

# **CLARKSTAN CORP.**

**MANUFACTURING ENGINEERS**

**11927 West Pico Boulevard  
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# NOTES ON THE CLARKSTAN RV WIDE RANGE PICKUP

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With the advent of the Clarkstan Sweep Frequency test records, the qualification of pickups and equalizing networks by means of an oscilloscope has become a routine which the record enthusiast, as well as the technician, may perform.\*

The quality of the reproduction of signals from records is primarily dependent on the pickup. Stress should, therefore, be placed on its performance characteristics.

Among the several physical principles employed in transducer design, the variable reluctance or magnetic has lent itself to the most practical high-quality pickup performance.

The variable reluctance pickup is a velocity device. The instantaneous voltage generated by the movement of the stylus is dependent on the speed or velocity at which the stylus or needle moves from side to side (lateral recordings). Perfect reproduction is more nearly realized when the moving parts are of nominal mass and restoring force members are critically damped.

The Clarkstan RV Wide-Range Pickup has incorporated those physical principles upon which faithful reproduction of disc recording is predicated.

## TERMINATION

Surface noise is more or less inherent in all record material except in high grade plastics. Due to extreme wide range, the RV Pickup reproduces this incidental surface noise. This action was interpreted by Clarkstan engineers as a possible objectionable quality. There was introduced in the circuit a roll-off resistor built in the case of the pickup. The value of the resistance across the inductance is approximately 15,000 ohms. The net effect without any external equalization is to produce a modified NAB curve from the transition point up. The result is, as seen on the oscilloscope, with no external termination, a gradual falling off at the upper end. It was the decision that this expedient was a protection for the user against operating the Pickup without proper roll-off. Since there had been no other pickup at that time, and there still is no pickup commercially produced with as wide a response range as this unit, another problem presented itself which also called for the terminating resistor to be incorporated in the unit. That problem was the introduction of harmonics of a higher order which exist in some of the high frequencies of certain static test records, and which can also come from the amplifiers and networks with which the pickup may be used. The resistor materially helps in overall performance of the equipment in these cases.

## WIDE RANGE

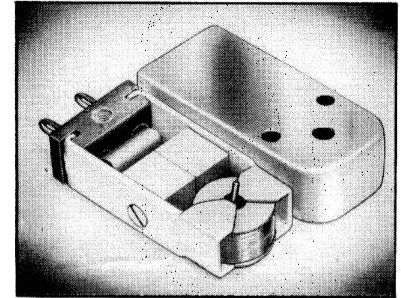
Attention is called to the broad range of the RV. Reference is made to its use in the reproduction of high speed signals of various frequencies recorded on the outer section of 16-inch discs. Excellent signals of good wave form are reproduced, involving frequencies up to 20 kc. Except in very special cases the broad range possible in the RV is, for the most part, not used. It has been found that for shellac pressings a roll-off, starting in the region of 4,500 cycles, is satisfactory. In the case of NAB recorded transcriptions, which are used in nearly all radio broadcast reproduction, the NAB curve is optimum. This predicated a "condenser roll-off" down about 12-1/2 db at 10,000 cycles. The RV roll-off is not quite this severe, and so requires more equalization for transcriptions. The RV unequaled has a characteristic which is velocity responsive throughout. It still has a substantial output at 23 kc, which may be obtained by operating a 10 kc signal cut at 33-1/3 rpm and reproduced at 78.26 rpm. The use of this signal, however, is justified for technical applications in the laboratory.

## PRE-AMPLIFICATION

With the relatively high output of the RV it is practical to take care of all equalization required for the pickup without reducing the signal to a low value where hum or other noise factors are in evidence. Were the output reduced materially, a pre-amplifier for use in reproducing records would always be necessary. This is the case in other pickups of low output.

The use of a pre-amplifier, however, should not necessarily be avoided. This is especially true where the pickup is to be used with low gain power amplifiers or as in use with high quality audio sections of radios. The signal from the detector is higher than that from any good pickup.

\* See "Analyzing Sweep Frequency Transcriptions" by Wayne R. Johnson, Audio Engineering, November, 1947.



CLARKSTAN TYPE RV PICKUP

For conditions where higher input levels are required, the equalizer amplifier with low-frequency compensation described by C. G. McProud in Audio Engineering, for July, 1947, is highly recommended. Roll-off networks for the high frequency equalization are shown in Clarkstan Data Sheets.

## BASS EQUALIZATION

As with all constant velocity pickups, bass equalization must be provided below the transition or cross-over point. This is the point below which recording changes from constant velocity to constant amplitude. The frequency at which this occurs depends on the type of recording and may be at 1,000 cps, 700 cps, 500 cps or, as in the case of some foreign recordings at 250 cps. To provide bass equalization it is necessary to destroy or attenuate the high frequencies to a degree corresponding to the desired "raise" or "boost" in the low frequencies. The highs or lows, therefore, as seen on an oscilloscope without equalization, are never as they are used when reproducing records for listening pleasure. Actual circuits for bass equalization without tubes are presented elsewhere in Clarkstan literature.

## NEEDLE TALK

During the development of the Clarkstan RV pickup there appeared the problems of high output versus three factors; low needle noise, wide range response and consistency of quality. Each problem has been carefully weighed and the solving of them has resulted in a pickup of well-balanced design.

The phenomenon of needle talk has been carefully studied. Most peculiarly, users of pickups in general believe that the erroneously called "needle chatter" comes from the needle itself. This is definitely not the case. The radiated noise comes from an area of the rotating record in the immediate vicinity of the stylus. It is caused by the mass reactance of the needle and/or associated mechanical structure. This becomes obvious when consideration is given to the simple fact that a surface as small as a needle can not radiate noise to the extent that it is heard with nearly all pickups. The amount of acoustically radiated noise, except in certain cases, bears little or no relation to the faithful tracing of the groove by the needle. The fidelity of reproduction in a pickup is unaffected by acoustically radiated noise except in gross cases of stiffness as exist in some low cost types.

In the case of the Clarkstan RV Pickup attenuation of the so-called needle noise is accomplished by the reduction in mass of the stylus-armature.

## REMOVABLE STYLUS

Particularly, in radio station use, the stylus which can be changed as desired has been a outstanding innovation. With the Clarkstan RV Wide Range pickup it is possible to change the size of the sapphire ball point at will. This is an important factor if consideration is given to the fact that the needle which will track a transcription satisfactorily will rattle around in the bottom of the groove of a shellac pressing. Also, in radio stations where records represent a considerable portion of the program material, the stylus can be changed easily and quickly as soon as the sapphire becomes worn.

## CHANGING THE STYLUS

Frequent changing of the stylus does not affect adversely its mechanical suspension within the sheath. The performance of the pickup is unaffected by the slight permanent set taken by the aperture in the stylus sheath after use. The part of the mechanical structure that affects the damping is never strained into any kind of a permanent set, and an equilibrium is always reached within the structure immediately. The minute orifice is originally punched undersize in the neoprene stack and it is intended that an elongation of the hole parallel to the pole faces should occur at the time that the needle is inserted.

## BARKHAUSEN EFFECT

A magnetic phenomenon known as the Barkhausen effect is observable in the RV Pickup, as well as in others of the magnetic type. It may be heard by moving the stylus slowly from side to side when the gain is turned up. The sound is aptly described as a "swish." The average random frequency of this signal is higher as the lateral velocity is increased or, in other words, as the sidewise movement is faster. This is not a form of distortion. It is entirely absent from the signal in normal use.

In the recording laboratory, the RV pickup is used for the exacting requirements of dubbing and for the checking of metal masters. In the research laboratory, it is applied to the reproduction of frequencies from a few cycles per second to well into the superaural region. In the realm of pure entertainment, among discriminating music lovers, the Clarkstan RV Wide Range Pickup has won favor, as it has in the commercial field where excellent performance and ruggedness are required in combination with trouble-free operation, flexibility and adaptability to varying types of circuits.

## USING THE CLARKSTAN RV PICKUP IN AUTOMATIC RECORD CHANGERS

Due to the various tripping mechanisms and other mechanical features which are a part of the system in record changers, it is generally necessary to take precautions when installing a high-fidelity pickup.

The side thrust necessary to carry the arm from the outside to the inside by means of the groove imposes a mechanical bias on the stylus and armature of a pickup. This mechanical bias is necessarily a greater force in the case of changers at the change or tripping cycle than in lightly balanced arms used for transcriptions. The fine setting necessary to make a record changer operate does not always lend itself to giving the pickup the best conditions for its operations. However, most of the well-designed changers can be made to operate satisfactorily when using a high-grade pickup if the following precautions are observed:

The needle force should not be greater in the case of the Clarkstan RV Pickup than  $7/8$ ths of an ounce. One-half of an ounce is optimum. The side thrust should not be more than 25 grams for the change cycle. The bend in the stylus allows the needle attack to the groove to be always in a negative direction when the arm is as short as 9 inches, and the stack of records not greater than 10. Some types of record changers allow the needle to deviate seriously from the vertical. This deviation may be as great as 10 degrees without harmful effects. It is usually not advisable to change from a crystal to the Clarkstan without making the above-mentioned optimum conditions possible for use with the Clarkstan. The high lateral stiffness of the crystal pickup is necessary for the operation of some types of changers.

# TYPES OF STYLII

## FOR USE WITH CLARKSTAN RV WIDE RANGE PICKUP

### MANY ADVANTAGES of a Pickup with Removable Stylus.

The quick change feature of the Clarkstan stylus eliminates costly repair needed to replace the point of a fixed stylus type of pickup.

No one size of ball point radius will reproduce satisfactorily all types of records. There is a Clarkstan stylus size for every type of record.

### STYLUS AND GROOVE DIMENSION RELATIONSHIP.

Optimum mechanical coupling between the stylus and the groove is of first importance in the good reproduction of sound from disc recordings. The most satisfactory results are obtained when broadcast transcriptions and shellac pressings are played with the correct size stylus.

Since the introduction of the fine groove long playing record proper stylus dimensions have assumed an even greater importance.

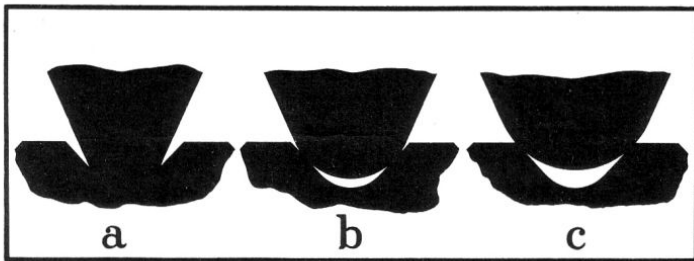


Fig. 1. (a) The stylus radius too small. Resultant distortion comes from the stylus actually being thrown from side to side in the bottom of the groove. More noise is also introduced from the bottom of the groove.

(b) Two points of tangency confine the needle to the groove. This condition contributes to the best overall tracing of the modulated groove.

(c) The stylus is of too large a radius. A distinct loss of highs results. The larger the radius the greater is the loss of highs.

**THE STANDARD STYLUS** has an angle of  $10^{\circ} \pm 2^{\circ}$  incorporated in the shank. This angle allows the plane of the pickup head to deviate from parallelism with the record so that a negative rake is not apt to occur. At the point of bend the stylus is flattened for the purpose of orientation each time it is replaced.

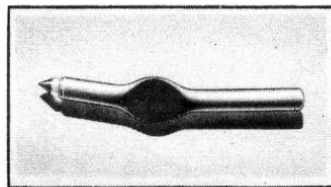
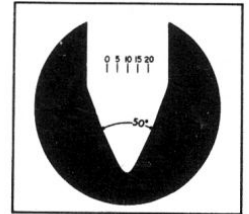


Fig. 2. Clarkstan Removable Stylus for RV Widerange Pickup

Cueing or back tracking may be safely performed under all circumstances. As an example the straight arm (#210) equipped with a standard pickup and needle will satisfactorily reproduce any signal from either side of the turntable spindle. It will work equally well with the rotation either toward or away from the pickup.

### QUALITY OF SAPPHIRE AND POLISHING

Only the highest quality sapphire rod is used in the production of the styli. The entire cone is finely polished. The spherical section of the tip which is the working portion is super-polished.



These styli are consistently uniform in finish, workmanship, and specifications. Each point is individually shadowgraphed.

### TIP RADII AND THEIR APPLICATIONS

**.0030" RADIUS (ORANGE-BLACK) STANDARD.** For use with nearly all shellac pressings and vinylite pressings made from the same stampers. The greatest number of recordings in existence are of this type.

**.0025" RADIUS (RED-GREEN).** For vinylite transcriptions this stylus dimension gives the best results. Where it is *NECESSARY* to play both shellac and vinylite transcriptions with the same stylus this dimension is recommended. NAB standards include this tip and the .0022" radius for transcription reproduction.

**.0022" RADIUS (RED-RED).** Some operators prefer this radius for general transcription reproduction and some acetates.

**.0020" RADIUS (RED-BLACK).** For use with some of the finest grooved transcriptions and acetates.

**.0015" RADIUS (BROWN-GREEN).** Some very high quality vinylite transcriptions will take this size radius satisfactorily without groove decoupling. Also used with some high quality foreign records.

**.0010" (BROWN-BLACK).** Manufacturer's recommended stylus radius for long playing fine groove records such as Columbia's LP Microgroove.

**.0040" RADIUS (YELLOW-BLACK).** A special stylus for use with old type records that have a high surface noise. Undue surface noise can come from several sources. The more important are the particle size of the loading material, and wear. Since the average wave length of the noise components is shorter than the more important frequencies of the signal, the larger radius stylus will favor the signal over the noise. (This tip made on special order only.)

**The Diamond Stylus #254.10 (.0010" rad.) - #254.20 (.0020" rad.) - #254.5 (.0025" rad.)**

For the operator who prefers the diamond stylus and for specific installations where it is not necessary to change the ball point radius for different types of recordings, the diamond fills a definite need.

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## COLOR CODE

The RMA Color Code is used for stylus radius identification. The significant figures are the third and fourth to the right of the decimal point.

Examples: .0030" is orange-black, .0025" is red-green.

0 - Black	5 - Green
1 - Brown	6 - Blue
2 - Red	7 - Violet
3 - Orange	8 - Grey
4 - Yellow	9 - White

## PRICE LIST

NO.	DESCRIPTION	LIST PRICE
251	Sapphire stylus, tubular shank . . . . .	\$ 4.00
	When ordering, specify radius of ball point desired by number and radius.	
	#251.10 - - - .0010" radius	#251.5 - - - .0025" radius
	#251.15 - - - .0015" radius	#251.3 - - - .0030" radius
	#251.2 - - - .0022" radius	
252	Sapphire stylus, solid shank . . . . .	\$ 5.00
	When ordering, specify radius of ball point desired by number and radius.	
	#252.10 - - - .0010" radius	#252.5 - - - .0025" radius
	#252.2 - - - .0022" radius	#252.3 - - - .0030" radius
254	Diamond stylus for RV cartridge, tubular shank . . . . .	\$45.00
	When ordering specify radius of ball point desired by number and radius.	
	#254.10 - - - .0010" radius	#254.5 - - - .0025" radius
	#254.20 - - - .0020" radius	

*All prices are F.O.B. Factory and are subject to change without notice.*

# THE NEW TRIONIC ARM



WITH THE QUICK ACTING WEIGHT ADJUSTMENT

Positive—Accurate

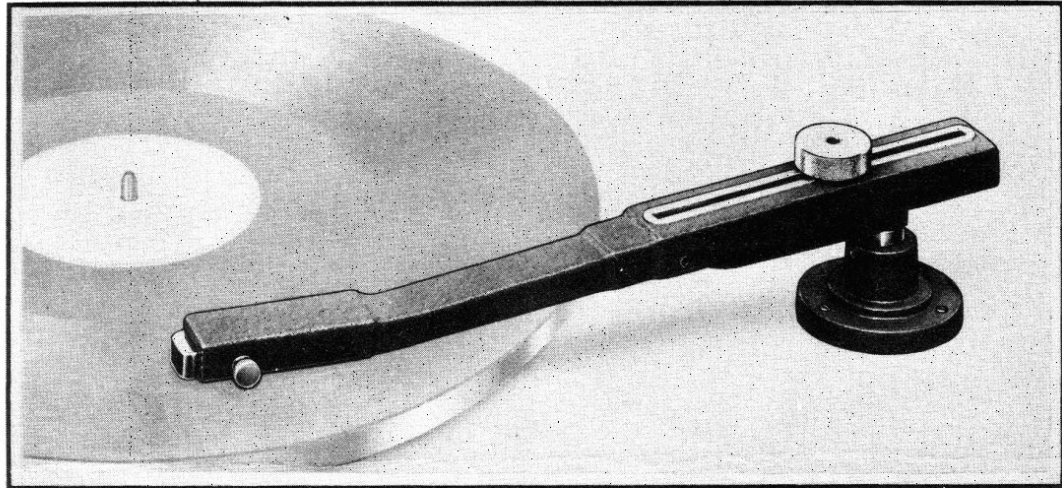


WITH THE SLIDE IN CARTRIDGE HOLDER

No Soldering



ADJUSTABLE FOR TABLE HEIGHT



The new Trionic arm offers several novel and desirable improvements. The slide-in cartridge holder allows instantaneous mounting. Any cartridge (not over 3/4" wide) may be used with the arm. Silver-plated plunger contacts provide electrical coupling.

The leaf spring clamp connects the pickup to ground in such a manner that the pickup case is not deformed. A quick twist of the thumbscrew and the cartridge is held securely until released.

## SPECIFICATIONS

12" ARM for mounting on tables with limited space for use with 10" and 12" records

16" ARM for professional tables for use with all records up to 17"

HEIGHT ADJUSTMENT from 1 11/16" to 2 5/16" above base plane

WEIGHT ADJUSTMENT with any pickup from 5 gm. up

OFFSET HEAD nominal tracking error

ALL PICKUPS not over 3/4" wide will fit the slide-in cavity

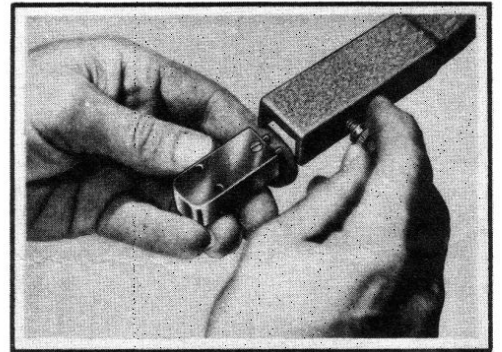
VERTICAL ROLLER BEARING minimizes cramping -- no mechanical bias on the pickup

LOW ARM RESONANCE -- Aluminum castings

MAY BE USED with all types of existing equipment

ARM REST rubber tipped single hole mounting

FINISH grey wrinkle and brushed chrome



Installation of the cartridge is simple and efficient, silver-plated, spring loaded plungers maintain positive electrical contact.

Model 212 16" Transcription Arm Net \$22.50  
" 213 12" Transcription Arm Net 22.50

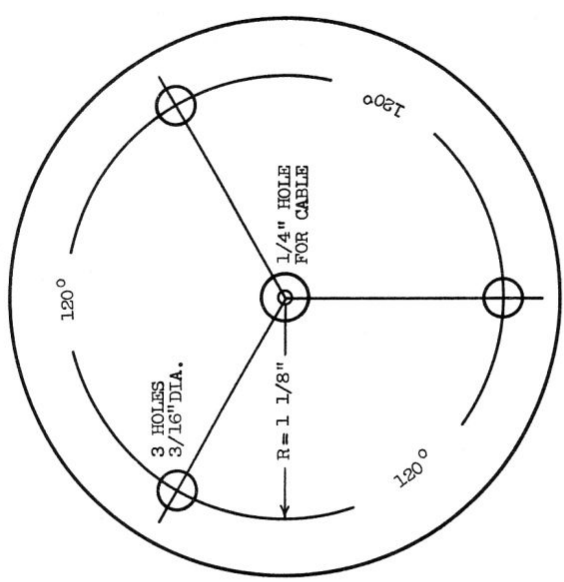
*All prices are F.O.B. Factory and are subject to change without notice.*

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MANUFACTURING ENGINEERS  
Los Angeles 34, Calif. U.S.A

MOUNTING DATA FOR  
**MODEL 212**  
**TRIONIC**  
 REMOVABLE CARTRIDGE  
 ADJUSTABLE WEIGHT  
 TRANSCRIPTION ARM

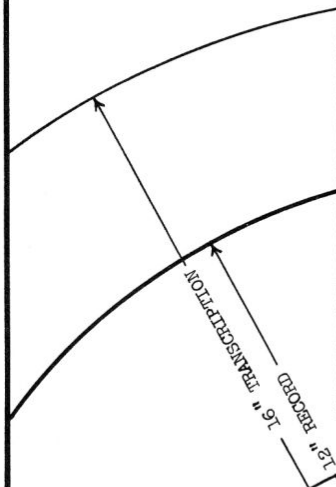
**CLARKSTAN**  
 CO.  
 MANUFACTURING ENGINEERS  
 Los Angeles 34, Calif., U.S.A.



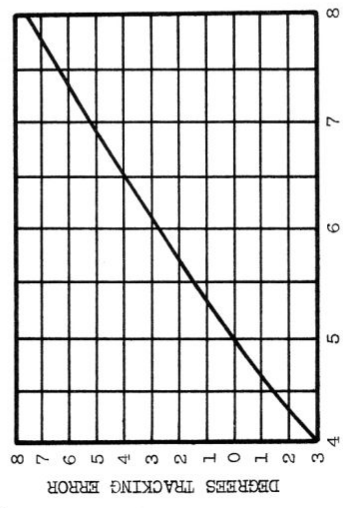
DRILL TEMPLATE  
 FULL SCALE

**INSTRUCTIONS**

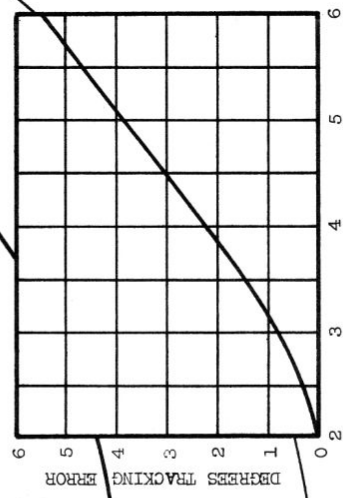
THE MODEL 212 TRIONIC ARM will accommodate any pickup that is not over 3/4" wide. FOR SHORT PICKUPS install the tubular solder lugs furnished with the pickup on the cartridge pins. The end of the pickup should extend so that the stylus tip is about 12 3/8" from the center of the base of the arm. FOR PICKUPS WITH PINS IN A VERTICAL PLANE bend the solder lugs sidewise so that the ends make contact with the arm plungers. THE ARM REST may be installed in any convenient place on the table at a distance of 9" 13/4" from the center of the arm base.



12 3/8"



INCHES FROM CENTER POST  
 TRACKING ERROR FOR  
 16" TRANSCRIPTIONS



INCHES FROM CENTER POST  
 TRACKING ERROR FOR  
 10" & 12" RECORDS

SUBJECT: 60-10,000 CPS Sweep Frequency Transcription.  
Specifications and Instructions for use.

INDEX: A 122

DATE: 6/1/46

PAGE: 1 OF 2 PP.

## GENERAL CHARACTERISTICS

The SWEEP FREQUENCY TRANSCRIPTION is a new method of making instantaneous frequency response runs. It has been designed with all correction factors included in the original recording, therefore, no charts or graphs are needed. Before the development of the Sweep Frequency Transcription, the tone record was used for frequency response measurements on playback systems. This method was both time consuming and laborious. If adjustments were required, a new frequency run was required after each adjustment. Now all that is needed is a cathode ray oscilloscope and a Sweep Frequency Transcription for instantaneous response measurements. Only a few quick adjustments on the equalizer circuits and the job is done.

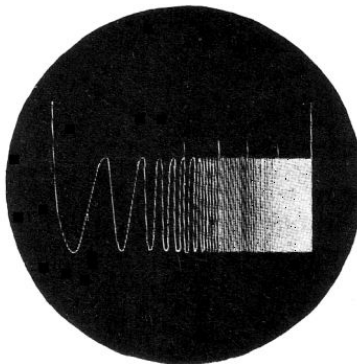


Fig. 1—A perfect reproduction of the Sweep Frequency Transcription, showing marker pulses (see specifications).

## USE AS A SWEEP FREQUENCY GENERATOR

Testing of playback systems is not the only use of the Sweep Frequency Transcription. It may be used with a high quality playback system as a secondary sweep frequency generator for testing audio amplifiers, loud speakers, microphones, acoustical networks, electrical filter networks and many other uses.

## FOR THE BROADCAST STATION

This Transcription offers the broadcast engineer the opportunity to make frequent quick checks of the entire transmission system or any of its components. Line transmission performance characteristics may be quickly and easily observed. Studio to transmitter telephone loop may be checked along with the transmitter to give the overall picture of the broadcast station. In this way tolerances of the overall equipment may be checked.

## FOR PRODUCTION TESTING

For instantaneous and complete production testing of reproducers, filter networks, audio amplifiers, pre-amplifiers, transformers, attenuators, tone control systems, each component may be quickly and thoroughly tested for its overall performance.

## TO LOCATE HARMONIC DISTORTION

Harmonic distortion may be observed as a bright line usually running irregularly through the middle of the pattern. The phase may change with frequency and amplitude, this will cause the line to go either up or down if there is a phase shift. Critical observation can be made with an expanded sweep. The distortion frequency may be computed by observing the nearest marker pulse. This provides a qualitative analysis of the distortion generated by the playback system.

## FOR LABORATORY USE

The Sweep Frequency Transcription is not limited to frequency response measurements. It may be used to observe a number of important parameters. Being logarithmic, the higher frequencies are swept at a much faster rate. This shows the transient response performance of the playback system at the higher frequencies. By using an expanded sweep of the oscilloscope, clear detail is obtained (Figs. 3 and 5). With high quality playback systems the pattern will approximate the pattern which is obtained from the monitor oscilloscope of a primary standard sweep frequency generator. The playback system will become a secondary standard sweep frequency generator sufficiently accurate for most laboratory measurements.

## FOR THE FM STATION

The special uses of the Sweep Frequency Transcription pertaining to the audio system are particularly helpful to the FM engineer. For instance, the dynamic AC axis shift of playback reproducers is sometimes a serious problem. It is caused by the reproducer arm having mechanical horizontal resistance. This may be attributed either to a turntable which is not level or to a tight bearing. The trouble is noticed with intermodulation and harmonic distortion showing up at the same time. The armature is displaced out of its normal position by a force to the right or to the left, causing a non-linear conversion to electrical energy which results in distortion. The pattern on the scope will be displaced up or down at the frequency in which the distortion is predominate.

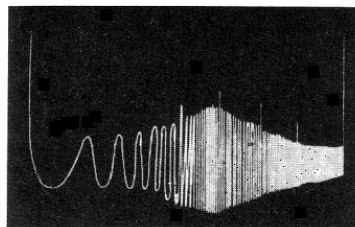


Fig. 2—Low and high frequencies attenuated.

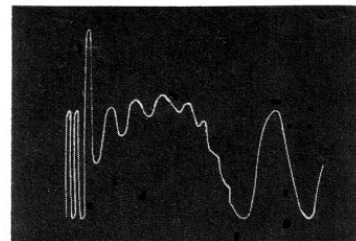


Fig. 3—An expanded sweep showing a portion of the low and high frequency spectrum. Poor transient response.

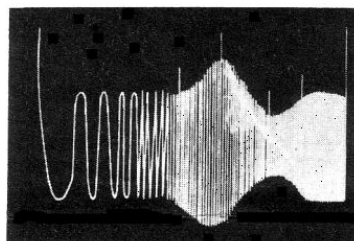


Fig. 4—A peak and a dip in the middle frequencies accompanied by distortion.

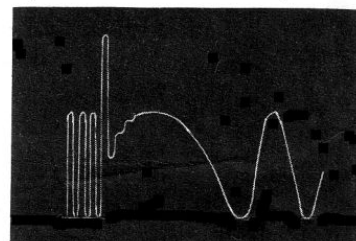


Fig. 5—Same as Fig. 3, but with excellent transient response.



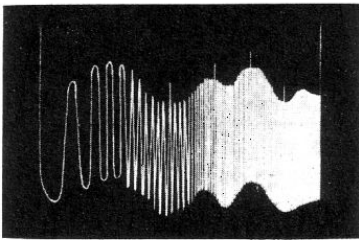


Fig. 6—Flat frequency response with large amount of mechanical vibration.

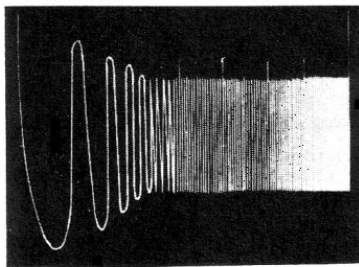


Fig. 7—Low frequencies accentuated.

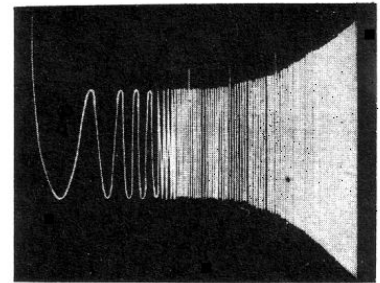


Fig. 8—High frequencies accentuated.

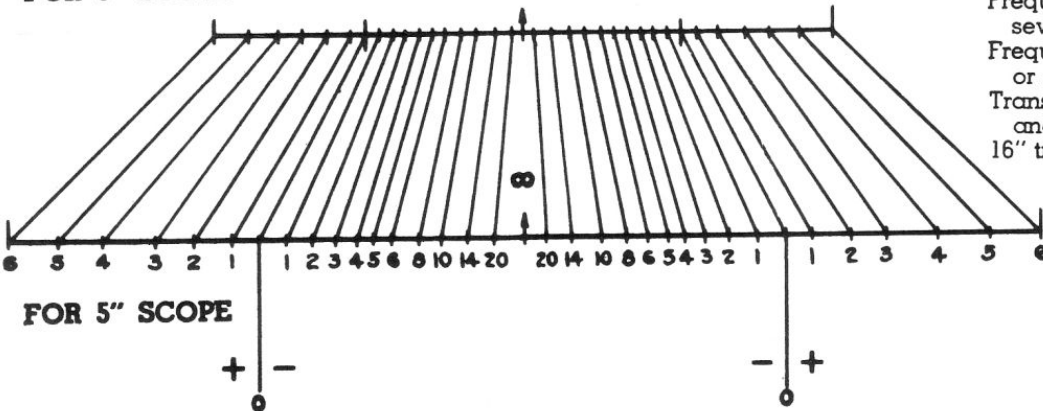
**TO CHECK TRANSIENT RESPONSE**

Many playback systems use sharp cutoff filters to remove the higher frequencies because of needle scratch and intermodulation. This may be checked for transient response by observing the 200 microsecond synchronizing pulse at the start of the sweep. The horizontal gain control of the oscilloscope may be advanced to produce an expanded sweep, at the same time adjusting the frequency adjustment control to bring the pattern into view (Figs. 3 and 5). Playback systems adjusted to conform to the sweep frequency transcription will have a superior degree of quality.

**READ DIRECTLY IN DECIBELS**

In order to read the amplitude frequency response directly in decibels, a scale is provided below. The scale was derived from the formula  $\text{Log } 20E^{1/E^2}$ . Scales for any size oscilloscope may be made using this formula.

**FOR 3" SCOPE**



**NET PRICES**

**CLARKSTAN SWEEP FREQUENCY TRANSCRIPTION**

(lateral recordings)

Number 1000A	12" Vinylite transcription, 78 RPM, 70 to 10,000 CPS, recorded flat $\pm 1$ db.....	6.60
Number 1000D	12" Vinylite transcription, 78 RPM, 5 KC to 15 KC, recorded flat $\pm 1$ db.....	6.60
Number 100A	16" Vinylite transcription, 33 1/3 RPM, 60 to 10,000 CPS, recorded with NAB curve.....	15.00

**CLARKSTAN SWEEP FREQUENCY FILM**

(Variable Density)

Number 115	35mm, positive print, in 10 ft. lengths.....	\$10.00
	additional footage.....per foot....	On request

All prices are NET, F O B Los Angeles, subject to change without notice.

PAT. PENDING

**FOR THE MOTION PICTURE STUDIO AND THEATER SOUND EQUIPMENT**

For instantaneous qualitative and quantitative analysis of the performance of entire studio recording systems and their individual requirements, such as microphones, transmission lines, power amplifiers, pre-amplifiers, light valves and monitoring systems.

**SPECIFICATIONS**

Characteristics of the Sweep Frequency Transcription are as follows:—

The frequency sweep range is from 60 cycles per second to 10,000 cycles per second on the 16" record and from 70 cycles per second to 10,000 cycles per second on the 12" record. Constant amplitude below 500 CPS and constant velocity above 500 CPS (for 78 RPM record).

Synchronizing pulse of 200 microseconds.

Repetition rate 20 CPS.

Logarithmic frequency sweep.

Frequency marker pulses at one, three, five, seven and ten thousand cycles per second.

Frequency response variations are within plus or minus one decibel.

Transcriptions are of vinylite, 12" at 78 RPM and 16" at 33 1/3 RPM.

16" transcription is recorded with N.A.B. curve.

—WAYNE R. JOHNSON,  
Recording Engineer.