C/PEK-3
Instruction Manual
for
Phonograph Evaluation Kit

This Stereo Cartridge Analyzer is for use by Qualified Factory Trained personnel only.

Manufactured by

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I. INTRODUCTION

The Shure Model C/PEK-3 Phonograph Evaluation Kit is designed for use with stereo magnetic phonograph cartridges. The C/PEK-3 may also be used to test the *stereo* capabilities of discrete quadriphonic phonograph cartridges. Note that (1) the quadriphonic properties of these cartridges must be evaluated through listening tests, and (2) stylus wear may be more critical in discrete quadriphonic cartridges; moderate wear that yields acceptable stereo playback may seriously affect discrete quadriphonic playback.

II. EQUIPMENT CHECKLIST

The following equipment is necessary for the C/PEK-3:

A. C/PEK-3 Stereo Cartridge Analyzer.
B. Good quality microscope (with side or ring illumination).
C. Reference turntable with tone arm (preferably SME) and high quality Shure phono cartridge.
D. Oscilloscope with at least 150 mV/cm sensitivity.
E. Stereo amplifier with magnetic phono inputs and a pair of quality speakers.
F. At least two copies of the Shure TTR-103 and one of the TTR-109.

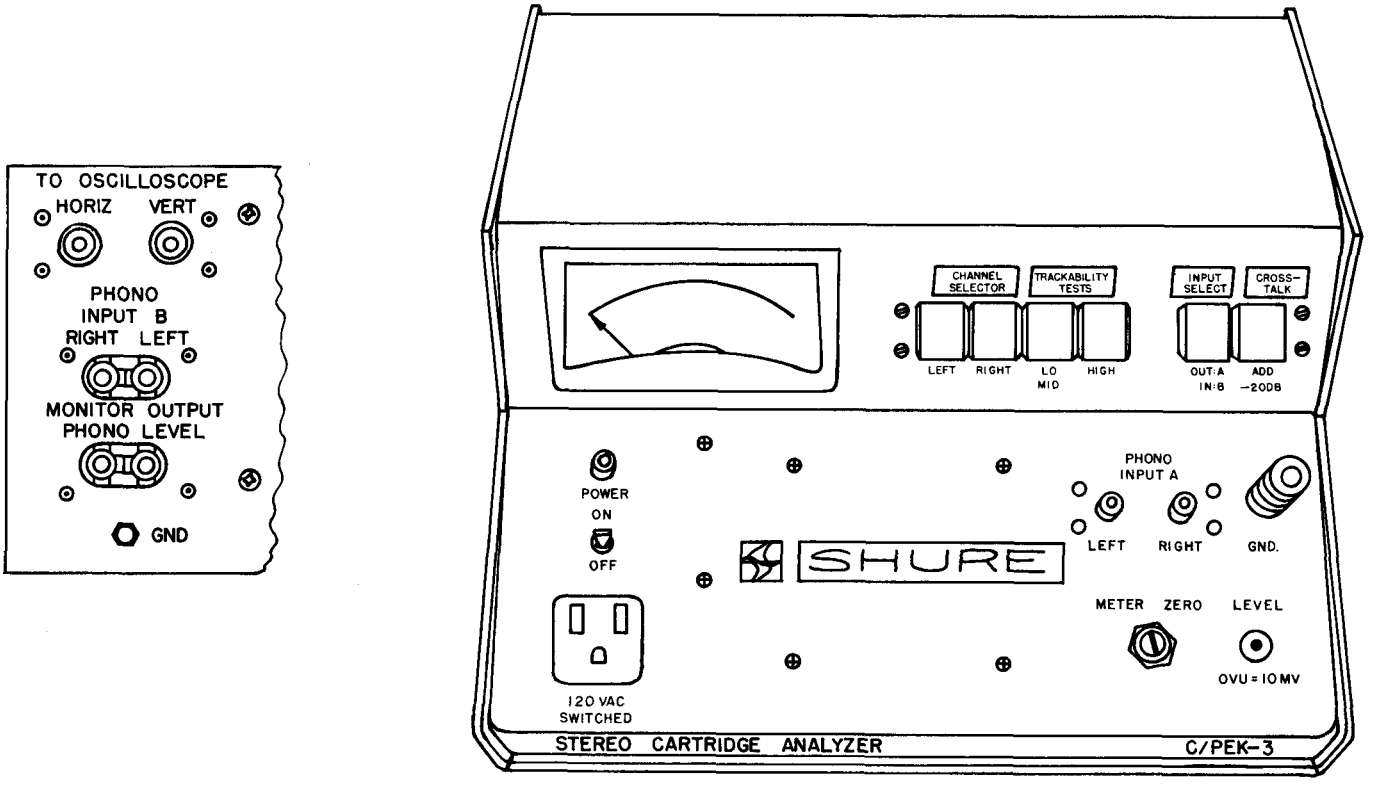
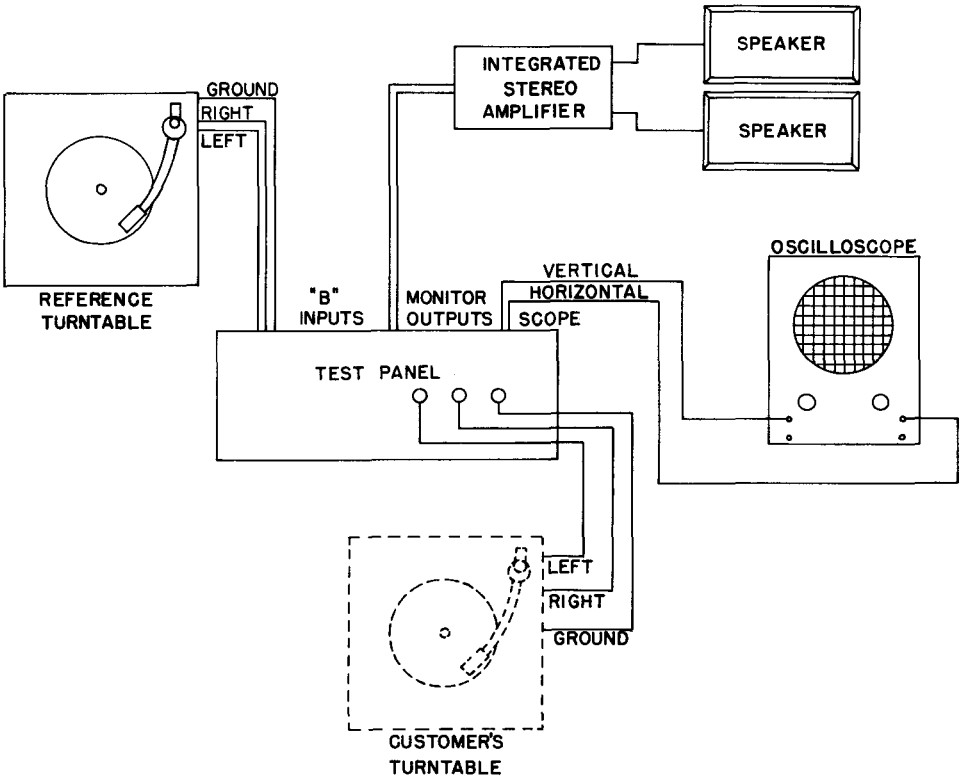


Fig. 1



III. ELECTRONIC EQUIPMENT SETUP AND CHECK

The following steps (A-H) refer to drawings (Fig. 1 and 2):

A. Connect the ground wire from the reference turntable to the binding post marked "GND" on the back of the Test Panel.
B. Plug the left channel output from the reference turntable into "B Left" on the back of the Test Panel.
C. Plug the right channel output from the reference turntable into "B Right" on the back of the test panel.
D. Plug the C/PEK-3 power cord into a 120 Vac (50-60 Hz) outlet.
E. A listening test may be performed by connecting the monitor outputs on the rear of the test panel to the magnetic phono inputs on a stereo amplifier. It is recommended that a pair of good quality speakers be used. The volume control of the stereo amplifier will control the listening volume only, and will not affect the tests.
F. Connect the "Vert" output on the back of the test panel to the vertical input of the oscilloscope.
G. Connect the "Horiz" output on the back of the test panel to the horizontal input of the oscilloscope.
H. On the oscilloscope:
   1. Set horizontal input to external.
   2. Set vertical and horizontal sensitivity to approximately 150 mV/cm.

To test the reference turntable, depress the turntable selector switch on the test panel ("In:B"), follow the test sequence, start by testing the turntable speed.

TESTING OF CUSTOMER'S SYSTEM

I. CLEANING AND INSPECTION OF THE STYLUS TIP

A. *Cleaning the Stylus*

For the stylus to trace the groove accurately, it must be clean. To clean the stylus, use a camel's-hair brush (size No. 2 or smaller), trimmed to a length no longer than ¼ inch. Dip the brush in an ethyl alcohol and distilled water solution (mixed about 50/50) and brush the stylus with a forward motion, from the rear (terminal end) of the cartridge to the front. Never brush or wipe the stylus from front to rear or from side to side. The alcohol will remove any sludge deposits which may have coated the stylus.

Note: All Shure styli may be cleaned in this way. However, for other makes of pickups, obtain manufacturer's procedure before using the alcohol solution, as permanent damage may result.

B. *Stylus Tip Inspection*

The stylus tip can be checked with a microscope having a minimum of 200X magnification, such as the Shure Stylus Evaluation Kit. The stylus should be positioned under the lens so that the bottom or record side of the tip is facing the lens. The tip must be illuminated on the two sides corresponding to the record groove walls. After focusing the image, the wear can be determined by comparing the image of the tip to the photographs (Figures 4 through 12).

Caution: A badly worn tip will drastically reduce the life of the test record, and it is not advisable to continue with the remaining tests except for the turntable speed check.

Fig. 3

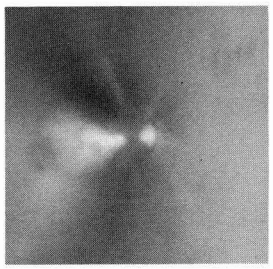


Fig. 4
New spherical stylus

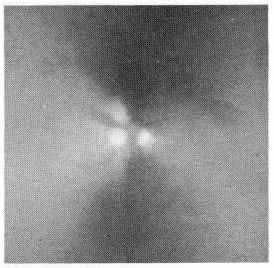


Fig. 5
Worn spherical stylus

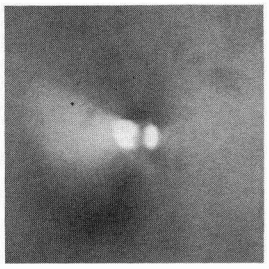


Fig. 6
Severely worn spherical stylus

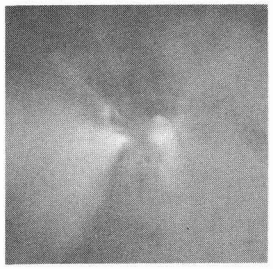


Fig. 7
New elliptical stylus

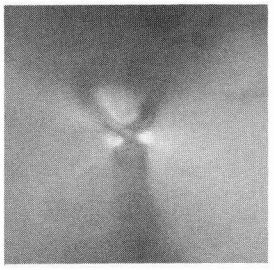


Fig. 8
Worn elliptical stylus

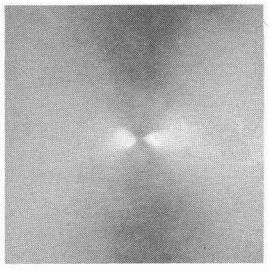


Fig. 9
Severely worn elliptical stylus

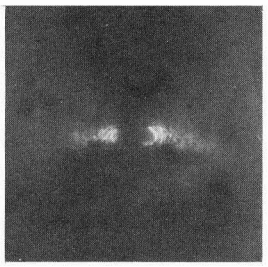


Fig. 10
New hyperbolic stylus

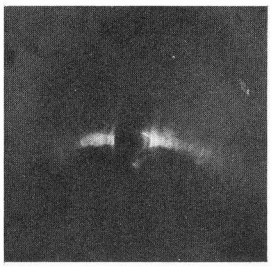


Fig. 11
Worn hyperbolic stylus

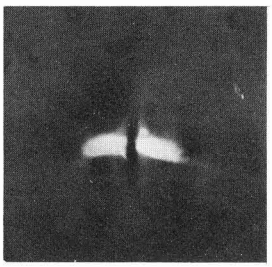


Fig. 12
Severely worn hyperbolic stylus

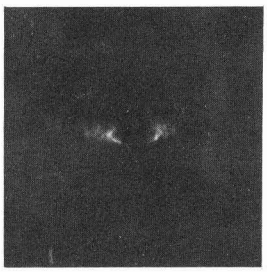


Fig. 13
New hyperelliptical stylus

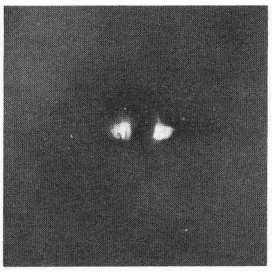


Fig. 14
Worn hyperelliptical stylus

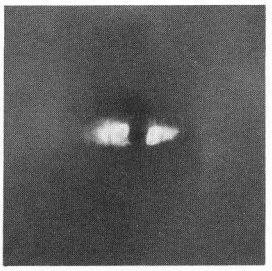


Fig. 15
Severely worn hyperelliptical stylus

II. CONNECTION OF CUSTOMER'S EQUIPMENT

A. Connect the ground wire to the binding post marked "GND" on the front of the test panel.
B. Plug the left channel output from the customer's turntable into the "left" input on the front of the test panel.
C. Plug the right channel output from the customer's turntable into the "right" input on the front of the test panel.
D. Plug the ac cord from the customer's equipment into the ac outlet on the front of the test panel.
E. Push turntable selection switch on test panel to "Out:A" position.

III. TURNTABLE SPEED

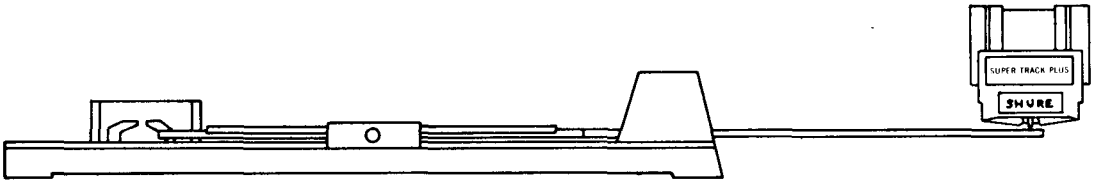
Check the turntable connections per Section II. If all connections are correct, place TTR-109 on the turntable, and set the speed to 33⅓ rpm. Using the strobe disc printed on the TTR-109 label, check the speed of the turntable at 33⅓ rpm (outer ring). Now set the turntable speed to 45 rpm, and check the speed of the turntable using the inner strobe. (Attach 50 Hz strobe label for the TTR-109 when line frequency is 50 Hz.)
ALL TRACKABILITY TESTS USING THE TTR-103 SHOULD BE PERFORMED AT 45 RPM; LEVEL AND CROSSTALK TESTS USING THE TTR-109 SHOULD BE PERFORMED AT 33⅓ RPM.

IV. TRACKING FORCE AND ANTISKATING FORCE ADJUSTMENT

A. Set the stylus tracking force adjustment on the tone arm to zero.
B. Balance the arm in accordance with instructions of the tone arm manufacturer.
C. Set the tracking force at the middle of the tracking force range stated by the cartridge manufacturer.
Example: If the suggested range is two to four grams, set the tracking force to three grams.

D. Check the actual tracking force with the Shure SFG-2 Stylus Force Gauge by placing the gauge in position on the turntable or, if the turntable is not suitably flat, on a record on the turntable. Position the stylus tip into the appropriate groove on the force gauge lever arm for the desired range: "times 1" or "times 2," then move the rider weight to balance the gauge, which indicates the actual tracking force at the stylus tip; re-adjust stylus force setting if necessary.

E. Set antiskating to the recommended value of the tone arm manufacturer.



STYLUS FORCE GAUGE

V. CHANNEL ORIENTATION, CROSSTALK, AND BALANCE TESTS

A. *Channel Orientation*

Set up equipment as shown in Section III. Place the Shure TTR-109 on the turntable. *THIS IS a 33⅓ RPM RECORD.* Set the cartridge playing conditions per Section IV. Press the "Left" button on the test panel and play Band 1, 3 or 5 for the left channel. You should observe a vertical line (Fig. 16) on the scope. Play Band 2, 4 or 6 for the right channel, and press the "Right" button on the test panel. You should observe a horizontal line (Fig. 17). If the results are reversed, the channels have been reversed. If necessary, reverse the leads from the changer so the proper orientation is obtained.

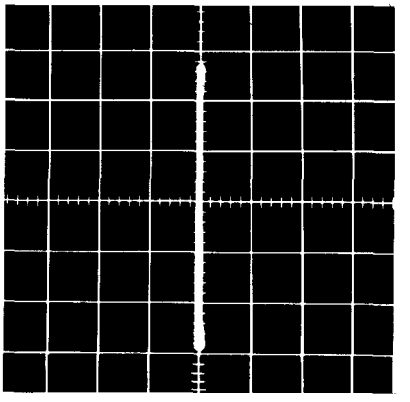


Fig. 16

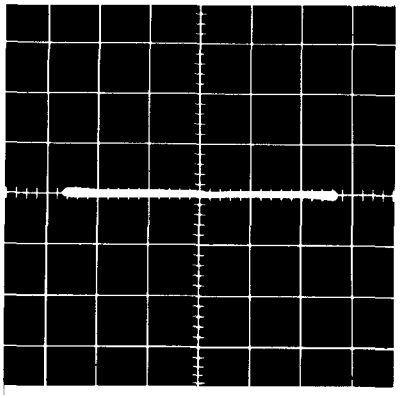


Fig. 17

B. *Crosstalk*

To measure 1 kHz crosstalk, depress the "Left" button on the test panel and play a left channel band of the TTR-109. Adjust the "Zero Adjust" control until the meter reads "0." Depress the "Crosstalk" button, and the meter will indicate the left to right crosstalk relative to a signal 20 dB below the left channel output. For example: a reading of −5 dB on the meter with the "Crosstalk" button depressed would indicate a crosstalk signal 25 dB down from the left channel output, whereas a reading of +2 dB would indicate a crosstalk signal 18 dB down from the main channel. Meaningful crosstalk measurements can be made for signals down as much as 30 dB.

The right to left channel crosstalk may be measured by repeating the above test with the "Right" button depressed and playing a right channel band of the TTR-109.

C. *Channel Balance*

To check channel balance: Press the "Left" button on the test panel and place the tone arm on a left channel band. Use the "Zero Adjust" control so the meter reads "0." Switch to the "Right" button on the test panel, and play a right channel band. The meter should read "0," ideally. The variance (in dB) should not be any greater than 2 on the meter, which is the difference between left and right channel outputs. This check may be combined with the above crosstalk test to save time and facilitate testing.

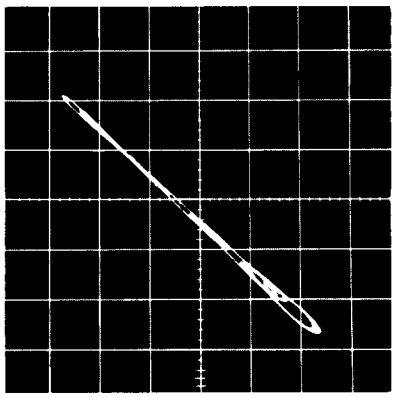


Fig. 18

To measure actual voltage output of the cartridge, play a left channel band or a right channel band of the TTR-109. Push the "Level" button on the panel. The meter will read on a linear scale in relation to the percentage of modulation (lower scale).

Example: 100% = 10 mV
50% = 5 mV
35% = 3.5 mV

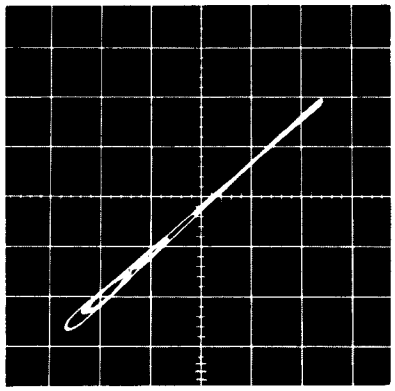


Fig. 19

VI. PHASE CHECK

Place TTR-103, Side 2 on the turntable; the *TTR-103 IS A 45 RPM RECORD.* Press the "Low/Mid" button on the test panel and play Band 5. If you observe a pattern as shown in Fig. 18, the channels are out of phase. To correct this problem, reverse the "hot" and ground leads on one channel at the pickup. Choose a channel which has no ground tab. If this malfunction is found, the customer should be advised to check the phasing of his entire stereo system by means of a test record such as the Shure "Audio Obstacle Course." Fig. 19 is the pattern observed, using Band 5, Side 2 of the TTR-103 when all equipment is set correctly and operating normally.

VII. ANTISKATING FORCE AND TRACKING FORCE EXPLANATION

A. *Antiskating Force Explanation*

When the stylus contacts the record groove, a certain amount of friction is present at the stylus tip. As the stylus tracking force increases, this friction force also increases. This force pulls along a line running through the length of the body of the pickup. The offset angle (which is used on most tone arms to reduce the lateral tracking angle error) directs this force in such a relation to the pivot point of the tone arm, as to pull the tone arm in toward the center of the record. This inward force, called skating force, unbalances the forces on the groove wall. By adding an outward pulling force, called antiskating force, to the tone arm, this force can be balanced. The stylus is then able to exert equal force on both groove walls. Since the skating force is proportional to the tracking force, any increase in the tracking force will increase the skating force and will require greater antiskating to balance it. At this time, the antiskating force should still be set to the recommended value of the manufacturer.

B. *Tracking Force Explanation*

The ability of a cartridge to track properly at low tracking force is very desirable; the wear on the record and the stylus is then kept to a minimum. However, a stylus tracking at a tracking force too light to maintain contact with the groove wall (mistracking) can cause permanent damage to the recording. Therefore, the proper adjustment of the tracking force is very important in terms of both reducing mistracking distortion and insuring maximum stylus and record life.

Any stereo pickup in good condition should be able to track Band 5, Side 2 of the TTR-103 or 15 cm/sec at the median recommended force. A high trackability cartridge should be able to track properly on Band 7 or 8 of the TTR-103 at the median tracking force recommended by the manufacturer.

VIII. ANTISKATING AND TRACKING FORCE OPTIMIZATION USING THE TRACKABILITY TEST

The trackability test on the Shure TTR-103 is divided into three sections: high frequency, mid-frequency, and low frequency. The high frequency, 10.8 kHz, pulse tracking test is recorded on both sides of the TTR-103, Bands 1 through 4; the left channel is on Side 1; the right channel is on Side 2. The mid-frequency tracking test is on Side 1, Bands 5 through 8. The test is a 1,000 + 1,500 Hz lateral cut tone. The low frequency tracking test is on Side 2, Bands 5 through 8. This test is a 400 + 4,000 Hz lateral cut tone. The low and high frequency tests have four velocities: 15, 19, 24, and 30 cm/sec. The mid-frequency test has four velocities: 20, 25, 31.5, and 40 cm/sec.

Note: *THE TTR-103 IS A 45 RPM RECORD.*

A. *High Frequency Trackability Test*

(BANDS 1, 2, 3, & 4. SIDE 1 LEFT CHANNEL)
(BANDS 1, 2, 3, & 4. SIDE 2 RIGHT CHANNEL)

Description and Interpretation of The Test Signal

The high frequency test signal consists of a group of high frequency component signals, centered at 10.8 kHz and recurring in bursts at a rate of 270 Hz. If this signal could be reproduced without any distortion, only these high frequency component signals would be detected. However, any alteration of this signal produces a detectable component signal at 270 Hz.

In a phono reproduction system, distortion results from such system non-linearities as tracing distortion, tip indentation, vertical tracking angle error, stylus dynamics, record wear, electronic signal processing and mistracking. The contributions to distortion from each of these non-linearities add and subtract from one another, yielding a total 270 Hz signal which is unique for a given set of test conditions. Although mistracking is the dominant contributor to distortion, some confusion may result as it is conceivable that one pickup might have a larger 270 Hz signal while tracking than another pickup has while mistracking.

However, the mistracking contribution to distortion is not only very large, but also is typically very unstable, and is, therefore, recognizable.

Record warps also cause instability in the 270 Hz signal, but of a different type. Warps increase and decrease the instantaneous tracking force about the set tracking force, which can cause intermittent mistracking. This type of instability is a breakup which occurs at a rate related to turntable speed, whereas mistracking results in a random instability. In the presence of a warp, the mistracking point has been reached when the breakups are occurring, on a particular band, *most of the time.*

The modulation of tracking force by a warp permits the operator to see a particular pickup's distortion both tracking and mistracking, thus eliminating the confusion due to nonlinearities other than mistracking. It also suggests the means to separate the contribution to distortion of mistracking from the other possible causes, without benefit of a warp. By checking the pickup at two different tracking forces on the same band, a large change in distortion at the lower force would indicate mistracking at the lower force. A small change in distortion may be expected at the two forces as a result of indentation, irrespective of mistracking.

Test Procedure

The C-PEK-3 displays the total 270 Hz component signal on the oscilloscope by depressing the "High" button on the test panel. Begin the test by playing Band 1, Side 1, of the TTR-103. The test must begin with the pickup tracking this band, with appropriate consideration of record warp. The display should resemble Figure 20. The tracking should be verified by checking the pickup at two tracking forces. Changing the force is easily accomplished by placing a weight on the head shell and then removing it. The weight should be about ½ gram for pickups in the ¾ to 1½ gram range, about 1 gram for pickups in the 1½ to 3 gram range, and 1½ grams for pickups in the 3 to 5 gram range. In some cases, the additional weight will increase the tracking force beyond the recommended range, but, for all Shure pickups, no damage will result during the short observation period.

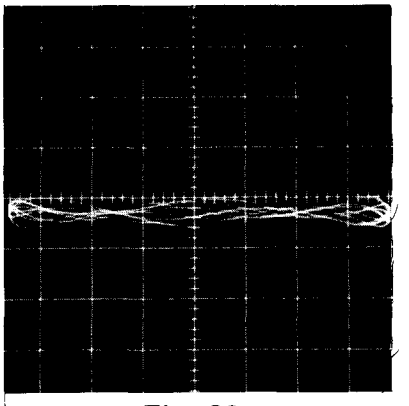


Fig. 20

Note: Under no circumstances should the tracking force be set above the recommended range *for long term use.*

The test has been designed for high quality pickups, and many pickups on the market today will not be able to track the first band, even at their maximum tracking force. These pickups are typically those with minimum tracking forces above 1½ grams. In testing such a pickup, the tracking force should be set at its maximum recommended force. If a large, unstable display is observed on Band 1 (aside from the warp effect), add a weight and, if any change is detected, the pickup is mistracking the first band. It is useless to continue with the test since the mistracking point is less than 15 cm/sec at 10.8 kHz. The customer should be advised to operate the pickup at the maximum force to minimize the damage to his records due to excessive mistracking.

Once tracking on the first band has been established, proceed through Bands 2, 3, and 4 or until mistracking occurs as shown in Figure 21.

Note: Once mistracking is observed, do not continue to play the band, as *severe record damage will result.*

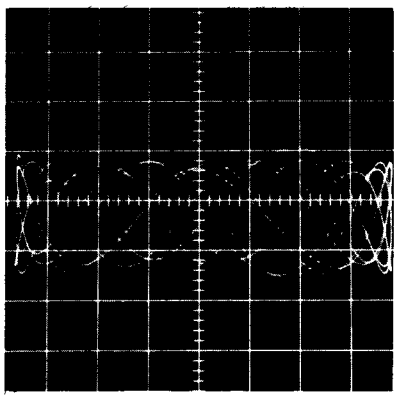


Fig. 21

Repeat the test on Side 2. The skating compensation is optimum at the desired tracking force when mistracking occurs at the same band number for each channel. The desired tracking force chosen should be the minimum tracking force at which the pickup will track 19 cm/sec on the high frequency test, 25 cm/sec on the mid-frequency test and 15 cm/sec on the low frequency test. Although some retesting may be necessary to find the optimum force, the optimum skating compensation should be set using the high frequency test and *not* changed for the mid- and low-frequency tests.

In all cases, the observation of mistracking is enhanced if the operator *listens* to the signal while watching the oscilloscope display. Mistracking sounds like a mid-frequency "buzz" while proper tracking sounds like a high frequency "whistle."

B. *Mid-Frequency Trackability Test*
(BANDS 5, 6, 7, & 8. SIDE 1 LATERAL)
The display for the mid-frequency test is obtained by depressing the "Low/Mid" button on the test panel. The display will resemble Figure 22, while the pickup is tracking. Mistracking will change the display to resemble Figure 23.

C. *Low-Frequency Trackability Test*
(BANDS 5, 6, 7, & 8. SIDE 2 LATERAL)
With the "Low/Mid" button still depressed and pickup tracking, the display will resemble Figure 24. Mistracking will change the display to resemble Figure 25.

Note: The exact display for the low- and mid-frequency tests will again depend on the particular pickup and record. Also, in the presence of a record warp, the operator must judge when the pickup is mistracking a band *most of the time.*

IX. CHECKING WEAR OF THE SHURE TTR-103 AND TTR-109

A log of usage of the TTR-103 and TTR-109 should be maintained, since a record should be used only for a limited period of time. After about 25 tests, the record should be checked by using a cartridge of known trackability. The TTR-103 should be compared to another copy of the TTR-103. The TTR-109 is identical on both sides, so one side should be compared to the other. In either case, the cartridge should exhibit the same tracking capabilities, and a similar pattern should be observed on the oscilloscope for corresponding bands on the new and used records. When a major difference is noted, a new TTR-103 should be used, or the TTR-109 should be turned to the new side. When substituting a new TTR-103 or using Side 2 of TTR-109, a new record should be ordered, so that one new copy will always be available.

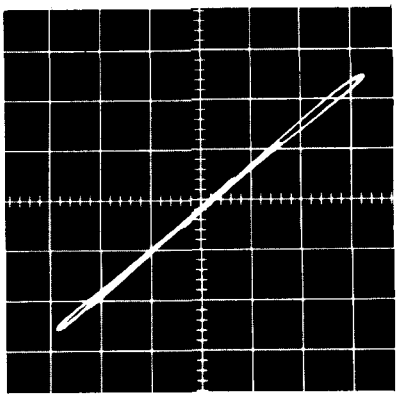


Fig. 22

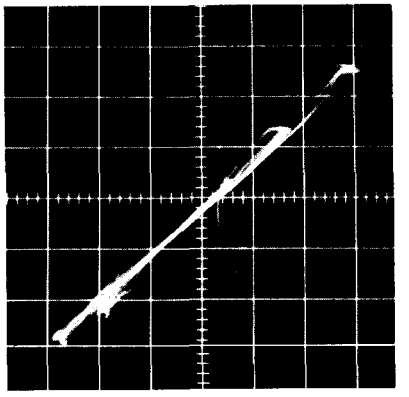


Fig. 23

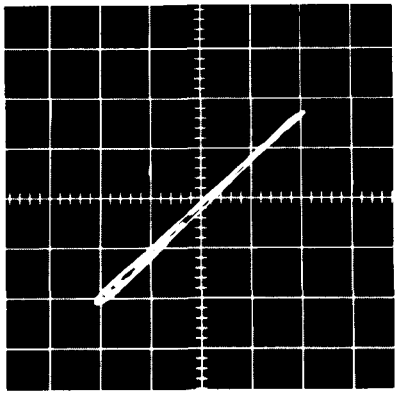


Fig. 24

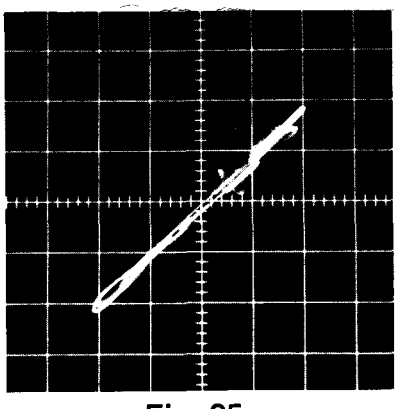


Fig. 25

ADDENDA

I. MODEL C/PEK-3/T

The Model C/PEK-3/T consists of a Model C/PEK-3 Stereo Cartridge Analyzer and a 240 to 120 Vac autotransformer which allows the Analyzer to be operated from a 216 to 264 Vac, 50-60 Hz, power source.

The autotransformer is supplied with a permanently attached three-conductor ac power (mains) cord without a connector on the "mains" end. A suitable connector must be installed by qualified service personnel. To attach a connector, connect the brown conductor of the power cord to the "live" terminal of the connector, the blue conductor to the "neutral" terminal, and the green-yellow conductor to the "earth" terminal.

To operate the Analyzer, plug the C/PEK-3 power cord into the power receptacle provided on the autotransformer. Connect the power cord from the autotransformer to the 240 Vac (mains) power source. The C/PEK-3 will now operate as it would if it were directly connected to a 120 Vac power source and 120 Vac (80 watts *maximum load*) will be available at the switched power outlet on the front of the unit.

II. GUARANTEE

This Shure product is guaranteed in normal use to be free from electrical and mechanical defects for a period of one year from date of purchase. Please retain proof of purchase date. This guarantee includes all parts and labor. This guarantee is in lieu of any and all other guarantees or warranties, express or implied, and there shall be no recovery for any consequential or incidental damages.

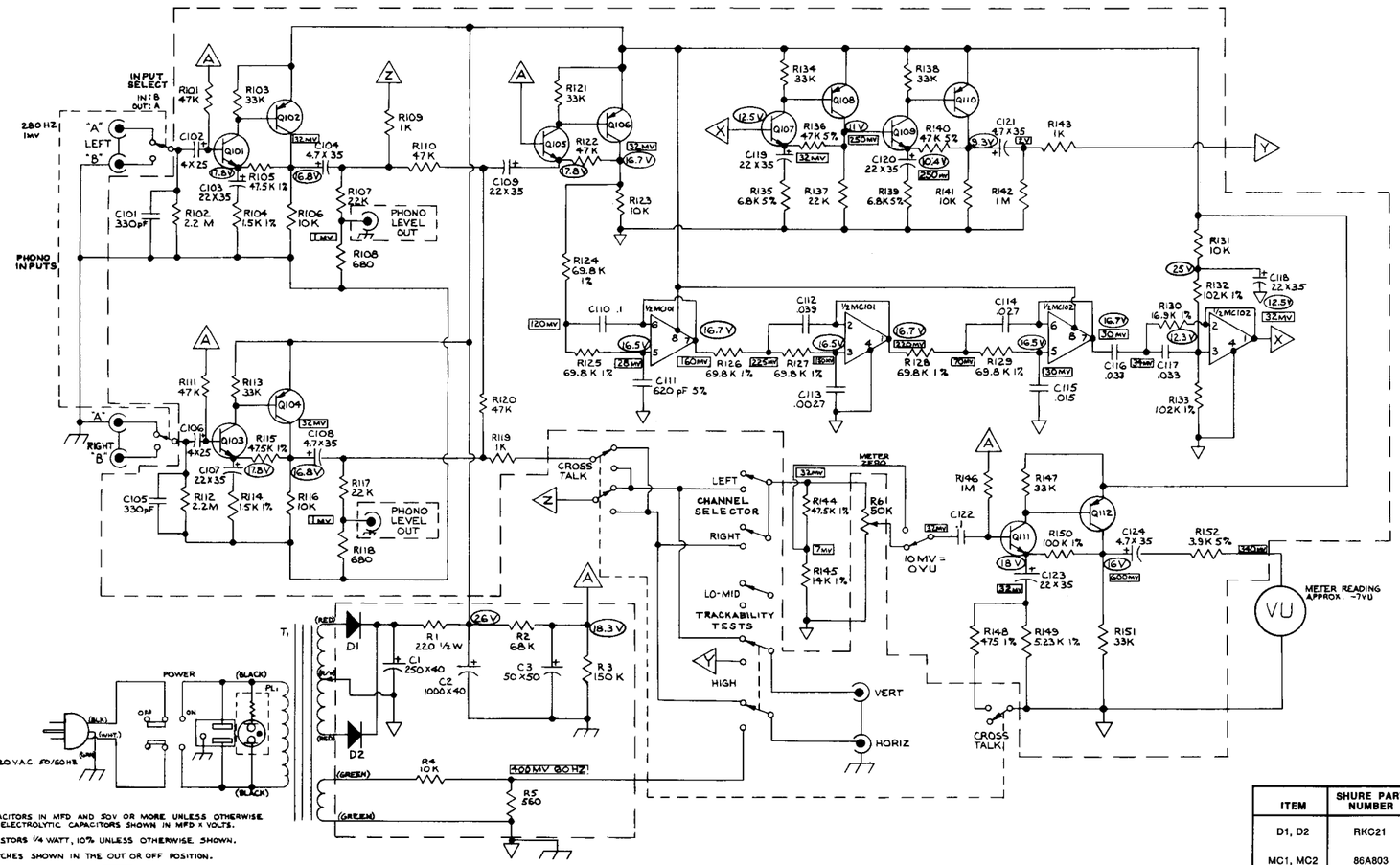
III. SHIPPING INSTRUCTIONS

Carefully repack the unit and return it prepaid to:

Shure Brothers Incorporated
Attention: Service Department
1501 West Shure Drive
Arlington Heights, Illinois 60004

If outside the United States, return the unit to your dealer or Authorized Shure Service Center for repair. The unit will be returned to you prepaid.

SHURE®
222 HARTREY AVE., EVANSTON, IL. 60204 U.S.A.
MICROPHONES AND ELECTRONIC COMPONENTS
AREA CODE 312/866-2200 • CABLE: SHUREMICRO
TWX: 910-231-0048 TELEX: 72-4381



NOTES:

1. ALL CAPACITORS IN MFD AND 50V OR MORE UNLESS OTHERWISE SHOWN. ELECTROLYTIC CAPACITORS SHOWN IN MFD × VOLTS.
2. ALL RESISTORS ¼ WATT, 10% UNLESS OTHERWISE SHOWN.
3. ALL SWITCHES SHOWN IN THE OUT OR OFF POSITION.
4. (oval) DENOTES D.C. VOLTAGE, [rectangle] DENOTES A.C. VOLTAGE. ALL VOLTAGES MEASURED WITH A.C. LINE = 120 V 60 HZ. ALL A.C. VOLTAGES TAKEN WITH 1MV A.C. 280 HZ LEFT OR RIGHT, "A" OR "B" INPUT, WITH INPUT SELECTOR SET APPROPRIATELY. D.C. VOLTAGES TAKEN WITH 10 MΩ VTVM. A.C. VOLTAGES TAKEN WITH HEWLETT-PACKARD 400GL A.C. VOLTMETER TO TAKE A.C. VOLTAGE READINGS FOR METER AMPLIFIER CIRCUIT, APPROPRIATE CHANNEL SELECTOR BUTTON MUST BE DEPRESSED AND METER ZERO CONTROL FULL CLOCKWISE. ALL OTHER A.C. READINGS TAKEN WITH TRACKABILITY TEST SELECTOR, HIGH DEPRESSED. VOLTAGES ARE TYPICAL AND MAY VARY ±15%

REPLACEMENT PARTS LIST

ITEM	SHURE PART NUMBER	QTY. IN RKC KIT	DESCRIPTION	ITEM	SHURE PART NUMBER	QTY. IN RKC KIT	DESCRIPTION
D1, D2	RKC21	4	Diode, Silicon, 100V, 1/2A (Motorola 1N4002)	R6	46A036	1	Potentiometer, 50k
				T1	51A253	1	Transformer, Power
MC1, MC2	86A803	1	Dual Operational Amplifier (Motorola MC1458C-P1 or Signetics N5558V)	—	95A615	1	Meter Assembly, VU (API Instruments 361, A-Scale)
PL1	RKC45	1	Pilot Lamp (Leecraft 36N1311-6)	—	55A110	1	Ac Switch, DPDT (Alco 205N-49)
				—	55A109	1	Push-Button Switch, 7-Station
Q101, Q103, Q105, Q107, Q109, Q111	RKC89	4	Transistor, Silicon, NPN (Motorola 2N5210)	—	55A111	1	Push-Button Switch, SPDT (Switchcraft 953)
Q102, Q104, Q106, Q108, Q110, Q112	86A348	1	Transistor, Silicon, PNP (Motorola 2N5087)	—	RKC2	1	Ac Line Cord with Plug (Belden 17238)
				—	95B552	1	Ac Receptacle

MODEL C/PEK-3 STEREO CARTRIDGE ANALYZER CIRCUIT DIAGRAM