LTE Filter for MRD/AG Receivers

Application Note

Sencore LTE Filter Kit:
AG-MRD-LTE-FILTER-OPT

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About Sencore

Sencore is an engineering leader in the development of high-quality signal transmission solutions for the broadcast, cable, satellite, IPTV, and telecommunications markets. The company's world-class portfolio includes video delivery products, system monitoring and analysis solutions, and test and measurement equipment, all designed to support system interoperability and backed by best-in-class customer support. Sencore products meet the rapidly changing needs of modern media by ensuring the efficient delivery of high-quality video from the source to the home. More information about Sencore is available at the company's website, www.sencore.com.

Revision History

Date	Version	Description	Author
08/20/2020	1.0	LTE Filter Application Note	GlenK

Table of Contents

Introduction

This application note describes the purpose and use of an LTE filter to mitigate the increasing potential of terrestrial digital TV reception issues caused by broadband mobile LTE signals. It describes the changes to the TV UHF receive spectrum as more UHF TV channels are transitioned to cellular services. It provides some understanding of the receive challenges it imposes on digital TV receivers. Finally, an introduction to an LTE filter and how to install it so as to mitigate these receive challenges.

TV VHF/UHF Spectrum and LTE Cellular Signals

There is increasing consumer demand for broadband mobile services. These demands have accelerated the growth of standards and reallocation of signal spectrum by the FCC to accommodate this demand. Mobile services standards have moved through several generations including 2G, 3G, 4G and now 5G implementations. LTE, standing for "Long-term Evolution" refers to an incremental path followed by the standards to achieve 4G speeds. LTE is commonly used as a global reference to all cellular services/signals as it is in this application note.

The FCC has incrementally moved TV UHF frequency spectrum to broadband mobile services. Recall, that up to 2009 television broadcasting was split between 3 bands, low VHF Channel 2-6, high VHF channels 7-13, and UHF channels 14 to 69. The UHF channels ranged from 470 MHz to 806 MHz. An initial FCC repack reduced the UHF TV channels from 470 MHz to 698 MHz reallocating frequencies above 700 MHz for LTE use. More recently, UHF TV channels 38 to 52 (600-700 MHz) where abandoned and reallocated also to mobile service providers for a new LTE network across the country. This implementation has UHF channel 36 as the highest TV channel for digital TV broadcast/reception. Channel 37 is not used or assigned for digital TV reception.

TV Receive Issues – LTE Interference

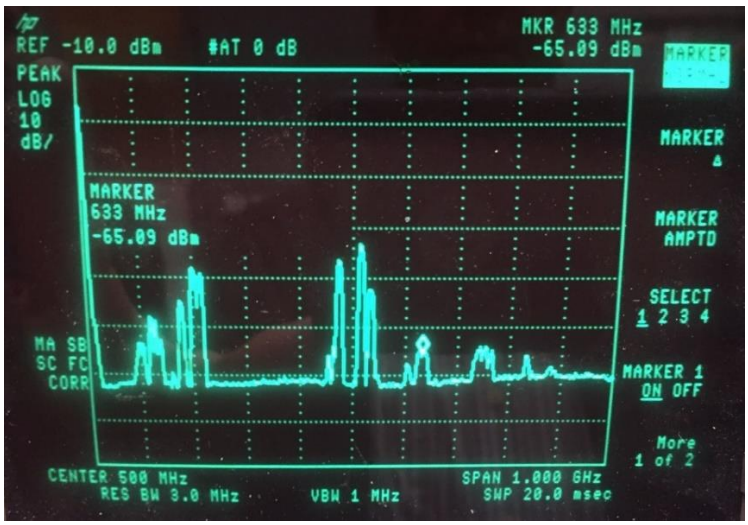
There are many complexities in understanding antennas, modern receivers, and distribution systems which are beyond the scope of this application note. This note provides only a summary so as to understand LTE interference and filtering.

First, consider that the same TV antennas used to receive UHF channels to channel 69 at 806 MHz in the past now does an excellent job receiving LTE signals from 600 to 800 MHz. More specifically, if the antenna has a UHF section with very short elements, it is a good LTE receive antenna. In many instances, the LTE transmitting towers are located at the same location as the receive antennas or only a few blocks away. This means

very strong LTE signals are picked up by the antenna and passed through distribution system amplifiers, signal dividers and onto the inputs of the digital TV receiver(s). Technically, these are considered out-of-band signals as they are above the normal desired UHF – TV receive frequency band.

The potentially strong signal pickup of these LTE signals by the antenna and the characteristics of these LTE signals make them especially troublesome with many digital receivers. Transmitted LTE signals are further described to output additional or maximum power peaks for several seconds when establishing connections.

LTE signals and their strength can be viewed by a spectrum analyzer. Notice on the spectrum analyzer screen below the marker (MKR) showing an LTE signal at 633 MHz and another (unmarked) is above it at 750 MHz.



A user may be thinking these signals are far above the digital TV channels they receive in their area or that they do not have any UHF channels. But modern digital TV tuners are much different than previous tuner technologies. First, they all commonly are designed to receive cable channels all the way to 1000 MHz passing them to the input circuitry. And, unlike past tuner technologies there is no separate tuner or tuner section in which an input filter routes the higher UHF/cable channels, making the VHF channels immune from the issue. The new solid-state chip tuners employ no input filtering permitting all the signals from 50 to 1000 MHz to pass to the tuner I.C.

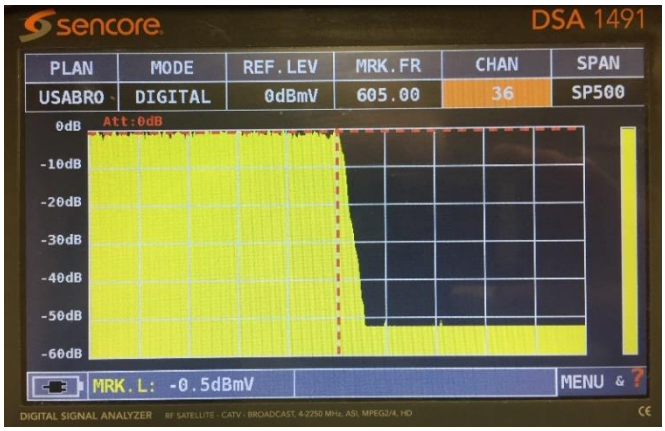
Also, solid state tuners have improved input sensitivity, meaning they can receive much weaker signals than previous designs. While this improves reception of weak signals, it increases the potential of strong out-of-band signals, such as LTE, FM radio, emergency radio, from negatively impacting the receiver. Depending on the number of out-of-band signals and their accumulative input levels, the receiver input can be overdriven causing

interruptions or loss of reception. These interruptions can vary in severity and frequency.

Understanding LTE Filters

An LTE filter can provide a solution to filter out unwanted LTE signals, mitigating their potential troublesome effects on digital TV receivers. An LTE filter is technically a low pass filter with a cutoff or roll-off starting near 605 MHz. A popular LTE filter is the Channel Master CM-3201. It permits all TV VHF and UHF frequencies up to channel 36 to pass through it with less than 1 dB of through signal loss. Channel 36 has about a 4 dB signal loss through the filter as its channel bandpass nears the roll off point of the filter. Attenuation of the filter to signals above 630 MHz are about 50 dB. More detailed specifications are available from the manufacturer.

The image below shows the CM-3201 LTE filter tested with a broadband noise generator and a Sencore DSA 1491 spectrum analyzer. Note the frequency roll off starting at the marker position for channel 36 at 605 MHz. Frequencies below this pass through the filter while frequencies above, include LTE, are blocked (attenuated 50 dB).

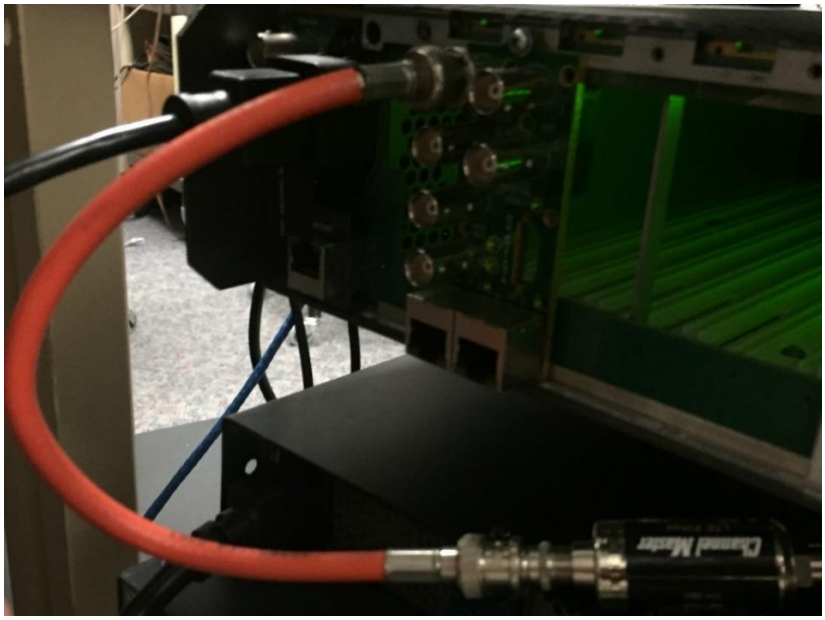


Sencore offers the CM-3201 LTE filter as a kit that provides versatility for installations with Sencore receiver/decoders. The kit includes the LTE filter, a short BNC cable, and a BNC to F adapter. The kit part number is: AG-MRD-LTE-FILTER-OPT

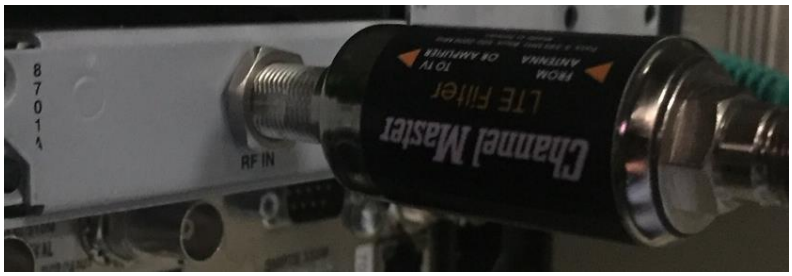
Installing an LTE Filter

Installation of an LTE filter is as simple as getting the filter in the signal path coming from the antenna to the receiver(s). The ideal or most efficient installation point would be on the antenna side or input to a distribution amplifier. Or if there is no amplifier, the input to the distribution splitter. This installation would be the most efficient, requiring the use of only one LTE filter. The less than 1 dB of insertion loss for all channels 2 to 35 should not be an issue at either insertion location. *Note: Be aware that channel 36 would have about 4 dB of insertion loss through the LTE filter.*

For Sencore AtlasGear frames with AG2600/4400/5800/6000 receiver cards, the RF input port is a BNC connector. The Sencore kit includes a short BNC cable as an option for installing LTE filter(s) as shown below. Connect the cable from the output side of the LTE filter to the cable and the other end of the cable to the RF input port as shown.



For Sencore MRD receiver/decoders/gateway products with an 8VSB receive card or capabilities, locate the RF input to the receiver. These products use a traditional F-connector. The LTE filter output side may be connected directly to the input F connector as shown below. Connect the signal input from the antenna to the input side of the LTE filter.



LTE Filters Do Not Solve All Receive Issues

This application note describes only one potential issue regarding digital TV reception and offers a solution. Other receive issues unrelated to LTE signals can cause poor or intermittent reception and will not be resolved by installing an LTE filter. A spectrum analyzer should be employed to monitor received signals in the 50 to 1000 MHz range to identify other out-of-band signals which may be impacting the receiver. A spectrum analyzer with a peak hold function is especially helpful. A common example would be FM radio signals in the 88-108 MHz band, just above TV channel 6. Emergency radio services have also been found in the past to cause intermittent receive issues.

All receive locations and antennas are unique and provide varying challenges. Digital TV reception and 8VSB modulation, is impacted by multi-path. An analyzing instrument, such as the Sencore SLM 1479 or DTU-236 with RFXpert software, can provide confirmation of acceptable signal receive levels and MER on each channel. Spectrum analyzer channel span views can show multipath as flatness variation and guide the needed antenna improvements.

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