F O U R

TUNERS

Angus McKenzie reviews Hitachi FT5500 II, Magnum Dynalab, Trio KT-990 & Rotel RT 850 FM tuners

I LOOKED AGAIN RECENTLY AT SOME TUNER REVIEWS I wrote en and more years ago, noting my enthusiasm for such products as the Yamaha CT7000, which was fitted with a special narrow filter, and for various other famous models. My favourite was the Trio KT917 which had the most outstanding performance of any tuner that I had measured. In general service it had one snag, however, at least in North London: that of picking up some form of medium-wave interference which came through as a very low level whistle behind stereo programmes, and which I could never eliminate.

Those older tuners always seemed to be well up to specification on RF input sensitivity, usually around 1µV for 30dB IHF. Looking through figures on at least two dozen tuners tested in the last two or so years, though, it struck me that hardly any of them met their specified sensitivity. I began to wonder if the test equipment itself could be incorrect at very low levels, but when I used a muTek Band 2 preamplifier in the aerial feed to the tuner under scrutiny I almost invariably got figures that were even better than those of the old tuners. Obviously tuner manufacturers have abandoned sensitivity in favour of front-end intermodulation performance and selectivity.

In general this is not a bad thing, as long as manufacturers are honest about it. It is true that most households with a reasonable aerial system can pick up several FM stations at signal strengths far higher than 1mV, but the problem is that each transmitter generates noise off-channel. If you are receiving a typical BBC transmission at a signal strength of, say, 10mV, then it will undoubtedly be introducing noise at the 1µV level (*ie*, −80dB) quite a way off channel, thus introducing noise below weak stations. Considering the number of strong stations getting into the tuner, one can see that accumulated off-channel transmitter noise can increase the noise floor of the tuner by many dBs, but, of course, in these circumstances ultimate sensitivity is not so important. However, if you are in an area where (a) the station strengths are well below 1mV, (b) there are no very strong signals just outside the band, and (c) the tuner's RF selectivity is also very good, you can use as much sensitivity as you can get, to improve the subjective dynamic range of stereo transmissions. It is in these circumstances that modern tuners are not good enough, and one can gain tremendously by the addition of an external preamplifier such as the muTek* which has a low 9dB of gain, a very low input noise, and extremely low RF distortion.

Tuner front-ends have most certainly improved in intermodulation performance, and models such as the Hitachi 5500 Mk II reviewed here appear to be almost bombproof! As more and more stations come on to Band 2, front-end performance and IF selectivity have to improve, and the best tuners allow the option of narrow or wide IF selectivity. Wide selectivity gives much less distortion and frequently improved crosstalk, whereas narrow allows the capturing of a weaker station even if it is close in frequency to a strong one. If a tuner cannot offer switchable selectivity, then its setting should be a good compromise, as is offered on the Revox B261, which remains my favourite modern tuner.

After the FM signal has been converted to audio by the discriminator, the signal has to be decoded to give a stereophonic output. Many stereo decoders seem to be rather noisy and some are driven so hard to avoid that noise that the output itself is distorted. Whilst the Hitachi 5500 Mk II offers both low distortion *and* a very wide dynamic range, the Dynalab, also reviewed here, has much too much noise. Sometimes, the multiplex tones are inadequately filtered, with the result that younger listeners can be disturbed by high pitched whistles. Many tuners supplied in music centres or rack systems have these limitations. A few Japanese tuners have used a pilot tone cancellation circuit instead of a proper low-pass multiplex filter. These circuits may well give excellent rejection of the 19kHz pilot tone, but all too often there are nasty noises remaining on the output as a result of partial demodulation of signals such as radio-data information transmitted on extremely high frequency subcarriers.

Very few modern tuners have retained an analogue tuning knob, favouring instead up and down pushbuttons. Two tuning modes are normally available, apart from direct access to memory. The first is to peck and hunt one synthesised channel at a time. Some tuners take a second or two to unmute after the frequency has been changed (which is infuriating if you are trying to scan the band for unusual stations). The other mode, usually called auto, scans in the required direction and then opens up when the tuner has found an acceptable signal. The problem here is that models such as the Rotel will accept incredibly weak signals, so that it takes an age to look for usable stations.

Many tuners include AM of such abominable quality as to remove any entertainment value whatsoever, distortion at low frequencies reaching way over 10%. There are very few decent AM receivers around these days, which is a great pity.

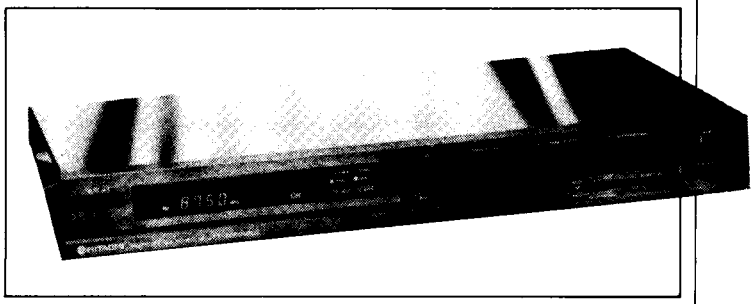
Returning to front-end sensitivity, the latest solid-state device, which offers an exceptionally fine low-noise performance, is the Gallium Arsenide Field Effect Transistor (GaAs-FET). This device was specifically designed for use at microwave frequencies above 1000MHz. At normal VHF, the device only offers a slight advantage if the circuitry surrounding it is very esoteric. But there is a very serious *disadvantage* in using it, too, since its RF intermodulation performance is far worse than that of a normal low-noise VHF transistor, unless it is combined in-circuit with a normal transistor with feedback. However, the GaAs-FET is one of the latest devices to hit the market, and many hi-fi enthusiasts, hearing that is is being used for preamplifiers in satellite TV reception, might imagine that it would offer a vastly superior performance on Band 2. In the most carefully thought out circuits a GaAs-FET might show, perhaps, a 0.4dB improvement in sensitivity. (Theoretically one might be able to reach around 0.08µV IHF if all other parts of the circuitry are well-nigh perfect.) Unfortunately, very few designers know how to use them properly, and having measured many GaAs-FET preamps, I have been alarmed to find that the typical intermodulation performance can actually be 20dB *worse* than that of a good NPN device. Is a 0.4dB sensitivity improvement worthwhile for such a degradation in RF intermodulation on today's crowded bands? I suggest that the use of GaAs-FET in tuners is little more than a marketing ploy!

Hitachi FT5500 Mk II £199

This model was introduced early in 1985 and although it is very similar to the Mk I version, the normal input RF stage has been replaced by a GaAs-FET.

Other minor changes in the circuitry have been incorporated to improve the performance. When stereo signals are weaker than 50µV HF blending occurs, which degrades HF crosstalk but greatly improves the subjective signal/noise ratio.

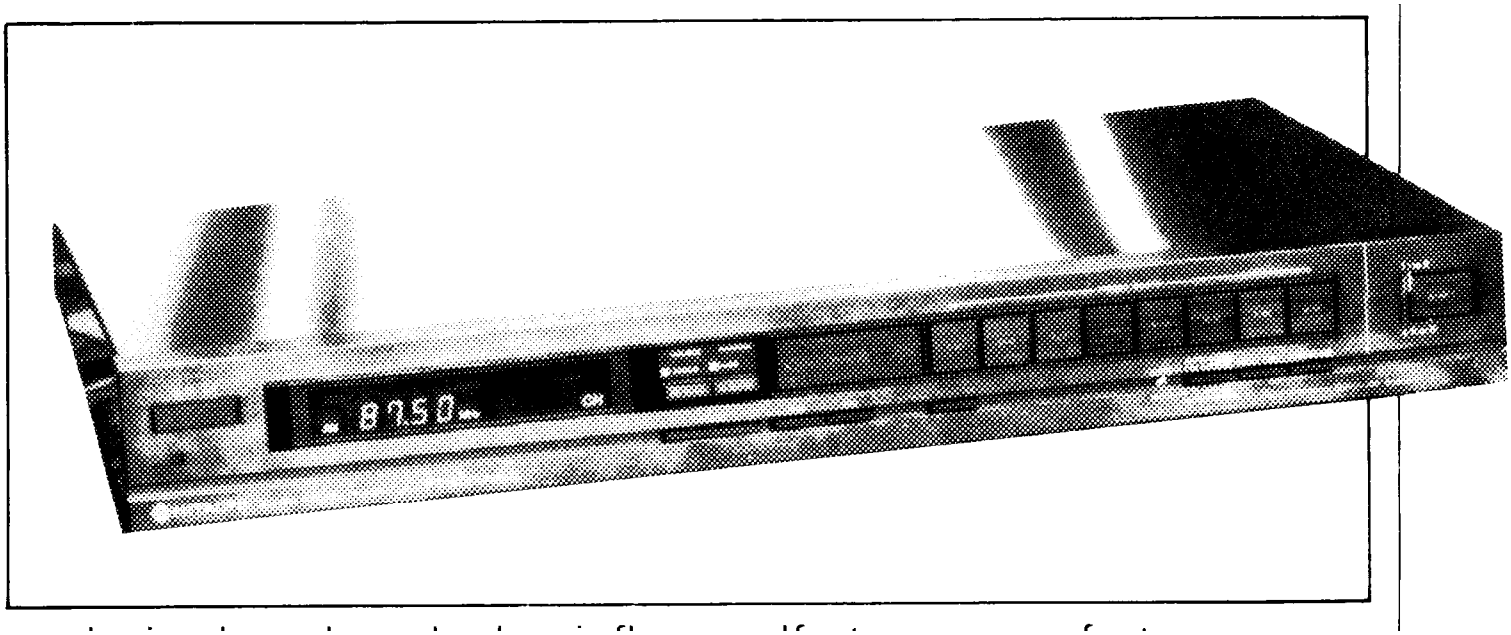
The RF preamplifier is a 3SK114, which is probably also a GaAs-FET, but this wasn't confirmed. The mixer, a 3SK113, *is* claimed in the manual to be a GaAs-FET and to have superior overload properties. As I've said, this is where I feel that the



marketing boys have had an influence. If a tuner manufacturer wanted to design a really good front-end, he would use a low-noise NPN circuit into a ring diode mixer having a high local oscillator injection level. This would give a fantastic performance for a marginal increase in production cost. Many British-made and designed VHF communication front-ends employ this type of circuit to great effect, and it seems that Japan is far behind in this respect.

The tuner is supplied in an attractive, black finished metal case. It is quite wide at 435mm but surprisingly slim at 26mm, with a depth of 17"

** muTek, Bradworthy, Holsworthy, Devon, EX22 7TU Tel: 040 924 543. These are made to special order only, using BNC professional connectors. Price approx. £50.* **Dep Ed.**



267mm. The front panel carries a fluorescent digital frequency display having a resolution of 50kHz; the up/down frequency stepping buttons operate in 50kHz steps. Various other functions are displayed on the readout: frequency lock, memory channel number and FCCS selected (see later). There is also a stereo indicator. Separate LEDs indicate RF attenuation on/off (labelled RF double or single), IF narrow/wide and auto/manual tuning engaged. Finally, an LED indicates whether you have selected memories 1-8 or 9-16.

The front panel controls are all pushbutton types. With auto tuning selected, the up/down buttons initiate searching, with the tuner stopping at the first reasonably receivable station; in the manual position it will go up one channel at a time in 50kHz steps, or around 1MHz in 1.5 seconds if the button is held down. 'RF band' seems to be just a switchable RF attenuator, and when 'double' is selected, the attenuation is approximately 6dB.

Regarding the wide or narrow IF bandwidth options, our tests showed the selectivity to be excellent, but as I was already rather enthusiastic about this tuner, we decided to run a complete plot of front-end bandwidth and bandwidth of the wide and narrow filtering. For the RF bandwidth we took the output from the mixer, bridging it with a high impedance RF probe, and plotted the response with the new Marconi 2382 tracking system, using an external remixing technique. Plot 1 shows the combination of RF and mixer output bandwidth, from which it can be seen that the −3dB width is around 500kHz and the −10dB width around 1.3MHz. The RF bandwidth characteristics are thus quite good at rejecting strong signals at least 1MHz off channel. The next plot shows the bandwidth immediately prior to the main IF filters, although some IF roofing filtering has already been applied. The −3dB width here is about 250kHz, and the skirts are rather steeper, with −10dB bandwidth at around 400kHz. This shows that by this point in the circuit, there is a good rejection of alternate channel signals. The third plot includes the response of both the narrow and wide filters. The narrow plot shows a −3dB bandwidth of only 120kHz or so, and this will contribute to increased distortion, but the adjacent channel selectivity is very good, the bandwidth at −50dB being around 400kHz, a result one sometimes finds at only 3dB down in the wide positions of a few esoteric tuners!

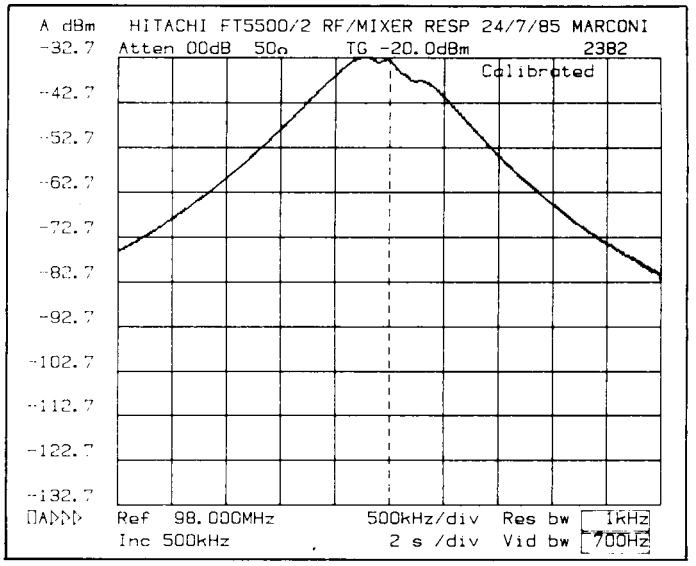
The wider plot shows a −3dB bandwidth of around 360kHz, which is a little excessive! The −50dB bandwidth, however, is extremely wide at 840kHz. If one bears in mind the bandwidth/energy plot which I included recently in my 'Radio' column (October p33), a 300kHz bandwidth would be more than enough for extremely low distortion at all frequencies.

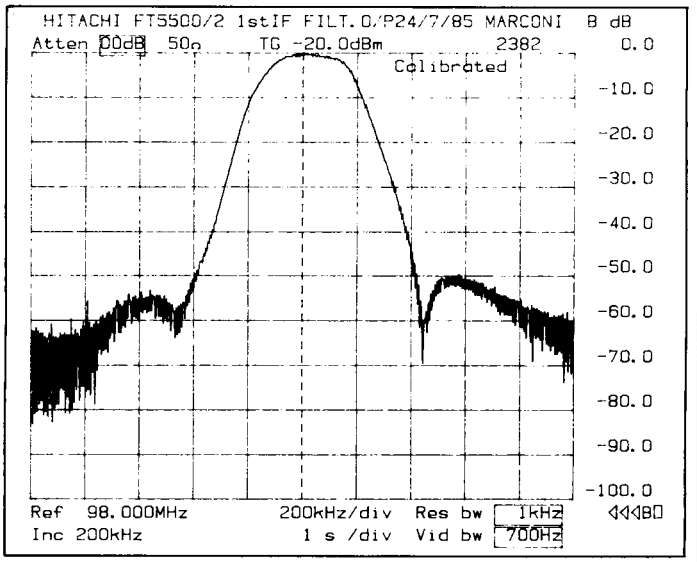
Hitachi have again included their 'Field Condition Computer System', or FCCS for short. This gadget operates under microprocessor control, and when it is engaged the tuner scans the band to look for signals reasonably close-in to the tuned frequency, and for any very strong signals *on* the band; it then automatically selects the most appropriate IF filter for optimum reception. Theoretically it should switch in the RF attenuator, but I was unable to find a condition that caused this. This optimum setting can be stored in memory for future use, together with the frequency and stereo/mono setting. Additionally, after you have accessed a memory you can change any of the parameters at will. We experimented with this facility by receiving Chiltern Radio on 97.6MHz with a high gain beam on Wrotham. The Chiltern signal was quite weak yet was well received with narrow IF selectivity; but when switched to wide, the tuner muted in the stereo mode. Switched to mono and wide, there was bad interference from LBC on 97.3MHz. The wide selectivity gave just 15dB reduction in IF gain at LBC's frequency, whereas the narrow filter rejected it by more than 70dB. This shows the tremendous improvement in reception to be had with switchable selectivity.

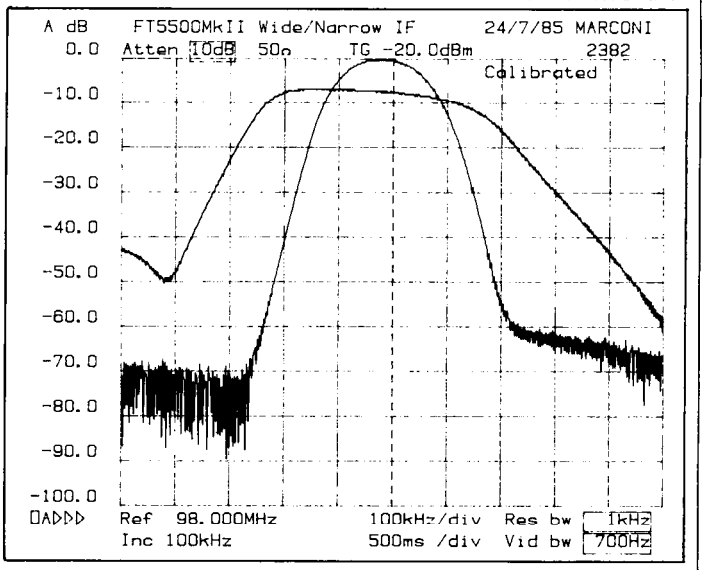
Although there are only eight memory pushbuttons, a shift button introduces eight more positions. Either medium-wave or VHF frequencies can be stored in each memory. Use of the memory has been made very simple: one presses the memory button followed by the memory channel required. The auto button gives two functions at the same time: the on position allows the tuner to switch to stereo automatically for a stereo broadcast, at the same time selecting the auto tuning function; in the manual position, manual tuning is selected with mono reception, whether the signal is in stereo or not.

A record 'cal' button mutes the tuner, and supplies a rather distorted 330Hz at 12dB below 75kHz mono deviation, which in practice will be around 9dB below normal peak stereo modulation. In the instruction book, Hitachi suggest that a cassette deck meter should read around −1VU, and a reel-to-reel deck around +1VU. This level might be about right for the latter, but will likely blast the living daylights out of an average cassette tape on program! Perhaps Hitachi assume the user will have a three-head Nakamichi cassette deck with a very high quality metal cassette.

Another front panel option gives a readout of signal strength in dBs above 1μV, and this proved quite accurate. Weak signals tended to under-read by 2dB or so, but signals above 100μV over-read by 1dB, still a quite remarkable performance.







The mains lead is a two-core captive type, and phono sockets are provided for the audio outputs. An FM antenna can be connected either via a male Belling Lee type socket (RMA), or on two small terminals which are also 75ohms. Two AM terminals are fitted for connection to a circular loop antenna which has screw holes to allow fixing to a wall etc. This loop is 165mm in diameter, and connects via some twisted flex.

Technical Measurements

At 1.3μV EMF/2 the front-end sensitivity is good, but 3dB poorer than many tuners of 10 years ago. With narrow selectivity the sensitivity would degrade slightly because of the decreased distortion at full

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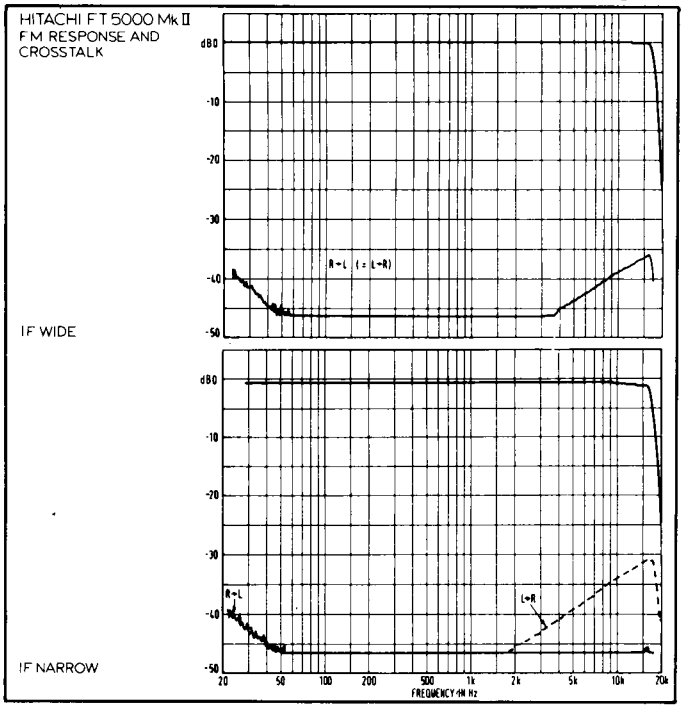
deviation on a very weak signal, although on average the subjective sensitivity would be slightly improved most of the time. More crackle would be heard in the noise at peak modulation, which would of course affect measurement. Two signals spaced at 1 and 2MHz off-channel at around 1mV created a just audible intermodulation product on-channel, and as far as I can remember this is not as good as one of the earlier Hitachi models. The intermodulation performance at 400/800kHz is around 8dB worse, whilst for 2/4MHz spacings it is around 8dB better. This performance should be good enough for most users.

We plotted the overall frequency responses and crosstalk on both wide and narrow selectivity positions. The responses were virtually ruler flat from 20Hz to 16kHz, with an extremely rapid attenuation above 16kHz. With wide selectivity the crosstalk plot shows a superb performance to above 10kHz, with −45dB from around 60Hz to 4.5kHz. Somewhat surprisingly, the crosstalk is also extremely good



for a fairly low-level tone. A full deviation signal of 1kHz gave an excellent crosstalk result, even including all the noise and distortion components. We checked the 26dB signal/noise sensitivity, basic stereo sensitivity and limiting threshold, and these were all very good. The image response at RF was quite remarkable, requiring almost the full output of my signal generator to measure it. Our reading was −118dB, which should cut out interference from aircraft flying at 200ft over the house quite satisfactorily! AM rejection was −66dB, again one of the best figures that we have measured.

The tuner was capable of switching to stereo on a signal of around 3μV. The capture ratio measured particularly well at 1dB. In the wide position the IF selectivity was indeed extremely wide (again *too* wide) but the narrow position gave superb results, a 200kHz off-channel station being rejected by an average of 28dB. The alternate channel selectivity at 400kHz was very poor on the upper side, but the narrow selectivity was again excellent and about as good as I have measured.

The signal/noise ratios in mono and in stereo are phenomenally good. An antenna signal of 1mV gave a signal/noise ratio approaching 79dB, CCIR/ARM weighted, reference absolute maximum deviation, so the typical performance in practice would be around 76dB. We checked the stereo signal/noise on very weak signals and must particularly commend the 50dB CCIR/ARM ratio for stereo at 17μV, this allowing weak stereo stations to be far more acceptable than usual.

The distortion of a 1kHz signal sent on the sum channel at full deviation is remarkably low at 0.05% on the wide filter. I was somewhat surprised, however, at the good figure of 0.12% with narrow selectivity; this shows the extremely good group time delay characteristics of the IF filters, combined with superb limiting. I would have expected a much worse figure than this having examined the IF passband plots. These excellent characteristics also explain the very good crosstalk plots on narrow selectivity, which are a lesson to many other manufacturers.

Checking distortion on wide selectivity, by sending left or right only at 30%, and even 100% deviation, we were astonished to see virtually identical figures, averaging 0.05%, which had been previously noted for L=R. Figures of below 0.1% were noted even at 100% modulation with narrow selectivity, which again confirms the unusually good IF group time delay characteristics. The typical maximum audio output for full modulation at 1kHz is around 0.775V, or −2.2dBV. (This level is conventionally referred to as 0dBm, although it is not strictly correct.) The 19/38kHz filtering is excellent. Note the steep roll-off above 16kHz.

Subjective Tests

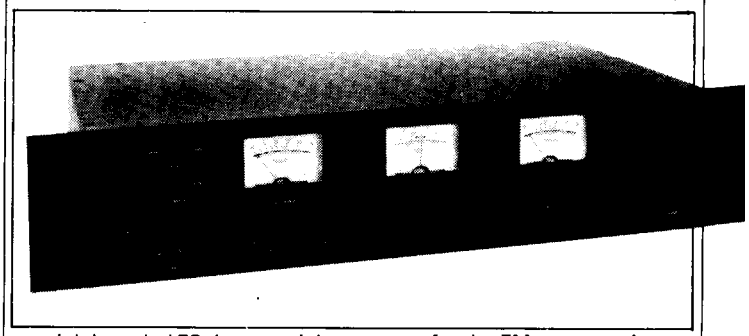
I used this tuner for all my normal listening over quite a long period, and during one session tuned around the band listening carefully for weak stations very close to strong ones. I have a fixed Fuba antenna pointing ESE to Wrotham, and it picks up a rather poor signal from Chiltern radio off the back. The Hitachi picked it up superbly well with narrow selectivity, and also captured quite a few Continental stations clearly which had been most unsatisfactory on wide. The atmospheric conditions were average. The only other tuners that I had around at the time which were as good were the latest Revox, which costs around 3½ times more, and the Trio.

I have always been keen on previous incarnations of this tuner, but this version is really excellent. Classical music on Radio 3 was so clean, and the high frequency performance was particularly fine, confirming the measurements we made in the lab. The presets were extremely easy to use, and the FCCS system worked very well, although I have to admit that I personally prefer to choose such parameters manually.

The AM quality was a little better than usual, but nowhere near what it could be. As usual, detector distortion, AGC characteristics and IF distortion are still not good enough for today's crowded bands. At least the audio response was tolerable, although rather limited. I can recommend this tuner very strongly, but would point out that it was subject to a severe supply shortage at the time of writing (late August).

Dynalab FT101

This FM tuner is made in Brampton, Ontario, Canada and has an analogue tuning system. Although it uses digital frequency readout with only 100kHz resolution, it is possible to tune continuously to any frequency. The front panel includes lever switches to select mono/stereo, IF narrow/wide, automatic frequency control on/off and mute on/off. The mains on/off switch is also a lever and the European model is nominally 220V AC, although it works perfectly satisfactorily on 240VAC. The display includes a stereo indicator and meters for signal strength, multipath indication and centre tuning. The tuning knob (rather stiff and appearing to have a slightly variable tension) provides an average of 1.5MHz per rotation. The tuner is quite large, and is fitted with a rack-mountable front panel, the main body being 420mm wide, 92mm high and 257mm deep excluding projections. Audio outputs are on phono sockets on the rear panel, which also includes a captive two-core mains lead and an infuriating



special threaded 75ohm coaxial connector for the FM antenna. A 300ohm balun is supplied with the tuner for use with balanced ribbon cable.

The editor was keen for me to review this highly-recommended model to see how it would compare with modern designs from the UK and Japan. I have to be frank and express my disappointment with several areas of its audio section. The RF front-end is actually very good, but the IF and discriminator distortion levels are not really good enough to compete with the best alternative products.

The front-end is extremely sensitive, and uses three separate MOSFETs before the mixer, with voltage-controlled tuning circuits. I suggest that there is much too much front-end gain, and the RFIM performance could have been significantly better with a complete re-think in the RF front-end design.

The tuner is referred to as analogue-digital, and many a potential purchaser might think that the use of the word digital implies modern magic. The only digital part of this tuner, however, is a very basic frequency counter which measures the local oscillator frequency and displays the equivalent RF input channel.

There is much to be said in favour of the lever switches, which I much prefer to touch-sensitive pushbuttons. You can see or feel

exactly what state a control is in, and the facilities provided are just what one normally needs in an analogue tuner.

Technical Measurements

The RF sensitivity was indeed excellent, achieving nearly 1µV sensitivity for 30dB IHF. The 26dB signal/noise sensitivity was superb at around 0.6µV, but the RFIM performance was a few dB worse than that of the Hitachi. Since the sensitivity was quite a lot better, however, intermodulation products would be discernible from considerably weaker high-level signals that are off-channel. For this reason, the tuner would be far more appropriate for use in a fringe reception area where there are no really strong signals around; it would not be very suitable in the average US or Canadian city.

The reciprocal mixing performance seemed quite good, and whilst IF selectivity on 'narrow' measured very well indeed for the rejection of adjacent channel modulation, the alternate channel rejection was no more than fairly good, which is surprising. The 'wide' selectivity was about right, as a compromise, but the alignment was none too good, and although distortion was within specification, the results were not particularly good.

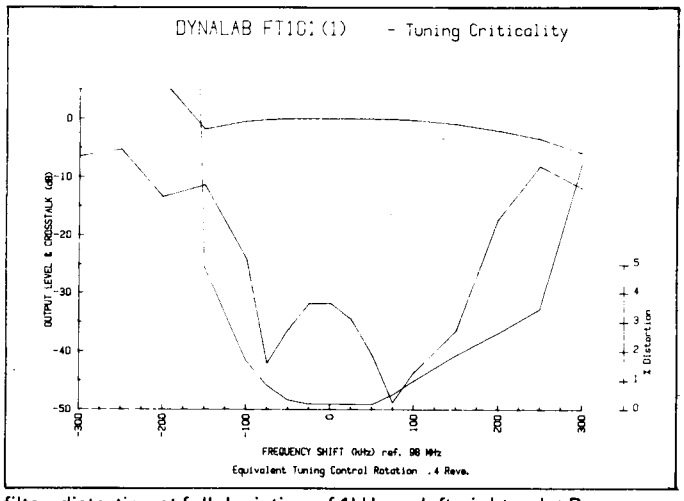
The signal strength meter was extremely sensitive, and weak stereo signals were displayed as stronger than they really were in practice. A 10µV signal only produced a reading of 3.5 out of a full scale 5, however. This seems a bit ridiculous, unless one accepts that the tuner is designed primarily for fringe area reception.

Limiting was excellent, and the capture ratio at 1.6 on 'wide' was also good. AM rejection, though, was not too good at 53dB. The tuner accepted extremely weak stereo signals, hence the lack of the normal automatic stereo/mono switching threshold. The muting threshold was set at around 1.4µV which is perhaps a little bit too sensitive. The digital readout was very accurate.

The review sample was supplied with 50µs de-emphasis for Europe, but of course the US/Canadian models are set at 75µs. The frequency responses were extremely flat from 20Hz to 15kHz on both channels and on both selectivities. The pen chart shows the excellent low-pass filter action above 15kHz, with a very fine rejection of 19kHz pilot tone etc. On wide selectivity, the crosstalk can be seen to be very flat indeed from 50Hz to 15kHz, but it is not good enough on a modern tuner. On narrow selectivity the result was quite poor at −24dB and this is inadequate, especially if compared with the Hitachi or Trio.

It is in the area of signal/noise ratio that this tuner fails miserably: 65dB, CCIR/ARM weighted, ref absolute maximum deviation is nowhere near good enough. The BBC are able to transmit at least 70dB S/N, and even a tuner with a similar performance to that would show a 3dB degradation in S/N because the tuner's noise floor would add to that of the transmission. On a 1mV signal, the typical S/N of the Dynalab was only around 63dB on stereo, which is appalling; almost as poor as a metal cassette tape without any Dolby processing! However, a 50dB S/N ratio is achieved at around 27µV, which is useful. It seems, therefore, that there is much too much noise introduced after the FM discriminator.

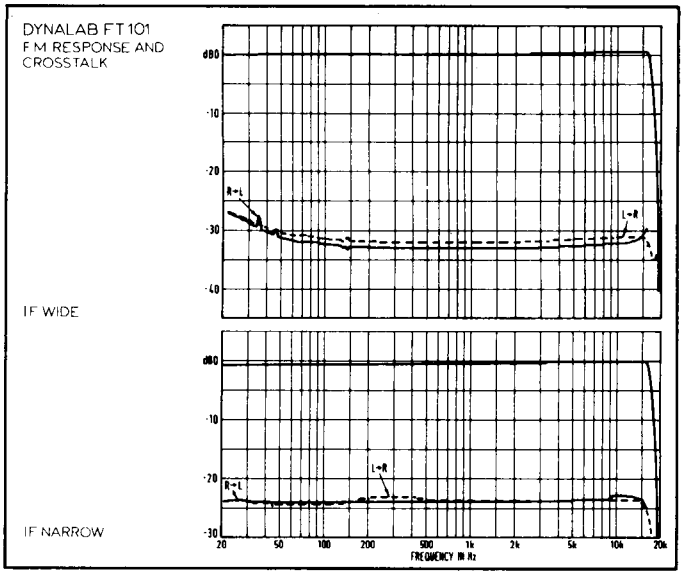
I am not at all happy with the distortion measurements. When switched to narrow selectivity, L+R distortion at full deviation was moderately acceptable, but left or right only reached 1%, which is not good enough. At lower modulation levels the THD readings were limited by the very poor background noise. Switching in the wide IF



filter, distortion at full deviation of 1kHz on left, right or L+R was around 0.2%, which is fairly good but no more than that. At 30% modulation the distortion readings were limited by noise.

The tuner will give peaks on average program of around 0.6V, with full deviation reaching 0.775V. The image rejection was fairly good at −78dB, but not in the same class as the Hitachi.

As this is an analogue tuning model, we applied our 'tuning criticality' computerised program to show distortion, crosstalk, and audio output level as the transmitted signal varied from −300 to +300kHz ref a nominal tuned frequency. The plot taken with AFC switched off shows very clearly that the discriminator/decoder alignment is somewhat poor; the crosstalk improves dramatically at ±75kHz from centre tuning. However, distortion *is* at its minimum on centre tuning ±50kHz with wide filter. The plot of the narrow filter characteristics again shows the best crosstalk figure at well off centre tuning, but distortion in turn at its lowest *on* tune.



Subjective Tests

The RF sensitivity was extremely good, and we could pick up many weak Continental stations satisfactorily. I liked the ergonomics, generally, apart from the rather stiff tuning knob and the awkward antenna socket. However, there seems little point in giving a lengthy discourse about received audio quality on a tuner which has a signal/noise ratio that is poor compared with almost all its competition. I tuned in the Revox B261 and the Dynalab on separate antennas to a Radio 3 Prom, and system gains were set identically. In the quietest passages, the hiss from the Dynalab was very pronounced, compared with negligible noise from the Revox, and I was aware of the poor background noise much of the time. Continuity speech and stereo drama were even more seriously affected. For this reason I cannot recommend this model even for weakish signal strength areas, but it could be useful for extreme fringe area reception where background noise is limited by a sheer lack of RF signal strength.

Incidentally, this tuner is supplied with an extraordinary antenna contraption which vaguely resembles a coathanger or a warped three-leaf clover. The various elements pull in and out in the same way as a metal tape measure. This antenna would be fine for reducing very strong signals to allow the tuner to become a truly fringe area model in strong signal areas. This so-called 'silver ribbon' antenna is also claimed to be effective, and even best suited, for VHF (as opposed to UHF) TV reception.

[**Note:** This tuner is not presently available in the UK, but we wanted to include it because of its much talked about 'audiophile' status in other reviews worldwide – **Dep Ed.**]

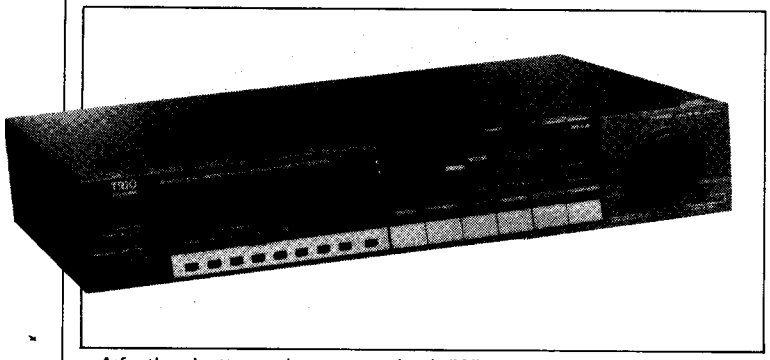
Trio KT-990-SDL £329

Trio have introduced some very fine tuners over the years, but this new one is particularly interesting because it offers the most stunning selectivity in its 'narrrow' position. Even on wide selectivity it is very good, preserving very low distortion. As usual, the unit is metal cased and finished in black. Measurements are 440mm wide by 88mm high and 300mm deep, excluding protrusions. Although it is synthesiser controlled, a tuning knob is retained, albeit with a difference. Two tuning modes are selectable, and on auto, the frequency increments or decrements by 1MHz in every 3.5s to the next receivable station. In manual mode it carries on going up or down, provided you continue turning, but the tuning speed is not affected by the rate at which you turn the knob.

There are two sets of eight memories, each being able to store FM, LW or MW channels. Other front panel controls include a programming button, A, B or off. A and B memories can each store eight stations, but there is a restriction if you want to use the remote start function program facility available on setting A, which selects the last-used frequency when first switched on. Switched off again and then on later, it then selects memory 8. This could be a quite ▶

useful facility used with an appropriately set external timer.

Above the memory preset buttons is a horizontal slider which alters the AM pass-band from fairly muffled to extremely muffled! Trio seem to have missed an excellent opportunity here to provide IF bandwidths from 10kHz down to around 6kHz, which would have given audio responses flat to 5 or 3kHz. (Perhaps, too, someone could tell them that the European response standard is extended between 4.5 and 5kHz at HF on AM.)



A further button selects record cal. (When pressed this puts out a tone on left and right channels approximately 4.5dB below peak deviation, which in practice will be around 2dB below peak program levels.) If set to around 4dB above Dolby level on a cassette deck, this should not be too far out. (The instruction book is incorrect here, suggesting the level be set for 6dB below 0VU on the cassette deck, which would lead to severely under-recorded tapes.) The oscillator tone seems reasonably clean at around 400Hz.

Another button selects wide/narrow IF bandwidths for FM. Additional controls select LW, MW or VHF, auto/manual tuning and tuning lock. There is a digital frequency display with 50kHz resolution on FM, 9kHz on LW, these all representing the relevant frequency steps. A combined signal strength and tuning matrix indicator is fitted, which is most useful. This is arranged in nine vertical columns, each with seven fluorescent points. As you tune in to a station, the vertical bar comes in from one side or the other; when it is central you are correctly tuned. The vertical height is an indication of signal strength, and signals above 1mV light up all seven indicators, 100µV lighting up six, 10µV lighting up three and a signal around the 30dB IHF sensitivity lighting up one. This performance is very good within its limits, and the display is most helpful. A horizontal bargraph indicates program levels using 12 segments. This is calibrated in percent with 50, 100 and even 200% modulation depths marked. Other indicators include stereo and basic status functions. When you switch the tuner on, a sign comes up saying 'distance'; I presume that on another version there might have been a sign for 'local', with provision for an antenna attenuator, which is omitted from this model. The back panel carries phono sockets for the audio outputs, two terminals for interconnecting a flex-fed frame antenna for AM (there is a pivot socket for this, allowing horizontal movement only), and a male Belling Lee type coax socket for 75ohm FM antenna connection. The two-core mains lead is captive.

No circuit diagram is supplied, so it was not possible to ascertain details about what must be quite fascinating circuitry. This is a pity, because I feel that Trio should be sharing their technical know-how much more with technical enthusiasts. In the past they have introduced many circuit innovations.

Technical Tests

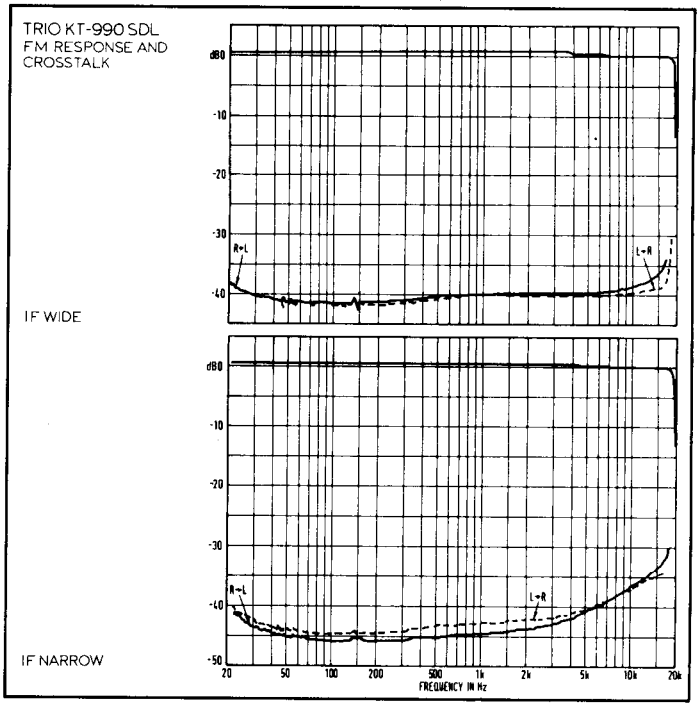
Although the RF sensitivity is only reasonably good, at 1.6µV for 30dB IHF, the RFIM performance is outstanding, showing a very well optimised RF preamp and mixer design. This tuner should be virtually 'indestructible' under normal conditions, and the RFIM performance is several dB better than that of the Hitachi 5500. The IF selectivity is stunning on narrow, but of course distortion is sacrificed when left- or right-only tests are carried out.

The alternate chanel selectivities are both excellent. The wide filter has a very reasonable selectivity for 200kHz offset, approaching that of the Revox, yet this is achieved with a surprising freedom from distortion in all modes. Limiting characteristics are excellent, but the image response is unfortunately only fair. AM rejection is excellent, showing that the discriminator itself must be somewhat unusual. The stereo and muting thresholds are at around 2.5µV, which is just slightly more sensitive than optimum, in my opinion. The capture ratio was no more than fairly good, and was just below specification, although it should prove reasonably adequate provided the weaker station is *appreciably* weaker than the required one on the same channel.

The frequency responses on left and right channels were very flat from 20Hz to around 17kHz, but it seems once again that pilot tone rejection is done with an automatic cancellation circuit rather than the strongly advisable low-pass filter. When we checked for various breakthroughs above the audio range, there were quite a few pimples at around 38kHz, although these were admittedly at fairly low levels. There could be a problem with radio-data breakthrough.

Crosstalk on the first sample tested was around −27dB, even with wide IF selected, so I requested a second sample which was far better. The average figure on wide was now around −40dB, with narrow, somewhat surprisingly, at around −45dB, deteriorating above 5kHz to −37dB at 15kHz, which is still a good figure.

Distortion tests on the sum channel, with the wide filter, showed



that the tuner was virtually testing my own test equipment: the figure of 0.03% for 1kHz at full deviation is truly remarkable. When left- or right-only was transmitted, the distortion was still only around 0.065%, even at full deviation. At lower deviations distortions were all incredibly low. When we switched to the narrow IF filter, the sum channel distortion at 1kHz for full deviation was still down around 0.07%, but when left- or right-only were transmitted at full deviation, it collapsed to 1%, which is still tolerable in the context of an otherwise almost unreceivable station. Once again, distortion reduced rapidly at lower deviation levels in all modes.

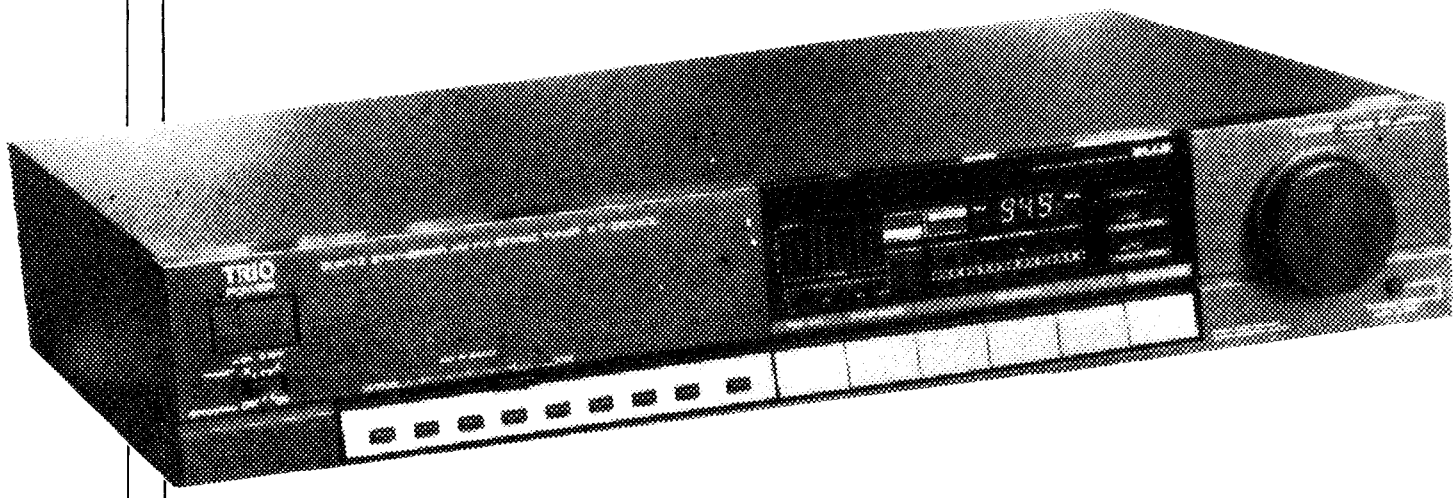
The stereo weighted signal/noise ratio measured extremely well at around 75dB, certainly good enough for use in the UK. The signal required to give 50dB S/N in stereo was around 30µV. The output levels unfortunately showed an imbalance of 0.5dB, which is a little careless in quality control. The maximum level normally put out on program is around 0.5V, which is just a little low, though not seriously so. The tuning criticality test showed exactly what we would have expected, with no problems noted.

Subjective Tests

This tuner performed extremely well in all the listening tests, although it was not quite as sensitive as I would have liked for use in fringe areas. However, in my own area, in which there are many very strong signals on the band, the reception of weak Continentals was first class, with almost no interference noted other than that which I would attribute to signal strength fading. At its best, with wide selectivity on the best BBC broadcasts, the sound quality was superb. The reproduced dynamic range was no different to that of the Revox, and was not audibly inferior to that of the Hitachi in practice, so in this area it is certainly good enough.

Throughout the time I used this set I did not notice any breakthrough problems attributable to transmitted subcarrier information, so it may well give sufficient rejection, in practice, in all circumstances. The AM sound quality was fairly acceptable on average stations, and sensitivity with a Heloop antenna was quite good on LW and MW, provided this was placed in an optimum pick-up position. Bass distortion on very local AM stations, though, was chronically bad, but it should be just acceptable if you are at least 25 miles away from a powerful transmitter.

At a typical price of around £325 this is a quite expensive tuner, but one should note that many previous top-end models cost over twice this amount, and their performances are not appreciably better, apart from in RF sensitivity. This model's distortion levels are signficantly better at high deviations than those of the Revox, but the latter is still



my personal favourite, despite its extremely high price.

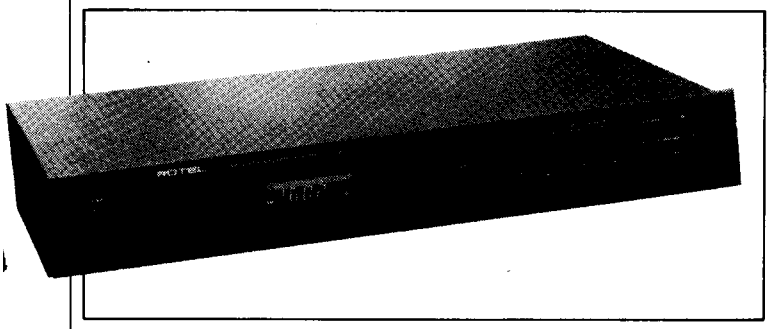
I am slightly disturbed that the first sample tested had a poor crosstalk performance, so there may be some sample variations. I can safely recommend purchase, however, since the user would be able to tell if there was a crosstalk problem if he tried monitoring the BBC test tone transmissions late at night. (Schedule available from the BBC's Engineering Information Department.) The BBC transmit perhaps −40dB crosstalk, or even better, so if you listen first on the modulated channel and then on the theoretically quiet one, you should hear only a very slight signal.

I quite liked the ergonomics of this tuner, preferring the slightly strange tuning knob system to up and down buttons. Indeed, users who are familiar with a conventional tuning knob may well also prefer Trio's system. It is a fascinating tuner, but I wish I could have known more about its technical background.

Rotel RT-850L £150

Another metal encased tuner with a black finish! It has synthesiser controlled tuning on FM, LW and MW. Although there are only eight memory buttons, each memory can store both an FM and an AM frequency, AM combining the LW and MW ranges. Putting a frequency into memory is very simple: press the memory button followed by the required channel. On FM, the tuner operates in the usual 50kHz steps with up and down buttons. On AM, the medium-wave increments are set at 9kHz, but on long-wave 1kHz is used, which is unfortunately necessary at the moment whilst new frequencies are being sorted out in Europe. This makes LW tuning incredibly laborious, but at least you can use presets for those stations that you require regularly.

Two basic tuning modes are available when using the up and down tuning buttons. When the selector is set to auto, and one of the tuning buttons is pressed, the receiver finds the next fairly strong signal, stops on it and then unmutes (if muting is switched on). If muting is off, you can hear it chugging across the band, but still reasonably muted while scanning. It was not possible to find Chiltern radio on 97.6MHz in auto mode as it was too weak for the automatic tuning sensor. This is not a bad thing, for it will enable the next



station giving a reasonable signal to be found fairly quickly. In the manual mode, the buttons either change channel in 50kHz steps, or, if held down, increment at around 3s per MHz. Each time the button is depressed, the tuner takes around 0.5s to change channel and then unmute, which is somewhat tiresome.

Other facilities include access buttons for LW, MW and FM, AW wide/narrow (this seems to switch in bass and treble cut on AM rather than altering selectivity), muting on/off (unfortunately switches to mono when muting is off), and auto-manual tuning. The frequency display also incorporates five LEDs to indicate signal strength, 1mV and above lighting up all five, 100μV lighting up three, and 10μV lighting up just one. This seems fairly sensible for a simple indicator. There are also stereo indicator and memory LEDs.

A captive two-core mains lead is fitted and the back panel also includes phono sockets for left and right outputs, a male Belling Lee type coaxial socket for a 75ohm downlead, and terminals for interconnecting an oblong loop-type antenna for AM reception which is provided with a rather short flex. There is a retaining clip on the back panel for the loop but this only provides horizontal movement.

Technical Tests

The input RF sensitivity measured 1.4μV for 30dB IHF, but this improved when we offset the signal generator by 20kHz, becoming 1.2μV. The limiting threshold was at a very low level, which is excellent. The 26dB signal/noise point was also at a very low level, showing that the 30dB IHF measurement was mainly distortion. The RFIM performance was none too good, though, and on average it was about 10dB worse than that of the Hitachi. Thus, strong local signals could create intermodulation products at various points which might cause interference to wanted weak stations.

Adjacent channel selectivity was very poor, showing hardly any rejection of stations 200kHz off-channel, and alternate channel selectivity at 400kHz was only good on one side. Image rejection was acceptable at 83dB, but was again beaten hollow by the Hitachi. AM rejection was very poor at −44dB, so be aware of ignition problems or thermostat interference on weaker signals.

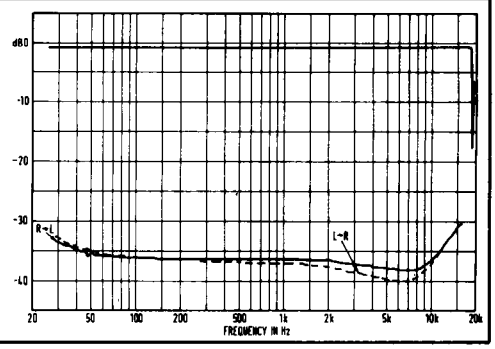
The muting and stereo switching thresholds were at the same point, opening up at just above 5μV, which is quite sensible. The capture ratio was no more than fairly good at 2.2dB, and I would have expected rather better, considering the wide IF bandwidth.

The frequency responses on left and right channels were extremely flat from 20Hz to at least 17kHz, and the response charts show the use of an automatic pilot tone rejection circuit, for the response comes up again at 20kHz. As I've said, in my experience such circuits tend to produce supersonic subcarrier breakthrough problems, including radio-data interference. I cannot understand how the message about steep low-pass filters for Europe has failed to reach Rotel's design team. The crosstalk charts show an acceptable performance, averaging at −34dB across the board, but once again I would have expected better.

The signal/noise ratio in stereo is quite reasonable at just over 70dB ref full modulation, but is easily bettered by the Hitachi and Trio models. One might notice just a few dB more noise than is possible on the best broadcasts, although this result is very many dB better than that of the Dynalab. 50dB S/N is reached in stereo for an input signal of around 27μV. The sum channel distortion at 1kHz for full deviation was 0.11%, which is good. When the modulation is transmitted on left- or right-only, however, it deteriorates to around 0.32%, which is a little disappointing. At lower modulation levels distortion is no problem at all.

Typically the tuner will give peak output levels of around 0.5V on full modulation, and this is around 4dB lower than I like to see, although probably satisfactory for most purposes.

ROTEL RT-850L
FM RESPONSE AND
CROSSTALK



Subjective Tests

This unit was sensitive enough, but it did not pull in weak stations at all well if they were only fairly close in frequency to stronger ones. Its price, typically at around £150 inc VAT, is reasonable enough, but I don't think it offers a sufficiently good performance to be rated good value for money. It is certainly better than quite a few tuners on the market, but is not in the same league as the Hitachi and Trio. √

MODEL	HITACHI FT-5500/II	DYNALAB FT101	ROTEL RT-850L	TRIO KT-990SDL
Mono RF sensitivity IHF (μV)	1.3	1.0	1.4	1.6
Mono RF sensitivity for 26dB S/N (μV)	1.1	0.6	0.65	0.9
Average RF intercept point (dBm)	+8	+1	−6	+13
RFIM ratio for 30dB IHF product (dB)	75	72	66	79
Adjacent channel selectivity Wide IF (dB)	4	13	4	21
Adjacent channel selectivity Narrow IF (dB)	28	35	–	43
Alternate channel selectivity Wide IF Low/High (dB)	53/38	57/57	75/47	78/79
Alternate channel selectivity Narrow IF Low/High (dB)	77/79	56/60	–	80/80
Image rejection ratio (ref 26dB S/N) (dB)	118	78	83	77
Capture ratio (wide)	1	1.6	2.2	3.2
AM rejection (30% mod) (dB)	<67	<53	−44	<73
Muting threshold (μV)	3	1.3	5.5	2.2
RF level for 50dB S/N (CCIR/ARM weighted) (μV)	17	27	27	30
1kHz distortion R=L 100% wide IF (%)	0.05	0.22	0.11	0.03
1kHz distortion R=L 100% narrow IF (%)	0.12	0.25	–	0.07
1kHz distortion single channel Av wide IF (%)	0.05	0.21	0.32	0.06
1kHz distortion single channel Av narrow IF (%)	0.1	1.0	–	1.0
Stereo S/N CCIR/ARM weighted ref 75kHz deviation (dB)	76	63	70	75
Max output level 75kHz deviation (V)	0.77	0.77	0.6	0.55