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# Reducing interference issues between 5G and C-band satellite communications ●●

The re-allocation of C-band for mid-band wide area coverage of 5G presents increased interference issues between new networks and existing RF systems. UK-based Filtronic, which last year received the Queen's Award for Enterprise for International Trade 2021, is helping its customers resolve the situation.

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Interference is a problem that is as old as telecommunications technology itself. However, new frequencies where issues can occur are constantly emerging as demand for spectrum and bandwidth becomes more intense. In recent years, new spectrum has been carved out by the re-farming of existing frequency bands from technologies that are being phased out, and also from the release of spectrum such as that resulting from the switch-over from analogue to digital television – known as the 'Digital Dividend'. The latest problem is the proximity of the mid-band 5G spectrum (in the range 3.4 – 3.8GHz) to established satellite communications channels in C-band [1].

These recent changes in spectrum allocations have inevitably led to the occurrence of interference problems between new networks and existing RF systems. Minimizing spectral emissions and attenuating interference is an issue that is therefore constantly evolving, although the basic mitigation techniques are well-established and just require some adaptation to meet the latest specifications. Many of the new channels are small and close to others, which means that interference mitigation filters need to provide a level of rejection that causes the smallest possible loss of usable spectrum, and with minimal impact on the characteristics of the wanted signal. Depending on the application, interference and blocking protection can be designed either as a standalone unit or be integrated with other filtering or combining functions.

## INTERFERENCE AT SATELLITE GROUND TERMINALS

Satellite communication terminals operating in C-band have a receive band in the range 3.4 – 4.2GHz and a transmit band of 5.85 – 6.425GHz. Although the 3.5GHz band was previously allocated for WiMax it did not achieve widespread use in that application, and the band has now been re-allocated for mid-band wide area coverage 5G. Spectrum auctions have been organised by local regulators in various regions of the world, including in the UK where the winning bids for 3.6 – 3.8GHz allocations were announced in April 2021.[2]

Because the satellite signals received at a ground terminal are orders of magnitude weaker than the 5G signal, it is these signals that need to be protected from interference. Even if the 5G signal meets all the relevant regulatory specifications, interference could still occur if the base station is near the ground terminal. If other electromagnetic radiation is also occurring locally – for example from aviation, AM and FM radio and TV transmitters – then it can be exceedingly difficult to predict what problems might occur. Even when the interference is out of band, intermodulation products between the interfering signal and either the satellite receive signal itself or the local oscillator can appear within the band.

For effective mitigation it is therefore necessary to survey the whole RF environment surrounding the ground

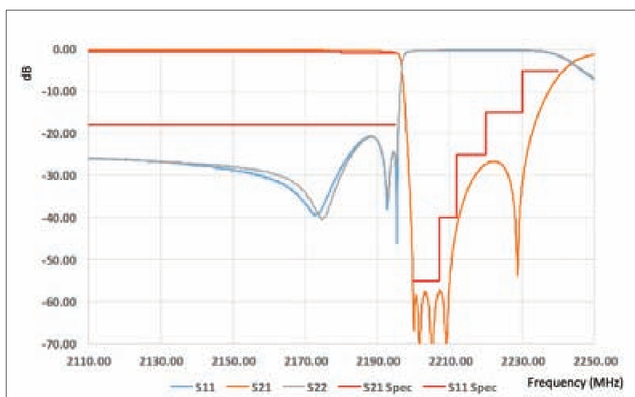


*Figure 1: Typical response of quad bandstop filter giving 55dB minimum attenuation in the 2200 – 2207MHz band* ●●●

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#Filtronic #5G #C-band #Interference

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terminal, as even third order and fifth order intermodulation can interfere with the received satellite signal in an unpredictable or unexpected way. It has been determined by Norsat[1] that the interference sensitivity of a C-band satellite low noise block (LNB) is typically -55dBm, which represents the threshold below which any interfering signals must be reduced. This unpredictability means that for satellite ground stations, interference mitigation is unlikely to be solved by an off-the shelf filter but would need customization for each location and its surroundings.

Other problems that can be caused by interference include receiver saturation, which can occur when the interfering signal is greater than about -45dBm, blocking reception of the wanted signal. Gain compression can also take place if the total power at the input exceeds the input P1dB figure, which can cause distortion, and in extreme cases can cause the modem to lose its lock on the received signal. Noise floor degradation has also been identified as a potential problem.

## FILTER PERFORMANCE

A range of filter technologies are available, dependent upon the specific filter requirements such as size, response, power handling, insertion loss and rejection. The standard technologies include metal cavity filters, ceramic, combline, interdigital, lumped element, suspended substrate, waveguide and thin-film. Enhanced functionality including field reconfigurable filters and switchable filters, or DC feedthrough, can also be provided. Previously successful designs have been produced to solve interference mitigation problems including:

- LTE 800 interference with air-to-ground (ATG) cellular and specialised mobile radio (SMR), and with digital TV during the transition from analogue to digital.
- LTE 2600 interference between FDD and TDD, and with radar systems.
- Interference between GSM-R and 3G or EGSM.

An example of the performance available from these filters can be seen in Figure 1, which shows the typical response of an AWS quad bandstop filter giving 55dB minimum attenuation in the 2200 – 2207MHz band. The receiver passband is 1710 – 1780MHz, with a maximum insertion loss of 0.3dB and minimum return loss of 18dB. The transmitter passband is 2110 – 2195MHz, and the AISG passband is 2.176MHz ±100ppm with a maximum insertion loss of 0.2 dB and 18dB minimum return loss. The isolation between the Rx and Tx passbands is rated at 60dB, and passband average power handling capability is 75W (500W peak). Intermodulation products in the receiver band are below -118dBm. Figure 2 shows a block diagram of the filter.

## CONCLUSION

Filtronic has a long track record in technology for mitigating interference, and its range of filters provide a simple, cost effective and low loss solution for minimising unwanted spectral emissions and attenuating interference signals. Interference mitigation filters can be designed for easy integration into the system, with minimum size and weight, and with flexible mounting options to suit the application. Custom or reconfigurable designs can be created to suit the filtering requirements of a particular cellular base station or satellite ground station scenario.

**References**


[1] M. Ardavan, "Mitigating 5G Interference Signals in The C-Band" www.satmagazine.com/story.php?number=2132459167

[2] www.ofcom.org.uk/spectrum/spectrum-management/spectrum-awards/awards-archive/700-mhz-and-3.6-3.8-ghz-auction


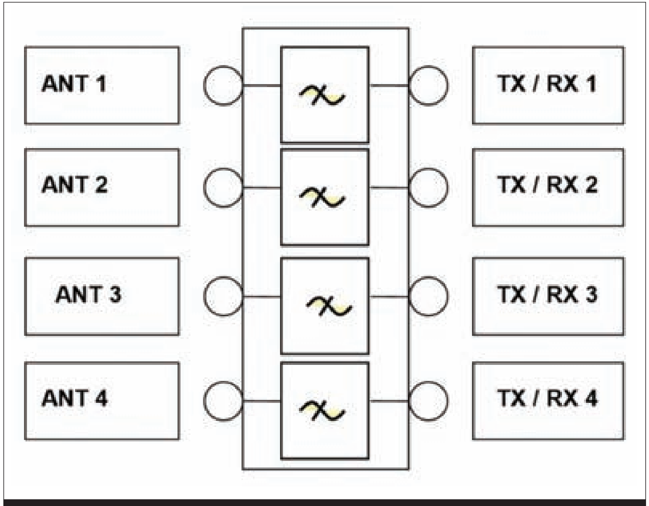


*Figure 2: Block diagram of quad bandstop filter*