

VOICE BANDWIDTH PRIVATE LINE DATA CIRCUITS TRANSMISSION REQUIREMENTS

1. GENERAL

1.01 This section lists the transmission requirements for voice-bandwidth channels used for private line data service. This service includes telemetry, alternate voice/data, 2-point, multipoint, and certain switched arrangements.

1.02 This section is reissued for the following reasons:

- (a) To make changes in Tables B, C, D, F, H, and M.
- (b) To add Tables R and S which provide the transmission requirements for D-5 conditioning.

This reissue does not affect the Equipment Test Lists. Revision arrows are used to indicate the more significant changes.

1.03 Descriptive information common to the transmission of data on the public switched net-

work (PSN), private line (PL) services, and switched service networks (SSN) is covered in the following sections:

- Data General, Analog Transmission Parameters, Description (Section 314-010-100)
- Data General, Data Testing Principles (Section 314-010-101)
- Data General, Data Services Support (Section 314-010-102)
- Data General, Interconnection/Interpositioning (Section 314-010-103).

A basic understanding of the Data General Sections is recommended prior to the use of this section.

2. TRANSMISSION REQUIREMENTS

2.01 ♦The PL data transmission requirements are given in Tables A through S.♦ These requirements correspond to the order of tests as required for trouble investigation.

TABLE A

1004-HZ LOSS DEVIATION (NOTE)

CONNECTION	CIRCUIT ORDER	ROUTINE OR TROUBLE ISOLATION
End Link	±0.5 dB	±2.0 dB
Midlink	±0.5 dB	±1.0 dB
End-to-End	±1.0 dB	±4.0 dB
Loop-Back	±0.8 dB	±2.0 dB

Note: Maximum deviation from EML stated on circuit layout record card.

NOTICE

Not for use or disclosure outside the
Bell System except under written agreement.

♦TABLE B♦

**C-NOTCHED NOISE REQUIREMENTS
FOR MIXED-COMPANDORED/
NONCOMPANDORED FACILITIES
(NOTES 1 AND 2)**

CIRCUIT LENGTH (MILES)	DBRNC0	
	N1, ON, D1A, D1B CARRIER	N2, N3, N4, D2, D3, D4 CARRIER
0-100	48	41*
101-200	48	42*
201-400	48	42*
401-1000	48	43
1001-1500	48	43
1501-2500	48	45
2501-4000	49	45
4001-8000	50	48
8001-16000	52	50

Note 1: For noncompandored facilities use Table C. For mixed compandored/noncompandored facilities or compandored only, use Table B.

Note 2: Standard circuits should have at least a 24-dB signal to C-notched noise ratio. D-conditioned circuits should have at least a 28-dB signal to C-notched noise ratio.

* If LT1-B connectors are used the reading should be 43.

♦TABLE C♦

**C-NOTCHED NOISE REQUIREMENTS
ON NONCOMPANDORED FACILITIES
ONLY**

CIRCUIT LENGTH (MILES)	NOISE MEASUREMENT (DBRNC0)
0-100	32
101-200	34
201-400	35
401-1000	38
1001-1500	39
1501-2500	41
2501-4000	43
4001-8000	46
8001-16000	49
Satellite	44*

* Add satellite link to land link using sum of powers.

♦TABLE D♦

**MAXIMUM ALLOWABLE IMPULSE
COUNTS (15-MINUTE PERIOD) (NOTE)**

	COUNTER CIRCUIT	MAXIMUM COUNTS
1	Threshold	15
2	Threshold +4 dB	9
3	Threshold +8 dB	5

Note: The threshold for use at the customer premises is 71 dBrnC0 overall. The threshold for use on end links is 67 dBrnC0. For midlink tests, use the threshold given in Table E on a mileage basis.

TABLE E

IMPULSE NOISE THRESHOLD
SETTINGS IN DBRNC0 (NOTES 1 AND 2)

LENGTH MILES	TYPE FACILITY (NOTE 3)				
	(1)	(2)	(3)	(4)	(5)
0-59	54	73	67	70	58
60-124	54	73	67	70	58
125-249	54	73	67	70	59
250-499	54	73	67	70	59
500-999	—	—	—	—	59
1000-1999	—	—	—	—	61
Over 2000	—	—	—	—	64

Note 1: These thresholds assume the use of a -13 dBm0 holding tone. Do not use other holding tone levels as the above thresholds for type 2 (compandored) facilities would be incorrect.

Note 2: On PBX tie trunks, a minimum threshold of 59 dBrnC0 should be used to account for impulse noise which may originate at the PBX switch.

Note 3: The notations (1), (2), (3), (4), and (5) are used to identify the type facilities as follows:

- (1) Voice frequency cable facilities only
- (2) N3 carrier with VF amplifiers
- (3) N1, O, ON, N3L junction facilities or T-carrier facilities
- (4) N2, N3, or N4 carrier facilities
- (5) LMX carrier facilities.

TABLE F

MAXIMUM PEAK-TO-PEAK PHASE JITTER
REQUIREMENTS (NOTE)

FACILITY LENGTH (MILES)	MAXIMUM LIMITS (DEGREES P-P)		
	BELL (20-300 HZ)	LF (4-20 HZ)	BELL PLUS LF 4-300 HZ
0-250	2	5	7
251-500	4	5	9
501-1000	6	5	11
1001-2000	8	5	13
2001-4000 (Overall)	10	5	15

Note: Phase jitter requirements are given in mileage bands for use at test positions. Phase jitter requirements for carrier facilities are given in Section 356-022-504 and are determined by the number of modulation steps. In the case of a conflict, the requirements given in Section 356-022-504 shall take precedence.

TABLE G

MINIMUM P/AR OBJECTIVES

CONNECTION	MINIMUM VALUE
Midlink	80
End Link	80
End-to-End	50

♦TABLE H♦

P/AR VALUES FOR SINGLE AND MULTIFACILITY CHANNELS

TYPE	MAXIMUM (NOTE 1)	MAINTENANCE LIMIT (NOTE 2)	TYPICAL VALUE (NOTE 3)
O, ON, N3	94	86	90
N1	98	86	92
L or Radio A-Carrier*	99	87	93
N2	101	93	97
T1	102	93	97
2T1	97	88	92
2N3	93	83	88
2N2	96	88	92
2N1	93	85	89
T1 + N3	95	87	91
T1 + N2	96	88	92
N1 + N3	97	87	92
ON + T1	96	87	91
ON + A	93	83	88
ON + N3	93	83	88
ON + N2	96	88	92
ON + N1	96	88	92
2 ON	91	83	87
T1 + N1	96	87	91
N2 + N3	97	87	92
N1 + N2	95	87	91
2 "A" Type	92	82	87
A + T1	95	86	90
A + N3	91	83	87
A + N2	96	86	91
A + N1	96	86	91
3A	83	74	78

Note 1: Highest allowable value

Note 2: Minimum allowable value

Note 3: Expected value

* A-Carrier is considered to be L or R channel.

TABLE I

P/AR VALUES FOR NONREPEATERED CABLE

TYPE	LENGTH	MAINTENANCE LIMIT
Nonloaded	0 — 18 kft	97
H88	0 — 18 kft	94

TABLE J

P/AR VALUES FOR REPEATERED CABLE

TYPE	LENGTH	MAINTENANCE LIMIT
Nonloaded	0 — 18 kft	90
H88	0 — 36 kft	90
H88	>36 kft	80

TABLE K

PRIVATE LINE VOICE BANDWIDTH CIRCUIT ATTENUATION DISTORTION REQUIREMENTS (DB) (NOTES 1 AND 2)

FREQUENCY RANGE IN HZ	2- POINT	0	1		2		3		4	
		MIDLINK	MIDLINK		MIDLINK		MIDLINK		MIDLINK	
		END LINK	END LINK	MIDLINK	END LINK	MIDLINK	END LINK	MIDLINK	END LINK	MIDLINK
3002 (Also 2001)										
BASIC	(VB)	(VBE0)	(VBE1)	(VBM1)	(VBE2)	(VBM2)	(VBE3)	(VBM3)	(VBE4)	(VBM4)
500 – 2500	-2 to +8	-1.5 to +4	-1 to +4	-1 to +3.5	-1 to +4	-1 to +3.5	-1 to +3.5	-0.8 to +3.5	-0.8 to +3.5	-0.8 to +3
300 – 3000	-3 to +12	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1 to +4.5	-1.5 to +4.5	-1 to +4.5
C1	(C1)	(C1E0)	(C1E1)	(C1M1)	(C1E2)	(C1M2)	(C1E3)	(C1M3)	(C1E4)	(C1M4)
1000 – 2400	-1 to +3	-0.7 to +1.5	-0.6 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1	-0.5 to +1.5	-0.5 to +1
300 – 2700	-2 to +6	-1.5 to +3	-1 to +3	-1 to +3	-1 to +3	-1 to +2.5	-1 to +3	-0.8 to +2	-0.8 to +3	-0.8 to +2
300 – 3000	-3 to +12	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +6	-1.5 to +5	-1.5 to +5	-1.5 to +4.5	-1.5 to +4.5	-1 to +4.5
C2	(C2)	(C2E0)	(C2E1)	(C2M1)	(C2E2)	(C2M2)	(C2E3)	(C2M3)	(C2E4)	(C2M4)
500 – 2800	-1 to +3	-0.7 to +1.5	-0.6 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1.5	-0.5 to +1	-0.5 to +1.5	-0.5 to +1
300 – 3000	-2 to +6	-1.5 to +3	-1 to +3	-1 to +3	-1 to +3	-1 to +2.5	-1 to +3	-0.8 to +2	-0.8 to +3	-0.8 to +2
C4	(C4)	Classification Codes — Examples 								
500 – 3000	-2 to +3									
300 – 3200	-2 to +6									
C5	(C5)									
500 – 2800	-0.5 to +1.5									
300 – 3000	-1 to +3									

Note 1: The following are symbol definitions:

() Figures in parentheses are classification codes which may be found on some CLR cards to indicate the conditioning requirement for each link of the circuit.

+ Means loss with respect to 1004 Hz.

- Means gain with respect to 1004 Hz.

Note 2: Requirements using the Collins CLA-101A System are given in Section 314-410-104.

TABLE L
OVERALL INTERMODULATION DISTORTION
LIMITS

WITHOUT D-TYPE CONDITIONING	
PRODUCT	LIMIT
Second Order	27 dB
Third Order	32 dB
WITH D-TYPE CONDITIONING	
PRODUCT	LIMIT
Second Order	35 dB
Third Order	40 dB

TABLE M
PHASE HIT, GAIN HIT, AND DROPOUT LIMITS (NOTE)

TRANSIENT	MIDLINK	END LINK	END-TO-END
Phase Hits	≤ 2 in 15 min $\geq 20^\circ$	≤ 2 in 15 min $\geq 20^\circ$	≤ 8 in 15 min $\geq 20^\circ$
Gain Hits	≤ 2 in 15 min ≥ 3 dB	≤ 2 in 15 min ≥ 3 dB	≤ 8 in 15 min ≥ 3 dB
Dropouts	≤ 2 in 12 min ≥ 3 dB	≤ 2 in 12 min ≥ 3 dB	≤ 2 in 12 min ≥ 3 dB

Note: The following are symbol definitions:
 \geq Equal to or greater than.
 \leq Equal to or less than.

TABLE N

RETURN LOSS REQUIREMENTS

NUMBER OF 2-WIRE STATIONS	MINIMUM RETURN LOSS (EACH STATION)
1 — 2	10 dB
3 — 4	16 dB
5 — 8	22 dB
Over 8	28 dB

TABLE O

SINGLE FREQUENCY INTERFERENCE
REQUIREMENTS

CIRCUIT LENGTH MILES	LEVEL OF MEASURED TONE DBRNC0
0 — 50	28
51 — 100	31
101 — 400	34
401 — 1000	38
1001 — 1500	40
1501 — 2500	42
2501 — 4000	44
4001 — 8000	47
8001 — 16,000	50
Satellite Channel	41

TABLE P

FREQUENCY OFFSET REQUIREMENTS
(NOTE)

CONNECTION	MAXIMUM ALLOWABLE SHIFT
Midlink	≤ 1 Hz
End Link	≤ 1 Hz
End-to-End	≤ 5 Hz max.

Note: The following is the symbol definition:
 \leq Equal to or less than.

TABLE Q

PRIVATE LINE VOICE BANDWIDTH CIRCUIT ENVELOPE DELAY REQUIREMENTS (MICROSECONDS) (NOTES 1 AND 2)

FREQUENCY RANGE IN HZ	2- POINT	0	1		2		3		4	
		MIDLINK	MIDLINK		MIDLINK		MIDLINK		MIDLINK	
		END LINK	END LINK	MIDLINK	END LINK	MIDLINK	END LINK	MIDLINK	END LINK	MIDLINK
3002 (Also 2001)										
BASIC	(VB)	(VBE0)	(VBE1)	(VBM1)	(VBE2)	(VBM2)	(VBE3)	(VBM3)	(VBE4)	(VBM4)
800 – 2600	1750	960	685	550	550	400	400	375	375	275
C1	(C1)	(C1E0)	(C1E1)	(C1M1)	(C1E2)	(C1M2)	(C1E3)	(C1M3)	(C1E4)	(C1M4)
1000 – 2400	1000	550	400	300	300	250	250	200	200	175
800 – 2600	1750	960	685	550	550	400	400	375	375	275
C2	(C2)	(C2E0)	(C2E1)	(C2M1)	(C2E2)	(C2M2)	(C2E3)	(C2M3)	(C2E4)	(C2M4)
1000 – 2600	500	275	200	150	150	125	125	100	100	80
600 – 2600	1500	825	600	450	450	375	375	300	300	260
500 – 2800	3000	1650	1200	900	900	750	750	600	650	500
C4	(C4)	<p style="text-align: center;">Classification Codes – Examples</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>VB / E / 3</p> <p>Basic Conditioning End Link No. of End Links</p> </div> <div style="text-align: center;"> <p>C2 / M / 2</p> <p>C2 Conditioning Mid-link No. of Midlinks</p> </div> </div>								
1000 – 2600	300									
800 – 2800	500									
600 – 3000	1500									
500 – 3000	3000									
C5	(C5)									
1000 – 2600	100									
600 – 2600	300									
500 – 2800	600									

Note 1: Figures in parentheses are classification codes which may be found on some CLR cards to indicate the conditioning requirement for each link of the circuit.

Note 2: Requirements using the Collins CLA-101A System are given in Section 314-410-104.

♦TABLE R♦

TRANSMISSION REQUIREMENTS FOR D-5 CONDITIONING (NOTE)

	MULTIPOINT	END-TO-END REQUIREMENTS									
C-Notched Noise	See Table S.	49 dBrnc0 max. (28 dB signal to C-notched noise based on 90 dBrnC).									
Intermodulation Distortion (4-Tone Method)	<table border="0"> <tr> <td></td> <td style="text-align: center;">R2</td> <td style="text-align: center;">R3</td> </tr> <tr> <td>Midlinks:</td> <td style="text-align: center;">≥43 dB</td> <td style="text-align: center;">≥51 dB</td> </tr> <tr> <td>End Links:</td> <td style="text-align: center;">≥43 dB</td> <td style="text-align: center;">≥51 dB</td> </tr> </table>		R2	R3	Midlinks:	≥43 dB	≥51 dB	End Links:	≥43 dB	≥51 dB	R2: ≥35 dB R3: ≥40 dB
	R2	R3									
Midlinks:	≥43 dB	≥51 dB									
End Links:	≥43 dB	≥51 dB									

Note: The following is the symbol definition:
 ≥ Equal to or greater than.

♦TABLE S♦

 C-NOTCHED NOISE LIMITS (DBRNC0)
 (END LINK OR/MIDLINK) (NOTES 1 AND 2)

CARRIER TYPE	CIRCUIT MILEAGE					
	0 TO 50	51 TO 100	101 TO 200	201 TO 1000	1001 TO 2000	OVER 2000
	X,Y	X,Y	X,Y	X,Y	X,Y	X,Y
LMX	32,38	32,38	34,38	36,42	40,44	43,46
N4	38,41	40,43	43,45	—	—	—
T1/D1D, D2, D3, D4	41,42	41,42	42,43	—	—	—

Note 1: Use -13 dBm0 1004-Hz test tone.

Note 2: The following are symbol definitions:

X = Circuit order and maintenance limit

Y = Immediate action limit.