COM7, Aerials, Amplifiers and Filters

Back in June 2022, we saw Channel 55, also known as COM7 switch off. This was the final multiplex (mux) above channel 48 and saw the completion of the 5G / 700MHz clearance program. As an industry we are left with a reduced bandwidth and an ever-increasing risk of interference from external sources.

This document looks at the implications for aerials, amplifiers and filters

Aerials

An aerial covering a small range of channels can be expected to have higher gain than an aerial of comparable size but covering a wide range of channels. Therefore, many years ago groups A, B, C/D, E and W were defined. More recently groups K and T have been added to account for the clearance of the 700 MHz and 800 MHz bands.

Group	Channels	Colour code	Install after June 2022?
A	21 - 37	Red	Yes
B	35 - 53	Yellow	No
C/D	48 - 68	Green	No
E	35 - 68	Brown	No
K	21 - 48	Grey	Yes
T	21 - 60	White	No/Yes[#]
W	21 - 68	Black	No

With the first phase of spectrum clearance, TV transmissions in the 800 MHz band (channels 61 to 68) were moved to lower channels and replaced by high power LTE base stations, which are capable of creating very high signal levels at the aerial output. These can cause interference to TV reception.

In the second phase, TV transmissions in the 700 MHz band (channels 49 to 60) were moved to lower channels. Widespread deployment of further base stations for mobiles is expected to get under way shortly.

To help protect amplifiers and receivers from the effects of harmful interference, it is strongly recommended not to use an aerial where the range of channels that it is designed to work with covers any part of the cleared 700 MHz and 800 MHz bands. Normally the gain of an aerial reduces quite rapidly above its intended frequency range, and this will help reduce the reception of interference signals. A group K aerial will satisfy this requirement.

There are a few exceptions to this recommendation:

- [#] In areas where channel 45 to 48 is used but reception is marginal, a group T aerial may give better performance on these channels than a group K due to the design of the group K aerial rejecting channels above 48. (Installers found the same issue with channel 59/60 and used W aerials to compensate for the 4G implementation)
- Where reception of COM7 on channel 55 is required right up to its closure in June 2022, a group T aerial can be fitted. It may be necessary to fit a filter that cuts off above channel 48 after COM7 has ceased or change the aerial for a group K (or both).
- Where higher gain is necessary, and all multiplexes are in the range of channels from 21 to 37, a group A aerial can be used.

Amplifiers

Here is a reminder of the five amplifier classes in the ETSI standard used to demonstrate compliance with RED, followed by some ideas about how they should be used.

Class	Type and Use
0	Wideband from 470 MHz to 862 MHz. A separate filter is recommended to be fitted in the system, the choice of which can be selected based on the type required 4G or 5G and the level of LTE interference and amplifiers capability of handling the overload[1]. This is the only class where products can be used with locally modulated signals that are carried on cable only (i.e. never radiated), and where these signals are in the 700 MHz and 800 MHz bands.
1	Passes signals from 470 MHz to 694 MHz. Intended for use after 700 MHz clearance, and where the interim multiplex on channel 55 is not used. These do have restricted applications see note [2]
2	Not used in the UK.
3	Passes signals from 470 MHz to 782 MHz. Intended for use after 800MHz clearance, but where channel 60 (782 MHz to 790 MHz) is not used. These do have restricted applications see [3] and are not designed to reject 5G interference[4].
4	Passes signals from 470 MHz to 790 MHz. Intended for use after 800MHz clearance, and where channel 60 is used. These do have restricted applications see [3] and are not designed to reject 5G interference[4].

[1] Please refer to the "Choice of amplifier" and signal handling capabilities
[2] Please note these cannot be used on systems with locally modulated signals that are carried on cable only (i.e. never radiated), and where these signals are in the 700-850 MHz bands
[3] Please note these cannot be used on systems with locally modulated signals that are carried on cable only (i.e. never radiated), and where these signals are in the 800-850 MHz bands
[4] Please note the choice of "placing a proLTE5G700 filter" in front of the amplifier for additional protection.

The objective of an external filter used with class 0 amplifiers and the internal filters of classes 1-4 is to reduce the level of mobile phone (sometimes called User Equipment, UE) and base station signals presented to the amplifier. These signals need to be reduced enough that they do not overload the amplifier, which would affect its ability to deliver good quality DTT signals.

The filter characteristics for classes 1-4 have been chosen as a balance between cost and the ability to deal with as many interference cases as possible. But there are some situations, such as where a base station is directly in line with the DTT transmitter and quite close to the receiving aerial, where the amount of signal remaining after filtering is still too much for the amplifier. In these cases service may be restored by either:

- Using a higher grade of filter that gives more attenuation of the unwanted signals.
- Replacing the amplifier with one that has particularly good strong signal handling capability (see "Choice of amplifier" below).

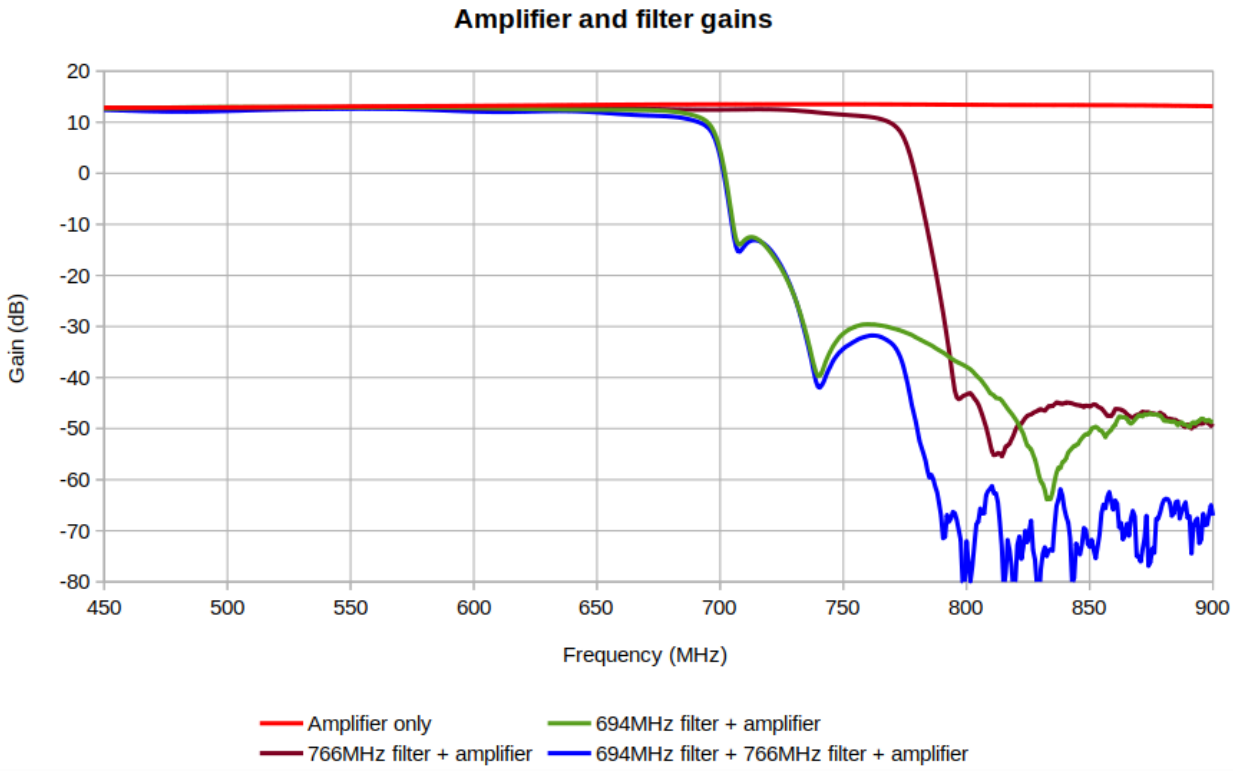
Note that it may be necessary to do both the above steps to achieve satisfactory performance. Note also that cascading two or more similar filters may have the following undesirable effects:

- The attenuation achieved may not be as high as expected;
- The noise in the system may be increased;
- The amplitude variation in the passband may be increased, especially in the upper passband channels.

To explore this, Blake UK has carried out some tests on how a class 0 amplifier performs with either one or two external filters: a proLTE5G700 which cuts off above 694 MHz and a proLTE1 which cuts off above 766 MHz. The results are shown in the graph below, where it can be seen that:

- the amplifier alone (red line) has a flat frequency response extending well above 862 MHz;
- the amplifier and 766 MHz filter (brown line) provides over 50 dB of rejection of signals above 790 MHz;
- the amplifier and 694 MHz filter (green line) provides over 40dB of rejection of signals above 730 MHz;
- the amplifier with both filters (blue line) provides over 70 dB rejection of signals above 770 MHz;
- the filters cause a small increase in gain variation in the passband (470 MHz to 694 MHz). This would be unlikely to cause a problem in practice.

These tests indicate that placing a proLTE5G700 filter in front of a class 3 or 4 amplifier should also achieve similar results.



Choice of amplifier

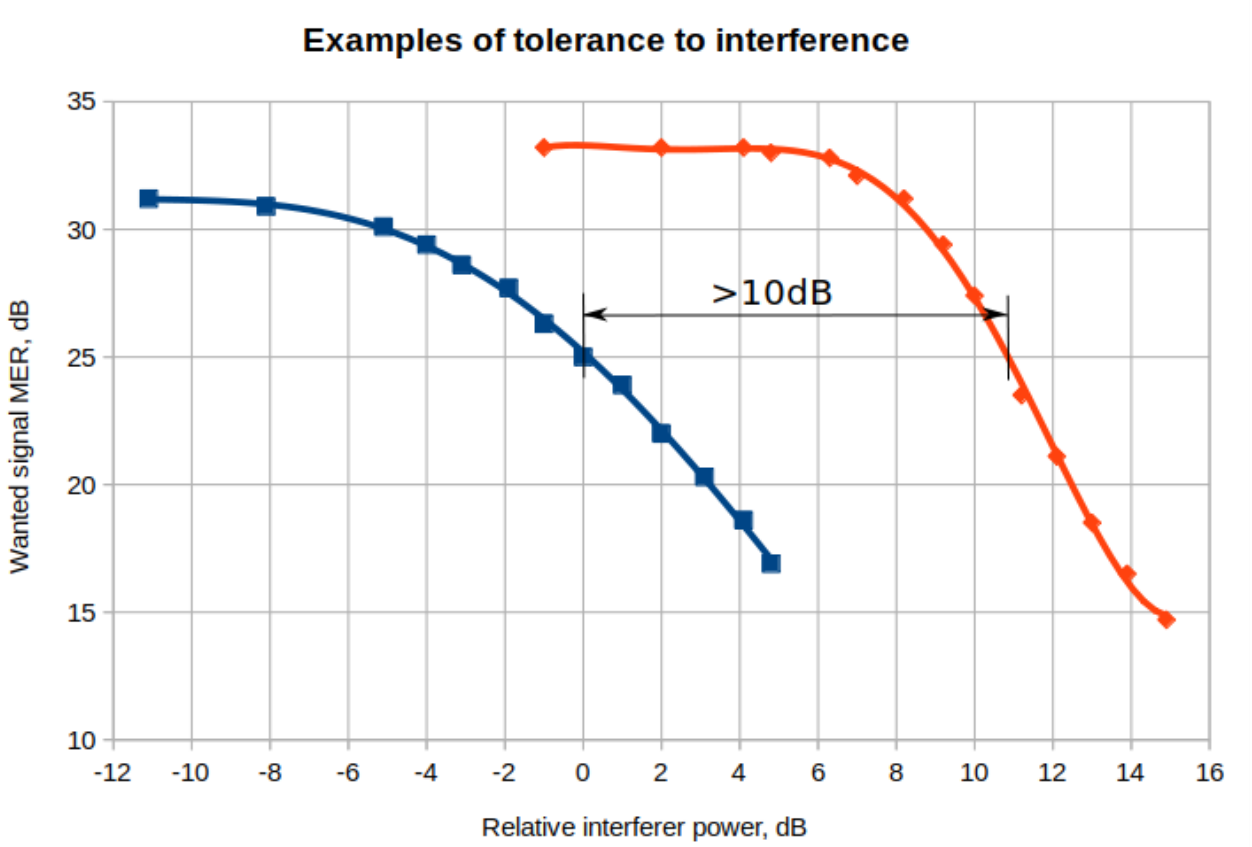
Meeting the minimum requirements of the standard used to show compliance with RED does not necessarily mean that an amplifier will be able to cope with all situations where there is an interfering signal from a network for mobiles. To explore this, Blake UK has carried out some tests on two amplifiers: one from another supplier that just meets the requirements of the standard (Amplifier 1), and the other a proAMP11 (Amplifier 2).

Both amplifiers were fed with a set of off-air signals that had been combined with a locally generated signal representing interference from a mobile phone network. The interference signal could be varied in power, while the MER of one of the off-air signals was measured at the output of the amplifiers.

Referring to the graph below, both amplifiers clearly show that as the interference power increases, the MER of the wanted DTT signals initially is unaffected, and then decreases. The horizontal axis has been set to zero at an MER of 25 dB for Amplifier 1 (blue line). Looking across to Amplifier 2 (orange line) also at 25 dB MER shows that Amplifier 2 can tolerate over 10 dB more interference than Amplifier 1, for the same level of signal degradation. This is before any filtering has been added.

In summary, to build a system that is robust against interference, both the filter and the amplifier need to be chosen carefully.

Examples of amplifiers from the Blake UK range with especially good strong signal handling include proAMP11, proAMP12 indoor amplifiers, and proMHD11L and proMHD14R masthead amplifiers.



New installations

If channel 55 is required, the following options are available:

- Fit a class 0 amplifier, with a low pass filter that attenuates signals above about channel 60 (e.g proLTE1) on its input. Then when channel 55 is no longer available, replace the filter with one that attenuates signals above channel 48 (e.g. proLTE5G700). This then retains the ability to for use on systems with locally modulated signals that are carried on cable only (i.e. never radiated), and where these signals are in the 700 MHz and 800 MHz bands.
- Fit a class 3 or 4 amplifier, then when channel 55 is no longer available, fit a low pass filter that attenuates signals above channel 48 (e.g. proLTE5G700) on the input to the amplifier.

If channel 55 is not required:

- In most cases the best solution will be to fit a class 1 amplifier, especially in areas with strong LTE interference
- Fitting a class 0 amplifier and if needed with a filter that attenuates signals above channel 48 (e.g. proLTE5G700) should also give good performance.

Existing installations

If an existing installation begins to suffer interference, contact Restore TV to see if they can help, for example by providing a suitable filter.

To reduce the likelihood of interference in the future as more base stations are deployed:

- If an existing system contains a class 3 or 4 amplifier, or an amplifier that predates the classifications for RED; preferably replace the amplifier or as a minimum install a filter that attenuates signals above channel 48 (e.g. proLTE5G700) at its input.
- If an existing system contains a class 0 amplifier with a filter, replace the filter with one that attenuates signals above channel 48 (e.g. proLTE5G700). If there is no filter, fit one.
- Review the condition and age of the aerial and replace with a Group K[#]