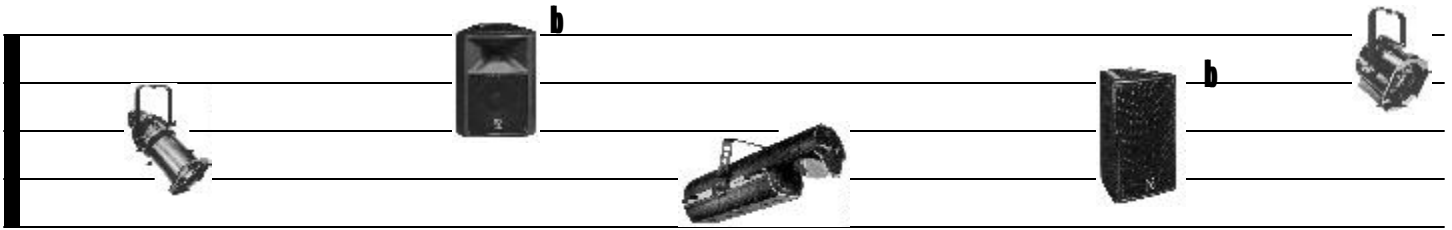


Jack A. Frost Ltd. STAGE NOTES



Jack A. Frost Ltd.

Volume 3, Issue 1

Supply and Rental of Power, Lighting, Sound and Staging Equipment

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Unplugged & Unravelled**

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Newest Employee**

Wireless Microphones - Unplugged & Unravelled

"Going Wireless" seems to be the new catch phrase with cellular phones, pagers and wireless modems gaining in popularity and interest. Everyone wants the freedom of working in a world without wires. So how does this apply to the theatre or live sound application? Simple - wireless microphones. These devices allow personal freedom on the stage for the performing artist, and greater flexibility for the sound engineer or designer in creating an optimum audio reinforcement environment.

Is the technology new? Certainly not. In essence, the wireless microphone is only a glorified radio, which has been around since the days of Marconi. However, transistor technology, battery innovation, and miniaturization have now allowed it to be produced economically and packaged for portability, to make it useful for audio applications.

Essentially, the wireless microphone is a miniature radio station. The microphone picks up audio sound waves and converts them into an electrical signal. The transmitter converts the electrical signals into radio waves that are sent out through the air. The receiver picks these radio waves up, and converts them back into an electrical signal which can now be used by your mixer or amplifier.

Let's take a brief look at the different types of radio waves that are available for use by wireless microphones. As you will remember from a previous article (Mysteries of the Microphone Revealed, Volume 1, Issue 2) sound is created by the modulation of airwaves at a specific frequency. Radio waves are also created in the same manner - it is just that the frequency is much, much higher than the audible range. Surprisingly enough, radio frequencies are measured in the same way as sound frequencies - in hertz or Hz for short. However, since the frequencies are much higher than audible sound, the standard metric prefixes have been added to them - kilohertz (kHz) for 1,000 hertz, megahertz (MHz) for 1,000,000 hertz, and gigahertz (Ghz) for 1,000,000,000 hertz. Most wireless microphones are measured in megahertz, so we will use that term predominantly throughout this article.

Megahertz? Sure did. Took me a week to get better.

When it comes to radio frequencies, the government regulates their use and decides who can use which frequency. This is important as it allows, for example, radio stations to transmit at a specific frequency location that is not used by another local radio station - in essence, allowing you to listen to either one or the

other, but not both at the same time. The Canadian Radio-television and Telecommunications Commission (CRTC) regulates all frequency use in Canada. They have divided up frequencies for use by wireless microphones (and related products) into the following categories.

Low Band VHF: This section of frequencies (or "bandwidth" as it is sometimes known) spans from 49 to 72 MHz. Generally, any consumer-level product that uses general radio communication is permitted to use this bandwidth for transmission. "FM" walkie-talkies, baby room monitors, and wireless speakers/headphones all use the region around 49 MHz. This causes a lot of "clutter" and, in general practice, is inappropriate for sound reinforcement use.

High Band VHF: This bandwidth spans from 169 to 214 MHz. The first section - up to 172 MHz - is generally open and

VHF TV Channel Frequency Data

Channel Number	Frequency Range (MHz)
7	174-180
8	180-186
9	186-192
10	192-198
11	198-204
12	204-210
13	210-216

Channels 2 through 6 are not used for wireless microphones

reserved for professional wireless microphones. The second section, from 172 to 214 MHz, is shared by local television stations 7 through to 13. (Note that this is the “real” channel on the dial if you are using an antenna - not cable!) However, if there is not a local station using that frequency, you can generally use the particular channel allocation. Most professional VHF wireless microphones use this section of frequencies. Most potential problems with conflicting channel frequencies can be worked out before you purchase them simply by doing some research into the publicly used frequencies in your particular region.

UHF: This ever-expanding frequency range is seeing more and more use to date. The two bandwidths — Low band UHF covering from 450 to 614 MHz, and High band UHF ranging from 806-952 MHz — are still fairly open and have a large range of selectable frequencies. Additionally, most of the currently developing wireless microphone products are within this range, so any new features are more likely to show up in a UHF model. One of the nice features commonly found on a UHF wireless microphone is the ability to “tune” the microphone to a specific frequency. For example, if you found that a particular frequency was giving you interference you could select a switch on the transmitter and receiver that would change the frequency the system was using.

In the future, look for higher frequencies to be used. Licensing is becoming available in the 1.2 GHz band for new wireless microphone technology. With higher frequencies available, the microphones and transmitters will probably become smaller and easier to use, with fewer problems. As a higher frequency requires a smaller antenna¹ and less power to transmit, savings can be made with battery size and power consumption, along with physical space required for antennas.

Don't forget that if you get confused about which frequency is the right one for you, you can always get some good free advice from your local dealer² or manufacturer. They can identify problem and conflicting regional interference quite easily and let you know which frequencies to use in your area.

Diversity

One of the other confusing terms in wireless microphone technology is known as “diversity.” This identifies the manner in which the microphone receiver discriminates between “good” and “bad” signals, in order to give you the best possible sound.

As mentioned earlier, radio waves emit from the antenna on the wireless transmitter in all directions. The receiver is located nearby, and receives the radio waves. Problems arise, however, when “direct signal” (radio waves going directly from the transmitter to the receiver) and “reflected signal” (radio waves going from the transmitter, and bouncing off a couple of walls, ceilings, or other reflective areas, and then making their leisurely way to the receiver) interfere with each other. On a standard non-diversity unit, this interference can be the cause of such undesirable sounds as pops, static, and signal dropouts.

In order to rectify this situation, two antennas are placed on a unit, with some degree of space between them. Each antenna independently evaluates the incoming radio signal, and a central computer selects the best signal to be used. When the other antenna becomes the better signal receiver, the computer will switch to it. Units which use this system are known as diversity units. Practically, diversity creates a significantly better audio signal than non-diversity.

What you don't get!

There are still a few disadvantages to using wireless microphones. The corded

microphone will always have a distinct place on the stage, or in any sound reinforcement situation. Some examples of where you should be using a corded microphone are for backstage announcements, or to mic musical instruments in a pit band. The general rule of thumb is still “If you can run the wire - do it.” No matter how good your wireless microphones are, when you use radio frequencies to transmit your audio, you can have audible problems. So to limit these problems, use a cable wherever possible.

When working on the stage for musical theatre or other similar productions, there are still a number of different ways to avoid using wireless microphones. Boundary microphones can be used at the front of the stage in order to pick up large vocal choruses, or general speech. Hanging microphones can be hung over the stage, or hidden in various scenic elements, to provide much the same level of audio support. (These microphones, their general use and functions, will be detailed in a future issue of StageNotes.)

How to use wireless microphones

When you must use a wireless microphone, there are specific ways to get the best sound out of the systems that you are using. We can look at the three types of wireless - handheld, headset, and miniature lavalier microphones. The selection is dependent on the type of production and sound reinforcement desired.

Handheld wireless microphones are generally used for small ensembles, usually in the pop music category. You can use these microphones for performers who have a tendency to move around the stage a lot. If they did have a corded microphone they would have tied it into a huge knot by the end of their performance. The handheld wireless microphones are the best ones of all, since the audio source is right next to the microphone element, and there is less chance of feedback. Because the microphone uses a dynamic element, you get a rich, deep sound (called the “proximity effect”) when it is used properly — this is characteristic of dynamic elements.³ Also, to use the microphone, you just sing or speak into it the way you would do with a normal corded handheld microphone.⁴

You can also use a handheld wireless microphone in a theatrical environment where a “prop” handheld mic is appropriate. An example from personal experience is the scene from “*Joseph and the Amazing*



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printed on
recycled paper

Technicolour Dreamcoat,” where “The Pharoah” (Elvis Impersonator Extraordinaire) sings a little tune. In this instance, a “real” microphone fit well with the character, and offered the deep, rich sound of “Elvis,” so we used it for that number.

Skipping over headset microphones for the time being, we move on to wireless lavalier microphone systems. These systems come in two parts, the microphone element, and the transmitter pack. The microphone element is made as small and unobtrusive as possible, so that it may be hidden on a convenient place on the actor. The transmitter pack is made small, averaging the size of a packet of playing cards. Again, this allows you to find a nice place to hide it on the actor. Use the lavalier (“lav”) systems in places where you don’t want to see the microphone, to give a natural look to the actors and still amplify their individual voices.

Lav microphones are generally condensers. This allows a broader range of pickup and greater sensitivity, usually with a “flat” (natural) range of audio frequency response. However, they lack the solid boominess of

- 1 The higher the frequency the smaller the device that is required to produce it. Look at the difference in speakers. A large 15" or 18" woofer produces frequencies from 30 to 300 Hz, yet for the higher audible frequencies of 10 to 22 KHz only approximately 1 square inch is required. Your FM radio (88 to 109MHz) uses a telescoping antenna of around 30" in length, but your cellular phone (approximately 800 MHz) uses one of only 6".
- 2 We recommend Jack A. Frost Ltd. as a good source for wireless microphone information. But then again, why wouldn't we?
- 3 Again, see our article called "Mysteries of the Microphone Revealed" in a previous issue of Stage Notes. If you don't have it any more, we would be happy to send you another one, or look it up on our web site.
- 4 General practice dictates that singing "over" the microphone, rather than directly into it, allows the most natural sound from the vocalist to come from the mic. Some analogies have compared it to an ice-cream cone as far as placement from the performer's face. Be sure to consult with your manufacturer or dealer for specific details as models vary.

Shure UT Series

The UT Series gives you all the freedom and flexibility in a UHF fixed frequency format. You will get a less crowded operating band for a clear, interference-free sound.

The UT features Shure's exclusive MARCAD® Diversity receiver with intelligent circuitry. MARCAD delivers the best possible performance by combining audio signals from two independent receiver sections. Sodropout and switching noise are eliminated, while operating range is dramatically improved.



Shure's "battery saver" technology provides up to 12 hours of battery life and operates in conjunction with two LED indicators; one for on/off and another to warn when battery life is low. A convenient mute switch delivers noiseless control of audio on/off functions.

Systems from \$549.95

Shure UC Series

The flexibility of the UC Series makes it an ideal choice for a wide range of applications. Choose from over 100 frequencies quickly and easily to avoid interference. Up to 16 systems can run simultaneously and its half-rack-space receiver design assures that it will fit into any space.

MARCAD® diversity circuitry provides superior reception and exceptional freedom from dropouts.

The system is available in body-pack microphones (lavalier, headworn, instrument or cable) and handheld microphones (SM58, Beta 58A, SM87A or Beta 87A).



Systems from \$1449.95

Pricing is plus shipping and applicable taxes. Sale ends December 17th, 1999.

a dynamic microphone and sometimes will seem to sound a bit “tinny.” The microphones also have a wide pattern of pickup, either wide cardioid or omnidirectional. This eases placement concerns as it will pickup from all directions around the microphone.

While there is generally a real “art” in the placement of the lav elements and the body packs, there are a few things that you can keep in mind to make things easier. For the body pack, you want to keep it accessible, safe and dry. Make sure that the antenna is straight and not coiled up into a little ball. Most of the time the pack is worn in the small of the back. If the actor has a tendency to sweat a lot consider putting the pack into a small plastic bag. Remember that wherever you put the pack, that it still needs to be accessible during the show should you need to change a battery or replace it.

For the lavalier element itself, you have a number of options for placement. First of all, look at the microphone. If it is the same size or just slightly larger than the cable, then you have a professional microphone that can be installed on the actor’s head. Generally the microphone is placed just below the hairline, pointing down, and secured in place. You can hide the cable with a bit of latex or even medical tape. Run the cable around the back of the head and down the back to the body pack. If you don’t have one of these tiny microphones, but a larger one perhaps - then you have a “tie clip” (or actually, the real “lavalier” by definition) microphone, and you do just that with it. Place it on the front of the shirt four to six inches below the neckline.

If you are good with these microphones - and good to them - then you will get the best, most natural sound out of your cast and chorus. But like any skill, mixing with

these is a task of trial, error, and practice, so don’t expect it to sound beautiful the first time around!

Headset microphones are a little bit of a cross-breed between a handheld and a lavalier microphone. The body pack remains the same as the lavalier style, however the microphone is a small dynamic or condenser (depends on manufacturer) element that is attached to a little boom arm in front of the artist’s head.

The visual style of these headsets really only makes them suitable when you want to see someone wearing a headset. However, on the plus side, it does allow the artist to have complete stage movement, including both of their arms, while maintaining clear, rich vocals. Especially when the microphone is a dynamic one.

The only recommendation regarding the placement of a headset microphone is to make sure that it stays on. Most models have some form of elastic or rubber strap to fit around the back of the neck for support. You would want to watch the unit the first time you use to make sure it is going to stay on at all times, and perhaps assist with a well-placed hairpin or safety pin.

Making Wireless Sound Better

Now that you have all of your wireless microphones set up, it is time to run a rehearsal and see how they sound. There are a few good pointers to note in order to get the best sound possible out of these units.

All wireless transmitters use a battery for electrical power. The power is used to maintain the radio transmitter portion of the unit, and in some cases, provides “phantom power” to the condenser microphone element. Make sure that you are only using new batteries of the alkaline type. Usually a battery can last you one performance, or two rehearsals. (two rehearsals is pushing your luck, but it is only a rehearsal, so save money where you can) Make sure that you always have a good supply of spare batteries on hand, and keep records of their replacement.

There are some audio tools which can help in the general sculpting of the sound, to assist in making the overall reinforcement sound better. The first is equalization - the general tailoring of the sound by increasing or decreasing certain audible frequencies. You can get a few different types of equalizers. The first is the standard graphic equalizer, which provides a slider for each frequency range. The slider allows you to increase or decrease the specific frequency as required. The second type of equalizer

Paula Lambe

While growing up on a farm in Northern Ontario I always managed to find time to practice my entertainment arts skills. Whether I was singing to cows, designing costumes for the cats, dancing in the hayloft or putting coloured light bulbs in the barn, I was happy. In high school my interest in the arts branched into concert band and musical theatre. Unfortunately, at that time our high school only produced one show a year, but that was all it took for me to realize my place. After stage ‘mangling’ for the first time, it was all downhill (oh, I mean uphill) from there.

With the support of my parents I was off to the ‘big city’ of Toronto, to Humber College’s Technical Theatre Program. It was there that the creative process overwhelmed me. I didn’t know there were other fixtures besides strip lights and PAR-cans, but I’m sure glad there were. In college, with the help of teachers like Paul Court (now a colleague of mine at Frost), learning was 90% hands on and performances were plentiful. After two years of exploring all the different aspects of technical theatre I graduated top of my class, however undecided on a theatrical speciality.

From there, like most tech students, it was off to summer stock theatre. Home for me for the next two summers would be Huron County Playhouse in Grand

Bend. Perhaps it was the fact it was a remodelled barn that drew me in.

Next it was on to Ottawa University where I expanded into other areas of interest like directing and, believe it or not, acting. However, it came to pass that my area of speciality would be lighting design. During my last year I designed for some of the local community theatres.

After graduating with a BA with concentration in theatre, circumstances lead me back to Sudbury, but I soon returned to Toronto. I found what I thought was temporary employment, at Living Lighting as a sales representative. I soon realised that residential lighting also held some interest for me. Eventually my interest subsided, and I knew it was time to move on.

And so ends my tale. Here I am at Jack Frost, as a sales representative to the educational market. I’m very excited to be here. I hope to assist teachers and students alike in producing their best shows ever this year, regardless if the school produces ten or only one. We all know that great potential can be found in our young technicians if they are only given the chance to show us. I look forward to helping everyone in any way I can. Please feel free to call me anytime.

is a parametric E.Q. and allows specific frequency selection and increase/decrease by the use of knobs or dials. Both of these units will allow you to make up for deficiencies in the microphone elements. For example, removing the “tinniness” in the sound of the microphone by reducing the amount of high frequencies (in the range of 4,000 to 16,000 Hz) proportionally.

The third device that you can use for equalization is an automatic device called a Feedback Eliminator. This will do the most important part of equalization, getting rid of feedback, for you. If you don't know what feedback is, it is that nasty howling sound you get when a microphone gets too close to a speaker.⁵ Basically, the Feedback Eliminator will listen for feedback, and when it occurs, it will automatically adjust the equalization of the system to reduce the frequency that is feeding back.⁶

One good way of softening the often harsh sound of a microphone is to add a little bit of reverb to it. When you are amplifying a voice into a larger space, it will be very dry because it has not had a chance to naturally reverberate through the space. There are many electronic reverb units on the market that you can use to insert a small amount of echo or reverb into the vocal signal. This will create the auditory illusion of the performance space on the vocal signal.

Again, most of these units are good to use only if you are comfortable using them. The best way to gain confidence in their use is to get them set up in advance and try different things to see what they do. This is what rehearsals are for - to customize the general sound and get it to the point where you have the best sound possible. I do not recommend trying things out during an actual show.

Comb Filter Effect

When two microphones are used in close proximity, there is an effect known as the “comb filter” which occurs. Obviously, with the mobility of wireless microphones, this has a habit of happening quite a bit.

What happens is that the sound reaches the two microphones at slightly different times. (Sound travels fairly slowly through air.⁷) The two waveforms combine and ultimately cause destructive interference between each other. You will notice this sound to be somewhat distorted or airy, modulating with new frequencies, or other “bad sounding stuff.” If you looked at this destructive interference on an oscilloscope it would look like a comb - hence the name.

The most common occurrence of the comb filter effect happens during a duet or trio on stage. The microphones are all in close proximity and pick up each actor's voice in

varying degrees. Because the actors are moving around, so does the degree of pickup, and the time delay it takes for the sound to reach each individual microphone.

In order to compensate in this situation, you have to play with the levels on the sound console in real time. If you can pick up a duet with only one of the two microphones, you should do this as it will eliminate the comb filter. If this is impractical or does not give you the sound you want, try changing the levels of each individual microphone in order to reduce the effect to an inaudible level.

Receiver Placement

In order to maintain the best reception from the transmitters to the receiver units, placement of the receivers is a key concern. Radio waves travel through air quite well, and through building materials such as concrete badly. The best way to pick the location of your receivers is to maintain line-of-sight between the transmitter and receiver at all times.

Distance from transmitter to receiver also plays a key role in the placement of the receivers. If you have ever traveled in a car while listening to the radio, you know that the farther away you get from the radio station, the less signal and quality you get. The same holds true for wireless microphones, of course on a much smaller scale. Keep the receivers on stage whenever possible, keeping the line-of-sight rule in mind.

Some other items to keep in mind for placement are to keep the receivers away from any potential electrical problems (radio waves can get interference from large electrical motors, or theatrical dimming equipment) and to keep the antennas on the units straight and clear of obstructions. Also, do not connect anything to an antenna such as a longer wire or another antenna. The antenna lengths supplied with the wireless system are specifically designed to work the best with the radio frequencies that they use.

During dry months, static electricity on the actors themselves can cause additional interference. Always keep a can of Static-Guard⁸ handy to make sure that your actors are static-free and avoid polyester or synthetic fabrics wherever possible.

The Backup Plan

By their very nature, wireless microphones are not 100% reliable. It is always good to have a backup plan so that your show can continue in the case of a failure. We have already discussed having stage

microphones installed (boundary or hanging) in order to help with general reinforcement. In the case of wireless failure, you can always crank their volume to help out. Another way to be prepared is to have two microphones placed on your key actors. One can be used all the time, until it has a problem, and then you can switch to the other one as required. The Phantom in “*The Phantom of the Opera*” wears at least three microphones during a performance. This ensures that his vocals (indeed, the very basis of the production) are heard at all times.

You should also plan on having backup equipment available backstage. Have a spare wireless microphone available, and a crew member on headsets that can grab the actor during an offstage moment and quickly place the replacement on them. Should an actor's microphone fail and there not be a replacement available, have your crew member mention this to them when they are backstage. The actor could then sing louder⁹, if possible, or manoeuvre themselves closer to a stage microphone or another actor's wireless microphone.

Some important notes to remember

When budgeting the show, and your wireless microphones, it is important to keep in mind all of the different items we have discussed so far. You will need a backup unit. Count the numbers of batteries that you require, and plan on purchasing them all at the same time (generally you can get a price break on quantities.) And above all, make sure that you budget the very best microphones that are available to you.

-
- 5 Usually causing the entire audience to about-face and glare at the sound engineer. If you're quick, you can duck and hide under the console.
 - 6 Feedback generally occurs at frequencies of 500, 2000, 4000 and 8000 Hz. But it can happen anywhere in the audio spectrum at very inopportune moments.
 - 7 Sound travels at about 1,130 feet per second in air in case you were wondering.
 - 8 Static-Guard is a registered trademark of Alberto Culver. Nifty stuff though.
 - 9 If you put a microphone on an amateur actor they will sing quieter. If you tell them it doesn't work they will sing louder. It's sort of a psychosomatic vocal disorder.

Cheap wireless microphones are very tempting, but when the show is done, the number of audio problems you would have encountered negate the lower budget you calculated in the beginning. Try to stay with professional VHF or UHF systems, with diversity, and good sounding microphone elements.

You can reduce the number of microphones you need by carefully planning both stage microphones and some pre-show analysis of the script. (Later in this issue of StageNotes.) Microphones can be shared and passed between actors, so that when a specific actor is not singing, another one can be using their microphone.

Crew

For general show operation, you will need a skilled operator on the sound console, and one backstage to monitor the receivers, and troubleshoot problems as they arise. Make sure that the sound operator is working in the house so that they hear the same sound as the audience does. If your show requires a large number of sound effects, as well as heavy amounts of reinforcement,

it may be prudent to add another crew member to take care of the sound effects. Mixing a musical theatre show is really a full time job.

Location

Each specific theatre or auditorium location is a little bit different as far as how well wireless microphones work. Make sure that you have done adequate research into the various elements that may affect wireless operation in your location. Look for potential interference problems, such as taxi or tow truck company dispatch buildings, local construction sites, and television or radio stations. Also evaluate carefully the construction of your theatre, looking for thick concrete walls, air conditioners, electrical fans and motors, and so forth. This research only needs to be done once, but it will assist you in selecting the best wireless microphone setup that you can.

Still Confused?

Assistance in working with wireless microphones is always available in some form or another. Look for local sound

engineers or cable TV companies for a bit of "hands-on" advice or instruction. Sound companies often offer workshops or seminars for your particular group to go over in finer detail the practical workings of a sound system. And finally, there are some excellent books available - some of them from wireless microphone manufacturers - which are very handy to use as a resource.

Sit back and relax!

It's very important to have fun and enjoy what you do, so don't let wireless microphones get you down. Rent some and experiment for a few days to see what you can do. And when they do work for you - have a great show!

Al Bourke
al.bourke@jfrost.com

Wireless Microphone Rentals



Our rental department features Electro-Voice MS2000 Systems available with handheld, lapel and headset microphones. Call us to help you determine the configuration that will fit your needs and budget. We have systems starting from \$ 35.00 per day. We also have used systems for sale.

Visit our website at www.jfrost.com/rentals to download our complete Equipment Rental Catalogue.

Wireless Microphones - The Three P's

Plotting, Preparation & Placement

Using wireless microphones successfully for a musical production involves a few steps that must begin before entering the theatre. Some of it may not be very exciting but I am reminded of a phrase my father said to me many times. *Measure twice, cut once.* Translation: plan, plan, plan.

Plotting

The first step is to determine how many microphones are required. In order to do this you must read the script. You should read the script several times. For the first time set aside an evening and read the script front to back. Enjoy yourself. Try not to even think about wireless microphones, effects or anything else related to sound.

Once you complete this process your chart will show how many wireless microphones that you would require if everybody who sang had his or her own microphone. (chart 1) However, by the very nature of the script you should see some characters that only sing one or two songs. Some characters may sing in only the first act and some may sing only in the second act. Look at your chart and see where you can share microphones between characters. When doing this check to make sure that there is enough time between when the character that is wearing the microphone leaves the stage and when the character that is receiving the microphone walks on the stage. Move the character names on your chart over and cross out the column headings of microphones that are no longer required.

You will now have a chart that shows how many microphones you require so every performer that sings has a microphone during his or her song. (Chart 2) Get a

microphone kit. The kit should consist of everything you will need to put the microphones on the cast and maintain the system through the run of the show.

Bobby Pins. These are used to anchor the wire of the microphone into the hair of the cast member. Get yourself a package of black and a package of brown so that you can accommodate different hair colour.

Surgical Tape. Use this type of tape to fasten the microphone wire to the cast members skin running down their back. It comes off easily at the end of each show with little residue. Any residue left can be removed with rubbing alcohol.

Spirit Gum. Spirit gum dries clear and is therefore good for attaching the microphone wire to a cast members skin where it might be seen. Also good for affixing the microphone to places such as just above the ear for Daddy Warbucks in Annie.

Safety Pins. If you are clipping the microphone to a jacket lapel then safety pin the cable to the rear of the jacket as a strain relief.

Bodypack Belts. The belt fits around the cast members waist so that the bodypack can clip onto it (or sewn into a pouch) at the small of the back. You can make these belts from 2-3" wide elastic and Velcro to make it adjustable.

Masking Tape & Marker. Properly label the bodypacks so that they match the letter coding used on your running sheets and mixing console. Also use the masking tape to tape over the power switch once you turn it on at the beginning of the show. This will save copious amounts of grief later.

Spare Batteries. Enough Said.

The little tiny screwdriver that comes with each wireless system to adjust the bodypack's gain. Have it handy.

The Wizard of Oz - Wireless Microphone Breakdown												
	A	B	C	D	E	F	G	H	U	J	K	
Over the Rainbow	Dorothy											
Munchkin Musical Sequence	Dorothy				Barrister	Coronor	Mayor	Glinda				
Yellow Brick Road	Dorothy						Mayor					
If I Only Had a Brain	Dorothy	Scarecrow										
We're Off to see the Wizard	Dorothy	Scarecrow										
If I Only Had a Heart	Dorothy	Scarecrow	Tinman						Tree 1	Tree 2	Tree 3	
We're Off to see the Wizard	Dorothy	Scarecrow	Tinman									
If I Only Had the Nerve	Dorothy	Scarecrow	Tinman	Lion								
We're Off to see the Wizard	Dorothy	Scarecrow	Tinman	Lion								
Poppies	Dorothy	Scarecrow	Tinman	Lion				Glinda				

Chart 1

The second time reading a script should be to determine sound effects and sound atmospheres. Sound effects and atmospheres would be an entire article in StageNotes itself, so we won't cover it here.

After you have accomplished this set aside a few hours. Make a chart that has the letters A through J across the column headings. These headings represent your individual wireless microphones. Now reread the script and each time you come across a musical number put its title in a row heading. Write down all the character names that sing in the number, no matter how small their line may be, under individual columns. When you have finished the first number move onto the next. Write down the character names in the same fashion. Make sure that if the person has sung before you write them in the same column. Do this procedure for the entire script. If you need to, make more column headings.

quotation for the rental of this number of microphones plus an appropriate number of spares. Never use your spares for your regular performance. When you do this it will be the exact moment that you need the spare for a failed microphone.

If the rental price for this amount of microphones is within your budget (don't forget about batteries in your budget), then book them. If not, then you have to look at your chart and determine what characters with minor lines in songs do not absolutely require a microphone. Talk with your director about this. They may have some ideas. Rework your chart based on this to reduce the overall number of microphones required.

Preparation

In addition to all this you will need to put together a wireless

The Wizard of Oz - Wireless Microphone Breakdown						
	A	B	C	D	E	F
Over the Rainbow	Dorothy					
Munchkin Musical Sequence	Dorothy		Barrister	Coronor	Mayor	Glinda
Yellow Brick Road	Dorothy				Mayor	
If I Only Had a Brain	Dorothy	Scarecrow				
We're Off to see the Wizard	Dorothy	Scarecrow				
If I Only Had a Heart	Dorothy	Scarecrow	Tinman	Tree 1	Tree 2	Tree 3
We're Off to see the Wizard	Dorothy	Scarecrow	Tinman			
If I Only Had the Nerve	Dorothy	Scarecrow	Tinman	Lion		
We're Off to see the Wizard	Dorothy	Scarecrow	Tinman	Lion		
Poppies	Dorothy	Scarecrow	Tinman	Lion		Glinda

Chart 2

Placement

The biggest hurdle for natural sounding wireless microphones is probably proper placement on the cast member. The best place is mounted so that the actual microphone is on the forehead at the hairline pointing down towards the person's mouth. If you are able to put the microphone here you can achieve the most natural sound with the least dropouts in volume.

Start by threading the microphone at the base of the neck, through the hair until you reach the forehead. Anchor the wire in place with the bobby pins from your kit alternating the direction for security. Once you have this done leave a little slack in the wire and place a piece of surgical tape on the neck out of view just below the costume neckline.

You can let the wire hang free between the neck and the waist mounted bodypack as long as there is not too much. But there shouldn't be, the microphone wires were designed just for this.

If this type of placement can not be achieved then the best alternate places are over the ear and on the lapel of a costume jacket. However these methods have their

downfalls. The ear is a difficult place to fasten a microphone, even with gum. If the microphone is on the jacket and the cast member turns their head to the side while still speaking or singing, they have turned away from the microphone and therefore can not be heard anymore.

Once you have the bodypack and microphone on the cast member take them to the location of the receivers. Ask the person to sing in the loudest voice that they would use during the show. With the tiny screwdriver adjust the gain of the bodypack (usually hidden behind a lid) so that the bodypack and receiver are not overloaded. There is typically a meter on the receiver that shows this level.

When you have done this procedure for each cast member you are ready for the first rehearsal.

During rehearsals you will probably have to re-adjust the gain on the bodypacks because actors are notorious for adjusting their volume once they get on stage.

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