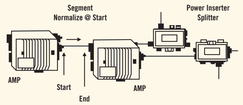
“Find & Fix” Guide Using SDA or DSAM

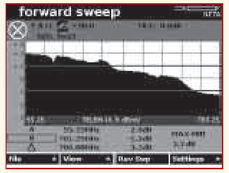
Sweep and Balancing: Still the Best Find & Fix Tool

- Analog or digital, the cable plant is one seamless HFC network. Defective network components that cause analog signals to fail also can impair digital signals. The best way to find these faults is to use normalized sweep.

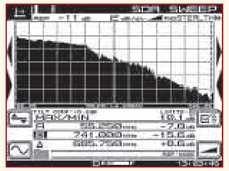
Key Sweep tips:

- - Divide or segment the plant between actives by using normalization. Test each segment to plant specs. Normalization requires that you take a sweep reference at the ‘start side’ of each segment.
- - Sweep provides a non-invasive, in-service measurement for analog and digital signals. Sweep is compatible with all digital DTV and cable modem formats—use sweep and spectrum tools with QAM measurements to diagnose digital faults!



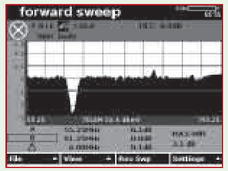


Bad Sweep Trace: Cause: amp is over-driven, or the Tilt is bad. Too much amp gain can cause CTB/CSO-intermodulation. In the reverse path case, too much gain can cause the reverse optical node to clip. Gain set too low can deteriorate C/N and MER.



Finding Tap and Connector Problems

- Bad taps or connectors can cause a suck-out (notch) in frequency response. Suck-outs cause in-channel and/or adjacent channel impairments.
- Tip: Sweep (upper display) is the best tool for finding these faults. Sweep is used up to 1000 MHz. FULLSCAN mode (lower display) is fast, but may not show the real problem. FULLSCAN modes are limited to the channel plan
- Tip: SDA meters also allow viewing of in-channel spectrum.
- Causes are:
  - Humidity problems.
  - Bad connector mountings/housings.
  - Small RF leaks to ground.

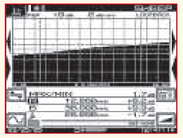


Bad Forward Sweep Trace with Suck-out.

On FULLSCAN, Suck-out is Less Visible.

Optical Node Test and Reverse Measurements

- In cascade maintenance, alignment of the Reverse Path driver-amp laser must be done first. With a loop-back mode, the generated test signal is measured back through the driver-amp.
- After the driver-amp is aligned, the reverse sweep and alignment can be performed for accurate balancing of the return path. SDA’s reverse alignment display shows the absolute reverse levels in dBmV/dBuV.
- Tip: with the absolute levels displayed, you can see the signal behavior of the cable modem signals during this setup and test.

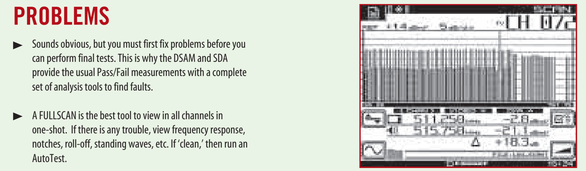


Local Sweep Loop-back Mode.

Reverse Alignment Sweep Trace.

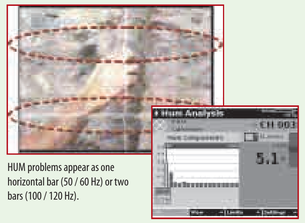
LEVEL PROBLEMS

- Sounds obvious, but you must first fix problems before you can perform final tests. This is why the DSAM and SDA provide the usual Pass/Fail measurements with a complete set of analysis tools to find faults.
- A FULLSCAN is the best tool to view in all channels in one-shot. If there is any trouble, view frequency response, notches, roll-off, standing waves, etc. If ‘clean,’ then run an AutoTest.
- A FULLSCAN with on-line limit check gives a real-time indication of proof of performance pass/fail. However: two limit sets—one for an analog carriers and one for digital—are required for Auto/Log testing to work.



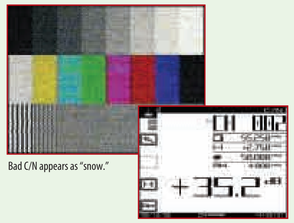
HUM Problems and Carrier-to-Noise Problems

- Causes of HUM problems:
  - Bad power supplies in amplifiers.
  - Earth-loops on coax cables.
  - Bad ground blocks.
  - Bad connection to ground.
  - Earth-loops in head end, interfering with the TV modulators.



HUM problems appear as one horizontal bar (50 / 60 Hz) or two bars (100 / 120 Hz).

- Causes of C/N problems:
  - TV-carrier levels too low.
  - Not enough amplifier gain.
  - Raised noise floor.
- Tools to find and fix C/N problems:
  - Use SWEEP-mode to find gain/loss problems.
  - Use FULLSCAN, MINISCAN, and/or LEVEL-mode to find individual level problems.
  - Use Spectrum view to see elevated noise impairments



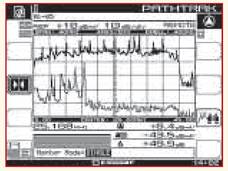
Bad C/N appears as “snow.”

New Problems on the Reverse Path

- To quickly find & fix ingress problems, JDSU’s Fieldview Interoperation tool is vital. With it, two ingress spectrum measurements are done simultaneously, one at the head end or hub-site, and one in the field. Both spectrum traces are then compared in real time on the SDA meter display.

Advantages of JDSU Interoperation:

- Avoid self-inflicted errors.
- Easy and fast fault finding by seeing in which direction to diagnose to/from the head end.
- Isolate the cause of Common Path Distortion (CPD). Common path distortion is a mechanical problem, which requires real-time feedback to measure spectra in the hub-site.
- Quick commissioning and confirmation of the repaired fault. Ability for one person to check if the repair efforts solved the problem.



Common Path Distortion.

- Common Path Distortion can result from corrosion or oxidation on connectors. This causes a diode-effect, introducing potentially harmful 2nd and 3rd order intermodulation beats every 6, 7 or 8 MHz (channel plan dependent). Appearing in the reverse path, these beats are very small but accumulate when several reverse paths are combined at the node.
- Tip: Use of a low-pass filter is recommended. This filter (built into the SDA meter) removes the channels on the forward path that could interfere with the instrument’s RF input section.

C/N vs. BER/SES* vs. MER

*Bit Error Rate/Severely Errored Seconds

Analog signals degrade linearly with signal impairments

Digital video channels stay clear until FEC can no longer compensate for signal impairments

As MER degrades below its modulation threshold the receiving device is no longer able to properly distinguish the data contents of the signal, causing the channel to breakdown

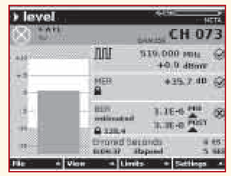
Digital Quality Testing

Modulation Error Ratio (MER)

- The MER is a measure of the signal-to-noise ratio (SNR) in a digitally modulated signal and is good at showing consistent issues such as a raised noise floor or a constant ingress spike. If MER is low, check the signal level to be sure it has not dropped too low and check to be sure there is not a raised noise problem.

Bit Error Rate (BER)

- BER can occur from noise on the system, ingress, or service capacity issues and is good at showing quick or intermittent issues. BER occurs when a binary 1 is mistaken for a binary 0 and vise-versa.



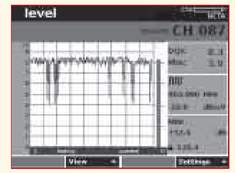
Level Mode shows MER, Pre/Post FEC BER, and digital average power level of that QAM carrier

Digital Quality Index (DQI)

- DQI is a simple indicator of the overall quality of a QAM digital stream. DQI is a statistical measure of the signal impairments that can cause uncorrected bit errors, resulting in video tiling and data packet loss, but it also detects impairments that have not yet caused any errors, including Pre BER errors.

DQI:

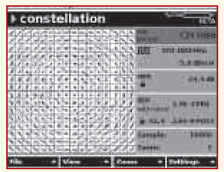
- Has a faster response than BER on intermittent impairments
- Is more sensitive to impairments that are too small or quick to cause bit errors or degradation of MER
- Is very easy to interpret, technicians with less training or experience will find it easier to use and less confusing than BER measurements
- TIP: Watch for momentary drops in quality to detect sporadic ingress.

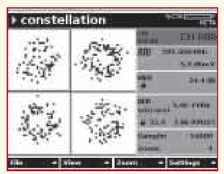


DQI makes troubleshooting intermittent QAM issues easier by simplifying results while at the same time increasing the sample rate of the QAM symbols.

Constellation Displays: Headend or Field Fault?

- Constellation is an ideal tool to find QAM modulator problems. Distinguishable shapes/patterns of the constellation reveal modulator issues in the head end versus faults (ingress, CTB, CSO, etc.) in the field.
- Tip: Constellation displays show noise or ingress, but usually only if the interference is very severe. Also, micro reflection faults aren’t visible. Use SDA Stealth Ingress and EQ modes to diagnose and find ingress, noise and micro-reflection problems.
- Typical errors originating from the head end:
  - Phase Noise: The constellation appears to be rotating at the extremes while the middle dots remain centered in the decision boundaries. Such phase noise is caused by head end converters. (top screen shot)
  - Coherent Interference: Pixels appear donut shaped with the dots clustered around the middle of the boundary area but with none in the middle of the cluster. Usually caused by ingress, CSO/CTB harmonics. (bottom screen shot)
  - Gain Compression: The outer dots on the constellation are pulled into the center while the middle dots remain centered in the decision boundaries. Gain Compression is caused by bad filters, IF equalizers, converters, and amplifiers.
  - I Q Imbalance: The constellation is taller than it is wide. This is a difference between the gain of the I and Q channels. IQ Imbalance is caused by base band amplifiers, filters, or the digital modulator.
  - Carrier Leakage

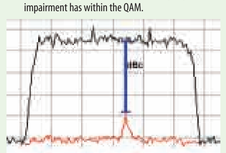




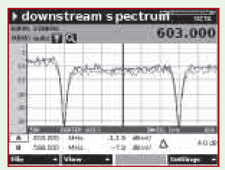
Ingress under the Carrier

- The QAM Ingress test allows the user to view what is going on under a live QAM channel. Techs can see anomalies causing digital video impairments (MER or BER) that would not be visible with a spectrum analyzer.

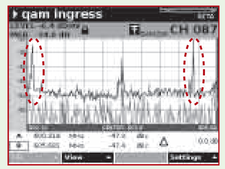
Measuring the power under the carrier (dBc) shows how much power the impairment has within the QAM.



Black is QAM Channel
Red is Noise below QAM
Blue is difference between QAM carrier and ingress under the carrier (dBc)



Looking at the QAM Haystack does not reveal impairments hiding below



Shown are two misplaced sweep points causing the QAM channel to incur slight BER problems degrading the quality of the channel

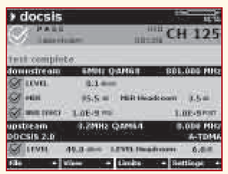
QAM Ingress shows anomalies under digital haystack. Such as:

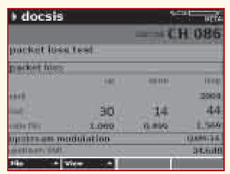
- Off-air carrier leakage
- Raised Noise spikes
- Misplaced Sweep Points
- Composite interference
  - *Such as CSO and CTB*
  - *Other harmonic events*

In Service DOCSIS® Troubleshooting

- Running a DOCSIS test helps insure subscriber high speed data (HSD) services are running properly. Acceptable downstream and upstream levels are important and so are good downstream MER and BER. Marginal connections to the network are unacceptable. The slightest change in network configuration would have the potential to disconnect the subscriber from their HSD services.

Perform DOCSIS IP tests to check for packet loss and throughput at the Sub’s home. High packet loss as well as low throughput speeds many times are caused by excessive ingress. Other issues can also cause HSD issues such as frequency response, group delay, and standing waves on the network.





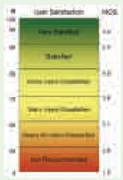
In Service VoIP Troubleshooting

- Voice over Internet Protocol (VoIP) is very similar to HSD testing but requires a different set of IP tests.

Physical testing of the QAM carrier(s) should show digital level, MER, and BER within corporate specifications in order to operate effectively.

The IP tests performed on VoIP typically include Delay, Packet loss, and Jitter. Where bad jitter and delay are usually associated with network congestion and routing problems, packet loss can usually be attributed to ingress in either the forward path, or more commonly the return path.

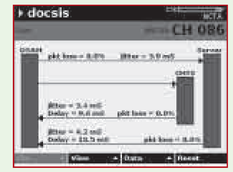
The quality of a call can be summarized using either the Mean Opinion Score (MOS) or R-Value. Both of these measurements take into account the amounts of delay, packet loss, and jitter on a call. The higher the delay, packet loss, and jitter the lower the quality of the call.



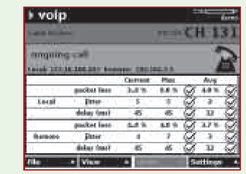
The MOS scale ranges from 1 to 5 with 5 being the best.

R-Value scale ranges from 0 to 100 with 100 being the best.

Both measure the overall performance of a VoIP telephone call. This chart gives an approximate score to the subscriber’s opinion of call quality.



VoIPCheck™ verifies VoIP service over the DOCSIS® communication connection



The PacketCable™ VoIP test actually communicates like an MTA on the network. The user can test the communication while placing and receiving calls.

To learn more, visit www.jdsu.com/HFC

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