FIVE TUNERS

Angus McKenzie

I HAVE TO ADMIT that although testing FM tuners is extremely interesting, it has in the past been very laborious, some tests taking 30 minutes or so for just one measurement, *eg*, capture ratio, selectivity or RFIM characteristics. Having computerised many of our audio test procedures during 1982, it seemed only natural to try to automate most FM tuner tests as well. At the planning stage, quite frankly, we all thought the program writing and debugging would be a piece of cake, but it took very many weeks of brain-strain, with cold, wet towels round our heads, before a program was devised which worked. This program automatically measures front-end sensitivity, both IHF and DIN, adjacent and alternate channel selectivity (both sides), RFIM (both sides), capture ratio, various signal/noise and audio limiting measurements, various distortions and output level measurements, image response, signal strength meter calibration, stereo switching and muting levels and signal/noise plots with RF level variation.

Equipment used included two Marconi 2019 signal generators, a Radiometer SMG40 encoder driving one of the Marconi's external mod inputs, an HP 8903 audio analyser, CCIR filter, HP85 controller with HP dual disc drive and matrix printer. Frequency responses, crosstalk and some other measurements were made with normal analogue equipment from B&K.

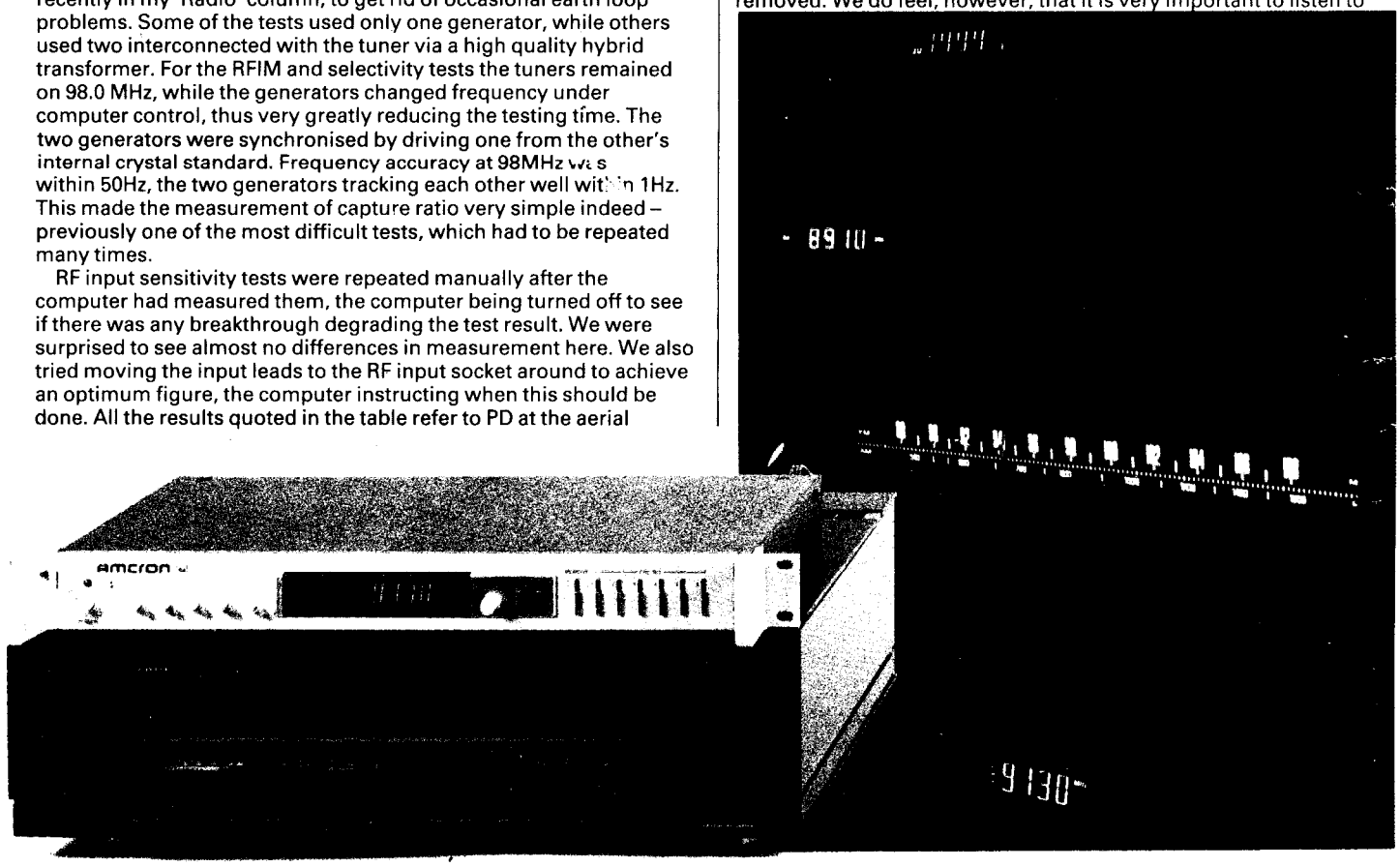
The first problem we encountered was of computer noise breakthrough into the tuners in varying degrees. This was very much lower when we moved the tuner under test around 15ft away from the computer. We also had to build up a braid breaker box, described recently in my 'Radio' column, to get rid of occasional earth loop problems. Some of the tests used only one generator, while others used two interconnected with the tuner via a high quality hybrid transformer. For the RFIM and selectivity tests the tuners remained on 98.0 MHz, while the generators changed frequency under computer control, thus very greatly reducing the testing time. The two generators were synchronised by driving one from the other's internal crystal standard. Frequency accuracy at 98MHz was within 50Hz, the two generators tracking each other well within 1Hz. This made the measurement of capture ratio very simple indeed – previously one of the most difficult tests, which had to be repeated many times.

RF input sensitivity tests were repeated manually after the computer had measured them, the computer being turned off to see if there was any breakthrough degrading the test result. We were surprised to see almost no differences in measurement here. We also tried moving the input leads to the RF input socket around to achieve an optimum figure, the computer instructing when this should be done. All the results quoted in the table refer to PD at the aerial input or audio output of the tuner. The differences between 30dB IHF and 26dB signal/noise are interesting, since they usually show a very considerable difference. The 30dB IHF test involves a modulated RF carrier being received, and a measurement made of the point at which there is a 30dB ratio between the audio level out of the tuner and the distortion and noise on the output, having filtered out the fundamental modulation tone. In the 26dB signal/noise check, the computer system measured the point at which there is a 26dB ratio between the audio output level resulting from a given modulation, and the noise output in the absence of that modulation. Tuners having fairly sharp selectivity normally have higher distortion, particularly at low RF levels on high deviation modulation. Sharper selectivity can thus degrade a 30dB IHF measurement as compared with its equivalent with wide IF. This difference can be seen particularly with the Trio tuner. Weak signals with high modulation depth normally reproduce with more crackling in the background than is heard when the modulation is removed, and so the 26dB signal/noise measurements are much better.

We have measured dynamic range in two different ways, one computerised – the radio frequency intermodulation distortion test – the other reciprocal mixing, as detailed recently in my monthly column. Two strong carriers spaced 1 and 2MHz on one side of a very weak wanted station, for example, will generate an IM product which might well cover up the weak station. The RFIM ratio is the difference between the levels of two equally strong carriers, off channel, that produce a 30dB IHF carrier on the wanted channel, and the level required to give a 30dB IHF carrier with the signal on channel. (Only one of the off channel signals is modulated.)

In the RFIM test the RF levels of both signal generators are stepped in tandem under computer control until the test equipment sends the required reading back to the computer. In the case of the reciprocal mixing test, this has to be done manually at the moment, and is very time consuming. However, we are in the midst of organising a special crystal controlled generator to deliver the very strong off-channel signal required for the test. It should be possible to design an oscillator for, say, 96MHz which has sideband noise as low as -155 to -160dBC/Hz, which will be far quieter than the local oscillator we are likely to encounter in tuners for many years.

For the capture ratio test the computer control, combined with the locked stability of both generators, allows the test to be completed within 30 secs to 1 minute. This test used to take around 30 minutes! What is particularly pleasing is the remarkable consistency of measurements under computer control, many human errors being removed. We do feel, however, that it is very important to listen to

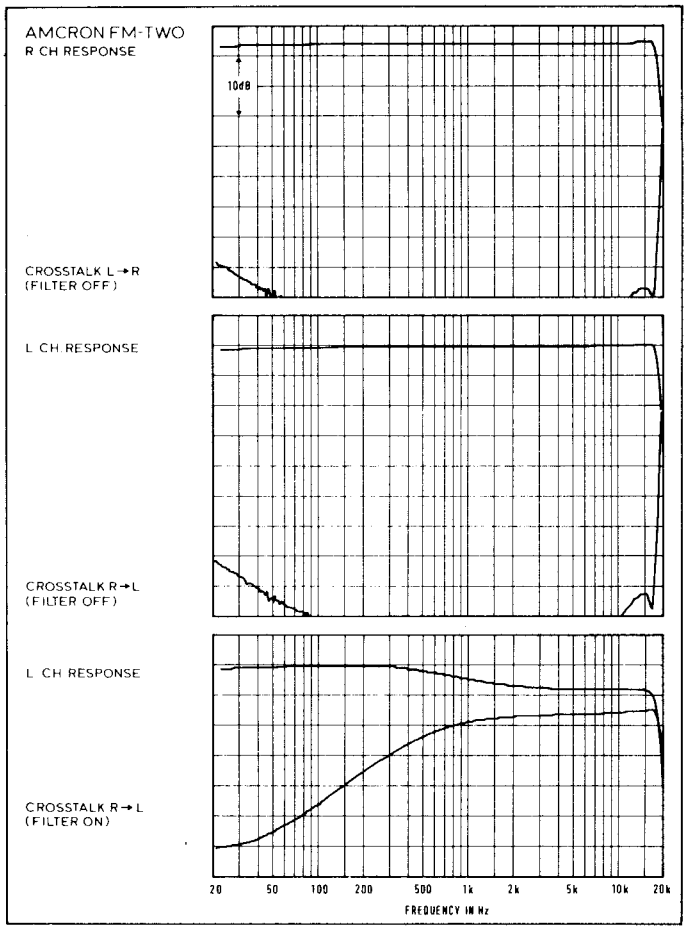



TRIO

the audio output during the computer tests, for just occasionally something can go wrong, which requires an immediate re-test.

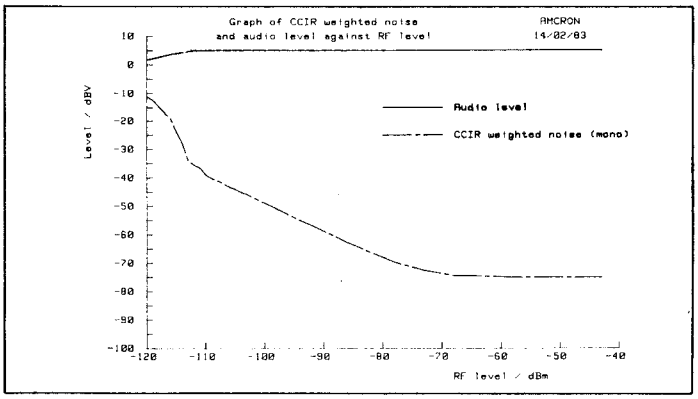
Amcron FM Two

This is the first Amcron tuner that I have come across, and I must say straight away that I found much to disappoint in its design and performance. It has an extremely slim profile, and is fitted with rack-mounting slots and handles. Controls on the front include push buttons for power on/off, 25µs/normal de-emphasis, high-blend filter on/off, mute on/off, mono/stereo, dim/bright display, and scan/



normal tuning. Pivoted lever buttons are provided to select up or down tuning (scanning for the next station, shifting in 50kHz steps, or changing frequency quickly if held depressed), memory insert, and six preset stations. The tuner only has an FM band II facility. A digital readout provides frequency indication with 50kHz resolution. The two-core mains lead on the back panel is captive. A remote control socket is fitted for interconnection with other Amcron equipment. The coaxial antenna socket is the 75 ohm threaded type, often found on Japanese tuners, but only rarely in Europe, and I would have much preferred the more usual Belling Lee type. The only other interconnections on the back are two phono sockets for audio output, each having its own output potentiometer.

The first thing I do with a new tuner is to check that it actually works, and although this one did, I was totally baffled because everything seemed to be wrong. A rapid check showed that the left and right output sockets were connected the wrong way round internally, that once the preset levels had been set flat out one channel sounded much louder than the other, and that the sound seemed very muffled. Laboratory tests confirmed that maximum output levels were indeed mismatched by 2.7dB, and that the tuner had been supplied with American de-emphasis, which is hard to excuse. The aerial socket was slightly loose, too, and the signal wire



eventually broke off the back of the socket and had to be fixed in the lab.

Some stations seemed to reproduce with a strange whistle on them, and this problem was confirmed in the lab. The tuner was obviously very sensitive, but all the problems encountered had by this time made me realise that it could not be recommended. The importers were informed of all the problems, but we were not told until the last minute that an unlabelled internal switch on one of the circuit boards was a 50/75µs de-emphasis switch. There was only time to make new response pen charts, but other measurements that would be affected are marked with an asterisk in the table.

Sometimes when using the search mode, a new station would be located 50kHz too early, and this is extremely poor. Some of the push buttons felt a little sticky in operation. When stepped tuning is selected, the tuner mutes for one second, which is very annoying. We also felt that six presets are insufficient on an expensive tuner.

Briefly interpreting the test results, RF sensitivity was excellent, RFIM characteristics reasonable, and reciprocal mixing/blocking performance quite good, while adjacent channel selectivity showed the tuner to be a little wide, compromising for low distortion rather than DX station selection. Alternate channel selectivity was good, however, though not outstanding. Capture ratio was a little disappointing considering the selectivity, although certainly not poor. The signal strength meter seemed rather ridiculous, since full-scale deflection was indicated for all signals above 100µV, while half-scale was reached for a surprisingly weak signal. Signal/noise ratio was affected by the intrusive whistles mentioned above, and was thus poor. All distortion measurements were extremely good, and almost down to signal generator residuals. The photograph shows 19kHz pilot breakthrough to be remarkably low, with acceptable lower sideband Radio Data breakthrough, and almost no upper sideband components. L/R frequency responses were extremely flat once we had found the de-emphasis switch, and crosstalk characteristics were excellent. (Note the chart showing the ▶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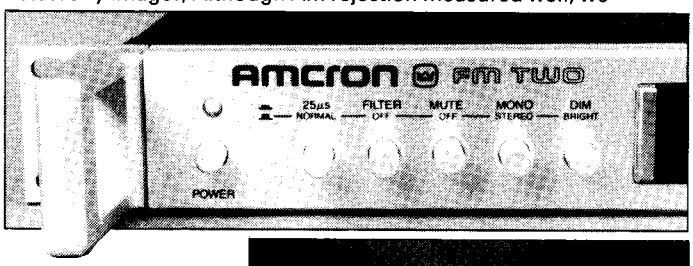
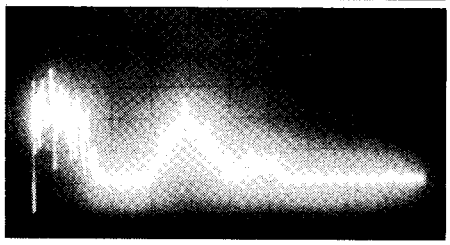
action of the high blend facility.) The stereo switching level was at the tuner's 30dB IHF point, but muting did not open up until 9μV, which is on the high side. Image rejection measured fantastically well. (We pushed in as high an RF signal as we dared, but could not detect any image!) Although AM rejection measured well, we





Distributor: HHB Hire & Sales, Unit F, New Crescent works, Nicoll Road, London NW10 9AX Price £529
Right: Radio Data breakthrough, 14-24kHz band (1kHz/horizontal div. 10dB/vert. div) Base line −90dB ref. full modulation at 1kHz.

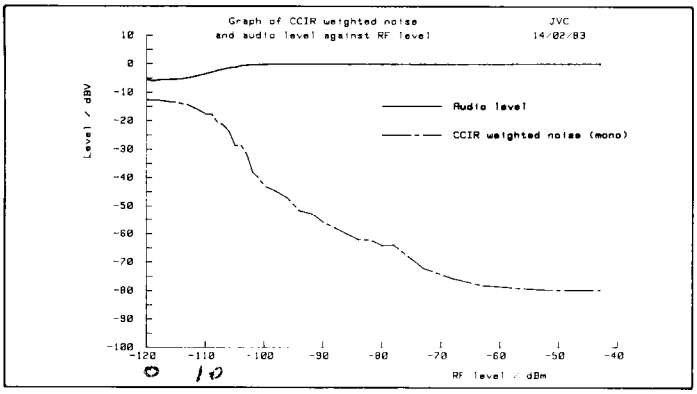
detected some hum on the carrier, which was added by the tuner.

In conclusion I feel that although there are some good points in this design, I cannot recommend it because there are too many problems, both in design and ergonomics.

JVC T-X55

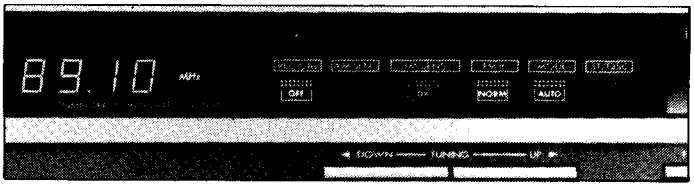
Despite the relatively modest price of this tuner, some quite fascinating facilities are built in, and the overall performance is certainly very worthwhile. All the basic operational controls are push-button operated, and select power on/off, memory/external timer controls, frequency up/down, preset stations – eight each for VHF and AM – the display indicating frequency or signal strength in dBf (0dBf = −120dB ref 1mW), AM sensitivity high/low, FM sensitivity (switches in 10 or 15dB attenuation in cycling steps), FM IF normal/narrow, FM mono/stereo/muting, record cal (333Hz at 3dB below full deviation, which in my opinion is much too high a level), and finally AM and FM selection for medium wave/Band 2 VHF. On the back are terminals for 75 ohms/300 ohms VHF and AM live/earth, a detachable loop antenna also being provided, which can be hinged on the back if required. The mains cord is detachable, having a standard type miniature socket. Audio outputs are via phono sockets, no output level controls being fitted. The tuner has a very 'space age' appearance with a variety of coloured landing and take-off lights! Removing the top cover exposes a beautifully engineered, airy interior, which is unusual in having clearly printed indications for all the different sections of the circuitry. The layout is so neat that if it is ever necessary to service the tuner this should be easier than usual.

The tuner incorporates a built-in programmable microprocessor which selects up to six stations in sequence each time the tuner is switched on, thus allowing different programmes to be recorded during the day by an external, remote timer. Once a station is tuned in, the IF bandwidth, aerial attenuation and mono-stereo are automatically switched by the tuner unless manually overridden. The preset memories also hold these parameters. Up/down tuning is in



50kHz steps, but search is initiated if the buttons are held down for just over half a second. Unfortunately muting is automatically switched on when tuning, and this is infuriating if you are looking for a weak station. This also happens for half a second when the frequency/signal strength switch is pressed. I had a battle with the tuner's automatically controlled high blend, which unfortunately the tuner won, for I could not obtain full stereo on weak signals!

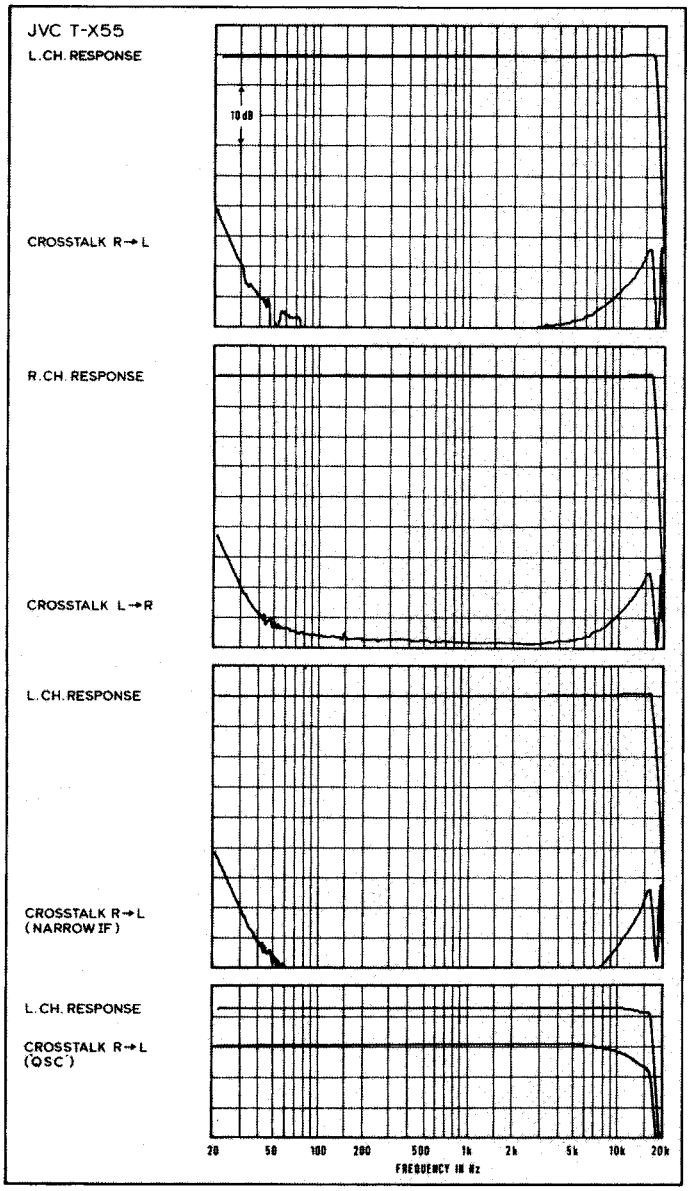
The sound quality on mono and stereo FM was excellent, especially on strong signals. MW quality was surprisingly good, particularly on the 'hi-fi' position, in which the IF bandwidth is much wider than normal. Unfortunately when an FM aerial with a very long down lead is interconnected, there seem to be whistles produced on



Distributor: JVC UK Ltd, Eldonwall Trading Estate, Staples Corner, 6-8 Priestley Way, London NW2. Price £215
Right: Radio Data breakthrough, 14-24kHz band (1kHz/horizontal div.) Base line −90dB ref. Full modulation at 1kHz.

medium wave which disappear when the VHF antenna is removed. Also the muting switch is not separated from mono/stereo switching, and this too was a little annoying.

The lab tests revealed the RF sensitivity to be only just good enough, and several dB worse than perhaps it should have been on a modern tuner. RFIM was satisfactory, though not good, but the reciprocal mixing performance was poor, showing dynamic range to be rather limited in a practical situation where a great variety of stations of widely varying strength are being received. Note that with the narrow IF, the decreased sideband noise produced by the interaction with the local oscillator gives a better reading. Selectivity ▶



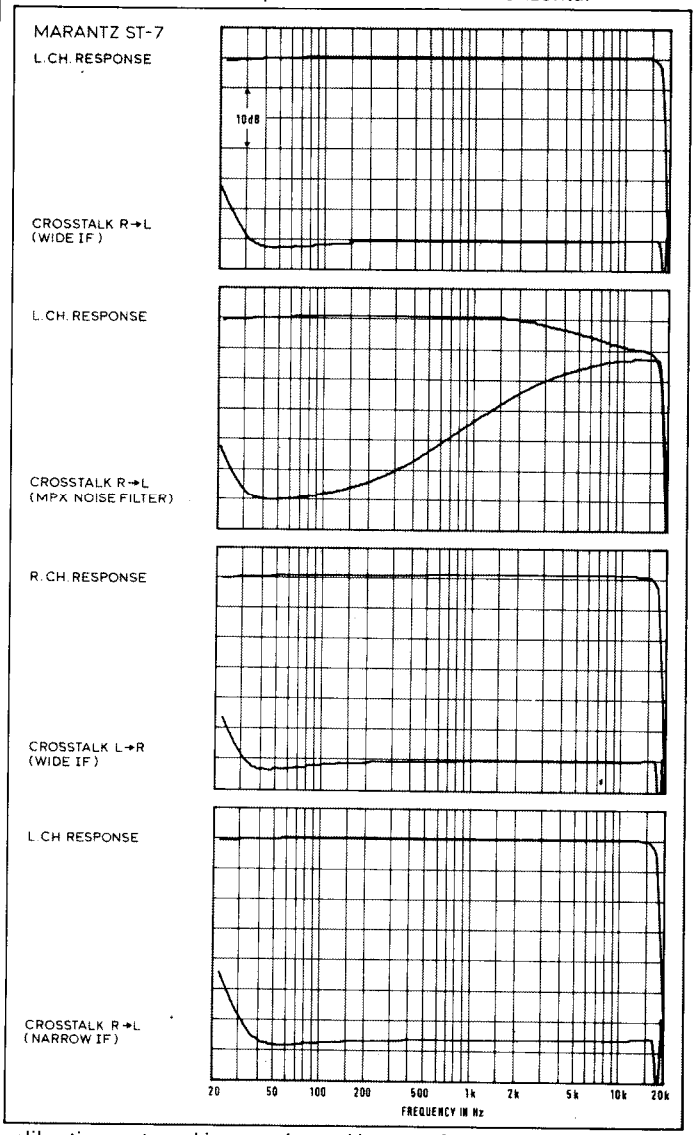
was quite wide in the normal position and moderately narrow with 'narrow' switching, alternate selectivity measuring well. Capture ratio measured very well. Image rejection was the poorest of the tuners tested, although good enough for normal purposes.

AM rejection was satisfactory, but again not good. Both switching and muting levels were well optimised at the same point, whilst limiting was reached very rapidly, which is good. I must particularly commend the accuracy of the signal strength readings in dBf, the accuracy of all levels from extremely low to very high being within 3dB or so, higher levels being particularly good. Signal/noise ratios measured very well, and frequency responses were incredibly flat, with crosstalk generally at a very low level. Rather surprisingly, distortion levels, although measuring well, were not quite so good for 3rd harmonic, with the wider IF distortion falling very rapidly, with only a very small deviation drop. Output levels were quite normal and pilot tone rejection was excellent without any observable Radio Data problems, which is most welcome.

Summing up, this tuner gave a good all-round audio performance, and generally I liked its ergonomics. JVC should try to improve their RF front-end sensitivity and RF dynamic range parameters, but even so, what is perhaps most important is that the tuner is very good value for money, and can be recommended.

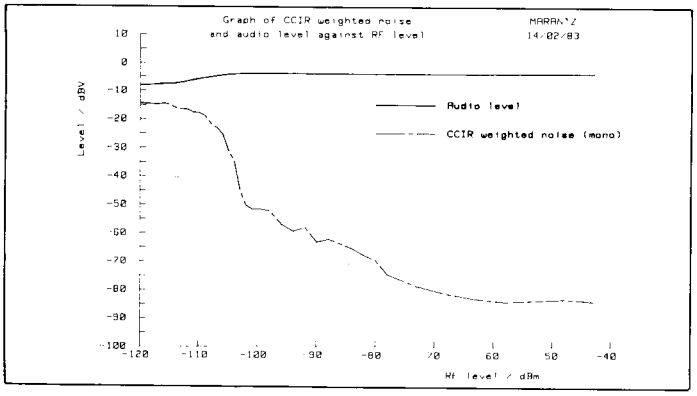
Marantz ST-7

This tuner is quite large, and incorporates a cathode-ray tube on the front panel which can be used as a tuning indicator, for signal strength, for multipath indication or for showing audio levels, left and right, against each other. Here, mono signals produce a bottom left-top right diagonal line, while out-of-phase, stereo, signals appear as a line from top left to bottom right. Thus the display usefully gives phase as well as intensity information on stereo broadcasts. Front panel controls for the scope include vertical and horizontal

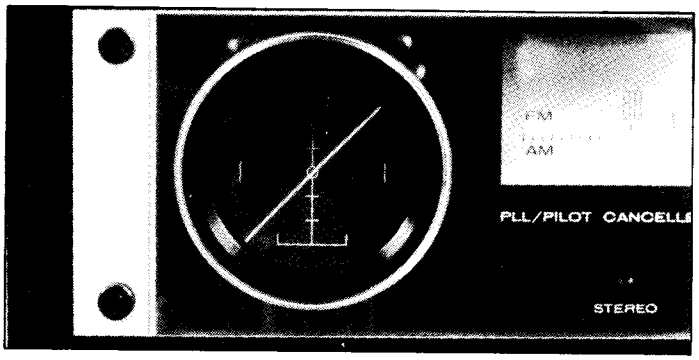


calibration, external input gain, and buttons for selecting scope on/off, external input/audio/tuning/multipath facilities. Two more pots control audio output level (ganged) and muting level with switched 'off' position. Push buttons also select wide or narrow IF bandwidth, FM/AM, quartz lock on/off, record calibration tone (level appropriately at 5.5dB below peak deviation which is reasonable), MPX noise filter (actually the usual high blend) mono/stereo and power on/off. The tuner uses analogue tuning via a wheel whose edge protrudes from the front panel. The quartz lock is switched off when this wheel is touched, this being confirmed by an LED. The analogue scale is marked in MHz, and numbered every 2MHz. This is reasonably easy to read, though of course a digital readout is much better. Unfortunately the tuning assembly on the review model tended to stick somewhat and required a considerable 'transient' push on the wheel to shift it. On the back panel there is a ferrite rod for AM, which has an internal screw adjustment for peaking its sensitivity. The 75 ohm coaxial antenna socket is of the Japanese screw thread type, complemented by both 75 ohm and 300 ohm terminals, an additional terminal being provided for AM. The captive mains lead is two-core, and there are both fixed and variable level pairs of audio output sockets, a further set being provided for external access to the oscilloscope. Presets on the back panel provide adjustment for scope brightness and focus. A single American-type unswitched and unshuttered mains outlet socket is provided (these are now outlawed in the UK, so take care not to get a shock).

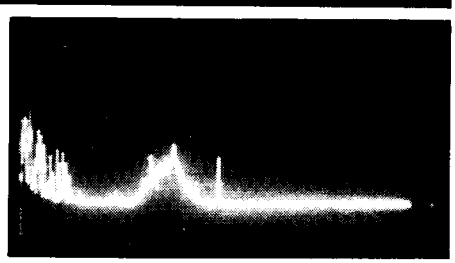
In the subjective tests the sound quality on FM seemed very good at all times, and the tuning ergonomics were liked apart from the binding mechanics. The scope worked well, and provided an excellent tuning indication. Watching the multipath indication as I tuned my main Galaxy antenna off Wrotham, we found the multipath indication very positive – just before it became audibly apparent. Signal/noise ratio received favourable comment, and distortion seemed very low. Selectivity was thought excellent, particularly on narrow. The lack of preset stations was thought a slight disadvantage.



I do not mean to be insulting in praising this Marantz wireless for its ability to pick up medium wave stations like my Granny's very old radio, which I remember from many years ago! Medium wave sensitivity seemed very good indeed, the selectivity being just right and the quality surprisingly good on the best stations, with an audio response that was reasonably extended for AM. Audio distortion from medium wave was far better than usual, and with its absence of whistles and nasty RFIM products, this Marantz is clearly a lesson to most Japanese manufacturers whose medium wave circuits are often quite horrible.



Distributor: Marantz Audio UK Ltd, 15/16 Saxon Way Industrial Estate, Moor Lane, Harmondsworth, Middx UB7 0LW. Price: £349



Right: Radio Data breakthrough, 14-24kHz band (1kHz/horizontal div., 10dB vert. div.) Base line −90dB ref. Full modulation at 1kHz.

The lab tests showed a very good RF input sensitivity, but a slightly lop-sided RFIM performance which was some 7dB worse on one side than the other. The reciprocal mixing dynamic range performance measured quite well, though. Adjacent channel selectivity was very good in the narrow position, while alternate channel was superb in narrow, but rather poor on wide. Capture ratio measured incredibly well and image rejection was superb; we didn't want to break the front-end by over-driving in an effort to get a measurement! AM rejection was very good, and although stereo switching and the most sensitive muting levels were optimally set, the mute could still be adjusted so that only stations above 20µV could open it. Limiting began at an extremely low level, which is excellent. The signal strength indication on the scope tube was reasonably linear in general, but began squashing on very strong signals. Signal/noise measurements were all extremely good and the responses were very flat, although crosstalk was strangely disappointing, being no better than 30dB on wide IF (but curiously better with narrow IF, so possibly some poor quality control here). Distortion measurements were all extremely good with IF on wide, but deteriorated to slightly worse than 0.1% on narrow, which is still very good. I think the narrow IF is very well optimised between distortion and selectivity for picking out weak stations. The variable output level was high enough to meet all normal requirements, but the fixed is a little on the low side for some applications. Pilot tone rejection was excellent, and no radio data problems were noted.

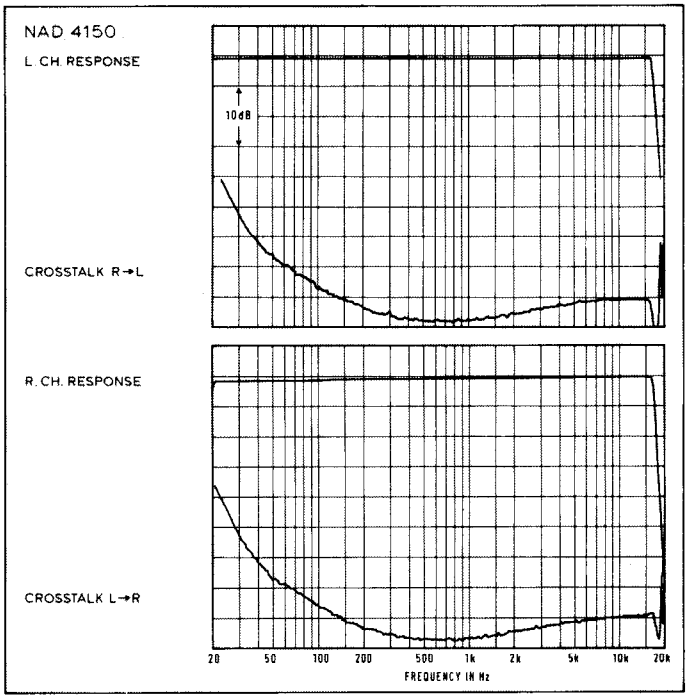
I really liked this tuner, for it sounded particularly good and had some welcome ergonomic features. Assuming that normal samples do not have a cursor light wire which catches on the internal components, I can recommend it strongly, but it ought to be noted that I have a preference for this 'old-fashioned' kind of manual tuning. A very well thought out product, but it requires more care in crosstalk adjustment.

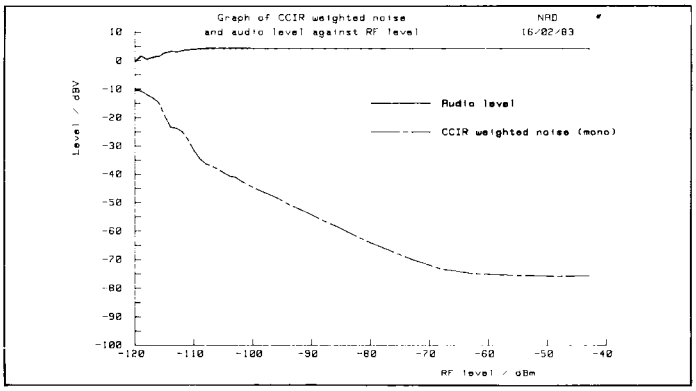
NAD 4150

This much talked about tuner has only just become available for review. It incorporates the widely acclaimed Schotz detector circuit, which automatically adjusts the discriminator bandwidth with signal strength and signal quality. NAD claim this tuner to be very sensitive, and indeed it is the most sensitive I have ever tested, almost, but not quite, defying the laws of physics! Unfortunately, sensitivity is not quite everything.

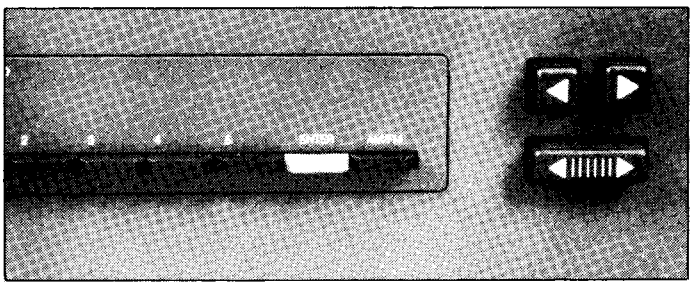
Metal encased,the tuner is quite slim, but some of the corners were rather sharp. All the front panel controls are pushbuttons, providing power on/off, mono/stereo, muting on/off, up and down tuning/searching, search/step tuning, 5 preset stations, together with memory insert and AM/FM. Note that five medium wave stations can be preselected as well as five on FM. The mains lead is a captive three-core type. A ganged stereo preset pot on the back panel adjusts the audio output levels on two phono sockets, the maximum level being more than ample. A turnable ferrite rod antenna is fitted at the rear, which can be pointed in any direction; better than most in this respect. Clamp terminals are provided for 75 and 300 ohms FM, and AM, an earth terminal also being provided. I felt that the earth was too far away from the 75 ohm clamp, but surprisingly this didn't seem to interfere with sensitivity. Frequency readout on the front panel is digital, with signal strength indicated by five LEDs. The centre-tuning indication is very crude, with arrows indicating which way to retune, although tuning had to be more than 50kHz off channel for the error to be indicated, which is poor. On AM, the auto search tuning tends to find stations one channel too early, which are therefore mistuned by 9kHz.

NAD make strong claims for their tuner's ability to deal with signals which are prone to multipath distortion, but I cannot substantiate this since we found that while listening, for example, to LBC with an aerial beamed on Wrotham (around 50° anticlockwise) distortion was evident which should not normally be audible on a good tuner. The main problem here was a tendency for bad 'spitch' to be audible on speech peaks. Many weakish and medium strength stations seemed noisier than usual, with either twittering or swishing noises in the background. Slight RFIM products were noted in the 'on aerial' test, with a few whistles here and there. Tuning ergonomics were quite liked, and 'mute off' from a step change was achieved more quickly than usual. FM scanning for the next station was excellent. Received medium wave quality was quite reasonable, with distortion quite low, and selectivity well compromised, favouring quality rather than DX performance. The AM quality was thought better than that of most other tuners, but both the JVC and Marantz reviewed above were better still. Even the strongest received stations on FM never seemed quite as clean as on some of the other tuners, there being a tendency to produce very slight burbling noises in the background. RF sensitivity was spectacularly good, and RFIM measured well despite the criticisms on the aerial test. The dynamic range established by the reciprocal mixing test measured very well, so I don't know where some of the background noises come from. Adjacent channel selectivity seemed very sharp indeed; probably too sharp, although alternate channel selectivity was very poor, showing a rather odd filter design, which I am sure could be bettered quite easily. Capture ratio was fairly poor despite NAD's claim, but image response was excellent. AM rejection measured very badly, and

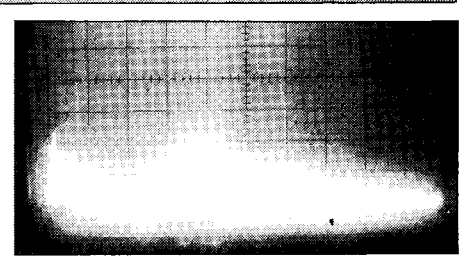




must be put right.Stereo switching and muting levels were much too sensitive, but limiting began at an extremely low RF level, which is very good. The signal strength indications were reasonably well compromised. Signal/noise ratios were good but not excellent, while



Distributor: Hi-Fi Markets, Unit 3 Colonial Way, Watford, Herts. Price: £169
Right: Radio Data breakthrough, 14-24kHz band (1kHz/horizontal div., 10dB/vert. div.) Base line −90dB ref. Full modulation at 1kHz.



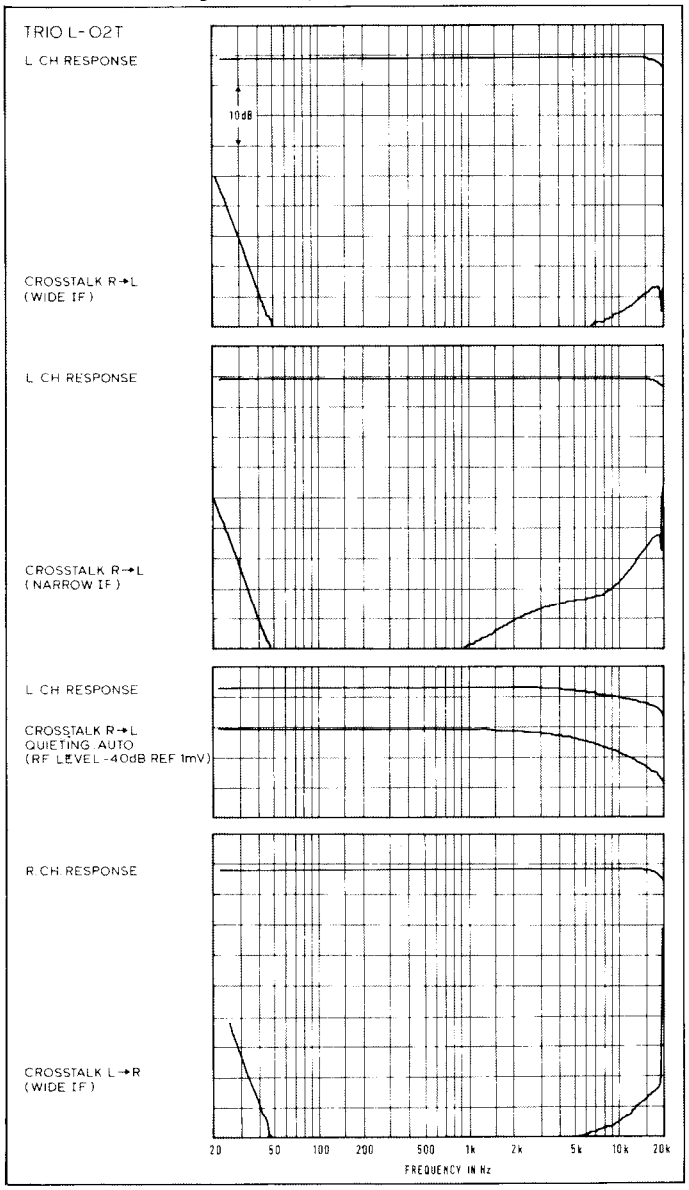
the frequency responses were very flat indeed, crosstalk also measuring very well. Note the incredibly steep cut-off of the MPX filter, giving excellent pilot tone rejection and virtually no Radio Data breakthrough. Distortion measurements were rather odd, for ▶

although the figures were very low indeed when the tuner was first switched on, the second harmonic climbed from 0.06% to 0.16% after two minutes, and to 0.37% after 15 minutes. We could find no explanation for this, but it happened each time we tried it.

This tuner is very reasonably priced, but there are a few points which quite clearly need to be put right before I can be enthusiastic about it. I suggest you wait a while and see what transpires, for I hope it will be improved.

Trio L-02T

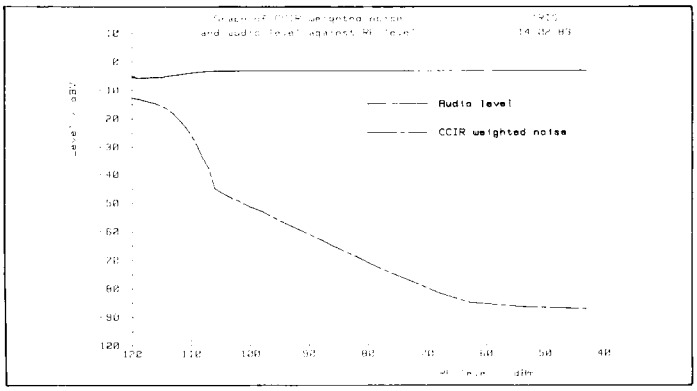
I am told by the importers that this model is Trio's last fling at top-end analogue tuner design, because they claim that many of the analogue components are now becoming so expensive that it is hardly economically viable. This is about the largest and heaviest tuner I have tested, and the first decision centres on whether you have room for it! The enormous front panel offers both a superb analogue readout system, which is adjustable to perfection, and a digital display. Tuning is accomplished via a large tuning knob which has a beautifully engineered flywheel action. Controls on the front provide for the 'sigma drive' audio output level, adjustable muting level, mono, auto stereo or full stereo modes. Pushbuttons operate power on/off, signal strength/multipath metering, record cal. tone (5dB below full deviation), stereo only reception, muting on/off, wide/narrow IF bandwidths, 20dB aerial attenuation on/off, and de-emphasis normal or 25μs (75/50μs switch on the rear panel). By the side of the tuning knob is a pushbutton which selects quartz lock



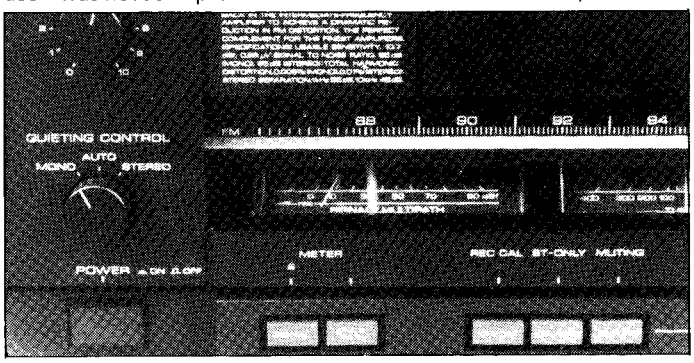
(with LED indication). The 75 ohm aerial input is on the usual threaded Japanese coax socket, an independent earth terminal being provided. The detachable mains lead is two-core. The main audio outputs are on rather odd audio connectors, with special leads ending in superb quality phono plugs. Separate fixed level outputs are available on phono sockets, complemented by two multipath test outputs for scope interconnection.

I liked this tuner very much indeed from an ergonomic point of view; what better way is there for tuning around a band than rotating a well engineered tuning knob? It was so much easier to explore DX station locations, to gain a quick idea of the shape of a band, than any other tuner in this survey, but the colossal price surely places it out of reach of virtually everybody, which is a pity. The sound quality at best was truly excellent, and the distortion amazingly low, particularly on the wide IF position. I did not note any RFIM problems, and very weak stations could be easily discerned on the narrow IF position only 100kHz away from quite strong ones. I had the feeling, however, that the RF sensitivity was not as good as it should have been, although the signal/noise seemed very good. I cannot personally see the point of Trio's 'Sigma Drive' gimmick, which doesn't seem to make any audible difference compared with fixed outputs.

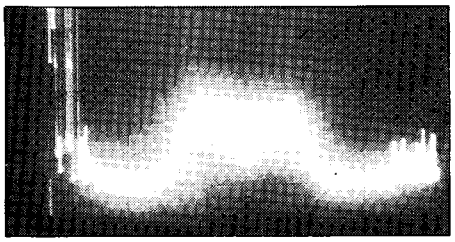
The lab tests revealed that the RF sensitivity was in fact around 3dB inferior to Trio's earlier magnificent 917 tuner, which I reviewed a few years ago, although one could certainly not call the measurements poor. The RFIM tests gave good results, and dynamic range, based upon reciprocal mixing tests, measured very well indeed. The wide selectivity position gave exceptionally low distortion while maintaining a moderate degree of selectivity, but in the narrow position adjacent channel selectivity measured stunningly well, with alternate selectivity as good as I have ever noted on an FM tuner. These selectivity readings clearly back up the subjective findings: this tuner seems to pick out DX stations amazingly close to strong ones where many others fail. It is slightly



surprising that the capture ratio is no more than reasonable, but the image response was, of course, fantastically good, the computer giving up at the point where we might have started to overload the input at around ½V! The AM rejection also measured amazingly well, contrasting dramatically with the NAD! The 19kHz pilot rejection, whilst being good – and easily good enough for normal use – was not as impressive as in some of the other tuners, and there



Distributor: Harman UK Ltd, Mill Street, Slough, Berks. Price: £1100



Right: Radio Data Breakthrough, 14-24kHz band (1kHz/horizontal div. 10dB/vert. div.) Base line −90dB ref. Full modulation at 1kHz.

was also a small amount of Radio Data breakthrough, which was rather a shame, and which Trio should rectify. The signal strength indication in dBf was very accurate indeed, apart from the very weakest signal, and this is most useful.

Returning to the input sensitivity measurements, we found that on narrow selectivity the 30dB figure degraded, which is intriguing. I would have expected that the 26dB signal/noise figure would have been perhaps a dB better than it was, comparative to the 30dB IHF

▶65

result, but the measurements suggest that there was less crackling than usual in the background in the presence of mod. I suspect that the front-end aerial transformer was slightly mistuned.

All the signal/noise results were very good, and responses were very flat indeed, crosstalk also being excellent, but this is to be expected on such a fine tuner. A year or two ago I spent many happy hours trying to get the distortion on my Radiometer SMG 40 encoder/transmitter down to incredibly low limits, and I am delighted to see that on wide selectivity this Trio tuner seems to be giving figures which are down to the residuals of my test equipment. Even on narrow selectivity the distortion levels are very low indeed, and this is frankly amazing considering the extremely good adjacent channel selectivity. Many of the excellent measurements are the direct result of Trio's very advanced circuitry, but unfortunately space precludes my giving in-depth details.

Most certainly this is a tuner which I wish that I could afford, and which can be recommended warmly if you feel that its purchase can be justified at its almost unbelievable price. My only slight disappointment was the front-end sensitivity.

Conclusions

In looking over the five tuners surveyed this time, I feel that two models should, for the time being, be put aside: the Amcron as it was expensive, yet exhibited careless quality control, and the NAD which did not seem to have had enough time spent on perfecting the design and factory production. The JVC is almost certainly the best they have yet made, and seems exceptionally good value for money. They are obviously now well aware of the Radio Data problem, since their previous model caused quite a lot of trouble (see 'Radio' over the last few months). I particularly liked the Marantz for its excellent overall performance and ergonomics, and this is my personal favourite. (I am biased against up/down pushbutton tuning, but at least I admit it!) The Trio generally performed magnificently, as indeed it should costing over £1000, but the front-end sensitivity was only fairly good and there was some slight Radio Data breakthrough.

If you examine the computer plots of audio signal/noise against RF input level, you will see several points of interest. The Amcron and NAD tuners were both very sensitive, and both manufacturers claim rather special discriminator circuitry. It will be seen that the rate of increase of noise with decreasing RF level is more linear than with the other tuners which tend almost to hit a brick wall of noise below a particular RF level. It is interesting that the NAD and the Trio models both have large ranges of RF level where the S/N RF level curve remains in a sensible straight line. The Trio, though, continues to get quieter at higher RF levels than the NAD. The Marantz chart was unfortunately affected by some computer noise breakthrough and some local PMR interference within the system. This was not spotted until it was too late, and thus affects the weaker signal/noise ratios. Slight breakthrough was also noted on the JVC plot. It will be seen too that the JVC's noise levels are generally higher, almost all the way, than the other tuners, and this is quite clearly because it had the worst RF sensitivity, which affects performance even at high levels. If the JVC chart is overlaid on the top and slightly to the side of the Trio there is almost perfect correlation between them.

A number of readings on the Amcron tuner would be affected by the incorrect de-emphasis at the time of test, but there was no time for them to be repeated before writing up the test results. All signal/noise figures will be slightly worse than those shown, therefore, including the 50dB S/N point, and in the noise plot the curve will not go so far down at high levels. Other RF and IF measurements should not be affected, though.

The Radio Data breakthrough and 19kHz rejection photographs were taken from the audio output of each tuner, with full deviation at 1kHz calibrated for the top of the picture. Each tuner was tuned in to BBC Radio 2 from an aerial giving around 7mV signal into the tuner. The Trio had the worst breakthrough, which will be seen to be in two lumps around 2kHz wide either side of the pilot tone. Each scan is from 14kHz to 24kHz, a major horizontal division corresponding to 1kHz. Each vertical division is 10dB. The bandwidth used on the HP 3580 spectrum analyser was 30Hz, so it must be remembered that whilst the levels indicated may not look very high – for example on the Trio – the total energy that would be audible in the 19kHz region to bats, birds, dogs, cats and bug-eared humans could be disturbing. The JVC and NAD filters, both acting from around 16kHz, show most impressive fall-offs on the response chart, which is helpful.

The Marantz crosstalk of only 30dB with IF on wide is not as disturbing as some specmanship marketing people might imagine, and 30dB separation is most certainly good enough for normal users. But this does leave the question of whether the crosstalk will worsen with time, as circuit components age. An examination of the crosstalk and response charts shows one particular curiosity on the Trio, where the swept response on one channel nulls well at 19kHz with pilot tone cancellation, but pops up on the other at only 4dB below the sweep level of the normal channel. This shows quite clearly that Trio are not using any form of proper low-pass multiplex filtering. Finally, I must comment again, as I have so often done previously, that RF front-end design still seems a long way short of what it should be. Why could the Trio not have been 3dB more sensitive, for example? We checked to see if it was just a Trio front-end problem by remeasuring the overall 30dB IHF sensitivity with the Mutek preamplifier in circuit in front of the Trio (the Mutek was mentioned recently in 'Radio'). The measured sensitivity was improved by an amazing 4dB, but of course RFIM, etc, would suffer. However, this system could, of course, be highly beneficial if you live way out in the sticks. As far as RFIM is concerned, I have measured some incredibly good tuners, including the Hitachi and redesigned Technics models last year, so why couldn't RFIM be better again one year later? I am beginning to wonder if manufacturers are being more influenced by their gimmick-fancying marketing departments than by their engineers, who I am sure would like to perfect areas of basic circuit design. Let's have better engineering and fewer gadgets. And let us not abandon the friendly old tuning knob!

	Trio L-02T	JVC T-X55	Marantz ST-7	Amcron FM-two	NAD 4150
Sensitivity (30dB IHF)	1.25µV	1.6µV	0.95µV	0.8µV	0.65µV
Sensitivity (26dB S/N)	0.95µV	1.05µV	0.6µV	0.45µV	0.38µV
Sensitivity, stereo 50dB S/N	35µV	40µV	33µV	18µV	21µV
S/N ratio, stereo, 1mV (CCIR/ARM weighted)	72.5dB	72.8dB	74.0dB	69dB	71.8dB
S/N ratio, stereo, 5mV (CCIR/ARM weighted)	75.0dB	74.4dB	75.5dB	69dB	72.5dB
L, R only sent: **Stereo distortion**, 2nd harmonic	–72dB	–66dB	–64dB	–73dB	–64dB to –49dB
L, R only sent: **Stereo distortion**, 3rd harmonic	<–85dB	–58dB	–66dB	–72dB	–68dB
L, R only sent: **Stereo distortion**, 2nd harmonic (narrow IF)	–62dB	–65dB	–59dB	—	—
L, R only sent: **Stereo distortion**, 3rd harmonic (narrow IF)	–68dB	–64dB	–66dB	—	—
L = R sent: **Stereo distortion**, 2nd harmonic	–76dB	–72dB	–65dB	–71dB	–68dB to –60dB
L = R sent: **Stereo distortion**, 3rd harmonic	<–85dB	–64dB	–70dB	–72dB	–72dB
L = R sent: **Stereo distortion**, 2nd harmonic (narrow IF)	–76dB	–71dB	–56dB	—	—
L = R sent: **Stereo distortion**, 3rd harmonic (narrow IF)	–82dB	–64dB	–60dB	—	—
Output Level	1.2V (var)	0.9V	1.2V (var)	2.3/1.7V	1.5V
Stereo switching level	1.25µV	3.6µV	3.0µV	0.8µV	0.55µV
Muting level	3.0–4.50µV	3.6µV	3.2–20µV	9µV	0.6µV
1dB limiting point	0.9µV	1.3µV	0.65µV	0.55µV	0.45µV
Image rejection ratio	>115dB	82.5dB	>117dB	>118dB	>119dB
Capture Ratio	1.8dB	1.2dB	0.8dB	1.9dB	2.5dB
Selectivity, adj. channel (wide IF)	7dB	6dB	4dB	10dB	21dB
Selectivity, alt. channel (wide IF)	50dB	58dB	41dB	71dB	45dB
Selectivity, adj. channel (narrow IF)	25dB	12dB	15dB	—	—
Selectivity, alt. channel (narrow IF)	84dB	76dB	81dB	—	—
RFIM (lower side)	75.6dB	70.7dB	72.6dB	69.0dB	74.6dB
RFIM (upper side)	72.7dB	67.0dB	65.2dB	73.4dB	70.0dB
AM rejection ratio	–65.5dB	–54.3dB	–61.6dB	>–60dB	–34.2dB
Reciprocal mixing dynamic range (wide IF)	79dB	67dB	76dB	79dB	83dB
Reciprocal mixing dynamic range (narrow IF)	81dB	74dB	78dB	—	—
19kHz pilot rejection	–66dB	–72dB	–74dB	–80dB	–74dB
Rec. cal. tone level (ref peak deviation)	–5dB	–3dB	–5.5dB	—	—
Signal strength meter reading at 10mV, 1mV, 100µV, 10µV and 30dB IHF figure repectively	89, 72, 53, 32, 18 (dBf)	90, 70, 48, 25, 12 (dBf)	6 (max), 5½, 3½, 1½, ½ (divisions on scope)	5, 5, 5, 3, 1 (segments on display)	5, 4, 2, 1, 0 (segments on display)