Meridian 1

Summary of transmission parameters

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Contents

About this document

This document is a global document. Contact your system supplier or your Nortel Networks representative to verify that the hardware and software described is supported in your area.

The transmission parameters in this document apply to Meridian 1 options system and Meridian SL-1 systems with North American and International versions of X11 software.

> ***Note:*** For system option 11 transmission parameters, see the chapter titled “Transmission parameters” in the *Option 11C and 11C Mini Technical Reference Guide* (553-3011-100).

Meridian 1 communication systems provide two methods of converting signals from analog to digital or digital to analog:

— µ-Law, used in North America and Japan

— A-Law, used in most other areas of the world, including Europe

Since Meridian 1 and Meridian SL-1 systems are backward compatible, various system configurations are possible. The ports within a system can be configured in the following:

— intelligent peripheral equipment (IPE) modules

— peripheral equipment (PE) modules or PE shelves in an SL-1 cabinet

— various common equipment modules or shelves

IPE modules support intelligent peripherals, such as NT8D14 Universal Trunk Cards and NT8D09 Message Waiting Line Cards. PE modules or shelves support PE cards that are identified by “QPC” codes. Various common equipment modules or shelves support digital trunk interface (DTI) and primary rate interface (PRI) cards.

IPE, PE, and common equipment ports may be interconnected to support transmission requirements. The loss tables in this document provide the transmission requirements for these interconnections.

References

See the *Meridian 1 planning and engineering guide* for the following line and trunk card documents:

— *Line Cards: Description* (553-3001-105)

— *Trunk Cards: Description* (553-3001-106)

See *Private Branch Exchange (PBX) Switching Equipment for Voiceband Applications* (ANSI/EIA/TIA-464-A-1989) for more details regarding transmission parameter standards.

Loss plan

End-to-end connection loss is one of the most important aspects to consider when planning private networks. That is because end-to-end connection loss is a major element in controlling transmission performance parameters, such as received volume, echo, noise, and crosstalk. In digital networks, loss provisioning is a function of network switching. Therefore, in private networks the loss plan of the PBX is fundamental to the overall network loss design.

The insertion loss of a PBX connection is defined as the level difference between the power delivered from a reference signal source connected across an input port to a measuring instrument connected across an output port, with

— the path through the PBX connected

— the path through the PBX replaced by a direct connection

For insertion loss tests, both the signal source and the measurement instrument are terminated in 600 ohm. The reference signal source frequency is between 1000 Hz and 1020þHz for North America, and between 800 Hz and 820 Hz for most other locations. The insertion loss values are expressed as absolute loss between interface ports and, within the limits of overload and tracking error, are independent of the signal level.

Loss plan for µ-Law applications

General

The insertion losses between intelligent peripheral equipment (IPE) ports, IPE and peripheral equipment (PE) ports, and analog and digital ports are connection-specific to be compatible with end-to-end network connection loss requirements. The Meridian 1 loss specifications are in agreement with North American standards, which are formulated to provide satisfactory end-to-end performance for connections within private networks and connections between private and public networks. These specifications include evolving standards for connections involving ISDN-compatible stations (ICS) and Integrated Services (IS) trunks.

The loss plan strategy for IPE combines electrical inserted loss with terminal acoustic parameters for optimum transmission performance. This strategy enables IPE to accommodate a variety of voice terminals while maintaining acoustic equivalence with traditional telephones.

Some connections between digital and analog ports have asymmetrical loss to conform to network loss plans or to provide compatibility with the transmission characteristics of various voice terminals. This asymmetry is resolved at a remote point, for example another switch, in the overall connection.

A satellite tie trunk connects a satellite or tributary PBX (defined as a PBX that does not have its own directory number for incoming calls) to the main PBX. Satellite tie trunks, in some connections, require different loss treatment than nonsatellite tie trunks.

> ***Note:*** In this context, the term *satellite* has no relationship to, and should not be confused with, an earth-orbiting transponder or circuits associated with an earth orbiting transponder.

Trunk options

To accommodate specific network and facility characteristics, you can select various options for Meridian 1 analog trunk ports. These options lead to variations in the loss plan as follows:

- Transmission class of service (COS):

  Note: *COS* is the acronym used for transmission class of service in Electronic Industry Association (EIA) and Telecommunications Industry Association (TIA) standards.

  Analog trunks are assigned one of the following class of service options:

  — via net loss (VNL) for facilities with loss proportional to length

  — non-VNL, as follows:

    – transmission compensated (TRC) for 2-wire non-VNL facilities with a loss of 2 dB or greater, or for which impedance compensation is provided, or for a 4-wire non-VNL facility

    – nontransmission compensated (NTC) for 2-wire non-VNL facilities with a loss of less than 2 dB or when impedance compensation is not provided

  Note: Class-of-service options for IPE are available with X11 release 17 or later software.

- Signaling arrangements:

  Depending on signaling arrangements, analog tie trunks may interface with a Meridian 1 through equipment compatible with E&M trunks or with loop dial repeater (LDR) trunks.

  — IPE LDR tie trunks utilize a loss plan compatible with industry standards for tie trunks.

  — PE LDR tie trunk loss insertion is the same as for PE central office (CO) trunks.

  — LDR trunks for public switched telephone network (PSTN) access—for example, direct inward dial (DID) service—follow the loss plan for CO trunks.

- Facility termination:

  IPE E&M tie trunks may be configured to interface 4-wire or 2-wire facility terminations.

  Note: Facilities associated with the Nortel Networks Electronic Switched Network (ESN) offering for dialing features are recommended to be 4-wire for optimum transmission; thus, the 4-wire option is often referred to as the ESN option and the 2-wire as the non-ESN option. The presence or absence of the ESN package does not constrain the selection of the facility termination option.

  — With the 4-wire (ESN) option invoked, the loss insertion in each direction is 0.5 dB less than for the 2-wire (non-ESN) option.

  — PE E&M tie trunks (including satellite tie trunks) with QPC237C or later vintage are compatible with the loss requirements of 4-wire facility terminations (as recommended for ESN applications) and are reflected thus in the loss plan; for earlier vintages and 2-wire PE E&M tie trunks, the loss is 0.5þdB more in each direction.

Loss plan specifications

The loss plan tables are in a matrix format. The transmission direction of the loss values is shown by arrows. The values are independent of the originating or terminating function of the ports connected. Positive values denote loss, negative values denote gain. For example:

- In Table 1 (IPE ports to IPE ports), the electrical loss from an E&M tie trunk to an analog telephone is 3.5 dB; in the reverse direction the electrical loss is 2.5 dB. (If the trunk is optioned for 2-wire facility termination, the losses are 4 and 3 dB, respectively.)
- In Table 2 (digital ports to IPE ports), the electrical loss from a digital tie trunk port to an analog E&M tie trunk is 3 dB; in the reverse direction the electrical loss has a negative value of –3 dB, which indicates a 3 dB gain.

For simplicity, Tables 1 through 6 present the loss plan for system default settings as follows:

IPE E&M tie trunk:	VNL, 4-wire
IPE LDR tie trunk:	TRC
IPE satellite E&M tie trunk:	TRC, 2-wire
IPE CO (local) trunk:	TRC
IPE TO (tandem or IC access) trunk:	VNL
PE E&M tie trunk:	VNL
PE satellite tie trunk:	TRC
PE CO (local) trunk:	TRC
PE TO (tandem, IC access) trunk:	VNL

Tables 1 through 6 provide loss values measured in decibels (dB), for connections between IPE ports (line and analog trunk ports), digital ports (PRI or DTI ports), and PE ports (line and analog trunk ports), as noted here:

	IPE ports	Digital ports	PE ports
IPE ports	Table 1		
Digital ports	Table 2	Table 3	
PE ports	Table 4	Table 5	Table 6

The complete loss values for the class-of-service options (VNL, TRC, NTC) are presented in Tables 1 through 6. The loss values given for IPE tie trunks are based on the selection of the 4-wire facility termination option; those for IPE satellite trunks are based on the selection of the 2-wire facility termination option. Digital ports are not shown because the loss between analog trunks and digital ports is the same for all classes of service and is also covered in Tables 1 through 6.

Note 1: The losses presented in Tables 1 through 6 for connections to, from, and between IPE analog line ports reflect a 2 dB reduction in the electrical loss in the transmission direction to the line card. This reduction is implemented in cards shipped after October 1991 to accommodate the longer station loops being installed in distributed customer environments.

Note 2: The toll office values in Tables 1 through 6 reflect a trunk that is connected to an office in the public switched network with a higher rank than the local serving office. In general, this trunk connects to a local access and transport area (LATA) tandem or to an interexchange carrier point of presence (IC POP).

Tables 1 through 6 show the loss plan for line and trunk IPE port connections.

Table 1
Electrical loss—IPE ports to IPE ports (Part 1 of 2)

IPE port	Class**	IPE port (COS)	Analog station ONS ↑ ↓	Analog off-prem station OPS ↑ ↓	Meridian digital set D/ONS ↑ ↓	ISDN terminal ICS ↑ ↓	2W E&M tie* (NTC) A/TT ↑ ↓	2W E&M tie* (TRC) A/TT ↑ ↓	4W E&M tie* (VNL) S/ATT ↑ ↓
Analog station		→	4						
	ONS	←	4	—	—	—	—	—	—
Analog off-prem station		→	1.5	1					
	ONS	←	1.5	1	—	—	—	—	—
Meridian digital set		→	0.5	0	0				
	D/ONS	←	3.5	3	0	—	—	—	—
ISDN terminal		→	6.5	0	6	0			
	ICS	←	3.5	–3	0	0	—	—	—
2W E&M tie* (NTC)		→	1	0.5	0.5	–2.5	1		
	A/TT	←	3	2.5	–0.5	–0.5	1	—	—
2W E&M tie* (TRC)		→	1	0.5	0.5	–2.5	1	1	
	A/TT	←	3	2.5	–0.5	–0.5	1	1	—
4W E&M tie* (VNL)		→	3.5	3	3	–3	0.5	0.5	0
	A/TT	←	2.5	2	–1	–1	0.5	0.5	0
LDR tie (NTC)		→	0.5	0	0	–6	0.5	0.5	0
	A/TT	←	0.5	0	–3	–3	1.5	0.5	0
LDR tie (TRC)		→	0.5	0	0	–6	0.5	0.5	0
	A/TT	←	0.5	0	–3	–3	0.5	0.5	0
LDR tie (VNL)		→	0.5	0	0	–6	0.5	0.5	0
	A/TT	←	0.5	0	–3	–3	0.5	0.5	0
CO/FX/WATS (NTC)		→	0.5	0	0	–6	0.5	0.5	3
	A/CO	←	0.5	0	–3	–3	1.5	0.5	1
CO/FX/WATS (TRC)		→	0.5	0	0	–6	0.5	0.5	0
	A/CO	←	0.5	0	–3	–3	0.5	0.5	0
Toll office (VNL)		→	4.5	4	4	1	3.5	3.5	0
	A/TO	←	4.5	4	1	4	4.5	1.5	0

*E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and ICS) denotes Telecommunications Industry Association (TIA) port designation for cross-reference purposes.

Table 1
Electrical loss—IPE ports to IPE ports (Part 2 of 2)

IPE port	Class**	IPE port (COS)	LDR tie (NTC) ONS ↑ ↓	LDR tie (TRC) OPS ↑ ↓	LDR tie (VNL) D/ONS ↑ ↓	CO/FX/ WATS (NTC) ICS ↑ ↓	CO/FX/ WATS (TRC) A/TT ↑ ↓	Toll office (VNL) A/TT ↑ ↓
Analog station		→						
	ONS	←	—	—	—	—	—	—
Analog off-prem		→						
station	**ONS**	←	—	—	—	—	—	—
Meridian digital set		→						
	D/ONS	←	—	—	—	—	—	—
ISDN terminal		→						
	ICS	←	—	—	—	—	—	—
2W E&M tie*		→						
(NTC)	**A/TT**	←	—	—	—	—	—	—
2W E&M tie*		→						
(TRC)	**A/TT**	←	—	—	—	—	—	—
4W E&M tie*		→						
(VNL)	**A/TT**	←	—	—	—	—	—	—
LDR tie		→	1					
(NTC)	**A/TT**	←	1	—	—	—	—	—
LDR tie		→	1	1				
(TRC)	**A/TT**	←	1	1	—	—	—	—
LDR tie		→	1	1	1			
(VNL)	**A/TT**	←	1	1	1	—	—	—
CO/FX/WATS		→	1	1	1	1		
(NTC)	**A/CO**	←	1	1	1	1	—	—
CO/FX/WATS		→	1	1	1	1	1	
(TRC)	**A/CO**	←	1	1	1	1	1	—
Toll office		→	1	1	1	1	1	1
(VNL)	**A/TO**	←	1	1	1	1	1	1

*E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and ICS) denotes Telecommunications Industry Association (TIA) port designation for cross-reference purposes.

Table 2
Electrical loss—digital ports to IPE ports

Digital port / IPE port (COS) / Class**		Analog set ONS ↑ ↓	Analog OPS OPS	Meridian digital set D/ONS ↑ ↓	ISDN terminal ICS ↑ ↓	E&M tie* A/TT ↑ ↓	Satellite tie* S/ATT ↑ ↓	CO/FX/ WATS A/CO ↑ ↓	Toll office A/TO ↑ ↓
Tie	→	8.5	6	8	0	3	6.5	3	3
D/TT	←	2.5	0	–1	0	–3	0.5	–3	–3
Satellite tie*	→	2.5	2	2	–3	0	0.5	0	3
S/DTT	←	2.5	2	-1	0	0	0.5	0	3
CO/FX/WATS/DID	→	2.5	0	2	–3	2	0.5	0	3
D/CO	←	2.5	0	–1	0	2	0.5	0	3
Toll office	→	8.5	0	8	3	3	6.5	6	6
FX/WATS/DID D/TO	←	2.5	0	–1	0	–3	0.5	0	0
Primary rate interface	→	6.5	0	6	0	3	6.5	3	3
IST	←	3.5	0	0	0	0	0.5	–3	–3

*E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and ICS) denotes TIA port designation for cross-reference purposes.

Table 3
Electrical loss—digital port to digital ports

Digital port / Digital port (COS) / Class*		Tie D/TT ↑ ↓	Satellite tie S/DTT ↑ ↓	CO/FX/WATS D/CO ↑ ↓	Toll office D/TO ↑ ↓	Primary rate interface IST ↑ ↓
Tie	→	0				
D/TT	←	0	—	—	—	—
Satellite tie	→	0	0			
S/DTT	←	6	0	—	—	—
CO/FX/WATS /DID	→	0	0	3		
D/CO	←	6	0	3	—	—
Toll office	→	0	6	6	0	
FX/WATS/DID D/TO	←	0	0	0	0	—
Primary rate interface	→	0	6	3	0	0
IST	←	0	0	0	0	0

*Class (for example, D/TT and D/CO) denotes TIA port designation for cross-reference purposes.

Table 4
Electrical loss—IPE ports to PE ports

IPE port (COS)	Class**	PE port (COS)	Analog set	Analog off-prem set	E&M tie* (NTC)	E&M tie* (TRC)	E&M tie* (VNL)	CO/FX/ WATS (NTC)	CO/FX/ WATS (TRC)	CO/FX/ WATS (VNL)
		Class**	ONS	OPS	A/TT	A/TT	A/TT	A/CO	A/CO	A/CO
			↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓	↑ ↓
Analog station		→	4.5	0.5	0	0	2	0.5	0.5	4.5
	ONS	←	4.5	0.5	0	0	2	0.5	0.5	4.5
Analog		→	2	0	–0.5	–0.5	2	0.5	0.5	0.5
Off-Premise Station	**OPS**	←	2	0	–0.5	–0.5	2	0.5	0.5	0.5
Meridian digital set		→	1	1	–3.5	–3.5	–1.5	–3	–3	1
	D/ONS	←	4	4	–0.5	–0.5	1.5	0	0	4
ISDN terminal		→	7	0	–0.5	-3.5	1.5	–3	–3	4
	ICS	←	4	–3	–3.5	–6.5	–1.5	–6	–6	1
2-W E&M tie*		→	1.5	1.5	0	0	0	1.5	0.5	4.5
(NTC)	**A/TT**	←	3.5	3.5	0	0	0	3.5	0.5	3.5
2-W E&M tie*		→	1.5	1.5	0	0	0	0.5	0.5	0.5
(TRC)	**A/TT**	←	3.5	3.5	0	0	0	0.5	0.5	0.5
4-W E&M tie*		→	4	4	–0.5	–0.5	–0.5	1	0	0
(VNL)	**A/TT**	←	3	3	–0.5	–0.5	–0.5	3	0	0
LDR tie		→	1	1	0.5	0.5	0.5	1	1	1
(NTC)	**A/TT**	←	1	1	0.5	0.5	0.5	1	1	1
LDR tie		→	1	1	0.5	0.5	0.5	1	1	1
(TRC)	**A/TT**	←	1	1	0.5	0.5	0.5	1	1	1
LDR tie		→	1	1	0.5	0.5	0.5	1	1	1
(VNL)	**A/TT**	←	1	1	0.5	0.5	0.5	1	1	1
CO/FX/WATS		→	1	1	0.5	0.5	2.5	1	1	1
(NTC)	**A/CO**	←	1	1	0.5	0.5	2.5	1	1	1
CO/FX/WATS		→	1	1	0.5	0.5	0.5	1	1	1
(TRC)	**A/CO**	←	1	1	0.5	0.5	0.5	1	1	1
Toll office		→	5	5	2.5	2.5	0.5	1	1	1
(VNL)	**A/TO**	←	5	5	2.5	2.5	0.5	1	1	1

*IPE E&M tie trunk transmission category is 4-wire; satellite tie trunk is 2-wire.

**Class (for example, ONS and OPS) denotes TIA port designation for cross-reference purposes.

Table 5
Electrical loss—digital ports to PE ports

Digital port (COS) / Class* / PE port (COS)		Analog set ONS ↑	↓	Analog OPSt OPS ↑	↓	E&M tie A/TT ↑	↓	Satellite tie S/ATT ↑	↓	CO/FX/WATS A/CO ↑	↓	Toll office A/TO ↑	↓
Tie	→	9		6		6.5		4.5		6		3	
D/TT	←		3		0		0.5		–1.5		0		–3
Satellite tie	→	3		2		0.5		–1.5		0		3	
S/DTT	←		3		2		0.5		–1.5		0		3
CO/FX/WATS/DID	→	3		0		2.5		0.5		0		3	
D/CO	←		3		0		2.5		0.5		0		3
Toll office	→	9		6		6.5		4.5		6		6	
FX/WATS/DID D/TO	←		3		0		0.5		–1.5		0		0
Primary rate interface	→	7		7		6.5		4.5		3		3	
IST	←		4		4		0.5		–1.5		–3		–3

*Class (for example, ONS and OPS) denotes TIA port designation for cross-reference purposes.

Table 6
Electrical loss—PE ports to PE ports

PE port (COS)	Class*		Analog set ONS ↑ ↓	Analog off-prem set OPS ↑ ↓	E&M tie (NTC) A/TT ↑ ↓	E&M tie (TRC) A/TT ↑ ↓	E&M tie (VNL) A/TT ↑ ↓	CO/FX/ WATS (NTC) A/CO ↑ ↓	CO/FX/ WATS (TRC) A/CO ↑ ↓	Toll office (VNL) A/TO ↑ ↓
Analog set		→	5							
	ONS	←	5	—	—	—	—	—	—	—
Analog		→	5	1						
Off-Prem Sta'n	**ONS**	←	5	1						
E&M tie		→	0.5	0.5	0					
(NTC)	**A/TT**	←	0.5	0.5	0	—	—	—	—	—
E&M tie		→	0.5	0.5	0	0				
(RTC)	**A/TT**	←	0.5	0.5	0	0	—	—	—	—
E&M tie		→	2.5	2.5	0	0	0			
(VNL)	**A/TT**	←	2.5	2.5	0	0	0	—	—	—
CO/FX/WATS		→	1	1	0.5	0.5	2.5	1		
(NTC)	**A/CO**	←	1	1	0.5	0.5	2.5	1	—	—
CO/FX/WATS		→	1	1	0.5	0.5	0.5	1	1	
(TRC)	**A/CO**	←	1	1	0.5	0.5	0.5	1	1	—
Toll office		→	5	5	2.5	0.5	0.5	1	1	1
(VNL)	**A/TO**	←	5	5	2.5	0.5	0.5	1	1	1

*Class (for example, ONS and OPS) denotes TIA port designation for cross-reference purposes.

Table 7 shows the loss tolerance for all of the connections in Tables 1 through 6.

Table 7
Insert loss tolerance

Type of connection	Insertion loss tolerance (dB)
Line to line	± 1.0
Line to analog trunk	± 0.7
Line to digital trunk	± 0.7
Analog trunk to analog trunk	± 0.7
Analog trunk to digital trunk	± 0.7
Digital trunk to digital trunk	± 0.2

Loss plan for conference connections

When three or more conferees that terminate on 2-wire ports are connected through a Meridian 1 conference bridge, the 2-wire terminations cause reflections that are compensated by added loss in the conference bridge. The added loss is a function of the number of 2-wire ports and the type of port. Table 8 lists the port to port loss for conferences with three to six ports and IPE connections between analog lines and trunks.

> ***Note:*** A maximum of three trunks are recommended on a conference connection.

Table 8
Loss insertion for conference connections

Connection (A-B)	Three ports		Four ports	
	Loss A-B (dB)	Loss B-A (dB)	Loss A-B (dB)	Loss B-A (dB)
Line to line	4.0	4.0	7.0	7.0
Line to CO trunk	0.5	0.5	3.5	3.5
Line to tie trunk	2.5	0.5	5.5	3.5
CO trunk to CO trunk	0.0	0.0	0.0	0.0
CO trunk to tie trunk	2.0	0.0	2.0	0.0
Tie trunk to tie trunk	2.0	2.0	2.0	2.0
Connection (A-B)	**Five ports**		**Six ports**	
	Loss A-B (dB)	**Loss B-A (dB)**	**Loss A-B (dB)**	**Loss B-A (dB)**
Line to line	8.5	8.5	10.0	10.0
Line to CO trunk	5.0	5.0	6.5	6.5
Line to tie trunk	7.0	5.0	8.5	6.5
CO trunk to CO trunk	1.5	1.5	3.0	3.0
CO trunk to tie trunk	3.5	1.5	5.0	3.0
Tie trunk to tie trunk	3.5	3.5	5.0	5.0

Loss plan for A-Law applications

The insertion loss values for connections between ports are location specific. If not modified for specific locations—for example, to meet approval requirements of a particular administration—the µ-Law loss plan applies. The insertion loss limits are listed in Table 7.

Transmission characteristics—µ-Law

Transmission characteristics for IPE

Tables 9 through 22 provide the transmission characteristics for IPE.

Frequency response

Frequency response (attenuation distortion) at a given frequency is the difference between the loss at that frequency and the loss at 1000 Hz. Table 9 shows the minimum and maximum loss differences at significant frequency breakpoints for

— station to station interfaces and station to 2-wire trunk interfaces

— 4-wire analog trunk to 4-wire analog trunk interfaces

Table 9
Frequency response—µ-Law

Frequency (Hz)	Frequency response (dB)			
	Station to station/ station to 2-wire		4-wire to 4-wire	
	Minimum	Maximum	Minimum	Maximum
60	+20.0	—	+16.0	—
200	0.0	+5.0	0.0	+3.0
300	–0.5	+1.0	–0.3	+0.3
3000	–0.5	+1.0	–0.3	+0.3
3200	–0.5	+1.5	–0.3	+1.5
3400	0.0	+3.0	0.0	+3.0

Note: Positive values denote loss; negative values denote gain (measured at 1000 Hz with 0 dBm0 input level).

Overload level

Overload levels are measured with respect to the zero-level point in the PBX, which is defined as having an overload point of +3 dBm in an analog to digital conversion.

Therefore, the overload level in the receive direction is defined as the analog signal level (at the port interface) with an average power that is 3 dB greater than that of the signal, which after encoding produces the equivalent of the digital milliwatt (PBX zero-level point).

The overload level in the transmit direction is defined as the analog signal level (at the port interface) with an average power that is 3 dB greater than that of the signal, which after decoding results from the equivalent of the digital milliwatt. Table 10 shows the overload levels in both the receive and the transmit directions.

> ***Note:*** The digital milliwatt is the digital representation of a 1 kHz signal at 0 dBm.

Table 10
Overload level—μ-Law

Type of circuit	Overload level (dBm)	
	Receive (analog to digital)	Transmit (digital to analog)
Line	+6.5	+2.5
CO trunk	+3.0	+6.0
Tie trunk	+3.5	+3.5
Tie (4-wire)	+3.0	+4.0

Note: For trunks, overload is specified for pads-out mode.

Tracking error (gain variation with level)

Level tracking measures how closely changes in the level of the input signal cause corresponding changes in output level. Tracking error, as shown in Table 11, is the deviation, in decibels, in gain or loss through specified ranges of input level relative to the deviation of a nominal 1000-Hz input signal at the 0 dBm0 level.

Table 11
Tracking error (gain variation with level)—µ-Law

Input signal (dBm0)	Maximum tracking error (dB)	Average tracking error (dB)
0 to –37	± 0.5	± 0.25
–37 to –50	± 1.0	± 0.5

Note: The input signal level is referenced to the zero relative power level (dBm0).

Return loss

Return loss at an impedance discontinuity in a transmission path is the ratio, in decibels, of the power level of an incident signal to the power level of the resulting reflected signal. Echo return loss (ERL) is a weighted average of the return loss values over the frequency range of 500 to 2500 Hz. Single-frequency return loss (SFRL) is the lowest value of nonweighted return loss occurring in the frequency range of 200 to 3200 Hz.

Table 12 shows the return loss needed to satisfy the in-service parameter values shown in Table 13. For each interface type (line and 2-wire trunk), a connection is made through the PBX to a 4-wire trunk interface, and the return loss is measured at both interfaces. Terminating impedance is 600 ohms for all IPE cards.

For the EPE cards, the terminating impedance, as measured from MDF to MDF, is:

— 600 ¾ for Meridian 1 lines and 4-wire trunks

— 600 ¾ and 2.16 µF for PBX lines

— 600 ¾/900 ¾ and 2.16 µF for 2-wire trunks

Table 12
Return loss—design parameter values—µ-Law

Connection	Echo return loss (dB)	Single-frequency return loss (dB)
Line interfaces:		
line side	>18	>12
4-wire trunk side	>25	>19
2-wire trunk interfaces:		
2-wire trunk side	>22	>17
4-wire trunk side	>28	.22

Table 13
Return loss—in-service parameter values—µ-Law

Connection from 4-wire VNL tie trunk to:	Circuit termination	Echo return loss (dB)	Single-frequency return loss (dB)	Notes
4-wire VNL tie trunk	4-wire legs of hybrid terminated in 600 ¾	>27	>20	1, 3
4-wire non-VNL tie trunk	600 ¾ at tip/ring of channel in distant PBX	>22	>15	1, 3
2-wire non-VNL tie trunk	600/900 ¾ at tip/ring of channel in distant PBX	>18	>10	1, 4
CO or FX trunk (TRC)	900 ¾ at CO	>18	>10	2, 3
PBX station line	600 ¾	>24	>18	1, 5
PBX station line	Station off-hook	>12	>8	1, 5

Note 1: Reference impedance is 600 ¾.

Note 2: Reference impedance is 900 ¾.

Note 3: Nominal trunk to trunk loss is 0 dB.

Note 4: Nominal trunk to trunk loss is 0.5 dB.

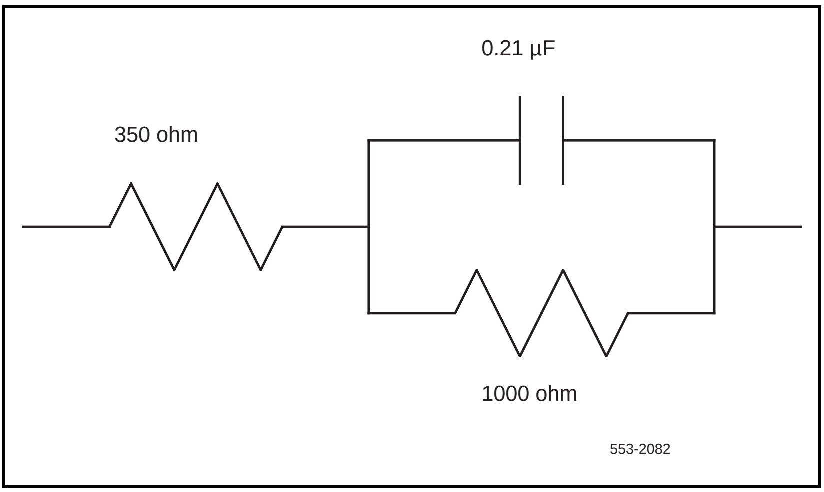
Note 5: Nominal loss is 3.5 dB, trunk to station; 2.5 dB, station to trunk.

Transhybrid loss

Impedance mismatches between hybrid compromise networks and 2-wire terminations (line or trunk) may result in instability and listener echo degradations in the 4-wire switching path of a digital PBX. The echo return loss requirements presented in Tables 12 and 13 do not adequately address this problem. Thus, for digital PBXs, requirements are placed on the return loss at the hybrid between the 2-wire interface and the 4-wire switching path. This requirement is called transhybrid loss.

Two-wire ports with external facilities present a distribution of impedances to the PBX interface. To effect a good match with this distribution and to achieve the transhybrid loss specifications shown in Table 14, a three-element compromise impedance network is used in 2-wire analog trunk ports to balance the impedance of the trunk (see Figure 1).

Figure 1
Compromise impedance network



Transhybrid loss is measured from a balanced 4-wire port (with transmit and receive legs at equal level) to the 2-wire port. The 2-wire port is terminated in a compromise impedance network that consists of 600 ohms (for stations) or the network in Figure 1 (for 2-wire trunks). Table 14 gives the minimum transhybrid loss over the indicated frequency ranges for input signals at the 4-wire port.

Table 14
Transhybrid loss—µ-Law

Two-wire port	Transhybrid loss (dB)	
	200 to 3400 Hz	500 to 2500 Hz
Line	>17	>19
Trunk	>18	>21

Input impedance

Input impedance (see Table 13) for a 2-wire port of a digital PBX is the impedance seen looking into the port from an external source. The requirements shown in Table 15 pertain to the minimum return loss of the port when

— the return loss is measured with a return-loss test set terminated with a specified reference impedance at the PBX

— the port is connected through the PBX to a 4-wire port with 600 ohms termination

The return loss is a function of frequency and increases without limit as the port input impedance approaches the reference impedance.

Table 15
Input impedance—µ-Law

Path through PBX to 4-wire trunk from 2-wire port	Reference impedance	Frequency range (Hz)	Minimum return loss (dB)
Line	600 ¾	200–500	20
		500–3400	26
Trunk	600 ¾	200–500	20
		500–1000	26
		1000–3400	30

Note: For trunks, the minimum return loss specifications are supported for the 600-ohm termination option of the trunk. The specifications are not supported for the 900-ohm termination option.

Idle channel noise

Idle channel noise (noise in the absence of a signal) is the short-term, average, absolute noise power, measured with either C-message weighting or 3000 Hz flat weighting, as shown in Table 16.

— C-message weighting measures noise with a frequency weighting that reflects the characteristic of the human ear.

— 3000-Hz flat weighting measures noise with equal weighting for all frequencies in the 200–3000 Hz frequency range, measured at the PBX tip and ring.

Table 16
Idle channel noise—µ-Law

Connection type	C-message weighted noise (dBrnC)			3000-Hz flat noise (dBrn)
	Analog to analog	Analog to digital	Digital to analog	
Line to line	< 20	< 15	< 13	< 29
Line to trunk *	< 20	< 15	< 13	< 29
Line to CO trunk at trunk port	< 23	< 16	< 16	< 29
Trunk to trunk	< 20	< 15	< 13	< 29

*At the line port or at the tie trunk port

Longitudinal balance

Longitudinal balance (longitudinal to metallic), as shown in Table 17, defines the amount of metallic noise voltage (conductor to conductor) resulting from longitudinal voltage (conductor to ground) at the circuit input. The equation for calculating longitudinal-to-metallic balance is as follows:

longitudinal balance (dB) = 20 log [Vs/Vm]

Note: Vs is the disturbing longitudinal voltage, and Vm is the resulting metallic voltage of the same frequency. Ideally, the metallic noise voltage is negligible and the longitudinal balance approaches infinity. All measurements are at the PBX tip and ring.

Table 17
Longitudinal balance—µ-Law

Frequency (Hz)	Minimum balance (dB)	Average balance (dB)
200	58	63
500	58	63
1000	58	63
3000	53	58

Crosstalk

Crosstalk is the presence of unwanted voice signals coupled from one voice channel to another. Crosstalk not only is an annoyance to the listener but also is perceived as a violation of privacy. The crosstalk coupling attenuation for every combination of through connections in all interface categories, measured with input signals from 200 to 3200þHz at 0 dBm0, are listed in Table 18.

Table 18
Crosstalk—µ-Law

Connection	Minimum crosstalk attenuation (dB)
Line to line	> 75
Line to trunk	> 75
Trunk to trunk	> 75

Quantization distortion

Quantization distortion is the distortion introduced when an analog signal is encoded to digital format, then decoded to analog format. The quantization noise is the difference between the original analog speech signal and the analog signal (speech plus noise) resulting from the decoding process.

Table 19 shows the minimum signal-level to distortion-level ratio values for 1000-Hz sine-wave input signal levels and C-message weighted output (distortion) levels.

Table 19
Quantization distortion—µ-Law

Input signal level (dBm0)	Minimum signal-distortion ratio (dB)	
	Analog to analog	Digital to analog or analog to digital
+0 to –30	33	35
–30 to –40	27	29
–40 to –45	22	25

Intermodulation distortion

Intermodulation distortion is caused by nonlinearities present in the electric-to-electric transfer function of the PBX. This form of distortion primarily affects data transmission.

Intermodulation distortion is measured by using the four-tone method that employs two pairs of equal-level tones transmitted at a total, composite power level of –13 dBm. One pair of tones uses 857 Hz and 863 Hz frequencies, while the second pair uses 1372 Hz and 1388 Hz frequencies. The second- and third-order products of distortion are denoted as R2 and R3, respectively.

The power levels for R2 and R3 (see Table 20) are expressed in decibels below the received power level and are calculated as follows:

— R2 is the average power level measured in two different ranges of the voiceband between 503 Hz and 537 Hz, and between 2223 Hz and 2257 Hz.

— R3 is the total power level in the frequency range between 1877 Hz and 1923 Hz.

Table 20
Intermodulation distortion—μ-Law

Connection type	Distortion limits (dB) below received level		Test-signal input level (dBm)
	R2	R3	
Line to line	39	51	–9
Line to trunk	39	51	–9 at line –13 at trunk
Trunk to trunk	39	51	–13

Envelope delay

Envelope delay in a system is the propagation time through the system of a low-frequency sinusoidal envelope of an amplitude-modulated sinusoidal carrier. The carrier frequency is varied throughout the frequency range of interest to obtain the envelope delay as a function of frequency.

Relative envelope delay is the difference between the envelope delay at a given frequency and the global minimum envelope delay within the frequency range. The values in Table 21 indicate the relative envelope delay for the frequency ranges shown.

Table 21
Relative envelope delay—µ-Law

Bandwidth (Hz)	Relative envelope delay (µs)	
	Line to line	Line to trunk and trunk to trunk
800 to 2700	750	375
1000 to 2600	380	190
1150 to 2300	300	150

Impulse noise

Impulse noise is noise bursts or spikes that exceed normal peaks of idle-channel noise. Impulse noise is measured by counting the number of spikes exceeding a preset threshold over a defined time duration. Over a five-minute interval, the number of counts above 55 dBrnC is zero under fully loaded busy-hour PBX traffic conditions.

Echo path delay

Echo path delay is the maximum round-trip port to port delay for all frequencies in the 200–3400 Hz range (see Table 22).

Table 22
Echo path delay—μ-Law

Path	ms
Analog to analog	3.0
Analog to digital	2.4
Digital to digital	2.0

Transmission characteristics for PE

The transmission characteristics for PE are the same as for IPE (see Tables 9 through 22) except for the following characteristics.

Overload level

The overload levels for PE with trunks in pads-out mode are listed in Table 23.

Table 23
Overload level—µ-Law

Port	Receive (analog to digital)	Transmit (digital to analog)
Line	+7.0	+2.0
CO trunk	+3.0	+6.0
2-wire and 4-wire tie trunk	+3.0	+6.0
Tie (4-wire)	+2.5	+6.5

Return loss

The requirements for return loss of PE are the same as those for IPE (see Tables 12 and 13), however, the conditions for the requirements listed in Table 13 are modified as follows:

— The nominal loss for a tie trunk (2-wire or 4-wire, VNL or non-VNL) to or from a 4-wire tie trunk is 0 dB.

— The nominal loss for a CO/FX trunk to or from a 4-wire tie trunk is 0.5 dB.

— The nominal loss for a station line (including an SL-1 telephone line) to or from a 4-wire tie trunk is 2.5 dB.

Note: The preceding conditions are based on 4-wire tie trunk ports utilizing trunk card vintage QPC237C or later for North America and QPC296C or later internationally.

Transhybrid loss

The trunk specifications for transhybrid loss (see Table 14) apply to PE trunks that are compatible with Electronic Industries Association (EIA) specifications.

Input impedance

The trunk specifications for input impedance (see Table 15) apply to PE trunks that are compatible with EIA specifications.

Transmission characteristics—A-Law

Transmission characteristics for IPE

Tables 1 through 15 provide the transmission characteristics for IPE.

Frequency response

Frequency response (attenuation distortion) at a given frequency is the difference between the loss at that frequency and the loss at 2820 Hz. Table 1 shows the minimum and maximum loss differences at significant frequency breakpoints for 2-wire and 4-wire interfaces.

Table 1
Frequency response—A-Law

Frequency (Hz)	2-wire interface (dB)		4-wire interface (dB)	
	Minimum	Maximum	Minimum	Maximum
200	0.0	+5.0	0.0	+3.0
300	–0.5	+1.0	–0.3	+0.3
400	–0.6	+2.0	–0.5	+0.5
600	–0.6	+0.7	–0.5	+0.5
REF	–0.6	+0.7	–0.5	+0.5
2400	–0.6	+0.7	–0.5	–0.5
3000	–0.6	+1.0	–0.5	+0.9
3400	–0.6	+3.0	–0.5	+1.0
3600	0.0	—	0.0	—

Note: Positive values denote loss; negative values denote gain (measured at 2820 Hz with 0 dBm0 input level.

Overload level

Overload levels are measured with respect to the zero-level point in the PBX, which is defined as having an overload point of +3 dBm in an analog-to-digital conversion.

Therefore, the overload level in the receive direction is defined as the analog signal level (at the port interface) with an average power that is 3 dB greater than that of the signal, which after encoding produces the equivalent of the digital milliwatt (PBX zero-level point). The overload level in the transmit direction is defined as the analog signal level (at the port interface) with an average power that is 3 dB greater than that of the signal, which after decoding results from the equivalent of the digital milliwatt. Table 2 shows the overload levels in both the receive and the transmit directions.

Table 2
Overload level—A-Law

Type of circuit	Overload level (dBm)	
	Receive (analog to digital)	Transmit (digital to analog)
Line	+6.5	+2.5
CO trunk	+3.0	+6.0
Tie trunk	+3.5	+3.5
Tie (4-wire)	+3.0	+4.0

Note: For trunks, overload is specified for pads-out mode.

Tracking error (gain variation with level)

Level tracking measures how closely changes in the level of the input signal cause corresponding changes in output level. Tracking error, as shown in Table 3, is the deviation, in decibels, in gain or loss through specified ranges of input level relative to the deviation of a nominal 820-Hz input signal at the 0 dBm0 level.

Table 3
Tracking error (gain variation with level)—A-Law

820-Hz signal input (dBm0)	Variation in insertion loss (dB)
–55 to –10	+0.5
–10 to +3	+0.5

Return loss

Return loss at an impedance discontinuity in a transmission path is the ratio, in decibels, of the power level of an incident signal to the power level of the resulting reflected signal. Echo return loss (ERL) is a weighted average of the return loss values over the frequency range of 500 to 2500 Hz. Single-frequency return loss (SFRL) is the lowest value of nonweighted return loss occurring in the frequency range of 200 to 3200 Hz.

Table 4 shows return losses guidelines to satisfy the in-service requirements shown in Table 5. For each interface type (line and 2-wire trunk), a connection is made through the PBX to a 4-wire trunk interface, and the return loss is measured at both interfaces. All terminating impedances are 600 ohms.

Table 4
Return loss—in-service parameter values—A-Law

Connection	Echo return loss (dB)	Single-frequency return loss (dB) (300–3200 Hz)	Notes
Line interfaces:			
Line side	>18	> 12	1
4-wire trunk side	> 21	> 19	2
2-wire trunk interfaces:			
2-wire trunk side	> 22	> 17	2
4-wire trunk side	> 28	> 22	2

Note 1: Terminating impedances are 600 ¾ for a Meridian 1 line and 600 ¾ and 2.16 µF for a PBX line.

Note 2: Terminating impedances are 600 ¾ for a Meridian 1 line and 900 ¾ and 2.16 µF for a PBX line.

Note 3: Terminating impedances are 600 ¾/900 ¾ and 2.16 µF for a 2-wire trunk.

Note 4: Terminating impedances are 600 ¾ for a Meridian 1 line and a 4-wire trunk.

Note 5: The design requirements in this table are intended to ensure the satisfaction of the in-service requirements in Table 5.

Table 5
Return loss—in-service attenuation—A-Law

Connection from 4-wire VNL tie trunk to:	Circuit termination	Echo return loss	Single-frequency return loss	Notes
4-wire VNL tie trunk (through balance)	4-wire legs of hybrid terminated in 600 ¾	> 27	> 20	1, 3
4-wire non-VNL tie trunk (terminal balance)	600 ¾ + 2.16 µF at distant PBX	> 22	> 15	1, 3
2-wire non-VNL tie trunk (terminal balance)	600 ¾ + 2.16þµF at distant PBX	> 18	> 10	1, 5
CO or FX trunk (terminal balance)	900 ¾ + 2.16 µF at CO	> 18	> 10	2, 5
PBX line (terminal balance)	600 ¾ + 2.16 µF	> 24	> 18	1, 4
Meridian 1 line (terminal balance)	600 ¾	> 24	> 18	1, 4
PBX line (terminal balance)	Set off-hook	> 12	> 8	1, 4

Note 1: Reference impedance is 600/900 ¾ + 2.16 µF.

Note 2: Reference impedance is 900 ¾ + 2.16 µF.

Note 3: Switchable pads set for nominal loss of 1 dB.

Note 4: Switchable pads set for nominal loss of 3 dB.

Note 5: If facility loss is less than 2 dB or adequate impedance correction is not provided, nominal loss has to be increased to 3 dB by switching in the 2 dB pad.

Idle channel noise

Idle channel noise (noise in the absence of a signal) is the short-term, average, absolute noise power, measured with either psophometric weighting or 3000-Hz flat weighting, as shown in Table 6:

— Psophometric weighting measures noise with a frequency weighting that reflects the characteristic of the human ear.

— 3000-Hz flat weighting measures noise with equal weighting for all frequencies in the 200–3000 Hz frequency range, measured at the PBX tip and ring.

Table 6
Idle channel noise—A-Law

Connection type	Psophometric dBm0p	3000-Hz flat noise (dBrn)
Line to line	< –65	< 29
Line to trunk:		
Trunk side	< –65	< 29
Line side	< –65	< 29
Trunk to trunk	< –65	< 29

Longitudinal balance

Longitudinal balance (longitudinal to metallic), as shown in Table 7, defines the amount of metallic noise voltage (conductor to conductor) resulting from longitudinal voltage (conductor to ground) at the circuit input. The equation for calculating longitudinal-to-metallic balance is as follows:

longitudinal balance (dB) = 20 log [Vs/Vm]

Note: Vs is the disturbing longitudinal voltage, and Vm is the resulting metallic voltage of the same frequency. Ideally, the metallic noise voltage is negligible and the longitudinal balance approaches infinity. All measurements are at the PBX tip and ring.

Table 7
Longitudinal balance—A-Law

Frequency (Hz)	Minimum balance (dB)	Average balance (dB)
200	58	63
500	58	63
1000	58	63
3000	53	58

Crosstalk

Crosstalk is the presence of unwanted voice signals coupled from one voice channel to another. Crosstalk not only is an annoyance to the listener but also is perceived as a violation of privacy. The crosstalk coupling attenuation for every combination of through connections in all interface categories, measured with input signals from 200 to 3200þHz at 0 dBm0, are listed in Table 8.

Table 8
Crosstalk—A-Law

Connection	Crosstalk attenuation (dB)
Line to line	> 75
Line to trunk	> 75
Trunk to trunk	> 75

Quantization distortion

Quantization distortion, shown in Table 9, is the distortion introduced when an analog signal is encoded to digital format, and then decoded to analog format. The quantization noise is the difference between the original analog speech signal and the analog signal (speech plus noise) resulting from the decoding process.

Table 9
Quantization distortion—A-Law

Input level (dBm0)	Minimum signal/distortion ratio (dB)
0 to –30	33
–31 to –40	27
–41 to –45	22
Note: Input signal is 820 Hz sine-wave; output is measured with psophometric weighting.	

Intermodulation distortion

With the input driven with a composite signal consisting of two sine-wave signals (denoted as f1 and f2), each in the range of 450–2050 Hz (but not harmonically related) and of equal level in the range of –21 to –4 dBm0, the system will not produce any 2f2-f1 intermodulation product at the output having a level greater than 35 dB below the power level of the composite input signal.

Envelope delay

Envelope delay in a system is the propagation time through the system of a low-frequency sinusoidal envelope of an amplitude-modulated sinusoidal carrier. The carrier frequency is varied throughout the frequency range of interest to obtain the envelope delay as a function of frequency.

Relative envelope delay is the difference between the envelope delay at a given frequency and the global minimum envelope delay within the frequency range.

The values in Table 10 indicate the relative envelope delay for the frequency ranges shown.

Table 10
Relative envelope delay—A-Law

Bandwidth (Hz)	Relative envelope delay (µs)	
	Line-line	Line to trunk/ trunk to line/ trunk to trunk
800 to 2700	750	375
1000 to 2600	380	190
1150 to 2300	300	150
Note: The above limits apply to 95 percent of all connections.		

Impulse noise

Impulse noise is noise bursts or spikes that exceed normal peaks of idle-channel noise. Impulse noise is measured by counting the number of spikes exceeding a preset threshold, as shown in Table 11. Impulse noise level is measured as the number of counts above 55 dBrnC during a five-minute interval, under fully loaded busy-hour PBX traffic conditions.

Table 11
Impulse noise—A-Law

Noise level (dBrnC)	Counts
55	0 counts for 5 minutes

Echo path delay

Echo path delay, as shown in Table 12, is the maximum round-trip port-to-port delay for all frequencies in the 200–3400 Hz range.

Table 12
Echo path delay—A-Law

Path	µs
Analog to analog	3000
Analog to digital	2400
Digital to digital	2000

Spurious in-band

Table 13 specifies the image signal level required for in-band frequencies as measured selectively at the output port.

Table 13
Spurious in-band image signals—A-Law

Input signal	Image signal level (300–3400 Hz)
0 dBm0 (700–1100 Hz)	< –40 dBm0

Spurious out-of-band

Table 14 specifies the image signal level required for out-of-band frequencies as measured selectively at the output port.

Table 14
Spurious out-of-band image signals—A-Law

Input signal	Image signal level (above 3–4 kHz)
0 dBm0 (300 Hz–3.4 kHz)	< –25 dBm0

Discrimination against out-of-band signals

Table 15 specifies the image signal level required for the designated input signals as measured at the output port.

Table 15
Discrimination against out-of-band signals—A-Law

Input signal	Image signal level (at any frequency)
–25 dBm0 (above 4.6 kHz)	25 dB below level of test signal

Transmission characteristics for PE

The transmission characteristics for PE are the same as for A-law IPE (see Tables 10 through 22). The PE overload levels are the same as for the µ-Law overload levels in Table 23.

Transmission parameters for Meridian Modular Telephones

Meridian Modular Telephones have the following system-defined transmission parameters:

— transmit objective loudness rating (TOLR)

— receive objective loudness rating (ROLR)

— sidetone objective loudness rating (SOLR)

These transmission parameters are defined in the Configuration Record (LD17) and are downloaded to all Meridian Modular Telephones after a system reload (sysload). This accommodates the needs of international installations where different loss and level plans are in place.

> ***Note:*** The transmission parameters are not downloaded during parallel reload procedures.

The default transmission settings for Meridian Modular Telephones are designed, under the North American loss and level plan, to appear identical at the CO to the settings of 500/2500 type sets. Note that the North American loss and level plan assumes trunk losses of 3 to 4 dB to the CO.

Contact your Nortel Networks representative for the recommended transmission parameters for countries not using the North American loss and level plan.

Receive and transmit objective loudness rating

To obtain optimal transmit and receive performance in North America, it is important that the following transmission parameters be used:

— a transmit offset of –45 dB (LD17 prompt TOLR = 0)

— a receive offset of +45 dB (LD17 prompt ROLR = 0)

Table 24 shows the values entered for LD17 prompts ROLR and TOLR and the associated loudness rating for North America.

The ROLR and the TOLR are considered as quantities of loss. Here are some examples:

— If the ROLR of a telephone changes from +45 dB to +50þdB, there is 5 dB *more loss* and, consequently, the receive path is *quieter*.

— If the ROLR changes from +45 dB to +39 dB, there is 6þdB *less loss* and, consequently, the receive path is *louder*.

— If the TOLR changes from –45 dB to –50 dB, there is 5þdB *less loss* and, consequently, the transmit path is *louder*.

— If the TOLR changes from –45 dB to –40 dB, there is 5þdB *more loss* and, consequently, the transmit path is *quieter*.

Another way of looking at both TOLR and ROLR is that if the number *increases* in value (becomes more positive or less negative) the path will be *quieter*, and as the number *decreases* in value (becomes less positive or more negative) the path will be *louder*.

X11 international ROLR and TOLR values are listed in Table 25. In addition, separate Handsfree receive (HRLR) and Handsfree transmit (HTLR) objective ratings can be defined. See Table 26.

Table 24
Receive and transmit transmission parameters (North America)

Value for prompt ROLR or TOLR in LD17	ROLR	TOLR
00	+45.00	–45.00
01	+45.85	–44.50
02	+46.70	–44.50
03	+47.55	–44.00
04	+48.40	–43.50
05	+49.25	–43.00
06	+50.10	–43.00
07	+50.95	–42.50
08	+51.80	–42.00
09	+52.65	–41.50
10	+53.50	–41.50
11	+54.35	—
12	+55.20	—
13	+56.05	—
14	+56.90	—
15	+57.75	—
16–31	—	—
32	+45.00	–45.00
33	+44.15	–45.50
34	+43.30	–46.00
35	+42.45	–46.00
36	+41.60	–46.50
37	+40.75	–47.00
38	+39.90	–47.50
39	+39.05	–47.50
40	—	–48.00
41	—	–48.50
42	—	–49.00
43	—	–49.00
44	—	–49.50
45	—	–50.00
46	—	–50.50
47	—	–50.50
48	—	–51.00
49	—	–51.50
50–52	—	–52.00
53	—	–53.00
54–63	—	—

Table 25
Handset receive and transmit transmission parameters (international)

Quieter					Louder				
LD17 value	Change from nominal		LD22 output		LD17 value	Change from nominal		LD22 output	
	ROLR	TOLR	ROLR	TOLR		ROLR	TOLR	ROLR	TOLR
#	dB	dB	dB	dB	#	dB	dB	dB	dB
00	0.00	0.0	+45.00	–45.00	32	0.00	0.0	+45.00	–45.00
01	0.85	0.5	+45.85	–44.50	33	0.85	0.5	+44.15	–45.50
02	1.70	0.5	+46.70	–44.50	34	1.70	1.0	+43.30	–46.00
03	2.55	1.0	+47.55	–44.00	35	2.55	1.0	+42.45	–46.00
04	3.40	1.5	+48.40	–43.50	36	3.40	1.5	+41.60	–46.50
05	4.25	2.0	+49.25	–43.00	37	4.25	2.0	+40.75	–47.00
06	5.10	2.0	+50.10	–43.00	38	5.10	2.5	+39.90	–47.50
07	5.95	2.5	+50.95	–42.50	39	5.95	2.5	+39.05	–47.50
08	6.80	3.0	+51.80	–42.00	40	6.80	3.0	+38.20	–48.00
09	7.65	3.5	+52.65	–41.50	41	7.65	3.5	+37.35	–48.50
10	8.50	3.5	+53.50	–41.50	42	8.50	4.0	+36.50	–49.00
11	9.35	4.0	+54.35	–41.00	43	9.35	4.0	+35.65	–49.00
12	10.20	4.5	+55.20	–40.50	44	10.20	4.5	+34.80	–49.50
13		5.0		–40.00	45	11.05	5.0	+33.95	–50.00
14		5.0		–40.00	46	11.90	5.5	+33.10	–50.50
15		5.5		–39.50	47	12.75	5.5	+32.25	–50.50
16		6.0		–39.00	48	13.60	6.0	+31.40	–51.00
17		6.5		–38.50	49	14.45	6.5	+30.55	–51.50
18		6.5		–38.50	50	15.30	7.0	+29.70	–52.00
19		7.0		–38.00	51		7.0		–52.00
20		7.5		–37.50	52		7.5		–52.50
21		8.0		–37.00	53		8.0		–53.00
22		8.0		–37.00	54		8.5		–53.50
23		8.5		–36.50	55		8.5		–53.50
24		9.0		–36.00	56		9.0		–54.00
25		9.5		–35.50	57		9.5		–54.50
26		9.5		–35.50	58		10.0		–55.00
27		10.0		–35.00	59		10.0		–55.00
28		10.5		–34.50	60		10.5		–55.50
29		11.0		–34.00	61		11.0		–56.00
30		11.0		–34.00	62		11.5		–56.50
31		11.5		–33.50	63		11.5		–56.50

Table 26
Handsfree receive and transmit transmission parameters (international)

Quieter					Louder				
LD17 value	Change from nominal		LD22 output		LD17 value	Change from nominal		LD22 output	
	HRLR	HTLR	HRLR	HTLR		HRLR	HTLR	HRLR	HTLR
#	dB	dB	dB	dB	#	dB	dB	dB	dB
00	0.00	0.0	+42.00	–44.00	32	0.00	0.0	+42.00	–44.00
01	0.85	0.5	+42.85	–43.50	33	0.85	0.5	+41.15	–44.50
02	1.70	0.5	+43.70	–43.50	34	1.70	1.0	+40.30	–45.00
03	2.55	1.0	+44.56	–43.00	35	2.55	1.0	+39.45	–45.00
04	3.40	1.5	+45.40	–42.50	36	3.40	1.5	+38.60	–45.50
05	4.25	2.0	+46.25	–42.00	37	4.25	2.0	+37.75	–46.00
06	5.10	2.0	+47.10	–42.00	38	5.10	2.5	+36.90	–46.50
07	5.95	2.5	+47.95	–41.50	39	5.95	2.5	+36.05	–46.50
08	6.80	3.0	+48.80	–41.00	40	6.80	3.0	+35.20	–47.00
09		3.5		–40.50	41		3.5		–47.50
10		3.5		–40.50	42		4.0		–48.00
11		4.0		–40.00	43		4.0		–48.00
12					44		4.5		–48.50
13					45		5.0		–49.00
14					46		5.5		–49.50
15					47		5.5		–49.50
16					48		6.0		–50.00
17					49		6.5		–50.50
18					50		7.0		–51.00
19					51		7.0		–51.00
20					52		7.5		–51.50
21					53		8.0		–52.00
22					54		8.5		–52.50
23					55				
24					56				
25					57				
26					58				
27					59				
28					60				
29					61				
30					62				
31					63				

Sidetone objective loudness rating

Sidetone is provided by coupling a portion of the transmitted voice signal back to the telephone receiver. This allows you to hear your own voice, which provides a natural quality to the conversation. The value of the SOLR is a measure of the loss of sidetone. The recommended SOLR value is +12 dB. Table 27 lists the values allowed for LD17 prompt SOLR.

Table 27
Allowable SOLR values

SOLR	Loudness rating
0	7 dB
1	12 dB (default)
2	17 dB
3	22 dB
4	sidetone disabled

Note: The default value in X11 releases 14 and 15 is 0 (7 dB). The default value in releases 16 and later is 1 (12 dB). The recommended value for all releases is 1 (12 dB).

As the SOLR value increases, less of the transmitted signal is coupled back to the receiver. As the SOLR value decreases, more of the transmitted signal (near-end person's voice, or room noise) is coupled back to the receiver.

Factoring in the return loss of the trunk interface, the default SOLR value of 12 dB produces an effective SOLR of 9 dB with nominal return loss on external calls.

Note that when the SOLR value (transmission setting) is changed, only the integral sidetone control circuits in the telephone are affected. Other sources that contribute sidetone (such as return loss at trunk interfaces at the PBX, at the CO, and through the entire network to the far end) are independent of the SOLR transmission setting.

> ***Note:*** The SOLR download is accepted by all Meridian Modular Telephones except the M2216ACD-1 and M2216ACD-2 telephones that have sidetone values fixed at the default level of 12 dB.

List of terms

A/CO

Analog trunk interface to analog central-office trunk

A/TO

Analog trunk interface to analog toll-office trunk

A/TT

Analog trunk interface to tie trunk

BRI

Basic rate interface

CCITT

International Telegraph and Telephone Consultative Committee

CO

Central office

COS

Class of service

CPE

Customer-premises equipment

D/CO

Digital trunk interface to digital central-office trunk

D/ONS

Digital trunk interface to on-premises set line

D/TO

Digital trunk interface to digital toll-office trunk

D/TT

Digital trunk interface to digital tie trunk

DID

Direct inward-dialing

DOD

Direct outward-dialing

DSX

Digital signal cross-connect

DTI

Digital trunk interface

DX

Duplex signaling

EIA

Electronic Industries Association

ERL

Echo return loss

ESN

Electronic switched network

FX

Foreign exchange

IC

Interexchange carrier

ICS

ISDN-compatible stations

IPE

Intelligent peripheral equipment

IS

Integrated Services

ISDN

Integrated Services Digital Network

IST

Integrated switching and transmission

LATA

Local access and transport area

LDR

Loop dial repeater

NCOS

Network class of service

NTC

Nontransmitted compensated

ONS

On-premises set

OPS

Off-premises set

PE

Peripheral equipment

POP

Point of presence

PRI

Primary rate interface

PSN

Public switched network

PSTN

Public switched telephone network

ROLR

Receive objective loudness rating

S/DTT

Satellite PBX digital tie-trunk interface to digital trunk

S/ATT

Satellite PBX analog tie-trunk interface to analog trunk

SFRL

Single-frequency return loss

SDN

Switched digital network

SOLR

Sidetone objective loudness rating

TIA

Telecommunications Industry Association

TO

Toll office

TOLR

Transmit objective loudness rating

TRC

Transmission compensated

VNL

Via net loss

WATS

Wide-area transmission service

Index

H

I

L

M

N

O

P

Meridian 1

Summary of transmission parameters

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