

# Measuring Hum on a QAM Digital Carrier

## What is Hum?

Hum is a signal impairment which causes the amplitude of a modulated carrier to vary, typically at the powerline frequency or some multiple of the frequency. Hum is often caused by poor filtering in an amplifier's power supply. In an analog TV signal, hum causes horizontal lighter/darker bands in the picture. In a digital QAM signal, it can cause a low modulation error ratio (MER), and can raise the bit error ratio (BER) when the hum is severe, which will directly impact the subscribers' quality of experience.

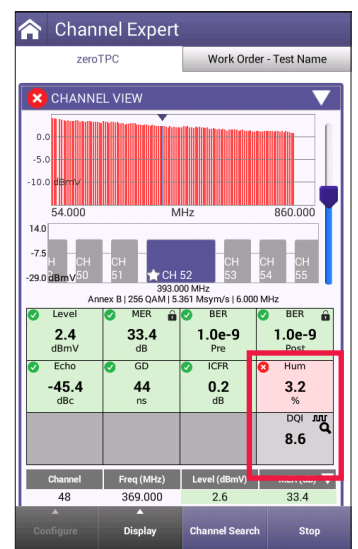
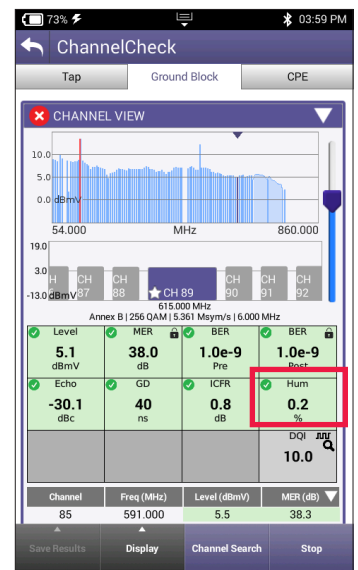
## How is Hum Measured?

The FCC mandates that TV signals have no more than 3% total hum<sup>1</sup>. Recognizing the challenge in measuring hum on a modulated analog video carrier, the FCC allows the hum measurement to be performed on an unmodulated analog video carrier. Such a measurement is not ideal because the unmodulated carrier takes some of the valuable downstream bandwidth. The unmodulated carrier method also fails to detect hum coming from a modulator.

## How Much Hum Is Too Much?

QAM demodulators used in cable modems and set-top boxes vary widely in their ability to cancel hum. They are designed to cancel at least 3% hum, the amount allowed by the FCC. They will typically operate to 5% hum without problems. If the hum reaches 7%, some demodulators will report a MER below 32 dB and will exhibit uncorrected bit errors. The presence of other types of impairments may also negatively impact a demodulator's capacity to deal with hum.

Users have found that a low DQI also indicates a customer impacting issue is present, in some cases before hum degrades to the point of crossing FCC limits. In these cases, DQI is more effective in showing that there is a problem than MER or BER degradation. More information on DQI can be found in this VIAMI application note: [http://www.viamisolutions.com/ProductLiterature/DQI\\_App\\_Note.pdf](http://www.viamisolutions.com/ProductLiterature/DQI_App_Note.pdf).



<sup>1</sup> The peak-to-peak variation in visual signal level caused by undesired low frequency disturbances (hum or repetitive transients) generated within the system, or by inadequate low frequency response, shall not exceed 3 percent of the visual signal level. Measurements made on a single channel using a single unmodulated carrier may be used to demonstrate compliance with this parameter at each test location. FCC regulations, Part 76, Section 76.605.

## Finding and Correcting Hum

When an amplifier's power supply begins to degrade and causes the amplifier to generate hum distortion, it generally affects all downstream frequencies. The hum cannot be filtered out by other devices. The hum can be detected on any channel, whether it is digital or analog, at any point downstream from the defective amplifier. A technician can isolate the problem by measuring at different points in the plant. Hum may also come from a bad modulator or edge QAM. Only the carrier(s) it generates will be affected. A technician can determine that the hum is not coming from an amplifier if only one channel or a small number of channels are affected.

For more information about digital hum and other OneExpert CATV capabilities, visit the OneExpert CATV product page on [www.viavisolutions.com](http://www.viavisolutions.com).



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