# Satellite television distribution systems

**Bill Wright 2004**

*New television distribution systems almost always include satellite reception these days. In this beginner's guide Bill Wright looks at small installations and then goes on to the medium sized ones typically found in apartment buildings.*

*Test equipment*

You can't install a terrestrial and satellite distribution system without decent test gear. Analogue-only equipment is almost useless. It is essential that you can measure signal strength and BER (Bit error ratio), and ideally you should be able to measure carrier to noise ratio.

A modern spectrum analyser, whilst not absolutely vital, makes the job so much easier, but an analyser intended for analogue-only use will not help much. The band of 'noise' that represents the digital multiplex will not indicate the true signal level because the measurement bandwidth is incorrect. This and the lack of BER measurement is why there are so many very nice but rather middle-aged analysers available for peanuts at the moment. Those of our brethren in the trade who are, let's say, not exactly at the cutting edge, are finally realising that they will have to shell out some serious money for a test gear upgrade.

If you are new to this sort of work and you don't own a suitable meter or analyser it is well worth hiring the latter. This will give you a chance to try out a particular model before taking the plunge and buying your own. I'll assume throughout this article that the reader has access to reasonable test equipment. The measurement unit normally used for RF distribution systems is the dBmV (dB relative to one millivolt) so that's what I'll be using here. Those accustomed to the 'small signal unit', dBµV, need to add 60 to all my numbers, since 60dBµV = 0dBmV. The use of dBmV makes the mental arithmetic for calculating signal levels along a system easier, because the numbers are much smaller.

Incidentally I've confined the scope of this article to reception of Sky digital (and the other services from the same group of satellites), but the reader should be aware that systems can be designed for the distribution of signals from pretty well any combination of satellites.

*The workshop*

There's more to this job than site work. Head-ends and repeaters are best built and tested in the comfort and calm of the workshop. If you don't already have a workshop you could manage with a small bench in the corner of the garage. Whatever your workshop facilities, don't attempt to build a large head end on site unless you want to drive yourself barmy.

As well as the obvious hand tools, mains isolation equipment and so forth, a well equipped head-end builder's workshop will have:

- A simple multimeter.
- A good up to date spectrum analyser. All the screenshots in this article were taken on a Promax Prolink 4.
- A good modern TV set.
- A DTT receiver.
- A Sky digital receiver. There's no need for a card.
- A bench power supply unit. This need only be a little 3A one.
- A range of coaxial patch cords with quickfit 'f' connectors.
- A frequency agile VSB UHF modulator. This is to test channel filters when there is no locally available signal.
- A noise generator. This helps align and re-tune UHF channel filters and diagnose frequency response errors.

It's necessary to have a good range of signals coming into the workshop. These should include:

- The four fixed polarities/bands from 28˚E. A 70 or 80cm dish with an LNB of known performance should be used.
- The output from a Sky minidish.
- A clean feed from a UHF aerial, with all local analogue and DTT signals at good strength and good c/n ratio. In some areas it is worth having wideband aerials of both polarities on a rotator.
- Feeds from a DAB aerial and a VHF-FM aerial.

My own workshop has a few extra items that I regard as essential. These include an intercom to the kitchen ("Any chance of a cuppa darling?") and an easy chair. This is the 'thinking chair' and it has solved many a knotty problem. I also have a decent hi-fi, justified because music seems to stop me pulling my hair out.

*The basics*

I hope experienced dish installers will bear with me while I cover the basics of Sky digital satellite reception.

The microwave signals received by the dish cannot be sent along ordinary coaxial cable, so they are down converted at the dish to more manageable frequencies. The LNB (the 'low noise block down converter') accepts the incoming signals via a feedhorn, down-converts them, and since they are very weak also amplifies them by about 50dB. The LNB output occupies frequencies just above the UHF TV band. These down-converted signals are known as 'satellite intermediate frequencies' or 'satellite IF'. If that were all there was to it satellite distribution would be as straightforward as ordinary UHF distribution. But there's a complication; in fact there are several.

*Polarity*

The first snag is that the relevant satellites transmit signals on two polarities, horizontal and vertical. The channel centres on one polarity are half way between those on the other, but the two sets of signals can't be mixed because they overlap. Fig 1 was obtained by superimposing the spectrum analyser displays of the same section of the two high band polarities. I coloured one polarity a pretty pink (I really had fun). As you can see it would be impossible to mix the two polarities on the same cable. The result would be garbage. Since it would be unwieldy to run more than one cable from the LNB to the receiver the latter must signal to the LNB which set of signals (horizontal or vertical) it needs. This is done quite simply by switching the LNB supply between 13V and 18V. If the LNB supply is 13V the vertical signals are sent to the receiver and it is 18V the horizontal ones are sent.

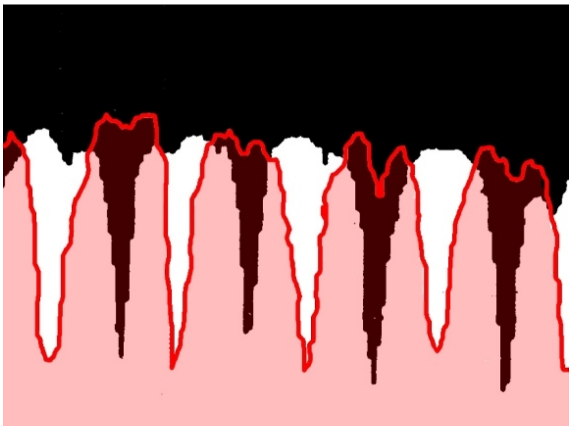

*Fig 1 . Superimposition of vertical and horizontally polarized satellite signals.*

*Band switching*

The second major complication is that the range of frequencies transmitted by the satellites is far greater than the input bandwidth of a domestic receiver. The solution is for the LNB to down-convert by two different factors. Thus we have what are loosely called 'high band' and 'low band' signals. High band signals are downconverted by 10,600MHz and low band ones by 9,750MHz. Again it is necessary for the receiver to let the LNB know which set of signals it needs. A 22kHz tone on the LNB supply instructs the LNB to send high band, whilst without the tone the LNB defaults to low band. So there are four sets of channels available to the receiver, selected by a combination of the supply voltage and tone sent to the LNB, as shown in table 1. Sky+ receivers need two such dish feeds, and these must be independently switchable so that both tuners have full access to all channels.

| Channel set required by the receiver | LNB supply from the receiver | Maximum frequency range received | Approximate actual frequency range received | Conversion factor | Receiver input range required |
|---|---|---|---|---|---|
| Vertical low band (VL) | 13V 0kHz | 10,700MHz – 11,900MHz | 10,720MHz – 11,700MHz | 9,750MHz | 950 – 2,150MHz |
| Horizontal low band (HL) | 18V 0kHz | | | | |
| Vertical high band (VH) | 13V 22kHz | 11,550MHz – 12,750MHz | 11,700MHz – 12,480MHz | 10,600MHz | |
| Horizontal high band (HH) | 18V 22kHz | | | | |

*Table 1. The four sets of satellite IF signals sent from the LNB to the receiver.*

*Multi-output switchable LNBs*

If the number of receivers is small, and if they are not too far from the dish, it is feasible for each receiver to have its own cable from the LNB. A special LNB is used with four independent outputs. Any of the LNB outputs supplied with power and tone will return the appropriate group of signals to the receiver. These are 'quad' LNBs, but I always ask for 'an LNB with four universal outputs, please' to avoid confusion with the 'quattro' LNBs, of which moremuch morelater. A quad LNB is always used for Sky+ installations, even if the other two outputs aren't needed. In a one-dwelling installation, that's all there is to it.

LNBs are now available with eight independent outputs, although I can't quite bring myself to ask for an octuplet! These give a simple way of providing one Sky+ facility at each of four flats for instance, although there are a couple of problems. Firstly, the terrestrial signals have to be combined with the satellite ones, unless separate cables and outlets are to be installed. Secondly, this would be classed as a communal TV system and therefore would have to be earth bonded, even though it would not need a mains supply of its own. More about earth bonding later. Although it is feasible to use quad and 'octuplet' LNBs for very small multi-dwelling systems I am inclined not to, preferring the conventional methods always used for larger systems.

*Small multi-dwelling systems*

I'm going to take you through the installation of a straightforward twelve-outlet system, from the dish to the outlet plates. Later we'll look in more detail at each component, then we'll consider bigger systems. Let's visualise a block of twelve flats. It's 'new build', so we can put the cables in at an early stage. The block is nice and compact, with three floors each of four small flats. There is a central stairway with an adjacent riser, and it is decided that the system head-end will be installed in the cleaners' store under the stairs on the middle floor. Each flat is to have a living room TV outlet providing satellite and terrestrial reception (the 'master' outlet), and 'slave' outlets that allow the living room satellite receiver output to be viewed in the bedrooms. Fig 2 is a schematic of the main system for the whole building and the 'mini system' in each flat. The downleads from the head-end will run above the ceilings, in the small void below the structural concrete. This means that they will all take fairly direct routes.

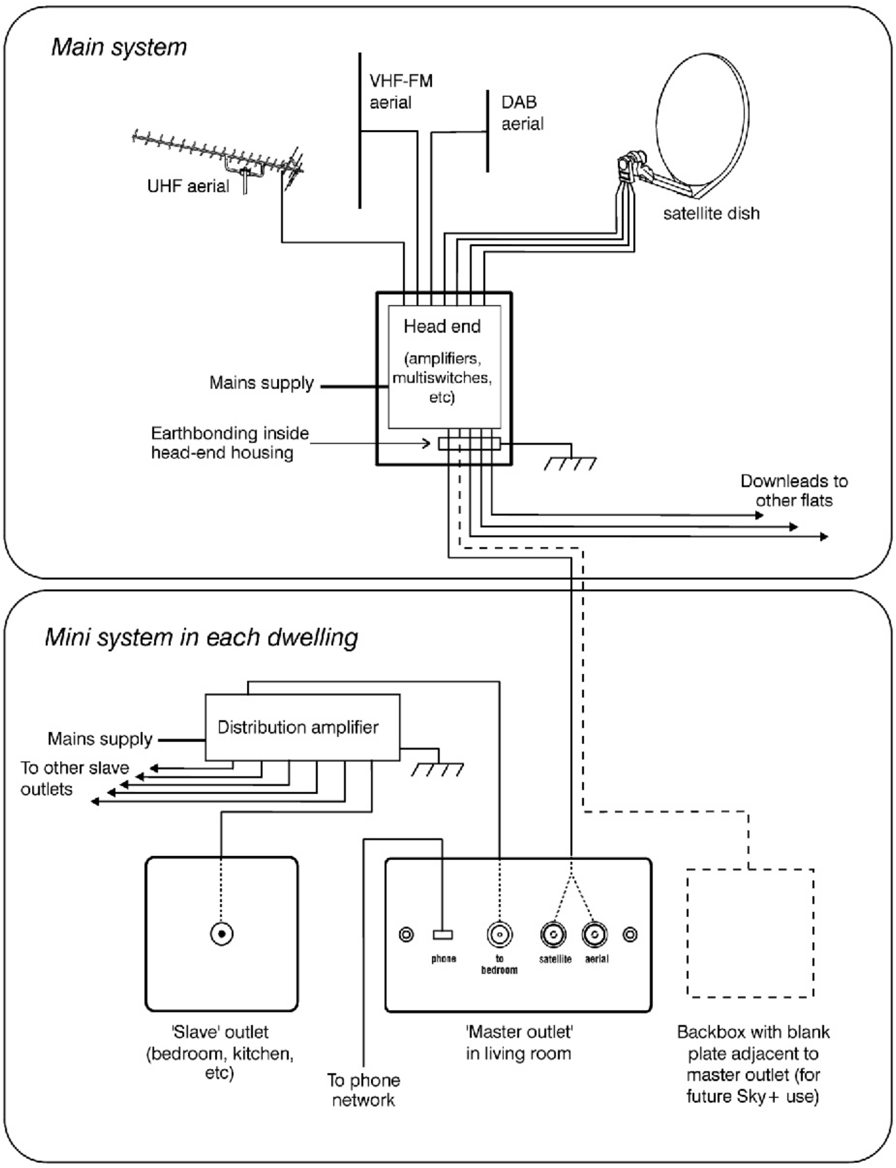


*Fig 2. A schematic showing a typical small system, including the 'mini-system' for one flat.*

*The dish — how big?*

On a small system the only active satellite IF component between the LNB and the outlet sockets is the polarity switch. A small system like this does not need any other satellite IF amplification. Although the switch amplifies the satellite IF signals a little to compensate for internal splitter losses it adds very little noise, so the c/n ratio is only slightly worsened (there will be more about c/n ratios later in this article). This means that we can use a dish and LNB combination that provides a relatively modest c/n improvement compared to a standard Sky minidish. In areas where Sky recommends the smaller minidish (roughly south of a line from Liverpool to Newcastle) a good quality 65cm dish is perfectly adequate for a small distribution system. Further north a 75cm or 85cm dish should be used.

*Fixed output LNBs*

Take another look at fig 2. There are four cables from the LNB to the head-end. Each carries one fixed set of channels, VL, HL, VH, or HH. The LNB is not a quad; it is a quattro, which means that the four outputs are fixed and the LNB does not respond to 13/18V or 0/22kHz commands. I always ask for 'a four-fixed outputs LNB' to avoid confusion with the quad type.

So we have four sets of satellite IF signals available at the head end. Each of the twelve outlets must have access at any one time to any one of the four sets of satellite signals, plus the terrestrial signals. Clearly there has to be some switching at the head end.

*The 'magic switch'*

Fig 3 shows a polarity and band switcher with five inputs and eight outputs. This is a multiswitch known colloquially as a 'magic switch' the heart of any satellite distribution system. Four of the inputs are for the satellite IF signals. The fifth accepts terrestrial signals. Each of the eight outputs provides satellite IF and terrestrial signals. Each output is receptive to 13/18V or 0/22kHz commands, so as far as each Skybox is concerned there is a normal dish at the other end of the cable with all signals available. Switches are available with four to sixteen outputs.


*Fig 3. Global 5X8M mains-powered multiswitch in situ. The one terrestrial and four satellite inputs are on the right, and the outputs are along the bottom. This photograph was taken before the installation was earth bonded.*

This is a 'stand alone' multiswitch. It needs a mains supply because it takes virtually no power from the receivers. It is an 'active terrestrial' switch, meaning that it amplifies the terrestrial signals to compensate (approximately) for internal splitter losses. The switch therefore has to be considered as part of the terrestrial amplification when planning a large system. Its maximum terrestrial input and output signal levels and its noise contribution must be taken into account. The gain or loss of the satellite IF signals also varies with make and type of switch. It is vital to consider the specification of the switch when the system is designed.

*Terrestrial performance of the multiswitch*

Only one cable connects the head end to each 'master' outlet, so the switch combines the terrestrial signals with the satellite IF signals. Irrespective of the 13/18V or 0/22kHz commands, or even if no satellite receiver is in use, the terrestrial signals will be available at each output. Because satellite IF shares a downlead with the UHF signals, an important function of the switch is to filter out LNB noise from the UHF band. The LNB noise on the UHF band has to be reduced by a minimum of 50dB. To test the performance of the switch in this respect temporarily attenuate the UHF aerial signals until the level of analogue channels at the switch output is 0dBmV. This should give a noise-free picture just. Connection and disconnection of the LNB feeds should have very little effect on the picture. The same test can be done for terrestrial digital, by observing any change in BER.

Figs 4 to 8 (overleaf) show the disastrous effects on UHF reception of unbridled LNB noise.

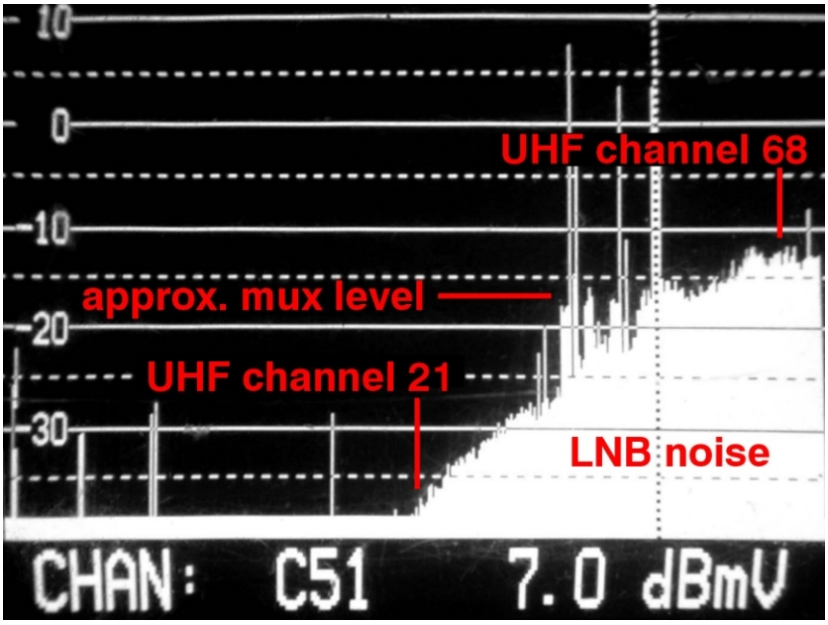


*Fig 4. LNB noise on the UHF band. This is the result if the multiswitch does not filter out LNB noise from the UHF band. The amount of UHF noise varies a great deal between LNBs. In this case the LNB was the standard one supplied with a mini-dish.*

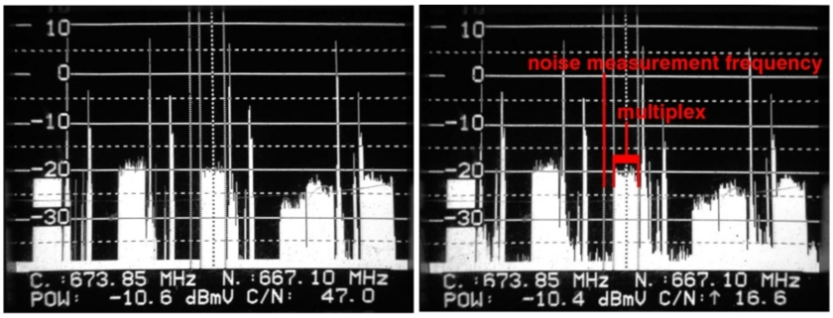


*Fig 5. Spectrum analyser displays of the Emley Moor channels. The multiswitch's filtering of the UHF noise from the LNB was seriously deficient. On the left the LNB is disconnected. On the right it is connected, and the noise is just visible at the bottom of the display. Note the c/n ratios indicated.*

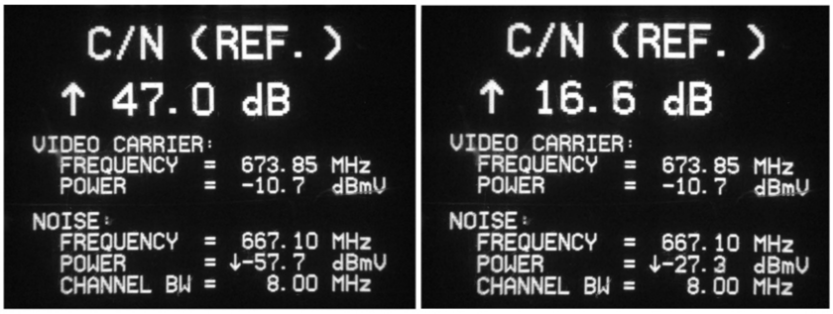


*Fig 6. Caption: Display of c/n ratio, on the left without and on the right with LNB noise. The analyser tuning and signal source are the same as in fig 5.*

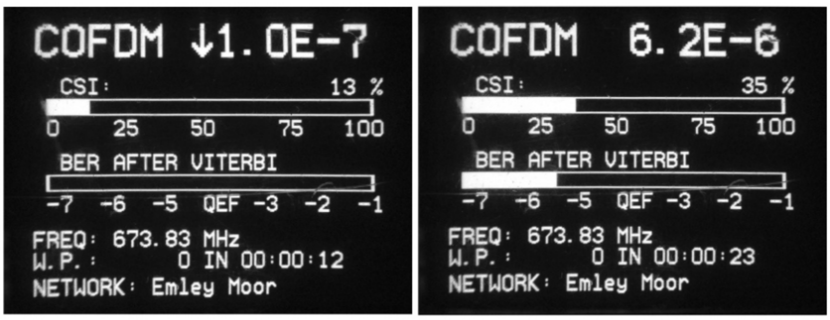


*Fig 7. Display of BER, on the left without and on the right with LNB noise. The analyser tuning and signal source are the same as in fig 5. If the BER after Viterbi drops below the QEF (quasi error free) level there will be no picture. A reading like this indicates very unreliable reception.*

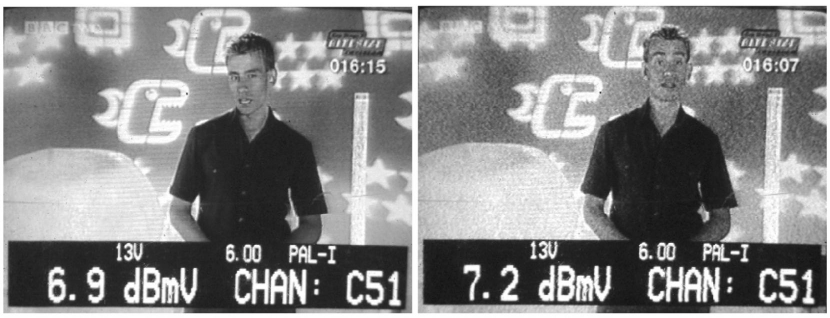


*Fig 8. The effect of LNB noise on UHF analogue reception. These shots are from the same installation as the analyser displays in fig 5. Note that although the signal level remains about the same, the picture on the right (with the LNB connected to the multiswitch) is very snowy.*

*Download routes*

You will have realised by now that the need for polarity and band switching means that the optimum layout is for each download to go all the way to the head end, as shown in fig 2. Tap-off lines are not cost-effective for a small system. Our block of flats is not a big building, so none of the twelve downleads is excessively long. Signal loss on cable is a big factor in system design, but on a small system like this it is not an overriding concern since the downleads will not exceed 25 metres. The head-end is on the middle floor near the centre of the building, and this minimises variations in downlead length.

*Outlet plates*

One downlead links each living room outlet (the 'master' outlet) to the head-end. The type of outlet plate commonly used in the living room (figs 9 and 10) has three sections. These are the connection to the distribution system, the connection to feed the bedroom(s), and the phone socket.


*Fig 9. Typical of the various makes of 'master' wallplate, this Labgear PSW242T includes a triplexed satellite/UHF/VHF outlet, a socket for the return feed to other rooms, and a phone socket.*

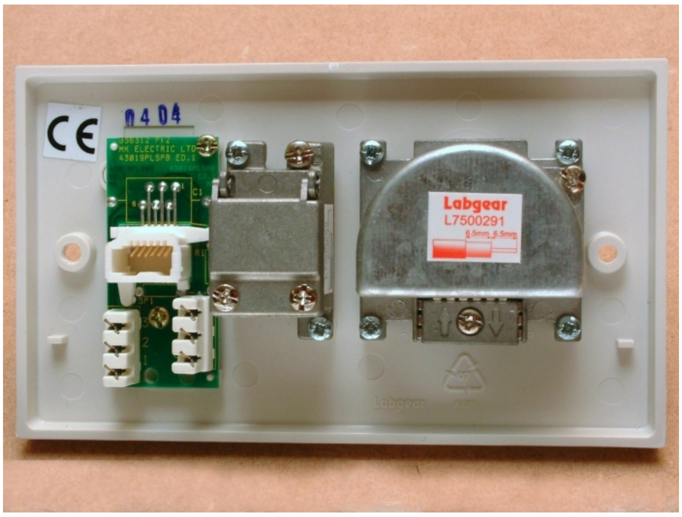


*Fig 10. Labgear PSW242T rear view.*

Because the downlead carries satellite IF, UHF TV, and probably VHF radio, the outlet includes a diplexer or triplexer to separate the signals. The satellite IF port must carry DC and 22kHz so the receiver can signal to the multiswitch. The UHF and VHF ports might or might not include full high voltage safety isolation, but in any case the inner conductors will be isolated so that the satellite DC and 22kHz don't appear at the UHF and VHF ports.

The satellite IF to UHF diplexing cannot prevent LNB noise on the UHF band from affecting terrestrial reception. The multiswitch must filter out this noise.

The VHF port should have a passband extending from 87MHz up to 250MHz, to allow for FM and DAB.

*Additional outlets*

Most homes have more than one TV set, so a good distribution system will include outlets in the bedrooms and probably in other rooms as well. The client will specify the number and locations of outlets. So that residents can view satellite in every room from their living room receiver, it has become common to install 'mini distribution systems' in each dwelling, as shown in our old friend fig 2. The feed from the head-end to the living room outlet is the only connection the dwelling has to the main distribution system. The living room outlet is then known as the 'master' outlet. The 'return' or 'uplink' port on the master outlet takes the RF output of the satellite receiver, together with all the terrestrial signals, to the other rooms. The outlets in the bedrooms, etc, are called 'slaves'. If there is only one slave all that's needed is a cable from the master return port to the slave. If there is more than one slave a distribution amplifier is needed. This is usually fitted near to the electricity consumer unit. The amplifier should be compatible with the Sky remote eye system so that the satellite receiver can be controlled from any room. The amplifier should have about 6dB of gain to each output, to compensate for the extra cable and outlet losses. Don't use the types with 12dB or more gain because you have provided good signal levels at the master outlet and the output of a Sky box is quite high so such gain is unnecessary and could be detrimental. The slave outlets must be non-isolating types because of the 9V supply to the Sky remote eyes.

Suitable distribution amplifiers are available from many different manufacturers. My experience has been that the budget DIY products are not good enough for commercial installations. The 6MHz signal that carries the remote control commands from the 'Sky eye' back to the receiver is not strong enough to stand a great deal of attenuation. Some amplifiers weaken the return signals considerably and I have found these to be unreliable, especially where cable runs are long. There is usually no easy way to earth the DIY products either. After some experimentation we have standardised on the Labgear MSR range. These are twice the price of a typical DIY amplifier and in my opinion worth every penny. The data sheet for this product can be found at *http://www.labgear.co.uk/pdf/7.pdf*.
So that's our little block of flats all set up with good TV reception. Now let's delve more deeply into the complexities of satellite IF distribution, starting with the crucial issue of carrier to noise ratio.

*Carrier to noise ratio*
This is pretty much the same thing as the more familiar analogue 'signal to noise ratio'. In analogue systems a worsening s/n ratio will of course give an increasingly 'snowy' picture, but when the transmission is digital the transition from perfect reception to no reception is much more sudden. This is the well known 'digital cliff' and we must be very sure that our distribution system will not tumble over it. The way to do this is to keep c/n ratios as high as possible at every point in the system.
Every active device along the chain will add a little random RF noise, so on a large system with amplifiers and repeaters the c/n ratio will gradually worsen along the signal path. This is inevitable, but we must minimise the degradation as much as we can, so as to provide every receiver with the cleanest possible signal. The first thing is to make sure that the c/n ratio at the LNB is good and healthy, as discussed shortly.

*Measuring carrier to noise ratio*
The measurement of c/n ratio is not straightforward. The theory is that you find the ratio between the level of the carrier and the level of the noise that occupies the same bandwidth. How can the noise level be measured in the presence of the carrier, I hear you ask. Of course it can't, and even if you have a very persuasive telephone manner it's unlikely that Astra will turn off the mux for a few minutes while you make your measurement. So there has to be a fudge of some kind. The usual method is to measure the noise level on the closest unoccupied frequency. Alternatively, point the dish at a quiet part of the sky. Neither of these methods is foolproof. The minimum c/n ratio for QPSK satellite television is about 12dB, but in practice a system should deliver a significantly better figure at each outlet. The measurement bandwidth can be adjusted on most analysers, incidentally.*Measuring bit error ratio*
It isn't usually necessary to measure c/n ratio directly. Measurement of BER (bit error ratio) gives a valid indication of the practical effects of c/n ratio, and is foolproof and almost always unambiguous. After the QPSK decoder two error correction methods are applied, Viterbi and Reed-Solomon. Although most test equipment will indicate the post-Viterbi error rate and the Reed-Solomon error rate (wrong packets), the measurement we're interested in is the raw BER. This is derived from the QPSK demodulator before error correction. The BER after Viterbi gives a nice comforting indication that the picture will be fine, but is of little real value. Your analyser or meter will probably also provide a 'wrong packets' reading. This is cumulative, so will let you know if an intermittent fault occurs whilst your back is turned.
BER is given in scientific notation. For instance 2 E3 means that two out of every thousand bits are incorrect and 3 E5 means that three out of every 100,000 bits are incorrect.
If you connect your analyser or meter to a good working Sky minidish you will be surprised at the low (poor) pre-correction BER. 7.0 E3 is typical. Domestic Sky reception relies heavily on error correction. The weaker muxes will not be very far above threshold. By 'threshold' I mean the point where the error correction starts to break down and the picture starts to freeze. Very roughly, n E2 will result in uncorrectable errors and stop-start pictures, n E3 covers the range between 'very dubious' and 'acceptable', and n E4 is rock solid.
The general standard of a commercial installation should be much higher than that of a domestic Sky system, and BER is an important aspect of this. The BER values appropriate for distribution systems are therefore higher than for domestic Sky installations. In particular the LNB output must have a high BER to allow for noise added by amplifiers and switches. At the outlets aim for pre-correction BER values of no lower than 1.0 E3. Ideally all muxes should be n E4 or better. These values are for an overcast or rainy day.

*Carrier to noise ratio at the LNB*

Increasing the dish size will lift signal levels by one or two dB at most. What's the point of that you might reasonably ask, when the same could be achieved by a tad more gain in the multiswitch, when LNB gain figures vary by 4dB from one sample to the next and when every 10m of cable will lose 3dB? Could I take a moment to dispel a myth? Bigger dishes are not used to 'get a stronger signal' for its own sake. Since the signal collected by the dish is in effect mixed with the noise background of the LNB, every extra smidgen of signal from the dish gives an equivalent improvement in the carrier to noise ratio, and that improvement carries through the whole system. Every extra 1dB of pure clean signal gathered by the dish improves the c/n ratio by 1dB, all the way to the last outlet. At the LNB even a fraction of a dB improvement in c/n ratio matters, because it will improve the BER significantly. This brings us to a concept that is central to the black art of satellite IF distribution. We are almost always concerned with carrier to noise ratio rather than signal strength *per se*. Generally signal levels are much higher than they really need to be, and even if they aren't it is easy to increase them, so they needn't be a concern. What we have to look after is carrier to noise ratio. If it were not for this magazine's mature and sober editorial style I would ask the editor to print this last sentence in bright colours and surround it with stars!

Even if the c/n ratio is subsequently reduced during further amplification the figure obtained from the LNB will continue to have a direct bearing on the c/n ratio at the final outlets. It should be possible to obtain BER readings at the LNB ranging from 2.0 E5 to 6.0 E6.


*Fig 11. A quattro LNB. The four outputs are fixed: vertical low band, vertical high band, horizontal low band, and horizontal high band.*

*Choice of LNB*

Since the multiswitch has an input for each of the four sets of signals, the LNB (fig 11) should be a quattro (four fixed outputs) rather than a quad (four switchable outputs). Some multiswitches will obligingly send the appropriate voltage/tone to each of the four LNB outputs, enabling the use of a quad, but this is an unnecessary complication just something else to go wrong.

The noise generated inside the LNB is the biggest factor in the c/n equation. It is more significant than celestial background noise, and in a system that is even halfway properly planned much more significant than either amplifier or receiver noise. For receiver noise to become a serious factor signal levels would be at least 15dB below what they should be. So it's the LNB noise that matters.

In 1986 I paid £300 for an LNB with a noise figure that is by modern standards laughable. Nowadays you can get a 'four fixed output' LNB with a noise figure of 0.7dB for £50. Interestingly, there seems to be small differences between samples of the same type of LNB. It's quite easy to slot a series of LNBs onto a dish in quick succession (don't bother with the clamp; use your hand!) and compare c/n ratios. Don't compare signal level alone since small LNB gain variations don't matter.

After LNB noise the other big factor in the c/n equation is the LNB's ability to discriminate against signals of the 'other' polarity. Good cross-polar rejection makes a lot of difference to BER. To compare LNBs find a really strong steady signal on a frequency where the other polarity is quiet. You might need to look at 13˚E or 19˚E. Rotate each LNB in the mount to find the position where the received signal is at its strongest, then at its weakest. The two positions should be 90˚ apart, and the ratio between the levels is the LNB's cross-polar rejection. Ignore absolute levels: it's the ratio that matters. There will be very slight cross-polar 'leakage' at the satellite, but if you are performing comparative tests between LNBs that doesn't matter.

*Polarity offset and crosstalk*

I don't need to tell you that accurate dish alignment is vital, but what about polarity offset? This is the rotation of the LNB in its holder to get the polarity exactly right, and it is also known as 'skew adjustment'. Having carefully selected an LNB with good cross-polar rejection it is vital to set the skew precisely. It isn't so much a case of maximising one polarity as of minimising the other. Once you are certain that the dish is aligned for maximum carrier levels find a transponder where the two overlapping channels on the opposite polarity are both in use. Slacken the LNB clamp and rotate the LNB very slowly whilst reading the BER (bit error ratio). This needs a bit of patience. After each adjustment take your hand away and allow any slight movement of the LNB arm to stabilise. It takes the instrument a little while to recalculate BER each time. Cross polarity greatly reduces c/n ratio and thus BER and the easiest way to make this adjustment accurately is to monitor the BER. Accurate polarity offset is essential for distribution system installations. If the system starts with poor c/n ratio it is more or less doomed to failure, even if everything that follows is perfect.

After careful skew adjustment each polarity should have minimum contamination by the other, and it should stay like that all the way through the system. Cross-polarisation can occur inside the multiswitch with the result that the BER worsens more than it should between the switch input and output. This is easy to measure, and the acid test is to remove three IF inputs from the switch whilst monitoring BER on the output of the fourth. If this improves BER significantly the switch is of poor quality or defective.

The terrestrial input of the multiswitch should have no effect on satellite BER, and should show up nothing on the analyser across the satellite IF band. This test should always be performed. If any nasty little spikes appear the first thing to suspect, strangely, is the analyser itself! Several analysers of my acquaintance exhibit spurious traces on the satellite IF band when their input includes strong UHF. Test for this by connecting the analyser to the switch output via a UHF/SAT diplexer or a diplexed outlet. Once the analyser is exonerated, check that the UHF signal levels are not too high for the switch, then look for strong signals on the aerial feed in the range 950  2050MHz. If these are the cause of the trouble use channel filters on the UHF input, as discussed later.

*Dishes and fixings*

Now I know that some installers will use a minidish for a distribution system, but this is wrong. Apart from the reasons given in the sections above, a distribution system should always be planned and installed to a high standard. The minidish represents the smallest dish that Sky felt they could get away with for domestic use. A minidish has very little margin for snow and heavy rain and it is built to a price rather than for longevity. System installers should see the minidish for what it is: a piece of domestic kit ideal for its intended use, but not suitable for a commercial installation.

The dish used should be physically strong and accurately constructed. My personal recommendation is the Hirschmann range of solid offset dishes. They are marvellously easy to assemble and very strong. You will pay a bit more but when you set the higher cost against the savings made by the extra reliability it's a no-brainer really. Please don't use one of the ultra-cheap makes. I have been to countless systems where the dish has moved in the wind, or the LNB arm has come loose, or the reflector has distorted, not because of incorrect installation but simply because of the poor quality of the product. If you find yourself tightening a fixing more and more because the dish just doesn't seem secure, only to have the metal bend and buckle, well maybe you should have used a better product!

Because a lot of my dishes are fixed on ground stands and masts I stock only pole-mounted dishes. If I do fix to a wall I use a pair of substantial wall brackets and a short length of 2 inch diameter mast as shown in figs 12, 13, and 14 (overleaf). Some dishes intended for wall mounting have good strong bracketry, but those with a titchy little wall bracket should not be used. This sort of fixing is appropriate for domestic minidishes but not for anything bigger.

If the dish is on a ground stand that is held in position only by gravity the installation should be stable, with a substantial concrete anchors spaced well apart, as shown in fig 15 (overleaf). An example of a bad installation is shown in fig 16 (overleaf).

*The aesthetics of dish installations*

The sudden appearance of a satellite dish on a building can arouse surprisingly passionate responses from all concerned. A satellite dish is a relatively small fixture, of reasonably pleasing and harmonious shape, and it is undoubtedly of great utility to the occupiers. In purely aesthetic terms it is certainly preferable to a massive television aerial or an air conditioning unit, and arguably less offensive than a large security light, a CCTV camera, a basketball target, or many of the other things that are fixed to the walls of residential complexes without a moment's thought. Alarm system bell boxes are fixed in deliberately prominent positions on front elevations, are painted in garish colours and sometimes even have flashing lights, yet no-one objects to their appearance. Huge yellow and black notices warning the local criminals to keep away or threatening the wheel clamping of unwary souls stopping to buy a newspaper are fixed in


*Fig 12. 65cm Hirschmann dish fixed on 'T & K' wall brackets.*

*Fig 13. Another 65cm Hirschmann dish fixed on 'T & K' wall brackets.*

*Fig 14. 75cm Hirschmann dish fixed on a pair of 600mm tripod stand-off brackets.*

*Fig 15. This 65cm dish and log-periodic UHF aerial are fixed onto a steel groundstand. The groundstand is bolted to three concrete slabs and these stand on rubber sheeting to protect the roof* membrane.

*Fig 16. A groundstand with a small base and no diagonal supports has very little strength. It should only be used to support a very modest load and even then it needs to be bolted to a large piece of concrete, not to a pair of path edgings like this. It was possible to push this installation over with one finger!*