

**21-28 VTP**

**Remote Termination Panel**

**Version 1.00**

**Printings**

Version 1.00: 7/11/2014

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## SPECIFICATIONS

|                              |   |
|------------------------------|---|
| Input Voltage                | 15 Vdc 24W Wall Transformer<br>2.1mm * 5.5 mm barrel conn. Center + |
| Current consumption @ 15 Vdc | 450 mA (TX)<br>800 mA (RX)<br>400 mA (Standby)                      |
| Temperature range            | 0 to +60 deg C  |
| Relative humidity            | 90% at 50 deg C   |
| Receive hum & noise          | -47 dB (ref. 0 dBm)   |
| Transmit hum & noise         | -60 dB (ref. 0dBm) (When using high bit rate codec)                 |
| Speaker audio output         | 3 W into 4 ohms   |
| Distortion (at rated output) | < 3% (When using high bit rate codec)                               |
| Frequency response           | +1, -3 dB (300 to 3000 Hz)  |
| Line control                 | 2 or 4 wire audio   |
| Notch filter depth           | > 45 dB (RX)<br>> 45 dB (TX)  |
| Dimensions                   | 7.5" x 7.5" x 1.5"  |

## 1.0 GENERAL DESCRIPTION

### 1.1 Description

The Model 21-28 VTP Remote Termination Panel is designed to control remotely located base stations or repeaters. The 21-28 VTP Remote Termination Panel also sends update information back to the remotes and provides a two-way audio path. The communication between the 21-28 VTP Termination Panel and the 24-66 VoIP Remote Controllers is done via a TCP/IP Ethernet connection. The communication with the tone remote controllers uses one of two methods: MSK signaling (with the 21-28 MSK option installed) or sequential tones (without 21-28 MSK option installed). The operating characteristics of the 21-28 VTP panel are modified using a computer through a web browser accessing the appropriate IP address that is assigned to the 21-28 VTP panel. The 21-28 VTP panel acts as the master host for all 24-66 VoIP Remotes (up to 20 total) that are connected to it through the LAN / WAN network. As the 24-66 VoIP remotes are connected, the 21-28 VTP panel sets them up with the appropriate personality profile.

TCP is one of the main protocols in TCP/IP networks, whereas the IP protocol deals only with packets, TCP enables two hosts to establish a connection and exchange streams of data. TCP guarantees delivery of data and also guarantees that packets will be delivered in the same order in which they were sent.

The audio between the panel and the tone remote(s) can be set up for 2-wire or the 4-wire mode. The audio between the panel and the VoIP remote(s) can be set up for Multicast and/or Unicast protocols. This option is selected in the System Audio Settings screen of the 21-28 VTP and in the Profile Configuration screen of the 24-66 VoIP. From a bandwidth standpoint, the Multicast protocol is a much more efficient method of transmitting audio to multiple recipients. All audio is sent and received as UDP data packets. See the installation diagram and description in the back of this manual for more information on configuring for Multicast and Unicast protocols.

For applications that require local operation of the base station, a local control option is available which includes a speaker jack, volume control, and a desk microphone. (Option RTM-604)

### 1.2 Capabilities and Features

- ◆ PC programmable using WEB Browser
- ◆ VoIP G.711, G.723.1, G.726 CODEC algorithms
- ◆ MSK or sequential tone signaling
- ◆ Tone 2 wire or 4 wire operation
- ◆ Non-volatile memory
- ◆ 8 programmable open collector outputs
- ◆ 2 programmable open collector/relay outputs
- ◆ Local control option
- ◆ Remote update
- ◆ Interfaces to various different radios

## **2.0 INSTALLATION AND SETUP**

### **2.1 Inspection**

Please refer to the checklist packed with the 21-28 VTP in order to become familiar with the unit and to insure that everything ordered has been received. In the event a part is missing from the checklist, please call the Customer Services Department at 1-701-280-1122.

This unit was thoroughly inspected before leaving the factory. If the outer package appears damaged, please inspect the unit for possible damage immediately. Any dents, scratches, or marks suggest rough handling in shipping. Please notify the shipper if you find any indications of mishandling. If there are any concerns about the condition of the 21-28 VTP when it is received, please don't hesitate to call the Customer Services Department.

### **2.2 Disassembly and Reassembly**

When performing the alignment procedure or making changes to the jumpers on the 21-28 VTP, it may be necessary to remove the printed circuit board from the case. This is accomplished by removing the two black screws from the front of the 21-28 VTP and removing the front panel. Remove the top cover by sliding it off the 21-28 VTP. Since the printed circuit board contains sensitive circuitry, be sure to take the necessary precautions against static discharge.

To reassemble the 21-28 VTP, replace the top cover and the front panel, making sure the front and back panels are seated properly with the case. Replace the two black screws but do not over-tighten them.

### **2.3 Installation Procedure (VoIP)**

This section provides a basic step-by-step VoIP installation procedure for the 21-28 VTP. Refer to sections **2.5 - 2.11** for detailed installation information. Refer also to the 21-28 VTP installation diagram in the back of this manual. Detailed information on adjusting the 21-28 VTP audio levels can be found in section **4.0 Programming Procedures**.

1. The system should initially be set up and tested on the bench. Use only one remote at first. Additional remotes can be added later.
2. Connect the 21-28 VTP to the base station radio. Be sure to program the base station radio as required.
3. Set the 21-28 VTP jumpers as required.
4. Program the 21-28 VTP and the remote to allow the remote to control the base station radio as desired. See the programming procedure for the 24-66 VoIP and for the 21-28 VTP.

## 2.3 Installation Procedure (cont.)

5. Connect the optional wall transformer power supply to power connector on the back of the 21-28 VTP. If power is being supplied to the 21-28 VTP from the radio, make sure the radio's switched B+ output can supply the necessary current. Also, JP12 must be in the correct position. Position 2-3 is for power from radio and position 1-2 is for power from the optional wall transformer.
6. Connect the TCP/IP Ethernet connection to appropriate connector on the back of the 21-28 VTP. If the connection being used is also to be shared with an existing computer, the computer can be connected to the computer Ethernet connector on the back of the 21-28 VTP. This allows the 21-28 VTP and the computer to share one network cable. The green link LED on the Ethernet connector should turn on showing a connection to the network. Refer also to the 21-28 VTP installation diagram in the back of this manual.
7. Connect a 24-66 VoIP remote to the network. The 21-28 VTP panel will configure the remote with the appropriate profile.
8. Receive audio from the base station radio should now be heard at the remote.
9. Press PTT on the remote. The remote should key the base station radio reliably.
10. The remote should also be able to control radio functions such as change channels or systems and groups on the base station radio if the system is configured for that.
11. If the local control option is installed in the 21-28 VTP, connect the desk microphone to the 21-28 VTP and press the PTT button to verify that the radio transmits.
12. If the local control option is installed in the 21-28 VTP, connect a 4 ohm speaker to the 21-28 VTP. Remote audio should be heard in the speaker when PTT on the remote is pressed. Adjust the volume control on the front of the 21-28 VTP as desired.
13. Program any additional remotes as required. Generally, they should be programmed the same as the first remote. See the programming procedure for the 24-66 VoIP and for the 21-28 VTP.
14. Connect additional remotes to the network
15. Adjust the transmit and receive levels of the remotes as required. Audio from all remotes should be set to the same level. Refer to **Section 4.2 for Audio Adjustments.**

## 2.4 Installation Procedure (Tone)

This section provides a basic step-by-step Tone installation procedure for the 21-28 VTP. Refer to sections **2.5 - 2.11** for detailed installation information. Refer also to the 21-28 VTP installation diagram in the back of this manual. Detailed information on adjusting the 21-28 VTP audio levels can be found in section **4.0 Programming Procedures**.

1. The system should initially be set up and tested on the bench. Use only one tone remote at first. Additional tone remotes can be added later.
5. Connect the 21-28 VTP to the base station radio. Be sure to program the base station radio as required.
6. Set the 21-28 VTP jumpers as required.
7. Program the 21-28 VTP and the tone remote to allow the remote to control the base station radio as desired.
16. Connect the 21-28 VTP to an earth ground and then connect the line from the 21-28 VTP to the tone remote.
17. Receive audio from the base station radio should now be heard at the remote. Adjust the *RX Audio to Line Level* for the desired level to the line. Adjust the receive audio in the remote as necessary.
18. Press PTT on the remote. If the base station radio does not key, adjust the *Line Input Level* until the base station radio keys when PTT is pressed on the remote. The *2175 Hz Detect Level* may also need to be adjusted.
19. Once the tone remote is able to key the base station radio reliably, adjust the transmit audio in the remote as necessary. Then adjust the *Line to TX Audio Level* for the desired transmitter deviation from the base station radio.
20. The tone remote should now be able to change channels or systems and groups on the base station radio. The 21-28 VTP should also be able to update the remote when the channel or the system and group are changed from the faceplate of the base station radio. If not, check the *2175 Hz Encode Level* on the 21-28 VTP and the tone detect levels on the remote.

**21-28 VTP MSK Control Only:** Also check the *MSK Encode Level*.

**21-28 VTP Tone Control Only:** The panel must be programmed for 'Remote Update', and the remotes must be capable of decoding those tones for the panel to be able to update the tone remote.

21. If the local control option is installed in the 21-28 VTP, connect the desk microphone to the 21-28 VTP and press the PTT button. Adjust the *Local Mic to TX Audio Level* for the desired transmitter deviation from the base station radio. Adjust the *Local Mic to Line Level* for the desired level to the line.



## 2.4 Installation Procedure (cont.)

22. If the local control option is installed in the 21-28 VTP, connect a 4 ohm speaker to the 21-28 VTP. Remote audio should be heard in the speaker when PTT on the tone remote is pressed. Adjust *Line to Speaker Level* if necessary. If receive audio from the base station radio to the speaker is enabled, adjust *RX Audio to Speaker Level* for a comfortable listening level while the base station radio is receiving a transmission from another radio.
23. Program any additional remotes as required. Generally, they should be programmed the same as the first tone remote.
24. Connect additional remotes in parallel to the first tone remote. Make sure all remotes except for one are set to high impedance.
25. Adjust the transmit and receive levels of the remotes as required. Audio from all remotes should arrive at the 21-28 VTP with the same level.
26. Verify that all desired functions of the base station radio can be controlled by all of the remotes. Also verify that all of the remotes are updated by the 21-28 VTP when a change is made from the faceplate of the base station radio.

## 2.5 Radio Connection

The DB-25 connector labeled "RADIO" on the back of the 21-28 VTP is used to interface the 21-28 VTP to a base station radio. For the pin functions on the DB-25 connector, refer to the 21-28 VTP installation diagram in the back of this manual. In addition, **Appendix A** contains interface information for connecting the 21-28 VTP to radios.

## 2.6 Ethernet Connections

The 21-28 VTP allows Remote Control of a base station via an Ethernet LAN. A computer can also be connected to a remote that is on the same LAN to allow the computer access to the network without the need for a hub.

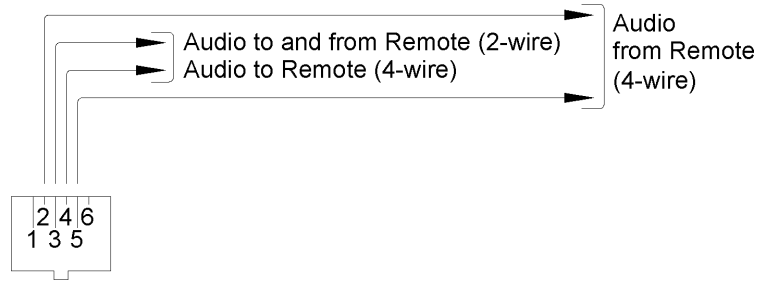
The Ethernet connectors are found on the back of the 21-28 VTP. The Ethernet cable should be a standard cable that is available anywhere that telephone and computer accessories are sold. Refer also to the 21-28 VTP installation diagram in the back of this manual.

## 2.7 Line Connection

The 21-28 VTP allows either 2-wire or 4-wire lines to be used when connecting the 21-28 VTP to a tone remote. The line connection should be made to the modular jack labeled "LINE" on the back of the 21-28 VTP. The connections that need to be made are detailed in **Figure 1**. For 2-wire lines, audio to and from the remote share the same two wires, pins 3 and 4 of the modular jack. For 4-wire lines, pins 3 and 4 of the modular jack are used for audio to the tone remote while pins 2 and 5 are used for audio from the remote. Use only 2 or 4 conductor cable between the 21-28 VTP and the tone remote. The use of 6 conductor cable can cause erratic operation.

## 2.7 Line Connection (cont.)

If a 4-wire line is being used, the transmit and receive pairs need to be reversed. The inside pair needs to become the outside pair and the outside pair needs to become the inside pair. This is done by cutting the cable and connecting the red wire to the black wire, the black wire to the red wire, the green wire to the yellow wire, and the yellow wire to the green wire. This should be done only to the cable connecting the 21-28 VTP to the first remote. Additional tone remotes should be wired in parallel. If the line from the 21-28 VTP is plugged into a wall jack, the transmit and receive pairs can be reversed on the back side of the wall jack.



J11 Line Connector

Figure 1

## 2.8 Earth Ground Connection

A good earth ground should be connected to the earth ground screw on the 21-28 VTP to allow the surge arresters to provide maximum protection from line transients. Without a good earth ground, the ability of the surge arresters to protect the internal circuits of the 21-28 VTP from line transients will be limited. Refer to **Figure 2** for the location of the earth ground screw and access hole for the ground wire.

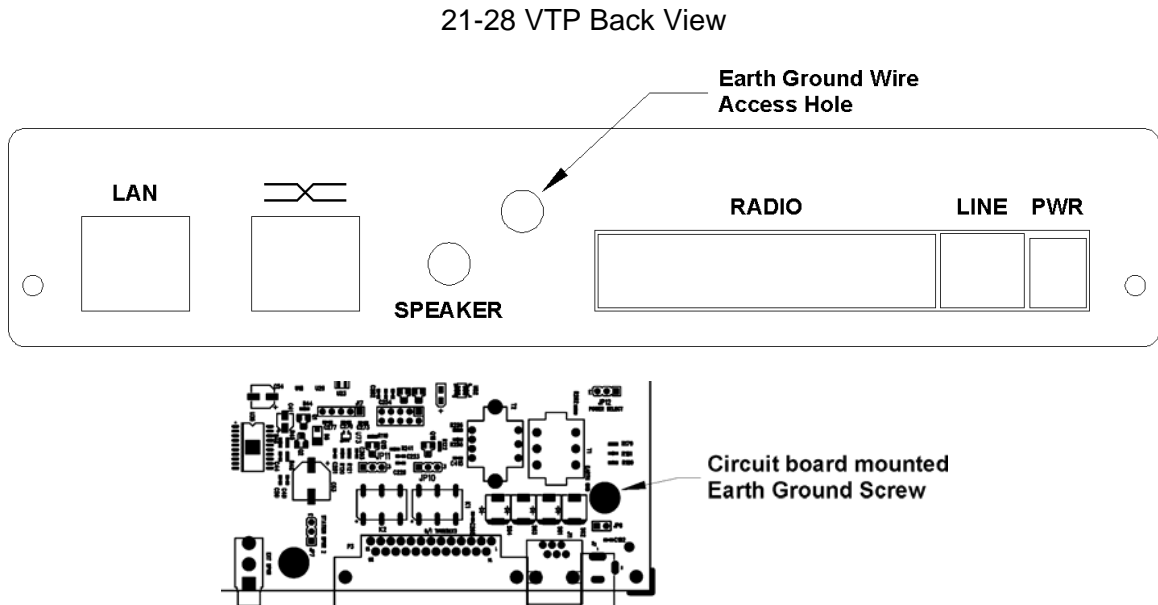
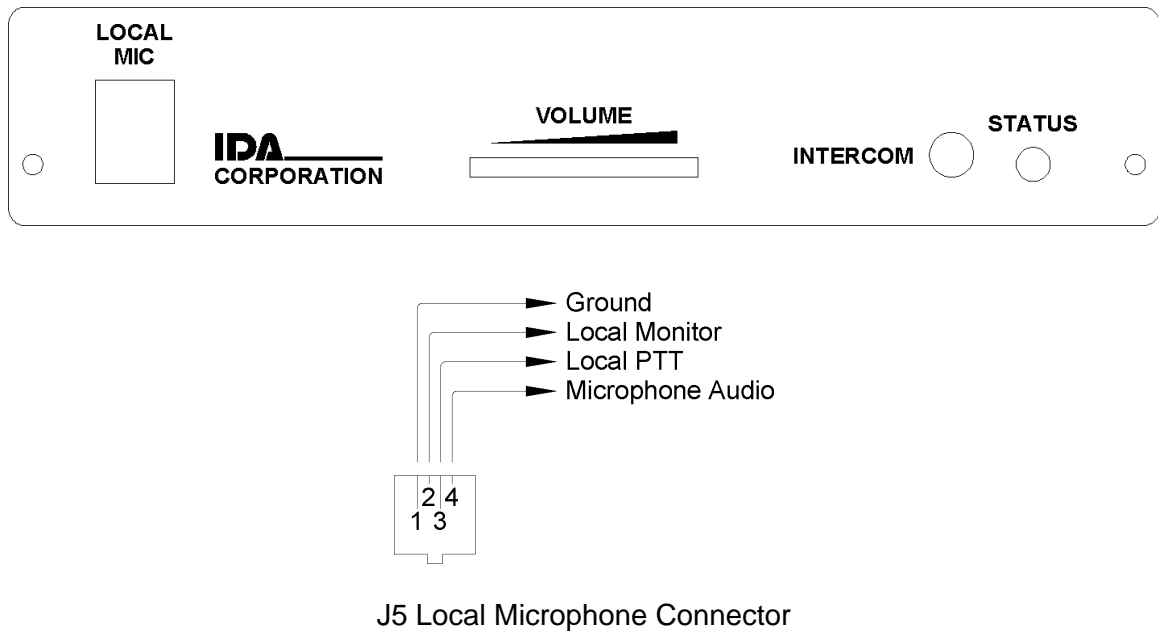


Figure 2

## 2.9 Desk Microphone Connection

If the local control option is installed in the 21-28 VTP, the desk microphone should be connected to the modular jack labeled "LOCAL MIC" on the front of the 21-28 VTP. The connections that the local microphone jack provides are detailed in **Figure 3**.

21-28 VTP Front View – Local Control

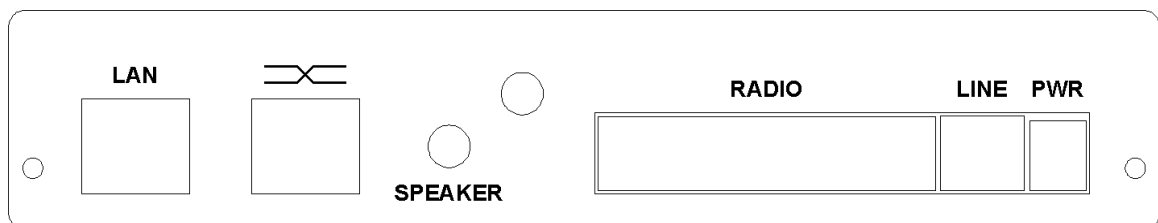


**Figure 3**

## 2.10 Speaker Connection

If the local control option is installed in the 21-28 VTP, a speaker can be connected to the 21-28 VTP to allow audio to be heard. A 4 ohm speaker (supplied by the user) should be connected to the speaker plug supplied with the 21-28 VTP. The speaker plug should then be inserted into the jack labeled "SPEAKER" on the back of the 21-28 VTP, Refer to **Figure 4**.

21-28 VTP Back View



**Figure 4**

## 2.11 Jumper and Switch Settings

The 21-28 VTP has test points, number of jumpers, and switches located on the board that controls the operation of the 21-28 VTP. The jumpers, switches and their settings are described below. JP1 and JP9 should always be installed. JP7 (Default IN) and JP8 (Default 1-2) should be left at default setting, for more information contact the factory.

**SW1** Reset Switch.

**SW2** \*\*Network Defaults Switch.

**SW3** Flash Mode Switch.

**JP 4** IN for LOW TX Audio impedance.

OUT for HIGH TX Audio impedance.

**JP 12** \*2-3 for POWER from radio

1-2 for Power from External Wall Transformer

**JP 10** 1-2 for open collector output 9.

2-3 for K1 relay output on output 9.

**JP 11** 1-2 for open collector output 10.

2-3 for K2 relay output on output 10.

\* If using POWER from the radio and not the EXTERNAL WALL TRANSFORMER, make sure the radio can provide the current needed by the 21-28 VTP. The default is BC for POWER from the WALL TRANSFORMER.

\*\* SW2 allows the panel's network address (including subnet and gateway) and password to be reset to factory defaults.

To begin, hold SW2 down while pressing and then releasing SW1. Continue to hold SW2 down until LED D3 and D4 turn on and then begin to flash off and on. At this point, the network address has been reset and the panel is rebooting, so discontinue holding SW2 down. The panel should finish rebooting.

The network address of the panel is now:

IP Addresss: 10.0.0.203

Subnet Mask: 255.255.255.0

Gateway: 10.0.0.1

The user name and password of the panel is now:

User name: admin

Password: idacorp

### 3.0 OPERATION

#### 3.1 General

Once the installation is complete, the 21-28 VTP panel will communicate with the 24-66 VoIP remotes via Ethernet TCP/IP protocol and the tone remotes via MSK or sequential tone signaling on 2-wire or 4-wire lines. The remotes will be able to control the functions of the radio such as transmit and channel selection, as well as receive and transmit audio.

#### 3.2 Update Sequences (Tone)

Update sequences are sent from the remote to the 21-28 VTP and from the 21-28 VTP to the remote. These update sequences allow the remote to control the different base station radio functions, such as current channel and scan status, and to keep the remote (and any paralleled remotes) updated to the current base station radio status. Figure 4 shows the different components of the update sequence for the 21-28 VTP MSK. The 21-28 VTP Tone update sequence is similar except it uses sequential tone(s) in place of the MSK tone. It is important to note that the update sequence is defined by levels as well as tone frequencies. Line loss needs to be taken into consideration and will probably be a factor at installation. The levels shown in Figure 4 will most likely be less when they arrive at either the 21-28 VTP or the remote, but in the same proportion. The 21-28 VTP is setup for the correct tones and levels from a 600 ohm source with no line loss. However, due to loading of paralleled remotes on the same line, as well as line loss, some audio levels may need to be increased. In paralleled remote installations, all remotes should arrive at the 21-28 VTP with the same levels.

The guard tone is defined as 2175 Hz at +10 dBm and is the first tone in an update sequence. The guard tone is used to signal the start of an update sequence. If the guard tone is not detected properly, the rest of the update sequence will be ignored. Following the guard tone in the update sequence is the MSK tones (or sequential tone) at a level of 0 dBm. The tones are decoded to determine the action required by the update sequence. When the update sequence is sent by a remote, the tones may be followed by the hold tone. The hold tone is defined as 2175 Hz at -20 dBm and indicates that the remote's PTT is being pressed. When the 21-28 VTP detects the hold tone, it will key the base station radio and pass audio from the remote to the base station radio. The audio from the remote rides on top of the hold tone. The 21-28 VTP will keep the base station radio keyed until the hold tone is no longer detected.



Figure 1

### **3.3 MSK Control Option (MSK Control Option is not available at this time)**

The MSK option contains an MSK modem that allows bytes of data to be transferred between the 21-28 VTP and the 24-66 MSK remote by encoding and decoding the MSK tones that are sent and received in the update sequences. These bytes of data are used to indicate an action to be taken such as enabling scan or changing to a different channel or system and group.

### **3.4 Outputs**

The 21-28 VTP contains 10 open collector outputs. Two of these outputs, outputs 9 and 10, can also be switched to relay outputs. The outputs are available as general purpose outputs and can be programmed as active high or active low and also as timed outputs. The outputs are controlled by the remote, which can enable or disable any number of outputs with a single update sequence.

### **3.5 Local Control Option**

The local control option allows local control of the base station radio. This option provides a speaker jack, volume control, a desk microphone, and other associated circuitry. When PTT is pressed on the desk microphone, the 21-28 VTP will key the base station radio. Audio from the desk microphone will be passed to the base station radio for transmission, will also be sent to the network and the 2-wire or 4-wire line so that the remote users can hear the transmission. If the intercom switch on the front panel of the 21-28 VTP is depressed, the 21-28 VTP will not key the base station radio when PTT is pressed on the desk microphone. Instead, the audio from the desk microphone will only be sent to the network and the 2-wire or 4-wire line to allow the local user to intercom to the remotes.

A 4 ohm speaker can be connected to the speaker jack to allow the local user to hear audio from a remote that is transmitting. Audio from a remote in intercom mode will also be heard through the speaker. Receive audio from the base station radio can also be passed to the speaker. This allows the local user to hear transmissions from other radios through the local speaker instead of through the speaker of the base station radio. The volume control on the front of the 21-28 VTP allows the local user to adjust the speaker volume to a comfortable listening level.

## 4.0 PROGRAMMING PROCEDURES

All audio and configuration adjustments are done using a web browser directed at the IP Address that is assigned to the 21-28 VTP except the 2175 notch filters and 2175 bandpass filter.

The following will explain the adjustment procedure for the 21-28 VTP. Most audio levels are factory preset and will, in most cases, not need adjustment. All of the audio adjustments are accessible from a computer using a web browser. The default address is 10.0.0.203 with the subnet of 255.255.255.0. The IP address and the subnet address will need to be changed to connect to your network. The user name is "admin" and the default password is "idacorp". Once you logon you should change the password to something else to protect your system. If you are configuring multiple 21-28 VTP Panels or 24-66 VoIP Remotes, you may need to reset the computer NIC card or restart the computer if the next 21-28 VTP your computer is connected to does not respond. The following will explain the adjustment procedure for the 21-28 VTP.

### 4.1 Programming Parameters

All of the programming and audio parameters are accessible through a WEB browser on a PC that is on the network accessing the IP Address that is assigned to the 21-28 VTP. The default IP Address is **10.0.0.203**. The default account name is **admin**. The default password is **idacorp**. It is suggested that the password be changed to protect the system. **Refer to the Help screens under each of the configuration parameter headers for more detailed information on programming options.**

#### Network

The screen below shows the Network Configuration Parameters.

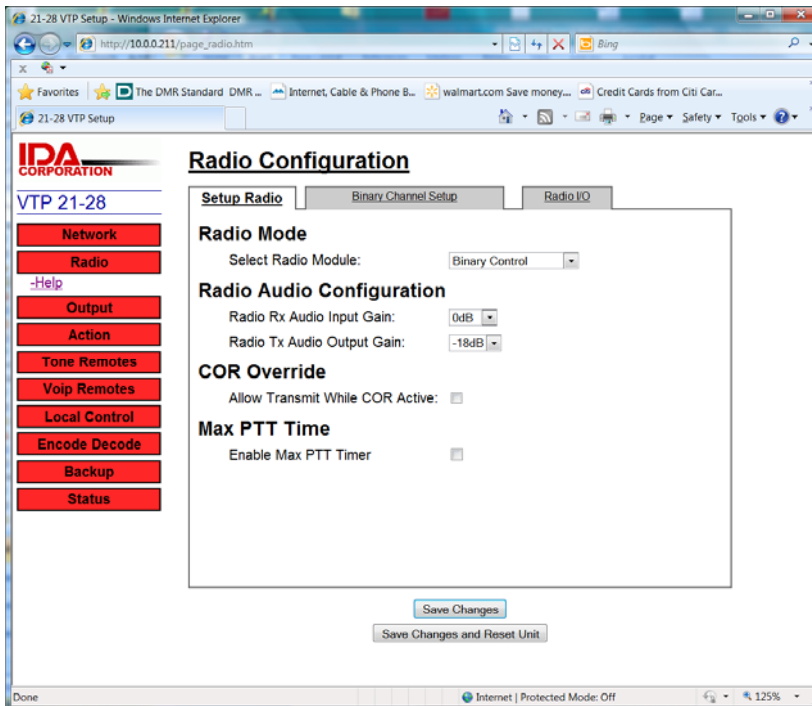
The screenshot shows a web browser window displaying the 'Network Configuration' page for an IDA Corporation VTP 21-28 unit. The page has a sidebar with navigation buttons: Network (selected), Password, Help, Radio, Output, Action, Tone Remotes, Voip Remotes, Local Control, Encode Decode, Backup, and Status. The main content area is titled 'Network Configuration' and contains two sections: 'Unit Identification' and 'Network Identification'. The 'Unit Identification' section shows 'Unit Name' as 'VTP 21-28' and 'MAC Address' as '00:50:C2:37:AC:44', with a 'Change Password' button. The 'Network Identification' section shows 'IP Address' as '10 . 0 . 0 . 203', 'Subnet Mask' as '255 . 255 . 255 . 0', and 'Gateway' as '10 . 0 . 0 . 1'. At the bottom of the form are 'Save Changes' and 'Save Changes and Reset Unit' buttons.

| Field       | Value               |
|-------------|---------------------|
| Unit Name   | VTP 21-28           |
| MAC Address | 00:50:C2:37:AC:44   |
| IP Address  | 10 . 0 . 0 . 203    |
| Subnet Mask | 255 . 255 . 255 . 0 |
| Gateway     | 10 . 0 . 0 . 1      |

## 4.1 Programming Parameters (cont.)

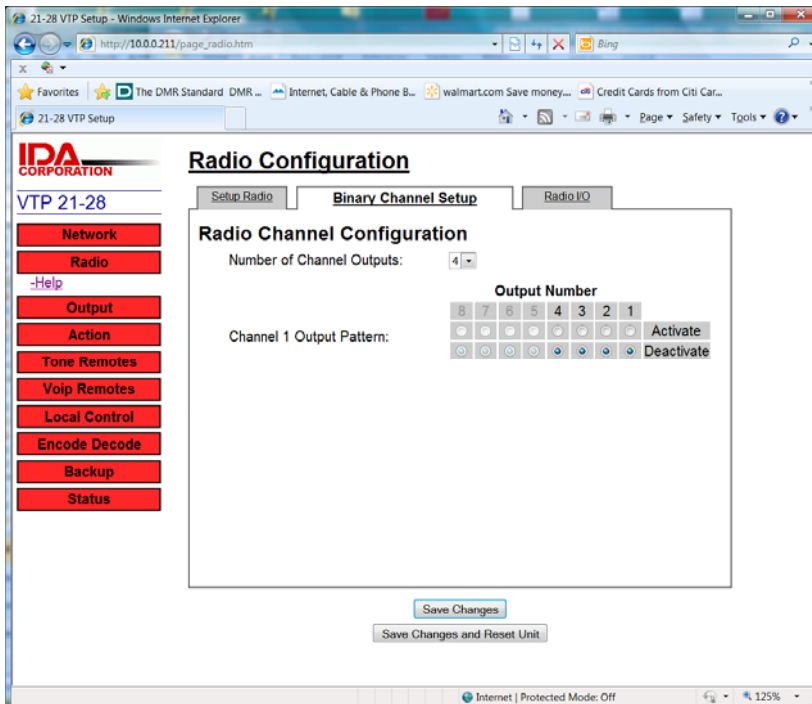
### Radio

The screen below shows the Setup Radio tab.



### Radio

The screen below shows the Binary Channel Setup tab.

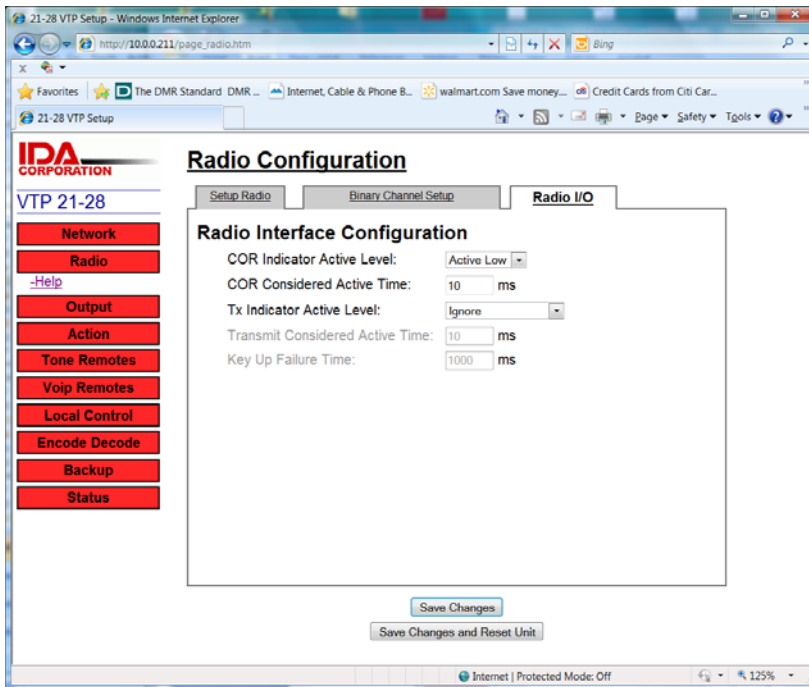




## 4.1 Programming Parameters (cont.)

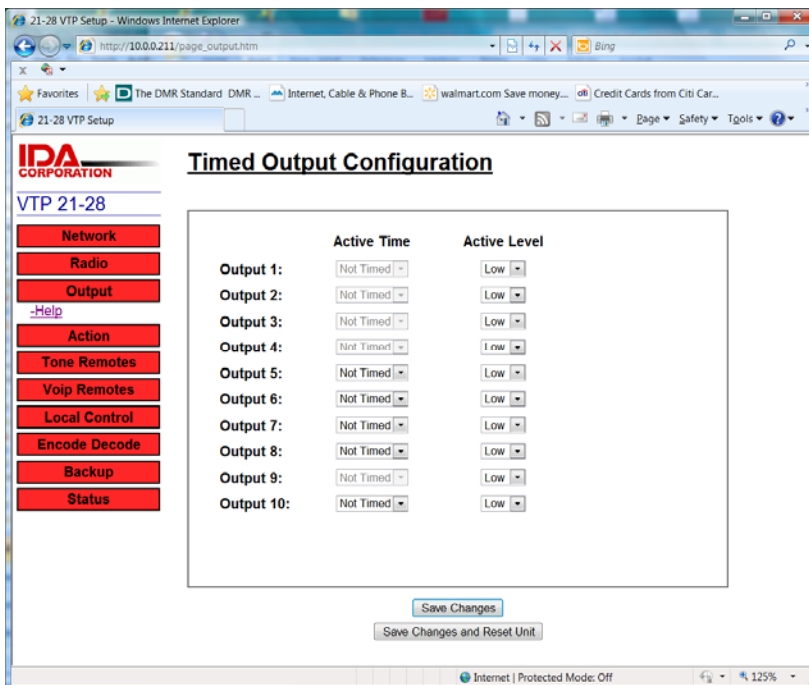
### Radio

The screen below shows the Radio I/O tab.



### Output

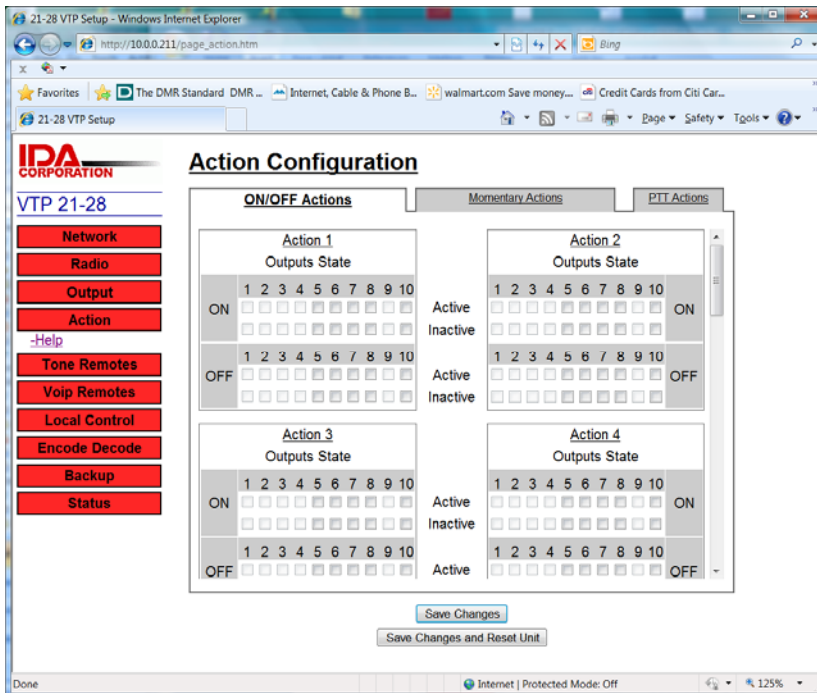
The screen below shows the Output Parameters.



## 4.1 Programming Parameters (cont.)

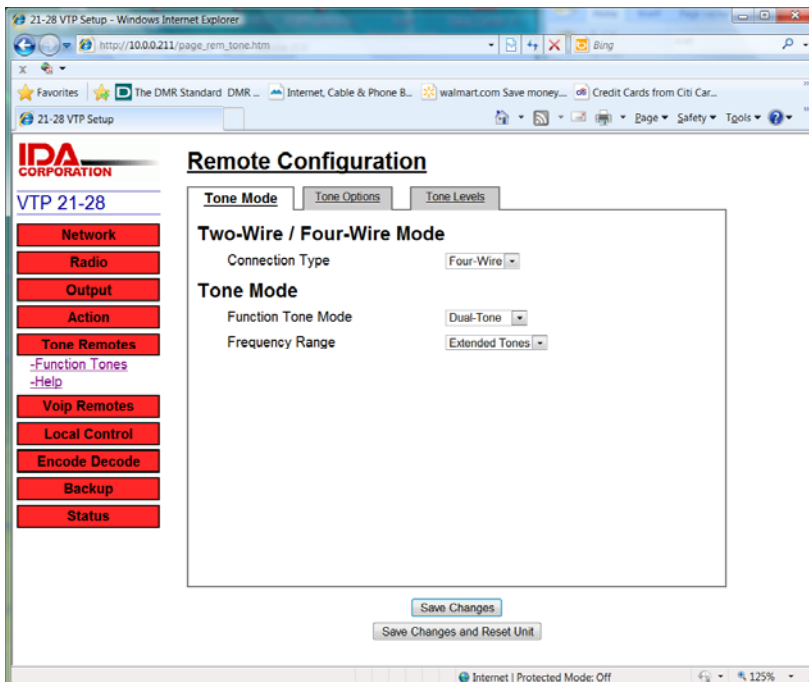
### Action

The screen below shows the Action Parameters.



### Tone Remotes

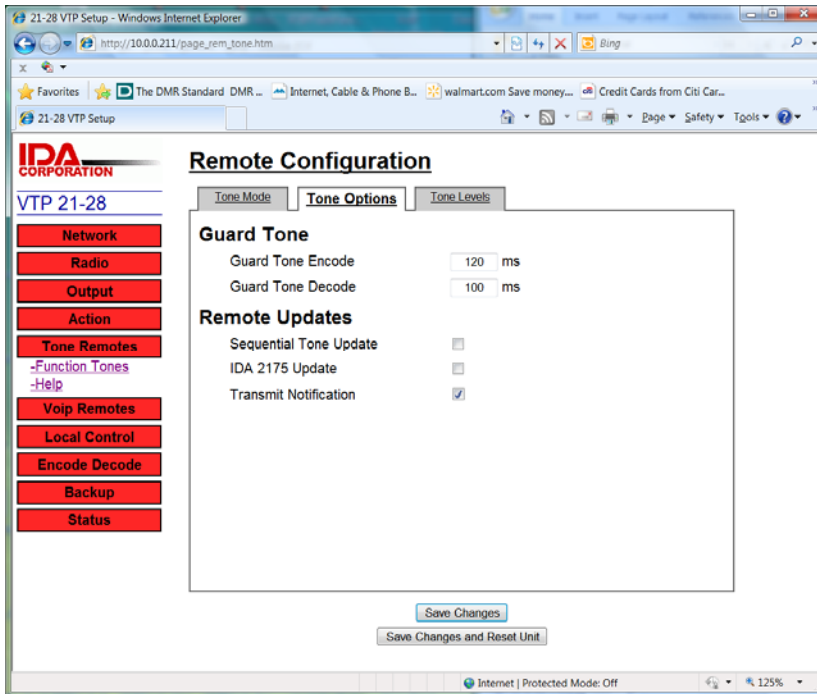
The screen below shows the Tone Mode Parameters.



## 4.1 Programming Parameters (cont.)

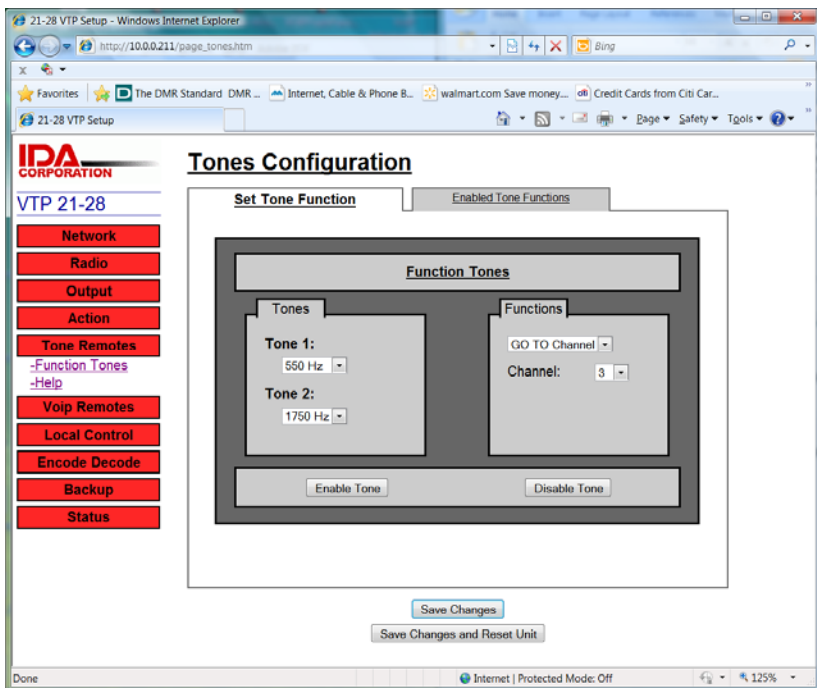
### Tone Remotes

The screen below shows the Tone Options Parameters.



### Function Tones/Tones Configuration

The screen below shows the Set Tone Function Parameters.



## 4.1 Programming Parameters (cont.)

### Function Tones/Tones Configuration

The screen below shows the Enabled Tone Function Parameters.

The screenshot shows the 'Tones Configuration' page in a web browser. The page title is 'Tones Configuration' and it is part of the 'VTP 21-28' setup. The interface includes a sidebar with navigation buttons for Network, Radio, Output, Action, Tone Remotes, Voip Remotes, Local Control, Encode Decode, Backup, and Status. The main content area is titled 'Enabled Tone Functions' and contains a table with columns for 'Tone 1', 'Tone 2', and 'Action'. Each row has an 'Edit' and 'Disable' button. Below the table are 'Save Changes' and 'Save Changes and Reset Unit' buttons.

|  | Tone 1 | Tone 2  | Action       |
|--|--------|---------|--------------|
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> |        | 550 Hz  | Action 1 Off |
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> |        | 650 Hz  | Action 1 Off |
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> |        | 750 Hz  | Action 1 Off |
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> |        | 850 Hz  | Action 1 Off |
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> | 550 Hz | 1550 Hz | GOTO Grp:1   |
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> | 550 Hz | 1650 Hz | GOTO Grp:2   |
| <input type="button" value="Edit"/> <input type="button" value="Disable"/> | 550 Hz | 1750 Hz | GOTO Grp:3   |

### VoIP Remotes

This screen below shows the VoIP Home Parameters.

The screenshot shows the 'Remote Configuration' page in a web browser. The page title is 'Remote Configuration' and it is part of the 'VTP 21-28' setup. The interface includes a sidebar with navigation buttons for Network, Radio, Output, Action, Tone Remotes, Voip Remotes, Local Control, Encode Decode, Backup, and Status. The main content area is titled 'Home Button Configuration' and contains a table with columns for 'Channel' and 'Channel'. Below the table is a 'Panel TimeServer Configuration' section with a 'Panel Timeserver' dropdown menu. At the bottom are 'Save Changes' and 'Save Changes and Reset Unit' buttons.

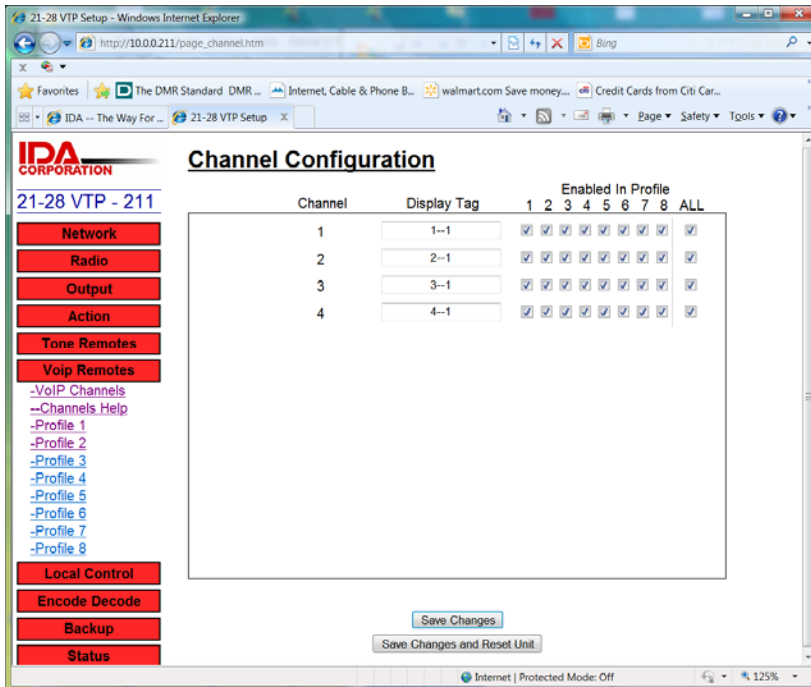
|         | Channel | Channel   |
|---------|---------|-----------|
| Home #1 | 1       | Home #2 1 |
| Home #3 | 1       | Home #4 1 |
| Home #5 | 1       | Home #6 1 |
| Home #7 | 1       | Home #8 1 |

Panel Timeserver:

## 4.1 Programming Parameters (cont.)

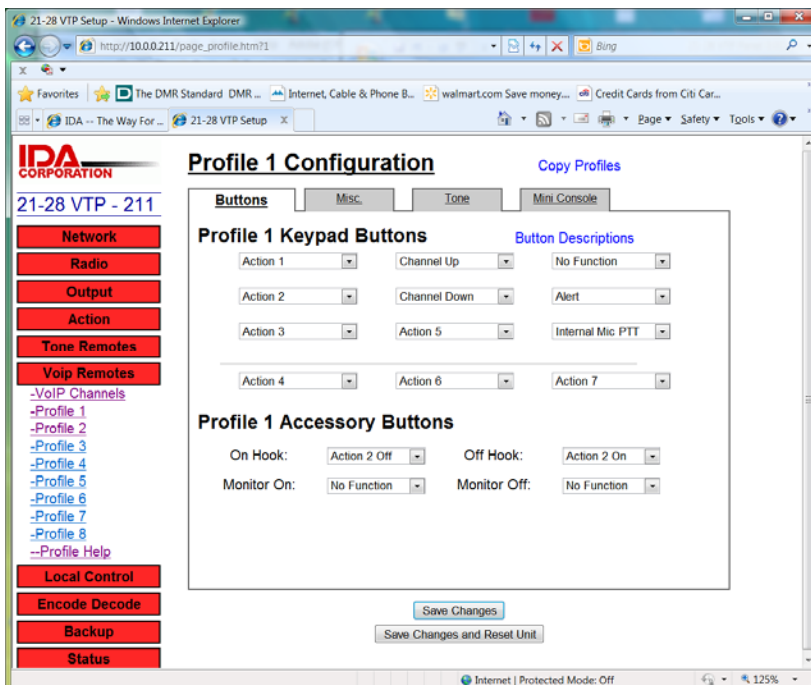
### VoIP Remotes

This screen below shows the VoIP Channel Configuration Parameters.



### VoIP Remotes

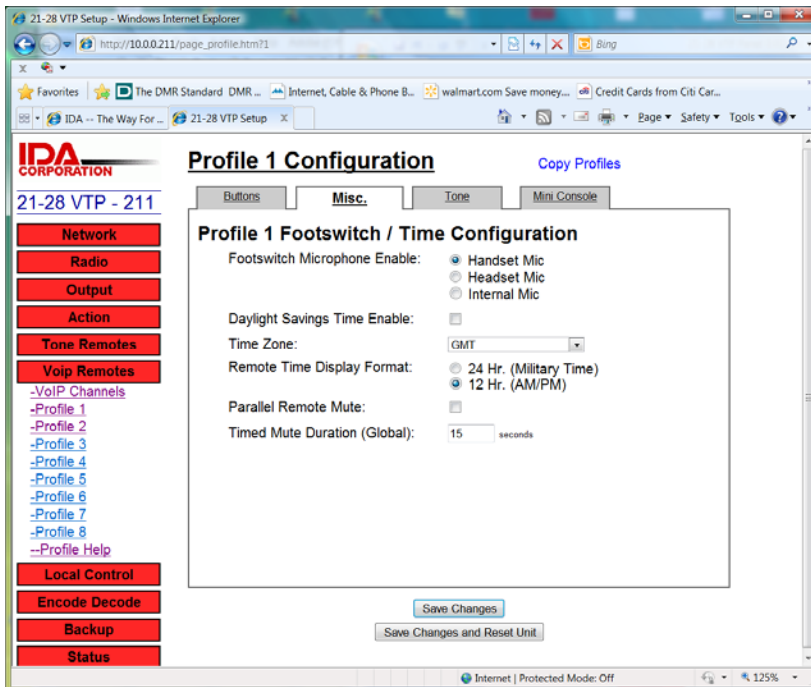
The screen below shows the VoIP Remote Button Parameters for Profile 1.



## 4.1 Programming Parameters (cont.)

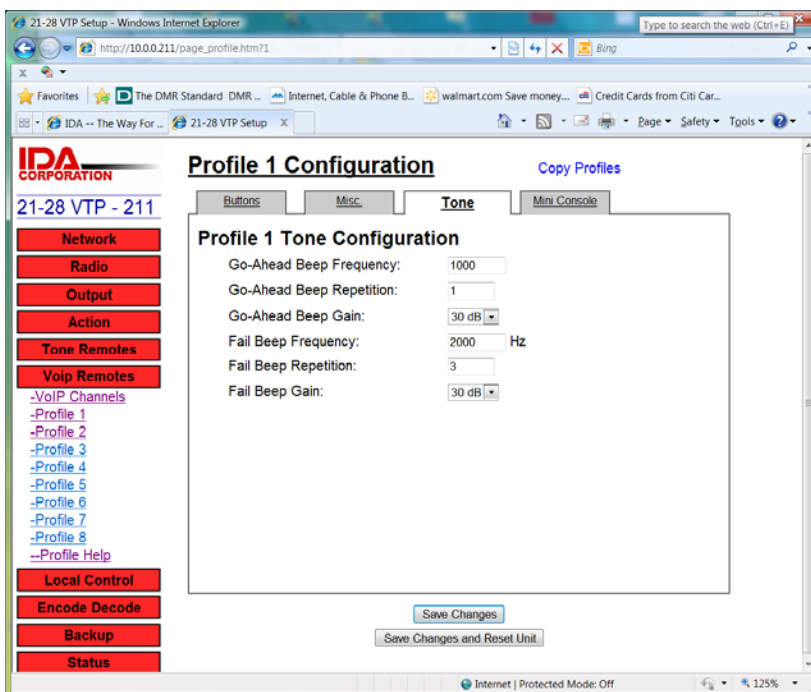
### VoIP Remote

The screen below shows the Miscellaneous Configuration for profile 1.



### VoIP Remote

The screen below shows the VoIP Remote Tone Configuration for profile 1.



## 4.1 Programming Parameters (cont.)

### VoIP Remote

The screen below shows the Mini Console Configuration for profile 1.

The screenshot displays the IDA Corporation web interface for configuring a 21-28 VTP. The browser window shows the URL `http://10.0.0.211/page_profile.htm?1`. The main content area is titled "Profile 1 Configuration" and includes a "Copy Profiles" link. The "Mini Console" tab is selected, showing the following configuration options:

- Profile 1 Direct Site Select Button Operation**
  - Direct Site Select:
- Profile 1 Timed Mute**
  - Timed Mute Duration:  seconds
- Profile 1 Dwell Times**
  - After PTT Dwell Time:  seconds
  - Audio Receive Dwell Time:  seconds
- Profile 1 Selected Site Audio Priority**
  - Priority Audio Interrupt:

At the bottom of the configuration area, there are two buttons: "Save Changes" and "Save Changes and Reset Unit".

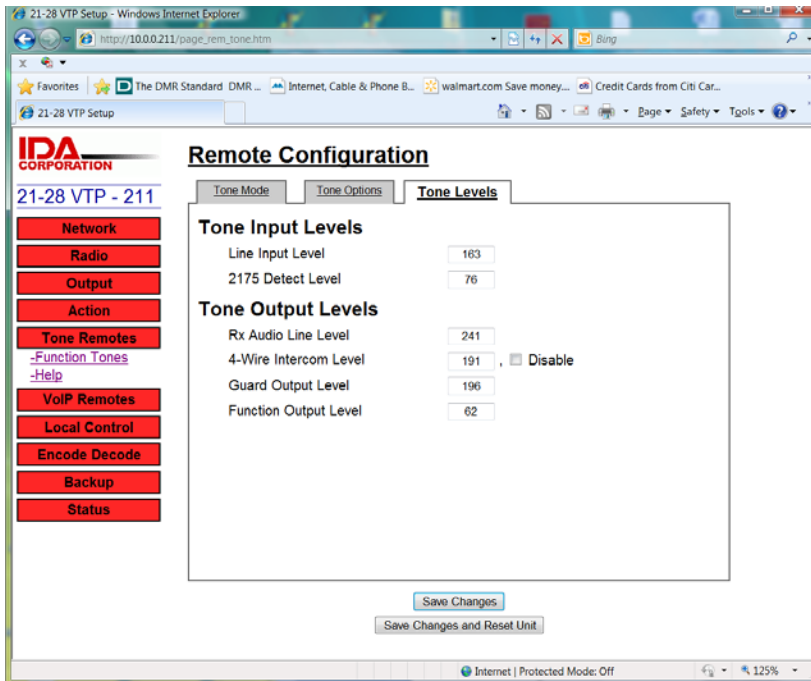
The left sidebar contains a navigation menu with the following items:

- Network
- Radio
- Output
- Action
- Tone Remotes
- Voip Remotes
- VoIP Channels
- Profile 1
- Profile 2
- Profile 3
- Profile 4
- Profile 5
- Profile 6
- Profile 7
- Profile 8
- Profile Help
- Local Control
- Encode Decode
- Backup
- Status

## 4.2 Audio Adjustments

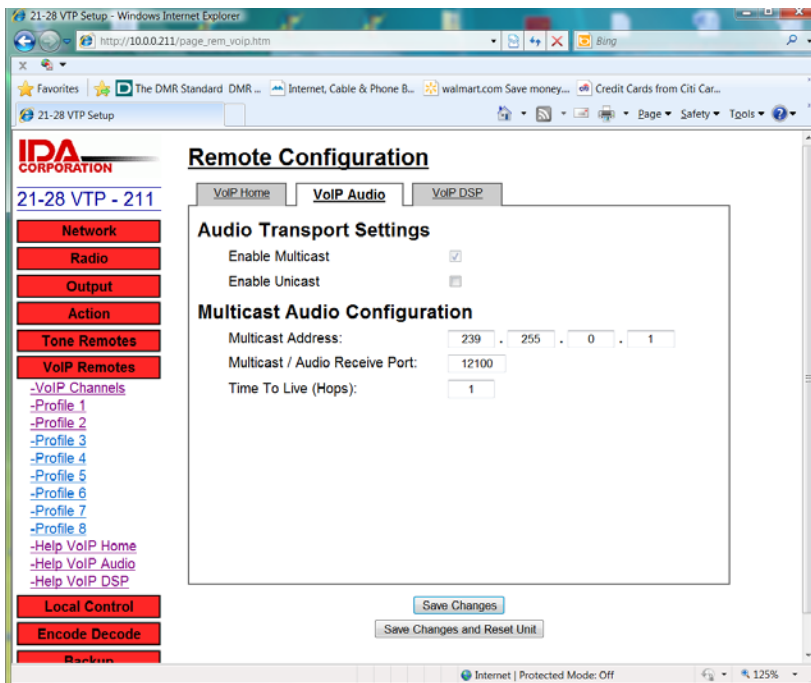
### Tone Remotes

The screen below shows the Tone Levels Configuration tab.



### VoIP Remotes

The screen below shows the VoIP Audio Configuration tab.

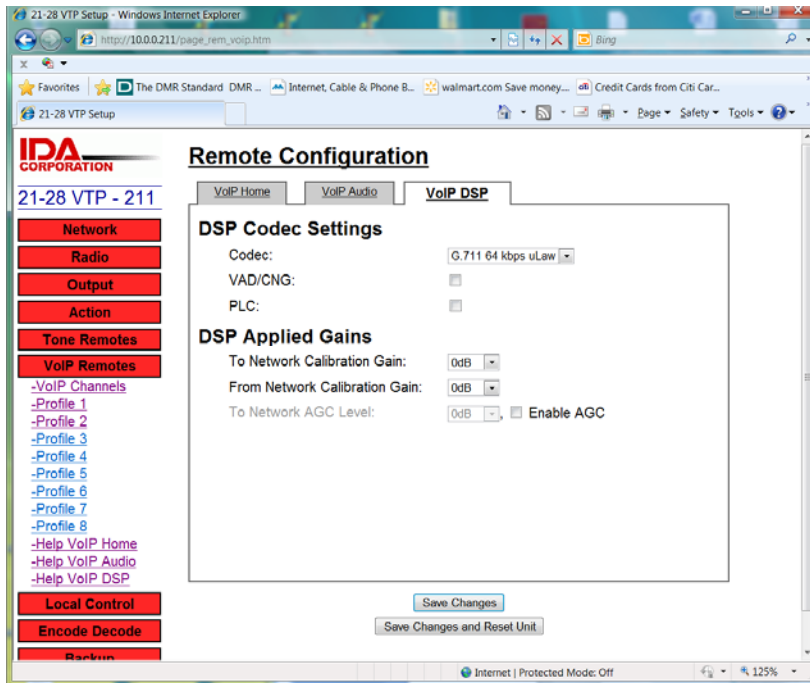




## 4.2 Audio Adjustments (cont.)

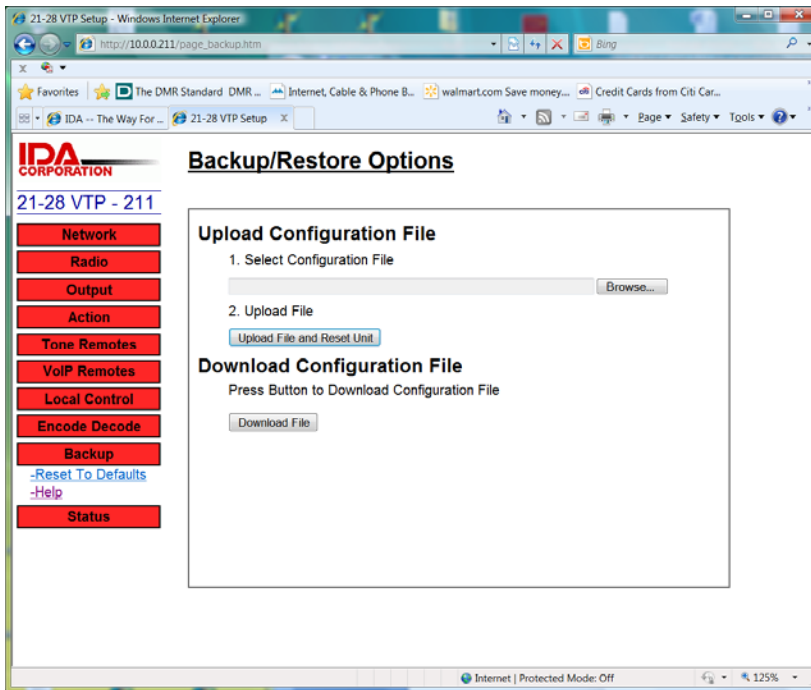
### VOIP REMOTES

The screen below shows the VoIP DSP Configuration tab



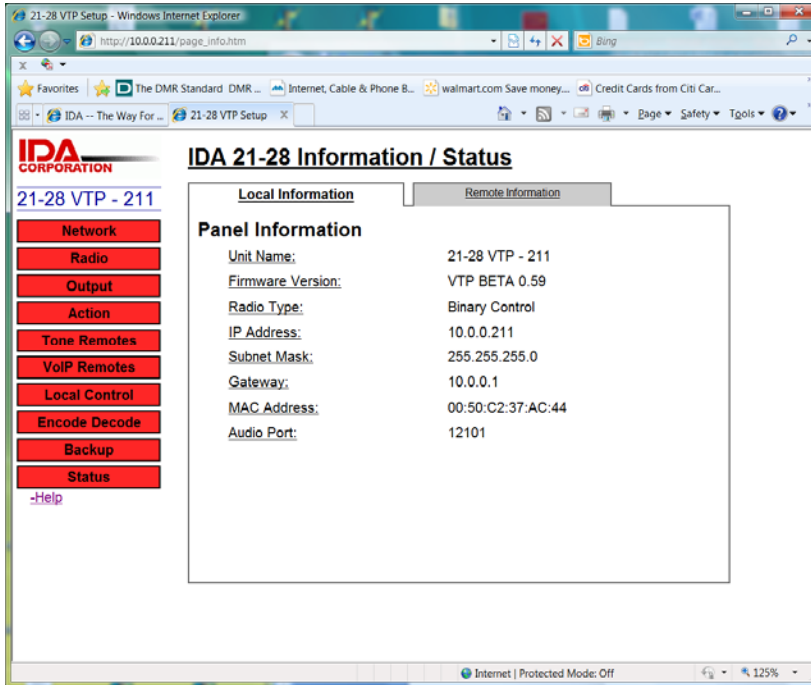
## 4.3 Backup

The screen below shows the Backup / Restore feature.



## 4.4 Status

The screen below shows the Local Information tab.

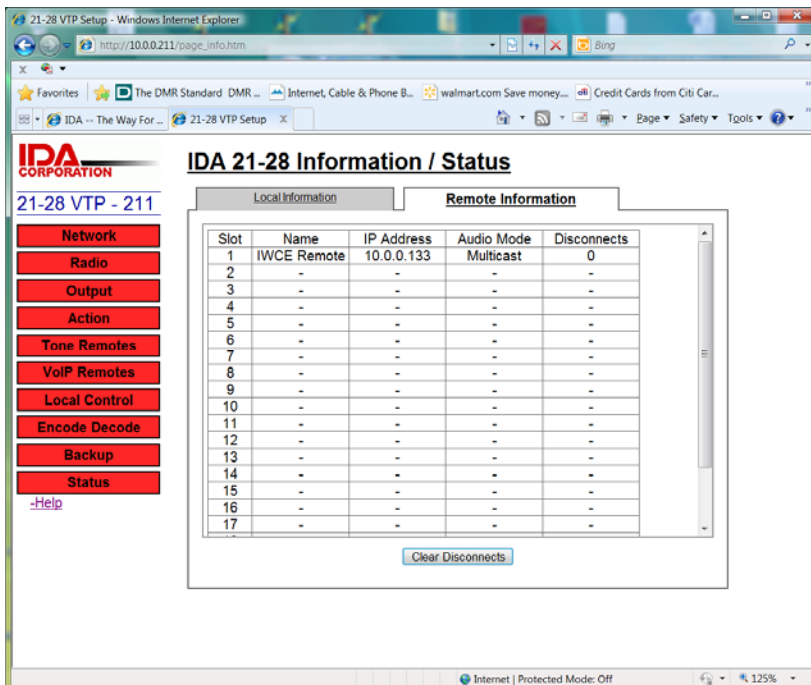


The screenshot shows the 'Local Information' tab of the IDA 21-28 VTP Setup interface. The page title is 'IDA 21-28 Information / Status'. On the left, there is a navigation menu with buttons for Network, Radio, Output, Action, Tone Remotes, VoIP Remotes, Local Control, Encode Decode, Backup, Status, and -Help. The main content area displays the following information:

| Parameter         | Value             |
|-------------------|-------------------|
| Unit Name:        | 21-28 VTP - 211   |
| Firmware Version: | VTP BETA 0.59     |
| Radio Type:       | Binary Control    |
| IP Address:       | 10.0.0.211        |
| Subnet Mask:      | 255.255.255.0     |
| Gateway:          | 10.0.0.1          |
| MAC Address:      | 00:50:C2:37:AC:44 |
| Audio Port:       | 12101             |

## Information

The screen below shows the Remote Information tab.



The screenshot shows the 'Remote Information' tab of the IDA 21-28 VTP Setup interface. The page title is 'IDA 21-28 Information / Status'. On the left, there is a navigation menu with buttons for Network, Radio, Output, Action, Tone Remotes, VoIP Remotes, Local Control, Encode Decode, Backup, Status, and -Help. The main content area displays a table of remote information:

| Slot | Name        | IP Address | Audio Mode | Disconnects |
|------|-------------|------------|------------|-------------|
| 1    | IWCE Remote | 10.0.0.133 | Multicast  | 0           |
| 2    | -           | -          | -          | -           |
| 3    | -           | -          | -          | -           |
| 4    | -           | -          | -          | -           |
| 5    | -           | -          | -          | -           |
| 6    | -           | -          | -          | -           |
| 7    | -           | -          | -          | -           |
| 8    | -           | -          | -          | -           |
| 9    | -           | -          | -          | -           |
| 10   | -           | -          | -          | -           |
| 11   | -           | -          | -          | -           |
| 12   | -           | -          | -          | -           |
| 13   | -           | -          | -          | -           |
| 14   | -           | -          | -          | -           |
| 15   | -           | -          | -          | -           |
| 16   | -           | -          | -          | -           |
| 17   | -           | -          | -          | -           |

Below the table is a 'Clear Disconnects' button.

## 5.0 CIRCUIT DESCRIPTION

The 21-28 VTP consists of one circuit board that combines both Tone Remote control and VoIP Remote control circuits to control a single radio.

### 5.1 Power Supply

Power is supplied to the 21-28 VTP via the optional 15VDC wall transformer or the switched B+ output from the radio. The polarity of the 15VDC wall transformer connector must be correct. This optional 15VDC wall transformer is connected to J7 on the 21-28 VTP board. From J7 the power is routed through JP12, a 1 amp fuse F2 and a diode D8. Diode D8 prevents a reverse polarity from harming the 21-28 VTP. Power is fed into U35 PA\_A+ and voltage regulator U2. The output voltage of U2 is set to 12.0 Vdc. This 12.0 Vdc drives the audio section of the 21-28 VTP. It is also fed into voltage regulator U1, U4 and U10. The output voltage of U1 is set to 3.3 Vdc and this 3.3 Vdc is also fed into voltage regulator U5. The output voltage of U5 is set to 1.5 Vdc. The output voltage of U4 is set to 5.0 Vdc and this 5.0 Vdc is also fed into voltage regulator U3. The output voltage of U3 is set to 2.5 Vdc. The output voltage of U10 is set to 10 Vdc and this 10 Vdc is also fed into voltage regulator U11. The output voltage of U11 is set to 5.0 Vdc REF. The 3.3 Vdc, 2.5 Vdc, and the 1.5 Vdc powers the digital section of the 21-28 VTP.

### 5.2 Transmit Audio (VoIP)

Transmit audio UDP packets from the Ethernet interface section U64 are passed to the microprocessor U15 for decoding. The decoded digital audio is then sent to the DSP U32. The DSP then converts the digital audio to analog and adjusts the level out. The audio is passed to pin 21 of the radio interface connector P3. Jumper JP4 determines if the transmit audio output is a high or a low impedance.

The audio is also fed into the speaker driver U35. U35 and its associated circuitry is a wide band audio amplifier set to have a gain of 36 dB. The output of the speaker driver goes to pin 1 of the speaker jack J16.

### 5.3 Receive Audio (VoIP)

Receive audio from the radio comes from pin 1 of the radio interface connector P3. The audio is then passed through the DSP U32 where it is converted to digital. The digital audio is then sent to the microprocessor U15 to be assembled in to UDP packets. The UDP Packets are then passed to the Ethernet interface section U64.

## 5.4 Transmit Audio (Tone)

Audio appearing on the line enters the 21-28 VTP on pins 3 and 4 of J11 when using a 2-wire line and on pins 2 and 5 of J11 when using a 4-wire line. SG1 - SG4 are surge arresters that protect the 21-28 VTP from line transients. Line audio is coupled into the 21-28 VTP by T1 (4-wire) or T2 (2-wire). R262 (4-wire) is used to provide a 600 ohm impedance to the line. Audio from T1 goes to audio gate U57B and audio from T2 goes to audio gate U57A which determines if a 2-wire or a 4-wire line is being used. The audio then passes to EPOT U56A. This EPOT passes the audio to U43A which is an amplifier stage that is used to compensate for line loss. EPOT U56A controls the gain of this amplifier stage.

The audio then enters the automatic gain control (AGC) circuit which compensates for varying input levels by providing a constant output over an input range of 30 dB. The AGC circuit is comprised of U49B and U43D and their associated components. The audio signal on pin 13 of U49B is rectified internally and is used to control the gain of the internal gain cell connected between pins 9 and 11 of U49B. The attack time of the AGC is determined by C244 and the recovery time is determined by C69. The AGC output is at pin 14 of U43D.

The audio then enters the TX 2175 Hz notch filter through audio gate U57C or U57D. These Audio gates determine if the transmit audio comes from the AGC output or if it bypasses the AGC circuit. The notch filter is comprised of U43B and U43C and their associated components. Potentiometers R64 and R54 are used to tune the notch filter to 2175 Hz. The notch filter removes the 2175 Hz hold tone from the transmit audio to prevent it from being heard.

The audio will then pass through the DSP U32 where it is converted to digital for VoIP and adjusts the analog transmit audio level out. The audio then passes to pin 21 of P3 which is the transmit audio output. Jumper JP4 determines if the transmit audio output is a high or a low impedance.

## 5.5 Receive Audio (Tone)

Receive audio from the base station radio enters the 21-28 VTP on pin 1 of P3. The audio is then passed through the DSP U32 where it is converted to digital for VoIP and the analog receive audio is sent to the RX 2175 notch filter.

The audio then enters the RX 2175 Hz notch filter. The notch filter is comprised of U42B and U42C and their associated components. Potentiometers R56 and R57 are used to tune the notch filter to 2175 Hz. The notch filter removes any 2175 Hz component present in the receive audio to prevent falsing any 2175 Hz detectors in the remote.

The audio will then pass through the EPOT U56C when this EPOT is enabled by the control section. The audio passes to U42A which is a summing amplifier stage that is used to provide the proper level of audio to the line. EPOT U56C controls the gain of the receive audio through this stage. The audio then passes to line driver U52 and U53 which drives the line coupling transformer T2 when enabled by the control section. Audio coupled to the line by T2 appears across pins 3 and 4 of J11.

## 5.6 Guard and Hold Tone Detect (Tone)

Line audio from U43A is passed into the 2175 Hz bandpass filter through EPOT U44. EPOT U44 adjusts the level of audio into the bandpass filter and into the guard and hold tone detect circuits. The bandpass filter is comprised of U38A, U38B, and U38C and their associated components. Potentiometer R52 is used to tune the bandpass filter to 2175 Hz.

The 2175 Hz tones that come out of the bandpass filter are passed into the guard and hold tone detect circuits. The guard tone detect circuit is comprised of U39A and its associated components. Diodes D6 pass only the positive transitions of the 2175 Hz tones to capacitor C59 which causes C59 to charge up. During negative transitions, C59 is discharged by resistor R55. The charge on C59 is passed to U39A which is a comparator that compares the charge on C59 to a reference level. U39A outputs a high to the control section when the charge on C59 exceeds the reference level which indicates that guard tone is being detected.

The hold tone detect circuit is comprised of U38D and U39B and their associated components. U38D is an amplifier stage that provides approximately 30 dB of gain. Diodes D7 pass only the positive transitions of the 2175 Hz tones to capacitor C204 which causes C204 to charge up. During negative transitions, C204 is discharged by resistor R175. The charge on C204 is passed to U39B which is a comparator that compares the charge on C204 to a reference level. U39B outputs a high to the control section when the charge on C204 exceeds the reference level which indicates that hold tone is being detected.

## 5.7 4-Wire Intercom (Tone)

Line audio from U43A passes through the EPOT U56D when enabled by the control section. The audio passes back to the line through the summing amplifier U42A. EPOT U56D controls the gain of the 4-wire intercom audio through the summing amplifier. The 4-wire intercom circuit allows audio from a remote that is transmitting to be received by paralleled remotes when using a 4-wire line.

## 5.8 Tone Control

The sequential tones are controlled by U36 an 8-bit microcontroller. Data written to it by U15 controls the Signaling Processor U37. U37 is used to generate the tones required by the 21-28 VTP including the guard tone, hold tone, function tones, alert tone and various other tones. U37 also decodes function tone sequences from the line and reports them to U36.

## 5.9 MSK Control Option

This section is intentionally left blank for future addition of this option.

## 5.10 Outputs

The output states are controlled by U32 on the 21-28 VTP board. The outputs are then sent to the open collector output drivers Q4 thru Q11, Q15 and Q16 on the 21-28 VTP Board then out on P3. Outputs 9 and 10 are optionally connected to relay outputs by JP10 and JP11.

## 5.11 Local Control

The local desk microphone is connected to J5, which passes audio, PTT and monitor directly to the DSP, U32 where the audio, PTT and monitor functions are processed. The intercom switch is also connected directly to the DSP. The local speaker audio is sent from the DSP to the audio amplifier U35 and then sent to J16, the speaker jack.

## 5.11 Encode Decode Header

The Encode/Decode Header, J4 passes audio and PTT directly to the DSP U32 where the audio and PTT functions are processed. All connections for J4 are processed by the DSP U32. Receive audio from the base station radio, line audio and VoIP audio are passed to pin 6 of J4 by the DSP U32. Pin 4 of J4 is the Encode PTT input to the DSP U32. Any audio on pin 5 of J4 will be passed by the DSP U32 to pin 21 of P3, transmit audio output, after the DSP U32 receives an Encode PTT signal.

## 5.12 Microprocessor

The Net+ARM 7520B MCU U15 provides the network interface functions and provides the platform for the application code. Integrated peripherals include a 10/100 Ethernet MAC, two serial ports, and numerous general-purpose I/O pins. A RTOS and a TCP/IP stack are included along with drivers for the internal peripherals.

## 5.13 Digital Signal Processor

The DSP U32 provides the audio processing functions. This DSP has six audio inputs, four audio outputs, a single Sigma-Delta CODEC, and an audio multiplexor to connect the CODEC to one audio input and one audio output. It also has numerous general-purpose I/O pins and a host interface. The DSP firmware comes pre-programmed in ROM and the functions provided can be controlled by the host CPU U15 through the host interface. The DSP firmware provides the following standard CODEC algorithms: G.711, G.723.1, and G.726.

## 5.14 Ethernet Interface

The Ethernet interface consists of a three port 10/100 Base-TX Switch U64. One port is connected externally to the LAN and the second port is connected externally to a computer to allow the computer access to the LAN. The third port is connected internally to the Ethernet port of the NET+ARM MCU U15. LEDs integrated into the Ethernet connectors will provide Connect and Activity status. The Ethernet port for connecting to the PC will be cross-wired to allow straight-through cables to be used on both ports.

## APPENDIX A - RADIO INTERFACES

This appendix contains instructions for interfacing the 21-28 VTP panel for various radio applications.

### Conventional Binary Interface

The following steps outline the procedure for interfacing a conventional radio requiring binary control signals to the 21-28 VTP:

1. Identify which radio functions should be controlled by the 21-28 VTP. The available functions of the conventional binary interface on the 21-28 VTP are described below.
  - **COR:** Control signal from the radio that is active while receiving audio.
  - **PTT:** Control signal from the 21-28 VTP that is active when the radio should transmit.
  - **Channel Control Outputs:** Control signals from the 21-28 VTP to change the channel on the radio through binary output patterns. The number of outputs used for channel control can be programmed from 1 to 8. Consult the table below for the number of outputs required. Note that output #1 will always be the least significant output. Outputs #2 to #8 not used for channel control are available as user defined outputs.

| Number of Channel Outputs | Max. # of Channels |
|---------------------------|--------------------|
| 1                         | 2                  |
| 2                         | 4                  |
| 3                         | 8                  |
| 4                         | 16                 |
| 5                         | 32                 |
| 6                         | 64                 |
| 7                         | 128                |
| 8                         | 255                |

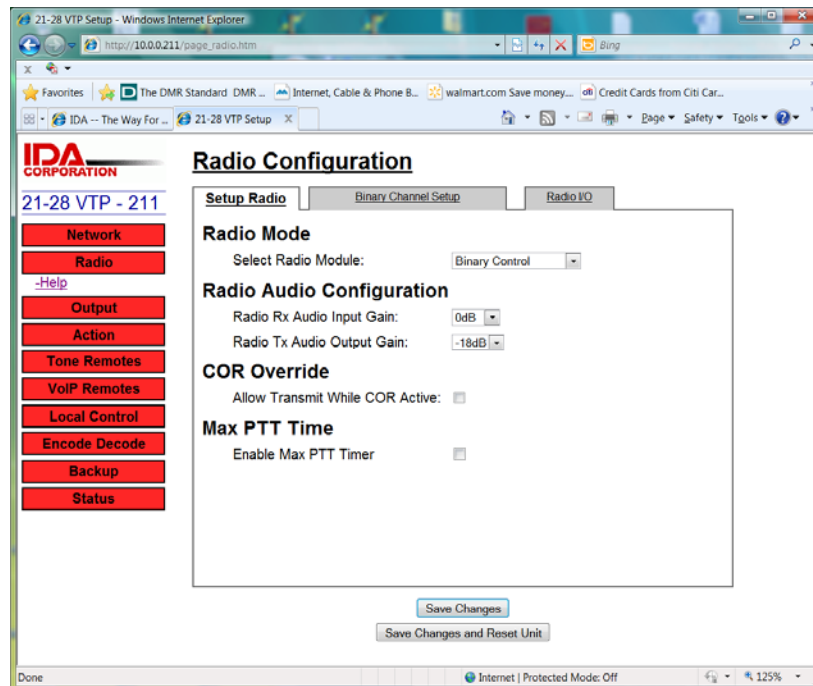
- **User Defined Outputs:** Several additional outputs are available for controlling other radio functions.
2. Construct the cable end that will connect to the 21-28 VTP's P3 Radio connector. A generic cable kit is available from IDA Corporation (Part No. 102-OPT371). The following table lists the connections required to a DB25 male connector for each 21-28 VTP function.

| Connection                       | Function                  |
|----------------------------------|---------------------------|
| Pin #1                           | RX Audio                  |
| Pin #7                           | Ground                    |
| Pin #20                          | +13.8 Vdc                 |
| Pin #21                          | TX Audio                  |
| Pin #25                          | COR                       |
| Output #1-7<br>User-programmable | Channel Output<br>Pattern |
| Output #8                        | User Defined              |
| Output #9                        | PTT                       |
| Output #10                       | User Defined              |



## Conventional Binary Interface (cont.)

3. Connect the other end of the cable to the radio. This may require modifications to the radio. Consult the radio manual for details.
4. Configure the jumpers on the 21-28 VTP based on the system requirements. Check the audio level adjustments.



## Trunking Radio Interface

The 21-28 VTP may also be interfaced to a trunking radio for transmit and receive only with no channel or scan control. Full featured, radio model specific interfaces are available, contact the factory. In order to provide handshake tones in a trunking application, it is necessary to utilize the TRANSMIT INDICATOR input on the 21-28 VTP. The TRANSMIT INDICATOR input is on Pin 9 of P3. The 21-28 VTP must also be programmed for the correct TX Active HI / LOW polarity under the RADIO CONFIGURATION/RADIO I/O screen as shown above. It needs to remain active throughout the entire transmission. For conventional applications it should be set to IGNORE.

## Additional Radio Interfaces

For radio specific interfaces, refer to the Radio Configuration Parameters screen of the 21-28 VTP or contact the factory for the availability of updates for additional radio interfaces.

## PARTS LISTS

### 21-28 VTP Main Board

| Item | Reference  | Description          | Part No.  | Qty |
|------|--|----------------------|-----------|-----|
| 1    | C1,2,4   | CAP, .01UF X7R 10%50 | 375-5103R | 3   |
| 2    | C3   | CAP, 2700PF X7R 50V  | 375-5272R | 1   |
| 3    | C5,15,32,73,78,84,85   | CAP, A ELEC 47UF 6.3 | 381-0470R | 7   |
| 4    | C6,7,8,9,10,17,18,19,20,21,26,<br>29,36,44,45,47,50,59,72,79,93,<br>94,95,98,99,102,103,104,106,<br>107,109,110,111,112,114,115,<br>117,119,120,121,123,124,126,<br>127,128,129,130,132,135,136,<br>138,139,140,141,142,145,146,<br>147,148,150,152,153,155,157,<br>159,163,164,167,168,169,170,<br>174,175,181,185,189,191,193,<br>194,195,196,202,206,212,218,<br>219,220,221,222,224,225,230,<br>244,246,248,252,253,264,268,<br>269,286,287,294,295,305,316,<br>317,318,336,337,338,346,347,<br>348,349,350,351,352,371,372,<br>373,384,385,388,389, | CAP, .1UF X7R 16V    | 375-2104R | 125 |
| 5    | C11,12,13,14,46,53   | CAP, A ELEC 470UF 25 | 381-3471R | 6   |
| 6    | C16,24,25  | CAP, A ELEC 47UF 16V | 381-2470R | 3   |
| 7    | C22,23,28,51,55,69,74,75,76  | CAP, TANT, 1UF 35V   | 392-4105R | 9   |
| 8    | C27,49,82,83,86,96,97,105,<br>108,113,116,118,122,125,131,<br>133,134,137,143,151,154,156,<br>158,162,165,166,171,173,178,<br>182,184,186,190,192,201,215,<br>217,226,228,229,234,241,245,<br>251,254,263,265,270,273,277,<br>282,285,303,304,306,307,312,<br>319,345,386,387,397,399,400,<br>401  | CAP, 100PF 50V       | 375-5101R | 65  |
| 9    | C30,31   | CAP, A ELEC 4.7UF 25 | 381-3475R | 2   |
| 10   | C33,63,204,227,232,233   | CAP, .47UF Y5V 16V   | 375-2474R | 6   |
| 11   | C34  | CAP, A ELEC 150UF 10 | 381-1151R | 1   |
| 12   | C35,38,56  | CAP, ELEC 10UF 16V   | 381-2100R | 3   |
| 13   | C39,40,100,101   | CAP, 10PF NPO 50V    | 375-5100R | 4   |
| 14   | C41,42   | CAP, A ELEC 1UF 50V  | 381-5105R | 2   |
| 15   | C43,62   | CAP, ELEC 2.2UF 35V  | 381-42R2R | 2   |
| 16   | C48,52,57,58,60,61,64,65,67,<br>68   | CAP 10000PF 100V     | 372-7103R | 10  |
| 17   | C54  | CAP ELECT 47UF 25V   | 381-3470R | 1   |
| 18   | C183,187   | CAP, 18PF 50V        | 375-5180R | 2   |
| 19   | C188,203   | CAP .22UF Y5Y 16V    | 375-2224R | 2   |

|    |   |                        |           |    |
|----|---|------------------------|-----------|----|
| 20 | C205,266,339,359  | CAP 22PF NPO 50V       | 375-5220R | 4  |
| 21 | C231,247,296  | CAP 330PF 50V          | 375-5331R | 3  |
| 22 | D1,2  | DIODE SCHOTTKY SMA     | 110-2304R | 2  |
| 23 | D3,4  | LED, SUPER RED 0603    | 112-0201R | 2  |
| 24 | D5  | DIODE, ZEN 500XXW      | 112-2403R | 1  |
| 25 | D6,7  | DIODE, MMBD4148SE      | 110-2210R | 2  |
| 26 | D8  | DIODE, SCHOTTKY 3A     | 110-2305R | 1  |
| 27 | D9  | LED, DUAL COLOR        | 110-2500  | 1  |
| 28 | D9  | 3 LEAD LED HOLDER RA   | 112-0150  | 1  |
| 29 | D10,11  | DIODE, SW 200V 250MW   | 110-2203R | 2  |
| 30 | D12   | ZEN 1N5226/4728 3.3V   | 111-0015  | 1  |
| 31 | F2  | FUSE, RESET 2.50A 16   | 290-1003  | 1  |
| 32 | J4,17   | CONN 36 POS BKWY HDR   | 231-1040  | 2  |
| 33 | J5  | JACK, MOD 4POS SIDE    | 231-0021  | 1  |
| 34 | J6  | INSERT, CKFE440-4      | 200-0306  | 1  |
| 35 | J6  | SCW, 4-40 X ¼ PHLP     | 199-3055  | 1  |
| 36 | J7  | CONN, R/A POWER        | 234-0114  | 1  |
| 37 | J8  | JACK MOD, RJ45 LED     | 234-0121  | 1  |
| 38 | J9  | JACK MOD, RJ45 LED     | 234-0120  | 1  |
| 39 | J11   | JACK MOD 6POS (UL)     | 234-0066U | 1  |
| 40 | J12   | CONN, HDR 20POS.100    | 231-1091  | 1  |
| 41 | J16   | JACK SPKR PNL MNT      | 234-0091  | 1  |
| 42 | J18   | CONN D HDR 10POS.100   | 231-1089  | 1  |
| 43 | JP 1,4,8,9  | CONN 2 POS GOLD POST   | 231-1002  | 4  |
| 44 | JP 7,10,11,12   | CONN 3 POS GOLD POST   | 231-1003  | 4  |
| 45 | K 1,2   | RELAY, PC MOUNT MINI   | 700-0100  | 2  |
| 46 | L 1   | POWER IND, 33.00UH     | 306-3002R | 1  |
| 47 | L 2   | POWER IND, 47.00UH     | 306-3001R | 1  |
| 48 | L 3,4,5,6,7,8   | FERRITE, 1500OHM 800MA | 306-2003R | 6  |
| 49 | P 3   | CONN, DB25 RA          | 234-0125  | 1  |
| 50 | P 4   | HDR 14 POS ,1 X .1     | 231-1076  | 1  |
| 51 | Q 1,2,3,4,5,6,7,8,9,10,11,14,15,16  | DIODE, TRANS 350MW     | 110-2206R | 14 |
| 52 | Q 12,13   | TRANS, 2N7002          | 180-1003R | 2  |
| 53 | R1,2,48,49,110,111,162,214,215  | RES, 100 1% 1/16W      | 322-1000R | 9  |
| 54 | R5,13,15,19,118,150,151,179,180,181,270,293,294,296,297   | RES, 0 5% 1/10W        | 323-000R  | 15 |
| 55 | R6  | RES, 56 5% 1/10W       | 323-1560R | 1  |
| 56 | R7,9,10,11,18,45,46,66,68,75,77,101,103,120,121,133,136,137,138,139,156,160,178,183,201,202,210,211,239,253,266,271,272,275,276,291,292,304,305,315,316,317 | RES, 10K 5% 1/10W      | 323-1103R | 42 |
| 57 | R14,35,36,37,38,39,40,59,135,140,141,142,143,145,146,147,217,274,289,290  | RES, 1K 5% 1/10W       | 323-1102R | 20 |
| 58 | R16,17,58,116   | RES, 330 5% 1/10W      | 323-1331R | 4  |

|     |   |                      |           |    |
|-----|---|----------------------|-----------|----|
| 59  | R20,21,24,27,28,29,30,31,32,34  | RES, 33 5% 1/10W     | 323-1330R | 10 |
| 60  | R22,23,33   | RES, 820 5% 1/10W    | 323-1821R | 3  |
| 61  | R25,26  | RES, 2K 5% 1/10W     | 323-1202R | 2  |
| 62  | R41,255,256   | RES, 10 5% 1/10W     | 323-1100R | 3  |
| 63  | R43   | RES, 10M 5% 1/10W    | 323-1106R | 1  |
| 64  | R44,104,106,107,108,109,119,122,125,126,127,128,129,130,144,174,190,199,209,213,237,283,299,300,301,302,303,313,314 | RES, 4.7K 5% 1/10W   | 323-1472R | 29 |
| 65  | R47,132   | RES, 1M 1% 1/16W     | 322-1004R | 2  |
| 66  | R50,55,203  | RES, 3.9K 5% 1/10W   | 323-1392R | 3  |
| 67  | R51   | POT 50K SLIDE/AUDTAP | 340-0003  | 1  |
| 68  | R52,54,56,57,64   | POT 2K 22 T TOP ADJ  | 352-0004  | 5  |
| 69  | R53   | RES, 3.0K 5% 1/10W   | 323-1302R | 1  |
| 70  | R60   | RES, 620 5% 1/10W    | 323-1621R | 1  |
| 71  | R61,65  | RES, 2.67K 1%        | 322-2671R | 2  |
| 72  | R62,232   | RES, 1.78K 1%        | 322-1781R | 2  |
| 73  | R63,164,192,226   | RES, 46.4K 1%        | 322-4642R | 4  |
| 74  | R69,70,71,72,73,74,81,82,85,86,95,96,97,102,112,113,114,115   | RES, 49.9 1% 1/16W   | 322-49R9R | 18 |
| 75  | R105  | RES, 499K 1% 1/16W   | 322-4993R | 1  |
| 76  | R134  | RES, 2.7K 5% 1/10W   | 323-1272R | 1  |
| 77  | R154  | RES, 40.2K 1%        | 322-4022R | 1  |
| 78  | R155,177,185  | RES, 6.8K 5% 1/10W   | 323-1682R | 3  |
| 79  | R157,166,168  | RES, 7.15K 1%        | 322-7151R | 3  |
| 80  | R158  | RES, 374K 1%         | 322-3743R | 1  |
| 81  | R159  | RES, 11.8K 1%        | 322-1182R | 1  |
| 82  | R161  | RES, 750K 1%         | 322-7503R | 1  |
| 83  | R163,196  | RES, 470K 5% 1/10W   | 323-1474R | 2  |
| 84  | R165,167  | RES, 220K 5% 1/10W   | 323-1224R | 2  |
| 85  | R173  | RES, 22K 5% 1/10W    | 323-1220R | 1  |
| 86  | R175  | RES, 2.2K 5% 1/10W   | 323-1222R | 1  |
| 87  | R184,191  | RES, 7.32K 1%        | 322-7321R | 2  |
| 88  | R194,195,233  | RES, 24K 5% 1/10W    | 323-1243R | 3  |
| 89  | R207,208,247  | RES, 33K 5% 1/10W    | 323-1333R | 3  |
| 90  | R234  | RES, 6.2K 5% 1/10W   | 323-1622R | 1  |
| 91  | R241  | RES, 510 5% 1/8W     | 321-1511R | 1  |
| 92  | R242,243  | RES, 12K 5% 1/10W    | 323-1123R | 2  |
| 93  | R244,245  | RES, 10.0K 1%        | 322-1103R | 2  |
| 94  | R246  | RES, 16K 5% 1/10W    | 323-1163R | 1  |
| 95  | R262  | RES, 680 5% 1/10W    | 323-1681R | 1  |
| 96  | R273  | RES, 3.01K 1% 1/16W  | 322-3011R | 1  |
| 97  | SG1,2,3,4   | DIODE SMCJ30C        | 112-0401R | 4  |
| 98  | SW1,2,3   | SWITCH, TACT 2.36MM  | 616-0003  | 3  |
| 99  | SW4   | SWCH SUB MIN PUSH PC | 611-0044  | 1  |
| 100 | T1  | TRANS. GE RMT.MIDCOM | 410-0005  | 1  |
| 101 | T2  | TRANS. 2-COIL COUPLG | 410-0006  | 1  |

|     |              |                       |          |   |
|-----|--------------|-----------------------|----------|---|
| 102 | TP93,94      | TEST POINT PC MOUNT   | 200-0013 | 2 |
| 103 | U1           | IC, LM2673S-3.3       | 131-4002 | 1 |
| 104 | U2           | IC, LM2673S-12        | 131-4007 | 1 |
| 105 | U3           | IC, REG 1.5A LDO      | 131-4006 | 1 |
| 106 | U4           | IC, LM1086IS-5.0      | 131-4003 | 1 |
| 107 | U5           | IC, LP3984IMF-1.5     | 131-5004 | 1 |
| 108 | U6           | IC, PCA9540BD         | 131-1095 | 1 |
| 109 | U7,13,24     | IC, SN74AHC1G08DBVR   | 131-5002 | 3 |
| 110 | U8           | IC, 24LC256           | 131-1060 | 1 |
| 111 | U9           | IC, SN74LVC1GU04DBVR  | 131-5005 | 1 |
| 112 | U10          | IC,LM2937IMP-10       | 131-5010 | 1 |
| 113 | U11          | IC, LM2937IMP-5.0     | 131-5011 | 1 |
| 114 | U12          | IC, TC1270TERCTR      | 131-5003 | 1 |
| 115 | U14,31       | IC, SN74LVC2G34DBVR   | 131-5016 | 2 |
| 116 | U15          | IC, NS7520B-1C55      | 131-6000 | 1 |
| 117 | U16          | IC, S29AL008J70TFI020 | 131-1063 | 1 |
| 118 | U17,19       | IC, SN74LVC1G175DBVR  | 131-5012 | 2 |
| 119 | U18,20       | IC, SN74LVC2G240DCTR  | 131-7005 | 2 |
| 120 | U21          | IC, MCP3221A5T-I/OT   | 131-5001 | 1 |
| 121 | U22          | IC, SN74AH1G02DBVR    | 131-5014 | 1 |
| 122 | U23          | IC, SN74AHC1G32DBVR   | 131-5015 | 1 |
| 123 | U27,28       | IC, HY57V161610DTC-7  | 131-1064 | 2 |
| 124 | U32          | IC, VP101X12DQC-1     | 131-2010 | 1 |
| 125 | U35          | IC, TPA1517DWPR       | 131-1061 | 1 |
| 126 | U36          | IC, ATTINY84-20SSU    | 131-1097 | 1 |
| 127 | U37          | IC, MX803ADW          | 131-1099 | 1 |
| 128 | U38,42,43,48 | IC, TLO64ID           | 131-1098 | 4 |
| 129 | U39          | IC, LM2903M           | 131-1094 | 1 |
| 130 | U44          | IC, AD5280BRUZ50      | 131-7001 | 1 |
| 131 | U45,47,57    | IC, ADG444BRZ         | 131-1096 | 3 |
| 132 | U49          | IC, SA572D            | 131-1038 | 1 |
| 133 | U42,53       | IC, LMH6639MF/NOPD    | 131-5013 | 2 |
| 134 | U56          | IC, AD5263BRUZ50      | 131-7003 | 1 |
| 135 | U64          | IC, KSZ8993           | 131-2009 | 1 |
| 136 | Y1           | CRY, 18.432MHZ 20PF   | 305-0109 | 1 |
| 137 | Y3           | CRY, 4.096MHZ 20PF    | 305-0112 | 1 |
| 138 | Y4           | CRY, 4.00MHZ 20PF     | 305-0108 | 1 |
| 139 | Y6           | CRY, 25.00MHZ 18PF    | 305-0110 | 1 |

**PARTS LISTS (Cont.)**

**21-28 VTP Panel Cabinet**

| <b>Item</b> | <b>Description</b>     | <b>Part No.</b> | <b>Qty</b> |
|-------------|------------------------|-----------------|------------|
| 1           | S/N LBL IDA PRODUCT    | 199-6009        | 1          |
| 2           | HOLE PLUG .250 BLK     | 203-1150        | 1          |
| 3           | CABLE ETHERNET 10FT    | 800-2080        | 1          |
| 4           | CAB, 21-28 VTP         | 900-6090        | 1          |
| 5           | FACEPLATE, 2128 BK SCR | 900-6092s       | 1          |
| 6           | FACEPLATE, 2128 FR SCR | 900-6091s       | 1          |

**21-28 VTP Local Control Option**

| <b>Item</b> | <b>Description</b>     | <b>Part No.</b> | <b>Qty</b> |
|-------------|------------------------|-----------------|------------|
| 1           | S/N LBL IDA PRODUCT    | 199-6009        | 1          |
| 2           | HOLE PLUG .250 BLK     | 203-1150        | 1          |
| 3           | CABLE ETHERNET 10FT    | 800-2080        | 1          |
| 4           | CAB, 21-28 VTP         | 900-6090        | 1          |
| 5           | FACEPLATE, 2128 BK SCR | 900-6092s       | 1          |
| 6           | FACEPLATE, 2128 FR SCR | 900-6091s       | 1          |

## **SCHEMATICS**

For schematics of the VoIP board, see the 24-66 VoIP manual.

Insert  
Schematics  
here.

## INSTALLATION DIAGRAMS

Insert  
Installation Diagram  
here.