

## Equipment Profiles (continued)

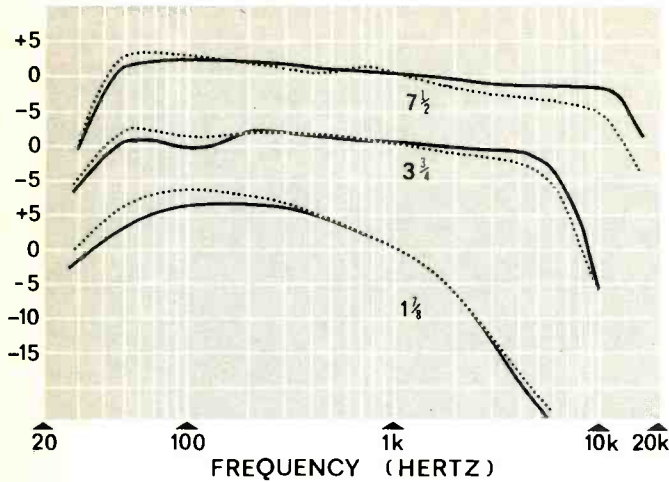


Fig. 3—Record/play curves for the Panasonic RS-761S Tape Recorder.

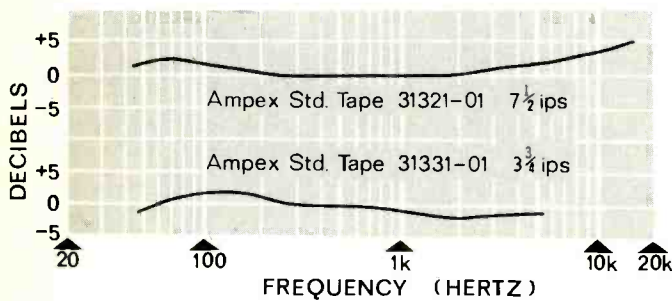


Fig. 4—Playback response from Ampex Standard Tapes.

playback mode as well as when recording.

The electrical signal output from a standard frequency tape shows the response to be within  $\pm 3$  dB from 40 to 15,000 Hz at  $7\frac{1}{2}$  ips, and  $\pm 2$  dB from 40 to 5000 at  $3\frac{3}{4}$ —these frequencies being the limits of our standard tapes.

With signals recorded at a constant input level and played back, the response was within  $\pm 5$  dB from 40 to 16,000 Hz at  $7\frac{1}{2}$  on the left channel, and within  $\pm 7$  dB on the right channel. At  $3\frac{3}{4}$  ips, the response measured  $\pm 5$  dB from 30 to 8000 Hz, with the two channels differing by not more than 2 dB. At  $1\frac{1}{8}$ , response was within  $\pm 5$  dB from 30 to 2200 Hz. The manufacturer's specs do not indicate any tolerances, unfortunately, so our measurements cannot be compared. These figures are respectable for a complete system in the RS-761S's price category, however.

Tone-control action was relatively gentle, providing very little bass boost and about 8 dB of cut at the low end, and about 3 dB of boost and 10 dB of cut at the high end. While these tone-control figures do not sound very impressive, it is surprising how effective they are with the system's speakers. (Tone-control circuits were modified in early production to meet the follow-

ing specifications, according to the manufacturer: Bass,  $\pm 10$  dB at 100 Hz; Treble,  $+10$ ,  $-15$  dB at 10 kHz. —Ed.)

Rewind time clocked 2:58 for a 1200-ft. reel of tape, while fast forward required 3:25 for the same reel. These figures are slower than normal for machines in this general category. The 50-kHz bias frequency is lower than generally used for modern tape recorders; if it appears on the tape it might show up on a stereo recording from a tuner as a 12-kHz squeal.

Crosstalk between channels measured slightly better than 40 dB at 1000 Hz, and about 34 dB at 10 kHz, which is good. Distortion measured below 3% at the speaker jacks up to 1 W output, rising to 5% at 3 W. An output of 1 W provided an adequate listening level with the system's highly efficient speakers.

In summation, the Panasonic RS-761S is a handsome machine, with dark wood, chrome, and black employed tastefully in both the recorder and the loudspeakers. The machine is easy to thread, and easy to operate, with a transport that handles tape gently. Panasonic's RS-761S certainly offers one a nice, complete tape package at \$269.95.

Check No. 44 on Reader Service Card

## Dual Model 1015 Automatic Turntable

**MANUFACTURER'S SPECIFICATIONS—**  
Speeds:  $16\frac{2}{3}$ ,  $33\frac{1}{3}$ , 45, and 78 rpm.  
Operation: Manual, auto-single, or auto-changer. Pickup Arm: Dynamically balanced. Tracking Force: 0 to 5 grams.  
Price: \$89.50.

Transcription turntable/tone-arm combinations probably received their first real challenge from record changers when changers' tone arms were decoupled during play from the crude springs, levers, and cams of their arm-lifting and record-changing mechanisms. A host of other improvements followed—reduced wow and flutter, lower rumble, less tone-arm pivot friction to permit tracking with newest phono cartridges, anti-skating compensation to further reduce tracking-force requirements, cueing devices, and so on.

Today, there are few practical advantages of the finest manual turntable/tone-arm combinations over the finest automatic changers in the manual playing mode). The former is less complex mechanically, of course, and therefore potentially more reliable. Manual types also remain more flexible in being able to be mated to various tone arms to achieve optimum performance. Additionally manual types are designed for operation with one record only, rather than from one to, say, 10, so that the weight imposed on the turntable platter remains constant, and the tone arm always "rides" parallel to the record. The changer, on the other hand, offers the convenience of automatic start and stop, not to mention the ability to play several record sides in sequence when desired. And catching up in many respects to performance capabilities of the manual types, changers indeed have earned the appellation, "automatic turntables." Depending on applications, then, we need both types.

The Dual automatic turntables, as they are sometimes called, have been in the forefront of the record changer's challenge to manual turntables. The Dual Model 1015 continues this tradition. (A new version of the 1015, the 1015F, is identical to the model examined here with the following exceptions: It has a variable-speed control which permits each speed to be varied over a 6% range, and the  $16\frac{2}{3}$  speed is eliminated. The price remains the same.—Ed.)

Similar in appearance and operation to the costlier Dual 1009SK (\$20.00 more), it is a nicely made piece of ma-

## Equipment Profiles (continued)

chinery that performs exceptionally well by standards for both manual and automatic units. The price differential between it and the 1009SK is due to a single-play spindle that does not revolve with the record; a two-piece vs. one-piece cast platter; a different arm counterweight, and a different motor.

An idler wheel, driven by the stepped pulley on the motor's shaft, connects to the inside rim of a cylindrical sub-platen, riveted to the main one. The 4-lb., cast, non-ferrous turntable platen is not dynamically balanced (at least it shows no signs of balancing holes or slugs) and uses a ball-bearing thrust brace support for the brass sleeve on which it rests. Teeth cast into the outside of the shaft form a gear which drives the record-changing mechanism.



Fig. 1—Dual Model 1015 Automatic turntable.

A ribbed rubber pad with raised "gunwales" to support the record is fixed to the turntable. The "gunwale," together with two other concentric smaller ribs, help in supporting warped records. The turntable itself is 10 $\frac{5}{8}$ -in in diameter.

The tubular tone arm, with a sliding counterweight that is lockable in any position, is supported by hardened steel points, each supported by ball bearings. In the horizontal plane, double ball-bearing races are used. Tracking force is applied at the pivot point by a multiple-coiled mainspring. A calibrated dial sets in the desired tension. This dial was found to be accurate to within 0.1 gram.

The anti-skating compensation is applied by means of a spring which pulls on a finger extended from behind the arm pivot. Though the spring is stretched as the arm moves toward the disc's center, compensation remains essentially constant due to the angle which correspondingly reduces the pull of the spring. The amount of anti-skating compensation is set with a second calibrated dial located in front of the base of the tone-arm pedestal post. One simply turns this dial to the

same number appearing on the stylus force dial. Dual uses about 12% as the ratio of the anti-skating force and stylus force (playing weight). Naturally, the ratio can be changed by altering the anti-skating dial setting relative to the tracking force. We found this anti-skating compensator as effective as any that we have seen thus far. For those who have forgotten, skating force is a term used to describe an undesirable inward force exerted on the stylus (therefore the tone arm).

The arm's cartridge holder accepts all cartridges with the standard half-inch mounting-screw spacing (which includes just about every cartridge). The cartridge holder drops out of the tone arm when the arm's finger lift is pushed to the rear. A plastic gauge,

which snaps over the cartridge holder, allows accurate overhang adjustment by acting as a benchmark for sliding the cartridge forward and backward. A tapered wedge, also supplied, provides optimum 15-deg. tracking angle when one record is on the turntable—in case one plays a single record exclusively or primarily. Dual thought of everything, it seems. The vertical tracking angle of the stylus increases as the stack of records already on the turntable increases, and the object is to remain as close to 15 deg., the current standard, as possible. In order for the stylus to maintain a 15-deg. angle at every disc up to, say, 10 discs, either the arm or the cartridge would somehow have to be raised by increments proportional to the record stack. But many records have been cut not at the standard 15-deg. angle but anywhere between 0 and 25 deg. Furthermore, pickup cartridges vary also, though not as much anymore. Therefore, the 15-deg. requirement is not too critical and could be set up to average out in the record stack—which is what Dual does in the 1015. The difference between the first and the 5th record is just a few degrees. The purist can still set it to

record #1, if he so chooses.

The Dual 1015 can be operated manually, automatically, or anywhere in between. It has a fabulous manual lever-actuated lowering and raising device that gently and *accurately* lowers and raises the tone arm for use when playing a certain portion of a disc, for instance. The control was so true in its lift and drop that, barring an off-center record and other variables, it was possible to lower the arm so that the stylus descended back into the same groove from which it was lifted. (However, a two- or three-groove variation would generally be expected due to eccentricity of grooves, etc.) The anti-skating force doesn't seem to affect the lift here, though it does affect lifts in some other tone arms that we have tried. Aside from the manual cue control, a single lever controls all start, stop, and reject functions of the unit. During changer operation, the large "elevator action" spindle, which holds up to 10 records, lifts the stack except for the bottom disc, which is released to drop to the turntable. A silent cam-operated muting switch shorts the phono output during cycling.

### Performance

We tested this unit using two popular phono cartridges. The horizontal and vertical friction of the arm pivot were too low for us to measure, which makes it an exceptionally low friction (Dual claims .04 horizontal and .01 vertical). The sideways arm thrust required to trip the changing mechanism at the run-out grooves measured under half a gram (Dual says it's  $\frac{1}{4}$  gram). In any case, the unit is suitable for the most compliant of high-compliance cartridges around these days. A cartridge tracking at just  $\frac{1}{2}$  gram trips the mechanism, which is a neat feat.

Rumble, including vertical and lateral components, came out to -33 dB and -38 dB with vertical components cancelled (mono operation). This is unweighted rumble, referred to 3.54 cm/sec 45-deg. velocity at 1000 Hz, the standard NAB reference for rumble measurement. These are excellent figures, surpassed only by the very best manual turntables and Dual's own higher-priced automatic units. Wow and flutter was checked at .07%, which is also a very good figure.

At 33 $\frac{1}{3}$  rpm and one record playing, the turntable of our sample was more than 1% fast. (*The upcoming 1015F has a variable speed control to cor-*

rect for such a deficiency.—Ed.) Speed was constant over line-voltage variations between 95 and 125 volts. We got perfect 33 $\frac{1}{3}$  rpm speed at 85 volts input from a Variac.

Tone arm tracking error, a function of length and offset angle of the cartridge, was very low.

In playing records at a tracking force of 2.5 grams, the Dual 1015 performed flawlessly, though slightly fast. The arm has a smooth feel to it, the motor is quiet, and the changing mechanism is gentle. When using a cart-

ridge that was not well shielded, the changer's motor induced some hum through a wide-range stereo system.

When the changer is mounted on a base, it rests in its three soft, damped springs for isolation from vibrations and acoustic feedback. We found this quite effective. But the main reason for the excellent vibration resistance of the 1015 is its tone-arm design. This was proved by mounting the unit in several different ways while subjecting it to feedback and vibration-inducing conditions. One mounting technique was to

leave it in its starchy styrofoam packing material, which, incidentally, makes an excellent temporary base.

In all, the Dual 1015 is an exceptionally fine medium-priced automatic turntable. Considering the soon-to-be-introduced 1015F's addition of a variable speed control, while eliminating the generally useless 16 $\frac{2}{3}$ -rpm speed, it's worth waiting for. Price of the new version remains the same (\$89.50).

Check No. 46 on Reader Service Card

## Shure Model SM60 Dynamic Microphone



**MANUFACTURER'S SPECIFICATIONS—**  
Polar Pattern: Omnidirectional. Impedance: 150 ohms (matches inputs from 50 through 250 ohms). Output level: -59 dB (0 dB = 1 mW with 10 microbars.) EIA Sensitivity Rating: -153 dB. Net weight: 6 oz. (less cable). Dimensions: 1 $\frac{1}{4}$ " diam., 6 $\frac{1}{4}$ " long. Cable: 20-ft. 2-conductor shielded broadcast type, with Cannon XLR-3-11C connector on microphone end. Accessories furnished: Swivel "snap-in" adapter; cloth protective cover. Net Price: \$49.20.

The dynamic microphone has proved itself for applications where rugged, self-contained, and versatile transducers are required. While the condenser microphone has become the standard for measurement purposes, as well as for applications requiring the highest possible quality, it does have the disadvantage of requiring a source of polarizing voltage for the capsule and another source for the heater and

anode current for the cathode follower (in more recent models, a source of current for the FET, which is taking over from the vacuum tube in the latest models).

The ribbon microphone, long the standard in the broadcast industry, is still used for certain applications where its "Figure-8" pattern is desirable, but even that pattern can be duplicated by either dynamic or condenser microphones. The dynamic, however, is the workhorse of radio and TV studios, and it has become the standard for public address uses, and is practically universal in the home recording field. Its simplicity and reliability have earned for it the "workhorse" cognomen.

There are many grades of dynamic microphones, however—some can be purchased for as little as \$7.00, and some cost as much as \$150.00. This one has a practical price at \$49.20 net, but is a quality product, listed by Shure as a professional model. The SM60 is essentially omnidirectional, showing only a slight directionality in the higher frequency range, largely due to its physical construction (the body of the unit provides some shielding against high-frequency sounds coming directly from the rear.)

The microphone body is  $\frac{7}{8}$ -in. in diameter, (the same diameter as the Cannon plug) expanding to a maximum of 1 $\frac{1}{4}$ -in., and then tapering down to its 1-in. business end. Its overall length is 6 $\frac{1}{4}$ -in. giving it attractive proportions. The body is a steel tube,

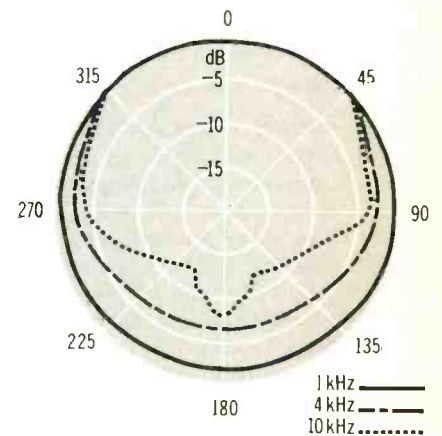


Fig. 3—Polar-response curves for the SM-60 microphone at three different frequencies.

with a non-ferrous tapering section topped by a steel protective grille, which houses the built-in wind and pop filter which eliminates the need for add-on windscreens for outdoor use. Finish is matte chrome. Because of the low impedance, no transformer is required, which eliminates one possible source of distortion. The cartridge ground and case ground are connected to terminal 1 of the Cannon receptacle (the usual professional practice), with the two coil leads appearing on terminals 2 and 3.

The microphone is provided with a plastic snap-in swivel adapter adjustable from vertical to horizontal, and threaded to fit the usual  $\frac{5}{8}$ -27 microphone stand.

Fig. 2—Frequency response of Shure SM-60 microphone on axis.

