

High-Speed Voice and Data Link™ Remote Terminal

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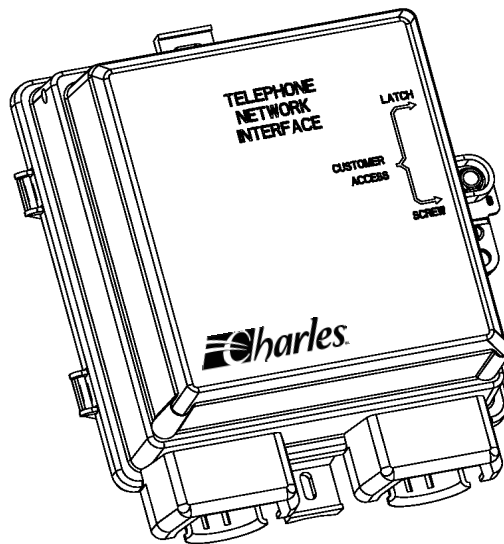


Figure 1. HVDL RT

1. GENERAL

1.1 Document Purpose

This document provides a general, installation and troubleshooting information for the High-Speed Voice and Data Link (HVDL 3.1) Remote Terminal (RT) line unit. This document covers the following model numbers:

Model #	Description	Voice Lines	Data Lines
HVDL47511	RT (wall-mount NID with sealed electronics)	1	1
HVDL47531	RT (wall-mount NID with sealed electronics)	3	1
HVDL47731	RT (wall-mount NID with sealed electronics, Fail-to-POTS option)	3	1
HVDL07531	Replacement cover (RT) with sealed electronics	3	1
HVDL07731	Replacement cover (RT) with sealed electronics, Fail-to-POTS option	3	1

1.2 Document Status

This document is reprinted to add model HVDL47511 (HVDL 1.1).

1.3 Equipment Purpose and Description

The HVDL system is a G.SHDSL-based multiplexing system that combines up to 3 voice lines and one 10 BaseT Ethernet line onto a single twisted-copper pair. This system consists of a central office terminal (COT), a remote terminal (RT) and an optional repeater. The COT multiplexes the voice lines and 10 BaseT Ethernet line. It also provides power to the RT, which demultiplexes the voice lines and 10 BaseT Ethernet lines, and to the repeater (if used) which extends the allowable distance between the COT and the RT.

HVDL components have been designed for use in all areas, regardless of environmental constraints.

The HVDL system is rate-selective. Data rates between 0 and 832 K can be configured at the COT. The data rate can be increased beyond 832 K by turning off unused POTS channels. For each POTS channel that is turned off, 64 K is added to the system data rate.

As the system data rate is decreased, DSL distance can be extended.

Note: HVDL systems with fewer than 3 POTS lines automatically assign the extra bandwidth to the data line (so with 1 voice line, 1 data line, the maximum data rate is 960 K)

1.3.1 EPREP Feature (non-repeater mode only)

The EPREP feature allows the HVDL RT to interact with the HVDL COT, providing easy circuit turn-up or turn-down without end-to-end coordination. The HVDL COT must be installed before the HVDL RT. When first installed, the HVDL COT will perform a metallic bypass around the COT electronics, connecting line 1 from the Central Office (CO) switch to the subscriber's line. This bypass condition can remain in effect indefinitely, keeping the customer in service. The COT continuously monitors the line (which will become the DSL) for the presence of a HVDL RT. When the RT is connected to the pair at the desired installation site, its unique signal will be detected by the COT. The COT will remove the bypass and cause the system to go into service, providing up to three voice lines and a 10 BaseT Ethernet line digitally over the DSL pair.

1.3.2 Metallic Bypass (non-repeater mode only)

Metallic bypass enables line 1 on the COT to remain connected to line 1 of the central office (CO) switch. In the unlikely event of a system failure the COT connects line 1 from the switch onto the DSL span.

1.3.3 Fail-to-POTS Feature (non-repeater mode only)

The RT connects the DSL span to its line 1, thereby connecting line 1 of the switch to the customer premises equipment connected to RT line 1. This feature requires FTP-enabled RTs.

1.3.4 Repeater Mode

Through the front panel of the COT, the system can be configured with repeaters (up to 3) between the COT and the RT, increasing the system range. In repeater mode, the COT applies DSL voltage (+/-130 VDC) to the DSL

line immediately to begin synchronizing with the RT. The COT does not wait to detect the RT as in EPREP mode. In repeater mode, turning off unused POTS channels extends DSL range.

1.3.5. Rate Selection Feature

Use the rate selection feature to select the optimum data/DSL rate for a given application using the front panel controls on the COT.

At start-up, the system will synchronize at the lowest data rate (0 K). Once this is accomplished, the COT will instruct the RT and repeater(s) (if used) to synchronize at either the factory-programmed data rate (512 K) or the data rate that was previously configured. If the system cannot synchronize at the configured data rate (usually because there is too much distance between the COT and the RT), it will start “stepping down” the rate until it finds a rate it can synchronize at (the highest possible rate below the requested rate). The COT LED displays “WAIT” momentarily for each step-down sequence. The system will operate in this mode, but the COT will send an alarm indicating “bad COT”. The COT’s LED display will flash the current data rate, indicating that the rate is lower than the requested rate.

1.4 Equipment Mounting

The RT is wall-mounted, inside or outside.

1.5 Equipment Features

The HVDL RT provides the following features:

- 0–3 voice lines available with Lifeline and CLASS services (depending on model)
- Always On 10 BaseT Ethernet line ready to connect to other 10/100 BaseTx peripherals
- Craftsperson-selectable Ethernet data transport speed/DSL speed
- Wall-mountable RT NID with enhanced lightning protection
- Repeater-ready for extra-long DSL loops
- EPREP feature for one-man turn up
- Functions with multiple repeaters (up to 3)

1.5.1. Optional features

- Fail-to-POTS RT provides a metallic connection on voice line 1 if system failure occurs

2. INSPECTION

2.1 Inspect for Damages

Inspect the equipment thoroughly upon delivery. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company.

2.2 Equipment Identification

Charles Industries’ equipment is identified by a model and issue number imprinted on the front panel or located elsewhere on the equipment. Each time a major engineering design change is made on the equipment, the issue number is advanced by 1 and imprinted on subsequent units manufactured. Therefore, be sure to include both the model number and its issue number when making inquiries about the equipment.

2.3 Static Concerns

Each unit is shipped in static-protective packaging to prevent electrostatic charges from damaging static-sensitive devices. Use approved static-preventive measures, such as static-conductive wrist straps and a static-dissipative mat, when handling units outside of their protective packaging. A unit intended for future use should be tested as soon as possible and returned to its original protective packaging for storage.



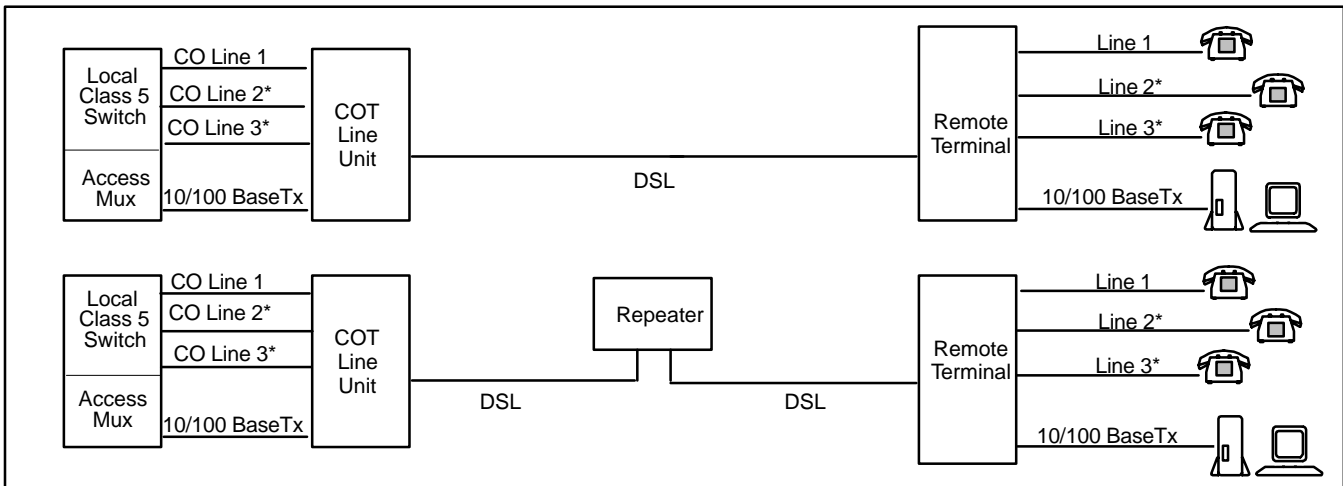
This equipment contains static-sensitive electronic devices. To prevent electrostatic charges from damaging static-sensitive units:

- Use approved static preventive measures (such as a static-conductive wrist strap and a static-dissipative mat) at all times whenever touching units outside of their original, shipped static-protective packaging.
- Do not ship or store units near strong electrostatic, electromagnetic, or magnetic fields.
- Use static-protective packaging for shipping or storage.

3. APPLICATION GUIDELINES

3.1 Typical Application

A typical application of the HVDL System consists of a 300-mechanics COT connected to a switch in the central office, and the wall-mounted RT connected to the subscriber line. Figure 2 illustrates typical applications.



* Depending on model.

Figure 2. Typical HVDL Applications, with and without a Repeater

Figure 3 shows a typical connection to the computer. The Ethernet connects into the Network Interface Card (NIC) on the computer. If a NIC is not provided with the computer, one may be purchased through local computer supply distributors. Both 10 BaseT and 10/100 BaseTx NIC cards are compatible with HVDL.

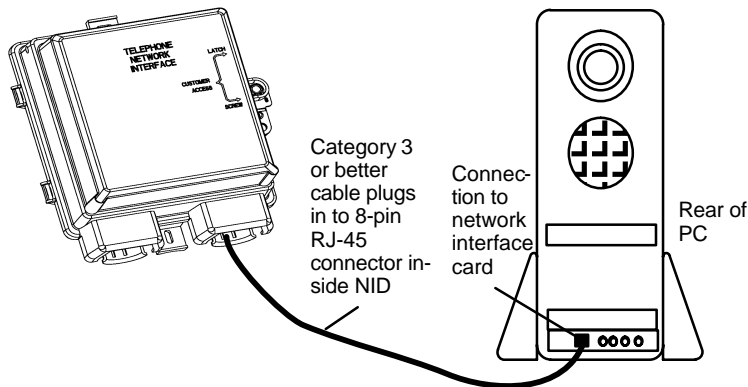


Figure 3. Typical Connection to a PC

Multiple computers at the same site can be connected using a hub. Figure 4 shows a typical connection to the HVDL system with a hub. When properly configured, each computer can access data, print, and communicate

with other computers on the hub and through the HVDL link. Since data is transferred in bursts, each user generally experiences the same high-speed data transfer rate regardless of the number of users connected to the hub.

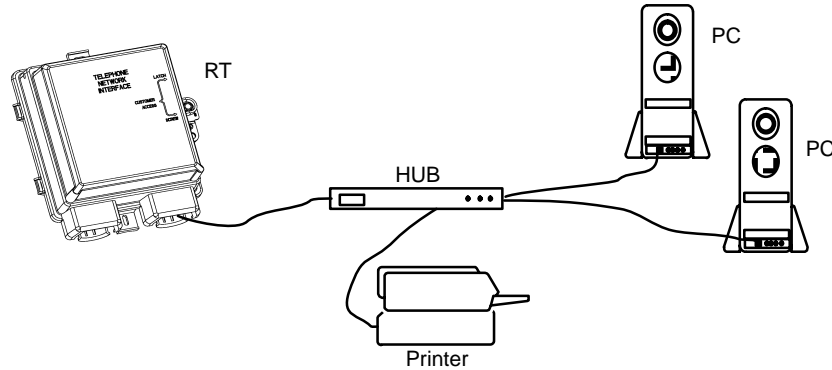


Figure 4. Typical Connection with a Hub

4. INSTALLING THE SYSTEM

A few elements need to be considered before you begin installing the HVDL system

4.1 Repeater

Decide whether or not a repeater will be used. Use a repeater under any one of the following conditions:

- The distance between the COT and RT exceeds the maximum non-repeater distance.
- Cable loss is high.
- Excess noise on the cable pair limits distance.

If you are installing with a repeater, install the RT and the repeater prior to installing the COT. If you are installing without a repeater, install the COT prior to installing the RT. Refer to the HVDL repeater documentation for HVDL repeater types and applications.

Note: Metallic bypass is not available in repeatered mode. EPREP and FTP will not work.

4.2 Choosing the Proper Location for the Repeater and the RT

HVDL operation distance is significantly longer with a repeater. Distance of operation is directly related to wire gauge and above/below ground routing. Software is available to help you calculate the distance of operation and verify your configuration: order part number SM-CSHVDL3.1T.

4.3 Bridge Taps

Bridge tap loss depends on the length and location of the bridge tap. For best results, remove all bridge taps.

4.4 Load Coils

All load coils must be removed.

5. INSTALLING THE RT

Determine if the RT enclosure is to be mounted on a masonry-type wall, on a wood studded wall, or a hollow wall. Proceed to the appropriate mounting instructions. Obtain the necessary equipment, tools, and hardware before starting the installation.

Note: The RT should be located as close as possible to a proper ground.

5.1 Equipment Needed

Depending on the the type of mounting used, some or all of the following will be required:

- Drill bits: #25 (0.1495 dia.), 7/16-inch (0.4375 dia.), or 1/4-inch (0.250 dia.) masonry bit
- Two #10 pan head wood screws
- Two #10 screw expansion anchors for masonry walls
- Two 3/16-inch hollow wall fasteners
- Power or hand drill
- Center punch and hammer
- Flat-blade and/or Phillips blade screwdrivers
- 216 tool (3/8-inch hex nut driver — “can wrench”)

5.2 Opening the RT Enclosure

Using the 216 tool, open the security/locking mechanism by turning the tamper-resistant hex screw counterclockwise until the enclosure cover can be opened.

5.3 Mounting the RT

Step	Action
1.	Determine the location and the desired height where the RT is to be mounted. If you are mounting on a wood-studded wall, find the wood stud in the desired location.
2.	Mark the wall at the top and bottom mounting holes using the opened RT as a template.
3.	<p>Mounting on a stone/brick/masonry wall. Using a drill and a 1/4-inch masonry drill bit, drill the two marked holes for #10 screw expansion anchors. Install the expansion anchors in the drilled holes.</p> <p>Mounting on a wood studded wall. Using a drill and a #25 (0.1495 dia.) drill bit, drill the two marked holes for #10 wood screws.</p> <p>Mounting on a hollow wall. Using a drill and a 7/16-inch drill bit drill the two marked holes. Install the 3/16-inch hollow wall fasteners in the drilled holes.</p>
4.	Mount the RT enclosure by using the top and bottom mounting holes and two appropriate screws.
5.	Carefully tighten the top and bottom screws.

After mounting the RT enclosure, run the 2W (two wire) DSL cable, an earth ground wire, and the subscriber telephone lines to the RT mounting location.

5.4 Connecting the 2W Digital Subscriber Line (DSL) and Ground Cables

Use the HVDL system configuration software, part # SM-CSHVDL3.1T as a guide to selecting the cable length for DSL applications.

CAUTION

Hazardous voltages exist on the DSL. Always exercise caution when wiring a live circuit or when performing maintenance.

CAUTION

Disconnect the modular plugs from the RJ11 jacks before installation of premises wiring.

Step	Action
1.	Open the internal TELCO access cover by turning the tamper-resistant, 3/8-inch hex screw counterclockwise.
2.	Pull the 2W DSL and ground cables through the left side opening. Allow extra cable inside the enclosure for a service loop (this will provide strain relief). Observe proper TELCO procedures for attaching grounds.
3.	Connect the 2W DSL and ground cables to the protector unit terminals.

Step	Action
4.	Connect the voice and data line interconnect from the cover to the 10 pin keyed connector.
5.	Tighten all terminal screw connections.

5.5 Connecting Subscriber Telephone Lines and Data Line

Step	Action
1.	Pull the subscriber's telephone lines through the right side opening. Allow extra cable inside the enclosure for a service loop (this will provide strain relief).
2.	Terminate the subscriber's telephone line on the Line 1 terminal block.
3.	<i>(For models with more than 1 voice line.)</i> Terminate the subscriber's telephone lines on the Line 2 and Line 3 terminal blocks.
4.	Tighten all terminal screw connections.
5.	Reconnect all plugs into jacks.
6.	Plug the subscriber's category 3 or better 10 BaseT cable into the RJ-45 jack.

5.5.1. Subscriber Cable Selection

In most applications, a straight cable is all that is needed to make the data connection; however, in some cases you will need to use a crossover cable (shown in Figure 5) to connect properly. Situations in which a crossover cable is needed may include the following:

- Non-standard PC card.
- Connecting the PC to another PC.
- Connecting a PC to a hub
- Connecting 2 COTs on an individual network.

See the *Troubleshooting* section of this document for more information.

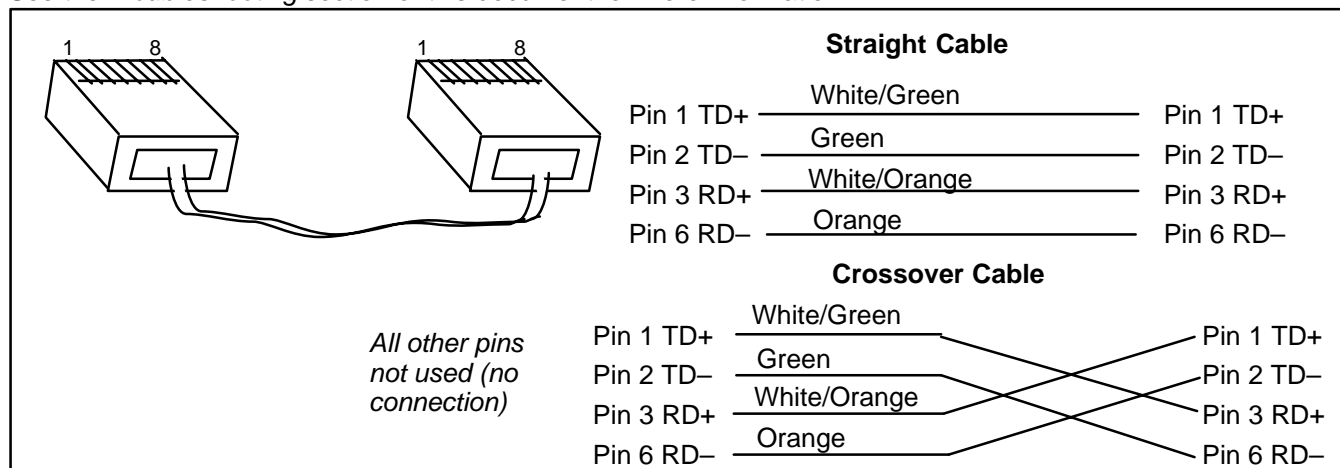
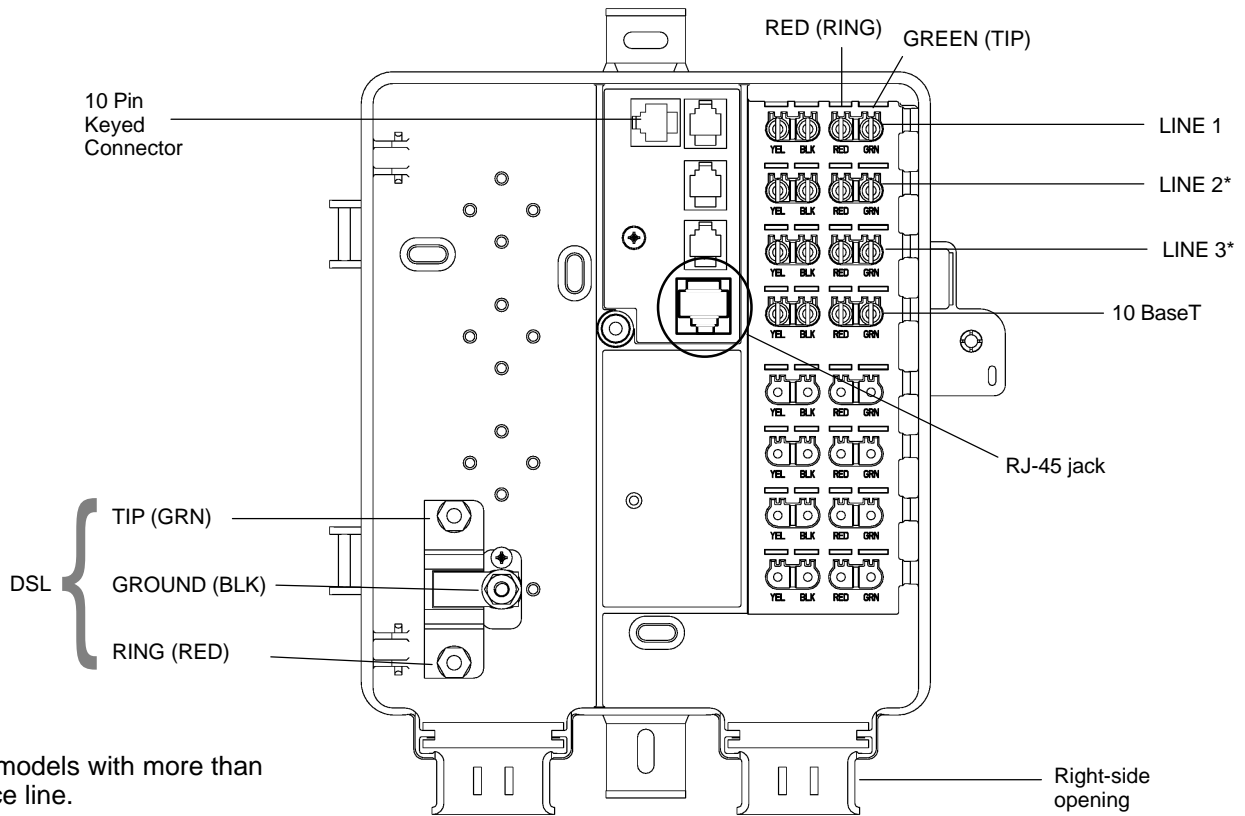


Figure 5. Straight and Crossover Cable Illustrated

Note: If TESTING is to be performed, do not close the TELCO access cover at this time.



* On models with more than 1 voice line.

Figure 6. 400-Type Network Interface Device (NID) Housing Connections

5.6 LED Definitions

Definitions for the LEDs on the HVDL RT line unit are shown in Table 1.

Table 1. LEDs on the HVDL RT

LED	Color	Status	Indicates...
SYNC	GREEN	ON	Normal operation
		OFF	DSL communication halted due to an alarm, EPREP or bypass
		Double Flash	Training in progress
QUAL	YELLOW	ON	Poor DSL communication quality
		OFF	Good DSL communication quality
		Double Flash	Training in progress
BUSY (composite of voice channels 1-3)	GREEN	ON	Off-hook condition
		OFF	On-hook condition
		Double Flash	Ringing detected
10 BaseT Link LED	GREEN	ON	10/100 BaseTx physical link established at RT & COT
		Single Flash	Remote terminal 10/100 BaseTx physical connection good; COT 10/100 BaseTx physical connection not connected
		Flashes once every 5 sec.	Physical link not established. The system is searching for a 10/100 BaseTx connection.
		OFF	The system is training. The LED display shows EPR or RPT with a rotating arrow; however, if the LED remains off for more than 30 seconds, see the Troubleshooting section of this document.

6. TESTING

CAUTION

Hazardous voltages exist on the DSL. Always exercise caution when wiring a live circuit or when performing maintenance.

6.1 Equipment Needed

The following test equipment is required.

- Test telephone with clip leads
- High impedance DC voltmeter

6.2 Performing the Turn-up Test

After the 2W DSL cable, the earth ground cable, and the subscriber telephone lines have been installed, the following turn-up test can be performed at the RT (see Figure 6).

Step	Action
1.	If present, open the "tip & ring" covers.
2.	Connect the modular plugs both jacks.
3.	Connect the clip leads of the test telephone to LINE 1 Red and Green terminals.
4.	Initiate a call toward the COT.
5.	Arrange to have a call initiated from the COT toward the RT.
<i>On models with more than 1 voice line available, continue with step 6. Otherwise, continue with step 8.</i>	
6.	Test LINE 2 by connecting the clip leads of the test telephone to LINE 2 Red and Green terminals. Repeat Steps 4 and 5 above.
7.	Test LINE 3 by connecting the clip leads of the test telephone to LINE 3 Red and Green terminals. Repeat Steps 4 and 5 above. When testing is completed, remove the test telephone.
8.	If the RT does not operate properly, verify that the installer connections are complete and correct. Next, with a high impedance voltmeter, verify the voltages shown in Table 2.
9.	Verify that the 10 BaseT data link LED is ON (not flashing) indicating a good data connection.
10.	Close and secure both the internal and external TELCO access covers.
11.	Seal the TELCO access cover if required.

Table 2. Remote Terminal Voltages

Voltage Checkpoints	Voltage (VDC)
DSL TIP (+) & DSL RING (-)	125 to 260 volts
DSL TIP (+) & EARTH GROUND	Less than 200 volts, 130 volts typical
DSL RING (-) & EARTH GROUND	Less than 200 volts, 130 volts typical

Note: Check voltages with a high impedance voltmeter with all subscriber lines in the on-hook condition. Voltage reversal has no effect on RT operation.

6.3 Removing Digital Service

Use the following procedure to turn down RT service.

Step	Action
1.	Open the RT enclosure cover.
2.	Open the TELCO cover

Step	Action
3.	Carefully remove the green DSL TIP wire from the lightning protection block using insulated tools.
4.	Wait for all LEDs to extinguish.
5.	Disconnect the DSL and subscriber wires.
6.	The subscriber's line and inside wiring should be reconnected at a protector or network interface device per local procedures.

7. TROUBLESHOOTING

Use the following table to troubleshoot some of the most common problems with the HVDL system. You may also find answers to your questions under "Commonly Asked Questions".

Problem	Possible Cause(s) and Solution(s)
The link LED on the RT (or the COT far LED) is not steady on	RT is not in sync with the COT. Check the SYNC LED on the RT or phone display at the COT. Customer unplugged the 10 BaseT cable from the computer. Customer needs a crossover 10 BaseT cable. Customer's computer is not on. Customer's network connection software is not set up properly (reboot the computer after reconfiguring).
The RT link LED is single-flashing	The RT link is good; the COT link is not established.
COT near link LED not steady on	COT 10 BaseT cable not connected to a hub, switch or router. Cable needs to be a crossover 10 BaseT cable.
The RT and COT link LEDs are steady ON, but no data is being transferred	DSL is not synced up. The data rate is set to 0 K; change the data rate. Some 100 BaseTx cards cause a "link steady ON" indicator, but can't transmit data. Make sure that the HVDL3.1 is linked to a 10 BaseT or 10/100 BaseTx card.
Customer not getting high speed data rates	COT rate not set up in configuration. Reconfigure the COT, and the new rate will be available immediately. The customer misunderstands bits and bytes. Because of invisible Ethernet overhead, a quick rule of thumb is 1 byte=about 10 bits of transmitted data. The backbone system connected to the COT (i.e. Internet) is slower than the HVDL system.
COT indicates QUAL on the display and/or QUAL LED is on at the RT	RT is too far from the COT. Add a repeater. Excess cable loss. Add a repeater. RT or COT electronics are failing.
The COT and RT won't sync	RT not connected to COT. RT is too far from the COT. Add a repeater. Excess cable loss. Add a repeater. RT or COT electronics are failing.
The customer's phone does not ring or is very low in volume	Too many REN loads on the line. Some very old ringers were not designed to any specifications and require excess power to ring. Install a local ring amplifier on the voice lines leaving the RT.

Problem	Possible Cause(s) and Solution(s)
The system fails with a ground fault	The cable is leaking current to ground. Check for bad cable and moisture. The cable has connection to ground. Remove the connection. Check the cable with a test device, such as a Sidekick 7B™ by Tempo. Wrong CO primary surge protector in the distribution/interconnect frame. Change to a surge protector with at least 260 volts to ground protection.
Caller ID doesn't work	This system is transparent to caller ID. Check the Class 5 switch for proper setup. Check the customer's caller ID device.
The COT LED display is flashing between the 3 phone display and the current data rate.	The system cannot synchronized at the desired data rate. The COT will step down in 128K increments, attempting to synchronize until a successful rate is determined. The COT will display the lower rate and start an alarm with a corresponding "bad COT" signature. RT is too far from COT; add a repeater. Excessive cable loss; add a repeater. RT, repeater or RT electronics failure.
Self test error (ERR).	Re-seat the COT. If problem is not fixed, the COT is damaged and needs to be replaced.
10 BaseT link never turns on or flashes.	If the COT LED display shows EPR or RPT or a data rate with the training arrow, the system is training—wait for the voice line display. The 10 BaseT link is malfunctioning—replace the unit.
Changed the EPREP/REPEATER setting on the front panel and nothing happened.	The COT card needs to be rebooted for the change to take effect. Remove the card and reinsert it to reboot it.
The voice channel is not operating.	No connection or a bad connection at the COT and/or the RT. DSL is not synced up. The voice channel is OFF; turn it on through the menu.
Cannot change settings on the COT front panel; can only view current settings.	The system administrator has locked the front panel through the access multiplexer to prevent unauthorized changes. Contact the system administrator.
The LED display shows "X" in the line status display (once DSL has established sync).	The POTS lines with "X" beside them are unavailable. This is caused by a mismatch between the number of POTS lines available on the COT and the number available on the RT. There is no undesirable effect on active data and POTS lines. Matching components with the same number of POTS lines removes the X.

7.1 Commonly Asked Questions

Does the data rate change with distance?

No, the data rate is selected from the front panel and does not change with distance, The system can be configured for longer distances at the lower data rates. See configuration software, #SM-CSHVDL3.1T.

How do I shut off data transmission to a customer?

Using the COT front panel, change the data rate to "0". The data rate will take effect immediately—no truck roll is necessary.

The customer does not have category 3 or better wire in the house. Will this cause problems?

For short distances, this may not cause any problems. However, data operation when using other than category 3 cable or better is not guaranteed.

Does the HVDL system need an IP address?

The system can be thought of as a “bridge”. It does not need an IP address.

The system works OK with only an RT, but will not work with a repeater.

Configure the COT using the front panel for repeater mode.

The system instantly powers up the line, and I don't have a repeater.

Configure the COT using the front panel for EPREP operation.

The customer's data rate is to be changed (i.e. sold a better rate to the customer). What do I do?

Reconfigure the data rate at the COT front panel. The COT will have to retrain, and during retraining data will be lost if the customer is on-line. The customer may need to reboot his or her PC for the data rate to take effect. No truck roll is necessary.

How can I make voice line 2 (or voice line 3) the line bypassed in BYPASS mode? (For models with more than 1 voice line)

By definition, voice line 1 is the only line available for bypass. Rearrange the voice lines so that the line to be active during bypass mode is connected to voice line 1.

Can I use 10/100 BaseTx card to connect to the HVDL3.1 system?

Yes. 10 BaseT and 10/100 BaseTx cards will link to the HVDL3.1. However, 100 BaseTx-only cards will not link.

8. TECHNICAL ASSISTANCE

If technical assistance is required, contact Charles Industries' Technical Services Center at:

847-806-8500

847-806-8556 (FAX)

800-607-8500

techserv@charlesindustries.com (e-mail)

9. WARRANTY & CUSTOMER SERVICE

9.1 Warranty

Charles Industries, Ltd. offers an industry-leading, 5-year warranty on products manufactured by Charles Industries. Contact your local Sales Representative at the address or telephone numbers below for warranty details. The warranty provisions are subject to change without notice. The terms and conditions applicable to any specific sale of product shall be defined in the resulting sales contract.

Charles Industries, Ltd.

5600 Apollo Drive

Rolling Meadows, Illinois 60008-4049

847-806-6300 (Main Office)

847-806-6231 (FAX)

9.2 Field Repairs (In-Warranty Units)

Field repairs involving the replacement of components within a unit are not recommended and may void the warranty and compatibility with any applicable regulatory or agency requirements. If a unit needs repair, contact Charles Industries, Ltd. for replacement or repair instructions, or follow the *Repair Service Procedure* below.

9.3 Advanced Replacement Service (In-Warranty Units)

Charles Industries, Ltd. offers an “advanced replacement” service if a replacement unit is required as soon as possible. With this service, the unit will be shipped in the fastest manner consistent with the urgency of the situation. In most cases, there are no charges for in-warranty repairs, except for the transportation charges of the unit and for a testing and handling charge for units returned with no trouble found. Upon receipt of the advanced replacement unit, return the out-of-service unit in the carton in which the replacement was shipped, using the pre-addressed shipping label provided. Call your customer service representative at the telephone number above for more details.

9.4 Standard Repair and Replacement Service (Both In-Warranty and Out-Of-Warranty Units)

Charles Industries, Ltd. offers a standard repair or exchange service for units either in- or out-of-warranty. With this service, units may be shipped to Charles Industries for either repair and quality testing or exchanged for a replacement unit, as determined by Charles Industries. Follow the *Repair Service Procedure* below to return units and to secure a repair or replacement. A handling charge applies for equipment returned with no trouble found. To obtain more details of this service and a schedule of prices, contact the CI Service Center at 217-932-5288 (FAX 217-932-2943).

Repair Service Procedure

1. Prepare, complete, and enclose a purchase order in the box with the equipment to be returned.
2. Include the following information:
 - Company name and address
 - Contact name and phone number
 - Inventory of equipment being shipped
 - Particulars as to the nature of the failure
 - Return shipping address
3. Ship the equipment, purchase order, and above-listed information, transportation prepaid, to the service center address shown below.

CI Service Center
503 N.E. 15th St., P.O. Box 339
Casey, IL 62420-2054

4. Most repaired or replaced units will be returned within 30 or 45 days, depending on the product type and availability of repair parts. Repaired units are warranted for either 90 days from the date of repair or for the remaining unexpired portion of the original warranty, whichever is longer.

10. SPECIFICATIONS

10.1 Power Source

The HVDL RT line unit is powered over the DSL carrier pair from the COT; no batteries or local power required.

10.2 Electrical Characteristics

The electrical characteristics of the HVDL RT line unit are as follows:

- (a) SYSTEM LOSS IN EACH DIRECTION OF TRANSMISSION: 3.5 \pm 1.0 dB nominal
- (b) FREQUENCY RESPONSE: The loss relative to 1004Hz with 0dBm0 input signal:

Frequency	Minimum Loss	Maximum Loss
300 Hz	0.0 dB	+3.0 dB
400 Hz to 3000Hz	-0.5 dB	+1.0 dB
3200 Hz	-0.5 dB	+1.5 dB
3400 Hz	0.0 dB	+3.0 dB

- (c) IDLE CHANNEL NOISE AT THE OUTPUT OF THE RT: 20dBmC maximum
- (d) CHANNEL CROSSTALK: With 0dBm0 single frequency input signals between 300 and 3400Hz applied to any line, the C-message weighted any other lines at the RT in the 300 and 3400Hz frequency band is less than -65dBm0 (*For models with more than 1 voice line*)
- (e) DC SUPERVISORY RANGE: Rdc is the maximum external loop resistance capability of the system. The Rdc for the RT is 530 ohms, specified as a 430 ohm telephone instrument plus a 100 ohm cable

- (f) RETURN LOSS (Ref: 600 ohms + 2.16 μ F): ERL> 18dB; SRL> 10dB
- (g) OFF-HOOK CURRENT TO EACH LINE: 23mA minimum
- (h) ON-HOOK VOLTAGE TO EACH LINE: -42.5V minimum
- (i) RINGING FREQUENCY: 20 Hz \pm 2Hz
- (j) RINGING CAPACITY: Non-repeater OR repeater mode = 5 REN per line, 8 REN simultaneously (all lines total)
HVDL 1.1 ONLY: 5 REN per line, 5 REN total
- (k) DATA: 10 BaseT Ethernet, 100 meters (330 feet), Category 3 or better

10.3 Physical Specifications

The physical characteristics of the RT are shown in Table 3.

Table 3. Physical Specifications

Feature	U.S.	Metric
Height	9.5 inches	24.1 centimeters
Width	7.5 inches	19.1 centimeters
Depth	5.28 inches	13.4 centimeters
Weight	3.0 pounds	1.36 kilograms
Temperature	-40 to 149° F	-40 to +65° C
Humidity	To 100%	

10.4 Regulatory Specifications

- Complies with Underwriters Laboratories Standard 1950, Second Edition. Field repairs may void compliance.
- Designed to meet Telcordia (Bellcore) GR-49-CORE
- FCC Part 15 Class B

FCC PART 15 CLASS B NOTE

This equipment generates and uses radio frequency energy, and if not installed and used in accordance with the instructions in this practice, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class B digital device, pursuant to Subpart B of Part 15 FCC Rules, which are designed to provide protection against such interference when operated in a residential or commercial environment.

10.4.1. Accessories

An optional ring lug kit is available for grounding for either 6 or 10 AWG solid wire. Order part # 97-001764-A.

