Recording a Folk Rock Record:
Using Acoustic Reverb Chambers in Post-Production

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Thesis Credits:

Areti Andreopoulou and Jess Rowland – Matlab code
Lisa Martin – Editing

Sound Recording Liner Notes:

Produced, Recorded, and Mixed by Amos A. and Senem Pirler
All Songs written by Sandra Covin
All music arranged by Sandra Covin, Amos A. and Senem Pirler

Band:
Sandy Covin: Vocals, Acoustic Guitar, Banjo, Electric Guitars
Ian Cook: Drums, Percussion
Amos A.: Basses, Background Vocals
Senem Pirler: Piano, Rhodes

Auxiliary Musicians:
Jess Rowland: Piano
Sarah Starpoli: Accordion
Backing Vocals on *Challenger*: Joshua Guthals, Andrew Madden, Alex Marse, Abra Smith, Viva DeConcini

Technical Support: Brian Bourk, Crystal Kim, Peter MacDuffie, Vivian Stoll

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To listen to the music from this project, please visit: www.otcprod.com

INTRODUCTION

Today, with so many technologies available for creating ambience in recorded music productions, an artist must know which of these technologies to use in order to create the most aesthetically rich, coherent, and impactful work. For this project, state-of-the-art technology was available to the production team, Senem Pirler and myself, including a multitude of convenient high-end audio plug-ins for reverberation. However, due to my curiosity about using room ambience, as well as my assessment of the project's aesthetic needs, the use of acoustic reverb chambers as a primary means of attaining reverberation, was decided upon.

The recorded production part of this thesis is made up of a collection of original folk rock songs. I use the terms "folk" and "rock" in ways that is not genre related; it does not sound like a Bob Dylan or Joni Mitchell record from the 1960s. I look at the terms "folk" and "rock" separately, and from a unique perspective.

This recording is folk in spirit, in that it was made collaboratively by a group of musicians who are close friends, and wanted to make music purely for the love of making music together. It is also folk in that almost every musical influence on the recording evolved from American folk music, specifically, the type that emerged from the blending of the English and African musical traditions. Also, the minimal production approach inherent in the early recordings of folk music, due to the technological capabilities of the recording equipment at the time, was used as an aesthetic in our recorded production, to dramatically contrast some of the slick modern rock production techniques that were also used.

The rock aspect of this project exists within some of its sonic characteristics as well as in the spirit in which this project was made. For example, some of the production techniques used, as well as instrumentation, and overall aesthetic, are derived from many genres of rock. The attitude with which many of the songs were performed, may also be described as "rock".

The primary objective was to produce this recording using an overall minimalist production style, which was customary to part of the general folk philosophy. First, this meant, focusing on capturing stellar performances in the most natural way possible. Further, we had to be mindful about what tools to use for creating the ecumenical sound of the record. Therefore, the technology employed in every step of the production needed to be chosen properly in order to preserve the natural, intimate quality of the music. Because there were some great sounding rooms in proximity that could be used as reverb chambers, it was decided that they would be employed in the way they had been in the great sounding recordings of the 1960s.

Months before the project began, I had been reading about the use of reverb chambers in the New York City recording studios of the 1960s. I was familiar with the sound of many of the records made in that era, and was very interested in experimenting with using reverb chambers as they had been used on those recordings. The methods seemed both intriguing and challenging. And, considering the project at hand, it seemed the most appropriate artistic choice in attaining ambience.

In the early folk recordings, though the primary concern was on capturing performance, ambience was a production consideration as well, and, it was attained by using real spaces. This further supported the concept of this project, by connecting folk production techniques to our explorations with using real rooms for ambience. Upon further research, I discovered that many producers of modern-day recordings preferred using real room reverb over the virtual models. This was enough to pique my curiosity even more about the art of using reverb chambers as musical tools in recorded productions.

In this project, two reverb chambers were used in post-production: one for background vocals and one for overhead drums. In capturing ambience by using real spaces, we further preserved the folk essence in our production. Also, the long reverb times, and dense reverberant fields that the chambers produced, provided a stark contrast to our austere folk influenced production approach; therefore providing the contrast that is required for an interesting recording.

The rooms were auditioned by ear to determine which instruments would be used in them for post-production. After room analysis and post-production, the properties of the reverb chambers were then compared to the desired sonic characteristics of the reverb effect, which would be used to facilitate the artistic expression.

The scientific findings regarding reverb time in each chamber were surprising, in that the larger space had the shorter reverb time. This was due to the unpredictable effects of room modes in small spaces. Other surprising discoveries were our artistic choices of microphone arrays. With background vocals, I would have thought that brightness was of paramount importance; it was not. Depth and width was a more valued aesthetic trait for that instrument. For drums, I was regretful about our array choices, after mixing was finished. Upon revisiting the arrays, I concluded that the spaced pair would have actually been a better choice, over the 3D array that was selected.

In this paper, the genre of American folk music, and the technology that was used to record it is reviewed. I felt it appropriate to review this genre, for my historical section; because it is a somewhat clearly definable focal point from which the majority of musical influences on this recording project stem. The history of how reverberation was employed in spaces for artistic impact is discussed. The use of various types of reverb chambers in audio production is also discussed. Testing methods to determine

reverb characteristics in rooms are explained, as well as what reverberation is. Then the production of this project is outlined, with regard to microphone techniques used, and my philosophies on production process are articulated. Finally an in-depth discussion about the mixing procedures for one of the songs is provided, as well as a full musical analysis and a Moylan sound-recording analysis.

HISTORICAL CONTEXT

Two of the many musical influences on American folk music come from English and African musical traditions (Ledgin, 2010). The merging of these two musical cultures in 17th century America and its impact on American folk music, will be the main focus of the historical section of this paper. Many of the influences on the music that was recorded for this thesis, such as blues, jazz, country, etc, are descendents of the type of American folk music that evolved from the blending of English and African musical traditions (Lornell, 2002).

Defining Folk Music

Some say folk music is rural peasant music; many think folk songs, or the style in which a song is composed, must be old in order for it to be considered folk. Other scholarly descriptions of folk music are as follows: It is culturally conservative, and is transmitted orally. It is composed within an identifiable community, expressing the nature of the group (Bruno, 1976). Folk tunes are often anonymous in authorship, and are learned in an informal setting. Mostly, folk musicians do not make a living playing their music. The music can be complex, but the traditional forms and progressions are often simple (Ledgin, 2010). Folk music evolves over time because of assimilation into the dominant culture, and musical interpretation (Lornell, 2002).

Folk Music in Society

Often folk music accompanies specific social activities. For example, it is present in home entertainment, church services, social functions, and in work situations (Lornell, 2002). In societies where folk music is preserved as a pure folk practice, it is never formalized, nor practiced as a profession (Bruno, 1976). Also, most of the people in these communities participate in the music making. In America, however, the distinctions between pure folk and professional popular music are blurry. Since the beginning of folk's assimilation into mainstream American culture, music that may have started as pure folk, gradually moves into the popular and professional domain. Regardless of the context within which it exists, the essential quality of folk music is that it is constantly changing, evolving, and being reinterpreted (Bruno, 1976).

Folk Sound

Folk music has distinctive sonic traits. Singing predominates in folk societies; rhythmic form is related to the rhythm of the text (Ledgin, 2010). Forms are simple and repetitive; however, asymmetric forms and irregular tempos are often found, such as in early blues, where the number of bars of a tune varied each time the musician played it; and the tempo purposely fluctuated (ABM Records, 1999). Pentatonic scales are common, and there is usually a tonic resolution at the end of the song (Bruno, 1976). Ornamental tones are also common. Polyphony, in which one voice predominates and the other instruments are supportive, is common, as in the early guitar blues of the Deep South. Also, folk styles and melodic contours are regional (Bruno, 1976).

Folk Instruments

(a) Fife

(b) String Instrument

(c) Mouth Bow

Figure 1. Folk Instrument Examples

Most folk instruments are acoustic, but electric instruments were incorporated in many folk communities starting after WWII. Some examples of folk instruments are accordion, dulcimer, fiddle, fife, harmonica, mandolin, mouth bow, one-string, quills, washboard, and guitar (Bruno, 1976). Musical instruments from all over the world have been incorporated into American folk culture (Lornell, 2002).

American Folk Instruments

The instruments used in American folk music, come from an eclectic mix of many folk cultures. A few examples are: the slide from Hawaii, which greatly influenced the southern American blues slide guitarists (Netil, 1976). European settlers contributed the fiddle, which was their main traditional folk instrument (Malone, 1979). Some American Indian instruments, specifically from the Pueblo population, were integrated into Hispanic American folk cultures in the southwestern United States (Netil, 1976). The banjo was a major contribution by Black African musicians, and was a common instrument among Black slaves in America (Lornell, 2002). The zither is an East Asian instrument which is used in Appalachian folk music (Sakata, 1999).

American Folk Music

Origins

American folk music comes from a mixture of many immigrant populations. It consists of English folk songs, African slave songs (Bruno, 1976), music from Asia (Lee & Nadeau, 2010), Germany, Italy, Greece, Czechoslovakia, Poland, Russia, and Ukraine, as well as the Caribbean and South America (Bruno, 1976). Immigrants who settled in various parts of the country influenced, and were influenced by, the music that was happening around them. Due to the isolation of various segments of the populations, the music varied considerably from region to region (Lornell, 2002).

The British Tradition

Some of the oldest forms of American folk music were imported from Britain. The British ballad was a main musical form; it was transmitted orally, and, early on, was exclusively a solo vocal composition. The ballad is a narrative with dark, tragic subject matter, an impersonal depiction of melodrama, with universal themes. The stories are told dispassionately from an objective perspective (Lornell, 2002). The British ballad had a big influence on early Anglo-American music, and made up a huge part of the American folk music repertoire (Bruno, 1976). The origin of most ballads is unknown; however, poor rural folk musicians played them, re-arranged them, and composed new forms (Malone, 1979).

African Influence

The large number of Africans that were forcibly transplanted to the Americas brought with them their traditional African folk music. African music consists of songs that accompany daily activities and special ceremonies: rites of passage, work songs, etc. (Miller, 2010). In African culture, music is integral to everyday life. Musically, there is syncopation, simple melodic phrases with improvisation, and complex rhythms. Instruments like drums, rattles, xylophones, bells, horns, and plucked strings are used to accompany vocals, which are often sung in call and response style (Bruno, 1976).

Early American Black music came from the slaves' African heritage (Malone, 1979). Despite early legal sanctions against Black culture in America, Black slaves incorporated music into their daily lives in the same ways as their African brothers and sisters (Miller, 2010). Most especially, slaves sang work songs with lyrical themes about love, heroic escape, and protest (Lornell, 2002). Work songs that were

short and repetitive, accompanied almost all forms of laboring, and were sung in unison or call and response. They relieved tension, and provided a rhythm for coordinating the workers (Lornell, 2002). Many of these songs originated in the South (Bruno, 1976). African slave songs influenced the European settlers' English folk music, and vice versa. Due to common characteristics such as diatonacism and polyphony, European and African music merged somewhat easily (Bruno, 1976).

More Immigrant Populations

Immigrants settled in America from all over the world, bringing their music with them. They came from many parts of Europe (Bruno, 1976), Asia (Lee & Nadeau, 2010), Mexico, the Caribbean Islands, Cuba, etc. The folk music from those regions was either assimilated into the dominant American culture, thus influencing American folk music, or it remained isolated and strictly traditional (Bruno, 1976).

In the 20th century, many Western European immigrants settled in parts of rural America, some preserving their religious music. For example, the Amish still practice old German hymns, which no longer exist in Germany, but were preserved by the American Amish (Bruno, 1976). The Germans brought the polka, which was integrated into the Cajun culture of Louisiana. Klezmer music was brought to the U.S. by professional Eastern European musicians (Lornell, 2002). And the French that migrated to New England from Canada brought French folk songs, along with their waltzes and two-steps (Bruno, 1976).

Music from Hispanic immigrants is strongly tied to the music of their homeland (Malone, 1979). For instance, mariachi music entered the U.S. mainstream through the early cowboy films; however, it has retained its original Mexican folk quality with its instruments, outfits, and native Spanish texts. Many Hispanic immigrant musicians migrated to urban environments in the U.S. (Malone, 1979).

Early Folk Genres – *White and Black Folk Cultures*

White Religious Folk Music

Psalmody was the first religious folk music sung in the United States by European settlers. It was an import of the British tradition of Christian congregational singing. Psalmody is the chanting of bible verses from the Psalms of David; it was later replaced by hymnody, the singing of newly composed

hymns (Lornell, 2002). Hymns were religious poems with text that was directed to God. This new form of English folk music continued to evolve, and other forms sprang from it (Filene, 2000).

Shape-note books housed many of these new, more social forms of religious folk songs. Hymns, Southern spirituals, and camp meeting songs were transcribed into the shape-note system (Ledgin, 2010). Since most of the common church folk could not read music, the shape-notation was more basic and less complex than standard music notation, therefore easier to learn. Shape-note texts were published and circulated up until the 1970s, and contained compositions by both Black and White composers (Malone, 1979).

Southern religious music was derived from common sources, such as hymnody, revival hymns, etc. (Ledgin, 2010). Because the white population had more access to the church, they were learning this music more than the black population. Therefore, Black musical influences were slightly different from those in white folk communities. Although Blacks were allowed to be in segregated parts of White churches, their main Christian instruction came from camp meetings (Lornell, 2002).

Camp meetings were large non-segregated religious events that started in the 1800s. They were basically bible camps for both Blacks and Whites. Presbyterians, Methodists, and Baptists would gather together for dramatic evangelical bible lessons. White and Black Southerners would exchange and alter old hymns and write new songs, some of which were published in the shape-note songbooks (Lornell, 2002).

Black Religious Folk Music

Music from the Black church was the main foundation of African-American traditional folk music. The Black spiritual is one of the main compositional forms, and is closely related to the Southern White folk hymns. Often Blacks would take parts of English hymnody and reconstruct them into their own songs they called spirituals. These new creations were banjo and fiddle dance tunes that evolved from the European melodies. Spirituals are the earliest sacred Black folk songs (Netil, 1976).

Spirituals were composed in the English folk-song tradition, using pentatonic scales, with four equal-length phrases, and English folk-song rhythms. However, the personal interpretation by Black singers gave these songs an original sound (Miller, 2010). They were of anonymous authorship, and passed along through oral tradition. They were sung by small groups that supported a leader, with call and response vocal practices (Lornell, 2002). Spirituals are also known as anthems, jubilees, or gospel songs (Lankford, 2005). They have sad and sorrowful texts; however, hope, freedom, and unburdening are also common themes. Many are performed polyphonically, as opposed to the monophonic White

hymns. They are infused with improvisation and heavy syncopation, traits found in the blues, children's songs, ballads and work songs (Bruno, 1976). Later, spirituals became political protest songs (Lankford, 2005).

Pentecostal singing and guitar evangelism began in the Deep South between 1895 and 1905. These musicians claimed to have direct contact with the Holy Spirit, and to be called to music by God. They used dramatic vocals, strings and horn accompaniment, supportive vocal ensembles, collective improvisation, and spontaneity (Charters, 1975).

The first African-American songs that had authorship were gospels, songs of praise that drew from the Black sacred *and* secular experience. Gospel lyrics were New Testament messages aimed at humankind. The themes related to *all* people, and they were simple compositions (Epstein, 1977). Harmonic and melodic structures were deliberately similar to popular tunes. Later, gospel was marketed as popular music and recorded media was disseminated to many. Once this folk genre moved into the popular realm, gospel groups were no longer exclusive to the Church, and toured throughout America and Europe (Lornell, 2002).

Figure 2: blues musician (Yazoo, 2001)

There were several forms of gospel. Gospel quartets sang bible parables, and gave sermons. These groups had lead singers, and the music had percussive syncopated bass (Epstein, 1977). Gospel quartets started in the folk genre, then radio exposure moved them into the popular domain; they began touring professionally. Hard gospel came from early gospel. It had an emotionally powerful lead singer. Both gospel and hard gospel started out acapella, and later added at least one instrument. Hard gospel spanned two genres simultaneously, popular and folk. Though it became commercially viable, people continued to sing it in church and small communities (Lornell, 2002).

The Blues

The folk music of African Americans, the blues, has been around for almost the entire 20th century. Its roots span continents and time. The blues came from the human experiences of African Americans who had endured unimaginable suffering (Miller, 2010). It was developed in a folk setting, and is tied to black folk heritage, both religious and secular. The blues reflects both the personal, as well as the collective American Black folk experience (Malone, 1979). It is a music that blends despair and

hope; it was used as a release; it was a form of self expression and it provided entertainment for listeners (Epstein, 1977).

Within the blues, interesting and original techniques were developed: objects were used on the necks of guitars for slides; polyrhythms were employed, growling vocals were sung; and the music was harmonically ambiguous (Bruno, 1976). Lyrics were in the form of regular speech between the people, and reflected personal misery and despair. The form was flexible; there was much syncopation, and blue notes were introduced (Bruno, 1976). The music was regional and varied in sound (ABM Records, 2002).

Southern folk culture of the early 20th century, which consisted of poor blacks and whites with a highly complex and volatile relationship, produced the blues; and since the Civil War in the South, the blues had been brewing (Seeger & Horowitz, 1996). The blues developed in east Texas and the Mississippi Delta during the early 1900s. There were various regional styles, unknown outside of the regions in which they were developed. Texas blues seemed to be influenced by the field holler songs, which were closely related to work songs; they predated the blues. Texas blues was not as regionally isolated as the blues from the deep South. Musician migration brought different styles of the blues to different areas of the country (Yazoo, 2001). But it wasn't until the blues was co-opted by professionals of non-folk origins, that greater America became exposed to it (Malone, 1979). When recorded media was introduced, the blues moved into the commercial realm (Lornell, 2002). The blues originated in the U.S., but the genre and its influence has stretched all over the globe. In and of itself the blues is still alive today, and its influence permeates American popular music (Miller, 2010).

Dissemination

Folk music made its way across the United States through various means: touring minstrel and medicine shows of the mid 1800s toured across America, spreading folk music nationwide (Malone, 1979). In the later 1800s when interest in folk music was waning, the American Folklore Society was founded, which renewed interest in the American folk tradition (Malone, 1979). Also, there were various publications of folk songs, starting from the late 1800s. Musicologist John Lomax and his son Alan traveled the U.S. in the early 1900s making field recordings of hundreds of rural folk musicians (Cohen, 2002). In 1910 White collectors became interested in the blues, and, in the 1920s, the recording industry started recording a lot of White Southern folk music, otherwise known as "hillbilly music" (Wade, 2012).

Publications

In 1927 the *American Songbook*, a book of 280 folk songs, was published, exposing the public to folk music (Cohen, 2002). It was appended with a list of 16 other folk sources, including the American publication *Journal of American Folklore*. Readers were therefore given access to a wealth of knowledge about folk music and folk culture (Cohen, 2002). In 1932, Cecil Sharp published *English Folk Songs From the Southern Appalachians* (Malone, 1979). This publication initiated interest in Appalachian folk music. Although Sharp's book included mainly original English music traditions that had been preserved in the Appalachians, much of the new music that had been written by these folk communities had been omitted, giving a biased viewpoint of the folk culture of that area. Huge interest was sparked in Appalachian music at that time. However, Appalachian folk music was romanticized as *pure* American folk, though it had been integrating new material into its folk repertoire since at least the mid-1800s. Regardless, this spawned an interest in folk culture in general (Malone, 1979). There were many academic publications from folklorists as well (Cohen, 2002).

Radio

The early days of radio were largely unregulated, and disc jockeys experimented with what they played (Lornell, 2002). Radio programmers relied on local talent for their content and had regular live shows with local folk musicians (Malone, 1979). In the 1920s, folk music moved into the commercial realm through recorded media and radio. The dissemination of folk music through mass media outlets kept it alive, and has influenced American music greatly (Seeger & Horowitz, 1996). Also, musicologist Alan Lomax organized and aired various folk music shows on the radio. In the middle and late 1940s, folk music exploded, due to the many radio shows that had regularly featured folk musicians (Filene, 2000).

The Record Industry

Record companies largely ignored folk music until the 1920s (Malone, 1979). When it was first distributed, they segregated the way in which it was marketed. White folk music was called "old-time", "hillbilly", or "country"; and Black folk music was called "race" music (Lornell, 2002). The blues was only recorded regularly from 1926 until the Great Depression. It wasn't until Blind Lemon Jefferson's recording of 1926 that people became interested in the down-home style of blues (Dixon & Godrich, 1970).

Folk-music culture has always had a strong grassroots support system, and has remained largely independent. In 1944, Moe Asch and Marian Distler started what is now called Folkways American Roots, a non-profit independent record label (Smithsonian Folkways, 1996). The label has retained its true independent character, wholly unconcerned with monetary ambitions, and has released a diverse collection of folk recordings (Cohen, 2002). John Lomax, an important folklorist and musicologist, released many field recordings of folk musicians he visited during his expeditions through the deep South in the early part of the 20th century. His son Alan Lomax continued to release folk songs as well. This brought rural folk beyond its immediate communities and into cities and other locations (Bruno, 1976). From 1926 to 1932, Harry Smith, a filmmaker, lay anthropologist, artist, and philosopher, compiled and released a collection of American folk music (Smithsonian Folkways, 1997). The collection of commercially released folk music was recorded from the 1920s and 1930s, and was a comprehensive study of the music, culture, and philosophy of rural American folk music. 1927 was the year electronic recording technology and music reproduction made significant advances, which enabled Smith's releases. In 1932, Smith ceased his collection releases due to the Great Depression (Smithsonian Folkways, 1997). However, in 1952 Folkways re-released Harry Smith's *Anthology of American Folk Music*, which was considered a bible for the folk revivalists of the 1960s (Moist, 2007). The revivalists brought folk back into the mainstream; and since then, the number of independent record companies devoted to grassroots music has increased (Lornell, 2002).

Recording Technology

The phonautograph was the first recording device invented, and folk music was the first genre ever recorded. The French folk song, *Au Clair de la Lune* was the first piece of music recorded on the phonautograph in 1860. It used a stylus to transfer sound waves onto a piece of paper. You could not play back the recording, but you could see the sound waves. It wasn't until the late 2000s that these first graphical music recordings were transferred into sound (National Public Radio, 2009).

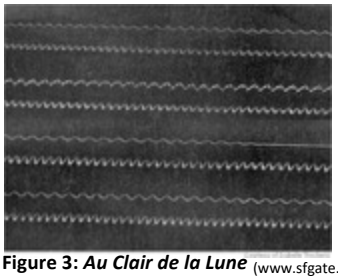

Figure 3: ***Au Clair de la Lune*** (www.sfgate.com)

In 1877, Thomas Edison invented the phonocylinder; the recording industry was born at this point, and the phonocylinder was used to make commercial recordings (Mix Professional Audio and Music Production, 2006). Many important pure folk songs were recorded from 1895–1899 with cylinder technology that later would become part of the Harry Smith collection (Cantwell, 1996).

Following cylinder technology, phonograph disc recording was invented in 1889 (Time Magazine, 2010). It was cheaper to produce, required less media storage space, and the recordings could be mass produced more easily. Also, it was louder than the phonocylinder, but not of higher fidelity. Recording ranges were limited and mid heavy, with high and low-frequency attenuation. It was a robust technology, and has evolved significantly from its beginnings (Read, 1959).

Figure 4: phonograph
(www.homebrewaudio.com)

Figure 5: aluminum disc
(www.videointerchange.com)

Aluminum discs were first used as the recording medium for the phonograph recorders. Aluminum discs could be used for one-off recordings. An amplified audio signal was sent to an electromagnetic recording head with a stylus that engraved a sound-modulated groove into the surface of the metal. Surface noise from the recording stylus and high-frequency attenuation made for an extremely low-fidelity audio recording. The playback needle was bamboo or some kind of plant thorn so that the soft aluminum would not be damaged. The newer and improved aluminum discs had a cellulose coating that provided support; it was the acetate disc (Hall, 2011).

This technological advance in disc making had many benefits: high-frequency content was preserved; new discs had extremely low noise and recordings were now broadcast quality. However, the pay-off was durability; the aluminum discs were superior in that way. Over time, the acetate discs shrank, deteriorated, and became brittle (Hall, 2011).

The shellac discs revolved at 78 revolutions per minute--aptly called the 78--and were manufactured well into the 1950s (Read, 1952). Phonograph disc recording was the dominant technology in the early 1900s, and was used by John and Alan Lomax on their initial folk-recording expeditions in the 1930s (Millard, 1995).

John Lomax was passionate about documenting the folk music in rural America (Filene, 2000). His and son Alan's contributions to folk scholarship are vast. Lomax was adamant about mostly recording the music, as opposed to talking about the music. He believed this was the way to study folk music: to listen to it, not to read about it. In fact, he considered the recordings to be the literature of folk music study (Filene, 2000).

The Lomaxs were also very passionate about experimenting with recording techniques (Filene, 2000). They were documentarians, and because recording technology at the time was so primitive, they experimented in many ways, mainly to decrease the distortion issues. Their recording environments consisted of outside work camps, under shade trees, and other make-shift recording environments. They would acoustically "treat" the spaces with whatever resources they had at their disposal: hay barrels or farming equipment that was lying around whatever barn they were recording in (Filene, 2000).

In 1933 John Lomax persuaded the Library of Congress to fund one of his recording expeditions through the deep South (Filene, 2000). He and Alan ventured through the Southern U.S., recording various obscure folk musicians. With his funding, Lomax was able to purchase one of the first "portable" recording machines of the time. It was a 350-pound dictaphone recorder that was built into the back of a car. It came with two 75-pound batteries, a microphone, cables, and blank aluminum and celluloid disks (Filene, 2000).

Figure 6: John Lomax's Field Recorder
(www.echo.ucla.com)

ARTISTS & REPERTORY

Artists

This project was a collaborative effort between a core group of four artists. Sandra Covin was the composer and poet, guitarist and lead singer; she provided the original acoustic guitar/vocal songs, which were folk-based, singer-songwriter ballads. I was bassist and producer and acted as creative director, deciding the instrumentation, outlining a general production model for the project, and managing and organizing sessions and musicians. Ian Cook played drums and built drum arrangements. Senem Pirler was the main pianist and keyboardist, coproducer, and acted as principal engineer.

Over a period of two months in early 2012, Covin, myself and Pirler built the arrangements of the compositions and decided on the repertoire. Originally there were 15 songs to choose from; during the selection process, 13 were chosen. Covin recorded demos of her singing and playing the acoustic guitar for all of the songs. Pirler and I imported the songs into Abelton Live's music editing software and worked on the arrangements, sending them to Covin for any final revisions. Covin then recorded new demos with which Cook built drum compositions. He sketched out his arrangements, then he and I finessed them in a series of rehearsals. Prior to the first recording sessions, Covin and Cook had a two-day rehearsal and further tightened any loose ends in the arrangements. All drum tracks were recorded in two days, followed by a week's worth of recording of all acoustic guitars, banjo, and lead vocal parts. Over summer and fall 2012, the rest of the parts were recorded, and all of the music was edited. Finally the project went into post-production.

The artists on this project come from various musical backgrounds; therefore, a well of musical influence was there to draw upon. While keeping in mind the context of the music, and understanding the essence of the pieces, the artists were free to bring themselves fully to the music-making table, and were simply asked to engage wholeheartedly in the process. There were no preconceptions about how the repertoire as a whole, or individual songs, were to sound; therefore, we were free to offer our perspectives and ideas. The people involved in this project were chosen carefully based on their talents, skills, and dedication to the *art* of making music.

Sandra Covin

Sandra Covin is a musician and singer-songwriter; she wrote the music for this project. I have collaborated on many music projects with Covin for over 20 years. Covin was approached for this project because I knew that she would provide quality material, and Covin was interested in recording many of the songs that she had written over the past couple of years. Also, our working relationship was such that we completely trust each other's creative choices, and have similar aesthetics and philosophies about music; therefore, allowing for limitless creative and explorative potential for the music. This being the most important part of a truly creative process, Covin was an obvious choice for me.

Sandra Covin's musical interests vary from 20th century art music composers like Edgar Varèse, to neo-folk outsider artists like John Fahey. Covin's music often straddles a line between folk and experimental. In 2009, Covin began writing again, after a four-year hiatus from playing music. She had just completed her graduate studies in Spanish literature and felt the need to reconnect with her composing and performing. She started playing solo guitar shows in experimental venues in St. Louis, Missouri, where she currently resides, and began writing folk-based songs again. Thus were born the seminal pieces of this current project.

Initially, she started writing melodies and guitar parts without words, fragments of music with vague meanings. At the end of 2010 she moved back to her parents' home in order to be a caregiver to her dying father. As a release from the difficult circumstances, she channeled her feelings into working on the seeds of older and newer songs.

Sandra Covin was born in Tampa, Florida to a Cuban mother and American father. Music first came into her life through her parents' love for old Cuban music from the 1950s, 60s and 70s by artists like Celia Cruz and Arturo Sandoval. She was first recorded singing at age 6, when she still had a heavy Spanish accent; she sang along to "Baila Rumbero" and vocalized the horn parts, timbales and piano, as well as the melodies.

When she first saw the Mamas & Papas on television, their music sounded like the soundtrack of a horror film to her. The spooky psychedelia, the reverb-laden production of their songs and instruments attracted her, and she began to listen to the radio for more music like this. However, her father prohibited rock music in the house, so she listened to, and recorded in secret, songs from the radio. At the same time, she was taking poems from children's poetry collections like those of Robert

Louis Stevenson and strumming a cheap guitar while inventing melodies. Putting music to words had a profound effect on her inner creative life; the words took on a magical resonance, as if the music

released the hidden colors of the words. She began to be interested in drums and percussion, and would form imaginary orchestras in the living room while running around to play all the parts using kitchen utensils.

At around age 16, she taught herself guitar using a methods book that showed her how to play chords. The first song she learned to play was "My Sweet Lord" and subsequently learned songs from a Catholic hymnbook. She was always tinkering with song creation. In college, she wrote songs and performed them for her friends and in open mics. Her creative writing classes offered her a chance to work on poetry and lyrics. After joining a cover band, she played weekly and would intersperse her original songs with those of the Indigo Girls and Peter Murphy, but they seemed out of place. In Covin's words, "after meeting lifelong collaborator, Amos A., I began to learn the missing link to my harmonic inadequacies--how to resolve a phrase". "This was a moment of illumination that changed the direction of my music". She delved into experimental, film, outsider and electronic music, and moved away from pop and folk. She began recording and releasing her own music projects on her Tascam 424.

The 4-track had always been a part of her songwriting/compositional process. In the beginning, during her early twenties, the parameters of the machine increased her creativity, and she began to experiment with the pop form again without abandoning avant-garde music. She also discovered John Fahey, perhaps the single most important musical influence on her art. Fahey, a re-inventor of early finger-style blues guitar, was a bridge between experimental and folk. She took a year of classical guitar when she was 25 in order to work on her right hand technique. Then she began work on her first record, The Butt Vicinity, all recorded at home on her 4-track, then later dumped into the DAW, and mixed in ProTools. A year later, she released Life of the South, an EP of electric guitar instrumentals in the Fahey style.

Ian Cook

In 2005, I met and briefly played with Cook in an electronics band. Within two seconds of hearing him play, I knew that this was my New York drummer. He was metronomically perfect, versatile, and a solid heavy hitter. He was quiet, intense, and serious, with a no-nonsense, blunt attitude; I admired him instantly. Though I left the electronics band soon after, a few years later we started working on several projects together, both live and in the studio. In December 2012, I approached Cook about playing on a full-length project that I was recording for my thesis; he agreed. Cook brought his unique and varied approach to the project, which pushed the music beyond a traditional folk-rock genre.

Cook is a drummer and electronic musician who has been involved with music since auditioning for the drum chair in first grade. He played in many rock bands in high school where he also played semi-professionally in a number of jazz and rock combos and recorded his first two records at age 17. In college Cook continued private music lessons while studying sound recording and mixing as part of a film degree, for which he scored a number of student and independent productions. He quickly became fascinated with electronic instruments and has been integrating samplers, drum machines, midi devices and software instruments into his drumming ever since. While continuing on again/off again private instruction in jazz drumming, he continued to explore electronics and sound design and has worked (sometimes as a drummer, sometimes as an electronic percussionist, or both) with Dave Douglas, Travis Sullivan, Rachel Z, Soft Machine, Lucia Micarelli, Dave Eggar, Dads Yakuza and numerous indie acts in N.Y. and Chicago. He is Ableton-certified and regularly teaches on the subject of integrating electronic instruments and sequencing into a live performance context.

Senem Pirler

Senem Pirler is the principal engineer, pianist, co-arranger and coproducer on this project. I met her at a Switch Society of Women in Technology meeting in the N.Y.U. Music Technology department in 2011. A year later we started working on a music project together, recording and producing an indie electronics band in my studio in Brooklyn, N.Y. We won the first annual 2012 N.Y.U. Recording Competition for best electronics composition with that mix. With Pirler's stellar engineering and communication skills, and my organizational abilities and production experience, we realized we made a complimentary team.

Senem Pirler is a sound engineer, sound designer, and musician currently based in New York. Born in Turkey, she studied classical piano at Hacettepe State Conservatory and sound engineering and design at Istanbul Technical University (MIAM). She composed, performed, and worked as a recording engineer in Turkey for many years before moving to the U.S. in 2010 to study music technology at N.Y.U. with a Fulbright Fellowship. Her areas of interest include computer music composition and sound design for film, theater, and multimedia environments. She considers herself not only a technician, but also a sound artist.

Amos A.

I am the bassist, backing vocalist, co-arranger, and coproducer on this project. I am a multi-instrumentalist, composer, and visual artist who works as a soloist, and as a collaborator on various music and art projects. I play a hybrid bass/guitar, which I invented, fretless electric bass, piccolo bass and electric bass, along with various FX pedals and loop stations.

My formal music education is in jazz and classical electric bass. In my early career I concentrated on playing as many styles on the bass as possible and took the Jaco Pastorius approach of learning standard jazz melodies on the bass. I quickly started playing professionally and embarked on a career as a session bassist. In my early twenties, while playing on a country recording session in Florida, the engineer told me, "You have a career ahead of you." He was a successful engineer from Nashville and had worked with many of the country greats, like Dolly Parton. He gave me some phone numbers for some connections in the Nashville country music scene. I never made the calls; instead, I left the session musician path and went on my way to becoming a starving artist. Though spiritually rewarding, it may not have been the best career move.

I continued my obsession with recording and production into the early 90s; I experimented (mostly as an artist, rather than engineer) with many recording mediums: 4-tracks, reel-to-reel ¼" decks, ADAT, 24-track 2" tape, clunky 1st wave Digital Audio Workstations, and mostly with low-budget recording gear. The main point for me was to experiment with sound, and record the compositions in my head with the least amount of hiss possible. Because of my impulsive nature, I never really thought to pick up a how-to recording manual until my graduate studies in the N.Y.U. Music Technology department. Once there, my left brain came alive and I began supplementing my hands-on knowledge with technical information.

My production interests lie in using music technology to create a highly visual experience of the music. I come from a "D.I.Y." background, fully embracing the "lo-fi" aesthetic, while aspiring to the high-fi technical finesse. I believe in always making art, regardless of the professional caliber of the tools at hand. I am interested in merging all elements of recorded production: analog and digital, low tech and high tech, as well as working in mobile and traditional recording environments. Much of the technology I use is gear that I build, such as tube microphones, preamps, and various gadgets. I mostly prefer tracking to analog tape, using as much outboard gear as possible for EQ and compression, while saving the "DAW" for snazzy post-production automated mixing techniques.

Artistic Concepts

Concept in this case is multilayered. There is a general concept of the project as a whole, or "process." Then there is the creative concept of the body of work, as well as the individual meanings and approaches for each of the songs. The process is that the individual creative concepts regarding the songs and work as a whole were either articulated during or after the project.

Process

The general concept was to allow the creative process to be the determining factor of creative outcomes. There were no preconceptions about how the music was supposed to sound, or desired outcome by the singer-songwriter. Covin provided the acoustic guitar/vocal songs and surrendered all creative control to the exploratory process, both in arrangement and production.

As for the supporting artists, their jobs were to articulate clear musical ideas that supported the essence of the songs. A specific crew of musicians was chosen to fulfill this task. Since no limits were placed upon them, it was demanded that each person search for unique solutions to creative problems, rather than relying on stock ideas or typical approaches. Eleven of the 13 songs are text based, so one can discern a basic idea of what is being said. However, instead of having Covin explain what the songs meant to her, each artist was free to listen to the demos and interpret the meaning for themselves. They brought to the table their initial creative impulses and, with me, collaborated on shaping the ideas into cohesive musical structures.

Songs

Parallel to the general concept of creative process, are the concepts of the overall body of music, along with the essence of the individual songs. The musical and production concepts of this project function as support for the interpreted meanings behind the songs. Mostly, the conceptual ideas were fleshed out "on the fly", as opposed to a contrived, rigid discussion of how the song meanings would be depicted musically. The concepts were discussed prior to the process of making the art, then conceptual thinking was mostly discarded, and instinct and spontaneous brainstorming led the way during the creative process.

Reflection upon the songs in hindsight indicates certain perspectives on metaphor that may be adopted. For instance, in *Arbor Day*, the automated reverb on the last four lines of the lead vocal changes in such a way as to depict a specific visual scene. The song is about a person facing her imminent demise on a makeshift, sinking vessel; thus, the slow increase in reverb, and decrease in dry signal on the last vocal passages, gives the effect of the vocalist moving into the horizon on her way to the bottom of the "deep, dark sea." Also I wanted to convey a "doomed vessel's last party scene" mixed with a landscape inhabited by fluorescent deep sea creatures. The idea is that people are enjoying their last moments to the fullest, even though they know they're sinking, so the "jamming" outro section was performed in a frantic, lively way. The fade and automated increased reverb is employed to indicate that the ship is sailing off into the distance even as it is sinking.

The intent behind the production and arrangements was to paint sonic pictures, and the process was cinematic. Communicating with the musicians was like giving directions to actors. It wasn't solely about suggesting which musical figures to play; it was about suggesting a mindset in which to play, so that the musician became a type of character during performance, and then painted musical landscapes that would be relevant to that character's experience. The musicians were personalities acting within those landscapes, physical settings with very specific images. For example, on *POA 1,* I communicated to the other musicians that this piece be played as though they were on their front porch in North Carolina, sipping sweet tea on a super hot and humid day. We were all "buddies" playing a "tune" together after a hard day's work. Luckily everyone had vast imaginations and had no problem whatsoever with this kind of approach to music-making.

We continued with this metaphorical approach when making creative decisions for many of the songs. For instance, in *Challenger,* we organically began composing parts that would support the storyline. The song is about witnessing the 1986 space shuttle disaster as a child in school. In the bridge, the piece breaks down into a seven-part vocal passage. We decided on using 7 notes, because we wanted to pay homage to the seven astronauts who died in that fatal crash. At the end of the song, we brought many people in to participate in the group singing section. I wanted to convey a unified feeling of people supporting one another in song while experiencing something really terrible. These hopeful words were repeated: "We would stand, we would stand, we would stand so strong". The piano and Rhodes repeating figure at the end trails off into the distance, signifying the astronauts' spirits going to heaven. In *Annabelle,* the fretless bass was used to depict the darkness of a twisted romantic relationship. We layered three tracks of low, rumbling, dynamically de-tuned bass parts that crescendo

in the end and swallow the rest of the music. In *Summer Never Ends,* the song has a sort of longing, unrequited romantic love for the lyrical theme; it conveyed a very old-school 1950s lovesick feeling, so I took a very Beach Boys/doo-woppy approach to the sound. Multiple background vocal pads were layered and recorded; every arpeggiated tone was at least tripled or quadrupled and drenched in reverb. The intent was to create a very thick wall of sound. With *Horseaisle,* the song conveyed a down-home feeling in the lyrics with a simple straightforward story. We conveyed that feeling by using a country 2 feel in the bass. In the bridge sections, when the story shifts to more spiritual subject matter, it creates a juxtaposition with the very earthy and grounded quality of the verses. Background vocals in high octaves, along with a very syncopated bass line, were added to the bridges to support this lyrical juxtaposition. These creative choices lifted the song from its grounded position, giving it an airy, unstable quality. *Whipporwil* had an overall dark, mysterious quality. The music fully supports the essence of this song. The fretless bass harmonics are atonal and arhythmic without harmonic stability, which is suitable to the text. The background vocals further provide an eeriness to the song with their heavy reverberation and open fifths. The drums were played by hand as opposed to sticks, and were heavily syncopated in the verses; later they are played with sticks and with a heavy dynamic. The idea was to give it a more raw, unstable feeling that moves to intensity, which acts as a support to the lyrical idea of some imminent force approaching the narrator. *The River* denotes a kind of hopeful spiritual connection that moves one beyond the problems of this daily life. The drums and bass are related polyrhythmically. The drums are playing a very non-standard textural musical figure in 4/4, while the bass plays a repetitive and simple line in ¾. So the one is obscured. I felt that this approach fully supported the essence of this song in that it is textually dealing with spiritual and mystical subject matter; therefore, a groundlessness in the rhythm was appropriate. A stable downbeat would be completely inappropriate for this song. Also, it is played on fretless bass, which creates a more fluid sound in the bass registers. The bass octave sections in the verses that seemingly appear out of nowhere create a feeling of something opening. This is meant to convey the experience of suddenly feeling the presence of something omnipotent, something more expansive than one's self.

After the recording was completed, Covin provided insights into the process and meanings of her music. The songs on this project reached different points of illumination throughout the year Covin spent cultivating them. Generally the songs are all connected by themes of loss, deception, freedom, and nostalgia. Songs such as *Smallest Bird* and *Bullet Dancer* are sort of bookends. The first begins a story and the second is the aftermath of a relationship wracked by individual demons that each person

brings to it. There is an innocence in the first that is smashed in the second. The story in *Summer Never Ends* finds itself in the center of these two songs. Others such as *Horseaisle Whippoorwill, Oh My Heart, Challenger*, and *Voices from Inside* are semi-biographical, semi-autobiographical. *The River* pays homage to religious hymns and is a sort of a conclusion: open-ended, life-affirming, a rebirth, a benediction of sorts.

Body of Work

The concept for the body of work as a whole was decided after the fact, as the album was compiled into some material form, and when the thesis was being written. It was to be treated as an art piece, both as a collection of musical works, and as a physical presentation of those works. It was something that someone would sit down and listen to, with undivided attention, from start to finish, in order to experience a cohesive musical adventure. Listening to this project would be similar to the way one might read a novel, watch a film, or look at a painting. Although it might also serve as a musical backdrop to accompany other activities, in order to experience the music as it was intended, it required engagement and attention from the listener. As for the physical presentation of this project, it was to be presented as a piece of art as well. Covin and I worked on the conceptual design of the physical presentation over the span of the project.

TECHNICAL FOCUS

Reverberation

Reverberation is a quick succession of decaying echoes occurring after the source sound, between .01ms–1ms apart, and is determined by room size and reflecting surfaces (Angus, 2009). The larger the room, the longer it takes sound to travel to various surfaces; the more reflective the room's surfaces are, the more the sound continues to bounce around in the room (Rossing, 2007). Therefore larger, more reflective rooms generally have longer reverb times, which may vary anywhere between .2s and about 10s (Schroeder, 1960).

Ideally, a reverberant field has a constant power level throughout the room. It is a perfectly diffuse field; meaning, sound scatters from reflective surfaces in all directions equally. In a diffuse environment, all decays are perfectly smooth throughout the frequency spectrum (Griesinger, 1996). However, in reality reverb time is variable with frequency because absorption coefficients of room materials are frequency dependent. Therefore, reverb decay times differ across the frequency spectrum, accounting for a room's distinct timbre (Schroeder, 1960).

Sound waves are arriving at the listener from all directions, making up the reverberant field, which has a build-up, a steady state, and a decay.

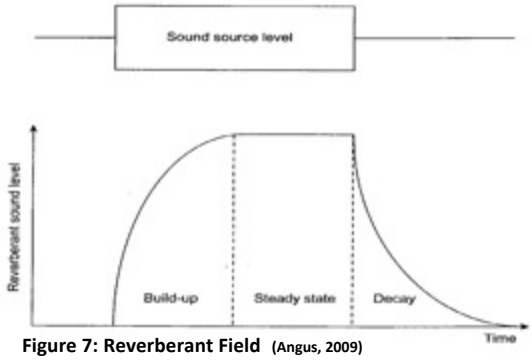

Figure 7: Reverberant Field (Angus, 2009)

The steady state of the reverberant field is constant throughout the room; whereas, the direct sound's strength varies for the listener with distance (Everest, Pohlmann, 2009). The farther away the listener moves from a source, the weaker the direct source sound becomes. The point at which the reverberant field equals the direct sound is referred to as the critical distance; beyond this distance, the reverberant field dominates. Depending upon the absorption and size of the room, the critical distance varies. A more absorptive room equals a longer critical distance (Everest, Pohlmann, 2009).

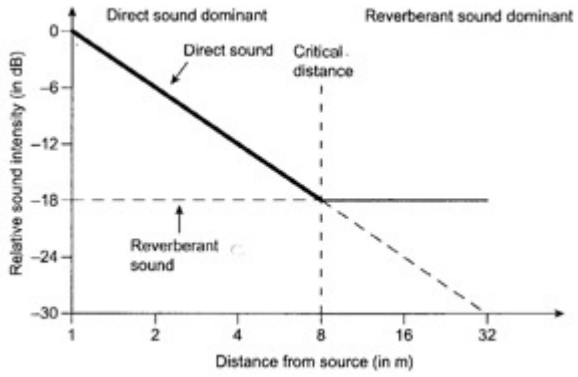

Figure 8: Critical Distance (Angus, 2009)

Determinants of Reverb

There are many determining factors defining the reverberation characteristics of a room, such as the size, shape, acoustical properties, and ephemeral states in a space (Beranekk, 2008). Room size affects rate of reflections, therefore affecting the time it takes for the reverberant field to build up to its steady state signal. Absorption affects spectral decay rates and the reverberant field power level. Room modes and air pressure are also determining factors of reverb character (Griesinger, 1996).

Depending on the size of spaces, reverberation has specific qualities (Baranekk, 2008). The Mean Free Path describes the time it takes a sound to travel to a surface in the room. The larger the room, the longer the time it takes for a sound to travel from one surface to another. The Mean Free Path equation is 4V/S, which describes the average distance a sound travels between two successive reflections. V is the volume of the room, and S is the surface area of the room (Baranekk, 2008).

By nature, reverberation is a perfectly random field (Griesinger, 1997). In small rooms, low-frequency modal resonances cause a lack of uniformity in the sound field. Because room modes are resonances based on a room's dimensions, a diffuse sound field is difficult to achieve in a small room. However in small, highly reflective rooms, one can achieve surprisingly long reverberation times (Griesinger, 1997).

The Schroeder frequency, the crossover frequency at which a room changes from a resonant cavity to a reflective cavity, also determines reflective properties in small rooms. A room with a high Schroeder frequency may produce unpredictable reflective characteristics, at frequencies below the crossover frequency, due to modal resonances. This is why small rooms with highly reflective surfaces may produce unusually long reverb times (Everest, Pohlmann, 2009).

Reverberation time is dependent upon the power level of the reverberant field, and its spectral decays, which are both affected by absorption (Ando, 1985). The amount of absorption in the room

determines the amount of sound energy that is available for the reverberant field. If less energy is absorbed by surfaces, there is more energy in the reverberant field (Ando, 1985). Also, because materials' absorption properties are frequency dependent, reverb decay times differ within the frequency spectrum (Angus, 2009). For instance, if a surface in a room absorbs high frequencies more than low frequencies, the timbral quality of the reverb will be affected, because the high frequencies will decay faster than the low frequencies (Slusser, 1973). Further, the absorption quality of the room determines the number of times the sound will travel from surface to surface (Pallett, Pierce, Toth, 1976). The less sound energy absorbed by surfaces, the longer time it will take for the sound to stop bouncing from surface to surface. The more times a sound travels from surface to surface within a given structure, the longer its decay time (Slusser, 1973).

The shape of a room as well as the properties of its transitory states affect reverberation (Duanqi, Zheng, Jinjing, 1991). A more reverberant space that is connected to a room through an opening will act as a reflector, and can provide reverberation to the non-reverberant space (Ando, 1985). In these acoustically coupled spaces, people near the connective opening will experience a double sloped reverb decay, where the combined reverb time is greater than it is in one space alone. The changing states of a room, like air humidity, affect absorption, therefore affecting reverberation. For instance, dry air absorbs high frequencies more (Ando, 1985).

Calculating Reverb Time

Calculating reverberation in a room is about calculating decay times (Everest et al., 2009). Reverb time is a measure of the rate of decay of a sound in seconds. It is the amount of time it takes for sound intensity in a room to drop by 60dB from an original source level. This reverb measurement is called RT_{60} which "represents a change in sound intensity or sound power of 1 million (10 log (1,000,000) = 60dB) or a change of sound pressure or sound pressure level of 1 thousand (20log (1000) = 60dB)." Reverb time is measured in logarithmic form, and is expressed in decibels. 60dB is considered the general level at which sound becomes inaudible (Everest et al., 2009).

W.C. Sabine devised the first measurements and equations for measuring reverberation (Rossing, 2007). In 1900, Sabine concluded that reverb depends upon room absorption and room size: more absorption = less reverb; larger room = longer reverb (Everest et al., 2009). The Sabine equation is as follows: $RT_{60} = 0.049V/A$ where V is volume or room in ft^3; and A is total absorption of room in sabins. Reverb time (RT_{60}) is expressed in seconds (Everest et al., 2009).

Absorption of the surfaces within a room varies because different materials have different absorption coefficients (Everest et al., 2009). In order to find total absorption of a room, one calculates the absorption of each surface area. This is done by multiplying the surface area by its absorption coefficient and then summing all of the calculations. Therefore, total absorption $A = S_1\alpha_1 + S_2\alpha_2 + S_3\alpha_3\ldots$, where S is surface area and α is that surface's absorption coefficient. Absorption coefficients vary with frequency; therefore, one must calculate reverb time at different frequencies. Typical reference frequencies for reverb calculations are: 125Hz, 500Hz, 2k, and are indicated by $RT_{60/125}$, $RT_{60/250}$, etc. The Sabine equation is accurate for live rooms where the average absorption coefficient is less than 0.25 (Everest et al., 2009).

For absorptive rooms where absorption is greater than 0.25, the Eyring-Norris equation is employed (Everest et al., 2009). It states that: $RT_{60} = 0.049V/\text{-Sin}\ (1\text{-}\alpha_{average})$, where V = room volume in ft^3; S = total surface area of a room in ft^2; In = natural log (to base e); and $\alpha_{average}$ = the average absorption coefficient. Both the Sabine and Eyring-Norris equations are intended for rooms that have uniform diffuse sound, in other words, large rooms (Everest et al., 2009).

Measuring Reverb Time

Measuring reverberation characteristics rather than calculating them is more accurate because of the discrepancies of absorption coefficients (Davis, Jones, 1987). Impulse sources can be used as a measurement tool. An ideal impulse is an infinitely loud, infinitely short signal. Common practical impulses are balloon pops, gunshots, cannons, or a steady-state source such as a sine sweep, white or pink noise, or octave and 1/3rd octave bands of random noise. The impulse must excite the entire spectrum significantly above the noise floor. The room's response measured over time is used to examine the temporal characteristics of sound in a room. Measuring devices used are loudspeakers, a noise generator, microphones (small diaphragm), a recorder, and software that will analyze the tests (Davis, Jones, 1987).

Figure 9: Reverb Measurement Process

The combination of the time between surface reflections and the exponential decay of the sound energy determines the reverberation of a space (Angus, 2009). A thorough way to conduct reverb analysis of a room is to measure 5 or so decays per octave, with random noise, from a very low frequency to a very high frequency, at several microphone placements. Consequently, the rate of decay for many frequencies in the room is measured, displaying the timbral characteristic of the reverb (Everest et al., 2009).

One method for measuring reverb is as follows: A pink-noise source is band pass filtered to produce octave-band noise at these center frequencies: 63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, and 8k. The source produces a steady-state then is turned off. It is recorded, and $RT_{60\,is}$ observed at the center frequencies above. Results are plotted on a graph with time versus frequency. Microphone and loudspeaker specifications are irrelevant; however, their placements are important, because reverb characteristics are position variable within the room (Everest et al., 2009). Customarily reverb time is measured from 500Hz–1kHz, but can also be measured at 125Hz, 250Hz, 2kHz and 4kHz (Rossing, 2007).

Reverberation in Context

Whether a room is considered acoustically good or bad is subjective (Ando, 1985). Preferences regarding timbral characteristics of reverb, decay times, and ratio of reverberant field to direct sound in a room vary (Ando, 1985). Reverberation is used in many contexts: testing, music, speech, and more (Angus, 2009). For music, reverb adds richness to sound because it integrates all sounds, which combine to create unique phase relationships; this adds multiple layers of timbre to the overall sound. For speech, it helps project a sound. In testing, reverberant fields give us information about the physical properties of matter. Depending upon the function of sound in a volume, ideal reverberation characteristics will vary (Angus, 2009).

People are used to hearing at least some amount of reverb in acoustic spaces. If we hear sound with very little or no reverberation, it sounds unnatural and produces an undesirable acoustic effect (Griesinger, 1997). In speech, direct sound is important for intelligibility; however, some reverb is needed to project the voice and provide a natural ambience. Too much reverb masks consonances, making content unintelligible (Everest et al., 2009). Depending upon reverb time and reverb level relative to direct sound, the reverberant field can pose a considerable problem for speech distinction. For clarity, the direct sound should be greater or equal to the reverberant sound, and the listener should not be beyond the critical distance from the source (Davis et al., 1987).

Intelligibility can also be important in certain contexts of music listening. Depending upon genre, or intention, little reverb may be desired. For instance, in this recording project, articulation of the songs' texts was of paramount importance. So, the lead vocal needed to be clear and understandable. The songs' stories have meanings to be conveyed to the listener, even if the interpretation is a personal one. The reverberation chosen for that application was only to supply a minor amount of ambience, while still retaining clarity. Too much reverb would have obscured the content and been inappropriate for the genre.

Reverberation times in home-listening environments are also somewhat low (Everest et al., 2009). Because most recordings are produced in such a way as to contain a desired ambience, adding more room ambience to that experience simply obscures the artistic content on the recording. n recording studios, however, live reverberant rooms for tracking acoustic instruments are often preferred. A variable reverb, where one can build the desired reverb for different instruments, is ideal. In studio control rooms, reverb times are at a minimum in order to achieve accurate mixes (Everest et al., 2009).

For clarity and intelligibility, little reverberation is desired. For immersion, mostly in live-listening contexts, more reverb is usually favored (Angus, 2009). For concert halls, reverb characteristics must fit appropriately with the music that is being performed. However, the amount and type of reverb preferred is highly subjective and is variable across genres (Beranekk, 2008).

By today's standards a reverb time of 1.9s for symphonic music is appropriate (Angus, 2009). The first reflection (the first sound heard after the direct sound), also known as the initial-time delay gap (ITDG), is also very important in concert hall acoustics. Fifteen milliseconds are ideal, and greater than 35ms are too much. Azimuth location (the ability for the listener to localize the source), along with listener envelopment, are also determining factors of "good" acoustics in concert halls. The direct sound should be no lower than -10dB from the entire sound (reverberant field + direct sound). The lateral reflections, a determinant of source width, are marked by the proportion of early reflections that arrive at the listener (laterally) within the first 100ms. These reflections also determine good listening environments in concert halls, and immerse the listener in sound (Angus, 2009).

The optimum reverb time in reverberation chambers used for conducting scientific measurements, is an objective amount (Everest et al., 2009). For instance, the longest RT_{60} that is practically attainable is ideal for studying the absorption coefficients of construction materials. The longer the RT_{60} is in these contexts, the more accurate the measurements of absorption (Everest et al., 2009).

Optimum reverb time for most audio-related applications is subjective, and is dependent upon the perceiver, the context, and the sound source being considered (Beranekk, 2008). There are many conflicting theories about optimum reverb time; however, a general preference is that speech and recorded media be intelligible and/or accurately represented, and live music listening be immersive. Therefore, low reverberant fields are optimum for intelligibility goals; while reverberation times for live music experiences are longer. Also, a longer low frequency decay time is generally preferred because it provides warmth for the overall sound (Beranekk, 2008).

Reverb Chambers

A reverb chamber is any volume in which a reverberant field exists, and is employed specifically for its reverberant quality (Oxford, n.d.). Reverberation in spaces has been used for many centuries, and is used for many functions. The Greeks used reverberation in their theatres to aid in vocal projection, and to create a more powerful, lively effect. Reverberation in churches was perfected by acousticians in order to enhance the emotional impact of sacred music (Oxford, n.d.). Concert halls of the early 19th century were designed specifically with a particular reverberation in mind for chamber and orchestral music. (Ando, 1985). Reverb chambers are also used for testing purposes, like studying absorption of materials, in which case, the chamber provides a diffuse sound field, long reverb times, and uniform sound distribution (Duangi, et al., 1991). Early recording studios used dedicated rooms and makeshift enclosures as reverb chambers to provide ambience on audio recordings (Simons, 2004). Nowadays, some studios still use chambers to create ambience and/or achieve specific sonic effects (Simons, 2007).

History

The desire to produce reverberation in rooms for aesthetic purposes spans the ages (Oxford, n.d.). In the early Greek theatres, actors wore masks to create a megaphone effect, and painted skins were hung from the backs of stages to enhance projection and accentuate certain frequencies. The size of the stage also served as a main reflector and intensified high-frequency content for the orchestra. These early tools created resonance in outside theatres that had no ambience. Increasing the size and altering the shapes of rooms, and increasing stage height were all design considerations in containing sound, projecting it through the space, and creating resonance at certain frequencies. The essential goal was not only to project the sound, but to create color of sound in order to have a desired aesthetic impact (Oxford, n.d.).

In 1st century B.C. acoustician Vitruvius designed a method using bronze vases placed in compartments in theatres to create resonances that made certain sounds louder (Oxford, n.d.). The tuning stressed fundamental pitches, while also resonating at 4ths and 5ths (up to 2 octaves) from the fundamental. This created a reverb time of up to 500ms in an open theatre that otherwise had no reverb. Although these methods of creating reverberation were limited, it was mildly effective. In medieval times, earthenware vases were used as resonators; they were spaced and inserted into the stone walls approximately 2.5 meters from ground level, with the opening facing outward toward the choir. These resonant vases were used up until the 17th century (Oxford, n.d.).

The construction changes of the Romanesque churches altered the acoustics dramatically (Oxford, n.d.). With higher naves and stone vaulted ceilings, diffusion was lessened, reflections increased, and reverberation times were longer and less uniform. The higher ceilings of the Gothic churches improved the acoustics; although the reverberation was non-uniform. Uniform diffuse fields were obtained in acoustic design by replacing the stone ceilings of the older churches with wooden ones that were covered with elaborate decoration of small ribs or coffering, which acted as low-frequency absorption and diffusion (Oxford, n.d.).

The Renaissance and Baroque structures produced shorter reverb times of 1.6s with excellent diffusion (Oxford, n.d.). They were built for more clarity, and had low-frequency absorption by using draperies, wood paneling, and carvings, while high frequencies were bright and clear. This change was beneficial for clarity in speech, but wasn't as aesthetically supportive for the music. The Venetian theatres of the 17th century were small, made of wood and had flat ceilings. Surfaces were decorated and audiences were often packed into the space. Low frequencies were absorbed and high frequencies were reflected, which made the sound brilliant with short reverberation times (Oxford, n.d.).

In the 18th and 19th centuries, acousticians continued designing theatres with wood (Oxford, n.d.). However the small construction of the theatres with their shorter ceilings, greatly decreased reverb times. Composers of this era did not like the sounds of these halls. Starting in the 1700s, rooms were built specifically for music performances. The narrow rectangular hall was preferred by composers of this era. Some of the main concert halls in Europe had reverberation times from 0.9s–1.7s, with an increasing reverberation time of low frequencies, which is generally preferred because it creates warmth. The long, narrow wooden hall may have short reverberation times, but they combine clarity with a sense of spaciousness; clarity being established by the quick reflections that reach the ear, and spaciousness by the lateral reflections (Oxford, n.d.).

In the 19th century, the development of the large orchestra facilitated the need for longer reverberation times (Oxford, n.d.). Music halls were larger with classical ornamentation, which produced good diffusion, and a lower ratio of direct to reflected sound. The goal was to have a reverberation that would enhance the sound of the music, but to also have clarity. The orchestra pit was developed to project and blend the tones of the orchestra, and side columns acted as reflective diffusers (Oxford, n.d.).

In 20th century acoustic design for concert halls, the emphasis was on having longer reverb times while retaining a high level of direct and first reflected sound (Ando, 1985). The spaced, suspended ceiling panels that were used reflected sound back into the audience, while allowing some sound to move higher into the room between the panels, before returning as reverberation. One of the issues with this design was the frequency imbalance of first reflections (Ando, 1985).

In the early recording studios of the 20th century, reverberant rooms were the first means to attain ambience on recordings (Simons, 2007). Some studios had dedicated spaces that were used as reverb chambers, or stairwells, bathrooms, and other reverberant rooms were used. They would play back tracks through a loudspeaker that was placed somewhere in the chamber and then remic it to get reverb and echo effects. Reverb adjustments were obtained by either microphone or speaker placement in the reverberant room or by adjusting the amount of reverb used during the mixing process (Simons, 2007). Engineers experimented constantly with the chamber. The unique characteristic of some of the recording rooms in N.Y.C. were such that phone lines were used to patch in other studios so that they could use the chambers remotely (Simons, 2004).

Reverberation in Folk Music

For less formal musical genres, like early American folk music, very little reverberation was employed, both as an aesthetic and a need. Partially because of a desire to understand the text, because the music was story based, little reverberation was used on the early folk recordings. Also, because the recording technology of the time was in its formative stages; the emphasis was on documenting the music with the highest signal to noise ratio; room reverb, although employed, was a secondary production consideration (Millard, 1995).

For this recording, reverberation was used as a tool for contrast. Because the folk aesthetic mostly uses small reverberant fields, using a highly saturated long reverb effectively juxtaposes the folk aesthetic, which creates an overall richer production. For instance, the lead vocal was treated with minimal reverberation, a decision in keeping with the early folk recordings. Because this was story-

based folk influenced music, the lead vocal needed to be clearly intelligible. However, large reverberant fields were used on other instruments, to severely contrast the austere production quality of the lead vocal.

On the early recordings of American folk music, natural room reverberation was employed for ambience. Whether it was recorded in the living room of someone's home, or a barn, room reverberation, though used minimally, was considered and employed. In alignment with the early means of achieving ambience on folk recordings, for this project, we also wanted to use real rooms for reverberation, as opposed to virtual models. Furthermore, we wanted to achieve the most natural and rawest sound possible; using room reverb would help facilitate this goal. This was a folk based recording, and in order to adhere to the overall folk aesthetic of "naturalness", we employed real rooms for reverberation, aka reverb chambers.

Reverb Chambers in Audio Production

In audio production, a reverb chamber is a space with a "live" reflective sound quality that has microphones and loudspeakers. In this application, reverb chambers are used in different ways: sometimes musicians are recorded inside the spaces or reverb is attained in post-production. In post-production, audio tracks are run through a speaker in the chamber and recorded through the microphone (Simons, 2007). During the mixing stage, the reverberated track is raised or lowered, depending on the amount of reverb desired in the mix. Producers have employed a few tricks when mixing with the chambered track: 1. Pre-delay is often applied to the chambered track, which widens the gap between the direct signal and the chambered signal, adding dimension to the track; 2. Running the chambered signal through a compressor maximizes the reverberant ring. One does not have to put a lot of signal into the chamber to get a lot of reverb (Simons, 2007).

The chambers of the 1950s and '60s were mostly set up to use during the mixing process (Simons, 2004). A microphone and a speaker were set up in opposite corners to maximize the reverberation; a signal was fed through the speaker, then recorded, then mixed back into the track. Often multiple tracks were fed into the chamber simultaneously, which blended the tones very well; phase additions and cancellations created new tones that would add richness to the sound. It blended the sound of the recording into one cohesive track (Simons, 2004).

At the beginning of the recording era, producers used rooms for ambience because that's what was available to them (Simons, 2004). At the Associated and Columbia Records recording studios in the 1960s, they used their stairwells as a primary means for ambience. Engineers like Phil Ramone stated

that he would make reverb chambers out of any room that he could use. Using the properties of these chambers was part of the technique of recording (Simons, 2004).

The rooms that were used in the main studios of the 1960s were workable rooms, in that they could be altered to get different reflection and absorption characteristics (Simons, 2004). The 30th Street Columbia studios were known to have the best reverb chambers in the 1960s. As Roy Halee said, he used the reverb chambers when he recorded there, because they were great. Although the reverb chamber was the only way to get ambience on a record, when the more convenient plate and spring reverbs came out, many engineers still preferred the sound of the chambers (Simons, 2004).

Along with the changes in economics and real estate in the 1970s and '80s, Lexicon released a reverb unit in 1978 that seemed to push the chamber into the "out-of-date" status (Simons, 2007). As technology progressed and the focus became on multi-tracking, instead of capturing performances, people started using spring and plate reverbs and electronic reverb units (Simons, 2007). Reverb chambers are unpredictable (Simons, 2004). Historically, some chambers were better than others, but they were unique. Many veteran engineers claim that the reverb chamber is the superior ambience-creating tool, and claim that the more convenient methods like plate and spring reverbs, tape delays, and digital plug-ins do not compare to a live room. Many engineers feel that using separate artificial reverbs gives recordings of today a very sterile sound. Producer Roy Halee states that many records that are recorded with the musicians in isolation booths have little character and sound dull (Simons, 2004).

Today, why go through the trouble of using an actual room as a reverb chamber when room modeling offers more convenient ways to achieve ambience? Producers who have used reverb chambers claim they are superior and more unique in sound character than their virtual imitations. It depends on what one's goal is in music production. If the aim is to manufacture a product in the fastest, easiest way possible, then convenience over craft would be the way to go. However, if one is more interested in adventure, artistic process, and unique sound quality, then the craft of making a piece of art wins over convenience. Also, if you can't afford a high-quality, expensive plug-in package, using the space around you can be a cheap alternative that may actually be more unique and interesting. Your chamber is yours alone, and no one can buy it in a music store (Simons, 2007).

If you can't build a dedicated reverb chamber, nor have a good sounding room, there are many other "found" chambers that can be employed: bathroom shower stalls, stairwells, metal trashcans, aluminum heating ducts, large salon-style hairdryers, etc. (Simons, 2007). Small volumes actually can produce fairly large reverberant fields. With the right materials, motivation, and creativity, one can

make a reverb chamber, because any space with a desired sounding reverb may be used as a reverb chamber (Davis et al., 1987).

Reverb Chamber Design

Reverb chambers can be made using dedicated rooms, or somewhat small volumes (Simons, 2007). You can obtain reverb out of almost any size space; it does not have to be a large room in order to get a large reverb. As for rooms, long narrow spaces are often very well suited for reverberation. Having reflective wall materials like plaster with shellacked or high-gloss latex painted walls facilitate echo. Also rounded edges on the room corners keep the sound waves moving. The room must be sealed, and the walls underneath the plaster should be totally solid. And, one of the best ways to get a diffuse sound field is using irregular-shaped and tilted walls, with fixed concrete spherical diffusers (Simons, 2007). As for unconventional reverberant volumes, many things with reflective surfaces can be used as reverberation chambers (i.e., metal mailboxes and trashcans, small wooden boxes, and other small reverberant objects). For example, for this project, two atypical reverb chambers were built. They were not used for the technical focus of this project, however, they had interesting sonic characteristics; the *piano chamber* was an adventurous experiment, and the *beauty chamber* was a serendipitous occurrence.

The *piano chamber* that was built, consisted of the grand piano in Dolan Studios, a Vox AC15 amplifier, panel absorbers, and panel reflectors. The top of the piano was raised, and the amplifier was placed onto the metal frame. The speaker faced the piano strings in order to resonate them. Several microphone arrays, which are explained in detail in the Production section, were set up to capture the ambience of the chamber. The *beauty chamber* was a found object that was converted into a reverb chamber. It was a discarded professional-grade hair-drying unit that was being disposed of by a beauty salon in SoHo. On our way to a recording session in May 2012, Covin and I saw the hair dryer on the street, schlepped it to Dolan Studios, and rigged it up as a reverb chamber for electric guitar.

Figure 10: Piano Chamber

Figure 11: Beauty Chamber

As for setting up the chamber, there are a few considerations (Simons, 2007). One needs a microphone array and loudspeaker setup. The speaker inside the chamber should be small and facing the direction relative to the microphone that gives one the desired reverb effect. For more reverberant field and less direct signal, the speaker should face a wall, not the microphone. Facing your microphone array away from the speaker toward the opposite corners will also give one more of the reverberant field (Simons, 2007).

Engineers who use chambers swear by them, and tend to never return to the virtual options (Simons, 2007). But due to the labor intensity of making a chamber, even a small-scale one, most people don't use them, because it's easier to use a plug-in. However, if uniqueness is what you're interested in, then the chamber is the way to go (Simons, 2007).

Test Methods

For this project, two rooms were used in the Steinhardt building as reverberation chambers: the 7th floor men's bathroom and the North stairwell. These spaces were chosen both because of location (they were close to the Dolan studios patching point in the 6th floor hallway) on the North side of the building, in which street noise was nonexistent, and their desirable sounding reverberation characteristics.

Three microphone arrays were set up in both rooms, along with one full-range loudspeaker. Measurements of the rooms' dimensions and the microphone placements were made; building materials of each space were assessed. An impulse response (IR) and sine sweep were played through the loudspeaker and recorded through each microphone array. The IR and frequency response sound files were later analyzed using Matlab.

Once all of the measurements were made, the reverb chambers were used for specific music tracks. One music part for each of six songs was chosen to run through a mono loudspeaker in either

one of the two reverb chambers. For example, the drums in the song *Summer Never Ends* were played back through the loudspeaker in the North stairwell reverb chamber, and re-recorded through each of the three microphone arrays. Then the three newly tracked drums were compared sonically in post-production and chosen according to the most desirable sounding reverberation. This aesthetic choice was based on the conceptual intent, and/or sonic appropriateness for the song. Once the reverberation was chosen, the "chambered" track was either mixed in with the dry signal or used by itself.

Equipment:
(1) Alesis loudspeaker
Impulse response
Sine sweep
Matlab RT_{60} Analysis Program

Mic Arrays:
Double MS: Shure VP-88
Spaced Pair: DPA 4006
Quad: Earthworks M30

Reverb Chambers

7th floor men's bathroom (Urinal Chamber): The walls are covered in bath tile, and a dense painted wall (actual material unknown). The flooring is Terrazzo. There is a large mirror on the wall, along with two ceramic sinks, two ceramic toilets and urinals, and two metal stalls. The illustration on the next page shows the layout and dimensions of the room, along with loudspeaker placement and microphone arrays.

Absorption coefficients for construction materials in Urinal Chamber:

Material	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Ceramic Tile	0.01	0.01	0.01	0.01	0.02	0.02
Terrazzo Flooring	0.01	0.01	0.015	0.02	0.02	0.02

Figure 12: (Rossing, 2007)

North stairwell chamber: The walls, ceiling and stairs are made of concrete. A 9-foot wall of panel absorbers was constructed behind the speaker in order to block noise from the meter system behind the door at the top of the stairs. The illustration below shows the layout and dimensions of the stairwell, along with loudspeaker placement and microphone arrays.

Absorption coefficients for construction materials in Stairs Chamber:

Material	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
Concrete Block	0.01	0.05	0.06	0.07	0.09	0.08
Painted Concrete	0.01	0.01	0.02	0.02	0.02	0.02

Figure 13: (Rossing, 2007)

Reflective Properties

Upon initial assessment of the two reverb chambers, we assumed that the stairwell would offer a longer reverb time, because it was significantly larger. During testing and analysis, it was surprising to find that the Urinal Chamber offered a longer reverb time than the stairwell, mainly because it is a much smaller room.

For the Urinal Chamber, the Schroeder Frequency may explain why acoustic expectations were not met. The Schroeder Frequency of the Urinal Chamber of 942 Hz is much higher than the SF for the stairwell at 227Hz. The modal resonances in the Urinal Chamber may have caused the room's unexpected acoustical behavior.

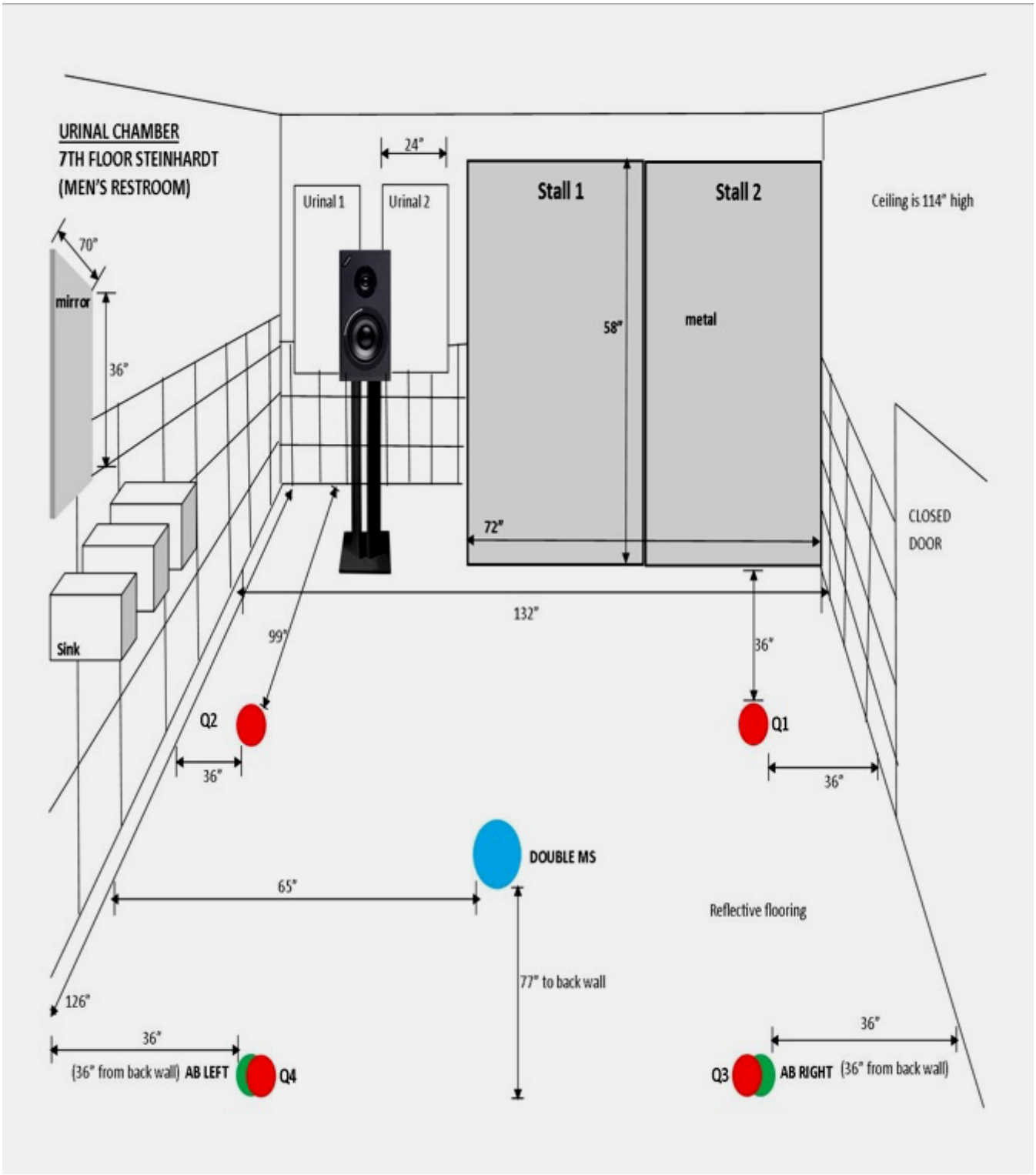

Figure 14: Urinal Reverb Chamber

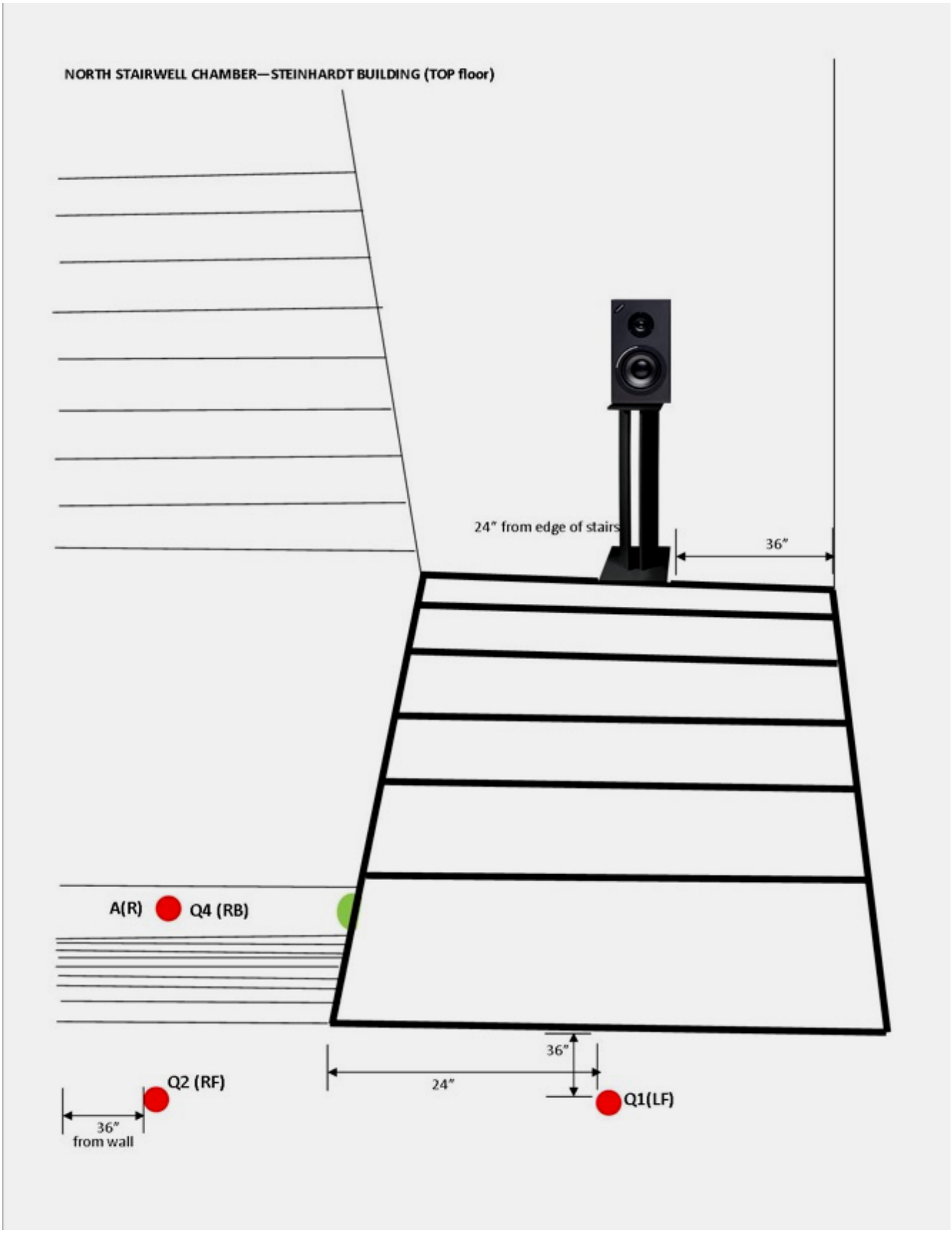

Figure 15: Stairwell Reverb Chamber – 1st Floor

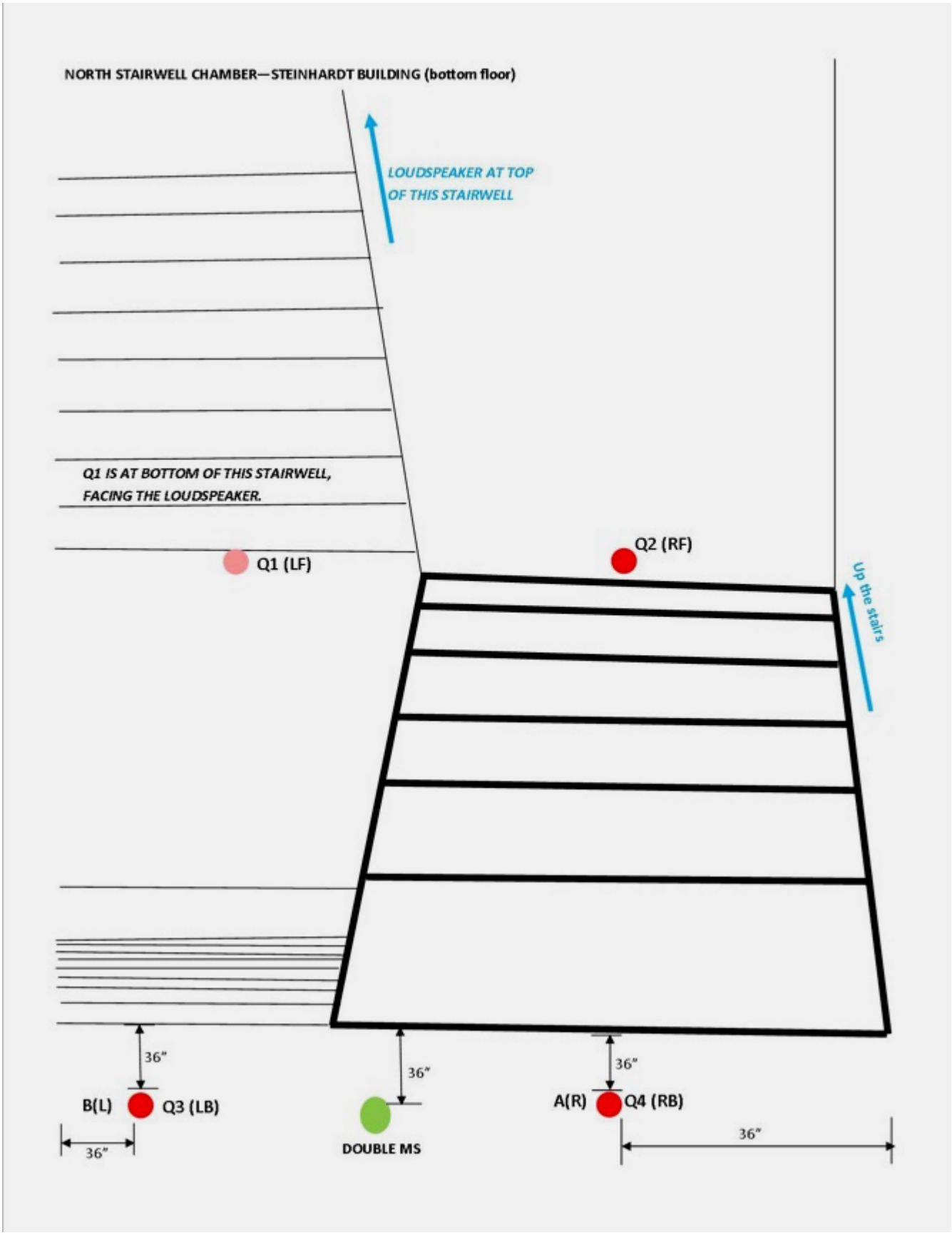

Figure 16: Stairwell Reverb Chamber – 2nd Floor

Data Analysis

A Matlab program for RT_{60} analysis was written for this project. The data produced consist of graphs indicating decay times for octave bands starting from 125Hz, up to 8kHz. Therefore, frequency characteristics of the reverb chambers are also observed.

Impulse responses for each of the microphones in the three arrays were run through the Matlab program. For each of the arrays, all of the decay times for the microphones were averaged, giving the total RT_{60}. The three arrays' data were plotted on a graph for each reverb chamber so that the frequency characteristics and RT_{60} could be observed and compared. The reverb characteristics were correlated with the aesthetic choices that were made regarding the chambered tracks. Therefore, a deeper understanding of the preferred reverb chambers' characteristics along with the preferred mic arrays was gained, and can be used in the future to make more informed aesthetic decisions.

TEST RESULTS (all time values in seconds)
RT_{60} Analysis

Urinal Chamber

Double MS:

SR1 (125Hz–8kHz) octave bands:
6.7764 6.7763 6.7763 6.7761 6.7673 6.6248 5.7948

LM1 (125Hz–8kHz) octave bands:
6.8303 6.8303 6.8303 6.8301 6.8193 6.7358 6.9288

LM2 (125Hz–8kHz) octave bands:
7.0852 7.0852 7.0852 7.0851 7.0849 7.0256 6.6477

SR2 (125Hz–8kHz) octave bands:
7.0400 7.0399 7.0360 7.0356 7.0308 6.8332 6.3614

$RT_{60(DBL\ MS\ avg)}$ (125Hz–8kHz) = 6.932_{125Hz} 6.932_{250Hz} 6.931_{500Hz} 6.931_{1kHz} 6.925_{2kHz} 6.804_{4kHz} 6.433_{8kHz}

Quad:

Left (125Hz–8kHz) octave bands:
6.3384 6.3384 6.2940 6.2940 6.2940 6.3926 6.1565

Left Back (125Hz–8kHz) octave bands:
6.3501 6.3501 6.3501 6.3500 6.3500 6.3914 6.0544

Right (125Hz–8kHz) octave bands:
6.3553 6.3554 6.3554 6.3554 6.3554 6.3826 6.1266

Right Back (125Hz–8kHz) octave bands:
6.2973 6.2973 6.2973 6.2972 6.2972 6.4031 6.0025

$RT_{60(QUAD\ avg)}$ (125Hz–8kHz) = 6.335_{125Hz} 6.335_{250Hz} 6.324_{500Hz} 6.324_{1kHz} 6.324_{2kHz} 6.392_{4kHz} 6.085_{8kHz}

Stereo Pair:

Left (125Hz–8kHz) octave bands:
6.5470 6.5470 6.5470 6.5470 6.5467 6.5750 6.6117

Right (125Hz–8kHz) octave bands:
6.5247 6.5247 6.5248 6.5247 6.5973 6.6025 6.2232

$RT_{60(STEREO\ PAIR\ avg)}$ (125Hz–8kHz) = 6.535_{125Hz} 6.535_{250Hz} 6.535_{500Hz} 6.535_{1kHz} 6.572_{2kHz} 6.588_{4kHz} 6.417_{8kHz}

Stairwell Chamber

Double MS:

SR1 (125Hz–8kHz) octave bands:
5.3451 5.3451 5.3451 5.3451 5.3451 5.4320 5.2853

LM1 (125Hz–8kHz) octave bands:
5.3894 5.3894 5.3894 5.3894 5.3894 5.3893 5.3455

LM2 (125Hz–8kHz) octave bands:
5.3722 5.3722 5.3722 5.3722 5.3722 5.3517 5.3439

SR2 (125Hz–8kHz) octave bands:
5.3205 5.3205 5.3205 5.3205 5.3205 5.3933 5.3574

$RT_{60(DBL\ MS\ avg)}$ (125Hz–8kHz) = 5.356_{125Hz} 5.356_{250Hz} 5.356_{500Hz} 5.356_{1kHz} 5.356_{2kHz} 5.391_{4kHz} 5.333_{8kHz}

Quad:

Left (125Hz–8kHz) octave bands:
5.3052 5.3052 5.3053 5.3053 5.3051 5.3053 5.2901

Left Back (125Hz–8kHz) octave bands:
5.3597 5.3597 5.3597 5.3597 5.3597 5.3774 5.3251

Right (125Hz–8kHz) octave bands:
5.3495 5.3495 5.3495 5.3629 5.3629 5.3847 5.1949

Right Back (125Hz–8kHz) octave bands:
5.2166 5.2166 5.2166 5.2166 5.2166 5.3414 5.3150

$RT_{60(QUAD\ avg)}$ (125Hz–8kHz) = 5.307_{125Hz} 5.307_{250Hz} 5.307_{500Hz} 5.311_{1kHz} 5.311_{2kHz} 5.352_{4kHz} 5.281_{8kHzs}

Stereo Pair:

Left (125Hz–8kHz) octave bands:
5.4829 5.4829 5.4829 5.4829 5.4829 5.4827 5.3140

Right (125Hz–8kHz) octave bands:
5.4503 5.4503 5.4503 5.4504 5.4504 5.4377 5.4298

$RT_{60(STEREO\ PAIR\ avg)}$ (125Hz–8kHz) = 5.466_{125Hz} 5.466_{250Hz} 5.466_{500Hz} 5.466_{1kHz} 5.466_{2kHz} 5.460_{4kHz} 5.371_{8kHz}

REVERB CHAMBERS (RT_{60} COMPARATIVE)

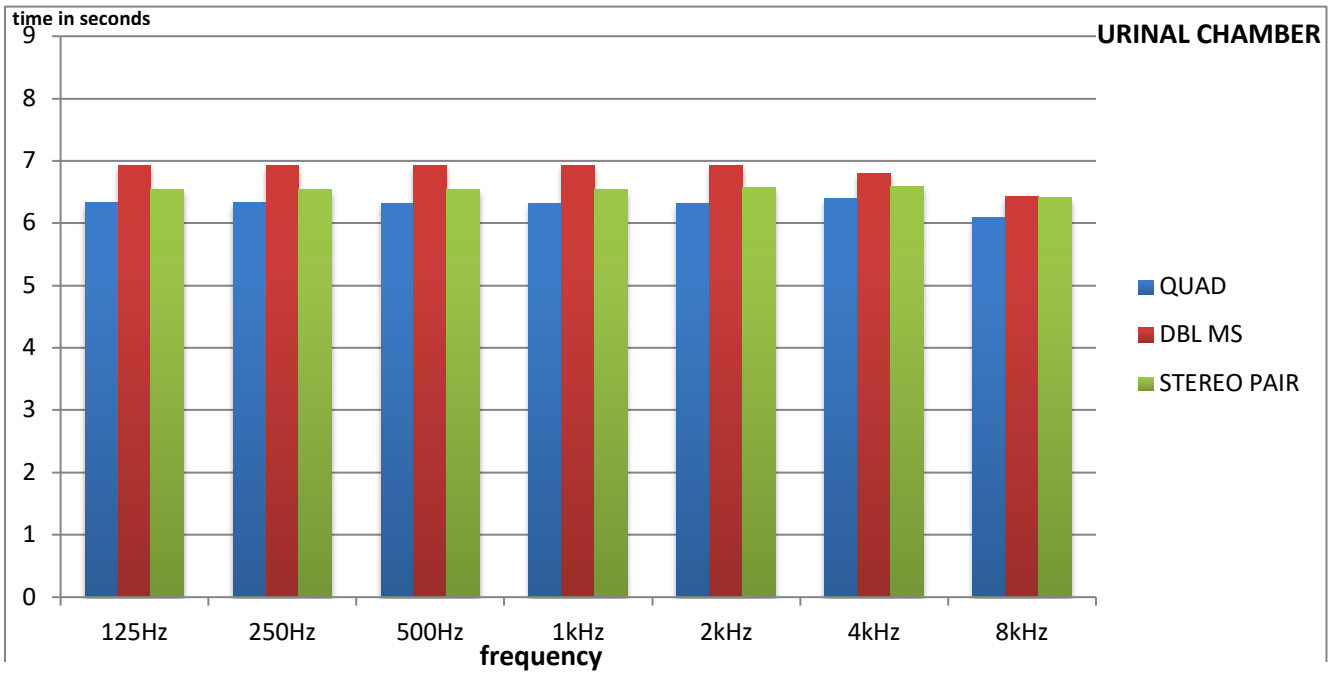

Figure 17: RT60 – Urinal Chamber

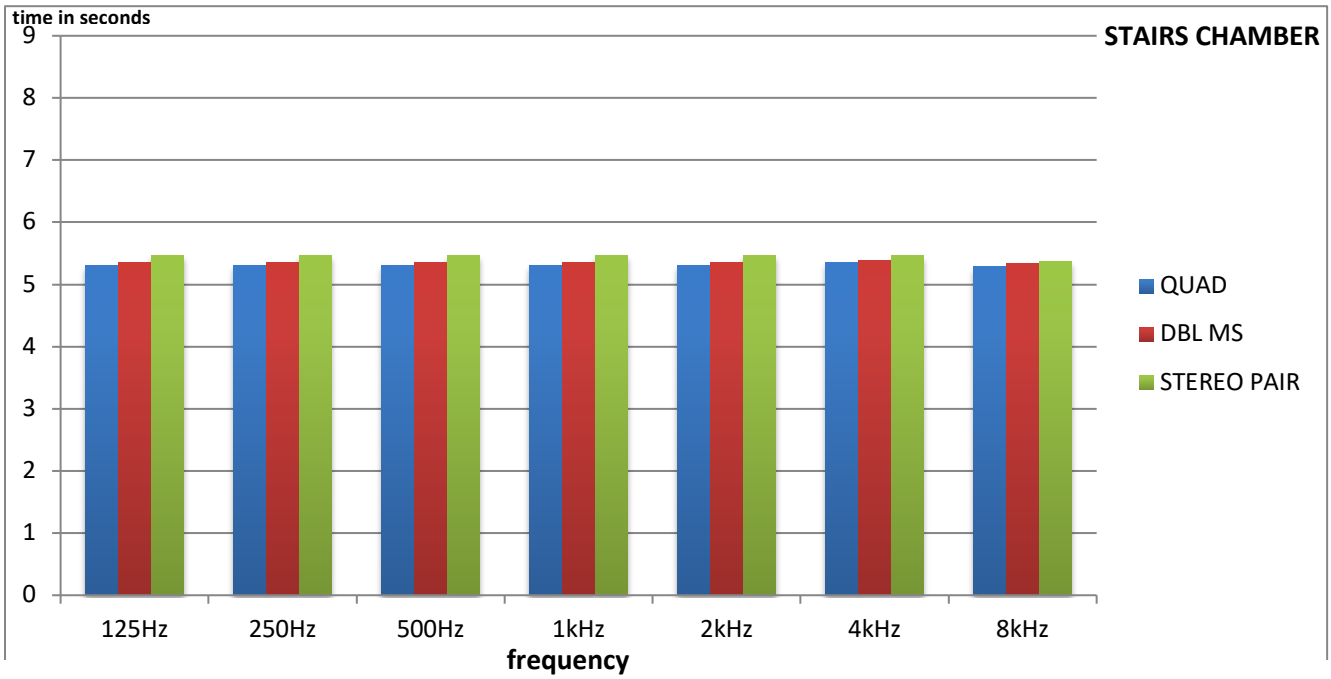

Figure 18: RT60 – Stairs Chamber

Phase and Width Analysis:

All of the microphone arrays for each song were soloed to determine phase and width characteristics. Visual observations of these properties were recorded on an illustration of the SSL phase meter. The results are as follows:

Stairwell Chamber:

Double MS - for *SNE* & *Challenger*, it showed negative phase correlation. For *Smallest Bird*, it showed both positive and negative correlation equally. It gave the most width for *Smallest Bird*, and it was equal in width to the Quad for *SNE* & *Challenger.*

Quad – for all three songs, it showed positive phase correlation.

Spaced Pair – For *SNE,* it showed an equal signal in the stereo field; while it showed negative phase correlation for *Challenger* & *Smallest Bird.*

Urinal Chamber:

Double MS – For all songs, it showed negative phase correlation.

Quad – For *Oh My Heart*, it showed positive phase correlation. For *SNE*, it showed an equal signal in the stereo field, and for *Whipporwil*, it showed positive phase correlation. This array gave the most width for all three songs.

Spaced Pair – For all songs, it showed positive phase correlation.

Microphone Array & Reverb Chamber Sonic Preferences:

ARRAYS		
QUAD		Back Vocals (SNE) Back Vocals (Chall)
DOUBLE MS	Drums (OMH) Drums (SNE) Drums (Whipor)	Back Vocals (Bird)
LARGE AB		
REVERB CHAMBERS	Urinal Chamber	Stairs Chamber

Table 1: RT60 – Microphone Array Choices

DISCUSSION

The data derived from the impulse responses for each reverb chamber and microphone array were compared to the objectives regarding the aesthetic choices made. For the background vocals, Pirler and I wanted a highly saturated, high-end quality for the reverb characteristic, to accentuate the timbral characteristics of the backing vocal and dramatically contrast the dry lead vocal. We auditioned both chambers by ear, and chose the stairwell chamber for post-production of the background vocals. For the drums, we wanted a uniform reverberant quality with a slight boost in the lower mid frequencies. We, auditioned both reverb chambers, and decided upon the Urinal Chamber.

Background Vocals

The microphone arrays that were chosen for the background vocals were the Quad and the Double MS in the Stairwell Chamber. The RT_{60} of these setups are the shortest for all six possibilities. However, the Quad has the longest relative decay time at 1kHz, to decay times less than 500Hz, of the six possibilities; and the longest relative decay time at 4kHz, to the decay times less than 500Hz, of the arrays in the stairs chamber.

Since the stairs chamber gave the shortest reverb times, it makes theoretical sense that it was chosen for vocal processing, when one objective was intelligibility. Also, the aesthetic decision to select a reverberant quality that has the most high-end, may theoretically be supported by the fact that there is a 1kHz boost, relative to frequency content less than 500Hz, for the Quad array in the stairs chamber. However, the Quad array was selected for two of the three songs only, *Summer Never Ends* and *Challenger*, and for those songs, it wasn't the brightest *sounding* array, when it was soloed. However, it did offer the most depth, and perhaps this quality took aesthetic precedence over high-end. For the 3rd song, *Smallest Bird*, the Double MS was used. It was in fact the brightest sounding array for that song, as well as offering the most width.

Though Pirler and I had specific aesthetic objectives in mind for the production, with regard to reverberant quality, theoretical observations of what was chosen can be summarized as follows: The reverb chamber with the shortest RT_{60} was chosen to process the background vocals perhaps to enable intelligibility of the content. The array with the most relative high-frequency content however, was not chosen for any of the three songs. Lastly, the array offering the most depth *or* width, was always selected.

Drums

The microphone array that was chosen for the drums for all three songs, was the Double MS in the Urinal Chamber. The test data indicated the properties of this setup as having the longest reverb decay time (6.9s), while also having the least amount of high-frequency content of all arrays tested in both chambers. It shows that at 4kHz and 8kHz, decay rates are from 120ms to 500ms shorter than the lower frequency content, which is the biggest difference between higher and lower frequency decay times for all arrays in both chambers. The data correlate with our initial aesthetic objectives, because we wanted a highly saturated and timbrally uniform drum sound, with a slight attenuation at high frequencies. As for depth and/or width, the double MS offered the least of both, compared to the Quad and Spaced Pair, as indicated by the console's phase meter and the sonic comparisons. So it seems that depth and width were not an aesthetic priority for the drums within the context of the songs. Instead, the double MS was chosen because it was at the front of the sound stage and took up more space in stereo field.

There was an interesting contradiction with regard to spectral content, for sound quality of the Double MS vs. test data. The phase negatively correlated; thus, there may have been phase cancellation in lower frequencies, causing it to actually sound the brightest of the three arrays, instead of what the data suggest, the most attenuated at high frequencies. Pirler and I ended up preferring the more high-end quality of the Double MS, as opposed to our initial objective for a reverberant quality with more uniform spectral content, with an *attenuation* at high frequencies.

PRODUCTION PROCESS

Production Philosophy

The most important element in a music production is the artistic integrity of the work. Assessing all of the tools available, such as repertoire, people, and technology; carefully choosing which to employ; and doing so skillfully, are what create this integrity. Every component of the production is important, from clerical organization of sessions to the music composition skills.

There are many facets to achieving artistic integrity. One of the main components is complete surrender to the creative process, which has completely unknown outcomes; this is about risk taking, and trust in the process. Only when everyone involved surrenders to the creative energy is something great achieved. Finding artists who are willing to give up personal agendas and control is rare; so choosing the artists with which to embark on such a creative journey is the first important step in making a great music production. All people involved must be artists at what they do, rather than simply skilled technicians. They must be emotionally invested in, and completely dedicated to, the musical integrity of the project.

The next step is knowing all of the technology that is available, assessing which is appropriate for the task at hand, and using it skillfully. The technology can range from the rooms in which to capture performance to which EQs will be used on each instrument. Using the most appropriate technology, and also knowing which technology not to use, are of paramount importance. For this project, because this was music that was heavily influence by the folk aesthetic, the objective was to have a very natural overall sound, so the technology employed supported that aesthetic. For instance, the LA2A compressor was used on the DI bass as an enhancement tool because it provided the most transparent, smooth compression available, without making the bass sound compressed. However, when sound coloration was desired, the API compressor was used as more of a compression effect, as when it was used for stereo compression of the drums to severely alter the sound. Any piece of technology must be used solely to support the artistic integrity, not just because it is there. Depending upon the genre of music, technology significantly shapes the artistic content.

Lastly, each production project is approached individually, with its specific needs in mind. There is no formula to making a music production. Prior to beginning the project, content is scrutinized and inquired about, and concepts are discussed among all the artists involved. Specifics that can be logically planned before and during the project are done (i.e., which musicians to assemble, which spaces to use, instrumentation, technologies to employ, etc.). Finally, when in the midst of making the production, a

fine balance between raw instinct and intellect must be achieved, and the creative flow must be surfed skillfully and with wild abandon.

Production Approach

I decided upon a production concept for this project after reviewing all of the demos, finalizing the repertoire, and brainstorming with the core artists involved. I concluded that because the songs were folk-based ballads, they required a minimalist production approach, with emphasis on capturing performance, and using multiple perspectives of the rooms to create color. This also meant editing sparingly, simply for building overall great performances. For instance, choosing the best chorus from one take and using it with the best verse from another take was acceptable, as long as the overall feel had continuity. However, lining up instruments so that they were metronomically perfect or tuning every vocal note was out of the question. I consciously left in many human imperfections because the aesthetic called for it.

The initial demos clearly expressed the essence of what the writer was saying. They were well-crafted stories supported by strong melodies and harmonic structures. However, the songs needed basic arrangement finessing as far as tempo and form adjustments. The original tempos were somewhat the same from song to song. Because this project was going to be approached as an album of music, rather than a number of separate songs, the tempos needed to have more variety. Many of the tempo changes also lifted the songs up into a livelier feel. Form issues were addressed in order to tighten up arrangements and add unpredictability and dynamicism. Core instrumentation was the next consideration. Because these were straightforward singer-songwriter pieces, I decided upon a traditional folk-rock core instrumentation of acoustic guitar, vocals, bass, and drums. The core instrumentation was to sound the same throughout the production – rather than, for example, changing the sound of the drums for each song. It was also decided that any auxiliary instruments would be added prior to recording the basic instrumentation of the songs, and that these auxiliary instruments would be what could sonically change drastically from song to song; they would be the musical elements that provided variety, while the core instrumentation would provide a strong foundation and sonic continuity. Also, these songs were to sound finished with the core acoustic instrumentation alone. Overcrafting the production would have killed the raw spirit of the songs. The songs needed a strong instrumental support system, not drastic production tinkerings. The goal was to solidly support the songs and to magnify the essence of what was already there.

The next step was finding the right musicians to provide strong musical support to the songs, as well as the right production team to provide technical and creative support. The music was intimate, and I wanted the production to sound the same. This required establishing a band, rather than plugging in various studio musicians to play parts. And it was imperative that the musicians not only be emotionally invested in the project, but highly skilled and uniquely talented. Naturally in line with the folk aesthetic, I called upon my friends.

For drums, Ian Cook was chosen because of his dedication, versatility, musicianship, and ability to bring a jazz rhythmic complexity to the project without being cheesily jazzy. I decided upon myself as the bassist because I had played music with Covin for many years, and knew what bass lines to write for her songs. The piano, which was sort of a bridge instrument between core and auxiliary instrumentation, was played by two talented pianists with very different styles. Jess Rowland lent a somewhat dark, odd and jazzish influence to the more gritty tunes on the project, while Senem Pirler had a lighter classical sensibility that went nicely with the tunes that called for that approach.

The production team was built organically over a year's time. I met Pirler at a Music Technology meet-and-greet in 2010. We slowly became friends, eventually collaborating on one of my production projects in my Brooklyn studio. We both decided that we made an excellent production team due to my organizational and leadership skills and Pirler's technical finesse and tactful communication.

As for which technological tools would be used, Pirler and I had state-of-the-art equipment at our disposal: some of the best plug-ins (i.e., virtual environments, filters and FX, etc.), high-end microphones, treatable rooms, expensive hardware EQs, and compressors. However, each tool needed to have a purpose, rather than be used for convenience, or simply because it was there.

Because I wanted to focus on capturing superb performance in the most natural way, the obvious technological tools to focus on were multiple microphone techniques, along with exploiting various perspectives of real spaces. I wanted to have as many choices in timbre, depth, and width at the performance level, and use as little processing in post-production as possible in obtaining these qualities. After all, this was a collection of intimate folk songs written for no other reason than to express intimate feelings, so the production needed to be simply about capturing that sentiment.

Microphone Techniques

The primary interest for this project was creating a variety of tone color, depth, and width by using various microphone techniques. Multiple surround, boundary, and support microphone arrays were set up for the acoustic guitars, drums, banjo, piano, piano reverb chamber, and electric guitars. In post-production during technical mixing, the various arrays were auditioned and then selected.

Achieving stellar acoustic guitar sounds, specifically, was very important. In particular, one objective was to capture the transparent warmth of the Martin, and juxtapose that with the brighter sound of the parlor guitar for the second layer. There was a lot of experimentation with many different micing techniques, which were inspired by the classic reference guide, *Microphone Manual,* as well as from newfound knowledge of surround techniques from the summer *Recording Techniques I & II* Tonemeister courses. Eventually, there was a micing technique grid that was decided upon for the acoustic guitars, which was slightly altered, depending on whether one was recording the 1st or 2nd layer acoustic guitars or the overdubs.

The primary microphone grid for all of the acoustic guitars was made up of seventeen microphones arranged in ten different arrays. Support mics, boundary mics, stereo, and an Omni Square surround array were used. Some of the favorite mics and techniques used were the Omni Square, made up of four Schoepps; the Overhead Center (Schoepps Omni), placed three feet above and behind the player's head; and the Royer R121 stereo support mic. The R121 was a warmer and smoother compliment to the U87. The Omni Square was used in two different ways to achieve depth; sometimes the front L/R mics were used, while other times the back L/R mics were used.

One area of experimental microphone use was in the Piano Chamber. The PC was a structure that was made in the studio by Pirler and myself. The objective was to use the grand piano in Dolan Studios as a reverb chamber. A wall of panel absorbers and reflectors were built surrounding the piano, while a Vox AC15 amplifier was placed face down toward the piano strings on the metal frame inside the piano. The electric guitar was routed through the Vox and the output vibrated the piano strings, which created dissonant resonances. Various microphone arrays were set up within the chamber to capture these sounds. High and low stereo pairs, two boundaries, and a bottom support mic were the arrays that were used in the chamber, with the boundary mics mostly being favored in post-production.

In technical mixing, mic arrays were chosen, sometimes changing throughout the song, when the desire was to open or close, widen or narrow the sonic space. This approach provided subtle changes in depth, width, and tone color while retaining an overall natural-sounding production. For more information on all microphones and techniques used for each song, please see Appendix.

Project Methods

I chose to work with singer-songwriter Sandra Covin because she provided solid musical material and was open to any production outcome. Covin presented 15 acoustic guitar/vocal demos as candidates for this project. I, along with collaborator Senem Pirler, listened to the material, discussed the potential for each song with Covin, and chose 13 of the 15 songs to record. In January of 2012, Pirler and I worked on the arrangements and made new demos for each of the songs. With Covin's final approval, draft song arrangements were finished in mid-February.

In February and March 2012, Cook and I rehearsed Cook's drum compositions for the songs. During this time, I also started writing the bass lines. There were discussions about auxiliary instrumentation as well; the idea was to keep them at a minimum and to focus on those choices during post-production.

The next step was to coordinate the sessions for laying down the basic tracks. I decided that all of the drums for the 13 songs would be recorded in 2 ½ days, along with scratch acoustic guitar and lead vocal lines. I opted out of tracking bass during the drum sessions because I needed to focus on engineering and production during that time. I scheduled two rehearsals for Cook and Covin two days prior to the initial recording date. They ran through all of the songs and made any last- minute arrangement changes.

The first drum session started on a Friday night at 9 PM. It took about eight hours to set up the drum mics and get the right drum sounds. We decided to start tracking the next morning. Time was of the essence, so Covin, Pirler and I had to sleep in Dolan Studios on dirty absorber blankets for the weekend because we could not leave the studio without having to tear down the drum setup. We successfully finished recording drums for all 13 songs by Sunday at 5 PM. The next step was choosing the drum performances, and then recording all of the acoustic guitars, banjos, and lead vocals. Everything had to be doubled, and the vocals sometimes tripled—in one week because Covin had to go back home to St. Louis.

For the lead vocals, a vocal booth with absorber and reflective panels was set up in the live room. The Coles 4038 was "ab'd" with the U87 to see which primary vocal mic would be used for Covin. It was decided that the Coles 4038 would be used for the first-layer lead vocals, while the second- and third-layer overdubs would be recorded with the U87. This created a full sound for the overall lead vocal, with the Coles suiting Covin's mid-rangy voice, and the U87 providing presence.

Due to my full-time day job, the recording sessions ran from 10 PM to 7 AM. Despite various mental breakdowns, everyone survived the first week and reached the recording goals. It was decided

that Covin would return in late July to record all of the electric guitar parts and the rest of the lead vocals. For the next several months the recorded material was edited; this mostly meant selecting and building performances from various takes. Also during this time I continued writing and recording the bass parts and background vocals.

Through the summer Pirler and I overdubbed more instruments over the basic tracks. For piano, I wanted very different approaches to some of the songs. Therefore, I asked two pianists with highly contrasting stylistic perspectives: Jess Rowland, an experimental visual artist and composer who played Jazz, progressive rock, and noise music, and Senem Pirler, a classically trained musician with a more traditional approach. The auxiliary instruments were Rhodes, group vocals and accordion. For the group vocal section in the song *Challenger*, Pirler and I enlisted random people who were hanging around the 6th floor.

When Covin returned in July, we began recording the electric guitars. The electric guitar parts provided a big contrast to the earthy acoustic vibe of the basic tracks. They were ambient, with much delay and reverb, which added dimension and color to the recording. Several amplifiers were used, and differed according to the song. The electric guitar amping system consisted of a dual parallel mono configuration. One signal was routed through a Rivera Fandango 212A and was set up in the big live room, while another signal went through a Vox AC15 located inside the piano chamber, which was set up in the smaller live room. For the mono overdubs, the amps used were Pignose, Peavey Rage, Honeytone, and Roland Jazz Chorus.

A modified Hamasaki surround array, along with two support mics and a stereo pair were employed to record the clean and mono electric guitar signals. The modification to the Hamasaki was that one cardioid was substituted for the center mic, instead of using the usual three cardioids plus a baffle. The Beauty Chamber was a found object that was used as a reverb chamber. It gave a superb high mid-range quality to the electric guitar signal that was used as an effect on a few of the songs. For the remainder of the summer the rest of the editing and recording was completed.

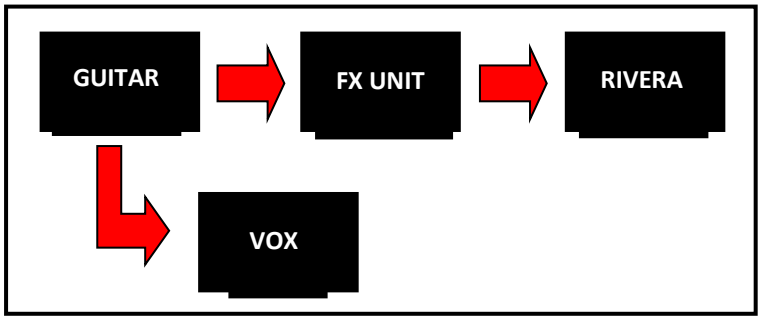

Figure 19: Dual Parallel Mono Configuration for Electric Guitar

The next part of the project entailed the use of two reverb chambers: Steinhardt's North stairwell, and the 7th floor men's bathroom. Selected parts for some of the songs were to be played back in the chambers, and rerecorded using three microphone arrays. I decided to rerecord backup vocals and drum overheads in the reverb chambers. With regard to vocal production, my idea was to contrast the dry lead vocals with very ambient, lush background vocals. For the drum overheads, I wanted a dense reverberation. Specifically for the song *Summer Never Ends,* I wanted a highly saturated, warm, full-bodied reverberant sound for the drums. The song had a very Motown-influenced melodic and harmonic structure and drum beat. I was going for the "wall of sound" production quality that was typical of the recordings of that time. The reverb chamber (7th floor men's bathroom) provided those sonic characteristics perfectly.

The reverb chamber recording session was physically demanding. Pirler and I worked for 25 hours straight to complete the recordings. Three microphone arrays were set up in both spaces to capture a mono signal from one full-range loudspeaker. A stereo pair, a quad array, and Double MS were used to capture playback of background vocals, then drums for 5 different songs. A 9-foot wall of panel absorbers was erected in the North stairwell to shield noise coming from the wall-mounted meters. This recording session was by far the most exhausting session of the project due to setup and breakdown, as well as the initial troubleshooting issues of the signal path.

The next endeavor was reamping the bass. Two amps were used, along with a DI signal. Amplifier 1 was an Ampeg Diamond Blue Flip Top, which was set up in the isolation booth and miced with a Coles 4038. A Rivera Fandango 212A was used exclusively to capture the high end; it was set up in the live room and miced with an SM57. The DI signal was routed through the LA2A compressor.

There was also the issue with backing up sessions. I was adamant about having a minimum of two backup systems. The sessions were becoming larger and larger, therefore backup time was increasing significantly, taking up to 15 hours at a time to back up the entire project. After most of the editing was completed, Pirler and I had to clean the sessions. This meant deleting unused playlists and erasing unused tracks. This process took approximately 40 hours.

After the session cleans were finished, the project went into post-production, which was divided into two parts: technical and creative mixing. The general idea for technical mixing was: First, the microphone arrays that would be used for each instrument were selected; first draft pans and volumes were set for all instruments; and basic mix arrangements were crafted. Then outboard EQs and compression settings were processed and recorded for each track. For creative mixing, the reverb chamber tracks were imported and selected; and pan and volume settings were finessed. Mix

arrangements often changed slightly or drastically during this part of the process, and all FX processing and automation was performed. Usually five or six creative mix drafts were made before the final mix was settled upon.

POST-PRODUCTION

Mixing Philosophy

The mixing process is divided into two parts: technical and creative mixing. While both processes are entirely different, and require completely different approaches, they are interrelated, and there is some interplay between the two processes. However when doing one or the other, one can focus more clearly on the distinct objectives required for each process.

During technical mixing, it is important to focus on all of the aspects that make a well-balanced, sonically cohesive mix. Equalization, compression, balance between instruments, masking, and sound-stage placement are the technical considerations when dealing with each instrument. Also, how each instrument relates with all other instruments, from a purely technical standpoint, must be logical, while still supporting the overall aesthetic. The order of steps in technical mixing is specific and invariable, but sometimes changes are made later to previous technical decisions.

In general, during the technical mixing process, a basic arrangement of the composition is decided upon; for example, the entrances and exits of instruments, layering, and any song length changes. Then each instrument is dealt with accordingly: the microphone techniques, if applicable, are chosen; it is equalized and compressed appropriately; and rough panning and volume settings are dialed in. Also, some reverbs, or other creative filtering may be added, if the impulse occurs. Lastly, a rough mix is made and reviewed for any last technical changes that are needed.

The second step to the mixing process and, for me, the most exciting and “magical part” of an entire music production, is creative mixing. This is where the production team must become totally open to the creative forces, and allow them to work their magic on the song. This is when unexpected things happen that can completely change the sound and direction of the mix.

During this process anything can happen. Compression and EQ changes may be made; overdubs are sometimes added to what previously seemed like a finished composition, and so on. This is the most fragile, frustrating, and joyous part of the music making. On one hand, one can become totally lost as to where the mix is going. Or, it can be the time when one gets completely taken away by the creative forces, and the mix comes into fruition almost effortlessly. Usually, the process is a mixture of these two extremes, and is finally finished when this interplay is completed, and when one believes that no more changes to the mix need to be made

Mixing Process – *Challenger*

Challenger was chosen for the mixing analysis because it most strongly represents the fundamental sound and sentiment of the entire project. It is not the flashiest, nor the most minimal, nor the most experimental mix of the project. Instead, it is the most straightforward mix, while still creating a feeling of otherworldliness with some of its subtle production choices, which were made with an effort to support the narrative of the piece.

Technical Mixing

This part of the mixing process was very methodical and calculated. The most intensive and scientific listening occurred during technical mixing. For example, almost every instrument was referenced to an instrument on a CD that Pirler and I wished to emulate. The sound from the reference was deconstructed verbally by us, and EQ and compression were applied accordingly. A photo was taken of the outboard gear settings for each instrument and applied to the same instrument for the entire project. However, the electric guitars had more variability from song to song with regard to EQ and compression.

Instruments were processed in the following order: drums, acoustic guitars, bass, piano, lead vocals, Rhodes, electric guitars 1 & 2, background vocals, and reverb chamber arrays. For each instrument, microphones were chosen; then each microphone was equalized and compressed with outboard gear. All EQ and compression were printed back to the DAW. Lastly, general effects, if any, were applied; and basic volume and panning were added.

Drums

Each drum was referenced from a CD that I wished to emulate. The kick drum was Phil Collins' on Brian Eno's *St. Elmo's Fire*; the snare was from the Beatles' *Drive My Car*; and the toms are from Big Star's *September Girls*.

INSTRUMENT	**EQUALIZATION**	**COMPRESSION**	**EFFECTS**
Kick Hole	**Manley:** Boost 68Hz @ 13dB Bell	**API2500:** Thr: +8 Att: .1 Ratio: 10 Rel: .1 Tone: hard, norm, old	
	-11dB @ 580Hz Bell		
	-9dB @ 4kHz Shelf		
	-12dB @ 1kHz8 Bell		
Kick Beater	**Manley:** Boost 100Hz @ 8dB Bell	**API2500:** Thr: -8 Att: .1 Ratio: 10 Rel: .1 Tone: soft, norm, old	
	-14dB @ 1kHz2 Bell		
	-12dB @ 5kHz Shelf		
High Hat	PTEQ: Hpass from 734 Hz -2dB @ 3.5kHz		
Snare Top		Elop: 20 Output 10:00 Fet Lmt: 3:00 Rel: 10 Input: max	**Full Snare:** TrueVerb: Dim: 3.0 Size: 5516 Dist: 10.02 Decay: 1.2

			Density: .850 Lowcut: 16
Snare Bottom			Low: 511 & 1.3x High: .4x, 7104 Rshelf: -3 ER: -6 High F: 4095
Hi Tom	Low cut @ 53Hz **Waves:** -5.5dB @ 231Hz +7.6dB @ 6.8kHz		
Floor Tom	Low cut @ 50.9Hz **Waves:** +4dB @ 90Hz +1.5dB @ 151Hz -7dB @ 866Hz	**API2500:** Thr: -20 Att: 1 Ratio: 10 Rel: .1 Tone: Hard, Norm, New	
Overheads	low cut from 397Hz **Waves:** -4dB @ 707Hz +2.5dB @ 14kHz		**TrueVerb:** Dim: 3.0 Size: 5516 Dist: 10.02 Decay: 1.2 Density: .850 Lowcut: 16 Low: 511 & 1.3x High: .4x, 7104 Rshelf: -3 ER: -6 High F: 4095

Table 2: Drums Processing Settings

Acoustic Guitars

The first layer of acoustic guitars was referenced to Big Star's *#1 Record* for a very bright, high-end sound. The second-layer acoustic was referenced to Nick Drake's *Pink Moon* for a rich, dark tone. Both guitars had entirely different sounds that complemented each other perfectly. They were each hard panned in opposite directions. Once the sound was achieved for both layers of acoustic guitars, it remained the same for every song.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Acoustic GTR1	**API550A:** +2dB @ 5kHz +6dB @ 3kHz -12dB @ 40Hz High Pass on	none	
Acoustic GTR2	**API550A:** +6dB @ 5kHz +4dB @ 1.5kHz -2dB @ 300Hz	none	

Table 3: Acoustic Guitars Processing Settings

Bass

There were many fingering styles and techniques played on the two different basses used on this project. Some of them were traditional fingerstyle, pick-playing, extended fretless techniques, harmonics, and so on. So the timbres varied. I did not try and emulate a bass sound from a CD, as we had for the drums and acoustic guitars. Rather, the objective was to place the bass correctly in the mix, mostly just on top of the kick drum, or if it was a bass solo, in the higher register.

In *Challenger,* there were three bass signals to deal with: the DI for punch, the reamped Ampeg for a full low end, and the reamped Rivera for high end. A submix of the three tracks was made that was used for the fundamental bass sound in all of the songs.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Bass DI	**API550A:** +9dB @ 7kHz +6dB @ 1.5kHz -12dB @ 40Hz	**API2500:** Thr: 0 Att: 9:00 Ratio: 6 Rel: 5 Tone: Hard, Norm, New	
Bass Ampeg	**Manley:** +16dB @ 30Hz Bell -9dB @ 180Hz Bell -5dB @ 680Hz Shelf -8dB @ 1kHz Shelf	LA2A	
Bass Rivera	**API:** +4dB @ 2.5kHz +6dB @ 3kHz High Pass		

Table 4: Bass Processing Settings

Piano

The piano had to sit securely in the middle of the mix without taking up too much space. A reference track was not used for the piano in this song, although it was for others when a specific sound was the objective. For *Challenger*, Pirler and I simply wanted the piano to sound clean and smooth, but not too bright; the 2dB boost at 300Hz helped facilitate this.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Piano	**API550A:** +4dB @ 15kHz +4dB @ .6kHz +2dB @ 300Hz High Pass	**API2500:** Thr: -4 Att: .1 Ratio: 10 Rel: 2 Tone: Hard, Med, New	**True Verb**

Table 5: Piano Processing Settings

Lead Vocals

The vocalist portrays a deadpan, matter-of-fact, resigned feeling in performance, and her tonal color is subdued. The sonic treatments of Covin's voice needed to support the essence of what she was expressing, as well as appropriately and subtly enhance the tonal color.

The reference CD that reflected the desired vocal qualities of Covin's voice was Suzanne Vega's *Book of Dreams*. Covin's vocal range, tonal color, and performance delivery are similar to Vega's. Interestingly, like Vega's vocal treatments, the objective was to have very dry lead vocals, which is what was achieved. However, though it sounds dry, there is actually a significant amount of reverb far in the background.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Lead Vocal	**Manley:** +7dB @ 270Hz Bell	**Manley Slam:** ELOP: 26 input is 1:00 LMTR: 24 REL: 2	**Air Chorus** **Spring Reverb** **Delay** **TC Electronics large hall**
	-10dB @ 680Hz Bell		
	+9dB @ 1kHz8 Bell		
	SSL: (post comp) HF boost; HMF cut		

Table 6: Lead Vocal Processing Settings

Back Vocals

Because the properties of the backing vocals contrasted drastically to the lead vocals, there was an opportunity to create a well-rounded overall vocal production. To create a dramatic contrast to the lead vocals, the backing vocals were treated with high-reverb saturation and a different EQ. A shelf was applied at 5kHz that emphasized the upper register of my voice. For effects processing, long, lush reverberation was applied to all of the backing vocals.

For *Challenger*, there was a seven-layer harmonic bed in the bridge, whose parts were panned throughout the stereo field and then down-mixed to a stereo buss. They were then heavily stereo compressed with the API 2500. The reverb was attained using the stairs chamber, which provided heavy saturation and a reverb time of 5.3s. The reverb chamber was EQ'ed slightly with mainly a low- cut filter.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Back Vocals	**Manley:** +6dB @ 220Hz Bell	**API2500:** Thr: 0 Att: 9:00 Ratio: 10 Rel: 1 Tone: Soft, Norm, New	
	+6dB @ 1kHz2 Bell	**CI:** Thresh: -26.7 Ratio: 10:3:01	
	-4dB @ 680 Hz Bell	Attack: 2 Rel: 100	
	+8dB @ 5kHz6 Shelf		

Table 7: Back Vocal Processing Settings

Electric Guitars 1 & 2

The ambience of the electric guitars was captured with microphones and effects pedals at the performance stage. Therefore, all that was left to do was EQ and compression that aided their fitting snugly into the mix. When it came time to place them, all of the other instruments had already been processed, so there were obvious spaces in the mix that could be filled.

Both of the electrics were heavily compressed in order to fit them into the narrow slots of the mix that had inadvertently been designated for them. Panning was done so that they complimented one another; one guitar was more to the left, the other more to the right. Additional digital EQ was placed on them after they were compressed in order to tighten their fit.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Elec GTR 1 & 2	**Manley:** *exact parameters* *unknown*	**API2500** *exact parameters* *unknown*	

Table 8: Electric Guitars Processing Settings

Rhodes

The Rhodes was recorded in stereo, and the left and right channels were processed slightly differently. They were both EQ'ed the same, except for the low cut. The channel that was low cut more severely was heavily compressed, while the other channel was more natural.

INSTRUMENT	EQUALIZATION	COMPRESSION	EFFECTS
Rhodes (stereo)	Low cut from 103Hz -12.3dB @ 770Hz -8.5dB @ 12.2kHz -14.4dB @ 1kHz (-4.6dB @ 5.29kHz) both		**Delay**
	Low cut from 423.6Hz -12.3dB @ 770Hz -8.5dB @ 12.2kHz -14.4dB @ 1kHz	**Comp2:** Thresh: -35.7 **Ratio:** 10:3:01 Attack: 1 Rel: 100	

Table 9: Rhodes Processing Settings

Creative Mixing

Because *Challenger* was one of the more straightforward pieces, the creative mixing process was minimal. Minor equalization finessing was made with the digital EQs, some automated effects were added, all panning and volume were finalized, and any final arrangement changes in the composition were made.

The effects additions included the end-reverb automation on the Rhodes, and the delay automation for the Rhodes in the bridge section. The result of the automated effects metaphorically supported the narrative of the song. In the bridge section, the backing vocals were written to pay homage to the seven astronauts, represented by seven backing vocal parts, that perished in the *Challenger* shuttle crash in 1986. I wanted that section to have a dreamy, atmospheric, airy quality. This was accomplished with the highly saturated reverb on the back vocals, which was from the stairs chamber, accompanied by a delay-infused Rhodes that was supposed to represent the sounds that a spaceship would make.

At the end of the song, the Rhodes is playing a repetitive figure; the reverb is automated to increase significantly on it, as the song ends. This was supposed to be a metaphor for the ascending spirits of the astronauts at their death. The reverb fades slowly as it increases in saturation.

During the creative mixing process for *Challenger*, a few pertinent composition arrangement changes were made. In verse 1, the lead vocal was accompanied by only the kick and bass. It was decided that the full drum kit would enter with a snare pickup to the second half of the first verse. Also, since the bridge was to be the “light and dreamy” section, the drums were omitted for the first half of it.

CONCLUSIONS

Using reverb chambers to achieve ambience can be a distinguishing component of the sound of an audio production. I researched the use of reverb chambers in present-day recordings, as well as recordings of the past, and decided that exploring the use of reverb chambers to achieve ambience was the best choice, given the aesthetic context of the project. Because the music was folk rock, with primarily acoustic instrumentation, the main objective of achieving the most natural, yet vibrant and rich sounding recording, was most supported by using reverb chambers to create much of the ambience.

Using real rooms for ambience was the only production option when American folk music was originally recorded. For this project, I decided to use that production method, as an aesthetic, because I wanted the music to sound as "natural" as possible. Using real rooms for ambience helped facilitate this goal, which further tied our recording project to the source of all of its musical influences, American folk music.

The reverb chambers were used with two different instruments in post-production, using the technique that was employed in the 1960s recordings from the Columbia recording studios of N.Y.C. Three microphone arrays were used in each chamber. One array was then selected for usage in the song. Impulse responses from the chambers were also taken, using classic methods of reverb analysis. The data were then analyzed, and compared to the artistic choices that were made. In completion, an in-depth review of the production process was made that covered microphone techniques, post-production procedures, and more. Also, a detailed musical analysis and sound-recording analysis were completed for a song in the repertoire that most accurately represented the overall sound of the project.

One of the most interesting findings during my exploration with reverb chambers and microphone arrays, was a newly developed preference for the stereo pair in post-production processing for overhead drums. It provided depth, warmth, and richness, along with an overall sonic subtlety that is especially suitable to acoustic based recordings, such as this one. Although I actually chose the 3D array for drum processing, upon further listening, I grew to appreciate the spaced pair more, and now wish to experiment more deeply with it. Linked to this idea, is the desire to experiment with 3D microphone arrays for *recording* drums, while using the spaced pair in reverb chambers for post-production processing of drums.

Overall, I am very happy with the sound of the recording. However, if I could change anything, I would choose the spaced pair and work more with the EQ on that array within the mix. Initially, I quickly

dismissed it, because it didn't offer the most spectral depth, and "punch" as the 3D array did. The spaced pair was more subtle, but, would have been better suited to this recording, in the end. Also, had I more time, I would have processed all of the electric guitars through the Urinal Chamber, using the 3D array, because it would have provided more spectral depth, and an overall vibrancy to the sound.

The post-production and analysis process of the reverb chambers proved to be a rewarding and challenging experience that informed the process of making a solid audio recording. Like many music producers of today, I also came to revere this post-production technique in attaining ambience on a project of this nature. Most importantly, in completion of this project, I am even more inspired to continue exploring more deeply with these post-production techniques.

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List of Figures & Tables

APPENDIX I: MUSICAL ANALYSIS – *Challenger*

Challenger is a blues song. It's an appropriate style for it, considering the narrative. It's about witnessing the space shuttle *Challenger* crash, as a kid. Every facet of the composition, as well as the performance, convey the feelings that accompanied this experience.

Form

Intro · Verse 1 · Chorus 1 · Verse 2 · Chorus 2 · Bridge · Tag

Melody

The vocal melody implies the blue notes, rather than actually playing them; however, the lyrical blues phrasing and syncopation reveal the obvious blues flavor. The rhythm of the melody swings the 8th note, so to the ear, 1/8 ths become 1/8th note triplets with a rest for each center triplet. At one point in the chorus, the jazz rhythmic influence reveals itself in the melody, with a series of dotted 1/8th notes which suspend rhythmically for 1 ½ beats, until a grand resolution at the end of the chorus.

Verse:

The melody utilizes the G-major pentatonic scale, chord tones, and 9 ths and 11 ths as passing tones. Interestingly, the first vocal phrase, which is played over a G-major chord, is repeated 4 bars later over the iii chord. This is a brilliant repetition of a phrase that is barely recognizable due to the use of the minor chord for the repeat. At the end of the verse, there is a melodic suspension (+5 +11 +11 3 3 +11 +5) that resolves to the tonic in the following bar.

Chorus:

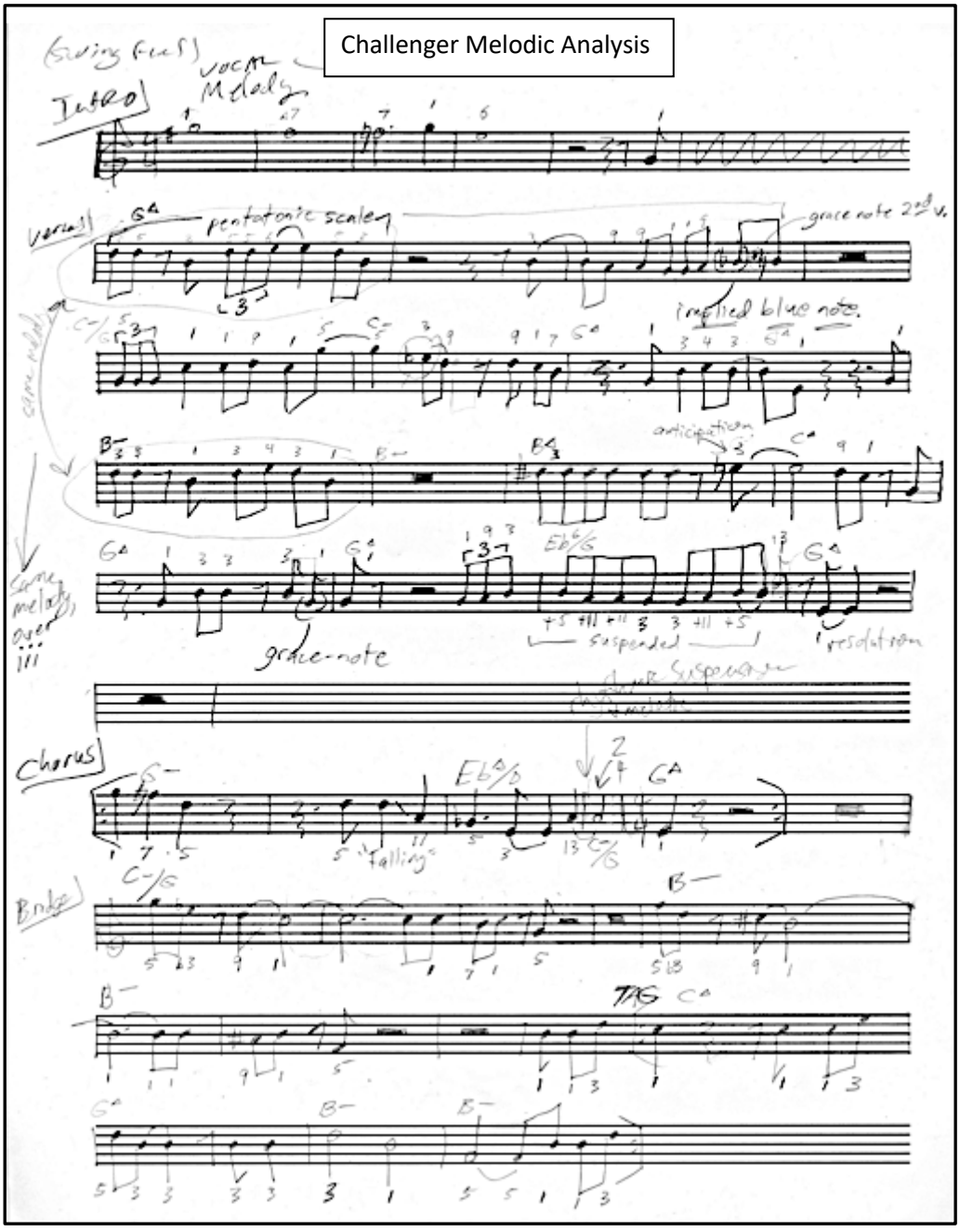
The melody exceptionally reflects the text in that it descends, like the spaceship, from the beginning of the phrase to end, starting on the octave, and ending on the root. There is a melodic suspension on the 13 th at the 2/4 bar, which is also rhythmically suspended, effectively conveying the meaning of the lyric "trailed".

Bridge:

The melody in this section is a descending minor arpeggio, with the 9th used as a passing tone. The 4-bar melodic phrase repeats once, until moving on to the tag.

Tag:

The melody is a repeated round made up of arpeggios over the major and minor chords. The line is additive in that it keeps building on itself with small phrases until it completes itself as a full 2-bar phrase.

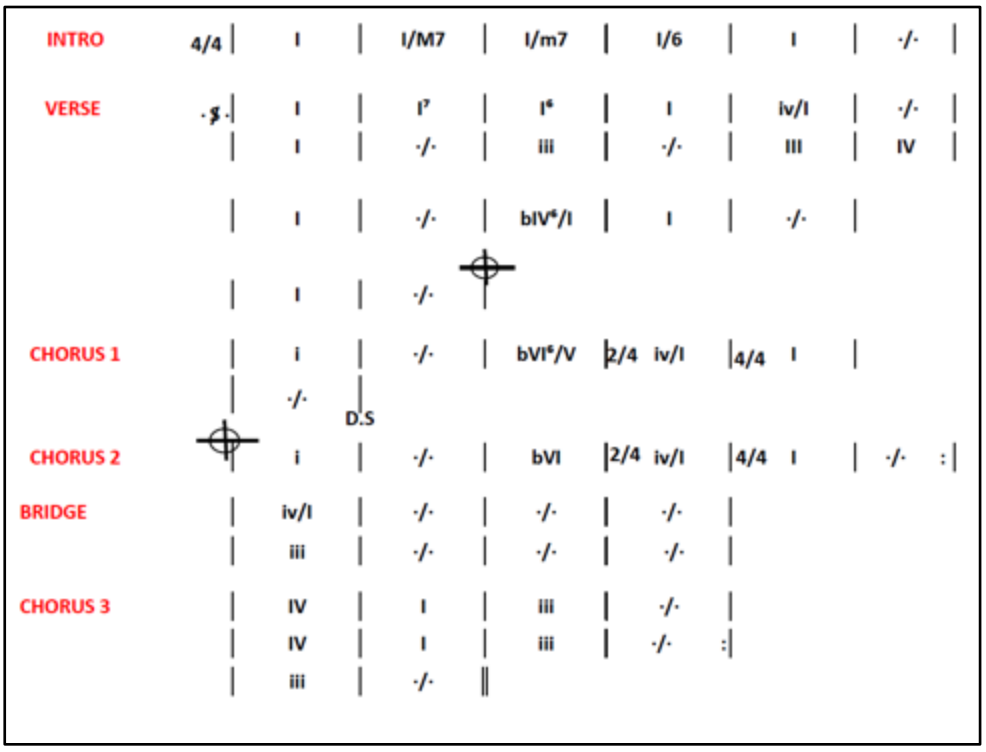


Harmony:

The song is primarily in the key of G major; however, a III and a bVI occur both in the verses and the choruses. The III chord propels the harmony forward to the IV, while the bVI chord provides harmonic suspension.

In the chorus, the key switches to G minor for the first 4 bars, then resolves back to G major. The prominent bass pedal tone maintains the harmonic stability, while the upper register guitar chords move in and out of the major key to create the tension and release of the harmonic structure.

On the tag, it is a round, so there is no harmonic resolution, although the I chord is present. Instead, the iii chord is the final chord, which makes for an odd and unexpected ending.



Rhythm

Challenger has a swing shuffle feel with a subdivision of 1/8th-note triplets. As in jazz and blues styles, beats 2 and 4 are emphasized.

Lyrics

The narrative is a semiautobiographical childhood memory of the space shuttle *Challenger* crash in 1986.

Bass

The opening bass figure, which descends from the 6th, to the 5th, to the b3rd, ending on the root, is a traditional blues pattern. In the verse, the bass pedals on G, playing octaves and open harmonics that create a wall of the pedal tone. At the B minor, the same rhythm is continued, but the roots of the next four chords are played.

In chorus 1 the bass plays a walking line up the G-minor scale to the b3rdd. For the second chorus, the walking line is extended up to the Eb in the higher register, which creates dissonance with the vocal line. Also, the low end drops out there, to create a suspended feeling that complements the lyrics.

In the bridge section, the bass rhythm opens up until the tag, where it walks through the entire range of the instrument. In doing so, it propels the piece forward, matching the perpetual motion of the harmonic progression. The phrases in this section were made up of arpeggios, scalular runs, and octave chords.

Drums

The opening kick-only section was a production choice. The rest of the drums come in with a swing shuffle beat, for the 2nd half of the verse, with a half-time feel on the snare. In the first chorus, the drums are jazz big-band influenced, with dramatic setups to downbeats and accented beats. The sound is explosive and dramatic, which is an appropriate support to the text.

In the 2nd verse and chorus, the drums pick up the swing feel by adding the snare on beat 2. The drums drop out in the open bridge section, to repeat the kick-only idea that was executed in the 1st verse. The full kit comes in again on the second half of the bridge, with the swing beat, but with an open high hat to facilitate the big crescendo to the tag. Then the drums continue the swing beat, with many fills throughout, until the last few bars of the song, where it breaks everything down with the high hat.

Acoustic Guitars

The acoustic guitar parts are in a classic folk-rock style with blues licks, arpeggiations, and thick strums in the choruses. They were played with a fingerpick style and a hand-strumming technique.

Piano

The piano is an auxiliary instrument in *Challenger* and is classically influenced. The pianist played thick consonant chords that moved through several octaves. A distinct repetitive motif in the end section is one of the main melodic hooks of the tune.

Electric Guitars

The electric guitars provide the atmospheric sounds and some of the melodic phrases that complement the vocals and acoustic guitar, and/or play off of the harmony. In the verses, a set of phrases make up one long, non-repeating lyrical phrase. In chorus 1 the guitars harmonize with the vocal line; and in chorus 2 they play two different parts for each section. In the first half, they stay on the tonal center, while the harmony changes, which creates tension and release. For the second half, they repeat what was played in the first chorus. In the bridge, they support the acoustic guitar, and in the tag, they play a repeating 4-note figure.

Rhodes

The Rhodes is an auxiliary instrument in *Challenger* that plays a very important and specific role. This instrument has been used in many 60s science fiction films to depict various outer space scenes and hi-fi technologies. So it was somewhat of an unconscious reference to that usage. Also, because of the storyline of the song, it was appropriately used as a metaphor for the spaceship and the astronauts.

APPENDIX II: SOUND RECORDING ANALYSIS

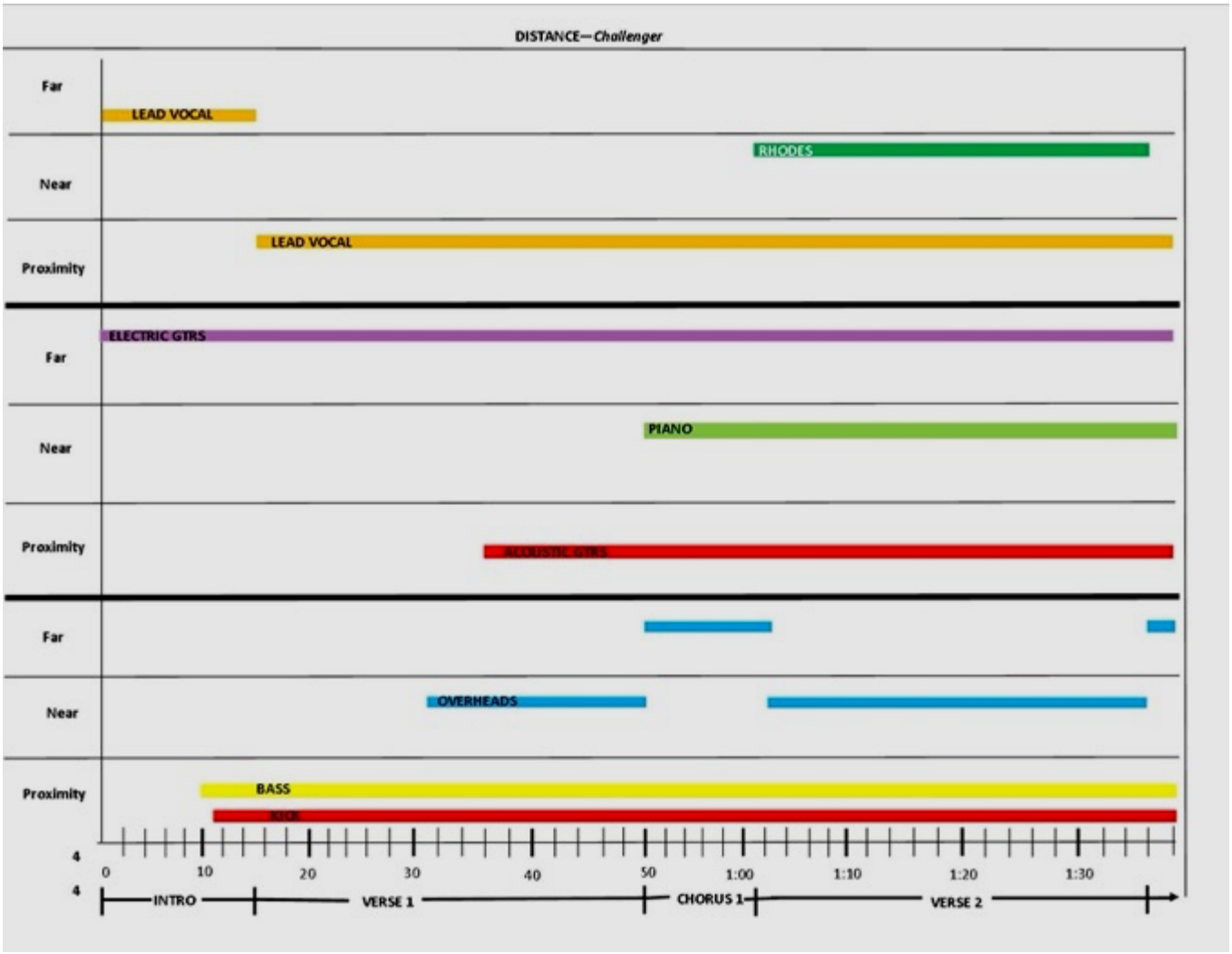


Figure 20: Moylan Graph – Distance 1

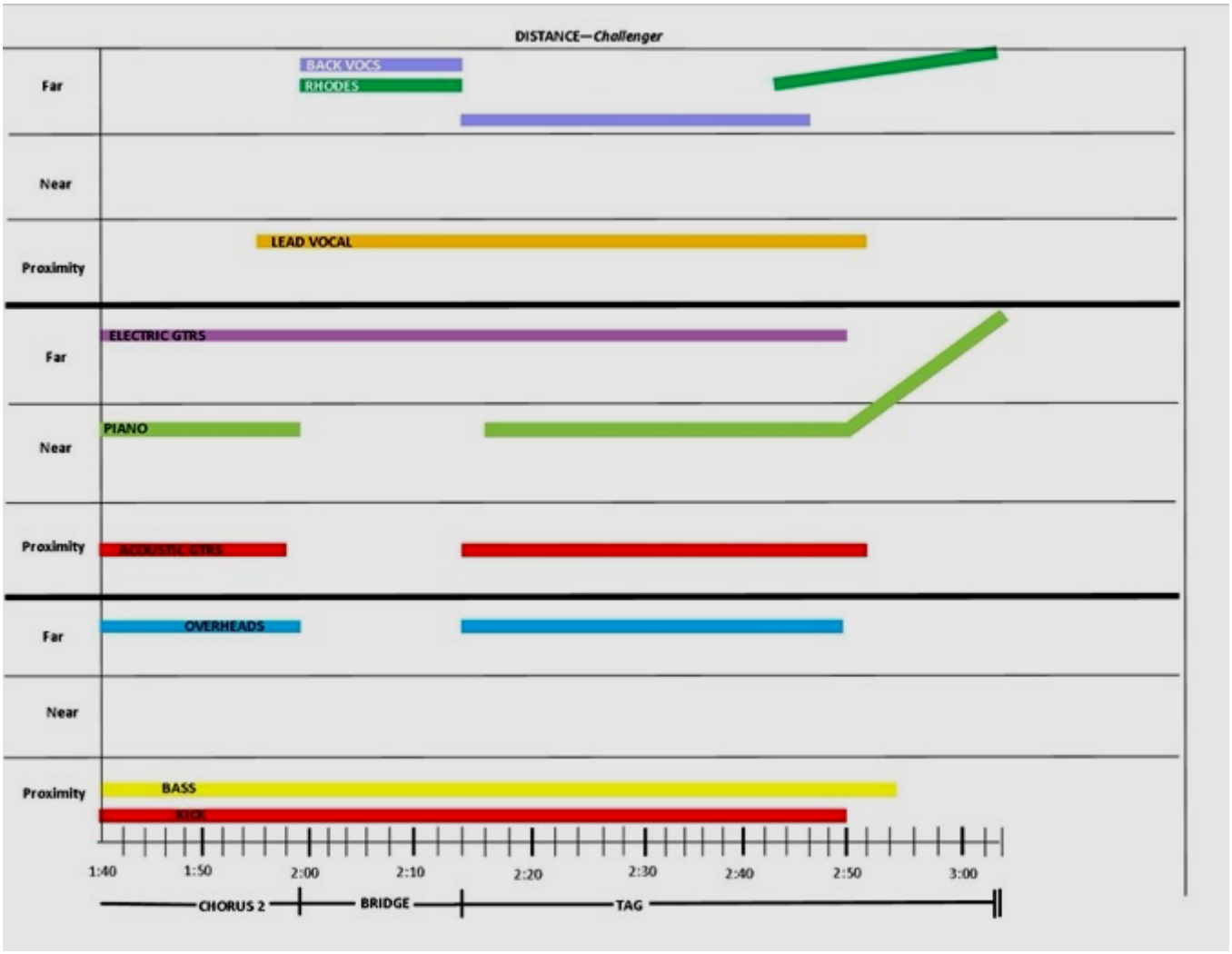


Figure 21: Moylan Graph – Distance 2

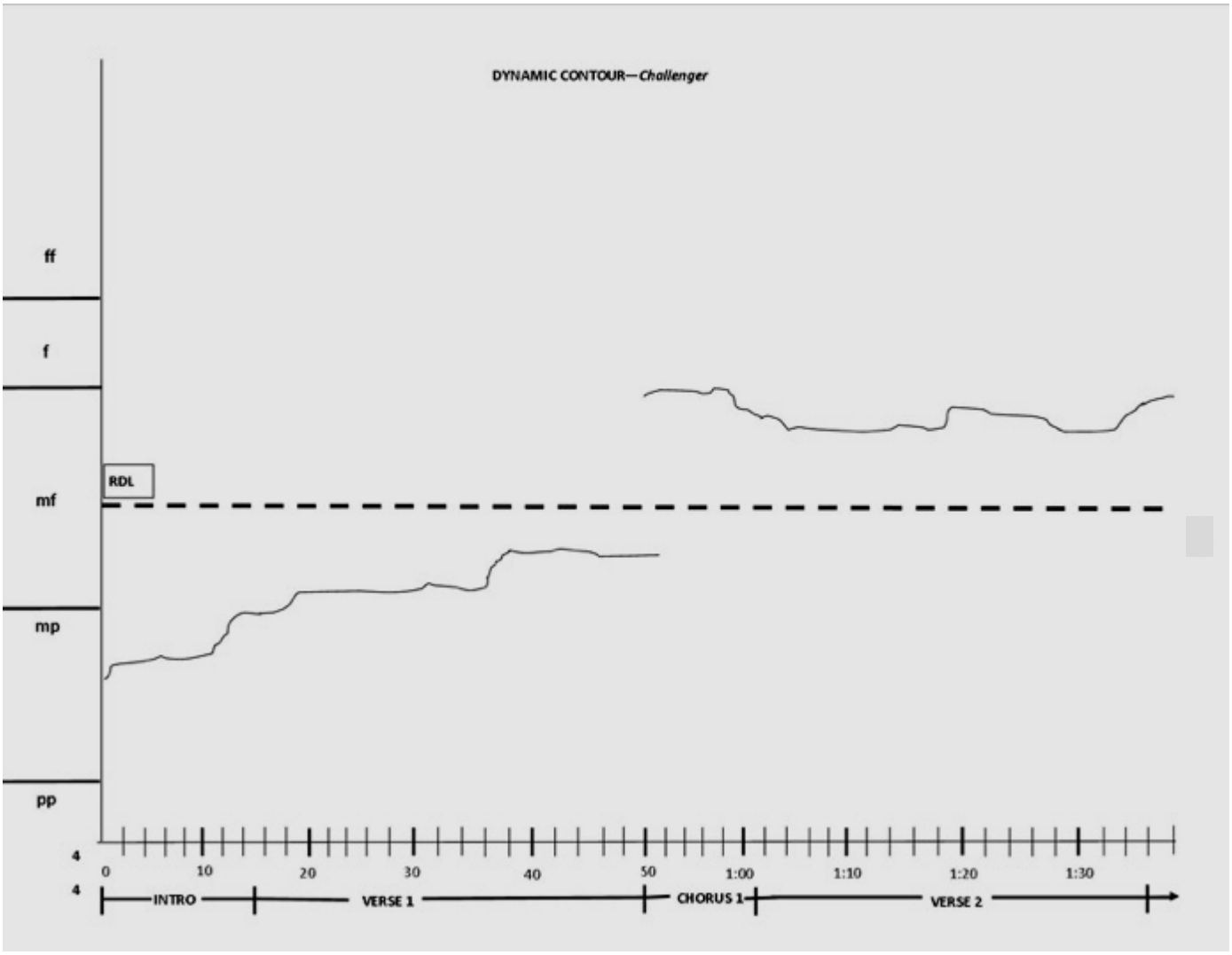


Figure 22: Moylan Graph – Dynamic Contour 1

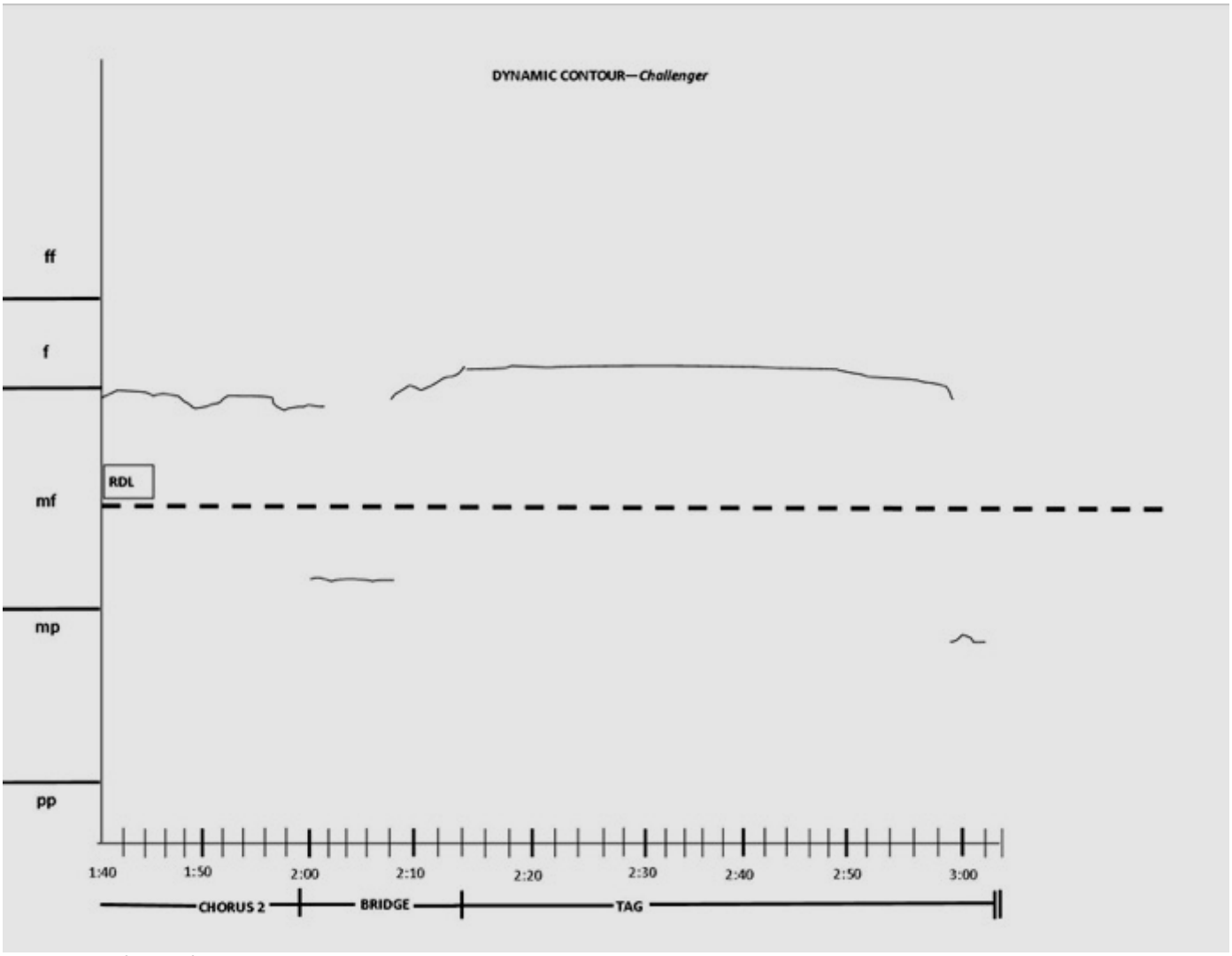


Figure 23: Moylan Graph – Dynamic Contour 2

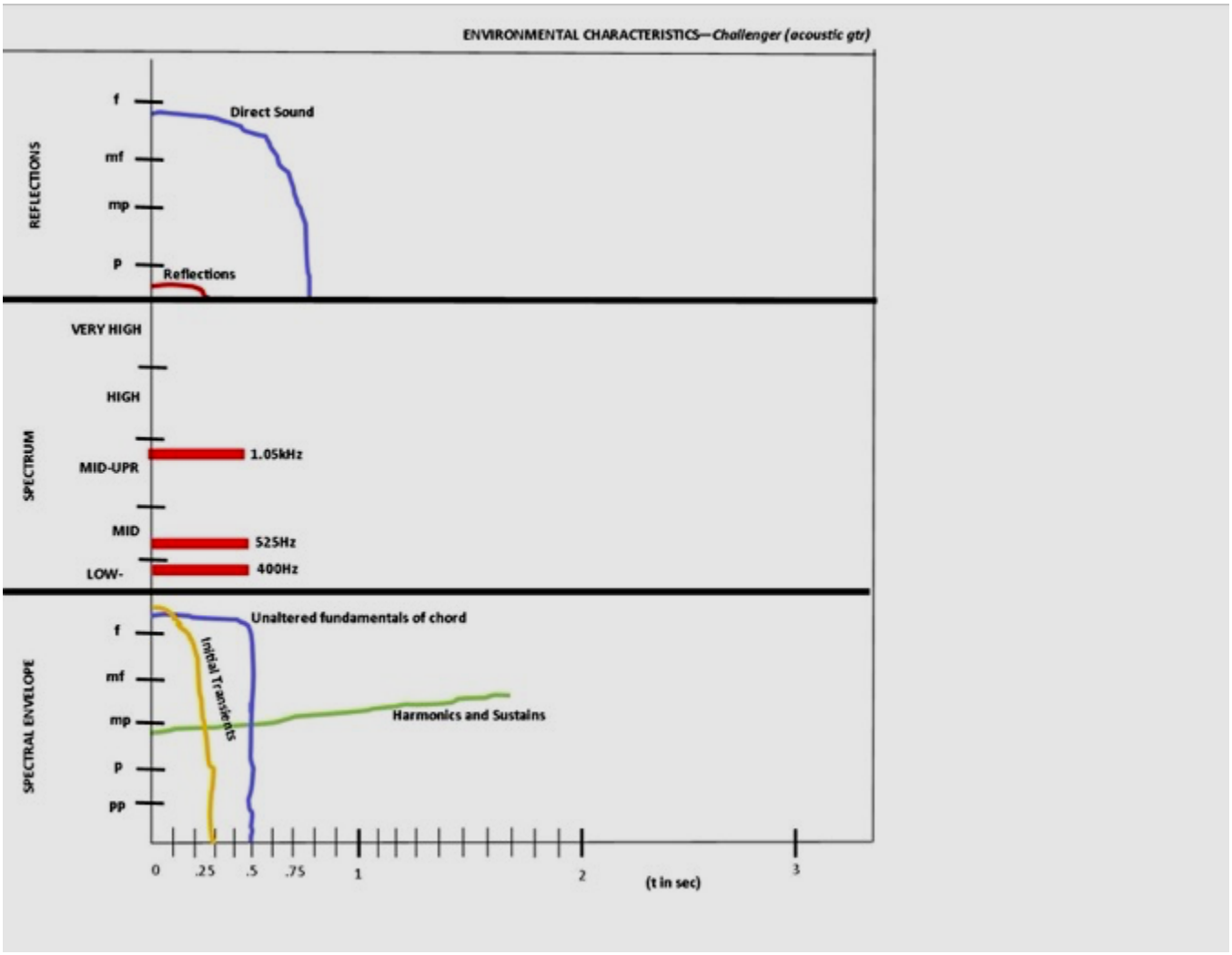


Figure 24: Moylan Graph – Environmental Characteristics (Acoustic Guitar)

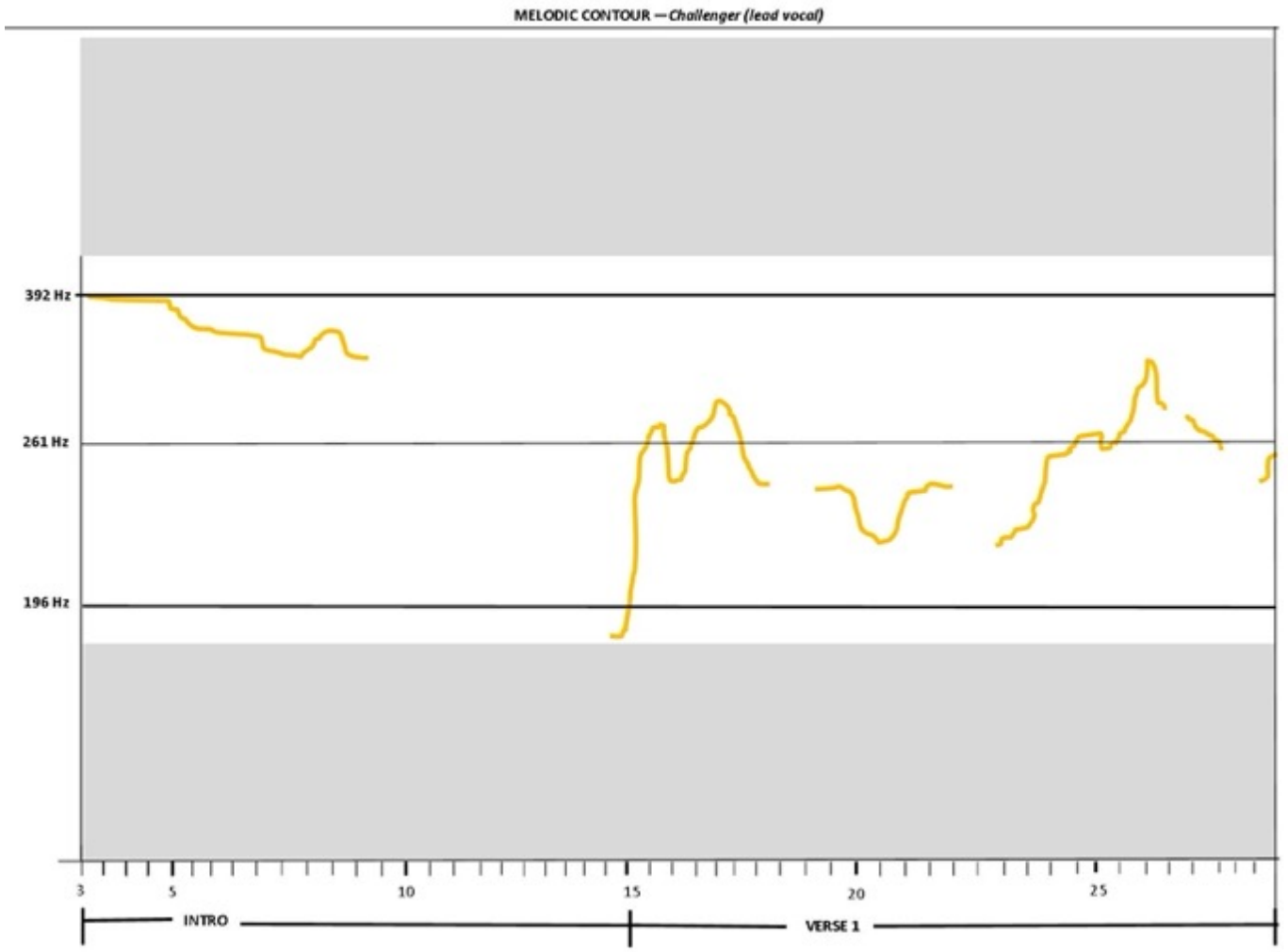


Figure 25: Moylan Graph – Melodic Contour 1 (Lead Vocal)

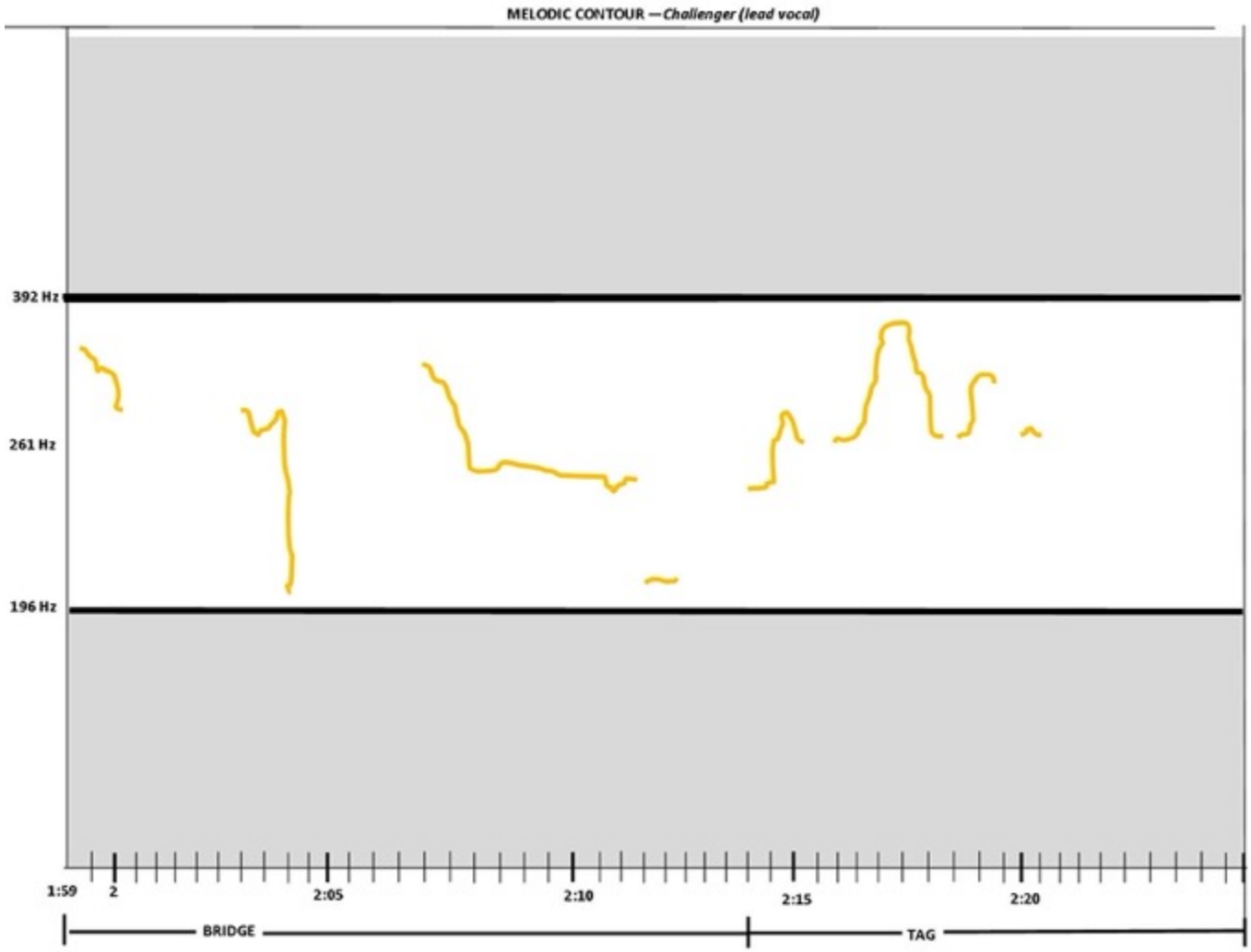


Figure 26: Moylan Graph – Melodic Contour 2 (Lead Vocal)

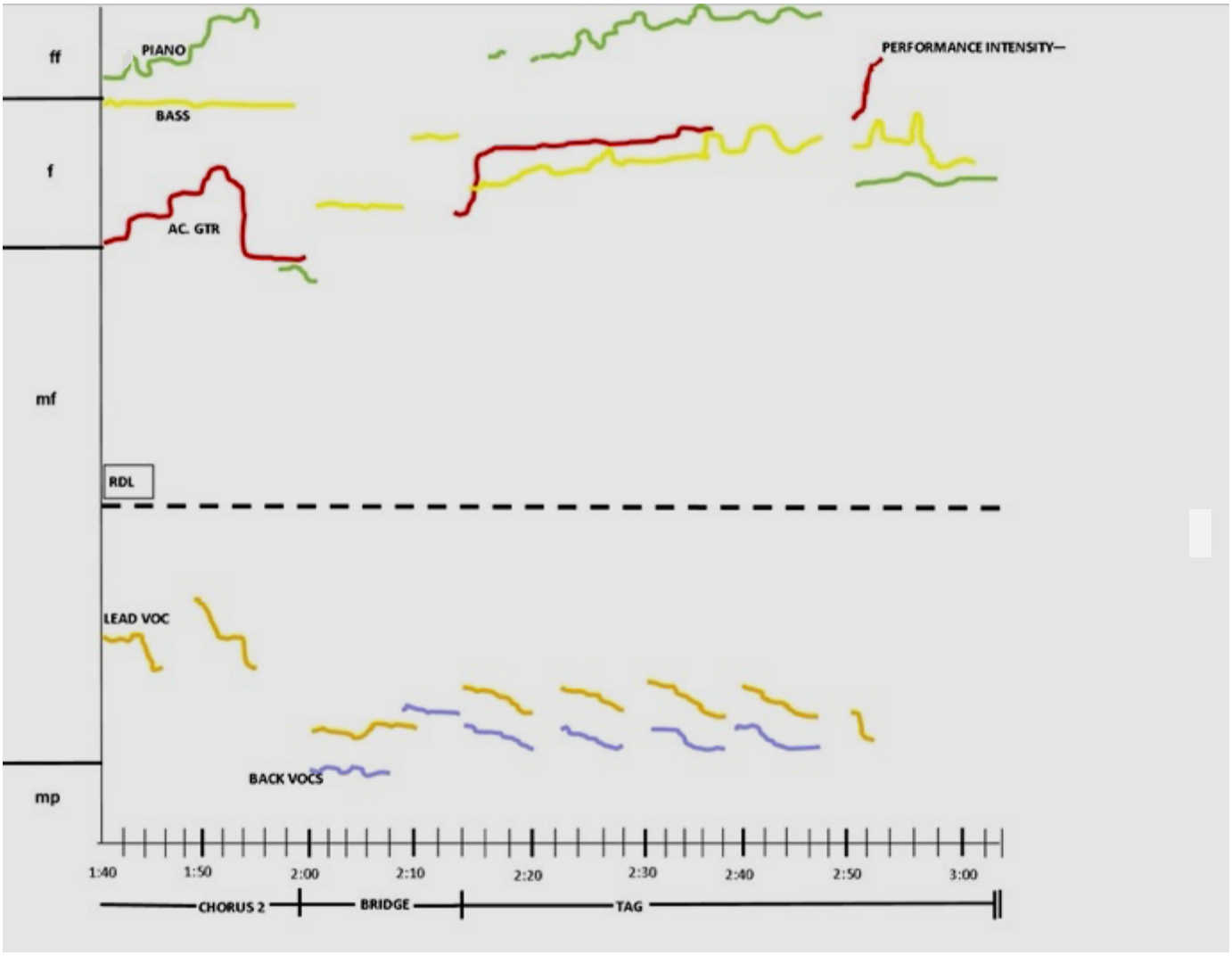


Figure 27: Moylan Graph – Performance Intensity 1

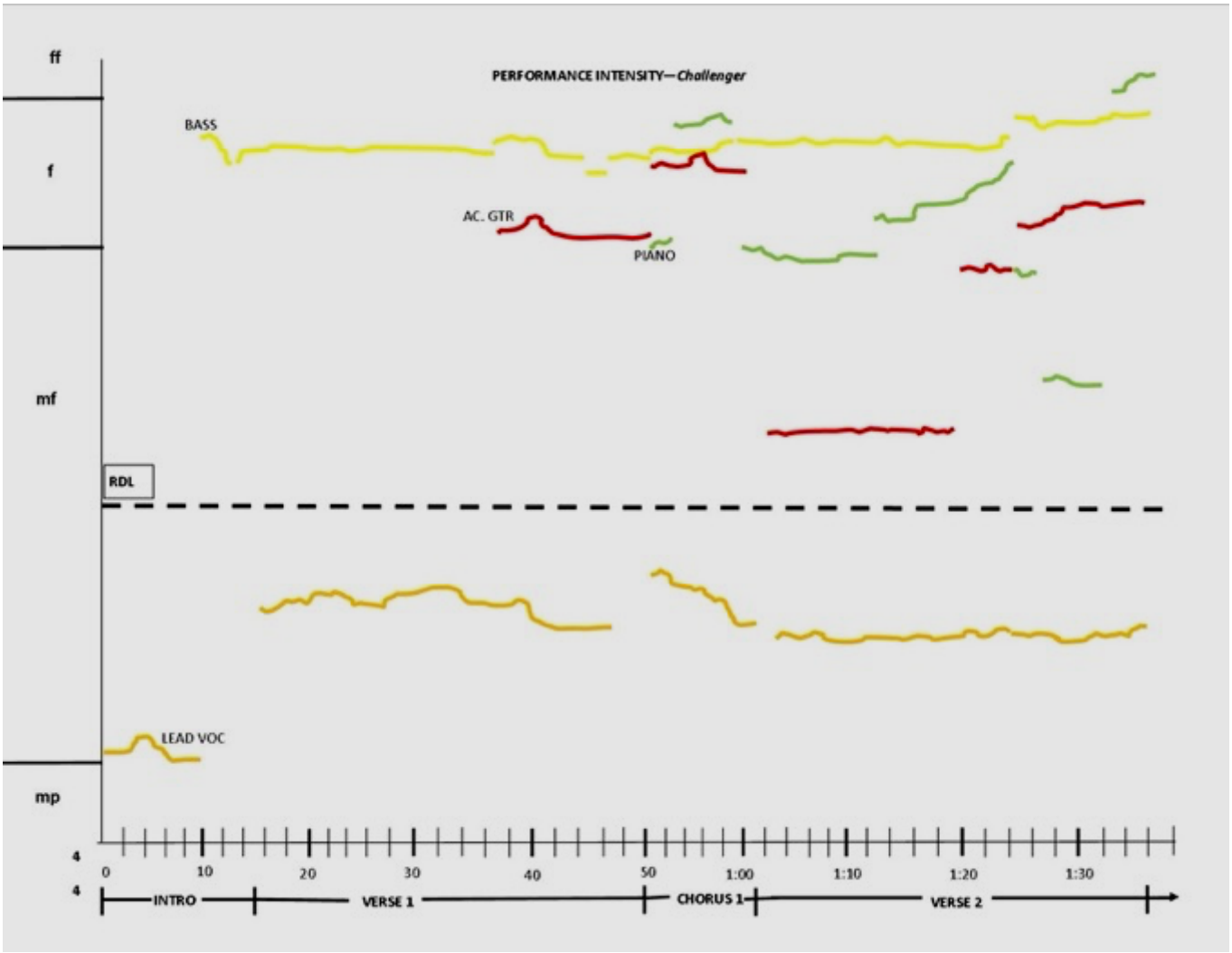


Figure 28: Moylan Graph – Performance Intensity 2

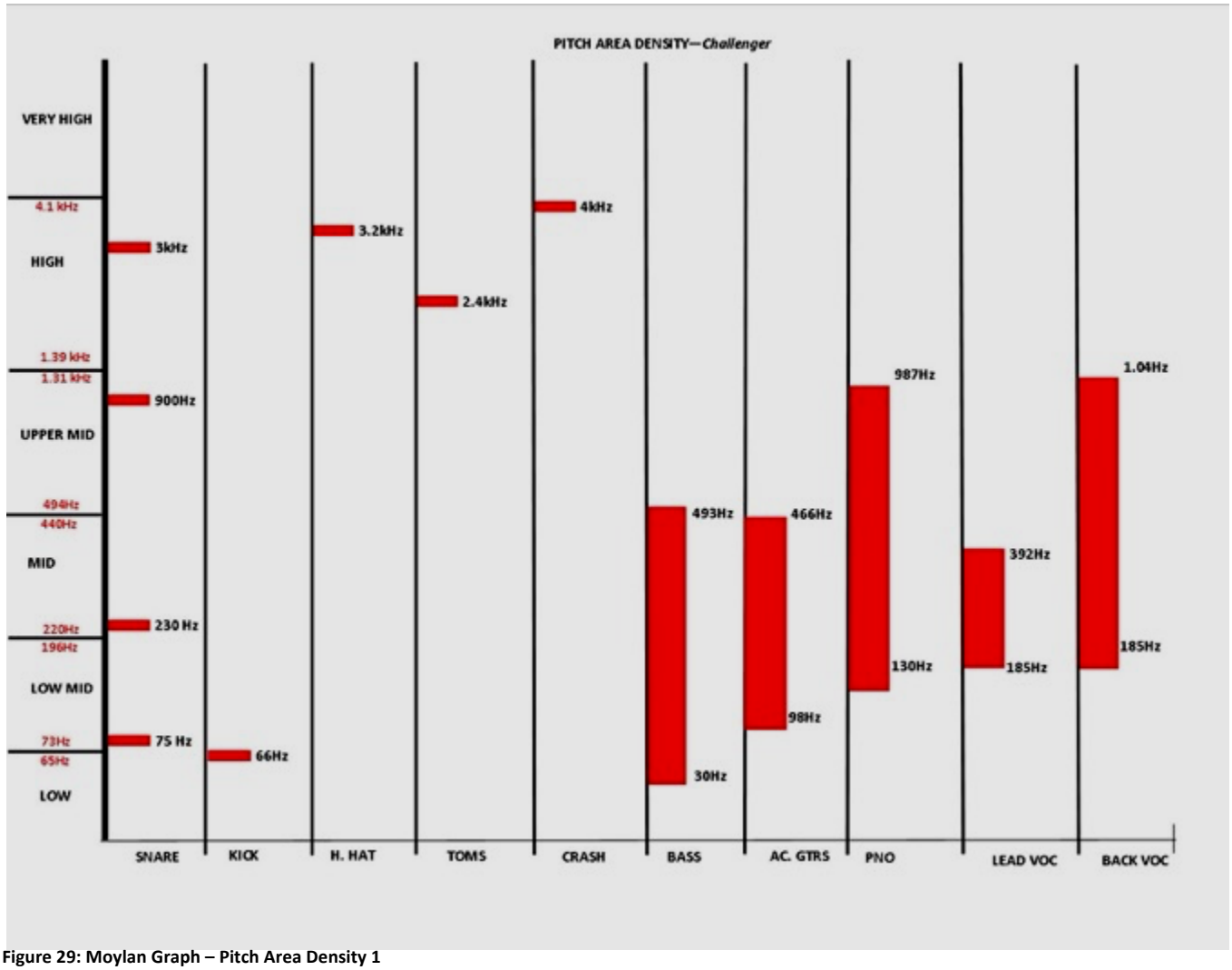


Figure 29: Moylan Graph – Pitch Area Density 1

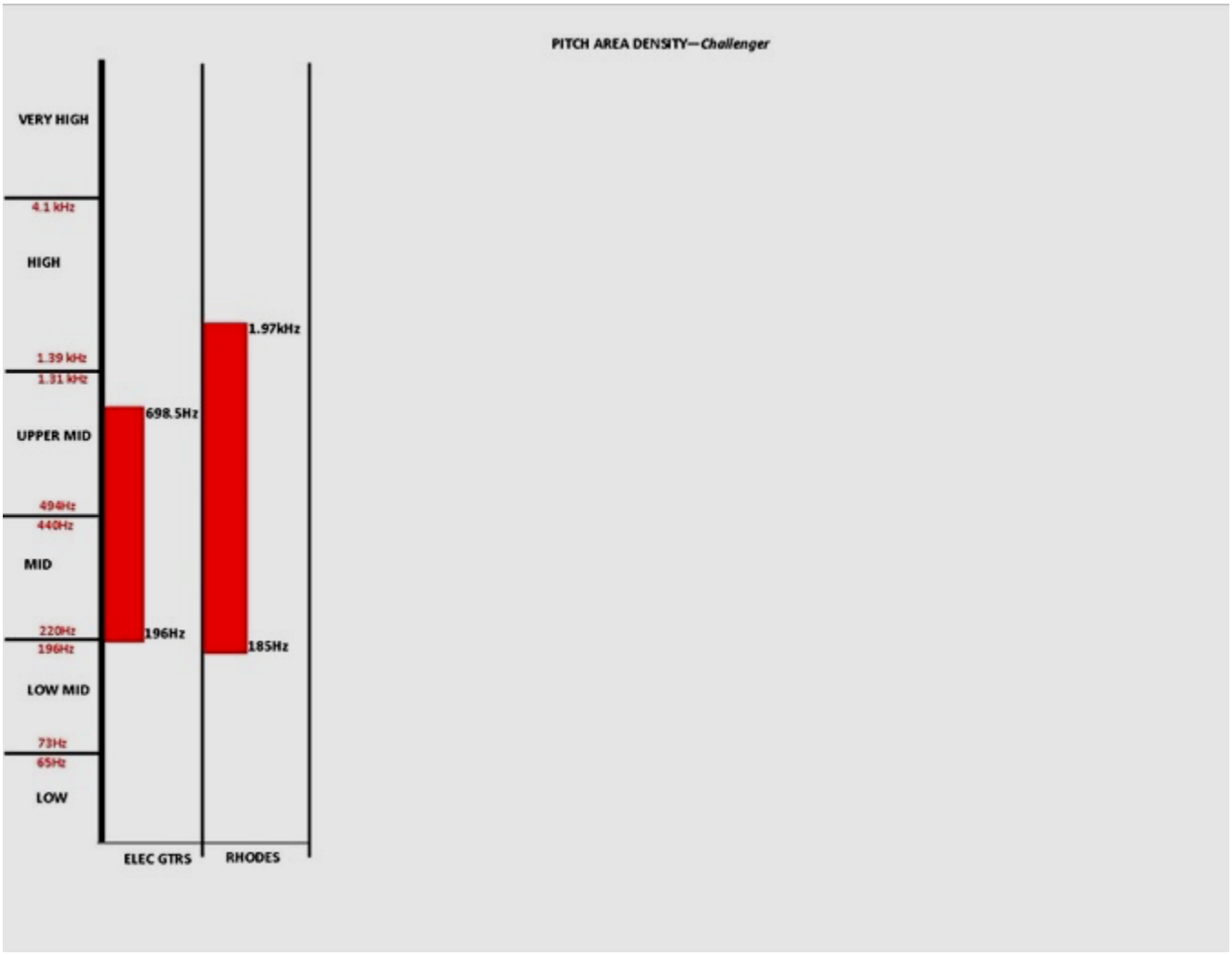


Figure 30: Moylan Graph – Pitch Area Density 2

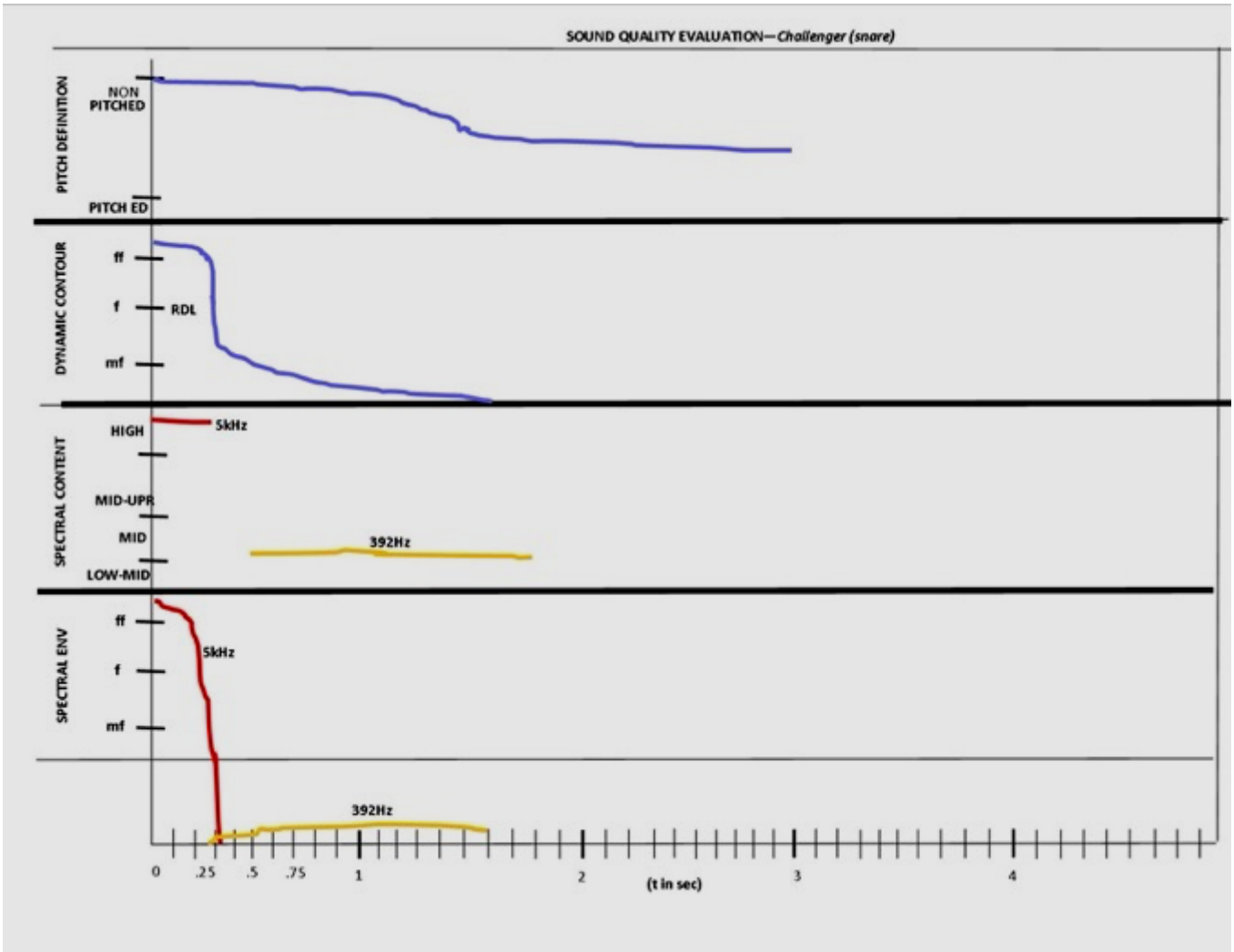


Figure 31: Moylan Graph – Sound Quality Evaluation (snare)

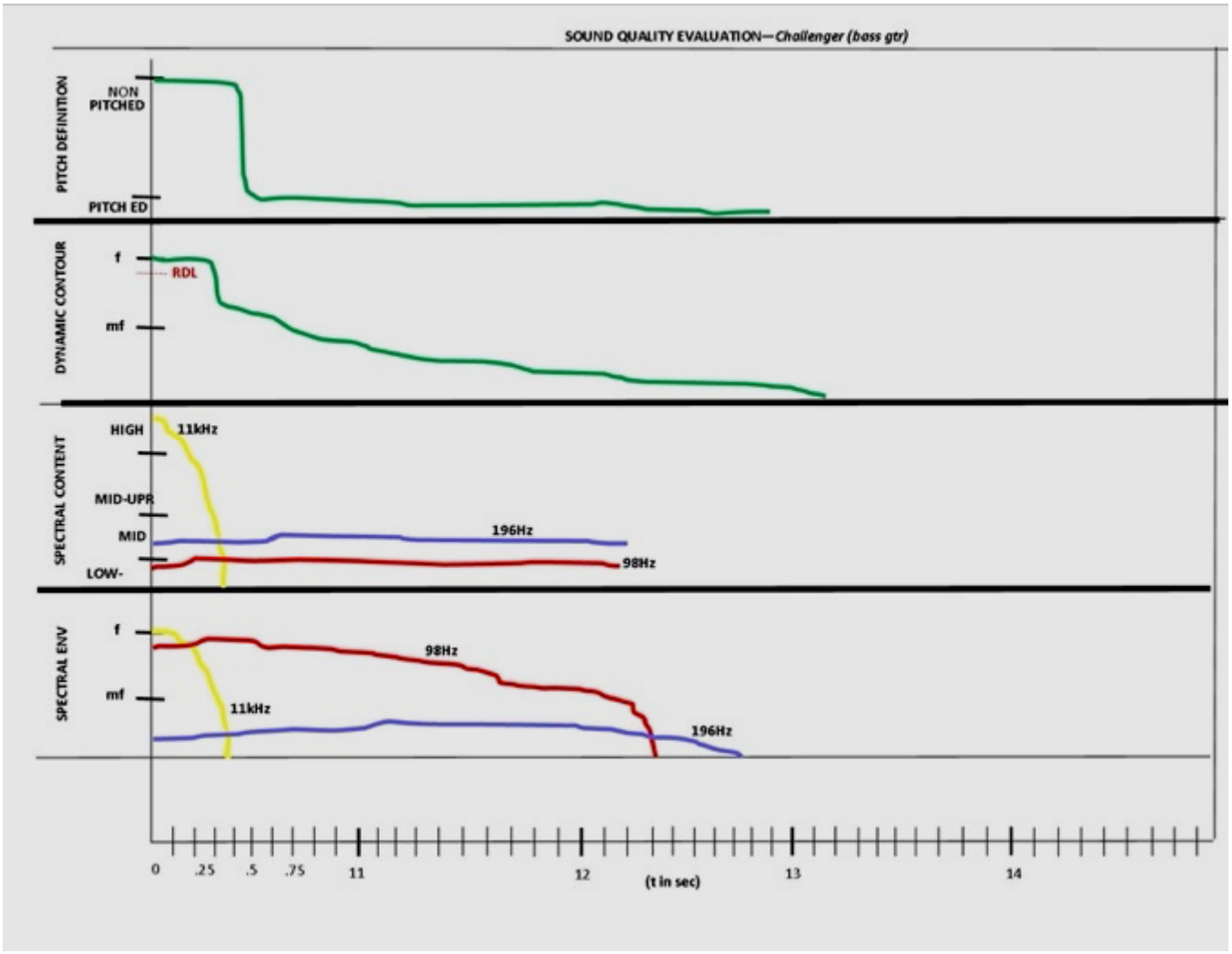


Figure 32: Moylan Graph – Sound Quality Evaluation (bass)

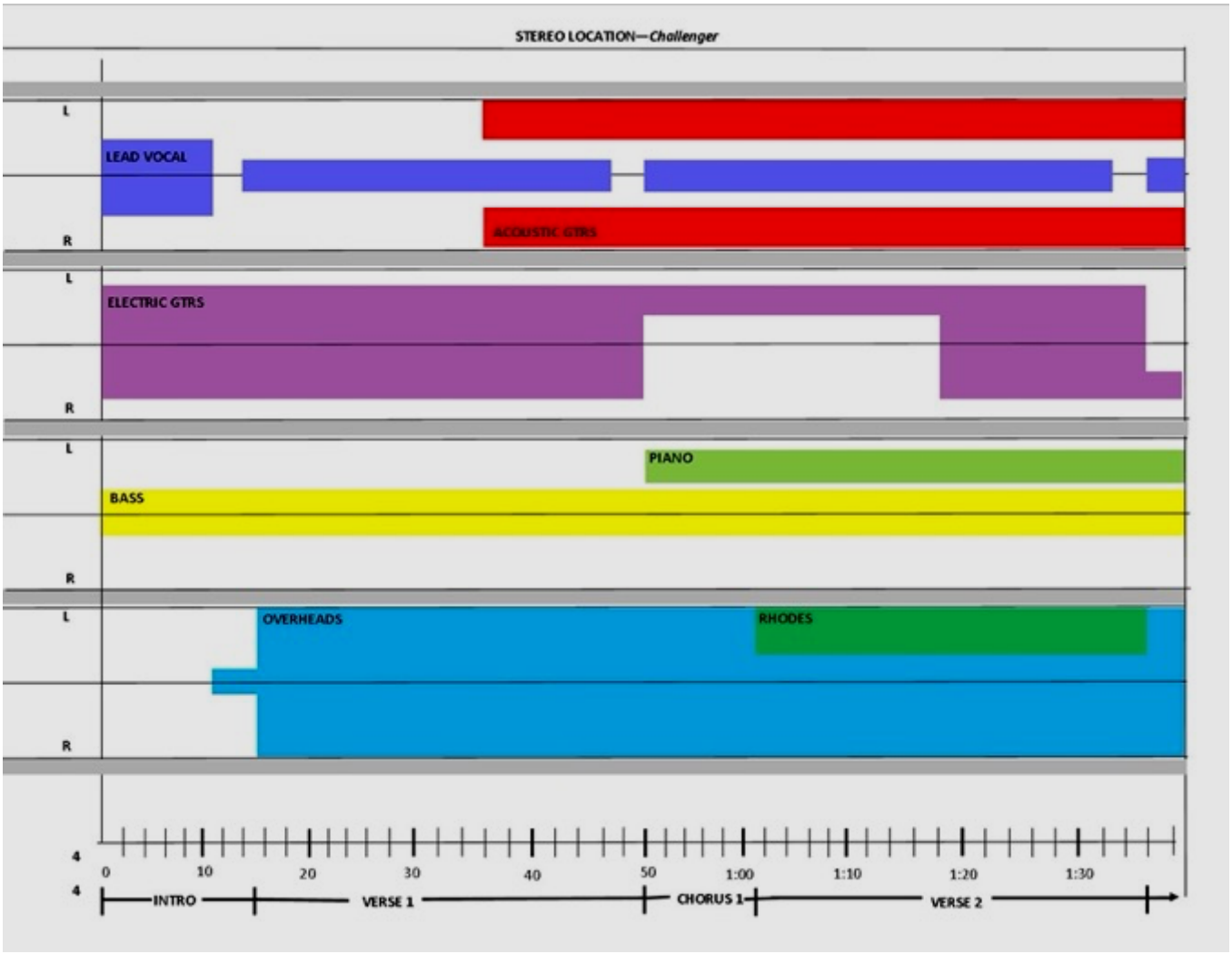


Figure 33: Moylan Graph – Stereo Location 1

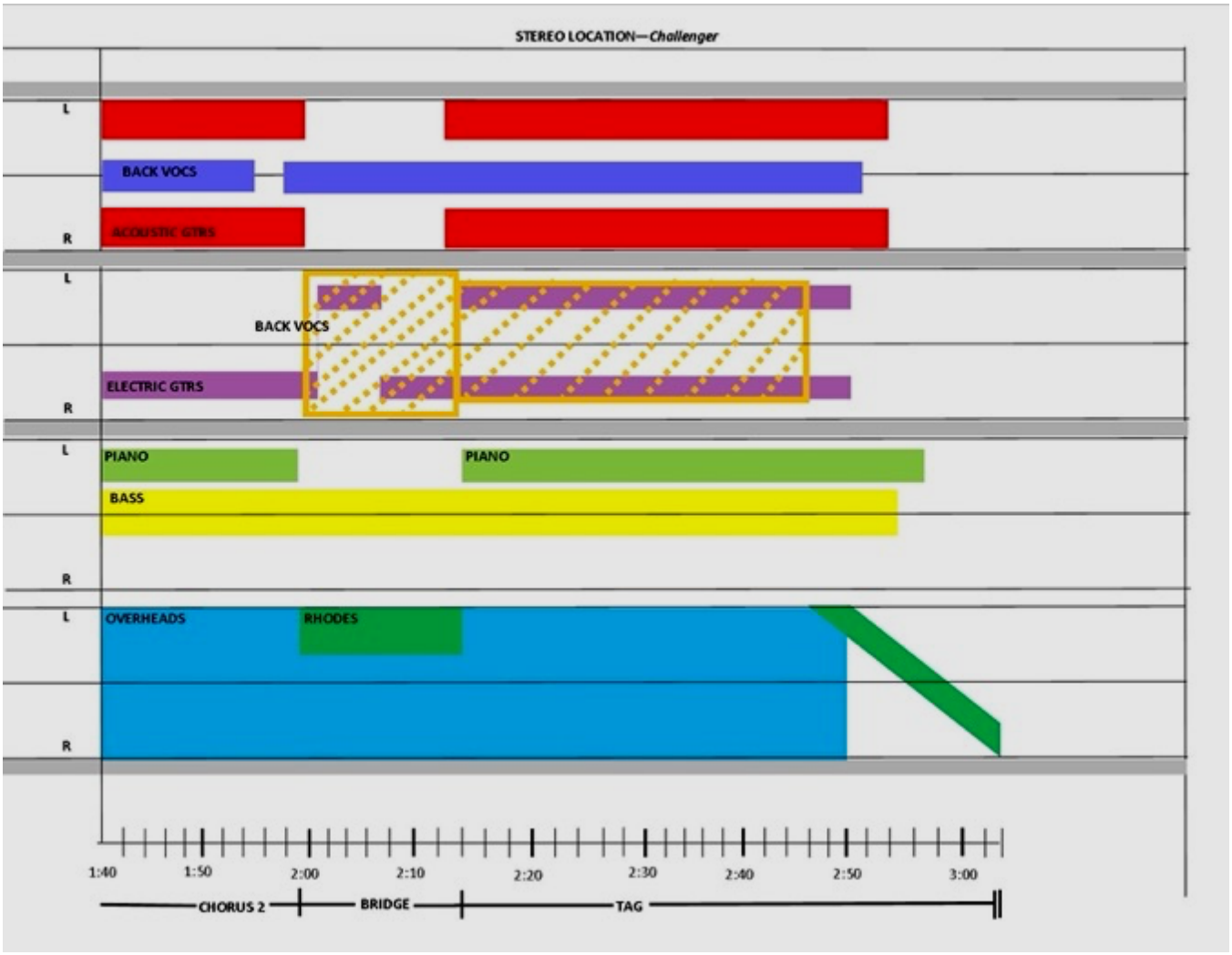


Figure 34: Moylan Graph – Stereo Location 2

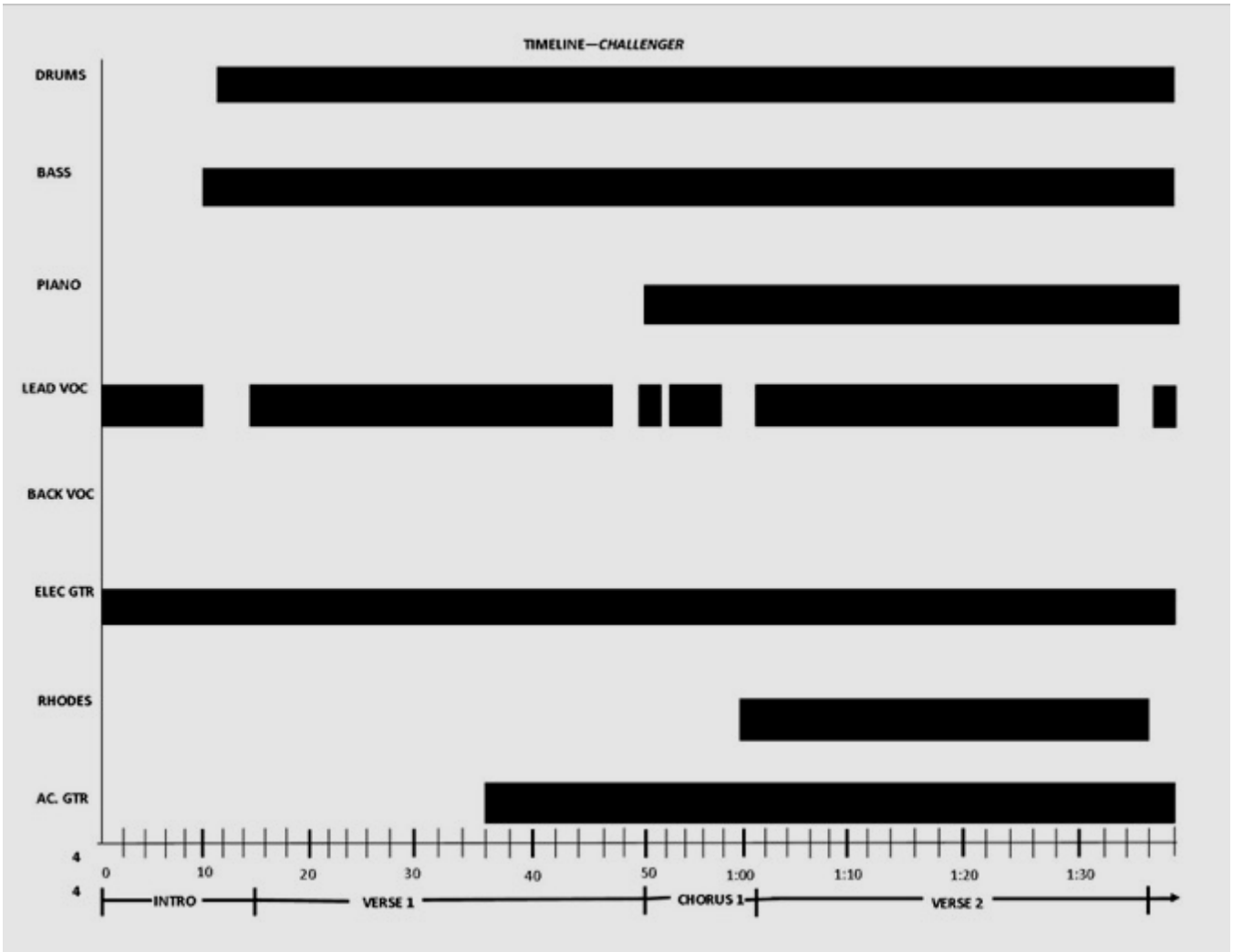


Figure 35: Moylan Graph – Timeline 1

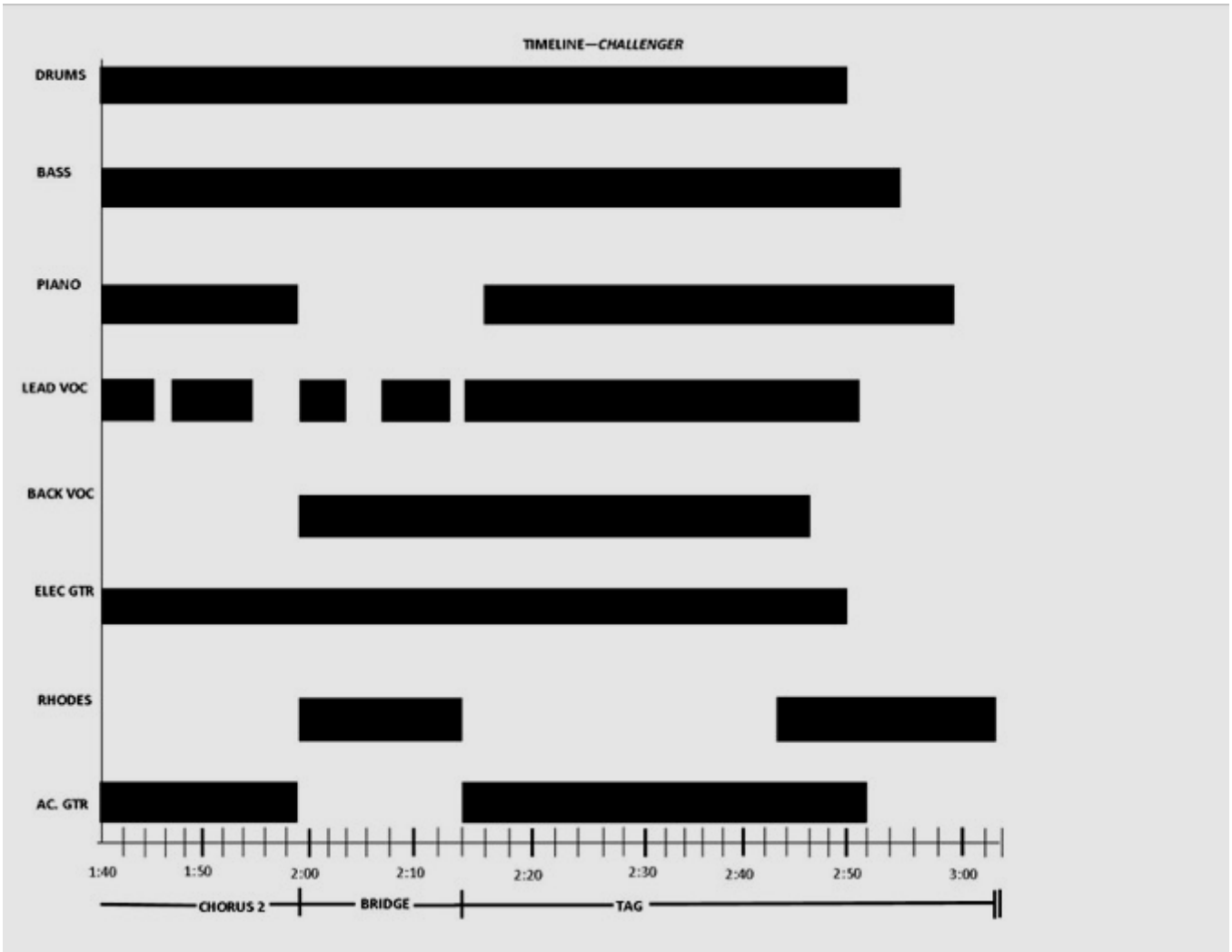


Figure 36: Moylan Graph – Timeline 2

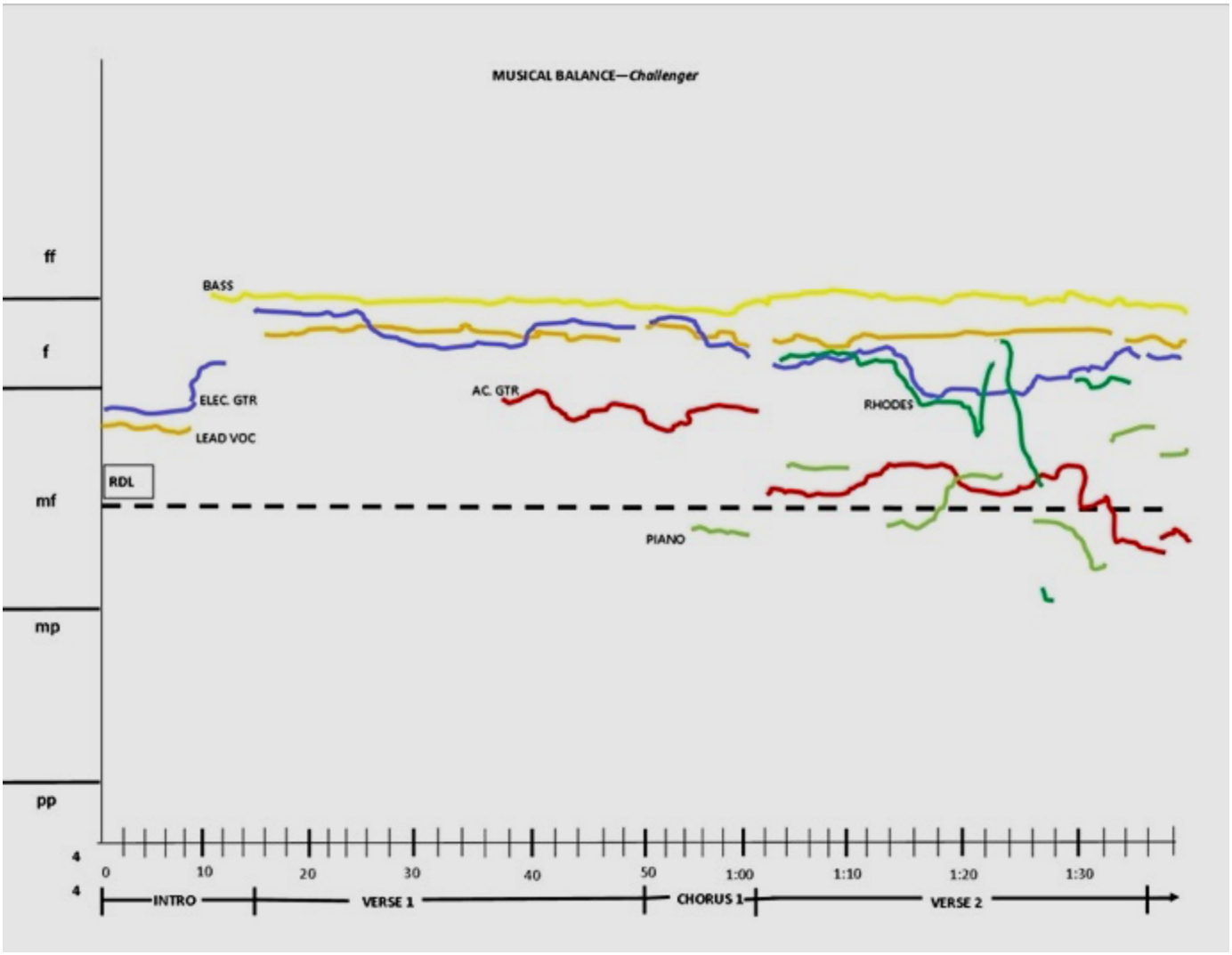


Figure 37: Moylan Graph – Musical Balance 1

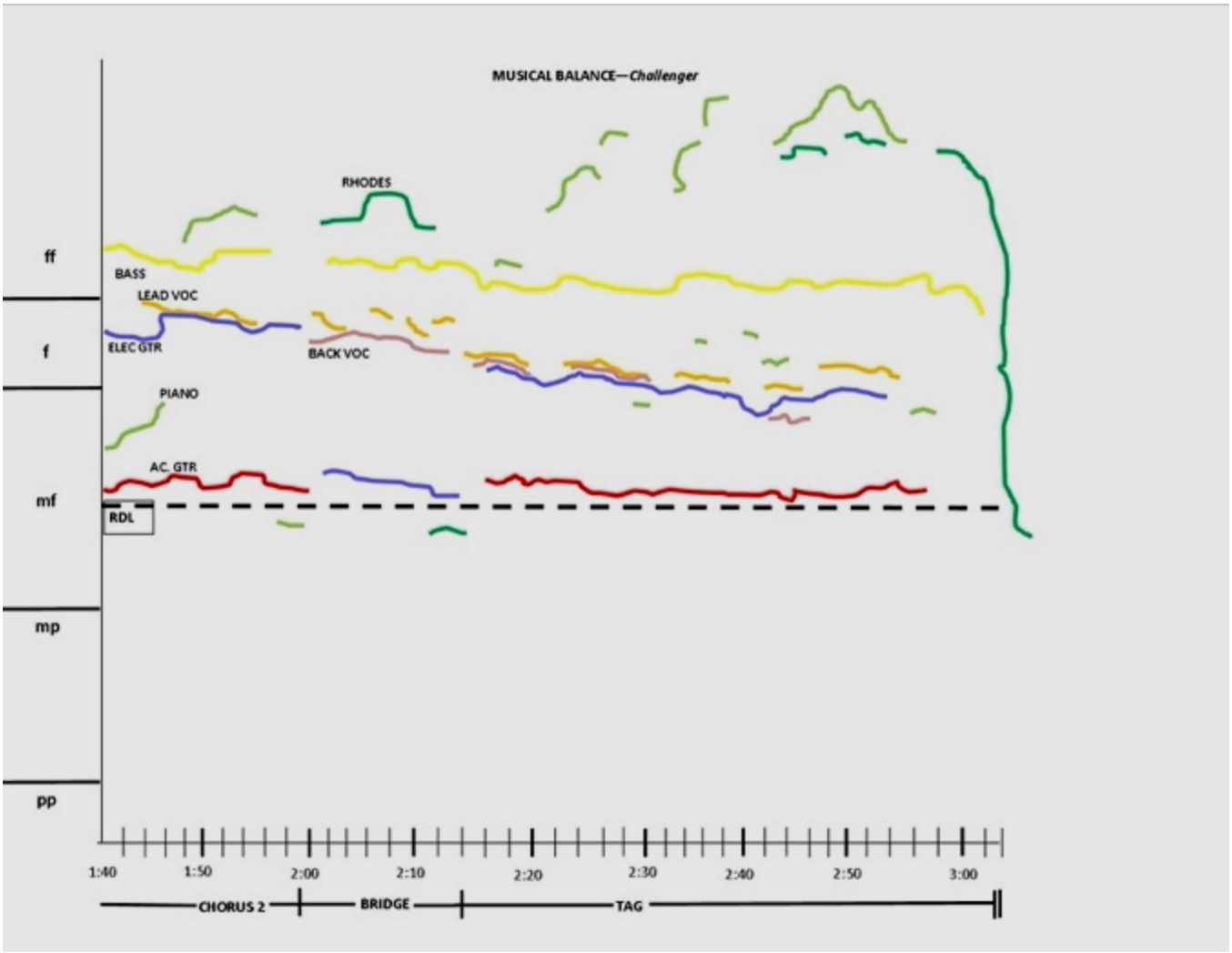


Figure 38: Moylan Graph – Musical Balance 2

APPENDIX III: Auxiliary Repertory

Thesis Music – Repertoire List AND BPM

Approximate time – 45:38

1. **Smallest Bird 4:16**
2. **Voices from Inside 1:46**
3. **The River 4:09**
4. **Horseaisle 5:30**
5. **Whipporwil 4:00**
6. **Annabelle 4:19**
7. **Challenger 4:05**
8. **Arbor Day 3:30**
9. **Bullet Dancer 3:03**
10. **Oh My Heart 3:05**
11. **POA 1 3:20**
12. **POA2 2:45**
13. **Summer Never Ends**

BPM:
Arbor Day:
bpm = 144

The River:
Intro bpm = 60
Rest of song bpm = 80

Horseaisle
Bpm = 176

Whippoorwill
Bpm = 98

Voices From Inside
Bpm = 104

Challenger
Bpm = 117

Annabelle
BPM = 105

Bullet Dancer
Bpm = 140

POA 1
Bpm = 125

POA 2
Bpm = 160

Oh My Heart
Bpm = 141

Smallest Bird
Bpm = 114

Song Lyrics:

Annabelle
Annabelle, you know,
there's something on my mind.
I can't keep it to myself,
there's something on my mind.
That look on your face,
I don't have to look twice.

I feel estranged by your love,
but I want to stay,
I feel estranged by your love,
the longer I stay

Your heart beats hard against mine,
there's something on your mind.
You don't have to feel ashamed,
I know there's something on your mind.
And all the things you've said--
you know, I have a bad feeling.
our hearts no longer beat in time.

I feel estranged by your love,
I feel estranged by your love,
but I want to stay,
but the longer I stay
I feel estranged by your love,
I feel estranged by your love,
the longer I stay
the more I feel afraid

We have a way of covering our eyes

we nestle after the rain,
in silence, in vain.

Arbor Day
I set sail on Arbor Day
But I knew it would be no good
I built a boat out of crabgrass
A mast made of balsa wood
The wind above the hostile waves,
the looks, oh, that the seagulls gave to me!

All of it got a hold of me
Oh oh oh sent me down down
The troubled walk of the plank
Into the dead dark sea
sent me down down down
I couldn't see the end of what was
to happen to me
I went down down down
into the dead dark sea

And as I went down, your face I could see
your beautiful beautiful face
I remembered the words you'd written me
floating in a tiny glass vase
I could not decipher your friendliness
I wanted it to mean something else

Something closer to desire, oh oh oh
so I went down down down
The troubled walk of the plank
into the deep dark sea
I went down down down
With a nagging insecurity.
There was so much more
I had wanted to say to you
There was so much more
I had wanted to say to you

But all is well and done
The waves swelled,
the ship turned round and round
And I knew that to live
I needed to make my own life mine
And revel in the light
shining down on me
So the next time I go down down
Part of you will stay with me

La la la la……

Bullet Dancer
So it goes your bullets fly
they fly high
and I dance for my supper
and I dance for your time

Ricochet in the desert dust
your gun taps a holy sign
you say when I shoot to torment
I like to watch you cry.

There's a place I fix my eye
in the sky
I should've gone blind by now
I should've gone blind.

Tomorrow I'll hang these sweat soaked boots out to dry
and wear slippers of satin and suede.
I fly on my feet and go to the city for a while
find a place to dance away the pain.

With a wicked whisper you let out a sigh
You're my blazing glory you say
the apple of my eye

What a funny feeling my heart never went astray
Now my longing divides inside of me
Now my longing divides inside of me
How was I supposed to know this love has a secret name
How was I supposed to know this love has a secret name

A pirouette, an hour glass
A window to another place
An open sky
Where I can live without you
And the wind that was yesterday
That's what you are to me

Challenger
And that day the memorized pledge
soared in our tiny throats
towering flag kept in the corner,
in the cold and dusty shadows
beneath us the diamondbacks
swallowed some Missouri dirt
and we, the living testament
buried our voices in the teacher's skirt

that's the day the falling bird trailed smoke

the recess bell called us out
to bear witness to an empty sky
and when we were done

the crows and the swallows
had the sky all to themselves
the beginning felt like the end
and ending felt like we'd just begun
and the song we'd stopped singing
fell like a ship without wings to the ground

that's the day the falling bird trailed smoke
that's the day the falling bird trailed smoke

and through the day the wind had blown
the spirits soared from the bodies cold

we would stand,
we would stand,
we would stand so strong…
in the rising dark.

Horseaisle
The old man
ambles slowly, sits upon
the old bed,
watches her as she gets up and
gets dressed,
and quietly begins to think aloud

baby,
why not sing the song that always
slays me,
the time is coming soon when these bones will
barely,
barely will they rise to meet the sun.

All night
angels bending over
over me
angels bending over
All night
angels bending over
over me
angels bending over

angels bending over
over me...

And miles away
the beautiful ponies

on lonesome Horse Isle
untouched by bridle
untouched by gloom
flare their nostrils
at the distant blinking rooms

And miles away
two hands a-joining
under the checkered eiderdown
comforted by the moonlight
to see them through
while through the window
lies the restless sea of blue

ooh ooh ooh ooh

Oh My Heart
The Christmas bells
soar over this lonely room
your tinsel dress
crumbled in the corner
these are dying days of winter
breaks apart
over my dead body
you'll break my heart

Oh my heart
the fire keeps me from aching
oh my heart
the snow will bury me dead
lover of mine gone
to build a home in the west
well I intend to break my mind
of your scent on my breath

To want too much
It's so easy to want too much
To want too much
It's so easy to want too much
a minaret, a sawtooth blanket
an empty bed
these things I possess
but empty-handed I walk towards death

La la la la la…

Smallest Bird
smallest bird of my heart
you sing in the silent dark
smallest bird of my heart
you sing in the silent dark
you come to me in the morning
you stay all the way through the night
come to me in the morning
a nest of wires is my heart

smallest bird of my heart
the morning's been an overflow
of bottles of gin on the nightstand
of shadows from the night before
I search the skies for your wingspan
from the bottom of the windowsill
I search the skies for a sign
from the bottom of the windowsill

Sometimes you fly away
it tears the nest apart
unraveled on the bedroom floor
I pick it up and watch the door
I sit and wait for you to return
with a twig or abandoned ribbon
to sew this nest back up

Waiting too long to save you
I might have been
hoping that I could quit you
I might have been

stranger's hand 'round my neck
a few scattered words of love
I get a small impression
things will somehow change

Smallest bird of my heart,
it's coming on strong again
slowly hold my hand out
to test the eastern winds
all this time looking outside
oh how was I to know

slowly make my way back
so I can begin again
I slowly make my way back
so I can begin again

Summer Never Ends
Summer never ends when you want it to
I leave the docks empty handed
Wanna fill my pockets with your hands.
You'll go home to cook her dinner
On the stove she bought last winter
I'll drive around like a fool.

Wondering who you'll be, the next time I see you
Wondering where to put, my wayward hands

Summer never ends when you want it to
I leave the docks empty handed
Wanna fill my pockets with your hands.

Ahhhhh…..

The River
When you cannot remember
When you can't find the words
Or you've lost your way

You can sing oh…
You can sing oh…

Dying inside of the day
The night lifts her ghostly grey veil

She cries oh…
She cries oh…

and one day you will see
if you come out from behind that tree
that she's come to pave the way
for you and me
oh, you know what it can mean
to be free

Come over to the water
Let it touch you through your armor
Let it reach into your splendor

Voices from Inside
They're calling you
to come inside
but the night air holds you back

Someone beside you
lifts a glass
a chill, a sparkle, a gleam against the snow

You hear a word
that sounds so far away
a word
we heard
before...

The only thing to do is pretend
pretend that we never met
and watch the frost grow
on the rot iron fence
They're calling from inside
but we linger in the cold
Avoid the thing I should say
so I'll say it anyway

Inside my head
You'll love a broken raft
that had me drifting away
and when I finally swam back
I found my eyes had been closed
the entire time

Whippoorwill
Be careful child
There's a winter coming soon
The sun fades over the water
And destiny
Has never been the friend
Of those who till the fields of slaughter

You can sleep
And sleep and sleep and sleep

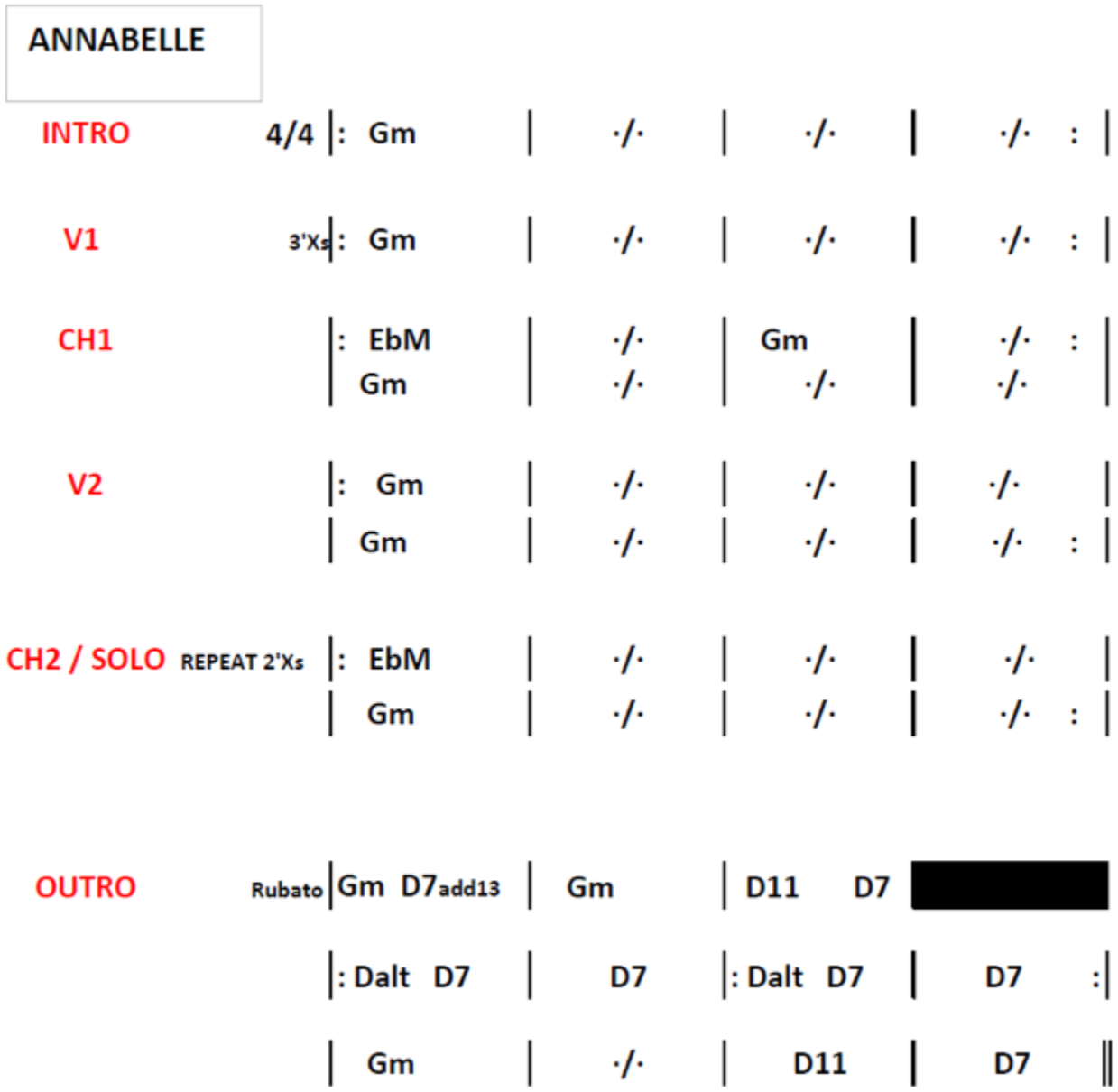
The Whippoorwill
Clipped her own wings
Returned to the place of her nesting
I can hear her song
But she won't show her face

And you wander the night
Never resting

The burs in your eyes
Glisten when you cry
Oh oh
The tears catch as they fall
Oh oh
Whippoorwill's song
Caught on your tongue
Oh oh
Whippoorwill's song
Caught on your tongue
Oh oh
There's trouble in your eyes
Winter's coming soon
Eyes cast a parting glance
At the moon
The burs in your eyes
Glisten when you cry
Oh oh
The tears catch
As they fall
Oh oh
Whippoorwill's song
Caught on your tongue
Oh oh

Singin' oh oh…
I've come back for you

Music Charts:



ARBOR DAY

INTRO 4/4 |: A7+11 | ·/· | G7+11 | ·/· :|

VERSE ·𝄋· | A7+11 | ·/· | ·/· | ·/· |
G7+11	·/·	·/·	·/·
G7+11	·/·	·/·	·/·
FM	·/·	·/·	·/·

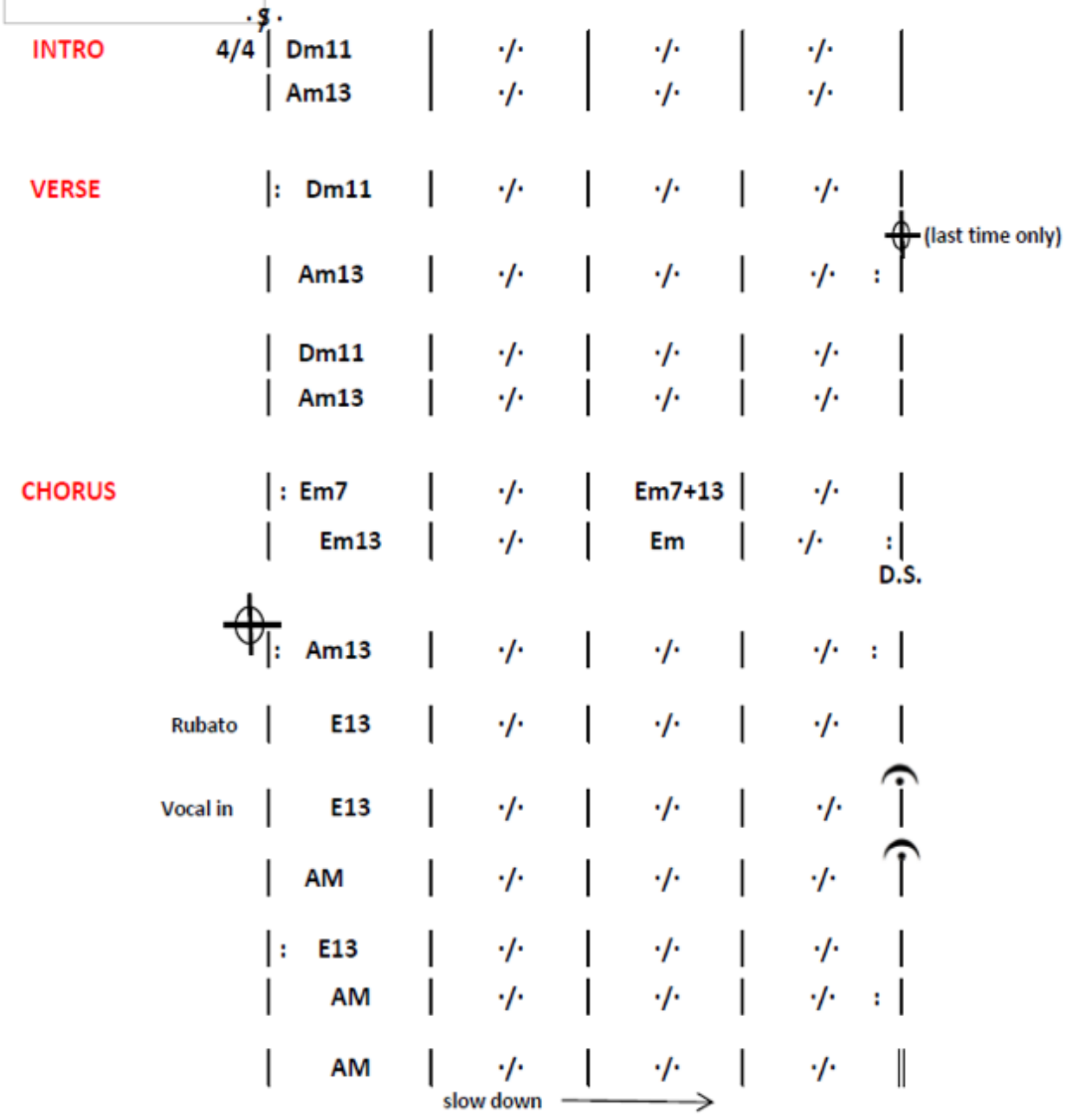
CHORUS | GM | ·/· | F#M | ·/· |
| GM | ·/· | F#M | ·/· |
| GM | ·/· | F#M | ·/· |

D.S.

F#M	·/·	F#M	·/· :
: GM	·/·	F#M	·/·
GM	·/·	F#M	·/· :
: AM	·/·	E7	·/· :

Repeat and fade

BULLET DANCER



CHALLENGER
bpm = 117

INTRO	4/4 GM	GM/F#	GM/F	GM/E	GM	·/·	
VERSE	GM	G7	G6	GM	Cm/G	·/·	
	GM	·/·	Bm	·/·	BM	CM	
	GM	·/·	Eb6/G	GM	·/·		
	GM	·/·					
CHORUS 1	Gm	·/·	EbM/D	2/4 Cm/G	4/4 GM		
	·/· D.S.						
CHORUS 2	: Gm	·/·	EbM	2/4 Cm/G	4/4 GM	·/·	:
BRIDGE	Cm/G	·/·	·/·	·/·			
	Bm	·/·	·/·	·/·			
CHORUS 3	: CM	GM	Bm	·/·			
	CM	GM	Bm	·/· :			
	Bm	·/· ‖					

HORSEAISLE

INTRO 2/4 | AM | ·/· | ·/· | ·/· |

VERSE 1

: AM	·/·	·/·	·/·
EM	·/·	·/·	·/·
D6/G(2ndx only)	·/·	·/·	·/·

1. ·/· | DM :

2. D6 | ·/· | DM7b5 | DM | DM7b5 |
·/·

BRIDGE 1

: DM7b5	DM	DM7b5	·/·
DM7b5	DM	DM7b5	DM :

repeat3x's

: Bm7	·/·	·/·	·/· :
Bm7	·/·		

𝄋 ·(repeat on D.S. only)

: Bm7 | ·/· | ·/· | ·/· :

BRIDGE 2

Bm7 | ·/· | ·/· | ·/·

: EM	B6	·/·	·/·	·/·
F#M	·/·	·/·	·/·	
G#m	·/·	·/·	·/· :	

D.S. (2nd x only)

𝄋

EM	B6	·/·	·/·	·/·	·/·
F#M	·/·	·/·	·/·	G#m	·/·
·/·	·/·	EM	B6	·/·	·/·
·/·	F#M	·/·	·/·	·/·	G#m
G#m	·/·	·/·			
G#m	·/·	·/·	·/·		
: G#m	·/·	EM	·/· :		

OH MY HEART

INTRO	4/4	|:	Gm	·/·	·/·	·/·	:|	
VERSE 1		|:	Gm	·/·	·/·	·/·	|	
		|	Gm	·/·	·/·	·/·	:|	
		|	Gm	·/·	·/·	·/·	|	
VERSE 2		|:	Gm	·/·	·/·	·/·	|	
		|	Gm	·/·	·/·	·/·	:|	
		|	Gm	|				
VERSE 3		|:	Gm	·/·	·/·	·/·	|	
		|	Gm	·/·	·/·	·/·	:|	
OUTRO		|:	Eb6	·/·	CM	·/·	|	
		|	Eb6	·/·	CM	·/·	:‖	

accelerate gradually to bpm = 158

Repeat and fade

POA 1
bpm = 160

INTRO	4/4	|:	Em	|	·/·	|	·/·	|	·/· :|
VERSE 1		|:	DM	|	·/·	|	E/B	|	·/· |
		|	DM	|	·/·	|	E/B	|	·/· :|
VERSE 2		|:	DM	|	·/·	|	E/B	|	·/· |
		|	DM	|	·/·	|	E/B	|	·/· :|
VERSE 3		|:	DM	|	·/·	|	AM	|	·/· |
		|	DM	|	·/·	|	AM	|	·/· :|
		|:	DM	|	·/·	|	AM	|	DM |
		|	DM	|	·/·	|	AM	|	DM :|
BRIDGE		|:	GM	|	·/·	|	·/·	|	·/· |
		|	DM	|	·/·	|	·/·	|	·/· :|
OUTRO		|:	Bm	|	·/·	|	Gm	|	·/· |
		|	Bm	|	·/·	|	Gm	|	·/· :‖

POA 2

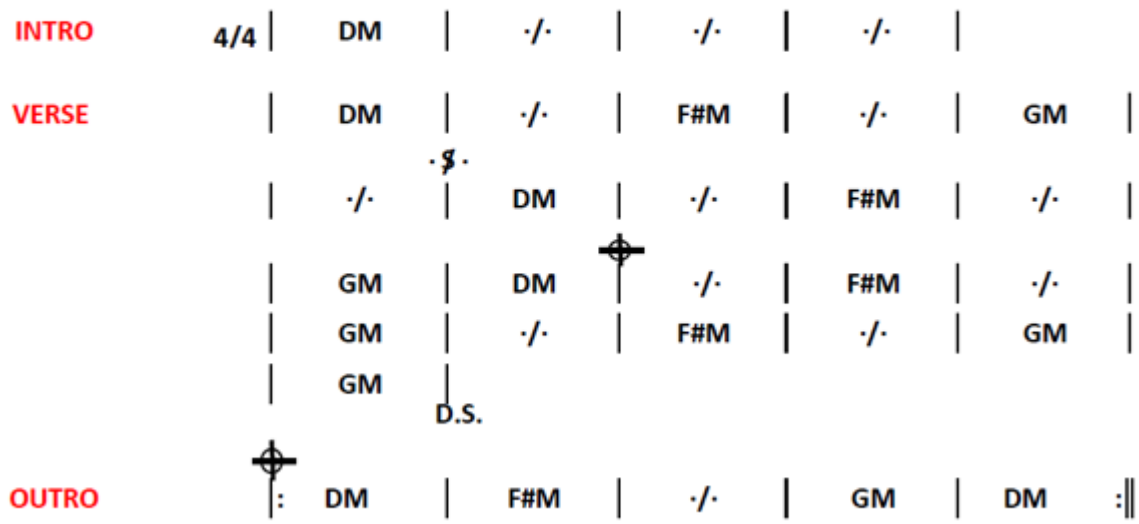
VERSE 1	4/4	:| Bm	CM	DM	·/·	
		Bm	CM	1. DM	·/·	:|
		2. DM	·/·	·/·	·/·	
		DM	·/·	·/·	·/·	
BRIDGE 1	repeat 3 x's	:| GM	·/·	·/·	·/·	
		DM	·/·	·/·	·/·	:|
BRIDGE 2		Bm	·/·	·/·	·/·	
		GM	·/·	·/·	·/·	
VERSE 2		DM	·/·	·/·	·/·	
		DM	·/·	·/·	·/·	
OUTRO		:| Bm	CM	DM	·/·	
		Bm	CM	DM	·/·	:|
TAG		:| DM	·/·	·/·	·/·	:|

SMALLEST BIRD

INTRO	4/4	FM	·/·	·/·	·/·
VERSE 1 & 2		: FM	Am	CM	FM
		FM	Am	CM	FM (1. 3.) :
		2. 4. FM	FM :		
CHORUS		FM	·/·	CM	·/·
		GM	·/·	Am	·/·
		FM	·/·	Am	·/·
		FM	DM	FM	Am
		·/·			
		: FM	FM GM	Am	·/· :|
		FM	FM GM	Am	CM
		FM	FM GM	Am	·/·
SOLO		FM	·/·	Am	·/·
		FM	·/·	Am	·/·
		FM	·/·	CM	·/·
		GM	·/·	Am	·/·
VERSE 5		: FM	Am	CM	FM
		FM	Am	CM	FM :|
	rubato	FM	Am	CM	FM ‖

SUMMER NEVER ENDS

intro bpm = 109



THE RIVER
intro bpm = 60
form bpm = 160

INTRO

4/4	CM	·/·	Am	·/·	FM
	CM	·/·	CM	·/·	

VERSE

	CM	Dm	·/·	·/·	·/·
	·/·	·/·	CM	Dm	·/·
	·/·	·/·	·/·		

CHORUS

	CM	·/·	·/·	Dm	·/·
	·/·	·/·			
	CM	·/·	·/·	·/·	

VERSE 2

	CM	Dm	·/·	·/·	·/·
	·/·	CM	Dm	·/·	·/·
	·/·				

D.S.

BRIDGE

	C	·/·	·/·	·/·	
	C	·/·	·/·	·/·	
	C	·/·	Dm	·/·	
	Dm	·/·	·/·	·/·	

OUTRO

	CM	·/·	·/·	·/·	
	CM	·/·	·/·	·/·	

VOICES FROM INSIDE
bpm = 104

INTRO	**4/4**	**GM**		**·/·**				

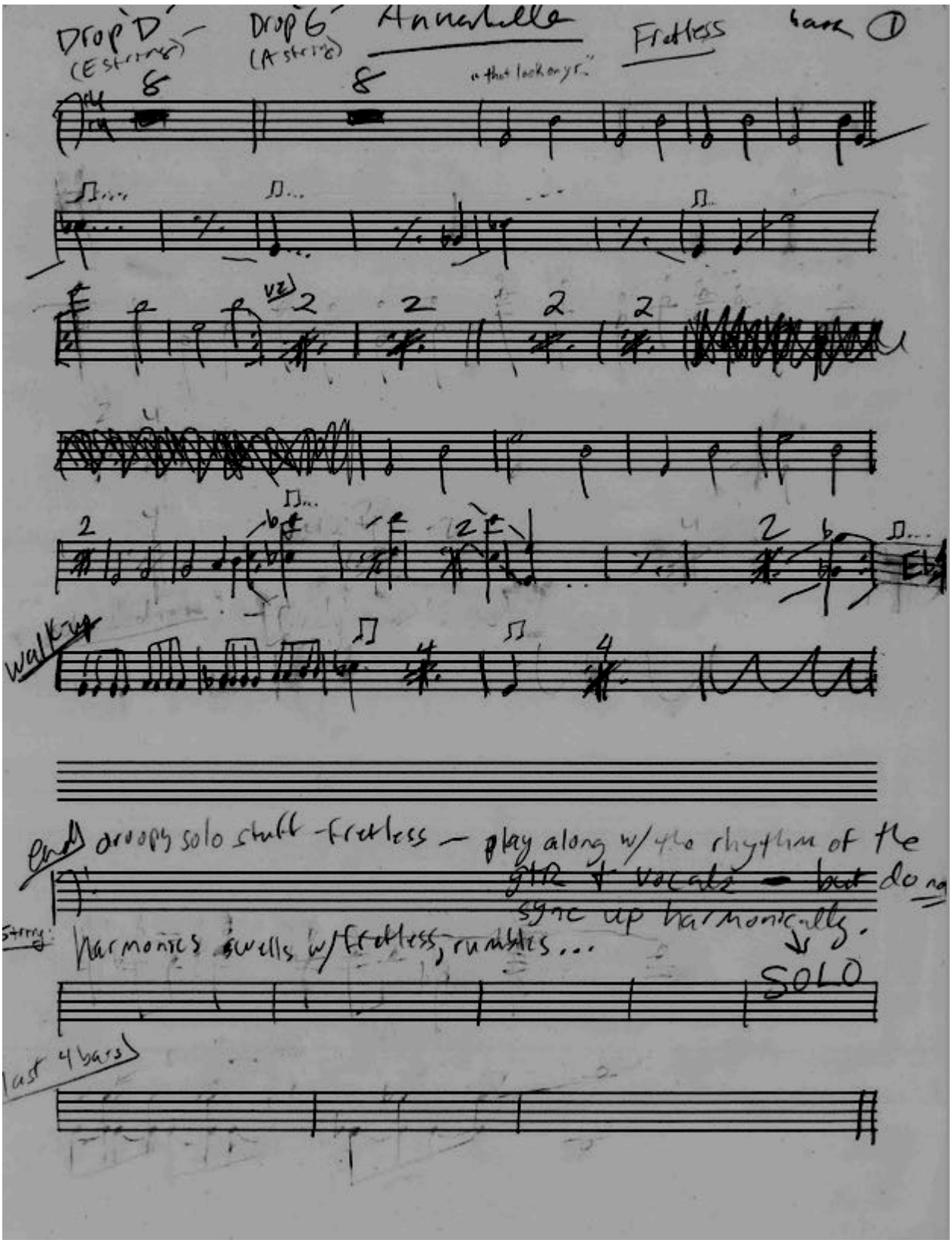
VERSE 1	**:**	**GM**		**·/·**		**Bm**		**·/·**
		GM		**·/·**		**DM**		**·/·**
		Bm		**·/·**		**GM**		**·/·**
		DM		**F#M**		**GM**		**·/·**
		GM		**·/·**		**Bm**		**·/·**
		GM		**·/·**		**Bm**		**·/·**
	:	**Gm**		**·/·**		**DM**		**·/·**
		Bm		**GM**		**DM**		**·/·**
		GM		**·/·**		**DM**		**·/·**
		·/·		**F#M**		**GM**		

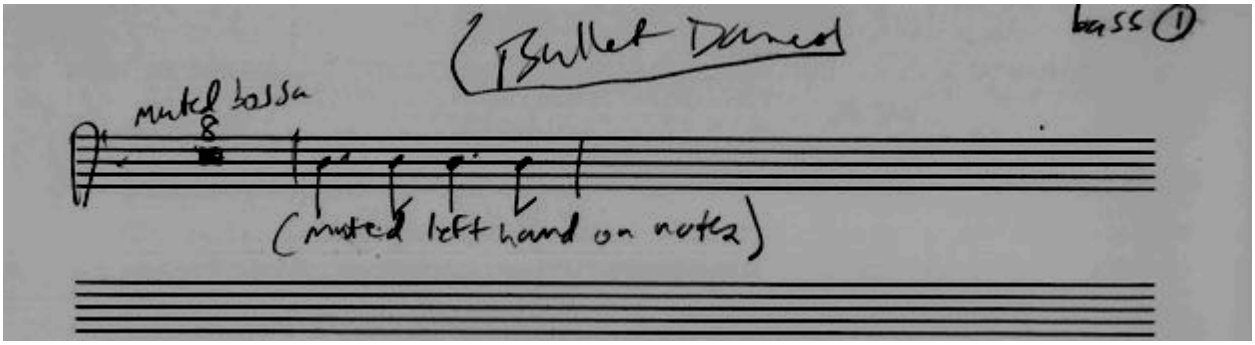
WHIPPORWILL

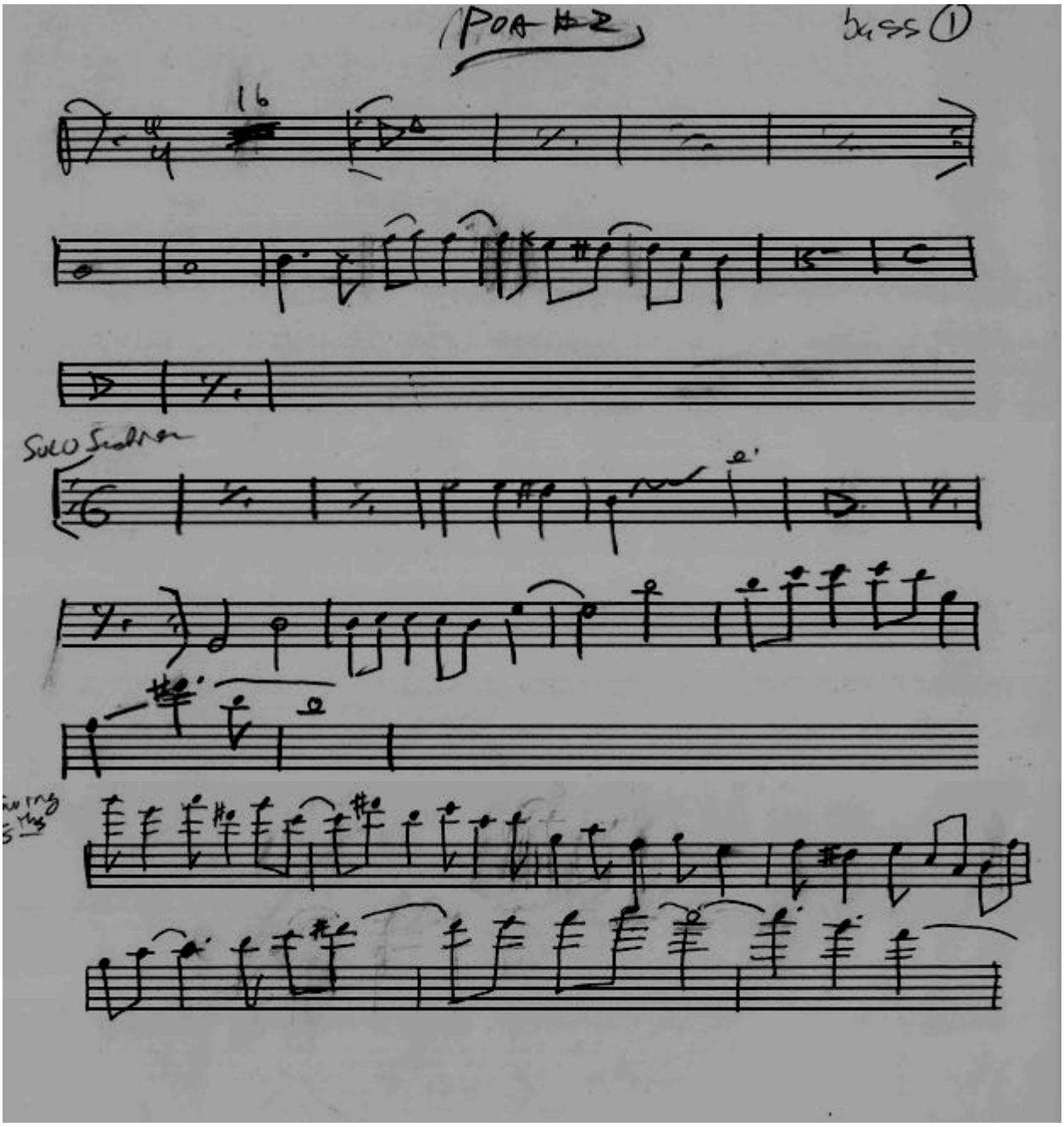
drum intro

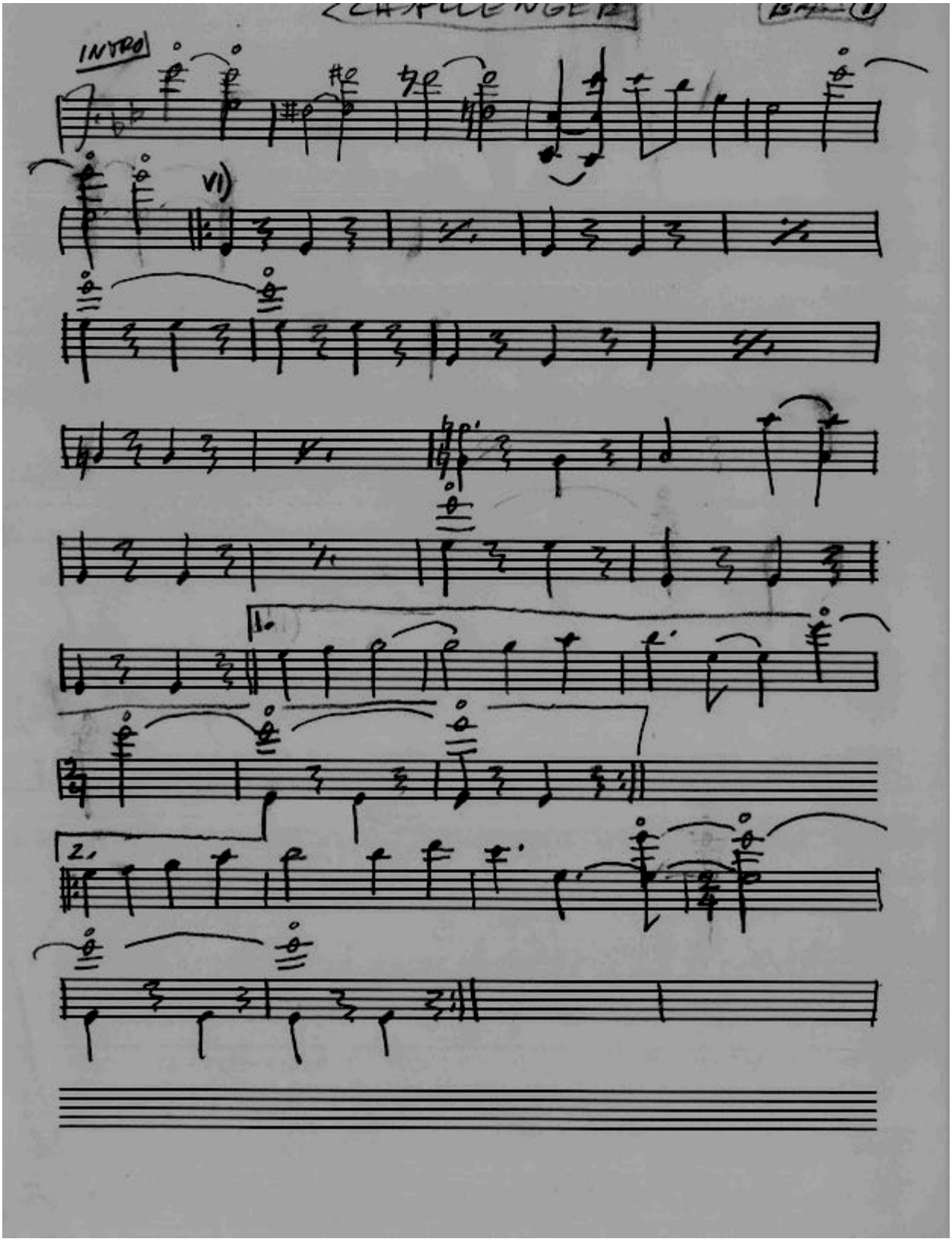
INTRO	3/4	:|	·/·		·/·		·/·		·/·	:|
						1. 2. 3.			
VERSE 1		:|	C#m		·/·		DM7		·/·	:|
			4.								
				AM		·/·					
CHORUS 1				Bm		AM		C#m		·/·	
VERSE 2		:		C#m		·/·		DM7		·/·	
				C#m		·/·		AM		·/·	:|
CHORUS 2		:		Bm		AM		C#m		·/·	
				Bm		AM		C#m		·/·	
				Bm		AM		C#m		·/·	
				Bm		AM		C#m		·/·	:|
				Bm		AM		C#m		·/·	
				Bm		AM		C#m		·/·	
				C#m		·/·	‖				

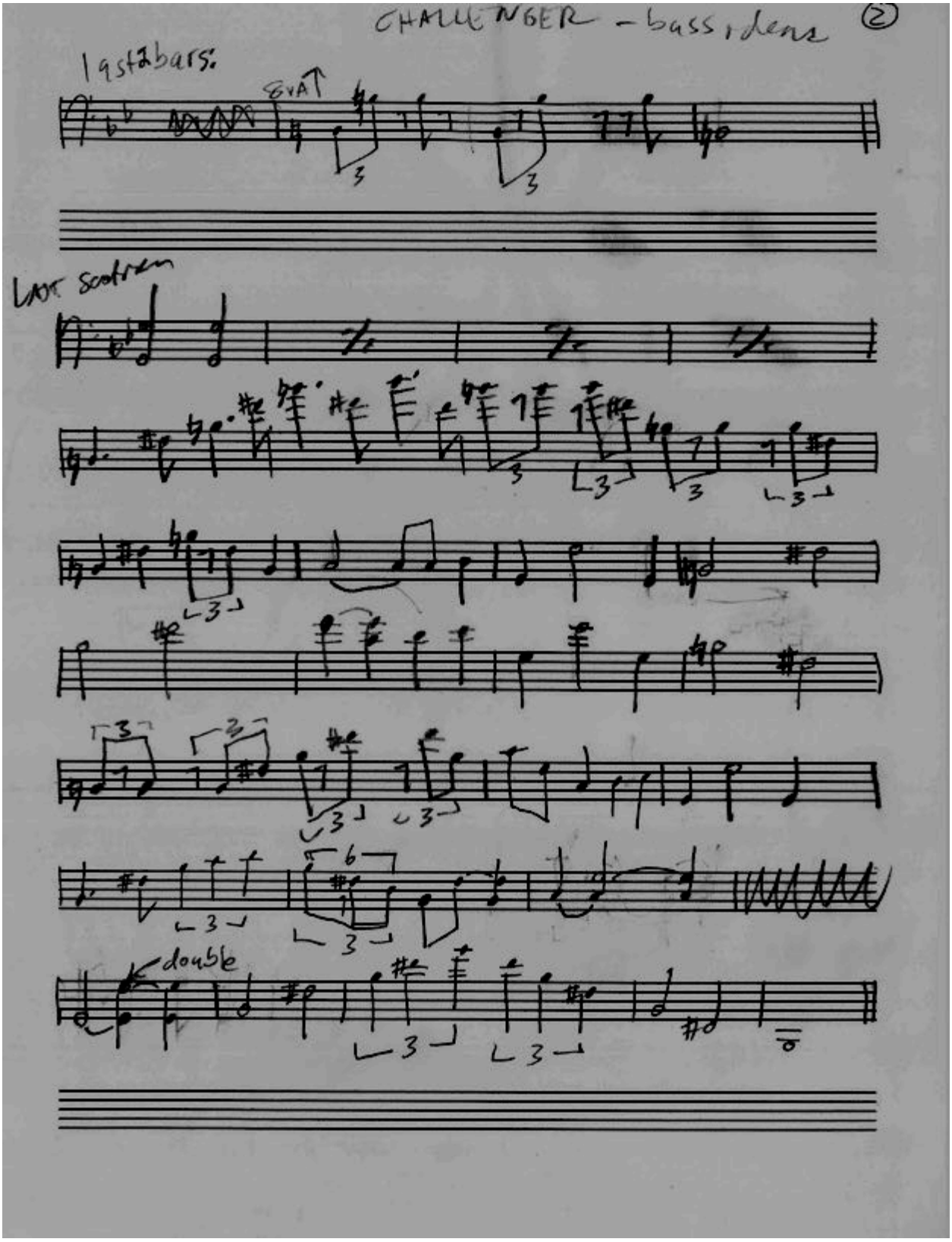
Electric Bass Parts:

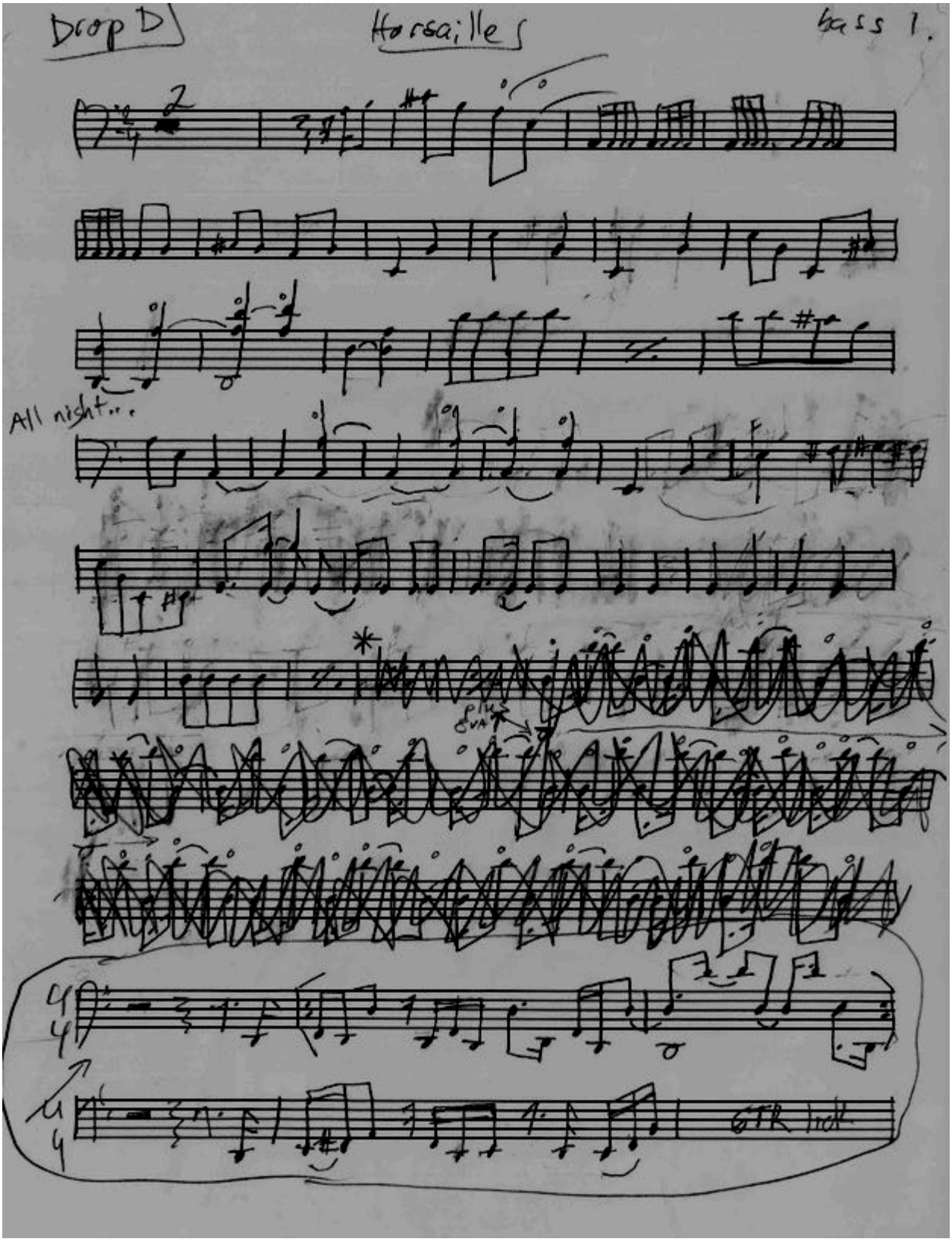


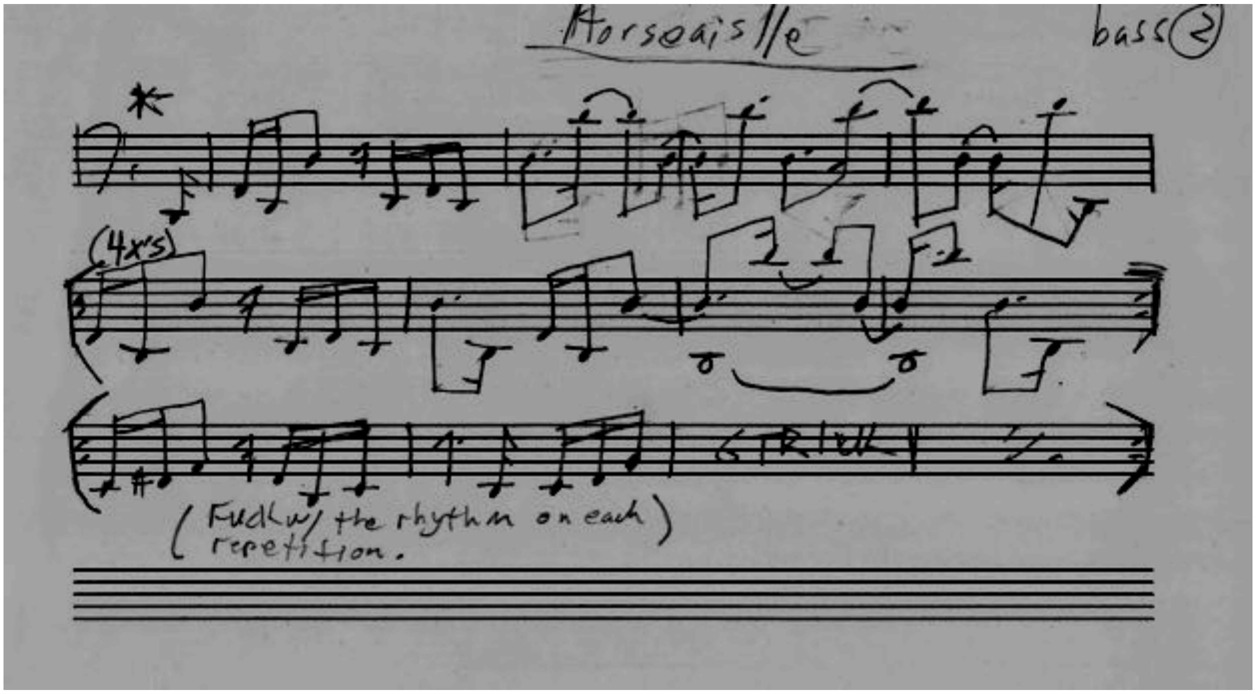

Bullet Dance
bass ①
muted bossa
(muted left hand on notes)

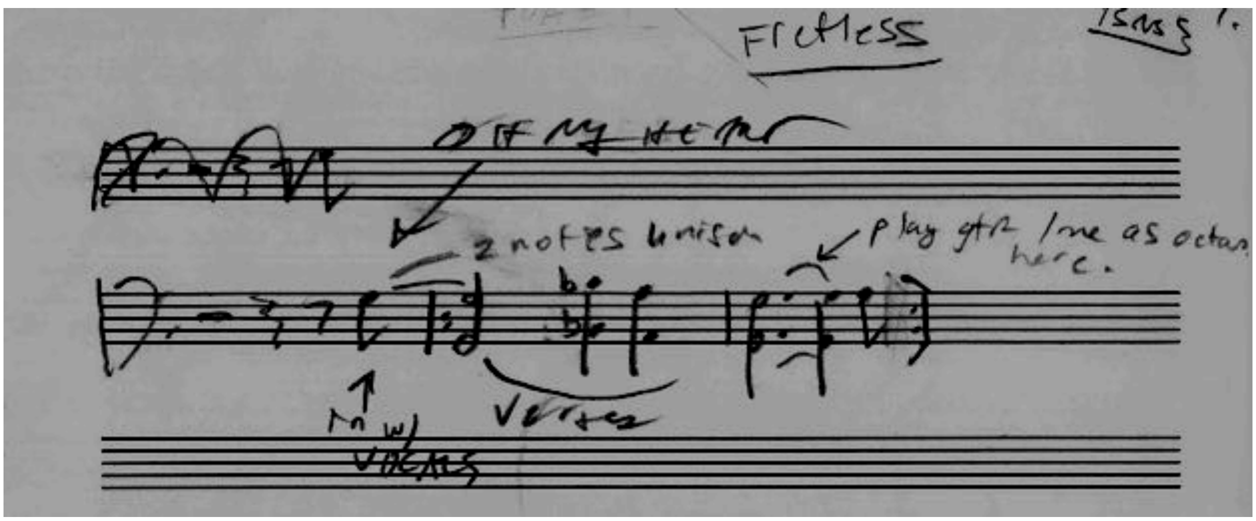

PART 2
bass ①
16
SOLO Section

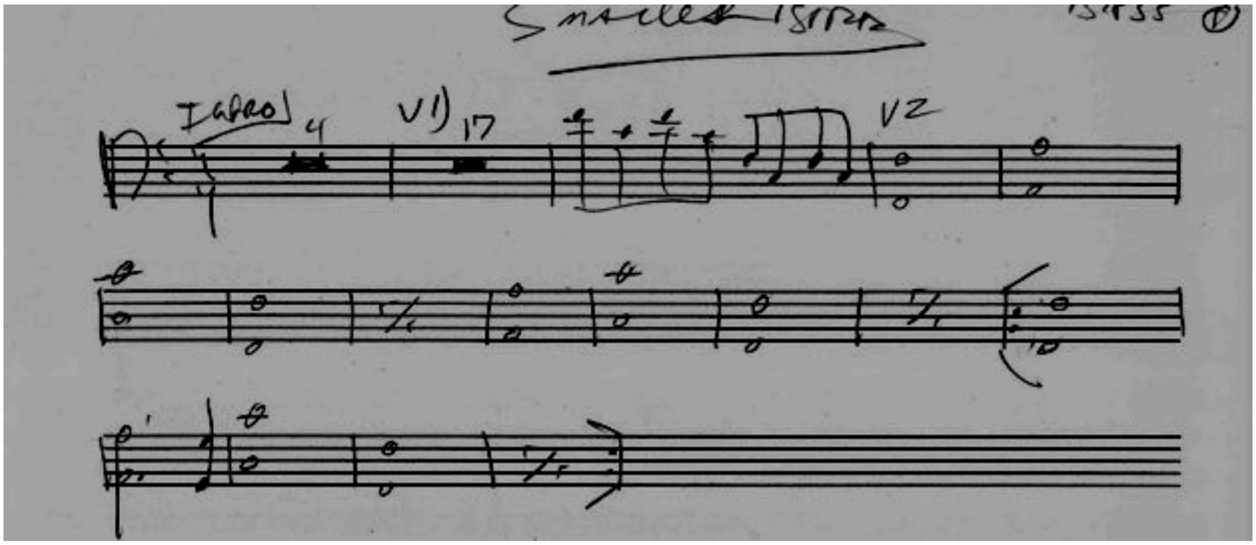

INTRO
VI)
1.
2.

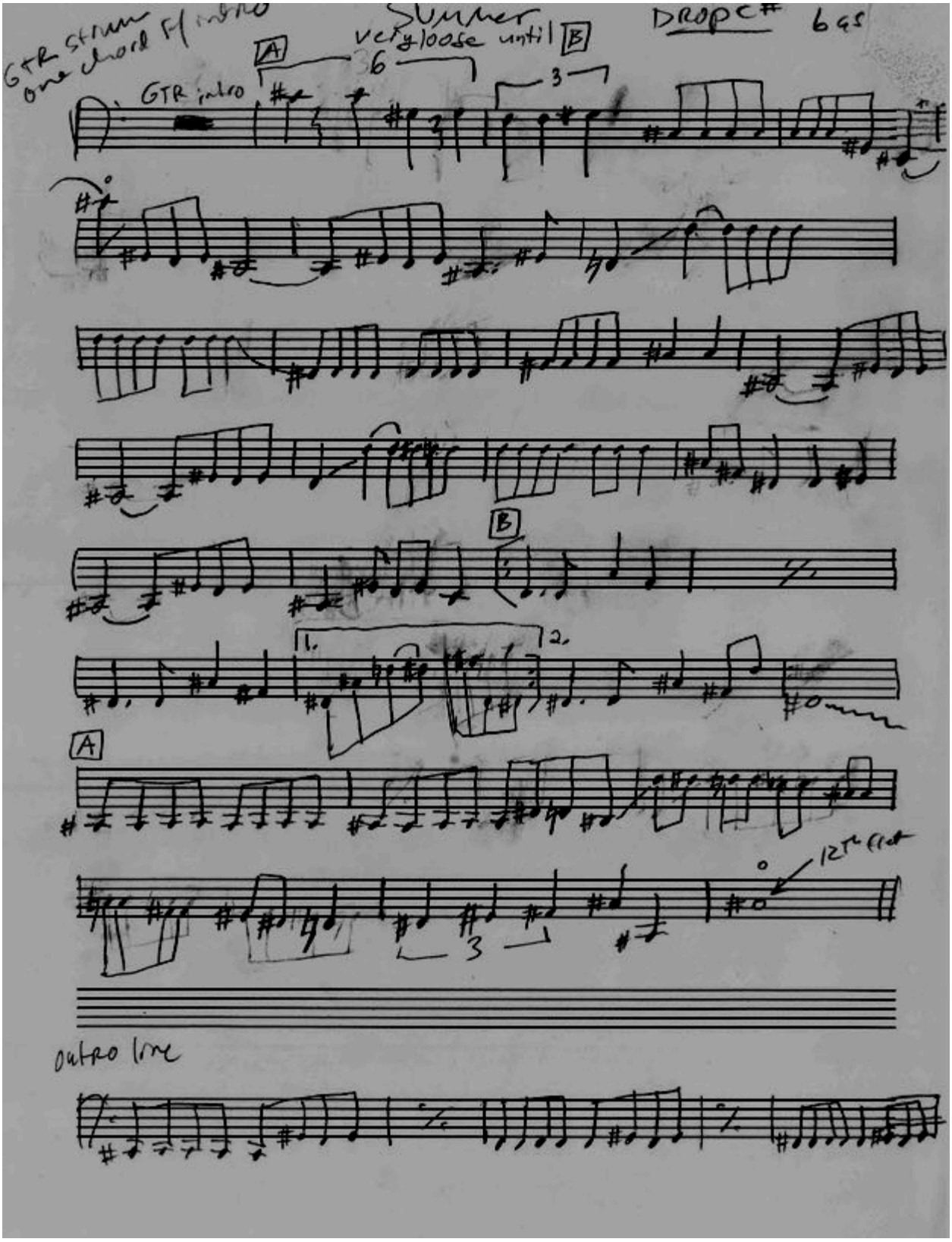

CHALLENGER - bass + drums
2
last 2 bars:
8vA
Last section
double

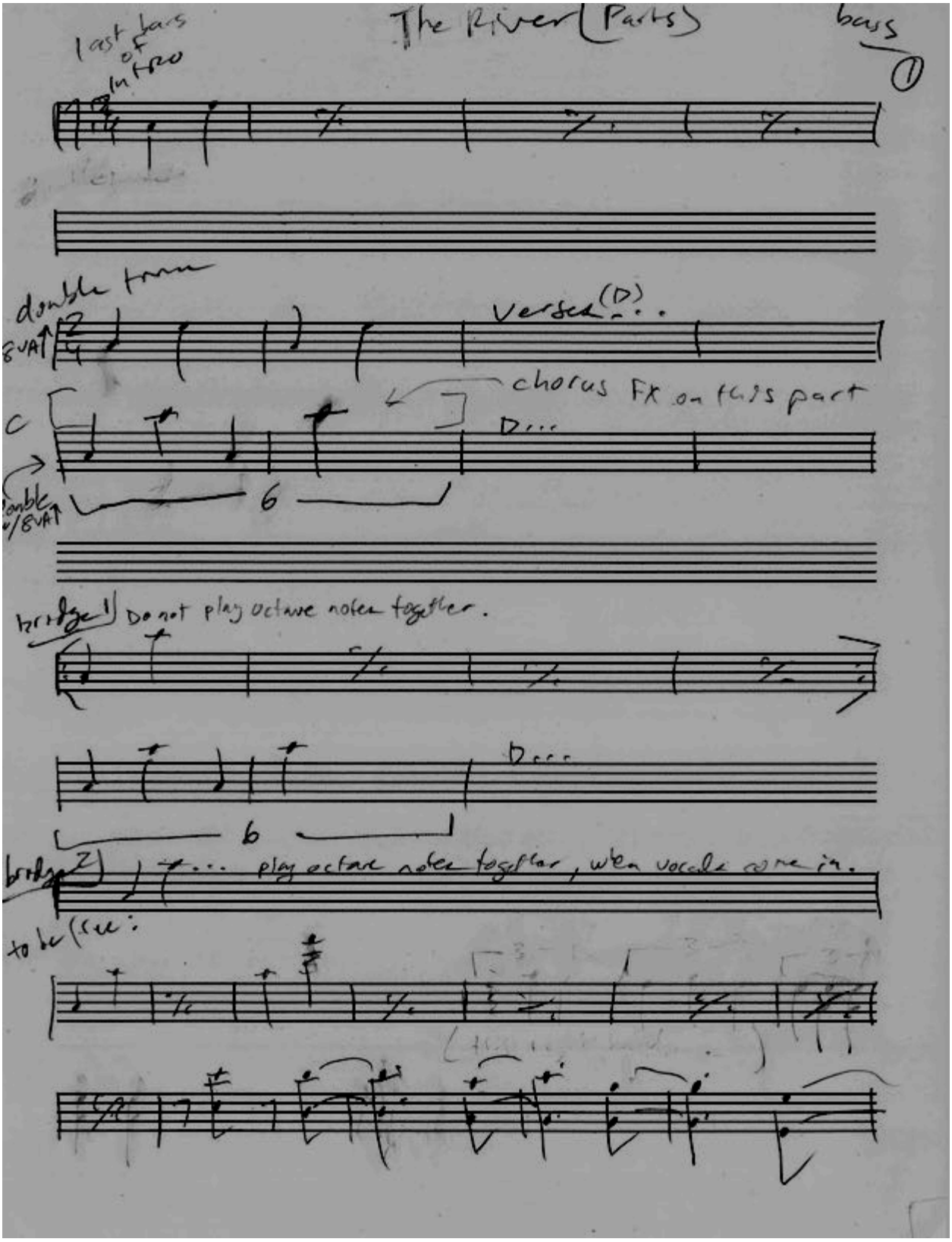

Drop D
Horsailles
bass 1.
All night...
8va
GTR. Incl.

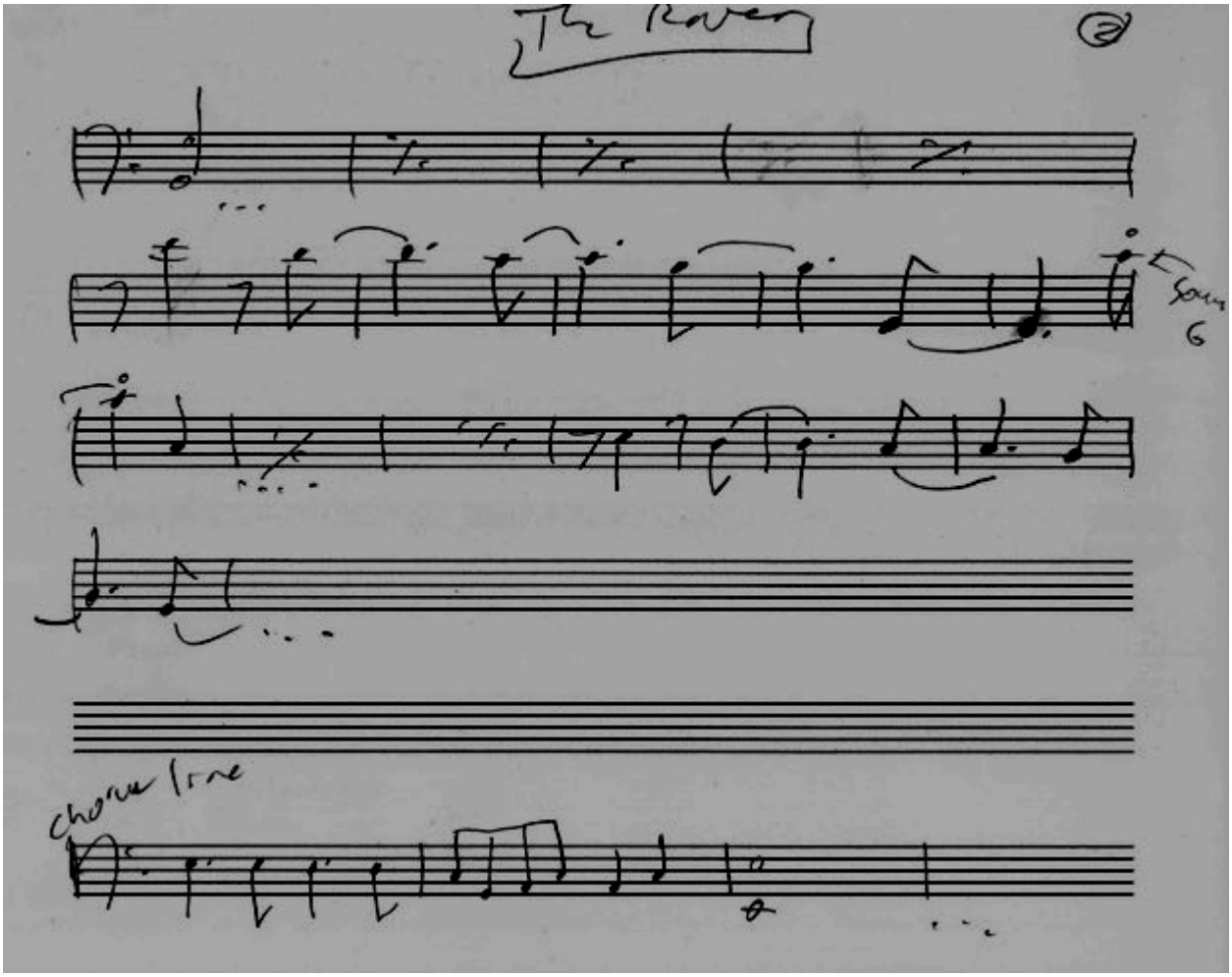

bass (2)
(4x's)
GTR lick
(Fuck w/ the rhythm on each repetition.)

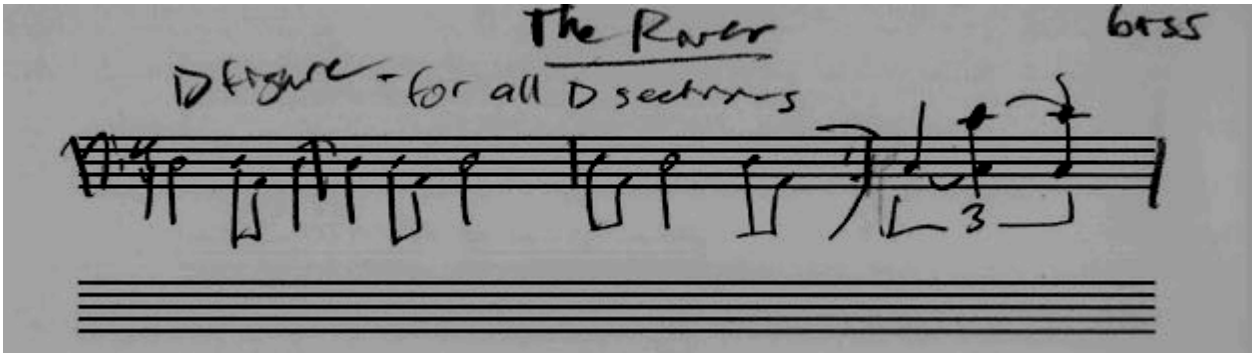

Fretless
2 notes unison
play gtr line as octav here.
in w/ vocals
verses

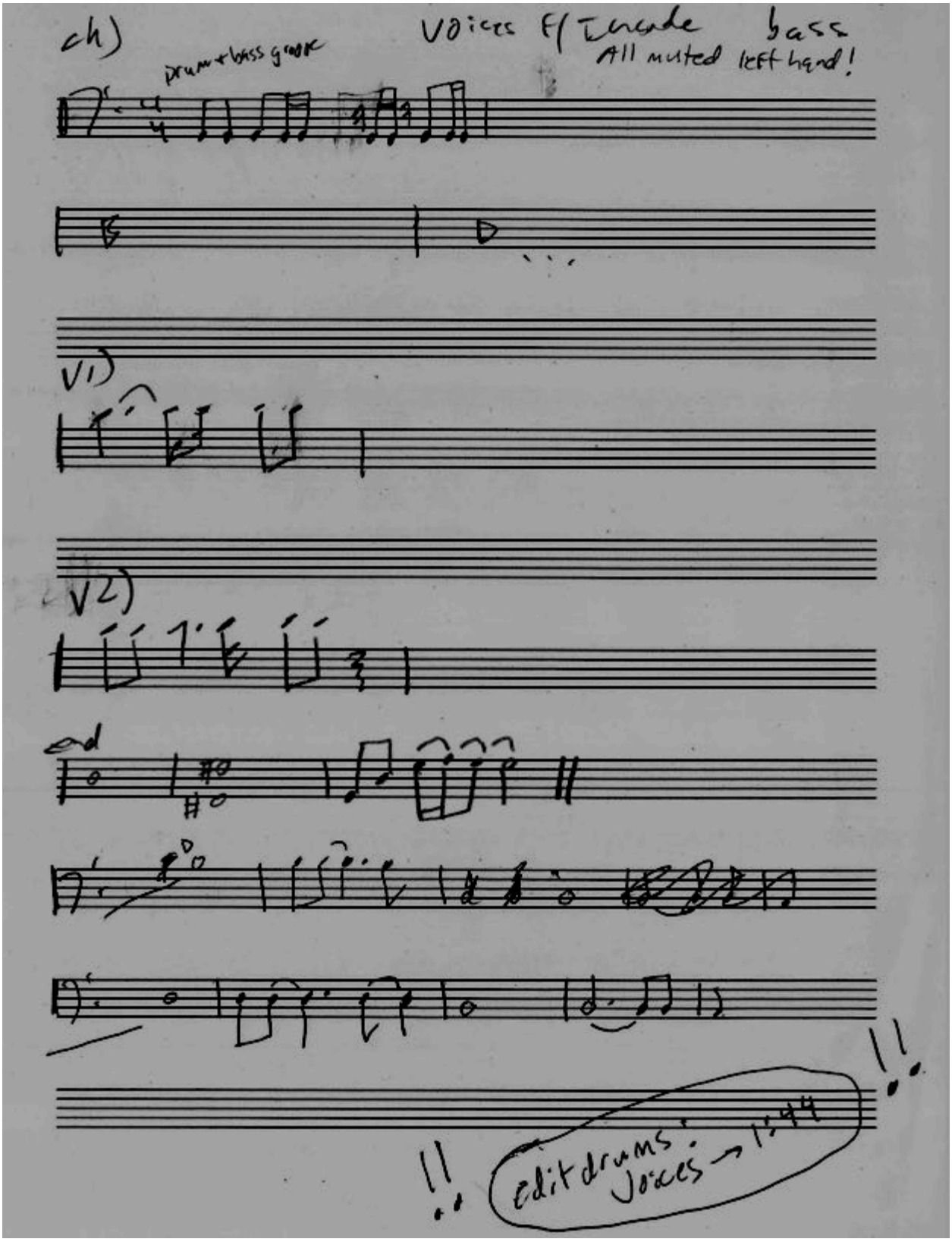

INTRO
4
V1
17
V2

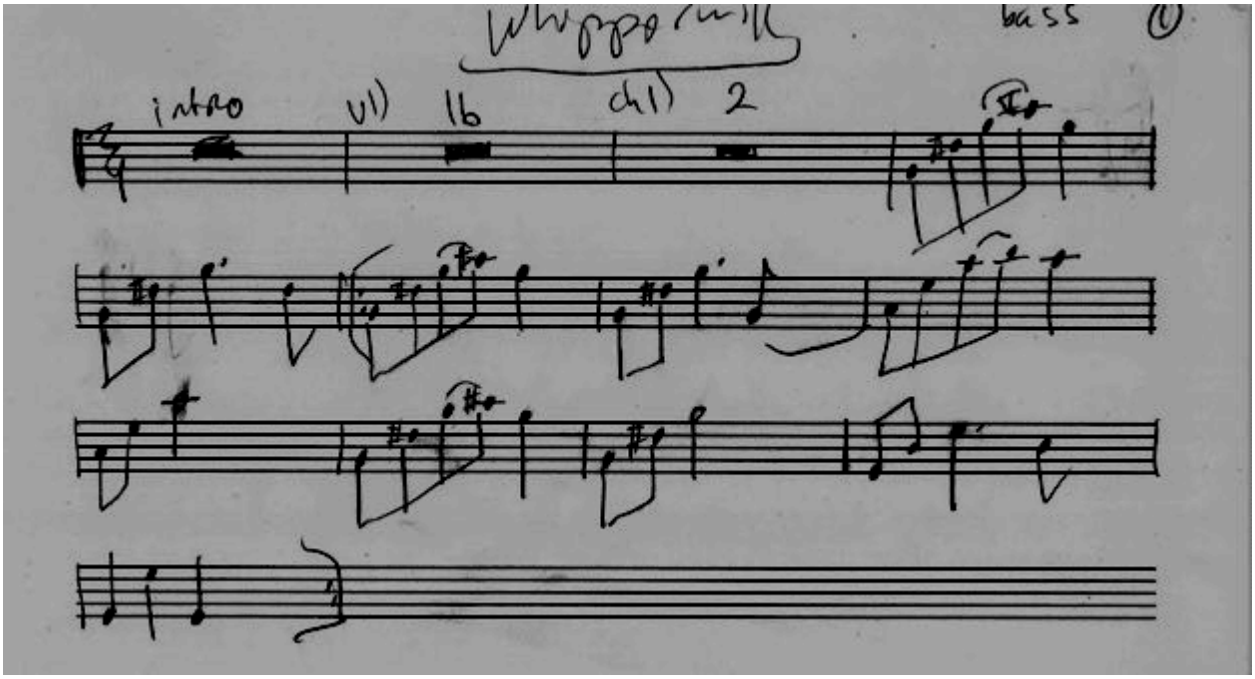

GTR strum one chord for intro
A
GTR intro
Summer
very loose until
B
DROP C# 6 4 5
6
3
B
1.
2.
A
12th fret
3
outro line


The River (Parts)
bass
1
last bars of intro
double time
8VA
Verse (D)
D...
chorus FX on this part
C
6
bridge
Do not play octave notes together.
D...
6
bridge 2
play octave notes together, when vocals come in.
to be (cue:


The River
2
E form
6
chorus line


The River
bass
D figure - for all D sections
3

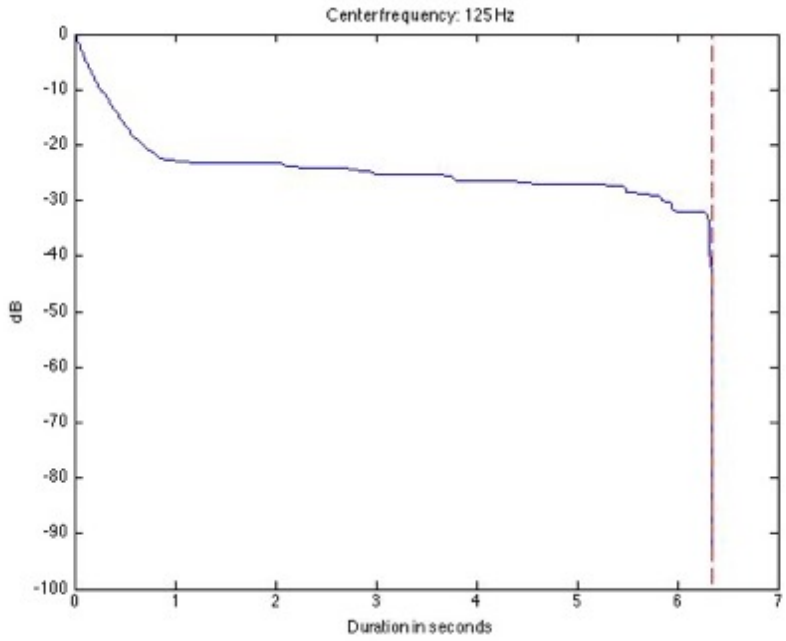

ch)
drum+bass groove
Voices f/ Encode bass
All muted left hand!
VI)
V2)
ad
edit drums
Voices → 1:44

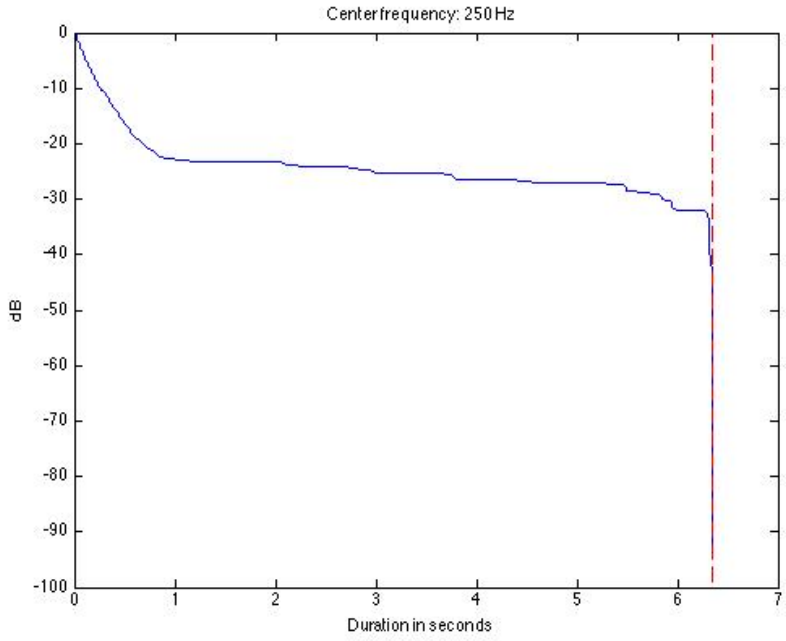

bass
intro
vii
16
ch1
2

APPENDIX IV: Auxiliary Technical Focus

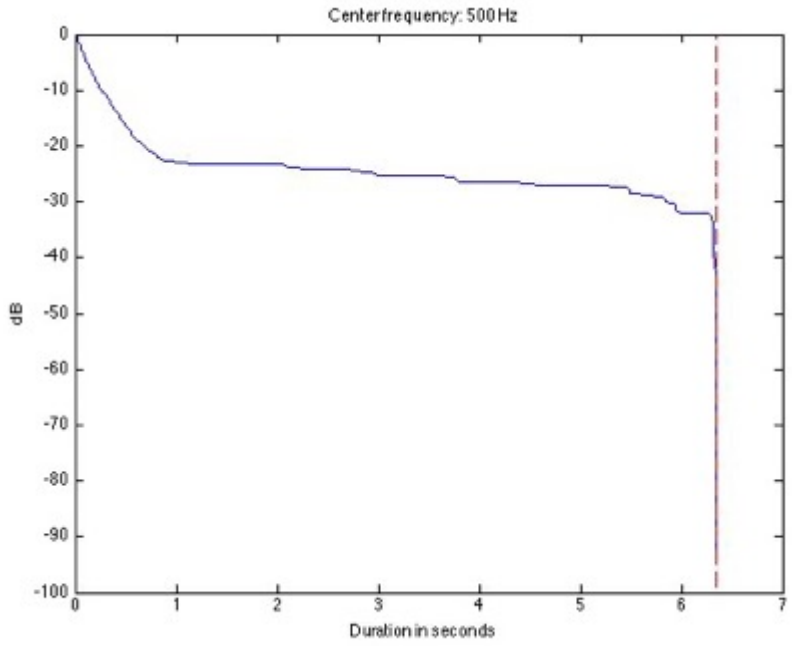
RT60 Raw Data:

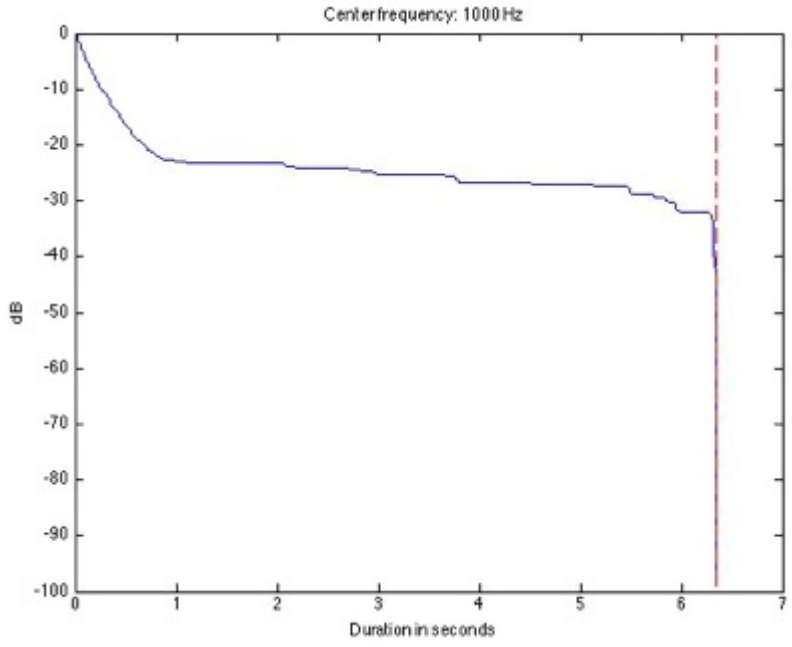
$RT_{60(URINALS)}$ Quad (Left Back) (125Hz & 250Hz)



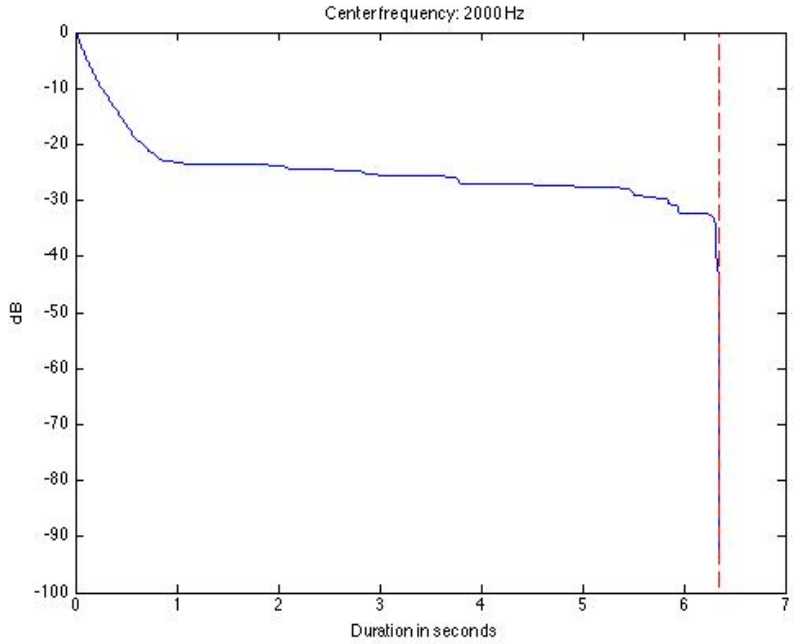


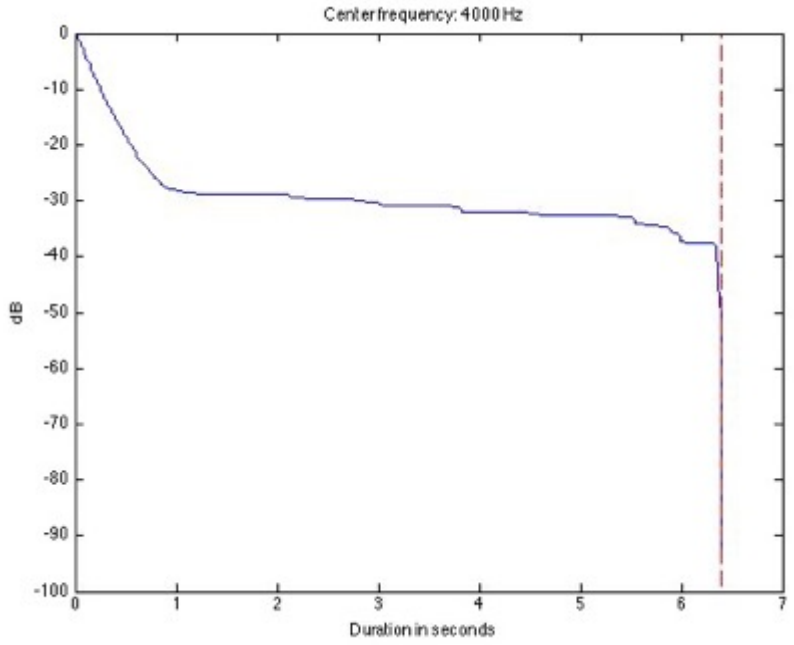
$RT_{60(URINALS)}$ Quad (Left Back) (500Hz & 1 kHz)



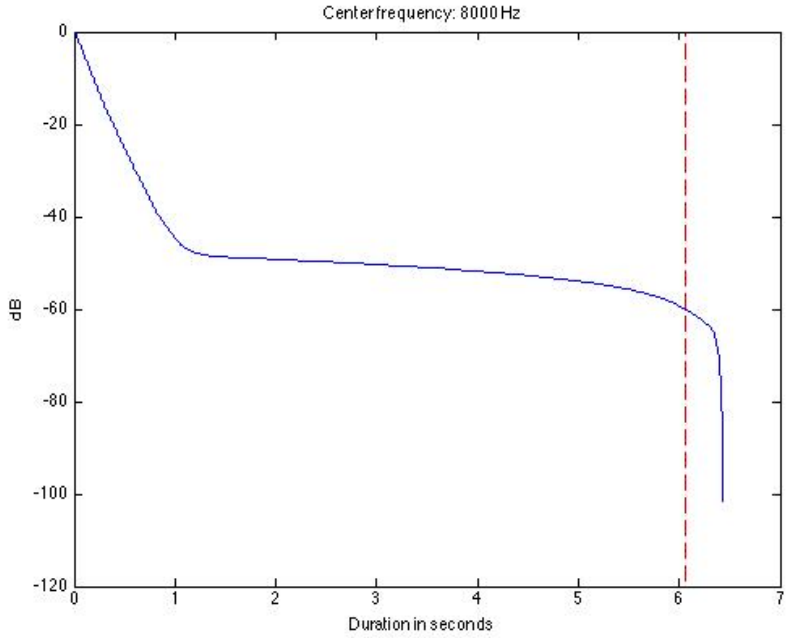


$RT_{60(URINALS)}$ Quad (Left Back) (2 kHz & 4 kHz)

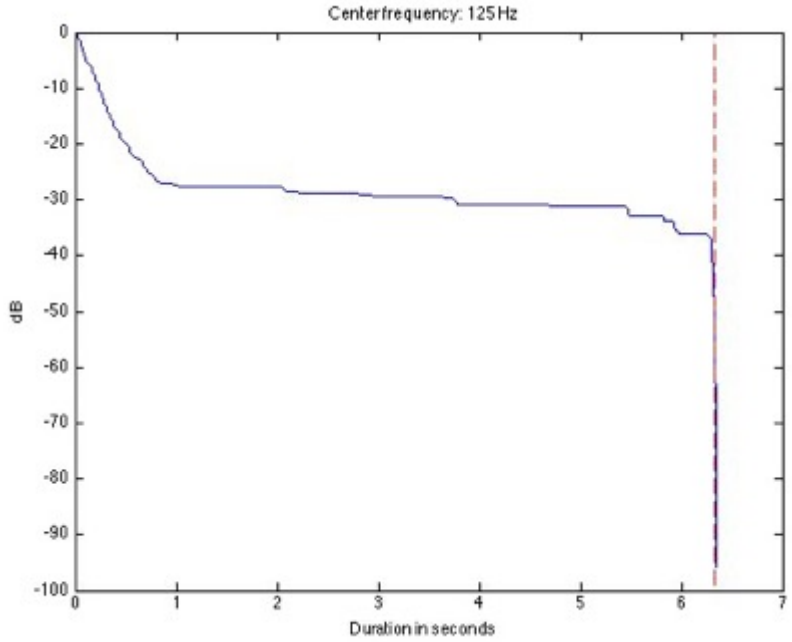


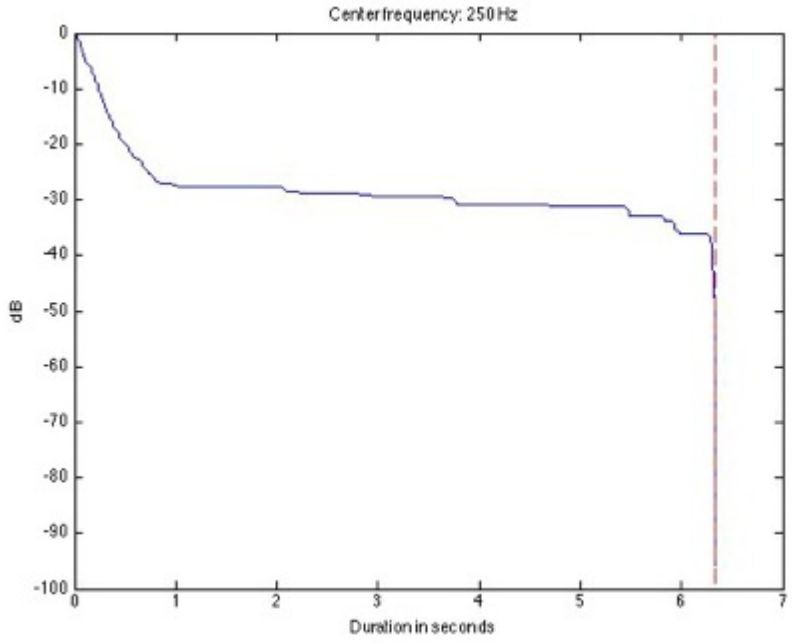


$RT_{60(URINALS)}$ Quad (Left Back) (8 kHz)

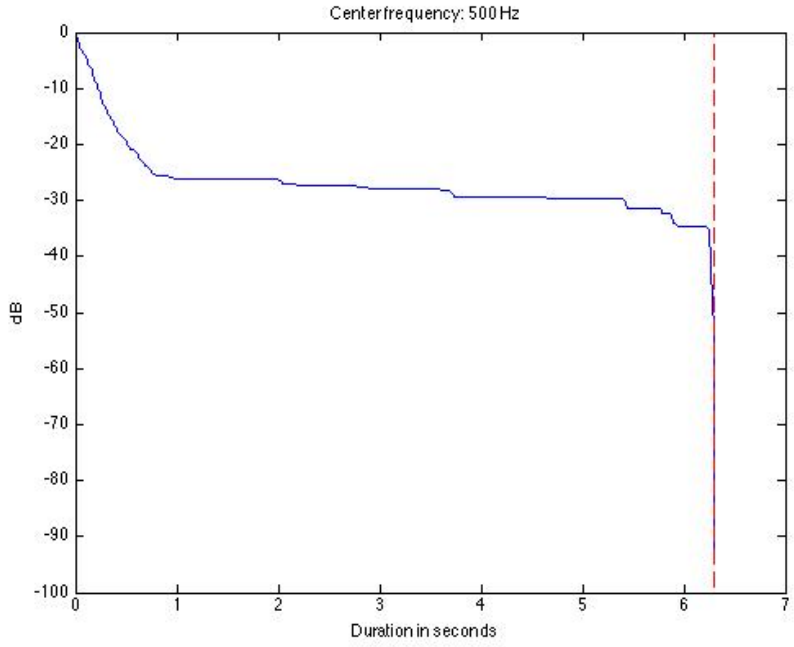


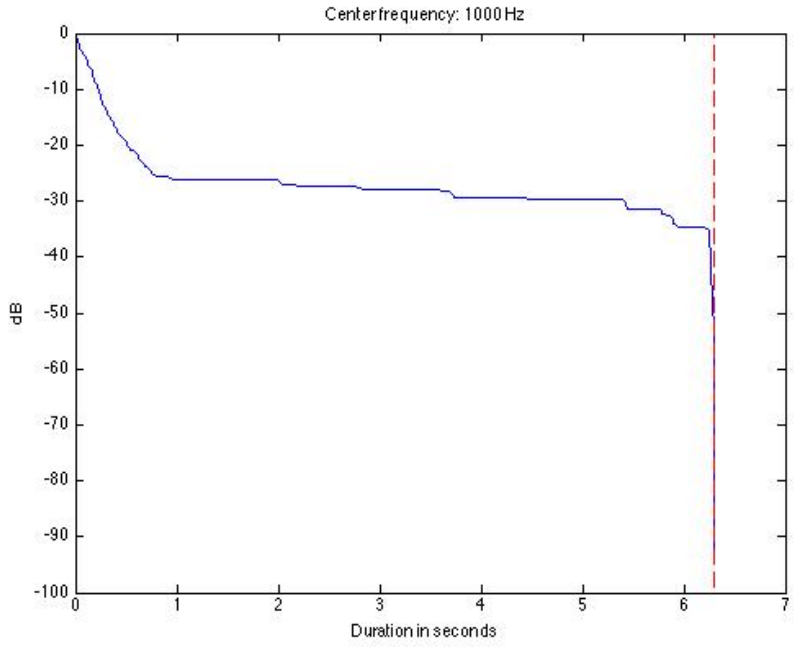
$RT_{60(URINALS)}$ Quad (Left Front) (125Hz & 250Hz)



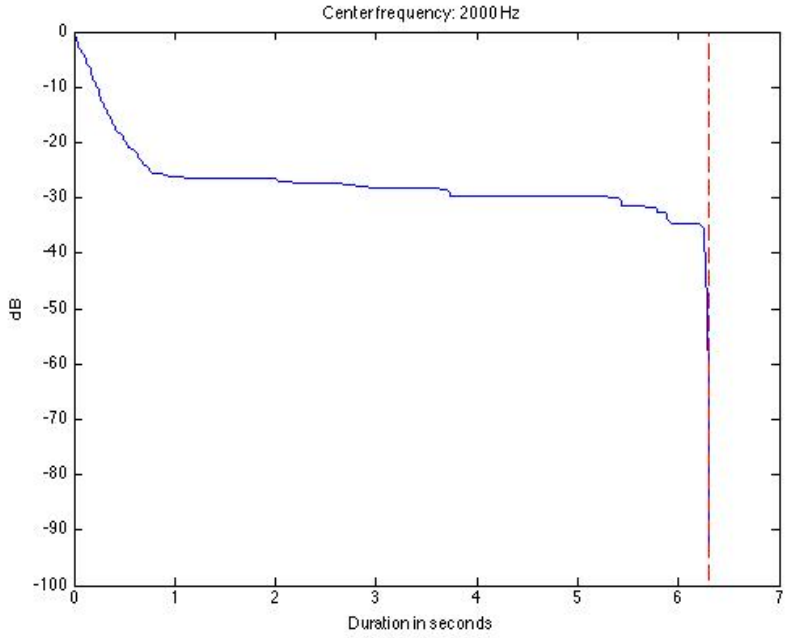


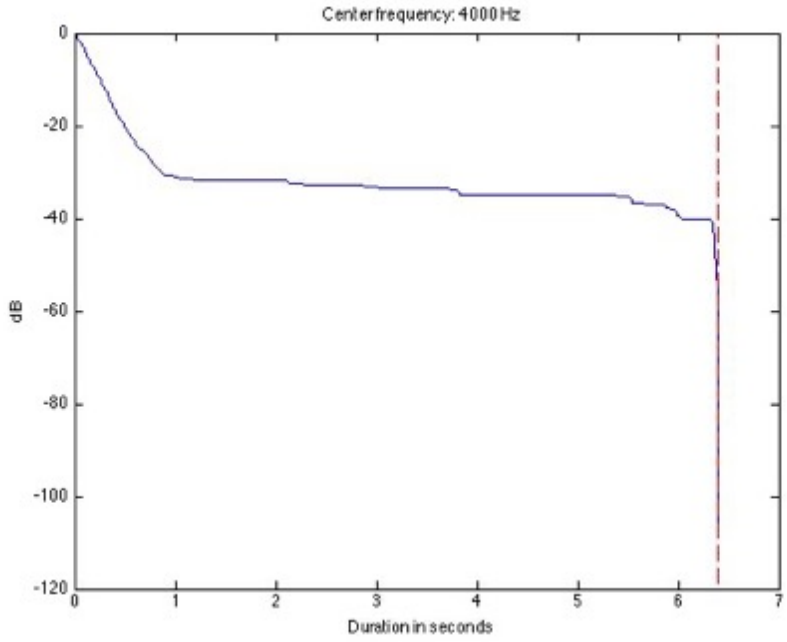
$RT_{60(URINALS)}$ Quad (Left Front) (500Hz & 1kHz)



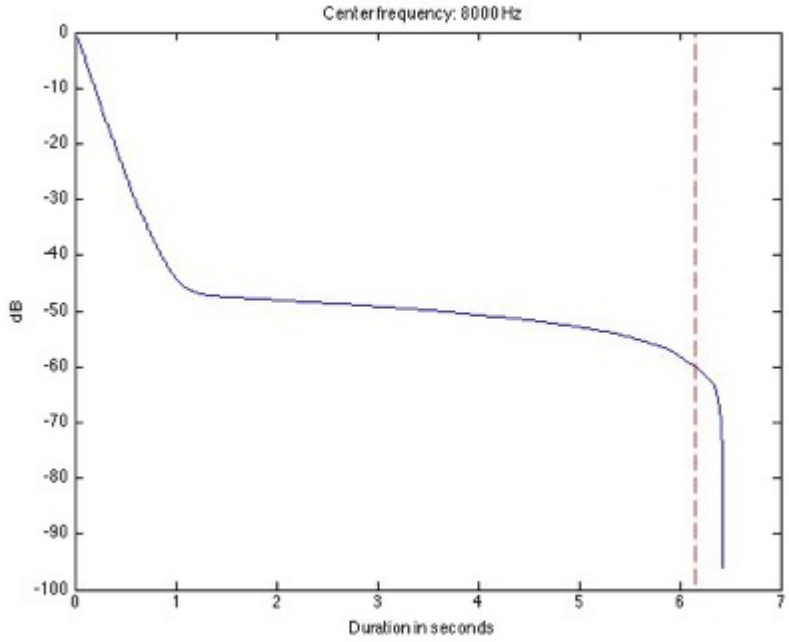


$RT_{60(URINALS)}$ Quad (Left Front) (2kHz & 4kHz)

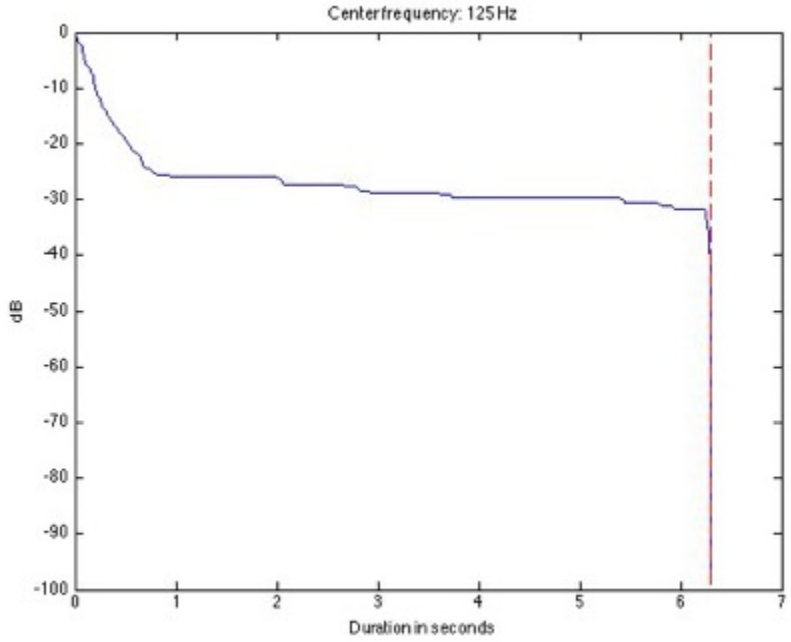


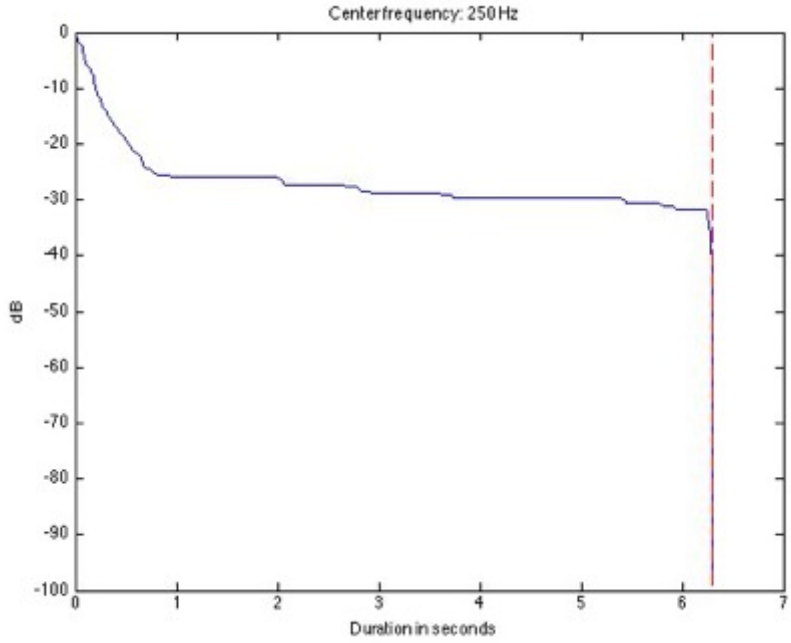


$RT_{60(URINALS)}$ Quad (Left Front) (8kHz)

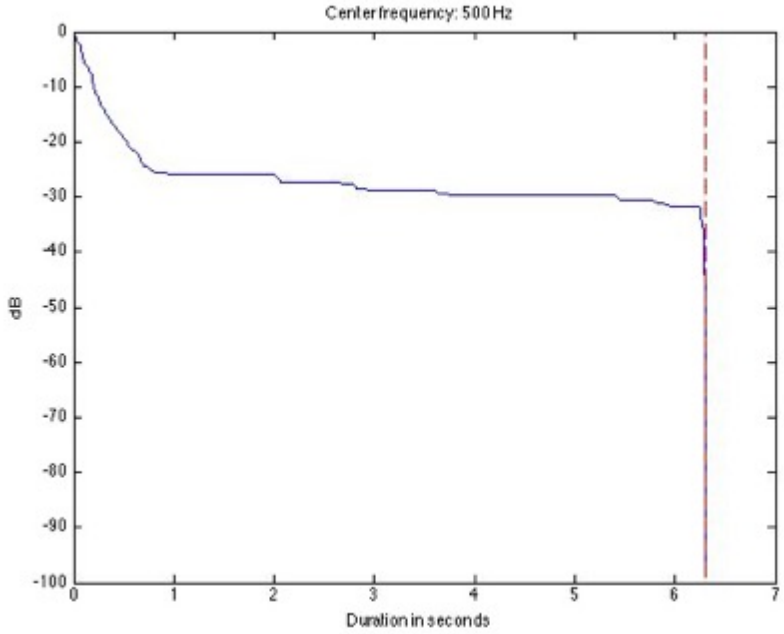


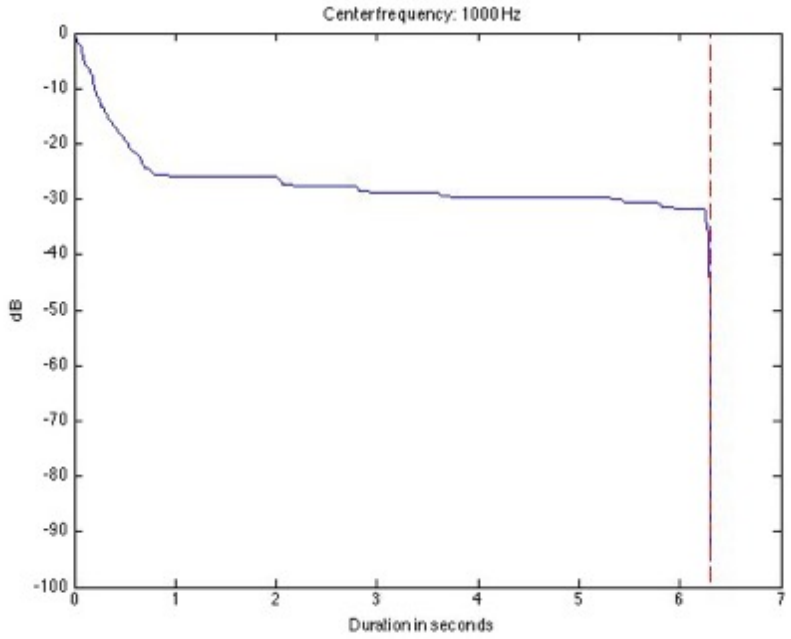
$RT_{60(URINALS)}$ Quad (Right Back) (125Hz & 250Hz)



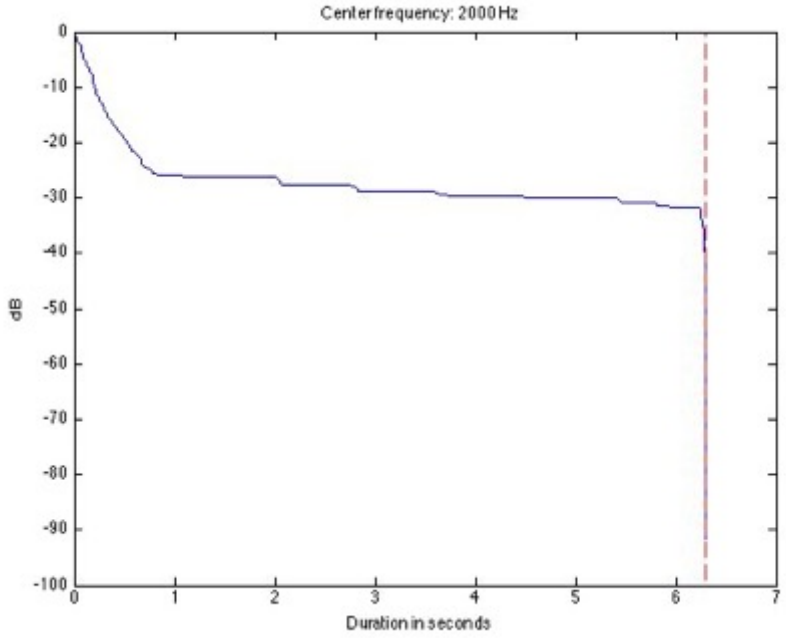


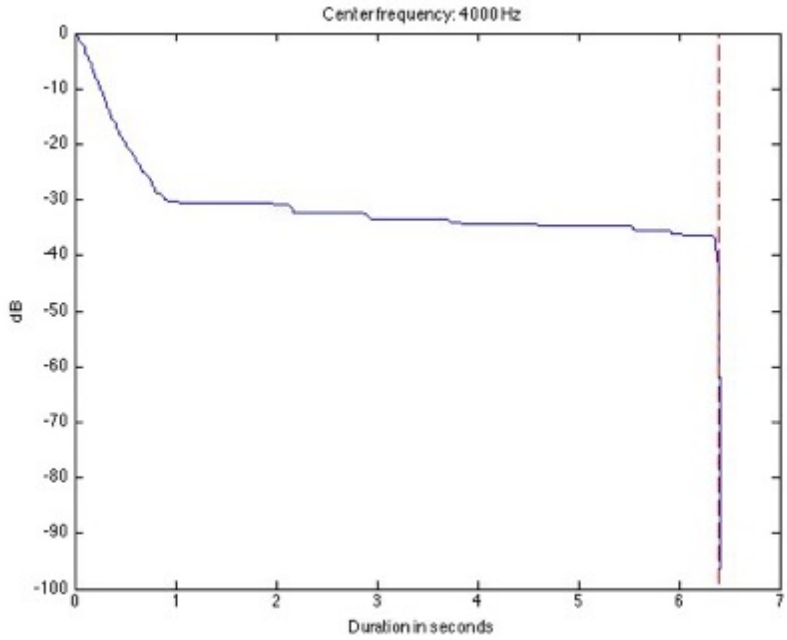
$RT_{60(URINALS)}$ Quad (Right Back) (500Hz & 1kHz)



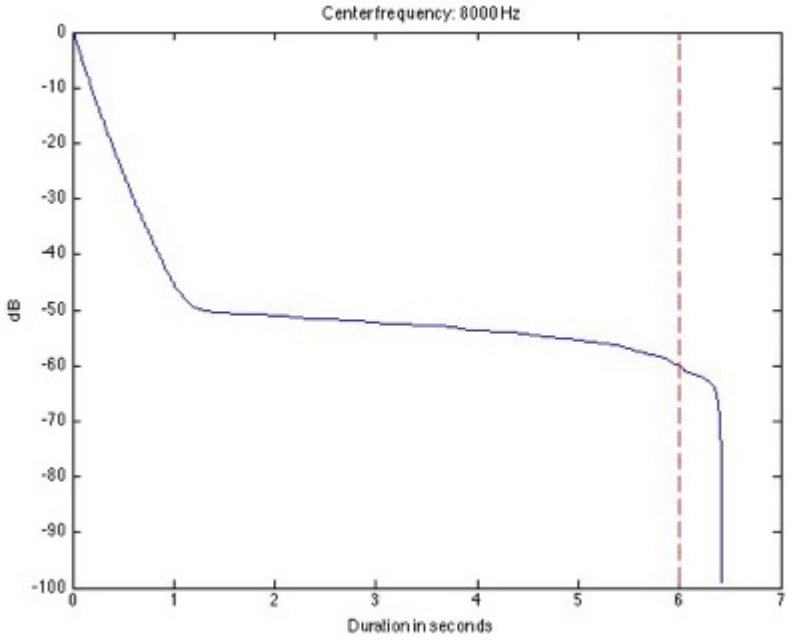


$RT_{60(URINALS)}$ Quad (Right Back) (2kHz & 4kHz)

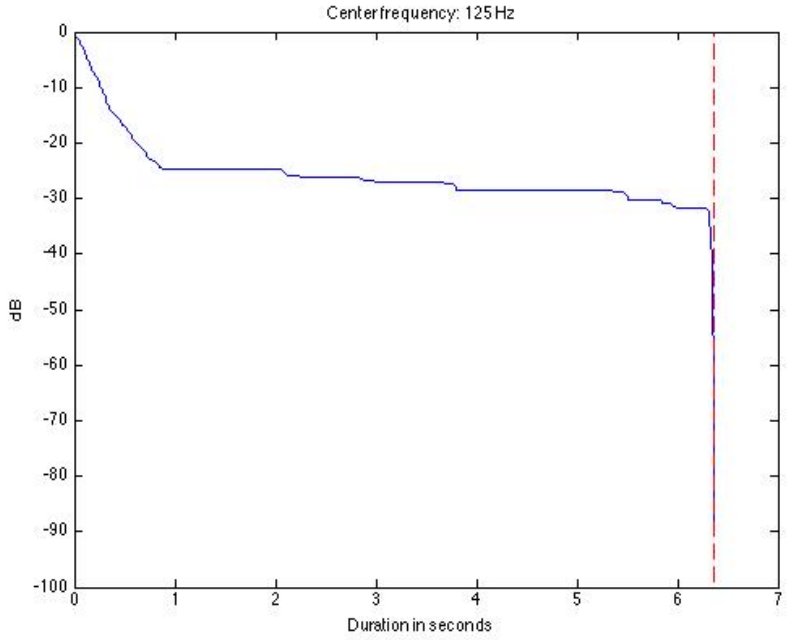


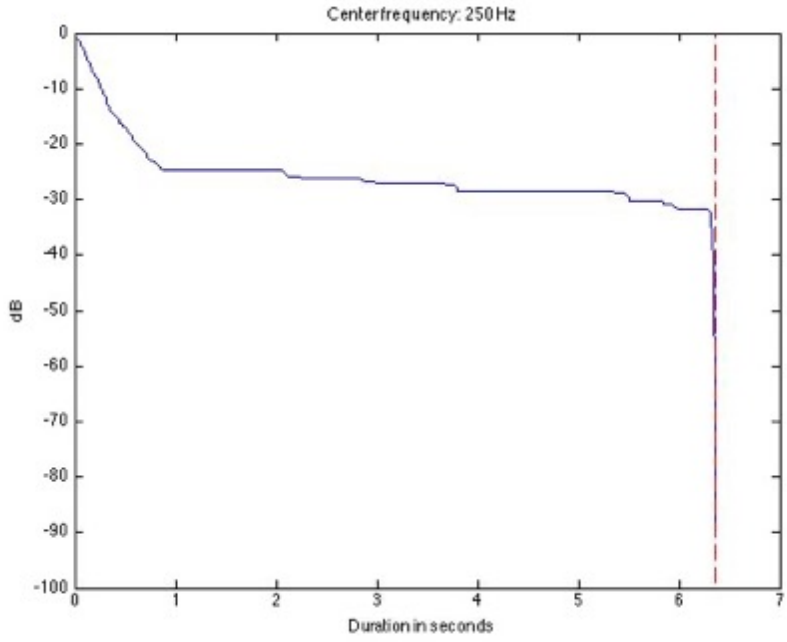


$RT_{60(URINALS)}$ Quad (Right Back) (8kHz)

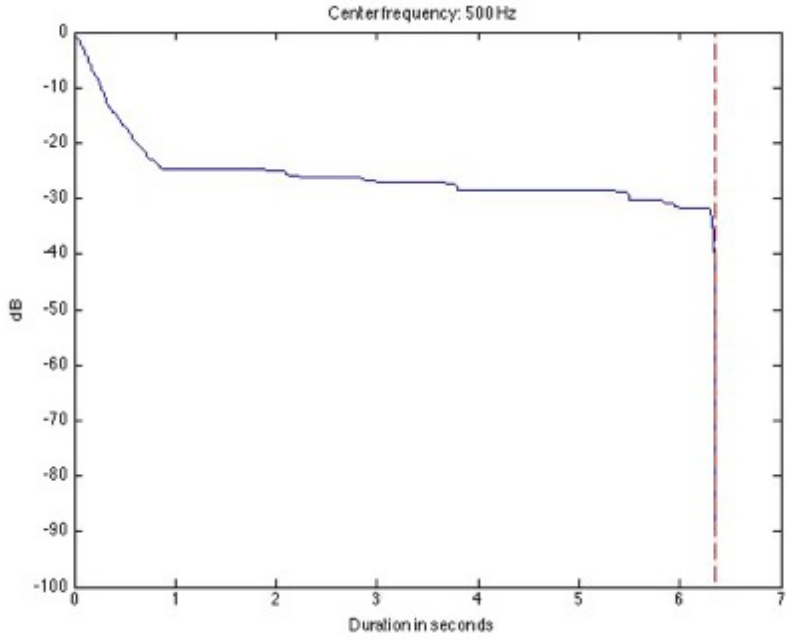


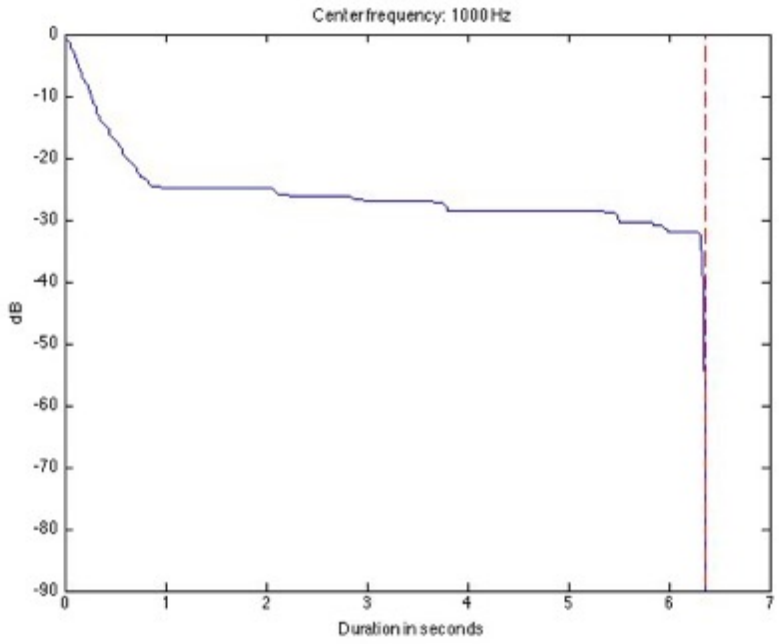
$RT_{60(URINALS)}$ Quad (Right Front) (125Hz & 250Hz)



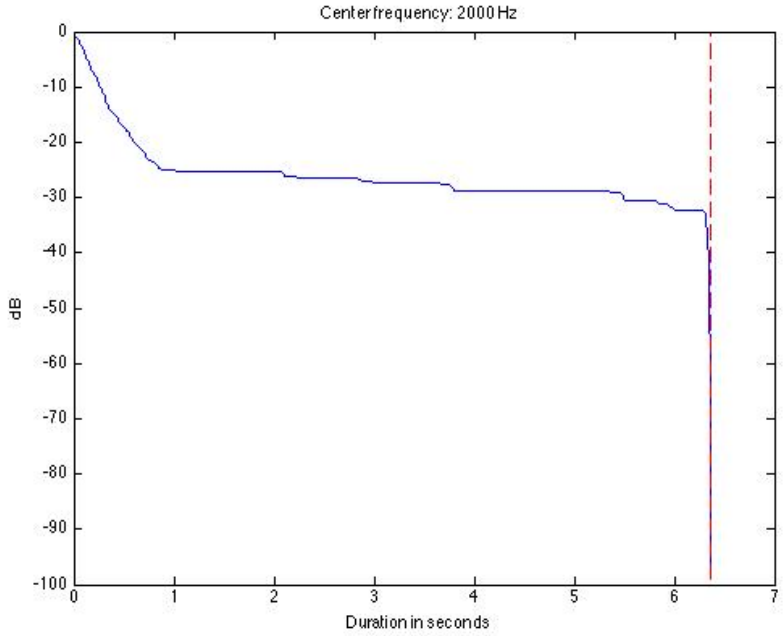


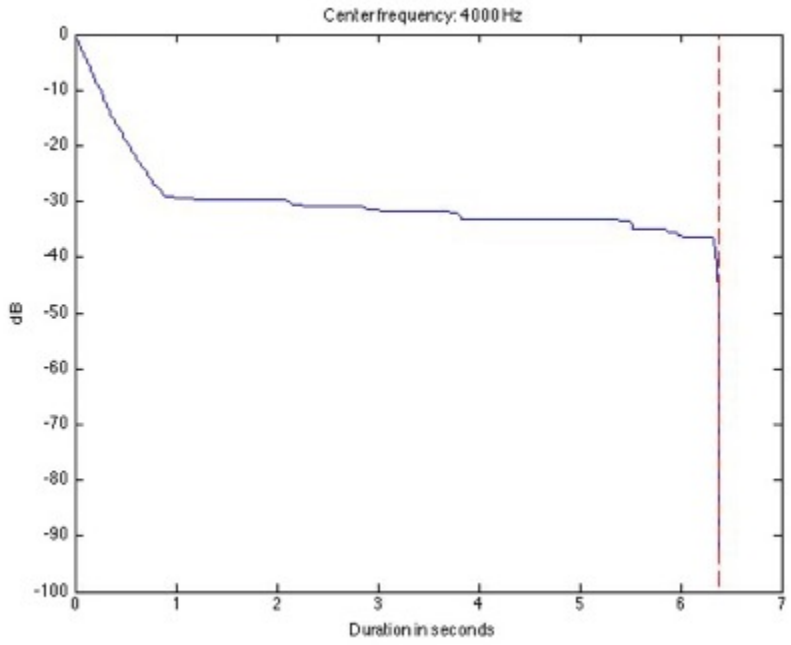
$RT_{60(URINALS)}$ Quad (Right Front) (500Hz & 1kHz)



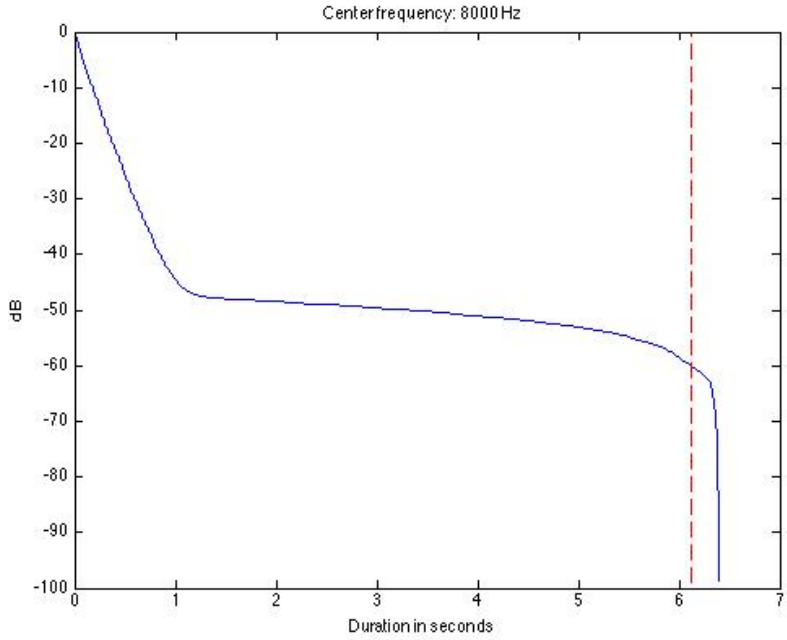


$RT_{60(URINALS)}$ Quad (Right Front) (2kHz & 4kHz)

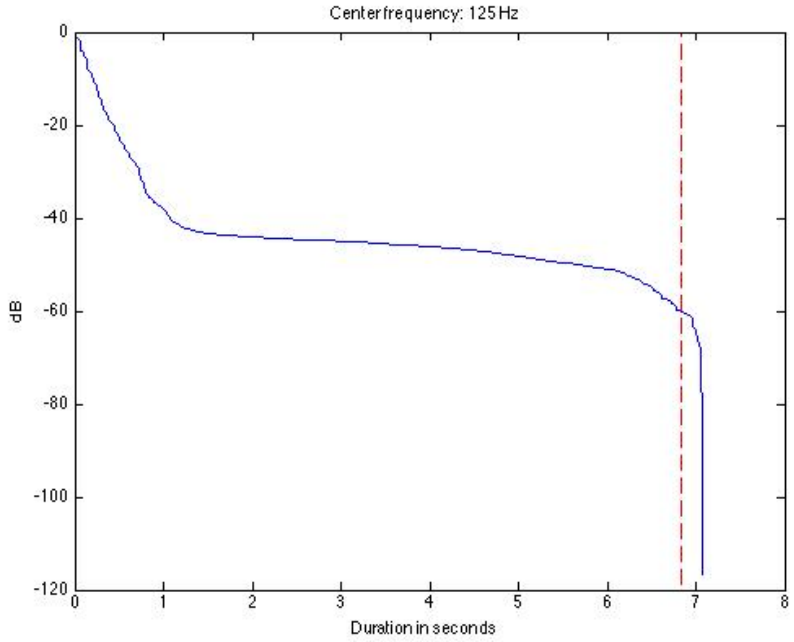


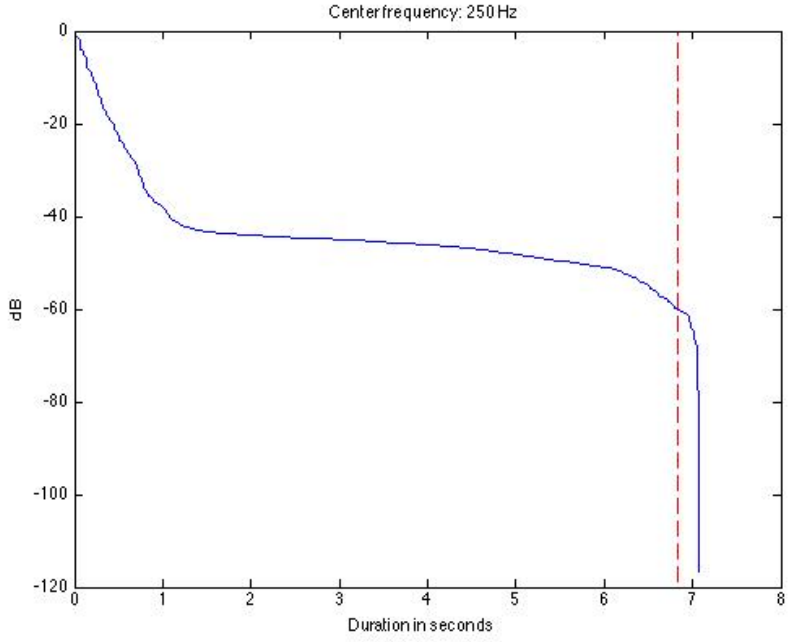


$RT_{60(URINALS)}$ Quad (Right Front) (8kHz)

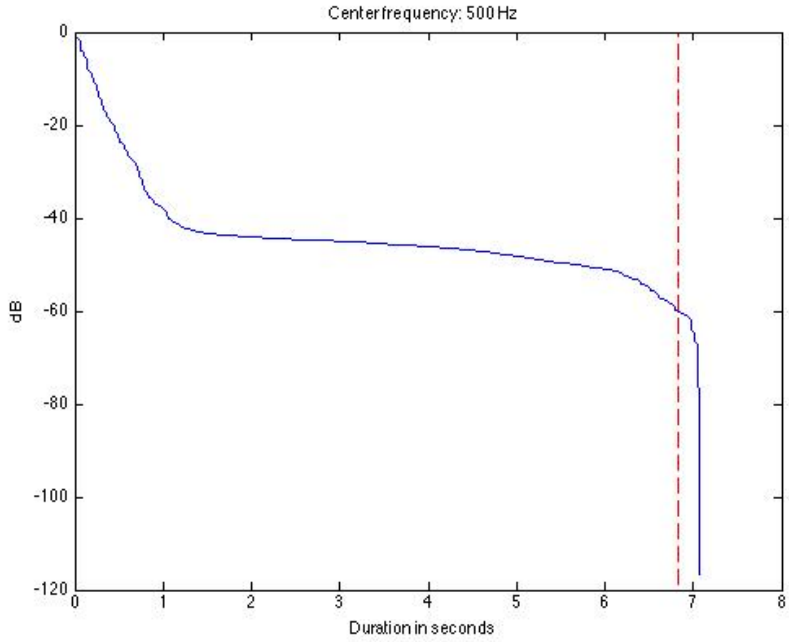


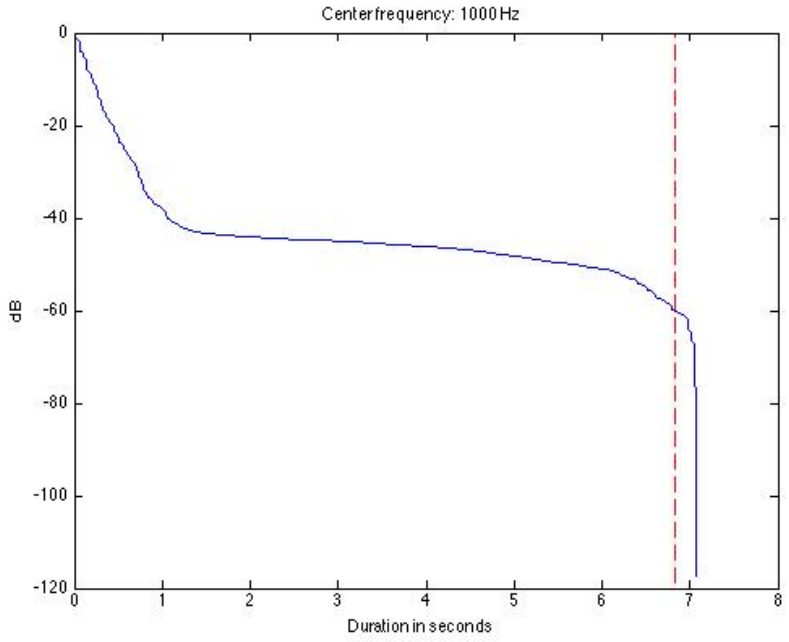
$RT_{60(URINALS)}$ Double MS (MS1 LM) (125Hz & 250Hz)



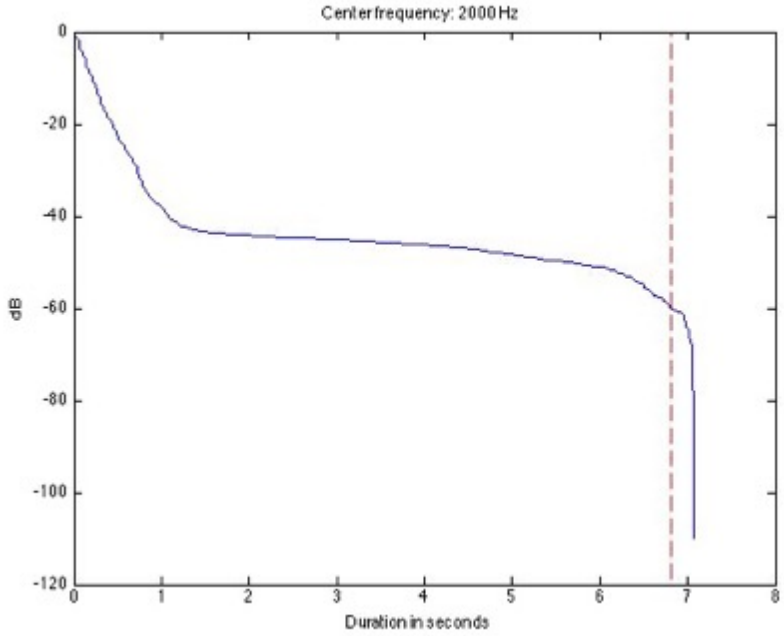


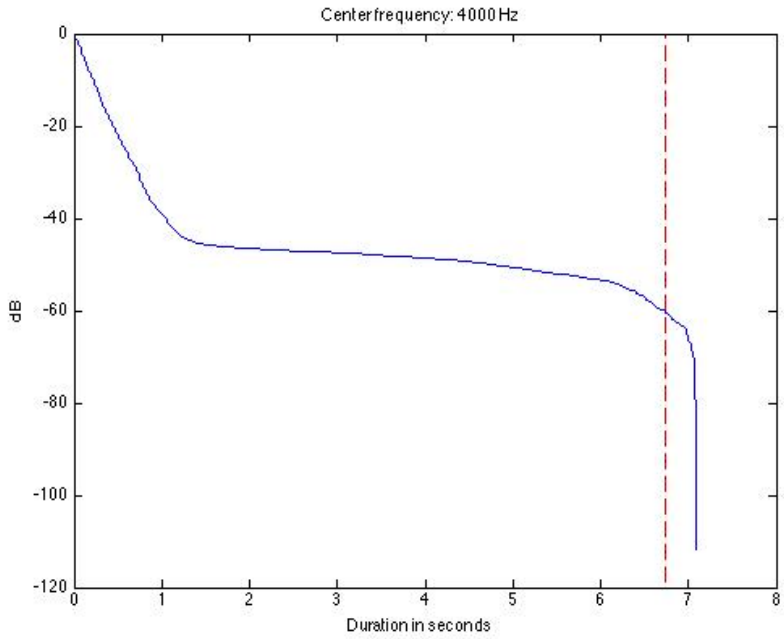
$RT_{60(URINALS)}$ Double MS (MS1 LM) (500Hz & 1kHz)



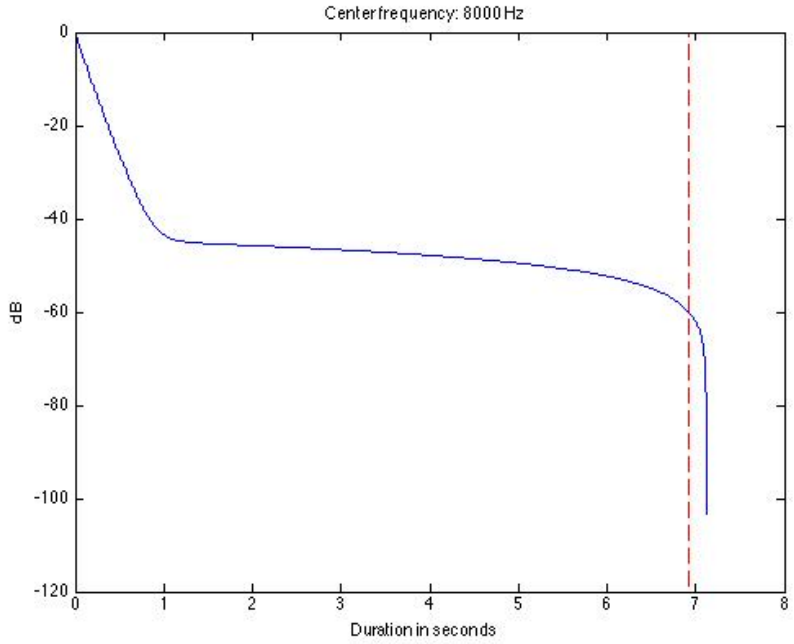


$RT_{60(URINALS)}$ Double MS (MS1 LM) (2kHz & 4kHz)

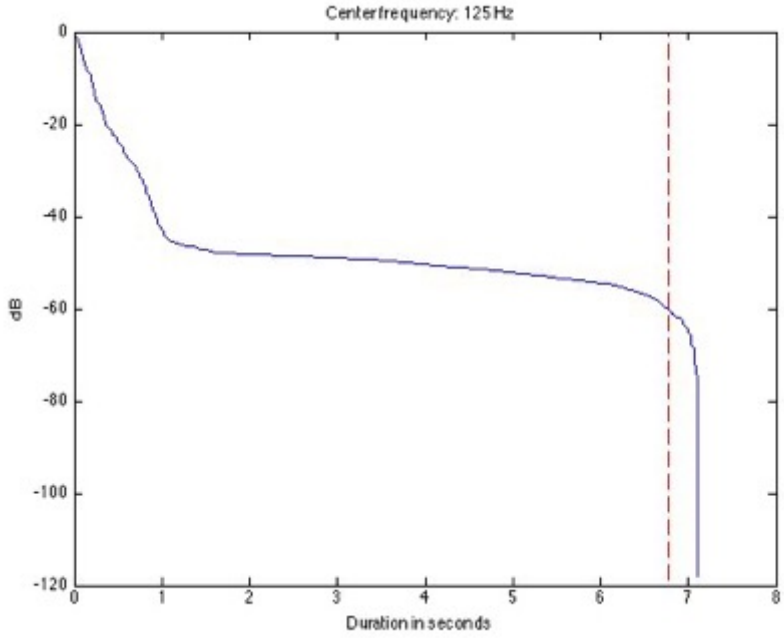


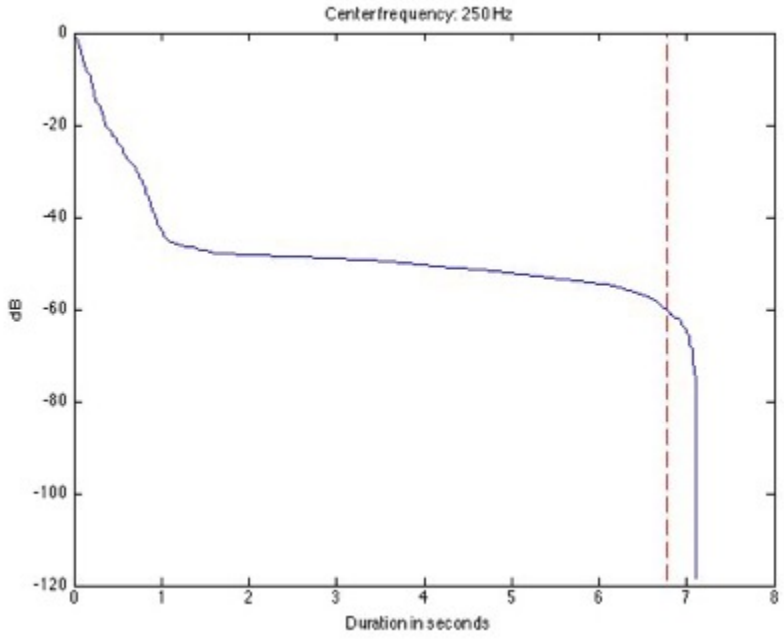


$RT_{60(URINALS)}$ Double MS (MS1 LM) (8kHz)

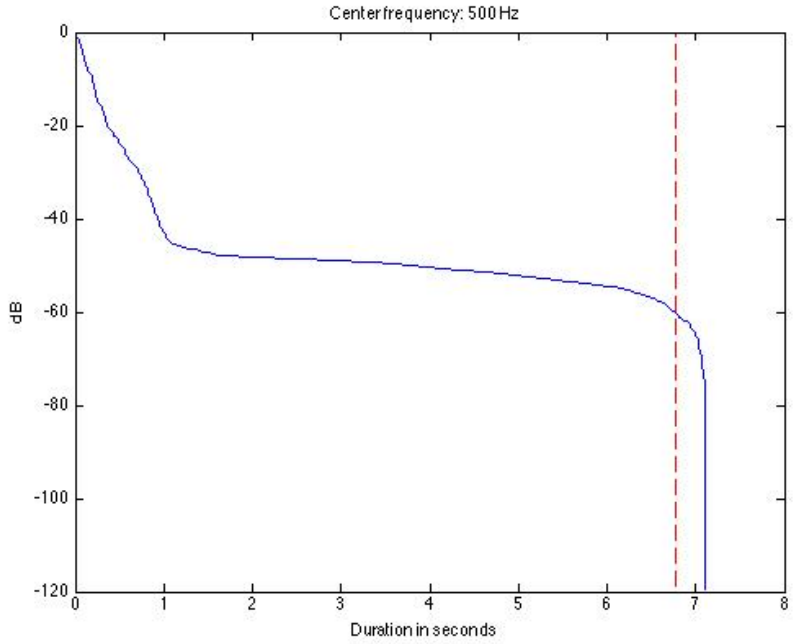


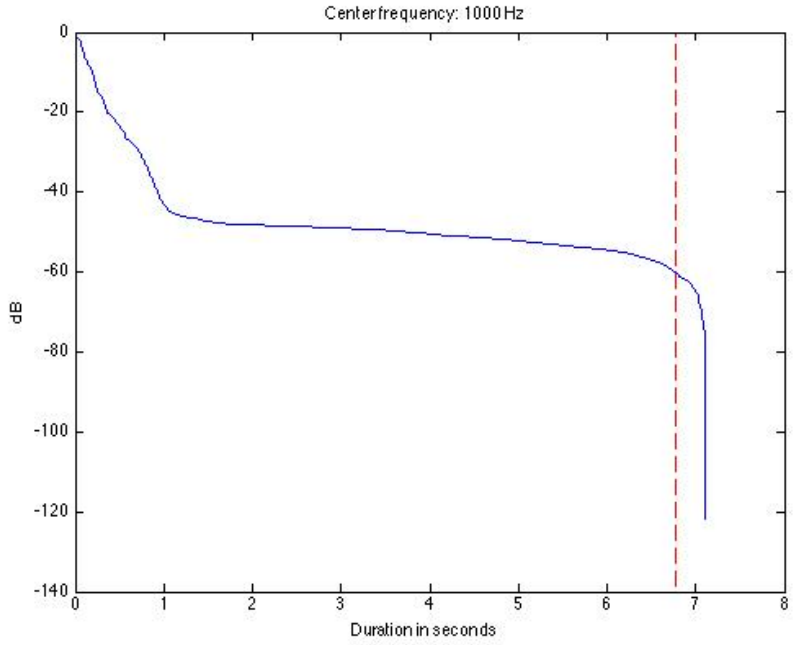
$RT_{60(URINALS)}$ Double MS (MS1 SR) (125Hz & 250Hz)



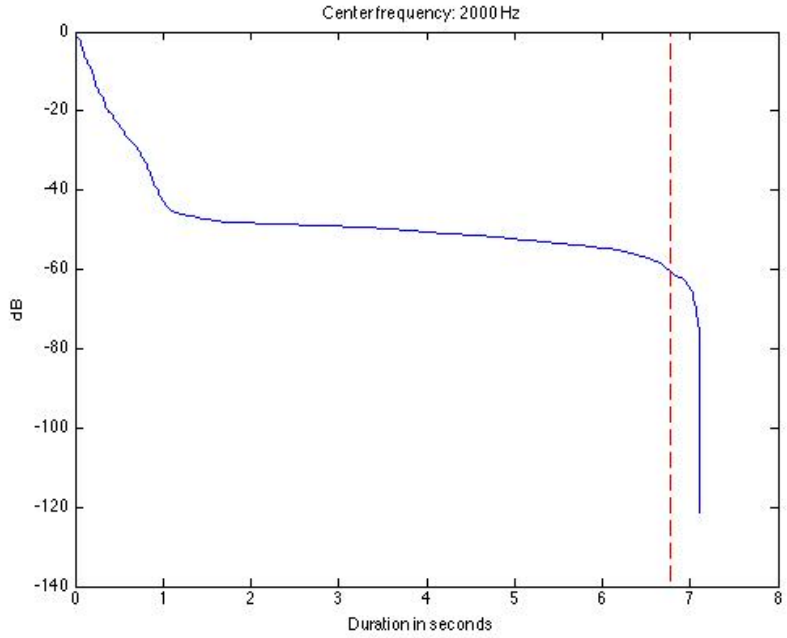


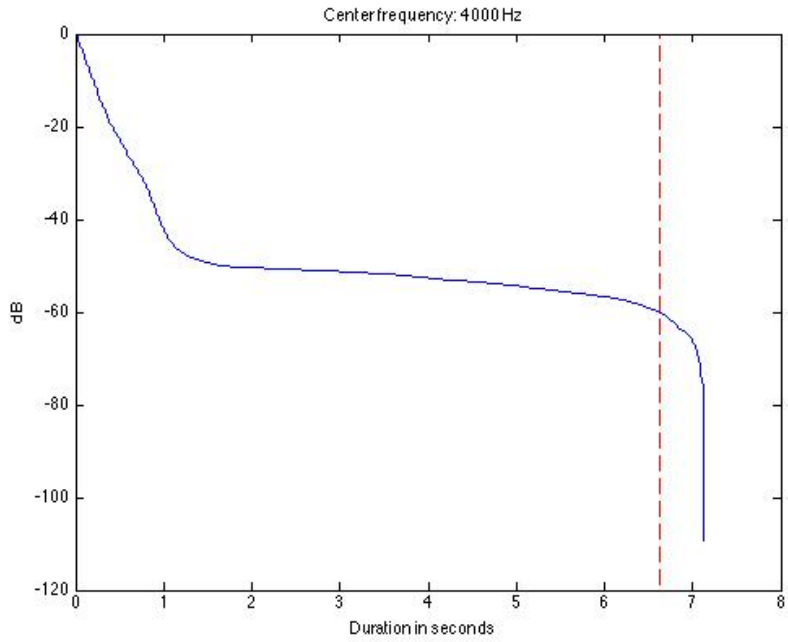
$RT_{60(URINALS)}$ Double MS (MS1 SR) (500Hz & 1kHz)



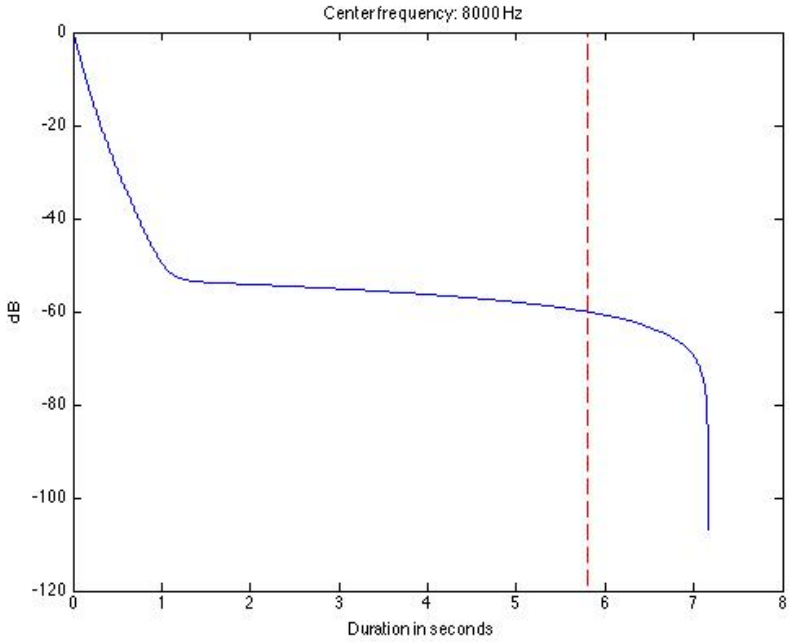


$RT_{60(URINALS)}$ Double MS (MS1 SR) (2kHz & 4kHz)

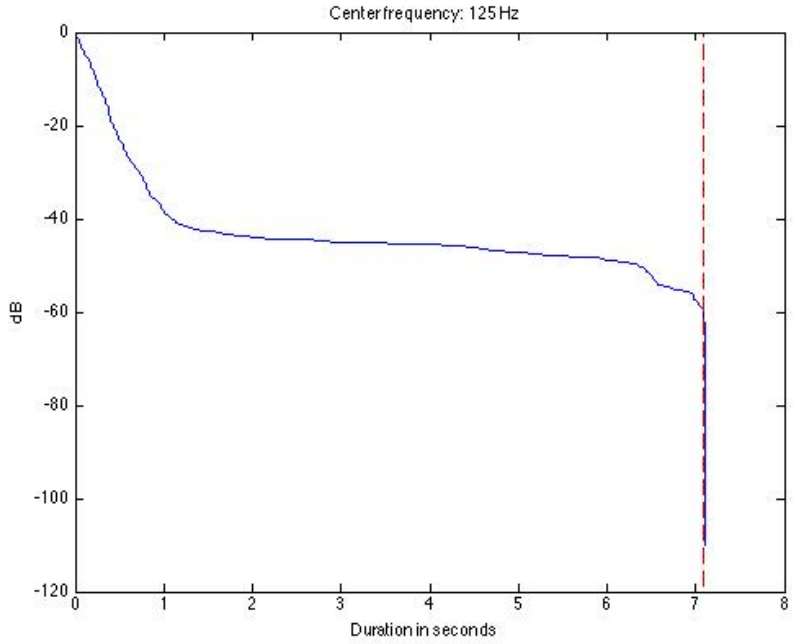


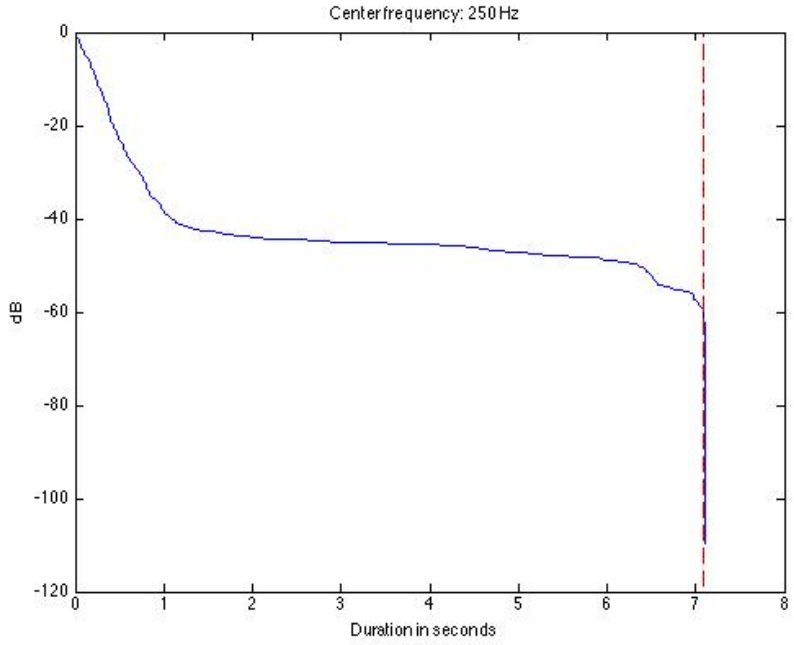


$RT_{60(URINALS)}$ Double MS (MS1 SR) (8kHz)

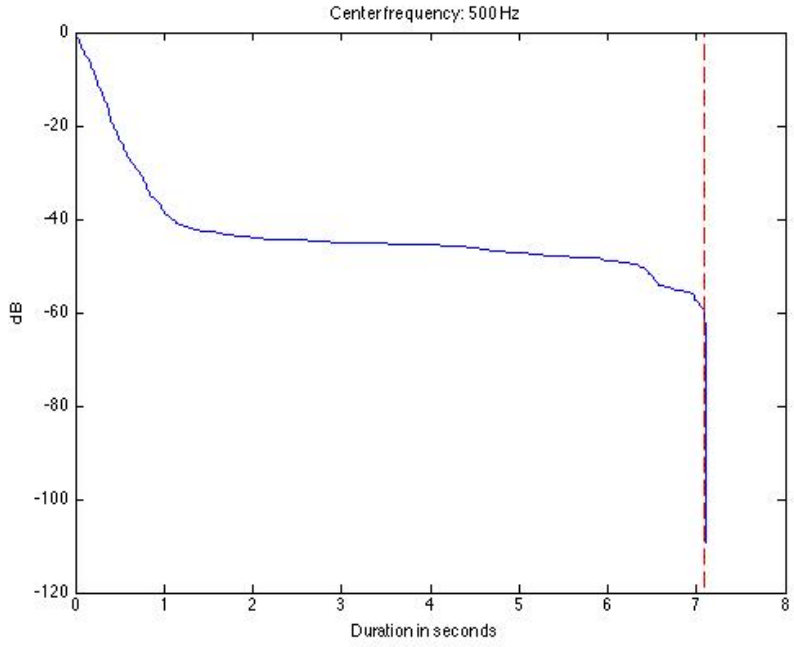


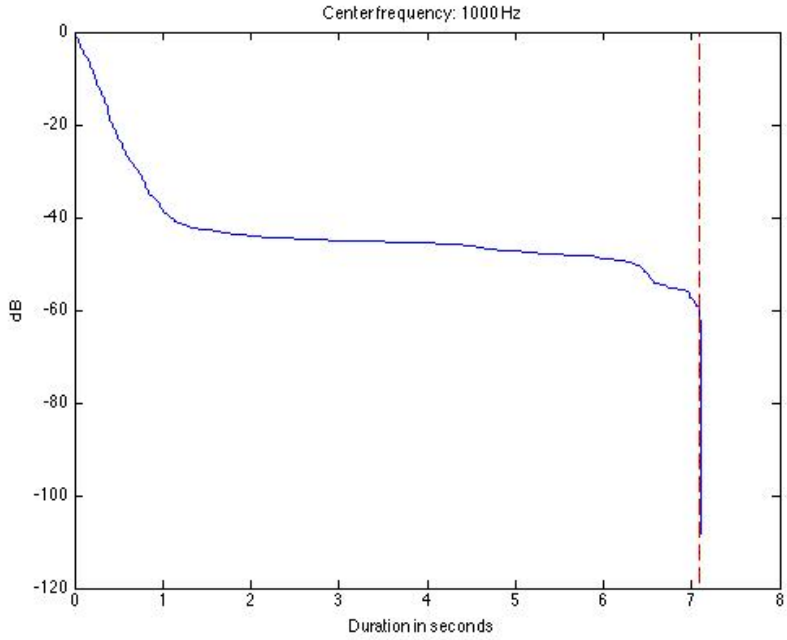
$RT_{60(URINALS)}$ Double MS (MS2 LM) (125Hz & 250Hz)



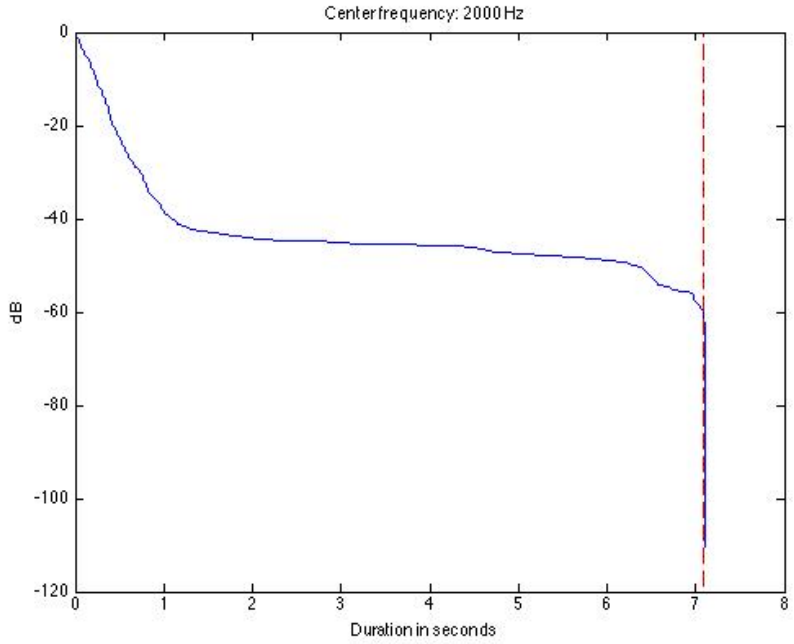


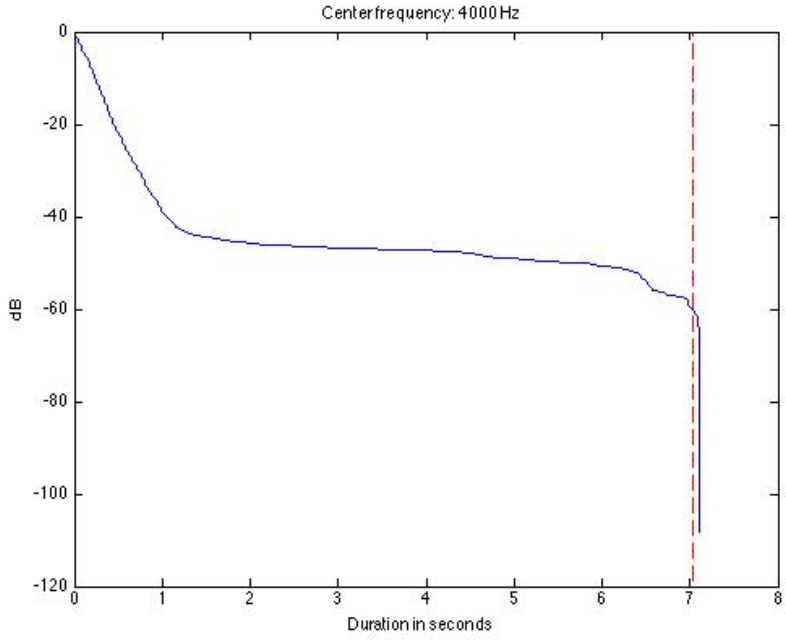
$RT_{60(URINALS)}$ Double MS (MS2 LM) (500Hz & 1kHz)



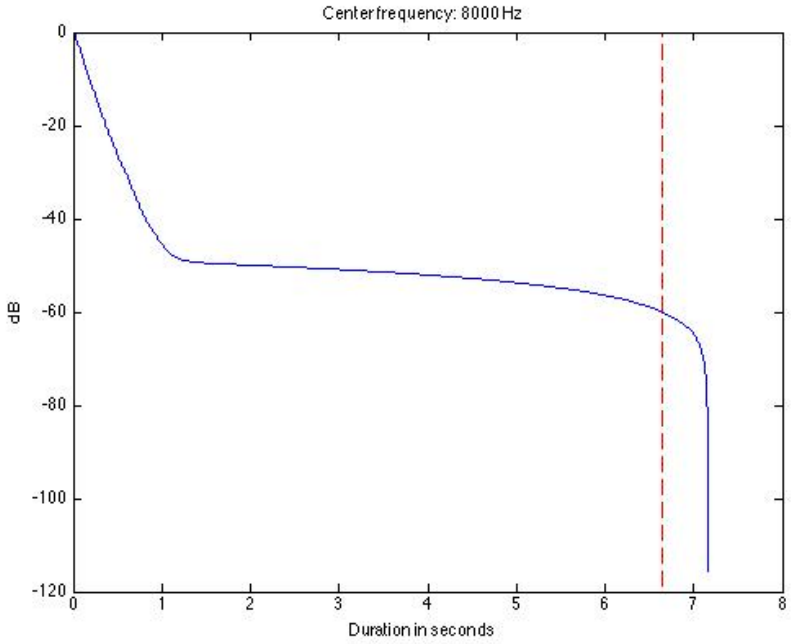


$RT_{60(URINALS)}$ Double MS (MS2 LM) (2kHz & 4kHz)

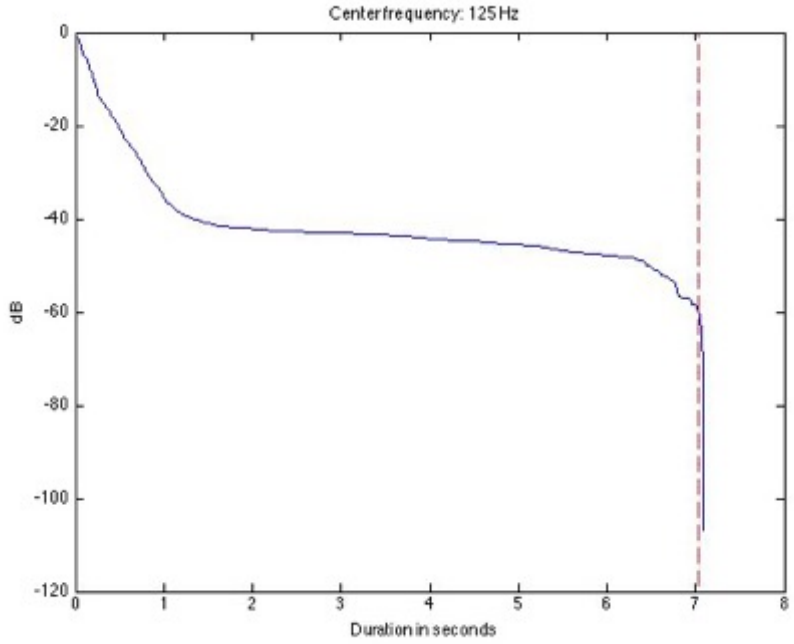


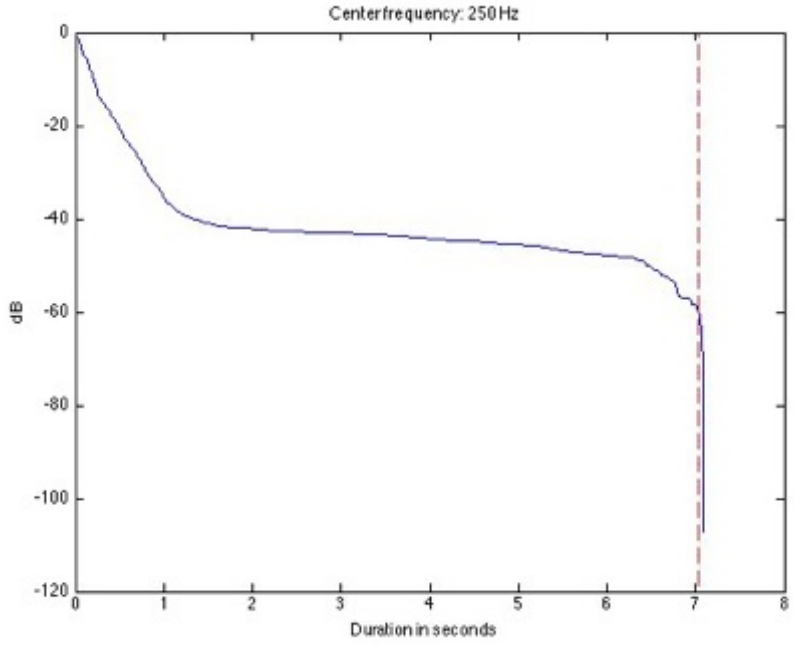


$RT_{60(URINALS)}$ Double MS (MS2 LM) (8kHz)

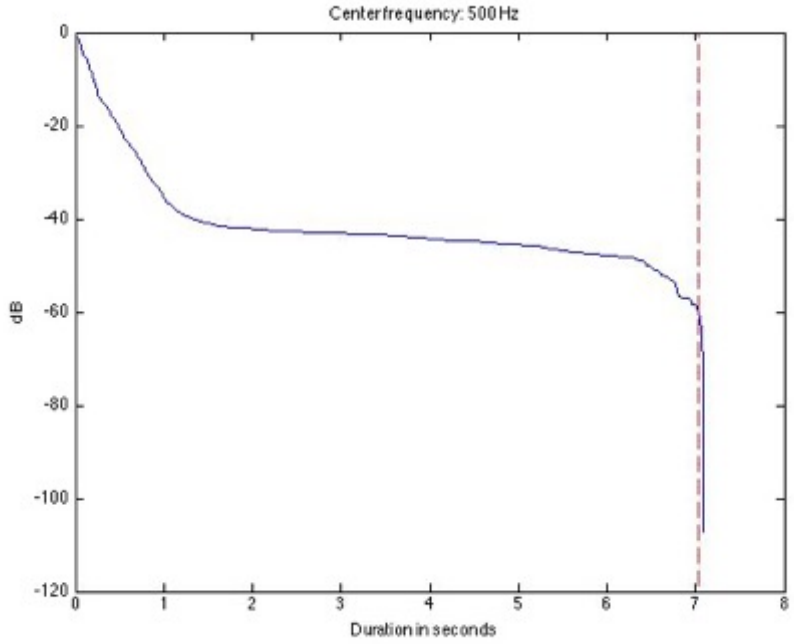


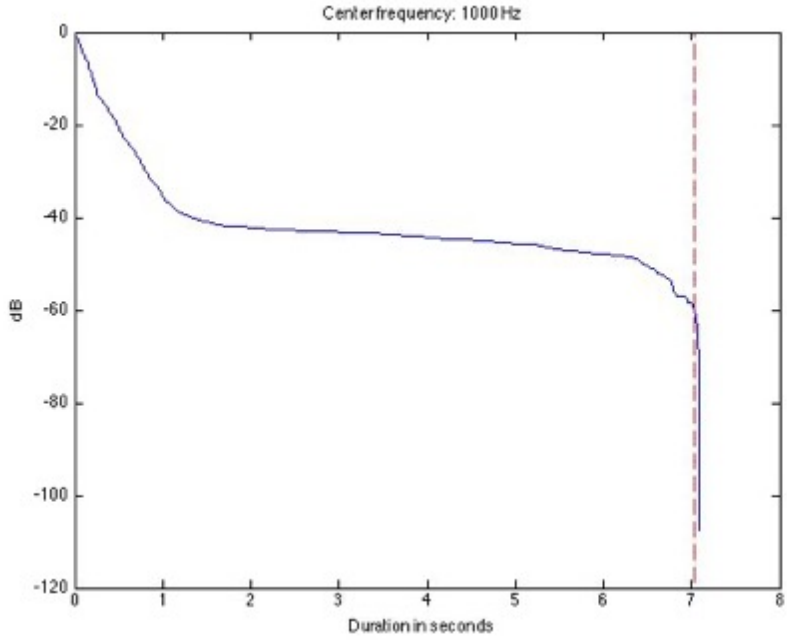
$RT_{60(URINALS)}$ Double MS (MS2 SR) (125Hz & 250Hz)



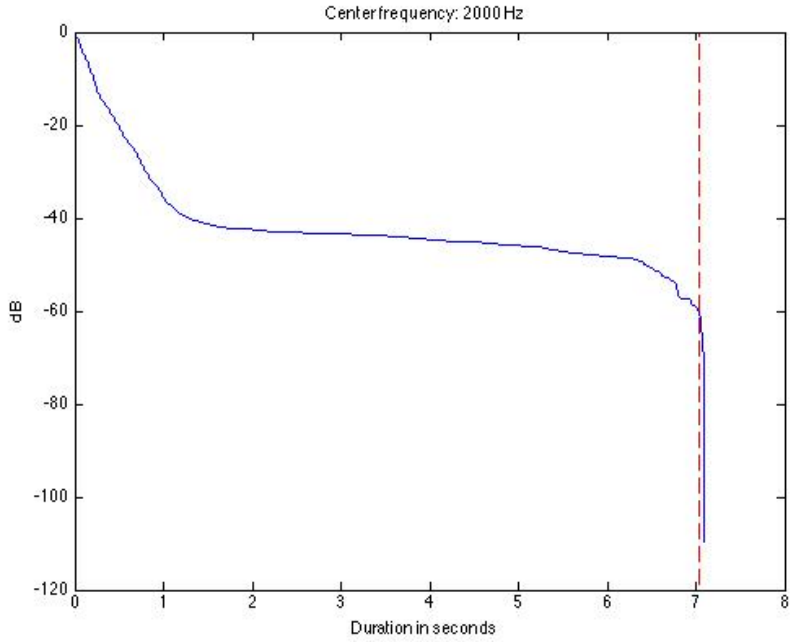


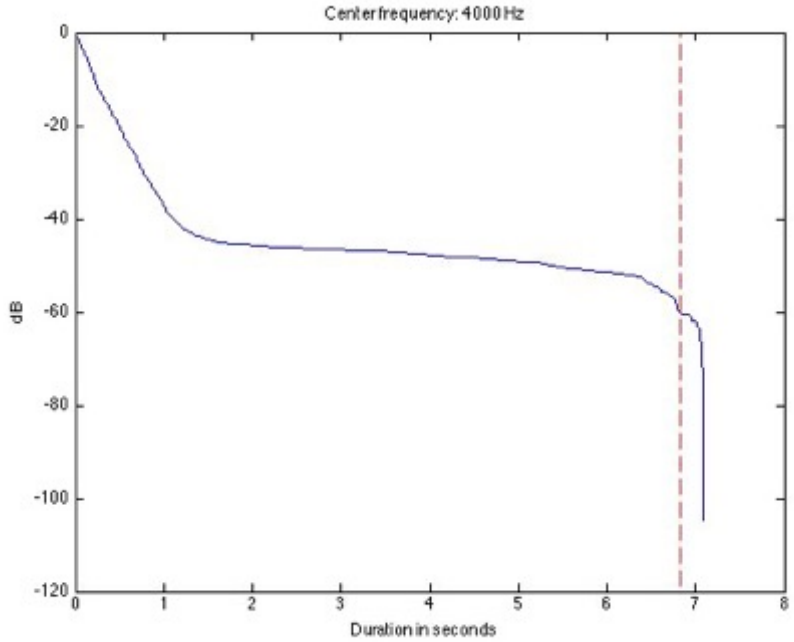
$RT_{60(URINALS)}$ Double MS (MS2 SR) (500Hz & 1kHz)



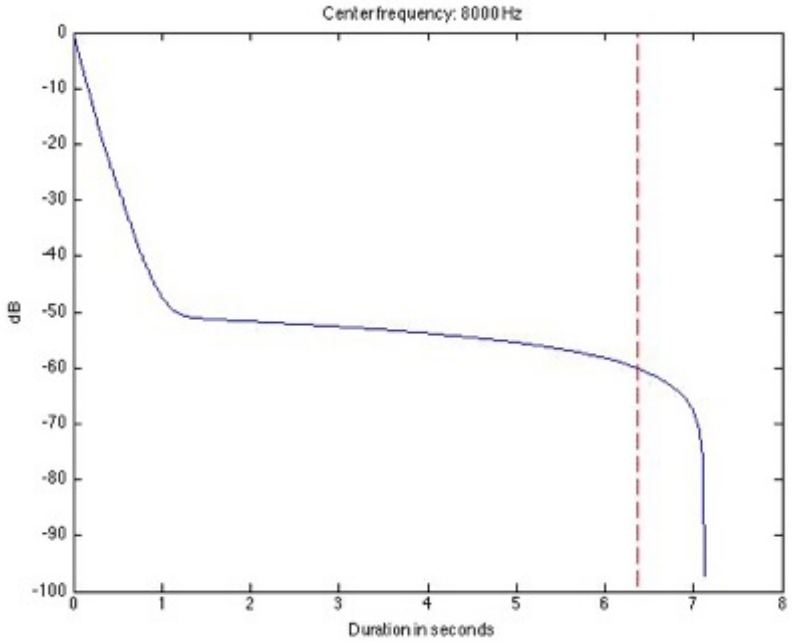


$RT_{60(URINALS)}$ Double MS (MS2 SR) (2kHz & 4kHz)

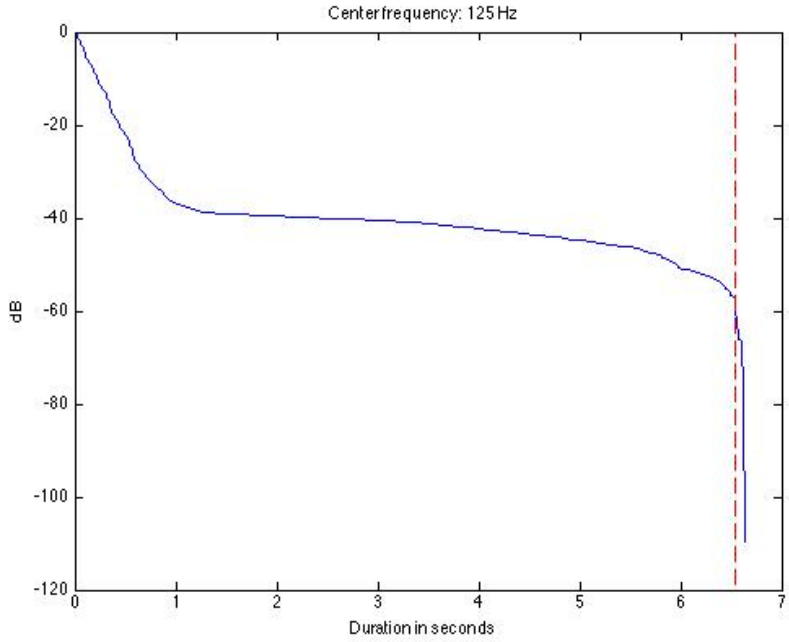


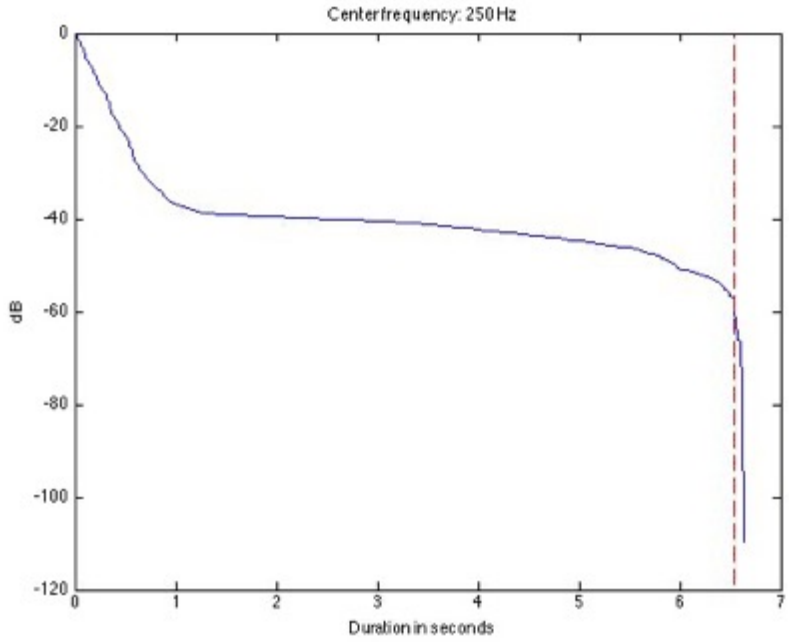


$RT_{60(URINALS)}$ Double MS (MS2 SR) (8kHz)

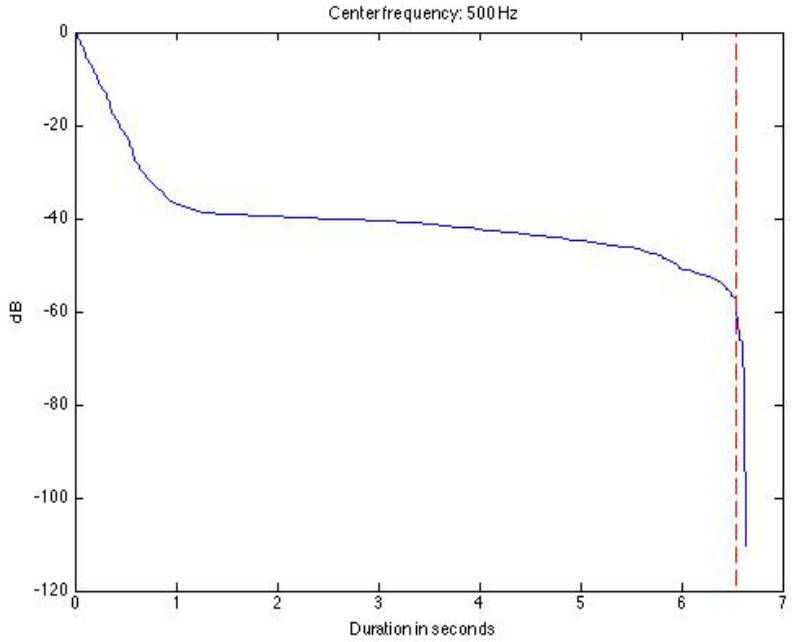


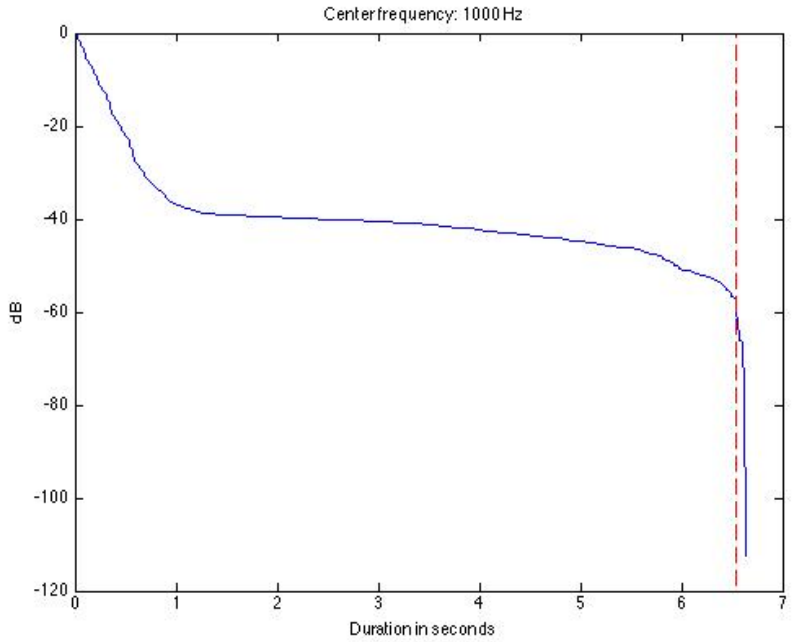
$RT_{60(URINALS)}$ Spaced Pair (Left) (125Hz & 250Hz)



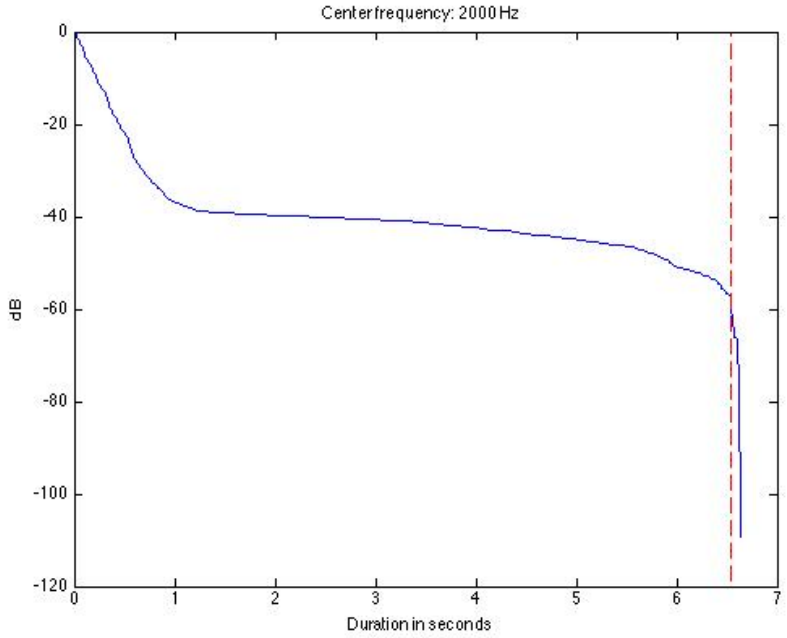


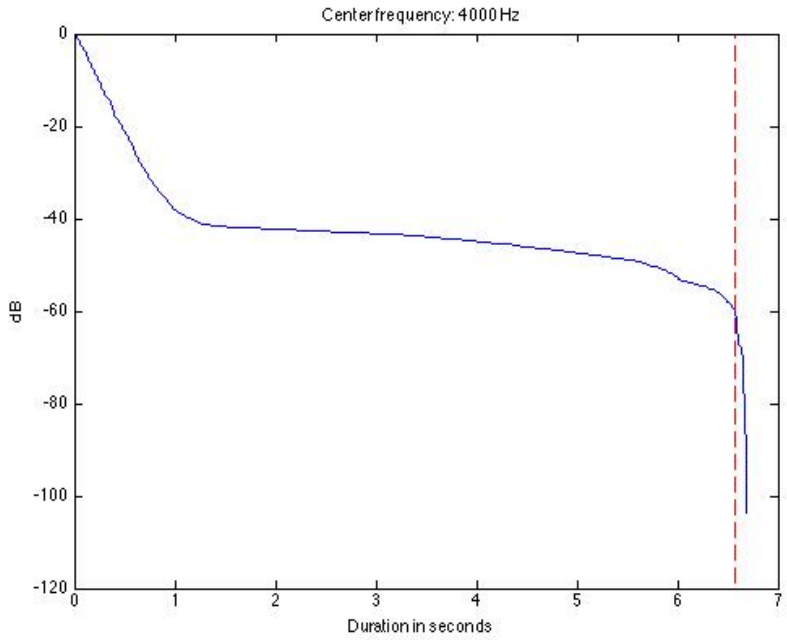
$RT_{60(URINALS)}$ Spaced Pair (Left) (500Hz & 1kHz)



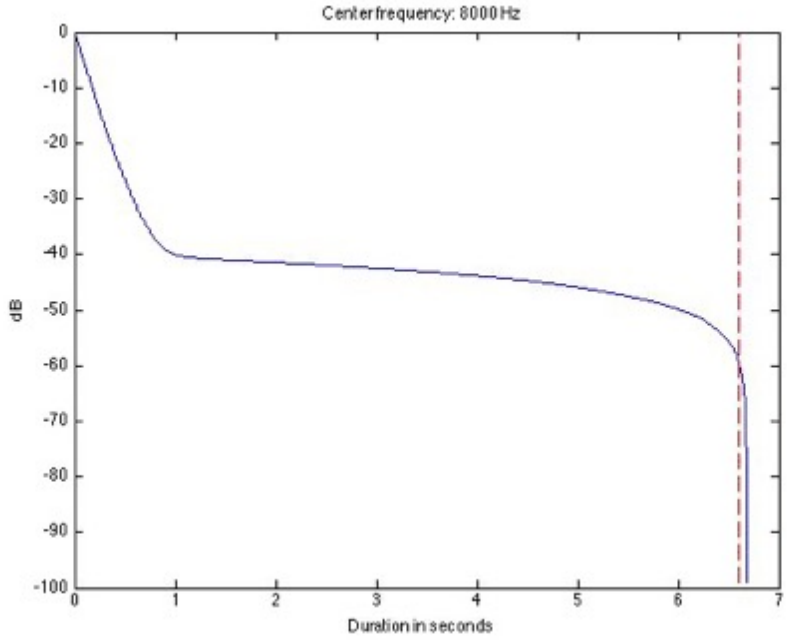


$RT_{60(URINALS)}$ Spaced Pair (Left) (2kHz & 4kHz)

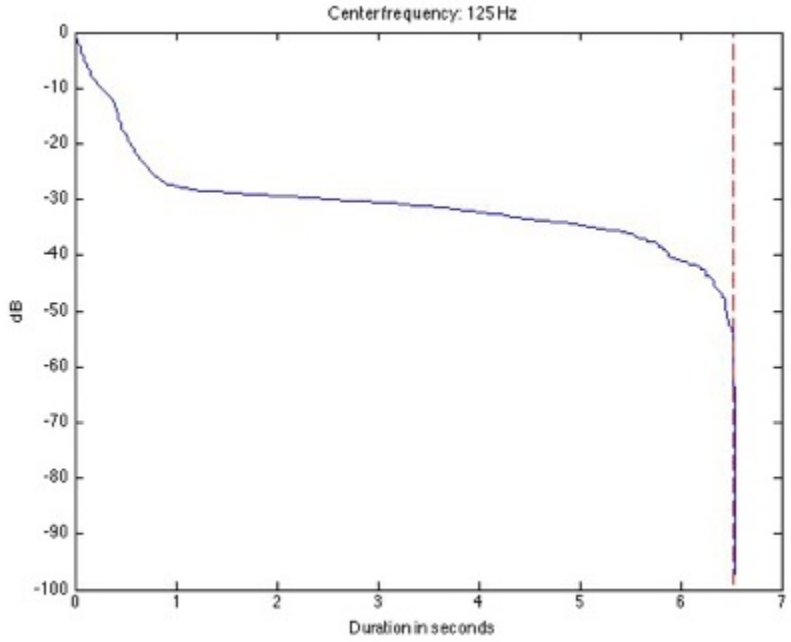


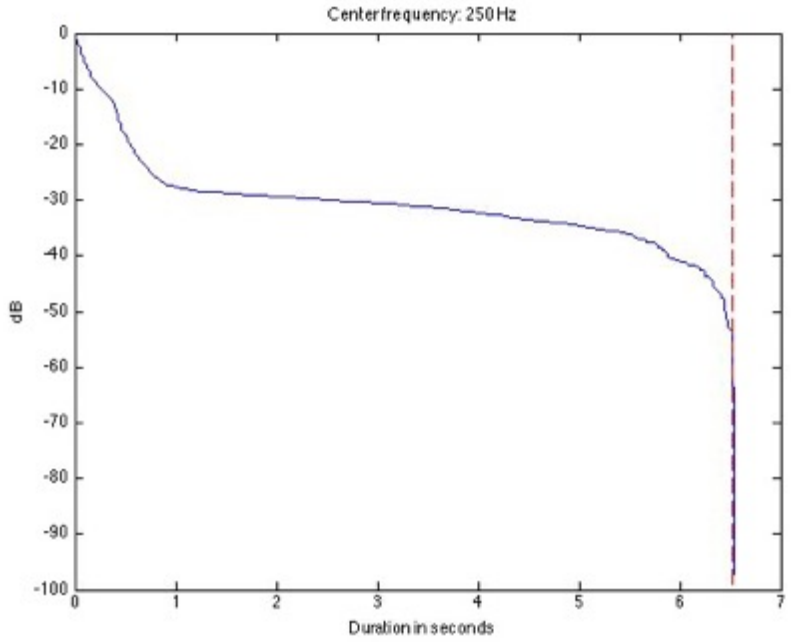


$RT_{60(URINALS)}$ Spaced Pair (Left) (8kHz)

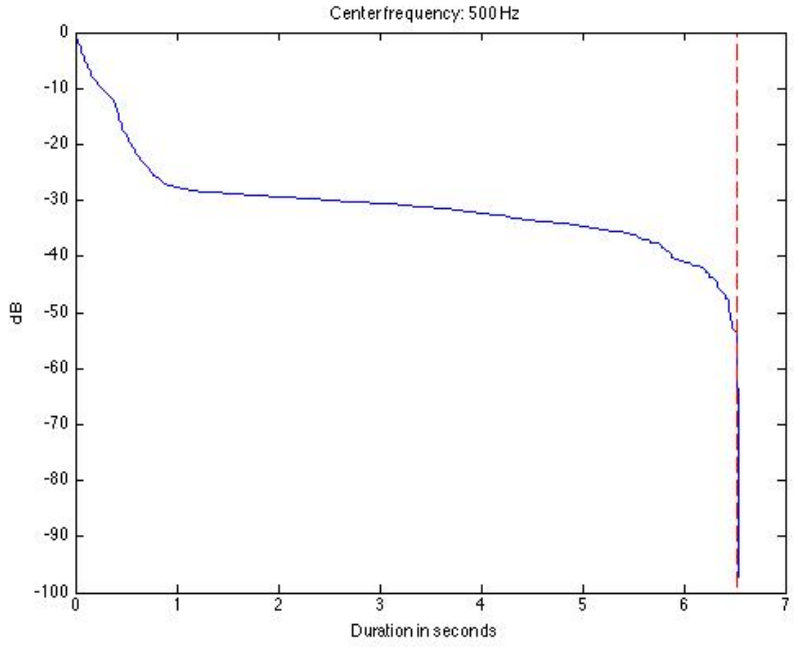


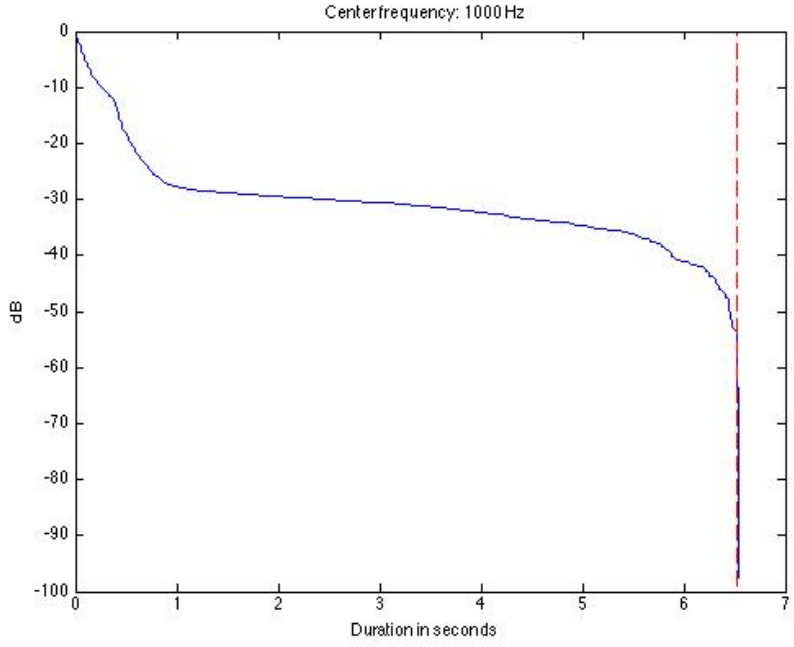
$RT_{60(URINALS)}$ Spaced Pair (Right) (125Hz & 250Hz)



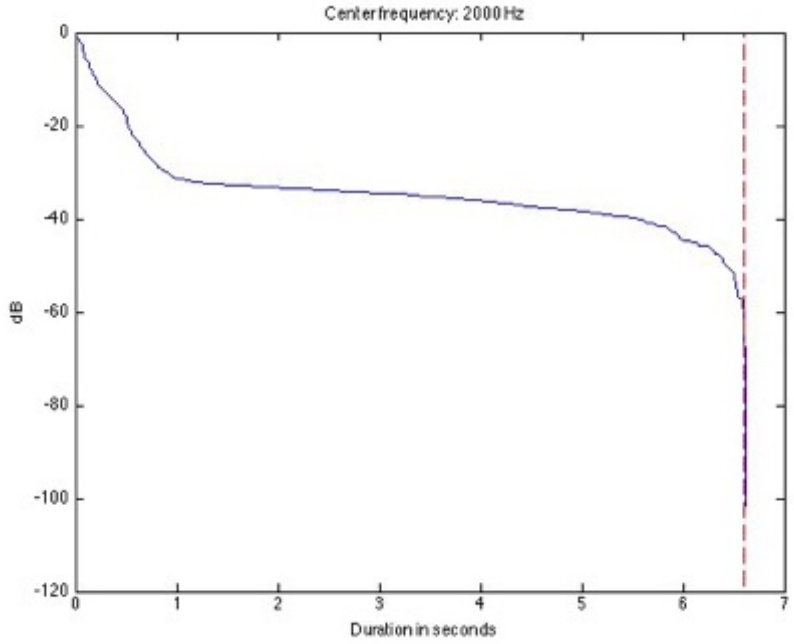


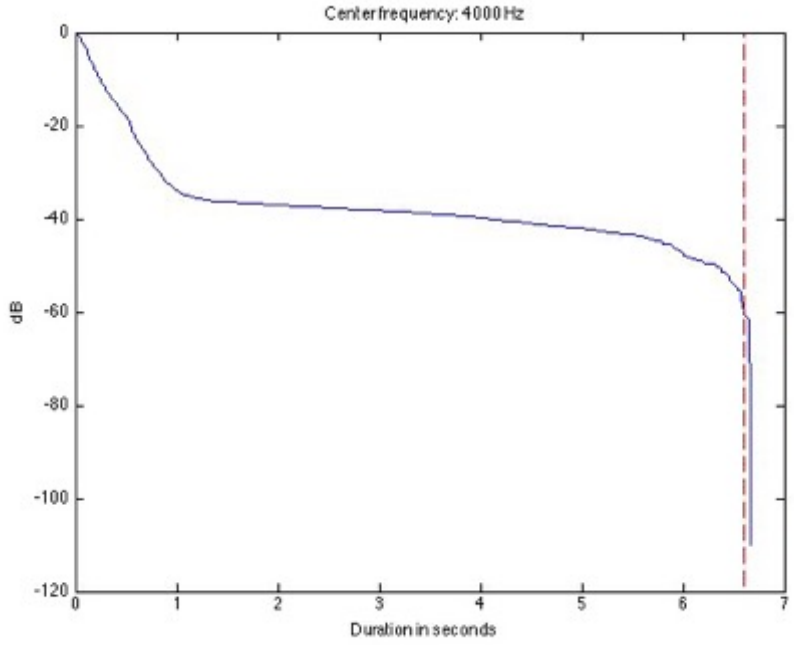
$RT_{60(URINALS)}$ Spaced Pair (Right) (500Hz & 1kHz)



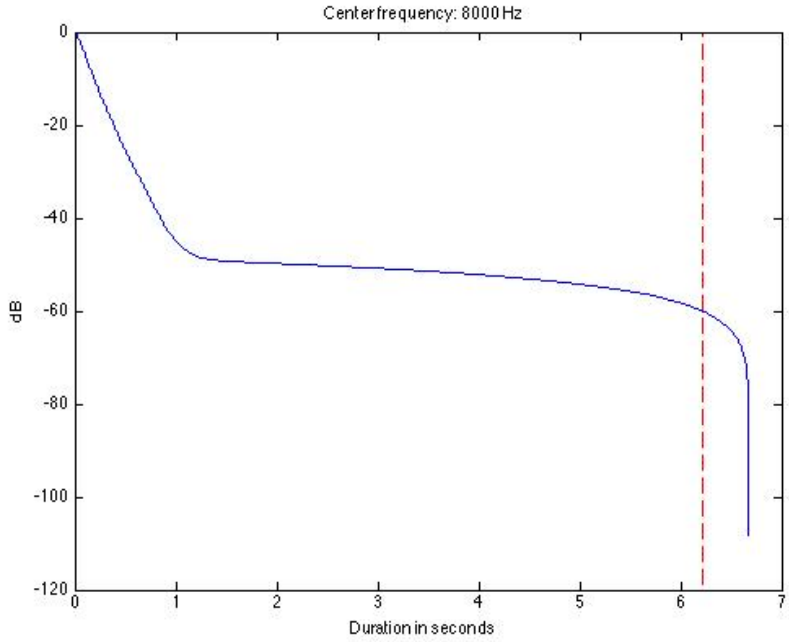


$RT_{60(URINALS)}$ Spaced Pair (Right) (2Hz & 4kHz)

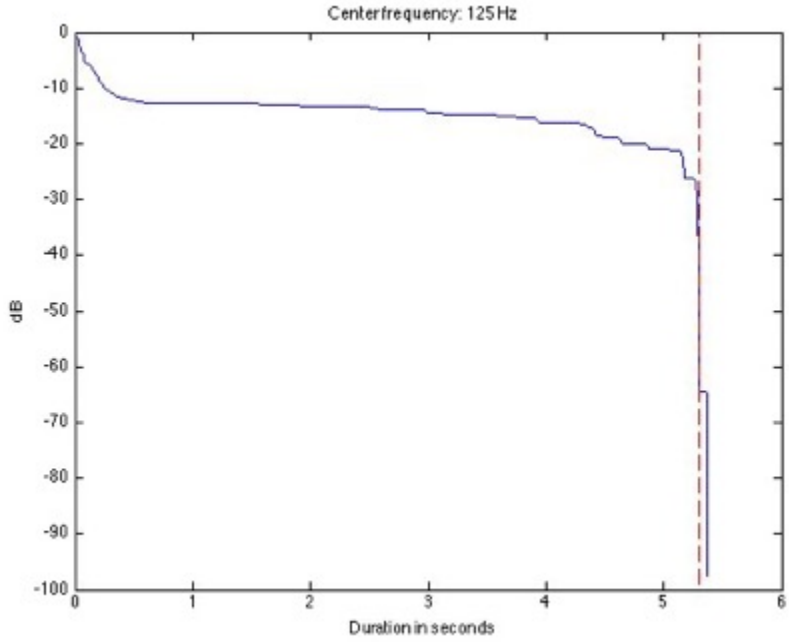


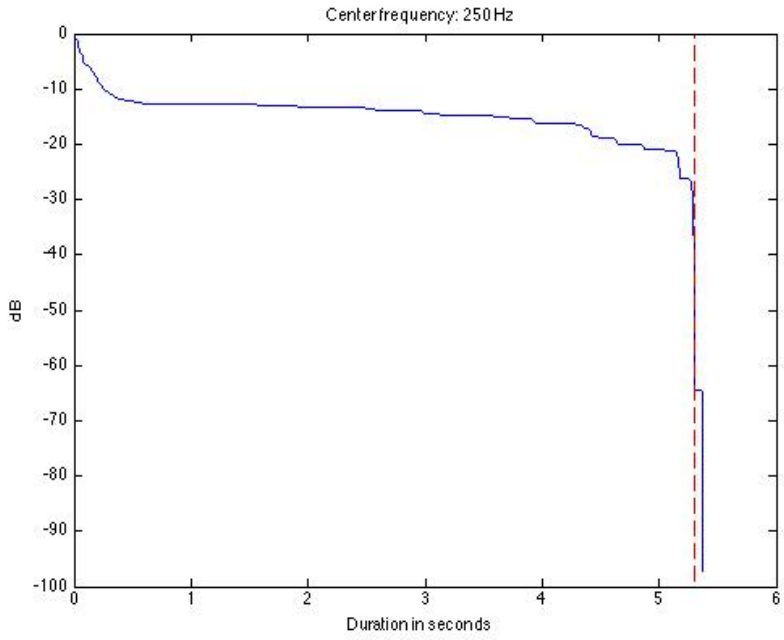


$RT_{60(URINALS)}$ Spaced Pair (Right) (8kHz)

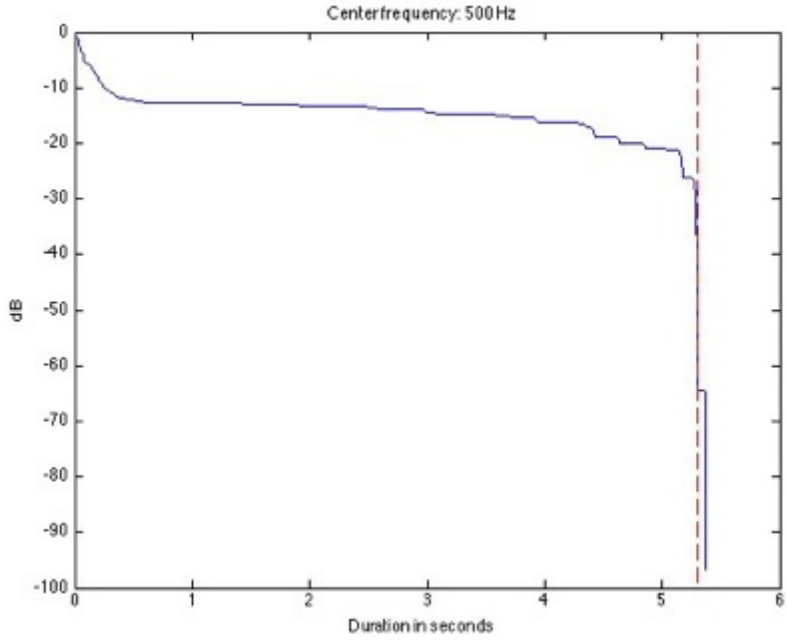


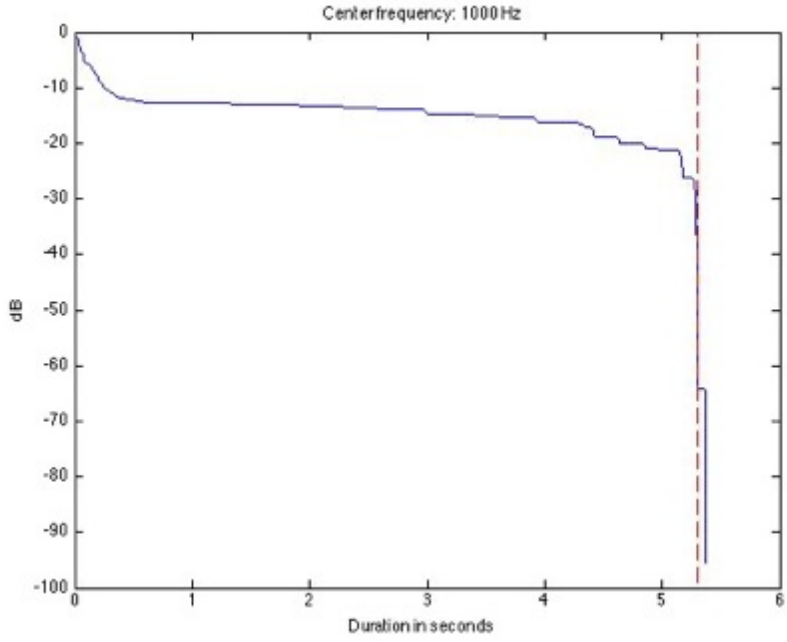
$RT_{60(STAIRS)}$ Quad (Left Front) (125Hz & 250Hz)



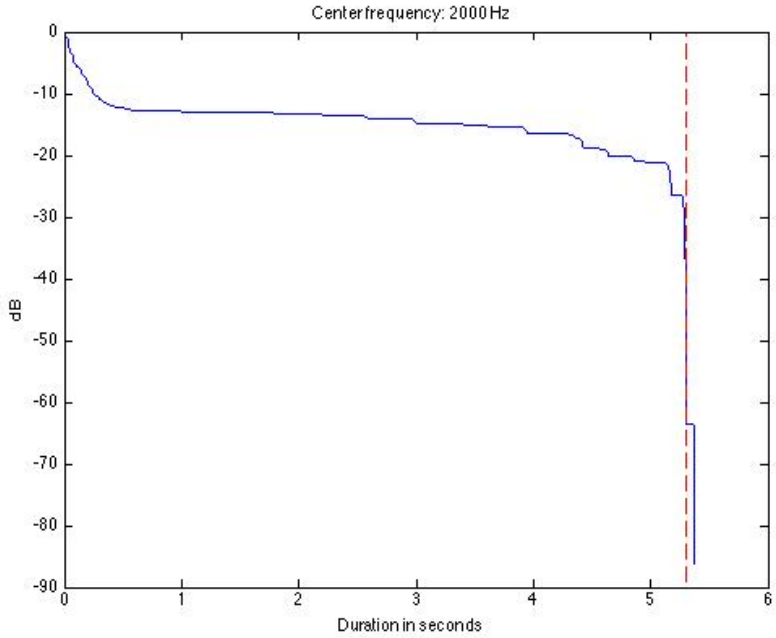


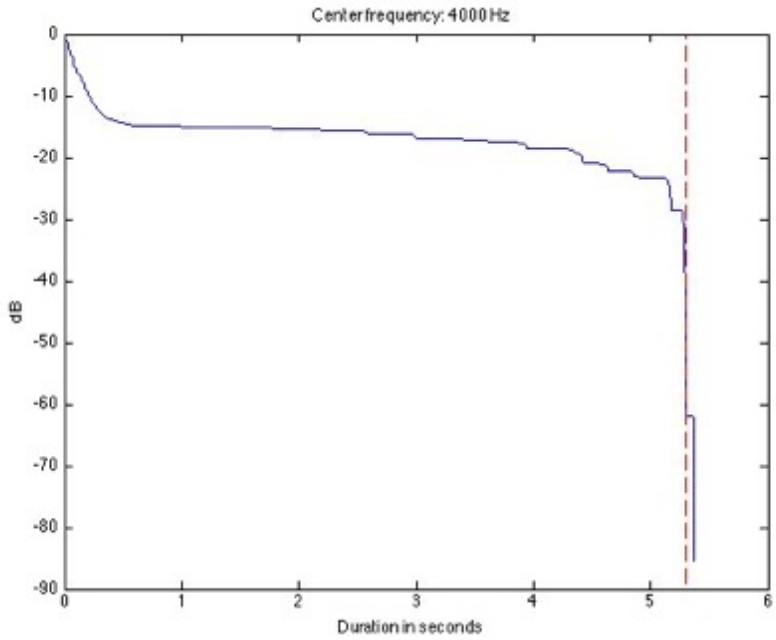
$RT_{60(STAIRS)}$ Quad (Left Front) (500Hz & 1kHz)



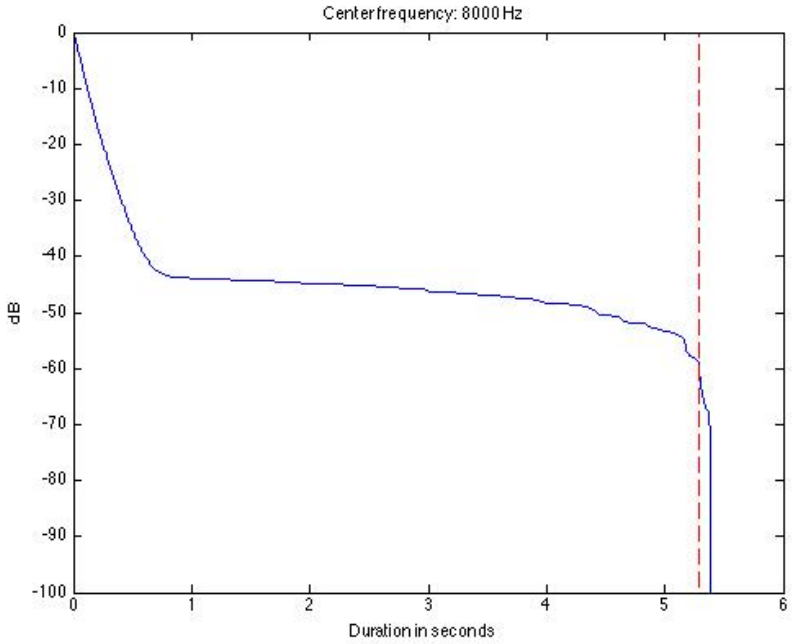


$RT_{60(STAIRS)}$ Quad (Left Front) (2kHz & 4kHz)

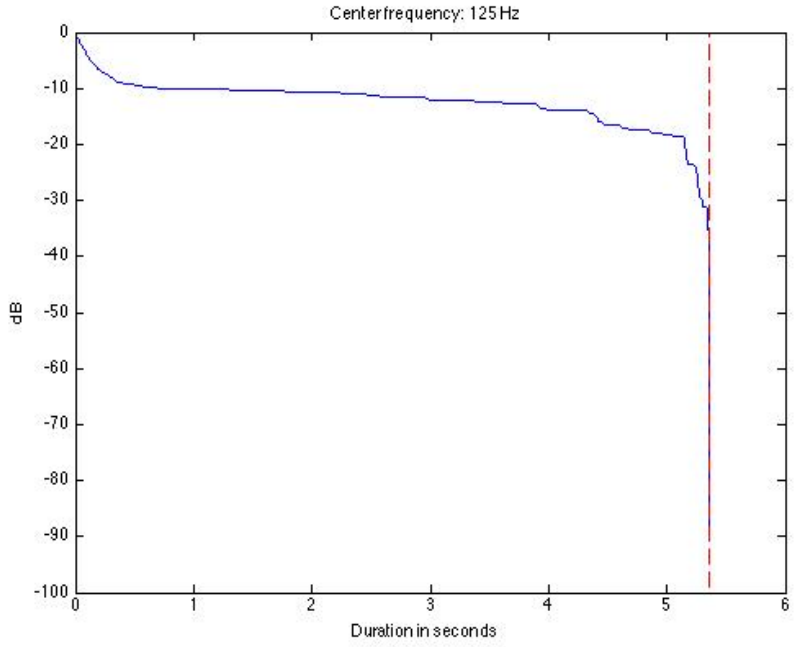


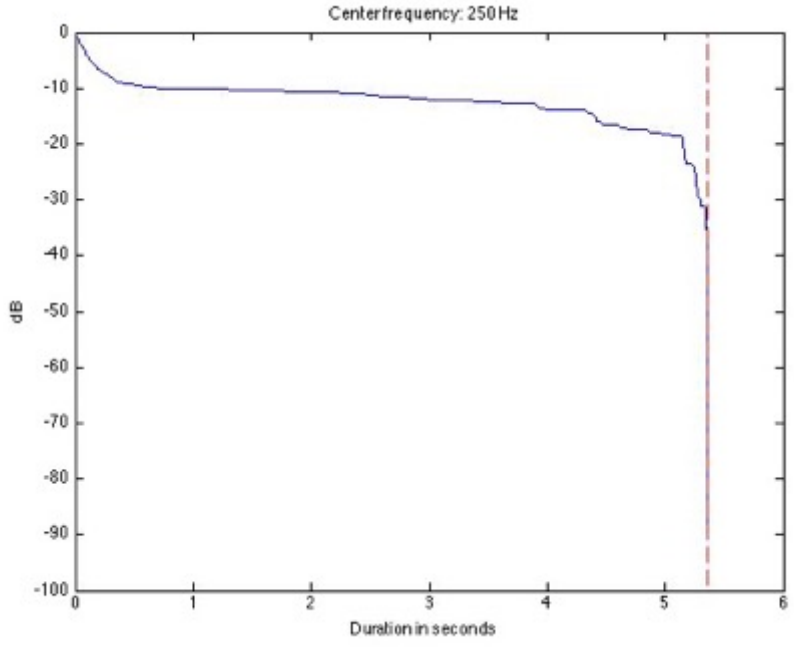


$RT_{60(STAIRS)}$ Quad (Left Front) (8kHz)

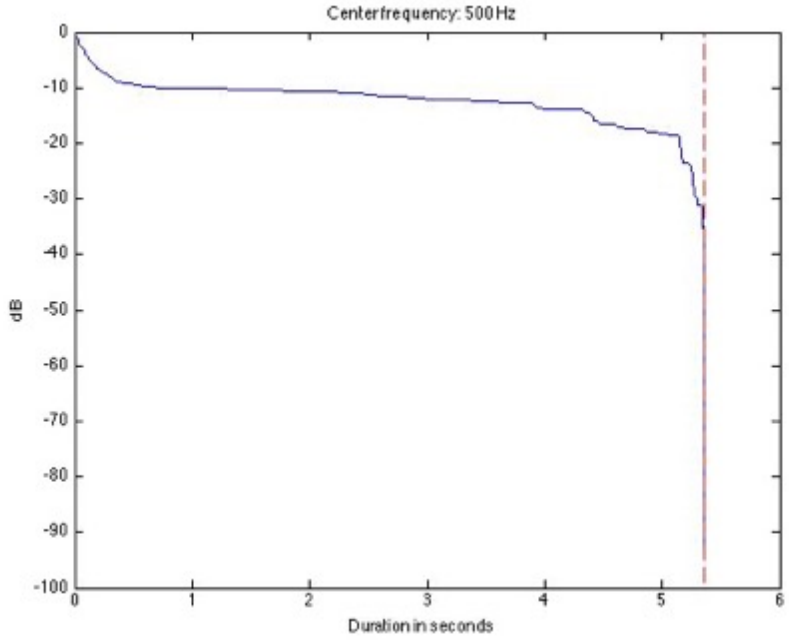


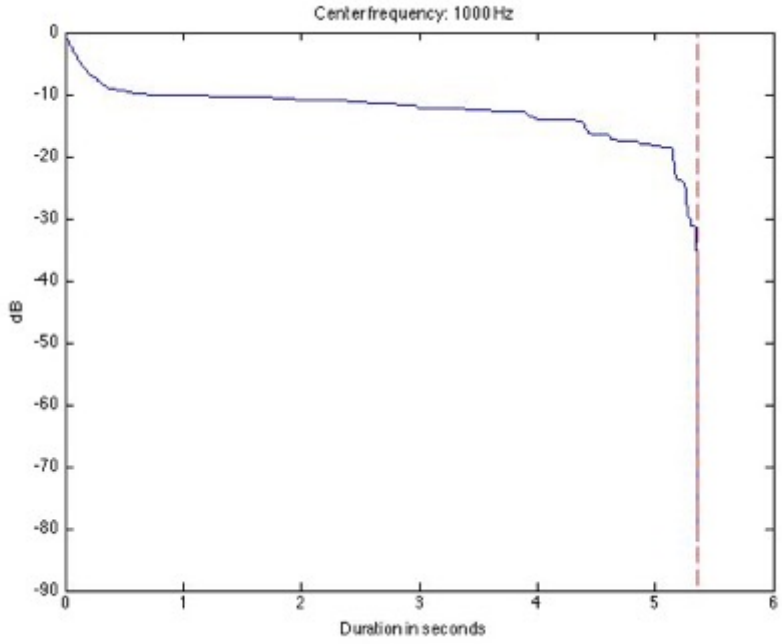
$RT_{60(STAIRS)}$ Quad (Left Back) (125Hz & 250Hz)



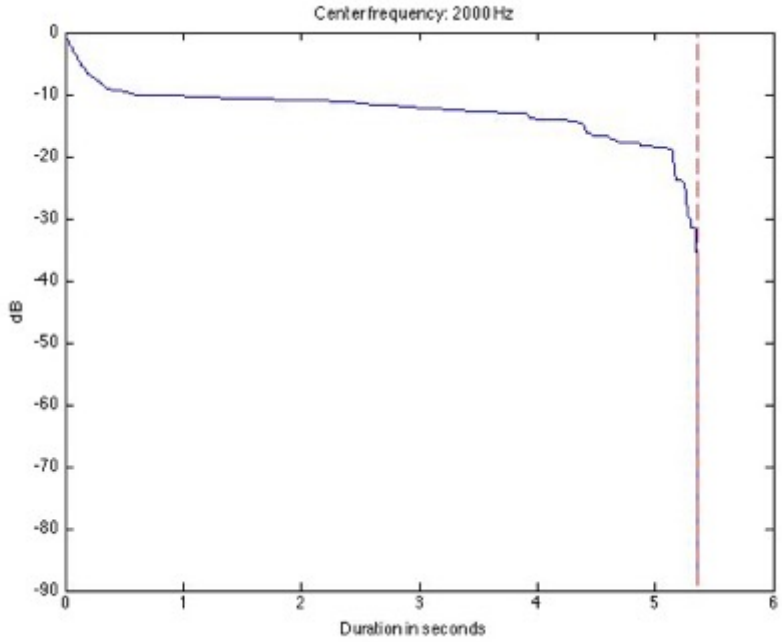


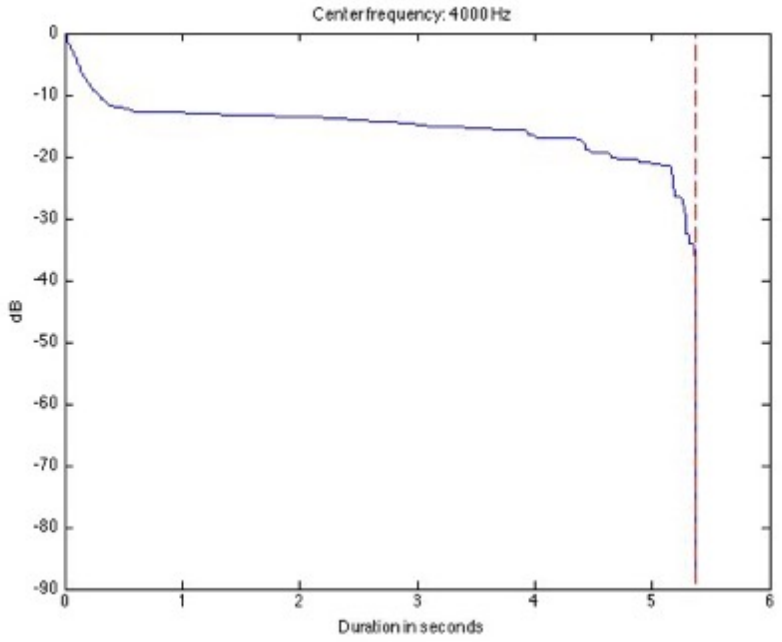
$RT_{60(STAIRS)}$ Quad (Left Back) (500Hz & 1kHz)



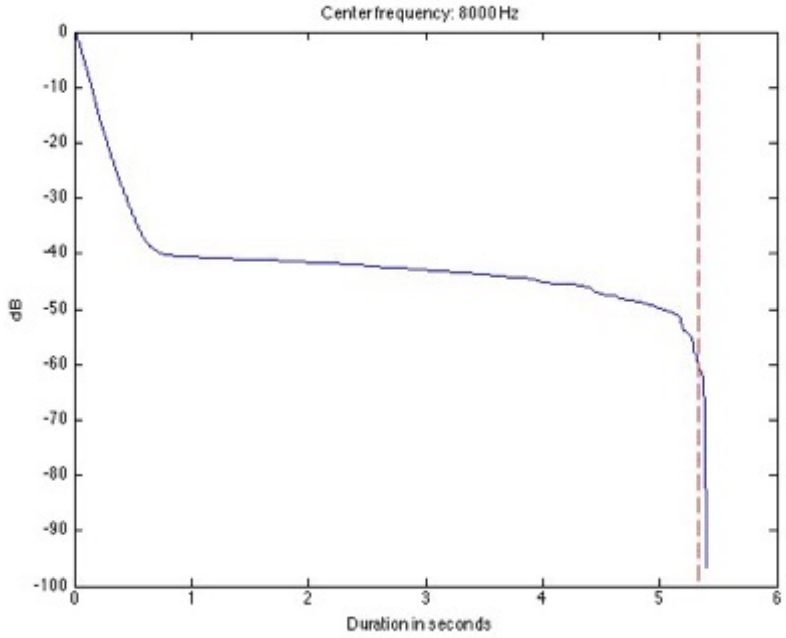


$RT_{60(STAIRS)}$ Quad (Left Back) (2kHz & 4kHz)

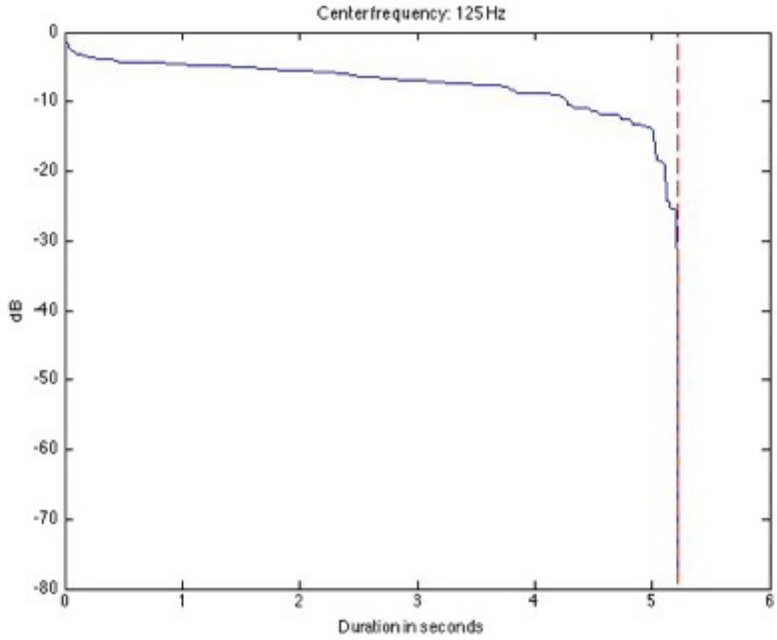


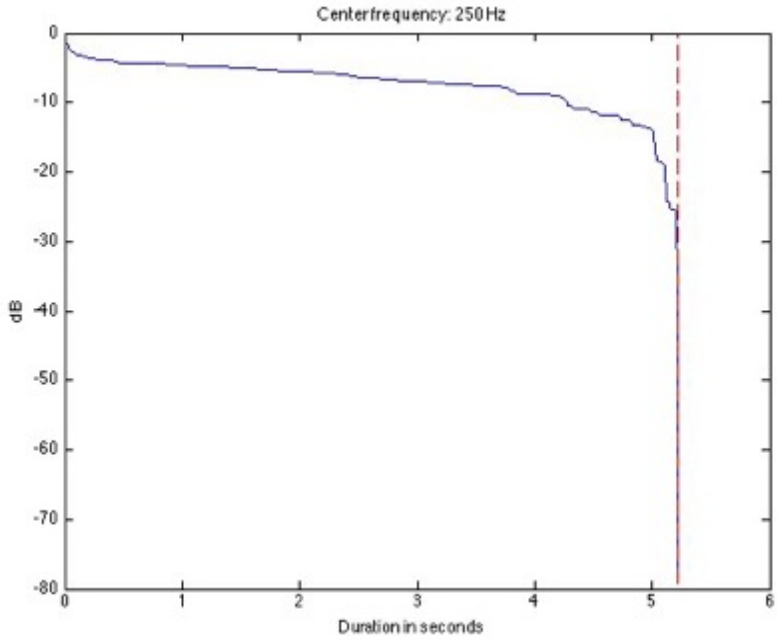


$RT_{60(STAIRS)}$ Quad (Left Back) (8kHz)

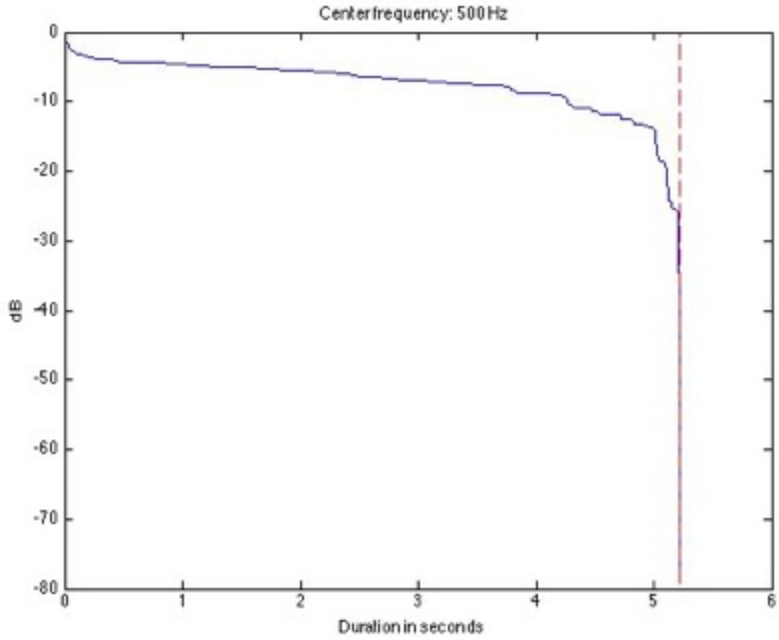


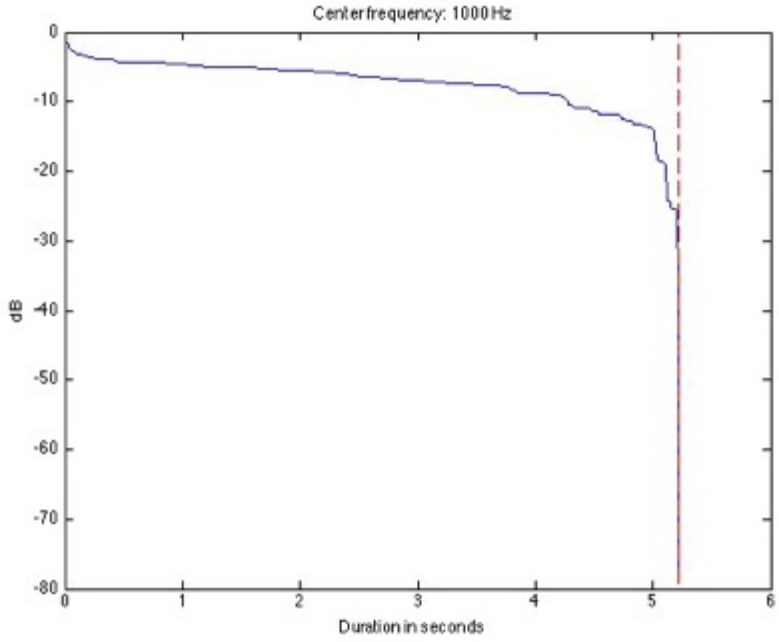
$RT_{60(STAIRS)}$ Quad (Right Back) (125Hz & 250Hz)



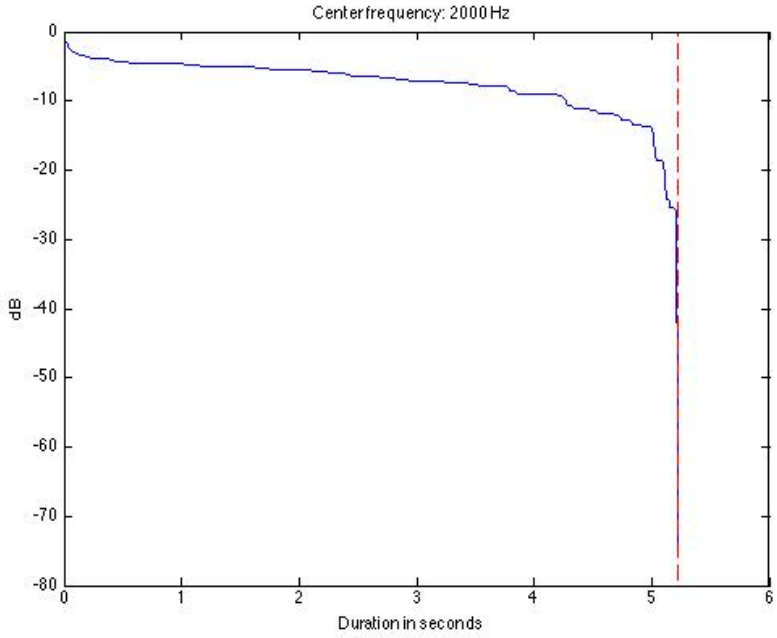


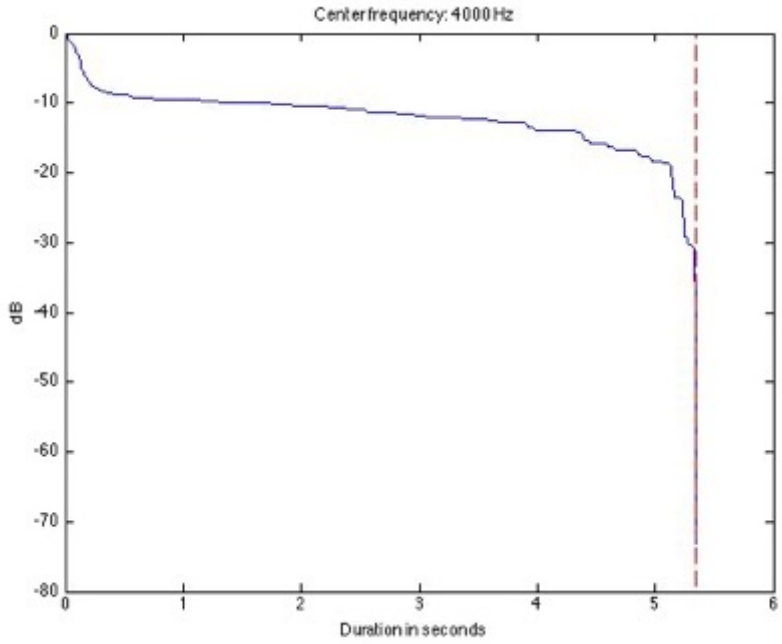
$RT_{60(STAIRS)}$ Quad (Right Back) (500Hz & 1kHz)



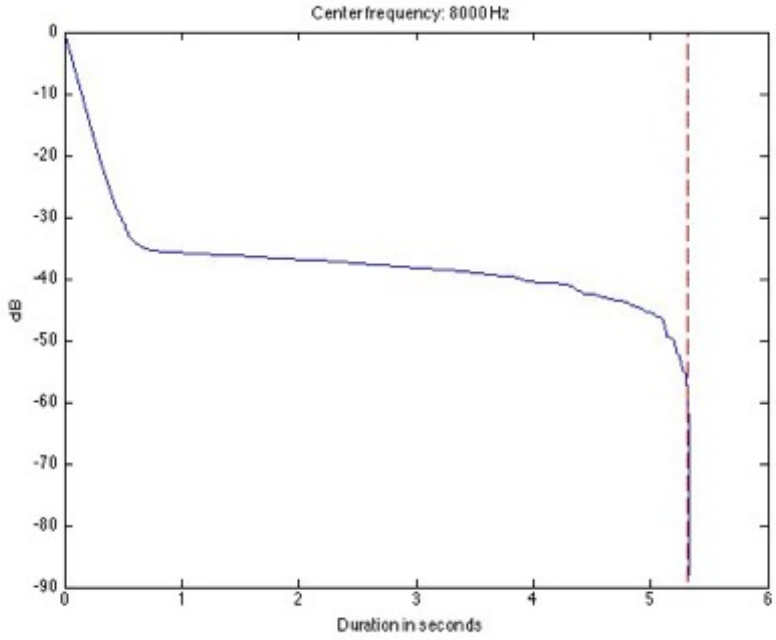


$RT_{60(STAIRS)}$ Quad (Right Back) (2kHz & 4kHz)

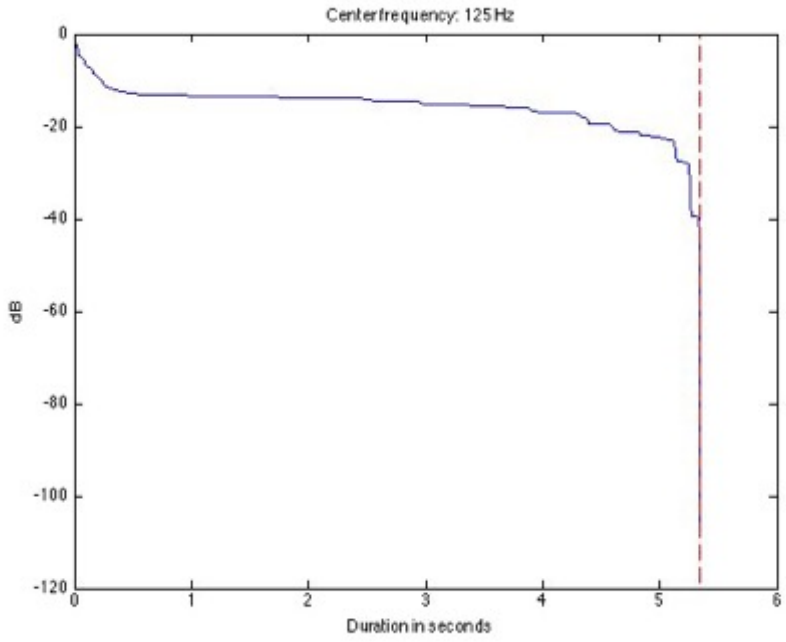


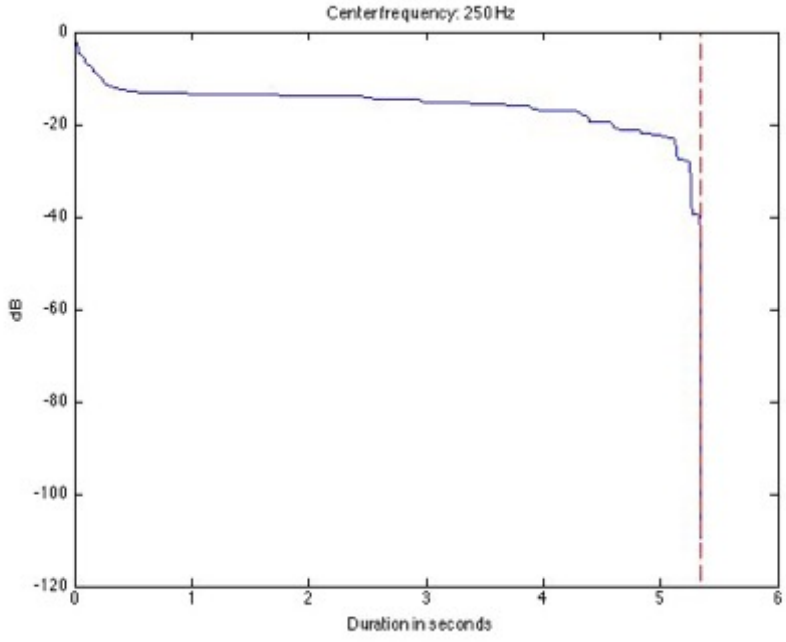


$RT_{60(STAIRS)}$ Quad (Right Back) (8kHz)

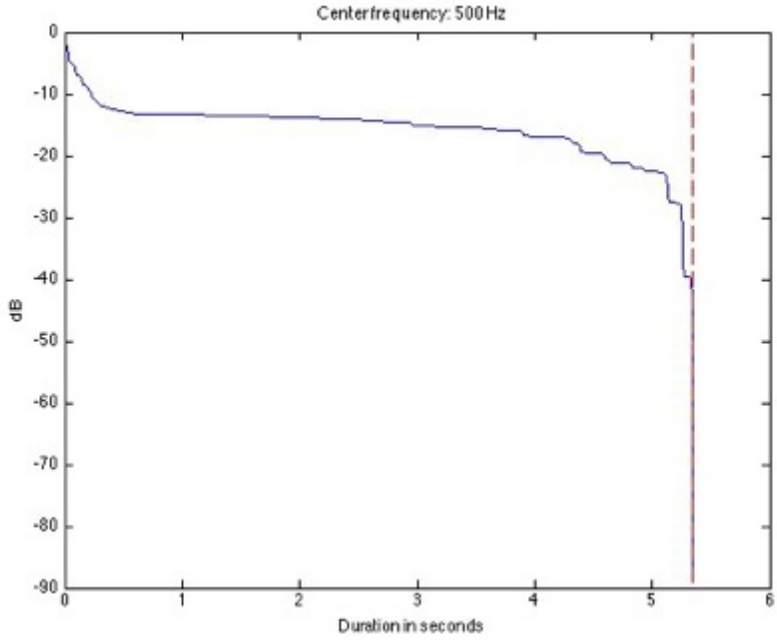


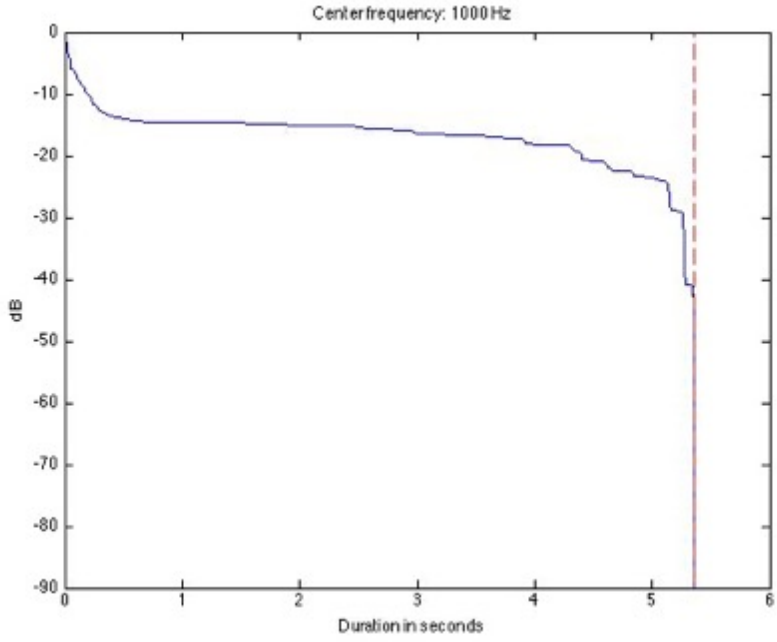
$RT_{60(STAIRS)}$ Quad (Right Back) (125Hz & 250Hz)



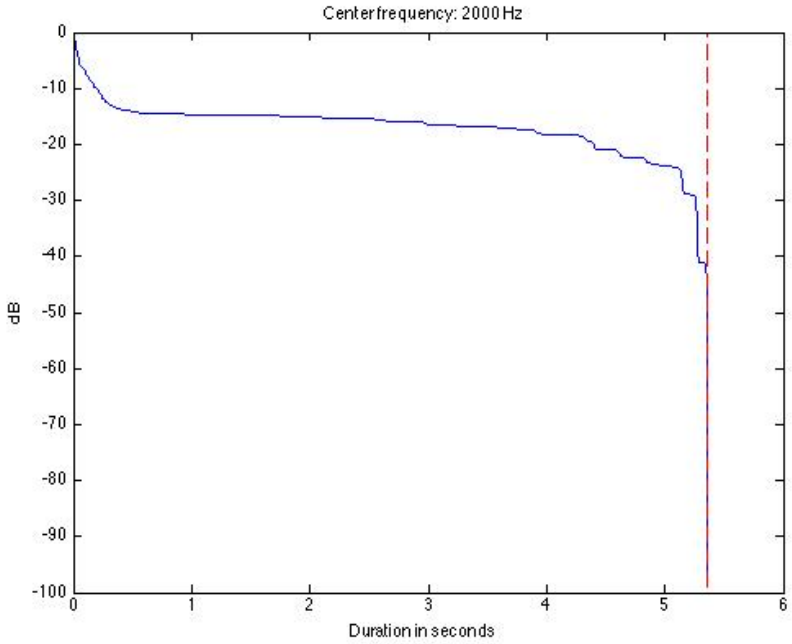


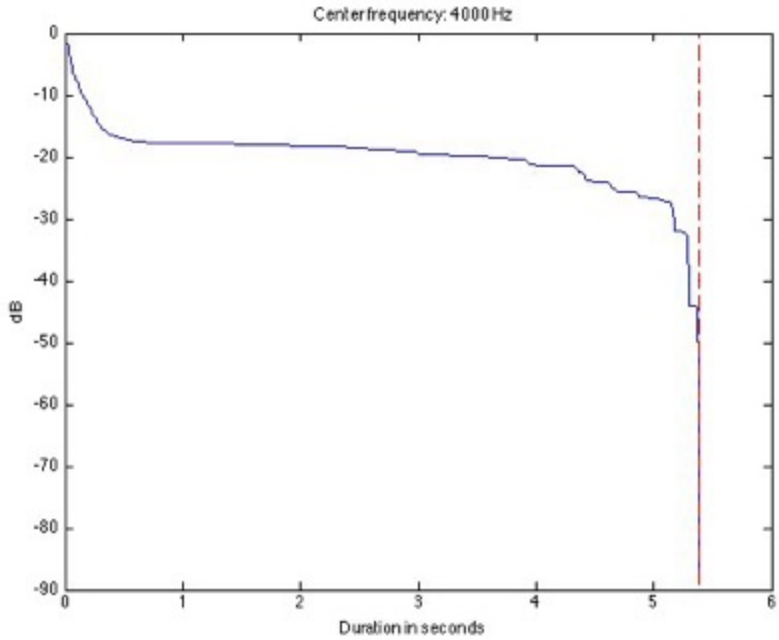
$RT_{60(STAIRS)}$ Quad (Right Front) (500Hz & 1kHz)



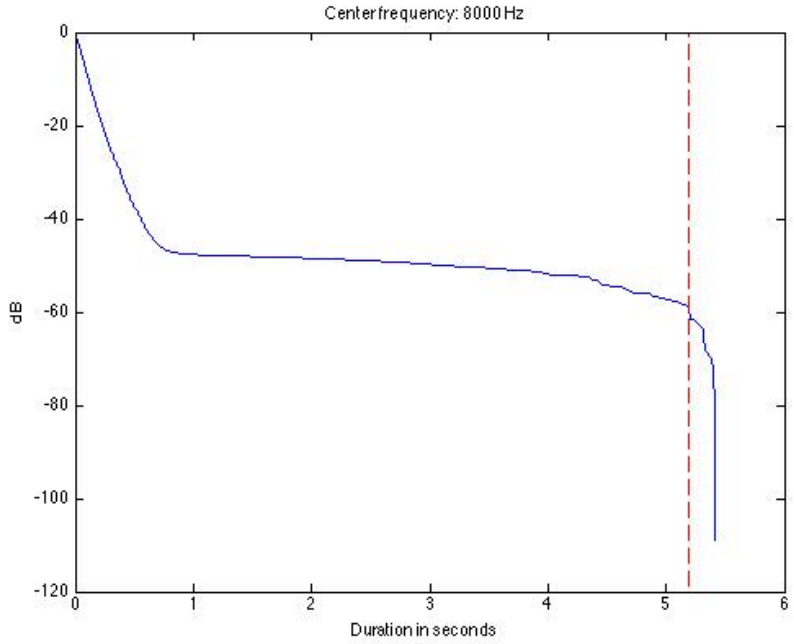


$RT_{60(STAIRS)}$ Quad (Right Front) (2kHz & 4kHz)

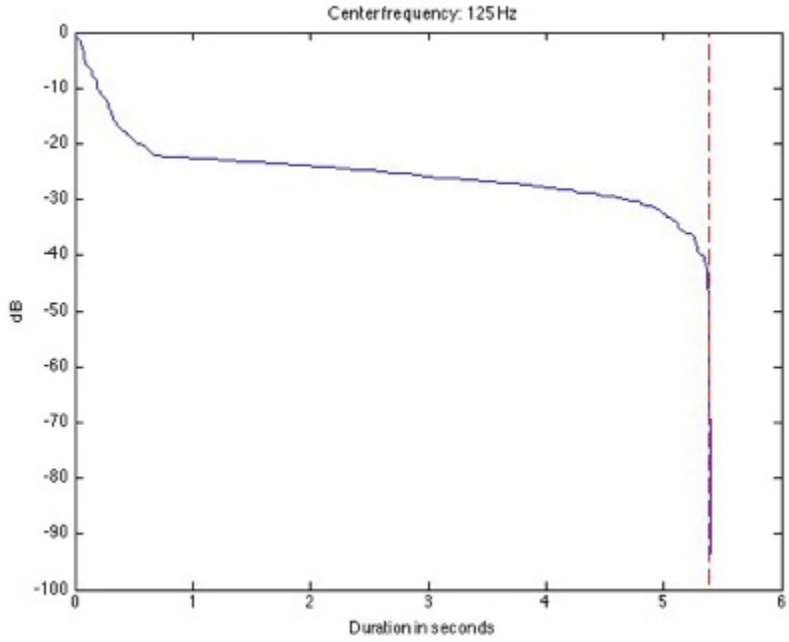


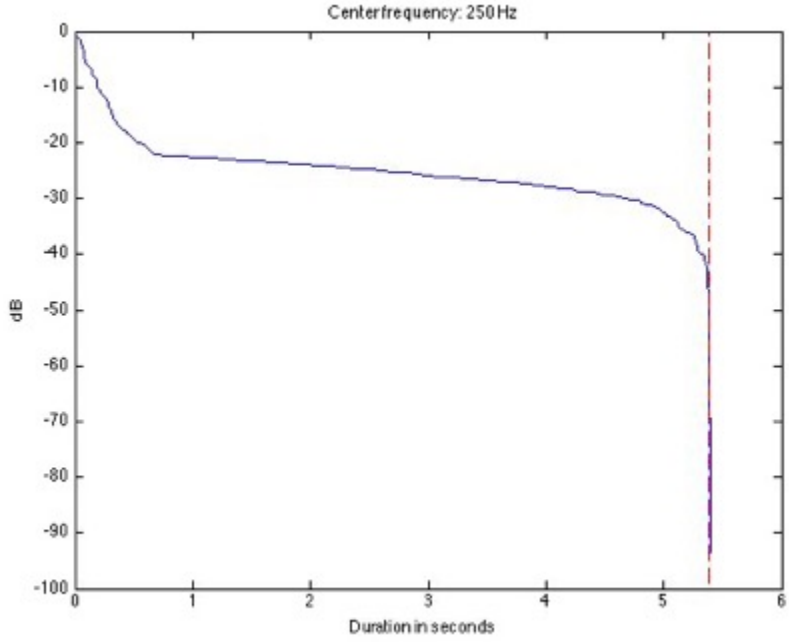


$RT_{60(STAIRS)}$ Quad (Right Front) (8kHz)

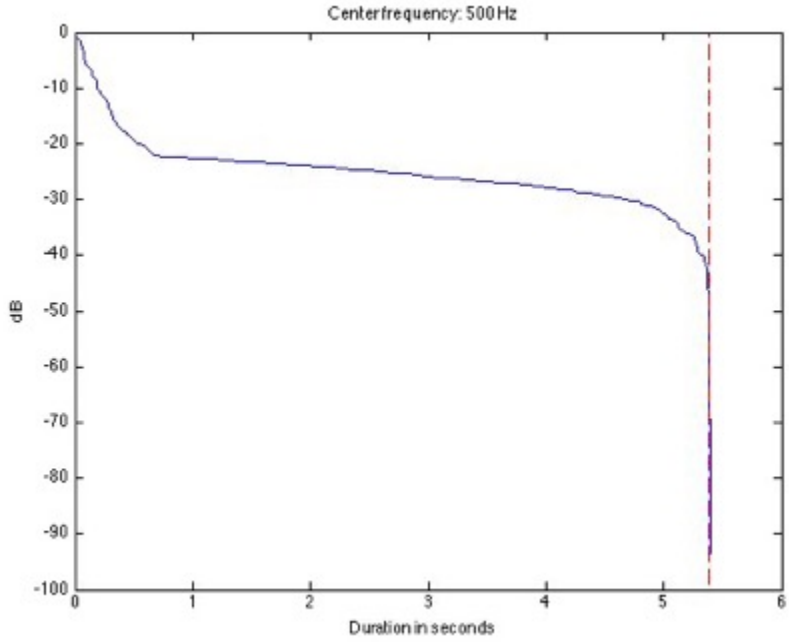


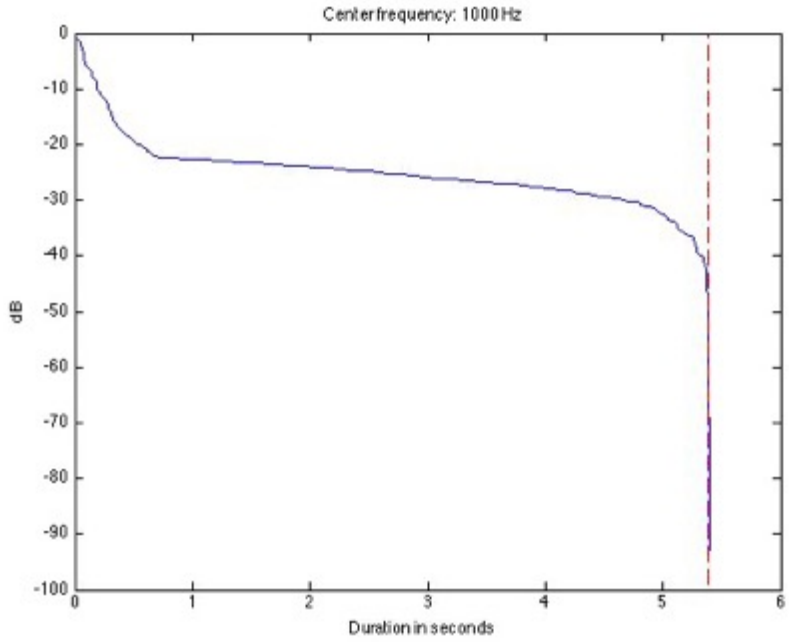
$RT_{60(STAIRS)}$ Double MS (LM1) (125Hz & 250Hz)



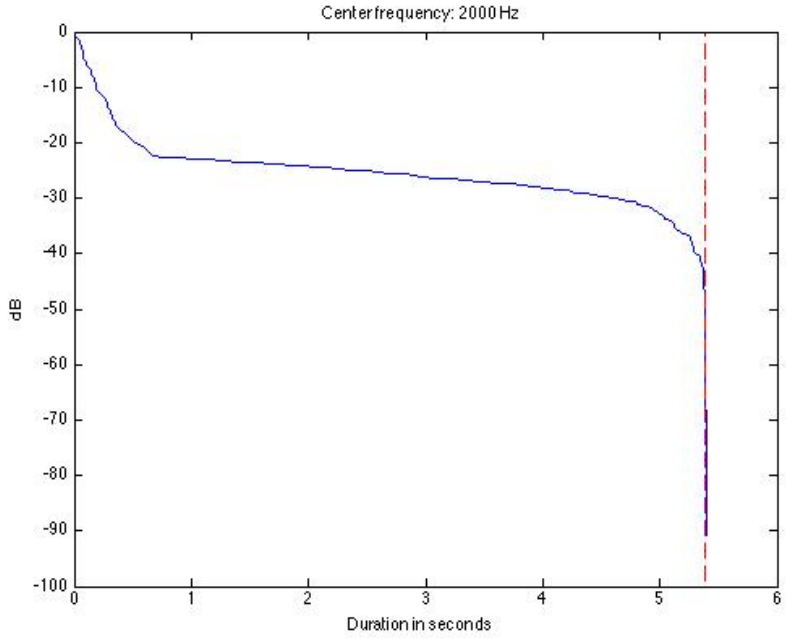


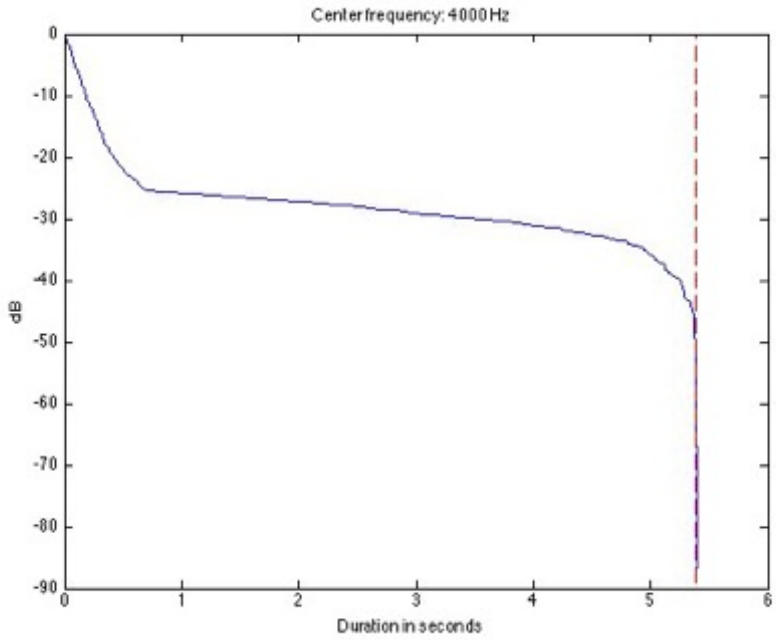
$RT_{60(STAIRS)}$ Double MS (LM1) (500Hz & 1kHz)



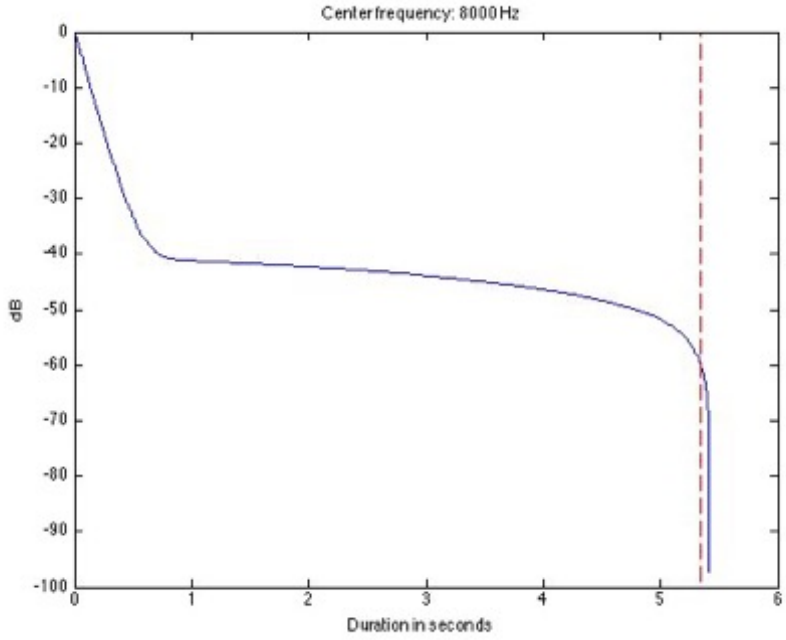


$RT_{60(STAIRS)}$ Double MS (LM1) (2kHz & 4kHz)

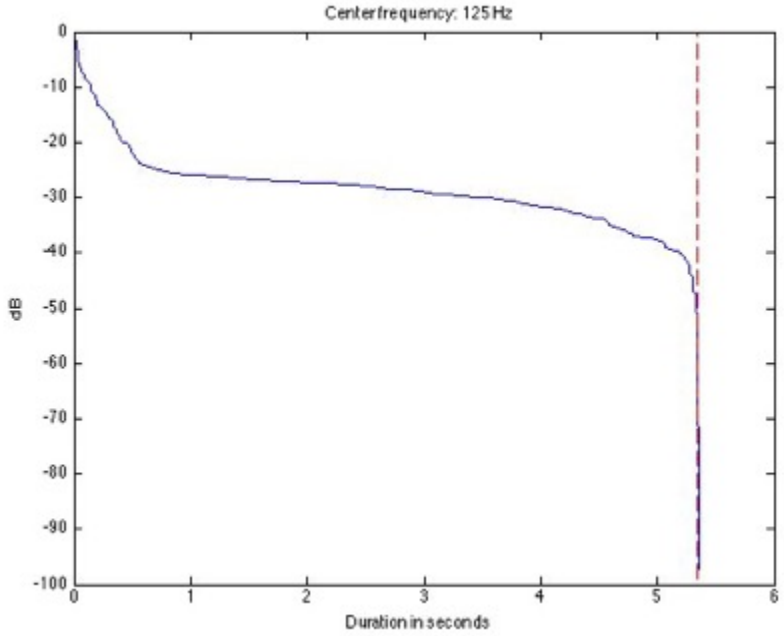


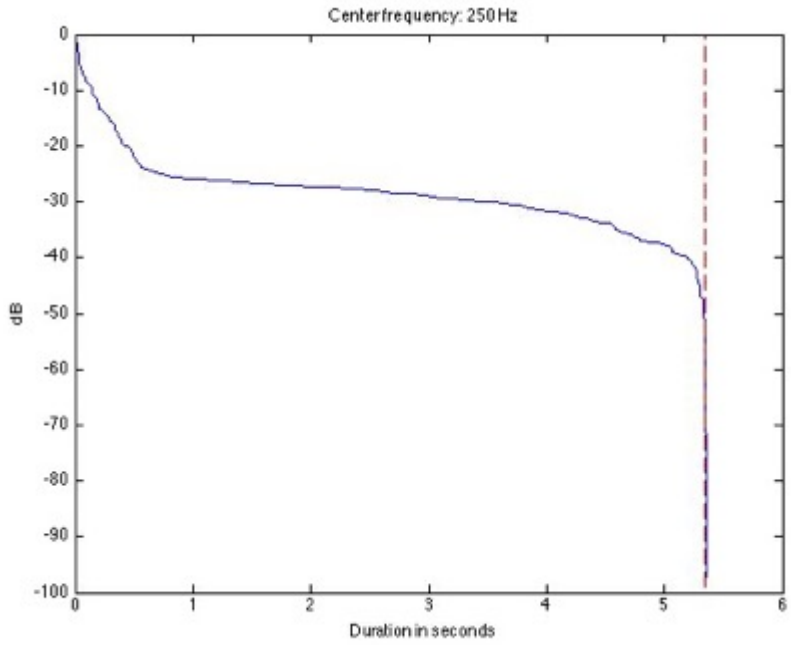


$RT_{60(STAIRS)}$ Double MS (LM1) (8kHz)

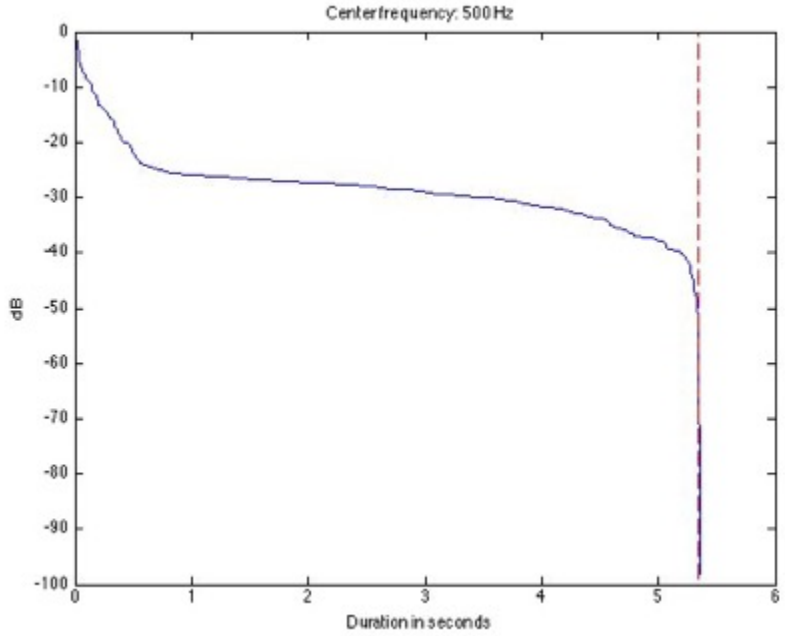


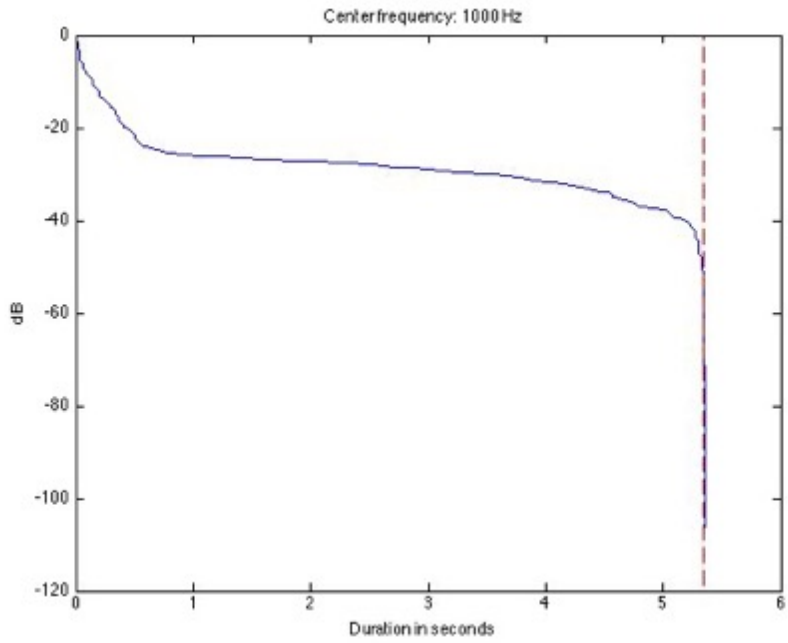
$RT_{60(STAIRS)}$ Double MS (SR1) (125Hz & 250Hz)



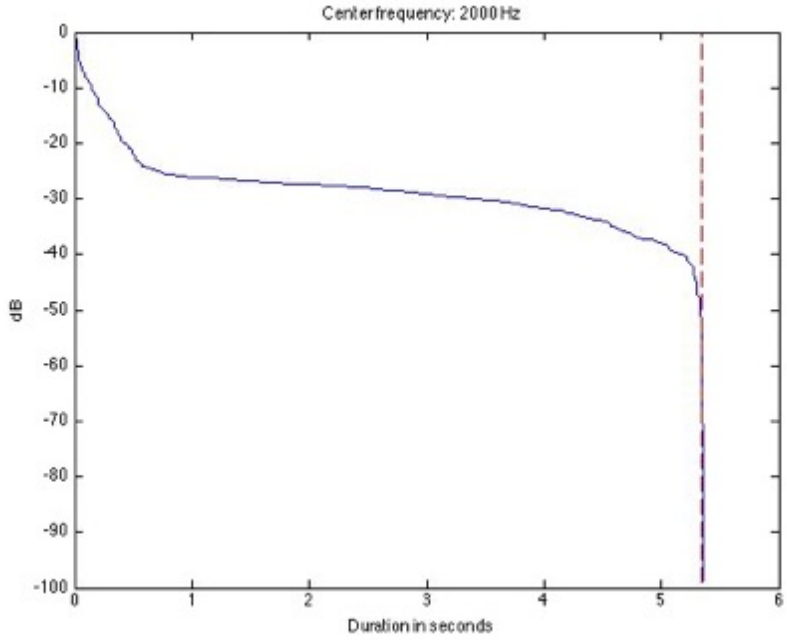


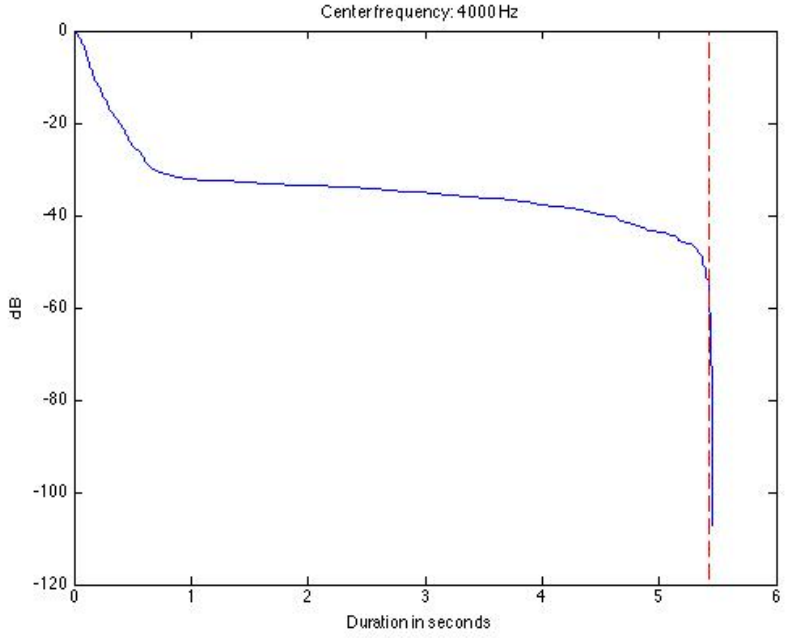
$RT_{60(STAIRS)}$ Double MS (SR1) (500Hz & 1kHz)



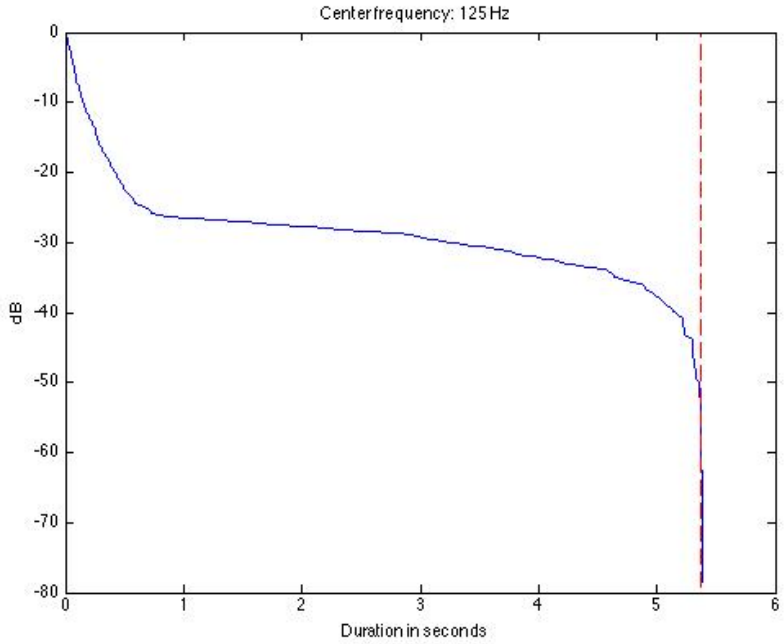


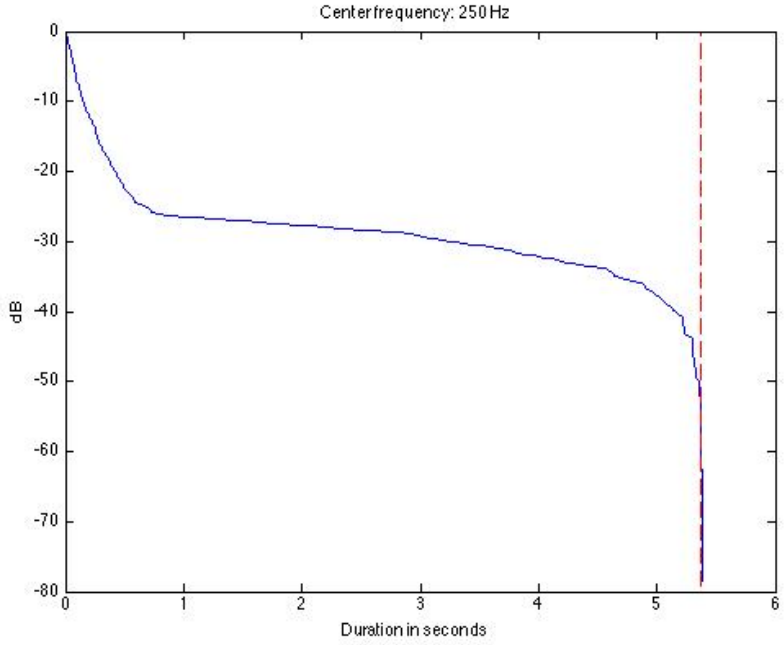
$RT_{60(STAIRS)}$ Double MS (SR1) (2kHz & 4kHz)



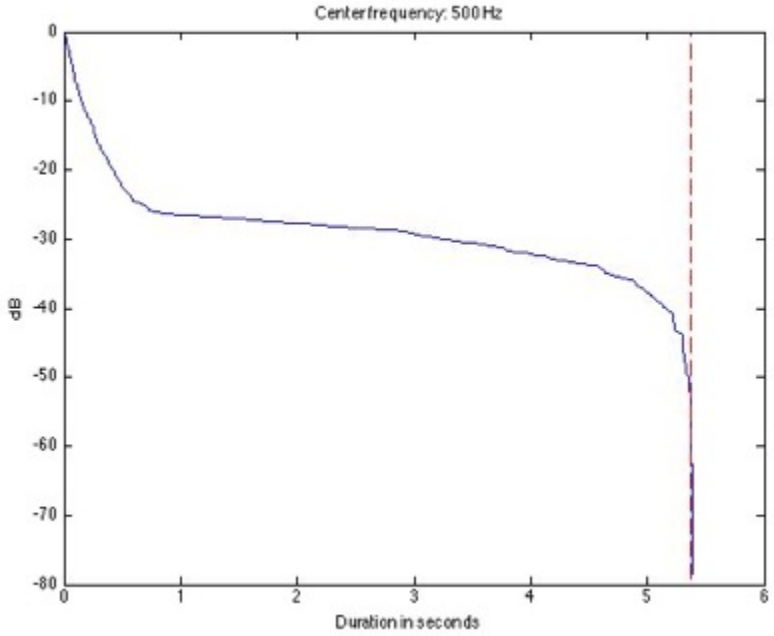


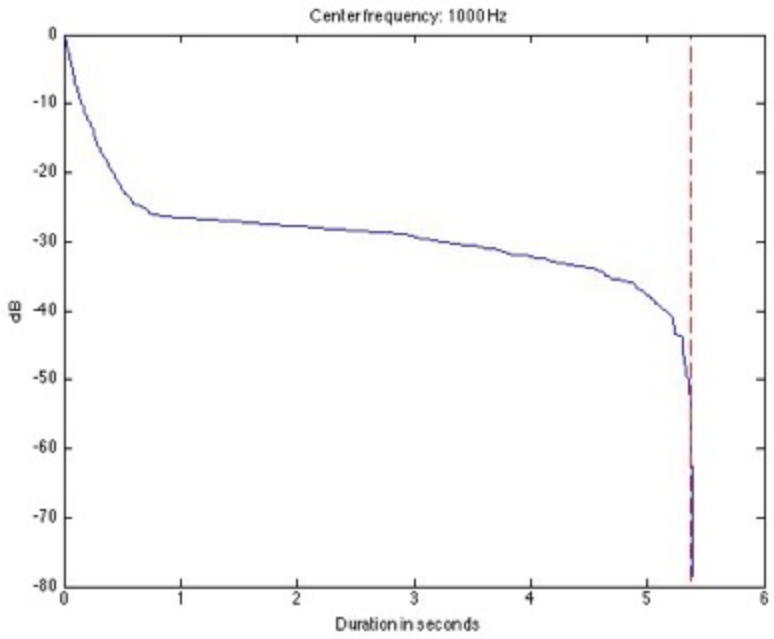
$RT_{60(STAIRS)}$ Double MS (LM2) (125Hz & 500Hz)



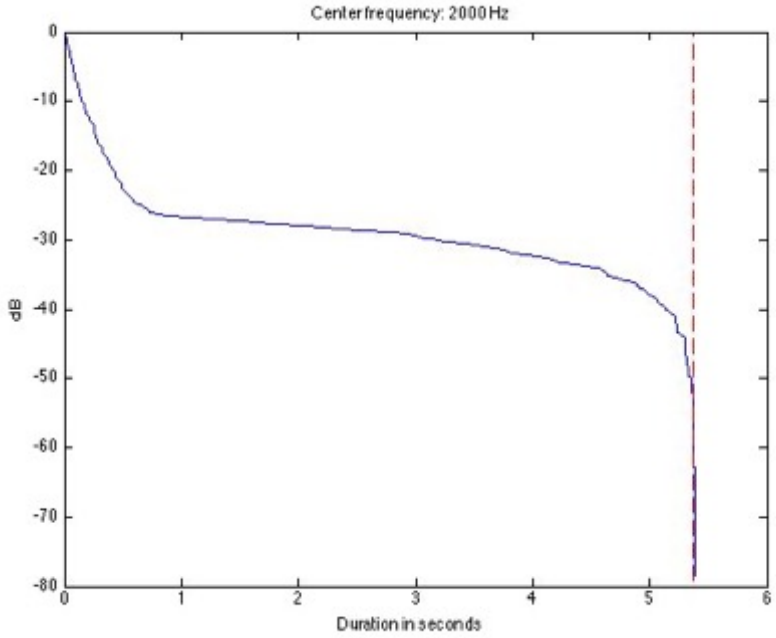


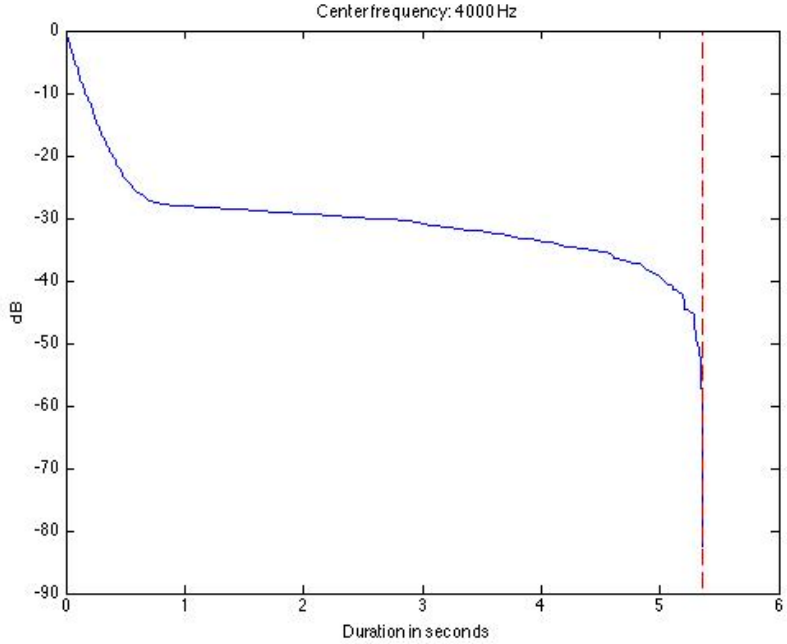
$RT_{60(STAIRS)}$ Double MS (LM2) (500Hz & 1kHz)



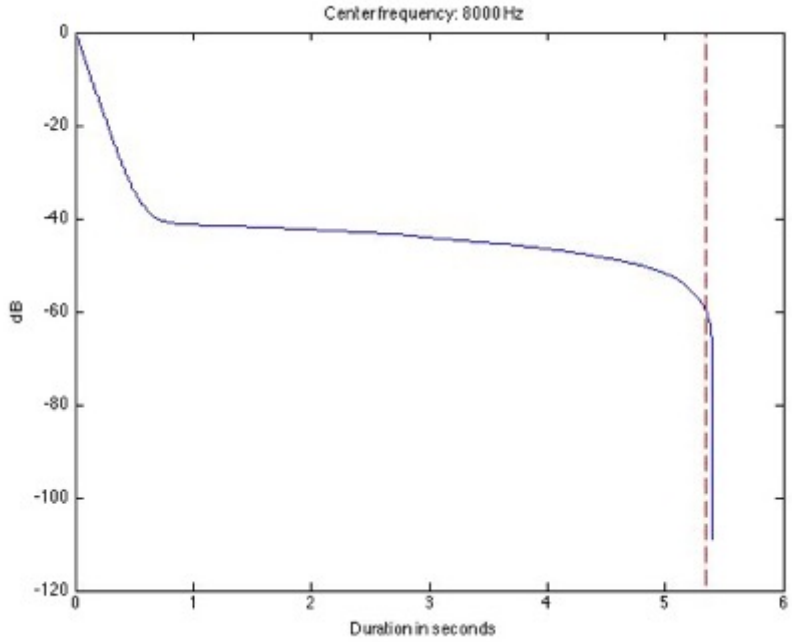


$RT_{60(STAIRS)}$ Double MS (LM2) (2kHz & 4kHz)

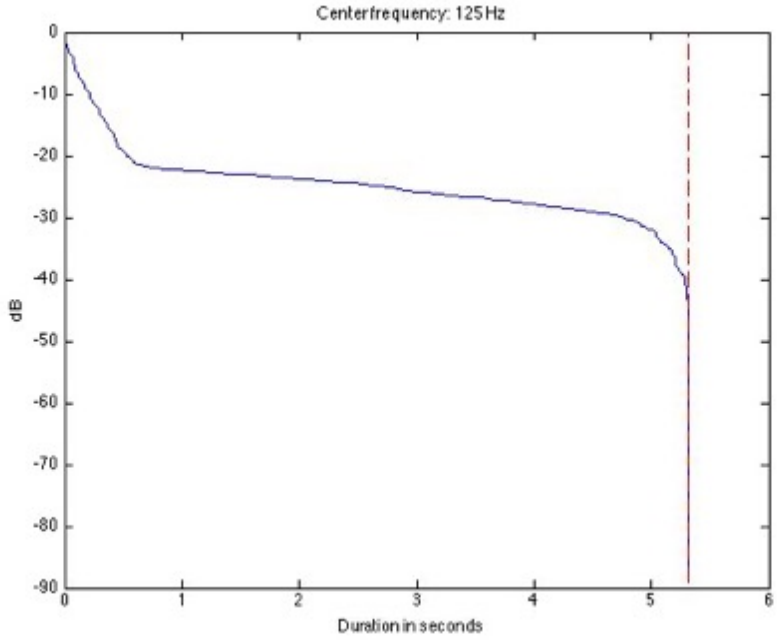


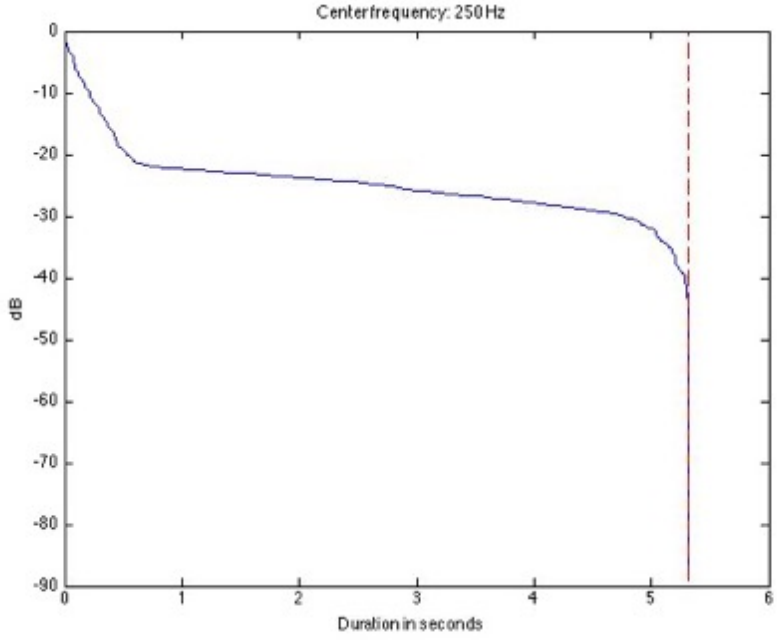


$RT_{60(STAIRS)}$ Double MS (LM2) (8kHz)

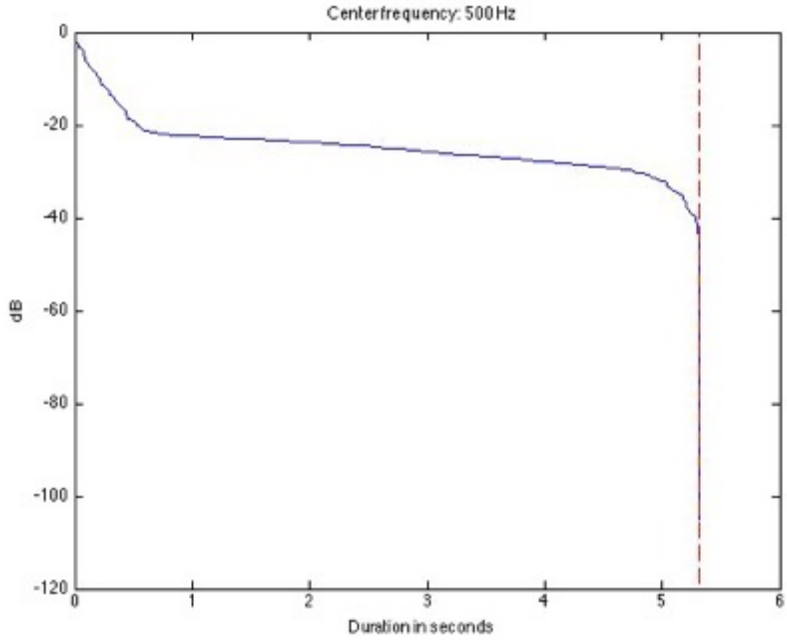


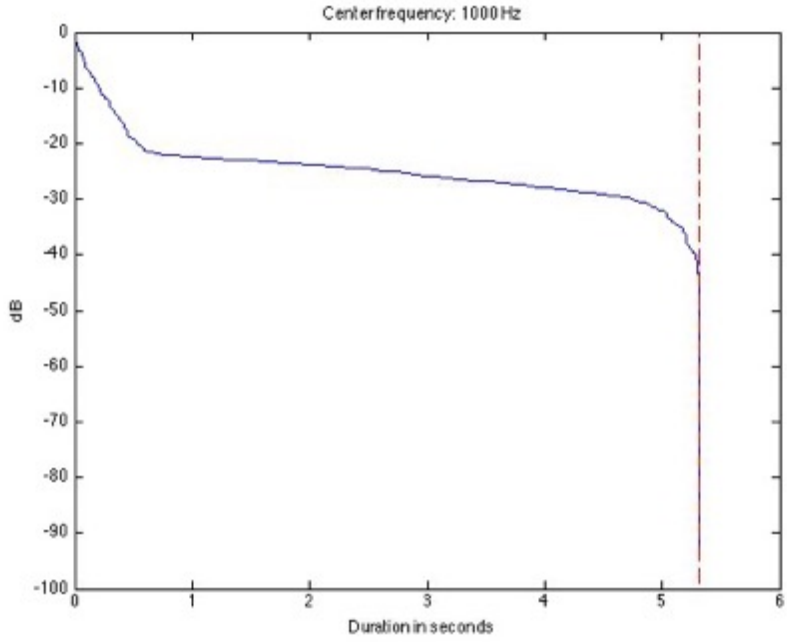
$RT_{60(STAIRS)}$ Double MS (SR2) (125Hz & 250Hz)



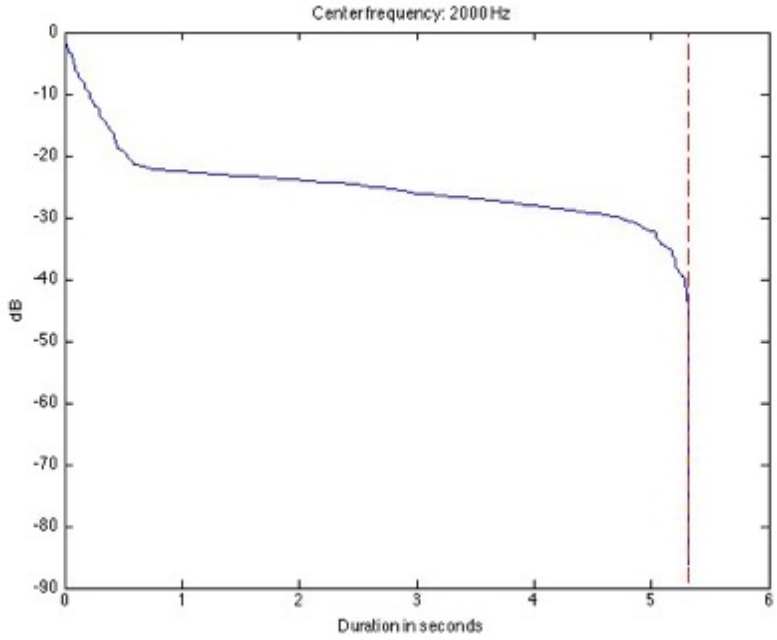


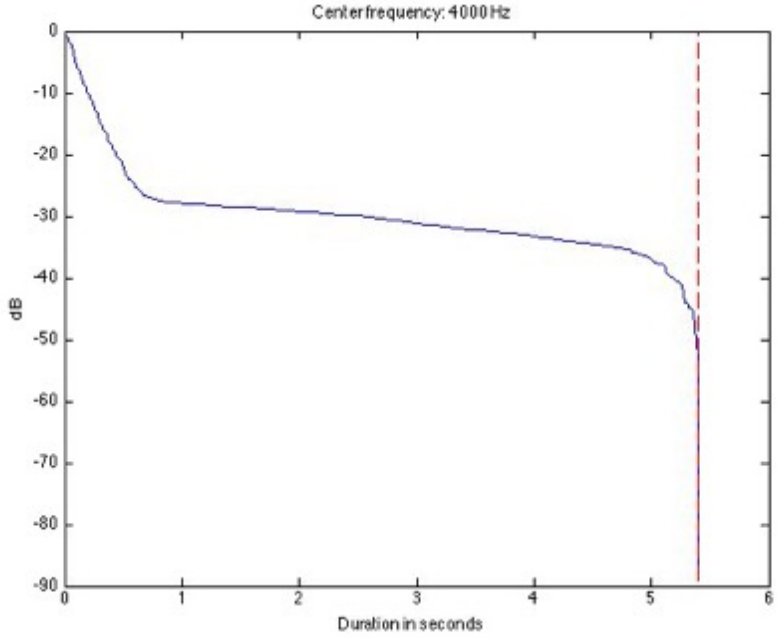
$RT_{60(STAIRS)}$ Double MS (SR2) (500Hz & 1kHz)



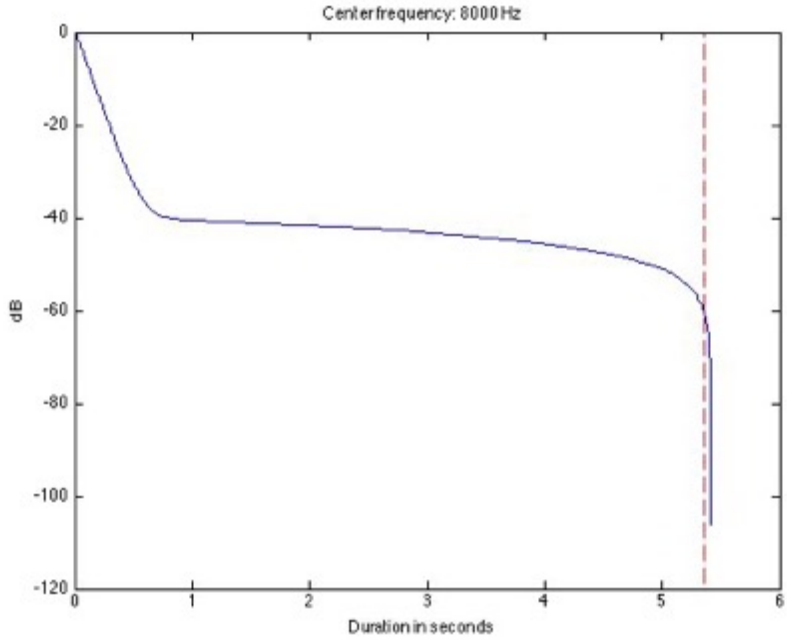


$RT_{60(STAIRS)}$ Double MS (SR2) (2kHz & 4kHz)

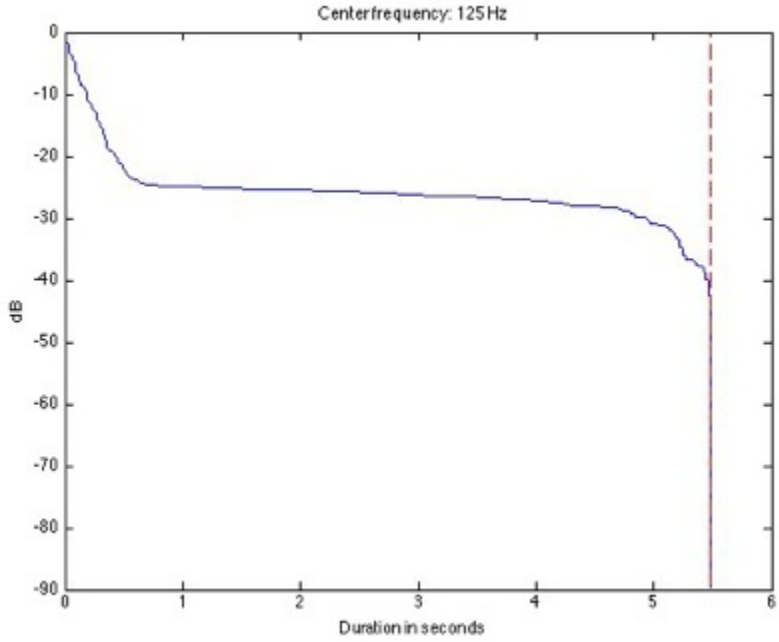


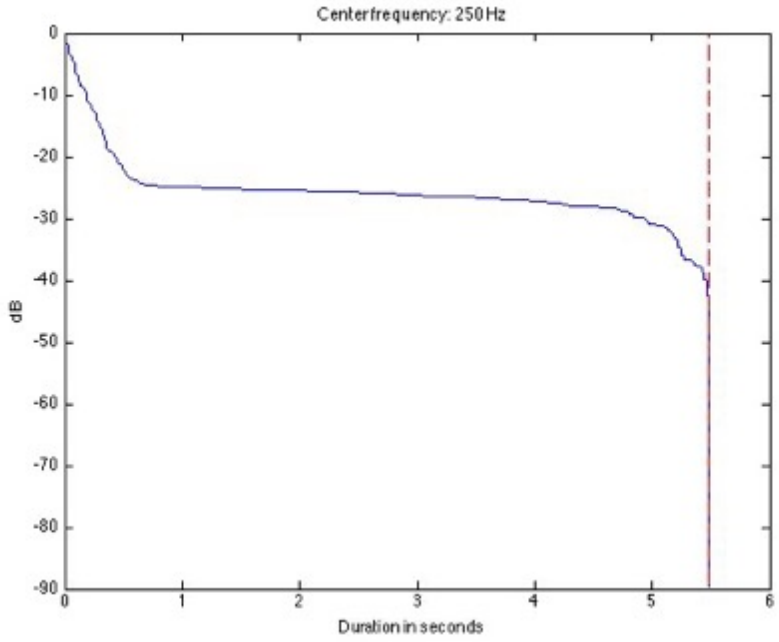


$RT_{60(STAIRS)}$ Double MS (SR2) (8kHz)

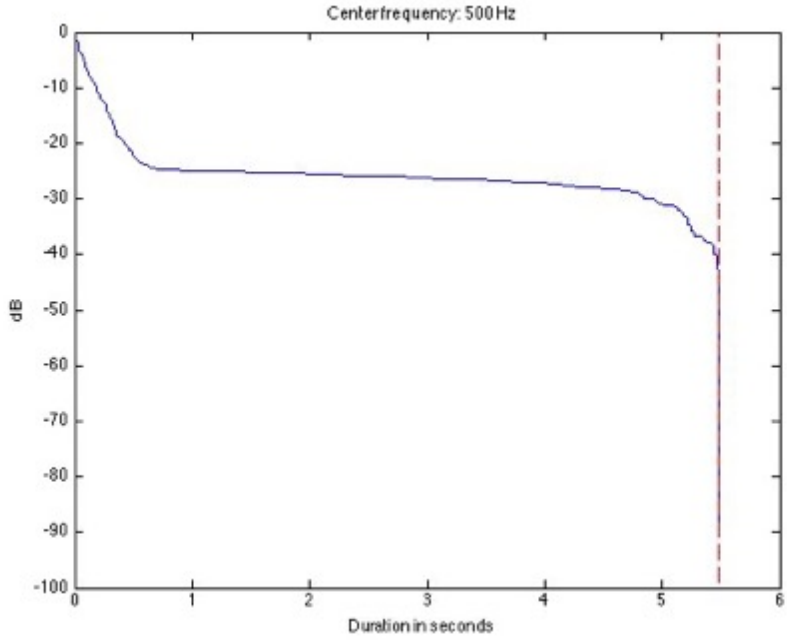


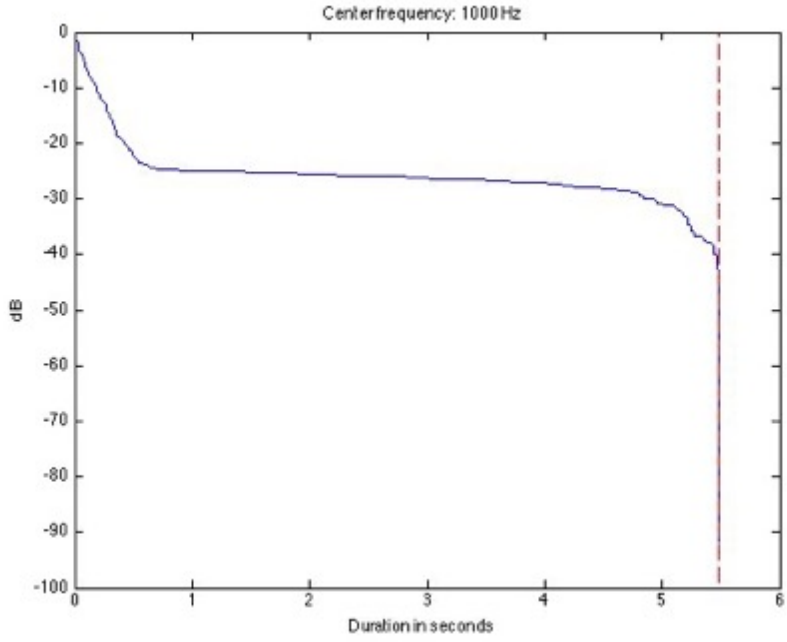
$RT_{60(STAIRS)}$ Spaced Pair (Left) (125Hz & 250Hz)



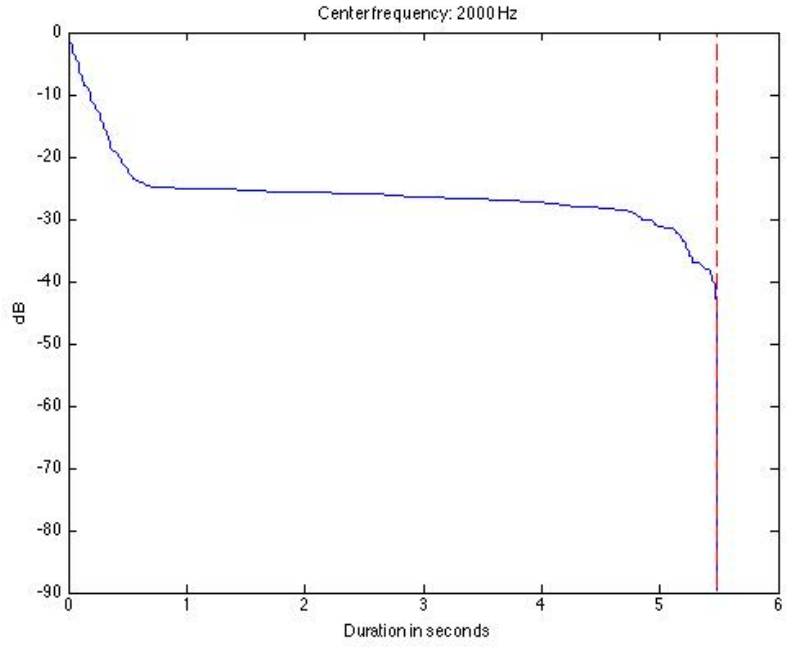


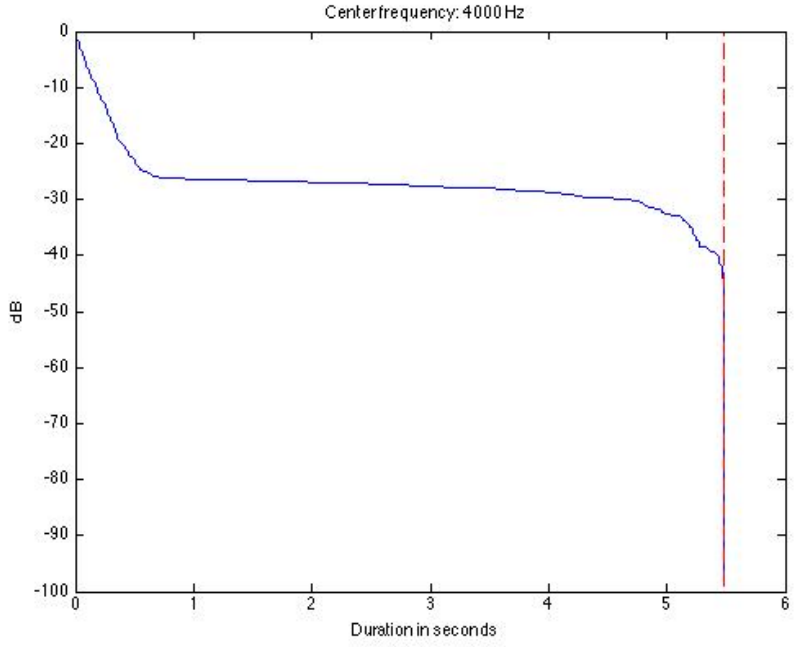
$RT_{60(STAIRS)}$ Spaced Pair (Left) (500Hz & 1kHz)



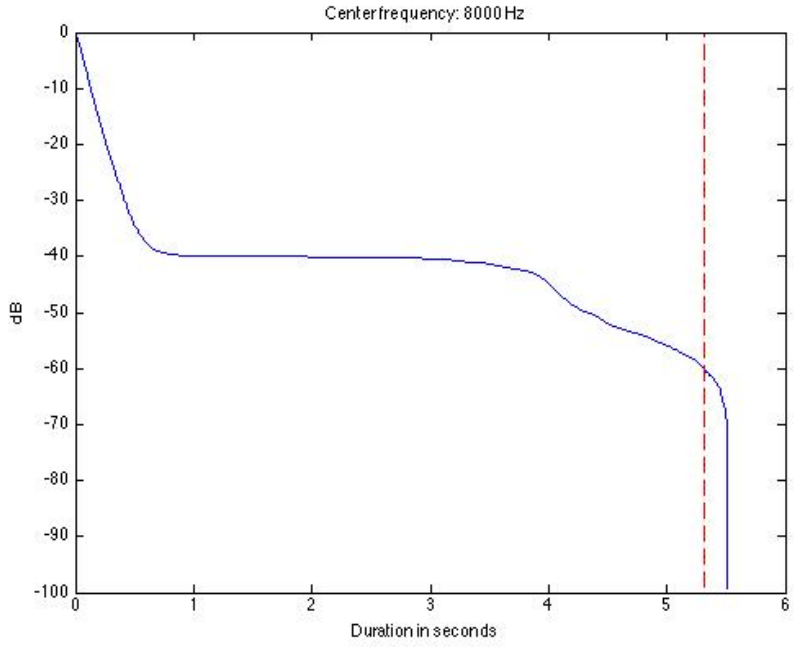


$RT_{60(STAIRS)}$ Spaced Pair (Left) (2kHz & 4kHz)

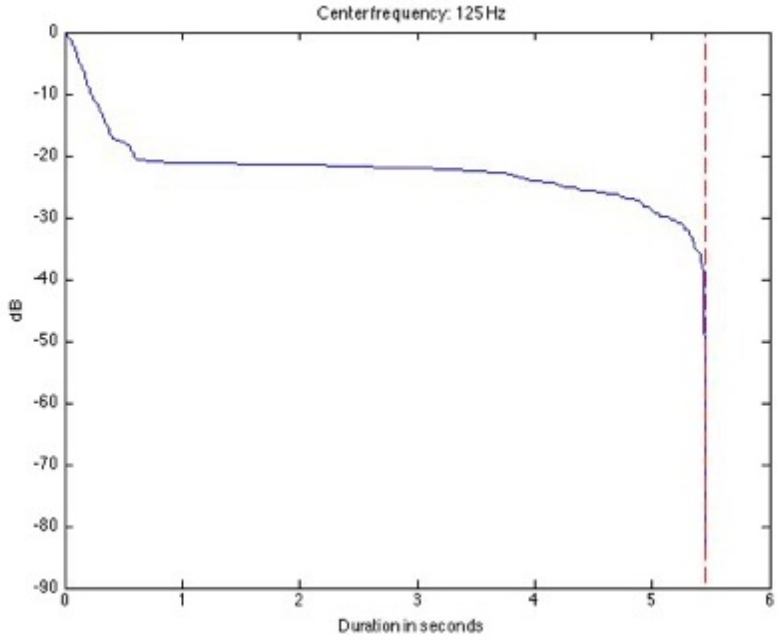


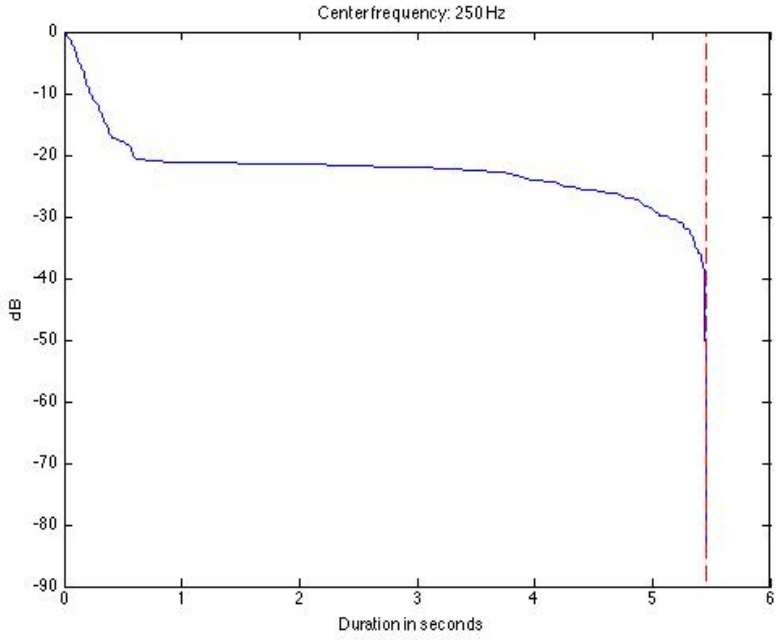


$RT_{60(STAIRS)}$ Spaced Pair (Left) (8kHz)

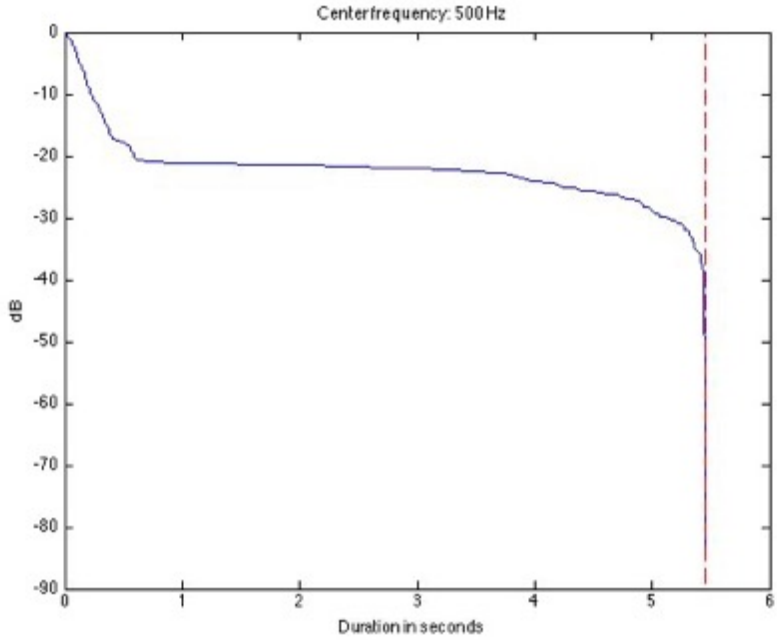


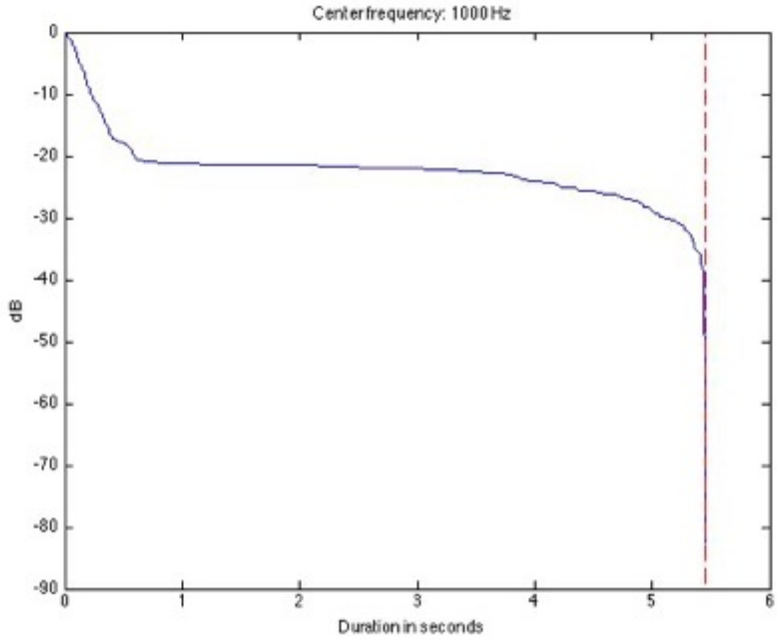
$RT_{60(STAIRS)}$ Spaced Pair (Right) (125Hz & 250Hz)



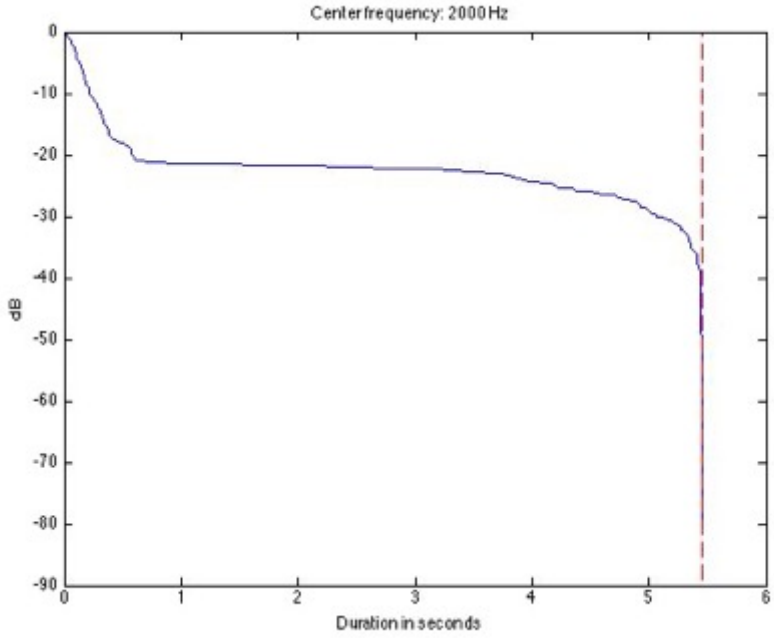


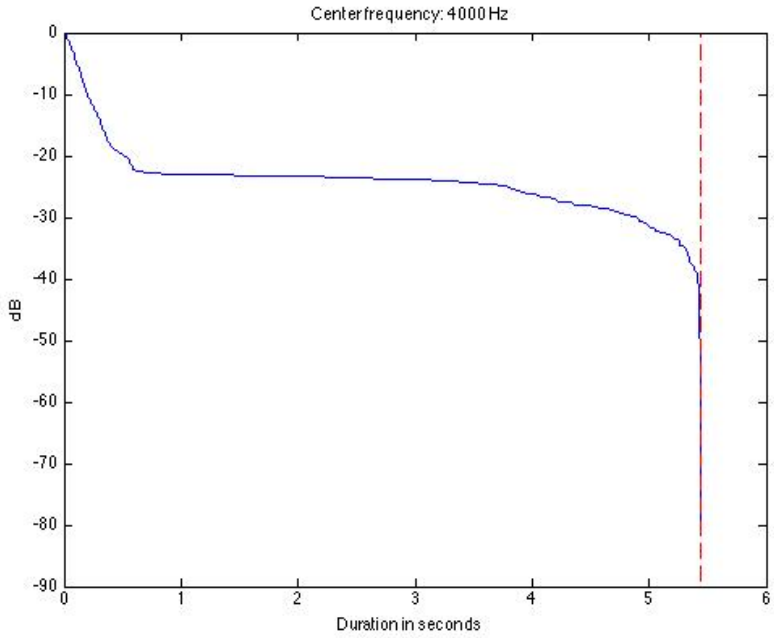
$RT_{60(STAIRS)}$ Spaced Pair (Right) (500Hz & 1kHz)



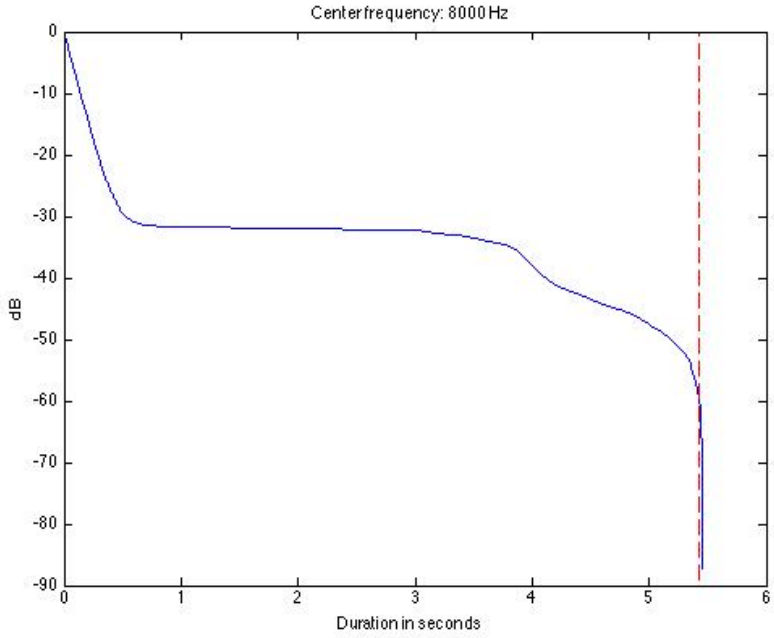


$RT_{60(STAIRS)}$ Spaced Pair (Right) (2kHz & 4kHz)





$RT_{60(STAIRS)}$ Spaced Pair (Right) (8kHz)



MatLab RT60 Code

```
function T60 = rt60(filename)
% computes the rt60 time for various octave bands
% Inout: the filename of the wave you want to analyze
% Output: a vector with reverberation times for each band
% The function needs the crossing function to run so don't lose it.

% read in signal
[signal, srate] = wavread(filename);

% convert to mono if not mono already
if size(signal, 2) > 1
    signal = sum(signal, 2) / size(signal, 2);
end

lowerBnds = [62, 125, 250, 500, 1000, 2000, 4000];
upperBnds = [187, 375, 750, 1500, 3000, 6000, 12000];
center = [125, 250, 500, 1000, 2000, 4000, 8000];
% Band limit signal and calculate rt60
for i = 1 : length(lowerBnds)
    up = upperBnds(i)/(srate/2);
    low = lowerBnds(i)/(srate/2);
    [b, a] = fir1(20, [low, up], 'bandpass');
    signalBand = filter(b, a, signal);

    % compute background noise
    rms = sqrt(mean((signalBand(end-5000 : end)).^ 2));

    % compute minimum Phase
    [~,ind] = max(signalBand);
    minPhase = signalBand(ind:end);

    % upper limit of integration
    intUpperLim = length(minPhase);

    sqIR = minPhase.^2 - rms^2; % squared IR with rms noise subtracted

    for k=1:intUpperLim
        if sqIR(k) < 0
            sqIR(k) = 0;  % lower limit of zero
        end
    end

    rev = sqIR(intUpperLim:-1:1); % backwards squared IR
    revInt = cumtrapz(rev); % backwards-integrated squared IR
    int = revInt(end:-1:1);
    Eoverall = max(int);
    dbInt = 10*log10(int/Eoverall);

    % timeVector
    len = length(dbInt);
    t = [0:len-1]/srate;

    % Find -60dB crossing
    minus60ind = crossing(dbInt,t,-60);
    T60(i) = minus60ind / srate;
```

```
    figure(i)
    plot(t, dbInt);
    title(sprintf('Center frequency: %i Hz', center(i)));
    xlabel('Duration in seconds');
    ylabel('dB');
    hold on
    yLimits = get(gca,'YLim');
    line([T60(i), T60(i)] , yLimits,'Marker','none','LineStyle','--',
'Color','r')

end
```

```
function [ind,t0,s0,t0close,s0close] = crossing(S,t,level,imeth)
% CROSSING find the crossings of a given level of a signal
%   ind = CROSSING(S) returns an index vector ind, the signal
%   S crosses zero at ind or at between ind and ind+1
%   [ind,t0] = CROSSING(S,t) additionally returns a time
%   vector t0 of the zero crossings of the signal S. The crossing
%   times are linearly interpolated between the given times t
%   [ind,t0] = CROSSING(S,t,level) returns the crossings of the
%   given level instead of the zero crossings
%   ind = CROSSING(S,[],level) as above but without time interpolation
%   [ind,t0] = CROSSING(S,t,level,par) allows additional parameters
%   par = {'none'|'linear'}.
%   With interpolation turned off (par = 'none') this function always
%   returns the value left of the zero (the data point thats nearest
%   to the zero AND smaller than the zero crossing).
%
%   [ind,t0,s0] = ... also returns the data vector corresponding to
%   the t0 values.
%
%   [ind,t0,s0,t0close,s0close] additionally returns the data points
%   closest to a zero crossing in the arrays t0close and s0close.
%
%   This version has been revised incorporating the good and valuable
%   bugfixes given by users on Matlabcentral. Special thanks to
%   Howard Fishman, Christian Rothleitner, Jonathan Kellogg, and
%   Zach Lewis for their input.

% Steffen Brueckner, 2002-09-25
% Steffen Brueckner, 2007-08-27     revised version

% Copyright (c) Steffen Brueckner, 2002-2007
% brueckner@sbrs.net

% check the number of input arguments
error(nargchk(1,4,nargin));

% check the time vector input for consistency
if nargin < 2 || isempty(t)
    % if no time vector is given, use the index vector as time
    t = 1:length(S);
elseif length(t) ~= length(S)
```

```
    % if S and t are not of the same length, throw an error
    error('t and S must be of identical length!');
end

% check the level input
if nargin < 3
    % set standard value 0, if level is not given
    level = 0;
end

% check interpolation method input
if nargin < 4
    imeth = 'linear';
end

% make row vectors
t = t(:)';
S = S(:)';

% always search for zeros. So if we want the crossing of
% any other threshold value "level", we subtract it from
% the values and search for zeros.
S   = S - level;

% first look for exact zeros
ind0 = find( S == 0 );

% then look for zero crossings between data points
S1 = S(1:end-1) .* S(2:end);
ind1 = find( S1 < 0 );

% bring exact zeros and "in-between" zeros together
ind = sort([ind0 ind1]);

% and pick the associated time values
t0 = t(ind);
s0 = S(ind);

if strcmp(imeth,'linear')
    % linear interpolation of crossing
    for ii=1:length(t0)
        if abs(S(ind(ii))) > eps(S(ind(ii)))
            % interpolate only when data point is not already zero
            NUM = (t(ind(ii)+1) - t(ind(ii)));
            DEN = (S(ind(ii)+1) - S(ind(ii)));
            DELTA =  NUM / DEN;
            t0(ii) = t0(ii) - S(ind(ii)) * DELTA;
            % I'm a bad person, so I simply set the value to zero
            % instead of calculating the perfect number ;)
            s0(ii) = 0;
        end
    end
end

% Addition:
% Some people like to get the data points closest to the zero crossing,
% so we return these as well
```

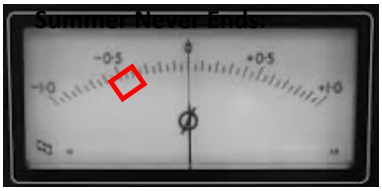
```
[CC,II] = min(abs([S(ind-1) ; S(ind) ; S(ind+1)]),[],1);
ind2 = ind + (II-2); %update indices

t0close = t(ind2);
s0close = S(ind2);
```

Phase Meter Readings for Reverb Chamber Tracks *** indicates array selected for song.**

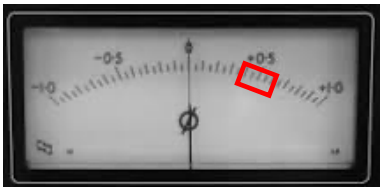
Red Boxes indicate width and phase.

Background Vocals – Stairs Chamber

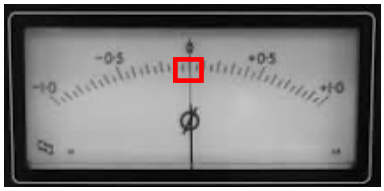
Summer Never Ends:



Double MS



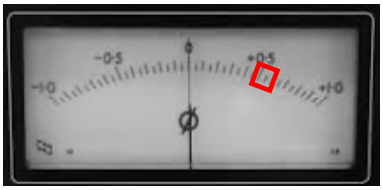
***Quad**



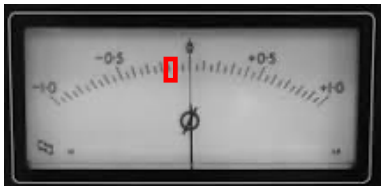
Spaced Pair

Challenger:

Double MS

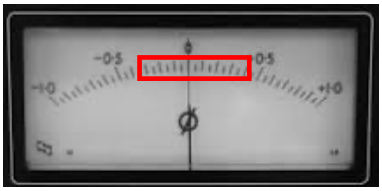


***Quad**

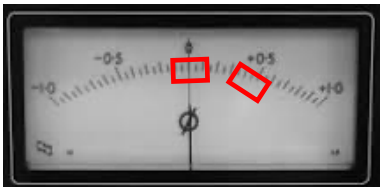


Spaced Pair

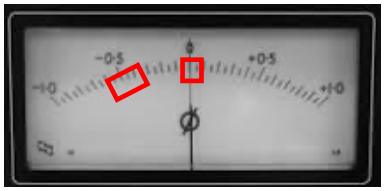
Smallest Bird:



***Double MS**



Quad



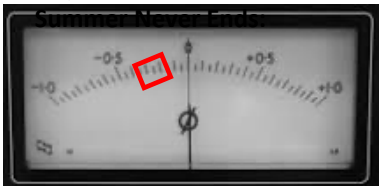
Spaced Pair

Phase Meter Readings for Reverb Chamber Tracks * indicates array selected for song.

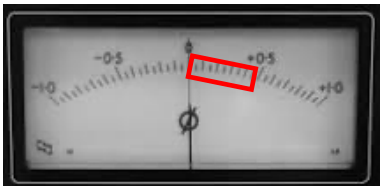
Red Boxes indicate width and phase.

Drums – Urinal Chamber

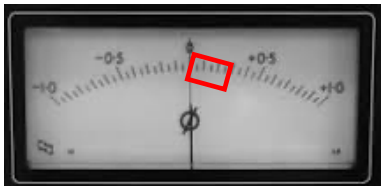
Oh My Heart:



***Double MS**

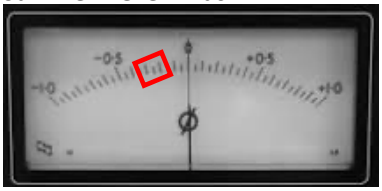


Quad

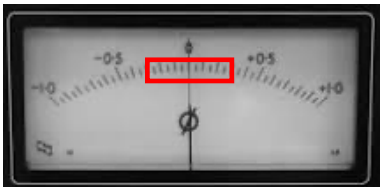


Spaced Pair

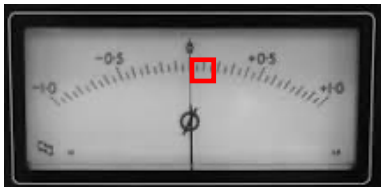
Summer Never Ends:



***Double MS**

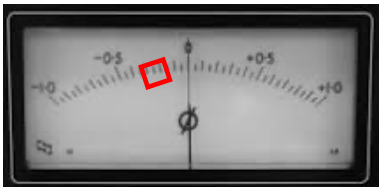


Quad



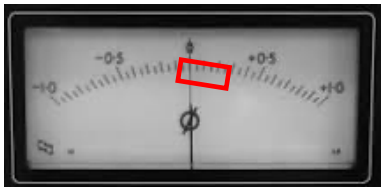
Spaced Pair

Whipporwil:



***Double MS**

Quad



Spaced Pair

APPENDIX V: Auxiliary Production Process

Instrument IOs:

Drums I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
Boundary L	DPA 4011	25	SSL		21
Boundary R	DPA 4011	M105	SSL		22
Omni Square FL	Schoeps multis	33	SSL		27
Omni Square FR	Schoeps multis	34	SSL		28
Omni Square LB	Schoeps multis	36	SSL		29
Omni Square RB	Schoeps multis	35	SSL		30
Overhead L	M49	23	Neve 1		16 --> 17
Overhead R	M49	24	Neve 2		17 --> 18
Overhead C	DPA 4006	M102	API 10	Mytek 8	18 --> 16
Kick Hole	EV RE 20	17	API 3	Mytek 1	26 --> 9
Kick Beater	AKG D112	18	API 4	Mytek 2	12 --> 10
Tom High	Sein 421	21	API 7	Mytek 5	13 --> 13
Tom Low	Sein 421	22	API 8	Mytek 6	15 --> 14
Snare Top	SM 57	19	API 5	Mytek 3	10 --> 11
Snare Bottom	Sein MKH 1	20	API 6	Mytek 4	11 --> 12
High Hat	Coles Fig 8	M101	API 9	Mytek 7	9 --> 15

ACCORDION I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER
Blumlein (L)	Royer Ribbon	17	API 3	Apogee 1
Blumlein (R)	Royer Ribbon	18	API4	Apogee 2
Support	Coles	19	Neve 1	Apogee 3
Support	U87	20	API5	Apogee 4

ACOUSTIC GTR 2 I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
ORTF Left	dpa 4011	23	API 3	Mytek 1	13
ORTF Right	dpa 4011	24	API 4	Mytek 2	14
Support	DPI 4011	21	Neve 1	Apogee 1	15
Support hole	U87	22	Neve 2	Apogee 2	16
Support hole 2	Royer R-121	25	API 5	Mytek 3	18
OH C	DPA 4006	19	SSL 21	SSL 21	21
Omni Sq RF	Scheops multis	34	SSL	SSL	34
OM SQ LF	Scheops multis	33	SSL	SSL	33
OM SQ LB	Scheops multis	35	SSL	SSL	35
OM SQ RB	Scheops multis	36	SSL	SSL	36
Bluimline	Royer Stereo Ribbon (upper)	26	API 7	Mytek 5	19
Bluimline	Royer Stereo Ribbon (lower)	27	API 8	Mytek 6	20

BANJO I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
ORTF Left	dpa 4011	23	API 3	Mytek 1	13
ORTF Right	dpa 4011	24	API 4	Mytek 2	14
Support	DPA 4011	21	Neve 1	Apogee 1	15
Support hole	Coles	22	Neve 2	Apogee 2	16
Support hole 2	Royer R-121	25	API 5	Mytek 3	18
Support neck	U 87	26	API 7	Mytek 5	19
OH C	DPA 4006	19	SSL 21	SSL 21	21

ELECTRIC GUITARS I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER
Close Mic	Coles	17	Neve 1	
Close Mic 2	U87	18	API 10	Mytek 8
ORTF (L)	KM 184	19	API 8	Mytek 6
ORTF R	KM 184	20	API 9	MYTEK 7
DI	NA	NA	NEVE 2	ROSETTA 2
Mod Hamasaki L	Schoeps	35	API 5	Mytek 3
Mod Hama R	Schoeps	37	API 7	Mytek 5
Mod Hama C	Schoeps	36	API 6	Mytek 4
Mod Hama LB	DPA 4006	33	API 3	Mytek 1
Mod Hama RB	DPA 4006	34	API 4	Mytek 2

LEAD VOCAL I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
Support 2	U 87	33	Neve 1	Apogee 1	13

PIANO CHAMBER I/O

INSTRUMENT	MICROPHONE
Boundary 1 Reflect	DPA 4006
Boundary 2 @ Pno	DPA 4006
AB low	Royer
AB high	Royer
Below	Omni Seinheiser 800

ACOUSTIC GTR 1 I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
ORTF Left	DPA 4011	m02	API 3	Mytek 1	9
ORTF Right	DPA 4011	m03	API 4	Mytek 2	10
Support bridge	U87	19	API 7	Mytek 3	11
Support hole	U87	18	API 6	Mytek 4	12
Support hole 2	DPA 4006	17	API 5	Mytek 5	13
Boundary L	Royer Ribbon r121	20	API 8	Mytek 6	14
Boundary R	Royer Ribbon r121	21	API 9	Mytek 7	15
OH C	Schoeps 4006	M 101	API 10	Mytek 8	16
PZM Right	DPA 4006	M105	SSL 18		18
PZM Left	DPA 4006	M 104	SSL 17		17
Omni Sq R	Scheops multis	33	SSL	SSL	19
Omni SQ L	Scheops multis	34	SSL	SSL	20
Omni SQ LB	Scheops multis	36	SSL	SSL	21
Omni SQ RB	Scheops multis	35	SSL	SSL	22
Bluimline	Royer Stereo Ribbon	M 106	Neve 1	Apogee 1	26
Bluimline	Royer Stereo Ribbon	M 107	Neve 2	Apogee 2	27

BACK VOCALS I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
Support	U 87	M 117	Neve 1	Apogee 1	13

BEAUTY CHAMBER I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
Tunnel	Seinheiser 840	26	Neve	Apogee	26

ELECTRIC BASS I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	Compressor
Bass DI	NA	NA	Neve 1	LA2A
REAMPING:				
Rivera	SM 57 (support)	34	API 3	
Ampeg fliptop	Coles (support)	1	Neve 2	
Peavey	Royer R121 (support)	33		

A/D CONVERTER
Apogee 1
Apogee 2
Apogee 3
Apogee

PIANO I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
Small A/B room (L)	DPA 4006	33	API 5	MYTEK 3	17
Small A/B room (R)	DPA 4006	34	API 6	MYTEK 4	18
Blumlein (L)	Royer Ribbon	25	Brent Avrial	Apogee 1	13
Blumlein (R)	Royer Ribbon	26	Brent Avrial	Apogee 2	14
Small A/B close (L)	MK 147	17	API 3	MYTEK 5	15
Small A/B close (R)	MK 147	18	API 4	MYTEK 6	16

RHODES I/O

INSTRUMENT	MICROPHONE	WALL JACK	MIC. PRE	A/D CONVERTER	PT OUT TO SSL
Rhodes	Coles (support)	M117 (L)	Neve 1	Apogee 3	15
Rhodes	Coles (support)	M118 ®	Neve 2	Apogee 4	16

Production Process Raw Chronology

12.21.11
Wrote Ian (drummer) about playing on the project.

1.04.12
Ian agreed to play drums on the project. Repertoire is still undetermined.

1.14.12
Phone meeting with Sandy (singer songwriter) about repertoire. Still trying to figure out the repertoire.

1.17.12
Listened to Sandy's tunes.

1.18.12
Received the 2nd batch of Sandy's songs. Still reviewing material for repertoire.

1.19.12
Choosing repertoire.
Importing Sandy songs to use into PT for arranging.
Built PT sessions for Sandy songs: **Annabelle, Caguanes** and **Sawfly**. Made arrangement suggestions to her and cut and paste ideas in PT.

1.20.12
Sandy sent 4 more songs. 2 were selected: **Challenger** and **Arbor Day**.
Listened to **Whippoorwill** again to check on my arrangement changes. I decided that I want to keep all of the lyrics and record it as Sandy originally sent it, except, I am extending the end, and changing it slightly.
Imported **Voices From Inside, Whippoorwill, Smallest Bird**.
Made notes for changes. Going to record **Voices** as a faster instrumental too.
Adding an accelerated tempo outro section in **Whipporwil.**
Added an instrumental solo section after 2nd bridge in **Smallest Bird**.
Sent Sandy my notes of the changes.
Sent Ian email about rehearsals starting in March.

1.24.12
Requested days in studio A for working on Sandy's tunes.
Made sessions in PT for **Challenger, Horseaisle**.
Decided that arrangements are good as-is.

1.25.12
Worked on the repertoire: Chose **The Bullet Dancer** and **Oh My Heart.** I wrote a new arrangement for **Oh My Heart**, and am sending it to Sandy for her approval.
Worked on **OMH –** want to use a modified bossa beat. Work with the tempo. Maybe pick it up?????
Drums are high energy with static dynamics all the way through – LOUD and BIG!! Extend the end into big noise and jam.

1.26.12
Listened to all songs and made notes for Sandy to re-record some of the demos.

Demo Notes to Sandy:

Oh My Heart - record it as my arrangement. Record it to a click with bpm = 141.

Smallest Bird – ** please listen to my draft for form reference: I repeated bridge 1 before the last verse. I want you to play those chords, but no vocals; that's going to be the instrumental section before the last verse.
Please record the chords only (no vocals) of bridge 1, then go into the last verse (with vocals), but play the guitar like you do for the first verse, softly and arpeggiated.
Repeat the last line:
slowly make my way back
So I can begin again
slowly make my way back ← **play this rubato; strum and hold the chords on 'slowly' and 'way back'**
So I can begin again ← **ritard (slow down) and arpeggiate the chords.**

Annabelle - Please re-record it to my new arrangement.
** listen to my mp3 for arrangement change, and look at attached lyric sheets for notes. I inserted a 3rd chorus that will be an instrumental section.

Voices From Inside – I want you to arpeggiate the chords with continuous 16th notes, but a repetitive pattern.

Bullet Dancer – Please re-record as-is.

Sawfly – Please rerecord this as my arrangement, and with an intro of the chords in the A section.

Caguanes – Do not re-record. Play as-is, but extend ending.

Whipporwil – Do not re-record. See lyric sheet for minor changes in tempo.

Horseaisle – Do not re-record. Play as-is.

Challenger – Do not re-record. I want to amp up the energy on this and rock it out. Play electric guitar on this one.

Arbor Day – Do not re-record. See lyric sheet for ending change – just repeat and fade… I want this one all electric too. We're gonna rock it out.

1.27.12
Confirmed booking of first round of rehearsals / recording sessions in Studio A. I will be working with Ian on the drum parts.
Sent Ian, Sandy and Senem an email about the March rehearsals / sessions.
Sent Sandy an email about raising money for the people who work on this record.
Wrote a contract for me and Sandy and emailed it to her.
Selected full repertoire – FINIS!

1.29.12

Senem meeting: Listening and getting ideas for production, recording and arrangements:

1. Challenger – start with bridge 1: rubato chorale vocals do 'ooohs'… then, the bass figure at the end of bridge 1 plays, and the beat starts. Drums are kick and snare only, with a shuffley swingin' 1/8th note triplets on the closed high hat at some point.
   Drums in Chorus 1 are low key, but very nuanced phrases.
   Worked with tempo. Original is 108. New bpm is 117.

Sandy Meeting: Discussed money – payment for Ian and Senem and all other musicians. Sandy is paying. We discussed fund raising ideas. Discussed our trade contract – she agreed to the terms, we made a few changes… we are in agreement.

1.30.12

Ian drum rehearsal schedule APRIL:
Available through April, except: **4.16 – 19 & 4.21 – 23**
Scheduling final rehearsals with Sandy and Ian before the recording dates.
Made a reference cd for tracking and mixing.

Sandy mtg: Talked about scratch vocs for sessions.
Schedule rehearsals for anytime 4/21 – 4/26.

Senem mtg: Finished Challenger arrangement.
Worked on Cauguanes arrangement.

1.31.12

Edited the end of Challenger and sent lyric notes and Final arrangement to Sandy.
Worked on Caguanes arrangement with Senem – finished with the arrangement.
Worked on **Smallest Bird** – jam progression needs to be:
I	I	iii	iii
I	I	iii	iii
I	I	V	V
II	II	iii	iii

2.1.12

Sent Ian and Sandy the rehearsal schedule for 4/24 & 4/25.
Sent Ian the repertoire with recordings and lyric sheets.

2.2.12

Booked rehearsals for Sandy and Ian on April 24 (7pm – 10pm) & April 25 (7pm – 11pm) at Michiko Studios, Studio B for $20/hr. 149 W 46th Street NY, NY 212-302-4011
Senem and I arranged **Whippoorwill** and **Voices from Inside**.

2.3.12

Extended intro on **Whippoorwill.**
Pasted correct jam progression in **Smallest Bird.**

2.6.12
Worked on **Challenger** bass line.
Worked on **Sawfly** arrangement. Still working on this one, I think I want it to be super wild.
Increased **Smallest Bird** bpm to 114.

2.7.12
Worked on **Oh My Heart** – recorded the proper demo version.
Worked on **Sawfly** – recorded my version. May only use the A section and instrumental.
POA1 is finished. Sent Ian the demo with more of the guitar parts. Gave him notes on what we wanted drum-wise. Lazy feeling – in our garage jamming with our buds. Dynamics are mf.
Sent Ian and Sandy the final arrangement of **Smallest Bird** with the new bpm at 114.

2.8.12
Worked on **Horseaisle** arrangement – try bpm=176 and cut one bar before bridge 1. Tightened ending.
Bullet Dancer – finished. NEED LYRICS
Arbor Day – bumped bpm to 144. Verse 2 needs to be very different and dynamically break it WAAAAY down. RE-record this.
Annabelle – settled on the arrangement. Kept chorus 1 the way Sandy did it (by accident), the 2nd draft.
Sent Sandy an email about the other recordings we need. Arrangements will be done by Sunday.

2.10.12
Sandy Meeting: Music as emotional subtext…. Juxtaposed with the dry and 'monotonatic' vocal dynamics.

2.13.12
Got all arrangements

2.14.12
Sent final arrangements to Ian.

2.17.12
Worked on session notes.

2.22.12
Finished session notes.
Sent Sandy the scratch vocal recording notes.

3.6.12
Idea: record the bass on 2" tape in another studio, then dump it to ProTools. I am going to use the acoustic/electric bass. I will record DIRECT, AMPED, and MICED.

3.9.12
Working on bass parts for Caguanes, Challenger (finished), Sawfly, Annabelle. We may omit Sawfly from the repertoire. I don't like it now.

3.10.12

1st drum rehearsal with Ian. Worked on Challenger, Cagunanes, Annabelle. Went very well.

3.13.12
Wrote bass lines for Caguanes and Annabelle.

3.17.12
Rehearsed drum parts with Ian. Great work. Forms are pretty much done for: **Challenger, Caguanes, Arbor Day, Smallest Bird, Voices f/ Inside, Whipporwil**

3.19.12
Worked on Bass parts for **Challenger, Caguanes, Annabelle**

3.20.12
Met with Peacock and discussed thesis direction.

3.21.12
Worked on bass lines today.
Set up a meeting with Agniezska to focus my technical part of the thesis.

3.24.12
Ian rehearsal – worked on drum arrangements.

3.27.12
Worked on bass lines.

3.28.12
Worked on bass lines.

3.29.12
Worked on bass lines.

4.25.12
Started writing chord charts with Sandy.

4.26.12
Made the rest of the chord charts with Sandy.

4.27.12
DOLAN:
Wrote out final chord charts.
8PM: Set up mics for drums. Got drum sounds and started recording a bit after Midnight. **Challenger, Summer Never Ends, Oh My Heart**
Finished around 4AM – slept at the studio so that we wouldn't have to break down the drum mics again.

4.28.12
DOLAN:
Picked drum takes

4.29.12
DOLAN:
Drum tracking

5.02.12
DOLAN:
Picked Drum takes

5.03.12
DOLAN:
Acoustic Guitar and lead vocal tracking.

5.04.12
DOLAN:
Picked Acoustic guitar tracks.

5.5.12
DOLAN:
Redirecting folder from desktop to Audio 1.
Backup to Audio 3, Lacie

5.6.12
DOLAN:

5.15.12
Backed up *Thesis 4.27 – 5.11* folder to Seagate and Archives Drives.

5.16.12
Using the new Thesis folder on Work drive and Current backup drive.
Opened all sessions to ensure functionality.

5.17.12
Annabelle: Chose all drums, all acoustic gtrs, vocals, banjos. Did rough edits.

5.18.12
Arbor Day: Chose 2nd layer acoustic guitars, and did rough edit for them.
Challenger: Chose 2nd layer acoustic guitars, vocals, and did rough edit for all of them.

5.20.12
DOLAN:
Backed up current Thesis folder to Dolan drives.
Recorded Piano: Challenger
Recorded Bass: cut finger, couldn't record.

5.24.12
Made scratch mixes for practicing.

Jess songs: She will record piano for: Voices, Smallest Bird, Annabelle, Arbor Day
Sent scratch mixes to Senem, Jess and Sandy
6.12.12
Arbor Day: edited

6.13.12 – 6.15.12
DOLAN:

6.23.12
DOLAN:

6.27.12
Horseaisle: tuned and edited bass. Picked vocals and edited.

6.28.12
Challenger: edited bass. Checked all Senem edits – good.
POA 1: checked Senem edits – good.
POA 2: checked Senem edits – good.

To Do Backing Vocals:
Horseaisle – last oohs
Whipporwhill - through entire song

6.29.12:
Summer: Edited and Tuned Vocals
Challenger: Edited Piano part, tuned U87vocals.

6.30.12
DOLAN:
Challenger: Piano and Rhodes recording.
Smallest Bird: Piano and Rhodes recording.
Arbor Day: Piano and Rhodes recording.

7.1.12
DOLAN:
Summer Never Ends, Challenger, Horseaisle, Oh My Heart, The River Smallest Bird, Whipporwil:
recorded backing vocals

7.03.12
Oh My Heart, Horseaisle: edited and tuned lead vocals.

7.04.12
Smallest Bird: edited lead vocals and backing vocals.
Whipporwil: selected lead vocal.
BACKED UP THESIS FOLDER TO ARCHIVES DRIVE AT HOME.

7.05.12
Voices, The River: edited vocals
7.06.12
Annabelle: Edited lead vocals. No tuning is needed.
Arbor Day: Do the vocals again.
Challenger: Edited vocals. Tuned only small parts. Main vocals are finished.

7.10.12
Horseaisle: tuned only some parts of the vocals. Lead vocals are finished.
Smallest Bird: Lead and back vocals are done.

7.11.12
The River: Tuned intro of lead vocals. Lead vocals are finished.
Voices: Tuned one part of lead vocals. Lead vocals are finished.
LEAD VOCAL EDITING AND TUNING IS FINISHED
Whipporwil, Voices: edited and tuned all backing vocals.

7.12.12
The River: edited and tuned all backup vocals. Edited Bass parts.

7.13.12
Summer: edited backing vocals.

7.14.12
Bass parts for **Smallest Bird and Bullet Dancer.**
Edited **Smallest Bird** bass part.

7.14 & 15.12
Bullet Dancer, Arbor Day – recorded Lead vocals
Summer, Annabelle – doubled vocals

7.15.12
Smallest Bird – doubled and tripled lead vocals; Sandy doubled backup vocals (probably won't use Sandy backups).
Horseaisle – doubled and tripled lead vocals.
Challenger – doubled lead vocals, Andrew and Joshua backups on group ending.
Whipporwil, Voices, The River, OMH – doubled lead vocals.

7.16.12
Arbor Day: Selected lead vocals
Backed up all to Backup at work.
Dolan:
Summer Never Ends, Bullet Dancer, Smallest bird: Recorded electric guitars.

7.17.12
Arbor Day – finished editing lead vocals.
Bullet Dancer – added info to Electric gtr session. Edited lead vocals.

7.18.12
Summer: edited backup vocals.
Dolan:
Built Piano chamber
Smallest Bird, Annabelle, Horseaisle: recorded electric guitars

7.19.12
DOLAN:
Built Piano Chamber
Whipporwil, OMH, Voices – recorded guitar parts.

7.20.12
Summer: edited backing vox

7.21.12
DOLAN:
Built 2 reverb chambers: Piano Chamber and Beauty Chamber
Arbor Day, POA1 & 2, Challenger, The River: recorded electric guitar parts.
Took impulse responses of Piano Chamber and Beauty Chamber.

7.22.12
DOLAN:
Arbor Day, Bullet Dancer: doubled lead vocals.
Bullet Dancer: doubled lead vocals.
7.23.12
Summer: edited backup vocals

7.24.12
Summer: edited all backup vocals and tuned. DONE.
Selected bass and edited.

7.25.12
Summer: Selected doubled guitars. Selected doubled vocals.

7.26.12
POA2: Selected electric guitars.
Bounced a pre-mix.

7.28.12
Smallest Bird: Edited Rhodes solo.

7.30.12
Smallest Bird: edited electric guitars.

8.4.12
DOLAN:

Arbor Day, POA1, Voices: recorded bass

8.5.12
DOLAN:
Voices: doubled bass parts
Oh My Heart: recorded bass

8.6.12
Smallest Bird: edited 2nd electric guitar layer.

8.7.12
Smallest Bird: edited 2nd layer electric guitars. –finished.
Edited doubled and tripled lead vocals.

8.8.12
Smallest Bird: finished all vocals! This song is done with editing!!
Backed it up to the work backup drive

8.9.12
Whipporwil: drums are edited. Acoustic gtrs are edited
Edited doubled acoustic gtrs (3 LAYERS)
Edited distorted electric gtrs.

Smallest Bird:
Backed up to work backup drive

8.10.12
Backed up entire Thesis folder to Work Backup Drive.

8.15.12
Whipporwil: edited all electric gtrs.
Pasted more backup vocals in outro.
Started editing doubled vocals.
Backed up to backup work drive.

8.16.12
Whipporwil:
Edited and tuned double vocals.

8.17.12
Whipporwil:
Corrected remainder of double vocals.
Edited triple vocals.
Done.

Arbor Day:
Edited doubled vocals but they are unusable. Must come up with a different solution.

8.18.12
DOLAN:
POA1: recorded bass and fretless solo.
Whipporwil: recorded fretless bass.
FINISHED WITH ALL BASS FOR SANDY PROJECT!!

8.21.12
Whippoorwill, Arbor Day: edited bass parts.

8.22.12
Arbor Day: edited bass part. Finis.

8.27.12
Arbor Day: checked and edited Piano parts. Backed up to work backing drive.

8.30.12
Arbor Day: edited bass2. Edited Rhodes solo.

8.31.12
Arbor Day: edited electric guitars. Backed up to Work backup.

9.06.12
Arbor Day: edited all electric gtrs (Elec Gtr2, and Reverse Gtrs). Backed up to Work backup. Done with ALL editing.

9.10.12
Bullet Dancer: Selected double lead vox.

9.11.12
Bullet Dancer: edited doubled vox. Selected bass.

9.12.12
Bullet: edited all bass parts. Imported electric guitars. Backed up to Work backup drive. Edited Electric gtrs.

9.13.12
Bullet: edited all electric gtr parts. Song is finished thus far. Backed up to Work Backup drive.

9.15.12
Challenger: selected doubled vox.
BACKED UP ENTIRE THESIS TO ARCHIVES HOME DRIVE.

9.18.12
Challenger: edited Piano 2, edited and tuned doubled lead vocals., consolidated many parts.

9.19.12

Annabelle, Challenger, Horseaisle: organized sessions and calculated 'to do' list.

9.20.12
Oh My Heart, POA1, POA2, The River, Summer, Bird, Voices, Whipporwil, all tunes: sessions are organized, and editing needs are accounted for on each session.

9.21.12
Summer: Edited electric guitars. Finished all editing. Backed up to Work Backup Drive.

10.2.12
POA2: edited bass.

10.3.12
POA1: edited bass, edited electric gtrs.
Horseaisle: checked Senem double vox edits and consolidated.
BACKED UP **POA 1, POA2, HORSEAISLE** TO WORK BACKUP DRIVE.

10.4.12
Horseaisle: edited double vocs, edited triple vocs, edited both backing vocs, electric gtrs. DONE EDITING
BACKED UP TO WORK BACKUP DRIVE

10.9.12
Voices: checked Senem edits – dbl gtr, dbl voc, bass, electric gtr1 and 2.
BACKED UP TO WORK BACKUP DRIVE.

10.10.12
Heart: edited bass, back vocs; checked Senem dbl gtr and dbl lead vocal edits. Imported electric guitars.

10.11.12
Heart: edited all electric gtrs. Editing is done.
BACKED UP TO WORK BACKUP.
River: checked dbl lead vocs and dbl gtrs. Edited electric gtrs. Done.
BACKED UP TO WORK BACKUP DRIVE.

10.12.12
Challenger: edited elec gtrs, Rhodes, Back vocals. Finished
BACKED UP TO WORK BACKUP.
Annabelle: checked dbl vocal edits – all good. Organized electric gtrs for editing tomorrow.

10.13.12
Annabelle: edited bass, electric gtrs. Checked dbl lead vocal edits. Done.
BACKED UP ENTIRE SANDY THESIS TO ARCHIVES DRIVE.

10.14.12

Whipporwil: doubled low back vocal. Doubled low chorus back vocal. Doubled outro low vocals. Added backing vocals in the outro.
Challenger: added Viva, Alex and Abra in last chorus.
Summer: added last verse backing vocals. Doubled all outro backing vocals.

10.15.12
Challenger: edited group vocals. Done
Summer: imported all dbl backup vox. Tuned one.

10.16.12
SESSION CLEANS:
Annabelle
Summer: edited all vocals. Done. Backed up to Work Backup Drive.
Whipporwil: edited and tuned backup vocs 3 & 4. Cannot import back vocs 5 – 7 because we have exceeded the number of allowable tracks for this session. Must clean, then edit those vocals.

10.17.12
Paul Mtg: ready for echo chamber recordings. Got access letter.
Whipporwil: backed up to Work Backup Drive
Challenger: backed up to Work Backup Drive.
SESSION CLEANS: Bullet Dancer, Horseaisle, Oh My Heart, POA1, POa2, Smallest Bird

10.18.12
SESSION CLEANS: Summer, River, Voices, Challenger, Arbor Day
BACKED UP CLEANED THESIS FOLDER TO WORK BACKUP DRIVE.

10.19.12
SESSIONCLEANS:
Partial clean for **Whipporwil.**
Backed up to Work Backup Drive

10.20.12
Reamped all bass.

10.21.12
DOLAN
Reverb Chambers

10.23.12
Studio D
Annabelle: drum mixing.

10.24.12
STUDIO D
Annabelle:
Studio D – Drum mixing. Used Eno Another Green World, Track 2 for KICK drum reference. Used DBX compressor.
Used Beatles Rubber Soul, Track 1 for snare ref. Used Universal Compressor.

Cleaned all close-mic drum tracks.

10.25.12
Studio D
Annabelle: finished drum mix
Arbor Day: got drum mix…. REDO SNARE!

10.27.12
DOLAN
Smallest Bird: recorded 2 accordion parts.
Horseaisle: recorded accordion part.
Annabelle: Manley EQd the kicks. Re-did them. Printed them separately.
API compressed kicks and printed.

10.28.12
DOLAN
Annabelle: Mixed basses. Mixed Acc. Gtr 1

10.30.12
Bullet Dancer: Cleaned all drums.

10.31.12
Challenger: Cleaned drums.

11.01 – 11.05 HURRICAIN SANDY – NO STUDIO ACCESS

11.06.12
DOLAN
Annabelle: Redid bass EQ. Redid Acc gtr1 EQ. Did EQ for Acc gtr2.

11.07.12
DOLAN:
Annabelle: Redid Acc gtr 1 EQ, redid Acc gtr double EQ, did lead vocal EQ and compression.

11.9.12
DOLAN:
Annabelle: Banjo - API with a small boost of Waves EQ and LA2A.
PNO – API with some Waves EQ. No compression.
Elec Gtrs (red) – can't hear anymore.

11.10.12
DOLAN:
Annabelle: Elec Gtr Red: API → MaNLEY → Api Compressor
Elec Gtr Hot Pink: Pultec → Manley Slam
Elec Gtr Purple: Pultec → API → Manley Slam
Dbl Vocs: Pultec → Manley Slam… chorus and reverb plug-ins.

Mixing…

11.13.12
Dolan:
Arbor Day: EQs and Compression: kick, snare – drums are done. Basses.

11.14.12
DOLAN:
Arbor Day: Finished getting EQs and Compressions.

11..15.12
DOLAN:
Bullet Dancer: EQs and Compressions.

11.16.12
DOLAN:
Bullet Dancer: Finished all EQs and Compression except double vox.

11.17.12
Studio A:
Challenger: STUDIO DID NOT WORK – NO WORK DONE

11.18.12
DOLAN:
Challenger: Drums, bass, acoustic gtrs, piano, lead vocal, electric guitars, Rhodes

11.20.12
DOLAN:
Challenger: Dbl vocs, backing vocs.

11.21.12
DOLAN:
Summer: Drums, bass, acc gtr1, acc gtr dbl

11.27.12
DOLAN:
Summer: Lead vocs, back vocs.

11.28.12
DOLAN:
POA1: Did all cleans.
Summer: Backing vocals. STUDIO PROBLEMS, COULD NOT FINISH.

11.29.12
DOLAN:
Smallest Bird: Edited Accordions.

11.30.12
STUDIO A:
Smallest Bird: Cleaned kick drums.
Studio A:
Summer: Finished backup vocs.

12.1.12
DOLAN:
POA1: Finished.

12.2.12
DOLAN:

12.4.12
DOLAN:
Smallest Bird: mixing

12.5.12
DOLAN:
Smallest Bird: mixing

12.6.12
DOLAN:
Oh My Heart: mixing

12.9.12
DOLAN:
Horseaisle: Finished all except accordion and electric gtrs.

12.11.12
DOLAN:
River: cleaned
Horseaisle: mixing

12.13.12
DOLAN:
River: mixing finished.

12.14.12
DOLAN:
Voices: cleaned and mixing.

12.16.12
DOLAN:
Whipporwil: Drums, basses, lead vox, dbl vox, triple vox, acc gtrs, dbl acc gtr. Chose all elec gtr mics.

1.28.13
DOLAN:

The studio was not working. We went to Studio A instead.
Annabelle: Mixed it. Finished the 1st mix.

1.29.13
DOLAN:
Arbor Day: Dolan is working. We decided to record some more backup vocals! Did it, edited, Eq, and compressed them. Mixing -

1.30.13
DOLAN:
Arbor Day: Almost finished whole mix.

1.31.13
DOLAN:
Arbor Day: Mixed! Did small tweaks from notes. Bounced pre-comp and comp mix.
ANNABELLE: Tweaked mix: brought down verse vocals and outro vocals. Burned mixes.

2.1.13
DOLAN:
mixing

2.3.13
DOLAN:
Bullet Dancer: Mixing… difficult. Have to add material. Adding singing bowls of Sandy field recordings. Doing arrangement… building section between the two verses. Did back vocals.

2.4.13
DOLAN:
Bullet Dancer: Mixed. Added lotsa stuff: Buchla drums and keys. Pads. Constructed the rest of the arrangement and added a bunch of Buchla and synth.

2.5.13
DOLAN:
Bullet Dancer: Mixed all.

2.7.13
DOLAN:
Challenger: Mixed. Used reverb chamber for astronaut backup vocs: Earthworks quad in the stairs. Rhodes: in the astronaut section, we added a bunch of delay… astronauts are phoning in. Mixed everything. Mixed in reverb chamber in for astronaut vocals. We used the Earthworks quad setup.

2.8.13
DOLAN:
Horseaisle: Mixed – finished 1st draft.
Oh My Heart: mixing

2.10.13
DOLAN:

mixing

2.11.13
DOLAN:
Oh My Heart: Only used reverb chamber on some fills for the drums. We had to cut the end, and it is a bit faster at the edit point, but, I don't think it is noticeable.
Chose double MS men's bathroom for drum reverb.
POA1: Finished mix!

2.12.13
DOLAN:
Arbor Day Mix Fixes: Fixed lead vocal levels; Increased Reverb on lead vocal until the La Las….
POA1: Fixed mix. Brought up the drums and regular bass by +8dB.
Brought up the electric guitar in the last section.

2.13.12
DOLAN:
Smallest Bird: Mix. Used reverb chamber for backing vocals: chose double MS stairs chamber for backup vocals.

2.14.13
DOLAN:
Smallest Bird: Mixed!!
POA2: Mixed!!

2.15.13
DOLAN:
mixing

2.17.13
Studio A:
The River: Mixed.
Summer Never Ends: Reverb chamber used: Used double MS for the drum overheads. Used Earthworks for the backup vocals because it fit better in the mix and was smoother.

2.18.13
DOLAN:
mixing

2.19.13
DOLAN:
Summer Never Ends: Did a purposely fucked up mix. Wanted to make all vocals equal level, and panned lead vocals right and put harmonized vocals center. Wanted to make this mix, monochromatic and non-traditional for a song mix.
Voices: Mixing.

2.20.13

DOLAN:
Voices: Mixed
Whipporwil: Mixed.
4.08.13
10pm -
DOLAN:
Final Mixing: Checked mixes – these mixes are good, but need to be bounced: Annabelle, Arbor Day, Challenger, Bullet Dancer

4.10.13
DOLAN:
Final Mixing:

4.12.13
DOLAN:
FINAL MIXING!!

PROJECT HOURS TALLY:

DOLAN, Studio D, Studio A RECORDING AND MIXING HOURS:

2012
April: 41 hrs
May: 67 hrs
June: 51hrs
July: 157 hrs
August: 108 hrs
September: 0
October: 121 hrs
November: 274 hrs
December: 176 hrs

Total Hours 4.2012 – 12.2012: 995 hrs

2013
Jan: 28 hrs
Feb: 260 hrs
Apr: 60 hrs

Total Hours 1.2013 – 2.2013: 288 hrs

TOTAL STUDIO HOURS: 1343 HRS

EDITING, ARRANGEMENT, REHEARSAL HOURS:
2012
Jan: 22 hrs
Feb: 19 hrs
Mar: 25 hrs
Apr: 2 hrs
May: 13 hrs
Jun: 8 hrs
Jul: 33 hrs
Aug: 25 hrs
Sep: 20 hrs
Oct: 25 hrs

TOTAL HOURS: 192 HRS

GRAND TOTAL PROJECT PRODUCTION HOURS: 1535 HRS