

This year  
all Dual  
turntables  
feature ULM.  
The Ultra  
Low Mass  
tonearm  
and cartridge  
system.



## ULM a major breakthrough in record playback technology.

To appreciate the significance of Dual's new Ultra Low Mass tonearm and cartridge system, you need a clear understanding of what happens when the stylus tracks the record groove. And there is much more to it than meets the eye.

If all records were perfectly flat and perfectly concentric, the stylus would have only the contours of the recorded groove to contend with. To reproduce music the stylus is forced to change directions—up, down and sideways—from 20 to 20,000 times a second. That's enough of a challenge.

Not so well understood, however, are some of the other forces that also affect the way the stylus moves—forces that introduce distortion to the music.

Warp is the most serious of these forces.

The realities of record manufacturing today result in most records being warped. And even when

warps are barely visible, they interfere with accurate tracking. The stylus must follow the groove whether it's flat or warped. And how well it follows the warps is a function of tonearm and cartridge engineering.

The heavier the tonearm and cartridge, the more the stylus will tend to dig in when it rides up the warp and to lose contact on the way down. This is a natural result of inertia—the tendency of an object at rest to remain at rest and in motion to remain in motion.

The amount of inertia the tonearm and cartridge present to the stylus is determined by their total effective mass—the moving weight of the combined tonearm and cartridge as it affects the stylus in motion.

Total effective mass is measurable. Conventional tonearms and cartridges have a total effective mass of approximately 18 grams. (Some are even higher.)

To determine precisely how much total effective mass affects the tracking of warped records, Dual made a special test record. It

has a 300-Hz test tone and carefully spaced 1.5 mm warps—typical of those on today's records.

In an extensive series of tests, 18-gram tonearm and cartridge combinations generated an average of 2.7 percent total harmonic distortion. (Anything over 1.0 percent THD is considered audible.) Also, tracking force varied as much as 30 percent from warp to warp—an action which reduces stylus and record life.

Playing the same record under the same conditions, the ULM tonearm and cartridge system—with only 8 grams total effective mass—reduced THD to an astonishingly low 0.01 percent. That's a reduction of 270 times!

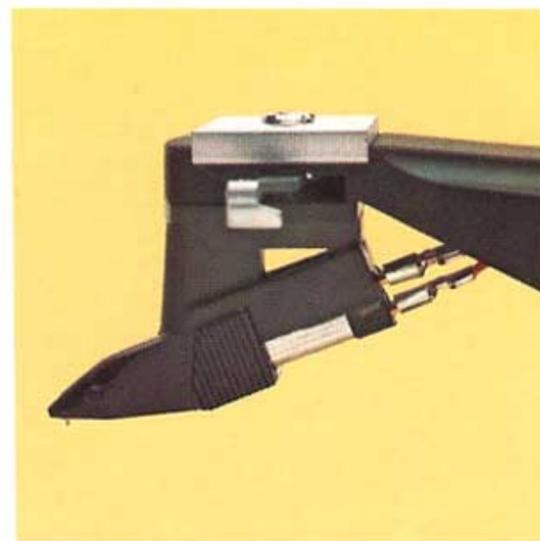
Another form of distortion resulting from warped records—frequency intermodulation distortion (FIM)—was also measured. It's known as "warp wow", and you hear it as an unpleasant warble. With the ULM system, FIM measures half that of conventional tonearm and cartridge combinations.

The benefits of ULM are clear in



The potential for an Ultra-Low-Mass system has long existed in Dual's straight-line tubular tonearm with its four-point gyrosopic gimbal suspension. The tonearm mass is centered at the pivot point. The vernier-adjustable counterbalance establishes zero balance with micrometer-like precision. A tempered flat-wound spring applies tracking force directly at the pivot—without increasing effective mass.

And the tonearm remains in perfect dynamic balance throughout play, even if the turntable is not level. This basic design has now been reengineered—with a lighter head and counterbalance, and a slimmer tube—so that it can accommodate cartridges weighing as little as two grams.



The ULM cartridge series results from a collaboration between Dual and Ortofon engineers. These cartridges were designed to match Dual's new ULM tonearm so that the combined tonearm and cartridge mass would be optimized—at 8 grams. The ULM cartridge itself weighs only 2.5 grams including mounting bracket and hardware. The ULM cartridge is a moving-iron type, based on the variable-magnetic-shunt (VMS) principle. It is miniaturized in many respects, including the stylus tip. Among its important specifications: Frequency response from 10 Hz to as high as 30,000 Hz; channel separation as much as 28 dB, and shielding from hum better than 10 dB over conventional cartridges.

ULTRA LOW MASS  
**ULM**

All Dual turntables feature ULM... the Ultra Low Mass tonearm and cartridge system with only 8 grams total effective mass.

every parameter of record playback, including: tracking accuracy, signal-to-noise, THD and FIM distortion, stylus and record life.

In short, music sounds better and your stylus and records last longer with ULM.

**Resonance: another record playback problem uniquely solved by Dual technology.**

If you've been wondering why your high-power amplifier and fine speaker system don't deliver the deep, clean bass you'd like—especially at high listening levels—the problem may be the effects of resonance in your turntable.

Resonance refers to a specific frequency at which any mechanical system combining mass and compliance (elasticity) tends to vibrate. And although the stylus should move only in response to the groove contours, it is also activated by various resonances. The major resonance is produced by the combined mass of the tonearm and cartridge interacting with the motion of the stylus.

Since resonances are a natural

consequence of the laws of physics, they cannot be entirely eliminated, but their effects can be minimized.

The overall design of Dual tonearms establishes their resonance within the most desirable frequency range: between 7 and 12 Hz. This is above record-warp frequencies and below audible sound.

In addition, the amplitude—or energy level—of the resonances has been substantially reduced.

The need for reducing resonant energy has long been known. Although the resonant frequencies of the tonearm and cartridge combination can be placed in the inaudible range, they can still cause excessive woofer-cone movements and drain amplifier power. You hear this as muddy bass. In extreme cases, you can see the tonearm vibrate and even leave the record groove.

Dual's solution is a mechanical filter (housed in the tonearm counterbalance) tuned broadly to the range of resonant frequencies to be damped. The filter vibrates out-

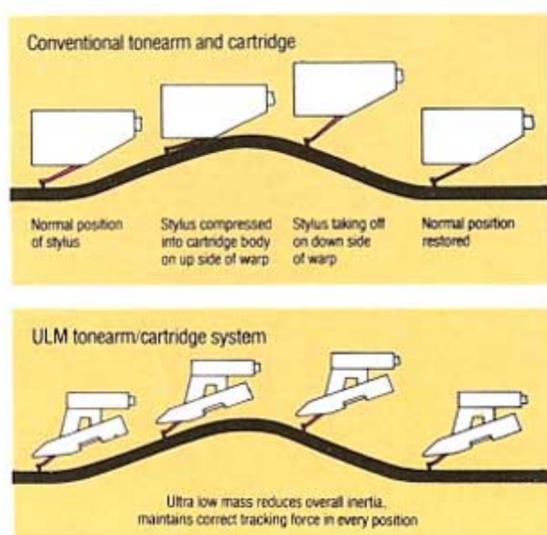
of-phase with the resonance, thus cancelling it.

This design, which Dual introduced several years ago, has now been further refined. The filter can be precisely tuned to match the tonearm to the mass and stylus compliance of all available cartridges.

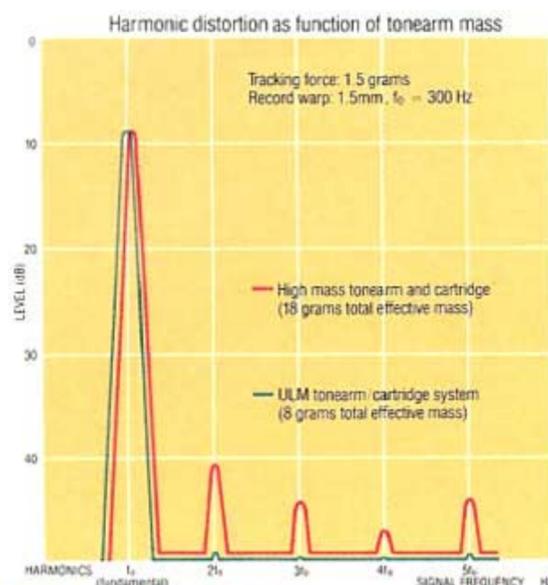
The tunable anti-resonance filter is featured on the 600 and 700 series direct-drive models and on the 1264 belt-drive model. All other Dual turntables have elastically damped counterbalances which are also very effective in damping tonearm and cartridge resonances.

The nine current Dual turntables are described on the following pages. All feature the ULM tonearm and cartridge system, plus many other important innovations that contribute to flawless tracking, better sound reproduction and longer record life.

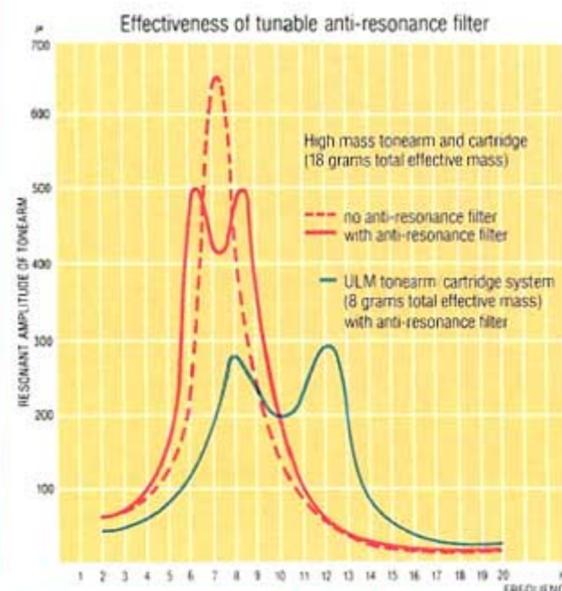
It is significant—but not at all surprising—that Dual is the only turntable manufacturer to have made such important contributions to record playback technology.



TOP: Conventional tonearm and cartridge with approximately 18 grams total effective mass: High inertia of this combination causes the stylus to dig in and take off as the warped surface rises and falls. Stylus angle and tracking force constantly change. Results: increased distortion and excessive wear of both stylus and record. BOTTOM: ULM tonearm and cartridge system with only 8 grams total effective mass: Stylus follows the warp easily, maintaining consistent tracking accuracy. The stylus can also follow the side-to-side movements of the record's eccentricities, so equal tracking force is maintained on each groove wall.



Influence of total effective mass on total harmonic distortion is demonstrated by test record with 300-Hz test tone and a series of 1.5 mm warps. (1.5 mm warps are not unusual for records made today.) Red line: conventional tonearm and cartridge with approximately 18 grams total effective mass generated 2.7 percent THD, which is clearly audible. Blue line: ULM tonearm and cartridge system reduces THD to only 0.01 percent. 270 times less!



Effect of tonearm and cartridge design on resonant amplitude is demonstrated three different ways. Broken red line: conventional tonearm and cartridge. Solid red line: Conventional tonearm and cartridge with addition of anti-resonance filter. (Amplitude reduced 20 percent.) Solid blue line: ULM tonearm and cartridge system with anti-resonance filter. Amplitude reduced 50 percent.)



# 714Q & 731Q

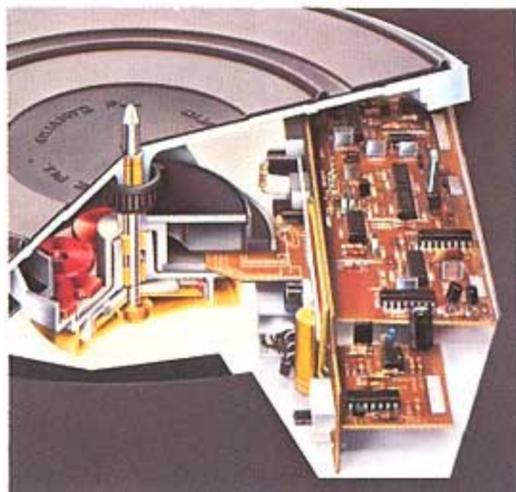
Single play, quartz PLL direct drive

- ULM tonearm and cartridge system (ULM 60E cartridge optional)
- Also accepts any standard 1/2-inch cartridge
- 8 gram total effective mass with ULM cartridge
- Tunable anti-resonance filter
- Four-point gyroscopic gimbal suspension
- Tracking force applied at pivot
- Multi-calibrated anti-skating system
- Variable cue-control descent speed
- Quartz PLL direct-drive system
- 11 percent pitch control
- Illuminated strobe
- Handsomely styled base and removable spring-loaded dust cover that remains open in any position
- Rumble: >78 dB (DIN B)
- Wow and flutter: 0.015 percent (WRMS)

All of Dual's technology comes brilliantly together in these two quartz PLL direct-drive turntables.

Both the 714Q and 731Q feature the ULM tonearm and cartridge system and tunable anti-resonance filter described on the previous pages. Operating controls are solenoid-activated and are located on the front panel, where they are accessible with the cover closed. (We think you'll appreciate the strikingly handsome metallic bronze front of the bases.)

Both models also offer the most advanced quartz phase-locked-loop (PLL) drive system ever developed. Unlike typical quartz drive systems, the quartz oscillator



The quartz PLL direct-drive motor developed by Dual for the 714Q and 731Q is all-electronic, brushless DC, with Hall-effect feedback control and regulated power supply.

is an integral part of the pitch-control system, providing absolutely reliable and repeatable changes over an 11 percent range. And unlike some quartz systems, the strobe is also referenced to the quartz oscillator for unwavering precision.

Performance of this drive system is extraordinary. Rumble is conservatively rated at better than 78 dB (DIN B) and wow/flutter is better than 0.015 percent (WRMS).



All Dual tonearms are mounted in this four-point gyroscopic gimbal. Tonearm mass is centered and pivots precisely where the vertical and horizontal axes intersect.

## 714Q semi-automatic

The innovative thinking of Dual engineers is typified by a unique feature of the 714Q: the lead-in groove sensor. Unlike other semi-automatic turntables, the 714Q makes it easy—even "automatic"—to locate the lead-in groove of either 12-inch or 7-inch records. No hunting, no guessing.

When you lift the tonearm and move it toward the record, a detent indicates the stylus is located precisely over the 12-inch record's lead-in groove. Move the tonearm further in and you will feel a second detent for the 7-inch record.

And here's another feature you'll appreciate. When you've located the lead-in groove you can safely let go of the tonearm. It will remain suspended over the record until you release it with the cue-control lever on the chassis or the solenoid-activated switch on the front panel.

The operation of the pitch control is also innovative. You can switch it on and set platter speed anywhere within an 11 percent range. Switch pitch control off and platter speed quickly returns to the

standard speed, but the pitch-control setting remains in memory. Thus by switching pitch-control in and out you can compare the effects.

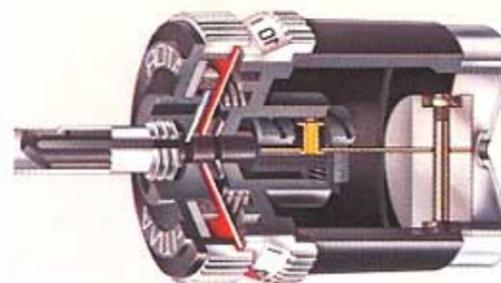
## 731Q fully automatic

The top of Dual's turntable line, the 731Q has even more operating conveniences than the 714Q.

Solenoid-activated controls on the front panel include: on/off, pitch control, start, stop and cue.

Start is fully automatic. A press of the "start" button lifts the tonearm, moves it to the record and sets it down in the lead-in groove. If you would like the record to replay automatically, simply set the continuous repeat switch. Play will then be repeated until you stop it.

The cue-control is damped in both directions, assuring smooth action of the tonearm without a hint of bounce. Cueing can be controlled either by the solenoid-



Tunable anti-resonance filter matches ULM tonearm to any cartridge. Resonant amplitude can be reduced from 20 to 50 percent, depending on cartridge. Feedback is reduced, tracking ability improved and the sound is audibly cleaner.

activated switch on the front panel or by the lever on the chassis. Further, the descent speed is variable.

An array of LED indicators supplements the illuminated strobe and provides clearly visible indications of all pitch-control variations throughout an 11 percent range.

ULTRA LOW MASS  
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# 6066, 622 & 650RC Single play, direct drive

- ULM tonearm and cartridge system (ULM 55E cartridge optional) • Also accepts any standard 1/2-inch cartridge
- 8 gram total effective mass with ULM cartridge • Tunable anti-resonance filter
- Four-point gyroscopic gimbals suspension • Tracking force applied at pivot • Multi-calibrated anti-skating
- Double-damped cue-control • CMOS-IC direct drive system • 10 percent pitch control
- Illuminated strobe • Handsome base and removable spring-loaded dust cover that remains open in any position
- Rumble: >75 dB (DIN B) • Wow and flutter: 0.03 percent (WRMS)

### Three fine examples of what Dual engineering is all about.

If you prefer a direct-drive system and don't require the unparalleled performance that only the Dual "Q" models can offer, one of the 600-series turntables is your best choice.

All three models feature the ULM tonearm and cartridge system and the tunable anti-resonance filter. The difference among them is in the degree of automation: the 606 is semi-automatic, the 622 fully automatic, and the 650 fully automatic with solenoid-activated controls and optional wireless remote control.

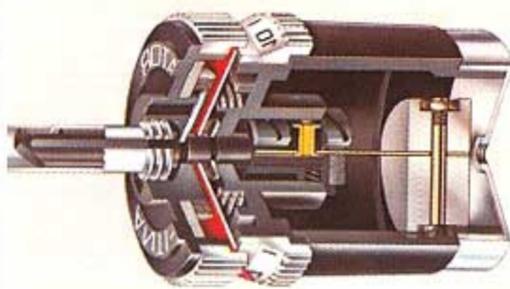


All Dual tonearms are mounted in this four-point gyrosopic gimbal. Tonearm mass is centered and pivots precisely where the vertical and horizontal axes intersect.

The direct-drive motor employed in each of these turntables is a highly-advanced DC servo type with high torque. The speed-monitoring system employs an extremely sensitive CMOS regulator circuit and integral frequency generator. Each rotation of the platter is subjected to 120 speed-accuracy checks—and any variation is instantaneously corrected. The end result: wow/flutter and rumble specifications well below the limits of audibility.

Pitch control is variable over a 10 percent range. And the illuminated strobe lets you see at all times whether speed has been set slow, fast or at exactly  $33\frac{1}{3}$  or 45 rpm.

Another feature shared by these three models is cue-control damped in both directions to prevent bounce. The tonearm lifts and lowers at the same smooth rate no matter how slowly or rapidly the cue-control is activated.



Tunable anti-resonance filter matches ULM tonearm to any cartridge. Resonant amplitude can be reduced from 20 to 50 percent, depending on cartridge. Feedback is reduced, tracking ability improved and the sound is audibly cleaner.

### 606 semi-automatic

The 606 is the lowest-priced direct-drive model in this series—but it differs from the other two only in its fewer automatic features. In all aspects of its precision design and quality performance, it is identical.

To begin play, you lift the tonearm from its rest post and move it toward the record. But from that point, you experience a typical Dual touch of precision.

You won't have to hunt for the lead-in groove. Dual's exclusive lead-in groove sensor does that for you. You will feel a detent when the stylus is located precisely over each lead-in groove where play should begin.

At the end of play, shut-off is automatic and complete.

### 622 fully-automatic

The 622 offers all the precision of the 606 plus two additional touches of automation. To begin play you need only press the start switch. The tonearm will lift, move to the record and descend for play. If you would like the record to replay automatically, simply set the continuous repeat switch. Play will then be repeated until you stop it.

### 650RC

The 650 RC is the wireless remote control version of the 622. Its operation is essentially identical. However, the 650 can be controlled from either the solenoid-activated controls on the bronzed front panel or by means of an optional wireless remote control system.

The remote control system includes two units: the RE 120 receiver which plugs into the unit and can be placed several feet away; and the wireless RC 152 transmitter. With this system the turntable can be started, stopped and cued from as far as 40 feet.

The infra-red system used, in conjunction with pulse-code-modulation principles, will not interfere with any other home electronic devices.



Wireless remote control operates start, stop, and cue. Infra-red and PCM technology prevents interference with other home electronic devices. Same system also operates new Dual 839 cassette deck. (650RC)

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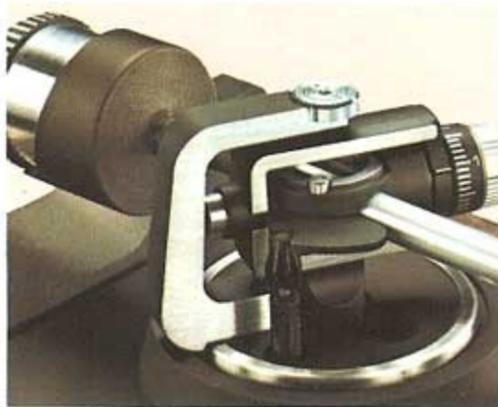
# 506 & 522

Single play, Vario-belt drive

- ULM tonearm and cartridge system (ULM 55E cartridge optional)
- Also accepts any standard 1/2-inch cartridge
- 8 gram total effective mass with ULM cartridge
- Four-point gyroscopic gimbal suspension
- Tracking force applied at pivot
- Multi-calibrated anti-skating
- Double-damped cue-control
- Vario-belt drive system
- 6 percent pitch control
- Illuminated strobe
- Handsome base and removable spring-loaded dust cover that remains open in any position
- Rumble: >70 dB (DIN B)
- Wow and flutter: 0.04 percent (WRMS)

**Moderately-priced turntables combining Dual precision engineering and reliable performance.**

These two single play, belt-drive turntables are excellent examples of Dual quality and value. Although moderately priced, each provides performance that will satisfy the most demanding requirements. Each also typifies Dual's rugged construction that assures many years of trouble-free opera-



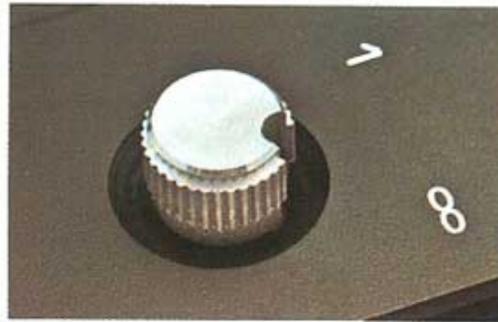
All Dual tonearms are mounted in this four-point gyrosopic gimbal. Tonearm mass is centered and pivots precisely where the vertical and horizontal axes intersect.

tion. And each has the many design features—including the ULM tonearm and cartridge system—so important for flawless sound reproduction.

The 506 and 522 also feature Dual's unique, patented Vario-belt drive system with high-torque synchronous motor, Vario-pulley and precision-ground belt.

Speeds can be changed even while the platter is rotating, and the belt is never twisted or distorted. Speeds are adjusted by expansion and contraction of the Vario-pulley.

Every element of this drive system is designed and engineered to assure a high degree of speed



Continuous repeat allows any record to be played automatically as many times as desired. (522)

accuracy and the virtual absence of drive-system vibration, the primary source of rumble.

For example, the rotor of every motor is dynamically balanced in all planes of motion. Each Vario-pulley is individually machined of phosphor-bronze and examined with precision instruments to ensure perfect balance and concentricity. The drive belt is precision-ground to close tolerances in order to eliminate weak spots that shorten belt life.

The materials selected for these turntables, the close tolerances in the fabricating of each part, the craftsmanship employed in every manufacturing process and the constant quality control checks during assembly—all contribute to the many trouble-free years you can expect to enjoy these fine turntables.

## 506 semi-automatic

Here is Dual precision engineering in our lowest-priced single-play turntable.

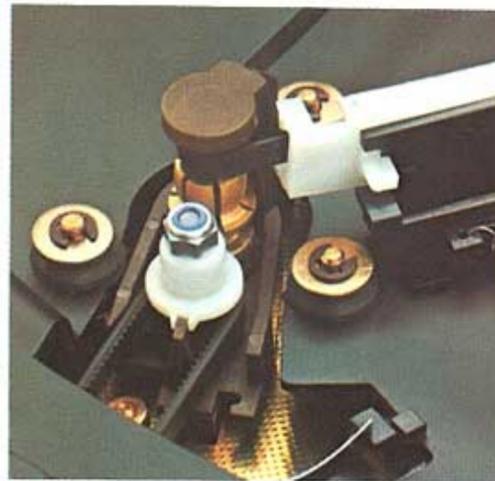
This model includes all the benefits of the ULM tonearm and cartridge system: flawless tracking, extended record and stylus life, audibly improved sound.

To begin play, you can confidently lift the tonearm from its

resting post, move it to the record and then release it. The tonearm won't drop to the record, but will remain suspended safely over it until you flick the cue-control lever. There's no possibility of damaging the stylus or record.

And you don't have to remember to set the cue-control in the up-position—that's done for you automatically at the end of each play when the tonearm lifts from the record and the motor shuts off.

Other features include 6 percent pitch control and illuminated strobe.



Every element of the Vario-belt drive system accounts for accuracy and durability. Vario-pulley is individually machined from phosphor-bronze for perfect concentricity and balance. Belt is precision-ground to eliminate weak spots that can shorten life.

## 522 fully automatic

As with each group of Dual single-play models, the difference between the 506 and 522 is the degree of automation. If you prefer the total convenience of fully automatic start, the 522 will be your choice.

It also offers the added feature of continuous repeat at any time by merely presetting the switch provided.

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# 1257 & 1264

## Multiple-play, Vario-belt drive

- ULM tonearm and cartridge system (ULM cartridges optional)
- Also accepts any standard 1/2-inch cartridge
- 8 gram total effective mass with ULM cartridge
- Tunable anti-resonance filter (1264)
- Four-point gyroscopic gimbal suspension
- Tracking force applied at pivot
- Multi-calibrated anti-skating
- Double-damped cue-control
- Rotating single-play spindle
- 6-record multiple-play spindle
- Vario-belt drive system
- 6 percent pitch control
- Illuminated strobe
- Handsome base and removable spring-loaded dust cover that remains open in any position
- Rumble (DIN B): >68 dB (1257), >70 dB (1264)
- Wow and flutter (WRMS): 0.05 percent (1257), 0.04 percent (1264)

**The ULM tonearm system plus an hour or more of uninterrupted play**

Perhaps the first decision you will make about your next turntable is how much automation you would like and whether it should provide multiple-play as well as single-play.

For years the most serious music lovers, including audio editors and record reviewers, have enjoyed the convenience of multiple-play knowing that the way records are changed on a Dual assures no loss in record performance or longevity.

For example, records stacked on Dual's multiple-play spindle are, in effect, given "single-play" treatment. (See illustration)

Dual's patented single-play spindle is designed to function as an integral part of the platter so that it rotates with the record. This contributes importantly to the low wow and flutter specifications of these Dual turntables.

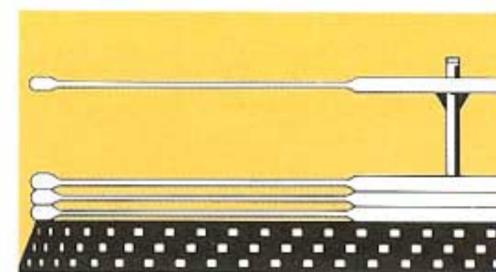
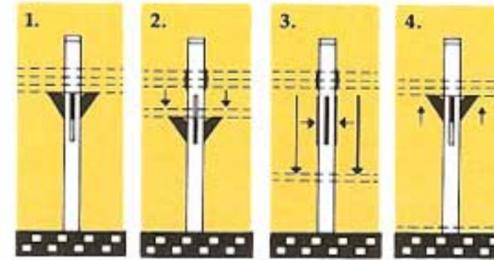
Throughout play, the tonearm is completely disengaged from the automatic cycling mechanism—just as with all Dual single-play models. In short, there is no compromise in performance.



All Dual tonearms are mounted in this four-point gyrosopic gimbal. Tonearm mass is centered and pivots precisely where the vertical and horizontal axes intersect.

# 1257

This is our lowest-priced turntable, yet we confidently invite you to compare it with anyone else's highest-priced turntable.



Dual's exclusive elevator-action spindle. 1) Records are supported entirely by platform. 2) Bottom record is lowered away from stack above. 3) Platform retracts, gently releasing record to platter. 4) Platform rises to engage stack.

Record-groove surfaces never touch when stacked. Raised edges and centers leave air cushion between grooved areas.

You're not likely to find a tonearm that seriously matches the 1257's ULM tonearm with its four-point gimbal suspension and all the other design features it shares with other Dual tonearms.

You might, in fact, compare the 1257's tonearm with any of the most exotic separate tonearms available. You'll find they cost as much as the entire 1257.

The 1257's many features include these: The cueing system is damped in both directions to prevent bounce. Pitch-control is variable over a 6 percent range, and the strobe is illuminated. Vertical-bearing friction is astonishingly low—less than 8 milligrams.



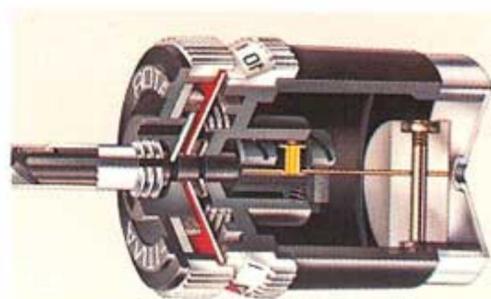
The tonearm can track as low as 0.25 gram—any cartridge can operate at its own optimum tracking force.

And if you compare the 1257 with the higher-priced Dual turntables, you'll find they have additional refinements but no difference in design integrity or manufacturing quality.

The specifications, performance and reliability of this extraordinary turntable make it the best value that Dual has ever offered.

# 1264

Our finest multiple-play model is the Dual that offers everything in precision design and versatility. It features the ULM tonearm and cartridge system and the tunable anti-resonance filter. Also: cue-control damped in both directions, 6 percent pitch control and illuminated strobe.



Tunable anti-resonance filter matches ULM tonearm to any cartridge. Resonant amplitude can be reduced from 20 to 50 percent, depending on cartridge. Feedback is reduced, tracking ability improved and the sound is audibly cleaner.

The 1264's operation is not only fully automatic, but includes continuous repeat as well.

All this, plus its superb specifications makes the 1264 the finest of all the multiple-play turntables available anywhere.

## Quick comparison of features and specifications

Operation	Multi-Play Turntables		Single-Play Turntables						
	1257	1264	506	522	606	622	650RC	714Q	731Q
Manual start & stop	all models								
Automatic start & stop	yes		stop only	yes	stop only	yes		stop only	yes
Rotating single-play spindle	yes								
Multi-play (6 records)	yes		not applicable						
Damped cue-control	all models								
Pitch-control range (%)	6%			10%			11% quartz-locked		
Continuous repeat	no	yes	no	yes	no	yes	yes	no	yes
Lead-in groove sensor	n/a		no	n/a	yes	n/a	n/a	yes	n/a
<b>Tonearm design</b>									
Four-point gimbal	all models								
Effective length (inches)	8¼		8¾						
Bearing friction (grams)	0.008		0.007						
Total effective mass	8 grams (with ULM cartridge)								
Cartridge wt. range (grams)	2-9								
Min. tracking force (grams)	0.25								
Anti-skating system	calibrated for all stylus types								
Tunable anti-resonance filter	no	yes	no				yes		
<b>Motor and drive system; platter</b>									
Motor type	high-torque synchronous				DC electronic; CMOS			DC quartz; P.L.L.	
Drive system	Vario-belt drive				direct drive				
Platter size	10½" dia.		12" dia.						
Illuminated strobe	yes							yes, quartz-synched	
<b>Specifications</b>									
Rumble (wtd. DIN B)	>68 dB		>70 dB		>75 dB		>78 dB		
Wow/flutter (WRMS)	±0.05%		±0.04%		±0.03%		±0.015%		
<b>Dimensions: bases &amp; covers</b>									
Chassis (inches)	13 x 10.75		14.75 x 12						
Base (inches)	16.5 x 14.5 x 3.5								
Height with cover (inches)	7¼		5.18						
<b>ULM cartridge series specifications</b>									
Model	ULM 50E		ULM 55E				ULM 60E		
Stylus type	6 x 18 µm, biradial diamond								
Tracking force (grams)	1.50-2.50		1.25-1.75				0.75-1.50		
Frequency response	10 Hz-25 kHz								
FIM distortion	<1%		<0.8%						
Output voltage	>0.7 mV/1 cms <sup>-1</sup> per channel @ 1 kHz								
Compliance (µm/mN)	20		25				30		
Channel separation @ 1 kHz	>23 dB		>25 dB				>28 dB		
Net weight (grams)	2.5, including mounting bracket and hardware								

Printed in USA

## Nearly eight decades of precision manufacturing

The highest standards of craftsmanship have been a way of life for nearly eighty years with the Dual people of the Black Forest. Today, the third generation of the founding family heads the company, with the same dedication to care and precision that has made Dual internationally respected.

Nowhere is this more evident than in the assembly and test lines. Every fifth assembly step is immediately followed by a quality-control check. One entire quality control department is dedicated to quality assurance for the motors alone. Fully assembled Duals then undergo three more quality-control check procedures. One is for mechanical operation; another for electrical and acoustical performance. Then, just before shipment, a separate group of quality control auditors randomly select one out of ten finished and packed models and inspect the *quality of the quality control*.

This is why you can select even the lowest-priced Dual and be confident of getting the finest playback performance and reliability. Every Dual turntable carries a two-year limited warranty.



United Audio, 120 So. Columbus Ave., Mt. Vernon, New York 10553