

U S WEST
Communications, Inc.
Technical Publication

Local Area Data Service (LADS)

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Technical Publication

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1. General

This publication provides information on Local Area Data Channels, U S WEST standard offering of private line channels for limited distance data transmission. These channels are intended to be used with the type of data communications equipment generally referred to as limited distance data set, or limited distance modem, which require transmission facilities with characteristics similar to those of non-loaded metallic cable pairs. The arrangements and transmission parameters discussed apply in general to channels offered in state tariffs.

Local Area Data Channels are offered for the connection of two customer terminal locations within a single serving wire center area. Provision of these channels is dependent on the availability of appropriate facilities and does not contemplate construction of such facilities expressly for this service over any route other than that over which U S WEST would normally provide this service. The customer should also be aware that U S WEST has no obligation to continue to provide this service if suitable facilities are no longer available. Nonavailability of suitable facilities may be caused by the continuing need to add new central offices and to transfer areas between serving wire centers, and the increasing use of Digital Loop Carrier technology on lines between the serving wire center and customers locations.

Equipment connected to these channels must use the frequency spectrum above voiceband for the transmission of non-spurious signals (i.e., signals which if band-pass filtered to contain only voiceband frequencies would lose their intelligibility) and must conform to the requirements for maximum signal power and applied voltages and currents which are specified under Interface Criteria in Chapter 4 of this publication. The requirements permit higher signal levels than allowed on channels normally provided for voiceband transmission (particularly the voiceband public switched network) because only cable facilities are used for this service and because special administrative procedures are used to prevent interference with other sensitive services.

2. Service Arrangements Provided

Local Area Data Channels are offered solely for the transmission of data signals between two points located within the same Telephone Company serving wire center area. Channels may be made available for distances up to six cable route miles. Interconnection of more than two points (i.e., multipoint circuits) will not be provided.

2.1 Types of Local Area Data Channels

Channels may be requested in either one of two configurations: 2-wire or 4-wire. The 2-wire type is implemented with 2-wire cable facilities and presents a 2-wire interface to the data set. The 4-wire type implemented with 4-wire cable facilities, presents a 4-wire interface, and allows for two directions of transmission simultaneously.

2.2 Determination of Channel Length

Upon receipt of a customer request (see questionnaire example in Appendix A) for a Local Area Data Channel, U S WEST will determine if there are suitable facilities available and the channel length that can be provided. Channel length is determined by the actual physical length of the facilities used. Physical proximity between the customer terminal locations to be connected is not an indication of channel length or even that the channel can be provided at all. If the terminal locations are served by different wire centers or the overall length of the facilities exceeds six route miles, then a channel cannot be provided under this service offering and the customer will be so notified.

OPTIONAL CHANNEL PERFORMANCE:

OPTIONAL FEATURES	NCI CODE		CHANNEL LENGTH (MILES)	MAXIMUM RESISTANCE (OHMS)
	EU-A	EU-Z		
2 POINT				
Local Area Data Service (LADS)	02LD5	02LD5	1	500
	04LD5	04LD5	2	1000
			3	1500
			4	2000
			5	2500
			6	3000

Notes:

- LADS is offered intra-office only.
- LADS requires nonloaded metallic facilities and therefore is offered where, at the option of U S WEST facilities and operational conditions permit.
- The channel 6 miles.

4. Electrical Interface Criteria

4.1 Signal Power Requirements

To prevent interference with other telecommunication services and to protect Telephone Company personnel against hazardous voltages and currents, all the signal power requirements specified in this section, must be complied with. The requirements limit the maximum metallic and longitudinal voltages and current at the channel interface. They apply to all possible data signal sequences (e.g., such patterns as all-ones, all-zeros, 101010..., 11001100..., random data, etc.) under all operating states of the terminating equipment.

- Weighted RMS Voltage Limitation
 - The weighted root-mean-squared (rms) metallic voltage in the 10 Hz to 4 kHz frequency range shall not exceed the maximum indicated below, when averaged over 100 milliseconds. This limit applies to the metallic voltage that is the result of all the component voltages in this band, after weighting according to the graph in Exhibit 1. The graph in Exhibit 1 has an absolute gain of unity between 1 and 4 kHz.

<u>Frequency Range</u>	<u>Maximum RMS Voltage</u>
10 Hz to 4 kHz	+ 8 dBV* (2.5 volts)

- RMS Voltage in 100-Hz Bands
 - The root-mean-squared (rms) metallic voltage in all of the possible 100-Hz bands centered at frequencies within the range extending from 200 Hz to 1 MHz shall not exceed the following limits, when averaged over 100 milliseconds.

<u>Center Frequency of 100-Hz Band</u>	<u>Maximum RMS Voltage in 100-Hz Band Centered at f</u>
200 Hz to 680 Hz	$(-30 \log_{10} f)$ dBV
680 Hz to 4 kHz	+5 dBV
4 kHz to 4.6 kHz	-0.5 dBV
4.6 kHz to 5.45 kHz	$(59.2 - 90 \log_{10} f)$ dBV
5.45 kHz to 59.12 kHz	$(7.7 - 20 \log_{10} f)$ dBV
59.12 kHz to 300 kHz	$(43.1 - 40 \log_{10} f)$ dBV
300 kHz to 1MHz	-56 dBV

Where f = center frequency in kHz of each of the possible 100-Hz bands

dBV = $20 \log_{10}$ (voltage in rms volts)

Exhibit 2 shows a graphical representation of these limits.

- RMS Voltage in 8-KHz Bands
- The rms metallic voltage in all of the possible 8-kHz bands centered at frequencies within the 8 kHz to 1MHz frequency range shall not exceed the following limits, when averaged over 100 milliseconds:

<u>Center Frequency of 8-Hz Band</u>	<u>Maximum RMS Voltage in 8-kHz Band Centered at f</u>
8 kHz to 120 kHz	(17.6 - 20 log ₁₀ f) dBV
120 kHz to 757 kHz	(59.2 - 40 log ₁₀ f) dBV
757 kHz to 1 MHz	-56 dBV

Where f = center frequency in kHz of each of the possible 8-kHz bands

dBV = 20 log₁₀f (voltage in rms volts)

Exhibit 3 shows a graphical representation of these limits.

- Peak Voltage Limitation
- The peak metallic voltage of signals at frequencies above 1 kHz must not exceed 25 dBV (17.8 volts rms).
- Longitudinal Voltage Limitations
- The longitudinal voltage shall not exceed the limits indicated below, when determined from measurements across the specified longitudinal and metallic terminations.
 - Voltage in the 10 Hertz to 4 kHz Frequency Range
 - The weighted rms voltage averaged over 100 milliseconds that is the result of all the component longitudinal voltages in this frequency range, after weighting according to the graph in Exhibit 4, shall not exceed the maximum indicated below. The graph in Exhibit 4 has an absolute gain of unity at 4 kHz.

<u>Frequency Range</u>	<u>Max RMS Voltage</u>	<u>Longitudinal Terminating Impedance</u>	<u>Metallic Terminating Impedance</u>
10 Hz to 4 kHz	-30 dBV (31.6 mV)	500 ohms	600 ohms

- Voltage in the 4 kHz to 1 MHz frequency range shall not exceed the limits indicated below, when averaged over 100 milliseconds:

The rms voltage in all of the possible 8-kHz bands within this

<u>Center Frequency of 8-kHz Band</u>	<u>Max RMS Voltage in 8-kHz Band Centered at f</u>	<u>Longitudinal Terminating Impedance</u>	<u>Metallic Terminating Impedance</u>
8 kHz to 12 kHz	(-18.4 - 20 log ₁₀ f) dBV	500 ohms	300 ohms
12 kHz to 60 kHz	(3-40 log ₁₀ f) dBV	90 ohms	135 ohms
60 kHz to 90 kHz	-68 dBV	90 ohms	135 ohms
90 kHz to 1 MHz	-62 dBV	90 ohms	135 ohms

Where f = center frequency in kHz of each of the possible 8-kHz bands

dBV = 20 log₁₀ (voltage in rms volts)

Exhibit 5 shows a graphical representation of these limits.

- Maximum Current and Voltages
- Under no circumstances shall the current and voltages (including all harmonics and spurious signals) at the channel interface exceed the limits indicated below.
 - Where channels with dc continuity are provided, the following limits apply:
 - The rms current per conductor, including dc and ac components, shall not exceed 250 milliamperes.
 - The voltage between the tip and ring connections shall not exceed 36 volts peak.
 - The voltage between any conductor and ground shall not exceed 54 volts peak. In addition, any dc component must be negative with respect to ground, except during brief maintenance periods.
 - Where channels without dc continuity are provided, the following limits apply:
 - The dc current per conductor shall not exceed 0.5 milliamperes.
 - The voltage between the tip and ring connections shall not exceed 18 volts AC peak, nor 2.02 volts dc.
 - The total weighted rms voltage within the frequency range extending below 500 Hz shall not exceed 12 volts. This limit applies to the voltage between the tip and ring connections, after weighting according to the following function:

$$H(f) = 600/f$$
 where f is the numerical value of the frequency in Hertz.
- Coherent Keying

- When several Local Area Data Channels occupying the same cable are keyed coherently, the noise level in the cable may increase significantly and cause interference among existing services. To prevent interference, it may be necessary to reduce the maximum allowable signal levels detailed in the subsection entitled Signal Power Requirements, first five items, or the number of transitions occurring simultaneously. To reduce the number of transitions occurring simultaneously, it is recommended that equipment which may transmit over a large number of channels at the same time be arranged to stagger the transitions in time over a nominal signal element such that simultaneous transitions from more than one disturber occur randomly.

4.2 Determination of Compliance*

Compliance with the signal power limitations specified in the previous section, first five subsections, can be determined by using the circuits shown in Exhibits 6 and 7 or equivalent channel simulations. Exhibit 6 illustrates test circuits intended for demonstrating compliance with the metallic voltage requirements while Exhibit 7 provides a set of terminations that may be used in determining compliance with the longitudinal voltage requirements.

* Compliance with signal power limitations may be affected by the following considerations associated with terminating equipment: All possible data signal sequences, all operating states, loop current which may be drawn for such purpose as loopback, application of ground to exposed conductive surfaces, the length of interface leads to other equipment and their terminations, connections to external ground, and any optional connection, if it exists, of an interface signal ground reference (power supply secondary) to green wire ground.

For equipment with a 4-Wire line interface, compliance should be determined for each tip-ring interface with the tip-ring interface not under test terminated in a metallic and longitudinal impedance as specified for the interface under test.

The longitudinal voltage limitations, specified in the subsection entitled "Signal Power Requirements," also apply in the presence of a single frequency tone applied from a balanced source (with metallic terminating impedance R_m) across tip-ring interface, with the resultant longitudinal voltage measured across a longitudinal termination (R_l). The limitations apply with the tone at any frequency up to 300 kHz and with its voltage adjusted to produce a metallic voltage, across the tip-ring interface, up to the maximum rms voltages specified in the subsection "Longitudinal Voltage Limitations," for the various frequency bands of concern.

The subsections "RMS Voltage in 8-KHz Bands" and "Longitudinal Voltage Limitations", specify voltage limits "in all of the possible 8-kHz bands" within the indicated frequency ranges. Common laboratory equipment is not normally equipped with a bandwidth resolution of 8-kilohertz. However, many spectrum analyzers are equipped with a 10-kilohertz bandwidth resolution. Use of the latter is acceptable for assuring compliance with the voltage limitations of those Sections, as long as the equipment under test meets the limitations. However, if the equipment under test fails to meet the limitations in any 10-kilohertz band, then it may not meet the same in the corresponding 8-kilohertz band.

4.3 Network Electrical Environment

Interface leads may be connected to cable facilities which are subject to lightning hits and accidental power crosses. Although protectors are installed on the customer's premises to limit the effect of such occurrences, residual voltages of significant magnitudes may appear on the interface leads. Therefore, it is recommended that customer-provided terminal equipment be adequately isolated at its interface with the channel, to prevent equipment failure and/or hazard to users.

Bell Communications Research's Technical Reference "Lightning and 60Hz Disturbances at the Bell Operating Company Network Interface", TR-EOP-000001, dated June, 1984, provides additional information on the non-telephone voltages and currents that may be encountered at the interfaces with U S WEST facilities.

5. Transmission Facility Parameters

The transmission facility parameters covered in this section represent potential impairments to a data signal that can be caused the transmission facility in conjunction with the environment in which it operates. The values specified for insertion loss are maximums that should not be exceeded unless a trouble condition exists. The noise values, on the other hand, represent maximums that should not be exceeded under the normal range of circumstances. Because of the nature of this service offering and in view of the influence that the environment can have on facilities, the background and impulse noise levels specified should be regarded as a guide. No guarantee is implied that these levels will not be exceeded, since there may be unusual conditions not under the control of U S WEST.

5.1 Insertion Loss

The insertion loss limits of Local Area Data Channels are specified below, for channels up to six route miles in length. The limits represent the maximum end-to-end losses at the various frequencies indicated, when the channel is terminated in 135 ohm resistive impedances at both ends. The actual insertion loss may be lower depending on the exact length and type of cable facilities used to provide the channel. However, no guarantee is made of minimum values of insertion.

INSERTION LOSS LIMITS FOR 135 OHM TERMINATIONS

Maximum End-to-End Channel Length <u>In Route Miles</u>	*Maximum Measured Loss(dB)				
	<u>1000 Hz</u>	<u>2400 Hz</u>	<u>Frequency</u> <u>4800 Hz</u>	<u>9600 Hz</u>	<u>19200 H</u>
1	10.5	12.0	15.0	19.0	22.5
2	14.5	16.5	20.5	27.5	35.5
3	18.0	21.0	27.0	36.5	50.0
4	21.0	26.0	34.0	46.0	69.0
5	23.5	30.5	39.5	53.5	85.5
6	26.5	33.0	43.5	58.5	99.5

*Includes the 500Z Channel Protection Unit Loss

5.2 Background Noise

The background noise specified for these channels reflects contributions from two main sources of noise in the telephone loop plant: induction for power lines and crosstalk from other telecommunication services. The values indicated are intended as a guideline on the maximum metallic noise voltage levels that should be expected when a channel is terminated in 135 ohms resistive metallic impedances. It should be noted, however, that the actual noise voltages present at the interface may exceed the indicated levels, and depend on the metallic and longitudinal terminating impedances and the longitudinal-to-metallic balance of the data sets. The noise voltage levels indicated below are based on terminations with longitudinal impedance equal to or greater than 10,000 ohms* and with longitudinal-to-metallic balance** equal to or greater than the balance objective shown in Exhibit 8.

* The longitudinal requirement applies over the frequency range of 60 to 660 Hz. At 60 and 180 Hz, it applies to rms voltage of 1 volt superimposed on a 60 Hz voltage of up to 50 volts rms. (For equipment that has longitudinal impedance, which is independent of voltage, up to 50 volts rms, the impedance at higher frequencies does not have to be determined in the presence of the 60 Hz voltage.)

** See Glossary for the definition of this requirement.

The guideline for the background noise voltages levels of Local Area Data Channels is as follows:

- Tones in 60 to 660 Hz Band: Noise in this band results from power line induction (60 Hz and associated harmonics) with major contributions from 60 Hz and its odd harmonics up to 660 Hz as follows:

<u>Frequency (Hz)</u>	<u>Noise Voltage Level in dBV</u>
60	-50
180	-60
300	-70
420	-76
540	-81
660	-85

Tones will be present at all frequencies. However, at the levels indicated only two tones may be present simultaneously.

- Noise in 600 Hz to 24 kHz Band:
 - The rms noise voltage level (in dBV) in any 4-kHz band centered at f , where f ranges from 2.6 kHz to 22 kHz, is a weighted function of frequency equal to
$$\frac{[-80 - 10.2 \log_{10} f \text{ (kHz)}]}{2.6} \text{ dBV}$$
- Noise in 24 kHz to 80 kHz Band:
 - The rms noise voltage level (in dBV) in any 8-kHz band centered at f , where f ranges from 28 kHz to 76 kHz, is a weighted function of frequency equal to
$$\frac{[-87 + 30 \log_{10} f \text{ (kHz)}]}{28} \text{ dBV}$$
- Noise above 80 kHz:
 - The rms noise voltage level in any 8-kHz band centered at f , where f is equal to or greater than 84 kHz, is -74 dBV.

Exhibit 9 shows a graphical representation of this guideline.

5.3 Impulse Noise

Impulse noise is characterized by large peaks or impulses in the total noise waveform. It is measured with an instrument which responds to noise waveform excursions above a selectable power threshold, using a counter having a maximum counting rate of 7 counts per second. Because of this maximum counting rate, once a count occurs, further counts will not be made for an interval of 150 milliseconds.

The impulse noise measurement for Local Area Data Channels involves counting the number of noise peaks exceeding a threshold of 50 dB_{rn} (-40 dBm), over the frequency range extending from 50 Hz to 25 kHz. The limit is a maximum of 15 counts in 15 minutes, with the channel terminated in 135 ohm resistive impedances.

In general, impulse noise may be expected to decrease with channel length for channels with 4 miles or greater length. For example, the maximum count indicated above is not expected to be exceeded when the threshold is reduced by the amount in dB that the 1004-Hz insertion loss (referenced to 135 ohm terminations) of the 4- or 6-mile channel under consideration exceeds 18 dB.

The reader should be aware that the stated threshold of 50 dB_{rn} represents the actual power developed across 135 ohms. When test equipment calibrated to read power into 600 ohms is connected in the bridging mode across a 135-ohm termination, an adjustment of -6 dB is required. In this case the adjusted threshold becomes 44 dB_{rn}.

5.4 DC Loop Resistance

Where direct current continuity is provided, the dc loop resistance of the channel will depend on the actual length and gauge of the cable facilities used. However, it should not exceed 3000 ohms, the upper value corresponding to a 6-mile channel.

6. Maintenance Considerations

When trouble is experienced with a Local Area Data Channel employing customer provided terminal equipment, the customer should first isolate (sectionalize) and check his portion of the system before reporting any trouble. This will preclude the customer from incurring a service charge for visits by U S WEST to the customer's premises where the service difficulty or trouble report results from the use of equipment provided by the customer. U S WEST will test the transmission characteristics of the channel and will correct those problems resulting from defective operation of their equipment or facilities, but will not assume responsibility for locating trouble in the customer's equipment. U S WEST will not endorse the recommendations of a particular supplier of terminal equipment or give advice as to whether the terminal equipment can perform satisfactorily or is compatible with the channel.

7. Interface Illustrations

7.1 Interface type 02LD5

APPLICATION: Connects IC or end user Limited Distance Data Sets to a U S WEST Local Area Data Service (LADS).

OPERATING MODE: Limited Distance Data Transmission.

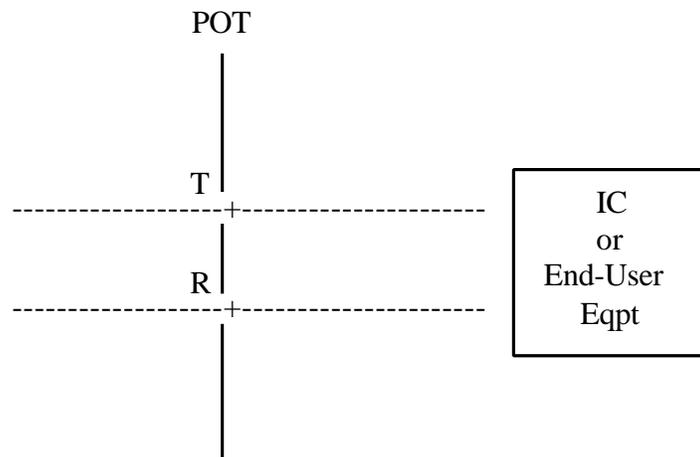
PHYSICAL DESCRIPTION: 2 - Wire (T,R)

LENGTH OF FACILITIES: Up to 6 miles

IMPEDANCE: 135 ohms

ILLUSTRATION:

U S WEST Communications, Inc.



7.2 Interface type 04LD5

APPLICATION: Connects IC or end user Limited Distance Data Sets to a U S WEST Local Area Data Service (LADS).

OPERATING MODE: Limited Distance Data Transmission.

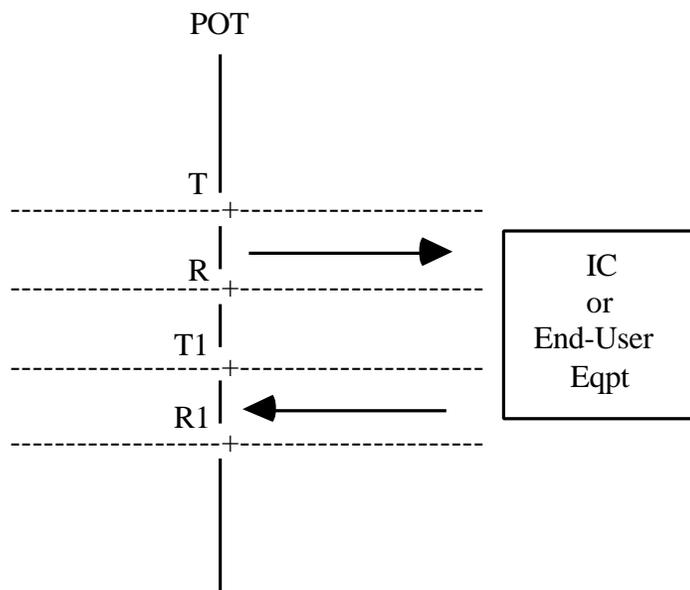
PHYSICAL DESCRIPTION: 4 - Wire (T,R, T1, R1)

LENGTH OF FACILITIES: Up to 6 miles

IMPEDANCE: 135 ohms

ILLUSTRATION:

U S WEST Communications, Inc.



8. Local Area Data Service (LADS) Questionnaire

Exhibit 10 is a copy of the LADS questionnaire. The information requested on this form will be used to provide Local Area Data Service as described in U S WEST Communications, Inc. Technical Publication 77314, (See Exhibit 10).

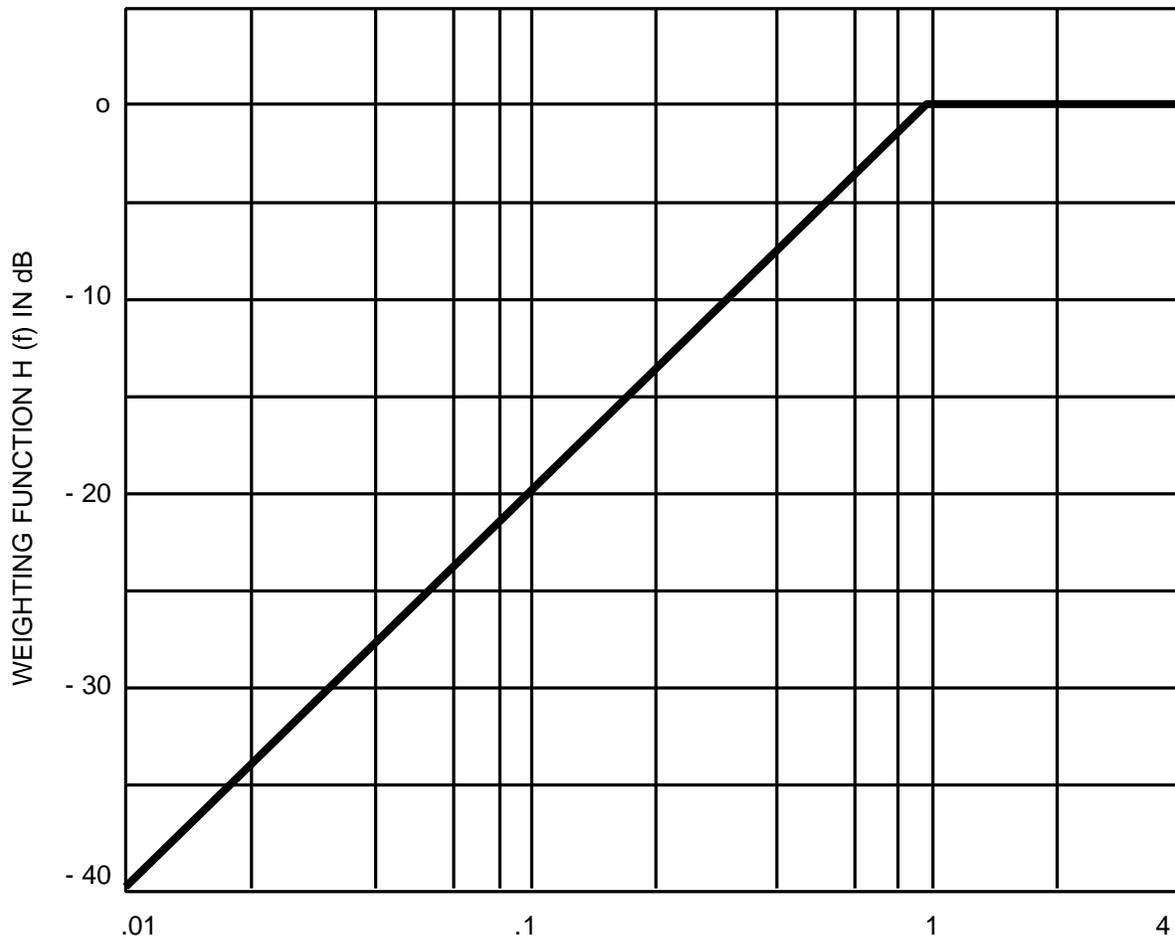
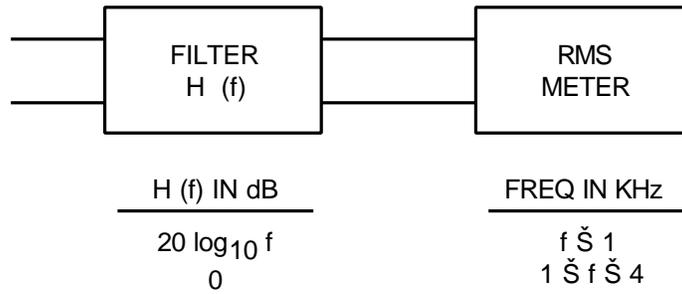


Exhibit 1 Weighting Function For Metallic Voltage Limitation
10 Hz To 4 KHz Frequency Range Local Area Data Service (LADS)

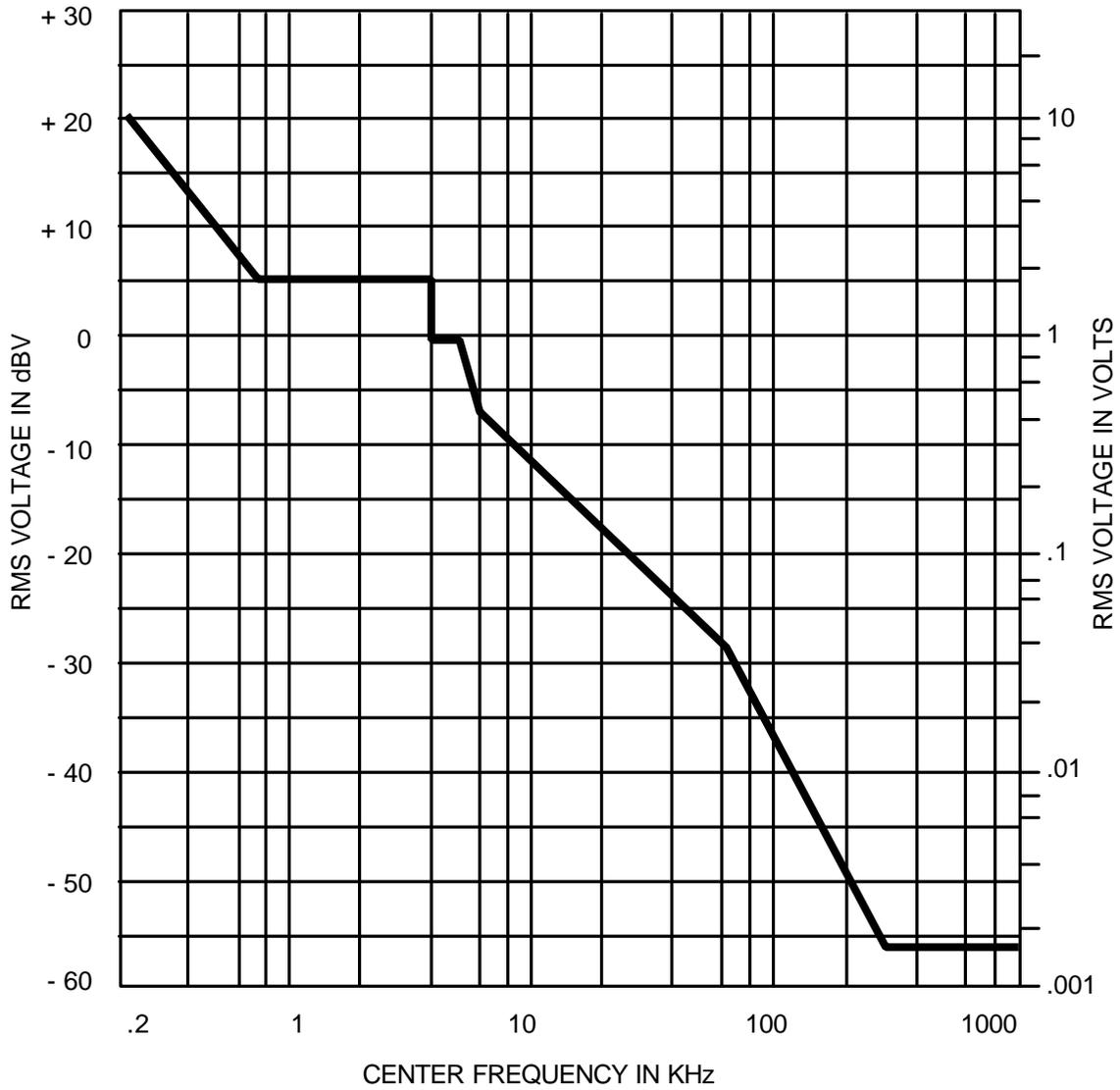


Exhibit 2 Maximum Metallic Voltage In 100-Hz Bands
150 Hz To 1 Mhz Frequency Range Local Area Data Service (LADS)

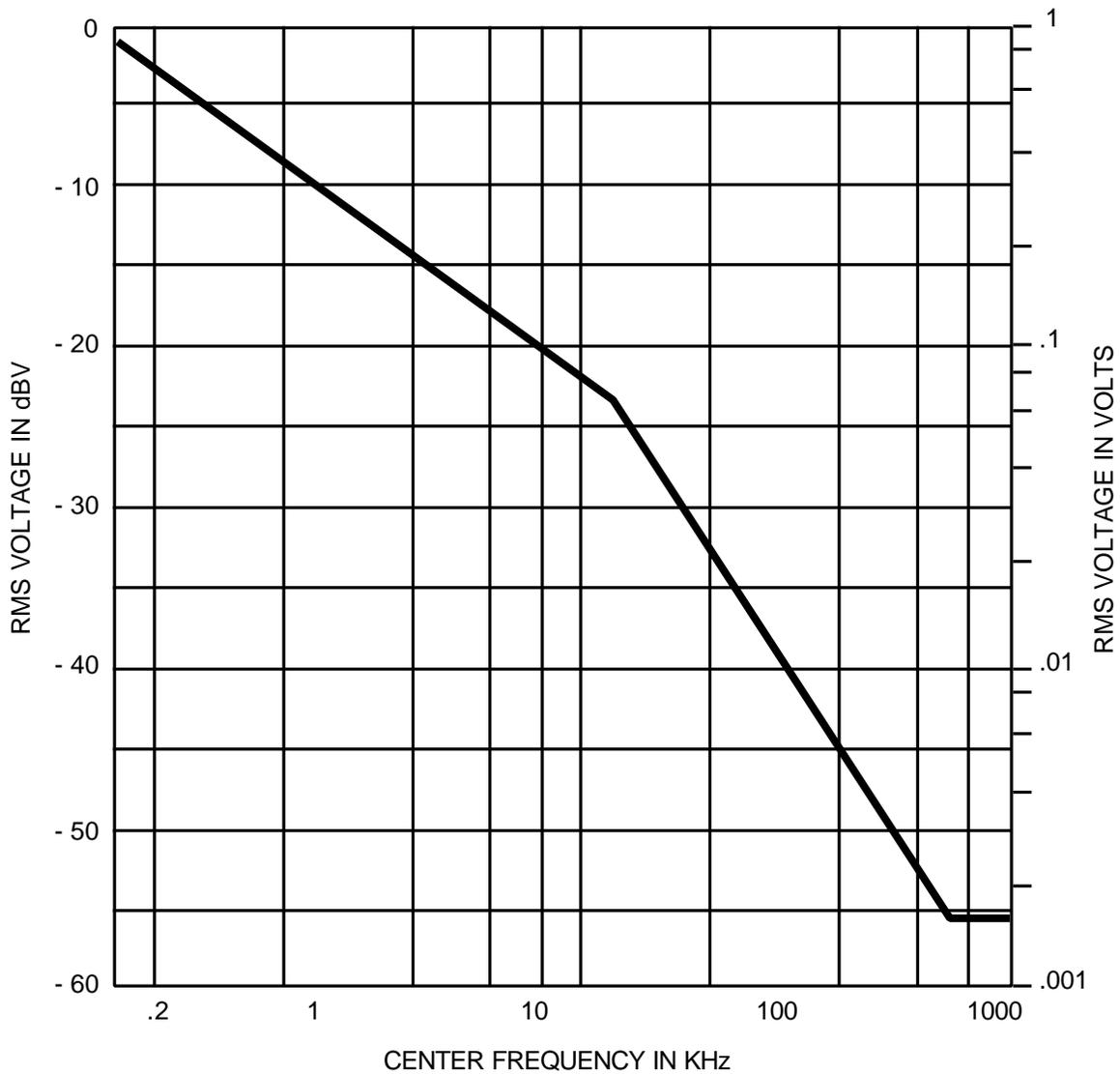
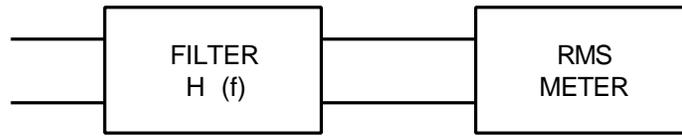


Exhibit 3 Maximum Metallic Voltage In 8-Khz Bands
4 KHz To 1 Mhz Frequency Range Local Area Data Service (LADS)



$$H(f) = -(12 - 20 \log_{10} f)$$

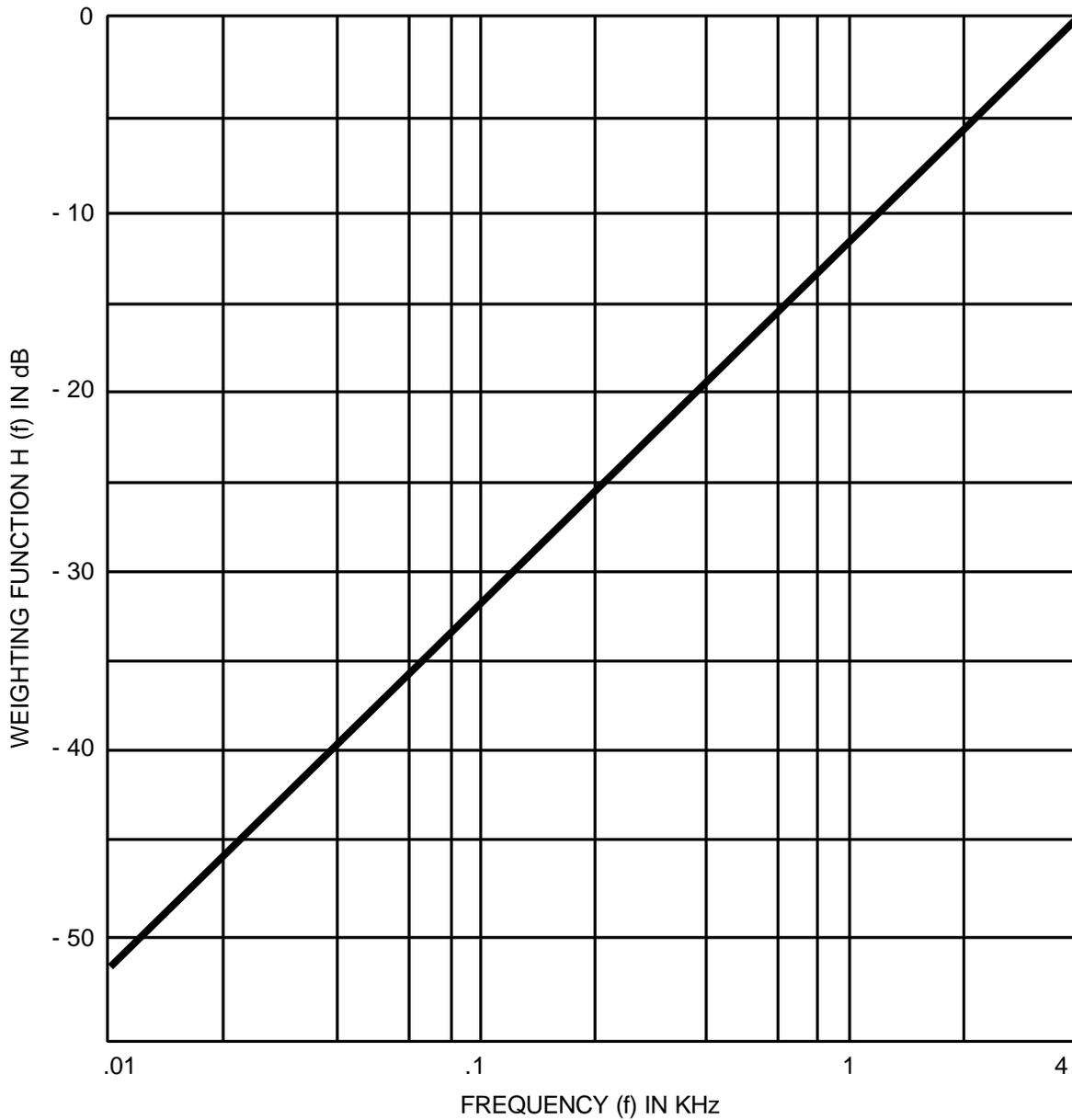


Exhibit 4 Weighting Function For Longitudinal Voltage Limitation
10 Hz To 4 kHz Frequency Range Local Area Data Service (LADS)

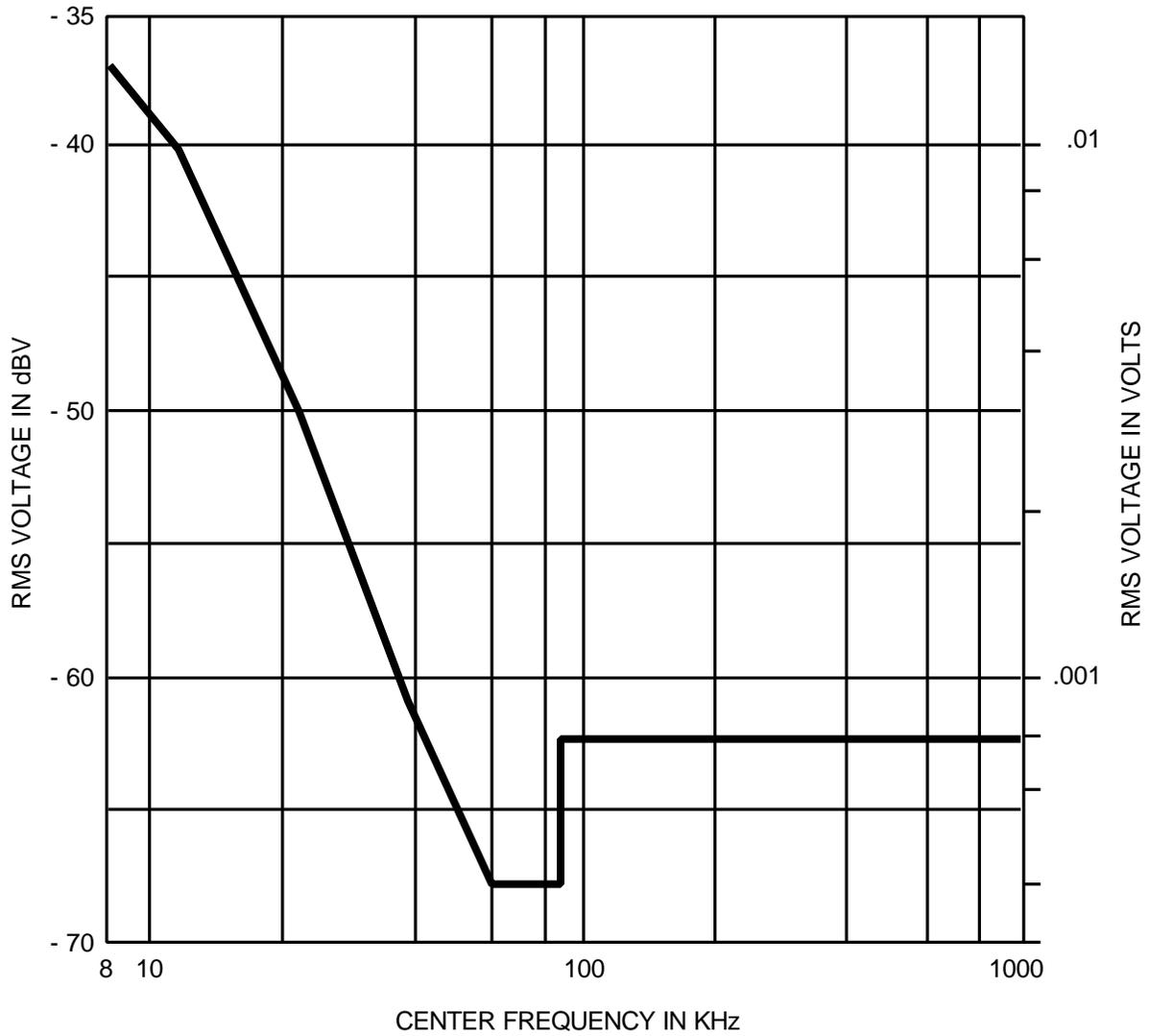
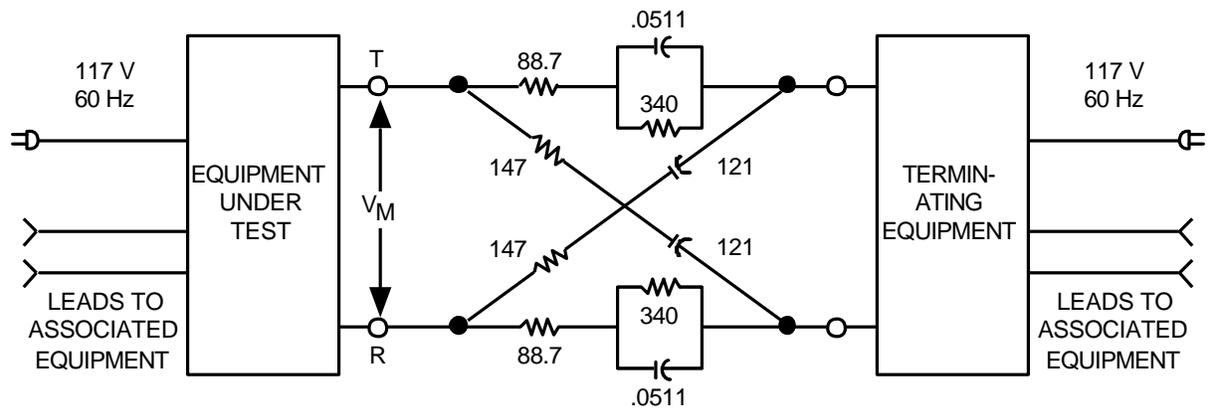


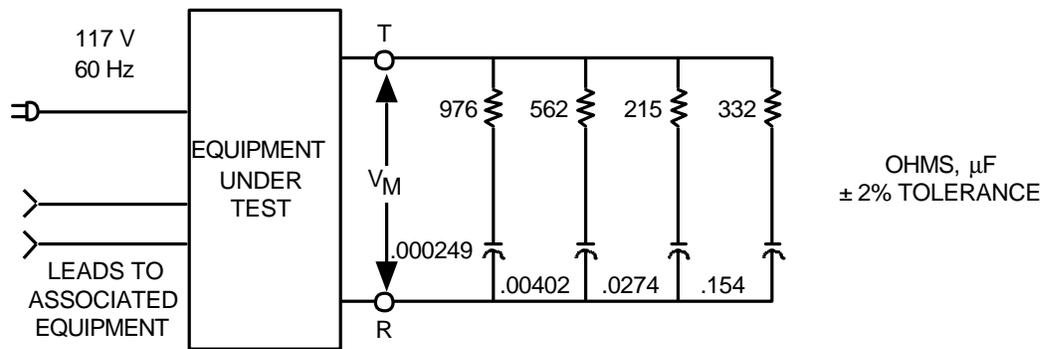
Exhibit 5 Maximum Longitudinal Voltage In 8-Khz Bands
4 kHz To 1 MHz Frequency Range Local Area Data Service (LADS)



OHMS, μ F, $\pm 2\%$ TOLERANCE

*EQUIPMENT NORMALLY USED FOR COMMUNICATION WITH EQUIPMENT UNDER TEST

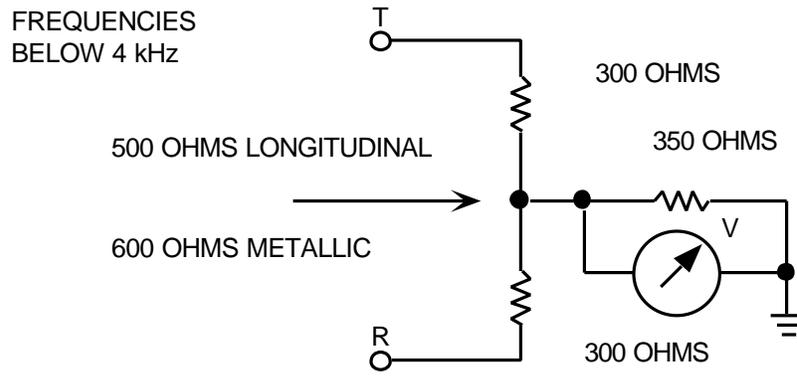
TEST CIRCUIT FOR FREQUENCIES BELOW 20 kHz



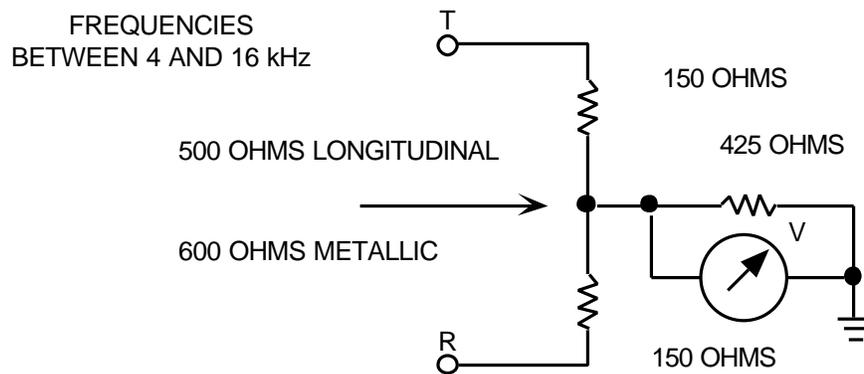
OHMS, μ F
 $\pm 2\%$ TOLERANCE

TEST CIRCUIT FOR FREQUENCIES ABOVE 12 kHz

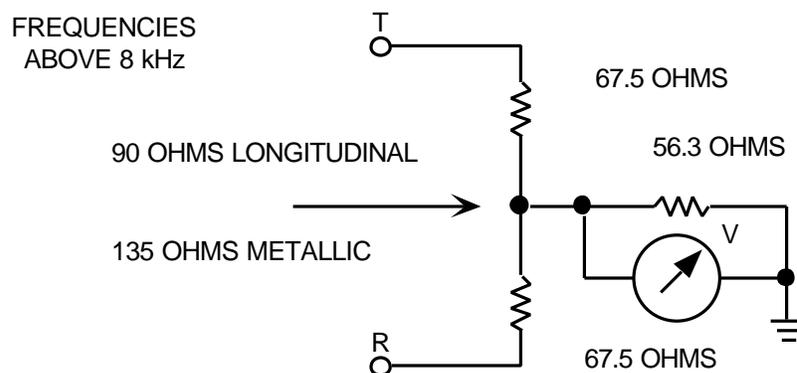
Exhibit 6 Metallic Voltage Test Circuits Local Area Data Service (LADS)



$$V_{\text{LONGITUDINAL}} (\text{dB}) = V (\text{dB}) = 3.1 \text{ dB}$$



$$V_{\text{LONGITUDINAL}} (\text{dB}) = V (\text{dB}) = 1.4 \text{ dB}$$



$$V_{\text{LONGITUDINAL}} (\text{dB}) = V (\text{dB}) = 4 \text{ dB}$$

Exhibit 7 Longitudinal Voltage Test Circuits Local Area Data Service (LADS)

$$\text{BALANCE}_{l-m} = 20 \log_{10} \left| \frac{e_l}{e_m} \right|$$

e_l = applied longitudinal voltage
 e_m = resultant metallic voltage

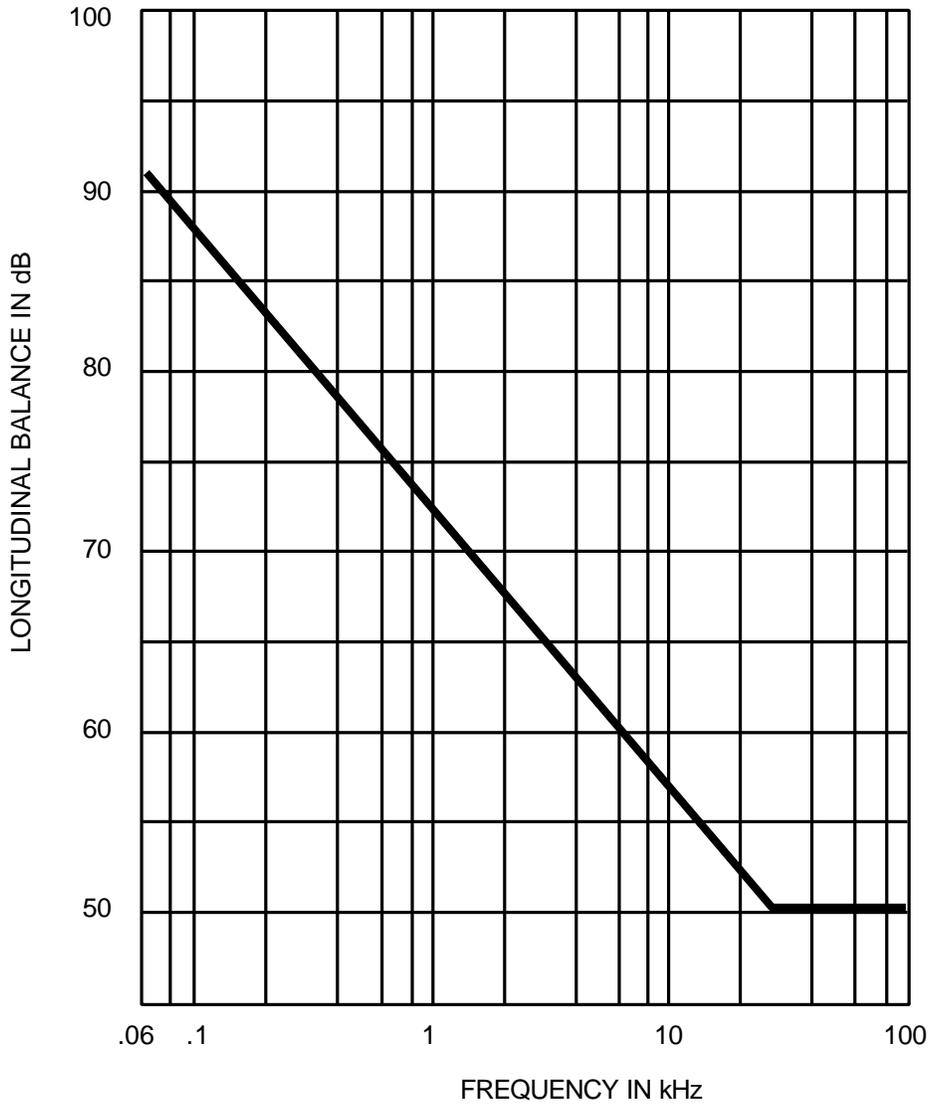
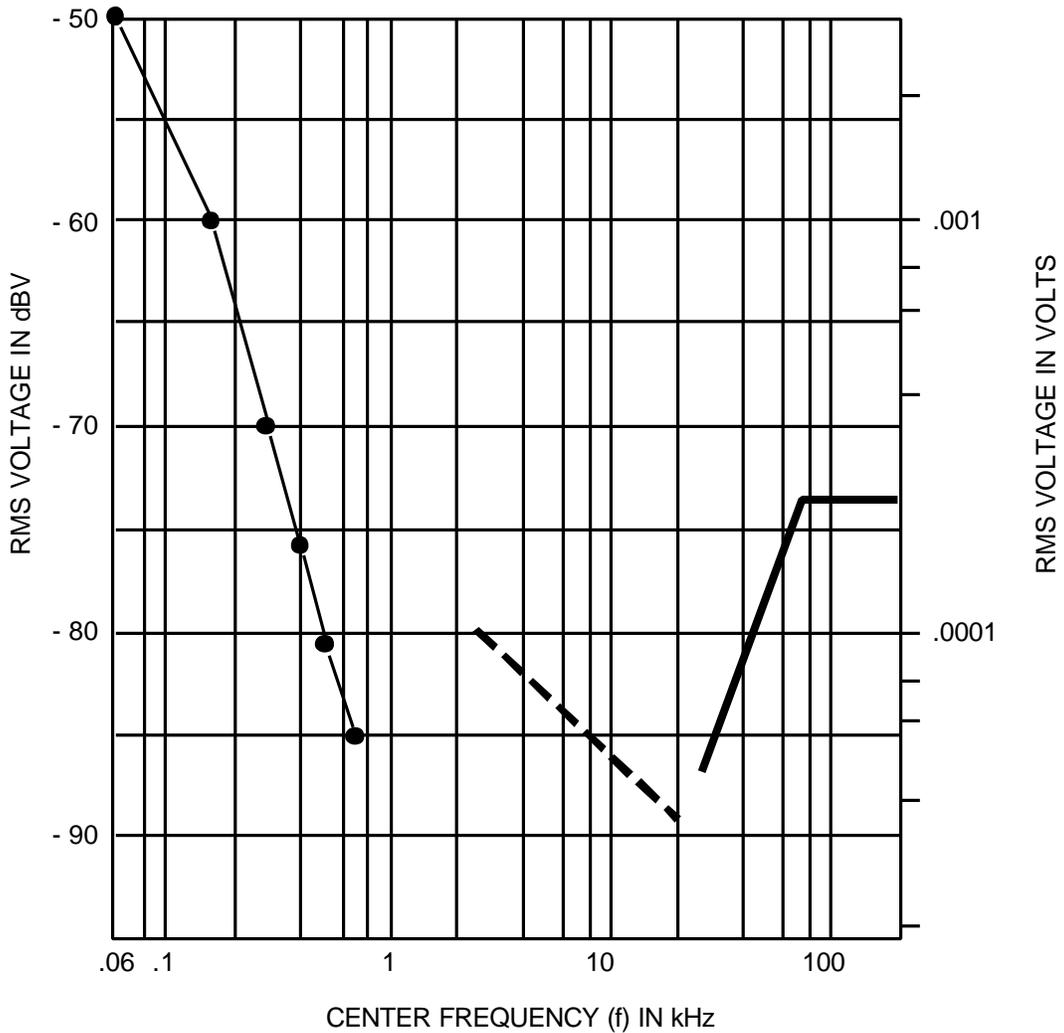


Exhibit 8 Longitudinal-to-Metallic Balance
Objective Local Area Data Service (LADS)



- RMS VOLTAGE PF 60 Hz AND HARMONICS UP TO 660 Hz
- - - - - RMS VOLTAGE OF NOISE IN 4 kHz BAND CENTERED AT f, WHERE 2.6 KHZ ≤ f ≤ 22 kHz
- RMS VOLTAGE OF NOISE IN 8 kHz BAND CENTERED AT f, WHERE f ≥ 28 kHz

Exhibit 9 Background Noise Voltages Local Area Data Service (LADS)

Local Area Data Service (LADS)
Questionnaire

The information requested on this form will be used to provide Local Area Data Service as described in U S WEST PUB 77314.

Date _____
Customer's Name _____ Telephone No. _____
Address _____ Customer Contact Name _____
Telephone No. _____

Address of Customer Terminations: (Street Address, City, and Telephone Number) (Use extra sheet if needed)

(Transmit Address) _____
(Transmit Telephone #) _____
(Receive Address) _____
(Receive Telephone #) _____

Your Telephone Company Representative: _____ Enter Info. When Service Ordered
Name _____ Order No. _____
Address _____ Circuit No. _____
Telephone No. _____ Due Date _____

I. General Characteristics (Customer Provided Modem)

1. Type of Service: _____ Digital: _____ Analog: _____
2. Mode of Operation: _____ 1-way: _____ 2-way nonsimult.: _____ 2-way simult.
3. Method of Termination: _____ 2-wire: _____ 4-wire

II. Data Set Characteristics (Customer Provided Modem)

1. Manufacturer _____ Model Number _____
2. Speed (s) _____ bps
3. The customer agrees that the above complies with the specifications as stated in the U S WEST Pub 77314, Local Area Data Service (LADS) Channels, or PUB 43401, Transmission Specifications for Private Line Metallic Circuits. (This information is generally supplied by the modem manufacturer.)
Specify: Yes _____ or No _____

III. Network Channel Interface Requested: _____ 02LD5
_____ 04LD5

IV. Engineer Contact Name:

Tel. No.: _____
Service to be Provided: Yes _____ No _____
Max. Tel. Co. Modem Speed Permitted _____ bps
Channel Loaded _____ Non-Loaded _____
Channel Length _____

Exhibit 10 Local Area Data Service (LADS) Questionnaire

9. Definitions

9.1 Acronyms

LADS	Local Area Data Service
NC	Network Channel
NCI	Network Channel Interface
TR	Technical Reference

9.2 Glossary

Metallic Voltage

The potential difference between the tip and ring connections.

Longitudinal Voltage

One half of the vector sum of the potential difference between the tip connection and earth ground, and the ring connection and earth ground.

Metallic Impedance

The impedance between the tip and ring connections.

Longitudinal Impedance

The impedance between the tip and ring connections, taken together, and ground.

Longitudinal-to-Metallic Balance

The longitudinal-to-metallic balance ($BALANCE_{1-m}$) is defined as follows:

$$BALANCE_{1-m} = 20 \log_{10} \frac{|e_1|}{|e_m|}$$

Where e_1 is the magnitude of an applied longitudinal voltage at the indicated frequency, and e_m is the magnitude of the resultant metallic voltage measured across a metallic termination equal to the effective cable source impedance which has the following values:

Frequency of Applied Longitudinal Voltage	Impedance of Metallic Termination
<u>(Hz)</u>	<u>(ohms)</u>
60-660	1300
2600	675
20000	170
2800-100000	120

The longitudinal balance applies at 60 and 180 Hz with an rms voltage (e_1) of up to 50 and 15 volts, respectively. The balance at higher frequencies applies with an rms voltage (e_1) of 1 volt superimposed on a 60-Hz voltage of up to 50 volts. (For equipment that has a longitudinal impedance which is independent of voltage, up to 50 volts rms, the balance at higher frequencies does not have to be determined in the presence of the 60-Hz voltage.)

10. References

10.1 Bellcore Publication

TR-EOP-000001 *Lightning and 60 Hz Disturbances at the Bell Operating Company Network Interface.* June, 1984.

PUB 43401 *Transmission Specifications for Private Line Metallic Circuits.*

10.2 Ordering Information

Technical References (TRs) should be requested in writing, through a company's designated

Bellcore contact, to:

Document Registrar
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445 South Street, Room 2J-125
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