

# SOLVING TV RECEPTION PROBLEMS

Not happy with your TV reception? Most TV reception problems can be solved, or at least minimised, providing you tackle them the right way. You have to know what you're doing though, or you can easily spend a fair bit of time and money making things worse, rather than better!

Ask many people what causes poor TV reception, and they'll say they're due to weak signals from the TV stations. As a result the first thing that people often do, when they get poor TV reception, is go out and buy an expensive masthead amplifier to 'boost' the signals. Then 8 times out of 10 they become very unhappy when they discover that their new masthead amp either makes no difference, or actually makes the reception WORSE.

The truth is that low signal strength or 'weak signals' are the cause of only one kind of poor reception, as we're going to explain shortly. And this kind of poor reception really only occurs in about 15-20% of cases; the other 80 - 85% of cases are due to other things like signal overload, electromagnetic interference or 'ghosting' (multipath reception).

With these other more common causes of poor reception, boosting the signal strength with a masthead amp can easily make the problem worse rather than better. And even though a masthead amp can at times help when poor reception IS due to weak signals, this is generally NOT the first line of attack. In most cases you'll achieve much more improvement by changing to a higher gain antenna, as we'll explain soon.

In this Tech Note we're going to help you avoid making expensive and frustrating mistakes by explaining the basics of TV reception and the various kinds of problems that can occur. We're also going to explain how to diagnose the symptoms for each type of reception problem, and then how to go about solving them. With this information under your belt you should be able to solve most reception problems quickly,

confidently and with a minimum of cost.

## Reception basics

As you might know already, TV broadcasting uses electromagnetic radiation or 'radio waves' — just like AM and FM radio broadcasting, shortwave broadcasting or even cellular mobile phones. The only difference is that the waves used for TV carry picture information as well as sound, and have frequencies in channels which are reserved for TV broadcasting in the VHF (very high frequency) and UHF (ultra high frequency) bands.

At the TV station's transmitter, the video (picture) and audio (sound) information from the studio is used to *modulate* the transmitter's VHF or UHF carrier signals, which are then fed up via cables to the transmitting antennas at the top of the station's tower. The antennas are designed to radiate the signals as radio waves, as evenly as possible around the station's service area.

As a result if you put up a receiving antenna in most parts of the receiving area, it should be able to pick up enough energy from the radiated waves to generate electrical signals which are strong enough to feed into the antenna input of your TV set, so that it can *demodulate* them to recreate that station's pictures and sound with excellent quality. That's the ideal, anyway.

So why doesn't this always happen? There are quite a few reasons, and to understand them you need to know a bit more about radio waves — and in particular those with frequencies in the VHF and UHF bands.

For a start, the waves which radiate away from the TV station's transmitting antennas travel most easily in dry air, and in paths that are very close to a straight line. Even in dry air they do gradually become weaker with

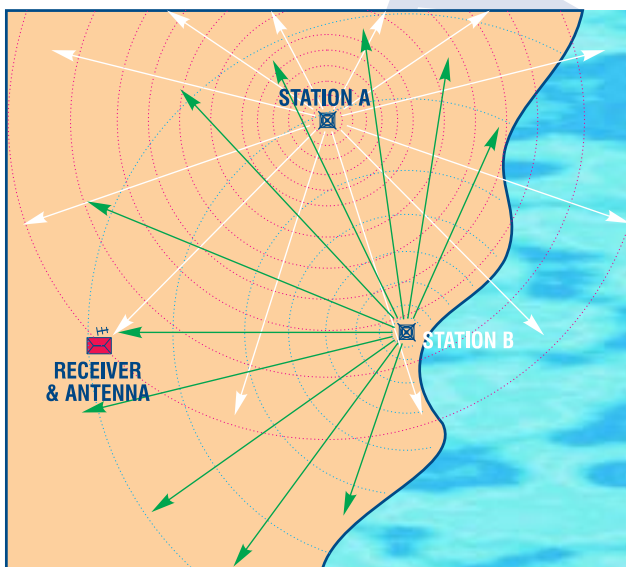
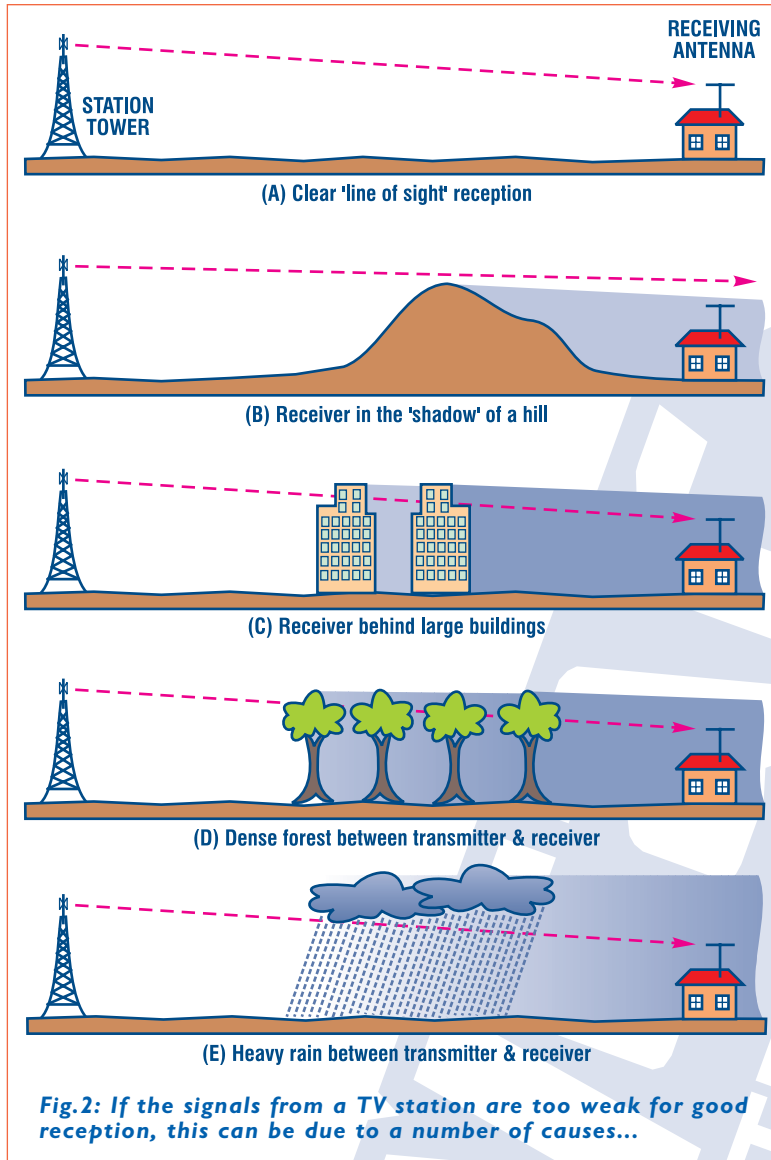


Fig.1: The radio waves from each TV station radiate from its transmitting antenna evenly throughout the station's service area. As they do, they spread out and therefore get weaker with distance...



A fairly high gain TV antenna, the Jaycar LT-3142. It has 7 longer elements for VHF reception, and 12 shorter elements for UHF reception. This one is shown facing directly to the left, by the way.



distance, because of the way they are steadily spreading out as they radiate away (see Fig.1). But providing there's a reasonably clear 'line of sight' between your receiving antenna and the transmitter tower, and you're no more than about 30km or so from it, they're still likely to be strong enough for good reception in most conditions — using a decent outdoor antenna, at least.

At these frequencies, though, radio waves do become much weaker passing through solid objects like earth, rock, buildings or a lot of foliage. They also become weaker passing through water — such as heavy rain. So if you and your TV antenna are down in a gully, or behind a hill or some large buildings, or in a dense forest, the signals that reach your antenna might well be weakened enough to cause poor reception.

This can also happen during a heavy downpour, even if you do have a clear 'line of sight'

**Fig.3: When TV signals are too weak for good reception, this is the kind of picture you get. This is usually described as an image covered in 'snow', or 'coloured pepper and salt'.**



reception path but are more than about 30km from the transmitter. (Fig.2)

It's true that low-band VHF signals (channels 0 - 5A) do 'bend' to some extent around hills and large buildings, so that you can often get reasonable reception in the upper 'shadow' area behind them. However further down in a valley, reception may be very poor.

The screen shot in Fig.3 shows the kind of reception produced by weak signal strength. As you can see the picture becomes 'snowy' and covered in specks of coloured noise, often called 'pepper and salt'. There's a loss in picture detail and colour saturation, and in severe cases the picture may lose colour altogether.

We'll discuss how you can tackle this sort of problem later. At present, let's look at what else can go wrong apart from the signals becoming too weak for good reception.

### Multipath reception: ghosts

In many ways a much more common problem is **multipath reception**, where signals from the same station can reach your antenna by two or more distinct paths which differ significantly in length. This can happen because VHF and UHF radio waves can be *reflected* by large buildings or metal structures (like bridges), hills and cliff faces, and even reasonable sized bodies of water like that in a reservoir, lake or bay.

The waves being reflected by these objects isn't in itself a problem. In fact sometimes reflected signals can be strong enough for good reception, if you're in a location behind a hill or some large buildings where the direct-path signals are themselves too weak. (More about this later.)

The *real* problem with reflected signals is when they reach your receiving antenna along with the direct-path signals, because when they do they tend to cause unwanted 'ghost' images that upset picture clarity.

Can you guess why this happens? It's because radio

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waves travel in air at virtually the same speed as light. As you might know this is very fast, but still quite finite. In fact it's very close to 300,000km/s (kilometres per second).

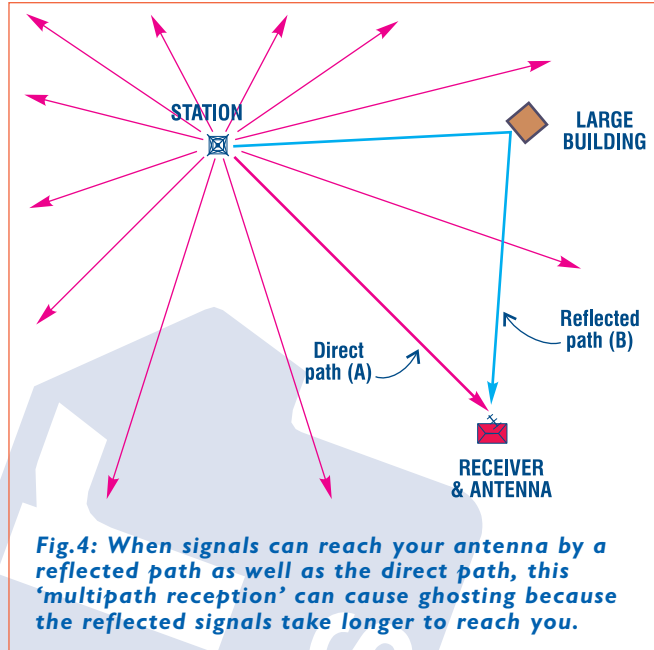
So if your receiving antenna is say 10km from a station's transmitting tower — line of sight — its signals will actually be taking 10/300,000 or 33µs (33 millionths of a second) to reach it. Not that you'll be aware of this tiny delay, of course. In itself it's not of any importance, either.

But this finite speed DOES become important when reflected signals from the same station can also reach your antenna — say by reflection from a building, as shown in Fig.4. Because these reflected signals also travel at 300,000km/s, but clearly they're travelling along a longer path to get to your antenna. This means that they'll take slightly longer to get there, arriving just after the signals which come via the direct path (which is also clearly the shortest path).

For example in Fig.4, the direct path A might be 10km, but the reflected path B will probably be about 50% longer — say 15km. So the reflected signals will be travelling an extra 5km, which means they'll arrive at your antenna and set about 16µs after the direct path signals.

As a result, the set will be receiving a mixture of two distinct versions of the station's signal, one always arriving 16µs after the other. So instead of getting just one picture on the screen, you'll have two — the main one (from the direct path) and a weaker one (from the reflected path). The weaker one will be shifted to the right, because of the way the TV set 'paints' the picture lines from left to right. The second picture is usually less distinct and more weakly coloured, both because it's from a weaker signal and also because of the way the PAL colour TV system used in Australia and New Zealand works.

But although these extra 'ghost' images may be fainter and more weakly coloured, they can still be quite distracting and seriously degrade the clarity of your main picture. That's why they're regarded as a reception problem. An example of a picture with multipath



reception ghosting is shown below in Fig.5.

It can be surprisingly difficult to track down the exact source of the reflected signal that's producing a ghost. However you can at least work out one important point from a careful inspection of the TV screen: how much further the reflected signal is travelling, compared with the direct path signal. You do this by carefully measuring how far the ghost image is to the right of the main image, as a proportion of total picture width.

The idea behind this is that with the PAL TV system used in Australia and New Zealand, the electron beam in the picture tube takes exactly 64µs (microseconds) to 'paint' each line of the picture. So the full picture width corresponds to a 'time ruler', with a total length of 64µs (Fig.6). Therefore by measuring the separation between the main and the ghost images, dividing this by the total picture width and then multiplying this by 64, you can find the time in microseconds that the reflected signal is being delayed compared with the main signal.

For example in Fig.5, the ghost image was very close to 73mm to the right of the main image, as measured on a 560mm wide screen (68cm diagonal). This corresponds to 0.13 (73/560) of the screen width, and 0.13 times 64µs corresponds to 8.3µs. So that's the time delay involved in the extra path length for that particular reflected signal.

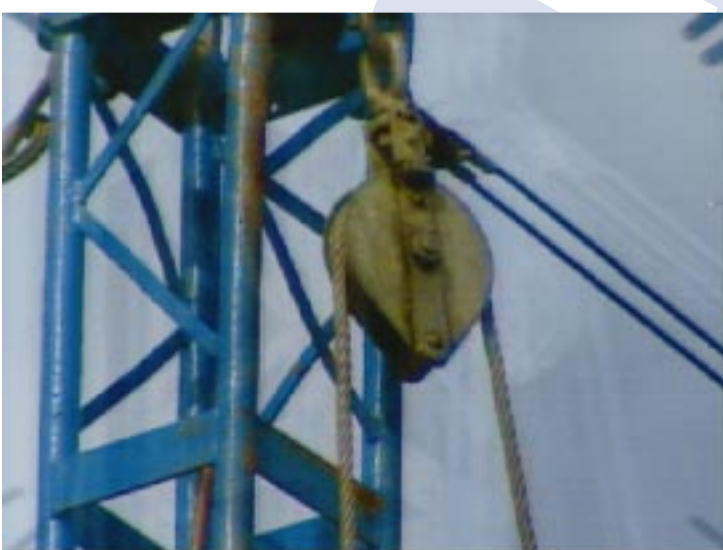
Then knowing that radio waves travel at 300,000km/s, or 0.3km/µs, it's easy to work out the extra path length that results in this time delay. To find the extra path length in kilometres, you simply multiply the delay in microseconds by 0.3:

$$Px = Td \times 0.3$$

where Px is the extra path length in km and Td is the reflected signal delay in µs worked out from the ghost image separation.

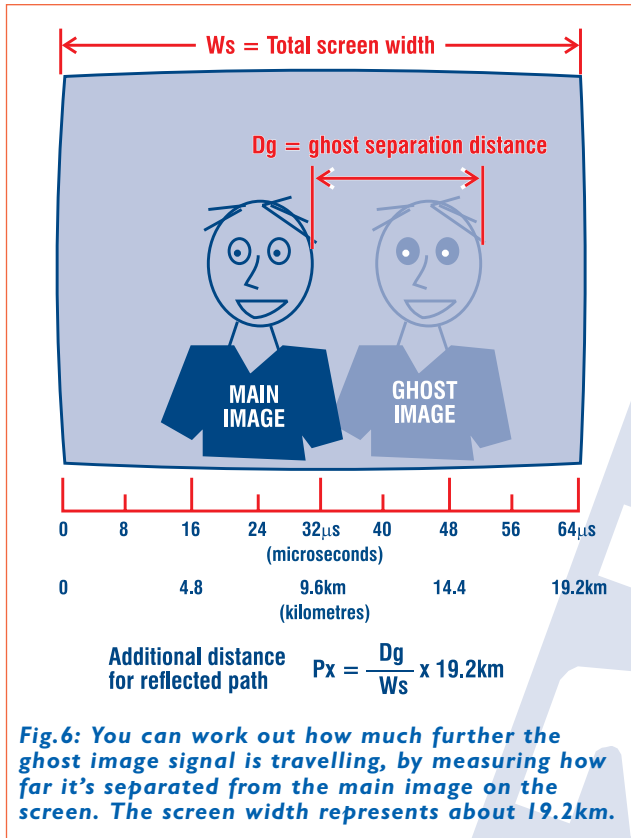
So the reflected signal in Fig.5 must be travelling very close to an extra 2.5km, as 0.3 x 8.3µs = 2.49km.

Another way of working out the extra path length directly is to remember that because



**Fig.5: A TV picture with multipath reception ghosting. In this case the second image is a negative, and shifted to the right of the main image by about 13% of the screen width. Although pale, it can be quite distracting when the main image has high-contrast detail...**





the full screen width represents 64 $\mu$ s, this also represents 19.2km of extra path length at the speed that radio waves travel. So if you measure the distance between the main and ghost images, as a fraction of total screen width, you can simply multiply this by 19.2 to get the extra path length in km. For our example of Fig.5, this would mean:

$$P_x = (D_g/W_s) \times 19.2 = 0.13 \times 19.2 = 2.49\text{km}$$

where  $D_g$  is the distance between the main and ghost images, and  $W_s$  is the screen width.

So it's fairly easy to work out the extra path length that a reflected signal is travelling, from the on-screen distance between the ghost image and the main image. Of course you still have to work out the direction that the reflected signal is coming from as well, because this will also determine what you can do to reduce the impact of the reflected signal. More about this later.

### Interference: EMI

Now let's look briefly at the third main cause of reception problems: electromagnetic interference (EMI), also known as radio frequency interference (RFI).

Like multipath reception, EMI is another example of reception of the signals from your TV station(s) being disturbed by other signals picked up by your antenna. But instead of the extra signals being reflected and delayed versions of the main signal, in this case they're from a different source of radio waves altogether (see Fig.7). They might be coming from an industrial heater or welder; or a medical diathermy machine; or a nearby computer; or sparking from a big motor drive system (for lifts or elevators), power tools or appliance motors; or from corona discharge from high-voltage power lines; or radiation from a commercial two-way radio transmitter, CB or amateur radio transmitter. They might even be from an FM station or another TV transmitter on either the same channel as your local

station or an adjoining channel, whose signals are still able to reach your antenna with sufficient strength to cause interference.

EMI from FM broadcasting transmitters, industrial heaters, diathermy machines and computers tends to cause moving coloured lines or patterns superimposed on the picture, and again disturbing its clarity. As shown in Fig.8 the coloured lines are usually slanted, but they can be at any angle between horizontal and vertical, and sloping either way. They can also be in a variety of colours, depending on the exact frequency of the EMI signal compared to that from the TV station.

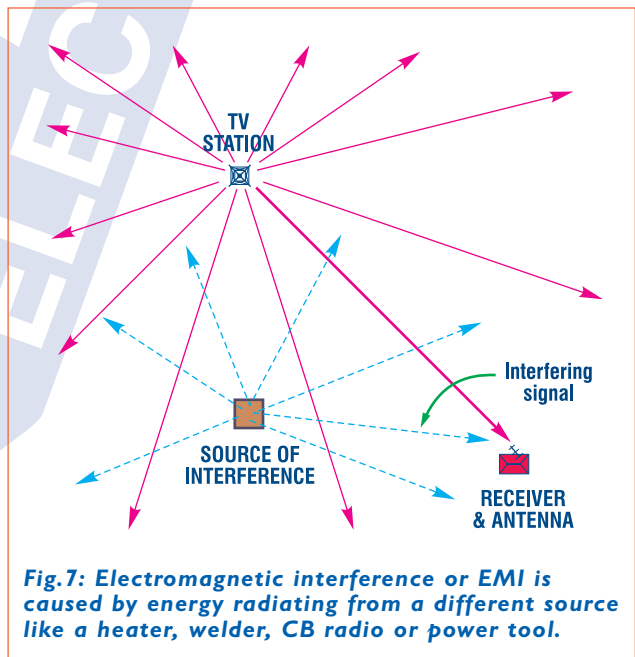
Some signals from radio transmitters and similar sources of EMI can also produce audible interference, if they're strong enough. This takes the form of beat tones or 'whistles', or garbled and distorted speech, along with the TV programme sound.

EMI from 'noise' sources like sparking motors or corona discharge from power lines tends to produce horizontal lines or bands of 'sparkling' noise superimposed on the picture, as shown in Fig.8. The noise bands are often fairly fixed in position vertically, but they may move slowly up or down. Sometimes the noise from computers can behave this way too.

Interference from another TV station on the same channel is easy to recognise: like ghosting it manifests as another picture on the screen, but in this case it's not the same picture shifted to the right, but a different picture altogether. In almost every case it's not fixed in position either — instead it moves slowly from left to right or vice-versa.

Before we leave EMI problems, there one kind of interference which we haven't mentioned as yet. That's the kind that's due to **signal overload**: situations where one or more of the TV signals reaching your set from the antenna are simply too strong. This can cause the radio receiver part of the TV set to distort the signals itself, and make them interfere with each other as a result.

The symptoms of overload can be negative and unstable pictures, picture 'tearing', lines and patterns across the picture (very similar to other kinds of EMI), other images moving across the picture you're trying to watch, and/or distorted sound. These are the sort of





**Fig.8:** The kind of effect you can get from EMI caused by a continuous radio signal, such as from a radio transmitter or diathermy. The coloured lines can be sloping either way, and at any angle.



**Fig.9:** Another kind of EMI, caused by impulse noise from a power tool or food mixer. Corona discharge from high voltage power lines can look similar, but with the noise in horizontal 'bands'.

problems you'll tend to get if you're very close to one TV station's tower, or very near another high powered transmitter.

### Tackling weak signals

Now that you're aware of the various causes of poor TV reception and the signs to look for in diagnosing them, we can move forward to look at the best ways of tackling each problem. We'll start with weak signal reception, because this is the type of problem where many people immediately race off in the wrong direction (to buy an expensive masthead amp).

Let's say you're down in a valley, with a fair-sized hill blocking your antenna's view of a station's transmitter tower. Or you're effectively behind a collection of buildings, or a small forest of trees, which will give much the same result: weak signals. How do you go about improving reception in this kind of situation?

Well, the first thing to do is make sure you have a good outside antenna — at least for the reception of that particular station. It should also be as high off the ground as you can mount it, because this will generally allow it to find stronger signals. That's why you see TV antennas in rural 'fringe areas' up on high masts, of course.

But what exactly is a 'good' antenna, I hear you ask? Basically one that has a high **gain** — or in other words, one that is designed to be particularly good at sensing the presence of passing radio waves, especially those arriving directly from its front. In fact a high gain antenna also tends to be very **directional**, meaning that it's very sensitive to signals arriving from the front, but relatively *insensitive* to signals arriving from the sides or from the rear. Another term you'll see used to describe this is **front-to-back ratio**.

Does this sound a bit technical and confusing? It isn't really. Just look at Fig.10, which shows how a simple dipole antenna (the type often used for indoor FM reception) picks up signals equally well from either side, and in fact from most directions apart from along its

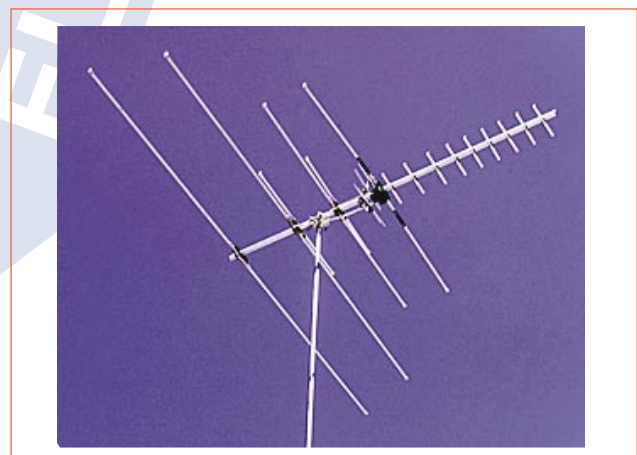
**Right:** Another example of a high gain VHF/UHF antenna, the Jaycar LT-3155. It offers considerable gain on both VHF and UHF channels, as well as a good front-to-back ratio (i.e., it's very directional). This one is 'pointing' towards the upper right.

own axis at each side. So this is a good example of a low gain antenna.

Things improve significantly, though, when the manufacturer adds extra 'elements' to the antenna — usually one or more rods or a metal mesh rectangle mounted a fixed distance behind the main element (forming a 'reflector') and again one or more shorter rods at fixed distances in front of the main element (the 'directors'). These extra elements all have the effect of reducing the antenna's sensitivity to waves coming from the rear and sides, and at the same time boosting its sensitivity to waves arriving directly from the front. Broadly speaking the more elements that are added, the more its front signal-collecting ability and directionality are improved.

This is all a bit like the way the lenses work in a telescope or pair of binoculars: they allow us to see much further directly in front, but they do this by narrowing our viewing angle.

So high gain TV antennas tend to have quite a few rods and other elements, and they can become quite large and bulky. But make no mistake: if you're in a weak signal area, the most cost-effective way to ensure the best reception is to use this kind of antenna, mounted as high as possible. That's because you'll be obtaining the strongest possible signals from the waves coming from the station(s) it's pointed at. The signals will also be accompanied by the least noise and interference as



well, because they tend to be weaker as you take the antenna higher.

Why can't you achieve similar results from a less fancy (i.e., lower gain) antenna, plus a masthead amplifier? Simply because a lower gain antenna produces less signal, mixed with more noise and interference. As a result when you pass its signals through a masthead amp to boost the wanted signals, the noise and interference gets boosted as well. In fact there's even more noise and interference generated in the masthead amp itself, so there's actually a small *deterioration* in reception rather than an improvement.

This is also why those fancy indoor set-top antennas with rods, dishes and inbuilt 'masthead' amplifiers are really only suitable for situations where you have very strong signals and very low noise. In a weak signal area they simply don't pick up enough signal, and too much noise.

So the first and main step in tackling weak signal problems is to use a high gain antenna, and mount it up as high as you can.

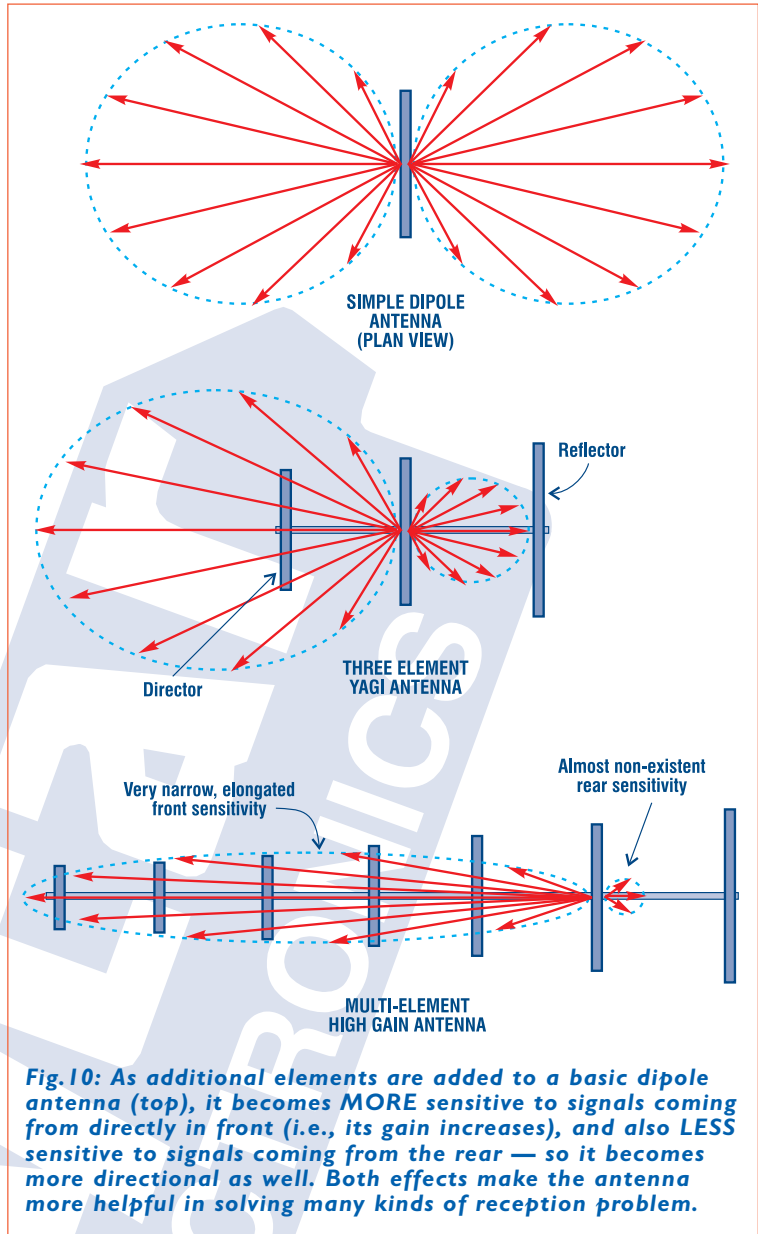
Of course the main drawback of a high gain antenna is that it will be very *directional* — that's how its high gain is achieved, after all. So you'll have to make sure it's very carefully pointed at the station you want, because it will be very poor at receiving signals from any other direction.

What if you want to receive weak signals from a number of stations, and they're all in different directions? There are two ways of solving this one.

### You may need a rotator

One approach is to use a single high gain antenna with a remotely-controlled rotator system, so you can swing it around to point to whichever station you want to watch. Modern rotator systems can have a 'memory' which stores the correct bearing for each of your stations, so they can automatically swing the antenna to the correct position at the touch of a button.

The other approach is to have a number of fixed high gain antennas, each pointing at one of the stations, and with their signals either selected by a set-top switch box, or combined using a device called a *diplexer*.



**Fig.10:** As additional elements are added to a basic dipole antenna (top), it becomes **MORE** sensitive to signals coming from directly in front (i.e., its gain increases), and also **LESS** sensitive to signals coming from the rear — so it becomes **more directional** as well. Both effects make the antenna **more helpful** in solving many kinds of reception problem.

This type of rotating or multi-antenna system can get a bit complicated and expensive, but the results will always be much better than using a low gain, less directional antenna with a masthead amplifier.

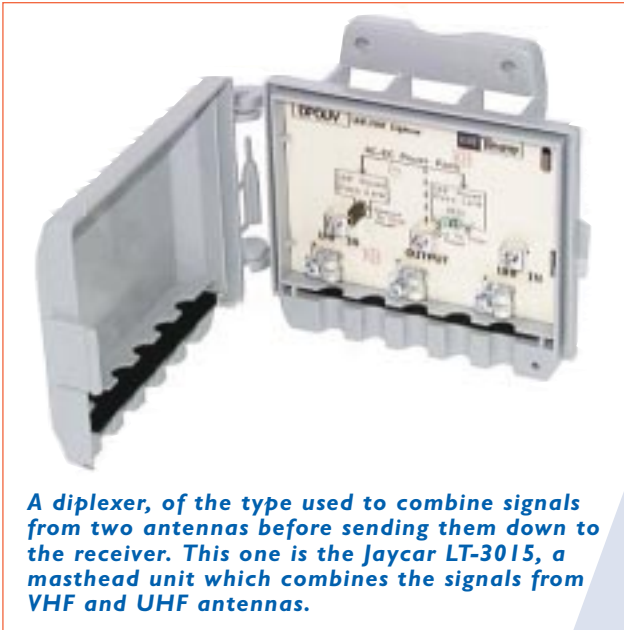
OK, I hear you ask, what if I am already using a top-notch high gain antenna, mounted as high as possible, but my signal strength **STILL** isn't strong enough for good reception. What do I try next?

This can certainly happen, especially in deep fringe areas, and it is in fact one of the few situations where you **MAY** be able to get a worthwhile improvement using a masthead amplifier. But be warned: it may not help much, and it may also bring with it some problems of its own, as we'll discuss later.

Be aware too that if it's to give you any real improvement in reception, a masthead amplifier **MUST**

**Here's an example of a very high gain, highly directional antenna for UHF reception only. This is the Jaycar model LT-3182, which has a total of no less than 91 elements. It's pointed towards the upper left, of course (smallest elements to the front).**





**A diplexer, of the type used to combine signals from two antennas before sending them down to the receiver. This one is the Jaycar LT-3015, a masthead unit which combines the signals from VHF and UHF antennas.**

be mounted exactly where its name suggests: right up at the top of the mast, as close as possible to the antenna. There's no point in fitting one down at the bottom of the mast or next to the TV set, because the weak signals from the antenna will be even weaker by the time they travel down the antenna cable — which attenuates signals, but at the same time introduces more noise.

Two more comments, before we leave the topic of weak signal problems. In some situations where the direct-path signals are too weak even when you use a high gain antenna, there may be stronger reflected signals coming to you from a different direction — from a cliff face away to the side, for example. So it's a good idea in these situations to try swinging the antenna around, just to see what kind of reception can be achieved. Just occasionally the reflected signals can give better reception — so set your antenna up pointing in that direction instead.

Another source of alternative signals is UHF repeaters and translators — 'relay stations' which are used to make the signals from stations available in areas with known reception problems. So if you still can't get acceptable reception of a station on its usual frequency channel, try looking for the same signal on another channel in the UHF band.

In the Sydney area, for example, all of the main stations (both VHF and UHF) are also carried on repeaters and translators working on channels in the UHF band. This is also the case in most other metropolitan areas. As a result if you can't get a station's main signal at acceptable strength, you may still be able to get good reception via a UHF translator's signal.

You can find out the UHF channels used by TV translators for the various channels in your area from the Australian Broadcasting Authority website ([www.aba.gov.au](http://www.aba.gov.au)).

### Expelling ghosts

The most promising way of tackling poor TV reception due to weak signals, then, is to get a high gain antenna — but what if your problem is ghosts instead? Surprising though it may seem, a high gain antenna is still the best way of tackling this type of problem too.

That's because as we've already seen, a high gain antenna is also very *directional*. In fact the higher its gain, the more an antenna responds only to signals coming from directions which are inside a narrow cone shape directly in front (Fig.10).

As a ghost image corresponds to a second version of the signal from the TV station, reflected from a large object and thus arriving via a longer path, this means that often it's also arriving from a different direction (Fig.4). So with a high gain, very directional antenna it's often possible to swing the antenna around a little to the left or right so that it still receives the 'direct path' signal at good strength, but picks up very little of the 'reflected path' signal that was responsible for the ghost. This is shown in Fig.11.

Of course this approach can't help you if the reflected signal is coming from almost exactly the same direction as the direct path signal — for example from a source which is behind the station's transmitting tower, from your own antenna's point of view. But there's very little you can do about this type of multipath ghosting anyway — so it's just as well this only happens very rarely.

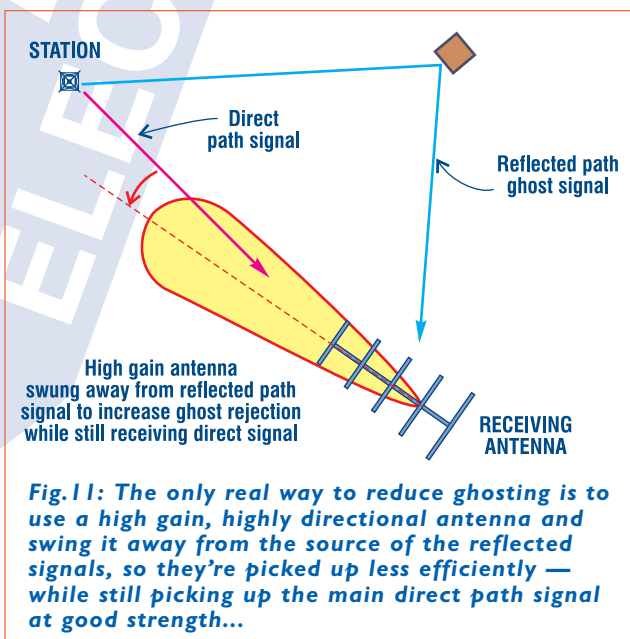
Luckily most ghosts seem to be caused by reflection from objects at a reasonable distance to one side of the direct path, so they often respond quite well to using a very directional antenna as shown in Fig.11.

In really stubborn cases where a single very directional antenna can't reject the reflected path signal enough by itself to 'lay the ghost', it's possible to use a second very directional antenna to receive the reflected path signal by itself, and then add this antenna's signal to that from the main antenna with the connections reversed — so the reflected path signal is cancelled out. This is fairly expensive and can be tricky to set up, but it's about the only way to tackle a very troublesome multipath ghost problem.

### Repelling EMI

Now let's consider the various kinds of TV reception problem cause by EMI, and how you can go about solving them — or at least minimising them.

Again, if the EMI from the source of your interference is coming from a different direction to the TV station signals, a high gain and very directional antenna will very likely let you reduce the amount of EMI picked up, just



**Fig.11: The only real way to reduce ghosting is to use a high gain, highly directional antenna and swing it away from the source of the reflected signals, so they're picked up less efficiently — while still picking up the main direct path signal at good strength...**

by swinging it a little to the opposite side. So this is again the first thing to try.

If that doesn't solve the problem, you may need to try other approaches as well. For example if the interference is coming from a transmitter or noise source with a frequency *outside* the actual TV channel(s) you're trying to receive, it may be possible to reduce the EMI by using a rejection or **notch filter**, connected 'inline' — i.e., series with the antenna cable.

A notch filter is basically a tuned circuit, which can be adjusted to stop signals in a small range of frequencies from passing through — while allowing signals of all other frequencies to pass. So by adjusting the filter to 'reject' the signals from your source of EMI, they are prevented from interfering with the TV signals.

If on the other hand the interference is coming from a transmitter of some kind with a frequency *inside* one of the channels you're trying to receive, a notch filter is not likely to be able to help. Instead you may have to use an **inline attenuator** — a device which lowers the level of all signals passing through it.

The idea here is that by using an adjustable attenuator and carefully adjusting its degree of attenuation, you may be able to reduce the EMI signals to a level where they cause minimal disturbance to the receiver, while still leaving the TV station signals at a strength high enough to allow good noise-free reception.

### Tackling overload

As we saw earlier, one type of reception problem is due to **overloading**, where the TV signals interfere with each other in the 'front end' of the receiver itself, because one or more of the signals from the stations is/are too strong.

The remedy in this kind of situation depends on whether the overloading is due to just one very strong signal (because you're very close to that transmitter), or more than one. If only one is too strong, the most likely solution will probably be to connect an inline notch filter, and adjust it to largely reject the over-strong signal. In severe cases, you might also need to fit a metal shield around the back of the TV set itself, connected to the 'ground' side of the set's antenna input. (The metal shield should be perforated, so that it doesn't block ventilation and make the set overheat.)



**Masthead amps have quite specific uses, as we explain in the text. This one is the GME Kingray MHW34GP (Jaycar LT-3290).**

**Right: A variable inline attenuator, of the type which can be used to solve signal overload problems. (LT-3050)**



**Left: A four-way signal splitter, used to share TV signals among a number of outlets. (LT-3047)**

Many notch filters allow you to adjust not only the tuning of the rejection notch, but its degree of rejection as well. This allows you to reduce the level of the over-strong signal just enough to prevent overloading.

If your overloading is being caused by more than one over-strong signal, you may be able to fit additional notch filters and adjust each of them to throttle back one of the offending signals. Or if the signals are ALL too strong, you may be able to achieve the same result using an inline attenuator. In this case you'd adjust its degree of attenuation so that the signals are weakened just enough to prevent overloading, but still strong enough for good noise-free reception.

(This is clearly the kind of situation where a masthead amp will do more harm than good. We need to make the signals *weaker*, not stronger.)

### When masthead amps ARE used

By this stage, you may well be wondering just where it IS appropriate to use a masthead amplifier. We've discussed quite a few situations where you *shouldn't* try to use one, so perhaps before we end up it would be a good idea to clarify just when these misunderstood and often maligned gadgets ARE likely to help.

First of all, as we saw earlier a masthead amp may well be able to help in fringe area situations where you're already using a very high gain antenna mounted as high as possible, but the signals it picks up are still not strong enough for good noise-free reception. So that's one important use for them. Just remember that in this sort of application, the masthead amp must be fitted right up at the antenna, or it won't be able to improve reception much at all.

The only other real use for a masthead amp is in situations where the signals from a single antenna need to be shared by a significant number of receivers. An example is a block of home units or apartments, which may use a single antenna on the roof to feed signals to one or more outlets in each unit or apartment.

This type of signal sharing is achieved by passing the signals through **splitters**, which use resistor networks to divide the incoming signals so a proportion of each signal is fed to every outlet. As a result the splitter output signals are inevitably weaker than the signals from the antenna — and if many outlets are involved, this means that each outlet tends to get much weaker signals. In fact if there are N outlets, each outlet tends to get signals which are 1/Nth of the antenna signal strength. So if there are 4 outlets, each gets a signal only 1/4th as strong as the signal from the antenna.

Needless to say this can easily make the signals at each outlet too weak for good reception. But this can be corrected by using a masthead amplifier to boost the



signal strength from the antenna before it passes through the splitter system, so that each outlet gets strong enough signals after the splitting losses.

If the basic signals from the antenna are strong enough in this type of situation, it's not even necessary to have the amplifier right up at the antenna. The amp can be down near the splitter system — in which case it becomes an **RF distribution amplifier** rather than a masthead amp. But note that this can only be done if the signals from the antenna itself are strong enough, so that the amplifier is not being used to make weak signals strong, but to make strong signals even stronger before they are divided up by the splitter system.

Actually because strong signals can interfere with each other in this kind of RF distribution amplifier, many models are in reality a collection of amplifiers — one dedicated for each TV station signal. The incoming signals from the antenna are separated by tuned filters, and then passed through their own amplifier. Then the outputs from each amplifier and combined again with a diplexer/multiplexer system, to feed the input(s) on the splitter system.

Hopefully you can see from this explanation that masthead and RF distribution amplifiers have quite specific uses, where they do play an important role. But apart from these uses, they don't offer any help in a lot of ordinary TV reception problem situations.

### If all else fails...

Let's end up by addressing one question which you might still want answered, after reading all of the foregoing. That is: what do you do if you're in a really difficult location, you've mounted a really good high gain directional antenna as high as possible, you've carefully pointed it in the best direction, you've tried notch filters and attenuators and so on, but the reception STILL isn't good enough?

In this sort of a situation there's really only one remaining solution: subscribe to a cable TV or 'CATV' service. Virtually all CATV services distribute clean versions of the local 'free to air' TV signals over their cable as well as their own Pay-TV programming, so this will enable you to get the stations at optimum viewing quality without an antenna at all.

Of course even this may not be an option if you're way out in the bush, or in a suburb which isn't serviced by a CATV company. In that case you might have to subscribe to a satellite or microwave Pay-TV service instead, or decide to watch movies on DVD.

But in most cases it should be possible to achieve very acceptable reception of your local TV stations, if you follow the tips we've given you in this Tech Note.

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## TV Antenna & Reception Glossary

Here's the meaning of the technical jargon you're most likely to meet:

**Attenuator:** A device used to reduce deliberately the level/strength of over-strong signals, to prevent overloading.

**Balun:** A BALanced-to-UNbalanced transformer; used to ensure a correctly matching connection between an antenna and a cable, or between a cable and a TV receiver. This is important for the best reception quality.

**Diplexer:** A device used to combine the signals from two receiving antennas, so they can be fed down a single cable to the receiver. Some diplexers can combine VHF signals and some UHF signals, while others can combine both.

**Directional antenna:** An antenna which is much more sensitive to radio waves coming from one direction (its 'front') than from the opposite direction (its 'back').

**Director:** A metal rod or other element added to the front of an antenna to improve its gain and directional behaviour.

**Direct path:** The path via which radio waves travel directly from the TV station tower to a receiving antenna.

**EMI:** Electromagnetic interference — what happens when radio frequency signals from other sources interfere with reception. Visual symptoms include coloured lines across the picture, horizontal bands of noise specks, and so on.

**Fringe area:** At a significant distance from the TV transmitting towers, the signal strength has deteriorated to a level where a high gain antenna must be used to get acceptable reception quality. This is known as 'fringe area reception'.

**Front-to-back ratio:** The sensitivity of a receiving antenna to signals arriving directly from its front, compared with its sensitivity to signals arriving directly from the back. Also known as 'directionality'.

**Ghosting:** Pale extra images on the TV screen and to the right of the main image, caused by the reception of signals reflected from buildings or other structures, in addition to (and arriving slightly after) the direct path signals.

**High gain antenna:** An antenna which has particularly high sensitivity to signals arriving from directly in front.

**Line-of-sight reception:** The ideal situation, where there's a clear visual path from the TV station tower to your antenna.

**Masthead amplifier:** A wideband RF amplifier designed to boost the strength of signals directly at the receiving antenna.

**Multipath reception:** When the signals from a TV station are reaching your TV antenna by two or more paths — i.e., one or more reflected paths as well as the main direct path. This can result in ghosting.

**Notch filter:** A small tuneable device which can be used to prevent interfering signals from reaching the antenna input of your TV set, to minimise EMI. It's tuned to 'notch out' or reject the interfering signal, while allowing all other signals to pass through.

**Reflected path:** An indirect path by which TV signals can reach your antenna, after being reflected from a building or bridge, etc.

**Reflector:** One or more metal rods or a metal mesh, fitted to the back of an antenna to improve its gain and directionality.

**Rotator:** A motor-driven assembly used to allow an antenna to be 'pointed' in various directions as desired, by remote control.

**Snow:** Visible noise specks on the TV screen, due to low signal strength. Also called 'pepper and salt'.

**Splitter:** A device used to divide up the signal from a receiving antenna, in order to drive a number of outlets and TV sets.

**VHF:** Very high frequencies, as used by Australian TV channels 0 - 12. (From 45 - 230MHz)

**UHF:** Ultra high frequencies, as used by Australian TV channels 27 - 69. (From 526 - 820MHz)

**UHF translator:** A transmitter operating on a UHF channel, which rebroadcasts the signal from a TV station to enhance reception.