

**“The 1-kHz square-wave response is the flattest I have ever seen, with very little or no overshoot.”**

With this test record, it is a simple matter to determine the Total Trackability Index (TTI) of any cartridge as a single numerical figure. Trackability is defined as the ability of a cartridge to maintain contact with record-groove walls in the presence of high-amplitude, high-velocity, and high-acceleration audio signals. The TTR-117 contains three test tones, representing low, medium, and high musical frequencies combined and weighted to create a single trackability test signal. At graduated velocity levels, the signal is representative of actual recorded music. By following directions on the record jacket, it is possible to determine the TTI for any phono cartridge. In addition to the TTI, the TTR-117 test record provides for testing arm-cartridge resonance, level, channel balance, and skating compensation. The skating compensation band provides an excellent way to accurately set the anti-skating adjustment of practically any tonearm one might use.

#### Measurements

The Shure V15 Type V phono cartridge was mounted in a Technics EPA-A501H interchangeable arm unit used with the Technics EPA-500 tonearm mounted on a Technics SP-10 Mk II turntable. The cartridge was oriented in the headshell and tonearm with the Shure Duo-Point Alignment Gauge and Leveling Alignment Stylus. The cartridge alignment was then checked with the Dennesen Geometric Soundtracktor and the two gave identical results. The vertical stylus alignment was made with the Shure Leveling Alignment Stylus.

Laboratory tests were conducted at an ambient temperature of 72° F (22.22° C) and a relative humidity of 65% ±3%. The tracking force for all reported tests was 1.0 gram, with an anti-skating force of 1.6 grams. The load resistance was 47 kilohms, and load capacitance was 262 pF. All reported measurements were made without using the Dynamic Stabilizer except when measuring the arm-cartridge resonance, where the measurements were made both with and without the damping device. By using this technique, I was able to measure the actual phono cartridge parameters. The listening tests were also done with and without the Dynamic Stabilizer. As is my practice, measurements are made on both channels, but only the left channel is reported unless there is a significant difference between the two channels, in which case both channels are reported for a given measurement.

The following test records were used in making the reported measurements: Columbia STR-170, STR-100, STR-112; Shure TTR-103, TTR-109, TTR-110, TTR-115, TTR-117; Deutsches HiFi No. 2; Nippon Columbia Audio Technical Record (PCM) XL-7004; B & K QR-2010, and Ortofon 0002, A5906A-1, and A5906B-1.

Frequency response, using the Columbia STR-170 test record (Fig. 1), was +0.75, -0.5 dB from 40 Hz to 20 kHz, and +0, -0.5 dB from 1 kHz to 20 kHz. Separation was 28.5 dB at 1 kHz, 29.25 dB at 4 kHz, 25.25 dB at 10 kHz, 27.25 dB at 12 kHz, 23.75 dB at 15 kHz, and 21.75 dB at 20 kHz. From these data it is quite evident that the V15 Type V has an excellent frequency response and a very good high-frequency separation. I believe this is the flattest cartridge frequency response I have ever measured.

The 1-kHz square-wave response, Fig. 2, is the flattest I have ever seen, with very little or no overshoot followed by very low-level ringing that was probably cut into the record at the time it was made. This square-wave response was produced without the use of the Dynamic Stabilizer. The arm-cartridge low-frequency resonance was almost impossible to measure with the EPA-A501H arm unit. It was necessary to disable the arm's anti-resonance unit and, also, not use the Dynamic Stabilizer. Following this procedure, two lateral low-frequency resonance points were identified—one at 8 Hz with a 1 dB rise and the second at 12 Hz with a 4.5 dB rise. Vertical resonance is at 7 Hz with a 4.5 dB rise. Neither the lateral nor the vertical arm-cartridge low-frequency resonance was measurable when the arm's anti-resonant unit and the Dynamic Stabilizer were used. The high-frequency resonant point is at 37 kHz.

Using the Dynamic Sound Devices DMA-1 Dynamic Mass Analyzer, the arm-cartridge dynamic mass was measured as 10.25 grams, and the dynamic vertical compliance as  $30 \times 10^{-6}$  cm/dyne at the vertical resonant frequency of 7 Hz. Both the anti-resonant unit on the arm and the Dynamic Stabilizer were defeated for this test.

The harmonic distortion components of the 1-kHz, 3.54 cm/s rms 45° velocity signal from the Columbia STR-100 are: 1.8% second harmonic and 0.5% third harmonic, with less than 0.2% higher order terms.

The vertical stylus angle measured 24.5° using the Vertical Tracking Angle Meter (Inclination Meter), Model 3002, developed by the CBS Technology Center (227 High Ridge Rd., Stamford, Conn. 06905). Other measured data are:

Wt., 6.76 g; d.c. res., 884 ohms; ind., 384.5 mH; opt. tracking force, 1.0 g without and 1.5 g with the Dynamic Stabilizer; opt. anti-skating force, 1.6 g; output, left 0.93, right 0.99 mV/cm/s; IM distortion (4:1): +9 dB lateral, 200/4000 Hz, left: 1.2%, right: 3.1%; +6 dB vertical, 200/4000 Hz, left: 1.5%, right: 2.9%; crosstalk (using Ortofon A5906B-1) left: -30 dB, right: -26.4 dB; channel balance, 0.5 dB; trackability: high freq. (10.8 kHz, pulsed), 30 cm/s, mid-freq. (1000 and 1500 Hz, lat. cut), 31.5 cm/s, low freq. (400 and 4000 Hz, lat. cut), 30 cm/s; Deutsches HiFi No. 2, 300-Hz test band was tracked cleanly to 86 microns (0.0086 cm) lateral at 16.2 cm/s at +9 dB and 43.1 microns (0.00431 cm) vertical at 8.12 cm/s at +3.64 dB. I checked this parameter with two other Type Vs and obtained the same results with this test record as well as with other manufacturers' similar test records.

The Shure V15 Type V phono cartridge played all the test bands cleanly on both the Shure Obstacle Course—Era III and the Era IV musical test records, at 1.0 gram, without mistracking. The newest Shure test record, the Audio Obstacle Course—117, presented no problem to the Type V as it played the six trackability test bands without mistracking. Accordingly, the Total Trackability Index for the V15 Type V measured 103. I doubt that very many cartridges will be able to accomplish this feat.

#### Use and Listening Tests

When listening to records I find the need for absolute stylus cleanliness imperative, regardless of who made the cartridge, for no stylus is immune to its natural enemy—dust