## VDL-RS CONTENTS

### SECTION 1 GENERAL

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>1-2</td>
<td>REMOTE CONTROL / UNKEY</td>
</tr>
<tr>
<td>1-3</td>
<td>UNIVERSAL DELAY LINE</td>
</tr>
<tr>
<td>1-4</td>
<td>ADDRESSING</td>
</tr>
<tr>
<td>1-5</td>
<td>SECURITY</td>
</tr>
<tr>
<td>1-6</td>
<td>FLAT GAIN</td>
</tr>
<tr>
<td>1-7</td>
<td>MOUNTING</td>
</tr>
<tr>
<td>1-8</td>
<td>I/O and POWER</td>
</tr>
<tr>
<td>1-9</td>
<td>ANCILLARY PRODUCTS</td>
</tr>
<tr>
<td>1-10</td>
<td>SPECIFICATIONS VDL-RS</td>
</tr>
</tbody>
</table>

### SECTION 1 ILLUSTRATIONS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>REAR PANEL, PHOTO</td>
</tr>
<tr>
<td>1-1</td>
<td>BLOCK DIAGRAM / VDL-RS</td>
</tr>
<tr>
<td>1-2</td>
<td>DELAY LINE PANEL, DRAWING</td>
</tr>
<tr>
<td>1-2</td>
<td>ANCILLARY PRODUCTS, TABLE</td>
</tr>
<tr>
<td>1-2</td>
<td>806A TEST SET, PHOTO</td>
</tr>
</tbody>
</table>

### SECTION 2 INSTALLATION

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>2-1</td>
<td>RECEIVING INSPECTION</td>
</tr>
<tr>
<td>2-1</td>
<td>QUICK SETUP</td>
</tr>
<tr>
<td>2-1</td>
<td>INSTALLATION - WALL MOUNT</td>
</tr>
<tr>
<td>2-1</td>
<td>INSTALLATION - RACK MOUNT</td>
</tr>
<tr>
<td>2-2</td>
<td>RECEIVING OPERATIONAL CHECK</td>
</tr>
<tr>
<td>2-2</td>
<td>SUPPORT</td>
</tr>
<tr>
<td>2-2</td>
<td>WARRANTY</td>
</tr>
<tr>
<td>2-2</td>
<td>PRODUCT REPAIR SERVICE</td>
</tr>
</tbody>
</table>

### SECTION 2 ILLUSTRATIONS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>FRONT / REAR PANEL, DRAWING</td>
</tr>
</tbody>
</table>

### SECTION 3 OPERATION

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>INTRODUCTION</td>
</tr>
<tr>
<td>3-1</td>
<td>OPERATION</td>
</tr>
<tr>
<td>3-1</td>
<td>LOCAL CONTROL / RS-232 PORT</td>
</tr>
<tr>
<td>3-2</td>
<td>REMOTE CONTROL</td>
</tr>
<tr>
<td>3-2</td>
<td>TOUCH-TONE SETTING COMMANDS</td>
</tr>
<tr>
<td>3-2</td>
<td>ADDRESSING</td>
</tr>
<tr>
<td>3-2</td>
<td>TOUCH-TONE ADDRESS COMMANDS</td>
</tr>
<tr>
<td>3-2</td>
<td>UNIVERSAL ADDRESS 99</td>
</tr>
<tr>
<td>3-2</td>
<td>SECURITY</td>
</tr>
<tr>
<td>3-2</td>
<td>TOUCH-TONE SECURITY COMMANDS</td>
</tr>
<tr>
<td>3-2</td>
<td>TOUCH-TONE (DTMF) GENERATION</td>
</tr>
<tr>
<td>3-2</td>
<td>TOUCH-TONES VIA 806A TIMS SET</td>
</tr>
<tr>
<td>3-3</td>
<td>VIA TOUCH-TONE GENERATOR</td>
</tr>
<tr>
<td>3-3</td>
<td>TOUCH-TONES VIA HYPERTERMINAL</td>
</tr>
<tr>
<td>3-4</td>
<td>CONFIGURING HYPERTERMINAL</td>
</tr>
<tr>
<td>3-4</td>
<td>OPERATION TEST / NO PC</td>
</tr>
<tr>
<td>3-5</td>
<td>SETTING THE ADDRESS</td>
</tr>
<tr>
<td>3-6</td>
<td>OPERATION TEST USING A PC</td>
</tr>
<tr>
<td>3-6</td>
<td>DEPLOYMENT RECOMMENDATIONS</td>
</tr>
<tr>
<td>3-7</td>
<td>ROUND TRIP DELAY / 806A</td>
</tr>
<tr>
<td>3-7</td>
<td>ROUND TRIP DELAY</td>
</tr>
<tr>
<td>3-7</td>
<td>EDD ENVELOPE DELAY DISTORTION</td>
</tr>
<tr>
<td>3-7</td>
<td>TERMS</td>
</tr>
<tr>
<td>3-7</td>
<td>PROCEDURE, ROUND TRIP DELAY</td>
</tr>
</tbody>
</table>

### SECTION 3 ILLUSTRATIONS

<table>
<thead>
<tr>
<th>PAGE</th>
<th>CONTENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-1</td>
<td>TERMINAL CONTROL SCREEN</td>
</tr>
<tr>
<td>3-1</td>
<td>BLOCK DIAGRAM / VDL-RS</td>
</tr>
<tr>
<td>3-3</td>
<td>TOUCH-TONE GENERATOR, CIRCUIT DIAGRAM</td>
</tr>
<tr>
<td>3-3</td>
<td>PC SCREEN / DTMF VIA HYPERTERMINAL</td>
</tr>
<tr>
<td>3-3</td>
<td>EQUIPMENT HOOKUP / NO PC</td>
</tr>
<tr>
<td>3-3</td>
<td>EQUIPMENT HOOKUP / PC</td>
</tr>
<tr>
<td>3-3</td>
<td>DEPLOYMENT DIAGRAM</td>
</tr>
<tr>
<td>3-7</td>
<td>EQUIPMENT HOOKUP / EXTENDED RT DELAY</td>
</tr>
<tr>
<td>3-7</td>
<td>EQUIPMENT HOOKUP / EXTENDED RT DELAY</td>
</tr>
<tr>
<td>3-7</td>
<td>EQUIPMENT HOOKUP / PC</td>
</tr>
<tr>
<td>3-10</td>
<td>MAIN MENU / UPDATE FIRMWARE</td>
</tr>
<tr>
<td>3-10</td>
<td>SEND TEXT FILE - SELECTION SCREEN</td>
</tr>
<tr>
<td>3-11</td>
<td>MAIN MENU / FIRMWARE TRANSFER</td>
</tr>
<tr>
<td>3-11</td>
<td>TRANSFER COMPLETE / WAIT 30 SECONDS</td>
</tr>
</tbody>
</table>
1-1 INTRODUCTION  The VDL-RS Variable Delay Line is used in radio systems to match the time delay of diverse transmission paths. This prevents garbled reception in areas where multiple transmitters “overlap”. The VDL-RS operates on baseband, voice frequencies and provides a wide range of delay adjustment and 12 dB of amplitude adjustment.

The RS-232 Control Port is a convenient control method for central sites or when an operator is physically present. Touch-tones provide a convenient means of adjusting units at remote locations. A “DTMF” Indicator is provided as a diagnostic tool. This LED lights when valid (DTMF) touch-tones are detected. Valid DTMF commands are acknowledged with a tone burst output.

1-2 REMOTE CONTROL  The VDL-RS can be installed at remote transmitter sites used in paging or simulcast radio systems. Remote control saves resources by eliminating the need to send a truck to the remote sites to make adjustments. The VDL-RS is controlled by applying touch-tones to the working channel, or an individual base station can be remotely unkeyed by activating the QUIET Feature.

1-3 UNIVERSAL DELAY LINE  With a delay range of 300 to 2,000,000 micro-seconds, the VDL-RS replaces a wide range of conventional delay lines. Conventional devices typically have a small adjustment range which requires a fixed delay line in series. The VDL-RS provides a universal solution by combining wide range with high resolution.

1-4 ADDRESSING  Delay and level is remotely controlled by touch-tones. Since multiple delay lines may serve the same channel, an addressing arrangement is used. This permits units to be controlled individually. The VDL-RS can be set-up to respond to a unique two-digit address. Up to 99 units can be individually controlled from a common source. A ZONE Control permits up to 10 groups of VDL’s to be silenced or restored. Otherwise, VDL’s are restored after a time-out. A universal address permits all units to be controlled simultaneously. Once adjusted, the VDL-RS’s can be made “deaf” random touch-tones with a security feature.

1-5 SECURITY  The security feature disables the touch-tone control so that the delay lines will not be altered by random touch-tones. The security feature is activated and deactivated using a specific 8 digit sequence. Once activated the delay line will remain deaf to all touch-tone commands except one. A second 8 digit sequence unlocks the security feature. Further, the security feature can be applied on a selective or universal basis. Selectivity permits control activation of a single unit - keeping all other units locked. Universal application permits all units to be locked or unlocked simultaneously.
1-6 FLAT GAIN  Flat gain amplifies or attenuates all frequencies by a variable factor to compensate for transmission level differences to diverse transmitters. Flat gain is also controlled by touch-tones so that precise level adjustments can be made from a central or strategic site. This permits a system to be conveniently normalized from a central location. Gain is adjustable from 6 dB loss to 6 dB gain in 0.1 dB steps.

1-7 MOUNTING  The VDL-RS can be wall mounted or rack mounted. It is wall mounted using slotted screw holes in the base. Rack mounting requires (1U) 1.75 inches of vertical space. A rack-mounting panel (Model DLP-19) will accommodate up to four delay lines. The delay lines are attached to the panel using four screws.

1-8 I/O and POWER  A two-piece connector with screw locks is provided for signal and power wires. Standard Power is 12 VDC (VDL-RS-12). Options are: VDL-RS-24 and VDL-RS-48 (48 VDC). An AC to 12 VDC Adapter is available: DAC-12. It powers one to four VDL’s.

1-10 SPECIFICATIONS  VDL-RS

- RS-232 Port: Serial Asynchronous
- Full Duplex
- 8 bit ASCII / 1 Stop bit, No Parity
- Baud Rate: 9,600 bps fixed
- 9 Pin D, Female / DCE
- Communications: Simple Menu displays status of all parameters. Select a parameter to be changed.
- Touch-Tone Control: Addressable: 00 to 98
- Universal address: 99
- Zone / Quiet Control 0 to 9
- “Quiet” opens relay / pins 3&6
- Touch-Tone Range: -26 to -6 dBm
- On / Off Time: 100 mSec minimum
- DTMF LED
- Command ACK: 976 Hz Acknowledgment Tone
- Security: 8 Character sequences disable and enable control.
  Set individually or universally.
- Frequency Range: 56 Hz to 3400 Hz
- Gain Range: -6 dB to +6 dB, 0.1 dB steps
- Delay Range: 300 to 2,000,000 microseconds in 1 microsecond steps
- I/O Impedance: 600 ohm - balanced, floating
- I/O Return Loss: Greater than 26 dB
- Input/Output Level: +10 dBm maximum
- Nonlinear Distortion: Less than 1%
- Noise: -60 dBmC typical
- Environmental: -30° to +60 °C, 0 to 95% R.H.
- Power Requirements: -12: 10 - 18 VDC / 150 mA max
  Options: -24: 19 - 36, -48: 37 - 75 VDC
- Dimensions: 1.7” H x 4.25” W x 9.4” D
  4.32 cm x 10.8 cm x 23.9 cm
- Weight: 1.0 lb., 0.45 kg
2-1 INTRODUCTION This section is organized into five parts dealing with: Receiving Inspection, Receiving Operational Check, Installation - Wall Mount, Installation - Rack Mount, Support and Service. Receiving Inspection consists of a visual examination and brief operational check to verify that the VDL-RS has not been damaged in transit. Installation - Wall Mount discusses I/O and Power connections. Installation - Rack Mount discusses mounting, I/O, and Power hook-up. Support and Service includes factory assistance with applications, operation, repairs or installation.

2-2 RECEIVING INSPECTION Prior to shipment each VDL-RS is tested electrically and inspected for good mechanical condition. New units should be free of mechanical defects and new (or repaired) units should be in good operating order. Inspect the equipment on receipt to insure that it has not been damaged in transit. If damage is observed, retain the shipping carton and its contents and file a claim with the freight carrier.

2-3 QUICK SETUP Connect 12 VDC (or other voltage per the label) to the power contacts on the green connector, observing the marked polarity. Connect a PC running HyperTerminal to the RS-232 Control Port. (Port parameters: Asynchronous, Full Duplex, DCE, 8 bit ASCII / 1 Stop bit, No Parity, Baud Rate: 9,600 bps fixed) Ref: Section 3-2-1 on Page 3-1. Use terminal control to setup the VDL-RS as needed. Factory defaults are:
   Delay = 300 uS (micro seconds)
   Flat Gain = 0.0 dB.

2-4 INSTALLATION - WALL MOUNT The VDL-RS can be installed on a wall using the slotted screw holes in the base.

1. Set two screws in the wall on five inch centers to accommodate the slotted screw holes on the base of the delay line.
2. Adjust the screws such that the VDL-RS locks securely in place. Then remove the VDL-RS from the wall while connecting signal and power leads.
3. Connect a grounding wire to the Earth Ground Lug on the rear of the VDL-RS.
4. Fuse one of the power leads with a .25 Amp, slow-blo fuse.
5. Connect the power leads to the Power contacts on the green connector. Observe the polarity, and leave the power off while connecting the signal leads.
6. Connect signal leads to the Input contacts on the green connector. Tip / Ring polarity indicators are provided so that signal polarity can be maintained.
7. Connect signal leads to the Output contacts on the green connector. Avoid signal inversion by connecting the output leads with the same polarity as the input leads. Note: The VDL-RS maintains signal polarity - T/R Input to T/R Output with the Phase Inversion set to NORMAL.
8. For REMOTE UNKEY, wire the transmitter PTT contact in series with green connector pins 3 and 6. During normal operation, there is a relay closure across pins 3 & 6. When the VDL is put into QUIET Mode, the relay opens to unkey the transmitter.
9. Mount the VDL-RS on the wall and apply power. Use a test set to check that that the VDL-RS is passing signal properly. Refer to Section 2-6.

2-5 INSTALLATION - RACK MOUNT The VDL-RS is attached to a Model DLP-19 Delay Line Panel which mounts in 1 vertical space (1.75 inches) of a 19 inch rack or cabinet.
1. Attach the VDL-RS to the panel using four of the 
#6-32 machine screws furnished with the panel.
2. Mount the panel to the rack or cabinet with two 
screws (not furnished) at either end of the panel. 
I/O and power wires are connected from the rear.
3. A ground wire does not need to be connected to 
the rear of the VDL-RS when its chassis is 
grounded by the rack.
4. Fuse one of the power leads with a .25 Amp, 
slow-blo fuse.
5. Connect the power leads to the Power contacts 
on the green connector. Observe the polarity, and 
leave the power off while connecting the signal 
leads.
6. Connect signal leads to the Input contacts on the 
green connector. Tip / Ring polarity indicators are 
provided so that signal polarity can be observed.
7. Connect signal leads to the Output contacts on 
the green connector. Avoid signal inversion by 
connecting the output leads with the same 
polarity as the input leads. Note: The VDL-RS 
maintains signal polarity - T/R Input to T/R Output 
with the Phase Inversion set to NORMAL.
8. For REMOTE UNKEY, wire the transmitter PTT 
contact in series with green connector pins 3 and 6. 
During normal operation, there is a relay closure 
across pins 3 & 6. When the VDL is put into QUIET 
Mode, the relay opens to unkey the transmitter.

2-6 RECEIVING OPERATIONAL CHECK The 
receiving operational check is used to verify that 
the VDL-RS is operational. This is a quick check to 
verify that new, or repaired, units pass signal. A 
test set is used to supply a signal to the input of the 
delay line and measure the signal level at the 
output. Any accurate test set with a 600 Ohm 
output and input impedance will work. A Convex 
Model 806A TIMS Test Set is recommended.
1. Connect the send of the test set to the INPUT of 
the VDL-RS. Polarity doesn't matter.
2. Connect the receive of the test set to the 
OUTPUT of the VDL-RS. Polarity doesn't matter.
3. Connect 12 VDC to the power contacts on the 
green connector, observing the marked polarity.
4. Power the test set and adjust send and receive 
impedance for 600 Ohms. Put the test set in level 
mode, and send a 0 dBm / 1004 Hz tone to the 
delay line.
5. If the test set is receiving 1004 Hz between -0.5 
and +0.5 dBm, then the delay line is passing signal 
with a nominal (0 dB) gain setting. The VDL-RS is 
operational.
6. If the test set is receiving 1004 Hz between -6 to 
-0.5 or between 0.5 and + 6 dBm, the delay line is 
passing signal - but gain may be offset. In this 
situation refer to Section 3, and set flat gain to 0 
dB.
7. If the If the test set is receiving less than -7 dBm, 
then something is awry. Refer to Section 2-7 to 
contact the factory.

2-7 SUPPORT We invite your comments, 
questions or technical support requirements.

On the Internet:    http://www.ConvexCorp.com 
e-mail:    Turner_J@ConvexCorp.com

In the USA:
Phone (703) 433-9901    /    FAX (703) 433-9904

If repair work is required, ship the product to the 
factory:

CONVEX CORPORATION
1319 Shepard Drive
Sterling, VA 20164  USA

Include a note:
Trouble description
Your name / phone number
Return shipping address

2-8 WARRANTY All Convex products are 
warranted to be free of manufacturing defects for a 
period of one year from the date of shipment. At its 
option, Convex will either repair or replace products 
which prove to be defective during the warranty 
period. No other warranties are expressed or 
IMPLIED. Convex Corporation is not liable for 
consequential damages.

2-9 PRODUCT REPAIR SERVICE Post warranty 
repair service is available for Convex products. 
Where there is no observable mechanical damage, 
the Model VDL-RS will be repaired for a fixed fee. 
Otherwise, Convex will advise as to the nature and 
cost of repair and, subject to customer instructions, 
will promptly repair and return the product.
3-1 INTRODUCTION This section describes the operation of the VDL-RS Variable Delay Line using local and remote control. Deployment recommendations are also provided.

3-2 OPERATION The VDL-RS Variable Delay Line is used in radio systems to match the time delay of diverse transmission paths. This prevents garbled reception in areas where multiple transmitters "overlap". The VDL-RS operates on baseband, voice frequencies providing precision control of delay and level of signals going to transmitters. Remote control is conveniently provided via touch-tones. Local Control is provided through the RS-232 Serial Port.

3-2-1 LOCAL CONTROL / RS-232 PORT
The VDL-RS is controlled via the RS-232 Port using a PC running a terminal emulation program such as HyperTerminal or Procomm. Control selections are made from the simple menu above. The menu shows the current SETTING and allowable RANGE of each parameter. The RS-232 Port parameters are: Asynchronous, Full Duplex, DCE 8 bit ASCII / 1 Stop bit
No Parity
Baud Rate: 9,600 bps fixed
Setup the terminal emulation program per the RS-232 Port parameters. HyperTerminal is part of the operating system for Windows 95 and later.

3-2-2 REMOTE CONTROL When the VDL-RS is installed at remote sites, remote control saves time and resources by eliminating the need to send a truck to the transmitter sites to make adjusts. The VDL-RS is controlled by applying touch-tones to the working channel. Referring to the Block Diagram on page 3-1, the delay line is adjusted by sending touch-tone commands in place of the normal voice band signal.

3-2-3 TOUCH-TONE SETTING COMMANDS:
Format: *xx*yyyy#
where:  
xx = two digit address 00 thru 99  
(universal / factory default = 99)  
y = 0 for flat gain adjustment,  
= 1 for delay adjustment,  
= 4 for quiet / normal control,  
= 5 for quiet zone setting  
= 7 for quiet time-out setting  
= 8 for phase inversion control  
zzzzzzz = setting data:  
0 thru 60 for positive gain  
(0 thru +6.0 dB in 0.1 dB steps)  
101 thru 160 for negative gain  
(-0.1 thru -6.0 dB in 0.1 dB steps)  
300 to 2000000 for delay in uSec  
0 thru 91 for quiet / normal control  
0 thru 9 for zone setting  
0 thru 9 for quiet time-out  
0 = no time-out, 1-9 = 10-90 Min.  
0 for normal or 1 for inverted

Examples:
*990*60# Sets flat gain = +6.0 dB  
*990*124# Sets flat gain = -2.4 dB  
*991*367# Sets bulk delay = 367 uSec.  
*991*1234567# Sets bulk delay = 1,234,567 uSec  
*994*1# Sets individual unit to quiet  
and opens relay / pins 3 & 6  
*994*0# Sets individual unit to normal  
and closes relay / pins 3 & 6  
*994*91# Sets all zone 9 units to quiet  
*994*90# Sets all zone 9 units to normal  
*995*1# Sets unit to zone 1  
*995*9# Sets unit to zone 9  
*997*9# Sets quiet time-out to 90 minutes  
*997*0# Disables quiet time-out.  
*998*1# Sets inverter phase

3-2-4 ADDRESSING Delay and level are remotely controlled by touch-tones. The addressing feature is used when multiple delay lines share the same channel. This permits specific delay lines to be controlled individually. Prior to deployment, the VDL-RS is set-up to respond to a unique two-digit address (00 to 98). This permits up to 99 units to be individually controlled from a common source.

3-2-5 TOUCH-TONE ADDRESS COMMANDS:
Format: **xx**yy#  
where:  
xx = old address  
yy = new address

3-2-6 UNIVERSAL ADDRESS 99 A universal address is provided which permits all units to be controlled simultaneously. The universal address saves the time of sending the same command to each address. An example of a universal application is the security feature. Once the VDL-RS’s are properly adjusted, a universal security command can be sent to make all units “deaf” random touch-tones.

3-2-7 SECURITY The security feature disables the touch-tone control so that the delay lines will not be altered by random touch-tones. The security feature is activated and deactivated using a specific 8 digit sequence. Once activated the delay line will remain deaf to all touch-tone commands except one. A second 8 digit sequence which unlocks the security feature. The security feature can be applied on a selective or universal basis. Selectivity permits control activation of a single unit - keeping all other units locked. Universal application, permits all units to be locked or unlocked simultaneously.

3-2-8 TOUCH-TONE SECURITY COMMANDS:
Format: *xx**9y#  
where:  
xx = address  
y = 0 to Unlock  
1 to Lock

Example:  
*99**91# Locks all units

3-3 TOUCH TONES (DTMF) GENERATION
Three alternate methods of generating Touch-Tones are presented:
1. Use of an 806A TIMS Set - controlled via PC  
2. Use of a hardware Touch-Tone Generator  
3. Use of PC / HyperTerminal and a modem

3-3-1 TOUCH-TONES VIA 806A TIMS Set
The Model 806A TIMS Test Set can generate touch-tones when operated with a PC. If a PC is not available, a touch-tone generator will be used to manage the VDL-RS. If a VDL-RS is not responding, the touch-tone generator can also be used to send a 20 second tone to reset the processor on the VDL-RS.
3-3-2 VIA TOUCH-TONE GENERATOR
A touch-tone generator consists of a touch-tone phone, a battery to provide power, and coupling transformer. The exact components are not critical. The touch-tone generator is plugged into the “D” Jack provided on the front of the 806A TIMS for dialing. When not sending touch-tones, keep the phone On-Hook to save battery, and keep the touch-tone generator from terminating the TIMS signal generator.

3-3-3 TOUCH-TONES VIA HYPERTERMINAL
Touch-tones can also be generated using HyperTerminal (or other terminal emulation), a modem and “AT” Commands. AT Commands are used to cause the modem to dial on a “dry” line connected to the VDL-RS input.

Required:
1) Desktop or Notebook Computer with an internal or external modem and HyperTerminal (or similar) terminal emulation software.
2) Cable with an RJ11 plug on one end and the red and green wires stripped and accessible on the other end (or connectorized for network access).

Procedure:
1) Connect the RJ11 plug into the modem’s LINE connector. Connect the other end of the cable to the input terminals of the delay line (or network access point that leads to the input of the delay line).
2) Configure HyperTerminal to communicate with the modem (see Configuring HyperTerminal on the next page.)
3) Command the modem to bypass dial tone (atx0).
4) Prefix all DTMF commands with atdt.

Example Session:

<table>
<thead>
<tr>
<th>Type</th>
<th>Response</th>
<th>(Remark)</th>
</tr>
</thead>
<tbody>
<tr>
<td>at&lt;enter&gt;</td>
<td>OK</td>
<td>(modem present)</td>
</tr>
<tr>
<td>atx0&lt;enter&gt;</td>
<td>OK</td>
<td>(bypass dial tone)</td>
</tr>
<tr>
<td>atdt<em>991</em>1000#&lt;enter&gt;</td>
<td>audible dtmf</td>
<td>(sets delay to 1000 usec)</td>
</tr>
<tr>
<td>&lt;enter&gt;</td>
<td>NO CARRIER</td>
<td>(bypass sync attempt)</td>
</tr>
<tr>
<td>atdt<em>990</em>20#&lt;enter&gt;</td>
<td>audible dtmf</td>
<td>(sets gain to +2.0 dB)</td>
</tr>
<tr>
<td>&lt;enter&gt;</td>
<td>NO CARRIER</td>
<td>(bypass sync attempt)</td>
</tr>
</tbody>
</table>
3-3-4 CONFIGURING HYPERTERMINAL
For first time setup run HyperTerminal:

In the “Connection Description” dialog box type DTMF (or any name to describe the session)

In the “Connect To” dialog box set “Connect using” to the serial port your modem is configured for (select the COM port, not your modem name if it’s in the list).

In the “COM Properties” dialog box click “OK” to accept the defaults shown or select another baud rate from the list then click “OK”.

You should now be in a terminal session with your modem. Type at-enter> and you should get an “OK” response from the modem.

If you don’t get an “OK” from your modem you may not have the correct COM port selected. From the “Call” menu select “Disconnect”. From the “File” menu select “Properties”. From the “Connect to” tab beside “Connect using” select the correct COM port for the modem and try to get the “OK” prompt again.

If you get an “OK” from the modem but you can’t see the command as you type. From the “Call” menu select “Disconnect”. From the “File” menu select “Properties”. From the “Settings” tab select “ASCII Setup…”. From the “ASCII Setup” dialog box check mark “Echo typed characters locally”.

If you see two letters for every letter you type. From the “Call” menu select “Disconnect”. From the “File” menu select “Properties”. From the “Settings” tab select “ASCII Setup…”. From the “ASCII Setup” dialog box uncheck “Echo typed characters locally”.

Once you’ve got HyperTerminal setup successfully you can save the setup for future use using File/Save. Then to run the previously saved session from the Menu select HyperTerminal=>DTMF.ht (or whatever name you chose earlier).

3-4 OPERATION TEST / NO PC. This procedure is used to verify operation of the VDL-RS, and familiarize the user with the controls. It can be used if a PC is not available. Use of a PC to control the TIMS is the preferred method.
13. Set the SEND to DIAL, and send the following touch-tones to set the VDL-RS Delay to 2 seconds: 
\[ *991*2,000,000# \]

14. Put the phone On-Hook, and set SEND to dBm. After the delay reading settles, note that the TIMS reading is 8,000 uSec +/- 50 uSec.

   *Note: the TIMS delay measurement “rolls over” (repeats) every 12,000 uSec. At 2 seconds the reading has rolled over 166.67 times. 0.67 x 12,000 uSec = 8,000 uSec.*

15. Set SEND to DIAL, and send 3 quick touch-tones to the VDL-RS. Adjust the volume on the TIMS speaker so that the 2 second delay can be heard. Keep the pick-up on the phone away from the TIMS speaker to avoid feedback.

16. Set the SEND to DIAL, and send the following touch-tones to set the VDL-RS Delay to 300 uSec: 
\[ *991*300# \]

17. Put the phone On-Hook, and set SEND to dBm. After the delay reading settles, note that the TIMS reading is within 0.01 mS of 0.300 mS.

If any of the above steps fail to work properly, contact the factory for support. See page 2-2.

Having completed the operation test, this is a good point to set the address.

**3-5 SETTING THE ADDRESS** When the VDL-RS is deployed such that multiple units are exposed to the same touch-tone commands, a unique address is required for each unit. *Individual addressing is a good practice in all cases to minimize errors.*

1. Connect the RS-232 Control Port on the VDL-RS to a serial port on the PC. Run HyperTerminal as described on page 3-1. Enter 6 to access the DTMF Address selection submenu, and set the address using a unique number from 0 to 98.

**3-6 OPERATION TEST USING A PC** This is the preferred procedure to verify operation of the VDL-RS, and familiarize the user with the controls.

1. Connect the equipment per Hookup Diagram / Operation Test - at the top of Page 3-5. Then apply power to the VDL-RS.

2. Set the TIMS for 600 Ohm Send / Receive Impedance, LEVEL Mode, Send 1004 Hz / 0 dBm. Note the receive level.

3. Set the TIMS to DIAL, and send the following touch-tones to set the VDL-RS - gain to 0 dB. 
\[ *990*0# \]

4. Return the TIMS to Level Mode, and note that the receive level is 0 dBm +/- 0.5 dB.

5. Change the TIMS measurement to NOISE / C MSG. Note that the noise reading is less than + 36 dBm.

6. Set the TIMS to DIAL. Send the following touch-tones to set the VDL-RS - gain to +6 dB. 
\[ *990*60# \]

7. Return the TIMS to Level Mode. Note that the receive level is +6 dBm +/- 0.5 dB.

8. Set TIMS to DIAL, and send the following touch-tones to set the VDL-RS gain to 0 dB. 
\[ *990*0# \]

9. Return the TIMS to Level Mode. Note that the receive level returns to 0 dBm +/- 0.5 dB.

10. Put the TIMS into DELAY Mode, and send 1804 Hz / 0 dBm. Connect the TIMS B Port directly to the A Port, and ZERO the Delay Measurement.

11. Set the TIMS to DIAL, and send the following touch-tones to set the VDL-RS Delay to 300 uSec: 
\[ *991*300# \]

12. Return the TIMS to Delay Mode, note that delay is within 10 uSec of 300 uSec.

13. Set the TIMS to DIAL, and send the following touch-tones to set the VDL-RS Delay to 2 seconds: 
\[ *991*2,000,000# \]

14. Return the TIMS to Delay Mode. After the delay reading settles, note that the TIMS reading is 8,000 uSec +/- 50 uSec.

   *Note: the TIMS delay measurement “rolls over” (repeats) every 12,000 uSec. At 2 seconds the reading has rolled over 166.67 times. 0.67 x 12,000 uSec = 8,000 uSec.*
15. Set the TIMS to DIAL, and send touch-tones to the VDL-RS. Adjust the volume on the TIMS speaker so that the 2 second delay can be heard.

16. Set the TIMS to DIAL, and send the following touch-tones to set the VDL-RS Delay to 300 uSec: *991*300#

17. Return the TIMS to Delay Mode. After the delay reading settles, note that the TIMS reading is within 10 uSec of 300 uSec.

If any of the above steps fail to work properly, contact the factory for support. See page 2-2.

3-7 DEPLOYMENT RECOMMENDATIONS. This section recommends methods of managing the VDL-RS deployed at remote sites. The simplified Deployment Diagram below is used for discussion.

Since there are multiple VDL-RSs on a single channel, addresses (01, 02) were set into the respective delay lines prior to installation.

1. Use the universal address to set both delay lines to 300 uSec delay and 0 dB gain. Send touch-tones: *991*300# followed by *990*0#

2. Shut down Site 2 so that only antenna 1 is transmitting.

3. Measure and record the round trip delay of transmitter 1.

   Note: See Section 3-8 regarding Round Trip Delay

4. Shut down Site 1 so that only antenna 2 is transmitting.

5. Measure and record the round trip delay of transmitter 2.

6. The site with the longest delay will have its VDL-RS set to 1,000 uSec. (The 1,000 uSec is an arbitrary “buffer” to give the long site some downward adjustment range to accommodate future changes. For example, send *021*1000#

7. The site with the short delay will be set to match the total delay of the long site. For example, send *011*3515#

8. Repeat steps 2 to 5 and adjust the delay of the short site to match the long site. For example, if the short site is still short 2 uSec., send *011*3517#

Note: The Deployment Diagram above shows a Test Receiver being used to measure Round Trip Delay. Where feasible, it is preferable to “loopback” the talk-out to talk-in at the transmitters when measuring Round Trip Delay.

Note: The transmitter sites should be designed so that the nominal flat gain adjustment on the VDL-RS is 0 dB. However when needed, the gain of VDL-RS can be remotely adjusted to improve system performance.

9. When the delay and gain have been set to the desired values, set the security feature in all of the delay lines. Send *99**91# to lock all of the VDL’s.

To make adjustments in the future, unlock only the unit in need of adjustment using its address. For example send *02**90# to unlock VDL-RS with address 02.
3-8 ROUND TRIP DELAY. Convex 806A and 807A Transmission Test Sets measure Round Trip Delay and Envelope Delay Distortion. Both measurements are based on the phase shift of a (83.333 Hz) 12 mS reference.

NOTE
If the system delay is likely to exceed 9 milliseconds, refer to Section 3-9 EXTENDED ROUND TRIP DELAY.

3-8-1 ROUND TRIP DELAY is used to measure the input to output transmission time of a system. It is an absolute time measurement made at a single frequency - normally 1804 Hz. The test signal is first zeroed with the test set generator directly connected to the receiver. Then the signal is passed through the system under test and returned (round trip) to the test set. The test set display is interpreted as positive milliseconds.

3-8-2 EDD. For reference ENVELOPE DELAY DISTORTION is a relative time measurement which makes no statement as to actual input to output transmission time. It measures the difference in transmission time of various frequencies compared to that of a "zero" reference frequency.

3-8-3 TERMS.
Round Trip Delay is also called PHASE DELAY. Envelope Delay is also called GROUP DELAY.

FREQUENCY \( w \) radians / second

PHASE \( P(w) \) radians

PHASE DELAY \( T_p = -P(w) / w \) seconds

GROUP DELAY \( T_g = -dP(w) / dw \) seconds

3-8-4 PROCEDURE Round Trip Delay / 806A
1. Select DELAY Measurement Mode. Select the 15 kHz Filter and set the generator to 1804 Hz.
2. Connect test set SEND directly to the RECEIVE. When the display settles, ZERO the delay reading. Then wait for the zero reading to settle.
3. Connect the test set to the system under test and record the delay when the display settles.

NOTE: By nature, Round Trip Delay and EDD have a 12 mS "rollover". The test set display is configured to read between -3.000 and +9.000 mS.

3-9 EXTENDED ROUND TRIP DELAY. Extended Round Trip Delay is available for 806A Test Sets. It overcomes the 12 millisecond ambiguity associated with the 83 Hz delay measurement. Extended Round Trip Delay directly measures out to 1000 mS with up to 001 mS resolution.

3-9-1 EXTENDED ROUND TRIP DELAY is used to measure the input to output transmission time of a system. It is an absolute time measurement made at a single frequency - normally 1804 Hz. The test signal is first zeroed with the test set generator directly connected to the receiver. Then the signal is passed through the system under test and the delay is measured.

3-9-2 Procedure - Extended Round Trip Delay
1. On the front panel, select the 15 kHz Filter and select DELAY Measurement Mode. Then press the MEAS Key for about one second until the DELAY LED blinks.
2. Connect test set SEND directly to the RECEIVE. When the display settles, ZERO the delay reading. Then wait for the zero reading to settle.
3. Connect the test set to the system under test and record the delay when the display settles.

3-9-3 NOTES: In extended mode, the instrument is setup to measure "positive" delay only. Therefore any reduction of delay after zeroing will be misinterpreted.

It can take 6 seconds for an Extended Round Trip Delay measurement to settle. The LED display blinks to indicate each new reading update.

3-9-4 HIGH RANGE / 3 Seconds. If the reading is greater than one second or does not settle to a steady value, press the UP Arrow to assert the high range. Note that the display blinking slows to about three seconds per update. With the slow update rate it can take 12 seconds for readings to settle. (Press the DOWN Arrow to return to the one second range.)
3-9-5 Equipment Hookup Extended RT Delay.
When a PC is not available, use the front panel controls of the 806A to control Extended Round Trip Delay. Refer to Section 3-3 regarding the touch-tone generator.

3-9-6 Extended RT Delay / Control via PC.
Extended Round trip delay is preferable measured using PC Software to control the 806A.

1. In Delay, select ROUND TRIP - 1 SEC Mode:

```
                        ===============d:com2
DELAY +  0000 uSEC  01-04 12:34
ROUND TRIP - 1 SEC
15 kHz[    ]

RCV A + 0.1 dBm 600 TERM   1.805 kHz
NORM  4W

SND B + 0.0 dBm 600 TERM   1.804 kHz
SWEEP ZERO 1004 1204 1804 CONT DATA MENU
<F1> <F2> <F3> <F4> <F5> <F6> <F7> <F8>
```

PC SCREEN / EXTENDED RT DELAY

2. Connect test set SEND directly to the RECEIVE. When the display settles, ZERO the delay reading. Then wait for the zero reading to settle.

*The test set can be rezeroed after being connected to the system provide delay is not subsequently reduced!*

3. Connect the test set to the system under test and record the delay when the display settles.
3-10 TOUCH-TONE COMMANDS

3-10-1 Setting Commands:

Format:  
\[ *\text{xx}*\text{yyyy}# \]

where:
- \( \text{xx} \) = two digit address 01 thru 99 (factory default = 99)
- \( \text{y} \) = 0 for flat gain adjustment, 
  = 1 for delay adjustment, 
  = 4 for quiet / normal control, 
  = 5 for zone setting 
  = 7 for quiet time-out setting 
  = 8 for phase inversion control 

\[ \text{yyyy} \] = setting data: 
- 0 thru 60 for positive flat gain 0 thru +6.0 dB
- 101 thru 160 for negative flat gain (loss) –0.1 thru –6.0
- 300 thru 2096000 for delay (in uSec)
- 0 thru 91 for quiet / normal control
- 0 thru 9 for zone setting
- 0 thru 9 for quiet time-out setting 0 = no time-out,
  = 1 – 9 = duration in tens of minutes (default is 10 minutes)
- 0 for normal or 1 for inverted phase

Examples: 
- *990*60# Sets flat gain = +6.0 dB
- *990*124# Sets flat gain = -2.4 dB
- *991*367# Sets bulk delay = 367 uSec.
- *991*1234567# Sets bulk delay = 1,234,567 uSec.
- *994*1# Sets individual unit to quiet
- *994*0# Sets individual unit to normal
- *994*11# Sets all zone 1 units to quiet
- *994*10# Sets all zone 1 units to normal
- *994*91# Sets all zone 9 units to quiet
- *994*90# Sets all zone 9 units to normal
- *995*1# Sets unit to zone 1
- *995*9# Sets unit to zone 9
- *997*9# Sets quiet time-out to 90 minutes
- *997*0# Disables quiet time-out.
- *998*1# Sets inverted phase

3-10-2 Address Change Command:

Format:  
\[ **\text{xx}**\text{yy}# \]

where:
- \( \text{xx} \) = old address
- \( \text{yy} \) = new address

Example:  
**99*01# Changes address from 99 to 01

3-10-3 Entry Error Correction Command:

Format:  
\[ *# \]

If an entry error is made prior to the last # in a command, entering *# will cause the VDL-RS to ignore the command and setup to receive a new command sequence.
3-10-4 Command Security:

Control is disabled / enabled via 8 character strings.

Format:  *xx**9y#
where:  xx = address
       y = 0 to Unlock
       1 to Lock

Example:  *99**91#  Locks all units

3-10-5 Processor Reset:

The processor onboard the VDL-RS is only active when commands are received. If the VDL-RS fails to respond to touch-tone commands, the processor can be reset via touch-tone.

Format:  Use a touch-tone generator per page 3-3 and apply a touch-tone for 20 Seconds.

3-11 Firmware Update via RS-232 Port ( for VDL-RS s/n 5172 and higher. ) This section describes how to update the firmware on VDL-RS through the RS-232 Port. Firmware is furnished as a text file such as VDLv204.txt. (Version 2.04) that is downloaded into the unit from the Main Menu using the Hyperterminal file transfer feature.

Setup:  1. Copy the firmware text file into the same PC folder that is being used for Hyperterminal “session” files.
       2. Connect a USB to RS-232 Adapter between the PC and the RS-232 connector on the VDL-RS.
       3. Configure HyperTerminal for:

![HyperTerminal configuration](image)

Procedure:

1. Apply power to the VDL-RS. Establish communications with the unit through the RS-232 Port.
3. Click on Transfer on the Hyperterminal top tool bar.
4. From the Send Text File dialog box browse to find and select VDLv204.txt (the file to be transferred to the VDL-RS) file and select Open to start the download.
5. The bottom line in HyperTerminal will show data as it is transferred to the VDL. When the text stops streaming wait 30 seconds, then press Enter twice to bring up the Main Menu with the updated firmware.
MAIN MENU

Select 9 to Update Firmware.
Click on Transfer on the top tool bar.  --->

SEND TEXT FILE - SELECTION SCREEN
Select file to be transferred.
Click on Open to start.

The process takes several minutes, and during that time the unit is out of service. There are two steps to the process. First the text file is loaded into RAM on the VDL-RS. During the loading process each record of 40 characters is checked for errors. If the communications was error free, the new firmware will then be loaded from RAM into non-volatile Flash Memory. (This takes an additional 30 seconds.)

In the event of communications errors during the file transfer an error message will appear and the file transfer procedure will need to be repeated.

Procedure Outline

1. Establish communications with the VDL-RS through the RS-232 Port.
2. Select Item 9, Update Firmware
3. Click on Transfer on the top tool bar.
4. Select Send Text File from the Transfer drop-down box.
5. From the Send Text File - Selection Screen, select the new firmware text file. e.g. VDLv204.txt
6. Click on the Open button to start the file transfer from the PC to the VDL-RS. Wait for the completion message:

   1283 Records Transferred. Writing Flash, wait 30 seconds.

7. The completion message appears on the bottom line of the screen:

   TRANSFER COMPLETE
   Wait 30 Seconds Before Communicating

8. Allow 30 seconds for firmware to be written to Flash Memory. Then, press the Enter Key twice to refresh the Communications Menu. If the screen fails to refresh, press esc / enter to attempt to reset the VDL-RS. If esc / enter fails to establish communications, temporarily remove power from the VDL-RS to cause a hard reset.