EXPLORATION OF PAST AND PRESENT MUSIC PRODUCTION TECHNIQUES AND THEIR INFLUENCE ON THE RESULTING MUSIC RECORDINGS

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ii. Abstract

The art of music recording has seen many changes over the past 40 years. The process of recording music has adapted from live performances recorded live with few microphones using an analog medium, to complex overdubbed multi-track arrangements recorded by means of high-resolution digital audio. This work explores soul music of the late 1960's in order to uncover and understand past recording techniques and their relevance to modern recordings. An original piece of music is composed, arranged, and recorded in two different ways: by using past recording techniques, and by using contemporary recording practices. Audio examples are created to compare and contrast the two different process' recording, musical, and aesthetic results.

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I. Introduction: Audio, Musical, and Aesthetic Qualities of Recordings

When listening to music recordings, it is often possible for the listener to identify a certain era or time period in which the recording was created. Often there are "sonic fingerprints" to a recording that help us to identify when the recording was probably created, and also under what technical circumstances. These sonic attributes are numerous, and some are easier to detect than others. Some attributes have to do with the musical content of the recording, for instance style, instrumentation, and arrangement. An example could be trying to identify when a certain jazz record was produced.

Imagine after listening it is discovered that this record features a large band with drums, acoustic bass, piano, horns and woodwinds playing in the swing style. One may already begin to form thoughts regarding the musical traits to when this record was produced. There are also recording attributes that become apparent upon close listening, such as sound quality, spatial characteristics, and mix formats (among others). Let's take the jazz example one step further. Perhaps the recording is done in a mono mix format, has some very audible distortions, and has a muddy sound quality that makes it hard to clearly identify all the instruments in the recording. After looking at both the musical traits and recording traits, one can start to form a fairly accurate picture about the recording's history.

Because the music features an acoustic big band playing swing style jazz music, one may already imagine this record being produced in the mid 20th century. The recording characteristics also tell an interesting story, and suggest that it is a mid 20th century recording. Mono mix formats were done primarily before 1960, and because it is hard to clearly hear all the instruments in the recording, it suggests that it was recorded

with a limited number of microphones, and was recorded while the band was performing live in one recording space. After processing all this information, one can begin to formulate grounded arguments for when the record was most likely produced.

Music recordings from certain eras in music history also have aesthetic qualities, which result from the combination of the recording and musical attributes. The aesthetic qualities make recordings enjoyable in the many years following their original release. A listener may imagine themselves as being in the same space as the musicians while listening to their favorite jazz ballad recorded in a large reverberant hall. The sound of a rock record featuring huge, lively sounding drums may make a fan of the genre feel certain emotions. One may have the thought of somehow being in a place between the club and the church when hearing the organ make its introduction into their favorite soul record. These aesthetic qualities, like the musical and recording qualities mentioned earlier, leave a sonic imprint on recordings that can be heard, analyzed, and enjoyed.

As a songwriter, recording engineer, or record producer, knowledge of these attributes (recording and musical) can help with the approach of creating a music recording with a certain aesthetic quality. Being able to hear and identify these attributes can lead to a deeper exploration of music production and can influence the way in which new music is crafted and created. Incorporating sonic attributes from recording history's past into modern day record production could lead to a variety of artistic and musical results. To start to add these sonic attributes into modern recording productions requires a recording engineer to be able to identify first what the attributes are, second, what processes in the past music production yielded observed sonic qualities, and third, how to integrate these sounds into the modern music production setting.

Soul music production of the late 1960's is explored in order to uncover and understand past recording techniques, how they affect the aesthetic qualities of recordings, and their relevance to modern recording production. An original piece of music was written in the soul style and recorded in two different ways: by using past recording techniques, and by using contemporary recording practices. By analyzing the resulting recordings, the sonic and aesthetic traits of past and present music will be better understood.

A. A Short History of Soul Music

Before discussing the history of soul music, the terms "soul" and "rhythm & blues" need to be discussed, due to the fact they appear often when studying the subject. When researching the history of soul music, the term "rhythm & blues" appeared repeatedly, and, seemed to be used interchangeably with the term "soul". It is widely considered that the terms "rhythm & blues" and "soul" refer to the same type of music [1]. Jerry Wexler, a man who would produce many of soul's greatest artists, invented the term "rhythm and blues" as an alternative to "race records" while working for Billboard [2]. It should be noted to the reader that the two terms appearing in this paper are referring to the same musical style.

Soul music has its origins in mid 20th century America. In the words of music writer Peter Guralnick, soul music is "…the far less controlled, gospel-based, emotion-baring kind of music…" [1]. The link between gospel and rhythm & blues becomes clear when taking a close look at the stories of some of soul music's most revered artists. Sam Cooke, Wilson Pickett, Aretha Franklin, and

Solomon Burke were all known as gospel music performers [1, 3]. Sam Cooke was originally known as a rising star in the gospel community singing with the group the Soul Stirrers [1]. Cooke spent much of his early career traveling through southern communities performing gospel music. Soon came the time when Cooke had aspirations to sing more popular music, which would allow him to ultimately become more popular with larger audiences. The decision to leave traditional gospel behind and forge ahead into popular music sparked criticisms from the church community [1]. Just as disconcerting to the church communities were the instances when artists would change the traditional gospel words to become contemporary rhythm and blues songs. An early example of this is the landmark Ray Charles song "I Got A Woman", which was "taken from a gospel tune by Alex Bradford" [4, 5]. "I Got a Woman", released by Atlantic Records 1954, is considered one of the earliest forerunners of soul music. After "I Got a Woman," soul music was off and running.

Two record labels producing soul music from the mid 1950's through 1970 were Atlantic Records in New York City, and STAX Records in Memphis. While many soul records did come from other labels, it is fair to say that the two giants of soul at the time were Atlantic and STAX. The roster that recorded on either of these labels is long and illustrious. Atlantic artists include Ray Charles, Aretha Franklin, Wilson Pickett, Solomon Burke, and Sam and Dave. STAX artists include Otis Redding, Booker T. and the MG's, Isaac Hayes, David Porter, Carla Thomas, and Rufus Thomas. The production techniques used had a strong influence on the resulting sound.

B. Producing Soul Music

Record production was in many ways a much simpler process than it is today. A song would be written by a group or solo artist and was quickly put together and recorded in the studio. The overly meticulous and time-consuming process of the modern productions was not common practice in the mid to late sixties. Recording engineer Phil Ramone relates his experience by saying:

"In those days, we used to do three hour sessions, and half an hour overtime was considered a sin. In three hours you were supposed to cut at least four songs, so an album, on average, would take two days at the most – maybe three, and after that you edited and did anything else that was possible." [6]

Many of the technologies that are commonplace in today's studio (high quality digital recording, nearly unlimited tracks, the highly advanced mixing consoles, etc.) simply did not exist at the time. Records were made fast, cheaply, and with limited equipment. The process of producing good sounding recordings faced many technological limitations (limited frequency response of microphones, few microphone inputs, limited flexibility on consoles, few tracks on tape, poor recording environments, mono release format, etc). The success or failure of the recording depended, therefore, very much on what the artist, producer and engineer accomplished in these moments of concentrated effort.

C. Musical Characteristics of Soul

The recording production began, as it usually does, with a song. The style of soul music has many qualities; some that are similar to other types of music, and others unique to soul. These musical traits can be identified in many soul songs. These elements include song form, instrumentation, arrangement, as well as specific musical themes.

1. Song Form

Soul songs consist of form elements that are common in popular music. Songs are fairly short -- usually under four minutes in duration. Soul music usually has discernable verses, choruses, and bridges. The choruses are a very important part of the song and serve as the chance to create a memorable hook or melody for the listener to latch onto, sing along with, and keep humming after the song has ended. There are also sometimes instrumental sections in soul music. Introductions and endings can be purely instrumental, as well as the sections where an instrument may be performing a solo. Many soul songs also follow the blues form, which is usually a repetition of a 12-measure phrase containing usually just three chords.

2. Instrumentation

The instrumentation serves as one or the defining features of soul music. The rhythm and blues band consists primarily of drums, electric

bass, electric guitar, keyboards (a combination of a few to be discussed), a horn section, and a vocalist. The band is usually very versatile and can perform lively, up-beat songs, as well as soft and slow ballads. Soul music is based heavily on the vocalist, but there is instrumental soul as well. The singer carries much of the main musical message, but is heavily supported by a strong band to carry the intensity and groove. The band is the base for the music, and provides the rhythmic and musical foundation for a vocalist to give the emotional performance.

The instruments are not unlike that of a rock and roll band of the time, but the instruments of soul do have some characteristics that set them apart. First, the kick, snare, and hi-hat are the most important part of the drum-kit. Where jazz and rock music feature lots of different uses of the cymbals and toms, the soul drummer primarily lays down a solid, consistent beat. The bass is usually electric, and features no effects. The electric guitar also usually features little effects, aside from occasionally some vibrato or reverb. Where rock and roll was starting to feature a heavier use of effects (overdrive, distortion, delay, wah), the tone of a soul guitarist was usually much simpler, cleaner, and consistent from song to song.

A wide variety of keyboards are featured in the style. Most commonly used are acoustic piano and organ. The organ can either be amplified from a tone cabinet, or very popularly amplified using a Leslie cabinet. Other keyboards commonly heard in soul include Wurlitzer and

Fender Rhodes electric pianos. The horn section comprises of a variety of different brass and woodwind instruments. Any combination of the following instruments can form a soul horn section: baritone saxophone, tenor saxophone, alto saxophone, trumpet, and trombone.

3. Arrangement

The arrangement of the music, as in which musical ideas are provided by which instruments, is fairly consistent from song to song. The drums usually are responsible, as mentioned earlier, for supplying the steady, solid, “toe-tapping” beat. The bassist will aid the drummer in providing the rhythmic backing of the song, but is also the main support of harmonic progressions. While the bass part will help to drive the harmonic movement, many bass lines also serve to establish a constant melodic groove. The piano and guitar can both provide main melodic ideas, but they primarily provide the harmonies for the song. The main melodic ideas usually come from the vocalist or the horn section. The horn section can serve a lot of different purposes. A horn section can provide harmonic support, can provide melodic accents during verses, or can supply the main melodic ideas during instrumental sections or choruses.

4. Specific Musical Themes

The last element to be discussed is the combination of musical traits that are unique to soul music. The foundation of soul music, which

has been mentioned previously, is the strong rhythmic drive. Soul music makes the audience dance, snap their fingers and tap their toes. The rhythm section lays down a solid groove or beat for the singer to belt out their emotional vocals.

Yet another distinct trait is the horn section. Rhythm and blues horn parts are very different from those heard in jazz. Soul parts are often based on blues licks, honk out harmonic accents, and can supply that melody that gets stuck in your head. Horn parts are usually diatonic to the key, simple and repetitive. Jazz horn parts on the other hand can be complex, have a lot of harmonic and melodic movement, and can feature a lot of chromatic ideas.

The guitar sound has a bit of a country-western sound, sometimes choked back with a bit of brittle twang. The guitar sound is not clean like jazz, or distorted like rock. A big influence on guitar sounds of the time was the Fender Telecaster, which was a signature sound used by Steve Cropper on STAX recordings.

The emotion behind the vocal performance may be the one trait that is most identifiable. The voices of soul music can be loving, lustful, yearning, heart-broken, unbridled, empowering, spiritual, defiant, or completely wild and crazy. The soul singer does not play it safe, or hold anything back. The accuracy and strict musical timbre of a vocal passage takes a back seat to feeling and emotion. The performance may have lacked proper breathing technique or been slightly off pitch. The voice

could have cracked or been raspy. All of these things are secondary compared to the emotion and intensity behind the performance.

D. Recording Characteristics of Soul

The aspects concerning the recording process give soul records a very strong sonic imprint. Soul records produced between the mid to late sixties have very specific and identifiable sound qualities, all of which are evaluated in depth. Generally, recording studios of the time where technically much simpler and less developed than they are today. The most common and standard resources available in the contemporary recording studios are far more advanced than those of the past. The areas of the recording process that are the strongest contributors to the overall sound qualities of vintage soul productions include:

- Microphones: type, quantity, and placement
- The recording spaces
- The positioning of sound sources in the recording spaces
- Characteristics of recording consoles, tape machines, and sound effects
- The recording medium
- The mono mix and release format

1. Microphones and Placement

The basic transduction technologies of microphones have not changed over the past half-century. Contemporary recording practice still makes use of condenser, ribbon and moving coil dynamic microphones.

Microphones are still available with the different directional capabilities (cardioid, omni-directional, bi-directional).

Frequency response is one aspect of microphone technology that has changed. Many microphones currently respond to frequencies between 20 Hz and 20 kHz, approaching the frequency limits of human hearing. Microphones of the past did not have as wide a frequency response. More typical was a microphone where the bass frequencies would start to roll off below 60 Hz, and exhibit a high frequency response up to only about 15 kHz. Looking at the technical specifications of some of the commonly used microphones of the time reveal this fact. For example, the Neumann M 49 b condenser microphone has a stated frequency response 40-15,000 cps (cycles per second), as documented in the microphone's operating instructions published in 1960 [7].

Microphone choice, and its placement in the studio, was of great importance to the sound of the recording due to the diversity of aspects that were influenced from these production decisions. Since few mixing effects were used to alter or change the sounds of a recording after it was captured, the tone and equalization of a sound source was adjusted and established through initial microphone choice and positioning. Also, in addition to affecting the tonal characteristics of a single sound source, production decisions regarding microphones also affected the tonal balance of the entire mix of sound sources. Because a song was most likely being recorded live with all the sound sources in the same room,

microphones had to be deployed very thoughtfully and deliberately to either create desired sonic qualities, or to reduce unwanted sonic qualities. For example, to boost the low frequencies of an electric guitar signal, instead of reaching for an equalizer, an engineer may decide to use a cardioid microphone and move it in closer to leverage proximity effect. Or perhaps, to limit the amount of snare drum bleed in the horn section microphone, an engineer might use a bi-directional microphone, orienting the null toward the drum set, with the horns on axis. An engineer would principally use microphone techniques to achieve the desired tonal qualities of the recording rather than equalization and other effects.

2. Recording Spaces

In current music production, recording facilities are often multi-room and multi-purpose complexes, and can offer many different types of recording spaces. It would not be uncommon for a studio to have a large live-room that features hard wooden, stone and concrete surfaces providing an abundance of reflections, a medium size room with variable acoustic paneling to alter room characteristics, and a few isolation booths with really short reverb times. This type of studio simply was not a reality for recording productions of the mid to late 60's.

Many recording studios of the 60's were not spaces designed to be recording studios; today, acousticians and recording studio designers build a studio with precise characteristics in mind. The STAX recording studio

in Memphis, Tennessee used to be a movie theatre, and was 40 feet wide by 45 feet long by 25 feet high [4]. The studio was made up of concrete surfaces and had large drapes hung inside to alter the room acoustics (figure ID-1). These spaces were also filled with various gobos to help tailor the isolation in the studio during recording sessions.

The early recordings for Atlantic were done in a New York City office. Atlantic Record's first big studio (as they progressed beyond the small office) was 32 feet by 44 feet by 15feet [4]. As observed in the book *Good Vibrations,* engineer Tom Dowd designed the new studio at Atlantic for sessions to hold roughly 12-14 string players, 4 horns, 6 rhythm players, 5 background singers, and 1 principle singer simultaneously [6]. The spaces used as recording studios for soul music were big enough to accommodate a large ensemble.

3. Positioning of Sound Sources Within the Recording Space

Because recordings were made with all of the sound sources performing simultaneously in the same space, the positioning of sound sources in the studio was critical to the overall sound of the recording. There are many positive as well as negative aspects to recording with all of the sound sources in the same space. One positive aspect is that the musicians can be recorded in a scenario very close to how they perform in a concert. All the musicians can be in the same room, hear each other without headphones or loudspeakers, make eye contact, and communicate

quickly and easily. This enables the musicians to interact with each other without hindrance while they are playing, directly influencing the way they perform and sound as a group. “The vibe” is changed when a single musician is playing over a previously recorded performance as opposed to interacting with their fellow musicians in a live setting.

An additional positive sonic aspect that can result from live studio recording is the audibility of cohesive spatial characteristics. Because all the sound sources exist in the same space, they interact in common ways that form the global environmental characteristics of the recording, creating an acoustic fingerprint not easily simulated through artificial means, as would be the approach using contemporary recording practice.

One negative to placing all of the sound sources in the same space regards the issue of sound isolation. Recording practice today easily isolates multiple sound sources, as most recording facilities have multiple isolation booths. The use of isolated rooms was not common practice 40 years ago. Any given microphone signal recorded with all the sound sources performing in the same space will most likely contain sounds other than the one the engineer is trying to capture. For instance, if the sound recordist places a microphone in front of an amplifier to capture the electric guitar sound they will probably hear the electric guitar as well as drums, bass, piano, etc. The recorded level of these unwanted sounds, or the microphone bleed, depends on multiple factors, including the amount of isolation (e.g. gobos, blankets, etc.) used to attenuate the unwanted

sounds, the distance of the other sound sources in relation to the one of interest, the directional properties of the microphone, the radiation pattern of the sound sources, and the amplitude of the unwanted sounds in relation to the one of interest. The use of gobos, directional microphones, and distance between sound sources can limit the amount of microphone bleed in any given microphone signal.

When recording the ensemble live in a single room, it is very important for all of the musicians to give a great performance, due to the fact that overdubbing - replacing one element of the ensemble - is difficult. If the bass player hit a few wrong notes during the take, it would be difficult to do an overdub because even if you re-record the base performance, the old bass performance will most likely be present and audible in the other tracks due to microphone bleed. Also, because all the other sound sources were recorded in context to a live recording, an isolated bass signal may sound out of place musically, as well as acoustically.

When placing the musicians and their instruments in the recording space, both musical and recording issues must be considered. It would be good for acoustical considerations to use gobos to isolate the horn section in the corner, but bad for musical considerations if the horn players couldn’t see the other members of the band. Both the needs of the musicians and the recording process must be met during a live recording production, and sometimes compromises must be made to accommodate

one or the other. Musicians should be placed in the room to ensure their comfort and ease of communication. For isolating multiple sound sources, an engineer must consider the volume level of the sound sources, the distance between the sound sources, and the performance of any sound isolating gobos separating the sound sources. Good isolation can be achieved by putting distance between the sound sources, placing heavy gobos around the sound sources, using directional microphones to attenuate off-axis sounds, and adjusting the volume of the sound sources to minimize microphone bleed but to maintain the desired timbre qualities.

Finally, the global amplitude level of all the sound sources in the space has a great effect of the sonic qualities of the recording. Multiple sound sources emitting high amplitudes in a confined space can cause many unwanted sounds in a recording. Microphone bleed would be enhanced, room reflections and decay time would be more audible, unwanted room modes could become energized, and the probability of sounds masking one another would be greater. However, sound sources at too low a volume level could compromise the desired timbre of the sound source, as well as raise the audibility of the noise floor of the entire system. Striking a balance between the creative and technical needs of the recording often takes experimenting, compromise, and thoughtful decision-making.

4. Characteristics of Recording Consoles, Tape Machines, and Sound Effects

The modern recording studio is capable of producing very high-quality audio recordings with little technical limitations. The limitations of recording studios in the 1960's (few sound effects, low number of console inputs and recording tracks, etc.) are no longer limitations in contemporary sound recording. With both the large format console and digital audio workstation (DAW) in use today, it is typical to have in excess of 64 inputs available. Both consoles and DAW's have various features that allow recording engineers flexibility and control over the entire recording process. They include complex routing systems, automation, onboard sound effects, etc.

Both analog and digital multi-track recorders are used in contemporary recording. The recorders capture and playback high-quality audio and feature large number of available tracks. Analog 2'' tape machines can record 24 tracks, and it is possible through synchronization to use 2 tape machines simultaneously. There is nearly no limit to the amount of tracks a DAW can contain. Audio is recorded to and played back from digital storage devices. Digital storage devices (such as hard disk drives) are capable of holding large amounts of audio information.

Contemporary audio recordings feature heavy use of sound effects. Sound effects are available in both analog and digital technologies, and are utilized to create a wide variety of sound qualities. Sound effects are used

to alter sound sources' frequency, amplitude, and spatial characteristics. It is common for every track on a recording to contain some use of an audio effect, whether it's an equalizer, compressor, delay, or reverberation unit. These effects can achieve a wide range of sound qualities, and feature many adjustable parameters that allow a recording engineer to very specifically render the desired sound [8-12].

Consoles of the 1960's featured far fewer inputs, limited compression and equalization effects, and no automation. Guitarist and engineer Steve Cropper recalled combining two four-channel mixers at STAX to enable a total of eight channels [13]. Sunset Sound in California used a 14-input console [4], and Universal in Chicago used a 12-input console [4]. With fewer input channels, microphone choice and placement was very important. Panning on a console was also not crucial since most records were being mixed and released in mono. Engineers would typically just make volume adjustments on the fly and route signals to external sound effects when mixing records [4, 6]. Making volume adjustments to individual sound sources while mixing is often necessary to achieve the desired musical balance of the song. As stated by Alex Case in his book *Sound FX*, a desired musical balance is achieved during mixing through the adjustment and readjustment of "the volume of each and every track until the combination starts to make musical sense" [8]. Engineers may also have wanted to add some reverberation effects to

sound sources. This would be achieved by routing a signal to a system that could add reverberation characteristics, such as a plate or echo chamber.

Between 1965 and 1970 the 8-track tape recorder, as well as the earlier standard of 2 and 3-track recorders, were used for recording and playback in recording studios. In 1957, Atlantic was one of the first studios to acquire an 8-track tape recorder [6]. The soul hit "What'd I Say" by Ray Charles was one of the earliest to be recorded on the 8-track recorder at Atlantic [14, 15]. Steve Cropper noted that his hit "Green Onions" with fellow Booker T. and the MG's members for the STAX label was recorded using a mono tape machine [13, 16]. With a low number of tape tracks, mixing and storage capabilities were limited. It was uncommon for individual microphone signals to have their own dedicated track on the tape as is typical in today's multitrack recording approach. Often a single tape track contained a mix of multiple microphone signals. In addition, a low number of tape tracks also made overdubbing a difficult task.

Sound effects processing consisted mainly of equalization, compression, tape delay, and reverberation. Equalization and compression, mixing processes that are currently standard practice, were not heavily used in the 1960's. Atlantic engineer Tom Dowd says of the subject:

"... I very seldom used limiters on anything except vocals, and that was just to cut the peaks down. I would just ride the peaks with my hand

on the fader after I'd heard a song once or twice to get a feel for what the band were doing. I preferred it that way." [6]

The frequency characteristics of a signal were more often determined by the microphone choice during the recording rather than mixing stage. According to Steve Cropper, "Eq was just how you positioned the microphone." [13].

Plates, springs, and echo chambers were used to create reverberation effects. These effects have very few adjustable parameters. Creating reverberation through echo chambers was very commonly employed. Studio's would place a speaker and a microphone in a highly reflective room, use a studio send to route a signal to the speaker, and route the resulting reverberation picked up by the microphone back to the console to be mixed with the original dry signal. Spaces commonly used for echo chambers include bathrooms, basements, and stairwells. Atlantic and STAX studios both employed reverberation chambers [6, 13].

Tape delay was another effect used to simulate room reflections. The tape speed, and the distance between the record and playback heads on the machine determine the delay created. Feedback could also be introduced by returning the delay signal back into the system. Modern delay and reverberation units in comparison have many user variable parameters. Reverberation units can adjust reverb time, level of early reflections, room size, diffusion properties, etc.

5. The Recording Medium

The recording medium between the years 1965-1969 was analog magnetic tape. Magnetic tape has many inherent properties and imperfections that affect the sound quality of recordings. Before one hears the music of a soul recording, one often hears tape noise. The noise floor greatly affects the useable dynamic range of a recording. Often the music battles tape noise during quiet portions of a record, and can be heard at the beginning and end of a song. Another inherent quality is tape saturation. Because of the finite amount of dynamic range in magnetic tape, a high amplitude signal is vulnerable to clipping when the tape runs out of magnetic domains to accurately record the signal. The high amplitude portions of a waveform will be distorted and will result in peaks that are reduced in amplitude while leading to the often audible addition of artifacts related to harmonic distortion. The audible result sounds as if the signal has been compressed. Also, additional high-frequency information not present in the original signal is produced due to the harmonic distortion created from the clipping of waveforms.

Noisy and unwanted distortions are often present in soul recordings and can add aesthetic qualities. The recording “Hold On! I’m Comin” by Atlantic artists Sam and Dave (however produced at the STAX studio) is a good example of positive distortions [17]. During the second verse the singer is clearly exuding emotional intensity. As the performance gets more and more intense you can begin to hear harmonic distortions on

particularly loud words. It was the judgment of those creating the recording that these distortions were not a problem to be fixed but were perhaps a supportive source of emotion for the recording - it was released and became a hit for the duo.

6. The Mono Mix and Release Format

Mixing and releasing records in mono was the industry standard for many years in the middle of the 20th century. Although stereo records were produced as early as 1958, mono records were still very common in the late 1960's. A significant audio quality that results from mono mixing, and can be heard in soul records, is masking. Masking can occur in both the frequency and amplitude domain [8]. Sound sources are often masked in a mono recording due to the competition in frequency and amplitude information among them. For example, a piano part may at times be clearly audible and at other times become masked by the high amplitude instruments such as the drums and electric guitars. Stereo sound relies on to two directional sources (loud speakers) to emit sound. The two speakers are capable of creating a lateral sound stage, which gives the listener a perceived sense of width. Positioning sound sources in different locations of the sound stage (through use of panning) can potentially make sounds that were previously masked more audible.

II. Methodology

A. Song Composition

The final score to the song (including rhythm section chords progressions, organ melodies, horn parts, and lyrics) can be seen in figures IIA-1 through IIA-11.The first stage of the process was to compose an original piece of music in the soul style. Before writing the composition in earnest, a few building block ideas were known. The instrumentation should include drums, electric bass, electric guitar, piano, organ, vocals, and a horn section. The piece should be upbeat with a quick tempo, have form elements similar to those found in classic soul songs, and be under four minutes in duration. The parts written for each instrument should match their typical purpose in the soul style: The drums should supply a driving beat, the piano and guitar should provide harmonic motion, the horns should provide melody and harmonic accent, etc.

Before recording the actual vintage and modern versions of the song, a complete rough draft recording of the song was completed. By having a rough draft recording, how all the instruments and parts would sound together when the time came to record and mix the actual versions could be anticipated. It would also serve as a reference to the song for the recording engineer and the other musicians to listen to, practice to, and talk about. First the parts for the song would be composed in a DAW by using virtual instruments. This way the song would be composed one instrument at a time and would be a fair representation of the actual sound sources. With the song composed using the virtual instruments in

the DAW, real instruments would be recorded later to replace the virtual instrument parts.

1. Preparing the DAW Project for the Rough Draft Recording

A project was prepared in a DAW for which the rough draft would be recorded. In addition to using a click track, parts would also be recorded over a break-beat sampled from a drum performance on vinyl. A sampled break-beat has many elements of an actual performance that a click track and synthetic drums can't provide. It is a drum performance with real drums in an actual environment, with subtle timing and timbral changes, and has an aesthetic vintage feel having been taken from vinyl. A search began for a record that had a drum part featuring an up-beat tempo and feel, and that also had a vintage vibe. After finding a break-beat, it was recorded it into the DAW, edited to last for one measure, and duplicated many times (to have a drum foundation for the duration of the song). Next, the tempo of the break-beat was found by using the metronome. By establishing the tempo of the song in the project, the tracks could be applied to the metric grid in the DAW. This allows for flexibility in editing while keeping rhythmic stability, and the ability to use quantizing when recording virtual instrument parts.

2. Writing the Main Chord Progressions

Composing began by sitting at the piano and experimenting with different chords and progressions. The composition process began with the writing of chord progressions for the entire song. This would serve as a basis to write melodic parts, such as bass lines, lead lines, horn lines, etc. To get the creative process started, a simple 12-bar blues progression was improvised in the key of D. The chords used for this blues were the D7 chord, the G major chord, and the A major chord (the I, IV, and V chords in the key of D found in the blues form). After playing the blues form, it was decided that the chords should change more quickly and have more movement. After playing the D7 for one measure, a transition was made quickly to the G major chord at the beginning of measure two. Next, the chords quickly moved down the piano to an F major chord followed by a C major chord to end the second measure. The repetition of this two-measure phrase provided interesting harmonic movement due to the addition of harmonies not found in the key of D major. The F major and C major chords are not chords found in the key of D major, but are chords found in the D blues scale (a derivative of the D minor scale). By using a mix of chords from D major and D blues keys, the progression features harmonies that are all of major quality. The raising and flatting of certain notes in the harmonies due to the mix of keys adds a twist to traditional harmonic movement. A decision was made that this progression would be

the main harmonic statement of the piece. This progression would be used for the chorus sections.

Having written a progression for the chorus sections, a different progression for the verse sections needed to be written. The verse progression would relate to the chorus progression, but not be the same. The same chords were used from the chorus section, however the progression didn't move as quickly from chord to chord. The D7 chord sounded for six measures (instead of one), and took two measures to descend from a G major chord, to F major, to C major (instead of one). What resulted was a progression that was eight measures instead of two, and one that sounded very similar to the chorus section but was different. The idea of using the same chords for both sections but varying the harmonic rhythm provided a highly integrated way to compose the two sections for the song.

Following the verse would be a pre-chorus section that was a build up to the chorus section. Honoring the soul music tradition of harmonic simplicity, the chords used for the per-chorus sections were ones that had already been introduced in the chorus and verse sections. Because this section was to be a build-up, it made sense for the chords to ascend, rather than descend as in the chorus section. Repeating, one-measure phrases were played of an F major chord moving up to a G major chord. After repeating this phrase three times, the progression then ascended higher to the playing of a B flat major chord moving up to a C major chord. The

addition of the B flat major chord (VI chord) is again a borrowed harmony from the key of D minor. The harmonic movement of the pre-chorus described previously begins with a chord movement alternating between an F major (III) and G major (IV) chord. These chords are a whole step apart from one another, and are both of major quality. The pre-chorus ends with a move from a B flat major chord (VI) to a C major chord (VII). Again using the same theme of harmonic movement, the two chords are both a whole step apart and are of major quality. The pre-chorus begins with movement from a III to a IV chord (F to G), and ends with a movement from a VI to a VII chord (B flat to C). Landing on the VII chord (C major) to end the pre-chorus provides the tension to make a good resolution to the I chord (D7) for the beginning of the chorus.

Having written chord progressions for the verse, pre-chorus, and chorus sections, the foundation of the song was almost complete. The song form at this point was:

- Verse
- Pre-Chorus
- Chorus
- Verse 2
- Pre-Chorus 2
- Chorus 2
- Chorus 3

After listening to all the chord progressions composed thus far, it was decided that a short section was needed to introduce new chords and ideas before the last chorus of the song. A section was needed that lowered the energy after the second chorus. Composition of this section began with improvisation using minor seven chords, and until this section there had been no minor chords in the entire song. Phrases from the pre-chorus sections were manipulated with the insertion of some minor seven chords. With the use of some chromatic movement and minor seven chords, this section sounds if it was infused with a little bit of jazz influence. What resulted was a section that really contrasted in style and in energy and served as a pivot between the second chorus and the final chorus of the song.

A piano performance of the chord progressions was recorded for the rough draft. During the recording of the main chord progressions, a decision was made to add a few more short sections. With the addition of these sections, a final song form was achieved. In addition to the verses, per-choruses, choruses and bridge, an introduction, outro, and two instrumental solo sections were added. The introduction and outro were added to round out the song form, so as to not begin the song with the first word of the verse and end the song with the last word of the chorus. The introduction and outro provided a buffer for the main sections of the song. The instrumental sections were added as little breaks to feature solos from the musicians to build energy before verses.

The final song form is as follows:

- Introduction (16 measures)
- Instrumental Solo 1 (4 measures)
- Verse 1 (16 measures)
- Pre-Chorus 1 (5 measures)
- Chorus 1 (8 measures)
- Instrumental Solo 2 (4 measures)
- Verse 2 (16 measures)
- Pre-Chorus 2 (5 measures)
- Chorus 2 (8 measures)
- Bridge (8 measures)
- Chorus 3 (16 measures)
- Outro (3 measures)

3. Composing for Bass

With the harmonic foundation of the song in place, a bass part was composed. In the rough draft project a synth bass part, playing just the roots of the chords for the entire song, was added. Many soul songs feature a bass part that at times is very melodic and involves a bit more than just playing the root of the chord [18-20]. Bass lines were improvised over the chorus chord progression. A goal was to create a bass line that had movement and that had a memorable melodic line. In this

vein, a four-measure phrase to be used for the chorus sections was composed. A more root-oriented bass line was needed for the verses so to not compete and draw attention away from the lyrical statement. The bass line in this section still features a little melodic movement, but mainly supports the harmonic progression by playing the root notes of the harmonies. The bass in the pre-chorus and bridge sections plays exclusively root notes. The bass in the song plays a variety of roles. The bass provides melodic ideas, helps drive the harmonic progressions, and supports the harmonic foundation of the song.

4. Composing for Organ

The piano was to be the main keyboard instrument in the song. It is used in every section and is a main ingredient to the rhythm section. The organ is also very often used in soul music, and it was decided that an organ part would be composed as well [16, 21]. Since the piano is already playing chords, the organ would provide a main melodic hook to be repeated in the background during the chorus'. In addition, there would be an organ solo before the second verse. A short, blues-oriented melody was composed to open the song during the introduction, and to be an underpinning element during the chorus'.

5. Composing for Horns

The horn section in this song plays a variety of roles, as it does in many soul songs. The horn section in soul music usually provides harmonic support, and/or main melodic phrases [17, 22, 23]. During the chorus the horns accent the D7 chord (the I dom7 chord). Here the horns accent the chord tones of the D7 on beat one and two of every chorus phrase. In the original composition the chord tones of the D7 were divided between a baritone saxophone and two tenor saxophones (however the vintage recording features a stripped down arrangement featuring only a trombone and one tenor saxophone).

The horn section is also included in the pre-chorus. During the pre-chorus the horns provide the melodic statement. Here the horns play an ascending melody based on the chord tones of the harmonies during the pre-chorus. The horns in this section help to build the tension before arriving at the chorus. Here the horns are not harmonized, but rather are playing the same melodic line in unison. There is a contrast in texture between the pre-chorus and chorus horn parts. The pre-chorus contains a part much narrower in range, since all instruments are playing the same pitches. However, at the downbeat of the chorus, the horns split up and harmonize over a much larger range, making a strong difference between sections.

6. Collaborating to Compose the Drum Parts

A collaboration was made with musician Gabriel Cruiser to compose the drum parts. At our first meeting, Mr. Cruiser listened to the rough draft as it existed thus far. At this point the draft consisted of a break-beat (representing the drums), and synthesized piano, bass, and horns. After listening to the song, points were made to Mr. Cruiser regarding aspects that should be included in the drum performance. One aspect was that the main backbeat behind the verse and chorus sections should be very simple and repetitive, as is often featured in soul music [5, 24, 25]. Also, that there should be build-ups before verses and chorus' to increase tension. During the bridge it was asked that he play a smooth ride pattern to contrast from the main, hard-driving back beat of the other sections. Mr. Cruiser composed a part for the pre-chorus section where he accents the chord hits on the first half of a phrase, and then performs a tom fill during the second half of the phrase.

The last sections to discuss were the drum parts during the introduction and instrumental solos. Since the introduction features a thinned out arrangement with only drums, bass and organ playing, the drum part needed to be thinned out as well and include only the kick and snare drum. When the arrangement grows with the entire band entering at the downbeat of measure 9 of the song, the drums kick right into the driving backbeat with kick, snare, and hi-hat. These arrangement changes help to propel the song movement and give a sense of growth in the song.

At the end of the introduction comes the first instrumental solo section. During this section the arrangement gets narrower again, and here Mr. Cruiser just plays kick and hi-hat during the solo, and then performs a snare-roll that crescendos into the verse section. Mr. Cruiser wrote parts that fit the soul style and that featured lots of rhythmic, textural, and dynamic changes.

7. Collaborating to Compose the Guitar and Vocal Parts

Another collaboration was made with guitarist and singer Brian Sances to compose the guitar and vocal parts. Mr. Sances is a veteran rock and blues player, and it was felt that he would fit perfectly into this project. Through listening to Mr. Sances perform live and hearing his work on recordings, it was clearly evident that he was a highly experienced blues guitarist, and could sing and play live with comfort and ease. This aspect of live performance would prove to be very important when the time came to track the vintage version of the song.

To help Mr. Sances compose the guitar part, a suggestion was made that he consider himself a rhythm guitarist for this song, meaning that he should mainly play the chord progressions and support the harmony along with the bass and piano. It was also thought that Mr. Sances should improvise a solo during the first instrumental solo section. In addition to his guitar part, his guitar tone was also discussed. It was related to Mr., Sances that the guitar tone should sound fairly clean, with

just a bit of drive. Mr. Sances heard the guitar tone being searched for after listening to some Otis Redding and Sam and Dave records [26, 27]. Mr. Sances also adjusted his playing during the verses to make his guitar rhythm sound shorter and more chocked back, rather than holding longer, sustained chords.

Brian Sances wrote all of the vocal content for the song, including the words, vocal melodies, and vocal harmonies. The only guidance given to Mr. Sances was for the lyrical content to tell a story relative to daily life and situations, and for the vocal melodies to be based on the blues. The name of the song, “Take A Look”, was taken from the lyrics supplied by Brian Sances.

8. Finishing the Rough Draft Recording

After finishing the composition of all the parts for the song, many of the parts were re-recorded to complete a rough draft recording. The rough draft features drums, electric bass, electric guitar, lead vocals, harmony vocals, digital piano and organ, and a synthesized horn section. The rough draft recording was a good reference tool for the recording engineer and musicians while preparing for the vintage and modern tracking sessions.

B. Tracking and Mixing the Vintage Version of "Take A Look"

The goal for the tracking and mixing sessions of the vintage version of "Take A Look" was to try to recreate as much of the late 60's recording process and environment as possible. This process included choosing the recording space, selecting microphones, positioning the musicians and their instruments in the space, recording to the proper medium, and mixing according to '60s practices. The recording and mixing of the vintage version of the song was done at the University of Massachusetts Lowell's sound recording facilities.

1. The Recording Space

The chosen recording space was a band rehearsal room. This space is in many ways similar to the recording spaces of the sixties [3, 4, 6]. The room is roughly 60' x 37' x 15' in dimension (length x width x height). Figures IIB-1 and IIB-2 show both floor plan and cross section diagrams for room 113. It features a vinyl tile floor, hard reflective walls (of concrete, masonry, and gypsum wall board), and minimal acoustical treatment. The only acoustical treatments in the room are a couple of large, wood diffusers, and some large, heavy drapes. The key feature of this space was that it was not designed specifically to be a recording space; rather it was designed for the rehearsals of large ensembles. Similarly live acoustical conditions were part of many 1960's recording spaces [3, 4, 6].

This room contains microphone and cue lines that connect to the control room's console to make signal routing achievable.

2. Microphone Choice

Microphone choices for this recording were based on the proven successes of the 60's sessions [4, 6, 13, 14]. Microphones were chosen that had technological properties similar to those used in the past, as well as certain directional properties. Besides the drum kit, which was captured with four microphones, each of the other 6 sound sources (bass, piano, organ, horns, guitar, vocals) were recorded with one microphone each. In addition to these 10 microphones, two more were set up to capture the room sound, lending a total of 12 microphones. The microphones used in the vintage recording can be seen in figure IIB-3.

3. Positioning of Musicians and Instruments in the Space

The positioning of the musicians and their instruments were based on historical references, and acoustical and musical considerations [3, 4, 6, 13, 14]. Through the research process and seeing photos of how past recording sessions were set up, references were compiled of how musicians were positioned during some classic recording sessions. One hand drawing by STAX guitarist and engineer Steve Cropper shows the positioning of musicians during a typical STAX recording session (see figure IIB-4). This served as the primary reference in positioning the

musicians for this contemporary recreation of STAX recording craft. The bass guitar and drums were placed along the longest wall, and in the corner was placed the piano and the organ. Across from the drums is where the horn section was placed, which comprised of a saxophone and trombone player. In the corner farthest away from the piano and organ was where the vocalist and his guitar were placed. A drawing of the positioning of musicians for the "Take A Look" vintage session can be seen in figure IIB-5. This drawing also shows the positions of gobos in the space. Gobos were placed around and between sound sources to achieve better acoustical isolation and to reduce microphone bleed. From these positions musicians could easily see each other, making for good communication.

4. Placing Microphones and Establishing the Cue System

After the musicians were positioned in the room, microphones and the cue system were set up. The cue system refers to the signal routing and equipment set up by the recording engineer to allow the musicians to use headphones to hear their individual instruments, hear one another's instruments, and hear the recording engineer. The cue system allows for monitoring of the sound sources through headphones, and establishes communication between all the members of the production process.

Directional microphones were mostly used to help attenuate off-axis sounds such as room sound and bleed from other instruments. The

only bi-directional microphone was placed between the two horn players. Each horn player performed into the on-axis parts of the microphone, while the null part was facing towards the drum kit, again to attenuate bleed. Cardioid dynamic microphones were placed close to drums and electric instruments. The kick, snare, bass, guitar, and organ all featured close placed dynamic microphones. One cardioid condenser microphone was placed inside the piano, while another was placed between the snare and hi-hat. Two more cardioid condenser microphones were used to capture room sound and act as talkback microphones for the musicians. Lastly, cardioid tube-condenser microphones were used to capture the drum-kit overhead perspective, as well as the lead vocals.

The number of microphones used in the vintage session was restricted to simulate the limitations of the time. Even though the console for the session had over 40 inputs available, only 12 inputs were used. This technical limitation would have been the same for recording engineers tracking soul music in the 1960's [4, 6, 13, 14]. No stereo microphone techniques were used, anticipating a mono mix as the final mix format – consistent with the late 60s soul music aesthetic. Figures IIB-6 through IIB-16 show photographs of the microphone placements.

The cue system was established after microphones were placed on the instruments. Even though the band was all in the same room performing live, some key instruments, including lead vocals, piano, and horns, were not reinforced with amplifiers and needed to be heard by all

the musicians. A rough mix of the band was routed from the console (via aux sends) to the headphone amplifier in the live room. From here, the amplifier fed multiple different headphone boxes from which each musician could hear a mix in their headphones. Many of the musicians played with the headphones on one ear, listening to just the vocal cues, while leaving the other ear open to hearing the live sound in the room.

5. The Console and Recording to Analog 2'' Tape

A signal flow diagram for the vintage session can be seen by referencing figure IIB-17. The microphone lines from the live room were connected to the inputs of the recording console. Microphone pre-amplifiers first received the microphone signals from the live room. After applying phantom power to the relevant microphones and establishing healthy input levels for all the sound sources, the microphone signals were routed from the bus outputs of the console straight to the multi-track tape recorder. In addition to the microphone signals being recorded to tape, one additional signal, a copy of the vocal signal, was routed to a spare track on the tape. This duplicate vocal signal was recorded using very high input levels, causing the signal to heavily distort. This saturated vocal signal could possibly be used during the mixing process, mixed with the original vocal signal, to simulate distortions during intense vocal passages.

The signals were recorded to 2" analog magnetic tape. No effects (equalization, compression, etc.) were applied to the microphone signals

before being recorded to tape. Also, no noise reduction technology was used during the recording process. It was desirable to capture all of the imperfections and non-linear aspects of the analog recording process. From the tape machine, signals were re-routed back to the console to be monitored in mono.

6. Capturing Takes

The tracking of takes for the song began after the setup was complete. Mr. Cruiser, the drummer, was responsible for cuing the band to start by counting off the tempo into the beginning of the song. Typical of the recording process in which the entire band is tracked live, the band rehearsed, and practiced sections known to present the greatest performance challenge, while recording the entire time. The first five takes weren't completed due to various problems. The first two takes were abandoned due to false starts. Takes three and four had problems with the band transitioning into the bridge section. After going down to discuss the transition into the bridge with the band and rehearsing it a couple times, they made their adjustments and fixed their mistakes.

After making it nearly to the end of the song on take five, the band had trouble hitting the ending together. The last measure before the ending downbeat needed to contain some cues to help bring the musicians together for a clean ending. The bass and the piano needed to emphasize a C major chord on beats one and four to cue the ending on the D7 chord on

the following downbeat. After rehearsing it a few times the band completed their first full take on take six.

After take six the band was feeling really good and nailed an energetic take seven before taking a break. Take seven featured an intense, high-energy, and tight performance. The musicians played with excellent rhythm, melodic and harmonic phrasing, and transitioned smoothly between every section of the song. This would be the take that was used for the final version of the vintage "Take A Look". After a short break, we recorded two more complete takes of the song. The 2'' tape contains four complete takes of the song: takes 6 through 9. Even after additional recording attempts, take 7 represented the strongest performance, balancing energy and excitement with strong and technically correct musical fundamentals.

7. Mixing the Vintage Version

A couple of main guidelines were followed during the mixing process of the vintage version. Consistent with STAX practice, the final mix was going to be in mono, no compression or equalization was to be used, and mixing was to be done by riding faders instead of using automation [4, 6, 13]. After routing the tracks from the tape machine to the console, a rough mix was established. The volume levels of all the instruments were adjusted to achieve a musical balance. It was decided not to include the room microphone signals in the mix, or the microphone that

was placed between the snare and hi-hat. More than enough room sound was present from the combination of all the close microphones, and the snare/hi-hat microphone added nothing that the overhead microphone didn't capture. After balancing the instruments, a touch of reverberation was added to the lead vocal. This reverb effect was made possible by a spring reverb unit. The spring reverb added an effect that sounded very reminiscent of reverberation effects used during the sixties.

After setting a level for the reverberation returns, mix passes were performed. This process included altering levels of certain instruments on the fly by using the hands to ride volume faders. A diagram showing fader and mute adjustments can be seen in figure IIB-18. During the guitar solo, the level of the guitar was raised a bit, and then brought back down when it started playing rhythm under the vocal. The levels of the horns were adjusted during the melodic builds of the pre-chorus', as well as during the chorus'. The organ signal was adjusted during its solo because it contained a lot of dynamic range. The end of the solo was fairly quiet, so it needed to be raised quite a bit during the end so to be heard over the other instruments. After the solo the organ needed to return to its original set level. Getting the correct mix performance took quite a bit of practice. A few different mix passes were recorded through A/D (Analog to Digital) converters into a DAW.

C. Tracking and Mixing the Modern Version of "Take A Look"

The modern version of "Take a Look" was completed through contemporary music production practices [8-12]. Sound sources were recorded acoustically separated, often with many microphones capturing a single performance. Multiple recording spaces were used in the course of capturing all the tracks for this version, including medium sized live rooms, small isolation booths, and even a home studio space. Each sound source was recorded until a superlative performance was captured. The performance was further enhanced through editing. This approach enabled the removal of unwanted qualities, and the combining of the best parts of multiple takes to form a final performance. Once all the sound sources were edited, they were mixed with the addition of effects processing including equalization, compression, delay, and reverberation. While the vintage version relied on analogue tape with limited track availability, the modern version was made using digital recording interfaces and recording software, which provides high fidelity audio with a high number of recording tracks.

1. Tracking Drums

The drum kit performance was recorded at University of Massachusetts Lowell's sound recording facility. Room 114 is the facilities' acoustically designed live room, which features variable acoustic paneling, as well as an isolation booth. A diagram showing the signal flow of rooms 114 and 213 (the control room) can be seen in figure

IIC-1. The drum performance was captured through the placement of 11 microphones. Microphones were closely placed on every part of the drum kit, over the kit to capture the overhead prospective, and placed away from the kit to capture room sounds. The position of the drum kit in room 114, as well as positions for later overdubs can be seen in figure IIC-2. A cross section of room 114 can be viewed in figure IIC-3. Figure IIC-4 shows the microphone input/assignment sheet; documenting the microphones that were placed on the drum kit (as well as future sound sources). Figures IIC-5 through IIC-10 show photos of the microphone placements.

The DAW project contained a mix of the rough-draft recording for "Take a Look". This rough-draft version featured no drums, and would be used by the drummer, Gabriel Cruiser, as reference to perform to. Since the rough-draft version was recorded using a click track, Mr. Cruiser would perform to a click track and listen to the synchronized rough-draft recording as his performing reference. Mr. Cruiser only required the rough-draft mix and click in his headphone cue mix, due to the fact that he could easily hear his drums without the need for reinforcement. After routing the rough draft mix and click to his headphones, and double-checking the signal flow, recording takes of the drum performance began.

Multiple takes of the drum performance were recorded. Before overdubbing any additional instruments, it was important for there first to be a final edited drum performance so that every additional sound source recorded would align to the same rhythmic foundation. The drum

performances needed little editing. One take was nearly entirely useable, except for some rhythm issues in the beginning of the introduction. Here, the drums were speeding up and slowing down before the entrance of the entire band. Using the click track as a rhythmic reference, the drum part was edited so that every hit aligned with the click track.

2. Tracking Bass

No microphones were used for the recording of the bass performance. The bass guitar was recorded through a DI box right into the DAW. A direct bass sound was desired due to the tonal qualities of the direct signal. The direct signal captures even low and high-frequency information, as well as important timbral detail of the attack of a note. When a bass is played through an amplifier in a room, sometimes room acoustics and room modes boost and attenuate certain portions of the instruments frequency range that are undesirable. This unwanted coloration was to be avoided.

Because no microphones were used and a live environment was not needed, the bass was tracked at a high-quality project studio. The bass was plugged into an amplifier head that was used for tonal adjustments. The output of the amplifier head was then routed through the DI box and recorded into the DAW. The bass player, Brandon Downs, having been familiar with the song only needed the guidance of the drum performance to play his part. While monitoring the pre-recorded drum performance and

his live bass performance, Mr. Downs recorded 5 complete takes of the song, and recorded 5 individual sections of the song. Several performances were edited and combined to form the final bass track.

3. Tracking Guitar and Vocals

The guitar performance was recorded again at the SRT facilities at UMass Lowell. In Room 114, the facility's live room, two microphones were placed to capture the guitar performance. A Shure SM57 moving coil cardioid dynamic microphone was placed directly in front of the amplifier, and a Neumann M147 cardioid tube-condenser microphone was placed a few feet back to capture a distant perspective. The two signals could then be blended during the mixing stage to achieve the desired timbre.

Three composed parts of the guitar performance needed to be captured. The guitar parts included a rhythm guitar performance, a solo section performance, and a lead guitar performance. The rhythm guitar part is mainly the playing of chord progressions for all the harmonic movements in the song. The solo guitar performance is an improvised melodic statement that is the primary focus during a given section. A lead guitar part will feature melodic ideas that help support the harmonies and vocal parts during certain sections of the song.

Guitarist, Mr. Sances, listened to a cue mix in headphones that included the pre-recorded drums and bass, as well as his live guitar. Many

rhythm guitar takes were recorded. The takes were edited together to form a single, final rhythm guitar track.

Multiple guitar solos were recorded for the solo section. Mr. Sances improvised many different guitar solos. Not wanting to disrupt the character of each guitar solo, one guitar solo performance was chosen as the final guitar solo track, and no edits were made on the performance. Finally, during the last chorus, Mr. Sances was asked to improvise some guitar lead lines to be used to help drive the song forward to the end. We recorded many takes, and I chose to use one complete take for the final lead guitar track and performed no edits. Figures IIC-11 and IIC-12 show photos of the microphone placements during the guitar overdubs.

In the same afternoon, right after tracking guitar, Mr. Sances stepped into the vocal booth in room 114 to perform the vocal part. The three vocal parts that needed to be captured included the lead vocal, and two harmony vocal parts. One microphone, a Neumann M147 cardioid tube-condenser, was used to capture the vocal performance. This microphone accurately captures transient and high-frequency information present in the male voice, and adds subtle frequency coloration due to the tube technologies inherent in the microphone's design.

To begin the vocal overdubs, Mr. Sances sang a few different complete takes of the song. Next, takes were recorded of the song moving section by section. For example, Mr. Sances would sing a few takes of the verse section, then move on to record a few takes of the chorus, etc. Next,

Mr. Sances was recorded performing the harmony vocal parts during the verse and bridge sections. The lead vocal part was edited heavily to combine the best pitched and phrased performances from all the takes. The final edited vocal track, as seen in figure IIC-13, contained 57 individual edits. Figure IIC-14 shows the vocal overdub microphone placement.

4. Tracking Horns

The horn section in the modern version consisted of tenor and baritone saxophone. Two players, Seth Bailin on tenor saxophone and Bradley Stackpole on baritone saxophone, performed all of the horn parts for the modern version. The horn performances were recorded using a single Royer 121 ribbon microphone placed in the isolation booth in room 114. A decision was made to record the horns in the isolation booth rather than the live room to try to achieve a short, dry timbre, with little room sound. The composed horn part included a three-part harmony during the chorus sections, and a unison part during the pre-chorus section.

The tenor saxophone parts were recorded first, which included two harmony parts during the chorus section and a lead line during the pre-chorus. While recording the two harmony parts for the chorus, Mr. Bailin suggested adding an additional tenor harmony part to help make the section sound a little funkier. Mr. Bailin added a part where every phrase he played the seventh of the D7 chord (the pitch of C). The seventh did give the horn harmony a different character, and it was decided to keep the

part. After recording the tenor parts, Mr. Stackpole performed the baritone part, supplying the low-end timbre of the horn section during the chorus sections. Figure IIC-15 shows the microphone placement during the horn overdubs.

5. Tracking Piano and Organ

The last instruments that needed to be recorded for the modern version were the piano and organ. Phil Reese performed the keyboard parts. The keyboard parts were recorded at a high quality project studio. The piano part was performed on a digital piano and was recorded straight to the DAW using a DI box. Mr. Reese performed several takes of the piano part, and edits were made combining parts of the various takes. The three organ parts, a lead, solo, and rhythm part, needed to be recorded to complete the modern version tracking.

The organ parts were performed on a Hammond A100 organ playing through a Leslie rotating speaker amplifier. Four microphones were used to capture the organ performance, including two microphones in front of the Leslie's rotating horn, one in front of the Leslie's rotating baffle, and one microphone placed a few feet away from the Leslie to capture a distant perspective. Figure IIC-16 shows the microphone placements on the Leslie amplifier. First, the organ lead melodic line, played during the introduction and the chorus sections, was recorded. Second, Mr. Reese performed some chordal accompaniment during the

pre-chorus'. Lastly, the keyboardist performed many different takes of an improvised solo to comprise the second instrumental solo section. Again not wanting to alter the cohesiveness of the solo section, one complete take of the organ solo was chosen as the final track and no edits were performed.

6. Mixing the Modern Version of "Take A Look"

The modern version of "Take a Look" was mixed in the stereo format and featured a wide range of sound effects, including equalization, compression, delay and reverberation. One main characteristic of this version that was to be emphasized in the mix was the separation of the musical parts and the qualities of the different environments. Because the musical parts were recorded separately to their own individual tracks, each sound source received it's own individual treatment of sound effects and position in the stereo sound stage. The environmental characteristics of the recording spaces used in the modern version yielded much drier sound qualities due to the short reverberation times of the spaces. The environmental characteristics of the mix needed to accurately represent the recording process.

The DAW, acting as the multi-track recorder, returned the final edited tracks to the console via digital to analog converters. Once the tracks were on the console, a rough mix was first created to achieve a level musical balance. Work began next on enhancing the sound of the drum kit.

Compression and equalization were used on various parts of the drum kit for various reasons. Partly the compression was used to make the dynamics of the performance more consistent. Compression on the kick drum and the close mic'd snare drum signal also helped to emphasize the attack portion of the sounds. Equalization was used on the kick to boost the low frequencies, and also used to boost attack information (mainly the sound of the beater) in the mid and high frequencies. Equalization was used on the close mic'd snare sound to boost the high-end frequencies to help reveal the timbral detail of the upper frequency range of the snare. The room microphones that captured a distant perspective of the drum kit were mixed in to help form the snare sound. The room signals were gated as to open when the snare was performing. The gated signal was then compressed and mixed in with the close mic'd signal. This addition added timbral interest to the snare as well as making the decay portion of the snare longer.

After making a mix of the drum kit, work began on achieving sounds for the rhythm section and horn section instruments. The bass was compressed to constrain the performance's dynamic range and equalized to attenuate some low frequency information as well as boost some high range information. The guitar sound was a mix of both a close mic'd signal, as well as a distant microphone. The piano was equalized to boost the high frequencies to reveal the upper range timbral detail. The horn section was simply a mix of the individual parts without equalization and

without compression. The horn section was meant to sound very sharp and dry, and to be a faithful representation to how they were recorded.

The vocal featured the most studio effects out of any instrument. The vocal was first compressed to reduce the dynamic range. Next, a plug-in effect in the DAW was used to add some distortion to the vocal. A little distortion added some extra frequency information to the vocal, and made it sound a little less pristine. And finally, a low-level slap-back delay was added to simulate some reflection and to alter the timbre of the dry vocal.

After achieving the intended sound qualities, the amplitude levels of all of the sound sources were again adjusted to achieve a good musical balance. The last effect that was added was a small touch of reverberation to the snare sound, piano, and the organ. The organ needed a little environment so not to sound so dry during the introduction. The environment helped the digital piano sound a little more realistic, and helped the snare sound to last just a little longer.

With the mix balanced and almost finished, the console's automation system was used to take a snapshot of the settings of the console. By doing this, the console could recall the settings of the original mix at a later date should a remix be necessary. With the console's main mix outputs being routed to the DAW, I began recording mix passes. A mix pass refers to the performance of the entire mix, including any sonic adjustments made by the recording engineer. The console's automation system captures and saves any adjustments to the mix performed by the

engineer in real time as the mix plays from beginning to end. Because it is very difficult, if not impossible, for a recording engineer to perform all the sonic adjustments required during the duration of a mix in one pass, several passes are pieced together, each including one or several adjustments.

First, a pass was captured that brought in the instruments one by one into the introduction of the song. This was achieved through the muting and un-muting of sound sources in relation to the order they are introduced into the song. Next, passes were made making volume adjustments to certain sound sources during the mix. For example, the volume of the organ was raised during its solo to make it more prominent than in the other sections. Finally, tracks were faded out and muted to make for a smooth ending to the song, with no sound sources suddenly ending or being cut off. All of these adjustments combined formed the final mix of the modern version. Documentation from the mix session can be referenced in figures IIC-17 through IIC-31.

III. Discussions: Recording, Musical, and Aesthetic Qualities

A. Recording Qualities

1. The Recording Process

Two entirely different approaches were used to capture both the modern and vintage versions of the song. While the modern version had the advantage of having minimal time constraints, a good take had to be captured in one afternoon to have a vintage version. The modern version, including tracking and mixing, consisted of six different sessions, each one averaging about six hours in length (figure IIIA-1). In addition to the tracking and mixing sessions for the modern version, there were many additional hours spent on editing. The vintage version consisted of two sessions: one eight-hour tracking session, and one eight-hour mixing session (figure IIIA-2). For the vintage version, no time was spent on editing. Tracking each musician and part separately, as was done in the modern version, removes pressure from the players and the engineer. The player can lay down some tracks that they are very happy with, and the engineer can spend extra time editing any parts he/she feels necessary for the project. For the vintage version, if any one person involved in the project makes a mistake during tracking it could potentially result in a take being unusable. The energy of the group needs to be preserved so that each take has the potential to be the final take.

Modern recording practices allow for so much control and variability along the entire process. Environments can be added during the

mixing process, parts can be re-recorded or removed, a mix can be automated in great detail, etc. Using past recording practices, many decisions have to be made during the one tracking sessions, and the results of these decisions are very difficult to alter at a later time. The timbre of the sound-sources, the environmental qualities, the musical arrangement, etc., all have to be thought about and committed to in one recording session.

2. Environmental Qualities

Listening to both the modern and vintage versions, one audible difference exists regarding the environmental qualities of the two recordings. First, both were tracked in entirely different spaces. The vintage version was recorded in one space, a highly reverberant band-rehearsal room with little acoustical treatment. The modern version was recorded in multiple different spaces, including an acoustically designed medium sized room, an isolation booth, and a home studio space. All the spaces used in the modern version had low reverb times. While the vintage version sounds very live and reverberant, the modern version sounds very dry and tight.

Sound qualities in music recordings provide the listener with a sense of distance (e.g. how far away a sound source is perceived as being from the listener), environment (e.g. the audible qualities of the recording space(s)), and in the case of stereo sound reproduction, a sense of width

(e.g. how much lateral space the sound source consumes, and the width of the entire sound stage). For spatial characteristics in mono recordings, listeners can only perceive distance and environmental qualities due to the fundamental requirement that two sources (loud speakers) need to emit sound for lateral information to be determined.

a. Perception of Distance

There are sound qualities in the vintage version that lend to different perceptions of distance for each sound source. Some sound sources sound close to listener, while others sound distant. The perception of distance according to Dr. William Moylan is "primarily the result of timbral information and detail" [28]. A sound source with a high level of timbral detail will be perceived as being closer to the listener, while one with a low level of timbral detail will become distanced from the listener. Both the guitar and vocals in the vintage version are perceived as being close. Because they were recorded with good isolation and because they are not being masked by other elements of the mix, details can be clearly heard which lead hem to be perceived as being closer to the listener. Other instruments on the other hand, including the drums, bass guitar, and piano, are perceived as being further away. This distance perception is due to the loss of timbral detail that results from many factors of the recording process.

Listening to the isolated drum kit, one can hear attack information in the kick and the snare that make them sound close. The drums in the full mix sound distanced due to the combination of the accumulation of microphone bleed, and the loss of timbral detail caused by masking in the frequency and amplitude domains. The microphone bleed adds competing amplitude and frequency information to the close mic'd drum signals. This bleed leads to the masking of timbral detail, as well as environmental cues such as reverberation and reflections that add to the distancing effect.

The bass guitar loses important timbral detail also due to masking by other instruments in the mix. Also, because of high amounts of microphone bleed, the bass loses timbral detail with the accumulation of reflections and room sound. The loss of attack detail and the accumulation of reflections distanced the bass away from the listener. The piano loses much timbral detail through competition in the mix with other instruments occupying the same spectral range. This makes the piano harder to hear and gives the perception that it is farther away.

The modern version differs in that most of the instruments are perceived as being close to the listener. All of the instruments in the modern mix were recorded with closely placed microphones and the issue of masking was resolved in several ways. Through the use of panning, giving each sound-source its own specific

location in the stereo sound stage resulted in less frequency and amplitude competition. This allowed for important timbral information to be retained and for instruments to remain close in perception. Also, equalization was used when sound sources competed with one another in the frequency domain. The piano in the modern mix was also competing with other mid-range instruments, thereby becoming distanced. In this case, however, a boost in the high-frequency content of the piano revealed timbral and attack information that allowed it to become more easily audible.

b. Perception of Environmental Characteristics

Each individual sound-source from the vintage version, if listened to separately, contains it's own individual environmental characteristics. When all the sound-sources are combined and a full mix is created, the individual environmental characteristics combine with one another to form a global environment. The qualities of the global environment are in some cases very different than the qualities of individual sound-source environments. Examples of differences in individual and global environmental qualities can be heard in both the bass guitar and drums. The bass when isolated in the mix sounds very close and dry, despite having been recorded in a large space. Other instruments can be heard in

the bass signal due to microphone bleed, and this microphone bleed lends some perception of space. The close position cardioid microphone is receiving a high amount of really close direct bass sound and is attenuating the later arrival of off-axis room reflections. The sound of the bass has entirely different environmental characteristics in the mix. The environment of the bass in the full mix is highly reflective. The bass sound is big and muddy due to the amount of audible room reflections added from the accumulation of microphone bleed in each individual sound-source. Each note from the bass takes longer to decay in the full mix due to the added reflections.

The drums as well have different environmental characteristics when heard individually and heard in the context of the full mix. Listening to the isolated snare drum, much timbral detail is heard in the initial sounding of the snare, and following is an array of room reflections, which adds a low-level reverberation tail to the snare hit. In the isolated drum sound, there is a great amplitude distance between the direct sound and the room reflections. This similar quality can also be heard in the kick drum with a close direct sound followed by a low-level reverberation tail. The environmental characteristics of the kick and snare differ greatly in the context of the entire mix. Here, the amplitude difference between the direct sound and room reflections becomes

smaller. The amplitude of the room-reflections gets raised due again to the accumulation of drum sounds in the other microphones placed around the room. The snare and kick both take a longer time to decay. This global environment affects the kick drum in the same way that it affected the bass guitar, and makes it sound much larger and muddy.

Because each individual sound-source was recorded separately in the modern version, individual environmental characteristics were retained, and their combination leads to a different perception of global environment. The individual environments of sound-sources in the modern version were not very reflective, thereby resulting in low reverberation decay times. The accumulation of all the sound-sources gave a dry quality to the global environment. Artificial reverberation was added to some sound-sources, including the snare drum, organ, and piano. This artificial reverberation was added to simulate a small amount of room reflections to help slightly change the timbre of the sound-sources as well as making their decay time longer. Where in the vintage version each sound-source shared the same environmental traits, the modern version was a collection of different individual environments. The vintage version has a cohesive environmental quality that binds the sound-sources together, whereas the modern environmental quality at times separates the sound-sources and

enhances the fact that they were not a part of the same performance.

c. Perception of Width: The Stereo Sound Stage

With the modern version mixed in stereo, a width dimension was available and sounds were positioned in a lateral sound stage. This gave each sound-source its own unique position, allowing them to be more easily heard. Some sound-sources were recorded with stereo microphone placements, which allowed them to take up a larger area on the sound stage. The Leslie rotating speaker that amplified the organ was recorded using a stereo technique, and with the left and right signals hard panned to the edges of the sound stage, the rotating speaker effect was enveloping and resulted in some nice sonic interest.

The drums also gave the perception that they took up a large width in the stereo field. The piano took up stereo space with different ranges of the piano occupying different points on the sound stage. The contrast between mono sources and stereo sources provided much spatial diversity and made each element of the mix more unique and more easily audible.

Because the vintage version was mixed in a mono format, no sound stage width could be created. The mono mix is played back through a single loudspeaker, whereas two loudspeakers are

need for stereo sound. This mix lacked the spatial diversity that can be used to help reveal instruments and add interesting spatial effects. Because all of the sounds were layered on each other in the same point in space, they competed heavily with each other, adding to the negative masking effect.

3. Sound Effects

Many sound effects were used in the modern mix including equalization, compression, gating, delay, distortion, and reverberation. The effects were sometimes used to enhance timbral details of sound sources, stabilize dynamics, fix unwanted qualities of a sound, or to add extra sound qualities to give a part more sonic interest [8, 28]. The vintage version features only some spring reverberation and a small level of added distortion on the vocal part. Aside from the vocals, the vintage mix is an accurate representation of how the band was recorded live. Many contrasting sound qualities exist between the vintage and modern version due to the different uses of studio effects.

a. Dynamics

Compressors were used in the modern version to constrain the dynamic range of many parts of the mix. The use of compression results in parts having more stable and less fluctuating dynamic properties. For the kick and snare drum,

compression was used to emphasize a portion of the signal's dynamic envelope. In this case, a compressor was used to enhance the attack portion of the drum sound. The lead vocal part, because compressors were used, sounds stable and has less fluctuating loudness than compared with the originally recorded lead vocal track. Due to the constrained dynamics of individual sound sources, the mixing engineer has much more control over the global dynamics of the mix.

The dynamics of the individual instruments as well as the global loudness of the entire mix is much more variable and less controlled in the vintage version. Many times throughout the vintage version one can hear the lead vocal get louder during intense parts, quieter during soft parts, and also fluctuate in loudness as the singer moves towards and away from the microphone. While all of these sound qualities are realistic to the performance, often times they are not desired by a mixing engineer.

A sudden decrease in volume of the lead vocal for example can make some words or phrases harder to discern, while a sudden increase in volume may be distracting and may mask other sound-sources. Many examples of dynamic fluctuation can be heard on the lead vocal track of the vintage version. On the very opening line of the first verse, "No matter how hard I try", one can hear the

volume start low and then quickly rise up. This sounds as if the vocalist started singing away from the microphone and quickly moved in to continue the verse. Other dynamic fluctuations can be heard on the lead vocal during this first verse. Instances of higher performance intensity exhibit increased loudness levels. The horn section was also difficult at times to balance due to the unavailability of compression. Some hits during the chorus sections were soft, while other times the trombone really poked out with some loud notes.

b. Equalization

In the vintage version, the spectral qualities of sound-sources were not altered during the mixing process. The spectral qualities of sound-sources in the final mix are a good representation of how they were originally recorded. Many parts of the mix could have benefited from use of equalization to fix unwanted qualities, enhance desired qualities, reduce masking to increase audibility, or balance the global spectral qualities of the entire mix. The kick drum could have benefited from having a boost in the higher frequency range to enhance its attack characteristics. To make this change the engineer would either have had to consider possibly a different microphone, a different placement, or maybe both. The rhythm section instruments (drums,

bass, guitar, and piano) are often competing spectrally with one another and are causing much masking to take place. The accumulation of mid-range information in the mix causes much masking of the piano, and also masks the attack details of many of the instruments. Complimentary boosts and cuts in certain frequency ranges of the rhythm section could have helped to reveal desired sound qualities and increase audibility.

The vintage mix had some imbalances in spectral information in regards to the entire mix. There was more spectral information in the low and middle frequency ranges, and less in the high frequency ranges. The accumulation of low frequencies can be heard as a muddy and booming sound quality, mainly due to the recording environments inability to absorb low frequencies. Low-frequency information was allowed to build in the space and took a longer time to decay. Equalization on the individual and global level may have helped to resolve these unwanted imbalances.

c. Distortion, Delay, and Reverberation

Distortion, delay, and reverberation were processes used to add additional timbral interest. These processes we analogue effects in the vintage version, and digital effects in the modern version. The lead vocal track of each version were treated with similar effects, however, the resulting sound quality ultimately

sounded very different. Both tracks had a little distortion added to the original signal. The distortion in the vintage version is very noisy and extreme. It was achieved during the tracking process by recording a duplicate vocal signal to an empty tape track using extremely high input levels, causing the tape track to saturate and distort the signal. A little of this signal was added to the original during the mixing process to give the vocal an edgier, dirtier quality.

The distortion in the modern version was achieved through the use of a software plug-in. This plug-in effect had many adjustable parameters, including variability in the amount of 2nd and 3rd harmonic distortion. This effect was used to create additional spectral information to the lead vocal, meant to make it sound a little less clean. The two distortions were achieved through different means and yield two different sound qualities.

Like the use of distortion, delay and reverberation were both used on the lead vocal tracks but yielded entirely different sound qualities. In the vintage version, an analog spring reverberation unit was used with the lead vocal to simulate a large environment. These reverberation effects, along with echo chambers and plates, were heavily used during the 60's to simulate highly reflective environments. Reverberation effects in this style usually feature many reflections and a long decay time, usually

between 1-2 seconds. The spring reverberation has a long decay time, and gives the impression that the vocal was recorded in a very large space. This provides a very similar sound quality to vocal treatments of the 60's.

The modern lead vocal track featured the use of a delay software plug-in. This digital delay was used to simulate some low-level, short reflections. Because the entire modern mix sounds very dry, a reverb with a long decay time simulating many reflections would have sounded out of place. This delay adds subtle additional reflections, and smoothes the timbre of the vocal due to the short time between the direct signal and the arrival of the reflections.

4. Recording Technologies

Different sound qualities can be heard through the different technologies used in the vintage and modern version. The multi-track recorders highly affect the global sound qualities of the recordings. The modern version was recorded using high-quality digital converters in combination with computer processing, while the vintage version was recorded with an analog tape recorder in combination with 2'' analog magnetic tape. Noise and audible distortion due to the multi-track recorder was minimal if not inaudible in the modern version. The digital recording system exhibits a very low noise floor. Adversely, the vintage version

contains much more noise due to the analog system. Signals were recorded to tape with no noise-reduction technologies, which raises the noise floor significantly. Listening to the introduction of the vintage version provides many examples of the audio qualities representative of the analog system. First, the tape hiss is heard. Along with the tape hiss, various audible pops and clicks are introduced. These imperfections add the low-quality characteristic to the recording, which again is comparable to 60's recordings.

B. Musical Qualities

While both versions are performing the same piece of music, the final performances captured for the vintage and modern versions exhibit some differing traits. Differences exist in tempo, performance intensity, and performance quality. The vintage version is performed a bit quicker than the modern version. While the modern version has a more laid back feel with the tempo locked at 122 beats per minute (bpm), the vintage version is constantly pushing ahead at a faster speed, with a musically accelerating and decelerating tempo ranging from 125 bpm to 128 bpm.

The musicians play with more performance intensity in the vintage version. In every section you can hear the musicians excitedly giving energy out of their instruments, and it is hard for the energy to be restrained. While the performance intensity is more static in the vintage version, the modern version exhibits more changes in performance intensity. The introduction builds energy

and retracts for the verse, builds again to the chorus and retracts at the beginning of the second verse, etc. There is lots of changing performance intensity, which helps drive movement and keep the song moving forward.

Lastly, there are differences in performance quality. The performance quality includes pitch accuracy, rhythmic accuracy, how well the group transitions between sections, etc. Many of these qualities were manipulated for the modern version through the editing process. There are some mistakes heard in the vintage version where someone plays a wrong rhythm or a wrong note. These are aspects of the live performance and could not be changed. Many of these mistakes were made during the tracking of the modern version as well, however, these mistakes could be fixed through editing, and only the best parts are heard in the final mix.

C. Aesthetic Qualities

Each version inhibits a unique perception of the musical message, and each individual listener will have a unique perception. Simply, the vintage version captures the feeling of a live performance, while the modern version projects quality and accuracy. The listener feels as if they are listening to a live band performance in a single space when listening to the vintage version. One can hear the size of the room, the distance between themselves and the musicians, and feel the intensity of the groove. One can also hear qualities reminiscent of old recordings in the sound of the instrumental arrangement, spring reverberation, tape noise, the mono mix, and muddy sound quality of the large room. With all its sonic and musical imperfections, the vintage version accurately captures the

performance and the energy created only when the musicians are allowed to interact with one another and create a unique music experience.

The modern version exhibits high recording quality and a high level of musical quality. Through the process of capturing each instrument separately, editing, and mixing in stereo with the free use of effects, the modern version reveals a wide soundstage containing instruments with unique sound qualities that are easy to hear. One can clearly hear the separation of parts in the modern version and how each has its own space to exist. The modern version lacks a sense of communication and groove between performers, which is due to the fact that all of the performances were recorded individually and not together. The element of live music creation and interaction amongst performers is not as present in the modern version as it is in the vintage version.

IV. Conclusions

Different production practices can be used to achieve different sonic results. If an artist or engineer wants achieve a certain aesthetic outcome with their recording, every individual production decision needs to be deliberate and carefully considered. To achieve the booming and competing sound qualities of the vintage version, the band had to perform live in the same space. That specific sound quality could not be achieved by recording the instruments separately. The same is true for the modern version. If an engineer wants to emphasize fidelity and intimacy with each instrumental performance, the engineer should perhaps consider not recording them all together in a highly reflective space to a noisy recording medium. These simplified examples emphasize that individual production decisions should be made with the anticipation of the final musical message and how it should be perceived. The technologies and recording techniques are tools that can be used together to achieve desired sound qualities.

Despite the differences in sound quality between the two recordings, both have unique aesthetic qualities and both deliver a unique musical experience. The vintage version features a less polished and rougher sound quality due to masking and the interaction of sound sources in the live room. Also, the energy of the musicians interacting with one another is very accurately captured in the vintage version. The modern version is enjoyed on many levels of musicality and fidelity, and the performance features more individual parts rather than a group dynamic. While the modern version allows for intense control over all parameters of the recording process, there is a diminished sense of the live art of creating music amongst musicians, which the vintage version clearly contains.

V. Recommendations

Production decisions made for the recording of the vintage version were limited to the technologies and resources available. Many aspects of the vintage version were accurate representations of past recording practices, and some were not. A more accurate production might employ a sixties era recording console and tape machine, as well as some older built microphones. Collecting the resources to make some of these additions would provide an interesting comparison to this vintage recording.

In addition to a vintage and modern version, a third "hybrid" version could be recorded which is a combination of both production styles. Thoughtfully combining elements from both productions could yield unique sound qualities. Perhaps the drums and bass could be recorded separately for high quality, but have the rest of the rhythm section recorded together to add some live elements. Desired qualities from each production could be integrated to form a third additional recording for comparison. This recording would effectively yield yet another different, but no less valid aesthetic result.

VI. Literature Cited

1. Guralnick, Peter. *Sweet Soul Music*. New York: Back Bay Books / Little, Brown and Company, 1986. pp. 2-32

2. "Industry Legend Jerry Wexler Dies at 91". *Billboard.com*. <http://www.billboard.com/news/industry-legend-jerry-wexler-dies-at-91-1003839539.story#/news/industry-legend-jerry-wexler-dies-at-91-1003839539.story>

3. Ertegun, Ahmet. *"What'd I Say"- The Atlantic Story: 50 Years of Music.* New York: Welcome Rain Publishers, 2001

4. Cogan, Jim and Clark, William. *Temples of Sound*. San Francisco: Chronicle Books LLC, 2003. p. 46, 130, 170

5. Charles, Ray. "I've Got a Woman". *The Best of Ray Charles: The Atlantic Years*. Rhino/Atlantic, 2007. CD.

6. Cunningham, Mark. *Good Vibrations*. London: Sanctuary Publishing Limited, 1998. p. p. 48, 49, 56, 57, 59

7. Neumann.Berlin. *Operating Instructions For Condenser Microphones M 49b/M 50b and Accessories*. 1960. <http://eee.neumann.com/?lang=en&id=hist_microphones&cid=m49_publications>

8. Case, Alexander U. *Sound FX - Unlocking the Creative Potential of Recording Studio Effects*. Oxford: Focal Press, 2007

9. Huber, David M. *Modern Recording Techniques.* 5th ed. Burlington, MA: Focal Press, 1997

10. Brice, Richard. *Music Engineering.* 2nd ed. Burlington, MA: Newnes, 2001

11. Bartlett, Bruce, and Jenny Bartlett. *Practical Recording Techniques.* 3rd ed. Burlington, MA: Focal Press, 2002

12. Davis, Gary, and Ralph Jones. *Sound Reinforcement Handbook*. 2nd ed. Milwaukee: Hal Leonard, 1989

13. Daley, Dan. "Steve Cropper". *Mix Online*. Published by Penton Media

14. Jackson, Blaire. "Classic Tracks: Ray Charles' 'What'd I Say'". *Mix Online*. Published by Penton Media

15. Charles, Ray. "What'd I Say, Pts. 1&2". *The Best of Ray Charles: The Atlantic Years*. Rhino/Atlantic, 2007. CD.

16. Booker T. & The MG's. "Green Onions". *The Stax Story*. Stax, 2000. CD.

17. Sam & Dave. "Hold On, I'm Coming". *The Best of Sam & Dave*. Atlantic, 1987. CD.

18. Redding, Otis. "Respect". *Otis Blue/Otis Redding Sings Soul.* Rec. 1965. Atco, 1991. CD.

19. Sam & Dave. "Soul Man". *The Best of Sam & Dave*. Atlantic, 1987. CD.

20. Burke, Solomon. "Soul Meeting". *The Very Best of Solomon Burke*. Atlantic, 1998. CD.

21. Franklin, Aretha. "Dr. Feelgood (Love Is a Serious Business)". *I Never Loved a Man the Way I Love You.* Rec. 1967. Rhino, 1995. CD.

22. Floyd, Eddie. "Knock on Wood". *The Stax Story*. Stax, 2000. CD.

23. Brown, Ruth. "Mama He Treats Your Daughter Mean". *Ruth Brown-Miss Rhythm (Greatest Hits and More).* Atlantic, 1989. CD.

24. Sam & Dave. "I Take What I Want". *The Best of Sam & Dave*. Atlantic, 1987. CD.

25. Redding, Otis. "Down In The Valley". *Otis Blue/Otis Redding Sings Soul.* Rec. 1965. Atco, 1991. CD.

26. Redding, Otis. *Otis Blue/Otis Redding Sings Soul.* Rec. 1965. Atco, 1991. CD.

27. Sam & Dave. *The Best of Sam & Dave*. Atlantic, 1987. CD.

28. Moylan, William. *Understanding and Crafting the Mix: The Art of Recording*. 2nd ed. Burlington, MA: Focal Press, 2007. p. 190

29. Newell, Phillip. *Recording Studio Design.* Burlington, MA: Focal Press, 2003

30. LaRue, Jan. *Guidelines for Style Analysis.* 2nd ed. Warren, MI: Harmonie Park Press, 1992

31. Simons, David. *Studio Stories.* San Francisco: Backbeat Books, 2004

32. Various Artists. *The Stax Story*. Stax, 2000. CD.

33. Franklin, Aretha. *I Never Loved a Man the Way I Love You.* Rec. 1967. Rhino, 1995. CD.

34. Cooke, Sam. *Night Beat.* RCA, 2001. CD.

35. Pickett, Wilson. *In the Midnight Hour*. Atlantic, 1993. CD.

36. Green, Al. *I'm Still In Love With You*. Hi Records, 2003. CD

37. Brown, James. *James Brown: 40th Anniversary Collection.* Polygram, 1996. CD.

38. Thomas, Carla. "Gee Whiz". *The Stax Story*. Stax, 2000. CD.

39. Thomas, Rufus. "Walking The Dog". *The Stax Story*. Stax, 2000. CD.

40. Floyd, Eddie. "Knock on Wood". *The Stax Story*. Stax, 2000. CD.

41. Hayes, Isaac. "Walk on By". *The Stax Story*. Stax, 2000. CD.

42. The Mar-Keys. "Last Night". *The Stax Story*. Stax, 2000. CD.

43. Porter, David. "Can't See You When I Want To". *The Stax Story*. Stax, 2000. CD.

44. Bell, William. "You Don't Miss Your Water". *The Stax Story*. Stax, 2000. CD.

VII. Illustrations

Figure ID-1 – Photo of STAX recording studio

<http://staxrecords.free.fr/studioA.htm>

Figure IIA-1 – “Take A Look” score (page 1)

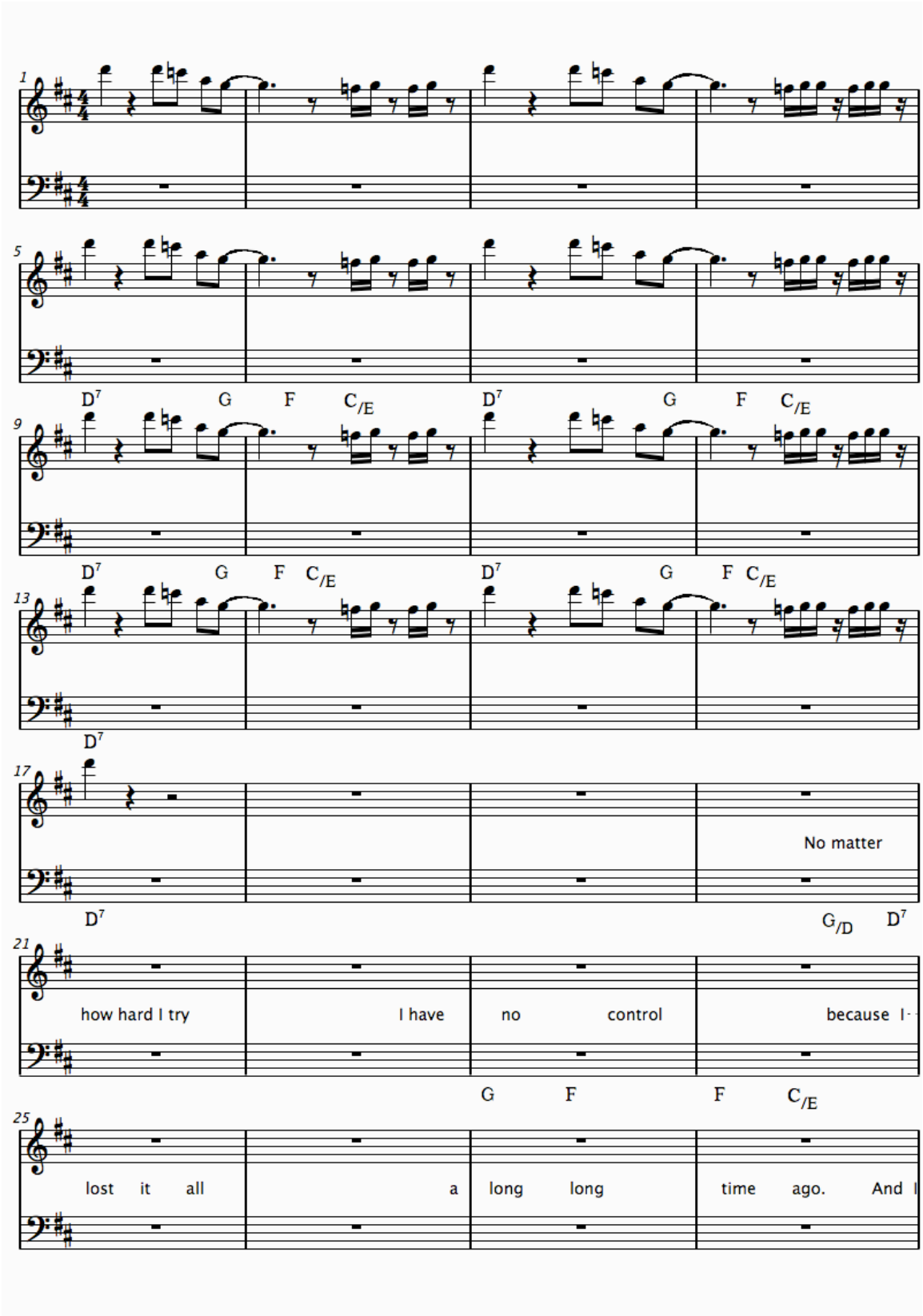

Figure IIA-2 – “Take A Look” score (page 2)

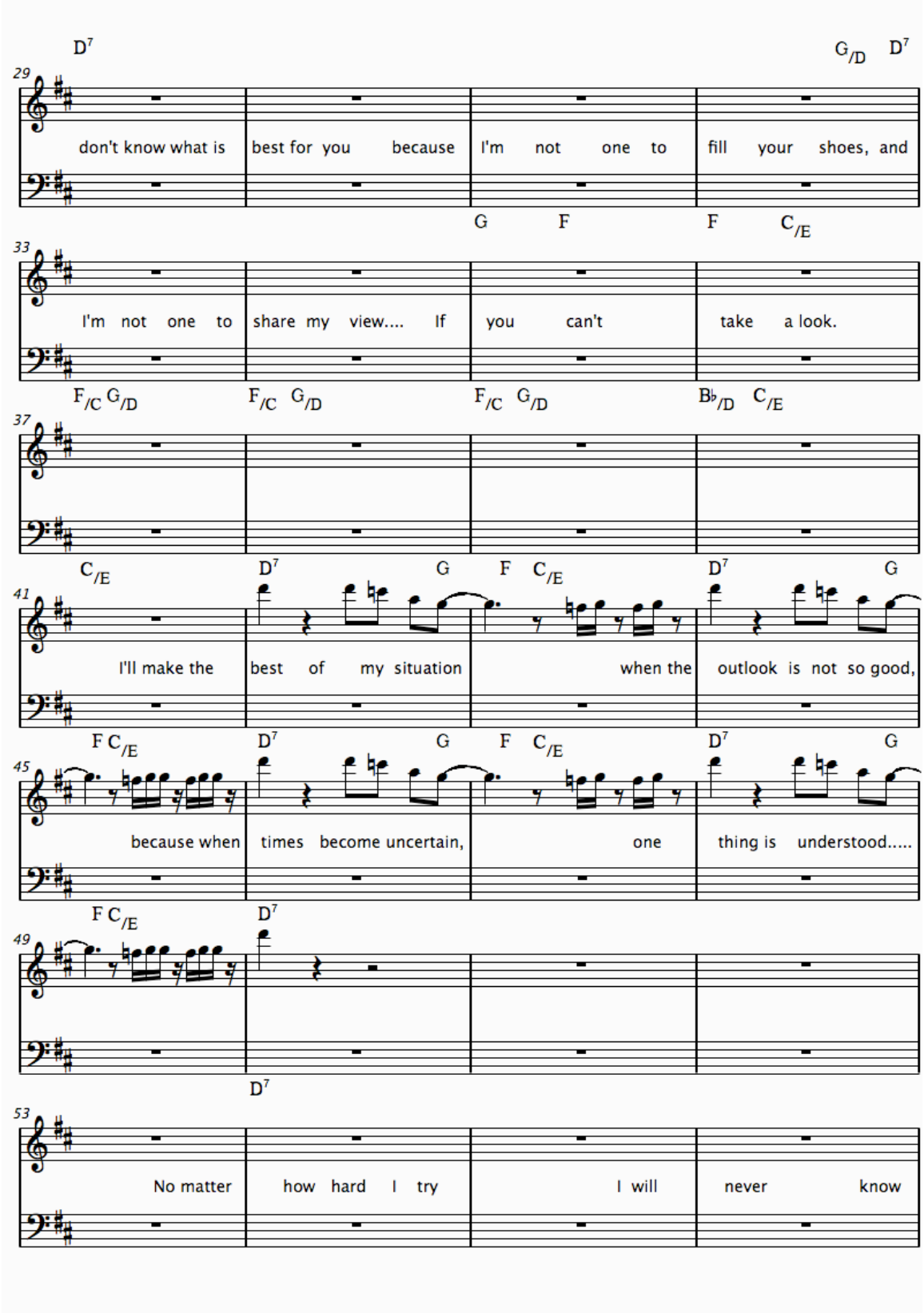

Figure IIA-3 – “Take A Look” score (page 3)

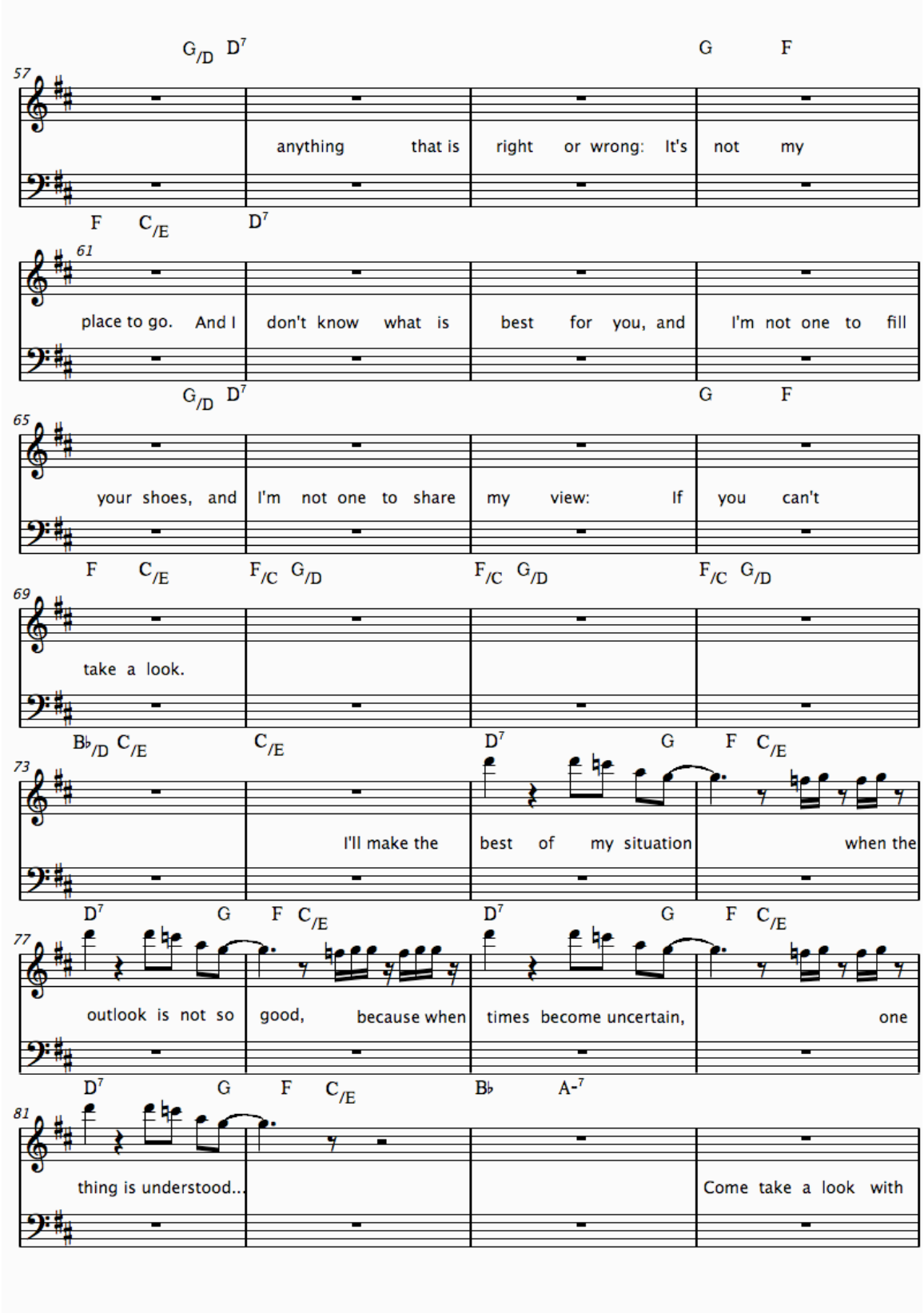

Figure IIA-4 – “Take A Look” score (page 4)

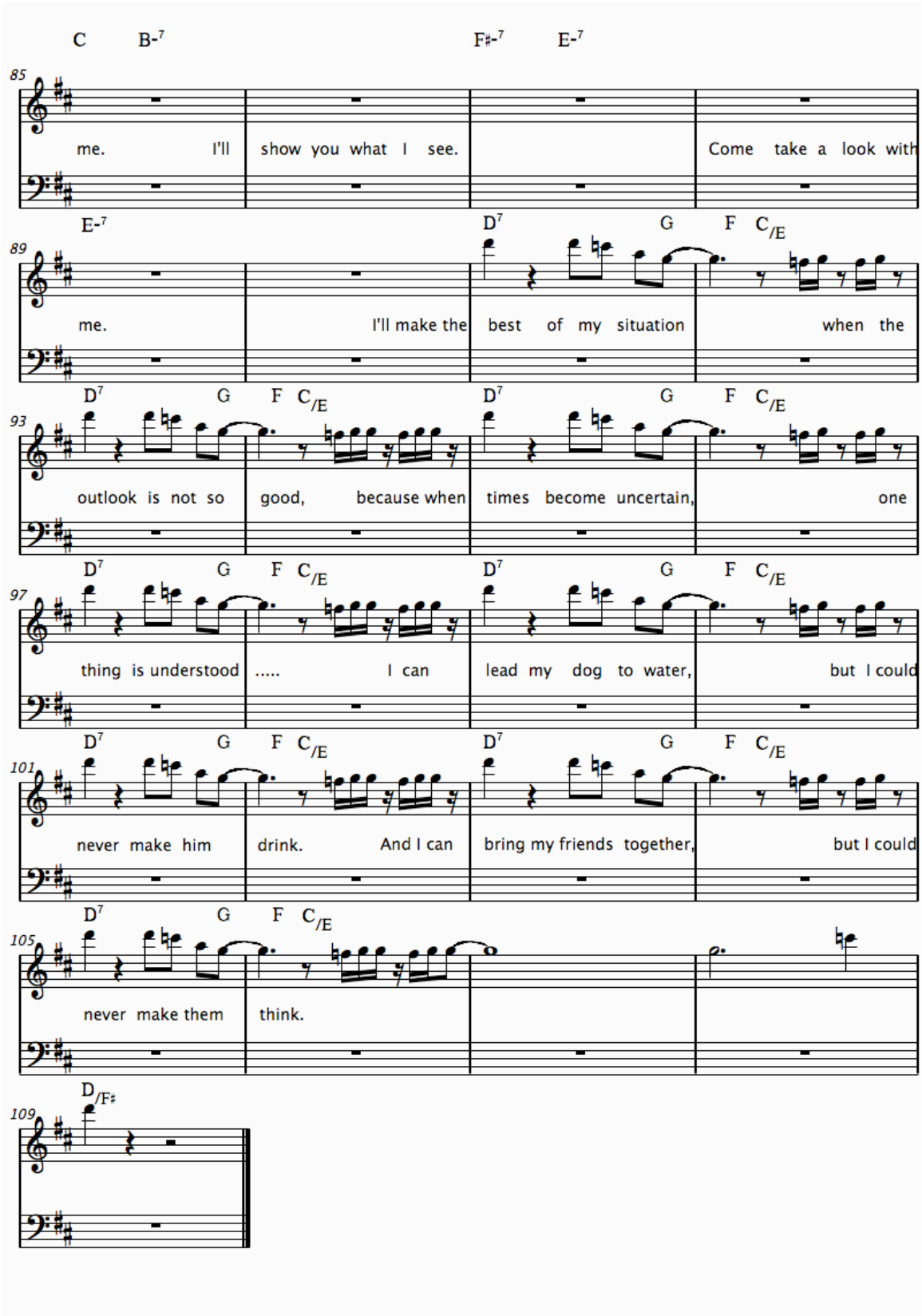

Figure IIA-5 – “Take A Look” horn section parts (page 1)

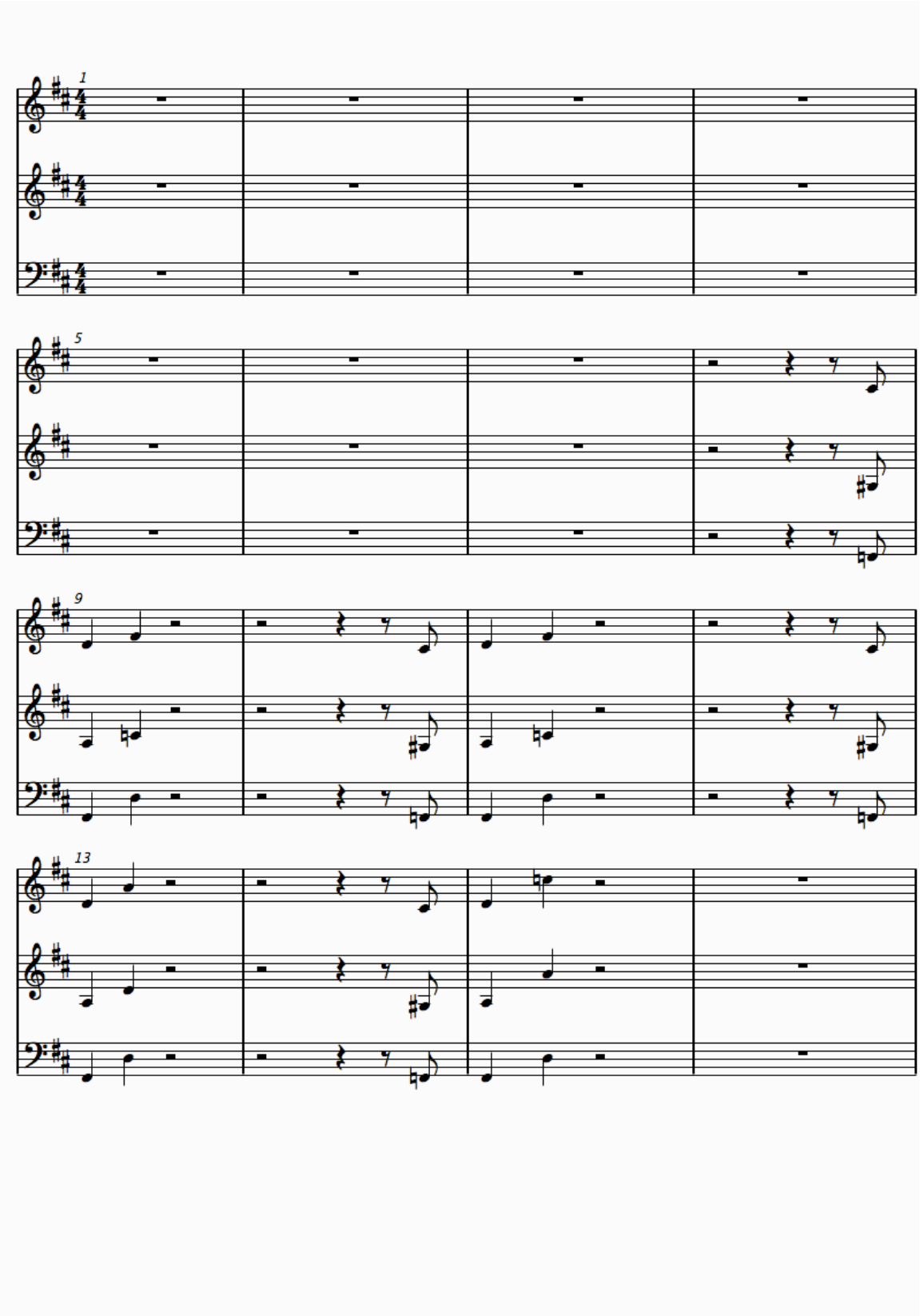

Figure IIA-6 – “Take A Look” horn section parts (page 2)

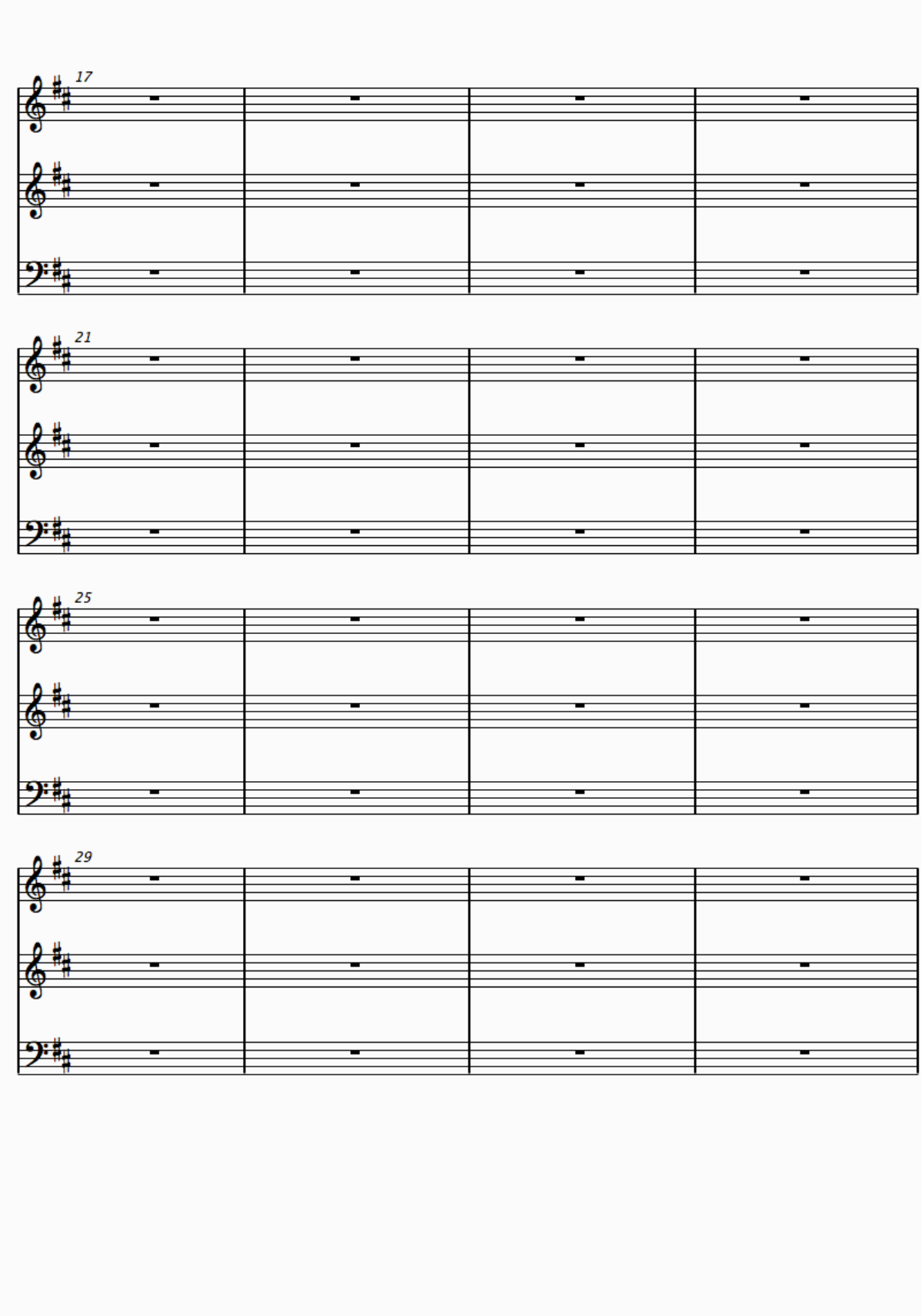

Figure IIA-7 – “Take A Look” horn section parts (page 3)

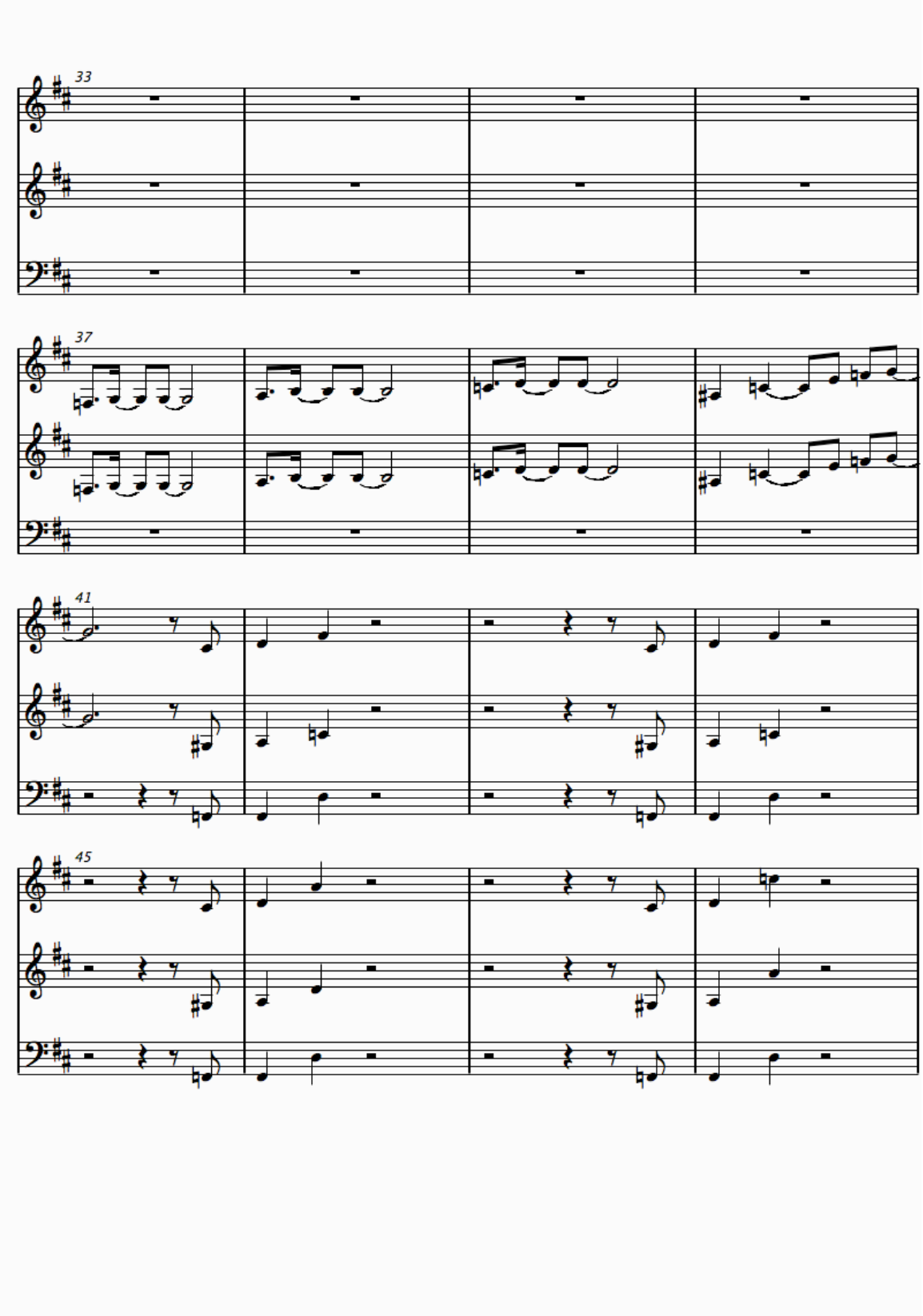

Figure IIA-8 – “Take A Look” horn section parts (page 4)

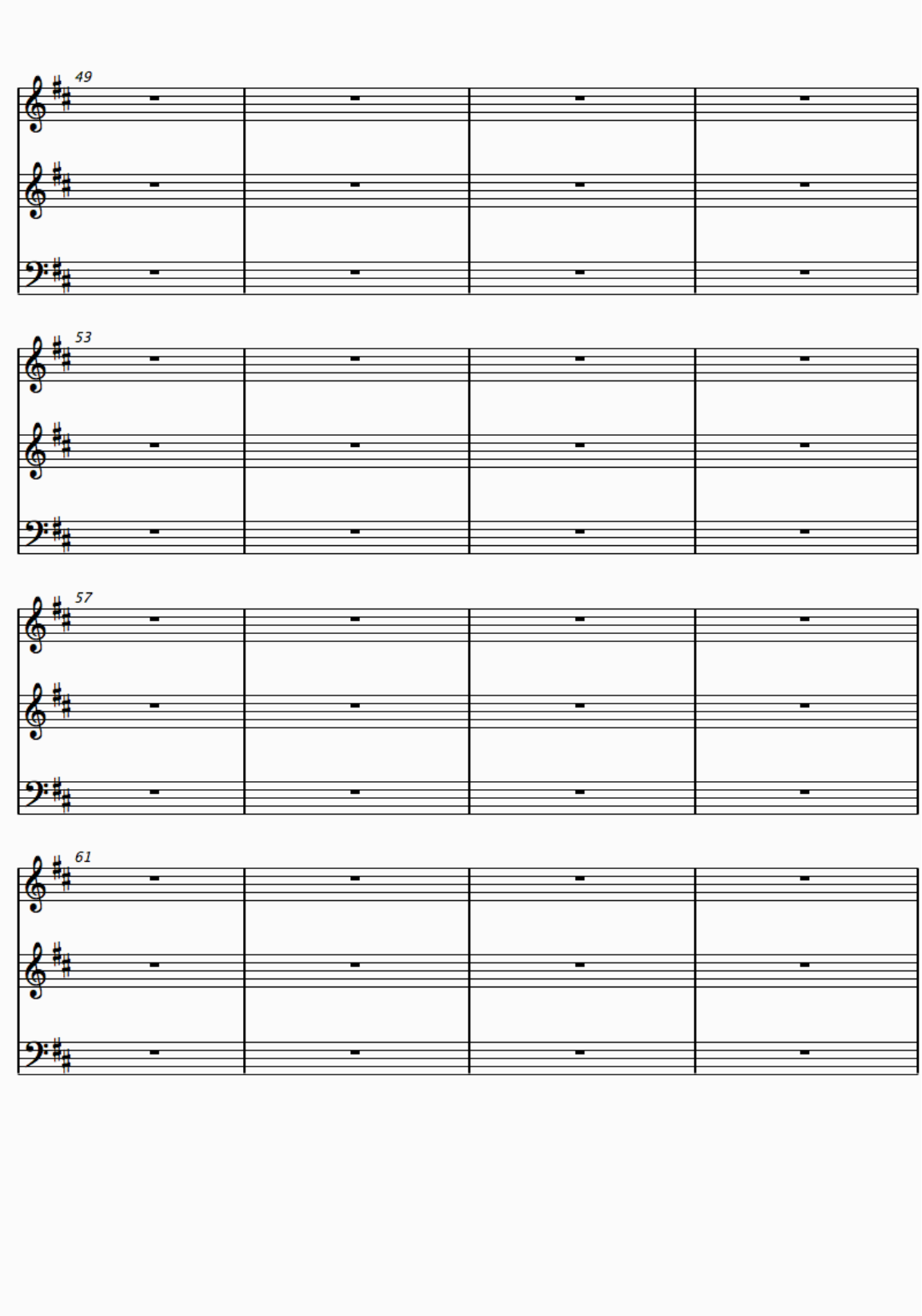

Figure IIA-9 – “Take A Look” horn section parts (page 5)

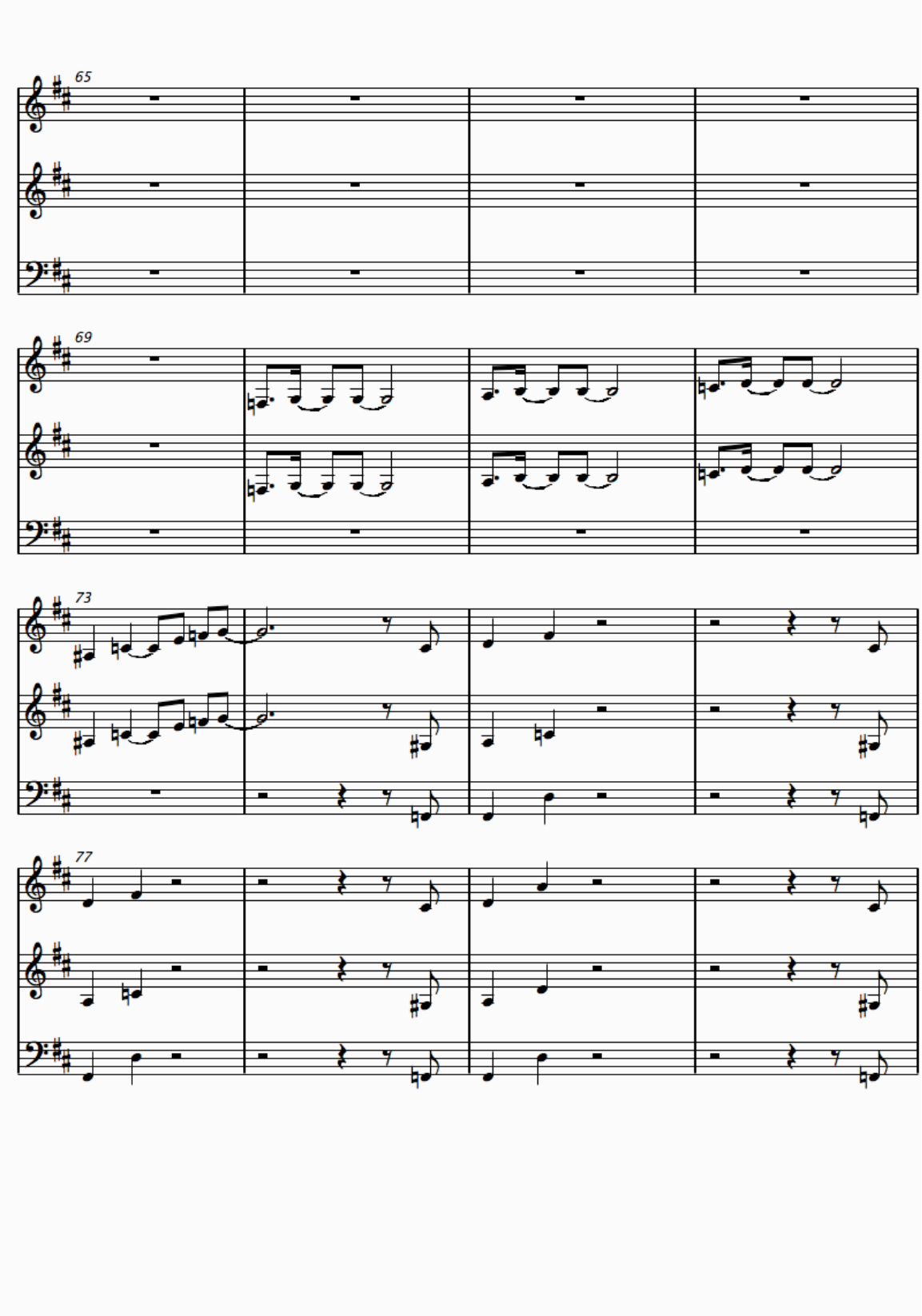

Figure IIA-10 – “Take A Look” horn section parts (page 6)

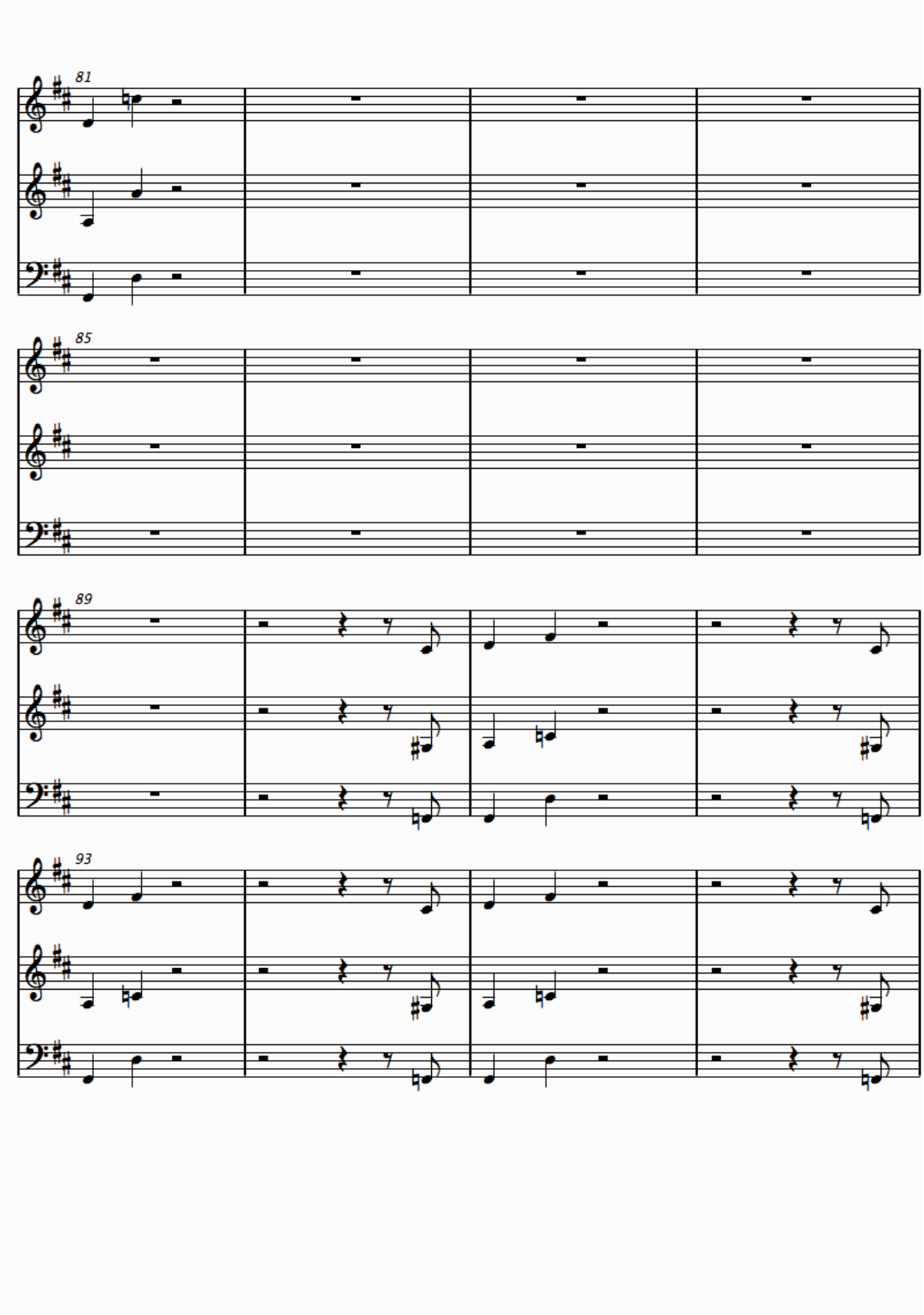

Figure IIA-11 – Horn section parts (page 7)

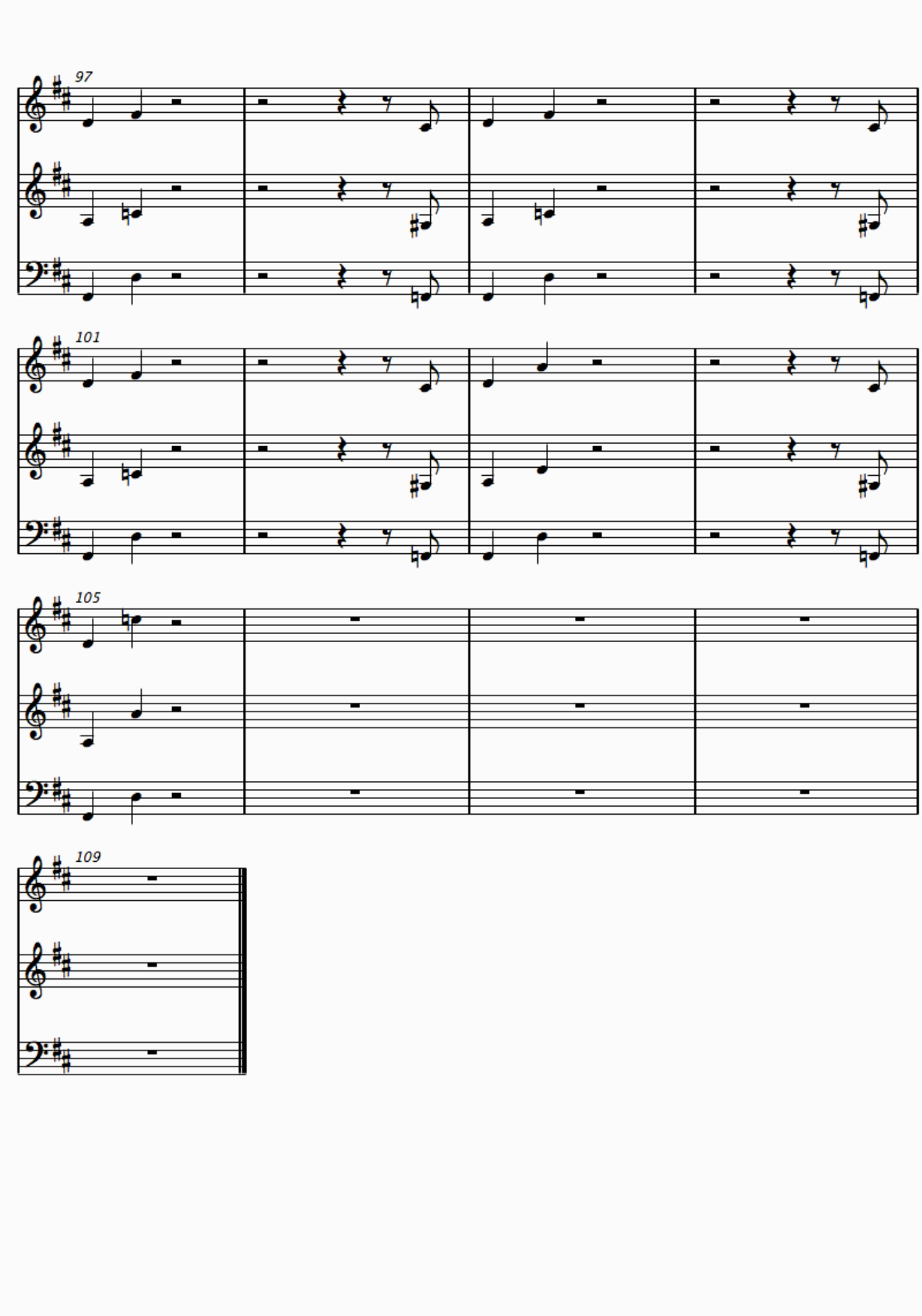

Figure IIB-1 – Room 113 floor plan

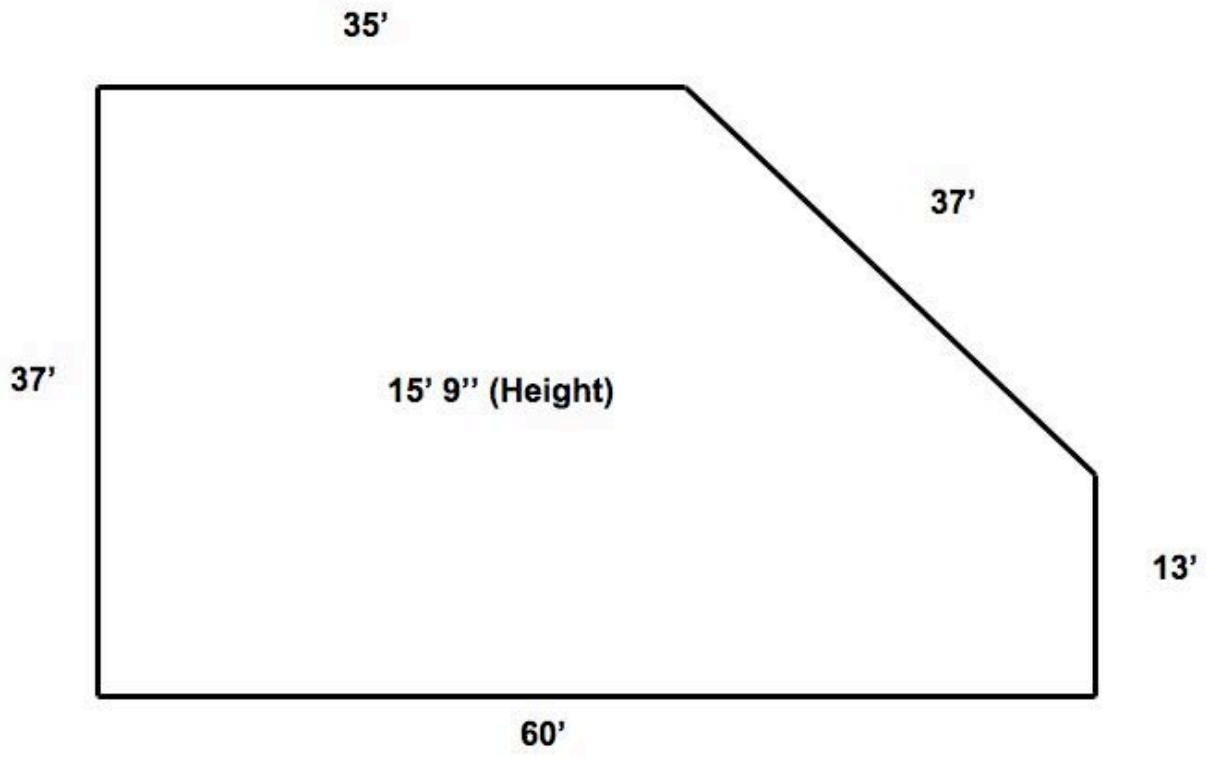

Figure IIB-2 – Room 113 cross section

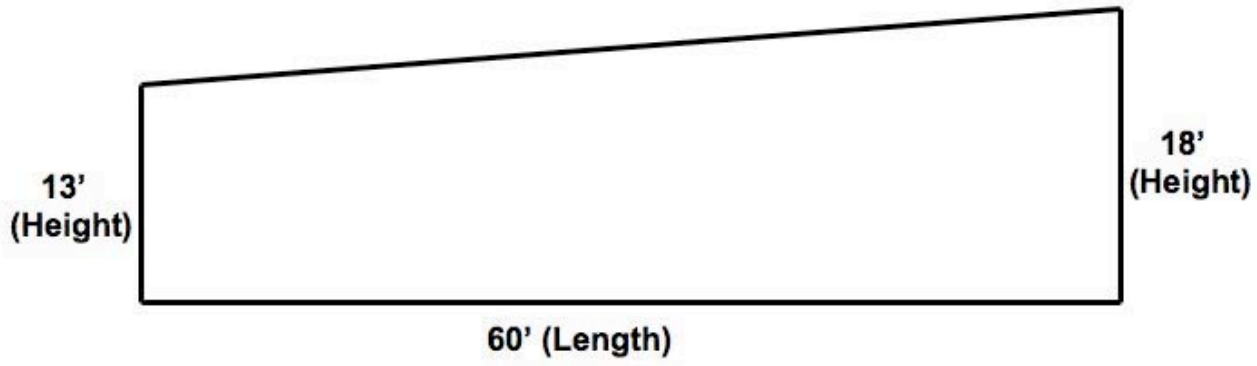

Figure IIB-3 – Vintage version microphone input sheet

MICROPHONE INPUT/ASSIGNMENT SHEET

Sound Recording Technology
University of Massachusetts Lowell
35 WILDER STREET SUITE 3
LOWELL, MASS 01854
(978) 934-3850

Date: 1/18/09 Page: ___ of
Studio/Machine: UML 113/213 Stider800
Course/Lab: Master's Thesis
Eng/Assist: Matthew Zaragoza / Logan Pathack
Artist: "Take a Look" BAND

INPUT	PREAMP	TRACK	INSTRUMENT	MIC	NAME/OTHER
1	API	1	Kick	D112	
2		2	Snare	SM57	
3		3	Snare TOP	AKG C414	
4		4	OH	M147	
5		5	Bass	RE20	
6		6	Piano	U87	
7		7	ORGAN	421	
8		8	GTR	SM57	
9		9	Vox	M147	
10		10	Horns	Royer R121	
11		11	Room	TLM103	
12	✓	12	Room	TLM103	
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
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44					
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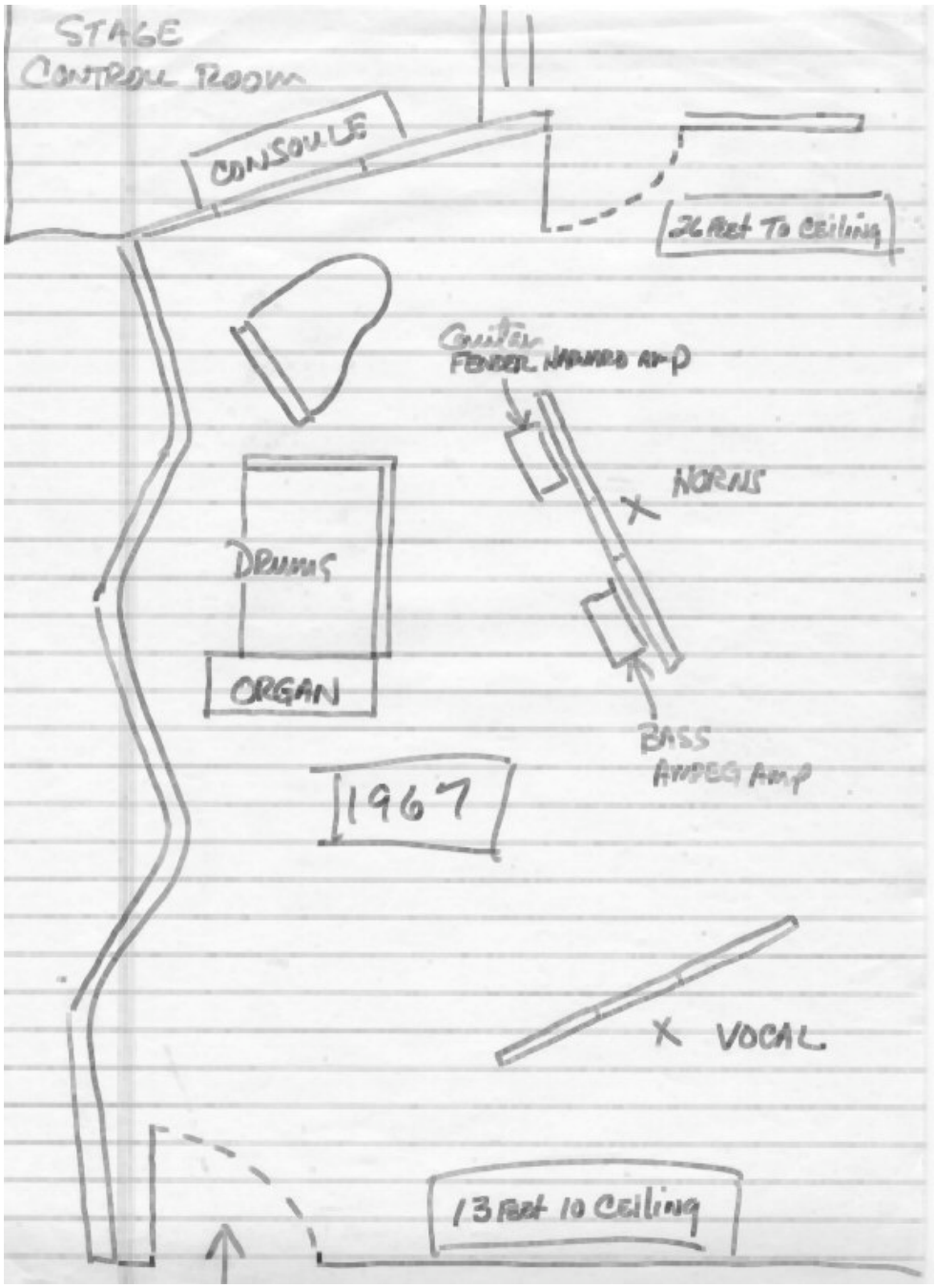
46					
47					

Figure IIB-4 – Steve Cropper drawing of STAX studio layout circa 1967



<http://staxrecords.free.fr/studioA.htm>

Figure IIB-5 – Vintage session studio setup in room 113. Shows instrument and gobo placements.

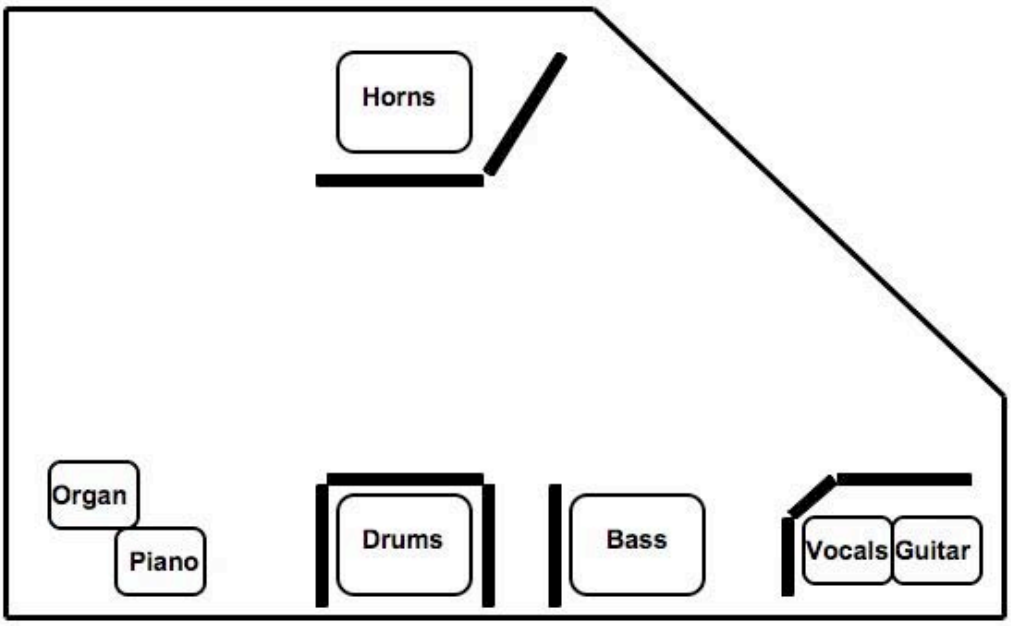


Figure IIB-6 – Vintage session microphone placements (kick drum)

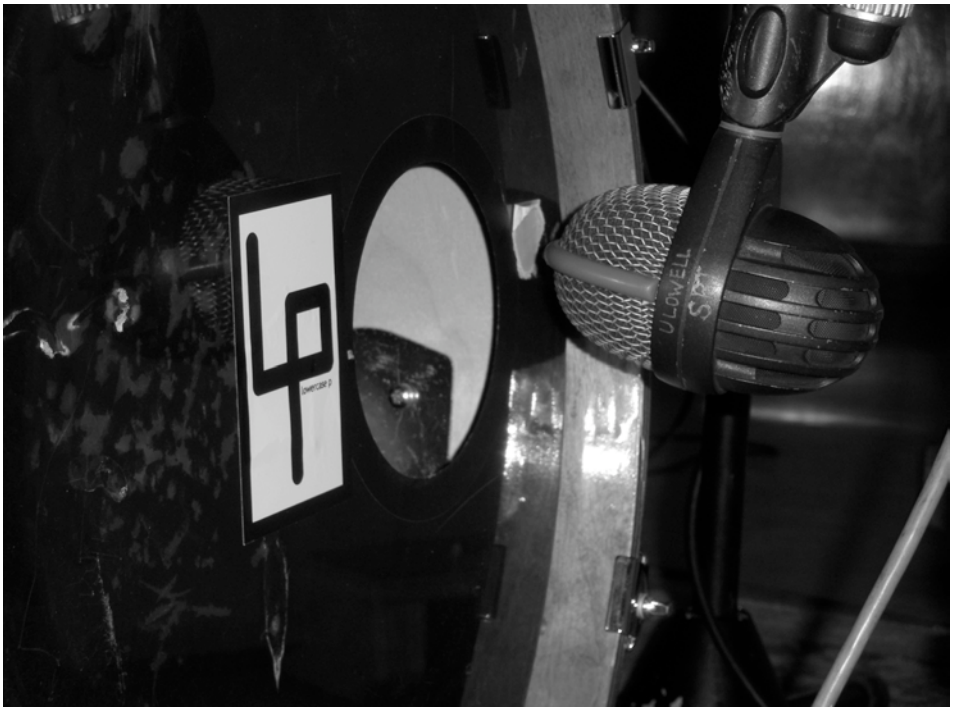


Figure IIB-7 Vintage session microphone placements (snare drum)

Figure IIB-8 – Vintage session microphone placements (kit 1)

Figure IIB-9 – Vintage session microphone placements (kit 2)

Figure IIB-10 – Vintage session microphone placements (guitar)

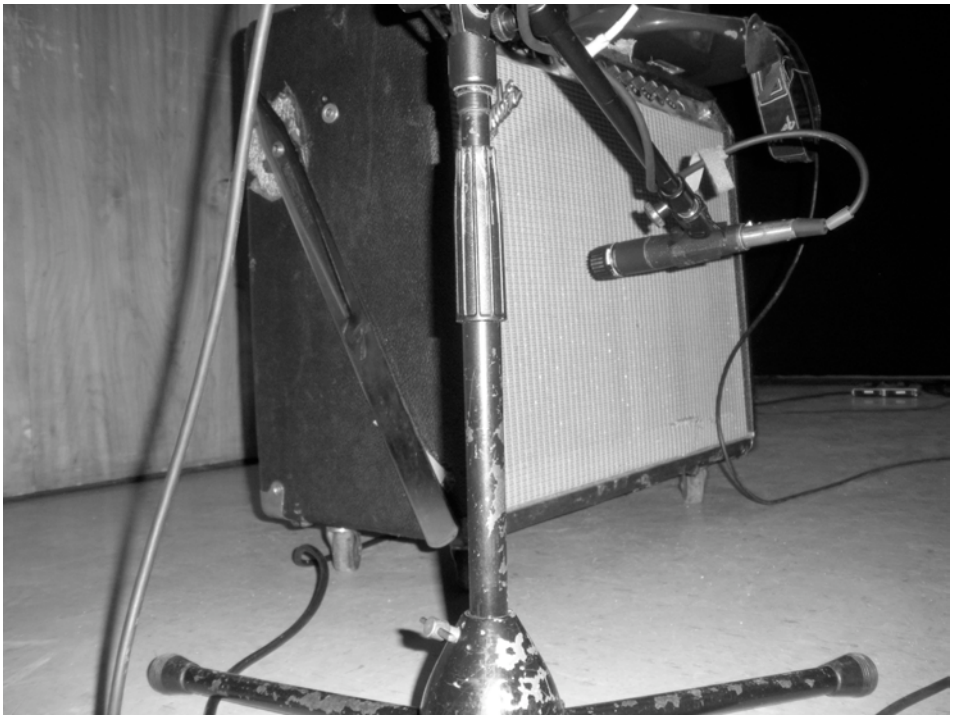


Figure IIB-11 – Vintage session microphone placements (bass)

Figure IIB-12 – Vintage session microphone placements (organ)

Figure IIB-13 – Vintage session microphone placements (piano)

Piano

Figure IIB-14 – Vintage session microphone placements (vocals)

Figure IIB-15 – Vintage session microphone placements (room left)

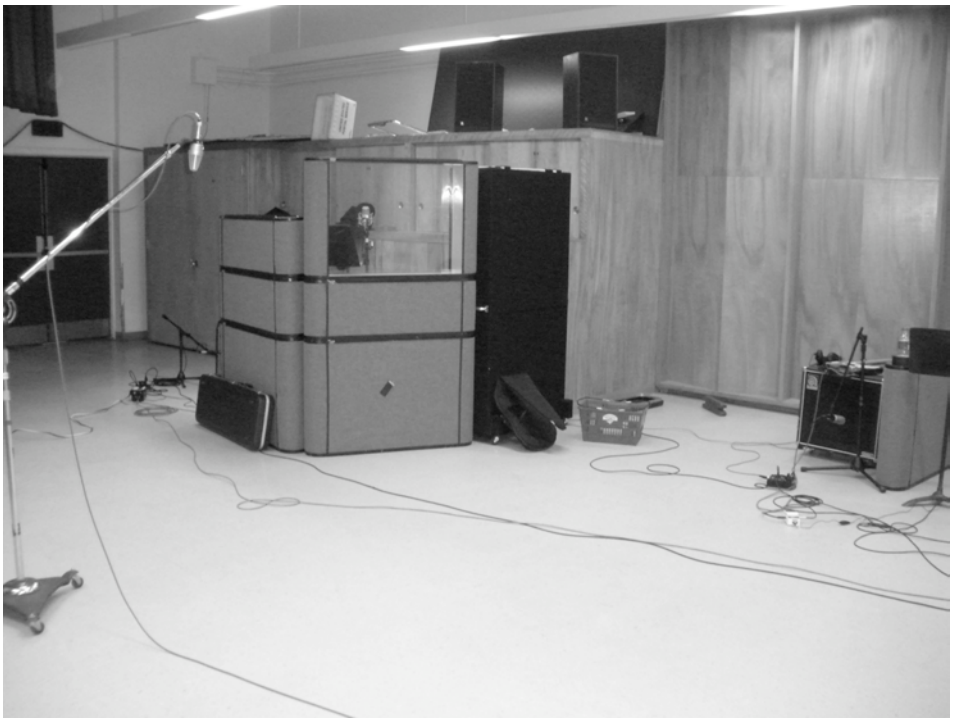


Figure IIB-16 – Vintage session microphone placements (room right)

Figure IIB-17 – Vintage session signal flow diagram

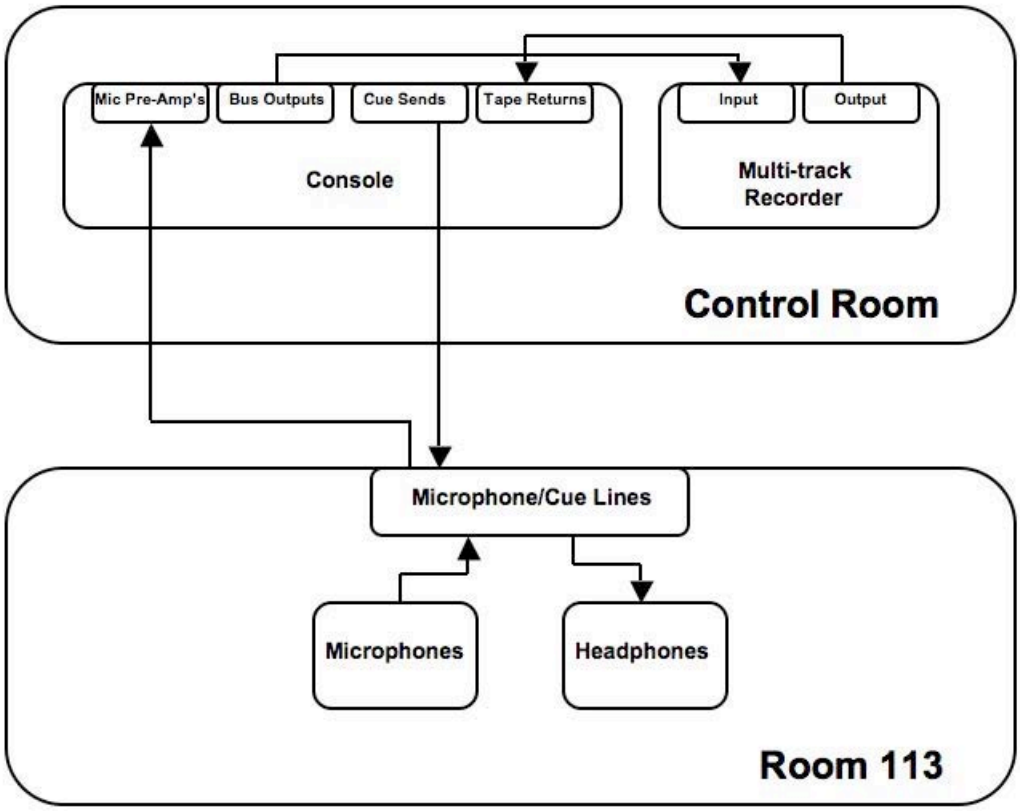


Figure IIB-18 – Shows mutes and fader adjustments for vintage mix

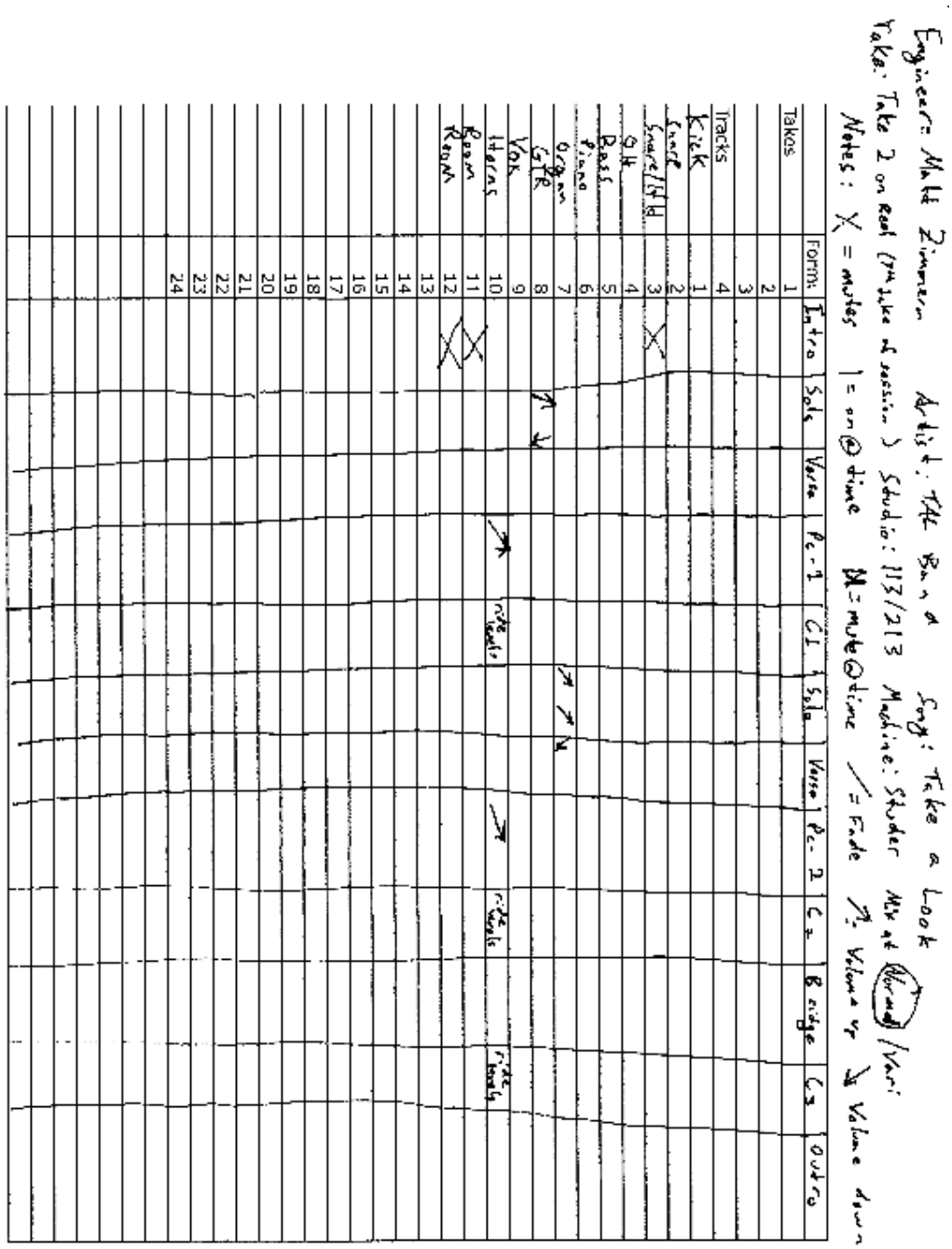


Figure IIC-1 – Modern session signal flow diagram

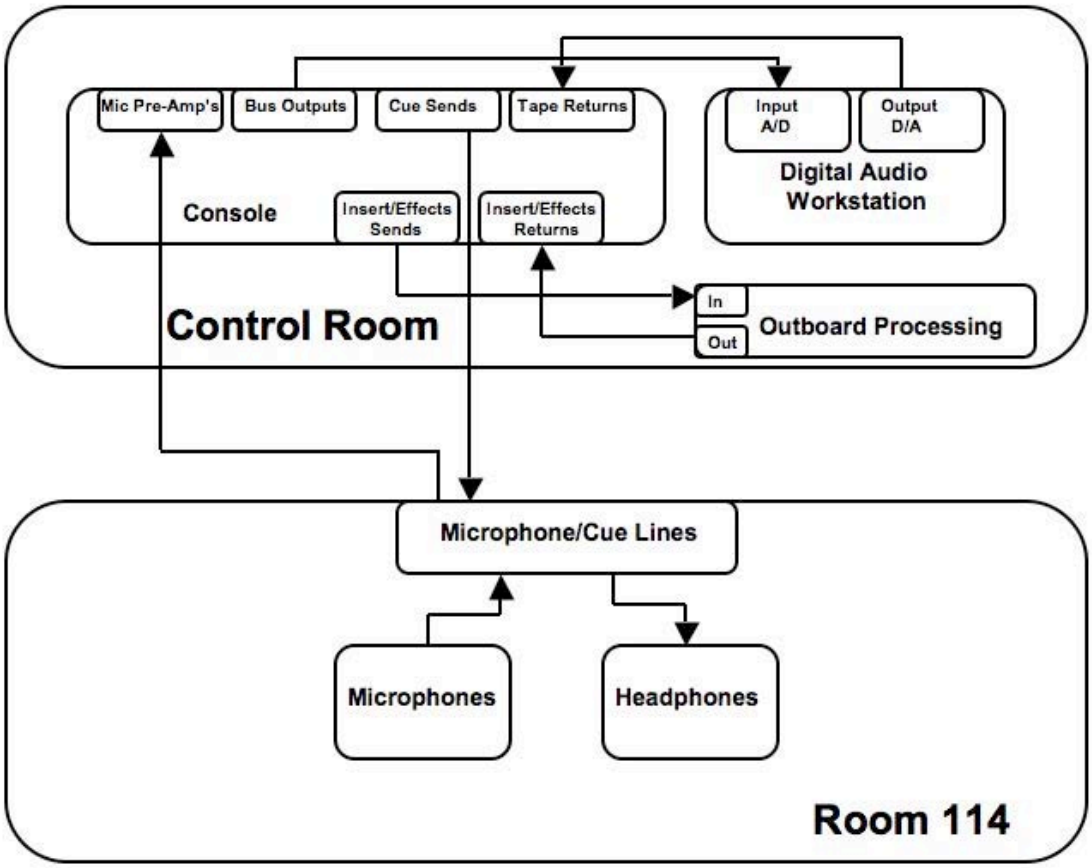


Figure IIC-2 - Modern session studio setup in room 114. Shows instrument placements.

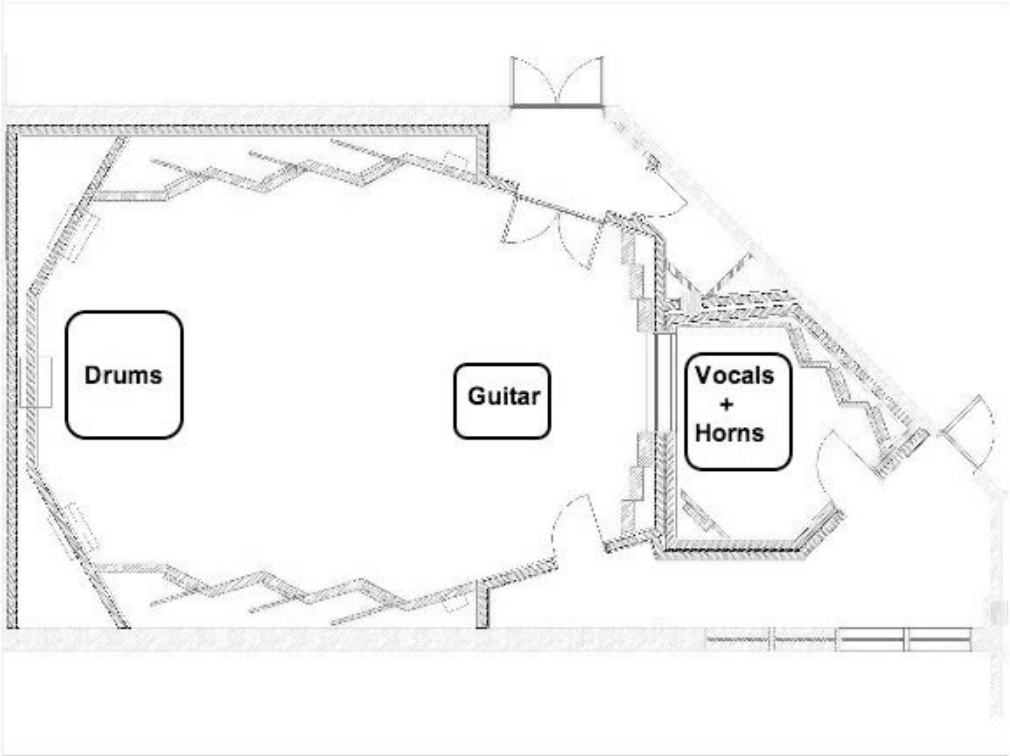


Figure IIC- 3 – Room 114 cross section

Figure: IIC-4 – Modern version microphone input/assignment sheet

Drummers perspective

MICROPHONE INPUT/ASSIGNMENT SHEET → For Modern Version

Sound Recording Technology
University of Massachusetts Lowell
35 WILDER STREET SUITE 3
LOWELL, MASS 01854
(978) 934-3850

Date: Spring/Summer 2009 Page: ___ of ___
Studio/Machine: ___
Course/Lab: ___
Eng/Assist: Matt Zimmerman
Artist: "Take A Look"

INPUT	PREAMP	TRACK	INSTRUMENT	MIC	NAME/OTHER
1	API 212L		Kick	D112	
2			Sn T	SM57	
3			Sn B	SM81	Hi pass/Biggest cut
4			HH	452EB	-20DB pad
5			T1	421	Music setting
6			T2	421	
7			OH L	KM140	
8			OH R	KM140	
9			RM L	DPA 4006	
10			RM R	DPA 4006	
11			RM (Mono)	M147	
12					
13					
14	Presonus		Bass	DI	
15					
16					
17	API 212L		GTR (Close)	SM57	
18	API 212L		GTR (Distant)	M147	
19					
20	API 212L		VOX	M147	
21					
22	API 212L		Tenor Sax	Royer 121	
23			Bari Sax		
24					
25					
26	Focusrite		Piano L	DI	
27	Focusrite		Piano R	DI	
28					
29	Focusrite		Organ L	SM57	
30			Organ R	SM57	
31			Organ Bottom	Beta 52	
32			Organ Distant	TLM 103	
33					
34					
35					
36					
37					
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39					
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44					
45					
46					
47					
48					

Figure IIC-5 – Modern version drum tracking microphone placements (kick)

Figure IIC-6 – Modern version drum tracking microphone placements (snare)

Figure IIC-7 – Modern version drum tracking microphone placements (hi hat)

Figure IIC-8 – Modern version drum tracking microphone placements (kit 1)

Figure IIC-9 – Modern version drum tracking microphone placements (kit 2)

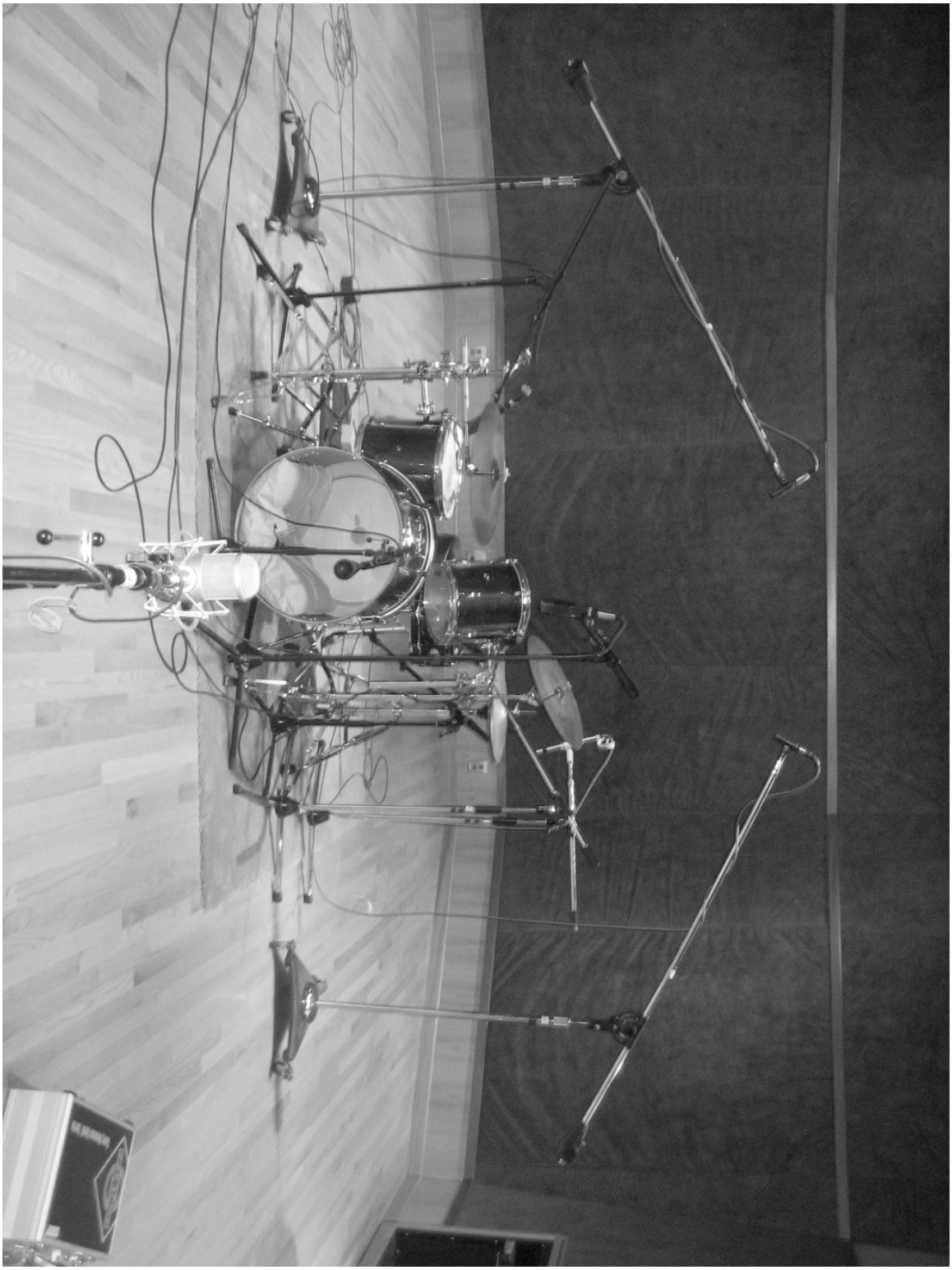


Figure IIC-10 – Modern version drum tracking microphone placements (kit 3)

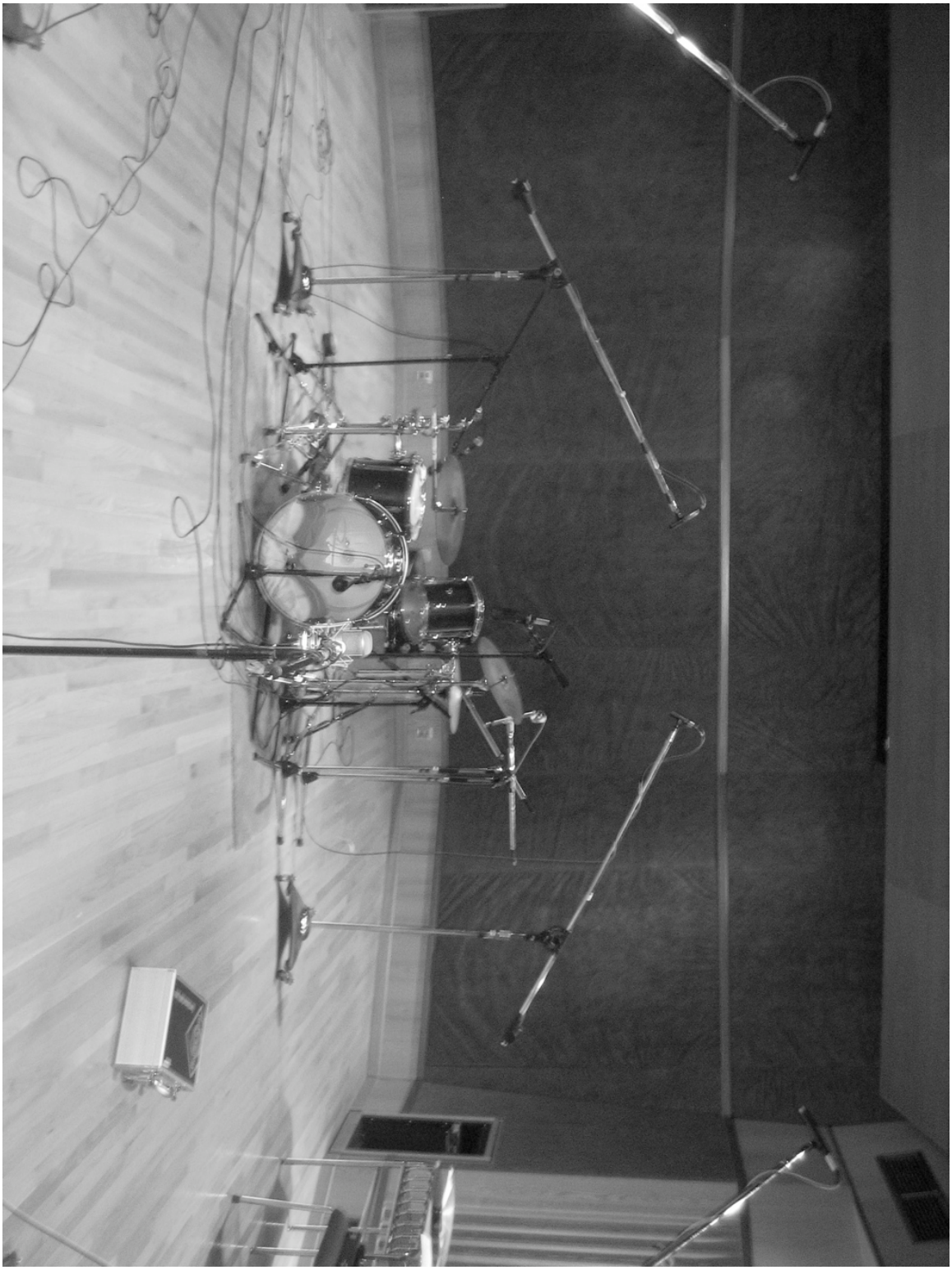


Figure IIC-11 – Modern version guitar overdub microphone placements (close)

Figure IIC-12 – Modern version guitar overdub microphone placement (distant)

Figure IIC-13 – Picture of the final edited lead vocal track for the modern version. Each vertical line on the waveform represents an edit made

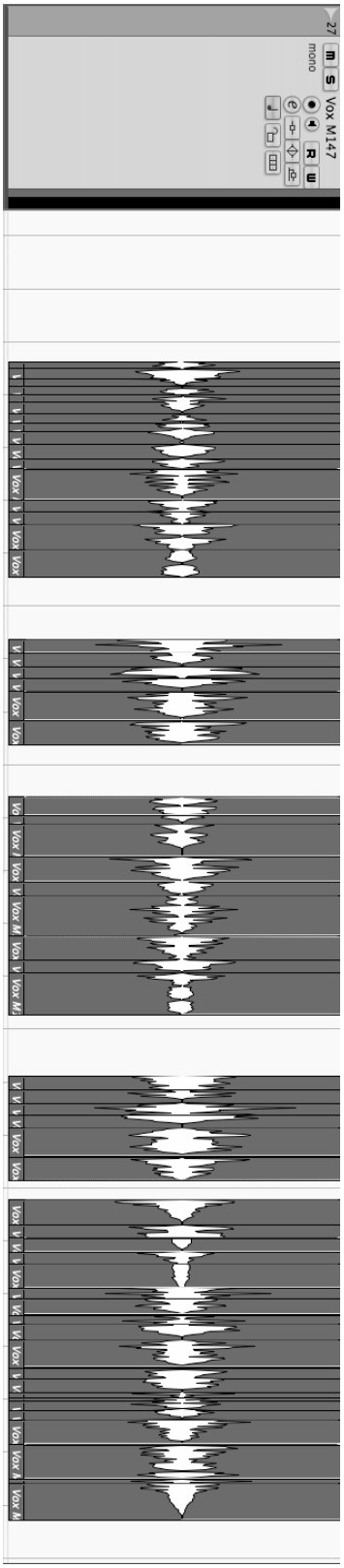


Figure IIC-14 – Modern version vocal overdub microphone placement

Figure IIC-15 – Modern version horn overdub microphone placement

Figure IIC-16 – Modern version organ overdub microphone placements

Figure IIC-17 – Channel faders 1-8 set up sheet (modern version mix documentation)

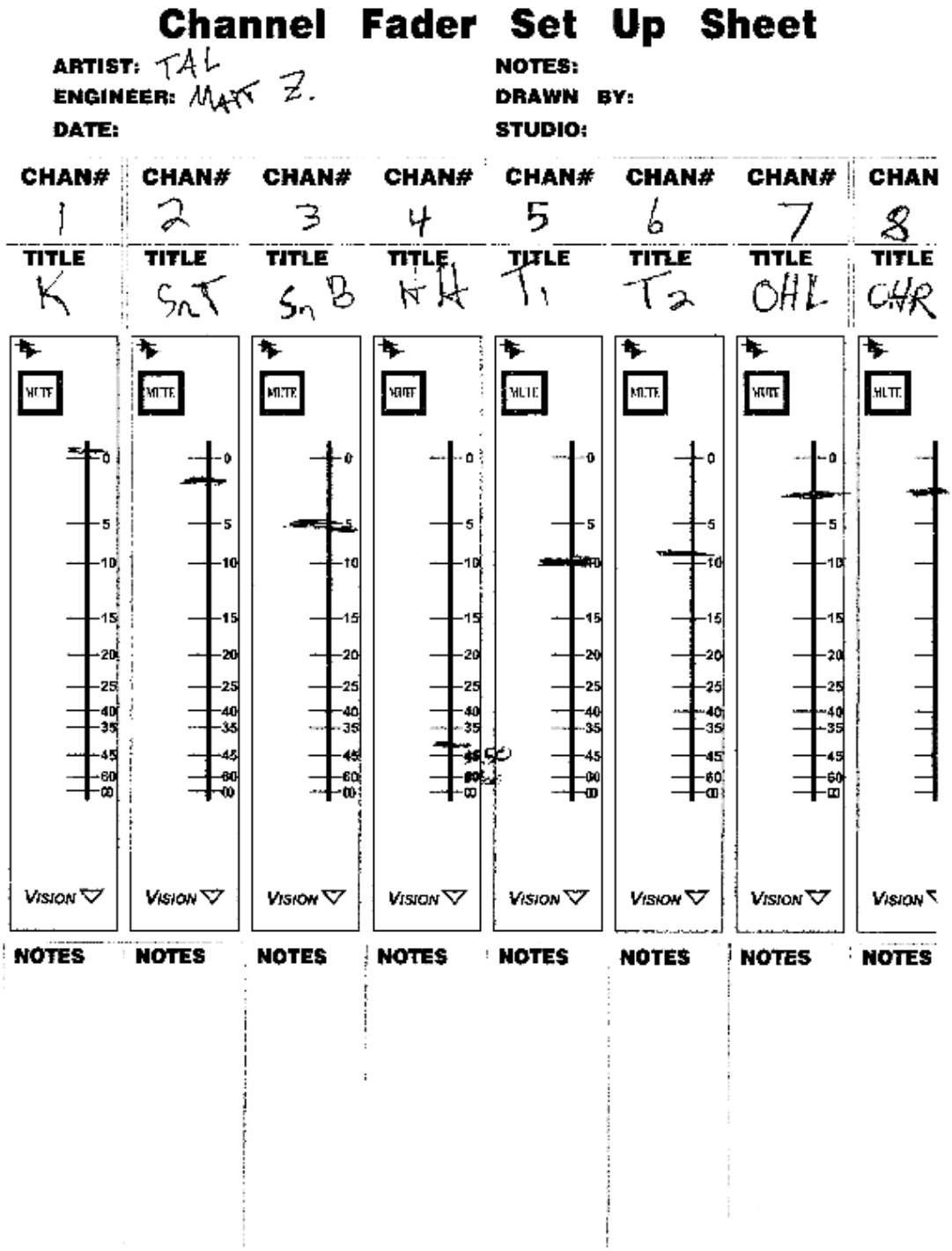


Figure IIC-18 – Channel faders 9-16 set up sheet (modern version mix documentation)

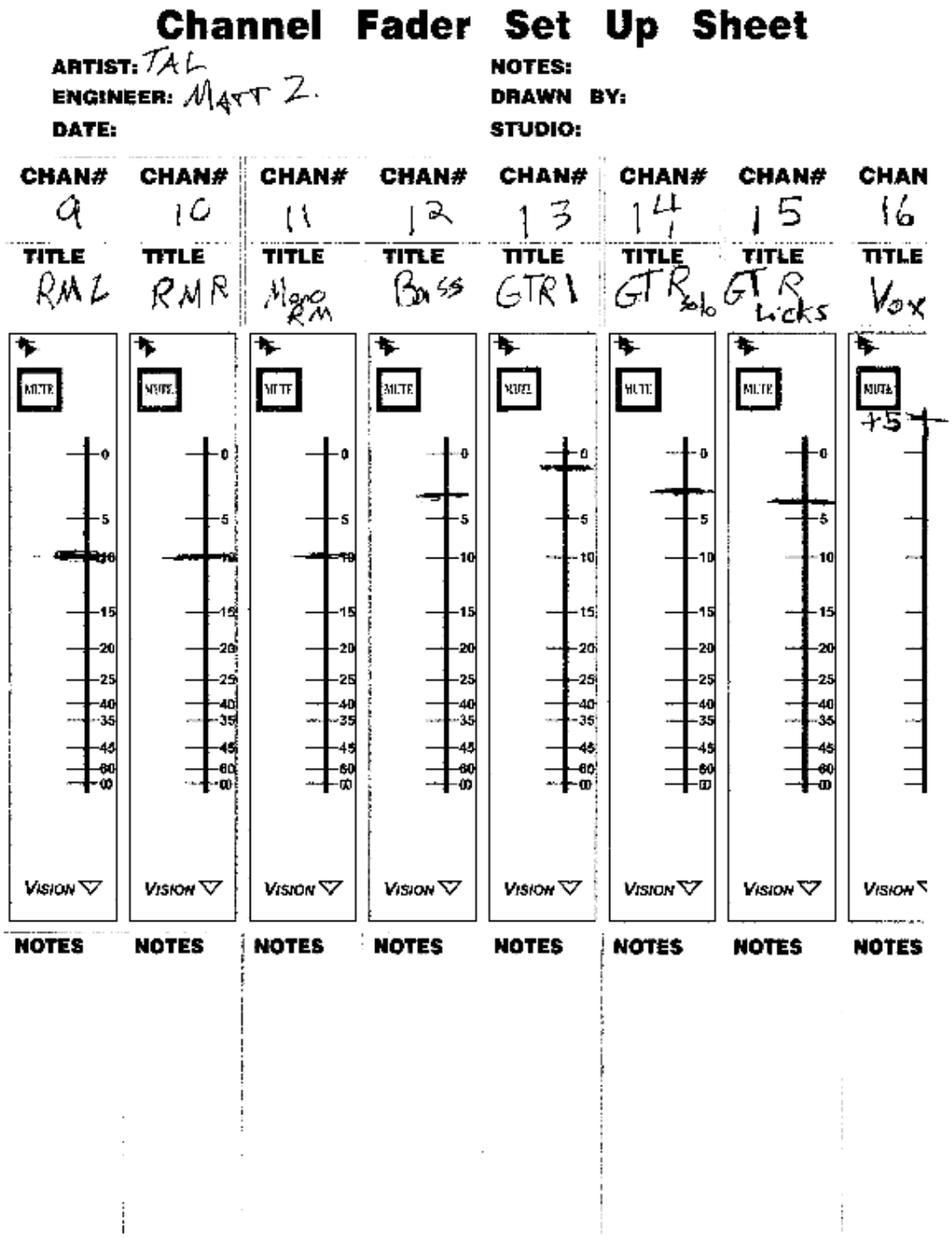
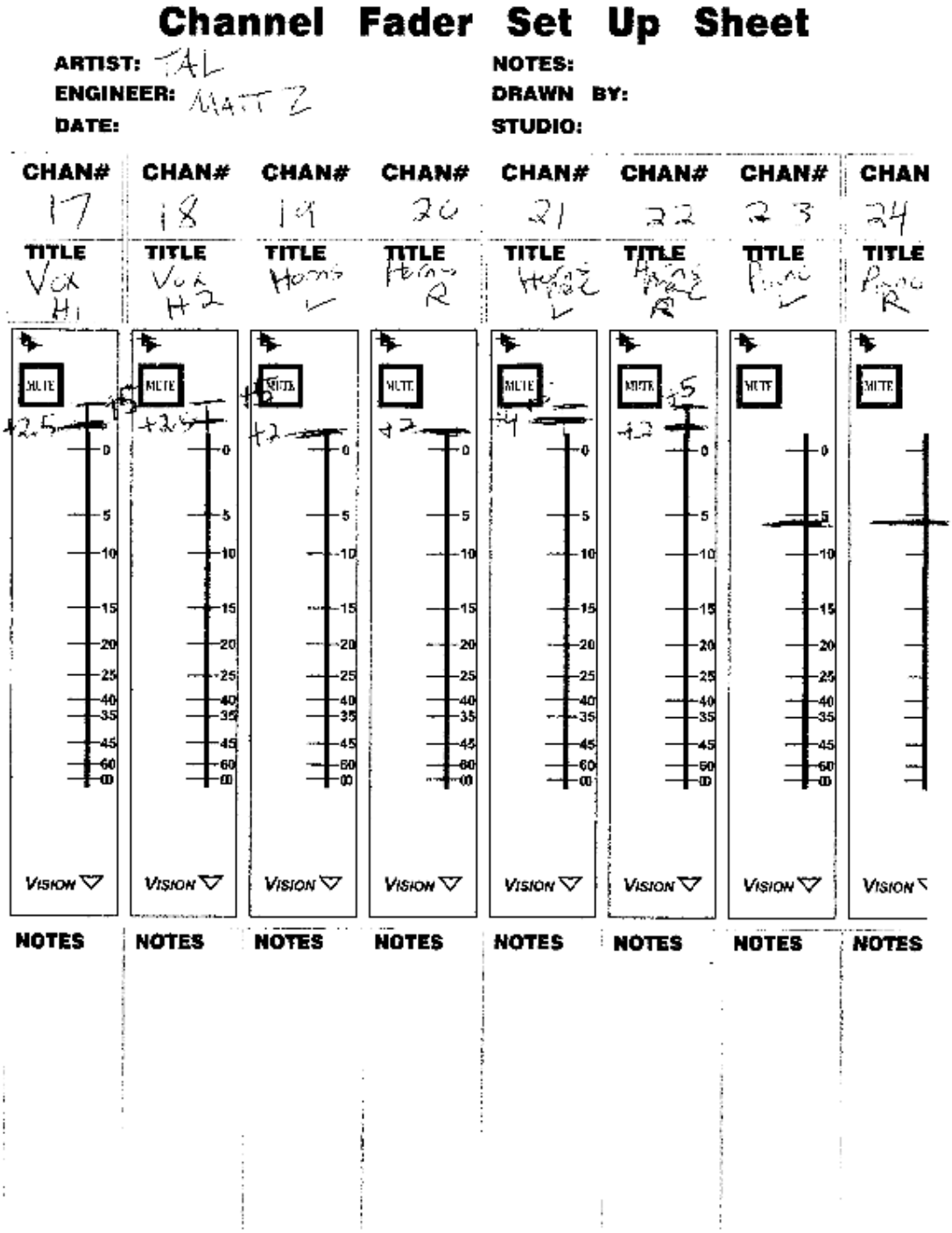


Figure IIC-19 – Channel faders 17-24 setup sheet (modern version mix documentation)

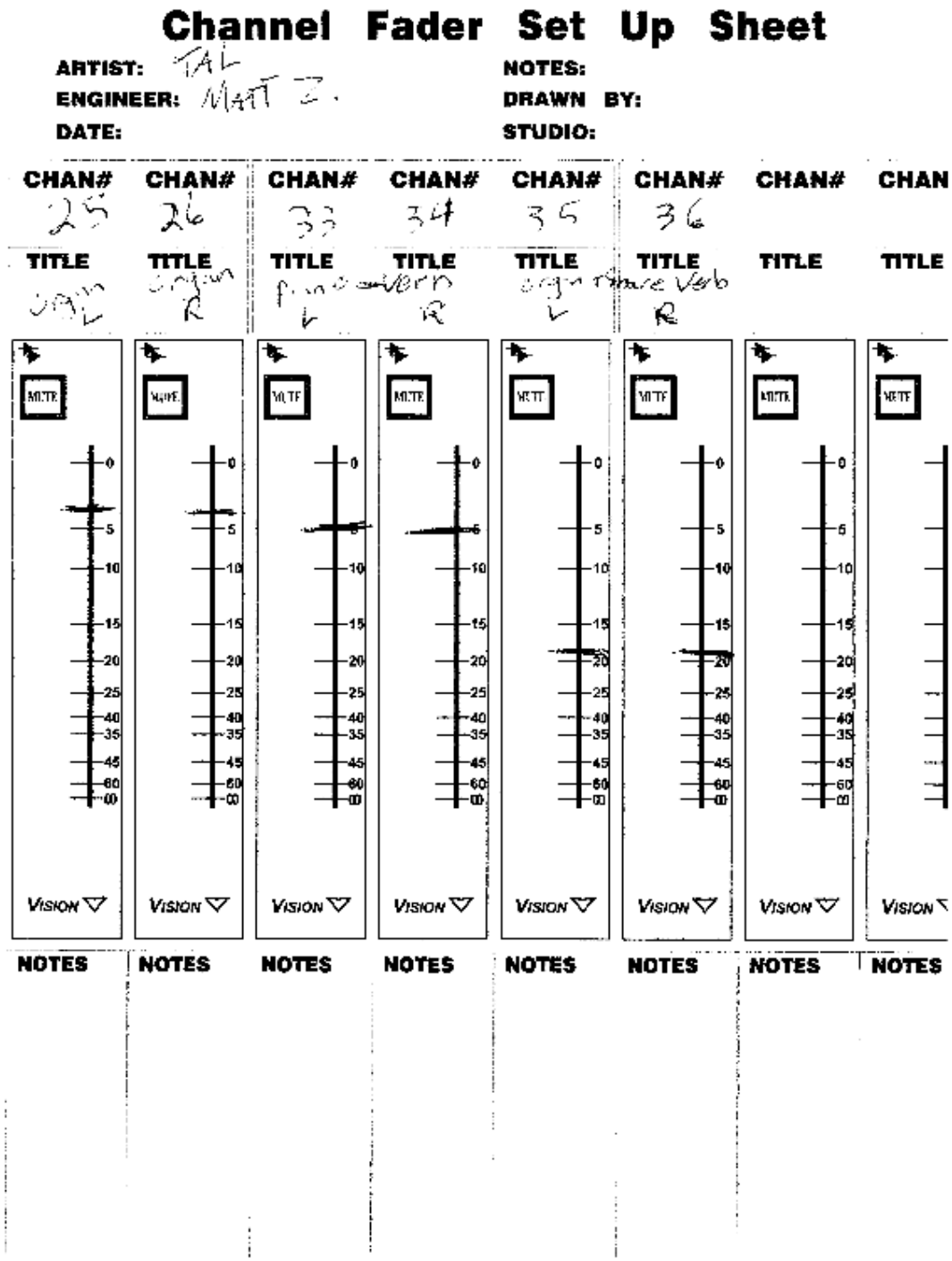


Channel Fader Set Up Sheet

ARTIST: TAL
ENGINEER: MATT Z
DATE:
NOTES:
DRAWN BY:
STUDIO:

CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN
17	18	19	20	21	22	23	24
TITLE Vox H1	TITLE Vox H2	TITLE Horns L	TITLE Horns R	TITLE Horns L	TITLE Horns R	TITLE Piano L	TITLE Piano R
MUTE	MUTE	MUTE	MUTE	MUTE	MUTE	MUTE	MUTE
+2.5	+2.5	+2	+2	+4	+2		
VISION	VISION	VISION	VISION	VISION	VISION	VISION	VISION
NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES

Figure IIC-20 – Channel faders 25-36 set up sheet (modern version mix documentation)

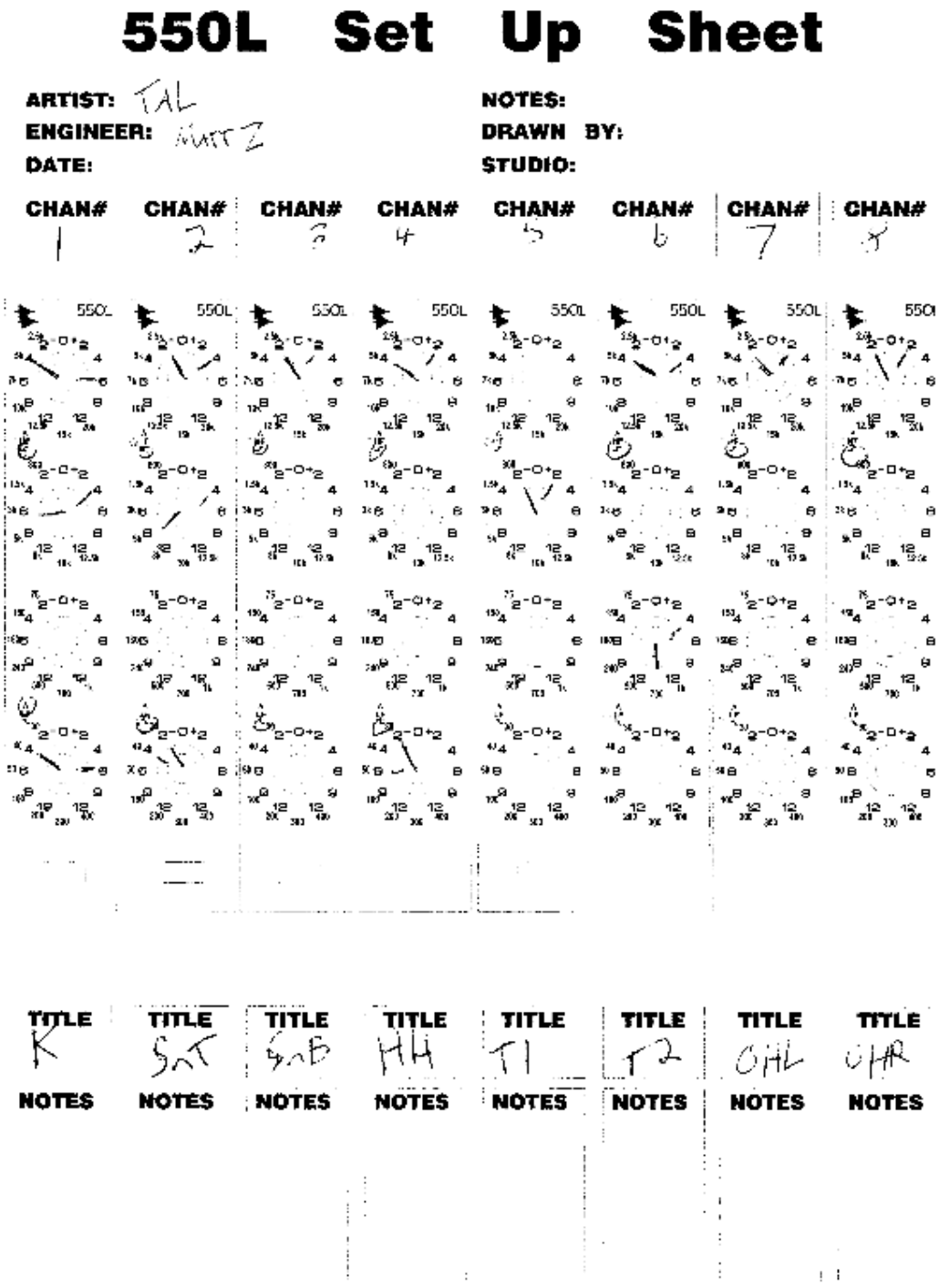


Channel Fader Set Up Sheet

ARTIST: TAL
ENGINEER: Matt Z.
DATE:
NOTES:
DRAWN BY:
STUDIO:

CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN
25	26	33	34	35	36		
TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE
Organ L	Organ R	Piano L	Piano R	Organ L	Reverb R		
MUTE	MUTE	MUTE	MUTE	MUTE	MUTE	MUTE	MUTE
VISION	VISION	VISION	VISION	VISION	VISION	VISION	VISION
NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES

Figure IIC-21 – 550L set up sheet 1 (modern version mix documentation)



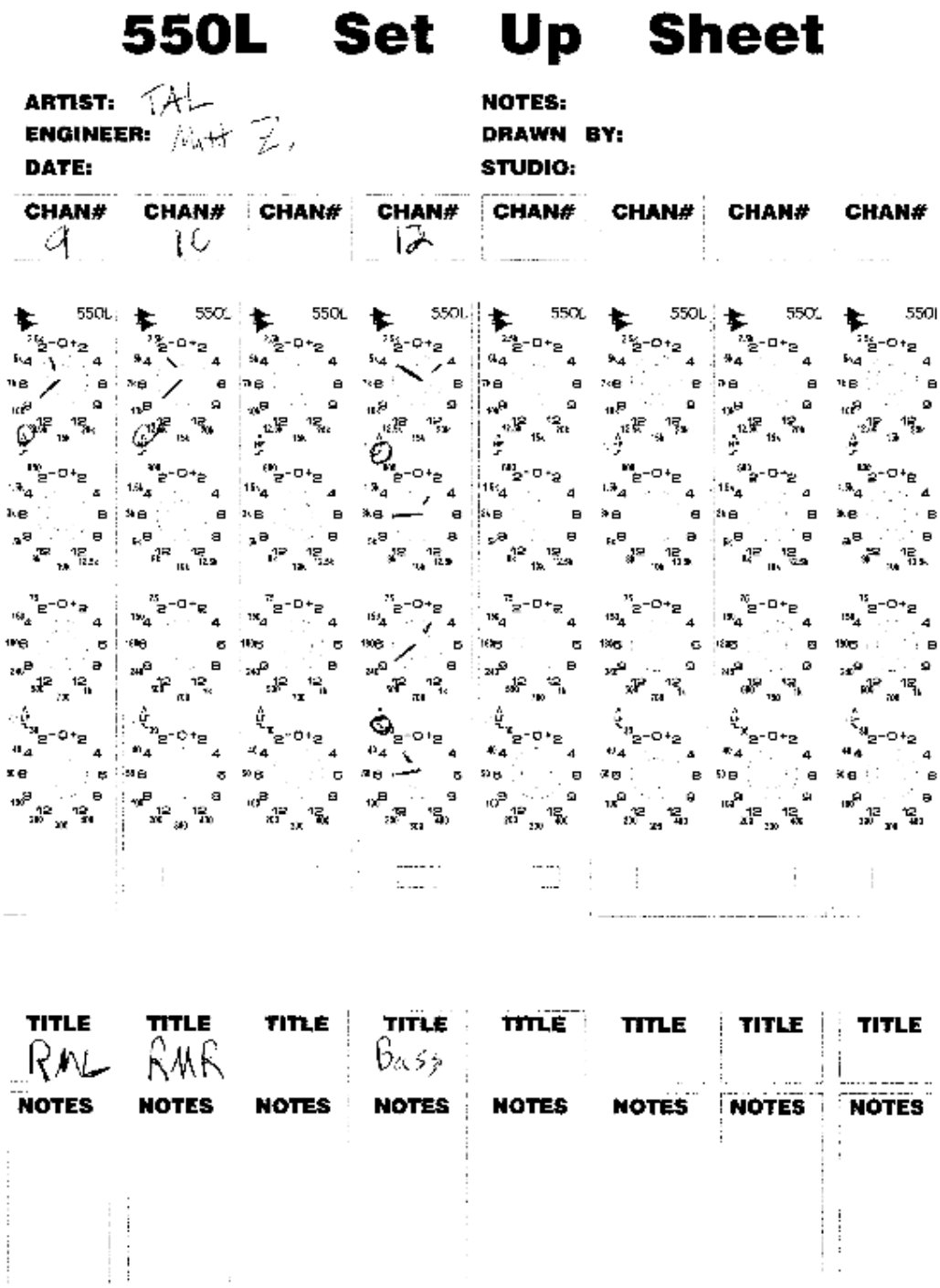
550L Set Up Sheet

ARTIST: TAL
ENGINEER: Matt Z
DATE:

NOTES:
DRAWN BY:
STUDIO:

CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#
1	2	3	4	5	6	7	8
550L	550L	550L	550L	550L	550L	550L	550L
TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE
K	SnT	SnB	HH	T1	T2	OHL	OHR
NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES

Figure IIC-22 – 550L set up sheet 2 (modern version mix documentation)

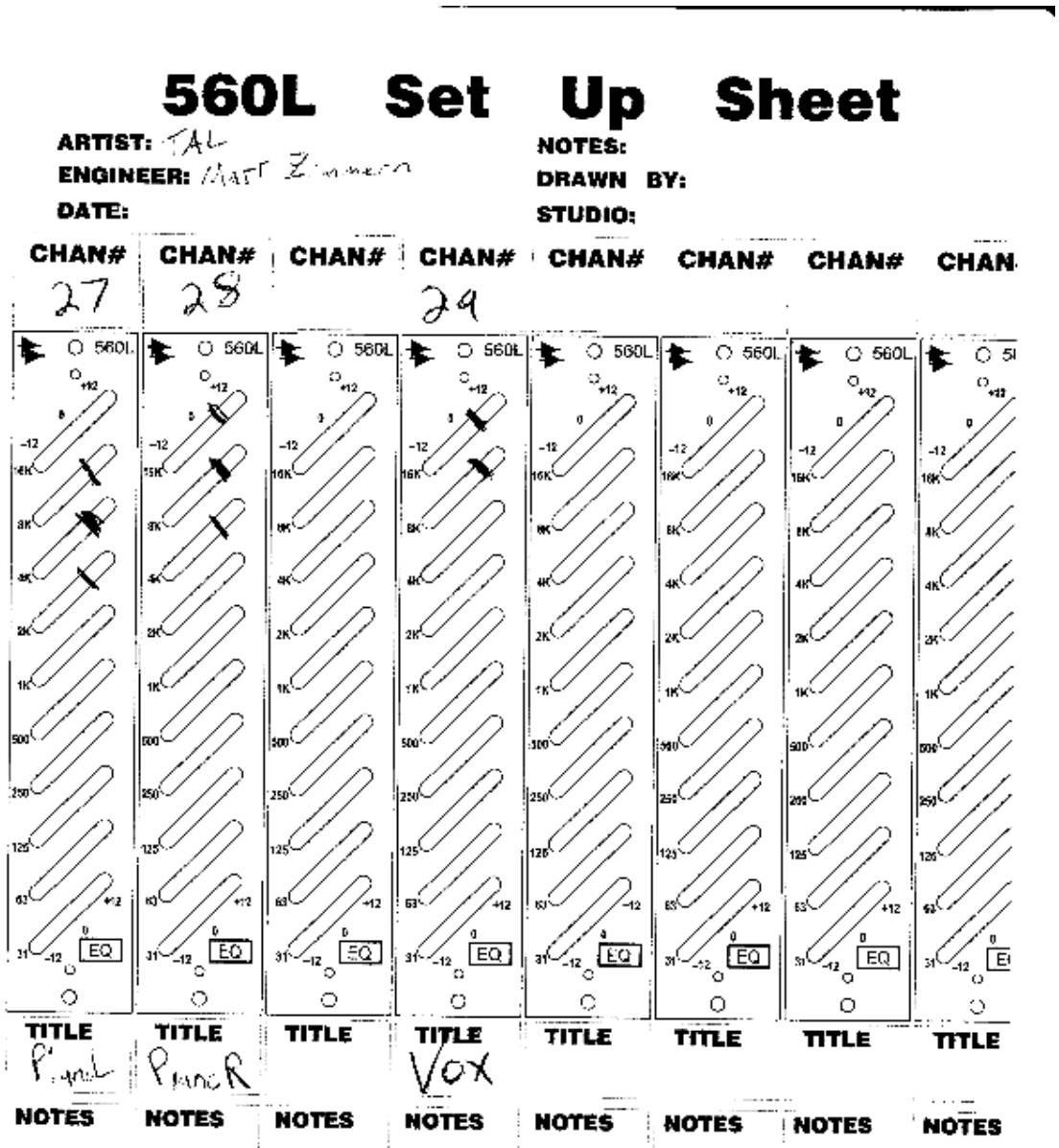


550L Set Up Sheet

ARTIST: TAL
ENGINEER: Matt Z.
DATE:
NOTES:
DRAWN BY:
STUDIO:

CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#
9	10		12				
TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE
RML	RMR		Bass				
NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES

Figure IIC-23 – 560L set up sheet (modern version mix documentation)



560L Set Up Sheet

ARTIST: TAL
ENGINEER: Matt Zimmerman
DATE:
NOTES:
DRAWN BY:
STUDIO:

CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN#	CHAN
27	28		29				
TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE	TITLE
Punch	Punch		Vox				
NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES	NOTES

Figure IIC-24 – 225L compressor settings (modern version mix documentation)

Figure IIC-25 – DCL-200 session recall sheet (modern version mix documentation)

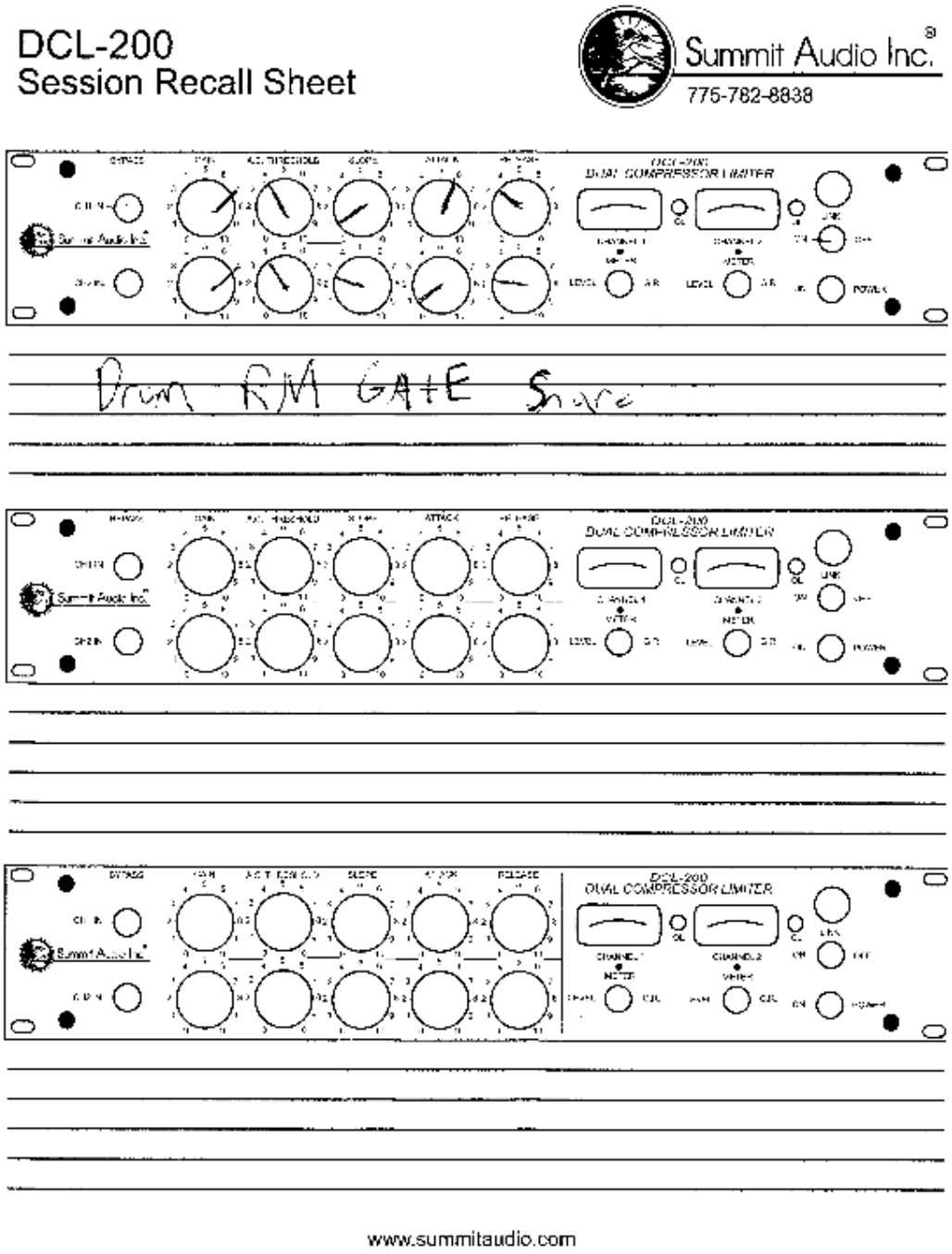


Figure IIC-26 – TC 6000 reverb settings (modern version mix documentation)

Take A Look Final Mix Reverb Settings

10/10/09 Modern Version Reverb Unit = TC 6000

Engine 1 =	Piano L	Aux 1	Q
in 9+10	Piano R	Aux 2	Q Cranked

Engine 2 =	SnT	Aux 3+4	⊖ ⊖
	SnB	Aux 3+4	
in 13+14	RML	Aux 3	⊘ Pre
	RMR	Aux 4	⊘ Pre
	ORGANL	Aux 3	Q = 0
	ORGANR	Aux 4	Q = 0

Settings on TC 6000

Engine 1 Large Warm Hall

Predelay	Decay	Rev delay	early colour	Hi Cut	Hi soften
0	2.0 s	14 ms	−7	2.5 kHz	14

Engine 2 Medium Room

Master Decay	Reverb size	Hi cut	Pre delay	Er decrease	Dry
.95 s	8	14.6 kHz	0	72%	0

Figure IIC-27 – Da Tube plug-in settings (modern version mix documentation)

Figure IIC-28 – Mono delay plug-in settings (modern version mix documentation)

Figure IIC-29 – Gate plug-in settings (modern version mix documentation)

Figure IIC-30 – Gate plug-in settings (modern version mix documentation)

Figure IIC-31 – Gate plug-in settings (modern version mix documentation)

Figure IIIA-1 – Length and number of sessions needed to complete the modern version

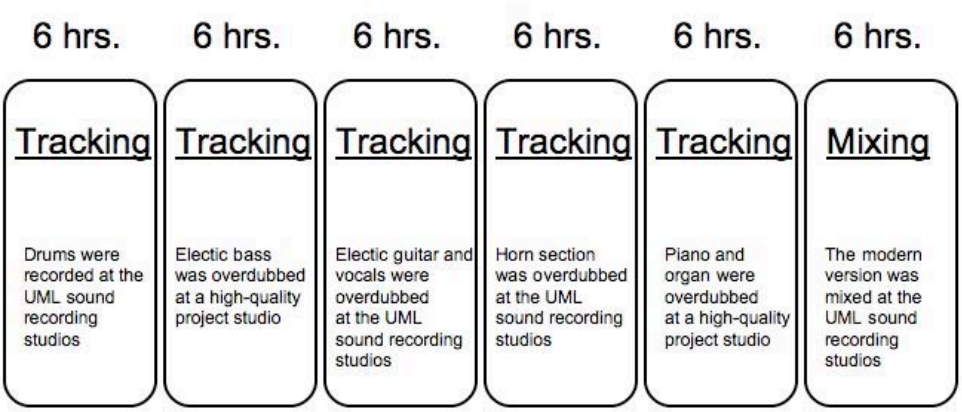


Figure IIIA-2 – Length and number of sessions needed to complete the vintage version

vi. Biographical Sketch of Author

Matthew Zimmern was born in Newburyport, Massachusetts in 1984. He conducted both his undergraduate and graduate studies at the University of Massachusetts Lowell. He received a B.M. in Sound Recording Technology in 2006, and a M.M. in Sound Recording Technology in 2010. He is currently a freelance recording engineer, and piano instructor at the Chelmsford Music Academy in Chelmsford, MA.