

VOICE BANDWIDTH PRIVATE LINE DATA CIRCUITS
TRANSMISSION REQUIREMENTS OF BELL SYSTEM DATA SETS

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1. GENERAL

- 1.01** This section provides current information on the characteristics of Bell System data sets.
- 1.02** The information in this section was previously contained in Appendix A of Section 314-410-500. This section represents a change from current requirements as follows:
- Provides information on new data sets
 - Deletes information on data sets that have been rated MD.

2. TRANSMISSION REQUIREMENTS OF BELL SYSTEM DATA SETS

- 2.01** This part lists the characteristics and transmission requirements of voice bandwidth data sets currently used in the Bell System.

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A. Data Sets 103F- and 108-Types

Data Input and Output: Serial, nonsynchronous

Bit Rate: Up to 300 bps

Type of Modulation: Frequency shift

Operating Frequencies: F1: S = 1070

M = Mark S = Space M = 1270

F2: S = 2025

M = 2225

Transmit Level: DS 103F-type: 0 to -14 dBm adjustable

DS 108-type: -6 to -26 dBm adjustable

Maximum Receive Sensitivity: DS 103F-type: -45 dBm

DS 108-type: -40 dBm

Input or Output Impedance: 600 or 900 ohms

Attenuation and Delay Distortion Equalizer: Not required

Recommended Conditioning: Basic channel

BSP References: Data Set 103F-Type

590-001-104 — Reference Guide

591-019-100 — Description

Data Set 108-Type

590-001-107 — Reference Guide

591-023-100 — Description

B. Data Sets 201A- and B-Types

Data Input and Output: Serial, synchronous

Bit Rate: DS 201A: 2000 bps
DS 201B: 2400 bps

Type of Modulation: Differential 4-phase

Operating Frequencies:	DS 201A	DS 201B
M = Mark S = Space	MM 2125-1125	2550-1350
	MS 1375-2375	1650-2850
	SM 1875-875	2250-1050
	SS 1625-2625	750-1950

Transmit Level: 201A3, A4 or 201B3, B4: 0 to -8 dBm adjustable in 2-dB steps (external pad is required for -12 dBm transmit level)

201A- or B-List Type: 0 to -12 dBm adjustable in 1-dB steps.

Maximum Receive Sensitivity: -42 dBm with equalizer
-50 dBm w/o equalizer

Input or Output Impedance: 600 or 900 ohms

Attenuation and Delay Distortion Equalizer: The single compromise equalizer is not used except if DDD backup is specified. If DDD backup is specified, DS 201C is recommended in lieu of DS 201B. Otherwise, the single compromise equalizer is used regardless of the private line conditioning specified on the service order.

Recommended Conditioning: DS 201A: Basic channel
DS 201B: See Note 1.

Note 1: Recommended conditioning DS 201B:

- (1) C4 conditioning — not sensitive to codes, no problems expected.
- (2) C2 conditioning — the following code restrictions apply:
 - Repeated “1010. .” — no degradation up to 50 bits. Increasing degradation beyond 40 bits up to 80 bits, at which point the clock reaches its maximum excursion.
 - Clock drift may be considered linear on a one-for-one basis. That is, to recenter the clock would require 1 dibit (2 bits) of any pattern other than “1010. .” for every dibit of “1010. .”
 - No degradation in data performance will occur if in any message the number of weak bits (repeated “1010. .”) does not exceed the number of strong bits (any other pattern). The successive number of weak bits should not exceed 40.

No restriction is placed on the number of steady 0s or 1s that may be transmitted.

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- (3) Basic channel — a channel just meeting the 3002 basic limits on attenuation distortion and envelope delay distortion (primarily the EDD) will not be adequate to provide supportable error performance with DS 201B. The channel must meet C2 or C4 conditioning limits, as indicated above, for performance to be supported.

Note 2: Both the attenuation and delay sections of the compromise equalizer are contained in a single physical unit and are so arranged that the sections cannot be split.

BSP References: Data Set 201A and B-Types
590-002-100 — Reference Guide
592-011-100 — Description

C. Data Set 201C

Data Input and Output: Serial, synchronous

Bit Rate: 2400 bps

Type of Modulation: Differential 4-phase

Operating Frequencies: MM = 2550-1350
MS = 1650-2850
SM = 2250-1050
SS = 750-1950

Transmit Level: 0 to -15 dBm adjustable in 1-dB steps (DDD)
0 dBm nominal (private line)

Maximum Receive Sensitivity: to -44 dBm (DDD)
-16 dBm \pm 7 dB (private line)

Input or Output Impedance: 900 ohms (DDD)
600 ohms (private line)

Attenuation and Delay A single compromise equalizer for both amplitude and distortion (equalizer
Distortion Equalizer: should be installed in all applications using basic channels)

Recommended Conditioning: Basic channel (see note)

Note: The code sensitivity experienced with DS 201C is less than that of DS 201B. The degradation is most pronounced for a repeated 1010 pattern. Repetitions of any dibit codes which persist for less than 100 bits will not cause a serious performance degradation.

BSP References: Data Set 201C
592-029-100 — Description

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D. Data Sets 202C-, D-, E-, and R-Types

Data Input and Output: Serial, nonsynchronous

Bit Rate: Up to 1800 bps

Type of Modulation: Frequency shift

Operating Frequencies: DS 202C and D: M = 1200 S = 2200
 M = Mark S = Space DS 202E and R: M = 1300 S = 2100

Transmit Level: 0 to -12 dBm adjustable by potentiometer

Maximum Receive Sensitivity: DS 202C and D: -40 dBm
 DS 202R: -42 dBm

Input or Output Impedances: 600 or 900 ohms (nominally 600 ohms for DS 202R)

Attenuation and Delay: An amplitude equalizer and a delay equalizer are provided as an option in DS
 Distortion Equalizer: 202C and D

Maximum Attenuation Distortion

Before Amplitude Equalizer In

Set Is To Be Used: 3 dB 1200-2200 Hz (no equalizer in DS 202E and R)

Maximum Envelope Delay Distortion 500 μ sec 1000-2600 Hz (no equalizer in DS 202E and R)Before Delay Equalizer In Set Is 1500 μ sec 600-2600 HzTo Be Used: 3000 μ sec 500-3000 Hz

Note: Either the attenuator or delay equalizer may be used separately or together as needed.

Recommended Conditioning: 0-1200 bps basic channel
 1200-1400 bps C1 conditioning
 1400-1800 bps C2 conditioning

BSP References: Data Set 202C-Type
 590-002-102 - Reference Guide
 592-015-100 - Description

Data Set 202D-Type
 590-002-103 - Reference Guide
 592-016-100 - Description

Data Set 202E-Type
 590-002-104 - Reference Guide
 592-018-100 - Description

Data Set 202R-Type
 590-002-108 - Reference Guide
 592-025-100 - Description

E. Data Set 202T

Data Set Input and Output: Serial, nonsynchronous

Bit Rate: Up to 1800 bps

Type of Modulation: Frequency shift

Operating Frequencies: M = 1200
M = Mark S = Space S = 2200

Transmit Level: 0 dBm (nominal)

Maximum Receive Sensitivity: -16 ± 7 dB

Input or Output Impedance: 600 ohms

Attenuation and Delay Distortion Equalizer: A single compromise equalizer for both amplitude and delay distortion (equalizer should be installed all the time)

Recommended Conditioning: 0-1400 bps basic channel
1400-1800 bps C2 conditioning

BSP References: Data Set 202T
592-031-100 — Description

F. Data Sets 203A-, B-, and C-Types

Data Input and Output: Serial, synchronous

Bit Rate: Speed option

LIST NO.	BIT RATE IN BPS		
	2-LEVEL	4-LEVEL	8-LEVEL*
2 and 4	2400	4800	7200
3	1800	3600	5400
5	3200	6400	9600
6	3600	7200	10,800
7	Provides a 150-bps auxiliary channel		

*May result in degraded performance. Refer to Section 592-019-100.

Type of Modulation: Vestigial sideband multilevel amplitude modulation (two, four, or eight levels)

Data Set Carrier and Pilot Frequencies (Hz):

LIST NO.	LOWER PILOT	CARRIER	UPPER PILOT
2	500	2300	2900
3	700	2200	2700
4	700	2300	2700
5	400	2400	2900
6	401	2543	2900

Auxiliary Channel Frequencies for List 7 (Hz):

MARK	SPACE	FREQUENCY SPECTRUM
450	375	300-525

Transmit Level: 0 to -15 dBm adjustable in 1-dB steps

Receive Sensitivity: -10 to -44 dBm

Input and Output Impedance: 600 or 900 ohms

Attenuation and Delay Distortion Equalizer: Adaptive, automatic equalizer

Recommended Conditioning: C2 conditioning for 4- or 8-level operation for all list options. This does not ensure successful operation. See * under Bit Rate table.

BSP References: Data Sets 203A-, B-, and C-types
590-002-107 — Reference Guide
592-019-100 — Description

G. Data Sets 208A- and B-Types

Data Input and Output: Serial, synchronous

Bit Rate: 4800 bps

Type of Modulation: Differential phase shift keying

Transmit Level: 208A (private line): 0 dBm nominal
208B (DDD): 0 to -15 dBm adjustable in 1-dB steps

Maximum Receive Sensitivity: 208A (private line): -16 dBm \pm 7 dB
208B (DDD): to -42 dBm

Input and Output Impedance: 208A: 600 ohms
208B: 900 ohms

Attenuation and Delay Distortion Equalizer: 208A: Choice of four compromise equalizer settings in addition to an adaptive automatic equalizer
208B: Compromise equalizer always in and an adaptive automatic equalizer

Recommended Conditioning: 208A: Basic channel

BSP References: Data Set 208A
590-002-110 - Reference Guide
592-027-100 - Description

Data Set 208B
592-030-100 - Description

H. Data Set 401J

Data Input and Output: Parallel, nonsynchronous receiver

Character Rate: 0 to 20 characters per second

Type of Modulation: 2 out of 8
3 out of 14

Operating Frequencies:	GROUP A	GROUP B	GROUP C
	600-rest	1098-rest	1950-rest
	697	1209	2050
	770	1336	2150
	852	1447	2250
	941	1633	

Transmit Level: -3 to -12 dBm adjustable for answerback tones

Maximum Receive Sensitivity: -48 dBm for Groups A and B
-53 dBm for Group C

Input and Output Impedance: Nominal 900 ohms

Attenuation and Delay Distortion Equalizer: Not required

Recommended Conditioning: Basic channel

BSP References: Data Set 401J
590-004-103 — Reference Guide
594-018-100 — Description

I. Data Sets 402C- and D-Types

Data Input and Output: Parallel, nonsynchronous

Character Rate: Up to 75 characters per second

Type of Modulation: Frequency shifts in narrow bands

Operating Frequencies:	CHANNEL	MARK	SPACE
M = Mark S = Space			
	1	730	800
	2	900	970
	3	1070	1140
	4	1240	1310
	Timing	1410	1480
	5	1580	1650
	6	1750	1820
	7	1920	1990
	8	2090	2160

Transmit Level: -1 to -12 dBm total power adjustable

Receive Sensitivity: -9 to -39 dBm total power

Input and Output Impedance: 600 or 900 ohms

Attenuation and Delay Distortion Equalizer: None provided

Maximum Attenuation Distortion: 7 dB 1000-2100 Hz
3 dB 700-1000 Hz

Maximum Envelope Delay Distortion: 750-2200 Hz 1500 μ sec

Recommended Conditioning: Basic channel

BSP References: Data Set 402C
590-004-104 — Reference Guide
594-019-100 — Description

Data Set 402D
590-004-105 — Reference Guide
594-020-100 — Description

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J. Data Sets 403D- and E-Types

Data Input and Output: Parallel, nonsynchronous receiver

Character Rate: 0 to 10 characters per second

Type of Modulation: 2 out of 8

Operating Frequencies:	GROUP A	GROUP B
	697	1209
	770	1336
	852	1477
	941	1623

Transmit Level: -3 to -12 dBm adjustable for answerback tones

Receive Sensitivity: +2 to -39 dBm total power

Input and Output Impedances: 600 or 900 ohms

Attenuation and Delay Distortion Equalizer: Not required

Maximum Attenuation Distortion:	4 dB	1000-1600 Hz
	3 dB	700-1000 Hz

Maximum Envelope Delay Distortion: 700-1600 Hz 2500 μ sec

Recommended Conditioning: Basic channel

BSP References: Data Set 403D
590-004-106 - Reference Guide
594-025-100 - Description

Data Set 403E
594-026-100 - Description

K. Data Set 407A

Data Input and Output: Parallel, nonsynchronous receiver

Character Rate: 0 to 10 characters per second

Type of Modulation: 2 out of 8

Operating Frequencies:	GROUP A	GROUP B
	697	1209
	770	1336
	852	1477
	941	1623

Transmit Level: -3 dBm, -7 dBm, or -12 dBm, adjustable for answerback tones

Receive Sensitivity: 0 to -36 dBm total power

Input and Output Impedances: 600 or 900 ohms

Attenuation and Delay Distortion Equalizer: Not required

Maximum Attenuation Distortion: 4 dB 1000-1600 Hz
3 dB 700-1000 Hz

Maximum Envelope Delay Distortion: 700-1600 Hz 2500 μ sec

Recommended Conditioning: Basic channel

BSP References: Data Set 407A
594-800-100 - Description

L. 1A Data Station

Data Input and Output: Serial, nonsynchronous

Channel Baud Rate: 0 to 75 bauds (single bandwidth channels)
0 to 150 bauds (double bandwidth channels)

Method of Operation: Frequency shift keying (FSK) in narrow bands for data channel operation. Alternate data/voice operation is not included.

Channel Capacity: 4-wire operation provides maximum channel capacity. See channels available with recommended conditioning.

Operating Frequencies (Hz):

SINGLE BANDWIDTH CHANNELS

CHAN NUMBER	SPACE	CENTER	MARK
1	390	425	460
2	560	595	630
3	730	765	800
4	900	935	970
5	1070	1105	1140
6	1240	1275	1310
7	1410	1445	1480
8	1580	1615	1650
9	1750	1785	1820
10	1920	1955	1990
11	2090	2125	2160
12	2260	2295	2330
13	2430	2465	2500
14	2600	2635	2670
15	2770	2805	2840
16	2940	2975	3010
17	3110	3145	3180

DOUBLE BANDWIDTH CHANNELS

CHAN NUMBER	SPACE	CENTER	MARK
21(57)	610	680	750
22(58)	950	1020	1090
23(51)	1290	1360	1430
24(52)	1630	1700	1770
25(53)	1970	2040	2110
26(54)	2310	2380	2450
27(55)	2650	2720	2790
28(56)	2990	3060	3130

Note 1: Center frequency transmitted only with ternary (binary plus supervision) operation.

Note 2: Dual numbering for double bandwidth channels is for those companies using the higher channel numbering assignments for existing 43A1 and 43B1 systems.

Transmit Level (dBm): Strap to deliver a maximum total composite system power of 0 dBm at a +13 TLP for the maximum number of channels anticipated. Refer to Section 591-813-101 for single channel power levels.

Receive Level (dBm): Maximum total composite system power of -16 dBm. Minimum per-channel level of -38 dBm required for 12-dB margin before carrier-fail operation.

Impedance: Transmit: 600 ohms
Receive: 600 ohms

Maximum Attenuation Distortion: Same as recommended grade of conditioning.

Maximum Envelope Delay Distortion: Same as recommended grade of conditioning.

Recommended Conditioning (2-Way Channels):

CONDITIONING	4-W CHANNEL CAPACITY		2-W CHANNEL CAPACITY	
	SW	DW	SW	DW
Basic	12	6	6	3
C1	14	6 (plus 2 SW)	7	3 (plus 1 SW)
C2	16	7 (plus 2 SW)	8	3 (plus 2 SW)
C4	17	8 (plus 1 SW)	8	4

Note: Single width (SW) and double width (DW) channels may be mixed. Two single width channels may electrically replace one equivalent bandwidth double width channel.

Channels Not Recommended With a Given Type of Conditioning:

TYPE OF CONDITIONING	CHANNEL NUMBER	
	SW	DW
Basic	1, 14, 15, 16, 17	27(55), 28(56)
C1	15, 16, 17	27(55), 28(56)
C2	17	28(56)
C4	—	—

BSP References: 1A Data Station
 591-813-100 — Description

NOTES