Calibrating Audio Levels For The Allstar Link System

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Proper audio level calibration is crucial for ensuring good audio quality, and consistent audio levels from node-to-node. Fortunately, the procedure is not that complicated. To properly perform the audio level calibration, you will need the following items:

1. An asterisk app_rpt.c at version 0.23 or later compiled with Asterisk and installed.
2. A service monitor, preferrably one capable of simultaneous generation and analysis (e.g. HP 8920, IFR1200, or a separate signal generator and deviation meter), plus cabling.
3. Terminal access to the machine being calibrated.
4. A tweaking tool to adjust the deviation pot in your repeater transmitter.
5. A tweaking tool for the pots on the Analog Radio Interface board or PCI Radio board.

Assumptions

1. The system you are calibrating uses 5Khz deviation (standard nbfm) as the maximum peak deviation.
2. That you have interfaced the repeater to the Analog Radio Interface Board or PCI radio board, and that you set initial audio levels by ear, and have been able to get DTMF commands to work with your rough audio levels.
3. You must know the node number and the channel number of the radio port you wish to test. This can be looked up in rpt.conf.

Procedure

1. Check to ensure you have the following lines in the *functions* section of yout rpt.conf file located in /etc/asterisk:

```
99=cop,4        ; Reference tone level
```

If the line above is not present, add it, and restart Asterisk.

2. Turn the TX gain pot fully clockwise for maximum gain.
3. Set the service monitor or devation meter to the transmitter's frequency.
4. From the Asterisk command line, type:

   rpt fun *node* *99

   You should should hear the 1004 Hz calibration tone on the service monitor receiver

which is monitoring the transmitter. The *node* parameter is numeric and should have been noted prior to starting the test. Substitute you numeric node number for *node*.

5. On the service monitor, check the **peak deviation** of the transmitter. If it is more than 5Khz, then adjust the transmitter deviation pot so that the deviation read on the service monitor is no more than 5Khz. Check the shape of the audio waveform on the service monitor's scope. It should show evidence of hard limiting (it should look like a square wave with rounded edges) If can't get to 5 Khz peak deviation with hard limiting, you either need to adjust the microphone gain of the your transmitter to get to 5Khz, or add some amplification to get the deviation up to 5Khz. If you are using the ARIB board and not the PCI radio board, make sure you have the 20db jumper installed if you cannot achieve 5Khz peak deviation.
6. Back the TX gain pot on the Analog Radio Interface Board, or the PCI radio board down (counter clockwise) until you get 3Khz of deviation.
7. From the asterisk command line, type:

   rpt fun *node* #

   This will kill the test tone and unky the transmitter.

8. If you are not encoding a CTCSS tone on the repeater transmitter, go to step 8. If there is a CTCSS tone generator being fed into the repeater transmitter you now need to see how much deviation the CTCSS tone generator has when it is running with no other repeated audio. Key up your repeater and see how much CTCSS tone deviation there is on the repeater tail (increase the tail time in rpt.conf if it is too short for the test). With the CTCSS deviation now known, key up the repeater and dial *99 again to turn on the reference tone generator. Adjust the TX gain pot to 3Khz **PLUS** the amount of CTCSS peak deviation noted in the repeater tail. Hit # to cancel the reference tone generation.

9. There are two methods for setting the receive level. Method A is preferred, but method B can be used to set the receive levels on simplex radios, or when the test equipment cannot generate and analyze a signal simultaneously.

   A. With the service monitor, or signal generator, generate a 1Khz tone with 3Khz of peak deviation on the repeater input. If your repeater requires a CTCSS tone, temporarily disable the CTCSS decoder and use carrier squelch as the additonal deviation of the CTCSS tone might cause the receive level to be mis-adjusted. While generating the tone(s) on the repeater input, look at the output of your repeater with the service monitor and adjust the RX gain pot until you get 3Khz of deviation. If you are running a CTCSS tone generator on the repeater transmitter continue adjusting the RX gain pot until you reach the **SUM** of 3Khz and your CTCSS as noted in step 7.

B. Use the ztmonitor command to note a level reading on the input with 3 Khz of peak deviation applied to the receiver. If your radio or repeater requires a CTCSS tone, temporarily disable the CTCSS decoder and use carrier squelch as the additional deviation of the CTCSS tone might cause the receive level to be mis-adjusted. Here is an example using ztmonitor on channel 1:

```
[root@radios zaptel]# ./ztmonitor 1 -v

Visual Audio Levels.
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 Use zapata.conf file to adjust the gains if needed.

( # = Audio Level  * = Max Audio Hit )
<----------------(RX)---------------->

 ###################*
```

You want to adjust the RX pot until the asterisk '*' (which is the peak audio level) dithers plus or minus 1 character position from the left parenthesis.

When the audio level is set, exit ztmonitor by typing control-c.

10. Check your repeated audio on the service monitor scope. There should be no evidence of hard limiting (it should look like a sine wave).
11. Turn off the signal source, and check the repeated audio level and quality. It should sound clean and intelligible
12. Check the audio levels between a nearby system linked to your repeater. There should be no noticeable difference in levels provided both systems have been correctly adjusted using this procedure.
13. Disable the test tone generation command in rpt.conf for additional security when you are done with audio level adjustments.