

Stereo Review

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Citation Twenty-Three Active Tracking Tuner

harman/kardon

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As part of the recently revived Citation line of premium-grade components, Harman Kardon has developed an innovative AM/FM tuner, the Citation Twenty-Three. The FM section of the tuner features an unusual circuit design, called Active Tracking, to provide exceptional selectivity when needed without sacrifice of any audible performance qualities during normal operation.

In a conventional FM tuner, selectivity—the ability to discriminate against interference from signals removed in frequency by one or two channels from the desired station—is provided by band-pass filters in the intermediate-frequency (IF) amplifier. Today's tuners use ceramic filters that require no adjustment. The bandwidth of an FM tuner's IF section must be at least 150 kHz to pass a fully modulated signal without distortion, and it is usually somewhat greater than that. Most tuners are able to reject signals 400 kHz from the desired one (alternate channels) without difficulty, but adjacent channels (200 kHz away) can present a severe problem. Typical adjacent-channel selectivity measurements are in the 3- to 5-dB range, which in practical terms means that the tuner simply cannot reject such interference effectively.

Some tuners have narrow-band filters than can be switched into the circuit when needed, but these typically introduce a large phase shift and amplitude change near the outer limits of the filter pass-band, causing significantly higher distortion and degraded channel separation and capture ratio. Harman Kardon's solution to the

problem is the Active Tracking system. When high adjacent-channel selectivity is needed, the usual IF filtering system is augmented by a phase-locked loop (PLL) similar in principle to the circuits used in stereo multiplex demodulators and in the digital-synthesis tuning sections of almost all tuners. Although few specific details were available, the following is our understanding of the operation of this circuit.

“The adjacent-channel selectivity...not only far surpassed the specifications, but has never been approached by any other FM tuner we know of.”

Basically, a PLL system “locks” the frequency of a voltage-controlled oscillator (VCO) to a signal from another source. In the Harman Kardon Active Tracking system, a local oscillator is locked to the instantaneous IF frequency (at the output of the mixer stage) and accurately follows its variations. The tracking limits of the system are set just beyond the maximum allow-

able frequency deviation of an FM broadcast signal (± 75 kHz). The VCO's output effectively replaces the original signal; the difference is that it does not include interfering signals from an adjacent channel.

The tuner's resulting *effective* IF-stage frequency response has “skirts” much steeper than those of tuners using conventional filters. Because the Active Tracking circuit excludes the low-level modulation sidebands that lie outside its ± 75 -kHz limits, but are vital to the accurate reproduction of the original program, certain tuner characteristics—such as capture ratio, channel separation, and distortion—are somewhat degraded, though not to an audible degree.

Like most contemporary tuners, the Citation Twenty-Three uses digital-synthesis tuning, but, unlike most, the desired frequency is set by a rotary knob. The knob, whose motion is smoothed by a flywheel, drives an optical shaft encoder that sends digital codes to the synthesizer circuits. To a user, the effect is much like that of an analog tuner except that the frequency changes in discrete steps of 100 kHz (10 kHz for AM). A fine-tuning feature, however, is enabled whenever the Active Tracking system is selected, and it can be used to adjust the frequency over a ± 25 -kHz range, which can help eliminate interference from a strong adjacent-channel signal by slightly detuning toward the desired signal.

Except for the large tuning knob and small FINE TUNING knob, all of the

operation controls of the Citation Twenty-Three are pushbuttons. Each button contains a green light that comes on when it is pressed. The display window has green LCD signal-strength indicators and large frequency numerals. The word "Stereo" appears when a stereo FM broadcast is received. Pressing the HI-Q button turns on the Active Tracking circuit and the FINE TUNING knob next to it. "Fine Tuning" and a center-tuned symbol then appear in the window; the symbol is replaced by left or right arrows as the FINE TUNING knob is turned. When the frequency is changed to another channel, the HI-Q circuit automatically disengages.

Each of the eight preset buttons can be switched between two frequencies by another button. The sixteen available preset channels can be divided between the FM and AM bands as desired. The interstation muting is turned on or off by a mute button, and a small knob on the rear apron adjusts the muting-threshold level. A group of four buttons selects the AM or FM band, mono mode, and seek tuning, in which the tuner scans the band and stops at the first signal whose strength exceeds its muting threshold. Unconventionally, a slight turn of the tuning knob is used to begin a scan from the current frequency.

The rear apron of the Citation Twenty-Three has binding-post terminals for AM and 300-ohm FM antennas and a coaxial F connector for a 75-ohm FM antenna. A hinged, removable wire-loop AM antenna is furnished. There are gold-plated fixed- and variable-level audio output jacks; the adjustment for the variable outputs is also on the rear. The tuner has a single unswitched AC outlet.

The Citation Twenty-Three tuner is supplied with a wireless remote control that duplicates all its front-panel controls except the HI-Q and fine-tuning systems. Using the remote, the tuner frequency can be varied by a pair of pushbuttons. The tuner is finished in black and measures 17 $\frac{3}{8}$ inches wide, 14 $\frac{1}{8}$ inches deep, and 2 $\frac{3}{4}$ inches high. It weighs 15 pounds. Price: \$650. Harman America, Dept. SR, 240 Crossways Park West, Woodbury NY 11797.

Lab Tests

We made most of our measurements in both the normal and HI-Q operating modes. The tuner's sensitivity was good in the normal mode, but in the HI-Q mode it was somewhat reduced. The noise level was slightly lower than rated in both modes. Alternate-channel selectivity comfortably

surpassed the ratings. The adjacent-channel selectivity, an average 5 dB in the normal mode, was a phenomenal 46 dB in the HI-Q mode, which not only far surpassed the specifications but has never been approached by any other FM tuner we know of.

Harman Kardon concedes that the Active Tracking system does reduce performance in some respects but claims there is no real sacrifice of listening quality. With the circuit in use, the distortion was roughly tripled though still negligible, and the channel separation decreased by 15 to 20 dB. Even so, the measured separation was a very uniform 30 dB or so across the audible frequency range, which is more than enough to produce full stereo performance.

Comments

The Harman Kardon Citation Twenty-Three is an attractive, easy-to-use tuner that always delivered clean sound quality in our listening tests. It has a few idiosyncrasies, however, which were exceptionally obvious because of its overall excellence.

The muting threshold was always higher than we felt it should have been. Even then the threshold was set at its minimum, the tuner excluded many perfectly listenable signals. With a good antenna, or the right location, this would be no problem, but with an indoor dipole antenna the high threshold made the tuner appear to be rather insensitive. Most of the time we preferred to use the tuner with the muting system switched off.

The fine-tuning control had the rated ± 25 -kHz range, although in our location we found no adjacent-channel stations strong enough to hear, let alone suffer interference. In many cases we could hear heavy program splatter when we tuned 200 kHz away from a strong station, but switching to HI-Q and adjusting the fine-tuning knob usually reduced this to near or total inaudibility. We never heard any deterioration of signal quality while listening to a number of stations in the HI-Q mode.

Ergonomically, the Citation Twenty-Three is a well-designed, attractive, and functional tuner. Our only criticism of its external features concerns the indicator lights in some of the smaller pushbuttons, particularly those in the ends of the present selectors. The lights are very difficult to see in a well-lit room or when viewed at a slight angle instead of head-on.

Although we have no substantive criticism of the Harman Kardon Citation Twenty-Three, it is a fairly expensive tuner. In a situation where adjacent-channel interference is a problem, however, the HI-Q feature alone makes the Citation Twenty-Three a clear winner. There is no other tuner that comes even close to matching its adjacent-channel selectivity. In addition, many people will consider that its attractive styling and general performance justify the price. We cannot imagine anyone being disappointed in it.

FEATURES

- Digital-synthesis tuning with flywheel knob
- Active Tracking circuit for high adjacent-channel selectivity
- Fine-tuning control with range of ± 25 kHz
- Sixteen present station memories using eight buttons
- Variable and fixed audio output levels
- Switchable muting with variable threshold level
- Wireless remote control for all functions except Active Tracking and fine tuning
- Antenna inputs for 300- and 75-ohm FM antennas, AM antenna
- Pivoted AM loop antenna

LABORATORY MEASUREMENTS

(All figures for FM only except frequency response)

Usable sensitivity (mono): 14 dBf (2.8 μ V) in normal mode, 20.5 dBf (5.8 μ V) in HI-Q mode

50-dB quieting sensitivity: mono, 17 dBf (4.1 μ V) normal, 18.5 dBf (5.6 μ V) HI-Q; stereo, 41 dBf (62 μ V) normal, 38 dBf (43.7 μ V) HI-Q

Signal-to-noise ratio at 65 dBf: mono, 84.5 dB normal, 83.8 dB HI-Q; stereo 72.5 dB normal, 72.7 dB HI-Q

Harmonic distortion (THD + noise) at 65 dBf: mono, 0.095% normal, 0.3% HI-Q; stereo, 0.11% normal, 0.32% HI-Q

Capture ratio at 65 dBf: normal, 1.2 dB; HI-Q, 6 dB

AM rejection at 65 dBf: normal, 64 dB; HI-Q, 74 dB

Image rejection: normal, 77 dB; HI-Q, 73 dB

Selectivity: alternate-channel, 69 dB normal, 84 dB HI-Q; adjacent-channel, 5 dB normal, 46 dB HI-Q

Stereo threshold: normal, 42 dBf (62 μ V); HI-Q, 35 dBf (31 μ V)

Muting threshold: maximum, approximately 64 to 81 dBf (870 to 6,170 μ V); minimum, 34 to 40 dBf (28 to 55 μ V)

Stereo channel separation at 100, 1,000, and 10,000 Hz: normal, 46.5, 51.5 46 dB, HI-Q, 34, 34, 28 dB

Frequency response: FM, 30 to 15,000 Hz ± 0.8 dB; AM, -6 dB at 22 and 4,700 Hz