Digital Data Service (DDS)
With and Without Secondary Channel (SC)
Design and Testing Guidelines

Contents

(continued)

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1 .General

**1.1
Purpose**

This practice provides guidelines for designing and testing Digital Data Service (DDS).

**1.2
Filing
Instructions
and
Supersedures**

Discard all previous issues and associated addenda of this practice and file this issue numerically in your GTE Telephone Operations practices set.

This practice supersedes and cancels:

- All policies, procedures, general instructions, letters, and memoranda which address this subject.
- Any document which provides information contrary to the information contained in this practice.

**1.3
Reason for
Reissuing**

This practice has been reissued to update information on EML in Section 7.5.

**1.4
Responsibility**

This practice was published by the GTE Telephone Operations Administrative Services Department. For more information about this practice, contact the GTE Telephone Operations Headquarters Network Engineering Department.

**1.5
Disclaimer**

This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, customers, and end users when installing, operating, maintaining, and repairing GTE Telephone Operations' equipment, facilities, and services. Any other use of this practice is forbidden. The information contained in this practice may not be applicable in all circumstances and is subject to change without notice. By using this practice the user agrees that GTE Telephone Operations will have no liability (to the extent permitted by applicable law) for any consequential, incidental, special, or punitive damages that may result.

2. **Overview**

2.1
Definitions

The following chart defines the acronyms and terms used in this practice.

Acronym or Term	Definition
ALBO	Automatic Line Build-Out
AML	Actual Measured Loss
BPNRZ	Bipolar Nonretum-to-Zero
BPRZ	Bipolar Return-to-Zero
C bit	Control Bit
C/S bit	Control and Secondary Channel Bit
CSU	Channel Service Unit
dB	Decibel
dBrn	Decibels above Reference Noise
DC	Direct Current
DDS	Digital Data Service
DSU	Data Service Unit
EML	Expected Maximum Loss
F bit	Framing Bit
FCC	Federal Communications Commission
FLBO	Fixed Line Build-Out
kb/s	Kilobytes per Second
kft	Kilofoot
kHz	Kilohertz
ma	milliamp
Mb/s	Megabytes per Second
mf	Microfarad
MJU	Multipoint Junction Unit

(continued)

2.1
Definitions,
continued

Acronym or Term	Definition
NMS	Noise Measuring Set
ecu	Office Channel Unit
OCUDP	Office Channel Unit Dataport
Pf	Picofarad
POT	Point Of Termination
S bit	Secondary Channel Bit
SC	Secondary Channel
SRDM	Subrate Data Multiplexer
TIDM	TI Data Multiplexer
TMS	Transmission Measurement Set
V	Volt
VOM	Volt-Ohm Meter

2.2
Purpose of
DDS

DDS is designed to meet the data transmission needs of customers in an efficient manner without the need for digital-to-analog conversion.

2.3
Transmission
Capabilities

DDS provides the capability to transmit digital data between an end user and an interexchange carrier or another end user on dedicated private line, two-point, and multipoint access circuits at the primary channel speeds of:

. 2.4 kb/s.
. 4.8 kb/s.
. 9.6 kb/s.
. 19.2 kb/s.
. 56 kb/s.
. 64 kb/s.

2. **Overview,** continued

2.3
Transmission
Capabilities,
continued

SC capability offers an associated digital transmission channel:

- At a lower bit rate.
- Independent of the primary channel.
- That permits the customer to remotely control and test his or her data network and peripheral devices without:
  - Taking the network out of service.
  - Lowering the speed of the primary DDS channel.

NOTE: **The associated digital transmission channel is not applicable for** 64 **kb/s service. -**

2.4
Network
Components

DDS is composed of a(n):

- Local distribution system to reach the subscriber.
- Interhub network of digital transmission facilities.
- Network of digital lines for collecting customer channels from many serving offices into one hub office.

From the network interface at the customer's premises, data is carried to the digital serving office by a loop transmission system that consists of:

- Customer premises station equipment.
- A four-wire local loop.
- An OCU.

If the data service office is not a hub office, the data can be transported to the hub office via dataport carrier.

A hub office in the DDS is defined as an office that has a DSX-0 and that employs SRDMs at the DS-O level (or first multiplexing stage). It can combine the datastreams from a number of local offices into signals suitable for transmission over DDS long-haul facilities.

NOTE: **Although DDS arrangements may share facilities with analog services in the network, DDS Is a functionally discrete system.**

2.5
Two-Step
Multiplexing

The first step in DDS is the SRDM. The SRDM accepts subrate channels (which have been converted to the DS-0 format by the OCU) and multiplexes them into a single DS-1 signal. The SRDM accepts any of the following:

- Twenty 2.4 kb/s service rate channels.
- Ten 4.8 kb/s service rate channels.
- Five 9.6 kb/s service rate channels.

The second step in DDS is the TI DM. The TI DM combines up to 23 DS-0 channels into a single DS-1 signal.

The result of the two-step multiplexing arrangement is that a flexible mix of customer channels can be carried on a single 1.544 Mb/s DS-1 signal, ranging from twenty-three 56 kb/s channels to four hundred and sixty 2.4 kb/s channels. Multipoint service is provided in the hub office by interconnecting standard point-to-point channels at the 64 kb/s level using MJUs. All multiplexers, channel units, MJUs, and test equipment operate synchronously from one master timing supply.

2. **Overview,** continued

**2.6
References**

The following chart provides sources of supplementary information relating to this practice. The documents could be required for performing certain tasks.

See...	**For Information About...**
AG Communication Systems Practice 350-650-100"	L500A Data Service Unit & L550A Channel Service Unit
Bell System Practice Section 314-410-510**	Local Loop Tests and Requirements, Digital Data System
Bell System Practice Section 880~600-l00**	Dataphone Digital Service Transmission Plan and System Objectives, Digital Data Service
Bell System Practice Section 880-601-115**	Digital Data System, Local Loops Engineering Guidelines
AT&T Practice 314-910-100~	Office Channel Units and Auxiliary Circuits Description, Digital Data System
Bell Communications Research Technical Reference TR-NPL-000157Tt	Secondary Channel in the Digital Data System: Channel Interface Requirements

  * Published by AG Communication Systems.

 ** Published by Bell Core.

  † Published by AT&T

 †† Published by Bell Core.

3. **Customer Equipment Requirements**

3.1
Isolation
from Ground

Both transmit and receive pairs at the network interface must be isolated from the local ground reference. Resistance from any lead to ground must exceed 300,000 ohms.

Stray capacitance of any lead must not exceed 500 pf to ground. The oliierence between the capacitance to ground of the two leads of any pair must not exceed 100 pf.

3.2
Simplex Path

A balanced DC path must be provided between transmit and receiving pairs. The balance:

- Must be held to a maximum difference of ± five percent in resistance or self-inductance, as appropriate.
- May be provided by:
  - Terminating resistances.
    OR
  - Coupling transformers.

If a DC simplex voltage of either polarity is imposed between the receive pair (Tl and R2) and the transmit pair (T and R), the simplex termination must satisfy the following current limitations:

- For a minimum simplex voltage of 7V, current through the termination is at least 4 ma.
- For a maximum simplex voltage of 28V, simplex current does not exceed 20 ma.
- For equal voltage on both wires of a pair, the current difference between the wires will not exceed 1 ma.

The OCU normally provides simplex current between 4 ma and 20 ma. Temporary absence of simplex current should not affect loop transmission. The simplex DC path is necessary to provide:

- Loop-sealing current.
- A signaling path for channel loopback.

4. **Wire Names and Functions**

4.1
**Physical
Network
Interface**

The physical network interface consists of four leads paired to provide a:

- Receive-data pair.
- Transmit-data pair.

The names of the wires, their abbreviations, and the paths of their signal transmissions are shown in the following chart.

Wire Name	Abbreviation	Signal Path
Receive Data	R1	From network interface to customer.
Receive Data	T1	From network interface to customer.
Transmit Data	R	From customer to network interface.
Transmit Data	T	From customer to network interface.

4.2
**FCC-Approved
Jacks**

Two jacks are FCC-approved for use with DDS circuits:

- RJ48S (miniature 8-position keyed).
- RJ48T @O-position miniature ribbon).

Pin assignments for the two jacks are shown in the following chart.

Jack	Line	----------Position----------			
		TI	**RI**	**T**	**R**
RJ48S	1	7	8	2	1
RJ48T	1	26	1	27	2
	2	28	3	29	4
	3	30	5	31	6
	4	32	7	33	8
	5	34	9	35	10
	6	36	11	37	12
	7	38	13	39	14
	8	40	15	41	16
	9	42	17	43	18
	10	44	19	45	20
	11	46	21	47	22
	12	48	23	49	24

5. Performance Objectives

5.1
Introduction

Digital data can achieve significant improvements over traditional analog data communications in both efficiency and signal quality. The digital data circuit is engineered to be a high-quality and reliable service. Because the primary and secondary channels use the same network equipment, both channels should have the same degree of quality and reliability.

5.2
Objectives

Performance objectives for DDS are based on three basic needs of the customer:

- Quality - An average of at least 99.5% error-free seconds.
- Availability - A long-term average availability of 99.96% (or, in terms of outage, an average downtime of no more than 3.5 hours per year on a channel).
- Maintainability - The objective is for no single service outage to extend beyond two hours from the time the outage is reported.

These objectives apply to two-point service and to each master-to-remote path of a multipoint service.

To ensure that these objectives are met, it is critical that the selected facilities meet or exceed the criteria in Sections 7 and 8.

6. Basic DDS and SC Signal Format

6.1
Introduction

Data in the basic (i.e., nonsecondary) DDS local loop is in a modified BPRZ signaling format. This bipolar format ensures no DC buildup. Intentional violations of the bipolar format are used to transmit control and supervisory information.

In the Digital Serving Office, the data channel is converted into a standardized 64 kb/s signal (DS-O) in a BPNRZ format. This is accomplished by an OCU or an OCU dataport.

6.2
Conversion by
Byte Stuffing

To obtain the DS-0 rate from the basic channel, the OCU converts the subrate input signals by a process called "byte stuffing." The OCU effectively examines sequences of six bits, adds a control bit (C bit) and an additional binary filler, then repeats the eight-bit byte an appropriate number of times to fill out the additional 64 kt, s byte intervals. For:

- 9.6 kb/s, the number of repetitions is 5.
- 4.8 kb/s, the number of repetitions is 10.
- 2.4 kb/s, the number of repetitions is 20.

For 56 kb/s, seven local channel bits plus a control bit are retimed to produce the 64 kb/s signal directly. All other office equipment operates with the 64 kb/s format.

6.3
Creating
Capacity
for SC

To accommodate SC, the DDS Network uses excess capacity in the eighth bit (the C bit) of each byte. Since the system uses more C bits than are necessary for operation, every third C bit is replaced with a Secondary Channel bit (S bit). The resulting SC capacity at each customer rate is shown in the chart in Section 6.4.

6. Basic DDS and SC Signal Format, continued

**6.3
Creating
Capacity
for SC,
continued**

In the nonsecondary local loop, there is no C bit, only customer data. Therefore, the excess capacity must be created for SC. This is accomplished by adding two extra bits to every byte of customer data, one to carry:

- The C/S bit.
- An F bit, which is added by the OCU.

Since the C bit is passed from the network through the OCU to the local loop, there is no need for bipolar violations with SC capability. The S bit:

- Can be used independently of the primary channel.
- Is derived at the network channel equipment (DSU).

On multipoint circuits, one station can communicate with the master on the primary channel, while another station communicates with the master on the SC at the same time.

**6.4
Channel
Bit Rates**

The bit transmission rates for primary and secondary channels, and the overall rate for DDS with SC, are shown in the following chart.

Primary Data Rate (b/s)	Secondary Channel (b/s)	Overall Data Rate of DDS with Secondary Channel (b/s)
2400	**133-113**	**3206**
4800	266-2/S	**6400**
9600	533-I/3	12860
19200	**1066-2/S**	**25600**
56000	2666~2/3	72000

7. Local Loop Engineering

**7.1
Introduction**

Data is exchanged between the end user and the DDS Network in band-limited bipolar format through the local loop. The local loop is a four-wire, nonloaded metallic path that connects an OCU or OCU dataport in the DDS serving central office to the CSU or DSU at the customer's premises.

The local loop may consist of:

- Local distribution cable pairs.
  OR
- Local distribution **and interoffice cable pairs.**

  NOTE: **Avoid using interoffice cable pairs for DDS whenever possible. Dataport carrier channels are the preferred interoffice facility. If interoffice cable pairs must be used, ensure assignment within the guidelines in Sections 7.3 and** 7.4.

7.1
Introduction,
continued

Local distribution and interoffice cable pairs may be used if the customer's normal telephone serving central office is not equipped for DDS. The loop is then wired through an intermediate central office to a DDS serving office. The resulting interoffice cable is included in the local loop. The intermediate office is referred to as a "baseband" office.

135ohm terminations are presented to the local loop by:

. OCU.
. OCUDP.
• CSU.
. DSU.
• Digital repeaters (if any exist in the loop).

7.2
Using
Nonloaded
Cable Pairs

DDS equipment is designed to operate only over nonloaded loops. Loading coils and build-out capacitors must be removed from cable pairs and from any associated bridge taps to be used for DDS local loops.

Bridge taps are not recommended. However, where bridge taps are present, they must be limited to the lengths specified in the chart in Section 7.3.

7.3
Bridge Tap
Limits

The maximum allowable lengths for individual bridge taps and cumulative bridge taps for DDS loops are shown in the following chart.

| Primary Data Rate (Ws) | --------Maximum Length-------- | |
	Individual Tap (kft)	Cumulative Tap (W
2.4	**6.0**	**6.0**
4.8	6.0	6.0
9.6	**6.0**	**6.0**
19.2	**6.0**	**6.0**
56.0	**2.0**	**2.5**
64.0	2.0	2.5

7. Local Loop Engineering, continued

7.4
Other Cable Considerations

To reduce the possibility of interference when selecting cable pairs for use as DDS loops, avoid cables that carry unbalanced current pulses, such as those for DC telegraph and some types of security systems.

Other factors that must be considered in selecting cable pairs include:

- When the data rate is 56 kb/s or 64 kb/s, it is necessary to determine whether any N carrier, 15 kHz program channels, or single-subscriber carrier systems (such as GTE Lenkurt 82A, 82B, and 84A) are present in the cable. If any of these are present, the pairs to be used for 56 kb/s and 64 kb/s data must be chosen from a nonadjacent binder or layer to reduce the possibility of interference.

- DDS data rates of 4.8 kb/s and 9.6 kb/s can interfere with program channels unless at least an adjacent-unit separation is maintained.

- The DDS loop signals (i.e., 2.4 kb/s, 4.8 kb/s, 9.6 kb/s, 19.2 kb/s, 56 kb/s, and 64 kb/s) are fully compatible with TI carrier, and may be assigned to the same binder group. This includes TI lines used for
  - Interoffice carrier systems.
  - 1.544 Mb/s data channels.
  - Subscriber loop multiplex systems.
  - Digital subscriber loop carrier systems.

7.5
Local Loop Range

The loop range for all DDS is limited by maximum calculated insertion losses of:

- 31 dB for design purposes

  OR

- 34 dB as actually measured on the loop at the Nyquist frequency.

The Nyquist frequency is numerically equal to one-half of the total loop bit rate. This value of insertion loss applies to services working without a repeater.

For 56 kb/s and 64 kb/s service, a maximum of two regenerative repeaters can be placed in the loop. (Because of the need for powering, two outside plant repeaters can be used only if a central office is between them.) This allows a maximum number of three sections per loop. The EML permitted is 34 dB at 28 kHz for each section using repeaters.

7.6
Insertion Loss Factors

The following chart gives the insertion loss factors at each Nyquist frequency for high-capacity (0.083 mf per mile) copper cable of 19, 22, 24, and 26 gauge. The factors in the chart are based on a nominal ambient temperature of 70°F.

Primary Channel Bit Rate (b/s)	Nyquist Frequency (Hz)	------Insertion Loss Factor------ 135Ohm Terminations (dB/kft)			
		19 ga.	22 ga.	24 ga.	26 ga.
2400 (without SC)	1200	0.27	0.42	0.55	0.74
2400 (with SC)	1600	0.32	0.49	0.64	0.85

(continued)

7.6
Insertion Loss Factors, continued

Primary Channel Bit Rate (b/s)	Nyquist Frequency (Hz)	------Insertion Loss Factor------ 135Ohm Terminations (dB/kft)			
		19 ga.	**22 ga.**	**24 ga.**	**26 ga.**
4800 (without SC)	2400	0.36	0.55	0.73	0.96
4800 (with SC)	3200	0.41	0.64	0.85	1.11
9600 (without SC)	4800	0.46	0.72	0.96	1.25
9600 (with SC)	**6400**	0.64	1.00	1.38	1.83
19200 (without SC)	9600	0.56	0.92	1.23	1.59
19200 (with SC)	12800	0.62	1.06	1.61	2.17
56000 (without SC)	28000	0.76	1.28	1.80	2.40
56000 (with SC)	36000	0.91	1.56	2.22	2.97
64000	**38ooo**	**0.91**	1.56	2.22	2.97

7.7
Increases in Insertion Loss Factors

When aerial cable is used, the maximum expected ambient temperature may exceed 70°F by a significant amount. In these cases, the insertion loss factor of a cable will be increased by the percentages shown in the following chart.

Primary Channel Bit Rate (b/s)	Nyquist Frequency (Hz)	Percentage of Increase in Insertion Loss Factors for Each 10 Degrees above 70°F
2400 (without SC)	1200	1 .10%
2400 (with SC)	1600	1.15%
4800 (without SC)	2400	1.20%
4800 (with SC)	3200	1.25%
9800 (without SC)	4800	1.30%
9600 (with SC)	6400	1.40%
19200 (without SC)	9600	1.45%
192900 (with SC)	12800	1.50%

(continued)

7. **Local Loop Engineering,** continued

7.7
Increases in
Insertion Loss
Factors,
continued

Primary Channel Bit Rate (b/s)	Nyquist Frequency (Hz)	Percentage of Increase in Insertion Loss Factors for Each 10 Degrees above 70°F
56000 (without SC)	28000	1.60%
56000 (with SC)	36000	1.75%
64000	36000	1.75%

7.8
Insertion
Losses for
Mixed-Gauge
Loops

To calculate the insertion loss factor for mixed-gauge loops, perform the following steps.

Step	Calculating the Insertion Loss Factor for Mixed-Gauge Loops
1	Multiply the total length of each gauge (in kft) by its loss factor (in dB/kft).
2	Total the insertion losses of the different gauges. Do **not** add bridge tap losses; these losses have already been allowed for in the calculations.

NOTE: **This is an approximation method. Results may differ from measured values.**

When the calculated EML of the local loop or loop section is less than 10 dB, the FLBO network must be activated in the:

● OCU.
● CSU, DSU, or repeater.

This ensures proper operation of the ALBO equalizers.

8. Local Loop Tests and Requirements

8.1
Record Test
Results

Record all test results for future use as benchmarks. Provide a copy of all test results to the Special Services Circuit Design Group.

8. Local Loop Tests and Requirements, continued

8.2
Foreign Voltage Test

Perform the foreign voltage test to check for foreign voltage on the cable pairs at the DDS serving office. For loops equipped with repeaters, the repeaters must be bypassed or removed from the loop. This test requires a VOM.

Step	Testing for Foreign Voltage
1	Set the meter range switch to the 60V DC scale.
2	Verify that the cable pairs are open circuited at both ends.
3	Connect the test probes to the: • Tip and Ring. • T1 and R1. • Tip and Ground. • Ring and Ground. • T1 and Ground. • R1 and Ground. **NOTE:** **Note the readings for each connection. The voltage must be less than** 1V.

8.3
Insulation Resistance Test

Perform the insulation resistance test to check the resistance between the cable pairs and ground at the DDS serving office. For loops equipped with repeaters, the repeaters must be bypassed or removed from the loop. This test requires a VOM.

Step	Testing Insulation Resistance
1	Open the T and R at the end-user POT
2	At the DDS serving office, set the meter range to the Ohms x 10,000 scale and zero the meter.
3	Verify that the cable pairs are open at the end-user POT.
4	Connect the test probes to the: • Tip and Ground. ● Ring and Ground. • T1 and Ground. • R1 and Ground. NOTE: **Note the readings for each connection. The resistance must be greater than 120K ohms.**

8. **Local Loop Tests and Requirements,** continued

8.4
Loop
Resistance Test

Perform the loop resistance test to ensure that the loop resistance of each cable pair meets the objective for maximum loop resistance. For loops equipped with repeaters, check the manufacturer's instructions for loop resistance limits. This test requires a VOM.

Step	Testing Loop Resistance
1	Short the T and R at the end-user POT
2	At the DDS serving office, set the meter range to the Ohms x 100 scale and zero the meter.
3	Open the cable pairs at the OCU or OCUDP.
4	Connect the test probes to the T and R pair and note the reading. The reading must be less than 4200 ohms.
5	Repeat Steps l-4 using the T1 or R1 pair.

8.5
OCU Simplex
Voltage Test

Perform the OCU simplex voltage test to check the voltage:

• Supplied by the OCU or OCUDP
• Used for the simplex current in the loop.

This test requires a VOM.

Step	Testing the OCU Simplex Voltage
1	Set the meter to the 60V DC scale at the DDS serving office.
2	Open the loop at the OCU.
3	Connect the meter's " + " test probe to the Transmit of the OCU.
4	Connect the meter's "-" test probe to the Receive of the OCU.
5	Read the meter. The measured voltage must be: • Less than -54V DC. • More than -49V DC.

8.6
Insertion Loss
Test

Perform the insertion loss test to ensure that the Receive signal is within the normal operating range of the line receiver. The insertion loss test requires:

• Testing equipment and operators at the:
  - DDS serving office.
  - End-user POT
• Two TMSs, such as the Hewlett Packard 4935A or equivalent.

8. Local Loop Tests and Requirements, continued

8.6

Insertion Loss Test, continued

For basic DDS, take measurements at:

- Two test frequencies for 2.4 kb/s and 4.8 kb/s.
- One test frequency for 9.6 kb/s and 19.2 kb/s.
- Three test frequencies for 56 kb/s.
- One test frequency for 64 kb/s.

For DDS with SC, one additional measurement at the SC Nyquist frequency is required. If repeaters are in use in the loop, make the tests between the repeaters.

To perform the insertion loss test, perform the following steps.

Step	Site	Testing for Insertion Loss
1	DDS serving off ice	A. Set the transmit section of the TMS for 135ohm termination.
		B. Remove the OCU.
		C. Connect the TMS to the T and R pair.
		D. Adjust the oscillator for 0 dBm output level.
2	End-user POT	A. Adjust the second TMS for 135ohm receive impedance.
		B. Connect the Receive section of the TMS to the T and R pair.
		C. Consecutively adjust the TMS to the appropriate test frequencies for the loop's basic data rate (see the chart in Section 8.7).
		D. Measure the AML for each frequency and note the readings. For the acceptable limits, see the chart in Section 8.7.
3	Both sites	Repeat Steps I-2 for the T1 and R1 pair.

8. Local Loop Tests and Requirements, continued

8.7
Insertion Loss Limits

The testing frequencies and AML limits for performing the insertion loss test on **DDS** loops are shown in the following chart.

NOTE: DDS w**ith SC must also meet the limits shown in the chart in Section 8.8.**

Basic Data Rate (kb/s)	Test Frequency (k Hz)	Actual Measured Loss Limits
2.4	1.2	AML is less than or equals 34 for OCU or OCUDP and AML equals the EML value + 5 or -2.5.
	4.8	AML is less than or equals twice the value of the AML measured at 1.2 kHz.
4.8	2.4	AML is less than or equals 34 for OCU or OCUDP and AML equals the EML value + 5 or -2.5.
	4.8	AML is less than or equals AML value at 2.4 kHz + 15.
9.6	4.8	AML is less than or equals 34 for OCU or OCUDP and AML equals the EML value + 5 or -2.5.
19.2	9.6	AML is less than or equals 34 for OCU or OCUDP and AML equals the EML value + 5 or -2.5.
56	**28**	AML is less than or equals 34 for OCU or OCUDP and AML equals the EML value + 5 or -2.5.
	82	AML is less than or equals AML value at 28 kHz +20.
	48	AML equals the sum of the AML at 28 kHz plus the AML at 82 kHz divided by 2. This quantity may vary + 2.5 or -2.5.
56 Loop Section with Repeater	28	AML is less than or equals 31 and AML equals the EML value + 5 or -2.5.
	82	AML is less than or equals AML value at 28 kHz +20.
	48	AML equals the sum of the AML at 28 kHz plus the AML at 82 kHz divided by 2. This quantity can vary + 2.5 or -2.5.
64	36	AML is less than or equals 34 for OCUDP and AML equals the EML value + 5 or -2.5.

(continued)

8. Local Loop Tests and Requirements, continued

8.7
Insertion Loss Limits, continued

Basic Data Rate (kb/s)	Test Frequency (kHz)	Actual Measured Loss Limits
64 Loop Sect ion with Repeater	**36**	AML is less than or equals 31 and AML equals the EML value + 5 or -2.5.

NOTE: **The purpose of the 4800 Hz test at the lower bit rates is to verify that all load coils have been removed.**

8.8
Secondary Channel Insertion Loss Limits

The testing frequencies and AML limits for performing the insertion loss test on DDS loops with SC are shown in the following chart.

Primary Channel Bit Rate (kb/s)	Signal Rate (kb/s)	Test Frequency (Hz)	Secondary Channel Actual Measured Loss Limits (dB)
2.4	3.2	1600	$\leqq$ **34**
4.8	6.4	3200	534
9.6	12.8	**6400**	$\leqq$ **34**
19.2	25.6	12800	$\leqq$ **34**
56.0	72.0	36000	$\leqq$ **34**

8.9
Background Noise Test

The background noise test checks the idle circuit noise on the cable pairs. The background noise test requires:

- Testing equipment and operators at the:
  - DDS serving office.
  - End-user POT
. Two TMSs.

8. **Local Loop Tests and Requirements,** continued

8.9
**Background
Noise Test,
continued**

To perform the background noise test, perform the following steps.

Step	Site	Testing for Background Noise
1	DDS serving off ice	A. Set the TMS for 135ohm termination, wideband weighted. 8. Set the TMS function switch on Noise. C. Connect the Transmit section to the T and R pair. D. Connect the Receive section to the TI and RI pair.
2	End-user POT	A. Set the second TMS for 135ohm termination, wideband weighted. B. Set the TMS function switch on Noise. C. Connect the Transmit section to the TI and RI pair. D. Connect the Receive section to the T and R pair.
3	Both sites	Read the meter. Background noise must meet the requirements shown in the chart in Section 8.10.

**8.10
Background
Noise Limits**

The bit rates and maximum allowable noise levels for the background noise test on DDS loops are shown in the following chart.

Primary Channel Bit Rate (kb/s)	Bit Rate (kb/s)	Maximum Noise Level (dBrn)
2.4 (without SC)	2.4	49
2.4 (with SC)	3.2	48
4.8 (without SC)	4.8	46
4.8 (with SC)	6.4	45
9.6 (without SC)	9.6	38
9.6 (with SC)	12.8	37
19.2 (without SC)	19.2	36
19.2 (with SC)	25.6	34

(continued)

8. Local Loop Tests and Requirements, continued

8.10
Background
Noise Limits,
continued

Primary Channel Bit Rate (kb/s)	Bit Rate (kb/s)	Maximum Noise Level (dBm)
56.0 (without SC)	56.0	35
56.0 (with SC)	72.0	34
64. 0	72.0	34

8.11
Impulse Noise
Test

The impulse noise test must be performed **after** the background noise test. The impulse noise test requires:

- Testing equipment and operators at the:
  - DDS serving office.
  - End-user POT
. Two TMSs.

For 56 kb/s and 64 kb/s repeatered loops, the tests are made for each section.

To perform the impulse noise test, perform the following steps.

Step	Site	Testing for impulse Noise
1	DDS serving off ice	A. Set the TMS for 135ohm termination. B. Set the TMS function switch on Impulse Noise. C. Set the TMS threshold to the appropriate setting (see the chart in Section 8.12). D. Connect the Transmit section to the T and R pair. E. Connect the Receive section to the TI and RI pair.
2	End-user POT	A. Set the second TMS for 135-ohm termination. B. Set the TMS function switch on Impulse Noise. C. Set the TMS threshold to the appropriate setting (see the chart in Section 8.12). D. Connect the Transmit section to the TI and RI pair. E. Connect the Receive section to the T and R pair.
3	Both sites	Note the impulse noise readings. Impulse noise measured at both ends of the circuit must meet the requirements shown in the chart in Section 8.12.

8. Local Loop Tests and Requirements, continued

8.12
Impulse Noise Limits

The thresholds and maximum allowable impulse noise counts per E-minute period for performing the impulse noise test are shown in the following chart.

Primary Channel Bit Rate (kb/s)	Signal Rate (kb/s)	*Limit for 1 %-Ohm Input Set Threshold (dBrn)	Maximum Number of Impulse Noise Counts in 15 Minutes
2.4 (without SC)	2.4	65	7
2.4 (with **SC)**	**3.2**	**64**	7
4.8 (without SC)	4.8	62	7
4.8 (with SC)	6.4	61	7
9.6 (without SC)	9.6	54	7
9.6 (with SC)	**12.8**	**53**	**7**
19.2 (without SC)	19.2	52	7
19.2 (with SC)	25.6	50	7
56.0""" (without SC)	56.0	51	7
56.0* (with SC)	72.0	50	7
64**	72.0	50	7

* Many NMSs have 135-ohm inputs.
** For 56 kb/s and 64 repeatered loops, the limit applies to each repeater section.