

239 H4R HDSL4 Repeater Installation and Maintenance

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1. GENERAL

This practice provides installation and maintenance (I/M) instructions for the ADTRAN 239 T1 HDSL4 Repeater (H4R), P/N 1221445L1. **Figure 1** is an illustration of the H4R. H4R equipment features include:

- TC PAM line coding
- Lightning protection
- In-band loopback control
- Standard 239 form factor repeater apparatus case design
- Remote provisioning and pass-through performance monitoring

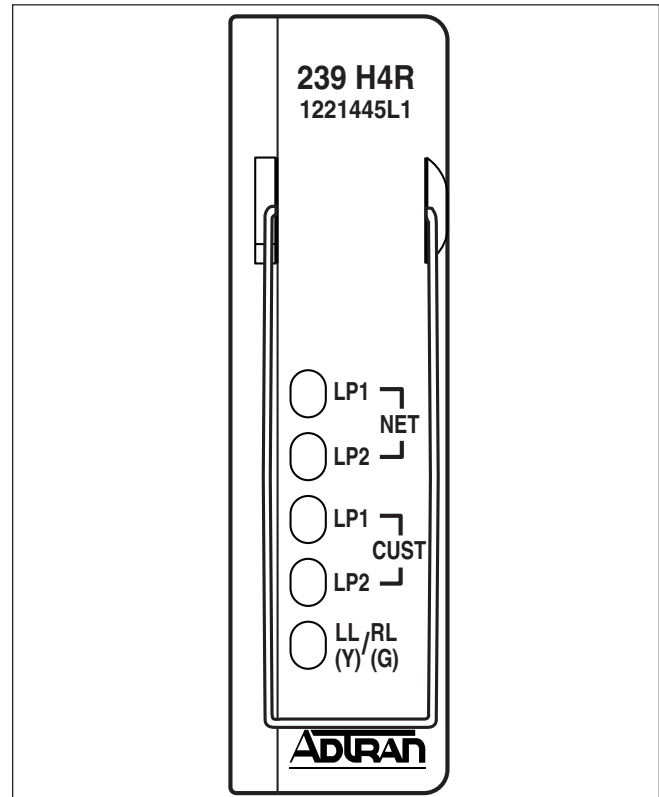


Figure 1. ADTRAN 239 H4R

An ADTRAN span powered HDSL4 circuit consists of an H4TU-C, up to two H4Rs and an H4TU-R. Due to span power limits, the number of H4Rs permitted in the circuit depends on the type of H4TU-C used. An ADTRAN 239 H4R provides DS1 transport on all revised resistance design (RRD) 26 AWG and/or 24 AWG loops. Two ADTRAN 239 H4R repeaters extend the range of a loop up to 42.5 kft (24 AWG). Repeater placement on single H4R loops depends only on the attenuation properties of the loop segment. Repeater placement for dual H4R loops requires both segment attenuation and segment DC resistance requirements be satisfied (refer to section 4, *HDSL4 Deployment Guidelines*).

The H4R is used in conjunction with any T1.418 compliant span powering T1 HDSL4 transceiver unit for the central office (H4TU-C) and HDSL4 transceiver unit for the remote end (H4TU-R). Compatible ADTRAN HDSL4 transceiver units are as follows:

Part Number	Unit Name
1181411L1.....	Total Access 3000 H4TU-C
1181411L4.....	Total Access 3000 H4TU-C
1181411L5.....	Total Access 3000 H4TU-C, Protection Switching
1221401L1.....	220/E220 H4TU-C
1221401L4.....	220/E220 H4TU-C
1221401L6.....	220/E220 H4TU-C
1221403L1.....	DDM+ H4TU-C
1221403L4.....	DDM+ H4TU-C
1221403L6.....	DDM+ H4TU-C
1221404L1.....	3192 H4TU-C
1221404L4.....	3192 H4TU-C
1221404L6.....	3192 H4TU-C
1221407L4.....	Soneplex® H4TU-C
1221426L1.....	T200 H4TU-R
1221426L6.....	T200 H4TU-R
1221426L7.....	T200 H4TU-R
1221424L1.....	T200 H4TU-R, Local Power
1221424L6.....	T200 H4TU-R, Local Power
1221424L7.....	T200 H4TU-R, Local Power

There are no manual option settings on the H4R.

H4R operating power is derived from an H4TU-C, independent of line impedance or wire gauge. The operating power from the H4TU-C is also used to span power the H4TU-R.

Revision History

This is the initial release of this document. Future revisions to this document will be explained in this subsection.

2. INSTALLATION



Remove the ADTRAN 239 H4R from the carton and visually ensure that damage has not occurred during shipping or handling. If damage has occurred, file a claim with the carrier, then contact ADTRAN. Refer to the *Warranty and Customer Service* section of this practice.

The ADTRAN 239 H4R is shipped in a separate carton and must be installed in an environmental apparatus case.

The ADTRAN 239 H4R is designed for deployment using any 239-type repeater case. A retainer patch is available for use with the 239 H4R for securing into the ADTRAN apparatus cases.

When installing the ADTRAN 239 H4R, refer to the Installation and Maintenance Practice for the housing being used.

All connections are made through card edge connectors. **Table 1** gives the card edge pin assignments.

CAUTION

The H4R dissipates a maximum of 5.4 watts.

Table 1. Card Edge Pin Assignment

Pin	Designation	Description
1	GND	Ground
2	NC	No Connect
3	T1	Customer Loop 1 Tip
4	R1	Customer Loop 1 Ring
5	T1	Network Loop 1 Tip
6	R1	Network Loop 1 Ring
7	NC	No Connect
8	T	Network Loop 2 Tip
9	R	Network Loop 2 Ring
10	GND	Ground
11	T	Customer Loop 2 Tip
12	R	Customer Loop 2 Ring

NOTE

Ensure that the chassis ground is securely connected to apparatus case. Ground pin designations are defined in **Table 1**.

Compliance

Table 2 shows the Compliance Codes for the H4R. The H4R complies with UL 60950, third edition. It is intended for installation in restricted access locations only and in equipment with a Type “B” or “E” installation code.

Table 2. Compliance Codes

Code	Input	Output
Power Code (PC)	C	C
Telecommunication Code (TC)	X	X
Installation Code (IC)	A	–

H4R Capacity Guidelines

The ADTRAN 239 H4R is designed for installation in a prewired apparatus case, and the capacity guidelines for deployment are defined in **Table 3** and **Table 4**. These housing capacity numbers are based upon testing results.

Table 3. 239 H4R Capacity Guidelines for ADTRAN Housings

Part Number	Description	CLEI Code	Slots	Stub	H4R Capacity		Recommended Slot Assignments		Material
					Above Ground	Below Ground	Above Ground	Below Ground	
1150027L1	239/439 Housing	DDMOABA1MA	4	Air	4	4	All	All	Stainless/ Polymer
1150027L2	239/439 Housing	DDMOBBA1MA	4	Gel	4	4	All	All	Stainless/ Polymer
1150057L1	Universal Housing	DDMODA01RA	4	Air	4	4	All	All	Stainless Steel
1150057L2	Universal Housing	DDMOCA01RA	4	Gel	4	4	All	All	Stainless Steel
1150058L1	Universal Housing	DDMOEE01RA	8	Air	8	8	All	All	Stainless Steel
1150058L2	Universal Housing	DDMOFE01RA	8	Gel	8	8	All	All	Stainless Steel

Table 4. 239 H4R Capacity Guidelines for Other Housings

Manufacturer	Description	Manufacturer's Part Number	Slots	Stub	H4R Capacity		Recommended Slot Assignments		Material
					Above Ground	Below Ground	Above Ground	Below Ground	
ADC	Radiator II	SPX-HRXC-30-AG-016GT	16	Air	16	16	All	All	Stainless Steel
ADC	Radiator II	SPX-HRXC-30-AG-016GT	16	Gel	16	16	All	All	Stainless Steel
ADC	Radiator	SPX-HRXC-30-B1	8	Air	8	8	All	All	Stainless Steel
Circa Telecom	HDSL-12A	760005	12	Air	12	12	All	All	Stainless Steel
Circa Telecom	HDSL-12B	760006	12	Gel	12	12	All	All	Stainless Steel
Arris/Lucent/ AT&T	Keptel® Inter Link™ 809	RF809A3-XXX or RF809B3-XXX	12	Gel	8	N/A	1, 3, 4, 6 7, 9, 10, 12	N/A	Polymer
Arris/Lucent/ AT&T	Keptel® Inter Link™ 818/819	RF819A1 or RF819A2	25	Air	12	16*	Chamber 1: 1, 4, 7, 8, 11, 14 Chamber 2: 15, 17, 19 20, 23, 25	Chamber 1: 1, 3, 5, 7, 8, 10, 12, 14 Chamber 2: 15, 16, 18, 19 20, 22, 24, 25	Polymer
Arris/Lucent/ AT&T	Keptel® Inter Link™ 818/819	RF819B1 or RF819B2	25	Air	12	16*	Chamber 1: 1, 4, 7, 8, 11, 14 Chamber 2: 15, 17, 19 20, 23, 25	Chamber 1: 1, 3, 5, 7, 8, 10, 12, 14 Chamber 2: 15, 16, 18, 19 20, 22, 24, 25	Polymer
Arris/Lucent/ AT&T	Keptel® Inter Link™ 820 Family	RF820AX or RF820BX	2 to 8	Air	Full	Full	All	All	Polymer
Arris/Lucent/ AT&T	Keptel® Inter Link™ 820 Family	RF820AX or RF820BX	2 to 8	Gel	Full	Full	All	All	Polymer

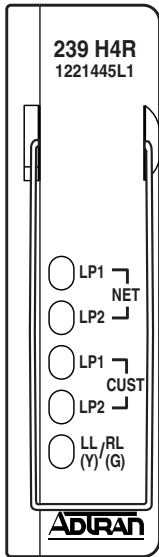
* For 16 slot use, the ambient air temperature measured 1 ft away and parallel to the housing should not exceed 115°F (46.1°C).

3. FRONT PANEL FEATURES

The ADTRAN H4R front panel has five LEDs indicating different states of the HDSL4 circuit.

Table 5 explains the meaning of the different LED indicators.

Table 5. LED Indicators
Five Tricolored Front Panel LEDs Indicate these H4R States.



LED	Indication	Description
LP1/LP2 NET	Off	No span power is present
	Solid Green	Synchronized with an SNR margin greater than the user defined SNR Margin Alarm Threshold
	Fast Blinking Green	(Blinking 3 times per second) Attempting to synchronize with the H4TU-C
	Slow Blinking Green	(Blinking 1 time per second) Synchronized with a SNR margin greater than the user defined SNR Margin Alarm Threshold and the pulse attenuation is greater than the user defined Loop Attenuation Alarm Threshold
	Solid Yellow	Synchronized with a SNR margin greater than 0 dB but less than the user defined SNR Margin Alarm Threshold
	Slow Blinking Yellow	Synchronized with a SNR margin greater than 0 dB but less than the user defined SNR Margin Alarm Threshold and the pulse attenuation is greater than the user defined Loop Attenuation Alarm Threshold
	Solid Red	Synchronized with a SNR margin of 0 dB
LP1/LP2 CUST	Off	No span power is present
	Solid Green	Synchronized with a SNR margin greater than the user defined SNR Margin Alarm Threshold
	Fast Blinking Green	(Blinking 3 times per second) Attempting to synchronize with the H4TU-R
	Slow Blinking Green	(Blinking 1 time per second) Synchronized with a SNR margin greater than the user defined SNR Margin Alarm Threshold and the pulse attenuation is greater than the user defined Loop Attenuation Alarm Threshold
	Solid Yellow	Synchronized with a SNR margin greater than 0 dB but less than the user defined SNR Margin Alarm Threshold
	Slow Blinking Yellow	Synchronized with a SNR margin greater than 0 dB but less than the user defined SNR Margin Alarm Threshold and the pulse attenuation is greater than the user defined Loop Attenuation Alarm Threshold
	Solid Red	Synchronized with a SNR margin of 0 dB
LL/RL	Solid Yellow	Indicates a loopback at the H4R toward the H4TU-C is active
	Slow Blinking Yellow	H4R is armed but not in loopback
	Solid Green	Indicates a loopback at the H4R toward the H4TU-R is active

4. HDSL4 DEPLOYMENT GUIDELINES

NOTE

The H4TU-Cs (P/Ns: 1221401L6, 1221403L6, and 1221404L6) **support only one H4R** in the HDSL4 circuit.

The different segments of an HDSL4 circuit are defined in **Figure 2**.

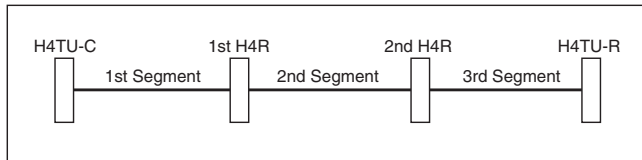


Figure 2. HDSL4 Circuit Segments

According to the number of H4Rs in the HDSL4 circuit, the following service ranges apply:

- HDSL4 circuit containing no H4Rs will reach up to 16 kft on the local loop (24 AWG)
- HDSL4 circuit containing one H4R will reach up to 16 kft on the first segment and 15 kft on the second segment (24 AWG)
- HDSL4 circuit containing two H4Rs will reach to 13.5 kft on the first segment, 14 kft on the second segment, and 15 kft on the third segment (24 AWG) *

**This is one example of a circuit with 2 H4Rs. Other loop length configurations are possible in compliance with loop resistance restraints.*

NOTE

Refer to the *H4TU-C* or *H4TU-R Installation and Maintenance Practice, HDSL4 Deployment Guidelines* section, for other loop parameters including Insertion Loss and Pulse Attenuation.

The ADTRAN HDSL4 system provides DS1-based services over loops designed to comply with the guidelines given below.

1. All loops are nonloaded only.
2. Any single bridged tap is limited to 2 kft.
3. Total bridged tap length is limited to 2.5 kft.

NOTE

Refer to the Detailed Status Screen (Main Menu selection “3,” Span Status selection “1”) for the current loop SNR Margin, Insertion Loss, and Pulse Attenuation status.

Each of the three segments associated with span powering two H4Rs and an H4TU-R must satisfy the recommended insertion loss, loop attenuation requirements in addition to the DC resistance budgets. In general, 22 and 19 AWG segments will be restricted by their loop attenuation while the DC resistance will restrict the segment reach for 26 and 24 AWG. When designing a dual H4R loop, the first segment should have lower DC resistance than the second segment. Single H4R spans do not require any restriction due to DC resistance.

The segment resistance (Ω_{segment}) is determined using the equation provided below.

$$\Omega_{\text{segment}} = L_{26} * \Omega_{26} + L_{24} * \Omega_{24} + L_{22} * \Omega_{22} + L_{19} * \Omega_{19}$$

where : $L_{\#}$ is the length of # AWG cable (kft, excluding bridge taps), $\Omega_{\#}$ is the D.C. Resistance of # AWG cable

Table 6 lists single pair cable DC resistance values to be used in the equation above.

Table 6. Single Pair Cable DC Resistance Value (Ω)

Resistance (ohms/kft)				
AWG	70 Deg (F)	90 Deg (F)*	120 Deg (F)	140 Deg (F)**
19	16.465	17.183	18.261	18.979
22	33.006	34.446	36.606	38.046
24	52.498	54.789	58.225	60.516
26	83.475	87.117	92.581	96.223

* Interpolated between 70° F and 120° F data
 ** Extrapolated from 70° F and 120° F data

Once the resistance of each segment is confirmed, refer to **Figure 3** to decide if the H4TU-C is capable of span powering two H4Rs and one H4TU-R. Follow these steps to utilize the graph shown in Figure 3:

1. Find the line on the graph which represents the known third segment resistance. These are the lines running diagonally across the graph labeled 300 - 1100 ohms. This line represents the upper limit for 2 H4Rs plus H4TU-R span powering.
2. Find the first segment resistance on the vertical axis.
3. Find the second segment resistance on the horizontal axis.

4. Find the instance where the two points from steps 2 and 3 meet on the graph.
5. The point found in step 4 must be below the upper limit line defined by the third segment measurement (step 1). If the instance where these two points is above this line, the H4TU-C cannot span power two H4Rs and the H4TU-R.

Note that these measurements represent only one of the two HDSL4 pairs.

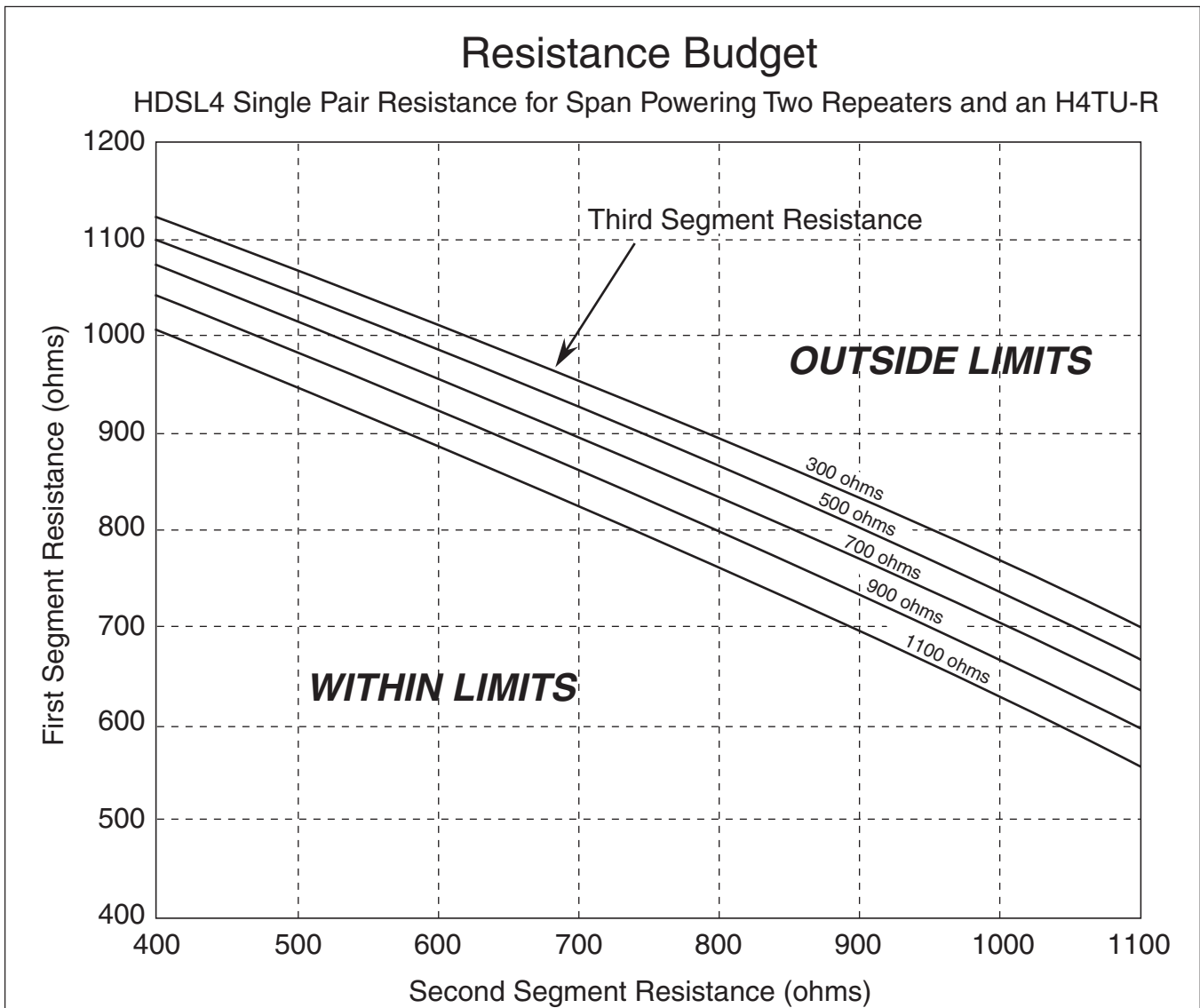


Figure 3. Resistance Budget Span Powering Two Repeaters

An example problem is illustrated in **Figure 4**. For this example, begin with three known measurements: 700 ohms first segment resistance, 800 ohms second segment resistance, and 900 ohms third segment resistance. See Figure 4 and the following steps to solve the example problem:

1. Find the 900 ohms third segment resistance line on the graph. This line is depicted in bold in Figure 4. This line is the upper span power limit.
2. Find the 700 ohms first segment resistance point on the vertical axis.
3. Find the 800 ohms second segment resistance point on the horizontal axis.

4. Find the instance on the graph where the points from steps 2 and 3 meet.
5. Is this point below the bold line defined in step 1? Yes. Therefore, a circuit with these parameters is capable of span powering two H4Rs and one H4TU-R.

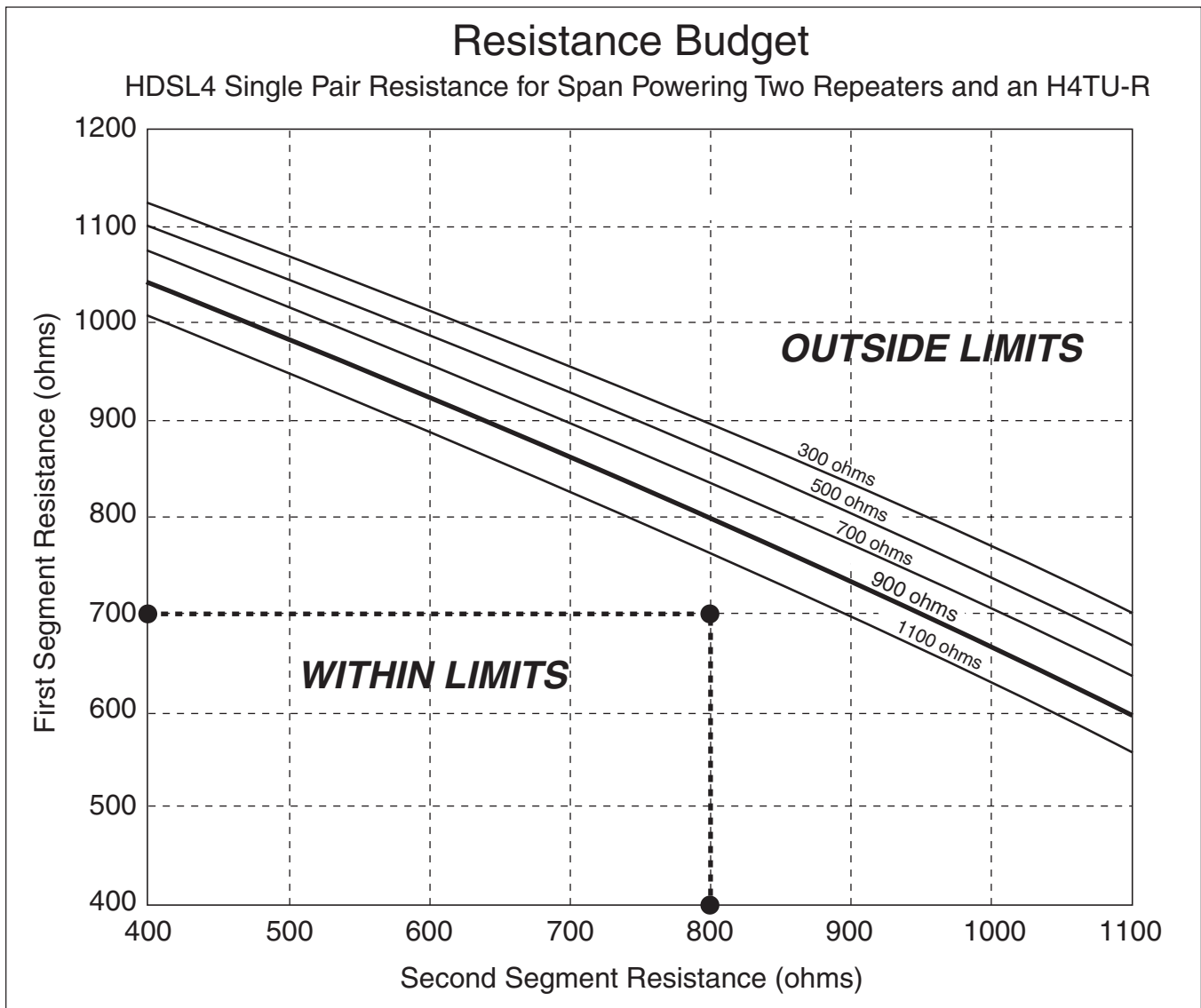


Figure 4. Resistance Budget Span Powering Two Repeaters (Example)

5. MAINTENANCE

The ADTRAN 239 H4R requires no routine maintenance. In case of equipment malfunction, perform an in-band loopback from the central office (CO). If a malfunction is confirmed, replace the unit.

The ADTRAN 239 H4R has looping capability through the channel allowing digital loopback in fault isolation. The looping is accomplished remotely.

Performance monitoring, diagnostics, and loopbacks are also available from the craft interface at the H4TU-C and H4TU-R.

The type of loopbacks that the H4R supports will depend on what type of transceiver units are used in the circuit. Refer to the Installation and Maintenance Practice of the specific H4TU-C or H4TU-R for a list of loopback codes.

When testing indicates a faulty circuit pack, refer to the housing Installation and Maintenance Practice for the entry and pressurization control, then replace the faulty circuit pack.

ADTRAN does not recommend field repair of this unit. Repair services may be obtained by returning the defective unit to the ADTRAN Customer and Product Support (CAPS) Department.

6. SPECIFICATIONS

Specifications for the ADTRAN 239 H4R are detailed in **Table 7**.

7. WARRANTY AND CUSTOMER SERVICE

ADTRAN will replace or repair this product within ten (10) years from the date of shipment if it does not meet its published specifications or fails while in service. Refer to ADTRAN *U.S. and Canada Carrier Networks Equipment Warranty*, Document 60000087-10.

Contact Customer and Product Services (CAPS) prior to returning equipment to ADTRAN.

For service, CAPS requests, or further information, contact one of the following numbers:

ADTRAN Sales

Pricing/Availability
(800) 827-0807

ADTRAN Technical Support

Pre-sales Applications/Post-sales Technical Assistance
(800) 726-8663

Standard hours: Monday-Friday, 7 a.m. - 7 p.m. CST
Emergency hours: 7 days/week, 24 hours/day

ADTRAN Repair/CAPS

Return for Repair/Upgrade
(256) 963-8722

Repair and Return Address

ADTRAN, Inc.
CAPS Department
901 Explorer Boulevard
Huntsville, Alabama 35806-2807

Table 7. ADTRAN 239 H4R Specifications

Loop Interface	
Modulation Type	16 TC PAM
Mode	Full Duplex, Partially overlapped echo canceling
Number of Pairs	Two
Line Rate	1.552 Mbps
Baud Rate	261.333 kbaud
Service Range	13.5 Kft First Segment, 14 Kft Second Segment, 15 Kft Third Segment (24 AWG); Note that other loop length combinations are possible.
Loop Loss	Refer to H4TU-C or H4TU-R Installation and Maintenance Practice (Section <i>HDSL4 Deployment Guidelines</i>)
Bridged Taps	Single Taps < 2000 ft, Total Taps < 2500 ft
Performance	Compliant with T1.418-2000 (HDSL2 Standard, issue 2)
H4TU-C Transmit Power (Data) Level	14.1 ± 0.5 dBm (0 to 400 kHz)
H4TU-C Transmit Power (Activation) Level	14.1 ± 0.5 dBm (0 to 307 kHz)
Input Impedence	135 ohm
Maximum Loop Resistance	Refer to H4TU-C or H4TU-R Installation and Maintenance Practice (Section <i>HDSL4 Deployment Guidelines</i>)
Return Loss	12 dB (50 kHz to 200 kHz)
Power	
Input Power	(Span powered by H4TU-C) 5.4 watts, maximum
Clock	
Clock Sources	DSX-1 Derived (with HDSL4 frame bit stuffing), Mux Fed
Internal Clock Accuracy	±25 ppm (Exceeds Stratum 4), Meets T1.101 Timing Requirements
Tests	
Diagnostics	Loopbacks initiated with HDSL4 in-band codes or from H4TU-C or H4TU-R craft interface.
Physical	
Weight	< 1 lb.
Environment	
Operating Temperature (Standard)	-40 Degrees to + 70 Degrees Celsius
Storage Temperature	-40 Degrees to + 85 Degrees Celsius
Compliance	
UL 60950	
NEBS Level 3	
FCC 47CFR Part 15, Class A	
Part Number	
239 H4R	1221445L1

