



SUNRISE TELECOM

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Application Series

SunSet xDSL: Wideband Power Spectral Density Measurements for DSL

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INTRODUCTION

xDSL achieves higher data rates over the existing copper by utilizing the frequencies well above the voice spectrum. POTS service uses the 300 Hz to 3200 Hz bandwidth; ADSL DMT uses up to 1.1 MHz and ADSL CAP extends up to 1.5 MHz.

Figure 1 shows a typical bit distribution for ADSL DMT. The frequency range is divided into 256 frequency bands of 4.3125 kHz each. The upstream signal uses the lower frequency tones (20 to 138 kHz) while the downstream signal uses the higher frequency tones (140 to 1100 kHz). The actual assignment of channels is flexible. And, the number of bits within each channel is flexible as the modems try to optimize the bit distribution based on the signal-to-noise ratio for each tone.

Since DSL uses such a wide frequency spectrum, it is particularly susceptible to interference from outside sources. Interference can be very harmful to DSL's data rate and signal to noise margin. It may lead to a lower data rate, or may prevent the modems from synchronizing at all.

The most likely culprit for interference is other digital signals transmitted in the same or adjacent binder groups. These signals can crosstalk at common frequencies. AM radio transmission could be another potential noise source as many AM stations broadcast their frequencies in the same range as DSL. DSL circuits carried over aerial cables are more at risk to AM interference than those carried underground.

A Power Spectral Density (PSD) measurement is an effective tool to identify potential interfering services. It checks for both intrinsic and extrinsic noise, including RFI from AM transmission, crosstalk from adjacent digital services in cable binders, as well as thermal and impulse noise sources.

SUNSET XDSL PSD DMT MEASUREMENT

The SunSet xDSL is a simple field spectrum analyzer with a resolution bandwidth of 4.3125 kHz and a range from 13 to 1600 kHz. The SunSet xDSL's background noise measurement can identify potential interfering noise sources. This test can be valuable for troubleshooting marginal circuits or for prequalifying a cable pair for DSL. Interferer masks can be superimposed on your measurement to help you determine what type of service is creating the interference. For example, you can compare your results to a sample template of noise from 10 HDSL signals in the same binder group. Other background noise tests place filters to check for noise at the frequencies used for ISDN BRI or HDSL.

Calibrating the Unit

If this is the first time running the background noise test, you will need to calibrate your unit. Make sure the SunSet is disconnected from the circuit. Press the MENU key; then enter LINE, CALIBRATION, BACKGROUND NOISE. Calibration may take up to 20 seconds. You should see a "Calibrate is Done!" message when finished. If the calibration fails, try to run it again. After successful calibration, proceed with your background noise test. After calibrating the unit once, you will not need to recalibrate until after you perform an Erase NV RAM.

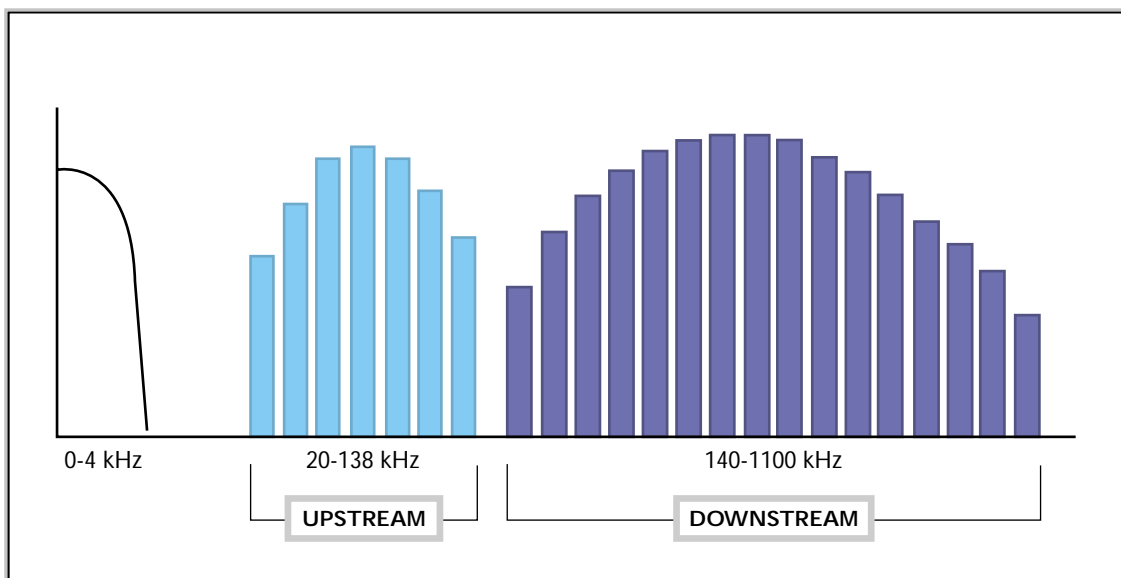


Figure 1 ADSL DMT frequency spectrum

PSD DMT Test

Follow these steps to run the PSD DMT background noise test:

1. Connect the SunSet to the pair to be tested with the TDR/LINE/DMM jack.
2. Press the MENU key on the 2nd row of the keypad.
3. Enter LINE. The LINE LED will light green indicating the set is performing a Line measurement.
4. Enter BACKGROUND NOISE.
5. You will need to configure the setup screen. Refer to Figure 2.
 - a. Set the receiver level (RxLEVEL) for the test set.
 - TERM (F1) places a 100 Ω termination on the received signal. This should be used for out-of-service testing only.
 - BRIDGE (F2) is a high-impedance mode that protects the live signal. You may use this mode for in-service testing.
 - b. Select the type of test (TYPE) by pressing the corresponding F-key.
 - PSD (F1): Measures noise in the full ADSL DMT/CAP spectrum, 22 kHz to 1.6 MHz.
 - E (F2): Measures noise in the spectrum for ISDN BRI at an impedance of 135 Ω for term mode. Sunrise Telecom recommends a 100 Ω to 135 Ω converter cable for the E filter measurement.
 - F (more, F1): Measures noise in the spectrum for HDSL at an impedance of 135 Ω for term mode. Sunrise Telecom recommends a 100 Ω to 135 Ω converter cable for the F filter measurement.
 - G (more, F2): Measures noise in the spectrum for ADSL at an impedance of 100 Ω for term mode.
6. After configuring the setup screen, press START (F3) to begin the measurement.
7. If you do not see a strong signal upon entering, try increasing the vertical gain. Keep pressing the up arrow key until the signal appears.
8. Noise appears as an upward spike or bump on the screen. Figure 3 shows an example of noise in the results screen. Figure 3's interference radiates across multiple frequencies. Other interference may appear as a sharp spike at a single frequency, like AM radio.

There are two different zoom factors for the screen display. ZOOM-OUT displays the full 1.6 MHz bandwidth on the screen. The resolution is 3 tones/pixel with the highest noise value of the three tones plotted on the screen. ZOOM-IN displays each tone individually. Use the ZOOM-IN/OUT (F1) key to change the scale.

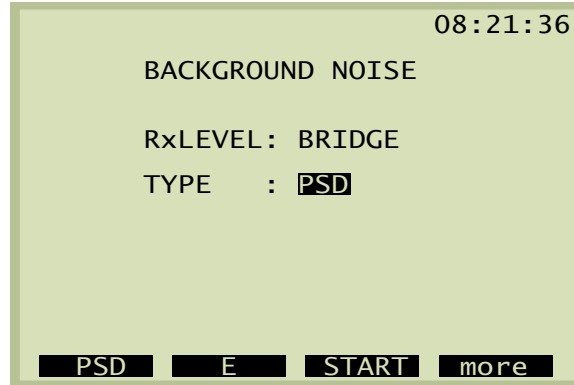


Figure 2 Background Noise Setup screen

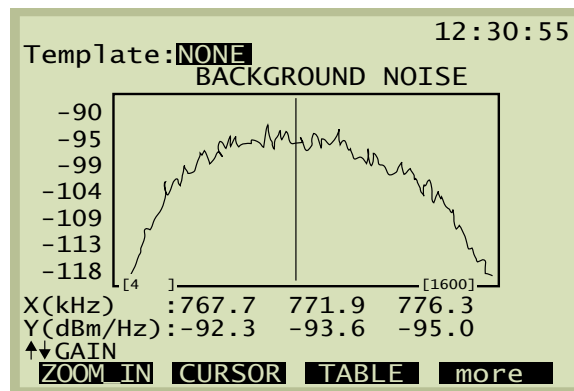


Figure 3 PSD results

9. You can determine the exact frequency of a disturber. Press the CURSOR F-key to control the cursor on the display. After pressing CURSOR, use the left & right arrow keys to move the cursor. Check the frequency reading at the bottom to learn the exact frequency.

The frequency reading can give you a good idea as to the type of interfering service. For example, if the interference centers around 772 kHz (Nyquist frequency for T1), chances are good that adjacent T1 services are causing the interference.

The frequency can also give an indication of AM radio interference. If you see an interference spike that does not match a central frequency of a common digital signal, simply turn on a radio and check for AM stations. An AM station could be broadcasting in the same frequency range as DSL. AM radio interference is typically caused by poor cable bonding or poor grounding.

The bottom results also show the power level for the noise. You can toggle the reading between dBm and dBm/Hz measurements by pressing the dBm and

dBm/Hz (more, F1) key. dBm is a pure power reading with reference to 1 milliwatt. The dBm/Hz measurement uses a reference of a certain frequency resolution bandwidth (4.3125 kHz) for the reading. It calculates an overall power of the interference within that resolution bandwidth.

10. Another way to determine the type of interfering service is to scroll through the various on-screen template masks. Press MASK (F2). Then use the left and right arrow keys to select the interferer type. These interferer types comply to the crosstalk models defined in ANSI T1.413 based on the number and type of disturber.

These masks represent the common disturbers associated with ADSL circuits. If you see an increase in the background noise level (Y-value), try scrolling through the various templates, until a template matches the signal. This indicates the interfering service on your circuit. Figure 4 shows the PSD background screen with a template.

In TERM mode, keep scrolling through the various templates until you find one that matches your signal. This indicates the type of interfering service on your circuit.

The technique differs for BRIDGE mode. Here the templates are transmitter masks, and give a pass/fail indication to determine if the DSL transmitter meets the specified allowable PSD threshold. The pass/fail indicator at the right refers to the position of the cursor, and not to the overall signal. To make sure the overall signal passes, check that the signal and mask do not overlap.

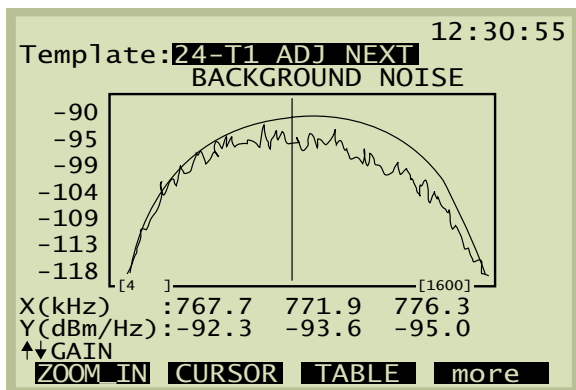


Figure 4 PSD Background Noise screen with template

Masks for TERM Mode:

- 24-DSL NEXT: 24 IDSL services in the same binder group
- 10-HDSL NEXT: 10 HDSL services in the same binder group
- 4-T1 ADJ NEXT: 4 T1 services in an adjacent binder group
- 24-T1 ADJ NEXT: 24 T1 services in an adjacent binder group
- 10-ADSL DN NEXT: 10 ADSL downstream services in the same binder group
- 10-ADSL UP NEXT: 10 ADSL upstream services in the same binder group
- T1.601 NEXT: ANSI T1.601 Basic Rate ISDN in the same binder group
- 10-DSL NEXT: 10 IDSL services in the same binder group.
- 10-ADSL NEXT: 10 ADSL services in the same binder group
- 10-T1 ADJ NEXT: 10 T1 services in an adjacent binder group
- INT AMI 2M: International 2.048 Mbps AMI signal (E1)
- ETSI BRA: ETSI Basic Rate ISDN service
- ETSI HDSL: ETSI HDSL service
- ADSL XTALK, ANSI 7,13: ADSL crosstalk ANSI loops 7 & 13
- ADSL XTALK CSA 4: ADSL crosstalk, CSA loop 4
- ADSL XTALK CSA 6: ADSL crosstalk, CSA loop 6
- ADSL XTALK CSA 7: ADSL crosstalk, CSA loop 7
- DSL NEXT: IDSL service in the same binder group
- HDSL NEXT: HDSL service in the same binder group
- G.DMT EC ADSL UP NEXT: G.DMT Echo-cancellation ADSL upstream service in the same binder group
- G.DMT FDM ADSL UP NEXT: G.DMT Frequency division multiplexing ADSL upstream service in the same binder group
- HDSL2 DN NEXT: HDSL2 downstream service in the binder group
- HDSL2 UP NEXT: HDSL2 upstream service in the same binder group
- T1 NEXT: T1 service in the same binder group
- EC ADSL DN: Echo-cancellation downstream ADSL
- G.DMT FDM ADSL DN NEXT: G.DMT Frequency division multiplexing ADSL downstream service in the same binder group

Some Available Masks for BRIDGE Mode:

- G.DMT ATU-C
- G.DMT ATU-R
- ETR 152 CAP 1-PAIR
- ETR 152 CAP 2-PAIR
- ETR 152 2B1Q 392K
- ETR 152 2B1Q 584K
- ETR 152 2B1Q 1160K