

harman/kardon

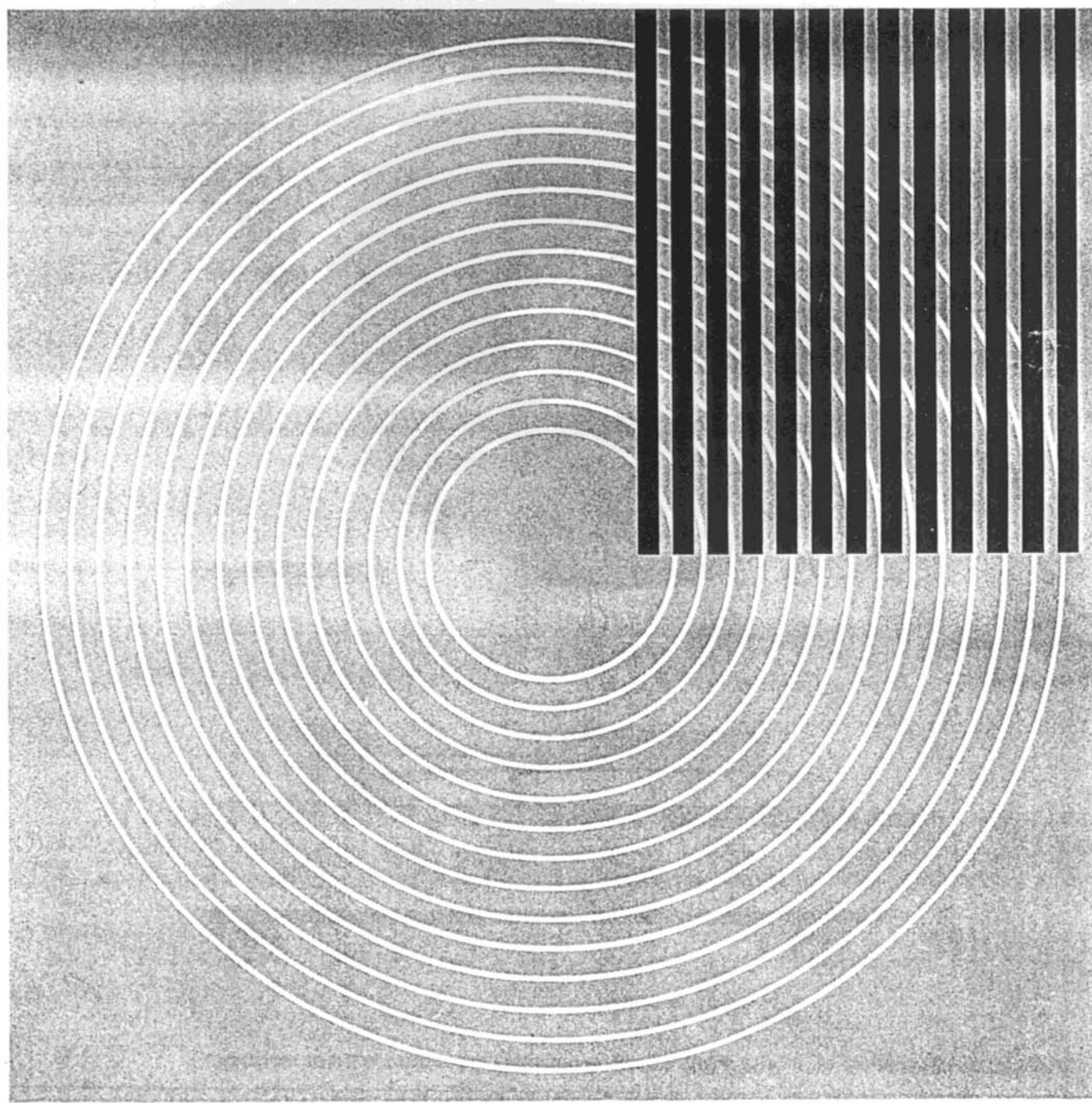
Rabco ST-7

straight line tracking system
owner's manual

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Specifications

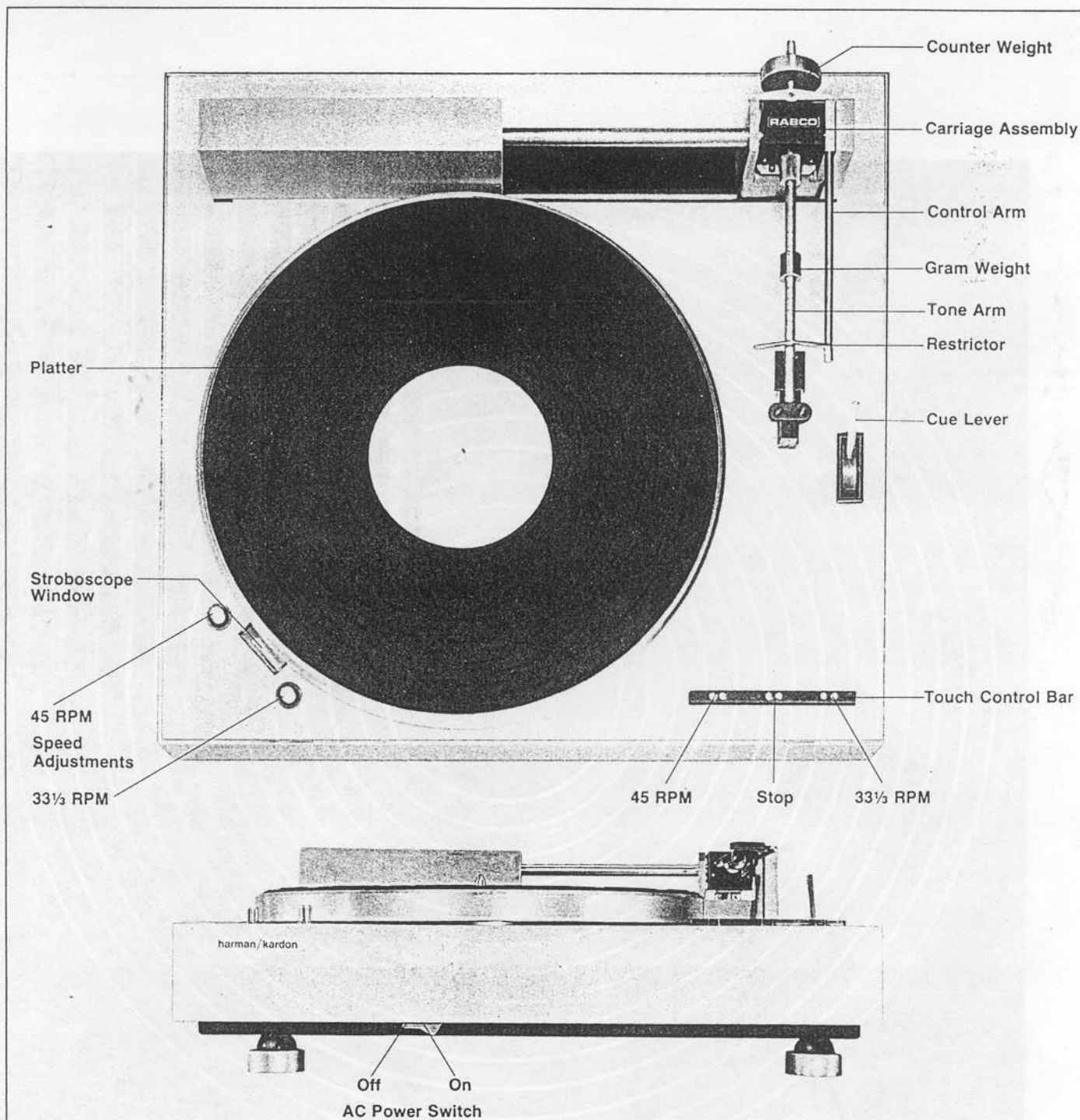
Figure 1: General view of ST-7 system



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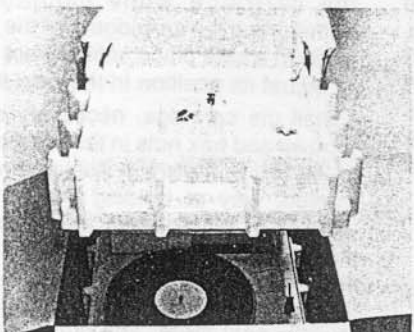
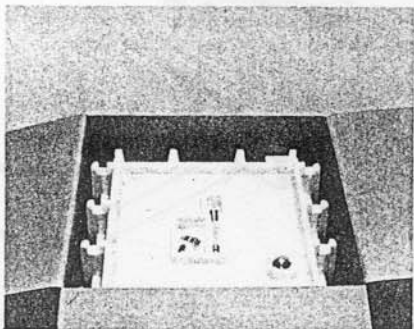
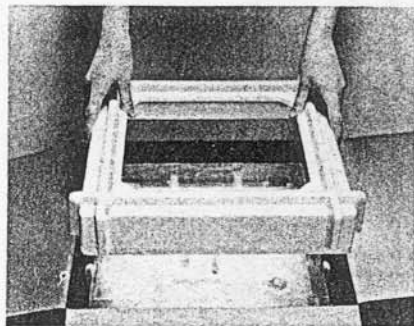
Figure 1 General view of ST-7 turntable



Warning: To prevent fire or shock hazard, do not expose this appliance to rain or moisture.

Unpacking

Your ST-7 turntable is a high precision machine which has been most carefully assembled and adjusted to bring you the highest standard of disc reproduction possible within the state of the art today. Our packaging system has been custom designed to preserve this precision and to afford the ST-7 the protection it deserves in shipment between our facility and your listening room. It is recommended that you retain the carton and frames when your installation is completed so the ST-7 may be moved or shipped with adequate protection.



Having opened the top of the ST-7 carton, you have found the owner's manual and other instructional literature. Looking into the carton, the top poly-foam packing frame and clear plexiglass dust cover may be seen. Grasp the upper part of the top packing frame with both hands and lift straight up to remove it from the carton. Remove the plexiglass dust cover.

Small parts such as the tone arm assembly, counterweight, cartridge locating gauge, screwdriver and hardware are packed in compartments on the top of the next packing frame. The spindle adapter for records with 1 1/2 inch (38 mm) center hole is packed in place on the platter. It is suggested that these components be left in place until actually needed to prevent their being damaged or lost.

Lift the upper packing shell straight up to remove it from the carton. The ST-7 turntable is now visible. Grasp both the metal ST-7 housing and the lower packing frame on both sides. Carefully lift both together from the carton and put them down on a firm supporting surface. Tilt the frame backwards so that one hand can reach beneath it to push the ST-7 housing up, partially freeing it from the frame. Since the ST-7 housing is completely enclosed you need not be concerned about the chance of putting your fingers into any of the mechanisms.

Work your hands to both sides of the ST-7 housing and lift it free of the frame. The power and output signal cables will follow.

Remove the protective plastic film wrap from the ST-7 and place the turntable in the location reserved for it in your system. If this location is crowded for space, you may prefer to continue with the installation of the cartridge and tone arm and preliminary adjustments in a more open work area.

Remove the two cardboard shims protruding from under the platter so that it can freely rotate.

Remove packing shim which secures the rolamite bearing and disengages the carriage tracking mechanism. Move the cue lever to the rear when you have removed this shim.

Note: The carriage assembly is designed to move only with the cue lever moved to its rear (stylus up) position. Do not attempt to move the carriage with the lever forward. Forcing of the carriage would be abusive to its tracking mechanism. It is suggested that you defer moving the carriage until you have carefully reviewed the manual sections covering assembly, use and description.

Before proceeding with the connection of the ST-7, there is one other item that you should take care of. Since you have just purchased the unit, you should still have the **bill of sale**. Make sure it is clearly marked showing the date of purchase. Now look on the bottom of the ST-7 and locate the serial number. Record this number on the bill of sale and then put it away in a safe place for future reference. This number will be important if your unit requires warranty service. It may also prove a useful identification if your unit becomes subject to theft. Also remember to fill out and mail in your registration card.

Assembly

Cartridge and Tone Arm Assembly

The ST-7 tone arm accepts cartridges which have a mounting hole center spacing of 1/2 inch (12.7mm) and a weight of 10 grams or less. Because cartridges differ in height, a set of shims and a gauge have been provided. This mounting technique establishes the proper attitude of the stylus relative to the plane of the disc grooves.

An adjustment and gauge are provided for setting the position of the stylus along the length of the tone arm. The stylus is positioned to travel along a radius of the platter, tangent to the grooves.

The tone arm includes a balance weight calibrated in grams for setting the tracking force as specified by the manufacturer of your cartridge.

Tracking angle, position and force adjustments are critical to achieve the superb performance possible with the ST-7. Use great care in making these adjustments.

Mounting the Cartridge in the Tone Arm Assembly

The tone arm assembly, shim set, gauge and hardware were packed in the upper shell of the polyfoam packing frame. Unpack and identify these items with the aid of **Figure 2**.

The cartridge gauge serves a dual purpose. First, its use will assist you in identifying the spacers (shims) you will need to set your cartridge at the proper height when it is finally installed. At this height, the stylus in the cartridge will assume the correct tracking angle (nominally 15°) for accurate playback of your discs.

Second, the gauge will help you adjust the position of your cartridge so its stylus will follow the correct straight line path across your discs.

Place the gauge on a smooth flat surface as illustrated in **Figure 4**. Place the flat mounting area (top side) of your cartridge on the smooth surface next to

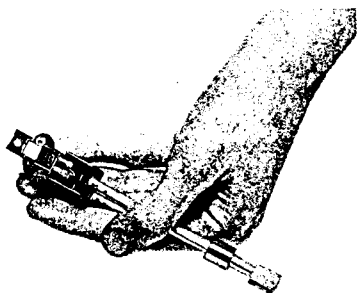
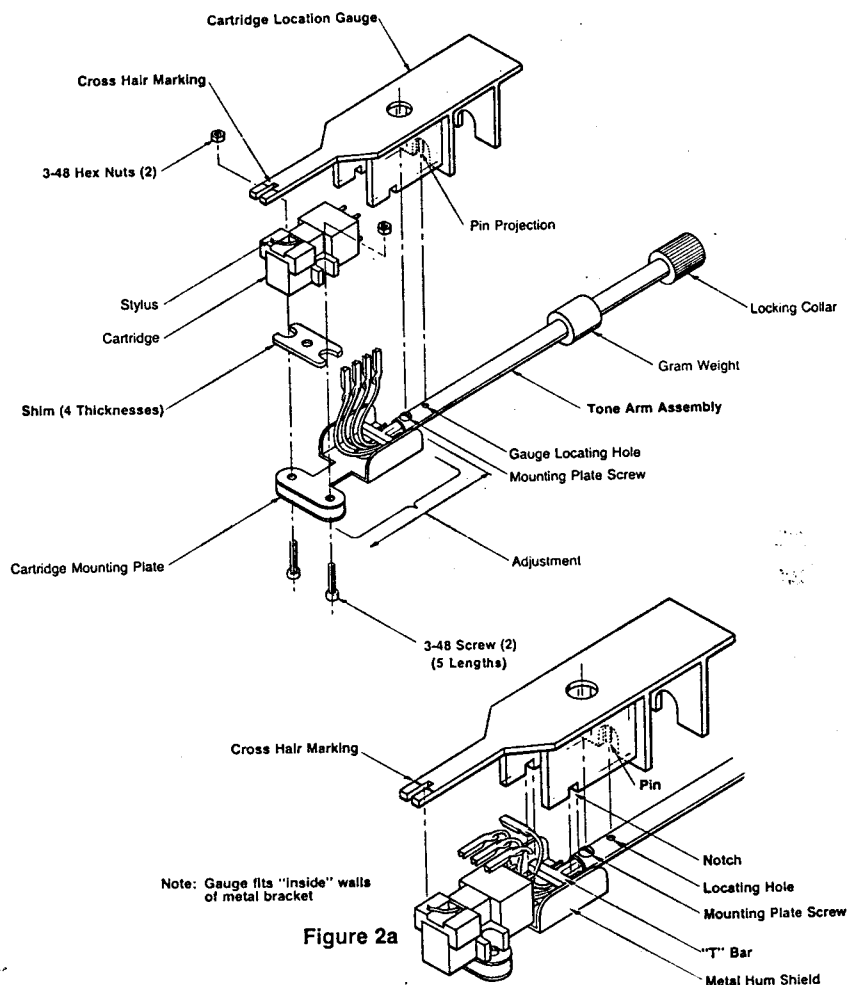


Figure 3 Correct hand position for holding tone arm during cartridge installation

Figure 2 Inverted view of the tone arm assembly, cartridge and location gauge



the gauge; its stylus should be facing upward. Carefully move the cartridge under the reference tab of the gauge. **(Caution: If the stylus does not fit easily under the tab, DO NOT force it there. Such a cartridge does not require shims so you may proceed to install the cartridge as explained below.)**

Shimming the Cartridge

In most cases there will be a space between the tip of the stylus and the lower surface of the reference tab of the gauge. Four (4) shims of different thickness are provided to offset the space. One of the shims will normally be the correct thickness for your cartridge but you may find it necessary to combine two shims to more accurately fill the space. **Figures 4a and 4b** offer a simple and accurate method of determining which shim(s) to use. While making this determination, **be very careful to avoid damage to the stylus.**

If convenient, remove the stylus from the cartridge while mounting or demounting the cartridge. Put the stylus aside in a safe place until you are ready to adjust its position in the next step.

Install the cartridge, necessary shims, screws and hex nuts in the order shown in **Figure 2**. **Figure 3** illustrates a convenient way of holding the mounting screws in place when the shims and cartridges are being mounted. Use the shortest screws that will hold the cartridge, and spin the hex nuts by hand to quickly seat them. The nuts should be snug at this point **but only finger tight.**

NOTE: Some cartridges will project back into the shroud. A limited few of these will be too wide to fit in the shroud. In these cases you should obtain a wide-shroud tone arm from your local dealer or the factory, part number CH-7W.

The next step is the final adjustment of the cartridge position and may require some reorientation of the cartridge.

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Addition of Note

NOTE

If you find the cue lever can not be easily moved to its fully forward position, it is possible that the lift gears have become engaged during shipment. To correct this condition:

1. Plug in unit.
2. Turn main power switch on.
3. Touch the control at the right end of the Touch Control bar (33-1/3 RPM).
4. Allow unit to run about 20 seconds.
5. Unit will shut off and red light will activate. Tone arm balancing can now be completed.

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Addition of Tracking Adjustment

TRACKING ADJUSTMENT

A tracking adjustment (Figure 6A) has been provided back of the carriage assembly. It has been preset at the factory and should not require adjustment. However, to ensure the most precise operation of the ST-7 in your home the following checkout procedure may be used.

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TRACKING ADJUSTMENT (cont.)

Energize your ST-7, and lower the tone arm on to a record turning at 33-1/3 RPM. Allow the arm to travel about one inch on the record. Observe if the tone arm remains lined up with the notch in the restrictor arm (Figure 6 of existing manual) as it moves across the record. If the arm leads or lags the restrictor arm notch, adjustment is necessary.

If the arm is leading, turn the adjustment handle (Figure 6A) slightly clockwise (as viewed from the rear). If it is lagging, turn the handle slightly counterclockwise. After adjusting, the tone arm should remain closely lined up with the restrictor arm notch as it tracks across a complete record.

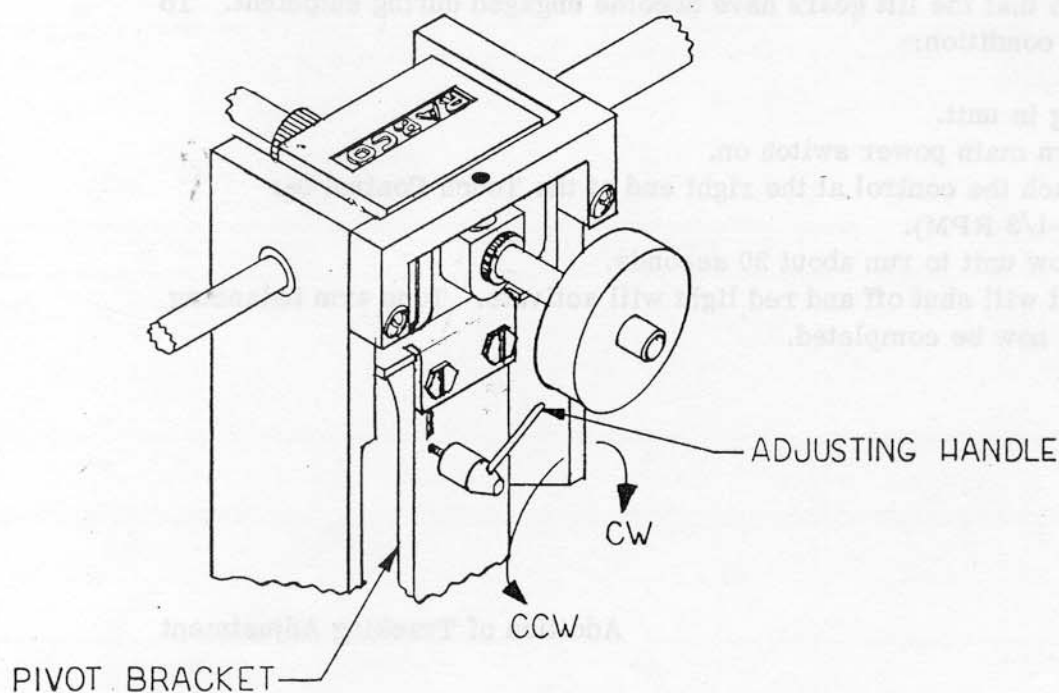


FIGURE 6A TRACKING ADJUSTMENT

TRACKING ADJUSTMENT
ADDENDUM/OWNERS MANUAL
91532075-B

Arm Length Adjustment

The ST-7 arm is designed to allow changes in its length to permit positioning of the cartridge so its stylus is located at precisely the correct point for accurate tangential tracking. Place the cartridge gauge on the arm as illustrated in **Figure 2a**. Note that the cartridge wires are dressed forward so as not to be in the way. The gauge should fit within the walls of the metal hum shield. The notch in the gauge fits over the black "T" bar, while the locating pin in the gauge fits in the corresponding hole in the tubular arm.

When fully seated on the arm, the stylus should be visible in the front slot of the gauge. Holding the back of the tone arm in your left hand, grasp the outside of the metal hum shield and slide the entire assembly forward or back until the tip of the stylus is lined up with the cross hair marking on the tip of the gauge. If you encounter excessive resistance, loosen the cartridge mounting screws slightly.

When this condition has been satisfied, tighten the mounting plate screw (access is provided through the large hole in the top of the gauge) and the two (2) cartridge retaining screws to lock your adjustment. **Important: Do not overtighten.** Remove the cartridge gauge being careful not to damage the stylus in the process.

Connecting the Signal Lead Wires to the Cartridge

Connect the cable lugs from the tone arm to the appropriate posts on your cartridge. The leads (wires) to the lugs are color coded, as shown in table. Use extreme care as these leads are very

delicate. The use of tweezers or long nose pliers will make connection easier.

Note: The cartridge manufacturer may use a different color code or other marking system for channel identification. Consult the instructions supplied with your cartridge for this information.

COLOR CODE		
ST-7 Tone Arm Connections		
	LEFT CHANNEL	RIGHT CHANNEL
Signal	White	Red
Ground	Black	Green

Mounting of the Tone Arm in the Carriage

The carriage, in conjunction with the cue lever mechanism, contains provision for engaging the tracking motion as well as elevation and lowering of the tone arm. With the cue lever pushed away from you, (the stylus is raised and the tracking roller is lifted from the rotating tracking shaft) side to side positioning is possible. Handle by the control arm only **not the tone arm** for positioning. With the cue lever forward, the tracking mechanism is engaged and the tone arm gently lowers.

With the ST-7 facing you, move the cue lever away from you to the rear (stylus raised) and position the carriage assembly at the right end of its travel.

Holding the tone arm with the cartridge end toward you, slide the gram weight and mounting collar toward you. The black connector is now exposed; notice the keying rib on the connector. The keying rib serves to align the tone arm and stylus.

Hold the counterweight shaft firmly to prevent the rolamite bearing from twisting during installation of the tone arm. Make sure that when you push the tone arm into its socket, the bearing is not forced to the rear and the nameplate cover does not become loosened.

Refer to **Figure 5**. Move the cue lever toward you. Introduce the tone arm under its restrictor. With the key rib up, gently push the arm into its keyed socket all the way until the flange ring seats against its stop. Secure the tone arm by screwing on the locking collar (clockwise). **Gently hand tighten only.** Hold the tone arm as you tighten the collar, making sure that the cartridge remains vertically straight. Return the cue lever to the rear.

Note: Additional tone arm assemblies are available through your dealer (Harman/Kardon Part Number CH-7), so that you can use more than one cartridge without having to gauge and remount for each.

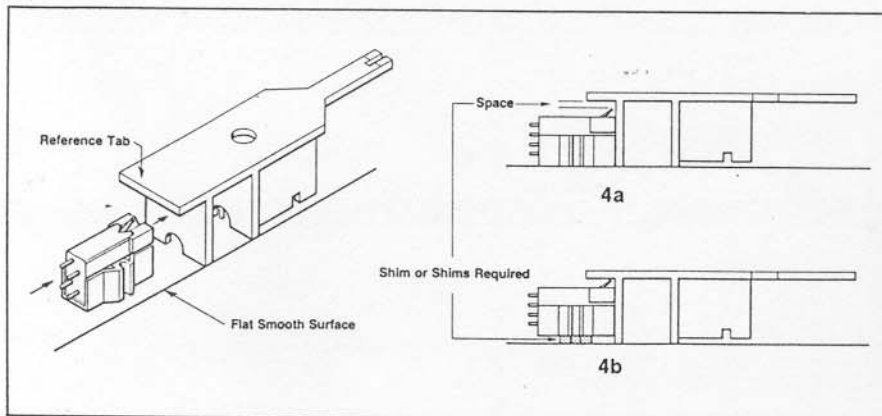


Figure 4 Selection of shim for cartridge mounting

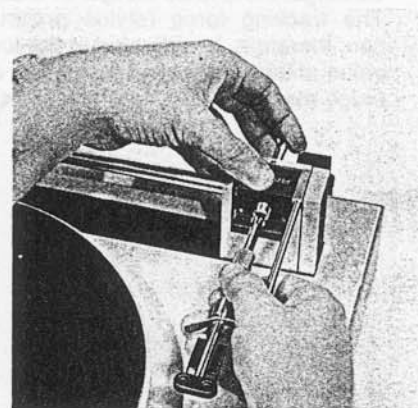
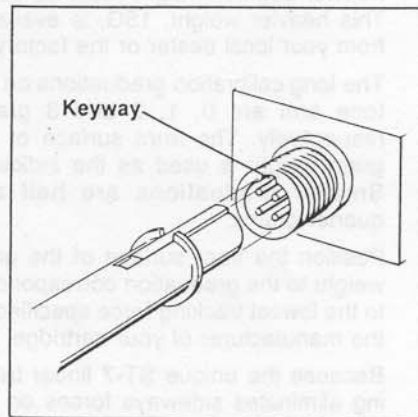


Figure 5 Insertion of tone arm connector into carriage receptacle

How to Calibrate the Tone Arm Balancing System for Your Cartridge

In order to accommodate variations in cartridges, your ST-7 includes provision for accurate calibration of the tracking force adjustment. This feature ensures that you can establish the proper tracking for your cartridge as specified by its manufacturer.

Set the gram weight so that its front surface lines up with the first graduation on the tone arm (0 grams). This is the rear-most graduation.

Locate and identify the counterweight which was also packed on the polyfoam packing frame. Slip the weight onto the shaft protruding to the rear of the carriage. If you encounter difficulty, lubricate the shaft by moistening its end with a drop of water (Figure 6).

For precise positioning of the counterbalance weight push or pull with a rotating motion. Adjust the position of the counterbalance weight along its shaft so that with the cue lever forward, the arm neither falls nor returns to its rest position. It may be necessary to gently tap the cartridge downward with your finger to perform this test. Return the cue lever to the rear (stylus raised) position.

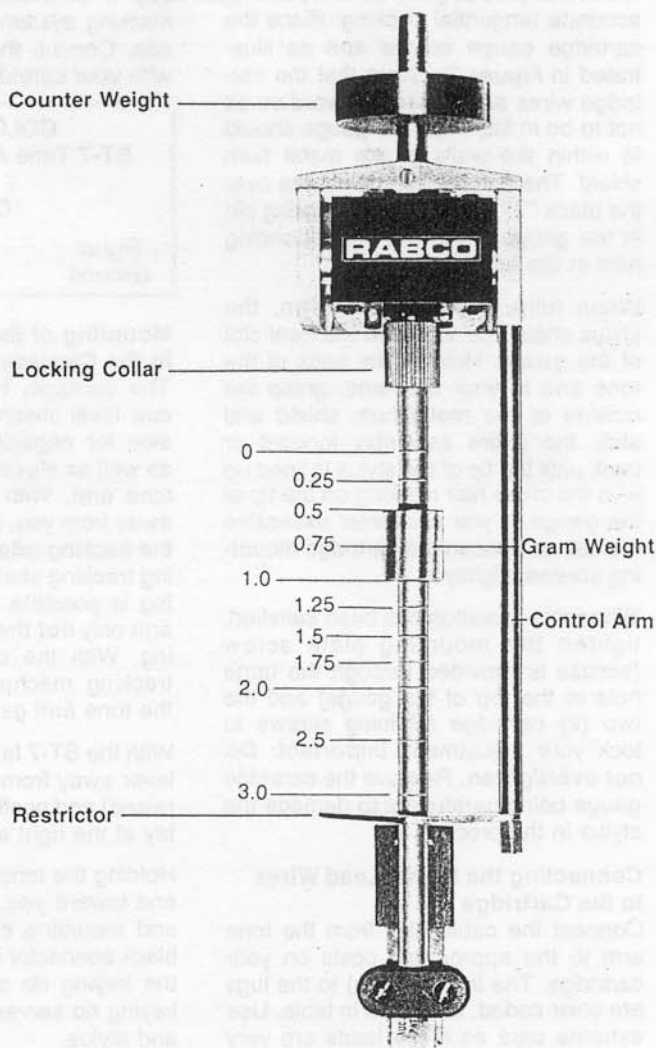
NOTE: If it is not possible to balance the tone arm your cartridge probably weighs from 10 to 15 grams, and a heavier counter weight must be used. This heavier weight, 15G, is available from your local dealer or the factory.

The long calibration graduations on the tone arm are 0, 1, 2 and 3 grams respectively. The front surface of the gram weight is used as the indicator. Smaller graduations are half and quarter grams.

Position the front surface of the gram weight to the graduation corresponding to the lowest tracking force specified by the manufacturer of your cartridge.

Because the unique ST-7 linear tracking eliminates sideways forces on the cartridge, there is no danger of skating. The tracking force (stylus pressure) can, therefore, be adjusted to the lower value of the range specified by the cartridge manufacturer.

Figure 6 Details of tone arm adjustments



Installation of the Dust Cover

The dust cover mounts to the two hinge assemblies located at the rear of the ST-7 case. Observe the two brackets located at the bottom rear of the cover.

With the cover approximately closed, rest the brackets on the hinges so that the posts of the hinges line up with the slots of the brackets.

Lift the front of the cover as if to open. When the brackets align with the angle of the hinges, the cover will seat itself.

The maximum overall height of the ST-7 with the dust cover fully opened is 18½ inches (47 cm).

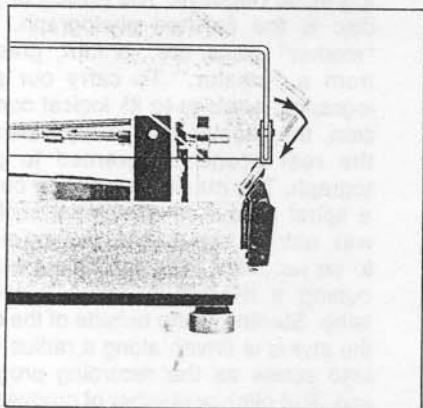


Figure 7 Attachment of dust cover

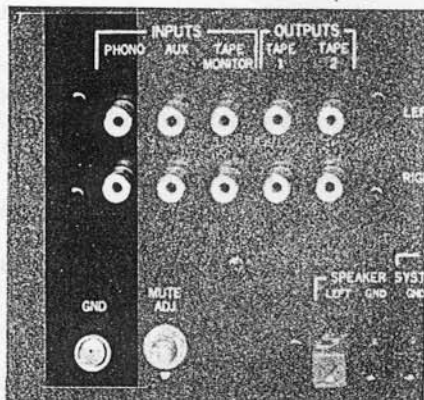


Figure 8 Typical amplifier input connections

Selecting the Best Location for Your ST-7

Your ST-7 turntable is now ready to be placed in its playing location. The unit should be placed on a firm, **level** surface. The unique combination of tangential tracking and floating type case supports eliminate the need for complex leveling devices and vibration isolation. Nevertheless, reasonable care should be exercised to choose a location which will be best for the turntable. This location should be clean, **level** and as vibration-free as possible.

Store the cartridge location gauge, excess hardware and spindle adaptor in a convenient safe place for future use.

Electrical Connections

Two electrical cables originate from the underside of the ST-7 case. These are the signal output cable (gray) and the AC power linecord (black). The signal output cable contains two shielded signal cables and an unshielded ground (earth) lead.

Two pin type RCA connectors and a brass spade lug are at the end of the signal output cable. The connectors are color coded for identification.

Left Channel—Black

Right Channel—Red

The wire containing the spade lug is already connected to the case ground of the ST-7.

Figure 8 shows the input connection panel of a typical amplifier.

Before connecting, make certain that your stereo receiver, preamplifier or amplifier is turned off. Locate the input connectors (receptacles) which are mounted on the back of most units. If the receptacles are other than RCA pin type, consult your dealer for a mating cable connector.

Consult the instructions furnished with your cartridge indicating which input connections of your amplifier to use. In lieu of other instructions, assuming that you have installed a high quality magnetic cartridge in your ST-7 tone arm, connect the cable pin plugs into the set of receptacles labeled Mag, Phono, Low Level Phono or Phono Input. **Do not connect** to receptacles which may be labeled Crystal, Xtal. or High Level Phono Input. Connect the Black coded plug into the Left Channel input receptacle and the Red coded plug into the Right Channel input receptacle. Firmly push the plug all the way in to seat it securely, making good electrical contact. Failure to do so will result in buzz or hum in playing.

The ground lead spade lug should be connected to the chassis ground of

your electronic unit. Many quality units provide a ground terminal for this purpose. If your unit does not have a terminal, connect the spade lug to a screw head or other unpainted metal part of the case of your unit.

Some cartridges may exhibit hum when the ground lead is connected. If this is the case with your cartridge, disconnect the lead.

If necessary to reach the connections on your unit, the molded sections of the signal cable may be separated by gently pulling apart. **Do not use the pin type plugs as handles for pulling the sections apart.**

The AC line cord may now be connected to an AC outlet (mains) receptacle. Your ST-7 line cord can be connected to a switched or unswitched receptacle if available on your amplifier. The switched receptacle, such as on the Harman/Kardon 430 Receiver, is most convenient, as the power switch on the ST-7 may be left in the On position at all times and controlled from the receiver.

Neatly coil or fold the slack remaining in the cables. Stow the cables where they will not be in the way or interfere with the mechanism of the ST-7.

Operation

With the ST-7 now connected, locate the AC power rocker switch which is placed just under the front of the case, approximately 5 inches (12.7cm) from the left edge. Power is switched **On** by depressing the Right side of the switch upwards, and **Off** by depressing the Left side. If the ST-7 power cable is connected to a switched receptacle on your electronics unit, the electronics unit must also be activated for the ST-7 to be operated.

The switched receptacle is most convenient since the power switch on the ST-7 may be left ON at all times. In this case power to the ST-7 will be controlled by the power switch of the amplifier. Turning on the amplifier will activate only the red pilot light on the Touch Control bar, the neon strobe light and the lamp in the automatic shutoff device. The current drain will be quite small since the motor will not operate unless you touch a speed selector on the Touch Control bar.

Activate the ST-7 by pressing the Right side of the power switch. Notice that two red lights are now illuminated: **At the center of the Touch Control bar, and in the stroboscope window partially under the platter at its left front.** Make sure that the turntable mat is centered on the platter.

Adjusting and Calibrating Turntable Speed

Touch the control at the *right* end of the Touch Control bar. It is necessary to touch both buttons simultaneously to activate the control. The platter will start and run at approximately 33 $\frac{1}{3}$ rpm; the Red light on the Touch Control will extinguish and be replaced by a Green light at the right end.

Look into the stroboscope window directly from above. Turn the control at the Right of the window in either direction, **Figure 9a**. Leave the control at the position where the strobe pattern is stationary. The turntable is now turning at an accurate 33 $\frac{1}{3}$ rpm.

Touch the center position of the Touch Control bar. The Green indicator will be replaced by the Red. Now touch the Left control on the Touch Control bar. The platter will now run at approximately 45 rpm. The Red light is replaced by the Blue at the left end of the bar.

Locate the Second pattern in the stroboscope window. Adjust the control to the Left of the window to calibrate the speed at 45 rpm, **Figure 9b**.

Stop the platter by touching the center control on the Touch Control bar.

The light seen in the stroboscope window is a neon lamp which flashes in synchronization with the 60 Hz (50 Hz European) AC power line. The controls adjust the motor speed by means of the current in its rotating field. The platter has a second set of strobe patterns for use with the 50 Hz power. These are blocked from view in units destined for areas using 60 Hz and vice versa.

Note: Although it is not necessary to wait for the platter to come to a stop when changing speeds, the Touch Control logic requires that the center Stop control be touched before touching the control for the new speed.

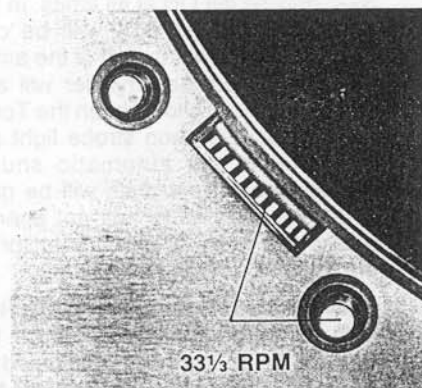


Figure 9a Stroboscopic window and speed adjustments 33 $\frac{1}{3}$ RPM.

Playing Records With The ST-7

In order that your records receive the gentlest treatment, we suggest that you put the record on with the turntable completely stopped, rather than dropping it on with the turntable in motion.

With the carriage at the Right end of its travel and the cue lever to the rear (stylus up), center your disc and lower it gently on the turntable. Use the spindle adaptor accessory with large center hole (1 $\frac{1}{2}$ inch, 38mm) records.

Touch the Right control of the Touch Control bar to start the platter at 33 $\frac{1}{3}$ rpm or the Left control at 45 rpm.

Using the rigid control arm rather than the tone arm, position the carriage so that as the cue lever is brought forward, the stylus will be gently lowered onto the lead-in groove.

Set your amplifier program selector (function switch) to Phono and adjust for desired level and balance.

All of the operations required to install your ST-7 for optimum performance have now been completed. You are now ready to enjoy the most distortion free reproduction from records that is possible.

You may at any point raise the stylus by pushing the cue lever to the rear, select another band or portion of your record and bring the lever forward to lower the stylus. Be assured that the damped mechanism will be extremely gentle to your record surface.

When the record is finished, an optical link senses that the stylus has entered the center grooves. Automatically, the cue lever will move to the rear, the stylus raise, and the motor switch off. Illumination of the Red indicator at the center of the Touch Control bar signals completion of the automatic shutoff cycle.

Use the rigid control arm to move the carriage to its extreme Right position before removing your record.

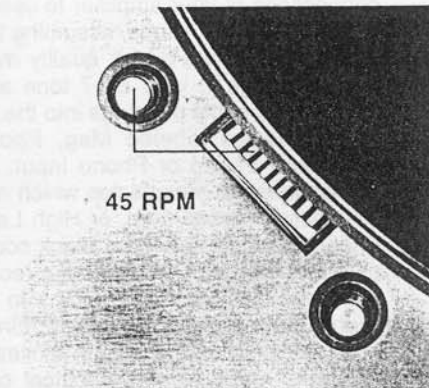


Figure 9b Stroboscopic window and speed adjustments 45 RPM.

Technical Description

Why are straight line stylus travel and tangential tracking so important?

Briefly stated, the primary features reduce distortion and also prolong record life at peak performance. These factors, combined with your sensitivity to and striving for the quality and excitement of live performance, governed your choice of components for your music system.

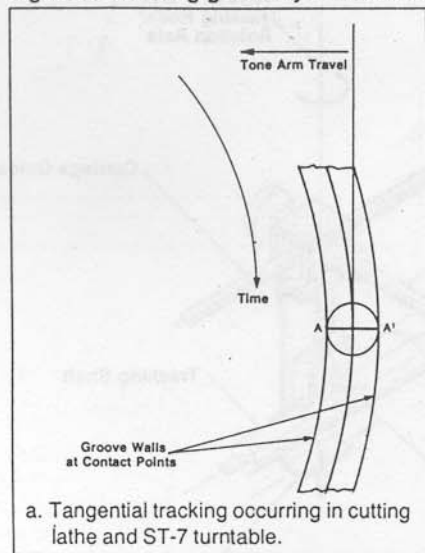
In order to explain how tangential tracking reduces music distortion, let us first consider how records are made. The discs that you purchase are pressings made from a "mother" which may be considered analogous to a photographic negative. The analog of your disc is the finished photograph. The "mother" discs are, in turn, pressed from a "master." To carry our photographic analogy to its logical conclusion, the master disc is equivalent to the real scene we wanted to photograph. The master is made by cutting a spiral groove in a material such as wax, using a stylus driven by the signal to be recorded. The machine used for cutting a master is called a cutting lathe. Starting at the outside of the disc, the stylus is driven along a radius by a lead screw as the recording progresses. The pitch or number of grooves per inch is adjusted depending on the length of material and extent of modulation to be recorded. Advanced cutting lathes use signal feedback to decrease the pitch, i.e., spread the grooves farther apart, when the signal contains higher modulation. This technique reduces cross talk between the grooves.

The master, therefore, is effectively pulled along beneath the stylus. The stylus, since it travels along a radius, is always tangent to the groove being cut.

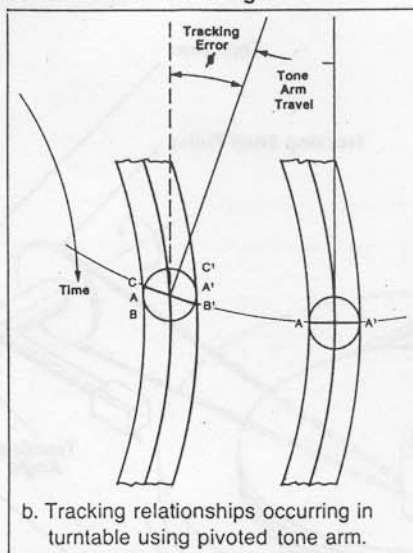
Until the advent of the ST-7, phonograph designers could contend with neither pitch variations nor actual groove locations in their attempts to faithfully track a disc recording. As the best compromise solution, a tone arm was mounted at a single pivot point. It is easy to visualize that the angle between the long horizontal axis of the cartridge relative to the tangent to the groove changes as the stylus moves from the outer to the inner groove. In order to reduce the amount of angular change in tracking, curved and articulated tone arms were made.

In order to visualize the impact of tracking angle error, refer to **Figure 10** which is a schematic of the geometric relationships of the cartridge and groove. **Figure 10a** shows the tangential tracking geometry of the cutting lathe and the ST-7. The modulation of the groove

Figure 10 Tracking geometry as a source of distortion due to tracking error



a. Tangential tracking occurring in cutting lathe and ST-7 turntable.



b. Tracking relationships occurring in turntable using pivoted tone arm.

is horizontal so that points A and A' are in phase or correspond to the same point in time in the recorded music. The cartridge is designed to optimally respond to stylus motion along the line AA' so that the tracking is ideal.

10b shows the geometrical relations existing when the tone arm is mounted to pivot about a fixed point. The tone arm travels along a circular arc so that the cartridge tracking axis is offset by an angle θ (tracking error) with respect to the tangent to the groove. Better tone arms are curved or offset to correct for tracking error, but because of the rigidity of the arm the correction can only be made for one point in the travel. The actual error typically becomes several degrees as the tone arm swings away from the point for which it was corrected. Although the stylus is physically supported at the points AA' its optimum response has shifted to direction B'C. The full impact of tracking angle distortion is shown in Figure 11.

Let us consider a numerical example to determine the magnitude of these relationships. For a 0.000,7 inch wide groove the linear displacement of the cartridge design travel is $\pm 0.000,03$ inches from the ideal AA' when θ is 5° . In the past this was not particularly bothersome since we were concerned with maximum bandwidths on the order of 10 to 20 kHz. Modern encoded quadraphonic discs require a bandwidth of almost 50 kHz to store the vast quantity of information that they contain. The wavelength of this frequency is only 0.000,2 inches for a 3 inch radius groove at $33\frac{1}{3}$ rpm. Considered in this context, the displacement due to tracking error represents a total phase difference of about $\frac{1}{3}$ wavelength at this frequency!!

When a single point pivot is used, mechanical forces are generated that tend to drive the stylus towards the center of the disc. This condition is referred to as skating. In order to prevent skating, tracking force is often increased so that the groove walls are used to hold the tone arm in place. This causes excessive wear of both records and stylus.

Why was shimming of my cartridge necessary in setting up and adjusting the ST-7?

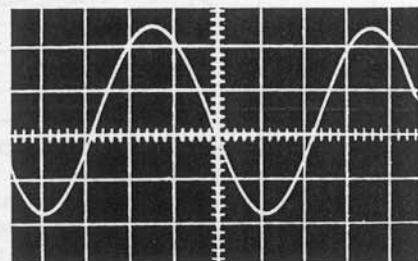
Serious audiophiles have traditionally sacrificed the convenience of automatic record changers for the improved performance of turntables. Two factors determine this improvement: gentler treatment may be given to records when individually played. Compare this to the surface abrasion experienced when one disc falls upon another in motion. Secondly and more important, the vertical angle between the stylus, cartridge and disc surface is constant.

One can easily visualize the change in angle as a stack of records grown in height on the platter of an automatic record changer. We have already considered tracking angle errors as a cause of distortion in our discussion of straight line and pivoted tone arms.

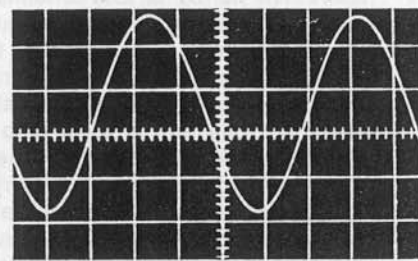
Similar considerations apply in the vertical axis so that the angle of the tone arm must be set so that groove modulation in the horizontal plane of the disc is transmitted horizontally to the cartridge. Since different manufacturer's cartridges are of different heights, we have provided shims so that you can adjust your stylus to be in proper vertical angle contact with the disc surface when the tone arm and cartridge are level.

Figure 11 Comparison between pivoted arm and ST-7 arm

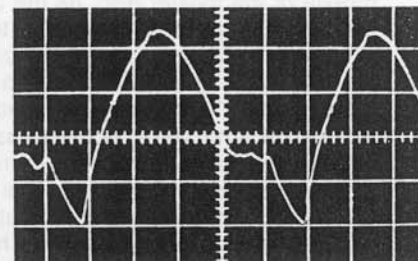
The four unretouched photographs below are of an oscilloscope presentation of a 400Hz tone recorded on a disc at 25 cm/sec. groove velocity. A high quality, high compliance cartridge was used with $1\frac{1}{2}$ grams stylus force. Anti-skating required by the pivoted arm was set at the manufacturer's recommended force.



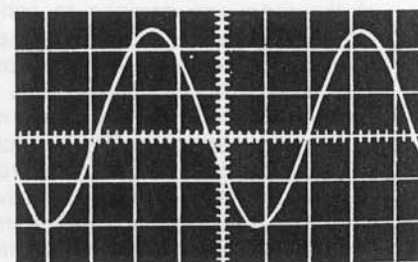
Pivoted arm 400 Hz tracing on outer groove.



ST-7 tone arm 400 Hz tracing on outer groove.

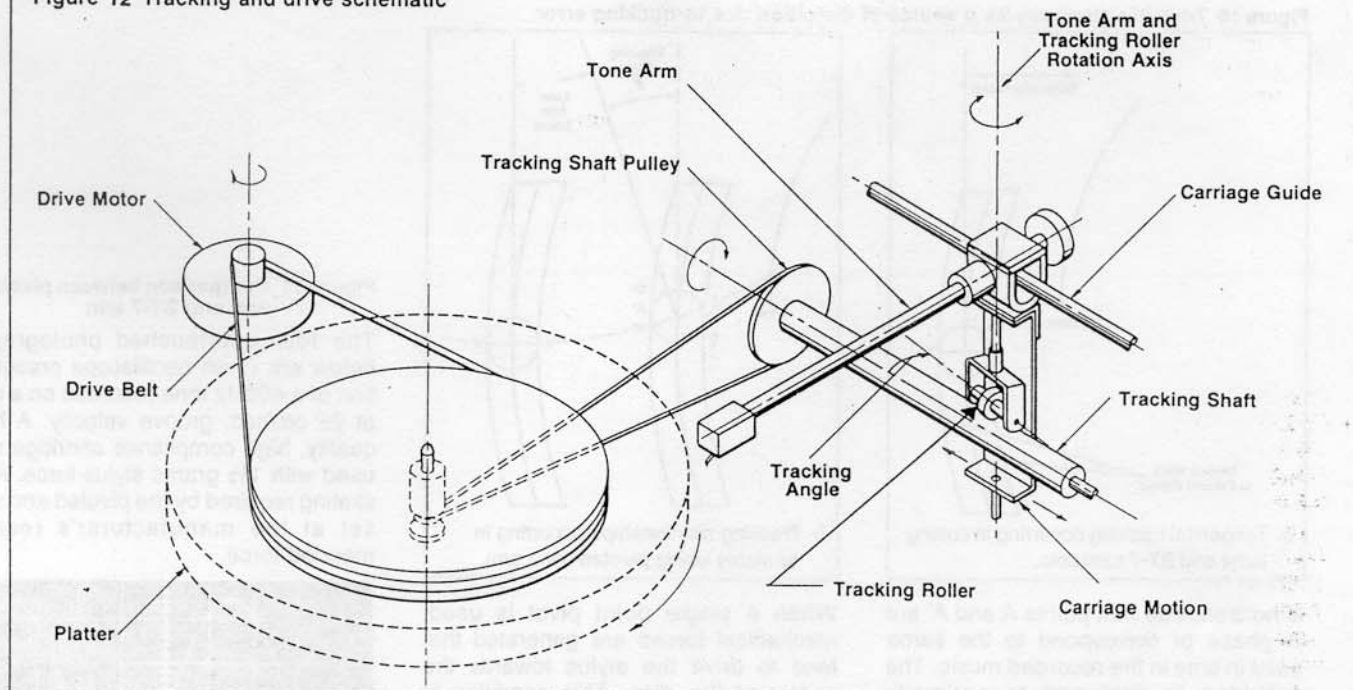


Pivoted arm 400 Hz tracing on inner groove.



ST-7 tone arm 400 Hz tracing on inner groove.

Figure 12 Tracking and drive schematic



How can the ST-7 track grooves have different or varying pitches?

The beauty of the concept of the mechanism lies in its simplicity of principle and is shown in **Figure 12**. The tone arm is supported in a two-axis gimbal mount. The horizontal axis contains the dashpot damped stylus elevation mechanism. In the vertical axis the tone arm is supported by a tracking roller which rolls against the tracking shaft. When the tone arm is tangent to the record groove the tracking wheel is biased in angle so that the carriage travels toward the platter center at approximately 0.17 inch per minute. This corresponds to the average velocity of the stylus used for cutting the groove of the master disc. As the tone arm attempts to pivot in angle to track pitch variations, the angle of the tracking roller axis changes relative to the cylinder axis. This change in direction of the tracking roller accelerates or decelerates the motion of the carriage to track the pitch of the groove. The correction is continuous, self-adjusting, and automatic. Other schemes have been designed which use optically or electrically actuated servo positioning of the tone arm carriage to achieve straight line tracking. All servo systems, however, suffer from a "dead zone" sensitivity limitation. This means that some minimum acceptable error must be exceeded to activate the correction, and that the correction must overcompensate by some amount to deactivate. Servo system correction, therefore, is unacceptable because of factors implicit to the design.

What are the implications of tracking force and compliance? How does the ST-7 tone arm design account for these factors?

Groove modulation, traced by the stylus is detected by its motion in the magnetic field of the cartridge as an electrical signal to be processed to drive your speakers. The stylus is, in effect, spring mounted in the cartridge so that when driven by the modulated groove, the cartridge body remains stationary. The art of the cartridge manufacturer is devoted to optimization of this relationship. Ideally, the stylus would be driven only by groove signal modulation. Unfortunately, however, records contain warps and eccentricities as well as signal modulation. It would be highly desirable if the stylus and cartridge would ride out these disturbances with no relative motion so that no output would be generated. Because such disturbances contain frequency components in or close to the low end of the audio spectrum, cartridges are designed to have low frequency cutoff characteristics that are as sharp as possible. Even when inaudible, such disturbances can cause severe overloading of amplifiers and speakers due to their high relative amplitude.

The need for critical mechanical tuning, therefore, is clear. The cartridge maker has designed the compliance (spring matching) of the stylus for a specific loading range. The tracking force loading acts to keep the stylus in the groove as well as maintain the spring tension within its proper operating range.

The calibration of your tone arm gram weight adjustment that you made permits you to tune this most critical adjustment with confidence.

Because the tendency of pivoted tone arms to skate is not present with tangential tracking, the tracking force can be adjusted at the low end of the specified range. Since there is sliding contact between the very hard stylus tip and the record groove, low tracking force will yield prolonged playing life of your records with minimum wear for undegraded fidelity.

What are the significant factors which determine the performance of the turntable drive system?

Flutter, wow and rumble specify the mechanical stability and quietness of a turntable. Not only must the drive train of a superior unit yield low figures in these areas when a unit is new, but it must be of a sufficiently robust and self-compensating nature to maintain its quality of performance throughout a long lifetime.

Flutter and wow describe high and low frequency fluctuations in the groove linear velocity relative to the stylus. Such fluctuations may be due to either instability in the rotational speed of the platter or record surface defects. To the listener of music, these distortions are heard as an unsteadiness or wavering of pitch.

Rumble is a low frequency noise which originates from drive motor vibration being mechanically transmitted through the platter or tone arm to the stylus.

The heart of the drive system of the ST-7 is the Brushless DC motor which uses a Hall effect generator for commutation and speed regulation.

The Hall device generates a potential between opposite edge points of a current carrying ribbon conductor in the presence of a magnetic field. The points are at equal potential when the field is removed. Our motor uses this principle to detect the position of the magnetic rotor poles and to commutate the armature windings by means of transistor controls. The Hall generator, sensing the rotor position energizes the appropriate winding to drive. When the winding is de-energized, the moving rotor induces a voltage for comparison with a regulated reference for speed regulation.

This advanced concept of control and regulation marks a breakthrough in turntable drive. This, in combination with a massive precision aluminum platter and belt drive, assures remarkably superior performance now and for years to come.

Care and Maintenance

Because of the exceptionally sophisticated level of engineering care that went into the design of your ST-7, maintenance is minimal. Occasional cleaning of the ST-7 is necessary to maintain peak operating conditions and to preserve its aesthetic appearance.

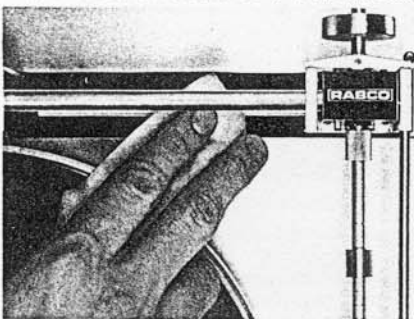
Clean the tracking shaft using a soft cloth moistened with Isopropyl rubbing alcohol. This cleaning is very important and should be performed at about monthly intervals.

Other stainless steel parts, e.g., slide, gram weight and control handle may be similarly cleaned.

We would suggest that dust be removed using the soft brush attachment of a canister type vacuum cleaner rather than a feather duster or cloth. The dust cover and case can be cleaned using a soft cloth and a household cleaner recommended for plastic.

Never use organic solvents for cleaning these parts.

We highly recommend that you do use the dust cover and that it always be kept closed when the ST-7 is not in use.



Limited 1 Year Warranty & Service Policy

We warrant this product to be free from defects in material and workmanship under normal use and service, and in accordance with the conditions set forth below. Should a defect occur within the period specified, provided that the unit is returned to either Rabco Division, Harman/Kardon Plainview or an authorized Harman/Kardon-Rabco warranty station, transportation prepaid, and which our examination shall disclose to our satisfaction to be defective, we will, for a period of one (1) year from the date of purchase, either repair or replace and install any defective parts of this product free of charge.

This warranty is not applicable to any product which shall have been repaired or altered in any way so as to, in our judgment, affect its stability or reliability; or to any product that has been subject to neglect, misuse, abuse, or accident; or which has had its serial number altered, effaced or removed. Neither shall this warranty apply to any product which has been connected other than in accordance with instructions furnished by us.

Exceptions

This warranty does not include any obligation as to the repair or replacement of the plexiglass dust cover, the phonograph cartridge and stylus or other similar accessory due to damage incurred after initial delivery, nor to any responsibility for transportation charges incurred in shipment of the defective product to or from Harman/Kardon Plainview or any of its authorized warranty stations.

The duration of implied warranties is 1 year. Our obligation under any warranty, express or implied, is limited to repair or replacement of any unit found to be defective. Under no circumstances shall we be liable for incidental or consequential damages.

Warranty Registration

To obtain service under the terms of the warranty policy, it is necessary for you to retain your **original bill of sale**. Any card or other registration device does not constitute proof of purchase nor will it be regarded as such. In the event your equipment requires service during the one-year warranty period, only presentation of your **original bill of sale** to either an authorized warranty station or the factory itself will insure your rights under the warranty policy described above.

Obtaining Service

We have a Customer Relations Department equipped to handle any questions you may have regarding the installation or operation of your unit. Feel free to correspond with us at any time. We will make every effort to give you prompt and complete advice on any inquiry.

If any problem cannot be resolved through correspondence with the factory, we may wish to refer you to an authorized warranty station in your area if we feel this is best in your situation. Similarly, we may prefer to authorize the return of your unit to the factory in Plainview, New York. Should this possibility arise, a Service Return Authorization form, and packing and shipping instructions will be mailed to you. This material will identify your unit as belonging to you during its processing through our Service Department and allow us to return it to you in the shortest possible time. This authorization form **must accompany** your unit when it is returned to us.

Under no circumstances should you ship a unit to us without prior authorization. You risk major delays in the processing of your unit and the possibility of loss of your equipment.

The Rabco ST-7 Specifications

Tracking Error:	0°
Skating Force:	0
Vertical Friction*:	0
Lateral Friction**:	0
Tone Arm Mass (effective):	6 gms.
Stylus Overhang:	0
Turntable Rumble DIN B.	-68 dB.
Wow and Flutter NAB weighted:	0.04%
DIN B.	0.09%
Hum (Tone Arm In) DIN 45544:	-76 dB.
Speeds:	33 1/3, 45 RPM. Adjustable ±5.5%
Speed Constancy:	±0.3%
Motor/Drive	Brushless D.C. (Hall effect) with precision ground belt
Platter Weight:	2.4 lbs./1.1 Kg.
Dimensions (incl. dust cover):	6 3/4" H x 16 1/2" W x 16 1/4" D 15.7 cm. H x 41.9 cm. W x 41.3 cm. D
Weight Total:	22.2 lbs./10 Kg.

*Zero vertical friction is achieved by a rolamite bearing utilizing counter-rotating metal bands which generate self-canceling forces and permit no sliding contact between moving elements.

**No relative rotation exists between stylus and driven end of tone arm.

