique.

The on-hook ringing realized by two tones, is sent over the VF path from the digital switch.

The off-hook alerting is controlled by messages from the digital switch. The messages control a buzzer on the set.

The O2WS line card provides the loop power required by the main EBS device. However, an additional local power supply may be required for the main set or add-ons. See NTP 297-2011-200 and NTP 297-2011-180 for standard engineering and applications guidelines.

System failure

If a carrier system fails, the battery feed is maintained. The VF and 8 kHz transmission is disabled for the duration of the system failure.

Specifications

This section provides specifications for EBS service on the NT4K67AB/AC line card.

Common specifications

See “Common VF transmission specifications” on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 50 Hz rejection (Hong Kong systems); 60 Hz rejection (North American systems)

Unique specifications

Table 2-16 lists theNT4K67AB/AC line card signaling and VF specifications that are unique to EBS service.

Table 2-16
NT4K67AB/AC signaling and VF specifications unique to EBS service

Parameter	Value
Maximum loop beyond RT ***(Note 1)*** Maximum loss at 8 kHz	1230 Ω loops 24 db
Maximum number of add-ons	3 (switch limitation)
Nominal loss at 1 kHz A/D and D/A	2 dB
Nominal input impedance	900 Ω + 2.16 µF
Frequency response (loss)	–0.25 to +0.5 dB, 400 to 2800 Hz
Input return loss ***(Note 2)***	ERL ≥ 20 dB SRL ≥ 14 dB
Hybrid balance ***(Note 3)***	ERL ≥ 20 dB SRL ≥ 15 dB
Note 1: Loops greater than 820 Ω require at least a 48 V talk battery current. ***Note 2:*** Measured with respect to 900 Ω + 2.16 µF with the 4-wire path broken. ***Note 3:*** Measured as 4-wire return loss at the 4-wire path with the RT terminated in 800 Ω || (50 nF + 100 Ω) with the nonloaded balance network selected and the reading adjusted for transmission loss.	

Private line automatic ringdown (PLAR) service

This section provides functional descriptions and specifications for the private line automatic ringdown (PLAR) service on the NT4K67AB/AC line card. The NT4K67AB/AC line card provides PLAR service for UDLC configurations only.

Functional description

The O2WS NT4K67AB/AC line card provides PLAR service when configured by software. PLAR is a nonswitched special service, which provides a private, full-time, exclusive connection between two stations.

PLAR service is initiated when the local line card detects an off-hook condition. The far-end line card then applies power ringing to its loop and returns an audible ringback signal to the local end. The PCM talk path is connected when ringing is tripped by the far end.

The provisionable transmission and signaling options for PLAR service are provisioned from the OPC as explained in the following sections.

Common functions

See “Common functions” on page 2-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The following are the provisionable transmission attributes for PLAR:

- Provisionable transmit and receive gain:
  RxGain, (D/A) –10.0 dB to +3.5 dB, in .1 dB increments (default: –1.0 dB)
  TxGain, (A/D) –5 dB to +6.5 dB, in .1 dB increments (default: –1.0 dB)
- Provisionable input impedance, either 600 Ω + 2.16 μF, or
  900 Ω + 2.16 μF impedance: (default: 600 Ω + 2.16 μF)
- Provisionable hybrid balance network from 0 to 127 settings: (default: 38)
- Provisionable transmit and receive equalization from 0 to 6: (default: 0)

Signaling

The O2WS line card provisioned for PLAR provides the following provisionable signaling attributes:

- Provisionable PLAR type for original and revised channel bank signalling specifications, either type 1 or type 2: (default: type 2)
- Provisionable fast-busy or howler tone after 2-minute time-out, either enabled/true or disabled/false: (default: disabled/false).

All other signaling attributes are fixed.

Loop closure/loop open

Upon receipt of a loop closure indication from the near end, the far end applies ringing to the far end station if it is on-hook. A resistance greater than 10 kohms is recognized as loop open.

Ringing

If the system detects an on-hook from the connecting equipment, and is receiving a loop closure from the far end, it applies an alerting signal to the tip/ring interface. The alerting signal and ringback have a nominal 6-second period. The cadence consists of a nominal 2-second ringing interval, and a nominal 4-second silent interval. Ringing is applied to the ring conductor with the tip grounded.

Ring trip

The alerting signal is removed within 200 ms after a 300-ohm off-hook is applied at the far end, during ringing or silent intervals. The alerting signal is replaced with loop current feed towards the connecting equipment.

Ring trip immunity

Ringing is not tripped when a termination of 10 kohms, in parallel with 8 microfarads, is applied directly at the tip and ring interface while the system is ringing toward the connecting equipment.

Ringing is not tripped when a 200-ohm off-hook is applied across the tip/ring interface for 12 ms or less. No ringing is applied toward the connecting equipment while continuously receiving loop open from the far end.

Showering lines

A steady loop open or loop closure is maintained toward the far end when the test conditions of TR-57, section 5.22.17 are applied.

Immunity to line crosses

The system functions normally, after the application and removal of shorts between tip-to-tip, ring-to-ring, tip-to-ring, tip-to-ground, and ring-to-ground on one or more line card outputs.

System failures

During a carrier system failure or maintenance activity, ringing is not applied to the lines affected by the failure or activity. For individual line card failures, continuous ringing is not applied if ring trip requirement can not be met.

Common specifications

See “Common VF transmission specifications” on page 2-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 2-17 lists the NT4K67AB/AC line card signaling and VF specifications unique to PLAR service.

Table 2-17
NT4K67AB/AC signaling and VF specifications unique to PLAR service

Parameter	Value
Maximum total external loop resistance	1250 ohms: 820 Ω loops plus 430 Ω for the set
Loop current	≥ 20 mA
Ringer load (> 40 Vrms, 20 Hz) at the end of an 820 Ω loop	5 REN
Ring trip delay	≤ 200 ms
Nominal loss at 1 kHz A/D and D/A	2 dB
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	900 Ω + 2.16 μF or 600 Ω + 2.16 μF (default)
Input return loss ***(Note 1)*** UDLC configuration	ERL ≥ 22 dB SRL ≥ 14 dB
Input return loss at FCOT ***(Note 2)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
—continued—	

Table 2-17 (continued)
NT4K67AB/AC signaling and VF specifications unique to PLAR service

Parameter	Value
Amplitude equalization A/D or D/A ***(Note 3)***	Equalized response, dB relative to 1 kHz
400 to 2800 Hz 300 to 3000 Hz	–0.5 to +3.0 –1.0 to +5.0 ("–" means less loss "+" means more loss)
Maximum equalization setting range for CSA loops: at 400 Hz at 2800 Hz	 –1.2 dB +1.6 dB (sufficient to equalize CSA loops)
Nominal level at 1 kHz Analog input to produce DRS (A/D) Analog output from DRS (D/A) Minimum adjustment step	 +5.0 to –6.5 dBm +3.5 to –10.0 dBm ***(Note 4)*** 0.1 dB
Note 1: Measured with respect to 900 Ω + 2.16 μF or 600 Ω + 2.16 μF (depending on the nominal input impedance selected) with the FCOT end terminated in 900 Ω + 2.16 μF. ***Note 2:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 μF. The RFT end is terminated in any CSA loop with 600-ohm termination. The balance network at the RFT is provisioned from the provisioning table in 323-3001-155, depending on the loop make-up. ***Note 3:*** Measured between an FCOT 2-wire or 4-wire terminal interface and the network interface beyond the RFT. The RFT is terminated in any CSA loop with 600-ohm termination. ***Note 4:*** Idle channel noise is £ 17 dBrnC0 within the range +3.5 to –5.0 dBm.	
—end—	

Integrated services digital network (ISDN) service

This section provides functional descriptions and specifications for ISDN service on the NT4K67AB/AC line card.To implement 3-DS0 ISDN or IDSL, you need one NT4K67AC (Rel. 20 or greater) line card at the RFT.

Functional description

The O2WS line card provides the line termination functionality for ISDN Basic Rate Interface when configured by software. The ISDN service is compliant with Bellcore TR-393, TR-397 and ANSI T1.601-1988. Point-to-point GR-303 DMS/MVI configurations with embedded operations channel (eoc) are supported, and 3DS0 ISDN configuration is supported with a multi point eoc.

The ISDN configured line card is located at the remote fiber terminal (RFT). The line card provides a U interface for 2-wire loops. The far end of the metallic loop must be connected to an NT1, or equipment with equivalent functionality. The line card transceiver acts like as master by providing the timing and control information to the slave NT1 transceiver.

Transceiver

The transceiver in the line card performs all encoding and decoding of the 2B1Q line signal. It uses a digital echo canceller to provide full duplex transmission over the 2-wire nonloaded loop.

Digital subscriber loop (DSL) signal

The transmission code is 2B1Q (2 binary, one quaternary, 4-level PAM code). The DSL signal includes two clear 64 kb/s B channels and a 16 kb/s D channel. (2B+D) in both directions of transmission. The D channel contains signaling and routing data for the B channels, as well as customer packet data. In addition, the DSL signal includes 4 kb/s of overhead to support network operations and an effective 12 kb/s for framing. The total line rate is 160 kb/s.

Start-up

Once locally powered and connected by a 2-wire loop, the line card and NT1 transceiver automatically, and without field adjustment, establish Layer-1 communication over the loop through a cold-start procedure as specified in ANSI T1.601-1988 and TR-393.

After a successful cold start, the DSL remains in active mode regardless of whether the D or B channels are in use. The restart is automatic following transmission interruptions due to electrical disturbances, NT1 power interruption, loop opens, loop shorts, or other disturbances external to the line card.

Synchronization with the network

The ISDN configured line card has the following synchronization properties:

- Receives timing from the ISDN local digital switch.
- If the timing reference is interrupted, it will free-run as a Stratum 4 clock and will transmit a long-term average symbol rate of 80 kbaud ± 32 ppm.
- The long-term average symbol rate is 80 kbaud ± 5 ppm when the timing reference is present.

Sealing current

The ISDN configured line card provides sealing current with the following properties:

- Periodic high level current pulse with low quiescent current between pulses.
- The DSL transmission performance is transparent to the presence or absence of sealing current.
- No impact on input impedance.

Maintenance

ISDN-based diagnostic testing is performed from the DMS-100 maintenance and administration position (MAP). You can diagnose line card hardware from the AccessNode network element user interface by downloading diagnostic software to the line card.

Performance monitoring

For 3DS0 ISDN service the line card tracks the block error (BE), errored seconds (ES), and severely errored seconds (SES) for both directions of transmission. An internal cyclic redundancy check (CRC) verification circuit monitors for customer-to-network block errors.

An overhead maintenance channel bit (FEBE) indicates detection of block errors in the network-to-customer direction. Thresholding is done on the ES and SES counts. The system controller resets the counter.

Loopbacks

The ISDN configured line card facilitates the following:

- Integrated ISDN supports transparent loopback at the line card, toward the network for either B1, B2, or 2B+D channel
- 3DS0 ISDN supports bidirectional loopback of B1, B2, or 2B+D
- Loopback at the NT1 activated by eoc messages for B1, B2, or 2B+D

System failure

If the system equipment fails for one second or more, the line card operates its protection relay to protect itself against foreign potentials. If no foreign potential exists on the loop, the relay resets automatically when the system recovers and automatically attempts to restart synchronization with the NT1.

Specifications

This section provides specifications for ISDN service on the NT4K67AB/AC line card.

Table 2-18 lists the NT4K67AB/AC line card signaling and VF specifications are unique to ISDN service.

Table 2-18
NT4K67AB/AC signaling and VF specifications unique to ISDN service

Parameter	Value (A/D or D/A during off-hook)
Loop range beyond RT	18 kft or 1300 Ω nonloaded with a maximum of 42 dB loss at 40 KHz
Sealing current mode Peak current Duration Interval between pulse Quiescent current	Periodic pulse 20 mA ± 3 mA < 3 s 1 hour ± 1 minute < 8 mA
Longitudinal balance: 500 Hz to 40 kHz 40 kHz to 1 MHz	 > 55 dB roll-off –20 dB per decade
Nominal input impedance	135 Ω resistive
Input return loss	> 20 dB, 10 kHz to 25 kHz roll-off 20 dB per decade to 1 kHz and 250 kHz
DSL data format	2B1Q
Line rate	160 kb/s
Free-run line rate (Stratum 4) if timing reference is lost	80 kbaud ± 32 ppm
Normal line rate	80 kbaud ± 5 ppm
Bit error rate (BER)	< 10E-7 for Bellcore loops #0 and 4-15 with all impairments (ANSI T1.601-1988)
Input jitter tolerance	Meets section 5.5.2 in TR-393

—continued—

Table 2-18 (continued)
NT4K67AB/AC signaling and VF specifications unique to ISDN service

Parameter	Value (A/D or D/A during off-hook)
Output jitter tolerance	Meets figure 5-4 in TR-393
Point-to-point eoc protocols	Complies with ANSI T1.601-1988 and TR-393
Pulse characteristics: output signal balance, power spectral density, total output power and pulse mask	Compliant with TR-393, T1.601-1988
—end—	

NT4K68AA: Omega 2-wire office

This chapter describes the NT4K68AA Omega 2-wire office (O2WO) line card and provides its specifications.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 3-2
Physical description	page 3-2
Common functions	page 3-3
Common VF transmission specifications	page 3-4
POTS	page 3-5
Universal Voice Grade (UVG) (locally switched) service	page 3-9
Dial pulse terminate (DPT) (locally switched) service	page 3-13
Coin service	page 3-16
Foreign exchange office (FXO) (non-locally switched) service	page 3-20
Transmission only/equalized transmission only (TO/ETO) (nonswitched) service	page 3-24

Line card general description

The O2WO line card is a service-adaptive line card which can be user-provisioned for any of the following services:

- plain old telephone (POTS) service
- universal voice grade (UVG) locally switched service
- dial pulse terminate (DPT) locally switched service
- coin service
- foreign exchange office (FXO) nonlocally switched service
- transmission only/equalized transmission only (TO/ETO) nonswitched service

The O2WO line card is the sink line card typically located at the central-office network element (FCOT) of the AccessNode. It is used in either a universal digital loop carrier (UDLC) configuration or an integrated digital loop carrier configuration using TR-08 communications.

Line card service provisioning in a UDLC, TR-08, GR-303 MVI, or DS1 Tandem configuration is performed from the operations controller (OPC). Line cards can be preprovisioned before actual installation in the copper-distribution shelf (CDS).

Physical description

The O2WO line card is 3.0 inches high by 3.7 inches deep, and occupies one slot in the line drawer of the copper-distribution shelf. Connection to the line drawer backplane is via 2 x 15 pin box connector.

The line card faceplate includes a red LED which is turned on by the system to indicate a line card failure, provisioning mismatch, or lamp test.

Table 3-1 lists the lead designations for a 2-wire circuit.

Table 3-1
NT4K68AA lead designations for a 2-wire circuit

CDS slot	Connector		Line card	
	Pair	Pin	Lead	Designation
01	01	26 1	T R	Tip Ring
02	02	27 2	T R	Tip Ring
and so on				

Common functions

The following functions are common to all services on the NT4K68AA line card.

Maintenance and testing

The line card allows self-diagnostic testing. Routines are downloaded to the line card to perform tests, such as analog, digital, and line interface tests, the combination of which ensures that all line card functions operate as intended.

Test access to customer lines is necessary to perform lineup, performance or maintenance testing. Split- or bridging-jack access to the tip and ring of the VF side of the line card is available through the T/R drop and line bantam jacks located on the local craft access panel (LCAP). Two metallic test buses are built into the equipment bay and line drawers to allow switchable access from any line card Tip and Ring (T/R) pair to the test jacks. A metallic test access card (MTAC) in each line drawer contains the relays that perform the switching. Jack access provisioning to allow T/R access to any line card is from the network element user interface.

If the line card is provisioned as a red-lined circuit, maintenance personnel can not access the line from the jack access panel. The customer must be notified before the circuit can be taken out of service. None of the provisionable parameters associated with the service can be changed until the red-lined attribute is disabled.

Transient protection

The line card is fully compatible with electrical safety and electromagnetic compatibility requirements relating to line cards in shelves located at the FCOT or RFT, and which may be located at the customer premises or central office.

Common VF transmission specifications

Table 3-2 lists the NT4K68AA line card voice-frequency (VF) specifications common to all services.

Table 3-2
NT4K68AA line card voice-frequency (VF) common specifications

Parameter	Value
Longitudinal balance (IEEE 455-1976 method) 200 Hz 500 Hz 1000 Hz 3000 Hz	 ≥ 63 dB ≥ 63 dB ≥ 63 dB ≥ 58 dB
Idle channel noise (for any Tx, Rx TLP) A/D and D/A	 ≤ 17 dBrnc0
1 kHz loss tolerance (A/D and D/A)	± 0.25 dB
Frequency response (relative to 1004 Hz) A/D or D/A 404 to 2804 Hz 304 to 3004 Hz (600 Ω line card impedance, with 600 Ω termination, or 900 Ω line card impedance, with 900 Ω termination).	 +0.15 dB to –0.5 dB +0.25 dB to –1.0 dB
Level tracking (A/D and D/A)	± 0.25 dB, at +3 to –37 dBm0, 1004 Hz
50 Hz loss A/D (Hong Kong systems) (relative to loss at 1 kHz) 60 Hz loss A/D (North American systems) (relative to loss at 1 kHz)	> 20 dB > 20 dB
Overload compression (relative to 0dBm0 input)	T-R inputA/D increased (dBm0) loss (dB) + 3 ≤ 0.5 + 6 ≤ 1.8 + 9 ≤ 4.5
Equal level echo path loss ***(Note 2)***	ERL ≥ 26 dB SRL ≥ 20 dB
Input return loss at FCOT ***(Note 3)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
—continued—	

Table 3-2 (continued)
NT4K68AA line card voice-frequency (VF) common specifications

Parameter	Value
Note 1: Measure relative to 900 Ω + 2.16 µF at the 2-wire input of the 2-wire sink, with the 4-wire path broken. ***Note 2:*** Measured at a 4-wire (0TLP) interface with the 2-wire sink terminated with 900 Ω + 2.16 µF. ***Note 3:*** Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 µF. The RFT end is terminated in 900 Ω + 2.16 µF.	
—end—	

POTS

This section provides a functional description and specifications for POTS service on the NT4K68AA line card. POTS is a single-party, locally-switched telephone service. The line card is always located in the FCOT for this service.

Functional description

Each of the following headings describes POTS functionality on the NT4K68AA line card.

Current sink

The current sink in the line card consists of an active circuit, which provides DC continuity and regulates the loop current to 23 mA.

20 Hz and 30 Hz ringing impedance and detection

Ringing detection of 20 Hz and 30 Hz is provided for calls terminating toward the subscriber. The 20 Hz and 30 Hz ringing impedance is greater than 2.3 kΩ and less than 14 kΩ.

Signature resistance

A signature resistance, tip to ground, ring to ground, and tip to ring is provided, which satisfies the requirements for mechanized loop testing, PGTC and Bell Canada 3703 RTU.

- Resistance tip to ground: 169 kΩ
- Resistance ring to ground: 169 kΩ
- Resistance tip to ring: 38.7 kΩ

Common functions

See “Common functions” on page 3-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The NT4K68AA line card provides the following transmission attributes:

- 0 dB loss A/D or D/A, off-hook
- 1 dB ± 0.5 dB A/D or D/A, on-hook
- 900 Ω + 2.16 μF input impedance
- Hybrid balance network 900 Ω + 2.16 μF (compromise with 3 kft of 26 gauge cable)

Signaling

The NT4K68AA line card provides the following signaling attributes:

- Loop start
- Forward disconnect
- Flash
- On-hook transmission, full time or activation by OSI or ringing
- Distinctive ringing

Provisionable parameters

The following parameter is provisionable.

Full-time on-hook transmission: on or off

On-hook transmission is possible in both directions, and can be provisioned for full time transmission or transmission only when activated.

If full time on-hook transmission is not desired (FULLTIME ONHK_TX not selected from the user interface), then transmission can be activated by two methods:

- Detection of 400 ms of 20 Hz ringing activates on-hook transmission during the silent period of ringing in both directions of transmission.
- Application of an OSI greater than 100 ms to the FCOT line card when it is not sending a loop closure activates on-hook transmission in both transmission directions within 200 ms after the OSI. Transmission persists for at least 15 seconds. An OSI greater than 500 ms does not activate transmission.

If full time on-hook transmission is desired (by selecting FULLTIME ONHK_TX from the user interface), then transmission is provided full time in both directions during the on-hook condition.

On-hook transmit and receive loss at 1 kHz in the NT4K68AA line card is 1 dB ± 0.5 dB. (The end-to-end loss with the NT4K67AB line card at the RFT is 4 dB ± 0.5 dB and with the NT4K65AA line card 3 dB ± 0.5 dB with 900 ohm source and termination impedances.)

Default parameters

The following is the default parameter:

- Full-time on-hook transmission = off

Fixed parameters

The following parameters are fixed:

- Test level point (TLP)

Off-hook	On-hook
Tx TLP = 0 (Tx gain=0)	Tx TLP = +1 ± 0.5, Tx GAIN = –1 ± .5
Rx TLP = 0 (Rx gain=0)	Rx TLP = –1 ± 0.5, Rx GAIN = –1 ± .5

- Structural impedance: 900 ohm + 2.16 μF
- Hybrid balance impedance: Set to a compromise for 3 kft, 26 gauge cable with a 900 ohm + 2.16 μF termination.
- Trunk conditioning = off

  If a CGA occurs, the line card will transmit a loop open toward the CO interface for the duration of the alarm.

Specifications

This section provides specifications for POTS service on the NT4K68AA line card.

Common specifications

See page 3-4 for the values for the following common VF specifications.

- Longitudinal balance
- Idle channel noise
- 60 Hz loss
- Overload compression
- 2-wire input return loss
- Equal level echo
- Frequency response
- 1 kHz loss tolerance
- Level tracking

Unique specifications

Table 3-3 lists the NT4K68AA line card signaling and VF specifications that are unique to POTS service.

Table 3-3
NT4K68AA signaling and VF specifications unique to POTS service

Parameter	Value
Maximum loop resistance (beyond FCOT)	280 ohms
Loop current sink regulation	23 mA dc ± 2 mA
Input ringing impedance 20 Hz	between 2.3 kΩ and 14 kΩ
Signature resistance tip to ground ring to ground tip to ring	 169 kΩ 169 kΩ 38.7 kΩ
Nominal loss at 1 kHz A/D or D/A, off-hook (600 ohms or 900 ohms with loop current) A/D or D/A, on-hook	 ± 0.25 dB 1.0 ± 0.5 dB
2-wire input impedance (nominal)	900 Ω + 2.16 μF

Universal Voice Grade (UVG) (locally switched) service

This section provides a functional description and specifications for the Universal Voice Grade (UVG) service, which is provided by the NT4K68AA line card. Signaling and Transmission criteria are met for the following services in a locally switched application.

- Local PBX Trunk - loop/ground start
- DOD - ground start
- 800 Service Trunk - ground start
- 800 Service Line - loop start
- WATS trunk out - ground start
- WATS line out - loop start
- WATS Trunk, 2 way - ground start
- WATS line, 2 way - loop start

The line card provides a 2-wire sink interface to the CO terminal interface, and will always be located in the FCOT for the locally switched services listed. The VF interface consists of a transformer coupled 2 to 4 wire hybrid and a loop or ground start signaling interface. Loop or ground start is automatically selected and requires no provisioning.

Functional description

This section contains a functional description of UVG service on the NT4K68AA line card.

Total off-hook loss

The total off-hook 1 kHz loss from the FCOT to the NI (network interface at the customer premise) will not exceed 5 dB. The application will consist of the 2-wire NT4K68AA and NT4K67AB line card pair at the FCOT and RFT respectively. Maximum cable at the RFT is within the guidelines of CSA. The loss is measured with a 900 ohms, 1 KHZ signal source at the FCOT, and a 600 ohm termination at the NI. Transmit and receive TLP at the NT4K68 line card is 0 dB in the off-hook condition.

Current sink

The current sink in the line card consists of an active circuit, which provides DC continuity and regulates the loop current to 23 mA.

20 Hz and 30 Hz ringing impedance and detection

Ringing detection of 20 Hz and 30 Hz is provided for calls terminating toward the subscriber. The 20 Hz and 30 Hz ringing impedance is greater than 2.3 kΩ and less than 14 kΩ.

Ring ground resistance

The line card is capable of automatically providing ground start operation. The ring ground resistance for call initiation toward the switch is 500 ohms.

Tip ground detection

For ground start operation, tip ground detection is provided for up to 1900 ohms tip to ground. Detection is possible for loop open, loop closed, or ring ground conditions.

Loss switching

The 2-wire line card pair will automatically make gain adjustments so that the minimum total loss will be equal to, or greater than 2 dB from FCOT to the NI over a cable range of 0 to CSA at the RFT. Gain adjustments are made at the NT4K67AB line card located at the RFT.

Common functions

See “Common functions” on page 3-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The NT4K68AA line card provides the following transmission attributes:

- 0 dB loss A/D or D/A, off-hook
- 1 dB ± 0.5 dB loss A/D or D/A, on-hook
- 900 Ω + 2.16 μF input impedance
- Hybrid balance network 900 Ω + 2.16 μF (compromise with 3 kft of 26 gauge cable)

Signaling

The NT4K68AA line card provides the following signaling attributes:

- Automatic loop or ground start supervision
- Forward disconnect
- Flash
- On-hook transmission full time, or by activation by OSI or ringing
- 20 Hz and 30 Hz ring detection
- Reverse battery to support line side answer supervision

Provisionable parameters

The following parameter is provisionable:

- Full time on-hook transmission: on or off

Default parameters

The following is the default parameter:

- On-hook transmission = off

Fixed parameters

The following parameters are fixed:

- Test level point (TLP)

Off-hook	On-hook
Tx TLP = 0	Tx TLP = +1 ± 0.5, Tx GAIN = –1 ± .5
Rx TLP = 0	Rx TLP = –1 ± 0.5, Rx GAIN = –1 ± .5

- Structural input impedance: 900 ohms + 2.16 µF
- Hybrid balance impedance: Set to a compromise for 3 kft, 26 gauge cable with a 900 ohm + 2.16 µF termination.
- Trunk conditioning = Off

  If a CGA occurs, the line card will transmit a loop open toward the CO interface for the duration of the alarm.

Specifications

This section provides specifications for UVG service on the NT4K68AA line card.

Common specifications

See page 3-4 for values for the following common VF specifications:

- Longitudinal balance
- Idle channel noise
- 60 Hz loss
- Overload compression
- 2-wire input return loss
- Equal level echo
- Frequency response
- 1 kHz loss tolerance
- Level tracking

Unique specifications

Table 3-4 lists the NT4K68AA line card signaling and VF specifications that are unique to UVG service.

Table 3-4
NT4K68AA signaling and VF specifications unique to UVG service

Parameter	Value
Maximum loop resistance (beyond FCOT)	280 ohms
Loop current sink regulation	23 mA dc ± 2 mA
Ring ground resistance	500 ohms
Input ringing impedance 20 Hz 30 Hz	 between 2.3 kΩ and 14 kΩ > 1 kΩ
Ground start/loop start	Automatically adapts to ground start or loop start
Tip ground detection (ground start) resistance tip to ground	 ≤ 1900 Ω
2-wire input impedance (nominal)	900 Ω + 2.16 μF

Dial pulse terminate (DPT) (locally switched) service

This section provides a functional description and specifications for the NT4K68AA when it is used in the dial pulse terminate (DPT) function of the one-way direct inward dial (DID) service. Transmission and signaling requirements will be met for the DID service where the RFT is located in a CSA environment. This service is supported in UDLC and TR-08 applications.

Functional description

It is assumed that the DID service provided by the AccessNode is locally switched. The DPT service on the line card provides a 2-wire sink loop reverse battery (LRB) signaling interface toward the customer premise, which is typically located in the RFT.

In UDLC applications, the NT4K68AA is located at the RFT for this service, and is paired with the NT4K67AB located at the FCOT. In TR-08 applications, the NT4K68AA is located by itself at the RFT.

The VF interface consists of a transformer coupled 2- to 4-wire hybrid. The VF specifications are the same as POTS with the exception of those described below. The signaling functions and specifications are also described below.

Current sink

The current sink in the line card consists of an active circuit, which provides DC continuity and regulates the loop current to 23 mA ± 2.0 mA dc.

Detection of voltage polarity

When the AccessNode is applying a loop closure to the NT4K68AA, the NT4K68AA detects whether the ring is negative with respect to the tip, or positive with respect to the tip, and transmit the same polarity (normal battery (NB), or loop reverse battery (LRB) toward the FCOT. This occurs for loop currents of equal to or greater than 15 mA.

Loop dial pulsing

When the AccessNode is applying loop dial pulsing (loop open - loop closed) to the NT4K68AA line card, the NT4K68AA reproduces the dial pulses toward the customer interface. For more information on loop dial pulsing, see *Line Card Testing Procedures*, 323-3001-316, in *Operations, Administration, and Provisioning*, Volume 4B.

Common functions

See “Common functions” on page 3-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The NT4K68AA line card provides the following transmission attributes:

- Provisionable transmit and receive gain/loss
- Provisionable input impedance
- Provisionable hybrid balance
- Provisionable transmit and receive equalization

Signaling

The NT4K68AA line card provides the following signaling attributes:

- Loop reverse battery signaling
- Wink, delay dial, immediate start
- CSA loop limits

Provisionable parameters

The following parameters are provisionable:

- Test level point (TLP)
  Tx TLP: –6.5 to + 5 dB
  Rx TLP: –10 to + 3.5 dB
- Trunk conditioning: ON or OFF
- Structural input impedance: 600 ohm + 2.16 μF, or 900 ohm + 2.16 μF
- Hybrid balance: 0 to 121 settings
- Equalization
  Rx equalization: 0 to 6 settings
  Tx equalization: 0 to 6 settings

Default parameters

The following are default parameters:

- Test level point (TLP)
  Tx TLP = 0
  Rx TLP = 0
- Hybrid balance: 68
- Structural input impedance: 600 ohm + 2.16 μF
- Trunk conditioning: ON

  Note: The DPT applies a loop open toward loop during an alarm or failure and stays there. But the DPT sends “idle” for 2-3 seconds toward the far end, and then sends “busy.”

- Equalization:
  Rx equalization: 0
  Tx equalization: 0

Specifications

This section provides specifications for DPT service on the NT4K68AA line card.

Common specifications

See page 3-4 for values for the following common VF specifications:

- Longitudinal balance
- Idle channel noise
- 50 Hz rejection (Hong Kong systems); 60 Hz rejection (North American systems)
- Overload compression
- 2-wire input return loss
- Equal level echo
- Frequency response
- 1 kHz loss tolerance
- Level tracking

Unique specifications

Table 3-5 lists the NT4K68AA line card signaling and VF specifications that are unique to DPT service.

Table 3-5
NT4K68AA signaling and VF specifications unique to DPT service

Parameter	Value
Maximum loop resistance (beyond RFT)	820 ohms (within CSA guidelines)
Loop current sink regulation	23 mA dc ± 2 mA
Signaling interface	Loop reverse battery
Signature resistance tip to ground ring to ground tip to ring	 169 kΩ 169 kΩ 38.7 kΩ
2-wire input impedance (nominal)	900 Ω + 2.16 μF, or 600 Ω + 2.16 μF

Coin service

This section provides a functional description and specifications for coin service on the NT4K68AA line card. The line card provides a 2-wire sink interface to the central-office terminal interface, and will always be located in the FCOT. Dial tone first service will be provided using loop start signaling, and coin first using ground start signaling.

The line card detects reverse battery after loop closure and transmits the ABCD bit code to the NT4K67AB where it is replicated, thus making it compatible with semi post pay telephone sets. The line card provides a 2- to 4-wire VF transformer coupled interface and a coin signaling interface to the central office.

Functional description

This section provides a functional description of coin service on the NT4K68AA line card.

Coin tip to ground resistance

During coin control test, the line card will provide a tip to ground resistance of between 1 kΩ and 2 kΩ for the purpose of indicating a coin present, coin return, or coin deposit.

Current sink

The current sink in the line card consists of an active circuit, which provides DC continuity and regulates the loop current to 23 mA.

20 Hz ringing impedance and detection

20 Hz ringing detection is provided for calls terminating toward the subscriber. The 20 Hz ringing impedance is greater than 2.3 kΩ and less than 14 K ohms.

Ring ground resistance

Loop start is typical for POTS, however the line card is capable of automatically providing ground start operation. The ring ground resistance for call initiation is 500 ohms.

Tip ground detection

For ground start operation, tip ground detection is provided for up to 1900 ohms tip to ground. Detection is possible for loop open, loop closed, or ring ground conditions.

Signature resistance

A signature resistance is provided tip to ground, ring to ground, and tip to ring, and satisfies mechanized loop testing (MLT), pair gain test controller (PGTC) and Bell Canada 3703 RTU requirements.

- Resistance tip to ground: 50.2 kΩ
- Resistance ring to ground: 50.2 kΩ
- Resistance tip to ring: 28.7 kΩ

Reverse battery

The line card transmits loop reverse signaling code toward the RFT when it detects that the tip is more negative than the ring lead.

Common functions

Descriptions of the following common functions can be found under the heading, “Common functions” on page 3-3:

- Maintenance and testing
- Transient protection

Transmission

The NT4K68AA line card provides the following transmission attributes:

- 0 dB loss A/D or D/A, off-hook
- 900 Ω + 2.16 μF input impedance
- Hybrid balance network 900 Ω + 2.16 μF (compromise with 3 kft of 26 gauge cable)

Signaling

The NT4K68AA line card provides the following signaling attributes:

- Coin first
- Dial tone first
- Semi post pay

Provisionable parameters

The following parameter is provisionable.

Full-time on-hook transmission: on or off

On-hook transmission is possible in both directions, and can be provisioned for full time transmission or transmission only when activated.

If full time on-hook transmission is not selected (that is, not selecting FULLTIME ONHK_TX from the user interface), then transmission can be activated by two methods:

- Detection of 400 ms of 20 Hz ringing activates on-hook transmission during the silent period of ringing in both directions of transmission.
- Application of an OSI greater than 100 ms to the FCOT line card when it is not sending a loop closure activates on-hook transmission in both transmission directions within 200 ms after the OSI. Transmission persists for at least 15 seconds. An OSI greater than 500 ms does not activate transmission.

If full time on-hook transmission is desired (by selecting FULLTIME ONHK_TX from the user interface), then Transmission is provided full time in both directions during the on-hook condition.

The OHT transmit and receive loss at 1 kHz in the NT4K68AA line card is 1 dB ± 0.5 dB. (The end-to-end loss with the NT4K67AB line card at the RFT is 4 dB ± 0.5 dB with 900 ohm source and termination impedances.)

Default parameter

The following is a default parameter.

- FULLTIME ONHK_TX=OFF

Fixed parameters

The following parameters are fixed:

- TLP:
  Tx TLP = 0 (Tx gain = 0) off hook
  Rx TLP = 0 (Rx gain = 0) off hook
- Structural input impedance: 900 ohm + 2.16 µF
- Hybrid balance impedance: The line card defaults to a compromise for 3 kft, 26 gauge with a 900 ohm + 2.16 µF termination.
- Trunk conditioning: off
  If a CGA occurs, the line card will transmit a loop open towards the central office interface for the duration of the alarm.

Specifications

This section provides specifications for coin service on the NT4K68AA line card.

Common specifications

See page 3-4 for values for the following common VF specifications:

- longitudinal balance
- idle channel noise
- 60 Hz loss
- overload compression
- 2-wire input return loss
- equal level echo
- frequency response
- 1 kHz loss tolerance
- level tracking

Unique specifications

Table 3-6 lists the NT4K68AA line card signaling and VF specifications that are unique to coin service.

Table 3-6
NT4K68AA signaling and VF specifications unique to coin service

Parameter	Value
Maximum loop resistance (beyond FCOT)	100 ohms
Loop current sink regulation	23 mA dc ± 2 mA
Ring ground resistance (coin first)	500 ohms
Input ringing impedance 20 Hz	Between 2.3 kΩ and 14 kΩ
Ground start/ loop start	Automatically adapts to coin first, or dial tone first signaling
Tip to ground resistance (coin control)	Between 1 kΩ and 2 kΩ
Tip ground detection (ground start) resistance tip to ground (coin first)	≤ 1900 Ω
Signature resistance tip to ground ring to ground tip to ring	50.2 kΩ 50.2 kΩ 28.7 kΩ
2-wire input impedance (nominal)	900 Ω + 2.16 μF

Foreign exchange office (FXO) (non-locally switched) service

This section provides a functional description and specifications for the NT4K68AA line card when it is used at the office-end for foreign exchange (FX) service. Transmission and signaling requirements will be met where the RFT is located in a CSA environment. The NT4K68AA and NT4K67AB 2-wire line card pair can be used to provide FX line and FX trunk services.

Functional description

The line card provides a 2-wire loop current sink signaling interface to the tip and ring, and is typically located in the FCOT for the non-locally switched foreign exchange office (FX) service. It may be located at the RFT for other special service applications.

The VF interface consists of a transformer coupled 2- to 4-wire hybrid and a loop or ground start signaling interface, which is automatically selected after being put in to service.

Current sink

The current sink in the line card consists of an active circuit, which provides DC continuity and regulates the loop current to 23 mA.

20/30 Hz ringing impedance and detection

20/30 Hz ringing detection is provided for calls terminating toward the subscriber. The 20 Hz ringing impedance is greater than 2.3 kΩ and less than 14 kΩ. The 30 Hz impedance is greater than 1000 ohms.

Ring ground resistance

Loop start is typical for POTS, however the line card is capable of automatically providing ground start operation. The ring ground resistance for call initiation toward the switch is 500 ohms.

Tip ground detection

For ground start operation, tip ground detection is provided for up to 1900 ohms tip to ground. Detection is possible for loop open, loop closed, or ring ground conditions.

Common functions

See “Common functions” on page 3-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The NT4K68AA line card has the following transmission attributes:

- Provisionable TLP
- Provisionable trunk conditioning
- Provisionable structural input impedance
- Provisionable full time on-hook transmission
- Provisionable hybrid balance
- Provisionable equalization

Signaling

The NT4K68AA line card has the following signaling attributes:

- automatic loop start/ground start
- On-hook transmission, full time or activation by OSI or ringing
- Forward disconnect
- 20/30 Hz ring detection
- Reverse battery to support line side answer supervision

Provisionable parameters

The following parameters are provisionable:

- Test level point (TLP)
  Tx TLP: –6.5 to +5 dB
  Rx TLP: –10 to +3.5 dB
- Trunk conditioning: ON or OFF
- Structural input impedance: 600 ohm + 2.16 µF, or 900 ohm + 2.16 µF
- Full time on-hook transmission: selected = ON; not selected = OFF
- Hybrid balance: 0 to 121 settings
- Equalization:
  Rx equalization: 0 to 6 settings
  Tx equalization: 0 to 6 settings

Default parameters

The following are the default parameters:

- Test level point (TLP)

Off-hook	On-hook
Tx TLP = 0 (Tx gain=0)	Tx TLP = +1 ± 0.5, Tx GAIN = –1 ± .5
Rx TLP = 0 (Rx gain=0)	Rx TLP = –1 ± 0.5, Rx GAIN = –1 ± .5

- Trunk conditioning: ON
- Structural input impedance: 900 ohm + 2.16 μF
- Full-time on-hook transmission: OFF
- Hybrid balance: 66 (900 ohm + 2.16 μF)
- Equalization:
  Rx equalization: 0
  Tx equalization: 0

Specifications

The following section contains specifications for FXO service on the NT4K68AA line card.

Common specifications

See page 3-4 for values for the following common VF specifications:

- Longitudinal balance
- Idle channel noise
- 60 Hz loss
- Overload compression
- 2-wire input return loss
- Equal level echo
- Frequency response
- 1 kHz loss tolerance
- Level tracking

Unique specifications

Table 3-7 lists the NT4K68AA line card signaling and VF specifications that are unique to FXO service.

Table 3-7
NT4K68AA signaling and VF specifications are unique to FXO service

Parameter	Value
Maximum loop resistance (beyond FCOT)	820 ohms (within CSA guidelines)
Loop current sink regulation	23 mA dc ± 2 mA
Ring ground resistance	500 ohms
Tip ground detection (ground start) resistance tip to ground	 ≤ 1900 Ω
Signature resistance tip to ground ring to ground tip to ring	 169 kΩ 169 kΩ 38.7 kΩ
Nominal loss at 1 kHz A/D or D/A, off-hook A/D or D/A on-hook	 ± 0.25 dB 1 ± 0.5 dB
2-wire input impedance (nominal)	900 Ω + 2.16 µF, or 600 Ω + 2.16 µF
Off-hook TLP range	Tx TLP: –6.5 to +5 dB Rx TLP: –10 to +3.5 dB
Tx and Rx amplitude equalization (relative to 1 kHz) Maximum gain 2804 Hz Maximum loss 404 Hz	Tx EQ, Rx EQ = 6 2.8 dB 2.0 dB
Full time on-hook transmission	Provisionable: ON or OFF (default OFF)
Hybrid balance	0 to 121 settings (default 66: 900 Ω + 2.16 µF)

Transmission only/equalized transmission only (TO/ETO) (nonswitched) service

This section provides a functional description and specifications for the NT4K68AA line card when it is used in a nonswitched, 2-point voice private line service.

Functional description

This service is provided in the AccessNode by using the NT4K68AA line card at FCOT and RFT, or with the NT4K68AA at either terminal, and the NT4K67AB line card at the opposite end. The NT4K68AA line card provides a sealing current sink interface. Sealing current can not be turned off by this line card. These are no DC signaling functions provided by TO/ETO service on this line card.

The VF interface consists of a transformer coupled 2- to 4-wire hybrid. The line card can be used in transmission only or equalized transmission applications.

Common functions

See “Common functions” on page 3-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The NT4K68AA line card has the following transmission attributes:

- Provisionable transmit or receive blocking
- Provisionable hybrid balance
- Provisionable transmit and receive equalization
- Provisionable A/D and D/A TLP
- Provisionable 600 Ω + 2.16 μF, or 900 Ω + 2.16 μF input impedance

Provisionable parameters

The following parameters are provisionable:

- Test level point (TLP)
  Tx TLP: −6.5 to + 5 dB
  Rx TLP: −10 to + 3.5 dB
- Structural input impedance: 600 ohm + 2.16 µF, or 900 ohm + 2.16 µF
- Blocking:
  Tx Blocking: ON or OFF
  Rx Blocking: ON or OFF
- Hybrid Balance: 0 to 121 settings
- Equalization:
  Rx equalization: 0 to 6 settings
  Tx equalization: 0 to 6 settings

Default parameters

The following are the default parameters:

- Test level point (TLP)
  Tx TLP: 0 dB
  Rx TLP: 0 dB
- Structural input impedance: 900 ohm + 2.16 µF
- Blocking:
  Tx Blocking: ON
  Rx Blocking: ON
- Hybrid balance: 66 (900 ohm + 2.16 µF, compromise to 0 to 3 kft of 26 gauge cable)
- Equalization:
  Rx equalization: 0
  Tx equalization: 0

Specifications

The following section contains specifications for TO/ETO service on the NT4K68AA line card.

Common specifications

See page 3-4 for values for the following common VF specifications:

- Longitudinal balance
- Idle channel noise
- 60 Hz loss
- Overload compression
- 2-wire input return loss
- Equal level echo
- Frequency response
- 1 kHz loss tolerance
- Level tracking

Unique specifications

Table 3-8 lists the specifications NT4K68AA line card unique to TO/ETO service.

Table 3-8
NT4K68AA specifications unique to TO/ETO service

Parameter	Value
Maximum loop resistance (beyond NT4K68AA line card)	820 ohms (within CSA guidelines)
Sealing current sink regulation	23 mA dc ± 2 mA
Signature resistance tip to ground ring to ground tip to ring	 169 kΩ 169 kΩ 38.7 kΩ
Nominal loss at 1 kHz A/D or D/A, off-hook	 ± 0.25 dB
2-wire input impedance (nominal)	900 Ω + 2.16 μF (default), or 600 Ω + 2.16 μF
TLP range	Tx TLP: –6.5 to +5 dB Rx TLP: –10 to +3.5 dB
Tx and Rx amplitude equalization (relative to 1 kHz) Maximum gain 2804 Hz Maximum loss 404 Hz	Tx EQ, Rx EQ = 6 2.8 dB 2.0 dB
VF transmission blocking	Tx enabled Tx disabled Rx enabled Rx disabled
Hybrid balance	0 to 121 settings (default 66: 900 Ω + 2.16 μF)

NT4K69AA: Omega 4-wire

This chapter contains specifications for the NT4K69AA Omega 4-wire (O4W) line card.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 4-2
Physical description	page 4-2
Common functions	page 4-3
Transmit only/equalized transmit only (TO/ETO) service	page 4-4
Foreign exchange office (FXO) service	page 4-7
Foreign exchange station (FXS) service	page 4-10
DX service	page 4-13
DDS OCUDP service	page 4-16
DDS DS0DP service	page 4-21

Line card general description

The O4W line card is a service-adaptive line card that can be used at the remote (RFT) network element or the central-office network element of the AccessNode. The O4W line card can be provisioned by the user for any of the following services:

- transmit only/equalized transmit only (TO/ETO) service
- foreign exchange office (FXO) service
- foreign exchange station (FXS) service
- duplex signaling (DX) service
- digital data service (DDS) office channel unit data port (OCUDP) service
- digital data service (DDS) DSO data port (DSODP) service

The 04W line card is used in universal digital loop carrier (UDLC) configurations. Line card provisioning in a universal digital loop carrier (UDLC) or DS1 tandem configuration is performed from the operations controller (OPC). Line cards can be preprovisioned before the line card is actually installed in the copper-distribution shelf.

Physical description

The O4W line card is 3.5 inches high by 6.0 inches deep and occupies two slots in the line drawer of the copper-distribution shelf. The card connects to two 2-row by 15-pin box connectors on the drawer backplane.

The line card faceplate includes a red LED which is turned on by the system to indicate a line card failure, provisioning mismatch, or lamp test.

Table 4-1 lists the lead designations for a 4-wire circuit.

Table 4-1
Lead designations for a 4-wire circuit

CDS slot	Connector		Line card	
	Pair	Pin	Lead	Designation
01	01	26 1	T R	Tip Ring
02	02	27 2	T1 R1	Tip 1 Ring 1
and so on				

Common functions

The following functions are common to all services on the NT4K69AA line card.

Maintenance and testing

The line card can perform self-diagnostic testing. Routines are downloaded to the line card to perform tests on the circuits associated with transmission, battery feed, supervision and ringing/high voltage generator to ensure that the line card functions operate as intended.

Split- or bridging-jack access to the tip and ring on the VF side of the line card is provided through the T/R and T1/R1 drop and line bantam jacks located on the local craft access panel (LCAP). Two metallic test busses are built into the equipment bay and line drawers to allow switchable access from any line card Tip and Ring pair to the test jacks. A metallic test access card (MTAC) in each line drawer contains the relays that perform the switching. There are also two Bantam jacks on the LCAP labelled Tx and Rx for DDS jack access.

Test access to customer lines is necessary in order to perform line-up performance, or maintenance testing.

Jack access to any 4-wire line card tip and ring pair is provisioned through the network element user interface.

If the line card is provisioned as a red-lined circuit, maintenance personnel can not access the line from the jack access panel. The customer must be notified before the circuit can be taken out of service. Also, none of the provisionable parameters associated with the service can be changed until the red-lined attribute is disabled.

Transient protection

The line card is designed to operate with any recognized primary protection, including carbon blocks. Heat coils may be present, but provide no additional benefits and are not required.

The line card is fully compatible with electrical safety and electromagnetic compatibility requirements relating to line cards in shelves located at the FCOT or RFT and which can located at the customer premises or the central office.

Transmit only/equalized transmit only (TO/ETO) service

This section provides a functional description and specifications for 4-wire TO/ETO (transmit only/equalized transmit only) service on the NT4K69AA line card.

Functional description

The 4-wire line card provides voice or data service on private lines. The NT4K69AA line card provisioned as TO/ETO can be used with another NT4K69AA line card at the far terminal, with an NT4K67AB, or with an NT4K68AA. The 4-wire line card has no dc signaling capability.

The VF interface consists of a transformer coupled transmit and receive port with 150, 600, or 1200 ohm impedance. Pre-equalization and post-equalization is provided and is capable of equalizing a loaded or non-loaded cable with 15 dB of 1 kHz loss.

Sealing current options are provided to allow sinking current, sourcing normal or reverse current, or to turn off sealing current.

Common functions

See “Common functions” on page 4-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Provisionable parameters

The following parameters are provisionable:

- Tx TLP
- Rx TLP
- Tx impedance
- Rx impedance
- Sealing current
- Tx equalization, post
- Rx equalization, pre
- Loaded/non-loaded equalization

Default parameters

The following are default parameters:

- Tx TLP (default 0)
- Rx TLP (default 0)
- Tx impedance (default 600 ohms)
- Rx impedance (default 600 ohms)
- Sealing current (default off)
- Tx equalization, post (default: Slope=0, Height=0, Bandwidth=0)
- Rx equalization, pre (default: Slope=0, Height=0, Bandwidth=0)
- Loaded/non-loaded equalization (default nonloaded)

Specifications

Table 4-2 lists the NT4K69AA line card specifications for TO/ETO service.

Table 4-2
NT4K69AA line card specifications for TO/ETO service

Parameter	Value
Maximum total external resistance (see note 1)	1900 ohms
Frequency response (relative to 1004 Hz) A/D or D/A 404 to 2804 Hz 304 to 3004 Hz (600 Ω line card impedance, with 600 Ω termination).	 ±0.1 dB ±0.15 dB
Equalization Transmit (post) Receive (pre) Slope Height Bandwidth	Equalizes a cable with 15 dB loss at 1 kHz (loaded or non-loaded cable) yes yes 0 to 15 steps (0 default) 0 to 16 steps (0 default) 0 to 16 steps (0 default)
60 Hz loss A/D	> 20 dB
TLP Range Tx TLP Rx TLP Step	 –17.5 to + 7 dB (0 default) –16 to + 8.5 dB (0 default) 0.1 dB
Sealing current Continuous current	 20 mA ± 5 mA
—continued—	

Table 4-2 (continued)
NT4K69AA line card specifications for TO/ETO service

Parameter	Value
Nominal loss (1 kHz tolerance) (relative to TLP setting) A/D or D/A	± 0.25 dB
Overload compression (relative to 0dBm0 input)	T-R input (dBm0) / A/D increase loss (dB) + 3 / ≤ 0.5 + 6 / ≤ 1.8 + 9 / ≤ 4.5
2-wire return loss (transmit or receive port relative to 600, 1200, or 150 ohms)	SFRL 1000 Hz ≥ 28 dB SFRL 300 to 3000 Hz ≥ 23 dB
Longitudinal balance (IEEE 455-1976 method) 200 Hz 500 Hz 1000 Hz 3000 Hz	 ≥ 63 dB ≥ 63 dB ≥ 63 dB ≥ 58 dB
Idle channel noise (for any TLP) A/D or D/A	≤ 17 dBrnc
2-wire input impedance (transmit or receive port)	150 ohms 600 ohms (default) 1200 ohms
Level tracking (A/D and D/A)	± 0.25 dB, at +3 to –37 dBm0, 1004 Hz
Note 1: Maximum total loop resistance is 900 Ω (simplex) + 1000 Ω (maximum terminal resistance) = 1900 Ω. ***Note 2:***The NT4K69AA line card meets an impulse noise specification of no more than 15 counts in 15 minutes at a threshold of 47 dBmCC for a TXTLP of +7 to –17.5 dB and a RXTLP of +8.5 to –16 dB except for the following condition: if the NT4K69AA RXTLP is between –8 and –16 dB with a dial pulsing NT4K68AA located in the next higher odd shelf position.	
—end—	

Foreign exchange office (FXO) service

This section provides a functional description and specifications for 4-wire foreign exchange office (FXO) service on the NT4K69AA line card.

Functional description

The line card provides a 4-wire VF interface with a loop start or ground start current sink signaling interface. The NT4K69AA line card provisioned as FXO can be used with another NT4K69AA line card provisioned as FXS, with an NT4K67AB (O2WS) provisioned as 2-wire FXS, or with an NT4K77AA provisioned as 6/8-wire tandem (office side).

The VF interface consists of a transformer coupled transmit and receive port with 150, 600, or 1200 ohm impedance. Pre-equalization and post-equalization is provided and is capable of equalizing a loaded or non-loaded cable with 15 dB of 1 kHz loss.

Common functions

See “Common functions” on page 4-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Provisionable parameters

The following parameters are provisionable:

- Tx TLP
- Rx TLP
- Tx impedance
- Rx impedance
- Sx Normal/Reverse
- Tx equalization
- Rx equalization
- Loaded/non-loaded equalization
- Trunk conditioning

Default parameters

The following are default parameters:

- Tx TLP (default 0)
- Rx TLP (default 0)
- Tx impedance (default 600 ohms)
- Rx impedance (default 600 ohms)

- Sx Normal/Reverse (default normal)
- Tx equalization (default: Slope=0, Height=0, Bandwidth=0)
- Rx equalization (default: Slope=0, Height=0, Bandwidth=0)
- Loaded/non-loaded equalization (default nonloaded)

Specifications

Table 4-3 lists the NT4K69AA line card specifications for FXO service.

Table 4-3
NT4K69AA line card specifications for FXO service

Parameter	Value
Ring ground resistance	500 ohms
Tip to ring resistance (dc current sink)	420 ohms
Total external 4-wire simplex resistance	1200 ohms
Input ringing impedance 20 Hz 30 Hz	 20 kΩ 16 kΩ
60 Hz loss A/D	> 20 dB
Maximum signaling simplex resistance	1200 ohms
Nominal loss (1 kHz tolerance) (relative to TLP setting) A/D or D/A	 ± 0.25 dB
Frequency response (relative to 1004 Hz) A/D or D/A 404 to 2804 Hz 304 to 3004 Hz (600 Ω line card impedance, with 600 Ω termination)	 ±0.1 dB ±0.15 dB
Overload compression (relative to 0dBm0 input)	T-R inputA/D increased (dBm0) loss (dB) + 3 ≤ 0.5 + 6 ≤ 1.8 + 9 ≤ 4.5
2-wire return loss (transmit or receive port relative to 600, 1200, or 150 ohms)	SFRL 1000 Hz ≥ 28 dB SFRL 300 to 3000 Hz ≥ 23 dB
Level tracking (A/D and D/A)	± 0.15 dB, at +3 to –37 dBm0, 1004 Hz
—continued—	

Table 4-3 (continued)
NT4K69AA line card specifications for FXO service

Parameter	Value
Longitudinal balance (IEEE 455-1976 method) 200 Hz 500 Hz 1000 Hz 3000 Hz	 ≥ 63 dB ≥ 63 dB ≥ 63 dB ≥ 58 dB
Idle channel noise (for any TLP) A/D and D/A	 ≤ 17 dBrnc
2-wire input impedance (transmit or receive port)	150 ohms 600 ohms (default) 1200 ohms
Equalization Transmit (post) Receive (pre) Slope Height Bandwidth	loaded or non-loaded yes yes 0 to 15 steps (0 default) 0 to 16 steps (0 default) 0 to 16 steps (0 default)
TLP Range Tx TLP Rx TLP Step	 –17.5 to + 7 dB (0 default) –16 to + 8.5 dB (0 default) 0.1 dB
Note: The NT4K69AA line card meets an impulse noise specification of no more than 15 counts in 15 minutes at a threshold of 47 dBmCC for a TXTLP of +7 to –17.5 dB and a RXTLP of +8.5 to –16 dB except for the following condition: if the NT4K69AA RXTLP is between –8 and –16 dB with a dial pulsing NT4K68AA located in the next higher odd shelf position.	
—end—	

Foreign exchange station (FXS) service

This section provides a functional description and specifications for 4-wire foreign exchange station (FXS) service on the NT4K69AA line card.

Functional description

The line card provides a 4-wire interface to a foreign exchange station. The line card provides a 4-wire VF interface and a signaling interface, which automatically options itself for ground start or loop start. The NT4K69AA line card provisioned as FXS can be used with another NT4K69AA line card provisioned as FXO, with an NT4K68AA (provisioned as 2-wire FXO), or with an NT4K77AA provisioned as 6/8-wire Tandem (station side).

The VF interface consists of a transformer coupled transmit and receive port with 150, 600, or 1200 ohm impedance. Pre-equalization and post-equalization is provided and capable of equalizing a loaded or non-loaded cable with 15 dB of 1 kHz loss. Pre- and post-equalization can be provisioned independently.

Common functions

See “Common functions” on page 4-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Provisionable parameters

The following parameters are provisionable:

- Tx TLP
- Rx TLP
- Tx impedance
- Rx impedance
- Sx Normal/Reverse
- Tx equalization
- Rx equalization
- Loaded/non-loaded equalization
- Trunk conditioning on/off

Default parameters

The following are default parameters:

- Tx TLP (default 0)
- Rx TLP (default 0)
- Tx impedance (default 600 ohms)

- Rx impedance (default 600 ohms)
- Sx Normal/Reverse (default normal)
- Tx equalization (default: Slope=0, Height=0, Bandwidth=0)
- Rx equalization (default: Slope=0, Height=0, Bandwidth=0)
- Loaded/non-loaded equalization (default nonloaded)
- Trunk conditioning on/off (default on)

Specifications

Table 4-4 lists the NT4K69AA line card specifications for FXS service.

Table 4-4
NT4K69AA line card specifications for FXS service

Parameter	Value
Maximum allowable cable resistance (2-wire loop, one direction)	2940 ohms
Maximum allowable external loop resistance for 20.0 mA dc (represents total 4-wire simplex resistance, plus 430 ohms for telephone set)	1900 ohms
Ring ground detection Maximum external ring to ground resistance (includes 735 ohms simplex resistance, plus 580 ohms for far end ring ground resistance)	1315 ohms
Ringing capability (maximum simplex resistance for 40 Vrms across ringer load) 5 REN 4 REN	 1350 ohms 1500 ohms
Ring trip (1600 ohm loop closure)	< 200 ms
60 Hz loss A/D	> 20 dB
Reverse loop current feed capability	yes
Signaling loop start or ground start	automatically selected
Nominal loss (relative to TLP setting) A/D or D/A	 ± 0.25 dB

—continued—

Table 4-4 (continued)
NT4K69AA line card specifications for FXS service

Parameter	Value	
Overload compression (relative to 0dBm0 input)	T-R input (dBm0) + 3 + 6 + 9	A/D increase loss (dB) ≤ 0.5 ≤ 1.8 ≤ 4.5
2-wire return loss (transmit or receive port relative to 600, 1200, or 150 ohms)	SFRL 1000 Hz ≥ 28 dB SFRL 300 to 3000 Hz ≥ 23 dB	
Longitudinal balance (IEEE 455-1976 method) 200 Hz 500 Hz 1000 Hz 3000 Hz	 ≥ 63 dB ≥ 63 dB ≥ 63 dB ≥ 58 dB	
Idle channel noise (for any TLP) A/D D/A	 ≤ 17 dBrnc ≤ 17 dBrnc	
2-wire input impedance (transmit or receive port)	150 ohms 600 ohms (default) 1200 ohms	
Equalization Transmit (post) Receive (pre) Slope Height Bandwidth	loaded or non-loaded yes yes 0 to 15 steps (0 default) 0 to 16 steps (0 default) 0 to 16 steps (0 default)	
TLP Range Tx TLP Rx TLP Step	 –17.5 to + 7 dB (0 default) –16 to + 8.5 dB (0 default) 0.1 dB	
Frequency response (relative to 1004 Hz) A/D or D/A 404 to 2804 Hz 304 to 3004 Hz	 ±0.1 dB ±0.15 dB	
Level tracking (A/D and D/A)	± 0.25 dB, at +3 to –37 dBm0, 1004 Hz	
—end—		

DX service

This section provides a functional description and specifications for 4-wire DX service on the NT4K69AA line card.

Functional description

The line card provides a full duplex, 2-state (DX) signaling interface, which can be used at the FCOT or RFT. The NT4K69AA line card, provisioned as a 4-wire DX, can be used with another NT4K69AA line card provisioned as DX, or with an NT4K77AA provisioned as E&M, PLR, or tandem. The line card is compatible with fixed or switched bias methods of signaling.

The VF interface consists of a transformer coupled transmit and receive port with 150, 600, or 1200 ohm impedance. Pre-equalization and post-equalization is provided and is capable of equalizing a loaded or non-loaded cable with up to 15 dB of 1 kHz loss. Pre- and post-equalization can be provisioned independently.

Common functions

See “Common functions” on page 4-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Provisionable parameters

The following parameters are provisionable:

- Tx TLP
- Rx TLP
- Tx impedance
- Rx impedance
- Sx normal/reverse
- Tx equalization
- Rx equalization
- Loaded/non-loaded equalization
- DX balance resistance
- Trunk conditioning

Default parameters

The following are default parameters:

- Tx TLP (default 0)
- Rx TLP (default 0)
- Tx impedance (default 600 ohms)

- Rx impedance (default 600 ohms)
- Sx normal/reverse (default normal)
- Tx equalization (default: Slope=0, Height=0, Bandwidth=0)
- Rx equalization (default: Slope=0, Height=0, Bandwidth=0)
- Loaded/non-loaded equalization (default nonloaded)
- DX balance resistance (default 0)
- Trunk conditioning (default on)

Specifications

Table 4-5 contains specifications for DX service on the NT4K69AA line card.

Table 4-5
NT4K69AA line card specifications for DX service

Parameter	Value
DC supervisory range (Maximum external resistance includes 2400 ohms of 4-wire simplex resistance, plus 1430 ohms for the Thevenin equivalent of the connecting DX unit)	3830 ohms
DX balance range	2400 ohms (from 1300 ohms to 3700 ohms)
DX balance adjustment increments	200 ohms
Nominal loss (relative to TLP setting) A/D or D/A	 ± 0.25 dB
60 Hz loss A/D	> 20 dB
Overload compression (relative to 0 dBm0 input)	T-R input (dBm0) / A/D increased loss (dB) + 3 / ≤ 0.5 + 6 / ≤ 1.8 + 9 / ≤ 4.5
2-wire return loss (transmit or receive port relative to 600, 1200, or 150 ohms)	SFRL 1000 Hz ≥ 28 dB SFRL 300 to 3000 Hz ≥ 23 dB
Idle channel noise (for any TLP) A/D D/A	 ≤ 17 dBrnc ≤ 17 dBrnc

—continued—

Table 4-5 (continued)
NT4K69AA line card specifications for DX service

Parameter	Value
Longitudinal balance (IEEE 455-1976 method) 200 Hz 500 Hz 1000 Hz 3000 Hz	 ≥ 63 dB ≥ 63 dB ≥ 63 dB ≥ 58 dB
2-wire input impedance (transmit or receive port)	150 ohms 600 ohms (default) 1200 ohms
Equalization Transmit (post) Receive (pre) Slope Height Bandwidth	loaded or non-loaded yes yes 0 to 15 steps (0 default) 0 to 16 steps (0 default) 0 to 16 steps (0 default)
TLP Range Tx TLP Rx TLP Step	 –17.5 to + 7 dB (0 default) –16 to + 8.5 dB (0 default) 0.1 dB
Frequency response (relative to 1004 Hz) A/D or D/A 404 to 2804 Hz 304 to 3004 Hz (600 Ω line card impedance, with 600 Ω termination)	 ±0.1 dB ±0.15 dB
Level tracking (A/D and D/A)	± 0.25 dB, at +3 to –37 dBm0, 1004 Hz
Note: The NT4K69AA line card meets an impulse noise specification of no more than 15 counts in 15 minutes at a threshold of 47 dBmCC for a TXTLP of +7 to –17.5 dB and a RXTLP of +8.5 to –16 dB except for the following condition: the NT4K69AA RXTLP is between –8 and –16 dB with a dial pulsing NT4K68AA located in the next higher odd shelf position.	
—end—	

DDS OCUDP service

This section provides a functional description and specifications for DDS office channel unit data port (OCUDP) service on the NT4K69AA line card. The DDS OCUDP service operates in the UDLC applications.

OCUDP transmitter functions

The following paragraphs describe the OCUDP transmitter functions.

Loop data detector

The loop data detector monitors the incoming data stream to insure that continuous activity is present on the customer DDS loop. If the detector observes an absence of incoming data bits for a period of two seconds, it flags an abnormal station condition by sending the abnormal station code word towards the customer loop.

Transmit code decoder

The transmit code decoder is used to operate on any DDS control messages which are obtained from the customer loop. Also, this decoder is used to frame incoming data bits when operating without the secondary channel option.

Byte assembler

The byte assembler joins a collection of serial data bits from the customer loop into properly framed parallel form. A 6, 7, 8, or 9-bit input sequence will exit the byte assembler as a framed 8-bit byte.

Error protection

The error protection process helps prevent data corruption by providing a degree of redundancy in the transmitted data. This error protection process works as follows:

- For 2.4, 4.8 and 9.6 kb/s, a 3-of-5 majority voting scheme is provided. In the 3-of-5 majority voting protection, processed DDS data is transmitted twenty times (2.4 kb/s), ten times (4.8 kb/s), or five times (9.6 kb/s).
- For 19.2 kb/s, a five-byte frame is established which contains a pair of bytes. One byte of each pair represents data. A (17, 9) BCH coded parity byte is paired with each data byte. The two pairs of bytes each consist of a data byte and a parity byte that are inserted into a five-byte frame and then transmitted.
- For 56 kb/s and 64 kb/s, a (17, 9) BCH coded parity byte is computed for each data byte. The data and parity bytes are transmitted using separate DS0 channels.

F-bit detector

The F-bit detector acquires and maintains frame synchronization of the customer data while operating with a secondary channel. This task is performed by monitoring the F-bit present in the incoming customer loop data.

OCUDP receiver functions

The following paragraphs describe the OCUDP receiver functions.

Error correction

The error correction process corrects erroneous DDS data bits in the data received from the network. This error protection process works as follows:

- For 2.4, 4.8, and 9.6 kb/s, repeated data bytes are checked using 3-of-5 majority voting.
- For 19.2 kb/s, a five-byte frame is established that contains a pair of bytes. One byte represents data while the other is a (17, 9) BCH coded parity byte. The error correction process examines each pair of bytes and corrects any single or double bit data (sometimes triple bit) error that may occur.
- For 56 kb/s and 64 kb/s, a pair of (17, 9) bytes are received using separate DS0 channels. One byte represents data while the other is a (17, 9) BCH coded parity byte. The error correction process examines this pair of bytes and corrects any single or double bit data (sometimes triple bit) errors that may occur.

Byte disassembler

The byte disassembler takes the network DDS data bytes and formats them for the customer loop.

F-bit generator

The F-bit generator is used in applications where the secondary channel is enabled. It selects the next sequential F-bit from a 6-bit repeating pattern for inclusion into the customer loop data stream.

Receive code decoder

The receive code decoder intercepts and processes any network control codes which arrive from the A-link. For example, the OCU loopback detector monitors the control data bytes in order to decode the OCU loopback. Similarly, the channel loopback detector, DSU loopback detector, and latching loopback detector, monitor for their respective loopback commands. Each of these loopback detectors performs their respective loopback action.

Common functions

Descriptions of the following common functions can be found under the heading, “Common functions” on page 4-3:

- Maintenance and testing
- Transient protection

Attributes

The line card with DDS OCUDP service has the following attributes:

- Data rate (2.4, 4.8, 9.6, 19.2, 56 or 64 kb/s)
- Secondary channel (except for 64 kb/s)
- Zero code suppression (except for 64 kb/s)
- Error correction
- Customer remote test (except for 64 kb/s)
- Latching loopbacks: OCU, channel and DSU
- Non-latching loopbacks: OCU, channel and DSU (except for 64 kb/s)
- Performance monitoring from the local craft access panel (LCAP)
- Sealing current source

Provisionable parameters

The following parameters are provisionable:

- Data rate (2.4, 4.8, 9.6, 19.2, 56 or 64 kb/s)
- Enable/disable secondary channel (except for 64 kb/s)
- Enable/disable zero code suppression (except for 64 kb/s)
- Enable/disable error correction
- Enable/disable customer remote test (except for 64 kb/s)
- Enable/disable latching loopback

Default parameters

The following are default parameters:

- Data rate (default: 56 kb/s)
- Enable/disable secondary channel (except for 64 kb/s) (default: disabled)
- Enable/disable zero code suppression (except for 64 kb/s) (default: enabled)
- Enable/disable error correction (default: disabled)
- Enable/disable customer remote test (except for 64 kb/s) (default: disabled)
- Enable/disable latching loopback: (default: enabled)

Specifications

This section contains DDS OCUDP specifications for the NT4K69AA line card.

Unique specifications

Table 4-6 shows the signaling and VF specifications that are unique to DDS OCUDP service on the NT4K69AA line card.

Table 4-6
NT4K69AA line card specifications for DDS OCUDP service

Parameter	Value
Operating mode	4-wire, full duplex
Line rate	2.4, 4.8, 9.6, 19.2, 56 or 64 kb/s 3.2, 6.4, 12.8 25.6 and 72 kb/s with secondary channel option
Local loop interface	
Subrate	50% bipolar, (zero suppression of 6 data bits is accomplished by bipolar violation coding)
56 kb/s	50% bipolar, (zero suppression of 7 data bits is accomplished by bipolar violation coding)
Maximum loop loss OCUDP to CSU	45 dB at half the data bit rate
Input/output impedance	135 ohms ± 20% up to the frequency of line rate
Output amplitude: across 135 ohm load line rates with secondary channel option shown in parentheses ( ). 2.4 kb/s (3.2 kb/s) 4.8 kb/s (6.4 kb/s) 9.6 kb/s (12.8 kb/s) 19.2 kb/s (25.6 kb/s) 56 kb/s (72 kb/s)	 1.6 V ± 5% 1.6 V ± 5% 0.8 V ± 5% 1.6 V ± 5% 1.6 V ± 5%
Output filter	First order with cutoff at 1.3 times the line rate
Minimum band rejection: 2.4 kb/s, 3.2 kb/s 4.8 kb/s, 6.4 kb/s 9.6 kb/s, 12.8 kb/s	Band: 24-32 kHz / 72-80 kHz 5 dB / 1 dB 13 dB / 9 dB 17 dB / 8 dB

—continued—

Table 4-6 (continued)
NT4K69AA line card specifications for DDS OCUDP service

Parameter	Value	
Amplitude of driving pulse	Open circuit	Closed circuit
2.4 kb/s, 3.2 kb/s, 4.8 kb/s 6.4 kb/s, 19.2 kb/s, 25.6 kb/s, 56 kb/s, and 72 kb/s	2.8 V ± 5%	1.6 V ± 5%
9.6 kb/s, 12.8 kb/s	1.4 V ± 5%	0.8 V ± 5%
Sealing current	The OCUDP provides a source for the dc sealing current that is normally circulated through the cable pairs to reduce splice resistance. Also, a reversal of the normal polarity of the current is required to signal the terminating DSU or CSU to initiate a channel loopback test configuration.	
Encoder	The transmitter binary sequences are applied to the RZ encoder that generates a bit synchronous dual-rail binary representation of a bipolar RZ signal.	
Equalizer range	45 dB at Nyquist rate of 56 kb/s for nonloaded cable with 0.083 µF per mile capacitance.	
Surge protection	Up to 1 kV with 10 µs maximum rise time, and 1 ms minimum fall time to 50% peak	
Control code	Respond to DDS compatible control codes, per Bellcore Spec TA-TSY-000083.	
Encoder	The transmitter binary sequences are applied to the RZ encoder that generates a bit synchronous dual-rail binary representation of a bipolar RZ signal.	
Simplex current: Polarity Open circuit voltage Current	 Transmit pair negative with respect to receive pair for normal operation, and reversed during channel loopback. –42 to –52 V (dependent on office battery. 4 to 20 mA	
Error correction	3 out of 5 majority decision for sub rate, BCH code error correction for 19 kb/s, 56 kb/s, and 64 kb/s	
—end—		

DDS DS0DP service

This section provides a functional description and specifications for DDS DS0 data port (DS0DP) service on the NT4K69AA line card. The DDS DS0DP operates in the UDLC application.

Functional description

The serial DS0 signal at the DS0DP transmitter input is acquired by the controller circuit.

The controller circuit frames these serial bits into 8-bit bytes and passes them to the processor. The processor circuit buffers these bytes, checks for loopback codes, provides optional error protection, and transfers the bytes on to the A-link.

DS0DP Transmitter functions

The following paragraphs describe the DS0DP transmitter functions.

Byte input buffer

The byte input buffer loads the incoming data byte into a working area where it can be checked by the transmit code decoder.

Transmit code decoder

The transmit code decoder monitors data in the byte input buffer and extracts any control codes. Only the codes used in the latching loopback are processed. All other control codes are ignored. The codes used for the L1 latching loopback are sent to the latching loopback detector.

Latching loopback detector

The latching loopback detector monitors the incoming data to detect the correct sequence of bytes for the L1 line-side latching loopback. When this sequence is detected, the DS0DP card goes into the loopback condition until the correct sequence of bytes is sent to unlatch the loopback.

Error protection

The error protection process helps prevent data corruption by providing a degree of redundancy in the transmitted data.

The error protection process works as follows:

- For 2.4, 4.8 and 9.6 kb/s, a 3-of-5 majority voting scheme is provided. In the 3-of-5 majority voting protection, a processed DDS data is transmitted twenty times (2.4 kb/s), ten times (4.8 kb/s), or five times (9.6 kb/s).
- For 19.2 kb/s, a five-byte frame is established, which contains a pair of bytes. One byte of each pair represents data. A (17, 9) BCH coded parity byte is paired with each data byte. The two pairs of bytes each consist of a data byte and a parity byte that are inserted into a five-byte frame and then transmitted.
- For 56 kb/s and 64 kb/s, a (17, 9) BCH coded parity byte is computed for each data byte. The data and parity bytes are transmitted via separate DS0 channels.

DS0DP Receiver functions

Data for the DS0DP receiver data is obtained from the A-link in the form of a single transaction (two transactions in the case of 56 kb/s and 64 kb/s service with error correction).

The processor receives the data and then provisionally performs error correction on it. Next, the processor looks for latching loopback codes, provisionally looks for all “0" codes and processes the data into the DS0 service format. The controller encodes the data and sends it out as a DS0 signal.

The following paragraphs describe the DS0DP receiver functions.

Error correction

The error correction process corrects erroneous DDS data bits in the data received from the network. This error correction process works as follows:

- For 2.4, 4.8, and 9.6 kb/s, repeated data bytes are checked using 3-of-5 majority voting.
- For 19.2 kb/s, a five-byte frame is established which contains a pair of bytes. One byte represents data while the other is a (17, 9) BCH coded parity byte. The error correction process examines each pair of bytes and corrects any single or double bit data (sometimes triple bit) errors that may occur.
- For 56 kb/s and 64 kb/s, a pair of (17, 9) bytes are received via separate DS0 channels. One byte represents data while the other is a (17, 9) BCH coded parity byte. The error correction process examines this pair of bytes and corrects any single or double bit data (sometimes triple bit) errors that may occur.

Receive code decoder

The receive code decoder is used for the detection of either an “all 0s” byte or the latching loopback byte sequence from the A-link. The “all 0s” code is detected by the zero code suppression process, while the loopback sequence is detected by the latching loopback detector.

Zero code suppression

When an “all 0" data byte is detected, the receive code decoder forces certain bits to “1" if the zero code suppression option is enabled. By enabling this option, the transmission of an all “0" byte is blocked, therefore assuring a minimum of ones bit density for clock recovery along the DDS network.

When the zero code suppression option is disabled, an “all 0" byte passes transparently along the DDS network allowing the clear channel capability, which uses B8ZS coding at the DS1 rate to avoid the all zeros condition.

Note: Zero code suppression does not apply to the 64 kb/s data rate.

Common functions

See “Common functions” on page 4-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Attributes

The line card with DDS DS0DP service has the following attributes:

- Data rate (2.4, 4.8, 9.6, 19.2, 56 or 64 kb/s)
- Zero code suppression (except for 64 kb/s)
- Error correction
- Latching loopback: line side (L1) and drop side (L2)
- Non-latching loopback: line side (L1) and drop side (L2) (except for 64 kb/s)
- Performance monitoring from the local craft access panel (LCAP)

Provisionable parameters

The following parameters are provisionable:

- Data rate (2.4, 4.8, 9.6, 19.2, 56 or 64 kb/s)
- Enable/disable zero code suppression (except for 64 kb/s)
- Enable/disable latching loopback
- Enable/disable error correction

Default parameters

The following are default parameters:

- 56 kb/s data rate
- Enabled zero code suppression (except for 64 kb/s)
- Enabled latching loopback
- Enabled error correction

Specifications

This section contains DS0DP specifications for the NT4K69AA line card. Table 4-7 shows the signaling and VF specifications that are unique to DDS DS0DP service on the NT4K69AA line card.

Table 4-7
NT4K69AA line card specifications for DS0DP service

Parameter	Value
Operating mode	4-wire, full duplex
Line rate	64 kb/s
Data rate	64 kb/s maximum, plus transmission of DDS control code bits
Line signal	100% bipolar, no return to zero
Output pulse amplitude	3.5 to 5.5 V (across 135 ohm load)
Unbalance in height of positive and negative pulses	5% maximum
Maximum rise or fall time	0.5 μs
Input/output impedance	135 Ω ± 20% up to the frequency of line rate
Cable length	1500 ft maximum, 24 gauge wire
Error correction Data rate:	 Method:
2.4 kb/s, 3.2 kb/s, 4.8 kb/s, 6.4 kb/s, 9.6 kb/s, 12.8 kb/s 19.2 kb/s, 25.6 kb/s, 56 kb/s, 72 kb/s	3 out of 5 majority (17, 9) BCH
Control code	DDS compatible per Bellcore Spec. TA-TSY-000077

NT4K77AA: Omega 6/8-wire

This chapter contains specifications for the NT4K77AA Omega 6/8-wire (O68W) line card.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 5-2
Physical description	page 5-2
Common functions	page 5-11
Common VF transmission specifications	page 5-12
E&M/PLR	page 5-13
6/8-Wire Tandem service	page 5-17

Line card general description

The O68W line card is a service-adaptive line card that can be used at the remote (RFT) network element or the central-office network element of the AccessNode. It is used in universal (UDLC) digital loop carrier configurations. The O68W line card is a service-adaptive line card which can be user-provisioned for any of the following services:

- PLR (private line ringdown) Type I, Type II
- E&M (ear and mouth) Type I, Type II, Type III
  - — Tandem Type I, Office Side, 3 State
  - — Tandem Type I, Station Side, 3 State
  - — Tandem Type II, Office Side, 3 State
  - — Tandem Type II, Station Side, 3 State
  - — Tandem Type I, 2 state
  - — Tandem Type II, 2 state

This chapter provides functional descriptions and specifications for each of the above services.

Line card provisioning in a universal digital loop carrier (UDLC) or DS1 tandem configuration is performed from the operations controller. Line cards can be preprovisioned before actual installation in the copper-distribution shelf.

Physical description

The O68W line card is 3.5 inches high by 6.0 inches deep and occupies four slots in the line drawer of the copper-distribution shelf. The card connects to four 2-row by 15-pin box connectors on the drawer backplane.

The line card faceplate includes a red LED, which is turned on by the system to indicate a line card failure, provisioning mismatch, or lamp test.

Table 5-1 and Table 5-2 list the lead designations for each service and Figure 5-1 through Figure 5-7 (starting on page 5-4) show the configuration diagrams for each service.

Table 5-1 lists the lead designations for a 6-wire circuit.

Table 5-1
Lead designations for an O68W 6-wire circuit

CDS slot	Connector		Lead	6-wire designation E&M1, PLR1	6-wire designation TDM1, TDM1O, TDM1S () = equivalent designation
	Pair	Pin			
01	01	26 1	tip ring	T R	T R
02	02	27 2	tip ring	T1 R1	T1 R1
03	03	28 3	tip ring	E not used	E (E1) not used
04	04	29 4	tip ring	M not used	EX (M1) not used
and so on					

Table 5-2 lists the lead designations for an 8-wire circuit.

Table 5-2
Lead designations for an O68W 8-wire circuit

CDS slot	Connector		Lead	8-wire designation E&M2, E&M3, PLR2 ()=equivalent designation		8-wire designation TDM2, TDM2O, TDM2S ()=equivalent designation	
	Pair	Pin					
01	01	26 1	tip ring	T R		T R	
02	02	27 2	tip ring	T1 R1		T1 R1	
03	03	28 3	tip ring	E SG	(EA) (EB)	E SG	(E1) (E2)
04	04	29 4	tip ring	M SB	(MA) (MB)	EX SGX	(M1) (M2)
and so on							

Figure 5-1 shows the configuration diagram for PLR Type I services.

Figure 5-1
Configuration diagram for AccessNode PLR Type I services, connecting equipment originates on E lead

PC-15738

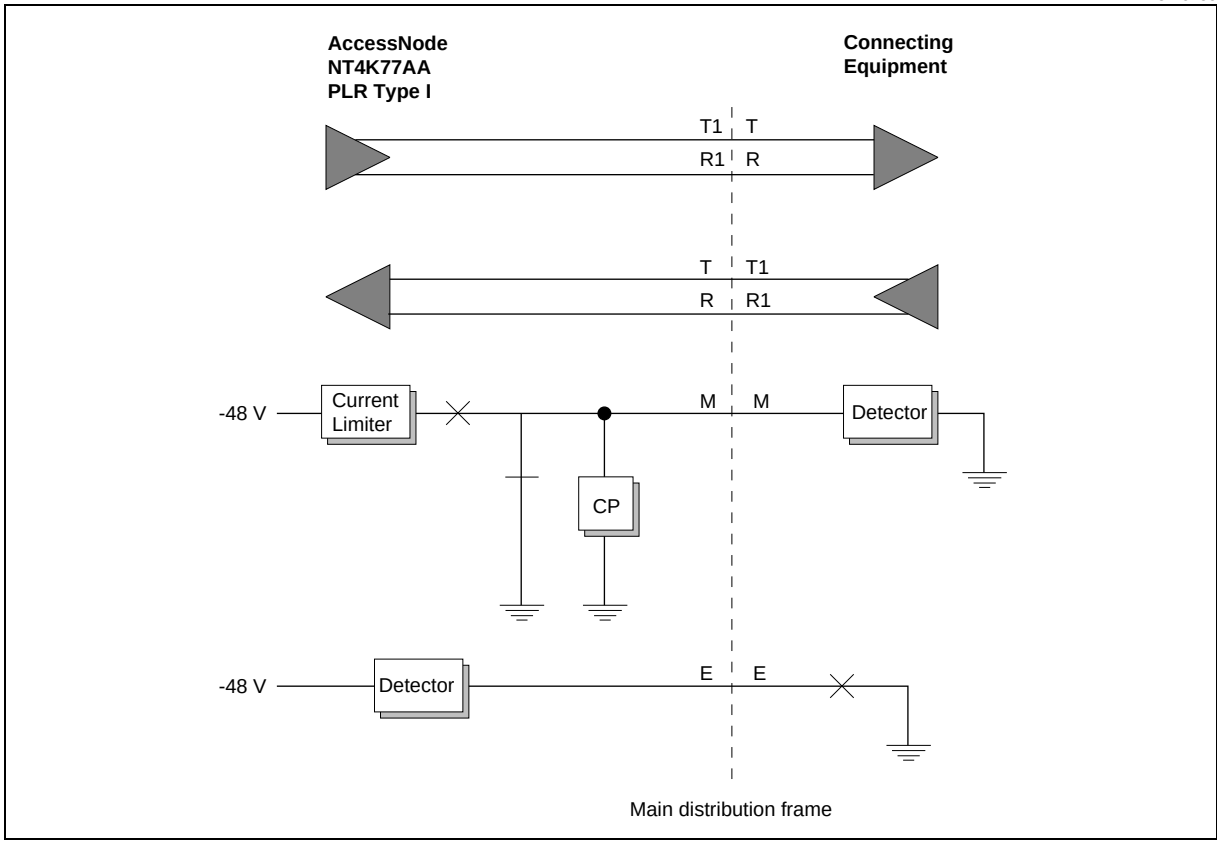


Figure 5-2 shows the configuration diagram for PLR Type II services.

Figure 5-2
Configuration diagram for AccessNode PLR Type II services, connecting equipment originates on E lead

PC-15739

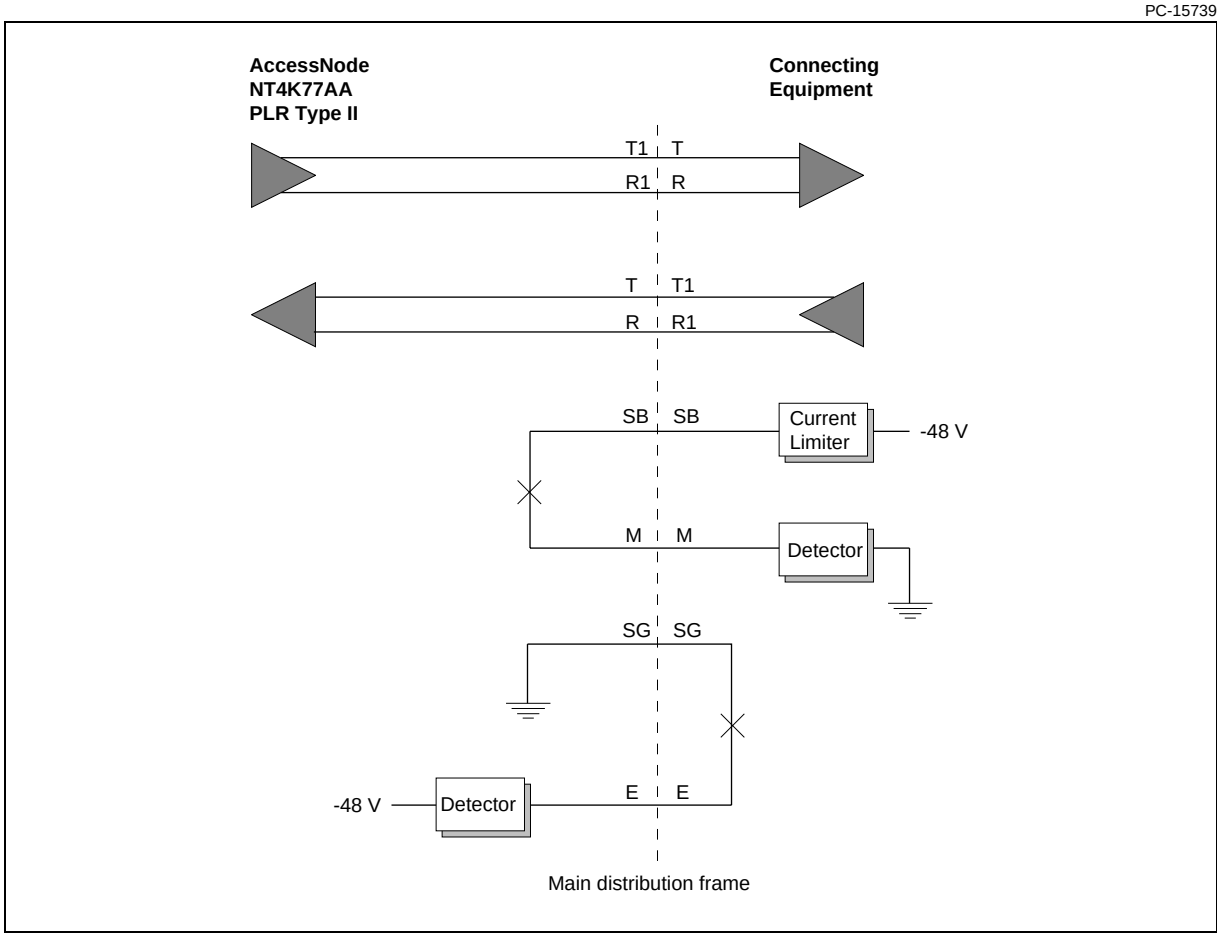


Figure 5-3 shows the configuration diagram for E&M Type III services.

Figure 5-3
Configuration diagram for AccessNode E&M Type III services, connecting equipment originates on M lead

PC-15740

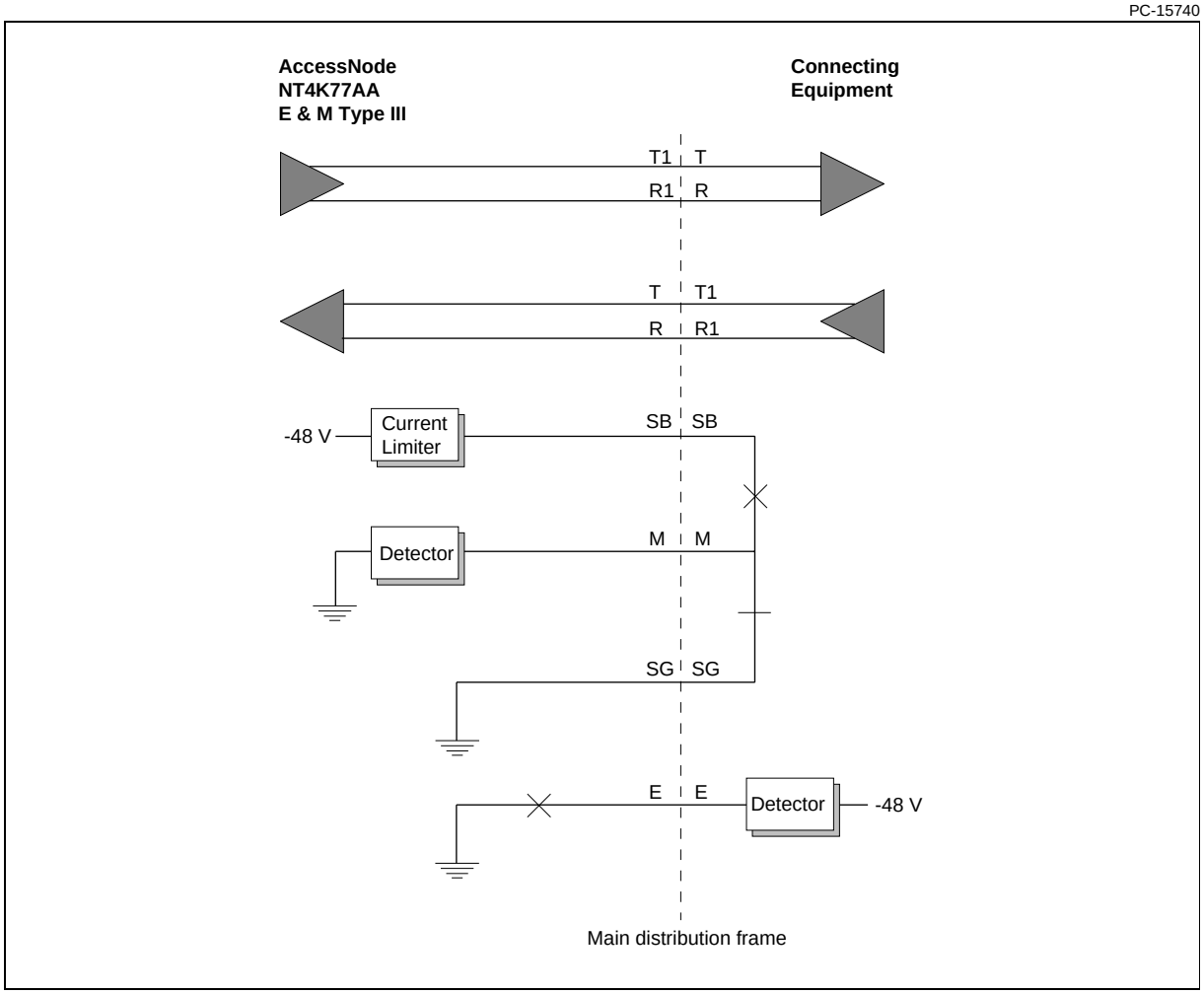


Figure 5-4 shows the configuration diagram for E&M Type II services.

Figure 5-4
Configuration diagram for AccessNode E&M Type II services, connecting equipment originates on M lead

PC-15741

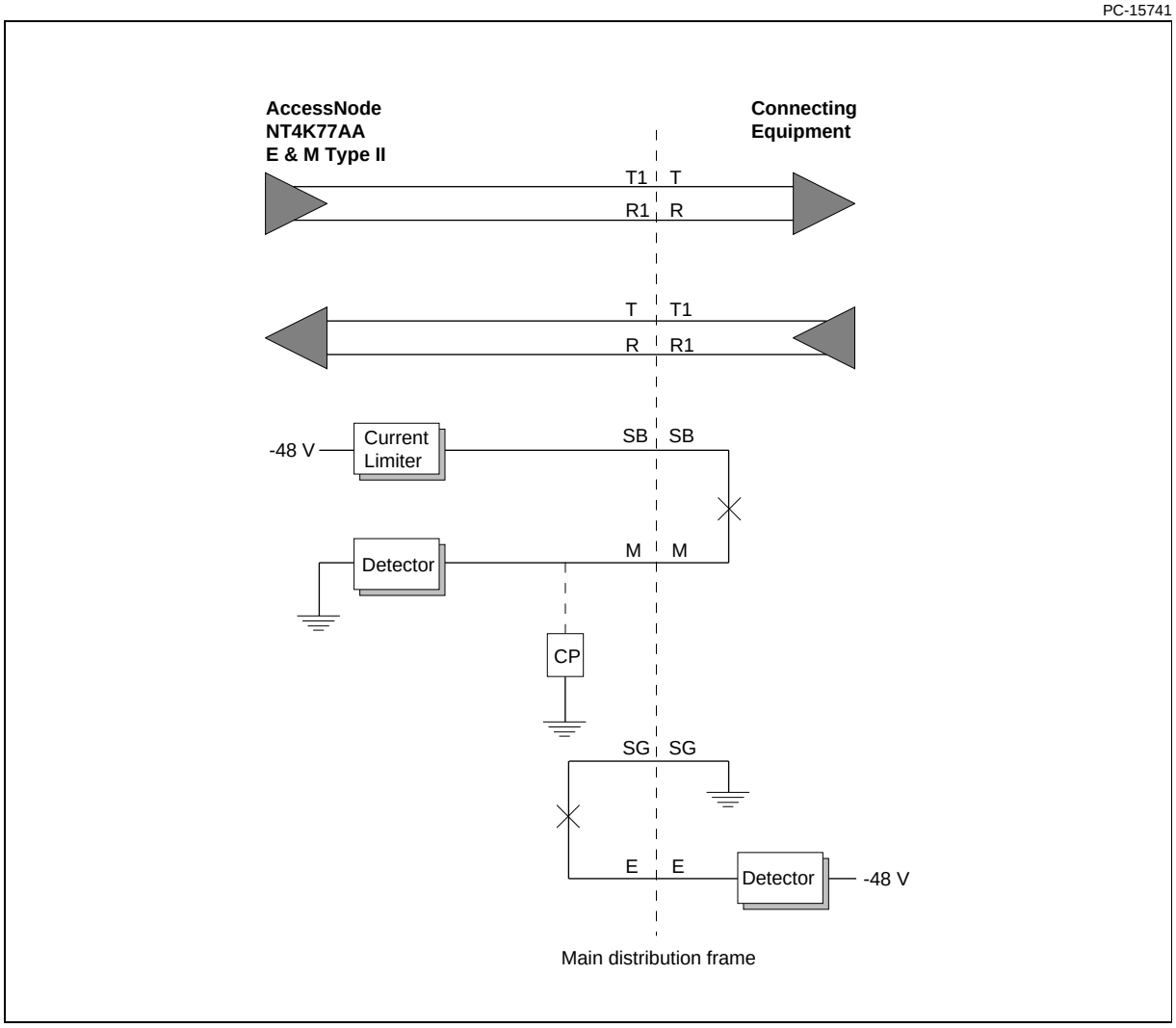


Figure 5-5 shows the configuration diagram for E&M Type I services.

Figure 5-5
Configuration diagram for AccessNode E&M Type I services, connecting equipment originates on M lead

PC-15742

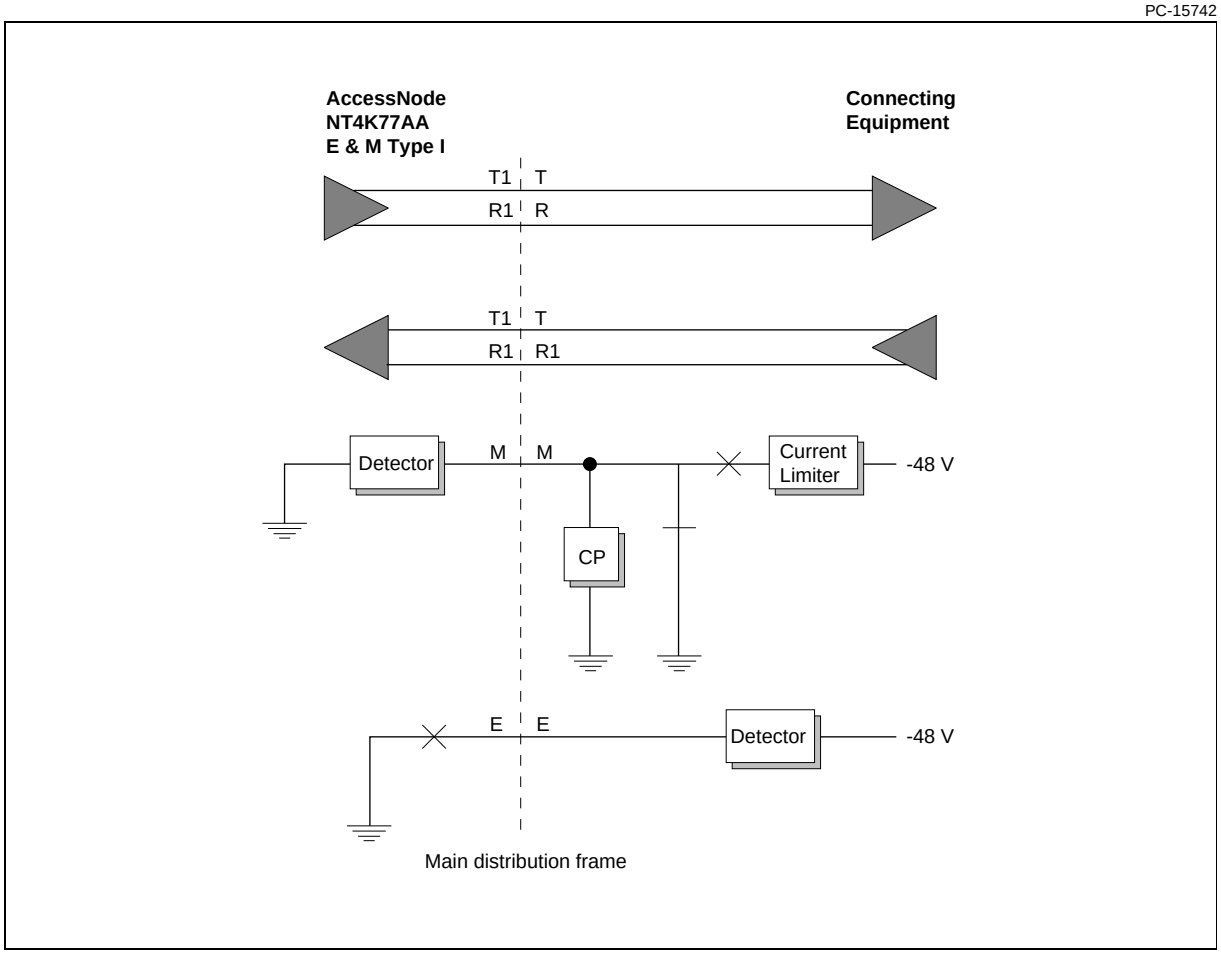


Figure 5-6 shows the configuration diagram for E&M Tandem Type I service.

Figure 5-6
Configuration diagram for AccessNode E&M Tandem Type I service

PC-15744

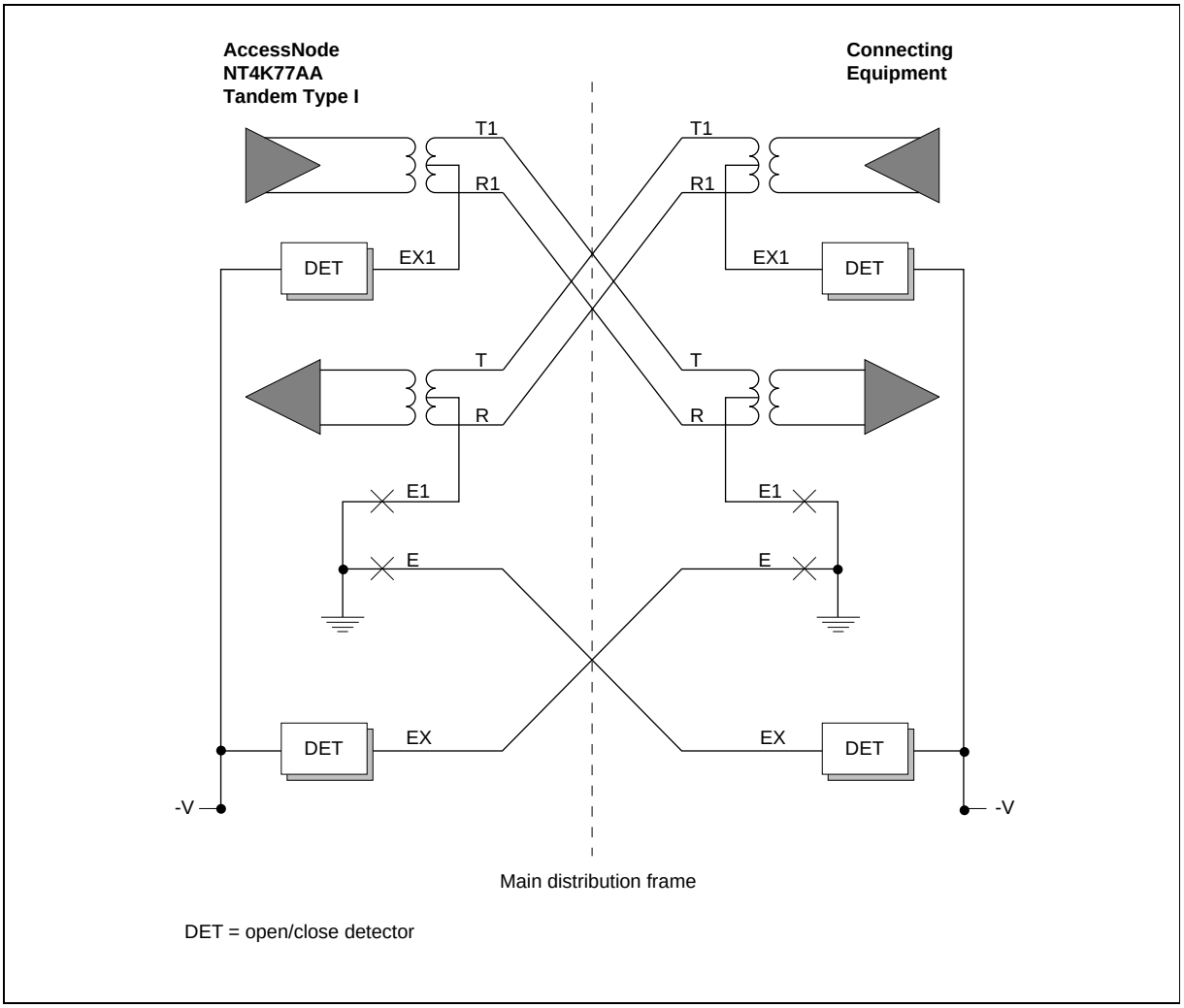
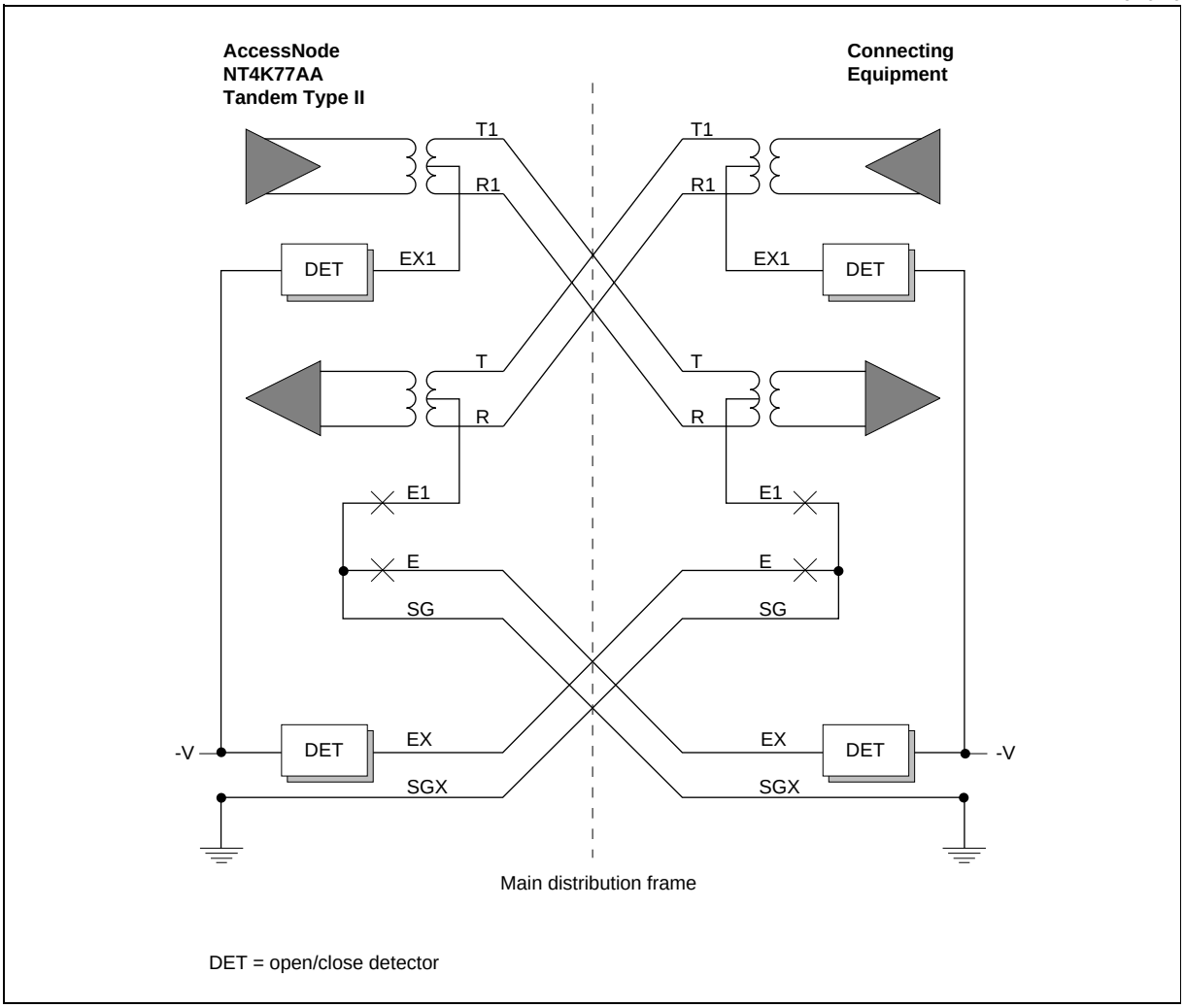


Figure 5-7 shows the configuration diagram for E&M Tandem Type II service.

Figure 5-7
Configuration diagram for AccessNode E&M Tandem Type II service

PC-15743



Common functions

The following functions are common to all services on the NT4K77AA line card.

Maintenance and testing

The line card provides the capability of performing self-diagnostic testing. Routines are downloaded to the line card to perform tests on the circuits associated with transmission and signaling to ensure that the line card functions operate as intended.

Split- or bridging-jack access to the tip and ring on the VF side of the line card is provided through the T/R and T1/R1 drop and line bantam jacks located on the local craft access panel (LCAP). Two metallic test busses are built into the equipment bay and line drawers to allow switchable access from any line card Tip and Ring pair to the test jacks. A metallic test access card (MTAC) in each line drawer contains the relays which perform the switching. There are also two Bantam jacks on the LCAP labeled E/M for drop and line access.

If the line card is provisioned as a red-lined circuit, maintenance personnel can not access the line from the jack access panel. The customer must be notified before the circuit can be taken out of service. Also, none of the provisionable parameters associated with the service can be changed until the red-lined attribute is disabled.

Transient protection

The line card is fully compatible with electrical safety and electromagnetic compatibility requirements relating to line cards in shelves located at the FCOT or RFT, and which are located at the customer premises or central office.

Common VF transmission specifications

The following voice-frequency (VF) specifications are common to all services on the NT4K77AA line card.

Table 5-3
NT4K77AA line card voice-frequency (VF) common specifications

Parameter	Value
Maximum transmit or receive cable loop resistance (≤ 3 kft of 26-gauge intra-building cable)	150 ohms
Nominal loss (1 kHz tolerance) (relative to TLP setting) A/D or D/A	 ± 0.25 dB
60 Hz loss A/D	> 20 dB
Overload compression (relative to 0dBm0 input)	T-R input A/D increased (dBm0) loss (dB) + 3≤ 0.5 + 6≤ 1.8 + 9≤ 4.5
2-wire return loss (transmit or receive port relative to 600, 1200, or 150 ohms)	SFRL 1000 Hz ≥ 28 dB SFRL 300 to 3000 Hz ≥ 23 dB
Longitudinal balance (IEEE 455-1976 method) 200 Hz 500 Hz 1000 Hz 3000 Hz	 ≥ 63 dB ≥ 63 dB ≥ 63 dB ≥ 58 dB
Idle channel noise (for any TLP) A/D or D/A	 ≤ 17 dBrnc0
TLP Range Tx TLP Rx TLP Step	 –17.5 to + 7 dB (0 default) –16 to + 8.5 dB (0 default) 0.1 dB
Level tracking (A/D and D/A)	± 0.25 dB, at +3 to –37 dB, 1004 Hz

E&M/PLR

This section provides a functional description and specifications for E&M/PLR service on the NT4K77AA line card.

Functional description

The NT4K77AA line card is used to provide an E&M or PLR (pulse link repeater) interface to either a private branch exchange (PBX) tie line, or an inter-office carrier system. The line card can be located at either the FCOT or RFT.

When the line card is provisioned for E&M, it can be used with another NT4K77AA line card provisioned as E&M or PLR at the far end, or with an NT4K69AA line card provisioned as DX.

E&M-lead signaling provides a 2-directional, 2-state method of signaling, and interfaces with connecting equipment which originates on the M-lead. There are three signaling lead configurations: Type I, Type II, and Type III.

PLR-lead signaling also provides a 2-directional, 2-state method of signaling and interfaces with connecting equipment which originates on the E-lead. There are two signaling lead configurations: Type I and Type II.

All E&M/PLR signaling functions are executed on the E and M leads for Type I, and on the E, M, SB and SG leads for Type II and Type III.

The VF interface consists of a transformer coupled transmit and receive port with 600 ohm impedance.

Common functions

See “Common functions” on page 5-11 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Provisionable parameters

The following parameters are provisionable:

- Tx TLP
- Rx TLP
- Trunk conditioning
- E&M Type I, Type II, or Type III
- PLR Type I, or Type II

Default parameters

The following are default parameters:

- Tx TLP (default 0)
- Rx TLP (default 0)
- Trunk conditioning (default on)
- E&M Type I, Type II, or Type III (default E&M Type I)

Fixed

The following parameters are fixed:

- Tx impedance (600 ohms)
- Rx impedance (600 ohms)
- Tx equalization = 0
- Rx equalization = 0

Specifications

The following section contains specifications for E&M/PLR service on the NT4K77AA line card.

Common specifications

See page 5-12 for values for the following common VF specifications:

- nominal loss (1 kHz tolerance)
- 60 Hz loss
- overload compression
- 2-wire input return loss
- longitudinal balance
- idle channel noise
- TLP range
- level tracking

Unique specifications

Table 5-4 lists the signaling and VF specifications are unique to E&M/PLR service on the NT4K77AA line card.

Table 5-4
NT4K77AA signaling and VF specifications unique to E&M/PLR service

Parameter	Value
2-wire input impedance (transmit or receive port)	600 ohms (fixed)
Equalization Transmit (post) Receive (pre) Slope Height Bandwidth	 no no 0 (fixed) 0 (fixed) 0 (fixed)
Maximum resistance between fiber loop carrier and connecting equipment signaling leads E, M, SB and SG	150 Ω
Frequency response (relative to 1004 Hz) 404 to 2804 Hz 304 to 3004 Hz 3004 to 3204 Hz (600 Ω line card impedance, with 600 Ω termination)	 ± 0.1 dB ± 0.15 dB + 0.15 dB to –0.75 dB
E&M Type I	
Detecting on-hook	≤ 150 Ω applied on M-lead to ground
Detecting off-hook	≥ 35.5 Vdc on M-lead through ≤ 150 Ω to ground
Sending on-hook (leakage resistance)	≥ 100 kΩ leakage E-lead to ground
Sending off-hook	ground on E-lead with ≤ 2 Vdc drop across E-lead to ground for ≤ 250 mA dc
E&M Type II	
Detecting on-hook	≥ 20 kΩ applied between M-lead and SB-lead
Detecting off-hook	≤ 300 Ω in series with ≤ 2 Vdc connected between M and SB-leads
Sending on-hook	≥ 500 kΩ leakage E-lead to SG-lead
Sending off-hook	Connect E to SG-lead with ≤ 2 Vdc drop up to 50 mA dc

—continued—

Table 5-4 (continued)
NT4K77AA signaling and VF specifications unique to E&M/PLR service

Parameter	Value
E&M Type III	
Detecting on-hook	≥ 20 kΩ applied between M-lead and SB-lead with ≤ 300 Ω between M and SG leads
Detecting off-hook	≤ 150 Ω in series with 2 Vdc connected between M and SB-leads with ≤ 1130 Ω between M and SB-leads
PLR Type I	
Detecting on-hook	≥ 20 kΩ applied between E-lead and ground
Detecting off-hook	≤ 150 Ω in series with 3 Vdc connected between E-lead and ground
Sending on-hook	apply ground on M-lead with ≤ 1 Vdc drop up to 50 mA dc
Sending off-hook	apply –42.5 Vdc to –56.5 Vdc on M-lead with ≤ 5 Vdc drop at 85 mA dc
PLR Type II	
Detecting on-hook	≥ 20 kΩ applied between E and SG-leads
Detecting off-hook	≤ 300 Ω in series with 2 Vdc connected between E and SG-leads
Sending on-hook	≤ 100 μA leakage M-lead to ground
Sending off-hook	connect M to SB-lead with ≤ 2 Vdc drop up to 50 mA dc
—end—	

6/8-Wire Tandem service

This section provides a functional description and specifications for tandem service on the NT4K77AA line card.

Functional description

The NT4K77AA line card provides one side of a 6-wire Type I or 8-wire Type II tandem signaling interface. Three-state tandem signaling is used to connect two carrier system together—typically at the central office—for services requiring loop or ground start signaling.

The 6/8-wire line card can be provisioned for 6-wire Type I station side or office side, or 8-wire station side or office side. If the NT4K77AA line card is provisioned as a station side Type I or Type II tandem interface at the FCOT, it is typically used with an NT4K69AA (4-wire) or NT4K67AB (2-wire) provisioned as FXS at the RFT.

If the NT4K77AA line card is provisioned as an office side Type I or Type II tandem interface at the FCOT, it is typically used with an NT4K69AA (4-wire) or NT4K68AA (2-wire) provisioned as FXO at the RFT.

Typical applications include foreign exchange line and trunk services as well as PBX off-premises station service.

The VF interface consists of a transformer coupled transmit and receive port with 600 ohm impedance.

Provisionable parameters

The following parameters are provisionable:

- Tx TLP
- Rx TLP
- Tandem Type I, office side, 3-state
- Tandem Type I, station side, 3-state
- Tandem Type II, office side, 3-state
- Tandem Type II, station side, 3-state
- Tandem Type I, 2-state
- Tandem Type II, 2-state

Default parameters

The following are default parameters:

- Tx TLP (default 0)
- Rx TLP (default 0)
- Tx impedance (default 600 ohms)

- Rx impedance (default 600 ohms)
- One of the following types:
  - — Tandem Type I, office side, 3-state
  - — Tandem Type I, station side, 3-state
  - — Tandem Type II, office side, 3-state
  - — Tandem Type II, station side, 3-state
  - — Tandem Type I, 2-state
  - — Tandem Type II, 2-state (default E&M, Type I)

Fixed parameters

The following parameters are fixed:

- Tx impedance (default 600 ohms)
- Rx impedance (default 600 ohms)
- Tx equalization = 0
- Rx equalization = 0

Specifications

This section contains specifications for 6/8-wire tandem service on the NT4K77AA line card.

Common specifications

See page 5-12 for values for the following common VF specifications:

- Nominal loss (1 kHz tolerance)
- 60 Hz loss
- Overload compression
- 2-wire input return loss
- Longitudinal balance
- Idle channel noise
- TLP range
- Level tracking

Unique specifications

Table 5-5 lists the signaling and VF specifications unique to 6/8-wire tandem service on the NT4K77AA line card.

Table 5-5
NT4K77AA signaling and VF specifications unique to 6/8-wire tandem service

Parameter	Value
2-wire input impedance (transmit or receive port)	600 ohms (fixed)
Equalization Transmit (post) Receive (pre) Slope Height Bandwidth	 no no 0 (fixed) 0 (fixed) 0 (fixed)
TLP Range Tx TLP Rx TLP Step	 –17.5 to + 7 dB (0 default) –16 to + 8.5 dB (0 default) 0.1 dB

Table 5-6 lists the specifications for send and detect parameters for tandem service on the NT4K77AA line card.

Table 5-6
NT4K77AA line card send and detect parameters for tandem service

6-wire Type I, office side Tandem, 3-state		
	E-lead to ground	**E1-lead to ground**
Send loop current feed open	open ≥ 100 kΩ ***(Note 1)***	open ≥ 100 kΩ ***(Note 1)***
Send loop current feed	closed (note 2)	open ≥ 100 kΩ (note 1)
Send ringing	closed (note 2)	closed (note 3)
	Ex to ground	**Ex1 to ground**
Detecting loop open	≥ 20 kΩ to ground ***(Note 5)***	≥ 20 kΩ to ground ***(Note 5)***
Detecting loop closed	≤ 2150Ω to ground ***(Note 4)***	≥ 20 kΩ to ground ***(Note 5)***
Detecting ring ground	≥ 20 kΩ to ground ***(Note 5)***	≤ 4150Ω to ground ***(Note 6)***

—continued—

Table 5-6 (continued)
NT4K77AA line card send and detect parameters for tandem service

8-wire Type II, office side tandem, 3-state		
	E-lead to SG	**E1-lead to SG**
Send loop current feed open	open ≥ 100 kΩ ***(Note 1)***	open ≥ 100 kΩ ***(Note 1)***
Send loop current feed	closed ***(Note 2)***	open ≥ 100 kΩ ***(Note 1)***
Send ringing	closed ***(Note 2)***	closed ***(Note 3)***
8-wire Type II, office side tandem, 3-state		
	Ex-lead to SGX	**Ex1 to SGX**
Detecting loop open	≥ 20 kΩ ***(Note 5)***	≥ 20 kΩ ***(Note 5)***
Detecting loop closed	≤ 2300Ω ***(Note 5)***	≥ 20 kΩ ***(Note 5)***
Detecting ring ground	≥ 20 kΩ ***(Note 5)***	≤ 4300Ω to ground ***(note 8)***
6-wire Type I, station side tandem, 3-state		
	E-lead to ground	**E1-lead to ground**
Send loop open	open ≥ 100 kΩ ***(Note 1)***	open ≥ 100 kΩ ***(Note 1)***
Send loop closed	closed ***(Note 2)***	open ≥ 100 kΩ ***(Note 1)***
Send ring ground	open ≥ 100 kΩ ***(Note 1)***	closed ***(Note 3)***
	Ex to ground	**Ex1 to ground**
Detecting loop current feed open	≥ 20 kΩ to ground ***(Note 5)***	≥ 20 kΩ to ground ***(Note 5)***
Detecting loop current feed	≤ 2150Ω to ground ***(Note 4)***	≥ 20 kΩ to ground ***(Note 5)***
Detecting ringing	≤ 2150Ω to ground ***(Note 4)***	≤ 4150Ω to ground ***(Note 6)***
8-wire Type II, station side tandem, 3-state		
	E-lead to SG	**E1-lead to SG**
Send loop open	open ≥ 100 kΩ ***(Note 1***)	open ≥ 100 kΩ ***(Note 1)***
Send loop closed	closed ***(Note 2)***	open ≥ 100 kΩ ***(Note 1)***
Send ring ground	open ≥ 100 kΩ ***(Note 1)***	closed ***(Note 3)***
	Ex-lead to SGX	**Ex1-lead to SGX**
Detecting loop current feed open	≥ 20 kΩ ***(Note 5)***	≥ 20 kΩ ***(Note 5)***
Detecting loop current feed	≤ 2300Ω ***(Note 7)***	≥ 20 kΩ ***(Note 5)***
Detecting ringing	≤ 2300Ω ***(Note 7)***	≤ 4300Ω ***(Note 8)***

—continued—

Table 5-6 (continued)
NT4K77AA line card send and detect parameters for tandem service

6-wire Type I, and 8-wire Type II, tandem, 2-state		
	Type I **E-lead to ground**	**Type II** **E-lead to SG**
Send loop open	open ≥ 100 kΩ ***(Note 1)***	open ≥ 100 kΩ
Send loop closed	closed ***(Note 2)***	closed
	Ex-lead to ground	**Ex1-lead to SGX**
Detecting loop closed Detecting loop open	≤ 2150Ω to ground ***(Note 4)*** ≥ 20 kΩ to ground ***(Note 5)***	≤ 2300Ω ***(Note 7)*** ≥ 20 kΩ ***(Note 5)***

Note 1: ≥100 kΩ leakage between the signaling lead and ground with –56.5 Vdc applied (SG lead grounded for Type II).

Note 2: Ground on the signaling lead with ≤3 Vdc drop with up to ±1 mAdc flowing (SG lead grounded Type II).

Note 3: Ground on the signaling lead with ≤ 5 Vdc drop with up to ±1 mAdc flowing (SG lead grounded Type II).

Note 4: ≤ 2150 ohms in series with ≤ 2 Vdc connected from the signaling lead to ground.

Note 5: ≥ 20 k ohms connected from the signal lead to ground or to SGX leads for Type II.

Note 6: ≤ 4150 ohms in series with ≤ 2 Vdc connected from the signaling lead to ground.

Note 7: ≤ 2300 ohms in series with ≤ 1 Vdc from the signaling lead to ground, or the SGX for Type II.

Note 8: ≤ 4300 ohms in series with ≤ 1 Vdc from the signaling lead to ground, or the SGX for Type II.

—end—

NT4K78AA: Manual ringdown

This chapter contains specifications for the NT4K78AA manual ringdown (MRD) line card.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 6-1
Physical description	page 6-2
Maintenance and testing	page 6-2
Transient protection	page 6-3
Voice frequency transmission specifications	page 6-3
Signaling	page 6-6

Line card general description

The MRD line card provides a 2-wire point-to-point private line, which is a nonswitched special service. The MRD line card provides the interface to the ringdown signaling and an interface between the voice frequency and the AccessNode digital carrier.

Manual ringdown refers to a method of signaling, whereby an AC ringing voltage, under the control of a calling subscriber, is used to alert the distant called subscriber. The manual signaling method works identically in either direction.

At a minimum, the customer premise station arrangement typically incorporates an interface accessing a ringing source (either 20 or 30 Hz), and a loop feed interface with a ringing control means toward the customer premise common equipment.

Physical description

The MRD line card is 3.0 inches high by 3.7 inches deep, including the faceplate, and occupies one slot in the line drawer of the copper-distribution shelf. A 2 x 15 pin box connector provides connection to the line drawer backplane.

The line card faceplate includes a red LED which is turned on by the system to indicate a line card failure.

Table 6-1 lists the lead designations for a 2-wire circuit:

Table 6-1
Lead designations for a 2-wire NT4K78AA line card circuit

CDS slot	Connector		Line card	
	Pair	Pin	Lead	Designation
01	01	26 1	T R	Tip Ring
02	02	27 2	T R	Tip Ring
and so on				

Maintenance and testing

The MRD line card can perform self-diagnostic tests. Routines can be downloaded to the line card to perform tests on the circuits associated with transmission, battery feed, supervision, and ringing/high voltage generator to ensure that the line card functions operate correctly.

The test-out relay provides bridging access to the subscriber loop. The test-in relay provides isolated access to the line card. The test-in bus is a separate test bus from the test-out bus at the line card level. Isolated access to the subscriber loop is provided by activating both relays and connecting the test equipment to the test-out bus. Another piece of test equipment can be connected to the test-in bus for simultaneous loop and line card testing.

> ***Note:*** Release 20 of the MRD line card requires the latest software release to perform line card diagnostics. Contact your next level of support for further assistance.

Transient protection

The MRD line card is designed to operate with any recognized primary protection, including carbon blocks. Heat coils may be present, but provide no additional benefits, and are not required.

The line card automatically opens the tip and ring leads, via the protection relay, to isolate itself from excessive foreign potentials of extended duration. The relay automatically resets once the line card determines that the fault has cleared and the service can be restored safely. If the protection relay fails to interrupt the current for any reason, the loop interface circuit has fail-safe characteristics.

Voice frequency transmission specifications

Table 6-2 lists the voice-frequency (VF) specifications for the NT4K78AA line card.

Table 6-2
NT4K78AA line card voice-frequency (VF) specifications

Parameter	Value
Provisionable VF transmission attributes ***(Note 1):***	Gain range/Transmission level point (TLP)
XMIT	–5 to 0 dB / +5 to 0 dB
RCV	–10 to 0 dB / –10 to 0 dB
Input impedance	900 Ω + 2.16 μF
Return loss ***(Note 2):***	
—ERL (echo return loss)	> 18 dB
—SRL (singing return loss)	> 10 dB
Longitudinal balance	≥ 50 dB, 60 Hz ≥ 58 dB, 200 to 1000 Hz ≥ 53 dB, 3000 Hz
Transmission level points ***(Note 3)***	Transmit gain and Transmission level point (TLP) provisionable in 0.1 dB increments
60 Hz loss	≥ 20 dB (A/D) at 1004 Hz
Frequency response ***(Note 4):***	
400-2800 Hz	–0.5 to + 1.5 dB
300-3000 Hz	–0.75 to +3.5 dB

—continued—

Table 6-2 (continued)
NT4K78AA line card voice-frequency (VF) specifications

Parameter	Value
Amplitude tracking for input level ***(Note 5):***	Maximum deviation/Average deviation:
–37 to +3 dBm0	± 0.5 dB / ± .25 dB
–45 to –37 dBm0	± 1.0 dB / ± .5 dB
–50 to –45 dBm0	± 3.0 dB / ± 1.5 dB
–55 to –50 dBm0	± 5.0 dB / ± 3.0 dB
Idle-channel noise	< 20 dBrnC0
Signal-to-distortion ration at input level ***(Note 2)***:	
–13	≥ 37 dB
0 to –30	> 33 dB
–30 to –40	> 27 dB
–40 to –45	> 22 dB
Impulse noise	No more than 15 counts in 15 minutes at a threshold of 47 dBrnC0 at the output of the MRD line card
Intermodulation distortion ***(Note 6)***	R2 > 49 dB, R3 > 51 dB
Overload compression at input leveL ***(Note 2):***	Increased loss:
+3 dBm0	≤ 0.5 dB
+6 dBm0	≤ 1.8 dB
+9 dBm0	≤ 4.5 dB
Single-frequency distortion	< –28 dBm0 at 0-12 kHz (0 dBm0 input signal at 0-12 kHz) < –40 dBm0 at 0-4 kHz (0 dBm0 input signal at 1004-1020 Hz)
System-generated tones ***(Note 2)***	Any single frequency tone ranging between 0-16 kHz measured at the port of the MRD line card is < –50dBm0
Peak-to-average ratio ***(Note 6)***	≥ 90
Channel crosstalk ***(Note 7)***	< –65 dBm0
Frequency offset	The end-to-end change in frequency of a received sinusoidal signal from the frequency of the transmitted signal is 0 ± 0.4 Hz.

—continued—

Table 6-2 (continued)
NT4K78AA line card voice-frequency (VF) specifications

Parameter	Value
60 Hz induction immunity	All transmission performance is met with 50 V rms, 60 Hz induced as described in TA 1089.

Note 1: VF parameters are measured at the port of the MRD line card. The term “end-to-end” (A/A) means from one analog port of one MRD through the AccessNode system to the analog port of the other MRD line card.

Note 2: To be measured at one MRD with opposite-end MRD terminated with reference impedance 900 Ω + 2.16 μF.

Note 3: To be measured with a 0dBm, 1004 Hz tone

Note 4: To be measured end-to-end (A/A) with a 0dBm0 signal level (+ means more loss)

Note 5: The end-to-end deviation in loss of a 1004 Hz tone with changes in input signal amplitude from the loss of a 0 dBm0 input signal

Note 6: To be measured end-to-end at –13 dBm0 total input level.

Note 7: The C-message weighted total output to any other line at either end of the MRD pair between 200 to 3400 Hz measured with a 0 dBm0 single frequency input signal between 200 and 3400 Hz applied to any line. This applies whether the disturbing signal is applied to the MRD or the MRD is tested as a disturbed unit.

—end—

Signaling

This section describes the signaling attributes for the manual ringdown line card.

Ringing detection

The ringing detector can detect voltages from 55 to 106 Vac rms @17 Hz to 33 Hz, superimposed on a negative or positive dc voltage from 0 to 56.5 V dc, ground referenced or floating. If dc superimposed battery is present on the incoming ringing voltage, the DC current flow is less than 3 mA as a result of the MRD impedance.

When ground referenced, or superimposed with a non-zero dc bias, the polarity of the applied voltage can be either tip-to-ring or ring-to-tip.

For 17 to 33 Hz, the ringing detector presents a ringer load of more than 2000 ohms to any allowable incoming ringing voltage. The presented ringing load impedance is greater than 3000 ohms at 20 Hz, and greater than 2500 ohms at 30 Hz.

Depending on the loop length, the range of ringing voltages at the MRD port is within 55 V to 88 V rms, at 20 Hz or 30 Hz, and received in a floating mode (not ground referenced) or ground-referenced mode. The detector is designed to detect as low as 40 volts to cover possible long loops and lower voltage ringing supplies. The crest factor (defined as the ratio of peak to rms voltage) of the incoming ringing signal ranges between 1.2 and 1.6.

End-to-end ringing detection and reproduction

The time to detect ringing at the originating end and reproduce ringing at the called end is equal to or less than 200 ms.

Ringing reproduction and generation

Note the following items about ringing reproduction and generation:

- The ringing voltage crest factor is between 1.35 and 1.45.
- The ringing frequency is 20 ±1 Hz.
- The MRD provides a minimum ringing voltage of 40 V rms across a ringing load of 3 REN at the end of a loop of up to 1500 ohms. The ringing voltage, with superimposed negative battery, is applied to the ring lead. The tip is toward ground during ringing.

The ringing is applied upon receiving a digital command from the originating end, via the AccessNode. Ringing is applied and removed at the zero value of its ac component plus the dc component. The ringing is applied as long as the digital command is received or up to five seconds, whichever is less, unless ringing is tripped by the called party.

If there has been no answer, and the digital command to ring is removed and received again before 1 second, application of ringing is delayed until a full interval of 1 second has elapsed; otherwise, application is immediate.

Ring trip

The ringing signal is removed within 200 ms of the application of a 330 ohm resistance at the end of the loop of resistance of 1500 ohms (Rdc).

System failures

During any system failure, the MRD line card does not apply ringing toward the loop, and does not send a ringing command pattern toward the digital end.

Immunity to crosses

After application and removal of shorts between tip-to-ring, ring-to-ring, and tip-to-tip between any two MRD line cards, both line cards work properly. Also, after application and removal of shorts, tip-to-ground or ring-to-ground, the line card works properly.

Showering lines

The line card is not damaged by 0 to 50 V rms applied to the MRD, and the MRD provides a steady no-ringing signal toward the far end.

Immunity is verified using voltages with the following variations: tip-to-ground with ring grounded, ring-to-ground with tip grounded, or tip-to-ground and ring-to-ground simultaneously.

Signaling specifications

Table 6-3 lists the signaling specifications for the NT4K78AA line card.

Table 6-3
NT4K78AA line card signaling specifications

Parameter	Value
Maximum total external loop resistance	1500 Ω
Ringer load (> 40 Vrms, 20 Hz) at the end of a 1500-ohm loop	3 REN
Ring trip (within 200 ms of application of a 330-ohm resistance at the end of the loop)	≤ 200 ms

NT4K79AA/AB: 2-wire station

This chapter describes the NT4K79AA/AB line card and lists its specifications.

Chapter contents

This chapter contains the following topics:

Topic	See
Line card general description	page 7-2
Physical description	page 7-2
Common functions	page 7-3
Common VF transmission specifications	page 7-4
UVG (Universal voice grade) service	page 7-5
POTS	page 7-10
Loop gnd bus (Loop start/ground start business) (locally switched special services - GR-303 DMS/CSC)	page 7-16

Line card general description

The NT4K79AA/AB line card is the source line card located at the remote fiber terminal (RFT).

It can be used in the following configurations between the AccessNode network element and the DMS SuperNode switch:

- in a universal digital loop carrier (UDLC) configuration using Common Signalling Channel communications
- in a digital multiplex switch configuration using Common Signalling Channel (GR-303 DMS/CSC) communications
- in a digital multiplex switch configuration using TR-08 (GR-303 DMS/TR-08) communications

The NT4K79AA/AB line card provides the following services:

- UVG (universal voice grade): locally switched special services in UDLC and GR-303 DMS/TR-08: page 7-5
- POTS: (loop start service in UDLC and GR-303 DMS/TR-08), or “Loop St. Res” (loop start residential service in GR-303 DMS/CSC): page 7-10
- Loop Gnd Bus (Loop Start/Ground Start Business): locally switched special services in GR-303 DMS/CSC: page 7-16

This chapter provides functional descriptions and specifications for each of the above services.

Physical description

The line card is 3.0 inches high by 3.7 inches deep, including the faceplate, and occupies one slot in the line drawer of the copper-distribution shelf. A 2 x 15 pin box connector provides connection to the line drawer backplane.

The line card faceplate includes a red LED which is turned on by the system to indicate a line card failure, provisioning mismatch, or lamp test.

Table 7-1 lists the lead designations for the NT4K79AA/AB 2-wire line card circuit.

Table 7-1
Lead designations for a 2-wire NT4K79AA/AB line card circuit

CDS slot	Connector		Line card	
	Pair	Pin	Lead	Designation
01	01	26 1	T R	Tip Ring
02	02	27 2	T R	Tip Ring
and so on				

Common functions

The following functions are common to all services offered by the NT4K79AA/AB line card.

Maintenance and testing

The line card can perform self-diagnostic tests. Routines are downloaded to the line card to perform tests on the circuits associated with transmission, battery feed, supervision and ringing/high voltage generator to ensure that the line card functions operate as intended.

Bridging access to the subscriber loop is provided via the test-out relay. Isolated access to the line card is provided via the test-in relay. The test-in bus is a separate test bus from the test-out bus at the line card level. Isolated access to the subscriber loop is provided by activating both relays and connecting the test equipment to the test-out bus. Another piece of test equipment can be connected to the test-in bus for simultaneous loop and line card testing.

The line card is compatible with pair gain test controller (PGTC) and mechanized loop testing (MLT) test methods.

If the line card is provisioned as a red-lined circuit, maintenance personnel cannot access the line from the jack access panel. The customer must be notified before the circuit can be taken out of service. Also, none of the provisionable parameters associated with the service can be changed until the red-lined attribute is disabled.

Split- or monitored-jack access to the metallic loop on the VF side of the line card is provided through the Test-In and Test-Out jacks located on the local craft access panel. Two metallic test busses are built into the equipment bay to allow switchable access from any line card Tip and Ring pair to the test jacks. A metallic test access card (either MTAC or MTAC 2) in each line drawer contains the relays which perform the switching.

Transient protection

The line card is designed to operate with any recognized primary protection, including carbon blocks. Heat coils may be present, but provide no additional benefits and are not required.

The line card automatically opens the tip and ring leads, via the protection relay, to isolate itself from excessive foreign potentials of extended duration. The relay automatically resets once the line card determines that the fault has cleared and the service can be restored safely. If the protection relay fails to interrupt the current for any reason, the loop interface circuit has fail safe characteristics.

Common VF transmission specifications

Table 7-2 lists voice-frequency (VF) specifications for the NT4K79AA/AB line card common to all services.

Table 7-2
NT4K79AA/AB line card voice-frequency (VF) specifications

Parameter	Value (A/D or D/A during off-hook)
Idle channel noise	≤ 17 dBrnC0
1 kHz loss tolerance	± 0.5 dB
Level tracking	± 0.25 dB at +3 to –37 dBm0, 1 kHz
Intermodulation distortion (see note 1)	R2 > 49 dB, R3 > 51 dB
Single-frequency distortion	≤ –46 dBm0 at 1 kHz, 0 dBm0
Overload A/D level	> +3.0 dBm0
Longitudinal balance	≥ 58 dB, 200 to 3000 Hz
60 Hz rejection	> 20 dB (A/D)

UVG (Universal voice grade) service

This section provides functional descriptions and specifications for universal voice grade (UVG) locally switched special services on the NT4K79AA/AB line card in UDLC and GR-303 DMS/TR-08 configurations.

Functional description

The line card can be used at the RFT in UDLC and GR-303 DMS/TR-08 configurations with a corresponding office (NT4K68AA) sink line card at the FCOT end. It can be used in a DS1 tandem configuration with a corresponding sink line card of a channel bank at the far end.

The NT4K79AA/AB line card can be provisioned for UVG service from the OPC.

There are no signaling or transmission options that need to be provisioned from the OPC except the on-hook transmission (OHT) feature which can either be provisioned or left in the default mode.

Common functions

See “Common functions” on page 7-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

All transmission attributes are fixed except the on-hook and off-hook transmission gains.

- Gain of the line card changes such that the total loss of the UDLC carrier and the CSA loop is maintained between 2 and 5 dB. Gain is adjusted based on the resistance of the external loop.
- Input impedance of 600 Ω + 2.16 µF
- Compromise balance network (600 Ω + 2.16 µF)
- Provisionable on-hook transmission loss A/D and D/A (default: 10 dB loss)

Signaling

The NT4K79AA/AB line card provides the following signaling attributes in UVG:

- Loop start and ground start
- Forward disconnect
- Toll diversion
- Ring pre-trip test
- On-hook transmission (loop start)
- Distinctive ringing
- Reminder ring

The above signaling options on the line card are not provisionable. The signaling states are set by the far-end via ABCD and AB bits (UDLC and GR-303 DMS/TR-08, respectively), and ABCD or AB bits in DS1 Tandem as set by provisioning (default is AB bits). Toll diversion and ring pre-trip test are not available with AB bit signaling.

For more information on UVG signaling, see *Line Card Testing Procedures*, 323-3001-316, in *Operations, Administration, and Provisioning*, Volume 4B.

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. The state of the hook switch is sent to the far end via ABCD bits.

Forward disconnect

Upon ABCD bit forward disconnect signaling status, the line card opens the tip lead as determined by the ABCD bits from the FCOT (UDLC), or by the AB bits from a digital switch (GR-303 DMS/TR-08).

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides distinctive ringing (Teen Ringing) patterns. In UDLC configurations, the line card repeats ringing signaling status sent from the FCOT via ABCD bits. In GR-303 DMS/TR-08 configurations, the line card repeats ringing signaling status sent from a digital switch via AB bits.

Reminder ring

The line card provides a 500 ms burst of ringing "Reminder Ring." In UDLC configurations, the line card repeats ringing signaling status sent from the FCOT via ABCD bits. In GR-303 DMS/TR-08 configurations, the line card repeats ringing signaling status sent from a digital switch via AB bits.

On-hook transmission

The line card allows on-hook transmission (OHT) coincidental with a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental with a terminating call (such as for meter reading). The OHT coincidental with a terminating call is allowed during all silent intervals of the ringing pattern.

The OHT not coincidental with a terminating call is turned on by an OSI (open switch interval). However, it can be provided at all times by provisioning the OHT option to ON. The default setting is OFF in order to save power.

> ***Note:*** In GR-303 DMS/TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).

System failure

If a carrier system fails, the line card opens the tip lead for 2 to 3 seconds, then closes the tip lead to reapply loop feed.

Specifications

This section provides specifications for UVG service on the NT4K79AA/AB line card.

Common specifications

See "Common VF transmission specifications" on page 7-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 7-3 lists the signaling and VF specifications that are unique to UVG service on the NT4K79AA/AB line card.

Table 7-3
NT4K79AA/AB line card voice-frequency (VF) specifications

Parameter	Value (A/D or D/A during off-hook)
Maximum external loop resistance	1250 ohms: 820 ohm loops plus 430 ohm terminal
Loop current	> 20 mA
Ringer load (> 40 Vrms, 20 Hz) at the end of an 820 ohm loop	5 REN
Ring trip delay	< 200 ms
Dial pulsing Loop dial pulsing: pulse rate input % break maximum load Touch tone addressing:	 8 to 12 pps 58 to 64% 5 C4A ringers and 15 kohm bridged DTMF
Total loss at 1 kHz UDLC carrier + CSA cable	2 to 5 dB from 0Kft to maximum CSA cable (respectively)
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Input return loss ***(Note 2)*** UDLC configurations	ERL ≥ 19 dB SRL ≥ 11 dB
Input return loss ***(Note 3)*** GR-303 DMS/TR-08 configurations	ERL ≥ 28 dB SRL ≥ 20 dB
Input return loss at FCOT ***(Note 4)*** UDLC and GR-303 DMS/TR-08 configurations	ERL ≥ 10 dB SRL ≥ 5 dB

Note 1: To be measured end-to-end (A/A) in UDLC applications

Note 2: Measured with respect to 600 Ω + 2.16 µF with the FCOT end terminated in 900 Ω + 2.16 µF

Note 3: Measured with respect to 600 Ω + 2.16 µF with the 4-wire path broken.

Note 4: Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 µF. The RFT end is terminated in any CSA loop with 600-ohm termination.

Table 7-4 lists the UVG on-hook transmission support provided by the NT4K79AA/AB line card.

Table 7-4
NT4K79AA/AB UVG on-hook transmission (OHT) support

OHT type	State	GR-303 DMS/TR-08		UDLC	
		A/D	**D/A**	**A/D**	**D/A**
Coincidental Ω with a terminating call	n/a	yes	yes	yes	yes
Not coincidental Ω with a terminating call Conditions:	Default Always on Controlled by OSI > 100 ms, < 500 ms	no optional yes	no optional yes	no optional yes	no optional yes
1 kHz loss if “ON”	n/a	0 to 10 dB Default A/D, D/A: 10 dB		0 to 10 dB Default A/D, D/A: 10 dB	
Note: In GR-303 DMS/TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).					

POTS

This section provides functional descriptions and specifications for plain old telephone service (POTS) on the NT4K79AA/AB line card.

Functional description

The NT4K79AA/AB line card can be provisioned for “Loop St Res” service from the MAP of the DMS-100 in GR-303 DMS/CSC configurations, or “2W POTS” from the OPC in UDLC and GR-303 DMS/TR-08 configurations.

In GR-303 DMS/CSC applications, there are no transmission parameters that need to be provisioned. Some signaling and call processing features need to be provisioned through the DMS-100 MAP.

In UDLC and GR-303 DMS/TR-08 applications, there are no signaling or transmission options that need be provisioned. The on-hook transmission (OHT) feature may be provisioned from the OPC if desired or left in the default mode. (See the OHT specifications table on page 7-15.)

Signaling is based on messages sent by the local digital switch (GR-303 DMS/CSC), ABCD bits sent from the FCOT (UDLC), or AB bits sent from a digital switch (GR-303 DMS/TR-08). Typically, the line card is located at the RFT.

Common functions

See “Common functions” on page 7-3 for descriptions of the following common functions:

- Maintenance and testing
- Transient protection

Transmission

The O2WS POTS line card provides the following transmission attributes:

- 2 dB loss A/D and D/A for short loops; 0 dB loss A/D and D/A for long loops. (The switching point is determined by loop resistance.)
- 900 Ω + 2.16 μF input impedance
- 800 Ω || (50 nF + 100 Ω) default hybrid balance network in a GR-303 DMS/CSC configuration, or an optimized digital compromise balance network in the UDLC and GR-303 DMS/TR-08 configurations.
- For GR-303 DMS/CSC, the hybrid balance can be either loaded or nonloaded, as specified in the BNV field of the DMS-100 line inventory table.

Signaling

The O2WS POTS line card provides the following signaling attributes:

- Loop start
- Forward disconnect
- Flash
- On-hook transmission
- Line side answer supervision
- Distinctive ringing
- Message waiting (GR-303 DMS/CSC only)

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops. Battery boost is provided during low office battery voltage to maintain an on-hook voltage compatible with Maintenance Terminating Units (MTU).

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected. Individual pulse digits are recognized based on the interruption of loop current for a specified period of time. Filtering is provided to reject false pulses and accept proper ones under various loop impairments.

Forward disconnect

Upon a message from the switch (GR-303 DMS/CSC), or ABCD and AB bit forward disconnect signaling status (UDLC and GR-303 DMS/TR-08 respectively), the line card does one of the following:

- opens both tip and ring leads for 900 ms in GR-303 DMS/CSC configurations
- opens the tip lead as determined by the duration of the ABCD/AB code for UDLC and GR-303 DMS/TR-08 configurations respectively

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides any one of seven distinctive ringing patterns (Teen Ringing) upon receiving messages from the local digital switch (GR-303 DMS/CSC).

In UDLC configurations, the line card repeats the ringing signaling status sent from the FCOT via ABCD bits. In GR-303 DMS/TR-08 configurations, the line card repeats the ringing signaling status sent from a digital switch via AB bits.

Reminder ring

The line card provides a 500 ms burst of ringing “Reminder Ring” upon message from the local digital switch (GR-303 DMS/CSC). In UDLC configurations, the line card repeats the ringing signaling status sent from the FCOT via ABCD bits. In GR-303 DMS/TR-08 configurations, the line card repeats the ringing signaling status sent from a digital switch via AB bits.

On-hook transmission (OHT)

The line card allows on-hook transmission (OHT) coincidental With a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental with a terminating call (such as for meter reading). The OHT coincidental with a terminating call is allowed during the long silent interval of the ringing pattern (GR-303 DMS/CSC) or during all silent intervals (UDLC and GR-303 DMS/TR-08).

In GR-303 DMS/CSC configurations, OHT is turned on by the DMS-100 switch whenever required. In UDLC and GR-303 DMS/TR-08 configurations, OHT not coincidental with a terminating call is enabled by an OSI (open switch interval). However, it can be provided at all times by provisioning the OHT option to ON. The default setting is OFF, in order to save power. (See the OHT specifications table on page 7-15).

> ***Note:*** In GR-303 DMS/TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).

System failure

In the event of a carrier system failure, the line card opens the tip lead for 2 to 3 seconds, then closes the tip lead to re-apply loop feed.

Specifications

This section provides specifications for POTS service on the NT4K79AA/AB line card.

Common specifications

See “Common VF transmission specifications” on page 7-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 7-5 lists the NT4K79AA/AB line card signaling and VF specifications that are unique to POTS service.

Table 7-5
NT4K79AA/AB signaling and VF specifications unique to POTS service

Parameter	Value
Maximum total external loop resistance	1900 ohms: 1470 Ω non-loaded or loaded, plus 430 Ω for the set
Loop current	≥ 20 mA in forward feed ≥ 18 mA feed in reverse feed
Ringer load (> 40 Vrms, 20 Hz) at the end of the loop	5 REN on loops < 900 Ω 4 REN on loops ≥ 900 Ω
Ring trip delay	≤ 200 ms
Dial pulsing Loop dial pulsing: pulse rate input % break maximum load Touch tone addressing:	 8 to 12 pps 58 to 64% 5 C4A ringers and 15 kohm bridged DTMF
Nominal loss at 1 kHz ***(Note 1)*** A/D and D/A	2 dB on short loops 0 dB on long loops

—continued—

Table 7-5 (continued)
NT4K79AA/AB signaling and VF specifications unique to POTS service

Parameter	Value
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Nominal input impedance	900 Ω + 2.16 μF
Input return loss ***(Note 2)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Input return loss ***(Note 3)*** GR-303 DMS/CSC and GR-303 DMS/TR-08 configurations	ERL ≥ 28 dB SRL ≥ 20 dB
Input return loss at FCOT ***(Note 4)*** UDLC configuration	ERL ≥ 18 dB SRL ≥ 10 dB
Hybrid balance ***(Note 5)*** GR-303 DMS/CSC and GR-303 DMS/TR-08 configurations	ERL ≥ 20 dB SRL ≥ 15 dB

Note 1: The nominal loss switching point is 1065 Ω total external resistance.

Note 2: Measured with respect to 900 Ω + 2.16 μF with the FCOT end terminated in 900 Ω + 2.16 μF.

Note 3: Measured with respect to 900 Ω + 2.16 μF with the 4-wire path broken.

Note 4: Measured as 2-wire input return loss at FCOT end with respect to 900 Ω + 2.16 μF. The RFT end is terminated in 900 Ω + 2.16 μF.

Note 5: Measured as 4-wire return loss. The line card is terminated in 800 Ω || (50 nF + 100 Ω) with the nonloaded balance network selected and the reading adjusted for transmission loss.

—end—

Table 7-6 lists the POTS on-hook transmission support provided by the NT4K79AA/AB line card.

Table 7-6
NT4K79AA/AB POTS on-hook transmission (OHT) support

OHT type	State	GR-303 DMS/CSC		GR-303 DMS/TR-08		UDLC	
		A/D	**D/A**	**A/D**	**D/A**	**A/D**	**D/A**
Coincidental with a terminating call	n/a	no	yes	yes	yes	yes	yes
1 kHz loss	n/a	-	0 dB	2 dB	2 dB	3 dB	3 dB
Not coincidental with a terminating call	Default	no	no	no	no	no	no
	Always on	optional	optional	optional	optional	optional	optional
Conditions	Per call basis, controlled by far-end switch	yes	yes	n/a	n/a	n/a	n/a
	Controlled by OSI > 100 ms, < 500 ms	n/a	n/a	yes	yes	yes	yes
1 kHz loss if “on”		5 dB	5 dB	2 dB	2 dB	3 dB	3 dB

Note 1: n/a indicates not applicable.

Note 2: In GR-303 DMS/TR-08 applications, an OSI is represented by a forward disconnect code (AB=10).

Loop gnd bus (Loop start/ground start business) (locally switched special services - GR-303 DMS/CSC)

This section provides a functional description and specifications for locally switched special services on the NT4K79AA/AB line card in GR-303 DMS/CSC configurations.

Functional description

The NT4K79AA/AB line card can be provisioned for Loop Gnd Bus (loop start or ground start locally switched special service) from the MAP of the DMS-100. Note the following provisioning requirements:

- The type of service (loop start/ground start) needs to be provisioned.
- There are no transmission options that need to be provisioned.

Signaling is based on messages sent by the local digital switch, with the exception of the ring pre-trip test which is done autonomously by the line card on terminating calls in ground start connections.

Common functions

See “Common functions” on page 7-3 for descriptions of the following common functions can be found under the heading:

- Maintenance and testing
- Transient protection

Transmission

The O2WS line card provides the following transmission attributes:

- 2 dB loss A/D and D/A
- 900 Ω + 2.16 μF input impedance
- 800 Ω || (50 nF + 100 Ω) default hybrid balance network configuration
- For IDC/CSC, the hybrid balance can be either loaded or nonloaded, as specified in the BNV field of the DMS-100 line inventory table.

Signaling

The O2WS line card provides the following signaling attributes:

- Loop start or ground start
- Forward disconnect
- Toll diversion
- Ring pre-trip test on ground start
- On-hook transmission (loop start)
- Line side answer supervision
- Distinctive ringing

Battery feed

The battery feed circuit provides the tip and ring loop voltage and current.

The battery feed circuit also provides a current limiting feature to reduce power dissipation on short loops. Battery boost is provided during low office battery voltage to maintain an on-hook voltage compatible with Maintenance Terminating Units in loop start applications.

Loop current detection

The supervision circuit performs the necessary tasks to detect and interpret customer initiated signaling, such as hook switch status. Various states such as on-hook, off-hook, dial pulsing and hook switch flash are detected.

Individual pulse digits are recognized based on the interruption of loop current for a specified period of time. Filtering is provided to reject false pulses and accept proper ones under various loop impairments.

Forward disconnect

Upon a message from the switch, the line card opens both tip and ring leads for 900 ms for loop start lines, and opens the tip lead for 900 ms for ground start lines.

Ringing

Two independently controlled relays connect the output of the internal ringing/high voltage generator to the ring side of the line.

Ring trip

The ringing signal is removed after an off-hook signal is applied.

Distinctive ringing

The line card provides distinctive ringing (Teen Ringing) patterns upon messages from the local digital switch.

Reminder ring

The line card provides a 500 ms burst of ringing “Reminder Ring” upon message from the local digital switch.

On-hook transmission

The OHT applies to loop start only.

The line card allows on-hook transmission (OHT) coincidental With a terminating call (such as for calling party identification in CLASS/CMS) and not coincidental With a terminating call (such as for meter reading). The OHT coincidental With a terminating call is allowed during the long silent interval of the ringing pattern.

The OHT not coincidental With a terminating call is turned on by the DMS-100 switch Whenever required.

Message waiting

Message waiting is supported in the Loop Start option of Loop Gnd Bus service. The message Waiting lamp at the subscriber set is activated by applying pulsed dc voltage to the ring side of the line at 150 volts cycled at 500 ms on, and 500 ms off while the set is on-hook. A one-second pause occurs after every fifth lamp flash.

System failure

In the event of a carrier system failure, the line card will open tip lead for 2 to 3 seconds, then close the tip lead to reapply loop feed.

Specifications

This section provides specifications for (loop gnd bus) locally switched special service on the NT4K79AA/AB line card.

Common specifications

See “Common VF transmission specifications” on page 7-4 for values for the following VF transmission specifications:

- Idle channel noise
- 1 kHz loss tolerance
- Level tracking
- Intermodulation distortion
- Single-frequency distortion
- Overload A/D level
- Longitudinal balance
- 60 Hz rejection

Unique specifications

Table 7-7 lists the NT4K79AA/AB line card signaling and VF specifications are unique to loop gnd bus service.

Table 7-7
NT4K79AA/AB signaling and VF specifications unique to loop gnd bus service

Parameter	Value
Maximum loop resistance	1250 ohms: 820 Ω non-loaded or loaded plus 430 Ω terminal
Loop current (in 820 Ω loop + 430 Ω terminal)	> 20 mA
Dial pulsing Loop dial pulsing: pulse rate input % break maximum load Touch tone addressing:	 8 to 12 pps 52 to 64% 5 C4A ringers and 15 kohm bridged, or 600 Ω + 0.5 µF bridged DTMF
Ringer load (>40 Vrms, 20 Hz) at the end of the CSA loop (930 Ω)	5 REN
Ring trip delay	< 200 ms
Nominal loss at 1 kHz A/D and D/A	 2 dB
Frequency response (loss)	–0.1 to +0.5 dB, 400 to 2800 Hz
Input return loss (see note 1)	ERL ≥ 28 dB SRL ≥ 20 dB
Hybrid balance (see note 2)	ERL ≥ 20 dB SRL ≥ 15 dB
Note 1: Measured with respect to 900 Ω + 2.16 µF with 4 wire path broken. ***Note 2:*** Measured as 4-wire return loss. The RFT end is terminated in 800 Ω || (50 nF + 100 Ω) with the nonloaded balance network selected and the reading adjusted for transmission loss.	

Table 7-8 lists the loop gnd bus on-hook transmission support provided by the NT4K79AA/AB line card.

Table 7-8
NT4K79AA/AB loop gnd bus on-hook transmission (OHT) support

		GR-303 DMS/CSC	
OHT type	**State**	**A/D**	**D/A**
Coincidental with a terminating call	n/a	no	yes
1 kHz loss		-	0 dB
Not coincidental with a terminating call	Default	no	no
Conditions:	Per call basis, controlled by far end switch	yes	yes
1 kHz loss if “ON”		5 dB	5 dB

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Publication number: 323-3001-181
Document release: Issue 3.0
Date: October 1999
Printed in Canada

NORTEL NETWORKS™