INSTRUCTIONS FOR USING THE STEREO REVIEW MODEL SRT14 STEREO TEST RECORD


Stereo Review's
STEREO TEST RECORD
model SRT14
for home and laboratory use

IMPORTANT: THE HIGH-FREQUENCY TEST BANDS ON THIS RECORD CAN BE PERMANENTLY DAMAGED BY PLAYING THEM WITH A WORN STYLUS OR WITH A LOW-QUALITY OR DEFECTIVE PHONO CARTRIDGE.

NOTE: Before proceeding with any of the following tests, verify that the record player's tracking force and skating compensation are properly adjusted by means of the cartridge tracking tests on Side One, Bands 4 and 5, and the antiskating adjustment test on Side Two, Band 8. The system controls should be set for stereo operation, and tone controls should be set for flat response except when otherwise indicated in the instructions. Accessories such as equalizers (unless required by the loudspeakers for flat frequency response) and noise reducers should be switched out or disconnected. All tests on Side One may be evaluated by ear; no test instruments are required. For those tests on Side Two requiring instruments, the appropriate instruments are indicated. (The term "Hz" or "Hertz" used throughout these instructions is the equivalent of "cycles per second" or "cps"; "kHz" or "kilohertz" is equivalent to 1,000 Hz.)
TECHNICAL NOTE: All material on this recording has been cut using standard RIAA phono equalization in the amplifying chain of the cutting instrument, and should be played back through a preamplifier circuit employing the complementary playback RIAA equalization (with the exception of Side Two, Band 10, as indicated in the specific instructions for that band). The appropriate playback equalization is provided by all record-playing equipment intended for consumer use.

Band 1—Frequency response, 1,280-20,480 Hz

This upper part of the audio-frequency spectrum is divided into eight half-octaves, each recorded as a warble tone that sweeps rapidly up and down through all the frequencies of the half octave. Unlike the case with steady tones, the relative loudness of warble tones can be accurately compared by ear. (Sonic reflections and resonances in a room confuse such comparisons when steady single-frequency tones are used.)

Each of the eight half-octave sections is announced by a number; the frequencies covered are shown in the table below. There are six warble tones recorded in this order: test warble... -5 dB reference warble... test warble... 0 dB reference warble... test warble...+5 dB reference warble. All the reference warbles cover the half-octave 920-1,280 Hz. The -5 dB reference warble is recorded 5 dB softer than the test warbles, the 0 dB reference warble is at the same level as the test warbles, and the +5 dB reference warble is recorded 5 dB louder than the test warbles.

Each of the eight groups of six warbles is run through twice, once in the left channel and once in the right. (The right speaker is the one to your right as you face the speakers.)

The eight half-octaves are as follows:

Voice Announcement	Test-Warble Frequencies
1	14,720-20,480 Hz
2	10,240-14,720
3	7,360-10,240
4	5,120-7,360
5	3,680-5,120 Hz
6	2,560-3,680
7	1,840-2,560
8	1,280-1,840

How to use the test. Before making final judgments, listen through the test several times. The purpose is to compare the strength of each test warble with the strength of the three reference warbles (-5 dB, 0 dB, +5 dB) that accompany it. If your playback system (including the room acoustics) were absolutely perfect, every test warble would be exactly as loud as the *middle* (0 dB) reference warble. If the test warble is just as loud as the -5 dB reference, the overall system response at that half-octave is 5 dB weaker than the response at the middle frequencies. If the test warble is just as loud as the +5 dB reference, the system response at that half-octave is 5 dB stronger than the response at middle frequencies. The ideal, of course, is to have the *middle* test warble equal the loudness of the reference warble in every case. However, remember that this test involves every element of your hi-fi system, plus your room's acoustics, *and your ears.*

You may find the comparisons difficult to make at first. Listen through the test several times. As your ear gets accustomed to the sequence of tones, your judgments will become more exact.

Treble beaming. Move from directly in front of the speaker to a side position during the higher-frequency warbles (numbers 1-4). A marked loss in loudness of the test warble as you move to the side means that the speaker system is beaming the highs over a narrow angle, rather than spreading them out for uniform coverage of the listening area. This lack of high-frequency dispersion could be inherent in the design of the speaker system.

Note: The ability to hear the high-frequency warbles in tests 1-4 diminishes with age. If you don't hear the test warble in any of these sequences, although you continue to hear record noise, the fault may be with your ears rather than with your sound system. You can check your own ears by having other people listen to the tones. Do not turn up the volume excessively, as damage to your tweeters may result.

Locked groove. At the end of the eighth sequence there is a locked groove; the pickup will play that groove until you lift it across to the beginning of Band 2. (The locked groove was necessary because of the special technique used in preparing the master disc for this record.)

Band 2—Frequency response, 20-920 Hz

Increase in level. Since Band 2 starts off approximately 10 dB louder than Band 1, turn down the volume control slightly before it starts. Once into Band 2, *set volume at the highest level you can listen to comfortably.* This will help compensate for the ear's normal loss of sensitivity at low-bass frequencies.

Note: The pitch of the voice on this band is slightly lower than normal. This does *not* indicate off-speed turntable operation, but results from the special recording technique employed.

The lower frequencies are divided into ten half-octaves (sequences Nos. 9-18) with the same reference frequency (920-1,280 Hz) and reference pattern as on Band 1. The frequencies are as follows:

Voice Announcement	Test-Warble Frequencies
9	640-920 Hz
10	460-640
11	320-460
12	230-320
13	160-230
14	115-160
15	80-115
16	57-80
17	40-57
18	28.5-40

The test is used in the same way as that on Band 1.

Note on low bass. Warbles 15 through 18 permit you to make reasonably accurate judgments of low-bass performance, but even with warble tones, room acoustics will influence the results considerably. Move around the room when judging the bass, and compare the bass at your usual listening position with that in other areas. Relocating the speakers can make great differences in bass performance. A corner position usually produces the strongest bass, but does not necessarily provide the best balance between the bass, the mid-range, and the higher frequencies.

Even the finest speakers will be approaching the limits of their capabilities in warble No. 17. Do not turn up the volume of your amplifier, for damage to the speaker may result. A speaker's response to Nos. 17 and 18 may be mostly harmonic distortion, which is heard as a higher frequency than the fundamental tone. True speaker response to the very low frequencies can be recognized by the very deep yet smooth characteristic of the tone, which is felt as well as heard. If the speaker is unable to reproduce frequencies below 40 Hz, you may hear noise made up of higher-order harmonics, or you may hear nothing. The latter is preferable.

Locked Groove. At the end of Band 2, you must move the pickup by hand to Band 3.

Band 3—Separation test

This permits you to judge whether or not there is excessive signal leakage from one stereo channel to the other; in other words, whether separation is adequate for good stereo. The frequencies from 400 to 12,800 Hz are divided into five sections, each an octave wide and each recorded as a warble tone. The sections are numbered and announced as follows:

Voice Announcement	Test-Warble Frequencies
1	6,400-12,800 Hz
2	3,200-6,400
3	1,600-3,200
4	800-1,600
5	400-800

Each test consists of a series of six warbles, as follows: leakage test warble...reference warble... leakage test warble... reference warble... leakage test warble... reference warble. Each set of reference warbles covers the same frequencies as the leakage test warble it accompanies. The reference warbles are recorded in the right channel and 15 dB softer than the leakage test warbles which are recorded in the left channel.

To use the test, turn off the left speaker, either by turning the balance control all the way to the right or by disconnecting the left speaker. When you play Band 3, you will hear in the *right* speaker the signal leakage from the leakage test warble recorded in the *left* channel alternated three times with the reference warble. The volume should be set to a comfortable level on the reference warbles.

If the leakage warble is as loud as the reference warble, then separation is 15 dB, which will provide adequate stereo. If the leakage warble is weaker than the reference warble, there is more than 15 dB of separation. If the leakage warble is louder than the reference warble, the separation is less than 15 dB in the octave under test and may not be adequate. Octaves Nos. 2, 3 and 4 are the most important for good stereo. If separation is good in these three, it can fall a little short in the first or last octave without greatly disturbing stereo perspective.

The test is repeated in the right channel, and is evaluated in the same way. For the right channel portion of the test, be certain that the *right* loudspeaker is disabled (by means of the balance control) or disconnected, and that the left loudspeaker is reconnected.

Band 4—Cartridge tracking, high frequency

This is a very demanding test; do not expect any pickup to perform perfectly. Two tones are recorded simultaneously: 16,000 Hz and 16,300 Hz. The recording starts at a low level easily tracked by any good pickup. The signal level then swoops up to a peak and back to the starting level, repeatedly. As the peak of each swoop is approached, the stylus will mistrack if the pickup design is inadequate, if the pickup is defective, or if the tracking force is set too low.

Many people, especially those more than 35 years old, will not be able to hear the 16,000-Hz and 16,300-Hz tones. However, they will be able to hear the 300-Hz "difference" tone produced by intermodulation of the two high-frequency tones, which is the essence of the test. Even with the finest pickups, residual intermodulation and tracing distortion will make the 300-Hz tone at least faintly audible at the peak of each swoop if the volume is set comfortably loud. Mistracking or excessive cartridge distortion is indicated by a raspy or buzzy quality in the 300-Hz tone and the presence of the tone during a fairly long part of each swoop. Good tracking and excellent performance in the highs will produce a short, clear, soft 300-Hz tone. If you are in doubt as to what a bad case of mistracking sounds like, you can demonstrate it by setting the tracking force to *half* the manufacturer's recommended force. This is certain to produce serious mistracking. Afterward, be sure to restore normal tracking force to prevent record damage.

Remember, do not expect perfect performance; pickups vary greatly in their handling of the frequencies around 16,000 Hz, and few, if any, will completely eliminate the 300-Hz tone. Your objective is to find the minimum tracking force that will produce the best performance your pickup is capable of. Thus, if the 300-Hz tone is long and distorted, increase the tracking force by small increments at a time until the tone shortens and quiets down noticeably.

If you hear no difference as tracking force is increased and the 300-Hz tone is fairly clean, adopt the tracking force setting indicated by the next test, on Band 6. The tracking force required will probably be in excess of 1 gram, but a requirement near the manufacturer's rated maximum does not necessarily indicate poor quality. However, if a force exceeding the maximum is needed to get reasonably good performance, the pickup is defective, misadjusted, or of too poor a quality for top-grade performance on stereo records. Do not ignore the possibility that accumulated dirt on the pickup stylus may be causing the distortion. Clean the stylus and try again.

If the two channels differ in their requirements, use the higher of the two tracking forces indicated. There may be a tendency for the right channel to require a higher tracking force because of the "skating force," which usually tends to push the stylus against the inner groove wall (left channel), underloading the right channel. If the tone arm on your turntable has an antiskating adjustment, use Band 6 on Side 2 to achieve the best compromise adjustment.

Important: Watch out for amplifier overload. You may get a buzzy or distorted 300-Hz tone at the peaks because of amplifier overload. To make sure this is not happening, turn down your volume control and listen for any difference in the tone.

Locked groove. At the end of Band 4, you must move the pickup by hand to the beginning of Band 6.

Band 5—Cartridge tracking, low frequency

This test is similar to the preceding one, except that the signal is a single 300-Hz tone. The tone swoops repeatedly from a low level to a high level and back again. Mistracking or excessive distortion is indicated by a distinct buzzy quality at the loudest part of each swoop. The length and strength of the buzz increases with the degree of mistracking. Make sure that any buzz you hear is not caused by the vibration of some small object in the room, such as a glass or tray on a shelf, a lampshade, and so forth.

This band is an extremely sensitive indicator of proper tracking in the middle and low frequencies. If the pickup does not buzz, decrease tracking force until the buzz just starts, then add just a bit more force. If there is a buzz at the top of each swoop on your first trial, increase the force by successive small increments until the buzz disappears. Most good cartridges will yield acceptable results with a force of a gram or so. If more than the cartridge's maximum rated tracking force is required, the pickup is defective, misadjusted, or does not have enough compliance for top-grade performance. Also, be aware that repeated playing of this and the preceding test with too low a tracking force may permanently damage the record, making it impossible to achieve good results with any cartridge.

Factors that could make the required tracking force excessively high are: cartridge loose in its mounting; excessive friction in the tone-arm bearings; dirt on the stylus; cartridge tilted or otherwise incorrectly installed; tight or binding tone-arm leads; a bent or otherwise damaged stylus assembly.

Again, watch out for amplifier overload or acoustic feedback (detrimental vibration of the record player by the sound from the speakers). And expect occasionally to find the right channel a little more demanding than the left.

Reconciling high-frequency and low-frequency tracking-force requirements. Most good cartridges will require more tracking force to cope with the high-frequency test than the low-frequency test. At the point where an increase in tracking force provides no further improvement on the high-frequency test, the optimum tracking force has probably been achieved, provided that it is sufficient to handle the low-frequency test. Should the low-frequency test require still more tracking force, increase the force accordingly, taking care to remain within the cartridge manufacturer's rated range of forces. Use of a good accessory tracking-force gauge is strongly advised for this adjustment, as the tracking-force calibrations on many tone arms cannot be depended upon for the necessary accuracy.

Band 6—Broad-band noise for channel balance

Two broad-band, random-noise signals are recorded, one in each channel. Since the two signals are not related there will be distinct right- and left-channel sounds, each originating from the appropriate speaker.

You can easily hear any difference in loudness between the two sounds. Adjust your system's balance control to make the two speakers seem equally loud at your usual listening position. Your two channels are then balanced for loudness. This test permits you to eliminate any imbalances that might originate in your cartridge, amplifier, speakers, or room acoustics. However, it will not properly compensate for any significant differences in the speakers' frequency responses, or any great variance in their distances from your listening position.

Since the two signals emcompass a very wide range of frequencies, they also provide a quick check of the frequency-response balance between the two channels. If one channel is substantially stronger in the highs than the other, it will sound "lighter," "sharper," or "crisper." Stronger bass will make the sound heavier or duller. You can learn what these differences sound like by turning your tone controls through their ranges while listening to the noise. Return the controls to "flat" before making your judgments. If there is a substantial difference in frequency response between the two channels, particularly in the highs, the system will not project stereo properly. You may be able to make the channels match by adjusting the tweeter and/or mid-range controls on your speakers or by adjusting the tone controls, provided your system incorporates separate tone controls for the two channels.

This test should also be useful for adjusting the balance of most four-channel matrix systems, because the random-phase nature of the recorded signals should provide roughly equal outputs to all four channels.

Band 7—Cartridge- and speaker-phasing test

There are seven low-frequency (80-160 Hz) warble tones alternating in and out of phase. The order is: in—out—in—out—in—out—in. First check the phono-cartridge phasing by switching your system to mono. The first, third, fifth, and seventh tones should be loud and the second, fourth, and sixth tones should be soft or totally inaudible if your cartridge is connected properly—that is, in phase. If there is a substantial loss of signal when the first, third, fifth, and seventh tones are played, the wiring at the cartridge terminals is probably incorrect. Check that the "hot" and "ground" lead connections of one channel are not reversed where they connect to the cartridge pins.

Having checked the phasing of your cartridge, proceed to the speaker-phasing test. Your amplifier control should be reset to stereo. Stand equidistant from your speakers. The first, third, fifth, and seventh in-phase warbles should seem to come from a single centered source directly in front of you. The second, fourth, and sixth out-of-phase warbles should sound diffused and unlocalized.

If these effects are reversed, with the first warble of each pair sounding diffused, the system is out of phase. Reverse the connections to *one* loudspeaker to correct this. Make the phasing test if the stereo image seems unclear, or unstable, or if you can't get a firm center image with a mono recording.

The acoustics of your particular room may make it difficult to judge the difference between the in- and out-of-phase warbles. In that case, if your speakers are movable, an alternate way to make the test is to place them side by side. Then if the system is properly in phase, the in-phase warbles will then be much louder than the out-of-phase, and vice versa.

Band 8—Low-Frequency noise test

A passage of piano music is recorded on this band at a level lower than that of the average recording. Turn up the volume of this music to a comfortable listening level, and adjust your amplifier's bass controls to the position at which they are normally set. Sit at a normal listening distance from your speakers. Then after you hear the words "quiet groove," without changing the bass or volume controls, listen for low-pitched noise. Do not be concerned with any record-surface ticks, pops, and scratches you may hear, because they do not affect the test. If they are present and you wish to eliminate them, you may switch in a scratch filter or turn down the treble control slightly.

Evaluate the hum and rumble in your system as follows:

If you hear no low-pitched noise: the noise level is excellent.

Slight noise: still good.

Moderate noise: borderline.

Strong noise: remedial action is required.

To analyze the source of the noise so that corrective action can be taken, first lift the pickup out of the groove with the cueing lever. Take your hand away, because a hand on or near the pickup often raises the hum level. Don't change the amplifier controls. If, with the arm off the record, the hum is excessively loud *at your normal listening position,* consult the manuals that came with your record player and other equipment for suggestions on eliminating hum. To judge the amount of rumble present in your turntable, place the pickup back in the quiet groove. An increase in low-pitched noise is caused by rumble. If it is loud enough to be a problem, your turntable may be incorrectly installed, need repair, or be of inherently poor quality.

Before the next band starts, turn the volume control back down to a normal listening level.

Band 9—Flutter test

This test permits you to judge the subjective seriousness of the flutter (rapid fluctuations in speed) in your turntable as it affects the music heard through your system. Three short passages of piano music are played. The first has very low flutter; the second, moderate flutter; and the last, very high flutter. Each passage is identified by the announcer.

If the flutter in your turntable is very low, the recorded increase in flutter from the first to the second passage will just be apparent. But if the turntable itself has about as much flutter as is recorded in the second passage, the flutter of the first will be masked and the two passages will sound alike.

Applying this principle throughout the test, we get the following criteria for your turntable's performance:

Increase in flutter from first to second passage perceptible: turntable has very low flutter.

No increase until third passage; moderate flutter.

All passages sound alike: high flutter.

The differences are likely to be difficult to hear on first trial of the test. To train your ear, we suggest that you listen to the third passage, "high flutter," and then quickly go back to the first. Do this two or three times. Concentrate on single, long-held notes. Flutter is heard as a wavery or "sour" quality. A clear, firm quality in the single notes indicates very low flutter. If you can hear no differences between the first and the third passages of the music after repeated comparisions, you probably have a turntable with high flutter.

Slow piano music particularly shows up any flutter that may be present. However, it is not likely to be audible in voice, fast orchestral music, or most other instruments, fast or slow, until it is considerably more severe than in any of the passages on this record.

SIDE TWO

Important warning on Bands 1 and 2: Do not play these bands with an older, heavy pickup of the kind requiring 3 to 4 grams of tracking force; nor with any pickup you suspect of being defective or having a badly worn stylus. The frequencies above 10,000 or 15,000 Hz can be completely wiped off the record, or at the least badly damaged, by such a pickup.

Band 1—40-kHz frequency response and separation test, left channel (chart recorder, A.C. voltmeter, or oscilloscope)

This is essentially a test of a phono cartridge's response at super-audible frequencies (10,000 to 40,000 Hz). In order to perform satisfactorily with CD-4 "discrete" four-channel records and other recordings employing ultrasonic carrier signals, the cartridge must be capable of significant output up to 40,000 Hz (40 kHz).

To perform the test, first bypass or disconnect any CD-4 demodulator in the system and plug the cables from the turntable directly into the system's normal phono-preamplifier inputs. The chart recorder, meter, or oscilloscope may be connected to any convenient point in the left-channel signal path thereafter, including the speaker terminals (for greatest accuracy, it is advisable to disconnect the left speaker when this is done). The test signal starts at 10,000 Hz and sweeps steadily up to 40,000 Hz. There are marker "beeps" at 10,000, 15,000, 20,000, 25,000, 30,000, 35,000, and 40,000 Hz. If the left speaker has been disconnected, switching the system to mono will enable these beeps to be heard through the right speaker.

No presently available cartridge will exhibit truly uniform or "flat" frequency response over this range. Nor is this necessary for satisfactory CD-4 performance. However, to be usable as a CD-4 pickup in typical systems, a cartridge should have an output at the higher test frequencies that does not deviate much more than 8 dB from its output at 10,000 Hz.

For a complete check of response and separation, an oscilloscope's horizontal inputs can be connected across the left-channel signal path and its vertical inputs across the right. The signal in the left channel can then be directly compared with the leakage into the right channel. If a chart recorder or voltmeter is used, it will be necessary to perform the test twice, measuring first the left channel and then the right channel and comparing the results to determine the amount of separation. Exceptional separation cannot be expected from any presently available phono cartridge across the entire range of frequencies employed in the test. However, separation should be at least 6 dB at all frequencies for proper CD-4 performance.

The sweep takes about 1 minute and 2 seconds.

Note: Many phono cartridges require that specially designed low-capacitance turntable cables be used if output is to be maintained above 20,000 Hz. Such cables are available from the manufacturers of many newer-model record players. Furthermore some preamplifiers, amplifiers, and receivers have their frequency responses deliberately curtailed above 20,000 Hz in order to avoid potentially troublesome effects from ultrasonic signals entering the systems. While this will not interfere with normal CD-4 performance in any way, it will make this test impossible to interpret properly unless components with flat response to 40,000 Hz are substituted for the response-limited components in the system.

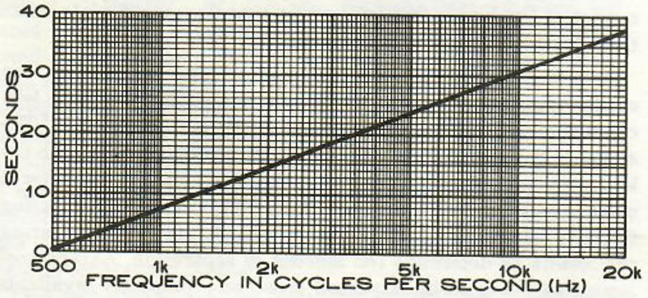
Band 2—40-kHz frequency response and separation test, right channel

The sweep is repeated in the right channel.

Band 3—Frequency-response sweep, 500-20,000 Hz, left channel (chart recorder, meter, or oscilloscope)

This is a test of system response over the range of the critical mid and high frequencies. The test starts with a level-set reference tone at 500 Hz. After an interruption, the tone sweeps continuously up to 20,000 Hz (20 kHz). The rate of the sweep is logarithmic (equal time per octave), and is timed to synchronize with the General Radio 1521A and 1521B Chart Recorder set for 30 divisions per minute. Any chart recorder can be used, however. The total time for the sweep is 38 seconds. This makes the time per octave 7.1 seconds, and the chart paper can be calibrated accordingly.

You can also use a meter (such as an audio voltmeter or a good VOM) to get a measurement, or an oscilloscope. By timing the sweep with a stopwatch, you can reconstruct the overall response curve with reasonable accuracy. Start the timing at the beginning of the sweep and stop at the point at which any dip or peak appears. The frequency of the irregularities at any given point in time can be determined by using the chart of frequency *versus* time shown below.



Band 4—Frequency response sweep, 500-20,000 Hz, right channel.

The sweep is repeated in the right channel.

Band 5—500-Hz square waves, left channel (oscilloscope)

The main purpose of this band is to provide a quick visual indication of the high-frequency response and resonances of the phono cartridge. (Most modern amplifiers will pass a 500-Hz square wave perfectly and therefore will have little or no effect on the significant portions of the waveform). For the left-channel test, connect the oscilloscope's vertical input across the system's left-channel speaker output terminals; for the right-channel tests, connect the oscilloscope across the right-speaker terminals. Since the square-wave frequency is 500 Hz, a scope sweep frequency of 250 Hz will show two complete waves. If the waveform is to be significant, the oscilloscope must have good high-frequency response up to at least 100,000 Hz. Otherwise, the waveform may be distorted by the deficiencies of the scope in addition to the characteristics of your pickup.

In this test, the important parts of the waveform are the shape of the leading (vertical) edge and its overshoot, or lack of it. (Slight tilt in the tops and bottoms of the wave is not significant on this recording.) As recorded, the leading edge of the waveform has a moderate rounding, as indicated in Fig. 1 (A). This rounding was an unavoidable consequence of cutting such a square wave with smooth tops and bottoms, so that the resonant characteristics of the playback cartridge can be studied. However, any tendency of a cartridge to exaggerate the rounding, causing the leading edge to rise less sharply upward, indicates a weakness in the cartridge's high-frequency response. A tendency to overshoot, indicated by ripples in the tops and bottoms of the waveform, suggests an underdamped resonance that probably results in a strong frequency-response "peak" somewhere in the cartridge's upper register. (Even the best cartridges may exhibit a small amount of overshoot, which may be exaggerated as the record becomes worn.) Excessive "tilt" or sloping in the tops and bottoms of the waveform indicates a weakness in low-frequency response—probably the result of inadequate phono-stylus compliance. Significant deformations of the waveform such as those shown by the solid and dashed lines of Fig. 1 (B) suggest excessive phase shift in the phono cartridge or its associated equipment, which may impair performance for CD-4 four-channel reproduction. The sample waveforms shown in the figures below will help in your evaluation of the test results.

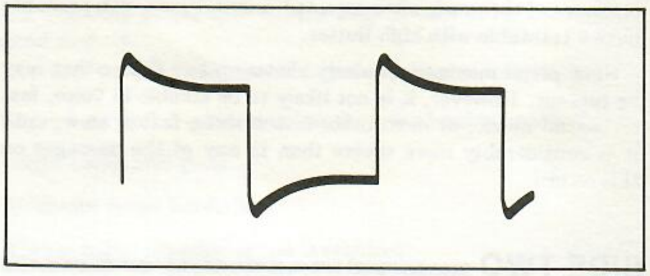


Fig. 1 (A). *This is the square wave as it is cut into the record. If a cartridge were perfect, it would produce an oscilloscope pattern that looked exactly like the waveform shown. The important points to note are the sharply rising vertical sides, the degree of rounding at the tops and bottoms of the waveform, and the smoothness of the tops and bottoms. This particular square wave shows a wide, flat response.*

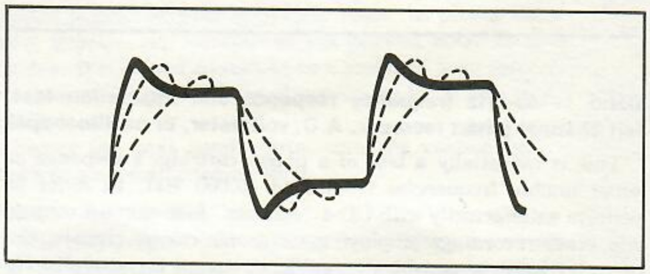


Fig. 1 (B). *If a phono cartridge or amplifier has poor high-frequency response, the square wave will look like this. Note the tilted verticals and the rounded corners at the leading edges of the wave. The dashed lines show two cases of progressively worse high-frequency response.*

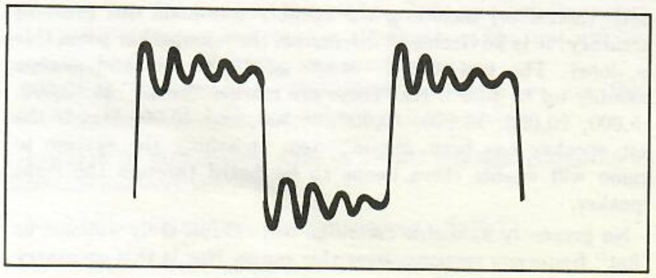


Fig. 1 (C) . *A severe resonance or a response peak will cause ripples in the square wave as in the above example. The frequency of the resonance can be determined by counting the number of cycles of ripple in one cycle of square wave. In the example above there are approximately ten ripples [five on top, five on the bottom] and the frequency of the square wave is, in this case, 500 Hz. The number of ripples multiplied by the square-wave frequency yields the frequency of the dip or peak: 10 x 500 = 5,000 Hz.*

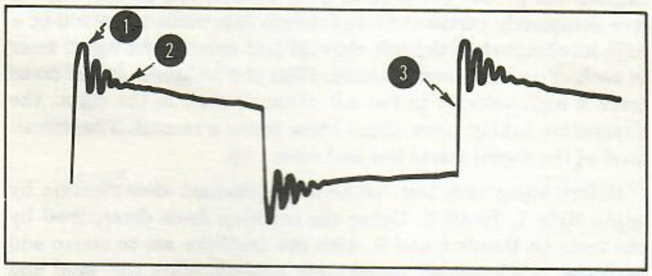


Fig. 1 (D) . *A typical phono cartridge may have a square-wave response that looks something like this. Note: [1] the ripples [ringing] after the leading edge of the top of the wave are closely spaced, indicating that the cartridge's resonant peak is at a high frequency; [2] the ripples are well damped, that is, they die down quickly; [3] the wave reaches its full amplitude rapidly, that is, the leading edge is nearly vertical. If your scope has a calibrated sweep, look for a rise time of 15 microseconds or better for the best phono cartridges.*

If the pattern on your scope is jumpy, this may be caused by turntable rumble, acoustic feedback, or oscilloscope instability. Turning down the bass tone control and/or switching in a low-frequency filter may make the wave tops and bottoms tilt more but will help stabilize the oscilloscope trace.

Band 6—500-Hz square waves, right channel (oscilloscope)

The test is repeated in the right channel.
Locked groove: the pickup must be moved by hand to Band 7.

Band 7—Tone-burst test (oscilloscope)

This band tests the transient response of a phono cartridge. The test signal is composed of series of tone bursts, each burst containing 16 complete sine waves. Each burst is followed by an off period of the same length. The frequency of the sine waves starts at 500 Hz and sweeps logarithmically up to 20,000 Hz. Thus, the timing chart above (Band 3) can be used to locate any given frequency. The sweep is interrupted four times, to provide calibration points, as follows:

First interruption:	1,000 Hz
Second	2,000
Third	5,000
Fourth	10,000

With your hi-fi system set for mono, connect the vertical input of the oscilloscope across the speaker-output terminals of either channel of the amplifier. Adjust the scope sweep frequency to display at least two bursts and pauses. Since the burst frequency steadily increases, you will have to keep adjusting the sweep-frequency control to keep the burst patterns synchronized on the scope screen. An example of good tone burst response appears below in Fig.4.

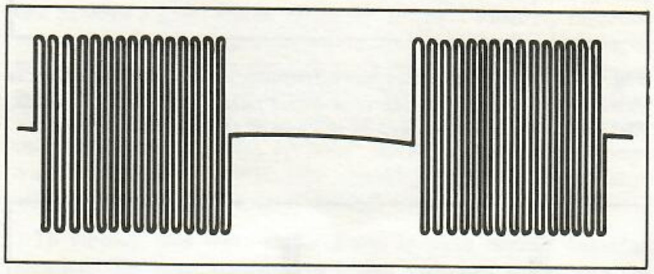


Fig. 4. *This is what a perfect tone-burst response would look like. The important points to note are that the burst reaches its full amplitude immediately, and when the burst stops there is no "ringing" [continuation of the signal].*

Various faults cause the patterns to appear as below.

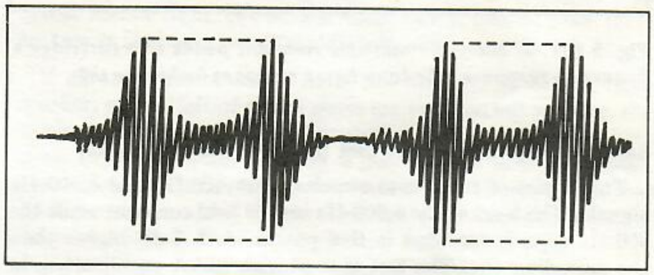


Fig. 5 (A) . *If your cartridge has a severe dip in its frequency response at the same frequency as the tone burst, the oscilloscope pattern will look like this. (The dots outline a perfect response.)*

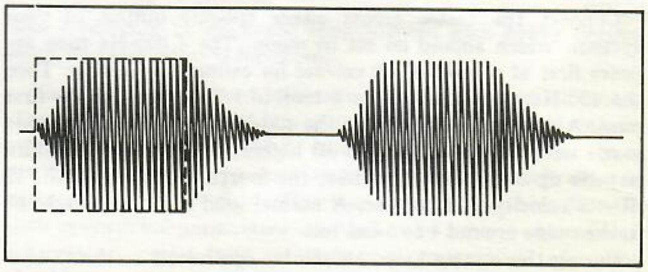


Fig. 5 (B) . *If your cartridge has a resonant peak at or near the frequency of the tone burst, the scope pattern will look like this.*

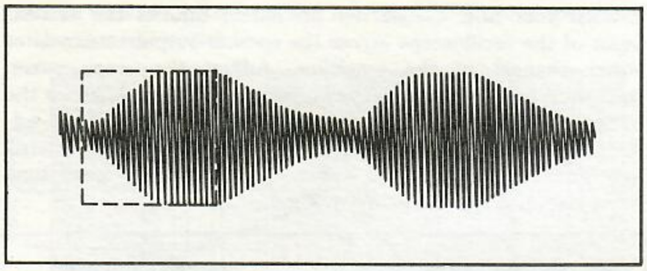


Fig. 5 (C). *If the cartridge has a frequency-response peak that is extremely pronounced, the tone-burst pattern will look like this. Note the spurious response at the end of the burst.*

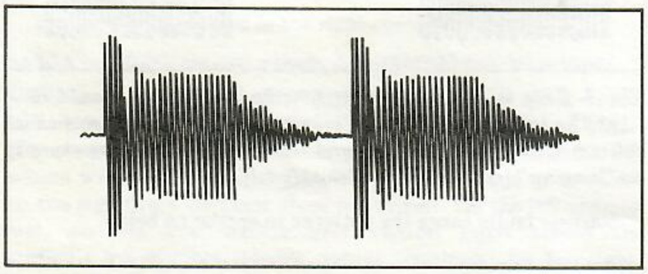


Fig. 5 (D). *If there are multiple resonant peaks in a cartridge's frequency response, the tone-burst response looks like this.*

Band 8—Intermodulation test (IM distortion analyser)

This series of tests uses simultaneous 400-Hz and 4,000-Hz signals. The level of the 4,000-Hz tone is held constant while the 400-Hz tone is recorded in five passes, each 3-dB higher than the preceding one. The test is used with RIAA equalization, in contrast to most intermodulation-test signals on records. For this test you must have an intermodulation-distortion meter that has some provision for calibration setting, filtering out the test tones, reading the distortion products, and measuring them on a meter calibrated in per cent of the 4,000-Hz tone.

Connect the meter across either speaker output of your system, which should be set to mono. The 4,000-Hz tone appears first at a level of 5.0 cm/sec for calibration setting. Then the 400-Hz tone is added, at a level of 1.7 cm/sec, for the first pass. After an interruption in the 400-Hz tone, the second pass starts with the 400-Hz tone 3-dB higher, or 2 cm/sec. The third pass is up 6 dB from the first; the fourth, 9 dB; the fifth, 12 dB—a velocity of 8 cm/sec. A normal loud recording might be in the range around 4 to 5 cm/sec.

During these tests keep the volume control set so that 1 to 4 volts appears across the speaker terminals. This will prevent amplifier distortion from confusing the readings.

Locked groove: the pickup must be moved by hand to Band 9.

Band 9—Antiskating adjustment

This test will permit you to judge, by ear, the optimum antiskating adjustment for your record player. The test signal consists of two simultaneous tones of approximately 300 Hz and 303 Hz. The phase difference between the two tones varies between 0 and 360 degrees about three times each second. At 0 degrees the groove cut is completely lateral, and at 180 degrees it is completely vertical. At an intermediate value there will be a high-level signal in the left channel and none in the right; later in each cycle the reverse occurs. Thus the pickup is called on to track a high velocity in the left channel, then in the right, the alternation taking place about three times a second. The overall level of the signal starts low and moves up.

Before using this test, recheck the channel identification by using Side 1, Band 1. Using the tracking force determined by the tests on Bands 5 and 6, with the amplifier set to stereo and with the recommended antiskating applied, start the band and stand equidistant from the two speakers. At some level the cartridge will mistrack, which will be evidenced by a buzz. As in the cartridge-tracking test of Side One, make sure that the buzz you hear is not coming from some object in the room.

If the buzz is heard first on the right channel (the outer wall of the groove), this means that there is too little (or no) antiskating force applied. In that case, *increase* the antiskating force until the buzz occurs simultaneously in both channels. The skating effect, which causes the arm to tend to swing toward the center of the record, will underload the outer wall of the groove, causing a buzz in the right channel as the stylus loses contact with the outer wall.

Conversely, if the buzz occurs first on the left side, there is excessive antiskating force. Reduce it until the buzz occurs simultaneously on both channels. Note that when one channel only is buzzing, the buzz rate is just half as much as when both channels buzz.

If you don't get any buzz at all the first time through, reduce tracking force until a buzz *is* heard in the final loudest section. By checking back and forth between the skating-force adjustment on this band and the tracking-force adjustment on Bands 5 and 6 on Side One you can achieve the lowest possible tracking force capable of providing optimum performance.

Don't be surprised if you get a left-channel buzz first, without antiskating force applied. There are a number of possible causes for this: a physical bias in the pole-piece/armature relation of a highly compliant pickup, an off-level turntable, an unbalanced tone arm, or tone-arm leads that inhibit free movement of the arm. Note that bias requirement as indicated by this test may not exactly match any of those recommended by the manufacturer of the turntable, since he is not able to take into account the specific characteristics of the phono cartridge used.

Radial-tracking tone arms such as those offered by a few manufacturers theoretically require no skating-force compensation and provide for none. However, should this test reveal a channel imbalance in tracking ability (for any of the above reasons) when a radial-tracking arm is used, a slight increase in tracking force will often reduce the imbalance to negligibility.

Band 10—1,000-Hz reference tones (oscilloscope)

You can use these four tones to determine the groove velocity of any recording by using the comparison method. The velocities of the references increase in 3-dB steps.

First tone	2.0 cm/sec
Second	2.8 cm/sec
Third	3.9 cm/sec
Fourth	5.5 cm/sec

Connect the vertical-input terminals of the scope across either the right- or left-channel speaker output on your system set to mono. Use one or more of the reference tones to calibrate the height of the scope pattern. Measure the height of the unknown signal using the units established by the reference tones.

Important: You must defeat the RIAA equalization in your system if the unknown signal is anything other than a 1,000-Hz sine wave. Use a microphone input, for example, which will not be equalized. Reasonably accurate results can also be achieved on a normal RIAA equalized phono input by setting the bass control to full cut and the treble control to full boost.

Locked groove: The pickup must be moved by hand to Band 11.

Band 11—3,150-Hz tone for flutter and speed tests (flutter and/or frequency meter)

This tone can be used with a flutter meter to measure turntable flutter or with a frequency meter to measure turntable speed. Do not conclude that you have too much flutter if you can hear it on the 3,150-Hz tone. A low level of flutter that will be audible in a 3,150-Hz sine wave will not necessarily be audible in music. The flutter test in Band 9 on Side One will indicate the audible effect of a turntable's flutter on music.

Many factors affect the audibility of flutter, but as a rough guide, a weighted flutter figure of about 0.08 per cent will be just audible on slow piano and oboe music. It takes considerably more flutter (often two or three times as much) to be apparent on fast music, voice, and most other instruments.

Note: An off-center record will produce a strong once-per-revolution flutter or wow. Side-to-side motion of the tone arm when the record is playing indicates that the record hole is off-center. A warped record that moves the tone arm up and down similarly affects the measurements.

The 3,150-Hz frequency is the standarized test frequency for flutter, and many test instruments today are set up especially to make use of this frequency.

Band 12—Test for stereo spread

The test is designed to determine whether or not your system can achieve a good stereo effect or "image". Properly recorded stereo sound should provide sharp and accurate localization of individual instruments and voices, at the same time maintaining a plausible *panorama* of these individual sound sources, so that the orchestra or band members seem evenly distributed across the stereo "stage," with no sonic discontinuities or bunchings together. In other words, you should perceive the performers arrayed before you as on a concert stage.

To employ this test, sit or stand in your normal listening location. Set your amplifier to stereo and turn down both the treble and bass controls slightly. The sounds are gun shots recorded out of doors. First there are four shots, in two groups of two each, exactly centered between the speakers. If the first four shots are not centered, recheck speaker phasing and then set the channel-balance control for proper centering.

The next group of two shots should be at the far right; then two at middle right; two at near right; two at center. Then there are two at near left, two at middle left, and two at far left.

If *all* the right-of-center shots are heard close to the right speaker, and *all* left-of-center shots are near the left speaker, the speakers are too far apart. If, at the other extreme, *all* the shots come from the center or from a narrow area near the center, your speakers are too close together or your system has inadequate separation. (Make sure that your amplifier is set for stereo, not mono, if the shots all come from the center.)

Keep in mind that, even if your system is set up for a continuous, well-distributed stereo image, any given stereo recording may itself lack properly balanced sound. Another factor that will influence stereo spread and separation is the "liveness" of your listening room. A room with lots of hard reflective surfaces and sparse furnishings will, in general, permit less separation to be heard than a room with heavy drapes, rugs, and over-stuffed furniture.

Note: It is sometimes interesting to try this test with four-channel systems employing matrix decoders in their "stereo enhancement" mode. The result will often be an even distribution of gunshot sources from left rear (or left side) to right rear (or right side). However, matrix decoders differ in their operational parameters, and failure to achieve this smooth left-rear to center-front to right-rear progression of sound should not be interpreted as a fault in the decoder, provided that the system performs correctly when operating in stereo mode.


STEREO TEST RECORD
for home and laboratory use