JOSEPHSON ENGINEERING, TECH NOTE 5

Origineel artikel, zie *http://www.josephson.com/tn5.html*

OPTIMUM STEREO SIGNAL RECORDING WITH THE JECKLIN DISK

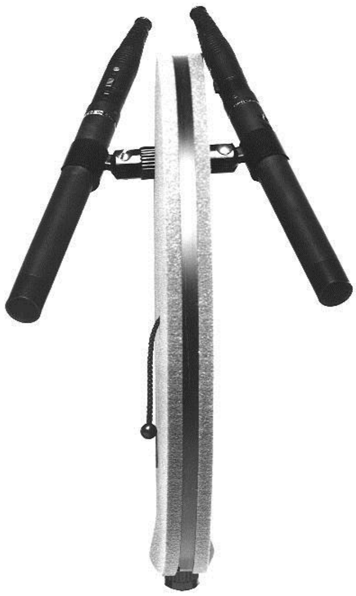

Photo of a Jecklin-type disk made by MB Electronics in the mid 1980s. The central plate is about 8 mm (a little less than 3/8") thick, covered on both sides with 8 mm thick foam. The foam is probably too thin; there is still too much high frequency energy reflected from the disk. The Jecklin-type disks supplied by Josephson Engineering since about 1995 use 25 mm foam. Jecklin is shown in his book with a disk of the same diameter but covered with lamb's fleece. The NHK (Japanese national broadcasting) version of the disk extends this covering to include the circumference of the disk as well. The following text is reproduced from Jürg Jecklin's 1980's paper *Microfon Aufnahme Systeme.* Note that Mr. Jecklin's suggestions and dimensions have changed a bit over the years. As of 2009 he was teaching at the *Universität für Musik und Darstellende Kunst Wien*(the Vienna University of Music and Performing Arts) and has published an excellent paper on microphones that contains updated details on the "Jecklin Disk."

A: The OSS technique (OSS = optimum stereo signal)

The idea of a new microphone arrangement is the result of the dissatisfaction about the sound of usual music recordings, which has made itself felt during the course of approximately 4000 recording sessions. Almost any sound engineer knows how it feels when the recording does not sound like he imagines it should, despite the use of a lot of microphones. In such a case, *i.e.,* if the technical expenditure cannot be increased meaningfully, one should start again and look for a new recording concept. The present recording technique of electronic music has grown out of the basic arrangement of two microphones (stereophonics). Since the recordings with only two microphones normally are not satisfactory, additional supporting microphones — often a large number of them — are used. Therefore, the solution of the problems has to start with the two insufficient main microphones. On the one hand, the stereo main microphone arrangement must guarantee an optimum sound; and, on the other hand, it must provide the correct stereo signal for reproduction via two loudspeakers in the room. The procedure for the conception of the OSS technique was therefore as follows:

I. Selection of suitable microphones

Practical experience has shown that condenser sound pressure microphones (omnidirectional characteristic) are superior to all other microphones. Even the sound balance and the spatial sound distribution of very large and complex orchestras (symohony orchestras) are correctly reproduced. This kind of microphone is therefore used for the OSS arrangement.

II. Optimum stereo signal

In the usual stereo recording, mainly intensity differences between the two channel are used as directional information. This so-called intensity stereophonics, however, is a mere simulation method with phantom sound sources between the two reproduction loudspeakers, which do not actually “stand” in the room as one would desire. When one listens directly, there are differences in delay time, frequency response and intensity between the two ears of the listener and their combination provides the directional informtion. These three parameters change with frequency and the angel of impact of the sound on the head. In the case of intensity stererophonics, only one of these three parameters is taken into consideration whereas an optimum stereo signal must include all three in the right combination. In the case of the OSS arrangement, all three parameters are used for the directional information and this in a combination which is ideal for the listener when reproduction comes from two loudspeakers in the usual arrangement.

B. Stucture of the OSS arrangement (Jecklin disc)

Two sound pressure microphones are arranged at a distance of 165 mm. This distance results in the correct delay time difference between the two channels. The two microphones are separated by an acoustically muffled disc of 300 mm diameter. The effect of this disc is as follows: as the frequency increases, the two microphones are more and more separated. Below the value of appromately 200 Hz, the two microphones record the same. The acoustic muffling of the disc results in a frequency response difference of the two channels depending on the angle of impact of the sound. In addition, there is a sound diffraction around the disc rim which is dependent on frequency and angle.

I. Characteristics of the OSS arrangement

The stereo signal is produced by purely acoustic mixing: on the recording side by the arrangement, and on the reproducing side by the interplay of the two loudspeaker and the reproduction room. The two microphones react only to the sound pressure. The entire acoustic pattern is recorded in one single spot in the room. The result of these clear acoustic conditions is a natural sound and a real spatial acoustic pattern. The simultaneous reproduction of the spatial sound distribution by the two loudspeakers cannot be achieved by any other recording technique. This is audible especially in the case of organ recordings. In the case of orchestra recordings, each instrument can be heard in the place where it is actually played. If the orchestra is arranged correctly, no supporting microphones are required.

II. Working with OSS technique

The technical expenditure is small. Good recordings can be achieved even with simple technology. The two microphones together emit one stereo signal. They must therefore be adjusted to the same output level in the diffuse sound field. Level differences during recording must not be balanced out. In the case of one-sided recording, the OSS arrangement or the arrangement of the orchestra must be changed.

Sound control at the mixing desk is not possible in the conventional sense. The sound control is moved into the studio or into the hall (changing of the orchestra arrangment). Supporting microphones may be used, *provided they are admixed with a time lag that corresponds to the delay time of the sound from the supported instrument to the main microphone.* For this recording technique, not only the intensity relationship but also the delay time relationship must be correct.

III. Recording in very reverberant or in acoustically problematic rooms

In an OSS arrangement, directional microphones cannot be used. When recording in acoustically unfavorable rooms, it is better to accept the room as it is than to fight its acoustics. In practice, natural recording always sounds better than unnatural, so-called improved recording. In any room where it is still possible for musicians to make music, OSS recording is also normally possible.

IV. Range of application of the OSS technique

For the recording of orchestras that are harmonious and are arranged correctly (symphony orchestra, chorus, brass band, chamber music, individual instruments, etc.).

The OSS technique is not suited for recordings where the recording technique is designed to co-determine the sound. The OSS technique is especially well suited for the recording of concerts aiming at a very natural sound. The OSS technique may be a step towards a more natural stereo recording. In comparison with conventional recordings, OSS recordings were preferred by all listeners during tests. The professional musicians are especially happy with the “new” sound. Recently, many recordings at radio stations have been made with this technique.

C. The Jecklin disc in practice

I. Microphones for recording with the Jecklin disc

For recording with the Jecklin disc, sound pressure microphones must always be used; *i.e.,* “real” sound pressure microphones. Microphones with a switchable directional characteristic, insofar as they are designed as double diaphragm microphones, may not be used.

II. Operating instructions

1. General

The disc has two microphone mounts (21mm) and one stand connecting piece. By putting the stand connecting piece into the individual borings, the setting angle of the disc can be adjusted to any situation. The measuring cord located in the center of the disc serves for the adjustment of the microphones on the disc. The measuring cord can be adjusted on both sides.

2. Mounting of the microphones onto the Jecklin disc

The microphones are pushed from the rear through the holding clamps of the Jecklin disc. Take care that the microphone capsules on both sides are located at a distance of approx 8 cm directly above the disc center. This can be checked by means of the pulled-in measuring cord. In this case, the angles of the microphones are drawn slightly towards the outside.

3. Mounting of the connecting piece

The Jecklin disc with the microphones is at first held by hand in the position that is required for the recording. By loosening the fastening screws at the stand intermediate piece, the intermediate piece can be removed and set into any of the borings at the disc rim; *i.e.,* the disc is attached at the preselected angle. Thus the balance of the entire arrangement is guaranteed and the adjustment to any situation is made possible.

Note from David Josephson: It isn't mentioned by Jecklin, but "the position that is required by the recording" is determined by the desired tone color balance. Most microphones are more sensitive toward the front than toward the sides and rear for high frequency sounds. Rotating the disc maintains the capsules at the correct distance from the disc but allows their angle to the sound to be adjusted for more or less high frequency information.

III. Recording with the Jecklin disc

Since the two microphones together emit a uniform stereo signal, they have to be adjusted prior to the recording in the diffuse sound field to the same output level. This can be checked best by means of a headphone: the spatial impression must be uniform. The room must not "hang" on one side. During the microphone test or the recording, level differences between the two channels must *not* be balanced out. In the case of one-sidedness, the disc must be turned or rearranged accordingly. A sound control in the conventional sense, balancing at the mixing desk, is not possible; *i.e.,* the sound control is moved from the control room into the studio or concert hall.

Placing of the Jecklin disc before the sound source is less critical than microphone placement in the case of other recording techniques. Depending on the distance of the disc from the sound source, the recording sounds nearer or more remote without being automatically too close or of too large an auditory perspective. When the disc is being used, the optimum distance from the sound source is larger than it is the case of any other recording technique. The disc must, however, be located within the diffuse-field distance of the room (the diffuse-field distance is the distance at which the direct sound from the source and the diffuse sound portion of the room are equal). The exact postion and the correct distance from the sound source, however, must always be determined by ear. Here, one can usually proceed as follows:

- Too near: Locate the disc at a larger distance, or higher.
- Too far: Locate the disc nearer or lower.
- Wrong spatial sound distribution: if the instruments in the rear of the orchestra are recorded too loud, locate the disc lower. If they are too soft, the disc must be located higher.
- Level variations: if the level of one channel of a correctly adjusted disc (adjusted in the diffuse sound field) is higher than the other, the disc must be turned accordingly.
- Distance of the disc from the sound source: as already mentioned, the disc must be located within the diffuse field. This distance can be calculated. In the following table, the diffuse-field distance depending on the room volume and the reverberation time for virtually all possible cases is indicated.

Room volume, cubic meters	Reverberation time, seconds 1.0	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0
500	1.27	1.04	0.96	0.9	0.85	0.8	0.74	0.68	0.64
1000	1.8	1.47	1.35	1.41	1.2	1.14	1.04	0.96	0.9
2000	2.55	2.08	1.93	1.8	1.7	1.61	1.47	1.36	1.27
5000	4.03	3.29	3.04	2.85	2.69	2.55	2.33	2.16	2.02
10000		4.65	4.3	4.03	3.8	3.6	3.3	3.05	2.85
15000			5.28	4.93	4.65	4.42	4.03	3.73	3.49
20000				5.7	5.37	5.1	4.65	4.31	4.03

The table shows diffuse field distance, in meters, from the center of a sound source, as a function of room volume and reverberation time. The disc should be placed closer to the sound source than this distance.

IV. Checking the technical equipment

Successful recording depends on the perfect functioning of all of the technical equipment used. In practice, this can be achieved most easily be means of the following check list.
Initial Setup

- Check the correct lateral position of the loudspeakers (headphone): monitor switch at the tape recorder to “tape” (check with a known recording).
- Adjust the reproduction volume (with a known recording).
- Check the correct lateral position and the functioning of the microphones (monitor switch to “input”).
- Check the tape run (visually). remove buckled tapes (the tapes are often deformed only at the beginning of the tape reel. Prewind accordingly).
- Check the recording function (monitor switch to “tape”, recording key pushed).

During the microphone test:

- Adjust the channel controller levels for the correct balance and the correct control of a loud passage.
- Recording test: compare “input” and “tape”.

During the recording:

- Do not touch the controllers (short sound overshooting is usually not that bad and is readjusted too late anyway).
- Always monitor behind the tape (monitor switch to “tape”); do not change the reproduction volume.

Thanks to Joel Conrad for typing in the original text and to Jon Singer for editing and proofreading.
Last modified: Oct 20 2009