Understanding RF Spectrum Visual Guide

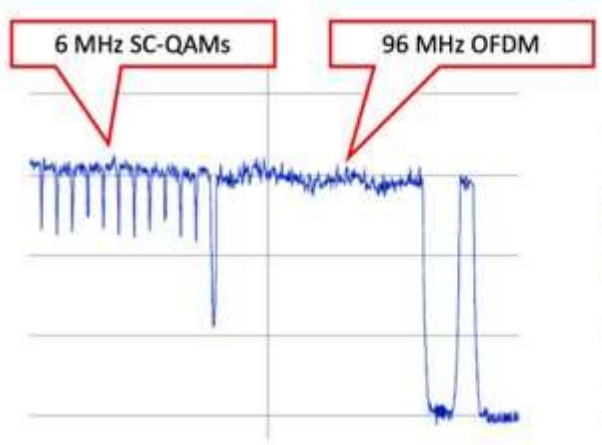
May 2022

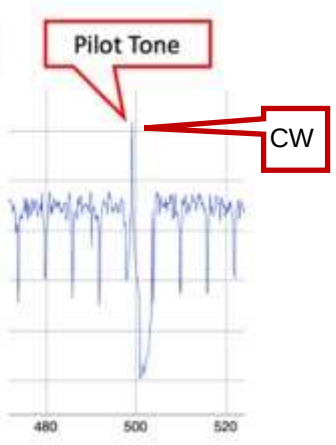
Larry Wolcott, Fellow, TPX NGAN Access Engineering
Mike O'Dell, Director, Network Maintenance

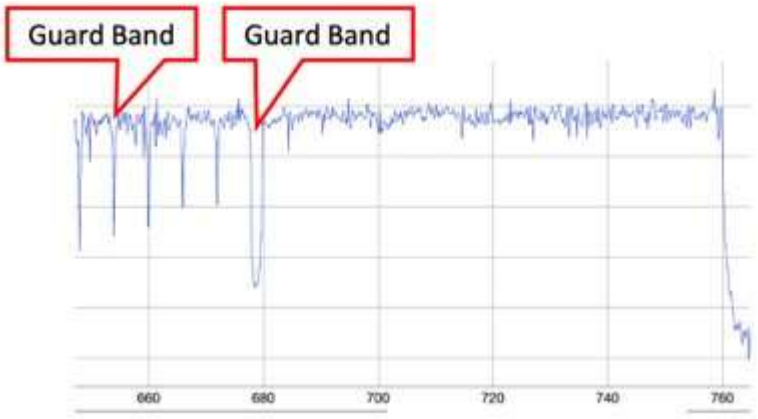
XPM NETWORK & HEADEND OPS

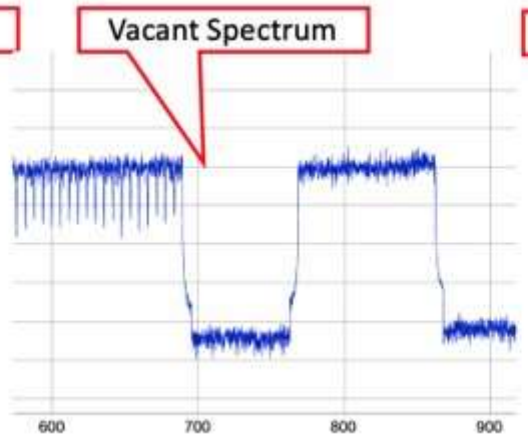
xfinity

Basic Things to Know About What Our Signal Looks Like



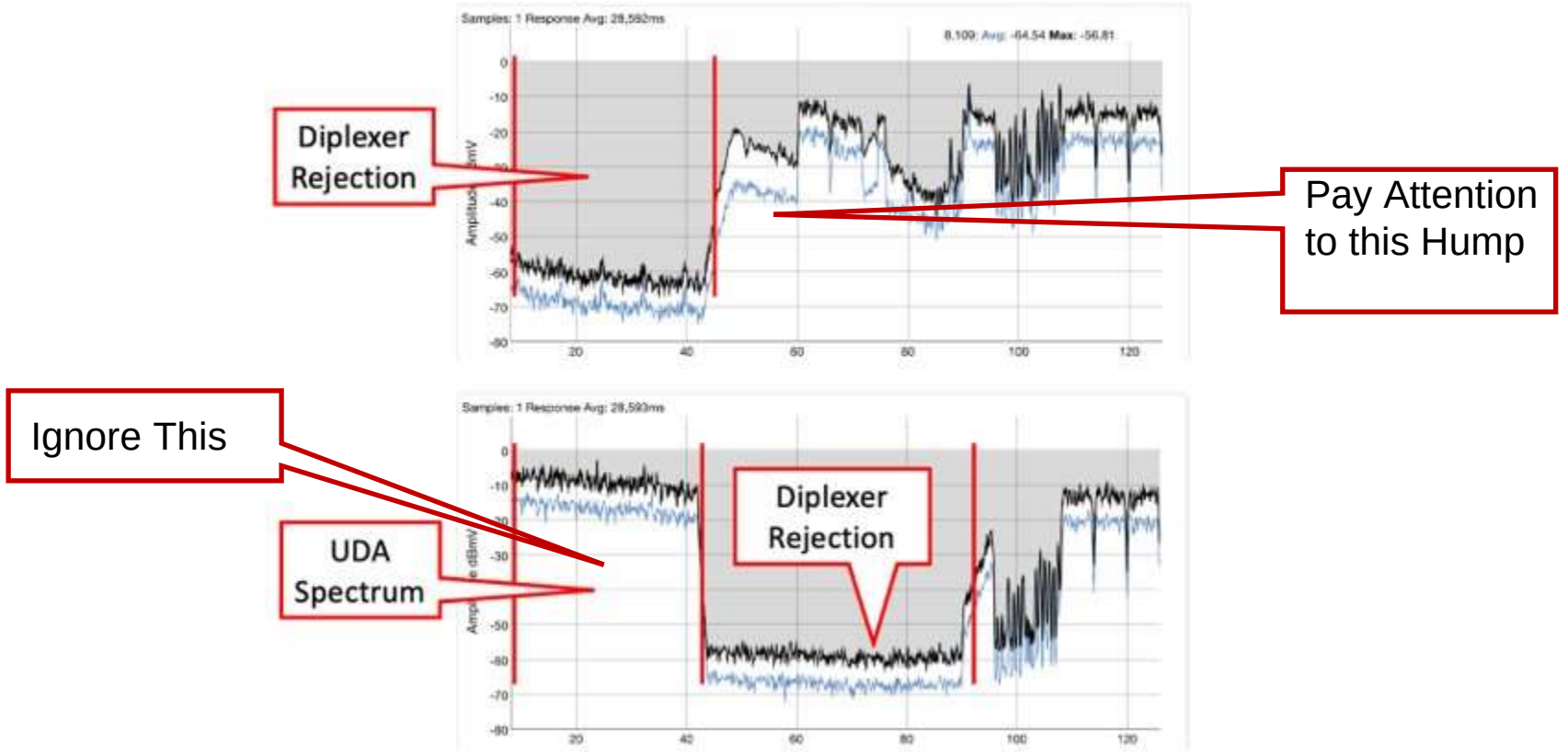






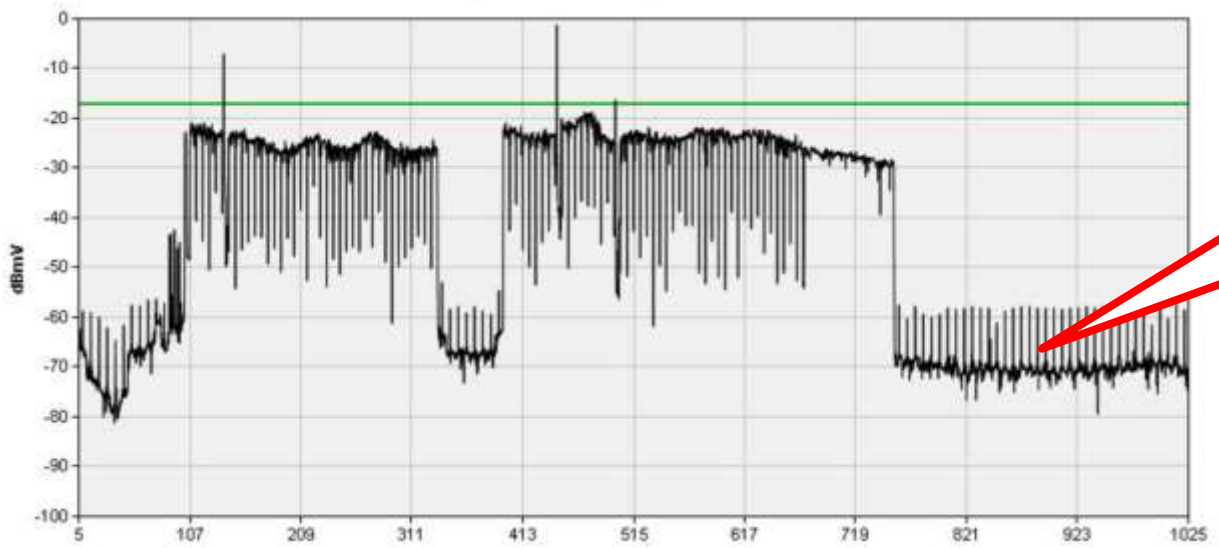
Other Things to Know About

UDA Spectrum is available on certain cable modems – Ignore it for now
Pay attention to large noise humps bleeding through the diplexer rejection band – these are noisy homes



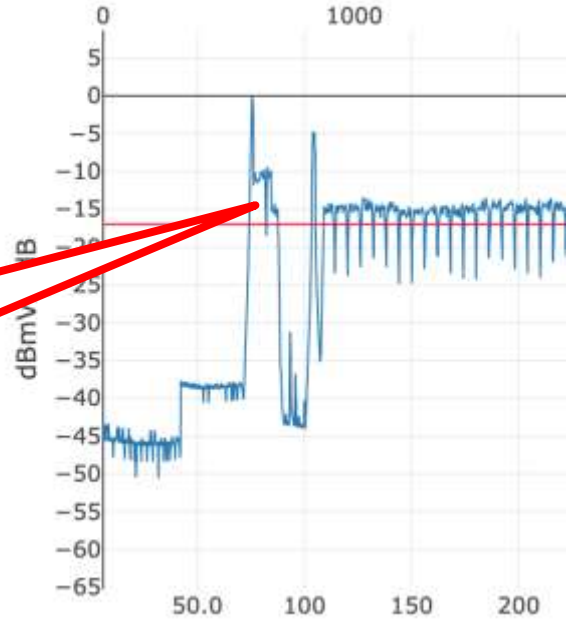
Even More Things to Know About

Some devices report spurs in the noise floor. These are not real. They are artifacts of the capture and stitching process. Some devices have switchable diplexers which also report a notch around 85 MHz. These are not real.



Artificial Noise Spurs

Switchable Diplexer Notch Artifact



The Last Thing You Need to Know About

Power on the Y-Axis is around -17 lower than reported channel power. This is because the resolution bandwidth of the spectrum analyzer is different than the channel power (6 MHz).

-17 dBmV on the spectrum chart is equivalent to 0 dBmV channel power.
The line on the chart at -17 dBmV is a visual reference to 0 dBmV channel power.

Device Health										
Registration State	6 (Online)									
Down Rx Power	0	-0.7	0.5	-0.4	0.5	-0.2	0	-0.2	0.5	0.2
Downstream SNR	38.6	38.9	38.9	38.9	38.6	38.6	38.6	38.9	38.6	38.9

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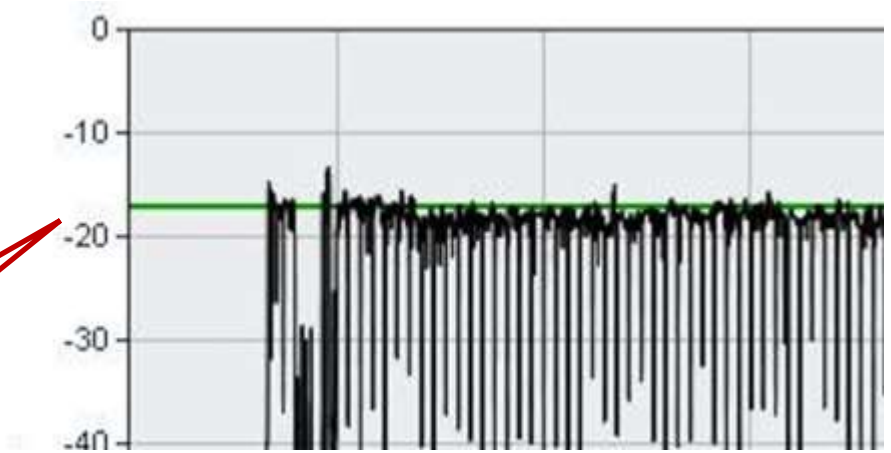
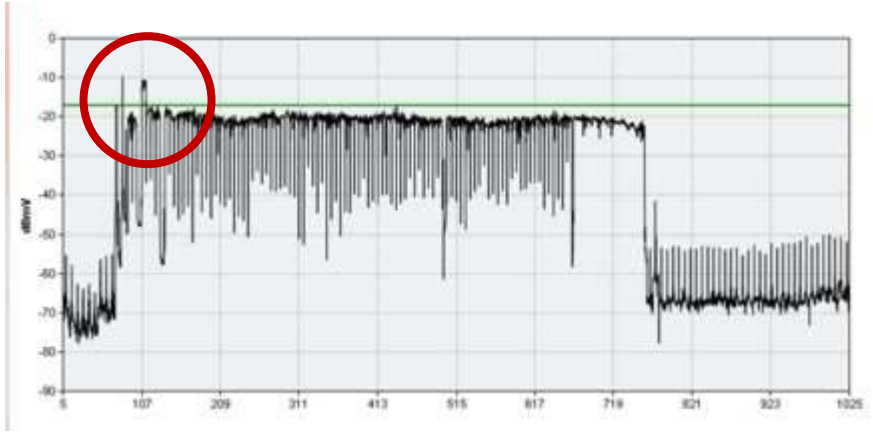
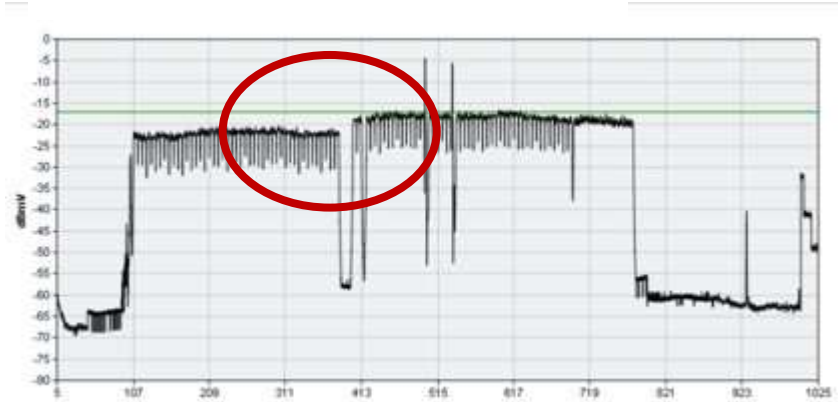


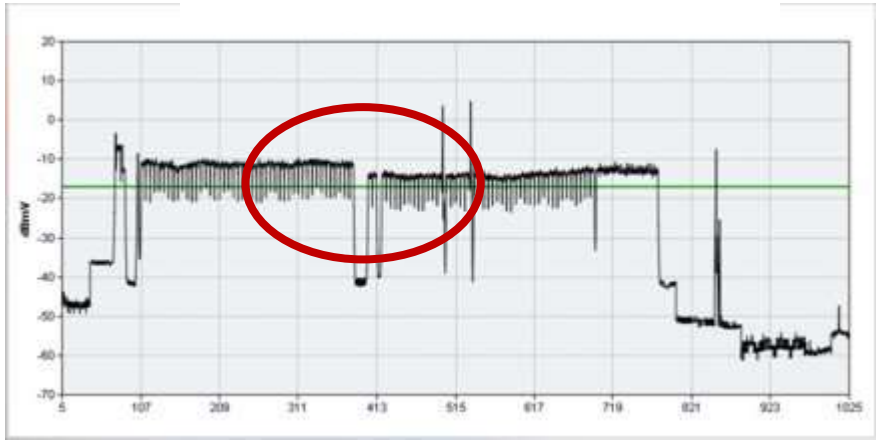
-17 dBmV here
equals **0 dBmV** channel power
(above)

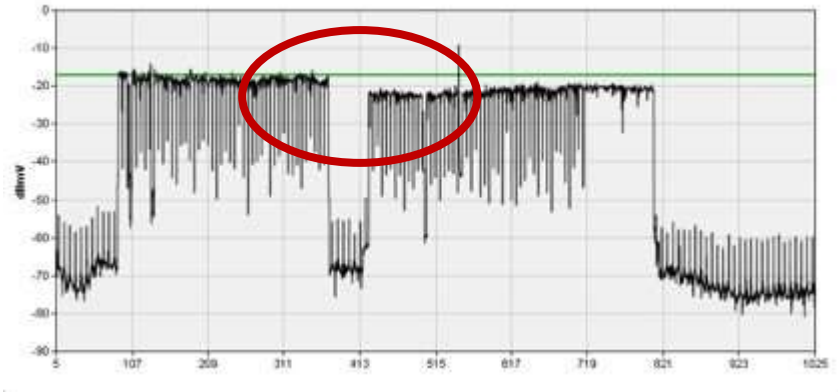
Adjacent Channel Alignment

One or more channels or blocks of channels that are combined at improper power levels.
This is almost always a HE problem but there are cases where it is caused by local insertion (MDUs, bulk properties, etc.)



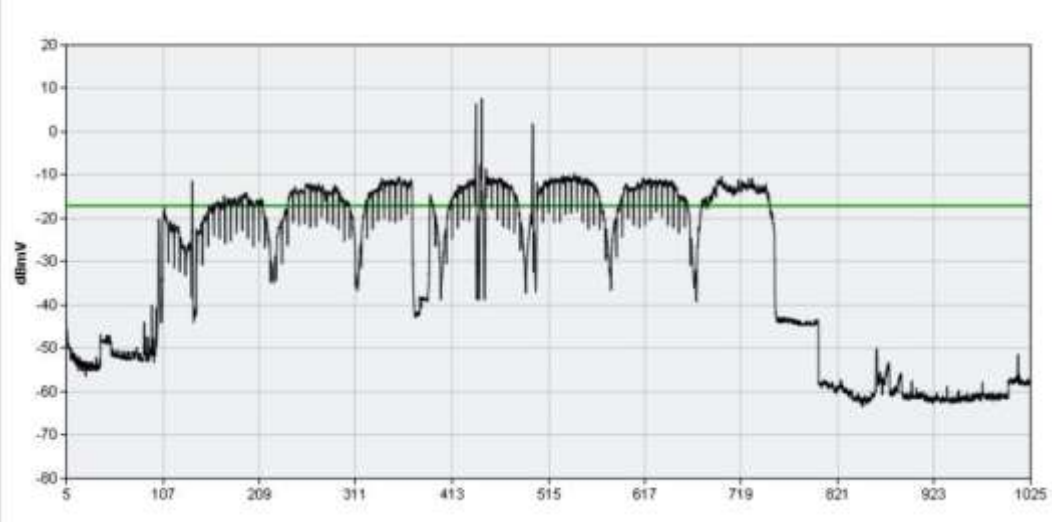


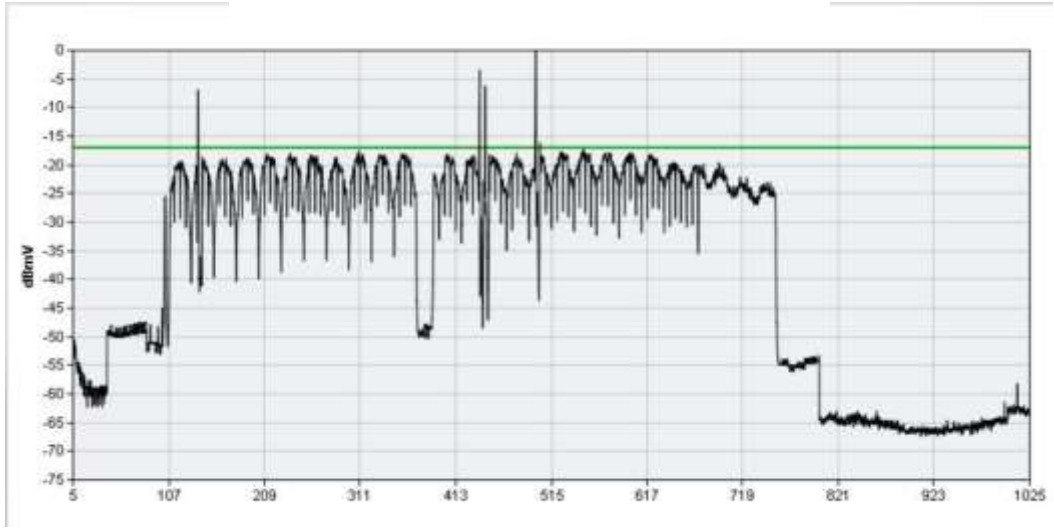


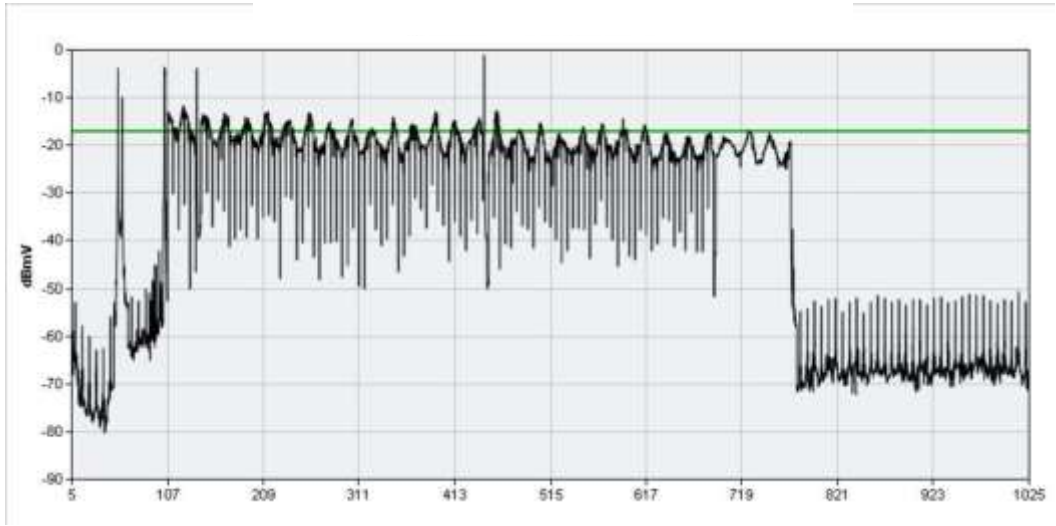


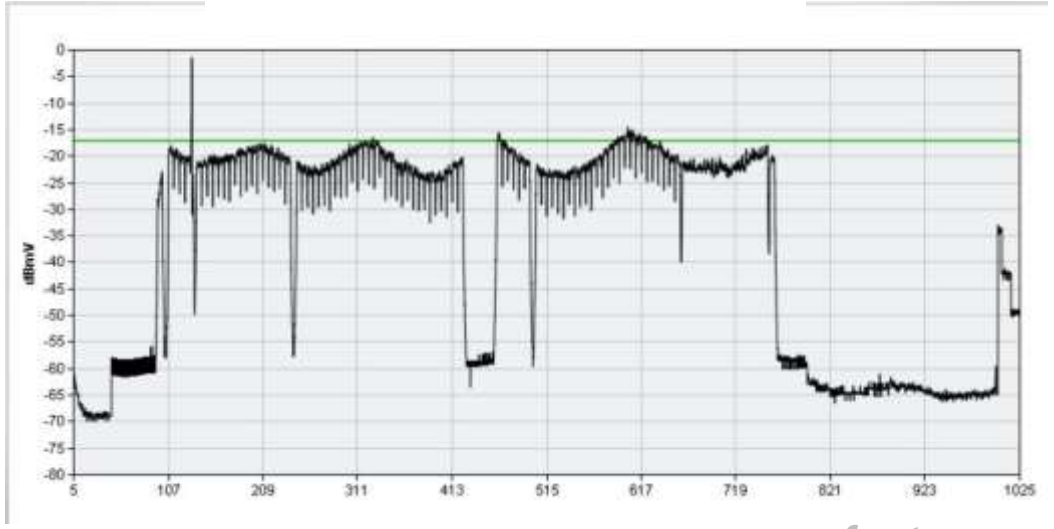
Standing Wave (Simple)

Periodic (repeating frequency) waves or ripples cause by impedance mismatches on the cable system



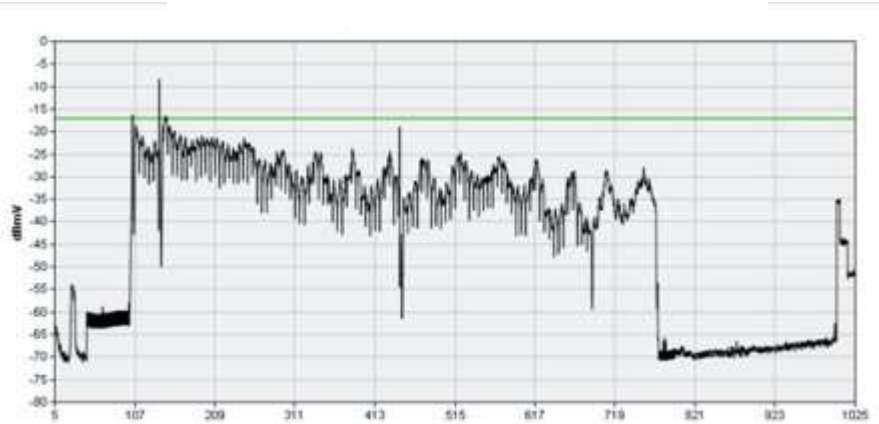


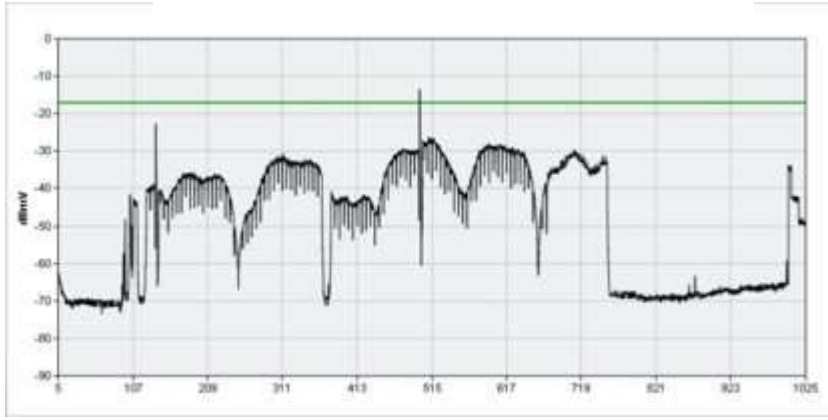


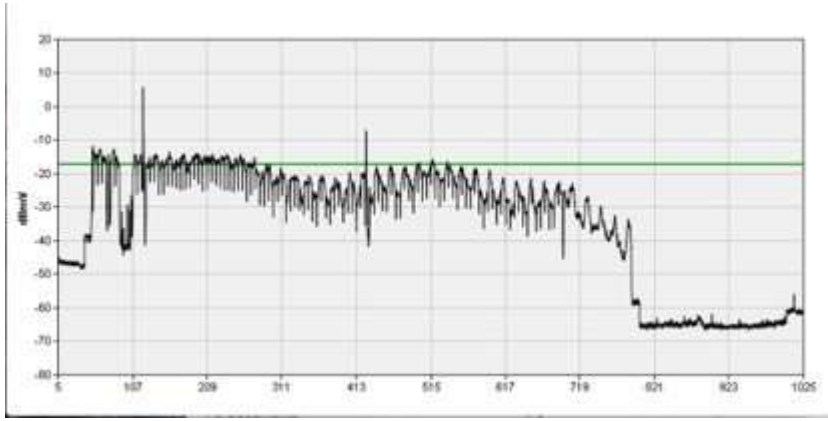


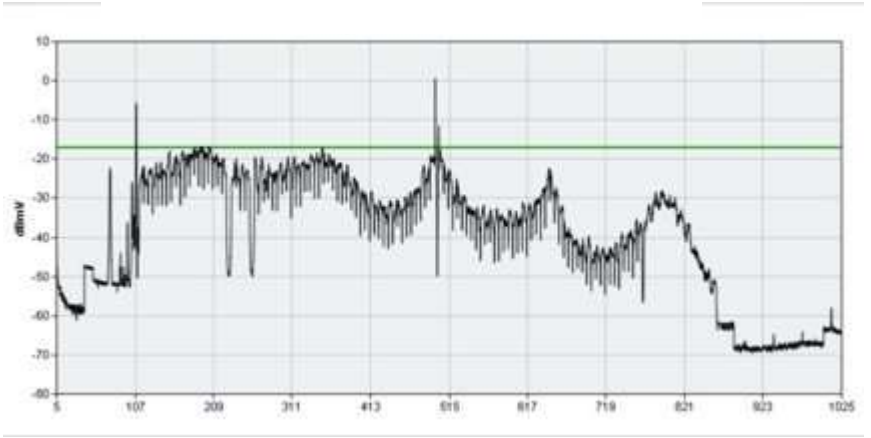
Standing Wave (Compound)

Multiple standing waves which are superimposed, caused by more than 1 standing wave being “mixed” with another



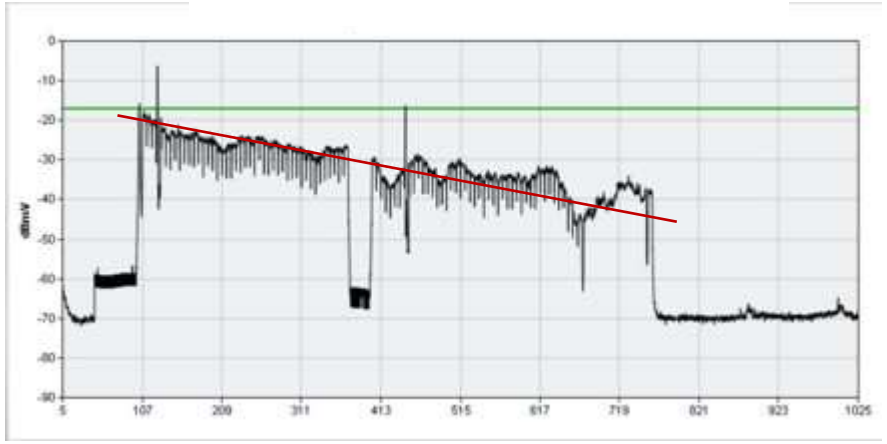


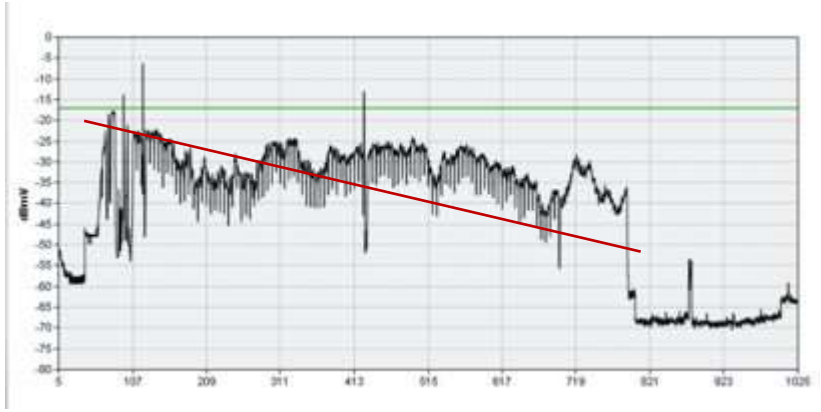




Water Wave (Drop Cables)

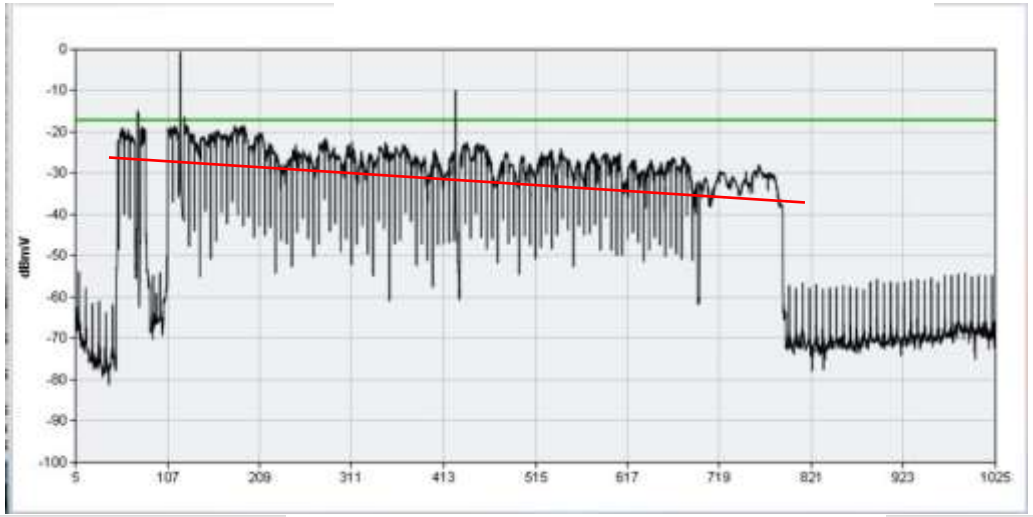
Non-periodic standing waves, caused by water presence in cables. High-frequency pockets of attenuation and sometimes large tilt are common in drop cables. Hardline cables will look slightly different.

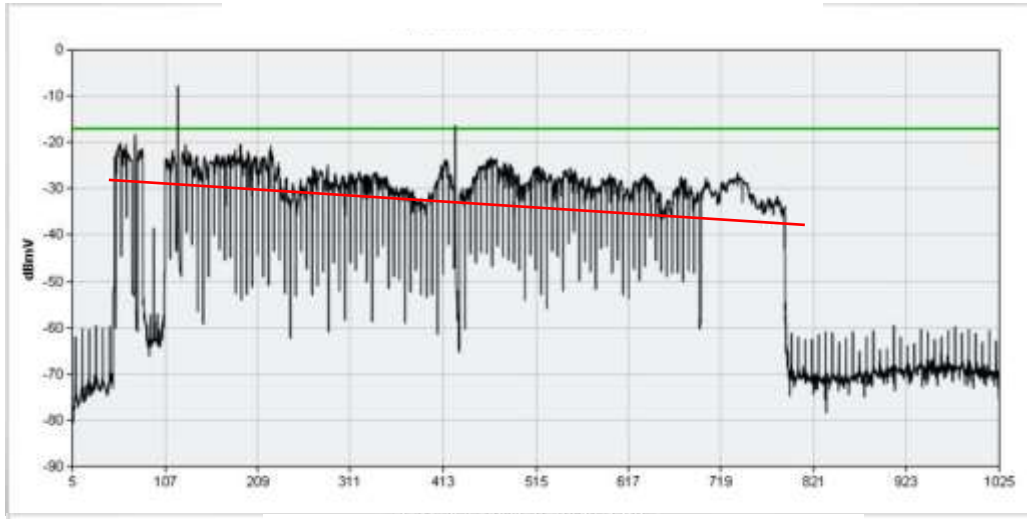


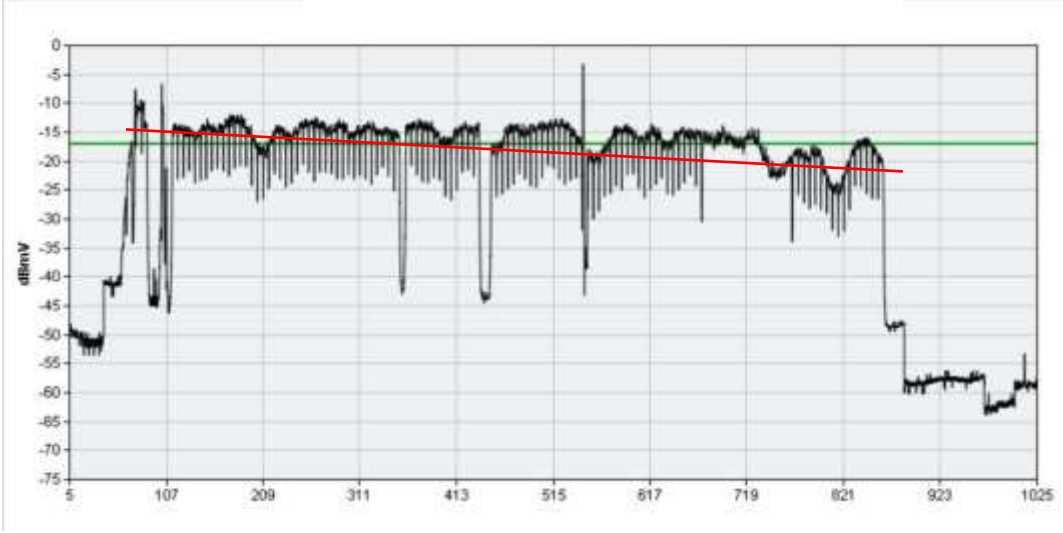


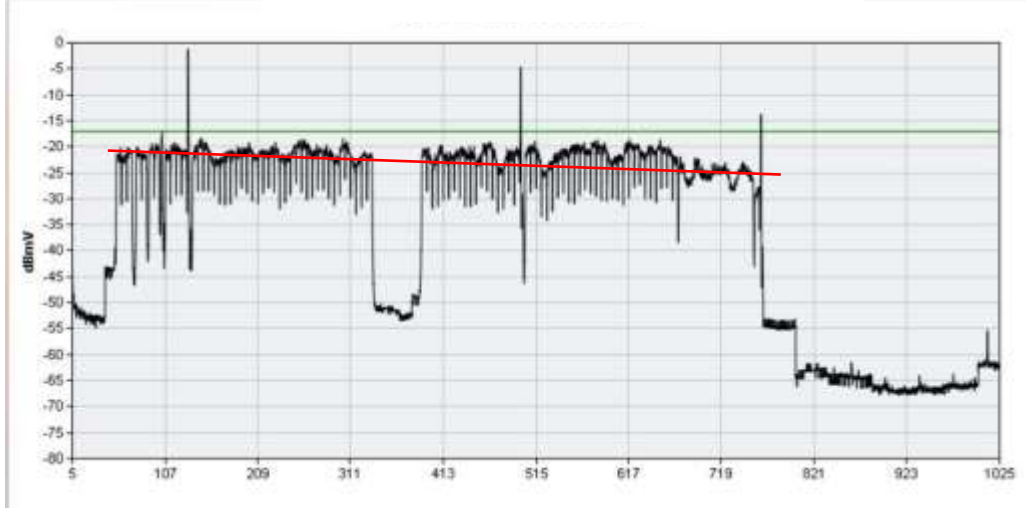
Water Wave (Hardline Cables)

Non-periodic standing waves, caused by water presence in hardline cables. Usually, less tilt and smaller pockets of attenuation in hardline cables.



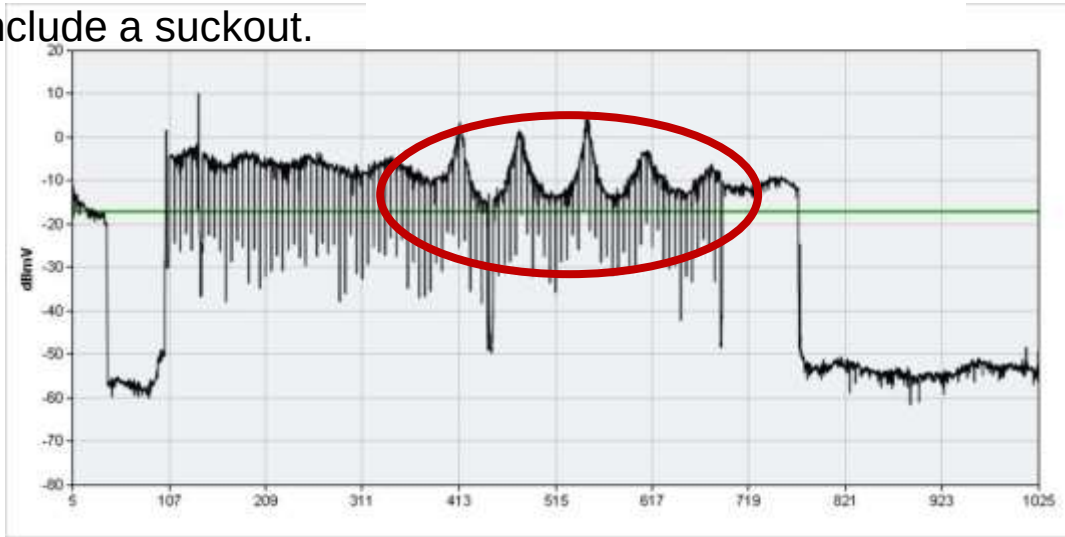


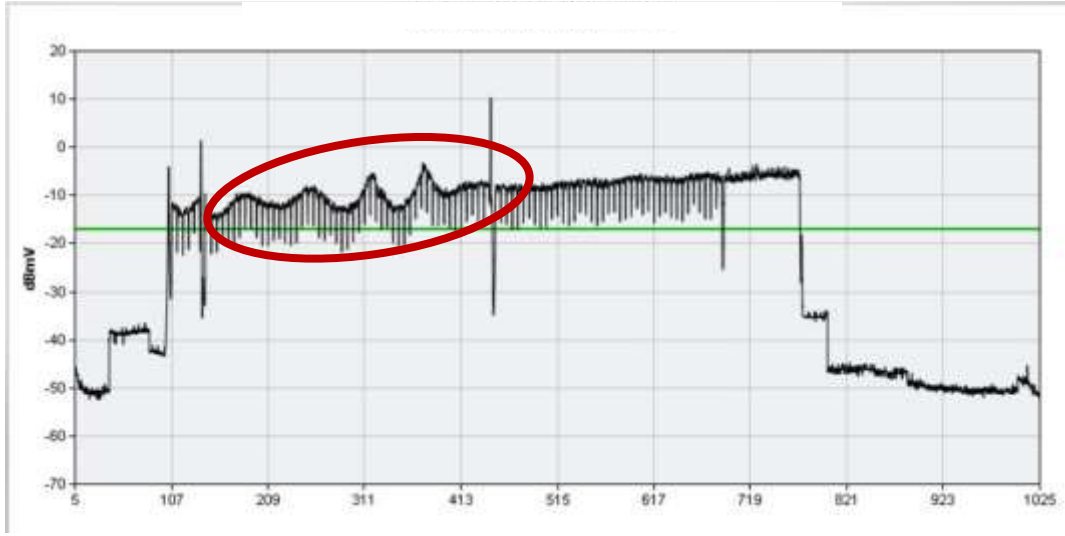


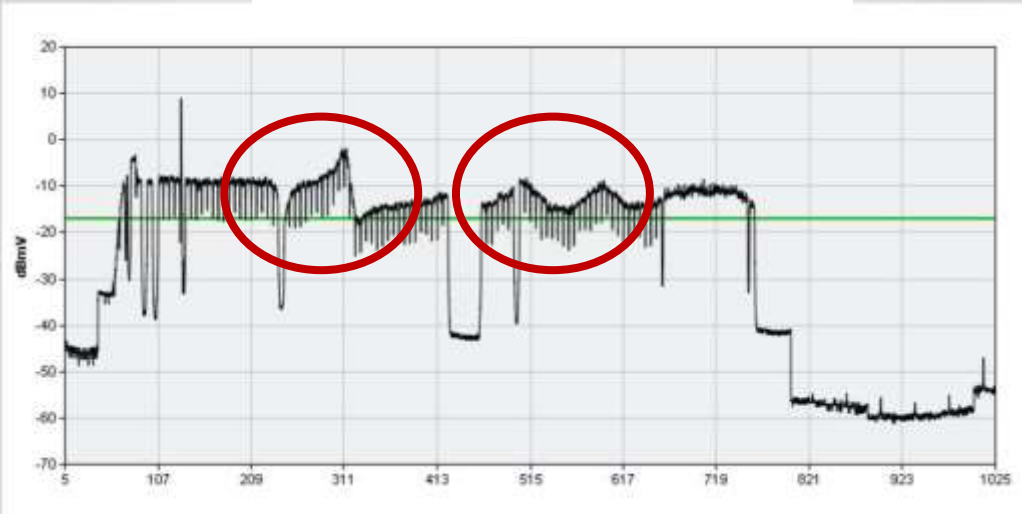


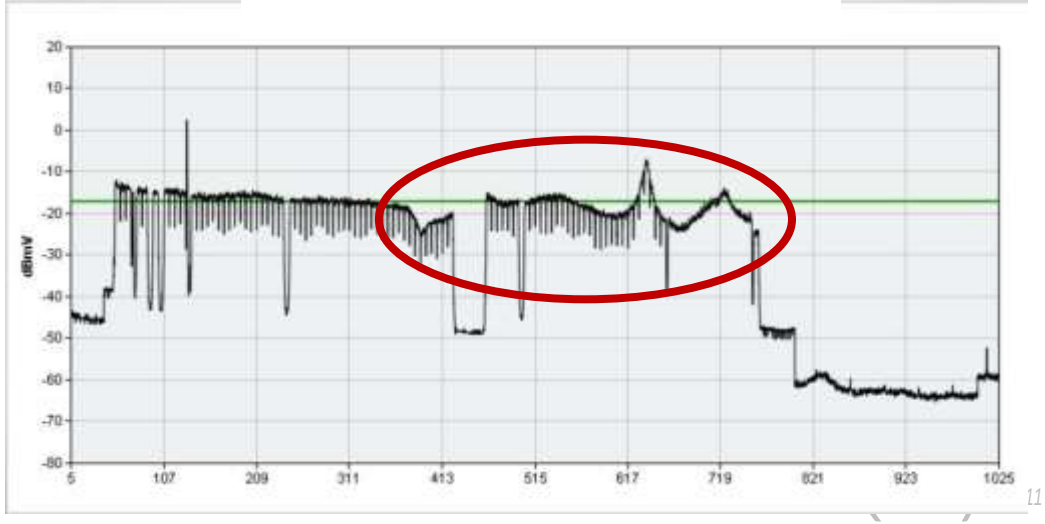
Resonant Peaking

Frequency specific gain, caused by grounding problems in actives. Usually amplifier module seating, oxidization and/or loose screws. Different equipment types are illustrated below. Peaks can move frequencies and sometimes include a suckout.



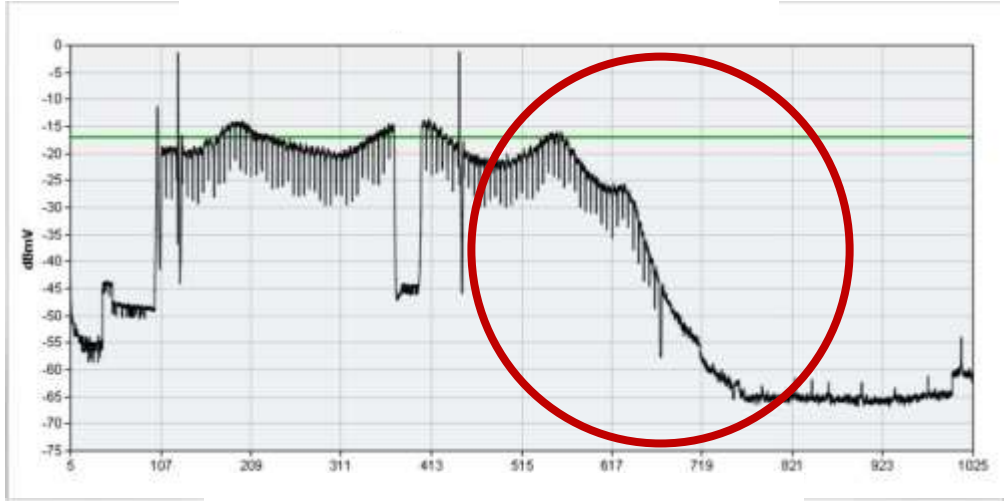


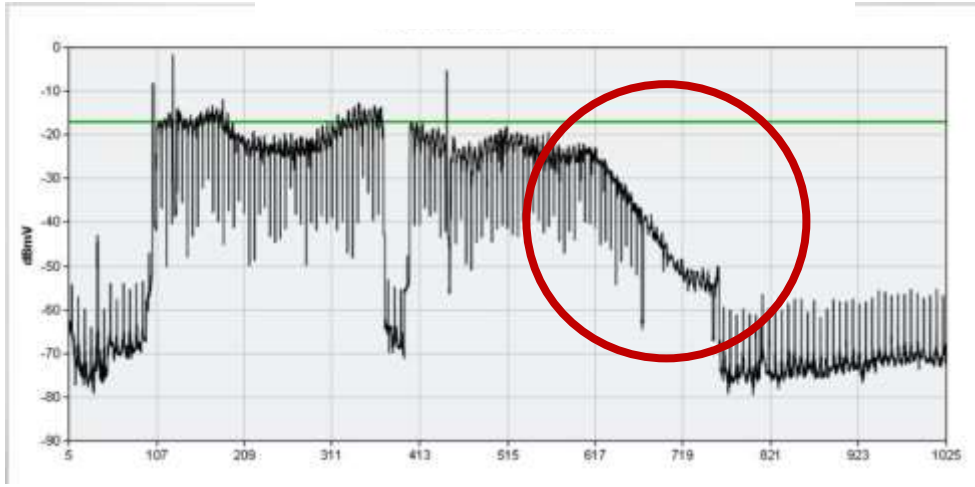


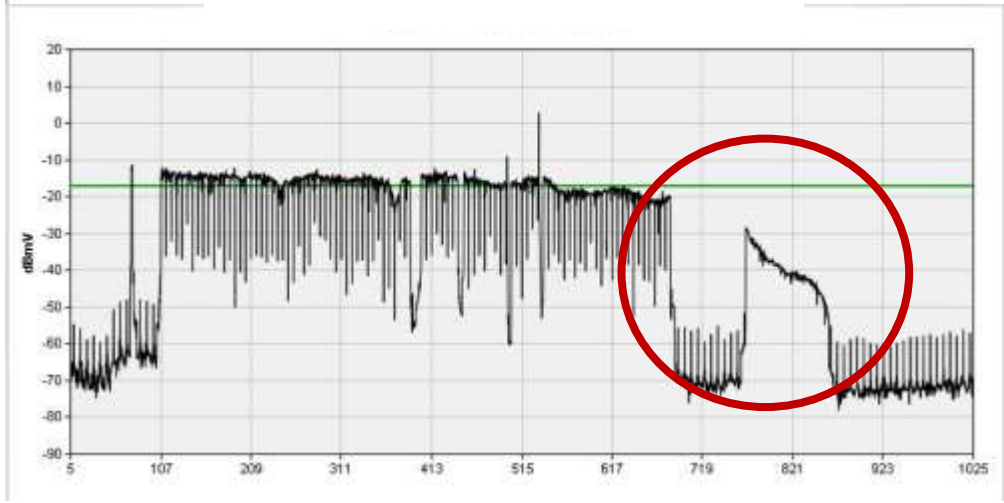


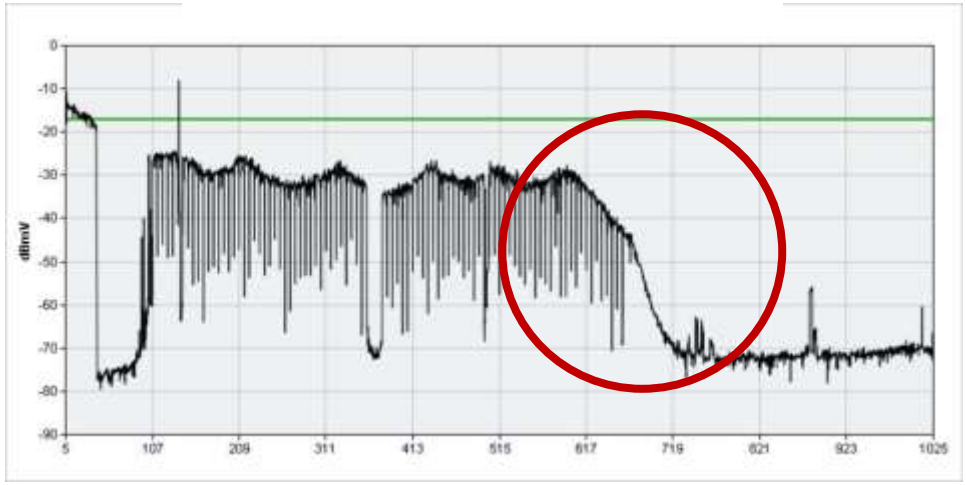
Rolloff (High Frequency)

Most commonly caused by water-soaked passive network elements. Often found with water damaged cables or devices, caused by water migration through the cable. *Remember: "high frequencies can't swim"*



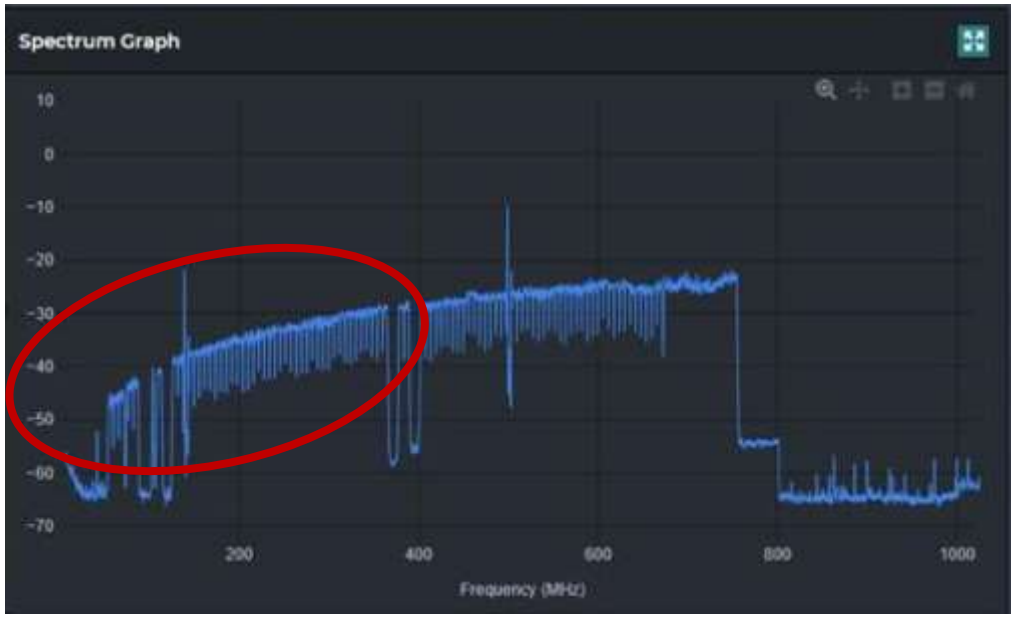


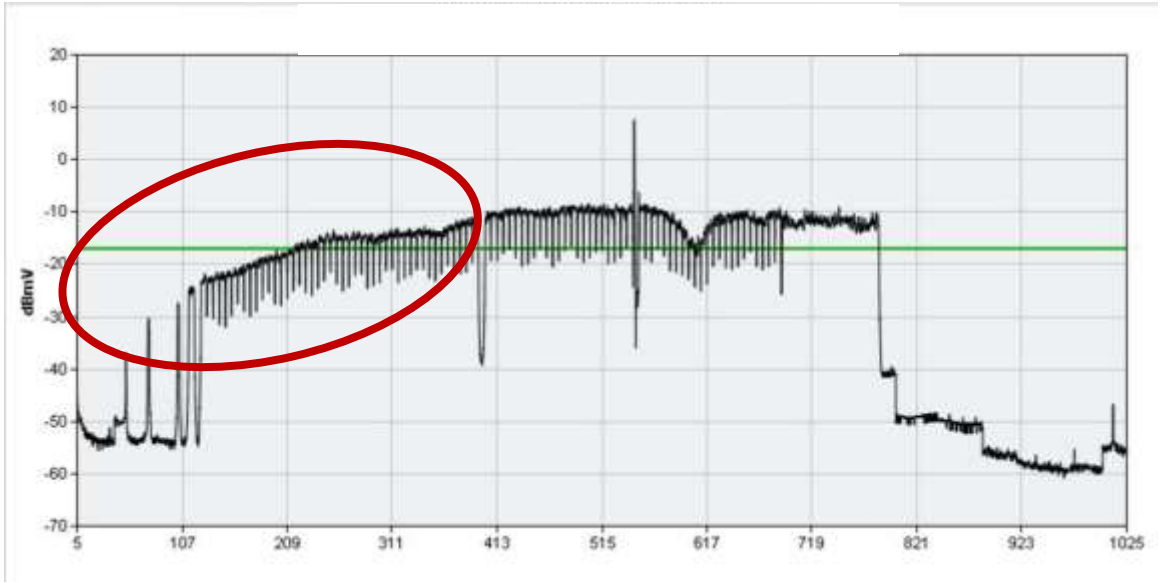




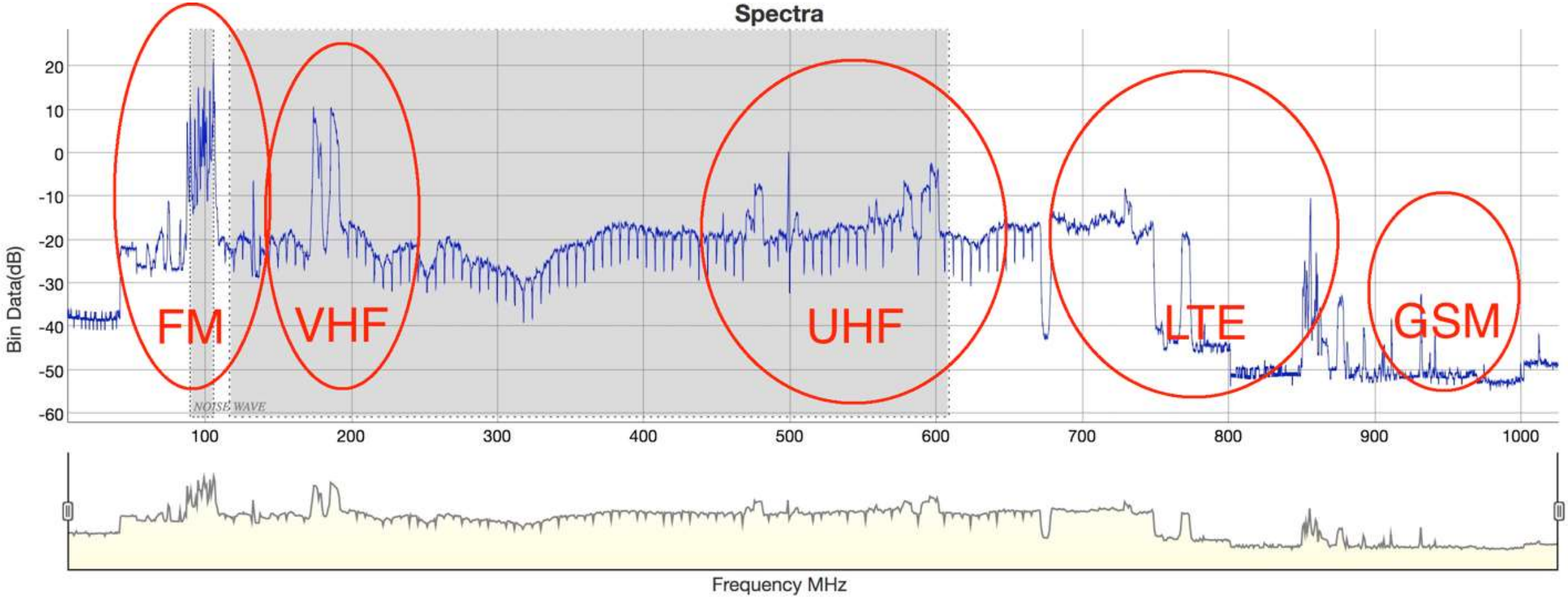
Pullout / Rolloff (Low Frequency)

Typically caused by physical separation of shielding on hard line (aka. pullout or sucked out connector).
Remember: “low frequencies can’t jump”



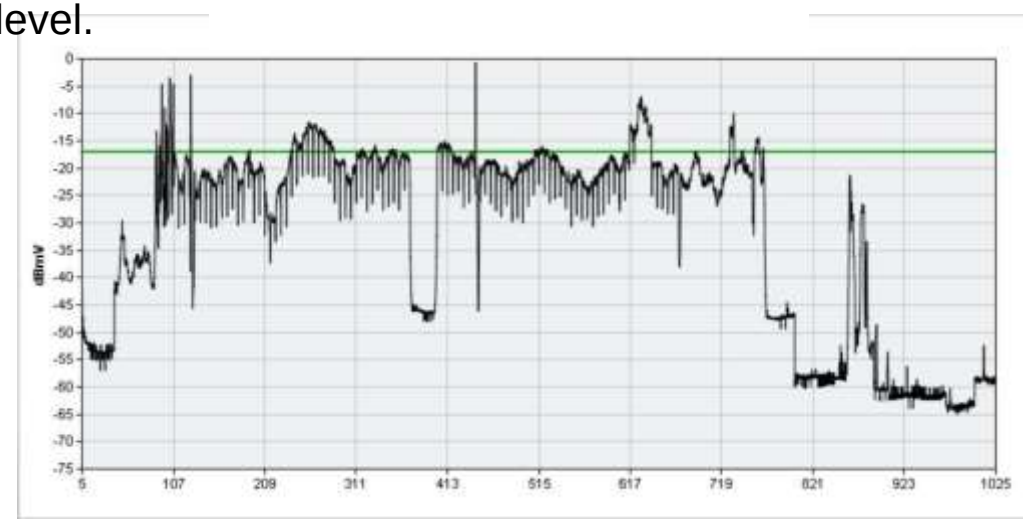


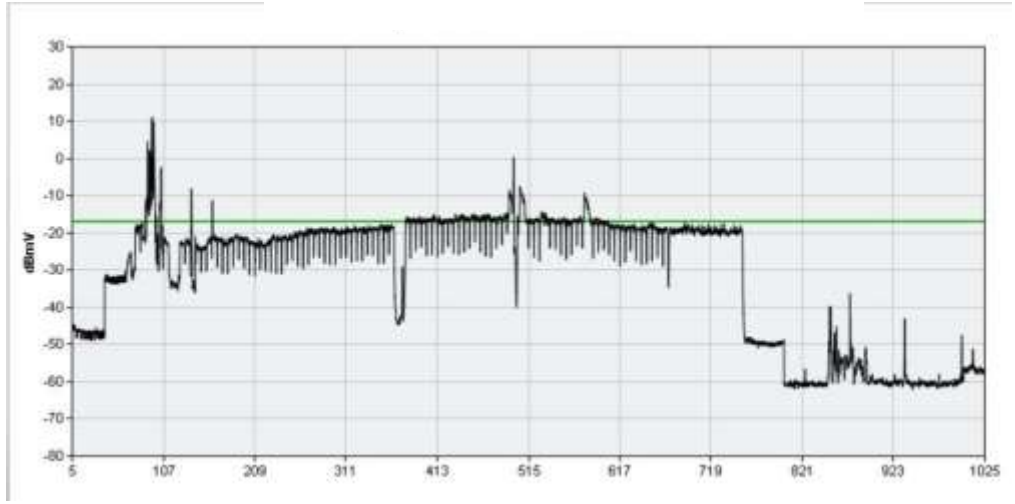
Common Ingress Types

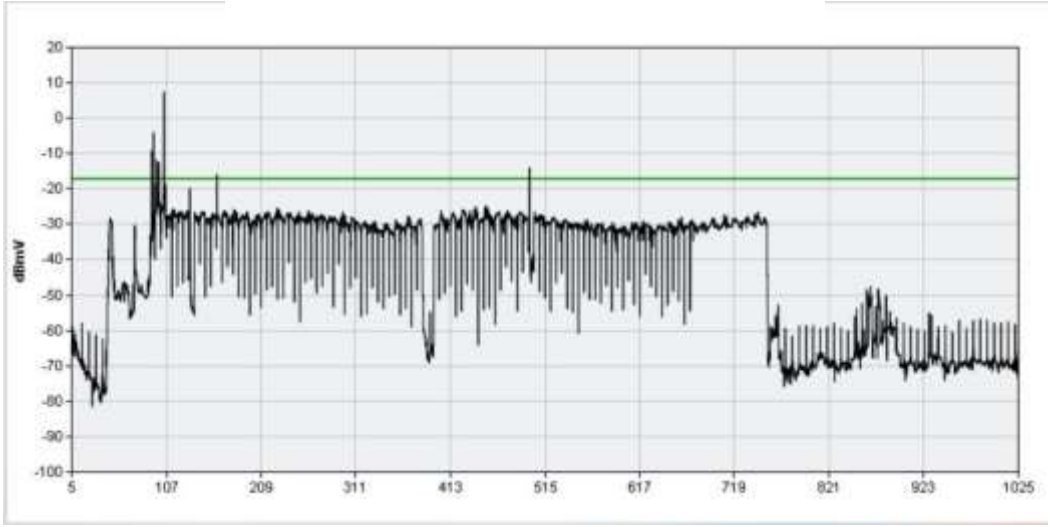


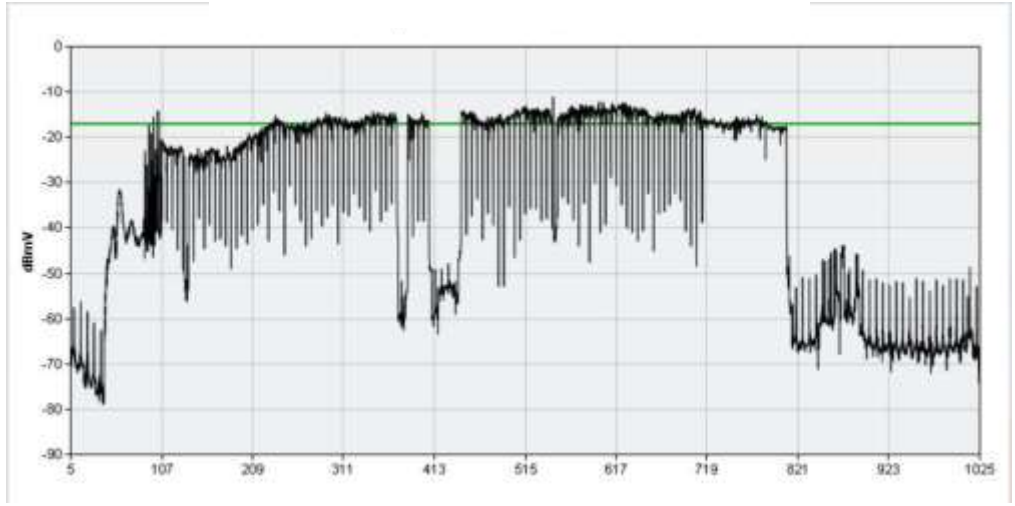
Wideband Ingress

Ingress across the full spectrum. Usually accompanied by high-energy FM relative to the downstream carrier power level.



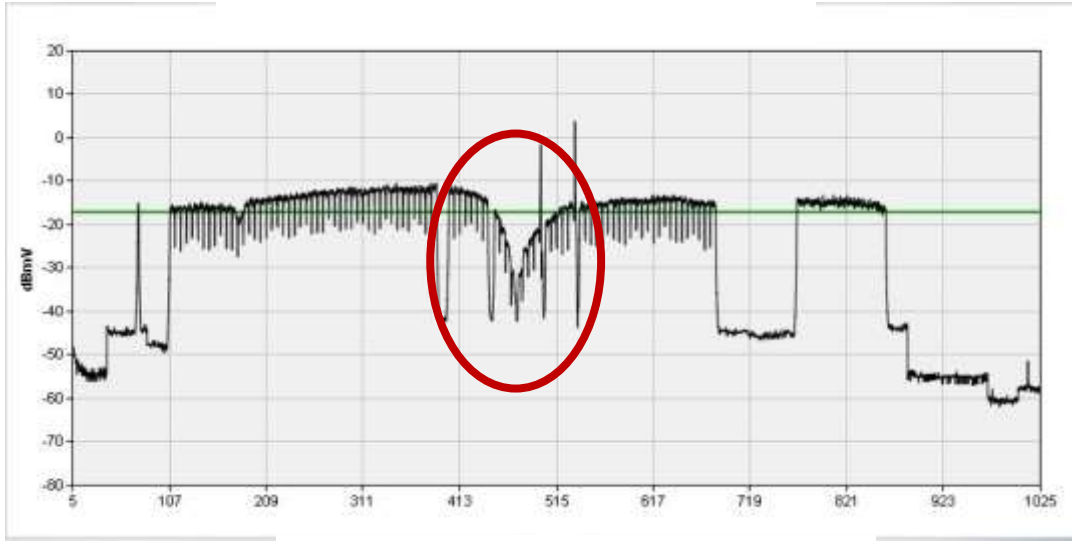


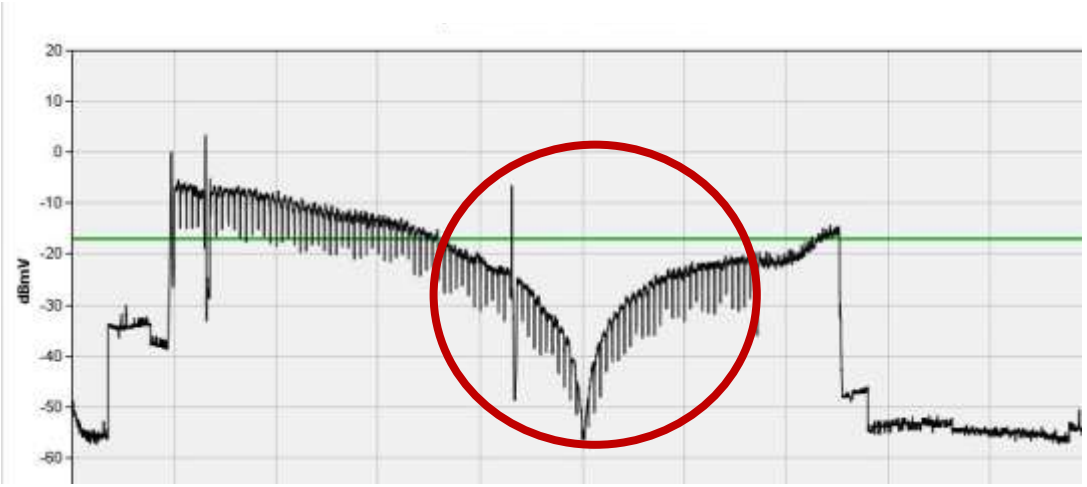


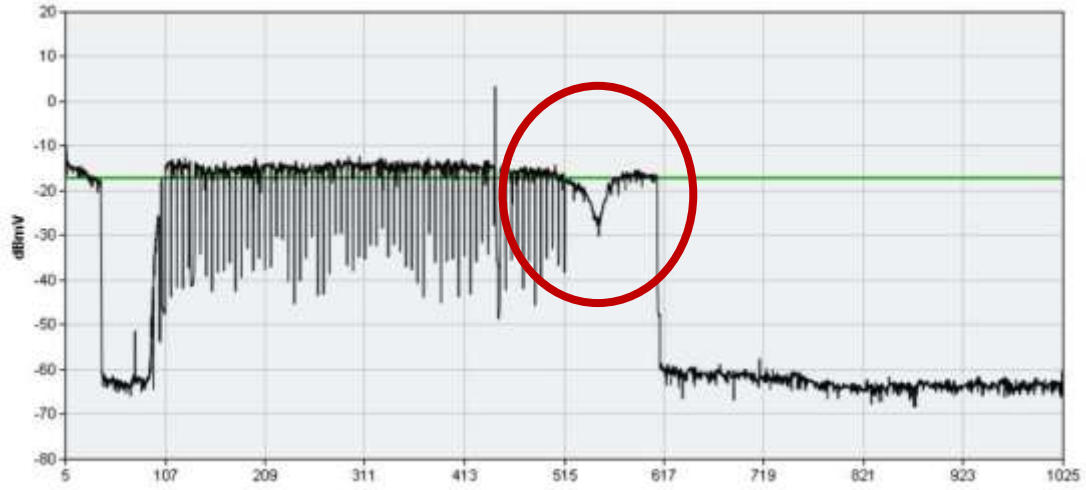


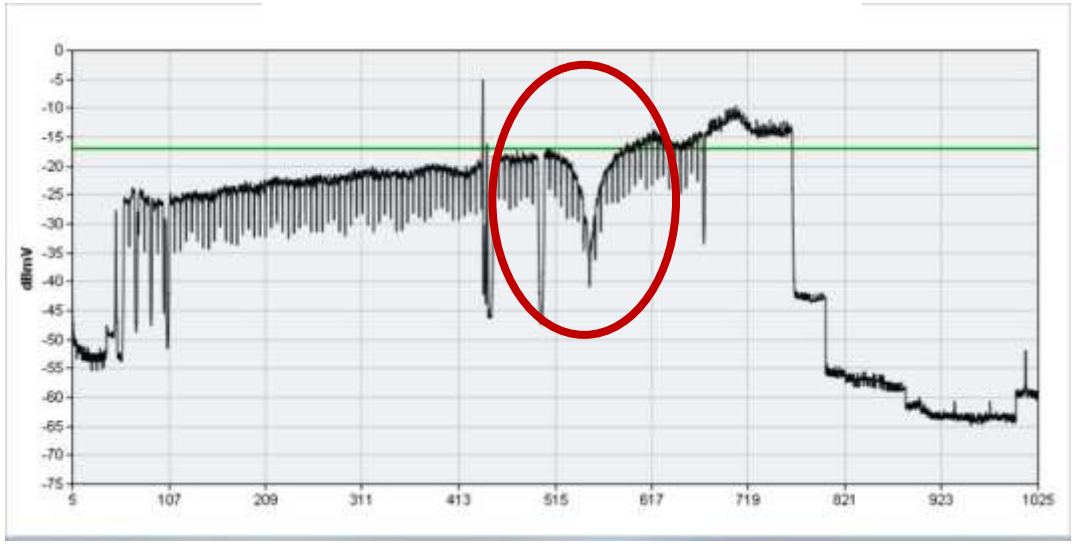
Suckout

Caused by impedance mismatches in the cable plant. A suckout is a half-period of a really long standing wave, caused by a very short reflection (less than 8 inches).



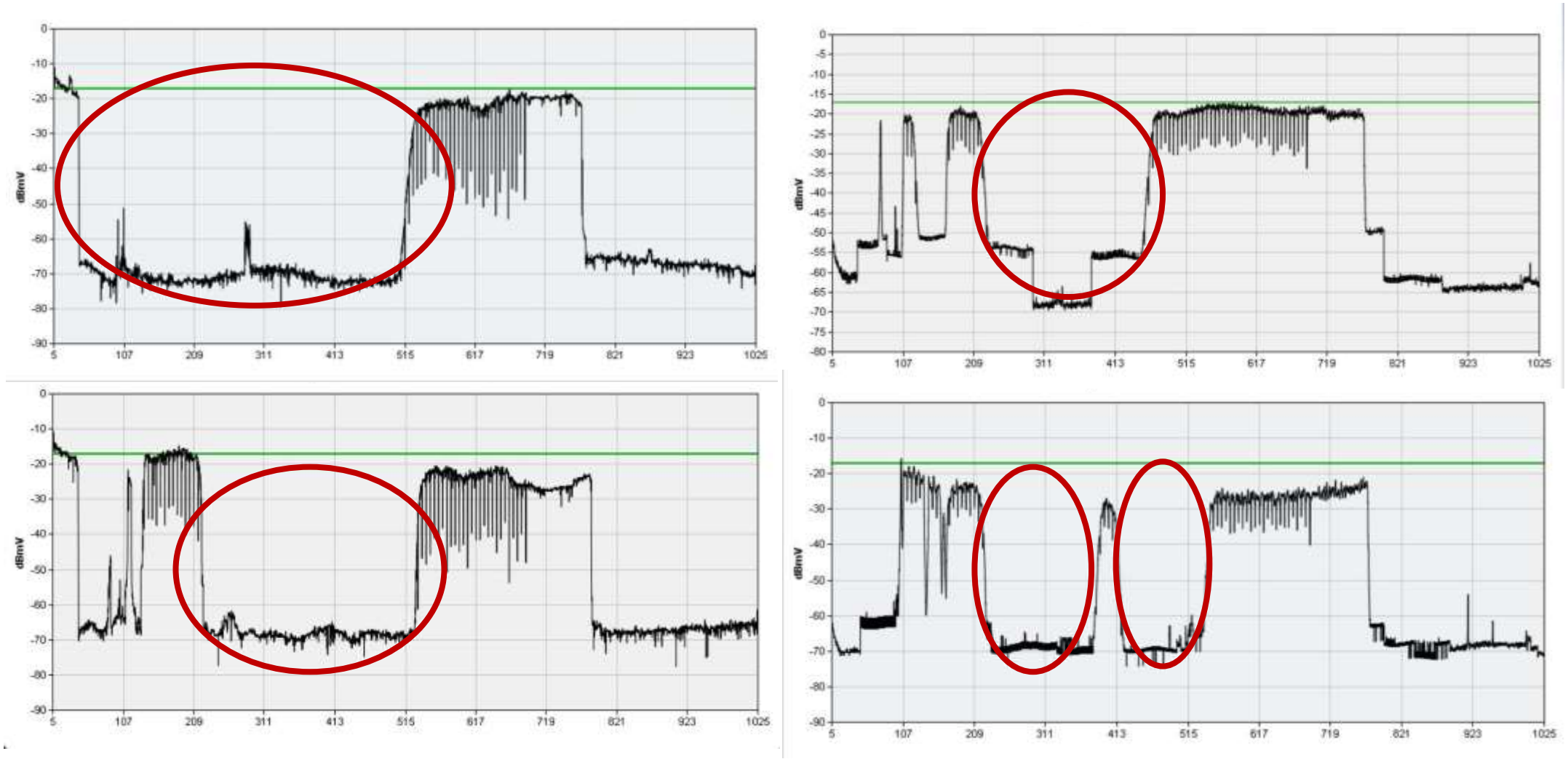






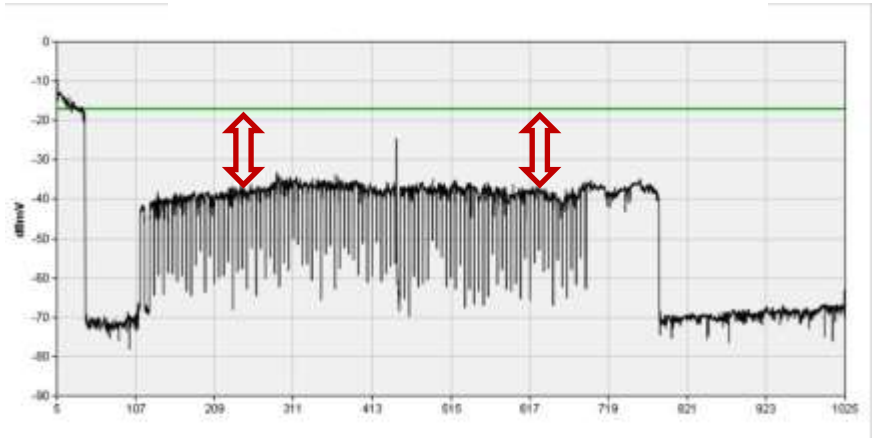
Video Traps / Missing Channels

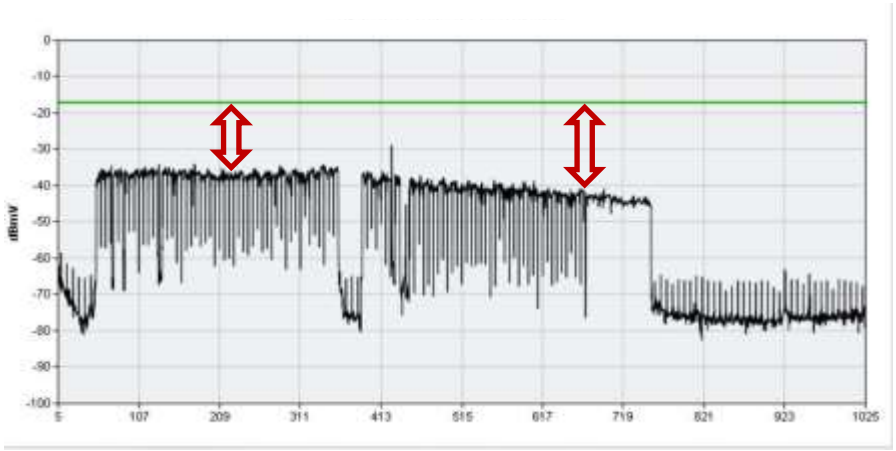
Caused by filters, which were used in the past but should have been removed.

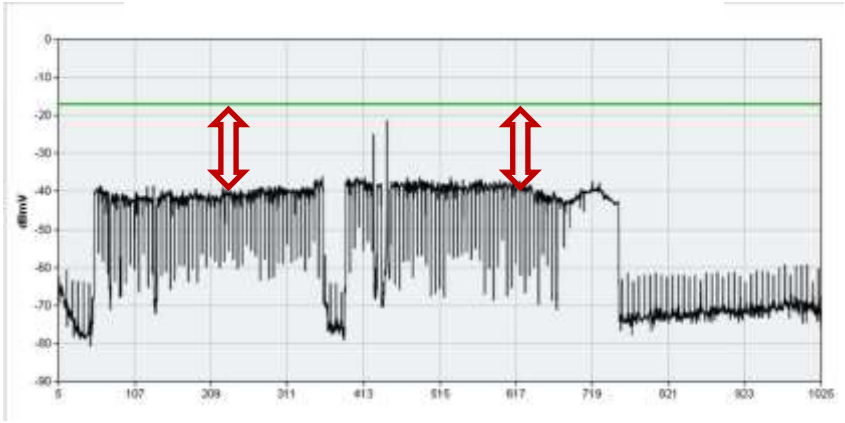


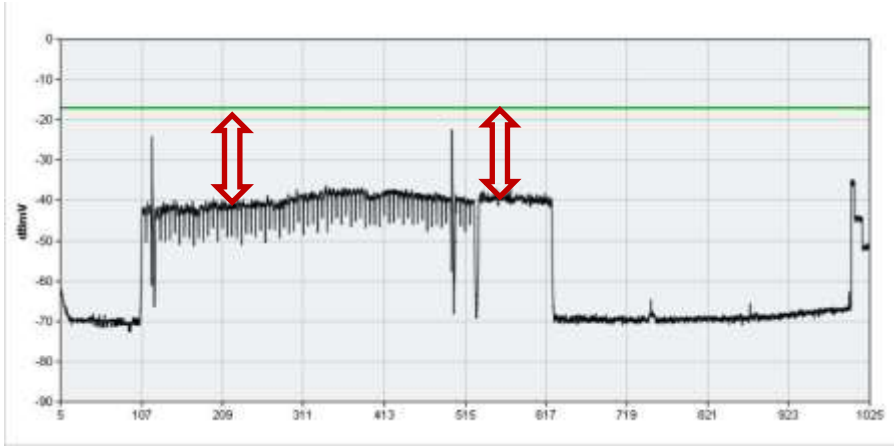
Flat Loss

Caused by excessive attenuation, **not associated to plain-old cable loss or tilt.** Usually, excessive splits or padding. Notice low signal levels compared to 0 dBmV channel power indicated by the green reference line.



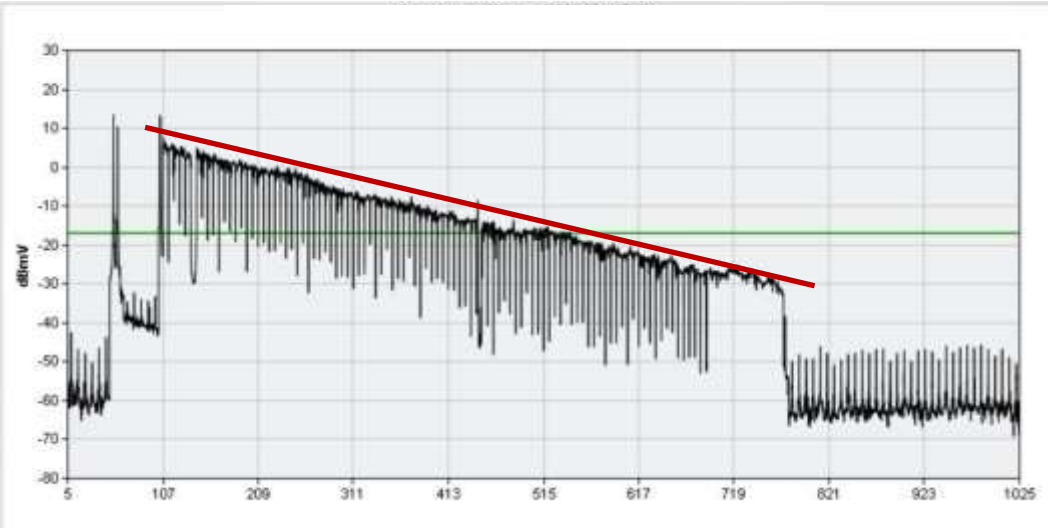






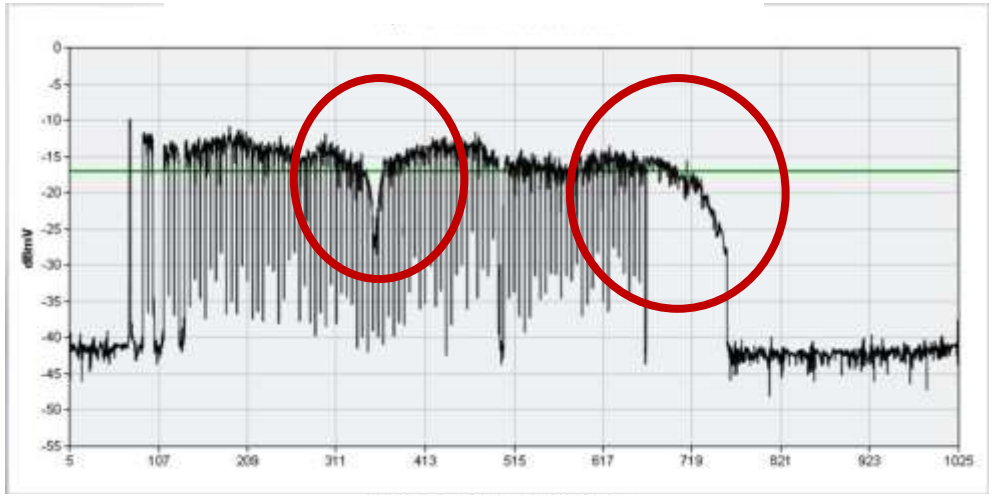
Tilt

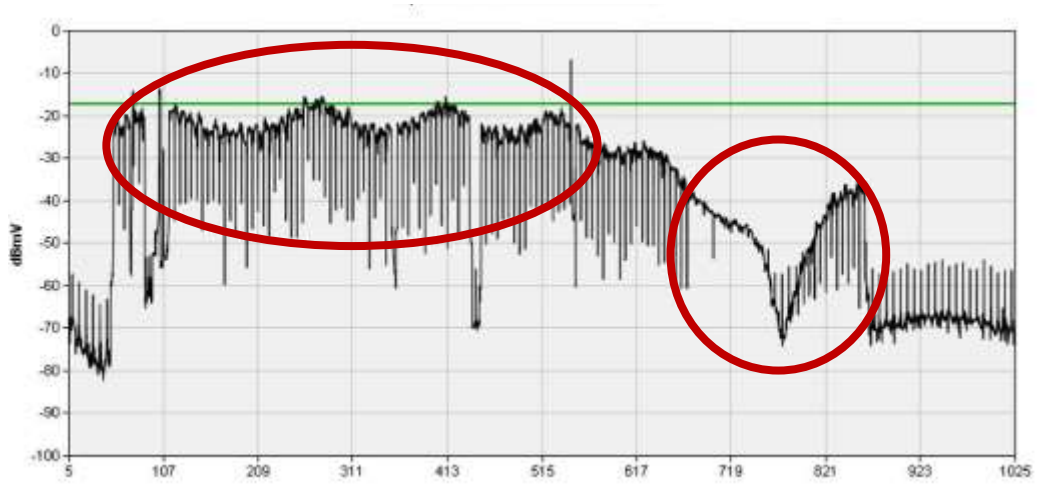
Not necessarily indicating a problem, often caused by location near amplifiers, end-of-lines or improper amplifier setup. The tilt may be in either direction (positive or negative tilt). Notice the power relative to the 0 dBmV reference.

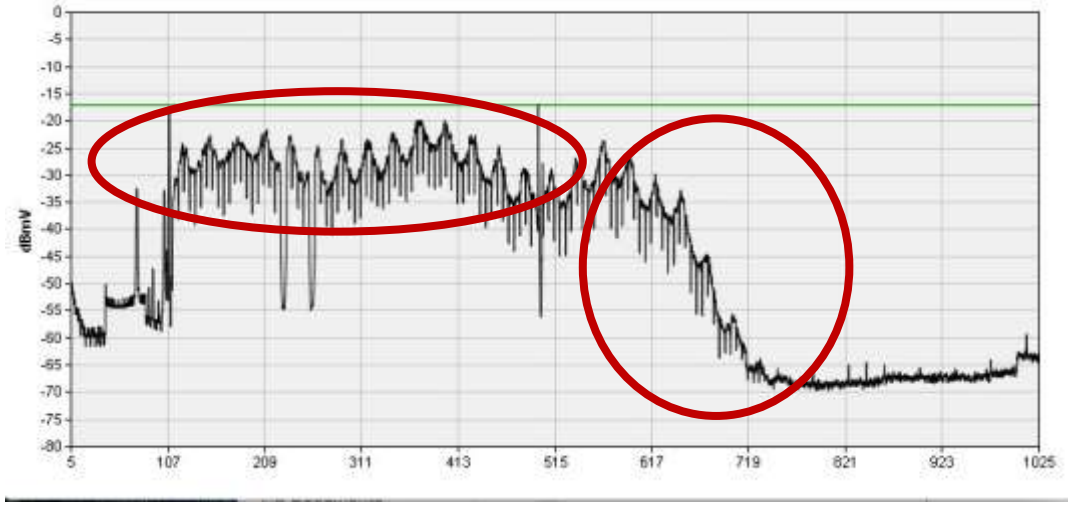


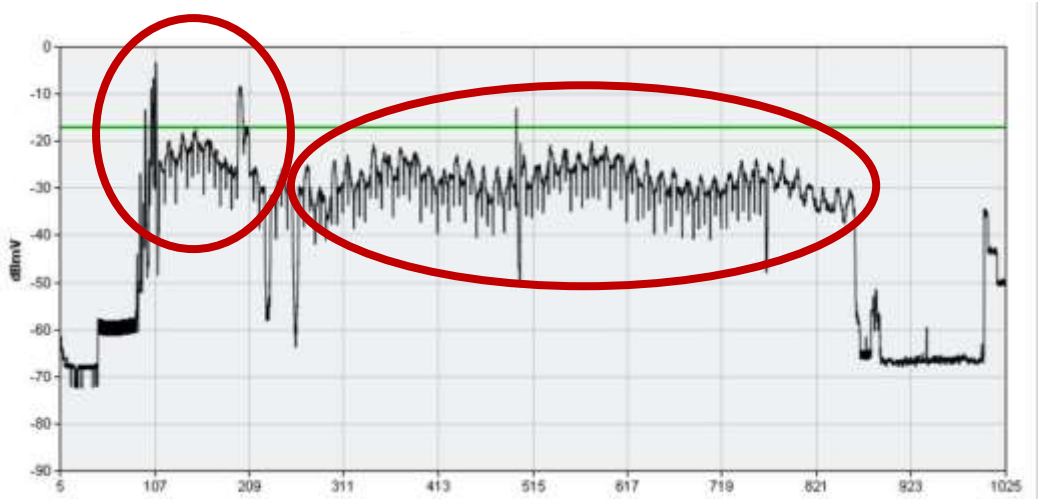
Compound Impairments

Any combination of the previously described impairments





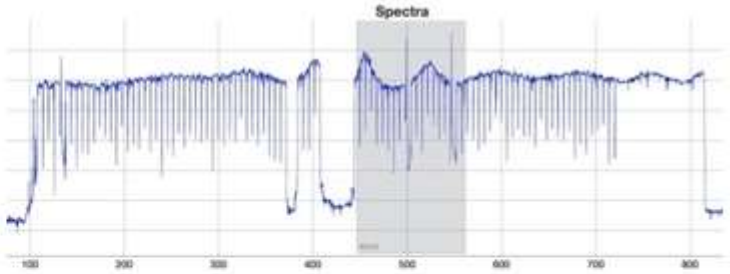


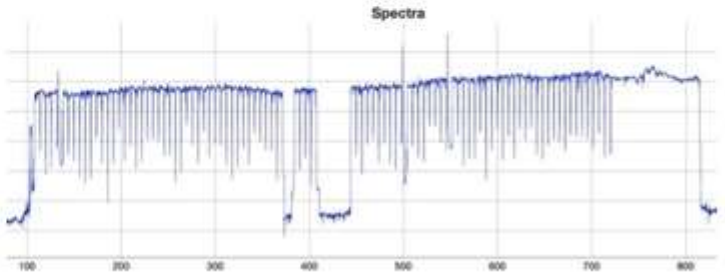


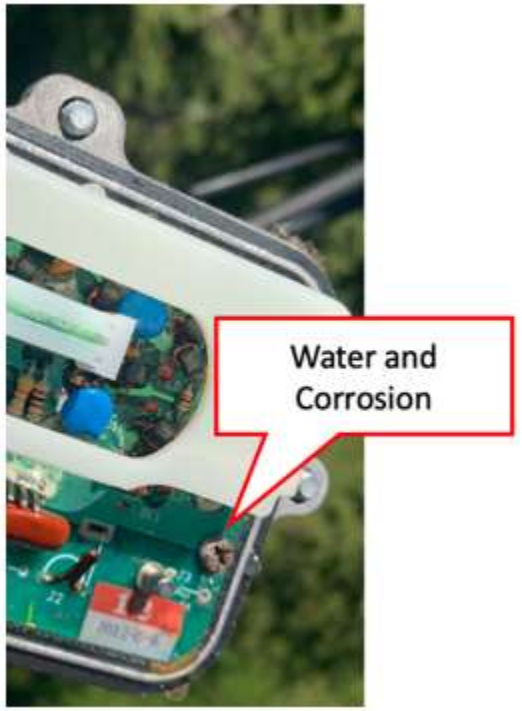
Causes versus Symptoms

- **Most of the images in this presentation were *symptoms* from intelligence tools.**
- **All of the solutions were likely *causes* aligned to one of the Pillars.**

- **There are many craft sensitive components in every HFC Node, that can fail and cause symptoms of impairment when not properly installed or maintained.**







Causes versus Symptoms

Alphabet Soup of Symptoms

We measure the performance of our OSP networks through the retrieval of data sets attached to various portions of the network.

Signal Integrity Impairments
- *SNR*
- *MER*
- *CNR*

Data Integrity Impairments
- *FEC*
- *BER*

Medium (cable) Integrity Impairments
- *CINR*
- *P/V – Frequency Response*
  - *Suckouts*
  - *ACP*
  - *Waves*
- *µV/m - Leakage*

Intelligence Tools and Test Equipment

Tying it all together

Intelligence tools (software) are great at identifying impairments in the Network. They are also great at verifying when they're resolved. In between, handheld test equipment can be the technician's best friend.

"A Craftsman is only as good as his tools!"

Appendix

SCTE.org – Coming Soon: NOS-IR-208r1 – Understanding Cable RF Spectrum 2022
Comcast Access Network Newsletter:
Shielding Integrity Pillar
Impedance Pillar
System Power Pillar
Optical Link Pillar part 1

Acknowledgements

Network Operations Subcommittee - Working Group 7 Members:
Chair: Larry Wolcott – Fellow, Comcast
Arni Lundale – Cogeco Communications
James Medlock – Akleza, Inc.
Dr. Jason Rupe - CableLabs
Brady Volpe – Volpe Firm, Inc. Nimble This
Ron Hranac – Legend
Dr. Thomas Kolze – Broadcom Limited

Thank you

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