SLX, Inc.

Specialists in Ultrasonic NDE Noise Suppression and Signal Enhancement

Noise Suppressor II™

"A Smart PreAmp"

"I Never Knew my UT Instrument could Perform So Well!"

Three Functions – PreAmp + Two Tunable Filters used to:

- *Increase S/N*
- *Suppress Noise*
- *Channel Gain into a Narrow Band to create a "Smart PreAmp"*

Always use at the highest setting, without clipping, for both boosting a weak signal and suppressing noise

Set either Filter = NULL to suppress an undesired signal (i.e., noise)

Set both Filters = NULL to "double up" suppressing an undesired signal

Tuning selects any Frequency within model's range

Five ranges:

50 -	240 KHz
150 -	700 KHz
0.5 -	2.4 MHz
1.5 -	7 MHz
8 -	25 MHz

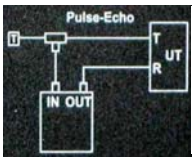
Set either Filter = MAX to boost a weak signal

Set both Filters = MAX to "double up" boosting a weak signal

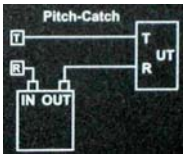
The Filters are sharply peaked & shaped like a Gaussian distribution

BandWidth controls the Filter's width and is a % of center frequency: Low=20%
Mid=30%
Wide=60%

Total Gain = PreAmp (30db) + Filter A (15db) + Filter B (15db) = 60db



Interfaces to any Flaw Detector, new or old, analog or digital, in both Pulse-Echo and Pitch-Catch modes



Flaw Detector Settings for Interface to NSII

- **Mode = Dual (even for Pulse-Echo)**
- **Damping = 50 or 150 ohms**
- **Gain (w/out NSII) = 30 to 50db min**
- **Gain (w/ NSII) = Reduce by amount added up front by NSII**

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Smart PreAmp / Noise Suppressor II

The *NSII* is produced in five models. Each model functions identically except for its own operating frequency range:

NSII-H	8	to	25 MHz	(Model NSII-H has one filter, Filter A)
NSII	1.5	to	7 MHz	
NSII-L	0.5	to	2.4 MHz	
NSII-XL	0.15	to	0.7 MHz	(150 to 700 KHz)
NSII-XXL	0.05	to	0.24 MHz	(50 to 240 KHz)

The *NSII-H* ("H" = high) is used for high resolution, high frequency applications including thin-walled tubes where IRIS-type systems are employed. The *NSII* is used for general NDT inspection work. The *NSII-L* ("L" = low) extends down into the KHz range and is used for lower frequency applications. The *NSII-XL* ("XL" = extra low) is for very low frequency NDT work, such as thick sections, where transducers in the KHz range are commonly used. The *NSII-XXL* ("XXL" = "extra extra low") is for extremely low frequency applications.

The *NSII* can be interfaced to any type of UT instrument, analog or digital, new or old. It operates in both the single transducer pulse-echo and dual transducer pitch-catch/through-transmission modes. It is an add-on unit and it is connected between the transducer(s) and the UT instrument's receiver. It does not affect any of the UT instrument's operations, including its vertical linearity calibration.

The *NSII* is small [7inL x 4inW x 1.5inH (18cm x 10cm x 4cm)], lightweight [14oz (0.4kg)], and ruggedized for field operation. It runs on either 9v dc power or ac power.

When used as a **Smart PreAmp**, the *NSII* provides ***selective amplification***, which means it ***boosts the desired signal only***. The Smart PreAmp feature can also ***suppress noise***. Gain is adjustable in steps of 10, 20, 30, 45, and 60 dB.

Adding the *NSII* to your NDT toolbox is an inexpensive way of obtaining a very significant performance enhancement from your UT instrument for either selectively amplifying signals, boosting weak signals, or suppressing noise and other undesired signals.

It is easy to use and, best of all, it really works!

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Noise Suppressor II – "Here's how it works"

The main point that is stressed continually in the documentation is to use as much PreAmp gain as possible (up to 30 dB in 10 dB steps) for BOTH the "Max" (i.e., enhancing weak signals) and "Null" (i.e., suppressing noise signals) as long as you don't observe clipping (same as signal "flat topping") on your UT instrument's display. This will give you the very best signal/noise response.

The BandWidth (BW) switch (for each Filter) has 3 positions -- Low, Mid, Wide. You will normally find that Low, or sometimes Mid, to be best for "Gain"ing weak signals and Wide to be best for "Null"ing noise signals. Play around and see for yourself.

Keep in mind that "noise" is defined as any undesired signal. It can truly be a noise spike or grain back-scatter, but it can also be any legitimate signal -- such as a geometrical reflector -- that is undesired.

There are two ways to improve the S/N ratio -- either by boosting a weak signal via the Max setting or by suppressing an undesirable signal via the Null setting. Here's how each approach works:

(1) Set one of the Filters for "Max" (and leave the other Filter Off for the time being) and dial the FREQuency switch until you observe the weak signal of interest to increase in amplitude. Dither the FREQ switch until you achieve the max response (remember that the PreAmp will have been set as high as possible and the Filter's "Max" setting provides an additional 15 dB of Gain just in that band). Try both the Low and Mid BW settings to find the optimum response. Then turn on the other Filter ("Max" setting) and set its three switches to the identical settings thereby adding another 15 dB in just that band (and nowhere else). You now have created 60 dB of gain (PreAmp = 30dB; Filter A = 15dB; Filter B = 15dB) in *one specific frequency band* prior to your UT unit seeing the signal. Cut down the gain in your UT instrument until the desired signal comes down out of saturation and you should see a dramatic improvement in the S/N ratio.

(2) Set one of the Filters for "Null" (and leave the other Filter Off for the time being) and dial the FREQuency switch until you observe the "grass" surrounding the desired weak signal decrease in amplitude. Dither the FREQ switch until you achieve the greatest decrease (again using the PreAmp). You should find the BW setting of Wide gives the best result. You have now created a notch filter with a 20 dB attenuation in just that specific frequency band. Now turn on the other Filter ("Null" setting) and set its three switches to the identical settings, thereby producing another 20 dB drop in just that band (and nowhere else). You now have created a 30 dB signal amplitude increase (via the PreAmp) and a 40 dB attenuation in just *one specific band*. Therefore, your desired signal (and everything in the sweep including the grass) enjoys a 30 dB enhancement while the undesired signal in the band suffers a 40dB attenuation. The net gain is now 30 dB for everything outside the specific notch band and a -10 dB "gain" (30 dB gain - 40 dB attenuation) for everything inside the specific band. Again, you should see a dramatic improvement in the S/N ratio.

One final tip involves the use of both Filters in the "doubling up" mode (as described above) when suppressing noise in the "Null" mode. Try setting the FREQ switch for the 2nd filter about twice as high as the optimum setting found in the first filter. Sometimes you can pick up a harmonic of the noise signal and cause even more of a reduction.

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Interfacing
The *Noise Suppressor II* to a UT Instrument

NSII Settings

- **PreAmp** set as high as possible without clipping signal for both signal enhancement and noise suppression

UT Instrument Settings

- **Dual mode** setting – even for pulse-echo inspection
- **Input Impedance** – set either at 50 ohms, 100 ohms, or 150 ohms, whichever produces the best signal
- **Gain** – set to at least 30dB to 50dB while NSII is in Bypass mode so that it can be reduced after the NSII is functioning
- **Filter** – do not use any filtering in the UT instrument; set UT instrument to either "wideband" or "no filter"

Troubleshooting Tips

- **Clipped Signal** is usually due to a large amplitude input signal that is saturating the NSII's amplifiers; try reducing the PreAmp level and/or placing a 10dB or 20dB in-line barrel attenuator connected to the IN port of the NSII
- **High Baseline Noise** is usually caused by setting the PreAmp too low; increase the PreAmp to maximum and reduce the UT Instrument gain

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Noise Suppressor II – Summary User's Guide

Interfacing *NSII* to UT Instrument

1. Put Flaw Detector (FD) into dual-transducer mode
2. Refer to back cover of NSII for hookup for pulse-echo or pitch-catch/thru-transmission
3. Remember to take out the gain in the FD that's been added by the front-end NSII

Suppress Noise

1. Set the PreAmp to at least +10 dB - higher is usually better, as long as saturation does not occur
2. Reduce the FD's gain by approximately the amount added in the PreAmp
3. Start with Filter A only and turn Off Filter B (Model NSII-H has one filter, Filter A)
4. Set up Filter A as: GAIN=Null BW=Wide
5. Tune FREQ knob until noise signal amplitude decreases; then fine tune to get minimum amp
6. "Double Up" to get further noise reduction by setting Filter B to same settings (not for NSII-H)
7. Try tuning Filter B to a different FREQ to see if additional harmonics of the noise signal can be suppressed

Enhance Signal

1. Set the PreAmp to at least +10dB - higher is better, as long as saturation does not occur
2. Reduce the FD's gain by approximately the amount added in the PreAmp
3. Start with Filter A only and turn Off Filter B (Model NSII-H has one filter, Filter A)
4. Set up Filter A as: GAIN=Max BW=Low
5. Tune FREQ knob until weak, desired signal amp increases, then fine tune to get max amp
6. Reduce the FD's gain by the amount added by Filter A (approximately +15 dB)
7. "Double Up" to get further signal enhancement by setting Filter B to same settings (not for NSII-H)
8. Reduce the FD's gain by the amount added by Filter B (approximately +15 dB)
9. Try turning BW knob to Mid or Wide settings to see if s/n improves; if not, return to Low setting

Note on Saturation/Clipping

The NSII will saturate if the INput signal exceeds 3V. If you see saturation/clipping on the FD's display (such as the signal level not increasing with PreAmp gain), reduce the INput signal by either decreasing the pulser voltage and/or adding an attenuator at the NSII's INput bnc connector.