

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.¹ 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. Several CATV test meters, including the Viavi DSAM series, can measure hum on analog carriers. Very few can measure hum on a QAM carrier. In fact, the Viavi VSE-1100 is currently the only cable test instrument on the market that can accurately measure hum on any digital TV or DOCSIS signal.

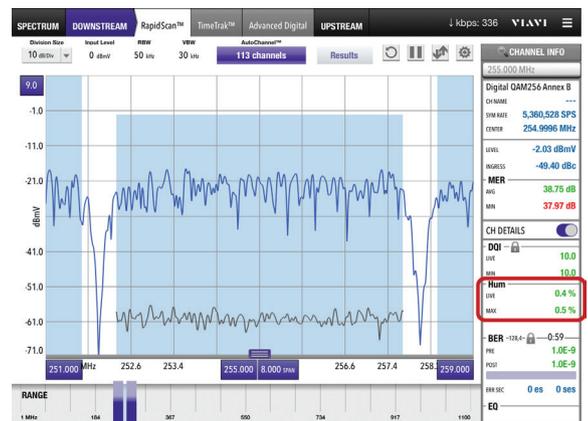


Figure 1. VSE-1100 measurement showing a good digital hum result

1. 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.

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 compound a demodulator's capacity to deal with hum.

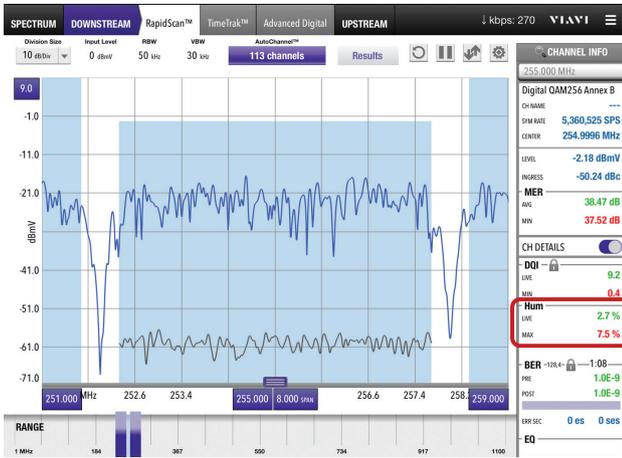


Figure 2. VSE-1100 measurement showing a borderline digital hum result

In Figure 2, the live digital hum value is just within the FCC guidance but the max value clearly shows that digital hum has exceeded the acceptable amount during the test. This is also reflected in the live and min digital quality index (DQI) result, indicating that the DQI measurement is capable of capturing the disruptions caused by hum where the MER only shows minor degradation and the BER hasn't registered it yet. The presence of 7.5% hum caused the DQI score to drop from 10.0 (a very clean signal) to 0.4 (very poor). DQI scores below 5.0 mean the impairment will impact service on some customer equipment. More information on DQI can be found in this Viavi application note: http://www.viavisolutions.com/ProductLiterature/DQI_App_Note.pdf.



Figure 3. VSE-1100 measurement showing excessive digital hum; both the live and max hum results show the QAM degradation (as well as the live and min DQI results).

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 VSE-1100 capabilities, visit the VSE-1100 product page on www.viavisolutions.com.



Contact Us **+1 844 GO VIAVI**
(+1 844 468 4284)

To reach the Viavi office nearest you,
visit viavisolutions.com/contacts.

© 2015 Viavi Solutions, Inc.
Product specifications and descriptions in this document are subject to change without notice.
vsehum-an-cab-nse-ae
30175923 900 0714