Reception Techniques for Channel 5

Bill Wright

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There simply wasn't room for a fifth channel on the UHF band, but we got one nevertheless. Proof if it was needed that accountants speak louder than engineers. The technical compromises and restricted coverage were inevitable, and they caused a wide variety of reception problems. The Channel 5 retuners have long since gone, but the problems remain.

For a quarter of a century the UK has enjoyed a rational and efficient UHF TV channel plan. Four channels, broadcast from co-sited transmitters of identical power and received on one small aerial, have been available to almost all of the population. A few channels in the middle of the band have been reserved for signals generated at the receiving site by VCRs and satellite receivers. Three channel groups have between them covered almost every transmitter, making the business of stocking and selling aerials very simple. Now, all this is to change with the advent of Channel 5.

A great deal has been said about the technical rights and wrongs of Channel 5, but on January 1st 1997 it will be a reality, and we must deal with it. There will be the initial period of hoo-ha when half the country suffers interference of one sort or another, and then we will settle down to the five channel (or four plus one channel) transmission environment. This article is concerned with the techniques which we will have to employ to receive Channel 5 once the VCR interference problems have been dealt with.

Will Channel 5 make us all rich?

Well no, I don't think it will. In a large part of the country the existing aerials will provide acceptable Channel 5 reception. These are areas where the new transmissions fall within or adjacent to the channel group already used, where the polarisation is the same, where the transmitted power is similar, and where the transmitters are co-sited (or at least in the same general direction). Most aerial manufacturers have modified their Group A and Group B products to include ch37—by far the most commonly used channel for the new service. A few quick tests show that even pre-Channel 5 Group B arrays perform reasonably well on ch37. Group A ones don't though, the response falling off significantly above channel 34. The Nottingham relay, incidentally, will have the new service on ch34, which is within the channel group already in use and a continuation of the existing sequence of chs 21, 24, 37, and 31. Same transmitter site, ERP, polarisation, and channel group — not much extra work there for the aerial riggers of Nottingham!

Will Channel 5 make some of us rich?

In many areas the Channel 5 signals are to be transmitted at much lower power than the existing services and on a frequency well outside their channel group. It looks as if a lot of viewers will have to spend money if they want to receive the new service satisfactorily — or to put it another way, a lot of people within the planned service areas are going to get no more than a very snowy Channel 5 picture for zero expenditure. How much will people be prepared to pay to receive this channel? Considering some customers' astonishing acceptance of degraded TV reception, it seems likely that many people will accept sub-standard Channel 5 reception rather than pay for another aerial. Many Channel 5 installations will need a diplexer and even a masthead amplifier, putting up the cost still further. Certainly, many viewers will wait to see if the channel is worth having before they decide to pay up. Enthusiasm will no doubt be heightened if the channel turns out to be a commercial success with attractive programming. None of this will apply to commercial installations, where the assumption is that all local TV services must be received with good quality.

An examination of the transmitter list will show that different parts of the country are going to have very different reception conditions. For aerial nerds like me, who travel the country peering excitedly at the rooftops, this will be an interesting test of local riggers' ingenuity, and I look forward to seeing many a strange configuration fixed to the nation's chimneys. Later in this article I'll look at the situation which is likely to arise in some parts of the country, taking Sheffield and East Anglia as representative reception areas. First, though, let's consider a few general problems.

Re-use of channel 37

The re-use of channel 37 by transmitters which are by all previous standards too close together, will inevitably cause co-channel interference. There will be large areas where otherwise good reception will be affected. A particular example will be that part of the country lying between Sheffield and Nottingham, where there will be a strong possibility of mutual interference between the Emley Moor and Lichfield transmitters. It appears that at some locations the two signals will be of equal strength, which will make usable reception impossible. One drawback of analogue TV transmission is the great susceptibility to co-channel interference: even where there is a 40dB differential between two signals there will be visible interference. The front-to-back ratio of the aerial could theoretically provide 25dB of rejection, but since the transmitter bearings at, for example, Alfreton, Derbys., are 130°, rather than 180°, apart, the practical rejection figure is likely to be much less. A signal which is itself too weak to produce a picture can still cause patterning.

Another area of channel 37 overlap will be the Isle of Man. There will be no Channel 5 transmitter on the island, so reception will be possible only in northern coastal areas, from the mainland. Unfortunately, any signals from Divis will probably suffer permanent or intermittent interference from Cambret Hill.

No doubt we will have to re-deploy anti-ghosting techniques: stacked and phased arrays, and the use of buildings as a screen. But no matter what we do, the effective service areas of some transmitters will inevitably be reduced by co-channel interference, which produces close-spaced horizontal lines on the screen. Even when slight this venetian blind effect can be very annoying, especially with a large tube size. Presumably the broadcaster will attempt to minimise the problem by the use of frequency offsetting. In offset operation carrier frequencies are adjusted from the nominal by either 0, +5/3, or –5/3 of line frequency. It has been found that these values minimise the visible effect of co-channel interference.

Transmitters not co-sited

In a radical departure from previous UHF planning, some of the Channel 5 transmitters will not be co-sited with the existing TV transmitters for that service area.

The service areas affected are: Divis: Channel 5 from Black Mountain; Ridge Hill: Channel 5 from Churchdown Hill; Crystal Palace: Channel 5 from Croydon; Sudbury: Channel 5 from Chelmsford; Rowridge: Channel 5 from Fawley; Rosemarkie: Channel 5 from Mounteagle; Pontop Pike: Channel 5 from Burnhope; Sutton Coldfield: Channel 5 from Lichfield

Where the two transmitters lie in the same direction, or within 10° or so, the same aerial will probably receive both without problems. No doubt where the two are, say, 45° apart, the cowboys will happily align aerials somewhere in the middle. A few bemused viewers, such as the inhabitants of Shenstone, in the English Midlands, and Annfield Plain, in the North-east, will find that their Channel 5 comes from a

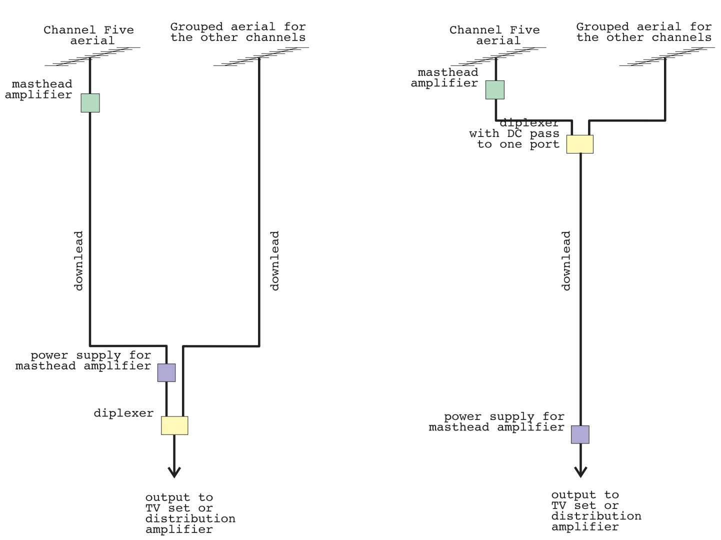


Fig 1. Channel 5 received on a separate aerial with a masthead amplifier. There are various reasons why Channel 5 field strength might be well below that of the other channels: lower transmitter power, unavoidable use of a more distant transmitter, or screening which has more effect on the higher channels. A possible solution is the use of a separate aerial and masthead amplifier. When Channel 5 is well outside the channel group already in use it should be possible to combine the signals using a diplexer. The left-hand diagram shows the diplexer mounted below the amplifier's power supply. If a diplexer with DC throughpass is used, as shown on the right-hand diagram, it can be fitted at the masthead, obviating the need for a second downlead.

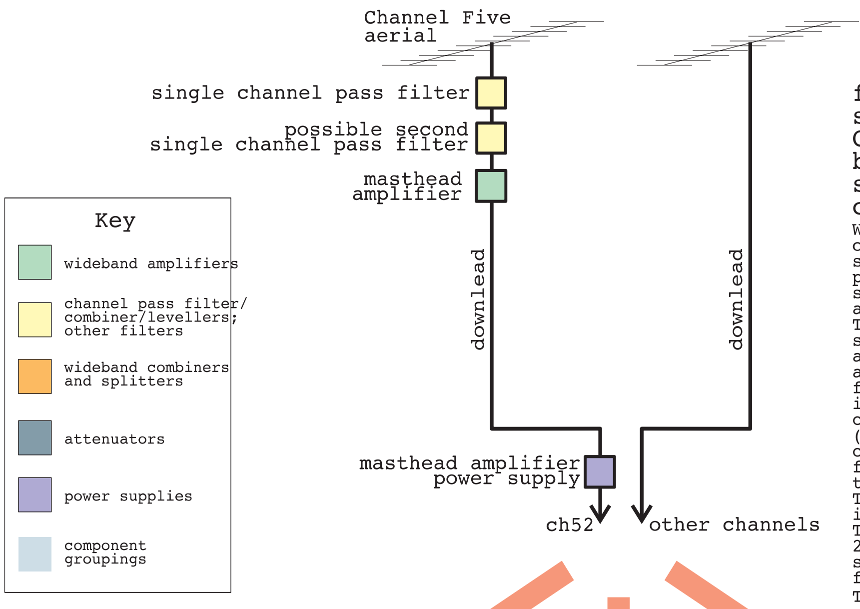
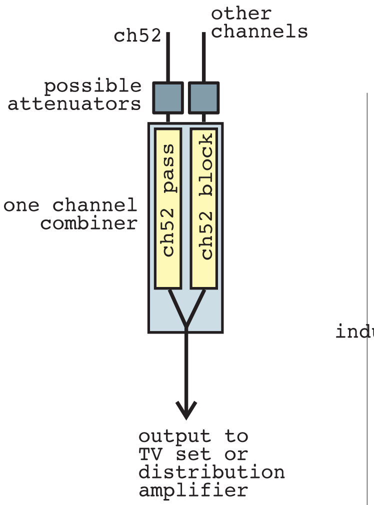
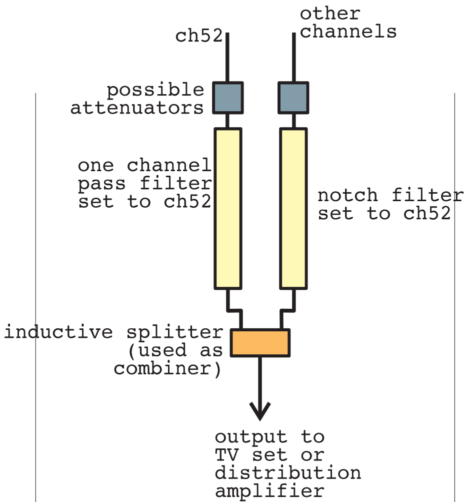


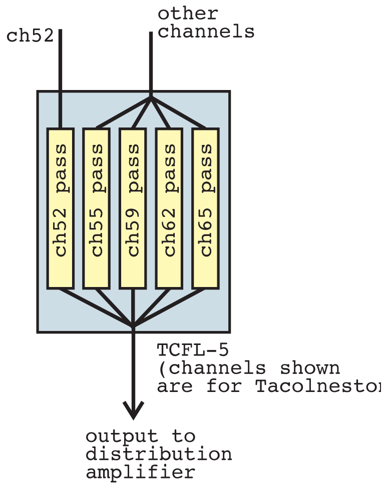
fig 2: Tacolneston and similar transmittersó Channel Five low powered but within (or near) the same channel group as the others.

Where there is a serious inbalance of signal levels between the new service and the existing four, one possible solution would be to use a separate aerial and masthead amplifier. In the case of Tacolneston, the Channel Five aerial should be Group B if a narrowband array is not available. A Group B aerial will minimise pick-up of the four 250kW Group C/D channels, and is likely to have better gain on ch52 than a Group C/D array. An 8MHz (one channel) pass filter tuned to ch52 attenuates the other channels further to avoid cross-modulation in the masthead amplifier. The Taylor TCFL-1 is suitable. A second identical filter might be necessary. Through-loss on these filters is 2dB, and they are not weatherproof so will need some protection if fitted outdoors.
The response of a diplexer is not

alternative methods of combining the signals







Use of a Taylor TCFL1-1CH

This item is intended to combine one UHF channel with all of the rest of the band. It has a single channel notch filter on one input and a single channel pass filter on the other. The notch filter ensures that unwanted ch52 signal does not get in to combine (in random phase relationship) with the wanted signal. The channel pass filter prevents masthead amplifier noise from degrading the signals on the other port.
Attenuators on the two inputs of the TCFL1-1CH may be necessary to obtain correct output levels.

Wright's Aerials (01709) 813419 (0860 610519)	
Job reference: Channel Five Reception Techniques	
This drawing: fig 2. Channel Five very low powered and within channel group, e.g. Tacolneston	
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Use of separate channelpass and notch filters

The trouble with the TCFL1-1CH is that it is factory-tuned, so it isn't feasible to keep stock for every channel. If you work in many different transmitter areas you need to be able to build your filters on the spot. The TCFL-1 and TBF4 are one channel pass and notch filters respectively. For band V use TBF5. The TCFL-1 is sold as a factory-tuned item, but can in fact be tuned about ten channels away from the nominal channel, so it's only necessary to stock four to cover the whole band. Accurate tuning needs a

Use of a Taylor TCFL5

If the signals are to feed a distribution system of any size, it is important that each channel is at the correct level. This justifies the expense of a TCFL5. This item consists of five one channel pass filters. Each filter has three tuned stages and a variable attenuator, allowing the level of each channel to be set independently. Various input configurations are available. For this application we need input option A, which has four channels fed from one aerial and one on its own fed from the other. Putting all off-air inputs through filters like this has another advantage: all unwanted signals are kept out, which eliminates many forms of interference and ensures that

Fig. 2.

direction more or less opposite to that of the other channels. I expect the cowboys will throw the reflectors away. Even where the two signals are coming from almost the same direction, problems might arise if there are large differences in field strength due to screening along one signal path.

There will inevitably be cases where a separate aerial is needed for Channel 5, either because the angle between the two transmitters is too great, because one or both signals are very weak, or because of severe ghosting problems. This raises the question of how to combine the signals. Never combine signals from two aerials with a splitter. This has a disastrous effect on the directional properties of the installation, especially when both aerials are of the same channel group. Ghosting will be likely. In the case of the Chelmsford and Sudbury transmitters a simple diplexer can be used, as shown in fig 1, because the channels are 41, 44, 47, and 51, versus 63. A normal A/B to C/D diplexer will suffice.

Antiference are to introduce a new range of diplexers, with Channel 5 in mind. These will cover most permutations, as follows:

model	low input	high input
UF3134	21 - 31	34 - 69
UF3437	21 - 34	37 - 69
UF3739	21 - 37	39 - 69
UF4648	21 - 46	48 - 69
UF4850	21 - 48	50 - 69
UF5052	21 - 50	52 - 69
UF5355	21 - 53	55 - 69
UF6567	21 - 65	67 - 69

These diplexers will be outdoor units, with switchable DC pass to one or both inputs.

In some cases it may be better to use a channel pass filter (see fig 2) rather than a diplexer. If Channel 5 is on a frequency close to the existing services, or if there is a need for particularly good out of band rejection, channel pass filters are to be preferred.

Local oscillator and image interference

The standard four-channel groupings used in the UK rigorously avoid 5 channel and 9 channel spacing. This is because of image-rejection and local oscillator interference problems which are inherent to receiver design. For the same reason, it is good practice to avoid these channel intervals when installing a satellite receiver or VCR. Imagine my surprise, therefore, when I found a number of n+5 and n+9 clashes as I compared the Channel 5 allocations with the existing four channels for each area. These clashes are as follows:

Transmitter	Existing service and channel	Channel 5 allocation	Clash
Black Hill	BBC-2 ch46	ch37	n+9
Huntshaw Cross	BBC-2 ch62	ch67	n+5
Presely	BBC-1 ch46	ch37	n+9
Lichfield/ Sutton Coldfield	BBC-1 ch46	ch37	n+9

Some TV sets and VCRs will react badly to this. I have two Panasonic VCRs at home, a G40 and an L20, and neither will receive ch59 properly because we also use ch54 (one day I'll do something about it!). I have recently been called out to a large communal aerial system which carries Crosspool (chs21, 24, 29, and 31) and Bilsdale ITV (ch29). It's a fairly deprived district and the TV sets are a rag-bag assortment. Quite a few of them display distinct patterning on ch24, because of the presence of the ch29 signal. It seems inevitable that the clashes shown in the table above will cause problems. There is no quick or cheap fix for this, other than decreasing the strength of one signal in the hope that the patterning on the other will disappear before the first becomes grainy, and of course by doing the converse—increasing the level of the channel suffering the interference. These tricks are not really a good idea, though –they are rarely very successful, and in any case we should always aim to present every TV set with all channels at a correct and equal level. Channel changers are the answer, but since good quality units would take the bill for receiving Channel 5 to more than the cost of a satellite system I can't see many domestic customers being interested. The new device from Pace, which apparently moves ch37 signals to ch68, might find an application here. Channel changers will be discussed later, in the section concerned with distribution systems.

Wide range of channels in use

Sheffield would be well within the Emley Moor service area, were it not for the fact that the city is low-lying and surrounded by hills. A high-powered relay transmitter, Crosspool, serves the city and many outlying areas. Crosspool transmits chs 21, 24, 27, and 31, at 5kW vertical. Channel 5 will be right up near the top of the band, on ch67, 2.5kW vertical. I've taken Sheffield as an example, but there will be a lot of other transmission areas where the existing four channels are within Group A and the new service is up at the top end of Group B or within

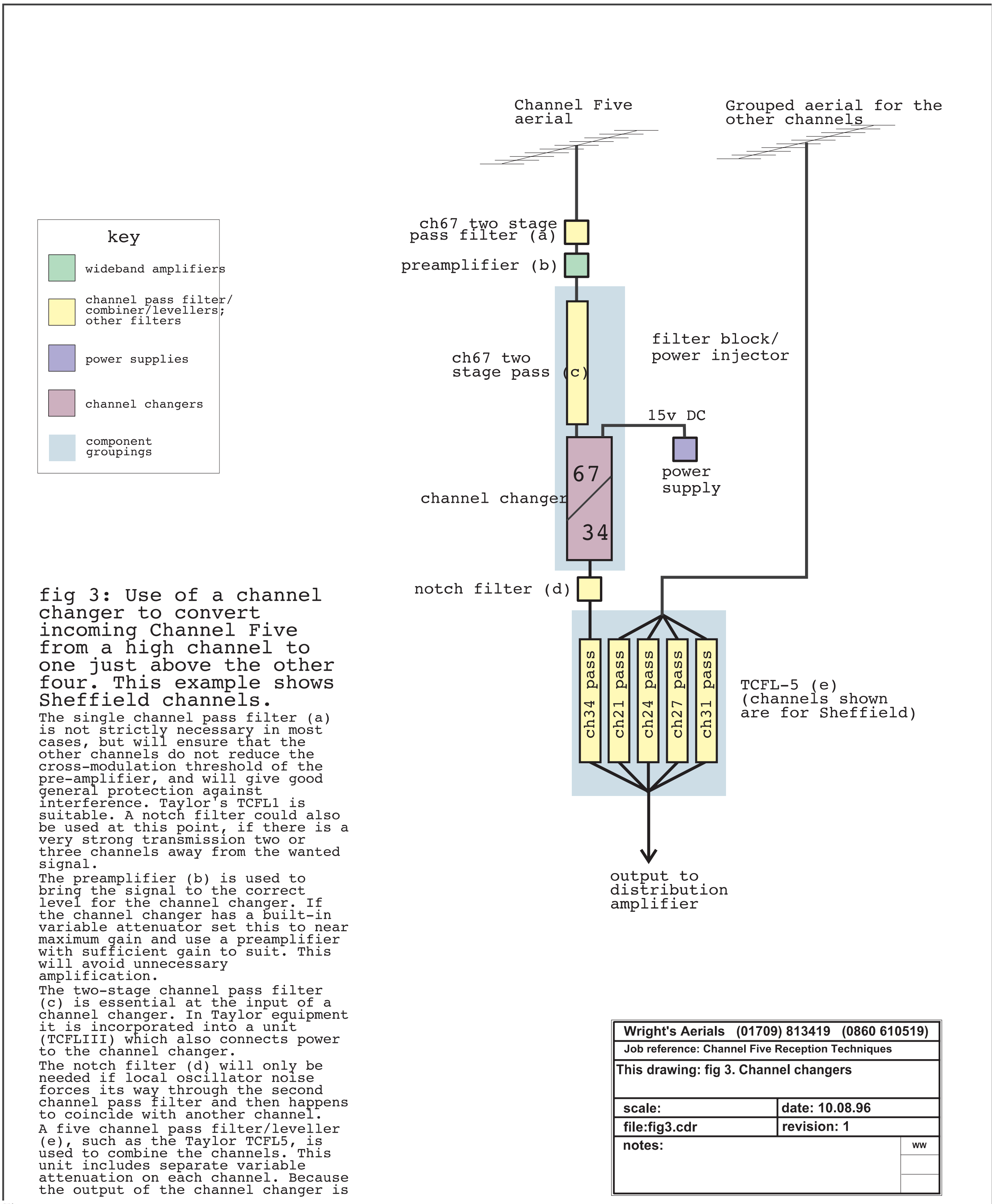

Fig. 3.

Group C/D. This section applies to all of the following: Belmont, Blaen Plwyf, Caldbeck, Craigkelly, Durris, and Fenham. Channel 5 reception is going to be very poor at most existing installations, because Group A aerials perform very badly on the higher channels. Most forms of signal screening—and in particular trees—attenuate high frequencies more severely than low ones, so we can expect some screened locations to have ch67 (in Sheffield's case) coming in at 15 or 20dB below the existing services. This is reminiscent of the start of UHF transmissions, when we discovered that bands IV and V had much more patchy coverage than band III. Those with even greyer beards than me will chime in 'Yes, and it was just the same when ITV started on ridiculously high frequencies such as 200Mc/s.' What a pity the new service could not be on ch34, which would mean that Sheffield would use the same channel line-up as Nottingham. And why should it not be on ch34? A casual look through the transmitter lists for any existing signals on that channel which might suffer interference finds nothing…

Wideband aerials

Where field strengths are high it will often be possible to carry out a straightforward replacement of the existing grouped aerial array with a wideband one. Remember though, that wideband arrays don't perform as well as their grouped equivalents. Channels near the ends of the band are particularly likely to suffer from reduced gain and directivity. For instance, the gain of an Antiference Group A XG8 aerial is 15.5dB on ch21. The wideband version manages only 8.5dB on that channel. Amplification might compensate for the signal level shortfall, but it will not help the ghosting, which will be a likely consequence of the wideband aerial's inferior directional properties.

The cheap 'contract quality' wideband yagi arrays, which consist of a folded dipole and reflector cut for Group A, and a chain of 8 directors cut for Groups B and C/D, are in my opinion next to useless. Log-periodic and stacked dipole ('fireguard') arrays are far better, but do not have brilliant gain figures. Simply replacing a grouped array with a wideband one is going to be a dodgy business. The customer won't thank you if your attempts to improve their Channel 5 result in poor reception of the other four channels!

Taking into account the lower transmitter ERP and the increased cable losses at higher frequencies, in unscreened locations the ch67 signal from the Sheffield transmitter will probably arrive at the TV set 8 to 10dB lower than the other channels. In areas of moderate or low field strength this will not be acceptable, and further measures must be considered. In many cases a broadband masthead amplifier will be fitted, lifting all signals more-or-less equally. At difficult sites, or on jobs where quality matters more than cost, installations will probably involve a separate aerial, a masthead amplifier, and a diplexer (fig 1), or set of channel pass filters (fig 2).

Narrowband aerials?

If a separate aerial was to be installed, it would only need to receive one channel. I wonder if some enterprising manufacturer will bring out a range of narrow-band arrays, for channels 34, 37, 56, and 67, the most commonly used ones for the new service. These would out-perform a normal grouped aerial hands down, since the design could be optimised for the one channel. Carrying the idea a stage further, a kit comprising a 'one-channel' aerial, a short connecting cable, and a combiner, would surely be a winner. The combiner would diplex the relevant channel (only) with the rest of the band, and would need switchable DC throughpass available on both inputs to allow for masthead amplifiers. Narrowband aerials would be a particular boon for ch37, which is used at high power from a number of main stations, many of which have coverage overlap with other transmitters which are going to broadcast Channel 5 either at very low power or not at all. An example is the large overlap area between Lichfield, Waltham, and Sandy. Lichfield will transmit ch37 at 1000kW, Sandy will transmit only 10kW, and Waltham won't carry the new service at all. Viewers in the Sandy and Waltham areas will want to keep their own regional programming, so it looks as if there will be a large market for add-on ch37 aerials. Furthermore, within the coverage areas of these ch37 main stations there are literally hundreds of local relays, which are not going to transmit the new service. Viewers using a relay will have to get their Channel 5 from the main transmitter. Reception is likely to be a problem (otherwise there wouldn't be a relay), and in most cases the new array will be fixed to the mast of the existing installation. What's needed is a compact, light, end-mounted aerial with very good gain and directivity—much easier to achieve if it's tailored to one channel. The alternative for ch37 is to use a Group A or a Group B array—not an attractive idea since either would be working at the very edge of its designed frequency range.

Because the Channel 5 transmitter network is only loosely modelled on that of the existing services, it looks as if it will become quite usual in many parts of the country to use a different transmitter for the new channel.

Channel 5 on permanent low power

The most significant factor in the Channel 5 transmission plan is the use of very low ERP (Effective Radiated Power) in many transmission areas. Taking East Anglia as an example, Tacolneston transmits on chs 55, 59, 62, and 65, with Channel 5 on ch52, which is fine because most Group C/D aerials work quite well down to ch49. The ERP of the new transmission is a bit of an eye-opener, though—a measly 4kW compared to 250kW for the existing four channels. Now, it's the opinion of many East Anglian aerial men that Tacolneston is underpowered as it is—and this is true, hence the ring of 13 relay transmitters around the edges of this relatively small, flat, region. Matters are made worse because the Tacolneston transmitting aerials are only 221 metres above sea level—much lower than virtually every other main transmitter in the country, even allowing for the fact that this is not a hilly area. Tacolneston doesn't even put a decent signal into some parts of Norwich, only 12 miles away, and the problem is field strength, not ghosting. So what chance has Channel 5, with 4kW? The early coverage maps showed Tacolneston's Channel 5 coverage to be quite a nice large area; not that much less than for the existing channels. Later versions showed the coverage considerably shrunk. With a signal more than 17dB down I think even the later version might prove to be optimistic. Sending out 4kW across the sparsely populated broad acres of rural Norfolk sounds very ineffective. Clearly, Channel 5 coverage is going to be very restricted in East Anglia, and in many other regions. Transmitters with the most striking power disparities are shown in the table below.

Transmitter Power Differences

Transmitter	Existing four channels power, kW	Channel 5 power, kW	approx. received signal level difference, dB
Tacolneston	250	4	17
Winter Hill	500	12.5	16
Caldbeck	500	10	17
Rowridge/Fawley	500	1	27
Huntshaw Cross	100	2	17
Sandy Heath	1000	10	20

Readers who operate in any of these transmission areas can amuse themselves by conducting the following 'thought experiment'. Imagine you are at customers' houses in various reception areas—good, bad, and indifferent. Fit an 18dB attenuator and observe the results. That's Channel 5!

Masthead amplifiers

Well, if this low power transmission is really going to happen, what's to be done? Some viewers—those whose rooftops have a clear line-of-sight to the transmitter—will be able to receive the new service perfectly, with little or no expense. In some cases the existing aerial installation will be highly inefficient, producing acceptable results only because of very high field strengths, but if a decent aerial is installed they might well get good reception on five channels. In places where the existing channels provide reasonable but not excessive signal levels, a masthead amplifier will probably bring in a decent Channel 5 picture. But at locations where the existing four channels are even slightly snowy, a masthead amplifier, whilst improving them, is unlikely to provide good Channel 5 reception. At North Walsham, well within the Tacolneston service area at 22 miles, and not particularly screened, the line-of-sight signal is around +16dB/mV—but few rooftops in the town have more than +4dB/mV available, and in many places the signal falls to –17dB/mV. For Channel 5, this translates to –13dB/mV at best (i.e. adequate for use with a masthead amp); to -34dB/mV (i.e. no chance) at worst. These figures assume the use of a good quality 18 element aerial; add 5 or 6dB if a really splendid high gain array is used.

A common complaint about Tacolneston reception is that the higher channels appear to be the weakest—Channel Four on ch65 being a particular problem in many locations. It will be interesting to see how the new Channel 5 signal compares the existing four, or 17dB below the worst? Since it will be the lowest frequency in use, things might not be so bad as could be expected. Many locations in rural East Anglia are screened from Tacolneston by trees, and have high gain aerials and masthead amplifiers. At first sight it might be supposed that Channel 5 reception will be impossible here, but it might not be, since it will be the lowest frequency in use.

At many locations, both screened and unscreened, it seems likely that the difference in field strength will be such that where amplifiers are necessary for Channel 5, it will only be possible to use low-gain ones. This is most likely in cases where a masthead amplifier is used with moderately good signal levels to compensate for losses in a long downlead. Two-stage amplifiers could well be driven into cross-modulation by the other channels. Where the imbalance of signal levels is a real problem, the answer will be to use a separate aerial for Channel 5, and put the signal through a one-channel pass filter before amplification (fig 2). The disadvantage is that the filter introduces slight signal loss just where you don't want it, in front of the amplifier.

If a separate aerial and masthead amplifier is used for Channel 5, the signals will have to be combined. If they are too close to diplex, channelpass filters will be needed (fig 2). This applies to Tacolneston, Burnhope/Pontop Pike, Huntshaw Cross, Perth, Oxford, Selkirk, Winter

Hill, and most transmitters where the existing four are Group A or B and the new service is on ch37.

Communal Systems

The majority of TV distribution systems are simple affairs consisting of an aerial, a broadband amplifier, and a distribution network connecting perhaps less than 50 dwellings. In places where Channel 5 will be received satisfactorily on the existing aerial, these systems will in most cases carry the new channel without intervention. The only major exception will be systems which have a four-channel pass filter fitted. This may have been done to equalise signal levels, or to exclude interfering signals. It will be necessary to replace the four-channel unit with one for five channels. The input option will depend on whether the new channel is to be received on the same, or on a different, aerial.

Wideband aerials

Where the new transmission is outside the channel group of the existing aerial, but all five signals come from the same direction and are at more-or-less the same strength, the use of a wideband array would be an option.

I mentioned earlier, however, that simple replacement of a grouped array with a wideband one might cause problems, and this is especially the case if the aerial is at the front end of a communal system. It will often be better to install an additional aerial. It is essential that work done to provide Channel 5 reception does not adversely affect the existing channels.

If an additional aerial is to be installed for Channel 5, its output will have to be combined with the existing signals in some way, unless channelised amplifiers are used. I've covered this in previous sections, and everything there applies in a similar way to broadband communal systems, except that quality counts for more and cost counts (usually) for less. Take particular care to obtain correct signal levels, and ensure that masthead amplifier noise does not defeat the main function of the combiner by affecting the channels from the other port.

Equalisation

Within a distribution network, signal losses worsen as frequency increases. For instance, the losses in 10 metres of Raydex CT100 cable are 1.4dB on ch21, rising to 1.85dB on ch68. This doesn't sound too bad, but on a large system the cumulative loss differential on hundreds of metres of cable and a succession of splitters and tap-off units can be serious. The answer is to use equalising filters. These attenuate lower frequencies more than high ones. The slope is chosen to compensate for the unequal system losses. The equalisers are normally fitted at the inputs of the repeater amplifiers. When a system carries a standard four channel group, in which the highest and lowest signals are only ten channels apart, equalisation is not really an issue. It's usually enough to slope the head-end outputs slightly. But the Channel 5 signal could be 35 channels further up the band.

Consider a system which has previously only carried channels 21, 24, 27, and 31. It's a large installation serving 400 bungalows and low-rise flats. Overall signal loss on ch31, from the aerial to the last subscriber on each line, is about 80dB. This is countered by 40dB of amplification at the head-end, and 20dB at each of two repeaters. There are actually ten repeaters, on five lines. The system was carefully planned and it was known at the time of installation that Group A signals would be used, so losses were calculated on that basis. Along comes Channel 5 on ch67. Without equalisation, end-to-end losses on ch67 will be 110dB. This sounds bad, because it means that a subscriber down at the bottom end of the estate who has been in receipt of a comfortable +5dB/mV (good picture) will get only –25dB/mV (virtually no picture) on the new channel. In fact, the situation is even worse than that, because both repeaters have a Channel 5 input signal which is well below the optimum—the second repeater input will be 20dB down. Noise from the repeaters will ensure that even a subscriber signal at –15dB/mV will be quite unwatchable.

Well, I've made it obvious that you can't just go along to a large system, fix a wideband aerial on the roof, and saunter off to the next call. The idea of merely locating and gaining access to every repeater is not attractive, never mind fitting equalisers and extra amplification when you get there. Extra amplification?—remember the equaliser merely attenuates the lower channels until they match the higher ones, so every equaliser needs compensating amplification. There must be an alternative—and there is, thank heavens! Given the situation outlined above I would be considering the use of a channel changer very seriously indeed.

On small systems it will often be possible to get away without channel changing. If the head-end amplifier will allow it, launch Channel 5 a few dB higher than the others. It's not so bad, if there are only one or two repeaters, to find them, add equalisers, and turn up the gain. But beyond that, use a channel changer. They cost money, but so do equalisers and so does your time.

Channel changers

There are many ways of lifting a TV signal from one channel and putting it down on another, and many reasons for doing it—this is a large subject. I'll confine myself to what is relevant to the present topic: simply the downconversion of one signal to avoid equalisation problems on a communal system.

This is best done with straightforward RF to RF conversion. One possible configuration is shown in fig 3. Most of the specialist manufacturers and importers list suitable equipment. Expect to pay a total of about £150 for a converter, input filters, output filters, and power supply. When ordering it is necessary to specify input and output channels. Channel converters have their vices, the main one being spurious outputs—in other words, unwanted signals and noise across the band. If incorrectly installed, a converter can wreak havoc on a system, putting patterning on every channel including its own. If correctly installed, the results will be perfect.

The obvious thing is to make sure the output is well filtered. Three tuned stages is the minimum. Be prepared to follow this with a notch filter to remove a specific interfering signal. Less obvious, but just as important, are input filters. The converter itself is a broadly tuned device, so it will cheerfully convert other channels above and below the input, producing unwanted signals at each side of the output. Two tuned stages on the input are the minimum. If there is a very strong signal on a channel near to the desired input, it will be unavoidably downconverted, reappearing in the same relative position near to the output. Select your output channel so that this unwanted signal will not interfere with anything else. A notch filter on the input is a possibility.

The other source of spurious output is the converter's own local oscillator. The answer is to make sure that the input signal level is correct. There isn't much leeway here, so direct RF conversion should not be used if the input signal is likely to vary, unless an AGC device is used. If the input signal level is too low the output will be low relative to unwanted local oscillator output. Keep the input no more than 6dB below the point where obvious signal distortion due to overload appears.

Some thought should go into the selection of the output channel. It should obviously be well down the band—if possible just above the existing four Group A channels. The table below shows commonly used four-channel sets, each with the next four available channels, avoiding n+9 and n+5 clashes.

Four channel set	Next four possible
21 24 27 31	34 35 37 38
22 25 28 32	35 36 38 39
23 26 29 33	36 37 39 40
23 26 30 33	36 37 40 41

This is a starting point, but there are other things to consider. Despite Channel 5's own cavalier attitude to the 'VCR slot', I don't think I would want to output a signal on channels 35, 36, or 37. Don't use a channel which is occupied by broadcasts in the area which are not carried on your system—there is the possibility of direct signal pick-up, which will cause patterning.

Downconversion to avoid the need for equalisation is the main reason why we might use channel changers, but there are others. Many systems carry channels from modulators—distributing satellite, VCR, and surveillance pictures. These may coincide with Channel 5 broadcasts. The cause will be obvious if it's the local Channel 5 transmission; less so if it's a distant signal. In the latter case the use of channelpass filters on all aerial signals should solve the problem: direct pick-up at receivers will be unlikely. If the local signal is to blame a decision will have to be made: change the channel of either the new transmission or the signal being affected. If the latter originates from a frequency-agile (tuneable) modulator, a cheap and effective solution becomes obvious. Re-tune the modulator, feed the output through new channelpass filters, and use the old filters to add Channel 5 to the system. If the affected signal is not easily retuneable (for instance a remote ITV on an adjacent channel to the local Channel 5), then one or other of the two competing signals will have to go through a channel-changer. To avoid direct pick-up problems, it will normally be better to distribute Channel 5 on its off-air channel, and move the other one. Where Channel 5 is on a channel adjacent to one already use either of them could be moved, and one of them will have to be moved. There won't be a direct pick-up problem, but it's no good distributing two signals on adjacent channels.

The money men and politicians have insisted that Channel 5 should go ahead, in spite of the problems which technically qualified people have pointed out. The resulting transmission plan will be unsatisfactory for both the broadcaster and the viewer. Nevertheless, Channel 5 will be made to work, by hook or by crook. All sorts of reception problems, great and small, will be fudged, ignored, or swept under the carpet.

There will, in fact, be quite a mess to clear up. I expect lots of customers will ring up wanting a teensy little favour: 'The retuners came round and we couldn't get the video to play back in the bedrooms when they'd gone, but they wouldn't come back. And now that Channel 5 has started, the satellite has got wavy lines on it. Could you just call round when you're passing and sort it out for me?' ('Call round when you're passing' being code for 'spend an hour at my house and not charge a cent'). In my opinion we should make it perfectly plain right from the start that we will not indirectly subsidise Channel 5 by making free or cut-price service calls, by replacing channelpass filters for less than the normal price, or by retuning televisions and VCRs in children's bedrooms for nothing.

After the initial fuss has died down, there might be some money to be made. Apart from the obvious aerial rigging side of it, there will be a lot of work to do on distribution systems, both private and commercial. I cannot imagine what the retuners are going to make of a large domestic system which returns the outputs of two satellite receivers and a VCR to the head-end in the loft, to pass through filters before being combined and distributed. I suppose the best tactic will be to let them have a go, to help convince the customer that the problem is not as slight as all the publicity has suggested. In some cases the customer will be in for a nasty surprise, because the bill for new filters, new aerial, new modulator (for the displaced channel), and retuning of every TV set and VCR in the house, is going to be well into the hundreds of pounds.

In the aftermath of the Channel 5 start-up our industry will have plenty to do. I have no doubt that there will be exasperating moments, but for the most part Channel 5 should be a chance to make some money. I hope this article will help contractors prepare for the problems—and opportunities—which next year will bring.