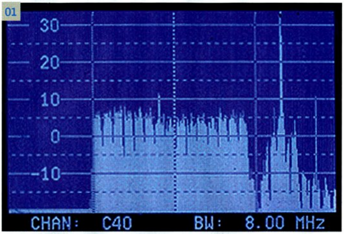
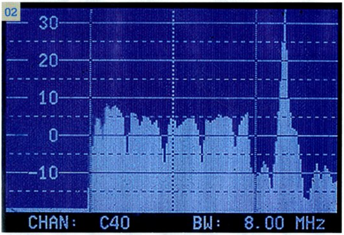
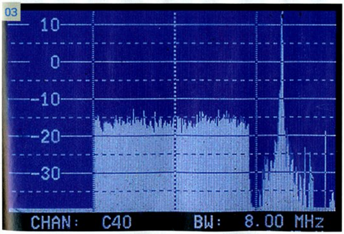
Dodgy digital? Check the amp!

Faulty aerial amplifiers can display misleading symptoms, especially when the power supply section is failing. But there are signs you can look for, says Bill Wright







1. The effect of amplifier mains ripple on a multiplex, as seen on an analyser in slow scan mode. The multiplex is central in the image, with an analogue video carrier on the right

2. The same signal, but with the analyser in fast-scan mode. The notches occur when the scan coincides with momentary low amplifier gain

3. For comparison, this is the signal before it passed through the faulty amplifier, with the analyser on slow scan

Bill Wright

Bill grew up with a TV aerial in his hand, helping his aerial installer dad. In 1971 he seized the reins and has never looked back. Nowadays he concentrates on distribution systems, leaving everything else to his son, Paul.

Those of us who have spent years working with analogue reception sometimes feel that digital TV can be a bit inscrutable!

The faults on analogue are so obvious and a TV picture derived from an analogue transmission is like an open book compared with its digital equivalent. A slightly weak or noisy analogue signal will give a snowy picture – a warning that if things get any worse, reception will become very poor. The digital equivalent might appear free of any blemish, but it will probably pixellate as soon as your back is turned.

Sneaky digital snags

The tendency of digital reception to play underhand tricks can catch you out when an amplifier is faulty. Masthead amplifiers and distribution amplifiers go wrong in many ways, but most faults are down to the PSU, or power supply unit. The PSU for a masthead amplifier is a separate item, and it's usually to be found behind the TV set. Distribution amplifiers are normally mains powered, with the PSU built in. A dead PSU is usually a dead giveaway (geddit?), because the output signal levels are so low that all reception fails. The facts that the little indicator LED is not on and the amplifier is stone cold are also good pointers! But do check that the mains supply is present before condemning the amplifier…

Other amplifier faults can give rise to misleading symptoms. Multistage amps can suffer the failure of one stage, so the gain drops. Although this will normally reduce output levels by about 20dB, DTT can continue working regardless, if the original levels were very high. This applies particularly when the masthead amplifier has excessive gain for the application – a mistake commonly made by installers. Always check signal levels at the outlet and make sure they're 'sensible' – never treat a good DTT picture as proof that everything is all right.

High-gain masthead amplifiers can oscillate. This might be due to internal feedback, or the aerial might be receiving signals that have been through the amplifier. On analogue pictures, the result is obvious patterning, but DTT reception might appear unaffected even though the amplifier is in a non-linear condition and the Bit Error Rate has been much worsened. If in doubt, a good squint at the analyser screen might reveal a single narrow 'spike' towering above the legitimate signals.

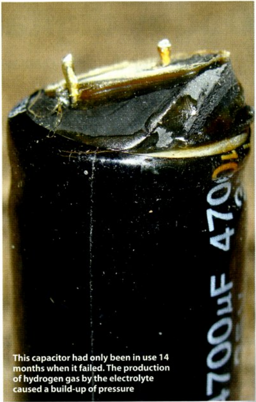
Incapacitated

Going back to the PSU, amplifiers need a low DC voltage – usually 12V – so it's the PSU's job to produce this from mains power. It's important that the 12V supply is very smooth, without any ripple or other variations. The ideal supply would be perfect DC, such as you would get from a battery. Since the mains supply is AC (alternating current), the PSU has to smooth its output thoroughly. This is done by one or two large capacitors that act a bit like little batteries, storing power when the voltage is high and releasing it when the voltage is low. Sometimes there's a voltage regulator IC as well, but when a problem arises it's almost always the capacitors that are to blame.

There has been an epidemic of bad electrolytic capacitors over the past ten years, the root cause being a matter of deep mystery and contention within the component industry. The electrolyte can produce hydrogen causing the case to bulge, and the seals can perish causing the capacitor to dry up. You can often see these faults quite easily if you take the PSU cover off. At this point I'm obliged to warn you not to electrocute yourself!

The capacitor loses its ability to smooth the voltage, so the amplifier attempts to function on power that's fluctuating rapidly between, say, 5V and 12V. Since the fluctuations are tied to the local mains frequency, and since this approximates to (but does not equal exactly) the frame frequency of the TV picture, the result on analogue TV is a dark band that moves slowly up or down the screen. The effect varies from one TV set to another, some sets having the ability to smooth out the fluctuating signal. This can be slightly confusing, but at least when you see a hum bar on a picture you know that somewhere there's a ripple on a PSU, even if it's only on the PSU of a VCR that's daisy-chained into the aerial feed. By the way, it's been called a hum bar since the early days of radio, when the same fault caused a deep hum to be emitted from the loudspeaker.

The effect on DTT is far more subtle, and you can easily miss it. PSU ripple will worsen the BER, but probably not enough to affect reception



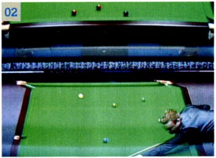
This capacitor had only been in use 14 months when it failed. The production of hydrogen gas by the electrolyte caused a build-up of pressure immediately, so if the aerial system is carrying only digital signals the fault can pass unnoticed. Look out for a worsening of BER when the signal from an outlet is compared with the direct aerial output. Of course, you should check first that the amplifier isn't being driven into cross-modulation by input levels that are too high.

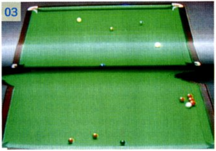
Ripple effect

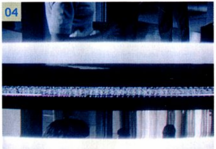
It's surprising, but PSU ripple that will cause severe hum bars and loss of sync on an analogue channel might have a relatively slight effect on digital BER. The fault will always worsen with time though, so it shouldn't be left even if reception seems to be all right. If the power to the masthead amplifier is suspect, use your analyser's built-in power source for a comparative test.

The effect of PSU ripple on a DTT signal is to cause the multiplex level to bounce rapidly up and down. You can see this on the analyser, but because of the interaction between the local mains frequency and the analyser's scan rate the effect will be to give the multiplex a toothed top, the width of the teeth depending on the analyser settings.

IDTVs and receivers vary in their ability to cope with the rapid fluctuation of signal level, so don't be surprised if





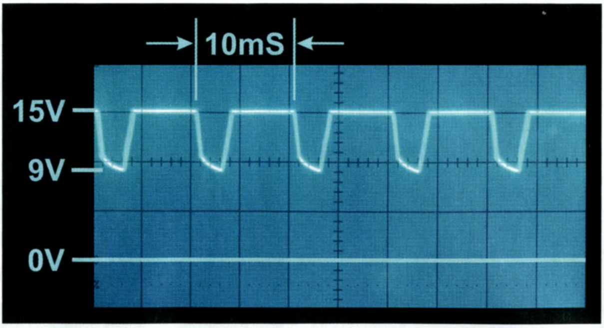


1. An analogue TV picture, affected by a distribution amplifier with a faulty PSU. The line sync has been disturbed. On DTT pixillation was caused, but only on the weakest multiplex

2. Here the TV set has lost frame sync thanks to the amplifier's supply ripple

3. Another example of the effect of supply ripple on an analogue channel

4. When the supply ripple is severe some analogue TV sets can produce solid white bars and loss of colour. In this case DTT reception was also affected severely



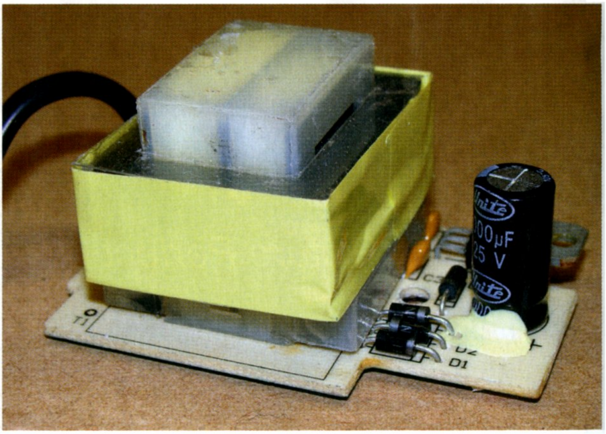
The output from a distribution amplifier's faulty PSU section. The output is held at 15V by the voltage regulator, except for the periods when the dried-out smoothing capacitors are unable to prevent the load pulling the output down to about 9V

some TV sets are more affected than others. Where signal levels are marginal or the BER is already poor due to co-channel interference or some other cause, the signal degradation caused by a dodgy amplifier will be more obvious.

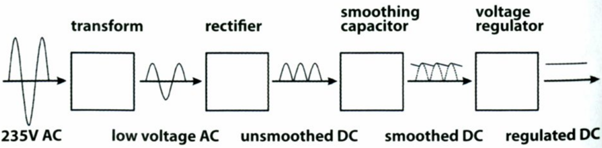
Mend it or bin it?

It isn't economic to repair a masthead amplifier's PSU, or even that of a small distribution amplifier, but you might feel like fixing a more expensive amplifier, especially if it's not very old. Replace the capacitors with ones of the same value (1,000μF is typical) and voltage rating (usually 25V). Make sure you fit the new ones with the correct polarity. If the PSU board is scorched or other components look distressed, throw the amplifier away.

Of course, you should not attempt this sort of repair work unless you are confident that you know what you're doing. And beware of electrolytic capacitors – they can hold a lethal charge for a long time.



The PSU from a medium-sized distribution amplifier. The smoothing capacitor is on the right. The yellow gunge is adhesive, not evidence of a leaky capacitor. The capacitor has a serrated top in order to reduce the force of the explosion should it fail catastrophically!



Distribution amplifiers usually have a simple power supply section