FIELD APPLICATION NOTE

Audio Quality Tuning for IP Telephones

Issue 2.0

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Abstract

IP Telephones can be fine-tuned to provide optimal audio quality performance by administering audio parameters in the file server settings file. This document provides a guide to administering those parameters as well as a description of each parameter and its range of settings. Examples of common customer audio quality problems are discussed with audio parameter settings identified to fix those problems. New to this document are the additional audio sidetone and noise reduction settings made available starting with IP Telephone patch release R2.810.

1 Introduction

This document describes the audio tuning parameters administrable via the 46xx/96xx settings file[1] and adjustments that can be made to optimize the phone for specific customer environments and audio impairments. The available range of programmable system parameters will allow the engineer/technician to adjust the audio performance of the IP Telephone (IPT) for the various customer locations and their respective environments.

After being introduced in R2.4, the AUDIOENV, AUDIOSTHS, and AUDIOSTHD parameters have underwent value changes in order to meet the needs of our customers. With the release of R2.810, new sidetone settings have been added to AUDIOSTHS and AUDIOSTHD so that any level available in a previous release can now be obtained with one of the ten settings now available in R2.810. AUDIOENV has also added two new noise reduction settings, which are described in section 3.2.2.

Appendix A provides a "drill down" of the various audio parameter settings that are now available. Appendix B contains a Quick Start Guide that identifies specific audio quality symptoms and the tuning parameter setting(s) that can be used to fix the issue. Appendix C provides guidelines for performing noise measurements.

2 Document History

Release Number	Date	Comments
1.0	June 29, 2006	Initial release
2.0	July 10, 2007	Updated to add new audio settings

3 Audio Quality Tuning Parameters

Audio quality tuning parameters were developed to address customer audio quality issues that arise from incoming audio signal impairments or those that originate from the customer's environment. The engineer/technician can mitigate these audio quality issues using the customizable audio parameters[2] available in the settings file. Note that the tuning parameters were not designed to fix system component defects or network performance issues.

The following sections provide an explanation of each audio parameter so that the reader can gain an understanding of these parameters and the types of audio issues that they can address. This will help when deciding which adjustments should be made to mitigate the customer's audio quality issue(s).

3.1 Tuning Parameter Changes from R2.4 to R2.810

AUDIOENV, AUDIOSTHS, and AUDIOSTHD parameter settings have changed in the interim releases (from R2.4 through R2.810) due to customer feedback. Because of this, an audio parameter setting in one release may not have the same performance as that same setting in a later release. This has all been remedied in release R2.810. New settings have been added to AUDIOSTHS and AUDIOSTHD so that any sidetone level available since R2.4 can be obtained with one of the ten settings now available in R2.810. See Table 1 of Appendix A.

[1] Except the 4690 and 4625 (prior to R2.7)
[2] Starting with IPT Release R2.4

The ability to turn off the expander (now more appropriately called NR[3]) was added in R2.7 and a more aggressive noise reduction setting (Excessive noise) was added in R2.810. The reason for the name change from expander to noise reduction (NR) is to more accurately describe the actual function being used – noise reduction (NR) as opposed to expansion (Exp).[4] See Table 2 and 3 in Appendix A.

Because of the two added states in AUDIOENV, the AUDIOENV matrix has grown from 108 to 299 possible settings. It is certainly not intended that trial and error be used when selecting an AUDIOENV setting to fix a customer audio quality issue. Rather, the intent is for the engineer/technician to isolate the audio impairment and select an AUDIOENV value that has a variable setting designed to address that audio impairment and improve the performance of the phone. See Table 4 in Appendix A.

3.2 Customizable Audio Tuning Parameters

The following audio parameters can be administered[5] on a system-wide basis, or, when a customer has multiple operating environments, the Group Feature[6] or local DHCP/file server[7] can section the customer environments into groups of users. Seek out the *4600 Series IP Telephone LAN Administrator Guide* or escalate to SSE Endpoints for assistance in making these network adjustments.

For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone.

3.2.1 AUDIOSTHS / AUDIOSTHD

The AUDIOSTHD and AUDIOSTHS variables provide sidetone customization for both headset and handset respectively. Typical use of these settings is to reduce the level of ambient noise (which has entered the microphone) from being heard in the handset/headset receiver. Appendix A provides a table of sidetone adjustments.

AUDIOSTHS – controls the sidetone for the handset. The range of values is from zero (default setting) to nine. The levels allow adjustment in ~3dB steps as defined in Table 1 of Appendix A.

AUDIOSTHD – controls the sidetone for the headset. The ranges of values are the same as those defined for AUDIOSTHS above.

3.2.2 AUDIOENV

AUDIOENV serves as an index into a matrix containing four audio parameters. Each AUDIOENV value is unique in that at least one audio parameter changes value as the AUDIOENV value changes. The AUDIOENV variable can be set to values ranging from 0 – 299 possible settings with the default setting being 0. The four audio parameters are defined below.

Starting with R2.810, two new noise reduction states/settings have been added: one to turn off noise reduction and one to increase the loss added to noise.

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[3] AUDIOENV variable names Exp_thresh_Hs and Exp_thresh_Hs are now known as NR_Thresh_HS and NR_Thresh_HD, respectively.

[4] Expansion reduces background noise by inserting loss on lower level microphone output signals while noise reduction inserts loss on any microphone output signal that is deemed noise.

[5] Although the customer can make sidetone adjustments on their own and to their liking, it is highly recommended that AUDIOENV setting adjustments be made only with direction from Avaya Services or the Business Partner technical representative.

[6] Requires the phones to be programmed manually – consult Tier IV.

[7] Note that settings files can be local to the environment or building if it has its own DHCP server.

AGC_Dyn_Range - Receive AGC Dynamic Range: Used to boost low-level speech from the far end party. Be aware that increasing the AGC dynamic range will not only boost speech, but will also boost any low-level environmental noise from the far end or circuit noise from network equipment in the call topology.

- AGC dynamic range has default value of 0 (+/-9dB). Other available settings are 1 (+/-12dB), 2(+/-15dB), and 3 (+/-18dB).

NR_Thresh_HD - Headset Noise Reduction Threshold. This variable is used to reduce/eliminate environmental (ambient) noise[8] from being transmitted to the far end party. Adding more loss will reduce the level of ambient noise from being transmitted to the far-end party. MARK

- The noise reduction threshold for the headset has a default value of zero for a typical office environment, 1 for noisy office environments, 2 for very noisy office environments, 3 to turn off noise reduction, and 4 for excessive noise in the environment. Setting 4 is recommended[9] for call centers or environments where there is sensitive information audible in the background.

NR_Thresh_HS - Handset Noise reduction Threshold. Same as NR_Thresh_HD above (except this affects handset).

HD_TX_Gain - Headset Transmit Gain. Used either to limit environmental noise from being heard in the headset (or being transmitted to the far end party) or to boost the headset user's speech so that the far end party can hear them better. Setting 1 used when far end complains they can't hear the headset user while setting 2 is used to limit the noise heard in the headset and/or limits the noise transmitted to the far end party.

- Headset transmit gain has a default value of zero for normal transmit gain, 1 for +6dB of gain, and 2 for -6dB of gain.

Appendix A provides the AUDIOENV matrix table that contains all the possible AUDIOENV settings.

4 Optimizing IPT Audio Quality for Customer Environments

This section identifies customer environments in which specific audio parameters were changed to successfully mitigate customer audio issues. The recommendation is to use the settings provided as a starting point and then, if needed, fine-tune the audio parameters for the specific customer environment. See Appendix C for typical noise levels and environments.

4.1 Normal or Quiet Offices

While most customer issues arise out of noisy environments, customers have also raised audio quality issues when using the IP Telephone in quiet environments. A quiet office is defined as having a dBA reading of about 40dBA while a normal office is defined as having a noise level of about 50dBA.

Usually when an office environment is quiet[10], a user will tend to hear or take notice of audible artifacts on the call that are usually masked[11] in a noisier environment. The user will sometimes describe the artifact as static, or an intermittent noise that sounds like cracking on the line. If the 46xx/96xx telephone user continues to hear this noise after they have upgraded their phone to

[8] Noise can be either mechanical or low level nearby speech.

[9] This setting is only a recommendation and is not a guarantee that sensitive information will still not be transmitted to the far end party. This is because the phones were designed to transmit speech, and if the nearby speech is loud enough, it will be passed to the far end.

[10] "Quiet" is subjective and is not bound by the defined noise levels provided.

[11] A weaker sound is masked if it is made inaudible in the presence of a louder sound.

R2.4 or later (which has a default AGC dynamic range of +/- 9dB), they should disable AGC on the headset, handset, and/or speakerphone depending on which mode of communication they are using to listen to the call. Disabling AGC will prevent the phone from boosting low level receive signals (such as noise).

4.2 Noisy Offices

A noisy office is defined as having a dBA reading of about 60dBA.

When the ambient noise in a customer's office environment is loud, it can adversely affect the audio quality of both the near-end and far-end party on the call. Knowing what end of the call the room noise is affecting will determine what type of audio adjustment to make. The following sections provide solutions for the effects environmental noise has on the near end phone user as well as the effect the near end noise has on the far end listener.

4.2.1 Far-end Audio Quality Problems caused by Near-end Environmental Noise

Ambient room noise (mechanical noise or nearby speech) entering the microphone of a handset or headset can be the cause of both a complaint from the far-end party (they cannot understand the handset/headset user) or a complaint by our customer that the nearby speech (containing sensitive information) is being sent to (and heard by) the far-end party. Whether mechanical or nearby speech, the transmission of this noise is unwanted.

Depending on whether the complaint is noise being transmitted or sensitive information making it to the far-end will determine what settings to start with or use to address the issue. The following parameter settings identify which parameters to adjust while the table provides the AUDIOENV settings (to mitigate ambient noise from being transmitted to the far-end).

Noise Heard at Far-end

AGC_Dyn_Range = whatever is currently set. Since AGC is a receive path function, it does not influence the far-end audio quality.

NR_Thresh_HS = Noisy office. This handset noise reduction threshold setting increases the amount of loss applied to background noise. If **Noisy office** does not fix the problem, try **Very noisy office** setting. If there is still noise, use the **Excessive noise** setting. If not a handset user, set this to **typical office**.

NR_Thresh_HD = Noisy office. This headset noise reduction threshold setting increases the amount of loss applied to background noise. If **Noisy office** does not fix the problem, try **Very noisy office** setting. If there is still noise, use the **Excessive noise** setting. If not a headset user, set this to **Typical office**.

HD_Tx_Gain = 0dB. 0dB is the default nominal setting. If the far-end can still detect speech or background noise coming from the headset user's environment after making the above NR_Thresh_HD adjustments, set HD_Tx_Gain to **-6dB**. Note that HD_Tx_Gain only applies to headset – not handset.

AUDIOENV Variable Settings for Noisy Office			
Customer's current AGC setting	**If Handset user**	**If Headset user**	
		1st choice	**2nd choice (*)**
+/- 9dB	9	3	5
+/- 12dB	36	30	32

AUDIOENV Variable Settings for Noisy Office			
Customer's current AGC setting	If Handset user	If Headset user	
		1st choice	2nd choice (*)
+/- 15dB	63	57	59
+/- 18dB	90	84	86

(*) Note that these settings add loss to the transmitted speech and can affect the ability of the far-end party to hear the headset user

AUDIOENV Variable Settings for Very Noisy Office			
Customer's current AGC setting	If Handset user	If Headset user	
		1st choice	2nd choice (*)
+/- 9dB	18	6	8
+/- 12dB	45	33	35
+/- 15dB	72	60	62
+/- 18dB	99	87	89

(*) Note that these settings add loss to the transmitted speech and can affect the ability of the far-end party to hear the headset user

See following for Excessive noise AUDIOENV settings table.

Nearby Speech Heard at Far-end

AGC_Dyn_Range = whatever is currently set. Since AGC is a receive path function, it does not influence the far-end audio quality.

NR_Thresh_HS = Excessive noise. This handset noise reduction threshold setting applies the maximum amount of loss to background noise. If not a handset user, set this to **typical office**.

NR_Thresh_HD = Noisy office. This headset noise reduction threshold setting applies the maximum amount of loss to background noise If not a headset user, set this to **Typical office**.

HD_Tx_Gain = 0dB. 0dB is the default nominal setting. If the far-end can still detect speech or background noise coming from the headset user's environment after making the above NR_Thresh_HD adjustments, set HD_Tx_Gain to **-6dB**. Note that HD_Tx_Gain only applies to headset – not handset.

AUDIOENV Variable Settings for Excessive Noise			
Customer's current AGC setting	If Handset user	If Headset user	
		1st choice	2nd choice (*)
+/- 9dB	240	288	290
+/- 12dB	243	291	293
+/- 15dB	246	294	296

AUDIOENV Variable Settings for Excessive Noise			
Customer's current AGC setting	If Handset user	If Headset user	
		1st choice	2nd choice (*)
+/- 18dB	249	297	299

(*) Note that these settings add loss to the transmitted speech and can affect the ability of the far-end party to hear the headset user

4.2.2 Near-end Audio Quality Problems caused by Near-end Environmental Noise

Two common complaints of handset/headset users (typically headset users) who work in high noise environments are that they cannot hear/understand the far-end talker or that they hear the ambient noise in their headset (as sidetone).

> ***User cannot hear/understand the far-end talker.*** This can be caused by a poor handset/headset ear seal that allows room noise to leak in and mask the far-end talker's speech. Increasing the dynamic range of the receive AGC may help by boosting low level received speech from the far end party and allow the agent to better hear the far end party over the local environmental noise. See Appendix A for an AUDIOENV value that has a higher AGC dynamic range setting. Make sure to incorporate any AUDIOENV parameter changes already made (if any).
>
> ***User hears ambient noise in handset/headset.*** This complaint of hearing the ambient noise in their handset/headset can be reduces/eliminated by adjusting the AUDIOSTHS or AUDIOSTHD setting to a lower sidetone setting. See Section 4.3.1.

Handset/headset users in environments with noise levels in the mid to high 60's (dBA) can find some improvement by increasing the receiver volume, but if the receiver volume is already at the maximum, then acoustic treatment of the room is typically needed. There are no AUDIOENV settings which increase the receive volume levels range.

4.3 Call Centers

Room noise in a call center is usually loud[12], and depending on the amount of isolation between call center agents, conversations from other agents may be picked up by the headset microphone of another agent and heard by the far-end. If a call center agent has been told by customers that they can clearly hear another agent's conversation, then an AUDIOENV of 8 should prevent that from occurring. As indicated in section 4.2.1, only use setting 8 if setting 6 does not fix the issue because an AUDIOENV of 8 will lower the headset transmit gain and as a result, cause complaints from the far end party that they can't hear the agent.

4.3.1 Background Noise in Agent/User Headset

If the agent is hearing other background chatter in their own headset receiver, then we recommend lowering their AUDIOSTHD setting by a step or two (see Table 1 in Appendix A). Lowering the sidetone along with using an AUDIOENV of 6 or 8 can be very effective in preventing the far end party from hearing any call center background noise/speech.

[12] See Appendix C for measuring noise and noise level table.

4.3.2 Agent to Agent Calls across Networks – with background noise issue

Under some circumstances, calls between agents across the customer's network may have a different complaint. The complaint may be that the agent has trouble hearing the other agent even after increasing their receive volume to maximum. In this case, an AUDIOENV value of 35 will help boost this level by setting the AGC dynamic range of +/-12dB. If the agent still cannot hear the far-end, then an AUDIOENV value of 62 will set AGC dynamic range to +-15dB (which should correct the problem). Note that the AUDIOENV settings of 35 and 62 have the same noise reduction threshold and transmit gain settings. See Table 4 of Appendix A.

5 Other System Component Settings

5.1 DS1 Echo Canceller

DS1 echo canceller settings can affect incoming audio quality by producing echo canceller artifacts during echo cancellation. Because of this, it is best to identify DS1 echo canceller artifacts first and make the appropriate e-can setting change prior to making any AUDIOENV changes.

5.2 Network Region Codec

Voice quality can be affected by the type of speech coder utilized in the telephone network. A low-rate coder such as a G.729 codec reduces speech to a low transmission rate (8000 bits-per-second) but sacrifices voice quality in the process. In contrast, the G.711 codec has a higher transmission rate of 64,000 bits-per-second that uses more bandwidth, but allows it to better represent the talker's voice (less impairments). For more information on distortions caused by low-rate coders, see *Troubleshooting Audio Quality Problems in the Field*[13]*.*

5.3 Comfort Noise Generator on Media Processor and Crossfire

When comfort noise is enabled either through the Media Processor or Crossfire boards, customers may complain of a hiss or noise generated when they stop talking. What the user is most likely hearing is the change in the idle-channel noise from the far-end as the echo canceller suppresses the echo and adds comfort noise to fill the "gap" left by the echo canceller. The comfort noise is "white noise", and if the customer is complaining, then the noise coming from the far-end environment is not likely "white" in character. Therefore, the user is hearing that transition from white noise created by the e-can to some non-white noise generated at the far-end talker's environment.

The best AUDIOENV setting (if comfort noise is used) is the default setting of zero that sets the AGC at +/- 9dB; thereby limiting the gain applied to low-level signals/noise. Typically, it is best to turn off the comfort noise generator in the MedPro/Crossfire board in order to eliminate this customer complaint.

5.4 Terminal Parameter Settings

Terminal Parameter gain settings <u>are not</u> downloaded to, or used by, the IP Telephones. A common misconception is that Primary TX Gain is used by the 46xx phone. Not true. A change in Primary TX Gain on page 2 of the Terminal Parameters form will only affect the gains used by the Media Processor when a DCP phone is on a call with an IP phone. This is necessary because the DCP phones and IP phones have different transmit/send levels and by modifying the gains in the

[13] On the Tier IV website: http://support.avaya.com/japple/css/japple?PAGE=ProductArea&temp.productID=275624

MedPro, an IP phone user will maintain the same talker level experience they have with an IP phone user as with a DCP phone user.

The Terminal Parameter settings on page 2 that do affect the IP Telephones are the following:

The **Volume for IP Types** setting can be set to either retain the receive volume between calls or leave the levels at default between calls.

5.5 Loss Plan

The loss plan in CM provides for the ability to change transmit and receive levels for any loss group (such as IP Telephones). It is not recommended to change or customize these levels under any circumstance in troubleshooting 46xx/96xx IP Telephone audio quality problems.

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APPENDIX A: AUDIO PARAMETERS

SIDETONE SETTINGS

As indicated in the main text of this document, both the AUDIOSTHD and AUDIOSTHS variables provide sidetone customization (for both headset and handset, respectively). One step will provide approximately 3dB of change (think of it as one chevron of volume control). A **step below** reduces the loudness of sidetone – a **step above** increases the loudness of sidetone.

Table 1 provides sidetone level settings for all of the IPT releases that provide audio quality tuning parameters. Release R2.810 is designed to provide the engineer with a comparable match when upgrading a customer from an earlier release to a later release[14].

Note that default sets the phone's headset sidetone to a nominal loudness. The typical default setting of "0" does not result in a nominal sidetone loudness level in R2.6 or R2.8 since these values were designed to be louder in 2.6 (3 steps above nominal) and lower in 2.8 (1 step below nominal). R2.4, R2.7, and R2.810 all have the same loudness at setting zero (default). If for example, a customer was upgrading from R2.6 to R2.810 and they were satisfied with sidetone setting 1 in R2.6, the comparable sidetone setting in R2.810 is setting 8.

Table 1. Sidetone Settings

AUDIOSTHS & AUDIOSTHD Value Setting	Effect on Sidetone Loudness by IPT Release (steps are relative to default)				
	R2.4	R2.6	R2.7	R2.8	R2.810
0	default	3 steps above	default	1 step below	default
1	1 step below	1 step above	3 steps below	4 steps below	3 steps below
2	off	off	off	off	off
3	n/a	n/a	n/a	5 steps below	1 step below
4	n/a	n/a	n/a	6 steps below	2 steps below
5	n/a	n/a	n/a	3 steps above	4 steps below
6	n/a	n/a	n/a	n/a	5 steps below
7	n/a	n/a	n/a	n/a	6 steps below
8	n/a	n/a	n/a	n/a	1 step above
9	n/a	n/a	n/a	n/a	2 steps above

THE AUDIOENV MATRIX

The AUDIOENV variable can be programmed with one of 299 possible values with each value representing a unique setting of AGC dynamic range, handset noise reduction threshold, headset noise reduction threshold and transmit-gain (for headset only). It is certainly not intended that trial and error be used when selecting an AUDIOENV setting to fix a customer audio quality issue. Rather, the intent is for the engineer/technician to isolate the audio impairment and select an AUDIOENV value that has a variable setting designed to address that audio impairment and improve the performance of the phone.

Although the customer can make sidetone adjustments on their own and to their liking, it is highly recommended that AUDIOENV setting adjustments be made only with direction from Avaya Services or the Business Partner technical representative.

MAKING AUDIO QUALITY AFFECTING ADJUSTMENTS

When making AUDIOENV adjustments, always start with the AGC setting as the baseline adjustment with default settings for the handset noise reduction, headset noise reduction, and TX gain. The AGC baseline settings are shaded in Table 4.

[14] Note that R2.6 setting 0 (3 steps above nominal) has no corresponding match in R2.810 since this was deemed too loud.

For example, an AUDIOENV setting of 0 (zero) is the default setting for all audio parameters. If an AGC of +/- 12dB is required (with default settings for the other variables), an AUDIOENV setting of 27 would be used. If the customer problem at that point involved ambient noise being transmitted to the far-end by a handset, the AUDIOENV setting would then change to 36 (this value only changes the handset noise reduction setting while keeping the AGC setting of +/- 12dB). If the far end party can still hear noise, then change AUDIOENV to 45 which provides even greater handset noise suppression. In order to obtain the maximum amount of handset noise suppression (and still maintain an AGC setting of +/- 12dB), an AUDIOENV setting of 243 would be required.

Use this systematic approach when modifying AUDIOENV values to fix specific customer audio issues. Again, only adjust what is necessary, and always start with the lowest variable value setting (noisy office before very noisy office or +/- 9dB before +/- 12dB, etc.).

Table 2. History of AUDIOENV Noise Reduction Variable Value Changes

Environment Setting	Amount of Noise Suppression by Release		
	R2.4 & R2.6	R2.7 & R2.8	R2.810
Typical office	- 6dB	- 8dB	- 6dB
Noisy office	- 9dB	- 16dB	- 15dB
Very noisy office	- 12dB	- 24dB	- 24dB
No noise reduction	n/a	n/a	Noise reduction off
Excessive noise	n/a	n/a	- 48dB

Table 3. AUDIOENV Variable Settings

Variable	Effect of Each Variable Value Setting				
	0	1	2	3	4
AGC_Dyn_Range	+/- 9dB	+/- 12dB	+/- 15dB	+/- 18dB	n/a
NR_Thresh_HS	Typical office	Noisy office	Very noisy office	No Noise reduction	Excessive Noise
NR_Thresh_HD	Typical office	Noisy office	Very noisy office	No Noise reduction	Excessive Noise
Tx_Gain_HD	0dB gain	+6dB gain	-6dB gain	n/a	n/a

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
0	+/- 9dB	Typical office	Typical office	0dB gain
1	+/- 9dB	Typical office	Typical office	+6dB gain
2	+/- 9dB	Typical office	Typical office	-6dB gain
3	+/- 9dB	Typical office	Noisy office	0dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
4	+/- 9dB	Typical office	Noisy office	+6dB gain
5	+/- 9dB	Typical office	Noisy office	-6dB gain
6	+/- 9dB	Typical office	Very noisy office	0dB gain
7	+/- 9dB	Typical office	Very noisy office	+6dB gain
8	+/- 9dB	Typical office	Very noisy office	-6dB gain
9	+/- 9dB	Noisy office	Typical office	0dB gain
10	+/- 9dB	Noisy office	Typical office	+6dB gain
11	+/- 9dB	Noisy office	Typical office	-6dB gain
12	+/- 9dB	Noisy office	Noisy office	0dB gain
13	+/- 9dB	Noisy office	Noisy office	+6dB gain
14	+/- 9dB	Noisy office	Noisy office	-6dB gain
15	+/- 9dB	Noisy office	Very noisy office	0dB gain
16	+/- 9dB	Noisy office	Very noisy office	+6dB gain
17	+/- 9dB	Noisy office	Very noisy office	-6dB gain
18	+/- 9dB	Very noisy office	Typical office	0dB gain
19	+/- 9dB	Very noisy office	Typical office	+6dB gain
20	+/- 9dB	Very noisy office	Typical office	-6dB gain
21	+/- 9dB	Very noisy office	Noisy office	0dB gain
22	+/- 9dB	Very noisy office	Noisy office	+6dB gain
23	+/- 9dB	Very noisy office	Noisy office	-6dB gain
24	+/- 9dB	Very noisy office	Very noisy office	0dB gain
25	+/- 9dB	Very noisy office	Very noisy office	+6dB gain
26	+/- 9dB	Very noisy office	Very noisy office	-6dB gain
27	+/- 12dB	Typical office	Typical office	0dB gain
28	+/- 12dB	Typical office	Typical office	+6dB gain
29	+/- 12dB	Typical office	Typical office	-6dB gain
30	+/- 12dB	Typical office	Noisy office	0dB gain
31	+/- 12dB	Typical office	Noisy office	+6dB gain
32	+/- 12dB	Typical office	Noisy office	-6dB gain
33	+/- 12dB	Typical office	Very noisy office	0dB gain
34	+/- 12dB	Typical office	Very noisy office	+6dB gain
35	+/- 12dB	Typical office	Very noisy office	-6dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
36	+/- 12dB	Noisy office	Typical office	0dB gain
37	+/- 12dB	Noisy office	Typical office	+6dB gain
38	+/- 12dB	Noisy office	Typical office	-6dB gain
39	+/- 12dB	Noisy office	Noisy office	0dB gain
40	+/- 12dB	Noisy office	Noisy office	+6dB gain
41	+/- 12dB	Noisy office	Noisy office	-6dB gain
42	+/- 12dB	Noisy office	Very noisy office	0dB gain
43	+/- 12dB	Noisy office	Very noisy office	+6dB gain
44	+/- 12dB	Noisy office	Very noisy office	-6dB gain
45	+/- 12dB	Very noisy office	Typical office	0dB gain
46	+/- 12dB	Very noisy office	Typical office	+6dB gain
47	+/- 12dB	Very noisy office	Typical office	-6dB gain
48	+/- 12dB	Very noisy office	Noisy office	0dB gain
49	+/- 12dB	Very noisy office	Noisy office	+6dB gain
50	+/- 12dB	Very noisy office	Noisy office	-6dB gain
51	+/- 12dB	Very noisy office	Very noisy office	0dB gain
52	+/- 12dB	Very noisy office	Very noisy office	+6dB gain
53	+/- 12dB	Very noisy office	Very noisy office	-6dB gain
54	+/- 15dB	Typical office	Typical office	0dB gain
55	+/- 15dB	Typical office	Typical office	+6dB gain
56	+/- 15dB	Typical office	Typical office	-6dB gain
57	+/- 15dB	Typical office	Noisy office	0dB gain
58	+/- 15dB	Typical office	Noisy office	+6dB gain
59	+/- 15dB	Typical office	Noisy office	-6dB gain
60	+/- 15dB	Typical office	Very noisy office	0dB gain
61	+/- 15dB	Typical office	Very noisy office	+6dB gain
62	+/- 15dB	Typical office	Very noisy office	-6dB gain
63	+/- 15dB	Noisy office	Typical office	0dB gain
64	+/- 15dB	Noisy office	Typical office	+6dB gain
65	+/- 15dB	Noisy office	Typical office	-6dB gain
66	+/- 15dB	Noisy office	Noisy office	0dB gain
67	+/- 15dB	Noisy office	Noisy office	+6dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
68	+/- 15dB	Noisy office	Noisy office	-6dB gain
69	+/- 15dB	Noisy office	Very noisy office	0dB gain
70	+/- 15dB	Noisy office	Very noisy office	+6dB gain
71	+/- 15dB	Noisy office	Very noisy office	-6dB gain
72	+/- 15dB	Very noisy office	Typical office	0dB gain
73	+/- 15dB	Very noisy office	Typical office	+6dB gain
74	+/- 15dB	Very noisy office	Typical office	-6dB gain
75	+/- 15dB	Very noisy office	Noisy office	0dB gain
76	+/- 15dB	Very noisy office	Noisy office	+6dB gain
77	+/- 15dB	Very noisy office	Noisy office	-6dB gain
78	+/- 15dB	Very noisy office	Very noisy office	0dB gain
79	+/- 15dB	Very noisy office	Very noisy office	+6dB gain
80	+/- 15dB	Very noisy office	Very noisy office	-6dB gain
81	+/- 18dB	Typical office	Typical office	0dB gain
82	+/- 18dB	Typical office	Typical office	+6dB gain
83	+/- 18dB	Typical office	Typical office	-6dB gain
84	+/- 18dB	Typical office	Noisy office	0dB gain
85	+/- 18dB	Typical office	Noisy office	+6dB gain
86	+/- 18dB	Typical office	Noisy office	-6dB gain
87	+/- 18dB	Typical office	Very noisy office	0dB gain
88	+/- 18dB	Typical office	Very noisy office	+6dB gain
89	+/- 18dB	Typical office	Very noisy office	-6dB gain
90	+/- 18dB	Noisy office	Typical office	0dB gain
91	+/- 18dB	Noisy office	Typical office	+6dB gain
92	+/- 18dB	Noisy office	Typical office	-6dB gain
93	+/- 18dB	Noisy office	Noisy office	0dB gain
94	+/- 18dB	Noisy office	Noisy office	+6dB gain
95	+/- 18dB	Noisy office	Noisy office	-6dB gain
96	+/- 18dB	Noisy office	Very noisy office	0dB gain
97	+/- 18dB	Noisy office	Very noisy office	+6dB gain
98	+/- 18dB	Noisy office	Very noisy office	-6dB gain
99	+/- 18dB	Very noisy office	Typical office	0dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
100	+/- 18dB	Very noisy office	Typical office	+6dB gain
101	+/- 18dB	Very noisy office	Typical office	-6dB gain
102	+/- 18dB	Very noisy office	Noisy office	0dB gain
103	+/- 18dB	Very noisy office	Noisy office	+6dB gain
104	+/- 18dB	Very noisy office	Noisy office	-6dB gain
105	+/- 18dB	Very noisy office	Very noisy office	0dB gain
106	+/- 18dB	Very noisy office	Very noisy office	+6dB gain
107	+/- 18dB	Very noisy office	Very noisy office	-6dB gain
108	+/- 9dB	No Noise reduction	No Noise reduction	0dB gain
109	+/- 9dB	No Noise reduction	No Noise reduction	+6dB gain
110	+/- 9dB	No Noise reduction	No Noise reduction	-6dB gain
111	+/- 12dB	No Noise reduction	No Noise reduction	0dB gain
112	+/- 12dB	No Noise reduction	No Noise reduction	+6dB gain
113	+/- 12dB	No Noise reduction	No Noise reduction	-6dB gain
114	+/- 15dB	No Noise reduction	No Noise reduction	0dB gain
115	+/- 15dB	No Noise reduction	No Noise reduction	+6dB gain
116	+/- 15dB	No Noise reduction	No Noise reduction	-6dB gain
117	+/- 18dB	No Noise reduction	No Noise reduction	0dB gain
118	+/- 18dB	No Noise reduction	No Noise reduction	+6dB gain
119	+/- 18dB	No Noise reduction	No Noise reduction	-6dB gain
120	+/- 9dB	No Noise reduction	Very noisy office	0dB gain
121	+/- 9dB	No Noise reduction	Very noisy office	+6dB gain
122	+/- 9dB	No Noise reduction	Very noisy office	-6dB gain
123	+/- 12dB	No Noise reduction	Very noisy office	0dB gain
124	+/- 12dB	No Noise reduction	Very noisy office	+6dB gain
125	+/- 12dB	No Noise reduction	Very noisy office	-6dB gain
126	+/- 15dB	No Noise reduction	Very noisy office	0dB gain
127	+/- 15dB	No Noise reduction	Very noisy office	+6dB gain
128	+/- 15dB	No Noise reduction	Very noisy office	-6dB gain
129	+/- 18dB	No Noise reduction	Very noisy office	0dB gain
130	+/- 18dB	No Noise reduction	Very noisy office	+6dB gain
131	+/- 18dB	No Noise reduction	Very noisy office	-6dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
132	+/- 9dB	No Noise reduction	Noisy office	0dB gain
133	+/- 9dB	No Noise reduction	Noisy office	+6dB gain
134	+/- 9dB	No Noise reduction	Noisy office	-6dB gain
135	+/- 12dB	No Noise reduction	Noisy office	0dB gain
136	+/- 12dB	No Noise reduction	Noisy office	+6dB gain
137	+/- 12dB	No Noise reduction	Noisy office	-6dB gain
138	+/- 15dB	No Noise reduction	Noisy office	0dB gain
139	+/- 15dB	No Noise reduction	Noisy office	+6dB gain
140	+/- 15dB	No Noise reduction	Noisy office	-6dB gain
141	+/- 18dB	No Noise reduction	Noisy office	0dB gain
142	+/- 18dB	No Noise reduction	Noisy office	+6dB gain
143	+/- 18dB	No Noise reduction	Noisy office	-6dB gain
144	+/- 9dB	No Noise reduction	Typical office	0dB gain
145	+/- 9dB	No Noise reduction	Typical office	+6dB gain
146	+/- 9dB	No Noise reduction	Typical office	-6dB gain
147	+/- 12dB	No Noise reduction	Typical office	0dB gain
148	+/- 12dB	No Noise reduction	Typical office	+6dB gain
149	+/- 12dB	No Noise reduction	Typical office	-6dB gain
150	+/- 15dB	No Noise reduction	Typical office	0dB gain
151	+/- 15dB	No Noise reduction	Typical office	+6dB gain
152	+/- 15dB	No Noise reduction	Typical office	-6dB gain
153	+/- 18dB	No Noise reduction	Typical office	0dB gain
154	+/- 18dB	No Noise reduction	Typical office	+6dB gain
155	+/- 18dB	No Noise reduction	Typical office	-6dB gain
156	+/- 9dB	Very noisy office	No Noise reduction	0dB gain
157	+/- 9dB	Very noisy office	No Noise reduction	+6dB gain
158	+/- 9dB	Very noisy office	No Noise reduction	-6dB gain
159	+/- 12dB	Very noisy office	No Noise reduction	0dB gain
160	+/- 12dB	Very noisy office	No Noise reduction	+6dB gain
161	+/- 12dB	Very noisy office	No Noise reduction	-6dB gain
162	+/- 15dB	Very noisy office	No Noise reduction	0dB gain
163	+/- 15dB	Very noisy office	No Noise reduction	+6dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
164	+/- 15dB	Very noisy office	No Noise reduction	-6dB gain
165	+/- 18dB	Very noisy office	No Noise reduction	0dB gain
166	+/- 18dB	Very noisy office	No Noise reduction	+6dB gain
167	+/- 18dB	Very noisy office	No Noise reduction	-6dB gain
168	+/- 9dB	Noisy office	No Noise reduction	0dB gain
169	+/- 9dB	Noisy office	No Noise reduction	+6dB gain
170	+/- 9dB	Noisy office	No Noise reduction	-6dB gain
171	+/- 12dB	Noisy office	No Noise reduction	0dB gain
172	+/- 12dB	Noisy office	No Noise reduction	+6dB gain
173	+/- 12dB	Noisy office	No Noise reduction	-6dB gain
174	+/- 15dB	Noisy office	No Noise reduction	0dB gain
175	+/- 15dB	Noisy office	No Noise reduction	+6dB gain
176	+/- 15dB	Noisy office	No Noise reduction	-6dB gain
177	+/- 18dB	Noisy office	No Noise reduction	0dB gain
178	+/- 18dB	Noisy office	No Noise reduction	+6dB gain
179	+/- 18dB	Noisy office	No Noise reduction	-6dB gain
180	+/- 9dB	Typical office	No Noise reduction	0dB gain
181	+/- 9dB	Typical office	No Noise reduction	+6dB gain
182	+/- 9dB	Typical office	No Noise reduction	-6dB gain
183	+/- 12dB	Typical office	No Noise reduction	0dB gain
184	+/- 12dB	Typical office	No Noise reduction	+6dB gain
185	+/- 12dB	Typical office	No Noise reduction	-6dB gain
186	+/- 15dB	Typical office	No Noise reduction	0dB gain
187	+/- 15dB	Typical office	No Noise reduction	+6dB gain
188	+/- 15dB	Typical office	No Noise reduction	-6dB gain
189	+/- 18dB	Typical office	No Noise reduction	0dB gain
190	+/- 18dB	Typical office	No Noise reduction	+6dB gain
191	+/- 18dB	Typical office	No Noise reduction	-6dB gain
192	+/- 9dB	Excessive noise	Excessive noise	0dB gain
193	+/- 9dB	Excessive noise	Excessive noise	+6dB gain
194	+/- 9dB	Excessive noise	Excessive noise	-6dB gain
195	+/- 12dB	Excessive noise	Excessive noise	0dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
196	+/- 12dB	Excessive noise	Excessive noise	+6dB gain
197	+/- 12dB	Excessive noise	Excessive noise	-6dB gain
198	+/- 15dB	Excessive noise	Excessive noise	0dB gain
199	+/- 15dB	Excessive noise	Excessive noise	+6dB gain
200	+/- 15dB	Excessive noise	Excessive noise	-6dB gain
201	+/- 18dB	Excessive noise	Excessive noise	0dB gain
202	+/- 18dB	Excessive noise	Excessive noise	+6dB gain
203	+/- 18dB	Excessive noise	Excessive noise	-6dB gain
204	+/- 9dB	Excessive noise	No Noise reduction	0dB gain
205	+/- 9dB	Excessive noise	No Noise reduction	+6dB gain
206	+/- 9dB	Excessive noise	No Noise reduction	-6dB gain
207	+/- 12dB	Excessive noise	No Noise reduction	0dB gain
208	+/- 12dB	Excessive noise	No Noise reduction	+6dB gain
209	+/- 12dB	Excessive noise	No Noise reduction	-6dB gain
210	+/- 15dB	Excessive noise	No Noise reduction	0dB gain
211	+/- 15dB	Excessive noise	No Noise reduction	+6dB gain
212	+/- 15dB	Excessive noise	No Noise reduction	-6dB gain
213	+/- 18dB	Excessive noise	No Noise reduction	0dB gain
214	+/- 18dB	Excessive noise	No Noise reduction	+6dB gain
215	+/- 18dB	Excessive noise	No Noise reduction	-6dB gain
216	+/- 9dB	Excessive noise	Very noisy office	0dB gain
217	+/- 9dB	Excessive noise	Very noisy office	+6dB gain
218	+/- 9dB	Excessive noise	Very noisy office	-6dB gain
219	+/- 12dB	Excessive noise	Very noisy office	0dB gain
220	+/- 12dB	Excessive noise	Very noisy office	+6dB gain
221	+/- 12dB	Excessive noise	Very noisy office	-6dB gain
222	+/- 15dB	Excessive noise	Very noisy office	0dB gain
223	+/- 15dB	Excessive noise	Very noisy office	+6dB gain
224	+/- 15dB	Excessive noise	Very noisy office	-6dB gain
225	+/- 18dB	Excessive noise	Very noisy office	0dB gain
226	+/- 18dB	Excessive noise	Very noisy office	+6dB gain
227	+/- 18dB	Excessive noise	Very noisy office	-6dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
228	+/- 9dB	Excessive noise	Noisy office	0dB gain
229	+/- 9dB	Excessive noise	Noisy office	+6dB gain
230	+/- 9dB	Excessive noise	Noisy office	-6dB gain
231	+/- 12dB	Excessive noise	Noisy office	0dB gain
232	+/- 12dB	Excessive noise	Noisy office	+6dB gain
233	+/- 12dB	Excessive noise	Noisy office	-6dB gain
234	+/- 15dB	Excessive noise	Noisy office	0dB gain
235	+/- 15dB	Excessive noise	Noisy office	+6dB gain
236	+/- 15dB	Excessive noise	Noisy office	-6dB gain
237	+/- 18dB	Excessive noise	Noisy office	0dB gain
238	+/- 18dB	Excessive noise	Noisy office	+6dB gain
239	+/- 18dB	Excessive noise	Noisy office	-6dB gain
240	+/- 9dB	Excessive noise	Typical office	0dB gain
241	+/- 9dB	Excessive noise	Typical office	+6dB gain
242	+/- 9dB	Excessive noise	Typical office	-6dB gain
243	+/- 12dB	Excessive noise	Typical office	0dB gain
244	+/- 12dB	Excessive noise	Typical office	+6dB gain
245	+/- 12dB	Excessive noise	Typical office	-6dB gain
246	+/- 15dB	Excessive noise	Typical office	0dB gain
247	+/- 15dB	Excessive noise	Typical office	+6dB gain
248	+/- 15dB	Excessive noise	Typical office	-6dB gain
249	+/- 18dB	Excessive noise	Typical office	0dB gain
250	+/- 18dB	Excessive noise	Typical office	+6dB gain
251	+/- 18dB	Excessive noise	Typical office	-6dB gain
252	+/- 9dB	No Noise reduction	Excessive noise	0dB gain
253	+/- 9dB	No Noise reduction	Excessive noise	+6dB gain
254	+/- 9dB	No Noise reduction	Excessive noise	-6dB gain
255	+/- 12dB	No Noise reduction	Excessive noise	0dB gain
256	+/- 12dB	No Noise reduction	Excessive noise	+6dB gain
257	+/- 12dB	No Noise reduction	Excessive noise	-6dB gain
258	+/- 15dB	No Noise reduction	Excessive noise	0dB gain
259	+/- 15dB	No Noise reduction	Excessive noise	+6dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
260	+/- 15dB	No Noise reduction	Excessive noise	-6dB gain
261	+/- 18dB	No Noise reduction	Excessive noise	0dB gain
262	+/- 18dB	No Noise reduction	Excessive noise	+6dB gain
263	+/- 18dB	No Noise reduction	Excessive noise	-6dB gain
264	+/- 9dB	Very noisy office	Excessive noise	0dB gain
265	+/- 9dB	Very noisy office	Excessive noise	+6dB gain
266	+/- 9dB	Very noisy office	Excessive noise	-6dB gain
267	+/- 12dB	Very noisy office	Excessive noise	0dB gain
268	+/- 12dB	Very noisy office	Excessive noise	+6dB gain
269	+/- 12dB	Very noisy office	Excessive noise	-6dB gain
270	+/- 15dB	Very noisy office	Excessive noise	0dB gain
271	+/- 15dB	Very noisy office	Excessive noise	+6dB gain
272	+/- 15dB	Very noisy office	Excessive noise	-6dB gain
273	+/- 18dB	Very noisy office	Excessive noise	0dB gain
274	+/- 18dB	Very noisy office	Excessive noise	+6dB gain
275	+/- 18dB	Very noisy office	Excessive noise	-6dB gain
276	+/- 9dB	Noisy office	Excessive noise	0dB gain
277	+/- 9dB	Noisy office	Excessive noise	+6dB gain
278	+/- 9dB	Noisy office	Excessive noise	-6dB gain
279	+/- 12dB	Noisy office	Excessive noise	0dB gain
280	+/- 12dB	Noisy office	Excessive noise	+6dB gain
281	+/- 12dB	Noisy office	Excessive noise	-6dB gain
282	+/- 15dB	Noisy office	Excessive noise	0dB gain
283	+/- 15dB	Noisy office	Excessive noise	+6dB gain
284	+/- 15dB	Noisy office	Excessive noise	-6dB gain
285	+/- 18dB	Noisy office	Excessive noise	0dB gain
286	+/- 18dB	Noisy office	Excessive noise	+6dB gain
287	+/- 18dB	Noisy office	Excessive noise	-6dB gain
288	+/- 9dB	Typical office	Excessive noise	0dB gain
289	+/- 9dB	Typical office	Excessive noise	+6dB gain
290	+/- 9dB	Typical office	Excessive noise	-6dB gain
291	+/- 12dB	Typical office	Excessive noise	0dB gain

Table 4. AUDIOENV Matrix

(Note: For AUDIOENV changes to take effect, they must be made prior to boot-up of the phone)

AUDIOENV	AGC_Dyn_Range	NR_Thresh_HS	NR_Thresh_HD	HD_Tx_Gain
292	+/- 12dB	Typical office	Excessive noise	+6dB gain
293	+/- 12dB	Typical office	Excessive noise	-6dB gain
294	+/- 15dB	Typical office	Excessive noise	0dB gain
295	+/- 15dB	Typical office	Excessive noise	+6dB gain
296	+/- 15dB	Typical office	Excessive noise	-6dB gain
297	+/- 18dB	Typical office	Excessive noise	0dB gain
298	+/- 18dB	Typical office	Excessive noise	+6dB gain
299	+/- 18dB	Typical office	Excessive noise	-6dB gain

APPENDIX B: QUICK START AUDIO PARAMETER SETTINGS

THE QUICK START TABLE

The table below provides settings that have successfully been used at customer sites to correct audio quality complaints. Note that these settings are applicable only to a customer with a current AUDIOENV setting of zero (default). See Appendix A for customers who have a setting other than zero (default) in order to use the matrix to locate the correct AUDIOENV setting.

Match the symptom in the table with the customer environment/complaint and make the **First** adjustment provided. If the problem still exists after testing the audio parameter change, try the **Second** and then **Third** column setting. If the settings do not correct the customer complaint, or if unsure of what adjustments to make, it is highly recommended that you contact SSE Endpoints for direction.

Table 5. Variable Settings for Specific Customer Issues

Symptom	Parameter	Recommended Settings		
		First	Second	Third
Quiet Environment: user hears static, or an intermittent noise that sounds like cracking on the line (**Note 1**)	AUDIOENV	0	Disable AGC on Phone	n/a
Noisy Environment (headset user): background noise or unwanted speech (as in a call center) heard by the far-end (**Note 2**)	AUDIOENV	6 (8)	288 (290)	n/a
Noisy Environment (handset user): ambient noise being transmitted from handset users to far-end	AUDIOENV	18	240	n/a
Low level receive audio on PSTN calls: this setting increases the AGC dynamic range so that lower level signals are boosted	AUDIOENV	27	54	81
Loud Sidetone (handset user): user hears too much of their own voice and/or ambient noise in handset receiver	AUDIOSTHS	3	4	1
Loud Sidetone (headset user): user hears too much of their own voice and/or ambient noise in headset receiver (**Note 3**)	AUDIOENV	6	288	n/a
	AUDIOSTHD	3	4	1

NOTES:

1. If AGC dynamic range of +/- 9dB does not fix problem, disable AGC on the headset, handset, and/or speakerphone - depending on what telephone mode of communication is used.
2. Number in parenthesis decreases handset transmit by 6dB which can help decrease the transmitted noise or nearby speech; but will also reduce the headset user's voice – possibly causing far-end complaints that they can't hear the headset user. So take note of this when using the setting in parenthesis.
3. See Table 1 in Appendix A for additional sidetone settings

APPENDIX C: SOUND LEVEL MEASUREMENTS

SOUND/NOISE:

Our ability to hear sound is different at different frequencies. Because of this, we do not perceive sound equally for the same level at one frequency as we do for another frequency and so sound/noise at the lower and higher frequencies is not as annoying as those at the middle frequencies. In order to measure room noise so that all the frequencies are equal, a sound level meter with the ability to correct for all frequencies is needed. Such a correction when performed is known as **A-weighting**. When a signal is measured with A-weighting, the units are in db(A) or dBA. See COMMON ENVIRONMENTAL SOUND LEVELS below.

MEASURING EQUIPMENT:

- Radio Shack Sound Level Meter (SLM) - Model 33-2055 - or sound level meter with the following functions:
    - A-Weighting, C-Weighting
    - Integrate measurements over time with Minimum, Average, and Maximum level measurement capability
    - dB range of 50 to 120

TYPES OF MEASUREMENTS:

There are two types of measurements: those averaged over short period and those averaged over longer periods. The short averaged measurement is typically used for measuring short-term noise that can affect speakerphone operation. Longer-term measurements are for call centers as the noise effect is cumulative on agents. See below on how to make the two types of measurements.

- **Call center** – noise heard in headset or by far-end. If unfamiliar with any part of the test setup, read the User Guide[15] provided with the SLM.
    - Setup:
        1. Set the Weighting to “A” and the “RESPONSE” to “Fast”.
        2. Set the meter range so that the signal level bars are close to the “0” at the bottom of the display.
        3. Press and hold the “DH” button until the number “1” appears. Press the “MAX” button until the number “20” is displayed.
        4. Place the meter on a chair or table in the room of interest (call center, office, etc.), making sure the meter is not near a ringing phone or other noise source that would bias the measurement.
    - Test:
        1. Perform this test during normal working hours and preferably, when the noise complaints are highest. Take at least two measurements during the course of the day: mid-morning and mid-afternoon.
        2. Press the “RESET” button to start the test. When the test is complete, the “DH” button will re-appear.
        3. The average noise level is displayed when both “MIN” and “MAX” are flashing.
        4. Press the “MAX” button to view the maximum noise measured during the 20-second period.
        5. Press the “MIN” button to view the minimum noise measured during the 20-second period.
        6. Press the “RESET” button to clear the results and start a new test.

[15] http://rsk.imageg.net/graphics/uc/rsk/Support/ProductManuals/3302055_PM_EN.pdf

- **Speakerphone** - complaints (local noise affecting speakerphone operation). If unfamiliar with any part of the test setup, read the User Guide[16] provided with the SLM.

    - Setup:
        1. Set the Weighting to “A” and the “RESPONSE” to “Fast”.
        2. Set meter range so that the signal level bars are close to the “0” at the bottom of the display.
    - Test:
        1. Place the meter within a few inches of the speakerphone’s microphone (usually located in the front-right corner of the speakerphone as you face it in normal fashion).Make sure no one is talking as speech will bias the measurement. Perform the test during normal working hours and preferably, when the noise complaints are highest.
        2. Press the “DH” button for approximately one second (until “DH” appears on the display). This will measure the average, minimum and maximum sound level over a 1-second period. See Call Center (above) for making measurements over longer periods.
        3. Average noise level is displayed after one second.
        4. Press the “MAX” button to view the maximum noise measured during the 1-second period.
        5. Press the “MIN” button to view the minimum noise measured during the 1-second period.
        6. Press the “RESET” button to clear the results.

COMMON ENVIRONMENTAL SOUND LEVELS:

The table below is only provided as a general guideline to sound levels and environments.

Environment	Cross-over Thresholds in dB(A)
Very Quiet Office	30 - 40
Quiet Office	40 - 50
Normal Office	50 - 55
Noisy Office	60 - 65
Very Noisy Office	70 - 75

[16] http://rsk.imageg.net/graphics/uc/rsk/Support/ProductManuals/3302055_PM_EN.pdf