

So, You Want to Do a Piece with Electronics?  
A Layperson's Guide to Works for Wind Band and Electronics

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## ABSTRACT

The number of compositions that use electronics alongside the wind ensemble has gradually increased in the 21st century, yet these compositions are infrequently programmed past their premieres. Explanations include lack of access to necessary resources, unfamiliarity with the repertoire, and inexperience with the technology they require. While there are other barriers to performance, this document focuses on familiarizing the repertoire and providing foundational knowledge necessary to overcome inexperience.

As the number of technology-native composers, audience members, and performers continues to increase, electronics in the ensemble are likely to become more standard. Without knowledge of the technology electronics require, these works will remain inaccessible. Composers attempt to bridge the technological knowledge gap by providing technical instructions for individual pieces, but this does not help people recognize the broader concepts that make all of these works more accessible. This document guides ensemble directors and performers to an understanding of these base concepts by developing a grading system for technology difficulty, assessing pedagogical and performance issues, and providing an annotated list of works currently available for electronics and winds.

## DEDICATION

To my wife, Melissa. Thank you for all your sacrifices and support through the long journey  
of graduate school.

and

To my family, for all their support, affirmation, and for reminding me of the significance of  
having made it this far.

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## GLOSSARY OF TERMS

Term: Audio Interface

Definition: A device that serves as the physical bridge between a computer and the external audio environment/equipment. Further discussion is found in Appendices B, C, and on page 22.

Term: Balanced

Definition: A cable with three wires inside, two signal wires and a separate sleeve or shield wire. The design of balanced cables makes them resistant to interference. They are identified by having three visible points of contact for each wire. TRS and XLR are examples of balanced cables. See figure 1, examples A, C, D, and E.

Term: Channel

Definition: The definition depends on the context:

1. Generally, a single path for carrying audio or data
2. On a mixer or interface, a set of controls for a single input (e.g., Input 1 corresponds to Channel 1)

Term: Daisy Chain

Definition: Connecting devices or speakers together in a chain so the signal passes from one to the other. Think of it as a string of lights: electricity passes into and illuminates one light, then out to the next, and so on. All the lights share the same electrical signal.

Term: Electronic Keyboard

Definition: An electronic piano-style keyboard capable of controlling an external processor. It can vary in the number of octaves or keys, up to a full 88-key piano-style keyboard.

Term: Input

Definition: The connector or device that accepts or receives a signal, such as the 1/4" inputs on an audio mixer or interface. It is usually labeled on devices as "input" or "in" with a number.

Term: MIDI

Definition: Abbreviation for Music Instrument Digital Interface, a type of connection used to connect digital musical instruments to their controllers. See figure 6, bottom, for an example of a female MIDI connection.

Term: Mono

Definition: A single channel signal, designed to be perceived as coming from a single position.

Term: Output

Definition: The connector or device that sends a signal, such as the 1/4" outputs on an audio mixer or interface. Usually labeled as "output" or "out," paired with an identifying number or "L" for Left or "R" for Right.

Term: Signal

Definition: An electrical translation of an audio event. They can be sent analog via voltage variations (e.g., any connection using a 1/4" or XLR connection is analog) or digitally via data packets (e.g., USB connections to an audio interface or MIDI connections).

Term: Stereo

Definition: A two-channel signal, usually one left and one right, designed to spatialize sound. Each signal is sent to a speaker, one placed to the left and one to the right of the listener. A stereo signal is fundamentally two separate mono signals working together to create a stereo sound field.

Term: Trigger

Definition: An electric signal that initiates an action, either within a computer program or other electric processor. The action can involve generating a sound, a series of sounds, changing settings, or other forms of automation.

## AUDIO CONNECTOR NOMENCLATURE

This document uses the standard connector naming schema of size, type, and gender. Each element of the schema is included only where applicable. For example, XLR connections come in only one size and therefore omit the size element. XLR connections do vary in the number of pins inside their connectors, but since only XLR3 (3-pin) connectors are discussed, they are shortened to the common abbreviation XLR.

Table 1. Types of Connectors Discussed

Size	Type	Gender
1/8"	TS	Male or Female
1/8"	TRS	Male or Female
1/4"	TS	Male or Female
1/4"	TRS	Male or Female
	XLR	Male or Female

Each connector type is an abbreviation of the connector’s physical appearance, most commonly the male connector as it is the easiest to identify. See figure 1 for visual examples of each.

Table 2. Descriptions of Cable Types Discussed

Type	Description
TS	An abbreviation for Tip and Sleeve. They can transmit only mono signals and are unbalanced. These connectors and jacks come in multiple widths, the most common being the 1/4" and the 1/8".
TRS	An abbreviation for Tip, Ring, Sleeve. Female connectors should be factory-labeled “balanced,” “stereo,” or “TRS,” since they are difficult to identify visually. TRS cables either serve as balanced cables when used with a mono signal or as unbalanced cables when used to send stereo. Its connectors and jacks come in various sizes, the most common being the 1/4" and the 1/8".
XLR	A type of audio cable often used for microphones and thus are commonly called microphone (mic) cables. Visually identifiable by their 3 pins (male) or holes (female) within a metal housing. There are other forms of XLR cables, but this document refers only to the XLR3 (3-pin) connectors.

## CHAPTER 1

### INTRODUCTION

Composers have been writing for winds and electronics since at least the 1950s.<sup>1</sup> As technology has become more prevalent, so too have pieces that use technology in their sonic landscapes. The number of works in this genre has increased by over 350% in just the last decade.<sup>2</sup> Despite this increase, there is not yet a comprehensive list of such works.

Additionally, no system exists to grade the content and difficulty of technology elements in a composition, similar to the system that already exists for grading musical content. This document offers a comprehensive, annotated list of works for wind band and electronics along with guidance for rehearsal and performance.

Thinking back on conversations with colleagues, the topic of electronics and wind band usually involves only three composers: Steven Bryant, Alex Shapiro, and Mason Bates. The fact that these are the only names that come up off-the-cuff highlights that the variety of repertoire for this medium is relatively unknown. So, one goal of this document is to make it easier to locate available works for winds and electronics by compiling them into a comprehensive annotated list. These conversations usually include a statement like, “Yeah, I’ve always wanted to program [insert piece here], but I have no idea how any of it works,” or “...but I’m scared to death of things going wrong.” A second goal of the project, then, is to provide a reference guide for approaching these compositions and offer some point of entry for working with electronics in the wind band.

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<sup>1</sup> Herbert Eimert, “How Electronic Music Began,” *The Musical Times* 113, no. 1550 (April 1972): 349, <https://doi.org/10.2307/954658>.

<sup>2</sup> Before 2010, there is evidence of 13 such works compared to a total of 60 works as of March 2020. At least an additional 47 compositions have been added to the oeuvre over the last decade.

Through these conversations, it became apparent that many ensemble leaders have the impression that *all* electronics are as complicated as the well know work *Ecstatic Waters* by Steven Bryant, when in fact many of them are as simple as pressing play. To clarify these electronic setups and to facilitate the two previously mentioned goals, this project develops grading criteria for the technology and electronic aspects of compositions. The grading system enables ensemble leaders to see quickly if a composition fits their needs. With the vast amount of repertoire available in general, anything that can make the initial programming steps easier is invaluable.

To focus the criteria, a wind band will be considered to be an ensemble of at least 20 musicians, with over 50% being wind instruments. 20 musicians parallels the size of a standard orchestral wind section, and the percentage allows for more percussionists. Most works in this genre are written for larger concert bands closer to 30 or more musicians with few for soloists with an ensemble. Very few of the works included in this document use strings other than a double bass.

As a genre, the term electroacoustic still lacks an agreed-upon usage among musicians and composers. Depending on the source, the term includes fixed media such as tape music and musique concrète as well as computer music, live electronics, digital musical instruments, and more. The Oxford English Dictionary frames the definition of “electroacoustic” well: of, designating, or relating to music incorporating electronically

produced or modified sounds.<sup>3</sup> The works included in this document were chosen based on this definition, with a focus on the electronics used to incorporate these sounds.

Throughout this discussion, the term “electronics” refers only to the audio portion of each composition, as opposed to any video, lighting, or other elements. Electronics include electronically created or reproduced sounds that contribute to the composition, both aesthetically and musically. They *require* amplification and contribute in ways acoustic instruments alone cannot. Electronics and electroacoustics used in the works in this document include pre-recorded tracks, audio files, synthesizers, digital musical instruments (DMIs), and computer software.

Based on this criterion, setups with a microphone used as part of a system to apply electronic effects to an acoustic sound is within the scope of this document. A microphone used with a sound system solely to reinforce an acoustic instrument over an ensemble is not, nor is replacing an acoustic instrument such as piano, organ, or harpsichord with an electric version. Similarly, works with physical effects such as videos and lighting are excluded unless they also include electroacoustics, and even then, only the sonic components of these works are discussed. Also excluded are works that use electric guitar and electric bass, since the few that currently exist feature these instruments as soloists rather than an element of the ensemble.

While every attempt was made to locate all available works, there are bound to be omissions. The quantity and speed with which composers release new works mean any attempt to list them will be incomplete. The inclusion of technology further diminishes the

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<sup>3</sup> Oxford English Dictionary, “electroacoustic, Adj.,” n.d., <https://www.oed.com/view/Entry/270068>.

ability to create a compressive list. As technologies and equipment become obsolete, the works that use them become lost to history. Likewise, every computer system, application version, composition, piece of equipment, and other components of an electronics setup has constantly changing quirks. It is not possible nor feasible to cover every possible combination of equipment. This document and its guides do their best to address the most standard and contemporary setups.

Many discussions of electronics, including much of this document, overlook the musical elements of electronics. While this oversight is unfortunate and is an area worth further study, the technical component remains the least understood aspect of these special instruments. Musical and aesthetic topics such as the purpose of electronics, their composition, how they interact with the acoustic elements, and how they affect audience perception and engagement have all influenced this document in one way or another. For now, however, the focus remains on spreading the knowledge of how to work with these instruments.

## CHAPTER 2

### A BRIEF SURVEY OF PIECES FOR WINDS AND ELECTRONICS

The history of electroacoustic works for wind band emerged in the 1970s, grew slowly until the mid-2000s, then exploded after 2008. The earliest electronic music outside the wind band can be traced back to the first electronic instruments, such as the Telharmonium, near the beginning of the 20th century. The experiments of the Italian and Russian futurists explored innovative soundscapes and timbres, opening the door for electronic sounds to be used more widely in music.<sup>1</sup> The musique concrète movement in France furthered the work of the Italian futurists during the 1940s and 50s. Musique concrète created music primarily by manipulating pre-recorded sounds and timbres; it did not create new sounds solely using electronic means. In the early 1950s, the first entirely electronic music appeared in Germany.<sup>2</sup> While wind quintets, trios, and solo works with electronics were written by composers such as Mario Davidovsky and Pierre Schaeffer, the only large ensemble work from this era for winds and electronics is Edgard Varèse's *Déserts*. The piece is for 14 winds, piano, five percussionists, and dual electronic tape via a stereophonic system. The electronics are created entirely by manipulating pre-recorded sounds, in true musique concrète fashion.<sup>3</sup> However, *Déserts* does not overlap the acoustic and electronic sounds; they sound in succession but not simultaneously. Even so, it is one of the first compositions for an ensemble of winds—not an orchestra, as it is often credited—and electronics.

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<sup>1</sup> Flora Dennis and Jonathan Powell, *Futurism* (Oxford University Press, 2001), <https://www.oxfordmusiconline.com/grovemusic/view/10.1093/gmo/9781561592630.001.0001/omo-9781561592630-e-0000010420>.

<sup>2</sup> Eimert, "How Electronic Music Began," 349.

<sup>3</sup> Edgard Varèse, *Déserts* (New York: Colfranc Music Publishing, 1959).

Inspired by Varèse, Donald Erb composed *Reticulation* in 1965 for wind band and electronic tape. *Reticulation* was one of the first wind band works to combine musique concrète approaches with electronically generated sounds.<sup>4</sup> Erb used the same setup from *Reticulation* to create the sounds for his composition *Stargazing* in 1969.<sup>5</sup> Unlike Varèse's *Déserts*, Erb's works used winds and electronics sounding simultaneously. The first work to use electronics as a cohesive element in the wind ensemble, however, was Erb's *The Purple Roofed Ethical Suicide Parlor*.<sup>6</sup> Composed in 1978, this work uses electronic tape with concert band minus baritone saxophone. The electronics sound like a modular synthesizer, mixing pure electronic and musique concrète sounds.<sup>7</sup> Thanks to the digitization of the tape tracks, these pieces have started to re-appear on concert programs.

Extant compositions for electronics and winds are sparse between 1980 and 2010. No other electroacoustic piece for winds appears until the late 1980s, and even then, only one is for wind band. Jim Mobberly's *Ascension* was initially written in 1988 using the technology of the time. Thankfully, Mobberly revamped the electronics in 2010 using contemporary technology. His update marks a departure from standard practice. Mobberly did not merely transfer the sounds from analog tape to a digital audio file such as a WAV or MP3; he redesigned the electronics using new samples and contemporary technology. With *Ascension* originally composed in 1988, nearly a decade gap exists before the next works for band and electronics appear. Two works from Jeffery Hass, from 1995 and 1996, respectively, both use fixed media with full band. These works are the first (in this setting) to

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<sup>4</sup> William Michael Parkinson, "An Analysis of the Wind and Jazz Ensemble Music of Donald Erb" (DMA Thesis, The University of Cincinnati, 1991), 71, ProQuest Dissertations & Theses Global.

<sup>5</sup> Parkinson, 99.

<sup>6</sup> Parkinson, 146.

<sup>7</sup> Parkinson, 147.

implement a separate conductor click track to help synchronize the ensemble with the tape. Previous works relied on audible cues and careful tempo maintenance to keep the ensemble synchronized.

2008 was a landmark year for electroacoustics and wind band, marking the first use of both dedicated applications and digital audio workstation software to control the electronics dynamically. Christopher Stark composed *Augenblick*, which uses a dedicated application to control its sound cues, and Steven Bryant composed the work *Ecstatic Waters*, which uses the software application Ableton Live to trigger sounds in real-time. Using a more dynamic approach freed the music from the rigid timeline dictated by tapes and CDs. Dynamic control meant the ensemble could now organically ebb and flow in many sections. These two works also introduced the laptop computer as an instrument in the wind band.

Approximately 12 pieces for band and electronics exist from before 2010, compared to the over 40 written from 2010 on. Despite the boom in compositions, there has been little advancement in the technology used. Pieces primarily use fixed media either via a dedicated application or by a compact disc or computer file (MP3, WAV, .AIFF, or similar file type). Some works use programs like Ableton Live to allow more dynamic control of the soundscapes, but at their core, these are still fixed media. In 2019, Steven Bryant's *The Automatic Earth* introduced even more dynamic control of the sounds. Its triggers are incredibly granular, allowing the electronics to be played more instrumentally. The electronics (mostly) follow the ensemble rather than the other way around, largely eliminating the need for click tracks and creating a more organic performance. Furthermore, Bryant's work implements speakers placed within specific sections of the ensemble to create an even more cohesive spatialization of sound. Future compositions are sure to further

expand the integration of electronics by using new controls and instruments. Among these exciting new instruments are the Mi.Mu gloves invented by Imogen Heap.<sup>8</sup> These gloves allow the wearer to manipulate and control electronics in real-time using customizable spatial gestures. These gloves could further free electronics from the fixed media paradigm while also making them just as visually engaging as their acoustic counterparts. The next groundbreaking wind band compositions should aspire to integrate wearable instruments like the Mi.Mu gloves.

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<sup>8</sup> “MI·MU | Home,” accessed March 28, 2020, <https://mimugloves.com/>.

## CHAPTER 3

### A PRIMER FOR WORKING WITH ELECTRONICS

#### Introduction to Working with Electronics

Approaching electronic music for the first time can seem daunting. There are a lot of wires, a lot of gear, and seemingly a lot of opportunities for error. A wind player's first experience assembling an instrument is not much different. Over time and with practice, both become more comfortable and more like second nature. There are key components and terms that are helpful in deciphering the jargon necessary to understand audio gear in general. Once the terms are understood, it no longer seems like a foreign language.

The general setup of electronics is fairly consistent. All setups will require some form of sound source: a laptop, an audio player, a digital musical instrument, or a similar device.<sup>1</sup> The setup will also require some means to amplify the sound from that source. The simplest form of amplification is a keyboard amplifier, all the way to multi-speaker surround sound setups. All of these components must be connected, of course, which is where the majority of the jargon appears. Each type of cable and connection has a specific name, size, and purpose. Once these components and terms are understood, assembly of the puzzle pieces becomes much clearer.

#### Understanding Audio Cables

All of these components must connect via a series of cables. Understanding and effectively communicating the type of each cable requires learning a bit of a new language. A term like

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<sup>1</sup> The most common setups used with wind band are discussed more in-depth in Chapter 4.

“headphone” connection is too vague, since headphones can connect in any number of ways. Asking for a “headphone” cable is a bit like ordering a soda: a size, type, and style. An extra-large Cherry Coke is not compatible with a person with diabetes who is allergic to cherries and has only a medium-sized cupholder. The specifics are key.

For the electronics discussed in this document, there are only two sizes of audio cables to know, and they are easy to identify visually: 1/8" (what most people call “headphone”) and 1/4". These two sizes come in two different types: TRS and TS. These are abbreviations referencing the appearance of the male connector and directly correspond to the number of conductors used by the connection. The Tip, Ring, and Sleeve (TRS) type is seen in examples A and C in Figure 1. It has three visible points of contact on the male connector. Compare that to the Tip and Sleeve (TS) connector in figure 1 example B, which



Figure 1. Common Audio Connectors Seen in Electronics Setups. From Left to Right: 1/8" TRS Male (A); 1/4" TS Male (B), 1/4" TRS Male (C); XLR Female (D); XLR Male (E).

has only two visible points of contact on the male connector. The female form of TRS and TS connections look identical and are difficult to identify if not labeled by the manufacturer.

Figure 1, example A, is a 1/8" TRS connector, and example C is a 1/4" TRS connector. The only other type of audio cable to know is the XLR. Often called microphone cables, XLR cables are easy to identify by their three-pin/three-hole connectors as seen in figure 1, example D and E. These cables come in only one size but can have more than three pins. The only XLR cables discussed in this document are XLR3 with three pins or holes. Last is the difference between male and female connections. Male connections are typically a plug, and female connections are a receptacle or jack that accepts that plug. Male connections have some sort of point, pin, or protrusion, and female connections have some sort of socket or slot. It is important to realize that male and female do not relate to the direction of the signal—both can either send or receive and are merely the means for connecting inputs to outputs and vice versa. So, the full names of what are commonly called “headphone” connectors are 1/8" TRS male connectors which plug into 1/8" TRS female connectors. To use these terms in context:

- To connect a device with a 1/8" TRS female output to a device with a 1/4" TRS female input, a 1/8" TRS male to 1/4" TRS male cable is required
- To connect a guitar to an amp, a 1/4" TS male cable is required

In terms of usage, TRS connections and cables are best for spanning long distances, such as between an audio interface and speaker. The longer a cable runs, the greater the chance of interference. Since TRS is balanced, it reduces the chance of interference. XLR is also balanced. In this setting, XLR is used primarily to connect microphones to interfaces but can also connect mixers and interfaces to speakers or be used to chain speakers together.

TS is unbalanced and more susceptible to interference. It should only be used to “patch” devices together over short distances (e.g., devices on the same table).

### Understanding Audio Signals: Why Mic vs. Line Matters

The most common audio signals in an electronic setup are mic and mic level signals. The basic characteristic to understand about them is that line level signals are stronger than mic level signals.<sup>2</sup> Since microphone level signals are relatively weak, mic inputs use a built-in pre-amplifier to boost their signals. Line-level signals are strong enough to not require pre-amplification, and thus line inputs do not have built-in pre-amplifiers. Microphones will not work well (if at all) when connected to a line input because they lack pre-amplification. Similarly, if a line level signal is connected to a mic input it will overload the pre-amp and cause distortion.<sup>3</sup> Examples of line level signals include the outputs from CD players, electronic instruments, and audio interfaces. To simply: line level signals should only connect to line inputs, and microphone level signals should only connect to mic inputs.

There is a third type of signal that is only pertinent if using an amplifier along with passive speakers (a topic covered in the next section) called speaker level. Speaker level is even stronger than line level. It must only be connected to a passive speaker or other device expecting a speaker-level signal could result in serious damage. It is so strong that it requires speaker cables to be transferred safely, and can cause serious damage if connected to “a source expecting anything less than a speaker level signal.”<sup>4</sup>

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<sup>2</sup> Bill Evans, *Live Sound Fundamentals* (Boston, MA, USA: Course Technology, 2011), 73.

<sup>3</sup> Evans, 74.

<sup>4</sup> “What’s the Difference between Mic, Instrument, Line, and Speaker Level Signals? | Sweetwater,” SweetCare, accessed April 6, 2020, <https://www.sweetwater.com/sweetcare/articles/whats-the-difference-between-mic-instrument-line-and-speaker-level-signals/>.

## Understanding Speakers: Powered vs. Passive

There are two main types of speakers: powered and passive. Since line level signals are too weak to power speakers on their own, both types require signals to be amplified in order to drive their sound-producing components. Passive speakers achieve this by using an external amplifier. Passive speakers are typically reserved for settings where portability is less of an issue, such as large venues that require much more power to fill the space. They are typically set up permanently—think house speakers in a theater. Powered speakers, on the other hand, have a built-in amplifier and serve as stand-alone units. Low level signals can connect directly to powered speakers and work. Most small venues and portable setups use powered speakers because they are simple to set up and easily relocated—think wedding DJ. Most ensembles are better off using powered speakers, given their simplicity and portability. The downside to powered speakers is that each must connect to an electrical outlet, which may require extension cords. The setups in this document assume the use of a portable system using powered speakers.

Regardless of choice in speakers, make sure any electrical outlets that are used can provide the necessary power without tripping an electrical breaker. To avoid issues, plug each speaker into separate outlets; avoid using the same receptacle or power strips unless you know the outlet can handle it. Test the loudest moment in the electronics, which will require the most power, to ensure there are no issues.

## Making Your Gear Last: Cases, Power Protection, and Wrapping Cords

Quality equipment is not usually cheap. Think of it as an investment. To protect that investment, be sure to store it properly. Store gear in cases, preferably hard-sided ones, to prevent dust from collecting in its moving parts and protect against other environmental

dangers. If hard cases are out of budget and the device did not come with one, store it in the box it came in. Get, make, and use storage bags or cases for components like speakers, mixers, and microphones.

Also consider protecting gear from power issues by using either surge protectors, power conditioners, or voltage regulators. Surge protectors can reduce surges from events like lightning strikes, but do not offer complete protection from possible damage.<sup>5</sup> They offer basic protection and are a cheap entry-level option. Plug-in power conditioners offer the best surge, interference, and noise protection,<sup>6</sup> but are also more expensive. Voltage regulators are the most expensive option but offer the best all-around protection. They monitor and adjusting incoming voltage, ensuring each device receives a consistent voltage despite external surges or dips in power (within reason).<sup>7</sup> They typically have built-in surge protection and conditioning, so they offer a reliable all-in-one option. The downside to voltage regulators is that long extension cords will be required to reach powered speakers. Consult with an audio specialist when considering adding voltage regulators to your setup.

Finally, there is a proper way to wrap a cable that will extend its life. Audio cables consist of metal wire surrounded by rubber and protective coatings. Like a paperclip, those wires break when flexed too many times. Improperly wrapping a cord flexes the wires unnecessarily, causes them to kink and not lay flat, and shortens their lifespan. It also makes them difficult to unwrap the next time they are needed, especially if they get mixed with

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<sup>5</sup> Andy Goldin, “Surge Strips Vs. Plug-in Power Conditioners,” *EC & M: Electrical Construction and Maintenance; Overland Park* 107, no. 5 (May 2008): 26–31.

<sup>6</sup> Goldin.

<sup>7</sup> “What’s the Difference between Power Strips and Power Conditioners? | Sweetwater,” SweetCare, accessed April 17, 2020, <https://www.sweetwater.com/sweetcare/articles/power-strips-power-conditioners-voltage-regulator-difference/>.

other improperly wrapped cables and turn into the dreaded “birds’ nest” of cabling. There are multiple methods for properly wrapping or rolling audio cables, and there are many how-to videos and instructions available online. The basic pattern involves alternating over and under wraps that follow the cable’s natural twist. Learn the process and teach it to anyone who works with your audio cables.

## CHAPTER 4

### UNDERSTANDING THE TECHNOLOGY

#### Technology is an Instrument

The basics of sound creation on a wind instrument are reasonably easy to understand in concept. The mechanics consist of three core elements:

1. The musician initiates a vibration using air and a reed (reed instruments), lips (brass instruments), or lip plate (flute).
2. That vibration's frequency and qualities are determined by the resonance of the bore.
3. The resonance of the bore creates standing waves<sup>1</sup>, amplifying the sound

This flow can be tailored to specific instruments, but the overall concept remains the same.

For a saxophone, for example:

1. The musician initiates a vibration using air and a reed.
2. That vibration's frequency and qualities are determined by the resonance of the saxophone bore.
3. The resonance of the saxophone bore creates standing waves, amplifying the sound.

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<sup>1</sup> A standing wave is a combination two waves with equal frequency and amplitude travelling in opposite directions. They can be created by trapping a wave, such as a sound wave, in a tube, string, or other finite space, causing it to reflect back on itself. According to the Oxford English Dictionary, a standing wave is one in which the positions of maximum and minimum oscillation remain stationary.

To better understand electronics, the same flow can be modified to use electronic-specific terminology:

1. The musician initiates a trigger using a controller.
2. That trigger's frequency and qualities are determined by the processor.
3. The processor creates signals sent to a sound system, amplifying the sound.

Just as with wind instruments, the flow can be tailored to specific electronic setups. For example, in most of Mason Bates's works, the flow would be:

1. The musician initiates a trigger using a laptop keyboard.
2. That trigger's frequency and qualities are determined by a computer application (Max/MSP).
3. The computer application creates signals sent to a sound system, amplifying the sound.

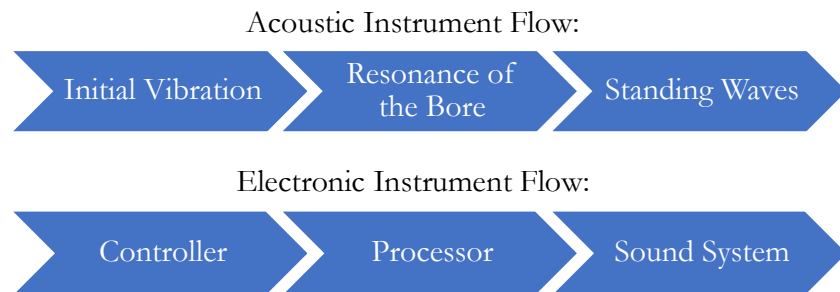


Figure 2. Graphic Comparing the Flow Sound Production on an Acoustic Instrument to That of an Electronics Setup.

Of course, this flow omits the subtle details that connect each stage. These details are critical for wind and percussion players—so much so that musicians spend lifetimes continuously honing them. With electronics, most musical decisions are made by the composer when they design the electronics, and the performer has little control over their

nuance. The sounds are most often played back at the press of a button. In the electronics component of wind band works, a performer focuses more on the intricacies of cabling, settings, and hardware. It is a far more complicated instrument to assemble than a wind instrument. To demystify the process, we will learn how to assemble the instrument for the first time.

Technology Grade:	Description
1	Requires a person to press play once and only uses a basic audio player (CD player, tablet, computer media player, and so on). No separate audio interface is required. If a click track is involved, the work is graded 1.5.
2	Requires a musician to activate multiple cues, usually using a computer or dedicated app, following basic rhythmic notation to stay with the ensemble. No additional controller is required. An audio interface is not required but can be used if desired. If a click track is involved, the work is graded 2.5.
3	Requires a musician to activate cues and an audio interface is required, either for audio quality or for additional outputs beyond left and right (e.g., a click track or extra monitor). Must be able to follow basic rhythmic notation.
4	In addition to an interface, a separate controller is required. Multiple cues are guaranteed at this level; the musician must be able to read notation as well as have at least novice experience with the style of instrument used (e.g., piano). A separate feed for a click track is typically required.
5+	In addition to a controller and audio interface, additional audio or technical components are used (e.g., surround sound, multiple speakers, or microphones); these generally require a more intricate understanding of computer and controller settings, and/or the work is very complicated to coordinate with the ensemble.

Figure 3. Technology Grades and Descriptions

#### Technology Grade 1 – Audio Player Only

By far the simplest method of controlling electronics with a large ensemble is the use of an audio player, such as a CD player or audio file on a laptop. Using an audio player offers simplicity and is the least intimidating option. Playing the electronics is akin to listening to

any other recording; it is just amplified on larger speakers and accompanies a group of winds. In terms of the flow of sound, an audio player serves as both the controller and the processor, which combines steps 1 and 2 and shrinks the flow to just two steps:

1. The musician initiates a pre-recorded track using a play button on an audio player, pressed once.
2. The audio player creates signals sent to a sound system, amplifying the sound.



Figure 4. Graphic Demonstrating the Flow of Sound in a System Using a Stand-Alone Audio Player.

While some composers include a physical CD with tracks or sounds, most offer downloadable audio files or other digital formats. In most cases, it is easiest to play files or discs from a laptop computer. The mouse and computer keyboard allow for faster navigation of the track in rehearsal. There are often separate tracks for rehearsal and performance, and it is vital to use them accordingly. Failure to do so could result in the audience hearing guides or cues meant for rehearsal purposes only. Some composers create separate files for each of their suggested rehearsal sections to make it easy to jump to specific sections in the piece during rehearsal. Other composers, such as in many of Alex Shapiro's works, supply the specific time stamps at each rehearsal number to be able to cue the appropriate point in the track as needed.

Using a prerecorded track and audio player offers the composer maximum control over the work and maximum simplicity for the performers. The tradeoff for performers is that these works are the least flexible and least engaging means of incorporating electronics. The instrument creating the electronic sounds lacks any visible connection to those sounds,

giving the audience little to engage with in terms of phrasing, tension, intensity, and even emotion.<sup>2</sup> The electronics dictate the tempo and are inflexible, and the balance of individual tracks or sounds within the electronics are fixed. In rehearsals, it is difficult to start at or rewind to an exact spot unless the composer provides individual tracks or time stamps. For the audience, audio players disembodied electronic sounds from a visible instrument.

### Technology Grade 2 – Using the Computer Keyboard and Multiple Cues

After being comfortable with compositions that use a single track, the next step is increasing the number of cues and controls for the electronics. Some compositions have multiple tracks to be started and stopped at specific points in the piece, but most are just press-play. At this level of technical ability, most works require a laptop or computer (some have dedicated tablet applications for iOS and Android devices). By using specific keys on the computer keyboard, composers divide the electronic sounds into multiple cues. For example, *The Machine Awakes* by Steven Bryant uses a dedicated application (downloaded from his website at no cost) that serves as the processor, using the computer keyboard as the controller. To put it in terms of the flow of sound:

1. The musician initiates a trigger using number keys 1, 2, and 3 on the laptop keyboard.
2. That trigger's frequency and qualities are determined by the *The Machine Awakes* application.

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<sup>2</sup> Michael Gurevich and A. Cavan Fyans, "Digital Musical Interactions: Performer–System Relationships and Their Perception by Spectators," *Organised Sound* 16, no. 2 (August 2011): 169, <https://doi.org/10.1017/S1355771811000112>.

3. The *The Machine Awakes* application creates signals sent to a sound system, amplifying the sound.

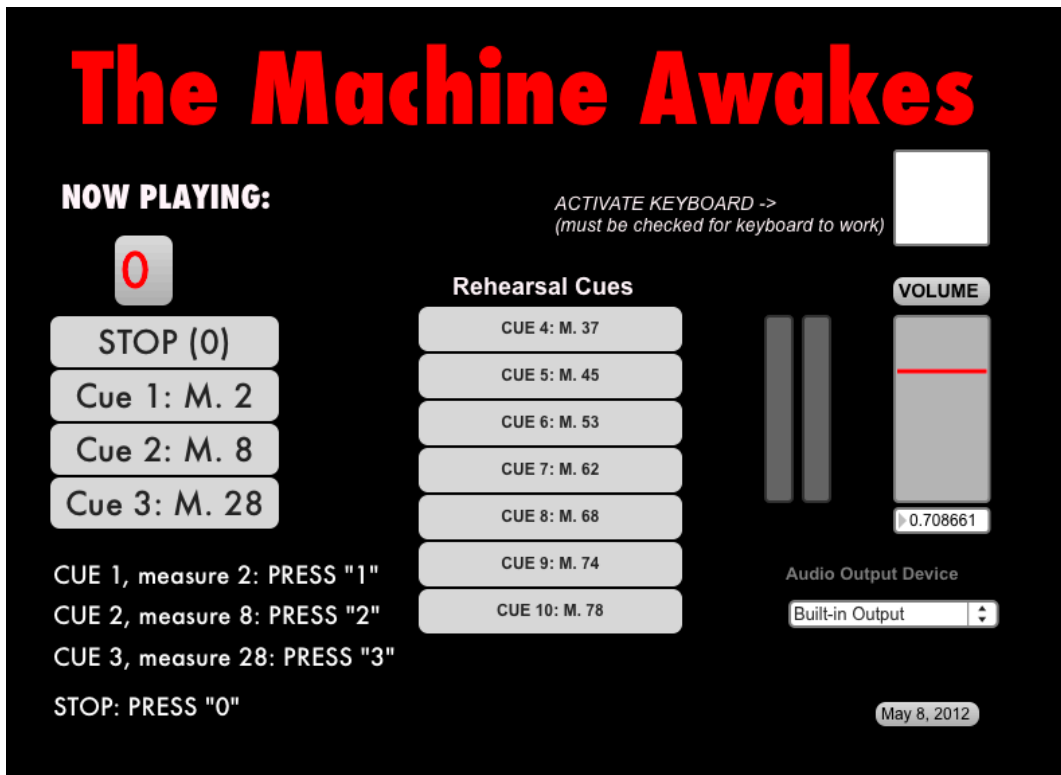


Figure 5. Screenshot of the Application for *The Machine Awakes* by Steven Bryant.

When the musician, usually a volunteer from the group who will not play their regular instrument on this piece, presses the “1” key on the computer keyboard, the application plays the pre-recorded track that starts precisely at the beginning of measure two. When the musician presses the “2” key, the track for measure eight plays. As shown in figure 5, the application tells the performer exactly what to do and includes rehearsal cues that allow the ensemble to start at the indicated measure numbers. In a worst-case scenario where the ensemble is not together with the electronics in performance, the rehearsal cues also can be used as an emergency fix by stopping the incorrect sounds using the “0” key and manually following the cues for the rest of the piece.

### Technology Grade 3 – Adding an Audio Interface

Audio interfaces are small boxes, typically slightly smaller than the size of the average textbook, that serve as the physical bridge between a computer and a sound system. In terms of the flow, figure 6 shows how an audio interface simply adds a layer between step 2 (the processor) and step 3 (the sound system). The compositions in this grade level require the use of a laptop, computer, or other processor; a phone, tablet, or CD player will not be adequate. Though intimidating, minimal study (and a cheat-sheet) makes using an audio interface as simple as assembling your primary instrument.



Figure 6. Graphic Demonstrating the Flow of Equipment When an Audio Interface Is Incorporated.

An interface bypasses the stock hardware of the computer, using its higher quality hardware to convert digital signals from the computer to analog ones required by the sound system. Interfaces can also do the opposite, converting analog signals such as microphone inputs to digital signals required by the computer. Each interface has a certain number and type of inputs and outputs and typically connects to a computer via a USB or Thunderbolt cable (see figure 12 in Appendix D). Some interfaces will require a separate power supply, but those connected via Thunderbolt or USB-C type connections often receive power directly from the computer. A device powered via its computer connection is more portable and reduces the number of electrical outlets needed. Note that not all Thunderbolt or USB-C connections provide power to the device. For example, the Focusrite 8i6 seen in figure 7 has a USB-C connection but requires an external power supply as well. Always check the

device's user manual to verify how it is powered. Furthermore, some interfaces connect to a computer without requiring additional software to be installed (called plug-n-play) but be sure to follow the instructions for any interface used.

When choosing an interface, ensure that it has the number of inputs and outputs needed. The most common interfaces have two or four 1/4" outputs. Two outputs accommodate the needs of works that require only a stereo signal. The upside of these smaller interfaces is that they are generally cheaper, but they only work for a limited number of compositions. An interface with four outputs, like the one seen in figure 7, will work for most compositions included in this document. Only one audio interface at a time will work, so it is important to plan for future expansion. Four outputs accommodate a left and right speaker and an isolated click track (with one unused output). For maximum expansion, make sure the interface has XLR connections so microphones can be plugged in as well.



Figure 7. Front (Top) and Back (Bottom) of the Focusrite Scarlett 8i6 Audio Interface. 2020 © Focusrite Audio Engineering Limited. All Rights Reserved.

There are many options for interfaces, each with a unique set of features, but they are all set up virtually the same. Once connected to the computer, the interface connects to the sound system. Rather than having to have any special cables, the interface uses standard 1/4" TRS or TS audio cables to send signals. As seen back in figure 5, the outputs on the interface often lack labels as to which is the left signal, right, or click. The software controlling the interface determines what is sent to each output, and can be used to determine which output is which.<sup>3</sup> In most cases, output 1 will be the left signal, output 2 will be the right, and output 3 will be the isolated click track if there is one.<sup>4</sup>



Figure 8. Screenshot of the Max/MSP Application for Mason Bates's *Mothership*.

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<sup>3</sup> See specifics for each program in Appendix B.

<sup>4</sup> See Chapter 6 for more on click tracks.

As an example of how to determine the appropriate outputs, let us use *Mothership* by Mason Bates. *Mothership* uses a dedicated app, seen in figure 8, custom designed using the software application Max/MSP. Clicking the “audio settings” button (just below the large yellow “Safety” button) produces the window seen in figure 9. Among the settings listed in the window are the input and output devices along with the specific output channels and their respective destinations. Since *Mothership* uses stereo audio without a click track, there are only two output channels listed: one for the left and right signals, respectively. Channel 1 shows “Output 1” as its destination and channel 2 shows “Output 2.” If an isolated click track was in use, Channel 3 and its destination would also be listed under “outputs” or could be found by clicking “Open I/O Settings” to see a complete list of inputs and outputs.

If the Focusrite 8i6 from Figure 7 were connected, the “Output Device” would show “Focusrite 8i6.” The outputs for “Ch 1” and “Ch 2” would still show “Output 1” and “Output 2,” respectively, indicating that the connection for the left speaker should plug into output #1 on the back of the interface and the connection for the right speaker should plug into output #2. The output settings should be changed only if necessary, and make sure to keep track of any changes and label everything accordingly. A piece of masking tape works well as a temporary label.

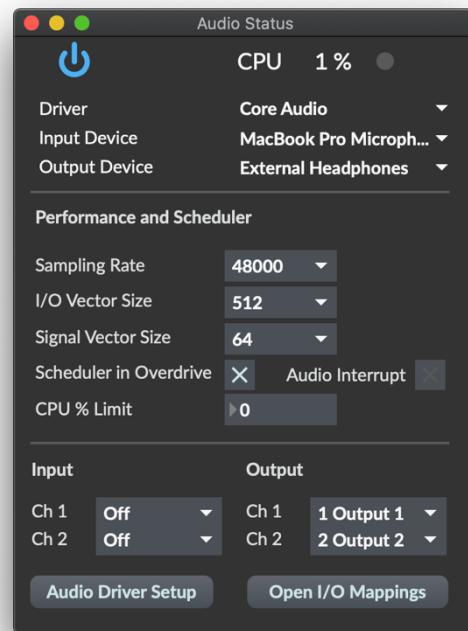


Figure 9. Screenshot of the Audio Settings for Mason Bates’s *Mothership* with No Audio Interface Connected.

To connect to a sound system, follow the instructions in Appendix C. If using a mixer, it is best to use adjacent channels. For example, connect the left signal to channel 1 and the right signal to channel 2. As Appendix C specifies, using a mixer requires separated stereo channels to be panned left and right, respectively. Failure to do so will overlap the left and right signals in both speakers, which will ruin stereo effects, degrade audio quality, and may cause phasing issues.

#### Technology Grade 4 – Adding an Electronic Keyboard or Controller

There are many options for controllers. The most basic is the simple audio player discussed in technology grade 1. On the more complicated side are electronic keyboards, motion controllers, and other cutting-edge devices. Since the majority of works listed in Appendix G use some form of an electronic keyboard, the focus will be primarily on keyboards.

The distinction between types of keyboards used in electronic works is a source of some confusion. The difference between a standard computer keyboard and an electronic piano-style keyboard (electronic keyboard) is simple to distinguish. They look very different and typically serve different purposes. The definition of an electronic keyboard, however, is a source of confusion. As mentioned in the glossary of terms, electronic keyboards must be capable of controlling an external processor. In order for an electric keyboard to serve as a controller, it must have some way to connect to an external processor. Any electronic keyboard specifically marketed as a controller will have a USB or MIDI connection for this purpose. Some digital pianos and synthesizers can also serve as controllers if they have this same USB or MIDI output. Be cautious with these dual-purpose keyboards, since some have USB ports that are for “service only,” which will not work for musical purposes. Consult the device’s manual and be sure to turn off any built-in speakers to prevent hearing factory

sounds and ensure any other necessary settings are configured to properly make the device a controller only.

Electronic keyboards can work with or instead of a computer keyboard or other devices to control software used to generate sounds. Electronic keyboards connect to computers in one of two ways: using a MIDI cable plugged into the “MIDI IN” on an audio interface, or directly into the computer using a USB cable. An example of a “MIDI IN” port appears in the back-panel photo in Figure 7. USB connections directly into the computer are best, since their response is nearly instantaneous compared to MIDI connections. MIDI can introduce just enough latency to be annoying, especially when precise rhythmic cues are necessary. Some works, such as Steven Bryant’s *Coil*, have rhythmic parts that must be executed in time with the ensemble to establish the groove (see Figure 10). Using a MIDI cable could cause this part to sound delayed through no fault of the performer. Many older electronic keyboards will only have MIDI as an option, which will work in most cases if a newer keyboard with a USB connection is not available. The performer will have to be aware of the possible delay, however, and adjust their execution accordingly.

As a quick aside, it is essential to note that the notation a musician follows does not typically correspond to concert pitches. They instead correspond to programmed sounds,

Figure 10. Steven Bryant’s *Coil*, mm. 49-52.



loops, and other events. In the excerpt from Steven Bryant's *Coil* seen in figure 10, for example, pressing C4 plays a distorted kick drum instead of a middle C. In parts that use the laptop keyboard, the cues are notated in corresponding terms: "Press K." Remember that a data cable such as USB or MIDI must connect the keyboard to the computer or interface. The keyboard uses data signals to control sounds generated in the computer, so a data cable is essential. An audio cable will not serve the necessary function, since they carry only analog audio signals. MIDI or USB are the standard connection options for controllers. Wireless and Bluetooth connections should be avoided at this point in their development. They are not reliable enough for live performance and are susceptible to interference, latency, and hijacking from outside signals. An audience member's or ensemble musician's cell phone could try to pair with the controller and cause unforeseeable issues. See Appendix D for detailed instructions for setting up controllers.

#### Technology Grade 5 – Microphones, Surround Sound, and Uncommon Setups

The most immersive electronic setups use microphones, surround sound, and digital musical instruments. In most instances, these items interact with a laptop or computer and will require the use of an audio interface.

Microphones are usually used to add digital effects to acoustic solos or sections. The microphone connects to one of the interface's mic pre-amp inputs (as opposed to a line input, which will not work with a microphone, see page 12), which feeds the sound into the laptop and, in turn, the effects software. From there, the sound follows the flow as usual. Examples of effects include adding digital delay to create an echo, adding distortion, and adding reverb. The processed sound is heard either along with the acoustic sound from the stage or is amplified to cover the acoustic sound. While the settings that control these levels

are set in advance by the composer, the volume on the microphone inputs can be adjusted for individual performances. None of the works on the list require more than two microphones, so the interface needs a maximum of two XLR mic inputs. The compositions that use microphones all include specific instructions in the score for microphone placement and type. An example of microphone use is Steven Bryant's *Ecstatic Waters*, which uses a microphone placed near the principal clarinet player to apply randomized digital delay and phasing to the clarinet solo in the fourth movement.

Most people are familiar with surround sound used in movie and home theater setups. Surround sound uses multiple speakers around the listener, each receiving a specific signal, to create a spatial experience of sound passing around the listener as it would in a real-world setting. Because they call for additional speakers beyond the left and right of simple stereo, surround setups require an interface with more outputs. In the case of a quadrophonic setup with a click track, five outputs are required: front left, front right, rear left, rear right, and a click track or monitor speaker. Quadrophonic surround sound is not highly complicated; it is essentially setting up two sound systems instead of just the one. The performer's part is no more difficult in surround sound than in stereo or mono. The composer pre-designs the surround sound effects to occur automatically, and the performer triggers them as usual, with no additional steps or performance responsibilities. Other than a more extensive interface, surround setups only require additional powered speakers, cables, and setup time. An example of a work that uses quadrophonic sound is Christopher Stark's *Augenblick*.

Less common setups are those that use audience cell phones to create sounds, tablets as digital musical instruments (DMIs), or more than one controller. When cell phones within

the audience are used, there are two common approaches. Audience members either connect to a specific website run by the composer and follow the instructions provided, or (more reliably) audience members connect to a dedicated WiFi router that is set up and run by a laptop on-site. From there, the connected devices automatically play sounds at the appropriate time in the composition, triggered either by a musician on-stage, after a specific amount of time, or by the audience members themselves. These setups generally require some familiarity with computers and networking, and also depend on your audience to follow the instructions to connect their device. Without a significant audience, human and technology errors result in underwhelming results. When executed and designed well, these compositions can cleverly distribute sounds throughout the audience and make for a mind-blowing spatial experience.<sup>5</sup> The only work on the list that uses this setup is Cody Brookshire's *Honeycomb*.

Using tablets and devices as DMI's is essentially the grade 2 difficulty with a twist. Using an app to generate sounds on a tablet is, in essence, turning the device into a DMI, albeit a very unengaging one visually. By running an application like GarageBand on an iPad, composers use the digital instruments within the program to turn the screen of the tablet into a virtual instrument. The musician plays the tablet using the on-screen keyboard, musical or otherwise, and the resulting output is amplified. When one tablet is used, those works are listed under technology grade two. In the case of Daniel Montoya Jr.'s *Axe to Grind*, however, three to four different tablets are used at once. The extra level of coordination required bumps these works into the grade 5 difficulty.

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<sup>5</sup> The spatial aspect of these works is even more engaging when audience members are allowed to walk around in the space. They can choose their own sonic adventure by exploring different parts of the performance space.

In more dynamic works, the number of cues and sounds can exceed the number of keys available to trigger them. Each key can be assigned only to one trigger at a time. A trigger itself can include any number of sounds, patterns, or events, but the button or key that activates a trigger is confined to that one job until told otherwise. Once all the keys on the laptop have been assigned a role, the only options for adding more are to create a different file for each movement, create some way for the performer to change the key assignments on the fly, or add an additional controller. A different file for each movement is cumbersome and risky (what if the settings do not load properly?), and changing assignments on the fly relies on the electronic part resting long enough for the musician to execute the change. For a work that is through-composed or without multiple movements, the only option is to add an additional controller. Such is the case in Steven Bryant's *The Automatic Earth*. All 88 keys on an electronic keyboard, along with a handful of laptop keys, are required to execute the incredible number of cues. The laptop keys are used for longer running loops, and the keyboard cues are pads, drum sounds, altered samples of the acoustic instruments, and other electronic sounds.

## SOUND SYSTEMS AND SPEAKERS

### Speaker Placement

One element all setups will have in common is some means of amplification. Whether a keyboard amplifier, an expensive pair of professional-grade speakers, or a permanent house audio system in a theater, amplification is required. There are ample resources for choosing loudspeakers and mixers, including local professional audio stores, resident audio specialists, and online guides such as Sweetwater Sound’s “PA Speaker Buying Guide.”<sup>1</sup> In addition to being beyond the scope of this document, there is as much bias in selecting audio equipment as there is in selecting acoustic instruments. For electronic works, however, it is essential to understand at least the differences between using house speakers in an auditorium versus using speakers set up within the ensemble. As a warning to the novice: the next two paragraphs get technical.

Though it is tempting to use the house speakers already set up in an auditorium or theater, it is not the best option. The issues with house speakers reduce to two basic concepts: integration of the electronic sounds with the acoustic ensemble and sound localization. Because the electronic sounds are designed to be part of the sound of the ensemble, Ahnert and Steffen state that “such systems cannot be fully replaced by largely ‘neutral’-sounding permanently installed ‘house’ sound reinforcement systems; they have to be used at least as reference sources on stage.”<sup>2</sup> That is to say, unless properly tuned by an

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<sup>1</sup> “PA Speaker Buying Guide | Sweetwater,” inSync, June 26, 2013, <https://www.sweetwater.com/insync/pa-speaker-buying-guide/>.

<sup>2</sup> Wolfgang Ahnert and Frank Steffen, *Sound Reinforcement Engineering: Fundamentals and Practice*, 2014, 288, <https://www.taylorfrancis.com/books/9781482267631>.

audio engineer and paired with on-stage speakers, house systems will sound othered rather than integrated.

The lack of integration is compounded by the issue of sound localization. Put simply, sound localization is the perceived location of a sound event.<sup>3</sup> Factors such as timing, loudness, and pitch all affect localization. The proximity of house speakers to the audience means their sound reaches them slightly sooner than the ensemble sound. The time difference causes the audience to localize sound closer to the speakers than the stage, and risks causing significant tempo and synchronization issues for the ensemble.<sup>4</sup> Properly configured delay (typically a few milliseconds) can help alleviate this problem, but still does not solve the previously discussed lack of integration. The solution for the ensemble issue requires additional speakers within the ensemble and a mixer to control them, adding both extra setup time and complications. Unless the composer intends for the audience to perceive the electronics and ensemble as separate entities, or unless there is no other choice, do not use the house speakers.

Using a portable sound system allows the performers to set up speakers behind and within the ensemble. Incorporating the electronic sounds into the ensemble largely eliminates phasing issues, the ensemble and conductor can hear the electronics more clearly, and the audience perceives a single coherent source of sound. Though some composers instruct the use of house speakers, evidence suggests these instructions be disregarded in favor of placing speakers behind or within the ensemble. Some works use surround sound

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<sup>3</sup> Jens Blauert, *Spatial Hearing: The Psychophysics of Human Sound Localization*, Rev. ed. (Cambridge, Mass: MIT Press, 1997), 2–4, <https://search-ebshost-com.ezproxy1.lib.asu.edu/login.aspx?direct=true&db=nlebk&AN=24381&site=ehost-live>.

<sup>4</sup> Ahnert and Steffen, *Sound Reinforcement Engineering*, 242.

and require additional speakers behind the audience, typically for a total of four speakers (quadrophonic sound). In these cases, the front speakers should still be a part of the ensemble to create a sound field that encompasses both the musicians and the audience in an incredibly immersive experience.

If a performance space or ensemble is large or balance is an issue, add additional speakers equally to the left and right channels. Additional speakers are a better solution than pushing the volume levels of fewer speakers beyond their limits, which results in distortion and potential damage. It could even be preferable to use multiple smaller (12") speakers rather than two higher output speakers. Extra speakers work best when daisy-chained off the main left and right speakers, respectively.<sup>5</sup> So long as the speakers are on the appropriate side of the space, these additional speakers do not need to face the audience directly. They can face acoustic shells and other hard surfaces on stage to deflect the sound.

If speaker placement still seems trivial, consider the aesthetic influence of antiphonal instruments, or of placing a soloist at the front of the stage, or the effect of surround sound. If the placement of sound is not essential, none of these effects would be achievable—speaker placement matters.

When placing speakers within the ensemble, it is imperative to accommodate the health and safety of the musicians. Sound intensity and pressure levels from speakers can easily damage the hearing of people sitting near them. Audience-facing speakers should be elevated over musician's heads using stands and must not be placed directly behind or near them. If electronics are particularly loud, ear plugs should be used as necessary.

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<sup>5</sup> See Glossary of Terms for an explanation of “daisy-chain.”

## Subwoofers

Composers like Steven Bryant, Mason Bates, and others suggest (and at times require) the use of subwoofers along with the main speaker setups. A subwoofer is a specialized speaker designed specifically to reproduce low frequencies, typically 120Hz and lower (about B<sub>2</sub> and lower). Depending on the speakers' frequency response and quality, as well as the electronics' content, a subwoofer is not always necessary.

Frequency response is “a component’s ability to produce audio output within a particular frequency range.”<sup>6</sup> Frequency response is usually presented in the form of a frequency range curve, which shows how a loudspeaker (or other device) responds across the spectrum of audible frequencies. The most desirable loudspeakers are those with a flat response curve, meaning they present all frequencies equally. A dip or peak in the curve indicates that the speaker will cut or boost the corresponding frequencies, respectively, which results in an uneven and less accurate reproduction of sound. Most general-purpose loudspeakers represent a compromise between achieving an even, full-range frequency response and the physical constraints (size and weight) of all the components required to do so.

The full-range frequency response of the QSC K12.2 speakers mentioned in Appendix F is relatively flat above 100 Hz, has a slight peak between 80-90 Hz, and drops exponentially as the frequency falls below 80 Hz. The lowest frequency response listed in its marketing materials is 50 Hz, or about G<sub>1</sub> in terms of musical notes.<sup>7</sup> Without a subwoofer,

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<sup>6</sup> Scott Hunter Stark, *Live Sound Reinforcement: A Comprehensive Guide to P.A. and Music Reinforcement Systems and Technology*, Mix Pro Audio Series (Emeryville, CA: MixBooks, 1996), 51.

<sup>7</sup> QSC, LLC, “Specifications Sheet - K.2 Series Active Loudspeakers,” 2019, [https://www.qsc.com/resource-files/productresources/spk/k.2/q\\_spk\\_k2\\_specs.pdf](https://www.qsc.com/resource-files/productresources/spk/k.2/q_spk_k2_specs.pdf).

this speaker can reproduce most low frequencies effectively. If the electronics make use of anything lower than 80 Hz (lower than E2), however, it will not be reproduced effectively. A subwoofer expands this range. The QSC KS112, for example, has a listed frequency response range of 41-108 Hz.<sup>8</sup> To adequately cover almost the entire range of human hearing, generally understood to span from 20 to 20,000 Hz, the speaker and subwoofer need to be paired together.

Beyond filling out the frequency response of a sound system, the dedicated low frequency power of subwoofers adds a characteristic felt-more-than-heard rumble to electronic bass sounds. Most performers will not have subwoofers readily available, but if the composer requests them, then there is a reason. They can be rented or borrowed instead of purchased; many schools with competitive marching bands or indoor ensembles will have subwoofers they may be willing to loan if they are not in use. If used, be sure to work with an audio technician or read the documentation for the gear used to help prevent an overpowering bass presence.

### Combining Speakers and Subwoofers

If using powered speakers and a single powered subwoofer, it is best to place the subwoofer near the center back of the ensemble. The left and right output signals from the interface or sound mixer will usually run into two separate inputs on the subwoofer first, then pass through the subwoofer's separate "out" connections and connect to the left or right speaker, accordingly. If using two separate powered subwoofers with powered speakers, one for the

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<sup>8</sup> QSC, LLC, "KS112 Specifications Sheet," 2018, [https://www.qsc.com/resource-files/productresources/spk/ks/ks112/q\\_spk\\_ks\\_112\\_specs.pdf](https://www.qsc.com/resource-files/productresources/spk/ks/ks112/q_spk_ks_112_specs.pdf).

left and one for the right, position them under the main speakers. The left and right out signals from the interface will connect to the appropriate subwoofer first, and then the subwoofer will connect and pass the signal to the speaker (daisy-chained together).

Regardless of the number of subwoofers used, both the main speakers and subwoofer need to have their settings configured correctly. There is usually a switch, knob, or setting on the rear panel that controls what is called the “crossover” frequency. This setting determines which frequency ranges the speaker is responsible for and which ones the subwoofer should handle. For example, setting the crossover frequency to 80Hz means the main speakers will handle all sounds above 80Hz, and the subwoofer will handle everything lower, with some overlap. The crossover frequency of both the subwoofer and speaker must be set appropriately and should be experimented with ahead of rehearsals. If not using a subwoofer, do not set a cross-over frequency or cut-off. Doing so will cause the speakers to omit any elements of the electronics below this frequency.

## CHAPTER 5

### WORKING WITH CLICK TRACKS

Click tracks are isolated metronomes, audible only to the conductor, that help the ensemble stay synchronized with the electronics. They require a dedicated audio signal to be sent to the podium, which connects to an earpiece worn by the conductor. Since the click and electronics are contained in the same file or audio output, they must be separated using the techniques outlined below and detailed in Appendix A. The exact method depends on how the electronics are integrated.

#### Click Tracks in Grade 1 Technology (Grade 1.5-2.5)

Most grade 1 works do not require or use a click track. Those that do make creative use of stereo audio files and are designated as grade 1.5. One channel, typically the left, carries the electronic sounds, and the other carries the click track. An audio mixer is used to split the channels and send them to the appropriate output. In order to send the signals to different outputs, each track of the audio file must be sent to a separate channel. The channel with the electronics is sent to the main speakers, and the click track is sent to the conductor's earpiece. Grade 2 works performed without an audio interface follow the same setup. How to achieve this is outlined in Appendix A.

#### Click Tracks in Grade 3+

With the addition of an audio interface, each individual track can be mapped to dedicated outputs. No splitters or adaptors are needed to separate the tracks. Each application requires a slightly different procedure. The specifics for each program are outlined in Appendix D.

## CHAPTER 6

### PEDAGOGICAL CONSIDERATIONS AND PERFORMANCE TIPS

#### Part Assignment and Pre-Rehearsal Preparations

As with other instrumental parts, assigning the correct musician to the electronics makes all the difference. A person who is capable with technology is the best choice, and experience with audio gear is a plus. Well before any rehearsal, any musician assigned to the electronics should have access to their part and be able to experiment and practice with the necessary gear and software. They should be able to work with each component and practice setting everything up at their own pace, outside the stress of finite rehearsal schedules. Much is learned in this trial-and-error period that will help prevent issues later. By allowing trial-and-error outside of rehearsal, it will also help prevent unnecessary frustrations and negativity from invading the rehearsal space. The amount of lead time needed will depend on the performer's previous knowledge and the complexity of the part. If a part or score must be followed, it is not uncommon to have an extra musician assist with following the part, turning pages, and troubleshooting so that the performer can keep their hands on the controller and focus on the music.

In addition to score study, works with electronics require both the conductor and the musicians to be intimately aware of the aural cues in the electronic parts—especially in the absence of a click track. To set the ensemble up for success, provide the musicians with access to the electronic tracks, a copy of the score or electronics part (which hopefully has a notated representation of the electronic sounds, at least in key moments), and a reference recording. The electronics should be familiar to everyone before being added to the rehearsal. Likewise, the musician playing the electronics should be familiar with any aural

cues in the ensemble that can help them find their spot should they lose track counting. Since they often not directly performing the part, it is easy to get confused and lose track of where they are in the music—especially if a technical problem occurs. Using electronics is an excellent opportunity to reinforce the concept that musicians should learn their individual parts ahead of time so they can use rehearsal to learn everyone else's.

As Murphy's law states, anything that can go wrong, will. Preparedness is the only deterrent. Preparation for rehearsing and performing with electronics starts with meticulous labeling. Once every item is set up and confirmed to be working correctly, label everything. Label all audio cables, where they connect to (both inputs and outputs), devices, and power cables. Remember that labels must be easy to read in the low-light setting of the performance stage. Once labeled, tear everything down and practice setting up again following the labels. After everything is set up and confirmed to be working again, assess if the labels were effective or if any modifications are needed to be clearer. Any member of the ensemble should be able to look at the gear and efficiently assist in assembling the puzzle, connecting cable #1 to output #1 and input #1, and so on. Labeling drastically simplifies setup and helps prevent simple errors that hold up rehearsals and ruin performances.

### Rehearsals

In terms of gear for rehearsal, it is ideal to use the same equipment in rehearsal as in performance. The musicians get used to the source of the sounds, what they will and will not be able to hear, how the equipment is set up, and how to balance to it. If consistency of gear is not a possibility, a smaller system such as the rehearsal room's sound system can be used. Additional cables and adaptors may be needed to achieve this, so plan and purchase accordingly. No matter which option is used, the electronics should be set up and tested

before rehearsal whenever possible. If everything was labeled meticulously, it is easy to train any member of the group (or in a pinch, someone in the preceding class) to set up the equipment. It can be tempting or even necessary to leave the electronics setup for time's sake. Keep in mind that by not practicing setting the gear up, the musician will probably take longer to set up for performance and be less equipped to troubleshoot errors. Add extra time to performance setup to account for this. Extra practice is not a huge issue, but it is worth weighing whether the extra time and potential stress before the performance negates the time gained in rehearsal.

In my experience, electronics should not be added immediately. The group must be capable of performing on their own first, developing a sense of ensemble sound and balance prior to adding the electronics. If electronics are added right away, musicians tend to first underplay to hear the electronics then over-play to hear themselves over the electronics. There is also the risk of diverting too much attention to getting the electronics “right” and missing all of the musical elements that require more guidance. In these first rehearsals, the musician assigned to the electronics should still set up all of the gear and practice executing each cue but have the volume turned off. Silent practice allows them to work out any idiosyncrasies before going live with the ensemble. After a few rehearsals without the electronics—so long as the big-picture musical elements for the ensemble are established and developing—it is time to introduce them in rehearsal.

There will be mistakes in the first rehearsal with electronics. It will feel like a disaster at times, especially if the focus is solely on the electronics. Patience must be practiced, and time must be used wisely. The conductor must be prepared to cover for the musician on electronics by rehearsing the ensemble while they troubleshoot technical issues. Avoid being

overly critical in these first rehearsals. Seek to understand problems rather than search for someone to blame. Being negative and overcritical in the early stages of rehearsal will only diminish confidence and foster uncertainty, both of which are contagious and the opposite of what the musician on electronics needs.

The structure of the first rehearsal with electronics depends on the size and content of the piece. For most works, the first rehearsal should include a full read of the work, followed by doing each section that includes electronics. For works that are extraordinarily long, contain a large number of cues, or are multi-movement, a full run could result in more frustration than progress. These works are best rehearsed in logical segments first, then assembled in larger segments as the performance approaches. Regardless of which order is chosen, the full read gives everyone a feel for the work as a whole, and the sections give them an opportunity to work out specific balance, intonation, and rhythmic issues. Hopefully, the group will have listened to the electronics on their own by this point, but there is the option of having the musician on the electronics play the section being rehearsed while the ensemble follows their parts and fingers along.

The musician performing the electronics should use the starting and stopping of different sections in rehearsal to practice techniques that could potentially save a performance. For example, if the electronics somehow get off by a measure starting in measure 45, knowing from rehearsal that there is a way to restart them at the proper spot in measure 53 could save the day. Most works that use Ableton Live, for example, will have a list of each cue with a measure number displayed in a frame on the right of the screen. It is best practice to use these resources to mark the electronic part with any possible safety net cues, even if they are not indicated by the composer or were designed mainly for rehearsal.

In an absolute emergency, stop the electronics and wait until the next viable cue. There will be a noticeable gap in the electronics, sure, but it may be better than risking all the manual activations described above and is certainly better than derailing the ensemble.

As rehearsals progress, the electronics should frequently be omitted in order for ensemble issues to be heard more clearly. It is not uncommon for groups to unintentionally allow electronics to cover up ensemble issues that would be otherwise obvious. Once the electronics are executed consistently, having them sit out now and then is of little concern. This is where being patient at the beginning of the rehearsal cycle process pays off. Once the performer on the electronics is confident and comfortable, they consistently execute their part.

### Performance

Allow plenty of setup time, ideally twice as much as was comfortable for rehearsal plus thirty minutes. The extra thirty-minute cushion is primarily for other musicians to warm up on the stage without competing with the electronics. It also allows for some emergency padding in case any serious issue arises. For example, if setup comfortably takes 30 minutes, your total setup time should be 1.5 hours. If soundcheck is at 6:00 PM, setup starts at 4:30 PM and is finished by 5:30, allowing other musicians 30 minutes to warm-up on-stage.

Have an extra cable of each type in case one fails. Have extra extension cords in case an electrical outlet is not working. Have reasonable backups as resources allow, especially for finicky or flakey equipment. For example, if the interface is a concern, have a second one next to it already plugged in, powered up, labeled, and ready to go at a moment's notice. Such redundancy may sound excessive, but it is no different from instrumentalists having

extra reeds or extra valve oil, or showing up early to make sure they are ready to go before the downbeat.

Essential steps that many people overlook are to close ALL unnecessary applications, put devices in “do not disturb” mode, and otherwise turn off Bluetooth, Wifi, and other connections, if possible. Close any connection or application that is not necessary for the performance. These steps prevent texts and emails from ruining tender musical moments and prevents applications from unexpectedly hijacking control of the computer’s audio output. Of course, remember the first step in most technology troubleshooting situations is to turn it off and back on again. Next, make sure every device is, in fact, plugged in correctly and powered on (labels!). Then look deeper if necessary. Failure to start with these steps inevitably results in 20 minutes wasted on trying to figure out why one speaker is not working, only to find out the cable was plugged into the wrong jack on the interface the whole time.

Ultimately, remember that it is live music. It is highly unlikely that there will be zero mistakes. The acoustic instrumentalists are bound to miss a note or two. The difference with electronics is that those mistakes typically have a longer life than a missed accidental. Either way, being flustered in the moment only leads to further mistakes. Anticipating them does not make them any less disappointing but does help keep the remainder of the performance intact. Besides, the majority of the audience will only remember how cool that piece with electronics was. The mistake is just proof that it was live, and it was human, despite being electronic!

## CHAPTER 7

### CLOSING THOUGHTS

Much of the base knowledge to perform works for wind band and electronics is contained in this document. None of it is novel; it is available in bits and pieces spread across multiple resources. This document provides a consolidated source and attempts to put the information in terms a novice can approach.

Works for wind band and electronics continue to increase in number. The many current composers are already technology savvy, and future generations are sure to be even more tech literate. It is only natural for technology and electroacoustics to continue to permeate acoustic ensembles. As audiences also become more attuned to technology, wind bands will have to program more of these works in order to draw and engage audiences effectively. The devices used in these works will continue to be more and more specialized. In addition to assigning the proper musician to the part, ensemble leaders will have to teach this musician how to work with these specialized devices and technologies. Before these works can be programmed, then, ensemble leaders and performers must understand the technology. Start with this document.

Composers should continue to include similar how-to guides with their works and embrace the grading system for the technology used. They must think beyond the premiere and provide guides that can be followed without the composer's direct input. Not only do such resources help ensemble leaders determine the suitability of compositions for their ensemble, but it also preserves the execution of the work for posterity. Without such an approach, these works will continue to be lost to the attrition of time and technological advancement.

Works with electronics are exciting. They hype up the musicians and intrigue the audience in ways acoustic works do not. Unfortunately, many ensemble leaders let the stress of the unknown prevent them from programming these works. Regardless of the depth of how-to guides, there is no substitute for the trial-and-error experiences offered within these works. The electronics must be viewed as an instrument, one that takes time to master. Just as with any first instrument, start small and simple and gradually expand. Sooner than later, you will find programming a work with electronics is not as daunting as it initially seemed. As many teachers have told their students in one form or another, take a chance, learn from the mistakes, and enjoy the experience.

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APPENDIX A

USING STAND-ALONE AUDIO PLAYERS (GRADES 1 AND 2)

Devices used in these setups (e.g., phones, tablets, and disc players) can typically be connected directly to a sound system without need for an audio interface. The outputs from these devices rarely match the inputs required by sound systems, so proper cables and adaptors are important. To begin, first:

1. Determine if your audio file requires stereo output. With the file playing, slowly pan from left to right. If you notice that the file distributes sounds unequally between the channels or uses one channel for the electronics and one for a click track, it will require a stereo connection. If the composer does not specify, listen to the sound file using headphones and carefully discriminate if the sounds the left and right ears are the same or different.
2. Examine the output on your device and the desired input on your sound system. Identify the size and type of each and make note of both.

To include all possible options is prohibitive. The most common setups are included here. Be sure to read the instructions completely before beginning any setup.

To connect a device with an 1/8" output to a sound system with a mixer:

1. Obtain a 1/8" TRS male to two 1/4" TS male splitter cable. The 1/4" ends should be labeled as to which one is the left channel (black or white) and which is the right (red).
2. Setup your sound system as usual and make sure the master volume on the mixer is down before connecting any cables.
3. Connect the 1/8" end of the splitter to the device, then connect the left 1/4" end to the first available channel on your sound system and the right to the next available channel. For example, the left splitter connector plugs into channel 1 on the mixer and the right plugs into channel 2.
4. Follow the appropriate steps to set the panning for your setup:
  - a. Mono Audio: If the composer *specifically* states the audio is mono, no panning should be necessary.
  - b. Stereo Audio: Use the panning controls to pan the left channel all the way left and the right all the way right.
  - c. Split Track with Electronics in one channel and click in the other:
    - i. For the channel with electronics, set the panning to center
    - ii. For the click track channel:
      1. Locate a pre-fader monitor or auxiliary knob, usually positioned above the volume and panning controls for the channel. Pre-fader knobs allow the main channel volume to be at zero while still sending a signal to another set of speakers or headphones.
      2. Leave the main channel volume all the way down and set the desired pre-fader monitor or auxiliary knob to 0 dB (typically centered).
      3. Locate this output on your mixer and connect your conductor's headphone cable to this output. If the click

track is audible, adjust the gain and pre-fader knob accordingly. If no sound is heard or it is too soft, an additional headphone/in-ear monitor amplifier will be needed at the conductor's podium (see Appendix F for suggestions)

4. For this channel only, step 5 can be skipped. At no point should the main channel volume be turned up for the click, as it will cause the click to be heard through the main speakers.
5. Set the gain for any channel in use to their lowest position, set each channel's main volume control to 0 dB, set the master volume to 0 dB (not the lowest, typically the center of a knob or 2/3 up for a fader), and set the volume on your connected device to maximum.
6. With the audio file playing, *slowly* raise gain knobs equally until the desired level of sound is achieved. Ideally do this with the loudest portion of the file.
7. Once the gains are set, use each channel's volume knobs to adjust the sound up and down as needed for rehearsal and performance.
8. Label everything and take pictures in case the settings are messed up at any point in the rehearsal/performance process.

For connecting an 1/8" directly to *powered* speakers (see page 13) without a mixer:

1. Decide on where the device will be located and who will trigger it.
2. Acquire the necessary cables, which will vary depending on your decisions in step 1:
  - One (1) Y-splitter, male 1/8" TRS that splits into two male 1/4" TRS or TS (one end will connect directly to its appropriate speaker; the other end will need an extension to reach its speaker)
  - One (1) 1/4" TRS extension cable (male 1/4" to female 1/4") long enough to reach between speakers, plus some slack
  - Optional (only needed if the device will be located somewhere other than next to one of the speakers, such as at the podium): One (1) additional 1/4" TRS extension cable
3. Setup your speakers in the desired location, making sure the speakers are either turned off or that their volume is set to the lowest setting before connecting any audio cables.
4. Make sure the speakers are set to "line" input and not microphone, or you risk damaging your speakers. See page 12
5. for discussion.
6. Connect the 1/8" end of the splitter cable to the device. Connect one of the 1/4" ends to its appropriate speaker (left or right) and connect the extension cable to the other 1/4" end, running it to the other speaker respectively. If the device will be located farther from the speakers, such as at the podium, use the other extension as appropriate.
7. Set your device volume to maximum and, with the audio file playing, slowly increase the volume on each speaker. It can be helpful to have an assistant at

one or both of the speakers so adjust them while listening from the hall or front of the rehearsal room. Ideally do this with the loudest portion of the file.

8. Label everything and take pictures in case the settings are messed up at any point in the rehearsal/performance process.

Some older works may require a CD player or other device that only has RCA type outputs (see figure 11). These devices will require a cable with two RCA male connectors on one end and two 1/4" TS male connectors on the other. From there, the setups above can be followed starting with step 2. Even if your mixer has RCA inputs, they are not for channel inputs or outputs and should not be used.



Figure 11. Male RCA Type Connectors. From Bottom Left to Top Right, Right Audio Signal (Red), Left (White), Video (Yellow).

APPENDIX B

ADDING AUDIO INTERFACES (GRADE 3+)

As mentioned in the main document, an audio interface serves as the physical bridge between the computer and the external audio environment. When first connecting an interface, follow the manufacturer's instructions to make sure any necessary drivers and utilities are installed. Once initially set up, this guide can be used to set up the interface for rehearsal or performance in the applications listed. Make sure the interface is set up on your computer per the manufacturer's instructions, is connected, and powered on if necessary.

#### Max/MSP (Mac OS or Windows)

1. Launch the patch or application for the composition.
2. Hopefully the composer added a button to the interface labeled "audio settings," "audio preferences," "audio status," or something similar. Click this button.
  - a. If this button does not exist, look to see if there is an "options" option in the application menu bar at the top of the screen or window. In that dropdown, there should be an option for "audio status." Click it.
3. In the window that appears, locate the "input device" and "output device" options.
4. In the dropdowns for "input device" and "output device," select your interface.
5. Close the window.
6. Test a few cues to confirm the sound is now being sent to the audio interface.

#### Ableton Live (Trial or Full Version)

1. Launch the Ableton file for the composition
2. Open the preferences:
  - a. On Mac OS: Click "Live" in the task bar at the top of the screen and select "Preferences"
  - b. On Windows: Click "Options" in the tool bar at the top of the screen or window and select "Preferences"
3. In the window that appears, select the "Audio" option from the list on the left
4. Locate the options labeled "Audio Input Device" and "Audio Output Device."
5. In both of these dropdowns, select your audio interface.
6. Configure your outputs and inputs:
  - a. Click the "Output Config" button. In the window that opens, make sure that all the outputs are activated (yellow) and click OK. If not using microphones, proceed to step 7.
  - b. Click the "Input Config" button. In the window that opens, make sure all required inputs are activated (yellow) and click OK.
7. Close the preferences window and test if audio from Ableton is being sent to the interface, and that audio is being received by Ableton if using microphones

#### GarageBand

1. Launch the file for the composition
2. In the taskbar, click "GarageBand" and select "Preferences"
3. Choose the "Audio/MIDI" tab
4. In the dropdowns for both "input device" and "output device," select your audio interface.
5. Close the preferences window
6. Test several cues to confirm the sound is now being sent to the audio interface.

## APPENDIX C

### CONNECTING AUDIO INTERFACES TO SOUND SYSTEMS (GRADE 3)

1. Follow the instructions in Appendix B to set up your interface.
2. Determine which outputs are in use and for what. If you took note of this when setting up the interface, you can skip to step 2:
  - a. Max/MSP (Mac OS or Windows)
    - i. Launch the patch or application for the composition.
    - ii. Hopefully the composer added a button to the interface labeled “audio settings,” “audio preferences,” “audio status,” or something similar. Click this button.
      1. If this button does not exist, look to see if there is an “options” option in the application menu bar at the top of the screen or window. In that dropdown, there should be an option for “audio status.” Click it.
    - iii. In the window that appears, locate the “Open I/O Mappings” button.
    - iv. Make note of all the output numbers being used and label them on the interface. In the typical stereo configuration, Output 1 is the Left signal, Output 2 is Right, and if a click track is used it is on Output 3.
      1. If the application does not identify the content of outputs, connect each to a speaker one at a time to identify them.
  - b. Ableton Live (Trial or Full Version)
    - i. Launch the Ableton file for the composition and make sure the audio interface is configured per the instructions in Appendix B.
    - ii. Find the “Master” channel, usually all the way to the right in the list of options. Above the fader for the “Master” channel, locate the “Master Output” dropdown. Identify what outputs it is set to, most likely 1/2.
    - iii. If there is a click track, locate it in the list of channels and identify what output the “Audio To” dropdown is set to. If the click track is not labeled, activate a cue and look for a channel with a noticeably constant pulsing signal—it is likely the click.
      1. If the click is not set to an output, use the “Audio To” dropdown to select an output not in use by the master (output 3 or 4).
    - iv. Label each of the outputs on the interface accordingly
  - c. GarageBand
    - i. GarageBand sends all audio output to channels 1/2 by default and this cannot be edited
3. Once all the outputs are labeled, begin connecting them to the appropriate locations:
  - a. Using a 1/4" TRS (balanced) or TS male cable, connect the left and right sends to the left and right speakers
  - b. If a click track is used, connect the appropriate cable and run it to the podium:
    - i. If your headphones work when connected directly to the output on the interface, the cable can be run to the podium without any extra gear. The cable will likely be a very long 1/4" TRS male to 1/8" TRS female.

- ii. If your headphones do not work when directly connected to the interface, an additional headphone/in-ear monitor amplifier will have to be added at the podium (see Appendix F for suggestion). An additional cable, likely a 1/4" TRS cable, will also be needed to connect the interface to this additional amplifier.

APPENDIX D

CONNECTING A CONTROLLER (GRADE 4)

Occasionally software will automatically detect the input when it launches, if the controller is connected and powered on. If this does not happen, follow the appropriate steps below to connect your device.

If using a MIDI cable to connect your controller via an audio interface:

1. Follow the procedures in Appendix E to add an audio interface
2. Find the “MIDI OUT” on your controller and the “MIDI IN” on the audio interface
3. Using a MIDI cable, connect the “MIDI OUT” on the controller to the “MIDI IN” on the interface.
4. Most interfaces have indicator lights on the front that blink when a MIDI signal is received. If your interface has this, press a key on the keyboard and make sure the indicator blinks.
5. In the software for the piece, confirm that the interface and MIDI device are configured properly:
  - Ableton Live:
    - i. Open the “Preferences” window
    - ii. Select the “Link/MIDI” tab from the options in the window that appears
    - iii. Under “Link” make sure “Start Stop Sync” is set to on
    - iv. Under “MIDI,” check the available options in the “Input” dropdown for option 1:
      1. If the name of your controller is available, select that as the input and skip to step 3
      2. If the name of your keyboard is not available but the name of your interface is, select the interface as the input
      3. Make sure the “Control Surface” dropdown is set to the name of your controller
    - v. Under the list of “MIDI Ports,” locate your controller name
    - vi. Make sure both the “Track” and “Remote” buttons next to your keyboard name are set to on
    - vii. Close the Preferences window and test your controller
  - Max/MSP:
    - i. **IMPORTANT:** The developer of the application has to have configured it to allow for MIDI connections. If they did not and it is a stand-alone app, you will be unable to set up a controller (nor is one probably needed)
    - ii. Since this is a custom configuration, the composer will have to have provided specialized instructions for connecting a controller.
  - Garage Band:
    - i. In the taskbar up top, select “GarageBand” then choose “Preferences”
    - ii. In the window that appears, select the “Audio/MIDI” tab
    - iii. Under the “MIDI” section, make sure that GarageBand has detected your MIDI device. If not, follow the in-application instructions for troubleshooting.

If connecting a controller using a USB connection:

1. Identify the type of USB connection both your controller and computer require, and make sure you have the appropriate cable. For example, many keyboards have a USB Type-B jack and most computers have USB Type-A, so a Type-B to Type-A cable will be needed. They are most likely one of the following:

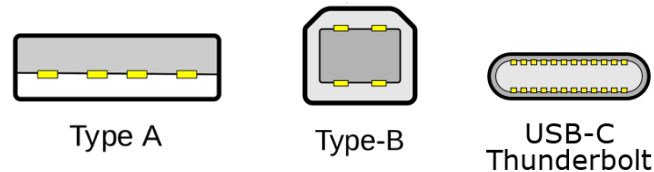


Figure 12. Common Types of USB Used with Controllers. From Left to Right: Type-A, Type-B, and Type-C or Thunderbolt (These Look Identical but Offer Different Capabilities).

2. Using the appropriate USB cable, connect the electronic keyboard directly to one of your computer's USB ports.
3. Once connected, launch the software for the piece and open the software's settings or preferences.
  - Ableton:
    - i. Open the "Preferences" window
    - ii. Select the "Audio" tab from the options to the left
    - iii. For both the "Audio Input" and "Audio Output" dropdowns, make sure they are set to your interface name
    - iv. Click the "Output Config" button
    - v. In the window that opens, make sure that all the outputs are activated (yellow)
    - vi. Click OK. If not using microphones, skip to step viii
    - vii. If using microphones, click the "Input Config" button and, in the window that appears, make sure all required inputs are activated (yellow) and click OK.
    - viii. Close the preferences window and test to make sure audio from Ableton is being sent to the interface, and that audio is being received by Ableton if using microphones
  - Max/MSP:
    - i. **IMPORTANT:** The developer of the application has to have configured it to allow for external controllers. If they did not and it is a stand-alone app, you will be unable to set up a controller (nor is one probably needed)
    - ii. Since this is a custom configuration, the composer will have to have provided specialized instructions for connecting a controller.

- Garage Band:
  - i. In the taskbar up top, select “GarageBand” then choose “Preferences”
  - ii. In the window that appears, select the “Audio/MIDI” tab
  - iii. Under the “MIDI” section, make sure that GarageBand has detected your device. If not, follow the in-application instructions for troubleshooting.

## APPENDIX E

### ADDING MICROPHONES AND OTHER COMPONENTS (GRADE 5+)

This guide is specifically for adding devices and components in Ableton, Max/MSP, and GarageBand. It does not cover adding microphones for basic sound reinforcement, recording, or for external effects processing using pedals or other equipment (though the setup would be similar).

Adding any auxiliary components requires an audio interface, almost without exception. The needs of the interface will depend on what the work calls for. Based on the works in Appendix G, additional components include:

#### Microphones

- Your interface will require one mic level XLR input per microphone needed
- Follow the instructions in Appendix B, making sure to properly configure the input settings as indicated for the software being used

#### Surround Sound

- Your interface will require one 1/4" output per speaker required, including click track. For example, a quadraphonic setup (4 speakers) with a click track will need FIVE outputs! There are no works included in Appendix G that require more than 8 outputs, and most require no more than 6.

APPENDIX F

EQUIPMENT SUGGESTIONS AND START-UP CHECKLIST

The equipment listed here is only for the purpose of establishing examples and do not represent an endorsement in any way. They are merely meant as a reference while searching for equipment that will fit your needs.

Speakers:

- QSC K12 or K12.2 (subwoofer pairing: KS112 or KS212C)
- JBL PRX812 (subwoofer pairing: JBL PRX815XLF or JBL PRX818XLF)
- Electro-Voice ELX200-12P or EKX-12P (subwoofer pairing: Electro-Voice ELX200-12SP or EKX-15SP)

Audio Interfaces (only the specifications pertinent to these works are included here):

- MOTU UltraLite-mk4 (~\$600)
  - USB 2.0 and USB 3.0
  - 8 x 1/4" TRS outputs
  - 2 x XLR inputs
  - MIDI IN and OUT
- Focusrite 8i6 3<sup>rd</sup> Generation or the older 6i6 (~\$250)
  - Works with any Grade 1-5 work that does not require surround sound
  - USB-C connection
  - 4 x 1/4" TRS outputs
  - MIDI IN and OUT
- Motu M4 (~\$200)
  - Works with any Grade 1-5 work that does not require surround sound
  - USB-C connection
  - 4 x 1/4" TRS outputs
  - 2 XLR inputs
  - MIDI IN and OUT
- Behringer U-Phoria UMC22 USB Audio Interface (~\$70)
  - Only works with grade 1-3 works with no click track or additional speakers needed
  - USB 2.0 connection
  - 2 x 1/4"

Headphone/In-Ear Monitor Amplifier:

- Behringer Powerplay P2
  - cheap, compact, battery operated, accepts XLR or TRS, and has a belt clip

## Controllers:

- Nektar Impact GX61 61-key Keyboard Controller (~\$120)
- M-Audio Keystation 88 88-key Keyboard Controller (~\$230)
- M-Audio Hammer 88 88-key Keyboard Controller (~\$500)

## Cables:

Many audio stores custom-make cables in various lengths and a variety of connectors. Many times they are labeled as whatever brand of cable is used to make them, along with the connectors on each end. You can save serious money if you know someone skilled at making cables and can buy in bulk. Avoid big box brands, since they are often overpriced for their level of quality. There are plenty of quality brands available, including:

- Mogami Gold (most expensive, stock sizes available up to 50')
- Pro Co (Mid-Grade)
- Hosa (Cheapest)

As for cable types to have on hand, follow these quantities per grade:

- Grade 1 & Grade 2
  - 1/8" TRS to dual 1/4" TS
- Grade 3 & Grade 4
  - 2 x 50' 1/4" TRS patch/interconnect/male to male cables (to route interface to speakers)
  - 1 x 25' 1/4" TRS male to 1/8" female (to route interface to conductor earbud for click track)
    - Alternatively, a longer 1/8" TRS male to female cable paired with a 1/8" TRS to 1/4" TRS adapter
  - If monitor speakers are used: an additional 1/4" patch cable per monitor
- Grade 5 or more
  - All of the cables for Grade 3/4, including the additional 1/4" patch cables
  - 2 x XLR microphone cable (male to female)

## Microphones:

An audio specialist can make the best suggestion for your needs, but for general instrument miking, these two microphones are durable industry work horses:

- Shure SM57 Cardioid Dynamic Microphone (~\$100)
- Shure Beta 57A Supercardioid Dynamic Instrument Microphone (~\$140)

APPENDIX G

COMPILED LIST OF WORKS FOR WIND BAND & ELECTRONICS

The works in this compilation were located using sources including windrep.org, individual composer and publisher websites, and a multitude of internet searches. The works are sorted primarily by technology grade, then by composer last name, musical grade, and year of composition. For an explanation of the grades, see figure 3.

### Grade 1 Technology

Title of Work: Disconnect  
Composer Name: Britt Andrew Burns (b. 1980)  
Year of Composition: 2019  
Duration: 3'40"  
Musical Grade: 4  
Technology Grade: 1  
Publisher: Indie Classical Publications  
Availability: Purchase  
URL: <https://www.jwpepper.com/Disconnect/11163838.item>

#### Description of Technology:

Disconnect uses a pre-recorded audio file playable from a device like a laptop, cell phone, or tablet. The piece starts with electronics only as the musicians are “preoccupied” with their cell phones, then gradually transitions to solely acoustic instruments.

Title of Work: Electric Boogaloo  
Composer Name: Benjamin Dean Taylor (b. 1983)  
Year of Composition: 2019  
Duration: 1'30"  
Musical Grade: 1.5  
Technology Grade: 1  
Publisher: Blue Dot Collective  
Availability: Purchase  
URL: <http://www.benjamin Taylormusic.com/electric-boogaloo-grade-1-with-audio-track.html>

#### Description of Technology:

The composer indicates that the electronics are optional, but strongly encouraged. They are very simple to execute, as they are just an audio file playable from a laptop, cell phone, tablet, or similar device.

Title of Work: Concert Band Meets 8-bit Video Game Soundtrack  
Composer Name: Benjamin Dean Taylor (b. 1983)  
Year of Composition: Expected 2021  
Duration: 3'  
Musical Grade: 2 to 2.5  
Technology Grade: 1  
Publisher: TBD

Availability: In Consortium  
URL: <http://www.benjamintaylormusic.com/grade-2-band-consortium-commission.html>

Description of Technology:

This composition is still in consortium and is a work in progress. It is safe to assume based on the consortium description and discussions with the composer that it will follow Benjamin Dean Taylor's other works and use an audio file playable from a laptop, cell phone, tablet, or similar device.

Title of Work: Psychology of FEAR/EXCITEMENT  
Composer Name: Benjamin Dean Taylor (b. 1983)  
Year of Composition: Expected 2021  
Duration: 4' to 5'  
Musical Grade: 3 to 3.5  
Technology Grade: 1  
Publisher: TBD  
Availability: In Consortium  
URL: <http://www.benjamintaylormusic.com/grade-3-band-consortium-commission.html>

Description of Technology:

This composition is still in consortium and is a work in progress. It is safe to assume based on the consortium description and discussions with the composer that it will follow Benjamin Dean Taylor's other works and use an audio file playable from a laptop, cell phone, tablet, or similar device.

Title of Work: Stargazing  
Composer Name: Donald Erb (1927-2008)  
Year of Composition: 1969  
Duration: 3'  
Musical Grade: 3.5  
Technology Grade: 1  
Publisher: Theodore Presser Company  
Availability: Purchase - Score & CD separate  
URL: <https://www.presser.com/145-40009-stargazing.html>

Description of Technology:

The electronics are pre-recorded files on a CD, but the conductor and musicians must memorize the aural cues from the electronics in order to stay synchronized as there is no click track. Of Erb's works, this is the easiest to coordinate and perform.

Title of Work: Reticulation  
Composer Name: Donald Erb (1927-2008)  
Year of Composition: 1965  
Duration: 6'

Musical Grade: 5  
Technology Grade: 1  
Publisher: Theodore Presser Company  
Availability: Purchase - Score & CD separate  
URL: <https://www.presser.com/115-40287-reticulation.html>

Description of Technology:

The electronics are a simple CD playback, but the lack of a click track makes it difficult to navigate the silences. A musician will have follow the time stamp of the playback and cue the conductor when the electronics reenter. As with Erb's other works, the conductor and musicians will need to be intimately familiar with the electronics. The electronics are played back from a CD, which can either be played on a CD player, computer with a CD drive, or the CD could be converted to an audio file and played back on any number of devices.

Title of Work: Purple Roofed Ethical Suicide Parlor  
Composer Name: Donald Erb (1927-2008)  
Year of Composition: 1972/79  
Duration: 10'15"  
Musical Grade: 5  
Technology Grade: 1  
Publisher: Theodore Presser Company  
Availability: Purchase - Score+Parts and CD are separate  
URL: <https://www.presser.com/145-40017-the-purple-roofed-ethical-suicide-parlor.html>

Description of Technology:

Though the execution of the electronics is simple, the musical difficulty and shifting tempos without a click track means the conductor and musicians must memorize the aural cues from the electronics in order to stay synchronized. The electronics are played back from a CD, which can either be played on a CD player, computer with a CD drive, or the CD could be converted to an audio file and played back on any number of devices.

Title of Work: Lost in the Funhouse  
Composer Name: Jeffery Hass (b. 1953)  
Year of Composition: 1996/98  
Duration: 14'15"  
Musical Grade: 5  
Technology Grade: 1  
Publisher: Ludwig Music Publishing Company  
Availability: Purchase  
URL: <https://music.indiana.edu/departments/academic/composition/recordings/hass/lost.shtml>

Description of Technology:

Lost in the Funhouse comes with an audio CD that, according to the publisher's description, "is easily synchronized with the acoustic score."

Title of Work: God Rest Ye Merry Peeps  
Composer Name: arr. Ed Kiefer (b. 1954)  
Year of Composition: 2013  
Duration: 2'  
Musical Grade: 1  
Technology Grade: 1  
Publisher: C. Alan Publications  
Availability: Purchase  
URL: <https://c-alanpublications.com/god-rest-ye-merry-peeps/>  
Description of Technology:

Very much a piece for beginning band, the electronics track is on a CD. It is essentially a play-along track that consists of techno synths, bass, and drums.

Title of Work: From the Blue Fog  
Composer Name: Jessica Rudman (Unknown)  
Year of Composition: 2009  
Duration: 11'50"  
Musical Grade: 3  
Technology Grade: 1  
Publisher: Self-Published  
Availability: Contact Composer  
URL: <https://www.jessicarudman.com/compositions/wind-ensemble/>  
Description of Technology:

A pre-recorded stereo track accompanies this work. There is no click track, and since the work is largely built on aleatory it is not necessary. The composer provides approximate timings in the score, but also says that the electronics can easily be faded if they continue too far beyond the end of the ensemble.

Title of Work: Techno Blade  
Composer Name: Benjamin Dean Taylor (b. 1983)  
Year of Composition: 2018  
Duration: 3'  
Musical Grade: 2  
Technology Grade: 1  
Publisher: Blue Dot Collective  
Availability: Purchase  
URL: <http://www.benjamintaylormusic.com/techno-blade-grade-2-with-audio-track.html>  
Description of Technology:

Techno Blade uses an audio file playable from a laptop, cell phone, tablet, or similar device. Either the conductor or a musician must play the file on the downbeat of measure 3 and follow the tempo of the track for the remainder of the piece.

Title of Work: Déserts  
Composer Name: Edgar Varèse (1883-1965)  
Year of Composition: 1954  
Duration: 28'  
Musical Grade: 6+  
Technology Grade: 1  
Publisher: Ricordi  
Availability: Rental  
URL: <https://www.ricordi.com/en-US/Composers/V/Varese-Edgar.aspx>

Description of Technology:

Being one of the earliest works for wind band and electronics, the electronics are played back on tape or from digitized audio files. The electronics serve as “interludes” between sections, and do not play at the same time as the ensemble. A musician is required to read cues from the conductor to start each interlude and cue the conductor as interludes are coming to an end.

#### Grade 2 Technology

Title of Work: Ringing Rocks  
Composer Name: Thomas Rex Beverly (Unknown)  
Year of Composition: 2012  
Duration: 6'  
Musical Grade: 3.5  
Technology Grade: 2  
Publisher: Self-Published  
Availability: Purchase  
URL: <https://thomasrexbeverly.com/products/ringing-rocks-for-wind-ensemble-with-or-without-electronics>

Description of Technology:

Ringing Rocks uses a stand-alone app designed using Max/MSP. A musician triggers the electronics by pressing the spacebar on the laptop at each trigger point. More detailed instructions are included with the score and app. There is also an option perform the work with a fifth percussion part in place of the electronics, though it is not preferred.

Title of Work: The Butterfly Chaser  
Composer Name: BJ Brooks (b. 1975)  
Year of Composition: 2016  
Duration: 6'  
Musical Grade: 4

Technology Grade: 2  
Publisher: Octatone  
Availability: Unknown  
URL: <http://octatone.com/portfolio/the-butterfly-chaser/>

Description of Technology:

How the electronics are executed is unclear based on the score. Based on the score and available recordings, there are multiple cues but it is unlikely that an interface or controller is necessary. Contact the composer for further information, including availability.

Title of Work: Song of the Tides  
Composer Name: Derek Charke (b. 1974)  
Year of Composition: 2006  
Duration: 10'  
Musical Grade: 2.5+  
Technology Grade: 2  
Publisher: Canadian Music Centre  
Availability: Purchase/Loan/Rental  
URL: <https://www.charke.com/works/tides.htm>

Description of Technology:

Only the second movement uses electronics. The audio files with this work are playable from any laptop, tablet, or similar device with an audio player. There are five tracks total, and they consist primarily of ambient sounds, enhancing the piece by incorporating "acousmatic soundscapes." The score includes instructions.

Title of Work: All Dark Is Now No More  
Composer Name: JAMES M. DAVID (b. 1978)  
Year of Composition: 2014  
Duration: 8'30"  
Musical Grade: 4  
Technology Grade: 2  
Publisher: Self-Published  
Availability: Purchase  
URL: <http://www.jamesmdavid.com/all-dark-is-now-no-more.html>

Description of Technology:

All Dark is Now No More uses an audio file playable from a device like a laptop, cell phone, or tablet.

Title of Work: All the Bells and Whistles  
Composer Name: Jeffery Hass (b. 1953)  
Year of Composition: 1997  
Duration: 8'30"  
Musical Grade: 4

Technology Grade: 2.5  
Publisher: Manhattan Beach  
Availability: Purchase  
URL:

<https://music.indiana.edu/departments/academic/composition/recordings/hass/bells.shtml>

Description of Technology:

The audio files provided consist of the electronics in the left track and a click track in the right. The stereo signal will have to be split in order to send the electronics (left) to the main speakers and the click (right) to only the conductor's earbud.

Title of Work: Blue Marble  
Composer Name: Derek Jenkins (b. 1986)  
Year of Composition: 2016  
Duration: 18'30"  
Musical Grade: 5  
Technology Grade: 2  
Publisher: Self-Published  
Availability: Purchase  
URL: <https://www.derekmjenkins.com/blue-marble>

Description of Technology:

The electronics consist of samples from JFK's Apollo speeches, famous audio from the missions, and a poem from Walt Whitman. They can either be performed using the provided Max/MSP patch, or by playing the separate audio files at the appropriate point in the score.

Title of Work: High Voltage  
Composer Name: Randall Standridge (b. 1976)  
Year of Composition: 2017  
Duration: 2'15"  
Musical Grade: 1.5  
Technology Grade: 2  
Publisher: FJH Music Company  
Availability: Purchase  
URL: <https://randallstandridge.com/high-voltage/>

Description of Technology:

The composer states the work is highly successful without the electronics and that they are meant to enhance the work, making this piece an easy introduction to using electronics. It does require the performer to download the sound effect files (four files total) and load them into a program or device that can play them back. Instructions are included with the score.

Title of Work: Deus Ex Machina  
Composer Name: Randall Standridge (b. 1976)

Year of Composition: 2020  
Duration: 5'  
Musical Grade: 4  
Technology Grade: 2  
Publisher: Randall Standridge Music, LLC  
Availability: Purchase  
URL: <https://randallstandridge.com/deus-ex-machina/>

Description of Technology:

*Deus Ex Machina* uses both electronic effects (played manually via separate sound files) as well as a synthesizer capable of performing split voices (one sound in lower staff, another in the upper). If your synthesizer does not have a split-voice function but can be used as a controller, computer programs like GarageBand, MainStage, and others can be configured to perform split voices using one controller.

Title of Work: Singularity  
Composer Name: Eli Fieldsteel (b. 1986)  
Year of Composition: 2014  
Duration: 15'  
Musical Grade: 4  
Technology Grade: 2.5  
Publisher: Unknown  
Availability: Contact Composer  
URL: <https://www.elifieldsteel.com/works/electroacoustic/singularity>

Description of Technology:

The electronics are performed on a laptop via Supercollider, a free app, and controlled by the laptop keyboard. An audio interface is optional, and the electronics are mostly pads and aleatory so they do not require much synchronization. The performer must load the provided code into Supercollider, then execute that code in order to see the controller. This sounds complicated, but it is not much more difficult than opening a document from the "File" menu in any other program. Instructions are included with the score and performance files.

### Grade 3 Technology

Title of Work: Solaris  
Composer Name: Devin Arne (b. 1985)  
Year of Composition: 2019  
Duration: 9'  
Musical Grade: 3.5  
Technology Grade: 3  
Publisher: Devin Arne  
Availability: Purchase  
URL: <http://devinarne.com/home/music/>

Description of Technology:

The electronics are all run through Ableton Live by pressing hotkeys on the laptop keyboard (e.g. Cue 5 is activated by pressing the 5 key on the computer keyboard). The files require a click track to perform successfully, so the interface will require a minimum of three outputs (Left, Right, Click Track). Depending on the interface used, a headphone amplifier may be needed for the click track signal sent to the podium.

Title of Work: Mothership  
Composer Name: Mason Bates (b. 1977)  
Year of Composition: 2012  
Duration: 10'  
Musical Grade: 4  
Technology Grade: 3  
Publisher: Aphra Music  
Availability: Rental  
URL: <https://www.masonbates.com/mothership-band/>

Description of Technology:

Mason Bates designs stand-alone applications for each of his works. Behind the scenes they use the software Max/MSP, but the user just sees the “Mothership” app. Cues are activated by holding the “shift” key (a safety to prevent accidental triggering) while pressing their corresponding keys on the laptop keyboard. If an external controller with a pitch wheel is added, tempo can be shifted slightly to match the ensemble.

Title of Work: Rusty Air in Carolina  
Composer Name: Mason Bates (b. 1977)  
Year of Composition: 2006/2015  
Duration: 12'  
Musical Grade: 4  
Technology Grade: 3  
Publisher: Aphra Music  
Availability: Rental  
URL: <https://www.masonbates.com/rusty-air-in-carolina-band/>

Description of Technology:

Mason Bates designs stand-alone applications for each of his works. Behind the scenes they use the software Max/MSP, but the user just launches the work specific application. Cues are activated by holding the “shift” key (a safety to prevent accidental triggering) while pressing their corresponding keys on the laptop keyboard.

Title of Work: Chicago, 2012  
Composer Name: Mason Bates (b. 1977)  
Year of Composition: 2014

Duration: 6'30"  
Musical Grade: 5  
Technology Grade: 3  
Publisher: Aphra Music  
Availability: Rental  
URL: <https://www.masonbates.com/chicago-band/>

Description of Technology:

Mason Bates designs stand-alone applications for each of his works. Behind the scenes they use the software Max/MSP, but the user just sees the “Chicago, 2012” app. Cues are activated by holding the “shift” key (a safety to prevent accidental triggering) while pressing their corresponding keys on the laptop keyboard.

Title of Work: Extinction  
Composer Name: Christopher Biggs (b. 1979)  
Year of Composition: 2015  
Duration: 8'  
Musical Grade: 5+  
Technology Grade: 3  
Publisher: Christopher Biggs Music  
Availability: Unknown  
URL: <https://christopherbiggsmusic.com/extinction>

Description of Technology:

The work requires Max/MSP to be installed on a laptop, which controls all the cues using the laptop keyboard. The score includes through instructions for how the app works. The app is unique in that it presents a spectral image of the electronics along with a reduction of the score to follow in the app itself. Most other works require the electronic performer to follow along in a separate score, which can be cumbersome. The composer recommends using a subwoofer with independent volume control, but it is not necessary.

Title of Work: Monument III: Charleston, Summer of 2015  
Composer Name: Scott Blasco (b. 1978)  
Year of Composition: 2015, rev. 2017  
Duration: 10'  
Musical Grade: 4  
Technology Grade: 3  
Publisher: Self-Published  
Availability: Contact Composer  
URL: <https://scottblasco.com/monument-iii-charleston-summer-of-2015/>

Description of Technology:

It is unclear how the electronics are executed based on the score for Monument III. There are multiple triggers listed in the score, so it can be assumed that they are triggered via an application. Contact the composer for further information.

Title of Work: Between Glimpses of Blue  
Composer Name: Ted King-Smith (b. 1988)  
Year of Composition: 2016  
Duration: 9'30"  
Musical Grade: 5  
Technology Grade: 3  
Publisher: Murphy Music Press  
Availability: Purchase  
URL: <http://murphymusicpress.com/products/w-433>

Description of Technology:

The composer provides two files, the electronics and the click track, which have to be loaded manually into audio software capable of routing tracks to separate outputs (Audacity, Ableton, GarageBand, any DAW). This will also require an interface with at least three outputs.

Title of Work: Ascension  
Composer Name: Jim Mobberly (b. 1954)  
Year of Composition: 1988/2010  
Duration: 8'  
Musical Grade: 5  
Technology Grade: 3  
Publisher: Cautious Music  
Availability: Contact Composer  
URL: <https://jamesmobberleymusic.com/list-of-works-score-samples/ascension-2010-pages-1-6/>

Description of Technology:

The newer version of this work (2010) uses pre-recorded audio files for the electronics. There is one file for the electronic soundscape and one for the click track that will have to be manually aligned in whatever software the performer chooses to use. The score provides instructions for multiple approaches to achieving this setup.

Title of Work: Rock Music  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2017  
Duration: 4'15"  
Musical Grade: 3  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: [https://www.alexshapiro.org/Rock\\_Musicpg1.html](https://www.alexshapiro.org/Rock_Musicpg1.html)

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

Title of Work: Tight Squeeze  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2013  
Duration: 3'15"  
Musical Grade: 4  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: [https://www.alexshapiro.org/Tight\\_Squeezepg1.html](https://www.alexshapiro.org/Tight_Squeezepg1.html)

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs. The composer states that the piece can be performed without the click since it is so percussive and constant, but she highly suggests the click is used.

Title of Work: Liquid Compass  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2014  
Duration: 9'  
Musical Grade: 5  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: [https://www.alexshapiro.org/Liquid\\_Compasspg1.html](https://www.alexshapiro.org/Liquid_Compasspg1.html)

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

Title of Work: Trains of Thought  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2017  
Duration: 7'15"  
Musical Grade: 5  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: [https://www.alexshapiro.org/Trains\\_of\\_Thoughtpg1.html](https://www.alexshapiro.org/Trains_of_Thoughtpg1.html)

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

Title of Work: Immersion  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2011  
Duration: 23'  
Musical Grade: 4-5  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: <https://www.alexshapiro.org/Immersionpg1.html>

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

Title of Work: Off the Edge  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2019  
Duration: 3'20"  
Musical Grade: 2.5+  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase - Exclusive to Consortium Members Until Summer 2020  
URL: <https://www.alexshapiro.org/OffTheEdgepg1.html>

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

Title of Work: Lights Out  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2015  
Duration: 4'30"  
Musical Grade: 4+  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: [https://www.alexshapiro.org/Lights\\_Outpg1.html](https://www.alexshapiro.org/Lights_Outpg1.html)

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least four outputs. There are also lighting and physical considerations in the piece, but the score provides many options and there are many resources available for the piece on Alex Shapiro's website.

Title of Work: Moment  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2016  
Duration: 5'45"  
Musical Grade: 4+  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase  
URL: <https://www.alexshapiro.org/Momentpg1.html>

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

Title of Work: Ascent  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2020  
Duration: 2'30"  
Musical Grade: 4+  
Technology Grade: 3  
Publisher: Activist Music  
Availability: Purchase - Exclusive to Consortium Members Until Summer 2020  
URL: <https://www.alexshapiro.org/Ascentpg1.html>

Description of Technology:

The work uses a pre-recorded track aligned to a separate click track, so a laptop with multitrack sequencing/playback software is required along with an audio interface with at least three outputs.

#### Grade 4 Technology

Title of Work: Solace  
Composer Name: Steve Bryant (b. 1972)  
Year of Composition: 2012  
Duration: 13'  
Musical Grade: 5  
Technology Grade: 4  
Publisher: Seven Bryant/Gorilla Salad Productions  
Availability: Rental

URL: <https://www.stevenbryant.com/music/catalog/solace-band>

Description of Technology:

Solace uses a laptop running Ableton Live controlled by an 88-key keyboard. It requires an interface with 3 outputs (left, right, and click track). As with all of Steven Bryant's pieces, there are thorough instructions included with the score.

Title of Work: Phase Shift

Composer Name: Robert Langenfeld (b. 1990)

Year of Composition: 2019

Duration: 6'10"

Musical Grade: 4

Technology Grade: 4

Publisher: RL Compositions

Availability: Exclusive to Consortium Members Until Fall 2020

URL: <http://www.rlcompositions.com/shop/phase-shift/>

Description of Technology:

This piece uses a laptop running Ableton Live, controlled by a 61-key (or larger) keyboard. The work uses the "t" key as a tempo sync, allowing the performer to tap along with the conductor to control the tempo of the electronic passages. The composer states that the electronics are completely optional, but highly encouraged.

#### Grade 5 Technology

Title of Work: Honeycomb

Composer Name: Cody Brookshire (b. 1985)

Year of Composition: 2016

Duration: 5'

Musical Grade: 5+

Technology Grade: 5

Publisher: Unknown

Availability: Unknown

URL: <https://www.codybrookshire.com/works>

Description of Technology:

This work uses the audience's cell phones to create an immersive sound field. No information is available on how this work achieves this, but similar setups require a dedicated wireless network router or access to the internet on each cell phone and a laptop. Audience members then connect to a specific website or address on their device, grant access to their device, and then this site takes care of all sound reproduction. The downside is that it requires audience members to follow specific instructions and there are any number of errors that can result in a lack-luster performance.

Title of Work: Ecstatic Waters

Composer Name: Steven Bryant (b. 1972)

Year of Composition: 2008  
Duration: 22'45"  
Musical Grade: 5  
Technology Grade: 5  
Publisher: Seven Bryant/Gorilla Salad Productions  
Availability: Rental  
URL: <https://www.stevenbryant.com/music/catalog/ecstatic-waters-wind-ensemble-electronics>

Description of Technology:

Ecstatic Waters requires a laptop with Ableton Live, a microphone setup for the principal clarinet player, and an interface with at least 3 outputs (left, right, and click track) and a microphone (XLR) input. Subwoofers are essentially required by this work in order for the electronics to be effective. All of the cues are controlled from the laptop keyboard, and there are thorough instructions in the score along with how-to-videos from the composer. The microphone is not optional, as it is used to apply live effects to the clarinet solo (a cue in Ableton turns these effects on and off).

Title of Work: The Automatic Earth  
Composer Name: Steven Bryant (b. 1972)  
Year of Composition: 2019  
Duration: 31'  
Musical Grade: 5  
Technology Grade: 5  
Publisher: Seven Bryant/Gorilla Salad Productions  
Availability: Rental  
URL: <https://www.stevenbryant.com/music/catalog/the-automatic-earth>

Description of Technology:

The Automatic Earth uses a laptop running Ableton Live, which is controlled by both an 88-key keyboard and the laptop keyboard. There are too many triggers for the 88-key keyboard alone, some of the longer running cues are triggered by laptop keys. It requires an audio interface with at least 3 outputs (left, right, and click track). This work also requires the use of subwoofers and monitor speakers in order for the piano, harp, and percussion to hear the electronics appropriately.

Title of Work: Between the Sea and Rhyl  
Composer Name: Gavin Fraser (Unknown)  
Year of Composition: 2018  
Duration: 12'  
Musical Grade: 5  
Technology Grade: 5  
Publisher: Self-Published  
Availability: Contact Composer - Thesis Project  
URL: <https://gfrasermusic.wixsite.com/composer/list-of-works>

Description of Technology:

Between the Sea and the Rhyl uses four speakers at the rear of the hall, behind the audience (quadraphonic sound). This will require an audio interface with at least four outputs, and it will use all of them. The electronics are performed from a laptop either using the provided Max/MSP patch or the original Logic Pro X file.

Title of Work: Are You Experienced?  
Composer Name: David Lang (b. 1957)  
Year of Composition: 1987  
Duration: 23'  
Musical Grade: 4+  
Technology Grade: 5  
Publisher: Red Poppy Publishing  
Availability: Rental  
URL: <https://davidlangmusic.com/music/are-you-experienced>

Description of Technology:

The only electronics used in this work are amplified Tuba with and without various effects. According to the instructions, the tuba is "an altered personification of Jimi Hendrix."

Title of Work: Axe to Grind  
Composer Name: Daniel Montoya Jr. (b. 1978)  
Year of Composition: 2019  
Duration: 3'45"  
Musical Grade: 2.5  
Technology Grade: 5  
Publisher: Daniel Montoya Jr. Music  
Availability: Purchase  
URL: <https://danielmontoyajr.com/music/axe-to-grind/>

Description of Technology:

Axe to Grind uses multiple grade 2 setups simultaneously, which bumps it up into the grade 5 category. Four separate iPads are used as instruments/controllers, each running the GarageBand application with the Alchemy Synth package installed (separate purchase). Each iPad will require amplification, either using separate keyboard amps or using a mixer with four separate inputs.

Title of Work: Augenblick  
Composer Name: Christopher Stark (b. 1980)  
Year of Composition: 2008  
Duration: 13'30"  
Musical Grade: 5  
Technology Grade: 5  
Publisher: Sommerso Publishing  
Availability: Unknown

URL: <https://www.christopher-stark.com/>

Description of Technology:

Augenblick uses a Max/MSP patch to trigger the electronics. It requires four speakers (front left, front right, rear left, and rear right) as well as a click track.

Title of Work: Velocity Meadows  
Composer Name: Christopher Stark (b. 1980)  
Year of Composition: 2015  
Duration: 11'30"  
Musical Grade: 5  
Technology Grade: 5  
Publisher: Sommerso Publishing  
Availability: Contact Composer  
URL: <https://www.christopher-stark.com/>

Description of Technology:

The work requires Max/MSP to be installed on a laptop, which controls all the cues using the laptop keyboard. It also requires two microphones to be setup for the solo oboe. The score includes through instructions for how the app works. This work requires an interface with two outputs (left and right) as well as two microphone inputs. A second laptop and professional projector are required to control the video component.

#### Optional-Grade and Unknown Grade Technology

Title of Work: The Haunted Carousel  
Composer Name: Erika Svanoë (b. 1976)  
Year of Composition: 2014  
Duration: 4'30"  
Musical Grade: 3  
Technology Grade: 1 to 2  
Publisher: Alfred Music  
Availability: Purchase  
URL: <http://www.erikasvanoë.com/the-haunted-carousel.html>

Description of Technology:

An iPad runs the app GarageBand, which is used to perform a theremin like sounds via the app's on-screen musical keyboard. The iPad is amplified via a keyboard amp or sound system. Detailed instructions are included with the score.

Title of Work: Paper Cut  
Composer Name: Alex Shapiro (b. 1962)  
Year of Composition: 2010  
Duration: 5'  
Musical Grade: 3  
Technology Grade: 1 or 3

Publisher: Hal Leonard/BandQuest  
Availability: Purchase  
URL: [https://www.alexshapiro.org/AS\\_Paper\\_Cut-Materials.html](https://www.alexshapiro.org/AS_Paper_Cut-Materials.html)

Description of Technology:

The work offers two options, either a pre-recorded track aligned to a click track or a simplified file with no click. If the click track version is selected, a laptop with multitrack sequencing/playback software is required along with an audio interface with at least four outputs is needed. The non-click track version can be performed using an audio player such as a laptop, phone, tablet or similar device.

Title of Work: Being in Time  
Composer Name: Judith Shatin (b. 1949)  
Year of Composition: 2015  
Duration: 10'  
Musical Grade: 4+\*  
Technology Grade: 1 to 5+  
Publisher: Wendigo Music  
Availability: Rental  
URL: <https://judithshatin.com/being-in-time-3/>

Description of Technology:

This work is available in an incredibly wide range of options. It can be done with just the electronics via tracks playable on a variety of devices, with all the kinetic controllers attached to the conductor and microphones to control the video elements. Contact the composer for the variety of options available.

Title of Work: New Era Fanfare  
Composer Name: Ranall Standridge (b. 1976)  
Year of Composition: 2013  
Duration: 3'  
Musical Grade: 2  
Technology Grade: 2 or 3  
Publisher: Grand Mesa Music  
Availability: Purchase  
URL: <https://randallstandridge.com/new-era-fanfare/>

Description of Technology:

This work does not require electronics, but is enhanced by adding a synthesizer capable of performing split voices (one voice in lower staff, another in the upper). If your synthesizer does not have a split voice function but can be used as a controller, computer programs like GarageBand, MainStage, and others can be configured to perform split voices using one controller.

Title of Work: Press Play  
Composer Name: Vince Oliver (Unknown)

Year of Composition: 2017  
Duration: 6'20"  
Musical Grade: 4  
Technology Grade: 2 or 4  
Publisher: World Projects  
Availability: Purchase  
URL: <https://www.vinceoliver.com/?project=press-play>

Description of Technology:

This work is setup to use a program called MainStage 3 by default, which is a mac-only software. Within MainStage the piece offers two options: press play once and follow a click track or have the player activate multiple cues and have the work feel more dynamic. Either option will require an interface with at least 3 outs (left, right, and click). In order to use the second option, the work requires an 88-key keyboard as well. The composer provides instructional videos with the piece that make setup fairly easy. The audio files are provided separately, if the performer would prefer to setup Ableton Live or other multitrack sequencing software instead of paying for MainStage--but this will require more intimate knowledge of these programs as videos for this are not provided.

Title of Work: Machine Awakes, The  
Composer Name: Steve Bryant (b. 1972)  
Year of Composition: 2012  
Duration: 5'45"  
Musical Grade: 2-2.5  
Technology Grade: 2 or 3  
Publisher: Seven Bryant/Gorilla Salad Productions  
Availability: Purchase  
URL: <https://www.stevenbryant.com/music/catalog/the-machine-awakes-band-electronics>

Description of Technology:

The Machine Awakes offers two options for electronics, either a free stand-alone program downloadable from the composer's website, or a \$0.99 dedicated app downloadable from the apple or google play store. Both options can be done with or without an audio interface.

Title of Work: Long Distance  
Composer Name: Steven Snowden (b. 1981)  
Year of Composition: 2015  
Duration: 15'  
Musical Grade: 5  
Technology Grade: 2 or 3  
Publisher: Talking Rocks Press  
Availability: Purchase  
URL: <https://www.stevensnowden.com/portfolio/long-distance/>

Description of Technology:

The composer provides detailed instructions with the files. There are two options: an app that controls all the sounds, or simply playing the .mp3.

Title of Work: Coil  
Composer Name: Steve Bryant (b. 1972)  
Year of Composition: 2014  
Duration: 5'30"  
Musical Grade: 3  
Technology Grade: 2 to 4  
Publisher: Seven Bryant/Gorilla Salad Productions  
Availability: Purchase  
URL: <https://www.stevenbryant.com/music/catalog/coil-band-electronics>

Description of Technology:

Coil currently offers two options for the electronics, either using Ableton Live and a connected keyboard controller or a stand-alone sound file with a click track. If using the Ableton Live and keyboard option, the electronics part will require someone who can perform basic keyboard parts. Nearly every sound has a separate trigger, which makes the part quite dynamic and engaging. If using the audio file, the click track must be used to keep the ensemble on track through the section where there are no electronics.

Title of Work: As the Lights Go Out  
Composer Name: Ben Robichaux (b. 1991)  
Year of Composition: 2018  
Duration: 16'  
Musical Grade: 4.5  
Technology Grade: 3 to 5  
Publisher: Self-Published  
Availability: Contact Composer  
URL: <http://www.benrobichaux.com/-as-the-lights-go-out>

Description of Technology:

The electronics for this work are available in either a standard stereo or surround sound (quadrophonic) option. Both options are performed via a Max/MSP patch, and the score includes instructions for either setup.

Title of Work: The universe is full of doors  
Composer Name: Ryan Chase (b. 1987)  
Year of Composition: 2019  
Duration: 70'  
Musical Grade: 5+  
Technology Grade: 4 or more\*

Publisher: Self-Published  
Availability: Exclusive to Consortium Members Until August 2020  
URL: <https://www.ryanchasemusic.com/the-universe-is-full-of-doors>

Description of Technology:

According to the instrumentation listed for this work on windrep.org, it includes a synthesizer part as well as triggered electronics. It is unclear how either are executed. Contact the composer for further information.

Title of Work: Anthropogenic Tides  
Composer Name: Tina Tallon (b. 1990)  
Year of Composition: 2018  
Duration: 12'  
Musical Grade: Unknown  
Technology Grade: Unknown  
Publisher: Self-Published  
Availability: Unknown  
URL: <http://tinatallon.com/compositions/>

Description of Technology:

Little information is available on this work, other than it was commissioned by David Vickerman and the San Jose State University Wind Ensemble. Contact the composer for further information.

Title of Work: Echo Chambers  
Composer Name: Peter Van Zandt Lane (b. 1985)  
Year of Composition: 2019  
Duration: 10'  
Musical Grade: Unknown  
Technology Grade: Unknown  
Publisher: Murphy Music Press  
Availability: Purchase - Exclusive to Consortium Members Until May 2020  
URL: <https://www.petervanzandtlane.com/works>

Description of Technology:

Little information is available on this work, other than it is exclusive to consortium members until May 2020. Contact the composer for further information.