AMMM & Welding Ultrasonic Power Supplies
Examples of proper selection of operating frequency ranges (during Scanning)

If you have impedance analyzer, make impedance measurements and select initial scanning range that will capture both series and parallel resonant frequency and little bit wider (on both sides).

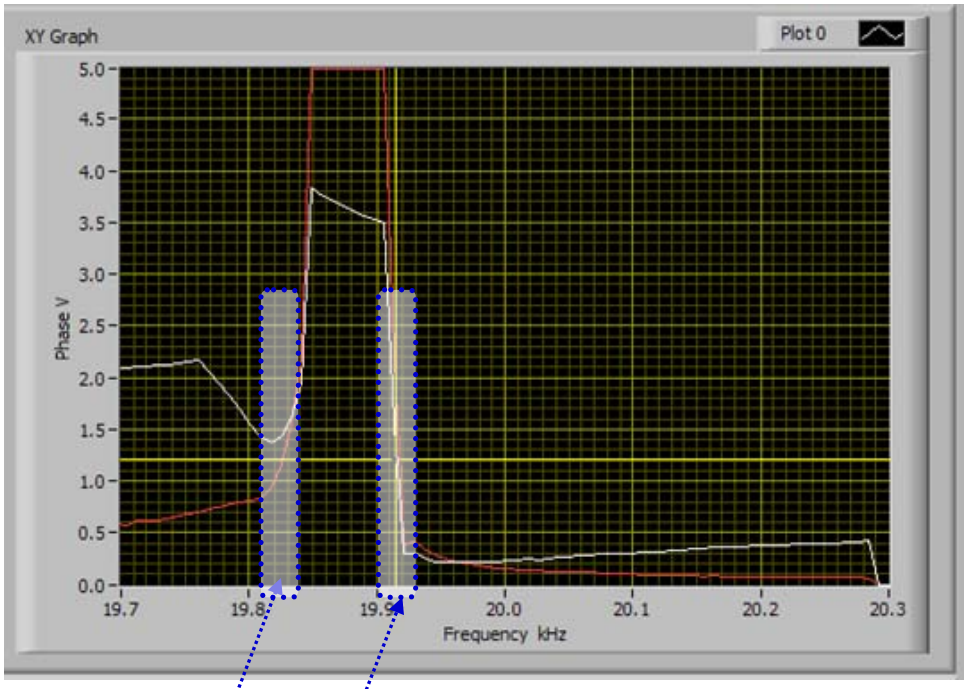

Fig. 1. Typical scanning curve (wide scanning range).

Somewhere in this area is **series resonance** (here, close to 19.82 kHz)

Somewhere in this area is **parallel resonance** (here, close to 19.92 kHz)

Before performing scanning, set amplitude to 0 (zero), set output capacitor to minimum (5 nF), set operating mode to “continuous”, disable all sweeping parameters (set them to 0), set operating frequency range (minimal and maximal frequency and Span) inside the expected operating frequency interval.

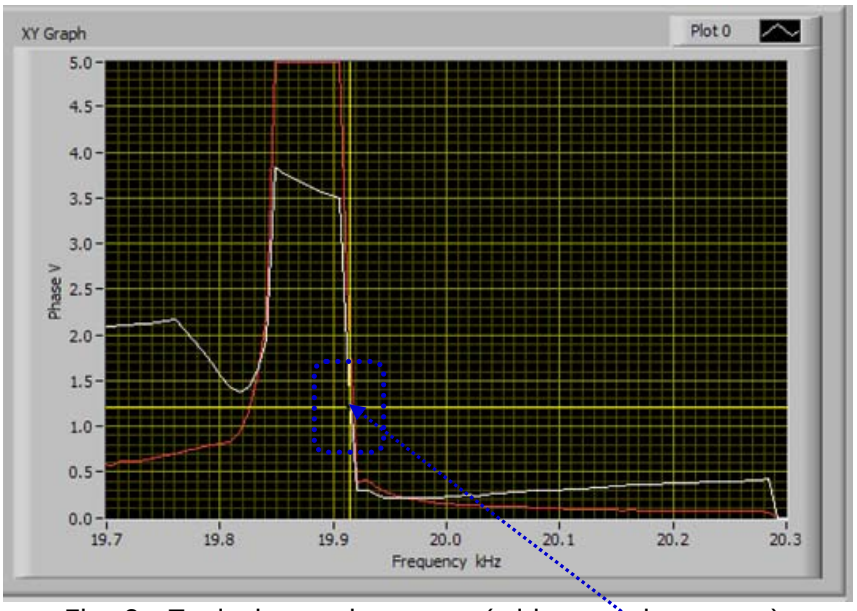

Fig. 2. Typical scanning curve (wide scanning range).

Somewhere in this area, it will be the best to select **set point for phase regulation**. For example, on this curve optimal phase values are between 0.5 and 2 V. Here selected optimum is 1.25 V.

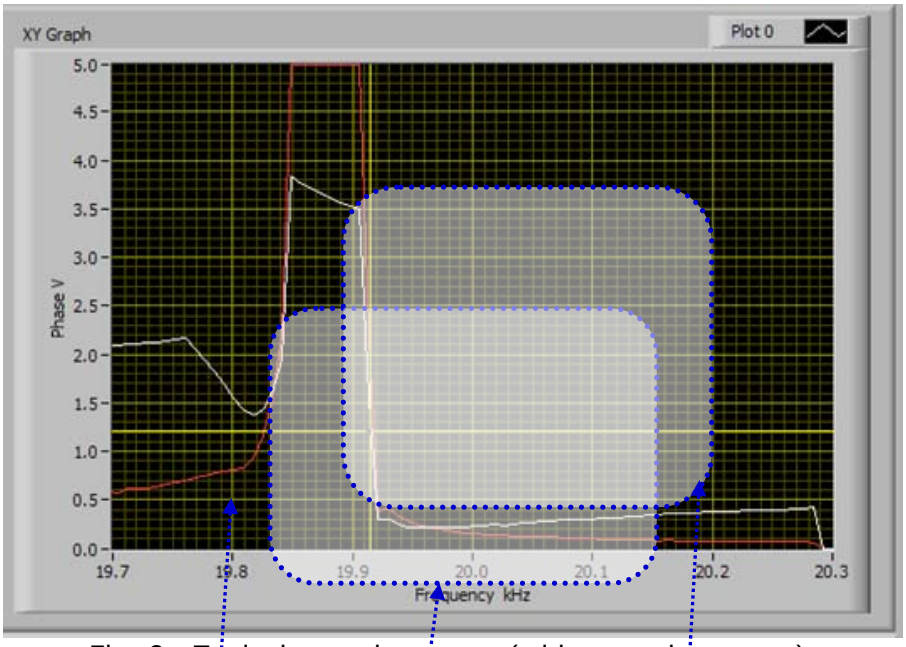

Fig. 3. Typical scanning curve (wide scanning range).

Here is relatively safe operating frequency area. Frequency capture range should be reduced to here-encircled area. For instance, in this case, proper selection for safe operating frequency area is from 19.82 to 20.23 kHz. This is good operating frequency area for very high power plastic welding, Sonochemistry, liquids processing and similar applications. Whenever operating frequency area (or frequency Span) is overlapping series resonant frequency, this presents potentially risky operating regime, which should be well tested. Operating frequency in this area will be automatically regulated from parallel resonant frequency to series resonant frequency and towards lower frequency values.

If we like to select **operating regime only in the close vicinity of parallel resonance**, operating frequency range (and frequency Span) should be selected like here. Series resonance should be excluded by setting minimal frequency (sufficiently high). This will be the safest operating regime for low and moderate acoustic loads, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

Here (below series resonance) is **the most powerful, most risky and heavy-duty, high stress operating frequency range**. Converter has increased heat dissipation in this area. Do not operate converter in air or low load conditions, here. Converter should be fully loaded before being activated in this frequency area. Avoid operating in this area whenever possible and not absolutely necessary.

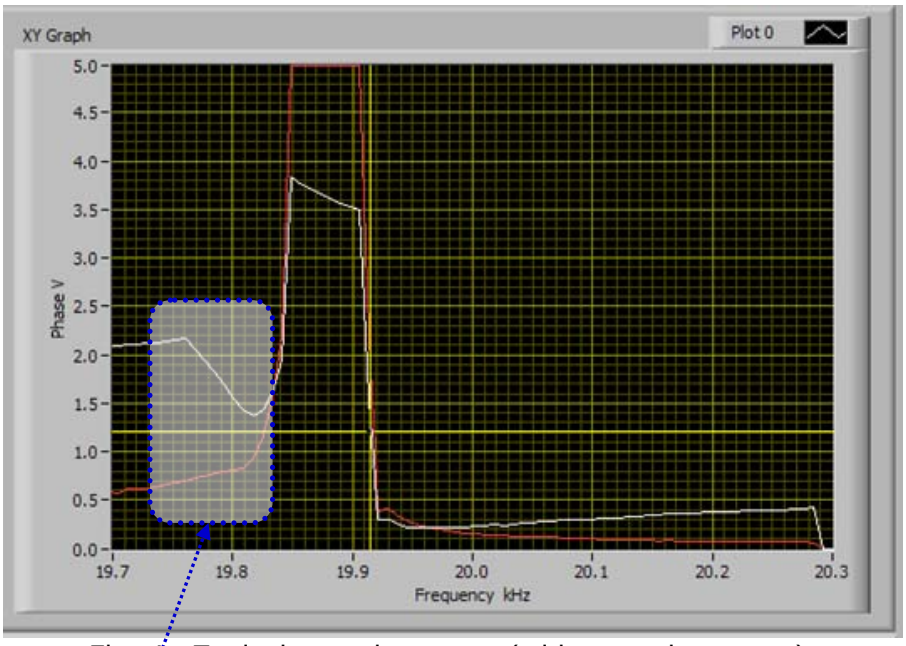

Fig. 4. Typical scanning curve (wide scanning range).

Here is very risky frequency area (high stress, high amplitude, increased converter heating, high oscillatory pressure). Better to avoid this area. This is the area below series resonant frequency. Be very careful if operating in this area. **Operate here only under heavy loading (not in air)**, like in cases of metal welding applications.

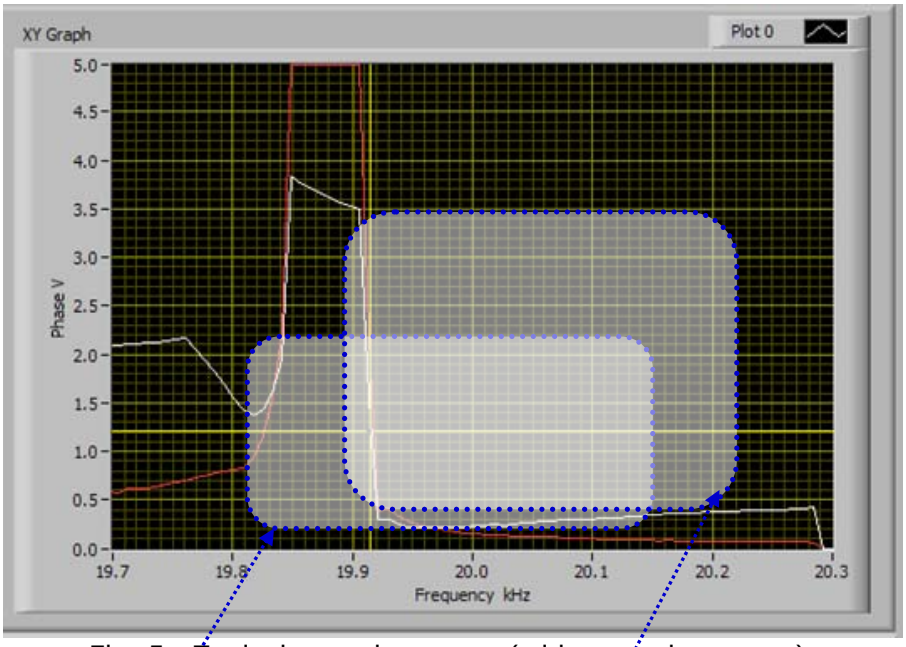

Fig. 5. Typical scanning curve (wide scanning range).

Select this **frequency area for heavy-duty operations under loading** (like metals welding). Here selected frequency range is from 19.79 to 20.21 kHz. Do not operate in air. Whenever operating frequency area (or frequency Span) is overlapping series resonant frequency, this presents potentially risky operating regime, which should be well tested. Operating frequency in this area will be automatically regulated from parallel resonant frequency to series resonant frequency and towards lower frequency values.

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

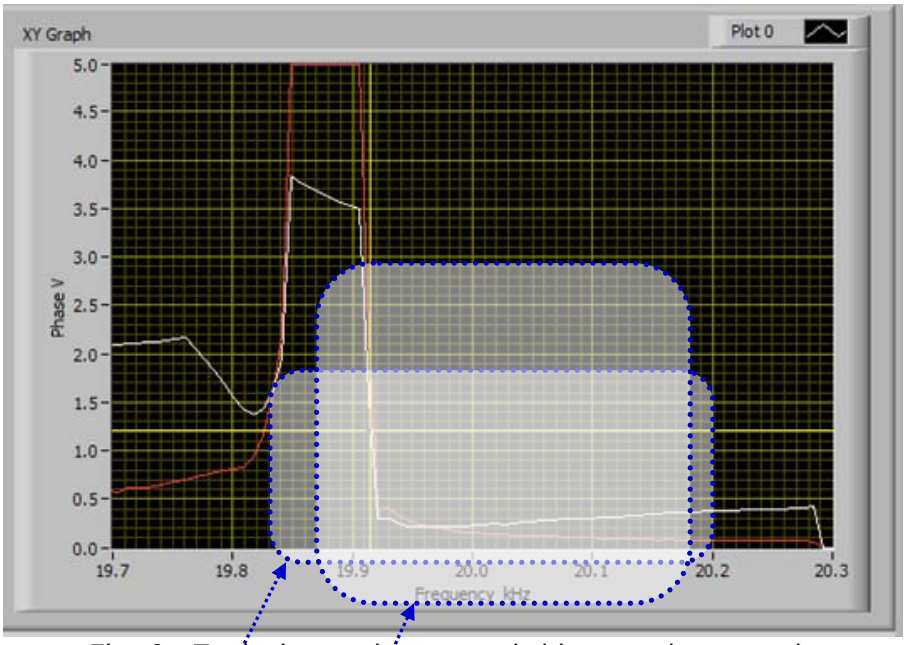

Fig. 6. Typical scanning curve (wide scanning range).

Select this **frequency area for continuous operating under moderate and high power loading** (like for welding and liquids processing). Here selected safe frequency range is from 19.84 to 20.3 kHz.

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

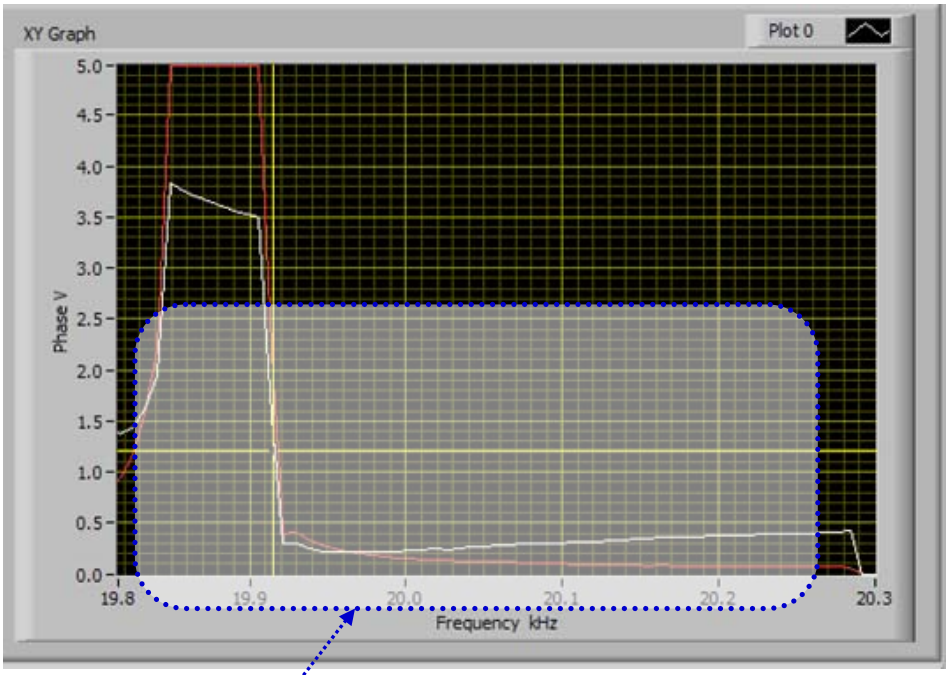

Fig. 7. Typical scanning curve (optimal, safe operating range).

Here is **well-selected (total), safe frequency capture and regulation area for most of high power welding and liquid processing applications**. Whenever operating frequency area (or frequency Span) is overlapping series resonant frequency, this presents potentially risky operating regime, which should be well tested. Operating frequency in this area will be automatically regulated from parallel resonant frequency to series resonant frequency and towards lower frequency values.

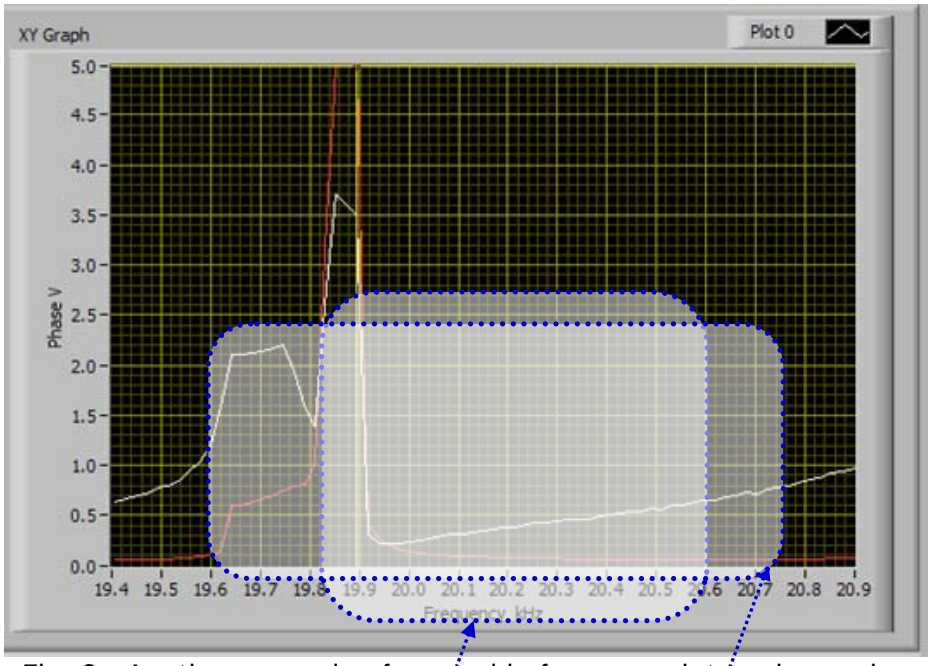

Fig. 8. Another example of very wide frequency interval scanning

Well selected frequency capture area **for most of moderate and high power applications**.

Frequency area **for metals welding and other heavy-duty applications under loading** (do not operate in air).

Whenever operating frequency area (or frequency Span) is overlapping series resonant frequency, this presents potentially risky operating regime, which should be well tested. Operating frequency in this area will be automatically regulated from parallel resonant frequency to series resonant frequency and towards lower frequency values.

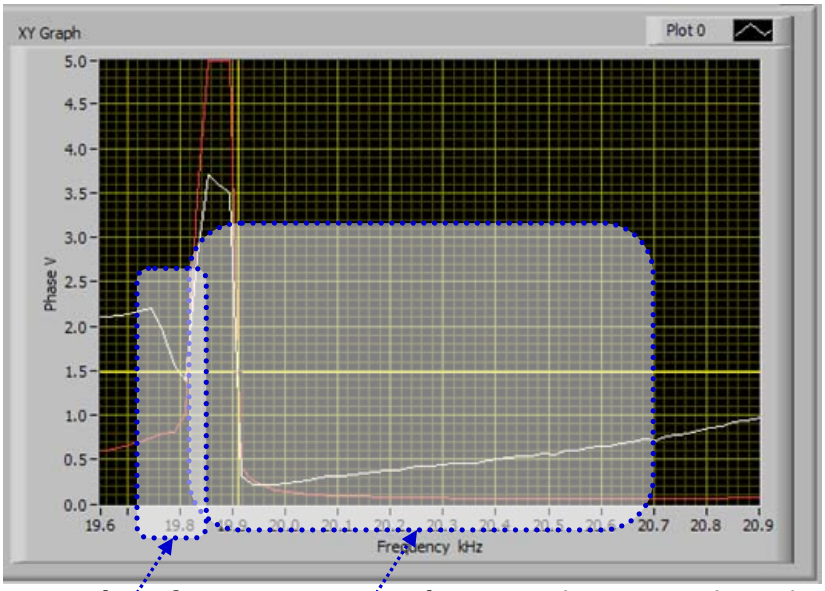

Fig. 9. **Heavy-duty frequency operating area** (operate only under loading)

Here is very risky, high stress operating area. Avoid operating here.

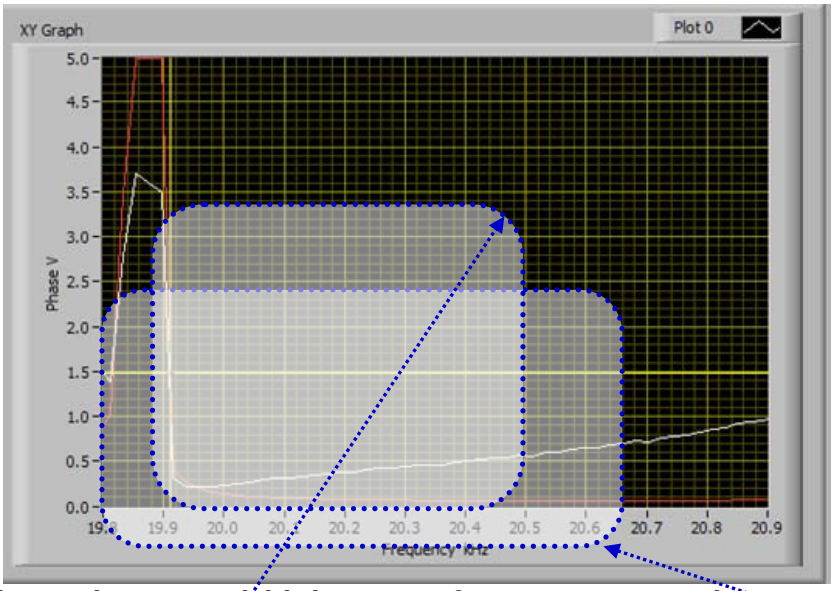

Fig. 10. **Wide moderate and high power frequency operating area** (for most of applications)

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

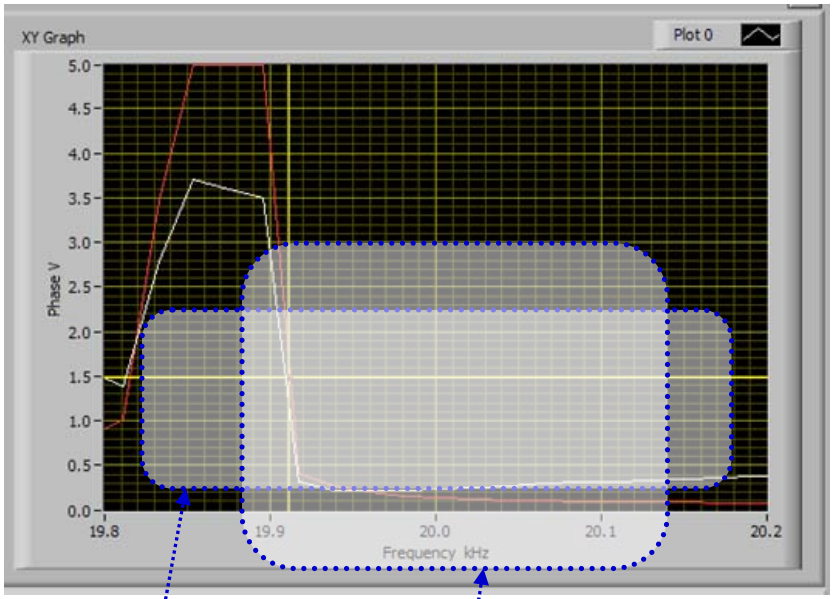

Fig. 11. **Well-selected frequency operating area for moderate and high power** (for most of applications)

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

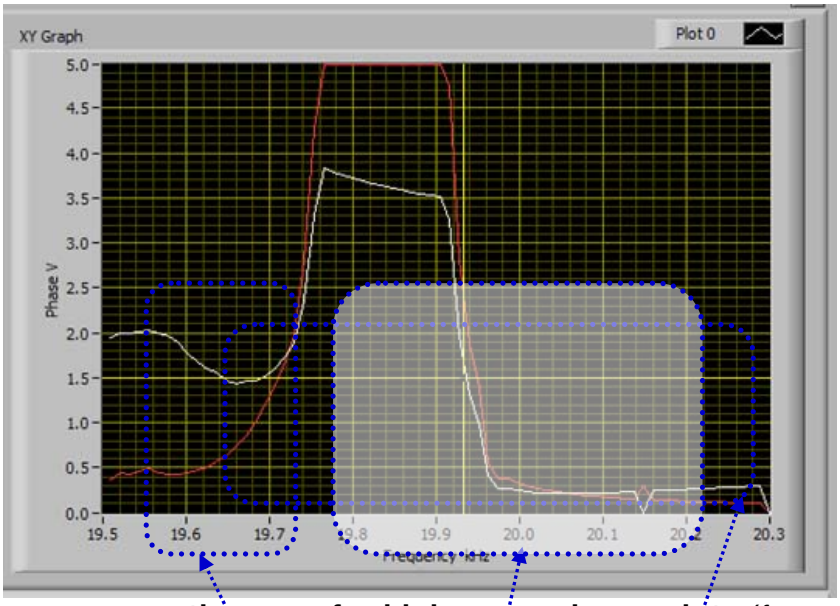

Fig. 12. Frequency **operating area for high power, heavy-duty** (for metals welding applications). Operate only under loading (not in air). Risky operating regime.

In all cases when series resonant frequency and certain frequency interval below is captured, this is presenting **very risky operating zone**. Test carefully and modify parameters until safe operating regime is found.

Moderate power, safe-operating frequency area (operating in air, for atomizing and powders sieving applications)

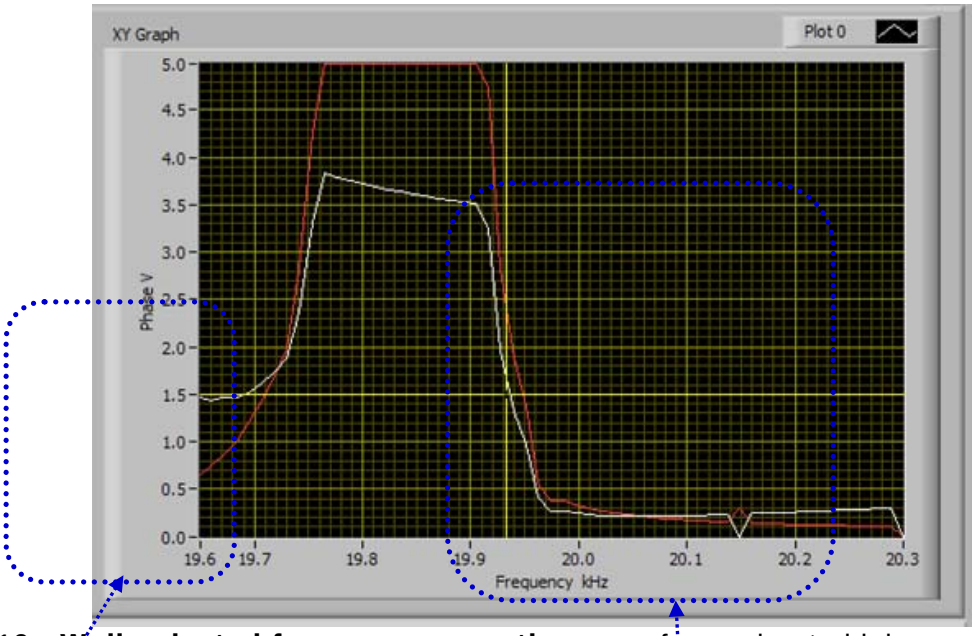

Fig. 13. **Well-selected frequency operating area** for moderate high power (for most of applications)

On this frequency-capture-range, **frequency area below series resonance is avoided**.

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

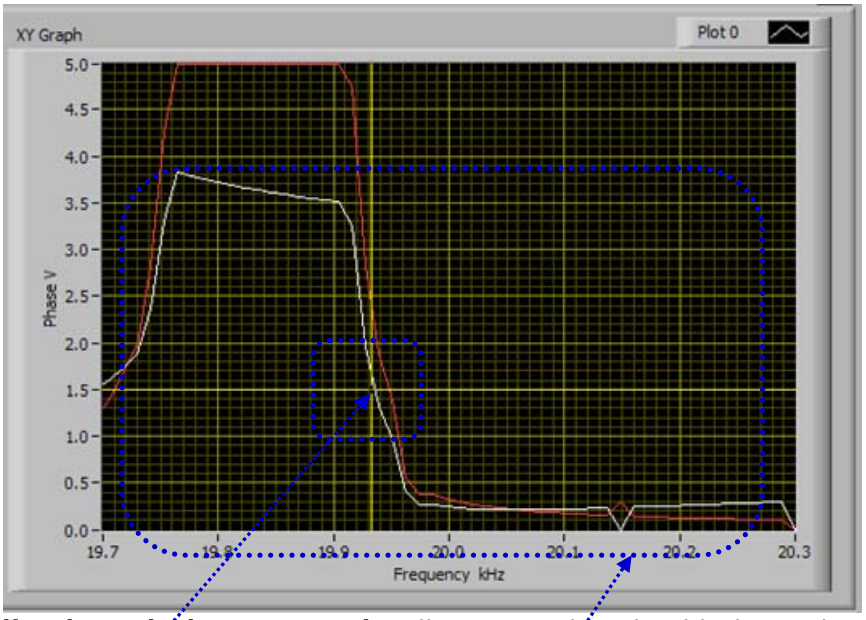

Fig. 14. **Well selected phase set point** (here 1.5 V). Should always be selected in a lower linear zone of phase curve with negative slope.

This is very well-selected frequency area for most of moderate and high power applications.

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.

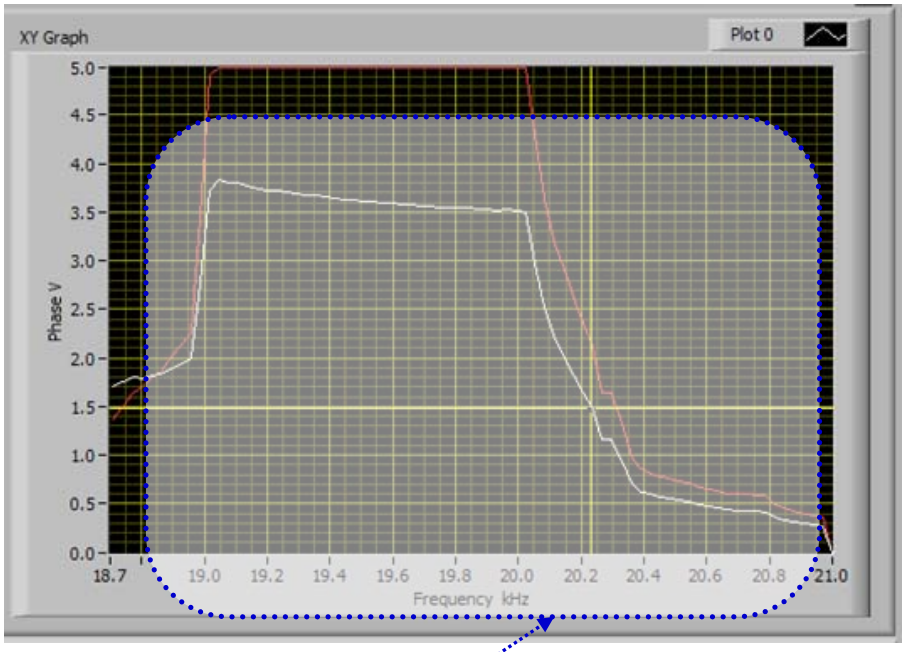

Fig. 15. **Well selected, reduced frequency operating area** for moderate and high power (for most of applications) and for very fast welding (start-up transient time between two welds is very short).

Select the frequency interval that covers only parallel resonance and higher frequencies, and does not cover series resonance. **This is the safest operating regime for low and moderate acoustic loads**, for welding, Sonochemistry, liquids atomizing and powders sieving applications, as well as for operating high amplitude in air. This operating regime has very high oscillating amplitudes and high oscillating velocity.